SPHERLS

1.0

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Contents

Chapter 1

Boundary Conditions

Member calNewD_R (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

doesn't allow mass flux through outter interface

Member calNewD_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

doesn't allow mass flux through outter interface

Member calNewD_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

doesn't allow mass flux through outter interface

Member calNewE_R_NA (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Setting energy at surface equal to energy in last zone.

Upwind gradient in dA1 term should be zero as there is no flow into the star.

Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

Member calNewE_R_NA_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to value at i.

grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGridOld[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1. Using the centered gradient instead.

Missing grid.dLocalGridOld[grid.nT][i+1][0][0]

missing energy outside the model, assuming it is the same as that in the last zone. That causes this term to be zero.

Member calNewE_RT_AD (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

grid.dLocalGridOld[grid.nE][i+1][j][k] is missing

grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGridOld[grid.nE][i+1][j][k] missing using inner gradient for both

Member calNewE_RT_NA (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to value at i.

grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGridOld[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1. Using the centered gradient instead.

Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

Member calNewE_RT_NA_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Missing ΔM_r outside model using Parameters::dAlpha times ΔM_r in the last zone instead.

Setting energy at surface equal to energy in last zone.

missing density outside model, setting it to zero

missing eddy viscosity outside the model setting it to zero

Upwind gradient in dA1 term should be zero as there is no flow into the star.

Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

missing energy outside the model, assuming it is the same as that in the last zone. That causes this term to be zero.

Member calNewE_RTP_AD (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to zero.

grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGridOld[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1.Using the centered gradient.

Member calNewE_RTP_NA (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to the value at i.

grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGridOld[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1. Using the centered gradient instead.

Missing grid.dLocalGridOld[grid.nT][i+1][0][0]

Member calNewE_RTP_NA_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Missing ΔM_r outside model using Parameters::dAlpha times ΔM_r in the last zone instead.

Missing W at i+1, assuming the same as at i

Setting energy at surface equal to energy in last zone.

missing density outside model, setting it to zero

missing eddy viscosity outside the model setting it to zero

Upwind gradient in dA1 term should be zero as there is no flow into the star.

Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

missing energy outside the model, assuming it is the same as that in the last zone. That causes this term to be zero.

Member calNewEddyVisc_RT_SM (Grid &grid, Parameters &parameters)

assuming that theta velocity is constant across surface

Member calNewEddyVisc_RTP_SM (Grid &grid, Parameters &parameters)

assuming that theta velocity is constant across surface

assume phi velocity is constant across surface

Member calNewU0_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass)

grid.dLocalGridOld[grid.nD][i+1][j][k] is missing

Member calNewU0_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass)

grid.dLocalGridOld[grid.nD][i+1][j][k] is missing

Member calNewU_R (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha $*$grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

Missing density outside model, setting it to zero.

Missing pressure outside surface setting it equal to negative pressure in the center of the first cell so that it will be zero at surface.

Member calNewU_R_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Missing grid.dLocalGridOld[grid.nD][nICen+1][j][k] in calculation of $\rho_{i+1/2}$, setting it to 0.0

missing grid.dLocalGridOld[grid.nU][i+1][j][k] using velocity at i

Assuming eddy viscosity outside model is zero.

Missing grid.dLocalGridOld[grid.nP][nICen+1][j][k] in calculation of S_1, setting it to -1.0$*$grid.dLocalGridOld[grid.nP][nICen][j][k].

Missing grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of centered A_1 gradient, setting it to zero.

Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nI-Cen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

Member calNewU_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Missing grid.dLocalGridOld[grid.nD][nICen+1][j][k] in calculation of $\rho_{i+1/2,j,k}$, setting it to zero.

assuming theta velocity is constant across surface

Missing grid.dLocalGridOld[grid.nDenAve][nICen+1][0][0] in calculation of $\langle\rho\rangle_{i+1/2}$, setting it to zero.

Missing grid.dLocalGridOld[grid.nP][nICen+1][j][k] in calculation of S_1, setting it to -1.0∗dP_ijk_n.

Missing grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of centered A_1 gradient, setting it to zero.

Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha ∗grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

Member calNewU_RT_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha ∗grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

Missing density outside of surface, setting it to zero.

Missing density outside model, setting it to zero.

assuming theta and phi velocity same outside star as inside.

Assuming theta velocities are constant across surface.

assuming that V at $i+1$ is equal to v at i.

Missing pressure outside surface setting it equal to negative pressure in the center of the first cell so that it will be zero at surface.

assume viscosity is zero outside the star.

Missing mass outside model, setting it to zero.

Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

Member calNewU_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

missing grid.dLocalGridOld[grid.nU][i+1][j][k] in calculation of $u_{i+1,j,k}$ setting $u_{i+1,j,k}$= $u_{i+1/2,j,k}$.

Missing grid.dLocalGridOld[grid.nD][i+1][j][k] in calculation of $\rho_{i+1/2,j,k}$, setting it to zero.

assuming theta velocity is constant across the surface.

assuming phi velocity is constant across the surface.

Missing grid.dLocalGridOld[grid.nDenAve][nICen+1][0][0] in calculation of $\langle\rho\rangle_{i+1/2}$ setting it to zero.

Missing grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of centered A_1 gradient, setting it equal to Parameters::dAlpha grid.dLocalGridOld[grid.nDM][nICen][0][0].

Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha ∗grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

Member calNewU_RTP_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha $*$grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

Missing density outside of surface, setting it to zero.

Missing density outside model, setting it to zero.

assuming theta and phi velocity same outside star as inside.

Assuming theta velocities are constant across surface.

assuming that V at $i+1$ is equal to v at i.

Missing pressure outside surface setting it equal to negative pressure in the center of the first cell so that it will be zero at surface.

assume viscosity is zero outside the star.

Missing mass outside model, setting it to zero.

Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

Member calNewV_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

grid.dLocalGridOld[grid.nV][i+1][j+1][k] is missing

missing upwind gradient, using centred gradient instead

Member calNewV_RT_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Assuming density outside star is zero

Assuming theta velocity is constant across surface.

Assuming eddy viscosity is zero at surface.

Member calNewV_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Assuming theta and phi velocities are the same at the surface of the star as just inside the star.

ussing cetnered gradient for upwind gradient outside star at surface.

Member calNewV_RTP_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

Assuming density outside star is zero

Assuming theta velocity is constant across surface.

Assuming eddy viscosity is zero at surface.

Member calNewW_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

missing grid.dLocalGridOld[grid.nW][i+1][j][k] assuming that the phi velocity at the outter most interface is the same as the phi velocity in the center of the zone.

missing grid.dLocalGridOld[grid.nW][i+1][j][k] in outter most zone. This is needed to calculate the upwind gradient for donnor cell. The centered gradient is used instead when moving in the negative direction.

Member calNewW_RTP_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

assume theta and phi velocities are constant across surface

assume eddy viscosity is zero at surface

assume upwind gradient is the same as centered gradient across surface

Member calOldEddyVisc_RT_SM (Grid &grid, Parameters &parameters)

assuming that theta velocity is constant across surface

Member calOldEddyVisc_RTP_SM (Grid &grid, Parameters &parameters)

assuming that theta velocity is constant across surface

assume phi velocity is constant across surface

Member dImplicitEnergyFunction_R_LES_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)

Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to value at i.

grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGridOld[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1. Using the centered gradient instead.

Missing grid.dLocalGridOld[grid.nT][i+1][0][0]

Member dImplicitEnergyFunction_R_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)

missing density outside model assuming it is zero

missing desnity outside model assuming it is zero

Assuming energy outside model is the same as the energy in the last zone inside the model.

A1 upwind set to zero as no material is flowing into the star

Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

Member dImplicitEnergyFunction_RT_LES_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)

Missing ΔM_r outside model using Parameters::dAlpha times ΔM_r in the last zone instead.

missing density outside model assuming it is zero

missing desnity outside model assuming it is zero

assuming V at ip1half is the same as V at i

Assuming energy outside model is the same as the energy in the last zone inside the model.

Assuming energy outside model is the same as the energy in the last zone inside the model.

A1 upwind set to zero as no material is flowing into the star

Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

Member dImplicitEnergyFunction_RT_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)

Using centered gradient for upwind gradient when motion is into the star at the surface

Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

Member dImplicitEnergyFunction_RTP_LES_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)

Missing ΔM_r outside model using Parameters::dAlpha times ΔM_r in the last zone instead.

missing density outside model assuming it is zero

missing desnity outside model assuming it is zero

assuming V at ip1half is the same as V at i

assuming W at ip1half is the same as W at i

Assuming energy outside model is the same as the energy in the last zone inside the model.

Assuming energy outside model is the same as the energy in the last zone inside the model.

A1 upwind set to zero as no material is flowing into the star

Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

Member dImplicitEnergyFunction_RTP_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)

Using $E_{i,j,k}^{n+1/2}$ for $E_{i+1/2,j,k}^{n+1/2}$

Using centered gradient for upwind gradient when motion is into the star at the surface

Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

Chapter 2

Todo List

Member calNewU0_R (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass)

At some point I will likely want to make this funciton compatiable with a 3D domain decomposition instead of a purely radial domain decomposition.

Member calNewU0_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass)

At some point I will likely want to make this funciton compatiable with a 3D domain decomposition instead of a purely radial domain decomposition.

Member calNewU0_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass)

At some point I will likely want to make this funciton compatiable with a 3D domain decomposition instead of a purely radial domain decomposition.

Member dImplicitEnergyFunction_R_LES (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)

this funciton should probably be turffed, the LES terms aren't needed in 1D. keeping it for now though.

Member initImplicitCalculation (Implicit &implicit, Grid &grid, ProcTop &procTop, int nNumArgs, char ∗cArgs[])

isFrom, isTo, matCoeff,vecTCorrections, vecTCorrections,vecRHS,vecTCorrections-Local ,kspContext,vecscatTCorrections all need to be destroyed before program finishes.

Member modelRead (std::string sFileName, ProcTop &procTop, Grid &grid, Time &time, Parameters &parameters)

At some point should get it working with only 1 processor

Member Time::nTimeStepIndex

should probably make this an unsigned variable, and perhaps also use the keyword long to help ensure there are enough values. Often need 7 decimal places.

Member updateLocalBoundaries (ProcTop &procTop, MessPass &messPass, Grid &grid)

Shouldn't need MPI::COMM_WORLD.Barrier() may want to test out removing this at some point as it might produce a bit of a speed up.

Member updateLocalBoundariesNewGrid (int nVar, ProcTop &procTop, MessPass &messPass, Grid &grid)

May want to do some waiting on this message at some point before the end of the timestep, but it doesn't need to be done in this function. It might also be that this is built into the code by waiting at some other point. This is something that should be checked out at somepoint, perhaps once the preformance starts to be analyzed. I would think that if the send buffer was being modified before the send was completed, that there would be some errors poping up that would likely kill the program.

Chapter 3

Class Index

3.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 4

File Index

4.1 File List

Here is a list of all documented files with brief descriptions:

Chapter 5

Class Documentation

5.1 eos Class Reference

```
#include <eos.h>
```

Public Member Functions

- eos ()
- eos (int nNumT, int nNumRho)
- eos (const eos &ref)
- ∼eos ()
- eos & operator= (const eos &eosRightSide)
- void readAscii (std::string sFileName)
- void readBobsAscii (std::string sFileName)
- void writeAscii (std::string sFileName)
- void readBin (std::string sFileName) throw (exception2)
- void writeBin (std::string sFileName)
- double dGetPressure (double dT, double dRho)
- double dGetEnergy (double dT, double dRho)
- double dGetOpacity (double dT, double dRho)
- double dDRhoDP (double dT, double dRho)
- double dSoundSpeed (double dT, double dRho)
- void getEKappa (double dT, double dRho, double &dE, double &dKappa)
- void getPEKappa (double dT, double dRho, double &dP, double &dE, double &d-Kappa)
- void getPEKappaGamma (double dT, double dRho, double &dP, double &dE, double &dKappa, double &dGamma)
- void getPEKappaGammaCp (double dT, double dRho, double &dP, double &dE, double &dKappa, double &dGamma, double &dCp)
- void getPKappaGamma (double dT, double dRho, double &dP, double &dKappa, double &dGamma)

- void gamma1DelAdC_v (double dT, double dRho, double &dGamma1, double &dDelAd, double &dC_v)
- void getPAndDRhoDP (double dT, double dRho, double &dP, double &dDRhoDP)
- void getEAndDTDE (double dT, double dRho, double &dE, double &dDTDE)
- void getDlnPDlnTDlnPDlnPDEDT (double dT, double dRho, double &dDlnPDlnT, double &dDlnPDlnRho, double &dDEDT)

Public Attributes

- int nNumRho
- int nNumT
- double dXMassFrac
- double dYMassFrac
- double dLogRhoMin
- double dLogRhoDelta
- double dLogTMin
- double dLogTDelta
- double ** dLogP
- double ** dLogE
- double ** dLogKappa

5.1.1 Detailed Description

This class holds an equation of state as well as many functions useful for manipulating it

5.1.2 Constructor & Destructor Documentation

5.1.2.1 eos::eos ( )

Constructor, doesn't really do anything

References dLogE, dLogKappa, dLogP, nNumRho, and nNumT.

5.1.2.2 eos::eos (int *nNumT*, int *nNumRho*)

Constructor, allocates memory for the 2D arrays

Parameters

`in`	*nNumT*	number of temperatures in the equaiton of state table
`in`	*nNumRho*	number of densities in the equaiton of state table

5.1.2.3 eos::eos (const eos & *ref*)

Copy constructor, simply constructs a new eos object from another eos object

References dLogE, dLogKappa, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, dLogTMin, dXMassFrac, dYMassFrac, nNumRho, and nNumT.

5.1.2.4 eos::∼eos ( )

Destructor, delets dynamic arrays

References dLogE, dLogKappa, dLogP, and nNumRho.

5.1.3 Member Function Documentation

5.1.3.1 double eos::dDRhoDP (double *dT,* double *dRho*)

This function calculates the partial derivative of density w.r.t. pressure

Parameters

`in`	*dT*	temperature at which the derivative is to be computed
`in`	*dRho*	density at which the derivative is to be computed

Returns

the partial derivative of density w.r.t. pressure.

References dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, dLogTMin, nNumRho, and nNumT.

5.1.3.2 double eos::dGetEnergy (double *dT,* double *dRho*)

This function linearly interpolates the energy to a given temperature and and density. Note that both `dT` and `dRho` are not in log space.

Parameters

`in`	*dT*	temperature to interpolate to.
`in`	*dRho*	density to interpolate to.

Returns

the interpolated energy.

References dLogE, dLogRhoDelta, dLogRhoMin, dLogTDelta, dLogTMin, nNumRho, and nNumT.

Referenced by dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_LES(), d-ImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicit-EnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction-_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), and dImplicitEnergyFunction_RTP_SB().

5.1.3.3 double eos::dGetOpacity (double *dT*, double *dRho*)

This function linearly interpolates the opacity to a given temperature and and density. Note that both `dT` and `dRho` are not in log space.

Parameters

`in`	*dT*	temperature to interpolate to.
`in`	*dRho*	density to interpolate to.

Returns

the interpolated opacity.

References dLogKappa, dLogRhoDelta, dLogRhoMin, dLogTDelta, dLogTMin, nNum-Rho, and nNumT.

Referenced by dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_LES(), d-ImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicit-EnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction-_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), and dImplicitEnergyFunction_RTP_SB().

5.1.3.4 double eos::dGetPressure (double *dT*, double *dRho*)

This function linearly interpolates the pressure to a given temperature and density. Note that both `dT` and `dRho` are not in log space.

Parameters

`in`	*dT*	temperature to interpolate to.
`in`	*dRho*	density to interpolate to.

Returns

the interpolated pressure.

References dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, dLogTMin, nNumRho, and nNumT.

Referenced by dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_LES(), d-ImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicit-

EnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction-_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), and dImplicitEnergyFunction_RTP_SB().

5.1.3.5 double eos::dSoundSpeed (double *dT,* double *dRho*)

This function calculates the adiabatic sound speed

Parameters

in	*dT*	temperature at which the derivative is to be computed
in	*dRho*	density at which the derivative is to be computed

Returns

the sound speed.

References dLogE, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, dLogTMin, n-NumRho, and nNumT.

5.1.3.6 void eos::gamma1DelAdC_v (double *dT,* double *dRho,* double & *dGamma1,* double & *dDelAd,* double & *dC_v*)

This function calculates gamma1 and the adiabatic gradient

Parameters

in	*dT*	temperature at which the derivative is to be computed
in	*dRho*	density at which the derivative is to be computed
out	*dGamma1*	gamma1
out	*dDelAd*	adiabatic gradient
out	*dC_v*	specific heat at constant volume

References dLogE, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, dLogTMin, n-NumRho, and nNumT.

5.1.3.7 void eos::getDlnPDlnTDlnPDlnPDEDT (double *dT,* double *dRho,* double & *dDlnPDlnT,* double & *dDlnPDlnRho,* double & *dDEDT*)

This function calculates various partial derivatives

Parameters

in	*dT*	temperature at which the derivative is to be computed
in	*dRho*	density at which the derivative is to be computed
out	*dDlnPDlnT*	derivative of ln(P) w.r.t. ln(T)

out	*dDlnPDln-Rho*	derivative of ln(P) w.r.t. ln(Rho)
out	*dDEDT*	derivative of temperature w.r.t. energy at constant density

References dLogE, dLogKappa, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, d-LogTMin, nNumRho, and nNumT.

5.1.3.8 void eos::getEAndDTDE (double *dT*, double *dRho*, double & *dE*, double & *dDTDE*)

This function calculates the partial derivative of temperature w.r.t. energy and the energy

Parameters

in	*dT*	temperature at which the derivative is to be computed
in	*dRho*	density at which the derivative is to be computed
out	*dE*	energy at dT and dRho
out	*dDTDE*	derivative of temperature w.r.t. energy at constant density

References dLogE, dLogRhoDelta, dLogRhoMin, dLogTDelta, dLogTMin, nNumRho, and nNumT.

Referenced by calNewTPKappaGamma_TEOS().

5.1.3.9 void eos::getEKappa (double *dT*, double *dRho*, double & *dE*, double & *dKappa*)

This function linearly interpolates the three dependent quantities (Pressure, Energy , Opacity) to a given temperature and density. Note that both `dT` and `dRho` are not in log space.

Parameters

in	*dT*	temperature to interpolate to.
in	*dRho*	density to interpolate to.
out	*dE*	energy at dT and dRho.
out	*dKappa*	opacity at dT and dRho.

References dLogE, dLogKappa, dLogRhoDelta, dLogRhoMin, dLogTDelta, dLogTMin, nNumRho, and nNumT.

5.1.3.10 void eos::getPAndDRhoDP (double *dT*, double *dRho*, double & *dP*, double & *dDRhoDP*)

This function calculates the partial derivative of density w.r.t. pressure and the pressure

Parameters

in	*dT*	temperature at which the derivative is to be computed
in	*dRho*	density at which the derivative is to be computed
out	*dP*	pressure at dT and dRho
out	*dDRhoDP*	derivative of density w.r.t. pressure at conatant temperature

References dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, dLogTMin, nNumRho, and nNumT.

5.1.3.11 void eos::getPEKappa (double *dT,* double *dRho,* double & *dP,* double & *dE,* double & *dKappa*)

This function linearly interpolates the three dependent quantities (Pressure, Energy , Opacity) to a given temperature and density. Note that both `dT` and `dRho` are not in log space.

Parameters

in	*dT*	temperature to interpolate to.
in	*dRho*	density to interpolate to.
out	*dP*	pressure at dT and dRho.
out	*dE*	energy at dT and dRho.
out	*dKappa*	opacity at dT and dRho.

References dLogE, dLogKappa, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, d-LogTMin, nNumRho, and nNumT.

5.1.3.12 void eos::getPEKappaGamma (double *dT,* double *dRho,* double & *dP,* double & *dE,* double & *dKappa,* double & *dGamma*)

This function linearly interpolates the energy and opacity to a given temperature and density. Note that both `dT` and `dRho` are not in log space.

Parameters

in	*dT*	temperature to interpolate to.
in	*dRho*	density to interpolate to.
out	*dP*	pressure at dT and dRho.
out	*dE*	energy at dT and dRho.
out	*dKappa*	opacity at dT and dRho.
out	*dGamma*	adiabatic index at dT and dRho.

References dLogE, dLogKappa, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, d-LogTMin, nNumRho, and nNumT.

Referenced by calNewPEKappaGamma_TEOS(), and calOldPEKappaGamma_TEO-S().

5.1.3.13 void eos::getPEKappaGammaCp (double *dT*, double *dRho*, double & *dP*, double & *dE*, double & *dKappa*, double & *dGamma*, double & *dCp*)

This function linearly interpolates the energy and opacity to a given temperature and density. Note that both `dT` and `dRho` are not in log space.

Parameters

`in`	*dT*	temperature to interpolate to.
`in`	*dRho*	density to interpolate to.
`out`	*dP*	pressure at dT and dRho.
`out`	*dE*	energy at dT and dRho.
`out`	*dKappa*	opacity at dT and dRho.
`out`	*dGamma*	adiabatic index at dT and dRho.
`out`	*dCp*	specific heat at constant pressure at dT and dRho.

References dLogE, dLogKappa, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, d-LogTMin, nNumRho, and nNumT.

5.1.3.14 void eos::getPKappaGamma (double *dT*, double *dRho*, double & *dP*, double & *dKappa*, double & *dGamma*)

This function linearly interpolates the energy and opacity to a given temperature and density. Note that both `dT` and `dRho` are not in log space.

Parameters

`in`	*dT*	temperature to interpolate to.
`in`	*dRho*	density to interpolate to.
`out`	*dP*	pressure at dT and dRho.
`out`	*dKappa*	opacity at dT and dRho.
`out`	*dGamma*	adiabatic index at dT and dRho.

References dLogE, dLogKappa, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, d-LogTMin, nNumRho, and nNumT.

Referenced by calNewTPKappaGamma_TEOS().

5.1.3.15 eos & eos::operator= (const eos & *eosRightSide*)

Assignment operator, assigns one eos object to another.

References dLogE, dLogKappa, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, d-LogTMin, nNumRho, and nNumT.

5.1.3.16 void eos::readAscii (std::string *sFileName*)

This fuction reads in an ascii file and stores it in the current object.

Parameters

`in`	*sFileName*	name of the equation of state file to read from.

References dLogE, dLogKappa, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, d-LogTMin, dXMassFrac, dYMassFrac, nNumRho, and nNumT.

5.1.3.17 void **eos::readBin** (std::string ***sFileName***) throw (**exception2**)

This fuction reads in a binary file and stores it in the current object.

Parameters

`in`	*sFileName*	name of the equation of state file to read from.

Referenced by init().

5.1.3.18 void **eos::readBobsAscii** (std::string ***sFileName***)

This fuction reads in an ascii file and stores it in the current object. The ascii file is in Bob's format.

Parameters

`in`	*sFileName*	name of the equation of state file to read from.

References dLogE, dLogKappa, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, d-LogTMin, dXMassFrac, dYMassFrac, nNumRho, and nNumT.

5.1.3.19 void **eos::writeAscii** (std::string ***sFileName***)

This fuction writes the equation of state stored in the current object to an ascii file.

Parameters

`in`	*sFileName*	name of the file to write the equation of state to.

References dLogE, dLogKappa, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, d-LogTMin, dXMassFrac, dYMassFrac, nNumRho, and nNumT.

5.1.3.20 void **eos::writeBin** (std::string ***sFileName***)

This fuction writes the equation of state stored in the current object to a binary file.

Parameters

`in`	*sFileName*	name of the file to write the equaiton of state to.

References dLogE, dLogKappa, dLogP, dLogRhoDelta, dLogRhoMin, dLogTDelta, dLogTMin, dXMassFrac, dYMassFrac, nNumRho, and nNumT.

5.1.4 Member Data Documentation

5.1.4.1 double∗∗ eos::dLogE

2D array of log10 energies. dLogE[i][j] gives the log10 energy at log10 density of eos::dLogRhoDelta∗i+eos::dLogRhoMin, and at log10 temperature of eos::dLogTDelta∗j+eos::dLogTMin.

Referenced by dGetEnergy(), dSoundSpeed(), eos(), gamma1DelAdC_v(), getDlnPDlnTDlnPDlnPDEDT(), getEAndDTDE(), getEKappa(), getPEKappa(), getPEKappaGamma(), getPEKappaGammaCp(), getPKappaGamma(), operator=(), readAscii(), readBobsAscii(), writeAscii(), writeBin(), and ∼eos().

5.1.4.2 double∗∗ eos::dLogKappa

2D array of log10 opacities. dLogKappa[i][j] gives the log10 opacity at log10 density of eos::dLogRhoDelta∗i+eos::dLogRhoMin, and at log10 temperature of eos::dLogTDelta∗j+eos::dLogTMin.

Referenced by dGetOpacity(), eos(), getDlnPDlnTDlnPDlnPDEDT(), getEKappa(), getPEKappa(), getPEKappaGamma(), getPEKappaGammaCp(), getPKappaGamma(), operator=(), readAscii(), readBobsAscii(), writeAscii(), writeBin(), and ∼eos().

5.1.4.3 double∗∗ eos::dLogP

2D array of log10 pressures. dLogP[i][j] gives the log10 pressure at log10 density of eos::dLogRhoDelta∗i+eos::dLogRhoMin, and at log10 temperature of eos::dLogTDelta∗j+eos::dLogTMin.

Referenced by dDRhoDP(), dGetPressure(), dSoundSpeed(), eos(), gamma1DelAdC_v(), getDlnPDlnTDlnPDlnPDEDT(), getPAndDRhoDP(), getPEKappa(), getPEKappaGamma(), getPEKappaGammaCp(), getPKappaGamma(), operator=(), readAscii(), readBobsAscii(), writeAscii(), writeBin(), and ∼eos().

5.1.4.4 double eos::dLogRhoDelta

Increment of the density between table entries in log10.

Referenced by dDRhoDP(), dGetEnergy(), dGetOpacity(), dGetPressure(), dSoundSpeed(), eos(), gamma1DelAdC_v(), getDlnPDlnTDlnPDlnPDEDT(), getEAndDTDE(), getEKappa(), getPAndDRhoDP(), getPEKappa(), getPEKappaGamma(), getPEKappaGammaCp(), getPKappaGamma(), operator=(), readAscii(), readBobsAscii(), writeAscii(), and writeBin().

5.1.4.5 double eos::dLogRhoMin

Minimum density of the table in log10.

Referenced by dDRhoDP(), dGetEnergy(), dGetOpacity(), dGetPressure(), dSoundSpeed(), eos(), gamma1DelAdC_v(), getDlnPDlnTDlnPDlnPDEDT(), getEAndDTDE(), getEKappa(), getPAndDRhoDP(), getPEKappa(), getPEKappaGamma(), getPEKappaGammaCp(), getPKappaGamma(), operator=(), readAscii(), readBobsAscii(), writeAscii(), and writeBin().

5.1.4.6 double eos::dLogTDelta

Increment of the temperature between table entries in log10.

Referenced by dDRhoDP(), dGetEnergy(), dGetOpacity(), dGetPressure(), dSoundSpeed(), eos(), gamma1DelAdC_v(), getDlnPDlnTDlnPDlnPDEDT(), getEAndDTDE(), getEKappa(), getPAndDRhoDP(), getPEKappa(), getPEKappaGamma(), getPEKappaGammaCp(), getPKappaGamma(), operator=(), readAscii(), readBobsAscii(), writeAscii(), and writeBin().

5.1.4.7 double eos::dLogTMin

Minimum temperature of the table in log10.

Referenced by dDRhoDP(), dGetEnergy(), dGetOpacity(), dGetPressure(), dSoundSpeed(), eos(), gamma1DelAdC_v(), getDlnPDlnTDlnPDlnPDEDT(), getEAndDTDE(), getEKappa(), getPAndDRhoDP(), getPEKappa(), getPEKappaGamma(), getPEKappaGammaCp(), getPKappaGamma(), operator=(), readAscii(), readBobsAscii(), writeAscii(), and writeBin().

5.1.4.8 double eos::dXMassFrac

Hydrogen mass fraction of the composition used to generate the equation of state table.

Referenced by eos(), readAscii(), readBobsAscii(), writeAscii(), and writeBin().

5.1.4.9 double eos::dYMassFrac

Helium mass fraction of the composition used to generate the equation of state table.

Referenced by eos(), readAscii(), readBobsAscii(), writeAscii(), and writeBin().

5.1.4.10 int eos::nNumRho

Number of densities in the equation of state table

Referenced by dDRhoDP(), dGetEnergy(), dGetOpacity(), dGetPressure(), dSoundSpeed(), eos(), gamma1DelAdC_v(), getDlnPDlnTDlnPDlnPDEDT(), getEAndDTDE(), getEKappa(), getPAndDRhoDP(), getPEKappa(), getPEKappaGamma(), getPEKappaGammaCp(), getPKappaGamma(), operator=(), readAscii(), readBobsAscii(), writeAscii(), writeBin(), and ∼eos().

5.1.4.11 int eos::nNumT

Number of temperatures in the equation of state table

Referenced by dDRhoDP(), dGetEnergy(), dGetOpacity(), dGetPressure(), dSoundSpeed(), eos(), gamma1DelAdC_v(), getDlnPDlnTDlnPDlnPDEDT(), getEAndDTDE(), getEKappa(), getPAndDRhoDP(), getPEKappa(), getPEKappaGamma(), getPEKappaGammaCp(), getPKappaGamma(), operator=(), readAscii(), readBobsAscii(), writeAscii(), and writeBin().

The documentation for this class was generated from the following files:

- /home/cgeroux/Documents/WORK/SPHERLS_git/src/eos.h
- /home/cgeroux/Documents/WORK/SPHERLS_git/src/eos.cpp

5.2 exception2 Class Reference

The documentation for this class was generated from the following files:

- /home/cgeroux/Documents/WORK/SPHERLS_git/src/exception2.h
- /home/cgeroux/Documents/WORK/SPHERLS_git/src/exception2.cpp

5.3 Functions Class Reference

```
#include <global.h>
```

Public Member Functions

- Functions ()

Public Attributes

- void(∗ fpCalculateNewVelocities)(Grid &, Parameters &, Time &, ProcTop &)
- void(∗ fpCalculateNewGridVelocities)(Grid &, Parameters &, Time &, ProcTop &, MessPass &)
- void(∗ fpCalculateNewRadii)(Grid &, Time &)
- void(∗ fpCalculateNewDensities)(Grid &, Parameters &, Time &, ProcTop &)
- void(∗ fpCalculateNewEnergies)(Grid &, Parameters &, Time &, ProcTop &)
- void(∗ fpCalculateDeltat)(Grid &, Parameters &, Time &, ProcTop &)
- void(∗ fpCalculateAveDensities)(Grid &)

- void(∗ fpCalculateNewEOSVars)(Grid &, Parameters &)
- void(∗ fpCalculateNewAV)(Grid &, Parameters &)
- void(∗ fpModelWrite)(std::string sFileName, ProcTop &, Grid &, Time &, Parameters &)
- void(∗ fpWriteWatchZones)(Output &, Grid &, Parameters &, Time &, ProcTop &)
- void(∗ fpUpdateLocalBoundaryVelocitiesNewGrid)(ProcTop &, MessPass &, Grid &)
- void(∗ fpImplicitSolve)(Grid &, Implicit &, Parameters &, Time &, ProcTop &, MessPass &, Functions &)
- void(∗ fpCalculateNewEddyVisc)(Grid &, Parameters &)

5.3.1 Detailed Description

This class holds function pointers used to indicate the functions which should be used to calculate the various needed quantities. These functions can be different from processor to processor. For example ProcTop::nRank=0 processor will have only 1D verions of the conservation equations, while the rest of the processors will have 3D versions. These functions will also change depending on what kind of model is being calculated and the number of dimensions the calculation includes.

5.3.2 Constructor & Destructor Documentation

5.3.2.1 Functions::Functions ( )

Constructor for the class Functions.

References fpCalculateAveDensities, fpCalculateDeltat, fpCalculateNewAV, fpCalculateNewDensities, fpCalculateNewEnergies, fpCalculateNewEOSVars, fpCalculateNewGridVelocities, fpCalculateNewRadii, and fpCalculateNewVelocities.

5.3.3 Member Data Documentation

5.3.3.1 void(∗ Functions::fpCalculateAveDensities)(Grid &)

Function pointer to the function used to calculate the new average density.

Referenced by Functions(), main(), and setMainFunctions().

5.3.3.2 void(∗ Functions::fpCalculateDeltat)(Grid &, Parameters &, Time &, ProcTop &)

Function pointer to the function used to calculate the new time step.

Referenced by Functions(), main(), and setMainFunctions().

5.3.3.3 void(∗ Functions::fpCalculateNewAV)(Grid &, Parameters &)

Function pointer to the function used to calculate new Artificial viscosity.

Referenced by Functions(), main(), and setMainFunctions().

5.3.3.4 void(∗ Functions::fpCalculateNewDensities)(Grid &, Parameters &, Time &, ProcTop &)

Function pointer to the function used to calculate the new densities.

Referenced by Functions(), main(), and setMainFunctions().

5.3.3.5 void(∗ Functions::fpCalculateNewEddyVisc)(Grid &, Parameters &)

Function pointer to the function that is used to calculate the new eddy viscosity.

Referenced by main(), and setMainFunctions().

5.3.3.6 void(∗ Functions::fpCalculateNewEnergies)(Grid &, Parameters &, Time &, ProcTop &)

Function pointer to the function used to calculate the new energies.

Referenced by Functions(), main(), and setMainFunctions().

5.3.3.7 void(∗ Functions::fpCalculateNewEOSVars)(Grid &, Parameters &)

Function pointer to the function used to calculate the new variables depending on the equation of state.

Referenced by Functions(), main(), and setMainFunctions().

5.3.3.8 void(∗ Functions::fpCalculateNewGridVelocities)(Grid &, Parameters &, Time &, ProcTop &, MessPass &)

Function pointer to the function used to calculate new grid velocities.

Referenced by Functions(), main(), and setMainFunctions().

5.3.3.9 void(∗ Functions::fpCalculateNewRadii)(Grid &, Time &)

Functin pointer to the function used to calculate new radii.

Referenced by Functions(), main(), and setMainFunctions().

5.3.3.10 void(∗ Functions::fpCalculateNewVelocities)(Grid &, Parameters &, Time &, ProcTop &)

Function pointer to the function used to calculate new velocities.

Referenced by Functions(), main(), and setMainFunctions().

5.3.3.11 void(∗ Functions::fpImplicitSolve)(Grid &, Implicit &, Parameters &, Time &, ProcTop &, MessPass &, Functions &)

Funciton pointer to the function that is used to implicitly solve for the temperature, then uses the equation of state to solve for energy, opacity, and pressure.

Referenced by main(), and setMainFunctions().

5.3.3.12 void(∗ Functions::fpModelWrite)(std::string sFileName, ProcTop &, Grid &, Time &, Parameters &)

Function pointer to the function used to write out models.

Referenced by fin(), main(), and setMainFunctions().

5.3.3.13 void(∗ Functions::fpUpdateLocalBoundaryVelocitiesNewGrid)(ProcTop &, MessPass &, Grid &)

Function pointer to the fnction that is used to update velocities across boundaries.

Referenced by main(), and setMainFunctions().

5.3.3.14 void(∗ Functions::fpWriteWatchZones)(Output &, Grid &, Parameters &, Time &, ProcTop &)

Function pointer to the function that is used to write out watch zone files

Referenced by main(), and setMainFunctions().

The documentation for this class was generated from the following files:

- global.h
- global.cpp

5.4 Global Class Reference

```
#include <global.h>
```

Public Member Functions

- Global ()

Public Attributes

- ProcTop procTop
- MessPass messPass
- Grid grid
- Time time
- Parameters parameters
- Output output
- Performance performance
- Functions functions
- Implicit implicit

5.4.1 Detailed Description

This class is simply a class that holds the other classes.

5.4.2 Constructor & Destructor Documentation

5.4.2.1 Global::Global ( )

Constructor for the class Global.

5.4.3 Member Data Documentation

5.4.3.1 Functions Global::functions

An instance of the Functions class.

Referenced by main().

5.4.3.2 Grid Global::grid

An instance of the Grid class.

Referenced by main().

5.4.3.3 Implicit Global::implicit

An instance of the Implicit class.

Referenced by main().

5.4.3.4 MessPass Global::messPass

An instance of the MessPass class.

Referenced by main().

5.4.3.5 Output Global::output

An instance of the Output class.

Referenced by main().

5.4.3.6 Parameters Global::parameters

An instance of the Parameters class.

Referenced by main().

5.4.3.7 Performance Global::performance

An instance of the Performance class.

Referenced by main().

5.4.3.8 ProcTop Global::procTop

An instance of the ProcTop class.

Referenced by main().

5.4.3.9 Time Global::time

An instance of the Time class.

Referenced by main().

The documentation for this class was generated from the following files:

- global.h
- global.cpp

5.5 Grid Class Reference

```
#include <global.h>
```

Public Member Functions

- Grid ()

Public Attributes

- int nM
- int nTheta
- int nPhi
- int nDM
- int nR
- int nD
- int nU
- int nU0
- int nV
- int nW
- int nT
- int nE
- int nP
- int nKappa
- int nGamma
- int nDenAve
- int nQ0
- int nQ1
- int nQ2
- int nDTheta
- int nDPhi
- int nSinThetaIJK
- int nSinThetaIJp1halfK
- int nCotThetaIJp1halfK
- int nCotThetaIJK
- int nDCosThetaIJK
- int nEddyVisc
- int nDonorCellFrac
- int nNumDims
- int nNumVars
- int nNumIntVars
- int nNum1DZones
- int nNumGhostCells
- int ∗ nGlobalGridDims
- int ∗∗ nVariables
- int ∗∗∗ nLocalGridDims
- double ∗∗∗∗ dLocalGridNew
- double ∗∗∗∗ dLocalGridOld
- int ∗∗ nStartUpdateExplicit
- int ∗∗ nEndUpdateExplicit

- int ** nStartUpdateImplicit
- int ** nEndUpdateImplicit
- int *** nStartGhostUpdateExplicit
- int *** nEndGhostUpdateExplicit
- int *** nStartGhostUpdateImplicit
- int *** nEndGhostUpdateImplicit
- int * nCenIntOffset
- int nGlobalGridPositionLocalGrid [3]

5.5.1 Detailed Description

This class manages information which pertains to grid data.

External variables used with Gamma Law (GL) gas equaiton of state and their array indexes:

1D (nNumVars=7)		2D (nNumVars=9)		3D (nNumVars=11)	
Variable	Index	Variable	Index	Variable	Index
nM	0	nM	0	nM	0
nDM	1	nTheta	1	nTheta	1
nR	2	nDM	2	nPhi	2
nD	3	nR	3	nDM	3
nU	4	nD	4	nR	4
nU0	5	nU	5	nD	5
nE	6	nU0	6	nU	6
		nV	7	nU0	7
		nE	8	nV	8
				nW	9
				nE	10

External variables used with Tabulated Equation Of State (TEOS) and their array indexes:

1D (nNumVars=7)		2D (nNumVars=9)		3D (nNumVars=11)	
Variable	Index	Variable	Index	Variable	Index
nM	0	nM	0	nM	0
nDM	1	nTheta	1	nTheta	1
nR	2	nDM	2	nPhi	2
nD	3	nR	3	nDM	3
nU	4	nD	4	nR	4
nU0	5	nU	5	nD	5
nT	6	nU0	6	nU	6
		nV	7	nU0	7
		nT	8	nV	8
				nW	9
				nT	10

Internal variables with GL gas equation of state:

1D (nNumIntVars=2)

Variable	Index
nP	nNumVars+0
nQ0	nNumVars+1

2D (nNumIntVars=8)

Variable	Index
nP	nNumVars+0
nQ0	nNumVars+1
nDenAve	nNumVars+2
nDCosThetaIJK	nNumVars+3
nQ1	nNumVars+4
nDTheta	nNumVars+5
nSinThetaIJK	nNumVars+6
nSinThetaIJp1halfK	nNumVars+7

3D (nNumIntVars=12)

Variable	Index
nP	nNumVars+0
nQ0	nNumVars+1
nDenAve	nNumVars+2
nDPhi	nNumVars+3
nDCosThetaIJK	nNumVars+4
nQ1	nNumVars+5
nDTheta	nNumVars+6
nSinThetaIJK	nNumVars+7
nSinThetaIJp1halfK	nNumVars+8
nCotThetaIJK	nNumVars+9
nCotThetaIJp1halfK	nNumVars+10
nQ2	nNumVars+11

Internal variables with TEOS:

1D (nNumIntVars=5)

Variable	Index
nP	nNumVars+0
nQ0	nNumVars+1
nE	nNumVars+2
nKappa	nNumVars+3
nGamma	nNumVars+4

2D (nNumIntVars=11)

Variable	Index
nP	nNumVars+0
nQ0	nNumVars+1
nDenAve	nNumVars+2
nDCosThetaIJK	nNumVars+3
nE	nNumVars+4
nKappa	nNumVars+5
nGamma	nNumVars+6
nQ1	nNumVars+7
nDTheta	nNumVars+8
nSinThetaIJK	nNumVars+9
nSinThetaIJp1halfK	nNumVars+10

3D (nNumIntVars=15)

Variable	Index
nP	nNumVars+0
nQ0	nNumVars+1
nDenAve	nNumVars+2
nDPhi	nNumVars+3
nDCosThetaIJK	nNumVars+4
nE	nNumVars+5
nKappa	nNumVars+6
nGamma	nNumVars+7
nQ1	nNumVars+8
nDTheta	nNumVars+9
nSinThetaIJK	nNumVars+10
nSinThetaIJp1halfK	nNumVars+11
nCotThetaIJK	nNumVars+12
nCotThetaIJp1halfK	nNumVars+13
nQ2	nNumVars+14

The variable indexes are set in modelRead based on the input model.

5.5.2 Constructor & Destructor Documentation

5.5.2.1 Grid::Grid ( )

sets how many zones out from the 1D-multi-D boundary that theta/phi velocities are not updated and thus kept at zero. Constructor for the class Grid.

References dLocalGridNew, dLocalGridOld, nCenIntOffset, nCotThetaIJK, nCotThetaIJp1halfK, nD, nDCosThetaIJK, nDenAve, nDM, nDonorCellFrac, nDPhi, nDTheta, nE, nEddyVisc, nEndGhostUpdateExplicit, nEndGhostUpdateImplicit, nEndUpdateExplicit, nEndUpdateImplicit, nGamma, nGlobalGridDims, nKappa, nLocalGridDims, nM, nP, nPhi, nQ0, nQ1, nQ2, nR, nSinThetaIJK, nSinThetaIJp1halfK, nStartGhostUpdate-Explicit, nStartGhostUpdateImplicit, nStartUpdateExplicit, nStartUpdateImplicit, nT, n-Theta, nU, nU0, nV, nVariables, and nW.

5.5.3 Member Data Documentation

5.5.3.1 double∗∗∗∗ Grid::dLocalGridNew

Updated local grid values. An array of size Grid::nNumVars+Grid::nNumIntVars by Grid::nLocalGridDims[0] +2∗Grid::nNumGhostCells by Grid::nLocalGridDims[1]+2∗Grid::nNumGhostCells by Grid::nLocalGridDims[2]+2∗Grid::nNumGhostCells provided that the variable is defined in all 3 directions. Variables that are not defined in all 3 directions will have the additional two ghost cells left out in that direction and will also have a dimension of size 1 in that direction. This array contains the current grid state as it is being updated through calculations. This is a processor dependent variable and contains only the local grid for the current processor plus ghost cells.

Referenced by average3DTo1DBoundariesNew(), calDelt_R_GL(), calDelt_R_TEO-S(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEO-S(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewDenave_R(), calNew-Denave_RT(), calNewDenave_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNew-E_R_NA_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewEddy-Visc_R_CN(), calNewEddyVisc_R_SM(), calNewEddyVisc_RT_CN(), calNewEddy-Visc_RT_SM(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_RTP_SM(), calNew-P_GL(), calNewPEKappaGamma_TEOS(), calNewQ0_R_GL(), calNewQ0_R_TEO-S(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewR(), calNewTPKappaGamma_TEOS(), cal-NewU0_R(), calNewU0_RT(), calNewU0_RTP(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), cal-NewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW-_RTP(), calNewW_RTP_LES(), calOldEddyVisc_R_CN(), calOldEddyVisc_RT_CN(), calOldEddyVisc_RTP_CN(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction-_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergy-Function_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction-_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_-SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), implicitSolve_R(), implicitSolve_-RT(), implicitSolve_RTP(), initUpdateLocalBoundaries(), setupLocalGrid(), update-LocalBoundaries(), updateLocalBoundariesNewGrid(), updateNewGridWithOld(), and updateOldGrid().

5.5.3.2 double∗∗∗∗ Grid::dLocalGridOld

Grid values from previous time step. An array the same size as Grid::dLocalGridNew but instead of containing the current grid state, it contains the last complete grid state. This is a processor dependent variable and contains only the local grid for the current processor plus ghost cells.

Referenced by average3DTo1DBoundariesNew(), average3DTo1DBoundariesOld(), calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt-_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewDenave_RT(), calNewDenave_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA-_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), cal-NewEddyVisc_RT_CN(), calNewEddyVisc_RT_SM(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_RTP_SM(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewR(), calNewT-PKappaGamma_TEOS(), calNewU0_RT(), calNewU0_RTP(), calNewU_R(), calNew-U_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_-LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), calOldDenave_R(), calOldDenave_RT(), calOldDenave_RTP(), calOldEddyVisc_R_CN(), calOldEddyVisc_R_SM(), calOld-EddyVisc_RT_CN(), calOldEddyVisc_RT_SM(), calOldEddyVisc_RTP_CN(), calOld-EddyVisc_RTP_SM(), calOldP_GL(), calOldPEKappaGamma_TEOS(), calOldQ0_R-_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), cal-OldQ0Q1Q2_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicit-EnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT-_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), d-ImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergy-Function_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), initDonorFrac-AndMaxConVel_R_GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAnd-MaxConVel_RT_GL(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAnd-MaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_TEOS(), initInternalVars(), initUpdateLocalBoundaries(), modelRead(), modelWrite_GL(), modelWrite_TEOS(), setDEDMClamp(), setupLocalGrid(), updateLocalBoundaries(), updateNewGridWith-Old(), updateOldGrid(), writeWatchZones_R_GL(), writeWatchZones_R_TEOS(), write-WatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_TEOS().

5.5.3.3 int∗ Grid::nCenIntOffset

Indicates the offset between interface and center quantities. If `nCenInt-Offset[l]=0` then the outter interface quantities have the same index as zone centered quantities in direction `l`. If `nCenIntOffset[l]=1` then the outter interface quantities are given by the index for the zone centered quantities +1, in direction `l`. The values are dependent on ProcTop::nRank and ProcTop::nPeriodic.

Referenced by average3DTo1DBoundariesNew(), average3DTo1DBoundariesOld(), calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt-_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewDenave_RT(), calNewDenave_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_L-ES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNew-EddyVisc_R_CN(), calNewEddyVisc_R_SM(), calNewEddyVisc_RT_CN(), calNew-EddyVisc_RT_SM(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_RTP_SM(), cal-NewQ0_R_GL(), calNewQ0_R_TEOS(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_T-

EOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewU0_RT(), calNewU0_RTP(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_-LES(), calNewU_RTP(), calNewU_RTP_LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), cal-OldDenave_RT(), calOldDenave_RTP(), calOldEddyVisc_R_CN(), calOldEddyVisc-_R_SM(), calOldEddyVisc_RT_CN(), calOldEddyVisc_RT_SM(), calOldEddyVisc_-RTP_CN(), calOldEddyVisc_RTP_SM(), calOldQ0_R_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_RTP_GL(), cal-OldQ0Q1Q2_RTP_TEOS(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction-_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergy-Function_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction-_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_-SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), initDonorFracAndMaxConVel_R_-GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_G-L(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_-GL(), initDonorFracAndMaxConVel_RTP_TEOS(), initInternalVars(), initUpdateLocal-Boundaries(), setDEDMClamp(), setupLocalGrid(), writeWatchZones_R_GL(), write-WatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_TEOS().

5.5.3.4 int Grid::nCotThetaIJK

Index of $\cot\theta$ at cell centeres of grids. This is an internal grid variable and is included in the count of Grid::nNumIntVars.

Referenced by calNewEddyVisc_RTP_SM(), calNewU_RT_LES(), calNewU_RTP_LE-S(), calNewW_RTP(), calNewW_RTP_LES(), calOldEddyVisc_RTP_SM(), Grid(), init-InternalVars(), modelRead(), and setInternalVarInf().

5.5.3.5 int Grid::nCotThetaIJp1halfK

Index of $\cot\theta$ at θ interfaces in grids. This is an internal grid variable and is included in the count of Grid::nNumIntVars.

Referenced by calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), Grid(), initInternalVars(), modelRead(), and setInternalVarInf().

5.5.3.6 int Grid::nD

Index of ρ in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an external grid variable included in the count Grid::nNumVars

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT-_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewDenave_R(), calNewDenave_RT(), calNewDenave_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_-NA(), calNewE_RTP_NA_LES(), calNewEddyVisc_R_SM(), calNewEddyVisc_RT_S-

M(), calNewEddyVisc_RTP_SM(), calNewP_GL(), calNewPEKappaGamma_TEOS(), calNewQ0_R_GL(), calNewQ0_R_TEOS(), calNewQ0Q1_RT_GL(), calNewQ0Q1_-RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewT-PKappaGamma_TEOS(), calNewU0_RT(), calNewU0_RTP(), calNewU_R(), calNew-U_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_-LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), calOldDenave_R(), calOldDenave_RT(), calOldDenave_RTP(), calOldEddyVisc_R_SM(), calOldEddyVisc_RT_SM(), calOld-EddyVisc_RTP_SM(), calOldP_GL(), calOldPEKappaGamma_TEOS(), calOldQ0_R-_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), cal-OldQ0Q1Q2_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicit-EnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT-_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), d-ImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergy-Function_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), initDonorFrac-AndMaxConVel_R_GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAnd-MaxConVel_RT_GL(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAnd-MaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_TEOS(), initWatchZones(), main(), modelRead(), setupLocalGrid(), writeWatchZones_R_GL(), writeWatchZones-_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatch-Zones_RTP_GL(), and writeWatchZones_RTP_TEOS().

5.5.3.7 int Grid::nDCosThetaIJK

Index of $\Delta \cos\theta$ defined at zone center in grids. This is an internal grid variable and is included in the count of Grid::nNumIntVars.

Referenced by average3DTo1DBoundariesNew(), average3DTo1DBoundariesOld(), calNewD_RT(), calNewD_RTP(), calNewDenave_RT(), calNewDenave_RTP(), cal-NewU0_RT(), calNewU0_RTP(), calOldDenave_RT(), calOldDenave_RTP(), Grid(), initInternalVars(), modelRead(), and setInternalVarInf().

5.5.3.8 int Grid::nDenAve

Index of $\langle\rho\rangle$ in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an internal grid variable and is included in the count of Grid::nNumIntVars. This variable is defined at cell centers only in the radial direction.

Referenced by calNewDenave_R(), calNewDenave_RT(), calNewDenave_RTP(), calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RT-P_NA_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RT-P_LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_L-ES(), calNewW_RTP(), calNewW_RTP_LES(), calOldDenave_R(), calOldDenave_-RT(), calOldDenave_RTP(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction_-R_LES(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicit-EnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergy-Function_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_L-

ES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), main(), modelRead(), setInternalVarInf(), writeWatchZones_RT_GL(), write-WatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP-_TEOS().

5.5.3.9 int Grid::nDM

Index of δM in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an external grid variable included in the count Grid::nNumVars

Referenced by calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), cal-NewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNew-V_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_R-TP(), calNewW_RTP_LES(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction-_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergy-Function_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction-_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_-SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), modelRead(), setDEDMClamp(), writeWatchZones_R_GL(), writeWatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_-RTP_TEOS().

5.5.3.10 int Grid::nDonorCellFrac

Index of the amount of donor cell to use at that particular radial zone. It is defined at zone centers, and is an internal grid variable and is included in the count of Grid::nNumIntVars.

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_T-EOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), cal-NewD_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), calNew-E_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), cal-NewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewU0_RT(), calNewU0_RTP(), cal-NewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNew-V_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicit-EnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT-_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), d-ImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergy-Function_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), initDonorFrac-AndMaxConVel_R_GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAnd-MaxConVel_RT_GL(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAnd-MaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_TEOS(), modelRead(), and setInternalVarInf().

5.5.3.11 int Grid::nDPhi

Index of $\Delta\phi$ in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an internal grid variable and is included in the count of Grid::nNumIntVars. This variable is defined at cell centers.

Referenced by average3DTo1DBoundariesNew(), average3DTo1DBoundariesOld(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_RTP(), calNewDenave_RTP(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_RTP_SM(), calNewU0_RTP(), calNewU_RTP(), calNewU_RTP_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), calOldDenave_RTP(), calOldEddyVisc_RTP_CN(), calOldEddyVisc_RTP_SM(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), initInternalVars(), modelRead(), and setInternalVarInf().

5.5.3.12 int Grid::nDTheta

Index of $\Delta\theta$ in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an internal grid variable and is included in the count of Grid::nNumIntVars. This variable is defined at cell centers.

Referenced by calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_RTP(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewEddyVisc_RT_CN(), calNewEddyVisc_RT_SM(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_RTP_SM(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), calOldEddyVisc_RT_CN(), calOldEddyVisc_RT_SM(), calOldEddyVisc_RTP_CN(), calOldEddyVisc_RTP_SM(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), initInternalVars(), modelRead(), and setInternalVarInf().

5.5.3.13 int Grid::nE

Index of E in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an internal grid variable included in the count Grid::nNumIntVars, unless the calculation is adiabatic in which case it is an external grid variable. This variable is defined at cell centers.

Referenced by calDelt_R_GL(), calDelt_RT_GL(), calDelt_RTP_GL(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewP_GL(), calNewPEKappaGamma_TEOS(), calNewTPKappaGamma_TEOS(), calOldP_GL(), calOldPEKappaGamma_TEOS(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergy-

Function_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_L-ES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), initUpdateLocalBoundaries(), modelRead(), setDEDMClamp(), setInternalVar-Inf(), writeWatchZones_R_GL(), writeWatchZones_R_TEOS(), writeWatchZones_RT-_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatch-Zones_RTP_TEOS().

5.5.3.14 int Grid::nEddyVisc

Index of the eddy viscosity in the grid, it is defined at zone centers in the grids. This is an internal grid variable and is included in the count of Grid::nNumIntVars.

Referenced by calNewE_R_NA_LES(), calNewE_RT_NA_LES(), calNewE_RTP_NA-_LES(), calNewEddyVisc_R_CN(), calNewEddyVisc_R_SM(), calNewEddyVisc_RT-_CN(), calNewEddyVisc_RT_SM(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_-RTP_SM(), calNewU_R_LES(), calNewU_RT_LES(), calNewU_RTP_LES(), calNew-V_RT_LES(), calNewV_RTP_LES(), calNewW_RTP_LES(), calOldEddyVisc_R_C-N(), calOldEddyVisc_R_SM(), calOldEddyVisc_RT_CN(), calOldEddyVisc_RT_SM(), calOldEddyVisc_RTP_CN(), calOldEddyVisc_RTP_SM(), dImplicitEnergyFunction-_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_RT_LE-S(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), Grid(), main(), modelRead(), setInternalVar-Inf(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_-RTP_GL(), and writeWatchZones_RTP_TEOS().

5.5.3.15 int∗∗∗ Grid::nEndGhostUpdateExplicit

Positions to end updating ghost cells with explicit calculatiosn. Is an array of size Grid::nNumVars+Grid::nNumIntVars by 2∗3 by 3. The second dimension corresponds to which ghost region, since each dimension can have two ghost regions. The ghost region 0, is the outter ghost region in direction 0, 1 is the inner ghost region in direction 0, etc.

Referenced by average3DTo1DBoundariesNew(), average3DTo1DBoundariesOld(), calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt-_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewDenave_R(), calNewDenave_RT(), calNewDenave_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP-_NA_LES(), calNewEddyVisc_R_CN(), calNewEddyVisc_R_SM(), calNewEddyVisc-_RT_CN(), calNewEddyVisc_RT_SM(), calNewEddyVisc_RTP_CN(), calNewEddy-Visc_RTP_SM(), calNewP_GL(), calNewQ0_R_GL(), calNewQ0_R_TEOS(), calNew-Q0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0-Q1Q2_RTP_TEOS(), calNewR(), calNewTPKappaGamma_TEOS(), calNewU0_R(), calNewU0_RT(), calNewU0_RTP(), calNewU_R(), calNewU_R_LES(), calNewU_-RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), cal-NewW_RTP_LES(), calOldDenave_R(), calOldDenave_RT(), calOldDenave_RTP(), calOldEddyVisc_R_CN(), calOldEddyVisc_R_SM(), calOldEddyVisc_RT_CN(), calOld-

EddyVisc_RT_SM(), calOldEddyVisc_RTP_CN(), calOldEddyVisc_RTP_SM(), calOld-P_GL(), calOldPEKappaGamma_TEOS(), calOldQ0_R_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_RTP_GL(), calOld-Q0Q1Q2_RTP_TEOS(), Grid(), initDonorFracAndMaxConVel_R_GL(), initDonorFrac-AndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_GL(), initDonorFrac-AndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_GL(), initDonorFrac-AndMaxConVel_RTP_TEOS(), initUpdateLocalBoundaries(), and updateOldGrid().

5.5.3.16 int∗∗∗ **Grid::nEndGhostUpdateImplicit**

Positions to end updating ghost cells with implicit calculations. Is an array of size Grid::nNumVars+Grid::nNumIntVars by 2∗3 by 3. The second dimension corresponds to which ghost region, since each dimension can have two ghost regions. The ghost region 0, is the outter ghost region in direction 0, 1 is the inner ghost region in direction 0, etc.

Referenced by calNewPEKappaGamma_TEOS(), calOldDenave_R(), calOldDenave_-RT(), calOldDenave_RTP(), calOldPEKappaGamma_TEOS(), Grid(), initUpdateLocal-Boundaries(), and updateOldGrid().

5.5.3.17 int∗∗ **Grid::nEndUpdateExplicit**

Positions to stop updating grid with explicit calculations. It is an array of size nNumVars+nNumIntVars by 3. The end positions are defined in initUpdateLocalBoundaries(). These start values are dependent on processor ProcTop::nRank.

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT-_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewDenave_R(), calNewDenave_RT(), calNewDenave_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_AD(), cal-NewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewEddyVisc_R_CN(), calNewEddyVisc_R_SM(), cal-NewEddyVisc_RT_CN(), calNewEddyVisc_RT_SM(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_RTP_SM(), calNewP_GL(), calNewQ0_R_GL(), calNewQ0_R_TEO-S(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewR(), calNewTPKappaGamma_TEOS(), cal-NewU0_R(), calNewU0_RT(), calNewU0_RTP(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNew-V_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RT-P(), calNewW_RTP_LES(), calOldDenave_R(), calOldDenave_RT(), calOldDenave_-RTP(), calOldEddyVisc_R_CN(), calOldEddyVisc_R_SM(), calOldEddyVisc_RT_CN(), calOldEddyVisc_RT_SM(), calOldEddyVisc_RTP_CN(), calOldEddyVisc_RTP_SM(), calOldP_GL(), calOldPEKappaGamma_TEOS(), calOldQ0_R_GL(), calOldQ0_R-_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_RT-P_GL(), calOldQ0Q1Q2_RTP_TEOS(), Grid(), initDonorFracAndMaxConVel_R_G-L(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_GL(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_TEOS(), initUpdateLocalBoundaries(), setDEDM-Clamp(), and updateOldGrid().

5.5.3.18 int∗∗ Grid::nEndUpdateImplicit

Positions to stop updating grid with implicit calculations. It is an array of size nNumVars+nNumIntVars by 3. The end positions are defined in initUpdateLocalBoundaries(). These start values are dependent on processor ProcTop::nRank.

Referenced by calNewPEKappaGamma_TEOS(), calOldDenave_R(), calOldDenave_-RT(), calOldDenave_RTP(), calOldPEKappaGamma_TEOS(), Grid(), initUpdateLocal-Boundaries(), setDEDMClamp(), and updateOldGrid().

5.5.3.19 int Grid::nGamma

Index of adiabatic index in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an internal grid variable and is included in the count of Grid::nNumIntVars. This variable is defined at cell centers.

Referenced by calDelt_R_TEOS(), calDelt_RT_TEOS(), calDelt_RTP_TEOS(), cal-NewPEKappaGamma_TEOS(), calNewQ0_R_TEOS(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_TEOS(), calNewTPKappaGamma_TEOS(), calOldPEKappa-Gamma_TEOS(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2-_RTP_TEOS(), Grid(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAnd-MaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_TEOS(), main(), model-Read(), and setInternalVarInf().

5.5.3.20 int∗ Grid::nGlobalGridDims

Size of the entire global grid. It is an array of size 3 to hold size of each dimension of global grid. This size does not include Grid::nNumGhostCells or the extra size required for interface centered quantities. The values of this variable are independent of processor ProcTop::nRank. In the case of 1D or 2D calculations the θ and ϕ dimensions are set to 1 or just the ϕ dimensions is set to 1 depending on the number of dimensions. The r, θ and ϕ dimensions are in the 0, 1 and 2 indices of the array respectively.

Referenced by Grid(), init(), initImplicitCalculation(), initUpdateLocalBoundaries(), init-WatchZones(), modelRead(), modelWrite_GL(), modelWrite_TEOS(), and setupLocal-Grid().

5.5.3.21 int Grid::nGlobalGridPositionLocalGrid[3]

The location at which the local grid starts in the global grid. This starts at 0, for the inner most cell, including ghost zones.

Referenced by calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewE_R_NA(), calNewE_RT_NA_LES(), calNewE_RTP_NA_LES(), calNewU_R(), calNewU_RT_-LES(), calNewU_RTP_LES(), calNewV_RT_LES(), calNewV_RTP_LES(), calNew-W_RTP_LES(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_LES(), d-ImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergy-Function_RT_LES_SB(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergy-Function_RTP_LES_SB(), initUpdateLocalBoundaries(), and setupLocalGrid().

5.5.3.22 int Grid::nKappa

Index of Opacity in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an internal grid variable and is included in the count of Grid::nNumIntVars. This variable is defined at cell centers.

Referenced by calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_NA(), calNew-E_RT_NA_LES(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewPEKappa-Gamma_TEOS(), calNewTPKappaGamma_TEOS(), calOldPEKappaGamma_TEOS(), Grid(), initUpdateLocalBoundaries(), modelRead(), and setInternalVarInf().

5.5.3.23 int∗∗∗ Grid::nLocalGridDims

Local grid dimensions. It is An array of size ProcTop::nNumProcs by Grid::nNumVars+Grid::nNumIntVars by 3. `nLocalGridDims`[p][n][l] gives the dimension of the local grid on processor `p` for variable `n` in direction `l`. This variable does not include Grid::nNumGhostCells. The values of this variable are independent of processor ProcTop::nRank.

Referenced by calNewU0_RT(), calNewU0_RTP(), Grid(), initImplicitCalculation(), init-InternalVars(), initUpdateLocalBoundaries(), initWatchZones(), modelRead(), model-Write_GL(), modelWrite_TEOS(), setupLocalGrid(), and updateNewGridWithOld().

5.5.3.24 int Grid::nM

Index of M_r independent variable in grid Grid::dLocalGridOld and Grid::dLocalGridNew. This is an external grid variable included in the count Grid::nNumVars. This is an independent grid variable.

Referenced by calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), dImplicitEnergyFunction_R(), dImplicitEnergy-Function_R_SB(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_-LES_SB(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES-_SB(), Grid(), modelRead(), and setDEDMClamp().

5.5.3.25 int Grid::nNum1DZones

Number of zones in 1D region of grid. The number of zones in 3D region is (Grid::nGlobalGridDims[0]- Grid::nNum1DZones). This is set when reading in the model input file in the function modelRead. The value of this variable is independent of processor ProcTop::nRank.

Referenced by init(), initUpdateLocalBoundaries(), initWatchZones(), modelRead(), modelWrite_GL(), modelWrite_TEOS(), and setupLocalGrid().

5.5.3.26 int Grid::nNumDims

Number of dimensions of the grid. It is used to chose the appropriate conservation equations. The value of this variable is independent of processor ProcTop::nRank.

Referenced by fin(), initImplicitCalculation(), initInternalVars(), initWatchZones(), main(), modelRead(), setDEDMClamp(), setInternalVarInf(), setMainFunctions(), setupLocal-Grid(), and updateNewGridWithOld().

5.5.3.27 int Grid::nNumGhostCells

Number of cells which are not included in local grid updating. This number is used in all dimensions to add to each local grid. When variables are not defined in a given direction ghost cells are not included in that direction. This is set when reading in the model input file in the function modelRead. The value of this variable is independent of processor ProcTop::nRank.

Referenced by calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewE_R_NA(), calNewE_RT_NA_LES(), calNewE_RTP_NA_LES(), calNewU0_RT(), calNewU0_-RTP(), calNewV_RT_LES(), calNewV_RTP_LES(), calNewW_RTP_LES(), calOld-EddyVisc_R_CN(), calOldEddyVisc_R_SM(), calOldEddyVisc_RT_CN(), calOldEddy-Visc_RT_SM(), calOldEddyVisc_RTP_CN(), calOldEddyVisc_RTP_SM(), calOld-PEKappaGamma_TEOS(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction-_R_LES(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RTP_LES(), d-ImplicitEnergyFunction_RTP_LES_SB(), initImplicitCalculation(), initInternalVars(), init-UpdateLocalBoundaries(), initWatchZones(), modelRead(), modelWrite_GL(), model-Write_TEOS(), setDEDMClamp(), setupLocalGrid(), and updateNewGridWithOld().

5.5.3.28 int Grid::nNumIntVars

Number of internal variables. Internal variables are variables which are not reported in model dumps, and are not required to fully specify a starting model. They are used to save important information required during computation, an example is $\sin\theta$. The value of this variable is independent of processor ProcTop::nRank. This variable is set depending on the model read in (adiabatic/non-adiabatic/number of dimensions) in the function modelRead located in the file dataManipulation.cpp.

Referenced by average3DTo1DBoundariesOld(), initUpdateLocalBoundaries(), model-Read(), setInternalVarInf(), setupLocalGrid(), updateNewGridWithOld(), and update-OldGrid().

5.5.3.29 int Grid::nNumVars

Number of grid variables. This is set when reading in the model input file in the function modelRead. It is the number of variables that are printed and read from a file. The total number of variables also includes Grid::nNumIntVars. The value of this variable is independent of processor ProcTop::nRank.

Referenced by average3DTo1DBoundariesOld(), initUpdateLocalBoundaries(), model-Read(), modelWrite_GL(), modelWrite_TEOS(), setInternalVarInf(), setupLocalGrid(), updateNewGridWithOld(), and updateOldGrid().

5.5.3.30 int Grid::nP

Index of Pressure in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an internal grid variable and is included in the count of Grid::nNumIntVars. This variable is defined at cell centers.

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewP_GL(), calNewPEKappaGamma_TEOS(), calNewQ0_R_GL(), calNewQ0_R_TEOS(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewTPKappaGamma_TEOS(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), calOldP_GL(), calOldPEKappaGamma_TEOS(), calOldQ0_R_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), Grid(), initDonorFracAndMaxConVel_R_GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_GL(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_TEOS(), initUpdateLocalBoundaries(), main(), modelRead(), setInternalVarInf(), writeWatchZones_R_GL(), writeWatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_TEOS().

5.5.3.31 int Grid::nPhi

Index of ϕ independent variable in grid Grid::dLocalGridOld and Grid::dLocalGridNew. This is an external grid variable included in the count Grid::nNumVars. This is an independent grid variable.

Referenced by Grid(), initInternalVars(), and modelRead().

5.5.3.32 int Grid::nQ0

Index of the radial artificial viscosity in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an internal grid variable and is included in the count of Grid::nNumIntVars. This variable is defined at cell centers.

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewQ0_R_GL(), calNewQ0_R_TEOS(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), calOldQ0_R_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction-_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergy-Function_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction-_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_-SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), initDonorFracAndMaxConVel_R_-GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_G-L(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_-GL(), initDonorFracAndMaxConVel_RTP_TEOS(), modelRead(), setInternalVarInf(), writeWatchZones_R_GL(), writeWatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_-RTP_TEOS().

5.5.3.33 int Grid::nQ1

Index of the theta artificial viscosity in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an internal grid variable and is included in the count of Grid::nNumIntVars. This variable is defined at cell centers.

Referenced by calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RT-P_TEOS(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNew-E_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewQ0Q1_RT_G-L(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_T-EOS(), calNewU_RT_LES(), calNewU_RTP_LES(), calNewV_RT(), calNewV_RT_LE-S(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_RTP_GL(), cal-OldQ0Q1Q2_RTP_TEOS(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction-_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RT_S-B(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicit-EnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), init-DonorFracAndMaxConVel_RT_GL(), initDonorFracAndMaxConVel_RT_TEOS(), init-DonorFracAndMaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_TEOS(), modelRead(), setInternalVarInf(), writeWatchZones_RT_GL(), writeWatchZones_RT_-TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_TEOS().

5.5.3.34 int Grid::nQ2

Index of the phi artificial viscosity in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an internal grid variable and is included in the count of Grid::nNumIntVars. This variable is defined at cell centers.

Referenced by calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewE_RTP_AD(), cal-NewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewQ0Q1Q2_RTP_GL(), calNewQ0-Q1Q2_RTP_TEOS(), calNewU_RTP_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), calOldQ0Q1Q2_RTP_GL(), calOldQ0Q1Q2-_RTP_TEOS(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), initDonorFracAndMaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_TEOS(), modelRead(), setInternalVarInf(), writeWatchZones_RTP_GL(), and writeWatchZones-

_RTP_TEOS().

5.5.3.35 int Grid::nR

Index of r in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an external grid variable included in the count Grid::nNumVars

Referenced by average3DTo1DBoundariesNew(), average3DTo1DBoundariesOld(), calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt-_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewDenave_RT(), calNewDenave_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA-_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), cal-NewEddyVisc_R_CN(), calNewEddyVisc_R_SM(), calNewEddyVisc_RT_CN(), cal-NewEddyVisc_RT_SM(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_RTP_SM(), calNewQ0_R_GL(), calNewQ0_R_TEOS(), calNewQ0Q1_RT_GL(), calNewQ0Q1_R-T_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewR(), calNewU0_RT(), calNewU0_RTP(), calNewU_R(), calNewU_R_LES(), calNewU_-RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), cal-NewW_RTP_LES(), calOldDenave_RT(), calOldDenave_RTP(), calOldEddyVisc_R-_CN(), calOldEddyVisc_R_SM(), calOldEddyVisc_RT_CN(), calOldEddyVisc_RT_-SM(), calOldEddyVisc_RTP_CN(), calOldEddyVisc_RTP_SM(), calOldQ0_R_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0-Q1Q2_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), dImplicitEnergyFunction_R(), d-ImplicitEnergyFunction_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicit-EnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_-RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RT_S-B(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicit-EnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), main(), modelRead(), writeWatchZones_R_GL(), writeWatchZones_R_TEOS(), writeWatch-Zones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_TEOS().

5.5.3.36 int Grid::nSinThetaIJK

Index of $\sin\theta$ defined at zone center in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an internal grid variable and is included in the count of Grid::nNumIntVars.

Referenced by calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewE_RT_AD(), cal-NewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_RTP_SM(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), cal-NewQ0Q1Q2_RTP_TEOS(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_L-ES(), calNewV_RT_LES(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_L-ES(), calOldEddyVisc_RTP_CN(), calOldEddyVisc_RTP_SM(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergy-Function_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction-

_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_S-B(), dImplicitEnergyFunction_RTP_SB(), Grid(), initInternalVars(), modelRead(), and setInternalVarInf().

5.5.3.37 int Grid::nSinThetaIJp1halfK

Index of $\sin\theta$ at θ interfaces in grids. This is an internal grid variable and is included in the count of Grid::nNumIntVars.

Referenced by calNewD_RT(), calNewD_RTP(), calNewE_RT_AD(), calNewE_RT_-NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNew-E_RTP_NA_LES(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0-Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewU_RT_LES(), calNewU_-RTP_LES(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNew-W_RTP_LES(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_-RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), dImplicitEnergyFunction_RT(), dImplicit-EnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergy-Function_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_L-ES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), initInternalVars(), modelRead(), and setInternalVarInf().

5.5.3.38 int*** Grid::nStartGhostUpdateExplicit

Positions to begin updating ghost cells with explicit calculations. It is an array of size Grid::nNumVars+Grid::nNumIntVars by 2$*$3 by 3. The second dimension indicates a particular ghost region. There are 2$*$3 since each direction can have two ghost regions. The ghost region 0, is the outter ghost region in direction 0, 1 is the inner ghost region in direction 0, etc.

Referenced by average3DTo1DBoundariesNew(), average3DTo1DBoundariesOld(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewDenave_R(), calNewDenave-_RT(), calNewDenave_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_N-A_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNew-E_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewEddyVisc_R-_CN(), calNewEddyVisc_R_SM(), calNewEddyVisc_RT_CN(), calNewEddyVisc_R-T_SM(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_RTP_SM(), calNewP_GL(), calNewQ0_R_GL(), calNewQ0_R_TEOS(), calNewQ0Q1_RT_GL(), calNewQ0Q1_R-T_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewR(), calNewTPKappaGamma_TEOS(), calNewU0_R(), calNewU0_RT(), calNewU0_RTP(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_-RTP(), calNewU_RTP_LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), calOldDenave_R(), calOldDenave_RT(), calOldDenave_RTP(), calOldEddyVisc_R_CN(), calOldEddyVisc-_R_SM(), calOldEddyVisc_RT_CN(), calOldEddyVisc_RT_SM(), calOldEddyVisc_RT-P_CN(), calOldEddyVisc_RTP_SM(), calOldP_GL(), calOldPEKappaGamma_TEOS(), calOldQ0_R_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_T-EOS(), calOldQ0Q1Q2_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), Grid(), initUpdate-LocalBoundaries(), and updateOldGrid().

5.5.3.39 int∗∗∗ Grid::nStartGhostUpdateImplicit

Positions to begin updating ghost cells with implicit calculations. It is an array of size Grid::nNumVars+Grid::nNumIntVars by 2∗3 by 3. The second dimension indicates a particular ghost region. There are 2∗3 since each direction can have two ghost regions. The ghost region 0, is the outter ghost region in direction 0, 1 is the inner ghost region in direction 0, etc.

Referenced by calNewPEKappaGamma_TEOS(), calOldDenave_R(), calOldDenave_-RT(), calOldDenave_RTP(), calOldPEKappaGamma_TEOS(), Grid(), initUpdateLocal-Boundaries(), and updateOldGrid().

5.5.3.40 int∗∗ Grid::nStartUpdateExplicit

Positions to begin updating grid with explicit calculations. It is an array of size nNumVars+nNumIntVars by 3. The start positions are defined in initUpdateLocalBoundaries(). These start values are dependent on processor ProcTop::nRank.

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT-_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewDenave_R(), calNewDenave_RT(), calNewDenave_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_AD(), cal-NewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewEddyVisc_R_CN(), calNewEddyVisc_R_SM(), cal-NewEddyVisc_RT_CN(), calNewEddyVisc_RT_SM(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_RTP_SM(), calNewP_GL(), calNewQ0_R_GL(), calNewQ0_R_TEO-S(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewR(), calNewTPKappaGamma_TEOS(), cal-NewU0_R(), calNewU0_RT(), calNewU0_RTP(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNew-V_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RT-P(), calNewW_RTP_LES(), calOldDenave_R(), calOldDenave_RT(), calOldDenave_-RTP(), calOldEddyVisc_R_CN(), calOldEddyVisc_R_SM(), calOldEddyVisc_RT_CN(), calOldEddyVisc_RT_SM(), calOldEddyVisc_RTP_CN(), calOldEddyVisc_RTP_SM(), calOldP_GL(), calOldPEKappaGamma_TEOS(), calOldQ0_R_GL(), calOldQ0_R-_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_RT-P_GL(), calOldQ0Q1Q2_RTP_TEOS(), Grid(), initDonorFracAndMaxConVel_R_G-L(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_GL(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_TEOS(), initUpdateLocalBoundaries(), setDEDM-Clamp(), and updateOldGrid().

5.5.3.41 int∗∗ Grid::nStartUpdateImplicit

Positions to begin updating grid with implicit calculations. It is an array of size nNumVars+nNumIntVars by 3. The start positions are defined in initUpdateLocalBoundaries(). These start values are dependent on processor ProcTop::nRank.

Referenced by calNewPEKappaGamma_TEOS(), calOldDenave_R(), calOldDenave_-RT(), calOldDenave_RTP(), calOldPEKappaGamma_TEOS(), Grid(), initUpdateLocal-Boundaries(), setDEDMClamp(), and updateOldGrid().

5.5.3.42 int Grid::nT

Index of T in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an external grid variable included in the count Grid::nNumVars. This variable is defined at cell centers.

Referenced by calDelt_R_TEOS(), calDelt_RT_TEOS(), calDelt_RTP_TEOS(), cal-NewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewPEKappaGamma_TEOS(), calNewTPKappaGamma_TEOS(), calOldPEKappaGamma_TEOS(), dImplicitEnergy-Function_R(), dImplicitEnergyFunction_R_LES(), dImplicitEnergyFunction_R_LES-_SB(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicit-EnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergy-Function_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP-_LES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_-SB(), Grid(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), initImplicit-Calculation(), initUpdateLocalBoundaries(), main(), modelRead(), setDEDMClamp(), writeWatchZones_R_TEOS(), writeWatchZones_RT_TEOS(), and writeWatchZones_-RTP_TEOS().

5.5.3.43 int Grid::nTheta

Index of θ independent variable in grid Grid::dLocalGridOld and Grid::dLocalGridNew. This is an external grid variable included in the count Grid::nNumVars. This is an independent grid variable.

Referenced by Grid(), initInternalVars(), and modelRead().

5.5.3.44 int Grid::nU

Index of u in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an external grid variable included in the count Grid::nNumVars

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT-_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), cal-NewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewEddyVisc_R_SM(), calNew-EddyVisc_RT_SM(), calNewEddyVisc_RTP_SM(), calNewQ0_R_GL(), calNewQ0_-R_TEOS(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_R-TP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewU0_R(), calNewU0_RT(), calNew-U0_RTP(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNewV_RT(), calNewV_RT_LES(), calNew-V_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), calOldEddy-Visc_R_SM(), calOldEddyVisc_RT_SM(), calOldEddyVisc_RTP_SM(), calOldQ0_R-

_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), initDonorFracAndMaxConVel_R_GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_GL(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_TEOS(), modelRead(), updateLocalBoundaryVelocitiesNewGrid_R(), updateLocalBoundaryVelocitiesNewGrid_RT(), updateLocalBoundaryVelocitiesNewGrid_RTP(), writeWatchZones_R_GL(), writeWatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_TEOS().

5.5.3.45 int Grid::nU0

Index of u_0 in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an external grid variable included in the count Grid::nNumVars

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewEddyVisc_R_SM(), calNewEddyVisc_RT_SM(), calNewEddyVisc_RTP_SM(), calNewR(), calNewU0_R(), calNewU0_RT(), calNewU0_RTP(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), calOldEddyVisc_RT_SM(), calOldEddyVisc_RTP_SM(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Grid(), initDonorFracAndMaxConVel_R_GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_GL(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_TEOS(), main(), modelRead(), writeWatchZones_R_GL(), writeWatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_TEOS().

5.5.3.46 int Grid::nV

Index of v in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an external grid variable included in the count Grid::nNumVars

Referenced by calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_RT(), calNewD_RTP(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP-_NA_LES(), calNewEddyVisc_RT_SM(), calNewEddyVisc_RTP_SM(), calNewQ0Q1-_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2-_RTP_TEOS(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RT-P_LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LE-S(), calNewW_RTP(), calNewW_RTP_LES(), calOldEddyVisc_RT_SM(), calOldEddy-Visc_RTP_SM(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2-_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), dImplicitEnergyFunction_RT(), dImplicit-EnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergy-Function_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_L-ES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), -Grid(), initDonorFracAndMaxConVel_RT_GL(), initDonorFracAndMaxConVel_RT_TE-OS(), initDonorFracAndMaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_T-EOS(), initUpdateLocalBoundaries(), modelRead(), updateLocalBoundaryVelocities-NewGrid_RT(), updateLocalBoundaryVelocitiesNewGrid_RTP(), writeWatchZones_R-T_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatch-Zones_RTP_TEOS().

5.5.3.47 int∗∗ Grid::nVariables

Provides information on grid variables. A 2D array of size Grid::nNumVars+Grid::nNumIntVars by 3+1. `nVariables[n][l]` has values:

- -1: indicating that variable n is not defined
- 0: indicating that variable n is zone centered quantity
- 1: indicating that variable n is an interface centered quantity

in directions `l=0,1,2` which corresponding to $\hat{r}$, $\hat{\theta}$, and $\hat{\phi}$ respectively. `nVariables[n][l]` with `l=3` is used to indicate if a variable is dependent on time (1) or not(0). The values of this variable are independent of processor ProcTop::nRank.

Referenced by average3DTo1DBoundariesNew(), average3DTo1DBoundariesOld(), -Grid(), initUpdateLocalBoundaries(), modelRead(), modelWrite_GL(), modelWrite_TE-OS(), setInternalVarInf(), setupLocalGrid(), and updateNewGridWithOld().

5.5.3.48 int Grid::nW

Index of w in grids, Grid::dLocalGridOld and Grid::dLocalGridNew. This is an external grid variable included in the count Grid::nNumVars

Referenced by calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_RTP(), calNew-E_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewEddyVisc_RT-P_SM(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewU_RT-P(), calNewU_RTP_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), calOldEddyVisc_RTP_SM(), calOldQ0Q1Q2_RTP_GL(), cal-OldQ0Q1Q2_RTP_TEOS(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction-_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RT-

P_SB(), Grid(), initDonorFracAndMaxConVel_RTP_GL(), initDonorFracAndMaxCon-Vel_RTP_TEOS(), initUpdateLocalBoundaries(), modelRead(), updateLocalBoundary-VelocitiesNewGrid_RTP(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_-TEOS().

The documentation for this class was generated from the following files:

- global.h
- global.cpp

5.6 Implicit Class Reference

```
#include <global.h>
```

Public Member Functions

- Implicit ()

Public Attributes

- int nNumImplicitZones
- Mat matCoeff
- Vec vecTCorrections
- Vec vecRHS
- Vec vecTCorrectionsLocal
- KSP kspContext
- VecScatter vecscatTCorrections
- int nMaxNumIterations
- double dTolerance
- int nNumRowsALocal
- int nNumRowsALocalSB
- int $*$ nNumDerPerRow
- int $**$ nTypeDer
- int $***$ nLocDer
- int $**$ nLocFun
- double dDerivativeStepFraction
- double dCurrentRelTError
- int nCurrentNumIterations
- int nMaxNumSolverIterations
- double dMaxErrorInRHS
- double dAverageRHS

5.6.1 Detailed Description

This class holds data required for the implicit calculation.

5.6.2 Constructor & Destructor Documentation

5.6.2.1 Implicit::Implicit ( )

constructor the the class Implicit.

References dCurrentRelTError, dDerivativeStepFraction, dMaxErrorInRHS, dTolerance, nCurrentNumIterations, nLocDer, nLocFun, nMaxNumIterations, nMaxNumSolverIterations, nNumDerPerRow, nNumImplicitZones, nNumRowsALocal, nNumRowsALocalSB, and nTypeDer.

5.6.3 Member Data Documentation

5.6.3.1 double Implicit::dAverageRHS

Holds the average value of the right hand side for the timestep where the error in the RHS is the largest dMaxErrorInRHS. Only set if TRACKMAXSOLVERERROR is set to 1.

Referenced by fin(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and main().

5.6.3.2 double Implicit::dCurrentRelTError

keeps track of the largest relative error in the calculation of the temperature

Referenced by fin(), Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and main().

5.6.3.3 double Implicit::dDerivativeStepFraction

Dicates the size of the step that should be used to evaluate the numerical derivitves of the energy equation, for solving for the temperature implicitily. This value multiplies the temperature to produce the step size. A good value is around 5e-7.

Referenced by Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and init().

5.6.3.4 double Implicit::dMaxErrorInRHS

If TRACKMAXSOLVERERROR set to 1, then this will be the current maximum absolute error between the RHS as calculated from the solution and the coeffecient matrix, and the actual RHS. This value is the maximum from all values at each iteration of the solution, from each time step since the last model dump.

Referenced by fin(), Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and main().

5.6.3.5 double Implicit::dTolerance

The amount of relative error that is allowed in the calculation of the temperature with the implicit calculation.

Referenced by Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), init(), and initImplicitCalculation().

5.6.3.6 KSP Implicit::kspContext

PETSc solver context.

Referenced by implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and initImplicitCalculation().

5.6.3.7 Mat Implicit::matCoeff

Parallel coeffecient matrix (spread across all processors)

Referenced by implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and initImplicitCalculation().

5.6.3.8 int Implicit::nCurrentNumIterations

keeps track of the number of iterations needed to converge to a solution

Referenced by fin(), Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and main().

5.6.3.9 int∗∗∗ Implicit::nLocDer

An array of size nNumRowsALocal by 2 by nNumDerPerRow [q] , where `q` is a row index. This array holds the global position of the current row `q` for the current derivative e.g. the `p` th derivative in the `q` th row would be in row and column (`nLocDer`[q][0][p] ,`nLocDer`[q][1][p]). The value of this variable is set in the function initImplicitCalculation .

Referenced by Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and initImplicitCalculation().

5.6.3.10 int∗∗ Implicit::nLocFun

An array of size nNumRowsALocal by 3 [q] , where `q` is a row index. This array holds the local grid position of the current row `q` e.g. the (i,j,k) location of the current row in the local grid. The value of this variable is set in the function initImplicitCalculation .

Referenced by Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and initImplicitCalculation().

5.6.3.11 int Implicit::nMaxNumIterations

The maximum number of iterations to try to get the largest value of vecTCorrections relative to the temperature below dTolerance. Ater which the calculation continues.

Referenced by Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), init(), and initImplicitCalculation().

5.6.3.12 int Implicit::nMaxNumSolverIterations

If TRACKMAXSOLVERERROR set to 1, then this will be the current maximum number of iterations required for the linear equaiton solver to solve for the temperature correction over all iterations and time steps since the last model dump.

Referenced by fin(), Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RT-P(), and main().

5.6.3.13 int* Implicit::nNumDerPerRow

An array of size nNumRowsALocal which contains the number of non-zero derivatives for a given row of A.

Referenced by Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and initImplicitCalculation().

5.6.3.14 int Implicit::nNumImplicitZones

The number of zones in the region near the surface which should used the implicit calculation of the energy equation. If zero no zones will use the implict calculation of energy.

Referenced by fin(), Implicit(), init(), initImplicitCalculation(), initUpdateLocal-Boundaries(), main(), and setMainFunctions().

5.6.3.15 int Implicit::nNumRowsALocal

The number of rows of the coeffecient matrix which is on the local processor.

Referenced by Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and initImplicitCalculation().

5.6.3.16 int Implicit::nNumRowsALocalSB

The number or rows of the coeffecient matrix which is on the local processor, and that are in the surface boundary region.

Referenced by Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and initImplicitCalculation().

5.6.3.17 int** Implicit::nTypeDer

An array of size nNumRowsALocal by nNumDerPerRow [q] , where q is a row index. Thus each row of the array can have a different length. This gives the type of derivative of row q for each derivative in that row. The value of this variable is set in the function initImplicitCalculation .

Referenced by Implicit(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and initImplicitCalculation().

5.6.3.18 Vec Implicit::vecRHS

RHS vector (spread across all processors)

Referenced by implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and initImplicitCalculation().

5.6.3.19 VecScatter Implicit::vecscatTCorrections

Scatter context, used to hold information about retrieving the distributed temperature corrections from vecTCorrections and placing them into the local vector vecTCorrectionsLocal.

Referenced by implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and initImplicitCalculation().

5.6.3.20 Vec Implicit::vecTCorrections

Temperature corrections solution vector (spread across all processors)

Referenced by implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and initImplicitCalculation().

5.6.3.21 Vec Implicit::vecTCorrectionsLocal

Corrections to local temperatures only (on local processor only).

Referenced by implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), and initImplicitCalculation().

The documentation for this class was generated from the following files:

- global.h
- global.cpp

5.7 MessPass Class Reference

```
#include <global.h>
```

Public Member Functions

- MessPass ()

Public Attributes

- MPI::Datatype $*$ typeSendNewGrid
- MPI::Datatype $*$ typeRecvOldGrid
- MPI::Datatype $**$ typeSendNewVar
- MPI::Datatype $**$ typeRecvNewVar
- MPI::Request $*$ requestSend
- MPI::Request $*$ requestRecv
- MPI::Status $*$ statusSend
- MPI::Status $*$ statusRecv

5.7.1 Detailed Description

This class manages information which pertains to message passing between processors.

5.7.2 Constructor & Destructor Documentation

5.7.2.1 MessPass::MessPass ( )

Constructor for class MessPass.

References requestRecv, requestSend, statusRecv, statusSend, typeRecvNewVar, typeRecvOldGrid, typeSendNewGrid, and typeSendNewVar.

5.7.3 Member Data Documentation

5.7.3.1 MPI::Request$*$ MessPass::requestRecv

Message handles.

Referenced by initUpdateLocalBoundaries(), MessPass(), updateLocalBoundaries(), and updateLocalBoundariesNewGrid().

5.7.3.2 MPI::Request$*$ MessPass::requestSend

Message handles.

Referenced by initUpdateLocalBoundaries(), MessPass(), and updateLocalBoundaries().

5.7.3.3 MPI::Status∗ MessPass::statusRecv

Message status.

Referenced by initUpdateLocalBoundaries(), MessPass(), updateLocalBoundaries(), and updateLocalBoundariesNewGrid().

5.7.3.4 MPI::Status∗ MessPass::statusSend

Message status.

Referenced by initUpdateLocalBoundaries(), MessPass(), and updateLocal-Boundaries().

5.7.3.5 MPI::Datatype∗∗ MessPass::typeRecvNewVar

Recieve data types for variables. It is of size ProcTop::nNumNeighbors by Grid::nNumVars.

Referenced by calNewU0_R(), calNewU0_RT(), calNewU0_RTP(), initUpdateLocal-Boundaries(), MessPass(), and updateLocalBoundariesNewGrid().

5.7.3.6 MPI::Datatype∗ MessPass::typeRecvOldGrid

Recv data types for entire grid. It is of sizee ProcTop::nNumNeighbors.

Referenced by initUpdateLocalBoundaries(), MessPass(), and updateLocal-Boundaries().

5.7.3.7 MPI::Datatype∗ MessPass::typeSendNewGrid

Send data types for entire grid. It is of size ProcTop::nNumNeighbors.

Referenced by initUpdateLocalBoundaries(), MessPass(), and updateLocal-Boundaries().

5.7.3.8 MPI::Datatype∗∗ MessPass::typeSendNewVar

Send data types for variables. It is of size ProcTop::nNumNeighbors by Grid::nNumVars.

Referenced by calNewU0_R(), calNewU0_RT(), calNewU0_RTP(), initUpdateLocal-Boundaries(), MessPass(), and updateLocalBoundariesNewGrid().

The documentation for this class was generated from the following files:

- global.h
- global.cpp

5.8 Output Class Reference

```
#include <global.h>
```

Public Member Functions

- Output ()

Public Attributes

- int nDumpFrequencyStep
- double dDumpFrequencyTime
- double dTimeLastDump
- int nNumTimeStepsSinceLastPrint
- bool bDump
- bool bPrint
- int nPrintMode
- std::string sBaseOutputFileName
- std::ofstream ∗ ofWatchZoneFiles
- std::vector< WatchZone > watchzoneList
- int nPrintFrequencyStep
- double dPrintFrequencyTime
- double dTimeLastPrint

5.8.1 Detailed Description

This class manages information pertianing to the output of data to files.

5.8.2 Constructor & Destructor Documentation

5.8.2.1 Output::Output ( )

Constructor for this class.

References bDump, nDumpFrequencyStep, nNumTimeStepsSinceLastPrint, ofWatch-ZoneFiles, and sBaseOutputFileName.

5.8.3 Member Data Documentation

5.8.3.1 bool Output::bDump

The number of time steps since the last print. Should the grid state be written to a file at a frequency of Output::nDumpFrequencyStep timesteps, and/or every

Output::dDumpFrequencyTime seconds of simulation time. This is set to true by putting a "<dump>" node into the "SPHERLS.xml" configuration file.

Referenced by init(), main(), and Output().

5.8.3.2 bool Output::bPrint

Should status updates be printed to the screen.

Referenced by init(), and main().

5.8.3.3 double Output::dDumpFrequencyTime

How ofter a the grid state should be written to a file according to simulation time in seconds. If it is 0 no dumps will be made according to simulation time.

Referenced by init(), and main().

5.8.3.4 double Output::dPrintFrequencyTime

How often the status is printed to the screen in simulation time.

Referenced by init(), and main().

5.8.3.5 double Output::dTimeLastDump

The simulation time at which the last dump was made using the Output::dDumpFrequencyTime criterion.

Referenced by init(), and main().

5.8.3.6 double Output::dTimeLastPrint

Simulation time when last status was printed.

Referenced by init(), and main().

5.8.3.7 int Output::nDumpFrequencyStep

How ofter a the grid state should be written to a file according to time step index. If it is 1 the will state will be written every time step, if it equals 2 it will be written every other time step etc. If it is 0 no dumps will be made according to the time step index.

Referenced by init(), main(), and Output().

5.8.3.8 int Output::nNumTimeStepsSinceLastPrint

The number of time steps since the last model dump.

Referenced by fin(), main(), and Output().

5.8.3.9 int Output::nPrintFrequencyStep

How often the status is printed to the screen in time steps.

Referenced by init(), and main().

5.8.3.10 int Output::nPrintMode

Sets the way in which information should be printed to the standard output during the run. If it is 0, it will print the standard information reporting on the progress of the code. If it is 1 it will print out information to diagnose timestepping problems.

Referenced by fin(), init(), and main().

5.8.3.11 std::ofstream$*$ Output::ofWatchZoneFiles

An array of output streams of size Output::watchzoneList .size() which are used to write out the information of the watched zones.

Referenced by finWatchZones(), initWatchZones(), Output(), writeWatchZones_R_G-L(), writeWatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT-_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_TEOS().

5.8.3.12 std::string Output::sBaseOutputFileName

Base filename used for output, default is "out". All model dumps, and output information will contain this file name and extend it to indicate their specific information. The value of this variable is independent of processor ProcTop::nRank.

Referenced by fin(), init(), initWatchZones(), main(), and Output().

5.8.3.13 std::vector$<$WatchZone$>$ Output::watchzoneList

A vector used to keep information used to specify the zones to be watched.

Referenced by finWatchZones(), initWatchZones(), writeWatchZones_R_GL(), write-WatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_TEOS().

The documentation for this class was generated from the following files:

- global.h
- global.cpp

5.9 Parameters Class Reference

```
#include <global.h>
```

Public Member Functions

- Parameters ()

Public Attributes

- bool bEOSGammaLaw
- bool bAdiabatic
- int nTypeTurbulanceMod
- double dPi
- double dSigma
- double dG
- double dGamma
- std::string sEOSFileName
- eos eosTable
- double dA
- double dAVThreshold
- double dDonorCellMultiplier
- double dDonorCellMin
- double dAlpha
- double dTolerance
- int nMaxIterations
- double dEddyViscosity
- double dMaxConvectiveVelocity
- double dMaxConvectiveVelocity_c
- double dPrt
- double dDEDMClampValue
- double dDEDMClampMr
- double dEDMClampTemperature
- bool bDEDMClamp
- std::string sDebugProfileOutput

5.9.1 Detailed Description

This class holds parameters and constants used for calculation.

5.9.2 Constructor & Destructor Documentation

5.9.2.1 Parameters::Parameters ( )

Constructor for the class Parameters

References bDEDMClamp, dA, dAlpha, dAVThreshold, dDEDMClampMr, dDEDM-ClampValue, dDonorCellMin, dEddyViscosity, dEDMClampTemperature, dG, dMax-ConvectiveVelocity, dMaxConvectiveVelocity_c, dPi, dPrt, and dSigma.

5.9.3 Member Data Documentation

5.9.3.1 bool Parameters::bAdiabatic

If true SPHERLS will use adiabatic functions to calculate the energy. This can be used for both gamma law gas and tabulated equations of state (see Parameters::bEOSGammaLaw).

Referenced by init(), and setMainFunctions().

5.9.3.2 bool Parameters::bDEDMClamp

Specifies if a DEDM clamp should be used. This should only be used when starting from a model with out any sizable convection. It could give undesirable results if used when starting a calculation from a model with already established convection.

Referenced by dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_SB(), d-ImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicit-EnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), init(), and Parameters().

5.9.3.3 bool Parameters::bEOSGammaLaw

If true SPHERLS will use a gamma law gas instead of a tabulated equation of state. This is set in the starting model.

Referenced by init(), initInternalVars(), initWatchZones(), modelRead(), setInternalVar-Inf(), and setMainFunctions().

5.9.3.4 double Parameters::dA

Artificial viscosity parameter, reasonable values range from 0 to $\sim$3.

Referenced by calNewQ0_R_GL(), calNewQ0_R_TEOS(), calNewQ0Q1_RT_GL(), cal-NewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calOldQ0_R_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_T-EOS(), calOldQ0Q1Q2_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), init(), modelRead(), modelWrite_GL(), modelWrite_TEOS(), and Parameters().

5.9.3.5 double Parameters::dAlpha

This parameter controls the amount of extra mass above the outter interface. it is read in from the starting model, so that it will be consistent with the value used in calculating the starting model.

Referenced by calNewE_RT_NA_LES(), calNewE_RTP_NA_LES(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RTP_LES_SB(), modelRead(), modelWrite_GL(), modelWrite_TEOS(), and Parameters().

5.9.3.6 double Parameters::dAVThreshold

The amount of compression before AV is turned on. It is in terms of a velocity difference between zone sides and is in fractions of the local sound speed.

Referenced by calNewQ0_R_GL(), calNewQ0_R_TEOS(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calOldQ0_R_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), init(), modelRead(), modelWrite_GL(), modelWrite_TEOS(), and Parameters().

5.9.3.7 double Parameters::dDEDMClampMr

The mass above which the DEDM clamp is applied.

Referenced by dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), init(), Parameters(), and setDEDMClamp().

5.9.3.8 double Parameters::dDEDMClampValue

The value to use for DEDM in energy conservation equation when Parameters::bDEDMClamp is true.

Referenced by dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), init(), Parameters(), and setDEDMClamp().

5.9.3.9 double Parameters::dDonorCellMin

The minimum amount of donor cell allowed. Set in constructor, Parameters::Parameters

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), initDonorFracAndMaxConVel_R_GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_GL(), init-

DonorFracAndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_GL(), init-DonorFracAndMaxConVel_RTP_TEOS(), Parameters(), and setDEDMClamp().

5.9.3.10 double Parameters::dDonorCellMultiplier

Multiplier used to determine the faction of the sound speed at which donor cell is full. e.g. a value of 1.0 means the donor cell will be full when the convective velocity is equal to the sound speed. A value of 0.5 will mean that it will be full donor cell when the convective velocity is twice the sound speed. A value of 2.0 will mean that it will use full donor cell when the convective velocity is half the sound speed.

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TE-OS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), init(), initDonorFracAndMaxConVel_R-_GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_G-L(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_G-L(), and initDonorFracAndMaxConVel_RTP_TEOS().

5.9.3.11 double Parameters::dEddyViscosity

Used in calculating the eddy viscosity, larger values will produce a larger value of the eddy viscosity, causing the rethermalization to happen at larger scales. This value should be kept small, a good value is 0.17, which seems to correspond with experi-ments.

Referenced by calNewEddyVisc_R_CN(), calNewEddyVisc_R_SM(), calNewEddyVisc-_RT_CN(), calNewEddyVisc_RT_SM(), calNewEddyVisc_RTP_CN(), calNewEddy-Visc_RTP_SM(), calOldEddyVisc_R_CN(), calOldEddyVisc_R_SM(), calOldEddyVisc-_RT_CN(), calOldEddyVisc_RT_SM(), calOldEddyVisc_RTP_CN(), calOldEddyVisc_-RTP_SM(), init(), and Parameters().

5.9.3.12 double Parameters::dEDMClampTemperature

The temperature at which to chose Parameters::dDEDMClampMr from the stating model.

Referenced by init(), Parameters(), and setDEDMClamp().

5.9.3.13 double Parameters::dG

The Gravitational constant G.

Referenced by calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), and Parameters().

5.9.3.14 double Parameters::dGamma

The adiabatic γ, used in calculating the equation of state. If using a gamma law gas.

Referenced by calDelt_R_GL(), calDelt_RT_GL(), calDelt_RTP_GL(), calNewQ0_R_-GL(), calNewQ0Q1_RT_GL(), calNewQ0Q1Q2_RTP_GL(), calOldQ0_R_GL(), calOld-Q0Q1_RT_GL(), calOldQ0Q1Q2_RTP_GL(), dEOS_GL(), initDonorFracAndMaxCon-Vel_R_GL(), initDonorFracAndMaxConVel_RT_GL(), initDonorFracAndMaxConVel_R-TP_GL(), initWatchZones(), modelRead(), and modelWrite_GL().

5.9.3.15 double Parameters::dMaxConvectiveVelocity

Holds the maximum convective velocity, it is set in the functions which calculate the timestep (see calDelt_R_GL, calDelt_R_TEOS, calDelt_RT_GL, calDelt_RT_TEOS, calDelt_RTP_GL, calDelt_RTP_TEOS, calDelt_CONST).

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_T-EOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewEddyVisc_R_CN(), calNew-EddyVisc_RT_CN(), calNewEddyVisc_RTP_CN(), calOldEddyVisc_R_CN(), calOld-EddyVisc_RT_CN(), calOldEddyVisc_RTP_CN(), fin(), initDonorFracAndMaxConVel_-R_GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_-GL(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_-GL(), initDonorFracAndMaxConVel_RTP_TEOS(), main(), and Parameters().

5.9.3.16 double Parameters::dMaxConvectiveVelocity_c

Holds the maximum of convective velocity divided by the sound speed. It is set in the functions which calculate the timestep (see calDelt_R_GL, calDelt_R_TEOS, calDelt_RT_GL, calDelt_RT_TEOS, calDelt_RTP_GL, calDelt_RTP_TEOS, calDelt_CONST).

Referenced by Parameters().

5.9.3.17 double Parameters::dPi

The value of π.

Referenced by calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA_LES(), cal-NewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNew-V_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_R-TP(), calNewW_RTP_LES(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction-_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergy-Function_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction-_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_-SB(), dImplicitEnergyFunction_RTP_SB(), Parameters(), writeWatchZones_R_GL(), writeWatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT_TE-OS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_TEOS().

5.9.3.18 double Parameters::dPrt

This is the value of the Prandtl number, a value of 0.7 is what is suggested by Lawrence D. Cloutman in "The LUVD11 Large Eddy Simulation Model" April 15, 1991 a Lawrence Livermore National Labratory report.

Referenced by calNewE_RT_NA_LES(), calNewE_RTP_NA_LES(), dImplicit-EnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergy-Function_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), and Parameters().

5.9.3.19 double Parameters::dSigma

The value of σ, the Stefan-Boltzmann constant.

Referenced by calNewE_R_NA(), calNewE_R_NA_LES(), calNewE_RT_NA(), cal-NewE_RT_NA_LES(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), dImplicit-EnergyFunction_R(), dImplicitEnergyFunction_R_LES(), dImplicitEnergyFunction_R_-LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicit-EnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergy-Function_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_L-ES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), and Parameters().

5.9.3.20 double Parameters::dTolerance

Amount of error to tolerate when calculating temperature from the equation of state.

Referenced by calNewTPKappaGamma_TEOS(), and init().

5.9.3.21 eos Parameters::eosTable

Holds the equation of state table. If using a tabulated equation of state.

Referenced by calNewPEKappaGamma_TEOS(), calNewTPKappaGamma_TEO-S(), calOldPEKappaGamma_TEOS(), dImplicitEnergyFunction_R(), dImplicitEnergy-Function_R_LES(), dImplicitEnergyFunction_R_LES_SB(), dImplicitEnergyFunction_-R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicit-EnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergy-Function_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP-_LES_SB(), dImplicitEnergyFunction_RTP_SB(), and init().

5.9.3.22 int Parameters::nMaxIterations

The maximum number of iterations to try to get the the relative error in the temperture below parameters::dTolerance.

Referenced by calNewTPKappaGamma_TEOS(), and init().

5.9.3.23 int Parameters::nTypeTurbulanceMod

This varible indicates the type of turbulance model to be used. If 0, no turbulance model will be used, if 1 it will use a constant times the zoning size, and if 2 it will use the Smagorinksy turbulance model which increases the value of the eddy viscosity parameter when there are large amounts of shear, and decrease it when there isn't.

Referenced by init(), initInternalVars(), modelRead(), setInternalVarInf(), setMainFunctions(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_TEOS().

5.9.3.24 std::string Parameters::sDebugProfileOutput

output file name for debuging profile, only used if DEBUG_EQUATIONS is set to 1

Referenced by fin(), init(), and main().

5.9.3.25 std::string Parameters::sEOSFileName

File name of equation of state table. This value is set either by the configuration file, SPHERLS.xml or in the model file read in. If it is specified in SPHERLS.xml it will overide the file name set in the model.

Referenced by init(), modelRead(), and modelWrite_TEOS().

The documentation for this class was generated from the following files:

- global.h
- global.cpp

5.10 Performance Class Reference

```
#include <global.h>
```

Public Member Functions

- Performance ()

Public Attributes

- double dStartTimer
- double dEndTimer

5.10.1 Detailed Description

This class manages information pertianing to performace analysis of the code.

5.10.2 Constructor & Destructor Documentation

5.10.2.1 Performance::Performance ( )

Constructor for the class Performance.

References dEndTimer, and dStartTimer.

5.10.3 Member Data Documentation

5.10.3.1 double Performance::dEndTimer

The time that the code timer was ended. The difference between Performance::dStartTimer and `dEndTimer` gives the total run time

Referenced by fin(), and Performance().

5.10.3.2 double Performance::dStartTimer

The time that the code timer was started.

Referenced by fin(), init(), and Performance().

The documentation for this class was generated from the following files:

- global.h
- global.cpp

5.11 ProcTop Class Reference

`#include <procTop.h>`

Public Member Functions

- ProcTop ()

Public Attributes

- int nNumProcs
- int ∗ nProcDims
- int ∗ nPeriodic
- int ∗∗ nCoords
- int nRank
- int nNumNeighbors
- int ∗ nNeighborRanks
- int nNumRadialNeighbors

- int ∗ nRadialNeighborRanks
- int ∗ nRadialNeighborNeighborIDs

5.11.1 Detailed Description

This class manages information which pertains to the processor topology.

5.11.2 Constructor & Destructor Documentation

5.11.2.1 ProcTop::ProcTop ( )

Constructor for class ProcTop.

References nCoords, nNeighborRanks, nNumNeighbors, nNumRadialNeighbors, nPeriodic, nProcDims, nRadialNeighborNeighborIDs, and nRadialNeighborRanks.

5.11.3 Member Data Documentation

5.11.3.1 int∗∗ ProcTop::nCoords

Coordinates of the processors. It is of size ProcTop::nNumProcs by 3. The values of this variable are independent of processor ProcTop::nRank.

Referenced by calNewU0_R(), calNewU0_RT(), calNewU0_RTP(), initImplicitCalculation(), initUpdateLocalBoundaries(), initWatchZones(), modelRead(), modelWrite_GL(), modelWrite_TEOS(), ProcTop(), setupLocalGrid(), and profileData::toFile().

5.11.3.2 int∗ ProcTop::nNeighborRanks

ProcTop::nRank s of the neighboring processors. An array of size nNumNeighbors to hold ranks of neighbouring processors.

Referenced by initUpdateLocalBoundaries(), ProcTop(), updateLocalBoundaries(), and updateLocalBoundariesNewGrid().

5.11.3.3 int ProcTop::nNumNeighbors

The number of neighbors surrounding the current processor. The maximum number of neighbors possible is 27, 3x3x3 don't forget the current processor itself can be its own neighbor because of periodic boundary conditions. The value of this variable is dependent on processor ProcTop::nRank.

Referenced by initUpdateLocalBoundaries(), ProcTop(), updateLocalBoundaries(), and updateLocalBoundariesNewGrid().

5.11.3.4 int ProcTop::nNumProcs

Number of processors in global communicator MPI::COMM_WORLD. The value of this variable is independent of processor ProcTop::nRank.

Referenced by init(), initImplicitCalculation(), initUpdateLocalBoundaries(), initWatchZones(), modelRead(), setupLocalGrid(), and profileData::toFile().

5.11.3.5 int ProcTop::nNumRadialNeighbors

The number of neighbors in the radial direction. Can range from 1 to 2 depending on weather there is a processor beneath or above the current preccessor.

Referenced by calNewU0_R(), calNewU0_RT(), calNewU0_RTP(), initUpdateLocalBoundaries(), ProcTop(), and profileData::toFile().

5.11.3.6 int∗ ProcTop::nPeriodic

Periodic boundary conditions. It is an array of size 3 to tell if a dimension is periodic (wraps) or not. It contains an interger value of 0 or 1. 0, the boundary condition is not periodic, 1 the boundary condition is periodic. The value of this variable is set in the configuration file "config.xml" which is parsed by the function init. The values of this variable are independent of processor ProcTop::nRank.

Referenced by initUpdateLocalBoundaries(), modelRead(), modelWrite_GL(), modelWrite_TEOS(), ProcTop(), and setupLocalGrid().

5.11.3.7 int∗ ProcTop::nProcDims

Dimensions of the processor topology. It is an array of size 3 to hold the size of the processor grid in each dimension. The value of this variable is set in the configuration file "config.xml" which is parsed by the function init. The values of this variable are independent of processor ProcTop::nRank.

Referenced by init(), initImplicitCalculation(), initUpdateLocalBoundaries(), initWatchZones(), modelRead(), modelWrite_GL(), modelWrite_TEOS(), ProcTop(), and setupLocalGrid().

5.11.3.8 int∗ ProcTop::nRadialNeighborNeighborIDs

Holds the ID of a radialial neighbor, to be used to obtain their ProcTop::nRank from ProcTop::nNeighborRanks

Referenced by calNewU0_R(), calNewU0_RT(), calNewU0_RTP(), initUpdateLocalBoundaries(), and ProcTop().

5.11.3.9 int∗ ProcTop::nRadialNeighborRanks

ProcTop::nRank s of the neighboring radial processors. It is an array of size ProcTop::nNumRadialNeighbors.

Referenced by calNewU0_R(), calNewU0_RT(), calNewU0_RTP(), initUpdateLocal-Boundaries(), ProcTop(), and profileData::toFile().

5.11.3.10 int ProcTop::nRank

Is a unique integer which identifies the processor. The values of `ProcTop::nRank` range from 0 to ProcTop::nNumProcs-1 depending on the processor.

Referenced by calDelt_CONST(), calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_G-L(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), cal-NewD_RT(), calNewD_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_NA-_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_-RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewU0_R(), calNew-U0_RT(), calNewU0_RTP(), fin(), implicitSolve_R(), implicitSolve_RT(), implicitSolve-_RTP(), init(), initImplicitCalculation(), initInternalVars(), initUpdateLocalBoundaries(), initWatchZones(), main(), modelRead(), modelWrite_GL(), modelWrite_TEOS(), setD-EDMClamp(), setMainFunctions(), setupLocalGrid(), profileData::toFile(), updateLocal-Boundaries(), updateLocalBoundariesNewGrid(), and updateNewGridWithOld().

The documentation for this class was generated from the following files:

- procTop.h
- procTop.cpp

5.12 profileData Class Reference

Public Member Functions

- void set (std::string sName, unsigned int nZone, double dValue)
- void set (std::string sName, unsigned int nZone, int nValue)
- void setSum (std::string sName, unsigned int nZone, double dValue)
- void setSum (std::string sName, unsigned int nZone, int nValue)
- void setMax (std::string sName, unsigned int nZone, double dValue)
- void setMax (std::string sName, unsigned int nZone, int nValue)
- void setMaxAbs (std::string sName, unsigned int nZone, double dValue)
- void setMaxAbs (std::string sName, unsigned int nZone, int nValue)
- void toFile (std::string sFileName, Time time, ProcTop procTop)
- void clear ()
- unsigned int nMaxNumZones ()
- bool test ()
- profileData ()

5.12.1 Constructor & Destructor Documentation

5.12.1.1 profileData::profileData ( )

Constructor for class

5.12.2 Member Function Documentation

5.12.2.1 void profileData::clear ( )

Resets values to their initial values. It doesn't free any memory.

5.12.2.2 unsigned int profileData::nMaxNumZones ( )

Returns the maximum number of zones found under a key

Referenced by toFile().

5.12.2.3 void profileData::set (std::string *sName*, unsigned int *nZone*, double *dValue*)

Sets a new bit of data to dValue, identified by sName in radial zone nZone.

5.12.2.4 void profileData::set (std::string *sName*, unsigned int *nZone*, int *nValue*)

Sets a new bit of data to nValue, identified by sName in radial zone nZone.

5.12.2.5 void profileData::setMax (std::string *sName*, unsigned int *nZone*, double *dValue*)

If the value is already set it will set it to which ever is largest, the current value or the new value I am trying to set it to

Referenced by test().

5.12.2.6 void profileData::setMax (std::string *sName*, unsigned int *nZone*, int *nValue*)

If the value is already set it will set it to which ever is largest, the current value or the new value.

5.12.2.7 void profileData::setMaxAbs (std::string *sName*, unsigned int *nZone*, double *dValue*)

If the value is already set it will set it to which ever has the largest absolute value, the current value or the new value.

5.12.2.8 void profileData::setMaxAbs (std::string *sName*, unsigned int *nZone*, int *nValue*)

If the value is already set it will set it to which ever has the largest absolute value, the current value or the new value.

5.12.2.9 void profileData::setSum (std::string *sName*, unsigned int *nZone*, double *dValue*)

If the value is already set it will add to it

Referenced by test().

5.12.2.10 void profileData::setSum (std::string *sName*, unsigned int *nZone*, int *nValue*)

If the value is already set it will add to it

5.12.2.11 bool profileData::test ( )

Runs a series of tests to insure that the functions are doing what they should be. - Returns true if all tests passed, returns false other wise.

References setMax(), and setSum().

5.12.2.12 void profileData::toFile (std::string *sFileName*, Time *time*, ProcTop *procTop*)

Prints the data to a file in the same format as the radial profiles generated by SPHERLSanal

References Time::dt, ProcTop::nCoords, nMaxNumZones(), ProcTop::nNumProcs, ProcTop::nNumRadialNeighbors, ProcTop::nRadialNeighborRanks, and ProcTop::nRank.

The documentation for this class was generated from the following files:

- profileData.h
- profileData.cpp

5.13 Time Class Reference

`#include <time.h>`

Public Member Functions

- Time ()

Public Attributes

- double dDeltat_np1half
- double dDeltat_nm1half
- double dDeltat_n
- double dt
- double dEndTime
- int nEndTimeStep
- double dTimeStepFactor
- int nTimeStepIndex
- bool bVariableTimeStep
- double dConstTimeStep
- double dPerChange
- double dDelRho_t_Rho_max
- double dDelT_t_T_max
- double dDelE_t_E_max

5.13.1 Detailed Description

This class manages information which pertains to time variables.

5.13.2 Constructor & Destructor Documentation

5.13.2.1 Time::Time ( )

Constructor for the class Time.

References dDelE_t_E_max, dDelRho_t_Rho_max, dDelT_t_T_max, dDeltat_n, dDeltat_np1half, dEndTime, dPerChange, dt, dTimeStepFactor, nEndTimeStep, and nTimeStepIndex.

5.13.3 Member Data Documentation

5.13.3.1 bool Time::bVariableTimeStep

If true a variable time step is used as specified by the Courant condition, times the dTimeStepFactor.

Referenced by init(), and setMainFunctions().

5.13.3.2 double Time::dConstTimeStep

If set to a value other than 0, will use that constant time step in place of the courant time step.

Referenced by calDelt_CONST(), and init().

5.13.3.3 double Time::dDelE_t_E_max

Keeps track of the maximum relative change in energy from one time step to the next. This quantity is only tracked if the calculation is adiabatic, else the temperature is tracked instead, see Time::dDelT_t_T_max

Referenced by calDelt_R_GL(), calDelt_RT_GL(), calDelt_RTP_GL(), and Time().

5.13.3.4 double Time::dDelRho_t_Rho_max

Keeps track of the maximum relative change in density from one time step to the next.

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), fin(), main(), and Time().

5.13.3.5 double Time::dDelT_t_T_max

Keeps track of the maximum relative change in temperature from one time step to the next. This quantity is only tracked if the calculation is non-adiabatic, else the energy is tracked instead, see Time::dDelE_t_E_max

Referenced by calDelt_R_TEOS(), calDelt_RT_TEOS(), calDelt_RTP_TEOS(), fin(), main(), and Time().

5.13.3.6 double Time::dDeltat_n

The time step centered at n in seconds. It is used for calculating new variables defined at time step $n+1/2$, e.g. the radial velocity Grid::nU. This value is determined by averaging the current Time::dDeltat_np1half, and the last Time::dDeltat_np1half.

Referenced by calDelt_CONST(), calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewU_R(), calNewU_R_LES(), calNewU_RT(), calNewU_RT_LES(), calNewU_RTP(), calNewU_RTP_LES(), calNewV_RT(), calNewV_RT_LES(), calNewV_RTP(), calNewV_RTP_LES(), calNewW_RTP(), calNewW_RTP_LES(), modelRead(), and Time().

5.13.3.7 double Time::dDeltat_nm1half

The previously used timestep centered at $n-1/2$ in seconds. It is used for calculating dDeltat_n the n centered time step.

Referenced by calDelt_CONST(), calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), modelRead(), modelWrite_GL(), and modelWrite_TEOS().

5.13.3.8 double Time::dDeltat_np1half

The time step centered at $n+1/2$ in seconds. It is used for calculating new variables defined at time step n, e.g. the density Grid::nD.

Referenced by calDelt_CONST(), calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_-GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_R_-NA_LES(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNew-E_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewR(), dImplicit-EnergyFunction_R(), dImplicitEnergyFunction_R_LES(), dImplicitEnergyFunction_R_-LES_SB(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicit-EnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergy-Function_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_L-ES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), fin(), main(), modelRead(), modelWrite_TEOS(), and Time().

5.13.3.9 double Time::dEndTime

The end time of the current calculation in seconds.

Referenced by init(), main(), and Time().

5.13.3.10 double Time::dPerChange

A percentage amount to allow the maximum horizontal temperture variation and radial, theta and phi convective velocities to change by from one time step to the next. The time step is reduced accordingly to keep this precent change intact.

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TE-OS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), init(), and Time().

5.13.3.11 double Time::dt

The current time of the simulation in seconds.

Referenced by calDelt_CONST(), calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_G-L(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), fin(), init(), main(), modelRead(), modelWrite_GL(), modelWrite_TEOS(), Time(), profileData::toFile(), writeWatchZones_R_GL(), writeWatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_-RTP_TEOS().

5.13.3.12 double Time::dTimeStepFactor

Used for determining the time step. It is the factor which the courrant time step is multiplied by in order to determine Time::dDeltat_np1half.

Referenced by calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TE-OS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), init(), and Time().

5.13.3.13 int Time::nEndTimeStep

The last time step to calculate, will stop if the current time step is larger than this. The default value is the largest integer of the system.

Referenced by init(), main(), and Time().

5.13.3.14 int Time::nTimeStepIndex

An index indecating the current time step. An index of zero corresponds to a Time::dt=0.

Todo should probably make this an unsigned variable, and perhaps also use the key-word long to help ensure there are enough values. Often need 7 decimal places.

Referenced by calDelt_CONST(), calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_G-L(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), fin(), implicitSolve-_R(), implicitSolve_RT(), implicitSolve_RTP(), initWatchZones(), main(), modelRead(), modelWrite_GL(), modelWrite_TEOS(), setDEDMClamp(), Time(), writeWatchZones_-R_GL(), writeWatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones-_RT_TEOS(), writeWatchZones_RTP_GL(), and writeWatchZones_RTP_TEOS().

The documentation for this class was generated from the following files:

- time.h
- time.cpp

5.14 WatchZone Class Reference

```
#include <watchzone.h>
```

5.14.1 Detailed Description

This class contains information used to monitor a particular zone of the grid.

The documentation for this class was generated from the following files:

- watchzone.h
- watchzone.cpp

Chapter 6

File Documentation

6.1 /home/cgeroux/Documents/WORK/SPHERLS_git/src/eos.cpp File Reference

```
#include <string> #include <fstream> #include <sstream>
#include <iostream> #include <cmath> #include <stdlib.-
h> #include "eos.h" #include "exception2.h"
```

6.1.1 Detailed Description

Implements the eos (equation of state) class defined in eos.h

6.2 /home/cgeroux/Documents/WORK/SPHERLS_git/src/eos.h File Reference

```
#include <string> #include "exception2.h"
```

Classes

- class eos

6.2.1 Detailed Description

Header file for eos.cpp

6.3 dataManipulation.cpp File Reference

`#include <cmath> #include <sstream> #include <fstream> #include <iomanip> #include <vector> #include <fenv.h> #include "dataManipulation.h" #include "global.h"× #include "xmlFunctions.h" #include "exception2.h" #include "dataMonitoring.h" #include "physEquations.h" #include <string> #include "fileExists.h"`

Functions

- void init (ProcTop &procTop, Grid &grid, Output &output, Time &time, Parameters &parameters, MessPass &messPass, Performance &performance, Implicit &implicit, int nNumArgs, char ∗cArgs[])
- void setupLocalGrid (ProcTop &procTop, Grid &grid)
- void fin (bool bWriteCurrentStateToFile, Time &time, Output &output, ProcTop &procTop, Grid &grid, Parameters &parameters, Functions &functions, Performance &performance, Implicit &implicit)
- void modelWrite_GL (std::string sFileName, ProcTop &procTop, Grid &grid, Time &time, Parameters &parameters)
- void modelWrite_TEOS (std::string sFileName, ProcTop &procTop, Grid &grid, Time &time, Parameters &parameters)
- void modelRead (std::string sFileName, ProcTop &procTop, Grid &grid, Time &time, Parameters &parameters)
- void initUpdateLocalBoundaries (ProcTop &procTop, Grid &grid, MessPass &messPass, Implicit &implicit)
- void updateLocalBoundaries (ProcTop &procTop, MessPass &messPass, Grid &grid)
- void updateLocalBoundariesNewGrid (int nVar, ProcTop &procTop, MessPass &messPass, Grid &grid)
- void updateOldGrid (ProcTop &procTop, Grid &grid)
- void updateNewGridWithOld (Grid &grid, ProcTop &procTop)
- void average3DTo1DBoundariesOld (Grid &grid)
- void average3DTo1DBoundariesNew (Grid &grid, int nVar)
- void updateLocalBoundaryVelocitiesNewGrid_R (ProcTop &procTop, MessPass &messPass, Grid &grid)
- void updateLocalBoundaryVelocitiesNewGrid_RT (ProcTop &procTop, MessPass &messPass, Grid &grid)
- void updateLocalBoundaryVelocitiesNewGrid_RTP (ProcTop &procTop, MessPass &messPass, Grid &grid)
- void initImplicitCalculation (Implicit &implicit, Grid &grid, ProcTop &procTop, int nNumArgs, char ∗cArgs[])
- void setDEDMClamp (Parameters &parameters, Time &time, Grid &grid, ProcTop &procTop)

6.3.1 Detailed Description

This file holds functions for manipulating data. This includes initializing the program, parsing the configuration file "config.xml", allocating memory for the model to be read in, reading in the input model, etc.

6.3.2 Function Documentation

6.3.2.1 void average3DTo1DBoundariesNew (Grid & *grid,* int *nVar*)

This function averages the 3D boundary recieved by the 1D processor (ProcTop::nRank ==0) into 1D. This average is volume weighted. This function only needs to be called by the 1D processor, and if called by other processors may have unexpected results. This function calculates the average from the new grid, and places the average into new old grid. It does so for only the specified variable. This function is used every time the grid boundaries are updated with updateLocalBoundariesNewGrid.

Parameters

`in,out`	*grid*	supplies the information for calculating the averages and recieves the averages.
`in`	*nVar*	index of the variable to be averaged with in the grid.

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nDCosThetaIJK, Grid::nDPhi, Grid::nEndGhostUpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, and Grid::nVariables.

Referenced by updateLocalBoundariesNewGrid().

6.3.2.2 void average3DTo1DBoundariesOld (Grid & *grid*)

This function averages the 3D boundary recieved by the 1D processor (ProcTop::nRank ==0) into 1D. This average is volume weighted. This function only needs to be called by the 1D processor, and if called by other processors may have unexpected results. This function calculates the average from the old grid, and places the average into the old grid. It does so for all variables external and internal. This function is used every time the grid boundaries are updated with updateLocalBoundaries.

Parameters

`in,out`	*grid*	supplies the information for calculating the averages and recieves the averages.

References Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nDCosThetaIJK, Grid::nDPhi, Grid::nEndGhostUpdateExplicit, Grid::nNumIntVars, Grid::nNumVars, Grid::nR, -Grid::nStartGhostUpdateExplicit, and Grid::nVariables.

Referenced by updateLocalBoundaries().

6.3.2.3 void fin (bool *bWriteCurrentStateToFile,* Time & *time,* Output & *output,* ProcTop & *procTop,* Grid & *grid,* Parameters & *parameters,* Functions & *functions,* Performance & *performance,* Implicit & *implicit*)

Finishes program execution by writing out last grid state, closing output files, and writting out run time.

Parameters

in	*bWrite-Current-StateToFile*	is a bool value which indicates wheather or not to write out current model state.
in	*time*	
in	*output*	
in	*procTop*	
in	*grid*	
in	*parameters*	
in	*functions*	
in	*performance*	
in	*implicit*	

References Implicit::dAverageRHS, Implicit::dCurrentRelTError, Time::dDelRho_t_-Rho_max, Time::dDelT_t_T_max, Time::dDeltat_np1half, Performance::dEndTimer, Parameters::dMaxConvectiveVelocity, Implicit::dMaxErrorInRHS, Performance::dStart-Timer, Time::dt, finWatchZones(), Functions::fpModelWrite, Implicit::nCurrentNum-Iterations, Implicit::nMaxNumSolverIterations, Grid::nNumDims, Implicit::nNumImplicit-Zones, Output::nNumTimeStepsSinceLastPrint, Output::nPrintMode, ProcTop::nRank, Time::nTimeStepIndex, Output::sBaseOutputFileName, and Parameters::sDebug-ProfileOutput.

Referenced by main().

6.3.2.4 void init (ProcTop & *procTop,* Grid & *grid,* Output & *output,* Time & *time,* Parameters & *parameters,* MessPass & *messPass,* Performance & *performance,* Implicit & *implicit,* int *argc,* char ∗ *argv[ ]*)

Initializes the program. It does this by reading a number of configuration options from the config file "SPHERLS.xml". It also reads in the starting model, as specified in the "SPHERLS.xml" file, using the function modelRead. During the reading of the initial model the modelRead function also calls setupLocalGrid to determine the sizes of the local grids and allocate memory for them.

Other things of note that are done in this function are:

- the calulation timer is started, Performance::dStartTimer
- It also reads in the equation of state table if using a tabulated equation of state (Parameters::bEOSGammaLaw = false) by calling eos::readBin
- Initilizes the watchZones, i.e. figure out which processors have which watch zones, opens the files and prints headers.

Parameters

out	*procTop*	all parts of this stucture are set, and do not change though-out the rest of the calculation.
out	*grid*	through the function modelRead the function setupLocalGrid is called to allocate memory for the grid, and set sizes of it.
out	*output*	
out	*time*	
out	*parameters*	
out	*messPass*	
out	*performance*	
out	*implicit*	
in	*argc*	
in	*argv*	

References Parameters::bAdiabatic, Parameters::bDEDMClamp, Output::bDump, -Parameters::bEOSGammaLaw, Output::bPrint, Time::bVariableTimeStep, Parameters-::dA, Parameters::dAVThreshold, Time::dConstTimeStep, Parameters::dDEDMClamp-Mr, Parameters::dDEDMClampValue, Implicit::dDerivativeStepFraction, Parameters-::dDonorCellMultiplier, Output::dDumpFrequencyTime, Parameters::dEddyViscosity, Parameters::dEDMClampTemperature, Time::dEndTime, Time::dPerChange, Output-::dPrintFrequencyTime, Performance::dStartTimer, Time::dt, Output::dTimeLastDump, Output::dTimeLastPrint, Time::dTimeStepFactor, Parameters::dTolerance, Implicit::d-Tolerance, Parameters::eosTable, initImplicitCalculation(), initInternalVars(), initUpdate-LocalBoundaries(), initWatchZones(), modelRead(), Output::nDumpFrequencyStep, Time::nEndTimeStep, Grid::nGlobalGridDims, Parameters::nMaxIterations, Implicit-::nMaxNumIterations, Grid::nNum1DZones, Implicit::nNumImplicitZones, ProcTop::n-NumProcs, Output::nPrintFrequencyStep, Output::nPrintMode, ProcTop::nProcDims, ProcTop::nRank, Parameters::nTypeTurbulanceMod, eos::readBin(), Output::sBase-OutputFileName, Parameters::sDebugProfileOutput, Parameters::sEOSFileName, and setDEDMClamp().

Referenced by main().

6.3.2.5 void initImplicitCalculation (Implicit & *implicit*, Grid & *grid*, ProcTop & *procTop*, int *nNumArgs*, char ∗ *cArgs[]*)

This function initilizes data structures and defines indixes of non-zero elements in the coeffecient matrix. It also sets up pathways for collection of the temperature corrections back to the processors which need them for their local grids.

Parameters

in,out	*implicit*	
in	*grid*	size information of the grid is used
in	*procTop*	
in	*nNumArgs*	number of command line arguments, PETSc wants them
in	*cArgs*	a list of command line arguments, PETSc wants them

Todo isFrom, isTo, matCoeff,vecTCorrections, vecTCorrections,vecRHS,vecTCorrectionsLocal ,kspContext,vecscatTCorrections all need to be destroyed before program finishes.

References Implicit::dTolerance, Implicit::kspContext, Implicit::matCoeff, ProcTop::nCoords, Grid::nGlobalGridDims, Grid::nLocalGridDims, Implicit::nLocDer, Implicit::nLocFun, Implicit::nMaxNumIterations, Implicit::nNumDerPerRow, Grid::nNumDims, Grid::nNumGhostCells, Implicit::nNumImplicitZones, ProcTop::nNumProcs, Implicit::nNumRowsALocal, Implicit::nNumRowsALocalSB, ProcTop::nProcDims, ProcTop::nRank, Grid::nT, Implicit::nTypeDer, Implicit::vecRHS, Implicit::vecscatTCorrections, Implicit::vecTCorrections, and Implicit::vecTCorrectionsLocal.

Referenced by init().

6.3.2.6 void initUpdateLocalBoundaries (ProcTop & *procTop*, Grid & *grid*, MessPass & *messPass*, Implicit & *implicit*)

Sets up MPI derived data types used for updating the local grid boundaries between processors. It sets where the local grids should start/stop updating the local grids (Grid::nStartUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nStartUpdateImplicit, Grid::nEndUpdateImplicit, Grid::nStartGhostUpdateExplicit, Grid::nEndGhostUpdateExplicit, Grid::nStartGhostUpdateImplicit, Grid::nEndGhostUpdateImplicit). It sets the radial processor neighbors (ProcTop::nNumRadialNeighbors).

It also allocates memeory for:

- MessPass::requestSend
- MessPass::requestRecv
- MessPass:statusSend
- MessPass:statusRecv

Parameters

`in,out`	*procTop*	
`in,out`	*grid*	
`in,out`	*messPass*	
`in,out`	*implicit*	

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, ProcTop::nCoords, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndGhostUpdateImplicit, Grid::nEndUpdateExplicit, Grid::nEndUpdateImplicit, Grid::nGlobalGridDims, Grid::nGlobalGridPositionLocalGrid, Grid::nKappa, Grid::nLocalGridDims, ProcTop::nNeighborRanks, Grid::nNum1DZones, Grid::nNumGhostCells, Implicit::nNumImplicitZones, Grid::nNumIntVars, ProcTop::nNumNeighbors, ProcTop::nNumProcs, ProcTop::nNumRadialNeighbors, Grid::nNumVars, Grid::nP, ProcTop::nPeriodic, ProcTop::nProcDims, ProcTop::nRadialNeighborNeighborIDs, ProcTop::nRadialNeighborRanks, ProcTop::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartGhostUpdateImplicit, Grid::nStartUpdateExplicit, Grid::nStartUpdateImplicit, Grid::nT, Grid::nV, Grid::n-Variables, Grid::nW, MessPass::requestRecv, MessPass::requestSend, MessPass-::statusRecv, MessPass::statusSend, MessPass::typeRecvNewVar, MessPass::type-RecvOldGrid, MessPass::typeSendNewGrid, and MessPass::typeSendNewVar.

Referenced by init().

6.3.2.7 void modelRead (std::string *sFileName*, ProcTop & *procTop*, Grid & *grid*, Time & *time*, Parameters & *parameters*)

Reads in a collected binary file into the local grid and calls setupLocalGrid to allocate memory and set various parameters of the model. Works for both gamma-law gas, and tabulated equation of state models.

Parameters

`in`	*sFileName*	name of the file containing the model to be read in
`out`	*procTop*	
`out`	*grid*	
`out`	*time*	
`out`	*parameters*	

Todo At some point should get it working with only 1 processor

References Parameters::bEOSGammaLaw, Parameters::dA, Parameters::dAlpha, -Parameters::dAVThreshold, Time::dDeltat_n, Time::dDeltat_nm1half, Time::dDeltat-_np1half, Parameters::dGamma, Grid::dLocalGridOld, Time::dt, DUMP_VERSION, ProcTop::nCoords, Grid::nCotThetaIJK, Grid::nCotThetaIJp1halfK, Grid::nD, Grid::n-DCosThetaIJK, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid-::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nGamma, Grid::nGlobalGridDims, Grid-::nKappa, Grid::nLocalGridDims, Grid::nM, Grid::nNum1DZones, Grid::nNumDims, Grid::nNumGhostCells, Grid::nNumIntVars, ProcTop::nNumProcs, Grid::nNumVars, Grid::nP, ProcTop::nPeriodic, Grid::nPhi, ProcTop::nProcDims, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, ProcTop::nRank, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nTheta, Time::nTimeStepIndex, Parameters::nTypeTurbulanceMod, -Grid::nU, Grid::nU0, Grid::nV, Grid::nVariables, Grid::nW, Parameters::sEOSFileName, setInternalVarInf(), and setupLocalGrid().

Referenced by init().

6.3.2.8 void modelWrite_GL (std::string *sFileName*, ProcTop & *procTop*, Grid & *grid*, Time & *time*, Parameters & *parameters*)

Writes out a model in distrubuted model format, meaning that each processor writes it's own local grid to a file in binary format. They can be combined, and or converted to ascii format using SPHERLSanal. This is for a gamma-law gas model.

Parameters

`in`	*sFileName*	base name of the output files
`in`	*procTop*	
`in`	*grid*	
`in`	*time*	
`in`	*parameters*	

References Parameters::dA, Parameters::dAlpha, Parameters::dAVThreshold, Time::d-Deltat_nm1half, Parameters::dGamma, Grid::dLocalGridOld, Time::dt, DUMP_VERSI-ON, ProcTop::nCoords, Grid::nGlobalGridDims, Grid::nLocalGridDims, Grid::nNum1D-Zones, Grid::nNumGhostCells, Grid::nNumVars, ProcTop::nPeriodic, ProcTop::nProc-Dims, ProcTop::nRank, Time::nTimeStepIndex, and Grid::nVariables.

Referenced by setMainFunctions().

6.3.2.9 void modelWrite_TEOS (std::string *sFileName,* ProcTop & *procTop,* Grid & *grid,* Time & *time,* Parameters & *parameters*)

Writes out a model in distrubuted model format, meaning that each processor writes it's own local grid to a file in binary format. They can be combined, and or converted to ascii format using SPHERLSanal. This is for a tabulated equation of state model.

Parameters

`in`	*sFileName*	base name of the output files
`in`	*procTop*	
`in`	*grid*	
`in`	*time*	
`in`	*parameters*	

References Parameters::dA, Parameters::dAlpha, Parameters::dAVThreshold, Time::d-Deltat_nm1half, Time::dDeltat_np1half, Grid::dLocalGridOld, Time::dt, DUMP_VERSI-ON, ProcTop::nCoords, Grid::nGlobalGridDims, Grid::nLocalGridDims, Grid::nNum1D-Zones, Grid::nNumGhostCells, Grid::nNumVars, ProcTop::nPeriodic, ProcTop::nProc-Dims, ProcTop::nRank, Time::nTimeStepIndex, Grid::nVariables, and Parameters::sE-OSFileName.

Referenced by setMainFunctions().

6.3.2.10 void setDEDMClamp (Parameters & *parameters,* Time & *time,* Grid & *grid,* ProcTop & *procTop*)

This function sets the DEDM clamp if starting from an initial model, otherwise it throws an exception.

References Parameters::dDEDMClampMr, Parameters::dDEDMClampValue, -Parameters::dDonorCellMin, Parameters::dEDMClampTemperature, Grid::dLocalGrid-Old, Grid::nCenIntOffset, Grid::nDM, Grid::nE, Grid::nEndUpdateExplicit, Grid::nEnd-UpdateImplicit, Grid::nM, Grid::nNumDims, Grid::nNumGhostCells, ProcTop::nRank, Grid::nStartUpdateExplicit, Grid::nStartUpdateImplicit, Grid::nT, and Time::nTimeStep-Index.

Referenced by init().

6.3.2.11 void setupLocalGrid (ProcTop & *procTop*, Grid & *grid*)

Determins size of local grids (Grid::nLocalGridDims) based on processor topology, and allocates memory for the local grids (Grid::dLocalGridNew, Grid::dLocalGridOld). It sets various other quantities aswell such as,

- the coordinates of all processors (ProcTop::nCoords)
- the offset for interface centered quantities (Grid::nCenIntOffset, which depends on zoning and boundary conditions
- the position the local grid is in relative to the global grid (Grid::nGlobalGridPositionLocalGrid).

Parameters

`in,out`	*procTop*	contains information about the processor topology
`in,out`	*grid*	contains information about gird

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, ProcTop-::nCoords, Grid::nD, Grid::nGlobalGridDims, Grid::nGlobalGridPositionLocalGrid, Grid-::nLocalGridDims, Grid::nNum1DZones, Grid::nNumDims, Grid::nNumGhostCells, -Grid::nNumIntVars, ProcTop::nNumProcs, Grid::nNumVars, ProcTop::nPeriodic, Proc-Top::nProcDims, ProcTop::nRank, and Grid::nVariables.

Referenced by modelRead().

6.3.2.12 void updateLocalBoundaries (ProcTop & *procTop*, MessPass & *messPass*, Grid & *grid*)

Updates the boundaries of the local grids from the data in the local grids of other processors. It does this for all variables and updates to the old grid. It also has processor ProcTop::nRank=0 call average3DTo1DBoundariesOld which averages the 3D information into the 1D boundaries.

Parameters

`in`	*procTop*	
`in`	*messPass*	
`in,out`	*grid*	

Todo Shouldn't need MPI::COMM_WORLD.Barrier() may want to test out removing this at some point as it might produce a bit of a speed up.

References average3DTo1DBoundariesOld(), Grid::dLocalGridNew, Grid::dLocal-GridOld, ProcTop::nNeighborRanks, ProcTop::nNumNeighbors, ProcTop::nRank, -

MessPass::requestRecv, MessPass::requestSend, MessPass::statusRecv, MessPass::statusSend, MessPass::typeRecvOldGrid, MessPass::typeSendNewGrid, and updateOldGrid().

Referenced by main().

6.3.2.13 void updateLocalBoundariesNewGrid (int *nVar,* ProcTop & *procTop,* MessPass & *messPass,* Grid & *grid*)

Updates the boundaries of the local grids from the data in the local grids of other processors. It does this for a specific variable specified by `nVar` and updates to the new grid. It also has processor ProcTop::nRank=0 call average3DTo1DBoundariesNew which averages the 3D information into the 1D boundaries for that specific variable.

Parameters

`in`	*procTop*	
`in`	*messPass*	
`in,out`	*grid*	

Todo May want to do some waiting on this message at some point before the end of the timestep, but it doesn't need to be done in this function. It might also be that this is built into the code by waiting at some other point. This is something that should be checked out at somepoint, perhaps once the preformance starts to be analyzed. I would think that if the send buffer was being modified before the send was completed, that there would be some errors poping up that would likely kill the program.

References average3DTo1DBoundariesNew(), Grid::dLocalGridNew, ProcTop::nNeighborRanks, ProcTop::nNumNeighbors, ProcTop::nRank, MessPass::requestRecv, MessPass::statusRecv, MessPass::typeRecvNewVar, and MessPass::typeSendNewVar.

Referenced by implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), main(), updateLocalBoundaryVelocitiesNewGrid_R(), updateLocalBoundaryVelocitiesNewGrid_RT(), and updateLocalBoundaryVelocitiesNewGrid_RTP().

6.3.2.14 void updateLocalBoundaryVelocitiesNewGrid_R (ProcTop & *procTop,* MessPass & *messPass,* Grid & *grid*)

Updates velocity boundaries of the new grid in a 1D calculations after the velocities have been newly calculated.

References Grid::nU, and updateLocalBoundariesNewGrid().

Referenced by setMainFunctions().

6.3.2.15 void updateLocalBoundaryVelocitiesNewGrid_RT (ProcTop & *procTop,* MessPass & *messPass,* Grid & *grid*)

Updates velocity boundaries of the new grid in a 2D calculations after the velocities have been newly calculated.

References Grid::nU, Grid::nV, and updateLocalBoundariesNewGrid().

Referenced by setMainFunctions().

6.3.2.16 void updateLocalBoundaryVelocitiesNewGrid_RTP (ProcTop & *procTop,* MessPass & *messPass,* Grid & *grid*)

Updates velocity boundaries of the new grid in a 3D calculations after the velocities have been newly calculated.

References Grid::nU, Grid::nV, Grid::nW, and updateLocalBoundariesNewGrid().

Referenced by setMainFunctions().

6.3.2.17 void updateNewGridWithOld (Grid & *grid,* ProcTop & *procTop*)

Copies the contents of the old grid to the new grid including ghost cells.

Parameters

`in,out`	*grid*	
`in`	*procTop*	

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nLocalGridDims, Grid::n-NumDims, Grid::nNumGhostCells, Grid::nNumIntVars, Grid::nNumVars, ProcTop::n-Rank, and Grid::nVariables.

Referenced by main().

6.3.2.18 void updateOldGrid (ProcTop & *procTop,* Grid & *grid*)

Updates the old grid with the new grid, not including boundaries.

Parameters

`in`	*procTop*	
`in,out`	*grid*	

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nEndGhostUpdate-Explicit, Grid::nEndGhostUpdateImplicit, Grid::nEndUpdateExplicit, Grid::nEndUpdate-Implicit, Grid::nNumIntVars, Grid::nNumVars, Grid::nStartGhostUpdateExplicit, Grid::n-StartGhostUpdateImplicit, Grid::nStartUpdateExplicit, and Grid::nStartUpdateImplicit.

Referenced by updateLocalBoundaries().

6.4 dataManipulation.h File Reference

`#include <mpi.h>` `#include "global.h"`

Functions

- void init (ProcTop &procTop, Grid &grid, Output &output, Time &time, Parameters &parameters, MessPass &messPass, Performance &performance, Implicit &implicit, int argc, char ∗argv[])
- void setupLocalGrid (ProcTop &procTop, Grid &grid)
- void fin (bool bWriteCurrentStateToFile, Time &time, Output &output, ProcTop &procTop, Grid &grid, Parameters &parameters, Functions &functions, Performance &performance, Implicit &implicit)
- void modelWrite_GL (std::string sFileName, ProcTop &procTop, Grid &grid, Time &time, Parameters &parameters)
- void modelWrite_TEOS (std::string sFileName, ProcTop &procTop, Grid &grid, Time &time, Parameters &parameters)
- void modelRead (std::string sFileName, ProcTop &procTop, Grid &grid, Time &time, Parameters &parameters)
- void initUpdateLocalBoundaries (ProcTop &procTop, Grid &grid, MessPass &messPass, Implicit &implicit)
- void updateLocalBoundaries (ProcTop &procTop, MessPass &messPass, Grid &grid)
- void updateLocalBoundariesNewGrid (int nVar, ProcTop &procTop, MessPass &messPass, Grid &grid)
- void updateOldGrid (ProcTop &procTop, Grid &grid)
- void updateNewGridWithOld (Grid &grid, ProcTop &procTop)
- void average3DTo1DBoundariesOld (Grid &grid)
- void average3DTo1DBoundariesNew (Grid &grid, int nVar)
- void updateLocalBoundaryVelocitiesNewGrid_R (ProcTop &procTop, MessPass &messPass, Grid &grid)
- void updateLocalBoundaryVelocitiesNewGrid_RT (ProcTop &procTop, MessPass &messPass, Grid &grid)
- void updateLocalBoundaryVelocitiesNewGrid_RTP (ProcTop &procTop, MessPass &messPass, Grid &grid)
- void initImplicitCalculation (Implicit &implicit, Grid &grid, ProcTop &procTop, int nNumArgs, char ∗cArgs[])
- void setDEDMClamp (Parameters &parameters, Time &time, Grid &grid, ProcTop &procTop)

6.4.1 Detailed Description

Header file for dataManipulation.cpp

6.4.2 Function Documentation

6.4.2.1 void average3DTo1DBoundariesNew (Grid & *grid,* int *nVar*)

This function averages the 3D boundary recieved by the 1D processor (ProcTop::nRank ==0) into 1D. This average is volume weighted. This function only needs to be called by the 1D processor, and if called by other processors may have unexpected results. This function calculates the average from the new grid, and places the average into new old grid. It does so for only the specified variable. This function is used every time the grid boundaries are updated with updateLocalBoundariesNewGrid.

Parameters

`in,out`	*grid*	supplies the information for calculating the averages and recieves the averages.
`in`	*nVar*	index of the variable to be averaged with in the grid.

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nDCosThetaIJK, Grid::nDPhi, Grid::nEndGhostUpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, and Grid::nVariables.

Referenced by updateLocalBoundariesNewGrid().

6.4.2.2 void average3DTo1DBoundariesOld (Grid & *grid*)

This function averages the 3D boundary recieved by the 1D processor (ProcTop::nRank ==0) into 1D. This average is volume weighted. This function only needs to be called by the 1D processor, and if called by other processors may have unexpected results. This function calculates the average from the old grid, and places the average into the old grid. It does so for all variables external and internal. This function is used every time the grid boundaries are updated with updateLocalBoundaries.

Parameters

`in,out`	*grid*	supplies the information for calculating the averages and recieves the averages.

References Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nDCosThetaIJK, Grid::nDPhi, Grid::nEndGhostUpdateExplicit, Grid::nNumIntVars, Grid::nNumVars, Grid::nR, -Grid::nStartGhostUpdateExplicit, and Grid::nVariables.

Referenced by updateLocalBoundaries().

6.4.2.3 void fin (bool *bWriteCurrentStateToFile,* Time & *time,* Output & *output,* ProcTop & *procTop,* Grid & *grid,* Parameters & *parameters,* Functions & *functions,* Performance & *performance,* Implicit & *implicit*)

Finishes program execution by writing out last grid state, closing output files, and writting out run time.

Parameters

`in`	*bWrite-CurrentStateToFile*	is a bool value which indicates wheather or not to write out current model state.
`in`	*time*	
`in`	*output*	
`in`	*procTop*	
`in`	*grid*	
`in`	*parameters*	
`in`	*functions*	
`in`	*performance*	
`in`	*implicit*	

References Implicit::dAverageRHS, Implicit::dCurrentRelTError, Time::dDelRho_t_-Rho_max, Time::dDelT_t_T_max, Time::dDeltat_np1half, Performance::dEndTimer, Parameters::dMaxConvectiveVelocity, Implicit::dMaxErrorInRHS, Performance::dStart-Timer, Time::dt, finWatchZones(), Functions::fpModelWrite, Implicit::nCurrentNum-Iterations, Implicit::nMaxNumSolverIterations, Grid::nNumDims, Implicit::nNumImplicit-Zones, Output::nNumTimeStepsSinceLastPrint, Output::nPrintMode, ProcTop::nRank, Time::nTimeStepIndex, Output::sBaseOutputFileName, and Parameters::sDebug-ProfileOutput.

Referenced by main().

6.4.2.4 void init (**ProcTop** & *procTop*, **Grid** & *grid*, **Output** & *output*, **Time** & *time*, **Parameters** & *parameters*, **MessPass** & *messPass*, **Performance** & *performance*, **Implicit** & *implicit*, int *argc*, char ∗ *argv[]*)

Initializes the program. It does this by reading a number of configuration options from the config file "SPHERLS.xml". It also reads in the starting model, as specified in the "SPHERLS.xml" file, using the function modelRead. During the reading of the initial model the modelRead function also calls setupLocalGrid to determine the sizes of the local grids and allocate memory for them.

Other things of note that are done in this function are:

- the calulation timer is started, Performance::dStartTimer
- It also reads in the equation of state table if using a tabulated equation of state (Parameters::bEOSGammaLaw = false) by calling eos::readBin
- Initilizes the watchZones, i.e. figure out which processors have which watch zones, opens the files and prints headers.

Parameters

`out`	*procTop*	all parts of this stucture are set, and do not change throughout the rest of the calculation.
`out`	*grid*	through the function modelRead the function setupLocalGrid is called to allocate memory for the grid, and set sizes of it.

out	*output*	
out	*time*	
out	*parameters*	
out	*messPass*	
out	*performance*	
out	*implicit*	
in	*argc*	
in	*argv*	

References Parameters::bAdiabatic, Parameters::bDEDMClamp, Output::bDump, -Parameters::bEOSGammaLaw, Output::bPrint, Time::bVariableTimeStep, Parameters-::dA, Parameters::dAVThreshold, Time::dConstTimeStep, Parameters::dDEDMClamp-Mr, Parameters::dDEDMClampValue, Implicit::dDerivativeStepFraction, Parameters-::dDonorCellMultiplier, Output::dDumpFrequencyTime, Parameters::dEddyViscosity, Parameters::dEDMClampTemperature, Time::dEndTime, Time::dPerChange, Output-::dPrintFrequencyTime, Performance::dStartTimer, Time::dt, Output::dTimeLastDump, Output::dTimeLastPrint, Time::dTimeStepFactor, Parameters::dTolerance, Implicit::d-Tolerance, Parameters::eosTable, initImplicitCalculation(), initInternalVars(), initUpdate-LocalBoundaries(), initWatchZones(), modelRead(), Output::nDumpFrequencyStep, Time::nEndTimeStep, Grid::nGlobalGridDims, Parameters::nMaxIterations, Implicit-::nMaxNumIterations, Grid::nNum1DZones, Implicit::nNumImplicitZones, ProcTop::n-NumProcs, Output::nPrintFrequencyStep, Output::nPrintMode, ProcTop::nProcDims, ProcTop::nRank, Parameters::nTypeTurbulanceMod, eos::readBin(), Output::sBase-OutputFileName, Parameters::sDebugProfileOutput, Parameters::sEOSFileName, and setDEDMClamp().

Referenced by main().

6.4.2.5 void initImplicitCalculation (Implicit & *implicit*, Grid & *grid*, ProcTop & *procTop*, int *nNumArgs*, char * *cArgs[ ]*)

This function initilizes data structures and defines indixes of non-zero elements in the coeffecient matrix. It also sets up pathways for collection of the temperature corrections back to the processors which need them for their local grids.

Parameters

in,out	*implicit*	
in	*grid*	size information of the grid is used
in	*procTop*	
in	*nNumArgs*	number of command line arguments, PETSc wants them
in	*cArgs*	a list of command line arguments, PETSc wants them

Todo isFrom, isTo, matCoeff,vecTCorrections, vecTCorrections,vecRHS,vecT-CorrectionsLocal ,kspContext,vecscatTCorrections all need to be destroyed before program finishes.

References Implicit::dTolerance, Implicit::kspContext, Implicit::matCoeff, ProcTop::nCoords, Grid::nGlobalGridDims, Grid::nLocalGridDims, Implicit::nLocDer, Implicit::nLocFun, Implicit::nMaxNumIterations, Implicit::nNumDerPerRow, Grid::nNumDims, Grid::nNumGhostCells, Implicit::nNumImplicitZones, ProcTop::nNumProcs, Implicit::nNumRowsALocal, Implicit::nNumRowsALocalSB, ProcTop::nProcDims, ProcTop::nRank, Grid::nT, Implicit::nTypeDer, Implicit::vecRHS, Implicit::vecscatTCorrections, Implicit::vecTCorrections, and Implicit::vecTCorrectionsLocal.

Referenced by init().

6.4.2.6 void initUpdateLocalBoundaries (ProcTop & *procTop*, Grid & *grid*, MessPass & *messPass*, Implicit & *implicit*)

Sets up MPI derived data types used for updating the local grid boundaries between processors. It sets where the local grids should start/stop updating the local grids (Grid::nStartUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nStartUpdateImplicit, Grid::nEndUpdateImplicit, Grid::nStartGhostUpdateExplicit, Grid::nEndGhostUpdateExplicit, Grid::nStartGhostUpdateImplicit, Grid::nEndGhostUpdateImplicit). It sets the radial processor neighbors (ProcTop::nNumRadialNeighbors).

It also allocates memeory for:

- MessPass::requestSend
- MessPass::requestRecv
- MessPass:statusSend
- MessPass:statusRecv

Parameters

`in,out`	*procTop*	
`in,out`	*grid*	
`in,out`	*messPass*	
`in,out`	*implicit*	

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, ProcTop::nCoords, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndGhostUpdateImplicit, Grid::nEndUpdateExplicit, Grid::nEndUpdateImplicit, Grid::nGlobalGridDims, Grid::nGlobalGridPositionLocalGrid, Grid::nKappa, Grid::nLocalGridDims, ProcTop::nNeighborRanks, Grid::nNum1DZones, Grid::nNumGhostCells, Implicit::nNumImplicitZones, Grid::nNumIntVars, ProcTop::nNumNeighbors, ProcTop::nNumProcs, ProcTop::nNumRadialNeighbors, Grid::nNumVars, Grid::nP, ProcTop::nPeriodic, ProcTop::nProcDims, ProcTop::nRadialNeighborNeighborIDs, ProcTop::nRadialNeighborRanks, ProcTop::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartGhostUpdateImplicit, Grid::nStartUpdateExplicit, Grid::nStartUpdateImplicit, Grid::nT, Grid::nV, Grid::nVariables, Grid::nW, MessPass::requestRecv, MessPass::requestSend, MessPass::statusRecv, MessPass::statusSend, MessPass::typeRecvNewVar, MessPass::typeRecvOldGrid, MessPass::typeSendNewGrid, and MessPass::typeSendNewVar.

Referenced by init().

6.4.2.7 void modelRead (std::string *sFileName,* ProcTop & *procTop,* Grid & *grid,* Time & *time,* Parameters & *parameters*)

Reads in a collected binary file into the local grid and calls setupLocalGrid to allocate memory and set various parameters of the model. Works for both gamma-law gas, and tabulated equation of state models.

Parameters

`in`	*sFileName*	name of the file containing the model to be read in
`out`	*procTop*	
`out`	*grid*	
`out`	*time*	
`out`	*parameters*	

Todo At some point should get it working with only 1 processor

References Parameters::bEOSGammaLaw, Parameters::dA, Parameters::dAlpha, -Parameters::dAVThreshold, Time::dDeltat_n, Time::dDeltat_nm1half, Time::dDeltat-_np1half, Parameters::dGamma, Grid::dLocalGridOld, Time::dt, DUMP_VERSION, ProcTop::nCoords, Grid::nCotThetaIJK, Grid::nCotThetaIJp1halfK, Grid::nD, Grid::n-DCosThetaIJK, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid-::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nGamma, Grid::nGlobalGridDims, Grid-::nKappa, Grid::nLocalGridDims, Grid::nM, Grid::nNum1DZones, Grid::nNumDims, Grid::nNumGhostCells, Grid::nNumIntVars, ProcTop::nNumProcs, Grid::nNumVars, Grid::nP, ProcTop::nPeriodic, Grid::nPhi, ProcTop::nProcDims, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, ProcTop::nRank, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nTheta, Time::nTimeStepIndex, Parameters::nTypeTurbulanceMod, -Grid::nU, Grid::nU0, Grid::nV, Grid::nVariables, Grid::nW, Parameters::sEOSFileName, setInternalVarInf(), and setupLocalGrid().

Referenced by init().

6.4.2.8 void modelWrite_GL (std::string *sFileName,* ProcTop & *procTop,* Grid & *grid,* Time & *time,* Parameters & *parameters*)

Writes out a model in distrubuted model format, meaning that each processor writes it's own local grid to a file in binary format. They can be combined, and or converted to ascii format using SPHERLSanal. This is for a gamma-law gas model.

Parameters

`in`	*sFileName*	base name of the output files
`in`	*procTop*	
`in`	*grid*	
`in`	*time*	
`in`	*parameters*	

References Parameters::dA, Parameters::dAlpha, Parameters::dAVThreshold, Time::d-Deltat_nm1half, Parameters::dGamma, Grid::dLocalGridOld, Time::dt, DUMP_VERSI-ON, ProcTop::nCoords, Grid::nGlobalGridDims, Grid::nLocalGridDims, Grid::nNum1D-Zones, Grid::nNumGhostCells, Grid::nNumVars, ProcTop::nPeriodic, ProcTop::nProc-Dims, ProcTop::nRank, Time::nTimeStepIndex, and Grid::nVariables.

Referenced by setMainFunctions().

6.4.2.9 void modelWrite_TEOS (std::string *sFileName,* ProcTop & *procTop,* Grid & *grid,* Time & *time,* Parameters & *parameters*)

Writes out a model in distrubuted model format, meaning that each processor writes it's own local grid to a file in binary format. They can be combined, and or converted to ascii format using SPHERLSanal. This is for a tabulated equation of state model.

Parameters

in	*sFileName*	base name of the output files
in	*procTop*	
in	*grid*	
in	*time*	
in	*parameters*	

References Parameters::dA, Parameters::dAlpha, Parameters::dAVThreshold, Time::d-Deltat_nm1half, Time::dDeltat_np1half, Grid::dLocalGridOld, Time::dt, DUMP_VERSI-ON, ProcTop::nCoords, Grid::nGlobalGridDims, Grid::nLocalGridDims, Grid::nNum1D-Zones, Grid::nNumGhostCells, Grid::nNumVars, ProcTop::nPeriodic, ProcTop::nProc-Dims, ProcTop::nRank, Time::nTimeStepIndex, Grid::nVariables, and Parameters::sE-OSFileName.

Referenced by setMainFunctions().

6.4.2.10 void setDEDMClamp (Parameters & *parameters,* Time & *time,* Grid & *grid,* ProcTop & *procTop*)

This function sets the DEDM clamp if starting from an initial model, otherwise it throws an exception.

References Parameters::dDEDMClampMr, Parameters::dDEDMClampValue, -Parameters::dDonorCellMin, Parameters::dEDMClampTemperature, Grid::dLocalGrid-Old, Grid::nCenIntOffset, Grid::nDM, Grid::nE, Grid::nEndUpdateExplicit, Grid::nEnd-UpdateImplicit, Grid::nM, Grid::nNumDims, Grid::nNumGhostCells, ProcTop::nRank, Grid::nStartUpdateExplicit, Grid::nStartUpdateImplicit, Grid::nT, and Time::nTimeStep-Index.

Referenced by init().

6.4.2.11 void setupLocalGrid (ProcTop & *procTop*, Grid & *grid*)

Determins size of local grids (Grid::nLocalGridDims) based on processor topology, and allocates memory for the local grids (Grid::dLocalGridNew, Grid::dLocalGridOld). It sets various other quantities aswell such as,

- the coordinates of all processors (ProcTop::nCoords)
- the offset for interface centered quantities (Grid::nCenIntOffset, which depends on zoning and boundary conditions
- the position the local grid is in relative to the global grid (Grid::nGlobalGridPositionLocalGrid).

Parameters

`in,out`	*procTop*	contains information about the processor topology
`in,out`	*grid*	contains information about gird

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, ProcTop::nCoords, Grid::nD, Grid::nGlobalGridDims, Grid::nGlobalGridPositionLocalGrid, Grid::nLocalGridDims, Grid::nNum1DZones, Grid::nNumDims, Grid::nNumGhostCells, Grid::nNumIntVars, ProcTop::nNumProcs, Grid::nNumVars, ProcTop::nPeriodic, ProcTop::nProcDims, ProcTop::nRank, and Grid::nVariables.

Referenced by modelRead().

6.4.2.12 void updateLocalBoundaries (ProcTop & *procTop*, MessPass & *messPass*, Grid & *grid*)

Updates the boundaries of the local grids from the data in the local grids of other processors. It does this for all variables and updates to the old grid. It also has processor ProcTop::nRank=0 call average3DTo1DBoundariesOld which averages the 3D information into the 1D boundaries.

Parameters

`in`	*procTop*	
`in`	*messPass*	
`in,out`	*grid*	

Todo Shouldn't need MPI::COMM_WORLD.Barrier() may want to test out removing this at some point as it might produce a bit of a speed up.

References average3DTo1DBoundariesOld(), Grid::dLocalGridNew, Grid::dLocalGridOld, ProcTop::nNeighborRanks, ProcTop::nNumNeighbors, ProcTop::nRank, MessPass::requestRecv, MessPass::requestSend, MessPass::statusRecv, MessPass::statusSend, MessPass::typeRecvOldGrid, MessPass::typeSendNewGrid, and updateOldGrid().

Referenced by main().

6.4.2.13 void updateLocalBoundariesNewGrid (int *nVar*, ProcTop & *procTop*, MessPass & *messPass*, Grid & *grid*)

Updates the boundaries of the local grids from the data in the local grids of other processors. It does this for a specific variable specified by `nVar` and updates to the new grid. It also has processor ProcTop::nRank=0 call average3DTo1DBoundariesNew which averages the 3D information into the 1D boundaries for that specific variable.

Parameters

`in`	*procTop*	
`in`	*messPass*	
`in,out`	*grid*	

Todo May want to do some waiting on this message at some point before the end of the timestep, but it doesn't need to be done in this function. It might also be that this is built into the code by waiting at some other point. This is something that should be checked out at somepoint, perhaps once the preformance starts to be analyzed. I would think that if the send buffer was being modified before the send was completed, that there would be some errors poping up that would likely kill the program.

References average3DTo1DBoundariesNew(), Grid::dLocalGridNew, ProcTop::nNeighborRanks, ProcTop::nNumNeighbors, ProcTop::nRank, MessPass::requestRecv, MessPass::statusRecv, MessPass::typeRecvNewVar, and MessPass::typeSendNewVar.

Referenced by implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), main(), updateLocalBoundaryVelocitiesNewGrid_R(), updateLocalBoundaryVelocitiesNewGrid_RT(), and updateLocalBoundaryVelocitiesNewGrid_RTP().

6.4.2.14 void updateLocalBoundaryVelocitiesNewGrid_R (ProcTop & *procTop*, MessPass & *messPass*, Grid & *grid*)

Updates velocity boundaries of the new grid in a 1D calculations after the velocities have been newly calculated.

References Grid::nU, and updateLocalBoundariesNewGrid().

Referenced by setMainFunctions().

6.4.2.15 void updateLocalBoundaryVelocitiesNewGrid_RT (ProcTop & *procTop*, MessPass & *messPass*, Grid & *grid*)

Updates velocity boundaries of the new grid in a 2D calculations after the velocities have been newly calculated.

References Grid::nU, Grid::nV, and updateLocalBoundariesNewGrid().

Referenced by setMainFunctions().

6.4.2.16 void updateLocalBoundaryVelocitiesNewGrid_RTP (ProcTop & *procTop,* MessPass & *messPass,* Grid & *grid*)

Updates velocity boundaries of the new grid in a 3D calculations after the velocities have been newly calculated.

References Grid::nU, Grid::nV, Grid::nW, and updateLocalBoundariesNewGrid().

Referenced by setMainFunctions().

6.4.2.17 void updateNewGridWithOld (Grid & *grid,* ProcTop & *procTop*)

Copies the contents of the old grid to the new grid including ghost cells.

Parameters

`in,out`	*grid*	
`in`	*procTop*	

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nLocalGridDims, Grid::n-NumDims, Grid::nNumGhostCells, Grid::nNumIntVars, Grid::nNumVars, ProcTop::n-Rank, and Grid::nVariables.

Referenced by main().

6.4.2.18 void updateOldGrid (ProcTop & *procTop,* Grid & *grid*)

Updates the old grid with the new grid, not including boundaries.

Parameters

`in`	*procTop*	
`in,out`	*grid*	

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nEndGhostUpdate-Explicit, Grid::nEndGhostUpdateImplicit, Grid::nEndUpdateExplicit, Grid::nEndUpdate-Implicit, Grid::nNumIntVars, Grid::nNumVars, Grid::nStartGhostUpdateExplicit, Grid::n-StartGhostUpdateImplicit, Grid::nStartUpdateExplicit, and Grid::nStartUpdateImplicit.

Referenced by updateLocalBoundaries().

6.5 dataMonitoring.cpp File Reference

```
#include <mpi.h> #include <sstream> #include <fstream>×
#include <iostream> #include <cmath> #include <iomanip>
#include <string>#include "watchzone.h"#include "exception2.-
h" #include "xmlFunctions.h" #include "dataMonitoring.h"
#include "global.h"#include "fileExists.h"
```

Functions

- void initWatchZones (XMLNode xParent, ProcTop &procTop, Grid &grid, Output &output, Parameters &parameters, Time &time)
- void writeWatchZones_R_GL (Output &output, Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void writeWatchZones_R_TEOS (Output &output, Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void writeWatchZones_RT_GL (Output &output, Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void writeWatchZones_RT_TEOS (Output &output, Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void writeWatchZones_RTP_GL (Output &output, Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void writeWatchZones_RTP_TEOS (Output &output, Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void finWatchZones (Output &output)

6.5.1 Detailed Description

This file holds functions used for examining the grid data during execution. This includes initializing structures, handlng watching zones during the execution of the program, opening files to write out the peak kinetic energy, etc.

6.5.2 Function Documentation

6.5.2.1 void finWatchZones (**Output** & *output*)

Closes the files opened for writting out the watchzones

Parameters

`in`	*output*	

References Output::ofWatchZoneFiles, and Output::watchzoneList.

Referenced by fin().

6.5.2.2 void initWatchZones (XMLNode *xParent*, **ProcTop** & *procTop*, **Grid** & *grid*, **Output** & *output*, **Parameters** & *parameters*, **Time** & *time*)

Reads in watchzones set in configuration file "SPHERLS.xml". A list is created on each processor containing the watchzones on that processor’s local grid. It also opens file streams for each watchzone and writes out a header.

Parameters

`in`	*xParent*	
`in`	*procTop*	
`in`	*grid*	
`in,out`	*output*	
`in`	*parameters*	
`in`	*time*	

References Parameters::bEOSGammaLaw, Parameters::dGamma, ProcTop::nCoords, Grid::nD, Grid::nGlobalGridDims, Grid::nLocalGridDims, Grid::nNum1DZones, Grid::n-NumDims, Grid::nNumGhostCells, ProcTop::nNumProcs, ProcTop::nProcDims, Proc-Top::nRank, Time::nTimeStepIndex, Output::ofWatchZoneFiles, Output::sBaseOutput-FileName, and Output::watchzoneList.

Referenced by init().

6.5.2.3 void writeWatchZones_R_GL (**Output & *output*, Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop***)

Writes out the information for each watchzone specified in "SPHERLS.xml" in the case of a 1D gamma-law gas.

Parameters

`in,out`	*output*	
`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*procTop*	

References Grid::dLocalGridOld, Parameters::dPi, Time::dt, Grid::nCenIntOffset, Grid-::nD, Grid::nDM, Grid::nE, Grid::nP, Grid::nQ0, Grid::nR, Time::nTimeStepIndex, Grid-::nU, Grid::nU0, Output::ofWatchZoneFiles, and Output::watchzoneList.

Referenced by setMainFunctions().

6.5.2.4 void writeWatchZones_R_TEOS (**Output & *output*, Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop***)

Writes out the information for each watchzone specified in "SPHERLS.xml" in the case of a 1D tabulated equation of state.

Parameters

`in,out`	*output*	
`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*procTop*	

References Grid::dLocalGridOld, Parameters::dPi, Time::dt, Grid::nCenIntOffset, Grid-::nD, Grid::nDM, Grid::nE, Grid::nP, Grid::nQ0, Grid::nR, Grid::nT, Time::nTimeStep-Index, Grid::nU, Grid::nU0, Output::ofWatchZoneFiles, and Output::watchzoneList.

Referenced by setMainFunctions().

6.5.2.5 void writeWatchZones_RT_GL (Output & *output,* Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

Writes out the information for each watchzone specified in "SPHERLS.xml" in the case of a 2D gamma-law gas.

Parameters

`in,out`	*output*	
`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*procTop*	

References Grid::dLocalGridOld, Parameters::dPi, Time::dt, Grid::nCenIntOffset, Grid-::nD, Grid::nDenAve, Grid::nDM, Grid::nE, Grid::nEddyVisc, Grid::nP, Grid::nQ0, Grid-::nQ1, Grid::nR, Time::nTimeStepIndex, Parameters::nTypeTurbulanceMod, Grid::nU, Grid::nU0, Grid::nV, Output::ofWatchZoneFiles, and Output::watchzoneList.

Referenced by setMainFunctions().

6.5.2.6 void writeWatchZones_RT_TEOS (Output & *output,* Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

Writes out the information for each watchzone specified in "SPHERLS.xml" in the case of a 2D tabulated equation of state.

Parameters

`in,out`	*output*	
`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*procTop*	

References Grid::dLocalGridOld, Parameters::dPi, Time::dt, Grid::nCenIntOffset, Grid-::nD, Grid::nDenAve, Grid::nDM, Grid::nE, Grid::nEddyVisc, Grid::nP, Grid::nQ0, Grid-::nQ1, Grid::nR, Grid::nT, Time::nTimeStepIndex, Parameters::nTypeTurbulanceMod, -Grid::nU, Grid::nU0, Grid::nV, Output::ofWatchZoneFiles, and Output::watchzoneList.

Referenced by setMainFunctions().

6.5.2.7 void writeWatchZones_RTP_GL (Output & *output,* Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

Writes out the information for each watchzone specified in "SPHERLS.xml" in the case of a 3D gamma-law gas.

Parameters

`in,out`	*output*	
`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*procTop*	

References Grid::dLocalGridOld, Parameters::dPi, Time::dt, Grid::nCenIntOffset, -Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nE, Grid::nEddyVisc, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Time::nTimeStepIndex, Parameters::nTypeTurbulance-Mod, Grid::nU, Grid::nU0, Grid::nV, Grid::nW, Output::ofWatchZoneFiles, and Output-::watchzoneList.

Referenced by setMainFunctions().

6.5.2.8 void writeWatchZones_RTP_TEOS (Output & *output,* Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

Writes out the information for each watchzone specified in "SPHERLS.xml" in the case of a 3D tabulated equation of state.

Parameters

`in,out`	*output*	
`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*procTop*	

References Grid::dLocalGridOld, Parameters::dPi, Time::dt, Grid::nCenIntOffset, -Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nE, Grid::nEddyVisc, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nT, Time::nTimeStepIndex, Parameters::nType-TurbulanceMod, Grid::nU, Grid::nU0, Grid::nV, Grid::nW, Output::ofWatchZoneFiles, and Output::watchzoneList.

Referenced by setMainFunctions().

6.6 dataMonitoring.h File Reference

```
#include <string>#include "xmlParser.h"#include "global.-
h"
```

Functions

- void initWatchZones (XMLNode xParent, ProcTop &procTop, Grid &grid, Output &output, Parameters &parameters, Time &time)
- void writeWatchZones_R_GL (Output &output, Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void writeWatchZones_R_TEOS (Output &output, Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void writeWatchZones_RT_GL (Output &output, Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void writeWatchZones_RT_TEOS (Output &output, Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void writeWatchZones_RTP_GL (Output &output, Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void writeWatchZones_RTP_TEOS (Output &output, Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void finWatchZones (Output &output)

6.6.1 Detailed Description

Header file for dataMonitoring.cpp

6.6.2 Function Documentation

6.6.2.1 void finWatchZones (Output & *output*)

Closes the files opened for writting out the watchzones

Parameters

in	*output*	

References Output::ofWatchZoneFiles, and Output::watchzoneList.

Referenced by fin().

6.6.2.2 void initWatchZones (XMLNode *xParent*, ProcTop & *procTop*, Grid & *grid*, Output & *output*, Parameters & *parameters*, Time & *time*)

Reads in watchzones set in configuration file "SPHERLS.xml". A list is created on each processor containing the watchzones on that processor's local grid. It also opens file streams for each watchzone and writes out a header.

Parameters

in	*xParent*	
in	*procTop*	
in	*grid*	

`in,out`	*output*	
`in`	*parameters*	
`in`	*time*	

References Parameters::bEOSGammaLaw, Parameters::dGamma, ProcTop::nCoords, Grid::nD, Grid::nGlobalGridDims, Grid::nLocalGridDims, Grid::nNum1DZones, Grid::n-NumDims, Grid::nNumGhostCells, ProcTop::nNumProcs, ProcTop::nProcDims, Proc-Top::nRank, Time::nTimeStepIndex, Output::ofWatchZoneFiles, Output::sBaseOutput-FileName, and Output::watchzoneList.

Referenced by init().

6.6.2.3 void writeWatchZones_R_GL (Output & *output,* Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

Writes out the information for each watchzone specified in "SPHERLS.xml" in the case of a 1D gamma-law gas.

Parameters

`in,out`	*output*	
`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*procTop*	

References Grid::dLocalGridOld, Parameters::dPi, Time::dt, Grid::nCenIntOffset, Grid-::nD, Grid::nDM, Grid::nE, Grid::nP, Grid::nQ0, Grid::nR, Time::nTimeStepIndex, Grid-::nU, Grid::nU0, Output::ofWatchZoneFiles, and Output::watchzoneList.

Referenced by setMainFunctions().

6.6.2.4 void writeWatchZones_R_TEOS (Output & *output,* Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

Writes out the information for each watchzone specified in "SPHERLS.xml" in the case of a 1D tabulated equation of state.

Parameters

`in,out`	*output*	
`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*procTop*	

References Grid::dLocalGridOld, Parameters::dPi, Time::dt, Grid::nCenIntOffset, Grid-::nD, Grid::nDM, Grid::nE, Grid::nP, Grid::nQ0, Grid::nR, Grid::nT, Time::nTimeStep-

Index, Grid::nU, Grid::nU0, Output::ofWatchZoneFiles, and Output::watchzoneList.

Referenced by setMainFunctions().

6.6.2.5 void writeWatchZones_RT_GL (Output & *output,* Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

Writes out the information for each watchzone specified in "SPHERLS.xml" in the case of a 2D gamma-law gas.

Parameters

`in,out`	*output*	
`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*procTop*	

References Grid::dLocalGridOld, Parameters::dPi, Time::dt, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nE, Grid::nEddyVisc, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Time::nTimeStepIndex, Parameters::nTypeTurbulanceMod, Grid::nU, Grid::nU0, Grid::nV, Output::ofWatchZoneFiles, and Output::watchzoneList.

Referenced by setMainFunctions().

6.6.2.6 void writeWatchZones_RT_TEOS (Output & *output,* Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

Writes out the information for each watchzone specified in "SPHERLS.xml" in the case of a 2D tabulated equation of state.

Parameters

`in,out`	*output*	
`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*procTop*	

References Grid::dLocalGridOld, Parameters::dPi, Time::dt, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nE, Grid::nEddyVisc, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nT, Time::nTimeStepIndex, Parameters::nTypeTurbulanceMod, -Grid::nU, Grid::nU0, Grid::nV, Output::ofWatchZoneFiles, and Output::watchzoneList.

Referenced by setMainFunctions().

6.6.2.7 void writeWatchZones_RTP_GL (Output & *output*, Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

Writes out the information for each watchzone specified in "SPHERLS.xml" in the case of a 3D gamma-law gas.

Parameters

`in,out`	*output*	
`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*procTop*	

References Grid::dLocalGridOld, Parameters::dPi, Time::dt, Grid::nCenIntOffset, -Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nE, Grid::nEddyVisc, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Time::nTimeStepIndex, Parameters::nTypeTurbulance-Mod, Grid::nU, Grid::nU0, Grid::nV, Grid::nW, Output::ofWatchZoneFiles, and Output-::watchzoneList.

Referenced by setMainFunctions().

6.6.2.8 void writeWatchZones_RTP_TEOS (Output & *output*, Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

Writes out the information for each watchzone specified in "SPHERLS.xml" in the case of a 3D tabulated equation of state.

Parameters

`in,out`	*output*	
`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*procTop*	

References Grid::dLocalGridOld, Parameters::dPi, Time::dt, Grid::nCenIntOffset, -Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nE, Grid::nEddyVisc, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nT, Time::nTimeStepIndex, Parameters::nType-TurbulanceMod, Grid::nU, Grid::nU0, Grid::nV, Grid::nW, Output::ofWatchZoneFiles, and Output::watchzoneList.

Referenced by setMainFunctions().

6.7 global.cpp File Reference

```
#include "global.h"
```

6.7.1 Detailed Description

Declares global variables used across files and functions. This file contains the constructors used to initialize the classes defined in global.h, and does little more than initilize the default values of various parameters.

6.8 global.h File Reference

`#include <vector> #include <mpi.h> #include "watchzone.h" #include "eos.h" #include "petscksp.h" #include <csignal> × #include <limits> #include "profileData.h" #include "procTop.h" #include "time.h"`

Classes

- class MessPass
- class Grid
- class Parameters
- class Output
- class Performance
- class Implicit
- class Functions
- class Global

Defines

- #define SIGNEGDEN 0
- #define SIGNEGENG 0
- #define SIGNEGTEMP 0
- #define TRACKMAXSOLVERERROR 0
- #define SEDOV 0
- #define VISCOUS_ENERGY_EQ 1
- #define DUMP_VERSION 1
- #define DEBUG_EQUATIONS 0
- #define DEDEM_CLAMP 1

6.8.1 Detailed Description

Header file for global.cpp.

This file contains definitions which are required throughout the program. The classes defined herein are used through out the program.

6.8.2 Define Documentation

6.8.2.1 #define DEBUG_EQUATIONS 0

If 1 will write out in the form of a profile file, all the horizontal maximum values of all terms in all equations.

Referenced by dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_SB(), d-ImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicit-EnergyFunction_RTP_LES(), and dImplicitEnergyFunction_RTP_LES_SB().

6.8.2.2 #define DEDEM_CLAMP 1

If 1 a clamp on the DEDM gradient will be used to limit how large DE/DM becomes in the advection term in the energy equation.

6.8.2.3 #define DUMP_VERSION 1

Sets the version of the dump file. Should be incremented if changes are made to the information that is printed out in a dump.

Referenced by modelRead(), modelWrite_GL(), and modelWrite_TEOS().

6.8.2.4 #define SEDOV 0

If 1 we are preforming the sedov test, which sets special boundary conditions, if 0 we use normal boundary conditions. It also handles artificial viscosity, and timestep slightly differently.

6.8.2.5 #define SIGNEGDEN 0

Raise signal on calculation of negative density if set to 1. Useful when debugging, it will stop the debugger at the location of the calculation of the negative density. If not 1, it will speed up calculation slightly and generate more useful output upon detection of negative densities. If 1 and not being run in the debugger, it likely won't generate any usefull output upon negative density, and wil simply abort the program.

6.8.2.6 #define SIGNEGENG 0

Raise signal on calculation of negative energy if set to 1, else don't rais a signal. -Otherwise it will be handled through the normal exception method. This is useful when debugging, it will stop the debugger at the location of the calculation of the negative energy. If not 1, it will speed up calculation slightly and generate more useful output upon detection of negative energy. If 1 and not being run in the debugger, it likely won't generate any usefull output upon negative energies, and wil simply abort the program.

6.8.2.7 #define SIGNEGTEMP 0

Raise signal on calculation of negative temperature if set to 1, else don't rais a signal. Otherwise it will be handled through the normal exception method. This is useful when debugging, it will stop the debugger at the location of the calculation of the negative energy. If not 1, it will speed up calculation slightly and generate more useful output upon detection of negative energy. If 1 and not being run in the debugger, it likely won't generate any usefull output upon negative energies, and wil simply abort the program.

6.8.2.8 #define TRACKMAXSOLVERERROR 0

Report the error of the linear equation solver if set to 1, else don't. Not tracking the error reduces the calculations per iteration and will speed up running, however if there is question of weather the solver is working accurately this is very handy to turn on.

6.8.2.9 #define VISCOUS_ENERGY_EQ 1

If 1 will include viscosity in the energy equation. If 0 it won't. This normally should be set to 1

6.9 main.cpp File Reference

`#include <mpi.h> #include <sstream> #include <string>` × `#include <fstream> #include <cmath> #include <vector> #include <algorithm>#include <iomanip>#include <csignal>` × `#include <fenv.h> #include "main.h" #include "global.h"` × `#include "watchzone.h" #include "exception2.h" #include "xmlParser.h" #include "xmlFunctions.h" #include "dataManipulation.h"#include "dataMonitoring.h"#include "physEquations.h"`

Functions

- int main (int argc, char ∗argv[])
- void signalHandler (int nSig)

6.9.1 Detailed Description

This file contains the main function which is the driver for SPHERLS.

6.9.2 Function Documentation

6.9.2.1 int main (int *argc*, char ∗ *argv[]*)

Main driving function of SPHERLS.

Parameters

`in`	*argc*	number of arguments passed from the command line
`in`	*argv*	array of character strings of size argc containing the arguments from the command line.

The flow of this function is as follows:

- Initilize program by calling init()
- Set function pointers by calling setMainFunctions()
- Update new grid with old grid by calling updateNewGridWithOld()
- Update boundaries of local grids
- Calculate the first time step by calling Functions::fpCalculateDeltat()
- Enter while loop until end time (Time::dEndTime) is reached, and for each interation of the loop:
  - Test to see if a model dump is needed (by checking Output::bDump and Output::nDumpFrequency), if so dump one by calling modelWrite()
  - Write out information for any watchzones present by calling writeWatchZones()
  - Write out information for peak kinetic energy per period by calling writePeakKE()
  - calculate time step by calling function pointed to by Functions::fpCalculateDeltat
- Calculate new velocities by calling the function pointed to by Functions::fpCalculateNewVelocities()
- Update velocities on new grid boundaries between processors by calling updateLocalBoundariesNewGrid() three times indicating the r-velocity (U), θ-velocity (V) and the ϕ-velocity (W).
- Calculate new grid velocities with Functions::fpCalculateNewGridVelocities().
- Calculate new radii with Functions::fpCalculateNewRadii().
- Update radii on new grid boundaries between processors by calling updateLocalBoundariesNewGrid() indicating radius is to be updated (R).
- Calculate new densities with Functions::fpCalculateNewDensities()
- Calculate new energies with Functions::fpCalculateNewEnergies()
- Update the old grid boundaries and centeres by calling updateLocalBoundaries()
- Calculating the next time step with Functions::fpCalculateDeltat()

Finish by dumping the last model computed

References Output::bDump, Output::bPrint, Implicit::dAverageRHS, Implicit::d-CurrentRelTError, Time::dDelRho_t_Rho_max, Time::dDelT_t_T_max, Time::d-Deltat_np1half, Output::dDumpFrequencyTime, Time::dEndTime, Parameters::dMax-ConvectiveVelocity, Implicit::dMaxErrorInRHS, Output::dPrintFrequencyTime, Time::dt, Output::dTimeLastDump, Output::dTimeLastPrint, fin(), Functions::fpCalculateAve-Densities, Functions::fpCalculateDeltat, Functions::fpCalculateNewAV, Functions::fp-CalculateNewDensities, Functions::fpCalculateNewEddyVisc, Functions::fpCalculate-NewEnergies, Functions::fpCalculateNewEOSVars, Functions::fpCalculateNewGrid-Velocities, Functions::fpCalculateNewRadii, Functions::fpCalculateNewVelocities, -Functions::fpImplicitSolve, Functions::fpModelWrite, Functions::fpUpdateLocal-BoundaryVelocitiesNewGrid, Functions::fpWriteWatchZones, Global::functions, -Global::grid, Global::implicit, init(), Global::messPass, Implicit::nCurrentNumIterations, Grid::nD, Grid::nDenAve, Output::nDumpFrequencyStep, Grid::nEddyVisc, Time::n-EndTimeStep, Grid::nGamma, Implicit::nMaxNumSolverIterations, Grid::nNumDims, Implicit::nNumImplicitZones, Output::nNumTimeStepsSinceLastPrint, Grid::nP, Output-::nPrintFrequencyStep, Output::nPrintMode, Grid::nR, ProcTop::nRank, Grid::nT, Time-::nTimeStepIndex, Grid::nU0, Global::output, Global::parameters, Global::performance, Global::procTop, Output::sBaseOutputFileName, Parameters::sDebugProfileOutput, setMainFunctions(), signalHandler(), Global::time, updateLocalBoundaries(), update-LocalBoundariesNewGrid(), and updateNewGridWithOld().

6.9.2.2 void signalHandler (int *nSig*)

Used for catching signals.

Referenced by main().

6.10 main.h File Reference

Functions

- void signalHandler (int nSig)
- int main (int argc, char ∗argv[])

6.10.1 Detailed Description

Header file for main.cpp

6.10.2 Function Documentation

6.10.2.1 int main (int *argc,* char ∗ *argv[]*)

Main driving function of SPHERLS.

Parameters

`in`	*argc*	number of arguments passed from the command line
`in`	*argv*	array of character strings of size argc containing the arguments from the command line.

The flow of this function is as follows:

- Initilize program by calling init()
- Set function pointers by calling setMainFunctions()
- Update new grid with old grid by calling updateNewGridWithOld()
- Update boundaries of local grids
- Calculate the first time step by calling Functions::fpCalculateDeltat()
- Enter while loop until end time (Time::dEndTime) is reached, and for each interation of the loop:
  - Test to see if a model dump is needed (by checking Output::bDump and Output::nDumpFrequency), if so dump one by calling modelWrite()
  - Write out information for any watchzones present by calling writeWatchZones()
  - Write out information for peak kinetic energy per period by calling writePeakKE()
  - calculate time step by calling function pointed to by Functions::fpCalculateDeltat
- Calculate new velocities by calling the function pointed to by Functions::fpCalculateNewVelocities()
- Update velocities on new grid boundaries between processors by calling updateLocalBoundariesNewGrid() three times indicating the r-velocity (U), θ-velocity (V) and the ϕ-velocity (W).
- Calculate new grid velocities with Functions::fpCalculateNewGridVelocities().
- Calculate new radii with Functions::fpCalculateNewRadii().
- Update radii on new grid boundaries between processors by calling updateLocalBoundariesNewGrid() indicating radius is to be updated (R).
- Calculate new densities with Functions::fpCalculateNewDensities()
- Calculate new energies with Functions::fpCalculateNewEnergies()
- Update the old grid boundaries and centeres by calling updateLocalBoundaries()
- Calculating the next time step with Functions::fpCalculateDeltat()

Finish by dumping the last model computed

References Output::bDump, Output::bPrint, Implicit::dAverageRHS, Implicit::d-CurrentRelTError, Time::dDelRho_t_Rho_max, Time::dDelT_t_T_max, Time::d-Deltat_np1half, Output::dDumpFrequencyTime, Time::dEndTime, Parameters::dMax-ConvectiveVelocity, Implicit::dMaxErrorInRHS, Output::dPrintFrequencyTime, Time::dt, Output::dTimeLastDump, Output::dTimeLastPrint, fin(), Functions::fpCalculateAve-Densities, Functions::fpCalculateDeltat, Functions::fpCalculateNewAV, Functions::fp-CalculateNewDensities, Functions::fpCalculateNewEddyVisc, Functions::fpCalculate-NewEnergies, Functions::fpCalculateNewEOSVars, Functions::fpCalculateNewGrid-Velocities, Functions::fpCalculateNewRadii, Functions::fpCalculateNewVelocities, -Functions::fpImplicitSolve, Functions::fpModelWrite, Functions::fpUpdateLocal-BoundaryVelocitiesNewGrid, Functions::fpWriteWatchZones, Global::functions, -Global::grid, Global::implicit, init(), Global::messPass, Implicit::nCurrentNumIterations, Grid::nD, Grid::nDenAve, Output::nDumpFrequencyStep, Grid::nEddyVisc, Time::n-EndTimeStep, Grid::nGamma, Implicit::nMaxNumSolverIterations, Grid::nNumDims, Implicit::nNumImplicitZones, Output::nNumTimeStepsSinceLastPrint, Grid::nP, Output-::nPrintFrequencyStep, Output::nPrintMode, Grid::nR, ProcTop::nRank, Grid::nT, Time-::nTimeStepIndex, Grid::nU0, Global::output, Global::parameters, Global::performance, Global::procTop, Output::sBaseOutputFileName, Parameters::sDebugProfileOutput, setMainFunctions(), signalHandler(), Global::time, updateLocalBoundaries(), update-LocalBoundariesNewGrid(), and updateNewGridWithOld().

6.10.2.2 void signalHandler (int *nSig*)

Used for catching signals.

Referenced by main().

6.11 physEquations.cpp File Reference

`#include <cmath>` `#include <sstream>` `#include <signal.-h>` `#include "exception2.h"` `#include "physEquations.h"`× `#include "dataManipulation.h"` `#include "dataMonitoring.-h"` `#include "global.h"` `#include <limits>` `#include "profile-Data.h"`

Functions

- void setMainFunctions (Functions &functions, ProcTop &procTop, Parameters &parameters, Grid &grid, Time &time, Implicit &implicit)
- void setInternalVarInf (Grid &grid, Parameters &parameters)
- void initInternalVars (Grid &grid, ProcTop &procTop, Parameters &parameters)
- void calNewVelocities_R (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewVelocities_R_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

- void calNewVelocities_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewVelocities_RT_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewVelocities_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewVelocities_RTP_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU_R (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU_R_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU_RT_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU_RTP_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewV_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewV_RT_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewV_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewV_RTP_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewW_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewW_RTP_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU0_R (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass)
- void calNewU0_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass)
- void calNewU0_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass)
- void calNewR (Grid &grid, Time &time)
- void calNewD_R (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewD_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewD_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_R_AD (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

- void calNewE_R_NA (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_R_NA_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_RT_AD (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_RT_NA (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_RT_NA_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_RTP_AD (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_RTP_NA (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_RTP_NA_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewDenave_None (Grid &grid)
- void calNewDenave_R (Grid &grid)
- void calNewDenave_RT (Grid &grid)
- void calNewDenave_RTP (Grid &grid)
- void calNewP_GL (Grid &grid, Parameters &parameters)
- void calNewTPKappaGamma_TEOS (Grid &grid, Parameters &parameters)
- void calNewPEKappaGamma_TEOS (Grid &grid, Parameters &parameters)
- void calNewQ0_R_TEOS (Grid &grid, Parameters &parameters)
- void calNewQ0_R_GL (Grid &grid, Parameters &parameters)
- void calNewQ0Q1_RT_TEOS (Grid &grid, Parameters &parameters)
- void calNewQ0Q1_RT_GL (Grid &grid, Parameters &parameters)
- void calNewQ0Q1Q2_RTP_TEOS (Grid &grid, Parameters &parameters)
- void calNewQ0Q1Q2_RTP_GL (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_None (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_R_CN (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_RT_CN (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_RTP_CN (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_R_SM (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_RT_SM (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_RTP_SM (Grid &grid, Parameters &parameters)
- void calOldDenave_None (Grid &grid)
- void calOldDenave_R (Grid &grid)
- void calOldDenave_RT (Grid &grid)
- void calOldDenave_RTP (Grid &grid)
- void calOldP_GL (Grid &grid, Parameters &parameters)
- void calOldPEKappaGamma_TEOS (Grid &grid, Parameters &parameters)
- void calOldQ0_R_GL (Grid &grid, Parameters &parameters)
- void calOldQ0_R_TEOS (Grid &grid, Parameters &parameters)
- void calOldQ0Q1_RT_GL (Grid &grid, Parameters &parameters)
- void calOldQ0Q1_RT_TEOS (Grid &grid, Parameters &parameters)
- void calOldQ0Q1Q2_RTP_GL (Grid &grid, Parameters &parameters)

- void calOldQ0Q1Q2_RTP_TEOS (Grid &grid, Parameters &parameters)
- void calOldEddyVisc_R_CN (Grid &grid, Parameters &parameters)
- void calOldEddyVisc_RT_CN (Grid &grid, Parameters &parameters)
- void calOldEddyVisc_RTP_CN (Grid &grid, Parameters &parameters)
- void calOldEddyVisc_R_SM (Grid &grid, Parameters &parameters)
- void calOldEddyVisc_RT_SM (Grid &grid, Parameters &parameters)
- void calOldEddyVisc_RTP_SM (Grid &grid, Parameters &parameters)
- void calDelt_R_GL (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calDelt_R_TEOS (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calDelt_RT_GL (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calDelt_RT_TEOS (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calDelt_RTP_GL (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calDelt_RTP_TEOS (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calDelt_CONST (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void implicitSolve_None (Grid &grid, Implicit &implicit, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass, Functions &functions)
- void implicitSolve_R (Grid &grid, Implicit &implicit, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass, Functions &functions)
- void implicitSolve_RT (Grid &grid, Implicit &implicit, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass, Functions &functions)
- void implicitSolve_RTP (Grid &grid, Implicit &implicit, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass, Functions &functions)
- double dImplicitEnergyFunction_None (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_R (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_R_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RT (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RT_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RTP (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RTP_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_R_LES (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_R_LES_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)

- double dImplicitEnergyFunction_RT_LES (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RT_LES_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RTP_LES (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RTP_LES_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dEOS_GL (double dRho, double dE, Parameters parameters)
- void initDonorFracAndMaxConVel_R_GL (Grid &grid, Parameters &parameters)
- void initDonorFracAndMaxConVel_R_TEOS (Grid &grid, Parameters &parameters)
- void initDonorFracAndMaxConVel_RT_GL (Grid &grid, Parameters &parameters)
- void initDonorFracAndMaxConVel_RT_TEOS (Grid &grid, Parameters &parameters)
- void initDonorFracAndMaxConVel_RTP_GL (Grid &grid, Parameters &parameters)
- void initDonorFracAndMaxConVel_RTP_TEOS (Grid &grid, Parameters &parameters)
- double dET4 (Parameters &parameters, double dEddyVisc_ijk_np1half, double dRho_ijk_np1half, double dLengthScale4_ijk_np1half)

6.11.1 Detailed Description

This file is used to specify the functions which contain physics. This includes conservation equations, equation of state, etc.. It also sets function pointers for these functions, so that main() will know which functions to call. This implementation also allows the functions called to calculate, for example new densities, to be different depending on the processor. This allows one processor to handle the 1D region and other processors to handle a 3D region.

6.11.2 Function Documentation

6.11.2.1 void calDelt_CONST (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function is used when a constant tie step is desired.

References Time::dConstTimeStep, Time::dDeltat_n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Time::dt, ProcTop::nRank, and Time::nTimeStepIndex.

Referenced by setMainFunctions().

6.11.2.2 void calDelt_R_GL (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates the time step by considering the sound crossing time in the radial direction only and is compatiable with a gamma law gass EOS.

Parameters

`in`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in,out`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology. This function uses ProcTop::nRank to pass messages.

References Time::dDelE_t_E_max, Time::dDelRho_t_Rho_max, Time::dDeltat_-n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Parameters::dDonorCellMin, -Parameters::dDonorCellMultiplier, Parameters::dGamma, Grid::dLocalGridNew, Grid-::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Time::dPerChange, Time::dt, Time::dTimeStepFactor, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::n-R, ProcTop::nRank, Grid::nStartUpdateExplicit, Time::nTimeStepIndex, Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.11.2.3 void calDelt_R_TEOS (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the time step by considering the sound crossing time in the radial direction only and is compatiable with a tabulated EOS.

Parameters

`in`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in,out`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology. This function uses ProcTop::nRank to pass messages.

References Time::dDelRho_t_Rho_max, Time::dDelT_t_T_max, Time::dDeltat_-n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Parameters::dDonorCellMin, -Parameters::dDonorCellMultiplier, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dMaxConvectiveVelocity, Time::dPerChange, Time::dt, Time::dTimeStep-Factor, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdate-Explicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nR, Proc-Top::nRank, Grid::nStartUpdateExplicit, Grid::nT, Time::nTimeStepIndex, Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.11.2.4 void calDelt_RT_GL (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates the time step by considering the sound crossing time in the radial and theta directions only and is compatiable with a gamma law gass EOS.

Parameters

`in`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in,out`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology. This function uses ProcTop::nRank to pass messages.

References Time::dDelE_t_E_max, Time::dDelRho_t_Rho_max, Time::dDeltat_-n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Parameters::dDonorCellMin, -Parameters::dDonorCellMultiplier, Parameters::dGamma, Grid::dLocalGridNew, Grid-::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Time::dPerChange, Time::dt, Time::dTimeStepFactor, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::n-DTheta, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, ProcTop::nRank, Grid::nStartUpdateExplicit, Time::n-TimeStepIndex, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.11.2.5 void calDelt_RT_TEOS (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates the time step by considering the sound crossing time in the radial and theta directions and is compatiable with a tabulated EOS.

Parameters

`in`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in,out`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology. This function uses ProcTop::nRank to pass messages.

References Time::dDelRho_t_Rho_max, Time::dDelT_t_T_max, Time::dDeltat_-n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Parameters::dDonorCellMin, -Parameters::dDonorCellMultiplier, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dMaxConvectiveVelocity, Time::dPerChange, Time::dt, Time::dTime-StepFactor, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nDTheta, -Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, ProcTop::nRank, Grid::nStartUpdateExplicit, Grid::nT, Time::nTimeStepIndex, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.11.2.6 void calDelt_RTP_GL (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the time step by considering the sound crossing time in the radial, theta and phi directions only and is compatiable with a gamma law gass EOS.

Parameters

`in`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in,out`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology. This function uses ProcTop::nRank to pass messages.

References Time::dDelE_t_E_max, Time::dDelRho_t_Rho_max, Time::dDeltat_-n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Parameters::dDonorCellMin, -Parameters::dDonorCellMultiplier, Parameters::dGamma, Grid::dLocalGridNew, Grid-::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Time::dPerChange, Time::dt, Time::dTimeStepFactor, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::n-DPhi, Grid::nDTheta, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdate-Explicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, ProcTop::nRank, Grid::n-SinThetaIJK, Grid::nStartUpdateExplicit, Time::nTimeStepIndex, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.7 void calDelt_RTP_TEOS (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the time step by considering the sound crossing time in the radial, theta and phi directions and is compatiable with a tabulated EOS.

Parameters

`in`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in,out`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology. This function uses ProcTop::nRank to pass messages.

References Time::dDelRho_t_Rho_max, Time::dDelT_t_T_max, Time::dDeltat_-n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Parameters::dDonorCellMin, -Parameters::dDonorCellMultiplier, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dMaxConvectiveVelocity, Time::dPerChange, Time::dt, Time::dTime-StepFactor, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nDPhi, Grid-

::nDTheta, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, ProcTop::nRank, Grid::nSinTheta-IJK, Grid::nStartUpdateExplicit, Grid::nT, Time::nTimeStepIndex, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.8 void calNewD_R (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new densities using terms in the radial direction only

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology, uses ProcTop::nRank when reporting negative densities

Boundary Conditions doesn't allow mass flux through outter interface

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nNumGhostCells, Grid::nR, ProcTop::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, -Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.11.2.9 void calNewD_RT (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new densities using terms in the radial and theta directions

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology, uses ProcTop::nRank when reporting negative densities

Boundary Conditions doesn't allow mass flux through outter interface

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDCosThetaIJK, Grid::nDonorCellFrac, Grid::nEnd-

GhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nNumGhostCells, Grid::nR, ProcTop::nRank, Grid::nSinThetaIJp1halfK, Grid::n-StartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::n-V.

Referenced by setMainFunctions().

6.11.2.10 void calNewD_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new densities using terms in the radial, theta, and phi directions

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology, uses ProcTop::nRank when reporting negative densities

Boundary Conditions doesn't allow mass flux through outter interface

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::n-CenIntOffset, Grid::nD, Grid::nDCosThetaIJK, Grid::nDonorCellFrac, Grid::nDPhi, Grid-::nDTheta, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobal-GridPositionLocalGrid, Grid::nNumGhostCells, Grid::nR, ProcTop::nRank, Grid::nSin-ThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.11 void calNewDenave_None (Grid & *grid*)

This function is a dumby funciton, and doesn't do anything. In the case of a 1D calculation the average density is undefined, and only the density is used. This is different from the case where the 1D region exsists on the rank 0 processor, but the grid as a whole is really 2D or 3D. In which case calNewDenave_R should be used instead.

Parameters

`in,out`	*grid*	

Referenced by setMainFunctions().

6.11.2.12 void calNewDenave_R (Grid & *grid*)

This function calculates the horizontal average density in a 3\1D region. This really just copies the density from the particular radial zone into the averaged density variable. This way it can be used exactly the same way in the 1D region as it is in the 3D region. This is done using the density in the new grid, and places the result into the new grid.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.

References Grid::dLocalGridNew, Grid::nD, Grid::nDenAve, Grid::nEndGhostUpdate-Explicit, Grid::nEndUpdateExplicit, Grid::nStartGhostUpdateExplicit, and Grid::nStart-UpdateExplicit.

Referenced by setMainFunctions().

6.11.2.13 void calNewDenave_RT (Grid & *grid*)

This function calculates the horizontal average density in a 2D region from the new grid density and stores the result in the new grid.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDCosThetaIJK, Grid::nDenAve, Grid::nEndGhostUpdateExplicit, Grid::nEnd-UpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdate-Explicit.

Referenced by setMainFunctions().

6.11.2.14 void calNewDenave_RTP (Grid & *grid*)

This function calculates the horizontal average density in a 3D region from the new grid density and stores the result in the new grid.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDCosThetaIJK, Grid::nDenAve, Grid::nDPhi, Grid::nEndGhostUpdateExplicit, -

Grid::nEndUpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by setMainFunctions().

6.11.2.15 void calNewE_R_AD (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new adiabatic energies using terms in the radial direction.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDM, Grid::nDonorCellFrac, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::n-Q0, Grid::nR, ProcTop::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdate-Explicit, Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.11.2.16 void calNewE_R_NA (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new non-adiabatic energies using terms in the radial direction and includes radiation diffusion terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions Setting energy at surface equal to energy in last zone.

Boundary Conditions Upwind gradient in dA1 term should be zero as there is no flow into the star.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Parameters::dSigma, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::n-EndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nKappa, Grid::nNum-GhostCells, Grid::nP, Grid::nQ0, Grid::nR, ProcTop::nRank, Grid::nStartGhostUpdate-Explicit, Grid::nStartUpdateExplicit, Grid::nT, Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.11.2.17 void calNewE_R_NA_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new non-adiabatic energies using terms in the radial direction and includes radiation diffusion terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to value at i.

Boundary Conditions grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGrid-Old[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1. Using the centered gradient instead.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0]

Boundary Conditions missing energy outside the model, assuming it is the same as that in the last zone. That causes this term to be zero.

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Parameters::dSigma, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nE, Grid::nEddyVisc, Grid::nEndGhostUpdate-Explicit, Grid::nEndUpdateExplicit, Grid::nKappa, Grid::nP, Grid::nQ0, Grid::nR, Proc-Top::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nT, Grid::nU, and Grid::nU0.

6.11.2.18 void calNewE_RT_AD (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new adiabatic energies using terms in the radial and theta directions.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions grid.dLocalGridOld[grid.nE][i+1][j][k] is missing

Boundary Conditions grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGridOld[grid.nE][i+1][j][k] missing using inner gradient for both

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, ProcTop::nRank, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.11.2.19 void calNewE_RT_NA (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new non-adiabatic energies using terms in the radial and theta directions and includes radiation diffusion terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to value at i.

Boundary Conditions grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGridOld[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1. Using the centered gradient instead.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Parameters::dSigma, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nE, Grid::nEndGhostUpdate-Explicit, Grid::nEndUpdateExplicit, Grid::nKappa, Grid::nP, Grid::nQ0, Grid::nQ1, -Grid::nR, ProcTop::nRank, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStart-GhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nT, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.11.2.20 void calNewE_RT_NA_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new non-adiabatic energies using terms in the radial and theta directions and includes radiation diffusion terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions Missing ΔM_r outside model using Parameters::dAlpha times ΔM_r in the last zone instead.

Boundary Conditions Setting energy at surface equal to energy in last zone.

Boundary Conditions missing density outside model, setting it to zero

Boundary Conditions missing eddy viscosity outside the model setting it to zero

Boundary Conditions Upwind gradient in dA1 term should be zero as there is no flow into the star.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

Boundary Conditions missing energy outside the model, assuming it is the same as that in the last zone. That causes this term to be zero.

References Parameters::dAlpha, Time::dDeltat_np1half, dET4(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dPrt, Parameters::dSigma, Grid-::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nD-Theta, Grid::nE, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdate-Explicit, Grid::nGlobalGridPositionLocalGrid, Grid::nKappa, Grid::nNumGhostCells, -Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, ProcTop::nRank, Grid::nSinThetaIJK, Grid::n-SinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid-::nT, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.11.2.21 void calNewE_RTP_AD (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates new adiabatic energies using terms in the radial, theta, and phi directions.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to zero.

Boundary Conditions grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGrid-Old[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1.Using the centered gradient.

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::n-DonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Proc-Top::nRank, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdate-Explicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.22 void calNewE_RTP_NA (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates new non-adiabatic energies using terms in the radial, theta, and phi directions and includes radiation diffusion terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to the value at i.

Boundary Conditions grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGrid-Old[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1. Using the centered gradient instead.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0]

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Parameters::dSigma, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nEnd-GhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nKappa, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, ProcTop::nRank, Grid::nSinThetaIJK, Grid::nSinTheta-IJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nT, Grid-::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.23 void calNewE_RTP_NA_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new non-adiabatic energies using terms in the radial, theta, and phi directions and includes radiation diffusion terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions Missing ΔM_r outside model using Parameters::dAlpha times ΔM_r in the last zone instead.

Boundary Conditions Missing W at i+1, assuming the same as at i

Boundary Conditions Setting energy at surface equal to energy in last zone.

Boundary Conditions missing density outside model, setting it to zero

Boundary Conditions missing eddy viscosity outside the model setting it to zero

Boundary Conditions Upwind gradient in dA1 term should be zero as there is no flow into the star.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

Boundary Conditions missing energy outside the model, assuming it is the same as that in the last zone. That causes this term to be zero.

References Parameters::dAlpha, Time::dDeltat_np1half, dET4(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dPrt, Parameters::dSigma, Grid::n-CenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEnd-UpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nKappa, Grid::nNumGhost-Cells, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, ProcTop::nRank, Grid::n-SinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStart-UpdateExplicit, Grid::nT, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.24 void calNewEddyVisc_None (Grid & *grid,* Parameters & *parameters*)

This function is a empty function used as a place holder when no eddy viscosity model is being used.

Parameters

`in,out`	*grid*	
`in`	*parameters*	

Referenced by setMainFunctions().

6.11.2.25 void calNewEddyVisc_R_CN (Grid & *grid,* Parameters & *parameters*)

This function calculates the eddy viscosity using a constant times the zoning with only the radial terms.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Parameters::dMax-ConvectiveVelocity, Grid::nCenIntOffset, Grid::nEddyVisc, Grid::nEndGhostUpdate-Explicit, Grid::nEndUpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

6.11.2.26 void calNewEddyVisc_R_SM (Grid & *grid,* Parameters & *parameters*)

This function calculates the eddy viscosity with only the radial terms.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::nCenIntOffset, -Grid::nD, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, and -Grid::nU0.

6.11.2.27 void calNewEddyVisc_RT_CN (Grid & *grid,* Parameters & *parameters*)

This function calculates the eddy viscosity using a constant times the zoning with only the radial and theta terms.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nDTheta, Grid::n-EddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid-::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by setMainFunctions().

6.11.2.28 void calNewEddyVisc_RT_SM (Grid & *grid,* Parameters & *parameters*)

This function calculates the eddy viscosity with only the radial and theta terms.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

Boundary Conditions assuming that theta velocity is constant across surface

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhost-UpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.11.2.29 void calNewEddyVisc_RTP_CN (Grid & *grid,* Parameters & *parameters*)

This function calculates the eddy viscosity using a constant times the zoning with only the radial, theta, and phi terms.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nDPhi, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid::nSinThetaIJK, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by setMainFunctions().

6.11.2.30 void calNewEddyVisc_RTP_SM (Grid & *grid*, Parameters & *parameters*)

This function calculates the eddy viscosity with only the radial, theta, and phi terms.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

Boundary Conditions assuming that theta velocity is constant across surface

Boundary Conditions assume phi velocity is constant across surface

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, -Grid::nCenIntOffset, Grid::nCotThetaIJK, Grid::nD, Grid::nDPhi, Grid::nDTheta, Grid-::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid-::nSinThetaIJK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.31 void calNewP_GL (Grid & *grid*, Parameters & *parameters*)

This function calculates the pressure. It is calculated using the new values of quantities and places the result in the new grid. It uses a gamma law gas give in dEOS_GL to calculate the pressure.

Parameters

`in,out`	*grid*	supplies the input for calculating the pressure and also accepts the result of the pressure calculations.
`in`	*parameters*	contains parameters used in calculating the pressure, namely the adiabatic gamma that is used.

References dEOS_GL(), Grid::dLocalGridNew, Grid::nD, Grid::nE, Grid::nEndGhost-UpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by setMainFunctions().

6.11.2.32 void calNewPEKappaGamma_TEOS (Grid & *grid*, Parameters & *parameters*)

This function calculates the Energy, pressure and opacity of a cell. It calculates it using the new vaules of quantities and places the result in the new grid.

Parameters

`in,out`	*grid*	supplies the input for calculating the pressure and also accepts the result of the pressure calculation
`in`	*parameters*	contains parameters used in calculating the pressure.

References Grid::dLocalGridNew, Parameters::eosTable, eos::getPEKappaGamma(), -Grid::nD, Grid::nE, Grid::nEndGhostUpdateImplicit, Grid::nEndUpdateImplicit, Grid::n-Gamma, Grid::nKappa, Grid::nP, Grid::nStartGhostUpdateImplicit, Grid::nStartUpdate-Implicit, and Grid::nT.

Referenced by implicitSolve_R(), implicitSolve_RT(), and implicitSolve_RTP().

6.11.2.33 void calNewQ0_R_GL (Grid & *grid*, Parameters & *parameters*)

This funciton calculates the artificial viscosity of a cell. It calculates it using the new values of quantities and places the result in the new grid. It does this for the radial component of the viscosity only. It uses the sound speed derived from the adiabatic gamma given for the gamma law gas equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation.
`in`	*parameters*	contains parameters used when calculating the artificial viscosity, namely the adiabatic gamma.

References Parameters::dA, Parameters::dAVThreshold, Parameters::dGamma, Grid-::dLocalGridNew, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid-::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, and Grid::nU.

Referenced by setMainFunctions().

6.11.2.34 void calNewQ0_R_TEOS (Grid & *grid*, Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old values of quantities and places the result in the old grid. It does this for the radial component of the viscosity only. It uses a sound speed derived from a tabulated equaiton of state for the calculation.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Grid::dLocalGridNew, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, -Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::n-StartUpdateExplicit, and Grid::nU.

Referenced by setMainFunctions().

6.11.2.35 void calNewQ0Q1_RT_GL (Grid & *grid*, Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the new values of quantities and places the result in the new grid. It does this for the radial and theta componenets of the viscosity. It uses the sound speed derived from the adiabatic gamma given for the gamma law gas equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculations.
`in`	*parameters*	contains parameters used when calculating the artificial viscosity, namely the adiabatic gamma.

References Parameters::dA, Parameters::dAVThreshold, Parameters::dGamma, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhost-UpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, -Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nV.

Referenced by setMainFunctions().

6.11.2.36 void calNewQ0Q1_RT_TEOS (Grid & *grid*, Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old values of quantities and places the result in the old grid. It does this for two component of the viscosity.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Grid::dLocalGridNew, Grid::d-LocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::n-EndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::n-SinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStart-UpdateExplicit, Grid::nU, and Grid::nV.

Referenced by setMainFunctions().

6.11.2.37 void calNewQ0Q1Q2_RTP_GL (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the new values of quantities and places the result in the new grid. It does this for the radial, theta, and phi componenets of the viscosity. It uses the sound speed derived from the adiabatic gamma given for the gamma law gas equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculations.
`in`	*parameters*	contains parameters used when calculating the artificial viscosity, namely the adiabatic gamma.

References Parameters::dA, Parameters::dAVThreshold, Parameters::dGamma, Grid-::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhost-UpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdate-Explicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.38 void calNewQ0Q1Q2_RTP_TEOS (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old values of quantities and places the result in the old grid. It does this for the three component of the viscosity.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Grid::dLocalGridNew, Grid::d-LocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::n-EndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid-::nStartUpdateExplicit, Grid::nU, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.39 void calNewR (Grid & *grid*, Time & *time*)

This function calculates the radii, from the new radial grid velocities

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*time*	contains time information, e.g. time step, current time etc.

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid-::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid::nStartGhost-UpdateExplicit, Grid::nStartUpdateExplicit, and Grid::nU0.

Referenced by setMainFunctions().

6.11.2.40 void calNewTPKappaGamma_TEOS (Grid & *grid*, Parameters & *parameters*)

This function calculates the Temperature, pressure and opacity of a cell. It calculates it using the new vaules of quantities and places the result in the new grid.

Parameters

`in,out`	*grid*	supplies the input for calculating the pressure and also accepts the result of the pressure calculation
`in`	*parameters*	contains parameters used in calculating the pressure.

References Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dTolerance, -Parameters::eosTable, eos::getEAndDTDE(), eos::getPKappaGamma(), Grid::nD, -Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nKappa, Parameters::nMaxIterations, Grid::nP, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, and Grid::nT.

Referenced by setMainFunctions().

6.11.2.41 void calNewU0_R (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*, MessPass & *messPass*)

This function calculates the radial grid velocity, it does so by considering only the radial terms

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial grid velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology
`in`	*messPass*	

Todo At some point I will likely want to make this funciton compatiable with a 3D domain decomposition instead of a purely radial domain decomposition.

References Grid::dLocalGridNew, ProcTop::nCoords, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, ProcTop::nNumRadialNeighbors, ProcTop::nRadialNeighborNeighborIDs, ProcTop::nRadialNeighborRanks, ProcTop::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, MessPass::typeRecvNewVar, and MessPass::typeSendNewVar.

Referenced by setMainFunctions().

6.11.2.42 void calNewU0_RT (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*, MessPass & *messPass*)

This function calculates the radial grid velocity, and does it by only considering the radial and theta terms

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial grid velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology
`in,out`	*messPass*	handles data needed for message passing

Todo At some point I will likely want to make this funciton compatiable with a 3D domain decomposition instead of a purely radial domain decomposition.

Boundary Conditions grid.dLocalGridOld[grid.nD][i+1][j][k] is missing

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, ProcTop::nCoords, Grid::nD, Grid::nDCosThetaIJK, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nLocalGridDims, Grid::nNumGhostCells, ProcTop::nNumRadialNeighbors, Grid::nR, ProcTop::nRadialNeighborNeighborIDs, ProcTop::nRadialNeighborRanks, ProcTop::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, MessPass::typeRecvNewVar, and MessPass::typeSendNewVar.

Referenced by setMainFunctions().

6.11.2.43 void calNewU0_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*, MessPass & *messPass*)

This function calculates the radial grid velocity, and does it by considering all radial, theta and phi terms

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial grid velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology
`in,out`	*messPass*	handles data needed for message passing

Todo At some point I will likely want to make this funciton compatiable with a 3D domain decomposition instead of a purely radial domain decomposition.

Boundary Conditions grid.dLocalGridOld[grid.nD][i+1][j][k] is missing

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, ProcTop::nCoords, Grid::nD, Grid::nDCosThetaIJK, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nLocalGridDims, -Grid::nNumGhostCells, ProcTop::nNumRadialNeighbors, Grid::nR, ProcTop::nRadialNeighborNeighborIDs, ProcTop::nRadialNeighborRanks, ProcTop::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, MessPass::typeRecvNewVar, and MessPass::typeSendNewVar.

Referenced by setMainFunctions().

6.11.2.44 void calNewU_R (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the radial velocity, and does it by only considering the radial terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha $*$grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

Boundary Conditions Missing density outside model, setting it to zero.

Boundary Conditions Missing pressure outside surface setting it equal to negative pressure in the center of the first cell so that it will be zero at surface.

References Parameters::dAlpha, Time::dDeltat_n, Parameters::dG, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDM, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nU0.

Referenced by calNewVelocities_R().

6.11.2.45 void calNewU_R_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the radial velocity, and does it by only considering the radial terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions Missing grid.dLocalGridOld[grid.nD][nICen+1][j][k] in calculation of $\rho_{i+1/2}$, setting it to 0.0

Boundary Conditions missing grid.dLocalGridOld[grid.nU][i+1][j][k] using velocity at i

Boundary Conditions Assuming eddy viscosity outside model is zero.

Boundary Conditions Missing grid.dLocalGridOld[grid.nP][nICen+1][j][k] in calculation of S_1, setting it to -1.0$*$grid.dLocalGridOld[grid.nP][nICen][j][k].

Boundary Conditions Missing grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of centered A_1 gradient, setting it to zero.

Boundary Conditions Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

References Parameters::dAlpha, Time::dDeltat_n, Parameters::dG, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDM, Grid::nDonorCellFrac, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nM, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nU0.

Referenced by calNewVelocities_R_LES().

6.11.2.46 void calNewU_RT (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the radial velocity, and does it by only considering the radial and theta terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions Missing grid.dLocalGridOld[grid.nD][nICen+1][j][k] in calculation of $\rho_{i+1/2,j,k}$, setting it to zero.

Boundary Conditions assuming theta velocity is constant across surface

Boundary Conditions Missing grid.dLocalGridOld[grid.nDenAve][nICen+1][0][0] in calculation of $\langle\rho\rangle_{i+1/2}$, setting it to zero.

Boundary Conditions Missing grid.dLocalGridOld[grid.nP][nICen+1][j][k] in calculation of S_1, setting it to -1.0∗dP_ijk_n.

Boundary Conditions Missing grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of centered A_1 gradient, setting it to zero.

Boundary Conditions Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

Boundary Conditions Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha ∗grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

References Parameters::dAlpha, Time::dDeltat_n, Parameters::dG, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nM, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by calNewVelocities_RT().

6.11.2.47 void calNewU_RT_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the radial velocity, and does it by only considering the radial and theta terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions	Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha $*$grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.
Boundary Conditions	Missing density outside of surface, setting it to zero.
Boundary Conditions	Missing density outside model, setting it to zero.
Boundary Conditions	assuming theta and phi velocity same outside star as inside.
Boundary Conditions	Assuming theta velocities are constant across surface.
Boundary Conditions	assuming that V at $i+1$ is equal to v at i.
Boundary Conditions	Missing pressure outside surface setting it equal to negative pressure in the center of the first cell so that it will be zero at surface.
Boundary Conditions	assume viscosity is zero outside the star.
Boundary Conditions	Missing mass outside model, setting it to zero.
Boundary Conditions	Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

References Parameters::dAlpha, Time::dDeltat_n, Parameters::dG, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJK, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by calNewVelocities_RT_LES().

6.11.2.48 void calNewU_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the radial velocity, and does it by including all radial, theta and phi terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions missing grid.dLocalGridOld[grid.nU][i+1][j][k] in calculation of $u_{i+1,j,k}$ setting $u_{i+1,j,k}$= $u_{i+1/2,j,k}$.

Boundary Conditions Missing grid.dLocalGridOld[grid.nD][i+1][j][k] in calculation of $\rho_{i+1/2,j,k}$, setting it to zero.

Boundary Conditions assuming theta velocity is constant across the surface.

Boundary Conditions assuming phi velocity is constant across the surface.

Boundary Conditions Missing grid.dLocalGridOld[grid.nDenAve][nICen+1][0][0] in calculation of $\langle\rho\rangle_{i+1/2}$ setting it to zero.

Boundary Conditions Missing grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of centered A_1 gradient, setting it equal to Parameters::dAlpha grid.dLocalGridOld[grid.nDM][nICen][0][0].

Boundary Conditions Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

Boundary Conditions Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha $*$grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

References Parameters::dAlpha, Time::dDeltat_n, Parameters::dG, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nM, Grid::nP, Grid::nQ0, Grid::nR, Grid::nSinThetaIJK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by calNewVelocities_RTP().

6.11.2.49 void calNewU_RTP_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the radial velocity, and does it by including all radial, theta and phi terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha $*$grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

Boundary Conditions Missing density outside of surface, setting it to zero.

Boundary Conditions Missing density outside model, setting it to zero.

Boundary Conditions assuming theta and phi velocity same outside star as inside.

Boundary Conditions Assuming theta velocities are constant across surface.

Boundary Conditions assuming that V at $i+1$ is equal to v at i.

Boundary Conditions Missing pressure outside surface setting it equal to negative pressure in the center of the first cell so that it will be zero at surface.

Boundary Conditions assume viscosity is zero outside the star.

Boundary Conditions Missing mass outside model, setting it to zero.

Boundary Conditions Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

References Parameters::dAlpha, Time::dDeltat_n, Parameters::dG, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJK, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, -Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by calNewVelocities_RTP_LES().

6.11.2.50 void calNewV_RT (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the theta velocity, and does it by only considering the radial and theta terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated theta velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions grid.dLocalGridOld[grid.nV][i+1][j+1][k] is missing

Boundary Conditions missing upwind gradient, using centred gradient instead

References Time::dDeltat_n, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by calNewVelocities_RT().

6.11.2.51 void calNewV_RT_LES (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates the theta velocity, and does it by only considering the radial and theta terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated theta velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions Assuming density outside star is zero

Boundary Conditions Assuming theta velocity is constant across surface.

Boundary Conditions Assuming eddy viscosity is zero at surface.

References Time::dDeltat_n, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJp1halfK, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nNumGhostCells, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by calNewVelocities_RT_LES().

6.11.2.52 void calNewV_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the theta velocity, and does it by considering the radial, theta, and phi terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated theta velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions Assuming theta and phi velocities are the same at the surface of the star as just inside the star.

Boundary Conditions ussing cetnered gradient for upwind gradient outside star at surface.

References Time::dDeltat_n, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJp1halfK, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by calNewVelocities_RTP().

6.11.2.53 void calNewV_RTP_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the theta velocity, and does it by considering the radial, theta, and phi terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated theta velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions Assuming density outside star is zero

Boundary Conditions Assuming theta velocity is constant across surface.

Boundary Conditions Assuming eddy viscosity is zero at surface.

References Time::dDeltat_n, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters-::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJp1halfK, Grid::nD, Grid::nDenAve, Grid::n-DM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nEddyVisc, Grid::nEnd-GhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, -Grid::nNumGhostCells, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::n-SinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStart-UpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by calNewVelocities_RTP_LES().

6.11.2.54 void calNewVelocities_R (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function simply calls a function that calculate the radial velocity. Calls the function calNewU_R to calculate radial velocity, including only radial terms.

Parameters

`in,out`	*grid*	contains the local grid data and supplies the needed data to calculate the new velocities as well as holding the new velocities.
`in`	*parameters*	contains parameters used in the calculation of the new velocities.
`in`	*time*	contains time step information, current time step, and current time
`in`	*procTop*	contains processor topology information

References calNewU_R().

Referenced by setMainFunctions().

6.11.2.55 void calNewVelocities_R_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function simply calls a function that calculate the radial velocity. Calls the function calNewU_R to calculate radial velocity, including only radial terms.

Parameters

`in,out`	*grid*	contains the local grid data and supplies the needed data to calculate the new velocities as well as holding the new velocities.
`in`	*parameters*	contains parameters used in the calculation of the new velocities.
`in`	*time*	contains time step information, current time step, and current time
`in`	*procTop*	contains processor topology information

References calNewU_R_LES().

6.11.2.56 void calNewVelocities_RT (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function simply calls two other functions that calculate the radial and theta velocities. Calls the two functions calNewU_RT and calNewV_RT to calculate radial and theta velocities, including both radial and theta terms.

Parameters

in,out	*grid*	contains the local grid data and supplies the needed data to calculate the new velocities as well as holding the new velocities.
in	*parameters*	contains parameters used in the calculation of the new velocities.
in	*time*	contains time step information, current time step, and current time
in	*procTop*	contains processor topology information

References calNewU_RT(), and calNewV_RT().

Referenced by setMainFunctions().

6.11.2.57 void calNewVelocities_RT_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function simply calls two other functions that calculate the radial and theta velocities. Calls the two functions calNewU_RT and calNewV_RT to calculate radial and theta velocities, including both radial and theta terms.

Parameters

in,out	*grid*	contains the local grid data and supplies the needed data to calculate the new velocities as well as holding the new velocities.
in	*parameters*	contains parameters used in the calculation of the new velocities.
in	*time*	contains time step information, current time step, and current time
in	*procTop*	contains processor topology information

References calNewU_RT_LES(), and calNewV_RT_LES().

Referenced by setMainFunctions().

6.11.2.58 void calNewVelocities_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function simply calls three other functions that calculate the radial, theta and phi velocities. Calls the two functions calNewU_RTP, calNewV_RTP and calNewW_RTP to calculate radial, theta, and phi velocities, including radial, theta, and phi terms.

Parameters

`in,out`	*grid*	contains the local grid data and supplies the needed data to calculate the new velocities as well as holding the new velocities.
`in`	*parameters*	contains parameters used in the calculation of the new velocities.
`in`	*time*	contains time step information, current time step, and current time
`in`	*procTop*	contains processor topology information

References calNewU_RTP(), calNewV_RTP(), and calNewW_RTP().

Referenced by setMainFunctions().

6.11.2.59 void calNewVelocities_RTP_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function simply calls three other functions that calculate the radial, theta and phi velocities. Calls the two functions calNewU_RTP, calNewV_RTP and calNewW_RTP to calculate radial, theta, and phi velocities, including radial, theta, and phi terms.

Parameters

`in,out`	*grid*	contains the local grid data and supplies the needed data to calculate the new velocities as well as holding the new velocities.
`in`	*parameters*	contains parameters used in the calculation of the new velocities.
`in`	*time*	contains time step information, current time step, and current time
`in`	*procTop*	contains processor topology information

References calNewU_RTP_LES(), calNewV_RTP_LES(), and calNewW_RTP_LES().

Referenced by setMainFunctions().

6.11.2.60 void calNewW_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the phi velocity, and does it by only considering the radial, theta, and phi terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated theta velocities
`in`	*parameters*	various parameters needed for the calculation

`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions missing grid.dLocalGridOld[grid.nW][i+1][j][k] assuming that the phi velocity at the outter most interface is the same as the phi velocity in the center of the zone.

Boundary Conditions missing grid.dLocalGridOld[grid.nW][i+1][j][k] in outter most zone. This is needed to calculate the upwind gradient for donor cell. The centered gradient is used instead when moving in the negative direction.

References Time::dDeltat_n, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters-::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJK, Grid::nD, Grid::nDenAve, Grid::nDM, -Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nEndGhostUpdateExplicit, -Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid-::nSinThetaIJK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by calNewVelocities_RTP().

6.11.2.61 void calNewW_RTP_LES (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates the phi velocity, and does it by only considering the radial, theta, and phi terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated theta velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions assume theta and phi velocities are constant across surface

Boundary Conditions assume eddy viscosity is zero at surface

Boundary Conditions assume upwind gradient is the same as centered gradient across surface

References Time::dDeltat_n, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters-::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJK, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhost-UpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::n-NumGhostCells, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinTheta-

IJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdate-Explicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by calNewVelocities_RTP_LES().

6.11.2.62 void calOldDenave_None (Grid & *grid*)

This function is a dumby funciton, and doesn't do anything. In the case of a 1D calculation the average density is undefined, and only the density is used. This is different from the case where the 1D region exsists on the rank 0 processor, but the grid as a whole is really 2D or 3D. In which case calOldDenave_R should be used instead.

6.11.2.63 void calOldDenave_R (Grid & *grid*)

This function does nothing as the averaged density is not needed in 1D calculations.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.

References Grid::dLocalGridOld, Grid::nD, Grid::nDenAve, Grid::nEndGhostUpdate-Explicit, Grid::nEndGhostUpdateImplicit, Grid::nEndUpdateExplicit, Grid::nEndUpdate-Implicit, Grid::nStartGhostUpdateExplicit, Grid::nStartGhostUpdateImplicit, Grid::n-StartUpdateExplicit, and Grid::nStartUpdateImplicit.

Referenced by initInternalVars().

6.11.2.64 void calOldDenave_RT (Grid & *grid*)

This function calculates the horizontal average density in a 2D region. This function differs from calNewDenave_RT in that it calculates the average density from the old grid density and stores the result in the old grid. While calNewDenave_RT calculates the average density from the new grid density and places the result in the new grid.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.

References Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDCosThetaIJK, Grid::nDenAve, Grid::nEndGhostUpdateExplicit, Grid::nEndGhostUpdateImplicit, Grid-::nEndUpdateExplicit, Grid::nEndUpdateImplicit, Grid::nR, Grid::nStartGhostUpdate-Explicit, Grid::nStartGhostUpdateImplicit, Grid::nStartUpdateExplicit, and Grid::nStart-UpdateImplicit.

Referenced by initInternalVars().

6.11.2.65 void calOldDenave_RTP (Grid & *grid*)

This function calculates the horizontal average density in a 3D region. This function differs from calNewDenave_RTP in that it calculates the average density from the old grid density and stores the result in the old grid. While calNewDenave_RTP calculates the average density from the new grid density and places the result in the new grid.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.

References Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDCosThetaIJK, Grid::nDenAve, Grid::nDPhi, Grid::nEndGhostUpdateExplicit, Grid::nEndGhostUpdate-Implicit, Grid::nEndUpdateExplicit, Grid::nEndUpdateImplicit, Grid::nR, Grid::nStart-GhostUpdateExplicit, Grid::nStartGhostUpdateImplicit, Grid::nStartUpdateExplicit, and Grid::nStartUpdateImplicit.

Referenced by initInternalVars().

6.11.2.66 void calOldEddyVisc_R_CN (Grid & *grid,* Parameters & *parameters*)

Calculates the eddy viscosity using a constant times the zoning including only the radial terms. It puts the result into the old grid. This funciton is used to initalize the eddy viscosity when the code begins execution.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nEddyVisc, Grid::n-EndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nNumGhostCells, Grid::nR, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by initInternalVars().

6.11.2.67 void calOldEddyVisc_R_SM (Grid & *grid,* Parameters & *parameters*)

Calculates the eddy viscosity including only the radial terms. It puts the result into the old grid. This funciton is used to initalize the eddy viscosity when the code begins execution. It uses the Smagorinsky model for calculating the eddy viscosity.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridOld, Grid::nCenIntOffset, -Grid::nD, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nNumGhostCells, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdate-Explicit, and Grid::nU.

Referenced by initInternalVars().

6.11.2.68 void calOldEddyVisc_RT_CN (Grid & *grid*, Parameters & *parameters*)

Calculates the eddy viscosity using a constant times the zoning including only the radial and theta terms. It puts the result into the old grid. This funciton is used to initalize the eddy viscosity when the code begins execution.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nDTheta, Grid::n-EddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nNum-GhostCells, Grid::nR, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by initInternalVars().

6.11.2.69 void calOldEddyVisc_RT_SM (Grid & *grid*, Parameters & *parameters*)

Calculates the eddy viscosity including only the radial and theta terms. It puts the result into the old grid. This funciton is used to initalize the eddy viscosity when the code begins execution.It uses the Smagorinsky model for calculating the eddy viscosity.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

Boundary Conditions assuming that theta velocity is constant across surface

References Parameters::dEddyViscosity, Grid::dLocalGridOld, Grid::nCenIntOffset, -Grid::nD, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEnd-UpdateExplicit, Grid::nNumGhostCells, Grid::nR, Grid::nStartGhostUpdateExplicit, -Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by initInternalVars().

6.11.2.70 void calOldEddyVisc_RTP_CN (Grid & *grid*, Parameters & *parameters*)

Calculates the eddy viscosity using a constant times the zoning including the radial, theta, and phi terms. It puts the result into the old grid. This funciton is used to initalize the eddy viscosity when the code begins execution.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nDPhi, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::n-NumGhostCells, Grid::nR, Grid::nSinThetaIJK, Grid::nStartGhostUpdateExplicit, and -Grid::nStartUpdateExplicit.

Referenced by initInternalVars().

6.11.2.71 void calOldEddyVisc_RTP_SM (Grid & *grid,* Parameters & *parameters*)

Calculates the eddy viscosity including the radial, theta, and phi terms. It puts the result into the old grid. This funciton is used to initalize the eddy viscosity when the code begins execution.It uses the Smagorinsky model for calculating the eddy viscosity.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

Boundary Conditions assuming that theta velocity is constant across surface

Boundary Conditions assume phi velocity is constant across surface

References Parameters::dEddyViscosity, Grid::dLocalGridOld, Grid::nCenIntOffset, -Grid::nCotThetaIJK, Grid::nD, Grid::nDPhi, Grid::nDTheta, Grid::nEddyVisc, Grid::n-EndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nNumGhostCells, Grid::nR, Grid::nSinThetaIJK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid-::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by initInternalVars().

6.11.2.72 void calOldP_GL (Grid & *grid,* Parameters & *parameters*)

This function calculates the pressure using a gamma law gas, calculate by dEOS_GL.

Parameters

`in,out`	*grid*	supplies the input for calculating the pressure and also accepts the results of the pressure calculations
`in`	*parameters*	contains parameters used in calculating the pressure, namely the value of the adiabatic gamma

References dEOS_GL(), Grid::dLocalGridOld, Grid::nD, Grid::nE, Grid::nEndGhost-UpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by initInternalVars().

6.11.2.73 void calOldPEKappaGamma_TEOS (Grid & *grid,* Parameters & *parameters*)

This function calculates the pressure, energy, opacity, and adiabatic index of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. This function is used to initialize the internal variables pressure, energy and kappa, and is suitable for both 1D and 3D calculations.

Parameters

`in,out`	*grid*	supplies the input for calculating the pressure and also accepts the result of the pressure calculation
`in`	*parameters*	contains parameters used in calculating the pressure.

References Grid::dLocalGridOld, Parameters::eosTable, eos::getPEKappaGamma(), - Grid::nD, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndGhostUpdateImplicit, - Grid::nEndUpdateExplicit, Grid::nEndUpdateImplicit, Grid::nGamma, Grid::nKappa, - Grid::nNumGhostCells, Grid::nP, Grid::nStartGhostUpdateExplicit, Grid::nStartGhost-UpdateImplicit, Grid::nStartUpdateExplicit, Grid::nStartUpdateImplicit, and Grid::nT.

Referenced by initInternalVars().

6.11.2.74 void calOldQ0_R_GL (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. It does this for the radial component of the viscosity only. This function is used when using a gamma law gas equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Parameters::dGamma, Grid-::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid-::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, and Grid::nU.

Referenced by initInternalVars().

6.11.2.75 void calOldQ0_R_TEOS (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. It does this for 1D viscosity only.

Parameters

`in,out`	*grid*	supplies the input for calculating the pressure and also accepts the result of the pressure calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, and Grid::nU.

Referenced by initInternalVars().

6.11.2.76 void calOldQ0Q1_RT_GL (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. It does this for the two components of the viscosity. This function is used when using a gamma law gas equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Parameters::dGamma, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nV.

Referenced by initInternalVars().

6.11.2.77 void calOldQ0Q1_RT_TEOS (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. It does this for two components of the viscosity. This function is used when using a tabulated equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Grid::dLocalGridOld, Grid-::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, -Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::n-SinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid-::nU, and Grid::nV.

Referenced by initInternalVars().

6.11.2.78 void calOldQ0Q1Q2_RTP_GL (Grid & *grid*, Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. It does this for the three components of the viscosity. This function is used when using a gamma law gas equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Parameters::dGamma, Grid-::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid-::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::n-SinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStart-UpdateExplicit, Grid::nU, Grid::nV, and Grid::nW.

Referenced by initInternalVars().

6.11.2.79 void calOldQ0Q1Q2_RTP_TEOS (Grid & *grid*, Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. It does this for the three components of the viscosity. This function is used when using a tabulated equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Grid::dLocalGridOld, Grid-::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinTheta-IJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdate-Explicit, Grid::nU, Grid::nV, and Grid::nW.

Referenced by initInternalVars().

6.11.2.80 double dEOS_GL (double *dRho*, double *dE*, Parameters *parameters*)

Calculates the pressure from the energy and density using a γ-law gas.

Parameters

`in`	*dRho*	the density of a cell
`in`	*dE*	the energy of a cell
`in`	*parameters*	contians various parameters, including γ needed to calculate the pressure.

Returns

the pressure

This version of dEOS_GL uses the same value of γ through out the model. The equation of state is given by $\rho(\gamma-1)E$.

References Parameters::dGamma.

Referenced by calNewP_GL(), and calOldP_GL().

6.11.2.81 double dET4 (Parameters & *parameters*, double *dEddyVisc_ijk_np1half*, double *dRho_ijk_np1half*, double *dLengthScale4_ijk_np1half*) `[inline]`

This is an additional turbulance term to be added to the energy equation.

Referenced by calNewE_RT_NA_LES(), calNewE_RTP_NA_LES(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RTP_LES(), and dImplicitEnergyFunction_RTP_LES_SB().

6.11.2.82 double dImplicitEnergyFunction_None (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This is an empty function, that isn't even called when no implicit solution is needed. This safe guards against future addition which may need to call an empty function when no implicit solve is being done.

Referenced by setMainFunctions().

6.11.2.83 double dImplicitEnergyFunction_R (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _R version of the funciton contains only the radial terms, and should be used for purely radial calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures.

Parameters

`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$,dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, d-Temps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$.
`in`	*i*	is the radial index to evaluate the function at.
`in`	*j*	is the theta index to evaluate the function at.
`in`	*k*	is the phi index to evaluate the function at.

References Parameters::bDEDMClamp, Parameters::dDEDMClampMr, Parameters::d-DEDMClampValue, Time::dDeltat_np1half, DEBUG_EQUATIONS, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, -Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nE, Grid::nGlobal-GridPositionLocalGrid, Grid::nM, Grid::nNumGhostCells, Grid::nQ0, Grid::nR, Grid::nT, Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.11.2.84 double dImplicitEnergyFunction_R_LES (Grid & *grid,* Parameters & *parameters,* Time & *time,* double *dTemps[ ],* int *i,* int *j,* int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _R version of the funciton contains only the radial terms, and should be used for purely radial calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures.

Parameters

`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$,dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, d-Temps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$.
`in`	*i*	is the radial index to evaluate the function at.
`in`	*j*	is the theta index to evaluate the function at.
`in`	*k*	is the phi index to evaluate the function at.

Todo this funciton should probably be turffed, the LES terms aren't needed in 1D. keeping it for now though.

References Time::dDeltat_np1half, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nE, Grid::nEddyVisc, Grid::nGlobalGridPositionLocalGrid, Grid::nNumGhostCells, Grid::nQ0, Grid::nR, Grid::nT, Grid::nU, and Grid::nU0.

6.11.2.85 double dImplicitEnergyFunction_R_LES_SB (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _R version of the funciton contains only the radial terms, and should be used for purely radial calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_R)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$ and time $n+1$, dTemps[1]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

Boundary Conditions Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to value at i.

Boundary Conditions grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGridOld[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1. Using the centered gradient instead.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0]

References Time::dDeltat_np1half, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDM, Grid::nDonorCellFrac, Grid::nE, Grid::nEddyVisc, Grid::nQ0, Grid::nR, Grid::nT, Grid::nU, and Grid::nU0.

6.11.2.86 double dImplicitEnergyFunction_R_SB (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _R version of the funciton contains only the radial terms, and should be used for purely radial calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_R)in that it is tailored to the surface boundary region.

Parameters

`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$ and time $n+1$, dTemps[1]=dT_im1jk-_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$.
`in`	*i*	is the radial index to evaluate the function at.
`in`	*j*	is the theta index to evaluate the function at.
`in`	*k*	is the phi index to evaluate the function at.

Boundary Conditions missing density outside model assuming it is zero

Boundary Conditions missing desnity outside model assuming it is zero

Boundary Conditions Assuming energy outside model is the same as the energy in the last zone inside the model.

Boundary Conditions A1 upwind set to zero as no material is flowing into the star

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Parameters::bDEDMClamp, Parameters::dDEDMClampMr, Parameters::d-DEDMClampValue, Time::dDeltat_np1half, DEBUG_EQUATIONS, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, -Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nE, Grid::nGlobal-GridPositionLocalGrid, Grid::nM, Grid::nNumGhostCells, Grid::nQ0, Grid::nR, Grid::nT, Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.11.2.87 double dImplicitEnergyFunction_RT (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RT version of the funciton contains only the radial and theta terms, and should be used for radial-theta calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

References Time::dDeltat_np1half, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nE, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.11.2.88 double dImplicitEnergyFunction_RT_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RT version of the funciton contains only the radial and theta terms, and should be used for radial-theta calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

References Parameters::bDEDMClamp, Parameters::dDEDMClampMr, Parameters::dDEDMClampValue, Time::dDeltat_np1half, DEBUG_EQUATIONS, dET4(), eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dPrt, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nNumGhostCells, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.11.2.89 double dImplicitEnergyFunction_RT_LES_SB (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RT version of the funciton contains only the radial and theta terms, and should be used for radial-theta calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_RT)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$.

`in`	*i*	is the radial index to evaluate the function at.
`in`	*j*	is the theta index to evaluate the function at.
`in`	*k*	is the phi index to evaluate the function at.

Boundary Conditions Missing ΔM_r outside model using Parameters::dAlpha times ΔM_r in the last zone instead.

Boundary Conditions missing density outside model assuming it is zero

Boundary Conditions missing desnity outside model assuming it is zero

Boundary Conditions assuming V at ip1half is the same as V at i

Boundary Conditions Assuming energy outside model is the same as the energy in the last zone inside the model.

Boundary Conditions Assuming energy outside model is the same as the energy in the last zone inside the model.

Boundary Conditions A1 upwind set to zero as no material is flowing into the star

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Parameters::bDEDMClamp, Parameters::dAlpha, Parameters::dDEDM-ClampMr, Parameters::dDEDMClampValue, Time::dDeltat_np1half, DEBUG_EQUAT-IONS, dET4(), eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::d-LocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dPrt, Parameters-::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid-::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nGlobal-GridPositionLocalGrid, Grid::nM, Grid::nNumGhostCells, Grid::nQ0, Grid::nQ1, Grid-::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.11.2.90 double dImplicitEnergyFunction_RT_SB (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RT version of the funciton contains only the radial and theta terms, and should be used for radial-theta calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_RT)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

Boundary Conditions Using centered gradient for upwind gradient when motion is into the star at the surface

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Time::dDeltat_np1half, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nE, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.11.2.91 double dImplicitEnergyFunction_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RTP version of the funciton contains terms for all three directions, and should be used for calculations involving all three directions. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_RT)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps,dTemps[0]=dT_ijk_np1*	is the temperature at radial position (i, j, k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1, j, k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1, j, k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i, j+1, k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i, j-1, k)$ and time $n+1$, dTemps[5]=dT_ijkp1_np1 is the temperature at radial position $(i, j, k+1)$ and time $n+1$, dTemps[6]=dT_ijkm1_np1 is the temperature at radial position $(i, j, k-1)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

References Time::dDeltat_np1half, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.92 double dImplicitEnergyFunction_RTP_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RTP version of the funciton contains terms for all three directions, and should be used for calculations involving all three directions. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_RT)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps,dTemps[0]=dT_ijk_np1*	is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$, dTemps[5]=dT_ijkp1_np1 is the temperature at radial position $(i,j,k+1)$ and time $n+1$, dTemps[6]=dT_ijkm1_np1 is the temperature at radial position $(i,j,k-1)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

References Parameters::bDEDMClamp, Parameters::dDEDMClampMr, Parameters::dDEDMClampValue, Time::dDeltat_np1half, DEBUG_EQUATIONS, dET4(), eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dPrt, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nNumGhostCells, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.93 double dImplicitEnergyFunction_RTP_LES_SB (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RTP version of the funciton contains terms for all three directions, and should be used for calculations involving all three directions. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_RT)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$, dTemps[5]=dT_ijkp1_np1 is the temperature at radial position $(i,j,k+1)$ and time $n+1$, dTemps[6]=dT_ijkm1_np1 is the temperature at radial position $(i,j,k-1)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

Boundary Conditions Missing ΔM_r outside model using Parameters::dAlpha times ΔM_r in the last zone instead.

Boundary Conditions missing density outside model assuming it is zero

Boundary Conditions missing desnity outside model assuming it is zero

Boundary Conditions assuming V at ip1half is the same as V at i

Boundary Conditions assuming W at ip1half is the same as W at i

Boundary Conditions Assuming energy outside model is the same as the energy in the last zone inside the model.

Boundary Conditions Assuming energy outside model is the same as the energy in the last zone inside the model.

Boundary Conditions A1 upwind set to zero as no material is flowing into the star

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Parameters::bDEDMClamp, Parameters::dAlpha, Parameters::dDEDMClampMr, Parameters::dDEDMClampValue, Time::dDeltat_np1half, DEBUG_EQUATIONS, dET4(), eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dPrt, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nNumGhostCells, Grid::nQ0, Grid-::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.94 double dImplicitEnergyFunction_RTP_SB (Grid & *grid,* Parameters & *parameters,* Time & *time,* double *dTemps[ ],* int *i,* int *j,* int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RTP version of the funciton contains terms for all three directions, and should be used for calculations involving all three directions. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_RT)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$, dTemps[5]=dT_ijkp1_np1 is the temperature at radial position $(i,j,k+1)$ and time $n+1$, dTemps[6]=dT_ijkm1_np1 is the temperature at radial position $(i,j,k-1)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

Boundary Conditions Using $E_{i,j,k}^{n+1/2}$ for $E_{i+1/2,j,k}^{n+1/2}$

Boundary Conditions Using centered gradient for upwind gradient when motion is into the star at the surface

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Time::dDeltat_np1half, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGet-Pressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters-::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::n-DM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.11.2.95 void **implicitSolve_None** (**Grid** & *grid*, **Implicit** & *implicit*, **Parameters** & *parameters*, **Time** & *time*, **ProcTop** & *procTop*, **MessPass** & *messPass*, **Functions** & *functions*)

This is an empty function, to be called when no implicit solution is needed. This allows the same code in the main program to be executed wheather or not an implicit solution is being preformed by setting the funciton pointer to this funciton if there is no implicit solution required.

Referenced by setMainFunctions().

6.11.2.96 void **implicitSolve_R** (**Grid** & *grid*, **Implicit** & *implicit*, **Parameters** & *parameters*, **Time** & *time*, **ProcTop** & *procTop*, **MessPass** & *messPass*, **Functions** & *functions*)

This function solves for temperature corrections based on derivatives of the radial non-adiabatic energy equation with respect to the new temperature. It then uses these derivatives as entries in the coeffecient matrix. The discrepancy in the balance of the energy equation with the new temperature, energy, pressure, and opacity are included as the right hand side of the system of equaitons. Solving this system of equaitons provides the corrections needed for the new temperature. This processes is then repeated until the corrections are small. At this point the new temperature is used to update the energy, pressure, and opacity in the new grid via the equaiton of state.

References calNewPEKappaGamma_TEOS(), Implicit::dAverageRHS, Implicit::d-CurrentRelTError, Implicit::dDerivativeStepFraction, Grid::dLocalGridNew, Implicit-::dMaxErrorInRHS, Implicit::dTolerance, Implicit::kspContext, Implicit::matCoeff, -Implicit::nCurrentNumIterations, Implicit::nLocDer, Implicit::nLocFun, Implicit::nMax-NumIterations, Implicit::nMaxNumSolverIterations, Implicit::nNumDerPerRow, Implicit-::nNumRowsALocal, Implicit::nNumRowsALocalSB, ProcTop::nRank, Grid::nT, Time-::nTimeStepIndex, Implicit::nTypeDer, updateLocalBoundariesNewGrid(), Implicit-::vecRHS, Implicit::vecscatTCorrections, Implicit::vecTCorrections, and Implicit::vec-TCorrectionsLocal.

Referenced by setMainFunctions().

6.11.2.97 void **implicitSolve_RT** (**Grid** & *grid*, **Implicit** & *implicit*, **Parameters** & *parameters*, **Time** & *time*, **ProcTop** & *procTop*, **MessPass** & *messPass*, **Functions** & *functions*)

This function solves for temperature corrections based on derivatives of the radial-theta non-adiabatic energy equation with respect to the new temperature. It then uses these derivatives as entries in the coeffecient matrix. The discrepancy in the balance of the energy equation with the new temperature, energy, pressure, and opacity are included as the right hand side of the system of equaitons. Solving this system of equaitons provides the corrections needed for the new temperature. This processes is then repeated until the corrections are small. At this point the new temperature is used to update the energy, pressure, and opacity in the new grid via the equaiton of state.

References calNewPEKappaGamma_TEOS(), Implicit::dAverageRHS, Implicit::dCurrentRelTError, Implicit::dDerivativeStepFraction, Grid::dLocalGridNew, Implicit::dMaxErrorInRHS, Implicit::dTolerance, Implicit::kspContext, Implicit::matCoeff, Implicit::nCurrentNumIterations, Implicit::nLocDer, Implicit::nLocFun, Implicit::nMaxNumIterations, Implicit::nMaxNumSolverIterations, Implicit::nNumDerPerRow, Implicit::nNumRowsALocal, Implicit::nNumRowsALocalSB, ProcTop::nRank, Grid::nT, Time::nTimeStepIndex, Implicit::nTypeDer, updateLocalBoundariesNewGrid(), Implicit::vecRHS, Implicit::vecscatTCorrections, Implicit::vecTCorrections, and Implicit::vecTCorrectionsLocal.

Referenced by setMainFunctions().

6.11.2.98 void implicitSolve_RTP (Grid & *grid*, Implicit & *implicit*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*, MessPass & *messPass*, Functions & *functions*)

This function solves for temperature corrections based on derivatives of the radial-theta-phi non-adiabatic energy equation with respect to the new temperature. It then uses these derivatives as entries in the coeffecient matrix. The discrepancy in the balance of the energy equation with the new temperature, energy, pressure, and opacity are included as the right hand side of the system of equaitons. Solving this system of equaitons provides the corrections needed for the new temperature. This processes is then repeated until the corrections are small. At this point the new temperature is used to update the energy, pressure, and opacity in the new grid via the equaiton of state.

References calNewPEKappaGamma_TEOS(), Implicit::dAverageRHS, Implicit::dCurrentRelTError, Implicit::dDerivativeStepFraction, Grid::dLocalGridNew, Implicit::dMaxErrorInRHS, Implicit::dTolerance, Implicit::kspContext, Implicit::matCoeff, Implicit::nCurrentNumIterations, Implicit::nLocDer, Implicit::nLocFun, Implicit::nMaxNumIterations, Implicit::nMaxNumSolverIterations, Implicit::nNumDerPerRow, Implicit::nNumRowsALocal, Implicit::nNumRowsALocalSB, ProcTop::nRank, Grid::nT, Time::nTimeStepIndex, Implicit::nTypeDer, updateLocalBoundariesNewGrid(), Implicit::vecRHS, Implicit::vecscatTCorrections, Implicit::vecTCorrections, and Implicit::vecTCorrectionsLocal.

Referenced by setMainFunctions().

6.11.2.99 void initDonorFracAndMaxConVel_R_GL (Grid & *grid*, Parameters & *parameters*)

Initializes the donor fraction, and the maximum convective velocity when starting a calculation. The donor fraction is used to determine the amount of upwinded donor cell to use in advection terms. The maximum convective velocity is used for calculation of constant eddy viscosity parameter. This version of the fuction is for 1D, gamma law calculations.

References Parameters::dDonorCellMin, Parameters::dDonorCellMultiplier, Parameters::dGamma, Grid::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nU0.

Referenced by initInternalVars().

6.11.2.100 void initDonorFracAndMaxConVel_R_TEOS (Grid & *grid*, Parameters & *parameters*)

Initializes the donor fraction, and the maximum convective velocity when starting a calculation. The donor fraction is used to determine the amount of upwinded donor cell to use in advection terms. The maximum convective velocity is used for calculation of constant eddy viscosity parameter. This version of the fuction is for 1D, tabulated equation of state calculations.

References Parameters::dDonorCellMin, Parameters::dDonorCellMultiplier, Grid::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nU0.

Referenced by initInternalVars().

6.11.2.101 void initDonorFracAndMaxConVel_RT_GL (Grid & *grid*, Parameters & *parameters*)

Initializes the donor fraction, and the maximum convective velocity when starting a calculation. The donor fraction is used to determine the amount of upwinded donor cell to use in advection terms. The maximum convective velocity is used for calculation of constant eddy viscosity parameter. This version of the fuction is for 2D, gamma law calculations.

References Parameters::dDonorCellMin, Parameters::dDonorCellMultiplier, Parameters::dGamma, Grid::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by initInternalVars().

6.11.2.102 void initDonorFracAndMaxConVel_RT_TEOS (Grid & *grid*, Parameters & *parameters*)

Initializes the donor fraction, and the maximum convective velocity when starting a calculation. The donor fraction is used to determine the amount of upwinded donor cell to use in advection terms. The maximum convective velocity is used for calculation of constant eddy viscosity parameter. This version of the fuction is for 2D, tabulated equation of state calculations.

References Parameters::dDonorCellMin, Parameters::dDonorCellMultiplier, Grid::d-LocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, -Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by initInternalVars().

6.11.2.103 void **initDonorFracAndMaxConVel_RTP_GL** (**Grid** & *grid*, **Parameters** & *parameters*)

Initializes the donor fraction, and the maximum convective velocity when starting a calculation. The donor fraction is used to determine the amount of upwinded donor cell to use in advection terms. The maximum convective velocity is used for calculation of constant eddy viscosity parameter. This version of the fuction is for 3D, gamma law calculations.

References Parameters::dDonorCellMin, Parameters::dDonorCellMultiplier, Parameters-::dGamma, Grid::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenInt-Offset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEnd-UpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by initInternalVars().

6.11.2.104 void **initDonorFracAndMaxConVel_RTP_TEOS** (**Grid** & *grid*, **Parameters** & *parameters*)

Initializes the donor fraction, and the maximum convective velocity when starting a calculation. The donor fraction is used to determine the amount of upwinded donor cell to use in advection terms. The maximum convective velocity is used for calculation of constant eddy viscosity parameter. This version of the fuction is for 3D, tabulated equation of state calculations.

References Parameters::dDonorCellMin, Parameters::dDonorCellMultiplier, Grid::d-LocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, -Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by initInternalVars().

6.11.2.105 void **initInternalVars** (**Grid** & *grid*, **ProcTop** & *procTop*, **Parameters** & *parameters*)

This function function is used to set the initial values of the internal variables. While external variables are initialized from the starting model, internal variables are calculated at startup.

Parameters

`in,out`	*grid*	supplies information needed for initilizing internal variables as well as storing the initilized internal variables
`in`	*procTop*	contians information about processor topology
`in`	*parameters*	contains parameters used in initializing the internal variables.

Warning

$\Delta\theta$, $\Delta\phi$, $\sin\theta_{i,j,k}$, $\Delta\cos\theta_{i,j,k}$, all don't have the first zone calculated. At the moment this is a ghost cell that doesn't matter, but it may become a problem if calculations require this quantity. This is an issue for quantities that aren't updated in time, as those that are will have boundary cells updated with periodic boundary conditions.

References Parameters::bEOSGammaLaw, calOldDenave_R(), calOldDenave_RT(), calOldDenave_RTP(), calOldEddyVisc_R_CN(), calOldEddyVisc_R_SM(), calOldEddyVisc_RT_CN(), calOldEddyVisc_RT_SM(), calOldEddyVisc_RTP_CN(), calOldEddyVisc_RTP_SM(), calOldP_GL(), calOldPEKappaGamma_TEOS(), calOldQ0_R_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), Grid::dLocalGridOld, initDonorFracAndMaxConVel_R_GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_GL(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_TEOS(), Grid::nCenIntOffset, Grid::nCotThetaIJK, Grid::nCotThetaIJp1halfK, Grid::nDCosThetaIJK, Grid::nDPhi, Grid::nDTheta, Grid::nLocalGridDims, Grid::nNumDims, Grid::nNumGhostCells, Grid::nPhi, ProcTop::nRank, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nTheta, and Parameters::nTypeTurbulanceMod.

Referenced by init().

6.11.2.106 void setInternalVarInf (Grid & *grid,* Parameters & *parameters*)

This function sets the information for internal variables. While external verabile information is derived from the starting model, internal variables infos are set in this function. In other words this function sets the values of Grid::nVariables.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.
`in`	*parameters*	is used when setting variable infos, since one needs to know if the code is calculating using a gamma law gas, or a tabulated equation of state.

References Parameters::bEOSGammaLaw, Grid::nCotThetaIJK, Grid::nCotThetaIJp1halfK, Grid::nDCosThetaIJK, Grid::nDenAve, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nGamma, Grid::nKappa, Grid::nNumDims, Grid::nNumIntVars, Grid::nNumVars, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Parameters::nTypeTurbulanceMod, and Grid::nVariables.

Referenced by modelRead().

6.11.2.107 void setMainFunctions (Functions & *functions*, ProcTop & *procTop*, Parameters & *parameters*, Grid & *grid*, Time & *time*, Implicit & *implicit*)

Used to set the functions that main() uses to evolve the input model.

Parameters

out	*functions*	is of class Functions and is used to specify the functions called to calculate the evolution of the input model.
in	*procTop*	is of type ProcTop. ProcTop::nRank is used to set different functions based on processor rank. For instance processor rank 1 requires 1D versions of the equations.
in	*parameters*	is of class Parameters. It holds various constants and run-time parameters.
in	*grid*	of type Grid. This function requires the number of dimensions, specified by Grid::nNumDims.
in	*time*	of type Time. This function requires knowledge of the type of time setp being used, specified by Time::bVariableTimeStep.
in	*implicit*	of type Implicit. This function needs to know if there is an implicit region, specified when Implicit::nNumImplicitZones$>$0.

The functions are picked based on model geometry, and the physics requested or required by the input model, and the configuration file. The specific functions pointers that are set are described in the Functions class.

References Parameters::bAdiabatic, Parameters::bEOSGammaLaw, Time::bVariableTimeStep, calDelt_CONST(), calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewDenave_None(), calNewDenave_R(), calNewDenave_RT(), calNewDenave_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewEddyVisc_None(), calNewEddyVisc_RT_CN(), calNewEddyVisc_RT_SM(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_RTP_SM(), calNewP_GL(), calNewQ0_R_GL(), calNewQ0_R_TEOS(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewR(), calNewTPKappaGamma_TEOS(), calNewU0_R(), calNewU0_RT(), calNewU0_RTP(), calNewVelocities_R(), calNewVelocities_RT(), calNewVelocities_RT_LES(), calNewVelocities_RTP(), calNewVelocities_RTP_LES(), dImplicitEnergyFunction_None(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Functions::fpCalculateAveDensities, Functions::fpCalculateDeltat, Functions::fp-

CalculateNewAV, Functions::fpCalculateNewDensities, Functions::fpCalculateNew-EddyVisc, Functions::fpCalculateNewEnergies, Functions::fpCalculateNewEOSVars, Functions::fpCalculateNewGridVelocities, Functions::fpCalculateNewRadii, Functions-::fpCalculateNewVelocities, Functions::fpImplicitSolve, Functions::fpModelWrite, -Functions::fpUpdateLocalBoundaryVelocitiesNewGrid, Functions::fpWriteWatchZones, implicitSolve_None(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), modelWrite_GL(), modelWrite_TEOS(), Grid::nNumDims, Implicit::nNumImplicitZones, ProcTop::nRank, Parameters::nTypeTurbulanceMod, updateLocalBoundaryVelocities-NewGrid_R(), updateLocalBoundaryVelocitiesNewGrid_RT(), updateLocalBoundary-VelocitiesNewGrid_RTP(), writeWatchZones_R_GL(), writeWatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_-GL(), and writeWatchZones_RTP_TEOS().

Referenced by main().

6.12 physEquations.h File Reference

```
#include "global.h"
```

Functions

- void setMainFunctions (Functions &functions, ProcTop &procTop, Parameters &parameters, Grid &grid, Time &time, Implicit &implicit)
- void setInternalVarInf (Grid &grid, Parameters &parameters)
- void initInternalVars (Grid &grid, ProcTop &procTop, Parameters &parameters)
- void calNewVelocities_R (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewVelocities_R_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewVelocities_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewVelocities_RT_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewVelocities_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewVelocities_RTP_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU_R (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU_R_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU_RT_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

- void calNewU_RTP_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewV_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewV_RT_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewV_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewV_RTP_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewW_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewW_RTP_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewU0_R (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass)
- void calNewU0_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass)
- void calNewU0_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass)
- void calNewR (Grid &grid, Time &time)
- void calNewD_R (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewD_RT (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewD_RTP (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_R_AD (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_R_NA (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_R_NA_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_RT_AD (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_RT_NA (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_RT_NA_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_RTP_AD (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_RTP_NA (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewE_RTP_NA_LES (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calNewDenave_None (Grid &grid)
- void calNewDenave_R (Grid &grid)
- void calNewDenave_RT (Grid &grid)

- void calNewDenave_RTP (Grid &grid)
- void calNewP_GL (Grid &grid, Parameters &parameters)
- void calNewTPKappaGamma_TEOS (Grid &grid, Parameters &parameters)
- void calNewPEKappaGamma_TEOS (Grid &grid, Parameters &parameters)
- void calNewQ0_R_GL (Grid &grid, Parameters &parameters)
- void calNewQ0_R_TEOS (Grid &grid, Parameters &parameters)
- void calNewQ0Q1_RT_GL (Grid &grid, Parameters &parameters)
- void calNewQ0Q1_RT_TEOS (Grid &grid, Parameters &parameters)
- void calNewQ0Q1Q2_RTP_GL (Grid &grid, Parameters &parameters)
- void calNewQ0Q1Q2_RTP_TEOS (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_None (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_R_CN (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_RT_CN (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_RTP_CN (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_R_SM (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_RT_SM (Grid &grid, Parameters &parameters)
- void calNewEddyVisc_RTP_SM (Grid &grid, Parameters &parameters)
- void calOldDenave_None (Grid &grid)
- void calOldDenave_R (Grid &grid)
- void calOldDenave_RT (Grid &grid)
- void calOldDenave_RTP (Grid &grid)
- void calOldP_GL (Grid &grid, Parameters &parameters)
- void calOldPEKappaGamma_TEOS (Grid &grid, Parameters &parameters)
- void calOldQ0_R_GL (Grid &grid, Parameters &parameters)
- void calOldQ0_R_TEOS (Grid &grid, Parameters &parameters)
- void calOldQ0Q1_RT_GL (Grid &grid, Parameters &parameters)
- void calOldQ0Q1_RT_TEOS (Grid &grid, Parameters &parameters)
- void calOldQ0Q1Q2_RTP_GL (Grid &grid, Parameters &parameters)
- void calOldQ0Q1Q2_RTP_TEOS (Grid &grid, Parameters &parameters)
- void calOldEddyVisc_R_CN (Grid &grid, Parameters &parameters)
- void calOldEddyVisc_RT_CN (Grid &grid, Parameters &parameters)
- void calOldEddyVisc_RTP_CN (Grid &grid, Parameters &parameters)
- void calOldEddyVisc_R_SM (Grid &grid, Parameters &parameters)
- void calOldEddyVisc_RT_SM (Grid &grid, Parameters &parameters)
- void calOldEddyVisc_RTP_SM (Grid &grid, Parameters &parameters)
- void calDelt_R_GL (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calDelt_R_TEOS (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calDelt_RT_GL (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calDelt_RT_TEOS (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calDelt_RTP_GL (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void calDelt_RTP_TEOS (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)

- void calDelt_CONST (Grid &grid, Parameters &parameters, Time &time, ProcTop &procTop)
- void implicitSolve_None (Grid &grid, Implicit &implicit, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass, Functions &functions)
- void implicitSolve_R (Grid &grid, Implicit &implicit, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass, Functions &functions)
- void implicitSolve_RT (Grid &grid, Implicit &implicit, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass, Functions &functions)
- void implicitSolve_RTP (Grid &grid, Implicit &implicit, Parameters &parameters, Time &time, ProcTop &procTop, MessPass &messPass, Functions &functions)
- double dImplicitEnergyFunction_None (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_R (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_R_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RT (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RT_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RTP (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RTP_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_R_LES (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_R_LES_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RT_LES (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RT_LES_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RTP_LES (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dImplicitEnergyFunction_RTP_LES_SB (Grid &grid, Parameters &parameters, Time &time, double dTemps[], int i, int j, int k)
- double dEOS_GL (double dRho, double dE, Parameters parameters)
- void initDonorFracAndMaxConVel_R_GL (Grid &grid, Parameters &parameters)
- void initDonorFracAndMaxConVel_R_TEOS (Grid &grid, Parameters &parameters)
- void initDonorFracAndMaxConVel_RT_GL (Grid &grid, Parameters &parameters)
- void initDonorFracAndMaxConVel_RT_TEOS (Grid &grid, Parameters &parameters)
- void initDonorFracAndMaxConVel_RTP_GL (Grid &grid, Parameters &parameters)
- void initDonorFracAndMaxConVel_RTP_TEOS (Grid &grid, Parameters &parameters)
- double dET4 (Parameters &parameters, double dEddyVisc_ijk_np1half, double dRho_ijk_np1half, double dLengthScale4_ijk_np1half)

6.12.1 Detailed Description

Header file for physEquations.cpp

6.12.2 Function Documentation

6.12.2.1 void calDelt_CONST (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function is used when a constant tie step is desired.

References Time::dConstTimeStep, Time::dDeltat_n, Time::dDeltat_nm1half, Time::d-Deltat_np1half, Time::dt, ProcTop::nRank, and Time::nTimeStepIndex.

Referenced by setMainFunctions().

6.12.2.2 void calDelt_R_GL (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates the time step by considering the sound crossing time in the radial direction only and is compatiable with a gamma law gass EOS.

Parameters

`in`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in,out`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology. This function uses ProcTop::nRank to pass messages.

References Time::dDelE_t_E_max, Time::dDelRho_t_Rho_max, Time::dDeltat_-n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Parameters::dDonorCellMin, -Parameters::dDonorCellMultiplier, Parameters::dGamma, Grid::dLocalGridNew, Grid-::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Time::dPerChange, Time::dt, Time::dTimeStepFactor, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::n-R, ProcTop::nRank, Grid::nStartUpdateExplicit, Time::nTimeStepIndex, Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.12.2.3 void calDelt_R_TEOS (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates the time step by considering the sound crossing time in the radial direction only and is compatiable with a tabulated EOS.

Parameters

`in`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in,out`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology. This function uses ProcTop::nRank to pass messages.

References Time::dDelRho_t_Rho_max, Time::dDelT_t_T_max, Time::dDeltat_-n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Parameters::dDonorCellMin, -Parameters::dDonorCellMultiplier, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dMaxConvectiveVelocity, Time::dPerChange, Time::dt, Time::dTimeStep-Factor, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdate-Explicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nR, Proc-Top::nRank, Grid::nStartUpdateExplicit, Grid::nT, Time::nTimeStepIndex, Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.12.2.4 void calDelt_RT_GL (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the time step by considering the sound crossing time in the radial and theta directions only and is compatiable with a gamma law gass EOS.

Parameters

`in`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in,out`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology. This function uses ProcTop::nRank to pass messages.

References Time::dDelE_t_E_max, Time::dDelRho_t_Rho_max, Time::dDeltat_-n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Parameters::dDonorCellMin, -Parameters::dDonorCellMultiplier, Parameters::dGamma, Grid::dLocalGridNew, Grid-::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Time::dPerChange, Time::dt, Time::dTimeStepFactor, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::n-DTheta, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, ProcTop::nRank, Grid::nStartUpdateExplicit, Time::n-TimeStepIndex, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.5 void calDelt_RT_TEOS (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the time step by considering the sound crossing time in the radial and theta directions and is compatiable with a tabulated EOS.

Parameters

`in`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in,out`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology. This function uses ProcTop::nRank to pass messages.

References Time::dDelRho_t_Rho_max, Time::dDelT_t_T_max, Time::dDeltat_-n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Parameters::dDonorCellMin, -Parameters::dDonorCellMultiplier, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dMaxConvectiveVelocity, Time::dPerChange, Time::dt, Time::dTime-StepFactor, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nDTheta, -Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, ProcTop::nRank, Grid::nStartUpdateExplicit, Grid::nT, Time::nTimeStepIndex, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.6 void calDelt_RTP_GL (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the time step by considering the sound crossing time in the radial, theta and phi directions only and is compatiable with a gamma law gass EOS.

Parameters

`in`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in,out`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology. This function uses ProcTop::nRank to pass messages.

References Time::dDelE_t_E_max, Time::dDelRho_t_Rho_max, Time::dDeltat_-n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Parameters::dDonorCellMin, -Parameters::dDonorCellMultiplier, Parameters::dGamma, Grid::dLocalGridNew, Grid-::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Time::dPerChange, Time::dt, Time::dTimeStepFactor, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::n-DPhi, Grid::nDTheta, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdate-Explicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, ProcTop::nRank, Grid::n-SinThetaIJK, Grid::nStartUpdateExplicit, Time::nTimeStepIndex, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.7 void calDelt_RTP_TEOS (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the time step by considering the sound crossing time in the radial, theta and phi directions and is compatiable with a tabulated EOS.

Parameters

`in`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in,out`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology. This function uses ProcTop::nRank to pass messages.

References Time::dDelRho_t_Rho_max, Time::dDelT_t_T_max, Time::dDeltat_-n, Time::dDeltat_nm1half, Time::dDeltat_np1half, Parameters::dDonorCellMin, -Parameters::dDonorCellMultiplier, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dMaxConvectiveVelocity, Time::dPerChange, Time::dt, Time::dTime-StepFactor, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nDPhi, Grid-::nDTheta, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, ProcTop::nRank, Grid::nSinTheta-IJK, Grid::nStartUpdateExplicit, Grid::nT, Time::nTimeStepIndex, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.8 void calNewD_R (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new densities using terms in the radial direction only

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology, uses ProcTop::nRank when reporting negative densities

Boundary Conditions doesn't allow mass flux through outter interface

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::n-CenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::n-EndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nNumGhostCells, Grid-::nR, ProcTop::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, -

Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.12.2.9 void calNewD_RT (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new densities using terms in the radial and theta directions

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology, uses ProcTop::nRank when reporting negative densities

Boundary Conditions doesn't allow mass flux through outter interface

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDCosThetaIJK, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nNumGhostCells, Grid::nR, ProcTop::nRank, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.10 void calNewD_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new densities using terms in the radial, theta, and phi directions

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology, uses ProcTop::nRank when reporting negative densities

Boundary Conditions doesn't allow mass flux through outter interface

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDCosThetaIJK, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nNumGhostCells, Grid::nR, ProcTop::nRank, Grid::nSin-

ThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.11 void calNewDenave_None (Grid & *grid*)

This function is a dumby funciton, and doesn't do anything. In the case of a 1D calculation the average density is undefined, and only the density is used. This is different from the case where the 1D region exsists on the rank 0 processor, but the grid as a whole is really 2D or 3D. In which case calNewDenave_R should be used instead.

Parameters

`in,out`	*grid*	

Referenced by setMainFunctions().

6.12.2.12 void calNewDenave_R (Grid & *grid*)

This function calculates the horizontal average density in a $3\backslash1$D region. This really just copies the density from the particular radial zone into the averaged density variable. This way it can be used exactly the same way in the 1D region as it is in the 3D region. This is done using the density in the new grid, and places the result into the new grid.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.

References Grid::dLocalGridNew, Grid::nD, Grid::nDenAve, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by setMainFunctions().

6.12.2.13 void calNewDenave_RT (Grid & *grid*)

This function calculates the horizontal average density in a 2D region from the new grid density and stores the result in the new grid.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDCosThetaIJK, Grid::nDenAve, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by setMainFunctions().

6.12.2.14 void calNewDenave_RTP (Grid & *grid*)

This function calculates the horizontal average density in a 3D region from the new grid density and stores the result in the new grid.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDCosThetaIJK, Grid::nDenAve, Grid::nDPhi, Grid::nEndGhostUpdateExplicit, -Grid::nEndUpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by setMainFunctions().

6.12.2.15 void calNewE_R_AD (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates new adiabatic energies using terms in the radial direction.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDM, Grid::nDonorCellFrac, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nR, ProcTop::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.12.2.16 void calNewE_R_NA (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates new non-adiabatic energies using terms in the radial direction and includes radiation diffusion terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions Setting energy at surface equal to energy in last zone.

Boundary Conditions Upwind gradient in dA1 term should be zero as there is no flow into the star.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Parameters::dSigma, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::n-EndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nKappa, Grid::nNum-GhostCells, Grid::nP, Grid::nQ0, Grid::nR, ProcTop::nRank, Grid::nStartGhostUpdate-Explicit, Grid::nStartUpdateExplicit, Grid::nT, Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.12.2.17 void calNewE_R_NA_LES (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates new non-adiabatic energies using terms in the radial direction and includes radiation diffusion terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to value at i.

Boundary Conditions grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGrid-Old[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1. Using the centered gradient instead.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0]

Boundary Conditions missing energy outside the model, assuming it is the same as that in the last zone. That causes this term to be zero.

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Parameters::dSigma, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nE, Grid::nEddyVisc, Grid::nEndGhostUpdate-Explicit, Grid::nEndUpdateExplicit, Grid::nKappa, Grid::nP, Grid::nQ0, Grid::nR, Proc-Top::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nT, Grid::nU, and Grid::nU0.

6.12.2.18 void calNewE_RT_AD (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new adiabatic energies using terms in the radial and theta directions.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions grid.dLocalGridOld[grid.nE][i+1][j][k] is missing

Boundary Conditions grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGrid-Old[grid.nE][i+1][j][k] missing using inner gradient for both

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::n-DonorCellFrac, Grid::nDTheta, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEnd-UpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, ProcTop::nRank, Grid::n-SinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStart-UpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.19 void calNewE_RT_NA (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new non-adiabatic energies using terms in the radial and theta directions and includes radiation diffusion terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to value at i.

Boundary Conditions grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGridOld[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1. Using the centered gradient instead.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Parameters::dSigma, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nE, Grid::nEndGhostUpdate-Explicit, Grid::nEndUpdateExplicit, Grid::nKappa, Grid::nP, Grid::nQ0, Grid::nQ1, -Grid::nR, ProcTop::nRank, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStart-GhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nT, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.20 void calNewE_RT_NA_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates new non-adiabatic energies using terms in the radial and theta directions and includes radiation diffusion terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions	Missing ΔM_r outside model using Parameters::dAlpha times ΔM_r in the last zone instead.
Boundary Conditions	Setting energy at surface equal to energy in last zone.
Boundary Conditions	missing density outside model, setting it to zero
Boundary Conditions	missing eddy viscosity outside the model setting it to zero
Boundary Conditions	Upwind gradient in dA1 term should be zero as there is no flow into the star.
Boundary Conditions	Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.
Boundary Conditions	missing energy outside the model, assuming it is the same as that in the last zone. That causes this term to be zero.

References Parameters::dAlpha, Time::dDeltat_np1half, dET4(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dPrt, Parameters::dSigma, Grid-::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nD-Theta, Grid::nE, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdate-Explicit, Grid::nGlobalGridPositionLocalGrid, Grid::nKappa, Grid::nNumGhostCells, -Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, ProcTop::nRank, Grid::nSinThetaIJK, Grid::n-SinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid-::nT, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.21 void calNewE_RTP_AD (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates new adiabatic energies using terms in the radial, theta, and phi directions.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions	Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to zero.
Boundary Conditions	grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGrid-Old[grid.nE][i+1][j][k] missing in the calculation of upwind

gradient in dA1.Using the centered gradient.

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::n-DonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Proc-Top::nRank, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdate-Explicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.22 void calNewE_RTP_NA (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates new non-adiabatic energies using terms in the radial, theta, and phi directions and includes radiation diffusion terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to the value at i.

Boundary Conditions grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGrid-Old[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1. Using the centered gradient instead.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0]

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Parameters::dSigma, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nEnd-GhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nKappa, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, ProcTop::nRank, Grid::nSinThetaIJK, Grid::nSinTheta-IJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nT, Grid-::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.23 void calNewE_RTP_NA_LES (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates new non-adiabatic energies using terms in the radial, theta, and phi directions and includes radiation diffusion terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated densities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	

Boundary Conditions Missing ΔM_r outside model using Parameters::dAlpha times ΔM_r in the last zone instead.

Boundary Conditions Missing W at i+1, assuming the same as at i

Boundary Conditions Setting energy at surface equal to energy in last zone.

Boundary Conditions missing density outside model, setting it to zero

Boundary Conditions missing eddy viscosity outside the model setting it to zero

Boundary Conditions Upwind gradient in dA1 term should be zero as there is no flow into the star.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

Boundary Conditions missing energy outside the model, assuming it is the same as that in the last zone. That causes this term to be zero.

References Parameters::dAlpha, Time::dDeltat_np1half, dET4(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dPrt, Parameters::dSigma, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nKappa, Grid::nNumGhostCells, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, ProcTop::nRank, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nT, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.24 void calNewEddyVisc_None (Grid & *grid,* Parameters & *parameters*)

This function is a empty function used as a place holder when no eddy viscosity model is being used.

Parameters

`in,out`	*grid*	
`in`	*parameters*	

Referenced by setMainFunctions().

6.12.2.25 void calNewEddyVisc_R_CN (Grid & *grid,* Parameters & *parameters*)

This function calculates the eddy viscosity using a constant times the zoning with only the radial terms.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Parameters::dMax-ConvectiveVelocity, Grid::nCenIntOffset, Grid::nEddyVisc, Grid::nEndGhostUpdate-Explicit, Grid::nEndUpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

6.12.2.26 void calNewEddyVisc_R_SM (Grid & *grid,* Parameters & *parameters*)

This function calculates the eddy viscosity with only the radial terms.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::nCenIntOffset, -Grid::nD, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, and -Grid::nU0.

6.12.2.27 void calNewEddyVisc_RT_CN (Grid & *grid,* Parameters & *parameters*)

This function calculates the eddy viscosity using a constant times the zoning with only the radial and theta terms.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nDTheta, Grid::n-EddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid-

::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by setMainFunctions().

6.12.2.28 void calNewEddyVisc_RT_SM (Grid & *grid,* Parameters & *parameters*)

This function calculates the eddy viscosity with only the radial and theta terms.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

Boundary Conditions assuming that theta velocity is constant across surface

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhost-UpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.29 void calNewEddyVisc_RTP_CN (Grid & *grid,* Parameters & *parameters*)

This function calculates the eddy viscosity using a constant times the zoning with only the radial, theta, and phi terms.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nDPhi, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid::nSinThetaIJK, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by setMainFunctions().

6.12.2.30 void calNewEddyVisc_RTP_SM (Grid & *grid,* Parameters & *parameters*)

This function calculates the eddy viscosity with only the radial, theta, and phi terms.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

Boundary Conditions assuming that theta velocity is constant across surface

Boundary Conditions assume phi velocity is constant across surface

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, -Grid::nCenIntOffset, Grid::nCotThetaIJK, Grid::nD, Grid::nDPhi, Grid::nDTheta, Grid-::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid-::nSinThetaIJK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.31 void calNewP_GL (Grid & *grid*, Parameters & *parameters*)

This function calculates the pressure. It is calculated using the new values of quantities and places the result in the new grid. It uses a gamma law gas give in dEOS_GL to calculate the pressure.

Parameters

`in,out`	*grid*	supplies the input for calculating the pressure and also accepts the result of the pressure calculations.
`in`	*parameters*	contains parameters used in calculating the pressure, namely the adiabatic gamma that is used.

References dEOS_GL(), Grid::dLocalGridNew, Grid::nD, Grid::nE, Grid::nEndGhost-UpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by setMainFunctions().

6.12.2.32 void calNewPEKappaGamma_TEOS (Grid & *grid*, Parameters & *parameters*)

This function calculates the Energy, pressure and opacity of a cell. It calculates it using the new vaules of quantities and places the result in the new grid.

Parameters

`in,out`	*grid*	supplies the input for calculating the pressure and also accepts the result of the pressure calculation
`in`	*parameters*	contains parameters used in calculating the pressure.

References Grid::dLocalGridNew, Parameters::eosTable, eos::getPEKappaGamma(), -Grid::nD, Grid::nE, Grid::nEndGhostUpdateImplicit, Grid::nEndUpdateImplicit, Grid::n-Gamma, Grid::nKappa, Grid::nP, Grid::nStartGhostUpdateImplicit, Grid::nStartUpdate-Implicit, and Grid::nT.

Referenced by implicitSolve_R(), implicitSolve_RT(), and implicitSolve_RTP().

6.12.2.33 void calNewQ0_R_GL (Grid & *grid,* Parameters & *parameters*)

This funciton calculates the artificial viscosity of a cell. It calculates it using the new values of quantities and places the result in the new grid. It does this for the radial component of the viscosity only. It uses the sound speed derived from the adiabatic gamma given for the gamma law gas equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation.
`in`	*parameters*	contains parameters used when calculating the artificial viscosity, namely the adiabatic gamma.

References Parameters::dA, Parameters::dAVThreshold, Parameters::dGamma, Grid::dLocalGridNew, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, and Grid::nU.

Referenced by setMainFunctions().

6.12.2.34 void calNewQ0_R_TEOS (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old values of quantities and places the result in the old grid. It does this for the radial component of the viscosity only. It uses a sound speed derived from a tabulated equaiton of state for the calculation.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Grid::dLocalGridNew, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, -Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, and Grid::nU.

Referenced by setMainFunctions().

6.12.2.35 void calNewQ0Q1_RT_GL (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the new values of quantities and places the result in the new grid. It does this for the radial and theta componenets of the viscosity. It uses the sound speed derived from the adiabatic gamma given for the gamma law gas equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculations.
`in`	*parameters*	contains parameters used when calculating the artificial viscosity, namely the adiabatic gamma.

References Parameters::dA, Parameters::dAVThreshold, Parameters::dGamma, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, -Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.36 void calNewQ0Q1_RT_TEOS (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old values of quantities and places the result in the old grid. It does this for two component of the viscosity.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.37 void calNewQ0Q1Q2_RTP_GL (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the new values of quantities and places the result in the new grid. It does this for the radial, theta, and phi componenets of the viscosity. It uses the sound speed derived from the adiabatic gamma given for the gamma law gas equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculations.
`in`	*parameters*	contains parameters used when calculating the artificial viscosity, namely the adiabatic gamma.

References Parameters::dA, Parameters::dAVThreshold, Parameters::dGamma, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.38 void calNewQ0Q1Q2_RTP_TEOS (Grid & *grid*, Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old values of quantities and places the result in the old grid. It does this for the three component of the viscosity.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.39 void calNewR (Grid & *grid*, Time & *time*)

This function calculates the radii, from the new radial grid velocities

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*time*	contains time information, e.g. time step, current time etc.

References Time::dDeltat_np1half, Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, and Grid::nU0.

Referenced by setMainFunctions().

6.12.2.40 void calNewTPKappaGamma_TEOS (Grid & *grid*, Parameters & *parameters*)

This function calculates the Temperature, pressure and opacity of a cell. It calculates it using the new vaules of quantities and places the result in the new grid.

Parameters

`in,out`	*grid*	supplies the input for calculating the pressure and also accepts the result of the pressure calculation
`in`	*parameters*	contains parameters used in calculating the pressure.

References Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dTolerance, -Parameters::eosTable, eos::getEAndDTDE(), eos::getPKappaGamma(), Grid::nD, -Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nKappa, Parameters::nMaxIterations, Grid::nP, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, and Grid::nT.

Referenced by setMainFunctions().

6.12.2.41 void calNewU0_R (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*, MessPass & *messPass*)

This function calculates the radial grid velocity, it does so by considering only the radial terms

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial grid velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology
`in`	*messPass*	

Todo At some point I will likely want to make this funciton compatiable with a 3D domain decomposition instead of a purely radial domain decomposition.

References Grid::dLocalGridNew, ProcTop::nCoords, Grid::nEndGhostUpdate-Explicit, Grid::nEndUpdateExplicit, ProcTop::nNumRadialNeighbors, ProcTop::nRadial-NeighborNeighborIDs, ProcTop::nRadialNeighborRanks, ProcTop::nRank, Grid::nStart-GhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, MessPass::type-RecvNewVar, and MessPass::typeSendNewVar.

Referenced by setMainFunctions().

6.12.2.42 void calNewU0_RT (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*, MessPass & *messPass*)

This function calculates the radial grid velocity, and does it by only considering the radial and theta terms

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial grid velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology
`in,out`	*messPass*	handles data needed for message passing

Todo At some point I will likely want to make this funciton compatiable with a 3D domain decomposition instead of a purely radial domain decomposition.

Boundary Conditions grid.dLocalGridOld[grid.nD][i+1][j][k] is missing

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, ProcTop::nCoords, Grid::nD, Grid::nDCosThetaIJK, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nLocalGridDims, Grid::nNumGhostCells, ProcTop::nNumRadialNeighbors, Grid::nR, ProcTop::nRadialNeighborNeighborIDs, ProcTop::nRadialNeighborRanks, ProcTop::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, MessPass::typeRecvNewVar, and MessPass::typeSendNewVar.

Referenced by setMainFunctions().

6.12.2.43 void calNewU0_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*, MessPass & *messPass*)

This function calculates the radial grid velocity, and does it by considering all radial, theta and phi terms

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial grid velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology
`in,out`	*messPass*	handles data needed for message passing

Todo At some point I will likely want to make this funciton compatiable with a 3D domain decomposition instead of a purely radial domain decomposition.

Boundary Conditions grid.dLocalGridOld[grid.nD][i+1][j][k] is missing

References Grid::dLocalGridNew, Grid::dLocalGridOld, Grid::nCenIntOffset, ProcTop::nCoords, Grid::nD, Grid::nDCosThetaIJK, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nLocalGridDims, -Grid::nNumGhostCells, ProcTop::nNumRadialNeighbors, Grid::nR, ProcTop::nRadialNeighborNeighborIDs, ProcTop::nRadialNeighborRanks, ProcTop::nRank, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, MessPass::typeRecvNewVar, and MessPass::typeSendNewVar.

Referenced by setMainFunctions().

6.12.2.44 void calNewU_R (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the radial velocity, and does it by only considering the radial terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha $*$grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

Boundary Conditions Missing density outside model, setting it to zero.

Boundary Conditions Missing pressure outside surface setting it equal to negative pressure in the center of the first cell so that it will be zero at surface.

References Parameters::dAlpha, Time::dDeltat_n, Parameters::dG, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDM, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nU0.

Referenced by calNewVelocities_R().

6.12.2.45 void calNewU_R_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the radial velocity, and does it by only considering the radial terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions Missing grid.dLocalGridOld[grid.nD][nICen+1][j][k] in calculation of $\rho_{i+1/2}$, setting it to 0.0

Boundary Conditions missing grid.dLocalGridOld[grid.nU][i+1][j][k] using velocity at i

Boundary Conditions Assuming eddy viscosity outside model is zero.

Boundary Conditions Missing grid.dLocalGridOld[grid.nP][nICen+1][j][k] in calculation of S_1, setting it to -1.0$*$grid.dLocalGridOld[grid.nP][nICen][j][k].

Boundary Conditions Missing grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of centered A_1 gradient, setting it to zero.

Boundary Conditions Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

References Parameters::dAlpha, Time::dDeltat_n, Parameters::dG, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDM, Grid::nDonorCellFrac, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nM, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nU0.

Referenced by calNewVelocities_R_LES().

6.12.2.46 void calNewU_RT (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates the radial velocity, and does it by only considering the radial and theta terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions	Missing grid.dLocalGridOld[grid.nD][nICen+1][j][k] in calculation of $\rho_{i+1/2,j,k}$, setting it to zero.
Boundary Conditions	assuming theta velocity is constant across surface
Boundary Conditions	Missing grid.dLocalGridOld[grid.nDenAve][nICen+1][0][0] in calculation of $\langle\rho\rangle_{i+1/2}$, setting it to zero.
Boundary Conditions	Missing grid.dLocalGridOld[grid.nP][nICen+1][j][k] in calculation of S_1, setting it to -1.0$*$dP_ijk_n.
Boundary Conditions	Missing grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of centered A_1 gradient, setting it to zero.
Boundary Conditions	Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.
Boundary Conditions	Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha $*$grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

References Parameters::dAlpha, Time::dDeltat_n, Parameters::dG, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nM, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by calNewVelocities_RT().

6.12.2.47 void calNewU_RT_LES (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates the radial velocity, and does it by only considering the radial and theta terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions	Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha $*$grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

Boundary Conditions Missing density outside of surface, setting it to zero.

Boundary Conditions Missing density outside model, setting it to zero.

Boundary Conditions assuming theta and phi velocity same outside star as inside.

Boundary Conditions Assuming theta velocities are constant across surface.

Boundary Conditions assuming that V at $i+1$ is equal to v at i.

Boundary Conditions Missing pressure outside surface setting it equal to negative pressure in the center of the first cell so that it will be zero at surface.

Boundary Conditions assume viscosity is zero outside the star.

Boundary Conditions Missing mass outside model, setting it to zero.

Boundary Conditions Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

References Parameters::dAlpha, Time::dDeltat_n, Parameters::dG, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJK, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by calNewVelocities_RT_LES().

6.12.2.48 void calNewU_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the radial velocity, and does it by including all radial, theta and phi terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions missing grid.dLocalGridOld[grid.nU][i+1][j][k] in calculation of

$u_{i+1,j,k}$ setting $u_{i+1,j,k}$= $u_{i+1/2,j,k}$.

Boundary Conditions Missing grid.dLocalGridOld[grid.nD][i+1][j][k] in calculation of $\rho_{i+1/2,j,k}$, setting it to zero.

Boundary Conditions assuming theta velocity is constant across the surface.

Boundary Conditions assuming phi velocity is constant across the surface.

Boundary Conditions Missing grid.dLocalGridOld[grid.nDenAve][nICen+1][0][0] in calculation of $\langle\rho\rangle_{i+1/2}$ setting it to zero.

Boundary Conditions Missing grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of centered A_1 gradient, setting it equal to Parameters::dAlpha grid.dLocalGridOld[grid.nDM][nICen][0][0].

Boundary Conditions Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocalGridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

Boundary Conditions Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha $*$grid.dLocalGridOld[grid.nDM][nICen][0][0] instead.

References Parameters::dAlpha, Time::dDeltat_n, Parameters::dG, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nM, Grid::nP, Grid::nQ0, Grid::nR, Grid::nSinThetaIJK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by calNewVelocities_RTP().

6.12.2.49 void calNewU_RTP_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the radial velocity, and does it by including all radial, theta and phi terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated radial velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions	Missing grid.dLocalGridOld[grid.nDM][i+1][0][0] in calculation of S_1 using Parameters::dAlpha $*$grid.dLocalGridOld[grid.nD-M][nICen][0][0] instead.
Boundary Conditions	Missing density outside of surface, setting it to zero.
Boundary Conditions	Missing density outside model, setting it to zero.
Boundary Conditions	assuming theta and phi velocity same outside star as inside.
Boundary Conditions	Assuming theta velocities are constant across surface.
Boundary Conditions	assuming that V at $i+1$ is equal to v at i.
Boundary Conditions	Missing pressure outside surface setting it equal to negative pressure in the center of the first cell so that it will be zero at surface.
Boundary Conditions	assume viscosity is zero outside the star.
Boundary Conditions	Missing mass outside model, setting it to zero.
Boundary Conditions	Missing grid.dLocalGridOld[grid.nU][i+1][j][k] and grid.dLocal-GridOld[grid.nDM][nICen+1][0][0] in calculation of upwind gradient, when moving inward. Using centered gradient instead.

References Parameters::dAlpha, Time::dDeltat_n, Parameters::dG, Grid::dLocalGrid-New, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJ-K, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nD-Theta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, -Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::n-Q2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdate-Explicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by calNewVelocities_RTP_LES().

6.12.2.50 void calNewV_RT (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates the theta velocity, and does it by only considering the radial and theta terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated theta velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions grid.dLocalGridOld[grid.nV][i+1][j+1][k] is missing

Boundary Conditions missing upwind gradient, using centred gradient instead

References Time::dDeltat_n, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters-::dPi, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, -Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdate-Explicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by calNewVelocities_RT().

6.12.2.51 void calNewV_RT_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the theta velocity, and does it by only considering the radial and theta terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated theta velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions Assuming density outside star is zero

Boundary Conditions Assuming theta velocity is constant across surface.

Boundary Conditions Assuming eddy viscosity is zero at surface.

References Time::dDeltat_n, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters-::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJp1halfK, Grid::nD, Grid::nDenAve, Grid::n-DM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdate-Explicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nNum-GhostCells, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSin-ThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by calNewVelocities_RT_LES().

6.12.2.52 void calNewV_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the theta velocity, and does it by considering the radial, theta, and phi terms.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated theta velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions Assuming theta and phi velocities are the same at the surface of the star as just inside the star.

Boundary Conditions ussing cetnered gradient for upwind gradient outside star at surface.

References Time::dDeltat_n, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJp1halfK, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by calNewVelocities_RTP().

6.12.2.53 void calNewV_RTP_LES (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function calculates the theta velocity, and does it by considering the radial, theta, and phi terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated theta velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions Assuming density outside star is zero

Boundary Conditions Assuming theta velocity is constant across surface.

Boundary Conditions Assuming eddy viscosity is zero at surface.

References Time::dDeltat_n, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJp1halfK, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, -Grid::nNumGhostCells, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by calNewVelocities_RTP_LES().

6.12.2.54 void calNewVelocities_R (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function simply calls a function that calculate the radial velocity. Calls the function calNewU_R to calculate radial velocity, including only radial terms.

Parameters

`in,out`	*grid*	contains the local grid data and supplies the needed data to calculate the new velocities as well as holding the new velocities.
`in`	*parameters*	contains parameters used in the calculation of the new velocities.
`in`	*time*	contains time step information, current time step, and current time
`in`	*procTop*	contains processor topology information

References calNewU_R().

Referenced by setMainFunctions().

6.12.2.55 void calNewVelocities_R_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function simply calls a function that calculate the radial velocity. Calls the function calNewU_R to calculate radial velocity, including only radial terms.

Parameters

`in,out`	*grid*	contains the local grid data and supplies the needed data to calculate the new velocities as well as holding the new velocities.
`in`	*parameters*	contains parameters used in the calculation of the new velocities.
`in`	*time*	contains time step information, current time step, and current time
`in`	*procTop*	contains processor topology information

References calNewU_R_LES().

6.12.2.56 void calNewVelocities_RT (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function simply calls two other functions that calculate the radial and theta velocities. Calls the two functions calNewU_RT and calNewV_RT to calculate radial and theta velocities, including both radial and theta terms.

Parameters

`in,out`	*grid*	contains the local grid data and supplies the needed data to calculate the new velocities as well as holding the new velocities.
`in`	*parameters*	contains parameters used in the calculation of the new velocities.
`in`	*time*	contains time step information, current time step, and current time
`in`	*procTop*	contains processor topology information

References calNewU_RT(), and calNewV_RT().

Referenced by setMainFunctions().

6.12.2.57 void calNewVelocities_RT_LES (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function simply calls two other functions that calculate the radial and theta velocities. Calls the two functions calNewU_RT and calNewV_RT to calculate radial and theta velocities, including both radial and theta terms.

Parameters

`in,out`	*grid*	contains the local grid data and supplies the needed data to calculate the new velocities as well as holding the new velocities.
`in`	*parameters*	contains parameters used in the calculation of the new velocities.
`in`	*time*	contains time step information, current time step, and current time
`in`	*procTop*	contains processor topology information

References calNewU_RT_LES(), and calNewV_RT_LES().

Referenced by setMainFunctions().

6.12.2.58 void calNewVelocities_RTP (Grid & *grid,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop*)

This function simply calls three other functions that calculate the radial, theta and phi velocities. Calls the two functions calNewU_RTP, calNewV_RTP and calNewW_RTP to calculate radial, theta, and phi velocities, including radial, theta, and phi terms.

Parameters

`in,out`	*grid*	contains the local grid data and supplies the needed data to calculate the new velocities as well as holding the new velocities.
`in`	*parameters*	contains parameters used in the calculation of the new velocities.

in	*time*	contains time step information, current time step, and current time
in	*procTop*	contains processor topology information

References calNewU_RTP(), calNewV_RTP(), and calNewW_RTP().

Referenced by setMainFunctions().

6.12.2.59 void calNewVelocities_RTP_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function simply calls three other functions that calculate the radial, theta and phi velocities. Calls the two functions calNewU_RTP, calNewV_RTP and calNewW_RTP to calculate radial, theta, and phi velocities, including radial, theta, and phi terms.

Parameters

in,out	*grid*	contains the local grid data and supplies the needed data to calculate the new velocities as well as holding the new velocities.
in	*parameters*	contains parameters used in the calculation of the new velocities.
in	*time*	contains time step information, current time step, and current time
in	*procTop*	contains processor topology information

References calNewU_RTP_LES(), calNewV_RTP_LES(), and calNewW_RTP_LES().

Referenced by setMainFunctions().

6.12.2.60 void calNewW_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the phi velocity, and does it by only considering the radial, theta, and phi terms.

Parameters

in,out	*grid*	contains the local grid, and will hold the newly updated theta velocities
in	*parameters*	various parameters needed for the calculation
in	*time*	contains time information, e.g. time step, current time etc.
in	*procTop*	contains information about the processor topology

Boundary Conditions missing grid.dLocalGridOld[grid.nW][i+1][j][k] assuming that the phi velocity at the outter most interface is the same as the phi velocity in the center of the zone.

Boundary Conditions missing grid.dLocalGridOld[grid.nW][i+1][j][k] in outter most zone. This is needed to calculate the upwind gradient for donnor cell. The centered gradient is used instead when moving in the negative direction.

References Time::dDeltat_n, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJK, Grid::nD, Grid::nDenAve, Grid::nDM, -Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nEndGhostUpdateExplicit, -Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by calNewVelocities_RTP().

6.12.2.61 void calNewW_RTP_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*)

This function calculates the phi velocity, and does it by only considering the radial, theta, and phi terms. It also includes the terms for including real viscosity, used in the LES.

Parameters

`in,out`	*grid*	contains the local grid, and will hold the newly updated theta velocities
`in`	*parameters*	various parameters needed for the calculation
`in`	*time*	contains time information, e.g. time step, current time etc.
`in`	*procTop*	contains information about the processor topology

Boundary Conditions assume theta and phi velocities are constant across surface

Boundary Conditions assume eddy viscosity is zero at surface

Boundary Conditions assume upwind gradient is the same as centered gradient across surface

References Time::dDeltat_n, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Grid::nCenIntOffset, Grid::nCotThetaIJK, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGlobalGridPositionLocalGrid, Grid::nNumGhostCells, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by calNewVelocities_RTP_LES().

6.12.2.62 void calOldDenave_None (Grid & *grid*)

This function is a dumby funciton, and doesn't do anything. In the case of a 1D calculation the average density is undefined, and only the density is used. This is different from the case where the 1D region exsists on the rank 0 processor, but the grid as a whole is really 2D or 3D. In which case calOldDenave_R should be used instead.

6.12.2.63 void calOldDenave_R (Grid & *grid*)

This function does nothing as the averaged density is not needed in 1D calculations.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.

References Grid::dLocalGridOld, Grid::nD, Grid::nDenAve, Grid::nEndGhostUpdateExplicit, Grid::nEndGhostUpdateImplicit, Grid::nEndUpdateExplicit, Grid::nEndUpdateImplicit, Grid::nStartGhostUpdateExplicit, Grid::nStartGhostUpdateImplicit, Grid::nStartUpdateExplicit, and Grid::nStartUpdateImplicit.

Referenced by initInternalVars().

6.12.2.64 void calOldDenave_RT (Grid & *grid*)

This function calculates the horizontal average density in a 2D region. This function differs from calNewDenave_RT in that it calculates the average density from the old grid density and stores the result in the old grid. While calNewDenave_RT calculates the average density from the new grid density and places the result in the new grid.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.

References Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDCosThetaIJK, Grid::nDenAve, Grid::nEndGhostUpdateExplicit, Grid::nEndGhostUpdateImplicit, Grid::nEndUpdateExplicit, Grid::nEndUpdateImplicit, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartGhostUpdateImplicit, Grid::nStartUpdateExplicit, and Grid::nStartUpdateImplicit.

Referenced by initInternalVars().

6.12.2.65 void calOldDenave_RTP (Grid & *grid*)

This function calculates the horizontal average density in a 3D region. This function differs from calNewDenave_RTP in that it calculates the average density from the old grid density and stores the result in the old grid. While calNewDenave_RTP calculates the average density from the new grid density and places the result in the new grid.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.

References Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nDCosThetaIJK, Grid::nDenAve, Grid::nDPhi, Grid::nEndGhostUpdateExplicit, Grid::nEndGhostUpdate-Implicit, Grid::nEndUpdateExplicit, Grid::nEndUpdateImplicit, Grid::nR, Grid::nStart-GhostUpdateExplicit, Grid::nStartGhostUpdateImplicit, Grid::nStartUpdateExplicit, and Grid::nStartUpdateImplicit.

Referenced by initInternalVars().

6.12.2.66 void calOldEddyVisc_R_CN (Grid & *grid,* Parameters & *parameters*)

Calculates the eddy viscosity using a constant times the zoning including only the radial terms. It puts the result into the old grid. This funciton is used to initalize the eddy viscosity when the code begins execution.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nEddyVisc, Grid::n-EndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nNumGhostCells, Grid::nR, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by initInternalVars().

6.12.2.67 void calOldEddyVisc_R_SM (Grid & *grid,* Parameters & *parameters*)

Calculates the eddy viscosity including only the radial terms. It puts the result into the old grid. This funciton is used to initalize the eddy viscosity when the code begins execution. It uses the Smagorinsky model for calculating the eddy viscosity.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridOld, Grid::nCenIntOffset, -Grid::nD, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nNumGhostCells, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdate-Explicit, and Grid::nU.

Referenced by initInternalVars().

6.12.2.68 void calOldEddyVisc_RT_CN (Grid & *grid,* Parameters & *parameters*)

Calculates the eddy viscosity using a constant times the zoning including only the radial and theta terms. It puts the result into the old grid. This funciton is used to initalize the eddy viscosity when the code begins execution.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nDTheta, Grid::n-EddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nNum-GhostCells, Grid::nR, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by initInternalVars().

6.12.2.69 void calOldEddyVisc_RT_SM (Grid & *grid*, Parameters & *parameters*)

Calculates the eddy viscosity including only the radial and theta terms. It puts the result into the old grid. This funciton is used to initalize the eddy viscosity when the code begins execution.It uses the Smagorinsky model for calculating the eddy viscosity.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

Boundary Conditions assuming that theta velocity is constant across surface

References Parameters::dEddyViscosity, Grid::dLocalGridOld, Grid::nCenIntOffset, -Grid::nD, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEnd-UpdateExplicit, Grid::nNumGhostCells, Grid::nR, Grid::nStartGhostUpdateExplicit, -Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by initInternalVars().

6.12.2.70 void calOldEddyVisc_RTP_CN (Grid & *grid*, Parameters & *parameters*)

Calculates the eddy viscosity using a constant times the zoning including the radial, theta, and phi terms. It puts the result into the old grid. This funciton is used to initalize the eddy viscosity when the code begins execution.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

References Parameters::dEddyViscosity, Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nDPhi, Grid::nDTheta, Grid::nEddyVisc, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::n-NumGhostCells, Grid::nR, Grid::nSinThetaIJK, Grid::nStartGhostUpdateExplicit, and -Grid::nStartUpdateExplicit.

Referenced by initInternalVars().

6.12.2.71 void calOldEddyVisc_RTP_SM (Grid & *grid*, Parameters & *parameters*)

Calculates the eddy viscosity including the radial, theta, and phi terms. It puts the result into the old grid. This funciton is used to initalize the eddy viscosity when the code begins execution.It uses the Smagorinsky model for calculating the eddy viscosity.

Parameters

`in,out`	*grid*	supplies the input for calculating the eddy viscosity.
`in`	*parameters*	contains parameters used in calculating the eddy viscosity.

Boundary Conditions assuming that theta velocity is constant across surface

Boundary Conditions assume phi velocity is constant across surface

References Parameters::dEddyViscosity, Grid::dLocalGridOld, Grid::nCenIntOffset, -Grid::nCotThetaIJK, Grid::nD, Grid::nDPhi, Grid::nDTheta, Grid::nEddyVisc, Grid::n-EndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nNumGhostCells, Grid::nR, Grid::nSinThetaIJK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid-::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by initInternalVars().

6.12.2.72 void calOldP_GL (Grid & *grid*, Parameters & *parameters*)

This function calculates the pressure using a gamma law gas, calculate by dEOS_GL.

Parameters

`in,out`	*grid*	supplies the input for calculating the pressure and also accepts the results of the pressure calculations
`in`	*parameters*	contains parameters used in calculating the pressure, namely the value of the adiabatic gamma

References dEOS_GL(), Grid::dLocalGridOld, Grid::nD, Grid::nE, Grid::nEndGhost-UpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nStartGhostUpdateExplicit, and Grid::nStartUpdateExplicit.

Referenced by initInternalVars().

6.12.2.73 void calOldPEKappaGamma_TEOS (Grid & *grid*, Parameters & *parameters*)

This function calculates the pressure, energy, opacity, and adiabatic index of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. This function is used to initialize the internal variables pressure, energy and kappa, and is suitable for both 1D and 3D calculations.

Parameters

`in,out`	*grid*	supplies the input for calculating the pressure and also accepts the result of the pressure calculation
`in`	*parameters*	contains parameters used in calculating the pressure.

References Grid::dLocalGridOld, Parameters::eosTable, eos::getPEKappaGamma(), Grid::nD, Grid::nE, Grid::nEndGhostUpdateExplicit, Grid::nEndGhostUpdateImplicit, Grid::nEndUpdateExplicit, Grid::nEndUpdateImplicit, Grid::nGamma, Grid::nKappa, Grid::nNumGhostCells, Grid::nP, Grid::nStartGhostUpdateExplicit, Grid::nStartGhostUpdateImplicit, Grid::nStartUpdateExplicit, Grid::nStartUpdateImplicit, and Grid::nT.

Referenced by initInternalVars().

6.12.2.74 void calOldQ0_R_GL (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. It does this for the radial component of the viscosity only. This function is used when using a gamma law gas equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Parameters::dGamma, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, and Grid::nU.

Referenced by initInternalVars().

6.12.2.75 void calOldQ0_R_TEOS (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. It does this for 1D viscosity only.

Parameters

`in,out`	*grid*	supplies the input for calculating the pressure and also accepts the result of the pressure calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, -

Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nR, Grid::nStartGhostUpdateExplicit, Grid::n-StartUpdateExplicit, and Grid::nU.

Referenced by initInternalVars().

6.12.2.76 void calOldQ0Q1_RT_GL (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. It does this for the two components of the viscosity. This function is used when using a gamma law gas equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Parameters::dGamma, Grid-::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid-::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, -Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nV.

Referenced by initInternalVars().

6.12.2.77 void calOldQ0Q1_RT_TEOS (Grid & *grid,* Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. It does this for two components of the viscosity. This function is used when using a tabulated equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Grid::dLocalGridOld, Grid-::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, -Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::n-SinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid-::nU, and Grid::nV.

Referenced by initInternalVars().

6.12.2.78 void calOldQ0Q1Q2_RTP_GL (Grid & *grid*, Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. It does this for the three components of the viscosity. This function is used when using a gamma law gas equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Parameters::dGamma, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nV, and Grid::nW.

Referenced by initInternalVars().

6.12.2.79 void calOldQ0Q1Q2_RTP_TEOS (Grid & *grid*, Parameters & *parameters*)

This function calculates the artificial viscosity of a cell. It calculates it using the old vaules of quantities and places the result in the old grid. It does this for the three components of the viscosity. This function is used when using a tabulated equation of state.

Parameters

`in,out`	*grid*	supplies the input for calculating the artificial viscosity and also accepts the result of the artificial viscosity calculation
`in`	*parameters*	contains parameters used in calculating the artificial viscosity.

References Parameters::dA, Parameters::dAVThreshold, Grid::dLocalGridOld, Grid::nCenIntOffset, Grid::nD, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nStartGhostUpdateExplicit, Grid::nStartUpdateExplicit, Grid::nU, Grid::nV, and Grid::nW.

Referenced by initInternalVars().

6.12.2.80 double dEOS_GL (double *dRho*, double *dE*, Parameters *parameters*)

Calculates the pressure from the energy and density using a γ-law gas.

Parameters

in	*dRho*	the density of a cell
in	*dE*	the energy of a cell
in	*parameters*	contians various parameters, including γ needed to calculate the pressure.

Returns

the pressure

This version of dEOS_GL uses the same value of γ through out the model. The equation of state is given by $\rho(\gamma-1)E$.

References Parameters::dGamma.

Referenced by calNewP_GL(), and calOldP_GL().

6.12.2.81 double dET4 (Parameters & *parameters*, double *dEddyVisc_ijk_np1half*, double *dRho_ijk_np1half*, double *dLengthScale4_ijk_np1half*) [inline]

This is an additional turbulance term to be added to the energy equation.

Referenced by calNewE_RT_NA_LES(), calNewE_RTP_NA_LES(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RTP_LES(), and dImplicitEnergyFunction_RTP_LES_SB().

6.12.2.82 double dImplicitEnergyFunction_None (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This is an empty function, that isn't even called when no implicit solution is needed. This safe guards against future addition which may need to call an empty function when no implicit solve is being done.

Referenced by setMainFunctions().

6.12.2.83 double dImplicitEnergyFunction_R (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _R version of the funciton contains only the radial terms, and should be used for purely radial calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	

in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$,dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

References Parameters::bDEDMClamp, Parameters::dDEDMClampMr, Parameters::dDEDMClampValue, Time::dDeltat_np1half, DEBUG_EQUATIONS, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, -Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nE, Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nNumGhostCells, Grid::nQ0, Grid::nR, Grid::nT, Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.12.2.84 double dImplicitEnergyFunction_R_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _R version of the funciton contains only the radial terms, and should be used for purely radial calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$,dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

Todo this funciton should probably be turffed, the LES terms aren't needed in 1D. keeping it for now though.

References Time::dDeltat_np1half, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::n-

DM, Grid::nDonorCellFrac, Grid::nE, Grid::nEddyVisc, Grid::nGlobalGridPositionLocal-Grid, Grid::nNumGhostCells, Grid::nQ0, Grid::nR, Grid::nT, Grid::nU, and Grid::nU0.

6.12.2.85 double **dImplicitEnergyFunction_R_LES_SB** (**Grid** & *grid*, **Parameters** & *parameters*, **Time** & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _R version of the funciton contains only the radial terms, and should be used for purely radial calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_R)in that it is tailored to the surface boundary region.

Parameters

`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$ and time $n+1$, dTemps[1]=dT_im1jk-_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$.
`in`	*i*	is the radial index to evaluate the function at.
`in`	*j*	is the theta index to evaluate the function at.
`in`	*k*	is the phi index to evaluate the function at.

Boundary Conditions Missing grid.dLocalGridOld[grid.nE][i+1][j][k] in calculation of $E_{i+1/2,j,k}$ setting it equal to value at i.

Boundary Conditions grid.dLocalGridOld[grid.nDM][i+1][0][0] and grid.dLocalGrid-Old[grid.nE][i+1][j][k] missing in the calculation of upwind gradient in dA1. Using the centered gradient instead.

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0]

References Time::dDeltat_np1half, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGet-Pressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters-::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDM, Grid::n-DonorCellFrac, Grid::nE, Grid::nEddyVisc, Grid::nQ0, Grid::nR, Grid::nT, Grid::nU, and Grid::nU0.

6.12.2.86 double **dImplicitEnergyFunction_R_SB** (**Grid** & *grid*, **Parameters** & *parameters*, **Time** & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _R version of the funciton contains only the radial terms, and should be used for purely radial calculations.

This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_R)in that it is tailored to the surface boundary region.

Parameters

`in`	*grid*	
`in`	*parameters*	
`in`	*time*	
`in`	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$ and time $n+1$, dTemps[1]=dT_im1jk-_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$.
`in`	*i*	is the radial index to evaluate the function at.
`in`	*j*	is the theta index to evaluate the function at.
`in`	*k*	is the phi index to evaluate the function at.

Boundary Conditions missing density outside model assuming it is zero

Boundary Conditions missing desnity outside model assuming it is zero

Boundary Conditions Assuming energy outside model is the same as the energy in the last zone inside the model.

Boundary Conditions A1 upwind set to zero as no material is flowing into the star

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Parameters::bDEDMClamp, Parameters::dDEDMClampMr, Parameters::d-DEDMClampValue, Time::dDeltat_np1half, DEBUG_EQUATIONS, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, -Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, -Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nE, Grid::nGlobal-GridPositionLocalGrid, Grid::nM, Grid::nNumGhostCells, Grid::nQ0, Grid::nR, Grid::nT, Grid::nU, and Grid::nU0.

Referenced by setMainFunctions().

6.12.2.87 double dImplicitEnergyFunction_RT (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RT version of the funciton contains only the radial and theta terms, and should be used for radial-theta calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

References Time::dDeltat_np1half, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nE, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.88 double dImplicitEnergyFunction_RT_LES (Grid & *grid,* Parameters & *parameters,* Time & *time,* double *dTemps[ ],* int *i,* int *j,* int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RT version of the funciton contains only the radial and theta terms, and should be used for radial-theta calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

References Parameters::bDEDMClamp, Parameters::dDEDMClampMr, Parameters::dDEDMClampValue, Time::dDeltat_np1half, DEBUG_EQUATIONS, dET4(), eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dPrt, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nNumGhostCells, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.89 double dImplicitEnergyFunction_RT_LES_SB(Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RT version of the funciton contains only the radial and theta terms, and should be used for radial-theta calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_RT)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

Boundary Conditions Missing ΔM_r outside model using Parameters::dAlpha times ΔM_r in the last zone instead.

Boundary Conditions missing density outside model assuming it is zero

Boundary Conditions missing desnity outside model assuming it is zero

Boundary Conditions assuming V at ip1half is the same as V at i

Boundary Conditions Assuming energy outside model is the same as the energy in the last zone inside the model.

Boundary Conditions Assuming energy outside model is the same as the energy in the last zone inside the model.

Boundary Conditions A1 upwind set to zero as no material is flowing into the star

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Parameters::bDEDMClamp, Parameters::dAlpha, Parameters::dDEDMClampMr, Parameters::dDEDMClampValue, Time::dDeltat_np1half, DEBUG_EQUATIONS, dET4(), eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dPrt, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nNumGhostCells, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.90 double dImplicitEnergyFunction_RT_SB (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RT version of the funciton contains only the radial and theta terms, and should be used for radial-theta calculations. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_RT)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

Boundary Conditions Using centered gradient for upwind gradient when motion is into the star at the surface

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Time::dDeltat_np1half, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDTheta, Grid::nE, Grid::nQ0, Grid::nQ1, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by setMainFunctions().

6.12.2.91 double dImplicitEnergyFunction_RTP (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RTP version of the funciton contains terms for all three directions, and should be used for calculations involving all three directions. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_RT)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps,dTemps[0]=dT_ijk_np1*	is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$, dTemps[5]=dT_ijkp1_np1 is the temperature at radial position $(i,j,k+1)$ and time $n+1$, dTemps[6]=dT_ijkm1_np1 is the temperature at radial position $(i,j,k-1)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

References Time::dDeltat_np1half, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.92 double dImplicitEnergyFunction_RTP_LES (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RTP version of the funciton contains terms for all three directions, and should be used for calculations involving all three directions. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_RT)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps,d-Temps[0]=d-T_ijk_np1*	is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$, dTemps[5]=dT_ijkp1_np1 is the temperature at radial position $(i,j,k+1)$ and time $n+1$, dTemps[6]=dT_ijkm1_np1 is the temperature at radial position $(i,j,k-1)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

References Parameters::bDEDMClamp, Parameters::dDEDMClampMr, Parameters::dDEDMClampValue, Time::dDeltat_np1half, DEBUG_EQUATIONS, dET4(), eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dPrt, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nNumGhostCells, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.93 double dImplicitEnergyFunction_RTP_LES_SB (Grid & *grid*, Parameters & *parameters*, Time & *time*, double *dTemps[ ]*, int *i*, int *j*, int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RTP version of the funciton contains terms for all three directions, and should be used for calculations involving all three directions. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_RT)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$, dTemps[5]=dT_ijkp1_np1 is the temperature at radial position $(i,j,k+1)$ and time $n+1$, dTemps[6]=dT_ijkm1_np1 is the temperature at radial position $(i,j,k-1)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

Boundary Conditions Missing ΔM_r outside model using Parameters::dAlpha times ΔM_r in the last zone instead.

Boundary Conditions missing density outside model assuming it is zero

Boundary Conditions missing desnity outside model assuming it is zero

Boundary Conditions assuming V at ip1half is the same as V at i

Boundary Conditions assuming W at ip1half is the same as W at i

Boundary Conditions Assuming energy outside model is the same as the energy in the last zone inside the model.

Boundary Conditions Assuming energy outside model is the same as the energy in the last zone inside the model.

Boundary Conditions A1 upwind set to zero as no material is flowing into the star

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Parameters::bDEDMClamp, Parameters::dAlpha, Parameters::dDEDMClampMr, Parameters::dDEDMClampValue, Time::dDeltat_np1half, DEBUG_EQUATIONS, dET4(), eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dPrt, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nGlobalGridPositionLocalGrid, Grid::nM, Grid::nNumGhostCells, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.94 double dImplicitEnergyFunction_RTP_SB (Grid & *grid,* Parameters & *parameters,* Time & *time,* double *dTemps[ ],* int *i,* int *j,* int *k*)

This function is used to determine the agreement of the updated values at $n+1$, with each other in the non-adiabatic energy equation. The _RTP version of the funciton contains terms for all three directions, and should be used for calculations involving all three directions. This function can also be used for calculating numerical deriviatives by varying the input temperatures. This funciton differs from the version without the "_SB" suffix (dImplicitEnergyFunction_RT)in that it is tailored to the surface boundary region.

Parameters

in	*grid*	
in	*parameters*	
in	*time*	
in	*dTemps*	dTemps[0]=dT_ijk_np1 is the temperature at radial position (i,j,k) and time $n+1$, dTemps[1]=dT_ip1jk_np1 is the temperature at radial position $(i+1,j,k)$ and time $n+1$, dTemps[2]=dT_im1jk_np1 is the temperature at radial position $(i-1,j,k)$ and time $n+1$, dTemps[3]=dT_ijp1k_np1 is the temperature at radial position $(i,j+1,k)$ and time $n+1$, dTemps[4]=dT_ijm1k_np1 is the temperature at radial position $(i,j-1,k)$ and time $n+1$, dTemps[5]=dT_ijkp1_np1 is the temperature at radial position $(i,j,k+1)$ and time $n+1$, dTemps[6]=dT_ijkm1_np1 is the temperature at radial position $(i,j,k-1)$ and time $n+1$.
in	*i*	is the radial index to evaluate the function at.
in	*j*	is the theta index to evaluate the function at.
in	*k*	is the phi index to evaluate the function at.

Boundary Conditions Using $E_{i,j,k}^{n+1/2}$ for $E_{i+1/2,j,k}^{n+1/2}$

Boundary Conditions Using centered gradient for upwind gradient when motion is into the star at the surface

Boundary Conditions Missing grid.dLocalGridOld[grid.nT][i+1][0][0] using flux equals $2\sigma T^4$ at surface.

References Time::dDeltat_np1half, eos::dGetEnergy(), eos::dGetOpacity(), eos::dGetPressure(), Grid::dLocalGridNew, Grid::dLocalGridOld, Parameters::dPi, Parameters::dSigma, Parameters::eosTable, Grid::nCenIntOffset, Grid::nD, Grid::nDenAve, Grid::nDM, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nR, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nT, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by setMainFunctions().

6.12.2.95 void implicitSolve_None (Grid & *grid*, Implicit & *implicit*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*, MessPass & *messPass*, Functions & *functions*)

This is an empty function, to be called when no implicit solution is needed. This allows the same code in the main program to be executed wheather or not an implicit solution is being preformed by setting the funciton pointer to this funciton if there is no implicit solution required.

Referenced by setMainFunctions().

6.12.2.96 void implicitSolve_R (Grid & *grid*, Implicit & *implicit*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*, MessPass & *messPass*, Functions & *functions*)

This function solves for temperature corrections based on derivatives of the radial non-adiabatic energy equation with respect to the new temperature. It then uses these derivatives as entries in the coeffecient matrix. The discrepancy in the balance of the energy equation with the new temperature, energy, pressure, and opacity are included as the right hand side of the system of equaitons. Solving this system of equaitons provides the corrections needed for the new temperature. This processes is then repeated until the corrections are small. At this point the new temperature is used to update the energy, pressure, and opacity in the new grid via the equaiton of state.

References calNewPEKappaGamma_TEOS(), Implicit::dAverageRHS, Implicit::d-CurrentRelTError, Implicit::dDerivativeStepFraction, Grid::dLocalGridNew, Implicit-::dMaxErrorInRHS, Implicit::dTolerance, Implicit::kspContext, Implicit::matCoeff, -Implicit::nCurrentNumIterations, Implicit::nLocDer, Implicit::nLocFun, Implicit::nMax-NumIterations, Implicit::nMaxNumSolverIterations, Implicit::nNumDerPerRow, Implicit-::nNumRowsALocal, Implicit::nNumRowsALocalSB, ProcTop::nRank, Grid::nT, Time-::nTimeStepIndex, Implicit::nTypeDer, updateLocalBoundariesNewGrid(), Implicit-::vecRHS, Implicit::vecscatTCorrections, Implicit::vecTCorrections, and Implicit::vec-TCorrectionsLocal.

Referenced by setMainFunctions().

6.12.2.97 void implicitSolve_RT (Grid & *grid*, Implicit & *implicit*, Parameters & *parameters*, Time & *time*, ProcTop & *procTop*, MessPass & *messPass*, Functions & *functions*)

This function solves for temperature corrections based on derivatives of the radial-theta non-adiabatic energy equation with respect to the new temperature. It then uses these derivatives as entries in the coeffecient matrix. The discrepancy in the balance of the energy equation with the new temperature, energy, pressure, and opacity are included as the right hand side of the system of equaitons. Solving this system of equaitons provides the corrections needed for the new temperature. This processes is then repeated until the corrections are small. At this point the new temperature is used to update the energy, pressure, and opacity in the new grid via the equaiton of state.

References calNewPEKappaGamma_TEOS(), Implicit::dAverageRHS, Implicit::d-CurrentRelTError, Implicit::dDerivativeStepFraction, Grid::dLocalGridNew, Implicit-::dMaxErrorInRHS, Implicit::dTolerance, Implicit::kspContext, Implicit::matCoeff, -Implicit::nCurrentNumIterations, Implicit::nLocDer, Implicit::nLocFun, Implicit::nMax-NumIterations, Implicit::nMaxNumSolverIterations, Implicit::nNumDerPerRow, Implicit-::nNumRowsALocal, Implicit::nNumRowsALocalSB, ProcTop::nRank, Grid::nT, Time-::nTimeStepIndex, Implicit::nTypeDer, updateLocalBoundariesNewGrid(), Implicit-::vecRHS, Implicit::vecscatTCorrections, Implicit::vecTCorrections, and Implicit::vec-TCorrectionsLocal.

Referenced by setMainFunctions().

6.12.2.98 void implicitSolve_RTP (Grid & *grid,* Implicit & *implicit,* Parameters & *parameters,* Time & *time,* ProcTop & *procTop,* MessPass & *messPass,* Functions & *functions*)

This function solves for temperature corrections based on derivatives of the radial-theta-phi non-adiabatic energy equation with respect to the new temperature. It then uses these derivatives as entries in the coeffecient matrix. The discrepancy in the balance of the energy equation with the new temperature, energy, pressure, and opacity are included as the right hand side of the system of equaitons. Solving this system of equaitons provides the corrections needed for the new temperature. This processes is then repeated until the corrections are small. At this point the new temperature is used to update the energy, pressure, and opacity in the new grid via the equaiton of state.

References calNewPEKappaGamma_TEOS(), Implicit::dAverageRHS, Implicit::d-CurrentRelTError, Implicit::dDerivativeStepFraction, Grid::dLocalGridNew, Implicit-::dMaxErrorInRHS, Implicit::dTolerance, Implicit::kspContext, Implicit::matCoeff, -Implicit::nCurrentNumIterations, Implicit::nLocDer, Implicit::nLocFun, Implicit::nMax-NumIterations, Implicit::nMaxNumSolverIterations, Implicit::nNumDerPerRow, Implicit-::nNumRowsALocal, Implicit::nNumRowsALocalSB, ProcTop::nRank, Grid::nT, Time-::nTimeStepIndex, Implicit::nTypeDer, updateLocalBoundariesNewGrid(), Implicit-::vecRHS, Implicit::vecscatTCorrections, Implicit::vecTCorrections, and Implicit::vec-TCorrectionsLocal.

Referenced by setMainFunctions().

6.12.2.99 void initDonorFracAndMaxConVel_R_GL (Grid & *grid,* Parameters & *parameters*)

Initializes the donor fraction, and the maximum convective velocity when starting a calculation. The donor fraction is used to determine the amount of upwinded donor cell to use in advection terms. The maximum convective velocity is used for calculation of constant eddy viscosity parameter. This version of the fuction is for 1D, gamma law calculations.

References Parameters::dDonorCellMin, Parameters::dDonorCellMultiplier, Parameters::dGamma, Grid::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nU0.

Referenced by initInternalVars().

6.12.2.100 void initDonorFracAndMaxConVel_R_TEOS (Grid & *grid,* Parameters & *parameters*)

Initializes the donor fraction, and the maximum convective velocity when starting a calculation. The donor fraction is used to determine the amount of upwinded donor cell to use in advection terms. The maximum convective velocity is used for calculation of constant eddy viscosity parameter. This version of the fuction is for 1D, tabulated equation of state calculations.

References Parameters::dDonorCellMin, Parameters::dDonorCellMultiplier, Grid::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nStartUpdateExplicit, Grid::nU, and Grid::nU0.

Referenced by initInternalVars().

6.12.2.101 void initDonorFracAndMaxConVel_RT_GL (Grid & *grid,* Parameters & *parameters*)

Initializes the donor fraction, and the maximum convective velocity when starting a calculation. The donor fraction is used to determine the amount of upwinded donor cell to use in advection terms. The maximum convective velocity is used for calculation of constant eddy viscosity parameter. This version of the fuction is for 2D, gamma law calculations.

References Parameters::dDonorCellMin, Parameters::dDonorCellMultiplier, Parameters::dGamma, Grid::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by initInternalVars().

6.12.2.102 void initDonorFracAndMaxConVel_RT_TEOS (Grid & *grid,* Parameters & *parameters*)

Initializes the donor fraction, and the maximum convective velocity when starting a calculation. The donor fraction is used to determine the amount of upwinded donor cell to use in advection terms. The maximum convective velocity is used for calculation of constant eddy viscosity parameter. This version of the fuction is for 2D, tabulated equation of state calculations.

References Parameters::dDonorCellMin, Parameters::dDonorCellMultiplier, Grid::d-LocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, -Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, and Grid::nV.

Referenced by initInternalVars().

6.12.2.103 void **initDonorFracAndMaxConVel_RTP_GL** (**Grid** & *grid*, **Parameters** & *parameters*)

Initializes the donor fraction, and the maximum convective velocity when starting a calculation. The donor fraction is used to determine the amount of upwinded donor cell to use in advection terms. The maximum convective velocity is used for calculation of constant eddy viscosity parameter. This version of the fuction is for 3D, gamma law calculations.

References Parameters::dDonorCellMin, Parameters::dDonorCellMultiplier, Parameters-::dGamma, Grid::dLocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenInt-Offset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEnd-UpdateExplicit, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by initInternalVars().

6.12.2.104 void **initDonorFracAndMaxConVel_RTP_TEOS** (**Grid** & *grid*, **Parameters** & *parameters*)

Initializes the donor fraction, and the maximum convective velocity when starting a calculation. The donor fraction is used to determine the amount of upwinded donor cell to use in advection terms. The maximum convective velocity is used for calculation of constant eddy viscosity parameter. This version of the fuction is for 3D, tabulated equation of state calculations.

References Parameters::dDonorCellMin, Parameters::dDonorCellMultiplier, Grid::d-LocalGridOld, Parameters::dMaxConvectiveVelocity, Grid::nCenIntOffset, Grid::nD, Grid::nDonorCellFrac, Grid::nEndGhostUpdateExplicit, Grid::nEndUpdateExplicit, -Grid::nGamma, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nStartUpdateExplicit, Grid::nU, Grid::nU0, Grid::nV, and Grid::nW.

Referenced by initInternalVars().

6.12.2.105 void **initInternalVars** (**Grid** & *grid*, **ProcTop** & *procTop*, **Parameters** & *parameters*)

This function function is used to set the initial values of the internal variables. While external variables are initialized from the starting model, internal variables are calculated at startup.

Parameters

`in,out`	*grid*	supplies information needed for initilizing internal variables as well as storing the initilized internal variables
`in`	*procTop*	contians information about processor topology
`in`	*parameters*	contains parameters used in initializing the internal variables.

Warning

$\Delta\theta$, $\Delta\phi$, $\sin\theta_{i,j,k}$, $\Delta\cos\theta_{i,j,k}$, all don't have the first zone calculated. At the moment this is a ghost cell that doesn't matter, but it may become a problem if calculations require this quantity. This is an issue for quantities that aren't updated in time, as those that are will have boundary cells updated with periodic boundary conditions.

References Parameters::bEOSGammaLaw, calOldDenave_R(), calOldDenave_RT(), calOldDenave_RTP(), calOldEddyVisc_R_CN(), calOldEddyVisc_R_SM(), calOldEddyVisc_RT_CN(), calOldEddyVisc_RT_SM(), calOldEddyVisc_RTP_CN(), calOldEddyVisc_RTP_SM(), calOldP_GL(), calOldPEKappaGamma_TEOS(), calOldQ0_R_GL(), calOldQ0_R_TEOS(), calOldQ0Q1_RT_GL(), calOldQ0Q1_RT_TEOS(), calOldQ0Q1Q2_RTP_GL(), calOldQ0Q1Q2_RTP_TEOS(), Grid::dLocalGridOld, initDonorFracAndMaxConVel_R_GL(), initDonorFracAndMaxConVel_R_TEOS(), initDonorFracAndMaxConVel_RT_GL(), initDonorFracAndMaxConVel_RT_TEOS(), initDonorFracAndMaxConVel_RTP_GL(), initDonorFracAndMaxConVel_RTP_TEOS(), Grid::nCenIntOffset, Grid::nCotThetaIJK, Grid::nCotThetaIJp1halfK, Grid::nDCosThetaIJK, Grid::nDPhi, Grid::nDTheta, Grid::nLocalGridDims, Grid::nNumDims, Grid::nNumGhostCells, Grid::nPhi, ProcTop::nRank, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Grid::nTheta, and Parameters::nTypeTurbulanceMod.

Referenced by init().

6.12.2.106 void setInternalVarInf (Grid & *grid*, Parameters & *parameters*)

This function sets the information for internal variables. While external verabile information is derived from the starting model, internal variables infos are set in this function. In other words this function sets the values of Grid::nVariables.

Parameters

`in,out`	*grid*	supplies the information needed to calculate the horizontal density average, it also stores the calculated horizontally averaged density.
`in`	*parameters*	is used when setting variable infos, since one needs to know if the code is calculating using a gamma law gas, or a tabulated equation of state.

References Parameters::bEOSGammaLaw, Grid::nCotThetaIJK, Grid::nCotThetaIJp1halfK, Grid::nDCosThetaIJK, Grid::nDenAve, Grid::nDonorCellFrac, Grid::nDPhi, Grid::nDTheta, Grid::nE, Grid::nEddyVisc, Grid::nGamma, Grid::nKappa, Grid::nNumDims, Grid::nNumIntVars, Grid::nNumVars, Grid::nP, Grid::nQ0, Grid::nQ1, Grid::nQ2, Grid::nSinThetaIJK, Grid::nSinThetaIJp1halfK, Parameters::nTypeTurbulanceMod, and Grid::nVariables.

Referenced by modelRead().

6.12.2.107 void setMainFunctions (Functions & *functions*, ProcTop & *procTop*, Parameters & *parameters*, Grid & *grid*, Time & *time*, Implicit & *implicit*)

Used to set the functions that main() uses to evolve the input model.

Parameters

out	*functions*	is of class Functions and is used to specify the functions called to calculate the evolution of the input model.
in	*procTop*	is of type ProcTop. ProcTop::nRank is used to set different functions based on processor rank. For instance processor rank 1 requires 1D versions of the equations.
in	*parameters*	is of class Parameters. It holds various constants and run-time parameters.
in	*grid*	of type Grid. This function requires the number of dimensions, specified by Grid::nNumDims.
in	*time*	of type Time. This function requires knowledge of the type of time setp being used, specified by Time::bVariableTimeStep.
in	*implicit*	of type Implicit. This function needs to know if there is an implicit region, specified when Implicit::nNumImplicitZones$>$0.

The functions are picked based on model geometry, and the physics requested or required by the input model, and the configuration file. The specific functions pointers that are set are described in the Functions class.

References Parameters::bAdiabatic, Parameters::bEOSGammaLaw, Time::bVariableTimeStep, calDelt_CONST(), calDelt_R_GL(), calDelt_R_TEOS(), calDelt_RT_GL(), calDelt_RT_TEOS(), calDelt_RTP_GL(), calDelt_RTP_TEOS(), calNewD_R(), calNewD_RT(), calNewD_RTP(), calNewDenave_None(), calNewDenave_R(), calNewDenave_RT(), calNewDenave_RTP(), calNewE_R_AD(), calNewE_R_NA(), calNewE_RT_AD(), calNewE_RT_NA(), calNewE_RT_NA_LES(), calNewE_RTP_AD(), calNewE_RTP_NA(), calNewE_RTP_NA_LES(), calNewEddyVisc_None(), calNewEddyVisc_RT_CN(), calNewEddyVisc_RT_SM(), calNewEddyVisc_RTP_CN(), calNewEddyVisc_RTP_SM(), calNewP_GL(), calNewQ0_R_GL(), calNewQ0_R_TEOS(), calNewQ0Q1_RT_GL(), calNewQ0Q1_RT_TEOS(), calNewQ0Q1Q2_RTP_GL(), calNewQ0Q1Q2_RTP_TEOS(), calNewR(), calNewTPKappaGamma_TEOS(), calNewU0_R(), calNewU0_RT(), calNewU0_RTP(), calNewVelocities_R(), calNewVelocities_RT(), calNewVelocities_RT_LES(), calNewVelocities_RTP(), calNewVelocities_RTP_LES(), dImplicitEnergyFunction_None(), dImplicitEnergyFunction_R(), dImplicitEnergyFunction_R_SB(), dImplicitEnergyFunction_RT(), dImplicitEnergyFunction_RT_LES(), dImplicitEnergyFunction_RT_LES_SB(), dImplicitEnergyFunction_RT_SB(), dImplicitEnergyFunction_RTP(), dImplicitEnergyFunction_RTP_LES(), dImplicitEnergyFunction_RTP_LES_SB(), dImplicitEnergyFunction_RTP_SB(), Functions::fpCalculateAveDensities, Functions::fpCalculateDeltat, Functions::fp-

CalculateNewAV, Functions::fpCalculateNewDensities, Functions::fpCalculateNew-EddyVisc, Functions::fpCalculateNewEnergies, Functions::fpCalculateNewEOSVars, Functions::fpCalculateNewGridVelocities, Functions::fpCalculateNewRadii, Functions-::fpCalculateNewVelocities, Functions::fpImplicitSolve, Functions::fpModelWrite, -Functions::fpUpdateLocalBoundaryVelocitiesNewGrid, Functions::fpWriteWatchZones, implicitSolve_None(), implicitSolve_R(), implicitSolve_RT(), implicitSolve_RTP(), modelWrite_GL(), modelWrite_TEOS(), Grid::nNumDims, Implicit::nNumImplicitZones, ProcTop::nRank, Parameters::nTypeTurbulanceMod, updateLocalBoundaryVelocities-NewGrid_R(), updateLocalBoundaryVelocitiesNewGrid_RT(), updateLocalBoundary-VelocitiesNewGrid_RTP(), writeWatchZones_R_GL(), writeWatchZones_R_TEOS(), writeWatchZones_RT_GL(), writeWatchZones_RT_TEOS(), writeWatchZones_RTP_-GL(), and writeWatchZones_RTP_TEOS().

Referenced by main().

6.13 procTop.cpp File Reference

`#include "procTop.h"` `#include <cstring>`

6.13.1 Detailed Description

Implementation file for the ProcTop class

6.14 procTop.h File Reference

Classes

- class ProcTop

6.14.1 Detailed Description

Header file for the ProcTop class

6.15 profileData.h File Reference

`#include <string>` `#include <vector>` `#include <map>` × `#include <limits>` `#include "time.h"` `#include "procTop.h"` `#include <fstream>`

Classes

- class profileData

6.15.1 Detailed Description

Header file for keepMax::cpp

6.16 time.cpp File Reference

`#include "time.h" #include <limits>`

6.16.1 Detailed Description

Implementation file for the Time class

6.17 time.h File Reference

Classes

- class Time

6.17.1 Detailed Description

Header file for the ProcTop class

6.18 watchzone.cpp File Reference

`#include "watchzone.h" #include "exception2.h" #include <sstream>`

6.18.1 Detailed Description

This file holds the implementation of the watchzone class.

6.19 watchzone.h File Reference

`#include <string> #include <fstream>`

Classes

- class WatchZone

6.19.1 Detailed Description

This file holds the definition of the watchzone class.

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