Interpola

v2.0

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Chapter 1

Interpola

Emission Interpolation to a new mesh by using a conservative flux method

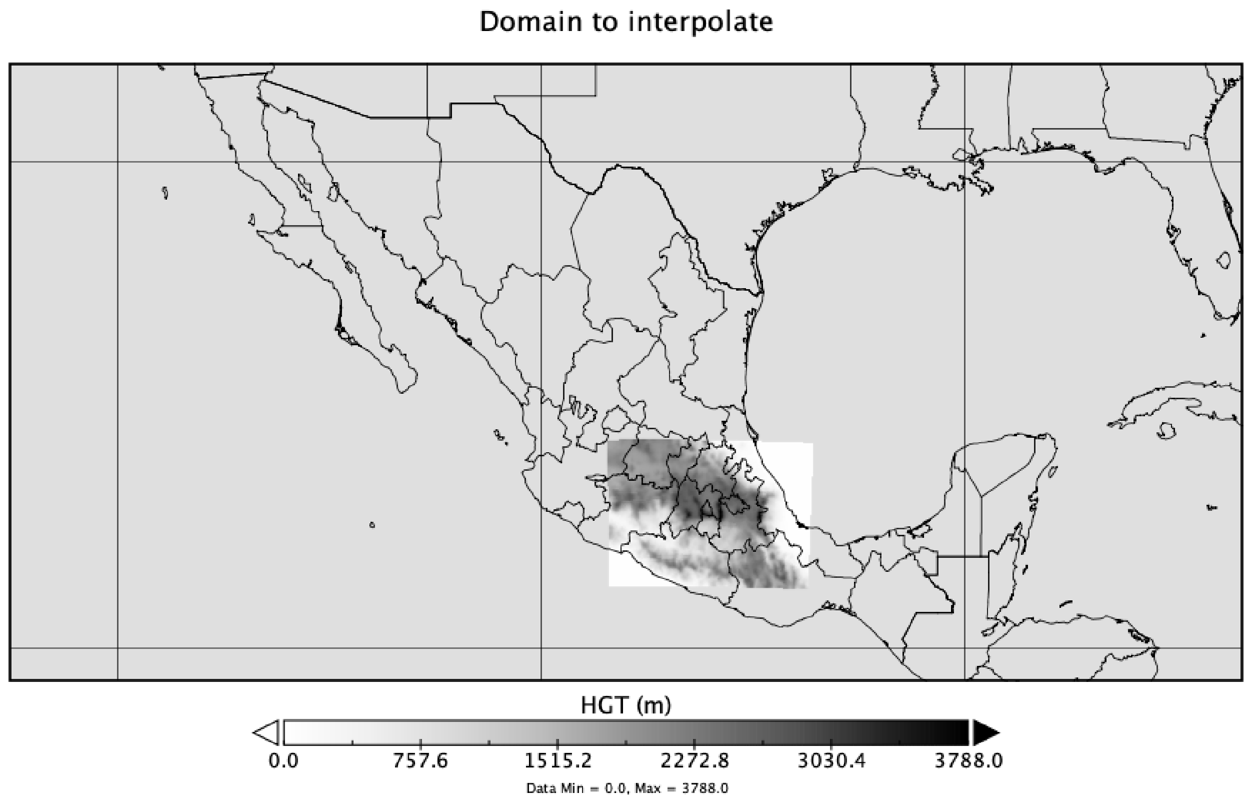
The new mesh is provided by the wrfinput file and the original grid with emissions are provided from wrfchem file
input files:

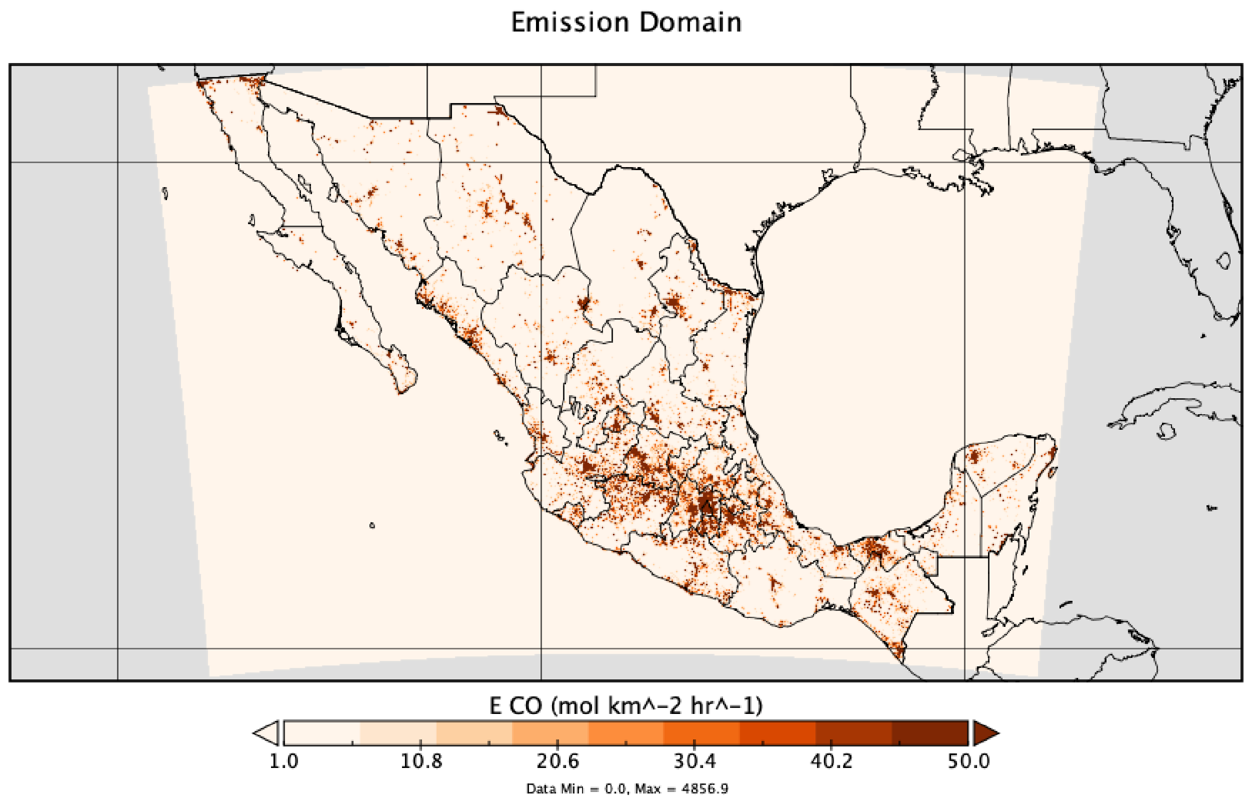
```
        wrfchemin.nc  ! A 12 hours emission file to be interpolated (0 to 11 hour or 12 to 23 hour)
        wrfinput      ! Domain where emissions will be interpolated
```

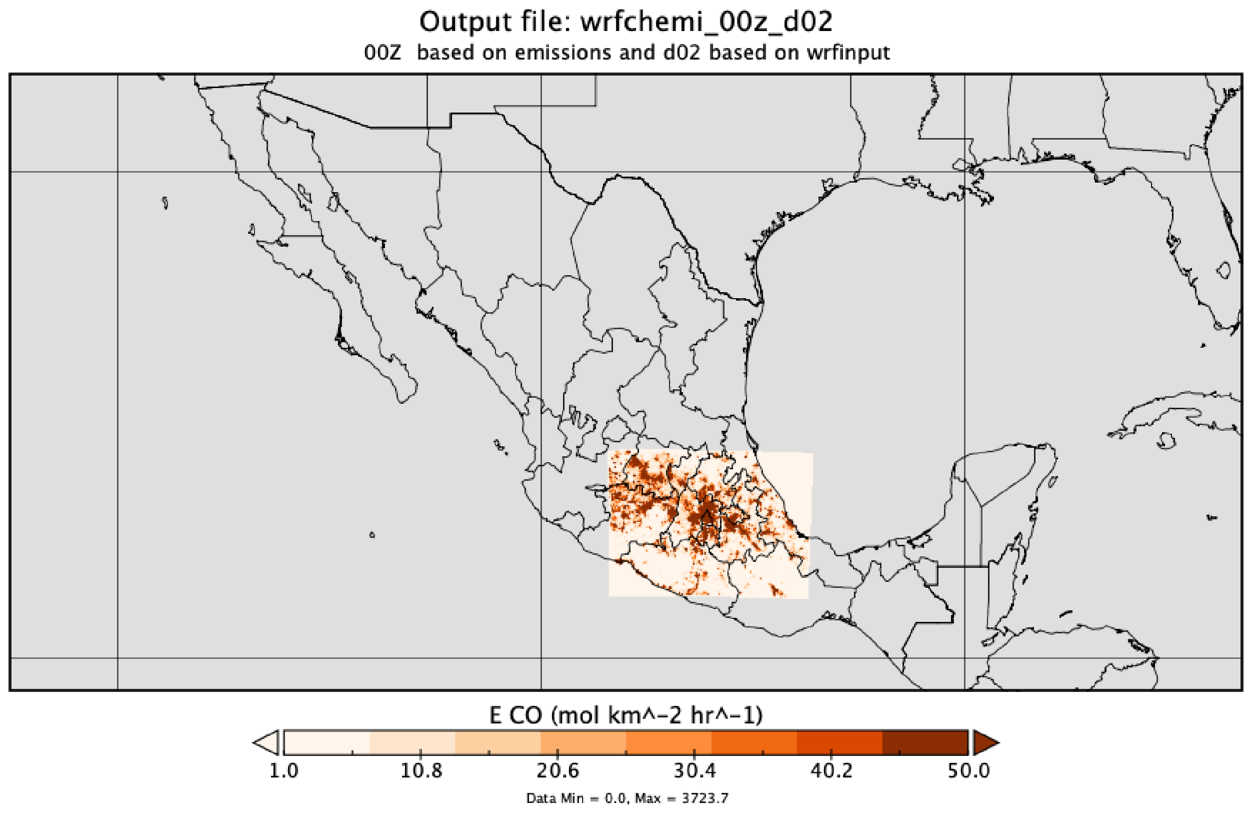
output file:

```
        wrfchemi_00z_d01 or wrfchemi_12z_d01 ! 00z or 12z based on emissions file.
                                             ! d01, d02,... based on wrfinput
```

wrfchemin.nc - file contain emissions starting with "E_"

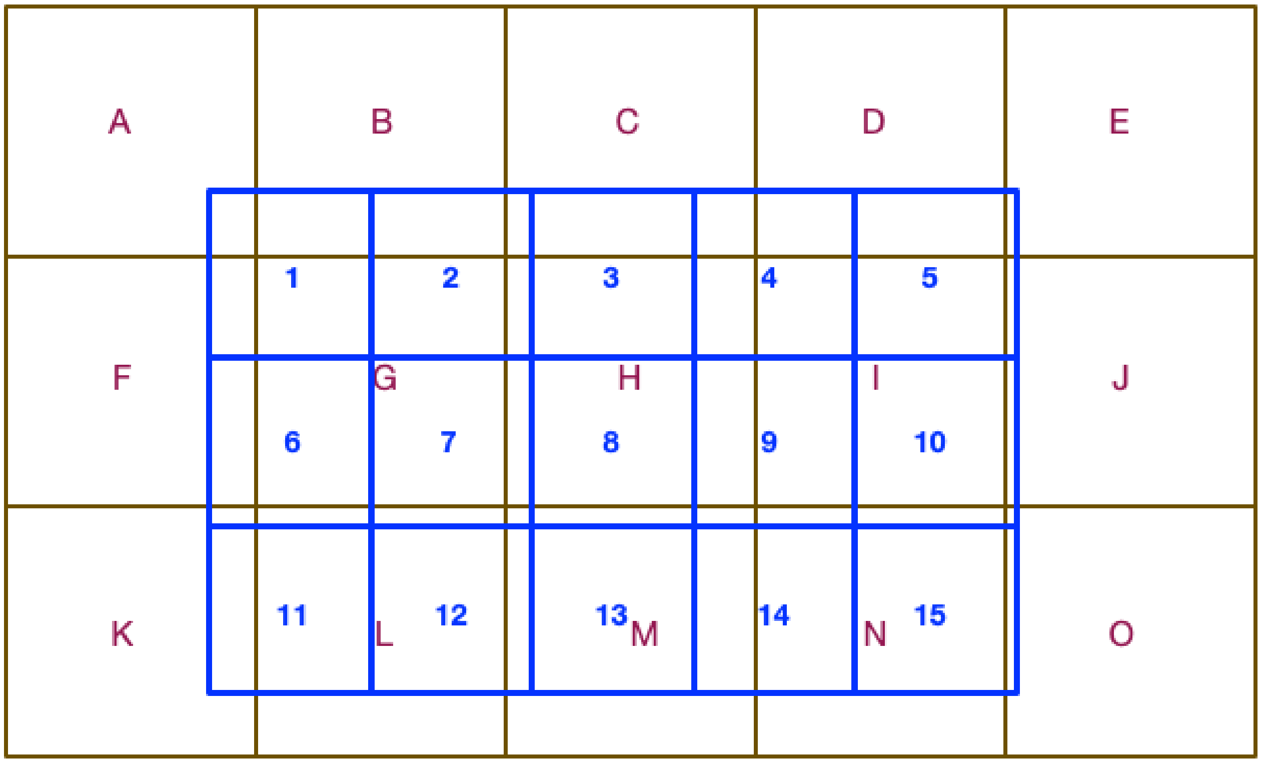



Emission Domain
E CO (mol km^-2 hr^-1)
1.0
10.8
20.6
30.4
40.2
50.0
Data Min = 0.0, Max = 4856.9


Output file: wrfchemi_00z_d02
00Z based on emissions and d02 based on wrfinput
E CO (mol km^-2 hr^-1)
1.0
10.8
20.6
30.4
40.2
50.0
Data Min = 0.0, Max = 3723.7

1.1 Mass conservative interpolation in overlaping grids

Emissions Inventories are generatred for represent global, regional or local emissions, air quality models domains are displayed in a different grid (dimensions and location) than the emissions. On other hand, emissions are a flux and it is necesary to use a mass conservative interpolation in order to avoid inconsistencies in the emissions. An example of overlaping grids is presented in the followgin figure.

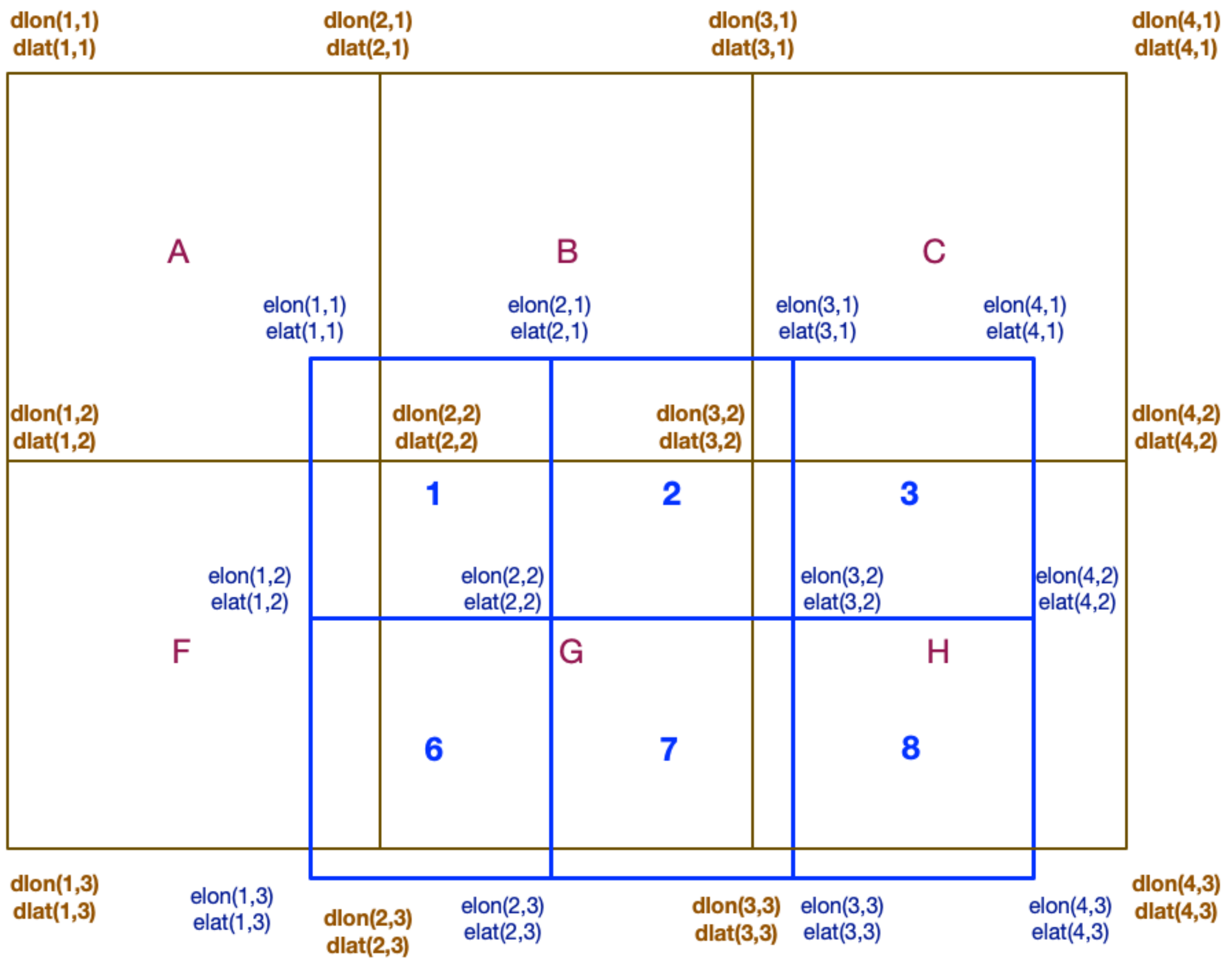


Grid with letters represents the new domain (it has coordinates dlat,dlon) and grid with numbers is the emissions (it has coordinates elat,elon). For N emission there are N+1 coordinates in each axis.

For the new domain to interpolate the emissions the following variables are set:

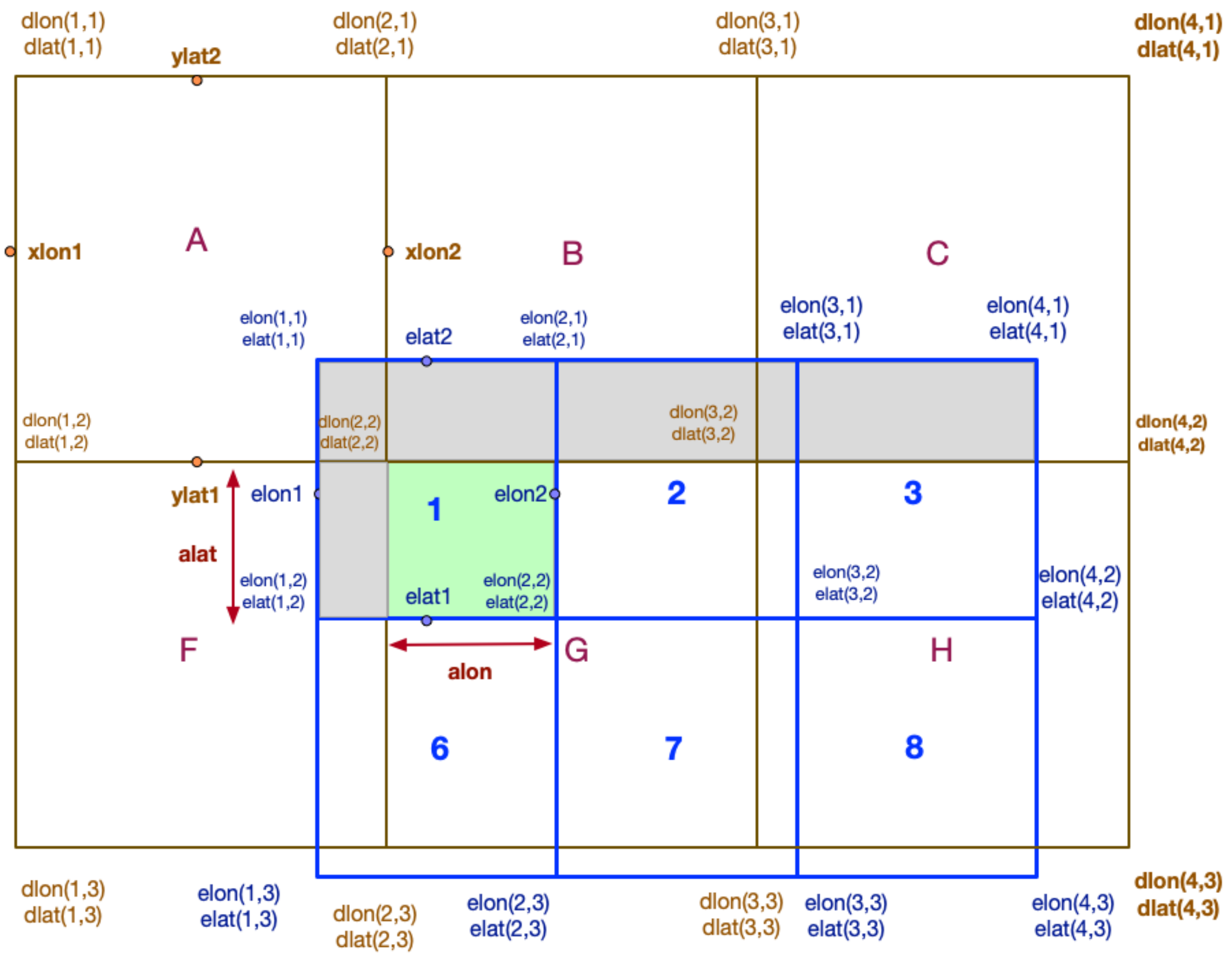
New domain	Emissions domain
`ylat1=.5*(dlat(i,j-1)+dlat(i,j))`	`elat1= 0.5*(elat(ii,jj)+elat(ii,jj-1))`
`ylat2=.5*(dlat(i,j+1)+dlat(i,j))`	`elat2= 0.5*(elat(ii,jj)+elat(ii,jj+1))`
`xlon1=.5*(dlon(i-1,j)+dlon(i,j))`	`elon1= 0.5*(elon(ii,jj)+elon(ii-1,jj))`
`xlon2=.5*(dlon(i+1,j)+dlon(i,j))`	`elon2= 0.5*(elon(ii,jj)+elon(ii+1,jj))`

The following figure presents the locations of the coordinates in each mesh.



The following procedure is followed for obtainig the new emissions in the new grid:

```
alat=(min(ylat2,elat2)-max(ylat1,elat1))
alon=(min(xlon2,elon2)-max(xlon1,elon1))
area=max(0.,alat*alon)
```



Emissions in cell **A** are a flux emission fraction from 1, for **B** a flux fractions from 1 and 2, and for **C** fluxes from 2 and 3, **F** fluxes from 1 and 6, **G** from 1, 2, 6 and 7 and **H** from 2, 3, 4, 7, 8 and 9, and so on.

Chapter 2

Modules Index

2.1 Modules List

Here is a list of all modules with brief descriptions:

Chapter 3

File Index

3.1 File List

Here is a list of all files with brief descriptions:

Chapter 4

Module Documentation

4.1 vars_dat Module Reference

Set up variables used during the process.

Variables

- integer, parameter nh =24
- integer ndims

  Number of dimension in wrfinput file.
- integer zlev

  Number of emissions layers (1 to 8)
- integer radm =0

  number of emissions classes
- real, dimension(:,:,:,:,:), allocatable ei

  emissions input file dimensions `nx`, `ny`,`level`, `nh`, `radm`
- real, dimension(:,:,:,:,:), allocatable ed

  emissions in new DOMAIN file dimensions `nx`, `ny`,`level`, `nh`, `radm`
- real, dimension(:,:), allocatable elat

  Latitudes from input file emissions.
- real, dimension(:,:), allocatable elon

  Longitudes from input file emissions.
- real, dimension(:,:), allocatable epob

  Density population from input file emissions.
- real, dimension(:,:), allocatable dlat

  Latitudes in new domain `nx`, `ny` *from new domain* `ed`.
- real, dimension(:,:), allocatable dlon

  Longitudes in new domain `nx`, `ny` *from new domain* `ed`.
- real, dimension(:,:), allocatable dpob

  Density population in new domain `nx`, `ny` *from new domain* `ed`.
- real, dimension(:,:,:), allocatable xlon

Longitudes in emissions domain nx, ny.
- real, dimension(:,:,:), allocatable xlat

  Latitudes in emissions domain nx, ny.
- integer dix

  Number of values in longitude in new file.
- integer djx

  Number of values in latitude in new file.
- integer eix

  Number of values in longitude in emissions file.
- integer ejx

  Number of values in latitude in emissions file.
- integer grid_id

  Domain number (d01, d02, etc.) from wrfinput.
- integer julyr

  Julian year in emissions file.
- integer julday

  Julian day in emissions file.
- integer mapproj

  Map projection type.
- integer iswater

  Value for land use water.
- integer islake

  Value for land use lake.
- integer isice

  Value for land use ice.
- integer isurban

  Value for land use urban.
- integer isoilwater

  Value for land use ice.
- integer unlimdimid

  ID unlimit variable (time)
- real cenlat

  Central latitude.
- real cenlon

  Central longitude.
- real dx

  Grid dimension in m output file x.
- real dy

  Grid dimension in m output file y.
- real dxe

  Grid dimension in m emissions file x.
- real dye

  Grid dimension in m emissions file y.
- real trulat1

  True latitud lower.
- real trulat2

  True latitud higer.

- real moadcenlat

  Mother of all domains center latitude.
- real stdlon

  Standard longitude.
- real pollat

  The pole latitude.
- real pollon

  The pole longitude.
- real gmt

  GMT time.
- real num_land_cat

  Number of land categories.
- character(len=3) cday

  Day type (lun, mar, mie, jue, vie, sab, dom)
- character(len=19) mminlu

  Land use input description.
- character(len=19) map_proj_char

  Map projection description.
- character(len=19) itime

  Counter for time in file.
- character(len=38) title

  Title description input/output files for V4 should have V4.0.
- character(len=19), dimension(1, 1) times

  Start date in input emissions file.
- character(len=19) current_date

  Current date in input emissions file.
- character(len=19) mecha

  Chemical mechanism name.
- character(len=19), dimension(:), allocatable sdim

  Vector of dimensions descriptions.
- character(len=11), dimension(:), allocatable ename

  Emissions description long.
- character(len=50), dimension(:), allocatable cname

  Emissions name variable short.
- character(len=50), dimension(:), allocatable cunits

  Units in emissions vars.
- logical, dimension(:), allocatable tvar

  true if input var is an emissions variable
- logical tpob

  true if input emissions files contains density population

4.1.1 Detailed Description

Set up variables used during the process.

Author

Jose Agustin Garcia Reynoso

Date

28-08-2012

Emissions Inventories Variables

Parameters

nh	Number of hours during the day

4.1.2 Variable Documentation

4.1.2.1 cday

```
character(len=3) vars_dat::cday
```

Day type (lun, mar, mie, jue, vie, sab, dom)

4.1.2.2 cenlat

```
real vars_dat::cenlat
```

Central latitude.

4.1.2.3 cenlon

```
real vars_dat::cenlon
```

Central longitude.

4.1.2.4 cname

```
character(len=50), dimension(:), allocatable vars_dat::cname
```

Emissions name variable short.

4.1.2.5 cunits

```
character(len=50), dimension(:), allocatable vars_dat::cunits
```

Units in emissions vars.

4.1.2.6 current_date

```
character (len=19) vars_dat::current_date
```

Current date in input emissions file.

4.1.2.7 dix

```
integer vars_dat::dix
```

Number of values in longitude in new file.

4.1.2.8 djx

```
integer vars_dat::djx
```

Number of values in latitude in new file.

4.1.2.9 dlat

`real, dimension(:,:), allocatable vars_dat::dlat`

Latitudes in new domain `nx`, `ny` from new domain `ed`.

4.1.2.10 dlon

`real, dimension(:,:), allocatable vars_dat::dlon`

Longitudes in new domain `nx`, `ny` from new domain `ed`.

4.1.2.11 dpob

`real, dimension(:,:), allocatable vars_dat::dpob`

Density population in new domain `nx`, `ny` from new domain `ed`.

4.1.2.12 dx

`real vars_dat::dx`

Grid dimension in m output file *x*.

4.1.2.13 dxe

`real vars_dat::dxe`

Grid dimension in m emissions file *x*.

4.1.2.14 dy

`real vars_dat::dy`

Grid dimension in m output file *y*.

4.1.2.15 dye

```
real vars_dat::dye
```

Grid dimension in m emissions file *y*.

4.1.2.16 ed

```
real, dimension(:,:,:,:,:), allocatable vars_dat::ed
```

emissions in new DOMAIN file dimensions `nx`, `ny`,`level`, `nh`, `radm`

4.1.2.17 ei

```
real, dimension(:,:,:,:,:), allocatable vars_dat::ei
```

emissions input file dimensions `nx`, `ny`,`level`, `nh`, `radm`

4.1.2.18 eix

```
integer vars_dat::eix
```

Number of values in longitude in emissions file.

4.1.2.19 ejx

```
integer vars_dat::ejx
```

Number of values in latitude in emissions file.

4.1.2.20 elat

```
real, dimension(:,:), allocatable vars_dat::elat
```

Latitudes from input file emissions.

4.1.2.21 elon

```
real, dimension(:,:), allocatable vars_dat::elon
```

Longitudes from input file emissions.

4.1.2.22 ename

```
character(len=11), dimension(:), allocatable vars_dat::ename
```

Emissions description long.

4.1.2.23 epob

```
real, dimension(:,:), allocatable vars_dat::epob
```

Density population from input file emissions.

4.1.2.24 gmt

```
real vars_dat::gmt
```

GMT time.

4.1.2.25 grid_id

```
integer vars_dat::grid_id
```

Domain number (d01, d02, etc.) from wrfinput.

4.1.2.26 isice

```
integer vars_dat::isice
```

Value for land use ice.

4.1.2.27 islake

```
integer vars_dat::islake
```

Value for land use lake.

4.1.2.28 isoilwater

```
integer vars_dat::isoilwater
```

Value for land use ice.

4.1.2.29 isurban

```
integer vars_dat::isurban
```

Value for land use urban.

4.1.2.30 iswater

```
integer vars_dat::iswater
```

Value for land use water.

4.1.2.31 itime

```
character(len=19) vars_dat::itime
```

Counter for time in file.

4.1.2.32 julday

```
integer vars_dat::julday
```

Julian day in emissions file.

4.1.2.33 julyr

```
integer vars_dat::julyr
```

Julian year in emissions file.

4.1.2.34 map_proj_char

```
character(len=19) vars_dat::map_proj_char
```

Map projection description.

4.1.2.35 mapproj

```
integer vars_dat::mapproj
```

Map projection type.

4.1.2.36 mecha

```
character (len=19) vars_dat::mecha
```

Chemical mechanism name.

4.1.2.37 mminlu

```
character(len=19) vars_dat::mminlu
```

Land use input description.

4.1.2.38 moadcenlat

```
real vars_dat::moadcenlat
```

Mother of all domains center latitude.

4.1.2.39 ndims

```
integer vars_dat::ndims
```

Number of dimension in wrfinput file.

4.1.2.40 nh

```
integer, parameter vars_dat::nh =24
```

4.1.2.41 num_land_cat

```
real vars_dat::num_land_cat
```

Number of land categories.

4.1.2.42 pollat

```
real vars_dat::pollat
```

The pole latitude.

4.1.2.43 pollon

```
real vars_dat::pollon
```

The pole longitude.

4.1.2.44 radm

```
integer vars_dat::radm =0
```

number of emissions classes

4.1.2.45 sdim

```
character (len=19), dimension(:), allocatable vars_dat::sdim
```

Vector of dimensions descriptions.

4.1.2.46 stdlon

```
real vars_dat::stdlon
```

Standard longitude.

4.1.2.47 times

```
character(len=19), dimension(1,1) vars_dat::times
```

Start date in input emissions file.

4.1.2.48 title

```
character(len=38) vars_dat::title
```

Title description input/output files for V4 should have V4.0.

4.1.2.49 tpob

```
logical vars_dat::tpob
```

true if input emissions files contains density population

4.1.2.50 trulat1

```
real vars_dat::trulat1
```

True latitud lower.

4.1.2.51 trulat2

`real vars_dat::trulat2`

True latitud higer.

4.1.2.52 tvar

`logical, dimension(:), allocatable vars_dat::tvar`

true if input var is an emissions variable

4.1.2.53 unlimdimid

`integer vars_dat::unlimdimid`

ID unlimit variable (time)

4.1.2.54 xlat

`real, dimension(:,:,:), allocatable vars_dat::xlat`

Latitudes in emissions domain `nx`, `ny`.

4.1.2.55 xlon

`real, dimension(:,:,:), allocatable vars_dat::xlon`

Longitudes in emissions domain `nx`, `ny`.

4.1.2.56 zlev

`integer vars_dat::zlev`

Number of emissions layers (1 to 8)

Chapter 5

File Documentation

5.1 calculos.F90 File Reference

Functions/Subroutines

- subroutine conversion

  It does the interpolation into the new Mesh.

5.1.1 Function/Subroutine Documentation

5.1.1.1 conversion()

```
subroutine conversion
```

It does the interpolation into the new Mesh.

Interpolates the emissions into new mesh conserving mass uses emission area and the fractional area between the original and new grid to set the emissions.

Computes the mass in the original mesh and compares against the new mesh, if both domains cover the same area the ratio `xemis/ xmas` should be 1

Author

Jose Agustin Garcia Reynoso

Date

28/08/2012.

Version

2.0

5.2 Interpola.F90 File Reference

Functions/Subroutines

- program interpola

  Conservative emission interpolation from one mesh to a new mesh.

5.2.1 Function/Subroutine Documentation

5.2.1.1 interpola()

```
program interpola
```

Conservative emission interpolation from one mesh to a new mesh.

Reads emissions from a wrfchemin file and interpolates to a new mesh provided from wrfinput.

Contains a call for tree subroutines that completes the procedure

file_reading

Reads Emission inventory and the mesh to interpolate.

conversion

Computations for emissions mass conservation into the new mesh.

file_out

Create output file and write results

Author

Jose Agustin Garcia Reynoso

Date

2012/06/20

Version

2.0

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5.3 lee_files.F90 File Reference

Functions/Subroutines

- subroutine file_reading

  Reads Emission inventory and the new Mesh to interpolate emissions.
- subroutine check (status)

  Evaluation of netcdf status.

5.3.1 Function/Subroutine Documentation

5.3.1.1 check()

```
subroutine check (
            integer, intent(in) status )
```

Evaluation of netcdf status.

In case of error prints error message description

Parameters

status	An error status that might have been returned from a previous call to some netCDF function

Date

28/08/2012.

5.3.1.2 file_reading()

```
subroutine file_reading
```

Reads Emission inventory and the new Mesh to interpolate emissions.

Reads from the emission wrfchemin file the variables and attributes put emissions in `ei` array and coordinates in `xlat`, `xlon`.

reads the new mesh from wrfinput, stores the new coordinates `dlat`, `dlon`

Author

Agustin Garcia

Date

28/08/2012.

Version

2.0

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5.4 README.md File Reference

5.5 salidas.F90 File Reference

Functions/Subroutines

- subroutine file_out

  file_out creates the output file and writes the interpolated emissions from the new mesh
- subroutine crea_attr (ncid, idm, dimids, svar, cname, cunits, id_var)

  creates attributes for gas variables and aerosol variables

5.5.1 Function/Subroutine Documentation

5.5.1.1 crea_attr()

```
subroutine file_out::crea_attr (
            integer, intent(in) ncid,
            integer, intent(in) idm,
            integer, dimension(idm), intent(in) dimids,
            character(len=*), intent(in) svar,
            character(len=*), intent(in) cname,
            character(len=*), intent(in) cunits,
            integer, intent(out) id_var )
```

creates attributes for gas variables and aerosol variables

Author

Agustin Garcia

Date

28/08/2012

Parameters

`in`	*ncid*	netCDF ID, from a previous call to NF90_OPEN or NF90_CREATE
`in`	*idm*	Number of dimensions in `dimids`
`out`	*id_var*	ID from variable to store
`in`	*dimids*	Array with ID for each dimension
`in`	*svar*	Short name of variable to store
`in`	*cname*	Description of variable to store
`in`	*cunits*	Units for variable to store

5.5.1.2 file_out()

```
subroutine file_out
```

file_out creates the output file and writes the interpolated emissions from the new mesh

Uses the attributes from wrfinput file

Uses current_date from wrfchemin file

Author

Agustin Garcia

Date

28/08/2012

5.6 vars_dat_mod.F90 File Reference

Modules

- module vars_dat

  Set up variables used during the process.

Variables

- integer, parameter vars_dat::nh =24
- integer vars_dat::ndims

  Number of dimension in wrfinput file.
- integer vars_dat::zlev

  Number of emissions layers (1 to 8)
- integer vars_dat::radm =0

  number of emissions classes
- real, dimension(:,:,:,:,:), allocatable vars_dat::ei

  emissions input file dimensions `nx`, `ny`,`level`, `nh`, `radm`
- real, dimension(:,:,:,:,:), allocatable vars_dat::ed

  emissions in new DOMAIN file dimensions `nx`, `ny`,`level`, `nh`, `radm`
- real, dimension(:,:), allocatable vars_dat::elat

  Latitudes from input file emissions.
- real, dimension(:,:), allocatable vars_dat::elon

  Longitudes from input file emissions.
- real, dimension(:,:), allocatable vars_dat::epob

  Density population from input file emissions.
- real, dimension(:,:), allocatable vars_dat::dlat

  Latitudes in new domain `nx`, `ny` from new domain `ed`.
- real, dimension(:,:), allocatable vars_dat::dlon

  Longitudes in new domain `nx`, `ny` from new domain `ed`.
- real, dimension(:,:), allocatable vars_dat::dpob

  Density population in new domain `nx`, `ny` from new domain `ed`.
- real, dimension(:,:,:), allocatable vars_dat::xlon

  Longitudes in emissions domain `nx`, `ny`.
- real, dimension(:,:,:), allocatable vars_dat::xlat

  Latitudes in emissions domain `nx`, `ny`.
- integer vars_dat::dix

  Number of values in longitude in new file.
- integer vars_dat::djx

  Number of values in latitude in new file.
- integer vars_dat::eix

  Number of values in longitude in emissions file.
- integer vars_dat::ejx

  Number of values in latitude in emissions file.
- integer vars_dat::grid_id

  Domain number (d01, d02, etc.) from wrfinput.
- integer vars_dat::julyr

  Julian year in emissions file.
- integer vars_dat::julday

  Julian day in emissions file.
- integer vars_dat::mapproj

  Map projection type.
- integer vars_dat::iswater

  Value for land use water.

- integer vars_dat::islake

  Value for land use lake.
- integer vars_dat::isice

  Value for land use ice.
- integer vars_dat::isurban

  Value for land use urban.
- integer vars_dat::isoilwater

  Value for land use ice.
- integer vars_dat::unlimdimid

  ID unlimit variable (time)
- real vars_dat::cenlat

  Central latitude.
- real vars_dat::cenlon

  Central longitude.
- real vars_dat::dx

  Grid dimension in m output file x.
- real vars_dat::dy

  Grid dimension in m output file y.
- real vars_dat::dxe

  Grid dimension in m emissions file x.
- real vars_dat::dye

  Grid dimension in m emissions file y.
- real vars_dat::trulat1

  True latitud lower.
- real vars_dat::trulat2

  True latitud higer.
- real vars_dat::moadcenlat

  Mother of all domains center latitude.
- real vars_dat::stdlon

  Standard longitude.
- real vars_dat::pollat

  The pole latitude.
- real vars_dat::pollon

  The pole longitude.
- real vars_dat::gmt

  GMT time.
- real vars_dat::num_land_cat

  Number of land categories.
- character(len=3) vars_dat::cday

  Day type (lun, mar, mie, jue, vie, sab, dom)
- character(len=19) vars_dat::mminlu

  Land use input description.
- character(len=19) vars_dat::map_proj_char

  Map projection description.
- character(len=19) vars_dat::itime

  Counter for time in file.
- character(len=38) vars_dat::title

Title description input/output files for V4 should have V4.0.

- character(len=19), dimension(1, 1) vars_dat::times

  Start date in input emissions file.
- character(len=19) vars_dat::current_date

  Current date in input emissions file.
- character(len=19) vars_dat::mecha

  Chemical mechanism name.
- character(len=19), dimension(:), allocatable vars_dat::sdim

  Vector of dimensions descriptions.
- character(len=11), dimension(:), allocatable vars_dat::ename

  Emissions description long.
- character(len=50), dimension(:), allocatable vars_dat::cname

  Emissions name variable short.
- character(len=50), dimension(:), allocatable vars_dat::cunits

  Units in emissions vars.
- logical, dimension(:), allocatable vars_dat::tvar

  true if input var is an emissions variable
- logical vars_dat::tpob

  true if input emissions files contains density population

Index