

EMPIRE DA

0.1

Generated by Doxygen 1.8.6

Mon Sep 22 2014 15:53:13

Contents

1	Main Page	1
2	Data Type Index	3
2.1	Data Types List	3
3	File Index	5
3.1	File List	5
4	Data Type Documentation	7
4.1	comms Module Reference	7
4.1.1	Detailed Description	7
4.1.2	Member Function/Subroutine Documentation	7
4.1.2.1	allocate_data	7
4.1.2.2	deallocate_data	8
4.1.2.3	initialise_mpi	8
4.1.3	Member Data Documentation	8
4.1.3.1	cpl_mpi_comm	8
4.1.3.2	gblcount	8
4.1.3.3	gbldisp	8
4.1.3.4	mype_id	8
4.1.3.5	myrank	8
4.1.3.6	npfs	8
4.1.3.7	nproc	8
4.1.3.8	pf_mpi_comm	8
4.1.3.9	pfrank	9
4.2	histogram_data Module Reference	9
4.2.1	Detailed Description	9
4.2.2	Member Function/Subroutine Documentation	9
4.2.2.1	kill_histogram_data	9
4.2.2.2	load_histogram_data	9
4.2.3	Member Data Documentation	9
4.2.3.1	rank_hist_list	9

4.2.3.2	rank_hist_nums	9
4.2.3.3	rhl_n	9
4.2.3.4	rhn_n	9
4.3	hqht_plus_r Module Reference	10
4.3.1	Member Function/Subroutine Documentation	10
4.3.1.1	hqhtr_factor	10
4.3.1.2	kill_hqhtr	10
4.3.1.3	load_hqhtr	10
4.4	pf_control Module Reference	10
4.4.1	Detailed Description	11
4.4.2	Member Function/Subroutine Documentation	11
4.4.2.1	allocate_pf	12
4.4.2.2	deallocate_pf	12
4.4.2.3	set_pf_controls	12
4.4.3	Member Data Documentation	12
4.4.3.1	pf	13
4.5	pf_control::pf_control_type Type Reference	13
4.5.1	Member Data Documentation	14
4.5.1.1	count	14
4.5.1.2	couple_root	14
4.5.1.3	efac	14
4.5.1.4	gen_data	14
4.5.1.5	gen_q	14
4.5.1.6	human_readable	14
4.5.1.7	init	14
4.5.1.8	keep	14
4.5.1.9	mean	15
4.5.1.10	nens	15
4.5.1.11	nfac	15
4.5.1.12	nudgefac	15
4.5.1.13	particles	15
4.5.1.14	psi	15
4.5.1.15	qscale	15
4.5.1.16	talagrand	15
4.5.1.17	time	15
4.5.1.18	time_bwn_obs	15
4.5.1.19	time_obs	15
4.5.1.20	timestep	15
4.5.1.21	type	16
4.5.1.22	ufac	16

4.5.1.23	use_mean	16
4.5.1.24	use_rmse	16
4.5.1.25	use_talagrand	16
4.5.1.26	use_traj	16
4.5.1.27	use_var	16
4.5.1.28	use_weak	16
4.5.1.29	weight	16
4.6	qdata Module Reference	16
4.6.1	Detailed Description	17
4.6.2	Member Function/Subroutine Documentation	17
4.6.2.1	killq	17
4.6.2.2	loadq	17
4.6.3	Member Data Documentation	17
4.6.3.1	qcol	17
4.6.3.2	qdiag	17
4.6.3.3	qn	17
4.6.3.4	qne	17
4.6.3.5	qrow	17
4.6.3.6	qscale	17
4.6.3.7	qval	17
4.7	random Module Reference	17
4.7.1	Detailed Description	18
4.7.2	Member Function/Subroutine Documentation	18
4.7.2.1	bin_prob	18
4.7.2.2	lngamma	19
4.7.2.3	random_beta	19
4.7.2.4	random_binomial1	19
4.7.2.5	random_binomial2	20
4.7.2.6	random_cauchy	20
4.7.2.7	random_chisq	20
4.7.2.8	random_exponential	20
4.7.2.9	random_gamma	21
4.7.2.10	random_gamma1	21
4.7.2.11	random_gamma2	22
4.7.2.12	random_inv_gauss	22
4.7.2.13	random_mvnorm	22
4.7.2.14	random_neg_binomial	22
4.7.2.15	random_normal	22
4.7.2.16	random_order	23
4.7.2.17	random_poisson	24

4.7.2.18	random_t	24
4.7.2.19	random_von_mises	24
4.7.2.20	random_weibull	24
4.7.2.21	seed_random_number	25
4.7.3	Member Data Documentation	25
4.7.3.1	dp	25
4.8	rdata Module Reference	25
4.8.1	Detailed Description	25
4.8.2	Member Function/Subroutine Documentation	25
4.8.2.1	killr	25
4.8.2.2	loadr	26
4.8.3	Member Data Documentation	26
4.8.3.1	rcol	26
4.8.3.2	rdiag	26
4.8.3.3	rn	26
4.8.3.4	rne	26
4.8.3.5	rrow	26
4.8.3.6	rval	26
4.9	sizes Module Reference	26
4.9.1	Detailed Description	26
4.9.2	Member Data Documentation	26
4.9.2.1	obs_dim	26
4.9.2.2	state_dim	26
5	File Documentation	27
5.1	src/controllers/old_pf_couple.f90 File Reference	27
5.1.1	Function/Subroutine Documentation	27
5.1.1.1	couple_pf	27
5.2	src/controllers/pf_control.f90 File Reference	28
5.3	src/controllers/pf_couple.f90 File Reference	28
5.3.1	Function/Subroutine Documentation	28
5.3.1.1	empire	28
5.4	src/controllers/sizes.f90 File Reference	29
5.5	src/data/Qdata.f90 File Reference	29
5.6	src/data/Rdata.f90 File Reference	29
5.7	src/filters/eakf_analysis.f90 File Reference	29
5.7.1	Function/Subroutine Documentation	29
5.7.1.1	eakf_analysis	29
5.8	src/filters/enkf_specific.f90 File Reference	30
5.8.1	Function/Subroutine Documentation	30

5.8.1.1	get_local_observation_data	30
5.8.1.2	h_local	31
5.8.1.3	localise_enkf	31
5.8.1.4	solve_rhalf_local	32
5.9	src/filters/equivalent_weights_step.f90 File Reference	32
5.9.1	Function/Subroutine Documentation	32
5.9.1.1	equal_weight_filter	32
5.10	src/filters/etkf_analysis.f90 File Reference	33
5.10.1	Function/Subroutine Documentation	33
5.10.1.1	etkf_analysis	33
5.11	src/filters/proposal_filter.f90 File Reference	34
5.11.1	Function/Subroutine Documentation	34
5.11.1.1	proposal_filter	34
5.12	src/filters/sir_filter.f90 File Reference	34
5.12.1	Function/Subroutine Documentation	35
5.12.1.1	sir_filter	35
5.13	src/filters/stochastic_model.f90 File Reference	35
5.13.1	Function/Subroutine Documentation	35
5.13.1.1	check_scaling	35
5.13.1.2	stochastic_model	35
5.14	src/operations/gen_rand.f90 File Reference	36
5.14.1	Function/Subroutine Documentation	36
5.14.1.1	mixture_random_numbers1d	36
5.14.1.2	mixture_random_numbers2d	37
5.14.1.3	normal_random_numbers1d	38
5.14.1.4	normal_random_numbers2d	39
5.14.1.5	random_seed_mpi	40
5.14.1.6	uniform_random_numbers1d	40
5.15	src/operations/operator_wrappers.f90 File Reference	41
5.15.1	Function/Subroutine Documentation	41
5.15.1.1	bprime	41
5.15.1.2	innerhqht_plus_r_1	42
5.15.1.3	innerr_1	42
5.15.1.4	k	43
5.16	src/operations/perturb_particle.f90 File Reference	44
5.16.1	Function/Subroutine Documentation	45
5.16.1.1	perturb_particle	45
5.16.1.2	update_state	45
5.17	src/operations/resample.f90 File Reference	46
5.17.1	Function/Subroutine Documentation	46

5.17.1.1	resample	46
5.18	src/tests/alltests.f90 File Reference	47
5.18.1	Function/Subroutine Documentation	47
5.18.1.1	alltests	47
5.19	src/tests/test_h.f90 File Reference	47
5.19.1	Function/Subroutine Documentation	48
5.19.1.1	test_h	48
5.20	src/tests/test_hqhtr.f90 File Reference	48
5.20.1	Function/Subroutine Documentation	48
5.20.1.1	test_hqhtr	48
5.21	src/tests/test_q.f90 File Reference	48
5.21.1	Function/Subroutine Documentation	49
5.21.1.1	test_q	49
5.22	src/tests/test_r.f90 File Reference	49
5.22.1	Function/Subroutine Documentation	49
5.22.1.1	test_r	49
5.23	src/tests/tests.f90 File Reference	49
5.23.1	Function/Subroutine Documentation	50
5.23.1.1	h_tests	50
5.23.1.2	hqhtr_tests	50
5.23.1.3	q_tests	51
5.23.1.4	r_tests	51
5.24	src/utls/comms.f90 File Reference	52
5.25	src/utls/data_io.f90 File Reference	52
5.25.1	Function/Subroutine Documentation	53
5.25.1.1	get_observation_data	53
5.25.1.2	output_from_pf	53
5.25.1.3	save_observation_data	53
5.25.1.4	save_truth	54
5.26	src/utls/diagnostics.f90 File Reference	54
5.26.1	Function/Subroutine Documentation	54
5.26.1.1	diagnostics	54
5.26.1.2	trajectories	55
5.27	src/utls/genQ.f90 File Reference	55
5.27.1	Function/Subroutine Documentation	55
5.27.1.1	genq	56
5.28	src/utls/histogram.f90 File Reference	56
5.29	src/utls/quicksort.f90 File Reference	56
5.29.1	Function/Subroutine Documentation	56
5.29.1.1	insertionsort_d	56

5.29.1.2 quicksort_d	57
5.30 src/utls/random_d.f90 File Reference	57
Index	58

Chapter 1

Main Page

This is where we put the stuff to go at the top of the documentation. looks like this

Chapter 2

Data Type Index

2.1 Data Types List

Here are the data types with brief descriptions:

comms	Module containing EMPIRE coupling data	7
histogram_data	Module to control what variables are used to generate rank histograms	9
hqht_plus_r	10
pf_control	Module to hold all the information to control the the main program	10
pf_control::pf_control_type	13
qdata	Module as a place to store user specified data for Q	16
random	A module for random number generation from the following distributions:	17
rdata	Module to hold user supplied data for R observation error covariance matrix	25
sizes	Module that stores the dimension of observation and state spaces	26

Chapter 3

File Index

3.1 File List

Here is a list of all files with brief descriptions:

src/controllers/old_pf_couple.f90	27
src/controllers/pf_control.f90	28
src/controllers/pf_couple.f90	28
src/controllers/sizes.f90	29
src/data/Qdata.f90	29
src/data/Rdata.f90	29
src/filters/eakf_analysis.f90	29
src/filters/enkf_specific.f90	30
src/filters/equivalent_weights_step.f90	32
src/filters/etkf_analysis.f90	33
src/filters/proposal_filter.f90	34
src/filters/sir_filter.f90	34
src/filters/stochastic_model.f90	35
src/operations/gen_rand.f90	36
src/operations/operator_wrappers.f90	41
src/operations/perturb_particle.f90	44
src/operations/resample.f90	46
src/tests/alltests.f90	47
src/tests/test_h.f90	47
src/tests/test_hqhtr.f90	48
src/tests/test_q.f90	48
src/tests/test_r.f90	49
src/tests/tests.f90	49
src/utills/comms.f90	52
src/utills/data_io.f90	52
src/utills/diagnostics.f90	54
src/utills/genQ.f90	55
src/utills/histogram.f90	56
src/utills/quicksort.f90	56
src/utills/random_d.f90	57

Chapter 4

Data Type Documentation

4.1 comms Module Reference

Module containing EMPIRE coupling data.

Public Member Functions

- subroutine [allocate_data](#)
- subroutine [deallocate_data](#)
- subroutine [initialise_mpi](#)

subroutine to make EMPIRE connections and saves details into [pf_control](#) module

Public Attributes

- integer [cpl_mpi_comm](#)
- integer [mype_id](#)
- integer [myrank](#)
- integer [nproc](#)
- integer [pf_mpi_comm](#)
- integer [pfrank](#)
- integer [npfs](#)
- integer, dimension(:), allocatable [gblcount](#)
- integer, dimension(:), allocatable [gbldisp](#)

4.1.1 Detailed Description

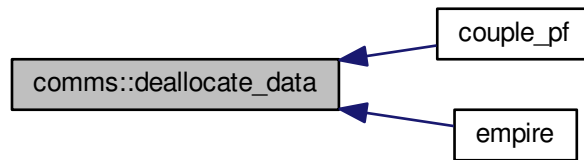
Module containing EMPIRE coupling data.

4.1.2 Member Function/Subroutine Documentation

4.1.2.1 subroutine `comms::allocate_data` ()

4.1.2.2 subroutine comms::deallocate_data ()

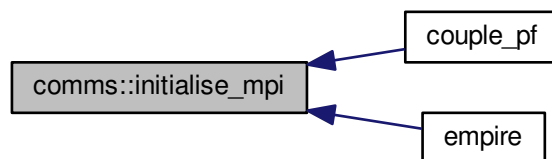
Here is the caller graph for this function:



4.1.2.3 subroutine comms::initialise_mpi ()

subroutine to make EMPIRE connections and saves details into `pf_control` module

Here is the caller graph for this function:



4.1.3 Member Data Documentation

4.1.3.1 integer `comms::cpl_mpi_comm`

4.1.3.2 integer, dimension(:), allocatable `comms::gblcount`

4.1.3.3 integer, dimension(:), allocatable `comms::gbldisp`

4.1.3.4 integer `comms::mype_id`

4.1.3.5 integer `comms::myrank`

4.1.3.6 integer `comms::npfs`

4.1.3.7 integer `comms::nproc`

4.1.3.8 integer `comms::pf_mpi_comm`

4.1.3.9 integer comms::pfrank

The documentation for this module was generated from the following file:

- [src/utils/comms.f90](#)

4.2 histogram_data Module Reference

Module to control what variables are used to generate rank histograms.

Public Member Functions

- subroutine [load_histogram_data](#)
subroutine to read from variables_hist.dat which variables to be used to make the rank histograms
- subroutine [kill_histogram_data](#)
subroutine to clean up arrays used in rank histograms

Public Attributes

- integer, dimension(:), allocatable [rank_hist_list](#)
- integer, dimension(:), allocatable [rank_hist_nums](#)
- integer [rhl_n](#)
- integer [rhn_n](#)

4.2.1 Detailed Description

Module to control what variables are used to generate rank histograms.

4.2.2 Member Function/Subroutine Documentation

4.2.2.1 subroutine histogram_data::kill_histogram_data ()

subroutine to clean up arrays used in rank histograms

4.2.2.2 subroutine histogram_data::load_histogram_data ()

subroutine to read from variables_hist.dat which variables to be used to make the rank histograms

4.2.3 Member Data Documentation

4.2.3.1 integer, dimension(:), allocatable histogram_data::rank_hist_list

4.2.3.2 integer, dimension(:), allocatable histogram_data::rank_hist_nums

4.2.3.3 integer histogram_data::rhl_n

4.2.3.4 integer histogram_data::rhn_n

The documentation for this module was generated from the following file:

- [src/utils/histogram.f90](#)

4.3 hqht_plus_r Module Reference

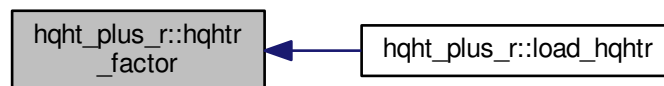
Public Member Functions

- subroutine [load_hqhtr](#)
- subroutine [hqhtr_factor](#)
- subroutine [kill_hqhtr](#)

4.3.1 Member Function/Subroutine Documentation

4.3.1.1 subroutine hqht_plus_r::hqhtr_factor ()

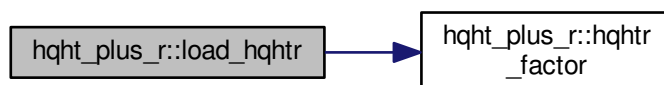
Here is the caller graph for this function:



4.3.1.2 subroutine hqht_plus_r::kill_hqhtr ()

4.3.1.3 subroutine hqht_plus_r::load_hqhtr ()

Here is the call graph for this function:



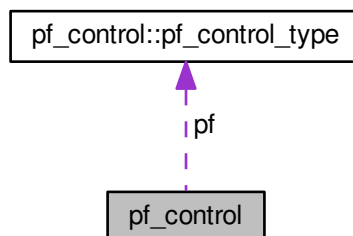
The documentation for this module was generated from the following file:

- [src/data/Rdata.f90](#)

4.4 pf_control Module Reference

module to hold all the information to control the the main program

Collaboration diagram for pf_control:



Data Types

- type `pf_control_type`

Public Member Functions

- subroutine `set_pf_controls`
- subroutine `allocate_pf`
- subroutine `deallocate_pf`

Public Attributes

- type(`pf_control_type`) `pf`

the derived data type holding all controlling data

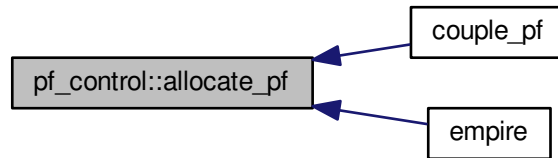
4.4.1 Detailed Description

module to hold all the information to control the the main program

4.4.2 Member Function/Subroutine Documentation

4.4.2.1 subroutine pf_control::allocate_pf ()

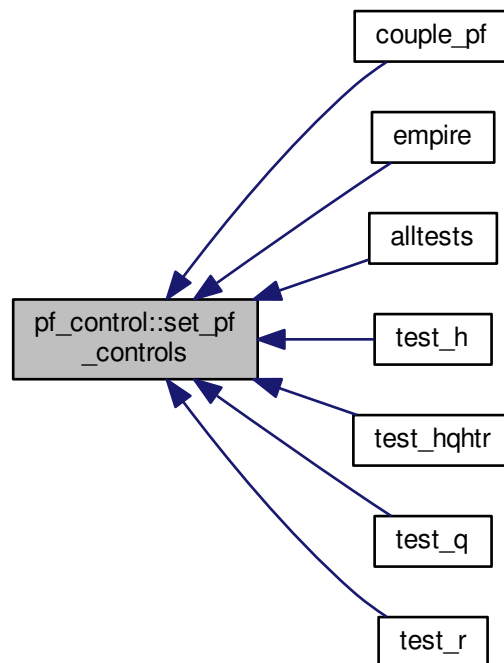
Here is the caller graph for this function:



4.4.2.2 subroutine pf_control::deallocate_pf ()

4.4.2.3 subroutine pf_control::set_pf_controls ()

Here is the caller graph for this function:



4.4.3 Member Data Documentation

4.4.3.1 type(pf_control_type) pf_control::pf

the derived data type holding all controlling data

The documentation for this module was generated from the following file:

- src/controllers/pf_control.f90

4.5 pf_control::pf_control_type Type Reference

Public Attributes

- integer [nens](#)
the total number of ensemble members
- real(kind=kind(1.0d0)), dimension(:), allocatable [weight](#)
the negative log of the weights of the particles
- integer [time_obs](#)
the number of observations we will assimilate
- integer [time_bwn_obs](#)
the number of model timesteps between observations
- real(kind=kind(1.0d0)) [nudgefac](#)
the nudging factor
- logical [gen_data](#)
true generates synthetic obs for a twin experiment
- logical [gen_q](#)
true attempts to build up Q from long model run
- logical [human_readable](#)
unused
- integer [timestep](#) = 0
the current timestep as the model progresses
- real(kind=kind(1.0d0)), dimension(:, :), allocatable [psi](#)
state vector of ensemble members on this mpi process
- real(kind=kind(1.0d0)), dimension(:), allocatable [mean](#)
mean state vector
- real(kind=kind(1.0d0)) [nfac](#)
standard deviation of normal distribution in mixture density
- real(kind=kind(1.0d0)) [ufac](#)
half width of the uniform distribution in mixture density
- real(kind=kind(1.0d0)) [efac](#)
- real(kind=kind(1.0d0)) [keep](#)
proportion of particles to keep in EWPF EW step
- real(kind=kind(1.0d0)) [time](#)
dunno
- real(kind=kind(1.0d0)) [qscale](#)
scalar to multiply Q by
- integer [couple_root](#)
empire master processor
- logical [use_talagrand](#)
switch if true outputs rank histograms
- logical [use_weak](#)
switch unused

- logical `use_mean`
switch if true outputs ensemble mean
- logical `use_var`
switch if true outputs ensemble variance
- logical `use_traj`
switch if true outputs trajectories
- logical `use_rmse`
switch if true outputs Root Mean Square Errors
- integer, dimension(:,:), allocatable `talagrand`
storage for rank histograms
- integer `count`
number of ensemble members associated with this MPI process
- integer, dimension(:), allocatable `particles`
particles associates with this MPI process
- character(2) `type`
which filter to use
- character(1) `init`
which method to initialise ensemble

4.5.1 Member Data Documentation

4.5.1.1 integer `pf_control::pf_control_type::count`

number of ensemble members associated with this MPI process

4.5.1.2 integer `pf_control::pf_control_type::couple_root`

empire master processor

4.5.1.3 real(kind=kind(1.0d0)) `pf_control::pf_control_type::efac`

4.5.1.4 logical `pf_control::pf_control_type::gen_data`

true generates synthetic obs for a twin experiment

4.5.1.5 logical `pf_control::pf_control_type::gen_q`

true attempts to build up Q from long model run

4.5.1.6 logical `pf_control::pf_control_type::human_readable`

unused

4.5.1.7 character(1) `pf_control::pf_control_type::init`

which method to initialise ensemble

4.5.1.8 real(kind=kind(1.0d0)) `pf_control::pf_control_type::keep`

proportion of particles to keep in EWPF EW step

4.5.1.9 `real(kind=kind(1.0d0)), dimension(:), allocatable pf_control::pf_control_type::mean`

mean state vector

4.5.1.10 `integer pf_control::pf_control_type::nens`

the total number of ensemble members

4.5.1.11 `real(kind=kind(1.0d0)) pf_control::pf_control_type::nfac`

standard deviation of normal distribution in mixture density

4.5.1.12 `real(kind=kind(1.0d0)) pf_control::pf_control_type::nudgefac`

the nudging factor

4.5.1.13 `integer, dimension(:), allocatable pf_control::pf_control_type::particles`

particles associates with this MPI process

4.5.1.14 `real(kind=kind(1.0d0)), dimension(:, :), allocatable pf_control::pf_control_type::psi`

state vector of ensemble members on this mpi process

4.5.1.15 `real(kind=kind(1.0d0)) pf_control::pf_control_type::qscale`

scalar to multiply Q by

4.5.1.16 `integer, dimension(:, :), allocatable pf_control::pf_control_type::talagrand`

storage for rank histograms

4.5.1.17 `real(kind=kind(1.0d0)) pf_control::pf_control_type::time`

dunno

4.5.1.18 `integer pf_control::pf_control_type::time_bwn_obs`

the number of model timesteps between observations

4.5.1.19 `integer pf_control::pf_control_type::time_obs`

the number of observations we will assimilate

4.5.1.20 `integer pf_control::pf_control_type::timestep = 0`

the current timestep as the model progresses

4.5.1.21 `character(2) pf_control::pf_control_type::type`

which filter to use

4.5.1.22 `real(kind=kind(1.0d0)) pf_control::pf_control_type::ufac`

half width of the uniform distribution in mixture density

4.5.1.23 `logical pf_control::pf_control_type::use_mean`

switch if true outputs ensemble mean

4.5.1.24 `logical pf_control::pf_control_type::use_rmse`

switch if true outputs Root Mean Square Errors

4.5.1.25 `logical pf_control::pf_control_type::use_talagrand`

switch if true outputs rank histograms

4.5.1.26 `logical pf_control::pf_control_type::use_traj`

switch if true outputs trajectories

4.5.1.27 `logical pf_control::pf_control_type::use_var`

switch if true outputs ensemble variance

4.5.1.28 `logical pf_control::pf_control_type::use_weak`

switch unused

4.5.1.29 `real(kind=kind(1.0d0)), dimension(:), allocatable pf_control::pf_control_type::weight`

the negative log of the weights of the particles

The documentation for this type was generated from the following file:

- [src/controllers/pf_control.f90](#)

4.6 qdata Module Reference

Module as a place to store user specified data for Q .

Public Member Functions

- subroutine [loadq](#)
Subroutine to load in user data for Q .
- subroutine [killq](#)

Public Attributes

- integer [qn](#)
- integer [qne](#)
- integer, dimension(:), allocatable [qrow](#)
- integer, dimension(:), allocatable [qcol](#)
- real(kind=kind(1.0d0)), dimension(:), allocatable [qval](#)
- real(kind=kind(1.0d0)), dimension(:), allocatable [qdiag](#)
- real(kind=kind(1.0d0)) [qscale](#)

4.6.1 Detailed Description

Module as a place to store user specified data for Q .

- the model error covariance matrix

4.6.2 Member Function/Subroutine Documentation

4.6.2.1 subroutine `qdata::killq ()`

SUBroutine to deallocate user data for Q

4.6.2.2 subroutine `qdata::loadq ()`

Subroutine to load in user data for Q.

4.6.3 Member Data Documentation

4.6.3.1 integer, dimension(:), allocatable `qdata::qcol`

4.6.3.2 real(kind=kind(1.0d0)), dimension(:), allocatable `qdata::qdiag`

4.6.3.3 integer `qdata::qn`

4.6.3.4 integer `qdata::qne`

4.6.3.5 integer, dimension(:), allocatable `qdata::qrow`

4.6.3.6 real(kind=kind(1.0d0)) `qdata::qscale`

4.6.3.7 real(kind=kind(1.0d0)), dimension(:), allocatable `qdata::qval`

The documentation for this module was generated from the following file:

- `src/data/Qdata.f90`

4.7 random Module Reference

A module for random number generation from the following distributions:

Public Member Functions

- `real(kind=kind(1.0d+0))` function `random_normal` ()
function to get random normal with zero mean and stdev 1
- `real(kind=kind(1.0d+0))` function `random_gamma` (s, first)
- `real(kind=kind(1.0d+0))` function `random_gamma1` (s, first)
- `real(kind=kind(1.0d+0))` function `random_gamma2` (s, first)
- `real(kind=kind(1.0d+0))` function `random_chisq` (ndf, first)
- `real(kind=kind(1.0d+0))` function `random_exponential` ()
- `real(kind=kind(1.0d+0))` function `random_weibull` (a)
- `real(kind=kind(1.0d+0))` function `random_beta` (aa, bb, first)
- `real(kind=kind(1.0d+0))` function `random_t` (m)
- subroutine `random_mvnorm` (n, h, d, f, first, x, ier)
- `real(kind=kind(1.0d+0))` function `random_inv_gauss` (h, b, first)
- integer function `random_poisson` (mu, first)
- integer function `random_binomial1` (n, p, first)
- `real(kind=kind(1.0d+0))` function `bin_prob` (n, p, r)
- `real(dp)` function `lngamma` (x)
- integer function `random_binomial2` (n, pp, first)
- integer function `random_neg_binomial` (sk, p)
- `real(kind=kind(1.0d+0))` function `random_von_mises` (k, first)
- `real(kind=kind(1.0d+0))` function `random_cauchy` ()
- subroutine `random_order` (order, n)
- subroutine `seed_random_number` (iounit)

Public Attributes

- integer, parameter `dp` = `SELECTED_REAL_KIND(12, 60)`

4.7.1 Detailed Description

A module for random number generation from the following distributions:

Distribution Function/subroutine name

Normal (Gaussian) `random_normal` Gamma `random_gamma` Chi-squared `random_chisq` Exponential `random_exponential` Weibull `random_weibull` Beta `random_beta` t `random_t` Multivariate normal `random_mvnorm` Generalized inverse Gaussian `random_inv_gauss` Poisson `random_poisson` Binomial `random_binomial1` * `random_binomial2` * Negative binomial `random_neg_binomial` von Mises `random_von_mises` Cauchy `random_cauchy`

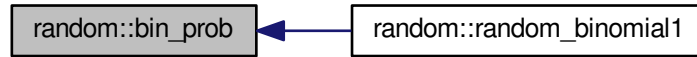
4.7.2 Member Function/Subroutine Documentation

4.7.2.1 `real(kind=kind(1.0d+0))` function `random::bin_prob` (integer, intent(in) *n*, `real(kind=kind(1.0d+0))`, intent(in) *p*, integer, intent(in) *r*)

Here is the call graph for this function:

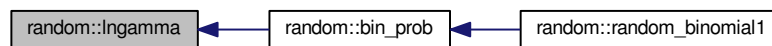


Here is the caller graph for this function:



4.7.2.2 `real(dp)` function `random::lngamma (real(dp), intent(in) x)`

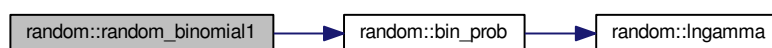
Here is the caller graph for this function:



4.7.2.3 `real(kind=kind(1.0d+0))` function `random::random_beta (real(kind=kind(1.0d+0)), intent(in) aa, real(kind=kind(1.0d+0)), intent(in) bb, logical, intent(in) first)`

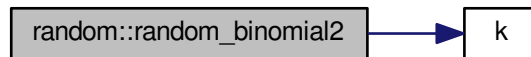
4.7.2.4 `integer` function `random::random_binomial1 (integer, intent(in) n, real(kind=kind(1.0d+0)), intent(in) p, logical, intent(in) first)`

Here is the call graph for this function:



4.7.2.5 integer function `random::random_binomial2` (integer, intent(in) *n*, real(kind=kind(1.0d+0)), intent(in) *pp*, logical, intent(in) *first*)

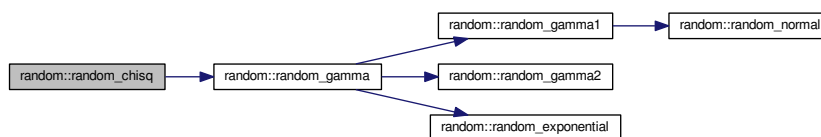
Here is the call graph for this function:



4.7.2.6 real(kind=kind(1.0d+0)) function `random::random_cauchy` ()

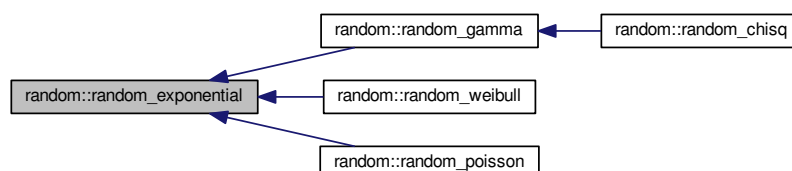
4.7.2.7 real(kind=kind(1.0d+0)) function `random::random_chisq` (integer, intent(in) *ndf*, logical, intent(in) *first*)

Here is the call graph for this function:



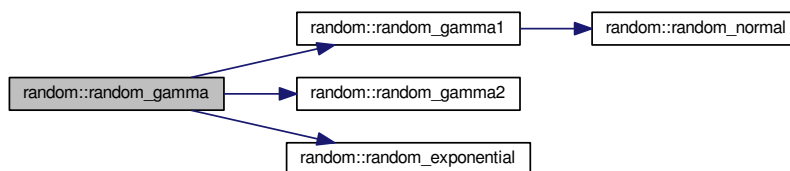
4.7.2.8 real(kind=kind(1.0d+0)) function `random::random_exponential` ()

Here is the caller graph for this function:



4.7.2.9 `real(kind=kind(1.0d+0)) function random::random_gamma (real(kind=kind(1.0d+0)), intent(in) s, logical, intent(in) first)`

Here is the call graph for this function:



Here is the caller graph for this function:

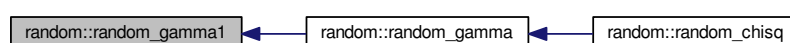


4.7.2.10 `real(kind=kind(1.0d+0)) function random::random_gamma1 (real(kind=kind(1.0d+0)), intent(in) s, logical, intent(in) first)`

Here is the call graph for this function:

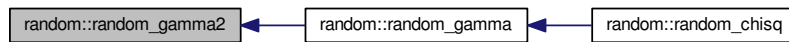


Here is the caller graph for this function:



4.7.2.11 `real(kind=kind(1.0d+0)) function random::random_gamma2 (real(kind=kind(1.0d+0)), intent(in) s, logical, intent(in) first)`

Here is the caller graph for this function:



4.7.2.12 `real(kind=kind(1.0d+0)) function random::random_inv_gauss (real(kind=kind(1.0d+0)), intent(in) h, real(kind=kind(1.0d+0)), intent(in) b, logical, intent(in) first)`

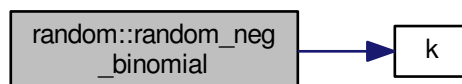
4.7.2.13 `subroutine random::random_mvnorm (integer, intent(in) n, real(kind=kind(1.0d+0)), dimension(:), intent(in) h, real(kind=kind(1.0d+0)), dimension(:), intent(in) d, real(kind=kind(1.0d+0)), dimension(:), intent(inout) f, logical, intent(in) first, real(kind=kind(1.0d+0)), dimension(:), intent(out) x, integer, intent(out) ier)`

Here is the call graph for this function:



4.7.2.14 `integer function random::random_neg_binomial (real(kind=kind(1.0d+0)), intent(in) sk, real(kind=kind(1.0d+0)), intent(in) p)`

Here is the call graph for this function:



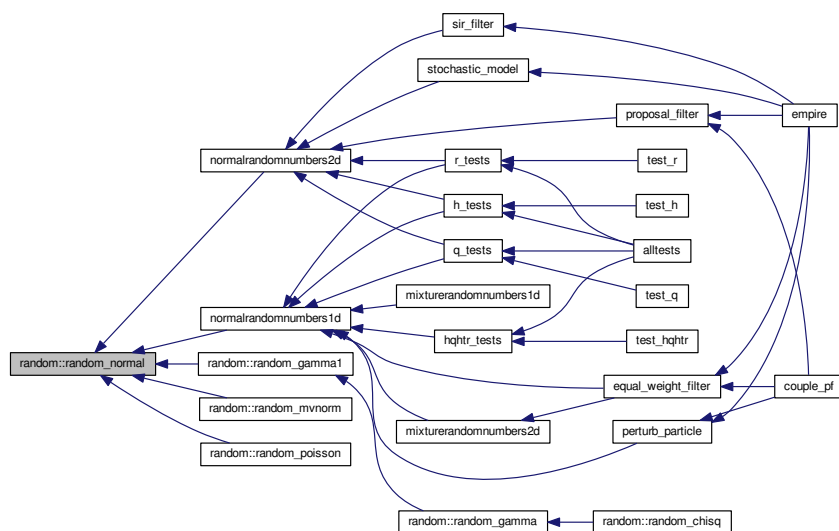
4.7.2.15 `real(kind=kind(1.0d+0)) function random::random_normal ()`

function to get random normal with zero mean and stdev 1

Returns

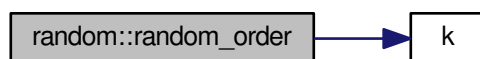
fn_val

Here is the caller graph for this function:



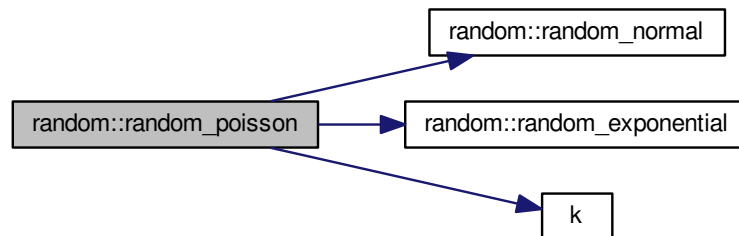
4.7.2.16 subroutine random::random_order (integer, dimension(n), intent(out) *order*, integer, intent(in) *n*)

Here is the call graph for this function:



4.7.2.17 integer function random::random_poisson (real(kind=kind(1.0d+0)), intent(in) *mu*, logical, intent(in) *first*)

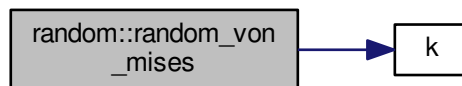
Here is the call graph for this function:



4.7.2.18 real(kind=kind(1.0d+0)) function random::random_t (integer, intent(in) *m*)

4.7.2.19 real(kind=kind(1.0d+0)) function random::random_von_mises (real(kind=kind(1.0d+0)), intent(in) *k*, logical, intent(in) *first*)

Here is the call graph for this function:



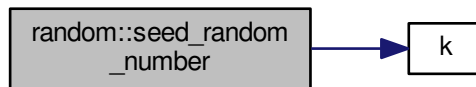
4.7.2.20 real(kind=kind(1.0d+0)) function random::random_weibull (real(kind=kind(1.0d+0)), intent(in) *a*)

Here is the call graph for this function:



4.7.2.21 subroutine random::seed_random_number (integer, intent(in) iounit)

Here is the call graph for this function:



4.7.3 Member Data Documentation

4.7.3.1 integer, parameter random::dp = SELECTED_REAL_KIND(12, 60)

The documentation for this module was generated from the following file:

- [src/utls/random_d.f90](#)

4.8 rdata Module Reference

Module to hold user supplied data for R observation error covariance matrix.

Public Member Functions

- subroutine [loadr](#)
Subroutine to load data for R.
- subroutine [killr](#)

Public Attributes

- integer [rn](#)
- integer [rne](#)
- integer, dimension(:), allocatable [row](#)
- integer, dimension(:), allocatable [rcol](#)
- real(kind=kind(1.0d0)), dimension(:), allocatable [rval](#)
- real(kind=kind(1.0d0)), dimension(:), allocatable [rdiag](#)

4.8.1 Detailed Description

Module to hold user supplied data for R observation error covariance matrix.

4.8.2 Member Function/Subroutine Documentation

4.8.2.1 subroutine rdata::killr ()

SUbroutine to deallocate R data

4.8.2.2 subroutine rdata::loadr ()

Subroutine to load data for R.

4.8.3 Member Data Documentation

4.8.3.1 integer, dimension(:), allocatable rdata::rcol

4.8.3.2 real(kind=kind(1.0d0)), dimension(:), allocatable rdata::rdiag

4.8.3.3 integer rdata::rn

4.8.3.4 integer rdata::rne

4.8.3.5 integer, dimension(:), allocatable rdata::rrow

4.8.3.6 real(kind=kind(1.0d0)), dimension(:), allocatable rdata::rval

The documentation for this module was generated from the following file:

- src/data/[Rdata.f90](#)

4.9 sizes Module Reference

Module that stores the dimension of observation and state spaces.

Public Attributes

- integer [obs_dim](#)
size of the observation space
- integer [state_dim](#)
dimension of the model

4.9.1 Detailed Description

Module that stores the dimension of observation and state spaces.

4.9.2 Member Data Documentation

4.9.2.1 integer sizes::obs_dim

size of the observation space

4.9.2.2 integer sizes::state_dim

dimension of the model

The documentation for this module was generated from the following file:

- src/controllers/[sizes.f90](#)

Chapter 5

File Documentation

5.1 src/controlers/old_pf_couple.f90 File Reference

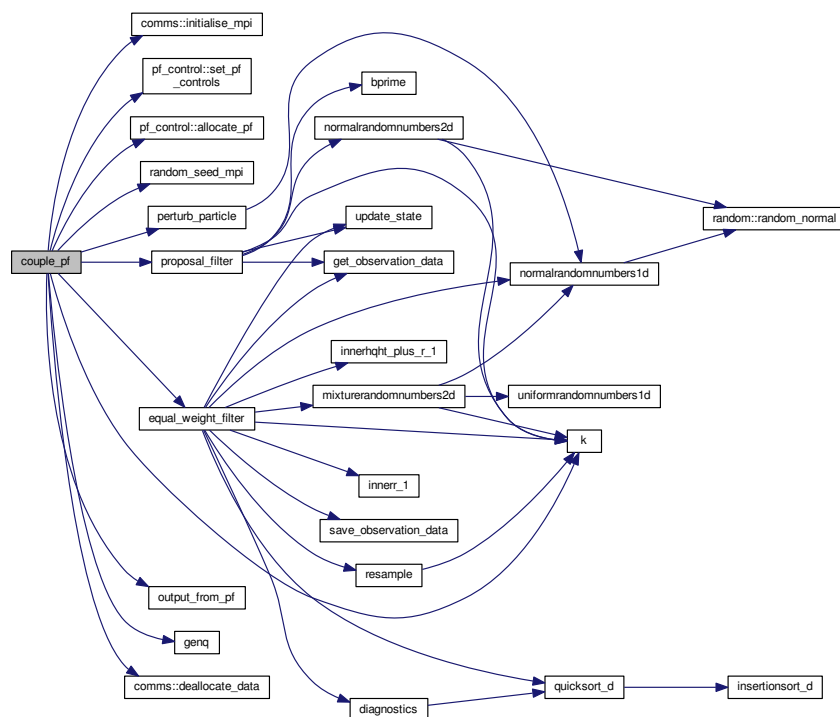
Functions/Subroutines

- program [couple_pf](#)

5.1.1 Function/Subroutine Documentation

5.1.1.1 program couple_pf ()

Here is the call graph for this function:



5.2 src/controllers/pf_control.f90 File Reference

Data Types

- module [pf_control](#)
module to hold all the information to control the the main program
- type [pf_control::pf_control_type](#)

5.3 src/controllers/pf_couple.f90 File Reference

Functions/Subroutines

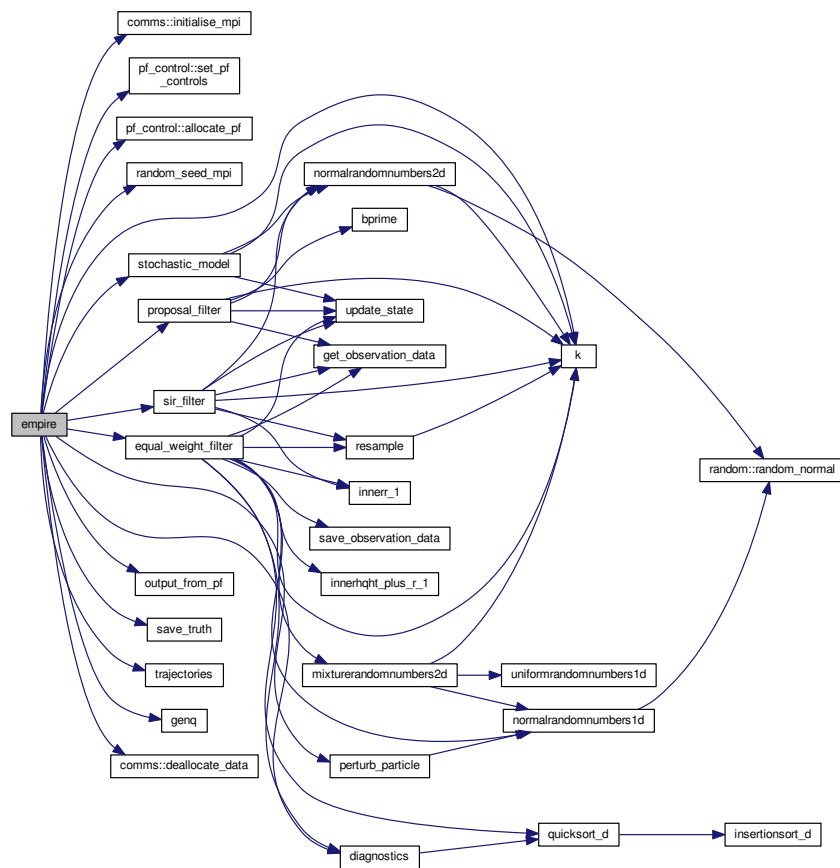
- program [empire](#)
the main program

5.3.1 Function/Subroutine Documentation

5.3.1.1 program empire ()

the main program

Here is the call graph for this function:



5.4 src/controllers/sizes.f90 File Reference

Data Types

- module [sizes](#)

Module that stores the dimension of observation and state spaces.

5.5 src/data/Qdata.f90 File Reference

Data Types

- module [qdata](#)

Module as a place to store user specified data for Q .

5.6 src/data/Rdata.f90 File Reference

Data Types

- module [rdata](#)

Module to hold user supplied data for R observation error covariance matrix.

- module [hqht_plus_r](#)

5.7 src/filters/eakf_analysis.f90 File Reference

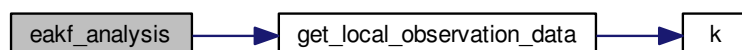
Functions/Subroutines

- subroutine [eakf_analysis](#) (num_hor, num_ver, this_hor, this_ver, boundary, x, N, stateDim, obsDim, rho)

5.7.1 Function/Subroutine Documentation

5.7.1.1 subroutine `eakf_analysis` (integer, intent(in) *num_hor*, integer, intent(in) *num_ver*, integer, intent(in) *this_hor*, integer, intent(in) *this_ver*, integer, intent(in) *boundary*, real(kind=rk), dimension(statedim,n), intent(inout) *x*, integer, intent(in) *N*, integer, intent(in) *stateDim*, integer, intent(in) *obsDim*, real(kind=rk), intent(in) *rho*)

Here is the call graph for this function:



Here is the caller graph for this function:



5.8 src/filters/enkf_specific.f90 File Reference

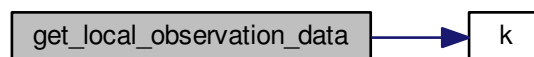
Functions/Subroutines

- subroutine [h_local](#) (num_hor, num_ver, this_hor, this_ver, boundary, nrhs, stateDim, x, obsDim, y)
- subroutine [solve_rhalf_local](#) (num_hor, num_ver, this_hor, this_ver, boundary, nrhs, obsDim, y, v)
- subroutine [get_local_observation_data](#) (num_hor, num_ver, this_hor, this_ver, boundary, obsDim, y)
- subroutine [localise_enkf](#) (enkf_analysis)

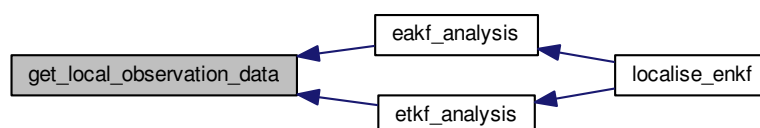
5.8.1 Function/Subroutine Documentation

5.8.1.1 subroutine `get_local_observation_data` (integer, intent(in) *num_hor*, integer, intent(in) *num_ver*, integer, intent(in) *this_hor*, integer, intent(in) *this_ver*, integer, intent(in) *boundary*, integer, intent(in) *obsDim*, real(kind=rk), dimension(obsdim), intent(out) *y*)

Here is the call graph for this function:

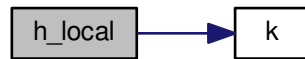


Here is the caller graph for this function:

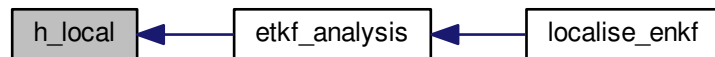


5.8.1.2 subroutine `h_local` (integer, intent(in) *num_hor*, integer, intent(in) *num_ver*, integer, intent(in) *this_hor*, integer, intent(in) *this_ver*, integer, intent(in) *boundary*, integer, intent(in) *nrhs*, integer, intent(in) *stateDim*, real(kind=rk), dimension(statedim,nrhs), intent(in) *x*, integer, intent(in) *obsDim*, real(kind=rk), dimension(obsdim,nrhs), intent(out) *y*)

Here is the call graph for this function:

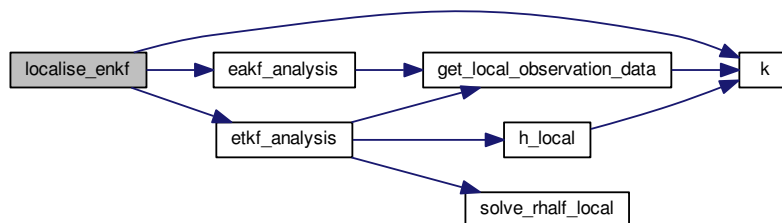


Here is the caller graph for this function:



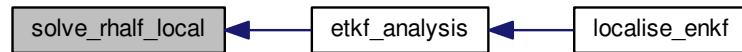
5.8.1.3 subroutine `localise_enkf` (integer, intent(in) *enkf_analysis*)

Here is the call graph for this function:



5.8.1.4 subroutine solve_half_local (integer, intent(in) num_hor, integer, intent(in) num_ver, integer, intent(in) this_hor, integer, intent(in) this_ver, integer, intent(in) boundary, integer, intent(in) nrhs, integer, intent(in) obsDim, real(kind=rk), dimension(obsdim,nrhs), intent(in) y, real(kind=rk), dimension(obsdim,nrhs), intent(out) v)

Here is the caller graph for this function:



5.9 src/filters/equivalent_weights_step.f90 File Reference

Functions/Subroutines

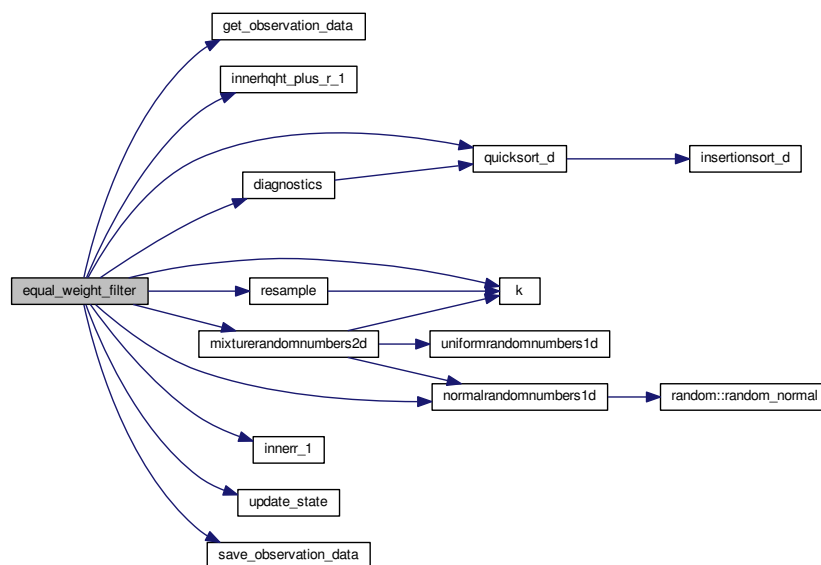
- subroutine [equal_weight_filter](#)
subroutine to do the equivalent weights step

5.9.1 Function/Subroutine Documentation

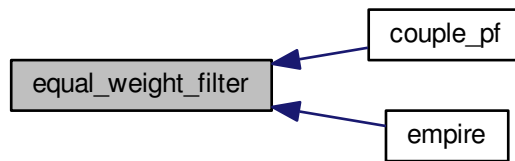
5.9.1.1 subroutine equal_weight_filter ()

subroutine to do the equivalent weights step

Here is the call graph for this function:



Here is the caller graph for this function:



5.10 src/filters/etkf_analysis.f90 File Reference

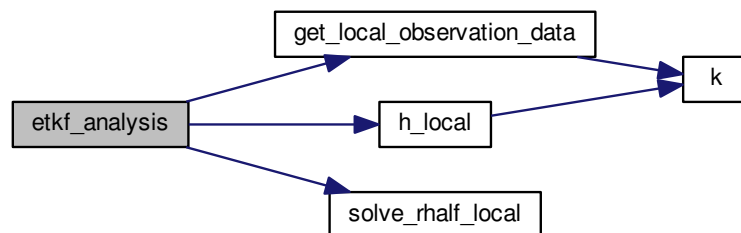
Functions/Subroutines

- subroutine [etkf_analysis](#) (num_hor, num_ver, this_hor, this_ver, boundary, x, N, stateDim, obsDim, rho)

5.10.1 Function/Subroutine Documentation

5.10.1.1 subroutine `etkf_analysis` (integer, intent(in) *num_hor*, integer, intent(in) *num_ver*, integer, intent(in) *this_hor*, integer, intent(in) *this_ver*, integer, intent(in) *boundary*, real(kind=rk), dimension(statedim,n), intent(inout) *x*, integer, intent(in) *N*, integer, intent(in) *stateDim*, integer, intent(in) *obsDim*, real(kind=rk), intent(in) *rho*)

Here is the call graph for this function:



Here is the caller graph for this function:



5.11 src/filters/proposal_filter.f90 File Reference

Functions/Subroutines

- subroutine [proposal_filter](#)

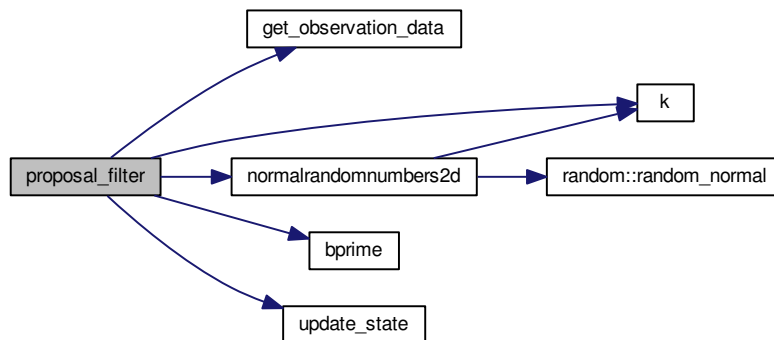
Subroutine to perform nudging in the proposal step of EWPF.

5.11.1 Function/Subroutine Documentation

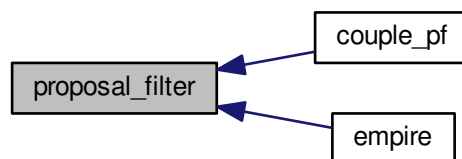
5.11.1.1 subroutine proposal_filter ()

Subroutine to perform nudging in the proposal step of EWPF.

Here is the call graph for this function:



Here is the caller graph for this function:



5.12 src/filters/sir_filter.f90 File Reference

Functions/Subroutines

- subroutine [sir_filter](#)

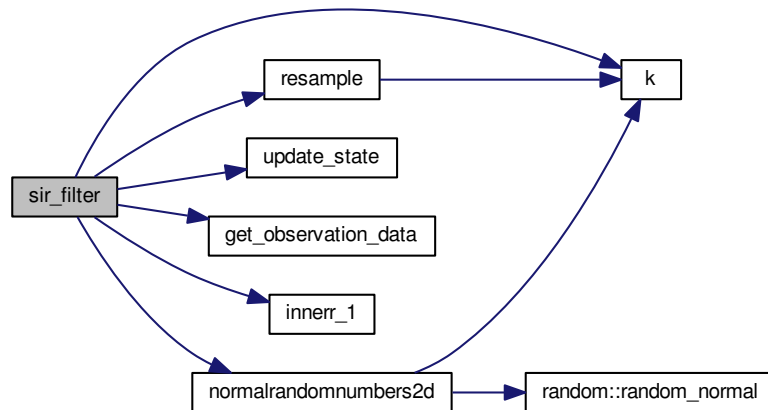
Subroutine to perform SIR filter (Sequential Importance Resampling)

5.12.1 Function/Subroutine Documentation

5.12.1.1 subroutine `sir_filter` ()

Subroutine to perform SIR filter (Sequential Importance Resampling)

Here is the call graph for this function:



Here is the caller graph for this function:



5.13 src/filters/stochastic_model.f90 File Reference

Functions/Subroutines

- subroutine [stochastic_model](#)
subroutine to simply move the model forward in time one timestep PAB 21-05-2013
- subroutine [check_scaling](#) (x, fx, b, scales)

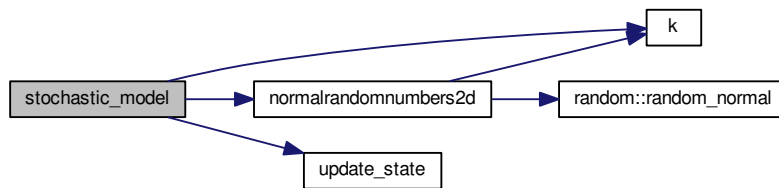
5.13.1 Function/Subroutine Documentation

5.13.1.1 subroutine `check_scaling` (real(kind=rk), dimension(state_dim), intent(in) x, real(kind=rk), dimension(state_dim), intent(in) fx, real(kind=rk), dimension(state_dim), intent(in) b, real(kind=rk), dimension(9), intent(inout) scales)

5.13.1.2 subroutine `stochastic_model` ()

subroutine to simply move the model forward in time one timestep PAB 21-05-2013

Here is the call graph for this function:



Here is the caller graph for this function:



5.14 src/operations/gen_rand.f90 File Reference

Functions/Subroutines

- subroutine [uniformrandomnumbers1d](#) (minv, maxv, n, phi)
generate one dimension of uniform random numbers
- subroutine [normalrandomnumbers1d](#) (mean, stdev, n, phi)
generate one dimension of Normal random numbers
- subroutine [normalrandomnumbers2d](#) (mean, stdev, n, k, phi)
generate two dimensional Normal random numbers
- subroutine [mixturerandomnumbers1d](#) (mean, stdev, ufac, epsi, n, phi, uniform)
generate one dimensional vector drawn from mixture density
- subroutine [mixturerandomnumbers2d](#) (mean, stdev, ufac, epsi, n, k, phi, uniform)
generate two dimensional vector, each drawn from mixture density
- subroutine [random_seed_mpi](#) (pfid)
Subroutine to set the random seed across MPI threads.

5.14.1 Function/Subroutine Documentation

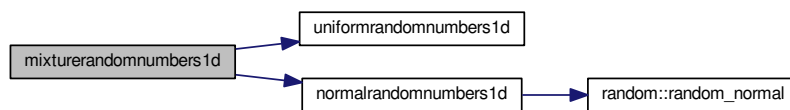
5.14.1.1 subroutine [mixturerandomnumbers1d](#) (`real(kind=kind(1.0d0))`, intent(in) *mean*, `real(kind=kind(1.0d0))`, intent(in) *stdev*, `real(kind=kind(1.0d0))`, intent(in) *ufac*, `real(kind=kind(1.0d0))`, intent(in) *epsi*, integer, intent(in) *n*, `real(kind=kind(1.0d0))`, dimension(n), intent(out) *phi*, logical, intent(out) *uniform*)

generate one dimensional vector drawn from mixture density

Parameters

in	<i>mean</i>	Mean of normal distribution
in	<i>stdev</i>	Standard deviation of normal distribution
in	<i>ufac</i>	half-width of uniform distribution that is centered on the mean
in	<i>epsi</i>	Proportion controlling mixture draw. if random_number > epsi then draw from uniform, else normal
in	<i>n</i>	size of output vector
out	<i>phi</i>	n dimensional mixture random numbers
out	<i>uniform</i>	True if mixture drawn from uniform. False if drawn from normal

Here is the call graph for this function:



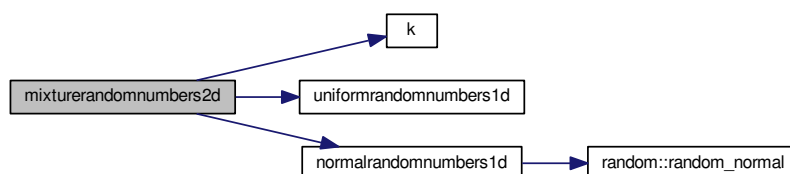
5.14.1.2 subroutine mixturerandomnumbers2d (real(kind=kind(1.0d0)), intent(in) *mean*, real(kind=kind(1.0d0)), intent(in) *stdev*, real(kind=kind(1.0d0)), intent(in) *ufac*, real(kind=kind(1.0d0)), intent(in) *epsi*, integer, intent(in) *n*, integer, intent(in) *k*, real(kind=kind(1.0d0)), dimension(n,k), intent(out) *phi*, logical, dimension(k), intent(out) *uniform*)

generate two dimensional vector, each drawn from mixture density

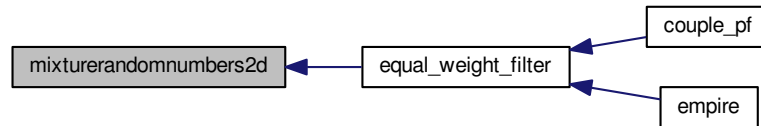
Parameters

in	<i>mean</i>	Mean of normal distribution
in	<i>stdev</i>	Standard deviation of normal distribution
in	<i>ufac</i>	half-width of uniform distribution that is centered on the mean
in	<i>epsi</i>	Proportion controlling mixture draw. if random_number > epsi then draw from uniform, else normal
in	<i>n</i>	first dimension of output vector
in	<i>n</i>	second dimension of output vector
out	<i>phi</i>	n,k dimensional mixture random numbers
out	<i>uniform</i>	k dimensional logical with uniform(i) True if phi(:,i) drawn from uniform. False if drawn from normal

Here is the call graph for this function:



Here is the caller graph for this function:



5.14.1.3 subroutine `normalrandomnumbers1d` (`real(kind=rk)`, intent(in) *mean*, `real(kind=rk)`, intent(in) *stdev*, integer, intent(in) *n*, `real(kind=rk)`, dimension(*n*), intent(out) *phi*)

generate one dimension of Normal random numbers

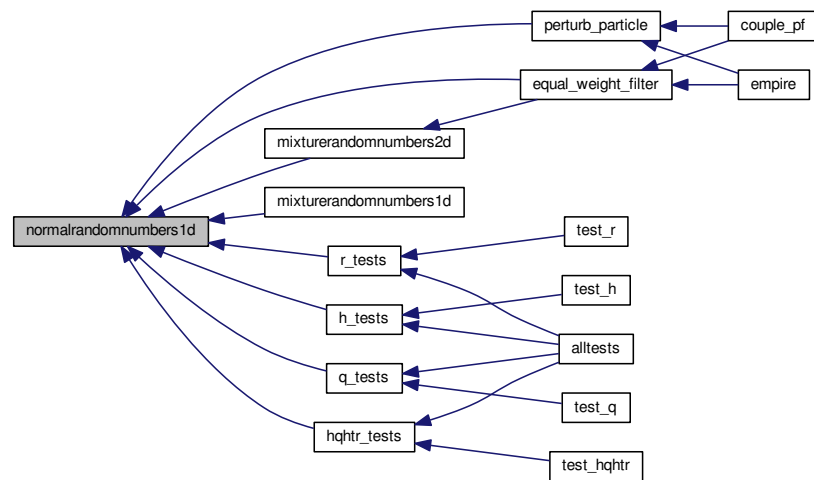
Parameters

in	<i>n</i>	size of output vector
in	<i>mean</i>	mean of normal distribution
in	<i>stdev</i>	Standard Deviation of normal distribution
out	<i>phi</i>	n dimensional normal random numbers

Here is the call graph for this function:



Here is the caller graph for this function:



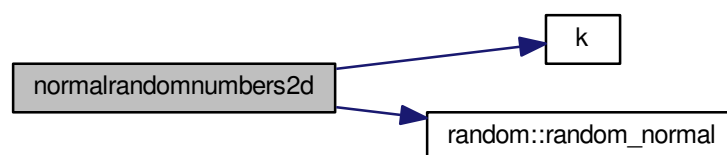
5.14.1.4 subroutine `normalrandomnumbers2d` (`real(kind=rk)`, intent(in) *mean*, `real(kind=rk)`, intent(in) *stdev*, `integer`, intent(in) *n*, `integer`, intent(in) *k*, `real(kind=rk)`, dimension(*n*,*k*), intent(out) *phi*)

generate two dimensional Normal random numbers

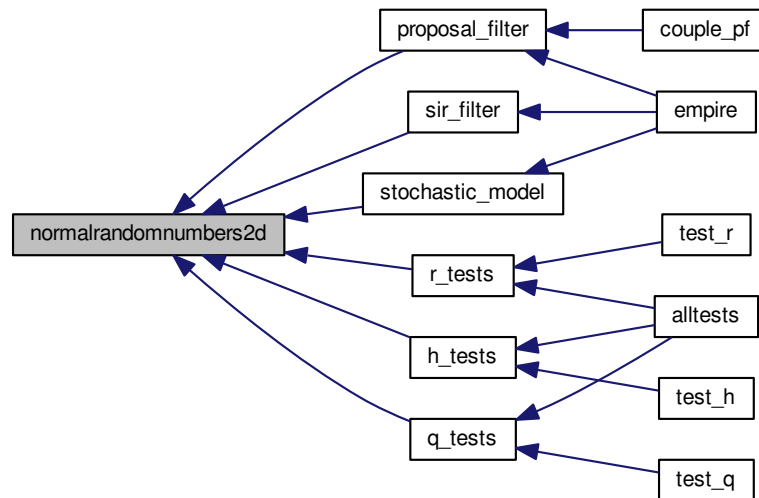
Parameters

in	<i>n</i>	first dimension of output vector
in	<i>n</i>	second dimension of output vector
in	<i>mean</i>	mean of normal distribution
in	<i>stdev</i>	Standard Deviation of normal distribution
out	<i>phi</i>	<i>n</i> , <i>k</i> dimensional normal random numbers

Here is the call graph for this function:



Here is the caller graph for this function:



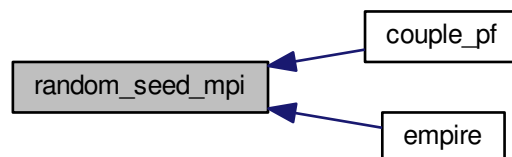
5.14.1.5 subroutine `random_seed_mpi` (integer, intent(in) *pfid*)

Subroutine to set the random seed across MPI threads.

Parameters

<i>in</i>	<i>pfid</i>	The process identifier of the MPI process
-----------	-------------	---

Here is the caller graph for this function:



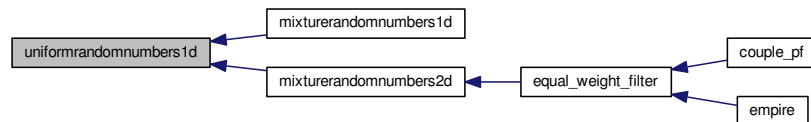
5.14.1.6 subroutine `uniformrandomnumbers1d` (real(kind=rk), intent(in) *minv*, real(kind=rk), intent(in) *maxv*, integer, intent(in) *n*, real(kind=rk), dimension(n), intent(out) *phi*)

generate one dimension of uniform random numbers

Parameters

in	n	size of output vector
in	$minv$	minimum value of uniform distribution
in	$maxv$	maximum value of uniform distribution
out	ϕ	n dimensional uniform random numbers

Here is the caller graph for this function:



5.15 src/operations/operator_wrappers.f90 File Reference

Functions/Subroutines

- subroutine [k](#) (y, x)
Subroutine to apply K to a vector y in observation space where $K := QH^T (HQH^T + R)^{-1}$.
- subroutine [innerr_1](#) (y, w)
subroutine to compute the inner product with R^{-1}
- subroutine [innerhqht_plus_r_1](#) (y, w)
subroutine to compute the inner product with $(HQH^T + R)^{-1}$
- subroutine [bprime](#) ($y, x, QHtR_1y, normaln, betan$)
subroutine to calculate nudging term and correlated random errors efficiently

5.15.1 Function/Subroutine Documentation

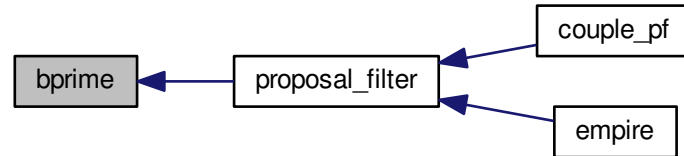
5.15.1.1 subroutine [bprime](#) ($real(kind=rk)$, dimension(obs_dim,pf%count), intent(in) y , $real(kind=rk)$, dimension(state_dim,pf%count), intent(out) x , $real(kind=rk)$, dimension(state_dim,pf%count), intent(out) $QHtR_1y$, $real(kind=rk)$, dimension(state_dim,pf%count), intent(in) $normaln$, $real(kind=rk)$, dimension(state_dim,pf%count), intent(out) $betan$)

subroutine to calculate nudging term and correlated random errors efficiently

Parameters

in	y	(obs_dim,pf%count) vectors of innovations $y - H(x^{n-1})$
out	x	(state_dim,pf%count) vectors of $pQ^{\frac{1}{2}}H^TR^{-1}[y - H(x^{n-1})]$
out	$QHtR_1y$	(state_dim,pf%count) vectors of $pQH^TR^{-1}[y - H(x^{n-1})]$
in	$normaln$	(state_dim,pf%count) uncorrelated random vectors such that $normaln(:,i) \sim \mathcal{N}(0, I)$
out	$betan$	(state_dim,pf%count) correlated random vectors such that $betan(:,i) \sim \mathcal{N}(0, Q)$

Here is the caller graph for this function:



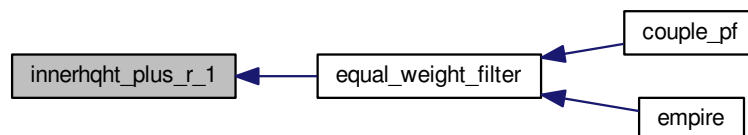
5.15.1.2 subroutine `innerhght_plus_r_1` (`real(kind=rk)`, `dimension(obs_dim)`, `intent(in) y`, `real(kind=rk)`, `intent(out) w`)

subroutine to compute the inner product with $(HQH^T + R)^{-1}$

Parameters

<code>in</code>	<code>y</code>	vector in observation space
<code>out</code>	<code>w</code>	scalar with value $y^T R^{-1} y$

Here is the caller graph for this function:



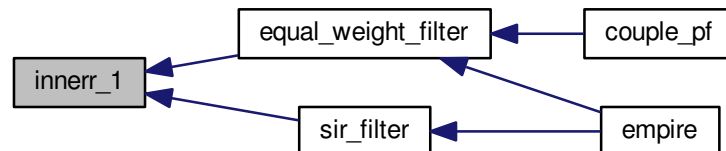
5.15.1.3 subroutine `innerr_1` (`real(kind=rk)`, `dimension(obs_dim,pf%count)`, `intent(in) y`, `real(kind=rk)`, `dimension(pf%count)`, `intent(out) w`)

subroutine to compute the inner product with R^{-1}

Parameters

<code>in</code>	<code>y</code>	multiple vectors in observation space (<code>pf%count</code> of them)
<code>out</code>	<code>w</code>	multiple scalars (<code>pf%count</code>) where <code>w(i)</code> has the value $y(:,i)^T R^{-1} y(:,i)$

Here is the caller graph for this function:



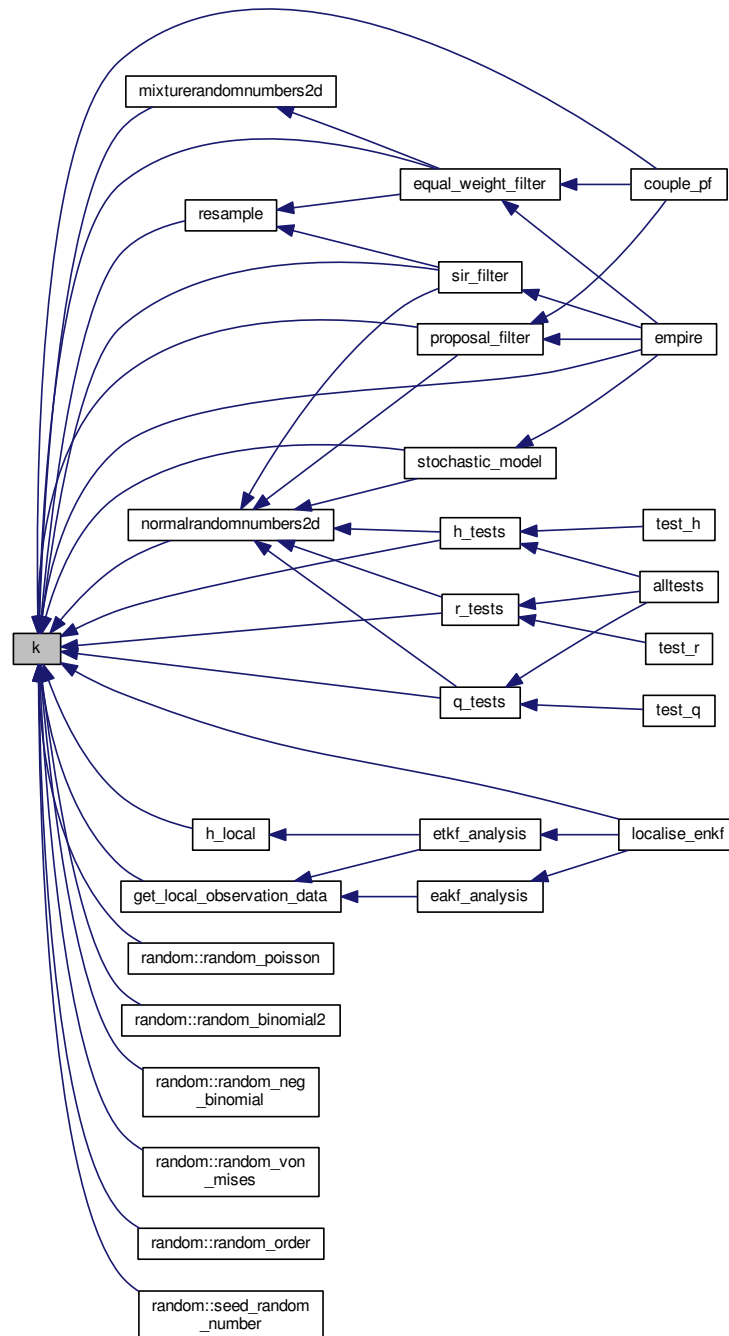
5.15.1.4 subroutine k (real(kind=rk), dimension(obs_dim,pf%count), intent(in) y, real(kind=rk), dimension(state_dim,pf%count), intent(out) x)

Subroutine to apply K to a vector y in observation space where $K := QH^T(HQH^T + R)^{-1}$.

Parameters

in	y	vector in observation space
out	x	vector in state space

Here is the caller graph for this function:



5.16 src/operations/perturb_particle.f90 File Reference

Functions/Subroutines

- subroutine [perturb_particle](#) (x)

Subroutine to perturb state vector with normal random vector drawn from $\mathcal{N}(0, Q)$.

- subroutine `update_state` (state, fps, kgain, betan)

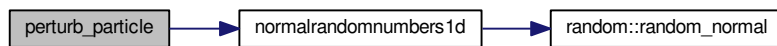
Subroutine to update the state.

5.16.1 Function/Subroutine Documentation

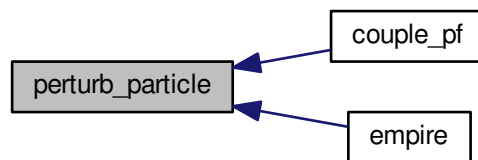
5.16.1.1 subroutine perturb_particle (real(kind=rk), dimension(state_dim), intent(inout) x)

Subroutine to perturb state vector with normal random vector drawn from $\mathcal{N}(0, Q)$.

Here is the call graph for this function:



Here is the caller graph for this function:



5.16.1.2 subroutine update_state (real(kind=rk), dimension(state_dim), intent(out) state, real(kind=rk), dimension(state_dim), intent(in) fps, real(kind=rk), dimension(state_dim), intent(in) kgain, real(kind=rk), dimension(state_dim), intent(inout) betan)

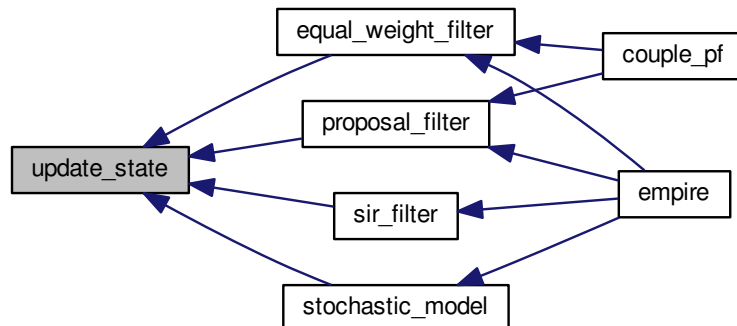
Subroutine to update the state.

This can be changed for the specific model if it needs to be

Parameters

in	<i>fps</i>	deterministic model update $f(x^{n-1})$
in	<i>kgain</i>	nudging term
in, out	<i>betan</i>	Stochastic term
out	<i>state</i>	The updated state vector

Here is the caller graph for this function:



5.17 src/operations/resample.f90 File Reference

Functions/Subroutines

- subroutine [resample](#)

Subroutine to perform Universal Importance Resampling.

5.17.1 Function/Subroutine Documentation

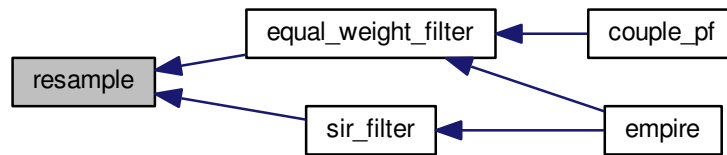
5.17.1.1 subroutine `resample` ()

Subroutine to perform Universal Importance Resampling.

Here is the call graph for this function:



Here is the caller graph for this function:



5.18 src/tests/alltests.f90 File Reference

Functions/Subroutines

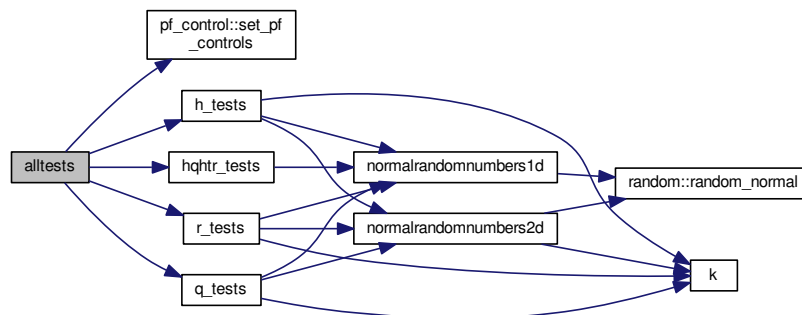
- program [alltests](#)
program to run all tests of user specific functions

5.18.1 Function/Subroutine Documentation

5.18.1.1 program alltests ()

program to run all tests of user specific functions

Here is the call graph for this function:



5.19 src/tests/test_h.f90 File Reference

Functions/Subroutines

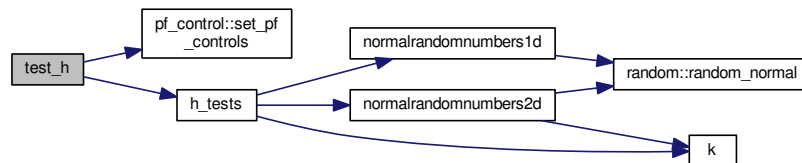
- program [test_h](#)
program to run tests of user supplied observation operator

5.19.1 Function/Subroutine Documentation

5.19.1.1 program test_h ()

program to run tests of user supplied observation operator

Here is the call graph for this function:



5.20 src/tests/test_hqhtr.f90 File Reference

Functions/Subroutines

- program [test_hqhtr](#)
program to run tests of user supplied linear solve

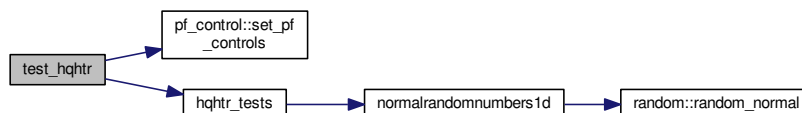
5.20.1 Function/Subroutine Documentation

5.20.1.1 program test_hqhtr ()

program to run tests of user supplied linear solve

$$(HQH^T + R)^{-1}$$

Here is the call graph for this function:



5.21 src/tests/test_q.f90 File Reference

Functions/Subroutines

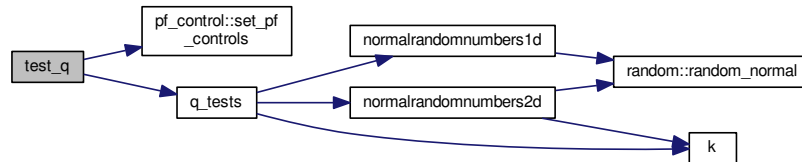
- program [test_q](#)
program to run tests of user supplied model error covariance matrix

5.21.1 Function/Subroutine Documentation

5.21.1.1 program test_q ()

program to run tests of user supplied model error covariance matrix

Here is the call graph for this function:



5.22 src/tests/test_r.f90 File Reference

Functions/Subroutines

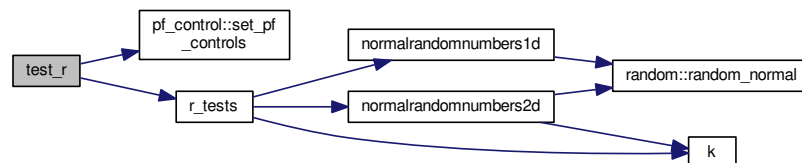
- program [test_r](#)
program to run all tests of user supplied observation error covariance matrix/

5.22.1 Function/Subroutine Documentation

5.22.1.1 program test_r ()

program to run all tests of user supplied observation error covariance matrix/

Here is the call graph for this function:



5.23 src/tests/tests.f90 File Reference

Functions/Subroutines

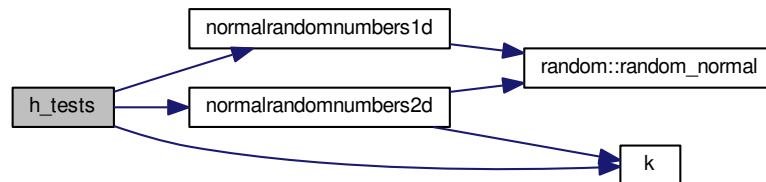
- subroutine [h_tests](#) ()
- subroutine [r_tests](#) ()
- subroutine [q_tests](#) ()
- subroutine [hqhtr_tests](#) ()

5.23.1 Function/Subroutine Documentation

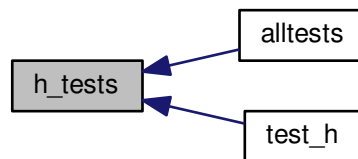
5.23.1.1 subroutine h_tests ()

These are some tests to check that the observation operator is implemented correctly

Here is the call graph for this function:



Here is the caller graph for this function:

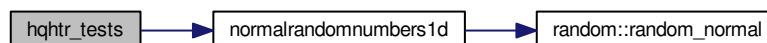


5.23.1.2 subroutine hqhtr_tests ()

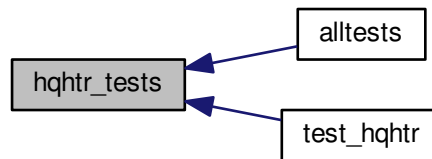
These are some tests to check that the linear solve operator is implemented correctly

This should check the operation $(HQH^T + R)^{-1}$ is working

Here is the call graph for this function:



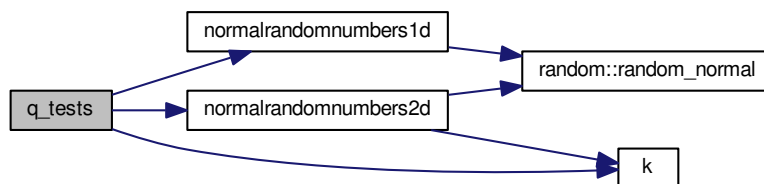
Here is the caller graph for this function:



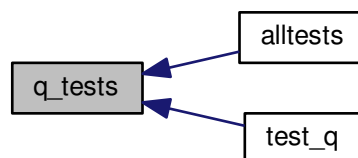
5.23.1.3 subroutine q_tests ()

These are some tests to check that the model error covariance matrix is implemented correctly

Here is the call graph for this function:



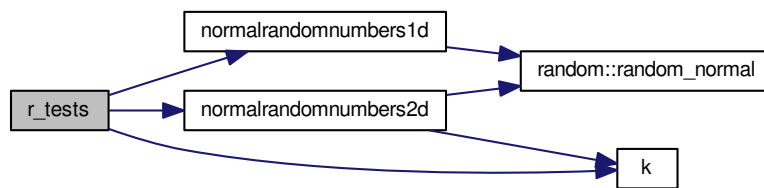
Here is the caller graph for this function:



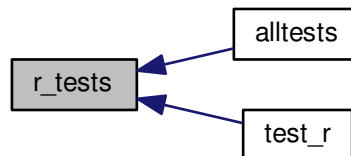
5.23.1.4 subroutine r_tests ()

These are some tests to check that the observation error covariance matrix is implemented correctly

Here is the call graph for this function:



Here is the caller graph for this function:



5.24 src/utils/comms.f90 File Reference

Data Types

- module [comms](#)
Module containing EMPIRE coupling data.

5.25 src/utils/data_io.f90 File Reference

Functions/Subroutines

- subroutine [get_observation_data](#) (y)
*Subroutine to read observation from a file
Uses pftimestep to determine which observation to read.*
- subroutine [save_observation_data](#) (y)
*Subroutine to save observation to a file
Uses pftimestep to determine which observation to save.*
- subroutine [save_truth](#) (x)
Subroutine to save truth to a file
- subroutine [output_from_pf](#)
subroutine to output data from the filter

5.25.1 Function/Subroutine Documentation

5.25.1.1 subroutine get_observation_data (real(kind=rk), dimension(obs_dim), intent(out) y)

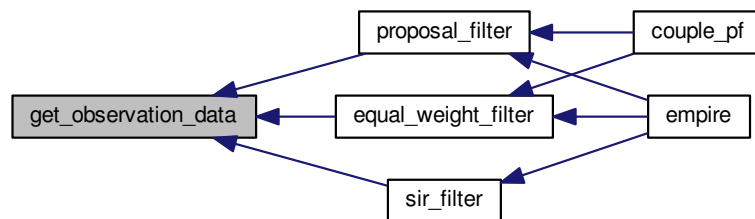
Subroutine to read observation from a file

Uses pftimestep to determine which observation to read.

Parameters

out	y	The observation
-----	---	-----------------

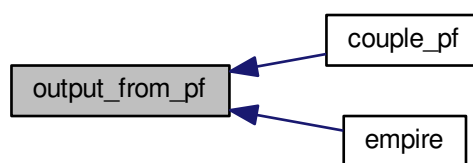
Here is the caller graph for this function:



5.25.1.2 subroutine output_from_pf ()

subroutine to output data from the filter

Here is the caller graph for this function:



5.25.1.3 subroutine save_observation_data (real(kind=rk), dimension(obs_dim), intent(in) y)

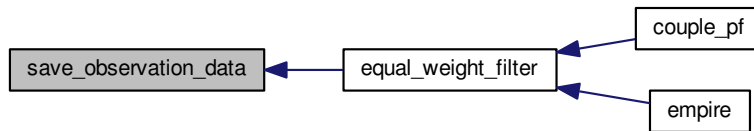
Subroutine to save observation to a file

Uses pftimestep to determine which observation to save.

Parameters

in	y	The observation
----	---	-----------------

Here is the caller graph for this function:



5.25.1.4 subroutine save_truth (real(kind=rk), dimension(state_dim), intent(in) x)

Subroutine to save truth to a file

.

Parameters

in	x	The state vector
----	---	------------------

Here is the caller graph for this function:



5.26 src/utls/diagnostics.f90 File Reference

Functions/Subroutines

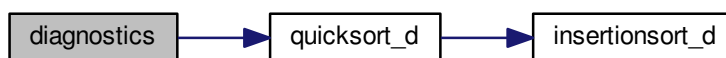
- subroutine [diagnostics](#)
Subroutine to give output diagnostics such as rank histograms and trajectories.
- subroutine [trajectories](#)
subroutine to output trajectories

5.26.1 Function/Subroutine Documentation

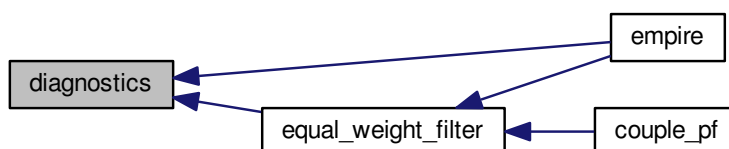
5.26.1.1 subroutine diagnostics ()

Subroutine to give output diagnostics such as rank histograms and trajectories.

Here is the call graph for this function:



Here is the caller graph for this function:



5.26.1.2 subroutine trajectories ()

subroutine to output trajectories

Here is the caller graph for this function:



5.27 src/utls/genQ.f90 File Reference

Functions/Subroutines

- subroutine [genq](#)

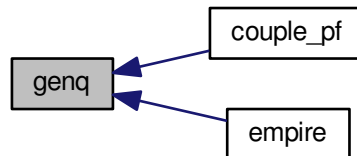
Subroutine to estimate Q from a long model run.

5.27.1 Function/Subroutine Documentation

5.27.1.1 subroutine genq ()

Subroutine to estimate Q from a long model run.

Here is the caller graph for this function:



5.28 src/utls/histogram.f90 File Reference

Data Types

- module [histogram_data](#)

Module to control what variables are used to generate rank histograms.

5.29 src/utls/quicksort.f90 File Reference

Functions/Subroutines

- recursive subroutine [quicksort_d](#) (a, na)

subroutine to sort using the quicksort algorithm

- subroutine [insertionsort_d](#) (A, nA)

subroutine to sort using the insertionsort algorithm

5.29.1 Function/Subroutine Documentation

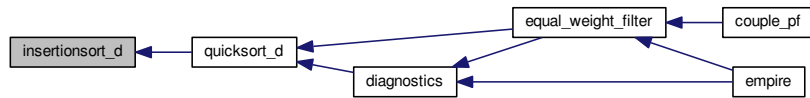
5.29.1.1 subroutine insertionsort_d (real(kind=kind(1.0d0)), dimension(na), intent(inout) A, integer, intent(in) nA)

subroutine to sort using the insertionsort algorithm

Parameters

in, out	a	array of doubles to be sorted
in	na	dimension of array a

Here is the caller graph for this function:



5.29.1.2 recursive subroutine quicksort_d (real(kind=kind(1.0d0)), dimension(na), intent(inout) a, integer, intent(in) na)

subroutine to sort using the quicksort algorithm

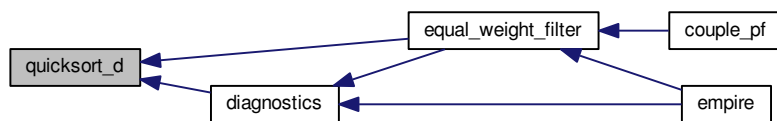
Parameters

in, out	a	array of doubles to be sorted
in	na	dimension of array a

Here is the call graph for this function:



Here is the caller graph for this function:



5.30 src/utils/random_d.f90 File Reference

Data Types

- module [random](#)

A module for random number generation from the following distributions:

Index

- allocate_data
 - comms, [7](#)
- allocate_pf
 - pf_control, [11](#)
- alltests
 - alltests.f90, [43](#)
- alltests.f90
 - alltests, [43](#)
- bin_prob
 - random, [16](#)
- bprime
 - operator_wrappers.f90, [38](#)
- check_scaling
 - stochastic_model.f90, [33](#)
- comms, [7](#)
 - allocate_data, [7](#)
 - cpl_mpi_comm, [8](#)
 - deallocate_data, [7](#)
 - gblcount, [8](#)
 - gbldisp, [8](#)
 - initialise_mpi, [8](#)
 - mype_id, [8](#)
 - myrank, [8](#)
 - npfs, [8](#)
 - nproc, [8](#)
 - pf_mpi_comm, [8](#)
 - pfrank, [9](#)
- count
 - pf_control::pf_control_type, [13](#)
- couple_pf
 - old_pf_couple.f90, [25](#)
- couple_root
 - pf_control::pf_control_type, [13](#)
- cpl_mpi_comm
 - comms, [8](#)
- data_io.f90
 - get_observation_data, [48](#)
 - output_from_pf, [49](#)
 - save_observation_data, [49](#)
 - save_truth, [50](#)
- deallocate_data
 - comms, [7](#)
- deallocate_pf
 - pf_control, [11](#)
- diagnostics
 - diagnostics.f90, [50](#)
- diagnostics.f90
 - diagnostics, [50](#)
 - trajectories, [51](#)
- dp
 - random, [22](#)
- eakf_analysis
 - eakf_analysis.f90, [27](#)
- eakf_analysis.f90
 - eakf_analysis, [27](#)
- efac
 - pf_control::pf_control_type, [13](#)
- empire
 - pf_couple.f90, [26](#)
- enkf_specific.f90
 - get_local_observation_data, [28](#)
 - h_local, [28](#)
 - localise_enkf, [29](#)
 - solve_rhalf_local, [29](#)
- equal_weight_filter
 - equivalent_weights_step.f90, [30](#)
- equivalent_weights_step.f90
 - equal_weight_filter, [30](#)
- etkf_analysis
 - etkf_analysis.f90, [31](#)
- etkf_analysis.f90
 - etkf_analysis, [31](#)
- gblcount
 - comms, [8](#)
- gbldisp
 - comms, [8](#)
- gen_data
 - pf_control::pf_control_type, [13](#)
- gen_q
 - pf_control::pf_control_type, [13](#)
- gen_rand.f90
 - mixturerandomnumbers1d, [34](#)
 - mixturerandomnumbers2d, [35](#)
 - normalrandomnumbers1d, [35](#)
 - normalrandomnumbers2d, [36](#)
 - random_seed_mpi, [37](#)
 - uniformrandomnumbers1d, [37](#)
- genQ.f90
 - genq, [51](#)
- genq
 - genQ.f90, [51](#)
- get_local_observation_data
 - enkf_specific.f90, [28](#)
- get_observation_data
 - data_io.f90, [48](#)

- h_local
 - enkf_specific.f90, 28
- h_tests
 - tests.f90, 45
- histogram_data, 9
 - kill_histogram_data, 9
 - load_histogram_data, 9
 - rank_hist_list, 9
 - rank_hist_nums, 9
 - rhl_n, 9
 - rhn_n, 9
- hqht_plus_r, 9
 - hqhtr_factor, 10
 - kill_hqhtr, 10
 - load_hqhtr, 10
- hqhtr_factor
 - hqht_plus_r, 10
- hqhtr_tests
 - tests.f90, 46
- human_readable
 - pf_control::pf_control_type, 13
- init
 - pf_control::pf_control_type, 13
- initialise_mpi
 - comms, 8
- innerhqht_plus_r_1
 - operator_wrappers.f90, 38
- innerr_1
 - operator_wrappers.f90, 39
- insertionsort_d
 - quicksort.f90, 52
- k
 - operator_wrappers.f90, 39
- keep
 - pf_control::pf_control_type, 13
- kill_histogram_data
 - histogram_data, 9
- kill_hqhtr
 - hqht_plus_r, 10
- killq
 - qdata, 14
- killr
 - rdata, 22
- lngamma
 - random, 16
- load_histogram_data
 - histogram_data, 9
- load_hqhtr
 - hqht_plus_r, 10
- loadq
 - qdata, 14
- loadr
 - rdata, 22
- localise_enkf
 - enkf_specific.f90, 29
- mean
 - pf_control::pf_control_type, 13
- mixture_randomnumbers1d
 - gen_rand.f90, 34
- mixture_randomnumbers2d
 - gen_rand.f90, 35
- mype_id
 - comms, 8
- myrank
 - comms, 8
- nens
 - pf_control::pf_control_type, 13
- nfac
 - pf_control::pf_control_type, 13
- normal_randomnumbers1d
 - gen_rand.f90, 35
- normal_randomnumbers2d
 - gen_rand.f90, 36
- npfs
 - comms, 8
- nproc
 - comms, 8
- nudgefac
 - pf_control::pf_control_type, 13
- obs_dim
 - sizes, 23
- old_pf_couple.f90
 - couple_pf, 25
- operator_wrappers.f90
 - bprime, 38
 - innerhqht_plus_r_1, 38
 - innerr_1, 39
 - k, 39
- output_from_pf
 - data_io.f90, 49
- particles
 - pf_control::pf_control_type, 13
- perturb_particle
 - perturb_particle.f90, 41
- perturb_particle.f90
 - perturb_particle, 41
 - update_state, 41
- pf
 - pf_control, 12
- pf_control, 11
 - allocate_pf, 11
 - deallocate_pf, 11
 - pf, 12
 - set_pf_controls, 12
- pf_control::pf_control_type, 12
 - count, 13
 - couple_root, 13
 - efac, 13
 - gen_data, 13
 - gen_q, 13
 - human_readable, 13

- init, 13
- keep, 13
- mean, 13
- nens, 13
- nfac, 13
- nudgefac, 13
- particles, 13
- psi, 13
- qscale, 13
- talagrand, 13
- time, 14
- time_bwn_obs, 14
- time_obs, 14
- timestep, 14
- type, 14
- ufac, 14
- use_mean, 14
- use_rmse, 14
- use_talagrand, 14
- use_traj, 14
- use_var, 14
- use_weak, 14
- weight, 14
- pf_couple.f90
 - empire, 26
- pf_mpi_comm
 - comms, 8
- pfrank
 - comms, 9
- proposal_filter
 - proposal_filter.f90, 32
- proposal_filter.f90
 - proposal_filter, 32
- psi
 - pf_control::pf_control_type, 13
- q_tests
 - tests.f90, 47
- qcol
 - qdata, 15
- qdata, 14
 - killq, 14
 - loadq, 14
 - qcol, 15
 - qdiag, 15
 - qn, 15
 - qne, 15
 - qrow, 15
 - qscale, 15
 - qval, 15
- qdiag
 - qdata, 15
- qn
 - qdata, 15
- qne
 - qdata, 15
- qrow
 - qdata, 15
- qscale
 - pf_control::pf_control_type, 13
 - qdata, 15
- quicksort.f90
 - insertionsort_d, 52
 - quicksort_d, 52
- quicksort_d
 - quicksort.f90, 52
- qval
 - qdata, 15
- r_tests
 - tests.f90, 47
- random, 15
 - bin_prob, 16
 - dp, 22
 - lngamma, 16
 - random_beta, 16
 - random_binomial1, 16
 - random_binomial2, 17
 - random_cauchy, 17
 - random_chisq, 17
 - random_exponential, 17
 - random_gamma, 18
 - random_gamma1, 18
 - random_gamma2, 19
 - random_inv_gauss, 19
 - random_mvnorm, 19
 - random_neg_binomial, 20
 - random_normal, 20
 - random_order, 20
 - random_poisson, 20
 - random_t, 21
 - random_von_mises, 21
 - random_weibull, 21
 - seed_random_number, 21
- random_beta
 - random, 16
- random_binomial1
 - random, 16
- random_binomial2
 - random, 17
- random_cauchy
 - random, 17
- random_chisq
 - random, 17
- random_exponential
 - random, 17
- random_gamma
 - random, 18
- random_gamma1
 - random, 18
- random_gamma2
 - random, 19
- random_inv_gauss
 - random, 19
- random_mvnorm
 - random, 19
- random_neg_binomial
 - random, 20

- random_normal
 - random, 20
- random_order
 - random, 20
- random_poisson
 - random, 20
- random_seed_mpi
 - gen_rand.f90, 37
- random_t
 - random, 21
- random_von_mises
 - random, 21
- random_weibull
 - random, 21
- rank_hist_list
 - histogram_data, 9
- rank_hist_nums
 - histogram_data, 9
- rcol
 - rdata, 22
- rdata, 22
 - killr, 22
 - loadr, 22
 - rcol, 22
 - rdiag, 22
 - rn, 22
 - rne, 22
 - rrow, 23
 - rval, 23
- rdiag
 - rdata, 22
- resample
 - resample.f90, 42
- resample.f90
 - resample, 42
- rhl_n
 - histogram_data, 9
- rhn_n
 - histogram_data, 9
- rn
 - rdata, 22
- rne
 - rdata, 22
- rrow
 - rdata, 23
- rval
 - rdata, 23
- save_observation_data
 - data_io.f90, 49
- save_truth
 - data_io.f90, 50
- seed_random_number
 - random, 21
- set_pf_controls
 - pf_control, 12
- sir_filter
 - sir_filter.f90, 32
- sir_filter.f90
 - sir_filter, 32
- sizes, 23
 - obs_dim, 23
 - state_dim, 23
- solve_rhalf_local
 - enkf_specific.f90, 29
- src/controllers/old_pf_couple.f90, 25
- src/controllers/pf_control.f90, 26
- src/controllers/pf_couple.f90, 26
- src/controllers/sizes.f90, 27
- src/data/Qdata.f90, 27
- src/data/Rdata.f90, 27
- src/filters/eakf_analysis.f90, 27
- src/filters/enkf_specific.f90, 28
- src/filters/equivalent_weights_step.f90, 30
- src/filters/etkf_analysis.f90, 31
- src/filters/proposal_filter.f90, 32
- src/filters/sir_filter.f90, 32
- src/filters/stochastic_model.f90, 33
- src/operations/gen_rand.f90, 34
- src/operations/operator_wrappers.f90, 38
- src/operations/perturb_particle.f90, 40
- src/operations/resample.f90, 42
- src/tests/alltests.f90, 43
- src/tests/test_h.f90, 43
- src/tests/test_hqhtr.f90, 44
- src/tests/test_q.f90, 44
- src/tests/test_r.f90, 45
- src/tests/tests.f90, 45
- src/utls/comms.f90, 48
- src/utls/data_io.f90, 48
- src/utls/diagnostics.f90, 50
- src/utls/genQ.f90, 51
- src/utls/histogram.f90, 52
- src/utls/quicksort.f90, 52
- src/utls/random_d.f90, 53
- state_dim
 - sizes, 23
- stochastic_model
 - stochastic_model.f90, 33
- stochastic_model.f90
 - check_scaling, 33
 - stochastic_model, 33
- talagrand
 - pf_control::pf_control_type, 13
- test_h
 - test_h.f90, 43
- test_h.f90
 - test_h, 43
- test_hqhtr
 - test_hqhtr.f90, 44
- test_hqhtr.f90
 - test_hqhtr, 44
- test_q
 - test_q.f90, 44
- test_q.f90
 - test_q, 44
- test_r

- test_r.f90, 45
- test_r.f90
 - test_r, 45
- tests.f90
 - h_tests, 45
 - hqhtr_tests, 46
 - q_tests, 47
 - r_tests, 47
- time
 - pf_control::pf_control_type, 14
- time_bwn_obs
 - pf_control::pf_control_type, 14
- time_obs
 - pf_control::pf_control_type, 14
- timestep
 - pf_control::pf_control_type, 14
- trajectories
 - diagnostics.f90, 51
- type
 - pf_control::pf_control_type, 14
- ufac
 - pf_control::pf_control_type, 14
- uniformrandomnumbers1d
 - gen_rand.f90, 37
- update_state
 - perturb_particle.f90, 41
- use_mean
 - pf_control::pf_control_type, 14
- use_rmse
 - pf_control::pf_control_type, 14
- use_talagrand
 - pf_control::pf_control_type, 14
- use_traj
 - pf_control::pf_control_type, 14
- use_var
 - pf_control::pf_control_type, 14
- use_weak
 - pf_control::pf_control_type, 14
- weight
 - pf_control::pf_control_type, 14