pyrad library reference for developers

Release 0.0.1

meteoswiss-mdr

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pyrad.flow.flow_aux.**_add_dataset**(*args*, **kwargs*)

   wrapper

   Parameters

   args, kwargs [arguments] The arguments of the function

   Returns

   func [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_create_cfg_dict**(*args*, **kwargs*)

   wrapper

> Parameters
>
>> **args, kwargs** [arguments] The arguments of the function
>
> Returns
>
>> **func** [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_create_datacfg_dict**(*args*, ***kwargs*)

> wrapper
>
>> Parameters
>>
>>> **args, kwargs** [arguments] The arguments of the function
>>
>> Returns
>>
>>> **func** [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_create_dscfg_dict**(*args*, ***kwargs*)

> wrapper
>
>> Parameters
>>
>>> **args, kwargs** [arguments] The arguments of the function
>>
>> Returns
>>
>>> **func** [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_create_prdcfg_dict**(*args*, ***kwargs*)

> wrapper
>
>> Parameters
>>
>>> **args, kwargs** [arguments] The arguments of the function
>>
>> Returns
>>
>>> **func** [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_generate_dataset**(*args*, ***kwargs*)

> wrapper
>
>> Parameters
>>
>>> **args, kwargs** [arguments] The arguments of the function
>>
>> Returns
>>
>>> **func** [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_generate_prod**(*args*, ***kwargs*)

> wrapper
>
>> Parameters
>>
>>> **args, kwargs** [arguments] The arguments of the function
>>
>> Returns
>>
>>> **func** [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_get_datasets_list**(*args*, ***kwargs*)

> wrapper

>> **Parameters**

>>> **args, kwargs** [arguments] The arguments of the function

>> **Returns**

>>> **func** [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_get_datatype_list**(*args*, ***kwargs*)

> wrapper

>> **Parameters**

>>> **args, kwargs** [arguments] The arguments of the function

>> **Returns**

>>> **func** [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_get_masterfile_list**(*args*, ***kwargs*)

> wrapper

>> **Parameters**

>>> **args, kwargs** [arguments] The arguments of the function

>> **Returns**

>>> **func** [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_get_radars_data**(*args*, ***kwargs*)

> wrapper

>> **Parameters**

>>> **args, kwargs** [arguments] The arguments of the function

>> **Returns**

>>> **func** [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_get_times_and_traj**(*args*, ***kwargs*)

> wrapper

>> **Parameters**

>>> **args, kwargs** [arguments] The arguments of the function

>> **Returns**

>>> **func** [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_initialize_datasets**(*dataset_levels*, *cfg*, *traj=None*, *infostr=None*)

> Initializes datasets. Creates the data set configuration dictionary

>> **Parameters**

>>> **dataset_levels** [dict] dictionary containing the list of data sets to be generated at each processing level

> **cfg** [dict] processing configuration dictionary
>
> **traj** [trajectory object] object containing the trajectory
>
> **infostr** [str] Information string about the actual data processing (e.g. 'RUN57'). This string is added to product files.

> **Returns**
>
>> **dscfg** [dict] dictionary containing the configuration data for each dataset
>>
>> **traj** [trajectory object] the modified trajectory object

pyrad.flow.flow_aux.**_initialize_listener**()
    initialize the input listener

> **Returns**
>
>> **input_queue** [queue object] the queue object where to put the quit signal

pyrad.flow.flow_aux.**_postprocess_datasets**(*dataset_levels*, *cfg*, *dscfg*, *traj=None*, *infostr=None*)
    Processes the radar volumes for a particular time stamp.

> **Parameters**
>
>> **dataset_levels** [dict] dictionary containing the list of data sets to be generated at each processing level
>>
>> **cfg** [dict] processing configuration dictionary
>>
>> **dscfg** [dict] dictionary containing the configuration data for each dataset
>>
>> **traj** [trajectory object] and object containing the trajectory
>>
>> **infostr** [str] Information string about the actual data processing (e.g. 'RUN57'). This string is added to product files.

> **Returns**
>
>> **dscfg** [dict] the modified configuration dictionary
>>
>> **traj** [trajectory object] the modified trajectory object

pyrad.flow.flow_aux.**_process_datasets**(**args*, ***kwargs*)
    wrapper

> **Parameters**
>
>> **args, kwargs** [arguments] The arguments of the function

> **Returns**
>
>> **func** [function] The original function if no profiling has to be performed or the function decorated with the memory decorator

pyrad.flow.flow_aux.**_user_input_listener**(*input_queue*)
    Permanently listens to the keyword input until the user types "Return"

> **Parameters**
>
>> **input_queue** [queue object] the queue object where to put the quit signal

pyrad.flow.flow_aux.**_wait_for_files**(*nowtime*, *datacfg*, *datatype_list*, *last_processed=None*)
    Waits for the master file and all files in a volume scan to be present returns the masterfile if the volume scan can be processed.

> **Parameters**

nowtime [datetime object] the current time

datacfg [dict] dictionary containing the parameters to get the radar data

last_processed [datetime or None] The end time of the previously processed radar volume

Returns

masterfile [str or None] name of the master file. None if the volume was not complete

masterdatatypedescr [str] the description of the master data type

last_processed [datetime] True of all scans found

pyrad.flow.flow_aux.**_wait_for_rainbow_datatypes**(*rainbow_files*, *period=30*)
   waits until the files for all rainbow data types are present.

Parameters

rainbow_files [list of strings] a list containing the names of all the rainbow files to wait for

period [int] the time it has to wait (s)

Returns

found_all [Boolean] True if all files were present. False otherwise

pyrad.flow.flow_aux.**_warning_format**(*message*, *category*, *filename*, *lineno*, *file=None*, *line=None*)

pyrad.flow.flow_aux.**profiler**(*level=1*)
   Function to be used as decorator for memory debugging. The function will be profiled or not according to its level respect to the global variable PROFILE_LEVEL

Parameters

level [int] profiling level

Returns

func or func wrapper [function] The function or its wrapper for profiling

PYRAD.FLOW.FLOW_CONTROL

functions to control the Pyrad data processing flow

main(cfgfile[, starttime, endtime, ...])	Main flow control.
main_rt(cfgfile_list[, starttime, endtime, ...])	main flow control.

pyrad.flow.flow_control.**main**(*cfgfile*, *starttime=None*, *endtime=None*, *trajfile=''*, *trajtype='plane'*, *flashnr=0*, *infostr=''*, *MULTIPROCESSING_DSET=False*, *MULTIPROCESSING_PROD=False*, *PROFILE_MULTIPROCESSING=False*)

Main flow control. Processes radar data off-line over a period of time given either by the user, a trajectory file, or determined by the last volume processed and the current time. Multiple radars can be processed simultaneously

> **Parameters**
>
> > **cfgfile** [str] path of the main config file
> >
> > **starttime, endtime** [datetime object] start and end time of the data to be processed
> >
> > **trajfile** [str] path to file describing the trajectory
> >
> > **trajtype** [str] type of trajectory file. Can be either 'plane' or 'lightning'
> >
> > **flashnr** [int] If larger than 0 will select a flash in a lightning trajectory file. If 0 the data corresponding to the trajectory of all flashes will be plotted
> >
> > **infostr** [str] Information string about the actual data processing (e.g. 'RUN57'). This string is added to product files.
> >
> > **MULTIPROCESSING_DSET** [Bool] If true the generation of datasets at the same processing level will be parallelized
> >
> > **MULTIPROCESSING_PROD** [Bool] If true the generation of products from each dataset will be parallelized
> >
> > **PROFILE_MULTIPROCESSING** [Bool] If true and code parallelized the multiprocessing is profiled

pyrad.flow.flow_control.**main_rt**(*cfgfile_list*, *starttime=None*, *endtime=None*, *infostr_list=None*, *proc_period=60*, *proc_finish=None*)

main flow control. Processes radar data in real time. The start and end processing times can be determined by the user. This function is inteded for a single radar

> **Parameters**
>
> > **cfgfile_list** [list of str] path of the main config files
> >
> > **starttime, endtime** [datetime object] start and end time of the data to be processed

infostr_list [list of str] Information string about the actual data processing (e.g. 'RUN57'). This string is added to product files.

proc_period [int] period of time before starting a new processing round (seconds)

cronjob_controlled [Boolean] If True means that the program is started periodically from a cronjob and therefore finishes execution after processing

proc_finish [int or None] if set to a value the program will be forced to shut down after the value (in seconds) from start time has been exceeded

Returns

end_proc [Boolean] If true the program has ended successfully

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PYRAD.PROC.PROCESS_AUX

Auxiliary functions. Functions to determine the process type, pass raw data to the product generation functions, save radar data and extract data at determined points or regions of interest.

get_process_func(dataset_type, dsname)	Maps the dataset type into its processing function and data set format associated.
process_raw(procstatus, dscfg[, radar_list])	Dummy function that returns the initial input data set
process_save_radar(procstatus, dscfg[, …])	Dummy function that allows to save the entire radar object
process_fixed_rng(procstatus, dscfg[, …])	Obtains radar data at a fixed range
process_fixed_rng_span(procstatus, dscfg[, …])	For each azimuth-elevation gets the data within a fixed range span and computes a user-defined statistic: mean, min, max, mode, median
process_roi(procstatus, dscfg[, radar_list])	Obtains the radar data at a region of interest.
process_grid(procstatus, dscfg[, radar_list])	Puts the radar data in a regular grid
process_azimuthal_average(procstatus, dscfg)	Averages radar data in azimuth obtaining and RHI as a result

pyrad.proc.process_aux.**get_process_func**(*dataset_type*, *dsname*)

Maps the dataset type into its processing function and data set format associated.

Parameters

dataset_type [str] The following is a list of data set types ordered by type of output dataset with the function they call. For details of what they do check the function documentation:

'VOL' format output: 'ATTENUATION': process_attenuation 'AZI_AVG': process_azimuthal_average 'BIAS_CORRECTION': process_correct_bias 'BIRDS_ID': process_birds_id 'BIRD_DENSITY': process_bird_density 'CDF': process_cdf 'CDR': process_cdr 'CLT_TO_SAN': process_clt_to_echo_id 'COSMO': process_cosmo 'COSMO_LOOKUP': process_cosmo_lookup_table 'DEALIAS_FOURDD': process_dealias_fourdd 'DEALIAS_REGION': process_dealias_region_based 'DEALIAS_UNWRAP': process_dealias_unwrap_phase 'ECHO_FILTER': process_echo_filter 'FIXED_RNG': process_fixed_rng 'FIXED_RNG_SPAN': process_fixed_rng_span 'HYDROCLASS': process_hydroclass 'HZT': process_hzt 'HZT_LOOKUP': process_hzt_lookup_table 'KDP_LEASTSQUARE_1W': process_kdp_leastsquare_single_window 'KDP_LEASTSQUARE_2W': process_kdp_leastsquare_double_window 'L': process_l 'NCVOL': process_save_radar 'OUTLIER_FILTER': process_outlier_filter 'PHIDP0_CORRECTION': process_correct_phidp0 'PHIDP0_ESTIMATE': process_estimate_phidp0 'PHIDP_KDP_KALMAN': process_phidp_kdp_Kalman 'PHIDP_KDP_LP': process_phidp_kdp_lp 'PHIDP_KDP_VULPIANI':

process_phidp_kdp_Vulpiani 'PHIDP_SMOOTH_1W': process_smooth_phidp_single_window 'PHIDP_SMOOTH_2W': process_smooth_phidp_double_window 'PWR': process_signal_power 'RAIN-RATE': process_rainrate 'RAW': process_raw 'RCS': process_rcs 'RCS_PR': process_rcs_pr 'RHOHV_CORRECTION': process_correct_noise_rhohv 'RHOHV_RAIN': process_rhohv_rain 'ROI': process_roi 'SAN': process_echo_id 'SELFCONSISTENCY_BIAS': process_selfconsistency_bias 'SELFCON-SISTENCY_KDP_PHIDP': process_selfconsistency_kdp_phidp 'SNR': process_snr 'SNR_FILTER': process_filter_snr 'TRAJ_TRT' : process_traj_trt 'VAD': process_vad 'VEL_FILTER': process_filter_vel_diff 'VIS_FILTER': process_filter_visibility 'VOL_REFL': process_vol_refl 'WIND_VEL': process_wind_vel 'WINDSHEAR': process_windshear 'ZDR_PREC': process_zdr_precip 'ZDR_SNOW': process_zdr_snow

'COLOCATED_GATES' format output: 'COLOCATED_GATES': process_colocated_gates

'COSMO_COORD' format output: 'COSMO_COORD': process_cosmo_coord 'HZT_COORD': process_hzt_coord

'GRID' format output: 'GRID': process_grid

'INTERCOMP' format output: 'INTERCOMP': process_intercomp 'INTER-COMP_TIME_AVG': process_intercomp_time_avg

'ML' format output: 'ML_DETECTION': process_melting_layer

'MONITORING' format output: 'GC_MONITORING': process_gc_monitoring 'MONITORING': process_monitoring

'OCCURRENCE' format output: 'OCCURRENCE': process_occurrence 'OC-CURRENCE_PERIOD': process_occurrence_period 'TIMEAVG_STD': process_time_avg_std

'QVP' format output: 'EVP': process_evp 'QVP': process_qvp 'rQVP': process_rqvp 'SVP': process_svp 'TIME_HEIGHT': process_time_height

'SPARSE_GRID' format output: 'ZDR_COLUMN': process_zdr_column

'SUN_HITS' format output: 'SUN_HITS': process_sun_hits

'TIMEAVG' format output: 'FLAG_TIME_AVG': process_time_avg_flag 'TIME_AVG': process_time_avg 'WEIGHTED_TIME_AVG': process_weighted_time_avg 'TIME_STATS': process_time_stats 'TIME_STATS2': process_time_stats2

'TIMESERIES' format output: 'POINT_MEASUREMENT': 'process_point_measurement' 'TRAJ_ANTENNA_PATTERN': process_traj_antenna_pattern 'TRAJ_ATPLANE': process_traj_atplane 'TRAJ_LIGHTNING': process_traj_lightning

'TRAJ_ONLY' format output: 'TRAJ': process_trajectory

dsname [str] Name of dataset

Returns

func_name [str or processing function] pyrad function used to process the data set type

dsformat [str] data set format, i.e.: 'VOL', etc.

pyrad.proc.process_aux.**process_azimuthal_average**(*procstatus*, *dscfg*, *radar_list=None*)
    Averages radar data in azimuth obtaining and RHI as a result

---

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [string. Dataset keyword] The data type where we want to extract the point measurement

gridconfig [dictionary. Dataset keyword] Dictionary containing some or all of this keywords: xmin, xmax, ymin, ymax, zmin, zmax : floats

minimum and maximum horizontal distance from grid origin [km] and minimum and maximum vertical distance from grid origin [m] Defaults -40, 40, -40, 40, 0., 10000.

hres, vres [floats] horizontal and vertical grid resolution [m] Defaults 1000., 500.

latorig, lonorig, altorig [floats] latitude and longitude of grid origin [deg] and altitude of grid origin [m MSL] Defaults the latitude, longitude and altitude of the radar

wfunc [str] the weighting function used to combine the radar gates close to a grid point. Possible values BARNES, CRESSMAN, NEAREST_NEIGHBOUR Default NEAREST_NEIGHBOUR

roif_func [str] the function used to compute the region of interest. Possible values: dist_beam, constant

roi [float] the (minimum) radius of the region of interest in m. Default half the largest resolution

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the gridded data

ind_rad [int] radar index

pyrad.proc.process_aux.**process_fixed_rng**(*procstatus*, *dscfg*, *radar_list=None*)
Obtains radar data at a fixed range

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of strings. Dataset keyword] The fields we want to extract

rng [float. Dataset keyword] The fixed range [m]

RngTol [float. Dataset keyword] The tolerance between the nominal range and the radar range

ele_min, ele_max, azi_min, azi_max [floats. Dataset keyword] The azimuth and elevation limits of the data [deg]

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the data and metadata at the point of interest

ind_rad [int] radar index

`pyrad.proc.process_aux.`**`process_fixed_rng_span`**(*procstatus*, *dscfg*, *radar_list=None*)
　　For each azimuth-elevation gets the data within a fixed range span and computes a user-defined statistic: mean, min, max, mode, median

　　　　Parameters

　　　　　　procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

　　　　　　dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

　　　　　　　　datatype [list of strings. Dataset keyword] The fields we want to extract

　　　　　　　　rmin, rmax [float. Dataset keyword] The range limits [m]

　　　　　　　　ele_min, ele_max, azi_min, azi_max [floats. Dataset keyword] The azimuth and elevation limits of the data [deg]

　　　　　　radar_list [list of Radar objects] Optional. list of radar objects

　　　　Returns

　　　　　　new_dataset [dict] dictionary containing the data and metadata at the point of interest

　　　　　　ind_rad [int] radar index

`pyrad.proc.process_aux.`**`process_grid`**(*procstatus*, *dscfg*, *radar_list=None*)
　　Puts the radar data in a regular grid

　　　　Parameters

　　　　　　procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

　　　　　　dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

　　　　　　　　datatype [string. Dataset keyword] The data type where we want to extract the point measurement

　　　　　　　　gridconfig [dictionary. Dataset keyword] Dictionary containing some or all of this keywords: xmin, xmax, ymin, ymax, zmin, zmax : floats

　　　　　　　　　　minimum and maximum horizontal distance from grid origin [km] and minimum and maximum vertical distance from grid origin [m] Defaults -40, 40, -40, 40, 0., 10000.

　　　　　　　　　　hres, vres [floats] horizontal and vertical grid resolution [m] Defaults 1000., 500.

　　　　　　　　　　latorig, lonorig, altorig [floats] latitude and longitude of grid origin [deg] and altitude of grid origin [m MSL] Defaults the latitude, longitude and altitude of the radar

　　　　　　　　wfunc [str] the weighting function used to combine the radar gates close to a grid point. Possible values BARNES, CRESSMAN, NEAREST_NEIGHBOUR Default NEAREST_NEIGHBOUR

　　　　　　　　roif_func [str] the function used to compute the region of interest. Possible values: dist_beam, constant

　　　　　　　　roi [float] the (minimum) radius of the region of interest in m. Default half the largest resolution

　　　　　　radar_list [list of Radar objects] Optional. list of radar objects

　　　　Returns

　　　　　　new_dataset [dict] dictionary containing the gridded data

　　　　　　ind_rad [int] radar index

`pyrad.proc.process_aux.`**`process_raw`**(*procstatus*, *dscfg*, *radar_list=None*)
  Dummy function that returns the initial input data set

  > **Parameters**
  >
  > > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
  > >
  > > **dscfg** [dictionary of dictionaries] data set configuration
  > >
  > > **radar_list** [list of Radar objects] Optional. list of radar objects
  >
  > **Returns**
  >
  > > **new_dataset** [dict] dictionary containing the output
  > >
  > > **ind_rad** [int] radar index

`pyrad.proc.process_aux.`**`process_roi`**(*procstatus*, *dscfg*, *radar_list=None*)
  Obtains the radar data at a region of interest.

  > **Parameters**
  >
  > > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
  > >
  > > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
  > >
  > > > **datatype** [string. Dataset keyword] The data type where we want to extract the point measurement
  > >
  > > **radar_list** [list of Radar objects] Optional. list of radar objects
  >
  > **Returns**
  >
  > > **new_dataset** [dict] dictionary containing the data and metadata at the point of interest
  > >
  > > **ind_rad** [int] radar index

`pyrad.proc.process_aux.`**`process_save_radar`**(*procstatus*, *dscfg*, *radar_list=None*)
  Dummy function that allows to save the entire radar object

  > **Parameters**
  >
  > > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
  > >
  > > **dscfg** [dictionary of dictionaries] data set configuration
  > >
  > > **radar_list** [list of Radar objects] Optional. list of radar objects
  >
  > **Returns**
  >
  > > **new_dataset** [dict] dictionary containing the output
  > >
  > > **ind_rad** [int] radar index

PYRAD.PROC.PROCESS_CALIB

Functions for monitoring data quality and correct bias and noise effects

[*process_correct_bias*](procstatus, dscfg[, . . .])	Corrects a bias on the data
[*process_correct_noise_rhohv*](procstatus, dscfg)	identifies echoes as 0: No data, 1: Noise, 2: Clutter, 3: Precipitation
[*process_gc_monitoring*](procstatus, dscfg[, . . .])	computes ground clutter monitoring statistics
[*process_occurrence*](procstatus, dscfg[, . . .])	computes the frequency of occurrence of data.
[*process_time_avg_std*](procstatus, dscfg[, . . .])	computes the average and standard deviation of data.
[*process_occurrence_period*](procstatus, dscfg)	computes the frequency of occurrence over a long period of time by adding together shorter periods
[*process_sun_hits*](procstatus, dscfg[, radar_list])	monitoring of the radar using sun hits

pyrad.proc.process_calib.**process_correct_bias**(*procstatus*, *dscfg*, *radar_list=None*)
    Corrects a bias on the data

    Parameters

    procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

    dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

        datatype [string. Dataset keyword] The data type to correct for bias

        bias [float. Dataset keyword] The bias to be corrected [dB]. Default 0

    radar_list [list of Radar objects] Optional. list of radar objects

    Returns

    new_dataset [dict] dictionary containing the output

    ind_rad [int] radar index

pyrad.proc.process_calib.**process_correct_noise_rhohv**(*procstatus*, *dscfg*, *radar_list=None*)
    identifies echoes as 0: No data, 1: Noise, 2: Clutter, 3: Precipitation

    Parameters

    procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

    dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

        datatype [list of string. Dataset keyword] The data types used in the correction

    radar_list [list of Radar objects] Optional. list of radar objects

Returns

>> **new_dataset** [dict] dictionary containing the output

>> **ind_rad** [int] radar index

`pyrad.proc.process_calib.`**`process_gc_monitoring`**(*procstatus*, *dscfg*, *radar_list=None*)
>> computes ground clutter monitoring statistics

> **Parameters**

>> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

>> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

>>> **excessgatespath** [str. Config keyword] The path to the gates in excess of quantile location

>>> **excessgates_fname** [str. Dataset keyword] The name of the gates in excess of quantile file

>>> **datatype** [list of string. Dataset keyword] The input data types

>>> **step** [float. Dataset keyword] The width of the histogram bin. Default is None. In that case the default step in function get_histogram_bins is used

>>> **regular_grid** [Boolean. Dataset keyword] Whether the radar has a Boolean grid or not. Default False

>>> **val_min** [Float. Dataset keyword] Minimum value to consider that the gate has signal. Default None

>>> **filter_prec** [str. Dataset keyword] Give which type of volume should be filtered. None, no filtering; keep_wet, keep wet volumes; keep_dry, keep dry volumes.

>>> **rmax_prec** [float. Dataset keyword] Maximum range to consider when looking for wet gates [m]

>>> **percent_prec_max** [float. Dataset keyword] Maxim percentage of wet gates to consider the volume dry

>> **radar_list** [list of Radar objects] Optional. list of radar objects

> **Returns**

>> **new_dataset** [Radar] radar object containing histogram data

>> **ind_rad** [int] radar index

`pyrad.proc.process_calib.`**`process_occurrence`**(*procstatus*, *dscfg*, *radar_list=None*)
>> computes the frequency of occurrence of data. It looks only for gates where data is present.

> **Parameters**

>> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

>> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

>>> **datatype** [list of string. Dataset keyword] The input data types

>>> **regular_grid** [Boolean. Dataset keyword] Whether the radar has a Boolean grid or not. Default False

>>> **rmin, rmax** [float. Dataset keyword] minimum and maximum ranges where the computation takes place. If -1 the whole range is considered. Default is -1

>>> **val_min** [Float. Dataset keyword] Minimum value to consider that the gate has signal. Default None

filter_prec [str. Dataset keyword] Give which type of volume should be filtered. None, no filtering; keep_wet, keep wet volumes; keep_dry, keep dry volumes.

rmax_prec [float. Dataset keyword] Maximum range to consider when looking for wet gates [m]

percent_prec_max [float. Dataset keyword] Maxim percentage of wet gates to consider the volume dry

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_calib.**process_occurrence_period**(*procstatus*, *dscfg*, *radar_list=None*)
    computes the frequency of occurrence over a long period of time by adding together shorter periods

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

regular_grid [Boolean. Dataset keyword] Whether the radar has a Boolean grid or not. Default False

rmin, rmax [float. Dataset keyword] minimum and maximum ranges where the computation takes place. If -1 the whole range is considered. Default is -1

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_calib.**process_sun_hits**(*procstatus*, *dscfg*, *radar_list=None*)
    monitoring of the radar using sun hits

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

rmin [float. Dataset keyword] minimum range where to look for a sun hit signal [m]. Default 50000.

hmin [float. Dataset keyword] minimum altitude where to look for a sun hit signal [m MSL]. Default 10000. The actual range from which a sun hit signal will be search will be the minimum between rmin and the range from which the altitude is higher than hmin.

delev_max [float. Dataset keyword] maximum elevation distance from nominal radar elevation where to look for a sun hit signal [deg]. Default 1.5

dazim_max [float. Dataset keyword] maximum azimuth distance from nominal radar elevation where to look for a sun hit signal [deg]. Default 1.5

elmin [float. Dataset keyword] minimum radar elevation where to look for sun hits [deg]. Default 1.

nbins_min [int. Dataset keyword.] minimum number of range bins that have to contain signal to consider the ray a potential sun hit. Default 10.

attg [float. Dataset keyword] gaseous attenuation. Default None

max_std_pwr [float. Dataset keyword] maximum standard deviation of the signal power to consider the data a sun hit [dB]. Default 2.

max_std_zdr [float. Dataset keyword] maximum standard deviation of the ZDR to consider the data a sun hit [dB]. Default 2.

az_width_co [float. Dataset keyword] co-polar antenna azimuth width (convoluted with sun width) [deg]. Default None

el_width_co [float. Dataset keyword] co-polar antenna elevation width (convoluted with sun width) [deg]. Default None

az_width_cross [float. Dataset keyword] cross-polar antenna azimuth width (convoluted with sun width) [deg]. Default None

el_width_cross [float. Dataset keyword] cross-polar antenna elevation width (convoluted with sun width) [deg]. Default None

ndays [int. Dataset keyword] number of days used in sun retrieval. Default 1

coeff_band [float. Dataset keyword] multiplicate coefficient to transform pulse width into receiver bandwidth

radar_list [list of Radar objects] Optional. list of radar objects

Returns

sun_hits_dict [dict] dictionary containing a radar object, a sun_hits dict and a sun_retrieval dictionary

ind_rad [int] radar index

pyrad.proc.process_calib.**process_time_avg_std**(*procstatus*, *dscfg*, *radar_list=None*)
    computes the average and standard deviation of data. It looks only for gates where data is present.

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

regular_grid [Boolean. Dataset keyword] Whether the radar has a Boolean grid or not. Default False

rmin, rmax [float. Dataset keyword] minimum and maximum ranges where the computation takes place. If -1 the whole range is considered. Default is -1

val_min [Float. Dataset keyword] Minimum reflectivity value to consider that the gate has signal. Default None

filter_prec [str. Dataset keyword] Give which type of volume should be filtered. None, no filtering; keep_wet, keep wet volumes; keep_dry, keep dry volumes.

rmax_prec [float. Dataset keyword] Maximum range to consider when looking for wet gates [m]

percent_prec_max [float. Dataset keyword] Maxim percentage of wet gates to consider the volume dry

lin_trans [Boolean. Dataset keyword] If True the data will be transformed into linear units. Default False

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

PYRAD.PROC.PROCESS_COSMO

Functions to manage COSMO data

process_cosmo(procstatus, dscfg[, radar_list])	Gets COSMO data and put it in radar coordinates
process_hzt(procstatus, dscfg[, radar_list])	Gets iso0 degree data in HZT format and put it in radar coordinates
process_cosmo_lookup_table(procstatus, dscfg)	Gets COSMO data and put it in radar coordinates using look up tables computed or loaded when initializing
process_hzt_lookup_table(procstatus, dscfg)	Gets HZT data and put it in radar coordinates using look up tables computed or loaded when initializing
process_cosmo_coord(procstatus, dscfg[, ...])	Gets the COSMO indices corresponding to each cosmo coordinates
process_hzt_coord(procstatus, dscfg[, ...])	Gets the HZT indices corresponding to each HZT coordinates

pyrad.proc.process_cosmo.**process_cosmo**(*procstatus*, *dscfg*, *radar_list=None*)

Gets COSMO data and put it in radar coordinates

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [string. Dataset keyword] arbitrary data type

keep_in_memory [int. Dataset keyword] if set keeps the COSMO data dict, the COSMO coordinates dict and the COSMO field in radar coordinates in memory

regular_grid [int. Dataset keyword] if set it is assume that the radar has a grid constant in time and there is no need to compute a new COSMO field if the COSMO data has not changed

cosmo_type [str. Dataset keyword] name of the COSMO field to process. Default TEMP

cosmo_variables [list of strings. Dataset keyword] Py-art name of the COSMO fields. Default temperature

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_cosmo.**process_cosmo_coord**(*procstatus*, *dscfg*, *radar_list=None*)

Gets the COSMO indices corresponding to each cosmo coordinates

Parameters

> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
>
> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
>
> > **datatype** [string. Dataset keyword] arbitrary data type
> >
> > **cosmopath** [string. General keyword] path where to store the look up table
> >
> > **model** [string. Dataset keyword] The COSMO model to use. Can be cosmo-1, cosmo-2, cosmo-7
>
> **radar_list** [list of Radar objects] Optional. list of radar objects

Returns

> **new_dataset** [dict] dictionary containing the output
>
> **ind_rad** [int] radar index

pyrad.proc.process_cosmo.**process_cosmo_lookup_table**(*procstatus*, *dscfg*, *radar_list=None*)

> Gets COSMO data and put it in radar coordinates using look up tables computed or loaded when initializing

Parameters

> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
>
> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
>
> > **datatype** [string. Dataset keyword] arbitrary data type
> >
> > **lookup_table** [int. Dataset keyword] if set a pre-computed look up table for the COSMO coordinates is loaded. Otherwise the look up table is computed taking the first radar object as reference
> >
> > **regular_grid** [int. Dataset keyword] if set it is assume that the radar has a grid constant in time and therefore there is no need to interpolate the COSMO field in memory to the current radar grid
> >
> > **cosmo_type** [str. Dataset keyword] name of the COSMO field to process. Default TEMP
> >
> > **cosmo_variables** [list of strings. Dataset keyword] Py-art name of the COSMO fields. Default temperature
>
> **radar_list** [list of Radar objects] Optional. list of radar objects

Returns

> **new_dataset** [dict] dictionary containing the output
>
> **ind_rad** [int] radar index

pyrad.proc.process_cosmo.**process_hzt**(*procstatus*, *dscfg*, *radar_list=None*)

> Gets iso0 degree data in HZT format and put it in radar coordinates

Parameters

> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
>
> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
>
> > **datatype** [string. Dataset keyword] arbitrary data type
> >
> > **keep_in_memory** [int. Dataset keyword] if set keeps the COSMO data dict, the COSMO coordinates dict and the COSMO field in radar coordinates in memory

regular_grid [int. Dataset keyword] if set it is assume that the radar has a grid constant in time and there is no need to compute a new COSMO field if the COSMO data has not changed

cosmo_type [str. Dataset keyword] name of the COSMO field to process. Default TEMP

cosmo_variables [list of strings. Dataset keyword] Py-art name of the COSMO fields. Default temperature

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_cosmo.**process_hzt_coord**(*procstatus*, *dscfg*, *radar_list=None*)
    Gets the HZT indices corresponding to each HZT coordinates

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [string. Dataset keyword] arbitrary data type

cosmopath [string. General keyword] path where to store the look up table

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_cosmo.**process_hzt_lookup_table**(*procstatus*, *dscfg*, *radar_list=None*)
    Gets HZT data and put it in radar coordinates using look up tables computed or loaded when initializing

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [string. Dataset keyword] arbitrary data type

lookup_table [int. Dataset keyword] if set a pre-computed look up table for the COSMO coordinates is loaded. Otherwise the look up table is computed taking the first radar object as reference

regular_grid [int. Dataset keyword] if set it is assume that the radar has a grid constant in time and therefore there is no need to interpolate the COSMO field in memory to the current radar grid

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

PYRAD.PROC.PROCESS_DOPPLER

Functions for processing Doppler related parameters

process_dealias_fourdd(procstatus, dscfg[, ...])	Dealiases the Doppler velocity field using the 4DD technique from Curtis and Houze, 2001
process_dealias_region_based(procstatus, dscfg)	Dealiases the Doppler velocity field using a region based algorithm
process_dealias_unwrap_phase(procstatus, dscfg)	Dealiases the Doppler velocity field using multi-dimensional phase unwrapping
process_wind_vel(procstatus, dscfg[, radar_list])	Estimates the horizontal or vertical component of the wind from the radial velocity
process_windshear(procstatus, dscfg[, ...])	Estimates the wind shear from the wind velocity
process_vad(procstatus, dscfg[, radar_list])	Estimates vertical wind profile using the VAD (velocity Azimuth Display) technique

pyrad.proc.process_Doppler.**process_dealias_fourdd**(*procstatus*, *dscfg*, *radar_list=None*)

Dealiases the Doppler velocity field using the 4DD technique from Curtis and Houze, 2001

> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [string. Dataset keyword] The input data type
> > >
> > > **filt** [int. Dataset keyword] Flag controlling Bergen and Albers filter, 1 = yes, 0 = no.
> > >
> > > **sign** [int. Dataset keyword] Sign convention which the radial velocities in the volume created from the sounding data will will. This should match the convention used in the radar data. A value of 1 represents when positive values velocities are towards the radar, -1 represents when negative velocities are towards the radar.
> >
> > **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
> > **new_dataset** [dict] dictionary containing the output
> >
> > **ind_rad** [int] radar index

pyrad.proc.process_Doppler.**process_dealias_region_based**(*procstatus*, *dscfg*, *radar_list=None*)

> Dealiases the Doppler velocity field using a region based algorithm
>
> > **Parameters**

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [string. Dataset keyword] The input data type

interval_splits [int, optional] Number of segments to split the nyquist interval into when finding regions of similar velocity. More splits creates a larger number of initial regions which takes longer to process but may result in better dealiasing. The default value of 3 seems to be a good compromise between performance and artifact free dealiasing. This value is not used if the interval_limits parameter is not None.

skip_between_rays, skip_along_ray [int, optional] Maximum number of filtered gates to skip over when joining regions, gaps between region larger than this will not be connected. Parameters specify the maximum number of filtered gates between and along a ray. Set these parameters to 0 to disable unfolding across filtered gates.

centered [bool, optional] True to apply centering to each sweep after the dealiasing algorithm so that the average number of unfolding is near 0. False does not apply centering which may results in individual sweeps under or over folded by the nyquist interval.

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_Doppler.**process_dealias_unwrap_phase**(*procstatus*, *dscfg*, *radar_list=None*)

Dealiases the Doppler velocity field using multi-dimensional phase unwrapping

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [string. Dataset keyword] The input data type

unwrap_unit [{'ray', 'sweep', 'volume'}, optional] Unit to unwrap independently. 'ray' will unwrap each ray individually, 'sweep' each sweep, and 'volume' will unwrap the entire volume in a single pass. 'sweep', the default, often gives superior results when the lower sweeps of the radar volume are contaminated by clutter. 'ray' does not use the gatefilter parameter and rays where gates ared masked will result in poor dealiasing for that ray.

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_Doppler.**process_vad**(*procstatus*, *dscfg*, *radar_list=None*)

Estimates vertical wind profile using the VAD (velocity Azimuth Display) technique

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [string. Dataset keyword] The input data type

> **radar_list** [list of Radar objects] Optional. list of radar objects

> **Returns**

>> **new_dataset** [dict] dictionary containing the output

>> **ind_rad** [int] radar index

`pyrad.proc.process_Doppler.`**`process_wind_vel`**(*procstatus*, *dscfg*, *radar_list=None*)
  Estimates the horizontal or vertical component of the wind from the radial velocity

> **Parameters**

>> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

>> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

>>> **datatype** [string. Dataset keyword] The input data type

>>> **vert_proj** [Boolean] If true the vertical projection is computed. Otherwise the horizontal projection is computed

>> **radar_list** [list of Radar objects] Optional. list of radar objects

> **Returns**

>> **new_dataset** [dict] dictionary containing the output

>> **ind_rad** [int] radar index

`pyrad.proc.process_Doppler.`**`process_windshear`**(*procstatus*, *dscfg*, *radar_list=None*)
  Estimates the wind shear from the wind velocity

> **Parameters**

>> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

>> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

>>> **datatype** [string. Dataset keyword] The input data type

>>> **az_tol** [float] The tolerance in azimuth when looking for gates on top of the gate when computation is performed

>> **radar_list** [list of Radar objects] Optional. list of radar objects

> **Returns**

>> **new_dataset** [dict] dictionary containing the output

>> **ind_rad** [int] radar index

PYRAD.PROC.PROCESS_ECHOCLASS

Functions for echo classification and filtering

[process_echo_id](procstatus, dscfg[, radar_list])	identifies echoes as 0: No data, 1: Noise, 2: Clutter, 3: Precipitation
[process_birds_id](procstatus, dscfg[, radar_list])	identifies echoes as 0: No data, 1: Noise, 2: Clutter, 3: Birds
[process_clt_to_echo_id](procstatus, dscfg[, ...])	Converts clutter exit code from rad4alp into pyrad echo ID
[process_echo_filter](procstatus, dscfg[, ...])	Masks all echo types that are not of the class specified in keyword echo_type
[process_cdf](procstatus, dscfg[, radar_list])	Collects the fields necessary to compute the Cumulative Distribution Function
[process_filter_snr](procstatus, dscfg[, ...])	filters out low SNR echoes
[process_filter_vel_diff](procstatus, dscfg[, ...])	filters out range gates that could not be used for Doppler velocity estimation
[process_filter_visibility](procstatus, dscfg)	filters out rays gates with low visibility and corrects the reflectivity
[process_outlier_filter](procstatus, dscfg[, ...])	filters out gates which are outliers respect to the surrounding
[process_hydroclass](procstatus, dscfg[, ...])	Classifies precipitation echoes
[process_melting_layer](procstatus, dscfg[, ...])	Detects the melting layer
[process_zdr_column](procstatus, dscfg[, ...])	Detects ZDR columns

pyrad.proc.process_echoclass.**process_birds_id**(*procstatus*, *dscfg*, *radar_list=None*)
identifies echoes as 0: No data, 1: Noise, 2: Clutter, 3: Birds

> **Parameters**
>
>> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
>>
>> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
>>
>>> **datatype** [list of string. Dataset keyword] The input data types
>>
>> **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
>> **new_dataset** [dict] dictionary containing the output
>>
>> **ind_rad** [int] radar index

pyrad.proc.process_echoclass.**process_cdf**(*procstatus*, *dscfg*, *radar_list=None*)
Collects the fields necessary to compute the Cumulative Distribution Function

> **Parameters**
>
>> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
>>
>> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
>>
>>> **datatype** [list of string. Dataset keyword] The input data types
>>
>> **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
>> **new_dataset** [dict] dictionary containing the output
>>
>> **ind_rad** [int] radar index

pyrad.proc.process_echoclass.**process_clt_to_echo_id**(*procstatus*, *dscfg*, *radar_list=None*)

> Converts clutter exit code from rad4alp into pyrad echo ID
>
> **Parameters**
>
>> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
>>
>> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
>>
>>> **datatype** [list of string. Dataset keyword] The input data types
>>
>> **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
>> **new_dataset** [dict] dictionary containing the output
>>
>> **ind_rad** [int] radar index

pyrad.proc.process_echoclass.**process_echo_filter**(*procstatus*, *dscfg*, *radar_list=None*)

> Masks all echo types that are not of the class specified in keyword echo_type
>
> **Parameters**
>
>> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
>>
>> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
>>
>>> **datatype** [list of string. Dataset keyword] The input data types
>>>
>>> **echo_type** [int] The type of echo to keep: 1 noise, 2 clutter, 3 precipitation. Default 3
>>
>> **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
>> **new_dataset** [dict] dictionary containing the output
>>
>> **ind_rad** [int] radar index

pyrad.proc.process_echoclass.**process_echo_id**(*procstatus*, *dscfg*, *radar_list=None*)

> identifies echoes as 0: No data, 1: Noise, 2: Clutter, 3: Precipitation
>
> **Parameters**
>
>> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
>>
>> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
>>
>>> **datatype** [list of string. Dataset keyword] The input data types
>>
>> **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**

> **new_dataset** [dict] dictionary containing the output
>
> **ind_rad** [int] radar index

pyrad.proc.process_echoclass.**process_filter_snr**(*procstatus*, *dscfg*, *radar_list=None*)

> filters out low SNR echoes
>
> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [list of string. Dataset keyword] The input data types
> > >
> > > **SNRmin** [float. Dataset keyword] The minimum SNR to keep the data.
> >
> > **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
> > **new_dataset** [dict] dictionary containing the output
> >
> > **ind_rad** [int] radar index

pyrad.proc.process_echoclass.**process_filter_vel_diff**(*procstatus*, *dscfg*, *radar_list=None*)

> filters out range gates that could not be used for Doppler velocity estimation
>
> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [list of string. Dataset keyword] The input data types
> > >
> > > **SNRmin** [float. Dataset keyword] The minimum SNR to keep the data.
> >
> > **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
> > **new_dataset** [dict] dictionary containing the output
> >
> > **ind_rad** [int] radar index

pyrad.proc.process_echoclass.**process_filter_visibility**(*procstatus*, *dscfg*, *radar_list=None*)

> filters out rays gates with low visibility and corrects the reflectivity
>
> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [list of string. Dataset keyword] The input data types
> > >
> > > **VISmin** [float. Dataset keyword] The minimum visibility to keep the data.
> >
> > **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
> > **new_dataset** [dict] dictionary containing the output
> >
> > **ind_rad** [int] radar index

`pyrad.proc.process_echoclass.`**`process_hydroclass`**(*procstatus*, *dscfg*, *radar_list=None*)

    Classifies precipitation echoes

        Parameters

            procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

            dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

                datatype [list of string. Dataset keyword] The input data types

                HYDRO_METHOD [string. Dataset keyword] The hydrometeor classification method. One of the following: SEMISUPERVISED

                RADARCENTROIDS [string. Datset keyword] Used with HYDRO_METHOD SEMISUPERVISED. The name of the radar of which the derived centroids will be used. One of the following: A Albis, L Lema, P Plaine Morte, DX50

            radar_list [list of Radar objects] Optional. list of radar objects

        Returns

            new_dataset [dict] dictionary containing the output

            ind_rad [int] radar index

`pyrad.proc.process_echoclass.`**`process_melting_layer`**(*procstatus*,   *dscfg*, *radar_list=None*)

    Detects the melting layer

        Parameters

            procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

            dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

                datatype [list of string. Dataset keyword] The input data types

            radar_list [list of Radar objects] Optional. list of radar objects

        Returns

            new_dataset [dict] dictionary containing the output

            ind_rad [int] radar index

`pyrad.proc.process_echoclass.`**`process_outlier_filter`**(*procstatus*,   *dscfg*, *radar_list=None*)

    filters out gates which are outliers respect to the surrounding

        Parameters

            procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

            dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

                datatype [list of string. Dataset keyword] The input data types

                threshold [float. Dataset keyword] The distance between the value of the examined range gate and the median of the surrounding gates to consider the gate an outlier

                nb [int. Dataset keyword] The number of neighbours (to one side) to analyse. i.e. 2 would correspond to 24 gates

                nb_min [int. Dataset keyword] Minimum number of neighbouring gates to consider the examined gate valid

> **percentile_min, percentile_max** [float. Dataset keyword] gates below (above) these percentiles (computed over the sweep) are considered potential outliers and further examined

> **radar_list** [list of Radar objects] Optional. list of radar objects

> **Returns**

> > **new_dataset** [dict] dictionary containing the output

> > **ind_rad** [int] radar index

pyrad.proc.process_echoclass.**process_zdr_column**(*procstatus*, *dscfg*, *radar_list=None*)
> Detects ZDR columns

> > **Parameters**

> > > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

> > > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

> > > > **datatype** [list of string. Dataset keyword] The input data types

> > > **radar_list** [list of Radar objects] Optional. list of radar objects

> > **Returns**

> > > **new_dataset** [dict] dictionary containing the output

> > > **ind_rad** [int] radar index

PYRAD.PROC.PROCESS_INTERCOMP

Functions used in the inter-comparison between radars

[`process_time_stats`](#)(procstatus, dscfg[, . . .])	computes the temporal statistics of a field
[`process_time_stats2`](#)(procstatus, dscfg[, . . .])	computes the temporal mean of a field
[`process_time_avg`](#)(procstatus, dscfg[, radar_list])	computes the temporal mean of a field
[`process_weighted_time_avg`](#)(procstatus, dscfg)	computes the temporal mean of a field weighted by the reflectivity
[`process_time_avg_flag`](#)(procstatus, dscfg[, . . .])	computes a flag field describing the conditions of the data used while averaging
[`process_colocated_gates`](#)(procstatus, dscfg[, . . .])	Find colocated gates within two radars
[`process_intercomp`](#)(procstatus, dscfg[, . . .])	intercomparison between two radars
[`process_intercomp_time_avg`](#)(procstatus, dscfg)	intercomparison between the average reflectivity of two radars

pyrad.proc.process_intercomp.**process_colocated_gates**(*procstatus*, *dscfg*, *radar_list=None*)

> Find colocated gates within two radars
>
> > **Parameters**
> >
> > > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> > >
> > > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> > >
> > > > **datatype** [list of string. Dataset keyword] The input data types
> > > >
> > > > **h_tol** [float. Dataset keyword] Tolerance in altitude difference between radar gates [m]. Default 100.
> > > >
> > > > **latlon_tol** [float. Dataset keyword] Tolerance in latitude and longitude position between radar gates [deg]. Default 0.0005
> > > >
> > > > **vol_d_tol** [float. Dataset keyword] Tolerance in pulse volume diameter [m]. Default 100.
> > > >
> > > > **vismin** [float. Dataset keyword] Minimum visibility [percent]. Default None.
> > > >
> > > > **hmin** [float. Dataset keyword] Minimum altitude [m MSL]. Default None.
> > > >
> > > > **hmax** [float. Dataset keyword] Maximum altitude [m MSL]. Default None.
> > > >
> > > > **rmin** [float. Dataset keyword] Minimum range [m]. Default None.
> > > >
> > > > **rmax** [float. Dataset keyword] Maximum range [m]. Default None.
> > > >
> > > > **elmin** [float. Dataset keyword] Minimum elevation angle [deg]. Default None.

elmax [float. Dataset keyword] Maximum elevation angle [deg]. Default None.

azrad1min [float. Dataset keyword] Minimum azimuth angle [deg] for radar 1. Default None.

azrad1max [float. Dataset keyword] Maximum azimuth angle [deg] for radar 1. Default None.

azrad2min [float. Dataset keyword] Minimum azimuth angle [deg] for radar 2. Default None.

azrad2max [float. Dataset keyword] Maximum azimuth angle [deg] for radar 2. Default None.

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [radar object] radar object containing the flag field

ind_rad [int] radar index

pyrad.proc.process_intercomp.**process_intercomp**(*procstatus*, *dscfg*, *radar_list=None*)
intercomparison between two radars

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

coloc_data_dir [string. Dataset keyword] name of the directory containing the csv file with colocated data

coloc_radars_name [string. Dataset keyword] string identifying the radar names

azi_tol [float. Dataset keyword] azimuth tolerance between the two radars. Default 0.5 deg

ele_tol [float. Dataset keyword] elevation tolerance between the two radars. Default 0.5 deg

rng_tol [float. Dataset keyword] range tolerance between the two radars. Default 50 m

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing a dictionary with intercomparison data and the key "final" which contains a boolean that is true when all volumes have been processed

ind_rad [int] radar index

pyrad.proc.process_intercomp.**process_intercomp_time_avg**(*procstatus*, *dscfg*, *radar_list=None*)
intercomparison between the average reflectivity of two radars

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

coloc_data_dir [string. Dataset keyword] name of the directory containing the csv file with colocated data

coloc_radars_name [string. Dataset keyword] string identifying the radar names

azi_tol [float. Dataset keyword] azimuth tolerance between the two radars. Default 0.5 deg

ele_tol [float. Dataset keyword] elevation tolerance between the two radars. Default 0.5 deg

rng_tol [float. Dataset keyword] range tolerance between the two radars. Default 50 m

clt_max [int. Dataset keyword] maximum number of samples that can be clutter contaminated. Default 100 i.e. all

phi_excess_max [int. Dataset keyword] maximum number of samples that can have excess instantaneous PhiDP. Default 100 i.e. all

non_rain_max [int. Dataset keyword] maximum number of samples that can be no rain. Default 100 i.e. all

phi_avg_max [float. Dataset keyword] maximum average PhiDP allowed. Default 600 deg i.e. any

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing a dictionary with intercomparison data and the key "final" which contains a boolean that is true when all volumes have been processed

ind_rad [int] radar index

pyrad.proc.process_intercomp.**process_time_avg**(*procstatus*, *dscfg*, *radar_list=None*)
computes the temporal mean of a field

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

period [float. Dataset keyword] the period to average [s]. Default 3600.

start_average [float. Dataset keyword] when to start the average [s from midnight UTC]. Default 0.

lin_trans: int. Dataset keyword If 1 apply linear transformation before averaging

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_intercomp.**process_time_avg_flag**(*procstatus*, *dscfg*, *radar_list=None*)
computes a flag field describing the conditions of the data used while averaging

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

period [float. Dataset keyword] the period to average [s]. Default 3600.

> > **start_average** [float. Dataset keyword] when to start the average [s from midnight UTC]. Default 0.
>
> > **phidpmax: float. Dataset keyword** maximum PhiDP
>
> **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
> > **new_dataset** [Radar] radar object
> >
> > **ind_rad** [int] radar index

pyrad.proc.process_intercomp.**process_time_stats**(*procstatus*, *dscfg*, *radar_list=None*)
> computes the temporal statistics of a field
>
> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [list of string. Dataset keyword] The input data types
> > >
> > > **period** [float. Dataset keyword] the period to average [s]. If -1 the statistics are going to be performed over the entire data. Default 3600.
> > >
> > > **start_average** [float. Dataset keyword] when to start the average [s from midnight UTC]. Default 0.
> > >
> > > **lin_trans: int. Dataset keyword** If 1 apply linear transformation before averaging
> > >
> > > **stat: string. Dataset keyword** Statistic to compute: Can be mean, std, cov, min, max. Default mean
> >
> > **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
> > **new_dataset** [dict] dictionary containing the output
> >
> > **ind_rad** [int] radar index

pyrad.proc.process_intercomp.**process_time_stats2**(*procstatus*, *dscfg*, *radar_list=None*)
> computes the temporal mean of a field
>
> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [list of string. Dataset keyword] The input data types
> > >
> > > **period** [float. Dataset keyword] the period to average [s]. If -1 the statistics are going to be performed over the entire data. Default 3600.
> > >
> > > **start_average** [float. Dataset keyword] when to start the average [s from midnight UTC]. Default 0.
> > >
> > > **stat: string. Dataset keyword** Statistic to compute: Can be median, mode, percentileXX
> >
> > **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
> > **new_dataset** [dict] dictionary containing the output
> >
> > **ind_rad** [int] radar index

pyrad.proc.process_intercomp.**process_weighted_time_avg**(*procstatus*, *dscfg*, *radar_list=None*)

computes the temporal mean of a field weighted by the reflectivity

Parameters

> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
>
> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
>
>> **datatype** [list of string. Dataset keyword] The input data types
>>
>> **period** [float. Dataset keyword] the period to average [s]. Default 3600.
>>
>> **start_average** [float. Dataset keyword] when to start the average [s from midnight UTC]. Default 0.
>
> **radar_list** [list of Radar objects] Optional. list of radar objects

Returns

> **new_dataset** [Radar] radar object
>
> **ind_rad** [int] radar index

PYRAD.PROC.PROCESS_MONITORING

Functions for monitoring of the polarimetric variables

[*process_selfconsistency_kdp_phidp*](...[, ...])	Computes specific differential phase and differential phase in rain using the selfconsistency between Zdr, Zh and KDP
[*process_selfconsistency_bias*](procstatus, dscfg)	Estimates the reflectivity bias by means of the selfconsistency algorithm by Gourley
[*process_estimate_phidp0*](procstatus, dscfg[, ...])	estimates the system differential phase offset at each ray
[*process_rhohv_rain*](procstatus, dscfg[, ...])	Keeps only suitable data to evaluate the 80 percentile of RhoHV in rain
[*process_zdr_precip*](procstatus, dscfg[, ...])	Keeps only suitable data to evaluate the differential reflectivity in moderate rain or precipitation (for vertical scans)
[*process_zdr_snow*](procstatus, dscfg[, radar_list])	Keeps only suitable data to evaluate the differential reflectivity in snow
[*process_monitoring*](procstatus, dscfg[, ...])	computes monitoring statistics

pyrad.proc.process_monitoring.**process_estimate_phidp0**(*procstatus*, *dscfg*, *radar_list=None*)

> estimates the system differential phase offset at each ray

> > **Parameters**

> > > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

> > > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

> > > > **datatype** [list of string. Dataset keyword] The input data types

> > > > **rmin** [float. Dataset keyword] The minimum range where to look for valid data [m]

> > > > **rmax** [float. Dataset keyword] The maximum range where to look for valid data [m]

> > > > **rcell** [float. Dataset keyword] The length of a continuous cell to consider it valid precip [m]

> > > > **Zmin** [float. Dataset keyword] The minimum reflectivity [dBZ]

> > > > **Zmax** [float. Dataset keyword] The maximum reflectivity [dBZ]

> > > **radar_list** [list of Radar objects] Optional. list of radar objects

> > **Returns**

> > > **new_dataset** [dict] dictionary containing the output

> > > **ind_rad** [int] radar index

`pyrad.proc.process_monitoring.`**`process_monitoring`**(*procstatus*, *dscfg*, *radar_list=None*)
    computes monitoring statistics

> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [list of string. Dataset keyword] The input data types
> > >
> > > **step** [float. Dataset keyword] The width of the histogram bin. Default is None. In that case the default step in function get_histogram_bins is used
> >
> > **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
> > **new_dataset** [Radar] radar object containing histogram data
> >
> > **ind_rad** [int] radar index

`pyrad.proc.process_monitoring.`**`process_rhohv_rain`**(*procstatus*, *dscfg*, *radar_list=None*)
    Keeps only suitable data to evaluate the 80 percentile of RhoHV in rain

> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [list of string. Dataset keyword] The input data types
> > >
> > > **rmin** [float. Dataset keyword] minimum range where to look for rain [m]. Default 1000.
> > >
> > > **rmax** [float. Dataset keyword] maximum range where to look for rain [m]. Default 50000.
> > >
> > > **Zmin** [float. Dataset keyword] minimum reflectivity to consider the bin as precipitation [dBZ]. Default 20.
> > >
> > > **Zmax** [float. Dataset keyword] maximum reflectivity to consider the bin as precipitation [dBZ] Default 40.
> > >
> > > **ml_thickness** [float. Dataset keyword] assumed thickness of the melting layer. Default 700.
> > >
> > > **fzl** [float. Dataset keyword] The default freezing level height. It will be used if no temperature field name is specified or the temperature field is not in the radar object. Default 2000.
> >
> > **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
> > **new_dataset** [dict] dictionary containing the output
> >
> > **ind_rad** [int] radar index

`pyrad.proc.process_monitoring.`**`process_selfconsistency_bias`**(*procstatus*, *dscfg*, *radar_list=None*)
    Estimates the reflectivity bias by means of the selfconsistency algorithm by Gourley

> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [list of string. Dataset keyword] The input data types

fzl [float. Dataset keyword] Default freezing level height. Default 2000.

rsmooth [float. Dataset keyword] length of the smoothing window [m]. Default 1000.

min_rhohv [float. Dataset keyword] minimum valid RhoHV. Default 0.92

max_phidp [float. Dataset keyword] maximum valid PhiDP [deg]. Default 20.

ml_thickness [float. Dataset keyword] Melting layer thickness [m]. Default 700.

rcell [float. Dataset keyword] length of continuous precipitation to consider the precipitation cell a valid phidp segment [m]. Default 1000.

dphidp_min [float. Dataset keyword] minimum phase shift [deg]. Default 2.

dphidp_max [float. Dataset keyword] maximum phase shift [deg]. Default 16.

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_monitoring.**process_selfconsistency_kdp_phidp**(*procstatus*, *dscfg*, *radar_list=None*)

Computes specific differential phase and differential phase in rain using the selfconsistency between Zdr, Zh and KDP

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of strings. Dataset keyword] The input data types

rsmooth [float. Dataset keyword] length of the smoothing window [m]. Default 1000.

min_rhohv [float. Dataset keyword] minimum valid RhoHV. Default 0.92

max_phidp [float. Dataset keyword] maximum valid PhiDP [deg]. Default 20.

ml_thickness [float. Dataset keyword] assumed melting layer thickness [m]. Default 700.

fzl [float. Dataset keyword] The default freezing level height. It will be used if no temperature field name is specified or the temperature field is not in the radar object. Default 2000.

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_monitoring.**process_zdr_precip**(*procstatus*, *dscfg*, *radar_list=None*)

Keeps only suitable data to evaluate the differential reflectivity in moderate rain or precipitation (for vertical scans)

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

ml_filter [boolean. Dataset keyword] indicates if a filter on data in and above the melting layer is applied. Default True.

rmin [float. Dataset keyword] minimum range where to look for rain [m]. Default 1000.

rmax [float. Dataset keyword] maximum range where to look for rain [m]. Default 50000.

Zmin [float. Dataset keyword] minimum reflectivity to consider the bin as precipitation [dBZ]. Default 20.

Zmax [float. Dataset keyword] maximum reflectivity to consider the bin as precipitation [dBZ] Default 22.

RhoHVmin [float. Dataset keyword] minimum RhoHV to consider the bin as precipitation Default 0.97

PhiDPmax [float. Dataset keyword] maximum PhiDP to consider the bin as precipitation [deg] Default 10.

elmax [float. Dataset keyword] maximum elevation angle where to look for precipitation [deg] Default None.

ml_thickness [float. Dataset keyword] assumed thickness of the melting layer. Default 700.

fzl [float. Dataset keyword] The default freezing level height. It will be used if no temperature field name is specified or the temperature field is not in the radar object. Default 2000.

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_monitoring.**process_zdr_snow**(*procstatus*, *dscfg*, *radar_list=None*)
    Keeps only suitable data to evaluate the differential reflectivity in snow

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

rmin [float. Dataset keyword] minimum range where to look for rain [m]. Default 1000.

rmax [float. Dataset keyword] maximum range where to look for rain [m]. Default 50000.

Zmin [float. Dataset keyword] minimum reflectivity to consider the bin as snow [dBZ]. Default 0.

Zmax [float. Dataset keyword] maximum reflectivity to consider the bin as snow [dBZ] Default 30.

SNRmin [float. Dataset keyword] minimum SNR to consider the bin as snow [dB]. Default 10.

SNRmax [float. Dataset keyword] maximum SNR to consider the bin as snow [dB] Default 50.

RhoHVmin [float. Dataset keyword] minimum RhoHV to consider the bin as snow Default 0.97

PhiDPmax [float. Dataset keyword] maximum PhiDP to consider the bin as snow [deg] Default 10.

elmax [float. Dataset keyword] maximum elevation angle where to look for snow [deg] Default None.

KDPmax [float. Dataset keyword] maximum KDP to consider the bin as snow [deg] Default None

TEMPmin [float. Dataset keyword] minimum temperature to consider the bin as snow [deg C]. Default None

TEMPmax [float. Dataset keyword] maximum temperature to consider the bin as snow [deg C] Default None

hydroclass [list of ints. Dataset keyword] list of hydrometeor classes to keep for the analysis Default [2] (dry snow)

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

PYRAD.PROC.PROCESS_PHASE

Functions for PhiDP and KDP processing and attenuation correction

pyrad.proc.process_phase.**process_attenuation**(*procstatus*, *dscfg*, *radar_list=None*)

Computes specific attenuation and specific differential attenuation using the Z-Phi method and corrects reflectivity and differential reflectivity

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

ATT_METHOD [float. Dataset keyword] The attenuation estimation method used. One of the following: ZPhi, Philin

fzl [float. Dataset keyword] The default freezing level height. It will be used if no temper-

ature field name is specified or the temperature field is not in the radar object. Default 2000.

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_phase.**process_correct_phidp0**(*procstatus*, *dscfg*, *radar_list=None*)
corrects phidp of the system phase

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

rmin [float. Dataset keyword] The minimum range where to look for valid data [m]

rmax [float. Dataset keyword] The maximum range where to look for valid data [m]

rcell [float. Dataset keyword] The length of a continuous cell to consider it valid precip [m]

Zmin [float. Dataset keyword] The minimum reflectivity [dBZ]

Zmax [float. Dataset keyword] The maximum reflectivity [dBZ]

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_phase.**process_kdp_leastsquare_double_window**(*procstatus*,
dscfg,
radar_list=None)
Computes specific differential phase using a piecewise least square method

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

rwinds [float. Dataset keyword] The length of the short segment for the least square method [m]

rwindl [float. Dataset keyword] The length of the long segment for the least square method [m]

Zthr [float. Dataset keyword] The threshold defining which estimated data to use [dBZ]

vectorize [Bool. Dataset keyword] Whether to vectorize the KDP processing. Default false

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

`pyrad.proc.process_phase.`**`process_kdp_leastsquare_single_window`**(*procstatus*,
dscfg,
radar_list=None)

Computes specific differential phase using a piecewise least square method

> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [list of string. Dataset keyword] The input data types
> > >
> > > **rwind** [float. Dataset keyword] The length of the segment for the least square method [m]
> > >
> > > **vectorize** [bool. Dataset keyword] Whether to vectorize the KDP processing. Default false
> >
> > **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
> > **new_dataset** [dict] dictionary containing the output
> >
> > **ind_rad** [int] radar index

`pyrad.proc.process_phase.`**`process_phidp_kdp_Kalman`**(*procstatus*, *dscfg*,
radar_list=None)

Computes specific differential phase and differential phase using the Kalman filter as proposed by Schneebeli et al. The data is assumed to be clutter free and continous

> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [list of string. Dataset keyword] The input data types
> > >
> > > **parallel** [boolean. Dataset keyword] if set use parallel computing
> > >
> > > **get_phidp** [boolean. Datset keyword] if set the PhiDP computed by integrating the resultant KDP is added to the radar field
> >
> > **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
> > **new_dataset** [dict] dictionary containing the output
> >
> > **ind_rad** [int] radar index

`pyrad.proc.process_phase.`**`process_phidp_kdp_Maesaka`**(*procstatus*, *dscfg*,
radar_list=None)

Estimates PhiDP and KDP using the method by Maesaka. This method only retrieves data in rain (i.e. below the melting layer)

> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [list of string. Dataset keyword] The input data types
> > >
> > > **rmin** [float. Dataset keyword] The minimum range where to look for valid data [m]
> > >
> > > **rmax** [float. Dataset keyword] The maximum range where to look for valid data [m]
> > >
> > > **rcell** [float. Dataset keyword] The length of a continuous cell to consider it valid precip [m]

>>> **Zmin** [float. Dataset keyword] The minimum reflectivity [dBZ]

>>> **Zmax** [float. Dataset keyword] The maximum reflectivity [dBZ]

>>> **fzl** [float. Dataset keyword] The freezing level height [m]. Default 2000.

>>> **ml_thickness** [float. Dataset keyword] The melting layer thickness in meters. Default 700.

>> **radar_list** [list of Radar objects] Optional. list of radar objects

> **Returns**

>> **new_dataset** [dict] dictionary containing the output

>> **ind_rad** [int] radar index

pyrad.proc.process_phase.**process_phidp_kdp_Vulpiani**(*procstatus*, *dscfg*, *radar_list=None*)

> Computes specific differential phase and differential phase using the method developed by Vulpiani et al. The data is assumed to be clutter free and monotonous

>> **Parameters**

>>> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

>>> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

>>>> **datatype** [list of string. Dataset keyword] The input data types

>>>> **rwind** [float. Dataset keyword] The length of the segment [m]

>>>> **n_iter** [int. Dataset keyword] number of iterations

>>>> **interp** [boolean. Dataset keyword] if set non valid values are interpolated using neighbouring valid values

>>>> **parallel** [boolean. Dataset keyword] if set use parallel computing

>>>> **get_phidp** [boolean. Datset keyword] if set the PhiDP computed by integrating the resultant KDP is added to the radar field

>>> **radar_list** [list of Radar objects] Optional. list of radar objects

>> **Returns**

>>> **new_dataset** [dict] dictionary containing the output

>>> **ind_rad** [int] radar index

pyrad.proc.process_phase.**process_phidp_kdp_lp**(*procstatus*, *dscfg*, *radar_list=None*)

> Estimates PhiDP and KDP using a linear programming algorithm. This method only retrieves data in rain (i.e. below the melting layer)

>> **Parameters**

>>> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

>>> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

>>>> **datatype** [list of string. Dataset keyword] The input data types

>>>> **fzl** [float. Dataset keyword] The freezing level height [m]. Default 2000.

>>>> **ml_thickness** [float. Dataset keyword] The melting layer thickness in meters. Default 700.

>>> **radar_list** [list of Radar objects] Optional. list of radar objects

>> **Returns**

>>> **new_dataset** [dict] dictionary containing the output

> > **ind_rad** [int] radar index

pyrad.proc.process_phase.**process_smooth_phidp_double_window**(*procstatus*, *dscfg*, *radar_list=None*)

> corrects phidp of the system phase and smoothes it using one window

> > **Parameters**

> > > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

> > > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

> > > > **datatype** [list of string. Dataset keyword] The input data types

> > > > **rmin** [float. Dataset keyword] The minimum range where to look for valid data [m]

> > > > **rmax** [float. Dataset keyword] The maximum range where to look for valid data [m]

> > > > **rcell** [float. Dataset keyword] The length of a continuous cell to consider it valid precip [m]

> > > > **rwinds** [float. Dataset keyword] The length of the short smoothing window [m]

> > > > **rwindl** [float. Dataset keyword] The length of the long smoothing window [m]

> > > > **Zmin** [float. Dataset keyword] The minimum reflectivity [dBZ]

> > > > **Zmax** [float. Dataset keyword] The maximum reflectivity [dBZ]

> > > > **Zthr** [float. Dataset keyword] The threshold defining wich smoothed data to used [dBZ]

> > > **radar_list** [list of Radar objects] Optional. list of radar objects

> > **Returns**

> > > **new_dataset** [dict] dictionary containing the output

> > > **ind_rad** [int] radar index

pyrad.proc.process_phase.**process_smooth_phidp_single_window**(*procstatus*, *dscfg*, *radar_list=None*)

> corrects phidp of the system phase and smoothes it using one window

> > **Parameters**

> > > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

> > > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

> > > > **datatype** [list of string. Dataset keyword] The input data types

> > > > **rmin** [float. Dataset keyword] The minimum range where to look for valid data [m]

> > > > **rmax** [float. Dataset keyword] The maximum range where to look for valid data [m]

> > > > **rcell** [float. Dataset keyword] The length of a continuous cell to consider it valid precip [m]

> > > > **rwind** [float. Dataset keyword] The length of the smoothing window [m]

> > > > **Zmin** [float. Dataset keyword] The minimum reflectivity [dBZ]

> > > > **Zmax** [float. Dataset keyword] The maximum reflectivity [dBZ]

> > > **radar_list** [list of Radar objects] Optional. list of radar objects

> > **Returns**

> > > **new_dataset** [dict] dictionary containing the output

> > > **ind_rad** [int] radar index

PYRAD.PROC.PROCESS_RETRIEVE

Functions for retrieving new moments and products

process_signal_power(procstatus, dscfg[, . . .])	Computes the signal power in dBm
process_rcs_pr(procstatus, dscfg[, radar_list])	Computes the radar cross-section (assuming a point target) from radar reflectivity by first computing the received power and then the RCS from it.
process_rcs(procstatus, dscfg[, radar_list])	Computes the radar cross-section (assuming a point target) from radar reflectivity.
process_vol_refl(procstatus, dscfg[, radar_list])	Computes the volumetric reflectivity in 10log10(cm^2 km^-3)
process_snr(procstatus, dscfg[, radar_list])	Computes SNR
process_l(procstatus, dscfg[, radar_list])	Computes L parameter
process_cdr(procstatus, dscfg[, radar_list])	Computes Circular Depolarization Ratio
process_rainrate(procstatus, dscfg[, radar_list])	Estimates rainfall rate from polarimetric moments
process_bird_density(procstatus, dscfg[, . . .])	Computes the bird density from the volumetric reflectivity

pyrad.proc.process_retrieve.**process_bird_density**(*procstatus*, *dscfg*, *radar_list=None*)
>   Computes the bird density from the volumetric reflectivity

>   **Parameters**

>>   **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

>>   **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

>>>   **datatype** [list of string. Dataset keyword] The input data types

>>>   **sigma_bird** [float. Dataset keyword] The bird radar cross section

>>   **radar_list** [list of Radar objects] Optional. list of radar objects

>   **Returns**

>>   **new_dataset** [dict] dictionary containing the output

>>   **ind_rad** [int] radar index

pyrad.proc.process_retrieve.**process_cdr**(*procstatus*, *dscfg*, *radar_list=None*)
>   Computes Circular Depolarization Ratio

>   **Parameters**

>>   **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

>>   **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

    datatype [string. Dataset keyword] The input data type

    radar_list [list of Radar objects] Optional. list of radar objects

Returns

    new_dataset [dict] dictionary containing the output

    ind_rad [int] radar index

`pyrad.proc.process_retrieve.`**`process_l`**(*procstatus*, *dscfg*, *radar_list=None*)

    Computes L parameter

    Parameters

        procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

        dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

            datatype [string. Dataset keyword] The input data type

        radar_list [list of Radar objects] Optional. list of radar objects

    Returns

        new_dataset [dict] dictionary containing the output

        ind_rad [int] radar index

`pyrad.proc.process_retrieve.`**`process_rainrate`**(*procstatus*, *dscfg*, *radar_list=None*)

    Estimates rainfall rate from polarimetric moments

    Parameters

        procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

        dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

            datatype [string. Dataset keyword] The input data type

            RR_METHOD [string. Dataset keyword] The rainfall rate estimation method. One of the following: Z, ZPoly, KDP, A, ZKDP, ZA, hydro

            alpha, beta [float] factor and exponent of the R-Var power law R = alpha*Var^Beta. Default value depending on RR_METHOD. Z (0.0376, 0.6112), KDP (None, None), A (None, None)

            alphaz, betaz [float] factor and exponent of the R-Z power law R = alpha*Z^Beta. Default value (0.0376, 0.6112)

            alphazr, betazr [float] factor and exponent of the R-Z power law R = alpha*Z^Beta applied to rain in method hydro. Default value (0.0376, 0.6112)

            alphazs, betazs [float] factor and exponent of the R-Z power law R = alpha*Z^Beta applied to solid precipitation in method hydro. Default value (0.1, 0.5)

            alphakdp, betakdp [float] factor and exponent of the R-KDP power law R = alpha*KDP^Beta. Default value (None, None)

            alphaa, betaa [float] factor and exponent of the R-Ah power law R = alpha*Ah^Beta. Default value (None, None)

            thresh [float] In hybrid methods, Rainfall rate threshold at which the retrieval method used changes [mm/h]. Default value depending on RR_METHOD. ZKDP 10, ZA 10, hydro 10

---

mp_factor [float] Factor by which the Z-R relation is multiplied in the melting layer in method hydro. Default 0.6

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_retrieve.**process_rcs**(*procstatus*, *dscfg*, *radar_list=None*)
    Computes the radar cross-section (assuming a point target) from radar reflectivity.

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

kw2 [float. Dataset keyowrd] The water constant

pulse_width [float. Dataset keyowrd] The pulse width [s]

beamwidthv [float. Global keyword] The vertical polarization antenna beamwidth [deg]. Used if input is vertical reflectivity

beamwidthh [float. Global keyword] The horizontal polarization antenna beamwidth [deg]. Used if input is horizontal reflectivity

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the output

ind_rad [int] radar index

pyrad.proc.process_retrieve.**process_rcs_pr**(*procstatus*, *dscfg*, *radar_list=None*)
    Computes the radar cross-section (assuming a point target) from radar reflectivity by first computing the received power and then the RCS from it.

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [list of string. Dataset keyword] The input data types

antenna_gain [float. Global keyword] The antenna gain [dB]

txpwrv [float. Global keyword] The transmitted power of the vertical channel [dBm]. Used if input is vertical reflectivity

mflossv [float. Global keyword] The matching filter losses of the vertical channel. Used if input is vertical reflectivity

radconstv [float. Global keyword] The vertical channel radar constant. Used if input is vertical reflectivity

lrxv [float. Global keyword] The receiver losses from the antenna feed to the reference point. [dB] positive value Used if input is vertical reflectivity

ltxv [float. Global keyword] The transmitter losses from the output of the high power amplifier to the antenna feed. [dB] positive value Used if input is vertical reflectivity

> > **lradomev** [float. Global keyword] The 1-way dry radome losses [dB] positive value. Used if input is vertical reflectivity
> >
> > **txpwrh** [float. Global keyword] The transmitted power of the horizontal channel [dBm]. Used if input is horizontal reflectivity
> >
> > **mflossh** [float. Global keyword] The matching filter losses of the vertical channel. Used if input is horizontal reflectivity
> >
> > **radconsth** [float. Global keyword] The horizontal channel radar constant. Used if input is horizontal reflectivity
> >
> > **lrxh** [float. Global keyword] The receiver losses from the antenna feed to the reference point. [dB] positive value Used if input is horizontal reflectivity
> >
> > **ltxh** [float. Global keyword] The transmitter losses from the output of the high power amplifier to the antenna feed. [dB] positive value Used if input is horizontal reflectivity
> >
> > **lradomeh** [float. Global keyword] The 1-way dry radome losses [dB] positive value. Used if input is horizontal reflectivity
> >
> > **attg** [float. Dataset keyword] The gas attenuation
>
> **radar_list** [list of Radar objects] Optional. list of radar objects

> **Returns**
>
> > **new_dataset** [dict] dictionary containing the output
> >
> > **ind_rad** [int] radar index

pyrad.proc.process_retrieve.**process_signal_power**(*procstatus*, *dscfg*, *radar_list=None*)
> Computes the signal power in dBm

> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [list of string. Dataset keyword] The input data types
> > >
> > > **mflossv** [float. Global keyword] The matching filter losses of the vertical channel. Used if input is vertical reflectivity
> > >
> > > **radconstv** [float. Global keyword] The vertical channel radar constant. Used if input is vertical reflectivity
> > >
> > > **lrxv** [float. Global keyword] The receiver losses from the antenna feed to the reference point. [dB] positive value Used if input is vertical reflectivity
> > >
> > > **lradomev** [float. Global keyword] The 1-way dry radome losses [dB] positive value. Used if input is vertical reflectivity
> > >
> > > **mflossh** [float. Global keyword] The matching filter losses of the vertical channel. Used if input is horizontal reflectivity
> > >
> > > **radconsth** [float. Global keyword] The horizontal channel radar constant. Used if input is horizontal reflectivity
> > >
> > > **lrxh** [float. Global keyword] The receiver losses from the antenna feed to the reference point. [dB] positive value Used if input is horizontal reflectivity
> > >
> > > **lradomeh** [float. Global keyword] The 1-way dry radome losses [dB] positive value. Used if input is horizontal reflectivity

       attg [float. Dataset keyword] The gas attenuation

    radar_list [list of Radar objects] Optional. list of radar objects

  Returns

    new_dataset [dict] dictionary containing the output

    ind_rad [int] radar index

pyrad.proc.process_retrieve.**process_snr**(*procstatus*, *dscfg*, *radar_list=None*)

  Computes SNR

  Parameters

    procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

    dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

       datatype [string. Dataset keyword] The input data type

       output_type [string. Dataset keyword] The output data type. Either SNRh or SNRv

    radar_list [list of Radar objects] Optional. list of radar objects

  Returns

    new_dataset [dict] dictionary containing the output

    ind_rad [int] radar index

pyrad.proc.process_retrieve.**process_vol_refl**(*procstatus*, *dscfg*, *radar_list=None*)

  Computes the volumetric reflectivity in 10log10(cm^2 km^-3)

  Parameters

    procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

    dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

       datatype [list of string. Dataset keyword] The input data types

       freq [float. Dataset keyword] The radar frequency

       kw [float. Dataset keyword] The water constant

    radar_list [list of Radar objects] Optional. list of radar objects

  Returns

    new_dataset [dict] dictionary containing the output

    ind_rad [int] radar index

PYRAD.PROC.PROCESS_TIMESERIES

Functions to obtain time series of radar data

process_point_measurement(procstatus, dscfg)	Obtains the radar data at a point location.
process_qvp(procstatus, dscfg[, radar_list])	Computes quasi vertical profiles, by averaging over height levels PPI data.
process_rqvp(procstatus, dscfg[, radar_list])	Computes range defined quasi vertical profiles, by averaging over height levels PPI data.
process_evp(procstatus, dscfg[, radar_list])	Computes enhanced vertical profiles, by averaging over height levels PPI data.
process_svp(procstatus, dscfg[, radar_list])	Computes slanted vertical profiles, by averaging over height levels PPI data.
process_time_height(procstatus, dscfg[, . . .])	Produces time height radar objects at a point of interest defined by latitude and longitude.

pyrad.proc.process_timeseries.**process_evp**(*procstatus*, *dscfg*, *radar_list=None*)
    Computes enhanced vertical profiles, by averaging over height levels PPI data.

> **Parameters**

> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

> > > **datatype** [string. Dataset keyword] The data type where we want to extract the point measurement

> > > **lat, lon** [float] latitude and longitude of the point of interest [deg]

> > > **latlon_tol** [float] tolerance in latitude and longitude in deg. Default 0.0005

> > > **delta_rng, delta_azi** [float] maximum range distance [m] and azimuth distance [degree] from the central point of the evp containing data to average. Default 5000. and 10.

> > > **hmax** [float] The maximum height to plot [m]. Default 10000.

> > > **hres** [float] The height resolution [m]. Default 250.

> > > **avg_type** [str] The type of averaging to perform. Can be either "mean" or "median" Default "mean"

> > > **nvalid_min** [int] Minimum number of valid points to consider the data valid when performing the averaging. Default 1

> > > **interp_kind** [str] type of interpolation when projecting to vertical grid: 'none', or 'nearest', etc. Default 'none'. 'none' will select from all data points within the regular grid height

bin the closest to the center of the bin. 'nearest' will select the closest data point to the center of the height bin regardless if it is within the height bin or not. Data points can be masked values If another type of interpolation is selected masked values will be eliminated from the data points before the interpolation

> **radar_list** [list of Radar objects] Optional. list of radar objects

Returns

> **new_dataset** [dict] dictionary containing the EVP and a keyboard stating whether the processing has finished or not.
>
> **ind_rad** [int] radar index

pyrad.proc.process_timeseries.**process_point_measurement**(*procstatus*, *dscfg*, *radar_list=None*)

> Obtains the radar data at a point location.

Parameters

> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
>
> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
>
>> **datatype** [string. Dataset keyword] The data type where we want to extract the point measurement
>>
>> **latlon** [boolean. Dataset keyword] if True position is obtained from latitude, longitude information, otherwise position is obtained from antenna coordinates (range, azimuth, elevation).
>>
>> **truealt** [boolean. Dataset keyword] if True the user input altitude is used to determine the point of interest. if False use the altitude at a given radar elevation ele over the point of interest.
>>
>> **lon** [float. Dataset keyword] the longitude [deg]. Use when latlon is True.
>>
>> **lat** [float. Dataset keyword] the latitude [deg]. Use when latlon is True.
>>
>> **alt** [float. Dataset keyword] altitude [m MSL]. Use when latlon is True.
>>
>> **ele** [float. Dataset keyword] radar elevation [deg]. Use when latlon is False or when latlon is True and truealt is False
>>
>> **azi** [float. Dataset keyword] radar azimuth [deg]. Use when latlon is False
>>
>> **rng** [float. Dataset keyword] range from radar [m]. Use when latlon is False
>>
>> **AziTol** [float. Dataset keyword] azimuthal tolerance to determine which radar azimuth to use [deg]
>>
>> **EleTol** [float. Dataset keyword] elevation tolerance to determine which radar elevation to use [deg]
>>
>> **RngTol** [float. Dataset keyword] range tolerance to determine which radar bin to use [m]
>
> **radar_list** [list of Radar objects] Optional. list of radar objects

Returns

> **new_dataset** [dict] dictionary containing the data and metadata at the point of interest
>
> **ind_rad** [int] radar index

pyrad.proc.process_timeseries.**process_qvp**(*procstatus*, *dscfg*, *radar_list=None*)

> Computes quasi vertical profiles, by averaging over height levels PPI data.

Parameters

> **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
>
> **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
>
> > **datatype** [string. Dataset keyword] The data type where we want to extract the point measurement
> >
> > **angle** [int or float] If the radar object contains a PPI volume, the sweep number to use, if it contains an RHI volume the elevation angle. Default 0.
> >
> > **ang_tol** [float] If the radar object contains an RHI volume, the tolerance in the elevation angle for the conversion into PPI
> >
> > **hmax** [float] The maximum height to plot [m]. Default 10000.
> >
> > **hres** [float] The height resolution [m]. Default 50
> >
> > **avg_type** [str] The type of averaging to perform. Can be either "mean" or "median" Default "mean"
> >
> > **nvalid_min** [int] Minimum number of valid points to accept average. Default 30.
> >
> > **interp_kind** [str] type of interpolation when projecting to vertical grid: 'none', or 'nearest', etc. Default 'none' 'none' will select from all data points within the regular grid height bin the closest to the center of the bin. 'nearest' will select the closest data point to the center of the height bin regardless if it is within the height bin or not. Data points can be masked values If another type of interpolation is selected masked values will be eliminated from the data points before the interpolation
>
> **radar_list** [list of Radar objects] Optional. list of radar objects

Returns

> **new_dataset** [dict] dictionary containing the QVP and a keyboard stating whether the processing has finished or not.
>
> **ind_rad** [int] radar index

pyrad.proc.process_timeseries.**process_rqvp**(*procstatus*, *dscfg*, *radar_list=None*)
> Computes range defined quasi vertical profiles, by averaging over height levels PPI data.

> **Parameters**

> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [string. Dataset keyword] The data type where we want to extract the point measurement
> > >
> > > **anglenr** [int] The sweep number to use. It assumes the radar volume consists on PPI scans
> > >
> > > **hmax** [float] The maximum height to plot [m]. Default 10000.
> > >
> > > **hres** [float] The height resolution [m]. Default 2.
> > >
> > > **avg_type** [str] The type of averaging to perform. Can be either "mean" or "median" Default "mean"
> > >
> > > **nvalid_min** [int] Minimum number of valid points to accept average. Default 30.
> > >
> > > **interp_kind** [str] type of interpolation when projecting to vertical grid: 'none', or 'nearest', etc. Default 'nearest' 'none' will select from all data points within the regular grid height bin the closest to the center of the bin. 'nearest' will select the closest data point to

the center of the height bin regardless if it is within the height bin or not. Data points can be masked values If another type of interpolation is selected masked values will be eliminated from the data points before the interpolation

rmax [float] ground range up to which the data is intended for use [m]. Default 50000.

weight_power [float] Power p of the weighting function 1/abs(grng-(rmax-1))**p given to the data outside the desired range. -1 will set the weight to 0. Default 2.

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the QVP and a keyboard stating whether the processing has finished or not.

ind_rad [int] radar index

`pyrad.proc.process_timeseries.`**`process_svp`**(*procstatus*, *dscfg*, *radar_list=None*)
Computes slanted vertical profiles, by averaging over height levels PPI data.

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

datatype [string. Dataset keyword] The data type where we want to extract the point measurement

angle [int or float] If the radar object contains a PPI volume, the sweep number to use, if it contains an RHI volume the elevation angle. Default 0.

ang_tol [float] If the radar object contains an RHI volume, the tolerance in the elevation angle for the conversion into PPI. Default 1.

lat, lon [float] latitude and longitude of the point of interest [deg]

latlon_tol [float] tolerance in latitude and longitude in deg. Default 0.0005

delta_rng, delta_azi [float] maximum range distance [m] and azimuth distance [degree] from the central point of the svp containing data to average. Default 5000. and 10.

hmax [float] The maximum height to plot [m]. Default 10000.

hres [float] The height resolution [m]. Default 250.

avg_type [str] The type of averaging to perform. Can be either "mean" or "median" Default "mean"

nvalid_min [int] Minimum number of valid points to consider the data valid when performing the averaging. Default 1

interp_kind [str] type of interpolation when projecting to vertical grid: 'none', or 'nearest', etc. Default 'none' 'none' will select from all data points within the regular grid height bin the closest to the center of the bin. 'nearest' will select the closest data point to the center of the height bin regardless if it is within the height bin or not. Data points can be masked values If another type of interpolation is selected masked values will be eliminated from the data points before the interpolation

radar_list [list of Radar objects] Optional. list of radar objects

Returns

new_dataset [dict] dictionary containing the svp and a keyboard stating whether the processing has finished or not.

ind_rad [int] radar index

pyrad.proc.process_timeseries.**process_time_height**(*procstatus,* *dscfg,* *radar_list=None*)

Produces time height radar objects at a point of interest defined by latitude and longitude. A time-height contains the evolution of the vertical structure of radar measurements above the location of interest.

> **Parameters**
>
> > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing
> >
> > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:
> >
> > > **datatype** [string. Dataset keyword] The data type where we want to extract the point measurement
> > >
> > > **lat, lon** [float] latitude and longitude of the point of interest [deg]
> > >
> > > **latlon_tol** [float] tolerance in latitude and longitude in deg. Default 0.0005
> > >
> > > **hmax** [float] The maximum height to plot [m]. Default 10000.
> > >
> > > **hres** [float] The height resolution [m]. Default 50
> > >
> > > **interp_kind** [str] type of interpolation when projecting to vertical grid: 'none', or 'nearest', etc. Default 'none' 'none' will select from all data points within the regular grid height bin the closest to the center of the bin. 'nearest' will select the closest data point to the center of the height bin regardless if it is within the height bin or not. Data points can be masked values If another type of interpolation is selected masked values will be eliminated from the data points before the interpolation
> >
> > **radar_list** [list of Radar objects] Optional. list of radar objects
>
> **Returns**
>
> > **new_dataset** [dict] dictionary containing the QVP and a keyboard stating whether the processing has finished or not.
> >
> > **ind_rad** [int] radar index

PYRAD.PROC.PROCESS_TRAJ

Trajectory functions. Functions to pass trajectory dataset data to the product generation functions.

process_trajectory(procstatus, dscfg[, . . .])	Return trajectory
process_traj_trt(procstatus, dscfg[, . . .])	Processes data according to TRT trajectory
process_traj_lightning(procstatus, dscfg[, . . .])	Return time series according to lightning trajectory
process_traj_atplane(procstatus, dscfg[, . . .])	Return time series according to trajectory
process_traj_antenna_pattern(procstatus, dscfg)	Process a new array of data volumes considering a plane trajectory.
_get_ts_values_antenna_pattern(radar, . . .)	Get the time series values of a trajectory using a synthetic antenna pattern
_get_gates(radar, az, el, rr, tt, trajdict)	Find the gates of the radar object that have to be used to compute the data of a trajectory
_get_gates_trt(radar, trajectory, voltime[, . . .])	Find the gates of the radar object that belong to a TRT cell
_get_gates_antenna_pattern(radar_sel, . . . [, . . .])	Find the gates of the radar object that have to be used to compute the data of a trajectory as seen by another radar system
_get_closests_bin(az, el, rr, tt, radar, tdict)	Get the radar bin closest to a certain trajectory position
_sample_out_of_sector(az, el, rr, radar_sel, . . .)	Check if trajectory sample is within radar sector
TargetRadar(latitude, longitude, altitude)	A class for dummy target radar object

class pyrad.proc.process_traj.**TargetRadar**(*latitude*, *longitude*, *altitude*)
> Bases: object

> A class for dummy target radar object

> > **Attributes**

> > > **latitude, longitude, altitude** [float] Position of the dummy radar

> **__class__**
> > alias of builtins.type

> **__delattr__**(*$self*, *name*, */*)
> > Implement delattr(self, name).

> **__dict__ = mappingproxy({'__module__': 'pyrad.proc.process_traj', '__doc__': '\n A c**

> **__dir__**(*$self*, */*)
> > Default dir() implementation.

> **__eq__**(*$self*, *value*, */*)
> > Return self==value.

__format__(*$self*, *format_spec*, */*)
    Default object formatter.

__ge__(*$self*, *value*, */*)
    Return self>=value.

__getattribute__(*$self*, *name*, */*)
    Return getattr(self, name).

__gt__(*$self*, *value*, */*)
    Return self>value.

__hash__(*$self*, */*)
    Return hash(self).

__init__(*latitude*, *longitude*, *altitude*)
    Initialize self. See help(type(self)) for accurate signature.

__init_subclass__()
    This method is called when a class is subclassed.

    The default implementation does nothing. It may be overridden to extend subclasses.

__le__(*$self*, *value*, */*)
    Return self<=value.

__lt__(*$self*, *value*, */*)
    Return self<value.

__module__ = **'pyrad.proc.process_traj'**

__ne__(*$self*, *value*, */*)
    Return self!=value.

__new__(*$type*, **args*, ***kwargs*)
    Create and return a new object. See help(type) for accurate signature.

__reduce__(*$self*, */*)
    Helper for pickle.

__reduce_ex__(*$self*, *protocol*, */*)
    Helper for pickle.

__repr__(*$self*, */*)
    Return repr(self).

__setattr__(*$self*, *name*, *value*, */*)
    Implement setattr(self, name, value).

__sizeof__(*$self*, */*)
    Size of object in memory, in bytes.

__str__(*$self*, */*)
    Return str(self).

__subclasshook__()
    Abstract classes can override this to customize issubclass().

    This is invoked early on by abc.ABCMeta.__subclasscheck__(). It should return True, False or NotImplemented. If it returns NotImplemented, the normal algorithm is used. Otherwise, it overrides the normal algorithm (and the outcome is cached).

__weakref__
    list of weak references to the object (if defined)

pyrad.proc.process_traj.**_get_closests_bin**(*az*, *el*, *rr*, *tt*, *radar*, *tdict*)

    Get the radar bin closest to a certain trajectory position

        Parameters

            az, el, rr [floats] The trajectory position respect to the radar

            tt [float] the trajectory time respect to the beginning of the radar scan

            radar [radar object] the current radar object

            tdict [dict] Dictionary containing trajectory parameters

        Returns

            radar_sel [radar object] The selected radar (Current or one of the two previous ones)

            ray_sel, rr_ind [int] The selected ray and range indices of the radar field

            el_vec_rnd, az_vec_rnd [array of floats] The elevation and azimuth fields of the selected radar rounded to the first decimal

pyrad.proc.process_traj.**_get_gates**(*radar*, *az*, *el*, *rr*, *tt*, *trajdict*, *ang_tol=1.2*)

    Find the gates of the radar object that have to be used to compute the data of a trajectory

        Parameters

            radar [radar object] The radar containing

            az, el, rr [floats] The trajectory position respect to the radar

            tt [float] the trajectory time respect to the beginning of the radar scan

            trajdict [dict] Dictionary containing the trajectory parameters

            ang_tol [float] Factor that multiplies the angle resolution. Used when determining the neighbouring rays

        Returns

            radar_sel [radar object] The radar volume selected as closest to trajectory point

            ray_sel, rr_ind [ints] ray and range indices of the radar gate closest to the trajectory position

            cell_ind [array of ints] indices of the surrounding rays

            rr_min [int] index of the minimum range of the surrounding gates

            rr_max [int] index of the maximum range of the surrounding gates

pyrad.proc.process_traj.**_get_gates_antenna_pattern**(*radar_sel*, *target_radar*, *az*, *rr*, *tt*, *scan_angles*, *alt_tol=1000.0*, *latlon_tol=0.04*, *max_altitude=12000.0*)

    Find the gates of the radar object that have to be used to compute the data of a trajectory as seen by another radar system

        Parameters

            radar_sel [radar object] The radar containing real data

            target_radar [radar object] The virtual radar

            az, rr [floats] The trajectory position respect to the radar

            tt [float] the trajectory time respect to the beginning of the radar scan

            scan_angles [array] The scan angles of the virtual radar object

> **alt_tol** [float] The tolerance in altitude [m]
>
> **latlon_tol** [float] The tolerance in latitude and longitude [deg]
>
> **max_altitude** [float] The maximum altitude where to look for radar data

> **Returns**

> **ray_ind, rng_ind** [array of ints] the indices of the radar data to use
>
> **w_ind** [array of ints] The indices of the one-dimensional antenna pattern to use

pyrad.proc.process_traj.**_get_gates_trt**(*radar*, *trajectory*, *voltime*, *time_tol=100.0*, *alt_min=None*, *alt_max=None*, *cell_center=False*, *latlon_tol=0.0005*)

Find the gates of the radar object that belong to a TRT cell

> **Parameters**

> **radar** [radar object] The radar containing
>
> **trajectory** [trajectory object] Object containing the TRT cell position and dimensions
>
> **voltime** [datetime object] The radar volume reference time
>
> **time_tol** [float] Time tolerance where to look for data [s]
>
> **alt_min, alt_max** [float] Minimum and maximum altitude where to look for data [m]

> **Returns**

> **inds_ray, inds_rng** [array of ints] The indices of the radar data inside the TRT cell

pyrad.proc.process_traj.**_get_ts_values_antenna_pattern**(*radar*, *trajectory*, *tadict*, *traj_ind*, *field_names*)

Get the time series values of a trajectory using a synthetic antenna pattern

> **Parameters**

> **radar** [radar object] The radar volume with the data
>
> **trajectory** [trajectory object] The plane trajectory
>
> **tadict** [dict] A dictionary containing parameters useful for trajectory computation
>
> **traj_ind** [array] The indices of trajectory data within the current radar volume time
>
> **field_names** [list of str] list of names of the radar field

> **Returns**

> **result** [Bool] A flag signaling whether radar data matching the trajectory was found

pyrad.proc.process_traj.**_sample_out_of_sector**(*az*, *el*, *rr*, *radar_sel*, *ray_sel*, *rr_ind*, *el_vec_rnd*, *az_vec_rnd*)

Check if trajectory sample is within radar sector

> **Parameters**

> **az, el, rr** [floats] The trajectory position respect to the radar
>
> **radar_sel** [radar object] The selected radar (Current or one of the two previous ones)
>
> **ray_sel, rr_ind** [int] The selected ray and range indices of the radar field
>
> **el_vec_rnd, az_vec_rnd** [array of floats] The elevation and azimuth fields of the selected radar rounded to the first decimal

> **Returns**

result [bool] False if the sample is out of sector. True otherwise

`pyrad.proc.process_traj.`**`process_traj_antenna_pattern`**(*procstatus,* *dscfg,* *radar_list=None,* *trajec-* *tory=None*)

Process a new array of data volumes considering a plane trajectory. As result a timeseries with the values transposed for a given antenna pattern is created. The result is created when the LAST flag is set.

Parameters

procstatus [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

dscfg [dictionary of dictionaries]

datatype [list of string. Dataset keyword] The input data types

antennaType [str. Dataset keyword] Type of antenna of the radar we want to get the view from. Can be AZIMUTH, ELEVATION, LOWBEAM, HIGHBEAM

par_azimuth_antenna [dict. Global ekyword] Dictionary containing the parameters of the PAR azimuth antenna, i.e. name of the file with the antenna elevation pattern and fixed antenna angle

par_elevation_antenna [dict. Global keyword] Dictionary containing the parameters of the PAR elevation antenna, i.e. name of the file with the antenna azimuth pattern and fixed antenna angle

asr_lowbeam_antenna [dict. Global keyword] Dictionary containing the parameters of the ASR low beam antenna, i.e. name of the file with the antenna elevation pattern and fixed antenna angle

asr_highbeam_antenna [dict. Global keyword] Dictionary containing the parameters of the ASR high beam antenna, i.e. name of the file with the antenna elevation pattern and fixed antenna angle

target_radar_pos [dict. Global keyword] Dictionary containing the latitude, longitude and altitude of the radar we want to get the view from. If not specifying it will assume the radar is collocated

range_all [Bool. Dataset keyword] If the real radar and the synthetic radar are co-located and this parameter is true the statistics are going to be computed using all the data from range 0 to the position of the plane. Default False

rhi_resolution [Bool. Dataset keyword] Resolution of the synthetic RHI used to compute the data as viewed from the synthetic radar [deg]. Default 0.5

max_altitude [float. Dataset keyword] Max altitude of the data to use when computing the view from the synthetic radar [m MSL]. Default 12000.

latlon_tol [float. Dataset keyword] The tolerance in latitude and longitude to determine which synthetic radar gates are co-located with real radar gates [deg]. Default 0.04

alt_tol [float. Datset keyword] The tolerance in altitude to determine which synthetic radar gates are co-located with real radar gates [m]. Default 1000.

pattern_thres [float. Dataset keyword] The minimum of the sum of the weights given to each value in order to consider the weighted quantile valid. It is related to the number of valid data points

data_is_log [dict. Dataset keyword] Dictionary specifying for each field if it is in log (True) or linear units (False). Default False

use_nans [dict. Dataset keyword] Dictionary specyfing whether the nans have to be used in the computation of the statistics for each field. Default False

> **nan_value** [dict. Dataset keyword] Dictionary with the value to use to substitute the NaN values when computing the statistics of each field. Default 0

> **radar_list** [list of Radar objects] Optional. list of radar objects

> **trajectory** [Trajectory object] containing trajectory samples

> **Returns**

> > **trajectory** [Trajectory object] Object holding time series

> > **ind_rad** [int] radar index

pyrad.proc.process_traj.**process_traj_atplane**(*procstatus*, *dscfg*, *radar_list=None*, *trajectory=None*)

> Return time series according to trajectory

> > **Parameters**

> > > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

> > > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

> > > > **datatype** [list of string. Dataset keyword] The input data types

> > > > **data_is_log** [dict. Dataset keyword] Dictionary specifying for each field if it is in log (True) or linear units (False). Default False

> > > > **ang_tol** [float. Dataset keyword] Factor that multiplies the angle resolution. Used when determining the neighbouring rays. Default 1.2

> > > **radar_list** [list of Radar objects] Optional. list of radar objects

> > > **trajectory** [Trajectory object] containing trajectory samples

> > **Returns**

> > > **trajectory** [Trajectory object] Object holding time series

> > > **ind_rad** [int] radar index

pyrad.proc.process_traj.**process_traj_lightning**(*procstatus*, *dscfg*, *radar_list=None*, *trajectory=None*)

> Return time series according to lightning trajectory

> > **Parameters**

> > > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

> > > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

> > > > **datatype** [list of string. Dataset keyword] The input data types

> > > > **data_is_log** [dict. Dataset keyword] Dictionary specifying for each field if it is in log (True) or linear units (False). Default False

> > > > **ang_tol** [float. Dataset keyword] Factor that multiplies the angle resolution. Used when determining the neighbouring rays. Default 1.2

> > > **radar_list** [list of Radar objects] Optional. list of radar objects

> > > **trajectory** [Trajectory object] containing trajectory samples

> > **Returns**

> > > **trajectory** [Trajectory object] Object holding time series

> > > **ind_rad** [int] radar index

pyrad.proc.process_traj.**process_traj_trt**(*procstatus*, *dscfg*, *radar_list=None*, *trajectory=None*)

> Processes data according to TRT trajectory

> > **Parameters**

> > > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

> > > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

> > > > **datatype** [list of string. Dataset keyword] The input data types

> > > > **time_tol** [float. Dataset keyword] tolerance between reference time of the radar volume and that of the TRT cell [s]. Default 100.

> > > > **alt_min, alt_max** [float. Dataset keyword] Minimum and maximum altitude of the data inside the TRT cell to retrieve [m MSL]. Default None

> > > **radar_list** [list of Radar objects] Optional. list of radar objects

> > > **trajectory** [Trajectory object] containing trajectory samples

> > **Returns**

> > > **trajectory** [Trajectory object] Object holding time series

> > > **ind_rad** [int] radar index

pyrad.proc.process_traj.**process_trajectory**(*procstatus*, *dscfg*, *radar_list=None*, *trajectory=None*)

> Return trajectory

> > **Parameters**

> > > **procstatus** [int] Processing status: 0 initializing, 1 processing volume, 2 post-processing

> > > **dscfg** [dictionary of dictionaries] data set configuration. Accepted Configuration Keywords:

> > > > **datatype** [list of string. Dataset keyword] The input data types

> > > **radar_list** [list of Radar objects] Optional. list of radar objects

> > > **trajectory** [Trajectory object] containing trajectory samples

> > **Returns**

> > > **new_dataset** [Trajectory object] radar object

> > > **ind_rad** [int] None

PYRAD.PROD.PRODUCT_AUX

Auxiliary functions to generate products

get_prodgen_func(dsformat, dsname, dstype)	maps the dataset format into its processing function

pyrad.prod.product_aux.**get_prodgen_func**(*dsformat*, *dsname*, *dstype*)
  maps the dataset format into its processing function

> **Parameters**
>
>> **dsformat** [str] dataset group. The following is a list of dataset groups with the function that is called to generate their products. For details about what the functions do check the function documentation:
>>
>>> 'VOL': generate_vol_products 'COLOCATED_GATES': generate_colocated_gates_products 'COSMO_COORD': generate_cosmo_coord_products 'GRID': generate_grid_products 'INTERCOMP': generate_intercomp_products 'ML': generate_ml_products 'MONITORING': generate_monitoring_products 'OCCURRENCE': generate_occurrence_products 'QVP': generate_qvp_products 'SPARSE_GRID': generate_sparse_grid_products 'SUN_HITS': generate_sun_hits_products 'TIMEAVG': generate_time_avg_products 'TIMESERIES': generate_timeseries_products 'TRAJ_ONLY': generate_traj_product
>
> **Returns**
>
>> **func** [function] pyrad function used to generate the products

PYRAD.PROD.PROCESS_PRODUCT

Functions for obtaining Pyrad products from the datasets

generate_occurrence_products(dataset, prd-cfg)	generates occurrence products. Accepted product types:
generate_cosmo_coord_products(dataset, prdcfg)	generates COSMO coordinates products. Accepted product types:
generate_sun_hits_products(dataset, prdcfg)	generates sun hits products. Accepted product types:
generate_qvp_products(dataset, prdcfg)	Generates quasi vertical profile-like products.
generate_ml_products(dataset, prdcfg)	Generates melting layer products. Accepted product types:

pyrad.prod.process_product.**generate_cosmo_coord_products**(*dataset*, *prdcfg*)

> **generates COSMO coordinates products. Accepted product types:**
>
> > **'SAVEVOL': Save an object containing the index of the COSMO model grid** that corresponds to each radar gate in a C/F radial file.
>
> > **Parameters**
> >
> > > **dataset** [tuple] radar object containing the COSMO coordinates
> > >
> > > **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries
> >
> > **Returns**
> >
> > > **filename** [str] the name of the file created. None otherwise

pyrad.prod.process_product.**generate_ml_products**(*dataset*, *prdcfg*)

> **Generates melting layer products. Accepted product types:**
>
> > **'ML_TS': Plots and writes a time series of the melting layer, i.e.** the evolution of the average and standard deviation of the melting layer top and thickness and the the number of rays used in the retrieval. User defined parameters:
> >
> > > **dpi: int** The pixel density of the plot. Default 72
>
> > **'SAVE_ML': Saves an object containing the melting layer retrieval** information in a C/F radial file
>
> > All the products of the 'VOL' dataset group
>
> > **Parameters**
> >
> > > **dataset** [dict] dictionary containing the radar object and a keyword stating the status of the processing

> **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries

> **Returns**

>> **filename** [str] the name of the file created. None otherwise

pyrad.prod.process_product.**generate_occurrence_products**(*dataset*, *prdcfg*)

> **generates occurrence products. Accepted product types:**

>> **'WRITE_EXCESS_GATES': Write the data that identifies radar gates** with clutter that has a frequency of occurrence above a certain threshold. User defined parameters:

>>> **quant_min: float** Minimum frequency of occurrence in percentage to keep the gate as valid. Default 95.

>> All the products of the 'VOL' dataset group

> **Parameters**

>> **dataset** [tuple] radar object and metadata dictionary

>> **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries

> **Returns**

>> **filename** [str] the name of the file created. None otherwise

pyrad.prod.process_product.**generate_qvp_products**(*dataset*, *prdcfg*)

> Generates quasi vertical profile-like products. Quasi vertical profiles come from azimuthal averaging of polarimetric radar data. With the variable 'qvp_type' the user decides if the product has to be generated at the end of the processing period ('final') or instantaneously ('instant') Accepted product types:

>> All the products of the 'VOL' dataset group

> **Parameters**

>> **dataset** [dict] dictionary containing the radar object and a keyword stating the status of the processing

>> **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries

> **Returns**

>> **filename** [str] the name of the file created. None otherwise

pyrad.prod.process_product.**generate_sun_hits_products**(*dataset*, *prdcfg*)

> **generates sun hits products. Accepted product types:**

>> **'PLOT_SUN_HITS': Plots in a sun-radar azimuth difference-sun-radar** elevation difference grid the values of all sun hits obtained during the processing period

>> **'PLOT_SUN_RETRIEVAL': Plots in a sun-radar azimuth difference-sun-** radar elevation difference grid the retrieved sun pattern

>> **'PLOT_SUN_RETRIEVAL_TS': Plots time series of the retrieved sun** pattern parameters User defined parameters:

>>> **dpi: int** The pixel density of the plot. Default 72

>>> **add_date_in_fname: Bool** If true the year is added in the plot file name

>> **'WRITE_SUN_HITS': Writes the information concerning possible sun hits** in a csv file

---

'WRITE_SUN_RETRIEVAL': Writes the retrieved sun pattern parameters in a csv file. User defined parameters:

> **add_date_in_fname: Bool** If true the year is added in the csv file name

All the products of the 'VOL' dataset group

Parameters

> **dataset** [tuple] radar object and sun hits dictionary
>
> **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries

Returns

> **filename** [str] the name of the file created. None otherwise

PYRAD.PROD.PROCESS_VOL_PRODUCTS

Functions for obtaining Pyrad products from a radar volume dataset

generate_vol_products(dataset, prdcfg)	Generates radar volume products. Accepted product types:

pyrad.prod.process_vol_products.**generate_vol_products**(*dataset*, *prdcfg*)

> **Generates radar volume products. Accepted product types:**
>
> > **'CDF': plots and writes the cumulative density function of data**
> >
> > > **User defined parameters:**
> > >
> > > > **quantiles: list of floats** The quantiles to compute in percent. Default None
> > > >
> > > > **sector: dict** dictionary defining the sector where to compute the CDF. Default is None and the CDF is computed over all the data May contain:
> > > >
> > > > > **rmin, rmax: float** min and max range [m]
> > > > >
> > > > > **azmin, azmax: float** min and max azimuth angle [deg]
> > > > >
> > > > > **elmin, elmax: float** min and max elevation angle [deg]
> > > > >
> > > > > **hmin, hmax: float** min and max altitude [m MSL]
> > > >
> > > > **vismin: float** The minimum visibility to use the data. Default None
> > > >
> > > > **absolute: Bool** If true the absolute values of the data will be used. Default False
> > > >
> > > > **use_nans: Bool** If true NaN values will be used. Default False
> > > >
> > > > **nan_value: Bool** The value by which the NaNs are substituted if NaN values are to be used in the computation
> > > >
> > > > **filterclt: Bool** If True the gates containing clutter are filtered
> > > >
> > > > **filterprec: list of ints** The hydrometeor types that are filtered from the analysis. Default empty list.
> >
> > **'BSCOPE_IMAGE': Creates a B-scope image (azimuth, range)**
> >
> > > **User defined parameters:**
> > >
> > > > **anglenr** [int] The elevation angle number to use
> >
> > **'CAPPI_IMAGE': Creates a CAPPI image**
> >
> > > **User defined parameters:**
> > >
> > > > **altitude: flt** CAPPI altitude [m MSL]

wfunc: str The function used to produce the CAPPI as defined in pyart.map.grid_from_radars. Default 'NEAREST_NEIGHBOUR'

cappi_res: float The CAPPI resolution [m]. Default 500.

'FIELD_COVERAGE': Gets the field coverage over a certain sector

User defined parameters:

threshold: float or None Minimum value to consider the data valid. Default None

nvalid_min: float Minimum number of valid gates in the ray to consider it valid. Default 5

ele_res, azi_res: float Elevation and azimuth resolution of the sectors [deg]. Default 1. and 2.

ele_min, ele_max: float Min and max elevation angle defining the sector [deg]. Default 0. and 30.

ele_step: float Elevation step [deg]. Default 5.

ele_sect_start, ele_sect_stop: float or None start and stop angles of the sector coverage. Default None

quantiles: list of floats The quantiles to compute in the sector. Default 10. to 90. by steps of 10.

AngTol: float The tolerance in elevation angle when putting the data in a fixed grid

'FIXED_RNG_IMAGE': Plots a fixed range image

User defined parameters:

AngTol [float] The tolerance between the nominal angles and the actual radar angles. Default 1.

ele_res, azi_res: float or None The resolution of the fixed grid [deg]. If None it will be obtained from the separation between angles

vmin, vmax [float or None] Min and Max values of the color scale. If None the values are taken from the Py-ART config file

'FIXED_RNG_SPAN_IMAGE': Plots a user-defined statistic over a fixed range image User defined parameters:

AngTol [float] The tolerance between the nominal angles and the actual radar angles. Default 1.

ele_res, azi_res: float or None The resolution of the fixed grid [deg]. If None it will be obtained from the separation between angles

stat [str] The statistic to compute. Can be 'min', 'max', 'mean', 'mode'. Default 'max'

'HISTOGRAM': Computes a histogram of the radar volum data

User defined parameters:

step: float or None the data quantization step. If none it will be obtained from the Py-ART configuration file

write_data: Bool If true the histogram data is written in a csv file

'PLOT_ALONG_COORD': Plots the radar volume data along a particular coordinate User defined parameters:

colors: list of str or None The colors of each ploted line

mode: str Ploting mode. Can be 'ALONG_RNG', 'ALONG_AZI' or 'ALONG_ELE'

value_start, value_stop: float The starting and ending points of the data to plot. According to the mode it may refer to the range, azimuth or elevation. If not specified the minimum and maximum possible values are used

fix_elevations, fix_azimuths, fix_ranges: list of floats The elevations, azimuths or ranges to plot for each mode. 'ALONG_RNG' would use fix_elevations and fix_azimuths 'ALONG_AZI' fix_ranges and fix_elevations 'ALONG_ELE' fix_ranges and fix_azimuths

AngTol: float The tolerance to match the radar angle to the fixed angles Default 1.

RngTol: float The tolerance to match the radar range to the fixed ranges Default 50.

'PPI_CONTOUR': Plots a PPI countour plot

User defined parameters:

contour_values: list of floats or None The list of contour values to plot. If None the contour values are going to be obtained from the Py-ART config file either with the dictionary key 'contour_values' or from the minimum and maximum values of the field with an assumed division of 10 levels.

anglenr: float The elevation angle number

'PPI_CONTOUR_OVERPLOT': Plots a PPI of a field with another field overplotted as a contour plot. User defined parameters:

contour_values: list of floats or None The list of contour values to plot. If None the contour values are going to be obtained from the Py-ART config file either with the dictionary key 'contour_values' or from the minimum and maximum values of the field with an assumed division of 10 levels.

anglenr: float The elevation angle number

'PPI_IMAGE': Plots a PPI image. It can also plot the histogram and the quantiles of the data in the PPI. User defined parameters:

anglenr: float The elevation angle number

plot_type: str The type of plot to perform. Can be 'PPI', 'QUANTILES' or 'HISTOGRAM'

step: float or None If the plot type is 'HISTOGRAM', the width of the histogram bin. If None it will be obtained from the Py-ART config file

quantiles: list of float or None If the plot type is 'QUANTILES', the list of quantiles to compute. If None a default list of quantiles will be computed

'PPI_MAP': Plots a PPI image over a map. The map resolution and the type of maps used are defined in the variables 'mapres' and 'maps' in 'ppiMapImageConfig' in the loc config file. User defined parameters:

anglenr: float The elevation angle number

'PROFILE_STATS': Computes and plots a vertical profile statistics. The statistics are saved in a csv file User defined parameters:

heightResolution: float The height resolution of the profile [m]. Default 100.

heightMin, heightMax: float or None The minimum and maximum altitude of the profile [m MSL]. If None the values will be obtained from the minimum and maximum gate altitude.

quantity: str The type of statistics to plot. Can be 'quantiles', 'mode', 'reqgression_mean' or 'mean'.

quantiles: list of floats If quantity type is 'quantiles' the list of quantiles to compute. Default 25., 50., 75.

nvalid_min: int The minimum number of valid points to consider the statistic valid. Default 4

make_linear: Bool If true the data is converted from log to linear before computing the stats

include_nans: Bool If true NaN values are included in the statistics

fixed_span: Bool If true the profile plot has a fix X-axis

vmin, vmax: float or None If fixed_span is set, the minimum and maximum values of the X-axis. If None, they are obtained from the Py-ART config file

'PSEUDOPPI_CONTOUR': Plots a pseudo-PPI countour plot

User defined parameters:

contour_values: list of floats or None The list of contour values to plot. If None the contour values are going to be obtained from the Py-ART config file either with the dictionary key 'contour_values' or from the minimum and maximum values of the field with an assumed division of 10 levels.

angle: float The elevation angle at which compute the PPI

EleTol: float The tolerance between the actual radar elevation angle and the nominal pseudo-PPI elevation angle.

'PSEUDOPPI_CONTOUR_OVERPLOT': Plots a pseudo-PPI of a field with another field overplotted as a contour plot User defined parameters:

contour_values: list of floats or None The list of contour values to plot. If None the contour values are going to be obtained from the Py-ART config file either with the dictionary key 'contour_values' or from the minimum and maximum values of the field with an assumed division of 10 levels.

angle: float The elevation angle at which compute the PPI

EleTol: float The tolerance between the actual radar elevation angle and the nominal pseudo-PPI elevation angle.

'PSEUDOPPI_IMAGE': Plots a pseudo-PPI image. It can also plot the histogram and the quantiles of the data in the pseudo-PPI. User defined parameters:

angle: float The elevation angle of the pseudo-PPI

EleTol: float The tolerance between the actual radar elevation angle and the nominal pseudo-PPI elevation angle.

plot_type: str The type of plot to perform. Can be 'PPI', 'QUANTILES' or 'HISTOGRAM'

step: float or None If the plot type is 'HISTOGRAM', the width of the histogram bin. If None it will be obtained from the Py-ART config file

quantiles: list of float or None If the plot type is 'QUANTILES', the list of quantiles to compute. If None a default list of quantiles will be computed

'PSEUDOPPI_MAP': Plots a pseudo-PPI image over a map. The map resolution and the type of maps used are defined in the variables 'mapres' and 'maps' in 'ppiMapImageConfig' in the loc config file. User defined parameters:

> **angle: float** The elevation angle of the pseudo-PPI
>
> **EleTol: float** The tolerance between the actual radar elevation angle and the nominal pseudo-PPI elevation angle.

'PSEUDORHI_CONTOUR': Plots a pseudo-RHI countour plot

User defined parameters:

> **contour_values: list of floats or None** The list of contour values to plot. If None the contour values are going to be obtained from the Py-ART config file either with the dictionary key 'contour_values' or from the minimum and maximum values of the field with an assumed division of 10 levels.
>
> **angle: float** The azimuth angle at which to compute the RPI
>
> **AziTol: float** The tolerance between the actual radar azimuth angle and the nominal pseudo-RHI azimuth angle.

'PSEUDORHI_CONTOUR_OVERPLOT': Plots a pseudo-RHI of a field with another field overplotted as a contour plot User defined parameters:

> **contour_values: list of floats or None** The list of contour values to plot. If None the contour values are going to be obtained from the Py-ART config file either with the dictionary key 'contour_values' or from the minimum and maximum values of the field with an assumed division of 10 levels.
>
> **angle: float** The azimuth angle at which to compute the RPI
>
> **AziTol: float** The tolerance between the actual radar azimuth angle and the nominal pseudo-RHI azimuth angle.

'PSEUDORHI_IMAGE': Plots a pseudo-RHI image. It can also plot the histogram and the quantiles of the data in the pseudo-RHI. User defined parameters:

> **angle: float** The azimuth angle at which to compute the RPI
>
> **AziTol: float** The tolerance between the actual radar azimuth angle and the nominal pseudo-RHI azimuth angle.
>
> **plot_type: str** The type of plot to perform. Can be 'RHI', 'QUANTILES' or 'HISTOGRAM'
>
> **step: float or None** If the plot type is 'HISTOGRAM', the width of the histogram bin. If None it will be obtained from the Py-ART config file
>
> **quantiles: list of float or None** If the plot type is 'QUANTILES', the list of quantiles to compute. If None a default list of quantiles will be computed

'QUANTILES': Plots and writes the quantiles of a radar volume

User defined parameters:

> **quantiles: list of floats or None** the list of quantiles to compute. If None a default list of quantiles will be computed.
>
> **write_data: Bool** If True the computed data will be also written in a csv file
>
> **fixed_span: Bool** If true the quantile plot has a fix Y-axis

> **vmin, vmax: float or None** If fixed_span is set, the minimum and maximum values of the Y-axis. If None, they are obtained from the Py-ART config file

'RHI_CONTOUR': Plots an RHI countour plot

> **User defined parameters:**
>
>> **contour_values: list of floats or None** The list of contour values to plot. If None the contour values are going to be obtained from the Py-ART config file either with the dictionary key 'contour_values' or from the minimum and maximum values of the field with an assumed division of 10 levels.
>>
>> **anglenr: int** The azimuth angle number

'RHI_CONTOUR_OVERPLOT': Plots an RHI of a field with another field over-plotted as a contour plot User defined parameters:

>> **contour_values: list of floats or None** The list of contour values to plot. If None the contour values are going to be obtained from the Py-ART config file either with the dictionary key 'contour_values' or from the minimum and maximum values of the field with an assumed division of 10 levels.
>>
>> **anglenr: int** The azimuth angle number

'RHI_IMAGE': Plots an RHI image. It can also plot the histogram and the quantiles of the data in the RHI. User defined parameters:

>> **anglenr: int** The azimuth angle number
>>
>> **plot_type: str** The type of plot to perform. Can be 'RHI', 'QUANTILES' or 'HISTOGRAM'
>>
>> **step: float or None** If the plot type is 'HISTOGRAM', the width of the histogram bin. If None it will be obtained from the Py-ART config file
>>
>> **quantiles: list of float or None** If the plot type is 'QUANTILES', the list of quantiles to compute. If None a default list of quantiles will be computed

'RHI_PROFILE': Computes and plots a vertical profile statistics out of an RHI. The statistics are saved in a csv file User defined parameters:

>> **rangeStart, rangeStop: float** The range start and stop of the data to extract from the RHI to compute the statistics [m]. Default 0., 25000.
>>
>> **heightResolution: float** The height resolution of the profile [m]. Default 100.
>>
>> **heightMin, heightMax: float or None** The minimum and maximum altitude of the profile [m MSL]. If None the values will be obtained from the minimum and maximum gate altitude.
>>
>> **quantity: str** The type of statistics to plot. Can be 'quantiles', 'mode', 'reqgression_mean' or 'mean'.
>>
>> **quantiles: list of floats** If quantity type is 'quantiles' the list of quantiles to compute. Default 25., 50., 75.
>>
>> **nvalid_min: int** The minimum number of valid points to consider the statistic valid. Default 4
>>
>> **make_linear: Bool** If true the data is converted from log to linear before computing the stats
>>
>> **include_nans: Bool** If true NaN values are included in the statistics
>>
>> **fixed_span: Bool** If true the profile plot has a fix X-axis

---

> **vmin, vmax: float or None** If fixed_span is set, the minimum and maximum values of the X-axis. If None, they are obtained from the Py-ART config file

'SAVEALL': Saves radar volume data including all or a list of user- defined fields in a C/F radial or ODIM file User defined parameters:

> **file_type: str** The type of file used to save the data. Can be 'nc' or 'h5'. Default 'nc'

> **datatypes: list of str or None** The list of data types to save. If it is None, all fields in the radar object will be saved

> **physical: Bool** If True the data will be saved in physical units (floats). Otherwise it will be quantized and saved as binary

> **compression: str** For ODIM file formats, the type of compression. Can be any of the allowed compression types for hdf5 files. Default gzip

> **compression_opts: any** The compression options allowed by the hdf5. Depends on the type of compression. Default 6 (The gzip compression level).

'SAVESTATE': Saves the last processed data in a file. Used for real- time data processing

'SAVEVOL': Saves one field of a radar volume data in a C/F radial or ODIM file User defined parameters:

> **file_type: str** The type of file used to save the data. Can be 'nc' or 'h5'. Default 'nc'

> **physical: Bool** If True the data will be saved in physical units (floats). Otherwise it will be quantized and saved as binary

> **compression: str** For ODIM file formats, the type of compression. Can be any of the allowed compression types for hdf5 files. Default gzip

> **compression_opts: any** The compression options allowed by the hdf5. Depends on the type of compression. Default 6 (The gzip compression level).

'SAVE_FIXED_ANGLE': Saves the position of the first fix angle in a csv file

'TIME_RANGE': Plots a time-range plot

User defined parameters:

> **anglenr: float** The number of the fixed angle to plot

'WIND_PROFILE': Plots vertical profile of wind data (U, V, W components and wind velocity and direction) out of a radar volume containing the retrieved U,V and W components of the wind, the standard deviation of the retrieval and the velocity difference between the estimated radial velocity (assuming the wind to be uniform) and the actual measured radial velocity. User defined parameters:

> **heightResolution: float** The height resolution of the profile [m]. Default 100.

> **heightMin, heightMax: float or None** The minimum and maximum altitude of the profile [m MSL]. If None the values will be obtained from the minimum and maximum gate altitude.

> **min_ele: float** The minimum elevation to be used in the computation of the vertical velocities. Default 5.

> **max_ele: float** The maximum elevation to be used in the computation of the horizontal velocities. Default 85.

> **fixed_span: Bool** If true the profile plot has a fix X-axis

> **vmin, vmax: float or None** If fixed_span is set, the minimum and maximum values of the X-axis. If None, they are obtained from the span of the U component defined in the Py-ART config file

Parameters

> **dataset** [dict] dictionary with key radar_out containing a radar object
>
> **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries

Returns

> **The list of created fields or None**

PYRAD.PROD.PROCESS_GRID_PRODUCTS

Functions for obtaining Pyrad products from gridded datasets

generate_sparse_grid_products(dataset, prdcfg)	generates products defined by sparse points. Accepted product types:
generate_grid_products(dataset, prdcfg)	generates grid products. Accepted product types:

pyrad.prod.process_grid_products.**generate_grid_products**(*dataset*, *prdcfg*)

> **generates grid products. Accepted product types:**
>
> > **'CROSS_SECTION': Plots a cross-section of gridded data**
> >
> > > **User defined parameters:**
> > >
> > > > **coord1, coord2: dict** The two lat-lon coordinates marking the limits. They have the keywords 'lat' and 'lon' [degree]. The altitude limits are defined by the parameters in 'rhiImageConfig' in the 'loc' configuration file
> >
> > **'LATITUDE_SLICE': Plots a cross-section of gridded data over a** constant latitude. User defined parameters:
> >
> > > **lon, lat: floats** The starting point of the cross-section. The ending point is defined by the parameters in 'rhiImageConfig' in the 'loc' configuration file
> >
> > **'LONGITUDE_SLICE': Plots a cross-ection of gridded data over a** constant longitude. User defined parameters:
> >
> > > **lon, lat: floats** The starting point of the cross-section. The ending point is defined by the parameters in 'rhiImageConfig' in the 'loc' configuration file
> >
> > 'SAVEVOL': save the gridded data in a C/F radial file 'SURFACE_IMAGE': Plots a surface image of gridded data.
> >
> > > **User defined parameters:**
> > >
> > > > **level: int** The altitude level to plot. The rest of the parameters are defined by the parameters in 'ppiImageConfig' and 'ppiMapImageConfig' in the 'loc' configuration file
>
> **Parameters**
>
> > **dataset** [grid] grid object
> >
> > **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries
>
> **Returns**
>
> > **None or name of generated files**

pyrad.prod.process_grid_products.**generate_sparse_grid_products**(*dataset*, *prdcfg*)

> generates products defined by sparse points. Accepted product types:
>
> > **'SURFACE_IMAGE': Generates a surface image**
> >
> > > **User defined parameters:**
> > >
> > > > **'field_limits': list of floats** The limits of the surface to plot [deg] lon0, lon1, lat0, lat1
> >
> > **Parameters**
> >
> > > **dataset** [dictionary containing the points and their values]
> > >
> > > **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries
> >
> > **Returns**
> >
> > > **no return**

PYRAD.PROD.PROCESS_TIMESERIES_PRODUCTS

Functions for obtaining Pyrad products from a time series datasets

generate_timeseries_products(dataset, prdcfg)	Generates time series products. Accepted product types:

pyrad.prod.process_timeseries_products.**generate_timeseries_products**(*dataset*, *prdcfg*)

> **Generates time series products. Accepted product types:**
>
> > **'COMPARE_CUMULATIVE_POINT': Plots in the same graph 2 time series of** data accumulation (tipically rainfall rate). One time series is a point measurement of radar data while the other is from a co-located instrument (rain gauge or disdrometer) User defined parameters:
> >
> > > **dpi: int** The pixel density of the plot. Default 72
> > >
> > > **vmin, vmax: float** The limits of the Y-axis. If none they will be obtained from the Py-ART config file.
> > >
> > > **sensor: str** The sensor type. Can be 'rgage' or 'disdro'
> > >
> > > **sensorid: str** The sensor ID.
> > >
> > > **location: str** A string identifying the location of the disdrometer
> > >
> > > **freq: float** The frequency used to retrieve the polarimetric variables of a disdrometer
> > >
> > > **ele: float** The elevation angle used to retrieve the polarimetric variables of a disdrometer
> > >
> > > **ScanPeriod: float** The scaning period of the radar in seconds. This parameter is defined in the 'loc' config file
> >
> > **'COMPARE_POINT': Plots in the same graph 2 time series of** data . One time series is a point measurement of radar data while the other is from a co-located instrument (rain gauge or disdrometer) User defined parameters:
> >
> > > **dpi: int** The pixel density of the plot. Default 72
> > >
> > > **vmin, vmax: float** The limits of the Y-axis. If none they will be obtained from the Py-ART config file.
> > >
> > > **sensor: str** The sensor type. Can be 'rgage' or 'disdro'
> > >
> > > **sensorid: str** The sensor ID.
> > >
> > > **location: str** A string identifying the location of the disdrometer
> > >
> > > **freq: float** The frequency used to retrieve the polarimetric variables of a disdrometer

> > > **ele: float** The elevation angle used to retrieve the polarimetric variables of a disdrometer

> > **'COMPARE_TIME_AVG': Creates a scatter plot of average radar data** versus average sensor data. User defined parameters:

> > > **dpi: int** The pixel density of the plot. Default 72

> > > **sensor: str** The sensor type. Can be 'rgage' or 'disdro'

> > > **sensorid: str** The sensor ID.

> > > **location: str** A string identifying the location of the disdrometer

> > > **freq: float** The frequency used to retrieve the polarimetric variables of a disdrometer

> > > **ele: float** The elevation angle used to retrieve the polarimetric variables of a disdrometer

> > > **cum_time: float** Data accumulation time [s]. Default 3600.

> > > **base_time: float** Starting moment of the accumulation [s from midnight]. Default 0.

> > **'PLOT_AND_WRITE': Writes and plots a trajectory time series.**

> > > **User defined parameters:**

> > > > **ymin, ymax: float** The minimum and maximum value of the Y-axis. If none it will be obtained from the Py-ART config file.

> > **'PLOT_AND_WRITE_POINT': Plots and writes a time series of radar data** at a particular point User defined parameters:

> > > **dpi: int** The pixel density of the plot. Default 72

> > > **vmin, vmax: float** The limits of the Y-axis. If none they will be obtained from the Py-ART config file.

> > **'PLOT_CUMULATIVE_POINT': Plots a time series of radar data** accumulation at a particular point. User defined parameters:

> > > **dpi: int** The pixel density of the plot. Default 72

> > > **vmin, vmax: float** The limits of the Y-axis. If none they will be obtained from the Py-ART config file.

> > > **ScanPeriod: float** The scaning period of the radar in seconds. This parameter is defined in the 'loc' config file

> > **'PLOT_HIST': plots and writes a histogram of all the data gathered** during the trajectory processing User defined parameters:

> > > **step: float or None** The quantization step of the data. If None it will be obtained from the Py-ART config file

> > **'TRAJ_CAPPI_IMAGE': Creates a CAPPI image with the trajectory position** overplot on it. User defined parameters:

> > > **color_ref: str** The meaning of the color code with which the trajectory is plotted. Can be 'None', 'altitude' (the absolute altitude), 'rel_altitude' (altitude relative to the CAPPI altitude), 'time' (trajectory time respect of the start of the radar scan leading to the CAPPI)

> > > **altitude: float** The CAPPI altitude [m]

> > > **wfunc: str** Function used in the gridding of the radar data. The function types are defined in pyart.map.grid_from_radars. Default 'NEAREST_NEIGHBOUR'

> > > **res: float** The CAPPI resolution [m]. Default 500.

Parameters

dataset [dictionary] radar object

prdcfg [dictionary of dictionaries] product configuration dictionary of dictionaries

Returns

no return

PYRAD.PROD.PROCESS_MONITORING_PRODUCTS

Functions for obtaining Pyrad products from monitoring datasets

generate_monitoring_products(dataset, prdcfg)	generates a monitoring product.

pyrad.prod.process_monitoring_products.**generate_monitoring_products**(*dataset*, *prdcfg*)

> generates a monitoring product. With the parameter 'hist_type' the user may define is the product is computed for each radar volume ('instant') or at the end of the processing period ('cumulative'). Default is 'cumulative'. Accepted product types:
>
> > **'ANGULAR_DENSITY': For a specified elevation angle, plots a 2D** histogram with the azimuth angle in the X-axis and the data values in the Y-axis. The reference values and the user defined quantiles are also plot on the same figure User defined parameters:
> >
> > > **anglenr: int** The elevation angle number to plot
> > >
> > > **quantiles: list of floats** The quantiles to plot. Default 25., 50., 75.
> > >
> > > **ref_value: float** The reference value
> > >
> > > **vmin, vmax** [floats or None] The minimum and maximum values of the data points. If not specified they are obtained from the Py-ART config file
> >
> > **'CUMUL_VOL_TS': Plots time series of the average of instantaneous** quantiles stored in a csv file. User defined parameters:
> >
> > > **quantiles: list of 3 floats** the quantiles to compute. Default 25., 50., 75.
> > >
> > > **ref_value: float** The reference value. Default 0
> > >
> > > **sort_by_date: Bool** If true when reading the csv file containing the statistics the data is sorted by date. Default False
> > >
> > > **rewrite: Bool** If true the csv file containing the statistics is rewritten
> > >
> > > **add_data_in_fname: Bool** If true and the data used is cumulative the year is written in the csv file name and the plot file name
> > >
> > > **npoints_min: int** Minimum number of points to use the data point in the plotting and to send an alarm. Default 0
> > >
> > > **vmin, vmax: float or None** Limits of the Y-axis (data value). If None the limits are obtained from the Py-ART config file
> > >
> > > **alarm: Bool** If true an alarm is sent

> **tol_abs: float** Margin of tolerance from the reference value. If the current value is above this margin an alarm is sent. If the margin is not specified it is not possible to send any alarm
>
> **tol_trend: float** Margin of tolerance from the reference value. If the trend of the last X events is above this margin an alarm is sent. If the margin is not specified it is not possible to send any alarm
>
> **nevents_min: int** Minimum number of events with sufficient points to send an alarm related to the trend. If not specified it is not possible to send any alarm
>
> **sender: str** The mail of the alarm sender. If not specified it is not possible to send any alarm
>
> **receiver_list: list of str** The list of emails of the people that will receive the alarm.. If not specified it is not possible to send any alarm

'PPI_HISTOGRAM': Plots a histogram of data at a particular elevation angle. User defined parameters:

> **anglenr: int** The elevation angle number to plot

'SAVEVOL': Saves the monitoring data in a C/F radar file. The data field contains histograms of data for each pair of azimuth and elevation angles

'VOL_HISTOGRAM': Plots a histogram of data collected from all the radar volume. User defined parameters:

> **write_data: bool** If true the resultant histogram is also saved in a csv file. Default True.

'VOL_TS': Computes statistics of the gathered data and writes them in a csv file and plots a time series of those statistics. User defined parameters:

> **quantiles: list of 3 floats** the quantiles to compute. Default 25., 50., 75.
>
> **ref_value: float** The reference value. Default 0
>
> **sort_by_date: Bool** If true when reading the csv file containing the statistics the data is sorted by date. Default False
>
> **rewrite: Bool** If true the csv file containing the statistics is rewritten
>
> **add_data_in_fname: Bool** If true and the data used is cumulative the year is written in the csv file name and the plot file name
>
> **npoints_min: int** Minimum number of points to use the data point in the plotting and to send an alarm. Default 0
>
> **vmin, vmax: float or None** Limits of the Y-axis (data value). If None the limits are obtained from the Py-ART config file
>
> **alarm: Bool** If true an alarm is sent
>
> **tol_abs: float** Margin of tolerance from the reference value. If the current value is above this margin an alarm is sent. If the margin is not specified it is not possible to send any alarm
>
> **tol_trend: float** Margin of tolerance from the reference value. If the trend of the last X events is above this margin an alarm is sent. If the margin is not specified it is not possible to send any alarm
>
> **nevents_min: int** Minimum number of events with sufficient points to send an alarm related to the trend. If not specified it is not possible to send any alarm

> **sender: str** The mail of the alarm sender. If not specified it is not possible to send any alarm
>
> **receiver_list: list of str** The list of emails of the people that will receive the alarm.. If not specified it is not possible to send any alarm

Parameters

> **dataset** [dictionary] dictionary containing a histogram object and some metadata
>
> **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries

Returns

> **filename** [str] the name of the file created. None otherwise

PYRAD.PROD.PROCESS_INTERCOMP_PRODUCTS

Functions for obtaining Pyrad products from datasets used in the intercomparison process

generate_intercomp_products(dataset, prd-cfg)	Generates radar intercomparison products. Accepted product types:
generate_colocated_gates_products(dataset, …)	Generates colocated gates products. Accepted product types:
generate_time_avg_products(dataset, prdcfg)	generates time average products. Accepted product types:

pyrad.prod.process_intercomp_products.**generate_colocated_gates_products**(*dataset*, *prd-cfg*)

> **Generates colocated gates products. Accepted product types:**
>
> > **'WRITE_COLOCATED_GATES': Writes the position of the co-located gates** in a csv file
> >
> > All the products of the 'VOL' dataset group
>
> > **Parameters**
> >
> > > **dataset** [tuple] radar objects and colocated gates dictionary
> > >
> > > **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries
> >
> > **Returns**
> >
> > > **filename** [str] the name of the file created. None otherwise

pyrad.prod.process_intercomp_products.**generate_intercomp_products**(*dataset*, *prdcfg*)

> **Generates radar intercomparison products. Accepted product types:**
>
> > **'PLOT_AND_WRITE_INTERCOMP_TS': Writes statistics of radar** intercomparison in a file and plots the time series of the statistics. User defined parameters:
> >
> > > **'add_date_in_fname': Bool** If true adds the year in the csv file containing the statistics. Default False
> > >
> > > **'sort_by_date': Bool** If true sorts the statistics by date when reading the csv file containing the statistics. Default False
> > >
> > > **'rewrite': Bool** If true rewrites the csv file containing the statistics. Default False
> > >
> > > **'npoints_min': int** The minimum number of points to consider the statistics valid and therefore use the data point in the plotting. Default 0

> **'corr_min': float** The minimum correlation to consider the statistics valid and therefore use the data point in the plotting. Default 0.

'PLOT_SCATTER_INTERCOMP': Plots a density plot with the points of radar 1 versus the points of radar 2 User defined parameters:

> **'step': float** The quantization step of the data. If none it will be computed using the Py-ART config file. Default None

'WRITE_INTERCOMP': Writes the instantaneously intercompared data (gate positions, values, etc.) in a csv file.

'WRITE_INTERCOMP_TIME_AVG': Writes the time-averaged intercompared data (gate positions, values, etc.) in a csv file.

> **Parameters**
>
> > **dataset** [tuple] values of colocated gates dictionary
> >
> > **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries
>
> **Returns**
>
> > **filename** [str] the name of the file created. None otherwise

pyrad.prod.process_intercomp_products.**generate_time_avg_products**(*dataset*, *prd-cfg*)

> **generates time average products. Accepted product types:** All the products of the 'VOL' dataset group
>
> > **Parameters**
> >
> > > **dataset** [tuple] radar objects and colocated gates dictionary
> > >
> > > **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries
> >
> > **Returns**
> >
> > > **filename** [str] the name of the file created. None otherwise

PYRAD.PROD.PROCESS_PRODUCT

Functions for obtaining Pyrad products from the datasets

generate_traj_product(traj, prdcfg)	Generates trajectory products. Accepted product types:

pyrad.prod.process_traj_products.**generate_traj_product**(*traj*, *prdcfg*)

> **Generates trajectory products. Accepted product types:**
>
> > **'TRAJ_MAP': Plots the trajectory on a lat-lon map with the altitude** color coded
> >
> > **'TRAJ_PLOT': Plots time series of the trajectory respect to the radar** elevation, azimuth or range User defined parameters:
> >
> > > **'datatype': str** The type of parameter: 'EL', 'AZ', or 'RANGE'
> >
> > 'TRAJ_TEXT': Writes the trajectory information in a csv file
>
> **Parameters**
>
> > **traj** [Trajectory object]
> >
> > **prdcfg** [dictionary of dictionaries] product configuration dictionary of dictionaries
>
> **Returns**
>
> > **None**

PYRAD.IO.IO_AUX

Auxiliary functions for reading/writing files

map_hydro(hydro_data_op)	maps the operational hydrometeor classification identifiers to the ones used by Py-ART
map_Doppler(Doppler_data_bin, Nyquist_vel)	maps the binary METRANET Doppler data to actual Doppler velocity
get_save_dir(basepath, procname, dsname, prdname)	obtains the path to a product directory and eventually creates it
make_filename(prdtype, dstype, dsname, ext_list)	creates a product file name
generate_field_name_str(datatype)	Generates a field name in a nice to read format.
get_datatype_metranet(datatype)	maps de config file radar data type name into the corresponding metranet data type name and Py-ART field name
get_datatype_odim(datatype)	maps the config file radar data type name into the corresponding odim data type name and Py-ART field name
get_fieldname_pyart(datatype)	maps the config file radar data type name into the corresponding rainbow Py-ART field name
get_fieldname_cosmo(field_name)	maps the Py-ART field name into the corresponding COSMO variable name
get_field_unit(datatype)	Return unit of datatype.
get_field_name(datatype)	Return long name of datatype.
get_file_list(datadescriptor, starttime, . . .)	gets the list of files with a time period
get_trtfile_list(basepath, starttime, endtime)	gets the list of TRT files with a time period
get_scan_list(scandescriptor_list)	determine which is the scan list for each radar
get_new_rainbow_file_name(master_fname, . . .)	get the rainbow file name containing datatype from a master file name and data type
get_datatype_fields(datadescriptor)	splits the data type descriptor and provides each individual member
get_dataset_fields(datasetdescr)	splits the dataset type descriptor and provides each individual member
get_datetime(fname, datadescriptor)	Given a data descriptor gets date and time from file name
find_raw_cosmo_file(voltime, datatype, cfg)	Search a COSMO file in netcdf format
find_cosmo_file(voltime, datatype, cfg, scanid)	Search a COSMO file in Rainbow format
find_hzt_file(voltime, cfg[, ind_rad])	Search an ISO-0 degree file in HZT format
find_rad4alpcosmo_file(voltime, datatype, . . .)	Search a COSMO file
_get_datetime(fname, datagroup[, ftime_format])	Given a data group gets date and time from file name

Continued on next page

Table 1 – continued from previous page	
find_date_in_file_name(filename[, date_format])	Find a date with date format defined in date_format in a file name.

pyrad.io.io_aux.**_get_datetime**(*fname*, *datagroup*, *ftime_format=None*)
   Given a data group gets date and time from file name

   Parameters

   > **fname** [str] file name

   > **datadescriptor** [str] radar field type. Format : [radar file type]:[datatype]

   > **ftime_format** [str or None] if the file is of type ODIM this contain the file time format

   Returns

   > **fdatetime** [datetime object] date and time in file name

pyrad.io.io_aux.**find_cosmo_file**(*voltime*, *datatype*, *cfg*, *scanid*, *ind_rad=0*)
   Search a COSMO file in Rainbow format

   Parameters

   > **voltime** [datetime object] volume scan time

   > **datatype** [str] type of COSMO data to look for

   > **cfg** [dictionary of dictionaries] configuration info to figure out where the data is

   > **scanid** [str] name of the scan

   > **ind_rad** [int] radar index

   Returns

   > **fname** [str] Name of COSMO file if it exists. None otherwise

pyrad.io.io_aux.**find_date_in_file_name**(*filename*, *date_format='%Y%m%d%H%M%S'*)
   Find a date with date format defined in date_format in a file name. If no date is found returns None

   Parameters

   > **filename** [str] file name

   > **date_format** [str] The time format

   Returns

   > **fdatetime** [datetime object] date and time in file name

pyrad.io.io_aux.**find_hzt_file**(*voltime*, *cfg*, *ind_rad=0*)
   Search an ISO-0 degree file in HZT format

   Parameters

   > **voltime** [datetime object] volume scan time

   > **cfg** [dictionary of dictionaries] configuration info to figure out where the data is

   > **ind_rad** [int] radar index

   Returns

   > **fname** [str] Name of HZT file if it exists. None otherwise

pyrad.io.io_aux.**find_rad4alpcosmo_file**(*voltime*, *datatype*, *cfg*, *scanid*, *ind_rad=0*)
   Search a COSMO file

Parameters

> **voltime** [datetime object] volume scan time
>
> **datatype** [str] type of COSMO data to look for
>
> **cfg: dictionary of dictionaries** configuration info to figure out where the data is
>
> **ind_rad: int** radar index

Returns

> **fname** [str] Name of COSMO file if it exists. None otherwise
>
> **scanid: str** name of the scan

pyrad.io.io_aux.**find_raw_cosmo_file**(*voltime*, *datatype*, *cfg*, *ind_rad=0*)
> Search a COSMO file in netcdf format

Parameters

> **voltime** [datetime object] volume scan time
>
> **datatype** [str] type of COSMO data to look for
>
> **cfg** [dictionary of dictionaries] configuration info to figure out where the data is
>
> **ind_rad** [int] radar index

Returns

> **fname** [str] Name of COSMO file if it exists. None otherwise

pyrad.io.io_aux.**generate_field_name_str**(*datatype*)
> Generates a field name in a nice to read format.

Parameters

> **datatype** [str] The data type

Returns

> **field_str** [str] The field name

pyrad.io.io_aux.**get_dataset_fields**(*datasetdescr*)
> splits the dataset type descriptor and provides each individual member

Parameters

> **datasetdescr** [str] dataset type. Format : [processing level]:[dataset type]

Returns

> **proclevel** [str] dataset processing level
>
> **dataset** [str] dataset type, i.e. dBZ, ZDR, ISO0, . . .

pyrad.io.io_aux.**get_datatype_fields**(*datadescriptor*)
> splits the data type descriptor and provides each individual member

Parameters

> **datadescriptor** [str] radar field type. Format : [radar file type]:[datatype]

Returns

> **radarnr** [str] radar number, i.e. RADAR1, RADAR2, . . .
>
> **datagroup** [str] data type group, i.e. RAINBOW, RAD4ALP, ODIM, CFRADIAL, COSMO,
> MXPOL . . .

> > **datatype** [str] data type, i.e. dBZ, ZDR, ISO0, . . .
>
> > **dataset** [str] dataset type (for saved data only)
>
> > **product** [str] product type (for saved data only)

pyrad.io.io_aux.**get_datatype_metranet**(*datatype*)
>   maps de config file radar data type name into the corresponding metranet data type name and Py-ART field name

> > **Parameters**
> >
> > > **datatype** [str] config file radar data type name
> >
> > **Returns**
> >
> > > **metranet type** [dict] dictionary containing the metranet data type name and its corresponding Py-ART field name

pyrad.io.io_aux.**get_datatype_odim**(*datatype*)
>   maps the config file radar data type name into the corresponding odim data type name and Py-ART field name

> > **Parameters**
> >
> > > **datatype** [str] config file radar data type name
> >
> > **Returns**
> >
> > > **metranet type** [dict] dictionary containing the odim data type name and its corresponding Py-ART field name

pyrad.io.io_aux.**get_datetime**(*fname*, *datadescriptor*)
>   Given a data descriptor gets date and time from file name

> > **Parameters**
> >
> > > **fname** [str] file name
> > >
> > > **datadescriptor** [str] radar field type. Format : [radar file type]:[datatype]
> >
> > **Returns**
> >
> > > **fdatetime** [datetime object] date and time in file name

pyrad.io.io_aux.**get_field_name**(*datatype*)
>   Return long name of datatype.

> > **Parameters**
> >
> > > **datatype** [str] The data type
> >
> > **Returns**
> >
> > > **name** [str] The name

pyrad.io.io_aux.**get_field_unit**(*datatype*)
>   Return unit of datatype.

> > **Parameters**
> >
> > > **datatype** [str] The data type
> >
> > **Returns**
> >
> > > **unit** [str] The unit

pyrad.io.io_aux.**get_fieldname_cosmo**(*field_name*)
>   maps the Py-ART field name into the corresponding COSMO variable name

---

Parameters

    field_name [str] Py-ART field name

Returns

    cosmo_name [str] Py-ART variable name

pyrad.io.io_aux.**get_fieldname_pyart**(*datatype*)

    maps the config file radar data type name into the corresponding rainbow Py-ART field name

Parameters

    datatype [str] config file radar data type name

Returns

    field_name [str] Py-ART field name

pyrad.io.io_aux.**get_file_list**(*datadescriptor*, *starttime*, *endtime*, *cfg*, *scan=None*)

    gets the list of files with a time period

Parameters

    datadescriptor [str] radar field type. Format : [radar file type]:[datatype]

    starttime [datetime object] start of time period

    endtime [datetime object] end of time period

    cfg: dictionary of dictionaries configuration info to figure out where the data is

    scan [str] scan name

Returns

    filelist [list of strings] list of files within the time period

pyrad.io.io_aux.**get_new_rainbow_file_name**(*master_fname*, *master_datadescriptor*, *datatype*)

    get the rainbow file name containing datatype from a master file name and data type

Parameters

    master_fname [str] the master file name

    master_datadescriptor [str] the master data type descriptor

    datatype [str] the data type of the new file name to be created

Returns

    new_fname [str] the new file name

pyrad.io.io_aux.**get_save_dir**(*basepath*, *procname*, *dsname*, *prdname*, *timeinfo=None*, *timeformat='%Y-%m-%d'*, *create_dir=True*)

    obtains the path to a product directory and eventually creates it

Parameters

    basepath [str] product base path

    procname [str] name of processing space

    dsname [str] data set name

    prdname [str] product name

    timeinfo [datetime] time info to generate the date directory. If None there is no time format in the path

> > **timeformat** [str] Optional. The time format.
> >
> > **create_dir** [boolean] If True creates the directory
>
> > Returns
> >
> > > **savedir** [str] path to product

pyrad.io.io_aux.**get_scan_list**(*scandescriptor_list*)
> determine which is the scan list for each radar

> > Parameters
> >
> > > **scandescriptor** [list of string] the list of all scans for all radars
> >
> > Returns
> >
> > > **scan_list** [list of lists] the list of scans corresponding to each radar

pyrad.io.io_aux.**get_trtfile_list**(*basepath*, *starttime*, *endtime*)
> gets the list of TRT files with a time period

> > Parameters
> >
> > > **datapath** [str] directory where to look for data
> >
> > > **startime** [datetime object] start of time period
> >
> > > **endtime** [datetime object] end of time period
> >
> > Returns
> >
> > > **filelist** [list of strings] list of files within the time period

pyrad.io.io_aux.**make_filename**(*prdtype*, *dstype*, *dsname*, *ext_list*, *prdcfginfo=None*, *time-info=None*, *timeformat='%Y%m%d%H%M%S'*, *runinfo=None*)
> creates a product file name

> > Parameters
> >
> > > **timeinfo** [datetime] time info to generate the date directory
> >
> > > **prdtype** [str] product type, i.e. 'ppi', etc.
> >
> > > **dstype** [str] data set type, i.e. 'raw', etc.
> >
> > > **dsname** [str] data set name
> >
> > > **ext_list** [list of str] file name extensions, i.e. 'png'
> >
> > > **prdcfginfo** [str] Optional. string to add product configuration information, i.e. 'el0.4'
> >
> > > **timeformat** [str] Optional. The time format
> >
> > > **runinfo** [str] Optional. Additional information about the test (e.g. 'RUN01', 'TS011')
> >
> > Returns
> >
> > > **fname_list** [list of str] list of file names (as many as extensions)

pyrad.io.io_aux.**map_Doppler**(*Doppler_data_bin*, *Nyquist_vel*)
> maps the binary METRANET Doppler data to actual Doppler velocity

> > Parameters
> >
> > > **Doppler_data_bin** [numpy array] The binary METRANET data
> >
> > Returns
> >
> > > **Doppler_data** [numpy array] The Doppler veloctiy in [m/s]

`pyrad.io.io_aux.`**`map_hydro`**(*hydro_data_op*)

> maps the operational hydrometeor classification identifiers to the ones used by Py-ART
>
> > **Parameters**
> >
> > > **hydro_data_op** [numpy array] The operational hydrometeor classification data
> >
> > **Returns**
> >
> > > **hydro_data_py** [numpy array] The pyart hydrometeor classification data

PYRAD.IO.CONFIG

Functions for reading pyrad config files

pyrad.io.config.**get_array**(*cfgfile*, *pos*, *nel*, *valtype*)
    reads an array in a config file

> **Parameters**
>
> > **cfgfile** [file object] config file
> >
> > **pos** [int] position in file object
> >
> > **nel** [int] number of elements of the ray
> >
> > **valtype** [str] type of array
>
> **Returns**
>
> > **arr** [array] array values
> >
> > **newpos** [int] new position in file object

pyrad.io.config.**get_array_type**(*dtype*)
    Determines Python array type from the config file array type

> **Parameters**
>
> > **dtype** [str] config file data type
>
> **Returns**
>
> > **pytype** [str] Python array type

pyrad.io.config.**get_num_elements**(*dtype*, *nelstr*)
    Checks if data type is an array or a structure.

> **Parameters**
>
> > **dtype** [str] data type specifier

> **nelstr** [str] number of elements

> **Returns**

>> **nel** [int] number of elements if type is *****ARR or STRUCT. 0 otherwise

>> **isstruct** [bool] true if the type is STRUCT

`pyrad.io.config.`**`get_struct`**(*cfgfile*, *pos*, *nels*, *fname*)
    reads an struct in a config file

> **Parameters**

>> **cfgfile** [file object] config file

>> **pos** [int] position in file object

>> **nel** [int] number of elements of the ray

>> **fname** [str] config file name

> **Returns**

>> **struct** [dict] dictionary of struct values

>> **newpos** [int] new position in file object

`pyrad.io.config.`**`init_array`**(*nel*, *dtype*)
    Initializes a Python array

> **Parameters**

>> **nel** [int] number of elements in the array

>> **dtype** [str] config file data type

> **Returns**

>> **pyarr** [array] Python array

`pyrad.io.config.`**`read_config`**(*fname*, *cfg=None*)
    Read a pyrad config file.

> **Parameters**

>> **fname** [str] Name of the configuration file to read.

>> **cfg** [dict of dicts, optional] dictionary of dictionaries containing configuration parameters where the new parameters will be placed

> **Returns**

>> **cfg** [dict of dicts] dictionary of dictionaries containing the configuration parameters

`pyrad.io.config.`**`string_to_datatype`**(*dtype*, *strval*)
    Converts a string containing a value into its Python value

> **Parameters**

>> **dtype** [str] data type specifier

>> **strval** [str] string value

> **Returns**

>> **val** [scalar] value contained in the string

PYRAD.IO.READ_DATA_RADAR

Functions for reading radar data files

pyrad.io.read_data_radar.**add_field**(*radar_dest*, *radar_orig*)

adds the fields from orig radar into dest radar. If they are not in the same grid, interpolates them to dest grid

Parameters

radar_dest [radar object] the destination radar

radar_orig [radar object] the radar object containing the original field

Returns

field_dest [dict] interpolated field and metadata

pyrad.io.read_data_radar.**get_data**(*voltime*, *datatypesdescr*, *cfg*)

Reads pyrad input data.

Parameters

voltime [datetime object] volume scan time

datatypesdescr [list] list of radar field types to read. Format :
[radarnr]:[datagroup]:[datatype],[dataset],[product] 'dataset' is only specified for
data groups 'ODIM', 'CFRADIAL' and 'ODIMPYRAD'. 'product' is only specified for
data groups 'CFRADIAL' and 'ODIMPYRAD' The data group specifies the type file
from which data is extracted. It can be:

'RAINBOW': Propietary Leonardo format 'COSMO': COSMO model data
saved in Rainbow file format 'DEM': Visibility data saved in Rainbow file format

'RAD4ALP': METRANET format used for the operational MeteoSwiss
data. To find out which datatype to use to match a particular METRANET
field name check the function 'get_datatype_metranet' in pyrad/io/io_aux.py

'RAD4ALPCOSMO': COSMO model data saved in a binary file format.
Used by operational MeteoSwiss radars

'RAD4ALPDEM': Visibility data saved in a binary format used by
operational MeteoSwiss radars

'RAD4ALPHYDRO': Used to read the MeteoSwiss operational
hydrometeor classification

'RAD4ALPDOPPLER': Used to read the MeteoSwiss operational
dealiased Doppler velocity

'ODIM': Generic ODIM file format. For such types 'dataset' specifies the
directory and file name date convention. Example: ODIM:dBZ,D{%Y-%m-
%d}-F{%Y%m%d%H%M%S}. To find out which datatype to use to match
a particular ODIM field name check the function 'get_datatype_odim' in
pyrad/io/io_aux.py

'MXPOL': MXPOL (EPFL) data written in a netcdf file

'CFRADIAL': CFRadial format with the naming convention and directory
structure in which Pyrad saves the data. For such datatypes 'dataset'
specifies the directory where the dataset is stored and 'product' spec-
ifies the directroy where the product is stored. Example: CFRA-
DIAL:dBZc,Att_ZPhi,SAVEVOL_dBZc

'ODIMPYRAD': ODIM file format with the naming convention and
directory structure in which Pyrad saves the data. For such datatypes
'dataset' specifies the directory where the dataset is stored and 'prod-
uct' specifies the directroy where the product is stored. Example:
ODIMPYRAD:dBZc,Att_ZPhi,SAVEVOL_dBZc

'RAINBOW', 'RAD4ALP', 'ODIM' and 'MXPOL' are primary data file sources and
they cannot be mixed for the same radar. It is also the case for their complementary data
files, i.e. 'COSMO' and 'RAD4ALPCOSMO', etc. 'CFRADIAL' and 'ODIMPYRAD'
are secondary data file sources and they can be combined with any other datagroup type.
For a list of accepted datatypes and how they map to the Py-ART name convention check
function 'get_field_name_pyart' in pyrad/io/io_aux.py

cfg: dictionary of dictionaries configuration info to figure out where the data is

Returns

radar [Radar] radar object

pyrad.io.read_data_radar.**get_data_mxpol**(*filename*, *datatype_list*)

> gets MXPol radar data

> > **Parameters**

> > > **filename** [str] name of file containing MXPol data

> > > **datatype_list** [list of strings] list of data fields to get

> > **Returns**

> > > **radar** [Radar] radar object

pyrad.io.read_data_radar.**get_data_odim**(*filename*, *datatype_list*, *scan_name*, *cfg*, *ind_rad=0*)

> gets ODIM radar data

> > **Parameters**

> > > **filename** [str] name of file containing odim data

> > > **datatype_list** [list of strings] list of data fields to get

> > > **scan_name** [str] name of the elevation (001 to 020)

> > > **cfg** [dict] configuration dictionary

> > > **ind_rad** [int] radar index

> > **Returns**

> > > **radar** [Radar] radar object. None if the reading has not been successful

pyrad.io.read_data_radar.**get_data_rad4alp**(*filename*, *datatype_list*, *scan_name*, *cfg*, *ind_rad=0*)

> gets rad4alp radar data

> > **Parameters**

> > > **filename** [str] name of file containing rainbow data

> > > **datatype_list** [list of strings] list of data fields to get

> > > **scan_name** [str] name of the elevation (001 to 020)

> > > **cfg** [dict] configuration dictionary

> > > **ind_rad** [int] radar index

> > **Returns**

> > > **radar** [Radar] radar object. None if the reading has not been successful

pyrad.io.read_data_radar.**get_data_rainbow**(*filename*, *datatype*)

> gets rainbow radar data

> > **Parameters**

> > > **filename** [str] name of file containing rainbow data

> > > **datatype** [str] field name

> > **Returns**

> > > **radar** [Radar or None] radar object if the reading of the data has been successful. None otherwise

pyrad.io.read_data_radar.**interpol_field**(*radar_dest*, *radar_orig*, *field_name*, *fill_value=None*, *ang_tol=0.5*)

> interpolates field field_name contained in radar_orig to the grid in radar_dest

> **Parameters**
>
> > **radar_dest** [radar object] the destination radar
> >
> > **radar_orig** [radar object] the radar object containing the original field
> >
> > **field_name: str** name of the field to interpolate
> >
> > **fill_value: float** The fill value
> >
> > **ang_tol** [float] angle tolerance to determine whether the radar origin sweep is the radar destination sweep
>
> **Returns**
>
> > **field_dest** [dict] interpolated field and metadata

pyrad.io.read_data_radar.**merge_fields_cosmo**(*filename_list*)

> merge COSMO fields in Rainbow file format
>
> **Parameters**
>
> > **filename_list** [str] list of file paths where to find the data
>
> **Returns**
>
> > **radar** [Radar] radar object

pyrad.io.read_data_radar.**merge_fields_dem**(*basepath*, *scan_name*, *datatype_list*)

> merge DEM fields into a single radar object.
>
> **Parameters**
>
> > **basepath** [str] name of the base path where to find the data
> >
> > **scan_name: str** name of the scan
> >
> > **datatype_list** [list] lists of data types to get
>
> **Returns**
>
> > **radar** [Radar] radar object

pyrad.io.read_data_radar.**merge_fields_pyrad**(*basepath*, *loadname*, *voltime*, *datatype_list*, *dataset_list*, *product_list*, *rmax=0.0*, *termination='.nc'*)

> merge fields from Pyrad-generated files into a single radar object. Accepted file types are CFRadial and ODIM.
>
> **Parameters**
>
> > **basepath** [str] name of the base path where to find the data
> >
> > **loadname: str** name of the saving directory
> >
> > **voltime** [datetime object] reference time of the scan
> >
> > **datatype_list** [list] list of data types to get
> >
> > **dataset_list** [list] list of datasets that produced the data type to get. Used to get path.
> >
> > **product_list** [list] list of products. Used to get path
> >
> > **rmax** [float] maximum range that will be kept.
> >
> > **termination** [str] file termination type. Can be '.nc' or '.h5'
>
> **Returns**
>
> > **radar** [Radar] radar object

pyrad.io.read_data_radar.**merge_fields_rainbow**(*basepath*, *scan_name*, *voltime*, *datatype_list*)

> merge Rainbow fields into a single radar object.

> > **Parameters**

> > > **basepath** [str] name of the base path where to find the data

> > > **scan_name: str** name of the scan

> > > **voltime** [datetime object] reference time of the scan

> > > **datatype_list** [list] lists of data types to get

> > **Returns**

> > > **radar** [Radar] radar object

pyrad.io.read_data_radar.**merge_scans_Doppler_rad4alp**(*voltime*, *datatype*, *cfg*, *ind_rad=0*)

> merge rad4alp dealised Doppler velocity scans. If data for all the scans cannot be retrieved returns None

> > **Parameters**

> > > **voltime: datetime object** reference time of the scan

> > > **datatype** [str] name of the data type to read

> > > **cfg** [dict] configuration dictionary

> > > **ind_rad** [int] radar index

> > **Returns**

> > > **radar** [Radar] radar object

pyrad.io.read_data_radar.**merge_scans_cosmo**(*voltime*, *datatype_list*, *cfg*, *ind_rad=0*)

> merge rainbow scans

> > **Parameters**

> > > **voltime: datetime object** reference time of the scan

> > > **datatype_list** [list] lists of data types to get

> > > **cfg** [dict] configuration dictionary

> > > **ind_rad** [int] radar index

> > **Returns**

> > > **radar** [Radar] radar object

pyrad.io.read_data_radar.**merge_scans_cosmo_rad4alp**(*voltime*, *datatype*, *cfg*, *ind_rad=0*)

> merge cosmo rad4alp scans. If data for all the scans cannot be retrieved returns None

> > **Parameters**

> > > **voltime: datetime object** reference time of the scan

> > > **datatype** [str] name of the data type to read

> > > **cfg** [dict] configuration dictionary

> > > **ind_rad** [int] radar index

> > **Returns**

> > > **radar** [Radar] radar object

pyrad.io.read_data_radar.**merge_scans_dem**(*basepath*, *scan_list*, *datatype_list*)

> merge rainbow scans

> > **Parameters**

> > > **basepath** [str] base path of rad4alp radar data

> > > **scan_list** [list] list of scans

> > > **datatype_list** [list] lists of data types to get

> > > **radarnr** [str] radar identifier number

> > **Returns**

> > > **radar** [Radar] radar object

pyrad.io.read_data_radar.**merge_scans_dem_rad4alp**(*voltime*, *datatype*, *cfg*, *ind_rad=0*)

> merge DEM rad4alp scans. If data for all the scans cannot be retrieved returns None

> > **Parameters**

> > > **voltime: datetime object** reference time of the scan

> > > **datatype** [str] name of the data type to read

> > > **cfg** [dict] configuration dictionary

> > > **ind_rad** [int] radar index

> > **Returns**

> > > **radar** [Radar] radar object

pyrad.io.read_data_radar.**merge_scans_hydro_rad4alp**(*voltime*, *datatype*, *cfg*, *ind_rad=0*)

> merge rad4alp hydrometeor classification scans. If data for all the scans cannot be retrieved returns None

> > **Parameters**

> > > **voltime: datetime object** reference time of the scan

> > > **datatype** [str] name of the data type to read

> > > **cfg** [dict] configuration dictionary

> > > **ind_rad** [int] radar index

> > **Returns**

> > > **radar** [Radar] radar object

pyrad.io.read_data_radar.**merge_scans_mxpol**(*basepath*, *scan_list*, *voltime*, *datatype_list*, *cfg*)

> merge rad4alp data.

> > **Parameters**

> > > **basepath** [str] base path of mxpol radar data

> > > **scan_list** [list] list of scans, in the case of mxpol, the elevation or azimuth denoted as 005 or 090 (for 5 or 90 degrees elevation) or 330 (for 330 degrees azimuth respectively)

> > > **voltime: datetime object** reference time of the scan

> > > **datatype_list** [list] lists of data types to get

> > > **cfg** [dict] configuration dictionary

> > **Returns**

> **radar** [Radar] radar object

`pyrad.io.read_data_radar.`**`merge_scans_odim`**(*basepath*, *scan_list*, *radar_name*, *radar_res*, *voltime*, *datatype_list*, *dataset_list*, *cfg*, *ind_rad=0*)

> merge odim data.

> > **Parameters**

> > > **basepath** [str] base path of odim radar data

> > > **scan_list** [list] list of scans (h5)

> > > **voltime: datetime object** reference time of the scan

> > > **datatype_list** [list] lists of data types to get

> > > **dataset_list** [list] list of datasets. Used to get path

> > > **cfg** [dict] configuration dictionary

> > > **ind_rad** [int] radar index

> > **Returns**

> > > **radar** [Radar] radar object

`pyrad.io.read_data_radar.`**`merge_scans_rad4alp`**(*basepath*, *scan_list*, *radar_name*, *radar_res*, *voltime*, *datatype_list*, *cfg*, *ind_rad=0*)

> merge rad4alp data.

> > **Parameters**

> > > **basepath** [str] base path of rad4alp radar data

> > > **scan_list** [list] list of scans (001 to 020)

> > > **radar_name** [str] radar_name (A, D, L, . . .)

> > > **radar_res** [str] radar resolution (H or L)

> > > **voltime: datetime object** reference time of the scan

> > > **datatype_list** [list] lists of data types to get

> > > **cfg** [dict] configuration dictionary

> > > **ind_rad** [int] radar index

> > **Returns**

> > > **radar** [Radar] radar object

`pyrad.io.read_data_radar.`**`merge_scans_rainbow`**(*basepath*, *scan_list*, *voltime*, *scan_period*, *datatype_list*, *cfg*, *radarnr='RADAR001'*)

> merge rainbow scans

> > **Parameters**

> > > **basepath** [str] base path of rad4alp radar data

> > > **scan_list** [list] list of scans

> > > **voltime: datetime object** reference time of the scan

> > > **scan_period** [float] time from reference time where to look for other scans data

> > > **datatype_list** [list] lists of data types to get

    cfg [dict] configuration dictionary

    radarnr [str] radar identifier number

  Returns

    radar [Radar] radar object

PYRAD.IO.READ_DATA_MXPOL

Functions for reading radar mxpol data files .. autosummary:

```
:toctree: generated/
classes – MXPOL:
    pyrad_MXPOL
classes – MCH:
    pyrad_MCH
utilities – read:
    row_stack
    findTimes
    int2float_radar
    readMXPOLRadData
    readCHRadData
utilities – config:
    load_myconfig
    get_mymetadata
    get_elevation_metadata
    generate_radar_table
    generate_polvar_metadata
    convert_polvar_name
```

pyrad.io.read_data_mxpol.**convert_polvar_name**(*convention*, *polvar*)

> Finds the correct variable name for a given convention (MXPOL, MCH) and a given variable name which was spelled with a different case or according to a different convention. For example, MXPOL convention uses 'Z' for the reflectivity variable, but if a user inserted 'Zh' this function will convert it to 'Z'. Parameters ———- convention : str, destination convention; either MCH or LTE polvar : str, key of polarimetric variable to be converted Returns ——- mykey : str, polarimertric variable key as used within the ProfileLab
>
> > toolbox context

pyrad.io.read_data_mxpol.**findTimes**(*num_sweep*)

> Finds the times at the beginning and at the end of each sweep. Information comes from the elapsed time since the beginning of the volume scan, from the Rad4Alp: Specifications/ Request for Proposal (RFP) document. Inputs —— num_sweep: int
>
> > rank of the sweep

> **elapsed_times[num_sweep][0]: float** the elapsed time since the beginning of the volume scan at the beginning of the sweep

> **elapsed_times[num_sweep][1]: float** the elapsed time since the beginning of the volume scan at the end of the sweep

pyrad.io.read_data_mxpol.**generate_polvar_metadata**(*polvar*, *filename=None*)

> Generates a dictionary with metadata for a polarimetric variable Parameters ———- polvar: str

polatimetric variable of interest

filename: str Filename of the configuration file. If None the default configuration file is loaded from the directory.

polvar_metadata: dict dictionary with metatdata for polarimetric variable of interest

pyrad.io.read_data_mxpol.**generate_radar_table**(*radarname*, *filename=None*)
    Generates a table with basic radar info, based on the given (or default) configfile Parameters ———- radarname: str

    name of the radar (i.e. 'ALB' or 'A', 'MXPOL' etc)

filename: str path and name of the configfile, if None, the default configfile is used

radar_table: dict table containing basic radar info

pyrad.io.read_data_mxpol.**get_elevation_metadata**(*radarname*, *filename=None*)
    Gets the elevation angles for each sweep from the configuration file Inputs —— radarname: str

    name of the radar for which to retrieve elevation angles

filename: str name of the configuration file, if None, the default configuration file is used

_DEFAULT_RADAR_INFO['elevations'][radarname]: list list of elevation angles in degrees

or None if not available

pyrad.io.read_data_mxpol.**get_mymetadata**(*p*, *filename=None*)
    Return a dictionary of metadata for a given parameter, p. An empty dictionary will be returned if no metadata dictionary exists for parameter p. Parameters ———- p: str

    parameter name (i.e. Polvar) for which to return metadata

filename: str Filename of the configuration file. If None the default configuration file is loaded from the directory.

_DEFAULT_METADATA[p].copy(): dict a copy of the parameter of interest from the metadata dictionary

pyrad.io.read_data_mxpol.**int2float_radar**(*data*, *varname*, *index_angle*)
    Converts radar moments from bit to float Inputs —— data: np.array

    moment data as loaded from h5 file

varname: str name of the moment (i.e. 'ZH')

index_angle: int rank of the sweep-1 (converted to base 0)

output: np.array moment data converted to float

pyrad.io.read_data_mxpol.**load_myconfig**(*filename=None*)
    Load configuration from a config file. Parameters ———- filename: str

    Filename of the configuration file. If None the default configuration file is loaded from the directory.

_DEFAULT_METADATA: dict Dictionary with metadata

---

class pyrad.io.read_data_mxpol.**pyrad_IDL**(*filename*, *field_names=None*, *max_range=inf*, *min_range=10000*)

 Bases: pyart.core.radar.Radar

Methods

add_field(field_name, dic[, replace_existing])	Add a field to the object.
add_field_like(existing_field_name, . . . [, . . .])	Add a field to the object with metadata from a existing field.
check_field_exists(field_name)	Check that a field exists in the fields dictionary.
extract_sweeps(sweeps)	Create a new radar contains only the data from select sweeps.
get_azimuth(sweep[, copy])	Return an array of azimuth angles for a given sweep.
get_elevation(sweep[, copy])	Return an array of elevation angles for a given sweep.
get_end(sweep)	Return the ending ray for a given sweep.
get_field(sweep, field_name[, copy])	Return the field data for a given sweep.
get_gate_x_y_z(sweep[, edges, . . .])	Return the x, y and z gate locations in meters for a given sweep.
get_nyquist_vel(sweep[, check_uniform])	Return the Nyquist velocity in meters per second for a given sweep.
get_slice(sweep)	Return a slice for selecting rays for a given sweep.
get_start(sweep)	Return the starting ray index for a given sweep.
get_start_end(sweep)	Return the starting and ending ray for a given sweep.
info([level, out])	Print information on radar.
init_gate_altitude()	Initialize the gate_altitude attribute.
init_gate_longitude_latitude()	Initialize or reset the gate_longitude and gate_latitude attributes.
init_gate_x_y_z()	Initialize or reset the gate_{x, y, z} attributes.
init_rays_per_sweep()	Initialize or reset the rays_per_sweep attribute.
iter_azimuth()	Return an iterator which returns sweep azimuth data.
iter_elevation()	Return an iterator which returns sweep elevation data.
iter_end()	Return an iterator over the sweep end indices.
iter_field(field_name)	Return an iterator which returns sweep field data.
iter_slice()	Return an iterator which returns sweep slice objects.
iter_start()	Return an iterator over the sweep start indices.
iter_start_end()	Return an iterator over the sweep start and end indices.

 __class__
  alias of builtins.type

 __delattr__(*$self*, *name*, */*)
  Implement delattr(self, name).

 __dict__ = mappingproxy({'__module__': 'pyrad.io.read_data_mxpol', '__init__': <func

 __dir__(*$self*, */*)
  Default dir() implementation.

 __eq__(*$self*, *value*, */*)
  Return self==value.

 __format__(*$self*, *format_spec*, */*)

Default object formatter.

__ge__(*$self*, *value*, */*)
Return self>=value.

__getattribute__(*$self*, *name*, */*)
Return getattr(self, name).

__getstate__()
Return object's state which can be pickled.

__gt__(*$self*, *value*, */*)
Return self>value.

__hash__(*$self*, */*)
Return hash(self).

__init__(*filename*, *field_names=None*, *max_range=inf*, *min_range=10000*)
Initialize self. See help(type(self)) for accurate signature.

__init_subclass__()
This method is called when a class is subclassed.

The default implementation does nothing. It may be overridden to extend subclasses.

__le__(*$self*, *value*, */*)
Return self<=value.

__lt__(*$self*, *value*, */*)
Return self<value.

__module__ = 'pyrad.io.read_data_mxpol'

__ne__(*$self*, *value*, */*)
Return self!=value.

__new__(*$type*, **args*, ***kwargs*)
Create and return a new object. See help(type) for accurate signature.

__reduce__(*$self*, */*)
Helper for pickle.

__reduce_ex__(*$self*, *protocol*, */*)
Helper for pickle.

__repr__(*$self*, */*)
Return repr(self).

__setattr__(*$self*, *name*, *value*, */*)
Implement setattr(self, name, value).

__setstate__(*state*)
Restore unpicklable entries from pickled object.

__sizeof__(*$self*, */*)
Size of object in memory, in bytes.

__str__(*$self*, */*)
Return str(self).

__subclasshook__()
Abstract classes can override this to customize issubclass().

This is invoked early on by abc.ABCMeta.__subclasscheck__(). It should return True, False or NotImplemented. If it returns NotImplemented, the normal algorithm is used. Otherwise, it overrides the normal algorithm (and the outcome is cached).

__weakref__
    list of weak references to the object (if defined)

_check_sweep_in_range(*sweep*)
    Check that a sweep number is in range.

_dic_info(*attr*, *level*, *out*, *dic=None*, *ident_level=0*)
    Print information on a dictionary attribute.

add_field(*field_name*, *dic*, *replace_existing=False*)
    Add a field to the object.

>   **Parameters**

>> **field_name** [str] Name of the field to add to the dictionary of fields.

>> **dic** [dict] Dictionary contain field data and metadata.

>> **replace_existing** [bool] True to replace the existing field with key field_name if it exists, loosing any existing data. False will raise a ValueError when the field already exists.

add_field_like(*existing_field_name*, *field_name*, *data*, *replace_existing=False*)
    Add a field to the object with metadata from a existing field.

Note that the data parameter is not copied by this method. If data refers to a 'data' array from an existing field dictionary, a copy should be made within or prior to using this method. If this is not done the 'data' key in both field dictionaries will point to the same NumPy array and modification of one will change the second. To copy NumPy arrays use the copy() method. See the Examples section for how to create a copy of the 'reflectivity' field as a field named 'reflectivity_copy'.

>   **Parameters**

>> **existing_field_name** [str] Name of an existing field to take metadata from when adding the new field to the object.

>> **field_name** [str] Name of the field to add to the dictionary of fields.

>> **data** [array] Field data. A copy of this data is not made, see the note above.

>> **replace_existing** [bool] True to replace the existing field with key field_name if it exists, loosing any existing data. False will raise a ValueError when the field already exists.

Examples

```
>>> radar.add_field_like('reflectivity', 'reflectivity_copy',
...                       radar.fields['reflectivity']['data'].copy())
```

check_field_exists(*field_name*)
    Check that a field exists in the fields dictionary.

If the field does not exist raise a KeyError.

>   **Parameters**

>> **field_name** [str] Name of field to check.

extract_sweeps(*sweeps*)
    Create a new radar contains only the data from select sweeps.

Parameters

> **sweeps** [array_like] Sweeps (0-based) to include in new Radar object.

Returns

> **radar** [Radar] Radar object which contains a copy of data from the selected sweeps.

get_azimuth(*sweep*, *copy=False*)

Return an array of azimuth angles for a given sweep.

Parameters

> **sweep** [int] Sweep number to retrieve data for, 0 based.
>
> **copy** [bool, optional] True to return a copy of the azimuths. False, the default, returns a view of the azimuths (when possible), changing this data will change the data in the underlying Radar object.

Returns

> **azimuths** [array] Array containing the azimuth angles for a given sweep.

get_elevation(*sweep*, *copy=False*)

Return an array of elevation angles for a given sweep.

Parameters

> **sweep** [int] Sweep number to retrieve data for, 0 based.
>
> **copy** [bool, optional] True to return a copy of the elevations. False, the default, returns a view of the elevations (when possible), changing this data will change the data in the underlying Radar object.

Returns

> **azimuths** [array] Array containing the elevation angles for a given sweep.

get_end(*sweep*)

Return the ending ray for a given sweep.

get_field(*sweep*, *field_name*, *copy=False*)

Return the field data for a given sweep.

When used with *get_gate_x_y_z()* this method can be used to obtain the data needed for plotting a radar field with the correct spatial context.

Parameters

> **sweep** [int] Sweep number to retrieve data for, 0 based.
>
> **field_name** [str] Name of the field from which data should be retrieved.
>
> **copy** [bool, optional] True to return a copy of the data. False, the default, returns a view of the data (when possible), changing this data will change the data in the underlying Radar object.

Returns

> **data** [array] Array containing data for the requested sweep and field.

get_gate_x_y_z(*sweep*, *edges=False*, *filter_transitions=False*)

Return the x, y and z gate locations in meters for a given sweep.

With the default parameter this method returns the same data as contained in the gate_x, gate_y and gate_z attributes but this method performs the gate location calculations only for the specified sweep and therefore is more efficient than accessing this data through these attribute.

When used with *get_field()* this method can be used to obtain the data needed for plotting a radar field with the correct spatial context.

> **Parameters**
>
> > **sweep** [int] Sweep number to retrieve gate locations from, 0 based.
> >
> > **edges** [bool, optional] True to return the locations of the gate edges calculated by interpolating between the range, azimuths and elevations. False (the default) will return the locations of the gate centers with no interpolation.
> >
> > **filter_transitions** [bool, optional] True to remove rays where the antenna was in transition between sweeps. False will include these rays. No rays will be removed if the antenna_transition attribute is not available (set to None).
>
> **Returns**
>
> > **x, y, z** [2D array] Array containing the x, y and z, distances from the radar in meters for the center (or edges) for all gates in the sweep.

get_nyquist_vel(*sweep*, *check_uniform=True*)
> Return the Nyquist velocity in meters per second for a given sweep.

> Raises a LookupError if the Nyquist velocity is not available, an Exception is raised if the velocities are not uniform in the sweep unless check_uniform is set to False.

> **Parameters**
>
> > **sweep** [int] Sweep number to retrieve data for, 0 based.
> >
> > **check_uniform** [bool] True to check to perform a check on the Nyquist velocities that they are uniform in the sweep, False will skip this check and return the velocity of the first ray in the sweep.
>
> **Returns**
>
> > **nyquist_velocity** [float] Array containing the Nyquist velocity in m/s for a given sweep.

get_slice(*sweep*)
> Return a slice for selecting rays for a given sweep.

get_start(*sweep*)
> Return the starting ray index for a given sweep.

get_start_end(*sweep*)
> Return the starting and ending ray for a given sweep.

info(*level='standard'*, *out=<_io.TextIOWrapper name='<stdout>' mode='w' encoding='UTF-8'>*)
> Print information on radar.

> **Parameters**
>
> > **level** [{'compact', 'standard', 'full', 'c', 's', 'f'}] Level of information on radar object to print, compact is minimal information, standard more and full everything.
> >
> > **out** [file-like] Stream to direct output to, default is to print information to standard out (the screen).

init_gate_altitude()
> Initialize the gate_altitude attribute.

init_gate_longitude_latitude()
> Initialize or reset the gate_longitude and gate_latitude attributes.

init_gate_x_y_z()
    Initialize or reset the gate_{x, y, z} attributes.

init_rays_per_sweep()
    Initialize or reset the rays_per_sweep attribute.

iter_azimuth()
    Return an iterator which returns sweep azimuth data.

iter_elevation()
    Return an iterator which returns sweep elevation data.

iter_end()
    Return an iterator over the sweep end indices.

iter_field(*field_name*)
    Return an iterator which returns sweep field data.

iter_slice()
    Return an iterator which returns sweep slice objects.

iter_start()
    Return an iterator over the sweep start indices.

iter_start_end()
    Return an iterator over the sweep start and end indices.

class pyrad.io.read_data_mxpol.**pyrad_MCH**(*filename*, *field_names=None*, *max_range=inf*)
    Bases: `pyart.core.radar.Radar`

Methods

add_field(field_name, dic[, replace_existing])	Add a field to the object.
add_field_like(existing_field_name, . . . [, . . .])	Add a field to the object with metadata from a existing field.
check_field_exists(field_name)	Check that a field exists in the fields dictionary.
extract_sweeps(sweeps)	Create a new radar contains only the data from select sweeps.
get_azimuth(sweep[, copy])	Return an array of azimuth angles for a given sweep.
get_elevation(sweep[, copy])	Return an array of elevation angles for a given sweep.
get_end(sweep)	Return the ending ray for a given sweep.
get_field(sweep, field_name[, copy])	Return the field data for a given sweep.
get_gate_x_y_z(sweep[, edges, . . .])	Return the x, y and z gate locations in meters for a given sweep.
get_nyquist_vel(sweep[, check_uniform])	Return the Nyquist velocity in meters per second for a given sweep.
get_slice(sweep)	Return a slice for selecting rays for a given sweep.
get_start(sweep)	Return the starting ray index for a given sweep.
get_start_end(sweep)	Return the starting and ending ray for a given sweep.
info([level, out])	Print information on radar.
init_gate_altitude()	Initialize the gate_altitude attribute.
init_gate_longitude_latitude()	Initialize or reset the gate_longitude and gate_latitude attributes.
init_gate_x_y_z()	Initialize or reset the gate_{x, y, z} attributes.
init_rays_per_sweep()	Initialize or reset the rays_per_sweep attribute.

Continued on next page

Table 2 – continued from previous page

iter_azimuth()	Return an iterator which returns sweep azimuth data.
iter_elevation()	Return an iterator which returns sweep elevation data.
iter_end()	Return an iterator over the sweep end indices.
iter_field(field_name)	Return an iterator which returns sweep field data.
iter_slice()	Return an iterator which returns sweep slice objects.
iter_start()	Return an iterator over the sweep start indices.
iter_start_end()	Return an iterator over the sweep start and end indices.

__class__
    alias of builtins.type

__delattr__(*$self*, *name*, */*)
    Implement delattr(self, name).

__dict__ = mappingproxy({'__module__': 'pyrad.io.read_data_mxpol', '__init__': <func

__dir__(*$self*, */*)
    Default dir() implementation.

__eq__(*$self*, *value*, */*)
    Return self==value.

__format__(*$self*, *format_spec*, */*)
    Default object formatter.

__ge__(*$self*, *value*, */*)
    Return self>=value.

__getattribute__(*$self*, *name*, */*)
    Return getattr(self, name).

__getstate__()
    Return object's state which can be pickled.

__gt__(*$self*, *value*, */*)
    Return self>value.

__hash__(*$self*, */*)
    Return hash(self).

__init__(*filename*, *field_names=None*, *max_range=inf*)
    Initialize self. See help(type(self)) for accurate signature.

__init_subclass__()
    This method is called when a class is subclassed.

    The default implementation does nothing. It may be overridden to extend subclasses.

__le__(*$self*, *value*, */*)
    Return self<=value.

__lt__(*$self*, *value*, */*)
    Return self<value.

__module__ = 'pyrad.io.read_data_mxpol'

__ne__(*$self*, *value*, */*)
    Return self!=value.

__new__(*$type*, **args*, ***kwargs*)
    Create and return a new object. See help(type) for accurate signature.

__reduce__(*$self*, */*)
    Helper for pickle.

__reduce_ex__(*$self*, *protocol*, */*)
    Helper for pickle.

__repr__(*$self*, */*)
    Return repr(self).

__setattr__(*$self*, *name*, *value*, */*)
    Implement setattr(self, name, value).

__setstate__(*state*)
    Restore unpicklable entries from pickled object.

__sizeof__(*$self*, */*)
    Size of object in memory, in bytes.

__str__(*$self*, */*)
    Return str(self).

__subclasshook__()
    Abstract classes can override this to customize issubclass().

    This is invoked early on by abc.ABCMeta.__subclasscheck__(). It should return True, False or NotImplemented. If it returns NotImplemented, the normal algorithm is used. Otherwise, it overrides the normal algorithm (and the outcome is cached).

__weakref__
    list of weak references to the object (if defined)

_check_sweep_in_range(*sweep*)
    Check that a sweep number is in range.

_dic_info(*attr*, *level*, *out*, *dic=None*, *ident_level=0*)
    Print information on a dictionary attribute.

add_field(*field_name*, *dic*, *replace_existing=False*)
    Add a field to the object.

        Parameters

            field_name [str] Name of the field to add to the dictionary of fields.

            dic [dict] Dictionary contain field data and metadata.

            replace_existing [bool] True to replace the existing field with key field_name if it exists, loosing any existing data. False will raise a ValueError when the field already exists.

add_field_like(*existing_field_name*, *field_name*, *data*, *replace_existing=False*)
    Add a field to the object with metadata from a existing field.

    Note that the data parameter is not copied by this method. If data refers to a 'data' array from an existing field dictionary, a copy should be made within or prior to using this method. If this is not done the 'data' key in both field dictionaries will point to the same NumPy array and modification of one will change the second. To copy NumPy arrays use the copy() method. See the Examples section for how to create a copy of the 'reflectivity' field as a field named 'reflectivity_copy'.

        Parameters

existing_field_name [str] Name of an existing field to take metadata from when adding the new field to the object.

field_name [str] Name of the field to add to the dictionary of fields.

data [array] Field data. A copy of this data is not made, see the note above.

replace_existing [bool] True to replace the existing field with key field_name if it exists, loosing any existing data. False will raise a ValueError when the field already exists.

Examples

```
>>> radar.add_field_like('reflectivity', 'reflectivity_copy',
...                       radar.fields['reflectivity']['data'].copy())
```

check_field_exists(*field_name*)

Check that a field exists in the fields dictionary.

If the field does not exist raise a KeyError.

> **Parameters**
>
> > **field_name** [str] Name of field to check.

extract_sweeps(*sweeps*)

Create a new radar contains only the data from select sweeps.

> **Parameters**
>
> > **sweeps** [array_like] Sweeps (0-based) to include in new Radar object.
>
> **Returns**
>
> > **radar** [Radar] Radar object which contains a copy of data from the selected sweeps.

get_azimuth(*sweep*, *copy=False*)

Return an array of azimuth angles for a given sweep.

> **Parameters**
>
> > **sweep** [int] Sweep number to retrieve data for, 0 based.
> >
> > **copy** [bool, optional] True to return a copy of the azimuths. False, the default, returns a view of the azimuths (when possible), changing this data will change the data in the underlying Radar object.
>
> **Returns**
>
> > **azimuths** [array] Array containing the azimuth angles for a given sweep.

get_elevation(*sweep*, *copy=False*)

Return an array of elevation angles for a given sweep.

> **Parameters**
>
> > **sweep** [int] Sweep number to retrieve data for, 0 based.
> >
> > **copy** [bool, optional] True to return a copy of the elevations. False, the default, returns a view of the elevations (when possible), changing this data will change the data in the underlying Radar object.
>
> **Returns**
>
> > **azimuths** [array] Array containing the elevation angles for a given sweep.

get_end(*sweep*)
> Return the ending ray for a given sweep.

get_field(*sweep*, *field_name*, *copy=False*)
> Return the field data for a given sweep.

> When used with `get_gate_x_y_z()` this method can be used to obtain the data needed for plotting a radar field with the correct spatial context.

> > **Parameters**

> > > **sweep** [int] Sweep number to retrieve data for, 0 based.

> > > **field_name** [str] Name of the field from which data should be retrieved.

> > > **copy** [bool, optional] True to return a copy of the data. False, the default, returns a view of the data (when possible), changing this data will change the data in the underlying Radar object.

> > **Returns**

> > > **data** [array] Array containing data for the requested sweep and field.

get_gate_x_y_z(*sweep*, *edges=False*, *filter_transitions=False*)
> Return the x, y and z gate locations in meters for a given sweep.

> With the default parameter this method returns the same data as contained in the gate_x, gate_y and gate_z attributes but this method performs the gate location calculations only for the specified sweep and therefore is more efficient than accessing this data through these attribute.

> When used with `get_field()` this method can be used to obtain the data needed for plotting a radar field with the correct spatial context.

> > **Parameters**

> > > **sweep** [int] Sweep number to retrieve gate locations from, 0 based.

> > > **edges** [bool, optional] True to return the locations of the gate edges calculated by interpolating between the range, azimuths and elevations. False (the default) will return the locations of the gate centers with no interpolation.

> > > **filter_transitions** [bool, optional] True to remove rays where the antenna was in transition between sweeps. False will include these rays. No rays will be removed if the antenna_transition attribute is not available (set to None).

> > **Returns**

> > > **x, y, z** [2D array] Array containing the x, y and z, distances from the radar in meters for the center (or edges) for all gates in the sweep.

get_nyquist_vel(*sweep*, *check_uniform=True*)
> Return the Nyquist velocity in meters per second for a given sweep.

> Raises a LookupError if the Nyquist velocity is not available, an Exception is raised if the velocities are not uniform in the sweep unless check_uniform is set to False.

> > **Parameters**

> > > **sweep** [int] Sweep number to retrieve data for, 0 based.

> > > **check_uniform** [bool] True to check to perform a check on the Nyquist velocities that they are uniform in the sweep, False will skip this check and return the velocity of the first ray in the sweep.

> > **Returns**

> > **nyquist_velocity** [float] Array containing the Nyquist velocity in m/s for a given sweep.

get_slice(*sweep*)
> Return a slice for selecting rays for a given sweep.

get_start(*sweep*)
> Return the starting ray index for a given sweep.

get_start_end(*sweep*)
> Return the starting and ending ray for a given sweep.

info(*level='standard'*, *out=<_io.TextIOWrapper name='<stdout>' mode='w' encoding='UTF-8'>*)
> Print information on radar.

> > **Parameters**

> > > **level** [{'compact', 'standard', 'full', 'c', 's', 'f'}] Level of information on radar object to print, compact is minimal information, standard more and full everything.

> > > **out** [file-like] Stream to direct output to, default is to print information to standard out (the screen).

init_gate_altitude()
> Initialize the gate_altitude attribute.

init_gate_longitude_latitude()
> Initialize or reset the gate_longitude and gate_latitude attributes.

init_gate_x_y_z()
> Initialize or reset the gate_{x, y, z} attributes.

init_rays_per_sweep()
> Initialize or reset the rays_per_sweep attribute.

iter_azimuth()
> Return an iterator which returns sweep azimuth data.

iter_elevation()
> Return an iterator which returns sweep elevation data.

iter_end()
> Return an iterator over the sweep end indices.

iter_field(*field_name*)
> Return an iterator which returns sweep field data.

iter_slice()
> Return an iterator which returns sweep slice objects.

iter_start()
> Return an iterator over the sweep start indices.

iter_start_end()
> Return an iterator over the sweep start and end indices.

class pyrad.io.read_data_mxpol.**pyrad_MXPOL**(*filename*, *field_names=None*, *max_range=inf*, *min_range=10000*)
> Bases: pyart.core.radar.Radar

Methods

[add_field](field_name, dic[, replace_existing])	Add a field to the object.
[add_field_like](existing_field_name, …[, …])	Add a field to the object with metadata from a existing field.
[check_field_exists](field_name)	Check that a field exists in the fields dictionary.
[extract_sweeps](sweeps)	Create a new radar contains only the data from select sweeps.
[get_azimuth](sweep[, copy])	Return an array of azimuth angles for a given sweep.
[get_elevation](sweep[, copy])	Return an array of elevation angles for a given sweep.
[get_end](sweep)	Return the ending ray for a given sweep.
[get_field](sweep, field_name[, copy])	Return the field data for a given sweep.
[get_gate_x_y_z](sweep[, edges, …])	Return the x, y and z gate locations in meters for a given sweep.
[get_nyquist_vel](sweep[, check_uniform])	Return the Nyquist velocity in meters per second for a given sweep.
[get_slice](sweep)	Return a slice for selecting rays for a given sweep.
[get_start](sweep)	Return the starting ray index for a given sweep.
[get_start_end](sweep)	Return the starting and ending ray for a given sweep.
[info]([level, out])	Print information on radar.
[init_gate_altitude]()	Initialize the gate_altitude attribute.
[init_gate_longitude_latitude]()	Initialize or reset the gate_longitude and gate_latitude attributes.
[init_gate_x_y_z]()	Initialize or reset the gate_{x, y, z} attributes.
[init_rays_per_sweep]()	Initialize or reset the rays_per_sweep attribute.
[iter_azimuth]()	Return an iterator which returns sweep azimuth data.
[iter_elevation]()	Return an iterator which returns sweep elevation data.
[iter_end]()	Return an iterator over the sweep end indices.
[iter_field](field_name)	Return an iterator which returns sweep field data.
[iter_slice]()	Return an iterator which returns sweep slice objects.
[iter_start]()	Return an iterator over the sweep start indices.
[iter_start_end]()	Return an iterator over the sweep start and end indices.

__class__
    alias of builtins.type

__delattr__(*$self*, *name*, /)
    Implement delattr(self, name).

__dict__ = mappingproxy({'__module__': 'pyrad.io.read_data_mxpol', '__init__': <func

__dir__(*$self*, /)
    Default dir() implementation.

__eq__(*$self*, *value*, /)
    Return self==value.

__format__(*$self*, *format_spec*, /)
    Default object formatter.

__ge__(*$self*, *value*, /)
    Return self>=value.

__getattribute__(*$self*, *name*, /)
    Return getattr(self, name).

__getstate__ ()
>   Return object's state which can be pickled.

__gt__ (*$self*, *value*, */*)
>   Return self>value.

__hash__ (*$self*, */*)
>   Return hash(self).

__init__ (*filename*, *field_names=None*, *max_range=inf*, *min_range=10000*)
>   Initialize self. See help(type(self)) for accurate signature.

__init_subclass__ ()
>   This method is called when a class is subclassed.

>   The default implementation does nothing. It may be overridden to extend subclasses.

__le__ (*$self*, *value*, */*)
>   Return self<=value.

__lt__ (*$self*, *value*, */*)
>   Return self<value.

__module__ = 'pyrad.io.read_data_mxpol'

__ne__ (*$self*, *value*, */*)
>   Return self!=value.

__new__ (*$type*, **args*, ***kwargs*)
>   Create and return a new object. See help(type) for accurate signature.

__reduce__ (*$self*, */*)
>   Helper for pickle.

__reduce_ex__ (*$self*, *protocol*, */*)
>   Helper for pickle.

__repr__ (*$self*, */*)
>   Return repr(self).

__setattr__ (*$self*, *name*, *value*, */*)
>   Implement setattr(self, name, value).

__setstate__ (*state*)
>   Restore unpicklable entries from pickled object.

__sizeof__ (*$self*, */*)
>   Size of object in memory, in bytes.

__str__ (*$self*, */*)
>   Return str(self).

__subclasshook__ ()
>   Abstract classes can override this to customize issubclass().

>   This is invoked early on by abc.ABCMeta.__subclasscheck__(). It should return True, False or NotImplemented. If it returns NotImplemented, the normal algorithm is used. Otherwise, it overrides the normal algorithm (and the outcome is cached).

__weakref__
>   list of weak references to the object (if defined)

_check_sweep_in_range (*sweep*)
>   Check that a sweep number is in range.

_dic_info(*attr*, *level*, *out*, *dic=None*, *ident_level=0*)
   Print information on a dictionary attribute.

add_field(*field_name*, *dic*, *replace_existing=False*)
   Add a field to the object.

   Parameters

   field_name [str] Name of the field to add to the dictionary of fields.

   dic [dict] Dictionary contain field data and metadata.

   replace_existing [bool] True to replace the existing field with key field_name if it exists, loosing any existing data. False will raise a ValueError when the field already exists.

add_field_like(*existing_field_name*, *field_name*, *data*, *replace_existing=False*)
   Add a field to the object with metadata from a existing field.

   Note that the data parameter is not copied by this method. If data refers to a 'data' array from an existing field dictionary, a copy should be made within or prior to using this method. If this is not done the 'data' key in both field dictionaries will point to the same NumPy array and modification of one will change the second. To copy NumPy arrays use the copy() method. See the Examples section for how to create a copy of the 'reflectivity' field as a field named 'reflectivity_copy'.

   Parameters

   existing_field_name [str] Name of an existing field to take metadata from when adding the new field to the object.

   field_name [str] Name of the field to add to the dictionary of fields.

   data [array] Field data. A copy of this data is not made, see the note above.

   replace_existing [bool] True to replace the existing field with key field_name if it exists, loosing any existing data. False will raise a ValueError when the field already exists.

   Examples

   ```
   >>> radar.add_field_like('reflectivity', 'reflectivity_copy',
   ...                      radar.fields['reflectivity']['data'].copy())
   ```

check_field_exists(*field_name*)
   Check that a field exists in the fields dictionary.

   If the field does not exist raise a KeyError.

   Parameters

   field_name [str] Name of field to check.

extract_sweeps(*sweeps*)
   Create a new radar contains only the data from select sweeps.

   Parameters

   sweeps [array_like] Sweeps (0-based) to include in new Radar object.

   Returns

   radar [Radar] Radar object which contains a copy of data from the selected sweeps.

get_azimuth(*sweep*, *copy=False*)
   Return an array of azimuth angles for a given sweep.

> **Parameters**
>
> > **sweep** [int] Sweep number to retrieve data for, 0 based.
> >
> > **copy** [bool, optional] True to return a copy of the azimuths. False, the default, returns a view of the azimuths (when possible), changing this data will change the data in the underlying Radar object.
>
> **Returns**
>
> > **azimuths** [array] Array containing the azimuth angles for a given sweep.

get_elevation(*sweep*, *copy=False*)
    Return an array of elevation angles for a given sweep.

> **Parameters**
>
> > **sweep** [int] Sweep number to retrieve data for, 0 based.
> >
> > **copy** [bool, optional] True to return a copy of the elevations. False, the default, returns a view of the elevations (when possible), changing this data will change the data in the underlying Radar object.
>
> **Returns**
>
> > **azimuths** [array] Array containing the elevation angles for a given sweep.

get_end(*sweep*)
    Return the ending ray for a given sweep.

get_field(*sweep*, *field_name*, *copy=False*)
    Return the field data for a given sweep.

    When used with *get_gate_x_y_z()* this method can be used to obtain the data needed for plotting a radar field with the correct spatial context.

> **Parameters**
>
> > **sweep** [int] Sweep number to retrieve data for, 0 based.
> >
> > **field_name** [str] Name of the field from which data should be retrieved.
> >
> > **copy** [bool, optional] True to return a copy of the data. False, the default, returns a view of the data (when possible), changing this data will change the data in the underlying Radar object.
>
> **Returns**
>
> > **data** [array] Array containing data for the requested sweep and field.

get_gate_x_y_z(*sweep*, *edges=False*, *filter_transitions=False*)
    Return the x, y and z gate locations in meters for a given sweep.

    With the default parameter this method returns the same data as contained in the gate_x, gate_y and gate_z attributes but this method performs the gate location calculations only for the specified sweep and therefore is more efficient than accessing this data through these attribute.

    When used with *get_field()* this method can be used to obtain the data needed for plotting a radar field with the correct spatial context.

> **Parameters**
>
> > **sweep** [int] Sweep number to retrieve gate locations from, 0 based.

> **edges** [bool, optional] True to return the locations of the gate edges calculated by inter-
> polating between the range, azimuths and elevations. False (the default) will return
> the locations of the gate centers with no interpolation.

> **filter_transitions** [bool, optional] True to remove rays where the antenna was in transi-
> tion between sweeps. False will include these rays. No rays will be removed if the
> antenna_transition attribute is not available (set to None).

> **Returns**

> > **x, y, z** [2D array] Array containing the x, y and z, distances from the radar in meters for
> > the center (or edges) for all gates in the sweep.

get_nyquist_vel(*sweep*, *check_uniform=True*)
    Return the Nyquist velocity in meters per second for a given sweep.

Raises a LookupError if the Nyquist velocity is not available, an Exception is raised if the velocities are
not uniform in the sweep unless check_uniform is set to False.

> **Parameters**

> > **sweep** [int] Sweep number to retrieve data for, 0 based.

> > **check_uniform** [bool] True to check to perform a check on the Nyquist velocities that
> > they are uniform in the sweep, False will skip this check and return the velocity of the
> > first ray in the sweep.

> **Returns**

> > **nyquist_velocity** [float] Array containing the Nyquist velocity in m/s for a given sweep.

get_slice(*sweep*)
    Return a slice for selecting rays for a given sweep.

get_start(*sweep*)
    Return the starting ray index for a given sweep.

get_start_end(*sweep*)
    Return the starting and ending ray for a given sweep.

info(*level='standard'*, *out=<_io.TextIOWrapper name='<stdout>' mode='w' encoding='UTF-8'>*)
    Print information on radar.

> **Parameters**

> > **level** [{'compact', 'standard', 'full', 'c', 's', 'f'}] Level of information on radar object to
> > print, compact is minimal information, standard more and full everything.

> > **out** [file-like] Stream to direct output to, default is to print information to standard out
> > (the screen).

init_gate_altitude()
    Initialize the gate_altitude attribute.

init_gate_longitude_latitude()
    Initialize or reset the gate_longitude and gate_latitude attributes.

init_gate_x_y_z()
    Initialize or reset the gate_{x, y, z} attributes.

init_rays_per_sweep()
    Initialize or reset the rays_per_sweep attribute.

iter_azimuth()
    Return an iterator which returns sweep azimuth data.

---

iter_elevation()
>   Return an iterator which returns sweep elevation data.

iter_end()
>   Return an iterator over the sweep end indices.

iter_field(*field_name*)
>   Return an iterator which returns sweep field data.

iter_slice()
>   Return an iterator which returns sweep slice objects.

iter_start()
>   Return an iterator over the sweep start indices.

iter_start_end()
>   Return an iterator over the sweep start and end indices.

pyrad.io.read_data_mxpol.**readCHRadData**(*filename*, *radar_name*, *variableList*, *radial_resolution*, *max_range=inf*, *min_range=0*)
>   Reads a HDF5 file containing processed radar data in polar coordinates Parameters ————- filename: str
>
>   complete path of the file

>   **radar_name: str** name of MCH radar

>   **variableList: list** list of variables to be read

>   **radial_resolution: float** resolution of the radar in metres (i.e. high: 83.3, low: 500.)

>   **max_range: float** maximum range upto which to read data

>   **min_range: float** mimimum range from which to read data

>   **varPol: dict** the projected variables, the azimuth and the range

pyrad.io.read_data_mxpol.**readIDLRadData**(*filename*, *variableList*, *max_range=inf*, *min_range=0*)
>   Reads a netcdf containing IDL processed radar data in polar coordinates Parameters ————- filename: str
>
>   complete path of the file

>   **variableList: list** list of variables to be read

>   **varPol: dict** dictionary containing the variables, the azimuth and the range

>   **metadata: dict** dictionary containing the metadata of the file

pyrad.io.read_data_mxpol.**readMXPOLRadData**(*filename*, *variableList*, *max_range=inf*, *min_range=0*)
>   Reads a netcdf containing processed radar data in polar coordinates Parameters ————- filename: str
>
>   complete path of the file

>   **variableList: list** list of variables to be read

>   **varPol: dict** dictionary containing the variables, the azimuth and the range

>   **metadata: dict** dictionary containing the metadata of the file

pyrad.io.read_data_mxpol.**row_stack**(*a1*, *a2*)

>   Stacks data from subsequent sweeps, while padding "empty" columns from subsequent sweeps. Inputs —— a1: np.array

>> destination array

>   **a2: np.array** array which is added onto the first array

>   **out: np.array** stacked destination and additional array, with uniform shape

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@author: fvanden

Configuration file for mxpol pyart.core.Radar class. Some information may be redundant because this file is a copy from the ProfileLab toolkit.

Functions to retrieve data from this file may be found in pyrad.io.read_data_mxpol under the utilities section

PYRAD.IO.READ_DATA_COSMO

Functions for reading COSMO data

cosmo2radar_data(radar, cosmo_coord, cosmo_data)	get the COSMO value corresponding to each radar gate using nearest neighbour interpolation
cosmo2radar_coord(radar, cosmo_coord[, . . .])	Given the radar coordinates find the nearest COSMO model pixel
get_cosmo_fields(cosmo_data, cosmo_ind[, . . .])	Get the COSMO data corresponding to each radar gate using a precomputed look up table of the nearest neighbour
read_cosmo_data(fname[, field_names, celsius])	Reads COSMO data from a netcdf file
read_cosmo_coord(fname[, zmin])	Reads COSMO coordinates from a netcdf file
_ncvar_to_dict(ncvar[, dtype])	Convert a NetCDF Dataset variable to a dictionary.
_prepare_for_interpolation(x_radar, y_radar, . . .)	prepares the COSMO 3D volume for interpolation:
_put_radar_in_swiss_coord(radar)	puts the Cartesian grid of the radar coordinates in Swiss coordinates

pyrad.io.read_data_cosmo.**_ncvar_to_dict**(*ncvar*, *dtype='float64'*)
> Convert a NetCDF Dataset variable to a dictionary.

pyrad.io.read_data_cosmo.**_prepare_for_interpolation**(*x_radar*, *y_radar*, *z_radar*, *cosmo_coord*, *slice_xy=True*, *slice_z=False*)

> **prepares the COSMO 3D volume for interpolation:**
>
>> 1. if set slices the cosmo data to the area (or volume)
>
> **covered by the radar**
>
>> 2. creates the x, y, z grid for the interpolation
>
> **Parameters**
>
>> **x_radar, y_radar, z_radar** [arrays] The Swiss coordinates of the radar
>>
>> **cosmo_coord** [dict] dictionary containing the COSMO coordinates
>>
>> **slice_xy** [boolean] if true the horizontal plane of the COSMO field is cut to the dimensions of the radar field
>>
>> **slice_z** [boolean] if true the vertical plane of the COSMO field is cut to the dimensions of the radar field
>
> **Returns**

x_cosmo, y_cosmo, z_cosmo [1D arrays] arrays containing the flatten swiss coordinates of the COSMO data in the area of interest

ind_xmin, ind_ymin, ind_zmin, ind_xmax, ind_ymax, ind_zmax [ints] the minimum and maximum indices of each dimension

pyrad.io.read_data_cosmo.**_put_radar_in_swiss_coord**(*radar*)

puts the Cartesian grid of the radar coordinates in Swiss coordinates

Parameters

radar [Radar] the radar object containing the information on the position of the radar gates

Returns

x_radar, y_radar, z_radar [2D arrays] arrays containing swiss coordinates of the radar [in m]

pyrad.io.read_data_cosmo.**cosmo2radar_coord**(*radar*, *cosmo_coord*, *slice_xy=True*, *slice_z=False*, *field_name=None*)

Given the radar coordinates find the nearest COSMO model pixel

Parameters

radar [Radar] the radar object containing the information on the position of the radar gates

cosmo_coord [dict] dictionary containing the COSMO coordinates

slice_xy [boolean] if true the horizontal plane of the COSMO field is cut to the dimensions of the radar field

slice_z [boolean] if true the vertical plane of the COSMO field is cut to the dimensions of the radar field

field_name [str] name of the field

Returns

cosmo_ind_field [dict] dictionary containing a field of COSMO indices and metadata

pyrad.io.read_data_cosmo.**cosmo2radar_data**(*radar*, *cosmo_coord*, *cosmo_data*, *time_index=0*, *slice_xy=True*, *slice_z=False*, *field_names=['temperature']*)

get the COSMO value corresponding to each radar gate using nearest neighbour interpolation

Parameters

radar [Radar] the radar object containing the information on the position of the radar gates

cosmo_coord [dict] dictionary containing the COSMO coordinates

cosmo_data [dict] dictionary containing the COSMO data

time_index [int] index of the forecasted data

slice_xy [boolean] if true the horizontal plane of the COSMO field is cut to the dimensions of the radar field

slice_z [boolean] if true the vertical plane of the COSMO field is cut to the dimensions of the radar field

field_names [str] names of COSMO fields to convert (default temperature)

Returns

cosmo_fields [list of dict] list of dictionary with the COSMO fields and metadata

pyrad.io.read_data_cosmo.**get_cosmo_fields**(*cosmo_data,   cosmo_ind,   time_index=0,
                                           field_names=['temperature']*)

> Get the COSMO data corresponding to each radar gate using a precomputed look up table of the nearest neighbour

> > **Parameters**

> > > **cosmo_data** [dict] dictionary containing the COSMO data and metadata

> > > **cosmo_ind** [dict] dictionary containing a field of COSMO indices and metadata

> > > **time_index** [int] index of the forecasted data

> > > **field_names** [str] names of COSMO parameters (default temperature)

> > **Returns**

> > > **cosmo_fields** [list of dict] dictionary with the COSMO fields and metadata

pyrad.io.read_data_cosmo.**read_cosmo_coord**(*fname*, *zmin=None*)

> Reads COSMO coordinates from a netcdf file

> > **Parameters**

> > > **fname** [str] name of the file to read

> > **Returns**

> > > **cosmo_coord** [dictionary] dictionary with the data and metadata

pyrad.io.read_data_cosmo.**read_cosmo_data**(*fname,   field_names=['temperature'],   celsius=True*)

> Reads COSMO data from a netcdf file

> > **Parameters**

> > > **fname** [str] name of the file to read

> > > **field_names** [str] name of the variable to read

> > > **celsius** [Boolean] if True and variable temperature converts data from Kelvin to Centigrade

> > **Returns**

> > > **cosmo_data** [dictionary] dictionary with the data and metadata

CHAPTER

TWENTYSEVEN

PYRAD.IO.READ_DATA_HZT

Functions for reading HZT data

hzt2radar_data(radar, hzt_coord, hzt_data[, . . .])	get the HZT value corresponding to each radar gate using nearest neighbour interpolation
hzt2radar_coord(radar, hzt_coord[, . . .])	Given the radar coordinates find the nearest HZT pixel
get_iso0_field(hzt_data, hzt_ind, z_radar[, . . .])	Get the height over iso0 data corresponding to each radar gate using a precomputed look up table of the nearest neighbour
read_hzt_data(fname[, chy0, chx0])	Reads iso-0 degree data from an HZT file
_prepare_for_interpolation(x_radar, y_radar, . . .)	prepares the HZT 2D volume for interpolation:

pyrad.io.read_data_hzt.**_prepare_for_interpolation**(*x_radar*, *y_radar*, *hzt_coord*, *slice_xy=True*)

> **prepares the HZT 2D volume for interpolation:**
>
>> 1. if set slices the cosmo data to the area covered by the radar
>>
>> 2. creates the x, y grid for the interpolation
>
> **Parameters**
>
>> **x_radar, y_radar** [arrays] The Swiss coordinates of the radar
>>
>> **hzt_coord** [dict] dictionary containing the HZT coordinates
>>
>> **slice_xy** [boolean] if true the horizontal plane of the HZT field is cut to the dimensions of the radar field
>
> **Returns**
>
>> **x_hzt, y_hzt** [1D arrays] arrays containing the flatten swiss coordinates of the HZT data in the area of interest [m]
>>
>> **ind_xmin, ind_ymin, ind_xmax, ind_ymax** [ints] the minimum and maximum indices of each dimension

pyrad.io.read_data_hzt.**get_iso0_field**(*hzt_data*, *hzt_ind*, *z_radar*, *field_name='height_over_iso0'*)

> Get the height over iso0 data corresponding to each radar gate using a precomputed look up table of the nearest neighbour
>
> **Parameters**
>
>> **hzt_data** [dict] dictionary containing the HZT data and metadata

> **hzt_ind** [dict] dictionary containing a field of HZT indices and metadata
>
> **z_radar** [ndarray] gates altitude [m MSL]
>
> **field_name** [str] names of HZT parameters (default height_over_iso0)

> Returns
>
> > **iso0_field** [list of dict] dictionary with the height over iso0 field and metadata

pyrad.io.read_data_hzt.**hzt2radar_coord**(*radar*, *hzt_coord*, *slice_xy=True*, *field_name=None*)

> Given the radar coordinates find the nearest HZT pixel
>
> > Parameters
> >
> > > **radar** [Radar] the radar object containing the information on the position of the radar gates
> > >
> > > **hzt_coord** [dict] dictionary containing the HZT coordinates
> > >
> > > **slice_xy** [boolean] if true the horizontal plane of the HZT field is cut to the dimensions of the radar field
> > >
> > > **field_name** [str] name of the field
> >
> > Returns
> >
> > > **hzt_ind_field** [dict] dictionary containing a field of HZT indices and metadata

pyrad.io.read_data_hzt.**hzt2radar_data**(*radar*, *hzt_coord*, *hzt_data*, *slice_xy=True*, *field_name='height_over_iso0'*)

> get the HZT value corresponding to each radar gate using nearest neighbour interpolation
>
> > Parameters
> >
> > > **radar** [Radar] the radar object containing the information on the position of the radar gates
> > >
> > > **hzt_coord** [dict] dictionary containing the HZT coordinates
> > >
> > > **hzt_data** [dict] dictionary containing the HZT data
> > >
> > > **slice_xy** [boolean] if true the horizontal plane of the COSMO field is cut to the dimensions of the radar field
> > >
> > > **field_name** [str] name of HZT fields to convert (default height_over_iso0)
> >
> > Returns
> >
> > > **hzt_fields** [list of dict] list of dictionary with the HZT fields and metadata

pyrad.io.read_data_hzt.**read_hzt_data**(*fname*, *chy0=255.0*, *chx0=-160.0*)

> Reads iso-0 degree data from an HZT file
>
> > Parameters
> >
> > > **fname** [str] name of the file to read
> > >
> > > **chy0, chx0: south west point of grid in Swiss coordinates [km]**
> >
> > Returns
> >
> > > **hzt_data** [dictionary] dictionary with the data and metadata

PYRAD.IO.READ_DATA_SENSOR

Functions for reading data from other sensors

read_thundertracking_info(fname)	Reads the TRT info used for thundertracking
read_trt_info_all(dir)	Reads all the TRT info files
read_trt_info(fname)	Reads the TRT info used for thundertracking and contained in a text file.
read_trt_scores(fname)	Reads the TRT scores contained in a text file.
read_trt_cell_lightning(fname)	Reads the lightning data of a TRT cell.
read_trt_data(fname)	Reads the TRT data contained in a text file.
read_trt_traj_data(fname)	Reads the TRT cell data contained in a text file.
read_lightning(fname[, filter_data])	Reads lightning data contained in a text file.
read_meteorage(fname)	Reads METEORAGE lightning data contained in a text file.
read_lightning_traj(fname)	Reads lightning trajectory data contained in a csv file.
read_lightning_all(fname[, labels])	Reads a file containing lightning data and co-located polarimetric data.
get_sensor_data(date, datatype, cfg)	Gets data from a point measurement sensor (rain gauge or disdrometer)
read_smn(fname)	Reads SwissMetNet data contained in a csv file
read_smn2(fname)	Reads SwissMetNet data contained in a csv file with format station,time,value
read_disdro_scattering(fname)	Reads scattering parameters computed from disdrometer data contained in a text file
read_disdro(fname)	Reads scattering parameters computed from disdrometer data contained in a text file

pyrad.io.read_data_sensor.**get_sensor_data**(*date*, *datatype*, *cfg*)
    Gets data from a point measurement sensor (rain gauge or disdrometer)

> **Parameters**
>
> > **date** [datetime object] measurement date
> >
> > **datatype** [str] name of the data type to read
> >
> > **cfg** [dictionary] dictionary containing sensor information
>
> **Returns**
>
> > **sensordate , sensorvalue, label, period** [tupple] date, value, type of sensor and measurement period

pyrad.io.read_data_sensor.**read_disdro**(*fname*)

Reads scattering parameters computed from disdrometer data contained in a text file

> **Parameters**
>
> > **fname** [str] path of time series file
>
> **Returns**
>
> > **date, preciptype, variable, scattering temperature: tuple** The read values

pyrad.io.read_data_sensor.**read_disdro_scattering**(*fname*)

> Reads scattering parameters computed from disdrometer data contained in a text file
>
> > **Parameters**
> >
> > > **fname** [str] path of time series file
> >
> > **Returns**
> >
> > > **date, preciptype, lwc, rr, zh, zv, zdr, ldr, ah, av, adiff, kdp, deltaco,**
> > >
> > > **rhohv** [tupple] The read values

pyrad.io.read_data_sensor.**read_lightning**(*fname*, *filter_data=True*)

> Reads lightning data contained in a text file. The file has the following fields:
>
> > flashnr: (0 is for noise) UTC seconds of the day Time within flash (in seconds) Latitude (decimal degrees) Longitude (decimal degrees) Altitude (m MSL) Power (dBm)
>
> > **Parameters**
> >
> > > **fname** [str] path of time series file
> > >
> > > **filter_data** [Boolean] if True filter noise (flashnr = 0)
> >
> > **Returns**
> >
> > > **flashnr, time_data, time_in_flash, lat, lon, alt, dBm** [tupple] A tupple containing the read values. None otherwise

pyrad.io.read_data_sensor.**read_lightning_all**(*fname,*   *labels=['hydro   [-]',   'KDPc*
                                                   [deg/Km]', 'dBZc [dBZ]', 'RhoHVc [-]',
                                                   'TEMP [deg C]', 'ZDRc [dB]'])

> Reads a file containing lightning data and co-located polarimetric data. fields:
>
> > flashnr time data Time within flash (in seconds) Latitude (decimal degrees) Longitude (decimal degrees) Altitude (m MSL) Power (dBm) Polarimetric values at flash position
>
> > **Parameters**
> >
> > > **fname** [str] path of time series file
> > >
> > > **labels** [list of str] The polarimetric variables labels
> >
> > **Returns**
> >
> > > **flashnr, time_data, time_in_flash, lat, lon, alt, dBm,**
> > >
> > > **pol_vals_dict** [tupple] A tupple containing the read values. None otherwise

pyrad.io.read_data_sensor.**read_lightning_traj**(*fname*)

> Reads lightning trajectory data contained in a csv file. The file has the following fields:
>
> > Date UTC [seconds since midnight] # Flash Flash Power (dBm) Value at flash Mean value in a 3x3x3 polar box Min value in a 3x3x3 polar box Max value in a 3x3x3 polar box # valid values in the polar box

Parameters

> **fname** [str] path of time series file

Returns

> **time_flash, flashnr, dBm, val_at_flash, val_mean, val_min, val_max,**
>
> **nval** [tupple] A tupple containing the read values. None otherwise

pyrad.io.read_data_sensor.**read_meteorage**(*fname*)

> Reads METEORAGE lightning data contained in a text file. The file has the following fields:
>
> > date: date + time + time zone lon: longitude [degree] lat: latitude [degree] intens: amplitude [kilo amperes] ns: number of strokes of the flash mode: kind of localization [0,15] intra: 1 = intra-cloud , 0 = cloud-to-ground ax: length of the semi-major axis of the ellipse [km] ki2: standard deviation on the localization computation (Ki^2) ecc: eccentricity (major-axis / minor-axis) incl: ellipse inclination (angle with respect to the North, +90° is
> >
> > > East) [degrees]
> >
> > sind: stroke index within the flash
>
> **Parameters**
>
> > **fname** [str] path of time series file
>
> **Returns**
>
> > **stroke_time, lon, lat, intens, ns, mode, intra, ax, ki2, ecc, incl,**
> >
> > **sind** [tupple] A tupple containing the read values. None otherwise

pyrad.io.read_data_sensor.**read_smn**(*fname*)

> Reads SwissMetNet data contained in a csv file
>
> **Parameters**
>
> > **fname** [str] path of time series file
>
> **Returns**
>
> > **smn_id, date , pressure, temp, rh, precip, wspeed, wdir** [tupple] The read values

pyrad.io.read_data_sensor.**read_smn2**(*fname*)

> Reads SwissMetNet data contained in a csv file with format station,time,value
>
> **Parameters**
>
> > **fname** [str] path of time series file
>
> **Returns**
>
> > **smn_id, date , value** [tupple] The read values

pyrad.io.read_data_sensor.**read_thundertracking_info**(*fname*)

> Reads the TRT info used for thundertracking
>
> **Parameters**
>
> > **fname** [str] Name of the file containing the info
>
> **Returns**
>
> > **A tupple containing the read values. None otherwise. The read values are**
> >
> > **id, max_rank, nscans_Xband, time_start, time_end**

`pyrad.io.read_data_sensor.`**`read_trt_cell_lightning`**(*fname*)

> Reads the lightning data of a TRT cell. The file has the following fields:
>
>> traj_ID yyyymmddHHMM lon lat area RANKr nflashes flash_dens
>
>> **Parameters**
>>
>>> **fname** [str] path of the TRT data file
>>
>> **Returns**
>>
>>> **A tupple containing the read values. None otherwise**

`pyrad.io.read_data_sensor.`**`read_trt_data`**(*fname*)

> Reads the TRT data contained in a text file. The file has the following fields:
>
>> traj_ID yyyymmddHHMM
>>
>> Description of ellipsis: lon [deg] lat [deg] ell_L [km] long ell_S [km] short ell_or [deg] orientation area [km2]
>>
>> Cell speed: vel_x [km/h] vel_y [km/h] det [dBZ]: detection threshold RANKr from 0 to 40 (int)
>>
>> Lightning information: CG- number (int) CG+ number (int) CG number (int) %CG+ [%]
>>
>> Echo top information: ET45 [km] echotop 45 max ET45m [km] echotop 45 median ET15 [km] echotop 15 max ET15m [km] echotop 15 median
>>
>> VIL and max echo: VIL [kg/m2] vertical integrated liquid content maxH [km] height of maximum reflectivity (maximum on the cell) maxHm [km] height of maximum reflectivity (median per cell)
>>
>> POH [%] RANK (deprecated)
>>
>> standard deviation of the current time step cell velocity respect to the previous time: Dvel_x [km/h] Dvel_y [km/h]
>>
>> cell_contour_lon-lat
>
>> **Parameters**
>>
>>> **fname** [str] path of the TRT data file
>>
>> **Returns**
>>
>>> **A tupple containing the read values. None otherwise**

`pyrad.io.read_data_sensor.`**`read_trt_info`**(*fname*)

> Reads the TRT info used for thundertracking and contained in a text file.
>
>> **Parameters**
>>
>>> **fname** [str] path of the TRT info file
>>
>> **Returns**
>>
>>> **A tupple containing the read values. None otherwise. The read values are**
>>>
>>> **trt_time, id, rank, nscans, azi, rng, lat, lon, ell_l, ell_s, ell_or,**
>>>
>>> **vel_x, vel_y, det**

`pyrad.io.read_data_sensor.`**`read_trt_info_all`**(*dir*)

> Reads all the TRT info files
>
>> **Parameters**

dir [str] directory where the files are stored

Returns

> **A tupple containing the read values. None otherwise. The read values are**
>
> **trt_time, id, rank, nscans, azi, rng, lat, lon, ell_l, ell_s, ell_or,**
>
> **vel_x, vel_y, det**

pyrad.io.read_data_sensor.**read_trt_scores**(*fname*)

> Reads the TRT scores contained in a text file. The file has the following fields:
>
> traj ID max flash density time max flash density rank max flash density max rank time max rank
>
> **Parameters**
>
> > **fname** [str] path of the TRT data file
>
> **Returns**
>
> > **A tupple containing the read values. None otherwise**

pyrad.io.read_data_sensor.**read_trt_traj_data**(*fname*)

> Reads the TRT cell data contained in a text file. The file has the following fields:
>
> traj_ID yyyymmddHHMM
>
> lon [deg] lat [deg] ell_L [km] long ell_S [km] short ell_or [deg] orientation area [km2]
>
> vel_x [km/h] cell speed vel_y [km/h] det [dBZ] detection threshold RANKr from 0 to 40 (int)
>
> CG- number (int) CG+ number (int) CG number (int) %CG+ [%]
>
> ET45 [km] echotop 45 max ET45m [km] echotop 45 median ET15 [km] echotop 15 max ET15m [km] echotop 15 median VIL [kg/m2] vertical integrated liquid content maxH [km] height of maximum reflectivity (maximum on the cell) maxHm [km] height of maximum reflectivity (median per cell) POH [%] RANK (deprecated)
>
> Standard deviation of the current time step cell velocity respect to the previous time: Dvel_x [km/h] Dvel_y [km/h]
>
> cell_contour_lon-lat
>
> **Parameters**
>
> > **fname** [str] path of the TRT data file
>
> **Returns**
>
> > **A tupple containing the read values. None otherwise**

PYRAD.IO.READ_DATA_SUN

Functions for reading data used in sun monitoring

read_sun_hits_multiple_days(cfg, time_ref[, ...])	Reads sun hits data from multiple file sources
read_sun_hits(fname)	Reads sun hits data contained in a csv file
read_sun_retrieval(fname)	Reads sun retrieval data contained in a csv file
read_solar_flux(fname)	Reads solar flux data from the DRAO observatory in Canada

pyrad.io.read_data_sun.**read_solar_flux**(*fname*)

Reads solar flux data from the DRAO observatory in Canada

Parameters

fname [str] path of time series file

Returns

flux_datetime [datetime array] the date and time of the solar flux retrievals

flux_value [array] the observed solar flux

pyrad.io.read_data_sun.**read_sun_hits**(*fname*)

Reads sun hits data contained in a csv file

Parameters

fname [str] path of time series file

Returns

date, ray, nrng, rad_el, rad_az, sun_el, sun_az, ph, ph_std, nph, nvalh,

pv, pv_std, npv, nvalv, zdr, zdr_std, nzdr, nvalzdr [tupple] Each parameter is an array containing a time series of information on a variable

pyrad.io.read_data_sun.**read_sun_hits_multiple_days**(*cfg*, *time_ref*, *nfiles=1*)

Reads sun hits data from multiple file sources

Parameters

cfg [dict] dictionary with configuration data to find out the right file

time_ref [datetime object] reference time

nfiles [int] number of files to read

Returns

> **date, ray, nrng, rad_el, rad_az, sun_el, sun_az, ph, ph_std, nph, nvalh,**
>
> **pv, pv_std, npv, nvalv, zdr, zdr_std, nzdr, nvalzdr** [tupple] Each parameter is an array containing a time series of information on a variable

pyrad.io.read_data_sun.**read_sun_retrieval**(*fname*)

> Reads sun retrieval data contained in a csv file
>
> > **Parameters**
> >
> > > **fname** [str] path of time series file
> >
> > **Returns**
> >
> > > **first_hit_time, last_hit_time, nhits_h, el_width_h, az_width_h, el_bias_h,**
> > >
> > > **az_bias_h, dBm_sun_est, std_dBm_sun_est, sf_h,**
> > >
> > > **nhits_v, el_width_v, az_width_v, el_bias_v, az_bias_v, dBmv_sun_est,**
> > >
> > > **std_dBmv_sun_est, sf_v,**
> > >
> > > **nhits_zdr, zdr_sun_est, std_zdr_sun_est,**
> > >
> > > **sf_ref, ref_time** [tupple] Each parameter is an array containing a time series of information on a variable

PYRAD.IO.READ_DATA_OTHER

Functions for reading auxiliary data

read_profile_ts(fname_list, labels[, hres, . . .])	Reads a colection of profile data file and creates a time series
read_histogram_ts(fname_list, datatype[, t_res])	Reads a colection of histogram data file and creates a time series
read_quantiles_ts(fname_list[, step, qmin, . . .])	Reads a colection of quantiles data file and creates a time series
read_rhi_profile(fname[, labels])	Reads a monitoring time series contained in a csv file
read_last_state(fname)	Reads a file containing the date of acquisition of the last volume processed
read_status(voltime, cfg[, ind_rad])	Reads rad4alp xml status file.
read_rad4alp_cosmo(fname, datatype[, ngates])	Reads rad4alp COSMO data binary file.
read_rad4alp_vis(fname, datatype)	Reads rad4alp visibility data binary file.
read_histogram(fname)	Reads a histogram contained in a csv file
read_quantiles(fname)	Reads quantiles contained in a csv file
read_excess_gates(fname)	Reads a csv files containing the position of gates exceeding a given percentile of frequency of occurrence
read_colocated_gates(fname)	Reads a csv files containing the position of colocated gates
read_colocated_data(fname)	Reads a csv files containing colocated data
read_colocated_data_time_avg(fname)	Reads a csv files containing time averaged colocated data
read_timeseries(fname)	Reads a time series contained in a csv file
read_ts_cum(fname)	Reads a time series of precipitation accumulation contained in a csv file
read_ml_ts(fname)	Reads a melting layer time series contained in a csv file
read_monitoring_ts(fname[, sort_by_date])	Reads a monitoring time series contained in a csv file
read_monitoring_ts_old(fname)	Reads an old format of the monitoring time series contained in a text file
read_intercomp_scores_ts(fname[, sort_by_date])	Reads a radar intercomparison scores csv file
read_intercomp_scores_ts_old(fname)	Reads a radar intercomparison scores csv file in old format
read_intercomp_scores_ts_old_v0(fname[, . . .])	Reads a radar intercomparison scores csv file in the oldest format
read_selfconsistency(fname)	Reads a self-consistency table with Zdr, Kdp/Zh columns
read_antenna_pattern(fname[, linear, twoway])	Read antenna pattern from file

pyrad.io.read_data_other.**read_antenna_pattern**(*fname*, *linear=False*, *twoway=False*)
>   Read antenna pattern from file

>> **Parameters**

>>> **fname** [str] path of the antenna pattern file

>>> **linear** [boolean] if true the antenna pattern is given in linear units

>>> **twoway** [boolean] if true the attenuation is two-way

>> **Returns**

>>> **pattern** [dict] dictionary with the fields angle and attenuation

pyrad.io.read_data_other.**read_colocated_data**(*fname*)
>   Reads a csv files containing colocated data

>> **Parameters**

>>> **fname** [str] path of time series file

>> **Returns**

>>> **rad1_time, rad1_ray_ind, rad1_rng_ind, rad1_ele, rad1_azi, rad1_rng,**

>>> **rad1_val, rad2_time, rad2_ray_ind, rad2_rng_ind, rad2_ele, rad2_azi,**

>>> **rad2_rng, rad2_val** [tupple] A tupple with the data read. None otherwise

pyrad.io.read_data_other.**read_colocated_data_time_avg**(*fname*)
>   Reads a csv files containing time averaged colocated data

>> **Parameters**

>>> **fname** [str] path of time series file

>> **Returns**

>>> **rad1_time, rad1_ray_ind, rad1_rng_ind, rad1_ele , rad1_azi, rad1_rng,**

>>> **rad1_val, rad2_time, rad2_ray_ind, rad2_rng_ind, rad2_ele, rad2_azi,**

>>> **rad2_rng, rad2_val** [tupple] A tupple with the data read. None otherwise

pyrad.io.read_data_other.**read_colocated_gates**(*fname*)
>   Reads a csv files containing the position of colocated gates

>> **Parameters**

>>> **fname** [str] path of time series file

>> **Returns**

>>> **rad1_ray_ind, rad1_rng_ind, rad1_ele, rad1_azi, rad1_rng,**

>>> **rad2_ray_ind, rad2_rng_ind, rad2_ele, rad2_azi, rad2_rng** [tupple] A tupple with the data read. None otherwise

pyrad.io.read_data_other.**read_excess_gates**(*fname*)
>   Reads a csv files containing the position of gates exceeding a given percentile of frequency of occurrence

>> **Parameters**

>>> **fname** [str] path of time series file

>> **Returns**

>>> **rad1_ray_ind, rad1_rng_ind, rad1_ele, rad1_azi, rad1_rng,**

> **rad2_ray_ind, rad2_rng_ind, rad2_ele, rad2_azi, rad2_rng** [tupple] A tupple with the
> > data read. None otherwise

pyrad.io.read_data_other.**read_histogram**(*fname*)
> Reads a histogram contained in a csv file

> > **Parameters**

> > > **fname** [str] path of time series file

> > **Returns**

> > > **hist , bin_edges** [tupple] The read data. None otherwise

pyrad.io.read_data_other.**read_histogram_ts**(*fname_list*, *datatype*, *t_res=300.0*)
> Reads a colection of histogram data file and creates a time series

> > **Parameters**

> > > **fname_list** [str] list of files to read

> > > **datatype** [str] The data type (dBZ, ZDR, etc.)

> > > **t_res** [float] time resolution [s]. If None the time resolution is taken as the median

> > **Returns**

> > > **tbin_edges, bin_edges, data_ma, datetime_arr[0]** [tupple] The read data. None otherwise

pyrad.io.read_data_other.**read_intercomp_scores_ts**(*fname*, *sort_by_date=False*)
> Reads a radar intercomparison scores csv file

> > **Parameters**

> > > **fname** [str] path of time series file

> > > **sort_by_date** [bool] if True, the read data is sorted by date prior to exit

> > **Returns**

> > > **date_vec, np_vec, meanbias_vec, medianbias_vec, quant25bias_vec,**

> > > **quant75bias_vec, modebias_vec, corr_vec, slope_vec, intercep_vec,**

> > > **intercep_slope1_vec** [tupple] The read data. None otherwise

pyrad.io.read_data_other.**read_intercomp_scores_ts_old**(*fname*)
> Reads a radar intercomparison scores csv file in old format

> > **Parameters**

> > > **fname** [str] path of time series file

> > **Returns**

> > > **date_vec, np_vec, meanbias_vec, medianbias_vec, quant25bias_vec,**

> > > **quant75bias_vec, modebias_vec, corr_vec, slope_vec, intercep_vec,**

> > > **intercep_slope1_vec** [tupple] The read data. None otherwise

pyrad.io.read_data_other.**read_intercomp_scores_ts_old_v0**(*fname*, *corr_min=0.6*, *np_min=9*)
> Reads a radar intercomparison scores csv file in the oldest format

> > **Parameters**

> > > **fname** [str] path of time series file

> > **Returns**

> > date_vec, np_vec, meanbias_vec, medianbias_vec, quant25bias_vec,
> >
> > quant75bias_vec, modebias_vec, corr_vec, slope_vec, intercep_vec,
> >
> > intercep_slope1_vec [tupple] The read data. None otherwise

pyrad.io.read_data_other.**read_last_state**(*fname*)

> Reads a file containing the date of acquisition of the last volume processed
>
> > **Parameters**
> >
> > > **fname** [str] name of the file to read
> >
> > **Returns**
> >
> > > **last_state** [datetime object] the date

pyrad.io.read_data_other.**read_ml_ts**(*fname*)

> Reads a melting layer time series contained in a csv file
>
> > **Parameters**
> >
> > > **fname** [str] path of time series file
> >
> > **Returns**
> >
> > > dt_ml, ml_top_avg, ml_top_std, thick_avg, thick_std, nrays_valid,
> > >
> > > nrays_total [tupple] The read data. None otherwise

pyrad.io.read_data_other.**read_monitoring_ts**(*fname*, *sort_by_date=False*)

> Reads a monitoring time series contained in a csv file
>
> > **Parameters**
> >
> > > **fname** [str] path of time series file
> > >
> > > **sort_by_date** [bool] if True, the read data is sorted by date prior to exit
> >
> > **Returns**
> >
> > > **date , np_t, central_quantile, low_quantile, high_quantile** [tuple] The read data. None
> > > otherwise

pyrad.io.read_data_other.**read_monitoring_ts_old**(*fname*)

> Reads an old format of the monitoring time series contained in a text file
>
> > **Parameters**
> >
> > > **fname** [str] path of time series file
> >
> > **Returns**
> >
> > > **date , np_t, central_quantile, low_quantile, high_quantile** [tuple] The read data in the
> > > current format. None otherwise

pyrad.io.read_data_other.**read_profile_ts**(*fname_list*, *labels*, *hres=None*, *label_nr=0*,
t_res=300.0)

> Reads a colection of profile data file and creates a time series
>
> > **Parameters**
> >
> > > **fname_list** [str] list of files to read
> > >
> > > **labels** [list of str] The data labels
> > >
> > > **hres** [float] Height resolution
> > >
> > > **label_nr** [int] the label nr of the data that will be used in the time series

---

>> **t_res** [float] time resolution [s]. If None the time resolution is taken as the median

> **Returns**

>> **tbin_edges, hbin_edges, np_ma, data_ma, datetime_arr[0]** [tuple] The read data. None otherwise

pyrad.io.read_data_other.**read_quantiles**(*fname*)

> Reads quantiles contained in a csv file

> **Parameters**

>> **fname** [str] path of time series file

> **Returns**

>> **quantiles, values** [tuple] The read data. None otherwise

pyrad.io.read_data_other.**read_quantiles_ts**(*fname_list*, *step=5.0*, *qmin=0.0*, *qmax=100.0*, *t_res=300.0*)

> Reads a colection of quantiles data file and creates a time series

> **Parameters**

>> **fname_list** [str] list of files to read

>> **step, qmin, qmax** [float] The minimum, maximum and step quantiles

>> **t_res** [float] time resolution [s]. If None the time resolution is taken as the median

> **Returns**

>> **tbin_edges, qbin_edges, data_ma, datetime_arr[0]** [tuple] The read data. None otherwise

pyrad.io.read_data_other.**read_rad4alp_cosmo**(*fname*, *datatype*, *ngates=0*)

> Reads rad4alp COSMO data binary file.

> **Parameters**

>> **fname** [str] name of the file to read

>> **datatype** [str] name of the data type

>> **ngates** [int] maximum number of range gates per ray. If larger than 0 the radar field will be cut accordingly.

> **Returns**

>> **field** [dictionary] The data field

pyrad.io.read_data_other.**read_rad4alp_vis**(*fname*, *datatype*)

> Reads rad4alp visibility data binary file.

> **Parameters**

>> **fname** [str] name of the file to read

>> **datatype** [str] name of the data type

> **Returns**

>> **field_list** [list of dictionaries] A data field. Each element of the list corresponds to one elevation

pyrad.io.read_data_other.**read_rhi_profile**(*fname*, *labels=['50.0-percentile'*, *'25.0-percentile'*, *'75.0-percentile']*)

> Reads a monitoring time series contained in a csv file

> **Parameters**
>
>> **fname** [str] path of time series file
>>
>> **labels** [list of str] The data labels
>
> **Returns**
>
>> **height, np_t, vals** [tupple] The read data. None otherwise

pyrad.io.read_data_other.**read_selfconsistency**(*fname*)

> Reads a self-consistency table with Zdr, Kdp/Zh columns
>
> **Parameters**
>
>> **fname** [str] path of time series file
>
> **Returns**
>
>> **zdr, kdpzh** [arrays] The read values

pyrad.io.read_data_other.**read_status**(*voltime*, *cfg*, *ind_rad=0*)

> Reads rad4alp xml status file.
>
> **Parameters**
>
>> **voltime** [datetime object] volume scan time
>>
>> **cfg: dictionary of dictionaries** configuration info to figure out where the data is
>>
>> **ind_rad: int** radar index
>
> **Returns**
>
>> **root** [root element object] The information contained in the status file

pyrad.io.read_data_other.**read_timeseries**(*fname*)

> Reads a time series contained in a csv file
>
> **Parameters**
>
>> **fname** [str] path of time series file
>
> **Returns**
>
>> **date , value** [tupple] A datetime object array containing the time and a numpy masked array
>> containing the value. None otherwise

pyrad.io.read_data_other.**read_ts_cum**(*fname*)

> Reads a time series of precipitation accumulation contained in a csv file
>
> **Parameters**
>
>> **fname** [str] path of time series file
>
> **Returns**
>
>> **date, np_radar, radar_value, np_sensor, sensor_value** [tupple] The data read

PYRAD.IO.WRITE_DATA

Functions for writing pyrad output data

write_fixed_angle(time_data, fixed_angle, ...)	writes an output file with the fixed angle data
write_ts_lightning(flashnr, time_data, ...)	writes the LMA sources data and the value of the colocated polarimetric variables
send_msg(sender, receiver_list, subject, fname)	sends the content of a text file by email
write_alarm_msg(radar_name, param_name_unit, ...)	writes an alarm file
write_last_state(datetime_last, fname)	writes SwissMetNet data in format datetime,avg_value, std_value
write_smn(datetime_vec, value_avg_vec, ...)	writes SwissMetNet data in format datetime,avg_value, std_value
write_trt_info(ids, max_rank, nscans, ...)	writes TRT info of the thundertracking
write_trt_cell_data(traj_ID, yyyymmd-dHHMM, ...)	writes TRT cell data
write_trt_cell_scores(traj_ID, ...)	writes TRT cells scores
write_trt_cell_lightning(cell_ID, cell_time, ...)	writes the lightning data for each TRT cell
write_rhi_profile(hvec, data, nvalid_vec, ...)	writes the values of an RHI profile in a text file
write_field_coverage(quantiles, values, ...)	writes the quantiles of the coverage on a particular sector
write_cdf(quantiles, values, ntot, nnan, ...)	writes a cumulative distribution function
write_histogram(bin_edges, values, fname[, ...])	writes a histogram
write_quantiles(quantiles, values, fname[, ...])	writes quantiles
write_ts_polar_data(dataset, fname)	writes time series of data
write_ts_ml(dt_ml, ml_top_avg, ml_top_std, ...)	writes time series of melting layer data
write_ts_cum(dataset, fname)	writes time series accumulation of data
write_monitoring_ts(start_time, np_t, ... [, ...])	writes time series of data
write_excess_gates(excess_dict, fname)	Writes the position and values of gates that have a frequency of occurrence higher than a particular threshold
write_intercomp_scores_ts(start_time, stats, ...)	writes time series of radar intercomparison scores
write_colocated_gates(coloc_gates, fname)	Writes the position of gates colocated with two radars
write_colocated_data(coloc_data, fname)	Writes the data of gates colocated with two radars
write_colocated_data_time_avg(coloc_data, fname)	Writes the time averaged data of gates colocated with two radars
write_sun_hits(sun_hits, fname)	Writes sun hits data.
write_sun_retrieval(sun_retrieval, fname)	Writes sun retrieval data.

pyrad.io.write_data.**send_msg**(*sender*, *receiver_list*, *subject*, *fname*)

> sends the content of a text file by email

> > **Parameters**

> > > **sender** [str] the email address of the sender

> > > **receiver_list** [list of string] list with the email addresses of the receiver

> > > **subject** [str] the subject of the email

> > > **fname** [str] name of the file containing the content of the email message

> > **Returns**

> > > **fname** [str] the name of the file containing the content

pyrad.io.write_data.**write_alarm_msg**(*radar_name*, *param_name_unit*, *date_last*, *target*, *tol_abs*, *np_trend*, *value_trend*, *tol_trend*, *nevents*, *np_last*, *value_last*, *fname*)

> writes an alarm file

> > **Parameters**

> > > **radar_name** [str] Name of the radar being controlled

> > > **param_name_unit** [str] Parameter and units

> > > **date_last** [datetime object] date of the current event

> > > **target, tol_abs** [float] Target value and tolerance

> > > **np_trend** [int] Total number of points in trend

> > > **value_trend, tol_trend** [float] Trend value and tolerance

> > > **nevents: int** Number of events in trend

> > > **np_last** [int] Number of points in the current event

> > > **value_last** [float] Value of the current event

> > > **fname** [str] Name of file where to store the alarm information

> > **Returns**

> > > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_cdf**(*quantiles*, *values*, *ntot*, *nnan*, *nclut*, *nblocked*, *nprec_filter*, *noutliers*, *ncdf*, *fname*, *use_nans=False*, *nan_value=0.0*, *filterprec=[]*, *vismin=None*, *sector=None*, *datatype=None*, *timeinfo=None*)

> writes a cumulative distribution function

> > **Parameters**

> > > **quantiles** [datetime array] array containing the measurement time

> > > **values** [float array] array containing the average value

> > > **fname** [float array] array containing the standard deviation

> > > **sector** [str] file name where to store the data

> > **Returns**

> > > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_colocated_data**(*coloc_data*, *fname*)

> Writes the data of gates colocated with two radars

> **Parameters**
>
> > **coloc_data** [dict] dictionary containing the colocated data parameters
> >
> > **fname** [str] file name where to store the data
>
> **Returns**
>
> > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_colocated_data_time_avg**(*coloc_data*, *fname*)

> Writes the time averaged data of gates colocated with two radars
>
> **Parameters**
>
> > **coloc_data** [dict] dictionary containing the colocated data parameters
> >
> > **fname** [str] file name where to store the data
>
> **Returns**
>
> > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_colocated_gates**(*coloc_gates*, *fname*)

> Writes the position of gates colocated with two radars
>
> **Parameters**
>
> > **coloc_gates** [dict] dictionary containing the colocated gates parameters
> >
> > **fname** [str] file name where to store the data
>
> **Returns**
>
> > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_excess_gates**(*excess_dict*, *fname*)

> Writes the position and values of gates that have a frequency of occurrence higher than a particular threshold
>
> **Parameters**
>
> > **excess_dict** [dict] dictionary containing the gates parameters
> >
> > **fname** [str] file name where to store the data
>
> **Returns**
>
> > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_field_coverage**(*quantiles*, *values*, *ele_start*, *ele_stop*, *azi_start*, *azi_stop*, *threshold*, *nvalid_min*, *datatype*, *time-info*, *fname*)

> writes the quantiles of the coverage on a particular sector
>
> **Parameters**
>
> > **quantiles** [datetime array] array containing the quantiles computed
> >
> > **values** [float array] quantile value
> >
> > **ele_start, ele_stop, azi_start, azi_stop** [float] The limits of the sector
> >
> > **threshold** [float] The minimum value to consider the data valid
> >
> > **nvalid_min** [int] the minimum number of points to consider that there are values in a ray
> >
> > **datatype** [str] data type and units
> >
> > **timeinfo** [datetime object] the time stamp of the data

> **fname** [str] name of the file where to write the data

> **Returns**

> > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_fixed_angle**(*time_data*, *fixed_angle*, *rad_lat*, *rad_lon*, *rad_alt*, *fname*)

> writes an output file with the fixed angle data

> > **Parameters**

> > > **time_data** [datetime object] The scan time

> > > **fixed_angle** [float] The first fixed angle in the scan

> > > **rad_lat, rad_lon, rad_alt** [float] Latitude, longitude [deg] and altitude [m MSL] of the radar

> > > **fname** [str] The name of the file where to write

> > **Returns**

> > > **fname** [str] the name of the file containing the content

pyrad.io.write_data.**write_histogram**(*bin_edges*, *values*, *fname*, *datatype='undefined'*, *step=0*)

> writes a histogram

> > **Parameters**

> > > **bin_edges** [float array] array containing the histogram bin edges

> > > **values** [int array] array containing the number of points in each bin

> > > **fname** [str] file name

> > > **datatype :str** The data type

> > > **step** [str] The bin step

> > **Returns**

> > > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_intercomp_scores_ts**(*start_time*, *stats*, *field_name*, *fname*, *rad1_name='RADAR001'*, *rad2_name='RADAR002'*, *rewrite=False*)

> writes time series of radar intercomparison scores

> > **Parameters**

> > > **start_time** [datetime object or array of date time objects] the time of the intercomparison

> > > **stats** [dict] dictionary containing the statistics

> > > **field_name** [str] The name of the field

> > > **fname** [str] file name where to store the data

> > > **rad1_name, rad2_name** [str] Name of the radars intercompared

> > > **rewrite** [bool] if True a new file is created

> > **Returns**

> > > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_last_state**(*datetime_last*, *fname*)

>   writes SwissMetNet data in format datetime,avg_value, std_value

>> **Parameters**

>>> **datetime_last** [datetime object] date and time of the last state

>>> **fname** [str] file name where to store the data

>> **Returns**

>>> **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_monitoring_ts**(*start_time*, *np_t*, *values*, *quantiles*, *datatype*, *fname*, *rewrite=False*)

>   writes time series of data

>> **Parameters**

>>> **start_time** [datetime object or array of date time objects] the time of the monitoring

>>> **np_t** [int or array of ints] the total number of points

>>> **values: float array with 3 elements of array of arrays** the values at certain quantiles

>>> **quantiles: float array with 3 elements** the quantiles computed

>>> **datatype** [str] The data type

>>> **fname** [str] file name where to store the data

>>> **rewrite** [bool] if True a new file is created

>> **Returns**

>>> **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_quantiles**(*quantiles*, *values*, *fname*, *datatype='undefined'*)

>   writes quantiles

>> **Parameters**

>>> **quantiles** [float array] array containing the quantiles to write

>>> **values** [float array] array containing the value of each quantile

>>> **fname** [str] file name

>>> **datatype :str** The data type

>> **Returns**

>>> **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_rhi_profile**(*hvec*, *data*, *nvalid_vec*, *labels*, *fname*, *datatype=None*, *timeinfo=None*, *sector=None*)

>   writes the values of an RHI profile in a text file

>> **Parameters**

>>> **hvec** [float array] array containing the alitude in m MSL

>>> **data** [list of float array] the quantities at each altitude

>>> **nvalid_vec** [int array] number of valid data points used to compute the quantiles

>>> **labels** [list of strings] label specifying the quantitites in data

>>> **fname** [str] file name where to store the data

> > > > **datatype** [str] the data type
> > > >
> > > > **timeinfo** [datetime object] time of the rhi profile
> > > >
> > > > **sector** [dict] dictionary specying the sector limits
> > >
> > > **Returns**
> > >
> > > > **fname** [str] the name of the file where data has been written

pyrad.io.write_data.**write_smn**(*datetime_vec*, *value_avg_vec*, *value_std_vec*, *fname*)
> writes SwissMetNet data in format datetime,avg_value, std_value
>
> > **Parameters**
> >
> > > **datetime_vec** [datetime array] array containing the measurement time
> > >
> > > **value_avg_vec** [float array] array containing the average value
> > >
> > > **value_std_vec** [float array] array containing the standard deviation
> > >
> > > **fname** [str] file name where to store the data
> >
> > **Returns**
> >
> > > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_sun_hits**(*sun_hits*, *fname*)
> Writes sun hits data.
>
> > **Parameters**
> >
> > > **sun_hits** [dict] dictionary containing the sun hits parameters
> > >
> > > **fname** [str] file name where to store the data
> >
> > **Returns**
> >
> > > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_sun_retrieval**(*sun_retrieval*, *fname*)
> Writes sun retrieval data.
>
> > **Parameters**
> >
> > > **sun_retrieval** [dict] dictionary containing the sun retrieval parameters
> > >
> > > **fname** [str] file name where to store the data
> >
> > **Returns**
> >
> > > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_trt_cell_data**(*traj_ID*, *yyyymmddHHMM*, *lon*, *lat*, *ell_L*, *ell_S*, *ell_or*, *area*, *vel_x*, *vel_y*, *det*, *RANKr*, *CG_n*, *CG_p*, *CG*, *CG_percent_p*, *ET45*, *ET45m*, *ET15*, *ET15m*, *VIL*, *maxH*, *maxHm*, *POH*, *RANK*, *Dvel_x*, *Dvel_y*, *cell_contour*, *fname*)
> writes TRT cell data
>
> > **Parameters**
> >
> > > **traj_ID, yyyymmddHHMM, lon, lat, ell_L, ell_S, ell_or, area,**
> > >
> > > **vel_x, vel_y, det, RANKr, CG_n, CG_p, CG, CG_percent_p, ET45,**
> > >
> > > **ET45m, ET15, ET15m, VIL, maxH, maxHm, POH, RANK, Dvel_x,**
> > >
> > > **Dvel_y, cell_contour:** the cell parameters

---

fname [str] file name where to store the data

Returns

fname [str] the name of the file where data has written

pyrad.io.write_data.**write_trt_cell_lightning**(*cell_ID*, *cell_time*, *lon*, *lat*, *area*, *rank*, *nflash*, *flash_density*, *fname*)

writes the lightning data for each TRT cell

Parameters

cell_ID [array of ints] the cell ID

cell_time [array of datetime] the time step

lon, lat [array of floats] the latitude and longitude of the center of the cell

area [array of floats] the area of the cell

rank [array of floats] the rank of the cell

nflash [array of ints] the number of flashes/sources within the cell

flash_density [array of floats] the flash/source density

fname [str] file name where to store the data

Returns

fname [str] the name of the file where data has written

pyrad.io.write_data.**write_trt_cell_scores**(*traj_ID*, *flash_density_max_time*, *flash_density_max_rank*, *nflashes_max_list*, *area_flash_max_list*, *flash_density_max*, *rank_max_time*, *rank_max*, *fname*)

writes TRT cells scores

Parameters

traj_ID [array of ints] The ID of the cells

flash_density_max_time [array of date times] The time at which the maximum flash density was reached for each cell

flash_density_max_rank [array of floats] The rank when the maximum flash density was reached for each cell

nflashes_max_list [array of ints] the number of flashes when the max flash density was reached

area_flash_max_list [array of floats] The area when the max flash density was reached

flash_density_max [array of floats] The maximum flash density for each cell

rank_max_time [array of datetime] the time at wich the maximum rank of each cell was reached

rank_max [array of float] the rank when the maximum rank of each cell was reached

fname [str] file name where to store the data

Returns

fname [str] the name of the file where data has written

pyrad.io.write_data.**write_trt_info**(*ids*, *max_rank*, *nscans*, *time_start*, *time_end*, *fname*)

writes TRT info of the thundertracking

Parameters

> > **ids, max_rank, nscans, time_start, time_end: array** the cell parameters
>
> > **fname** [str] file name where to store the data
>
> **Returns**
>
> > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_ts_cum**(*dataset*, *fname*)

> writes time series accumulation of data
>
> **Parameters**
>
> > **dataset** [dict] dictionary containing the time series parameters
> >
> > **fname** [str] file name where to store the data
>
> **Returns**
>
> > **fname** [str] the name of the file where data has written

pyrad.io.write_data.**write_ts_lightning**(*flashnr*, *time_data*, *time_in_flash*, *lat*, *lon*, *alt*, *dBm*, *vals_list*, *fname*, *pol_vals_labels*)

> writes the LMA sources data and the value of the colocated polarimetric variables
>
> **Parameters**
>
> > **flashnr** [int] flash number
> >
> > **time_data** [datetime object] flash source time
> >
> > **time_in_flash** [float] seconds since start of flash
> >
> > **lat, lon, alt** [float] latitude, longitude [deg] and altitude [m MSL] of the flash source
> >
> > **dBm** [float] flash power
> >
> > **vals_list** [list of arrays] List containing the data for each polarimetric variable
> >
> > **fname** [str] the name of the file containing the content
> >
> > **pol_values_labels** [list of strings] List containing strings identifying each polarimetric variable
>
> **Returns**
>
> > **fname** [str] the name of the file containing the content

pyrad.io.write_data.**write_ts_ml**(*dt_ml*, *ml_top_avg*, *ml_top_std*, *thick_avg*, *thick_std*, *nrays_valid*, *nrays_total*, *fname*)

> writes time series of melting layer data
>
> **Parameters**
>
> > **dt_ml** [date time array] array of time steps
> >
> > **ml_top_avg, ml_top_std: float arrays** the average and the standard deviation of the melting layer top height
> >
> > **thick_avg, thick_std: float arrays** the average and the standard deviation of the metling layer thickness
> >
> > **nrays_valid, nrays_total: int arrays** the number of rays where melting layer has been identified and the total number of arrays in the scan
> >
> > **fname** [str] file name where to store the data

Returns

fname [str] the name of the file where data has written

pyrad.io.write_data.**write_ts_polar_data**(*dataset*, *fname*)
    writes time series of data

Parameters

dataset [dict] dictionary containing the time series parameters

fname [str] file name where to store the data

Returns

fname [str] the name of the file where data has written

PYRAD.IO.TIMESERIES

TimeSeries class implementation for holding timeseries data.

[*TimeSeries*](desc[, timevec, timeformat, . . .])	Holding timeseries data and metadata.

class pyrad.io.timeseries.**TimeSeries**(*desc*, *timevec=None*, *timeformat=None*, *maxlength=None*, *datatype=”*)

   Bases: object

   Holding timeseries data and metadata.

>   **Attributes**
>
>>   **description** [array of str] Description of the data of the time series.
>>
>>   **time_vector** [array of datetime objects]
>>
>>   **timeformat** [how to print the time (default:] 'Date, UTC [seconds since midnight]'
>>
>>   **dataseries** [List of _dataSeries object holding the] data

Methods

[*add_dataseries*](label, unit_name, unit[, . . .])	Add a new data series to the timeseries object.
[*add_timesample*](dt, values)	Add a new sample to the time series.
[*plot*](fname[, ymin, ymax])	Make a figure of a time series
[*plot_hist*](fname[, step])	Make histograms of time series
[*write*](fname)	Write time series output

   __class__
       alias of builtins.type

   __delattr__(*$self*, *name*, */*)
       Implement delattr(self, name).

   __dict__ = mappingproxy({'__module__': 'pyrad.io.timeseries', '__doc__': "\n Holding

   __dir__(*$self*, */*)
       Default dir() implementation.

   __eq__(*$self*, *value*, */*)
       Return self==value.

   __format__(*$self*, *format_spec*, */*)
       Default object formatter.

__ge__ (*$self*, *value*, */*)
> Return self>=value.

__getattribute__ (*$self*, *name*, */*)
> Return getattr(self, name).

__gt__ (*$self*, *value*, */*)
> Return self>value.

__hash__ (*$self*, */*)
> Return hash(self).

__init__ (*desc*, *timevec=None*, *timeformat=None*, *maxlength=None*, *datatype=''*)
> Initalize the object.

> > **Parameters**

> > > **desc** [array of str]

> > > **timevec** [array of datetime]

> > > **timeformat** [specifies time format]

> > > **maxlength** [Maximal length of the time series]

> > > **num_el** [Number of values in the time series]

__init_subclass__ ()
> This method is called when a class is subclassed.

> The default implementation does nothing. It may be overridden to extend subclasses.

__le__ (*$self*, *value*, */*)
> Return self<=value.

__lt__ (*$self*, *value*, */*)
> Return self<value.

__module__ = 'pyrad.io.timeseries'

__ne__ (*$self*, *value*, */*)
> Return self!=value.

__new__ (*$type*, **args*, ***kwargs*)
> Create and return a new object. See help(type) for accurate signature.

__reduce__ (*$self*, */*)
> Helper for pickle.

__reduce_ex__ (*$self*, *protocol*, */*)
> Helper for pickle.

__repr__ (*$self*, */*)
> Return repr(self).

__setattr__ (*$self*, *name*, *value*, */*)
> Implement setattr(self, name, value).

__sizeof__ (*$self*, */*)
> Size of object in memory, in bytes.

__str__ (*$self*, */*)
> Return str(self).

__subclasshook__ ()
    Abstract classes can override this to customize issubclass().

    This is invoked early on by abc.ABCMeta.__subclasscheck__(). It should return True, False or NotImplemented. If it returns NotImplemented, the normal algorithm is used. Otherwise, it overrides the normal algorithm (and the outcome is cached).

__weakref__
    list of weak references to the object (if defined)

add_dataseries (*label*, *unit_name*, *unit*, *dataseries=None*, *plot=True*, *color=None*, *linestyle=None*)
    Add a new data series to the timeseries object. The length of the data vector must be the same as the length of the time vector.

add_timesample (*dt*, *values*)
    Add a new sample to the time series.

plot (*fname*, *ymin=None*, *ymax=None*)
    Make a figure of a time series

plot_hist (*fname*, *step=None*)
    Make histograms of time series

write (*fname*)
    Write time series output

class pyrad.io.timeseries.**_DataSeries** (*label*, *unit_name*, *unit*, *data*, *plot=True*, *color=None*, *linestyle=None*)
    Bases: `object`

Hold a data vector and some meta information.

Methods

set_value(i, val)	Append value to array

__class__
    alias of `builtins.type`

__delattr__ (*$self*, *name*, */*)
    Implement delattr(self, name).

__dict__ = mappingproxy({'__module__': 'pyrad.io.timeseries', '__doc__': '\n Hold a

__dir__ (*$self*, */*)
    Default dir() implementation.

__eq__ (*$self*, *value*, */*)
    Return self==value.

__format__ (*$self*, *format_spec*, */*)
    Default object formatter.

__ge__ (*$self*, *value*, */*)
    Return self>=value.

__getattribute__ (*$self*, *name*, */*)
    Return getattr(self, name).

__gt__(*$self*, *value*, */*)
　　Return self>value.

__hash__(*$self*, */*)
　　Return hash(self).

__init__(*label*, *unit_name*, *unit*, *data*, *plot=True*, *color=None*, *linestyle=None*)
　　Initalize the object.

__init_subclass__()
　　This method is called when a class is subclassed.

　　The default implementation does nothing. It may be overridden to extend subclasses.

__le__(*$self*, *value*, */*)
　　Return self<=value.

__lt__(*$self*, *value*, */*)
　　Return self<value.

__module__ = 'pyrad.io.timeseries'

__ne__(*$self*, *value*, */*)
　　Return self!=value.

__new__(*$type*, **args*, ***kwargs*)
　　Create and return a new object. See help(type) for accurate signature.

__reduce__(*$self*, */*)
　　Helper for pickle.

__reduce_ex__(*$self*, *protocol*, */*)
　　Helper for pickle.

__repr__(*$self*, */*)
　　Return repr(self).

__setattr__(*$self*, *name*, *value*, */*)
　　Implement setattr(self, name, value).

__sizeof__(*$self*, */*)
　　Size of object in memory, in bytes.

__str__(*$self*, */*)
　　Return str(self).

__subclasshook__()
　　Abstract classes can override this to customize issubclass().

　　This is invoked early on by abc.ABCMeta.__subclasscheck__(). It should return True, False or NotImplemented. If it returns NotImplemented, the normal algorithm is used. Otherwise, it overrides the normal algorithm (and the outcome is cached).

__weakref__
　　list of weak references to the object (if defined)

set_value(*i*, *val*)
　　Append value to array

PYRAD.IO.TRAJECTORY

Trajectory class implementation for reading trajectory file. Converting to different coordinate systems.

Trajectory(filename[, starttime, endtime, . . .])	A class for reading and handling trajectory data from a file.
_Radar_Trajectory(lat, lon, alt)	A class for holding the trajectory data assigned to a radar.

class pyrad.io.trajectory.**Trajectory**(*filename*, *starttime=None*, *endtime=None*, *trajtype='plane'*, *flashnr=0*)

Bases: object

A class for reading and handling trajectory data from a file.

Attributes

filename [str] Path and name of the trajectory definition file

starttime [datetime] Start time of trajectory processing.

endtime [datetime] End time of trajectory processing.

trajtype [str]

Type of trajectory. Can be 'plane' or 'lightning'

time_vector [Array of datetime objects] Array containing the trajectory time samples

wgs84_lat_deg [Array of floats] WGS84 latitude samples in radian

wgs84_lon_deg [Array of floats] WGS84 longitude samples in radian

wgs84_alt_m [Array of floats] WGS84 altitude samples in m

nsamples [int]

Number of samples in the trajectory

_swiss_grid_done [Bool] Indicates that convertion to Swiss coordinates has been performed

swiss_chy, swiss_chx, swiss_chh [Array of floats] Swiss coordinates in m

radar_list [list] List of radars for which trajectories are going to be computed

flashnr [int] For 'lightning' only. Number of flash for which trajectory data is going to be computed. If 0 all all flashes are going to be considered.

time_in_flash [array of floats] For 'lightning' only. Time within flash (sec)

flashnr_vec [array of ints] For 'lightning' only. Flash number of each data sample

dBm [array of floats] For 'lightning' only. Lightning power (dBm)

Methods

[add_radar](radar)	Add the coordinates (WGS84 longitude, latitude and non WGS84 altitude) of a radar to the radar_list.
[calculate_velocities](radar)	Calculate velocities.
[get_end_time]()	Get time of last trajectory sample.
[get_samples_in_period]([start, end])	"
[get_start_time]()	Get time of first trajectory sample.

__class__
    alias of `builtins.type`

__delattr__(*$self*, *name*, */*)
    Implement delattr(self, name).

__dict__ = mappingproxy({'__module__': 'pyrad.io.trajectory', '__doc__': "\n A class

__dir__(*$self*, */*)
    Default dir() implementation.

__eq__(*$self*, *value*, */*)
    Return self==value.

__format__(*$self*, *format_spec*, */*)
    Default object formatter.

__ge__(*$self*, *value*, */*)
    Return self>=value.

__getattribute__(*$self*, *name*, */*)
    Return getattr(self, name).

__gt__(*$self*, *value*, */*)
    Return self>value.

__hash__(*$self*, */*)
    Return hash(self).

__init__(*filename*, *starttime=None*, *endtime=None*, *trajtype='plane'*, *flashnr=0*)
    Initalize the object.

>   **Parameters**

>>   **filename** [str] Filename containing the trajectory samples.

>>   **starttime** [datetime] Start time of trajectory processing. If not given, use the time of the first trajectory sample.

>>   **endtime** [datetime] End time of trajectory processing. If not given, use the time of the last trajectory sample.

>>   **trajtype** [str] type of trajectory. Can be plane or lightning

>>   **flashnr** [int] If type of trajectory is lightning, the flash number to check the trajectory. 0 means all flash numbers included

__init_subclass__()
    This method is called when a class is subclassed.

    The default implementation does nothing. It may be overridden to extend subclasses.

__le__(*$self*, *value*, */*)
> Return self<=value.

__lt__(*$self*, *value*, */*)
> Return self<value.

__module__ = **'pyrad.io.trajectory'**

__ne__(*$self*, *value*, */*)
> Return self!=value.

__new__(*$type*, **args*, ***kwargs*)
> Create and return a new object. See help(type) for accurate signature.

__reduce__(*$self*, */*)
> Helper for pickle.

__reduce_ex__(*$self*, *protocol*, */*)
> Helper for pickle.

__repr__(*$self*, */*)
> Return repr(self).

__setattr__(*$self*, *name*, *value*, */*)
> Implement setattr(self, name, value).

__sizeof__(*$self*, */*)
> Size of object in memory, in bytes.

__str__(*$self*, */*)
> Return str(self).

__subclasshook__()
> Abstract classes can override this to customize issubclass().
>
> This is invoked early on by abc.ABCMeta.__subclasscheck__(). It should return True, False or NotImplemented. If it returns NotImplemented, the normal algorithm is used. Otherwise, it overrides the normal algorithm (and the outcome is cached).

__weakref__
> list of weak references to the object (if defined)

_convert_traj_to_swissgrid()
> Convert trajectory samples from WGS84 to Swiss CH1903 coordinates

_get_total_seconds(*x*)
> Return total seconds of timedelta object

_read_traj()
> Read trajectory from file

_read_traj_lightning(*flashnr=0*)
> Read trajectory from lightning file
>
> > **Parameters**
> >
> > > **flashnr** [int] the flash number to keep. If 0 data from all flashes will be kept

_read_traj_trt()
> Read trajectory from TRT file

add_radar(*radar*)
> Add the coordinates (WGS84 longitude, latitude and non WGS84 altitude) of a radar to the radar_list.
>
> > **Parameters**

> **radar** [pyart radar object] containing the radar coordinates

calculate_velocities(*radar*)
> Calculate velocities.

get_end_time()
> Get time of last trajectory sample.

get_samples_in_period(*start=None*, *end=None*)
> " Get indices of samples of the trajectory within given time period.

get_start_time()
> Get time of first trajectory sample.

class pyrad.io.trajectory.**_Radar_Trajectory**(*lat*, *lon*, *alt*)
> Bases: [object](#)

A class for holding the trajectory data assigned to a radar.

> **Attributes**
>
>> **latitude** [float] WGS84 radar latitude [deg]
>>
>> **longitude** [float] WGS84 radar longitude [deg]
>>
>> **altitude** [float] radar altitude [m] (non WGS84)
>>
>> **ch_y, ch_x, ch_alt** [float] radar coordinates in swiss CH1903 coordinates
>>
>> **elevation_vec** [float list] Elevation values of the trajectory samples
>>
>> **azimuth_vec** [float list] Azimuth values of the trajectory samples
>>
>> **range_vec** [float list] Range values of the trajectory samples
>>
>> **v_abs, v_r, v_el, v_az** [array-like] Velocity vectors of the absolute [m/s], radial [m/s], elevation [deg/s] and azimuth [deg/s] velocities

Methods

assign_trajectory(el, az, rr)	Assign a trajectory to the radar in polar radar coordinates.
assign_velocity_vecs(v_abs, v_r, v_el, v_az)	Assign velocity vectors to the radar.
convert_radpos_to_swissgrid()	Convert the radar location (in WGS84 coordinates) to swiss CH1903 coordinates.
location_is_equal(lat, lon, alt)	Check if the given coordinates are the same.

__class__
> alias of builtins.type

__delattr__(*$self*, *name*, */*)
> Implement delattr(self, name).

__dict__ = mappingproxy({'__module__': 'pyrad.io.trajectory', '__doc__': '\n A class

__dir__(*$self*, */*)
> Default dir() implementation.

__eq__(*$self*, *value*, */*)
> Return self==value.

__format__(*$self*, *format_spec*, */*)
  Default object formatter.

__ge__(*$self*, *value*, */*)
  Return self>=value.

__getattribute__(*$self*, *name*, */*)
  Return getattr(self, name).

__gt__(*$self*, *value*, */*)
  Return self>value.

__hash__(*$self*, */*)
  Return hash(self).

__init__(*lat*, *lon*, *alt*)
  Initalize the object.

> **Parameters**
>
>> **lat, lon , alt** [radar location coordinates]
>>
>> **nsamps** [number of samples]

__init_subclass__()
  This method is called when a class is subclassed.

  The default implementation does nothing. It may be overridden to extend subclasses.

__le__(*$self*, *value*, */*)
  Return self<=value.

__lt__(*$self*, *value*, */*)
  Return self<value.

__module__ = 'pyrad.io.trajectory'

__ne__(*$self*, *value*, */*)
  Return self!=value.

__new__(*$type*, **args*, ***kwargs*)
  Create and return a new object. See help(type) for accurate signature.

__reduce__(*$self*, */*)
  Helper for pickle.

__reduce_ex__(*$self*, *protocol*, */*)
  Helper for pickle.

__repr__(*$self*, */*)
  Return repr(self).

__setattr__(*$self*, *name*, *value*, */*)
  Implement setattr(self, name, value).

__sizeof__(*$self*, */*)
  Size of object in memory, in bytes.

__str__(*$self*, */*)
  Return str(self).

__subclasshook__()
  Abstract classes can override this to customize issubclass().

This is invoked early on by abc.ABCMeta.__subclasscheck__(). It should return True, False or NotImplemented. If it returns NotImplemented, the normal algorithm is used. Otherwise, it overrides the normal algorithm (and the outcome is cached).

__weakref__
> list of weak references to the object (if defined)

assign_trajectory(*el*, *az*, *rr*)
> Assign a trajectory to the radar in polar radar coordinates.

> > **Parameters**

> > > **el, az, rr** [array-like] elevation, azimuth and range vector

assign_velocity_vecs(*v_abs*, *v_r*, *v_el*, *v_az*)
> Assign velocity vectors to the radar.

convert_radpos_to_swissgrid()
> Convert the radar location (in WGS84 coordinates) to swiss CH1903 coordinates.

location_is_equal(*lat*, *lon*, *alt*)
> Check if the given coordinates are the same.

> > **Parameters**

> > > **lat, lon , alt** [radar location coordinates]

PYRAD.GRAPH.PLOTS_AUX

Auxiliary plotting functions

generate_fixed_rng_span_title(radar, field, stat)	creates the fixed range plot title
generate_fixed_rng_title(radar, field, fixed_rng)	creates the fixed range plot title
get_colobar_label(field_dict, field_name)	creates the colorbar label using field metadata
get_field_name(field_dict, field)	Return a nice field name for a particular field
get_norm(field_name)	Computes the normalization of the colormap, and gets the ticks and labels of the colorbar from the metadata of the field.

pyrad.graph.plots_aux.**generate_fixed_rng_span_title**(*radar*, *field*, *stat*, *datetime_format=None*)

creates the fixed range plot title

> **Parameters**
>
> > **radar** [radar] The radar object
> >
> > **field** [str] name of the field
> >
> > **stat** [str] The statistic computed
> >
> > **datetime_forat** [str or None] The date time format to use
>
> **Returns**
>
> > **titl** [str] The plot title

pyrad.graph.plots_aux.**generate_fixed_rng_title**(*radar*, *field*, *fixed_rng*, *datetime_format=None*)

creates the fixed range plot title

> **Parameters**
>
> > **radar** [radar] The radar object
> >
> > **field** [str] name of the field
> >
> > **fixed_rng** [float] The fixed range [m]
> >
> > **datetime_forat** [str or None] The date time format to use
>
> **Returns**
>
> > **titl** [str] The plot title

pyrad.graph.plots_aux.**get_colobar_label**(*field_dict*, *field_name*)
>   creates the colorbar label using field metadata

>> **Parameters**

>>> **field_dict** [dict] dictionary containing field metadata

>>> **field_name** [str] name of the field

>> **Returns**

>>> **label** [str] colorbar label

pyrad.graph.plots_aux.**get_field_name**(*field_dict*, *field*)
>   Return a nice field name for a particular field

>> **Parameters**

>>> **field_dict** [dict] dictionary containing field metadata

>>> **field** [str] name of the field

>> **Returns**

>>> **field_name** [str] the field name

pyrad.graph.plots_aux.**get_norm**(*field_name*)
>   Computes the normalization of the colormap, and gets the ticks and labels of the colorbar from the metadata of the field. Returns None if the required parameters are not present in the metadata

>> **Parameters**

>>> **field_name** [str] name of the field

>> **Returns**

>>> **norm** [list] the colormap index

>>> **ticks** [list] the list of ticks in the colorbar

>>> **labels** [list] the list of labels corresponding to each tick

PYRAD.GRAPH.PLOTS

Functions to plot Pyrad datasets

plot_density(hist_obj, hist_type, … [, …])	density plot (angle-values representation)
plot_scatter(bin_edges1, bin_edges2, … [, …])	2D histogram
plot_quantiles(quant, value, fname_list[, …])	plots quantiles
plot_histogram(bin_edges, values, fname_list)	computes and plots histogram
plot_histogram2(bin_centers, hist, fname_list)	plots histogram
plot_antenna_pattern(antpattern, fname_list)	plots an antenna pattern
plot_scatter_comp(value1, value2, fname_list)	plots the scatter between two time series
plot_sun_hits(field, field_name, fname_list, …)	plots the sun hits

pyrad.graph.plots.**plot_antenna_pattern**(*antpattern*, *fname_list*, *labelx='Angle [Deg]'*, *linear=False*, *twoway=False*, *title='Antenna Pattern'*, *ymin=None*, *ymax=None*, *dpi=72*)

>   plots an antenna pattern

>   **Parameters**

>>   **antpattern** [dict] dictionary with the angle and the attenuation

>>   **value** [float array] values of the time series

>>   **fname_list** [list of str] list of names of the files where to store the plot

>>   **labelx** [str] The label of the X axis

>>   **linear** [boolean] if true data is in linear units

>>   **linear** [boolean] if true data represents the two way attenuation

>>   **titl** [str] The figure title

>>   **ymin, ymax: float** Lower/Upper limit of y axis

>>   **dpi** [int] dots per inch

>   **Returns**

>>   **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots.**plot_density**(*hist_obj*, *hist_type*, *field_name*, *ind_sweep*, *prdcfg*, *fname_list*, *quantiles=[25.0, 50.0, 75.0]*, *ref_value=0.0*, *vmin=None*, *vmax=None*)

>   density plot (angle-values representation)

>   **Parameters**

>>   **hist_obj** [histogram object] object containing the histogram data to plot

> **hist_type** [str] type of histogram (instantaneous data or cumulative)
>
> **field_name** [str] name of the radar field to plot
>
> **ind_sweep** [int] sweep index to plot
>
> **prdcfg** [dict] dictionary containing the product configuration
>
> **fname_list** [list of str] list of names of the files where to store the plot
>
> **quantiles** [array] the quantile lines to plot
>
> **ref_value** [float] the reference value
>
> **vmin, vmax** [float] Minim and maximum extend of the vertical axis

> Returns
>
> > **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots.**plot_histogram**(*bin_edges*, *values*, *fname_list*, *labelx='bins'*, *labely='Number of Samples'*, *titl='histogram'*, *dpi=72*)

> computes and plots histogram

> > Parameters
> >
> > > **bin_edges** [array] histogram bin edges
> > >
> > > **values** [array] data values
> > >
> > > **fname_list** [list of str] list of names of the files where to store the plot
> > >
> > > **labelx** [str] The label of the X axis
> > >
> > > **labely** [str] The label of the Y axis
> > >
> > > **titl** [str] The figure title
> > >
> > > **dpi** [int] dots per inch
> >
> > Returns
> >
> > > **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots.**plot_histogram2**(*bin_centers*, *hist*, *fname_list*, *width=None*, *labelx='bins'*, *labely='Number of Samples'*, *titl='histogram'*, *dpi=72*, *ax=None*, *fig=None*, *save_fig=True*, *color=None*, *alpha=None*, *invert_xaxis=False*)

> plots histogram

> > Parameters
> >
> > > **bin_centers** [array] histogram bin centers
> > >
> > > **hist** [array] values for each bin
> > >
> > > **fname_list** [list of str] list of names of the files where to store the plot
> > >
> > > **width** [scalar or array-like] the width(s) of the bars. If None it is going to be estimated from the distances between centers
> > >
> > > **labelx** [str] The label of the X axis
> > >
> > > **labely** [str] The label of the Y axis
> > >
> > > **titl** [str] The figure title
> > >
> > > **dpi** [int] dots per inch
> > >
> > > **fig** [Figure] Figure to add the colorbar to. If none a new figure will be created

> **ax** [Axis] Axis to plot on. if fig is None a new axis will be created
>
> **save_fig** [bool] if true save the figure. If false it does not close the plot and returns the handle to the figure
>
> **color** [str] color of the bars
>
> **alpha** [float] parameter controling the transparency
>
> **invert_xaxis** [bool] If true inverts the x axis

> **Returns**
>
> > **fname_list or fig, ax: list of str** list of names of the created plots

pyrad.graph.plots.**plot_quantiles**(*quant*, *value*, *fname_list*, *labelx='quantile'*, *labely='value'*, *titl='quantile'*, *vmin=None*, *vmax=None*, *dpi=72*)

> plots quantiles

> **Parameters**
>
> > **quant** [array] quantiles to be plotted
> >
> > **value** [array] values of each quantile
> >
> > **fname_list** [list of str] list of names of the files where to store the plot
> >
> > **labelx** [str] The label of the X axis
> >
> > **labely** [str] The label of the Y axis
> >
> > **titl** [str] The figure title
> >
> > **vmin, vmax: float** Lower/Upper limit of data values
> >
> > **dpi** [int] dots per inch

> **Returns**
>
> > **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots.**plot_scatter**(*bin_edges1*, *bin_edges2*, *hist_2d*, *field_name1*, *field_name2*, *fname_list*, *prdcfg*, *metadata=None*, *lin_regr=None*, *lin_regr_slope1=None*, *rad1_name='RADAR001'*, *rad2_name='RADAR002'*)

> 2D histogram

> **Parameters**
>
> > **bin_edges1, bin_edges2** [float array2] the bins of each field
> >
> > **hist_2d** [ndarray 2D] the 2D histogram
> >
> > **field_name1, field_name2** [str] the names of each field
> >
> > **fname_list** [list of str] list of names of the files where to store the plot
> >
> > **prdcfg** [dict] product configuration dictionary
> >
> > **metadata** [str] a string with metadata to write in the plot
> >
> > **lin_regr** [tupple with 2 values] the coefficients for a linear regression
> >
> > **lin_regr_slope1** [float] the intercep point of a linear regression of slope 1
> >
> > **rad1_name, rad2_name** [str] name of the radars which data is used

> **Returns**
>
> > **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots.**plot_scatter_comp**(*value1*, *value2*, *fname_list*, *labelx='Sensor 1'*, *labely='Sensor 2'*, *titl='Scatter'*, *axis=None*, *metadata=None*, *dpi=72*, *ax=None*, *fig=None*, *save_fig=True*, *point_format='bx'*)

> plots the scatter between two time series

> > **Parameters**

> > > **value1** [float array] values of the first time series

> > > **value2** [float array] values of the second time series

> > > **fname_list** [list of str] list of names of the files where to store the plot

> > > **labelx** [str] The label of the X axis

> > > **labely** [str] The label of the Y axis

> > > **titl** [str] The figure title

> > > **axis** [str] type of axis

> > > **metadata** [string] a string containing metadata

> > > **dpi** [int] dots per inch

> > > **fig** [Figure] Figure to add the colorbar to. If none a new figure will be created

> > > **ax** [Axis] Axis to plot on. if fig is None a new axis will be created

> > > **save_fig** [bool] if true save the figure if false it does not close the plot and returns the handle to the figure

> > > **point_format** [str] format of the scatter point

> > **Returns**

> > > **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots.**plot_sun_hits**(*field*, *field_name*, *fname_list*, *prdcfg*)

> plots the sun hits

> > **Parameters**

> > > **radar** [Radar object] object containing the radar data to plot

> > > **field_name** [str] name of the radar field to plot

> > > **altitude** [float] the altitude [m MSL] to be plotted

> > > **prdcfg** [dict] dictionary containing the product configuration

> > > **fname_list** [list of str] list of names of the files where to store the plot

> > **Returns**

> > > **fname_list** [list of str] list of names of the created plots

PYRAD.GRAPH.PLOTS_VOL

Functions to plot radar volume data

[*plot_ppi*](radar, field_name, ind_el, prdcfg, …)	plots a PPI
[*plot_ppi_map*](radar, field_name, ind_el, …)	plots a PPI on a geographic map
[*plot_rhi*](radar, field_name, ind_az, prdcfg, …)	plots an RHI
[*plot_bscope*](radar, field_name, ind_sweep, …)	plots a B-Scope (angle-range representation)
[*plot_time_range*](radar, field_name, …)	plots a time-range plot
[*plot_fixed_rng*](radar, field_name, prdcfg, …)	plots a fixed range plot
[*plot_fixed_rng_span*](radar, field_name, …)	plots a fixed range plot
[*plot_cappi*](radar, field_name, altitude, …)	plots a Constant Altitude Plan Position Indicator CAPPI
[*plot_traj*](rng_traj, azi_traj, ele_traj, …)	plots a trajectory on a Cartesian surface
[*plot_rhi_contour*](radar, field_name, ind_az, …)	plots contour data on an RHI
[*plot_ppi_contour*](radar, field_name, ind_el, …)	plots contour data on a PPI
[*plot_pos*](lat, lon, alt, fname_list[, ax, …])	plots a trajectory on a Cartesian surface
[*plot_rhi_profile*](data_list, hvec, fname_list)	plots an RHI profile
[*plot_along_coord*](xval_list, yval_list, …)	plots data along a certain radar coordinate
[*plot_field_coverage*](xval_list, yval_list, …)	plots a time series
[*_plot_time_range*](rad_time, rad_range, …[, …])	plots a time-range plot

pyrad.graph.plots_vol.**_plot_time_range**(*rad_time, rad_range, rad_data, field_name, fname_list, titl='Time-Range plot', xlabel='time (s from start time)', ylabel='range (Km)', clabel=None, vmin=None, vmax=None, figsize=[10, 8], dpi=72*)

plots a time-range plot

> **Parameters**
>
> > **rad_time** [Radar object] object containing the radar data to plot
> >
> > **rad_range** [str] name of the radar field to plot
> >
> > **rad_data** [int] sweep index to plot
> >
> > **field_name** [str or None] field name. Used to define plot characteristics
> >
> > **fname_list** [list of str] list of names of the files where to store the plot
> >
> > **titl** [str] Plot title
> >
> > **xlabel, ylabel** [str] x- and y-axis labels
> >
> > **clabel** [str or None] colorbar label

> **vmin, vmax** [float] min and max values of the color bar
>
> **figsize** [list] figure size [xsize, ysize]
>
> **dpi** [int] dpi

> **Returns**

> **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_vol.**plot_along_coord**(*xval_list*, *yval_list*, *fname_list*, *labelx='coord'*, *labely='Value'*, *labels=None*, *title='Plot along coordinate'*, *colors=None*, *linestyles=None*, *ymin=None*, *ymax=None*, *dpi=72*)

> plots data along a certain radar coordinate

> **Parameters**

> **xval_list** [list of float arrays] the x values, range, azimuth or elevation
>
> **yval_list** [list of float arrays] the y values. Parameter to plot
>
> **fname_list** [list of str] list of names of the files where to store the plot
>
> **labelx** [str] The label of the X axis
>
> **labely** [str] The label of the Y axis
>
> **labels** [array of str] The label of the legend
>
> **title** [str] The figure title
>
> **colors** [array of str] Specifies the colors of each line
>
> **linestyles** [array of str] Specifies the line style of each line
>
> **ymin, ymax: float** Lower/Upper limit of y axis
>
> **dpi** [int] dots per inch

> **Returns**

> **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_vol.**plot_bscope**(*radar*, *field_name*, *ind_sweep*, *prdcfg*, *fname_list*)

> plots a B-Scope (angle-range representation)

> **Parameters**

> **radar** [Radar object] object containing the radar data to plot
>
> **field_name** [str] name of the radar field to plot
>
> **ind_sweep** [int] sweep index to plot
>
> **prdcfg** [dict] dictionary containing the product configuration
>
> **fname_list** [list of str] list of names of the files where to store the plot

> **Returns**

> **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_vol.**plot_cappi**(*radar*, *field_name*, *altitude*, *prdcfg*, *fname_list*, *save_fig=True*)

> plots a Constant Altitude Plan Position Indicator CAPPI

> **Parameters**

> **radar** [Radar object] object containing the radar data to plot

---

field_name [str] name of the radar field to plot

altitude [float] the altitude [m MSL] to be plotted

prdcfg [dict] dictionary containing the product configuration

fname_list [list of str] list of names of the files where to store the plot

save_fig [bool] if true save the figure. If false it does not close the plot and returns the handle to the figure

> Returns

fname_list [list of str or]

fig, ax [tupple] list of names of the saved plots or handle of the figure an axes

pyrad.graph.plots_vol.**plot_field_coverage**(*xval_list*, *yval_list*, *fname_list*, *labelx='Azimuth (deg)'*, *labely='Range extension [m]'*, *labels=None*, *title='Field coverage'*, *ymin=None*, *ymax=None*, *xmeanval=None*, *ymeanval=None*, *labelmeanval=None*, *dpi=72*)

plots a time series

> Parameters

xval_list [list of float arrays] the x values, azimuth

yval_list [list of float arrays] the y values. Range extension

fname_list [list of str] list of names of the files where to store the plot

labelx [str] The label of the X axis

labely [str] The label of the Y axis

labels [array of str] The label of the legend

title [str] The figure title

ymin, ymax [float] Lower/Upper limit of y axis

xmeanval, ymeanval [float array] the x and y values of a mean along elevation

labelmeanval [str] the label of the mean

dpi [int] dots per inch

> Returns

fname_list [list of str] list of names of the created plots

pyrad.graph.plots_vol.**plot_fixed_rng**(*radar*, *field_name*, *prdcfg*, *fname_list*, *azi_res=None*, *ele_res=None*, *ang_tol=1.0*, *vmin=None*, *vmax=None*)

plots a fixed range plot

> Parameters

radar [radar object] The radar object containing the fixed range data

field_name [str] The name of the field to plot

prdcfg [dict] dictionary containing the product configuration

fname_list [list of str] list of names of the files where to store the plot

azi_res, ele_res [float] The nominal azimuth and elevation angle resolution [deg]

ang_tol [float] The tolerance between the nominal and the actual radar angle

> > **vmin, vmax** [float] Min and Max values of the color scale. If None it is going to be taken
> > from the Py-ART config files
>
> > **Returns**
>
> > **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_vol.**plot_fixed_rng_span**(*radar*, *field_name*, *prdcfg*, *fname_list*, *azi_res=None*, *ele_res=None*, *ang_tol=1.0*, *stat='max'*)

> plots a fixed range plot
>
> > **Parameters**
>
> > **radar** [radar object] The radar object containing the fixed range data
>
> > **field_name** [str] The name of the field to plot
>
> > **prdcfg** [dict] dictionary containing the product configuration
>
> > **fname_list** [list of str] list of names of the files where to store the plot
>
> > **azi_res, ele_res** [float] The nominal azimuth and elevation angle resolution [deg]
>
> > **ang_tol** [float] The tolerance between the nominal and the actual radar angle
>
> > **Returns**
>
> > **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_vol.**plot_pos**(*lat*, *lon*, *alt*, *fname_list*, *ax=None*, *fig=None*, *save_fig=True*, *sort_altitude='No'*, *dpi=72*, *alpha=1.0*, *cb_label='height [m MSL]'*, *titl='Position'*, *xlabel='Lon [Deg]'*, *ylabel='Lat [Deg]'*, *limits=None*, *vmin=None*, *vmax=None*)

> plots a trajectory on a Cartesian surface
>
> > **Parameters**
>
> > **lat, lon, alt** [float array] Points coordinates
>
> > **fname_list** [list of str] list of names of the files where to store the plot
>
> > **fig** [Figure] Figure to add the colorbar to. If none a new figure will be created
>
> > **ax** [Axis] Axis to plot on. if fig is None a new axis will be created
>
> > **save_fig** [bool] if true save the figure if false it does not close the plot and returns the handle
> > to the figure
>
> > **sort_altitude** [str] String indicating whether to sort the altitude data. Can be 'No', 'Low-
> > est_on_top' or 'Highest_on_top'
>
> > **dpi** [int] Pixel density
>
> > **alpha** [float] Transparency
>
> > **cb_label** [str] Color bar label
>
> > **titl** [str] Plot title
>
> > **limits** [tupple or None] The limits of the field to plot
>
> > **Returns**
>
> > **fname_list** [list of str or]
>
> > **fig, ax** [tupple] list of names of the saved plots or handle of the figure an axes

---

pyrad.graph.plots_vol.**plot_ppi**(*radar*, *field_name*, *ind_el*, *prdcfg*, *fname_list*, *plot_type='PPI'*,
titl=None, *step=None*, *quantiles=None*, *save_fig=True*)

> plots a PPI

>> **Parameters**

>>> **radar** [Radar object] object containing the radar data to plot

>>> **field_name** [str] name of the radar field to plot

>>> **ind_el** [int] sweep index to plot

>>> **prdcfg** [dict] dictionary containing the product configuration

>>> **fname_list** [list of str] list of names of the files where to store the plot

>>> **plot_type** [str] type of plot (PPI, QUANTILES or HISTOGRAM)

>>> **titl** [str] Plot title

>>> **step** [float] step for histogram plotting

>>> **quantiles** [float array] quantiles to plot

>>> **save_fig** [bool] if true save the figure. If false it does not close the plot and returns the handle
to the figure

>> **Returns**

>>> **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_vol.**plot_ppi_contour**(*radar*, *field_name*, *ind_el*, *prdcfg*, *fname_list*,
contour_values=None, *linewidths=1.5*, *ax=None*,
fig=None, *save_fig=True*)

> plots contour data on a PPI

>> **Parameters**

>>> **radar** [Radar object] object containing the radar data to plot

>>> **field_name** [str] name of the radar field to plot

>>> **ind_el** [int] sweep index to plot

>>> **prdcfg** [dict] dictionary containing the product configuration

>>> **fname_list** [list of str] list of names of the files where to store the plot

>>> **contour_values** [float array] list of contours to plot

>>> **linewidths** [float] width of the contour lines

>>> **fig** [Figure] Figure to add the colorbar to. If none a new figure will be created

>>> **ax** [Axis] Axis to plot on. if fig is None a new axis will be created

>>> **save_fig** [bool] if true save the figure if false it does not close the plot and returns the handle
to the figure

>> **Returns**

>>> **fname_list** [list of str or]

>>> **fig, ax** [tupple] list of names of the saved plots or handle of the figure an axes

pyrad.graph.plots_vol.**plot_ppi_map**(*radar*, *field_name*, *ind_el*, *prdcfg*, *fname_list*)

> plots a PPI on a geographic map

>> **Parameters**

> **radar** [Radar object] object containing the radar data to plot
>
> **field_name** [str] name of the radar field to plot
>
> **ind_el** [int] sweep index to plot
>
> **prdcfg** [dict] dictionary containing the product configuration
>
> **fname_list** [list of str] list of names of the files where to store the plot

> Returns
>
> > **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_vol.**plot_rhi**(*radar*, *field_name*, *ind_az*, *prdcfg*, *fname_list*, *plot_type='RHI'*, *titl=None*, *step=None*, *quantiles=None*, *save_fig=True*)

> plots an RHI

> Parameters
>
> > **radar** [Radar object] object containing the radar data to plot
> >
> > **field_name** [str] name of the radar field to plot
> >
> > **ind_az** [int] sweep index to plot
> >
> > **prdcfg** [dict] dictionary containing the product configuration
> >
> > **fname_list** [list of str] list of names of the files where to store the plot
> >
> > **plot_type** [str] type of plot (PPI, QUANTILES or HISTOGRAM)
> >
> > **titl** [str] Plot title
> >
> > **step** [float] step for histogram plotting
> >
> > **quantiles** [float array] quantiles to plot
> >
> > **save_fig** [bool] if true save the figure. If false it does not close the plot and returns the handle to the figure

> Returns
>
> > **fname_list** [list of str] list of names of the created plots
> >
> > **fig, ax** [tupple] list of names of the saved plots or handle of the figure an axes

pyrad.graph.plots_vol.**plot_rhi_contour**(*radar*, *field_name*, *ind_az*, *prdcfg*, *fname_list*, *contour_values=None*, *linewidths=1.5*, *ax=None*, *fig=None*, *save_fig=True*)

> plots contour data on an RHI

> Parameters
>
> > **radar** [Radar object] object containing the radar data to plot
> >
> > **field_name** [str] name of the radar field to plot
> >
> > **ind_az** [int] sweep index to plot
> >
> > **prdcfg** [dict] dictionary containing the product configuration
> >
> > **fname_list** [list of str] list of names of the files where to store the plot
> >
> > **contour_values** [float array] list of contours to plot
> >
> > **linewidths** [float] width of the contour lines
> >
> > **fig** [Figure] Figure to add the colorbar to. If none a new figure will be created

ax [Axis] Axis to plot on. if fig is None a new axis will be created

save_fig [bool] if true save the figure if false it does not close the plot and returns the handle
to the figure

Returns

fname_list [list of str or]

fig, ax [tupple] list of names of the saved plots or handle of the figure an axes

pyrad.graph.plots_vol.**plot_rhi_profile**(*data_list, hvec, fname_list, labelx='Value', la-
bely='Height (m MSL)', labels=['Mean'], ti-
tle='RHI profile', colors=None, linestyles=None,
vmin=None, vmax=None, hmin=None, hmax=None,
dpi=72*)

plots an RHI profile

Parameters

data_list [list of float array] values of the profile

hvec [float array] height points of the profile

fname_list [list of str] list of names of the files where to store the plot

labelx [str] The label of the X axis

labely [str] The label of the Y axis

labels [array of str] The label of the legend

title [str] The figure title

colors [array of str] Specifies the colors of each line

linestyles [array of str] Specifies the line style of each line

vmin, vmax: float Lower/Upper limit of data values

hmin, hmax: float Lower/Upper limit of altitude

dpi [int] dots per inch

Returns

fname_list [list of str] list of names of the created plots

pyrad.graph.plots_vol.**plot_time_range**(*radar, field_name, ind_sweep, prdcfg, fname_list*)

plots a time-range plot

Parameters

radar [Radar object] object containing the radar data to plot

field_name [str] name of the radar field to plot

ind_sweep [int] sweep index to plot

prdcfg [dict] dictionary containing the product configuration

fname_list [list of str] list of names of the files where to store the plot

Returns

fname_list [list of str] list of names of the created plots

`pyrad.graph.plots_vol.`**`plot_traj`**(*rng_traj*, *azi_traj*, *ele_traj*, *time_traj*, *prdcfg*, *fname_list*, *rad_alt=None*, *rad_tstart=None*, *ax=None*, *fig=None*, *save_fig=True*)

plots a trajectory on a Cartesian surface

> **Parameters**
>
> > **rng_traj, azi_traj, ele_traj** [float array] antenna coordinates of the trajectory [m and deg]
> >
> > **time_traj** [datetime array] trajectory time
> >
> > **prdcfg** [dict] dictionary containing the product configuration
> >
> > **fname_list** [list of str] list of names of the files where to store the plot
> >
> > **rad_alt** [float or None] radar altitude [m MSL]
> >
> > **rad_tstart** [datetime object or None] start time of the radar scan
> >
> > **surface_alt** [float] surface altitude [m MSL]
> >
> > **color_ref** [str] What the color code represents. Can be 'None', 'rel_altitude', 'altitude' or 'time'
> >
> > **fig** [Figure] Figure to add the colorbar to. If none a new figure will be created
> >
> > **ax** [Axis] Axis to plot on. if fig is None a new axis will be created
> >
> > **save_fig** [bool] if true save the figure if false it does not close the plot and returns the handle to the figure
>
> **Returns**
>
> > **fname_list** [list of str or]
> >
> > **fig, ax** [tupple] list of names of the saved plots or handle of the figure an axes

PYRAD.GRAPH.PLOTS_GRID

Functions to plot data in a Cartesian grid format

plot_surface(grid, field_name, level, …)	plots a surface from gridded data
plot_latitude_slice(grid, field_name, lon, …)	plots a latitude slice from gridded data
plot_longitude_slice(grid, field_name, lon, …)	plots a longitude slice from gridded data
plot_latlon_slice(grid, field_name, coord1, …)	plots a croos section crossing two points in the grid

pyrad.graph.plots_grid.**plot_latitude_slice**(*grid*, *field_name*, *lon*, *lat*, *prdcfg*, *fname_list*)
    plots a latitude slice from gridded data

> **Parameters**
>
>> **grid** [Grid object] object containing the gridded data to plot
>>
>> **field_name** [str] name of the radar field to plot
>>
>> **lon, lat** [float] coordinates of the slice to plot
>>
>> **prdcfg** [dict] dictionary containing the product configuration
>>
>> **fname_list** [list of str] list of names of the files where to store the plot
>
> **Returns**
>
>> **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_grid.**plot_latlon_slice**(*grid*, *field_name*, *coord1*, *coord2*, *prdcfg*, *fname_list*)
    plots a croos section crossing two points in the grid

> **Parameters**
>
>> **grid** [Grid object] object containing the gridded data to plot
>>
>> **field_name** [str] name of the radar field to plot
>>
>> **coord1** [tupple of floats] lat, lon of the first point
>>
>> **coord2** [tupple of floats] lat, lon of the second point
>>
>> **fname_list** [list of str] list of names of the files where to store the plot
>
> **Returns**
>
>> **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_grid.**plot_longitude_slice**(*grid*, *field_name*, *lon*, *lat*, *prdcfg*, *fname_list*)
  plots a longitude slice from gridded data

>   **Parameters**

>> **grid** [Grid object] object containing the gridded data to plot

>> **field_name** [str] name of the radar field to plot

>> **lon, lat** [float] coordinates of the slice to plot

>> **prdcfg** [dict] dictionary containing the product configuration

>> **fname_list** [list of str] list of names of the files where to store the plot

>   **Returns**

>> **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_grid.**plot_surface**(*grid*, *field_name*, *level*, *prdcfg*, *fname_list*)
  plots a surface from gridded data

>   **Parameters**

>> **grid** [Grid object] object containing the gridded data to plot

>> **field_name** [str] name of the radar field to plot

>> **level** [int] level index

>> **prdcfg** [dict] dictionary containing the product configuration

>> **fname_list** [list of str] list of names of the files where to store the plot

>   **Returns**

>> **fname_list** [list of str] list of names of the created plots

PYRAD.GRAPH.PLOT_TIMESERIES

Functions to plot Pyrad datasets

[*plot_timeseries*](tvec, data_list, fname_list)	plots a time series
[*plot_timeseries_comp*](date1, value1, date2, …)	plots 2 time series in the same graph
[*plot_monitoring_ts*](date, np_t, cquant, …)	plots a time series of monitoring data
[*plot_intercomp_scores_ts*](date_vec, np_vec, …)	plots a time series of radar intercomparison scores
[*plot_ml_ts*](dt_ml_arr, ml_top_avg_arr, … [, …])	plots a time series of melting layer data
[*plot_sun_retrieval_ts*](sun_retrieval, … [, …])	plots sun retrieval time series series

pyrad.graph.plots_timeseries.**plot_intercomp_scores_ts**(*date_vec*, *np_vec*, *meanbias_vec*, *medianbias_vec*, *quant25bias_vec*, *quant75bias_vec*, *modebias_vec*, *corr_vec*, *slope_vec*, *intercep_vec*, *intercep_slope1_vec*, *fname_list*, *ref_value=0.0*, *np_min=0*, *corr_min=0.0*, *labelx='Time UTC'*, *titl='RADAR001-RADAR002 intercomparison'*, *dpi=72*)

plots a time series of radar intercomparison scores

Parameters

date_vec [datetime object] time of the time series

np_vec [int array] number of points

meanbias_vec, medianbias_vec, modebias_vec [float array] mean, median and mode bias

quant25bias_vec, quant75bias_vec: 25th and 75th percentile of the bias

corr_vec [float array] correlation

slope_vec, intercep_vec [float array] slope and intercep of a linear regression

intercep_slope1_vec [float] the intercep point of a inear regression of slope 1

ref_value [float] the reference value

np_min [int] The minimum number of points to consider the result valid

corr_min [float] The minimum correlation to consider the results valid

> **labelx** [str] The label of the X axis
>
> **titl** [str] The figure title

> **Returns**
>
> **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_timeseries.**plot_ml_ts**(*dt_ml_arr*, *ml_top_avg_arr*, *ml_top_std_arr*, *thick_avg_arr*, *thick_std_arr*, *nrays_valid_arr*, *nrays_total_arr*, *fname_list*, *labelx='Time UTC'*, *titl='Melting layer time series'*, *dpi=72*)

  plots a time series of melting layer data

> **Parameters**
>
> **dt_ml_arr** [datetime object] time of the time series
>
> **np_vec** [int array] number of points
>
> **meanbias_vec, medianbias_vec, modebias_vec** [float array] mean, median and mode bias
>
> **quant25bias_vec, quant75bias_vec: 25th and 75th percentile of the bias**
>
> **corr_vec** [float array] correlation
>
> **slope_vec, intercep_vec** [float array] slope and intercep of a linear regression
>
> **intercep_slope1_vec** [float] the intercep point of a inear regression of slope 1
>
> **ref_value** [float] the reference value
>
> **np_min** [int] The minimum number of points to consider the result valid
>
> **corr_min** [float] The minimum correlation to consider the results valid
>
> **labelx** [str] The label of the X axis
>
> **titl** [str] The figure title

> **Returns**
>
> **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_timeseries.**plot_monitoring_ts**(*date*, *np_t*, *cquant*, *lquant*, *hquant*, *field_name*, *fname_list*, *ref_value=None*, *vmin=None*, *vmax=None*, *np_min=0*, *labelx='Time [UTC]'*, *labely='Value'*, *titl='Time Series'*, *dpi=72*)

  plots a time series of monitoring data

> **Parameters**
>
> **date** [datetime object] time of the time series
>
> **np_t** [int array] number of points
>
> **cquant, lquant, hquant** [float array] values of the central, low and high quantiles
>
> **field_name** [str] name of the field
>
> **fname_list** [list of str] list of names of the files where to store the plot
>
> **ref_value** [float] the reference value
>
> **vmin, vmax** [float] The limits of the y axis
>
> **np_min** [int] minimum number of points to consider the sample plotable

labelx [str] The label of the X axis

labely [str] The label of the Y axis

titl [str] The figure title

dpi [int] dots per inch

Returns

fname_list [list of str] list of names of the created plots

pyrad.graph.plots_timeseries.**plot_sun_retrieval_ts**(*sun_retrieval*, *data_type*, *fname_list*, *labelx='Date'*, *titl='Sun retrieval Time Series'*, *dpi=72*)

plots sun retrieval time series series

Parameters

sun_retrieval [tuple] tuple containing the retrieved parameters

data_type [str] parameter to be plotted

fname_list [list of str] list of names of the files where to store the plot

labelx [str] the x label

titl [str] the title of the plot

dpi [int] dots per inch

Returns

fname_list [list of str] list of names of the created plots

pyrad.graph.plots_timeseries.**plot_timeseries**(*tvec, data_list, fname_list, labelx='Time [UTC]', labely='Value', labels=['Sensor'], title='Time Series', period=0, timeformat=None, colors=None, linestyles=None, markers=None, ymin=None, ymax=None, dpi=72*)

plots a time series

Parameters

tvec [datetime object] time of the time series

data_list [list of float array] values of the time series

fname_list [list of str] list of names of the files where to store the plot

labelx [str] The label of the X axis

labely [str] The label of the Y axis

labels [array of str] The label of the legend

title [str] The figure title

period [float] measurement period in seconds used to compute accumulation. If 0 no accumulation is computed

timeformat [str] Specifies the tvec and time format on the x axis

colors [array of str] Specifies the colors of each line

linestyles [array of str] Specifies the line style of each line

> > **markers: array of str** Specify the markers to be used for each line
>
> > **ymin, ymax: float** Lower/Upper limit of y axis
>
> > **dpi** [int] dots per inch
>
> **Returns**
>
> > **fname_list** [list of str] list of names of the created plots

pyrad.graph.plots_timeseries.**plot_timeseries_comp**(*date1*, *value1*, *date2*, *value2*, *fname_list*, *labelx='Time [UTC]'*, *labely='Value'*, *label1='Sensor 1'*, *label2='Sensor 2'*, *titl='Time Series Comparison'*, *period1=0*, *period2=0*, *ymin=None*, *ymax=None*, *dpi=72*)

> plots 2 time series in the same graph
>
> **Parameters**
>
> > **date1** [datetime object] time of the first time series
> >
> > **value1** [float array] values of the first time series
> >
> > **date2** [datetime object] time of the second time series
> >
> > **value2** [float array] values of the second time series
> >
> > **fname_list** [list of str] list of names of the files where to store the plot
> >
> > **labelx** [str] The label of the X axis
> >
> > **labely** [str] The label of the Y axis
> >
> > **label1, label2** [str] legend label for each time series
> >
> > **titl** [str]
> >
> > > The figure title
> >
> > > **period1, period2** [float] measurement period in seconds used to compute accumulation. If 0 no accumulation is computed
> >
> > **dpi** [int] dots per inch
> >
> > **ymin, ymax** [float] The limits of the Y-axis. None will keep the default limit.
>
> **Returns**
>
> > **fname_list** [list of str] list of names of the created plots

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PYRAD.UTIL.RADAR_UTILS

Miscellaneous functions dealing with radar data

`get_data_along_rng`(radar, field_name, …[, …])	Get data at particular (azimuths, elevations)
`get_data_along_azi`(radar, field_name, …[, …])	Get data at particular (ranges, elevations)
`get_data_along_ele`(radar, field_name, …[, …])	Get data at particular (ranges, azimuths)
`get_ROI`(radar, fieldname, sector)	filter out any data outside the region of interest defined by sector
`rainfall_accumulation`(t_in_vec, val_in_vec)	Computes the rainfall accumulation of a time series over a given period
`time_series_statistics`(t_in_vec, val_in_vec)	Computes statistics over a time-averaged series.
`join_time_series`(t1, val1, t2, val2[, dropnan])	joins time_series.
`get_range_bins_to_avg`(rad1_rng, rad2_rng)	Compares the resolution of two radars and determines if and which radar has to be averaged and the length of the averaging window
`belongs_roi_indices`(lat, lon, roi)	Get the indices of points that belong to roi in a list of points
`find_ray_index`(ele_vec, azi_vec, ele, azi[, …])	Find the ray index corresponding to a particular elevation and azimuth
`find_rng_index`(rng_vec, rng[, rng_tol])	Find the range index corresponding to a particular range
`find_nearest_gate`(radar, lat, lon[, latlon_tol])	Find the radar gate closest to a lat,lon point
`find_neighbour_gates`(radar, azi, rng[, …])	Find the neighbouring gates within +-delta_azi and +-delta_rng
`find_colocated_indexes`(radar1, radar2, …)	Given the theoretical elevation, azimuth and range of the co-located gates of two radars and a given tolerance returns the indices of the gates for the current radars
`get_target_elevations`(radar_in)	Gets RHI target elevations
`time_avg_range`(timeinfo, avg_starttime, …)	finds the new start and end time of an averaging
`get_closest_solar_flux`(hit_datetime_list, …)	finds the solar flux measurement closest to the sun hit
`get_fixed_rng_data`(radar, field_names, fixed_rng)	Creates a 2D-grid with (azi, ele) data at a fixed range
`get_fixed_rng_span_data`(radar, field_names)	Creates a 2D-grid with (azi, ele) data representing a user-defined statistic over a fixed range span
`create_sun_hits_field`(rad_el, rad_az, …)	creates a sun hits field from the position and power of the sun hits

Table 1 – continued from previous page

[create_sun_retrieval_field](par, field_name, …)	creates a sun retrieval field from the retrieval parameters
[compute_quantiles](field[, quantiles])	computes quantiles
[compute_quantiles_from_hist](bin_centers, hist)	computes quantiles from histograms
[compute_quantiles_sweep](field, ray_start, …)	computes quantiles of a particular sweep
[compute_histogram](field, field_name[, …])	computes histogram of the data
[compute_histogram_sweep](field, ray_start, …)	computes histogram of the data in a particular sweep
[get_histogram_bins](field_name[, step])	gets the histogram bins using the range limits of the field as defined in the Py-ART config file.
[compute_2d_stats](field1, field2, … [, …])	computes a 2D histogram and statistics of the data
[compute_1d_stats](field1, field2)	returns statistics of data
[compute_2d_hist](field1, field2, field_name1, …)	computes a 2D histogram of the data
[quantize_field](field, field_name, step)	quantizes data
[compute_profile_stats](field, gate_altitude, …)	Compute statistics of vertical profile
[compute_directional_stats](field[, avg_type, …])	Computes the mean or the median along one of the axis (ray or range)
[project_to_vertical](data_in, data_height, …)	Projects radar data to a regular vertical grid

pyrad.util.radar_utils.**belongs_roi_indices**(*lat*, *lon*, *roi*)

> Get the indices of points that belong to roi in a list of points

> > **Parameters**

> > > **lat, lon** [float arrays] latitudes and longitudes to check

> > > **roi** [dict] Dictionary describing the region of interest

> > **Returns**

> > > **inds** [array of ints] list of indices of points belonging to ROI

> > > **is_roi** [str] Whether the list of points is within the region of interest. Can be 'All', 'None', 'Some'

pyrad.util.radar_utils.**compute_1d_stats**(*field1*, *field2*)

> returns statistics of data

> > **Parameters**

> > > **field1, field2** [ndarray 1D] the two fields to compare

> > **Returns**

> > > **stats** [dict] a dictionary with statistics

pyrad.util.radar_utils.**compute_2d_hist**(*field1*, *field2*, *field_name1*, *field_name2*, *step1=None*, *step2=None*)

> computes a 2D histogram of the data

> > **Parameters**

> > > **field1, field2** [ndarray 2D] the radar fields

> > > **field_name1, field_name2** [str] field names

> > > **step1, step2** [float] size of the bins

> > **Returns**

H [float array 2D] The bi-dimensional histogram of samples x and y

xedges, yedges [float array] the bin edges along each dimension

pyrad.util.radar_utils.**compute_2d_stats**(*field1*, *field2*, *field_name1*, *field_name2*, *step1=None*, *step2=None*)

computes a 2D histogram and statistics of the data

Parameters

field1, field2 [ndarray 2D] the two fields

field_name1, field_nam2: str the name of the fields

step1, step2 [float] size of bin

Returns

hist_2d [array] the histogram

bin_edges1, bin_edges2 [float array] The bin edges

stats [dict] a dictionary with statistics

pyrad.util.radar_utils.**compute_directional_stats**(*field*, *avg_type='mean'*, *nvalid_min=1*, *axis=0*)

Computes the mean or the median along one of the axis (ray or range)

Parameters

field [ndarray] the radar field

avg_type :str the type of average: 'mean' or 'median'

nvalid_min [int] the minimum number of points to consider the stats valid. Default 1

axis [int] the axis along which to compute (0=ray, 1=range)

Returns

values [ndarray 1D] The resultant statistics

nvalid [ndarray 1D] The number of valid points used in the computation

pyrad.util.radar_utils.**compute_histogram**(*field*, *field_name*, *bin_edges=None*, *step=None*, *vmin=None*, *vmax=None*)

computes histogram of the data

Parameters

field [ndarray 2D] the radar field

field_name: str or none name of the field

bins_edges :ndarray 1D the bin edges

step [float] size of bin

vmin, vmax [float] The minimum and maximum value of the histogram

Returns

bin_edges [float array] interval of each bin

values [float array] values at each bin

pyrad.util.radar_utils.**compute_histogram_sweep**(*field*, *ray_start*, *ray_end*, *field_name*, *step=None*)

computes histogram of the data in a particular sweep

Parameters

    field [ndarray 2D] the radar field

    ray_start, ray_end [int] starting and ending ray indexes

    field_name: str name of the field

    step [float] size of bin

Returns

    bin_edges [float array] interval of each bin

    values [float array] values at each bin

pyrad.util.radar_utils.**compute_profile_stats**(*field*, *gate_altitude*, *h_vec*, *h_res*, *quantity='quantiles'*, *quantiles=array([0.25, 0.5, 0.75])*, *nvalid_min=4*, *std_field=None*, *np_field=None*, *make_linear=False*, *include_nans=False*)

Compute statistics of vertical profile

Parameters

    field [ndarray] the radar field

    gate_altitude: ndarray the altitude at each radar gate [m MSL]

    h_vec [1D ndarray] height vector [m MSL]

    h_res [float] heigh resolution [m]

    quantity [str] The quantity to compute. Can be ['quantiles', 'mode', 'regression_mean', 'mean']. If 'mean', the min, max, and average is computed.

    quantiles [1D ndarray] the quantiles to compute

    nvalid_min [int] the minimum number of points to consider the stats valid

    std_field [ndarray] the standard deviation of the regression at each range gate

    np_field [ndarray] the number of points used to compute the regression at each range gate

    make_linear [Boolean] If true the data is transformed into linear coordinates before taking the mean

    include_nans [Boolean] If true NaN will be considered as zeros

Returns

    vals [ndarray 2D] The resultant statistics

    val_valid [ndarray 1D] The number of points to compute the stats used at each height level

pyrad.util.radar_utils.**compute_quantiles**(*field*, *quantiles=None*)

computes quantiles

Parameters

    field [ndarray 2D] the radar field

    ray_start, ray_end [int] starting and ending ray indexes

    quantiles: float array list of quantiles to compute

Returns

    quantiles [float array] list of quantiles

> **values** [float array] values at each quantile

pyrad.util.radar_utils.**compute_quantiles_from_hist**(*bin_centers*, *hist*, *quantiles=None*)

> computes quantiles from histograms

> > **Parameters**

> > > **bin_centers** [ndarray 1D] the bins

> > > **hist** [ndarray 1D] the histogram

> > > **quantiles: float array** list of quantiles to compute

> > **Returns**

> > > **quantiles** [float array] list of quantiles

> > > **values** [float array] values at each quantile

pyrad.util.radar_utils.**compute_quantiles_sweep**(*field*, *ray_start*, *ray_end*, *quantiles=None*)

> computes quantiles of a particular sweep

> > **Parameters**

> > > **field** [ndarray 2D] the radar field

> > > **ray_start, ray_end** [int] starting and ending ray indexes

> > > **quantiles: float array** list of quantiles to compute

> > **Returns**

> > > **quantiles** [float array] list of quantiles

> > > **values** [float array] values at each quantile

pyrad.util.radar_utils.**create_sun_hits_field**(*rad_el*, *rad_az*, *sun_el*, *sun_az*, *data*, *imgcfg*)

> creates a sun hits field from the position and power of the sun hits

> > **Parameters**

> > > **rad_el, rad_az, sun_el, sun_az** [ndarray 1D] azimuth and elevation of the radar and the sun respectively in degree

> > > **data** [masked ndarray 1D] the sun hit data

> > > **imgcfg: dict** a dictionary specifying the ranges and resolution of the field to create

> > **Returns**

> > > **field** [masked ndarray 2D] the sun hit field

pyrad.util.radar_utils.**create_sun_retrieval_field**(*par*, *field_name*, *imgcfg*, *lant=0.0*)

> creates a sun retrieval field from the retrieval parameters

> > **Parameters**

> > > **par** [ndarray 1D] the 5 retrieval parameters

> > > **imgcfg: dict** a dictionary specifying the ranges and resolution of the field to create

> > **Returns**

> > > **field** [masked ndarray 2D] the sun retrieval field

pyrad.util.radar_utils.**find_ang_index**(*ang_vec*, *ang*, *ang_tol=0.0*)

> Find the angle index corresponding to a particular fixed angle

> **Parameters**
>
>> **ang_vec** [float array] The angle data array where to look for
>>
>> **ang** [float] The angle to search
>>
>> **ang_tol** [float] Tolerance [deg]
>
> **Returns**
>
>> **ind_ang** [int] The angle index

pyrad.util.radar_utils.**find_colocated_indexes**(*radar1*, *radar2*, *rad1_ele*, *rad1_azi*, *rad1_rng*, *rad2_ele*, *rad2_azi*, *rad2_rng*, *ele_tol=0.5*, *azi_tol=0.5*, *rng_tol=50.0*)

> Given the theoretical elevation, azimuth and range of the co-located gates of two radars and a given tolerance returns the indices of the gates for the current radars
>
> **Parameters**
>
>> **radar1, radar2** [radar objects] the two radar objects
>>
>> **rad1_ele, rad1_azi, rad1_rng** [array of floats] the radar coordinates of the radar1 gates
>>
>> **rad2_ele, rad2_azi, rad2_rng** [array of floats] the radar coordinates of the radar2 gates
>>
>> **ele_tol, azi_tol** [floats] azimuth and elevation angle tolerance [deg]
>>
>> **rng_tol** [float] range Tolerance [m]
>
> **Returns**
>
>> **ind_ray_rad1, ind_rng_rad1, ind_ray_rad2, ind_rng_rad2** [array of ints] the ray and range indexes of each radar gate

pyrad.util.radar_utils.**find_nearest_gate**(*radar*, *lat*, *lon*, *latlon_tol=0.0005*)

> Find the radar gate closest to a lat,lon point
>
> **Parameters**
>
>> **radar** [radar object] the radar object
>>
>> **lat, lon** [float] The position of the point
>>
>> **latlon_tol** [float] The tolerance around this point
>
> **Returns**
>
>> **ind_ray, ind_rng** [int] The ray and range index
>>
>> **azi, rng** [float] the range and azimuth position of the gate

pyrad.util.radar_utils.**find_neighbour_gates**(*radar*, *azi*, *rng*, *delta_azi=None*, *delta_rng=None*)

> Find the neighbouring gates within +-delta_azi and +-delta_rng
>
> **Parameters**
>
>> **radar** [radar object] the radar object
>>
>> **azi, rng** [float] The azimuth [deg] and range [m] of the central gate
>>
>> **delta_azi, delta_rng** [float] The extend where to look for
>
> **Returns**
>
>> **inds_ray_aux, ind_rng_aux** [int] The indices (ray, rng) of the neighbouring gates

---

pyrad.util.radar_utils.**find_ray_index**(*ele_vec*, *azi_vec*, *ele*, *azi*, *ele_tol=0.0*, *azi_tol=0.0*, *nearest='azi'*)

> Find the ray index corresponding to a particular elevation and azimuth
>
> > **Parameters**
> >
> > > **ele_vec, azi_vec** [float arrays] The elevation and azimuth data arrays where to look for
> > >
> > > **ele, azi** [floats] The elevation and azimuth to search
> > >
> > > **ele_tol, azi_tol** [floats] Tolerances [deg]
> > >
> > > **nearest** [str] criteria to define wich ray to keep if multiple rays are within tolerance. azi: nearest azimuth, ele: nearest elevation
> >
> > **Returns**
> >
> > > **ind_ray** [int] The ray index

pyrad.util.radar_utils.**find_rng_index**(*rng_vec*, *rng*, *rng_tol=0.0*)

> Find the range index corresponding to a particular range
>
> > **Parameters**
> >
> > > **rng_vec** [float array] The range data array where to look for
> > >
> > > **rng** [float] The range to search
> > >
> > > **rng_tol** [float] Tolerance [m]
> >
> > **Returns**
> >
> > > **ind_rng** [int] The range index

pyrad.util.radar_utils.**get_ROI**(*radar*, *fieldname*, *sector*)

> filter out any data outside the region of interest defined by sector
>
> > **Parameters**
> >
> > > **radar** [radar object] the radar object where the data is
> > >
> > > **fieldname** [str] name of the field to filter
> > >
> > > **sector** [dict] a dictionary defining the region of interest
> >
> > **Returns**
> >
> > > **roi_flag** [ndarray] a field array with ones in gates that are in the Region of Interest

pyrad.util.radar_utils.**get_closest_solar_flux**(*hit_datetime_list*, *flux_datetime_list*, *flux_value_list*)

> finds the solar flux measurement closest to the sun hit
>
> > **Parameters**
> >
> > > **hit_datetime_list** [datetime array] the date and time of the sun hit
> > >
> > > **flux_datetime_list** [datetime array] the date and time of the solar flux measurement
> > >
> > > **flux_value_list: ndarray 1D** the solar flux values
> >
> > **Returns**
> >
> > > **flux_datetime_closest_list** [datetime array] the date and time of the solar flux measurement closest to sun hit
> > >
> > > **flux_value_closest_list** [ndarray 1D] the solar flux values closest to the sun hit time

pyrad.util.radar_utils.**get_data_along_azi**(*radar*, *field_name*, *fix_ranges*, *fix_elevations*, *rng_tol=50.0*, *ang_tol=1.0*, *azi_start=None*, *azi_stop=None*)

    Get data at particular (ranges, elevations)

        Parameters

            radar [radar object] the radar object where the data is

            field_name [str] name of the field to filter

            fix_ranges, fix_elevations: list of floats List of ranges [m], elevations [deg] couples

            rng_tol [float] Tolerance between the nominal range and the radar range [m]

            ang_tol [float] Tolerance between the nominal angle and the radar angle [deg]

            azi_start, azi_stop: float Start and stop azimuth angle of the data [deg]

        Returns

            xvals [list of float arrays] The ranges of each rng, ele pair

            yvals [list of float arrays] The values

            valid_rng, valid_ele [float arrays] The rng, ele pairs

pyrad.util.radar_utils.**get_data_along_ele**(*radar*, *field_name*, *fix_ranges*, *fix_azimuths*, *rng_tol=50.0*, *ang_tol=1.0*, *ele_min=None*, *ele_max=None*)

    Get data at particular (ranges, azimuths)

        Parameters

            radar [radar object] the radar object where the data is

            field_name [str] name of the field to filter

            fix_ranges, fix_azimuths: list of floats List of ranges [m], azimuths [deg] couples

            rng_tol [float] Tolerance between the nominal range and the radar range [m]

            ang_tol [float] Tolerance between the nominal angle and the radar angle [deg]

            ele_min, ele_max: float Min and max elevation angle [deg]

        Returns

            xvals [list of float arrays] The ranges of each rng, ele pair

            yvals [list of float arrays] The values

            valid_rng, valid_ele [float arrays] The rng, ele pairs

pyrad.util.radar_utils.**get_data_along_rng**(*radar*, *field_name*, *fix_elevations*, *fix_azimuths*, *ang_tol=1.0*, *rmin=None*, *rmax=None*)

    Get data at particular (azimuths, elevations)

        Parameters

            radar [radar object] the radar object where the data is

            field_name [str] name of the field to filter

            fix_elevations, fix_azimuths: list of floats List of elevations, azimuths couples [deg]

            ang_tol [float] Tolerance between the nominal angle and the radar angle [deg]

            rmin, rmax: float Min and Max range of the obtained data [m]

Returns

> **xvals** [list of float arrays] The ranges of each azi, ele pair
>
> **yvals** [list of float arrays] The values
>
> **valid_azi, valid_ele** [float arrays] The azi, ele pairs

pyrad.util.radar_utils.**get_fixed_rng_data**(*radar*, *field_names*, *fixed_rng*, *rng_tol=50.0*, *ele_min=None*, *ele_max=None*, *azi_min=None*, *azi_max=None*)

> Creates a 2D-grid with (azi, ele) data at a fixed range
>
> **Parameters**
>
> > **radar** [radar object] The radar object containing the data
> >
> > **field_name** [str] The field name
> >
> > **fixed_rng** [float] The fixed range [m]
> >
> > **rng_tol** [float] The tolerance between the nominal range and the actual radar range [m]
> >
> > **ele_min, ele_max, azi_min, azi_max** [float or None] The limits of the grid [deg]. If None the limits will be the limits of the radar volume
>
> **Returns**
>
> > **radar** [radar object] The radar object containing only the desired data

pyrad.util.radar_utils.**get_fixed_rng_span_data**(*radar*, *field_names*, *rmin=None*, *rmax=None*, *ele_min=None*, *ele_max=None*, *azi_min=None*, *azi_max=None*)

> Creates a 2D-grid with (azi, ele) data representing a user-defined statistic over a fixed range span
>
> **Parameters**
>
> > **radar** [radar object] The radar object containing the data
> >
> > **field_name** [str] The field name
> >
> > **rmin, rmax** [float] The range limits [m]. If None the entire coverage of the radar is going to be used
> >
> > **ele_min, ele_max, azi_min, azi_max** [float or None] The limits of the grid [deg]. If None the limits will be the limits of the radar volume
>
> **Returns**
>
> > **radar** [radar object] The radar object containing only the desired data

pyrad.util.radar_utils.**get_histogram_bins**(*field_name*, *step=None*)

> gets the histogram bins using the range limits of the field as defined in the Py-ART config file.
>
> **Parameters**
>
> > **field_name: str** name of the field
> >
> > **step** [float] size of bin
>
> **Returns**
>
> > **bin_edges** [float array] The bin edges

pyrad.util.radar_utils.**get_range_bins_to_avg**(*rad1_rng*, *rad2_rng*)

> Compares the resolution of two radars and determines if and which radar has to be averaged and the length of the averaging window

---

> **Parameters**
>
> > **rad1_rng** [array] the range of radar 1
> >
> > **rad2_rng** [datetime] the range of radar 2
>
> **Returns**
>
> > **avg_rad1, avg_rad2** [Boolean] Booleans specifying if the radar data has to be average in range
> >
> > **avg_rad_lim** [array with two elements] the limits to the average (centered on each range gate)

pyrad.util.radar_utils.**get_target_elevations**(*radar_in*)

> Gets RHI target elevations
>
> **Parameters**
>
> > **radar_in** [Radar object] current radar object
>
> **Returns**
>
> > **target_elevations** [1D-array] Azimuth angles
> >
> > **el_tol** [float] azimuth tolerance

pyrad.util.radar_utils.**join_time_series**(*t1*, *val1*, *t2*, *val2*, *dropnan=False*)

> joins time_series. Only of package pandas is available otherwise returns None.
>
> **Parameters**
>
> > **t1** [datetime array] time of first series
> >
> > **val1** [float array] value of first series
> >
> > **t2** [datetime array] time of second series
> >
> > **val2** [float array] value of second series
> >
> > **dropnan** [boolean] if True remove NaN from the time series
>
> **Returns**
>
> > **t_out_vec** [datetime array] the resultant date time after joining the series
> >
> > **val1_out_vec** [float array] value of first series
> >
> > **val2_out_vec** [float array] value of second series

pyrad.util.radar_utils.**project_to_vertical**(*data_in*, *data_height*, *grid_height*, *interp_kind='none'*, *fill_value=-9999.0*)

> Projects radar data to a regular vertical grid
>
> **Parameters**
>
> > **data_in** [ndarray 1D] the radar data to project
> >
> > **data_height** [ndarray 1D] the height of each radar point
> >
> > **grid_height** [ndarray 1D] the regular vertical grid to project to
> >
> > **interp_kind** [str] The type of interpolation to use: 'none' or 'nearest'
> >
> > **fill_value** [float] The fill value used for interpolation
>
> **Returns**
>
> > **data_out** [ndarray 1D] The projected data

pyrad.util.radar_utils.**quantize_field**(*field*, *field_name*, *step*)
   quantizes data

   Parameters

   > **field** [ndarray 2D] the radar field
   >
   > **field_name: str** name of the field
   >
   > **step** [float] size of bin

   Returns

   > **fieldq** [ndarray 2D] The quantized field
   >
   > **values** [float array] values at each bin

pyrad.util.radar_utils.**rainfall_accumulation**(*t_in_vec*, *val_in_vec*, *cum_time=3600.0*, *base_time=0.0*, *dropnan=False*)
   Computes the rainfall accumulation of a time series over a given period

   Parameters

   > **t_in_vec** [datetime array] the input date and time array
   >
   > **val_in_vec** [float array] the input values array [mm/h]
   >
   > **cum_time** [int] accumulation time [s]
   >
   > **base_time** [int] base time [s]
   >
   > **dropnan** [boolean] if True remove NaN from the time series

   Returns

   > **t_out_vec** [datetime array] the output date and time array
   >
   > **val_out_vec** [float array] the output values array
   >
   > **np_vec** [int array] the number of samples at each period

pyrad.util.radar_utils.**time_avg_range**(*timeinfo*, *avg_starttime*, *avg_endtime*, *period*)
   finds the new start and end time of an averaging

   Parameters

   > **timeinfo** [datetime] the current volume time
   >
   > **avg_starttime** [datetime] the current average start time
   >
   > **avg_endtime: datetime** the current average end time
   >
   > **period: float** the averaging period

   Returns

   > **new_starttime** [datetime] the new average start time
   >
   > **new_endtime** [datetime] the new average end time

pyrad.util.radar_utils.**time_series_statistics**(*t_in_vec*, *val_in_vec*, *avg_time=3600*, *base_time=1800*, *method='mean'*, *dropnan=False*)
   Computes statistics over a time-averaged series. Only of package pandas is available otherwise returns None

   Parameters

   > **t_in_vec** [datetime array] the input date and time array
   >
   > **val_in_vec** [float array] the input values array

avg_time [int] averaging time [s]

base_time [int] base time [s]

method [str] statistical method

dropnan [boolean] if True remove NaN from the time series

Returns

t_out_vec [datetime array] the output date and time array

val_out_vec [float array] the output values array

PYRAD.UTIL.STAT_UTILS

Miscellaneous functions dealing with statistics

quantiles_weighted(values[, weight_vector, ...])	Given a set of values and weights, compute the weighted quantile(s).

pyrad.util.stat_utils.**quantiles_weighted**(*values*, *weight_vector=None*, *quantiles=array([0.5])*, *weight_threshold=None*, *data_is_log=False*)

Given a set of values and weights, compute the weighted quantile(s).

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