pyrad library reference for users

Release 0.0.1

meteoswiss-mdr

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CHAPTER

ONE

PROCESSING FLOW CONTROL (PYRAD.FLOW)

Functions to control the Pyrad data processing flow

main(cfgfile, starttime, endtime[, infostr, ...])	main flow control. Processes data over a given period of time

pyrad.flow.**main**(*cfgfile*, *starttime*, *endtime*, *infostr=''*, *trajfile=''*)

main flow control. Processes data over a given period of time

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

infostr : Information string about the actual data processing

(e.g. 'RUN57'). This sting is added to product files.

CHAPTER

TWO

DATASET PROCESSING (PYRAD.PROC)

Initiate the dataset processing.

2.1 Auxiliary functions

get_process_func(dataset_type, dsname)	maps the dataset type into its processing function and data set format
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_point_measurement(procstatus, dscfg)	Obtains the radar data at a point measurement
process_trajectory(procstatus, dscfg[, ...])	Return trajectory
process_traj_atplane(procstatus, dscfg[, ...])	Return time series according to trajectory

2.2 Echo classification and filtering

process_echo_id(procstatus, dscfg[, radar_list])	identifies echoes as 0: No data, 1: Noise, 2: Clutter,
process_echo_filter(procstatus, dscfg[, ...])	Masks all echo types that are not of the class specified in
process_filter_snr(procstatus, dscfg[, ...])	filters out low SNR echoes
process_filter_visibility(procstatus, dscfg)	filters out rays gates with low visibility and corrects the reflectivity
process_hydroclass(procstatus, dscfg[, ...])	Classifies precipitation echoes

2.3 Phase processing and attenuation correction

process_estimate_phidp0(procstatus, dscfg[, ...])	estimates the system differential phase offset at each ray
process_correct_phidp0(procstatus, dscfg[, ...])	corrects phidp of the system phase
process_smooth_phidp_single_window(...[, ...])	corrects phidp of the system phase and smoothes it using one window
process_smooth_phidp_double_window(...[, ...])	corrects phidp of the system phase and smoothes it using one window
process_kdp_leastsquare_single_window(...[, ...])	Computes specific differential phase using a piecewise least square method
process_kdp_leastsquare_double_window(...[, ...])	Computes specific differential phase using a piecewise least square method

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process_phidp_kdp_Maesaka(procstatus, dscfg)	Estimates PhiDP and KDP using the method by Maesaka
process_phidp_kdp_lp(procstatus, dscfg[, ...])	Estimates PhiDP and KDP using a linear programming algorithm
process_attenuation(procstatus, dscfg[, ...])	Computes specific attenuation and specific differential attenuation using

2.4 Monitoring, calibration and noise correction

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,
process_rhohv_rain(procstatus, dscfg[, ...])	Keeps only suitable data to evaluate the 80 percentile of RhoHV in rain
process_zdr_rain(procstatus, dscfg[, radar_list])	Keeps only suitable data to evaluate the differential reflectivity in
process_sun_hits(procstatus, dscfg[, radar_list])	monitoring of the radar using sun hits
process_selfconsistency_kdp_phidp(...[, ...])	Computes specific differential phase and differential phase in rain using
process_selfconsistency_bias(procstatus, dscfg)	Estimates the reflectivity bias by means of the selfconsistency
process_monitoring(procstatus, dscfg[, ...])	computes monitoring statistics
process_estimate_phidp0(procstatus, dscfg[, ...])	estimates the system differential phase offset at each ray
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
process_colocated_gates(procstatus, dscfg[, ...])	Find colocated gates within two radars
process_intercomp(procstatus, dscfg[, ...])	intercomparison between two radars

2.5 Retrievals

process_signal_power(procstatus, dscfg[, ...])	Computes the signal power in dBm
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

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

maps the dataset type into its processing function and data set format

Parameters **dataset_type** : str

data set type, i.e. 'RAW', 'SAN', etc.

dsname : str

Name of dataset

Returns **func_name** : str or function

pyrad function used to process the data set type

dsformat : str

data set format, i.e.: 'VOL', etc.

pyrad.proc.**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 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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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.

azmin [float. Dataset keyword] Minimum azimuth angle [deg]. Default None.

azmax [float. Dataset keyword] Maximum azimuth angle [deg]. 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_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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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

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_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]

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_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]

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_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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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_phidp_kdp_Maesaka**(*procstatus*, *dscfg*, *radar_list=None*)
Estimates PhiDP and KDP using the method by Maesaka

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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**process_phidp_kdp_lp**(*procstatus*, *dscfg*, *radar_list=None*)
Estimates PhiDP and KDP using a linear programming 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 [list of string. Dataset keyword] The input data types

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_point_measurement**(*procstatus*, *dscfg*, *radar_list=None*)

Obtains the radar data at a point measurement

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 of the point of interest

ind_rad : int

radar index

pyrad.proc.**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

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_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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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

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.

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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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

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

attg [float. Dataset keyword] The gas attenuation

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_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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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 20

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.

percent_bins [float. Dataset keyword.] minimum percentage 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 [float. Dataset keyword] maximum standard deviation to consider the data noise. Default 1.

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

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_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** : Radar

radar object

ind_rad : int

radar index

pyrad.proc.**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_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

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.proc.**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

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.proc.**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_zdr_rain**(*procstatus*, *dscfg*, *radar_list=None*)

Keeps only suitable data to evaluate the differential reflectivity in moderate 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.

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 20.

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** : Radar

radar object

ind_rad : int

radar index

CHAPTER

THREE

PRODUCTS GENERATION (PYRAD.PROD)

Initiate the products generation.

3.1 Auxiliary functions

get_dsformat_func	

3.2 Product generation

generate_vol_products(dataset, prdcfg)	generates radar volume products
generate_timeseries_products(dataset, prdcfg)	generates time series products
generate_sun_hits_products(dataset, prdcfg)	generates sun hits products
generate_monitoring_products(dataset, prdcfg)	
generate_traj_products	

pyrad.prod.**generate_monitoring_products**(*dataset*, *prdcfg*)

pyrad.prod.**generate_sun_hits_products**(*dataset*, *prdcfg*)

generates sun hits products

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.**generate_timeseries_products**(*dataset*, *prdcfg*)

generates time series products

Parameters **dataset** : dictionary

radar object

prdcfg : dictionary of dictionaries

product configuration dictionary of dictionaries

Returns no return

pyrad.prod.**generate_traj_product**(*traj*, *prdcfg*)
Generates trajectory products

Parameters **traj** : Trajectory object

prdcfg : dictionary of dictionaries

product configuration dictionary of dictionaries

Returns None

pyrad.prod.**generate_vol_products**(*dataset*, *prdcfg*)
generates radar volume products

Parameters **dataset** : Radar

radar object

prdcfg : dictionary of dictionaries

product configuration dictionary of dictionaries

Returns no return

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

Parameters **dsformat** : str

dataset group, i.e. 'VOL', etc.

Returns **func** : function

pyrad function used to generate the products

CHAPTER

FOUR

INPUT AND OUTPUT (PYRAD.IO)

Functions to read and write data and configuration files.

4.1 Reading configuration files

read_config(fname[, cfg])	Read a pyrad config file.

4.2 Reading radar data

get_data(voltime, datatypesdescr, cfg)	Reads pyrad input data.

4.3 Reading other data

read_status(voltime, cfg[, ind_rad])	Reads rad4alp xml status file.
read_rad4alp_cosmo(fname, datatype)	Reads rad4alp COSMO data binary file.
read_rad4alp_vis(fname, datatype)	Reads rad4alp visibility data binary file.
read_colocated_gates(fname)	Reads a csv files containing the posistion of colocated gates
read_colocated_data(fname)	Reads a csv files containing colocated data
read_timeseries(fname)	Reads a time series contained in a csv file
read_monitoring_ts(fname)	Reads a monitoring time series contained in a csv file
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_disdro_scattering(fname)	Reads scattering parameters computed from disdrometer data contained in a
read_sun_hits(fname)	Reads sun hits data contained in a csv file
read_sun_hits_multiple_days(cfg, time_ref[, ...])	Reads sun hits data from multiple file sources
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
read_selfconsistency(fname)	Reads a self-consistency table with Zdr, Kdp/Zh columns

4.4 Writing data

write_colocated_gates(coloc_gates, fname)	Writes the position of gates colocated with two radars
write_colocated_data(coloc_data, fname)	Writes the position of gates colocated with two radars
write_timeseries	
write_ts_polar_data(dataset, fname)	writes time series of data
write_monitoring_ts(start_time, np_t, ...)	writes time series of data
write_sun_hits(sun_hits, fname)	Writes sun hits data.
write_sun_retrieval(sun_retrieval, fname)	Writes sun retrieval data.

4.5 Auxiliary functions

get_save_dir(basepath, procname, dsname, prdname)	obtains the path to a product directory and eventually creates it
make_filename(prdtype, dstype, dsname, ext)	creates a product file name
get_datetime(fname, datadescriptor)	gets date and time from file name
get_datasetfields	
get_file_list(datadescriptor, starttime, ...)	gets the list of files with a time period
get_datatypefields	
get_fieldname_rainbow	
generate_field_name_str(datatype)	Generates a field name in a nice to read format.

4.6 Trajectory

Trajectory(filename[, starttime, endtime])	A class for reading and handling trajectory data from a file.

4.7 TimeSeries

TimeSeries(desc, timevec[, timeformat])	Holding timeseries data and metadata.

class pyrad.io.**TimeSeries**(*desc*, *timevec*, *timeformat=None*)

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)
dataseries	(List of _dataSeries object holding the) data

Methods

add_dataseries(label, unit, dataseries)	Add a new data series to the timeseries object.
plot(fname, label)	Make a figure of a time series
write(fname)	

__class__
alias of type

__delattr__
Implement delattr(self, name).

__dict__ = mappingproxy({'__weakref__': <attribute '__weakref__' of 'TimeSeries' objects>, '__doc__': '\n Holding ti

__dir__() → list
default dir() implementation

__eq__
Return self==value.

__format__()
default object formatter

__ge__
Return self>=value.

__getattribute__
Return getattr(self, name).

__gt__
Return self>value.

__hash__
Return hash(self).

__init__(*desc*, *timevec*, *timeformat=None*)
Initalize the object.

Parameters **desc** : array of str

tvec : array of datetime

__le__
Return self<=value.

__lt__
Return self<value.

__module__ = 'pyrad.io.timeseries'

__ne__
Return self!=value.

__new__()
Create and return a new object. See help(type) for accurate signature.

__reduce__()
helper for pickle

__reduce_ex__()
helper for pickle

__repr__
Return repr(self).

__setattr__
Implement setattr(self, name, value).

__sizeof__() → int
size of object in memory, in bytes

__str__
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*, *dataseries*)
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.

plot(*fname*, *label*)
Make a figure of a time series

write(*fname*)

class pyrad.io.**Trajectory**(*filename*, *starttime=None*, *endtime=None*)
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.
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

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 type

__delattr__
Implement delattr(self, name).

__dict__ = mappingproxy({'add_radar': <function Trajectory.add_radar>, '_get_total_seconds': <function Trajectory.

__dir__() → list
default dir() implementation

__eq__
Return self==value.

__format__()
default object formatter

__ge__
Return self>=value.

__getattribute__
Return getattr(self, name).

__gt__
Return self>value.

__hash__
Return hash(self).

__init__(*filename*, *starttime=None*, *endtime=None*)
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.

__le__
Return self<=value.

__lt__
Return self<value.

__module__ = 'pyrad.io.trajectory'

__ne__
Return self!=value.

__new__()
Create and return a new object. See help(type) for accurate signature.

__reduce__()
helper for pickle

__reduce_ex__()
helper for pickle

__repr__
Return repr(self).

__setattr__
Implement setattr(self, name, value).

__sizeof__() → int
size of object in memory, in bytes

__str__
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

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.

pyrad.io.**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.**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 : [radar file type]:[datatype]

cfg: dictionary of dictionaries

configuration info to figure out where the data is

Returns **radar** : Radar

radar object

pyrad.io.**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.**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, CFRADIAL, COSMO, ...

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.**get_datetime**(*fname*, *datadescriptor*)

gets date and time from file name

Parameters **fname** : file name

datadescriptor : str

radar field type. Format : [radar file type]:[datatype]

Returns **fdatetime** : datetime object

date and time in file name

pyrad.io.**get_fieldname_pyart**(*datatype*)
maps de 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.**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]

startime : 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 **radar** : Radar

radar object

pyrad.io.**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.**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.**make_filename**(*prdtype*, *dstype*, *dsname*, *ext*, *prdcfginfo=None*, *timeinfo=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 : array 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.**read_colocated_data**(*fname*)

Reads a csv files containing colocated data

Parameters **fname** : str

path of time series file

Returns rad1_ele , rad1_azi, rad1_rng, rad1_val, rad2_ele, rad2_azi, rad2_rng,

rad2_val : tupple

A tupple with the data read. None otherwise

pyrad.io.**read_colocated_gates**(*fname*)
Reads a csv files containing the posistion of colocated gates

Parameters **fname** : str

path of time series file

Returns **rad1_ele , rad1_azi, rad1_rng, rad2_ele, rad2_azi, rad2_rng** : tupple

A tupple with the data read. None otherwise

pyrad.io.**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.**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 **id, date , pressure, temp, rh, precip, wspeed, wdir** : arrays

The read values

pyrad.io.**read_monitoring_ts**(*fname*)
Reads a monitoring time series contained in a csv file

Parameters **fname** : str

path of time series file

Returns **date , np_t, central_quantile, low_quantile, high_quantile** : tupple

The read data. None otherwise

pyrad.io.**read_rad4alp_cosmo**(*fname*, *datatype*)
Reads rad4alp COSMO data binary file.

Parameters **fname** : str

name of the file to read

datatype : str

name of the data type

Returns **field** : dictionary

The data field

pyrad.io.**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_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_smn**(*fname*)
Reads SwissMetNet data contained in a csv file

Parameters **fname** : str

path of time series file

Returns **id, date , pressure, temp, rh, precip, wspeed, wdir** : tupple

The read values

pyrad.io.**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_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_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_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_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, nhits_v, el_width_v, az_width_v,

el_bias_v, az_bias_v, dBmv_sun_est, std_dBmv_sun_est, nhits_zdr,

zdr_sun_est, std_zdr_sun_est, dBm_sun_ref, ref_time : tupple

Each parameter is an array containing a time series of information on a variable

pyrad.io.**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.**write_colocated_data**(*coloc_data*, *fname*)

Writes the position 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_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_monitoring_ts**(*start_time*, *np_t*, *values*, *quantiles*, *datatype*, *fname*)
writes time series of data

Parameters **start_time** : datetime object

the time of the monitoring

np_t : int

the total number of points

values: float array

the values at certain quantiles

quantiles: float array

the quantiles computed

fname : str

file name where to store the data

Returns **fname** : str

the name of the file where data has written

pyrad.io.**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_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_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

CHAPTER

FIVE

PLOTTING (PYRAD.GRAPH)

Functions to plot graphics.

5.1 Plots

plot_ppi(radar, field_name, ind_el, prdcfg, ...)	plots a PPI
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_density(hist_obj, hist_type, ...[, ...])	density plot (angle-values representation)
plot_cappi(radar, field_name, altitude, ...)	plots a Constant Altitude Plan Position Indicator CAPPI
plot_quantiles(quant, value, fname_list[, ...])	plots quantiles
plot_histogram(bins, values, fname_list[, ...])	computes and plots histogram
plot_histogram2(bins, hist, fname_list[, ...])	plots histogram
plot_timeseries(date, value, 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_sun_hits(field, field_name, fname_list, ...)	plots the sun hits
plot_sun_retrieval_ts(sun_retrieval, ...)	plots a time series
get_colobar_label(field_dict, field_name)	creates the colorbar label using field metadata

pyrad.graph.**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.**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.**plot_cappi**(*radar*, *field_name*, *altitude*, *prdcfg*, *fname_list*)

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

Returns **fname_list** : list of str

list of names of the created plots

pyrad.graph.**plot_density**(*hist_obj, hist_type, field_name, ind_sweep, prdcfg, fname_list, quantiles=[25.0, 50.0, 75.0], ref_value=0.0*)

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

Returns **fname_list** : list of str

list of names of the created plots

pyrad.graph.**plot_histogram**(*bins*, *values*, *fname_list*, *labelx='bins'*, *labely='Number of Samples'*, *titl='histogram'*)

computes and plots histogram

Parameters **bins** : array

histogram bins

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

Returns **fname_list** : list of str

list of names of the created plots

pyrad.graph.**plot_histogram2**(*bins*, *hist*, *fname_list*, *labelx='bins'*, *labely='Number of Samples'*, *titl='histogram'*)

plots histogram

Parameters **quant** : array

histogram bins

hist : array

values for each bin

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

Returns **fname_list** : list of str

list of names of the created plots

pyrad.graph.**plot_monitoring_ts**(*date*, *np_t*, *cquant*, *lquant*, *hquant*, *field_name*, *fname_list*, *ref_value=None*, *labelx='Time [UTC]'*, *labely='Value'*, *titl='Time Series'*)

plots a time series of monitoring data

Parameters **date** : datetime object

time of the time series

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

labelx : str

The label of the X axis

labely : str

The label of the Y axis

titl : str

The figure title

Returns **fname_list** : list of str

list of names of the created plots

pyrad.graph.**plot_ppi**(*radar*, *field_name*, *ind_el*, *prdcfg*, *fname_list*, *plot_type='PPI'*, *step=None*, *quantiles=None*)

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)

step : float

step for histogram plotting

quantiles : float array

quantiles to plot

Returns **fname_list** : list of str

list of names of the created plots

pyrad.graph.**plot_quantiles**(*quant*, *value*, *fname_list*, *labelx='quantile'*, *labely='value'*, *titl='quantile'*)

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

Returns **fname_list** : list of str

list of names of the created plots

pyrad.graph.**plot_rhi**(*radar*, *field_name*, *ind_az*, *prdcfg*, *fname_list*, *plot_type='PPI'*, *step=None*, *quantiles=None*)

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)

step : float

step for histogram plotting

quantiles : float array

quantiles to plot

Returns **fname_list** : list of str

list of names of the created plots

pyrad.graph.**plot_scatter**(*bins1*, *bins2*, *hist_2d*, *field_name1*, *field_name2*, *fname_list*, *prdcfg*, *metadata=None*)

2D histogram

Parameters **bins1, bins2** : 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

Returns **fname_list** : list of str

list of names of the created plots

pyrad.graph.**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.**plot_sun_retrieval_ts**(*sun_retrieval*, *data_type*, *fname_list*)

plots a time series

Parameters **date** : datetime object

time of the time series

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

labely : str

The label of the Y axis

label1 : str

The label of the legend

titl : str

The figure title

period : float

measurement period in seconds used to compute accumulation. If 0 no accumulation is computed

Returns **fname_list** : list of str

list of names of the created plots

pyrad.graph.**plot_timeseries**(*date*, *value*, *fname_list*, *labelx='Time [UTC]'*, *labely='Value'*, *label1='Sensor'*, *titl='Time Series'*, *period=0*, *timeformat=None*)

plots a time series

Parameters **date** : datetime object

time of the time series

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

labely : str

The label of the Y axis

label1 : str

The label of the legend

titl : str

The figure title

period : float

measurement period in seconds used to compute accumulation. If 0 no accumulation is computed

timeformat : str

Specifies the date and time format on the x axis

Returns **fname_list** : list of str

list of names of the created plots

pyrad.graph.**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*)

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

Returns **fname_list** : list of str

list of names of the created plots

CHAPTER

SIX

UTILITIES (PYRAD.UTIL)

Functions to read and write data and configuration files.

6.1 Radar Utilities

get_range_bins_to_avg(rad1_rng, rad2_rng)	Compares the resolution of two radars and determines if and which radar
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
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
create_sun_hits_field(rad_el, rad_az, ...)	creates a sun hits field from the position and power of the sun hits
create_sun_retrieval_field(par, imgcfg)	creates a sun retrieval field from the retrieval parameters
compute_quantiles(field[, quantiles])	computes quantiles
compute_quantiles_from_hist(bins, hist[, ...])	computes quantiles from histograms
compute_quantiles_sweep(field, ray_start, ...)	computes quantiles of a particular sweep
compute_2d_hist(field1, field2, field_name1, ...)	computes histogram of the data
compute_2d_stats(field1, field2, ...[, ...])	computes histogram of the data
compute_histogram(field, field_name[, step])	computes histogram of the data
compute_histogram_sweep(field, ray_start, ...)	computes histogram of the data in a particular sweep

pyrad.util.**compute_2d_hist**(*field1*, *field2*, *field_name1*, *field_name2*, *step1=None*, *step2=None*)

computes histogram of the data

Parameters **field** : ndarray 2D

the radar field

field_name: str

name of the field

step : float

size of bin

Returns **bins** : float array

interval of each bin

values : float array

values at each bin

pyrad.util.**compute_2d_stats**(*field1*, *field2*, *field_name1*, *field_name2*, *step1=None*, *step2=None*)
computes histogram of the data

Parameters **field** : ndarray 2D

the radar field

field_name: str

name of the field

step : float

size of bin

Returns **bins** : float array

interval of each bin

values : float array

values at each bin

pyrad.util.**compute_histogram**(*field*, *field_name*, *step=None*)
computes histogram of the data

Parameters **field** : ndarray 2D

the radar field

field_name: str

name of the field

step : float

size of bin

Returns **bins** : float array

interval of each bin

values : float array

values at each bin

pyrad.util.**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 **bins** : float array

interval of each bin

values : float array

values at each bin

pyrad.util.**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.**compute_quantiles_from_hist**(*bins*, *hist*, *quantiles=None*)
computes quantiles from histograms

Parameters **bins** : 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.**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.**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.**create_sun_retrieval_field**(*par*, *imgcfg*)
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.**find_ray_index**(*ele_vec*, *azi_vec*, *ele*, *azi*, *ele_tol=0.0*, *azi_tol=0.0*)
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]

Returns **ind_ray** : int

The ray index

pyrad.util.**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.**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.**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.**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

CHAPTER

SEVEN

INDICES AND TABLES

- genindex
- modindex
- search

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Symbols

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