# **CF Standard Names for RADAR and LIDAR data in CfRadial**

## **Introduction**

In order to have the CfRadial format formally recognized by the Cf community, we need to agree upon a list of standard names for RADAR and LIDAR. Thus far, only reflectivity and radial velocity are in the list of standard names.

## **Links**

The CF conventions page is:

<http://cfconventions.org/latest.html>

The guidelines for standard names are provided here:

<http://cfconventions.org/Data/cf-standard-names/docs/guidelines.html>

The CF FAQ is here:

<http://cfconventions.org/faq.html>

## **Standard names for radar moments variables**

|  |  |  |
| --- | --- | --- |
| **Standard name** | **Description** | **Units** |
| equivalent\_reflectivity\_factor | A measure of backscattered power corrected for range, radar wavelength, operating characteristics and assuming liquid drops | dBZ |
| linear\_equivalent\_reflectivity\_factor | A measure of backscattered power corrected for range, radar wavelength, operating characteristics and assuming liquid drops | mm6 m-3 |
| radial\_velocity\_of\_scatterers\_away\_from\_instrument | Mean velocity along radar radial | m/s |
| doppler\_spectrum\_width | Radial velocity dispersion within resolution volume | m/s |
| log\_differential\_reflectivity\_hv | The ratio of horizontal (H) to vertical (V) polarization reflectivity values | dB |
| log\_linear\_depolarization\_ratio\_hv |  | dB |
| log\_linear\_depolarization\_ratio\_h | The ratio of received V power to H power for a H transmitted pulse | dB |
| log\_linear\_depolarization\_ratio\_v | The ratio of received H power to V power for a V transmitted pulse | dB |
| differential\_phase\_hv | The difference in the phase shift of H and V transmitted pulses due to propagation | degrees |
| specific\_differential\_phase\_hv | The difference in the phase shift of H and V transmitted pulses due to propagation over 1 km | degrees/km |
| cross\_correlation\_ratio\_hv | The complex correlation between H and V pulses that comprise radar bins |  |
| log\_power |  | dBm |
| log\_power\_co\_polar\_h | The H received power from a H transmitted pulse | dBm |
| log\_power\_cross\_polar\_h | The V received power from a H transmitted pulse | dBm |
| log\_power\_co\_polar\_v | The V received power from a V transmitted pulse | dBm |
| log\_power\_cross\_polar\_v | The H received power from a V transmitted pulse | dBm |
| linear\_power |  | mW |
| linear\_power\_co\_polar\_h | The H received power from a H transmitted pulse | mW |
| linear\_power\_cross\_polar\_h | The V received power from a H transmitted pulse | mW |
| linear\_power\_co\_polar\_v | The V received power from a V transmitted pulse | mW |
| linear\_power\_cross\_polar\_v | The H received power from a V transmitted pulse | mW |
| signal\_to\_noise\_ratio |  | dB |
| signal\_to\_noise\_ratio\_co\_polar\_h | The ratio of the H received power from a H transmitted pulse to the system noise in H | dB |
| signal\_to\_noise\_ratio\_cross\_polar\_h | The ratio of the V received power from a H transmitted pulse to the system noise in H | dB |
| signal\_to\_noise\_ratio\_co\_polar\_v | The ratio of the V received power from a V transmitted pulse to the system noise in V | dB |
| signal\_to\_noise\_ratio\_cross\_polar\_v | The ratio of the H received power from a V transmitted pulse to the system noise in V | dB |
| normalized\_coherent\_power (Note: this is also known as signal-quality-index) |  |  |
| corrected\_equivalent\_reflectivity\_factor |  | dBZ |
| corrected\_radial\_velocity\_of\_scatterers\_ away\_from\_instrument |  | m/s |
| corrected\_log\_differential\_reflectivity\_hv |  | dB |
| radar\_estimated\_rain\_rate |  | mm/hr |
| rain\_rate |  | kg/m2/s |
| radar\_echo\_classification (should be used for PID, HCA, HID etc) | Inferred dominant particle type | legend |

## **Standard names for covariance variables**

This section lists the proposed standard names for radar covariance variables, derived from the I/Q time series.

These are the fundamental quantities from which many of the radar moments are computed.

Lag0 covariances for a single channel (e.g. horizontal co-polar to horizontal co-polar) are real.

All other covariances are complex. These must be stored either as (real, imaginary) parts, or as (power, phase) pairs.

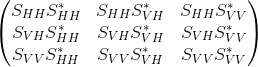
For this standard, we choose (log-power, phase) as the best way to store these complex variables.

|  |  |  |
| --- | --- | --- |
| **Proposed standard name** | **Description** | **Units** |
|  |  |  |
| **Lag-0 powers** | | |
| covariance\_lag0\_hc\_hc\_db | Lag-0 covariance for horizontal co-polar channel. This is effectively un-calibrated power for Hc. | dBm |
| covariance\_lag0\_vc\_vc\_db | Lag-0 covariance for vertical co-polar channel. This is effectively un-calibrated power for Vc. | dBm |
| covariance\_lag0\_hx\_hx\_db | Lag-0 covariance for horizontal cross-polar channel. This is effectively un-calibrated power for Hx. | dBm |
| covariance\_lag0\_vx\_vx\_db | Lag-0 covariance for vertical cross-polar channel. This is effectively un-calibrated power for Vx. | dBm |
|  |  |  |
| covariance\_lag0\_hc\_vx\_db | Lag-0 covariance horizontal co-polar to vertical cross-polar channel, power | dBm |
| covariance\_lag0\_hc\_vx\_phase | Lag-0 covariance horizontal co-polar to vertical cross-polar channel, phase | deg |
| covariance\_lag0\_vc\_hx\_db | Lag-0 covariance vertical co-polar to horizontal cross-polar channel, power | dBm |
| covariance\_lag0\_vc\_hx\_phase | Lag-0 covariance vertical co-polar to horizontal cross-polar channel, phase | deg |
|  |  |  |
| **Lag-1 complex values, stored as log-power and phase** | | |
| covariance\_lag1\_hc\_hc\_db | Lag-1 covariance for horizontal co-polar channel, power | dBm |
| covariance\_lag1\_hc\_hc\_phase | Lag-1 covariance for horizontal co-polar channel, phase | deg |
| covariance\_lag1\_vc\_vc\_db | Lag-1 covariance for vertical co-polar channel, power | dBm |
| covariance\_lag1\_vc\_vc\_phase | Lag-1 covariance for vertical co-polar channel, phase | deg |
|  |  |  |
| covariance\_lag1\_hc\_vc\_db | Lag-1 covariance for horizontal to vertical co-polar channels, power | dBm |
| covariance\_lag1\_hc\_vc\_phase | Lag-1 covariance for horizontal to vertical co-polar channels, phase | deg |
| covariance\_lag1\_vc\_hc\_db | Lag-1 covariance for vertical to horizontal co-polar channels, power | dBm |
| covariance\_lag1\_vc\_hc\_phase | Lag-1 covariance for vertical to horizontal co-polar channels, phase | deg |
|  |  |  |
| covariance\_lag1\_hx\_vx\_db | Lag-1 covariance for horizontal to vertical cross-polar channels, power | dBm |
| covariance\_lag1\_hx\_vx\_phase | Lag-1 covariance for horizontal to vertical cross-polar channels, phase | deg |
| covariance\_lag1\_vx\_hx\_db | Lag-1 covariance for vertical to horizontal cross-polar channels, power | dBm |
| covariance\_lag1\_vx\_hx\_phase | Lag-1 covariance for vertical to horizontal cross-polar channels, phase | deg |
|  |  |  |
| covariance\_lag1\_hc\_vx\_db | Lag-1 covariance for horizontal co-polar to vertical cross-polar channel, power | dBm |
| covariance\_lag1\_hc\_vx\_phase | Lag-1 covariance for horizontal co-polar to vertical cross-polar channel, phase | deg |
| covariance\_lag1\_vx\_hc\_db | Lag-1 covariance for vertical cross-polar to horizontal co-polar channel, power | dBm |
| covariance\_lag1\_vx\_hc\_phase | Lag-1 covariance for vertical cross-polar to horizontal co-polar channel, phase | deg |
|  |  |  |
| covariance\_lag1\_vc\_hx\_db | Lag-1 covariance for vertical co-polar to horizontal cross-polar channel, power | dBm |
| covariance\_lag1\_vc\_hx\_phase | Lag-1 covariance for vertical co-polar to horizontal cross-polar channel, phase | deg |
| covariance\_lag1\_hx\_vc\_db | Lag-1 covariance for horizontal cross-polar to vertical co-polar channel, power | dBm |
| covariance\_lag1\_hx\_vc\_phase | Lag-1 covariance for horizontal cross-polar to vertical co-polar channel, phase | deg |
|  |  |  |
| **Lag-2 complex values, stored as log-power and phase** | | |
| covariance\_lag2\_hc\_hc\_db | Lag-2 covariance for horizontal co-polar channel, power | dBm |
| covariance\_lag2\_hc\_hc\_phase | Lag-2 covariance for horizontal co-polar channel, phase | deg |
| covariance\_lag2\_vc\_vc\_db | Lag-2 covariance for vertical co-polar channel, power | dBm |
| covariance\_lag2\_vc\_vc\_phase | Lag-2 covariance for vertical co-polar channel, phase | deg |
|  |  |  |
| **Lag-3 complex values, stored as log-power and phase** | | |
| covariance\_lag3\_hc\_hc\_db | Lag-3 covariance for horizontal co-polar channel, power | dBm |
| covariance\_lag3\_hc\_hc\_phase | Lag-3 covariance for horizontal co-polar channel, phase | deg |
| covariance\_lag3\_vc\_vc\_db | Lag-3 covariance for vertical co-polar channel, power | dBm |
| covariance\_lag3\_vc\_vc\_phase | Lag-3 covariance for vertical co-polar channel, phase | deg |
|  |  |  |
|  |  |  |
|  |  |  |
| **Lag-0 powers for staggered PRT** | | |
| covariance\_lag0\_hc\_hc\_short\_db | Lag-0 covariance for horizontal co-polar channel for short PRT. | dBm |
| covariance\_lag0\_vc\_vc\_short\_db | Lag-0 covariance for vertical co-polar channel for short PRT. | dBm |
| covariance\_lag0\_hx\_hx\_long\_db | Lag-0 covariance for horizontal co-polar channel for long PRT. | dBm |
| covariance\_lag0\_vx\_vx\_long\_db | Lag-0 covariance for vertical co-polar channel for long PRT. | dBm |
|  |  |  |
| **Lag-1 complex values for staggered PRT, stored as log-power and phase** | | |
| covariance\_lag1\_hc\_hc\_short\_db | Lag-1 covariance for horizontal co-polar channel for short PRT, power | dBm |
| covariance\_lag1\_hc\_hc\_short\_phase | Lag-1 covariance for horizontal co-polar channel for short PRT, phase | deg |
| covariance\_lag1\_vc\_vc\_short\_db | Lag-1 covariance for vertical co-polar channel for short PRT, power | dBm |
| covariance\_lag1\_vc\_vc\_short\_phase | Lag-1 covariance for vertical co-polar channel for short PRT, phase | deg |
|  |  |  |
| covariance\_lag1\_hc\_hc\_long\_db | Lag-1 covariance for horizontal co-polar channel for long PRT, power | dBm |
| covariance\_lag1\_hc\_hc\_long\_phase | Lag-1 covariance for horizontal co-polar channel for long PRT, phase | deg |
| covariance\_lag1\_vc\_vc\_long\_db | Lag-1 covariance for vertical co-polar channel for long PRT, power | dBm |
| covariance\_lag1\_vc\_vc\_long\_phase | Lag-1 covariance for vertical co-polar channel for long PRT, phase | deg |
|  |  |  |
| covariance\_lag1\_hc\_hc\_short\_to\_long\_db | Lag-1 covariance for horizontal co-polar channel for short\_to\_long PRT, power | dBm |
| covariance\_lag1\_hc\_hc\_short\_to\_long\_phase | Lag-1 covariance for horizontal co-polar channel for short\_to\_long PRT, phase | deg |
| covariance\_lag1\_vc\_vc\_short\_to\_long\_db | Lag-1 covariance for vertical co-polar channel for short\_to\_long PRT, power | dBm |
| covariance\_lag1\_vc\_vc\_short\_to\_long\_phase | Lag-1 covariance for vertical co-polar channel for short\_to\_long PRT, phase | deg |
|  |  |  |
| covariance\_lag1\_hc\_hc\_long\_to\_short\_db | Lag-1 covariance for horizontal co-polar channel for long\_to\_short PRT, power | dBm |
| covariance\_lag1\_hc\_hc\_long\_to\_short\_phase | Lag-1 covariance for horizontal co-polar channel for long\_to\_short PRT, phase | deg |
| covariance\_lag1\_vc\_vc\_long\_to\_short\_db | Lag-1 covariance for vertical co-polar channel for long\_to\_short PRT, power | dBm |
| covariance\_lag1\_vc\_vc\_long\_to\_short\_phase | Lag-1 covariance for vertical co-polar channel for long\_to\_short PRT, phase | deg |
|  |  |  |

## **Standard names for SPECTRA variables**

This section lists the proposed standard names for spectra field variables. After assuming reciprocity there are 6 unique elements of the covariance matrix and the following names reflect those combinations. In the short name, the notation due to Bringi and Chandrasekar where SVH refers to the backscattering element where horizontal polarization is transmitted, but vertical polarization is received. The \* denotes complex conjugate.

The covariance matrix elements are given as



Elements below the diagonal are conjugate symmetric to elements above the diagonal.

|  |  |  |
| --- | --- | --- |
| **Standard name** | **Description** | **Units** |
| spectrum\_of\_copolar\_horizontal\_to\_copolar\_horizontal |  |  |
| spectrum\_of\_copolar\_horizontal\_to\_crosspolar\_vertical |  |  |
| spectrum\_of\_copolar\_horizontal\_to\_copolar\_vertical |  |  |
| spectrum\_of\_crosspolar\_vertical\_to\_crosspolar\_vertical |  |  |
| spectrum\_of\_crosspolar\_vertical\_to\_copolar\_vertical |  |  |
| spectrum\_of\_copolar\_vertical\_to\_copolar\_vertical |  |  |

## **Standard names for LIDAR field variables**

|  |  |  |
| --- | --- | --- |
| **Standard name** | **Description** | **Units** |
|  | Atmospheric temperature profile (e.g., imported from sonde) |  |
|  | Atmospheric pressure profile (e.g.,imported from sonde) |  |
| od | Optical depth |  |
| extinction | Total derived extinction | m^-1 |
| od\_aerosol | Aerosol optical depth |  |
| extinction\_aerosol | Aerosol or cloud extinction | m^-1 |
| llinear\_depolarization\_aerosol |  |  |
| backscatter\_coefficent\_aerosol | Aerosol backscatter coefficient | m^-1 sr^-1 |
| backscatter\_coefficent\_aerosol\_std | Uncertainty in aerosol backscatter coefficient due to shot noise | m^-1 sr^-1 |
| time |  |  |
| range/altitude |  | m |