Cloud Radar System (CRS) Data Description

IMPACTS 2020 Level 1B RevC Data Description

Gerald Heymsfield, Lihua Li, Matt McLinden, Peter Pantina, 2024/05/22

CRS Level 1B data consist of calibrated radar products (reflectivity, linear depolarization ratio, Doppler velocity, normalized radar cross section) with associated time and spatial information. The data products have been processed with a running average, sampled every 0.25 seconds.

NOTE: RevB has corrected Doppler velocity due to horizontal winds from HRRR reanalysis data. Rev C added noiseFloor variable and reduced precision of some variables; adjusted CRS calibration coefficient by -0.9dbZe from RevB.

Please contact Matt L. Walker McLinden (matthew.l.mclinden@nasa.gov) with questions or comments about this data.

Level 1B data is in a nested HDF5 file. Groups are:

/Information	(general information)
/Time	(time)
/Time/Data	(time data)
/Time/Information	(auxiliary time information & units)
/Products	(radar data)
/Products/Data	(radar data products)
/Products/Information	(radar data product information & units)
/Navigation	(radar position and pointing)
/Navigation/Data	(radar position data)
/Navigation/Information	(radar position information & units)

This RevC data does not use HDF5 attributes, so most data fields have associated data fields describing the information and units. Look in the '/Information' subgroups. For example, the description of radar reflectivity ('/Products/Data/dBZe') is found in /Products/Information/dBZe_description. These 'units' and 'description' fields are not listed in this document.

Data Field	Units	Dimensions	Information
/Information – General Information			
Aircraft	Text		Aircraft ('NASA ER-2')
DataContact	Text		Matthew L. Walker McLinden, ('matthew.l.mclinden@nasa.gov')
ExperimentName	Text		IMPACTS2020
FlightDate	Text		Flight date
InstrumentPI	Text		Instrument PI, ('Matthew Walker McLinden, NASA/GSFC')
L1A_ProcessDate	Text		L1A File Process Date
L1B_ProcessDate	Text		L1B File Process Date
L1B_Revision	Text		Revision Letter
L1B_Revision_Note	Text		Describes updates per revision.

MissionPI	Text		Mission PI, ('Lynn McMurdie, University of Washington')
RadarName	Text		Radar Name ('CRS')
/Time/Data – Time Data			
TimeUTC	Seconds	Time	UTC profile time in Unix Epoch format (seconds since 1970). Obtained from aircraft NTP. Note that CRS produces a profile every 0.25 seconds, however profiles are overlapping.
/Time/Information – Auxiliary Time Information			
TimeUTC_ 01Jan2020	Seconds	1	Time of 0 UTC, Jan 01, 2020, for reference if the user does not have an easy Linux time converter
/Products/Data – Radar Product Data			
dBZe	10*log10 (mm^6 /m^3)	Range, Time	Equivalent reflectivity factor in dB with 1-sigma noise threshold applied. $\|K\|^2 = 0.75$ rather than 0.93 for consistency with CloudSat. Use /Products/Information/MaskCoPol or /Products/Information/SNR for thresholding other than 1-sigma.
Velocity_ uncorrected	m/s	Range, Time	Doppler velocity with aircraft motion correction and 1-sigma noise threshold applied. Positive velocity is upward. Use /Products/Information/MaskCoPol for thresholding other than 1-sigma. Possible intrusion of horizontal winds into Doppler measurement due to slight off-nadir pointing. Check Navigation data (roll/pitch) to estimate impact or contact radar team.
Velocity_ corrected	m/s	Range, Time	Doppler velocity with aircraft motion and horizontal wind intrusion corrections applied. Positive velocity is upward. HRRR reanalysis winds were interpolated to the flight grid, converted to along/cross track components and scaled by aircraft pitch/roll to create an offset.
SpectrumWidth	m/s	Range, Time	Doppler velocity spectrum width estimate including aircraft motion and beamwidth. 1-sigma noise threshold applied. Use /Products/Information/MaskCoPol or /Products/Information/SNR for thresholding other than 1-sigma.
LDR	dB	Range, Time	Linear Depolarization Ratio with 2-sigma co- and cross-polarization noise thresholding applied. Use /Products/Information/MaskCrPol for thresholding other than 2-sigma.
sigma0	10*log10 (m^2 /m^2)	Time	Ocean Normalized Radar Cross Section. Only valid over ocean.

/Products/Information – Radar Product Information			
AircraftMotion	m/s	Time	Estimated aircraft motion in the direction of the beam that has been subtracted from the Doppler estimate.
AntennaSize	meters	1	Antenna Diameter (0.5 meters)
Antenna Beamwidth	degrees	1	Antenna 3 dB one-way beamwidth.
AveragedPulses	#	1	Number of averaged pulses per profile. Note that profiles are not independent, and are overlapping.
Frequency	Hz	1	Radar frequency (94 GHz)
GateSpacing	meters	1	Range gate spacing (26.25 meters)
HRRR_AlongWind	m/s	Range, Time	HRRR along-track winds, interpreted to the flight grid.
HRRR_CrossWind	m/s	Range, Time	HRRR cross-track winds, interpreted to the flight grid.
MaskCoPol	Special	Range, Time	Co-polarization signal-to-noise mask. (Mask >= N) corresponds with (SNR > N-sigma) noise thresholding.
MaskCrPol	Special	Range, Time	Cross-polarization signal-to-noise mask. (Mask >= N) corresponds with (SNR > N-sigma) noise thresholding.
noiseFloor	Relative power	Time	Uncalibrated estimate of noise floor
NominalAntenna Pointing	Text		Nadir
PRI	Text		'224 us / 280 us staggered'. Description of the pulse repetition interval.
Range	meters	Range	Range in meters from the aircraft of each range gate.
Resolution Horizontal6dB	meters	Range	Approximate horizontal resolution defined as the -6 dB width of spatial weighting as a function of the antenna pattern, horizontal averaging, and range.
Resolution Vertical6dB	meters	1	Approximate vertical resolution defined as the -6 dB width of the range weighting function
SNR	W/W	Range, Time	Estimated Signal-to-Noise Ratio.
Velocity_ horizwind_ offset	m/s	Range, Time	The horizontal wind offset removed from the uncorrected Doppler velocity to yield corrected Doppler velocity.
Wavelength	m	1	Radar wavelength
/Navigation/Data – Navigation Data			
Drift	degrees	Time	Difference between track and heading
EastVelocity	m/s	Time	Eastward portion of velocity
Heading	degrees	Time	Aircraft heading in degrees from north. 90 degrees is Eastward.
Height	meters	Time	Aircraft height above sea level.
Latitude	degrees	Time	Latitude
Longitude	degrees	Time	Longitude

NominalDistance	meters	Time	Nominal total along-track distance calculated by integrating instantaneous velocity. Used for simple plotting.
NorthVelocity	m/s	Time	Northward portion of velocity
Pitch	degrees	Time	Pitch
Roll	degrees	Time	Roll
Track	degrees	Time	Direction of motion in degrees from north. 90 degrees is Eastward motion.
UpVelocity	m/s	Time	Upward velocity.
dxdr	m/m	Time	Data cross-track distance from aircraft per radar range. Positive is in the starboard direction.
dydr	m/m	Time	Data along-track distance from aircraft per radar range. Positive is in the forward direction.
dzdr	m/m	Time	Data vertical distance from the aircraft per radar range. Positive is in upward direction.