



Data User Guide

GPM Ground Validation Wyoming Cloud Radar (WCR) LPVEx

Introduction

The GPM Ground Validation Wyoming Cloud Radar (WCR) LPVEx dataset includes reflectivity observations and Doppler velocity measurements, as well as aircraft navigation parameters gathered aboard the University of Wyoming King Air (UWKA) aircraft. These data were collected as part of the Light Precipitation Evaluation Experiment (LPVEx) from September 16, 2010 to October 20, 2010 in the Gulf of Finland. The dataset was collected to aid in achieving the overarching goals of LPVEx, to conduct a comprehensive evaluation of precipitation algorithms for current and future satellite platforms and to detect and understand the process of light rainfall formation at high latitudes. Multiple instruments were carried onboard the UWKA including the Cloud Microphysics instruments and the Wyoming Cloud Radar (WCR) instrument. Data files are in netCDF-3 format.

Citation

Lecuyer, Tristan and J. French. 2013. GPM Ground Validation Wyoming Cloud Radar (WCR) LPVEx [indicate subset used]. Dataset available online, [<http://ghrc.nsstc.nasa.gov>] from the NASA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/GPMGV/LPVEX/WCR/DATA101>

Keywords:

NASA, GHRC, Global Precipitation Measurement, GPM, LPVEx, Gulf of Finland, King Air, airborne, radar, cloud radar, reflectivity, Doppler velocity

Campaign

The Light Precipitation Evaluation Experiment (LPVEx) occurred in the Gulf of Finland in September and October 2010. The purpose of LPVEx was to characterize the ability of CloudSat, the Global Precipitation Mission (GPM) Dual-frequency Precipitation Radar (DPR), and existing/planned passive microwave (PMW) sensors such as the GPM

microwave imager (GMI) to detect light rain and evaluate their estimates of rainfall intensity in high latitude, shallow freezing level environments. A map of the LPVEx campaign region with the extent of radar coverage and other campaign related information marked is available through the [LPVEx website](#), as well as through the [GHRC LPVEx site](#). More detailed information about the Global Precipitation Measurement (GPM) mission is also available on the [Precipitation Measuring Mission \(PMM\) webpage](#).

Aircraft/Instrument Description

The University of Wyoming King Air (UWKA) aircraft is a Raytheon King Air 200T twin turboprop designed to be used for atmospheric research by the University of Wyoming (Figure 1). It supports a wide range of research instrumentation and is frequently used for measuring cloud properties, air motion, turbulence/fluxes, atmospheric chemistry, and aerosols. Typically accommodating a crew of three or four, the UWKA can remain aloft for up to four hours at maximum payload capacity, roughly 1,650 pounds, and operate at a maximum flight altitude of 28,000 feet. It was used during the LPVEx field campaign to acquire data over the Gulf of Finland. More information about the UWKA aircraft is available on the [University of Wyoming King Air Research webpage](#).

The Wyoming Cloud Radar (WCR) instrument was one of many payload packages flown during the LPVEx field campaign onboard the UWKA. The Cloud Microphysics instruments consisted of the Particle Measuring System (PMS), which uses the Two-Dimensional Cloud (2-DC) and the Two-Dimensional Precipitation (2-DP) probes to measure distributed droplets of drizzle and precipitation over ranges of 25-6,500 micrometers and 100-9,000 micrometers, respectively. The Forward Scattering Spectrometer Probe (FSSP) and Cloud Droplet Probe (FSSP/CDP) measured cloud droplet concentrations over 1-31 micrometers and 2-50 micrometers, respectively. Additional measurements from the PMS include numerous observations, such as static pressure, dew point temperature, relative humidity, mixing ratio, liquid water content, and droplet concentration. Further information about the PMS and Cloud Microphysics payloads can be found in the [LPVEx science plan document from 2010](#).



Figure 1: University of Wyoming King Air Research Aircraft (Top), NSF/NCAR C-130 Research Aircraft (Bottom Left), and WCR antenna (Bottom Right)
 (Image Source: <http://flights.uwyo.edu/uwka/wcr/>)

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Data Characteristics

The GPM Ground validation Wyoming Cloud Radar (WCR) LPVEx airborne radar data are available in netCDF-3 format at a level 1B processing level. For more information regarding NASA data processing levels, refer to this [link](#). Table 1 outlines key characteristics about the WCR data files.

Table 1: Data Characteristics

Characteristic	Description
Platform	University of Wyoming King Air (UWKA)
Instrument	Wyoming Cloud Radar (WCR)
Projection	N/A
Spatial Coverage	N: 61.540, S: 59.631 , E: 26.513, W: 19.837 (Gulf of Finland)
Spatial Resolution	Volume Resolution @ 1km, 250ns: 37 (range) x 12 x 15 m @ 3km, 250ns: 37 (range) x 36 x 39 m
Temporal Coverage	16 September 2010 - 20 October 2010
Temporal Resolution	Daily to < Weekly
Sampling Frequency	Pulse Repetition Frequency: 1 - 20 KHz
Parameter	Reflectivity and Doppler Velocity
Version	1
Processing Level	1B

File Naming Convention

The GPM Ground Validation Wyoming Cloud Radar (WCR) LPVEx dataset consists of .nc netCDF-3 files. The browse files are in a standard PDF format with the same naming convention as the data files with the exception of the antenna and pointing direction. The browse images write out the units of the data file the browse image was generated from, for example, Doppler velocity (DV1) or reflectivity (dBZhh1). The antenna pointing direction is also written out (updown, down-fore, down). The files are named with the following convention:

Data files: WCR.LPVEX10.YYYYMMDD.<start_time>_<stop_time>.CPP-+++++.nc

Browse files: WCR.LPVEX10.YYYYMMDD.#####_*****.CPP. "unit". "direction" .pdf

Table 2: File naming convention variables

Variable	Description
YYYY	Four digit year
MM	Two-digit month
DD	Two-digit day
<start_time>	File start time in hhmmss (hours, minutes, seconds)
<stop_time>	File stop time in hhmmss (hours, minutes, seconds)
+++++	H1, H2, V2 (All represent different antennas/pointing directions for the radar; H1: vertically up, H2: Down-slant, V2: vertically down. So if a file has all three the radar was transmitting/receiving to all three antennas; if a file only contains H1V2, then only those two antennas were being used for that particular file.)
.nc	netCDF-3 file extension

Data Format and Parameters

The GPM Ground Validation Wyoming Cloud Radar (WCR) LPVEx dataset files contain airborne radar data, such as Doppler velocity and radar reflectivity. The PI has composed a [User Notes document](#) that explains the data processing procedures for each variable in the dataset, as well as calibration notes. Table 3 outlines and describes the data fields found in the files:

Table 3: Data Fields

Field Name	Description	Data Type	Unit
acvcbeam	Platform velocity component along WCR beam. Positive is away from the radar	float	m/s
acwcbeam	Platform measured wind component along WCR beam. Positive is away from the radar	float	m/s
ALT	Radar platform Altitude from MSL	float	meters
irigstatus	WCR TFP card IRIG-B status 8-bit word	float	N/A
LAT	Radar platform Latitude	double	Degrees North
LON	Radar platform Longitude	double	Degrees East
noise	Estimated Receiver noise power in mm^6/m^3 at 1 km	float	mm^6/m^3
noisestd	Std. Dev. of noise power in mm^6/m^3 @ 1 km	float	mm^6/m^3
ppmag	Pulse Pair magnitude in mW	float	mW
ppnm	Pulse Pair Noise magnitude in mW	float	mW
range	Range to (geometric) center of radar range gates	float	meters
range_cor	Received power range(in km) correction ($1/r^2$)	float	dB
reflectivity	Equivalent reflectivity factor	float	mm^6/m^3
reflectivity_mask	Target mask(1=target,0=no signal,9=receiver saturation)	byte	N/A
TAS	Radar platform True airspeed	float	m/s
time	Profile acquisition time	double	seconds since 1970-01-01 00:00:00 +0000
velocity	Doppler radial velocity. Positive is toward the radar	float	m/s
wcraspect	$\text{WCRrangesampling}/(\text{WCRtimeint}*\text{tas})$	float	m/s
wcrbeamacvec	Radar beam unit vector in platform coordinates	float	N/A
wcrbeamvector	(East,North,Up) radar beam unit vectors	float	N/A

Algorithm

Reflectivity and Doppler velocity variables are the two primary measurements stored in the GPM Ground Validation Wyoming Cloud Radar (WCR) LPVEx dataset. No correction for scattering or absorption is applied to the reflectivity; however, mean noise is subtracted to remove negative values that are outliers, e.g. lower than the mean. The Doppler velocity values have been corrected for aircraft motion and orientation using navigation and GPS

data from the aircraft flight system. More information about the data processing algorithms used to produce this dataset is available in the [User Notes document](#) provided by the PI.

Quality Assessment

The GPM Ground Validation Wyoming Cloud Radar (WCR) LPVEx reflectivity products are corrected for noise and range correction. The Doppler velocity measurements have been corrected for platform, e.g. aircraft, motion and the beam orientation is provided in the Earth-relative coordinates for each beam. Further information about the filtering and correction algorithms are available in the [LPVEx science plan](#).

Software

This dataset is in netCDF-3 format and does not require any specific software to read; however, the data is easily read and viewed in [Panoply](#).

Known Issues or Missing Data

There are several gaps in the data caused by a variety of flight or sensor issues. The [PI Release Notes](#) provides detailed remarks for missing data issues and sensor errors.

References

NASA. (2011). Global Precipitation Measurement. Retrieved from <https://pmm.nasa.gov/GPM>

NASA. (2014). Light Precipitation Evaluation Experiment (LPVEx). Retrieved from <https://ghrc.nsstc.nasa.gov/home/field-campaigns/LPVEx>

University of Wyoming - Flight Center. (1977). University of Wyoming King Air Aircraft. <https://doi.org/doi:10.15786/M29M1V>

University of Wyoming - Flight Center. (1995). University of Wyoming Cloud Radar (WCR). <https://doi.org/doi:10.15786/M2237S>

Related Data

All data from other instruments collected during the LPVEx field campaign are related to this dataset. Other LPVEx campaign data can be located using the GHRC HyDRO 2.0 search tool.

Additionally, the Wyoming Cloud Radar (WCR) dataset was collected with a suite of instruments carried onboard the Wyoming King Air science aircraft. Other datasets associated with these tandem flights could be relatable to the LPVEx campaign overall and

the WCR dataset, for example the Cloud Microphysics dataset
(<http://dx.doi.org/10.5067/GPMGV/LPVEX/MULTPLE/DATA202>)

Contact Information

To order these data or for further information, please contact:

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