



Data User Guide

GPM Ground Validation McGill Vertical Pointing X-band (VertiX) Radar GCPEX

Introduction

The GPM Ground Validation McGill Vertical Pointing X-Band (VertiX) Radar GCPEX dataset consists of radar reflectivity and Doppler velocity data collected by the Vertically Pointing X-band (VertiX) radar during the Global Precipitation Measurement (GPM) mission Cold-season Precipitation Experiment (GCPEX) field campaign in Ontario, Canada during the 2011-2012 winter season. VertiX can detect all precipitation targets and some ice clouds, as well as measure the Doppler velocity of precipitation targets. These measurements contributed to the overarching goal of GCPEX to collect various snowfall data for the improvement of GPM satellite winter precipitation estimates. These data files are available from January 15 through February 29, 2012 in netCDF-3 format with browse imagery available in GIF format.

Notice:

For dates that have 2 netCDF-3 files, there is a gap in the data recording time between the end of the *.nc file and the beginning of the *_1.nc file.

Citation

Kollias, Pavlos. 2013. GPM Ground Validation McGill Vertical Pointing X-band (VertiX) Radar GCPEX [indicate subset used]. Dataset available online from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A.

DOI: <http://dx.doi.org/10.5067/GPMGV/GCPEX/VERTIX/DATA301>

Keywords:

NASA, GHRC, PMM, GPM GV, EC, GCPEX, X-band, Ontario, Canada, snowfall, radar, reflectivity, Doppler velocity

Campaign

The Global Precipitation Measurement mission Ground Validation (GPM GV) campaign used a variety of methods for validation of GPM satellite constellation measurements prior to and after the launch of the GPM Core Satellite, which launched on February 27, 2014. The instrument validation effort included numerous GPM-specific and joint agency/international external field campaigns, using state of the art cloud and precipitation observational infrastructure (polarimetric radars, profilers, rain gauges, and disdrometers). These field campaigns accounted for the majority of the effort and resources expended by the GPM GV mission. More information about the GPM GV mission is available on the [PMM Ground Validation webpage](#).

The GPM Cold-season Precipitation Experiment (GCPEX) took place in Ontario, Canada (Figure 1) during the 2011-2012 winter season. GCPEX included collaborative efforts from both GPM GV and [Environment Canada \(EC\)](#). This field campaign aimed to address the shortcomings in GPM snowfall retrieval algorithms. The experiment involved gathering the appropriate *in situ* and remote sensing measurements of the microphysical properties, radiative properties and spatial distribution of precipitating snow particles. These observations were also used to run model simulations. The collected snowfall data helped to improve the ability of active and passive satellite remote sensing instruments to accurately detect and estimate falling snow. These data were used to refine GPM snowfall algorithms in their active development stage prior to the launch of the GPM Core Satellite in 2014. Further details on GCPEX are available on the [GCPEX Field Campaign webpage](#) and the [PMM GCPEX webpage](#).



Figure 1: The GCPEX Field Campaign study area
 (Image source: [Skofronick-Jackson et al. 2015](#))

Instrument Description

The McGill University Vertically pointing X-band radar (VertiX) is a Doppler radar that measures the radar reflectivity and Doppler velocity of weather targets located directly overhead to produce time-height radar images (Figure 2). It is actually a marine radar transmitter-receiver system that has been adapted for weather observations. It is capable of detecting a range of different precipitation targets, from raindrops and drizzle to frozen rain and snow particles. Its Doppler capabilities allow it to measure the fall speeds of precipitation targets. VertiX is primarily used for research purposes due to its high spatial and temporal resolution. During GCPEX, the VertiX radar was located at the Centre for Atmospheric Research Experiments (CARE) facility in Ontario, Canada. More information about VertiX can be found on the [McGill VertiX instrument webpage](#) and [McGill VertiX example webpage](#).



Figure 2: The Vertix Radar
(Image source: [McGill Vertix instrument webpage](#))

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Data Characteristics

The GPM Ground Validation McGill Vertical Pointing X-Band (VertiX) Radar GCPEX dataset consists of radar reflectivity and Doppler velocity measurements in netCDF-3 file format along with reflectivity and Doppler velocity browse imagery in GIF format. These data are available at a Level 3 processing level. More information about the NASA data processing levels is available on the [EOSDIS Data Processing Levels webpage](#). The characteristics of this dataset are listed in Table 1 below.

Table 1: Data Characteristics

Characteristic	Description
Platform	Ground station
Instrument	Vertically Pointing X-band (VertiX) Radar

Spatial Coverage	N: 44.243, S: 44.223, E: -79.771, W: -79.791 (Ontario, Canada)
Spatial Resolution	~10 km range
Temporal Coverage	January 15, 2012 - February 29, 2012
Temporal Resolution	Daily -< Weekly
Sampling Frequency	3 seconds
Parameters	Reflectivity, Doppler velocity
Version	1
Processing Level	3

File Naming Convention

The GPM Ground Validation McGill Vertical Pointing X-Band (VertiX) Radar GCPEX dataset consists of netCDF-3 files with GIF browse imagery. The files are named using the following convention:

Data files:

vertix_gcpex_YYYYMMDD.nc
 vertix_gcpex_YYYYMMDD_1.nc

Browse files:

EC_CARE_xband_vertix_YYYYMMDD.gif

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
.nc	netCDF-3 file format
.gif	GIF image format

For the dates that have two netCDF-3 files, one file has the extension *.nc* and the other has the extension *_1.nc*. The files that include the extension *_1.nc* contain the remaining data that were not included in that date's initial *.nc* file. View the [McGill data documentation gcpex.txt](#) document for an example of the netCDF-3 files and information on unpacking the data.

Data Format and Parameters

The GPM Ground Validation McGill Vertical Pointing X-Band (VertiX) Radar GCPEX dataset files are available in netCDF-3 format and include data for various radar parameters. The data fields inside these files are listed in Table 3 below.

Table 3: Data Fields

Field Name	Description	Data Type	Unit
base_time	Unix date/time value for first record in seconds since 1970-0101 00:00 UTC	double	seconds
DBZ	Reflectivity factor	int	dBZ
DV	Doppler velocity	int	m/s
Nyquist_Velocity	Effective unambiguous range	double	m/s
radar_frequency	Radar frequency	double	GHz
radar_time	Starting time	double	hr
Range	Range	double	km
time_offset	time	double	seconds

Note: missing values are denoted by *-999.000*

Browse Imagery

The browse imagery files consist of animated GIF files that display time-height radar images of reflectivity and Doppler velocity. The GIF loops through these images, displaying the radar data for each hour of the entire day. The images include additional information such as radar status, height range, and radar location.

Algorithm

The data processing procedures used for McGill radar systems include signal processing, product generation, and visualization. The return signals detected by the radar's receiver from the meteorological targets are first processed in order to retrieve radar parameters such as reflectivity and Doppler velocity. This process includes removing unwanted signal noise. In the generation of radar products, they determine the type of error that might be associated with each type of radar product and consider sensor sensitivity. More information about the data processing procedures used for VertiX data is available on [McGill's Data Processing and Visualization webpage](#).

Quality Assessment

Attenuation, or reduction in the strength of the radar signal, can be caused by both the radome, the protective structure surrounding the radar antenna, and by the bright band melting layer. The "bright band" is a layer of high reflectivity detected by radar where precipitation is transitioning from frozen to liquid as it falls past the melting/freezing level. Particularly for X-band radar, there is often attenuation caused by the bright band melting layer of stratiform rain. This attenuation of the signal can be equal to or greater than the attenuation caused by the rain below it. A study by [Bellon, Zawadzki, and Fabry \(1997\)](#) investigated this phenomenon. The effects of attenuation are considered when analyzing X-band radar data.

Software

No special software is required to view these data files, however, [Panoply](#) can be used to view the netCDF-3 files. The GIF browse images can be opened and viewed on most software systems.

Known Issues or Missing Data

Missing data values are denoted by *-999.000*. For dates that have 2 netCDF-3 files, there is a gap in the data recording time between the end of the **.nc* file and the beginning of the **_1.nc* file.

References

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Related Data

All data collected during the GCPEX field campaign are considered related to this GCPEX VertiX dataset. These data can be located using the GHRC [HyDRO2.0](#) search tool and entering the term 'GCPEX' in the search box. The [GCPEX Field Campaign Data Collection](#) also lists all of the available datasets collected during the campaign

Contact Information

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

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