Data User Guide

GPM Ground Validation CAX1 Radar RB5 format OLYMPEX

Introduction

The GPM Ground Validation CAX1 Radar RB5 format OLYMPEX dataset consists of radar parameters, such as radar reflectivity, Doppler velocity, Doppler width, Differential reflectivity, and signal quality index, provided on a 0.4 to 1.0 km spatial resolution within the OLYMPEX field campaign study region in the state of Washington. These data were obtained for the GPM Ground Validation OLYMPEX field campaign by the SELEX Meteor 60DX10 Compact Weather (CAX1) radar. The CAX1 radar was located at the southern tip of Vancouver Island on the Canadian Forces Base (CFB) Esquimalt Albert Head (AHD) military training area. The CAX1 radar was operated by Environment and Climate Change Canada (ECCC) to support the OLYMPEX field campaign. These data are available in RB5 binary and PNG formats from November 13, 2015 to April 20, 2016.

Notice: The RB5 data format is proprietary and requires access to read code from SELEX. We encourage users wanting to use the CAX1 data to instead use the CAX1 ODIM or CFradial formatted data.

Citation

Hudak, David, Peter Rodriguez, Vlado Stajanovic, Norman Donaldson, and Robert Reed. 2018. GPM Ground Validation CAX1 Radar RB5 format OLYMPEX [indicate subset used]. Dataset available online 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/OLYMPEX/XPOL/DATA201

Keywords:

ECCC, GHRC, OLYMPEX, Washington, CAX1, RB5, Albert Head, radar reflectivity, Doppler velocity

Campaign

The Global Precipitation Measurement (GPM) mission Ground Validation campaign used a variety of methods for validation of GPM satellite constellation measurements prior to and after 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). Surface rainfall was measured by very dense rain gauge and disdrometer networks at various field campaign sites. These field campaigns accounted for the majority of the effort and resources expended by GPM GV. More information about the GPM mission is available at https://pmm.nasa.gov/GPM/.

One of the GPM Ground Validation field campaigns was the Olympic Mountains Experiment (OLYMPEX) which was held in the Pacific Northwest. The goal of OLYMPEX was to validate rain and snow measurements in mid-latitude frontal systems as they move from ocean to coast to mountains and to determine how remotely sensed measurements of precipitation by GPM can be applied to a range of hydrologic, weather forecasting, and climate data. The campaign consisted of a wide variety of ground instrumentation, radars, and airborne instrumentation monitoring oceanic storm systems as they approached and traversed the Peninsula and the Olympic Mountains. The OLYMPEX campaign was part of the development, evaluation, and improvement of GPM remote sensing precipitation algorithms. More information is available from the NASA GPM Ground Validation web site https://pmm.nasa.gov/olympex, and the University of Washington OLYMPEX web site http://olympex.atmos.washington.edu/.

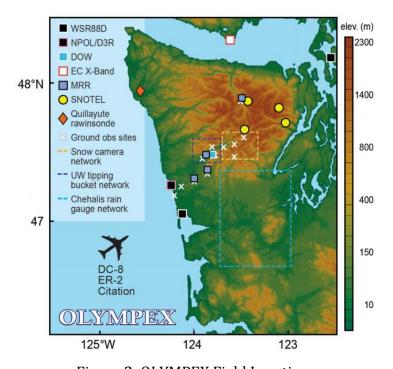Figure 1: OLYMPEX Domain
(Image Source: https://pmm.nasa.gov/OLYMPEX)

Figure 2: OLYMPEX Field Locations.
(Image Source: https://pmm.nasa.gov/OLYMPEX)

Instrument Description

This dataset contains measurements made by a compact dual-polarization X-band portable weather radar labeled "CAX1" that was located at the southern tip of Vancouver Island on the Canadian Forces Base (CFB) Esquimalt Albert Head (AHD) military training area (lat: 48.38711667, lon: -123.4780556) - labeled as EC X-band in Figure 2 above and DND - Albert Head in Figure 3 below which also shows the radar measurement extent as a yellow wedge region. The CAX1 radar was placed in a location to cover the northern lee-side of the Olympic Mountains and the inland waters. This location had a direct line-of-sight of Hurricane Ridge (HRR) on the Olympic Peninsula, an area of high elevation over which Pacific storms had to pass when moving from west to east.

The CAX1 radar is a SELEX Meteor 60DX10 Compact Weather radar with a 2.4m dish, a portable, low-cost, active radar that is capable of weather and target detection. This radar has a maximum range of 100 km. The radar operated continuously during of the field campaign from November 13, 2015 through April 20, 2016. The radar scanning pattern had a 5 minute repeat time. The series of scans in each cycle were 5 vertical cross sections (range height indicator scans) centered on Hurricane Ridge followed by 3 low level azimuthal scans (plan position indicator scans) on elevation angles of 1,5, 2.5 and 5.0 degrees out to a range of 100 km. The radar can perform Range Height Indicator (RHI) scans, as well as provide surveillance data. An RHI scan is where the radar holds the azimuth angle constant, but moves the elevation angle. Surveillance data is often used for high temporal resolution sampling of clear air and convection. More information about the

CAX1 dual polarization X-band radar is available in Hudak et al., 2016 and in the METEOR 60DX COMPACT WEATHER RADAR documentation.

Figure 3: CAX1 radar location and view with respect to other ECCC and University of Washington OLYMPEX instruments and the measurement region of the radar in yellow. (Image Source: Hudak et al., 2016)

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Data Characteristics

The GPM Ground Validation CAX1 Radar RB5 format OLYMPEX dataset files are in RB5 and PNG formats at Level 1B processing level. More information about the NASA data processing levels are available on the [NASA Data Processing Levels website](). Table 1 shows the characteristics of the data files.

Table 1: Data Characteristics

Characteristic	Description
Platform	Ground station
Instrument	Dual-polarization X-band radar
Projection	n/a
Spatial Coverage	N: 49.285, S: 47.489, E: -122.580, W: -124.376 (Washington)
Spatial Resolution	0.4 - 1.0 km
Temporal Coverage	November 13, 2015 - April 20, 2016
Temporal Resolution	5 minutes
Sampling Frequency	<1 second
Parameter	Radar reflectivity, Doppler velocity, Doppler width, Differential reflectivity, Differential phase, Differential phase shift, Correlation coefficient, Signal quality index
Version	1
Processing Level	1B

File Naming Convention

The GPM Ground Validation CAX1 Radar RB5 format OLYMPEX dataset consists of RB5 binary formatted data. The RB5 format is a proprietary data format for use by authorized users. The files contain an XML-type header followed by the binary data. The data files are stored in tarred and zipped archives organized by date, and scan type. Upon extracting, users will find a directory structure that contains images and data files. The files contain the file naming convention shown below.

Data files: olympex_cax1_YYYYMMDD_hhmmZ_<scan_name>-rb5.tgz
Browse files: olympex_cax1_YYYYMMDD_hhmmZ_<scan_name>-DBZH-dpatc.png

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
hh	Two-digit hour in Z
mm	Two-digit minute in Z

<scan_name>	BIRDBATH-azi: Plan Position Indicator (PPI) Scan DOPVOL1-A-azi: PPI Scan DOPVOL1-B-azi: PPI Scan DOPVOL1-C-azi: PPI Scan RHI-A-ele: Range Height Indicator (RHI) Scan RHI-B-ele: RHI Scan RHI-C-ele: RHI Scan RHI-D-ele: RHI Scan RHI-E-ele: RHI Scan
.tgz	Gzipped RB5 data files
.png	Portable Network Graphics format

Data Format and Parameters

The GPM Ground Validation CAX1 Radar RB5 format OLYMPEX dataset consists of RB5 data files, a proprietary binary format with XML header information derived directly from the radar instrumentation software. The RB5 data are accessible to authorized users. The XML header of the data can be read by using and text editor. There is online information and code for binary data access at wradlib. The RB5 data files are stored in tarred and zipped archives organized by date, and scan type. Upon extracting, users will find a directory structure that contains images and data files. The different scan types are distinguished in the file names using letters as designated in Table 2.

The files contain both radar parameters and selected PNG images made by the SELEX software. Tables 3-5 lists and describes the parameters within these data files.

Table 3: Radar Parameters

Variable	Description
dBuZ	Reflectivity (uncorrected)
dBZ	Reflectivity (corrected)
V	Doppler velocity
W	Doppler width
ZDR	Differential reflectivity
PhiDP	Differential phase
uPhiDP	Differential phase (uncorrected)
RhoHV	Correlation coefficient
SQI	Signal Quality Index

Table 4: Included <rayinfo> readbacks

Variable
startangle
stopangle
timestamp
txpower
noisepowerh

noisepowerv

Table 5: Selected PNG products within data files made by Rainbow

Variable	Units
dopvol1_A	dBZ
RHI_C	ZDR
Dopvol1_B	dBZ
	ZDR
Dopvol1_C	dBZ
Birdbath	V

These RB5 data files contain observations from 5-minute radar scans and provide radar parameters that include reflectivity, Doppler velocity, differential phase, and Doppler width, for the time period from November 13, 2015 through April 20, 2016. Users should also be aware of the large size of this dataset.

These RB5 data files have been converted into two other common radar data formats, CFradial and ODIM. The CFradial dataset contains netCDF-4 formatted files at GPM Ground Validation CAX1 Radar CFradial format OLYMPEX. The ODIM dataset contains HDF-5 files and is available at GPM Ground Validation CAX1 Radar ODIM format OLYMPEX.

Algorithm

Due to precipitation, the radar radiation and differential reflectivity are attenuated. The Dual-Pol based Attenuation Correction (DPATC) algorithm is used to correct the reflectivity values for rain attenuation. More information about the DPATC algorithm is provided in the DPATC - Dual-Pol based Attenuation Correction documentation.

Quality Assessment

The CAX1 radar operated about 96.7% of the time without any significant technical difficulties (less than 0.2%). When there was an outage, it was related to shutdowns for safety during on-site activities. In theory, the radar reflectivity value of a horizontal view of light raindrops should be 0.0, as well as appear spherical. To remove the possible effect of radome wetting, times where the precipitation rate was >0.01 mm/h were not included in the calculation of a daily mean radar reflectivity bias. This radar reflectivity bias was determined to be 0.75 dB for the entire dataset, where there was no significant day-to-day variation of the overall radar reflectivity bias. Also, no radar reflectivity bias correction was applied to this dataset. More information about the quality of these data are available in the CAX1 ZDR bias PI documentation.

Software

These data are in RB5 format. The header of these data can be read by using any text editor. To read the binary portion of the file, users will need to write their own read routines.

Some routines are available at wradlib. Users needing other data formats are directed to the CAX1 CFradial and ODIM format datasets.

Known Issues or Missing Data

It was a significant challenge to mitigate clutter in the radar data, including severe orography of the Olympic Peninsula as well as sea clutter and ship traffic in the Juan de Fuca Strait. Because of the orographic conditions of the area, the CAX1 radar could only take measurements on the lee side of the Olympic Mountains; however, there were still a number of precipitation events on the lee side of these mountains. More information about the known issues of these data can be found in Hudak et al., 2016.

References

Hudak, David, Peter Rodriguez, Norman Donaldson, and Daniel Kirshbaum (2016). OLYMPEX Canada.
https://ams.confex.com/ams/17Mountain/webprogram/Paper296448.html

METEOR 60DX COMPACT WEATHER RADAR. http://www.de.selex-es.com/documents/16243296/30914446/Kopie+von+Selex-ES-METEOR-60DX.pdf

Related Data

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

In particular, the following datasets are directly related to this CAX1 radar during the OLYMPEX field campaign:

GPM Ground Validation CAX1 Radar ODIM format OLYMPEX
(http://dx.doi.org/10.5067/GPMGV/OLYMPEX/XPOL/DATA101)

GPM Ground Validation CAX1 Radar CFradial format OLYMPEX
(http://dx.doi.org/10.5067/GPMGV/OLYMPEX/XBAND/DATA301)

Contact Information

To order these data or for further information, please contact:
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> User Services
> 320 Sparkman Drive
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> Phone: 256-961-7932
> E-mail: support-ghrc@earthdata.nasa.gov

Web: https://ghrc.nsstc.nasa.gov/

Created: June 11, 2018