Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Albert Head (AHD) Ground Meteorological Station (MET) OLYMPEX

Introduction

The GPM Ground Validation Albert Head (AHD) Ground Meteorological Station (MET) OLYMPEX dataset consists of precipitation rate, reflectivity, pressure, temperature, relative humidity, wind speed, and wind direction data which were measured by the MET station instruments operated by the Environment and Climate Change Canada (ECCC) and located in Albert Head, B.C., Canada. The MET station was comprised of a Vaisala FD12P Visibility Sensor, an OTT Parsivel2 Present Weather Sensor, an OTT Pluvio2 Precipitation Gauge, and a Vaisala WXT520 Weather Transmitter. The MET Station was also co-located with a CAX-1 radar to compare measurements from the MET station with the radar scans. These MET Station data files are available from November 13, 2015 through January 17, 2016 in ASCII-CSV and XML formats, with daily browse images of precipitation rate plots in PNG format.

Citation

Hudak, David, Peter Rodriguez, and Robert Reed. 2018. GPM Ground Validation Albert Head (AHD) Ground Meteorological Station (MET) 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/METSTATION/DATA101

Keywords:

ECCC, GHRC, OLYMPEX, GPM, Met Station, Albert Head, precipitation rate, reflectivity, pressure, temperature, relative humidity, wind speed, wind direction, pluvio, parsivel

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)

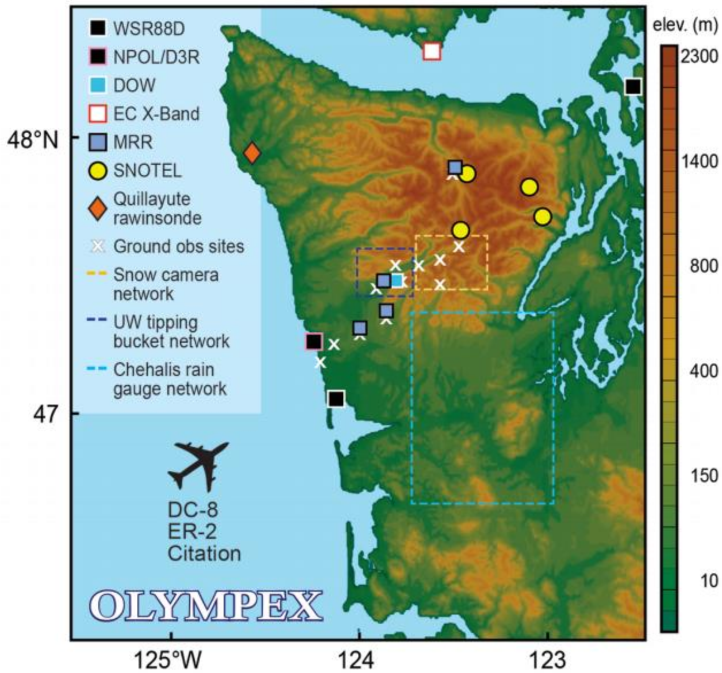


Figure 2: OLYMPEX Field Locations.
(Image Source: https://pmm.nasa.gov/OLYMPEX)

Instrument Description

This dataset is derived from measurements by instruments included in the Environment and Climate Change Canada (ECCC) ground Meteorological Station (MET). The station contained a Vaisala FD12P Visibility Sensor, an OTT Parsivel2 Present Weather Sensor, an OTT Pluvio2 Precipitation Gauge, and a Vaisala WXT520 Weather Transmitter. The MET Station was also co-located with the ECCC CAX-1 radar (the CAX-1 data also published at GHRC) to compare measurements from the MET station with the radar scans.

The OTT-built parsivel is a laser-based disdrometer that measures the size and fall velocity of hydrometeors that fall through a laser sheet that is approximately 180 mm long, 30 mm wide, and 1 mm high. The size of a hydrometeor is estimated from the maximum attenuation of the laser signal, and the fall speed is estimated by the duration of the hydrometeor within the laser beam. The drops are assumed to be spherical. Figure 3 shows an image of the OTT Parsivel2. Various other parameters are derived from the Parsivel2 measurements of particle size and drop speed, including the type and intensity of precipitation, reflectivity, and visibility. More information about the OTT Parsivel2 is available in Tokay et al., 2014 and in the Operating instructions Present Weather Sensor Parsivel manual.

Figure 3: Image of OTT Parsivel2
(Image source: https://gpm-gv.gsfc.nasa.gov/Disdrometer/)

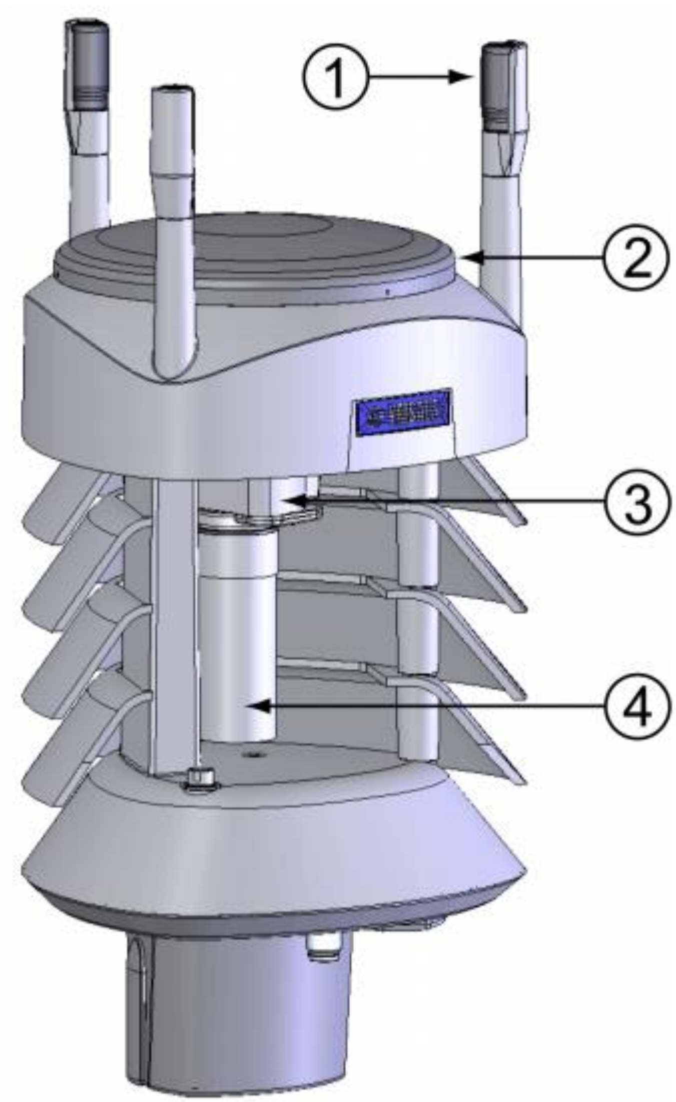
The Pluvio2 is a weighing precipitation gauge produced by OTT Hydromet. The Pluvio2 continuously monitors liquid, solid, and mixed precipitation accumulation. The Pluvio2 also features a temperature sensor that monitors environmental temperatures. The temperature, along with other factors that affect precipitation results, are factored into an algorithm that adjusts the precipitation data accordingly. To provide the best possible data, the load cell and sensor electronics are hermetically sealed against the environment. Figure 4 shows an image of the OTT Pluvio2 instrument. More information about the OTT Pluvio2 instrument can be found on the OTT Pluvio2 - Precipitation Gauge User's Guide.

Figure 4: Image of OTT Pluvio2.
(Image Source: OTT Pluvio2 - Precipitation Gauge User's Guide)

The Vaisala FD12P Weather Sensor is made up of three sensing elements: a forward scatter visibility meter, a rain detector, and a temperature sensor. The visibility meter is comprised of a transmitter that pulses near-infrared light and a receiver that measures the scattered part of the light from the transmitter. The visibility meter can measure optical range, optical precipitation intensity and optical precipitation amounts. The rain detector measures capacitance changes in two sensing elements to calculate precipitation amounts. The output of the rain detector is proportional to the amount of water on the capacitive sensors. The ratio of rain detector intensities and optical precipitation intensities can be used to determine basic precipitation types. Figure 5 shows an image of the FD12P weather sensor. More information about the Vaisala FD12P Weather Sensor can be found in the FD12P Weather Sensor User's Guide.

Figure 5: Image of Vaisala FD12P Weather Sensor
(Image Source: FD12P Weather Sensor User's Guide)

The Vaisala WXT520 Weather Transmitter is a small and lightweight transmitter that measures wind speed, wind direction, precipitation, relative humidity, atmospheric pressure, and temperature. This instrument has three wind transducers, a precipitation sensor, a pressure sensor inside the PTU module, and humidity and temperature sensors that are also inside the PTU module. Figure 6 shows a cutaway view of the WXT520 Weather Transmitter. More information about the WXT520 instrument is available in the Vaisala WXT520 Weather Transmitter User's Guide.



The following numbers refer to Figure 3 on page 20:

1	=	Wind transducers (3 pcs)
2	=	Precipitation sensor
3	=	Pressure sensor inside the PTU module
4	=	Humidity and temperature sensors inside the PTU module

Figure 6: Cutaway view of Vaisala WXT520 Weather Transmitter
(Image Source: Vaisala WXT520 Weather Transmitter User's Guide)

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Data Characteristics

The GPM Ground Validation Albert Head (AHD) Ground Meteorological Station (MET) OLYMPEX data files are available in ASCII-CSV and XML formats with daily browse images of precipitation rate plots for the station in PNG format. There are three types of data including raw, radar_matched, and combo. The combo and radar_matched data are at a Level 2 processing level, while the raw data are at a 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 file.

Table 1: Data Characteristics

Characteristic	Description
Platform	Ground station
Instrument	Meteorological ground station comprised of: Vaisala FD12P visibility sensor OTT Parsivel2 present weather sensor OTT Pluvio2 precipitation gauge Vaisala WXT520 weather transmitter
Projection	n/a
Spatial Coverage	MET station location: 48.387, -123.478 (Albert Head, B.C., Canada)
Spatial Resolution	point
Temporal Coverage	November 13, 2015 - January 17, 2016
Temporal Resolution	raw and combo: daily radar_matched: 5 minutes
Sampling Frequency	1 minute
Parameter	precipitation rate, reflectivity, pressure, temperature, relative humidity, wind speed, wind direction
Version	1
Processing Level	raw: 1B

	combo and radar_matched: 2

File Naming Convention

The GPM Ground Validation Albert Head (AHD) Ground Meteorological Station (MET) OLYMPEX dataset has the file naming convention shown below. These data are available in ASCII-CSV and XML formats with daily browse images of precipitation rate plots in PNG format. The ASCII-CSV data files consists of raw and primary data fields from all sensors, while the XML data files consists of MET station data where the time window is matched to the 5-minute CAX-1 radar scan cycles.

Data files: olympex_AHD_<date>_<station>.[csv|xml].gz
Browse files: olympex_AHD_YYYYMMDD_met-station.png

Table 2: File naming convention variables

Variable	Description
<date>	combo and raw: YYYYMMDD radar_matched: YYYYMMDD_hhmmZ where, YYYY: Four-digit year MM: Two-digit month DD: Two-digit day hh: Two-digit hour in UTC mm: Two-digit minute in UTC
<station>	met-station: combination of data from all instruments FD12P: Vaisala FD12P visibility sensor Parsivel: OTT Parsivel2 present weather sensor Pluvio2: OTT Pluvio2 precipitation gauge WXT520: Vaisala WXT520 weather transmitter
[csv|xml].gz	csv.gz: gzipped ASCII-CSV file xml.gz: gzipped XML file
png	Portable Network Graphics format

Data Format and Parameters

The GPM Ground Validation Albert Head (AHD) Ground Meteorological Station (MET) OLYMPEX dataset consists of ASCII-CSV and XML files containing precipitation rate, reflectivity, pressure, temperature, relative humidity, wind speed, and wind direction measurements. There are three different types of data available in these data including combo, radar_matched, and raw data types. The raw data files consist of measurements from each sensor. The combo data files consist of primary data fields from all sensors gathered in 1 file, while the radar_matched data files consist of MET station data where the time window is matched to the 5-minute CAX1 radar scan cycles for easy comparisons. Table 3 lists and describes the parameters in the combo data files. Table 4 lists and describes the parameters in the radar_matched data files. Most users will want to use the combo or radar_matched data files.

Table 3: Data Fields in combo data files

Column	Field Name	Description	Unit
1	time	Time in hh:mm where hh: two-digit hour mm: two-digit minute	UTC
2	precip_indicator	Count of precipitation sensor rates that are >= 0.2 mm/hr	-
3	FD12P_rate	Precipitation rate from FD12P sensor	mm/hr
4	FD12P_vis	Precipitation amount from FD12P sensor	m
5	PARSIVEL_rate	Precipitation rate from parsivel sensor	mm/hr
6	PARSIVEL_vis	Precipitation amount from Parsivel sensor	m
7	PARSIVEL_refl	Reflectivity from parsivel sensor	dBZ
8	PLUVIO2_rate	Precipitation rate from Pluvio2 sensor	mm/hr
9	WXT520_press	Pressure measurement from WXT520 sensor	hPa
10	WXT520_temp	Temperature measurement from WXT520 sensor	Degrees Celsius
11	WXT520_rh	Relative humidity measurement from WXT520 sensor	%
12	WXT520_rate	Precipitation rate from WXT520 sensor	mm/hr
13	WXT520_wspd	Wind speed measurement from WXT520 sensor	m/s
14	WXT520_wdir	Wind direction measurement from WXT520 sensor	degrees

Table 4: Data Fields in radar_matched data files

Field Name	Description	Unit
precip_indicator	Count of precipitation sensor rates that are >= 0.2 mm/hr	-
FD12P_rate	Precipitation rate from FD12P sensor	mm/hr
FD12P_vis	Precipitation amount from FD12P sensor	m
PARSIVEL_rate	Precipitation rate from parsivel sensor	mm/hr
PARSIVEL_vis	Precipitation amount from Parsivel sensor	m
PARSIVEL_refl	Reflectivity from parsivel sensor	dBZ
PLUVIO2_rate	Precipitation rate from Pluvio2 sensor	mm/hr
WXT520_press	Pressure measurement from WXT520 sensor	mb
WXT520_temp	Temperature measurement from WXT520 sensor	Degrees Celsius
WXT520_rh	Relative humidity measurement from	%

	WXT520 sensor	
WXT520_rate	Precipitation rate from WXT520 sensor	mm/hr
WXT520_wspd	Wind speed measurement from WXT520 sensor	m/s
WXT520_wdir	Wind direction measurement from WXT520 sensor	degrees

Algorithms

Proprietary algorithms are used to derive various parameters from the OTT Parsivel-measured particle size and particle speed. The additional parameters derived from the particle size and drop speed are the precipitation rate, reflectivity, and visibility. More information about the Parsivel is available in Loffler-Mang, 2008.

The Pluvio2 gauge includes a temperature sensor that monitors environmental temperatures. The temperature, along with other factors that affect precipitation measurement, are factored into an algorithm that adjusts the precipitation data accordingly.

For the FD12P visibility sensor, algorithms are used for determining visibility, detecting precipitation, estimating precipitation intensity, estimating precipitation accumulation, and determining precipitation types. Information about these processes are described in the Weather Sensor FD12P User's Guide.

For the WXT520 instrument, the detection of each individual drop enables computation of precipitation amount and intensity with high resolution. Minimum and maximum wind speeds are also calculated by using the Wind Measurement Averaging Method as described in the Vaisala Weather Transmitter WXT520 User's Guide.

Quality Assessment

The Pluvio2 features a temperature sensor that monitors environmental temperatures. The temperature, along with other factors that affect precipitation results, are factored into an algorithm that adjusts the precipitation data accordingly. To provide the best possible data, the load cell and sensor electronics are hermetically sealed against the environment. For the Parsivel2, the processing software assumes snowflakes as spheres and therefore provides only a one-dimensional length which is not necessarily representative of the equivalent diameter of the particle. More information about the quality of the Pluvio instrument is available in Wauben, 2004 and Tumbusch, 2003. More information about the quality of the Parsivel instrument is available in Tokay et al., 2014.

For the WXT250 instrument, the precipitation amount and intensity are computed with a high resolution. Also, the wind direction offset is calibrated as described in the Vaisala Weather Transmitter WXT520 User's Guide. The FD12P instrument was calibrated at the factory is was built at, and usually this instrument does not need to be recalibrated as long as the circuit boards are not changed. Certain sensors on the instrument are recalibrated every year to ensure quality data.

Software

These data are available in ASCII-CSV and XML formats so no software is required to view these data.

References

Loffler-Mang, Martin (2008): Enhanced Possibilities of PARSIVEL Disdrometer: Precipitation Type, Visibility, and Fog Type. https://www.wmo.int/pages/prog/www/IMOP/publications/IOM-96_TECO-2008/P2(04)_Loeffler-Mang_Germany.pdf

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Vaisala (2012): Vaisala Weather Transmitter WXT520 User's Guide. https://www.vaisala.com/sites/default/files/documents/M210906EN-C.pdf

Wauben, Wiel (2004): Precipitation amount and intensity measurements with the Ott Pluvio. http://bibliotheek.knmi.nl/knmipubTR/TR270.pdf

Related Data

The MET station was co-located with the CAX1 radar during the OLYMPEX field campaign. The following CAX1 datasets are available for comparison:

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

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

GPM Ground Validation CAX1 Radar RB5 format OLYMPEX (not yet published)

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.

Contact Information

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

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Created: May 18, 2018