Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Autonomous Parsivel Unit (APU) Wallops Flight Facility (WFF)

Introduction

The GPM Ground Validation Autonomous Parsivel Unit (APU) Wallops Flight Facility (WFF) dataset consists of precipitation data including precipitation amount, precipitation rate, reflectivity in Rayleigh regime, liquid water content, drop diameter, and drop concentration obtained from six Autonomous Parsivel Units (APUs) positioned at the Wallops Flight Facility (WFF) in support of the Global Precipitation Mission (GPM). The APU is an optical laser-disdrometer based on single particle extinction that measures particle size and fall velocity. It consists of the Parsivel^2 developed by OTT in Germany and supporting hardware developed by University of Alabama. Data are available in ASCII format for the period of May 6, 2013 through October 9, 2014.

Notice:
This dataset does not have continuous data. Data are missing for various dates.

Citation

Wolff, David B., Ali Tokay and Matthew T. Wingo. 2018. GPM Ground Validation Autonomous Parsivel Unit (APU) Wallops Flight Facility (WFF) [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/WFF/APU/DATA101

Keywords:

NASA, GHRC, WFF, Wallops, GPM, APU, Precipitation, Precipitation rate, Precipitation amount, Droplet size, Hydrometeors, Liquid water content, rain, reflectivity

Campaign

The Global Precipitation Measurement (GPM) mission Ground Validation (GV) campaign used a variety of methods for validating GPM satellite constellation measurements prior to and after launch of the GPM Core Satellite, which occurred on February 27, 2014. The GPM 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/.

Instrument Description

The Autonomous Parsivel Unit (APU) is an optical laser-based disdrometer that uses single particle extinction to measure particle size and fall velocity. The APU used for the GPM GV campaign consists of the Parsivel^2 and supporting hardware to allow for automatic data reporting.

The Parsivel^2 disdrometer produced by OTT Hydromet is a modern, laser-based optical system for measuring all types of precipitation. The transmitter unit of the sensor generates a flat, horizontal strip or sheet of light, which the receiver converts into an electrical signal. When no particles pass through the horizontal beam, the maximum voltage is detected at the receiver. The signal changes whenever a hydrometeor falls through the sheet of light anywhere within the measurement area. The blocked portion of the laser signal results in a reduced voltage output. The degree of dimming is a measure of the size of the hydrometeor and, together with the duration of the blockage, the fall velocity can be derived. The Parsivel^2 can also classify precipitation particles into 32 separate size classes and 32 velocity classes.

Further information on the Parsivel^2 can be found at https://www.ott.com/en-us/products/meteorological-sensors-26/ott-parsivel2-laser-weather-sensor-2392/ and Tokay et al. (2014).

This dataset consists of precipitation data collected from six APUs positioned at the Wallops Flight Facility in support of the Global Precipitation Mission. Table 1 lists the locations of these APU sites.

Table 1: WFF APU sites

Site ID	Latitude (°)	Longitude (°)
apu11	37.944	-75.463
apu12	37.934	-75.471

apu15	37.937	-75.466
apu16	37.929	-75.473
apu17	37.944	-75.481
apu18	37.937	-75.456

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Data Characteristics

The GPM Ground Validation Autonomous Parsivel Unit (APU) Wallops Flight Facility (WFF) dataset consists of precipitation data including precipitation amount, precipitation rate, reflectivity in Rayleigh regime, liquid water content, drop diameter, and drop concentration obtained from six APUs positioned at the WFF in support of the GPM. Data files are in ASCII format at a Level 3 processing level. More information about the NASA data processing levels are available on the EOSDIS Data Processing Levels webpage.

Table 2: Data Characteristics

Characteristic	Description
Platform	Ground stations
Instrument	Autonomous Parsivel Unit (APU)
Spatial Coverage	N: 38.044, S: 37.829, E: -75.356, W: -75.581(Virginia)
Spatial Resolution	Point
Temporal Coverage	May 6, 2013 to October 9, 2014
Temporal Resolution	One file per site, each site had various operation periods
Sampling Frequency	10 seconds integrated to 1 minute
Parameter	precipitation amount, precipitation rate, reflectivity in Rayleigh regime, liquid water content, drop diameter, and drop concentration
Version	1
Processing Level	3

File Naming Convention

The GPM Ground Validation Autonomous Parsivel Unit (APU) Wallops Flight Facility (WFF) dataset files are in ASCII format and have the following naming convention:

Data files: wff_apu##_rainevent.wal
wff_apu##_[dropcounts|raindsd|rainparameter]_min.wal
wff_apu##_[raindsd|rainparameter]_min_ter.wal

Table 3: File naming convention variables

Variable	Description
apu##	Parsivel units (11, 12, 15, 16, 17, 18). See Table 1 for site locations.
min	Data provided as 1-minute interpolated values derived from 10 second measurements
ter	Terminal velocity indicator
wal	ASCII file format

Data Format and Parameters

The GPM Ground Validation Autonomous Parsivel Unit (APU) Wallops Flight Facility (WFF) dataset consists of precipitation, precipitation amount, precipitation rate, reflectivity in Rayleigh regime, liquid water content, drop diameter, and drop concentration measurements. There are 7 files per parsivel site. Tables 4-7 describe how these measurements are organized in each file, as well as their units.

(1) wff_apu##_dropcounts_min.wal
The file provides the total number drops at each bin size at 1-minute integration. The file consists of 36 columns (Table 4).

(2) wff_apu##_rainparameter_min.wal
The file is designed to present the integral rain parameters based on measured fall velocities at 1-minute integration. The file consists of 12 columns (Table 5). More information on the disdrometer-based calculation of integral rain parameters can be found in Tokay et al. (2001).

(3) wff_apu##_rainparameter_min_ter.wal
The file provides the integral rain parameters based on terminal fall velocities at 1-minute integration. The file consists of 12 columns (Table 5).

(4) wff_apu##_raindsd_min.wal
The file provides the raindrop size distribution based on measured fall velocities at 1-minute integration. The file consists of 36 columns (Table 6).

(5) wff_apu##_raindsd_min_ter.wal
The file provides the raindrop size distribution based on terminal fall velocities at 1-minute integration. The file consists of 36 columns (Table 6).

(6) wff_apu##_rainevent.wal
The file provides the rain event summaries. The events are separated by 1-hour or more rain-free periods in rain rate time series that can be extracted from 2.3 or 2.4. The events that are less than 3 minute or rain total less than 0.1 mm are not included. The file has 10 Columns (Table 7).

Table 4: Data format within wff_apu##_dropcounts_min.wal files

Column	Description	Units
1	Year	-
2	Day of the year	-
3	Hour	Hour in UTC
4	Minute	Minute in UTC
5 - 36	Drop counts for each size bin	-

Table 5: Data format within wff_apu##_rainparameter_min.wal and wff_apu##_rainparameter_min_ter.wal files

Column	Description	Units
1	Year	-
2	Day of the year	-
3	Hour	Hour in UTC
4	Minute	Minute in UTC
5	Total number of drops	-
6	Total concentration	drops/m^3 of air
7	Liquid water content	g/m^3
8	Rain rate	mm/h
9	Reflectivity in Rayleigh regime	dBZ
10	Mass-weighted drop diameter	mm
11	Standard deviation of the mass-weighted drop diameter	mm
12	Maximum drop diameter	mm

Table 6: Data format within wff_apu##_raindsd_min.wal and wff_apu##_raindsd_min_ter.wal files

Column	Description	Units
1	Year	-
2	Day of the year	-
3	Hour	Hour in UTC
4	Minute	Minute in UTC
5-36	32-bin raindrop size distribution	Drops m^{-3} mm^{-1}

Table 7: Data format within wff_apu##_rainevent.wal files

Column	Description	Units
1	Year	-

2	Event start day of the year	-
3	Event start hour and minute	hh:mm hh = two-digit hour in UTC mm = two-digit minute in UTC
4	Event end day of the year	-
5	Event end hour and minute	hh:mm hh = two-digit hour in UTC mm = two-digit minute in UTC
6	Event rainy minutes	Minutes
7	Event maximum rain rate	mm/h
8	Event rain total	mm
9	Event maximum drop diameter	mm
10	Precipitation type (R - rain; S - snow)	-

Algorithm

For the minute-integrated data files, the 10-second observations are integrated to 1-minute. It should also be noted that the thresholds of 10 drops and 0.01 mm/h were applied to the 1-minute observations to eliminate noise from rainy minutes. In the 'wff_apu##_rainparameter_min.wal' files, four of the rain parameters, total concentration, liquid water content, reflectivity in Rayleigh regime, and mass-weighted drop diameter requires fall speed information in their formulations. More information on the disdrometer-based calculation of integral rain parameters can be found in Tokay et al. (2001). The corresponding terminal fall speed in m/sec followed the method of Beard (1976).

Quality Assessment

If rain events that are less than 3 minutes or the rain total is less than 0.1 mm, then it is not included in the 'wff_apu##_rainevent.wal' files.

Parsivel data have been validated using other disdrometer types as reported in Tokay et al. (2001) and Jaffrain and Berne (2011). Friedrich et al. (2013) identified a typical misclassification of particles by different stationary disdrometers that can occur at high wind speed and/or heavy rainfall. The authors hypothesize that when particles do not fall perpendicularly through the disdrometer sampling area the misclassification can occur. The Parsivel 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.

Software

Since these data files are in ASCII format, no software is required to read the data.

Known Issues or Missing Data

There are no known issues with these data. This dataset does not have continuous data. Data are missing for various dates. Several data lines in the 'wff_apu12_data.wal' file do not follow the year, day of year, hour, and minute format described in Table 4. Please ignore these data lines.

References

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Tokay, A., D. Wolff, and W. Petersen, 2014: Evaluation of the New Version of the Laser-Optical Disdrometer, OTT Parsivel^2. J. Atmos. Oceanic Technol., 31, 1276-1288, doi: https://doi.org/10.1175/JTECH-D-13-00174.1.

Related Data

All data from other instruments collected at the Wallops Flight Facility (WFF) in support of the Global Precipitation Mission (GPM) are considered related datasets. These data can be located by searching 'WFF' in HyDRO 2.0.

Below are datasets from other GPM GV field campaigns that used the APU instrument to collect data:

GPM Ground Validation Autonomous Parsivel Unit (APU) OLYMPEX (http://dx.doi.org/10.5067/GPMGV/OLYMPEX/APU/DATA301)

GPM Ground Validation Autonomous Parsivel Unit (APU) IFloodS (http://dx.doi.org/10.5067/GPMGV/IFLOODS/APU/DATA301)

GPM Ground Validation NASA Autonomous Parsivel Unit (APU) IPHEx
(http://dx.doi.org/10.5067/GPMGV/IPHEX/APU/DATA301)

GPM Ground Validation Autonomous Parsivel Unit (APU) LPVEx
(http://dx.doi.org/10.5067/GPMGV/LPVEX/APU/DATA301)

GPM Ground Validation Autonomous Parsivel Unit (APU) GCPEx
(http://dx.doi.org/10.5067/GPMGV/GCPEX/APU/DATA301)

GPM Ground Validation Autonomous Parsivel Unit (APU) MC3E
(http://dx.doi.org/10.5067/GPMGV/MC3E/APU/DATA301)

GPM Ground Validation Autonomous Parsivel Unit (APU) HyMeX
(http://dx.doi.org/10.5067/GPMGV/HYMEX/APU/DATA301)

GPM Ground Validation Autonomous Parsivel Unit (APU) NSSTC
(http://dx.doi.org/10.5067/GPMGV/NSSTC/APU/DATA201)

Contact Information

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

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Created: December 7, 2018