

GPM Ground Validation Met One Rain Gauge Pairs Wallops Flight Facility (WFF)

Introduction

The GPM Ground Validation Met One Rain Gauge Pairs Wallops Flight Facility (WFF) dataset contains rain rate data from 4 rain gauge networks located in Virginia and Maryland near the Wallops Flight Facility (WFF): Nassawadox, Pocomoke, HalfDeg and Wallops Flight Facility (WFF) Assorted Gauges. These data were collected in support of the Global Precipitation Mission (GPM) Ground Validation (GV) campaign. The Met One Rain Gauge Pairs are tipping bucket precipitation gauges which collect precipitation amounts and calculate rain rates. The dataset contains 3 products: formatted gauge tips (GAG), interpolated one-minute rain rates for a year (GMIN), and interpolated one-minute rain rates for a month (2A56). Data are available in ASCII format for the period of April 10, 2012 through October 1, 2018.

Citation

Wang, Jianxin. 2019. GPM Ground Validation Met One Rain Gauge Pairs 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/RAINGAUGE/DATA101>

Keywords:

NASA, GHRC, GPM, WFF, precipitation, rain gauge, Met One rain gauge, hydrologic services

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

This dataset was created using precipitation measurements from 4 GPM rain gauge networks in Virginia and Maryland near the Wallops Flight Facility: Nassawadox, Pocomoke, HalfDeg, and WFF Assorted Gauges. All 4 networks use the Met One Rain Gauge Pairs. The WFF Assorted Gauges network also includes several Hydrological Services Tipping Bucket Rain Gauges.

The Model 380 precipitation gauge, manufactured by Met One Instruments Inc., is a tipping bucket rain gauge which measures the amount of fallen precipitation (rain and/or snow). The gauge has a 30.5 cm (12 inch) diameter catchment funnel that directs precipitation to a tipping bucket assembly. When 0.254 mm (0.01 inch) of precipitation is collected, the tipping bucket assembly tips, draining the collection and activating a mercury switch for recording data. More detailed information is available on the [Met One Model 380 Precipitation Gauge webpage](#).

The Hydrological Services Tipping Bucket Rain Gauge is recognized as a world standard for measuring rainfall and precipitation in remote and unattended locations. The bucket tips when precipitation of the desired resolution has been collected. A pulse from each tip is sensed by the reed switch and logged to a data logger. The dual reed switch can also transmit the pulse to a telemetry system. More detailed information is available on the [Hydrological services Tipping Bucket Rain gauge webpage](#).

Investigators

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Data Characteristics

The GPM Ground Validation Met One Rain Gauge Pairs Wallops Flight Facility (WFF) dataset consists of rain rate estimates collected from 4 rain gauge networks at or near WFF in support of GPM. These data are available in ASCII format at a Level 2 processing level. More information about the NASA data processing levels are available on the [EOSDIS Data Processing Levels](#) webpage. Table 1 shows the characteristics of these data files.

Table 1: Data Characteristics

Characteristic	Description
Platform	Ground stations
Instrument	Met One Rain Gauge Pairs, Hydrological Services Tipping Bucket Rain Gauge
Spatial Coverage	N: 38.370, S: 37.453, E: -75.319, W: -75.879 (Virginia and Maryland)
Spatial Resolution	Point
Temporal Coverage	April 10, 2012 - October 1, 2018
Temporal Resolution	Monthly -< Annual
Sampling Frequency	1 minute
Parameter	Precipitation
Version	1
Processing Level	2

File Naming Convention

The GPM Ground Validation Met One Rain Gauge Pairs Wallops Flight Facility (WFF) dataset has the following file naming convention:

Data files:

wff_raingauge_[HalfDeg|Nassawadox|Pocomoke|*]_<gaugeID>_[YYYY|YYYYMM]_[2a56|gag|gmin].txt

Table 2: File naming convention variables

Variable	Description
[HalfDeg Nassawadox Pocomoke *]	Rain gauge network* *Note: Data from WFF Assorted Gauges network don't have network name in their file names
<gauge ID>	Gauge ID number For example, 0001_PAD1, 0001_A, NASA0001_A
[YYYY YYYYMM]	YYYY: Four-digit year MM: Two-digit month
[2a56 gag gmin]	2a56: Interpolated one-minute rain rates for a month gag: Formatted gauge tips gmin: Interpolated one-minute rain rates for a year
.txt	ASCII format

Data Format and Parameters

The GPM Ground Validation Met One Rain Gauge Pairs Wallops Flight Facility (WFF) dataset contains 3 products: formatted gauge tips (GAG), interpolated one-minute rain rates for a year (GMIN), and interpolated one-minute rain rates for a month (2A56). The

first line in each data file is file header that contains year, rain gauge network, rain gauge ID, gauge type, gauge bucket size. The second line lists out the data field names. Please find examples of each below:

2a56 text files:

Example:

```
2012 WFF 0001_PAD1 MetOne 0.2 mm 09/18/2012 23:13 09/29/2012 02:01
Year Mon Day Jday Hr Min Rain[mm/h] Lat Lon
2012 09 18 262 23 13 35.85 37.93438 -75.47081
2012 09 18 262 23 14 47.80 37.93438 -75.47081
2012 09 18 262 23 15 47.80 37.93438 -75.47081
2012 09 18 262 23 16 47.80 37.93438 -75.47081
```

The first line is file header (Table 3). The second line lists out the 9 data fields in 2a56 text files (Table 4).

Table 3: Contents in the first line of 2a56 text file

Content	Description
2012	year
WFF	Rain gauge network
0001_PAD1	Rain gauge ID
MetOne	Gauge type
0.2 mm	Gauge bucket size
09/18/2012 23:13	time stamp (month/day/year hour:minute in UTC) for the first rainy record in the month
09/29/2012 02:01	time stamp (month/day/year hour:minute in UTC) for the last rainy record in the month

Table 4: Data fields in 2a56 text files

Column	Data field
1	year
2	month
3	Day of month
4	Julian day of year
5	Hour in UTC
6	minute
7	Rain rate [mm/h]
8	Latitude in degree
9	Longitude in degree

gag text files:

Example:

```
2012 WFF 0001_PAD1 MetOne 0.2 mm
Year Mon Day Jday Hr Min Sec Rain[mm] Lat Lon
2012 09 18 262 23 13 15 0.200 37.93438 -75.47081
```

```

2012 09 18 262 23 13 22 0.200 37.93438 -75.47081
2012 09 18 262 23 13 31 0.200 37.93438 -75.47081
2012 09 18 262 23 13 37 0.200 37.93438 -75.47081
2012 09 18 262 23 13 43 0.200 37.93438 -75.47081

```

The first line is file header (Table 5). The second line lists out the 10 data fields in gag txt files (Table 6).

Table 5: Contents in the first line of the gag text file

Content	Description
2012	year
WFF	Rain gauge network
0001_PAD1	Rain gauge ID
MetOne	Gauge type
0.2 mm	Gauge bucket size

Table 6: Data fields in gag text files

Column	Data field
1	year
2	month
3	Day of month
4	Julian day of year
5	Hour in UTC
6	minute
7	second
8	Rain [mm] (eg. 1 tip = 0.254 mm)
9	Latitude in degree
10	Longitude in degree

gmin text files:

Example:

```

2012 WFF 0001_PAD1 MetOne 0.2 mm
Year Mon Day Jday Hr Min Rain[mm/h] Lat Lon
2012 09 18 262 23 13 35.85 37.93438 -75.47081
2012 09 18 262 23 14 47.80 37.93438 -75.47081
2012 09 18 262 23 15 47.80 37.93438 -75.47081
2012 09 18 262 23 16 47.80 37.93438 -75.47081

```

The first line is file header (Table 7). The second line lists out the 9 data fields in gmin text files (Table 8).

Table 7: Contents in the first line of the gmin text file

Content	Description
2012	year
WFF	Rain gauge network

0001_PAD1	Rain gauge ID
MetOne	Gauge type
0.2 mm	Gauge bucket size

Table 8: Data fields in gmin text files

Column	Data field
1	year
2	month
3	day of month
4	Julian day of year
5	Hour in UTC
6	minute
7	Rain rate [mm/h]
8	Latitude in degree
9	Longitude in degree

Algorithm

First, the numbers of raw tipping bucket (TB) tips in a rain event are summed into cumulative tip numbers at each “tip minute” (the minute when a tip occurs). These cumulative tip numbers are then converted into the cumulative rainfall in millimeters by multiplying the TB size of 0.254 mm.

A cubic spline-based interpolation algorithm is then applied to generate the 1-minute rain rate product 2A56 from tipping-bucket gauge measurements. The algorithm used is described in [Wang et al., 2008](#).

Quality Assessment

Errors in tipping bucket rain gauge measurements have been reported in [Ciach, 2003](#), [Tokay et al., 2010](#), [Wang et al., 2008](#), [Wang et al., 2010](#), and [Wang et al., 2012](#). One-minute rain rates suffer substantial errors, especially at low rain rates. When 1-min rain rates are averaged over 4-7 min intervals or longer, the errors dramatically reduce ([Wang et al., 2008](#)). The median relative absolute errors are about 22% and 32% for 1-min rain rates higher and lower than 3 mm/h, respectively. These errors decrease to 5% and 14% when rain rates are used at the 7-min scale. The rain gauges have a reported accuracy of $\pm 0.5\%$ at 13 mm/hr and $\pm 1\%$ at 25-75 mm/hr.

The time shift due to inaccurate clocks can also cause rain-rate estimation errors, which increase with the shifted time length.

Software

No software is required to view these ASCII data files.

Known Issues or Missing Data

The files only contain non-zero rainfall data. Time periods without rainfall were not recorded.

References

Ciach, Grzegorz J. (2003). Local random errors in tipping -bucket rain gauge measurements, J. Atmos. Oceanic Technol., 20, 752--759. doi: [https://doi.org/10.1175/1520-0426\(2003\)20%3C752:LREITB%3E2.0.CO;2](https://doi.org/10.1175/1520-0426(2003)20%3C752:LREITB%3E2.0.CO;2)

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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](#).

In addition, the Met One Tipping Rain Gauges were used in other GPM Ground Validation field campaigns. These other rain gauge datasets are listed below and may be of interest.

GPM Ground Validation Met One Rain Gauge Pairs IPHEX V2
(<http://dx.doi.org/10.5067/GPMGV/IPHEX/GAUGES/DATA201>)

GPM Ground Validation Met One Rain Gauge Pairs IFloodS V2
(<http://dx.doi.org/10.5067/GPMGV/IFLOODS/GAUGE/DATA202>)

GPM Ground Validation Rain Gauge Pairs MC3E V2
(<http://dx.doi.org/10.5067/GPMGV/MC3E/GAUGE/DATA202>)

Contact Information

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

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