



## Data User Guide

# ***GPM Ground Validation Iowa Flood Center (IFC) Rain Gauges IFloodS***

### **Introduction**

The GPM Ground Validation Iowa Flood Center (IFC) Rain Gauges IFloodS dataset was collected during the Iowa Flood Studies (IFloodS) field campaign from April 28, 2013 through May 20, 2013 near Shueyville City, Iowa. Four observation sites (15442, 15443, 15444, and 22390), each consisting of three tipping bucket rain gauges that collected 5-minute accumulations of precipitation data. The main goal of IFloodS was to evaluate how well the GPM satellite rainfall data can be used for flood forecasting. Specifically, this meant collecting detailed measurements of precipitation at the Earth's surface using ground instruments and advanced weather radars while simultaneously collecting data from satellites passing overhead. These IFC Rain Gauge data are available in ASCII format, with corresponding browse images available in PNG format.

### **Citation**

Krajewski, Witold. 2017. GPM Ground Validation Iowa Flood Center (IFC) Rain Gauges IFloodS [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/IFLOODS/GAUGES/DATA101>

### **Keywords:**

*NASA, GHRC, IFloodS, GPM GV, Iowa, rain gauge, IFC, precipitation, precipitation accumulation*

### **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 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 GPM GV. More information about the GPM mission is at <https://pmm.nasa.gov/GPM/>.

The Iowa Flood Studies (IFloodS) was a ground measurement campaign that took place throughout Iowa from May 1 to June 15, 2013. The main goal of IFloodS was to evaluate how well the GPM satellite rainfall data can be used for flood forecasting. Specifically, this meant collecting detailed measurements of precipitation at the Earth's surface using ground instruments and advanced weather radars and simultaneously collecting data from satellites passing overhead. The ground instruments characterize precipitation – the size and shape of raindrops, the physics of ice and liquid particles throughout the cloud and below as it falls, temperature, air moisture, and distribution of different size droplets – to improve rainfall estimates from the satellites, and in particular the algorithms that interpret raw data for the GPM mission's Core Observatory satellite, which launched in 2014. More information about IFloodS is available at <https://ghrc.nsstc.nasa.gov/home/field-campaigns/ifloods>. Additional information about the Iowa Flood Center is available at <http://iowafloodcenter.org/>.

## **Instrument Description**

The tipping bucket rain gauge measures the amount of fallen precipitation entering the gauge orifice, where there is a central swinging shaft with two small buckets on top and a magnet on the bottom. These tipping bucket rain gauges hold 0.01 inches, or 0.234 mm, of rain. Once the bucket reaches capacity, the bucket tips over, empties the contents, and records the bucket tip. The number of bucket tips are recorded by the magnet passing over two wires, causing them to touch, and completing an electrical circuit. The units are solar powered and transmit data via a built-in cell modem. The GPM Ground Validation Iowa Flood Center (IFC) Rain Gauges IFloodS dataset is comprised of four observation systems (sites 15442, 15443, 15444, and 22390) near Shueyville City, Iowa consisting of three tipping bucket rain gauges per site. More information about Iowa Flood Center (IFC) Rain Gauges can be found at <http://iowafloodcenter.org/iowa-flood-center-deploys-rain-gauges/> and <http://iowafloodcenter.org/notes-from-the-field-rain-gauges/>.

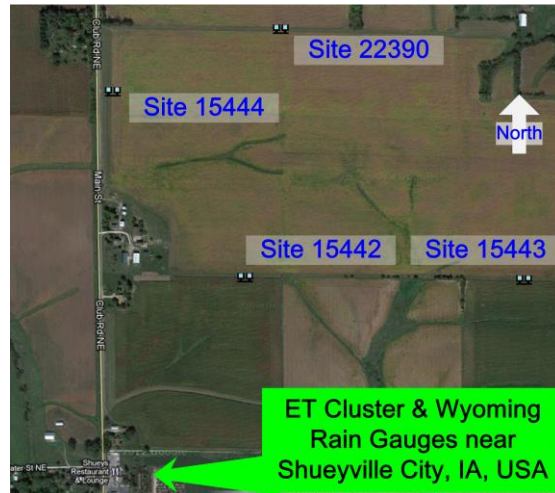


Figure 1: Rain gauges near Shueyville City, IA for the four observation systems locations  
(Image source:

[https://ghrc.nsstc.nasa.gov/pub/fieldCampaigns/gpmValidation/ifloods/disdrometers\\_and\\_gauges/rain\\_gauges\\_IFC/doc/ET\\_Cluster\\_and\\_Wyoming\\_Rain\\_Gauges\\_Sites.png](https://ghrc.nsstc.nasa.gov/pub/fieldCampaigns/gpmValidation/ifloods/disdrometers_and_gauges/rain_gauges_IFC/doc/ET_Cluster_and_Wyoming_Rain_Gauges_Sites.png))



Figure 2: Outside of a tipping bucket rain gauge  
(Image source: <http://iowafloodcenter.org/notes-from-the-field-rain-gauges/>)

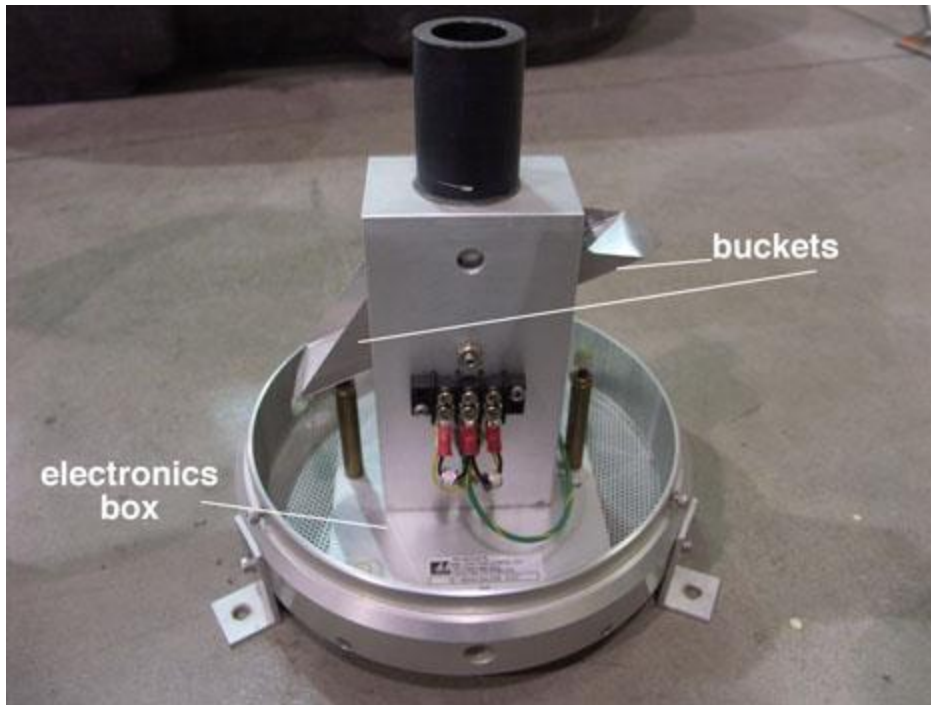


Figure 3: Inside of a tipping bucket rain gauge. Rain enters through the black pipe on top filling up one of the two buckets

(Image source: <http://iowafloodcenter.org/notes-from-the-field-rain-gauges/>)

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## File Naming Convention

The GPM Ground Validation Iowa Flood Center (IFC) Rain Gauges IFloodS dataset files are Level 1B instrument data in ASCII format, while browse images are in PNG format and show plots of the 5-min accumulations as daily bar plots. The files have the following naming convention:

**Data:** ifloods\_IA\_Shueyville\_Site#####\_Raindata\_YYYY-MM-DD.txt

**Browse:** ifloods\_IA\_Shueyville\_Site#####\_Raindata\_[start]\_[stop].png

Table 1: File naming convention variables

Variable	Description
Site#####	Rain gauge site name/number: Site 15442 = (41.855, -91.642) Site 15443 = (41.855, -91.635) Site 15444 = (41.859, -91.646) Site 22390 = (41.860, -91.641)

	Each site contains three rain gauge buckets
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
.txt	ASCII text file
[start]	Start time in YYYYMMDD where, YYYY = four-digit year MM = two-digit month DD = two-digit day
[end]	End time in YYYYMMDD where, YYYY = four-digit year MM = two-digit month DD = two-digit day
.png	Portable Network Graphics format

## Data Format Description

The GPM Ground Validation Iowa Flood Center (IFC) Rain Gauges IFloodS data are available in ASCII format, while associated browse images are available in PNG format. The ASCII files are Level 1B data files, which contain 5-minute accumulation of precipitation measurements collected by three different rain gauge buckets. More information on NASA processing levels is available at <https://science.nasa.gov/earth-science/earth-science-data/data-processing-levels-for-eosdis-data-products/>.

Table 2: Data Characteristics

Characteristic	Description
Platform	Ground Station
Instrument	Rain Gauges
Projection	n/a
Spatial Coverage	N: 41.860 , S: 41.855, E: -91.635, W: -91.646 (Shueyville City, Iowa)  Site 15442 = (41.855, -91.642) Site 15443 = (41.855, -91.635) Site 15444 = (41.859, -91.646) Site 22390 = (41.860, -91.641)  Each site contains three rain gauge buckets
Temporal Coverage	Start date: April 28, 2013 Stop date: May 20, 2013
Temporal Resolution	1 week
Sampling Frequency	5 minutes
Parameter	Precipitation, precipitation amount, precipitation rate

Version	1
Processing Level	1B

## Data Parameters

The GPM Ground Validation Iowa Flood Center (IFC) Rain Gauges IFloodS dataset consists of 5-minute accumulations of precipitation measurements collected by three different rain gauge buckets at each of the four sites. Table 3 gives a description and unit for each parameter provided in the data files.

Table 3: Data Fields in the IFC Rain Gauge ASCII data files

Column	Field Name	Description	Unit
1	TIMESTAMP(UTC)	Time in YYYY-MM-DD hh:mm:ss  where, YYYY = four-digit year MM = two-digit month DD = two-digit day hh = two-digit hour mm = two-digit minute ss = two-digit second	UTC
2	RECORD	Record number	-
3	BattV	Battery voltage	Voltz
4	B1_Tot	5-minute accumulation of precipitation measured by the first bucket	mm
5	B2_Tot	5-minute accumulation of precipitation measured by the second bucket	mm
6	B3_Tot	5-minute accumulation of precipitation measured by the third bucket	mm

## Quality Assessment

The rain gauges have a reported accuracy of  $\pm 2\%$  at 0-250 mm hr<sup>-1</sup> precipitation rate and  $\pm 3\%$  at 250-500 mm hr<sup>-1</sup>. Errors in tipping bucket rain gauge measurements have been reported in Ciach, 2003, Tokay et al., 2010, and Wang et al., 2010.

## Software

No software is required to view these data since they are in ASCII format.

## References

Ciach, Grzegorz (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)

Goddard Space Flight Center (2013): Global Precipitation Measurement (GPM) Science Implementation Plan. [https://pmm.nasa.gov/sites/default/files/document\\_files/GPM%20Science%20Implementation%20Plan%20-%20April%202013.pdf](https://pmm.nasa.gov/sites/default/files/document_files/GPM%20Science%20Implementation%20Plan%20-%20April%202013.pdf)

Tokay, Ali, Paul G. Bashor, Victoria L. McDowell (2010): Comparison of Rain Gauge Measurements in the Mid-Atlantic Region. *J. Hydrometeorol.*, 11, 553-565. doi:<https://doi.org/10.1175/2009JHM1137.1>

Wang, J., and D. B. Wolff (2010): Evaluation of TRMM ground-validation radar-rain errors using rain gauge measurements. *J. Appl. Meteor. Climatol.*, 49, 310-24. doi:<https://doi.org/10.1175/2009JAMC2264.1>

## Related Data

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

In addition, tipping bucket rain gauge instruments were used in previous GPM Ground Validation campaigns. The following datasets are tipping bucket rain gauge data from other field campaigns:

GPM Ground Validation Duke Rain Gauges **IPHEX**  
(<http://dx.doi.org/10.5067/GPMGV/IPHEX/GAUGES/DATA202>)

## Contact Information

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

NASA Global Hydrology Resource Center DAAC  
User Services  
320 Sparkman Drive  
Huntsville, AL 35805  
Phone: 256-961-7932  
E-mail: [support-ghrc@earthdata.nasa.gov](mailto:support-ghrc@earthdata.nasa.gov)  
Web: <https://ghrc.nsstc.nasa.gov/>