Global Hydrology Resource Center

Data User Guide

GPM GROUND VALIDATION TWO-DIMENSIONAL VIDEO DISDROMETER (2DVD) IFLOODS

Introduction

The GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) IFloodS dataset was collected during the GPM Ground Validation Iowa Flood Studies (IFLoodS) field campaign in central-northeastern Iowa in 2013. This campaign aimed to improve satellite precipitation measurements for flood prediction by using ground measurements to improve satellite retrieval algorithms. The Two-Dimensional Video Disdrometer (2DVD), developed by Joanneum Research (Graz, Austria), measures raindrop characteristics such as size distribution, shape, and velocity. The 2DVD IFloodS data was collected from 6 sites from April 3, 2013 to June 18, 2013. Officially, the IFloodS campaign ran from May 1 to June 15, 2013 but the 2DVD instruments were installed and calibrated prior to the start, allowing for the wider period of record. The dataset contains daily ASCII files that include measurements for various precipitation parameters.

Citation

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Keywords:

NASA, GHRC, PMM, GPM GV, IFloodS, Iowa, precipitation rate, drop size distribution, hydrometeor

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 the GPM GV mission. More information about the GPM mission is available on the PMM Ground Validation webpage.

The Iowa Flood Studies (IFloodS) field campaign was a ground measurement campaign that took place in central-northeastern Iowa (Figure 1) 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 while simultaneously collecting data from satellites passing overhead. The ground instruments were used to thoroughly characterize precipitation and contribute to improved satellite rainfall estimates; in particular, the improvement of algorithms that interpret raw data for the GPM mission's Core Observatory satellite. More information about IFloodS is available at the IFloodS Field Campaign webpage and more information about GPM's partner organization for this project, the Iowa Flood Center, is available on the Iowa Flood Center website.

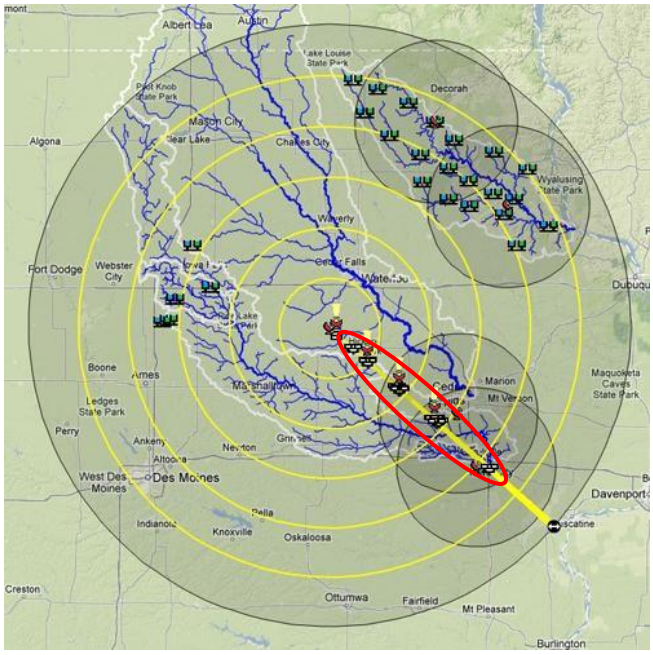

Figure 1: Areas of focus during the IFloodS campaign were the Cedar and Iowa River Basins, the South Fork Iowa River, and the Turkey River Basin in Northeast Iowa. The 2DVD instruments are indicated by the gray rectangular icons encircled by the red oval; stretching from the center of the image to the southeast.

(Image source:PMM IFloodS webpage)

Instrument Description

The Two-Dimensional Video Disdrometer (2DVD) uses two high speed line scan cameras to provide continuous measurements of size distribution, shape, and fall velocities of all precipitation particles and types. Two orthogonal light planes, provided by two internal lamps, transect the approximate 10x10 cm virtual measurement area and are projected onto two high speed line-scan cameras. Precipitation particles, also known as hydrometeors, that fall through the light planes cast a shadow that is recorded by the two cameras nested within the instrument. Detailed shape and size information for each individual hydrometeor is available through the two "side image shadows" that are recorded by the two cameras. The light planes are separated by a calibrated distance of 6 mm from which the vertical fall velocity can be measured. The line scan cameras sample each plane every 18 microseconds at a horizontal resolution of 200 microns (0.2 mm). Therefore, as a raindrop falls through the measurement area, several line scans of each image are recorded from two sides and two different heights. This allows for precise measurements to be made. More information about the 2DVD instrument can be found in Kruger and Krajewski (2002) and in the 2DVD Micro Article.

Figure 2: Two-Dimensional Video Disdrometer (2DVD)
(Image Source:GSFC GPM webpage)

The 2DVD instruments were located at 6 sites in Iowa. The serial numbers and site locations of the instruments are listed in Table 1.

Table 1: 2DVD instrument serial numbers and locations

2DVD Serial Number	Latitude	Longitude
2dvd_sn25	42.238611	-92.463611
2dvd_sn35	42.182222	-92.365278
2dvd_sn36	42.125833	-92.281667
2dvd_sn37	41.991389	-92.071667
2dvd_sn38	41.860278	-92.873889
2dvd_sn70	41.640556	-91.541667

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Data Characteristics

The GPM Ground Validation Two-dimensional Video Disdrometer (2DVD) IFloodS data files consist of measurements for various precipitation parameters. These data files are available in ASCII file 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 station
Instrument	Two-Dimensional Video Disdrometer (2DVD)
Projection	n/a
Spatial Coverage	N: 42.69 , S: 41.64 , E: -91.54 , W: -92.3 (Iowa)
Spatial Resolution	~0.2 mm nominal resolution
Temporal Coverage	April 3, 2013 - June 18, 2013
Temporal Resolution	Daily
Sampling Frequency	18 microseconds
Parameter	Precipitation rate, drop size distribution, hydrometeor characteristics (size, shape, etc.)
Version	1
Processing Level	3

File Naming Convention

The GPM Ground Validation 2DVD IFloodS dataset file names are archived in a daily tar format with the following naming convention:

Tarred data files: ifloods_2dvd_<sn>_YYYYMMDD_<latitude_longitude>.tar

Untarred data files: ifloods_2dvd_<sn>_YYYYMMDD_<latitude_longitude>_[file type].txt

Table 3: File naming convention variables

Variable	Description
sn	Serial number of 2dvd instrument (e.g., sn16). Locations are listed in Table 1
YYYYMMDD	Date of the data in YYYYMMDD where: YYYY = four-digit year MM = two-digit month DD = two-digit day
latitude_longitude	Geographic location of instrument (e.g., N363442.07_W0972640.90 is North 36°34'42.07"and West 97°26'40.90")
[file type]*	drops dropCounts rainDSD rainDSD_vT rainParams rainParams_vT rainEvents
.tar	"tar archive" (a method of bundling multiple files into one file)
.txt	ASCII text file format

*More information about these file types is listed in Table 4

Data Format and Parameters

The GPM Ground Validation 2DVD IFloodS tarred data files consist of ASCII encoded files containing information on each drop observed, the drop size distribution and integral precipitation parameters such as precipitation rate, reflectivity and mass-weighted mean diameter. It should be noted that each daily tar archive may not contain all files listed in Table 4. If an instrument did not collect any data or observe any precipitation on a given day, then no tar archive was created for that day. Tables 5-9 list the data fields for each file type. Additional information on the data formats and data levels can be found in the PI Documentation.

Table 4: 2DVD ASCII file types

Field Name	Description
*_drops.txt	ASCII file containing information on individual hydrometeors
*_dropCounts.txt	Quality-controlled number of hydrometeors in each diameter bin each minute hydrometeors were detected
*_rainDSD.txt	Quality-controlled raindrop size distribution (based on measured fall velocities) for each diameter bin (0. 2 mm bin size from 0-10 mm) each minute rain was detected
*_rainDSD_vT.txt	Quality-controlled raindrop size distribution (based on terminal fall velocities listed in the Appendix of the

	DataFormat_2dvd_ifloods document for each diameter bin (0.2 mm bin size from 0-10 mm) each minute rain was detected
*_rainParams.txt	Quality-controlled integral parameters (based on measured fall velocities) for each minute hydrometeors were detected
*_rainParams_vT.txt	Quality-controlled integrated parameters for rain (based on terminal fall velocities listed in the Appendix of the DataFormat_2dvd_ifloods document for each minute
*_rainEvents.txt	Quality-controlled total rainfall measured for a continuous period of precipitation

Table 5: Data fields for *.drops.txt files

Field Name	Description	Unit
hr	Hour	UTC
mn	Minute	UTC
ss	Seconds	UTC
ms	Milliseconds	UTC
eqdiam	Equivalent Diameter	mm
volume	Volume	mm^3
fspd	Fall Speed	m/s
oblate	Oblateness	-
area	Cross-sectional Area	mm^2
type	Precipitation type (R = rain, S = snow, not class. = not classified)	-
aht	Height In Camera A	mm
bht	Height In Camera B	mm
awdth	Width In Camera A	mm
bwdth	Width In Camera B	mm
min_a	Minimum Pixel Shadowed In A	-
max_a	Maximum Pixel Shadowed In A	-
min_b	Minimum Pixel Shadowed In B	-
max_b	Maximum Pixel Shadowed In B	-

Table 6: Data fields for *_dropCounts.txt files

Field Number	Description	Unit
1	Year	-
2	Day of Year	-
3	Hour	UTC
4	Minute	UTC
5-54	Number of drops in each of the 50 diameter bins (0 - 10.0mm spaced every 0.2mm)	-

Table 7: Data fields for *DSD.txt and *DSD_vT.txt files

Field Number	Description	Unit
1	Year	-

2	Day of Year	-
3	Hour	UTC
4	Minute	UTC
5-54	Particle concentration in each of the 50 diameter bins (0-10.0mm spaced every 0.2mm)	$m^{-3}mm^{-1}$

Table 8: Data fields for *_rainParams.txt and *_rainParams_vT.txt files

Field Number	Description	Unit
1	Year	-
2	Day of Year	-
3	Hour	UTC
4	Minute	UTC
5	Total number of drops	-
6	Total drop concentration	m^{-3}
7	Liquid water content	G m^{-3}
8	Rain rate	mm h^{-1}
9	Reflectivity in Rayleigh regime	dBZ
10	Mean mass-weighted diameter	mm
11	Maximum drop diameter	mm
12	Minimum drop diameter	mm
13	Standard deviation of mean mass-weighted diameter	mm

Table 9: Data fields for *_rainEvents.txt files

Field Number	Description	Unit
1	Year	-
2	Day of year precipitation begins	-
3	Beginning of precipitation (hh:mm)	UTC
4	Day of year precipitation ends	-
5	Ending of precipitation (hh:mm)	UTC
6	Number of rainfall observations	min
7	Event maximum rainfall rate	mm/hr
8	Event total rain accumulation	mm
9	Event maximum drop diameter	mm

Algorithm

The fall velocity for each drop was calculated by using the time it takes for the drop to enter into the measurement plane of Camera A, the time proceeding from the upper Camera A to the lower Camera B, and the time the drop enters into the measurement plane of Camera B of the instrument, as well as the distance between the two cameras. Size and shape information was obtained from the shadows casted by the hydrometeors as they fell

through the 2DVD light planes. More information about these calculations is available in Schönhuber, Lammer, and Randeu (2008) and Kruger and Krajewski (2002).

Quality Assessment

The 2DVD instrument is calibrated by measuring spheres with known diameter provided by the manufacturer. Software was provided to ensure proper alignment for the 2DVD apparatus. The manufacturer also has software available that uses an algorithm to correct measurements for horizontal movement of the precipitation particles. Raindrops exceeding 50% of their terminal fall speed are removed to eliminate invalid measurements caused by things such as insects. Also, minutes with fewer than 10 drops and rainfall rate below 0.01 mm/hr are removed to eliminate noise.

Software

No software is required to view these data files. The GPM Ground Validation 2DVD IFloodS ASCII text files can be viewed in a text editor or in a spreadsheet software, such as Microsoft Excel or Notepad++.

Known Issues or Missing Data

There were some issues with data collection for the 2DVD instruments due to varying causes; described in the 2DVD IFloodS instrument reports inside the GHRC IFloodS reports directory.

References

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Related Data

All data from other instruments collected during the IFloodS field campaign are considered to be related datasets. These data can be located by searching 'IFLOODS' in HyDRO 2.0. The complete IFloodS collection can be found here.

Below are datasets from other GPM GV field campaigns and sites that used the 2DVD instrument to collect data:

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) OLYMPEX (http://dx.doi.org/10.5067/GPMGV/OLYMPEX/2DVD/DATA/301)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) IPHEx (http://dx.doi.org/10.5067/IPHEX/2DVD/DATA301)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) MC3E (http://dx.doi.org/10.5067/GPMGV/MC3E/2DVD/DATA301)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) WFF V2 (http://dx.doi.org/10.5067/GPMGV/WFF/2DVD/DATA301)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) GCPEX (http://dx.doi.org/10.5067/GPMGV/GCPEX/2DVD/DATA101)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) LPVEx (http://dx.doi.org/10.5067/GPMGV/LPVEX/2DVD/DATA301)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) HyMeX (http://dx.doi.org/10.5067/GPMGV/HYMEX/2DVD/DATA301)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) NSSTC (http://dx.doi.org/10.5067/GPMGV/NSSTC/2DVD/DATA201)

Contact Information

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

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