Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) IPHEx

Introduction

The GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) IPHEx dataset was collected during the GPM Ground Validation Integrated Precipitation and Hydrology Experiment (IPHEx) held in North Carolina. The goal of IPHEx was to evaluate the accuracy of satellite precipitation measurements and use the collected data for hydrology models in the region. Collected from five sites, the data contains daily ASCII files with information on individual hydrometeors including the number of hydrometeors, raindrop size distribution, and particle concentration. Overall data dates range from April 23, 2014 through June 17, 2014; exact dates may vary per site.

Citation

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Keywords:

NASA, GHRC, GPM GV, 2DVD, IPHEx, North Carolina, drop size distribution, hydrometeors

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 on the GPM Core Satellite, which launched on February 27, 2014. The validation effort entailed 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, 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 mission. More information about the GPM GV mission is available at the PMM Ground Validation webpage.

The GPM Integrated Precipitation and Hydrology Experiment (IPHEx) was held in North Carolina during the months of April-June 2014. IPHEx seeks to characterize warm season orographic precipitation regimes, and the relationship between precipitation regimes and hydrologic processes in regions of complex terrain. The IPHEx focus includes the development, evaluation and improvement of remote-sensing precipitation algorithms in support of the GPM mission through the NASA GPM GV field campaign (IPHEX_GVFC) and the evaluation of Quantitative Precipitation Estimation (QPE) products for hydrologic forecasting and water resource applications in the Upper Tennessee, Catawba-Santee, Yadkin-Pee Dee and Savannah river basins: (IPHEX-HAP, H4SE). NOAA Hydrometeorology Testbed (HTM) has synergy with this project. More information about IPHEx is available at the IPHEx Field Campaign webpage.

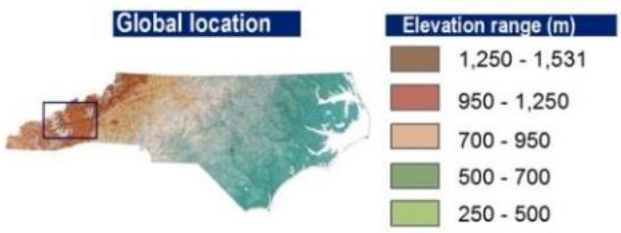

Figure 1: Region of North Carolina IPHEx campaign ground validation (image source: http://gpm-gv.gsfc.nasa.gov/Gauge/)

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. 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 et al., 2001 and in the 2DVD Micro Article.

Figure 2: Two-Dimensional Video Disdrometer (2DVD)
(Image Source: https://wallops-prf.gsfc.nasa.gov/Disdrometer/index.html)

The 2DVD instruments were located at 5 sites in North Carolina. The serial numbers and site locations of the instruments are provided in Table 1:

Table 1: 2DVD instrument serial numbers and locations

2DVD Serial number	Latitude	Longitude
2dvd_sn25	35.227	-82.056
2dvd_sn35	35.293	-82.171
2dvd_sn36	35.373	-82.370
2dvd_sn37	35.520	-83.095
2dvd_sn38	35.586	-83.073

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Data Characteristics

The GPM Ground Validation Two-dimensional Video Disdrometer (2DVD) IPHEx data files consist of precipitation amounts, precipitation rate, as well as other precipitation characteristics. These data files are available 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 station
Instrument	Two-Dimensional Video Distrometer (2DVD)
Spatial Coverage	N: 35.900 , S: 35.203 , E: -82.060 , W: -83.100 (North Carolina)
Spatial Resolution	~0.2 mm nominal resolution
Temporal Coverage	April 23, 2014 - June 17, 2014
Temporal Resolution	Daily
Sampling Frequency	< 1 second
Parameter	Precipitation, rain events, precipitation rate, drop size, hydrometeor characteristics
Version	1
Processing Level	3

File Naming Convention

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

Tarred Data files: iphex_2dvd_<sn>_YYYYMMDD_<latitude_longitude>.tar
Untarred Data files: iphex_2dvd_<sn>_YYYYMMDD_<latitude_longitude>_[filetype].txt

Table 3: File naming convention variables

Variable	Description
<sn>	Serial number of 2dvd instrument (e.g., sn16). Locations are listed in Table 1
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")
[filetype]*	dropCounts

	drops 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 IPHEx 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

File ending	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_iphex 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_iphex 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
10	Precipitation type (R = rain, S = snow)	-

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. More information about these calculations is available in Schönhuber et al., 2008 and Kruger and Krajewski, 2001.

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.

Between September 15-22, 2010, the 2DVD datasets collected at Emasalo (SN36) and Harmaja (SN37) were +2 hours offset from UTC, and the 2DVD dataset collected at Jarvenpaa (SN35) was +3 hours offset from UTC. The time stamps in these data files were corrected and re-posted to this archive in mid-September 2012.

Software

No software is required to view these data files. The GPM Ground Validation 2DVD IPHEx 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 are no known issues with these data or any known gaps in the dataset

References

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Related Data

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

Below are datasets from other GPM GV field campaigns 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) IFloodS (http://dx.doi.org/10.5067/GPMGV/IFLOODS/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 (http://dx.doi.org/10.5067/GPMGV/WFF/2DVD/DATA201)

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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