Data User Guide

GPM Ground Validation Duke Parsivel IPHEx

Introduction

The GPM Ground Validation Duke Parsivel IPHEx dataset were collected during the GPM Ground Validation Integrated Precipitation and Hydrology Experiment (IPHEx) field campaign which was held in the Southern Appalachian region, including the Piedmont and Coastal Plain regions, of North Carolina. OTT laser-based Parsivel instruments operated from May 1, 2014 through June 30, 2014. The IPHEx campaign was designed to characterize warm season orographic precipitation regimes and determine the relationship between precipitation regimes and hydrologic processes in regions of complex terrain. The parsivel data are available in ASCII-csv format for each of the parsivel locations and contain precipitation intensity and drop parameters.

Citation

Barros, A. P. 2017. GPM Ground Validation Duke Parsivel IPHEx [indicate subset used]. Dataset available online from the NASA Global Hydrometeorology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi:http://dx.doi.org/10.5067/GPMGV/IPHEX/APU/DATA302

Keywords:

NASA, GHRC, IPHEx, Duke, GPM GV, North Carolina, parsivel, disdrometers, precipitation, Number of particles, rain intensity, reflectivity

Campaign

The Global Precipitation Measurement (GPM) mission Ground Validation 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). 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/.

One of the GPM-GV field campaigns was the GPM Integrated Precipitation and Hydrology Experiment (IPHEx) which was held in North Carolina during 2013 and 2014 with an intense study period from May 1 to June 15, 2014. The goal of IPHEx was to characterize warm season orographic precipitation regimes and the relationship between precipitation regimes and hydrologic processes in regions of complex terrain. The IPHEx campaign was part of the development, evaluation, and improvement of remote-sensing precipitation algorithms in support of the GPM mission through 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 http://gpm.nsstc.nasa.gov/iphex/.

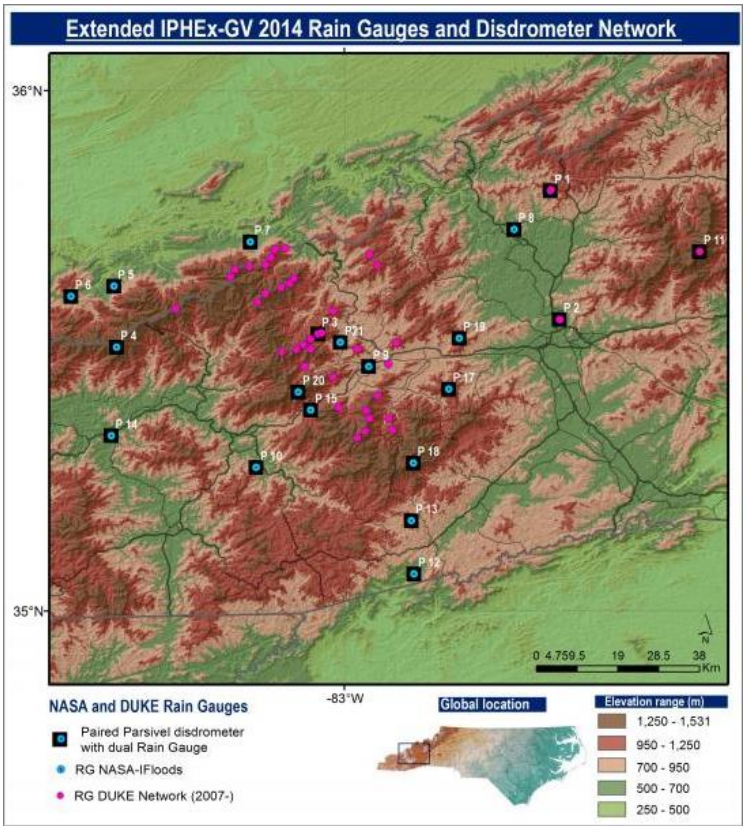

Figure 1: Details of Duke University parsivel and rain gauge locations for IPHEx field campaign ground validation project. Region of North Carolina IPHEx study shown as a black box in the bottom right of the figure of North Carolina.
(image source: http://iphex.pratt.duke.edu/instrumentation)

Instrument Description

The OTT-built parsivel is a laser-based disdrometer that measures the size and fall velocity of hydrometeors that fall through a laser sheet that is approximately 180 mm long, 30 mm wide, and 1 mm high. The size of a hydrometeor is estimated from the maximum attenuation of the laser signal and the duration of the hydrometeor within the laser beam provides the fall speed. The drops are assumed to be spherical. The Duke University researchers placed Parsivel Disdrometers at 13 sites during the IPHEx field campaign. This network of 13 disdrometer locations (Listed in Table 1) were used for measurements of precipitation drop size distribution and drop velocity and collected data from May 1, 2014 through June 30, 2014. For IPHEx, there were two parsivels labeled P1 and P2, both made by OTT, where P1 is older than P2 and the key improvement is the use of a more expensive laser device and better homogeneity of the laser sheet. Figure 2 shows a parsivel station in IPHEx. More information about the instrument can be found at http://iphex.pratt.duke.edu/instrumentation and Tokay (2014).

Figure 2: Parsivel disdrometer (image source: http://gpm-gv.gsfc.nasa.gov/Gauge/)

Table 1: Network of 13 IPHEx Duke University Parsivel lat/lon locations with elevation.

Site Location	Sensor Id	Sensor	Descriptive Location	Latitude	Longitude	Elev(m)
S1	243760	P1	S1 Marshall Ridge	35.885789°	-82.584286°	1188
S2	243769	P1	S2 UNCA	35.616300°	-82.56505°	646
S2	274686	P2	S2 UNCA	35.616300°	-82.56505°	646
S3	221995	P1	S3 Purchase Knob (GSNP)	35.586157°	-83.072477°	1493
S3	329770	P2	S3 Purchase Knob (GSNP)	35.586157°	-83.072477°	1493
S5	237565	P1	S5 Twin Creek Cherokee orchard rd. (GSNP)	35.686108°	-83.500819°	595

S6	237569	P1	S6 Elkmont (GSNP)	35.664548°	-83.590374°	634
S7	237566	P1	S7 Cosby (GSNP)	35.778874°	-83.214296°	528
S10	237564	P1	S10 WCU Health and Human Science Building	35.306469°	-83.201963°	690
S10	341503	P2	S10 WCU Health and Human Science Building * installed 1 may 2014	35.306469°	-83.201963°	690
S11	237560	P1	S11 Mount Mitchell	35.758625°	-82.271059	1897
S12	237558	P1	S12 Christian Wild Camp	35.083265°	-82.870649°	575
S13	237552	P1	S13 Pisgah Astronomical Research Institute (PARI)	35.195054°	-82.876221°	863
S14	237563	P1	S14 Southwestern Community College	35.373104°	-83.506194°	589
S17	237562	P1	Mount Pisgah	35.470258°	-82.797558°	1380
S21	237567	P1	S21 Haywood EMC	35.568237°	-83.025073°	788

Investigators

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File Naming Convention

The GPM Ground Validation Duke Parsivel Disdrometer IPHEx dataset is organized as monthly files in ASCII-csv (comma separated) format and have the following naming convention:

Data files: iphex_s#[#]_p*_YYYY-MM.csv

Table 2: File naming convention variables

Variable	Description
s#[#]	Site location number, expands to two places as needed
p*	Sensor at location (P1 or P2)
YYYY	Four-digit year
MM	Two-digit month
.csv	ASCII comma separated file format

Data Format Description

The GPM Ground Validation Duke Parsivel Disdrometer IPHEx dataset consists of monthly ASCII-csv files. Data characteristics are provided in Table 3 below. Each data file contains one header line with data lines following. Table 4 describes each column within the files.

Table 3: Duke IPHEx Parsivel Disdrometer Data Characteristics

Characteristic	Description
Platform	Ground Station
Instrument	Parsivel Disdrometer
Projection	N/A
Spatial Coverage	(North Carolina) N: 35.886 S: 35.083 E: -82.271 W: -83.590
Spatial Resolution	Point
Temporal Coverage	May 1, 2014 - June 30, 2014
Temporal Resolution of file	Monthly
Sampling Frequency of data	10 seconds
Parameter	Number of particles, rain intensity, reflectivity
Version	1
Processing Level	3

Table 4: Format within the file

Column Name	Description	Unit
Datetime UTC	Date and time of data in the following convention: M/D/YYYY hh:mm M: one-digit month D: one or two digit day YYYY: four-digit year hh: two-digit hour mm: two-digit minute	UTC
ID	Sensor serial number	-
H	Hour of day	hour
ST	Sensor status	-
TEMP	Temperature in the sensor	°C
NP	Number of detected particles	-
I	Rain intensity	mm/h
P	Precipitation total since start of device	mm
Z	Radar Reflectivity	dBz
MOR	MOR visibility during precipitation	m
WaWa	Weather code (see table in "Categorization of precipitation type by precipitation codes")	-
WW	Weather code (see table in PI doc)	-
D1	Number of particles with volume-equivalent diameter between 0 - 0.1245 mm	-
D2	between 0.1245 - 0.2495 mm	-
D3	between 0.2495 - 0.3745 mm	-
D4	between 0.3745 - 0.4995 mm	-

D5	between 0.4995 - 0.6245 mm	-
D6	between 0.6245 - 0.7495 mm	-
D7	between 0.7495 - 0.8745 mm	-
D8	between 0.8745 - 0.9995 mm	-
D9	between 0.9995 - 1.1245 mm	-
D10	between 1.1245 - 1.2495 mm	-
D11	between 1.25 - 1.5 mm	-
D12	between 1.5 - 1.75 mm	-
D13	between 1.75 - 2 mm	-
D14	between 2 - 2.25 mm	-
D15	between 2.25 - 2.5 mm	-
D16	between 2.5 - 3 mm	-
D17	between 3 - 3.5 mm	-
D18	between 3.5 - 4 mm	-
D19	between 4 - 4.5 mm	-
D20	between 4.5 - 5 mm	-
D21	between 5 - 6 mm	-
D22	between 6 - 7 mm	-
D23	between 7 - 8 mm	-
D24	between 8 - 9 mm	-
D25	between 9 - 10 mm	-
D26	between 10 - 12 mm	-
D27	between 12 - 14 mm	-
D28	between 14 - 16 mm	-
D29	between 16 - 18 mm	-
D30	between 18 - 20 mm	-
D31	between 20 - 23 mm	-
D32	between 23 - 26 mm	-

Data Parameters

The GPM Ground Validation Duke Parsivel Disdrometer IPHEx dataset consists of total number of detected particles, rain intensity in mm/h, and reflectivity in dBz for a given time period. Table 4 provides other variables included in the ASCII-csv files. The size range of measurable liquid precipitation particles is from 0.2 to 5 mm, for solid precipitation particles the size can range from 0.2 to 25 mm. Measured precipitation particles can have a velocity of 0.2 to 20 m/s.

Algorithm

Disdrometers are described in general in Kathiravelu, et al. (2016). The OTT Parsivel details are provided in the OTT Operating Instructions Present Weather Sensor Parsivel document and are also discussed in Tokay et al. (2014).

Quality Assessment

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

These data files are in ASCII-csv format, so no software is required to reach these data.

Known Issues or Missing Data

There are no known issues with these data or any known gaps in the dataset.

References

Friedrich, K., S. Higgins, F.J. Masters, and C.R. Lopez, 2013: Articulating and Stationary PARSIVEL Disdrometer Measurements in Conditions with Strong Winds and Heavy Rainfall. J. Atmos. Oceanic Technol., 30, 2063–2080, doi: https://doi.org/10.1175/JTECH-D-12-00254.1.

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Kathiravelu, G., T. Lucke, and P. Nichols, 2016: Rain Drop Measurement Techniques: A Review. Water, 8, 29, doi: https://doi.org/10.3390/w8010029.

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Tokay, A., W. A. Petersen, P. Gatlin, and M. Wingo, 2013: Comparison of raindrop size distribution measurements by collocated disdrometers. J. Atmos. Oceanic Technol., 30, 1672–1690, doi: https://doi.org/10.1175/JTECH-D-12-00163.1.

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.

OTT Guide for P1 (https://www.esrl.noaa.gov/psd/data/obs/instruments/OpticalDisdrometer.pdf)

OTT Guide for P2
(http://www.ott.com/download/operating-instructions-present-weather-sensor-ott-parsivel2/)

Related Data

All other data collected during the IPHEx field campaign is considered related data. IPHEx data can be located using the GHRC HyDRO search tool with the search term "IPHEx". In addition, the Parsivel disdrometers were used in other GPM Ground Validation field campaigns. Datasets from other campaigns can be located by using the search term "Parsivel".

There were several automated parsivel units in the IPHEx campaign that may be of interest:

GPM GROUND VALIDATION AUTONOMOUS PARSIVEL UNIT (APU) IPHEx
(http://dx.doi.org/10.5067/GPMGV/IPHEX/APU/DATA301)

Contact Information

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

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