



Data User Guide

GPM Ground Validation Reference Precipitation IPHEX

Introduction

The GPM Ground Validation Reference Precipitation IPHEX dataset consists of 10 years (December 31, 2007-December 31, 2017) of hourly rainfall intensity at 1 km² resolution over the core region of the Integrated Precipitation and Hydrology Experiment (IPHEX), that is centered in the Pigeon River Basin in North Carolina. The goal of the IPHEX field campaign was to evaluate the accuracy of satellite precipitation measurements and use the collected data for hydrology models in the region. Data files are available in ASCII format.

Citation

Barros, Ana P.. 2019. GPM Ground Validation Reference Precipitation IPHEX [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/IPHEX/GAUGES/DATA401>

Keywords:

GHRC, GPM GV, NASA, IPHEX, North Carolina, radar, rain gauge, precipitation

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 the 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 mission. More information about the GPM GV mission is available at the [PMM Ground Validation webpage](#).

One of the GPM Ground Validation field campaigns was the Integrated Precipitation and Hydrology Experiment (IPHEX) which was held in North Carolina during 2014 with an intensive 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 a part of the development, evaluation, and improvement of remote-sensing precipitation algorithms in support of the GPM mission through the NASA GPM Ground Validation 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](http://gpm-gv.gsfc.nasa.gov/Gauge/).

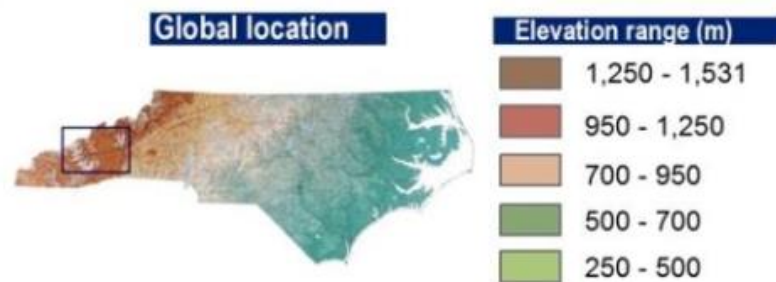


Figure 1: Region of North Carolina IPHEX campaign ground validation
(Image source: <http://gpm-gv.gsfc.nasa.gov/Gauge/>)

Instrument Description

The GPM Ground Validation Reference Precipitation IPHEX dataset consists of 10 years (December 31, 2007-December 31, 2017) of hourly rainfall intensity at 1 km² resolution over the core region of the Integrated Precipitation and Hydrology Experiment (IPHEX), that is centered in the Pigeon River Basin in North Carolina. This dataset was generated on the basis of two data sets: 1) the national combined radar-rain gauge Stage IV product (hourly, 16 km² spatial resolution); and 2) independent rain gauge measurements from a network of high elevation rain gauges in the region installed in support of NASA TRMM and GPM Ground Validation (GV) activities.

The NCEP (National Center for Environmental Prediction)/EMC (Environmental Modeling Center) Stage IV is a Quantitative Precipitation Estimation (QPE) product from the National Weather Service (NWS) derived from the regional hourly and 6-hourly Multisensor (radar + NWS rain gauges) Precipitation Estimator (MPE) analyses, which is further improved with new analyses from River Forecast Centers (RFCs) over the conterminous United States (CONUS). Due to ground clutter effects and uncertainty in retrieval algorithms, Stage IV data sets have significant biases and errors in rainfall detection in mountainous regions.

A high-resolution rain gauge network has been in operation in the Southern Appalachian

Mountains since 2007 in support of NASA's Precipitation Measurement Missions (PMM) program GV activities. Although the total number of gauges in the network has changed over time, a baseline network with a minimum of 34 rain gauges has been maintained in the Pigeon River basin, over the ten-year reference period 2007-2018 before, during and immediately after IPHEX. A topographic map of the baseline rain gauge network with individual gauges identified by numbers is shown in Figure 2. In-situ rain-gauge data can be found at <http://dx.doi.org/10.5067/GPMGV/IPHEX/GAUGES/DATA301>.

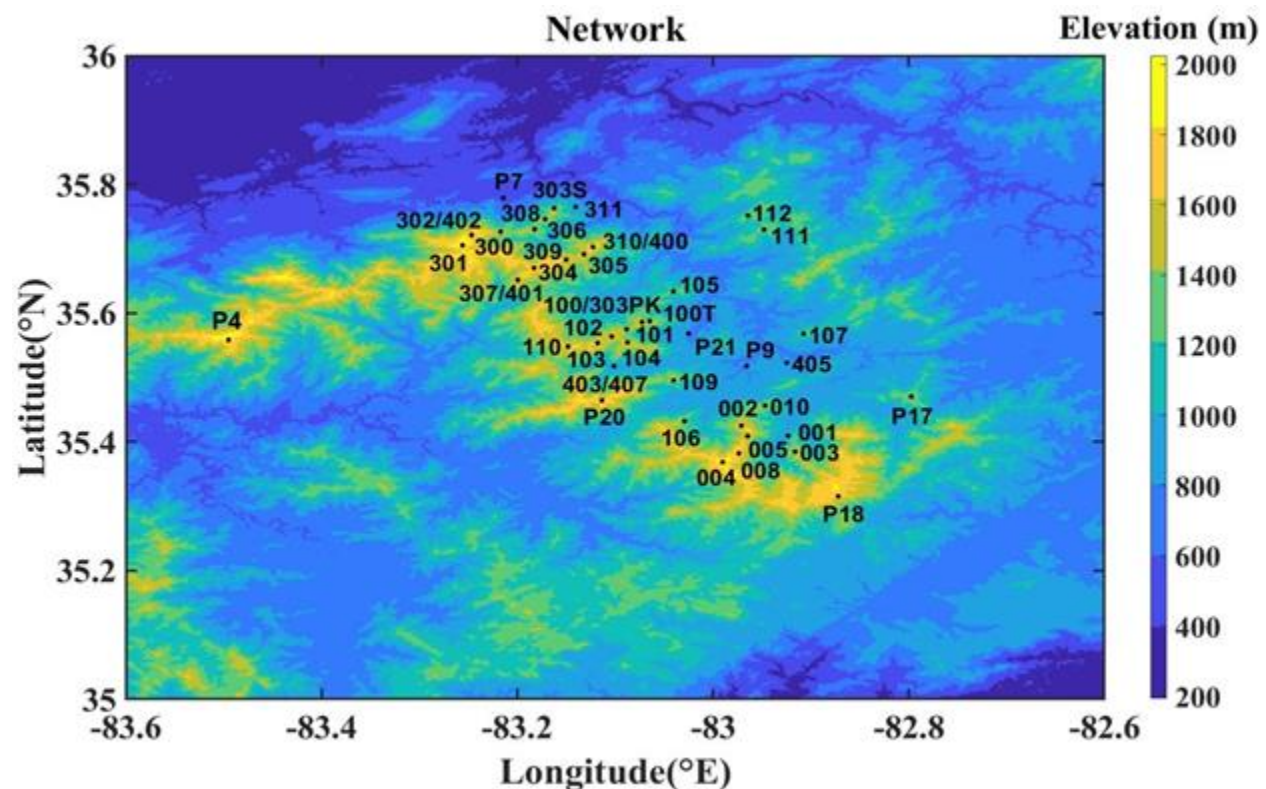


Figure 2: Map of ground-based observations. Locations marked by numbers only are rain gauges; locations marked by numbers preceded by P are disdrometers. The shaded background denotes the surface elevation.
(Image source: [Liao and Barros, 2019](#))

Investigators

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Data Characteristics

The GPM Ground Validation Reference Precipitation IPHEX dataset consists of 10 years (December 31, 2007-December 31, 2017) hourly rainfall intensity at 1 km² resolution over the core region of the IPHEX field campaign. Data files in ASCII format are available at a

Level 4 processing level. More information about the NASA data processing levels is available on the [EOSDIS Data Processing Levels](#) webpage. Table 1 lists the characteristics of this dataset.

Table 1: Data Characteristics

Characteristic	Description
Platform	Ground stations
Instrument	Radars, rain gauges
Spatial Coverage	N: 36.0 , S: 35.0, E: -82.6, W: -83.6 (North Carolina)
Spatial Resolution	1 km
Temporal Coverage	December 31, 2007 to December 31, 2017
Temporal Resolution	Hourly
Parameter	Precipitation
Version	1
Processing Level	4

File Naming Convention

This dataset contains hourly rainfall intensity data at a 1 km² resolution for the period of December 31, 2007 through December 31, 2017. Data files are in ASCII format and have the following file naming convention:

Data files: iphex_RefPrecip_YYYYMMDDhh.txt

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
hh	Two-digit hour in UTC
.txt	ASCII format

Data Format and Parameters

The GPM Ground Validation Reference Precipitation IPHEX data files are in ASCII format. Each ASCII file has 104 lines: the first 4 lines are data header and the following 100 lines contain rainfall intensity data (in mm) in a matrix of 100 columns by 100 rows. The spatial coverage is 35N to 36N and 83.6W to 82.6W, with the upper left corner/northwest pixel (1, 1) centered at (35.005N, -83.595E). The spatial resolution is 0.01 degrees.

Algorithm

To derive the GPM Ground Validation Reference Precipitation IPHEX dataset, hourly Stage IV data fields are downscaled to 1 km² resolution, and for each hour conditional bias correction and linear kriging algorithms are applied to derive an unbiased rainfall field at

hourly, seasonal and inter-annual scales at the rain gauge locations that compose the core IPHEX rain gauge network ([Barros et al., 2017](#)). Finally, light and convective rainfall corrections are applied.

More detailed information can be found in [Liao and Barros, 2019](#).

Quality Assessment

Performance metrics such as Threat Score (TS) and Heidke Skill Scores (HSS) are on average > 0.8 and close to 1 respectively for various rainfall thresholds over the 10-year period, and > 0.5 at the event time-scale (hourly). The Root Mean Square Error (RMSE) at the gauges is below 0.1 mm/hr and 0.5% for seasonal-scale accumulations. Evaluation against an independent disdrometer data set consisting of disdrometers at various locations indicates large overestimation errors ($\sim 30\%$) in the inner mountain region and at low elevations during the Intense Observing Period (IOP) of the IPHEX (IPHEX-IOP). This is in part attributed to the lack of low elevation rain gauges and the overshooting of both NEXRAD radars that contribute to the Stage IV product over the region and challenges in handling isolated convection ([Liao and Barros, 2019](#)).

Software

No special software is needed to read the ASCII data files.

Known Issues or Missing Data

Data are not available for the periods listed below:

Table 3: Missing periods in GPM GV Reference Precipitation IPHEX dataset

Missing period (YYYYMMDDhh*)
2008042007
2008110200-2008110223
2008031400
2008031500
2008031600
2008031700
2008031900
2008032000

2008032100
2008032200
2008032300
2008032400
2008032500
2008032518-2008032600
2009100216-2009100300
2012012100-2012012109

*YYYY: 4-digit year; MM: 2-digit month; DD: 2-digit day; hh: 2-digit hour in UTC

References

Liao M. and A. P. Barros (2019). The Integrated Precipitation and Hydrology Experiment – Hydrologic Applications for the Southeast US (IPHEX-H4SE) Part IV: High-Resolution Enhanced StageIV-Raingauge Combined Precipitation Product.

https://ghrc.nsstc.nasa.gov/pub/fieldCampaigns/gpmValidation/iphex/Reference_Precip/doc/IPHEX-Reference-Precipitation-Report-V1.pdf

Barros, A.P., Malarvizhi Arulraj, Anna M. Wilson, Douglas Miller, Gregory Cutrell, Paul Super, and Walter A. Petersen (2017). IPHEX-Southern Appalachian Mountains -- Rainfall Data 2008-2014. <https://doi.org/10.7924/G8CJ8BJK>.

Related Data

The GPM Ground Validation Southern Appalachian Rain Gauge IPHEX dataset contains in-situ rain-gauge data collected during the IPHEX field campaign. This dataset is available at <http://dx.doi.org/10.5067/GPMGV/IPHEX/GAUGES/DATA301>

All data from other instruments collected during the IPHEX field campaigns are related to this dataset. The full list of IPHEX campaign data can be located using [Hydro 2.0](#) and searching 'IPHEX'. The complete IPHEX field campaign data collection can be found [here](#).

Contact Information

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

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