Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Hydro-Estimator IFloodS

Introduction

The GPM Ground Validation Hydro-Estimator IFloodS dataset contains rainfall rate estimates derived using NOAA's Geostationary Operational Environmental Satellites (GOES) infrared (IR) brightness temperature data by researchers at the NOAA Center of Satellite Applications and Research's (STAR) using the Hydro-Estimator (H-E) algorithm. Rainfall rate estimates are produced every 15 minutes throughout the continental United States, but for this dataset, have been subset to the Iowa region for the Iowa Flood Studies (IFloodS) field campaign in support of Global Precipitation Measurement (GPM) ground validation. These data are available in netCDF-3 format and consist of rain rate values from April 25, 2013 through June 30, 2013.

Citation

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Keywords:

NASA, GHRC, IFloodS, GPM, Hydro-Estimator, Iowa, GOES, infrared, brightness temperature, rainfall rate

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/.

Product Description

The Hydro-Estimator rain rate product is provided by researchers at the NOAA Center of Satellite Applications and Research (STAR) program. The Hydro-Estimator (H-E) is a single-channel (11 micron) rain rate algorithm that uses the infrared (IR) brightness temperature data from NOAA's Geostationary Operational Environmental Satellite (GOES) imagers and supplementary data to determine rainfall rates. The IR data are calibrated against radar where available and corrections for atmospheric moisture, orography, and convective equilibrium level are made. The algorithm comes from a long heritage of previous products (the Interactive Flash Flood Analyzer from the late 1970's and the Auto-Estimator from the late 1990's). The H-E algorithm improves upon previous algorithms in that it only assigns rain to pixels that are colder than the average brightness temperature of surrounding cloudy pixels. This eliminates the error of assigning high rain rates to cold, non-raining cirrus clouds. It also uses separate precipitable water and relative humidity corrections derived from numerical weather prediction model data to reduce cold-season overcorrection. More details about the H-E algorithm can be found on the STAR Satellite Rainfall Estimates Hydro-Estimator - Technique Description webpage.

Rainfall rate estimates are produced every 15 minutes throughout the continental United States, but, for this dataset, have been subset to the Iowa region of the IFloodS field campaign. The H-E data product is also available globally through the use of geostationary data other than GOES such as METEOSAT over Europe, Africa, and western Asia, and MTSAT over Eastern Asia. More information about H-E is available on the STAR Satellite Rainfall Estimates - Hydro-Estimator webpage, and from two publications; Vicente et al., 1998, and Scofield, 1987.

Investigators

Roderick A. Scofield
NOAA/ National Environmental Satellite, Data, and Information Service (NESDIS)/STAR
Camp Springs, Maryland

Clay Davenport
NOAA/ National Environmental Satellite, Data, and Information Service (NESDIS)/STAR
Camp Springs, Maryland

Primary Contact:
Robert J. Kuligowski
NOAA/ National Environmental Satellite, Data, and Information Service (NESDIS)/STAR
Camp Springs, Maryland

Data Characteristics

The GPM Ground Validation Hydro-Estimator IFloodS dataset is a subset of the NOAA/ STAR Hydro-Estimator (H-E) algorithm. The H-E algorithm uses GOES IR brightness temperature data to estimate rainfall rates at 5-minute intervals. Data in this product are for the IFloodS field campaign study area. The data files are in netCDF-3 format and are considered Level 4 products. More information about the NASA data processing levels are available on the NASA Data Processing Levels website.

Table 1: Data Characteristics

Characteristic	Description
Platform	Geostationary Operational Environmental Satellites (GOES)
Instrument	GOES Imager
Projection	n/a
Spatial Coverage	N: 45.998, S: 39.016, E: -87.029, W: -96.982 (Iowa)
Spatial Resolution	~2.5 km
Temporal Coverage	April 24, 2013 - June 30, 2013
Temporal Resolution	15 minutes
Parameter	Rain rate
Version	1
Processing Level	4

File Naming Convention

The GPM Ground Validation Hydro-Estimator IFloodS dataset is available in netCDF-3 format. The data files consist of rainfall rate estimates derived from GOES IR brightness temperature data using the H-E algorithm. These data files are in the file naming convention as shown below.

Data files: HE_IFloodS.YYYJJJhhmm.nc.gz

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
JJJ	Three-digit Julian day of year
hh	Two-digit hour in UTC
mm	Two-digit minute in UTC
.nc.gz	Compressed netCDF-3 file

Data Format and Parameters

This dataset consists of rainfall rate estimates derived from GOES IR brightness temperature data in netCDF-3 format. Table 3 lists and describes the variables available within these data files.

Table 3: Data Fields

Field Name	Description	Data Type	Unit
latitude	Latitude	float	Degrees North
longitude	Longitude	float	Degrees West
rain_rate	Rainfall rate	float	mm/h

Algorithm

The H-E is a single-channel (11 micrometer) rain rate algorithm that assigns rainfall rate only to pixels that are colder than the average brightness temperature of surrounding cloudy pixels. Users are directed to the details about the STAR Satellite Rainfall Estimates Hydro-Estimator - Technique Description webpage, and in the relevant publications by Vicente et al., 1998, and Scofield, 1987 for more information about the H-E algorithm.

Quality Assessment

The H-E rain rate algorithm assigns rainfall amounts only to pixels colder than the average brightness temperature of surrounding cloudy pixels. This eliminates the error of assigning high rain rates to cold, non-raining cirrus clouds. The algorithm also uses separate precipitable water and relative humidity corrections to reduce cold-season overcorrection. Convective equilibrium adjustments are incorporated into the H-E to enhance rainfall in regions where the convective equilibrium level was too low in height for very cold cloud tops to develop, but where very heavy precipitation is still possible. If the coldest cloud top within a region of interest is no more than 10 degrees K colder than the equilibrium level, then the minimum temperature within this region is used instead of the pixel temperature. More information about the H-E algorithm and adjustments made is available on the STAR Satellite Rainfall Estimates Hydro-Estimator - Technique Description webpage.

Software

These data are available in netCDF-3 format, so no software is required. Panoply can be used to easily view these data.

References

Scofield, Roderick A. (1987): The NESDIS Operational Convective Precipitation Estimation Technique. *Monthly Weather Review*, 115, 1773-1792. doi: https://doi.org/10.1175/1520-0493(1987)115%3C1773:TNOCPE%3E2.0.CO;2

Vicente, Gilberto A., Roderick A. Scofield, and W. Paul Menzel (1998): The Operational GOES Infrared Rainfall Estimation Technique. *Bulletin of the American Meteorological Society*, 79, 9, 1883-1898. doi: https://doi.org/10.1175/1520-0477(1998)079%3C1883:TOGIRE%3E2.0.CO;2

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 using the term 'IFloodS'.

The Hydro-Estimator data were also gathered in support of the GPM-GV IPHEx field campaign and are available from GHRC:

GPM Ground Validation Hydro-Estimator IPHEx (http://dx.doi.org/10.5067/GPMGV/IPHEX/MULTIPLE/DATA401)

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
Web: https://ghrc.nsstc.nasa.gov/

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