GHRO
Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Naval Research Laboratory (NRL) Near-Real Time Rain Rates IFloodS

Introduction

The GPM Ground Validation Naval Research Laboratory (NRL) Near-Real Time Rain Rates IFloodS data product was created for the GPM Iowa Flood Studies (IFloodS) field campaign from April 23, 2013 through June 30, 2013. The IFloodS field campaign was a ground measurement campaign that took place in eastern Iowa. The goals of the campaign were to collect detailed measurements of precipitation at the Earth's surface using ground instruments and advanced weather radars and to simultaneously collect data from satellites passing overhead. This NRL real time rain rates data product was produced using the Probability Matching Method with rain gauge, Defense Meteorological Satellite Program (DMSP) F15 Special Sensor Microwave - Imager (SSM/I), and DMSP F16 Special Sensor Microwave - Imager/Sounder (SSMIS) data. This data product includes rain rate estimates and files are available in netCDF-4 and binary formats, as well as corresponding browse imagery in JPG format.

Citation

Yang, Song. 2018. GPM Ground Validation NRL Near Real-Time Rain Rates IFloodS [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/IFLOODS/INFRARED/DATA101

Keywords:

GHRC, NRL, IFloodS, Iowa, DMSP, SSM/I, SSMIS, rain gauge, rain rate

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/.

The Iowa Flood Studies (IFloodS) campaign was a ground measurement campaign that took place in eastern Iowa from May 1 to June 15, 2013. The goals of the campaign were to collect detailed measurements of precipitation at the Earth's surface using ground instruments and advanced weather radars and to simultaneously collect 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/content/gpm-ground-validation-iowa-flood-studies-ifloods-field-experiment and http://dx.doi.org/10.5067/GPMGV/IFLOODS/DATA101. Additional information about the Iowa Flood Center is available at http://iowafloodcenter.org/.

Product Description

The GPM Ground Validation Naval Research Laboratory (NRL) Near-Real Time Rain Rates IFloodS dataset is as select subset of data from an NRL-blend rain product available at the U.S. Naval Research Laboratory. The NRL-Blend produces precipitation estimates at regular time intervals (in this case, hourly) at quarter degree resolution between 60°S and 60°N latitude world-wide using passive microwave (PMW) data from Special Sensor Microwave - Imager (SSM/I) series of radiometers onboard the Defense Meteorological Satellite Program (DMSP) F15 and F16 satellites and visible and infrared (VIS/IR) data from several geostationary (GEO) satellite instruments.   The NRL rain products are based on a blended rain retrieval technique and is developed using 3 stages. The GEO Infrared-based rain retrievals are calibrated using a Probability Matching Method of the TBs-Rain relationships from the most recent collocated microwave observations so that quality of the IR-derived rainfall is improved significantly.   The relationship between the two data measurements are created at 2deg x 2deg resolution, then it is applied to generate rain rates within a 0.25 degree cell. In addition to the GEO and PMW data, numerical weather prediction (NWP) model data are used to account for underlying environmental conditions that are not detected (or not accounted for) in a satellite-only analysis. The Navy Operational Global Atmospheric Prediction System (NOGAPS) forecast model fields (interpolated to the satellite time), the 85—hPa wind vectors, temperature, humidity, and total column precipitable water (TPW) are combined with a high-resolution topographic

database.   The GPM Ground Validation Naval Research Laboratory (NRL) Near-Real Time Rain Rates IFloodS dataset is produced as a global 0.25° grid (480 lines x 1440 samples) of rain rates in mm/hr.   More information about how this product was created can be found in Kidd et al., 2012 and in the chapter entitled "The NRL-Blend High Resolution Precipitation Product and its Application to Land Surface Hydrology" from the book Satellite Rainfall Applications for Surface Hydrology (2009). The following publications also have some information: Rosenfeld et al., 1993 and Todd et al., 2001. Also see additional resources in the reference section.

Investigators

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Data Characteristics

The GPM Ground Validation Naval Research Laboratory (NRL) Near-Real Time Rain Rates IFloodS dataset contain both netCDF-4 and binary data files with corresponding JPG browse imagery from April 23, 2013 through June 30, 2013. These data are at a Level 3 processing level. More information about the NASA data processing levels are available on the NASA Data Processing Level website. Table 1 lists the characteristics of this dataset.

Table 1: Data Characteristics

Characteristic	Description
Platform	Defense Meteorological Satellite Program (DMSP) F15 and F16 Geostationary Operational Environmental Satellite (GOES)-15
Instrument	Special Sensor Microwave - Imager (SSM/I) (on F15) Special Sensor Microwave - Imager/Sounder (SSMIS) (on F16) GOES-15 Imager
Projection	Equirectangular
Spatial Coverage	N: 60.0, S: -60.0, E: 180.0, W: -180.0 (Global)
Spatial Resolution	0.25 degrees
Temporal Coverage	April 23, 2013 - June 30, 2013
Temporal Resolution	hourly
Parameter	Rain rate
Version	1
Processing Level	4

File Naming Convention

The GPM Ground Validation Naval Research Laboratory (NRL) Near-Real Time Rain Rates IFloodS dataset has the file naming convention shown below. These data are available in both netCDF-4 and binary (.geo) formats with corresponding JPG browse imagery.

Data files: ifloods_nrl_YYYYMMDD_hhmmss.[nc|geo]
Browse files: ifloods_nrl_YYYYMMDD_hhmmss.jpg

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
mm	Two-digit minute in UTC
ss	Two-digit second in UTC
[nc|geo]	nc: netCDF-4 format geo: binary format
jpg	Joint Photographic Experts Group format

Data Format and Parameters

The GPM Ground Validation Naval Research Laboratory (NRL) Near-Real Time Rain Rates IFloodS data files are available in netCDF-4 and binary formats with corresponding browse imagery. The netCDF-4 and .geo data files include rain rate estimations. Table 3 lists and describes the parameters in the netCDF-4 data files. Browse imagery shows the amount of rainfall accumulation within an hour. A code written in C can be used to convert the .geo data files to netCDF-4.

Table 3: Data Fields

Field Name	Description	Data Type	Unit
latitude	Latitude of observation	float	Degrees North
longitude	Longitude of observation	float	Degrees East
RainRate	Rainfall rate	float	mm/hr
time	Time of measurement	int	Minutes since time in filename

Algorithm

This data product was based on a blended rain retrieval technique and was developed using three stages. The GEO Infrared-based rain retrievals were calibrated using a Probability Matching Method of the TBs-Rain relationships from the most recent collocated microwave observations so that quality of the IR-derived rainfall is improved significantly. The relationship between the two data measurements were created at 2 x 2 degree resolution, then it is applied to generate rain rates within a 0.25 degree cell. In addition to the GEO and PMW data, numerical weather prediction (NWP) model data were used to account for underlying environmental conditions that were not detected (or not accounted

for) in a satellite-only analysis. The Navy Operational Global Atmospheric Prediction System (NOGAPS) forecast model fields (interpolated to the satellite time), the 85—hPa wind vectors, temperature, humidity, and total column precipitable water (TPW) are combined with a high-resolution topographic database.   More information about how this product was created can be found in Kidd et al., 2012 and on the NRL-Blend Satellite Rainfall Estimates from the Naval Research Laboratory webpage.

Quality Assessment

The NRL rain products have been involved in several rain validation projects and results indicate that this product is, in general, in the same range of accuracy as other rain products available to users. The GEO Infrared-based rain retrievals were calibrated using a Probability Matching Method of the brightness temperature-rain relationship from the most recent collocated microwave observations so that quality of the infrared-derived rainfall was significantly improved. More information about the quality of these data, as well as calibration methods, can be found in Kidd et al., 2012.

Software

The netCDF-4 files for this dataset can easily be viewed using Panoply. A code written in C can be used to convert the .geo data files to netCDF-4.

Known Issues or Missing Data

All data values that are less than 0 had been set to 0, and '_FillValue' had been set to 0 to enable transparency when visualized.

References

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Related Data

All data collected during the IFloodS field campaign should be considered related datasets. To locate other IFloodS data, use the GHRC search tool, HyDRO 2.0, with the search term 'IFloodS'.

The NRL-blended Products are available online from the U.S. Naval Research Laboratory at https://www.nrlmry.navy.mil/sat-bin/rain.cgi

Contact Information

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

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Created: August 31, 2018