Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) IPHEx

Introduction

The GPM Ground Validation Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) IPHEx dataset consists of brightness temperatures from 9 channels as measured by the CoSMIR instrument onboard the NASA ER-2 aircraft during the Global Precipitation Measurement (GPM) mission Integrated Precipitation and Hydrology Experiment (IPHEx) field campaign 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. CoSMIR is a conical and cross-track scanning radiometer with frequencies centered at 50.3, 52.8, 89.0, 165.5, 183.31 ±1, 183.31±3, and 183.31±7 GHz. Data files are available from May 7, 2014 through June 14, 2014 in ASCII format, with browse images available in the postscript format.

Notice:
There are missing data for a few of the CoSMIR channels during the IPHEx campaign. The missing values are denoted by -99.9.

Citation

Skofronick-Jackson, Gail, Jim Wang and Brian Monosmith. 2015. GPM Ground Validation Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) IPHEx [indicate subset used]. Dataset available online from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi:
http://dx.doi.org/10.5067/GPMGV/IPHEX/CoSMIR/DATA101

Keywords:

NASA, GHRC, PMM, GPM GV, CoSMIR, GMI, IPHEx, precipitation, North Carolina, brightness temperature

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 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 the GPM GV mission. More information about the GPM GV mission is available at the PMM Ground Validation webpage.

One of the GPM GV field campaigns was the Integrated Precipitation and Hydrology Experiment (IPHEx), which was held in North Carolina during 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 a part of 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 hydrological 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.

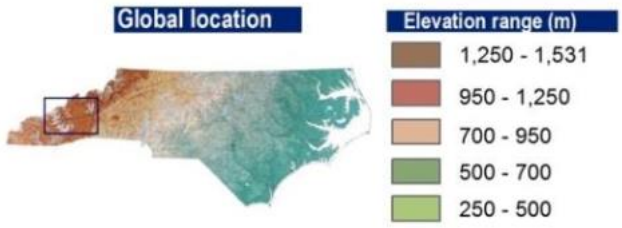

Figure 1: Region of North Carolina IPHEx campaign ground validation (image source: http://gpm-gv.gsfc.nasa.gov/Gauge/)

Instrument Description

The Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) instrument is a 9 channel airborne radiometer originally used to calibrate and validate the Defense Meteorological Satellite Project (DMSP) F-Series Special Sensor Microwave/Imager/Sounder (SSMIS). It has been adapted to the channel set of the GPM Microwave Imager (GMI). CoSMIR has four receivers near 50, 91, 150, and 183 GHz which measure horizontally polarized radiation with vertically polarized measurement capability at 89.0 and 165.5 GHz. The 9 channels of CoSMIR for GMI validation are 50.3H, 52.8H, 89.0H&V, 165.5H&V, 183.31+/-1H, 183.31+/-3H, and 183.31+/-7H GHz. CoSMIR performs

both conical and cross-track scanning from left to right with conical scanning in the forward direction (aircraft direction of travel) only. The CoSMIR instrument measurement footprint size varies with aircraft altitude and instrument look direction.

Receivers and radiometer electronics on the CoSMIR instrument are housed in a 21.5 cm diameter and 28 cm long cylindrical scan head, which is rotated by a two-axis gimbaled mechanism. There are two in-flight external calibration targets at cruising altitude: one heated to 328 K, and the other maintained at ambient temperature. Due to these onboard calibration targets, the data between 50 to 183 GHz have an accuracy of ±1 K. More information about the CoSMIR instrument can be found on the Mesoscale Atmospheric Processes webpage.

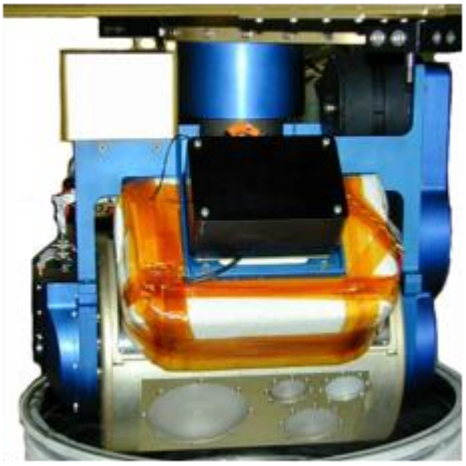

Figure 2: CoSMIR instrument
(Image source: Mesoscale Atmospheric Processes webpage)

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Data Characteristics

THe GPM Ground Validation Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) IPHEx datafiles are available as ASCII text files with browse imagery available as PostScript (PS) files. These data are available at a Level 1B processing level. More information about the NASA data processing levels are available on the EOSDIS Data Processing Levels webpage.

Table 1: Data Characteristics

Characteristic	Description
Platform	NASA Earth Resources 2 (ER-2) aircraft
Instrument	Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR)
Spatial Coverage	N: 46.700 , S: 30.400 , E:-68.00 , W: -88.00 (North Carolina)
Spatial Resolution	Conical scan footprint at 11.8 km aircraft altitude: 1.3 km x 1.9 km. Crosstrack scan footprint at 11.8 km aircraft altitude: 0.8 km x 0.8 km. Footprint size varies with aircraft altitude
Temporal Coverage	May 7, 2014 - June 14, 2014
Temporal Resolution	File per flight
Sampling Frequency	2 seconds for conical scan, 3 seconds for cross-track scan
Parameter	Brightness temperature
Version	1
Processing Level	1B

File Naming Convention

The GPM Ground Validation Conical Scanning Millimeter-Wave Imaging Radiometer (CoSMIR) IPHEx dataset ASCII and PS files are named with the following convention:

Data files: IPHEx_CoSMIR_YYYYMMDD_[CONFWD|CrossTrack].txt
Browse files: IPHEx_CoSMIR_YYYYMMDD_[CONFWD|CrossTrack]_#.ps

Table 2: File naming convention variables

Variable	Description
IPHEx	Integrated Precipitation and Hydrology Experiment
CoSMIR	Compact Scanning Millimeter-wave Imaging Radiometer
YYYYMMDD	year, month, and day of the data
[CONFWD|CrossTrack]	CONFWD: Conical scanning mode (forward) CrossTrack: Cross-track scanning mode
#	Scan number
.txt	Text file
.ps	Postscript file (can be read by Adobe software)

Data Format and Parameters

The GPM Ground Validation Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) IPHEx dataset consists of ASCII text files, as well as browse imagery available as PostScript (PS) files. Separate files exist for conical and cross-track scans. The text files contain brightness temperature data, relevant ER-2 aircraft measurements, and UTC time information. Table 3 describes the data fields within the ASCII files.

Table 3: Data Fields

Field Name	Description	Unit
year	Year	-
month	Month	-
day	Day of the month	-
hour	Hour of the day	UTC
minute	Minute	UTC
second	Second	UTC
50.3	Channel 50.3 Brightness temperature	kelvin
52.8	Channel 52.8 Brightness temperature	kelvin
89V	Channel 89 Brightness temperature (Vertical polarization)	kelvin
89H	Channel 89 Brightness temperature (Horizontal polarization)	kelvin
165V	Channel 165 Brightness temperature (Vertical polarization)	kelvin
165H	Channel 165 Brightness temperature (Horizontal polarization)	kelvin
183_1	Channel 183±1 Brightness temperature	kelvin
183_3	Channel 183±3 Brightness temperature	kelvin
183_7	Channel 183±7 Brightness temperature	kelvin
IncAng	Earth incidence angle of CoSMIR	degrees
Lat	Latitude of CoSMIR center of footprint	degrees
Lon	Longitude of CoSMIR center of footprint	degrees
Alt	GPS altitude	m
Roll	Roll	degrees
Pitch	Pitch	degrees
Heading	Aircraft heading	degrees

Algorithm

The CoSMIR instrument can obtain conical and cross-track data simultaneously, satisfying the requirements on the PMM algorithm team. The instrument is calibrated using two objects with opposing temperatures to increase brightness temperature accuracy. The 9 frequencies of measurement and various retrieval algorithms allow for the estimation of a wide range of parameters, from water vapor content to snowfall rates.Additional

information on the PMM precipitation algorithms can be found on the PMM Precipitation Algorithm webpage.

Quality Assessment

For calibration of CoSMIR, two targets are closely coupled to the scan head of the instrument. One object is held at an ambient temperature of around 250 K while the other is held at a hot temperature, about 328 K. These targets then rotate azimuthally with the scan head. The calibration accuracy of CoSMIR is ± 1 K for brightness temperatures between 200 and 300 K. Previous CoSMIR flight data have been compared to DMSP SSMIS brightness temperatures as described in the Wang et al., 2008 study.

Software

The GPM Ground Validation CoSMIR IPHEx ASCII text files can be viewed in a text editor or read into a spreadsheet software, such as Microsoft Excel or Notepad++. The CoSMIR PS files can be viewed using Adobe software.

Known Issues or Missing Data

There were issues with a few of the channels throughout the mission, including Channel 4, 5, and 6 for the 89H, 165V and 165H variables respectively. A value of -99.9 represents these missing data. The CoSMIR flight reports containing instrument status updates can be found in the GHRC CoSMIR directory for IPHEx instrument reports.

References

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Gibbs, Y. (2014). NASA Armstrong Fact Sheet: ER-2 High-Altitude Airborne Science Aircraft. https://www.nasa.gov/centers/armstrong/news/FactSheets/FS-046-DFRC.html

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Related Data

All data from other instruments collected during the IPHEx field campaign are considered to be related to this dataset. Other IPHEx field campaign data can be located by searching 'IPHEx' in HyDRO 2.0.

Below are datasets from other GPM GV field campaigns that used the CoSMIR instrument to collect data:

GPM Ground Validation Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) OLYMPEX (http://dx.doi.org/10.5067/GPMGV/OLYMPEX/COSMIR/DATA301)

GPM Ground Validation Conical Scanning Millimeter-Wave Imaging Radiometer (CoSMIR) GCPEx (http://dx.doi.org/10.5067/GPMGV/GCPEX/CoSMIR/DATA101)

GPM Ground Validation Conical Scanning Millimeter-Wave Imaging Radiometer (CoSMIR) MC3E (http://dx.doi.org/10.5067/GPMGV/MC3E/CoSMIR/DATA101)

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

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