Data User Guide

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

Introduction

The GPM Ground Validation Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) OLYMPEX dataset consists of brightness temperatures from 9 channels as measured by CoSMIR when flown on the NASA DC-8 aircraft during the Global Precipitation Mission (GPM) Olympic Mountains Experiment (OLYMPEX) campaign. 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 November 5, 2015 thru December 19, 2015 in HDF-5 format, with browse imagery files in PNG format containing brightness temperature time series plots.

Notice:

It should be noted that data within the file for November 5, 2017 were collected during the DC-8 aircraft flight from Palmdale, California to Lakewood, WA. All other data files are during the OLYMPEX field campaign and cover the Olympic Mountains region of Washington state. Values of -999 are considered to be missing values. Since the data files are collected during each NASA DC-8 flight, there may be missing days between November 5, 2015 and December 19, 2015.

Citation

Kroodsma, Rachael and Matthew Fritts. 2017. GPM Ground Validation Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) OLYMPEX [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/OLYMPEX/COSMIR/DATA301

Keywords:
NASA, GHRC, OLYMPEX, CoSMIR, Washington, radiometer, DC-8, brightness temperature

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 Ground Validation field campaigns was the Olympic Mountains Experiment (OLYMPEX) which was held in the Pacific Northwest. The goal of OLYMPEX was to validate rain and snow measurements in midlatitude frontal systems as they move from ocean to coast to mountains and to determine how remotely sensed measurements of precipitation by GPM can be applied to a range of hydrologic, weather forecasting, and climate data. The campaign consisted of a wide variety of ground instrumentation, several radars, and airborne instrumentation monitoring oceanic storm systems as they approached and traversed the Peninsula and the Olympic Mountains. The OLYMPEX campaign was part of the development, evaluation, and improvement of GPM remote sensing precipitation algorithms. More information is available from the NASA GPM Ground Validation web site https://pmm.nasa.gov/olympex and the University of Washington OLYMPEX web site http://olympex.atmos.washington.edu/.

Figure 1: OLYMPEX Domain

(Image Source: https://pmm.nasa.gov/OLYMPEX)

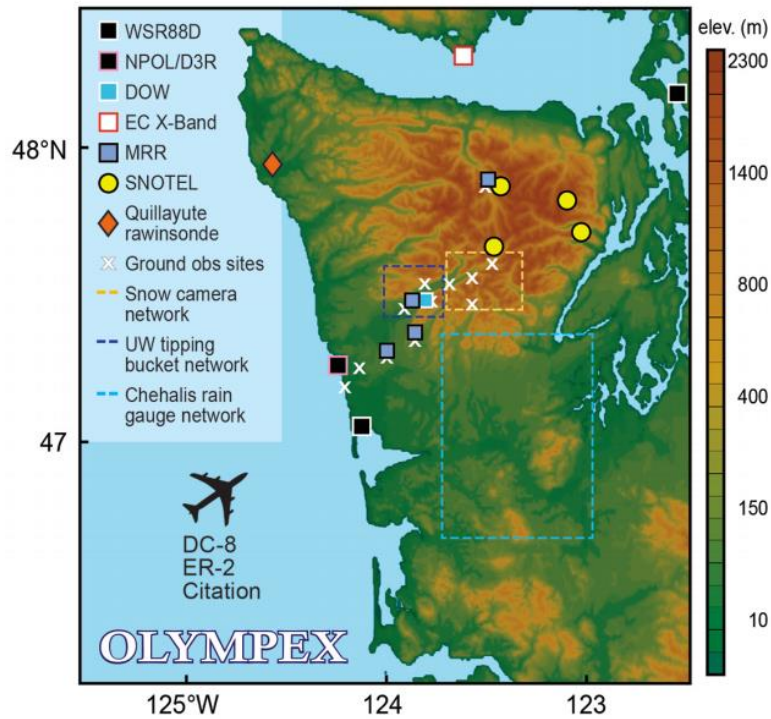

Figure 2: OLYMPEX Field Locations
(Image Source: https://pmm.nasa.gov/OLYMPEX)

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.

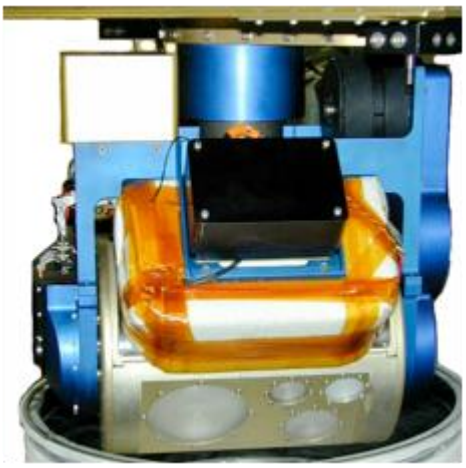

Figure 3: CoSMIR instrument
(Image source: Mesoscale Atmospheric Processes webpage)

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Data Characteristics

The GPM Ground Validation Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) OLYMPEX data files are available in HDF-5 format at a Level 1B data processing level. Corresponding browse images of brightness temperature time series are also available in PNG format. More information about the NASA data processing levels are available on the NASA Data Processing Levels website.

Table 1: Data Characteristics

Characteristic	Description
Platform	NASA DC-8 aircraft
Instrument	Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR)
Projection	n/a
Spatial Coverage	N: 49.737 , S: 29.931, E: -117.697, W: -129.622 (Washington)
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	November 5, 2015 - December 19, 2015
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) OLYMPEX dataset has the file naming convention shown below. The data files are available in HDF-5 format, and the browse images are available in PNG format.

Data files: olympex_cosmir_YYYYMMDD_[conical|crosstrack]_v1.hdf5
Browse files: [Conical|Crosstrack]_YYYYMMDD.png

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
[conical|crosstrack]	Conical: data from conical scans Crosstrack: data from cross-track scans
.hdf5	Hierarchical Data Format version 5 format
.png	Portable Network Graphics format

Data Format and Parameters

The GPM Ground Validation Conical Scanning Millimeter-wave Imaging Radiometer (CoSMIR) OLYMPEX dataset consists of HDF-5 data files, as well as associated PNG browse files of brightness temperature time series. Separate files exist for conical and cross-track scans. The data files contain brightness temperature data, relevant DC-8 aircraft measurements, and UTC time information. Table 3 describes the data fields within the HDF-5 data files.

Table 3: Data Fields

Field Name	Description	Unit
Aircraft Variables		
Altitude	GPS altitude	m
Heading	Aircraft heading	degrees
Latitude	Latitude	degrees
Longitude	Longitude	degrees
Pitch	Pitch	degrees
Roll	Roll	degrees
Speed	Group speed	m/s
CoSMIR Instrument Variables		

Azimuth	Azimuth angle of CoSMIR	degrees
Elevation	Elevation angle of CoSMIR	degrees
IncidenceAngle	Earth incidence angle of CoSMIR	degrees
Latitude	Latitude of CoSMIR center of footprint	degrees
Longitude	Longitude of CoSMIR center of footprint	degrees
Tb	Calibrated brightness temperature	K
Time Variables		
DayofMonth	Day of the month	day
Hour	Hour of the day in UTC	hour
MilliSecond	Millisecond in UTC	ms
Minute	Minute in UTC	minute
Month	Month	month
Second	Second in UTC	s
Year	Year	year

Quality Assessment

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 calibration methods, these data between 50 to 183 GHz has an accuracy of ±1 K.

Previous CoSMIR flight data have been compared to DMSP SSMIS brightness temperatures as described in Wang et al., 2008.

Software

The data files are self-describing HDF-5 format. Panoply can be used to easily view these HDF-5 data files.

Known Issues or Missing Data

IIt should be noted that data within the file for November 5, 2017 were collected during the DC-8 aircraft flight from Palmdale, California to Lakewood, WA. All other data files are during the OLYMPEX field campaign and cover the Olympic Mountains region of Washington state. Also, values of -999 are considered to be missing values. Since these data files are collected during each NASA DC-8 flight, there are missing days between November 5, 2015 and December 19, 2015 as flights did not occur on a regular basis.

References

Wang, J. R., G. M. Skofronick-Jackson, M. R. Schwaller, C. M. Johnson, W. B. Monosmith, and Z. Zhang (2013): Observations of Storm Signatures by the Recently Modified Conical Scanning Millimeter-Wave Imaging Radiometer. *IEEE Trans. Geosci. Remote Sens.*, 51(1), 411-424. doi: https://doi.org/10.1109/TGRS.2012.2200690

Wang, J. R., P. E. Racette, J. E. Piepmeier, B. Monosmith, and W. Manning (2007): Airborne CoSMIR Observations Between 50 and 183 GHz over Snow-Covered Sierra Mountains. *IEEE Trans. Geosci. Remote Sens.*, 45(1), 55-61. doi: https://doi.org/10.1109/TGRS.2006.885410

Wang, J. R., P. E. Racette, and J. R. Piepmeier (2008): A comparison of Near Concurrent Measurements from the SSMIS and CoSMIR for some Selected Channels over the Frequency Range of 50-183 GHz. *IEEE Trans. Geosci. Remote Sens.*, 46(4), 923-933. doi: https://doi.org/10.1109/TGRS.2007.904038

Related Data

All data from other instruments collected during the OLYMPEX field campaign are related to this dataset. Other OLYMPEX campaign data can be located using the GHRC HyDRO 2.0 search tool.

In addition, other data related to the CoSMIR instrument are in previous GPM Ground Validation campaigns. The following datasets are CoSMIR data from other field campaigns:

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

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:

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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