GPM Ground Validation Dual-frequency Dual-polarized Doppler Radar (D3R) IFloodS

Introduction

The GPM Ground Validation Dual-frequency Dual-polarized Doppler Radar (D3R) IFloodS dataset contains radar reflectivity and doppler velocity measurements from the Iowa Flood Studies (IFloodS) campaign. This campaign aimed to improve satellite precipitation measurements for flood prediction by using ground measurements to improve satellite retrieval algorithms. The D3R was developed by a government-industry-academic consortium with funding from NASA's Global Precipitation Measurement (GPM) Project. It operates at the ku (13.91 GHz ± 25 MHz) and ka (35.56 GHz ± 25 MHz) frequencies covering a fixed range from 450 m to 39.75 km. The D3R IFloodS dataset is available from May 9, 2013 through June 13, 2013 in netCDF-3 format with corresponding browse imagery available in PNG format.

Citation

Chandrasekar, V. . 2014. GPM Ground Validation Dual-frequency Dual-polarized Doppler Radar (D3R) IFloodS [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/IFLOODS/D3R/DATA101

Keywords:

NASA, GHRC, PMM, GPM GV, IFloodS, D3R, dual-polarized, dual-frequency, doppler radar, reflectivity, precipitation, Iowa, DSD

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

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.

More information about the IFloodS campaign is available at the IFloodS project webpage and the Iowa Flood Center webpage.

Instrument Description

The Dual-frequency Dual-polarized Doppler Radar (D3R), developed with funding from NASA's GPM Project, is a fully polarimetric, scanning weather radar system which provides estimations of hydrometeor classification and drop size distribution retrievals. The first generation D3R design is comprised of two separate co-aligned single-frequency antenna units mounted on a common pedestal with a dual-frequency dual-polarized solid- state transmitter. The D3R operates at the ku (13.91 GHz ± 25 MHz) and ka (35.56 GHz ± 25 MHz) frequencies covering a fixed range from 450 m to 39.75 km. These frequencies were selected for close compatibility with the GPM Dual-frequency Precipitation Radar (DPR) instrument onboard the GPM Core Observatory satellite. During IFloodS, the D3R instrument was located near Traer, Iowa (Lat: 42°16'5.0"N, Lon: -92°30'34.0"W). More detailed information on the D3R instrument can be found in this D3R information document and the GPM requirements for mobile Ka-/Ku-band radar is available here.

Figure 1: The D3R on its trailer
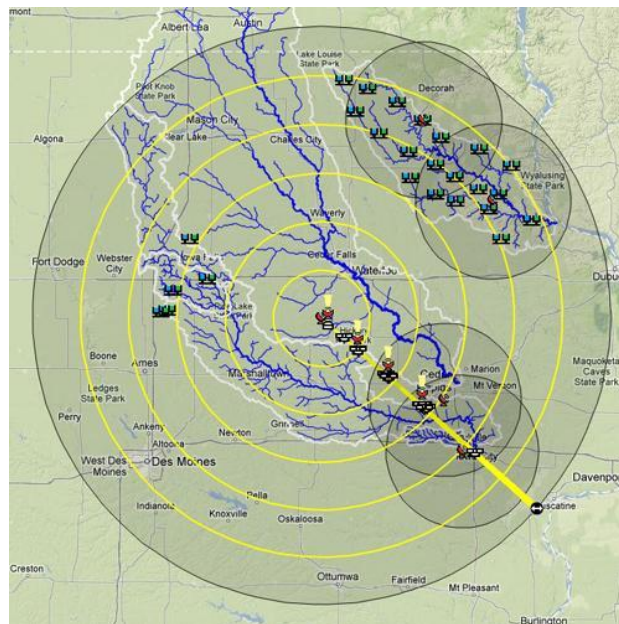(image source: https://pmm.nasa.gov/science/ground-validation/D3R)

Figure 2: Areas of focus during the IFloodS campaign were the Cedar and Iowa River Basins, the South Fork Iowa River, and the Turkey River Basin in Northeast Iowa.
(image source: https://pmm.nasa.gov/ifloods)

Investigators

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Data Characteristics

The GPM Ground Validation D3R IFloodS data files are available in netCDF-3 format with corresponding browse imagery available in PNG format at a Level 1B processing level. More information about the NASA data processing levels is available on the [EOSDIS Data Processing Levels](#) webpage. Table 1 shows the characteristics of these data files.

Table 1: Data Characteristics

Characteristic	Description
Platform	Ground Stations
Instrument	Dual-Frequency Dual-Polarized Doppler Radar (D3R)
Spatial Coverage	N: 42.500, S: 42.00, E: -90.100, W: -92.900 (Iowa)
Spatial Resolution	450 m - 30 km
Temporal Coverage	May 9, 2013 - June 13, 2013
Temporal Resolution	Second -< Minute
Sampling Frequency	1 second
Parameter	Reflectivity, differential reflectivity, copolar correlation coefficient, differential propagation phase, radial velocity, spectrum width
Version	1
Processing Level	1B

File Naming Convention

The GPM Ground Validation D3R IFloodS dataset netCDF-3 and PNG files are named with the following file naming convention:

Data files: ifloods_d3r_[freq]_YYYYMMDD_hhmmss_##.nc
Browse files:
ifloods_d3r_[freq]_YYYYMMDD_hhmmss_##_[scan]_[angle]_[degrees]_zdb.png

Table 2: File naming convention variables

Variable	Description
[freq]	Frequencies: ku (13.91 GHz ± 25 MHz) or ka (35.56 GHz ± 25 MHz)
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
##	Scan (or sweep) number within volume
[scan]	Radar scan type: PPI - Plan Position Indicator sector scan RHI - Range Height Indicator scan

[angle]	Scan angle: el - elevation angle az - azimuth angle
[degrees]	Degrees of the angle
.nc	netCDF-3 file
.png	PNG file

Data Format and Parameters

The GPM Ground Validation D3R IFloodS dataset contains radar reflectivity data, Doppler velocity data, and associated radar information from the D3R. These netCDF-3 files contain several data fields listed in Table 3 below.

Table 3: Data Fields

Field Name	Data Type	Unit
AfcSet	int	-
Azimuth	double	degrees
CrossPolCorrelation	float	-
DifferentialPhase	float	degrees
DifferentialReflectivity	float	dB
Elevation	double	degrees
GateWidth	int	millimeters
GcfState	int	-
NormalizedCoherentPower	float	-
Reflectivity	float	dBZ
SpecificPhase	float	degree per km
SpectralWidth	float	m/s
StartGate	int	-
StartRange	double	millimeters
Time	int	UTC
TxFrequency	double	hertz
TxLength	double	seconds
TxPower	double	dBM
Velocity	float	m/s

Table 4: "GcfState" states (ground clutter filtering)

Value	Description
0	Off (No ground clutter filter used)
1	On (GMAPTD ground clutter filtering enabled)

Algorithm

Retrieval algorithms were adjusted for the raindrop size distribution (DSD) measured by the D3R. The Ka- and Ku- bands used by the D3R are more affected by attenuation than the more common S- and C- band radars. More information on how these adjustments were made can be found in Chandrasekar et al., 2010.

Quality Assessment

The GPM GV radars routinely undergo various calibration procedures to maintain system accuracy and performance including receiver, sphere, and solar calibration. More information on these calibration procedures can be found in Chandrasekar et al., 2015.

Software

No software is required to view this data; however, Panoply can be used to easily examine the data.

Known Issues or Missing Data

Data is not available for the following dates: 5/11/13, 5/12/13, 5/13/13, 5/24/13, and 6/13/13 (for the ku band).

References

Bechini, R., & Chandrasekar, V. (2015). A semi-supervised robust hydrometeor classification method for dual-polarization radar applications. *Journal of Atmospheric and Oceanic Technology*, *32*, 22-47. doi: https://doi.org/10.1175/JTECH-D-14-00097.1

Chandrasekar, V., Baldini, L., Bharadwaj, N., & Smith, P. (2015). Calibration Procedures for Global Precipitation-Measurement Ground-Validation Radars. *The Radio Science Bulletin*, *355*, 45-73. doi: https://doi.org/10.23919/URSIRSB.2015.7909473

Chandrasekar, V., Schwaller, M. R., Vega, M., Carswell, J. R., Mishra, K. V., Meneghini, R., & Nguyen, C. (2010). Scientific and engineering overview of the NASA Dual-Frequency Dual-Polarized Doppler Radar (D3R) system for GPM Ground Validation. Proceedings from IGARSS 2010: IEEE Geoscience and Remote Sensing Society Meeting. Honolulu, HI: IEEE. doi: https://doi.org/10.1109/IGARSS.2010.5649440

Vega, M., Carswell, J. R., Chandrasekar, V., Schwaller, M. R. & Mishra, K. V. (2010). Realization of the NASA Dual-Frequency Dual-Polarized Doppler Radar (D3R). Proceedings from IGARSS 2010: *IEEE Geoscience and Remote Sensing Society Meeting*. Honolulu, HI: IEEE. doi: https://doi.org/10.1109/IGARSS.2010.5653929

Related Data

All data from other instruments collected during the IFloodS field campaign are considered related datasets. These data can be located by searching 'IFloodS' in HyDRO 2.0.

In addition, the D3R was used in other GPM GV field campaigns. These other D3R datasets are listed below and may be of interest.

GPM Ground Validation Dual-frequency Dual-polarized Doppler Radar (D3R) OLYMPEX (http://dx.doi.org/10.5067/GPMGV/OLYMPEX/D3R/DATA101)

GPM Ground Validation Dual-frequency Dual-polarized Doppler Radar (D3R) IPHEx (http://dx.doi.org/10.5067/GPMGV/IPHEX/D3R/DATA101)

GPM Ground Validation Dual-frequency Dual-polarized Doppler Radar (D3R) GCPEx (http://dx.doi.org/10.5067/GPMGV/GCPEX/D3R/DATA101)

Contact Information

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

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Created: 02/17/14
Updated: 02/21/19