GPM Ground Validation NEXRAD IPHEx

Introduction

The NEXt Generation Weather RADar system (NEXRAD) IPHEx datasets contain data from selected NEXRAD instruments in operation during the Integrated Precipitation and Hydrology Experiment (IPHEx) field campaign to help support the ground validation of the Global Precipitation Measurement (GPM) and evaluate Quantitative Precipitation Estimation (QPE) products for hydrologic forecasting in the southeast region of the United States. NEXRAD is a network of 160 stationary S-Band radars dispersed throughout the United States and select locations abroad. Datasets from seven NEXRAD stations, as listed below, extend from May 1, 2014 through June 12, 2014 as part of the GPM Ground Validation IPHEx datasets. The NEXRAD Level II datasets contain browse images of base reflectivity observations in the Portable Network Graphic (PNG) format. Base radar reflectivity is the measure of transmitted power returned to the radar after intercepting a target, for example, rain droplets. This information can illustrate the amount and size distribution of water particles in a given unit volume of atmosphere.

Notice: These data were downloaded from NOAA website during the IPHEx field campaign in near-real time. This type of data collection can have missing data and is not quality controlled. For a complete archive of data from each station, please utilize the NOAA archives at Amazon Web Services and Open Commons Consortium. See the [NOAA website](#) for more information.

Citations:

This user guide covers 7 datasets. Each contains browse imagery files from a specific NEXRAD instrument location. Use the appropriate citation listed below. There is a DOI for each individual station. More information about the instrument is available in this guide.

GPM Ground Validation KCAE NEXRAD IPHEx

Unidata and NWS Radar Operations Center. 2018. GPM Ground Validation KCAE NEXRAD IPHEx [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/IPHEX/NEXRAD/DATA101

GPM Ground Validation KGSP NEXRAD IPHEx

Unidata and NWS Radar Operations Center. 2018. GPM Ground Validation KGSP NEXRAD IPHEx [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/IPHEX/NEXRAD/DATA201

GPM Ground Validation KHTX NEXRAD IPHEx

Unidata and NWS Radar Operations Center. 2018. GPM Ground Validation KHTX NEXRAD IPHEx [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/IPHEX/NEXRAD/DATA301

GPM Ground Validation KLTX NEXRAD IPHEx

Unidata and NWS Radar Operations Center. 2018. GPM Ground Validation KLTX NEXRAD IPHEx [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/IPHEX/NEXRAD/DATA401

GPM Ground Validation KMHX NEXRAD IPHEx

Unidata and NWS Radar Operations Center. 2018. GPM Ground Validation KMHX NEXRAD IPHEx [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/IPHEX/NEXRAD/DATA501

GPM Ground Validation KMRX NEXRAD IPHEx

Unidata and NWS Radar Operations Center. 2018. GPM Ground Validation KMRX NEXRAD IPHEx [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/IPHEX/NEXRAD/DATA601

GPM Ground Validation KRAX NEXRAD IPHEx

Unidata and NWS Radar Operations Center. 2018. GPM Ground Validation KRAX NEXRAD IPHEx [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/IPHEX/NEXRAD/DATA701

Keywords:

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 Integrated Precipitation and Hydrology Experiment (IPHEx) which was held in North Carolina during 2013 and 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 part of the development, evaluation, and improvement of remote-sensing precipitation algorithms in support of the GPM mission through NASA GPM Ground Validation field campaign (IPHEX_GVFC) and the evaluation of Quantitative Precipitation Estimation (QPE) products for hydrologic 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 http://gpm.nsstc.nasa.gov/iphex/.
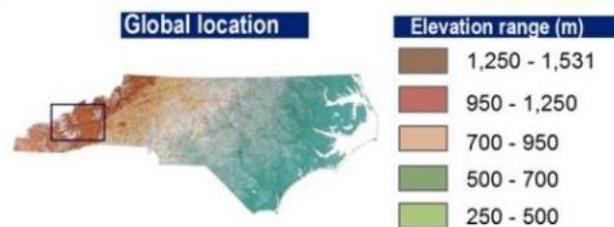

Figure 1: Region of North Carolina IPHEx campaign ground validation
(image source: http://gpm-gv.gsfc.nasa.gov/Gauge/)

Instrument Description

The NEXt generation RADar system (NEXRAD) consists of 160 Weather Surveillance Radar-1988 Doppler (WSR-88) sites located throughout the United States as well as some select overseas locations (Figure 1). The system is jointly operated and maintained by the

Department of Commerce, Department of Defense, and the Department of Transportation. However, the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) is the civilian agency responsible for general operations (OFCM, 2016).
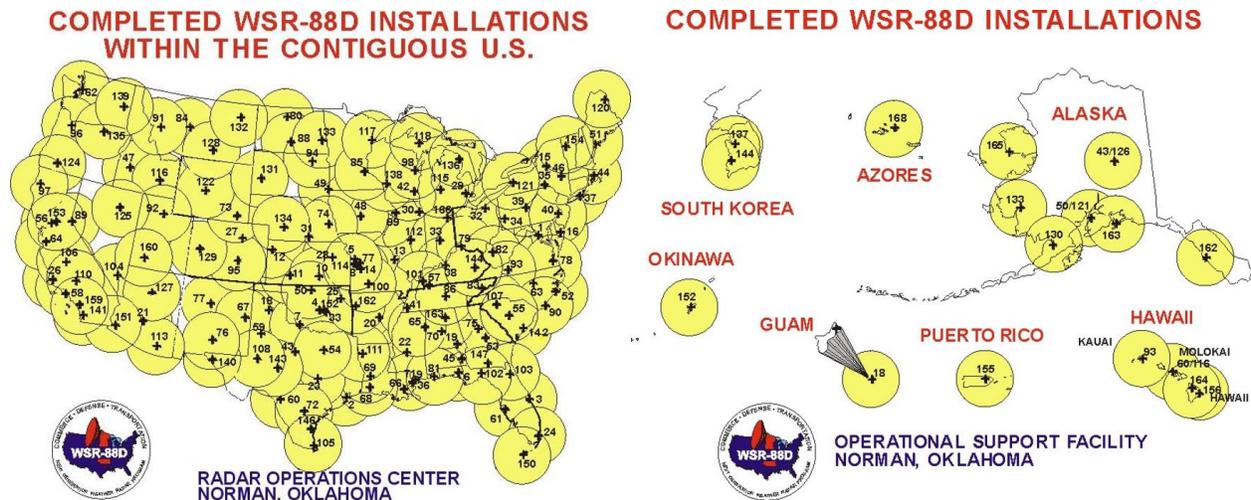

Figure 1: Location of WSR-88D NEXRAD radar stations.
Image source: (https://www.roc.noaa.gov/WSR88D/Maps.aspx)

NEXRAD is a 10 cm wavelength (S-Band) Doppler ground station radar with systems that operate within a range of 2,700 - 3,000 MHz (Figure 2). There are two scan modes for each station. Mode A is a fast tracking scan that designed to detect different types of precipitation during active weather events. Mode B is a slow-scanning mode for clearer weather used for observing air movements when there is little to no precipitation (NOAA National Center for Environmental Information, 2017). The NEXRAD radar stations collect data in a 360 degree swath, with the radar location at the center, at several predetermined elevation angles at specific periods of time. Most data products are generated from radar scan times of 4.5, 5, 6, and 10 minute periods. There are several products generated from NEXRAD, both from base data moments and dual polarization variables. These include base reflectivity, mean radial velocity, and spectrum width. Dual polarization variables include differential reflectivity, correlation coefficient, and differential phase (OFCM, 2016). Data coverage can vary by station but overall NEXRAD data is available from the mid-1990s to the present with nearly continuous archived data.

Figure 2: Image of NEXRAD radar site with antenna tower and radome.
Image Source: (https://www.ll.mit.edu/mission/aviation/faawxsystems/nexrad.html)

More information about the WRS-88D NEXRAD system can be found in the Federal Meteorological Handbooks at the Office of the Federal Coordinator for Meteorological Services and Supporting Research (http://www.ofcm.gov/publications/fmh/allfmh2.htm) as well as from NOAA's Nationa Center for Environmental Information (NCEI) site located at NOAA (https://www.ncdc.noaa.gov/data-access/radar-data/nexrad).

This user guide describes NEXRAD Level II data collected from the NEXRAD web site for use in the IPHEx field campaign. There were seven NEXRAD radar stations in operation during and within the area of study of the IPHEx field campaign. The table below contains the names and location of the seven stations. More information about NEXRAD II data is available on the NOAA website https://www.ncdc.noaa.gov/data-access/radar-data/nexrad and in Huber and Trapp (2009). Further information about individual NEXRAD stations can be found online.

Reflectivity browse images from seven NEXRAD stations are included in this dataset:

KCAE - Columbia, South Carolina
LATITUDE: 33.948, LONGITUDE: -81.118

KGSP- Greer, South Carolina
LATITUDE: 37.655, LONGITUDE: -97.443

KHTX - Huntsville, Alabama
LATITUDE: 34.931, LONGITUDE: -86.083

KLTX - Wilmington, North Carolina

LATITUDE: 33.989, LONGITUDE: -78.428

KMHX - Morehead City, North Carolina
LATITUDE: 34.776, LONGITUDE: -76.876

KMRX - Knoxville/Tri-Cities, Tennessee
LATITUDE: 36.168, LONGITUDE: -83.401

KRAX - Raleigh/Durham, North Carolina
LATITUDE: 35.665, LONGITUDE: -78.489

Investigators

Unidata - Data Services and Tools for the Geosciences
https://www.unidata.ucar.edu/data/index.html#radar

NWS Radar Operations Cener
https://www.roc.noaa.gov/wsr88d/Level_II/Level2Info.aspx

Data Characteristics

These GPM Ground Validation NEXRAD IPHEx datasets consist of browse images that are available as a georeferenced Portable Network Graphics (PNG) format. Each dataset contains images from one NEXRAD radar station located within the IPHEx area. These browse images show a 360 degree base radar reflectivity one kilometer away from the radar station. Temporal resolution may vary from file to file but in general show the radar reflectivity over a course of ten minutes. These images are considered Level 2 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	Ground station
Instrument	NEXt generation RADar (NEXRAD)
Spatial Coverage	**KCAE:** N: 36.046, S: 31.850, E: -79.020, W: -83.216 **KGSP:** N: 36.964, S: 32.768, E: -80.121, W: -84.31 **KHTX:** N: 37.028, S: 32.832, E: -88.181, W: -83.985 **KLTX:** N: 36.087, S: 31.891, E: -79.330, W: -80.527 **KMHX:** N: 36.874, S: 32.677, E: -74.777, W: -78.974 **KMRX**: N: 38.266. S: 34.070, E: -85.499, W: -81.303

	KRAX: N: 37.763, S: 33.567, E: -76.391, W: -80.587
Spatial Resolution	50 km radar range Note: 360 degree swaths at two elevation angles
Temporal Coverage	01 May 2014 - 12 June 2014
Temporal Resolution	<10 minutes
Sampling Frequency	<1 second
Parameter	Radar reflectivity
Version	1
Processing Level	2

File Naming Convention

The GPM Ground Validation NEXRAD Radar IPHEx datasets consist of PNG format browse images. There are two browse images for each time period. Both images have the same naming convention except there are two elevation number options. The first, "...ELEV_01" refers to the first elevation angle, or radar tilt angle, which is 0.0 degrees (parallel to the ground surface.) The second elevation angle, "...ELEV_02," is 0.5 degrees. More information about these angles can be found in the Part A, page 17 of the Federal Meteorological handbook No. 11 (OFCM, 2016). These browse image files have the following naming convention:

Browse files: Level2_[radar]_YYYYMMDD_hhmm_ELEV_##.png

Table 2: File naming convention variables

Variable	Description
[radar]	**KCAE - Columbia, South Carolina** LATITUDE: 33.948, LONGITUDE: 81.118 **KGSP- Greer, South Carolina** LATITUDE: 37.655, LONGITUDE: -97.443 **KHTX - Huntsville, Alabama** LATITUDE: 34.931, LONGITUDE: -86.083 **KLTX - Wilmington, North Carolina** LATITUDE: 33.989, LONGITUDE: -78.428 **KMHX - (Morehead City, North Carolina** LATITUDE: 34.776, LONGITUDE: -76.876 **KMRX - Knoxville/Tri-Cities, Tennessee** LATITUDE: 36.168, LONGITUDE: -83.401 **KRAX - Raleigh/Durham, North Carolina** LATITUDE: 35.665, LONGITUDE: -78.489

YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day of month
hh	Two digit hour UTC time
mm	Two digit minute UTC time
##	Elevation angle number, or tilt angle, designation. 01: 0.0 degrees elevation angle (parallel to ground) 02: 0.5 degrees elevation angle

Data Format and Parameters

The browse images provided in these datasets are in a georeferenced PNG format and can be easily opened in a Geographic Information System (GIS) or other application to overlay on other imagery or maps.

The browse images available for download show radar reflectivity within a 1 km and 360 degree area around the radar station.

Quality Assessment

The Base Reflectivity products, including the browse images available in these datasets, have undergone data quality assurance by NOAA which results in an intermediate, elevation cut product of 50 km radar range. Further data processing and product generation for other level 2 data products is generated using the DQA product, including the base reflectivity browse images available in these datasets. For information about the algorithms used, see Part C of the Federal Meteorological Handbook No. 3 (OFCM, 2017).

Software

These datasets only contain browse images and do not require any specific read software. Any image or graphics processing software can open the files contained in this dataset.

Known Issues or Missing Data

In general for the NEXRAD system, occasional data gaps and missing data are common. Typical causes of missing data include scheduled maintenance of an individual radar, severe weather, communication problems, and data archiving issues.

References

Barros, A. P., Petersen, W., Schwaller, M., Cifelli, R., Mahoney, K., Peters-Liddard, C., et al. (2014): NASA GPM - Ground Validation, 1–64. http://dx.doi.org/10.7924/G8CC0XMR.

Huber, M., and Trapp, J, 2009: A Review of NEXRAD Level II: Data, Distribution, and Applications. Journal of Terrestrial Observation, 1, 5 - 15. Available online at https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1042&context=jto

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OFCM (2017): Federal Meteorological Handbook Part C: WSR-88D Products and Algorithms. Silver City, MD. Retrieved from http://www.ofcm.gov/publications/fmh/FMH11/fmh11partC.pdf

Related Data

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

Contact Information

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

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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/

Created: January 5, 2018