Global Hydrology Resource Center

Data User Guide

Hurricane and Severe Storm Sentinel (HS3) Global Hawk High Altitude MMIC Sounding Radiometer (HAMSR)

Introduction

The Hurricane and Severe Storm Sentinel (HS3) Global Hawk High Altitude MMIC Sounding Radiometer (HAMSR) dataset includes measurements gathered by the HAMSR instrument during the HS3 campaign. HAMSR has 25 spectral channels in 3 bands (50-60 Ghz, 118 Ghz, and 183 Ghz). This dataset also contains measurements that can be used to infer the 3-dimensional distribution of temperature, water vapor, and cloud liquid water profiles in the atmosphere, even in the presence of clouds. HAMSR is mounted in payload zone 3 near the nose of the Global Hawk NASA aircraft. Data are available for 2011 through 2013 in netCDF and PDF format.

Notice:
HAMSR data for 2011 are test data, while data for 2012 and 2013 are actual field campaign data. Data for 2011 should be used as a reference data set.

Citation

Lambrigtsen, B.. 2016. Hurricane and Severe Storm Sentinel (HS3) Global Hawk High Altitude MMIC Sounding Radiometer (HAMSR) [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/HS3/HAMSR/DATA201

Keywords:

GHRC, NASA, HAMSR, HS3, Global Hawk UAV, temperature, potential temperature, calibrated brightness temperature, relative humidity, water vapor, cloud liquid water profile;

Campaign

The HS3 campaign was a five year NASA mission specifically targeted to investigate the processes that underlie hurricane formation and intensity change in the Atlantic Ocean.

Goals for HS3 included assessing the relative roles of the large-scale environment and storm-scale internal processes, addressing the controversial role of the Saharan Air Layer (SAL) in tropical storm formation, intensification, and addressing the role of deep convection in the inner-core region of storms. To achieve these goals, observations took place from 2012 through 2014 for one month during each hurricane season. Information about flights made in each campaign year are summarized in Table 2 of the HS3 BAMS paper at http://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-15-00186.1. More information about the HS3 campaign can be found at http://hs3.nsstc.nasa.gov/.

Instrument Description

The High Altitude Monolithic Microwave Integrated Circuit (MMIC) Sounding Radiometer (HAMSR) is a microwave atmospheric sounder developed by the NASA Jet Propulsion Laboratory (JPL) in Pasadena, California under the NASA Instrument Incubator Program. Operating with 25 spectral channels in 3 bands (50-60 Ghz, 118 Ghz, and 183 Ghz), it provides measurements that can be used to infer the 3 dimensional distribution of temperature, water vapor, and cloud liquid water profiles in the atmosphere, even in the presence of clouds. HAMSR is mounted in payload zone 3 near the nose of the Global Hawk NASA aircraft. The HAMSR instrument is compact enough to fit into a package that is 90 cm long, 38 cm wide, and 33 cm tall and weighs 45 kg. Its scan axis is oriented along the flight path, and its antenna system includes two back-to-back reflectors. Figure 1 shows, in gray, the location of the HAMSR instrument on the Global Hawk NASA aircraft. Data are processed through two processing levels. Level 1B data files contain calibrated brightness temperatures with geolocation and timestamp information. Level 2 data files include temperature, water vapor, cloud liquid water profiles, and derived products, such as potential temperature and relative humidity. More information about the HAMSR instrument can be found in Brown et al., 2011.

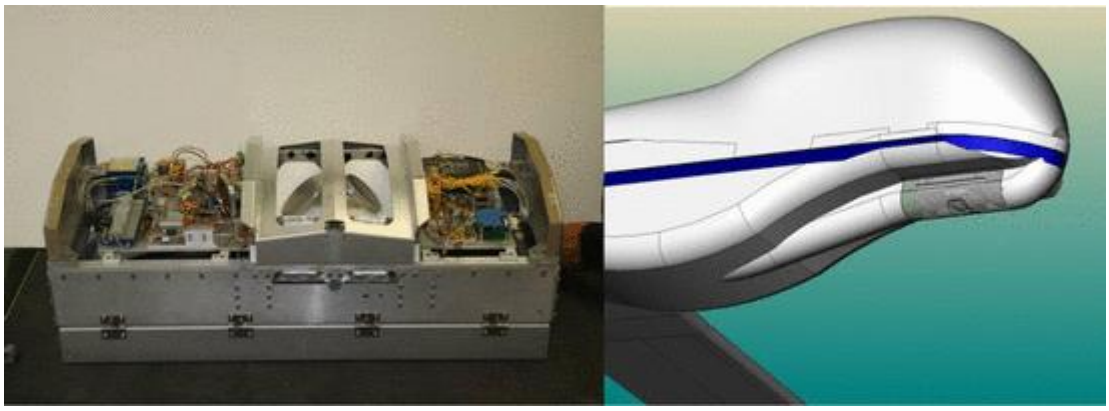

Figure 1: HAMSR instrument (left) and location on the Global Hawk NASA aircraft (right). Source: Brown et al., 2011

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File Naming Convention

The HS3 HAMSR dataset files are names with the following naming convention:

Data: HAMSR_L#_<start time>_<end time>_v01.nc
L2_validation_HAMSR_L2_<start time>_<end time>_v01.pdf

Table 1: File naming convention variables

Variable	Description
L#	Data processing level (1B or 2)
<start time>	YYYYMMDDThhmmss YYYY = four-digit year MM = two-digit month DD = two-digit day hh = two-digit hour mm = two-digit minute ss = two-digit second
<end time>	YYYYMMDDThhmmss YYYY = four-digit year MM = two-digit month DD = two-digit day hh = two-digit hour mm = two-digit minute ss = two-digit second
.nc	netCDF
.pdf	Adobe PDF file

Data Format Description

HAMSR data are available in netCDF and PDF format. Level 1B data consists of calibrated brightness temperatures with geolocation and timestamp data. More information about HAMSR Level 1B data format is available at https://microwavescience.jpl.nasa.gov/files/mws/HAMSR_L1B_description.pdf. Level 2 data consist of temperature, water vapor, cloud liquid water profiles, potential temperature, and relative humidity. More information about HAMSR Level 2 data format is available at https://microwavescience.jpl.nasa.gov/files/mws/HAMSR_L2_description.pdf.

Table 2: Data Characteristics

Characteristic	Description
Platform	Global Hawk UAV
Instrument	High Altitude MMIC Sounding Radiometer (HAMSR)

Projection	n/a
Spatial Coverage	**2012-2013:** N: 45, S: 0, E: 0, W: -100 (Atlantic Ocean) **2011:** N: 50.7, S: 25.7, E: -116.9, W: -155.5 (Pacific Ocean)
Spatial Resolution	2 km
Temporal Coverage	Start date: September 9, 2011 Stop date: September 25, 2013
Temporal Resolution	1 file per flight
Sampling Frequency	5 seconds
Parameter	Calibrated brightness temperature, temperature, water vapor, cloud liquid water profile, potential temperature, and relative humidity
Version	1
Processing Level	1B and 2

Data Parameters

Level 1B data consists of calibrated brightness temperatures with geolocation and timestamp data. Level 2 data consists of temperature, water vapor, cloud liquid water profiles, potential temperature, and relative humidity.

Quality Assessment

The HAMSR instrument is fully calibrated ensuring high quality measurements. The calibration tests include characterization of receiver linearity, stability, along scan biases, and end-to-end pass band. The bias of scan angles between ±45° is less than 0.8 K, and the bias of 118/183 GHz channels is less than 0.5 K within this ±45° scan range. The bias for brightness temperature is much larger with a bias of almost 70 K; however, brightness temperature measurements during flights at about 20 km altitude have a bias no greater than 0.5 K. These errors may be because the metal frame of the aircraft is mainly in the field of view of the scan. More information about these biases can be found in Brown et al., 2011.

Validation information for this dataset is available within the data in PDF format.

Software

No special software is needed to read these netCDF data files; however, Panoply is an easy-to-use free tool for reading and visualizing the data within these netCDF files.

References

Braun, S., P. Newman, and G. Heymsfield, 2016: NASA's Hurricane and Severe Storm Sentinel (HS3) Investigation. Bulletin of the American Meteorological Society, doi:10.1175/BAMSD-15-00186.1.

Brown, S. T., B. Lambrigtsen, R. F. Senning, T. Gaier, P. Kangaslahti, B. H. Lim, J. M. Tanabe, A. B. Tanner, (2011): The High-Altitude MMIC Sounding Radiometer for the Global Hawk

Unmanned Aerial Vehicle: Instrument Description and Performance, IEEE Transactions of Geoscience and Remote Sensing, 49, 3291-3301. doi: 10.1109/TGRS.2011.2125973.

Hurricane and Severe Storm Sentinel (HS3) Homepage: http://hs3.nsstc.nasa.gov/

Contact Information

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

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