



Data User Guide

High Altitude MMIC Sounding Radiometer (HAMSR) CPEX-AW

Introduction

The High Altitude MMIC Sounding Radiometer (HAMSR) CPEX-AW dataset includes measurements gathered by the HAMSR instrument during the Convective Processes Experiment – Aerosols & Winds (CPEX-AW) field campaign. CPEX-AW was a joint effort between the US National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA) with the primary goal of conducting a post-launch calibration and validation activities of the Atmospheric Dynamics Mission-Aeolus (ADM-AEOLUS) Earth observation wind Lidar satellite in St. Croix, U.S. Virgin Islands. HAMSR has 25 spectral channels which are split into 3 bands to provide 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 is available from August 17, 2021 through September 4, 2021 in netCDF-3 format, with associated browse files in PNG format.

Notice: The NASA DC-8 aircraft did not operate each day of the campaign, therefore HAMSR data are only available for aircraft flight days.

Citation

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Keywords:

NASA, GHRC, CPEX-AW, St. Croix, HAMSR, DC-8, humidity, cloud liquid water, brightness temperature, reflectivity, precipitable water vapor

Project

The Convective Processes Experiment – Aerosols & Winds (CPEX-AW) campaign is a joint effort between the US National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA) with the primary goal of conducting post-launch calibration and validation activities of the Atmospheric Dynamics Mission-Aeolus (ADM-AEOLUS) Earth observation wind Lidar satellite in St. Croix, US Virgin Islands. CPEX-AW is a follow-on to the Convective Processes Experiment (CPEX) field campaign which took place in the summer of 2017 ([CPEX](#)). In addition to joint calibration/validation of ADM-AEOLUS, CPEX-AW will study the dynamics and microphysics related to the Saharan Air Layer, African Easterly Waves and Jets, Tropical Easterly Jet, and deep convection in the InterTropical Convergence Zone (ITCZ). CPEX-AW science goals include:

- Better understanding interactions of convective cloud systems and tropospheric winds as part of the joint NASA-ESA Aeolus Cal/Val effort over the tropical Atlantic;
- Observing the vertical structure and variability of the marine boundary layer in relation to initiation and lifecycle of the convective cloud systems, convective processes (e.g., cold pools), and environmental conditions within and across the ITCZ;
- Investigating how the African easterly waves and dry air and dust associated with the Saharan Air Layer control the convectively suppressed and active periods of the ITCZ;
- Investigating interactions of wind, aerosol, clouds, and precipitation and effects on long range dust transport and air quality over the western Atlantic.

More information about the CPEX-AW field campaign can be found at [NASA JPL|CPEX-AW](#), [CPEX-AW 2017 | Campaign Overview](#), and [CPEX-AW ESPO](#).



Figure 1: CPEX-AW field campaign logo
(Image source: [CPEX-AW](#))

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 is 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](#).

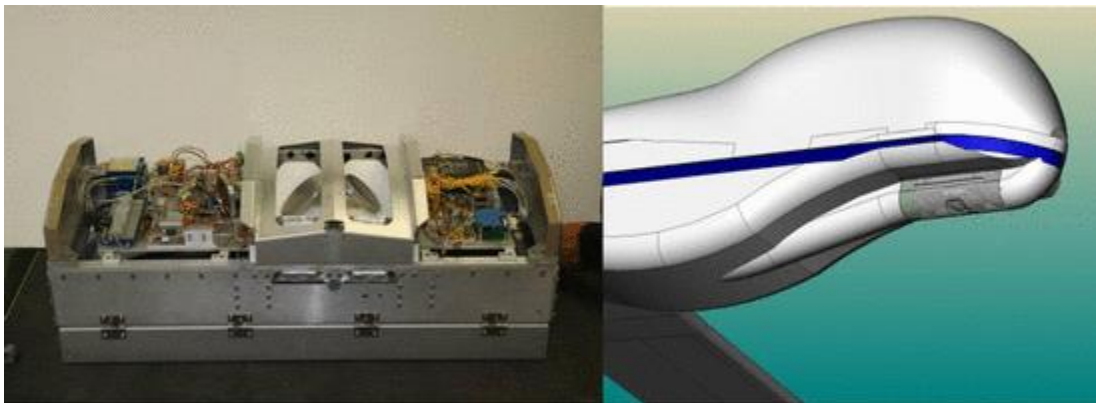


Figure 2: HAMSR instrument (left) and location on the Global Hawk NASA aircraft (right).
Source: [Brown et al., 2011](#)

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Data Characteristics

The HAMSR CPEX-AW dataset consists of measurements gathered by the HAMSR instrument during the CPEX-AW field campaign. These data are available at a Level 2 processing level. More information about the NASA data processing levels is available on the [EOSDIS Data Processing Levels webpage](#). The characteristics of this dataset are listed in Table 2 below.

Table 2: Data Characteristics

Characteristic	Description
Platform	NASA DC-8 aircraft
Instrument	High Altitude MMIC Sounding Radiometer (HAMSR)
Spatial Coverage	N: 34.613, S: 11.768, E: -45.122, W: -118.078 (St. Croix, Virgin Islands)
Spatial Resolution	2 km
Temporal Coverage	August 17, 2021 - September 4, 2021
Temporal Resolution	Hourly -< Daily
Sampling Frequency	5 seconds
Parameter	Cloud liquid water, absolute humidity, relative humidity, air temperature, derived reflectivity, precipitable water vapor, calibrated brightness temperature
Version	1
Processing Level	2

File Naming Convention

The HAMSR CPEX-AW data are within netCDF-3 files, with associated browse files in JPEG format, and are named using the following convention:

Data files:

CPEXAW_HAMSR_L2_realtime_<start date>_<end date>.nc

Browse files:

CPEXAW_HAMSR_<data field>_<start time>.jpg

Table 3: File naming convention variables

Variable	Description
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<start date>	Date when data collection began in YYYYMMDD format, where: YYYY = Four-digit year MM = Two-digit month DD = Two-digit day
<end date>	Date when data collection ended in YYYYMMDD format, where: YYYY = Four-digit year MM = Two-digit month DD = Two-digit day
<start time>	Date when data was collected in YYYYMMDD_hhZ format, where: YYYY = Four-digit year MM = Two-digit month DD = Two-digit day hh = Two-digit hour in UTC
.nc	netCDF-3 format
.jpg	JPEG format
<data field>*	<date field> Includes: dBZ_4km Flight_path PWV_CLW Qz RH TB Tz Tz_rel

<data field>*: Please refer to Table 4 for data field descriptions.

Data Format and Parameters

The HAMSR CPEX-AW data are available in netCDF-3 format. The data contains time-ordered and geo-located calibrated brightness temperatures for the Earth scan for each of the 25 HAMSR channels along with retrieved products, including cloud liquid water, absolute humidity, relative humidity, air temperature, derived reflectivity, and precipitable water vapor (Table 4). More information about HAMSR Level 2 data format is available at [Description of the High Altitude MMIC Sounding Radiometer \(HAMSR\) Level 2 data format](#).

Table 4: HAMSR CPEX-AW netCDF-3 data fields

Variable	Description	Scale Factor	Units
ACheading	Airplane Heading [-180:180]	0.01	degrees
AClat	Airplane Latitude [-90:90]	0.001	degrees_north
AClon	Airplane Longitude [-180:180]	0.001	degrees_east
ACpitch	Airplane Pitch [-180:180]	0.01	degrees
ACroll	Airplane Roll [-180:180]	0.01	degrees
altitude	Aircraft altitude from GPS in meters	0.1	m

TB	Calibrated Brightness Temperature	0.001	K
CLW	HAMSR Integrated Cloud Liquid Water - Regression Algorithm	0.0001	mm
ham_airQ	HAMSR Vertical Absolute Humidity	0.001	g m^{-3}
ham_airRH	HAMSR Vertical Relative Humidity	0.01	%
ham_airT	HAMSR Vertical Air Temperature	0.1	K
ham_dBz	HAMSR Derived Reflectivity Profile	0.01	dBz
ham_dBz_heights	HAMSR Height of Reflectivity Profile	1.0	m
ham_pres_levels	HAMSR Profile Pressure Levels	0.1	mb
PWV	HAMSR Precipitable Water Vapor - Regression Algorithm	0.001	cm
rain_flag	Rain flag (0-no rain, >0 rain)	1.0	-
inc	Pixel Incidence Angle [-180:180]	0.01	degrees
lat	Pixel Latitude [-90:90]	0.001	degrees_north
lon	Pixel Longitude [-180:180]	0.001	degrees_east
time	Measurement time (seconds since 2000-01-01 00:00:00.0)	1.0	seconds

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 $\pm 45^\circ$ is less than 0.8 K, and the bias of 118/183 GHz channels is less than 0.5 K within this $\pm 45^\circ$ 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](#).

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.

Known Issues or Missing Data

The aircraft did not operate each day of the campaign, therefore HAMSR data are only available for aircraft flight days.

References

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: <https://doi.org/10.1109/TGRS.2011.2125973>.

Related Data

All other datasets collected as part of the CPEX-AW campaign are considered related and can be located by searching the term "CPEX-AW" in the [Earthdata Search](#).

Contact Information

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

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