Office of Satellite and Product Operations
Environmental Satellite Processing Center

Hurricane Intensity and Structure Algorithm Microwave Sounder-based Tropical Cyclone Products External Users' Manual

Version 3.2

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Approval Page

Environmental Satellite Processing Center

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Changes/Revisions Record

This external users' manual is changed as required to reflect system, operational, or organizational changes. Modifications made to this document are recorded in the Changes/Revisions Record below. This record will be maintained throughout the life of the document.

Version Number	Date	Description of Change/Revision	Section/Pages Affected	Changes Made by Name/Title/ Organization
2.0	07/08/2019	Redefined the four files that are output from the TC algorithm	1.3 (pg. 8-10)	Michael Wilson, IMSG
3.0	07/10/2024	Updated history and product team: added information on metadata, variables, quality flags, updating satellites and wind field domain. Removed out-of-date NDE references.	All	Jennifer Unkle, OCS
3.1	07/18/2024	Added links to product monitoring, visualization	3.5, 3.5.1	Jeffery Augenbaum, ERT, Inc.
3.2	09/13/2024	Transfer contents to latest template, perform minor copy editing and formatting;	All	Hannah Bowie, Technical Writer, ERT Inc.
3.2	09/17/2024	Quality Assurance	All	Clint Sherwood, Quality Assurance Manager, ERT Inc.

Preface

This document comprises the National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS), Office of Satellite and Product Operations (OSPO), publication of this Hurricane Intensity and Structure Algorithm (HISA) Microwave Sounder-based TC Products External Users' Manual (EUM). This document reflects current operations for the DOC/NOAA/NESDIS Environmental Satellite Processing Center (ESPC) (NOAA5045) information technology systems. This document describes the established ESPC procedures for external users of HISA in accordance with Federal, DOC, NOAA, NESDIS and OSPO requirements.

Future updates and revisions to this document will be produced and controlled by DOC/NOAA/NESDIS for ESPC information technology systems.

The published version of this document can be found at the OSPO SharePoint Products Library.

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1. Products

1.1. Product Overview

This is an External Users' Manual (EUM) document describing the Hurricane Intensity and Structure Algorithm (HISA) microwave sounder-based Tropical Cyclone (TC) algorithm package. The intended users of the EUM are the end users of the HISA expected output files and the product verification and validation (V&V) teams. External users are users who do not have direct access to the algorithm package. The purpose of this manual is to help end users access, understand, and use any of the expected output files.

1.1.1. Product Requirements

Table 1-1 - Product Requirements

Requirement Description	Requirement Value
Satellite Sources	MetOp-B/C, NPP, N20, and N21
Product Name	An Objective Tropical Cyclone Intensity Estimation Derived from AMSU-A, MHS, ATMS, or MWS (future capability) Hurricane Intensity and Structure Algorithm (HISA)
Mapping Accuracy	RMSE ~ 13.7 kt, 10.4 hPa MAE ~ 13.5 kt, 9 hPa
Latency	3 hours
Timeliness	~ 6 hourly
Coverage	Global tropic regions

The HISA microwave sounder-based TC algorithm requires the following estimates, generated for each active TC when there is a satellite overpass within 700 km from the TC center and all input data is available:

Intensity estimates

Intensity estimates will be provided in terms of 1) the maximum sustained surface wind (Vmax) in knots and 2) the minimum sea level pressure (MSLP) in hPa.

Surface wind radii estimates

Surface wind radii estimates will be provided for the radius of 34-kt, 50-kt, and 64-kt winds for the NE, NW, SE, and SW quadrants relative to the TC center in units of nautical miles (nmi).

Two-dimensional (2-D) balanced winds at standard mandatory pressure levels for the local TC environment

2-D balanced wind fields for a 12 x 12 degree latitude/longitude domain centered on each active TC will be provided in units of knots at p = 1000, 850, 700, 600, 500, 400, 300, 250, 200, 150, and 100 hPa, together with the corresponding geopotential heights (meters) and temperatures (K), in both NetCDF4 and image format.

One-dimensional gradient (tangential) winds at every 1 km of height from 0 to 20 km and every 20 km of radius from 0 to 600 km

Collected in tandem with the temperature, pressure and atmospheric density (kg/m^3) on the storm centric cylindrical rz (radius – height) grid, in NetCDF4 format.

Intensity estimates and surface wind radii estimates are required in text format consistent with the Automated Tropical Cyclone Forecast (ATCF) system. The format required for the ATCF f-decks is described at http://www.nrlmry.navy.mil/atcf_web/docs/database/new/newfdeck.txt. Using this format, a single line of text is generated for each active TC at each run time. An example of this format for a case from a MetOp-C Advanced Microwave Sounding Unit (AMSU) Microwave Integrated Retrieval System (MiRS) retrieval is included below:

```
WP, 06, 202308011238, 30, AMSU, IPR, , 2533N, 12798E, , 1, 104, 2,  943, 2, MEAS,
34, NEQ , 229, 189, 169, 203, , , , , 2, 12, , W,  NSOF, OPS, , , , , , , 943, ,
METOPC, 34, NEQ , 229,  189, 169, 203, , , , , , , , , , , , 2, storm
center  extrapolated from t=-12 and t=0 adeck

WP, 06, 202308011238, 30, AMSU, R, , 2533N, 12798E, , 1, 104, 2,  943, 2, MEAS,
50, NEQ , 85, 75, 69, 78, , , , , 2, 12, , W,  NSOF, OPS, , , , , , , 943, ,
METOPC, 50, NEQ , 85,  75, 69, 78, , , , , , , , , , , , 2, storm
center  extrapolated from t=-12 and t=0 adeck

WP, 06, 202308011238, 30, AMSU, R, , 2533N, 12798E, , 1, 104, 2,  943, 2, MEAS,
64, NEQ , 45, 41, 39, 43, , , , , 2, 12, , W,  NSOF, OPS, , , , , , , 943, ,
METOPC, 64, NEQ , 45,  41, 39, 43, , , , , , , , , , , , 2, storm
center  extrapolated from t=-12 and t=0 adeck
```

2-D balanced winds are required in both NetCDF4 and image (png) format. One NetCDF4 file and image will be generated for each active tropical cyclone at each standard pressure level.

Product latency should be the same as the current AMSU sounder-based products, which are available approximately 3 hours after synoptic time or sooner, depending on the time of the last MetOp-B, MetOp-C, S-NPP, NOAA-20 or NOAA-21 pass of the TC.

1.1.2. Product Team

Table 1-2 - Product Team

Team Member	Organization	Role	Contact Information
Walter Wolf	OCS	Product Management Division Chief	walter.wolf@noaa.gov
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Team Member	Organization	Role	Contact Information
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Table 1-3 - Point of Contact

Name	Email
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Jerry Greenough	Jeremy.Greenough@noaa.gov

1.1.3. Product Description

HISA relies on a Cloud Containerized Algorithm Package (CCAP) to produce microwave sounder-based TC products. A total of five product types are produced through the operation of two processing units:

- Two NetCDF4 files (RZA and XYA)
- Nine PNG image files
- One FIX file
- One STA file
- One AFX file

These products offer estimates of TC intensity and surface wind structure by measuring the radial extent of 34-, 50-, and 64-kt winds in four quadrants (NE, SE, SW and NW) relative to the TC center. These estimates are derived from MiRS temperature and moisture soundings, combined with the hydrostatic relationship and statistics. MiRS retrievals may be collected from the following satellite instruments:

- Advanced Microwave Sounder Unit (AMSU) on MetOp-B
- Advanced Microwave Sounder Unit (AMSU) on MetOp-C
- Advanced Technology Microwave Sounder (ATMS) on S-NPP
- Advanced Technology Microwave Sounder (ATMS) on NOAA-20
- Advanced Technology Microwave Sounder (ATMS) on NOAA-21

1.2. Product History

AMSU-based intensity and wind radii algorithms have been running operationally at the National Center for Environmental Prediction (NCEP) since 2003. Algorithm and validation details are provided in Demuth et al. (2004; 2006). In addition, AMSU-based balanced wind algorithms have been running operationally since 2005 (Bessho et al. 2006).

The first HISA algorithm package was delivered in 2019. This second algorithm package, delivered in 2024, doubles the balanced wind field domain from 6 x 6 to 12 x 12, as well as incorporating instruments from MetOp-B and MetOp-C satellites.

1.3. Product Access

The NESDIS Policy on Access and Distribution of Environmental Data and Products is provided at: http://www.ospo.noaa.gov/Organization/About/access.html.

Users need to fill out the Data Access Request Form located on this site and submit to the PAL with a copy to nesdis.data.access@noaa.gov. This address provides the OSPO Data Access Team a copy of the correspondence. Once the request is approved by the OSPO management, the data will be delivered by the Product Distribution and Access (PDA) system. ESPC User Services (SPSDuserservices@noaa.gov) should be contacted for any data accessibility and data distribution problems.

In order to obtain the near real time data user needs to fill out the Data Access Request Form located on http://www.ospo.noaa.gov/Organization/About/access.html and submits to the PAL with a copy to nesdis.data.access@noaa.gov.

Table 1-4 describes the naming convention for the file path used to store the HISA processing product output.

Table 1-4 - Output Naming Convention

Type of File	Naming Convention
HISA Product Output	TC-<type>-atcf_storm_id><vXrY>_SatID>_s<DataStartDate>_e<DataEndDate>_c<CreationDate>.nc

Where:

<Type>	RZA or XYA
<atcf_storm_id>	Storm identifier; 2-digit basin_id, 2-digit storm month, 2-digit date
<vXrY>	Version and release
<SatID>	The satellite ID: npp, n20, n21, m01, or m03
<DataStartDate>	The data start date in 4-digit year, 2-digit month, 2-digit day format
<DataEndDate>	The Data End date in 4-digit year, 2-digit month, 2-digit day, 2-digit hour, 2-digit minute, 3-digit second
<CreationDate>	The file creation date in 4-digit year, 2-digit month, 2-digit day, 2-digit hour, 2-digit minute, 3-digit second

Table 1-5 lists the metadata present in HISA products.

Table 1-5 - Output File Metadata for HISA Products

Attribute Name	Example Value	Data Type	Array Size
Conventions	CF-1.5	String	Scalar

Attribute Name	Example Value	Data Type	Array Size
Metadata_Conventions	CF-1.5, Unidata Dataset Recovery 1.0	String	Scalar
_NCProperties	version=2, netcdf=4.8.1, hdf5=1.12.2	String	Scalar
atcf_method	CARQ	String	Scalar
atcf_storm_basin	al	String	Scalar
atcf_storm_date_time	2023-09-07T30:00:00Z	String	Scalar
atcf_storm_degrees_north	15	Integer	1
atcf_storm_degrees_north_12_h_before_overpass	14	Integer	1
atcf_storm_direction_degrees	292	Integer	1
atcf_storm_intensity_knots	70	Integer	1
atcf_storm_intensity_knots_12_h_before_overpass	999	Integer	1
atcf_storm_longitude_degrees_east	-48	Integer	1
atcf_storm_longitude_degrees_east_12_h_before_overpass	-46	Integer	1
atcf_storm_name	LEE	String	Scalar
atcf_storm_number	13	String	Scalar
atcf_storm_speed_knots	11	Integer	1
atcf_time	2023-09-07T06:00:00Z	String	Scalar
cdm_data_type	Grid	String	Scalar
creator_email	Sample.Email@noaa.gov	String	Scalar
creator_url	http://samplesite.edu	String	Scalar
date_created	2024-01-18T22:04:14Z	String	Scalar
geospatial_lat_max	22.0	Float	1
geospatial_lat_min	10.0	Float	1
geospatial_lat_resolution	0.2	Float	1
geospatial_lat_units	degrees_north	String	Scalar
geospatial_lon_max	-42.0	Float	1
geospatial_lon_min	-54.0	Float	1
geospatial_lon_resolution	0.2	Float	1
geospatial_lon_units	degrees_east	String	Scalar
history	HISA Version 2	String	Scalar
id	1b6303f9-9688-4e80-aa21-161f41187469	String	Scalar
institution	DOC/NOAA/NESDIS/OSPO > …	String	Scalar
instrument	ATMS	String	Scalar
keywords	TROPICAL CYCLONE MAXIMUM SUSTAINED WIND,	String	Scalar
keywords_vocabulary	GCMD	String	Scalar
max_vertical_pressure	100000	Integer	1
metadata_link	https://rammb2.cira.colostate.edu/	String	Scalar
min_vertical_pressure	10000	Integer	1
missing_value	-999.9	Float	1
n_vertical_pressure_levels	12	String	Scalar
naming_authority	gov.noaa.nesdis.ncei	String	Scalar
overpass_time	2023-09-07T05:08:18Z	String	Scalar
platform	NOAA21	String	Scalar
processing_level	NOAA Level 3	String	Scalar

Attribute Name	Example Value	Data Type	Array Size
production_environment	INT_j02	String	Scalar
production_site	PLAIT_j02	String	Scalar
project	NESDIS Common Cloud Framework	String	Scalar
publisher_email	espcoperations@noaa.gov	String	Scalar
publisher_name	DOC/NOAA/NESDIS/OSPO > …	String	Scalar
publisher_url	http://ospo.noaa.gov	String	Scalar
references	Demuth, J., M. DeMaria, and J.A. Knaff, 2006: improvement of…	String	Scalar
source	NPR-MIRS-IMG_v11r9_n21	String	Scalar
source_files	NPR-MIRS-IMG_v11r9_n21	String	Scalar
standard_name_vocabulary	CF Standard Time Name Table (version 17, 24 March 2011)	String	Scalar
summary	ATMS or AMSU tropical cyclone wind intensity and surface wind radii thresholds	String	Scalar
swath_date_time	2023-09-07T05:0818Z	String	Scalar
time_coverage_end	2023-09-07T05:13:18Z	String	Scalar
time_coverage_start	2023-09-07T05:03:18Z	String	Scalar
title	TC_XYA_al132023	String	Scalar
vertical_pressure_res	mandatory pressure levels, approximately 800 Pa on average	String	Scalar
vertical_pressure_units	Pa	String	Scalar

Table 1-6 lists all output variables present in HISA output files.

Table 1-6 - File Variables in HISA Products

Variable	Description	Dimensions
height	Height in km	21
mad	Mean azimuthal density, or air density in kg	21x31
magw	Mean azimuthal gradient wind speed, or wind speed in m	21x31
map	Mean azimuthal pressure, or air pressure in hPa	21x31
mat	Mean azimuthal temperature, or air temperature in K	21x31
quality_flag	Quality flag: see Section 3.3 for explanation	21x31
quality_information	Sets parameters for quality readouts	1
radius	radius in km	31

2. Algorithm

2.1. Algorithm Overview

Figure 2-1 demonstrates the processing workflow for the HISA CCAP.

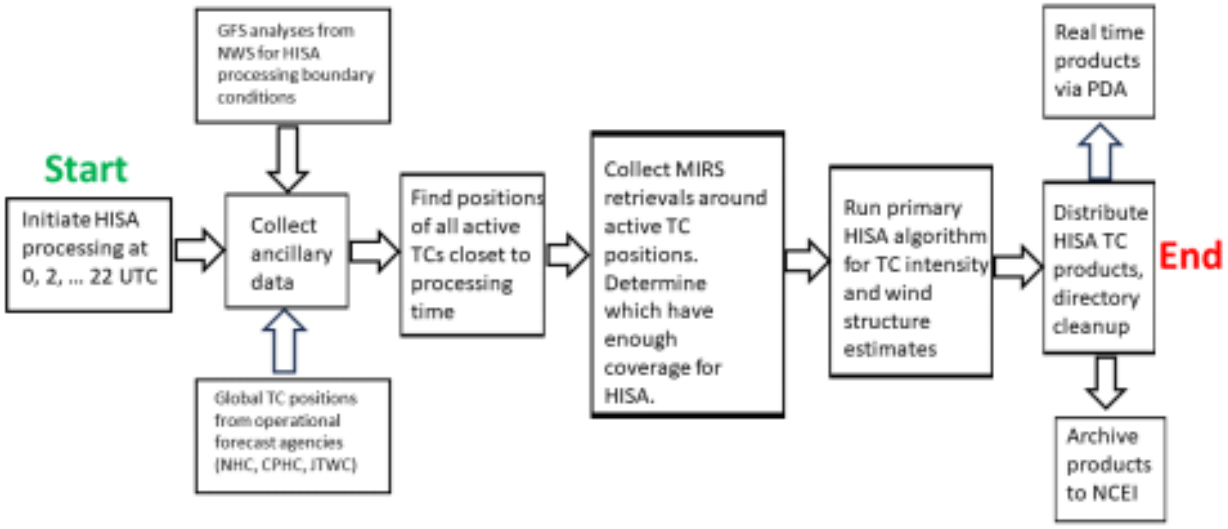

Figure 2-1 - HISA Processing Flowchart

The HISA CCAP generates its product files by running two processing units: the GFS processing unit, and the HISA processing unit. The GFS processing unit runs four times a day, processing GFS files for each synoptic time. It begins operation when it receives a new 1-degree GFS file, with a forecast time of f000. It then processes GFS files up to the previous 72 hours, based on the time when operation began. Any files **older than 72 hours** are skipped, and the next available GFS file is processed.

The GFS processing unit takes this 1-degree GFS file and produces a PACK.DAT as an intermediate file for the HISA processing unit, which runs every 2 hours for each satellite and each basin. It combines MiRS IMG and SND files from each satellite, along with the GFS processing unit's PACK.DAT and the ATCF System a-deck. The a-deck contains a complete listing of all available forecasts and projections for the entire storm history.

Typical runs of the HISA processing unit should produce the following files:

- Two NetCDF4 files (RZA and XYA)
- One of each FIX, STA, and AFX files
- Nine PNG image files

2.2. Input Satellite Data

2.2.1. Satellite Instrument Overview

Temperature and moisture soundings are obtained from the MiRS retrievals for the AMSU or ATMS sounders.

The AMSU sounder includes AMSU-A and MHS. AMSU-A is a cross track, passive microwave scanner with a swath width of ~2200 km and an instantaneous field view of 3.3°, giving a 48 km horizontal footprint at nadir for temperature channels. The AMSU-A instrument consists of two separate modules, AMSU-A1 and AMSU-A2. AMSU-A1 contains 13 channels operating at frequencies ranging from 50.3 to 89 GHz. AMSU-A2 contains 2 channels operating 23.8 GHz and

31.4 GHz. AMSU-A is used to derive vertical temperature profiles, total precipitable water and cloud liquid water. Prior to NOAA-18, the AMSU-A instrument was accompanied by AMSU-B, which was used for generating vertical water vapor profiles. Starting with NOAA-18 and MetOp-A, the AMSU-B instrument was replaced with the MHS. Like AMSU-A, the MHS is a cross-tack, passive microwave sounder with a swath width of ~1900 km and an instantaneous field of view of 1.1°, giving a 17 km horizontal footprint at nadir. The five channels of the MHS operate over the frequency range of 89 to 190 GHz and are used to generate vertical moisture profiles.

The ATMS is a cross-track scanner with a swath width of ~2600 km and a field of view (FOV) size of approximately 1.5 km. The ATMS has 22 channels that provide sounding observations needed to retrieve profiles of atmospheric temperature and moisture for weather and climate monitoring purposes. These 22 channels are divided into two groups: a low-frequency (23 to 57 GHz) group, and a high-frequency (88 to 183 GHz) group. The low frequency channels, 1 through 15, are primarily for temperature soundings and the high-frequency channels, 16 through 22, are primarily for humidity soundings (water vapor profiling). The footprint size at nadir is ~32 km for most of the temperature channels, and ~15 km for the moisture channels. ATMS combines all channels of the preceding AMSU-A1, AMSU-A2, and AMSU-B (or MHS) sensors and has improved spatial coverage (i.e., no gaps between swaths) over AMSU.

2.2.2. Satellite Data Preprocessing Overview

Satellite data preprocessing is done by MiRS. Please refer to the MiRS ATBD and SMM for details.

2.2.3. Input Satellite Data Description

The input satellite data are the atmospheric profiles derived from the ATMS measurements processed with the MIRS algorithm. The data include temperature and moisture profiles at 100 pressure levels, the total precipitable water, and the cloud liquid water. The latitude, longitude and time of the retrievals are also used. These data are read in from text files which were created from NetCDF4 files of the retrievals.

Table 2-1 showcases the naming conventions behind each input file used in the HISA algorithm package.

Table 2-1 - HISA Input File Naming Conventions

Description of File	Type of Input or Output	Naming Convention
Global Forecast System (GFS) model product at 1.0 degree resolution	Primary Input for GFS processing unit / Required	gfs.t<CoverageHour>z.pgrb2.1p00.<ForecastTime>.<DataStartDate>

Description of File	Type of Input or Output	Naming Convention
GFS PACK.DAT files	Intermediate Output from GFS processing unit / Primary Input for HISA processing unit. Needs up to 36 hours from the current runtime, and at least one file is required.	G000<YY>_<%><mm><dd>_PACK.DAT
Automated Tropical Cyclone Forecast (ATCF) System a-deck	Primary Input for HISA processing unit. Needs up to 36 hours from current runtime; at least one file is required.	a<basin><id><YYYY>.dat
MiRS IMG	Primary Input for HISA processing unit. Needs up to 18 hours from the current runtime. At least one file is required, and must be paired with a matching MiRS SND file.	NPR-MIRS-IMG_<vXXrY>_SatID>_s<DataStartDate>_e<DataEndDate>_c<CreationDate<.nc

Description of File	Type of Input or Output	Naming Convention
MiRS SND	Primary Input for HISA processing unit. Needs up to 18 hours from the current runtime. At least one file is required, and must be paired with a matching MiRS IMG file.	<SatID>_s<DataStartDate>_e<DataEndDate>_c<CreationDate>.nc

Where:

Convention	Description/Meaning
<CoverageHour>	2-digit hour of coverage (e.g. 00, 06, 12, 18)
<ForecastTime>	3-digit forecast time preceded by an 'f' followed by "000"
<DataStartDate>	The data start date in 4-digit year, 2-digit month, 2-digit day format
<DataEndDate>	The data end date in 4-digit year, 2-digit month, 2-digit day, 2-digit hour, 2-digit minute, 3-digit second format
<CreationDate>	The file creation date in 4-digit year, 2-digit month, 2-digit day, 2-digit hour, 2-digit minute, 3-digit second format
<YY>	Last two digits of input GFS file year
<%>	X or Y, internally determined by the science code
<mm>	2-digit month of the input file
<dd>	2-digit date from the input file, or 2-digit date from the input file plus 50
<basin>	One of the six supported basins (al, cp, ep, io, sh, wp)
<id>	2-digit storm identifier (1-49 is active tropical cyclones, 50-79 internal use)
<YYYY>	4-digit year associated with the storm

Convention	Description/Meaning
<vXrY>	Version and release
<SatID>	The Satellite ID: npp, n20, n21, m01, or m03

2.3. Input Ancillary Data

2.3.1. Dynamic Ancillary Data

The HISA processing unit relies on two pieces of dynamic ancillary data: the PACK.DAT files, and the ATCF a-deck.

The PACK.DAT files are generated by the GFS processing unit once it completes its tasks. Once the PACK.DAT files are ready, they are fed into the HISA Processing Unit, along with all MiRS files for the last 18 hours. (**NOTE:** both IMG and SND files are necessary for the submission.)

Additionally, there are different file requirements depending on the satellite(s) used for the input files:

- **At least 10** IMG and SND files are required for NOAA-20, NOAA21 and SNPP ATMS.
- **At least 1** IMG and SND file is required for Metop-B and Metop-C's Advanced Microwave Sounding Unit, since the AMSU granules are significantly larger than the other satellites' Advanced Technology Microwave Sounder granules.

The last dynamic input the HISA Processing Unit requires is an ATCF A-deck file **from the last 36 hours** for each active storm in the current basin. The necessary file type depends on the basin:

- For the North Atlantic (al) basin, use NHC files
- For all other basins (ep, cp, wp, io, sh), use JTWC files. **Do not use NHC files.**

2.3.2. Static Ancillary Data

All static ancillary data that the HISA processing unit needs can be found within its own ancillary directory subfolder.

3. Performance

3.1. Product Testing

3.1.1. Test Data Description

From September 9, 2023, to the end of the Atlantic hurricane season on November 30, 2023, ASSISTT ran the HISA algorithm using input from four of the five satellites assigned for MiRS retrievals. NOAA-21 was left out of preliminary validation as it was only added to the algorithm after November 30, but subsequent testing revealed that its performance was similar to both S-NPP and NOAA-20. The resulting data on maximum wind, Minimum Sea Level Pressure (MSLP) and wind radii estimates from these runs for all TCs in the Atlantic, eastern North Pacific and western North Pacific basins were compared with the working best track estimates from NHC and JTWC. 1,321 HISA estimates were included in the intensity sample.

3.1.2. Unit Test Plans

For information concerning ASSISTT's testing plans, please contact the ASSISTT team members listed in the Point of Contact table.

3.2. Product Accuracy

3.2.1. Test Results

Table 3-1 demonstrates the results of these accuracy tests, comparing the Mean Absolute Error (MAE) and bias for each measured result.

Table 3-1 - MAE and bias of STAR/ASSISTT NRT HAS runs 9 Sept-30 Nov 2023

	Vmax (kt)	MSLP (hPa)	R34 (nmi)	R50 (nmi)	R64 (nmi)
MAE	**14.4**	**8.0**	**43.7**	**23.7**	**15.6**
Bias	**-11.1**	**4.4**	**-18.5**	**-12.0**	**-10.5**
MAE (Bias Corrected)	**12.0**	**7.8**	**41.0**	**22.8**	**14.3**
Sample Size	**1321**	**1321**	**3454**	**1851**	**1136**

3.2.2. Product Accuracy

HISA TC products are derived from AMSU or ATMS MiRS retrievals. Accordingly, the accuracy of the HISA TC products is highly dependent on the accuracy of the MiRS retrievals. Refer to the MiRS ATBD to check MiRS validation statistics.

Based on global MiRS verification, temperature biases with respect to radiosonde measurements are under 1 K. The standard deviation of the temperature differences is around 3 K at low levels and around 2 K in the free atmosphere. Moisture retrieval bias and standard deviation are measured as a percentage of reference water vapor amounts. Typical biases range from 0.5 to 7% in the lower troposphere and around 20% in the upper troposphere; typical standard deviations are 20 to 65% in the lower troposphere and around 80% in the upper troposphere. The MiRS error statistics in the TC environment are not available.

3.3. Product Quality Output

There are three different quality states represented by their flag value:

- **Good quality_flag = 0** when distance from swath to TC is less than 300km and time coverage ended less than 4 hours past synoptic time
- **Caution quality_flag = 1** when distance from swath to TC is less than 600km and time coverage ended less than 2 hours past synoptic time
- **Bad quality_flag = 2** and represents all other scenarios.

3.4. External Product Tools

No external product tools are required for viewing product output.

3.5. Output Files

HISA final products are available on PDA for user subscription. The data retention time on PDA is the standard 7 days.

3.5.1. Product Monitoring and Visualization

HISA is not monitored by prodmon as is it an event driven process.

The NCCF Products Visualization Page at https://nccf-uat-pvpm-group-01.s3.amazonaws.com/Tools/HISA/index.html.

HISA products are generated every 3 hours for the active storms. Product images from the past 24 hours are kept on the HISA product page.

4. Product Status

4.1. Operations Documentation

Barnes, S., 1964. A technique for maximizing details in numerical map analysis, J. Appl. Meteor., 3(4), 396-409, doi: https://doi.org/10.1175/1520-0450(1964)003%3C0396:ATFMDI%3E2.0.CO;2

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Demuth, J.L., M. DeMaria, J.A. Knaff and T.H. Vonder Haar, 2004. Evaluation of Advanced Microwave Sounder Unit tropical cyclone intensity and size estimation algorithms. J. Appl. Meteor, 43(2), 282-296, doi: https://doi.org/10.1175/1520-0450(2004)043%3C0282:EOAMSU%3E2.0.CO;2

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Kim, E., C.-H. J. Lyu, K. Anderson, R. V. Leslie and W. J. Blackwell, 2004. S-NPP ATMS instrument prelaunch and on-orbit performance evaluation. J. Geophys. Res. Atmos., 119(9), 5653-5670, doi: https://doi.org/10.1002/2013JD020483

Landsea, C.W. and J. L. Franklin, 2013. Atlantic hurricane database uncertainty and presentation of a new database format. Mon. Wea. Review, 141(10), 3576-3591, doi: https://doi.org/10.1175/MWR-D-12-00254.1

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NOAA/NESDIS/STAR (2023), Hurricane Intensity and Structure Algorithm (HISA) Microwave Sounder-based TC Products Algorithm Theoretical Basis Document v.1.0.

NOAA/NESDIS/STAR (2024), HISA Final CCAP v1 Production Rules.

NOAA/NESDIS/STAR (2024), Hurricane Intensity and Structure Algorithm (HISA) Microwave Sounder-based TC Products System Maintenance Manual

4.2. Maintenance History

Information regarding the changes to the products is tracked by the Operational logs and will be available to users on request. Product metadata will be updated as per the changes required in the product including the version number, quality flags etc.

END OF DOCUMENT

5. Acronyms

Acronym	Definition
AMSU	Advanced Microwave Sounding Unit
ASSISTT	Algorithm Scientific Software Integration and System Transition Team
ATBD	Algorithm Theoretical Basis Document
ATCF	Automated Tropical Cyclone Forecast
ATMS	Advanced Technology Microwave Sounder
CCAP	Cloud Containerized Algorithm Package
DOC	Department of Commerce
ERT	Earth Resources Technology, Inc.
ESPC	Environmental Satellite Processing Center
EUM	External Users' Manual
FOV	Field of View
GFS	Global Forecast System
HISA	Hurricane Intensity and Structure Algorithm
MAE	Mean Absolute Error
MHS	Microwave Humidity Sounder
MiRS	Microwave Integrated Retrieval System
MSLP	Minimum Sea Level Pressure
MWS	Microwave Sounder
NCCF	NESDIS Common Cloud Framework
NCEP	National Center for Environmental Prediction
NDE	NPP Data Exploitation
NESDIS	National Environmental Satellite, Data, and Information Service
NetCDF	Network Common Data Form
NOAA	National Oceanic and Atmospheric Administration
NPP	National Polar-orbiting Partnership
OCS	Office of Common Services
OMS	Operations, Maintenance, and Sustainment
OSPO	Office of Satellite and Product Operations
PAL	Product Area Lead
PDA	Product Distribution and Access
QA	Quality Assurance
R2O	Research to Operations
RMSE	Root Mean Square Error
SMM	System Maintenance Manual
S-NPP	Suomi National Polar-orbiting Partnership
TC	Tropical Cyclone
V&V	Verification and Validation