**RELEASE NOTES**

**Model:** asmu\_estimation\_v1.3.0

**Released to NCO on:** 10/19/2021

**Purpose:**  The National Hurricane Center (NHC) AMSU application uses temperature retrievals from satellite microwave sounders (the Advanced Microwave Sounder Unit, AMSU) to estimate the maximum wind and the radii of 34, 50 and 64 kt winds in four quadrants relative to the storm center (NE, SE, SW, NW). A multiple regression is used to estimate the maximum wind and wind radii from retrieval parameters. The wind field is also retrieved from the temperature retrievals by integrating the hydrostatic equation from 100 hPa to the surface starting with an upper boundary condition from the GFS model to recover the geopotential height field. The gradient wind equation is then used to provide the tangential winds as a function of radius from the storm center, and the nonlinear balance equation is used to provide the 2-D horizontal winds. The gradient and nonlinear balance winds are calculated at the mandatory pressure levels. The gradient winds are also interpolated to constant height levels. The algorithm runs globally for all active tropical cyclones using position information from NHC, the Central Pacific Hurricane Center (CPHC), and the Joint Typhoon Warning Center (JTWC). AMSU data from 5 polar-orbiting satellites are used for the application, including NOAA-15, -16 -18, -19 and Metop -A. The AMSU instrument on NOAA-16 is no longer functioning, so no products are available from that satellite. This release includes updates necessary for the WCOSS Phase 3 to WCOSS2 transition.

**Primary developers:** Matt Sardi (NHC/TSB), Mark DeMaria, Julie Demuth, Jack Dostalek (CIRA/CSU), Alison Krautkramer

**Runs on:** The National Weather Service (NWS) Weather and Climate Operational Supercomputing System (WCOSS).

**Community Software:** The primary subroutine for the calculations is oparet.f . This was developed in conjunction with the NESDIS Regional and Mesoscale Meteorology Branch and the Cooperative Institute for Research in the Atmosphere. The retrieval and limb corrections were developed by NESDIS/STAR.

**Transition from:** WCOSS Phase 3 to WCOSS2

**Release tag:** git@git.nhc.noaa.gov:amsu\_estimation.git, tag/v1.3.0

**External software used:**

*Compilers*:

* ftn

*Modules:*

* *To build code:*
	+ PrgEnv-intel/8.1.0
	+ w3nco/2.4.1
	+ g2/3.4.1
	+ bacio/2.4.1
	+ jasper/2.0.25
	+ libpng/1.6.37
	+ zlib/1.2.11
	+ bufr/11.5.0
* *To run JAMSU\_ESTIMATION:*
	+ model/1.3.0
	+ intel/19.1.3.304
	+ bufr\_dump/2.0.0
	+ libjpeg/9c
	+ grib\_util/1.2.2
	+ perl/5.32.0

*Other WCOSS model dependencies:*

* gfs/v16.2

**Package modifications:**

All modifications outlined below were made to accommodate the new architecture on WCOSS2.

* doc/
	+ Removed all previous documentation
	+ Added amsu\_estimation\_v1.3.0\_release-notes.docx
	+ Added amsu\_estimation\_v1.3.0\_implementation-instructions.docx
	+ Added amsu\_estimation\_v1.3.0\_test-plan.docx
	+ Added amsu\_estimation\_v1.3.0\_production-overview.pdf
* ecf/
	+ jamsu\_estimation\_00.ecf
		- Replaced #BSUB entries with corresponding #PBS
		- Added ${PACKAGEROOT} path to version file
	+ jamsu\_estimation\_06.ecf
		- Replaced #BSUB entries with corresponding #PBS
		- Added ${PACKAGEROOT} path to version file
	+ jamsu\_estimation\_12.ecf
		- Replaced #BSUB entries with corresponding #PBS
		- Added ${PACKAGEROOT} path to version file
	+ jamsu\_estimation\_18.ecf
		- Replaced #BSUB entries with corresponding #PBS
		- Added ${PACKAGEROOT} path to version file
* fix/
	+ No modifications
* jobs/
	+ JAMSU\_ESTIMATION
		- Removed $jlogfile references
		- Changed $NWROOT to $PACKAGEROOT
		- Modified modules loaded for WCOSS2
		- Set COM using compath.py for COMIN and COMOUT
		- Updated COMNHC and COMJTWC for WCOSS2
		- Removed .ecf from ex-script execution
* lib/
	+ sorc/gfstopack/Makefile
		- Change compiler to ftn
	+ sorc/gfstopack/makegfspack.sh
		- Changed compiler to ftn
* parm/
	+ No modifications
* scripts/
	+ Removed “.ecf” from the end of script in this directory
* sorc/
	+ build\_all.sh
		- Added source of build.ver & loading corresponding modules needed for building AMSU estimation code
	+ amsu\_bin2pack.fd/makefile
		- Changed compiler to ftn
	+ amsu\_bintrans.fd/makefile
		- Changed compiler to ftn
	+ amsu\_compgfs.fd/makefile
		- Changed compiler to ftn
	+ amsu\_oparet.fd/Makefile
		- Changed compiler to ftn
	+ amsu\_pickgfs.fd/Makefile
		- Changed compiler to ftn
	+ amsu\_pullvar.fd/makefile
		- Changed compiler to ftn
	+ amsu\_readbufr.fd/Makefile
		- Change compiler to ftn
	+ amsu\_readcarq1.fd/Makefile
		- Changed compiler to ftn
	+ amsu\_readcoordinate.fd/Makefile
		- Changed compiler to ftn
	+ amsu\_tempretrieve.fd/Makefile
		- Changed compiler to ftn
* ush/
	+ amsu\_estimates.pl
		- Modified LIST to BUFR\_LIST to work with WCOSS2 bufr\_dump module
	+ amsu\_stormdata.pl
		- Removed ‘unless defined @raStorms’ due to errors being thrown
	+ TEST-amsu\_convertgfs.pl
* versions/
	+ Added build.ver
		- Includes module versions used for compiling code
	+ Added run.ver
		- Includes module and model package versions used for running code

**Input:**

No modifications were made to input data listed below, other than paths to their location. Note that NHC is still in the process of transitioning from SSH keys to LDM. The delivered package is based on the existing SSH key delivery method - it is presently unknown if additional changes will be required once dataflow is reconfigured.

*NHC Provided Inputs:*

* A-decks for storm positions of all active TCs from NHC, CPHC and JTWC. The storms are classified by TC basin, including the Atlantic and eastern North Pacific to 140oW (AL, EP), the central North Pacific from 140oW to the dateline (CP), the western North Pacific (WP), the Northern Indian Ocean (IO) and the southern hemisphere (SH). NHC provides forecasts for the AL and EP storms, CPHC for the CP storms, and JTWC for the WP, IO and SH storms. The A-decks have the form bbnnyyyy.dat where bb is the basin (AL, EP, etc), nn is the storm number and yyyy is the year. These are obtained from

 ../nhc/noscrub/data/atcf-noaa/aid (AL, EP, CP files)

 ../nhc/noscrub/data/atcf-navy/aid (WP, IO, SH files)

*WCOSS Inputs:*

* The GFS files for the upper boundary condition in grib2 format are obtained from:
 ../prod/com/gfs/${gfs\_ver}/gfs.YYYYMMDD/TT/atmos/
* The AMSU brightness temperatures are obtained from the BUFR tanks located in:
 ../prod/dcom/YYYYMMDD/

**Output:**

No modifications were made to output with this release. The primary output data is listed below and can be found in ../prod/com/nhc/amsu/v1.3/amsu/amsu.yyyymmdd/.

* GFS files used by the algorithm in a packed-ASCII format

There are subdirectories for each active TC named after the ATCF storm ID. Within the subdirectories there are output files for each available satellite. For each satellite case there are several output variables with different file name extensions, as follows:

.AFX - Max wind and wind radii in ATCF ASCII format

. FIX - ASCII file containing basic retrieval information

.LOC - ASCII file containing lon/lat of AMSU pixel locations used in the retrieval

.ret - ASCII file containing the brightness temperatures and retrieved temperatures.

.RZA - File containing the gradient winds as a function of radius and height

.STA - File containing the statistical predictors for the intensity and wind radii multiple regression

**Resources:**

PBS entries in ecFlow submission scripts were created with this release with the following resource information:

*jamsu\_estimation\_00.ecf:* select=1:ncpus=2:mem=5GB, serial job
*jamsu\_estimation\_06.ecf:* select=1:ncpus=2:mem=5GB, serial job
*jamsu\_estimation\_12.ecf:* select=1:ncpus=2:mem=5GB, serial job
*jamsu\_estimation\_18.ecf:* select=1:ncpus=2:mem=5GB, serial job

**Runtime:**

No changes with this release.

Each job takes less than 1 minute (per storm) of CPU time to complete.

**Disk space:**

No changes with this release.

AMSU estimation jobs use less than 50 MB per storm and 70 MB per model cycle for the packed-ASCII GFS files.

**Dissemination:**

No changes with this release.

The output files are also sent to the NCEP ftp server at: [ftp://ftp.ncep.noaa.gov/pub/data/nccf/com/nhc/prod/amsu](http://ftp.ncep.noaa.gov/pub/data/nccf/com/nhc/prod/amsu)

and NOMADS at:

<https://nomads.ncep.noaa.gov/pub/data/nccf/com/nhc/prod/amsu>

**HPSS storage:**

No changes with this release. There is no HPSS archive of this model.

**Canned data testing information:**

Input data used (from NHC): /lfs/h1/nhc/nhc/noscrub/data/atcf-noaa
 /lfs/h1/nhc/nhc/noscrub/data/atcf-navy

ECF scripts used in testing: /lfs/h1/nhc/nhc/noscrub/save/amsu/amsu\_estimation.v1.3.0/ecf/TEST-jamsu\_estimation.ecf

Log file output from ECF testing: /lfs/h1/nhc/nhc/noscrub/save/amsu/test/

Output files from canned data test:
 /lfs/h1/nhc/nhc/noscrub/save/amsu/test/amsu/amsu.20210824.O3\_opt