***High Resolution GOES MESO Sector Winds***

***ASF Modifications and Processing Overview***

This document provides information about both the modifications required to expand the Algorithm Services Framework (ASF) and the processing logistics employed to run the Enhanced (high spatiotemporal resolution) Atmospheric Motion Vector (AMV) datasets from GOES-16/18/19 MESO sector scans during Tropical Cyclone (TC) events for HAFS model assimilation.

This enhanced product provides wind vector observations from MESO sector imaging with much higher spatial and temporal resolution in the TC inner-core area than is available from current operational AMV products. As such, the up-front data handling and processing steps are different from previous implementations of GOES AMV winds processing. This document is being provided as a brief accounting of the ASF algorithms modified to handle this enhanced processing along with a high-level overview of the primary steps to generate these new high resolution MESO sector winds during TC and Invest events.

**Product Specifications/Needs**

## **Environmental Parameter**

Enhanced, storm-focused wind vector data derived with high spatiotemporal coverage during Tropical Cyclone (TC) and Invest events targeted by the GOES-16/18/19 MESO sector imaging (cloud-track channels only: Ch02, Ch07, Ch08, Ch14).

## **Geographical Coverage (e.g. orbital, global, regional, etc.)**

Regional (focusing on hurricane regions): Atlantic, East Pacific, and Central Pacific Ocean Basins

**Refresh Cadence (i.e., sampling interval)**

15 minutes

**Timestep (i.e., time between triplet images)**

1-minute

## **Frequency (i.e., Daily, Weekly, Orbital, Granularity, etc.)**

Continuous

**ASF Algorithm Modifications**

The modifications required to expand the ASF to enable processing of these new enhanced (high resolution) AMV datasets are fairly straightforward. There are four winds-specific algorithm modules and two winds-specific configuration modules that were updated (see below). All of the modified ASF modules and new HiRes MESO processing scripts are contained in tarballs posted to the following directory/files:

Modified ASF Modules:

/data/smcd8/abailey/TC\_HiRes\_MESO\_R2O\_Handoff/TC\_HiRes\_MESO\_ASF\_Mods.tar

Contains:

ABI-WINDS\_AMV\_EN.xml

Config-WINDS\_UNIT.xml

AMV\_EN\_target\_selection\_m.f90\*

AMV\_EN\_target\_selection\_utils\_m.f90\*

AMV\_EN\_winds\_inc.f90\*

AMV\_EN\_XPATH\_m.f90\*

NOTE: These modifications were made to the STAR GitLab ASF commit:

*commit a20e04e2909a6cb643aa1f7fc26053008cdd6f6f (HEAD -> 20230815\_zli\_GCC11\_update, origin/20230815\_zli\_GCC11\_update)*

*Author: Zhengpeng Li <zhengpeng.li@noaa.gov>*

*Date: Mon Apr 22 12:35:15 2024 +0000*

HiRes MESO Processing Scripts

/data/smcd8/abailey/TC\_HiRes\_MESO\_R2O\_Handoff/TC\_HiRes\_MESO\_Process\_Scripts.tar

Contains:

run\_Convert\_LatLon.bash\*

run\_Env\_Setup\_Hires\_Process.bash\*

run\_GOES\_CLOUDS\_HIRES.bash\*

run\_GOES\_WINDS\_HIRES.bash\*

run\_HIRES\_MESO.bash\*

run\_Make\_Basin\_Storm\_Files.bash\*

Rather than listing out the individual code changes made within each ASF module here, it is recommended that a simple search of the modified code for the term ‘HIRES’ (all caps) be employed to identify the specific code changes made for this new winds processing.

**Winds Processing Overview**

In addition to the standard inputs required for AMV processing (i.e., L1B data, GFS model data, etc.), the TC HiRes winds processing requires access to current Automated Tropical Cyclone Forecast (ATCF) best-track files (aka “b-deck”) files. The b-deck files contain official synoptic hour positions of TCs in comma delimited format and indicate the best position known at synoptic time. The AMV processing scripts make use of these synoptic hour positions to determine if any of the current GOES MESO sectors from GOES-16 and 18 (M1 and M2) are geolocated with any current storms being tracked by NHC. If they are, AMVs are produced for that particular sector.

**HiRes AMV Processing Scripts in this handoff**

run\_HIRES\_MESO.bash:

Primary driver script to handle all logistics of processing the TC HiRes MESO winds. This script runs via cron every 15 minutes (*hh*:00, *hh*:15, *hh*:30, *hh*:45) for each satellite/meso sector and compares the Lat/Lon values of the MESO sector to any potential TC/Invests being tracked by the NHC. If they are geolocated, the winds are processed for that cycle.

run\_Make\_Basin\_Storm\_Files.bash:

Called from *run\_HIRES\_MESO.bash* to handle the creation of the ATCF b-deck file lists for each basin covered by the GOES MESO sectors. Updated b-deck file lists are created for each basin (satellite dependent – East/West) every time the main driver script is run. These basin files are staged to working directories (based on the satellite/sector being processed) and accessed from the driver script to compare latitude/longitude values between any active TCs/Invests to the current MESO sector.

run\_Convert\_LatLon.bash:

Simple script to convert cardinal latitude/longitude values (used in b-deck files) to numerical values.

run\_Env\_Setup\_Hires\_Process.bash:

Called from *run\_HIRES\_MESO.bash* to setup the processing environment for each new TC/Invest identified when running the TC HiRes MESO winds. Separate directories (by basin/sat/sector) are created for each new Storm or Invest that is geolocated with a GOES MESO sector. All winds are then written to that directory for the life cycle of the storm/invest.

run\_GOES\_CLOUDS\_HIRES.bash

Script to set the environment and run the ASF Cloud algorithms for HiRes MESO winds

run\_GOES\_WINDS\_HIRES.bash

Script to set the environment and run the ASF Wind algorithms for HiRes MESO winds

**Running the HiRes AMV Processing**

Certain aspects of running the HiRes MESO sector winds described in this section are, obviously, specific to the STAR research environment. It is assumed and expected that this implementation will require adjustments to the scripting, particularly with regards to the up-front handling and staging of data acquired via SCDR (L1B, ATCF b-deck files, etc.). As such, what is presented here is expected to serve primarily as a guide to the initial processing environment setup, as well as a description of the major steps executed by the provided processing scripts.

Initial processing environment setup:

The scripts in this handoff expect an initial directory tree to be setup for each satellite and MESO sector. The following directories and sub-directories should be setup within the main processing directory as shown below. Additional storm specific sub-directories are created within the basin subdirectories during the actual running of the processing scripts.

GOES-16\_TC\_HIRES/

MESO1/

AL\_Basin/

b-deck\_file\_working\_dir/

cron\_logs/

EP\_Basin/

MESO2/

AL\_Basin/

b-deck\_file\_working\_dir/

cron\_logs/

EP\_Basin/

GOES-18\_TC\_HIRES/

MESO1/

CP\_Basin/

b-deck\_file\_working\_dir/

cron\_logs/

EP\_Basin/

MESO2/

CP\_Basin/

b-deck\_file\_working\_dir/

cron\_logs/

EP\_Basin/

Winds Processing Steps:

The primary driver script (*run\_HIRES\_MESO.bash*) is scheduled via cron to run separately for each satellite (GOES-16 and 18) and each MESO sector (MESO1 and MESO2) every fifteen minutes (at *hh*:00, *hh*:15, *hh*:30, *hh*:45). With each submission it starts by querying the Star Central Data Repository (SCDR) for all the L1B data required to generate a HiRes winds dataset and verifying there is enough L1B data available to form the necessary image triplet and run the cloud algorithms for the target image. A check of the central Lat/Lon of each image in the triplet is also performed to ensure they are consistent for each image and the MESO sector was not repositioned across the triplet.

If it is determined there is sufficient L1B imagery present, the script *run\_Make\_Basin\_Storm\_Files.bash* is executed to create ATCF b-deck file lists for each basin covered by the satellite currently being processed (GOES-East: Atlantic and East Pacific basins; GOES-West: East Pacific and Central Pacific basins). B-deck files are updated on the server primarily at synoptic times with current storm positions of any active Tropical Cyclones or Invests being tracked. As such, the script pulls the most recent seven hours of files for each basin and stages them to a working directory to be used in the next step by the driver script.

The main driver script then cycles through the list of b-deck files from each basin and compares the lat/lon values of any active storms or invests in that list to the central lat/lon value of the MESO sector being processed. If it is determined that a particular storm is geolocated with the MESO sector (i.e., within 5 degrees latitude and longitude of the sector center point), winds will be processed for the satellite/sector and staged to storm-specific output directories created as part of the winds processing. The winds data output is produced in NetCDF, ASCII and BUFR format. Any additional wind data sets processed for that particular storm or invest will be written to the same output location for the life cycle of the storm.

Obviously, there are aspects and sections of the processing scripts provided in this hand-off that are specific to the STAR research environment. Any questions about this processing and adopting it to a different environment should be directed to [Andrew.Bailey@noaa.gov](mailto:Andrew.Bailey@noaa.gov) or [Jaime.Daniels@noaa.gov](mailto:Jaime.Daniels@noaa.gov).