# NOAA ROSES Semi-Annual Report

**Reporting Period: September 2021 – February 2022 (3rd report)**

**PI:** Christopher Velden (UWisc-CIMSS)
**Co-PI(s):** D. Stettner and S. Wanzong (UWisc-CIMSS), R. Rabin (NSSL), J. Daniels (STAR)

**Project Title:** Improved Monitoring of the Rapidly-Evolving Wind Fields over the Core of Hurricanes from High Spatiotemporal Resolution Geostationary Satellite Observations.

## Executive Summary

The overarching goals are to build upon recent advances in extracting enhanced tropospheric wind information from meso-scan sectors provided by new-generation GEO satellites in hurricane environments and complete the research needed to bring this advanced capability to NOAA's operational hurricane applications.

## Progress toward FY21 Milestones and Relevant Findings

***Milestone 1***: During the last Atlantic hurricane season, we successfully completed the planned real-time demonstration of the end-to-end processing of the GOES-16 meso-scan AMV product tailored to hurricanes. The processed files were made available to NWP colleagues with 15 minute frequency and latency for real-time hurricane model ingest and assimilation for the full hurricane season in 2021. The maturity and quality of the data/product, as well as the real-time operability and reliability of the processing strategies were all successfully demonstrated.

We are now working with the STAR GOES-R Algorithm Working Group AMV Lead Jaime Daniels to set up the transfer of this product and processing strategy over to STAR for further operational assessment. The end goal is to get these strategies operational at OSPO. To help move this along, a NESDIS User Product Request (below) has been submitted on behalf of NWS/NCEP to OSPO that will hopefully be approved by the SPSRB as a first step in prioritizing the R2O of this product.


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**Request Title**
Enhanced Atmospheric Motion Vector (AMV) datasets from GOES-16/17 meso scans during tropical cyclone events for HAFS model assimilation

**Requestor Name \***
Zhan Zhang

**Requestor Agency/Office \***
NWS OBS

**Requestor Phone Number \***
301-683-3674

**Requestor Email \***
zhan.zhang@noaa.gov


**General Description of Change Needed \***

The NWS is seeking to use a new satellite-derived (GOES) product that is in the demonstrational phase. The product is enhanced, storm-focused AMV data derived with high spatiotemporal coverage during tropical cyclone (TC) events targeted by the NOAA/NESDIS GOES-16/17 meso-sector imaging. The product provides wind vector observations with much higher temporal and spatial resolution in the TC inner-core area than is available in current operational AMV products. These datasets will be assimilated in an experimental/demonstrational mode into the NOAA's next generation operational hurricane analysis and forecast system (HAFS).

**What is driving the needs \***

Previous studies by UW-CIMSS collaborators using the HWRF model have demonstrated considerable TC forecast improvement associated with using this product. Initial experiments conducted at EMC have also demonstrated that the high resolution GOES-16/17 AMVs significantly improved NOAA's hurricane prediction system. Assimilating high resolution AMVs helps hurricane models to analyze small-scale storm-top flow structures and also appears to improve the near-storm environment to improve forecasts. The need for this request arises from the fact that this AMV product is 1-2 years away from NESDIS operational transition, and in the meantime will only be available from the UW-CIMSS/STAR AWG development team.

**Is there any data or product you are currently getting from NESDIS? If yes, please tell us what those products are? \***

The NWS receives routine operational GOES-16/17 AMVs on an hourly basis from NESDIS OSPO, but this does not currently include the meso-sector scan high resolution AMVs processed by CIMSS that are tailored for hurricane events.

**Product Specifications/Needs**

**Environmental Parameter \***
Wind vector observations

**Latency (e.g. how soon after observation is product needed?) \***
< 2hour 45min

**Refresh (e.g. sampling interval) \***
15 minutes

**Frequency (e.g. Daily, Weekly, Orbital, Granularity, etc.) \***
Continuous

**Product Resolution \***

2 km

**Product Accuracy ***
~5 m/s

**User Priority ***
2 - Essential

**User Impact and Benefit ***

The NWS anticipates improvement to the hurricane intensity forecast guidance from NOAA's operational hurricane prediction systems.

**How will these products be used? ***

1. The high resolution GOES-R AMV data will be used in NOAA's next generational HAFS data assimilation system to improve hurricane intensity forecast guidance for North Atlantic and Northeastern Pacific Basins.

2. The data will be also used to diagnose hurricane model performance to further improve model physics schemes.

3. The wind vectors can be used qualitatively by TC forecasters to help visualize the wind field around TCs (available through AWIPS).

**Please tell us your readiness plan for using those products ***

The data has been successfully processed, assimilated and tested in real time hurricane prediction experiments conducted during the 2021 Atlantic hurricane season. NWS will coordinate with the product development and assimilation teams to tailor a plug-in to assimilate the observations in real time into NOAA's TC model forecast systems.

**Does this product need to be archived? If yes, please tell us how the archived data will be used.**

Yes, the datasets will be archived by both UW-CIMSS and EMC and may be used to conduct retrospective experiments.

**Please feel free to provide us additional information that is not covered in the previous questions, but will help us to do the request assessment?**

A very promising GOES-derived product has been developed, demonstrated and has reached a mature stage for operational consideration. However, the R2O process is expected to take 1-2 years to complete, at best. This request is to formalize an agreement between the UW-CIMSS/STAR product development team and NWS/EMC hurricane model development teams to bridge the research-to-operations gap by continuing the product real-time processing and dissemination and assimilation into HAFS. However, this is suboptimal since the development team does not have the resources for 24/7 real-time processing. While the product development team will provide 'best effort' dataset processing, NWS OBS hopes this request will help prioritize this product in the NESDIS R2O process.
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In addition to setting the table for operational transition of the enhanced AMV product and assimilation into the NCEP-EMC hurricane models, we have received significant interest from the hurricane research community about the availability of these enhanced AMV datasets. It is apparent through networking with colleagues that these datasets will also contribute significantly to ongoing and planned tropical cyclone research studies. For example, the enhanced meso-scan AMV datasets are being provided to AOML-HRD for inclusion in detailed hurricane analyses that complement the Hurricane Hunter aircraft observations and tail Doppler radar data. These analyses are being made available to the hurricane research community. Several such research projects and collaborations will be presented at the upcoming AMS Hurricane Conference in May.

***Milestone 2***: As noted above in Milestone 1, we have engaged NWP collaborators at AOML-HRD and NCEP-EMC on the promising aspects of the enhanced meso-scan AMV data tailored to hurricanes. The real-time datasets during the 2021 Atlantic hurricane season have been disseminated to NCEP-EMC for inclusion in their experimental Hurricane Analysis and Forecast System (HAFS). EMC used this initial real-time trial to start defining the optimal data dissemination and DA paths for this product. DA options are being explored in the operational HWRF model and the experimental HAFS system.

## Plans for Next Reporting Period

We plan to host another real-time demonstration of the GOES-16 hurricane-enhanced AMV product during the upcoming Atlantic hurricane season. This year we plan to extend the demo to the Eastern North Pacific and include GOES-17 datasets when available. This will entail extra processing strategies to work around the heat pipe periods. We will also adapt the processing to GOES-18 data on an experimental basis. If time and resources permit, we will explore the processing of Himawari-8 meso-scan AMV datasets during western North Pacific tropical cyclones.

Datasets will be disseminated to interested users in the community (both operational and research) in association with GOES-R Proving Ground activities. Applications to hurricane analysis will continue through collaborations, and eventually published in scientific journal articles. We will be exploring the possibility of displaying these datasets in AWIPS for interrogation at NWS sites (Collaborators at CIRA, Mark DeMaria and Galina Chirokova, will help facilitate this application).

The hurricane meso-scan AMV product evaluation will continue to be synthesized in coordination with the HAFS team via assimilation and impact analyses conducted by NCEP/EMC.

We will continue to work with our STAR colleagues to transfer the hurricane-tailored processing strategies and code mods to their working environment as an intermediate step in the R2O process. Co-PI Rabin will adapt the Optical Flow tracking element to STAR Enterprise framework-friendly code as part of future integration of the processing code package for R2O.