Development of Advanced Data Assimilation Techniques for Satellite-Derived Atmospheric Motion Vectors from GOES-16 and 17 in the Hurricane Weather Forecasting Model

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In collaboration with

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HFIP Annual Meeting, 15-18 November 2021
System Configurations

- Operational version of 2020 HWRF.
- Inclusion of Shortwave and Visible AMVs from GOES-16/17.
- New quality control procedures for all GOES-16/17 AMV types.
- Updated observational errors for GOES-16/17 AMVs.
2021 Major Milestones and deliverables

• Developed HWRF specific quality control procedures for hourly and 15min GOES-17 AMVs.
• Impact assessment of hourly and 15min GOES-16 AMVs for 2019-2020 hurricane season.
• Impact assessment of GOES-17 winds for 2020 hurricane season.
• Presentations at AMS and International Winds Workshop.
Key Results 1 – Hourly and high temporal GOES-16 AMVs

Combined verification statistics for 19 tropical cyclones from 2019 and 2020 hurricane seasons. Error bars represent a 95% confidence interval. The secondary x-axis shows the number of samples used in deriving these statistics.

(a) Track error in nautical miles.  
(b) Intensity error in knots.  
(c) Minimum center pressure error in hPa.

Improvements in track, for all forecast hours.  
Improvement in intensity up to 72 hours.  
Improvement in minimum center pressure up to 48 hours.

CTRL - operational version of 2020 HWRF with hourly GOES-16 IR, CTWV and CAWV AMVs.

AMV1 – CTRL + all GOES-16 hourly and 15 min wind types, new QCs and error profiles.
Key Results 2 – Hourly and high temporal GOES-17 AMVs

Combined verification statistics for 4 tropical cyclones from 2020 hurricane seasons. Error bars represent a 95% confidence interval. The secondary x-axis shows the number of samples used in deriving these statistics.

(a) Track error in nautical miles.
(b) Intensity error in knots.
(c) Minimum center pressure error in hPa.

Improvements in track, for all forecast hours.
Improvement in minimum center pressure 48 hours and beyond.

Degradation in intensity for the first 24 hours.

CTRL - operational version of 2020 HWRF with hourly GOES-17 IR, CTWV and CAWV AMVs.
AMV1 – CTRL + all GOES-17 hourly and 15 min wind types, new QCs and error profiles.
Updated GOES-17 AMVs

- NESDIS produced an updated GOES-17 AMVs for 5 EP storms. These are the 5 longest storm for the EP.
- Improvements to AMV algorithm
  - Improved height assignment from the use of products from enterprise cloud algorithm.
  - new AMV quality information that is specific to GOES-17 ABI Loop Heat Pipe mitigations. This does not affect the 5 storms as they do not fall in the LHP period.
- BUFR files prepared by NCEP OBSPROC for ingest into HWRF had the following issues.
  - BUFR read error for some of the files.
  - Missing AMVs
- Working with NESDIS and OBSPROC to track down the problem.
**Project Information and Highlights**

**Leads:** Agnes Lim, CIMSS

**Scope:**
Evaluation of GOES-16/17 AMVs for use in the HWRF to support a quick transition of GOES-16/17 AMVs to operations.

**Expected Benefits:**
- Technology readiness level 7.
- Improvements to hurricane forecasts.
- Presentations at AMS and International Winds Working Group.
- 1 publication expected.

**Implementation Date:**
- Code for quality control procedures for hourly AMVs and updated error profile handled off to EMC for incorporation to next year operational HWRF upgrade.
- Code for high temporal GOES-16 AMVs completed.

**Challenges/Problems:**
Delay in milestones for a year due to RDHPCS access.
Only 6 TCs tested for high temporal GOES-16 AMVs for 2019 hurricane season due to data reprocessing limitations.
Delay in operational production of GOES-17 AMVs limits its testing to only 2020 hurricane season.
Delay in getting updated GOES-17 ANVs data for experiments.

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**Deliverables**

<table>
<thead>
<tr>
<th>Milestones</th>
<th>Completion Quarter</th>
<th>Status</th>
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<tbody>
<tr>
<td>Complete the development of HWRF specific quality control procedures for hourly GOES-16 AMVs</td>
<td>2019 Q3</td>
<td>Completed</td>
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<tr>
<td>Complete forecast impact statistics for storms in 2018 and 2019 hurricane season for GOES-16 AMVs</td>
<td>2019 Q4</td>
<td>Completed</td>
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<tr>
<td>Presentation at 2020 AMS Annual Meeting</td>
<td>2019 Q2</td>
<td>Completed</td>
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<tr>
<td>Presentation to NCEP/EMC at NCWCP or HFIP</td>
<td>2019 Q3</td>
<td>Completed</td>
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<tr>
<td>Complete the development of HWRF specific quality control procedures for GOES-16 high temporal AMVs.</td>
<td>2020 Q2</td>
<td>Completed</td>
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<tr>
<td>Complete the development of HWRF specific quality control procedures for GOES-17 high temporal AMVs.</td>
<td>In Progress</td>
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<td>Complete forecast impact statistics for storms in 2019 and 2020 hurricane seasons for GOES-16 high temporal AMVs.</td>
<td>2020 Q2</td>
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<td>Presentation to International Winds Working Group</td>
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<tr>
<td>Presentation at 2022 AMS Annual Meeting</td>
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