Introduction
The GOES-R Algorithm Working Group and Risk Reduction activities are supporting the development, validation and model impact testing of high-resolution (space and time) AMVs derived from rapid-scans for applications in high-impact weather events such as hurricanes and severe weather. This includes the testing of new AMV production algorithms expected to be operational in the GOES-R era, and numerical model data assimilation experiments designed to exploit the full information content of the high-resolution data in mesoscale analyses. Processing algorithms are reconfigured in order to optimize AMVs for these scales, that is, the ‘full disk’ AMVs coming out of the GOES-R ground system on day 1 will not be sufficient for this application. Examples from Hurricane Sandy (2012) and a severe weather event in 2014 are presented.

AMV Processing Methodologies
1) Heritage algorithm – NESDIS operational, adapted to mesoscale processing (“benchmark”)
2) Developmental algorithm – GOES-R (“experimental”)
3) Major innovations briefly described below

• Novel nested tracking and clustering approach to determine most coherent cloud displacements

• New vector height assignment approach uses single pixel heights provided by GOES-R AWG Cloud Team algorithm. It also uses only the pixels matched to the largest tracking cluster.

Validation of new methods
A large sample (12-month period) of AMVs are processed with and without the above new approach. As an example of the impact, all AMVs assigned to NMRF is from each processing method are compared against their respective collocated (time and space) coincident pixels. The resulting error profiles are shown to the right for the AMVs without (gray) and with (red) the new innovations.

The new AMV methods show better agreement with minimum error values suggesting a closer link between tracking and height assignment.

Hurricane Sandy
Hurricane Sandy (2012) was identified as our initial tropical cyclone test case. Not only was Sandy an event of historic proportions, but GOES-14 was in SRSD mode with continuous 1-min. sampling for 5 days before/during landfall. This high rate of image refresh allows us to test AMV derivation in a simulated way to what GOES-R will provide.

Exploit higher temporal sampling to generate higher-density AMV coverage

Impact of AMVs assimilated into a hurricane forecast model
Both “Benchmark” and “Experimental” AMV datasets were produced and assimilated into the NCEP operational HWRF/FSIS for the Hurricane Sandy case. The system configuration explored in what is used operationally at NCEP, and all experiments were coordinated with our NCEP/NCEP project partner Vijay Tallapragada. The only deviation from operational practice was to disable the GSI functions that thin and QC the AMV data. The period of evaluation covers the time GOES-14 was in SRSD mode during Sandy roughly 4-5 days before landfall. The assimilation cycle was every 6 hours. A control run (CTL) used only radiosonde data and GFS analysis in background fields.

Results of forecast impact experiments for Hurricane Sandy (2012), where MAE is the Mean Absolute Error. CTL is our control run with only radiosonde assimilation. H214 is the operational HWRF run with full-complement of data and including mesoscale/analysis derived products and model data. He AMVs in core region. AMV1 is the CTL minus GOES-R AMVs assimilated using the heritage algorithm AMV2 is the “Experimental” GOES-R AMVs processed using the new GOES-R algorithm. The number of verifying forecasts for each forecast hour is listed across the top of the graph.

The runs assimilating the AMVs are encouraging:
Both the “Benchmark” and “Experimental” AMV forecast errors are lower than the CTL for both track and intensity at almost all forecast times except 72hrs and are comparable to the full data assimilation operational run (H214). These results are particularly impressive given the already relatively low HWRF forecast errors from the CTL and H214 for Sandy.

Future Work
Continue to adapt and tune the new GOES-R AMV processing algorithm for higher-resolution datasets
Examine additional hurricane cases toward assessing optimal AMV data assimilation and model impacts
Apply the new GOES-R AMV algorithm to severe storm events

Severe Storm Event
The GOES-14 1-min. super-rapid-scan-operations sampling also provides a testbed for tuning mesoscale AMV datasets with applications to severe storms. For selected cases during the activation period in May of 2014, UW-CIMSS processed AMV fields using the heritage algorithm and with processing settings tuned to achieve high-density vector coverage. Examples are shown in the figures below. No attempt has been made yet to reprocess AMVs with the GOES-R algorithm for a severe weather case.

We plan to produce AMVs for this case with the new processing methodology, and run data assimilation and forecast impact experiments using the High-Resolution Rapid Refresh (HRRR) model with our project partners at ESRL.

Contacts: Chrisv@ssec.wisc.edu jaime.daniels@noaa.gov

Research sponsor: NOAA/GOES-R Risk Reduction Program