GOESR3 Periodic Reporting

Reporting Period: July 2014 - December 2014 (first half of FY14 funding cycle)

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Project Title: Applications of concurrent super rapid sampling from GOES-14 SRSOR, radar and lightning data

Project Number: 222

FY14 Milestones

Combined analysis of 1-minute GOES-14, radar (NSSL MPAR and/or TDWR) and lightning (LMA) for available cases from 2012-2013 made available on interactive web-based tool; transfer of GOES-14 SRSOR data from SSEC to CLASS, as needed.

Accomplishments

- Cases with significant storms were selected where simultaneous observations from GOES-14, TDWR radar, and LMA networks were available during May 2014. No data were available from the NSSL phased array radar due to hardware problems and lack of storms in Oklahoma. Hence, the only radar data available with 1-minute sampling are from the TDWR systems. These radars obtain 1-minute scanning frequency at lowest elevation. Full volume scan data are available from the WSR-88D radars with approximately 5-minute frequency.

- The WSR-88D, TDWR, GOES-14, LMA and supplemental data were obtained for a variety of cases in Colorado, the Midwest and mid-Atlantic areas. The initial focus has been on starting an analysis of storms in northeast Colorado on 20-21 May 2014. There was a delay in obtaining the LMA data for both cases. Courtesy of Kris Bedka at
NASA Langley, overshooting top locations were generated from the GOES-14 1-minute observations. Atmospheric motion vectors (AMVs) were generated by the winds group (led by Chris Velden) at CIMSS. Initially, these were generated once an hour using images 3-minutes apart. The wind vectors appeared to be less reliable using intervals less than 3-minutes.

- Preparation has started to gather and ingest the data from the 20 May 2013 Moore tornado case (not SRSOR) and the 20-21 May 2014 cases into the Local Analysis and Prediction System (LAPS) at CIRA/ESRL. This involved retrieving routinely archived observational data from NOAA’s High Performance Computing Mass Storage. In addition, Level-II data were obtained from the National Climatic Center. The AMV data was reformatted to be readable by LAPS. Preliminary reanalysis runs with the routinely archived data and WRF forecast have been performed for the 20 May 2013 case.

- A multi-sensor wind analysis system to combine radial velocity wind observations from WSR-88D and TDWR Doppler radars, GOES AMVs, and surface Mesonet wind observations using a 3DVAR has been developed at the NOAA National Severe Storms Lab (NSSL), (Xu et al., accepted for publication). The method is an upgraded version of the radar-based wind analysis system (RWAS) with improved techniques for Doppler velocity dealiasing. A three-step incremental analysis strategy was designed to improve the mesoscale vector wind analysis. The first step analyzes the Velocity Azimuth Display (VAD) vector winds produced at each radar site together with GOES water vapor winds. The second step analyzes surface wind observations from the Oklahoma Mesonet. In the third step, the radar radial velocities were compressed into superobservations at consecutively refined resolution (from 30 km to 10 km) and the background covariance de-correlation length was adjusted adaptively to consecutively refined scale (from 100 km to 50 km).

- As demonstration example, the multi-sensor wind analysis system has been applied to radial-velocity observations from five operational WSR-88D radars (KTLX, KFDR, KINX, KVNX, KSRX) and one TDWR radar (TOKC) in combination with surface wind observations from Oklahoma Mesonet and GOES water vapor winds to produce vector wind fields for the Oklahoma Moore tornadic storm case on 20 May 2013. The background wind field is from the nearest NOAA Rapid Refresh (RAP) model predictions interpolated in time and space to the analysis grid in a 800x800x10 km³ domain centered at the KTLX radar. Wind analyzes at 0.25 km altitude valid at 1900 UTC are shown in Fig. 1 from the background (RAP) and RWAS respectively. These
figures cover a sub-region of the domain centered on the TOKC radar location. Dealiased radial wind velocities from the 0.5 deg elevation scans of the TOKC and KTLX radars are superimposed on the analysis wind vectors. Center locations of two mature thunderstorms “K1” and “K2”, and a developing cluster of storm cells “E” are labeled in the figures. Cells “K1” and “K2” weaken in the subsequent hour. Rapid development of “E” leads to the Moore tornado by 19:30 UTC. A wind shift or frontal boundary is evident near “E” in both the RAP and RWAS. The RWAS suggests a stronger horizontal wind shear and cyclonic flow in vicinity of “E” with southerly to southeasterly inflow and northwesterly flow to the rear, behind the frontal boundary. The RAP has weak southwesterly winds in that later region. The wind analysis also indicated stronger 0-3 km shear near, and to the south and east of the discrete thunderstorms. In this case, the impact of the GOES AMVs was most evident in the upper troposphere. At 10.0 km altitude for example, the local maximum of southwesterly winds in the jet core northwest of the developing storms appears to be stronger and more compact in the RWAS analysis than in RAP forecast (Fig. 2).

- A web-based tool is available for overlaying the TDWR radar reflectivity data on parallax corrected GOES visible imagery for the 20 May 2013 case. A southward moving boundary seen on satellite intersects the developing storm southwest of Moore (1845-1915 UTC):
  http://www.nssl.noaa.gov/users/rabin/public_html/vis_1km/20may13/goes13_par.html

- All the GOES-14 SRSOR GVAR data have been saved at the SSEC Data Center. All gaps in NOAA’s Comprehensive Large Array-data Stewardship System (CLASS) data archive for GOES-14 SRSOR data were filled by the SSEC Data Center. GOES-14 SRSOR data were supplied to CLASS for dates in June 2013 and May 2014.

### Additional Information

1. **Interaction with operational partners** –

   Discussions took place with forecasters and GOES-R proving ground liason at the NOAA/SPC on cases of interest and on subjective use of 1-minute GOES-14 imagery in forecasting.

2. **Conference/workshop participation** –

3. **Funding concerns** – None

4. **Outside project publicity** – None

5. **Journal articles** –

   - Schmit et al., 2015: Rapid Refresh Information of Significant Events: Preparing users for the next generation of geostationary operational satellites. BAMS: http://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-13-00210.1

**Plans for the next Reporting Period:**

- Analysis of the 20-21 May 2014 storms will proceed using RDAS and LAPS.
- GOES-14 data will be parallax corrected.
- Time series of overshooting tops, lightning and radar data will be constructed.
- Web-based visualizations of combined GOES-14 imagery and products, radar and lightning data will made available for the May 2014 case studies.
Fig. 1: Analyzed winds at grid points on 0.25 km altitude surface valid at 1900 UTC: a) RAP, b) RWAS. Grid points are separated by 20 km. Doppler radial velocity data from lowest elevation TOKC and KTLX radar scans are superimposed. County boundaries shown in light green. Storm cells K1,K2,E indicated.
Fig. 2. Wind direction and speed at 10.0 km altitude, 1900 UTC. Left panel is 1-hr RAP forecast, right panel is from the RWAS analysis. State and county boundaries in Oklahoma shown in light green.