18–22 September 2017, Pula, Croatia
ECSS2017-138

Numerical analysis of mesoscale shear in convective environments using data assimilation of super-rapid-scan GOES-derived wind vectors

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The accuracy of model-forecasted severe storms partly is limited by uncertainties of mesoscale shear variability in near-storm environments. Our knowledge of mesoscale shear variability is largely dependent on mobile radar data and proximity soundings from field projects; thus, operational observations of such variability typically are insufficient. Ongoing research by the coauthors and collaborators explores improvement in mesoscale details of shear surrounding developing severe convection achievable by assimilating rapid-scan GOES-derived atmospheric motion vectors (AMVs) into convection-permitting WRF ensembles using the Ensemble Kalman filter. AMVs typically are employed in simulations of tropical storms over oceans (where few in situ observations are available) and to track the early development of potentially severe thunderstorms in their initiation stages. The primary goal of this is research is to understand the impact of AMVs on the numerical analysis of convective environments over land relative to routine operational radiosondes, commercial aircraft, and radar wind observations.

Leading up to the launch of the new GOES-16, which has the potential to make the highest quality AMV data sets of all previous GOES, preliminary results seek to understand the impact of the rapid-scan GOES-11-derived AMVs collected on 5 June 2009. This date was selected because of the severe storms that formed that afternoon-evening, including the highly-documented VORTEX-2 Goshen County, Wyoming, tornadic supercell. Comparisons of shear simulated among mesoscale (4-km grid spacing) ensembles that assimilate different combinations of AMVs and operational wind data (verified against unassimilated operational and VORTEX-2 sondes launched in the vicinity of storms) will illustrate their relative impact on the convective environment. Subsequent nested storm-scale ($\sim$1-km grid-spacing) simulations within two regions of convection observed on this day, each using initial conditions from the parent mesoscale domains with and without assimilating the GOES AMVs, will show the impact of the AMVs on forecasts of fine-scale storm structure and severe weather. High-resolution dual-Doppler and surface observations collected by VORTEX-2 on that day will serve as verification of storm structure.