Assimilation of high resolution GOES-R ABI infrared water vapor and cloud sensitive radiances using the GSI-based hybrid ensemble-variational data assimilation system to improve convection initiation forecast

Principal Investigators: Xuguang Wang (Univ. of Oklahoma), Jason Otkin (CIMSS), Thomas Jones (CIMMS), Aaron Johnson (Univ. of Oklahoma), Xialyan Zhang (EMC), Yanqui Zhu (EMC)

Abstract

The unprecedentedly high temporal and spatial resolution of the GOES-R data makes it possible to resolve rapid moisture and cumulus development preceding the initial appearance of radar echoes. Such observations allow rapidly updated data assimilation (DA) systems to pick up fast varying pre-convective development and therefore increase lead times on convective hazardous weather forecast. The primary goal of the proposed project is to extend the NWS operational GSI-based hybrid ensemble-variational DA system to assimilate high resolution GOES-R ABI infrared water vapor and cloud sensitive radiances (6.2, 6.9, 7.3 μm) into convection resolving regional model and access their impact on convection initiation (CI) forecasts.

The proposed work will develop based on the GSI hybrid DA system which has been recently further extended by the proposing team and collaborators to directly assimilate ground based radar observations. The proposed work will also leverage the experiences that the proposing team gained in assimilating all-sky GOES, SEVIRI and simulated GOES-R data using ensemble based DA for convective scale predictions. Specifically, the proposing team will (a) further extend the GSI hybrid DA system for assimilating high resolution GOES-R ABI infrared water vapor and cloud sensitive radiance observations by ingesting convection resolving model's own high-resolution EnKF ensemble rather than the GFS ensemble and by directly updating cloud hydrometeor variables; (b) improve the usage of GOES-R ABI water vapor and cloud sensitive radiances for rapidly updated DA by refining data quality control, using high-resolution infrared land surface emissivity databases and exploring all-sky bias correction and observation error methods, and (c) test different DA configurations and evaluate the impact of assimilating GOES-R water vapor and cloud sensitive radiance observations for the prediction of diverse CI events when combined with ground based observation networks. The proposed work involves important players from both academia and the NOAA operational scientists and represents the fastest possible path to operations.