Improving Coastal Precipitation Forecast through Direct Assimilation of GOES-R ABI Radiances in GSI-NAM/HWRF

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Abstract

This proposal addresses research priorities A1 and A2 through refining the GOES and GOES-R satellite data assimilation schemes in the NCEP GSI/ARW for improved coastal quantitative precipitation forecasts (QPFs). The radiance observations from current GOES imager and future GOES-R Advanced Baseline Imager（ABI) will be incorporated into the GSI/ARW system. Scientifically sound, physically based, and operationally workable algorithms will be developed for bias correction, cloud detection, data thinning and quality control. Such a multi-disciplinary task will be completed through a close collaboration among the Center for Satellite Applications and Research (STAR), Florida State University (FSU), and NCEP Environmental Modeling Center (EMC). A transition process to operations at other NWP centers in US will be streamlined through strong collaborations with Joint Center for Satellite Data Assimilation (JCSDA) NOAA NWP/DA testbed. Such collaborations with EMC and JCSDA have been established through an existing three-year (2011-2014) project funded by the GOES-R3 program. Steady progresses have been made in the past years, including the incorporation of the infrared (IR) imager radiances from SEVIRI in NCEP operational global forecast system, refinement of microwave humidity sounder (MHS) cloud detection, development of GOES imager radiance cloud detection for data assimilation, and an incorporation of a dynamic-updated land surface emissivity dataset to the Community Radiative Transfer Model (CRTM). Assimilation of SEVIRI data in GSI has resulted in improved global analysis of water vapor fields, a small but positive impact on global medium-range forecasts. Assimilation of either GOES imager or MHS radiances significantly improved regional QPFs in the Gulf coast. However, the GOES and SEVIRI data were currently thinned to a 50 km resolution. We propose to further maximize the values of GOES and GOES-R imager radiance observations on severe weather forecasts by assimilating the high-resolution data at space and time. New algorithms for cloud detection, optimal data thinning, quality control, bias correction and assimilation strategies will be developed and tested with respect to the EMC operational forecast systems. New predictors for bias correction will be tested for better assimilating the IR radiances of optically thin clouds and surface sensitive channels. The predictors are more objective, less dependent of forecast model background fields, and therefore require less tuning from time to time. We will also expand the GOES and GOES-R data assimilation and QPF impact studies to investigate the role of gravity waves on QPFs given the capability of GOES-R ABI measurements in capturing many features of the fast evolving waves in the atmosphere. These wave structures are often the driving mechanisms for intensive precipitation events.