

# Assimilation of Simulated High-Resolution All-Sky Radiance and Radar Data for Storm-Scale Ensemble Forecasts

Youngsun Jung<sup>a</sup>, Ming Xue<sup>a,b</sup>, and Lewis Grasso<sup>c</sup>

<sup>a</sup> Center for Analysis and Prediction of Storms (CAPS), University of Oklahoma (OU), USA, [youngsun.jung@ou.edu](mailto:youngsun.jung@ou.edu), <sup>b</sup> School of Meteorology, University of Oklahoma, USA, <sup>c</sup> Cooperative Institute for Research in the Atmosphere, Colorado State University, USA.

Most operational numerical weather prediction (NWP) systems assimilate only clear-sky radiance data because of issues with cloudy radiance data, including nonlinearity of the forward observation operator, non-Gaussian observation errors, and non-stationarity of background errors [1], and because the limited capabilities of the coarse-resolution NWP model in adequately resolving and representing clouds and precipitation. Recent advances in NWP models, including the increase to convection-permitting or convection-resolving resolutions and better and explicit representation of cloud and precipitation processes, together with advancement in radiative transfer modeling in the presence of clouds, and development of ensemble-based data assimilation techniques more capable of handling nonlinear processes and observations, are all promising the potentially more effective utilization of radiance data in all-sky conditions to improve convective-scale weather forecasting.

This study investigates the potential impact of simulated radiance data from the future GOES-R satellite on analysis and forecasting using an ensemble Kalman filter (EnKF) through realistic observing system simulation experiments (OSSE). A nature run is created using the Weather Research and Forecasting (WRF) model running at 4 km grid spacing, using an initial condition that includes radar data. The Community Radiative Transfer Model (CRTM) is used to create the simulated GOES-R radiance data and as the observation operator in the EnKF, while the forecast model used in the OSSE is the Advanced Regional Prediction System (ARPS) running at the same resolution. The radiance data are assimilated with or without simulated WSR-88D radar data.

Preliminary results show that both simulated satellite radiance and simulated radar observations significantly improved the analyses in regions where there are no clouds, primarily by removing spurious clouds. In regions where there are clouds, the impact of satellite data is smaller when assimilated alone but still positive in most microphysical states. Radar data are found to be more effective in estimating precipitating hydrometeors. A more detailed error analysis and the impacts on forecasts will be presented at the symposium.

## References

[1] R. M. Errico, P. Bauer, and J.-F. Mahfouf. "Issues Regarding the Assimilation of Cloud and Precipitation Data," *J. Atmos. Sci.*, vol. 64, Issue 11, pp. 3785-3798, November 2007. (Journal Article)