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Convection-Permitting Ensemble All-sky Satellite Radiance Assimilation for the Prediction of Rapidly Intensifying Tropical Cyclones

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Prediction of rapidly intensifying tropical cyclones (TCs) have been a challenging topic. Because most TCs are born and develop over tropical oceans with limited in-situ observation networks and infrequent low Earth orbiting satellite overpasses, geostationary satellite observations are often the only available information to capture the lifecycle of TCs.

In this study, the impacts of assimilating all-sky satellite radiances from GOES-16, together with the set of conventional observations, on the prediction of the rapid intensification process of TCs are examined using convection permitting ensemble Kalman filter data assimilation system originally developed at Penn State University with WRF and CRTM. We have conducted assimilation experiments for 2017 Atlantic hurricane season. The assimilation of all-sky satellite radiances contributed to better constraining the dynamic and thermodynamic state variables, which helped to capture the developing convective activity within the inner-core region of TCs. The TC intensity forecast error was reduced by roughly 20 % at the peak time. We found that the all-sky satellite radiances contributed to more than 90 % of error reduction. This study will provide implications about what are the sources of uncertainty in predicting rapidly intensifying TCs, as well about the design of future observation networks tasked with better initializing and predicting developing TCs.