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Multiple Hydrometeors All-sky Microwave Radiance Assimilation in FV3GFS

Motivated by the use of the GFDL microphysics scheme in the FV3GFS, the all-sky radiance assimilation framework has been expanded to include precipitating hydrometeors. In this upgraded all-sky framework, the five hydrometeors, including cloud liquid water, cloud ice, rain, snow and graupel, are the new control variables, replacing the original cloud water control variable. Radiance observations from AMSU-A and ATMS over ocean are assimilated in all-sky approach. Precipitation screening, which screened out 2% to 3.6% of observations, was turned off. The Community Radiative Transfer Model (CRTM) was interfaced with the newly added precipitating hydrometeors. Subgrid cloud variability was considered in radiative transfer by using average cloud overlap scheme. Including precipitating hydrometeors generally increased the first guess departures, particularly in deep convection regions. This is likely caused by the inappropriate optical properties of precipitating hydrometeors in current released CRTM. Therefore, the original quality control based on scattering indexes were retained. More observations were assimilated in the Southern hemisphere and less observations were assimilated in tropical deep convection regions. This newly constructed all-sky framework shows neutral to positive impact on overall forecast skill. Improvement was found in 500 hPa geopotential height forecasts in both Northern and Southern Hemispheres. Temperature forecasts were also improved at 850 hPa in the Southern Hemisphere and the Tropics.

The new all-sky framework is being adopted in the GFDL SHiELD model, which is also a FV3 based global model with enhanced features in dynamical core and microphysics. To address the first guess departure biases observed in tropical deep convection region, and to effectively assimilate more observations in strong scattering areas, efforts are focused on including convective cloud and improving optical properties of precipitating hydrometeors. The updated results will be reported at the workshop.

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