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Assimilating All-Sky Microwave Brightness Temperature Data to Improve NASA GEOS Forecasts and Analyses

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The NASA Global Modeling and Assimilation Office (GMAO) has been pursuing efforts to utilize all-sky (clear+cloudy+precipitating) MW radiance data and has developed a system to assimilate all-sky GPM Microwave Imager (GMI) radiance data in the Goddard Earth Observing System (GEOS) during the last PMM funding period. The system provides additional constraints on the analysis process near the storm regions and adjusts the geophysical parameters such as precipitation, cloud, moisture, surface pressure, and wind by combining information from GMI radiance measurements and model forecasts in an optimal manner. The system proved that assimilating the GMI all-sky radiance data improve the GEOS atmospheric analyses and forecasts. This all-sky data framework has been included in the GEOS Forward Processing (FP) system since July 11, 2018 and assimilates all-sky GMI data in real-time for GEOS global analysis and forecast production at the GMAO. We are currently extending this all-sky GMI radiance data assimilation system to assimilate more all-sky MW radiance data from other sensors such as the Microwave Humidity Sounder (MHS), the Advanced Technology Microwave Sounder (ATMS), the Special Sensor Microwave Imager/Sounder (SSMIS), Advanced Microwave Scanning Radiometer 2 (AMSR2), and the Sounder for Atmospheric Profiling of Humidity in the Intertropics by Radiometry (SAPHIR) onboard the GPM constellation spacecrafts. Preliminary results from this extended all-sky system show increased benefit from cloud- and precipitation-affected MW radiances with much larger spatial and temporal coverages compared to the all-sky system assimilating GMI alone and improved GEOS forecast skills especially for lower tropospheric humidity fields.

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