All-sky Microwave Radiance Data Assimilation in GEOS

- The Goddard Earth Observing System (GEOS) Hybrid 4D-EnVar Atmospheric Data Assimilation System (ADAS) has been extended to assimilate all-sky microwave radiance data from various microwave sensors such as GPM Microwave Imager (GMI), Microwave Humidity Sounder (MHS), and Advanced Technology Microwave Sounder (ATMS).
- This system provides GEOS analyses with additional constraints on meteorological parameters in cloudy/precipitating regions that are dynamically sensitive to forecast accuracy for precipitation and storms.
- In addition, this all-sky ADAS system is used to generate GEOS Global Precipitation and Cloud Analysis products to support NASA Precipitation Measurement Mission (PMM).

Dynamic Thinning for All-sky Data

- All NWP centers apply large data thinning distances (e.g. 145 km in GEOS ADAS) in assimilating clear-sky radiance data to avoid correlated observation errors. However, satellite data in cloudy and precipitating regions have relatively small spatial correlations in observation errors due to inhomogeneous spatial distributions of clouds and precipitation.
- To maximize the impact of all-sky radiance data, a dynamic thinning distance method has been developed in GEOS all-sky framework to apply short thinning distances to the data in cloudy and precipitating regions while keeping 145 km thinning distance for the satellite data in clear sky regions.
- Using this method, benefits of all-sky microwave radiance data on GEOS hurricane analyses and forecasts are examined in this study.

GEOS All-sky Data Analysis System (Hybrid 4D-EnVar GSI based)

- Variational analysis
- NWP Model
- EnKF Model
- RT Model
- Satellite Tb Observations
- GSI Hybrid Solver
- Control variables: Ps, T, q, u, v
- Re-center ensembles around central GSI analysis

Impacts on Hurricane Analyses

Hurricane Gaston (2016)

Observations

GMI Observations

08/30/2016 (0300 UTC~0900 UTC)

GOES IR

Integrated Multi-Satellite Retrieval for GPM (IMERG)

Impacts on GEOS Forecasts

850hPa Specific Humidity FCST RMS Error

850hPa Temperature FCST RMS Error

NH

Tropics

SH

GEOS Global Precipitation Analysis Products

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