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Improved Weather Predictions Through Data Assimilation for GFDL SHiELD

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The Geophysical Fluid Dynamics Laboratory (GFDL)'s System for High□resolution prediction on Earth□to□Local Domains (SHiELD) model typically uses the National Centers for Environmental Prediction (NCEP) Global Forecast System (GFS) analyses to initialize its medium-range global forecasts. Both initial condition (IC) and forecast model have an impact on model prediction skills. The quality of the IC is partially determined by the model short-range forecast used as first guess in data assimilation.

A data assimilation (DA) system has been developed for the global SHiELD to demonstrate the prediction skills of the model initialized from its own analysis. The DA system largely leverages the advanced DA techniques used in GFS and assimilates all the observations assimilated in GFS. Compared to the SHiELD forecasts initialized from GFS analysis, SHiELD forecast skill is significantly improved by using its own analysis. Tremendous improvement was found in the Southern Hemisphere with positive impact lasting up to 10 days. The DA system is also useful in identifying and understanding model errors. The most noticeable model error detected by the DA system originates from the TKE-EDMF boundary layer scheme. The model error leads to insufficient ensemble spread, which could not be fully addressed by the multiplicative inflation and stochastic physics schemes used in the system. Including two versions of the TKE EDMF scheme in the ensemble can alleviate the systematic model error, which further improves forecast skills. The use of the interchannel correlated observation errors for Infrared Atmospheric Sounding Interferometer (IASI) and Cross-track Infrared Sounder (CrIS) was also investigated, which improves the forecast skill up to day 5 and further reduces the impact of the model error in the marine stratocumulus region. Further understanding of the model error associated with the TKE-EDMF scheme will be presented.