Implementation of Ensemble Forecast Sensitivity to Observations (EFSO) on a operational-like CFSv2 model and modifications for reanalysis

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Abstract

The EFSO (Kalnay et al., 2012) is a powerful tool to identify the beneficial or detrimental impact of every observation used in ensemble-based data assimilation (DA). Encouraged by the exciting success in the EFSO/PQC application on the operational GFS (Ota et al., 2013, Chen and Kalnay, 2020), we implemented the EFSO, for the first time, on the operational-like coupled system CFSv2-LETKF (Sluka et al., 2018). With the implementation of EFSO on the ocean components, the scientific questions we investigate are:
(1) Does the EFSO work for the coupled DA system with real observations?

(2) Ocean has a significantly longer timescale which is associated with depth. How long should the lead time be to capture meaningful signals?

(3) How do the different characteristics of ocean observations (i.e., distribution, density, and platforms) affect the observation impacts?
This study aims to provide more insights into how to optimize the use of observations and improve the forecasts and analysis within a coupled system. A series of experiments are conducted with the weakly coupled assimilation of the preBUFR data for atmosphere and the ocean profiles and the NOAA Level 4 SST for the ocean. Preliminary result shows that the EFSO can estimate the cross-components (i.e., atmosphere-ocean) observation impacts. We found that assimilating the sea temperature and the salinity observations provides significant beneficial effects on the ocean analysis, especially for the regions with large SST variability. Moreover, EFSO captures the significant beneficial impacts of SST, which is associated with tropical cyclones. This result gives a piece of clear evidence on how the SST WCDA can improve the ocean components perturbed by air-sea interactions.

Keywords: Ensemble Forecast Sensitivity to Observations (EFSO), Coupled Data Assimilation

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