Development of CFES–LETKF Ensemble Data Assimilation System

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Ensemble-based data assimilation techniques have been rapidly growing because of their advantages of the on-the-fly estimation of analysis and forecast errors, relative ease of implementation, and efficiency with parallel computers. Miyoshi and Yamane [2007] applied the local ensemble transform Kalman filter (LETKF) to an atmospheric general circulation model (GCM), AFES, to construct the AFES–LETKF ensemble data assimilation system. Miyoshi et al. [2007] performed one and a half years of AFES–LETKF experimental ensemble reanalysis (ALERA) using observational dataset of the Japan Meteorological Agency operational system. Based on ALERA, several observing system and predictability studies have been conducted [Inoue et al., 2009; Enomoto et al., 2010; Moteki et al., 2011]. Currently the second generation of ALERA (ALERA 2) is underway with the latest version of AFES and LETKF, assimilating observational data of the National Centers for Environmental Prediction (NCEP) global data assimilation system (PREPBUFR).

In ensemble data assimilation systems based on atmospheric GCMs (including AFES–LETKF), however, surface boundary conditions such as sea surface temperature (SST) and sea-ice distribution are the same among all ensemble members, which leads to an underestimation of the ensemble spread near the surface. Additionally air–sea coupled phenomena, e.g., lead–lag relationship between SST and precipitation over the tropics, are not well reproduced in such systems. To overcome these problems, we replace AFES with a coupled atmosphere–ocean GCM, CFES, to develop CFES–LETKF ensemble data assimilation system.

The resolution of the atmospheric component of CFES used in the system is T119 (~100 km) in the horizontal and 48 layers in the vertical, the same as in ALERA 2. The oceanic component has a resolution of 1/2º (~50 km) in the horizontal and 54 levels in the vertical, and is coupled with the atmospheric component every hour. Atmospheric observational data (NCEP PREPBUFR) are assimilated every 6 hours to update the atmospheric variables, whereas the oceanic variables are kept unchanged throughout the assimilation procedure. The analysis–forecast cycle starts on August 1, 2008, and the atmospheric initial conditions (40 members) are taken from ALERA 2 analyses. Outputs from a stand-alone oceanic simulation on August 1 from 1967 through 2006 are used as the 40-member oceanic initial conditions. Preliminary results will be presented at the workshop.

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