The Impact of Coupled versus Observed SST on Summer Season Predictions over America with the NCEP CFS Using Different Land Surface Models and Different Initial Conditions

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In this study, we use the state-of-art NCEP Coupled Forecast System (CFS) to examine the extent to which upgrades to the land model (OSU to Noah) and land data assimilation components (GR2 to GLDAS) of the CFS can improve CFS summer season predictions over the CONUS. Experiments were carried out over a 25-year period in fully coupled mode, where the old OSU LSM was initialized using GR2 land states and the new Noah LSM was initialized with the GLDAS land states. To further examine the impact on seasonal prediction of land upgrade, parallel experiments were also executed over the same period in the AMIP style (with the prescribed SST and sea ice). Comparisons were assessed on an ensemble basis and at seasonal timescales. The variables we examined are precipitation and 2-meter temperature with focus on the Continental U.S. (CONUS).

Coupled CFS experiments indicate that upgrade from the OSU land surface model to the advanced Noah land surface model does improve the overall summer season precipitation predictions, especially during El Niño Southern Oscillation (ENSO) neutral years, where such an improvement in CFS performance requires the execution of a companion global land data assimilation system (GLDAS) with the very same new land model as utilized in the land-component upgrade of the global climate model. Providing the land surface model with compatible and self-consistent land states is important to seasonal predictions. In contrast, improper initialization of the land surface model can degrade the global model performance, suggesting it is inappropriate to merely upgrade the land component of a global climate model for seasonal forecasting without simultaneously upgrading the land component of the companion global data assimilation system

Compared to the coupled runs, the AMIP-style experiments show lower scores with both precipitation and 2-meter temperature, but the differences in precipitation between before and after upgrades are still significant for the ENSO neutral years, demonstrating that the real benefits resulted from the land upgrades, and the benefits are more represented in a coupled mode. Ignoring any feedbacks from atmosphere using prescribed SST boundary conditions will adversely affect land-atmospheric interactions, and thus degrades the CFS performance over CONUS.