Summer Season Predictions with the NCEP Coupled Forecast System Using Different Land Models and Different Initial Land States

Rongqian Yang, Kenneth Mitchell, Jesse Meng, Helin Wei, and George Gayno
NOAA/NCEP/EMC
Camp Springs, Maryland

It is well known that in the N.H. summer season, the ENSO signal and influence is much weaker than in the winter season, hence seasonal predictions by coupled global climate models manifests significantly lower skill in the summer than in the winter season, especially over land. Research over the past decade has demonstrated that proper land state initialization (especially soil moisture) is essential to summer season precipitation predictions. To examine the impact of different initial land states on seasonal predictions, in this study, we use the state-of-the-art NCEP Coupled Forecast System (CFS) to examine to what extent that the land surface initialization has an impact on seasonal predictions. Hence CFS experiments are designed to run with different choices of Land Models and different initial land states aimed at demonstrating the extent to which upgrades to the land model and land data assimilation component of the CFS can improve CFS summer season predictions over the continental U.S. (CONUS).

The CFS which is equipped with the modern Noah Land Surface model with advanced physics is initialized with three different initial land states (GR2, GLDAS, and GLDAS climo). in comparison with the model run with the OSU Land surface model with the GR2 initial land states. Experiments have been carried out over a 25-year period with 10 and 15 ensemble members for different configurations, whose initial starting dates are from April 19 to May 3. We examine the impact of different land surface models and choice of different initial land states on seasonal precipitation, 2-meter temperature, 200 mb and 500 mb heights, SSTs, and on land surface characteristics including latent heat and sensible heat fluxes among others.

Results from our experiments indicate that different initializations of land surface model have a large impact on seasonal predictions, specifically, achieving the improvement in CFS performance is requiring 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 land surface model compatible and self-consistent land states is important to seasonal predictions, improper initialization of the land surface model can degrade the model performance, suggesting it is naive to merely upgrade the land component of a global climate model for seasonal forecasting without simultaneously similarly upgrading the land component of the companion global data assimilation system.