A Comparison Study of Summer-season Land Surface Climatology in CFSv2 with Two Experimental Runs Using a Different Atmospheric Model and Ocean Components

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We examine the impact of using different atmospheric and oceanic components on land surface water and energy predictions, summer-time land surface water and energy climatologies from the National Centers for Environmental Prediction’s (NCEP)’s latest fully-coupled Climate Forecast System version 2 (CFSv2). Here we cover a 23-yr period with 12 ensemble members, and compare control runs to those obtained from two experimental CFS runs with the same land model and self-consistent initial conditions, but using a different atmospheric model and ocean conditions, as well as to available observations and an off-line Global Land Data Analysis System (GLDAS) analysis. In the first experiment, both atmospheric and oceanic models in the CFSv2 are replaced with their earlier versions, which is designed to show how much improvement on the prediction skill benefited from the atmosphere and ocean upgrades, where the differences between the two can yield insight to directions for future CFS development. In the second experiment, the ocean model used in the first experiment is replaced with observed Sea Surface Temperature (SST), which reveals the importance of atmosphere-ocean coupling, and also may point out possible future enhancements to the atmospheric model. The experimental CFS is run on the same T126 resolution as in the CFSv2, and uses 10 ensemble members, whose initial conditions are from late April to early May.

Inter-comparisons of monthly June, July, August climatology and seasonal means in surface precipitation, evaporation, sensible and latent heat fluxes, soil moisture, 2-m temperature, downward and net radiation show that there are very good agreements between the three CFS runs, while some differences exist compared to available observations and the GLDAS analysis. The CFSv2 skill gains in predicting precipitation, 2-m temperature, and SST anomalies vary with geographic regions. This study demonstrates that the CFSv2 achieves a large improvement on depicting better surface water and energy climate. Nevertheless, there is still lots room for future improvements, including the CFS Noah land model itself.