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# Impact of realistic soil moisture initialization on seasonal forecasting of continental near surface variables.

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Although the amount of water contained in the soil seems insignificant when compared to the total amount of water on a global-scale, soil moisture is widely recognized as a crucial variable for climate studies. It plays a key role in regulating the interaction between the atmosphere and the land-surface by controlling the repartition between the surface latent and sensible heat fluxes. In addition, the persistence of soil moisture anomalies provides one of the most important components of memory for the climate system. Several studies have shown that, during the boreal summer in mid-latitudes, the soil moisture role in controlling the continental precipitation variability may be more important than that of the sea surface temperature (Koster et al. 2000, Hong and Kalnay 2000, Koster et al. 2000, Kumar and Hoerling 1995, Trenberth et al. 1998, Shukla 1998).

Although all of the above studies have demonstrated the strong sensitivity of seasonal forecasts to the soil moisture initial conditions, they have relied on extreme or idealized soil moisture levels. The question of whether realistic soil moisture initial conditions lead to improved seasonal predictions has not been adequately addressed. Progress in addressing this question has been hampered by the lack of long-term reliable observation-based global soil moisture data sets. Since precipitation strongly affects the soil moisture characteristics at the surface and in depth, an alternative to this issue is to assimilate precipitation. Because precipitation is a diagnostic variable, most of the current reanalyses do not directly assimilate it into their models (M. Bosilovitch, 2008). In this study, an effective technique that directly assimilates the precipitation is used.

We examine two experiments. In the first experiment, the model is initialized by directly assimilating a global, 3-hourly, 1.0° precipitation dataset, provided by Sheffield et al. (2006), in a continuous assimilation period of a couple of months. For this, we use a technique named the Precipitation Assimilation Reanalysis (PAR) and described in Nunes and Cocke (2004). This technique consists of modifying the vertical profile of humidity as a function of the observed and predicted model rain rates. In the second experiment, the model is initialized without precipitation assimilation. For each experiment, ten sets of seasonal forecasts of the coupled land-atmosphere Florida State University/Center for Ocean and Atmosphere Predictions Studies (FSU/COAPS) model were generated, starting from the boreal summer of each year between 1986 and 1995. For each forecast, ten ensembles are produced by starting the forecast from the 1st and the 15th of each month from April to August.

The results of these experiments show, first, that the PAR technique greatly improves the temporal and spatial variability of soil moisture throughout the precipitation assimilation. Second, using these realistic soil moisture initial conditions, we demonstrate an increase in the seasonal forecasting skills for the continental precipitation and temperature over the "hot spots" – identified by the GLACE-1 multi-model study as regions where the evaporation from soil moisture has a strong effect on precipitation (Koster et al. 2004) – of the central United States. The results of this study will be also involved in the GLACE-2 international multi-model experiment.