

Impact of realistic soil moisture initialization on 1-month forecast of continental precipitation.

Marie Boisserie (marie@coaps.fsu.edu), Steve Cocke, D. W. Shin and Jim O'Brien, COAPS/FSU, Tallahassee, FL, USA.

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 (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 (here after, series 1), the land-atmosphere Florida State University/Center for Ocean and Atmosphere Predictions Studies (FSU/COAPS) 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 series, 50 sets of 1-month forecast are generated. The forecast starting dates are the 1st of each month between April and August and each year between 1986 and 1995. Since, series 1 and series 2 differs only from the initialization method of the land surface state, by taking the difference between series 1 and series 2, it will show the effect of the realistic soil moisture initialization on the forecasting skills of the model.

The Figure 1 shows the correlation squared of raw precipitation and anomaly precipitation between each series and the observation. The precipitation observation used here, is the daily precipitation reanalysis of Higgins et al. (2000). For both the raw precipitation and the anomaly, the series-1 skills are significantly larger than the series-2 skills in the northern U.S with an increase skill up to 24%. On average across U.S, the 1-month forecast skills are increased by 1.2%. These results indicate that, this soil moisture initialization technique has the potential to increase the 1-month forecast skills of precipitation in the northern U.S.

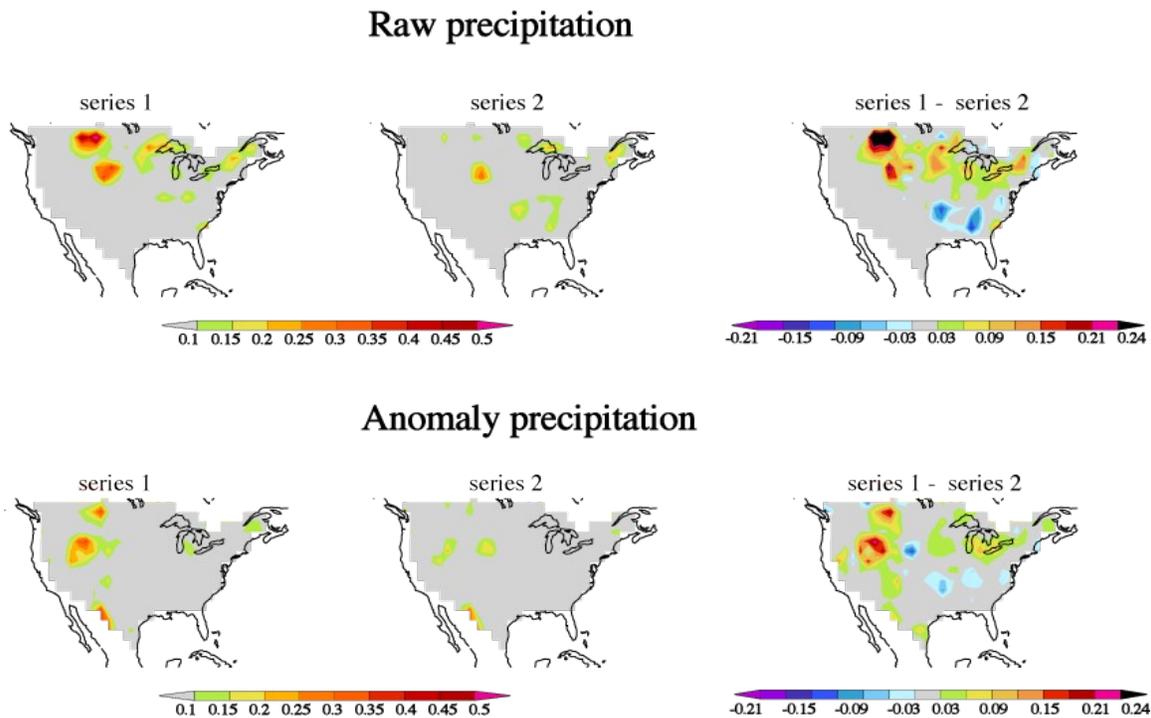


Figure 1: Spatial distribution of correlations squared (r^2) between FSU/COAPS model and the precipitation observation of the raw data (top) and the anomaly (bottom), for the series 1 (left), series 2 (middle) and the difference (right).