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Linking precipitation, evapotranspiration and soil moisture content for the improvement of predictability over land

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Climate change scenarios are expected to show an intensification of the hydrological cycle together with modifications of evapotranspiration and soil moisture content. Evapotranspiration changes have been already evidenced for the end of the 20th century. The variance of evapotranspiration has been shown to be strongly related to the variance of precipitation over land. Nevertheless, the feedbacks between evapotranspiration, soil moisture and precipitation have not yet been completely understood at present-day. Furthermore, soil moisture reservoirs are associated to a memory and thus their proper initialization may have a strong influence on predictability. In particular, the linkage between precipitation and soil moisture is modulated by the effects on evapotranspiration. Therefore, the investigation of the coupling between these variables appear to be of primary importance for the improvement of predictability over the continents.
The coupled manifold (CM) technique (Navarra and Tribbia 2005) is a method designed to separate the effects of the variability of two variables which are connected. This method has proved to be successful for the analysis of different climate fields, like precipitation, vegetation and sea surface temperature. In particular, the coupled variables reveal patterns that may be connected with specific phenomena, thus providing hints regarding potential predictability.
In this study we applied the CM to recent observational datasets of precipitation (from CRU), evapotranspiration (from GIMMS and MODIS satellite-based estimates) and soil moisture content (from ESA) spanning a time period of 23 years (1984-2006) with a monthly frequency. Different data stratification (monthly, seasonal, summer JJA) have been employed to analyze the persistence of the patterns and their characteristical time scales and seasonality.
The three variables considered show a significant coupling among each other. Interestingly, most of the signal of the evapotranspiration-precipitation coupled terms comes from the summer (JJA), when convective motions increase sensitivity to surface conditions over land. The CM analysis of the response of evapotranspiration to soil moisture allowed a characterization of the robustness of the coupling between these two variables which has been identified as a key requirement for precipitation predictability (Koster et al. 2000).

References

Navarra, A., and J. Tribbia (2005), The coupled manifold, J. Atmos. Sci., 62, 310–330.
Koster, R. D., M. J. Suarez, and M. Heiser (2000), Variance and predictability of precipitation at seasonal-to-interannual timescales, J. Hydrometeor., 1, 26-46.