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Spatiotemporal Variability of Precipitation and Modeled Soil Moisture in South America

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The land surface reservoirs of water and energy play an important role in the climate and weather due to its control over the fluxes of humidity and heat between surface and atmosphere. The most important among them are soil moisture, soil temperature, snow cover and vegetation (while moisture and vegetation are the dominant in most parts of the globe). The land surface in turn, is also affected by the atmosphere, creating a loop feedback. Specifically for this work we will choose precipitation and soil moisture as the main variables involved in the land surface-atmosphere interactions although recognizing the importance of the other variables. Consequently, this study investigates the linkage between precipitation and soil moisture over the continental South America, using a Climatology Research Unit (CRU) based record of near surface atmospheric variables spamming 1948 through 2008. Soil moisture states were generated by forcing the NOAH Land Surface Model (NOAH LSM) using surface air temperature, air humidity, precipitation, surface pressure, wind speed and downward shortwave and longwave radiation over the entire South American continent. In this study, the statistical analysis is composed of three steps: 1) normalization of the precipitation and the soil moisture in terms of the Standardized Precipitation Index (SPI); 2) a Multitaper Method - Singular Vector Decomposition (MTM-SVD) analysis and 3) a Canonical Correlation Analysis (CCA). The SPI is used to identify the droughts events along the period studied while the MTM-SVD determines the dominant spatiotemporal patterns of precipitation and soil moisture. Following the normalization and the identification of the dominant patterns, the CCA is employed to assess the variables covariability. Precipitation is used in terms of the Standardized Precipitation Index (SPI) so special attention is given to the drought events. Resulting relationship between precipitation and soil moisture is also presented in this work. as a result of a set of analysis in terms of empirical orthogonal functions (EOF) and principal components (PC). Interannual and longer time scales are evaluated and compared against AGCM and reanalysis studies in order to verify the consistency and the accuracy of the spatial variability of the variables. This study will support identification of regions that are more or less responsive to atmospheric data assimilation. In addition, it can contribute to the understanding of the major rainfall patterns over the South America related to the availability of soil moisture.