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The impact on climate of groundwater induced soil moisture memory : a study with a fully coupled WRF-LEAFHYDRO system

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Groundwater dynamics and its interactions with the land-atmosphere system are increasingly being taking into consideration in climate and ecosystem modeling studies. A shallow water table slows down drainage and affects soil moisture and potentially evapotranspiration (ET) and climate, particularly in water-limited environments. Our area of interest, the Iberian Peninsula, with a typical Mediterranean climate of dry growing season, is one of such regions where ET is largely constrained by water availability. We investigate how the induced memory on soil moisture by groundwater affects spring precipitation and summer temperatures there using a fully coupled WRF-LEAFHYDRO system. The LEAFHYDRO Land Surface Model includes groundwater dynamics with a realistic water table validated with hundreds of observations over Spain and Portugal. We perform two sets of long-term offline simulations, with and without groundwater forced by ERA-Interim and detailed precipitation analyses for the Iberian Peninsula. The corresponding fully coupled simulations with the Weather Research and Forecasting model (WRF), using exactly the same grid, take initial conditions from the off-line simulations at the end of the winter and are run for spring and summer, when we expect the impact of ET on climate to be largest. After a dry winter, in the run with groundwater soils are considerably wetter in regions with shallow water table and WRF results indicate that during spring the impact on precipitation can be sizeable when synoptic conditions are favorable for convection. Increased ET in the summer due also to more moisture availability in the run with groundwater leads in general to cooler temperatures. These preliminary results highlight the important role of groundwater on climate and the advantages of a fully coupled hydrology-atmospheric modeling system.