



## **Studying the hydrological cycle in the Iberian Peninsula using the LEAFHYDRO LSM: Influence of groundwater dynamics on soil moisture and land-atmosphere coupling. Impacts of artificial water extraction in the regional water cycle, including land-surface fluxes.**

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We perform long-term (10 year) simulations over the Iberian Peninsula at 2.5 km resolution with the LEAFHYDRO LSM, which includes groundwater dynamics and river routing. Atmospheric forcing comes from ERA-interim and a regional high-resolution analysis of precipitation over Spain and Portugal. The model simulates the coupled evolution of the groundwater, land surface (soil moisture and vegetation) and river reservoirs and we validate the simulation with all available observations of river flow and water table depth. In an experiment, we impose an artificial water extraction rate from the groundwater reservoir based on observations and estimations of irrigation withdrawals and we investigate the impact on the regional water cycle. The extraction rates induce a depression of the water table that over the years becomes quite significant and that matches observed decreasing rates of water table levels. The depressed water table discontinues groundwater input into rivers and the stream flow is diminished notably, in particular during the dry summer. Moreover, in areas with semiarid climate where the water table was naturally relatively shallow and connected to soil moisture and vegetation, which include most of the agricultural areas inland Spain, the depression of the water table has a significant impact on soil moisture and land-surface fluxes, with a decrease of root zone soil water availability and evapotranspiration and increasing water stress for the vegetation. The land hydrology alteration is more pronounced in the summer when there is an absence of precipitation, and as the model shows, through the induced changes in land-surface fluxes can potentially have a noticeably impact on the regional climate.