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How land-surface models reproduce drought conditions in Spain. Evaluation of simulations performed with high and low resolution forcing data and with different models

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Drought diagnosis is a fundamental issue for hydrological management in Spain, where recurrent water scarcity periods are the norm. Land-surface models (LSMs) could provide relevant information to water managers on how drought conditions evolve taking meteorological, soil moisture and hydrological drought into account. We explore here the usefulness of LSMs driven by atmospheric analyses of different resolution and accuracy in simulating soil moisture and streamflow drought. We perform simulations for the 1980-2014 period with SURFEX-RAPID (5km resolution) and LEAFHYDRO (2.5km resolution) forced by the Spanish SAFRAN dataset (at 5 km and 30 km of resolution) and the global eartH_2Observe datasets at 0.25 degrees (including the MSWEP precipitation dataset). The resulting natural streamflow time series are compared with observations and with the SIMPA hydrological model, the reference used by water managers. We also produce standardized indices for precipitation (SPI), soil moisture (SSMI) and streamflow (SSI) and compare them with benchmark data. Results show that model structure uncertainty remains an important issue in current generation large scale hydrological simulations based on land-surface models. This is true for both SSMI and SSI. The differences between simulated SSMI and SSI are large and dependent on model structure. Forcing datasets have an impact on the uncertainty of the results, but, in general, this is not as large as the uncertainty due to model formulation. The MSWEP quasi-global precipitation dataset, which includes satellite precipitation data, yields particularly good simulations, comparing with other global forcing datasets.