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Drought representation and propagation in ERA-Interim forced Regional Climate Model simulations over mainland Spain: from precipitation to soil moisture and streamflow.

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Drought is an important climatic risk, complex to model due to the interaction of atmospheric and continental processes. In addition, its intensity, frequency, and duration are expected to increase as a result of a warmer climate. Therefore, it is vital to better understand the processes involved and their representation by the current modeling.

The study herein presented, analyses how regional climate models represent meteorological, soil moisture, and hydrological drought, as well as the propagation from precipitation anomaly to soil moisture and streamflow anomalies. The analysis is carried out by means of standardized indices, calculated using variables directly related with each type of drought: precipitation (SPI), soil moisture (SSMI), runoff (SRI), and streamflow (SSI). The objective is to evaluate how these models modify drought and whether they improve its representation, compared to their driving and reference datasets.

Regional climate model simulations are provided by the Med-CORDEX database. The models used are RCSM4, CCLM4, and PROMES, all of them driven by ERA-Interim. The following datasets are used as reference: SAFRAN (meteorological drought), offline land surface model simulations from SURFEX and ORCHIDEE (soil moisture and hydrological droughts), and the SIMPA hydrometeorological model (hydrological drought).

On the one hand, these models are found to improve meteorological drought representation. On the other hand, large uncertainties are identified in their characterization of soil moisture and hydrological drought, as well as in the meteorological drought propagation. These are mainly explained by model formulation. For instance, it affects the temporal scale at which precipitation variability propagates to soil moisture and streamflow.