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## High-resolution root zone soil moisture-based indices for drought monitoring in the Ebro basin

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**Agriculture is an important factor on water resources, given the constant population growth and the strong relationship between water availability and food production. In this context, root zone soil moisture (RZSM) measurements are used by modern irrigators in order to detect the onset of crop water stress and to trigger irrigations. Unfortunately, in situ RZSM measurements are costly; combined with the fact they are available only over small areas and that they might not be representative at the field scale, remote sensing is a cost-effective approach for mapping and monitoring extended areas. A recursive formulation of an exponential filter was used in order to derive 1 km resolution RZSM estimates from SMAP (Soil Moisture Active Passive) surface soil moisture (SSM) over the Ebro basin. The SMAP SSM was disaggregated to a 1 km resolution by using the DISPATCH (DISaggregation based on a Physical And Theoretical scale CHange) algorithm. The pseudodiffusivity parameter of the exponential filter was calibrated per land cover type, by using ISBA-DIF (Interaction Soil Biosphere Atmosphere) surface and root zone soil moisture data as an intermediary step. The daily 1 km RZSM estimates were then used to derive 1 km drought indices such as soil moisture anomalies and soil moisture deficit indices (SMDI), on a weekly time-scale, covering the entire 2020 year. Results show that both drought indices are able to capture rainfall and drying events, with the weekly anomaly being more responsive to sudden events such as heavy rainfalls, while the SMDI is slower to react do the inherent inertia it has. Moreover, a quantitative comparison with drought indices derived from a model-based RZSM estimates has also been performed, with results**

showing a strong correspondence between the different indices. For comparison purposes, the weekly soil moisture anomalies and SMDI derived using 1 km SMAP-derived SSM were also estimated. The analysis shows that the anomalies and SMDI based on the RZSM are more representative of the hydric stress level of the plants, given that the RZSM is better suited than the SSM to describe the moisture conditions at the deeper layers, which are the ones used by plants during growth and development.

The study provides an insight into obtaining robust, high-resolution remote-sensing derived drought indices based on remote-sensing derived RZSM estimates. The 1 km resolution proves an improvement from other currently available drought indices, such as the European Drought Observatory's 5 km resolution drought index, which is not able to capture as well the spatial variability present within heterogeneous areas. Moreover, the SSM-derived drought indices are currently used in a drought observatory project, covering a region in the Tarragona province of Catalonia, Spain. The project aims at offering irrigation recommendations to water agencies, and the introduction of RZSM-derived drought indices will further improve such advice.