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Assessment of SMADI and SWDI agricultural drought indices using remotely sensed root zone soil moisture

Miriam Pablos, Ángel González-Zamora, Nilda Sánchez, and José Martínez-Fernández
University of Salamanca (USAL), Instituto Hispanoluso de Investigaciones Agrarias (CIALE), Villamayor, Spain
(mpablos@usal.es)

In the last years, drought has been one of the natural disasters with the worst impact in the agricultural regions worldwide, worsening over time with the most frequent extreme environmental phenomena. Drought monitoring is key to help mitigate its effects and remote sensing is a useful tool to globally mapping the agricultural drought. While this type of drought is directly linked to the availability of water content in the root zone for plants growth, current satellite soil moisture observations are only capable of characterizing the water content of surface soil layer (0-5 cm). In this research, two agricultural drought indices were obtained from June 2010 to December 2016 using root zone soil moisture (RZSM) estimations at 1 km from the Soil Moisture and Ocean Salinity (SMOS) satellite, instead of using surface soil moisture (SSM). The Soil Moisture Agricultural Drought Index (SMADI) and the Soil Water Deficit Index (SWDI) were analyzed over the Castilla y León region (Spain) at 1 km spatial resolution.

The estimation of the SMOS RZSM was done by applying the Soil Water Index (SWI) model to the SMOS SSM observations. The SMADI calculation employed the SMOS RZSM estimation and MODIS NDVI and LST observations. Then, SMADI maps were obtained over agricultural areas in the study region. By contrast, the SWDI computation required information of field capacity and wilting point water contents at the root zone. For this reason, the SWDI was obtained at 55 sample points along the region using soil profile data and pedotransfer functions, and using the SMOS RZSM of the 1 km pixels overlapping these points. Both indices were compared thorough statistical correlation with other two widely used agricultural drought indices, the Atmospheric Water Deficit (AWD) and the Crop Moisture Index (CMI). The AWD and CMI were computed at different weather stations distributed over the Castilla y Leon region. For the comparison, the SMADI pixels covering these stations were considered. In the case of SWDI, the nearest AWD and CMI stations to the 55 points were taken into account.

The preliminary results showed that both SMADI and SWDI using RZSM were less correlated with both AWD and CMI than when using SSM. This result seemed coherent, since AWD and CMI are related to the surface layer and the atmosphere processes. However, when SMADI and SWDI using RZSM were compared one to another, the correlations obtained were higher than when using the SSM, indicating a better agreement of these agricultural drought indices.