Root zone soil moisture and drought index from SMOS

Al Bitar Ahmad, Yann H. Kerr, Olivier Merlin, François Cabot, Jean-Pierre Wigneron

Root Zone Soil Moisture and Drought Index from SMOS

*Al Bitar, Ahmad*1; Kerr, Yann2; Merlin, Olivier3; Cabot, François3; Wigneron, Jean-Pierre3
1CESBIO, CNRS, FRANCE; 2CESBIO, FINLAND; 3CESBIO, FRANCE

Recent studies on extreme droughts do not agree on the increase in the rate and intensity of drought events occurring during the last decade (Sheffield et al., 2012), but it is clear that the impact of drought has increased. Drought monitoring and prediction tools are becoming intensely needed. Drought indices can be obtained by the use of precipitation data (Palmer Index, PDI), vegetation status (VDI), evapo-tanspiration data, or climate prediction model outputs. In this study, we define drought as the scarcity of available water in the root zone (up to 2 m depth) over a given period with respect to historical time series. We use the observed surface soil moisture from SMOS mission as the main input for our drought index combined to other ancillary datasets. The SMOS (Soil Moisture and Ocean Salinity) mission from ESA (European Space Agency) is an L-Band (1.4 Ghz) interferometric radiometer (Kerr et al., 2001). We use in this study the daily L3 global soil moisture maps from CATDS (Centre Aval de Traitement des Données SMOS). The water availability in the root zone is computed using a double bucket hydrological model. The soil moisture in the first layer is based on a simple bucket model and a simplified unsaturated flow equation for the second layer taking into consideration the vegetation transpiration driven by LAI from MODIS and weather prediction model outputs. The drought index is computed based on historical datasets from re-analysis products (MERRA-Interim). In this study, we present the methodology behind the development of the SMOS Drought Index (SDI). Validation with ground measurements of surface and root zone soil moisture across continents is also presented. The surface and root zone soil moisture are compared to model outputs from NCEP and exponential filter approach (Wagner et al. 1999, Albergel et al., 2008). The SDI is also compared to other drought indicators like vegetation indices from AVHRR and Palmer drought index over the continental United States. Results show that the SDI is a good vegetation stress indicator as it gives drought alert before the drop in vegetation LAI. The time lag between the two indicators is quantified. The major droughts during the last three years in the U.S., Europe, Brazil and Australia are analyzed to inspect the robustness. The results show that the drought index capture major droughts in RFI (Radio frequency interference) free areas. Some discrepancies are identified between SDI and other drought indices like in the western coast of the United States. Also the limits of using SMOS driven drought in forested areas are analyzed.