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Performance of a drought Standardized Soil Moisture Index based on ESA CCI Soil Moisture product: validation in India using crop data

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Drought is recognized as one of the most damaging natural hazard caused by a temporary water supply deficit relative to some long term average condition. Although there is not a universal definition of drought in the scientific community, previous studies have defined four types of droughts, intimately interrelated to each other, which occur at different time scales: meteorological, agricultural, hydrological and socio-economic. Soil moisture represents one of the most suitable variable to assess the effects of agricultural droughts and define different drought parameters, which include intensity, duration, severity and spatial extent. In fact, agricultural drought occurs when there is not enough soil moisture to support crop production. As ground-based soil moisture measurements are extremely hard to compare to large scale data sets because of their point-based nature, their limited coverage, and the well known high variability of soils, many studies have promoted the use of synoptic, timely and spatially continuous remote sensing soil moisture data from active and passive microwave sensors to assess agricultural drought conditions over large areas where ground monitoring instruments are sparse or non-existent.
In this work satellite soil moisture observations derived from the long-term ESA CCI soil moisture product from 1981 to 2016 (Dorigo et al., 2017) were used to obtain a drought index, the Standardized Soil Moisture Index (SSI). Finally, to evaluate the suitability and potential of SSI index for assessing agricultural drought impacts, we tested it against agricultural productivity.
We will show results of our analysis over the Districts of Maharashtra and Karnataka States in India, which have been affected by severe historical droughts in recent years. In order to integrate drought analysis with crop phenology, we used 18 years annual crop yield data (1998-2015) for two different crops: maize for the monsoon season (July to October); wheat for the winter season (October to March). Crop yield anomalies datasets for every district of the two states were compared with SSI. For a robust statistical analysis SSI was also compared with the Standardized Precipitation Index (SPI; McKee et al, 1993), computed by ground-based rainfall observations in India. The performance of SSI and SPI against agricultural productivity for different crops in the Districts of Maharashtra and Karnataka were tested and SSI showed higher correlation both in the monsoon period as in the winter season. On the contrary, SPI displayed good performance in the monsoon season and low performance for wheat in the winter season. In general, these results have led to the assumption that ESA-CCI soil moisture product can be consistently used for agricultural drought characterization.