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A Case Study on Agricultural Drought Monitoring using ASCAT Surface Soil Moisture at 6.25 km sampling over Eastern Africa

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Agriculture faces increased challenges due to intense and frequent droughts caused by climate change. Accurate and timely monitoring of drought conditions, therefore, becomes paramount to taking quick and decisive actions towards its impact mitigation. Agricultural droughts occur due to prolonged periods of low rainfall and high temperatures, which lead to soil moisture deficits, increasing plant water stress and adversely affecting crops. This study explores the potential use of a new demonstrational ASCAT surface soil moisture (SSM) product sampled at 6.25 km provided by EUMETSAT's Satellite Application Facility on Support to Operational Hydrology and Water Management (H SAF) to monitor agricultural droughts. The study focuses on East Africa, a region severely affected by consecutive years of droughts, resulting in acute food and water shortages that have put the livelihood of millions at risk.

This study offers a preliminary quality assurance of the ASCAT SSM 6.25 km product with ERA5-Land and ESA CCI (passive) SSM, respectively, focusing on the effects of subsurface scattering and changes in land cover. We first conducted a correlation analysis to gain insights into the general quality and subsurface scattering effects in arid regions of East Africa. Furthermore, to address significant wetting trends caused by land cover changes, which were previously observed in the H SAF ASCAT SSM 12.5 km climate data record product (H119), the dry and wet backscatter reference parameters are estimated on a yearly basis as part of the TU Wien change detection algorithm. The effectiveness of this novel approach is then quantified by comparing trends of ASCAT SSM 6.25 km product with trends of the other SSM datasets.

To assess the potential for agricultural drought monitoring, a convergence of evidence approach was used. Here, the ASCAT SSM 6.25 km anomalies are compared to anomalies in CHIRPS precipitation, LSA SAF (Land Surface Analysis of EUMETSAT) land surface temperature, and CGLS (Copernicus Global Land Service) vegetation datasets for previously recorded drought events. We also generated two drought indicators based on anomalies using the ASCAT SSM 6.25 km product: SMAPI (Soil Moisture Anomaly Percentage Index) and Z-scores, which were evaluated with SPEI (Standardised Precipitation and Evapotranspiration Index) to assess the similarity in spatial patterns of droughts.

Our assessments show that the demonstrational ASCAT SSM 6.25 km product corresponds well with other SSM datasets. Moreover, the drought indicators derived from it effectively capture precipitation deficits and increased land surface temperature compared to SPEI (drought conditions), indicating its potential for agricultural drought monitoring.