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Drought monitoring and early warning with satellite soil moisture data

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Many developing countries strongly depend on agriculture, but the sector is challenged by the increasing occurrence of droughts. Unfortunately, advanced agricultural drought monitoring that can trigger early warning and early action is still not widely available for many countries even though it is crucial to stakeholders including local and regional governments, NGOs, farmers, and vulnerable households. Classic drought monitoring tools often rely on precipitation data, which are influenced by the density of station data. Recently, satellite soil moisture data has gained interest, because of its direct link to plant available water content and the increased availability and quality of satellite soil moisture products over remote regions. Furthermore, when using radar observations, such as those from Sentinel-1 and Metop ASCAT spatial resolutions up to kilometers can be achieved and information on spatial variability of drought within districts can be provided. Despite advancements in the development of satellite soil moisture products, there remains a significant gap in their adoption and utilization by stakeholders in drought monitoring tools and operational systems. Although a large number of drought indicators are available (Vreugdenhil. et al. 2022), they lack rigorous quality-control with impact data and are not analysis-ready. In addition, users are not familiar with the data or its benefits and have difficulties interpreting the indicators in the context of operational decision-support.

This study will demonstrate the potential of satellite soil moisture for drought monitoring and yield prediction over Eastern Africa, highlighting strengths and weaknesses of satellite soil moisture. Particularly during the growing season, high correlations are found between different soil moisture products from H SAF Metop ASCAT, ESA CCI and ERA5-Land. During the dry season deviations occur due to subsurface scattering effects on the soil moisture signal. When analyzing droughts, the onset, intensity and duration of droughts differ strongly with the different indicators. For example, for the Gaza region in Mozambique, severe to extreme drought conditions occurred for 1, 4 or 47 months within a 15 year period depending on the chosen drought indicator. The impact of using different drought indicators and thresholds on drought severity classification creates challenges for integrating satellite soil moisture drought indicators in operational systems and parametric drought insurance.

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