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Monitoring agricultural drought in the Mediterranean region using a high-resolution (1-km) standardized evaporation deficit index

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Droughts, with their far-reaching and detrimental effects across multiple domains, remain critical climate events that demand better monitoring and early warning capabilities. Regions that are highly dependent on water supply for agriculture, such as the Mediterranean, are vitally dependent on timely monitoring of drought conditions. The crop losses in the region as a consequence of drought events continue to rise. Simultaneously, climate models agree regarding the exacerbation of drought following global warming in the region. Therefore, better understanding and monitoring of drought occurrence is imperative to mitigate drought adverse effects and improve water resource management in the region and beyond.
Operational drought monitoring, whether based on models or observed data, commonly employs a set of drought indices designed to assess anomalies in land or atmosphere dryness. However, these indices are typically available at relatively coarse spatio-temporal scales, rendering them unsuitable for evaluating the local drought impacts that are relevant to agriculture and ecosystems. This limitation does not facilitate decision-making by local authorities and farmers and impedes the straightforward development of on-site adaptation strategies.
In this study, we undertake the assessment and validation of an evaporation-based drought index, the Standardized Evaporation Deficit Index (SEDI: *Kim&Rhee 2016, GRL*), at an unprecedentedly high resolution (1 km, daily) over the Mediterranean domain. The index is constructed using data of potential and actual evaporation derived using GLEAM (*Miralles et al. 2011, HESS*), as part of the ESA 4DMED-Hydrology project. Unlike most other drought indices, SEDI is directly related to plant water stress, given the significance of the evaporation deficit for plant hydraulic and physiological processes. Such approach offers the potential to provide early-warning information on ecological and agricultural plant water stress at local scales. Our study of the relationship between SEDI and vegetation stress over seven years (2015–2021) and across 28 Mediterranean river basins, sheds light on critical factors that cause differential stress in crops and natural ecosystems under drought conditions. We also explore the role of irrigation in the SEDI–vegetation stress relationship using 1 km irrigation volumes obtained during the 4DMED-Hydrology project. In the future, the framework will be extended globally, with the subsequent aim to provide valuable information for optimizing irrigation timing in major irrigated breadbasket regions.