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Remote Sensing of Water Use and Water Stress in the African Savanna Ecosystem, from local to watershed scale.

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Savannas are among the most productive biomes of Africa, where they comprise half of its surface. They support wildlife, livestock, rangelands, crops, and livelihoods, playing an important socioeconomic role in rural areas. These water-limited ecosystems with seasonal water availability are highly sensitive to changes in both climate conditions, and in land-use/management practices. Since savannas are highly influenced by human activities, private and institutional practices play a key role in their conservation. Although monitoring programs for African savanna water use have been established in certain areas, most of them are largely restricted to point based measurements or coarse scales, and are not fully capable to provide distributed timely information for planning purposes. In this study we develop a mechanism for monitoring the water used by an African savanna ecosystem, located over the Kruger National Park (South Africa), from fine scale (meters) to watershed scale, integrating the effects of the water stress. Our hypothesis is that the Ecosystem Stress Index (ESI), applied with the new generation ESA sensors of Sentinel 2 (S2) and 3 (S3) satellites, is a valuable tool to downscale timely estimates of actual evapotranspiration at coarse scale. To monitor savanna water fluxes in a semi-continuous way this study integrates two different ET-estimation approaches, with different conceptual/operational capabilities and limitations. KC-FAO56 model (Allen et al., 1998), integrating reflectance-based “crop” coefficients, is used to derive unstressed savanna evapotranspiration (with high spatial resolution), and the two-source surface energy balance model -TSEB (Norman et al., 1995), integrating radiometric surface temperature allows the determination of water stress across savannas (ESI, with low spatial resolution). The choice of the two approaches is based on their proven ability to estimate ET over partially vegetated heterogeneous landscapes.