

Applications of the TIGER Savanna water use/stress modelling framework in monitoring Kruger National Park, South Africa.

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Semi-arid savanna sustains wildlife, livestock production, and livelihoods, highly influencing rural economy. The stability of this ecosystem is critical not only for the regional hydrological balance, but also in regulating global land-surface processes and water cycles. The precision, resolution, and accuracy of the information required for savanna water resource management differ across scales: farm-local (e.g. evaluating the effect of management practices, livestock and wild animals densities, crop production and grazing), to watershed (e.g. evaluating the effect of fire, detection of vulnerable areas) and regional (e.g. early prediction of drought). The strength of the modelling framework proposed is its suitability to cover rangeland management from local to broader scales. Our hypothesis is that the Ecosystem Stress Index (ESI), expressed as the ratio of actual to potential evapotranspiration (ET), is a valuable tool to downscale estimates of actual ET at coarse scale, to higher resolutions. Two different ET-estimation approaches are used: KC-FAO56 model integrating reflectance-based “crop” coefficients (Sentinel 2), to derive unstressed (i.e potential) savanna ET at high spatial resolution; and the two-source surface energy balance model -TSEB integrating radiometric surface temperature (Sentinel 3, MODIS and Landsat), to determine the water stress at medium-low spatial resolution. The tool has proved to perform well, validated over eddy covariance experimental sites at Kruger Park, and produced savanna water conditions maps reflecting the heterogeneity of the region, where the differences in meteorological, abiotic and biotic conditions create different savanna sub-types. This study explores the possible operational applications of the products generated, reviewing the outputs characteristics and determining the relevant time, and spatial scales resolutions, for each use.