



The Relationship Between Soil Moisture and Drought Monitoring Using Sentinel-3 SLSTR Data in Lower Eastern Counties of Kenya

Ghada Sahbeni¹, Peter K. Musyimi^{1,3}, Balázs Székely¹, and Tamás Weidinger²

¹ELTE Eötvös Loránd University, Department of Geophysics and Space Science, H-1117 Budapest Pázmány Péter sétány 1/C, Hungary

²ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Meteorology, H-1117 Budapest Pázmány Péter sétány 1/A, Hungary

³Karatina University, Department of Humanities and Languages, P.O BOX 1957-10101, Karatina, Kenya

Drought is an extreme climate phenomenon that influences Earth's water resources and energy balance. It affects hydrological cycle processes such as evapotranspiration, precipitation, surface runoff, condensation, and infiltration. Its extreme and severe occurrences threaten food security and drinking water availability for local populations worldwide. In this regard, this study uses Sentinel-3 SLSTR data to monitor drought spatiotemporal variation between 2019 and 2021 and investigate the crucial role of vegetation cover, land surface temperature, and water vapor amount in influencing drought dynamics over Kenya's lower eastern counties. Three essential climate variables (ECVs) of interest were extracted, namely, land surface temperature (LST), fractional vegetation cover (FVC), and total column water vapor (TCWV). These features were processed for four counties between the wettest and driest episodes in 2019 and 2021. The results showed that Makueni county has the highest FVC values of 88% in April and 76% in both periods and years. Machakos and Kitui counties had the lowest FVC estimates of 51% in September for both periods and range between 63% and 65% during dry seasons of both years. The land surface temperature has drastically changed over time and space, with Kitui county having the highest estimates of approximately 27 °C and 29 °C in April 2019 and September 2019, respectively. A significant spatial variation of TCWV was noticed across different counties, with the lowest value of 22 mm in Machakos county during the dry season of 2019, while Taita Taveta county had the highest estimates varying from 30 to 41 mm during the wettest season of 2021. Land surface temperature variation is negatively proportional to vegetation density and soil moisture content, as non-vegetated areas are expected to have lower moisture. A close link between TCWV and soil moisture content has been well established. Overall, Sentinel-3 SLSTR products depict an efficient and promising data source for drought monitoring, especially in cases where in situ measurements are scarce. ECVs produced maps will assist decision-makers in a better understanding of drought events that extremely influence agriculture in Kenya's arid and semi-arid areas. Similarly, Sentinel-3 products can be used to interpret hydrological, ecological, and environmental changes and implications under different climatic conditions.