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Fusing Landsat and MODIS Data for Enhancing Drought Monitoring in El Salvador

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Climate change in forms of prolonged dry spells and recurrent droughts has caused adverse effects on crop production, subsequently affecting food prices in the domestic markets and threatening the food security especially for poor countries. Drought monitoring over cropping areas is thus an important process for national agricultural planning in addressing food security issues. Optical remote sensing data for regular drought monitoring over fragmented cultivated areas at the local scale reveals drawbacks owing to its coarse spatial resolution. Considering advantages of spatial and temporal resolutions of satellite data produced from different optical sensors, this study aims to develop an approach for cropland drought monitoring in El Salvador using multi-temporal Landsat-MODIS fusion data. The data were processed for 2016–2017 through three main steps: (1) reconstructing MODIS land surface temperature (LST) using random forests (RF), (2) Landsat-MODIS data fusion using the spatial-temporal adaptive reflectance fusion model (STARFM), and (3) drought delineation using the temperature dryness vegetation index (TVDI). The results of LST reconstruction compared to the reference data indicated the average root mean square error (RMSE) value smaller than 1°C. The spectral bands and LST of Landsat data were fused with that of MODIS data (using STARFM). The fusion results compared with that from the reference Landsat data revealed close agreement with the correlation coefficient (r) values of higher than 0.84 for LST and 0.84 for EVI2 (produced from spectral bands). The fusion data were then used for drought delineation using TVDI. The results verified with that from the reference Landsat data indicated close correlation between these two datasets with the r value of 0.8. The TVDI results were reclassified into five classes (i.e. very wet, wet, normal, dry, and very dry) to characterize the spatiotemporal evolution of moisture conditions. The results indicated that the very dry moisture condition was not only observed for dry season, but also for certain periods during the rainy season of the main primera cropping season. Approximately 10.7% of the cropping areas was associated with the very dry moisture condition in the primera season. The findings drew an attention to farmers in drought-prone areas that insufficient rainfall amount for crop irrigation could trigger water stress during crop growth stages, subsequently leading to crop damages and lowering crop yields. Thus, based on spatiotemporal information of drought evolution, farmers should devise management strategies to mitigate adverse effects of droughts on agricultural production.