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Intercomparison of an ET-based Drought Index Derived from Geostationary Satellite Data with Standard Drought Indicators

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The utility and reliability of standard meteorological drought indices based on measurements of precipitation is limited by the spatial distribution and quality of currently available rainfall data. Furthermore, precipitation-based indices only reflect one component of the surface hydrologic cycle, and cannot readily capture non-precipitation based moisture inputs (e.g., irrigation, shallow groundwater tables, lateral flows) that may temper drought impacts, or affect the rate of water consumption across a landscape. The ESI conveys information about actual stress rather than potential for stress and reflects a different component of the hydrologic cycle that has typically not been considered in drought monitoring, focusing on water use (ET) rather than water supply (precipitation). The Evaporative Stress Index (ESI) quantifies anomalies in the ratio of actual to potential ET (PET) mapped using signals of diurnal land-surface temperature change obtained from geostationary satellites (e.g., GOES, MSG, MT-SAT, FY2) and the Atmosphere Land Exchange Inverse (ALEXI) model (Anderson et al. 1997). This study investigates the behavior and response timescales of the ESI through a retrospective comparison with standard precipitation-based drought indices, and with operational drought classifications recorded in the United States Drought Monitor (USDM). Drought indices based on anomalies in both ET and ET/PET are compared over the continental U.S. for the 2000-2010 growing seasons (April to October) to standard drought indicators including the Standardized Precipitation Indices and the Palmer drought indices. Quantitative analysis of spatial and temporal correlation suggests that the performance of the ESI is similar to that of precipitation-based indices of comparable timescale, but with higher spatial resolution and without requiring any precipitation data. This study suggests that the ESI is a useful complement to the current suite of drought indicators, with particular added value in parts of the world where rainfall data are sparse or unreliable. Finally, future work is being focused on the expansion and application of ALEXI and ESI to additional domains (currently Europe and Africa using MSG thermal data) with the ultimate goal of global application of ALEXI and ESI.