NEAR REAL-TIME DETECTION OF DROUGHT SEVERITY USING MODIS TIME SERIES: IMPLICATIONS FOR A NATIONAL MONITORING PROGRAM

J. J. Maynard[a], J. W. Karl[a], D. M. Browning[a]

[a]USDA-ARS, Jornada Experimental Range, Las Cruces, NM, USA – (jmaynard, jkarl, dbrownin)@nmsu.edu

KEY WORDS: Real-time, Monitoring, Climate, Change Detection, Management

ABSTRACT:

The frequency and severity of drought is expected to increase in the 21st century as a result of climate change. Understanding the timing, duration and spatial extent of prolonged periods of drought is important in managing and sustaining the ecological structure and function of managed ecosystems. The U.S. Bureau of Land Management (BLM) manages approximately 70 million ha of public lands within the continental U.S. BLM lands are managed for multiple uses (e.g., livestock grazing, recreation, timber harvesting), with each land-use having different potential ecological impacts in responses to drought. Additionally, the severity of drought across a landscape varies in response to landscape heterogeneity, thus creating even greater spatial and temporal variability in how individual land-uses may impact ecosystem function. Consequently, there is a critical need to develop a spatially-explicit drought monitoring framework that provides near real-time information at spatial scales relevant to land management decisions. Here we present a modeling framework that uses freely available MODIS satellite imagery to calculate the drought severity index (DSI) at a 1 km spatial resolution and 16-day temporal resolution across 70 million ha of BLM managed lands between the years 2000 and 2014. The DSI time series was analyzed using a near real-time disturbance monitoring approach based on a Breaks For Additive Seasonal and Trend (BFAST) model. The BFAST-type season-trend model automatically identified and modeled stable historical variation within each pixel time series from 2000 to 2009. Newly acquired data (2009-present) was then evaluated relative to this stable baseline, with significant positive (wetter) or negative (drier) deviations identified. Results from several drought-prone areas were evaluated using field-based soil moisture data. This approach quantified both the magnitude and date of significant change, providing land managers with spatially explicit near real-time information on drought condition that can help direct management actions to minimize land-use impacts.