Spatial Visualization of Historical Drought Impact on Agriculture in North and South Carolina

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Historical drought events have had severe impacts on Carolina's agriculture, but attempts to quantify and compare these impacts across space and time have been challenging because of the nonlinear and non–stationary nature of the crop yield time series. Crop yield and production are controlled by many factors, including scientific and technological advances, as well as weather and climate. This study distinguishes weather and climate factors from technological factors to allow spatial visualization of drought impact on agriculture. We use long–term state– and county–level corn and soybean yield data in North and South Carolina. We compare six trend simulation methods: a simple linear regression model, a second order polynomial regression model, a centered moving average model, a locally weighted regression model, a spline smoothing model and an empirical mode decomposition model. We find that a locally weighted regression model, coupled with a multiplicative decomposition model, is an appropriate data self–adaptive detrending method to remove the long–term trend from crop yield time series. We use these results to quantify the relationship between state–level detrended corn and soybean yield and multiple drought indices. Detrended corn yield is highly correlated with multiple drought indices in June, July and August, and detrended soybean yield is highly correlated with multiple drought indices in July, August and September. Finally, we show how the detrending process allows spatial visualization of drought impacts on corn and soybean yield in the Carolinas by using gridded 3–month SPI values to highlight the impacts of historical major droughts on corn and soybean yields.