Drought and its relationship to long-term climatological indicators in the Apalachicola-Chattahoochee-Flint River Basin

Kelly Stevens & Paul Ruscher
Department of Meteorology • The Florida State University

Recognition of water as a vital and sometimes limited resource is becoming increasingly important in many regions of the world. The water wars of the Apalachicola-Chattahoochee-Flint River Basin (ACF) began in the 1980s when a series of droughts in the southeast United States significantly reduced flows in the three named rivers. Water restrictions and allocation became a source of debate between the states of Alabama, Georgia, and Florida, who share the integral resources provided by the waters in the ACF.

Our study is an in depth continuation of a previous study by Arrocha and Ruscher (2005) that focused on precipitation deciles in attempt to identify historical droughts in the ACF. The previous study concluded there was no obvious pattern or relationship between precipitation deciles and the climate pattern known as the El Niño-Southern Oscillation (ENSO). Our study utilizes more surface meteorological variables including monthly maximum and minimum temperature, along with precipitation. The data is attained from 30 cooperative first order stations ranging over 7 climate divisions in the ACF, provided through National Climatic Data Center (NCDC). The Parameter-elevation Regressions on Independent Slopes Model (PRISM) data set was also utilized to fill in missing values for the surface variables from the years 1900-2001. The extensively used Standardized Precipitation Index (SPI) is computed and largely considered as a potential drought indicator for the purposes of this study. SPI was developed by McKee et al (1993) and uses a standardized probability distribution function based on the long term precipitation record to create an index for a particular area, ranging from -4 (severe and rare drought) to 4 (extremely wet period). The climate indices considered are the Atlantic Multidecadal Oscillation (AMO), North Atlantic Oscillation (NAO), Pacific Decadal Oscillation (PDO), and the Southern Oscillation Index (SOI). Previous research suggests each of these climate oscillations to have in impact on the aforementioned surface variables in the Southeast.

Our study includes careful investigation of the statistical relationships between all the variables using several approaches. One such method for the basic understanding of the patterns and frequencies is investigated using the Fast Fourier Transform (FFT). Relationships and possible predictability between the surface variables in the ACF and the climate indices is explored using both Multiple Linear Regression (MLR) and Canonical Correlation Analysis (CCA). We use this method to examine possible spatial and temporal patterns between drought and the four climate indices to work towards development of a possible predictor-predictand model to aid in the understanding of meteorological forcings on the hydrologic cycle of the volatile Apalachicola-Chattahoochee-Flint River Basin.