Abstract

The diurnal temperature ranges (DTRs) in the Southeastern United States have a wide distribution of magnitudes, and patterns in this distribution are witnessed on both spatial and temporal scales. Rapid or intense changes in daily temperatures can cause heartburn in animals or trigger a fire risk grid; therefore an accurate prediction of these climate-driven fluctuations will be helpful for the suppression, cattle, and energy industries. It is hypothesized that in addition to seasonal and annual distributions, DTRs also vary with respect to the climatological phase of the El Niño Southern Oscillation (ENSO). It is well documented that ENSO impacts on temperatures in the Southeast US, especially in the winter months. A 62-year record of quality-controlled observations collected from the National Weather Service’s Cooperative Observer Network (COOP) is being used for analysis. Probability distribution functions (PDFs) will be applied to show that DTRs vary in response to El Niño or La Niña with statistical significance. These varied temporal will be shown both temporally and spatially across the region. Results will show that DTRs are extreme with a higher probability during the La Niña phase compared to the mean, particularly during seasonal transitions. The converse is true for the El Niño phase. These results allow seasonal predictability of the extreme DTR events depending upon the current or expected phase of ENSO.

Case Study: Ocala

- The Conditional Ratios (CR) show the ratio between the Relative Frequencies (RF) of counts in DTR bins between La Niña and El Niño.

DTR Histogram, Station 86414, during DIF

Data & Methodology

- Temperature maxima and minima drawn from the National Weather Service’s Cooperative Observer Network (COOP), NCDC’s (2013), including five southeastern states (NCDC 2008). This data is quality controlled and missing values were replaced with a documental method using surrounding stations with multiple linear regression (Smith 2006).

Significance Testing

- Bootstrapping technique applied to the data.
- 1000 “simulated climatological” draws from 62 years of ENSO data with replacement
- The observed conditional ratios are compared with the simulated conditional ratios.
- The significance test determines whether the Conditional Ratios are significantly different from unity (1.0) with 95% confidence.
- Values are significant with respect to La Niña (>1.0) or El Niño (<1.0)

Conclusions & Future Work

- DTRs are normally distributed in the Southeastern US.
- During the winter and spring months, the distribution of DTRs during El Niño is shifted towards lower ranges, while the distribution of DTRs during La Niña is shifted towards higher range. It is noted that this is not reflected during summer or autumn.
- During the winter and spring months, the probability of high DTRs is 10% to 20% greater for La Niña. The probability of low DTRs is 10% to 20% greater for El Niño.
- The CRs show during the La Niña, higher DTRs are significant 2-4 times more common than during El Niño. Conversely, during El Niño, lower DTRs are significant 2-4 times more common than during La Niña in winter and spring.
- This signal is not strongly evident in the summer months, it is generally at least twice as large in surrounding significant differences. Spring ratios are generally also twice as large as winter ratios.

These results indicate that predictions of extreme (low or high) DTRs based on ENSO phase is possible, but further work is needed to explore the mechanisms (such as moisture or urban effects) for those DTR shifts during different ENSO phases must be sought. Possible connections with the AMH or AO is needed especially significantly. Additionally, exploring specific lead times to butterfly and cattlehead will be helpful for the equestrian, cattle, and energy industries.

References


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