Weather: Modeling Climate Change

Problem statement

Climate can be viewed as the long-term trends and variability in meteorology, typically precipitation, wind speed and surface temperature. Human-induced climate change - caused by the additional input of greenhouse gases into the atmosphere - is a hot topic today, particularly because of its association with changes in these variables.

While anthropogenic emissions have had a substantial impact on the global climate, there are other factors that play important roles. Most notably are the natural oscillations (recurring climate cycles whose effects are not attributable to humans), which have altered meteorology on local and global scales (Trenberth and Fasullo, 2013). El Niño is perhaps the most well-known of these phenomena for its connection with meteorological conditions in the western United States (Barlow et al., 2001; Rasmussen and Wallace, 1983). Because of such associations, skill in predicting the behavior of these oscillatory events would be invaluable for farmers, insurance companies, etc. who rely on weather for their jobs.

Project goal: The goal of this project is to model climate variation (measured via surface temperatures) over time and location across the globe to address a specific inference of interest.

Data Recources

We will provide a base data set of sea surface temperatures, but additional data can (and should) be collected from publically available sources as weathern underground. A glimpse of the data can be found here (suggestion: browse the README file):
ftp://ftp.cdc.noaa.gov/Datasets/icoads/2degree/

High-level project goals

1. The first step is to parse the data set. The data is composed of sea surface temperature readings from a grid around the globe over a long period of time (some measures since 1800). There is a lot of missingness that needs to be handled properly.

2. Create several models that explore the temporal relationship of climate change, and to see if other factors (like natural climate cycles) may account for such changes. Provide a specific inference that you are interested in exploring ('does climate change exist?' is too broad).

3. Perform a comparison of your models. This should include an error analysis and an evaluation of the predictive quality of your models. This should also compare the result of your inference across the various models.

References

1. Barlow, M., S. Nigam and Berbery, E. H. (2001): ENSO, Pacific decadal variability, and U.S. summertime precipitation, drought, and streamflow. J. Climate, 14, 2105-2128.

2. Hsieh, W. and Tang, B. (1998): Applying Neural Network Models to Prediction and Data Analysis in Meteorology and Oceanography. Bulletin of the American Meteorological Society, 79, 1855-1870.

3. Rasmussen, E. M. and Wallace, J. M. (1983): Meteorological aspects of the El Niño/Southern Oscillation. Science, 222, 1195-1202.

4. Trenberth, K. E., and Fasullo, J. T. (2013), An apparent hiatus in global warming? Earth's Future, 1, 19-32, doi:10.1002/2013EF000165.