Trend Analysis of Annual Maximum Daily Precipitation over North America Using MERAA and NCEP NARR Products

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Analysis of climate extremes is an emerging research area which has recently captured increasing interest among climate scientists and statisticians. Extremes by definition are rare events and lack of long term datasets is always a very challenging issue in modeling extremes. The problem becomes even harder when one tries to analyze extremes by the use of satellite observations. However, the global coverage of satellite observations, especially in remote regions where gauge and radar data are not available, is very helpful. With respect to climate studies, the problem with satellite observations is that they are not either long enough, or their coarse spatial temporal resolution makes their application limited. Here is where Reanalysis products can be very helpful. Reanalysis products are globally available at fine temporal and spatial resolution for long periods. Two reanalysis products called MERRA and NCEP NARR are used to investigate potential trends in annual maximum daily precipitation for the period of 1979 to 2010. The region of interests is North America where the performances of these reanalysis products are compared with radar and gauge data. “De-clustering” method is used to remove the potential temporal dependency between data. Extreme Value Theory, which is one of the most important disciplines in Statistics, is utilized for modeling extremes precipitation events. Two approaches are considered. In the first approach, a block maxima approach is taken. Based on that, only the maximum point of each block (such as a year) is considered to extract the time series of annual maximum daily precipitation. Generalized Extreme Value (GEV) is considered as the approximate distribution of this time series. In the second approach, a certain threshold is considered and the points that exceed that threshold are considered for modeling. Based on this method, more information will be available. Generalized Pareto Distribution (GPD) is used to model the exceedance over threshold points. Maximum Likelihood Estimate (MLE) method is used to estimate the GEV and GPD parameters. In both cases, a liner trend is considered for location parameter and log of scale parameter. In addition, the potential impacts of El-Nino Southern Oscillation (ENSO) and North Atlantic Oscillation (NAO) phenomena on extreme precipitation events are incorporated into the process model for location parameter. For this purpose, SOI (Southern Oscillation Index) and NAO are incorporated as two covariates. ENSO and NAO are considered for potential teleconnections with precipitation in the western and eastern parts of United States, respectively. To find out if incorporating these covariates has improved the model, likelihood-ratio test is performed. This is an ongoing project and the results will be presented in the meeting.

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