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Feasibility of the use of Wavelet theory for the analysis of climate changes

R. A. C. S. Ranawaka*

Faculty of Arts and Sciences, Sri Lanka Technological Campus, Padukka
*chathurir@sltc.ac.lk

Climate is the most important component that affects the environment, with direct and indirect influences of human activities. Generally, climate is the average weather prevailing over an area. The climate is dynamic in many ways, for example, changes in time and space, and the changes occur over fairly long time. Climate change is the change of patterns of climate factors of a region in the particular time period. The purpose of this study is to apply the Wavelet techniques for analyzing the climate changes of two districts of Sri Lanka. The two districts representing two different provinces were chosen for the study, which are Ratnapura and Hambantota. Ratnapura district has a wet climate zone whereas Hambantota represents dry zone of the country. The analysis was carried out through monthly secondary data of last twenty-four years (1990-2013) which were collected from the Department of Meteorology, Sri Lanka. Although there are several climatic factors affect the climate change; this study examines climate factors such as diurnal variation of temperature, maximum and minimum humidity and rainfall. This paper shows the application of the Wavelet transform for each climate factor other than the time series. Further, cross wavelet analysis is also conducted. The Wavelet analysis is frequently used as a tool to study the periodicity in climate time series since that is a method to decompose a time series-frequency space. According to the result of periodic patterns, it is possible to predict the future climate of regional and global. Wavelet can be introduced as the next level with a Fourier series. When Wavelet transform localizes both time and frequency, the Fourier transforms localize only the frequency. The collected data were analyzed to obtain Box plots, Time Series and Scatter Plots with the MINITAB software and Power Spectrums with the R Software. The box plot analysis demonstrates the dispersion of monthly data of each factor. The results concluded that the highest rainfall occurred in October and November for both districts. Furthermore, in both districts, the maximum the Diurnal variations of temperature and maximum relative humidity occurred in February and November respectively. Periodicities (monthly/annually band) of each factor for both districts were identified by the Wavelet Analysis. For the diurnal variation of temperature, there is a dominant constant annual oscillation in Ratnapura for the whole 24 years. Hambantota also has an annual periodicity for the whole 24 years, except years between 999 - 2003. It shows that 4 - 8 and 8 - 16 monthly band periodicities have occurred in both Ratnapura and Hambantota before 1998 for the maximum relative humidity. Similarly, the results can be interpreted for all factors. As future work, this can be applied to the whole country with the improved mathematical program through modern mathematical tools.

Keywords: Climate, Climate Factors, Wavelet Analysis, Time series, Power Spectrum