SPATIAL AND TEMPORAL VARIATION OF RAINFALL DURING SOUTH-WEST MONSOON PERIOD IN SRI LANKA AND GLOBAL TELECONNECTIONS

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ABSTRACT

Water plays both an important constructive function in modulating all the biological systems and destructive functions in physical systems on the Earth. Rainfall is one of the forms of water received from the atmosphere. The prediction of rainfall behavior is of importance in planning of agricultural and livestock activities, hydropower management, epidemiological prediction as well as disaster management. The anomalous behavior of the rainfall poses difficulties in accurately predicting chaotic nature of rainfall patterns and the associated parameters. The objective of the study was to examine the spatial and temporal behavior of rainfall and its relationship to teleconnections.

The mean monthly rainfall data of 24 stations from January 1961 to December 2010 were obtained from the Department of Meteorology. They were transformed into cumulative departure from mean and monthly rainfall anomaly using standard procedures. Missing data were replaced by mean using multiple imputations. The data relating to vector wind and vector wind anomaly, mean sea level pressure anomaly, outgoing longwave radiation, and outgoing longwave radiation anomaly, and velocity potential anomaly at pressure levels of 850, 500, and 200 hPa for the 50-year period from 1961 to 2010 were obtained from the National Centre for Environmental Prediction / National Centre for Atmospheric Research (NCEP / NCAR). The datasets were divided into 5-decade sub-sets to facilitate the analyses of the decadal variation of the parameters. Data were subjected to descriptive analysis and correlation analysis. Climatology maps were developed using rainfall anomaly and relevant data for each decade. Cumulative departures from the mean were mapped. Composite analysis was carried out for ENSO extreme and Pacific Decadal Oscillation indices for the

datasets. Principle component analysis was carried out in order to obtain temporal and spatial variants in rainfall data. Partial Least Squares Structural Equation Modeling (PLS-SEM) was performed on the rainfall teleconnection indices. Long-Short Term Memory (LSTM) was developed and validated for the predictive relevance of artificial neural networks in relation to teleconnection indices.

A discernible spatial variation in SWM rainfall was observed in the stations along the southwestern coastal belt and southwestern slopes of the Hill country indicating the strong relationship between the variation of wind velocity, alteration of the Walker cell position, and OLR anomaly. A gradual, uneven decadal reduction in SWM rainfall was observed from 1961 to 2000 and from 2000 onwards there was a reduction with minimum local minima. The recent chaotic behavior of SWM rainfall indicated an abortive progression of SWM. The PLS-SEM analysis of teleconnections showed their influences through direct, and indirect links to the SWM rainfall, and the effect of NINO, NAO, WHWP, and PDO were predominant on the SWM rainfall. PLS-SEM demonstrates its candidacy in filtering the variable in complex climatic systems. The values of LSTM predicted and observed rainfall values indicated a strong agreement during the modeling approach of predicting SWM rainfall from the selected teleconnection indices. The LSTM model was further improved through the incorporation of the rest of the teleconnections and other relevant parameters. The behavior of LSTM in predicting SWM rainfall implies the capability of Neural networks in the prediction of the time-bound parameters.