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Multi-Site and Multi-Variables Statistical Downscaling Technique in the Monsoon Dominated Region of Pakistan

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South Asia is under the severe impacts of changing climate and global warming. The last two decades showed that climate change or global warming is happening and the first decade of 21st century is considered as the warmest decade over Pakistan ever in history where temperature reached 53 0C in 2010. Consequently, the spatio-temporal distribution and intensity of precipitation is badly effected and causes floods, cyclones and hurricanes in the region which further have impacts on agriculture, water, health etc. To cope with the situation, it is important to conduct impact assessment studies and take adaptation and mitigation remedies. For impact assessment studies, we need climate variables at higher resolution. Downscaling techniques are used to produce climate variables at higher resolution; these techniques are broadly divided into two types, statistical downscaling and dynamical downscaling. The target location of this study is the monsoon dominated region of Pakistan. One reason for choosing this area is because the contribution of monsoon rains in this area is more than 80 % of the total rainfall. This study evaluates a statistical downscaling technique which can be then used for downscaling climatic variables. Two statistical techniques i.e. quantile regression and copula modeling are combined in order to produce realistic results for climate variables in the area under-study. To reduce the dimension of input data and deal with multicollinearity problems, empirical orthogonal functions will be used. Advantages of this new method are: (1) it is more robust to outliers as compared to ordinary least squares estimates and other estimation methods based on central tendency and dispersion measures; (2) it preserves the dependence among variables and among sites and (3) it can be used to combine different types of distributions. This is important in our case because we are dealing with climatic variables having different distributions over different meteorological stations. The proposed model will be validated by using the (National Centers for Environmental Prediction / National Center for Atmospheric Research) NCEP/NCAR predictors for the period of 1960-1990 and validated for 1990-2000. To investigate the efficiency of the proposed model, it will be compared with the multivariate multiple regression model and with dynamical downscaling climate models by using different climate indices that describe the frequency, intensity and duration of the variables of interest.

KEY WORDS: Climate change, Copula, Monsoon, Quantile regression, Spatio-temporal distribution.