Geophysical Research Abstracts
Vol. 20, EGU2018-11645, 2018
EGU General Assembly 2018

Time-Invariant and Time-Varying Downscaling Approaches for the Assessment of Extreme Temperatures Rise during 21st Century

Subbarao Pichuka (1) and Rajib Maity (2)

(1) Indian Institute of Technology Kharagpur, Civil Engineering, India (srpichuka@gmail.com), (2) Indian Institute of Technology Kharagpur, Civil Engineering, India (rajib@civil.iitkgp.ernet.in)

Future temperature rise within cities in the 21st century is assessed through time-varying and time-invariant downscaling approaches. A few Indian cities namely Delhi, Kolkata, Hyderabad, Mumbai, Chennai and Bengaluru are considered for this study. Outputs of two GCMs, namely Hadley centre Coupled Model, version-3 (HadCM3) and Canadian Earth System Model, version-2 (CanESM2), are used for downscaling. Observed historical temperature data is obtained from the India Meteorological Department (IMD). The relationship between causal and target variables is assumed to be time-invariant in most of the statistical downscaling approaches. Such relationship is debatable in the context of climate change. The historical timeseries of urban temperature may exhibit non-stationarity due to rapid increase in the recent past as compared to historical period. The daily maximum (Tmax) and minimum (Tmin) temperature values of each month are considered for the analysis. First, Tmax and Tmin are downscaled using time-varying (Time Varying Downscaling Model i.e. TVDM) approach and the outputs are compared with the time-invariant (Statistical Downscaling Model i.e. SDSM) approach. On an average, across all the cities, the difference between observed Tmax and downscaled Tmax during baseline period range between $\pm 0.3^{\circ}$C and $\pm 1.2^{\circ}$C using TVDM and SDSM respectively. It indicates the superiority of time-varying (TVDM) approach over time-invariant (SDSM) approach as the outputs corresponds better to the observations in the former case.

Next, the future temperature is downscaled for two different Representative Concentration Pathways (RCPs) scenarios – the data from medium-low type (RCP4.5) and high-emission (RCP8.5) scenarios are procured from CMIP5 data portal. The future period is divided into three epochs (30-years each) named as epoch-1 (2006-2035), epoch-2 (2041-2070) and epoch-3 (2071-2100) respectively. It may be noted that HadCM3 output is available only upto 2035, hence it is analyzed only for epoch-1. The temperature rise (both Tmin and Tmax) is compared with the baseline period (1971-2000). The maximum rise in Tmax is noticed during the monsoon (July-September) and winter months (November-February) during epoch-3 using RCP8.5 scenario as per TVDM. The increase is drastic ($\sim 4^{\circ}$C) during peak summer months (May and June). The comparison results reveal that SDSM show less increase as compared to the TVDM during the future period. On an average, the difference (TVDM-SDSM) of Tmax in future period (epoch-3) is almost double in RCP8.5 scenario as compared to RCP4.5. The maximum difference of 3.3°C and 4.6°C is observed as per RCP4.5 and RCP8.5 respectively in the capital city (Delhi) during September month. On the other hand, on an average, Tmin is found to rise by 1.8°C (1.2°C) for RCP8.5 (RCP4.5) scenario during epoch-3. Overall, the time-varying (TVDM) approach shows more rise during the future period as compared to time-invariant (SDSM) approach and the results from the former is more reliable since its performance during baseline period was much better than the latter.