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Recent Climate Trends over the Western Himalayas: An Application of Regional Climate Model (RegT-Band)

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It is a well-known fact that the present day General Circulation Models (GCMs) are unable to represent various regional scale processes because of their coarser resolution. On the other hand Regional Climate Models (RCMs), which have well established resolvability of sub-grid scale features such as topography and clouds may perform better compare to GCMs. So keeping in mind the edge of RCMs over GCMs an attempt has been made to study the regional climate especially the precipitation and surface air temperature during recent decades over the Western Himalayas (WH), which comes under East Asia CORDEX domain. This region receives its wintertime precipitation mainly in the form of snow, which is the main source of water for most of the Northern Indian Rivers. Recent studies using observational data show the variability of temperature and precipitation over this heterogeneous region for wintertime (December, January, February, DJF). In the present study, performance of tropical band version of regional climate model is examined in representing wintertime circulation and precipitation features (as well as variation in extreme years) during recent decades.
Latest version of ICTP Regional Climate Model (RegT-Band) has been integrated for a period of 30 years (1981 - 2011) at a horizontal resolution of 45 km. The model has been integrated for four months i.e. for each winter season separately (Nov 1981-Feb 1982; Nov 1982-Feb 1983;. . . ; Nov 2011-Feb 2012) where first one month is kept for model spin up. In order to understand the large scale circulation pattern as well as mid latitude synoptic systems that influence the climate/weather situation over the study area, the model domain is extended from 30˚S - 55˚N and 30˚E – 120˚E. The initial and lateral boundary conditions in the model are provided from National Centre for Environment Prediction (NCEP) - Department of Energy (DOE) reanalysis 2 data. The geophysical parameters from the United State Geological Survey and weekly mean sea surface temperature from National Oceanic and Atmospheric Administration are used to provide surface boundary conditions. The forcing data are interpolated spatially to the model grid. The model-simulated results are critically evaluated with NCEP-DOE reanalysis as well as surface observation data obtained from Snow and Avalanche Study Establishment (SASE), India.
Model simulated climatology of wind, temperature at different pressure levels agrees well with the verification analysis. The variation in circulation pattern between excess and deficit precipitation years also brought out well by the model. The comparison of the results of the RegCM simulation over the Western Himalayas with the SASE observations shows that the model can reproduce satisfactorily the temporal evolution of temperature and precipitation. A complete and statistically robust validation (such that bias, Root Mean Square Error (RMSE), spatial correlation coefficient (CC) and skill scores like Equitable Threat Score (ETS), Probability of Detection) also suggests that the RegT-Band model is able reproduce the climate of the recent past over the Western Himalayas reasonably well.

Key Words: Western Himalayas, winter precipitation, RegCM4.