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Seasonal Change Detection and Attribution of Surface Temperature changes over Interior Peninsular Region of India

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A good number of studies have investigated recent trends in the observed and simulated hydrometeorological variables across the world. It has been challenging for the research community to address whether the significant change in climate over the course of 2nd half of 20th century is caused either due to natural or manmade effects. Although evidences for an anthropogenic contribution to climatic trends have been accumulated rapidly worldwide, for India these are scarce. Hence the formal efforts have been undertaken to distinguish whether the recent changes in seasonal temperature over India occurred due to natural internal variation of climate system or human influence using rigorous detection and attribution (D&A) procedure.
The surface temperature is the most widely cited indicator of climate fluctuation. Hence maximum and minimum temperatures (Tmax & Tmin) which are among the six most commonly used variables for impact assessment studies are analyzed here. Seasonal divisions are based on conventional meteorological seasons: January-February (winter); March-May (pre monsoon); June-September (monsoon); October-December (post monsoon). Time span considered for this study is 1950-2005.
Climate Research Unit (Version 3.21) gridded monthly temperature datasets are considered as observed data. Initially TFPW-MK (Trend Free Pre Whitening Mann Kendall) test is used to search the significant trends in the four seasons over all India. Temporal change detection analysis in evapotranspiration (which is one of the key processes in hydrological cycle) is essential for progress in water resources planning and management. Hence along with Tmax and Tmin, potential evapotranspiration (PET) has also been analyzed for the similar conditions. Significant upward trends in Tmax, Tmin and PET are observed over most of the grid points in Interior Peninsula (IP) region over India. Significant correlation was obtained between PET and Tmax compared to PET and Tmin. Trends in Tmin clearly indicate the impact of anthropogenic GHGs (as it occurs during clear cloudless nights).Hence both Tmax and Tmin are considered for further analysis.
In the next step formal D&A analysis is carried out to assess the change in seasonal temperature of IP region considering seasonal Tmax and Tmin. While simulating historical temperature changes over India, climate models from CMIP5 performed better than CMIP3. Therefore, simulations from five different sets of experiments (piControl, historical, historicalNat, historicalMisc, historicalGHG) from CMIP5 are used. Fingerprint based D&A (Hasselmann, 1979) approach is employed here. Fingerprint is the expected pattern of climate response to anthropogenic forcing and it is searched in the observed and model responses with respect to different experiments. It is observed from the D&A analysis that variability in Tmax during post monsoon season and Tmin during pre monsoon and monsoon seasons are beyond the range of natural internal variability.

Hasselmann, K. 1979. On the signal-to-noise problem in atmospheric response studies. Meteorol.trop. oceans, 251-259.