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Short Comminucation

Temperature trend analysis of four stations of Chhattisgarh state

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Air temperature is one of the important weather elements which is discussed in most scientific conclave during the recent decades on the backdrop of global warming / climate change. Global surface mean temperature is likely to increase between 1.1°C and 2.6°C under RCP 4.5 scenario by the end of 21st century when compared to 1986-2005 period (IPCC, 2014). Under Indian conditions, many studies have been conducted on temperature trend at national, regional, state level and recently it has been reported that annual mean temperature of the country has increased by 0.6°C during 1901-2010 (Srivastava *et al.,* 2017).The ill effect of temperature rise on agricultural production is of great importance as the demand for food grains is increasing to feed the burgeoning population of the country.Trend analysis of weather elements and its rate of increase/decrease, change point detection would give better insight on climate change that occurs in a particular region. Keeping the above points in view, the present study is aimed to perceive trend, rate of change and change point in annual and seasonal temperature (maximum and minimum) at four locations of Chhattisgarh State.

Daily maximum and minimum temperatures for Raipur, Bilaspur, Ambikapur and Jagadalpur stations were collected from the Department of Agrometeorology, Indira Gandhi Krishi Viswavidyala, Raipur. The length of data period available for study was 33 years (1981-2013) for all stations except for Bilaspur (31 years; 1983-2013). Daily temperature data was converted in to seasonal viz. winter (Jan–Feb), summer (March–May), southwest monsoon (June –Sep), post monsoon (Oct–Dec) and annual format using weathercock software (Rao *et al.,* 2011).

The Mann-Kendall and Sen's slope estimate analysis was carried out. Sen's non parametric test is carried out to find slope of a trend and it can be used when trend is assumed to be linear. The change point refers to a point in time at which the parameters of the underlying distribution or the parameters of the model used to describe the time series abruptly change (e.g. mean, variance and trend). The techniques as described by Chakraborty *et al.,*(2017) have been applied in the present study.

Trend in maximum temperature (Tmax)

Results of Mann-Kendall and Sen's slope estimator analysis for annual maximum and minimum temperatures showed that the annual temperature has significant (@0.05°C y^{-1}) at Bilaspur (Table 1), while it has significant decreasing trend @ 0.025°C y^{-1} at Jagdalpur. The seasonal trends were more or less similar to annual trends. At Jagdalpur, the decreasing trend was significant during summer and S-W monsoon seasons only. The increasing trend at Bilaspur was significant in all the seasons except S-W monsoon season when it was non-significant. At other stations the trends were significant on annual as well as on seasonal basis. Change point analysis revealed that the significant changes in annual and seasonal maximum temperatures occurred in 1992, 1993, 1998 and 1999 at Jagdalpur and Bilaspur (Table 1).

Trends in minimum temperature (Tmin)

The minimum temperature has increasing trend only at Raipur and decreasing trends at all other stations. The increasing trend at Raipur was significant in annual as well as in all the seasons except winter where it was non- significant (Table 1). The decreasing trend at all other stations were non-significant except at Jagdalpur in annual as well as seasonal basis. However, at Ambikapur in winter season and at Bilaspur in summer season it was significant at 5 and 10 per cent level. The change point analysis of minimum temperature revealed that 1993, 1998, 1999 and 2000 were the years of sudden change in minimum temperature in different seasons at Raipur and Jagdalpur (Table 1).

Table 1: Annual and seasonal temperature trend, Sen's slope estimate and change point year at four stations of Chhattisgarh State

Station Name	Parameter	Winter	Summer	Southwest monsoon	Post monsoon	Annual
Ambikapur	Tmax	Increase-NS (0.026)[NS]	Increase-NS (0.006)[NS]	Decrease-NS (-0.009)[NS]	Increase-NS (0.018)[NS]	Increase-NS (0.000)[NS]
	Tmin	Decrease** (-0.038)[NS]	Increase-NS (0.013)[NS]	Decrease-NS (0.000)[NS]	Decrease-NS (-0.015)[NS]	Decrease-NS (-0.007)[NS]
Jagdalpur	Tmax	Decrease-NS (-0.022)[NS]	Decrease* (-0.023)[NS]	Decrease*** (-0.040) [1998***]	Decrease-NS (-0.011) [1992*]	Decrease** (-0.025) [1993**]
	Tmin	Decrease*** (-0.039) [1998***]	Decrease-NS (-0.096)[NS]	Decrease* (-0.020) [1999***]	Decrease-NS (-0.026) [1998**]	Decrease** (-0.043) [1998***]
Raipur	Tmax	Increase-NS (0.012)[NS]	Increase-NS (0.011)[NS]	Increase-NS (0.000)[NS]	Increase* (0.027)[NS]	Increase-NS(0.011)[NS]
	Tmin	Increase-NS (0.010)[NS]	Increase*** (0.058) [2000***]	Increase*** (0.042) [1993***]	Increase*** (0.049) [1996*]	Increase*** (0.046) [2000***]
Bilaspur	Tmax	Increase*** (0.074)[1998*]	Increase* (0.040)[NS]	Increase-NS (0.025)[NS]	Increase*** (0.060) [1999**]	Increase*** (0.050) [1998***]
	Tmin	Decrease-NS (-0.023)[NS]	Decrease* (-0.048)[NS]	Decrease-NS (-0.026)[NS]	Decrease-NS (-0.044) [1990**]	Decrease-NS (-0.025) [NS]

Note: *, ** and *** refers to significance at 10, 5 and 1 level, respectively; NS – Non significant; Values in round parenthesis ( ) is Sen's slope estimate indicating rate of change/year during the period of study. Significant change point year given in square parenthesis [ ] and NS – Non significant; *, ** and *** refers to significance at 10, 5 and 1 level, respectively;

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