

Short communication

Temperature trends across the different zones of Jammu region

**M.K. KHUSHU, MAHENDER SINGH, VISHAL SHARMA, CHARU SHARMA,
and SANJAY KAUSHAL**

*All India Coordinated Research Project on Agrometeorology
Sher-e-Kashmir University of Agricultural Sciences & Technology – J
Main Campus, Chatha, Jammu – 180009 (India)
Corresponding author: (dr_khushu@yahoo.co.in)*

A global warming of approximately 0.7°C has occurred over the past century, and is projected to cause a further 1 to 4°C increase during the twenty first century, primarily as a result of increasing concentrations of greenhouse gases (IPCC, 2007). A specific warming period started around 1980 and continued at least until 2005, with a temperature increase of about 0.17°C per decade (Lehmann *et al.*, 2011). Many studies reported that the upward temperature trend is significantly a result of primary human impacts such as greenhouse gases (IPCC 2001) and land use (Pielke *et al.*, 2007). According to Kothawale and Rupa Kumar (2005), the all-India mean annual temperature has increased by 0.5°C in the period 1901–2003 with temperature rise by 0.4°C and 0.7°C during winter and post-monsoon seasons, respectively. However, during the last 2–3 decades, the increase in the maximum and minimum temperatures during October to February has been about 0.3°C more than that during the rest of the months as reported by Dash and Hunt (2007). The findings also suggest that over the last two decades non-GHG anthropogenic processes have also contributed significantly to surface temperature changes (de Laat and Maurellis, 2006). On time scales of years to a decade, naturally induced surface temperature changes can dominate current anthropogenic warming of 0.2°C per decade (Easterling and Wehner, 2009) especially in some locations, where regional changes can exceed the global change.

Despite the availability of overwhelming evidence in support of climate change, uncertainty prevails over the precise nature of these changes especially at local level, making it difficult to plan and develop appropriate adaptation strategies, programmes, and technologies. Therefore, the present study was carried out with a broad objective of finding out the various decadal temperature trends across the different zones of Jammu region in order to develop strategies and future crop planning especially rainfed to cope up the warming impact on our crops.

Keeping importance of temperature, 30 years daily temperature data of different locations collected from India Meteorological Department (IMD), Pune and Agrometeorology Research Station of Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu are analysed. The Jammu province is broadly divided into three zones *namely* Low altitude sub tropical zone (Zone I), Sub tropical temperate transitional zone (Zone II) and Mid to high altitude temperate zone (Zone III). Among these three zones 5 representative locations were selected for studying temperature trend (Table 1). Time series analysis using the data on daily maximum and minimum temperatures and statistical significance of trends in temperature was examined using Mann-Kendall Test Statistics (Libiseller and Grimall, 2002).

Annual mean temperature trends

The rate of increase in temperature per decade was found maximum in Zone III (0.45°C) followed by Zone I (0.35°C) and then Zone II (0.30°C) (Table 1). This increase in temperature might be due to the deforestation, human intervention, industrialization and urbanization in these zones. Analysis of annual mean temperature data of three zones of Jammu province showed the increasing temperature trend from the year 1980 (Fig. 1).

The annual mean temperature of Jammu station varied between 22.2°C to 24.2°C. with significant increasing trend at the rate of 0.03°C per year and an overall increase of 0.84°C (Fig. 1). Katra station which lies 140 m above the Jammu station, the annual mean temperature varied between 19.1°C to 21.9°C with significant increasing trend 0.04°C per year. An overall increase of 1.24°C was observed in annual mean temperature of Katra which may be due to increase in number of devotees every year at this religious station and enhance the human intervention.

Table 1 : Year wise increasing trends in temperature of differnt zones of Jammu

Zones	Station	Location	Data series	Temperature range (°C)	Increase in temperature (°C/decade)
Low sub tropical zone (Zone I)	Jammu	32°40N 74°50 E, 360 m amsl	1983-2010	22.2 – 24.2	0.3
	Katra	32°00 N 74°54 E, 500 m amsl	1980-2010	19.1 – 21.9	0.4
Sub tropical temperate transitional zone (Zone II)	Batote	33°07 N 75°19 E, 1585 m amsl	1977-2010	13.9 – 16.7	0.3
Mid to high temperate zone (Zone III)	Bhaderwah	32°58 N 75°43 E, 1689 m amsl	1978-2010	13.3 – 16.8	0.6
	Banihal	33°35 N 75°10 E, 1624 m amsl	1972-2010	13.7 – 16.5	0.3

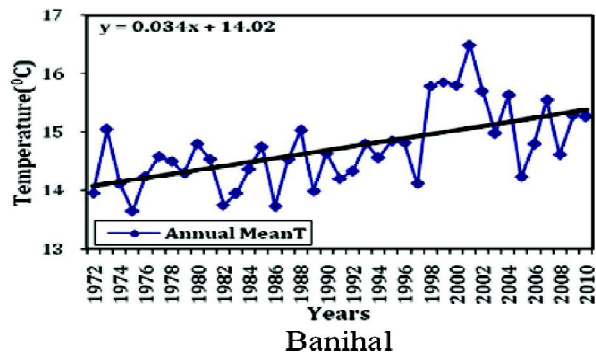
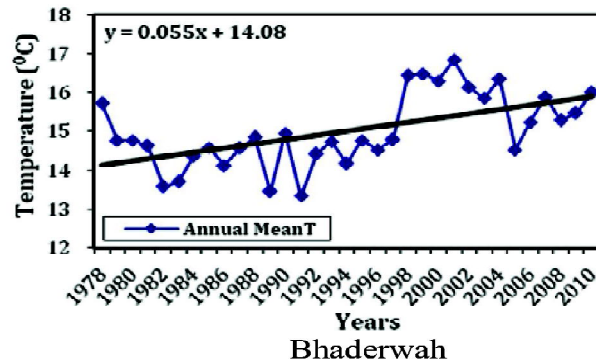
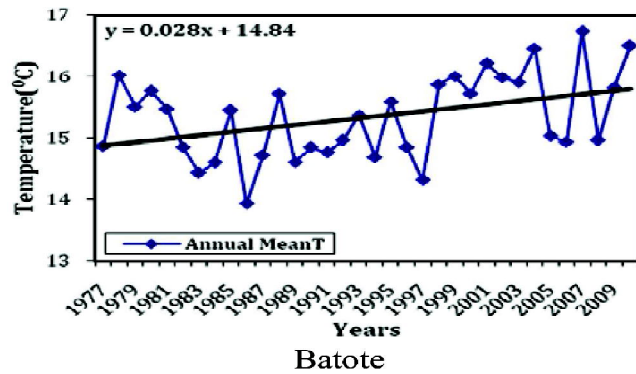
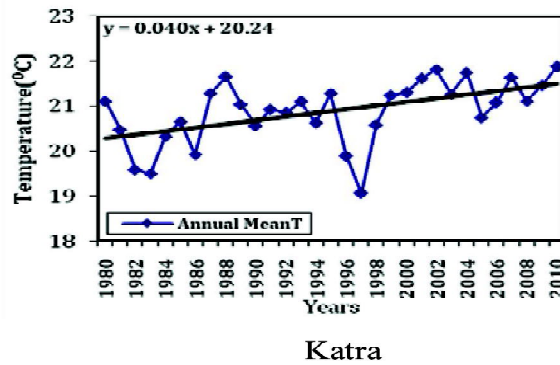
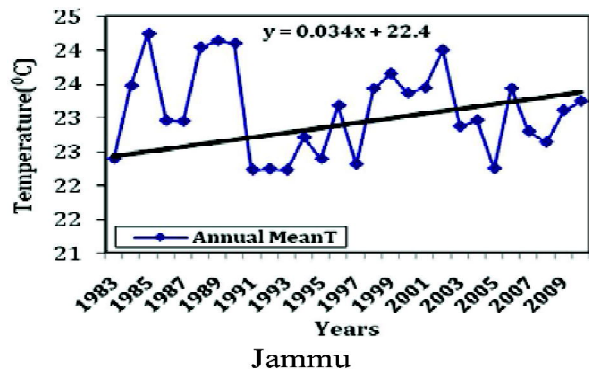


Fig. 1 : Trends in annual mean temperature of Jammu, Katra, Batote, Bhaderwah and Banihal in Jammu region

Annual mean temperature of Batote station varied between 13.9°C to 16.7°C and was found to be increasing at the rate of 0.03°C per year with an overall increase of 1.02°C in the last thirty four years (Fig.1). Hingane *et al.*, (1985) reported that the country wide annual surface air temperature has increased by 0.4°C per 100 year but the rate of increase slows down in the recent three decades.

The variation in mean annual temperature of Bhaderwah and Banihal stations were found to be in the range of 13.3°C to 16.8°C and 13.7°C to 16.5°C respectively. The mean annual temperature of Bhaderwah station for a period of 33 years showed a significant increasing trend (0.06°C per year). An overall increase of 1.6 °C was recorded in mean annual temperature of Bhaderwah during three decade period. The temperature increase was found highest among these zones. On the other hand, the rate of increase in temperature of Banihal station was found 0.03°C per year for a period of 39 years with an overall rise by 1.2°C during the study period. The results are in conformity with the report of the Intergovernmental Panel on Climate Change (IPCC) which predicted that global temperature would rise by 1.4 to 5.8°C by the year 2010.

It is concluded that temperature of five selected locations across Jammu regions of Jammu and Kashmir was found increasing clearly indicated warming trend in the region. The increase in temperature at this rate would adversely affect almost all crops of the region in terms of productivity ultimately the total production of the state. This would result economical set back of farmers of Jammu region and consequently the economics of Jammu and Kashmir.

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