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SHORT COMMUNICATION

Temperature and Rainfall Trend in Alaknanda Valley Srinagar Garhwal, Uttarakhand, India

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ABSTRACT

The rainfall and temperatures are the most important parameters among the atmosphere as these parameters decide the ecological situation of the specific area, which affects the agricultural productivity. The temperature, and rainfall trends are analysed for meteorological data of Automatic Weather Station (AWS), was installed September 2009 with 22 meteorological parameters in the Department of Rural Technology, HNB Garhwal, University, Srinagar Garhwal, and Uttarakhand. In the study assess the seven-year change in temperature and rainfall has been examination by linear tread analysis. It is observed that in velley of Srinagar Garhwal, Uttarakhand, coefficient of variation for mean temperature for Srinagar Garhwal Valley is highest in the month of February and lowest in the month of August. This means that mean temperature is most stable in the month of August and total monthly rainfall observed highest in the month of November and minimum for the month of July. This shows that rainfall is more stable in the month of July and is more variable in the month of November for the Valley.

***Keywords*:** Climate Change, Meteorological data, Rainfall, Trend, Temperature

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1. INTRODUCTION

Extreme values of meteorological components and weather phenomena are these days becoming an unexpected crisis in human life and human activity (Jewson and Caballero, 2003; Meze-Hausken et al., 2009). Meteorology today has progressed from a general art and science to an extremely sophisticated body of data and technology that will be applied to a wide variety of pragmatic exercises (Mitra et al., 2006). To comprehend the total good thing about these applications to the needs of society it is essential to provide professional meteorologists and non-meteorologists with some essential unification for measuring extremes of the meteorological events (Thornes and Stephenson, 2001 and Smith and Lawson, 2012).

The microclimate is that the environmental condition of the native region and it depends upon the various social and economic sectors because they may generate serious health issues to the population or may disturb transportation, construction and tourism activities Also, agricultural crops and yields are very sensitive to extreme climatic events, particularly those associated with temperature and precipitation (Fasullo and Webster 2003). A global warming/environmental change is one of the leading worldwide problems talked among the scientists and researchers (Preenu et al. 2017).

One of the consequences of climate change (CC) is the alteration of precipitation patterns and increase in temperature. According to Intergovernmental Panel on Climate Change (IPCC), 2007 report, the surface temperature of the earth has risen by 0.6 ± 0.2 °C over the 20th century. Also in the last 50 years, the rise in temperature has been about 0.13 ± 0.07 °C per decade. As the warming depends on emissions of GHGs in the atmosphere, the IPCC has projected a warming of about 0.2 °C per decade. Further, surface air temperature could rise between 1.1 °C to 6.4 °C over 21th century.

In India, the climate changes are predicted to adversely cause changes in precipitation, temperature, monsoon temporal order and extreme events (Ajil et al. 2010, Goswami et al. 2006 and Gadgil 2003). Because of global warming, precipitation amount, type and timing are changing or are required to change because of increased evaporation, especially in the tropics (Guhathakurta et al. 2011 and Rajeevan et al. 2008). The quantity of the precipitation are among the most important factors that influence agriculture production. Agriculture is vital to India's economy and livelihood of its people (Anantha et al.1988, Khavse et al 2015 and Satyanarayana and Sarat 2016). Several studies (Balling and Idso, 1989; Karl et al., 1993; Goodrich 1992, Singh et al., 2018) published in the last 15 years have attempted to assess the effects of urbanization on local and regional climate.

The trend analysis of rainfall and temperature recorded for seven-year periods provides information about rainfall pattern and temperature variability. The main objective of this paper is to analyse the variability and trend of rainfall and temperature pattern recorded by AWS data, around Srinagar garhwal velley.

2. STUDY AREA

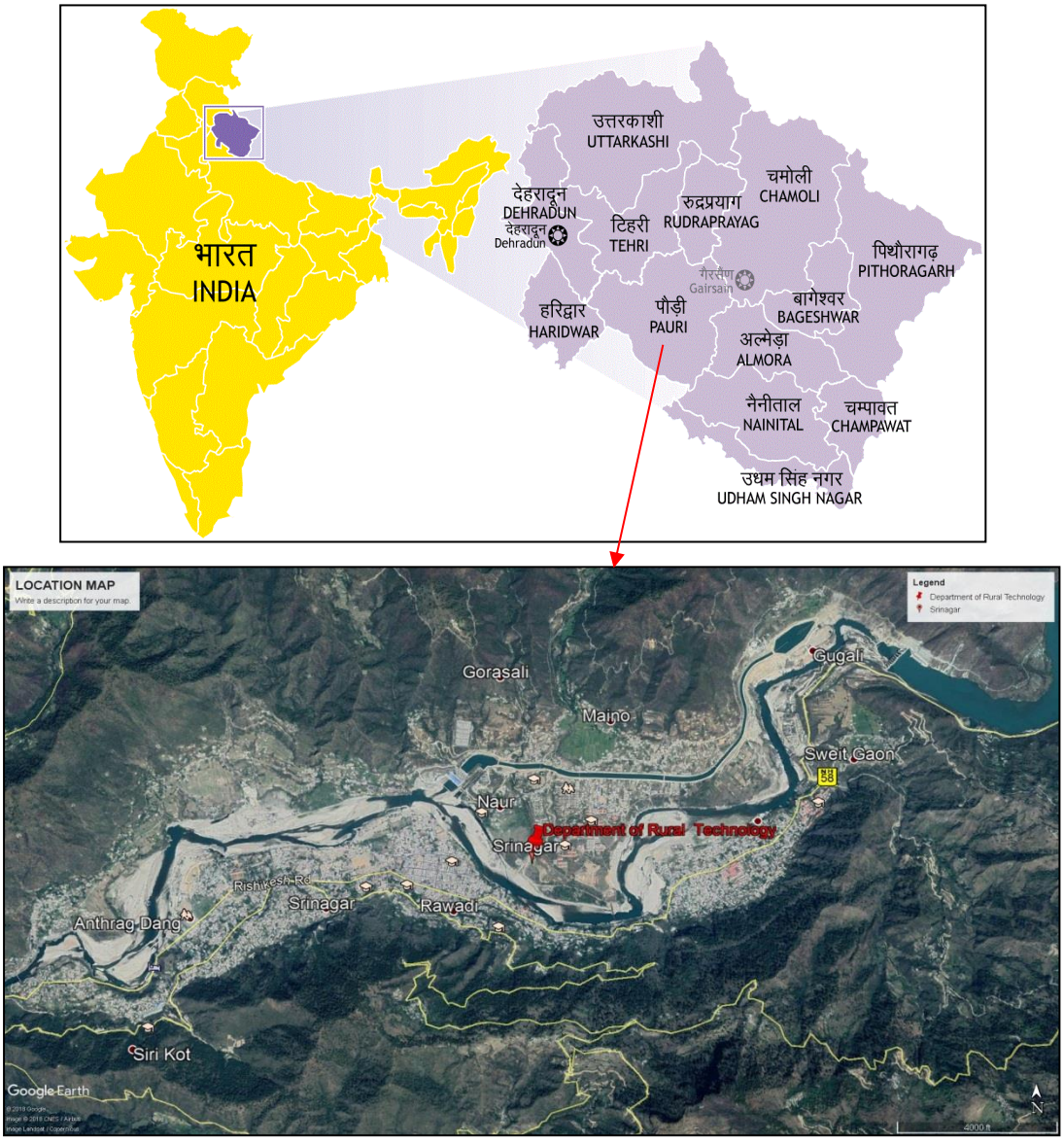

Figure 1. Location Map of Srinagar Garhwal Velley

Srinagar Garhwal is 30°13'-13'30" North Latitude and 78°45'-47'4" East Longitude is situated on the bank of river Alaknanda in the Lesser Himalaya, right in the heart of Garhwal region, enroute to the world famous Holy shrines of Badrinath and Kedarnath. It has an average elevation of 560 meters (1837ft). It is reached by national highway NH58 from Rishikesh. Superimposed thrust sheets characterize Srinagar area located in the Lesser Himalayan Zone. The area is demarcated by the North Almora Thrust (NAT) in NE part.

3. DATA AND METHODOLOGY

Monthly averages were taken of the available daily data and the resulting monthly mean temperature and total precipitation for the AWS, Dept of Rural Technology, HNB Garhwal University, Srinagar Garhwal, Uttarakhand. The yearly averages were calculated from the monthly readings, which are analyzed. Trend is defined as the general movement of a series over an extended period or it is the long-term change in the dependent variable over a long period of time (Webber and Hawkins, 1980).

4. RESULT ANALYSIS AND DISCUSSION

Daily temperatures and Rainfall are available from January 2010 to December 2016. However, these records are incomplete with various missing observations. From 2010, onwards very few observations are missing, the most being in 2010, 2011, 2012 and 2013. Mean, Standard Deviation (SD) and Coefficient of Variation (CV) and leniear regression were computed for temperature rainfall and RH. Excel and SPSS software package was used to study the trend of temperature rainfall and RH.

4. 1. Trend analysis of monthly mean of temperature

The trends of monthly mean maximum temperature over different years were obtained using linear regression best-fit lines. The linear regression trends with their linear regression equations and coefficient of determination for all the months from January to December are represented in Figure 1 and summarized in Table 1.

Table 1. Statistical summary of monthly mean temperatures

Month	Mean	SD	CV%	R^2
January	12.00	1.50	12.5	0.044**
February	15.72	2.10	13.35	0.089**
March	20.99	2.75	13.10	0.390**
April	24.96	2.16	8.65	0.215**
May	27.18	2.47	9.08	0.064**
June	27.65	2.52	9.11	0.061**
July	27.93	2.11	7.55	0.007**
August	27.59	1.35	4.89	0.000
September	26.37	1.55	5.87	0.499**
October	21.54	2.30	10.67	0.556*
November	17.19	1.74	10.12	0.033**
December	12.28	1.37	11.15	0.649*

It is evident from above table that monthly mean temperature have increased significantly for all the months. The maximum temperature 27.93 °C observed in the month of July, followed by 27.65 °C in the month of June and 27.59 °C in the month of August, while minimum temperature 12.00 °C observed in the month of January followed by 12.28 °C in the month of December. The statistical summary of maximum temperature for all months is finalized in Table 1. Coefficient of variation for mean temperature for Srinagar Garhwal Valley is highest in the month of February and it is observed as 13.35% whereas it is lowest in the month of August and it is 4.89%. This means that mean temperature is most stable in the month of August and least stable in the month of February for the Srinagar Garhwal Valley

Table 2. Statistical Summary of Monthly Total Mean Rainfall

Month	Mean	SD	CV%	R^2
January	27.05714	3.06	11.30	0.132**
February	53.68571	5.02	9.35	0.072**
March	27.62857	2.66	9.62	0.248**
April	14.71429	1.31	8.90	0.233**
May	40.45714	3.14	7.76	0.038**
June	121.2881	8.93	7.36	0.061**
July	197.7429	11.95	6.04	0.809*
August	173.7429	10.78	6.20	0.278**
September	91.4	6.76	7.39	0.567*
October	10.9	1.22	11.19	0.064**
November	1.171429	0.20	17.07	0.184**
December	11.4	1.56	13.68	0.243

4. 2. Trend Analysis of Monthly Mean Total Rainfall

The statistical summary of mean total rainfall for all months is finalized in Table 2. The coefficient of variation for total monthly rainfall observed highest in the month of November and it is 17.07 % whereas coefficient of variation is minimum for the month of July and it is 6.04 % for the Srinagar Garhwal Velley. This shows that rainfall is more stable in the month of July and is more variable in the month of November.

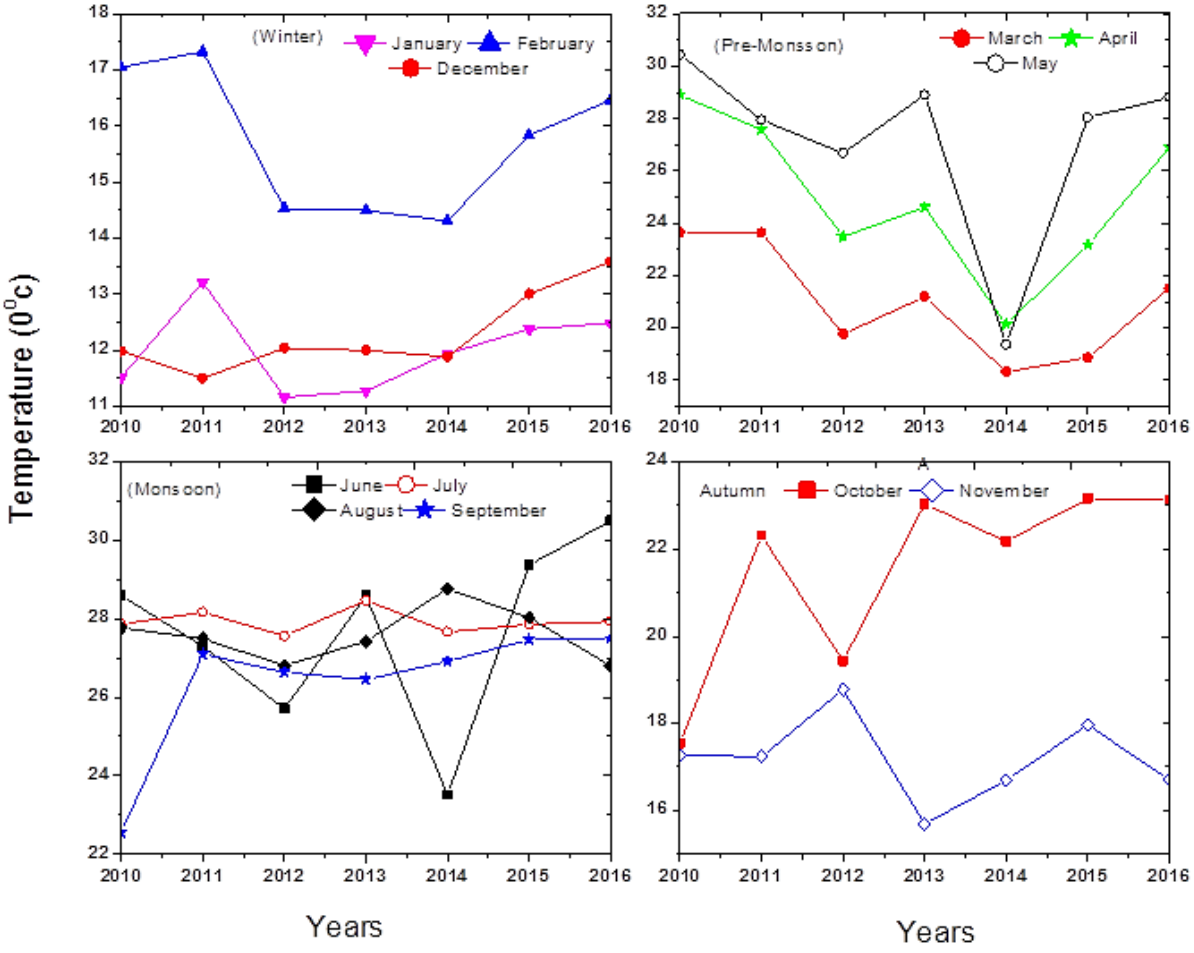

Figure 2. Seasonal variation of temperature

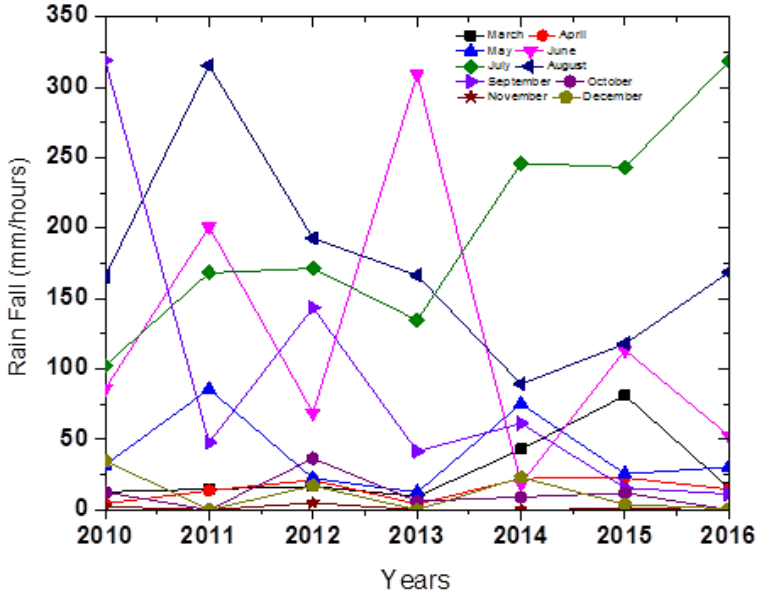

Figure 3. Yearly variation of Rainfall trends

5. CONCLUSIONS

The essential suggestion showing in this paper is to show the measuring scales for most important meteorological elements (temperatures and rainfall). They represent local climate features but they are comparable with the same climate features in different regions. Effectively the values of thresholds presented in this paper are only valid for Srinagar Garhwal Velley, but it is suggested that the methodology used be generally accepted.

It is observed that coefficient of variation for mean temperature for Srinagar Garhwal Valley is highest in the month of February and lowest in the month of August. This means that mean temperature is most stable in the month of August and total monthly rainfall observed highest in the month of November and minimum for the month of July. This shows that rainfall is more stable in the month of July and is more variable in the month of November for the Srinagar Garhwal Valley.

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