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Recent Trend of Minimum Temperature during Winter Season over Kolkata in West Bengal, India

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Abstract Different researchers have documented global and regional change of temperature on the basis of long term record of temperature and other meteorological data. Variation in temperature is generally assessed by characterizing trends in available climatic data. Winter season in West Bengal broadly coincides with three months namely December, January and February.

The aim of the present study was to investigate the change of winter temperature over Kolkata in West Bengal by analyzing monthly minimum temperature data of these three months (December–February) from 1901 to 2012. The study revealed that the month January shows a declining trend of minimum temperature (-0.003°C/year) whereas rising trend is noticed for the months of December (0.002°C/year) and February (0.008°C/year).

Keywords Trend, Climate change, Minimum temperature, Cold spell.

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Introduction

Today climate change attracts the attention of a group of scientists and the available climatic data proves the phenomena to be a hard reality. Winter weather fluctuation in West Bengal has become a matter of serious concern not only to the climatologists and scientists but also to the policy makers and farmers. Changing pattern of temperature has now been considered as a serious threat to sustainable development which not only affects the agricultural production and food security but also damages the economic activities of a region. Human nutrition sources such as water resources, agriculture, and food products are threatened by climate change (Mohorji et al. 2017).

There is seasonal and annual variation of surface temperature of any region which depends on latitude, altitude and location with respect to geographical features (river, lake, sea and mountain) (Jain and Kumar 2012). In view of the above , many researchers have attempted to investigate the trend of temperature for any region (Safari 2012, Chakraborty et al. 2014, Alghamdi and Moore 2014, Chattopadhyay and Edwards 2016, Rahmstorf et al. 2017) but the subject becomes complicated due to higher regional and temporal variation of temperature characteristics.

Scarcity and poor quality of meteorological data collected from the surface weather instruments make the investigation and characterization of climatic parameters very difficult. Besides, some countries have restrictions regarding the use and sharing of climatic data. Despite these shortcomings, researchers

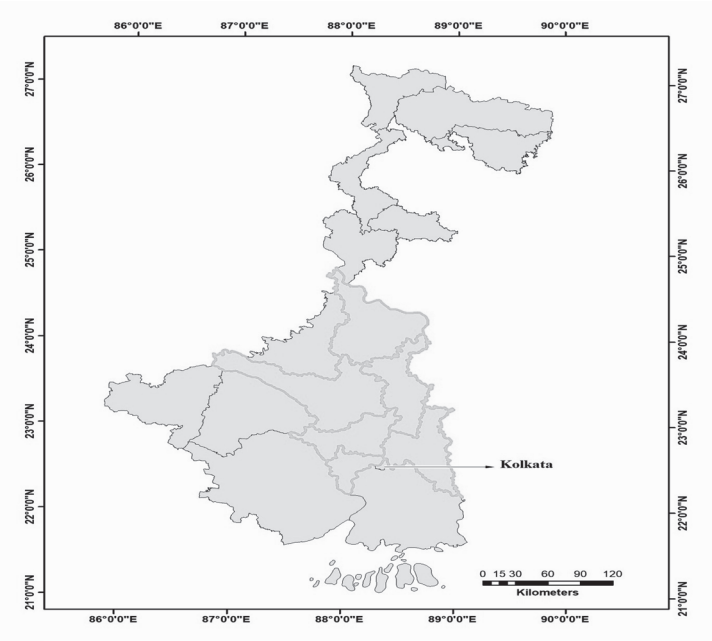

Fig. 1. Location map of the study area.

are interested in identifying the trend of temperature for the successful growth of agriculture and planning of water resources. So, keeping the above points in view, in the present study, an attempt has been made to identify the trend of temperature during winter over Kolkata city of West Bengal.

Kolkata, the capital of West Bengal is located at the eastern of the River Hooghly in the southern portion of the state with the latitudinal extension from 22°27′ N to 22°39′ N and longitudinal extension from 88°14′ E to 88°26′ E. This 300 years old city is the 3rd largest urban agglomeration of India and has witnessed greater development over the centuries.

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Materials and Methods

For the present study, minimum temperature data of Kolkata have been collected from Agricultural Meteorology Division of the State Agriculture Department, Government of West Bengal, NCEP and

Table 1. Descriptive statistics of winter temperature (1901-2012).

Months	Range Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Standard Deviation Statistic	Variance Statistic	Skewness Statistic	Skewness Std.Error	Kurtosis Statistic	Kurtosis Std.Error
Jan	6.24	10.68	16.92	14.0928	1.08713	1.182	-.297	.228	.083	.453
Feb	5.42	13.79	19.21	17.0062	1.00231	1.005	-.373	.228	.880	.453
Dec	5.50	12.22	17.71	14.4055	.95329	.909	.481	.228	.693	.453

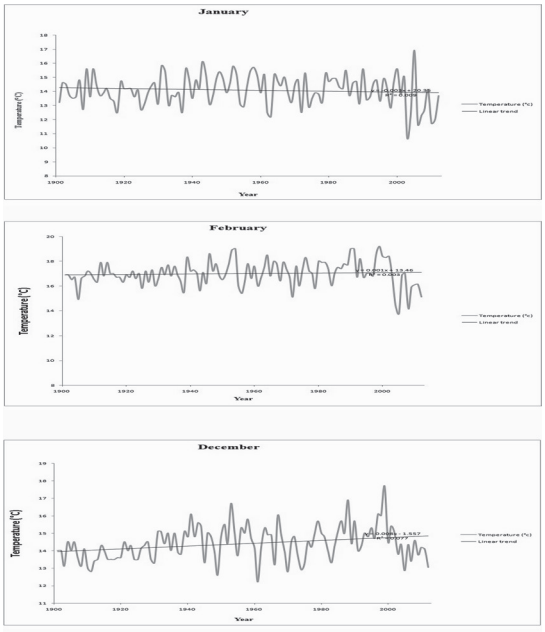

Fig. 2. Trend of minimum temperature during winter over Kolkata (1901-2012).

India Meteorological Department through the Indian water-portal website (http : //www.indiawaterportal.org/) for the time period of 1901 to 2012 (Fig.1.) The data were analyzed on monthly basis and statistical parameters like mean, standard deviation, range, kurtosis and skewness were determined with the SPSS software (version 24). Linear trends have been used to investigate the sequential change of minimum temperature over the time period of 112 years (1901-2012) during winter season.

Results and Discussion

The average winter temperature of the study area was found to be 15.2°C which ranges from 14.09°C in the month of January (lowest) to 17°C in the month of February (highest) during the last 112 years i.e. from 1901-2012 (Table 1). The study area , on an average, experienced low winter temperature in 1918, 1925, 2003, 2004, 2008 and 2012. Analysis of mean minimum temperature data of individual month from December to February revealed that Kolkata experienced lowest minimum temperature in the month of January (14.09°C) followed by December (14.41°C) and February (17°C).

There is inverse relation between the minimum temperature and the intensity of winter. Increase in the values of minimum temperature will reduce the intensity of winter (Fig.2). Mean minimum temperature is found to be increasing over the study area in the months of February (0.002°C/year) and December (0.008°C/year) while declining trend is noticed for the month of January (-0.003°C/year) thereby reducing the intensity of winter cold spell during February and December. The trend of minimum temperature of these 3 winter months have been presented in Figs 3, 4 and 5.

The entire span (1901-2012) of analysis has been divided into 20 years interval except from 2001 to 2012 where the time period is 12 years. From

Table 2. Trend of minimum temperature during winter over Kolkata (1901-2012).

Months	1901-1920	1921-1940	1941-1960	1961-1980	1981-2000	2001-2012
Jan	Slight decrease	Sharp increase	Slight decline	Moderate increase	Sharp decline	Sharp decline
Feb	Sharp increase	Moderate increase	Moderate increase	No change	Sharp increase	Sharp decline
Dec	Sharp decline	Sharp increase	Slight decline	Sharp increase	Sharp increase	Sharp decline

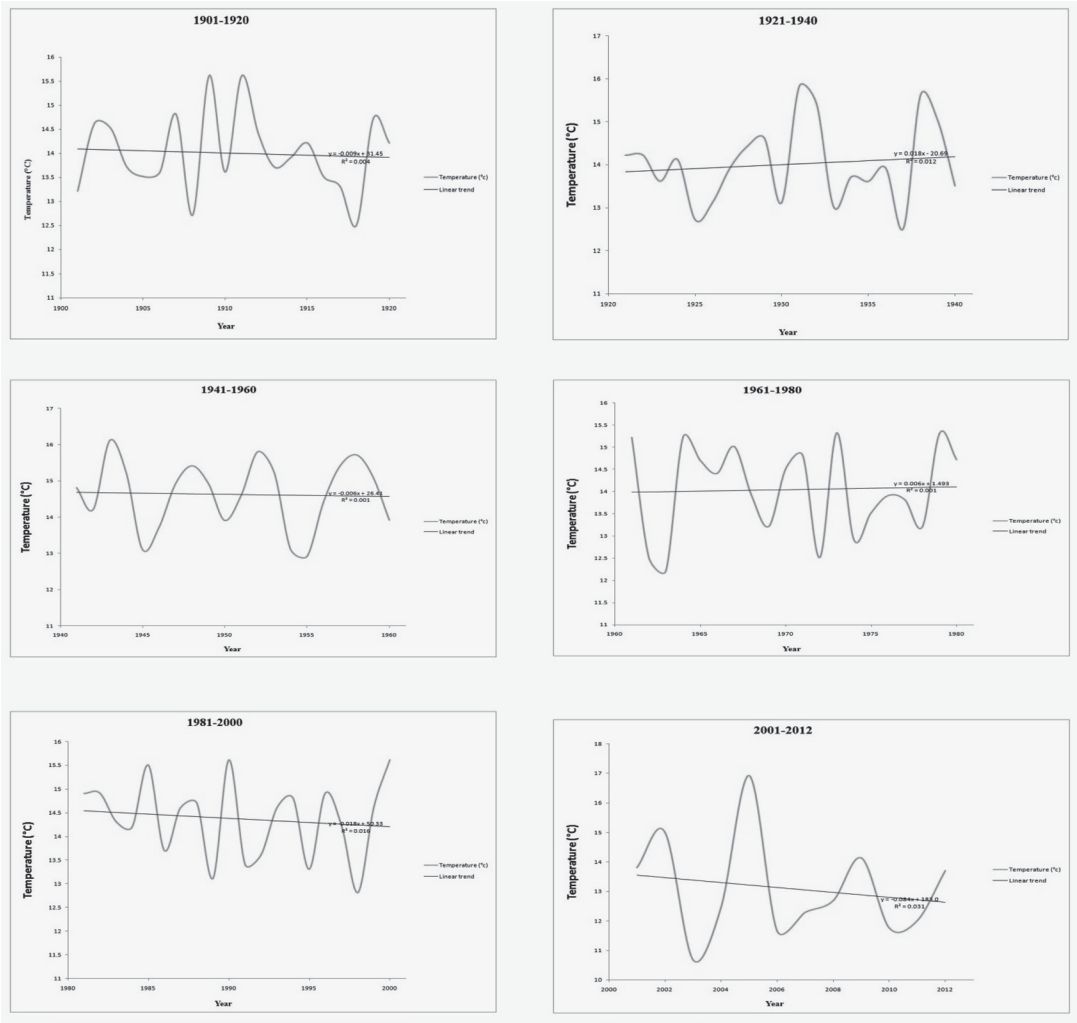

Fig. 3. Trend of minimum temperature over Kolkata in January.

1901 to 1920, winter temperature shows a rising trend for the month of February (0.02°C/year) while declining trend is noticed for January (-0.009°C/year) and December (-0.02°C/year). The situation changes in the next 20 years interval. All the months under consideration exhibit rising trend of mean minimum temperature for the time period of 1921 to 1940 (0.017°C, 0.02°C and 0.04°C/year for January, February and December respectively). Winter temperature shows declining trend from 1941 to 2012 for the month January (-0.006°C, -0.018°C and -0.08°C/year for the period 1941-1960,1981-2000 and 2001-2012 respectively) except for the time period of 1961 to 1980 where rising trend (0.006°C/year) of minimum temperature is noticed. Mean minimum temperature is found to increasing for the month of February from 1941 to 1960 at the rate of 0.009°C/year while no particular trend of temperature is detected for the time period of 1961 to 1980. Winter temperature shows a clear rising trend for December (0.076°C/year) and February (0.038°C/year) from 1981 to 2000. But trend of minimum temperature is found to be declining for all the 3 months from 2001 to 2012 at the rate of -0.08°C, -0.18°C and -0.11°C/

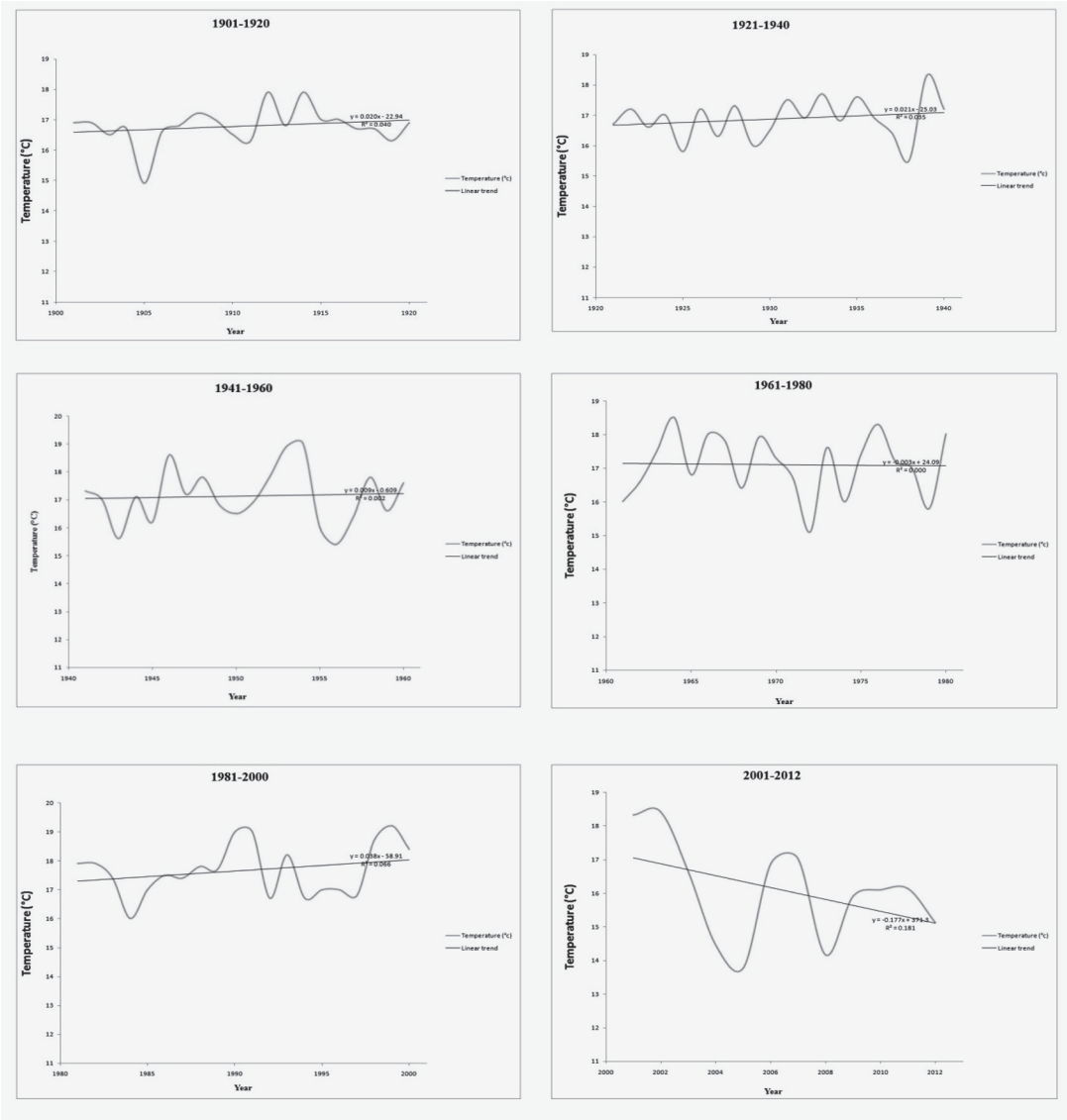

Fig. 4. Trend of minimum temperature over Kolkata in February.

year for the months January, February and December respectively (Table 2).

Conclusion

An understanding of spatio-temporal trend and variability of temperature is crucial for the planning and efficient management of water resources. Though the study are is not dependent on agricultural activities but minor fluctuations in winter temperature may hamper the comfort level of the city inhabitants. Rising trend of winter temperature may enhance the use of air coolers even during the winter season. The present study has highlighted the trend of minimum temperature during winter for the time period of 112 years i.e. from 1901 to 2012 using a large data set, consisting of 3 months i.e. from December to January. Inter annual variability of winter temperature has been represented by the time series graphs.

It was possible to observe a rising trend of mean

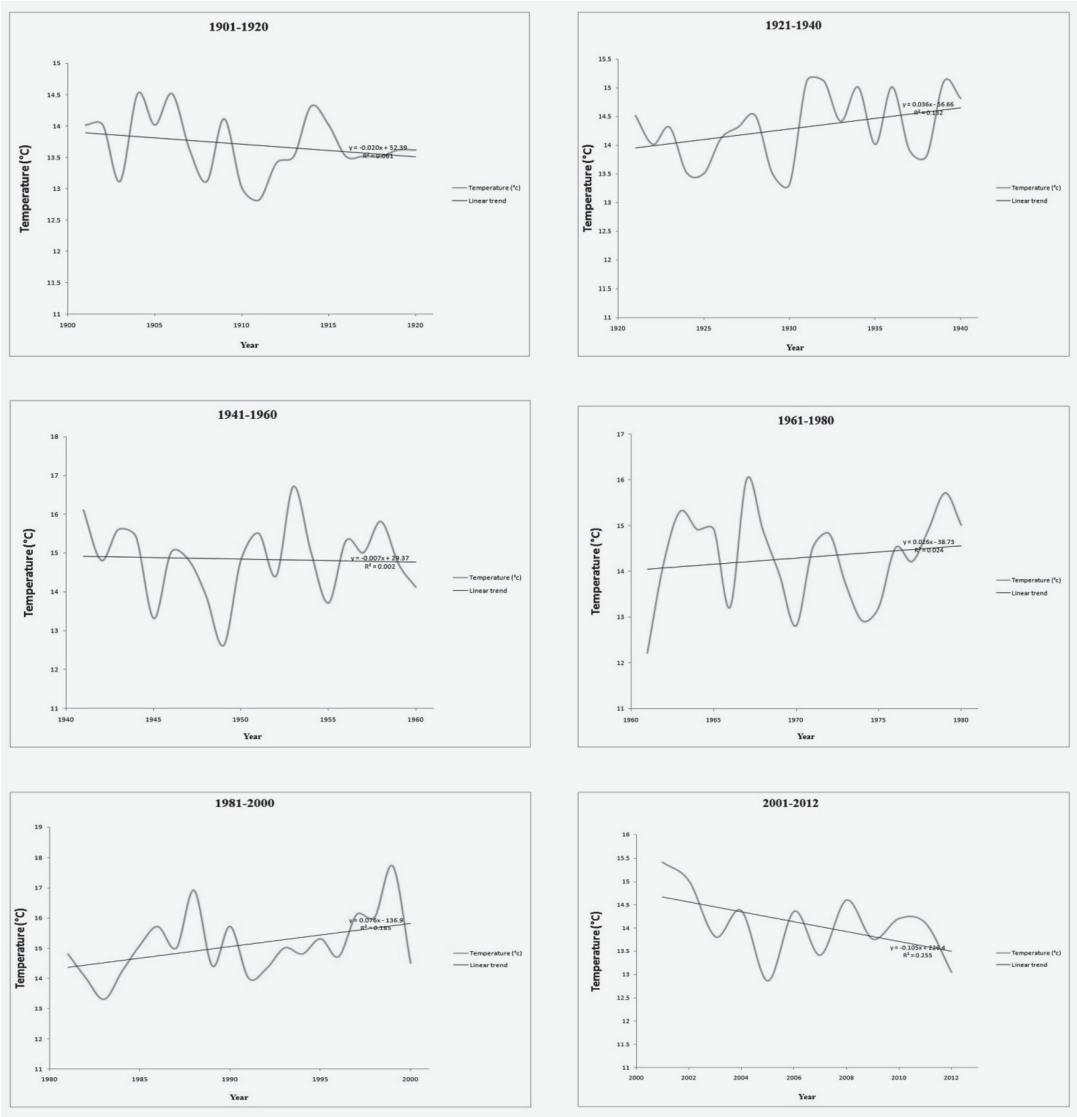

Fig. 5. Trend of minimum temperature over Kolkata in December.

minimum temperature during February and December while declining trend is noticed for the month of January which will intensify the cold spell during winter. The rising trend of winter temperature may increase the demand of electronic gadgets like air cooler, fan. During non-rainy season, dew becomes an important source of moisture. Though the present study has not highlighted the relation between winter temperature and dew concentration but it may not be out of place to mention that the rising trend of minimum temperature will reduce the amount of dew concentration. It is hoped that the study in general will be helpful for the scientists, climatologists and geographers, especially those who are interested in studying the climatic phenomena.

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