Research article Available online www.ijsrr.org ISSN: 2279–0543

International Journal of Scientific Research and Reviews

Diurnal Variation In Varanasi During 1950-2000

Singh Abhishek

Dept. of Farm Engineering ; Institute of Agricultural Sciences; Banaras HindUniversity,India,221005

ABSTRACT

The annual and monthly series of diurnal temperature range (DTR) of Varanasi during the period 1950-2000 was studied. Aim was to characterize and quantify the trend in diurnal temperature range in Varanasi. A statistically significant trend was found in the annual series of the DTR which compelled us to study the changes in trend over different months. Consequently the monthly series of DTR were analyzed for each month for the same period. It was found that statistically significant trend were obtained for the winter months namely January, February, March, November and December. Our observation was that the DTR showed a negative annual trend over this period and this negative trend was more prominent in winter months as compared to summer and rainy months.

KEY WORDS: Diurnal temperature, trend, time series.

Corresponding author:

Dr. Abhishek Singh,

Assistant Prof.,

Dept. Of Farm Engineering,

Institute of Agricultural Sciences,

Banaras Hindu University,

email; asbhu2006@gmail.com Mob no. 9451526775

INTRODUCTION:

One of the most important variables in meteorology is solar radiation but most of the times this variable is ignored while doing research related to climate change. Mean surface temperature is no longer an appropriate indicator of the climate change. Changes in Diurnal Temperature Range (DTR) provide more information than the mean temperature only because the mean temperature is affected by changes in either or both minimum and maximum temperatures. The Diurnal temperature which is the indicator of many phenomenon related to climate change is not included in most of the studies. Diurnal temperature is defined as the difference between the Day's maximum temperature and the minimum temperature. It is a known fact that the Diurnal temperature is highest on clear days and at minimum on cloudy and hazy days. Diurnal temperature is also a strong indicator of the climate change. It has been observed that the Diurnal Temperature Range (DTR) is decreasing over the last 50 yr all over the world which is generally attributed to the increase in daily minimum temperatures (Karl et al [1].; Easterling et al [2]; Vose et al.[3]). The changes in DTR are rarely explained and their seasonal or monthly variations are not studied and understood (Stone and Weaver[4]). Some of the recent studies (Zhou et al[5]; Lauritsen and Rogers [6]) has attributed these changes to multiple process such as cloud cover, soil moisture and precipitation variability. In this study the trend in Diurnal temperature in Varanasi has been studied for the duration of 50 years that is from 1950-2000. The annual trend of Diurnal temperature in Varanasi from the year 1950-2000 has been estimated. Moreover the monthly variation in diurnal temperature has been studied for this period to ascertain the trend and to gauge the quantum of changes in the variable.

MATERIAL AND METHODS: The yearly data of diurnal temperature range for the period of 50 years ie. 1950-2000 of Varanasi was considered for the analysis. And once the trend was significant the monthly data of the diurnal temperature range for Varanasi was considered for further analysis. Further the annual data was fitted with polynomials up to 2^{nd} order to characterize and quantify the trend in the data. Regression analysis was used to fit the corresponding equations to the data set. Analysis of Variance (ANOVA) tables was obtained for all the models and statistical significance was checked applying the F Test. For each fitted equation the trend coefficients were tested using the t test to ascertain there statistical significance. The residuals were tested for auto correlations and also for confirming the assumptions of regression analysis like Normality etc.

RESULTS AND DISCUSSION: Fig 1 depicts the changes in the diurnal temperature in Varanasi during 1950-2000. It was found that a linear trend fitted well to the observed values of the DTR. Though the R^2 (0.092) value for the fitted trend equation was very less nevertheless it was significant (P=.03) showing that there was a linear trend in the series of the observations. Moreover

the regression coefficient (b = -0.008) indicates that the DTR has significantly decreased during the period of the study which means that the difference between the maximum and minimum temperatures has gradually decreased during the period 1950-2000 in Varanasi.

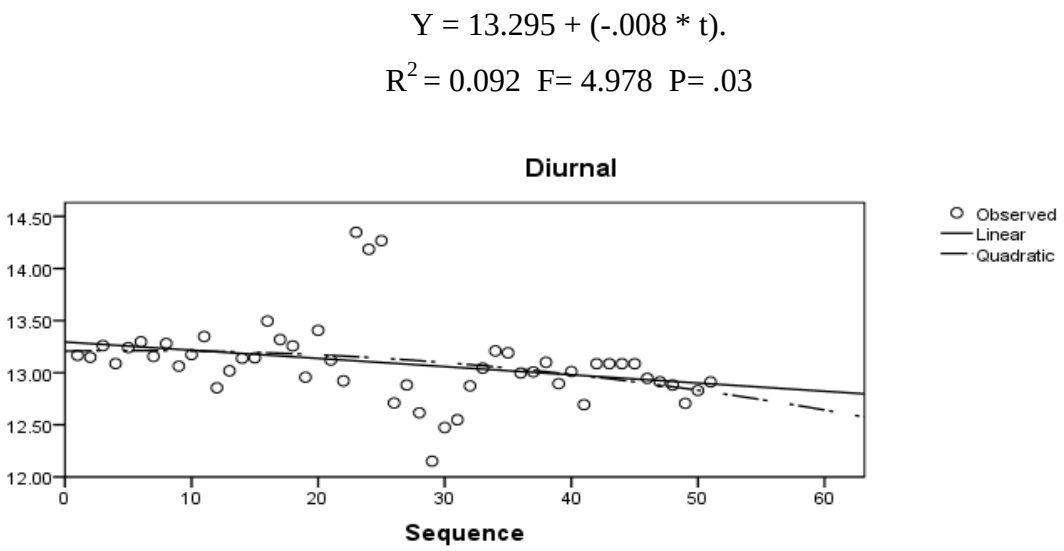


Fig. 1 Annual trend of Diurnal Temperature in Varanasi during 1950-2000

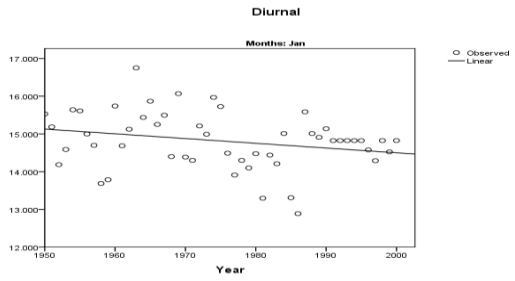
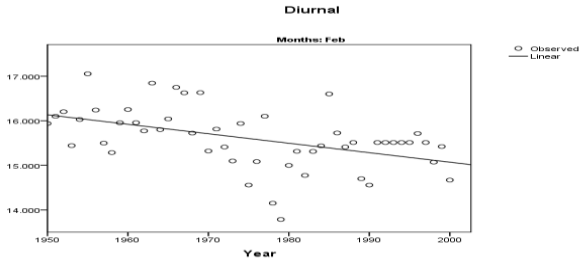
Though the quantum of change was small it was significant. Because this was the trend fitted on the annual series data, the diurnal temperature range was averaged over the months in the respective years. Our interest was to study the change or variation in the DTR in a month over the years. For this we fitted the trend equations to monthly data collected over the period 1950-2000, to ascertain the trend in the monthly variation over the years. The results of the month wise fitted equations along with the relevant statistics are given in the fig.2. The descriptive statistics of the respective months during the period 1950-2000 are presented in Table : 1

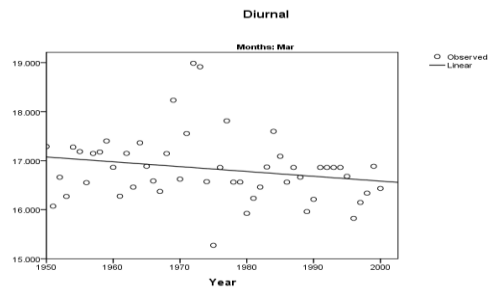
The maximum of the DTR was observed in the month of April (20) followed by May and March (19) and then January, February, November and December (17 each) and lastly by June (15),October (14), September (12), July, August (10). The minimum of the DTR was August (6) followed by July and September (7) and then June (10), January, November and December (13 each), February and May (14) each, April (16), March (15). The maximum variation was recorded in the month of May (0.821). The highest mean DTR was recorded for the month of March followed by April.

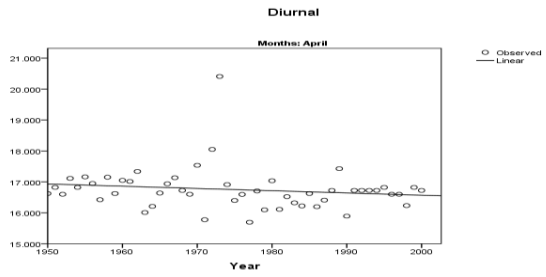
Month	Minimum (^oC)	Maximum(^oC)	Mean	Std. Deviation
January	13	17	14.82	0.748
February	14	17	15.80	0.670
March	15	19	16.83	.687
April	16	20	16.75	0.686
May	14	19	15.38	0.821
June	10	15	11.71	0.741
July	7	10	7.74	0.643
August	6	10	6.9	0.686
September	7	12	8.69	0.722
October	11	14	12.36	0.653
November	13	17	15.11	0.736
December	13	17	15.20	0.737

Table 1: The descriptive statistics of DTR of the different months during the period 1950-2000

The trend equation was fitted to all the months over the period 1950-2000. A perusal of the figures indicate that for the months April, May, June, July, August, September and October the trend equations were not statistically significant, indicating that there was no linear trend in the observations of these months. So the DTR does not significantly changes in the month of April, May, June, July, August, September and October. But During the months of January, February, March, November and December the fitted lines were significant. The level of significance though varied from 14% to 0 %. For the month of January, February, March, November and December it was 0.08, 0 .00, 0.13, 0.014 and 0.02 % respectively

JAN Y = 39.653 + (-.013 * t). R^2 = .062 F= 3.264 P= 0.077 	**FEB** Y = 57.577 + (-.021 * t). R^2 = 0.222 F= 13.986 P= 0.000 
Mar Y = 36.276+ (-.010 * t). R^2 = .045 F= 2.335 P= 0.133	**APRIL** Y = 31.141+ (-.007 * t). R^2 = 0.158 F= 1.252 P= 0.269

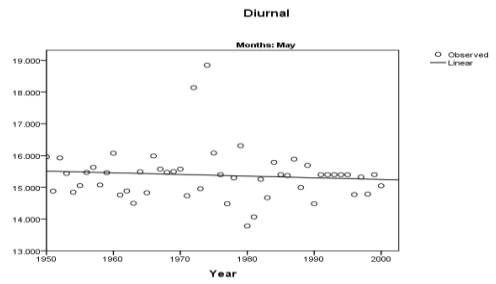




May

Y = 25.706+ (-.005 * t).

R^2 = .009 F= .444 P= 0.508



June

Y = 13.464+ (-.000 * t).

R^2 = .000 F= .016 P= 0.901

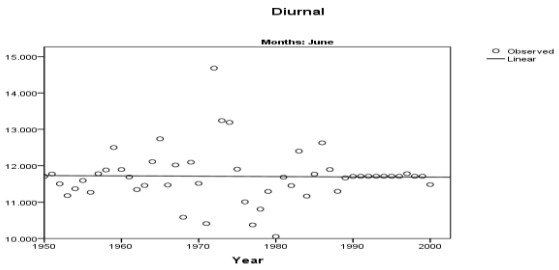


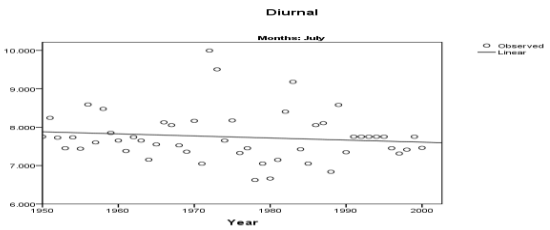
Fig. 2 The fitted equations on the monthly observations.

July

Linear

Y = 18.413+ (-.005 * t).

R^2 = .016 F= .777 P= 0.382

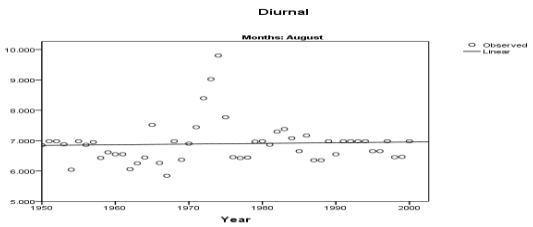


August

Linear

Y = 2.532+ (.002 * t).

R^2 = 0.048 F= 0.113 P= 0.738



Months = Sept

Linear

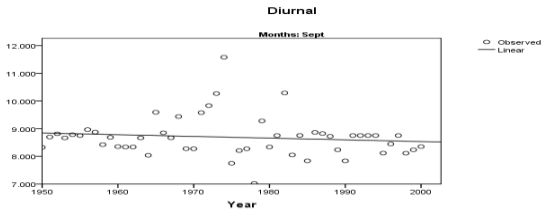
Y = 20.876+ (-.006* t).

Months = Oct

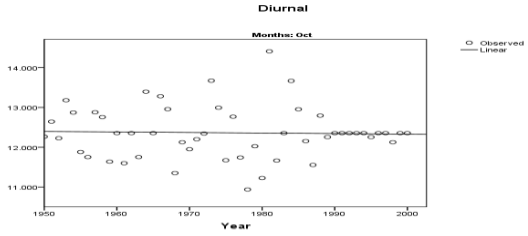
Linear

Y = 15.063+ (-.001 * t).

R^2 = .016 F= .804 P= .374



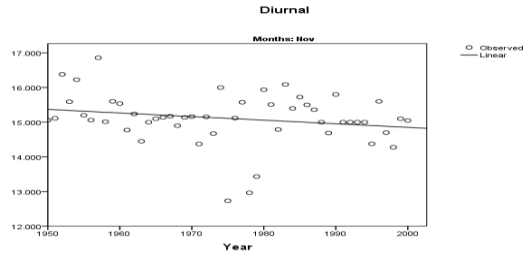
R^2 = .001 F= .047 P= 0.828



Months = Nov

Y = 35.604+ (-.010 * t).

R^2 = .044 F= 2.260 P= 0.139



DEC

Y = 47.468+ (-.016 * t).

R^2 = 0.109 F= 5.975 P= 0.018

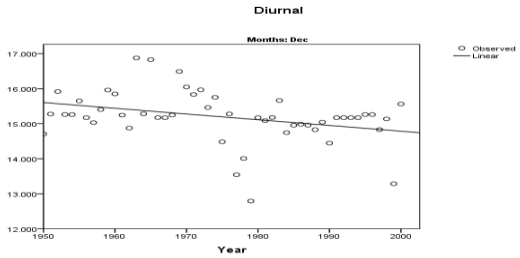


Fig. 2 The fitted equations on the monthly observations

Though the R^2 values were quite low for the month of January, February, March, November and December ie. 0.06, 0.22, 0.045, 0.044 and 0.11 respectively, they are significant indicating that DTR has significantly changed in these months over the years during the period 1950-2000. Further the trend coefficient in all the months ie. January, February, March, November and December is -.013, -.021,-.010,-.010 and -.016 respectively. All the trend coefficients were negative showing that there was a negative trend in the DTR over the period 1950-2000 in the months of January, February, March, November and December. This means that the DTR ie the difference between the maximum and minimum temperature was decreasing during these months. All the months ie January, February, March, November and December falls in the winter season. The changes in the DTR during the months of summer and rainy season did not show a statistically significant trend.

CONCLUSION: The variation in DTR has been studied over the globe and the studies have indicated that the average DTR showed a declining trend during the last 5 decades of the past century. But these studies were confined to annual average DTR changes. In the present study the annual variation in the DTR was studied for the period 1950-2000 for Varanasi and once it came out

to be significant the monthly variation was also studied. It was found that there was a significant trend in the trend coefficient during the winter months and during the months of summer and rainy season the trends were not statistically significant. Moreover the trend coefficients were all negative indicating that there was a decrease in the difference between the maximum and minimum temperatures in these months. Many reasons can be sighted for the decrease in the DTR but in most of the studies it has been attributed to a increase in the minimum temperatures as maximum temperatures have remain constant or increased only slightly. Other reasons which can affect the DTR are urban growth, desertification and variation in the land use. Urban areas show a relatively smaller DTR as compared to rural areas. Increases in cloud covers, green house gases, surface evaporation cooling and decreases in pan evaporation also affects the DTR.

REFERENCES:

1. Karl, T. R., Philips, D. Jones, Knight, Richard W. et al. Coauthors. Asymmetric trends of daily maximum and minimum temperature. Bull. Amer. Meteor. Soc.. 1993;74: 1007–1023.
2. Easterling, D. R. Horton, Briony. D. Jones, Philips. et al. Maximum and minimum temperature trends for the globe. Science. 1997; 277: 364–367.
3. Vose, R. S., D. R. Easterling, and B. Gleason. Maximum and minimum temperature trends for the globe: An update through 2004. Geophys. Res. Lett. 2005; 32: L23822.
4. Stone, D., and A. Weaver,: Factors contributing to diurnal temperature range trends in twentieth and twenty-first century simulations of the CCCma coupled model. Climate Dyn. 2003; 20: 435–445.
5. Zhou, L., A. Dai, Y. Dai, R. S. Vose, C.-Z. Zou, Y. Tian, and H. Chen. Spatial dependence of diurnal temperature range trends on precipitation from 1950 to 2004. Climate Dyn. 2008; 32: (2–3), 429–440.
6. Lauritsen, R. G., and J. C. Rogers. U.S. diurnal temperature range variability and regional causal mechanisms, 1901–2002. J. Climate, 2012; 25: 7216–7231.