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Research Article

A Case Study Of Man Induced Climate Chance In Manipur

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ABSTRACT

This research paper attempts to explain and examine the man induced climate change at local or regional level. This event is considered great and most challenging one at present . Therefore, the need comes to study it at micro level. It will help in making plans to prevent human and other living things from various impacts of climate change. The variation of monthly temperature is studied in it. The trend of increasing temperature has been analysed in this paper and it is found that the rise of mean temperature is associated with increase trend of minimum temperature.

Key words: climate change, temperature, greenhouse gas ,man induced and rising trend

Introduction

The most important climatic and weather element is temperature. Temperature is recorded twice a day , one being maximum and other being minimum. During the day net radiation is positive and the surface gains heat and at night, net radiation is negative, consequently the surface loses heat by radiating back to the space. The surface air has followed this cycle and this results in diurnal cycle of rising and falling air temperature. Generally the minimum diurnal temperature is found about a half hour after sunrise. Whereas the maximum temperature is observed in between 2 and 4 p.m. depending on local conditions (Strahier Alanetal, 2002). The lowest temperature of surface atmosphere is assumed before sunrise while the highest temperature is started to find when the sun appears above the horizon and it rises rapidly up to 0900 hours then its rate decreases till 1400 hours (Katiyar V.S., 1990). From this it is observed that the minimum temperature is represented as minimum daily temperature and the highest temperature represents the maximum temperature for a day. The temperature starts to fall at first slowly and afterwards more quickly up to about sun set and it reaches minimum shortly before sunrise. The range of temperature is also an important element of climate. The result of solar heating and radiation cooling produces the daily range of temperature (John E. Oliver etal, 2002). It is also an important thing in temperature analysis of a particular area. “In response to the irregular disposal the sun’s energy (solar radiation) the air temperatures show wide variations. These variations in turn cause other significant weather changes” (Donn, William L., 1975). Maximum temperature is found in early to mid afternoon while minimum temperature is observed just before sunrise. For the analysis of weather and climate of a region to study temperature is a must as it is the fundamental element.

The climate change over the earth was happened for the first, i.e. in between 10^6 to 10^8 years back, those associated with continental drift (Gopal Bhargava, 2004). However, rising pressure of demand on forest has depleted its density within a short span. On the other hand, population increase creates a lot of problems regarding global warming, which is purely anthropogenic. Global climate change is related with complex interactions between environmental, economic, political, institutional, social and scientific development processes (Berry Metz, 2001). The temperature changes from one year to another, as well as from decade to decade. These changes have exerted some impacts on the inhabitants and their physical milieu. The present change or fluctuation of climate is due to inadvertent or advertant human activities rather than natural process (Anuja Tigga & Bema Malini, 2003). The radiation from the sun is the main source of heat energy on the surface of the earth and its adjoining atmospheric layer. The short wave incoming solar radiation falls on the surface of the earth and it reflects back to the space in the form of long-wave infra-red terrestrial radiation through atmosphere. Thus, the lower parts of the earth have been heated up through this process. However, the amount of insolation received by the earth is not same through its whole area. It differs in the

temporal as well as spatial contexts. The changes in precipitation and temperature interact to affect climate and it is a multivariate concept (Andrew Grundstein, 2008).
The burning of fossil-fuel, land use changes, agricultural practices, the production and use of halocarbons etc. are the major factors of global climate change (Ashok Malik, 2008). All types of weather and climatic phenomena are directly or indirectly related to energy that comes from the sun, but form of energy may be unequal. Thus all types of dramas of weather and climatic phenomena are activated and associated with solar radiation. If we continue to increase the greenhouse gas emissions in the historical trend, then it is projected that the temperature will increased from 2.5°F to 10.4°F by 2100. (Singh chanchal, 2007). By a recent estimate it is indicated that 25 per cent of the world's mammals and 12 per cent of birds are at very risk of global extinction. The change in habitat and degradation affect nearly 89 per cent of all threatened birds and 83 per cent of all threatened mammals (Gopal Bhargwa, 2004).

Study area

Manipur has an area of 22,327 square kilometers which is only 0.7 percent of the country. It extends from 23°53/ N to 25°41/ N latitudes and 93°02/ E to 94°47/ E longitudes respectively . Altitude varies from 746 m to 2994m above the mean sea level. This is located in the north eastern part of the country, surrounded by Nagaland to the north, Upper Myanmar to the east, Chin hills of Myanmar and Mizoram to the south and Cachar district of Assam to the west. The southern tip of the state is nearly 2,600km away from the equator northward. Hilly areas occupy about 92 percent of the total surface area and the rest constitutes the plain area. The Imphal valley is only 780m above the mean sea level. It is only 250km away from the Bay of Bengal. The angle of incidence of Sun's ray at Imphal in summer solstice and winter solstice are 88° and 43°36/ respectively.

Objective

It is necessary to investigate and evaluate the validity of globally speaking climate change, especially the rising trend of surface air temperature at local or regional level. This is due to the fact that the temperature is changed from one place to another within a short distance in different degrees. People considered this rise of temperature is caused mainly by anthropogenic factors. So, there will be difference in the increase of temperature for different aerial unit since the level of cultural development is not same. For example, urban heat island is found in and around an urban area, but it does not exist in rural area. Base on this view, an attempt has been made to examine the change of temperature in Manipur.

Methodology

The pattern of variation in monthly temperature is evaluated by utilizing error bars. The trend of annual temperature is examined with the help of linear and growth model. Prediction equations are also used to predict future condition of temperature. Temperature data from 1972 to 2001 is used for this analysis from 13 different stations. Sources of data are Tulihal Meteorological Department, Directorate of Agriculture, Government of Manipur, Commerce and Statistics Department, Government of Manipur.

Discussion

The variation in mean temperature is generally large during south-west monsoon season. August and September record the highest variation with their mean values 24.12; 95% CI of 22.44 to 25.79 and 23.88; 95% CI of 22.20 to 25.55 respectively. The variation is found to be lowest in November. Other months such as January, December and October also have low level of variation. The variation in the mean monthly temperature has been found to be highly significant as witnessed by F - value of 41.5 at 1% level of significance (P<0.01).

Table-1.1 Variation of Monthly Mean temperature (°C), Manipur

Month	Mean	SD	95%CI		Test value
			Lower	Upper	
January	13.97	1.60	12.82	15.11	$F_{(11,108)}$=41.53 P<0.01
February	15.69	1.55	14.57	16.80	
March	18.39	1.69	17.17	19.60	
April	20.70	1.80	19.40	21.99	
May	22.41	1.91	21.04	23.77	
June	23.96	2.22	22.37	25.54	
July	24.66	2.28	23.02	26.29	
August	24.12	2.34	22.44	25.79	
September	23.88	2.34	22.20	25.55	
October	21.41	1.51	20.32	22.49	
November	18.46	1.44	17.42	19.49	
December	14.96	1.53	13.85	16.06	
Total	20.21	4.10	19.47	20.96	

In case of monthly maximum temperature the highest level of variation is observed in March with its mean value 27.67 ± 2.62; 95% CI of 25.79 to 29.54. The months of September and July have experienced high level of variation. The table 1.2 shows it very clearly. The lowest level of variation is noted in November (18.46 ± 1.44 with 95% CI: 17.42 – 19.49). Like a normal distribution, the monthly maximum temperature may be interpreted as it starts from the lowest level recorded in January and monotonically increases to February, March and so on tuching the peak point in July. It steadily comes down on August and the lower level of mean meets in December.

In statistical point of view, the monthly maximum temperature varies significantly with F= 14.82, P<0.01. It interprets that the monthwise variation in the maximum record of temperature is highly significant at 1% probability level of significance. It may be observed that the test value say F- value is higher in record (F=14.82). It statistically confirms that the variaability of monthly mean temperature is greater than the monthly maximum temperature.

Table-1.2 Variation in monthly maximum temperature (°C), Manipur

Month	Mean	SD	95%CI		Test value
			Lower	Upper	
January	23.07	2.10	21.56	24.57	F=14.820 P<0.01
February	25.06	2.19	23.49	26.62	
March	27.67	2.62	25.79	29.54	
April	29.15	2.08	27.65	30.64	
May	30.19	2.4002	28.47	31.90	
June	30.50	2.44	28.75	32.25	
July	30.85	2.41	29.12	32.57	
August	30.08	2.36	28.39	31.76	
September	29.70	2.58	27.85	31.54	
October	28.50	2.02	27.05	29.94	
November	26.70	1.87	25.35	28.04	
December	23.27	2.15	21.72	24.81	
Total	27.89	3.44	27.27	28.51	

In minimum temperature, the annual value for Manipur is found to be 12.59 ± 5.25 with 95% CI: 11.64 – 13.54. It is illustrated in table 1.3. The highest value of minimum temperature is noted to be 18.52 ± 2.60 with 95% of CI: 16.65 – 20.38 in July just deviated by 18.4 ± 2.49 with 95% CI: 16.61 – 20.18 in August, 18.04 ± 2.31 with 95% CI: 16.42 – 19.73 in September and the lowest value is observed in January (4.9 ± 1.96 with 95% CI: 3.49 – 6.30). In December, the lower value of monthly minimum temperature is noted to be 6.71 ± 1.65 with 95% CI; 5.52 – 7.89. However, the highest level of variation in this temperature is observed in July with its 95% CI of 16.65 to 20.38 and it is followed by August and June. The lowest variation is found to occur in October with its 95% CI of 13.31 to 15.38.

The pattern of the variation in mean value of monthly minimum temperature is somewhat different from that of monthly average temperature and monthly maximum temperature. In this analysis the minimum temperature starts from the lowest level in January (4.90°C) and monotonically advancing to February (6.37°C), March (9.18°C) and so on. After meeting the maximum level of 18.52°C in July it is declining soon on August (18.4°C), September (18.08°C) and the lower level meets in December (6.71°C). The variation is just skewed to the left say, July, June, May and so on that is far from normality.

Table-1.3 Variation of monthly minimum temperature (°C), Manipur

Month	Mean	SD	95%CI		Test value
			Lower	Upper	
January	4.90	1.96	3.49	6.30	F=55.816 P<0.01
February	6.37	1.92	4.99	7.74	
March	9.18	2.07	7.69	10.66	
April	12.28	2.29	10.63	13.92	
May	14.66	2.19	13.09	16.22	
June	17.45	2.44	15.70	19.19	
July	18.52	2.60	16.65	20.38	
August	18.40	2.49	16.61	20.18	
September	18.08	2.31	16.42	19.73	
October	14.35	1.44	13.31	15.38	
November	10.26	1.86	8.92	11.59	
December	6.71	1.65	5.52	7.89	
Total	12.59	5.25	11.64	13.54	

Trend analysis of temperature

The trend of annual temperature for three decades (1972-2001) is analysed through mean, maximum and minimum temperatures. Utilizing linear and growth models, the trend of annual mean temperature is observed to be positively moving. The increasing trend of mean temperature is highly significant as advocated by model summary, F=9.51, P<0.01 for linear model and 9.61, P<0.01 for growth (table 1.4). The trend line can explain 25% in the total variation in the annual mean temperature (R^2=0.254) which is graphically presented in figure 1.5. But the trend of annual maximum temperature during 30 years is insignificantly increasing (P=0.432 for linear and P=0.413 for growth). Low level of explanation say only 2% is noted by the trend line in total variation in the maximum record temperature (R^2=0.022).

Table-1.4 Model Summary and Parameter Estimates

Variable (temperature)	Model	Model Summary			Parameter Estimates	
		R-Square	F	P-value	Constant	b (coef.)
Annual mean	Linear	0.254	9.512	0.005	-42.164	0.031
	Growth	0.255	9.607	0.004	-0.094	0.002
Annual maximum	Linear	0.022	0.636	0.432	4.389	0.012
	Growth	0.024	0.692	0.413	2.445	0.001
Annual minimum	Linear	0.395	18.270	0.000	-90.159	0.052
	Growth	0.394	18.172	0.000	-5.568	0.004

From the present analysis, the highly significant increasing trend of annual mean temperature may perhaps be caused mainly by the very highly increasing trend of annual minimum temperature. It is proved by linear model's F-value, 18.27 and P<0.001. It means that the linear trend of minimum record temperature is highly significant at 0.1% probability level of significance. Also the increasing trend can explain about 40% of the total variation in minimum record temperature in Manipur (R^2=0.395). Figure-1.6 highlights the nature and pattern of variation in the minimum temperature.

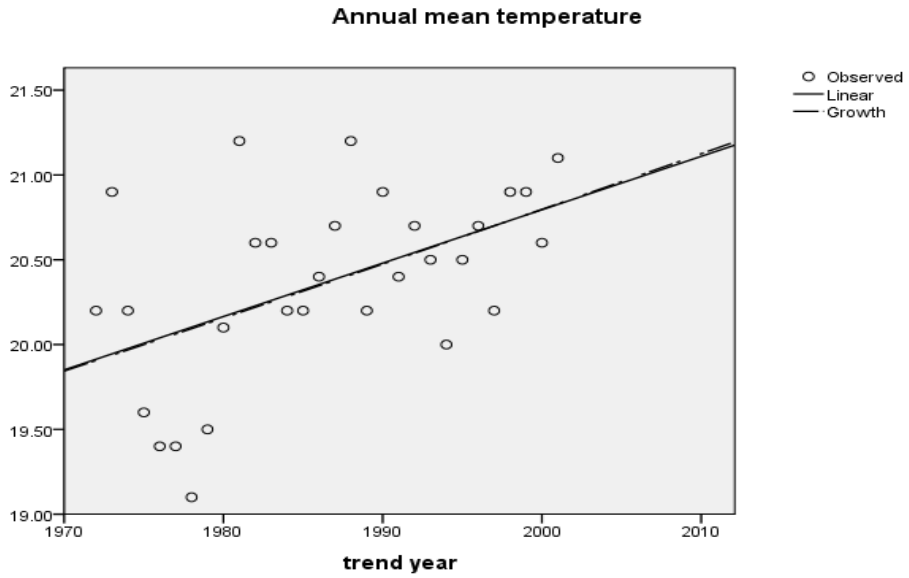

Figure- : 1 Trend line of annual mean temperature (°C) for 30 years (1972-2001), Manipur

By applying the prediction equations of linear model it can be foretell that the annual mean temperature in 2050 and 2100 will be 21.39°C and 22.94°C respectively in Manipur. Thus, the annual maximum temperature will become 28.99°C in 2050 and 29.56°C in 2100. The warming trend is seen to be continued in Manipur. It has been predicted that the annual minimum temperature will reach up to 16.44°C and 19.04°C in 2050 and 2100 respectively. The recorded annual mean minimum and maximum temperatures in 1975 in Manipur were 19.6°C, 12.3°C and 27.0°C respectively.

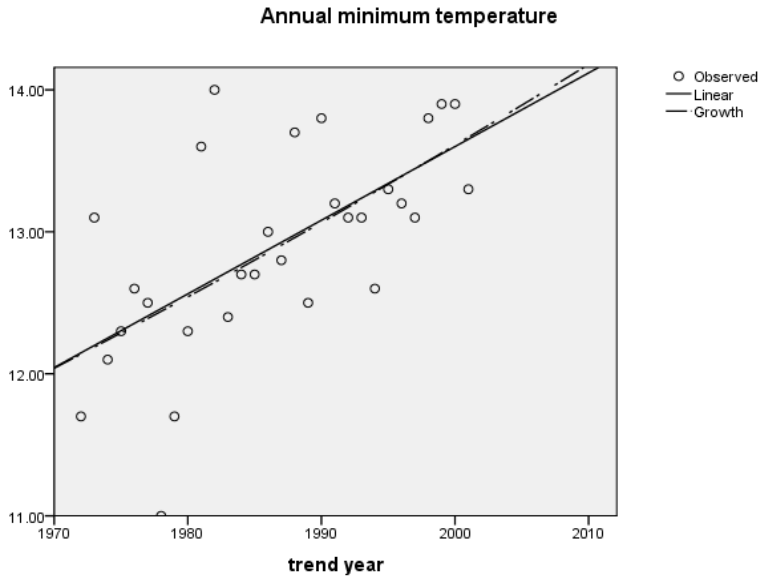

Figure : 2 Trend line of annual minimum temperature (°C) for 30 years (1972-2001), Manipur

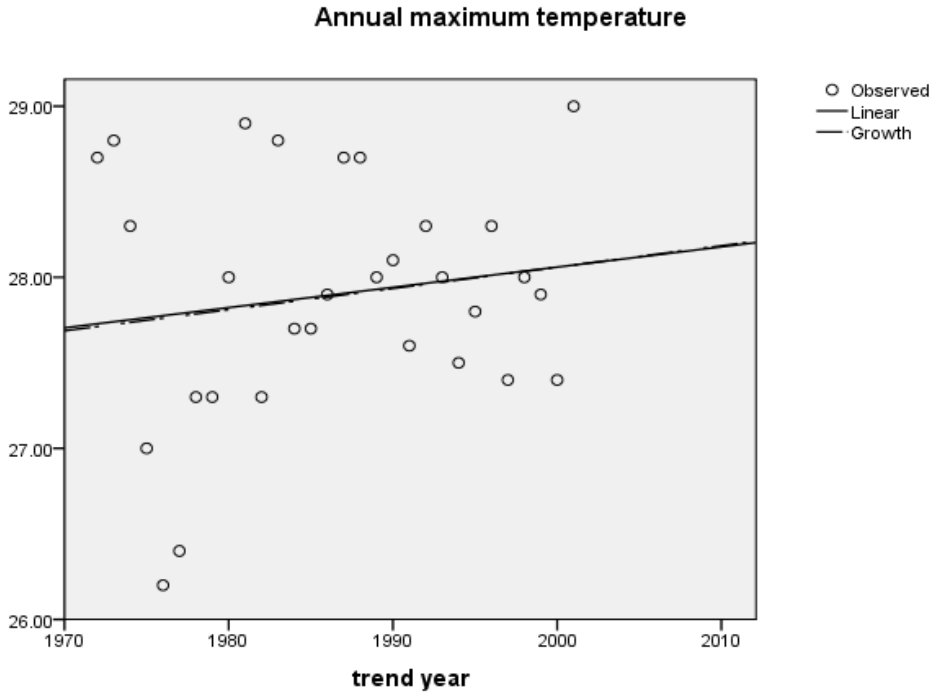

Figure : 3 Trend line of annual maximum temperature (°C) for 30 year 1972-2001), Manipur

Conclusion

It is found in Manipur that the variation in monthly temperature is statistically significant. So it is required to make different plans for human activities say agriculture, irrigation etc. For example different crops needs unequal amount of temperature for their growth, fruit etc. All the three types of temperature, i.e. mean, minimum and maximum temperature have their different significance levels of variation. The F-statistics value is highest in case of minimum temperature, say 55.816 at $P<0.01$. Thus, variation is found to be highest in monthly minimum temperature.

The trend of annual temperature is observed to be moved positively. But, the increase in annual minimum temperature is highly significant with F- value of 18.270 at $P<0.01$. Annual mean temperature is also increased significantly ($F=9.512$, $P<0.01$). However, the annual maximum temperature is increased insignificantly as advocated by its F-value of 0.636 at $P=0.432$. Now, it is confirmed that all the hypotheses given in this paper are observed to be statistically highly significant. It proves the validity of global trend of

rising temperature in Manipur. So, it is required to control this rising trend of temperature by checking up various greenhouse gases emission to save the human and its physical environment. If we do not check this rising trend of temperature, many unwanted impacts and consequences will happened on our earth.

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