STUDY ON IMAPCT OF CHENNAI CLIMATE

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ABSTRACT:

The weather in Chennai is mostly hot and humid. The main aim of this study is to detect the climatic changes in Chennai for the past 19 years (2000-2018) have an impact within the city. The estimation of temperature in Chennai is humid in comparison to past years. Chennai temperature will increased in the upcoming years. The research done in this study will help to detect the climatic changes going to occur. This study carried out to describe the temperature and wind speed time series from the online resources wrapping the past 19years (2000-2019) records. The annual change of mean temperature for 12 months over the years represented graphically. Computing Roughness coefficient (RC) for average of temperature and wind speed was made. The Pearson's correlation between temperature and wind speed using 12 months average over years. The parameter of temperature and wind speed for 12 months average over years is analyzed using regression. Also, the regression analysis is predicted for the succeeding years.

KEYWORDS – Climate change, Trend, Time series, Regression, Predictions

I. INTRODUCTION

Experiencing the 3 major seasons namely summers, monsoons and **winters**, the city of Chennai has a tropical climate. The months of April to June are the hottest months in Chennai. The maximum temperature during these months vary from 38-42 °C thus making Chennai very hot. However, now a day the temperature is increasing in Chennai due to urbanization and deforestation. The pleasant weather in the past years may turn into a hot weather.

STUDY OF THE AREA:

Coimbatore is situated in Tamil Nadu, southern part of India of latitude of 13.0827° N and longitude of 80.2707° E.

METHODOLOGY AND DATA:

Time series of monthly mean temperature, annual mean temperature and annual mean humidity from www.weatheronline.com the data covers about 19 years from 2000 to 2018.

TIME SERIES AND ROUGHNESS COEFFICIENT:

The natural order time series views are taken in accordance. Smoothing will be usually done to help us to see patterns in a time series in a better way. This will lead to smoothen the irregular roughness to view a clearer signal. At first we have examine the time series roughness scale by computing the Roughness coefficient (RC).

$$\mathrm{RC} = \frac{\sum_{t=2}^{n}(x_t - x_{t-1})^2}{\sum_{t=2}^{n}(x_t - \bar{x})^2}$$

$x_1, x_2, \ldots, x_n$ are the views of this series,is the average of time series elements, and n is the number of time series elements. The lesser the coefficient, the more smooth the data is. If not, we smooth the time series by using a moving average.

Roughness coefficient from 2000 to 2018:

Table: 1

January	2.19
February	2.43
March	1.89
April	2.40
May	1.69
June	2.62
July	2.39
August	2.03
September	2.35
October	1.28
November	2.07
December	2.53
Mean annual temperature	33.81
Mean annual wind speed	8.34

ORDINARY LEAST SQUARE:

Ordinary least squares is a technique is used in statistics that uses sample data to estimate the true population relationship between two variables. The following approach has been adopted to perform the analysis,

$$y_i = a + bx \text{ (i = 1,2,3,…n)}$$

Here the equation mentioned above is describing the linear regression between the time series and climate variable (Temperature or Wind speed) for the specified time period of 2000-2018. Considering as independent and dependent variable, regression coefficient 'b' and the regression constant 'a' of least-squares estimation have been calculated respectively by using the following relations.

$$\sum y = Na + b\sum x$$

$$\sum xy = a\sum x + b\sum x^2$$

PEARSON'S COEFFICIENT OF CORRELATION:

Pearson's correlation is denoted by '**r**' correlation coefficient commonly used in linear regression.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2}\sqrt{n(\sum y^2) - (\sum y)^2}}$$

Here, i = 1,2,3,…n (Time series), x = Monthly mean temperature, y = Monthly mean wind speed.
The calculation is done for temperature and wind speed in the below

Table : 2

x	y	Xy	X^2	Y^2
33.7	5.99	201.9191667	1135.69	35.90006944
33.98	8	271.8666667	1154.866944	64
33.86	7.67	259.5805556	1146.386736	58.77777778
33.81	6.67	225.3888889	1143.003403	44.44444444
33.48	7.73	258.8733333	1120.575625	59.80444444
33.69	8.85	298.17125	1135.128403	78.3225
33.9	9	305.1	1149.21	81
33.3	6.76	225.0525	1108.89	45.67506944
33.68	6.6	222.31	1134.566944	43.56
34.36	7.75	266.2770833	1180.495069	60.0625
33.48	9.22	308.6047222	1121.133611	84.94694444
33.93	9.31	315.8627778	1151.471111	86.64506944

The value of Pearson's Correlation is 0.223476 by using the above formula. This value shows there is no correlation between temperature and wind speed.

COEFFICIENT OF DERTERMINATION:

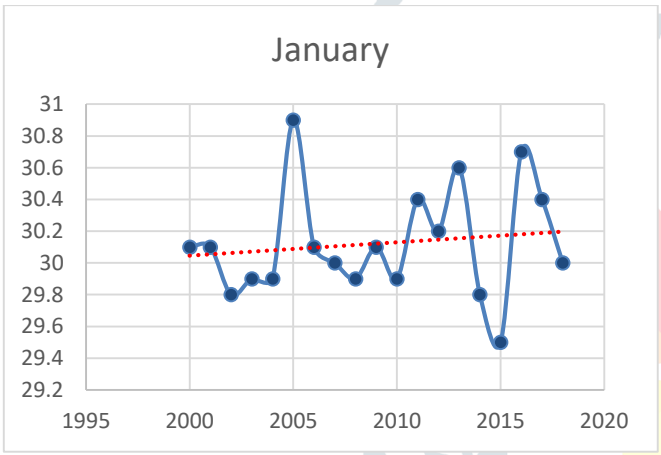
The coefficient of determination which is denoted by R^2 that indicates how well data points fit a line or curve using the data collected. There are many definitions for R^2. One of those definition is the squaring of correlation coefficient will be the coefficient of determination.

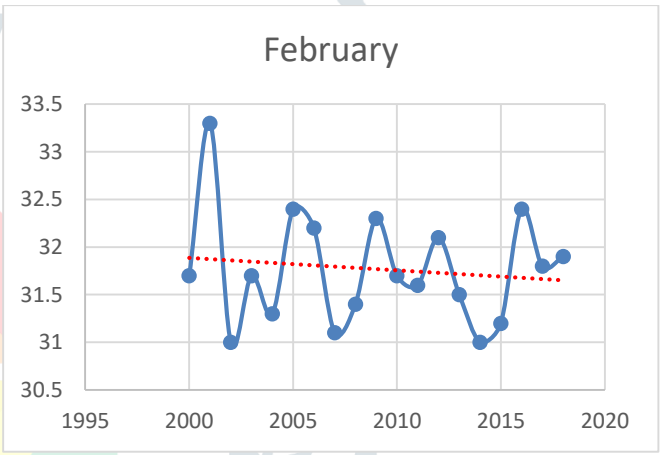
RESULT:

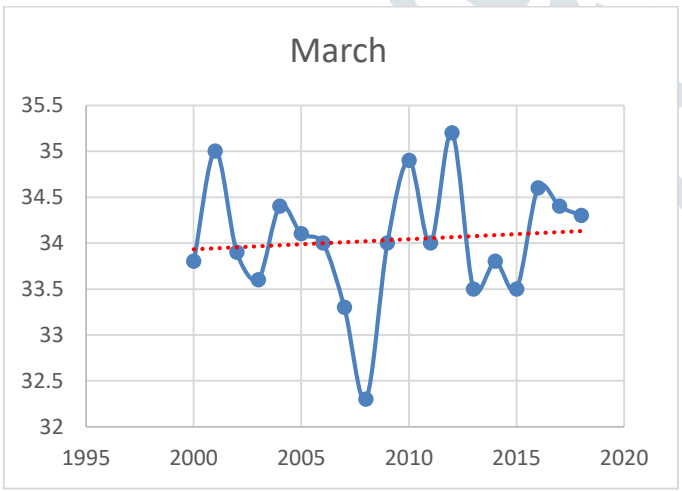
First, we examined the time series whether it was rough or smooth, Roughness coefficients were computed by using equation (1). Table (1) shows the results, all values in the table are small so that the time series is smooth and it is not necessary to smooth it. Table (1) represents roughness coefficient for monthly and annual mean for temperature and wind speed time series.

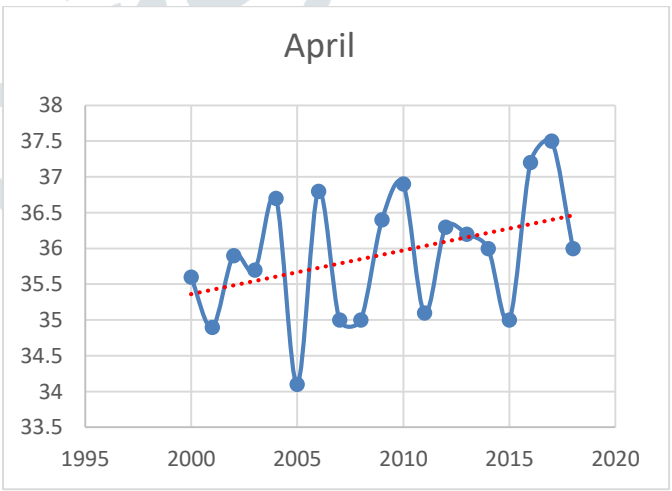
TEMPERATURE:

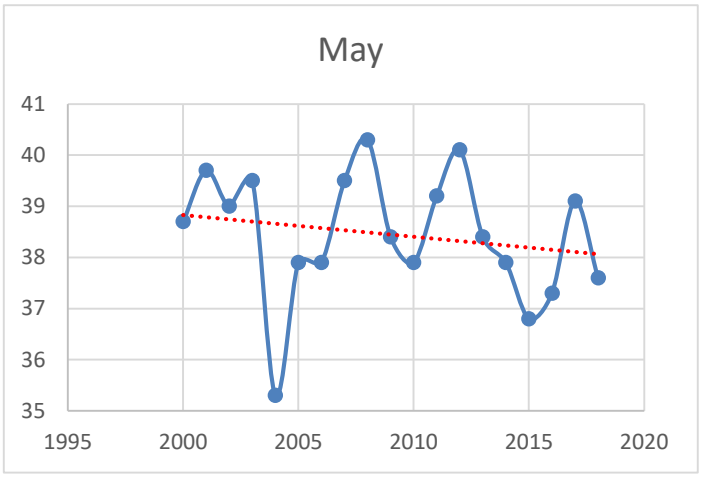
Annual mean temperature for each month of the year, plotted in MS Excel, and the linear trends observed were represented graphically for www.weatheronline.com with respect to their mean of 18 years (2000–2018). The graph shows the changes for mean temperature for 12 months (January2000 - 2018, February2000 – 2018,March2000 - 2018, April 2000 - 2018, May2000 -2018,June2000-2018,July2000-2018, August2000-2018, September2000-2018,October2000-2018, November2000-2018 , December2000-2018). The regression equation and the coefficient of determination (R^2) are determined by ordinary least squares method.







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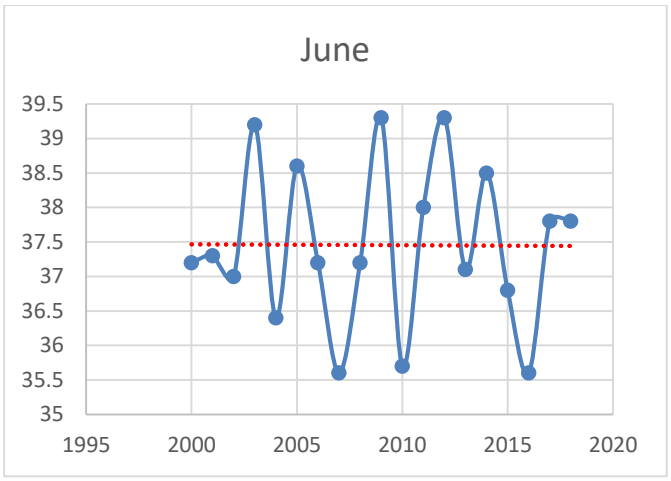
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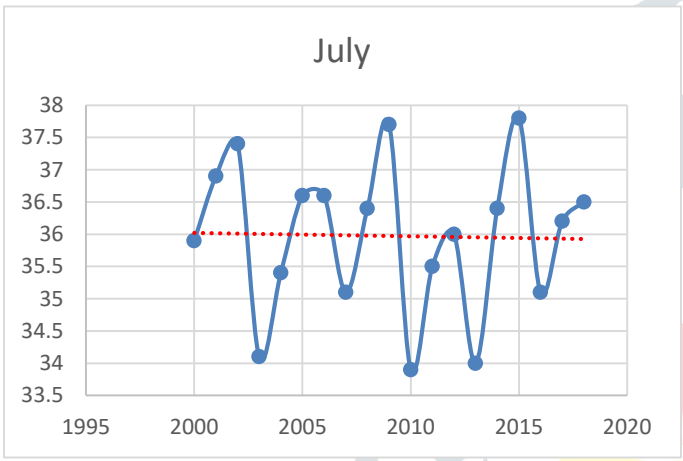
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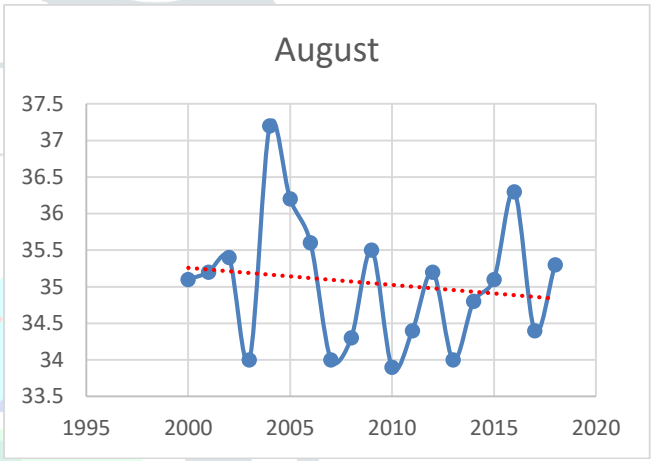
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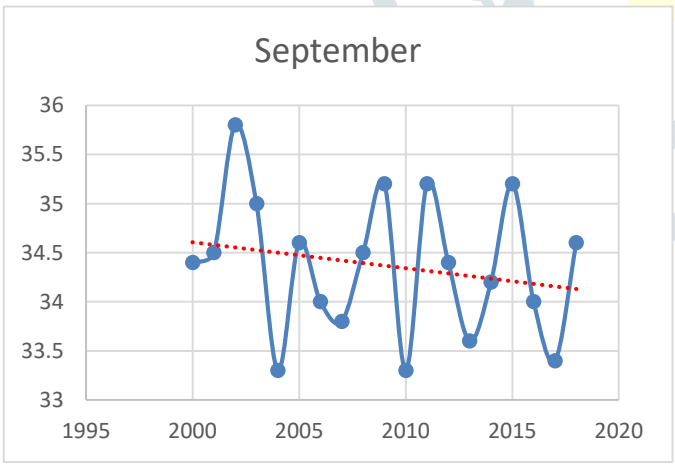
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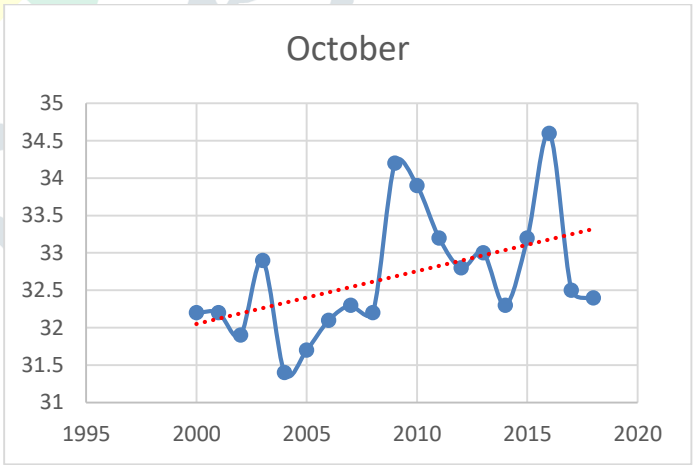
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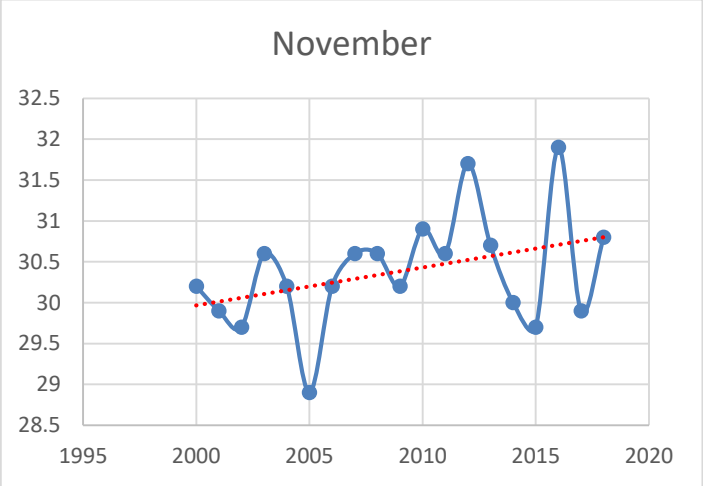


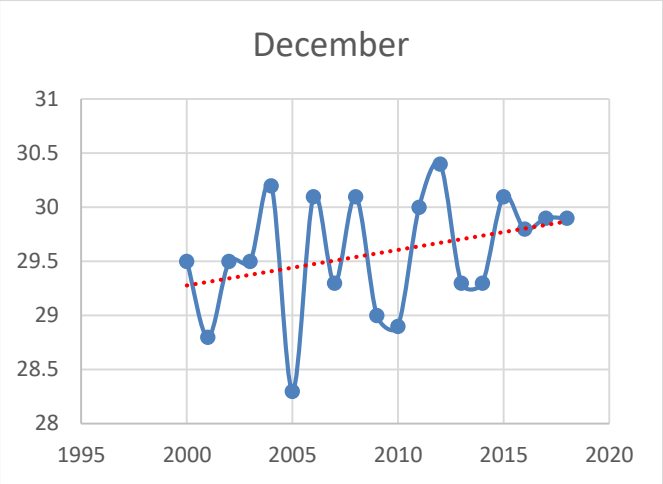


Table (2) Show the regression equation and coefficient of determination for temperature

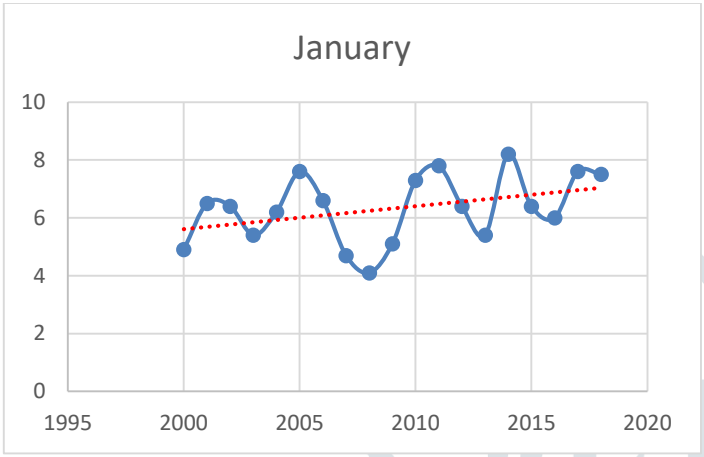
Months and annual	Formula number	Formula	Coefficient of determination
January	1	y= 0.00842x+13.20316	R^2 = 0.01879
February	2	y= -0.01316x+58.20263	R^2 = 0.01602
March	3	y = 0.01088x+12.1793	R^2 = 0.00828
April	4	y = 0.06105x-86.74421	R^2 = 0.14495
May	5	y = -0.04246x+123.74175	R^2 = 0.03782
June	6	y = -0.00123x+39.91982	R^2 = 0.00003
July	7	y = -0.00526x+46.54737	R^2 = 0.00065
August	8	y = -0.02333x+81.92404	R^2 = 0.02163
September	9	y=-0.02649x+87.5893	R^2 = 0.04395
October	10	y = 0.07053x-109.00316	R^2 = 0.22106
November	11	y = 0.04632x-62.66421	R^2 = 0.14143
December	12	y = 0.03281x-36.33561	R^2 = 0.10961

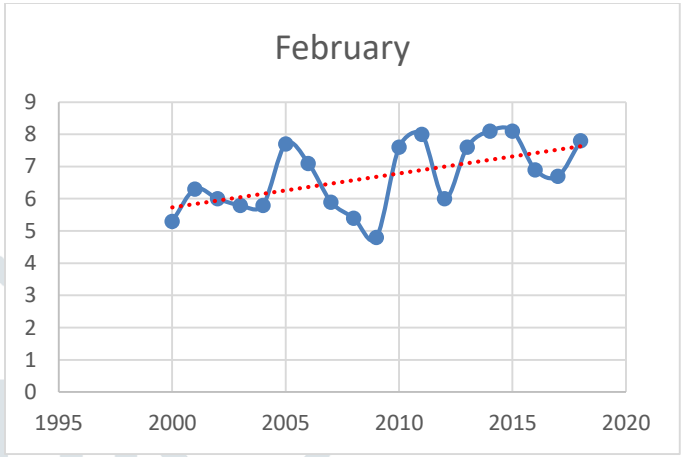
Table (3) show prediction of monthly temperature in (^{0}C)

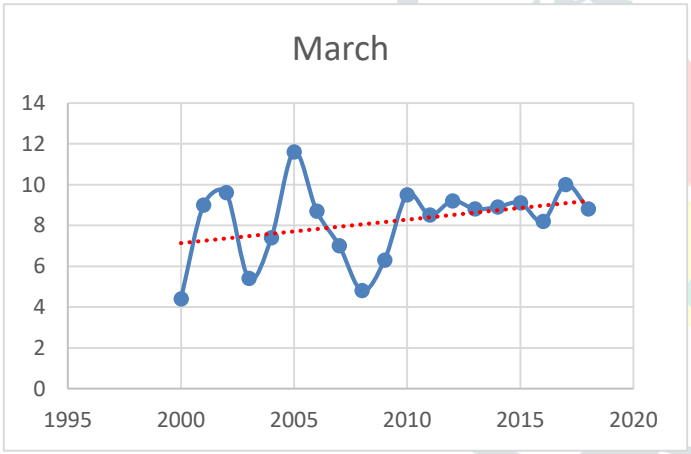
Years / Months	2019	2020	2021	2022
January	30.20314	30.21156	30.21998	30.2284
February	31.63259	31.61943	31.60627	31.59311
March	34.14602	34.1569	34.16778	34.17866
April	36.51574	36.57679	36.63784	36.69889
May	38.01501	37.97255	37.93009	37.88763
June	37.43645	37.43522	37.43399	37.43276
July	35.92743	35.92217	35.91691	35.91165
August	34.82077	34.79744	34.77411	34.75078
September	34.10599	34.0795	34.05301	34.02652
October	33.39691	33.46744	33.53797	33.6085
November	30.85587	30.90219	30.94851	30.99483
December	29.90778	29.94059	29.9734	30.00621

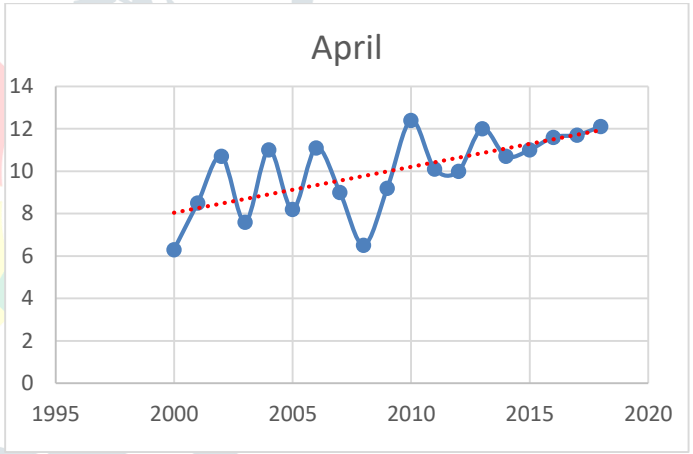
WIND SPEED:

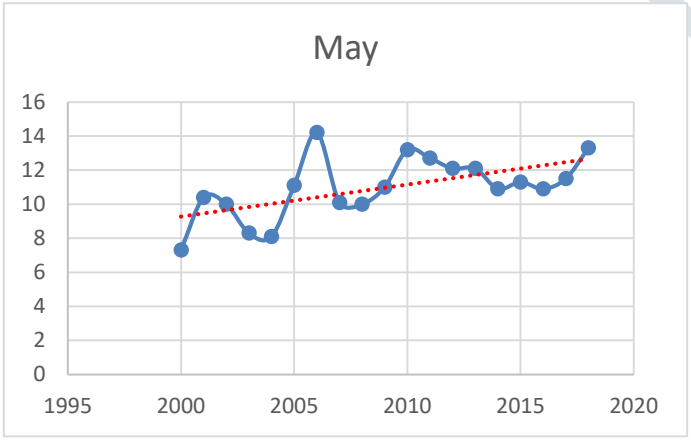
Annual mean wind speed for each month of the year, plotted in MS Excel, and the linear trends observed were represented graphically for www.weatheronline.com with respect to their mean of 18 years (2000–2018). The graph shows the changes for mean wind speed for 12 months (January2000 - 2018, February2000 – 2018, March2000 - 2018, April 2000 - 2018, May2000 -2018, June2000-2018, July2000-2018, August2000-2018, September2000-2018, October2000-2018, November2000-2018 , December2000-2018). The regression equations and the coefficient of determination (R^2) are determined by ordinary least squares method.

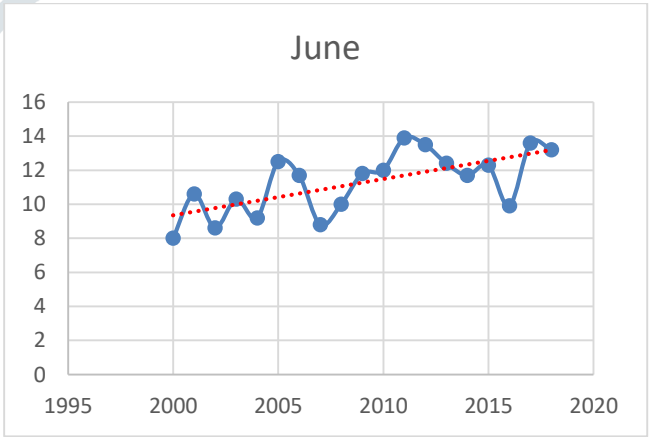


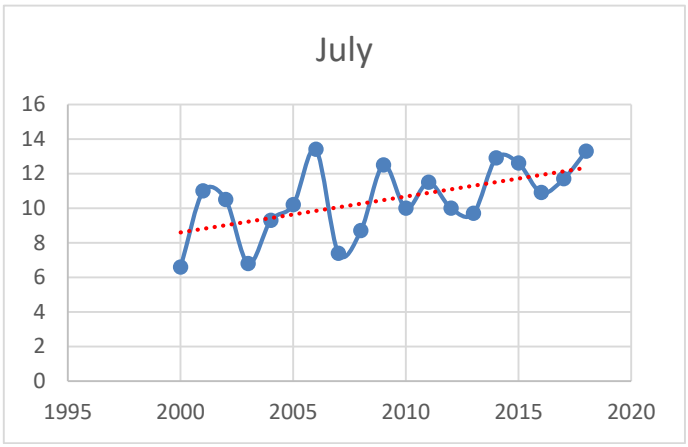


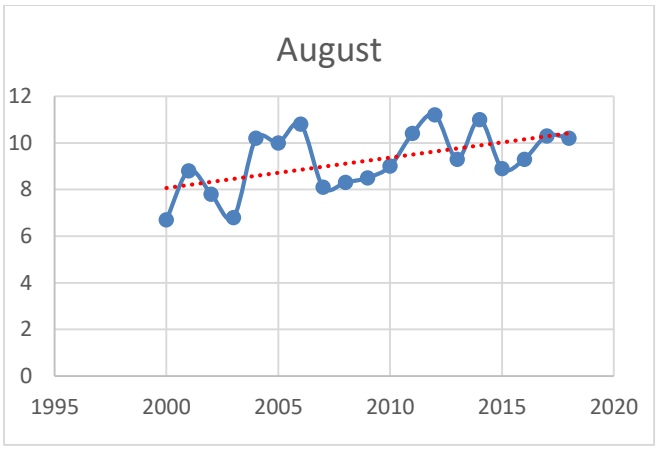


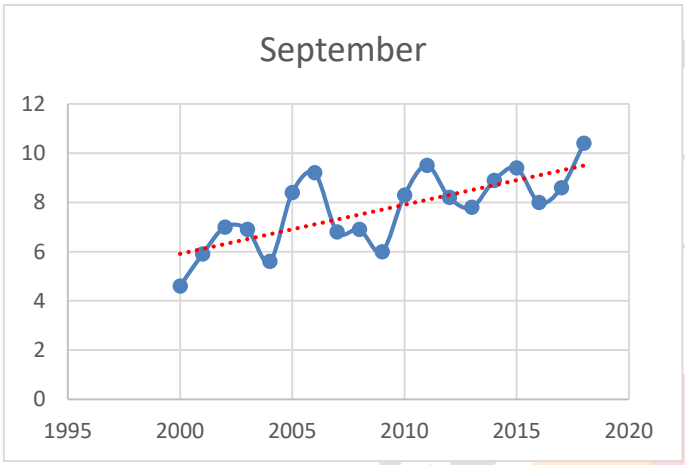


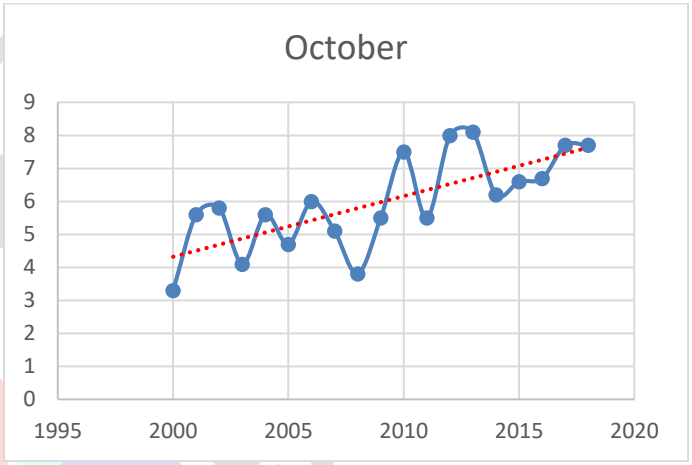


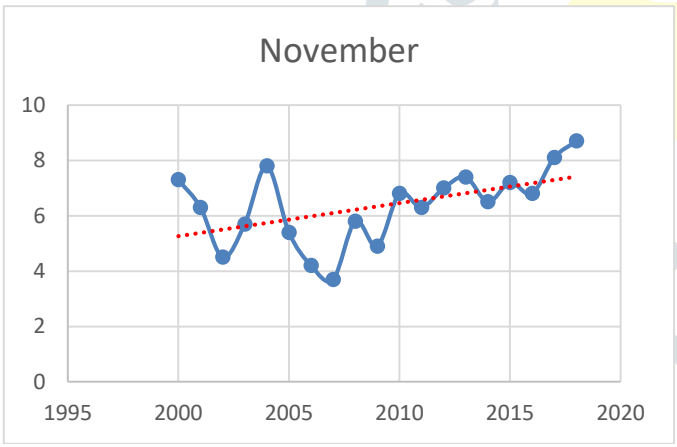












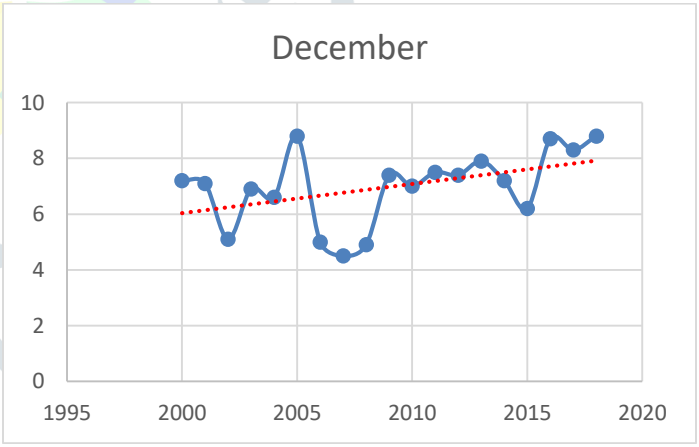


Table (4): Show the regression equation and coefficient of determination for wind speed

Months	Formula number	Formula	Coefficient of determination
January	1	y=0.07965x-153.69404	R^2 = 0.14849
February	2	y=0.10526x-204.79474	R^2 = 0.31125
March	3	y=0.11491x-222.69035	R^2 = 0.12148
April	4	y=0.21579x-423.53684	R^2 = 0.42369
May	5	y=0.18807x-366.8593	R^2 = 0.34407
June	6	y=0.21333x-417.32351	R^2 = 0.43846
July	7	y=0.20842x-408.24424	R^2 = 0.31876
August	8	y=0.13035x-252.63281	R^2 = 0.30412
September	9	y=0.19947x-393.03737	R^2 = 0.54192
October	10	y=0.18386x-363.40035	R^2 = 0.52911
November	11	y=0.11965x-234.03825	R^2 = 0.24679
December	12	y=0.10474x-203.44263	R^2 = 0.19789

Table (5): Show the predictions of monthly wind speed in (km/h) in years

Years / Months	2019	2020	2021	2022
January	7.11931	7.19896	7.27861	7.35826
February	7.7252	7.83046	7.93572	8.04098
March	9.31294	9.42785	9.54276	9.65767
April	12.14317	12.35896	12.57475	12.79054
May	12.85403	13.0421	13.23017	13.41824
June	13.38976	13.60309	13.81642	14.02975
July	12.55574	12.76416	12.97258	13.181
August	10.54384	10.67419	10.80454	10.93489
September	9.69256	9.89203	10.0915	10.29097
October	7.81299	7.99685	8.18071	8.36457
November	7.5351	7.65475	7.7744	7.89405
December	8.02743	8.13217	8.23691	8.34165

CONCLUSION:

The purpose of the study gives the future prediction which is going to high in both temperature and wind speed, we have predicted for twelve months (January 2000-2018 , February 2000-2018,march 200-2018,April 2000-2018,May 2000-2018,June 2000-2018,July 2000-2018,August 2000-2018, September 2000-2018, October 2000-2018,November 2000-2018,December 2000-2018)

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