Impact of climatic parameters on COVID-19 pandemic in India: analysis and prediction

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ABSTRACT

The COVID-19 is spreading very fast globally and various factors of it have to be analysed. The aim of this study is to analyze the effect of climatic parameters (Average Temperature (AT), Atmospheric Pressure (AP), Relative Humidity (RH), Solar Radiation (SR) and Wind Speed (WS)) on the COVID-19 epidemic during 25 March 2020 to 15 June 2020 in most affected states of India i.e. Maharashtra, Delhi and Tamilnadu. We quantitatively establish the correlation between these parameters by using Kendall & Spearman rank correlation test. The results indicate that the numbers of cases are highly correlated with the AT ($r^2 > 0.6, p < 0.001$) in Delhi where as a moderate correlation ($r^2 < 0.6, p < 0.001$) has been estimated for Maharashtra and Tamilnadu. Similarly, an intermediate range of correlation coefficient has been observed for other climatic parameters. A comparative study of climatic parameters in the current COVID-19 period with previous two years (2018-2019) has been carried out. Corresponding results imply a substantial trend for all three states. The range of climatic parameters have been found corresponding to maximum number of cases results as AT (25~40 ^{0}C), RH (40~70%), AT (740~965 mmHg), SR (200-250 W/mt ^{2}) and WS (.5~14 m/sec). Time series analysis depicts that the number of cases and mortality are increasing rapidly. COVID-19 epidemic peak has been predicted by SIR model for capital of India (New Delhi) and it would be around October 2020. The outcomes of this study will be helpful for the containment of COVID-19 not only in India but globally**.**

Keywords COVID-19, Climatic parameters, Epidemic peak, correlation coefficient, Lockdown, India

Introduction

COVID-19 has been declared as a worldwide pandemic by World Health organization (WHO) on March 11, 2020 (Cucinotta et al., 2020). Globally, the first COVID-19 case was reported on December 31, 2019 in Wuhan (China) (Zhu et al., 2020, Guan et al., 2020 Li et al., 2020, Deepak et al., 2020). At present, it has affected around 80% of world population and still growing at decent rate (https://www.worldometers.info/coronavirus). Investigation on COVID-19 recognized that its transition occurred by respiratory droplets, as well as human to human transition (Ge et al., 2013, Huang et al., 2020, Vandini et al., 2013). The common symptoms of COVID-19 infected patients are fever, cough and respiratory disorders (Holshue et al., 2020). In worst conditions, it might results as serious health issues like kidney failure, pneumonia which might cause death of patients (Wang et al., 2020, Ten et al., 2005, Perman,2020). The major concerns about COVID-19 are its tremendously growing cases and vulnerable community transmission in world. In addition, no vaccination of COVID-19 has been officially reported till date. Therefore, adequate precautions and preliminary research work on the factors affecting the spreading of COVID-19 might be helpful for development of vaccination process of COVID-19. Recent studies suggest that the spreading of COVID-19 is highly correlated with the atmospheric factors such as temperature, humidity etc (Ma et al., 2020, Chen et al.,2020, Qi et al.,2020, Wang et al.,2020). It has been reported that abrupt change in climatic conditions and population might be responsible for virus transmission (Rockloy et al., 2020, Sohrabi et al., 2020, Dalziel et al.,2018, Jaiswal et al.,2015, Hansel eta al., 2016). Conflictingly, few studies are not accounting meteorological parameters as carriers of transition of COVID-19 (Jamil et al.,2020, Mollalo et al.,2020, Shi et al., 2020). Another study indicates that the temperature, humidity can be responsible of transmission and existence of SARS-COV virus [(Bashir et al., 2020, Shi et al., 2020 b, Tan et al., 2020, Yuan et al., 2020). However, limited studies have been carried out in context of COVID-19 and climatic factors. *Tosepu et al.* have studied the correlation between weather and COVID-19 in Jakarta (Indonesia) in earliest stage of COVID-19 (Tosepu et al,. 2020) and predicted a connection between climatic factors (rainfall, temperature, humidity) and COVID-19 transmission cases. A few numbers of such works have also been reported but all these studies have been performed at the earliest of COVID-19 transmission and incorporate only limited data set (up to April 2020) (Ahmadi et al.,2020, Gupta et al,. 2020, Poole et al.,

2020). Further, it is expected that this correlation also depends on geographical conditions of study area. So far, such reported studies are only limited to European countries (Briz et al., 2020, Sajadi et al., 2020). To best of author's knowledge, no such study has been carried out for south Asian countries till date.

In this paper, we study the effects of varying climatic parameters (CPs) on the spread of COVID-19 from 15 March 2020 to 15 June 2020 in India. The aim of this study is to analyse journey of COVID-19 in India and forecast the effect of COVID-19 on climatic conditions in subsequent times. Moreover, to obtain detailed analysis of the COVID-19, we have emphasized our study to three most COVD-19 affected states of India i.e. Maharashtra, Tamilnadu and Delhi. In addition, the strategies such as nationwide lockdown implemented by Indian government to reduce COVID-19 spreading have been quantitatively evaluated in climatic framework. In India, the first confirmed COVID-19 case was reported in Kerala on January 30, 2020 (https://www.mohfw.gov.in). The total confirmed cases has been raised up to 3,54,065 within five months in India, which is the highest number of confirmed COVID-19 cases in Asia and fourth highest in world as on 15 June 2020 (https://www.worldometers.info/coronavirus). It implies that COVID-19 is drastically spreading among 1.3 billions of people in India. Out of the total confirmed cases, 1, 86,935 patients have been recovered and total 11,900 deaths in country till mid June 2020 (https://www.covid19india.org). As anticipation, nationwide lockdown was imposed by Indian government in five phases. During this lockdown period, all social activities like transport, industries, shopping malls etc. had been strictly prohibited in India.

2. Methodology:

2.1 Study area:

India is the second-highest populated country $(13*10^8$,17.7% of worldwide) after China located at north of the equator between 8°4' north to 37°6' north latitude and 68°7' east to 97°25' east longitude . It stands as the seventh-largest country in the world, with a total area of 3.28 $x10^6$ km^2. It is surrounded by Arabian Sea (in west), Indian Ocean (in south), and Bay of Bengal (in east). The north-east region of India has been covered with the Himalayas. Fig.1 shows the study area. The study further focuses on the three most crucial states of India in COVID-19 transmission i.e. Delhi, Maharashtra and Tamilnadu. These are the three major states of India.

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The population of these states are 1.8×10^7, 1.23×10^8 and 7.7×10^7 respectively as on 2019 (Census 2011; http://census2011.co.in). Most importantly, these three are most affected states of India from COVID-19 as on mid June 2020.

2.2 Data collection

The digital dataset for the COVID-19 in India has been obtained from Ministry of Health and Family Welfare (MoHFW) [https://www.mohfw.gov.in/] and official website of covid-19 [https://www.covid19india.org/]. The data related to CPs (AT, RH, AP, SR and WS) are authentically retrieved from official online portal of Central Pollution Control Board (CPCB) [https://www.cpcb.nic.in/]. Retrieved data of CPs and COVID-19 from the sources were not distributed normally. Therefore for estimating correlation coefficient between parameters we use Kendall and spearman rank test. Further SIR model has been used for prediction of epidemic of COVID-19 (Weisstein, Eric W). For interpretation of results and graphics we utilized machine learning technique.

3. Results and discussion

The spatial distribution of COVID -19 parameters (Positive cases (PC), recovery and Death(DT)) during the lockdown in India is shown in fig.2. The whole lockdown period has been categorized in two phases i.e. period-I (from 25 March 2020 to 3 May 2020) and period-II (from 4 May to 15 June). Fig. 2 clearly indicates that Delhi, Maharashtra and Tamil Nadu are the most affected states of India from COVID-19 pandemic till mid June 2020. The additional details of COVID-19 parameters during the different lockdown phases are mentioned in (Table.1). On observing table.1 carefully, it is clear that PC and mortality increases rapidly all over India during lockdown period. One more important observation is that the cases are still increases as on June 2020 and the saturation state of COVID-19 cases still not achieved in India.

Table 1: Details of COVID-19 parameters during different phases of Lockdown

Lockdown phase in India	I period	II period

		I Phase (25-march to 14-April)	II Phase (15-April to 3- May	III phase (4- May to 17 May)	IV Phase (18- May to 31- May)	V Phase (1- June to 15- June)
India (20.59 N, 78.96 E)	Positive cases	11485	31294	52920	94949	152423
	Mortality	396	1067	1562	2380	4512
	Recovered cases	1365	10398	25032	55067	88461
Delhi (28.70 N, 72.87 E)	Positive cases	1561	2988	5206	10089	22985
	Mortality	30	34	84	327	925
	Recovered cases	31	1331	2840	4276	7949
Maharashtra (19.75 N, 75.71 E)	Positive cases	2680	10294	20079	34602	43089
	Mortality	178	370	650	1088	1842
	Recovered cases	259	1856	5573	21641	26720
Tamil Nadu (11.12 N, 78.65 E)	Positive cases	1204	1819	8201	11110	24170
	Mortality	12	18	49	97	303
	Recovered cases	81	1298	2793	8585	12587

The variation in CPs (24hrs average value) of during the period of three months (25th April to 15th June) has been observed for previous three years (2018-2020) for three states of India i.e. Maharashtra, Delhi and Tamilnadu illustrated in fig.3 (a),(b),(c). We have observed similar trends in 2020 as compared to 2018 and 2019. However, a unique quantitative variation in CPs has been noticed for year 2020. AT significantly reduces with respect to previous years in the range of (5.2% ~ 10.4%). Moreover, the RH represents ascending trend in all three years with

relative difference (2.4% to 40%). It is an intuition that this variation is correlated with the COVID-19 pandemic up to some extent. Moreover, the study of variation of CPs has been carried out during lockdown period in Maharashtra, Delhi and Tamilnadu. Corresponding parameters have been tabulated in (Table.2). It depicts that the implementation of lockdown is a factor for considerable variations in CPs and air quality.

Table 2: Relative difference between climatic parameters for year 2018-2020(25 March to 15 June)

Climatic Parameter	Delhi			Maharashtra			Tamil Nadu		
	Avg.2020	Relative difference (%)		Avg.2020	Relative difference(%)		Avg.2020	Relative difference(%)	
		2018-2019	2019-2020		2018-2019	2019-2020		2018-2019	2019-2020
Average Temperature	29	9.5	10.45	31.64	5.2	5.99	28.9	8.6	7.4
Relative Humidity	50.59	2.4	38	68.07	2.4	2.4	66.27	11.54	21.09
Atmospheric pressure	982.38	18	0.17	734.68	40.18	40.19	749.8	33.85	31.8
Wind Speed	0.78	92.3	41.02	0.113	21.9	22.2	9.482	77.28	75.84
Solar Radiation	189.23	13.8	17.6	158.28	29.9	60.1	242.72	7.7	10.2

CPs (AT, AP, RH, SR, and WS) play an important role in stability of environment. To quantify the correlation between COVID-19 spread and CPs, we have statistically analyzed the data and estimated correlation coefficient between CPs and COVID-19 parameters by using Spearman rank test and Kendall test as shown in (Table.3). It was observed that number of (PC)

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was highly correlated with AT for Delhi ($r^2 > 0.6$) whereas moderate correlation is observed for Tamil Nadu and Maharashtra ($r^2 < 0.6$) with significant level of 0.1 % ($p < .001$).

Table 3 : Correlation coefficients between climatic parameters with COVID-19 parameters

Test	Climatic Parameters	Delhi		Maharashtra		Tamil Nadu	
		Positive cases	Mortality	Positive cases	Mortality	Positive cases	Mortality
Spearman Correlation Coefficient	Average Temperature	0.821	0.753	0.099	0.071	-0.550	-0.536
	Relative Humidity	0.054	-0.209	-0.438	-0.473	0.615	0.560
	Atmospheric Pressure	-0.842	-0.736	-0.784	-0.797	-0.799	-0.774
	Wind speed	0.326	0.047	0.421	0.413	0.733	0.722
	Solar Radiation	0.334	0.270	-0.297	-0.294	-0.329	-0.413
Kendall Correlation Coefficient	Average Temperature	0.635	0.635	0.081	0.056	-0.390	-0.398
	Relative Humidity	0.030	-0.172	-0.310	-0.334	0.465	0.423
	Atmospheric Pressure	-0.646	-0.563	-0.580	-0.602	-0.559	-0.559
	Wind speed	0.200	0.040	0.263	0.256	0.529	0.550
	Solar Radiation	0.214	0.187	-0.176	-0.180	-0.228	-0.302

In addition, the significant correlation between RH and PC was observed for the three states i.e. positive correlation ($r^2 > 0.6, p < 0.001$) and intermediate correlation for Delhi ($p > 0.1$) and Maharashtra($r^2 < 0.6$). However, SR is not significantly correlated with COVID-parameters. Meanwhile, it is observed that WS affect COVID-19 cases as the corresponding correlation coefficient is positive. In brief, the obtained statistical results for most of the CPs

were found very significant with $(p < 0.001)$ in India. It is further observed that the mortality rate is growing with time. The CPs were shows a moderate correlation with DT. To have more clear insight, the scattered correlation matrices of CPs and COVID-19 parameters for Delhi, Maharashtra and Tamil Nadu shown in fig. 4(a), 4(b) and 4(c). It is observed that the maximum PC have been reported within the AT range (25~40 ^{0} C). Similarly, the most frequent ranges for other CPs corresponding to most number of PC are 40~70%, 740~965 mmHg and 200~250 W/mt ^{2} for RH, AP, SR respectively. Particularly, a wide range for WS (.5~ 14 m/sec) has been calculated for having maximum no. of PC from Delhi to Tamilnadu and varying with latitude. In lower latitude the no. of PC are high within the range of WS (10~14 m/sec) although for northern region at higher latitude, it is observed (.5~1.5 m/sec). This lead to conclude that the areas experience such climatically condition have been mostly affected by COVID-19.

Figure 5 represent the time series of no. of PC and mortality during lockdown period (25th March - 15th June) for three crucial states of India i.e. Delhi, Maharashtra and Tamil Nadu. The corresponding plot indicates that variation in PC and mortality cases increase exponentially with respect to time. Fig.6 provides a prediction of the number of COVID-19 cases in subsequent times in Delhi. The epidemic peak for COVID-19 in Delhi has been predicted on October 2020 (Weisstein, Eric W).

Conclusion

The CPs (AT, RH, AP, SR and WS) are one of the crucial factors for in COVID-19 dissemination in India. On analyzing the available COVID-19 dataset, we have observed that the number of COVID-19 cases are still growing significantly despite of imposing containment strategies i.e. lockdown in India. It clearly indicates that there are some other factors (CPs) other than social activities which are influencing COVID-19 growth in India. It has been also observed that growth rate of COVID-19 is highest in three states of India i.e. Maharashtra, Delhi and Tamilnadu. In Delhi, the number of cases are positively correlated with AT ($r^2 > 0.6$) whereas the correlation is moderate for other two states. Similarly, all other CPs (AP, RH SR and WS) show critical correlation with transmission of COVID-19 in India with 0.1% of significance

level($p < 0.001$). Further, the substantial variations of CPs have also been observed in last three years. On comparing the AT (daily average of 24 hours) of previous three years (2018-2020), a unique trend (decreasing comparatively) is observed. Moreover the range of CPs have been found corresponding to maximum number of cases results as AT (25~40 ^{0} C), RH (40~70%), AT (740~965 mmHg), SR (200-250 W/mt ^{2}) and WS (.5~14 m/sec). This signified that for the maximum transition of COVID-19, a susceptible weathers condition is required. In addition, the epidemic peak (highest number of cases) in New Delhi (capital of India) has been predicted around October-November 2020. It implies that COVID-19 transmission decreases in winter in India which compliment the results obtained from correlation test.

Despite of the enthusiastic outcomes of this study, there are further specific factors (people emigration, various government policies for containment etc.) which must be considered to obtain a more accurate prediction of COVID-19 epidemic parameters. Nevertheless, this study has the potential to enhance the current understanding of COVID-19 spreading and will help for the advancement of vaccination process of COVID-19. More over this study indicates that the COVID-19 containment policy i.e. lockdown adapted across the globe leads to reduced pollution level, improve climatic conditions in last few months. Such exceptional change has never been observed in nature before in short time duration. Therefore, such activity in future would be effective in sustainable development of nature.

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Delhi

Maharastra

Tamilnadu

Positive Case	Recovry Case	Death Case
Low : 0 — High : 10000	Low : 0 — High : 2000	Low : 0 — High : 600
First Period	First Period	First Period

Positive Case	Recovry Case	Death Case
Low : 0 — High : 90000	Low : 0 — High : 50000	Low : 0 — High : 3500
Second Period	Second Period	Second Period
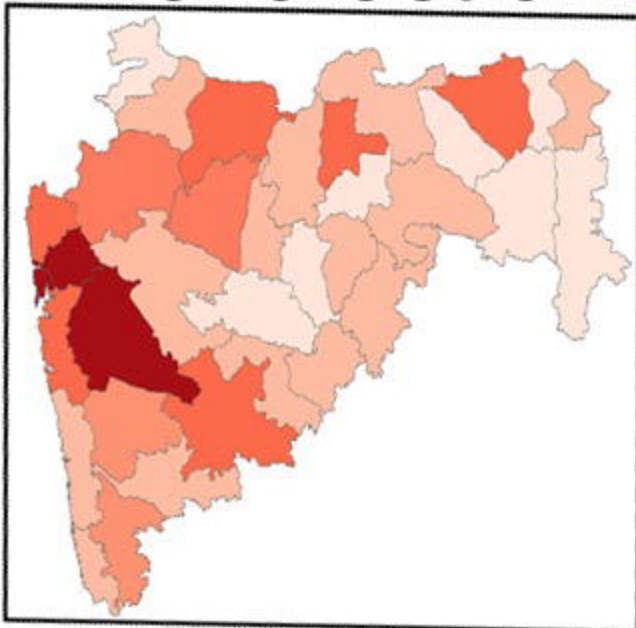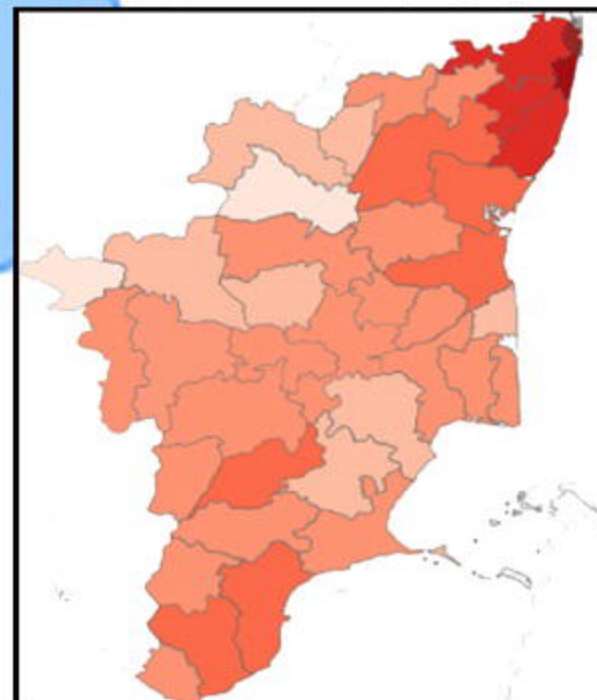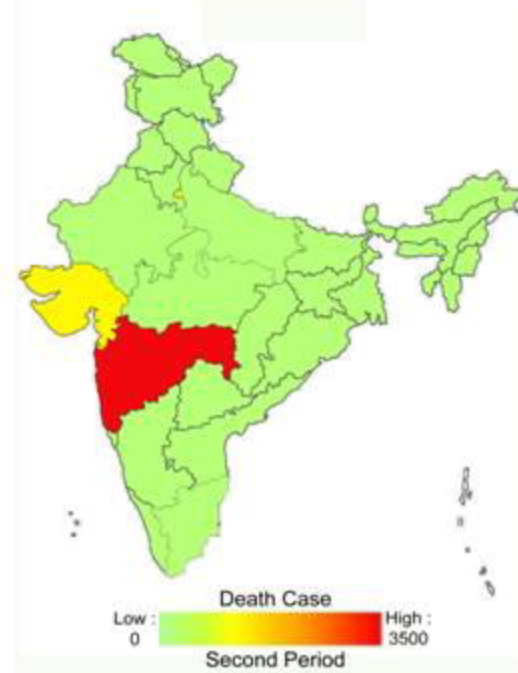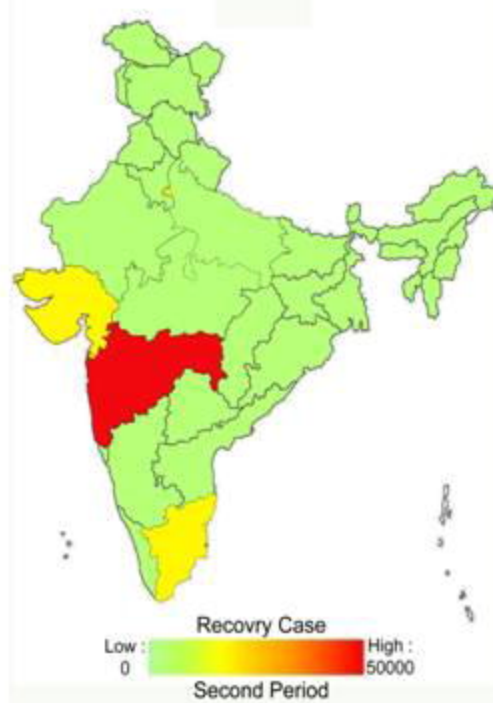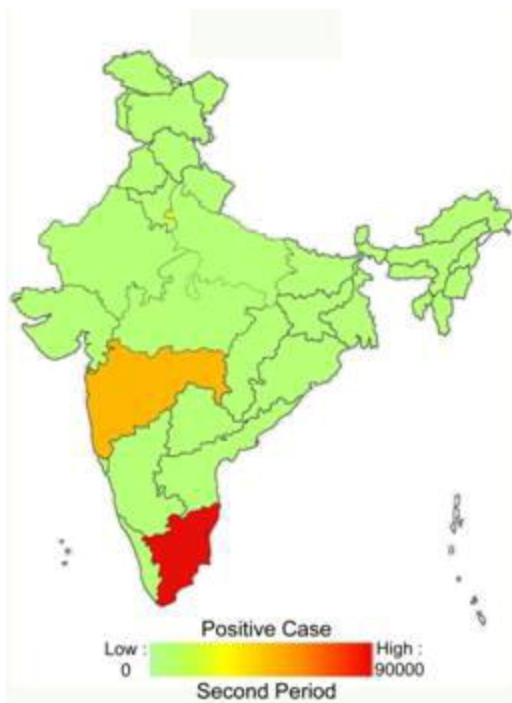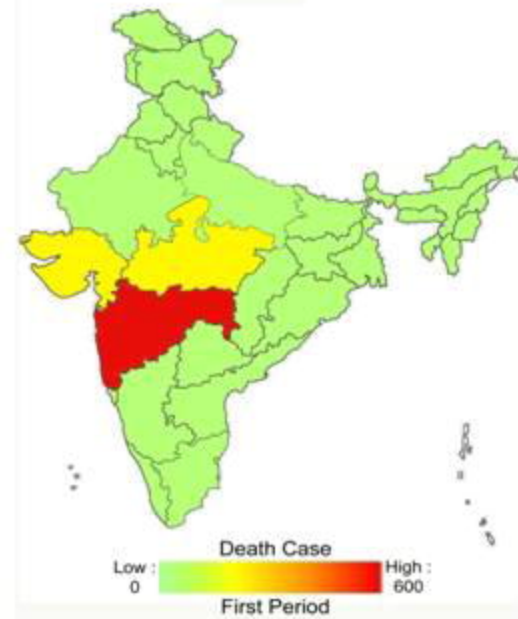
AVERAGE TEMPERATURE

2019

SUN	MON	TUE	WED	THU	FRI	SAT	AV
26.1	24.5	25.0	26.4	28.6	30.7	32.3	
30.0	28.8	29.5	30.5	31.8	32.9	33.3	
30.6	29.2	30.6	33.3	34.1	31.9	32.9	
33.3	35.1	26.3	23.9	26.2	28.9	30.9	
33.1	33.9	36.0	35.1	34.8	35.8	36.3	
36.3	34.5	35.3	33.7	31.9	30.7	31.1	
35.1	33.1	33.3	34.3	35.0	35.4	33.3	
32.7	32.1	30.1	28.6	29.4	27.9	27.7	
31.2	33.1	34.5	33.1	32.2	28.8	32.2	
33.3	34.7	34.8	36.0	37.2	36.6	36.4	
36.5	35.0	35.0	36.8	36.5	33.9	36.2	
36.3	38.0	38.2	34.8	36.1	37.0	37.5	

2020

SUN	MON	TUE	WED	THU	FRI	SAT	AV
		24.1	24.9	24.3	22.7	23.1	
24.2	24.0	24.8	25.3	25.0	24.2	24.5	
25.2	26.9	25.9	25.9	25.5	26.5	27.6	
27.5	27.9	28.7	29.1	28.8	28.5	26.8	
26.4	25.5	26.3	26.9	27.0	27.5	28.2	
25.4	25.7	26.8	28.2	28.8	28.9	28.1	
26.5	26.4	28.1	27.5	27.5	29.2	30.0	
26.5	27.0	28.0	27.7	27.9	28.3	28.8	
29.1	28.9	29.2	29.4	30.1	30.6	34.9	
39.7	38.7	39.3	39.5	36.1	33.5	33.5	
31.1	32.4	34.1	34.8	33.6	33.9	34.6	
34.0	35.5	37.4	37.7	37.3	38.0	35.5	
36.4	38.5						

RELATIVE HUMIDITY

2019
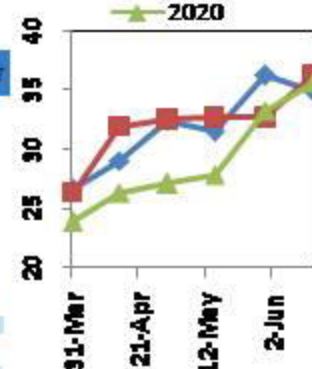
SUN	MON	TUE	WED	THU	FRI	SAT	AV
35.3	43.8	40.7	36.8	38.0	41.0	36.6	
29.6	29.4	29.8	28.7	31.5	31.7	30.7	
46.6	40.0	36.1	32.8	27.4	32.5	28.4	
27.3	24.0	45.4	34.1	2.5	2.5	2.5	
2.5	2.5	2.5	2.5	2.5	2.5	2.5	
2.5	20.5	21.4	29.8	34.9	37.5	30.4	
19.9	21.4	23.7	23.7	22.7	22.1	30.1	
32.1	37.7	46.1	56.4	52.8	60.8	63.7	
42.8	36.2	32.5	39.1	48.5	63.6	42.6	
32.8	28.4	22.9	25.1	25.5	27.8	36.6	
47.2	46.2	45.3	40.6	35.3	45.0	39.5	
33.8	29.6	24.4	39.6	39.4	28.5	24.4	

2020

SUN	MON	TUE	WED	THU	FRI	SAT	AV
		62.5	63.0	62.6	69.3	68.2	
57.8	55.9	54.1	53.5	51.9	47.0	50.0	
50.9	46.7	47.9	43.3	45.8	44.7	43.4	
43.1	44.3	43.7	38.4	38.0	38.4	48.6	
50.2	51.4	48.5	44.3	43.8	46.5	42.4	
54.8	58.8	54.4	51.4	48.9	52.3	52.6	
59.7	57.6	50.1	47.6	45.9	45.8	46.0	
54.7	55.3	51.2	54.4	56.9	47.6	42.9	
42.7	40.5	37.6	33.7	33.8	36.4	36.5	
34.1	35.1	34.5	34.6	48.3	55.8	57.1	
68.5	63.3	58.0	53.7	57.5	55.6	55.7	
56.7	53.9	49.8	48.9	50.8	50.3	59.1	
57.6	48.1						

ATMOSPHERIC PRESSURE

2019
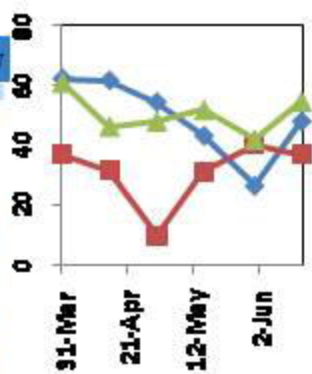
SUN	MON	TUE	WED	THU	FRI	SAT	AV
983	982	982	981	982	982	982	
982	982	981	982	982	981	983	
986	983	983	985	985	984	985	
985	984	984	984	984	984	984	
983	981	982	981	981	981	981	
981	980	977	977	979	981	983	
983	980	979	979	978	979	982	
981	980	981	982	983	983	983	
983	983	982	980	980	981	981	
979	979	978	977	976	976	976	
976	977	977	977	977	980	978	
976	973	973	976	976	975	975	

2020

SUN	MON	TUE	WED	THU	FRI	SAT	AV
		987	987	988	990	990	
988	988	987	986	986	988	988	
988	987	985	986	986	987	988	
986	984	984	984	982	982	984	
983	984	985	983	982	981	981	
984	987	987	984	983	981	981	
983	984	982	982	982	981	981	
983	984	983	982	981	981	979	
978	977	977	976	975	975	977	
977	977	975	974	976	979	980	
982	983	981	979	978	978	978	
977	977	976	976	975	974	974	
976	974						

WIND SPEED

2019
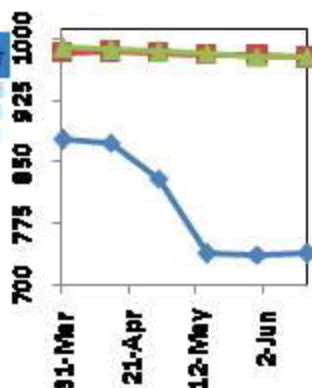
SUN	MON	TUE	WED	THU	FRI	SAT	AV
1.22	1.2	1.19	0.84	0.46	0.49	0.54	
1.77	1.61	0.68	0.66	0.68	0.82	1.01	
2.49	1.17	0.78	0.65	0.61	0.95	1.3	
1.39	1.17	2.56	1.99	0.73	0.7	0.55	
0.77	0.73	0.76	1.28	1.33	0.82	1.97	
1.55	0.75	0.89	0.71	1.92	1.32	0.62	
0.52	0.6	0.82	1.03	1.2	1.17	0.63	
0.84	0.86	0.58	0.94	0.57	1.03	0.72	
0.71	0.67	0.73	0.54	0.82	1.21	1.74	
1.13	1.08	1.14	0.8	0.86	0.94	1.7	
2.61	3.49	2.51	1.25	1.25	1.28	0.71	
0.58	0.64	0.91	2.69	0.9	1.14	1.24	

2020

SUN	MON	TUE	WED	THU	FRI	SAT	AV
		0.66	0.49	1.98	0.78	0.66	
0.53	0.58	0.56	0.57	0.66	0.47	0.40	
0.70	0.51	0.70	0.39	0.51	0.39	0.55	
0.56	0.66	0.46	0.50	0.55	0.99	1.44	
0.67	0.97	0.62	0.49	0.53	0.54	0.79	
1.51	1.82	0.98	0.67	0.75	1.22	1.66	
1.28	0.95	0.55	0.81	0.90	0.80	0.97	
1.40	1.04	1.13	0.59	0.75	0.55	0.49	
0.50	0.48	0.49	0.50	0.54	0.50	0.60	
0.61	0.79	0.93	1.16	1.87	1.81	1.08	
1.16	0.82	0.78	0.80	0.88	0.89	0.81	
0.93	0.64	0.54	0.84	0.89	0.73	0.81	
0.86	0.60						
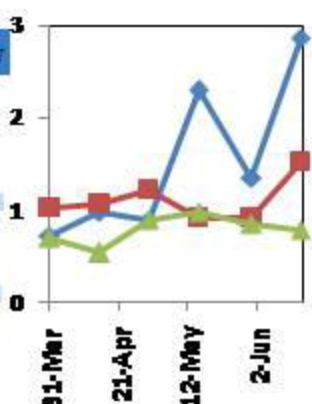
AVERAGE TEMPERATURE

2019

SUN	MON	TUE	WED	THU	FRI	SAT	AV
26.2	25.7	25.1	23.2	23.6	23.6	26.2	
24.5	24.4	23.8	23.8	23.9	24.2	24.9	
24.6	24.5	25.0	24.8	25.4	24.5	27.7	
25.6	24.0	22.9	22.5	23.5	23.2	22.6	
22.8	22.5	23.0	22.2	23.1	22.8	22.8	
21.8	20.7	23.9	38.7	39.4	38.2	39.3	
39.7	39.5	41.2	41.4	41.3	41.0	41.3	
41.1	41.0	40.9	38.9	41.4	41.4	40.6	
41.3	41.4	41.0	42.2	41.9	42.1	42.4	
41.2	43.4	43.6	41.1	40.3	38.2	36.5	
38.8	36.7	33.9	37.0	37.9	35.5	35.2	
36.7	35.4	34.8	34.8	33.9	34.6	34.9	

2020

SUN	MON	TUE	WED	THU	FRI	SAT	AV
		30.8	33.0	31.5	32.1	32.6	
32.8	32.9	32.9	31.6	34.9	30.5	30.8	
27.6	33.6	33.1	32.7	29.1	34.1	31.7	
34.0	33.1	36.7	33.7	34.6	36.9	34.4	
29.8	31.8	32.2	31.5	32.4	32.0	32.9	
32.2	31.1	29.8	31.4	31.6	31.8	33.1	
34.5	34.1	34.3	32.1	31.5	32.1	32.3	
29.6	31.0	31.5	32.0	32.7	33.5	32.3	
30.9	33.3	32.6	33.6	32.9	33.9	34.9	
35.4	35.7	35.1	36.2	36.1	36.6	34.4	
32.1	31.9	32.3	29.9	31.0	32.9	33.6	
33.9	34.5	34.9	33.4	30.7	30.3	30.7	
31.1	29.4						
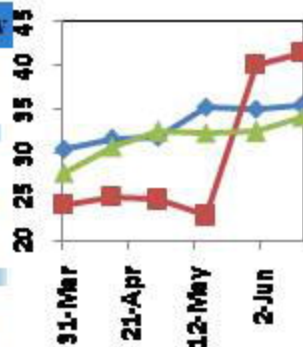
RELATIVE HUMIDITY

SUN	MON	TUE	WED	THU	FRI	SAT	AV
33.67	34.34	22.64	38.58	31.82	32.18	30.36	
33.8	30.7	37.5	36.8	39.1	34.9	31.5	
34.9	36.2	38.1	36.8	33.0	33.7	26.9	
31.4	34.1	33.6	39.3	36.5	40.0	41.6	
41.5	40.7	38.3	40.1	38.9	36.6	38.0	
36	36	38	27.4	30.7	31.3	27.3	
27.5	28.0	27.9	27.4	27.5	27.9	30.2	
31.1	30.9	31.5	36.0	30.9	28.7	29.0	
28.5	30.5	33.4	32.8	34.8	33.3	28.4	
30.5	27.3	27.6	28.4	32.5	36.1	40.3	
34.6	39.6	45.1	35.6	34.2	38.7	40.7	
35.2	27.7	17.1	6.6	24.3	36.9	34.8	

SUN	MON	TUE	WED	THU	FRI	SAT	AV.
		71.5	74.6	76.1	72.4	60.3	
59.3	64.5	71.2	72.3	72.1	73.5	76.3	
78.6	78.7	77.9	74.4	74.3	75.9	74.0	
79.0	78.7	74.1	75.5	76.9	78.8	74.4	
73.1	61.7		72.3	68.9	74.7	75.8	73.7
70.7	72.5	71.2	72.2	75.4	73.7	73.3	
74.7	74.2	71.4	78.9	74.1	73.0	73.3	
74.5	76.3	73.8	73.8	71.3	71.6	74.1	
72.4	71.9	70.5	71.1	71.9	72.0	74.1	
76.2	76.5	76.2	73.3	71.4	73.5	73.9	
70.1	55.1	50.8	39.0	42.0	27.2	17.2	
20.2	23.1	31.0	48.1	60.5	62.0	62.6	
62.0	70.8						
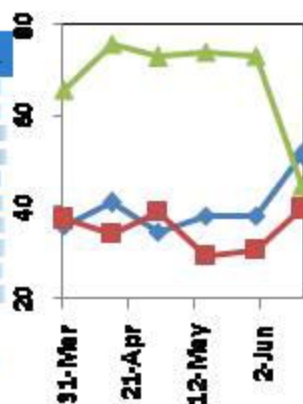
ATMOSPHERIC PRESSURE

SUN	MON	TUE	WED	THU	FRI	SAT	AV
743	743	743	743	743	743	743	
743	743	743	743	743	743	743	
743	742	743	743	743	743	743	
743	743	743	743	743	743	742	
742	742	742	746	741	742	743	
743	742	742	742	742	742	742	
743	742	742	742	742	742	742	
742	742	742	742	742	742	742	
742	742	742	742	742	742	742	
742	742	742	742	742	742	742	
742	742	742	742	742	742	742	

SUN	MON	TUE	WED	THU	FRI	SAT	AV
		765	765	766	768	767	
766	766	767	767	766	766	766	
767	768	767	768	768	767	768	
767	766	766	767	766	766	766	
766	765	767	766	766	766	766	
766	767	768	766	766	767	766	
766	766	767	765	766	766	766	
766	767	766	765	764	764	764	
764	764	763	763	764	765	765	
765	766	766	766	765	765	765	
765	734	735	736	735	734	734	
734	733	733	734	735	736	735	
736	736						
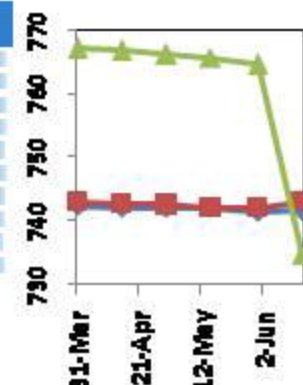
WIND SPEED

SUN	MON	TUE	WED	THU	FRI	SAT	AV
2.25	2.29	2.14	2.11	2.57	2.12	2.2	
2.48	2.35	2.37	2.37	1.91	2.35	2.36	
2.31	1.77	2.45	2.16	2.31	2.52	2.32	
2.31	2.32	2.23	2.08	1.69	2.36	2.9	
2.13	2.27	2.54	2.36	2.32	2.4	2.6	
2.75	3.04	3.55	3.28	2.97	2.72	2.37	
2.59	2.8	2.84	2.59	2.46	2.48	3.09	
3.19	2.88	3.15	3.12	2.82	2.21	3	
3.5	2.85	2.95	3.18	3.09	3.44	3.7	
3.02	2.83	3.4	4.08	3.82	2.77	2.98	
2.68	2.89	3.25	2.97	3.53	3.76	4.25	
4.7	4.34	4.86	5.16	5.26	4.85	4.96	

SUN	MON	TUE	WED	THU	FRI	SAT	AV
		0.09	0.1	0.08	0.08	0.13	
0.08	0.09	0.1	0.11	0.11	0.09	0.15	
0.08	0.11	0.09	0.1	0.1	0.07	0.08	
0.08	0.07	0.08	0.09	0.17	0.07	0.08	
0.11	0.08	0.11	0.08	0.09	0.09	0.07	
0.08	0.13	0.07	0.06	0.07	0.26	0.06	
0.05	0.07	0.06	0.08	0.07	0.07	0.06	
0.06	0.07	0.07	0.07	0.07	0.06	0.1	
0.06	0.07	0.07	0.09	0.09	0.18	0.23	
0.12	0.09	1.17	0.11	0.18	0.14	0.15	
0.22	0.3	0.3	0.3	0.3	0.3	0.3	
0.3	0.3	0.3	0.3	0.3	0.3	0.3	
0.3	0.3						
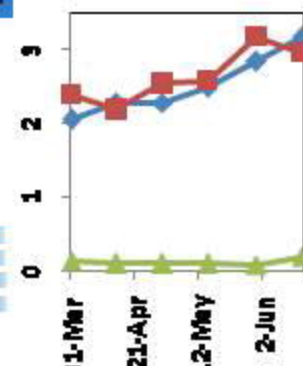
AVERAGE TEMPERATURE

2019

SUN	MON	TUE	WED	THU	FRI	SAT	AV
29.0	28.8	29.2	28.5	29.0	29.1	29.8	
32.0	29.8	29.4	29.3	29.3	29.4	29.6	
29.8	29.9	30.3	30.2	30.1	30.3	30.2	
29.9	29.8	29.7	31.1	30.6	30.8	31.1	
31.4	30.6	30.4	30.8	30.4	30.7	30.9	
30.6	31.0	31.6	31.4	33.0	33.3	32.4	
32.0	32.5	32.4	32.9	31.0	32.2	31.3	
30.0	30.1	32.0	31.5	31.7	31.5	31.3	
31.6	31.3	31.5	31.4	31.5	31.5	32.0	
32.4	31.9	32.2	32.4	31.4	32.3	32.7	
33.0	32.8	32.4	32.1	31.2	31.6	32.0	
33.4	33.4	33.6	34.4	33.0	33.2	33.4	

2020

SUN	MON	TUE	WED	THU	FRI	SAT	AV
		29.3	29.1	29.4	29.6	29.8	
29.9	30.3	30.6	30.1	30.6	30.2	30.5	
29.3	29.6	25.6	27.6	28.6	28.0	29.6	
30.0	30.2	30.6	30.3	30.2	30.5	30.4	
30.6	30.8	30.7	29.9	29.9	30.0	29.8	
28.6	29.2	29.3	29.4	28.8	29.0	29.1	
30.1	30.3	30.3	29.5	29.2	29.0	30.6	
31.5	30.7	30.7	32.1	30.2	29.1	28.0	
27.4	25.0	27.3	28.3	28.1	30.4	29.3	
29.7	29.9	29.9	29.1	28.2	26.6	27.5	
28.7	28.5	27.0	27.1	27.7	27.0	26.5	
25.8	26.5	27.3	26.6	25.3	24.5	25.2	
25.2	26.1						

RELATIVE HUMIDITY

2019
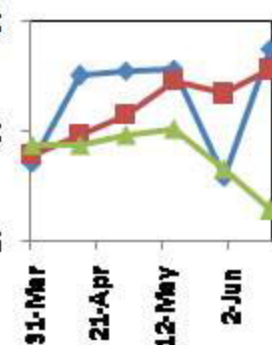
SUN	MON	TUE	WED	THU	FRI	SAT	AV
41.7	42.3	37.6	38.2	38.7	42.1	39.5	
43.1	44.2	43.5	41.7	41.8	45.4	41.2	
39.0	42.9	45.0	45.1	44.3	45.0	42.6	
44.0	42.9	43.0	41.3	62.7	59.5	55.2	
52.9	58.6	53.0	52.1	52.0	55.4	56.9	
58.4	60.8	57.3	50.0	39.6	40.2	49.6	
56.4	56.6	51.7	32.5	40.2	44.4	56.1	
63.4	63.5	65.3	64.1	65.0	69.0	71.5	
69.0	65.4	62.9	62.2	66.1	66.5	63.6	
56.1	58.9	58.3	54.0	68.2	61.5	55.4	
53.7	47.0	61.0	59.2	67.0	71.8	59.3	
56.9	48.6	41.0	39.0	38.1	44.0	46.0	

2020

SUN	MON	TUE	WED	THU	FRI	SAT	AV
		58.8	57.5	52.2	50.2	53.1	
55.6	55.8	46.6	49.2	52.2	58.2	54.3	
65.9	65.3	83.6	72.0	67.9	59.4	56.2	
53.7	53.6	52.7	59.9	64.1	63.8	65.0	
60.9	59.1	63.4	66.2	68.2	70.8	65.8	
64.2	69.6	69.0	70.9	68.8	69.9	76.4	
75.7	78.8	78.3	77.2	80.8	85.0	74.2	
68.5	69.7	59.5	42.8	71.0	68.8	79.3	
78.9	82.2	77.8	72.0	72.4	39.2	37.7	
37.7	31.2	65.5	79.0	77.9	78.3	79.8	
67.0	67.1	71.5	73.9	72.9	78.8	81.3	
81.6	78.7	80.3	82.5	84.9	86.5	84.2	
82.2	82.3						

ATMOSPHERIC PRESSURE

2019
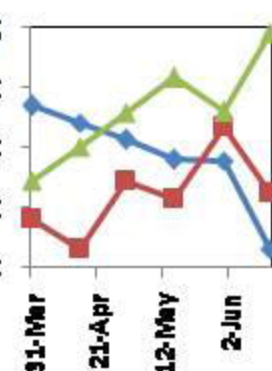
SUN	MON	TUE	WED	THU	FRI	SAT	AV
982	972	977	977	977	980	1001	
1041	1007	984	980	981	979	980	
983	985	984	982	981	982	979	
981	982	980	983	980	982	982	
983	972	972	971	972	979	981	
976	975	971	968	979	984	980	
983	987	987	979	982	985	986	
984	984	983	983	982	986	985	
986	988	987	987	988	997	1008	
1008	1008	1008	1008	1008	1008	1008	
1008	1008	1008	1008	1008	1008	1008	
1009	1009	1008	1008	1008	1008	1008	

2020

SUN	MON	TUE	WED	THU	FRI	SAT	AV
		751	751	752	753	752	
752	752	753	752	751	752	752	
752	752	751	751	752	752	753	
752	751	752	752	751	751	751	
751	751	751	751	750	750	749	
751	751	751	750	751	750	749	
749	750	750	750	750	750	750	
750	750	750	749	748	747	747	
746	744	743	744	745	746	747	
748	749	749	748	747	747	748	
749	749	749	748	748	748	748	
747	746	749	749	748	748	748	
748	747						
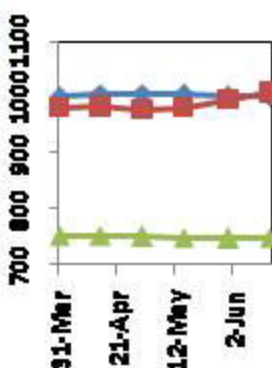
WIND SPEED

2019

SUN	MON	TUE	WED	THU	FRI	SAT	AV
2.4	1.5	2.0	1.9	1.9	2.2	2.5	
2.5	2.6	2.6	2.3	2.3	2.1	2.2	
2.4	2.6	2.6	2.4	2.3	2.4	2.1	
2.3	2.4	2.2	2.6	2.3	2.4	2.4	
2.5	1.5	1.4	1.4	1.5	2.1	2.4	
1.9	1.8	1.4	1.2	2.0	2.5	2.2	
2.5	2.7	2.8	2.1	2.3	2.6	2.8	
2.5	2.5	2.5	2.4	2.3	2.7	2.6	
2.7	2.9	2.8	2.8	2.9	2.8	2.7	
2.7	2.6	2.7	2.8	2.4	2.8	2.2	
2.4	1.8	1.9	2.5	2.8	2.8	2.3	
3.3	3.0	2.8	2.3	1.9	2.0	2.1	

2020

SUN	MON	TUE	WED	THU	FRI	SAT	AV
	9.5	6.2	6.3	7.5	7.2	6.9	
6.4	6.7	6.3	8.4	6.9	7.4	6.3	
6.7	7.3	7.9	8.0	7.9	7.4	7.9	
6.0	6.2	6.1	6.4	6.6	6.2	6.8	
6.5	7.6	6.5	7.6	8.0	8.5	10.6	
6.7	7.3	6.3	5.6	7.2	7.7	9.4	
7.2	6.7	6.4	8.0	8.0	6.7	6.0	
6.1	7.1	7.1	9.2	7.2	10.0	10.4	
10.5	12.7	15.8	16.0	13.7	15.2	13.7	
13.4	13.3	12.0	11.8	12.8	10.9	8.7	
11.8	14.8	15.6	15.9	15.9	14.1	15.1	
14.8	12.8	13.9	13.8	15.6	14.5	15.2	
16.5	15.7						