CLIMATOLOGY

OF

PASHAN

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IMD, PUNE- 411005

Executive Summary

1	Document title	Climatology of Pashan
2	Document type	Technical Report
3	Issue No.	CRS Technical Report No.2/2021
4	Issue date	
5	Security Classification	Unclassified
6	Control Status	Unclassified
7	No. of Pages	15
8	No. of Figures	12
9	No. of Tables	19
10	No. of reference	-
11	Annexure	-
13	Distribution	Unrestricted
14	Language	English
15	Authors/ Editors	G. K Sawaisarje, Ms Pooja Yadav, Dr Chetana Patil, Dr Shirish Khedikar, Dr Md Osaid Alam, Yogesh Visale, Pramod Mahajan, Sanatan Das, Ms Sandhya Ravikiran, Rajiv Oke, Anilkumar Neve, Arvind Bhole, Ravi Gore And Dr Somenath Dutta
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18	Reviewing and Approving Authority	Head, Climate Research & Services, India Meteorological Department, Pune
19	End users	Forecasters, Disaster Managers, Modelers and Researchers etc.
20	Abstract	-
21	Key Words	Climatology, Observatory, Pashan, Tables, Graphs

CONTENTS

सार

पाषाण वेधशाला के मौसम संबंधी तत्वों की जलवायु विज्ञान 1999 से 2018 तक 20 वर्षों में प्रस्तुत किया गया है। डेटा की जांच की गई है और लापता डेटा मौसम विज्ञान प्रशिक्षण संस्थान (एमटीआई) में उपलब्ध मौसम संबंधी रजिस्टरों से भरा गया था। हवा, हवा की दिशा, अधिकतम तापमान, न्यूनतम तापमान, शुष्क बल्ब तापमान, गीले बल्ब तापमान और वर्षा प्रत्यक्ष प्रेक्षण हैं और सापेक्ष आर्द्रता और ओस बिंदु तापमान की गणना इन प्रत्यक्ष प्रेक्षण से की जाती है। जलवायु विज्ञान से पता चलता है कि गर्मी के महीने अप्रैल और मई में वर्ष का अधिकतम तापमान दर्ज किया जाता है जबकि सर्दियों के महीने दिसंबर जनवरी में तीनों तापमान मापदंडों में वर्ष का न्यूनतम तापमान दर्ज किया जाता है। सर्दियों के मौसम के अलावा सबसे कम अधिकतम तापमान मानसून के महीनों जुलाई और अगस्त के दौरान देखा जाता है। सापेक्षिक आर्द्रता औसत तापमान के साथ सह संबंधी विरोधी पाई गई। वेधशाला में मानसून के महीनों जून से सितंबर के दौरान सबसे अधिक वर्षा दर्ज की जाती है। प्री-मानसून और मानसून के बाद की बारिश की संख्या दर्ज की गई है जो गरज के साथ गतिविधि से संबंधित हो सकती है। सभी मापदंडों के लिए प्रवृत्ति विश्लेषण किया गया है

Abstract

Climatology of meteorological elements of Pashan observatory is presented for 20 years from 1999 to 2018. The data has been scrutinized and missing data was filled from meteorological registers available at Meteorological Training institute (MTI). Wind, wind direction, Maximum temperature, minimum temperature, Dry bulb temperature, wet bulb temperature and rainfall are the direct observations and relative humidity and Dew point temperature are calculated from these direct observations. Climatology shows summer months April and May records maximum temperature of the year whereas winter months December January records minimum temperature of year in all three temperature parameters. Apart from winter seasons lowest maximum temperature is observed during monsoon months July and August. Relative humidity found to be anti-correlated with mean temperature. Observatory records highest rainfall during monsoon months June to September. Number of pre-monsoon and post monsoon showers are recorded which can be related with the thunderstorm activity. The trend analysis has been carried out for all the parameters.

1. Introduction

India Meteorological Department was established by the Government of India in the year 1875. In the first half of the 19th century, several observatories began functioning all over India. India Meteorological Department progressively expanded its network for observations all over the country.

On 20th July 1928, the IMD headquarters were shifted to Poona from Shimla for research on monsoon. At Pune Surface observatory was established in 1940 under Dr. L.A. Ramdas for the betterment of agricultural research and monsoon research.

As recording observations is the basic as well as some of the most important functions of IMD, it provides correct and periodic data of different meteorological elements. Hence, it is essential to provide proper training to the personals working in the meteorological department. In light of this, the in-house training unit in IMD was established in 1942 to meet the growing need of forecasters and supporting staff.

Since 1967 the training center has been extending its expertise on facilities to foreign trainees. The training facilities of IMD have been recognized as a Regional Meteorological Training Centre (RMTC) of the World Meteorological Organization (WMO) in 1986 which is among the center chosen by the WMO to support its global efforts in development of human resources in the field of meteorology. The regional Meteorological Training Center was constructed at Pashan, Pune in the year 1996 under the guidance of Dr. U.S. De, DDGM (WF)

To provide the hands-on training to Naval officers of Advanced Training Met Course, Meteorological Gr.-II (now Sc-B), trainees of intermediate training course, surface observatory have been installed at Pashan in 1998. Former DGM Dr. R.R. Kelkar declared Pashan observatory as “Climatic Observatory” as on 1st January 1999.

In the beginning, 03Z,06Z,09Z,12Z and 15Z observations were recorded per day, as the aim of this observatory is to provide training to trainees. Afterwards record only 03Z, 06Z, 09Z and 12Z observations. This observatory was installed as per WMO guidelines. It has a Mk-II Windvane and Mk-II Cup Counter Anemometer for measurement of Windspeed and Wind direction respectively. Ordinary Rain Gauge of 200 sq. cm diameter is used for measurement of precipitation. Single Stevenson’s

Screen containing Dry Bulb, Wet Bulb, Maximum and Minimum thermometer for measurement of temperature. It is also equipped with self-recording instruments like Self Recording Rain Gauge (SRRG), Thermograph and Hair Hydrograph for relative humidity. This observatory has both Kew Pattern and Fortin Barometer for measurement of Atmospheric Pressure.

This certainly leaves no doubt that climatology of Pashan will play an important role in the development and forecasting of Pune city.

2. Data and Methodology

Data Used : The daily Maximum temperature, Minimum temperature, Dewpoint temperature, Relative Humidity (0830 hrs IST) and Rainfall of Pashan and Shivajinagar Observatories for the period January to December 1999-2018 has been utilized. The data for above parameters for Shivajinagar Observatory was obtained from National Climate Data Centre, CRS Office, Pune.

Methodology : The data of Pashan Observatory was taken from Microsoft Excel sheet maintained at MTI. The data was scrutinized for errors and missing data were filled from Meteorological registers available at Meteorological Training Institute. Then this scrutinized data can be utilized for computations of averages (20 years) as per WMO technical note Computation of normal. The parameters are

1.Precipitation total (mm) Monthly total
2. Monthly mean values of a) max. temp., b) min. temp., c) daily mean temp.
3. Mean no. of days with maximum temperature >= 30,35 and 40 deg C
4. Highest and lowest recorded values of mean daily temp. deg C
5. Highest recorded value of daily max. temp deg C
6. Lowest recorded value of daily min. temp. deg C
7. Mean no. of days with daily precipitation >= 50,100, 150 mm
8. Monthly mean values of Dew point temperature
9. Monthly mean values of Relative humidity

The values with observations less than 8 in a month are neglected in analysis. The Climatological Tables and extremes are described in chapter 3.(3.1) and Intra-annual and Inter annual variability and trend analysis are described in Chapter 3.(3.2). The trend analysis has been carried out using Mann-kendal (M-K) statistics case. The trends obtained in various parameters at 95% and 99% significant level are presented in table 1. The Climatological Tables and Climatological Graphs are presented in Appendix 1a and 1b.

3. Result and Analysis

Average state of the atmosphere over a period of time is called as climate. For computing Climatology of Pashan, the meteorological elements considered are Dew point temperature, Maximum temperature, Minimum temperature, rainfall and relative humidity. The climatological table of these meteorological elements is given in Tables 1. Climatological table of same elements from Shivaji Nagar observatory which is around 8 km away from the Pashan observatory is presented in Table 2. The Mean Monthly Relative Humidity Climatology is given in Table 1 Lowest and Highest Maximum temperature in a month, Lowest and Highest Minimum temperature in a month, Lowest and Highest Mean temperature in a month, Highest rainfall in a month (in mm) are given in Tables 10, 11,12 and 13 respectively. Number of observations with maximum temperature > 30℃, 35℃ and 40℃ are given in Tables 14, 15 and 16. Number of observations with rainfall > 50 mm, 100 mm and 150 mm are given in Tables 17, 18 and 19. Brief description of the tables is given below. This chapter consist of two parts in first part climatological tables are described whereas in second part analysis with respect to climatological variables are explained.

3.1 Climatology Tablesand extremes

3.1.1 Mean Monthly Dew point temperature

Climatology of Mean monthly Dew point temperature over a 20-year period at Pashan observatory presented in Figure 1(a). Itsminimum temperature can be observed during January(12.0^{o}C), It shows gradual increase from January to June, its maximum value is observed during June(21.9^{o}C) month.After September it again starts decreasing gradually. Shivaji Nagar observatory climatology also shows similar pattern where minimum Mean monthly temperature is found in January(12.4) and maximum in June (21.5).Mean Monthly Dew Point temperature was lowest in January month in 2002 with a value of 10.2℃ and highest in 2012 with value of 17.5℃ with only 12 observations in the month. For the month of February month, it was lowest in 2008 with a value of 7.8℃ and highest value in 2012 with a value of 17.3℃ with only 12 observations in the month. During March month, Mean Monthly

Dew Point temperature is seen to be 8.7℃ and in April month it is 13.2℃ in 2004 with Mean Monthly Dew Point temperature values between 17.0℃ to 17.7℃ during the years 2008, 2015 and 2007. During May month Mean Monthly Dew Point temperature is seen to increase from that seen during March and April months. During June, July, August and September months Mean Monthly Dew Point temperature values are found to be greater than 21℃. The values of mean monthly Dew Point temperature are seen to decrease during the months October, November and December as we go from monsoon season. Annually over a 20-year period, it is lowest with a value of 7.8℃ in the February month of 2008 and highest with a value of 22.7℃ in August 2014.

3.1.2 Mean Monthly Maximum Temperature Climatology

Climatology of Mean monthly maximum temperature (Figure 1,b) shows yearly two maxima one in April (38.1^{o}C) and other one in October (31.43^{o}C). It shows two minima, lowest in the month of August (26.5^{o}C) and other one in January where 29.8^{o}C can be observed. Similar Pattern can be observed for Shivaji Nagar Climatology where April (38.1^{o} C), October (30.22^{o}C)months shows maxima and August (26.5^{o}C), January (29.92 ^{o}C) months shows minima. During the months January and February over a 20-year period Mean Monthly Maximum Temperature increases as the winter season progresses. The highest value is 34.3℃ and lowest value is 27.7℃ in 2002 and 2008. During pre-monsoon season Mean Monthly Maximum Temperature increases as we go from March to May months. The value of 38.1℃ in March 2004 is highest value in a 20-year period. For the April month the value of 39.7℃ is the highest value seen in 2016. The Mean Monthly Maximum Temperatures are observed to be greater than 38℃ for the years 2015 to 2018. As the monsoon season approaches the values of Mean Monthly Maximum Temperatures are seen to decreased significantly. For October Month, 33.5℃ in 2018 is highest among the values found between 1999 to 2017. However, in November month the value of 31.8℃ in 2003 is highest value over 20-year period. The values are lower in December month compared to November month. Annually it is seen that 39.7℃ is the highest value in April 2016 over the 20-year data period of 1999 to 2018. The lowest values of 26.6℃ are found in August 2004 and July 2006 over a period of 1999 to 2018.

3.1.3 Mean Monthly Minimum Temperature Climatology

Climatology of Mean Monthly Minimum temperature (Figure 1, c) at Pashan observatory shows minimum record of 11.8^{o}C in January after which it gradually started increasing and become highest in the month of June (22.5^{o}C). It again decreases gradually from September till December. Climatology of Mean monthly minimum temperature at Shivaji Nagar observatory shows minimum record of 11.2^{o}C in December and maximum record of 23.1^{o}C in May and June which is the similar pattern as Pashan observatory. For the January month over 20-year period the year 1999 has lowest value of 8.8℃ followed by 9.9℃ in 2011 with values between 10℃ and 12.8℃ for other years. In February month the value was found to be 9.1℃ in 2008. However, Mean Monthly minimum temperatures are increasing as we approach pre-monsoon season and monsoon season where there is cloud formation and cloud coverage. These values are decreasing as we go from October to November months. The value was 8.9℃ in December 2000 is the lowest value over 20-year period. Annually it is seen that the lowest value is 8.8℃ in January 1999 over a period of 1999 to 2018.

3.1.4 Total Monthly rainfall Climatology

Total Monthly rainfall climatology (Figure 2, a) shows minimum rainfall recorded in April (5.7 mm) and maximum (205.47) rainfall observed in August month at Pashan.The climatology shows maximum rainfall occurred in monsoon months (JJAS). Rainfall due to pre-monsoon showers can be observed in April May months and post monsoon showers in October November months. Climatology at Shivaji Nagar shows Minimum rainfall recorded in February (0.2 mm) and maximum rainfall observed in July (178.6) month. Both observatory shows similar pattern of rainfall but, minimum rainfall at Pashan is recorded in April whereas minimum at Shivaji Nagar is recorded in February. Also maximum rainfall at Pashan is recorded in August whereas at Shivaji Nagar maximum is recorded in July month.During January and February months the highest total monthly rainfall was 142.2 mm in January 2012. In pre-monsoon season months viz. March, April and May the highest total monthly rainfall is found to be 434.2 mm in March 2014. In the month of June, the highest total monthly rainfall was 362.8 mm in the year 2005 over a 20-year period. In July and August months it was 460.8 mm and 420.7 mm in the year 2006.

However, in September month it was 312.7 mm in 2011. In Post monsoon season in November 2008 the highest total monthly rainfall was 758.9 mm over the 20-year period. Annually it is seen that the highest total monthly rainfall was 758.9 mm over a period of 1999 to 2018.

3.1.5 Mean Monthly Relative Humidity Climatology

Climatology of Mean Monthly Relative Humidity shows two maxima and two minima in the year. Maxima value 89.13% and 81.5% observed in August and January month respectively whereas minima 51.87% and 80.57% observed in April and November months respectively. Similar behavior is observed at Shivaji Nagar where Maxima 86.1% and 87.94% observed in August and January month whereas two minima 48.6% and 77.29% observed in April and November months respectively. In winter months viz. January and February Mean Monthly Relative Humidity was 91.4 % which is the highest value in January 2014. The Mean Monthly Relative Humidity range in winter is between 57.1 % in 2001 and 91.4 % in January 2014. In premonsoon season the range is 41.9 % in 2004 to 82.1 % in May 2012 wherein only 12 number of observations in this month are considered. However, the value is 79.1 % in March 2015 and observations lay between 57.1% to 79.1%. In monsoon months of June to September the Mean Monthly Relative Humidity is more than 70%. In Post monsoon months the Mean Monthly Relative Humidity is greater than and equal to 67 %.

3.1.6 Average Mean Temperature Climatology

Climatology of Average Mean temperature (Figure 1,d) shows yearly two maxima, one in May (29.7^{o}C) and other one in September (25.3^{o}C). It shows two minima, lowest in the month of August (24.5^{o}C) and other one in January where 20.8^{o}C can be observed. Similar Pattern can be observed for Shivaji Nagar Climatology where May (30.1^{o} C), September (25.5^{o}C) months shows maxima and August (23.6^{o}C), January (20.6^{o}C) months shows minima.The Average Mean Temperature is between 18.4℃ in 2008 and 25.1℃ in 2012 in winter months of January and February. In premonsoon months Average Mean Temperature was between 24.4℃ and 31.1℃ over a 20-year period. In monsoon months of June to September Average Mean Temperature is less than 30℃. However, in Post monsoon season of October to December months the average Mean Temperature is

greater than or equal to 19.2℃in December 1999. Annually it is seen that over a 20-year period of 1999 to 2018 the highest value of Average Mean Temperature is 31.1℃.

3.1.7 Lowest and Highest Maximum Temperature in a month

The Lowest Maximum temperature is 19.6℃ in January 2001 and Highest Maximum Temperature is 37.8℃ in January 2012. In February month the Lowest Maximum temperature is 21℃ in 2016 and Highest Maximum Temperature is 39.3℃ in 2007. In the months of March to May the Highest Maximum temperature crosses 40℃ reaching 42.3℃ on many occasions over a 20-year period of 1999 to 2018. However, the Lowest Maximum Temperature occurred in March 2015 with a value of 19.2℃. In monsoon months of June to September the Lowest Maximum temperature is 22.3℃ in 2017 while the Highest Maximum Temperature is 39.7℃ in 2009. In Post monsoon months of October to December the Lowest Maximum temperature is 22.5℃ in November 2009 while the Highest Maximum Temperature is 39.4℃ in November 2012. Annually the Lowest Maximum temperature is seen to be in March 2015 with value 19.2℃ and the Highest Maximum temperature is 42.3℃ in April 2017.

3.1.8 Lowest and Highest Minimum Temperature in a month

The Lowest and Highest Minimum Temperature is seen to be 5.3℃ in January 2008 and 23.2℃ in January 2012 respectively. In premonsoon months the Lowest Minimum Temperature is 9.5℃ in March 2001 while Highest Minimum Temperature is 33.1℃ in May 2006. In Monsoon months of June to September the Lowest Minimum Temperature is 5.3℃ in September 2012 where relative humidity was 55% at 08.30 hrs. IST (03UTC) while the Highest Minimum temperature is 26.5℃ in June 2014. The Lowest and Highest Minimum Temperature is seen to be 5.2℃ in December 2018 and 27.5℃ in October 2006 respectively.

3.1.9 Lowest and Highest Mean Temperature in a month

The Mean temperature is the average of maximum temperature and minimum temperature in a month. The Lowest and Highest Mean Temperature is seen to be 15.4℃ in January 2008 and 29.5℃ in January 2012 respectively. In premonsoon months the Lowest Mean Temperature is 17.3℃ in March 2015 while Highest Mean

Temperature is 34.3℃ in May 2006. In Monsoon months of June to September the Lowest Mean Temperature is 17.1℃ in September 2012 while the Highest Mean temperature is 33℃ in June 2014. The Lowest and Highest Mean Temperature is seen to be 15℃ in December 2018 and 30.9℃ in November 2012 respectively.

3.1.10 Highest rainfall in a month

In January month the highest rainfall recorded by Pashan Observatory is 95.7 mm while in February it was 31.2 mm. In March month the highest rainfall is 43 mm in 2015. In April month it is 14.2 mm in 2014. In May month it is 87.2 mm in 2015. In June month it is 125.6 mm in 2007. In July month it is 102.9 mm in 2009. Highest rainfall is 78.7 mm in August 2004. In September the Highest rainfall is 66.4 mm in 2010. In October the highest rainfall is 172.6 mm in 2010 while in November 2009 the highest rainfall is 101.8 mm. In December 2011 the highest rainfall is 63.2 mm. The period under consideration is 1999 to 2018.

3.1.11a Mean number of observations with maximum temperature > 30℃

The maximum temperature does not cross 30℃ in January, July, August, September, November and December months over a 20-year period. However, the maximum temperature cross 30℃ in February, March, April, May, June and October months on a single occasion as seen from mean number of observations.

3.1.11b Mean number of observations with maximum temperature > 35℃

The maximum temperature cross 35℃ in March, April, May months on a single occasion as seen from mean number of observations. It is seen that the maximum temperature crossed 35℃ successively in the years 2016, 2017 and 2018.

3.1.11c Number of observations with maximum temperature > 40℃

The number of observations with maximum temperature > 40℃ is 6 in March 2017 and 3 in March 2004. In the month of April, it is 17 in 2016 and 15 in 2017 and 9 in 2010. In month of May, it is 10 and 12 in 2016 and 2017 and 8 each in 2015 and 2018. The years 2016 and 2017 were warmest in a 20-year period of 1999 to 2018.

3.1.12a Number of Observations with rainfall > 50 mm

Number of Observations with rainfall > 50 mm is 1 in January, November and December months. However, it crossed 3 occasion in July 2005, August 2004 and

August 2006 and November 2009 and 2 occasion in June 2002, 2005, 2010, 2013 and 2015, July 2006,2007, 2010 and 2014 and August 2005, 2014 and 2016.

3.1.12b Number of Observations with rainfall > 100 mm

Number of Observations with rainfall > 100 mm is 1 in June 2007, July 2007 and 2009, October 2010 and November 2009.

3.1.12c Number of Observations with rainfall > 150 mm

Number of Observations with rainfall > 150 mm is 1 in October 2010.

3.2 Intra- annual and Inter annual variability and trend analysis

3.2.1 Mean monthly dew point temperature (DPT)

Mean monthly dew point temperature (DPT) variation is presented in the figure 3(a) for 20 years (1999-2018). Lowest DPT is observed during January and February months for most of the years where it ranges between $10^{o}C$ – $15^{o}C$. 2001 and 2008 were the years when it was drop up to $8.7^{o}C$ and $7.8^{o}C$ respectively for February month. DPT in 2012 was recorded $17.7^{o}C$ and $17.5^{o}C$ for January and February months respectively. DPT observed utmost during monsoon months JJA (June, July August) Highest was recorded $22.7^{o}C$ in August 2014. Year 2012 was an exceptional when DPT was drop down up to $17.5^{o}C$ for July and $17.3^{o}C$ for August. During winter months minimum DPT can be observed and during monsoon months higher DPT can be observed. This behavior can also be seen in the annual DPT variation (Figure 3b) winter months shows lowest DPT. DPT started gradually increasing from January reaches maximum and remains almost constant during June to august after that it decreases gradually up to December. Lowest annual DPT was $7.5^{o}C$ during 2008 February and maximum in the year 2010 June which was around $22.9^{o}C$. In the year 2000 very less variation (between 15- $20^{o}C$ is observed in annual DPT from January to November where it went down up to $7.5^{o}C$ in the month of December.

3.2.2 Mean Maximum Temperature (MMT)

Figure 4(a) represents Mean Maximum Temperature (MMT) climatology. MMT ranges in between 26.3^{o}C to 39.6^{o}C for Pashan observatory. Lowest MMT observed in July and August in most of the years. Maximum MMT observed in April and May in most of the years which ranges between 34.8^{o}C – 39.6^{o}C, but in the year 2012 MMT in April and May it was recorded as 32.1^{o}C and 32.3^{o}C respectively. If we consider Annual Maximum Temperature (AMT) climatology (Figure 4b), it can be observed that the AMT gradually increases from January and becomes maximum in April where it again starts decreasing and become minimum in July to August after that it again starts increasing. Maximum AMT observed in April 2017, 39.6^{o}C whereas minimum up to 26.3^{o}C AMT noted in July 2018. AMT observed in Year 2002 was an exception where very less variation was recorded.

3.2.3 Mean Minimum Temperature (MMnT)

Figure 5(a) represents Mean Minimum Temperature (MMnT) climatology. MMnT ranges in between 8.9□ to 23.5□ for Pashan Observatory. Lowest MMnT observed in December and January in most of the years. Maximum MMnT observed in May, June & July in most of the years which ranges between 20.2^{o}C – 23.5^{o}C. If we consider Annual Mean Minimum Temperature (AMMnT) climatology (Figure 5b), it is observed that AMMnT gradually increases from January and becomes maximum in June where it again starts decreasing and becomes minimum in December. This may be due to maximum cloud cover over the Pashan Observatory during June and minimum cloud coverage during December and winter season. During drought years 2002 and 2004 MMnT is maximum in the month of May which may be due to thunderstorm activity. However, during 2009, 2013 & 2014 MMnT was maximum in the month of June which suggested maximum cloud cover over the Pashan Observatory and active monsoon during the month of June in those years.

3.2.4 Average Mean Temperature (AvMT)

Average Mean Temperature (AvMT) climatology (Figure 6a) shows the variation between 18.4^{o}C to 30.9^{o}C. Winter months DJF (December, January, February) recorded the lowest AvMT whereas summer months April and May recorded the highest temperature. Similar to MMT, AvMT in 2012 April (25.3^{o}C) and

May (25.3^{o}C) was an exception. Annual Mean Temperature climatology (AnMT) (Figure 6b) shows gradual increase in temperature from January to May, unlike to AMT the peak is observed in the month of May. After May AvMT starts decreasing up to July, August and increases in October. AvMT again starts decreasing after October and reaches lowest in December. Year 2000 was an exception where very less variation observed in AvMT. Two records in 2004 and 2009 indicated large deviation from the mean first one is highest temperature in March 2004 (30.4^{o}C) and second in 2009 September (29.0^{o}C).

3.2.5 Total Monthly Rainfall (TMR)

Figure 7(a)shows Mean Monthly Rainfall (TMR) Climatology from 1999 to 2018. Station receives maximum annual rainfall during monsoon months JJAS. TMR, as high as 1003 mm was recorded in August 2016. 2002,2004, 2009, 2013 and 2014 were the drought years, which are reflected in TMR also. In 2002 July and September rainfall was very low (less than 50 mm). In 2004 July and September rainfall was low (less than 100 mm). During 2009 June and September rainfall was low (less than 100 mm). In 2013 July and August recorded very low rainfall. During 2014 June and September recorded very less rainfall (less than 100 mm). Annual rainfall climatology (ARC) (Figure 7b) shows very less to nil ARC in January February months. ARC up to 100 mm recorded during March – May due to pre-monsoon showers. Monsoon months JJAS recorded maximum rainfall. Rainfall up to 150 mm is recorded during post monsoon months October November also where in October 2010 it was high up to 250 mm and in June 2017 it was recorded up to 255 mm. Maximum number of thunderstorm events are observed during pre-monsoon months March, April, May and Monsoon, Post monsoon months September, October which are significantly contributed in the station rainfall

3.2.6 Mean monthly relative humidity (MMRH)

Mean monthly relative humidity (MMRH) climatology is presented in Figure 6a. MMRH at station varies from 43.1 % to 92.3%. MMRH recorded lowest in April and highest in August. During 2012 maximum RH was 84.4 % in December and 75.4% in September. Average Relative Humidity (ARH) climatology presented in figure 8b indicated decrease in the ARH from January onwards and it reaches lowest in April after that it stars increasing again and became maximum during July. During

July and August ARH does not show much variation and after September it starts again declining slightly

3.2.7 The trend analysis

The trend analysis has been carried out using Mann-kendal (M-K) statistics case. The trends obtained in various parameters at 95% and 99% significant level are presented in table 1. Increasing Trend is observed in Maximum and Mean temperature in April and July month. Increasing trend in Relative humidity is observed during February, October and November months which could be associated with the thunderstorm activities during pre-monsoon and post-monsoon months. Decreasing trend in Dew point, Minimum and Mean temperature trend during December month is supporting the Decreasing tend observed in Relative Humidity indicating dry and cold weather over the station during December month.

Table 1: Trend analysis using Mann – Kendall statistics with significance level represented with month

No.	Parameter	Trend	Month
1.	Dew point temperature	Increasing	February (95 %), March (95 %), May (95 %)
		Decreasing	December (99%)
2.	Maximum Temperature	Increasing	March (95 %),April (95 %), July (95 %),
		Decreasing	--
3.	Minimum Temperature	Increasing	January (95 %), February (99%)
		Decreasing	December(99%)
4.	Mean Temperature	Increasing	January (95 %), April (99%), July (95%),
		Decreasing	December (99%)
5.	Relative humidity	Increasing	February (95 %), October (99%), November (99%),
		Decreasing	December (99%)
6.	Rainfall	Increasing	February (95 %),
		Decreasing	--

4 Appendix

Climatological Tables and Climatological Graphs are appended below in Appendix 1a & Appendix 1b. Fortran Program for computing climatology of Pashan Observatory is appended in Appendix 2.

Appendix -Ia

Climatological Tables

Table 2: Climatological Table at Pashan observatory

No.	Month	Mean Monthly Dew Point Temperature (°C)	Mean Monthly Maximum Temperature (°C)	Mean Monthly Minimum Temperature (°C)	Average Mean Temperature (°C)	Total Monthly rainfall (mm)	Mean Monthly Relative Humidity
1	January	12.0	29.8	11.8	20.8	8.2	81.5
2	February	12.3	32.3	13.5	22.9	24.0	72.1
3	March	13.9	35.5	16.9	26.2	29.8	60.8
4	April	15.4	37.9	20.3	29.1	5.7	51.9
5	May	19.2	36.9	22.4	29.7	48.3	62.3
6	June	21.9	31.6	22.5	27.1	186.7	80.8
7	July	21.7	28.2	21.7	24.9	194.3	87.2
8	August	21.5	27.9	21.2	24.5	205.5	89.1
9	September	21.2	29.6	20.9	25.3	135.2	86.7
10	October	19.9	31.4	18.9	25.2	81.5	82.3
11	November	16.3	30.5	15.3	22.9	85.4	80.6
12	December	13.3	29.4	12.4	20.9	20.7	82.5

Table 3: Climatological Table at Shivajinagar observatory

No	Month	Mean Monthly Dew Point Temperature (°C)	Mean Monthly Maximum Temperature (°C)	Mean Monthly Minimum Temperature (°C)	Average Mean Temperature (°C)	Total Monthly rainfall (mm)	Mean Monthly Relative Humidity
1	January	12.4	29.9	11.4	20.6	0.8	87.9
2	February	13.0	32.5	13.1	22.8	0.2	75.0
3	March	13.4	35.6	16.0	25.8	8.3	56.9
4	April	14.8	38.1	20.2	29.1	4.8	48.6
5	May	18.6	37.1	23.1	30.1	20.5	59.1
6	June	21.5	31.9	23.1	27.5	171.3	76.9
7	July	21.5	28.3	22.4	25.3	178.6	83.9
8	August	21.3	26.5	20.7	23.6	152.2	86.1
9	September	21.2	29.6	21.1	25.3	138.5	85.0
10	October	19.6	30.2	17.9	24.1	80.9	79.2
11	November	16.1	29.4	14.2	21.8	24.4	77.3
12	December	13.4	28.4	11.2	19.8	4.5	85.8

Table 4: Mean Monthly Dew Point Temperature Climatology(in ℃)

N – NUMBER OF OBSERVATIONS IN A MONTH

YEAR	Jan	N	Feb	N	Mar	N	Apr	N	May	N	Jun	N	Jul	N	Aug	N	Sep	N	Oct	N	Nov	N	Dec	N
1999	10.8	31	13.9	28	14.2	31	14.1	30	19.0	31	21.4	30	21.6	31	21.0	31	21.0	30	19.7	31	14.4	30	10.9	31
2000	10.8	31	11.6	29	9.9	31	15.3	30	19.9	31	21.8	30	21.2	31	21.3	31	21.0	30	20.2	31	14.6	30	8.1	31
2001	12.5	31	8.7	28	12.4	31	14.1	30	19.5	31	21.5	30	21.4	31	21.1	31	20.8	30	19.5	31	15.4	30	12.7	31
2002	10.2	31	11.8	9	11.9	31	14.4	30	20.9	31	22.1	30	21.4	31	21.1	31	20.6	30	18.9	31	14.1	30	12.4	31
2003	11.9	31	12.1	28	10.8	31	13.7	30	17.5	31	21.9	30	21.9	31	21.7	31	21.0	30	18.7	31	15.6	30	12.3	31
2004	11.8	31	10.5	29	11.3	31	13.2	30	19.6	31	21.3	30	21.3	31	21.3	31	21.1	20	18.0	31	16.2	30	11.9	31
2005	11.8	31	12.9	28	15.5	31	14.7	30	17.7	31	22.0	30	22.0	31	21.9	31	21.3	30	19.6	31	13.5	30	11.8	31
2006	10.5	31	11.2	28	13.8	31	14.0	30	19.0	31	22.1	30	22.1	31	21.7	31	21.7	30	20.5	31	18.3	30	13.9	31
2007	12.9	31	13.5	28	14.5	31	17.7	30	21.2	31	22.7	30	22.1	31	22.1	31	22.1	30	18.7	31	15.8	30	14.2	31
2008	10.3	31	7.8	11	13.6	31	17.0	30	20.1	31	21.6	30	21.8	31	21.7	31	21.4	30	18.5	31	16.1	30	14.3	31
2009	13.1	31	11.8	28	13.3	31	15.7	30	19.3	31	21.8	30	22.2	31	22.2	31	22.1	30	19.5	31	18.0	30	15.1	31
2010	13.3	31	14.3	28	14.6	31	15.9	30	20.1	31	22.9	30	22.2	31	22.4	31	22.0	30	21.3	31	20.4	30	13.7	31
2011	10.3	31	12.6	28	13.5	13	15.9	30	19.4	31	22.5	30	22.5	31	22.5	31	22.5	30	22.5	31	22.5	30	22.5	31
2012	17.5	12	17.3	12	18.8	12	18.4	12	18.8	12	18.5	12	17.5	12	17.3	12	16.7	12	18.3	31	15.3	30	14.2	31
2013	-	2	-	2	13.5	31	15.9	30	16.0	16	22.0	30	-	2	-	2	21.7	30	21.1	31	17.0	30	13.1	31
2014	14.0	31	13.6	28	15.3	31	16.8	30	20.0	31	22.6	30	22.5	31	22.7	31	21.6	30	20.3	31	17.6	30	13.0	31
2015	12.3	31	12.8	28	17.0	31	17.1	30	19.9	31	22.2	30	22.5	31	22.0	31	21.4	30	21.7	31	17.8	30	13.7	31
2016	10.7	31	12.9	29	15.3	31	15.8	30	18.6	31	22.5	30	22.5	31	22.1	31	21.3	30	19.6	31	12.6	30	11.9	31
2017	11.3	31	12.5	28	13.7	31	14.8	30	19.0	31	22.0	30	22.0	31	21.6	31	22.0	30	20.8	31	15.1	30	13.4	31
2018	11.9	31	12.8	28	14.7	31	13.5	30	17.7	31	22.3	30	22.0	31	21.7	31	20.8	30	19.7	31	16.1	30	11.9	31

Table 5: Mean Monthly Maximum Temperature Climatology (in ℃)

N – NUMBER OF OBSERVATIONS IN A MONTH

YEAR	Jan	N	Feb	N	Mar	N	Apr	N	May	N	Jun	N	Jul	N	Aug	N	Sep	N	Oct	N	Nov	N	Dec	N
1999	28.7	31	32.2	28	35.9	31	37.5	30	34.8	31	29.5	30	27.5	31	27.3	31	28.3	30	30.2	31	30.3	30	28.5	31
2000	30.0	31	30.3	29	34.6	31	38.0	30	34.4	31	30.0	30	27.3	31	28.0	31	29.9	30	32.2	31	30.9	30	29.7	31
2001	29.4	31	34.0	28	34.7	31	37.2	30	35.9	31	30.3	30	26.9	31	27.0	31	30.1	30	30.6	31	30.2	30	29.3	31
2002	27.7	31	30.1	9	35.2	31	37.8	30	36.2	31	30.5	30	28.1	31	26.7	31	29.4	30	33.0	31	30.7	30	29.8	31
2003	30.5	31	33.7	28	36.6	31	38.2	30	37.9	31	32.3	30	28.6	31	27.8	31	28.5	30	32.7	31	31.8	30	30.3	31
2004	30.5	31	33.0	29	38.1	31	38.3	30	35.9	31	30.9	30	28.6	31	26.6	31	29.4	20	30.9	31	29.9	30	29.8	31
2005	30.0	31	31.8	28	35.5	31	37.6	30	37.8	31	32.3	30	28.0	31	27.2	31	28.4	30	30.8	31	30.3	30	29.5	31
2006	30.2	31	33.9	28	34.4	31	37.9	30	37.5	31	31.4	30	26.6	31	26.3	31	30.1	30	31.1	31	29.9	30	29.7	31
2007	30.7	31	32.6	28	35.4	31	38.3	30	36.7	31	32.4	30	28.6	31	27.8	31	29.3	30	32.0	31	30.7	30	29.9	31
2008	30.5	31	27.7	11	35.5	31	37.3	30	36.5	31	30.4	30	28.2	31	27.7	31	29.3	30	31.6	31	31.2	30	30.2	31
2009	30.7	31	34.1	28	36.3	31	38.5	30	37.4	31	33.7	30	27.8	31	29.1	31	30.5	30	31.1	31	29.6	30	29.4	31
2010	29.2	31	33.1	28	36.8	31	39.1	30	38.3	31	32.1	30	28.6	31	28.2	31	29.6	30	31.2	31	29.6	30	28.3	31
2011	29.8	31	32.0	28	35.1	13	37.5	30	37.0	31	29.9	30	30.1	31	30.1	31	29.9	30	30.1	31	29.9	30	30.1	31
2012	32.0	12	32.1	12	32.4	12	32.1	12	32.3	12	32.0	12	31.8	12	32.2	12	32.0	12	31.4	31	31.1	30	30.8	31
2013	-	2	-	2	36.1	31	38.0	30	37.9	16	30.0	30	-	2	-	2	29.7	30	31.2	31	30.4	30	29.2	31
2014	29.6	31	31.3	28	34.6	31	38.4	30	37.3	31	34.5	30	29.1	31	28.4	31	29.0	30	31.6	31	30.1	30	27.7	31
2015	27.9	31	32.2	28	33.2	31	37.3	30	38.0	31	31.7	30	29.3	31	28.8	31	30.6	30	32.3	31	30.7	30	28.5	31
2016	28.5	31	32.5	29	36.1	31	39.7	30	38.7	31	33.3	30	27.0	31	26.9	31	28.2	30	29.8	31	30.7	30	29.6	31
2017	30.3	31	34.3	28	36.5	31	39.6	30	38.9	31	32.6	30	27.8	31	27.5	31	30.0	30	31.4	31	30.2	30	29.1	31
2018	30.2	31	32.8	28	36.1	31	38.9	30	39.0	31	32.1	30	26.3	31	26.4	31	30.0	30	33.5	31	31.6	30	28.6	31

Table 6: Mean Monthly Minimum Temperature Climatology (in ℃)

N – NUMBER OF OBSERVATIONS IN A MONTH

YEAR	Jan	N	Feb	N	Mar	N	Apr	N	May	N	Jun	N	Jul	N	Aug	N	Sep	N	Oct	N	Nov	N	Dec	N
1999	8.8	31	14.1	28	16.1	31	20.6	30	22.3	31	22.5	30	21.8	31	21	31	20.7	30	18.6	31	13.4	30	9.9	31
2000	10.9	31	12.3	29	14.2	31	20.9	30	22.1	31	22.4	30	21.2	31	21.3	31	20.3	30	19.2	31	13.5	30	8.9	31
2001	12.5	31	11.8	28	15	31	20.8	30	22.5	31	22.8	30	21.6	31	21.3	31	20.6	30	18.7	31	14.0	30	11.6	31
2002	10.0	31	13.1	9	16.1	31	20.8	30	24.0	31	22.8	30	22.3	31	21.3	31	20.5	30	18.7	31	13.5	30	11.7	31
2003	12.6	31	14.1	28	16.4	31	21.1	30	22.7	31	23.1	30	22.4	31	21.4	31	20.5	30	18.4	31	15.3	30	11.5	31
2004	12.0	31	13.2	29	22.7	31	20.2	30	23.0	31	22.9	30	21.8	31	21.2	31	20.6	20	17.3	31	15.2	30	10.3	31
2005	11.0	31	12.2	28	15.5	31	19.7	30	22.1	31	22.9	30	22.3	31	21.4	31	21.3	30	18.3	31	11.7	30	10.2	31
2006	10.2	31	12.9	28	16.5	31	19.7	30	23.3	31	22.4	30	21.7	31	21.2	31	21.3	30	19.4	31	17.1	30	12.3	31
2007	12.3	31	14.0	28	16.6	31	20.3	30	22.8	31	23.0	30	22.0	31	21.4	31	21.3	30	17.8	31	14.4	30	13.2	31
2008	10.3	31	9.1	11	17.3	31	20.2	30	21.9	31	22.5	30	21.3	31	21.0	31	20.7	30	16.8	31	14.9	30	13.6	31
2009	12.5	31	13.3	28	16.7	31	20.9	30	22.3	31	22.8	30	21.9	31	21.6	31	27.4	30	18	31	16.4	30	13.2	31
2010	12.8	31	14.7	28	17.9	31	20.9	30	23.4	31	22.8	30	22.1	31	21.8	31	20.9	30	19.7	31	19.2	30	12.1	31
2011	9.9	31	12.8	28	15.5	13	19.7	30	22.2	31	22.4	30	22.4	31	22.4	31	22.4	30	22.4	31	22.4	30	22.4	31
2012	17.7	12	18.0	12	18.8	12	18.4	12	18.4	12	18.9	12	17.8	12	17.8	12	17.3	12	17.6	31	14.8	30	13.6	31
2013	-	2	-	2	16.2	31	19.3	30	21.2	16	21.5	30	-	2	-	2	20.0	30	19.8	31	15.2	30	12.1	31
2014	13.3	31	13.6	28	17.2	31	21.3	30	22.9	31	23.8	30	22.4	31	21.6	31	20.9	30	19.6	31	16.2	30	12.3	31
2015	11.9	31	13.8	28	17.3	31	20.1	30	22.8	31	22.4	30	22.2	31	21.5	31	20.9	30	20.7	31	17.1	30	13.8	31
2016	11.4	31	16.5	29	18.3	31	21.2	30	23.1	31	23.3	30	21.9	31	21.6	31	20.8	30	18.9	31	12.2	30	11.9	31
2017	11.4	31	14.2	28	16.4	31	20.1	30	23.3	31	23.5	30	22.2	31	21.5	31	21.5	30	20.4	31	13.6	30	12.9	31
2018	12.1	31	13.7	28	17.3	31	19.7	30	22.2	31	22.1	30	20.6	31	20.2	31	19.0	30	18.1	31	14.9	30	11.0	31

Table 7: Average Mean Temperature Climatology(in ℃)

N – NUMBER OF OBSERVATIONS IN A MONTH

YEAR	Jan	N	Feb	N	Mar	N	Apr	N	May	N	Jun	N	Jul	N	Aug	N	Sep	N	Oct	N	Nov	N	Dec	N
1999	18.8	31	23.1	28	26.0	31	29.0	30	28.6	31	26.0	30	24.7	31	24.1	31	24.5	30	24.4	31	21.8	30	19.2	31
2000	20.4	31	21.3	29	24.4	31	29.5	30	28.3	31	26.2	30	24.2	31	24.7	31	25.1	30	25.7	31	22.2	30	19.3	31
2001	21.0	31	22.9	28	24.8	31	29.0	30	29.2	31	26.6	30	24.2	31	24.2	31	25.4	30	24.6	31	22.1	30	20.5	31
2002	18.9	31	21.6	9	25.7	31	29.3	30	30.1	31	26.7	30	25.2	31	24.0	31	24.9	30	25.8	31	22.1	30	20.8	31
2003	21.5	31	23.9	28	26.5	31	29.6	30	30.3	31	27.7	30	25.5	31	24.6	31	24.5	30	25.5	31	23.5	30	20.9	31
2004	21.2	31	23.1	29	30.4	31	29.3	30	29.5	31	26.9	30	25.2	31	23.9	31	25.0	20	24.1	31	22.6	30	20.0	31
2005	20.5	31	22.0	28	25.5	31	28.6	30	29.9	31	27.6	30	25.1	31	24.3	31	24.8	30	24.5	31	21.0	30	19.8	31
2006	20.2	31	23.4	28	25.4	31	28.8	30	30.4	31	26.9	30	24.2	31	23.8	31	25.7	30	25.3	31	23.5	30	21.0	31
2007	21.5	31	23.3	28	26.0	31	29.3	30	29.7	31	27.7	30	25.3	31	24.6	31	25.3	30	24.9	31	22.6	30	21.6	31
2008	20.4	31	18.4	11	26.4	31	28.7	30	29.2	31	26.4	30	24.7	31	24.3	31	25.0	30	24.2	31	23.0	30	21.9	31
2009	21.6	31	23.7	28	26.5	31	29.7	30	29.9	31	28.3	30	24.8	31	25.3	31	29.0	30	24.5	31	23,0	30	21.3	31
2010	21.0	31	23.9	28	27.3	31	30.0	30	30.8	31	27.5	30	25.3	31	25	31	25.3	30	25.5	31	24.4	30	20.2	31
2011	19.9	31	22.4	28	25.3	13	28.6	30	29.6	31	26.1	30	26.2	31	26.2	31	26.1	30	26.2	31	26.1	30	26.2	31
2012	24.8	12	25.1	12	25.6	12	25.3	12	25.3	12	25.5	12	24.8	12	25.0	12	24.6	12	24.5	31	23.0	30	22.2	31
2013	-	2	-	2	26.2	31	28.6	30	29.6	16	25.7	30	-	2	-	2	24.8	30	25.5	31	22.8	30	20.6	31
2014	21.5	31	22.4	28	25.9	31	29.8	30	30.1	31	29.2	30	25.8	31	25.0	31	25.0	30	25.6	31	23.1	30	20.0	31
2015	19.9	31	23.0	28	25.2	31	28.7	30	30.4	31	27.1	30	25.7	31	25.2	31	25.8	30	26.5	31	23.9	30	21.2	31
2016	19.9	31	24.5	29	27.2	31	30.4	30	30.9	31	28.3	30	24.4	31	24.3	31	24.5	30	24.4	31	21.4	30	20.8	31
2017	20.9	31	24.2	28	26.5	31	29.8	30	31.1	31	28.0	30	25.0	31	24.5	31	25.8	30	25.9	31	21.9	30	21.0	31
2018	21.1	31	23.2	28	26.7	31	29.3	30	30.6	31	27.1	30	23.5	31	23.3	31	24.5	30	25.8	31	23.3	30	19.8	31

Table 8: Total Monthly Rainfall Climatology (in mm)

N – NUMBER OF OBSERVATIONS IN A MONTH

YEAR	Jan	N	Feb	N	Mar	N	Apr	N	May	N	Jun	N	Jul	N	Aug	N	Sep	N	Oct	N	Nov	N	Dec	N
1999	0	31	2.1	28	0	31	0	30	28.1	31	160.3	30	179.9	31	46.5	31	129.9	30	136.3	31	0	30	0	31
2000	0	31	0	29	0	31	0	30	29.3	31	164.6	30	112.3	31	84.5	31	129.2	30	19.8	31	13.2	30	6.8	31
2001	5.1	31	0	28	0	31	4	30	7.7	31	92.7	30	149.3	31	89	31	148.5	30	122.4	31	16	30	0	31
2002	0	31	0	27	0	31	13.5	30	9.9	31	241.7	30	36.9	31	121.5	31	28.2	30	14	31	0.8	30	0	31
2003	0	31	3.8	28	0	31	0	30	0	31	173.5	30	99.4	31	93.7	31	51.1	30	47.2	31	1.7	30	0	31
2004	0	31	0	29	0	31	0	30	50.2	31	166.8	30	56	31	364.7	31	242.1	29	21.7	31	18	30	0	31
2005	8.6	31	0	28	0	31	28.8	30	33	31	362.8	30	386.5	31	265.2	31	304.7	30	80	31	0	30	0	31
2006	0	31	0	28	2.4	31	0	30	65.3	31	150.3	30	460.8	31	420.7	31	192.5	30	80.8	31	63.7	30	0	31
2007	0	31	0	28	0	31	7	30	5.5	31	288.9	30	281.2	31	154.8	31	86.3	30	0	31	13.3	30	0	31
2008	0	31	0	28	33.5	31	0	30	12	31	146.2	30	96.2	31	194.4	31	160.9	30	68.1	31	13	30	38.7	31
2009	0	31	0	28	8	31	6	30	10	31	73.9	30	354.6	31	176.8	31	86.5	30	92.7	31	205.8	30	0	31
2010	0	31	0	28	10.2	31	0	30	11.4	31	311.3	30	224	31	202.8	31	203.3	30	250.4	31	84.2	30	0	31
2011	0	31	0	28	0	30	6.6	30	30	31	276.8	30	213	24	123	24	74.4	23	52.7	24	10	23	83.8	25
2012	142.2	30	45.4	28	9.5	30	40.1	29	63.9	30	69.8	29	91.9	29	53.8	30	15.4	29	53.2	31	13.8	30	0.3	31
2013	17.7	23	19.8	21	1.6	31	0	30	0	30	309.4	30	170.7	22	10.4	22	229.6	30	22.6	31	1.6	30	1.9	31
2014	0	31	2.5	28	8.3	31	14.2	30	40.9	31	17.1	30	311.6	31	294.8	31	89.2	30	38.3	31	36.3	30	13.6	31
2015	0	31	0	28	68.3	31	0	30	98.1	31	259.6	30	119.9	31	27.6	31	136.8	30	87.9	31	92.6	30	0	31
2016	0	31	0	29	19.5	31	10.2	30	7.1	31	66.4	30	239.9	31	257.1	31	62.4	30	49.6	31	0	30	0	31
2017	0	31	0	28	0	31	0	30	9.2	31	151.9	30	255.2	31	134.9	31	181.6	30	102.7	31	5.1	30	3.8	31
2018	0	31	0	28	8.4	31	0.5	30	28.4	31	171.9	30	192.7	31	111.5	31	49.1	30	30	31	2	30	0	31

Table 9: Mean Monthly Relative Humidity Climatology (in %)

N – NUMBER OF OBSERVATIONS IN A MONTH

YEAR	Jan	N	Feb	N	Mar	N	Apr	N	May	N	Jun	N	Jul	N	Aug	N	Sep	N	Oct	N	Nov	N	Dec	N
1999	84.5	31	75.6	28	59.1	31	48.4	30	66.3	31	81.8	30	88.4	31	87.1	31	87.1	30	83.5	31	73.5	30	78.1	31
2000	76.4	31	73.1	29	50.0	31	50.7	30	69.4	31	84.7	30	86.3	31	86.8	31	85.8	30	82.3	31	74.3	30	67.0	31
2001	79.7	31	57.1	28	55.8	31	46.9	30	63.5	31	79.0	30	85.6	31	84.6	31	82.8	30	81.0	31	75.6	30	79.2	31
2002	77.5	31	72.9	9	50.7	31	47.2	30	67.1	31	76.4	30	83.3	31	88.8	31	83.7	30	74.0	31	69.9	30	78.8	31
2003	76.7	31	65.3	28	48.2	31	43.1	30	54.9	31	77.3	30	86.3	31	89.4	31	86.6	30	74.6	31	71.1	30	74.9	31
2004	77.1	31	61.9	29	46.0	31	41.9	30	63.7	31	75.8	30	83.1	31	91.0	31	84.8	20	75.6	31	76.7	30	79.5	31
2005	81.8	31	74.6	28	62.7	31	47.4	30	56.3	31	79.2	30	82.0	31	87.5	31	91.6	30	82.4	31	71.3	30	73.9	31
2006	72.1	31	61.5	28	58.9	31	47.4	30	60.9	31	81.3	30	86.5	31	89.5	31	86.5	30	82.6	31	81.9	30	78.1	31
2007	81.2	31	72.0	28	64.0	31	60.5	30	68.6	31	79.5	30	83.7	31	90.4	31	89.0	30	76.9	31	76.5	30	78.8	31
2008	75.4	31	63.1	11	57.2	31	56.3	30	65.0	31	80.9	30	85.0	31	83.9	31	83.8	30	76.2	31	74.7	30	80.7	31
2009	79.5	31	66.4	28	53.2	31	49.2	30	59.2	31	73.1	30	85.2	31	88.2	31	86.0	30	74.5	31	80.0	30	89.1	31
2010	84.1	31	77.4	28	58.1	31	46.7	30	59.8	31	73.4	30	80.8	31	85.5	31	89.2	30	86.8	31	89.3	30	88.9	31
2011	83.5	31	75.0	28	63.7	13	54.1	30	61.5	31	84.9	30	84.5	31	84.5	31	84.9	30	84.5	31	84.9	30	84.5	31
2012	77.5	12	76.1	12	80.8	12	80.8	12	82.1	12	80.2	12	77.6	12	77.3	12	75.4	12	81.5	31	78.9	30	84.4	31
2013	-	2	-	2	59.5	31	55.2	30	54.0	16	85.4	30	-	2	-	2	82.1	30	82.4	31	88.5	30	89.1	31
2014	91.4	31	82.4	28	65.0	31	55.5	30	64.3	31	74.2	30	79.2	31	87.8	31	87.7	30	84.3	31	89.0	30	91.6	31
2015	91.0	31	80.9	28	79.1	31	58.4	30	62.2	31	77.1	30	86.5	31	88.6	31	86.0	30	90.6	31	90.0	30	89.8	31
2016	87.0	31	77.1	29	68.1	31	49.1	30	55.9	31	80.0	30	71.3	31	92.3	31	89.7	30	90.5	31	88.0	30	87.3	31
2017	87.6	31	78.5	28	67.8	31	51.3	30	58.4	31	77.9	30	89.7	31	89.2	31	90.1	30	90.6	31	90.8	30	88.4	31
2018	87.3	31	79.0	28	68.8	31	47.3	30	53.6	31	81.2	30	91.6	31	92.1	31	87.0	30	85.5	31	83.2	30	85.4	31

Table 10: Lowest & Highest Maximum Temperature in a month(in ℃)

(a) N – NUMBER OF OBSERVATIONS IN A MONTH

YEAR	Jan			Feb			Mar			Apr			May			Jun		
	LOW	HIGH	N	LOW	HIGH	N	LOW	HIGH	N	LOW	HIGH	N	LOW	HIGH	N	LOW	HIGH	N
1999	25.9	31.7	31	29.0	35.4	28	34.5	38.8	31	30.3	39.6	30	30.9	39.8	31	24.9	33.8	30
2000	27.0	32.9	31	27.2	33.0	29	29.7	37.7	31	35.1	39.6	30	25.8	40.5	31	25.2	33.5	30
2001	19.6	32.7	31	31.7	37.2	28	32.9	36.8	31	33.9	40.7	30	30.1	41.7	31	25.9	34.4	30
2002	24.8	32.0	31	28.4	32.2	9	31.8	37.8	31	34.1	40.9	30	33.2	41.5	31	22.9	37.2	30
2003	24.9	34.6	31	29.2	35.9	28	34.4	38.8	31	31.8	41.0	30	35	41.9	31	25.5	38.9	30
2004	28.0	35.0	31	25.4	36.3	29	35.6	40.1	31	36.0	40.0	30	31.7	41.1	31	25.0	37.0	30
2005	26.2	33.0	31	21.8	36.4	28	30.2	40.0	31	34.6	40.1	30	33.9	41.5	31	25.0	37.9	30
2006	25.9	34.0	31	30.2	36.7	28	29.0	38.3	31	36.0	39.8	30	31.3	40.7	31	25.6	35.2	30
2007	27.8	33.8	31	30.0	39.3	28	30.2	39.3	31	36.5	40.1	30	31.2	41.3	31	26.2	38.2	30
2008	25.0	32.9	31	26.0	32.4	11	31.9	37.5	31	32.6	41.5	30	35.1	38.5	31	26.7	36.7	30
2009	27.4	35.0	31	32.0	36.9	28	33.2	38.4	31	31.2	40.9	30	25.4	40.6	31	25.7	37.1	30
2010	26.2	30.4	31	30.0	36.6	28	34.2	39.1	31	35.2	41.2	30	35.7	41.8	31	26.2	37.3	30
2011	25.0	37.5	31	28.3	33.6	28	32.9	37.1	13	34.9	40.1	30	35.0	40.1	31	25.0	36.6	30
2012	23.5	37.8	12	25.0	38.8	12	25.2	38.8	12	25.8	38.3	12	26.0	38.3	12	25.8	38.8	12
2013	-	-	2	-	-	2	32.0	37.7	31	32.3	41.2	30	32.9	41.0	16	25.0	36.0	30
2014	26.6	32.1	31	26.2	34.6	28	28.1	39.2	31	36.4	40.6	30	28.8	40.6	31	31.1	39.6	30
2015	23.6	29.6	31	24.7	35.2	28	19.2	38.2	31	34.0	41	30	32.8	41.1	31	25.3	38.2	30
2016	24.8	32.2	31	21.0	36.8	29	31.2	39.8	31	37.0	41.5	30	28.1	42.0	31	27.0	38.6	30
2017	27.4	33.1	31	31.8	37.0	28	30.2	41.5	31	36.5	42.3	30	33.0	42.1	31	26.0	38.8	30
2018	27.5	32.6	31	28.5	36.0	28	28.0	39.2	31	36.3	41.2	30	35.0	41.3	31	25.8	39.3	30

Table 10: (b) N – NUMBER OF OBSERVATIONS IN A MONTH

YEAR	Jul			Aug			Sep			Oct			Nov			Dec		
	LOW	HIGH	N	LOW	HIGH	N	LOW	HIGH	N	LOW	HIGH	N	LOW	HGH	N	LOW	HGH	N
1999	24.0	32.0	31	23.4	29.9	31	25.7	31.1	30	27.0	31.3	31	27.8	32.2	30	25.1	30.1	31
2000	23.9	29.6	31	23.6	31.6	31	26.1	32.6	30	29.2	33.6	31	29.0	32.8	30	28.3	31.4	31
2001	23.9	28.8	31	24.3	29.1	31	26.1	32.9	30	25.2	33.4	31	28.2	32.2	30	27.4	31.1	31
2002	24.0	29.8	31	24.1	29.8	31	24.0	32.9	30	27.1	36.1	31	28.1	32.2	30	27.4	31.8	31
2003	25.0	32.4	31	24.3	32.5	31	25.0	31.8	30	30.8	37.4	31	29.0	34.0	30	27.4	32.0	31
2004	25.5	33.0	31	23.5	29.6	31	26.5	31.1	20	29.0	32.8	31	24.7	33.1	30	27.8	32.0	31
2005	24.4	32.4	31	23.5	31.3	31	24.3	32.7	30	27.0	37.0	31	29.4	31.7	30	26.4	31.5	31
2006	23.4	29.5	31	22.7	28.4	31	27.3	32.8	30	26.2	33.2	31	28.2	32.0	30	27.3	31.5	31
2007	25.2	34.2	31	24.6	31.2	31	26.5	32.8	30	28.8	34.1	31	28.6	33.3	30	24.2	33.3	31
2008	24.4	31.1	31	22.5	32.5	31	24.2	32.9	30	25.6	33.2	31	24.6	33.6	30	28.5	31.8	31
2009	23.5	39.7	31	27.3	32.2	31	25.6	33.2	30	26.6	33.7	31	22.5	32.4	30	27.5	31.5	31
2010	24.3	31.5	31	24.4	31.4	31	23.9	32.7	30	29.0	33.8	31	24.8	32.4	30	24.6	30.9	31
2011	25.0	36.6	31	25.0	36.6	31	25.0	36.6	30	25.0	36.6	31	25.0	36.6	30	25.0	36.6	31
2012	26.3	37.3	12	27.0	39.6	12	28.4	39.3	12	27.0	39.0	31	26.1	39.4	30	26.3	38.7	31
2013	-	-	2	-	-	2	26.2	32.5	30	26.8	32.8	31	26.6	34.2	30	27.7	31.0	31
2014	23.6	34.9	31	24.2	32.3	31	24.6	33.0	30	23.5	33.8	31	23.8	32.6	30	23.7	31.2	31
2015	24.9	34.0	31	25.0	31.3	31	24.8	33.4	30	30.1	33.6	31	27.9	39.2	30	24.1	30.5	31
2016	24.9	30.8	31	24.3	29.0	31	25.0	30.9	30	24.5	32.3	31	28.3	33.8	30	23.0	34.0	31
2017	24.5	30.9	31	22.3	29.6	31	22.8	32.8	30	27.3	34.0	31	28.8	32.0	30	24.3	30.8	31
2018	23.3	32.0	31	23.6	28.5	31	25.2	34.0	30	30.0	35.5	31	28.3	34.2	30	24.8	31.7	31

Table 11: Lowest & Highest Minimum Temperature of the month (in ℃)

(a) N – NUMBER OF OBSERVATIONS IN A MONTH

YEAR	Jan			Feb			Mar			Apr			May			Jun		
	Low	High	N	Low	High	N	Low	High	N	Low	High	N	Low	High	N	Low	High	N
1999	6.8	11.6	31	6.8	17.2	28	13.6	19.1	31	17.0	22.8	30	18.2	24.3	31	20.0	26.3	30
2000	6.0	15.6	31	8.8	16.2	29	10.3	19.8	31	16.7	24.1	30	16.8	24.8	31	20.4	24.3	30
2001	8.7	17.5	31	9.1	15.4	28	9.5	21.4	31	15.0	24.8	30	20.3	25.0	31	21.4	24.0	30
2002	6.0	14.3	31	9.3	15.4	9	13.6	21.7	31	17.4	24.9	30	22.6	25.8	31	20.0	24.9	30
2003	6.8	16.6	31	11.1	19.8	28	11.4	21.0	31	16.7	25.1	30	17.0	25.4	31	20.5	25.0	30
2004	8.9	16.3	31	7.7	16.5	29	12.5	24.7	31	16.1	23.3	30	19.5	25.7	31	20.6	25.2	30
2005	5.4	15.4	31	6.4	17.5	28	12.0	19.8	31	14.5	25.0	30	17.4	25.5	31	20.4	24.5	30
2006	6.0	14.1	31	9.4	17.5	28	11.4	20.2	31	16.8	23.7	30	20.4	33.1	31	21.3	24.3	30
2007	9.9	17.2	31	11.7	19.1	28	12.3	22.0	31	17.1	24.4	30	20.2	24.4	31	21.7	25.1	30
2008	5.3	13.2	31	6.1	13.6	11	12.7	21.8	31	14.1	26.1	30	19.3	23.8	31	18.7	24.6	30
2009	8.8	16.0	31	9.4	15.7	28	14.3	20.2	31	14.9	24.3	30	20.2	25.2	31	20.7	24.4	30
2010	8.8	18.0	31	10.6	17.8	28	14.1	21.7	31	16.7	25.3	30	19.8	26.5	31	20.2	24.5	30
2011	5.5	13.7	31	10.3	18.2	28	11.2	18.5	13	14.0	23.1	30	19.3	25.4	31	20.7	24.0	30
2012	10.2	23.2	12	9.0	22.6	12	12.1	24.2	12	12.6	22.7	12	12.2	24.1	12	13.3	24.2	12
2013	-	-	2	-	-	2	10.8	20.9	31	12.5	23.6	30	8.2	25.0	16	8.7	24.1	30
2014	8.5	18.5	31	9.1	19.1	28	10.4	21.9	31	15.5	25.7	30	19.7	26.6	31	21.8	26.5	30
2015	6.9	15.5	31	10.8	16.8	28	10.8	22.8	31	15.7	24.8	30	19.0	24.8	31	21.1	24.2	30
2016	7.7	15.6	31	9.6	21.0	29	13.9	22.4	31	18.1	26.3	30	11.6	26.2	31	20.9	25.7	30
2017	7.7	15.2	31	12.4	15.7	28	11.2	23.6	31	15.6	24.3	30	20.2	25.5	31	20.4	25.2	30
2018	9.4	17.9	31	9.8	17.4	28	13.2	21.2	31	16.7	24.5	30	18.3	25.1	31	20.2	24.8	30

Table 11: (b) N – NUMBER OF OBSERVATIONS IN A MONTH

YEAR	Jul			Aug			Sept			Oct			Nov			Dec		
	Low	High	N	Low	High	N	Low	High	N	Low	High	N	Low	High	N	Low	High	N
1999	21.1	22.6	31	19.2	22.5	31	17.8	23.3	30	12.5	23.1	31	8.4	18.4	30	6.2	15.8	31
2000	19.3	22.9	31	19.5	23.2	31	17.6	22.0	30	13.3	23.3	31	10.7	18.6	30	6.7	17.4	31
2001	20.7	22.8	31	20.3	22.4	31	18.2	22.3	30	12.3	24.0	31	10.2	20.2	30	8.8	15.7	31
2002	20.8	23.5	31	19.0	23.8	31	17.9	23.6	30	11.5	23.2	31	9.6	19.0	30	8.9	15.5	31
2003	21.1	23.8	31	20.2	22.4	31	19.0	23.4	30	12.3	22.8	31	11.0	21.2	30	8.7	15.4	31
2004	20.3	23.4	31	19.5	22.1	31	18.8	22.5	20	12.2	21.6	31	9.8	21.2	30	7.5	14.5	31
2005	21.2	23.4	31	19.2	31.9	31	18.3	23.2	30	12.7	22.2	31	9.1	16.4	30	6.7	16.5	31
2006	19.7	22.7	31	19.2	22.1	31	19.7	31.1	30	14.4	27.5	31	13.1	21.7	30	8.7	19.7	31
2007	20.1	23.0	31	20.0	24.4	31	20.0	23.3	30	13.3	26.7	31	7.6	20.8	30	10.5	19.8	31
2008	20.5	22.5	31	19.1	23.1	31	17.4	23.1	30	11.6	21.6	31	9.8	21.3	30	8.4	20.2	31
2009	21.0	23.7	31	21.0	23.1	31	19.5	22.9	30	12.1	24.2	31	11.0	22.3	30	7.8	16.5	31
2010	21.2	23.4	31	20.5	23.3	31	19.0	22.1	30	15.3	23.1	31	13.6	22.0	30	6.7	17.7	31
2011	20.7	24.0	31	20.7	24.0	31	20.7	24.0	30	20.7	24.0	31	20.7	24.0	30	20.7	24.0	31
2012	10.4	22.1	12	9.4	22.7	12	5.3	23.7	12	6.9	23.2	31	7.5	22.8	30	6.3	22.7	31
2013	-	-	2	-	-	2	11.8	22.7	30	12.5	23.2	31	10.9	21.4	30	7.7	21.8	31
2014	20.9	24.2	31	20.6	23.5	31	18.9	22.4	30	14.1	22.6	31	11.8	20.5	30	8.3	18.9	31
2015	21.3	23.7	31	20.5	23.1	31	18.0	23.3	30	17.1	25.5	31	13.0	21.0	30	7.4	18.1	31
2016	21.0	23.0	31	20.7	22.6	31	18.9	22.5	30	12.6	22.7	31	9.7	18.5	30	8.5	20.0	31
2017	21.5	22.9	31	18.4	22.3	31	18.0	22.9	30	15.1	23.2	31	9.7	20.4	30	8.7	20.2	31
2018	19.2	21.4	31	18.7	21.9	31	16.8	21.2	30	12.1	20.4	31	10.8	20.4	30	5.2	15.7	31

Table 12: Lowest & Highest MEAN Temperature of the month (in ℃)

(a) N – NUMBER OF OBSERVATIONS IN A MONTH

YEAR	Jan			Feb			Mar			Apr			May			Jun		
	Low	High	N	Low	High	N	Low	High	N	Low	High	N	Low	High	N	Low	High	N
1999	16.4	20.5	31	18.8	25.3	28	24.5	27.8	31	23.6	31.0	30	26.7	31.0	31	23.3	28.7	30
2000	16.5	23.6	31	18.5	23.8	29	21.3	28.3	31	27.3	31.8	30	23.3	32.3	31	23.8	28.4	30
2001	18.0	23.8	31	20.7	25.3	28	21.2	29.1	31	24.5	32.5	30	26.1	33.3	31	23.6	28.7	30
2002	15.5	22.0	31	19.1	23.8	9	23.2	28.2	31	26.8	31.9	30	28.4	33.2	31	22.2	30.3	30
2003	16.0	25.2	31	20.2	26.2	28	23.2	29.5	31	25.4	32.5	30	27.0	32.7	31	24.0	31.5	30
2004	19.0	24.6	31	18.8	26.3	29	25.0	110.3	31	26.6	31.5	30	27.1	33.0	31	23.3	30.5	30
2005	16.6	23.6	31	15.9	26.8	28	22.5	29.4	31	25.6	31.5	30	27.1	32.8	31	23.3	30.6	30
2006	16.1	24.0	31	19.9	26.7	28	21.9	28.6	31	26.6	31.5	30	27.1	34.3	31	23.8	28.9	30
2007	19.0	24.7	31	20.9	27.1	28	22.4	30.5	31	27.2	32.1	30	27.3	32.8	31	24.2	30.7	30
2008	15.4	22.5	31	16.2	21.3	11	23.4	29.1	31	23.9	33.0	30	28.0	30.4	31	24.4	30.6	30
2009	19.4	24.9	31	21.3	25.8	28	24.2	28.7	31	23.4	32.2	30	24.0	32.4	31	24.9	30.6	30
2010	19.1	24.0	31	21.9	26.9	28	24.2	30.4	31	26.5	33.3	30	28.3	34.2	31	24.2	29.7	30
2011	9.0	23.6	31	20.8	25.0	28	23.0	27.1	13	24.5	31.2	30	27.5	32.3	31	23.2	30.1	30
2012	21.4	29.5	12	21.2	29.6	12	21.4	30.4	12	21.2	29.7	12	21.9	31.0	12	22.1	29.3	12
2013	-	-	2	-	-	2	22.9	29.3	31	23.3	32.3	30	20.9	31.5	16	20.4	29.6	30
2014	19.0	24.5	31	18.2	26.5	28	19.3	29.5	31	26.3	33.2	30	25.6	32.7	31	26.8	33.0	30
2015	17.2	22.5	31	18.2	25.7	28	17.3	30.3	31	25.4	32.4	30	28.1	32.8	31	23.8	31.2	30
2016	16.3	23.0	31	20.5	42.7	29	24.0	30.8	31	27.8	33.9	30	19.9	33.9	31	24.3	32.2	30
2017	18.4	23.4	31	22.1	26.3	28	20.7	32.4	31	26.8	32.5	30	28.5	33.5	31	24.5	32.0	30
2018	18.9	25.2	31	20.0	26.1	28	23.1	29.0	31	27.3	32.5	30	28.9	33.0	31	23.3	31.6	30

Table 12: (b) N – NUMBER OF OBSERVATIONS IN A MONTH

YEAR	Jul			Aug			Sept			Oct			Nov			Dec		
	Low	High	N	Low	High	N	Low	High	N	Low	High	N	Low	High	N	Low	High	N
1999	23.0	26.9	31	22.3	25.3	31	22.6	27.2	30	21.9	27.2	31	18.2	25.3	30	15.6	22.6	31
2000	22.8	25.9	31	22.0	26.8	31	22.9	27.3	30	22.7	28.4	31	19.9	24.8	30	17.6	24.1	31
2001	22.8	25.4	31	22.9	25.0	31	23.3	27.1	30	21.5	28.6	31	19.6	26.2	30	18.1	22.6	31
2002	22.8	26.6	31	22.0	26.3	31	22.6	27.8	30	21.5	28.5	31	19.5	24.9	30	19.0	22.0	31
2003	23.4	28.1	31	22.8	27.0	31	22.5	26.6	30	22.4	27.8	31	21.3	27.5	30	18.1	23.3	31
2004	22.9	27.7	31	22.2	25.2	31	23.2	26.5	20	21.4	26.5	31	19.5	26.5	30	18.5	22.3	31
2005	23.1	27.5	31	22.4	31.3	31	22.6	27.5	30	20.1	29.5	31	19.7	24.0	30	17.5	23.4	31
2006	21.8	25.5	31	21.8	25.0	31	24.0	31.7	30	22.6	29.5	31	21.0	25.5	30	19.0	25.4	31
2007	23.6	28.3	31	23.1	26.5	31	23.6	27.4	30	21.5	29.6	31	18.3	26.6	30	17.4	25.2	31
2008	22.7	26.8	31	22.1	27.8	31	22.7	27.5	30	21.5	26.5	31	19.8	25.9	30	19.6	25.5	31
2009	22.5	31.7	31	24.3	27.0	31	22.7	116.6	30	21.9	28.6	31	19.5	27.0	30	17.6	23.3	31
2010	22.8	27.0	31	22.8	26.7	31	22.5	27.3	30	22.5	28.5	31	21.5	26.9	30	16.8	23.5	31
2011	23.2	30.1	31	23.2	30.1	31	23.2	30.1	30	23.2	30.1	31	23.2	30.1	30	23.2	30.1	31
2012	21.9	27.7	12	20.8	29.3	12	17.1	30.9	12	17.9	30.7	31	17.1	30.9	30	16.4	30.4	31
2013	-	-	2	-	-	2	20.6	27.0	30	21.3	27.7	31	18.8	26.5	30	17.7	26.2	31
2014	22.7	29.6	31	22.8	27.8	31	22.3	27.1	30	20.9	27.8	31	20.4	26.4	30	16.4	24.5	31
2015	23.3	28.9	31	23.1	26.5	31	23.3	27.2	30	24.2	29.4	31	21.1	29.2	30	15.8	24.0	31
2016	23.1	26.6	31	22.7	25.3	31	22.9	26.0	30	21.8	27.1	31	19.3	24.9	30	6.1	25.0	31
2017	23.5	26.7	31	20.3	25.8	31	21.8	27.5	30	22.4	28.6	31	19.3	25.3	30	18.8	23.6	31
2018	21.3	26.5	31	21.9	24.5	31	21.2	27.6	30	22.1	27.5	31	20.2	25.9	30	15.0	23.6	31

Table 13: Highest rainfall in a month (in mm)

YEAR	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	HIGH	N	HIGH	N	HIGH	N	HIGH	N	HIGH	N	HIGH	N	HIGH	N	HIGH	N	HIGH	N	HIGH	N	HIGH	N	HIGH	N
1999	0.0	31	2.0	28	0.0	31	0.0	30	24.4	31	41.5	30	34.0	31	11.3	31	38.0	30	30.5	31	0.0	30	0.0	31
2000	0.0	31	0.0	29	0.0	31	0.0	30	11.6	31	37.3	30	39.5	31	28.8	31	58.8	30	6.5	31	13.2	30	6.8	31
2001	5.1	31	0.0	28	0.0	31	4.0	30	5.7	31	21.4	30	43.8	31	15.5	31	31.6	30	39.3	31	16.0	30	0.0	31
2002	0.0	31	0.0	9	0.0	31	11.3	30	8.4	31	83.5	30	6.9	31	18.4	31	10.2	30	12.4	31	0.8	30	0.0	31
2003	0.0	31	3.8	28	0.0	31	0.0	30	0.0	31	36.2	30	33.4	31	15.4	31	18.1	30	42.3	31	1.7	30	0.0	31
2004	0.0	31	0.0	29	0.0	31	0.0	30	15.0	31	86.0	30	20.9	31	78.7	31	30.8	20	18.0	31	15.6	30	0.0	31
2005	8.6	31	0.0	28	0.0	31	14.0	30	17.0	31	70.7	30	93.6	31	70.1	31	60.7	30	41.2	31	0.0	30	0.0	31
2006	0.0	31	0.0	28	2.4	31	0.0	30	42.8	31	32.2	30	70.4	31	78.4	31	55.0	30	27.4	31	28.6	30	0.0	31
2007	0.0	31	0.0	28	0.0	31	6.2	30	5.0	31	125.6	30	100.4	31	20.4	31	62.4	30	0.0	31	5.4	30	0.0	31
2008	0.0	31	0.0	11	22.6	31	0.0	30	12.0	31	45.5	30	15.0	31	68.3	31	55.0	30	32.9	31	12.4	30	38.7	31
2009	0.0	31	0.0	28	8.0	31	6.0	30	10.0	31	29.5	30	102.9	31	66.4	31	30.7	30	45.2	31	101.8	30	0.0	31
2010	0.0	31	0.0	28	9.7	31	0.0	30	6.8	31	96.5	30	52.0	31	61.5	31	66.4	30	172.6	31	29.0	30	0.0	31
2011	0.0	31	0.0	28	0.0	13	6.5	30	28.2	31	63.2	30	63.2	31	63.2	31	63.2	30	63.2	31	63.2	30	63.2	31
2012	95.7	12	31.2	12	6.4	12	9.4	12	47.1	12	28.8	12	5.4	12	7.2	12	10.8	12	26.0	31	10.3	30	0.3	31
2013	-	2	-	2	1.6	31	0.0	30	0.0	16	71.0	30	-	2	-	2	59.8	30	8.0	31	1.6	30	1.8	31
2014	0.0	31	2.5	28	4.0	31	14.2	30	17.1	31	7.0	30	97.4	31	57.4	31	33.2	30	19.0	31	25.8	30	13.6	31
2015	0.0	31	0.0	28	43	31	0.0	30	87.2	31	58.4	30	34.5	31	5.0	31	55.6	30	36.4	31	66.6	30	0.0	31
2016	0.0	31	0.0	29	14.8	31	10.2	30	7.1	31	18.2	30	57.0	31	77.5	31	19.2	30	40.8	31	0.0	30	0.0	31
2017	0.0	31	0.0	28	0.0	31	0.0	30	8.1	31	39.6	30	34.3	31	60.2	31	47.0	30	47.1	31	2.8	30	2.6	31
2018	0.0	31	0.0	28	8.2	31	0.5	30	28.0	31	60.6	30	35.6	31	12.6	31	14.6	30	8.0	31	1.0	30	0.0	31

Table 14: Number of observations with maximum temperature >30°C

YEAR	Jan	N	Feb	N	Mar	N	Apr	N	May	N	Jun	N	Jul	N	Aug	N	Sep	N	Oct	N	Nov	N	Dec	N
1999	4	31	27	28	31	31	30	30	31	31	12	30	3	31	0	31	4	30	20	31	18	30	1	31
2000	17	31	18	29	30	31	30	30	30	31	13	30	0	31	4	31	17	30	29	31	26	30	10	31
2001	13	31	28	28	31	31	30	30	31	31	12	30	0	31	0	31	16	30	24	31	16	30	12	31
2002	5	31	4	9	31	31	30	30	31	31	15	30	0	31	0	31	16	30	28	31	23	30	15	31
2003	20	31	27	28	31	31	30	30	31	31	20	30	3	31	1	31	5	30	31	31	29	30	21	31
2004	17	31	26	29	31	31	30	30	31	31	18	30	8	31	0	31	9	20	26	31	17	30	13	31
2005	19	31	23	28	31	31	30	30	31	31	20	30	8	31	4	31	8	30	23	31	22	30	10	31
2006	17	31	28	28	29	31	30	30	31	31	22	30	0	31	0	31	16	30	29	31	13	30	13	31
2007	20	31	28	28	31	31	30	30	31	31	23	30	7	31	4	31	14	30	29	31	19	30	13	31
2008	21	31	1	11	31	31	30	30	31	31	12	30	6	31	5	31	15	30	29	31	24	30	23	31
2009	18	31	28	28	31	31	30	30	30	31	26	30	4	31	9	31	22	30	25	31	17	30	11	31
2010	4	31	28	28	31	31	30	30	31	31	23	30	9	31	5	31	14	30	27	31	11	30	5	31
2011	19	31	27	28	13	13	30	30	31	31	10	30	11	31	11	31	10	30	11	31	10	30	11	31
2012	9	12	10	12	10	12	9	12	9	12	9	12	8	12	8	12	8	12	24	31	21	30	21	31
2013	0	2	0	2	31	31	30	30	16	16	15	30	0	2	0	2	15	30	26	31	18	30	7	31
2014	11	31	19	28	27	31	30	30	30	31	30	30	11	31	8	31	12	30	27	31	18	30	3	31
2015	0	31	25	28	26	31	30	30	31	31	20	30	13	31	8	31	24	30	31	31	19	30	6	31
2016	7	31	26	29	31	31	30	30	30	31	23	30	2	31	0	31	1	30	21	31	24	30	24	31
2017	16	31	28	28	31	31	30	30	31	31	24	30	3	31	0	31	15	30	25	31	19	30	9	31
2018	17	31	27	28	30	31	30	30	31	31	22	30	2	31	0	31	17	30	31	31	26	30	9	31

Table 15: Number of observations with maximum temperature >35°C

YEAR	Jan	N	Feb	N	Mar	N	Apr	N	May	N	Jun	N	Jul	N	Aug	N	Sep	N	Oct	N	Nov	N	Dec	N
1999	0	31	1	28	21	31	26	30	15	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2000	0	31	0	29	16	31	30	30	9	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2001	0	31	6	28	11	31	27	30	21	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2002	0	31	0	9	22	31	28	30	16	31	5	30	0	31	0	31	0	30	5	31	0	30	0	31
2003	0	31	8	28	28	31	27	30	31	31	11	30	0	31	0	31	0	30	1	31	0	30	0	31
2004	1	31	8	29	31	31	30	30	21	31	3	30	0	31	0	31	0	20	0	31	0	30	0	31
2005	0	31	5	28	18	31	28	30	30	31	12	30	0	31	0	31	0	30	1	31	0	30	0	31
2006	0	31	12	28	16	31	30	30	28	31	1	30	0	31	0	31	0	30	0	31	0	30	0	31
2007	0	31	1	28	17	31	30	30	27	31	9	30	0	31	0	31	0	30	0	31	0	30	0	31
2008	0	31	0	11	22	31	22	30	31	31	4	30	0	31	0	31	0	30	0	31	0	30	0	31
2009	1	31	7	28	27	31	29	30	28	31	13	30	1	31	0	31	0	30	0	31	0	30	0	31
2010	0	31	8	28	28	31	30	30	31	31	5	30	0	31	0	31	0	30	0	31	0	30	0	31
2011	1	31	0	28	6	13	29	30	31	31	3	30	4	31	4	31	3	30	4	31	3	30	4	31
2012	4	12	3	12	3	12	3	12	4	12	3	12	3	12	3	12	2	12	2	31	2	30	3	31
2013	0	2	0	2	28	31	28	30	14	16	3	30	0	2	0	2	0	30	0	31	0	30	0	31
2014	0	31	0	28	18	31	30	30	30	31	14	30	0	31	0	31	0	30	0	31	0	30	0	31
2015	0	31	2	28	10	31	26	30	30	31	7	30	0	31	0	31	0	30	0	31	2	30	0	31
2016	0	31	6	29	21	31	30	30	30	31	10	30	0	31	0	31	0	30	0	31	0	30	0	31
2017	0	31	10	28	25	31	30	30	30	31	6	30	0	31	0	31	0	30	0	31	0	30	0	31
2018	0	31	4	28	27	31	30	30	31	31	4	30	0	31	0	31	0	30	3	31	0	30	0	31

Table 16: Number of observations with maximum temperature >40°C

YEAR	Jan	N	Feb	N	Mar	N	Apr	N	May	N	Jun	N	Jul	N	Aug	N	Sep	N	Oct	N	Nov	N	Dec	N
1999	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2000	0	31	0	29	0	31	0	30	1	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2001	0	31	0	28	0	31	1	30	3	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2002	0	31	0	9	0	31	3	30	6	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2003	0	31	0	28	0	31	4	30	4	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2004	0	31	0	29	3	31	3	30	2	31	0	30	0	31	0	31	0	20	0	31	0	30	0	31
2005	0	31	0	28	1	31	1	30	3	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2006	0	31	0	28	0	31	0	30	5	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2007	0	31	0	28	0	31	3	30	4	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2008	0	31	0	11	0	31	5	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2009	0	31	0	28	0	31	4	30	2	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2010	0	31	0	28	0	31	9	30	3	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2011	0	31	0	28	0	13	1	30	1	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2012	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	31	0	30	0	31
2013	0	2	0	2	0	31	4	30	3	16	0	30	0	2	0	2	0	30	0	31	0	30	0	31
2014	0	31	0	28	0	31	3	30	3	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2015	0	31	0	28	0	31	2	30	8	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2016	0	31	0	29	0	31	17	30	10	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2017	0	31	0	28	6	31	15	30	12	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2018	0	31	0	28	0	31	6	30	8	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31

Table 17: Number of observations with rainfall>50mm

YEAR	Jan	N	Feb	N	Mar	N	Apr	N	May	N	Jun	N	Jul	N	Aug	N	Sep	N	Oct	N	Nov	N	Dec	N
1999	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2000	0	31	0	29	0	31	0	30	0	31	0	30	0	31	0	31	1	30	0	31	0	30	0	31
2001	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2002	0	31	0	9	0	31	0	30	0	31	2	30	0	31	0	31	0	30	0	31	0	30	0	31
2003	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2004	0	31	0	29	0	31	0	30	0	31	1	30	0	31	3	31	0	20	0	31	0	30	0	31
2005	0	31	0	28	0	31	0	30	0	31	2	30	3	31	2	31	1	30	0	31	0	30	0	31
2006	0	31	0	28	0	31	0	30	0	31	0	30	2	31	3	31	1	30	0	31	0	30	0	31
2007	0	31	0	28	0	31	0	30	0	31	1	30	2	31	0	31	1	30	0	31	0	30	0	31
2008	0	31	0	11	0	31	0	30	0	31	0	30	0	31	1	31	1	30	0	31	0	30	0	31
2009	0	31	0	28	0	31	0	30	0	31	0	30	1	31	1	31	0	30	0	31	3	30	0	31
2010	0	31	0	28	0	31	0	30	0	31	2	30	2	31	1	31	1	30	1	31	0	30	0	31
2011	0	31	0	28	0	13	0	30	0	31	1	30	1	31	1	31	1	30	1	31	1	30	1	31
2012	1	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	31	0	30	0	31
2013	0	2	0	2	0	31	0	30	0	16	2	30	0	2	0	2	1	30	0	31	0	30	0	31
2014	0	31	0	28	0	31	0	30	0	31	0	30	2	31	2	31	0	30	0	31	0	30	0	31
2015	0	31	0	28	0	31	0	30	1	31	2	30	0	31	0	31	1	30	0	31	1	30	0	31
2016	0	31	0	29	0	31	0	30	0	31	0	30	1	31	2	31	0	30	0	31	0	30	0	31
2017	0	31	0	28	0	31	0	30	0	31	0	30	0	31	1	31	0	30	0	31	0	30	0	31
2018	0	31	0	28	0	31	0	30	0	31	1	30	0	31	0	31	0	30	0	31	0	30	0	31

Table 18: Number of observations with rainfall >100mm

YEAR	Jan	N	Feb	N	Mar	N	Apr	N	May	N	Jun	N	Jul	N	Aug	N	Sep	N	Oct	N	Nov	N	Dec	N
1999	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2000	0	31	0	29	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2001	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2002	0	31	0	9	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2003	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2004	0	31	0	29	0	31	0	30	0	31	0	30	0	31	0	31	0	20	0	31	0	30	0	31
2005	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2006	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2007	0	31	0	28	0	31	0	30	0	31	1	30	1	31	0	31	0	30	0	31	0	30	0	31
2008	0	31	0	11	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2009	0	31	0	28	0	31	0	30	0	31	0	30	1	31	0	31	0	30	0	31	1	30	0	31
2010	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	1	31	0	30	0	31
2011	0	31	0	28	0	13	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2012	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	31	0	30	0	31
2013	0	2	0	2	0	31	0	30	0	16	0	30	0	2	0	2	0	30	0	31	0	30	0	31
2014	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2015	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2016	0	31	0	29	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2017	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2018	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31

Table 19: Number of observations with rainfall >150mm

YEAR	Jan	N	Feb	N	Mar	N	Apr	N	May	N	Jun	N	Jul	N	Aug	N	Sep	N	Oct	N	Nov	N	Dec	N
1999	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2000	0	31	0	29	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2001	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2002	0	31	0	9	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2003	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2004	0	31	0	29	0	31	0	30	0	31	0	30	0	31	0	31	0	20	0	31	0	30	0	31
2005	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2006	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2007	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2008	0	31	0	11	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2009	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2010	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	1	31	0	30	0	31
2011	0	31	0	28	0	13	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2012	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	31	0	30	0	31
2013	0	2	0	2	0	31	0	30	0	16	0	30	0	2	0	2	0	30	0	31	0	30	0	31
2014	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2015	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2016	0	31	0	29	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2017	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31
2018	0	31	0	28	0	31	0	30	0	31	0	30	0	31	0	31	0	30	0	31	0	30	0	31

Appendix -Ib

Climatological Graphs

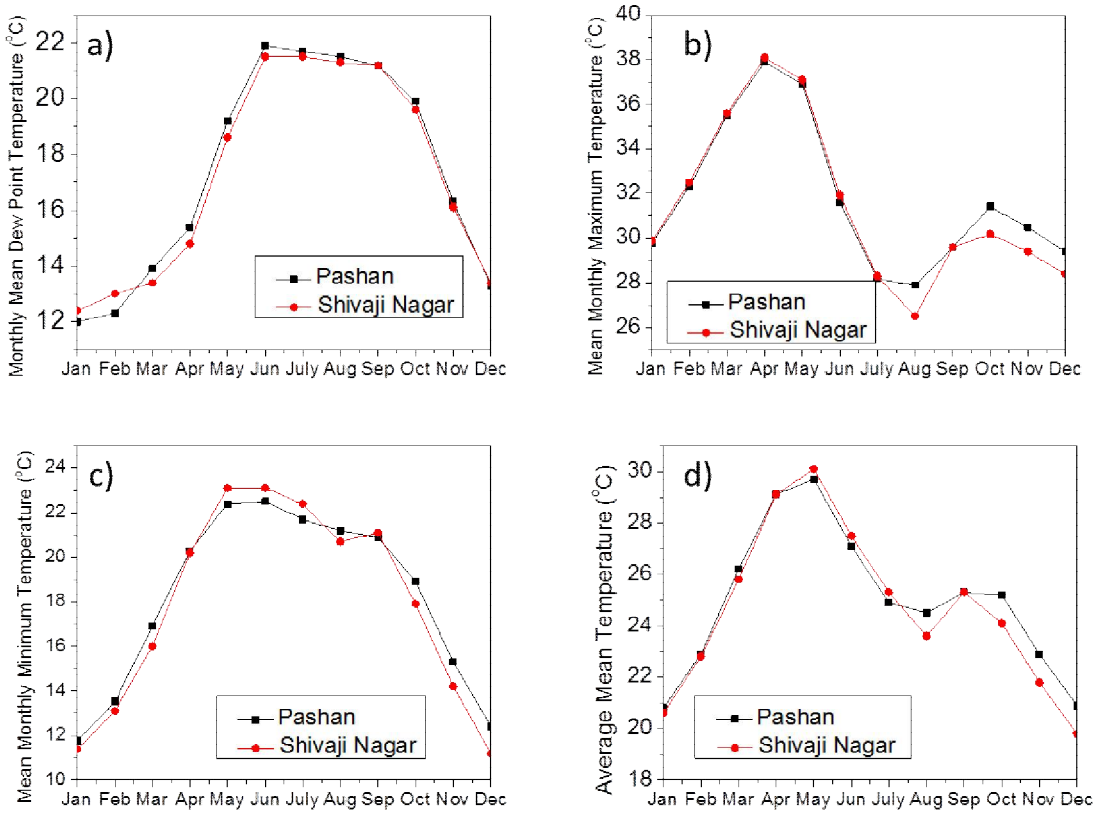

Figure 1. Climatology a) Mean Monthly Dew Point Temperature (^{o}C) b)Mean Monthly Maximum Temperature (^{o}C), c) Mean Monthly Minimum Temperature(^{o}C) , d) Average Mean Temperature (^{o}C)

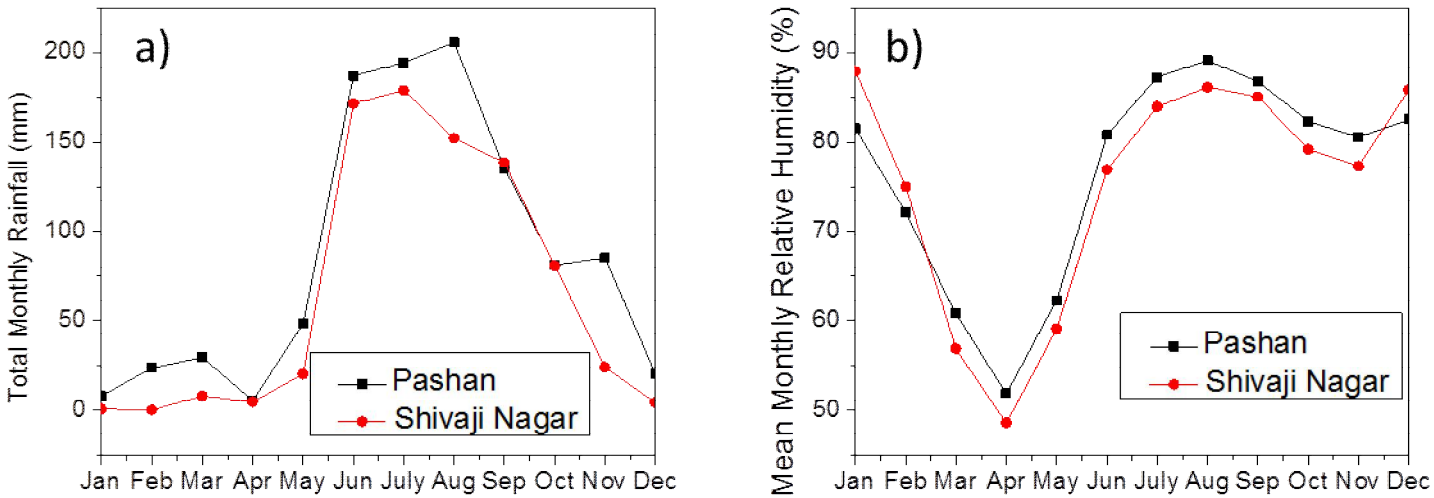

Figure 2. Climatology a) Total Monthly Rainfall (mm) b) Mean monthly Relative Humidity (%)

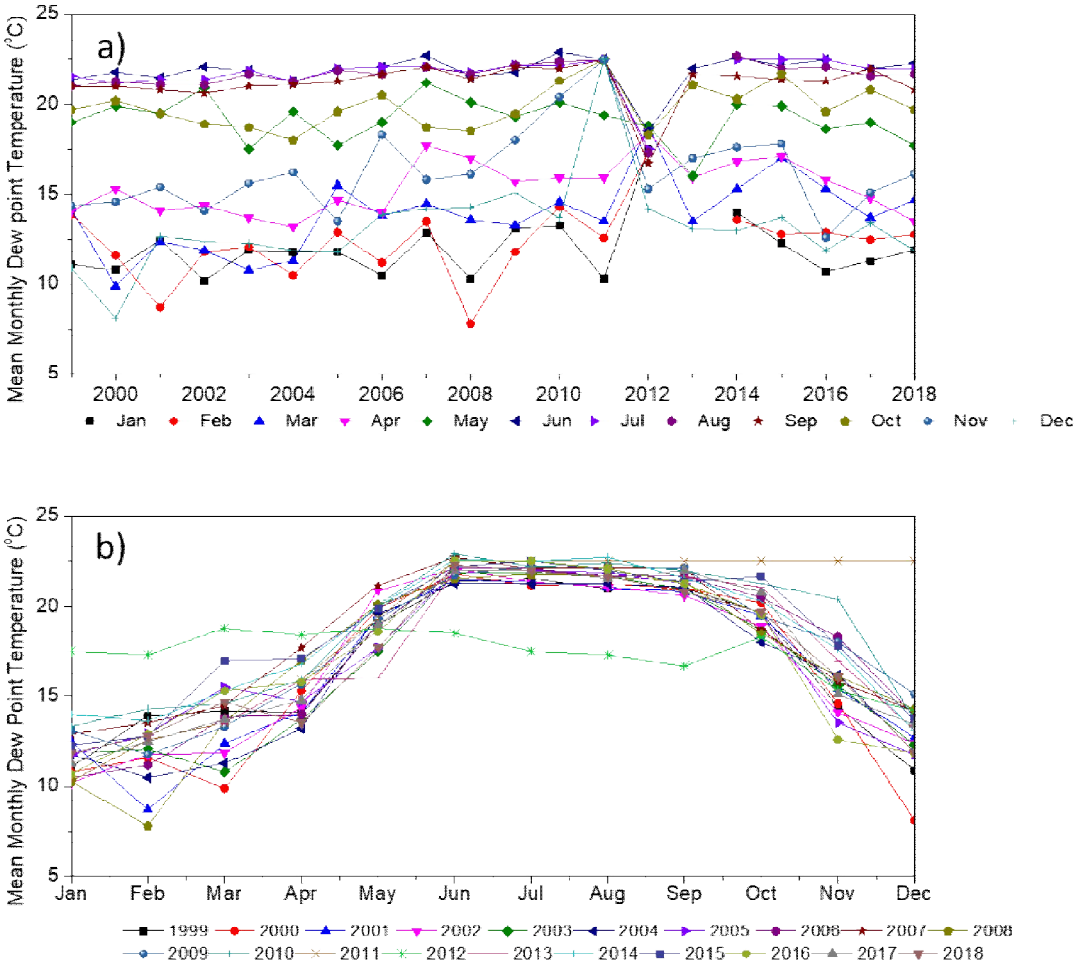

Figure 3. Mean Monthly Dew Point Temperature (°C)

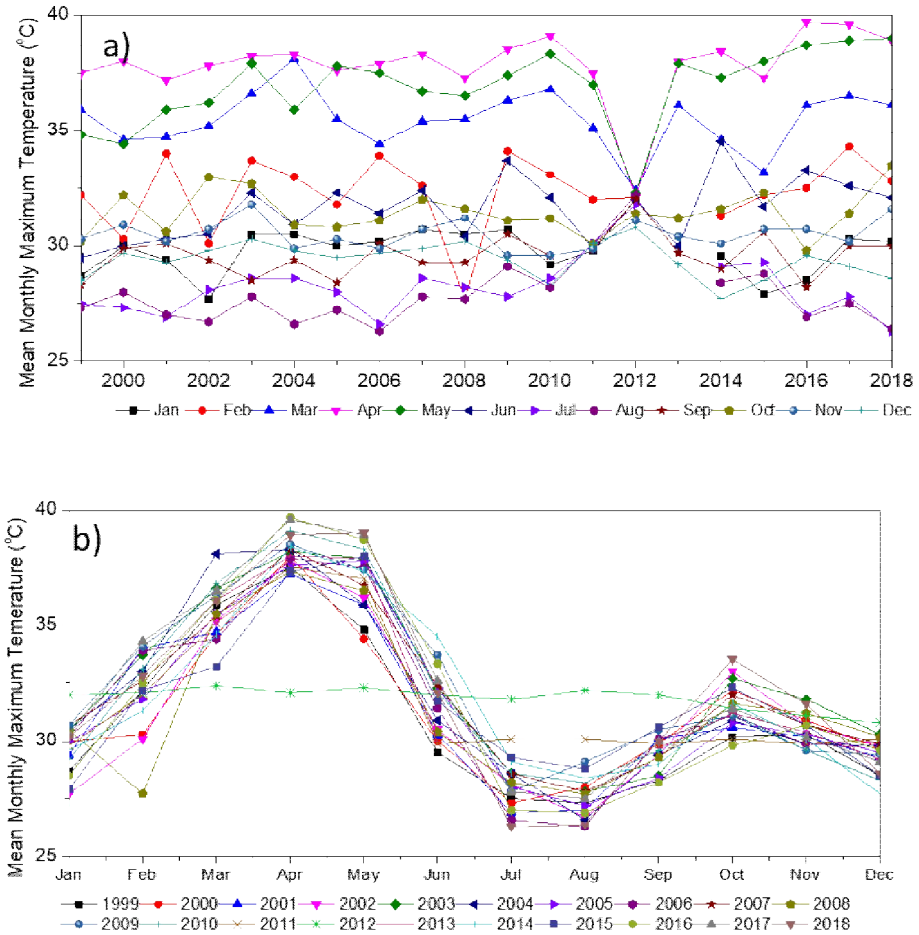

Figure 4. Mean Monthly Maximum Temperature (°C)

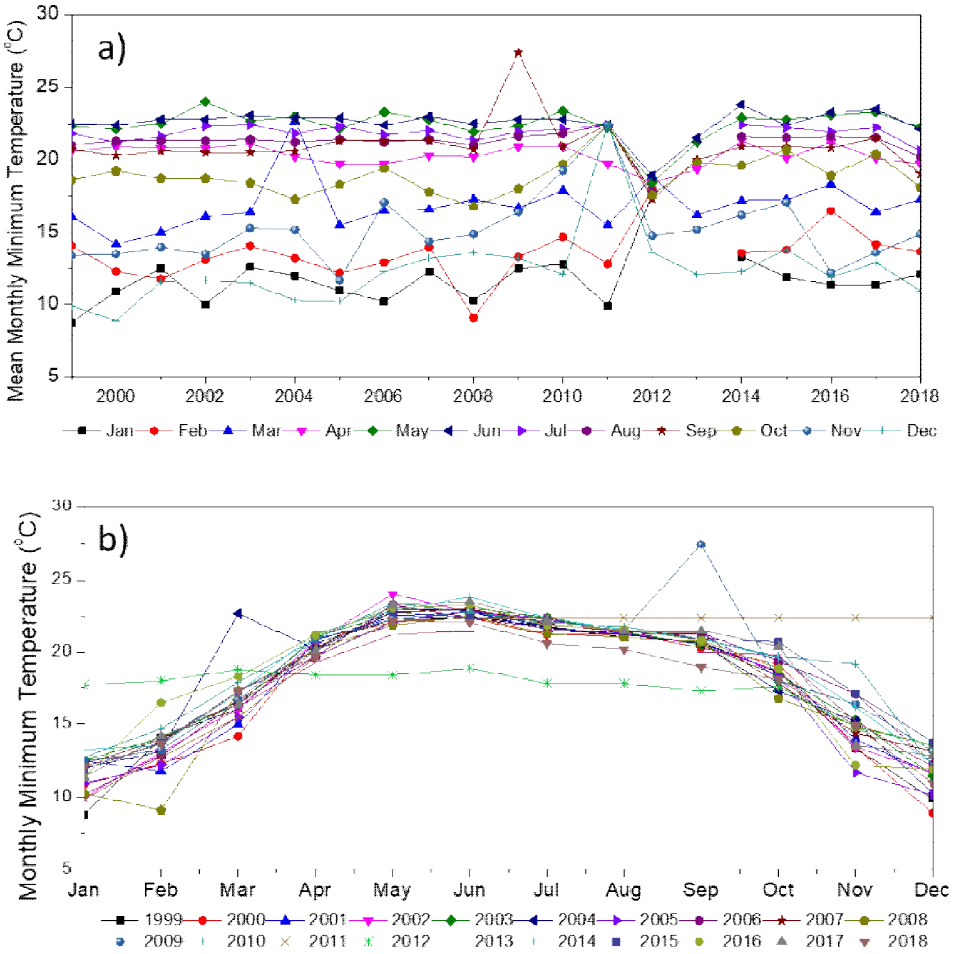

Figure 5. Mean Monthly Minimum Temperature (°C)

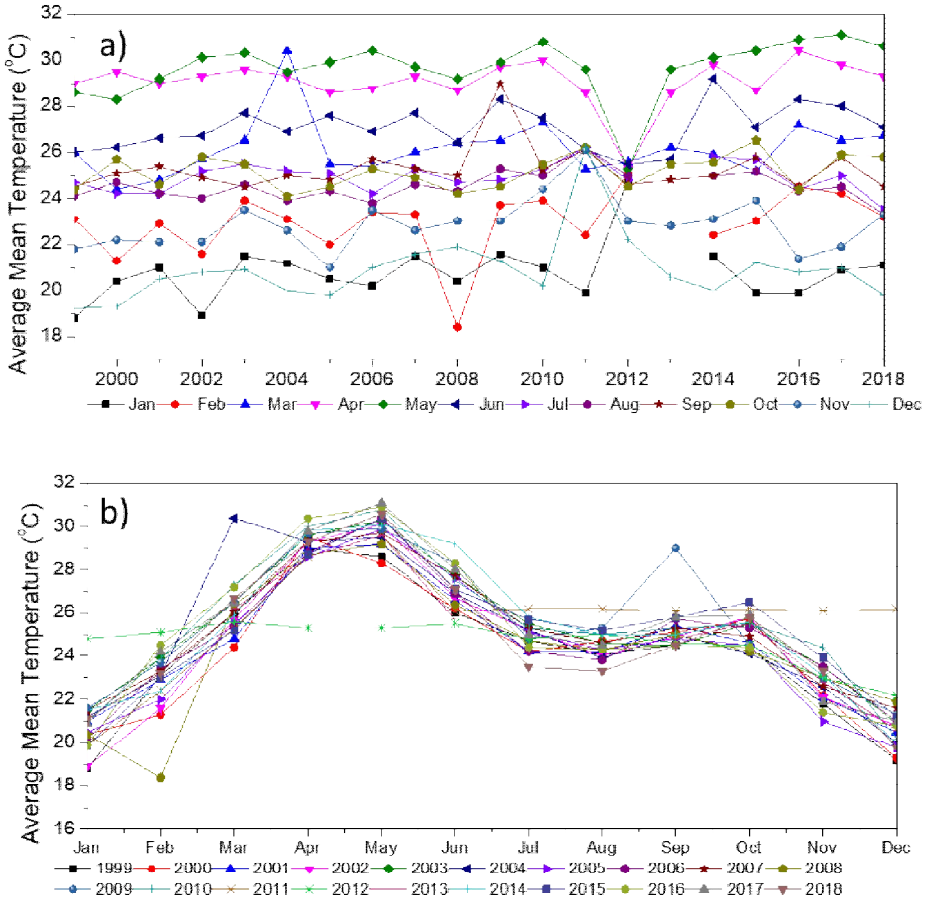

Figure 6. Average Mean Temperature (°C)

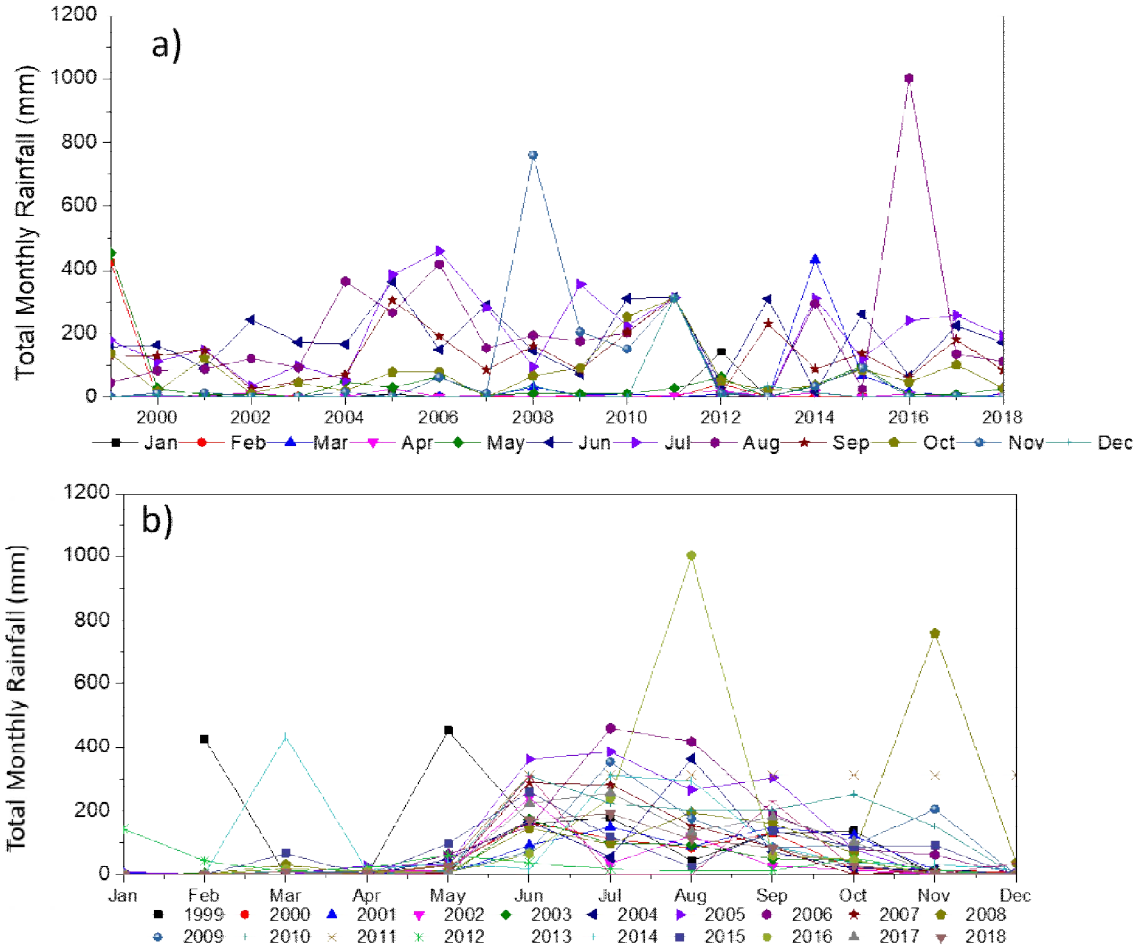

Figure 7. Total Monthly Rainfall (mm)

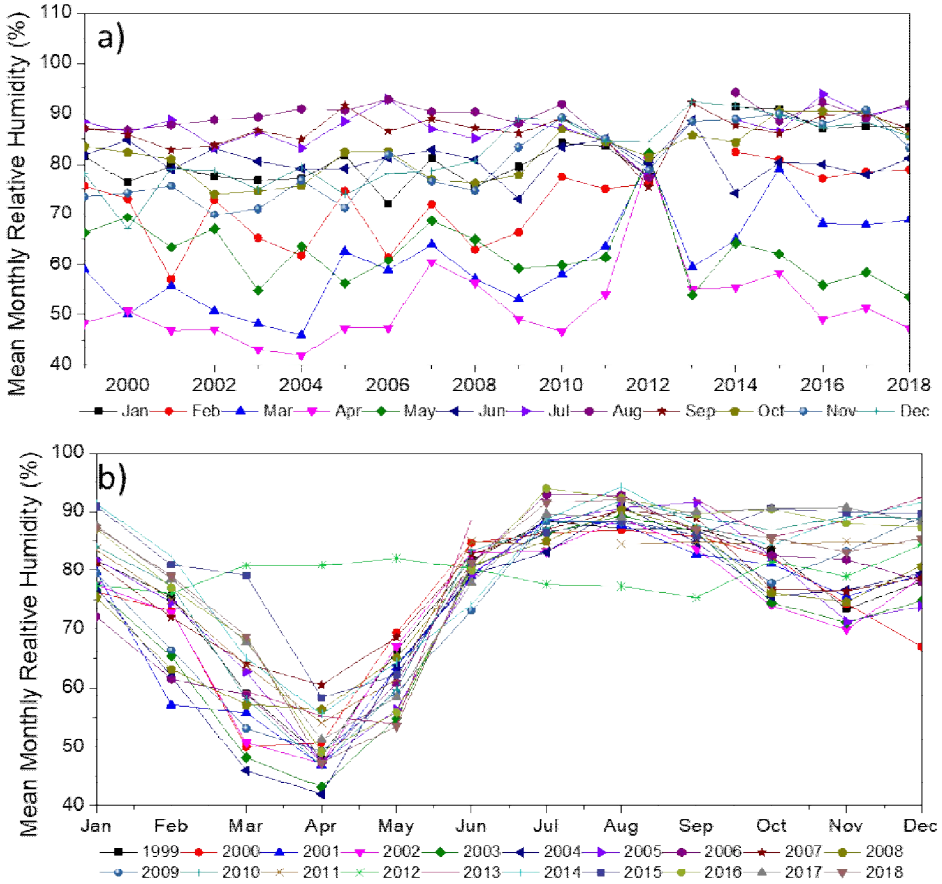

Figure 8. Mean Monthly Relative Humidity (%)

References

1. **WMO Guidelines on the Calculation of Climate Normals, 2017 Edition**
2. **Climatological Normals 1961 – 1990 and 1981 – 2010 Issued by Office of the Additional Director General of Meteorology (Research) India Meteorological Department Pune**

Acknowledgements

Authors would like to acknowledged DGM (IMD), Head CRS (Pune) and Head MTI (Pune) for support and encouragement. Authors are thankful to reviewers for all the helpful comments to improve this report.