Climate of Ahmedabad

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Preface

The meteorological observatory Ahmedabad was established on 18th January 1893. Ahmedabad observatory is recognized as a long term observing station by the World Meteorological Organization in September 2020 for more than 100 years of meteorological observations. In this report prepared by Meteorological Centre, Ahmedabad, the climatology of rainfall, temperature, wind and thunderstorm is described on the basis of 10 years data (2010 to 2019). The analysis has been done for four seasons and year as a whole. In each season the daily average of maximum and minimum temperatures, extreme maximum and minimum temperatures, daily average rainfall, monthly rainfall and thunderstorm and other weather phenomenon are analysed and discussed. The probabilities of weather phenomenon like rainfall occurrence and temperatures below or beyond any values are also analyzed. The highest rainfall in a day (24 hours cumulative) for each month is also presented. I congratulate Meteorological Centre, Ahmedabad for bringing out this report.

1. January 2022

Mrutyunjay Mohapatra
Director General of Meteorology

CONTENT

Geographical Location of Ahmedabad:

Ahmedabad is the largest city in the state of Gujarat located between latitude 23.02°N, longitude 72.35°E and latitude 23.03° N, longitude 72.58° E in western India at an elevation of 54.9 meters asl (180 ft.) on the banks of the River Sabarmati. It spans an area of 475 km^2. The city is almost flat except for the small hills of Thaltej- Jodpur Tekra. Two lakes situated within the city's limits are Kankaria Lake and Vastrapur Lake. Kankaria Lake is situated in the neighborhood of Mani Nagar, an artificial lake developed by the Sultan of Delhi, Qutb- ud-din Aybak, in 1451. According to the Bureau of Indian standards, the town falls under seismic zone-3, in the scale of I to V (in order of increasing vulnerability to earth quakes).

Ahmedabad is divided by the Sabarmati river into two physical distinct eastern and western regions. Ahmedabad, the city of Ahmed shah (Medieval ruler of Gujarat), is known for its rich past and its association with Mahatma Gandhi. Ahmedabad city offers the traveler a unique style of architecture, which is a blend of Hindu and Islamic styles (Indo-Saracenic style of architecture). Ahmedabad has also been famous for its textile mills and was often referred to as the "Manchester of the East".

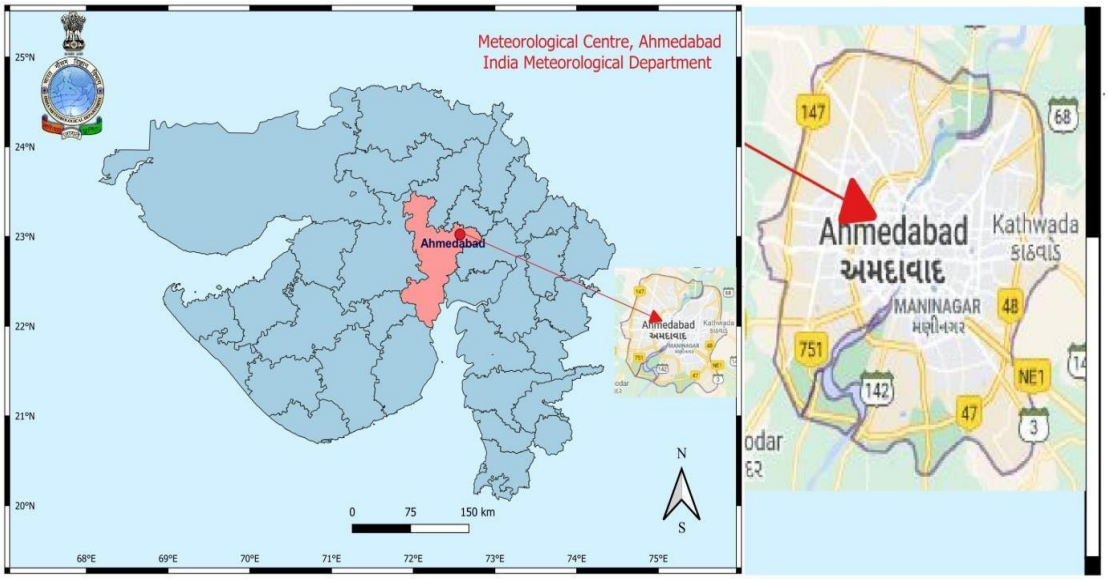


Figure-1 City map of Ahmedabad

Ahmedabad blends harmoniously an ancient heritage with a vibrant present. The city's prosperous and eventful past and present is embodied in its rich kaleidoscope of history, art and culture, rich architecture and imposing monuments. Besides the traditional Navratri and Rath Yatra, Ahmedabad hosts the contemporary international kite festival. The city of Ahmedabad is easily accessible from the other important cities of India besides the other cities of Gujarat.

Ahmedabad has been selected as one of the hundred Indian cities to be developed as a smart city under Government of India's flagship Smart Cities Mission. In July 2017, the Historic City of Ahmedabad or Old Ahmedabad was declared as India's first UNESCO World Heritage City. Morning heritage walk of Ahmedabad is given figure2.

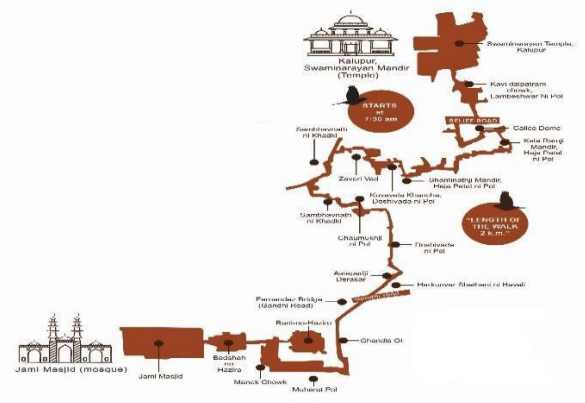


Figure 2 Heritage walk of Ahmedabad(image courtesy https:// ahmedabadcity.gov.in / portal/ jsp/Static_pages/ heritage_walk.jsp)

The meteorological Observatory, Ahmedabad was established on 18th January 1893 and the meteorological centre, Ahmedabad was established in October 1974. It had a few units at the time of establishment but with time, the activities and responsibilities of Meteorological centre Ahmedabad has increased in all fields/sectors, for rendering the meteorological services(weather forecast and warnings) to the general public of the state of Gujarat, and union territory of Diu, Daman, Dadra Nagar Haveli and the concerned departments of central and state government like Agriculture, Irrigation, Power, Aviation, Flood control, Relief and Rehabilitation, Roadways and Railways, Health, Disaster Managers etc.

General Climatology Of Ahmedabad:

To study the climatology of Ahmedabad, data of various meteorological parameters have been used of 10 years i.e. from 2010 to 2019. The climate of Ahmedabad is hot and semiarid, with annual normal rain fall 824 mm (2010-2019), which is marginally less than that required for savanna climate. The climate is extremely dry except for the monsoon months. The weather is hot and extremely dry during the month of March to June (Figure 3). The average summer maximum is 39˚C and average minimum is 24˚C (from 2010 to 2019). It was 41˚ C and 27˚ C respectively reported in the climatology of Ahmedabad based on the data from 1971 to 2010. Average maximum temperature from November to February is 30˚ C and average minimum is 15˚C (from 2010 to 2019). Highest average rainfall was during the month of July followed by August, September, June and October (Figure 3).

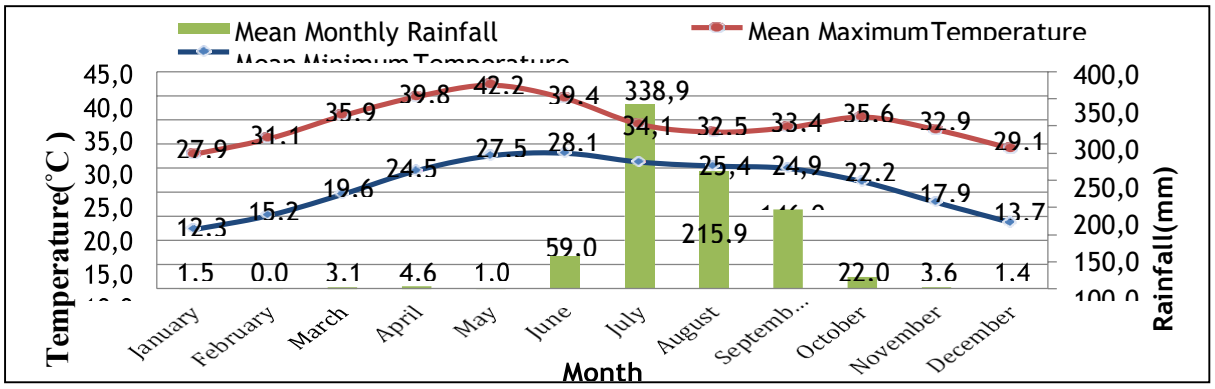


Figure 3. Monthly normal Maximum and Minimum temperature and average rainfall

Winter Season

The winter season in Ahmedabad starts in the month of December and lasts up to February. Uttarayan is a festival of kites celebrated all over Gujarat on 14th January. Wind and temperature are two parameters which are important on this day because of the kites flying.

Figure 4. Kite Festival on 14th January

TEMPERATURE

The daily normal maximum and minimum temperatures for the season are given in figure 5. The maximum temperature gradually fall throughout the month December, it fall from about 31˚C in the beginning of the month around 27˚C toward the end of month and remain around 27˚C till the 3rd week of the January then start rising till the end of the season. At end of the season it's about 34˚C i.e. at the end of the February.

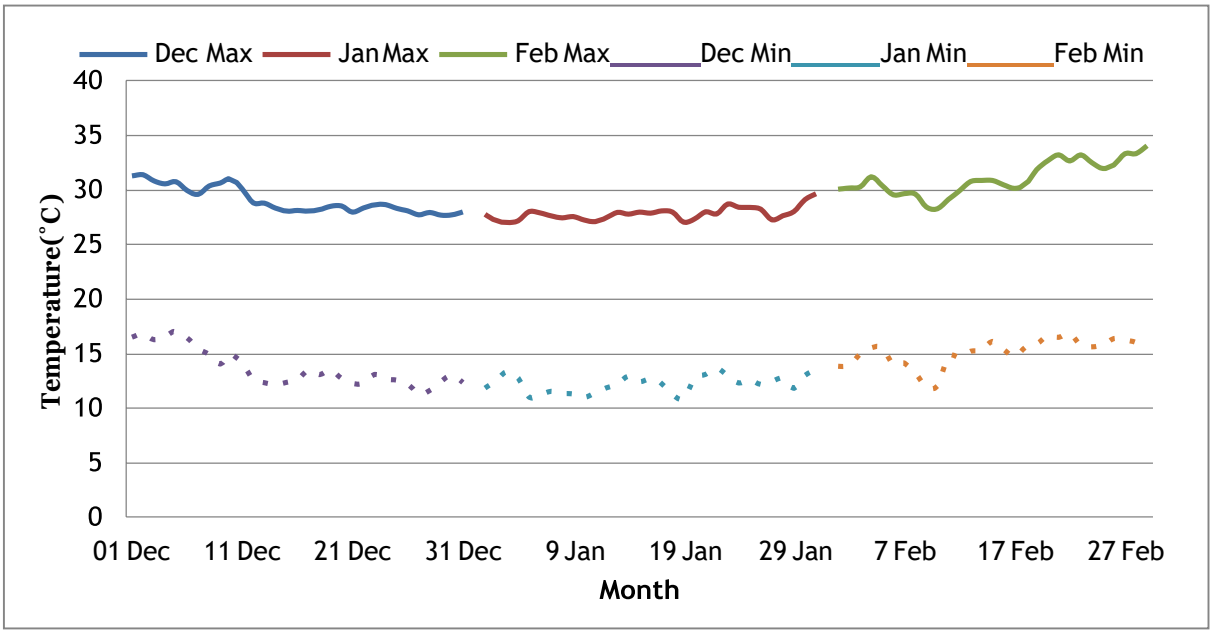


Figure 5. Normal Maximum and Minimum Temperatures for Winter Season

The minimum temperatures also have the same characteristics from the beginning of the season till the end of the season. In the beginning of the month December, it starts falling

from 16˚C to 12˚C at the end of the month and remains around the same up to the 3rd week of January then start rising till the end of the season up to 16 ˚C i.e. at the end of February though there is marginal fluctuations.

EXTREME TEMPERATURES

The highest and lowest maximum temperatures recorded during the winter season (2010- 2019) are shown in the figure 6. The highest maximum temperature in the month of December range around 30˚C to 36˚C during most of the year(2010-2019) it is 29˚C to 35˚C and 34˚C to 38˚ C during January and February respectively(2010-2019).

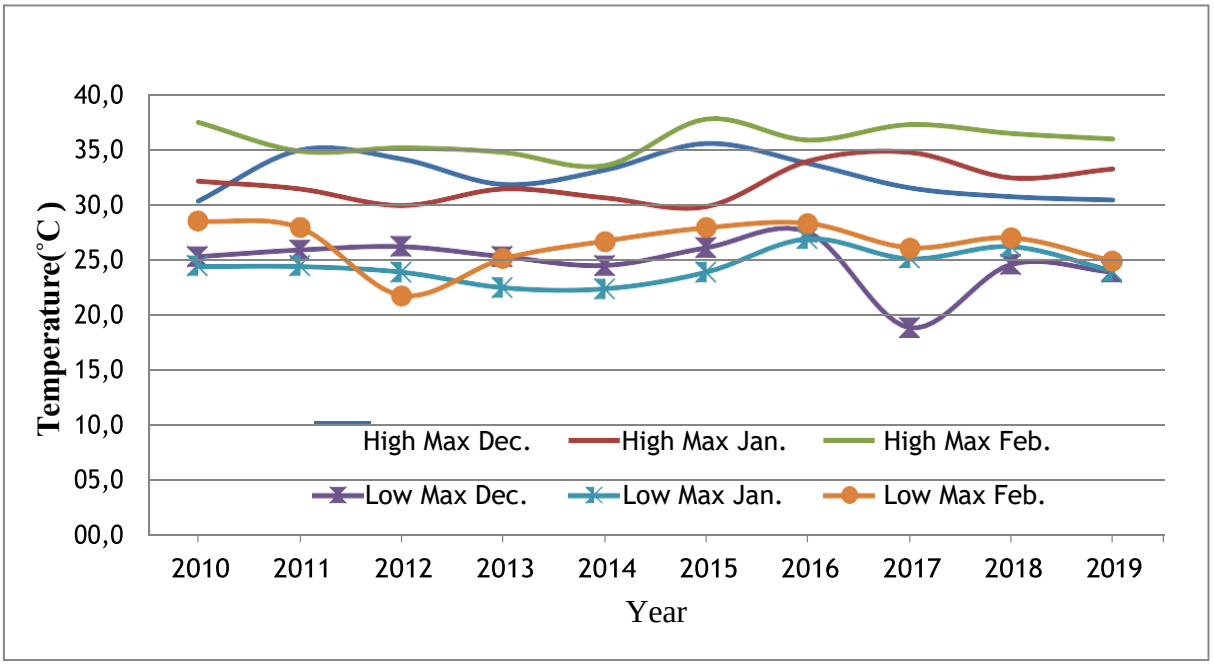


Figure 6. Highest and Lowest Maximum Temperatures during Winter Season

The highest maximum temperatures recorded during the period are 35.6˚C, 34.8˚C and 37.8˚C on 31st December 2015, 25th January 2017 and 24th February 2015.

Lowest maximum temperatures recorded during the period are 19.0˚C, 22.5 ˚C, 21.9 ˚C on 7th December 2017, 12thJanuary 2014 and 9th February 2012 respectively. Highest and lowest maximum temperatures are shown in the below table 1.

	2010-2019	
Highest Maximum	35.6˚C	31-Dec-2015
	34.8˚C	25-Jan-2017
	37.8˚C	24-Feb-2015
Lowest Maximum	19˚C	07-Dec-2017
	22.5˚C	12-Jan-2014
	21.9˚C	09-Feb-2012

Table 1. Highest and Lowest Maximum Temperatures.

The range of lowest minimum temperatures recorded in month of December is 7˚C to 12˚C, 6˚C to 11˚C in January and 5˚C to 13˚C in February (2010-2019). The lowest minimum temperatures recorded during the period are 7.4˚C on 15th December 2014, 6.6˚C on 17th January 2011 and 5.2˚C on 9th February 2012.

Lowest minimum temperatures recorded 3.6˚C on 27th December 1983, 3.3˚C on 10th January 1954 and 2.2˚C on 6th February 1920 are all time lowest minimum temperatures till date. The variation of minimum temperature during 2010 to 2019 are shown in the below figure 7. The highest and lowest minimum temperatures are also shown in the following table 2.

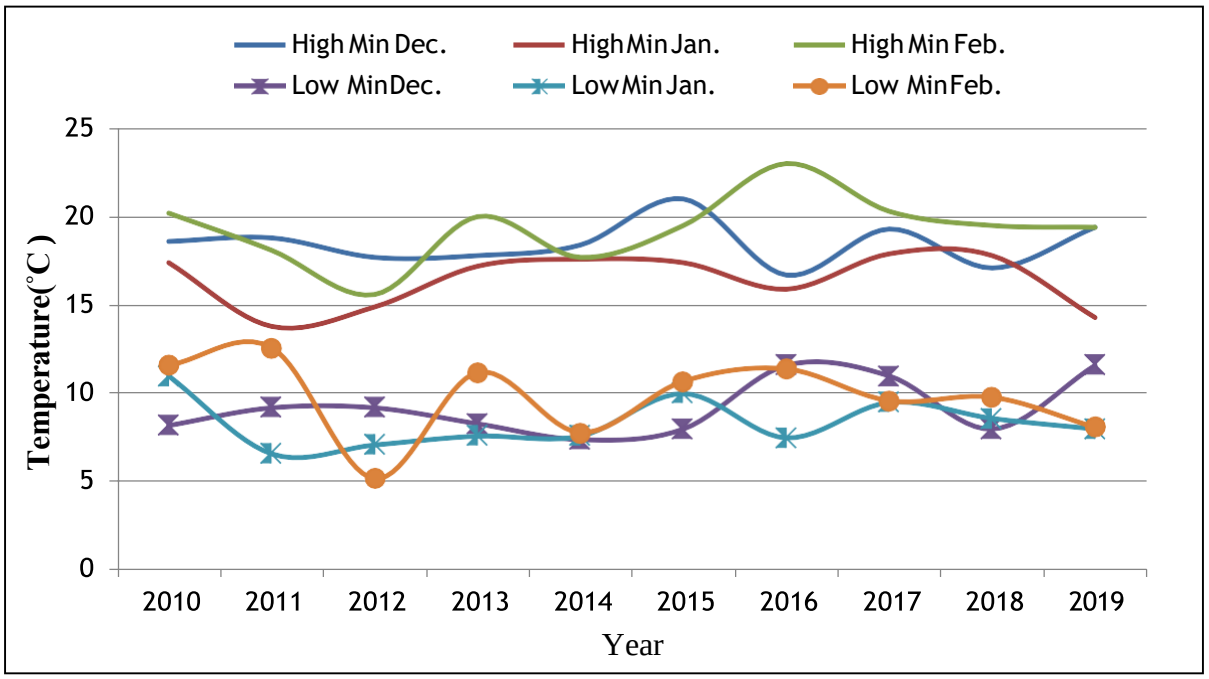


Figure 7. Highest and Lowest Minimum Temperatures during Winter Season

	2010-2019	
Highest minimum	21˚C	10-Dec-2015
	18˚C	26-Jan-2017
	23˚C	20-Feb-2016
Lowest minimum	7.4˚C	15-Dec-2014
	6.6˚C	17-Jan-2011
	5.2˚C	09-Feb-2012

Table 2. Highest and Lowest Minimum Temperatures till 2019.

The probability of the event is calculated by using of the number of days on which event occurs to the total number of days. The probability of Minimum Temperatures to fall below 05˚C and 10˚C is given in figure 8. The probability of Minimum Temperatures to fall below 05˚C is Zero throughout the winter season (from 2010 to 2019). The probability of temperatures to fall below 10˚C is zero in the first week of December then it start rising steadily to reach around 30% by the end of December and remain same around 30% till the first week of February and then again starts falling to reach zero by February end.

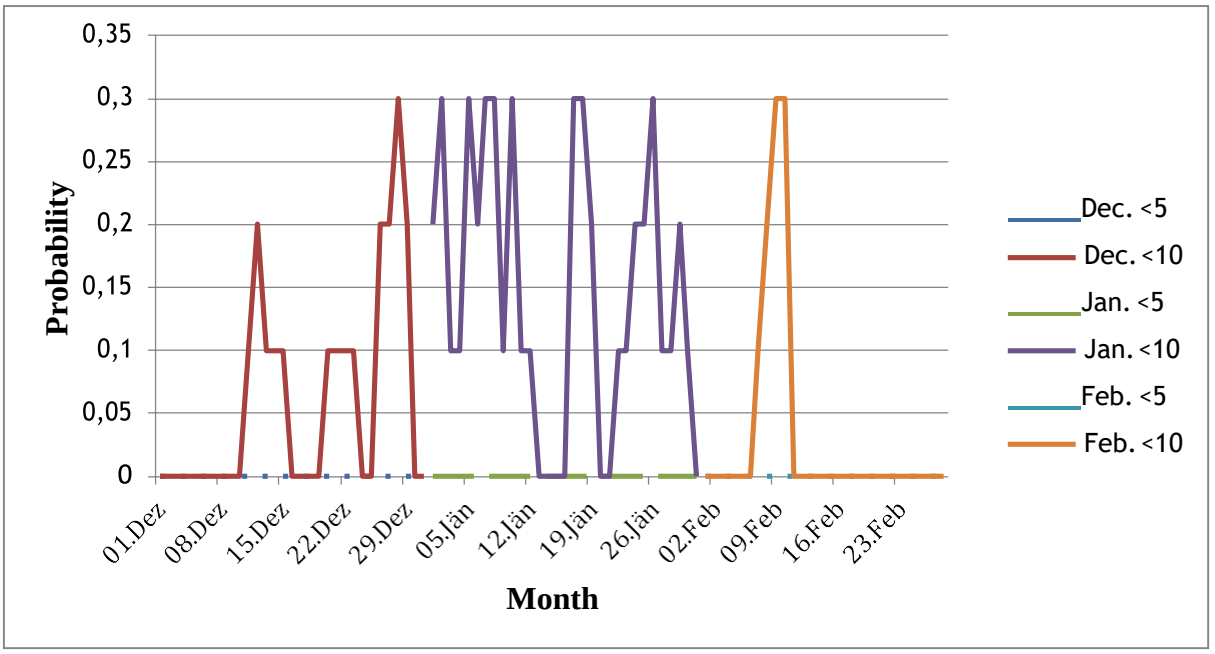


Figure 8. Probability of Minimum Temperatures to fall below 05˚C and 10˚C during the Winter Season.

RAINFALL

Winter is not rainy season for Ahmedabad. The average rainfall for winter season(December to February) is shown in figure 9 below. The Mean monthly rainfall during December, January and February is 1.4mm, 1.5mm 0mm respectively for the period of 2010 to 2019.

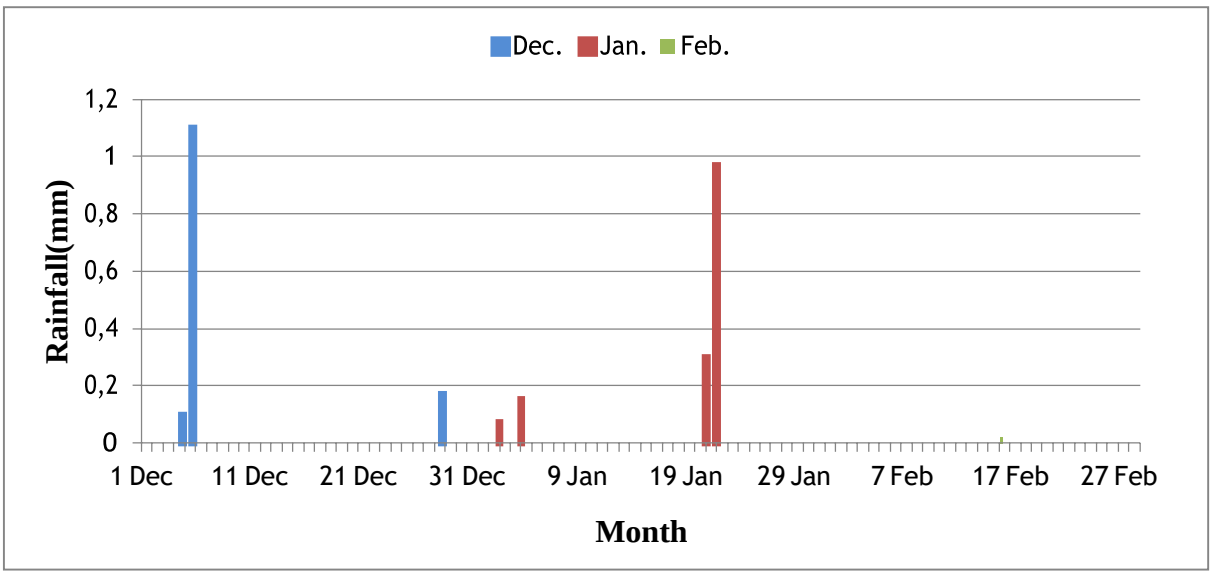


Figure 9. Daily Normal Rainfall for winter season

The probability of rainfall is almost zero for the whole season except for a few incidences during 2010 to 2019. The graph for the daily probability of rainfall is shown below in figure 10.

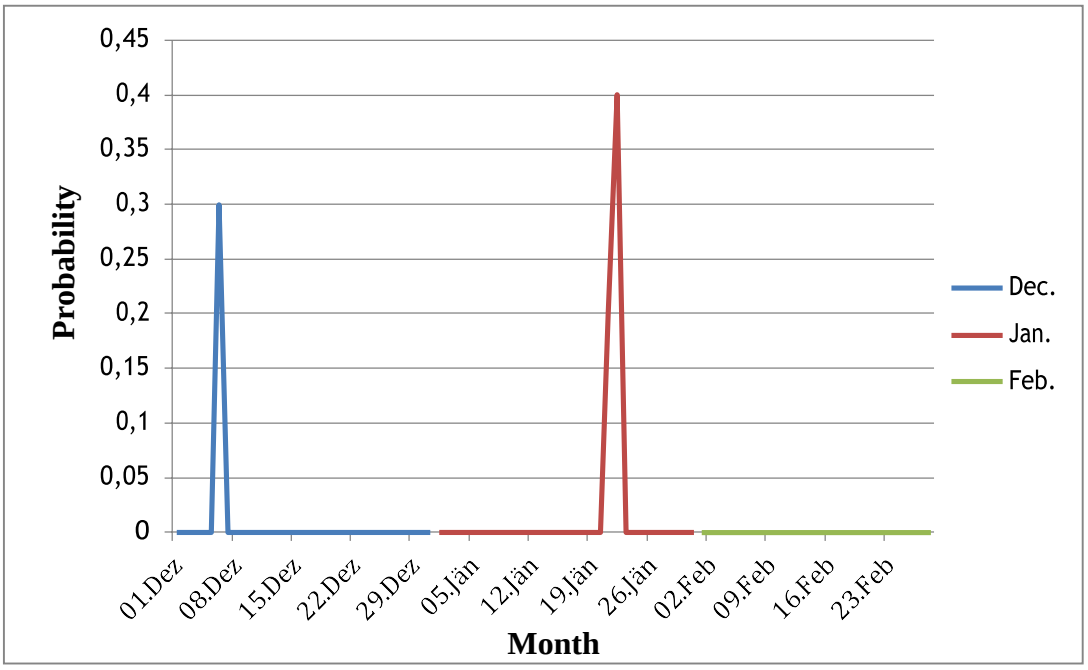


Figure 10. Daily Probability of Rainfall during winter season

HIGHEST RAINS

Generally heavy rains does not occur during winter season. The intensity of rainfall decreases as the season proceeds. Highest daily rainfall recorded during the period of 2010 to 2019 was 11mm on the 6th December 2017, 6.9mm on 22nd January 2015 and 0.2 mm 16th February 2013. It is also to be mentioned that there is no heavy rainfall events during winter.

Daily highest ever rainfall recorded till 2019 are 29.4mm on 05th December 1990, 30.7 mm on 19th January 1948 and 26.4mm on 03rd February 1917 which is shown in figure 11 and table 3.

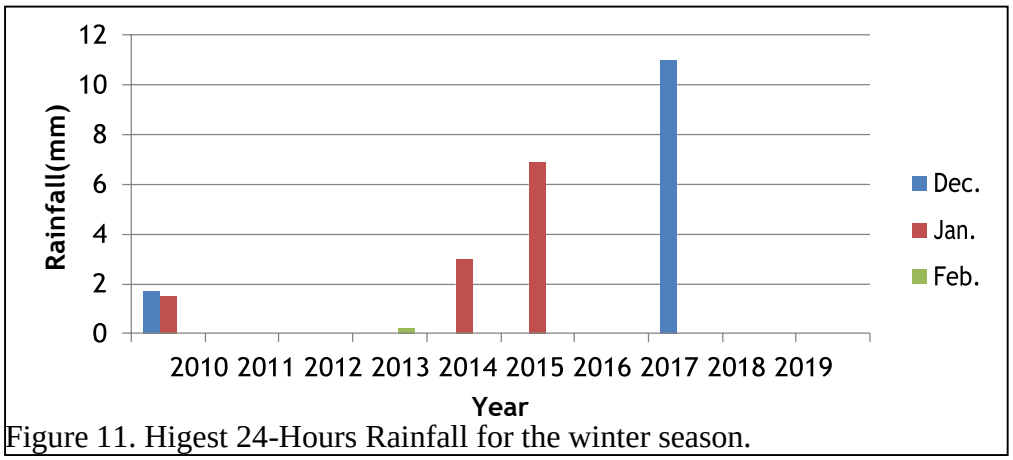


Figure 11. Higest 24-Hours Rainfall for the winter season.

	2010-2019		Extreme up to 2019	
Highest rains	11mm	06-Dec-2017	29.4mm	05-Dec-1990
	6.9mm	22-Jan-2015	30.7mm	19-Jan-1948
	0.2mm	16-Feb-2013	26.4mm	03-Feb-1917

Table 3. Highest 24-Hours rainfall for winter season.

Monthly total rainfall during 2010 to 2019 are shown in figure 12 below. The highest monthly total rainfall is 12mm for December 2017, 7.6mm for January 2015 and 0.2mm for February 2013.monthly highest rainfall up to 2019 is 31.2mm in December 1980, 57.4mm in January 1948 and 31.2mm in February 1917.

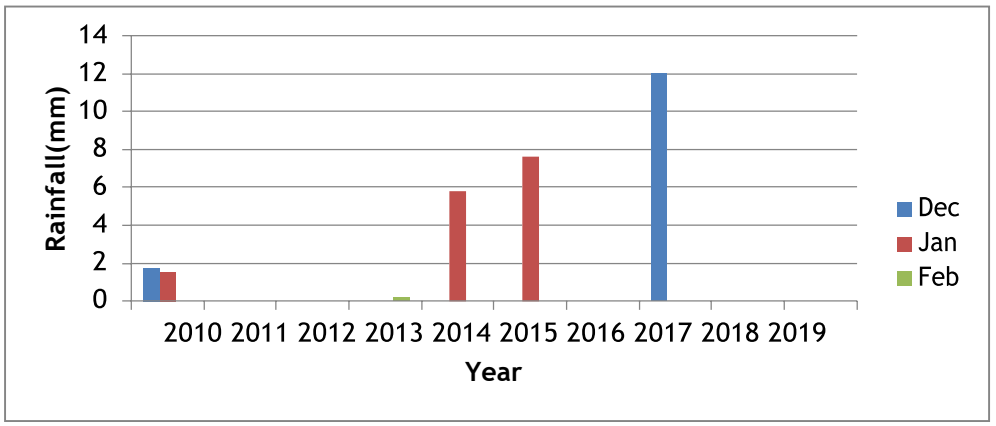


Figure 12. Monthly total Rainfall for Winter season.

THUNDESTORM AND OTHER WEATHER PHENOMENA

Thunderstorm activity is not very high during the season with an average of only 0.1 days of thunderstorm in December and January and 0.2 days for the month of February. Diurnal variation of Thunderstorms for the data 2010 to 2019 is shown in figure 13.

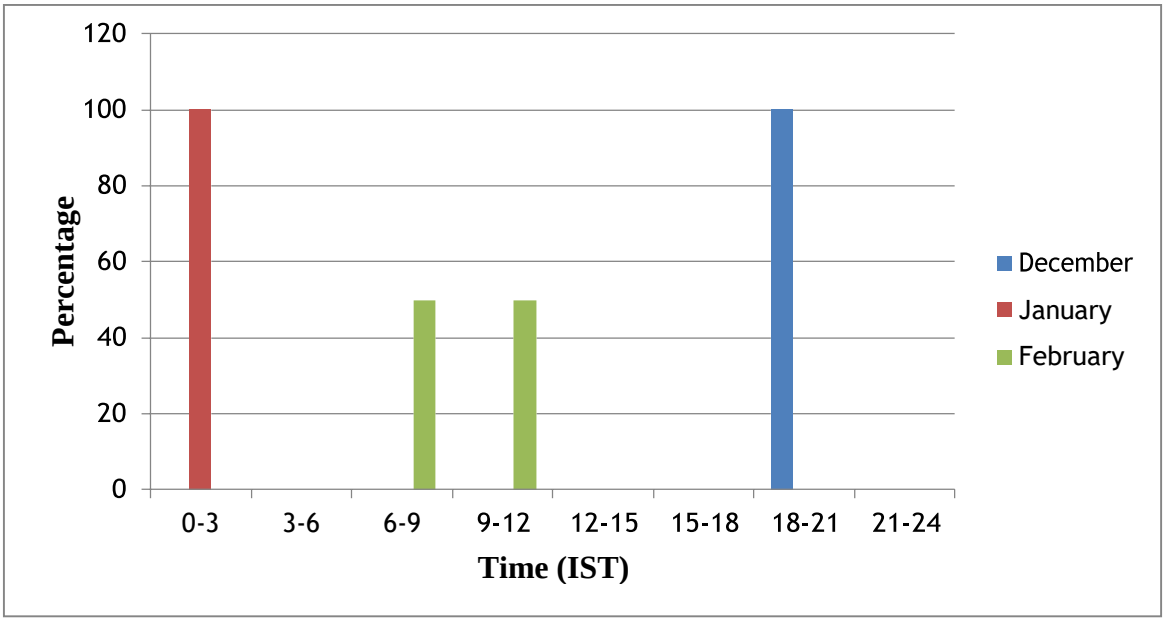


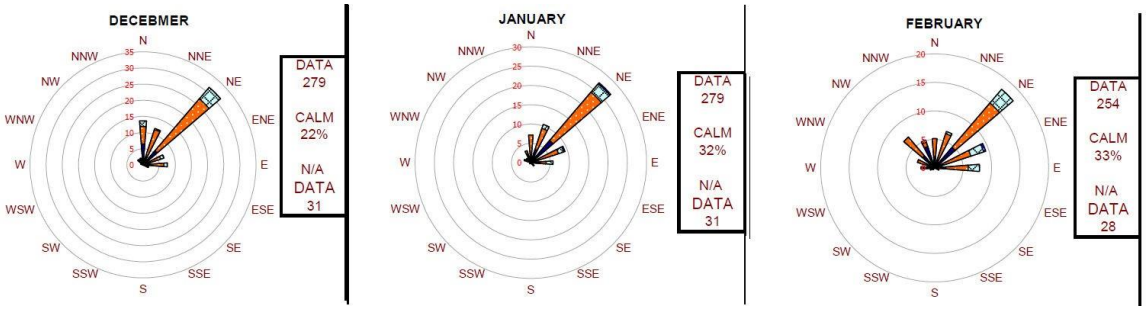
Figure 13. Diurnal variation of thunderstorms during winter season

WIND

Wind roses for winter season are shown below. During 3UTC in the morning time, Northeasterly wind is most prominent during December, January and February. In December and January, wind is mostly from Northerly to Easterly and in February, wind is from northwesterly to easterly.

During 12 UTC in the evening time, Northeasterly wind is most prominent during December and January however, Northwesterly wind is most prominent in February. Mostly wind is varying from Northwesterly to Northeasterly during December to February.

Morning



Evening

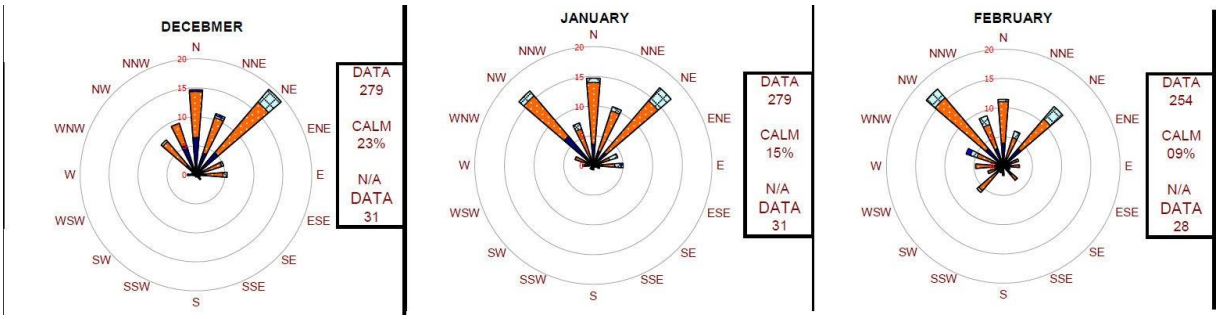


Figure 14. Wind roses for the winter season

SUMMER SEASON

Summer season consists of three months March, April and May. The season is characterized by dry and hot weather in Ahmedabad. Increasing insolation and high day temperatures with heat waves are the main features of the season.

Daily temperatures

In this season maximum and minimum temperatures keeps on increasing. Normal maximum temperature increases about 33˚C in the beginning of the March and at the end of April it is about 41˚C and at the end of the season (Month of May) it is around 42˚C. Normal minimum temperatures also increases about 16˚C at the beginning of the season and reach 28˚C at the end of the summer season.

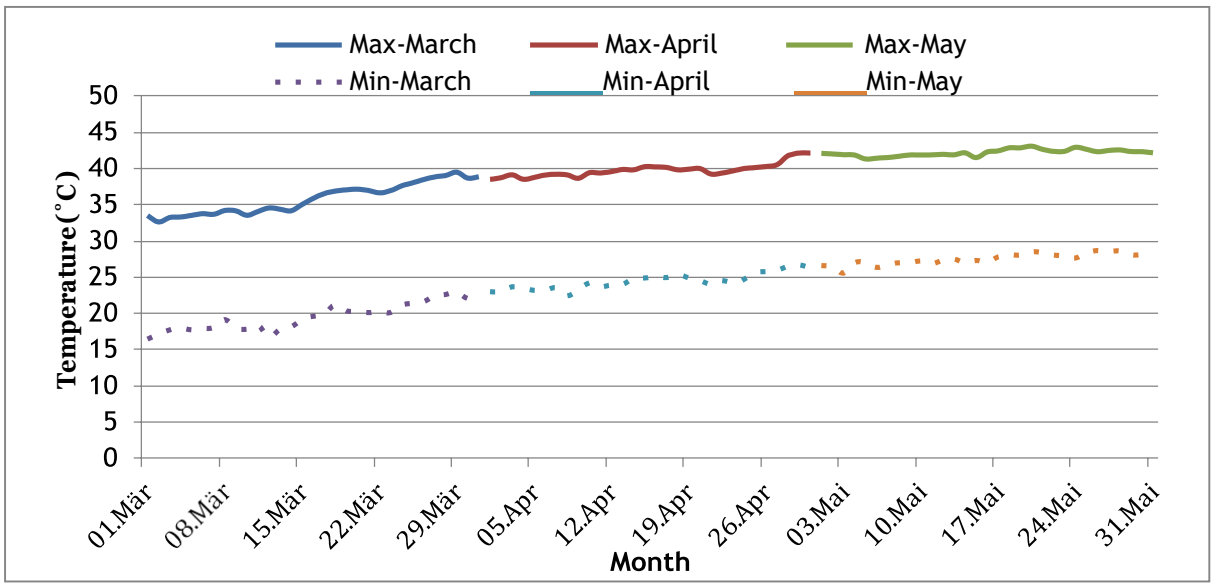


Figure 15. Normal Maximum and Minimum temperature for the Summer season

Extreme Temperatures

The highest and lowest maximum temperatures during 2010-2019 is shown in figure 16. The average of highest maximum temperature for March, April and May is 40˚C, 43˚C and 45˚C respectively. The monthly range of highest and lowest maximum temperatures is highest in the month of March which is about 10˚C. The highest maximum temperatures and lowest maximum temperatures during 2010-2019 are given in table 4.

	2010-2019	
Highest maximum	43˚C	21-Mar-2010
	44.6˚C	18-Apr-2010
	48˚C	20-May-2016
	2010-2019	
Lowest maximum	25.1˚C	02-Mar-2015
	31˚C	21-Apr-2012
	38˚C	15-May-2014

Table 4. Highest and Lowest Maximum temperatures

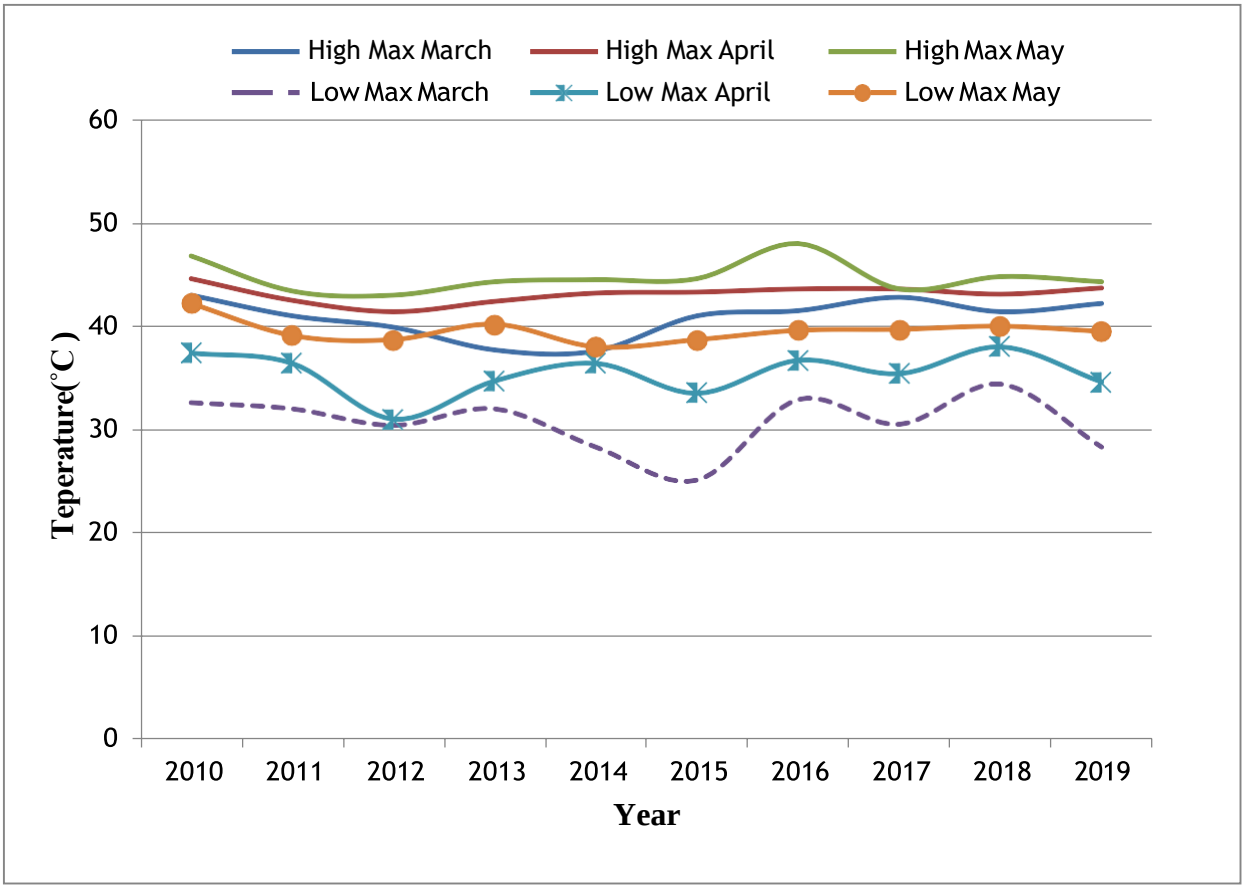


Figure 16. Highest and Lowest Maximum temperatures during the Summer season

The lowest average minimum temperatures are 13˚C, 20˚C and 24˚C for March, April and May respectively during period 2010 to 2019. The lowest minimum temperature recorded was 9.4˚C in 2nd March 1982, 16.2˚C on 08th April 2017 and 19.4˚C for 27th May 1974. Those are the ever lowest values till 2019. Minimum temperatures are highly variable in month of March and thus the different between highest and lowest minimum varies between 8˚C to 14˚C. Lowest minimum recorded in March, April, May during 2010 to 2019 and 1971 to 2019 is given in the table 5. Time series plot of monthly highest and lowest minimum temperature for the period 2010 to 2019 is given in figure 17.

	2010-2019		Extreme up to 2019	
Lowest minimum	10.2˚C	12-Mar-2017	9.4˚C	02-Mar-1982
	16.2˚C	08-Apr-2017	16.7˚C	24th Apr-1996
	23.4˚C	03-May-2018	19.1˚C	27-May-1974

Table 5. Lowest minimum temperatures during the summer season till 2019.

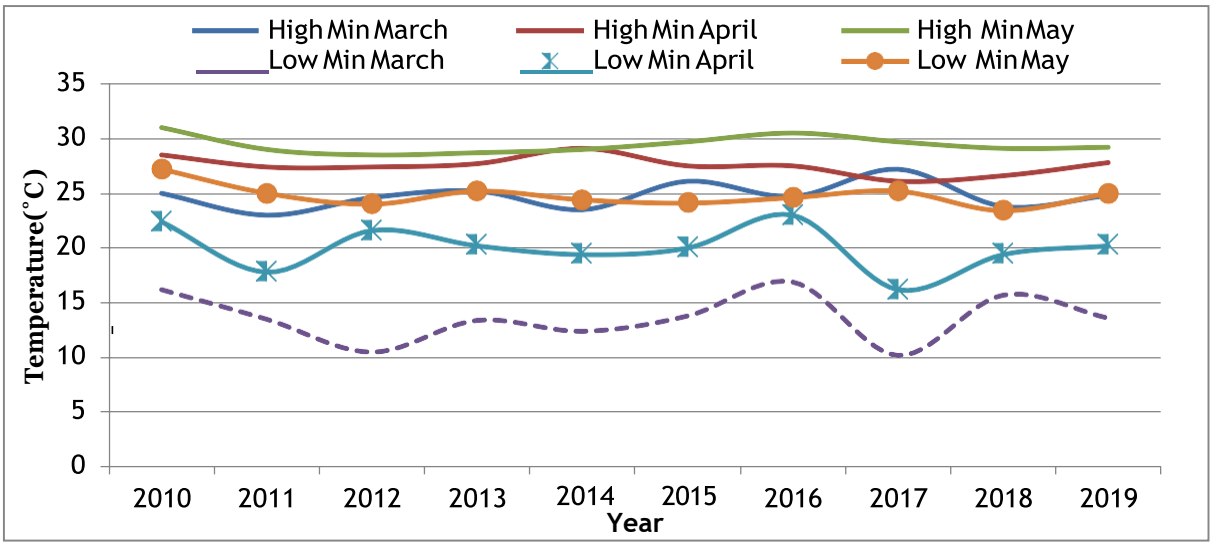


Figure 17. Highest and Lowest Minimum temperatures during the Summer season

The probability of maximum temperatures exceeding 35˚C and 40˚C is given in figure 18. The probability that the maximum temperature exceeding 35˚C is 40% in the beginning of March and it touches 100% in the 3rd week of March. The probability of temperature reaching 40˚C is nil up to 18th March but thereafter increases from 20% and reaches 90% at the end of April. During May, it fluctuates from 70 to 100 percent.

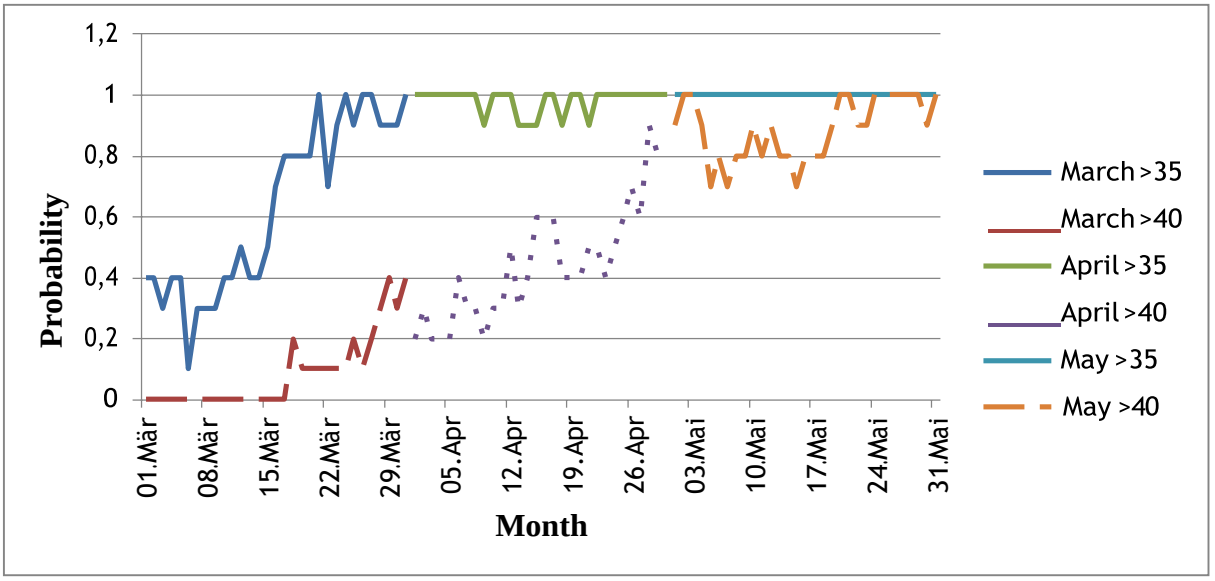


Figure 18. Probability of maximum temperatures to exceed 35˚C and 40˚C during the summer season

RAINFALL

Summer season is generally dry over Ahmedabad where March is the driest month and May is the wettest month. The daily average rainfall is shown in the figure 19. The highest average rainfall is 2.16mm during 2000 to 2019. However, the highest ever recorded 24-Hours rainfalls are 19.2mm on 01st March 2015, 21.9mm on 27th April 1982 and 138.3mm 09th May 1982 at Ahmedabad till 2019.

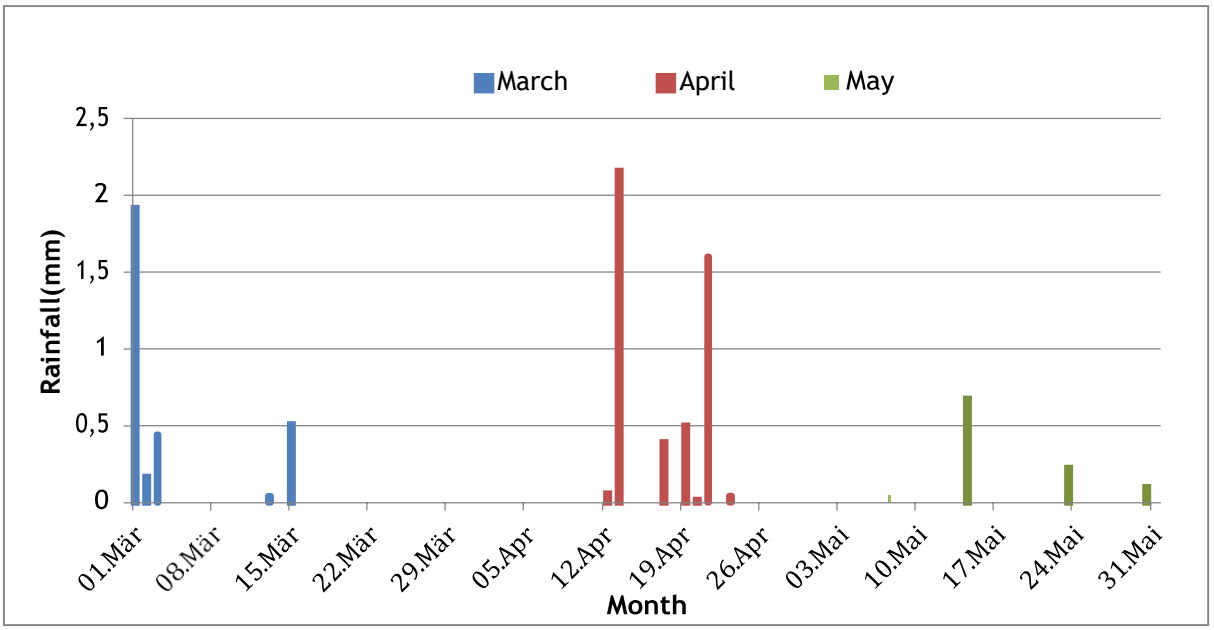


Figure 19. Daily Normal rainfall for Summer season.

Following figure 20 and table 6 shows the statistics of highest 24-Hours rainfall during March, April, May (2010-2019).

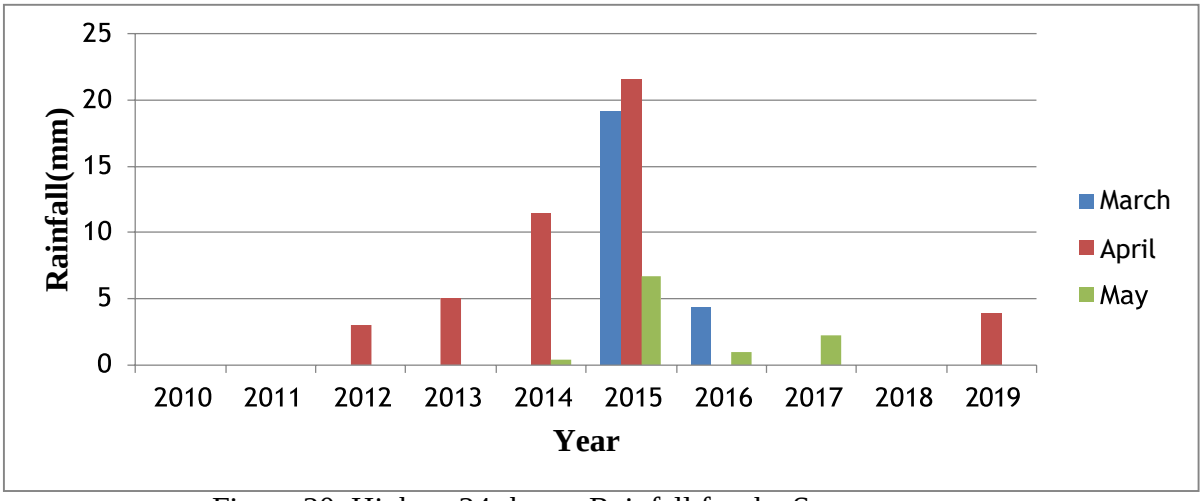


Figure 20. Highest 24- hours Rainfall for the Summer season

	2010-2019		Extreme up to 2019	
Highest rainfall	**19.2mm**	**01-Mar-2015**	**15.7mm**	**25-Mar-1967**
	21.6mm	**13-Apr-2015**	**21.9mm**	**27-Apr-1982**
	6.7mm	**14-May-2015**	**138.3mm**	**09-May-1982**

Table 6. 24- Hours highest rainfall for summer season

The average number of days of rain occurrences is 0.3 days, 0.5 days and 0.1 days in March, April and May respectively.

Figure 21 shows the probability of rainfall during summer season (from 2010 to 2019). Probability of occurrences of rainfall is 10% during 1st week of March and zero for the rest of the month. Probability of occurrences of rainfall is 10%

to 20% during the mid of April to end of April and 10% during mid of Many and zero probability in rest of the period of April and May.

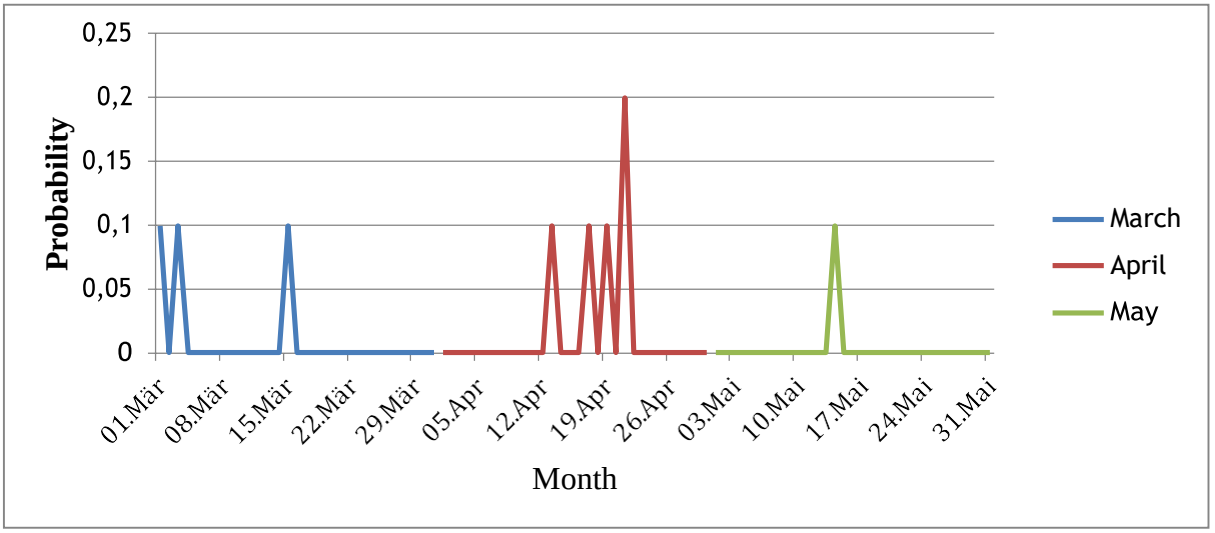


Figure 21. Daily Probability of Rainfall during Summer season

The total monthly rainfall during 2010-2019 is given in the figure 22. Maximum total monthly rainfall observed in 2015 (26.3mm in March, 22.1mm in April and 6.7mm May) during the period. Extreme monthly rainfall up to 2019 is 26.3mm in March 2015, 26.4mm in April 1947 and 230.7mm in May 1982.

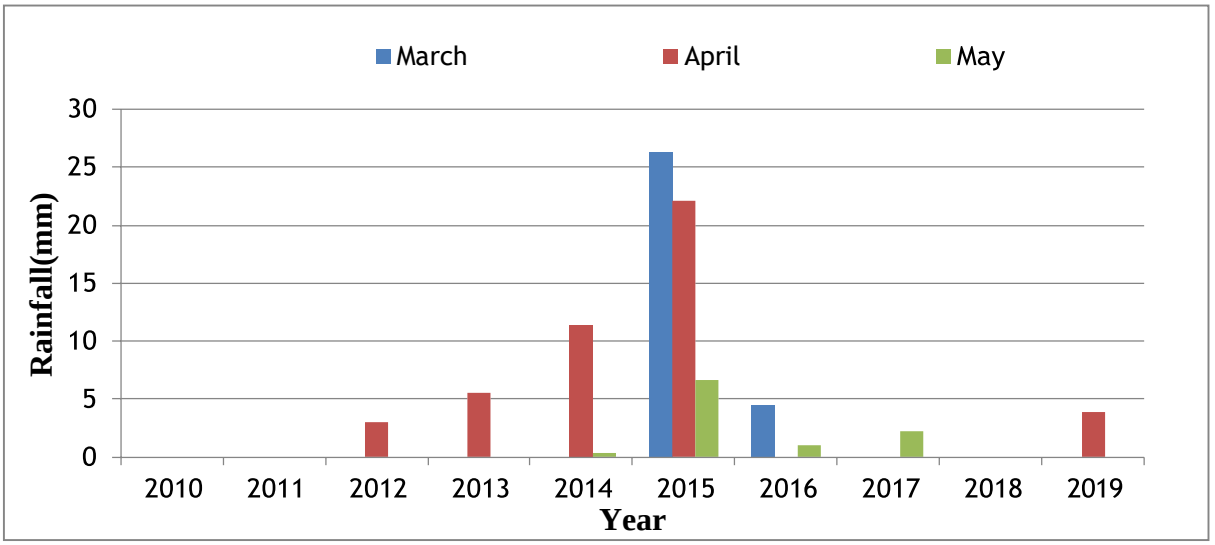
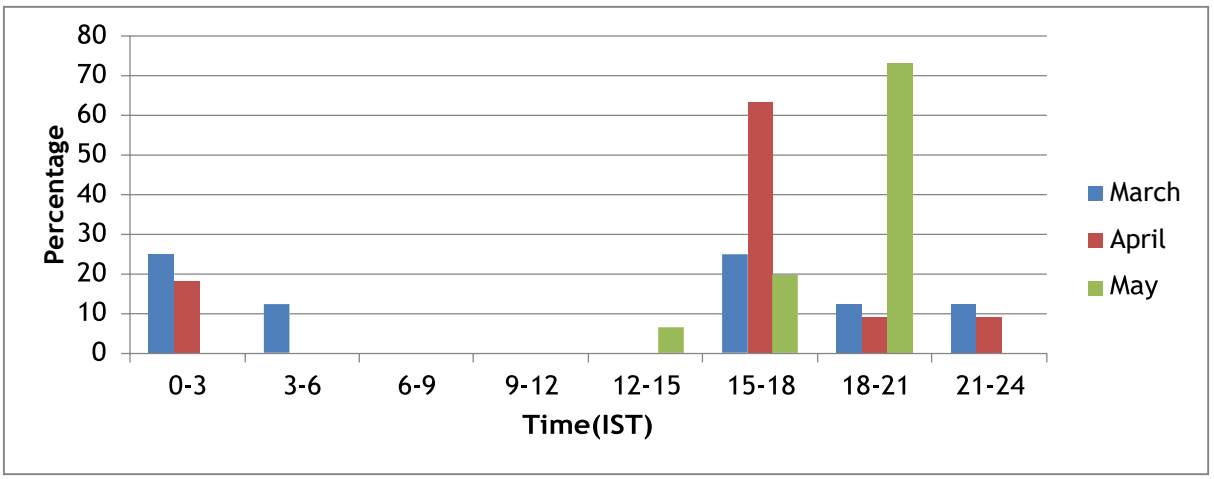


Figure 22. Monthly total rainfall during the Summer season

THUNDESTORM AND OTHER WEATHER PHENOMENON

The summer season in Northwest India is generally characterized with severe weather phenomena like dust storm, thunderstorm, hail and squalls. For Ahmedabad frequency of thunderstorm is quite low, it increases from March to May. The average number of thunderstorm day in March is 0.8, 1.1 in April and 1.5 in during 2010 to 2011. It is observed that mostly thunderstorms occur during 15 to 21 hour IST (afternoon to evening) due to the thermal convection.

Figure 23 shows the diurnal variation of thunderstorm during the summer season.

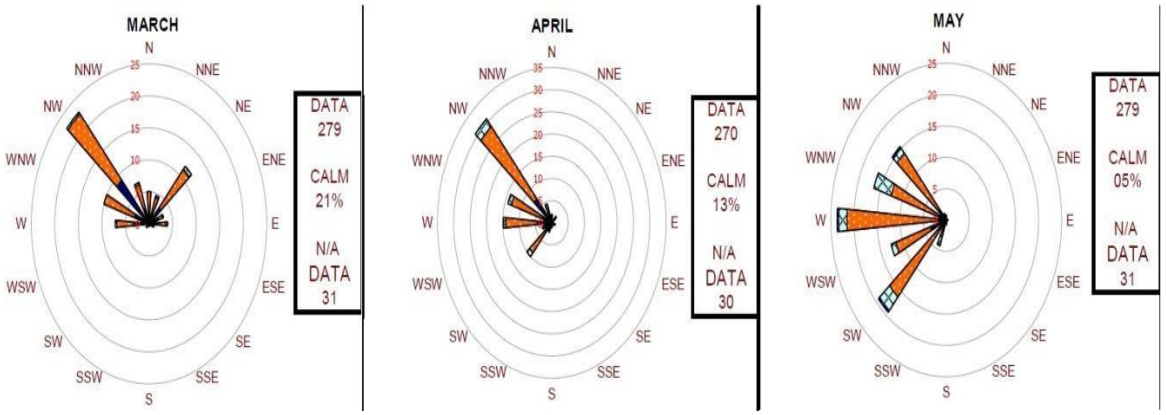


23. Diurnal variation of Thunderstorm during Summer season

Wind

Wind roses diagram for 3 UTC and 12 UTC for the month of March, April and May are given in figure 24. Wind is mostly northwesterly in March and April for both 3 UTC and 12 UTC. It is Northwesterly to Southwesterly during May. As season progresses wind rotates anti clockwise wind is mainly Southwesterly for 12UTC in May.

Morning



Evening

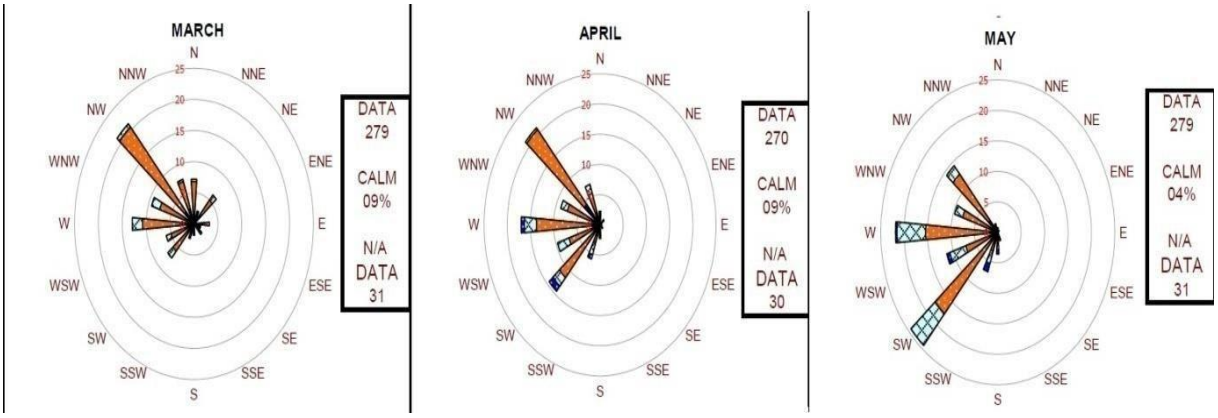


Figure 24. Wind roses for the Summer Seasom

Monsoon Season

The months of June, July, August and September constitute the monsoon season. This is the main rainy season for most part of the India. Frequent rainfall, thunderstorms, heavy rains are characteristics features of this season.

Onset And Withdrawal Of Monsoon

The Southwest monsoon sets in over Kerala around 1st June. It takes around 15 to 20 day to travel to Gujarat. The average date of onset of SW monsoon over Ahmedabad is 21st June. The onset and date of withdrawal of SW monsoon over Ahmedabad during period 2010 to 2019 are shown in figure 25. The earliest date of onset monsoon over Ahmedabad is 7th June in 2012. Before that it was 10th June in 1989 and 1995. And latest onset was 30th June in 2000. The earliest withdrawal was 15th September in 1983, 2003, 2004. Latest withdrawal is 15th October in 2013 before that it was 6th October in 2010.

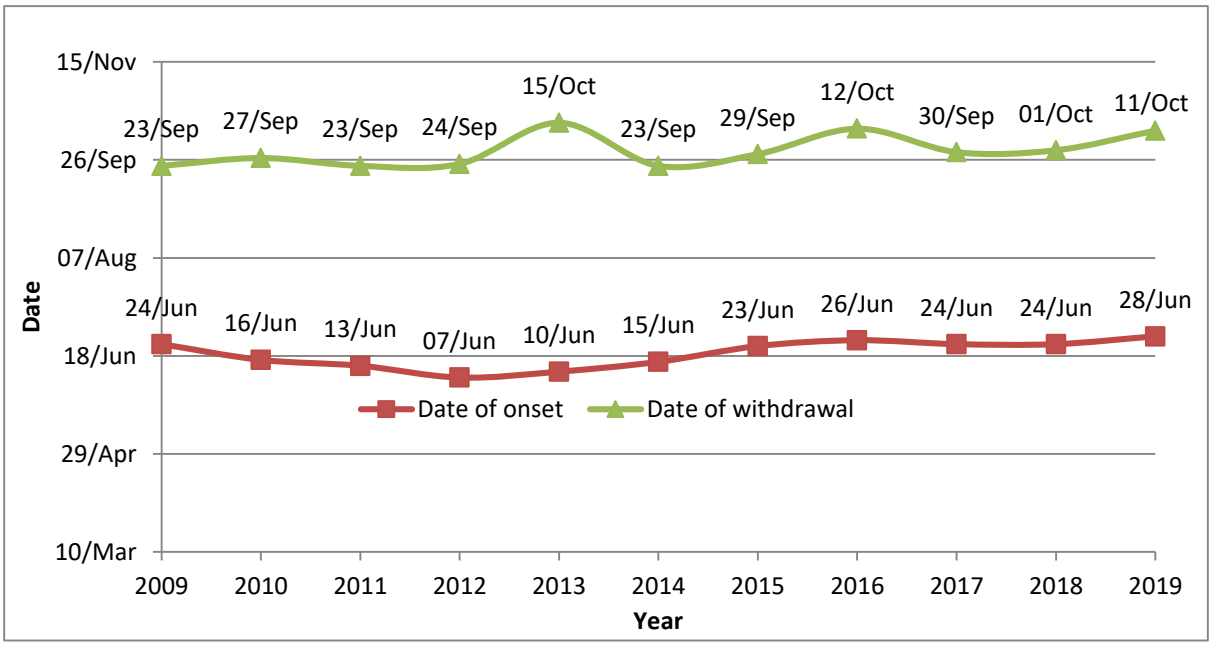


Figure 25. Dates of Onset and Withdrawal of Southwest monsoon over Ahmedabad

Rainfall

June to September is the Rainy season for Ahmedabad. Rain intensity increases from June till 2nd week of August and then decreases till the end of the season. For the period 2010 to 2019 daily normal rainfall was around 10 to 15mm. Daily normal rainfall is shown in figure 26. There was increase in rainfall intensity from last week of June till mid of August and gradual decrease till the end of the season. July and August months experience most of the rainfall and they together contribute more than 70% rainfall to the season's total rainfall. Figure 27 shows the daily rainfall probability during the Monsoon season. The probability increases from 10% to 70% from the 2nd week of June to the 2nd week of August and then decreases to 20% in September. The average number of rainy days (rain ≥2.5mm) for June is 2.9 days, for July is 11 days, August is 10.7 days and for September it is 7.3 days (from 2010 to 2019). Figure 28 shows the number of days with heavy rainfall (≥64.5mm). The average number of days is 0.1 for June, 1.4 days for July, 0.9 days for August and 0.3 day for September during period 2010 to 2019.

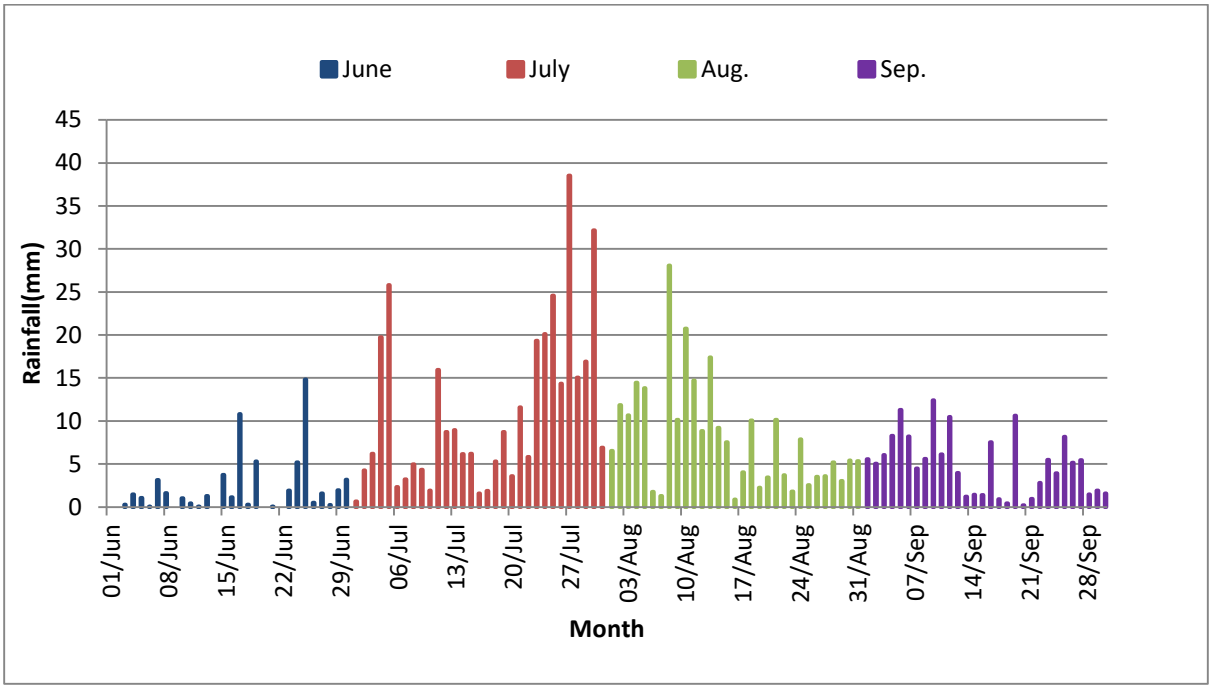


Figure 26. Daily Normal Rainfall for Monsoon season

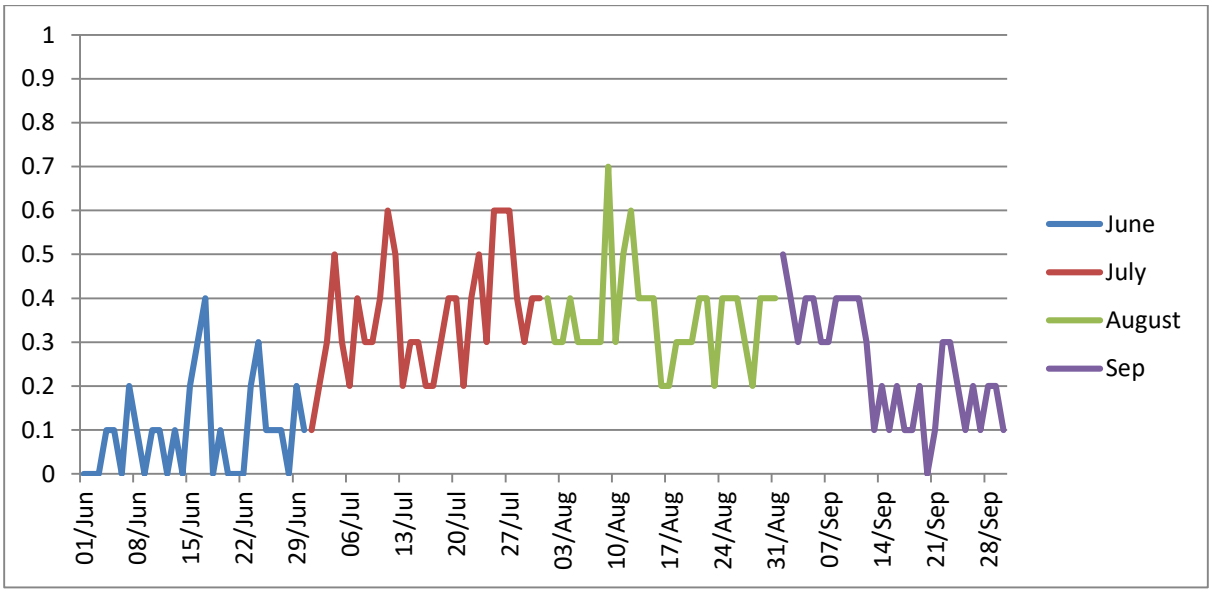


Figure 27. Daily probability of Rainfall during Monsoon season

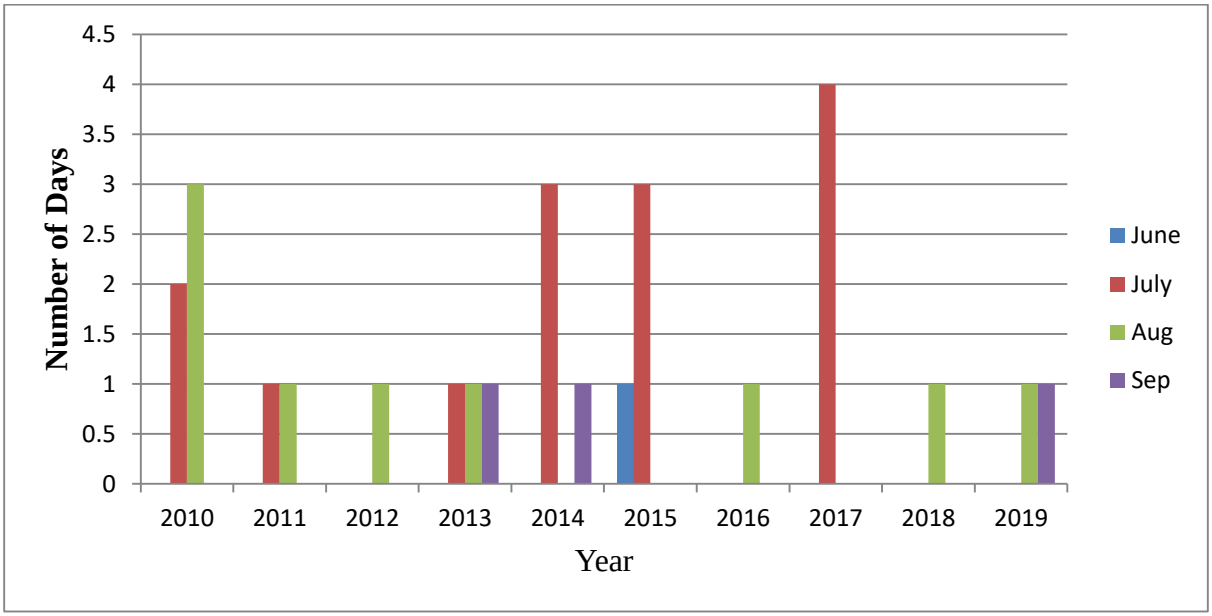


Figure 28. Number of days having rainfall ≥64.5mm

Ahmedabad mainly receives rain in Monsoon season and rest of the months are either dry or have very less rainfall. Figure 29 shows the seasonal rainfall and annual rainfall from 2010 to 2019. It shows that in Ahmedabad mostly rain occurred in Monsoon season. It is noticed that in year 2011 and 2018 there was rainfall only in Monsoon season and other months were dry. In the year 2012 Monsoon and annual rainfall difference is very less. Highest Monsoon and annual rainfall received in year 2017 which is 1146.7mm and 1160.9mm respectively (from 2010 to 2019).

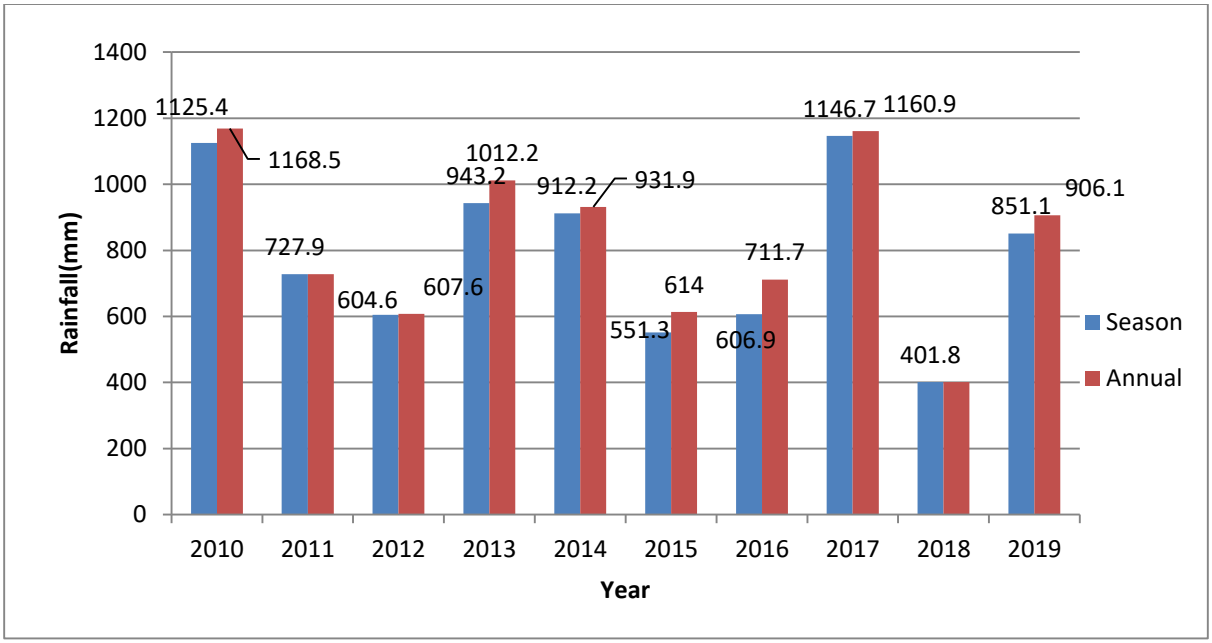


Figure 29. Monsoon season rainfall and Annual rainfall over Ahmedabad

Figure 30 shows the 10 year characteristics of highest 24 hours cumulative rainfall and table 7 shows highest rainfall within 24-hours over Ahmedabad in Monsoon season. Heavy rains are caused by monsoon depression or low pressure

area which develop in Bay of Bengal and move in west- northwest ward direction along the Monsoon trough.

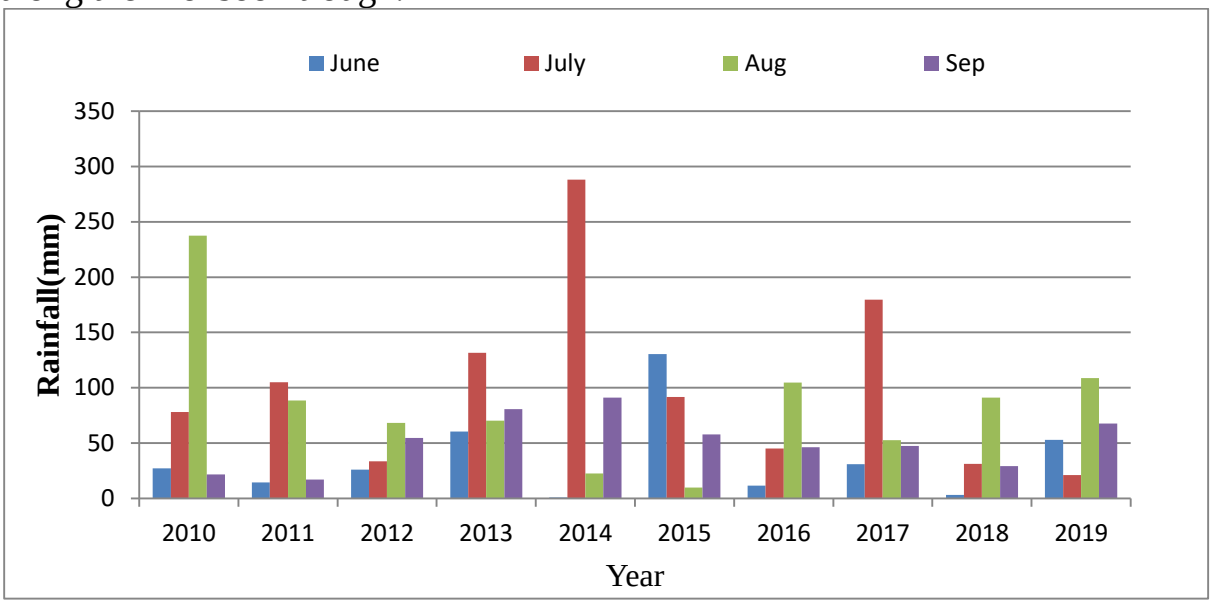


Figure 30. Highest 24 Hours cumulative rainfall received during south west Monsoon season(June, July, August. September)

	2010-2019	Date	Extreme up to 2019	Date
Heavy rainfall	130.4	25-Jun-2015	249.3	27-Jun-1997
	288.1	30-Jul-2014	414.8	27-Jul-1927
	237.4	08-Aug-2010	250	30-Aug-1976
	91	09-Sep-2014	257.8	17-Sep-1950

Table 7. Highest 24 Hours cumulative rainfall recorded in Ahmedabad during Monsoon season.

Mostly rain occurred in the month of July and August. It contributes about 70% of total seasonal rainfall (during 2010 to 2019). Figure 31 shows the monthly rainfall of Monsoon season during the period of 2010 to 2019.

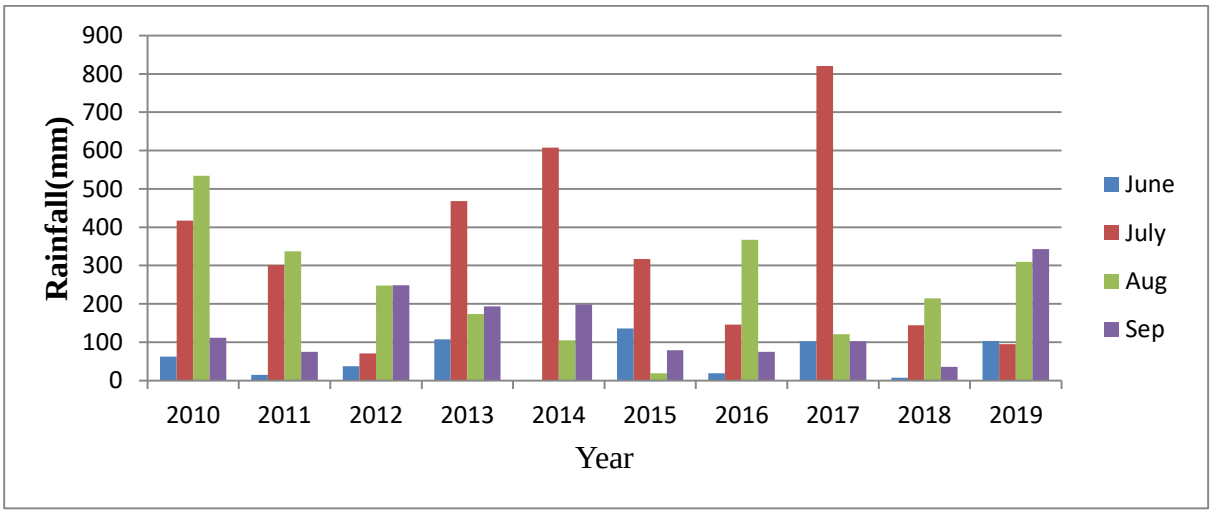


Figure 31. Monthly total rainfall during Monsoon season over Ahmedabad

Highest monthly rainfall for period 2010 to 2019 during June is 135.5mm (2015), July 821mm(2017), August 534.3mm(2010), September 343.3(2019). It is up to 2019 is 713.6 in June 1997, 952.5 July 1905, 609.8 August 1990 and 636.5 in September 1950.

thunderstorm and other weather phenomenon

The severe weather phenomena like thunderstorm occur mostly during Monsoon season over Ahmedabad. The average number of thunderstorms during the season is 4.8 in June, 7.1 in July, 5.1 in August and 5.8 for September during the period of 2010 to 2019. The diurnal variation of thunderstorm is shown in figure 32. During these years (2010 to 2019) most of the occurrences of thunderstorm are in the afternoon (15-18 IST) and in evening (18-21 IST). During this time period more than 50% thundering occurred.

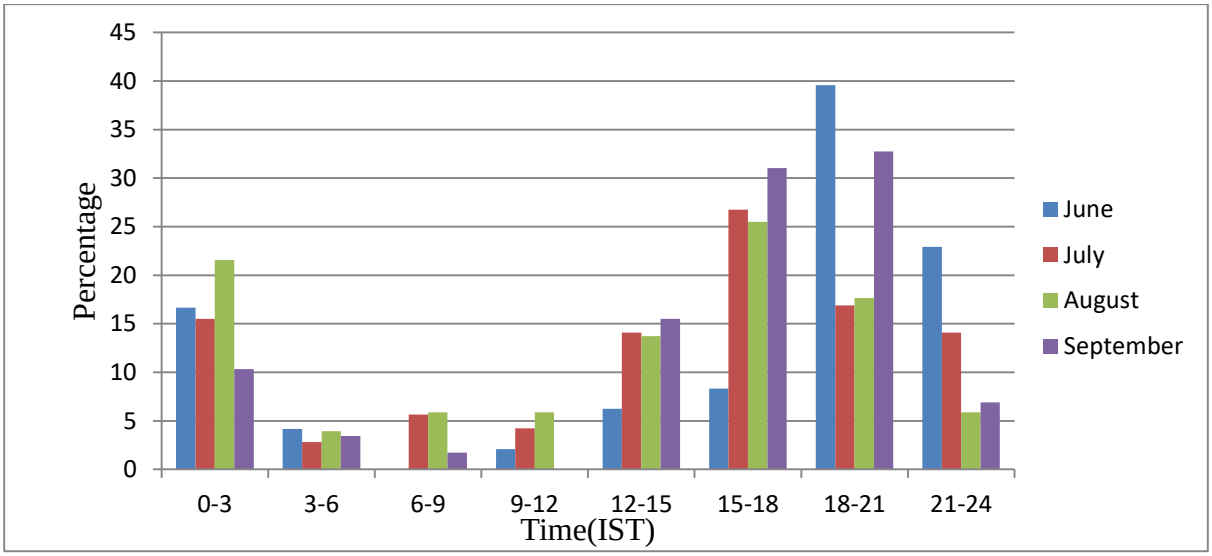


Figure 32.Diurnal variation of thunderstorm during Monsoon season

Temperature

The season begins with warm day with daily normal temperature around 42˚C and it start to fall as season progress. It is around 32˚C at the end of July. Normal maximum temperature at end of Season is around 33˚C. Minimum temperature also falls around 29˚C to 24˚C from the start to end of season (June to July). This variation is shows in figure 33.

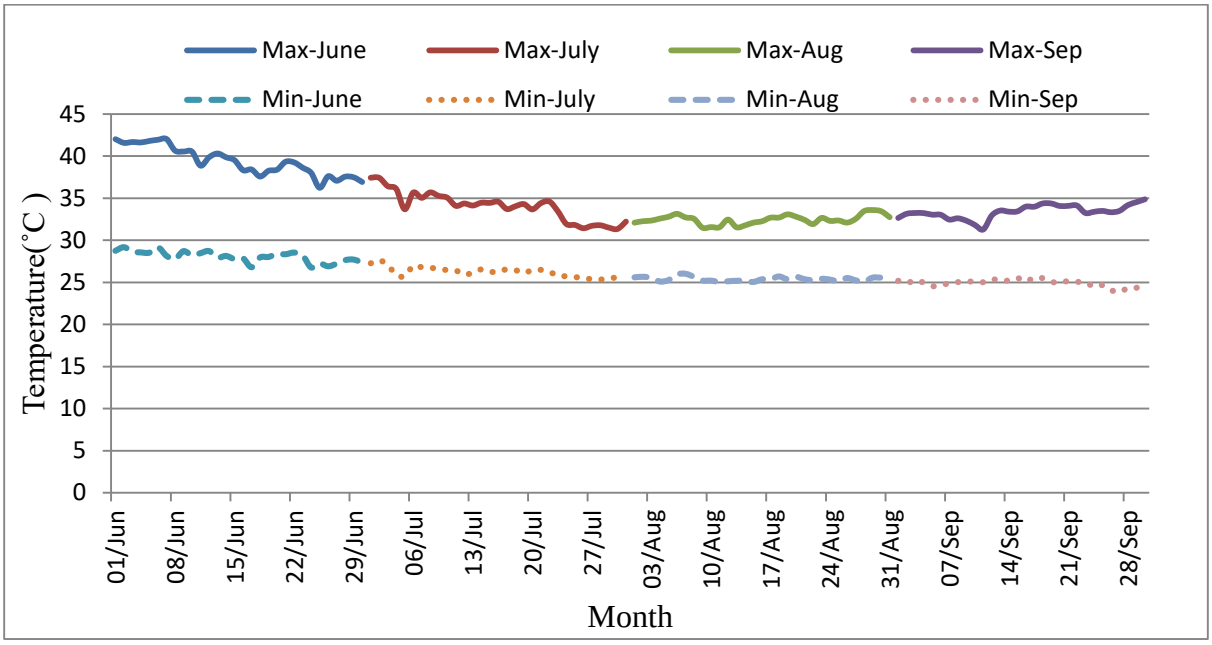


Figure 33. Normal Maximum and Minimum temperatures for Monsoon season

Extreme Temperature

Highest and lowest maximum temperatures for the monsoon season from June to September are shown in figure 34 during 2010 to 2019. For the month of June highest maximum temperature varies from 42˚ C to 45˚ C. It is 36˚C to 40˚C for July, 34˚C to 36˚C for the month of August and its 35˚C to 38˚C for the September.
Lowest maximum temperature varies from 31˚C to 36˚C for June, 25˚C to 28˚C for July, 26˚C to 30˚C for August it is 26˚C to 30˚C for the September during 2010 to 2019.

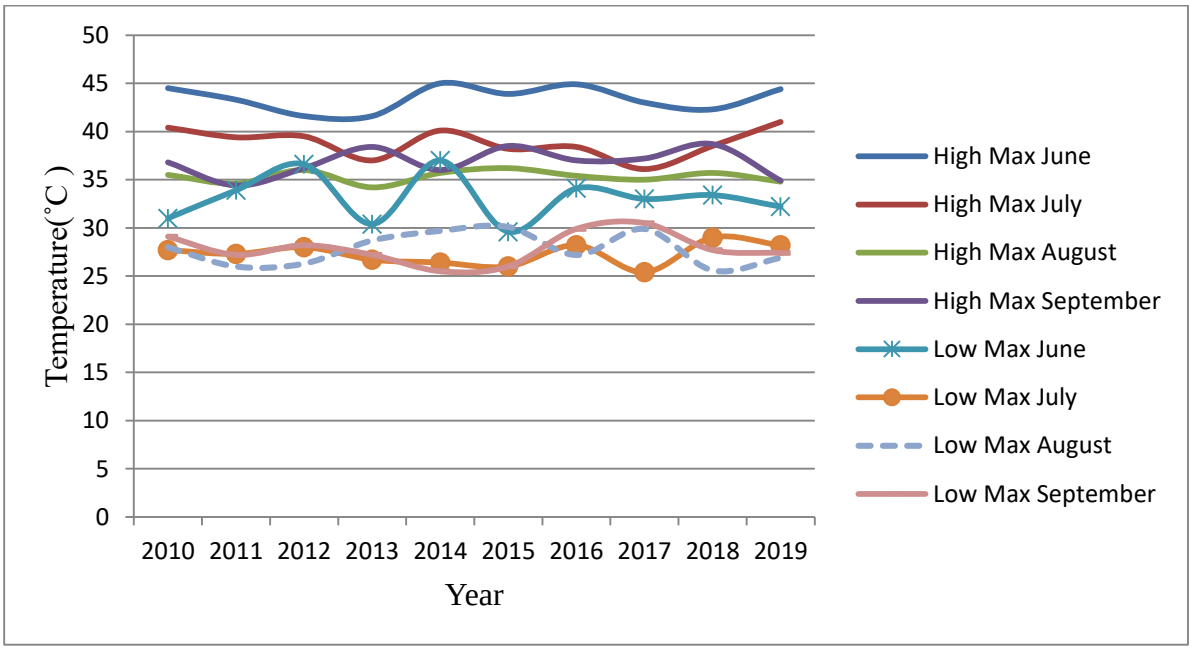


Figure 34. Highest and Lowest Maximum temperature during Monsoon season

The highest and lowest minimum temperatures for the season are shown in the figure 35. Lowest minimum temperature mostly varies between 22˚C to 23˚C for all the four months. Lowest minimum temperature varies from 22˚C to 24˚C from July to September during 2010 to 2019. For June it is 24˚C to 27˚C during 2010 to 2019. Highest minimum temperature for

June was around 30˚C and it is 25˚C to 29˚C for rest of the months of the season.

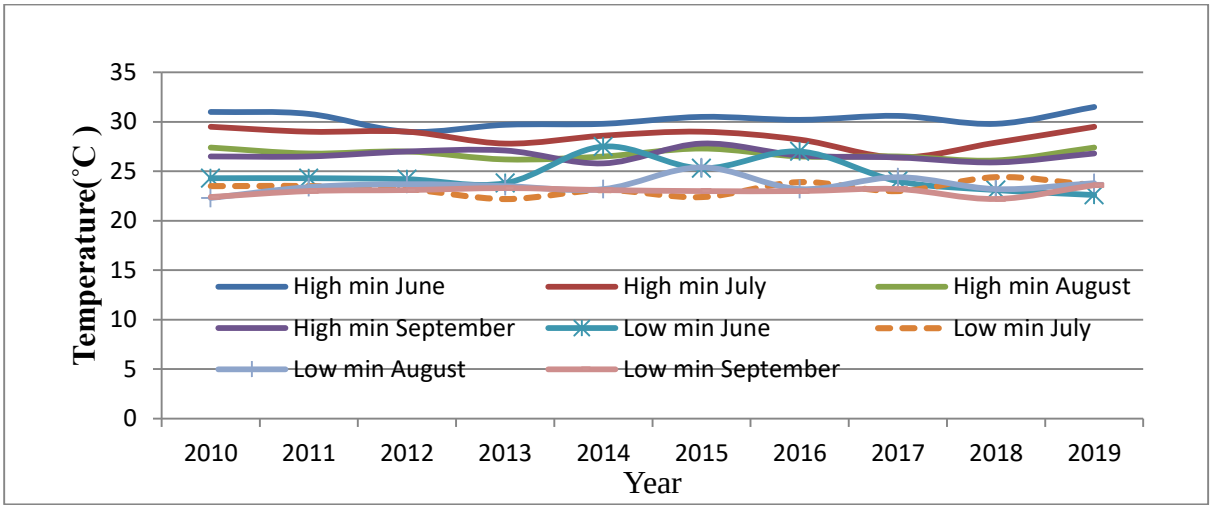
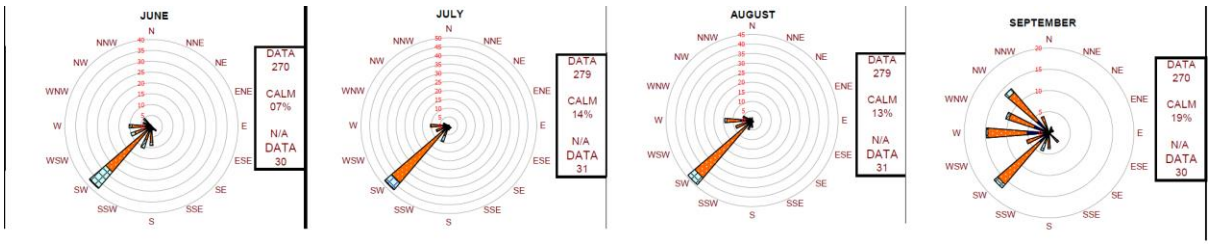


Figure 35. Highest and lowest minimum temperature during Monsoon season

Wind

In Monsoon season prominent wind direction is Southwesterly throughout the season. The calm wind percentage is 6% to 7% in June, 14% to 15% in July, 13% to 18% in August and 19% to 21% for September. Figure 36 shows the wind roses for 03UTC and 12 UTC for the Monsoon season. We clearly observe that for June to August wind is Southwesterly at 03UTC and 12UTC. In September at 03UTC wind is Southwesterly to Northwesterly and at 12 UTC wind is Southwesterly to Westerly.

Morning



Evening

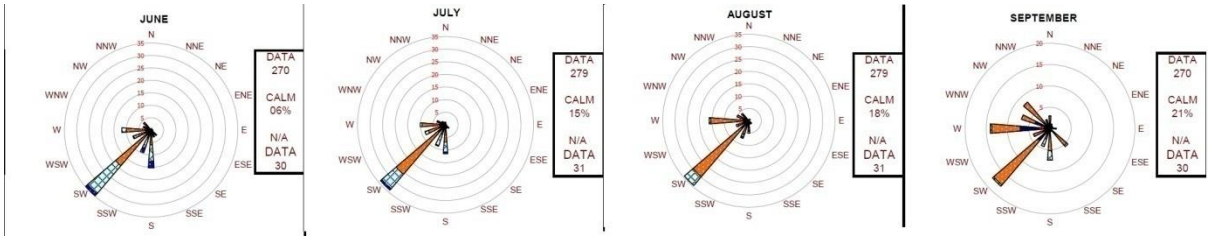


Figure 36. Wind roses for Monsoon season

Post monsoon

The Post Monsoon season from October to November is a transit season between Monsoon and Winter. The season is characterized by generally dry and pleasant weather with a constant decrease in mean temperatures. With the retreat of Southwest monsoon, wind is Northerly to Northeasterly. Temperature decreases steeply after 1 hour IST at night.

Temperature

The Sun move towards Tropic of Capricorn. Day temperature decreases as shown in figure 37. Mean maximum temperature fall from 35˚C to 31˚C at the end of the season. (2010-2019). Maximum temperature falls from 35˚C to around 33˚C during October and around 33˚C to 31˚C during November. Minimum temperature also falls from around 24˚C to 16˚C during October and November.

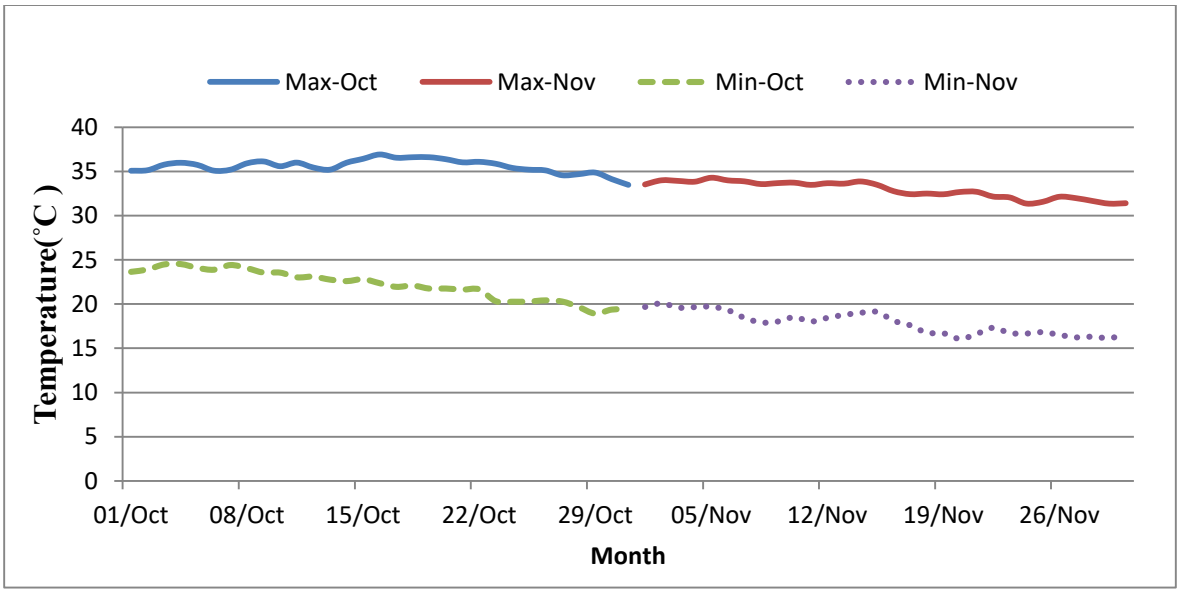


Figure 37. Normal Maximum and Minimum temperature for Post Monsoon season

Extreme temperature

Highest and lowest maximum temperatures variation are shown in figure 38. Highest maximum of October varies from 36˚C to 38˚C and for November it varies from 34˚C to 37˚C. The highest maximum for October is recorded 42.8˚C in the year 1920. And for November it is 38.9˚C in the year 1901.

	2010-2019		Extreme up to 2019	
Highest Maximum	39.4˚C 37.4˚C	06-Oct-2017 03-Nov-2017	42.8˚C 38.9˚C	5th Oct 1920 3rd Nov 1901
Lowest Maximum	26.8˚C 21.3˚C	06-Oct-2016 24-Nov-2010		

Table 8. Highest and Lowest Maximum temperature till 2019

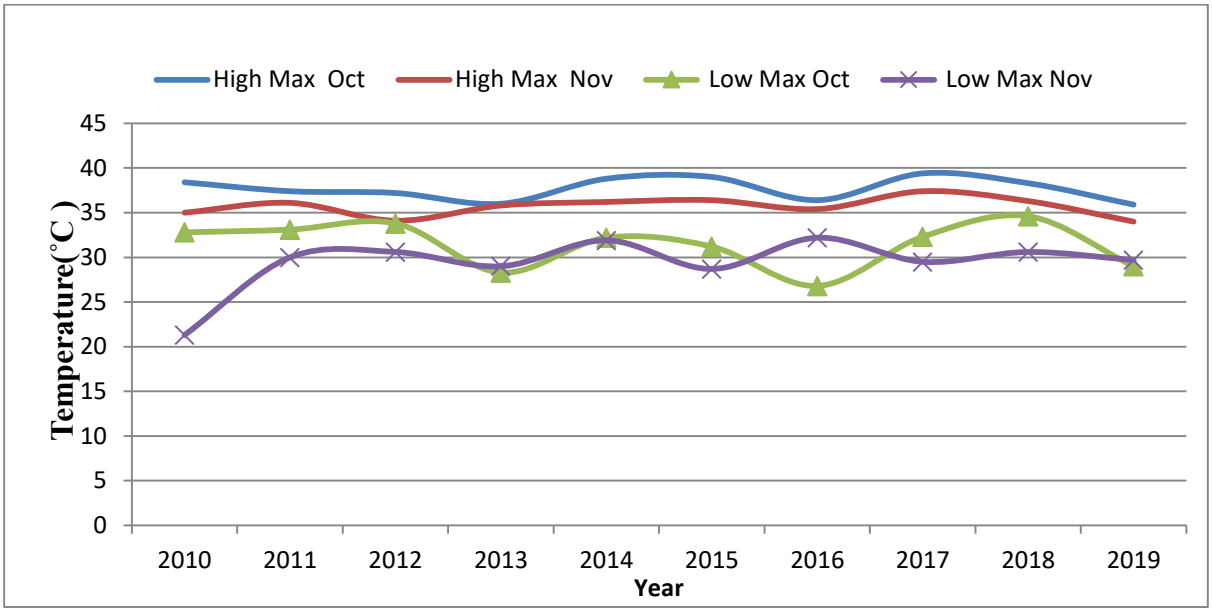


Figure 38. Highest and Lowest Maximum temperature during Post Monsoon

The highest and lowest minimum temperature for Post Monsoon season is shown in figure 39. Lowest minimum variation for October is between 17˚C to 20˚C and for November it is 11˚C to 16˚C. Lowest minimum temperature till date recorded for October is 12.3˚C in 1983 and 8.3˚C in November in 1975. Highest minimum temperature recorded is 27.6˚C in October 2009 and 25.5˚C on 10th November 2010 and dates are given in the Table 9. The highest minimum is due to warm air incursion ahead of Western Disturbance. Low minimum temperature is caused by Northerly wind after passage of Western disturbance.

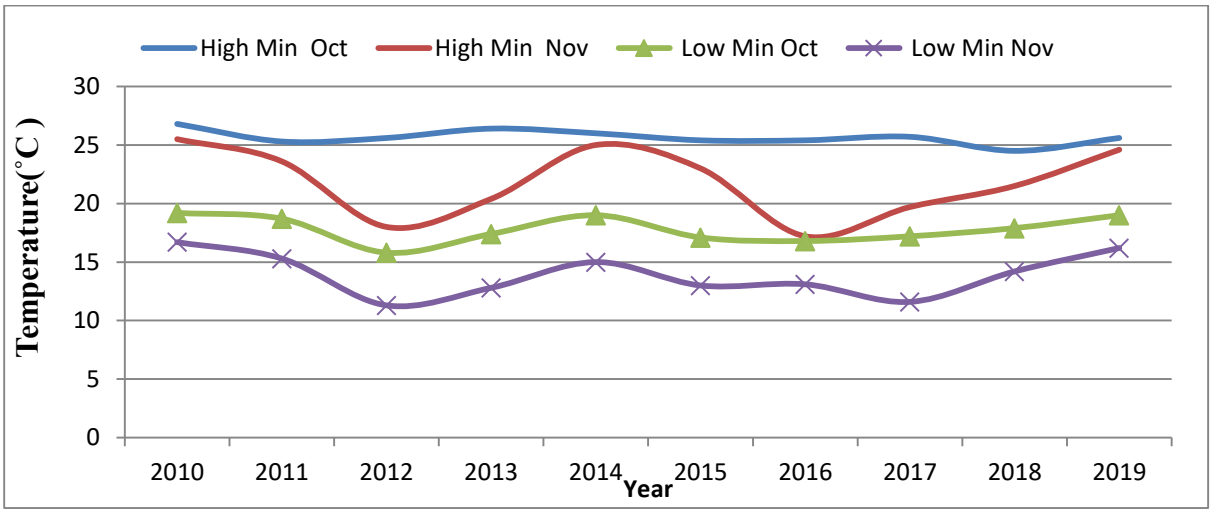


Figure 39. Highest and lowest minimum Temperature for Post Monsoon

Highest Minimum	26.8	20-Oct-2010	27.6	03-Oct-2009
	25.5	10-Nov-2010	25.5	10-Nov-2010
Lowest Minimum				
	15.8	29-Oct-2012	12.3	29-Oct-1983
	11.3	29-Nov-2012	8.3	29-Nov-1975

Table 9. Highest and Lowest Minimum temperature till 2019

Rainfall

Southwest monsoon withdraws from Northwest India during the second half of September. The daily normal rainfall during first fortnight is less than 1mm for October. The average monthly total rainfall is 22mm for October during 2010 to 2019 and 3.6mm for November during the same period. Daily normal rainfall during Post Monsoon period is shown in figure 40.

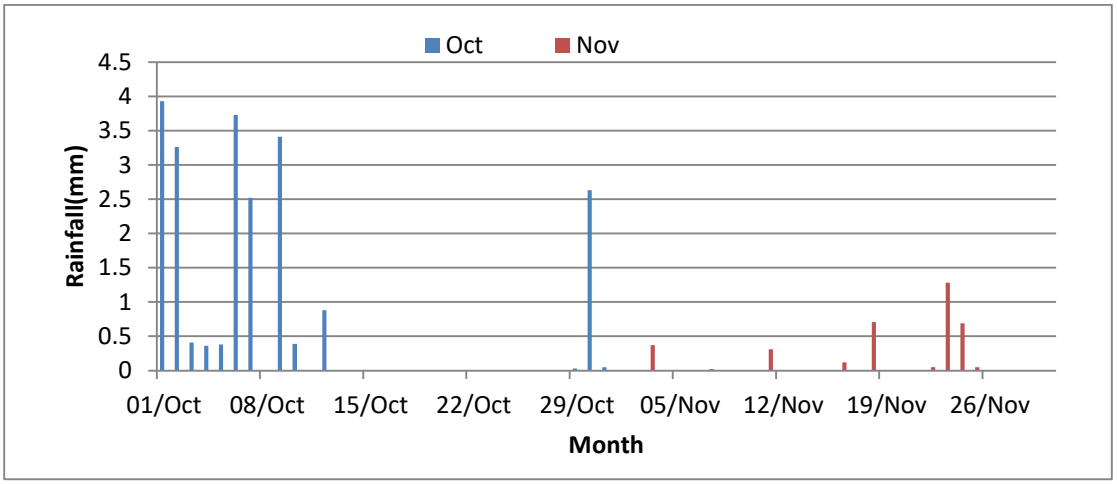


Figure 40. Daily normal rainfall during Post Monsoon period

The Probability of rainfall for individual days shows large fluctuations indicating uncertainty of rainfall in the season. There is decrease of 20% to 10% from the October to November which is shown in figure 41.

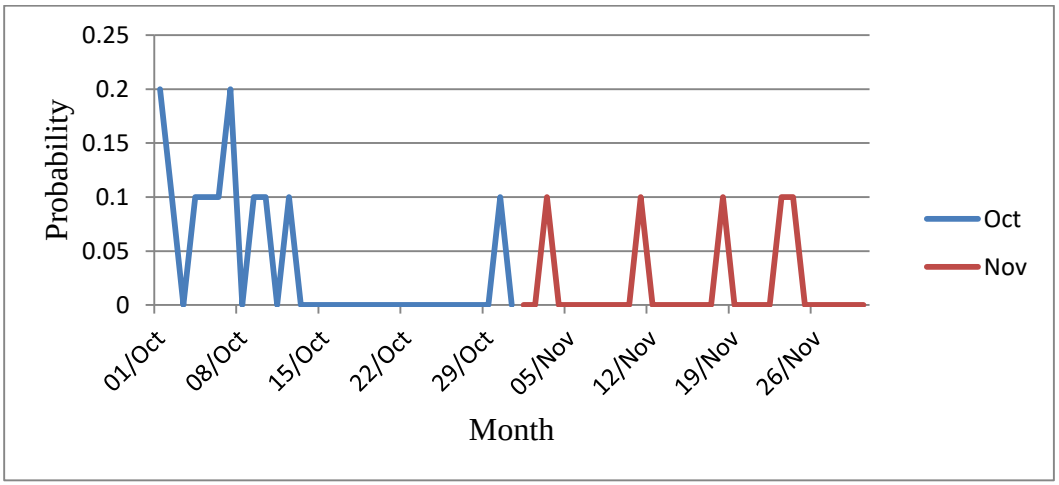


Figure 41. Probability of rainfall during Post Monsoon season

Monthly rainfall for October and November is shown in figure 42. During 2010 to 2019 highest monthly rainfall during whole the month is 99.4mm in October 2016 and 31.1mm in November 2010. Highest monthly rainfall up to 2019 is 257mm in October 1985 and 100.4mm in November 1982.

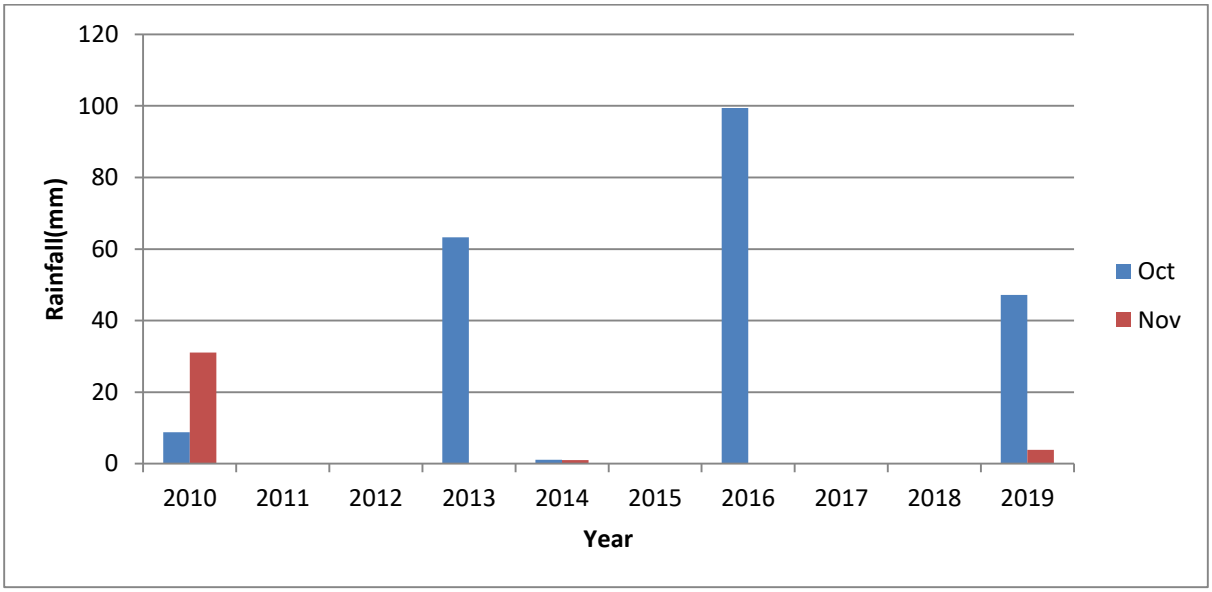


Figure 42. Monthly rainfall for October and November

highest rainfall

Generally heavy rain does not occur in this season. 24 hours highest rainfalls during 2010-2019 are shown in figure 43. In this period 24 hours highest rainfall is 36.9mm recorded on 06th October 2016 and 12.8mm recorded on 23rd November 2010. The highest rainfall recorded in this season is 166.3mm on 8th October 1985 and 76.8mm on 9th November 1982.

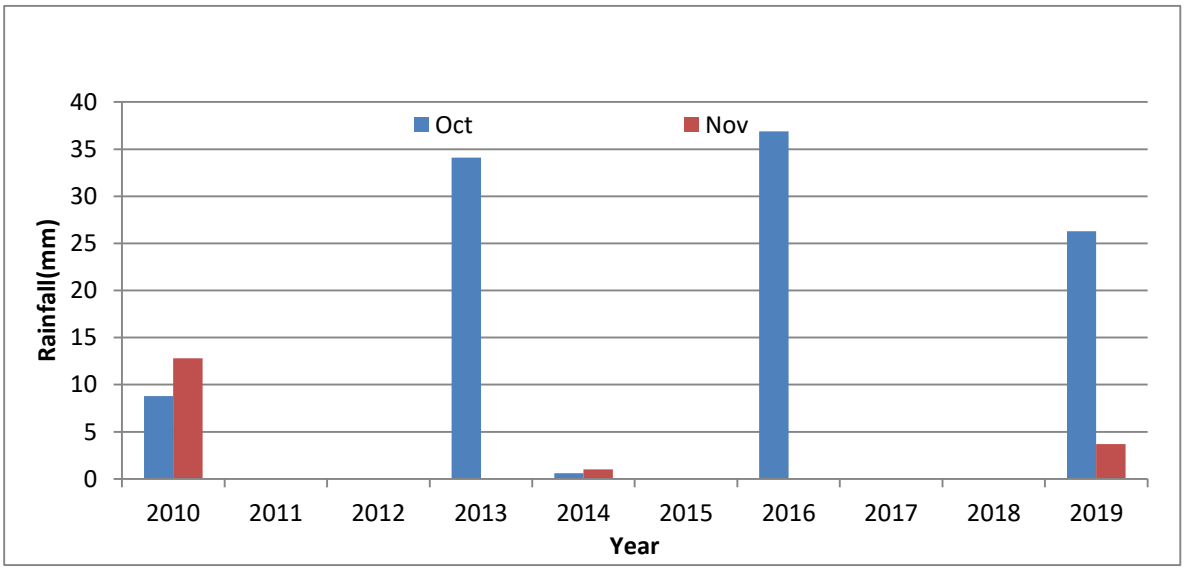


Figure 43. Highest 24-hours rainfall during Post Monsoon

Thunderstorm and other weather phenomenon

Thunderstorm activity is not very pronounced during this season the average number of thunderstorm is 1.1 for October and 0.4 for November. The diurnal variation of thunderstorm is shown in figure 44. Most prefer time of occurrence of thunderstorm is from after noon to midnight.

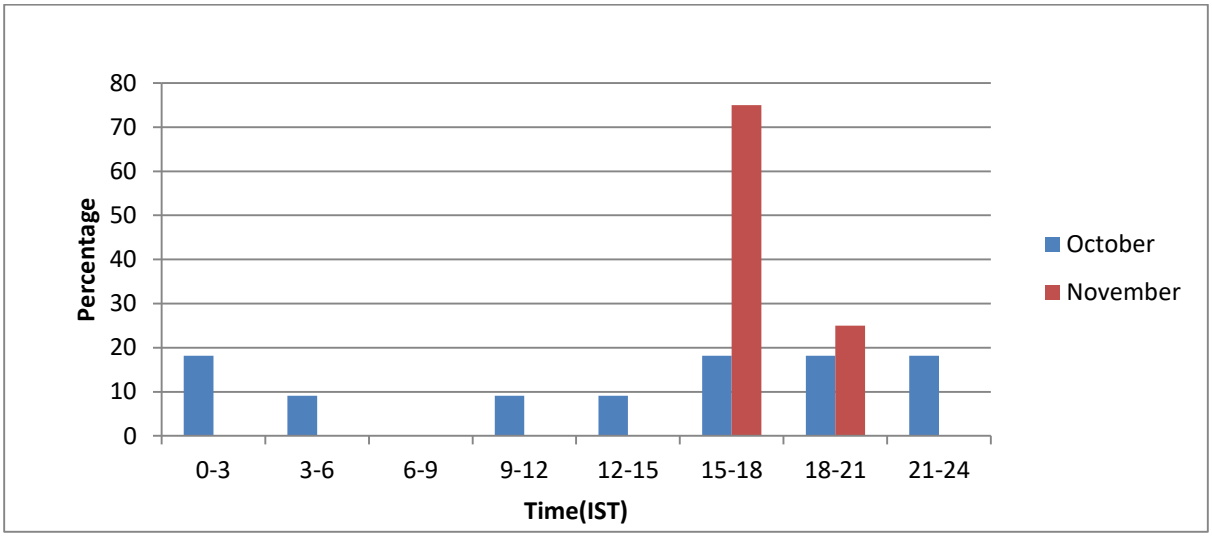
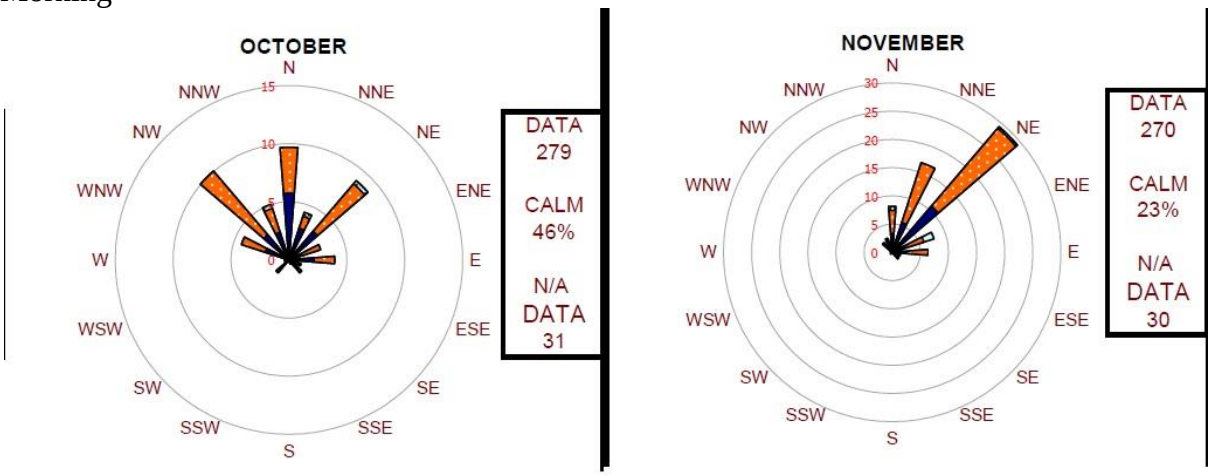


Figure 44. Diurnal variation of thunderstorm during Post Monsoon season

Wind

Winds more prominent during Monsoon withdrawal are Northeasterly to Northwesterly during 03 UTC and northeasterly during 12 UTC in October. It is northeasterly during both 3UTC and 12 UTC in November.

Morning



Evening

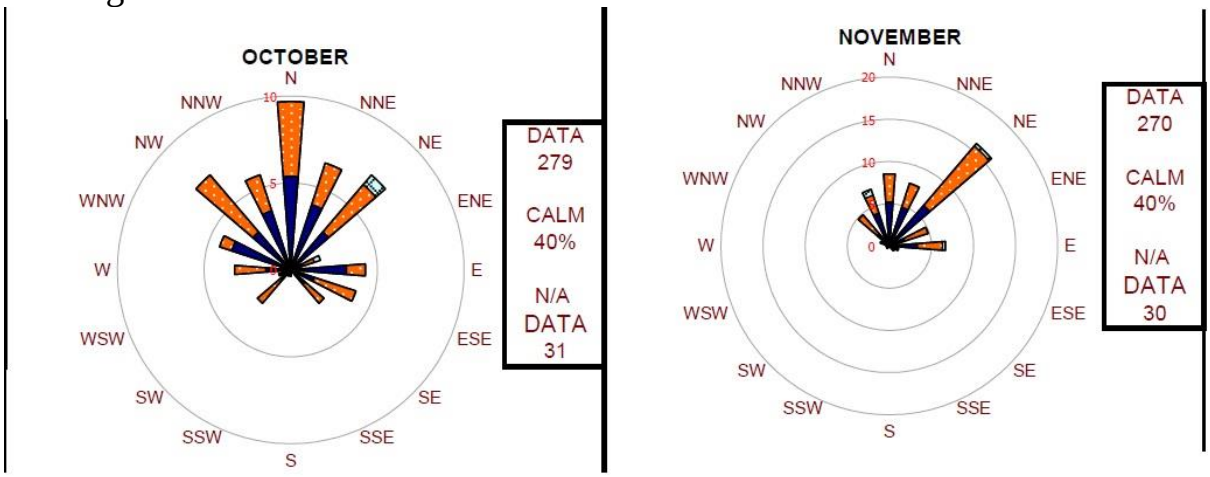


Figure 45. wind roses for Post Monsoon.

Weather on festivals

Uttarayan, festival of Kites (14th January)

Uttarayan is also known as Makar Sankranti in North part of India, Sun started to travel Northwards to the tropic of Capricorn. In Gujarat, Uttarayan is a holiday when every family can be met outdoors. People of all ages fly kites from dawn to dusk. Kite festival is celebrated all over the Gujarat on this day. The wind and temperature are most importance weather parameters to be watched.

Temperature

The Maximum temperature on 14th January based on 10 years data (2010 to 2019) varies 25°c to 30°c.the minimum temperature also varies between 11°c to 17°c. Minimum temperature recorded 11°c on 14th January 2010, lowest minimum till date on 14 January is 7°c in the year 1983.

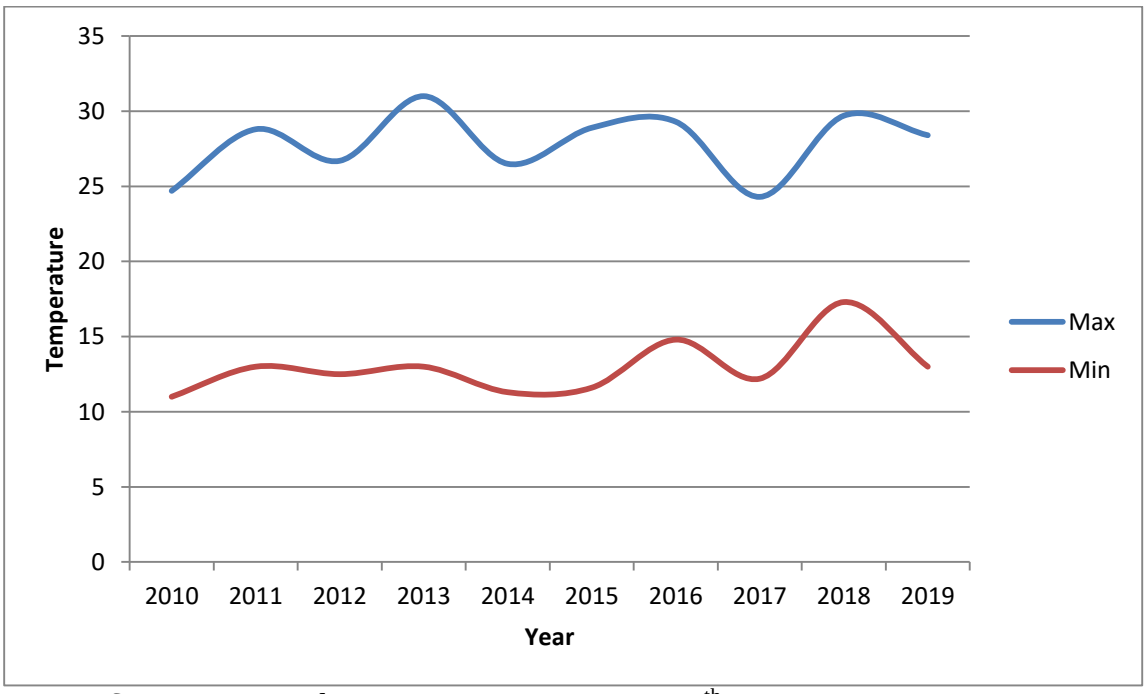


Figure 46. Maximum and Minimum temperature on 14th January.

Republic Day(26th January)

The weather on Republic day is marked by sunny afternoons with maximum temperatures varies 25°C to 30°C. Highest maximum recorded on this day is 34.4°C in 2017. Minimum temperature varies 10°C to 15°C. Lowest minimum recorded in the duration 2010 to 2019 is 8°C in 2016. Lowest minimum on 26th January till last 50 year is 7.9°C in 2008.

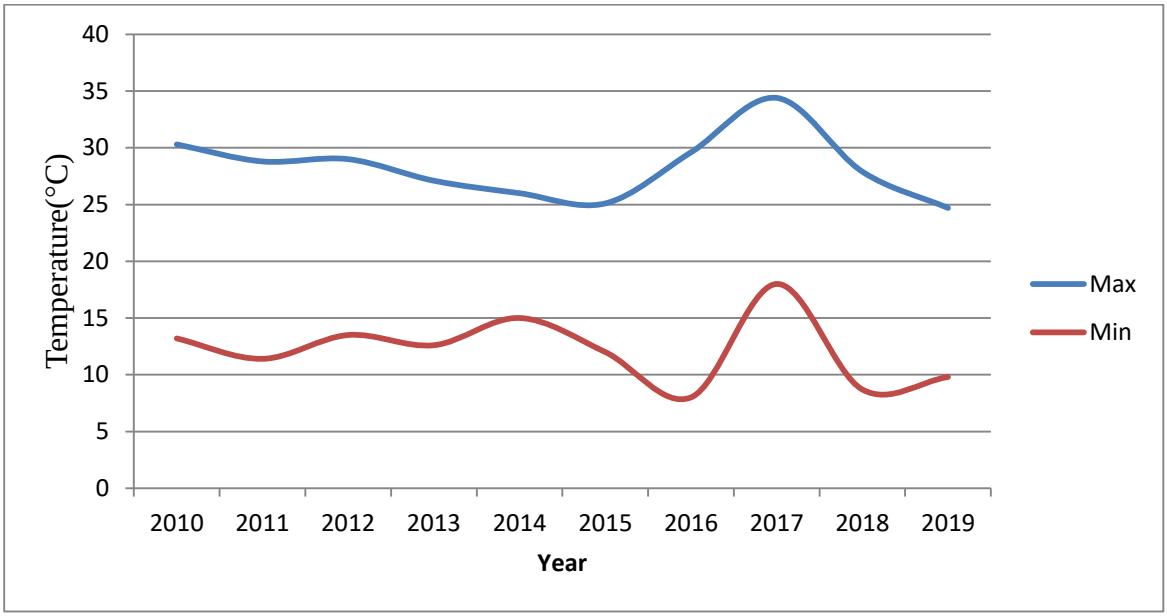


Figure 47. Maximum and Minimum temperature on 26th January.

Independence Day(15th August)

Maximum temperature, Minimum temperature and Rainfall on 15th August during 2010 to 2019 is shown in figure 48. Maximum temperature is between 30°C to 33°C. Highest maximum temperature recorded on the day is 34°C in the year 2016 however it is 37°C in the year 1972. Minimum temperature most of time around 25°C, it is clearly observed in figure 48 that the lowest minimum during the period 2010 to 2019 is 24°C recorded in 2012 and lowest temperature recorded in last 50 years was 23°C in the year 1984.

The probability of rainy day on the 15th August (rainfall≥2.5mm) is 40% based on data 2010 to 2019 (from figure 27). Rainfall more than 2.5mm recorded only in four years during 2010 to 2019. Highest rainfall for same period on the day is 42.6mm in 2011(2010-2019). However, it is 45mm on 15th August 2000.

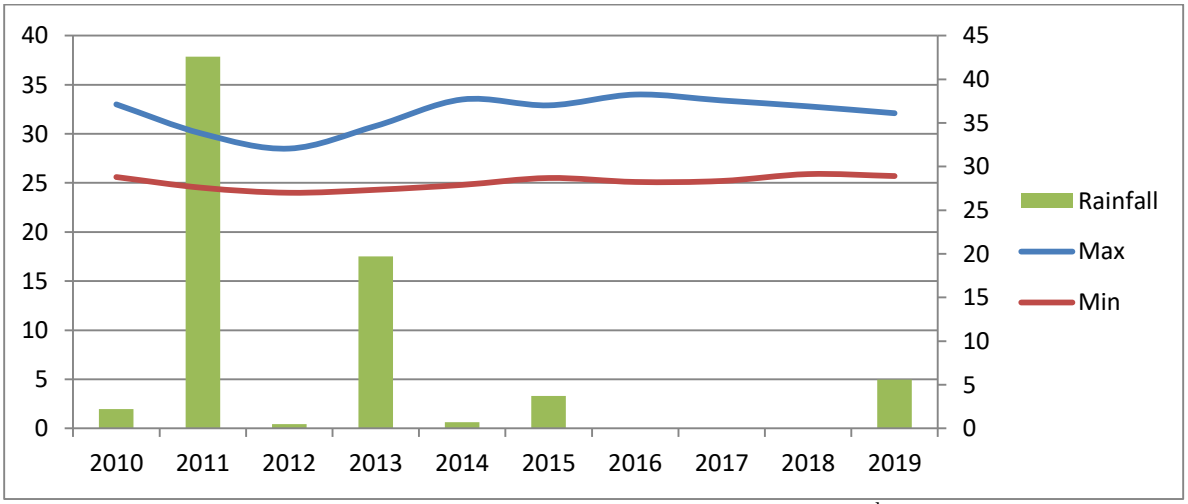


Figure 48. Maximum and Minimum temperature and Rainfall on 15th August

Average and Extremes of temperature over Ahmedabad (2010 to 2019)

Month	Maximum Temperature(°C)			Minimum Temperature(°C)		
	Mean	Highest	Date and year	Mean	Lowest	Date and year
January	27.9	34.8	25 Jan2017	12.3	6.6	17 Jan 2011
February	31.1	37.8	24 Feb 2015	15.2	5.2	09 Feb 2012
March	35.9	43	21 march 2010	19.6	10.2	12 March 2017
April	39.8	44.6	18 April 2010	24.5	16.2	8 April 2017
May	42.2	48	20 May 2016	27.5	23.4	3 May 2018
June	39.4	45	5 June 2014	28.1	22.6	24 June 2019
July	34.1	41	21July 2019	26.2	22.2	5 July 2013
August	32.5	36.2	30 August 2015	25.4	22.3	5 August 2010
September	33.4	38.7	22 Sep 2018	24.9	22.2	27 Sep 2018
October	35.6	39.4	6 Oct 2017	22.2	15.8	29 Oct 2012
November	32.9	37.4	3 Nov 2017	17.9	11.3	29 Nov 2012
December	29.1	35.6	31 Dec2015	13.7	7.4	15 Dec 2014

Table 10. Average and Extremes of temperature over Ahmedabad (2010 to 2019)

Average and Maximum number of days with cold wave in Ahmedabad (2010 to 2019)

Month	Average Number of days with		Maximum Number of days with cold wave/severe cold wave	
	Cold wave	Severe cold wave	Number	Year
December	**0.6**	**1.1**	**5**	**2010**
January	**1**	**0**	**3**	**2014**
February	**0.3**	**0.1**	**2**	**2019**

Table 11. Average and Maximum number of days with cold wave

Average and Maximum number of days with Heat wave in Ahmedabad(2010 to 2019)

Month	Average Number of days with		Maximum Number of days with heat wave/severe heat wave	
	Heat wave	Severe Heat wave	Number	Year
March	**1.0**	**0**	**5**	**2010**
April	**0.4**	**0**	**3**	**2010**
May	**0.3**	**0**	**2**	**2016**

Table 12. Average and Maximum number of days with Heat wave

Average and Extremes of rainfall over Ahmedabad (2010 to 2019)

Month	Monthly average	Highest in 24-hours(mm)		Highest in a month(mm)	
		Highest	Date and year	Rainfall	Year
January	1.49	6.9	22 Jan 2015	7.6	2015
February	0.02	0.2	16 Feb 2016	0.2	2016
March	3.07	19.2	1 March 2015	26.3	2015
April	4.59	21.6	13 April 2015	22.1	2015
May	1.03	6.7	14 May 2015	6.7	2015
June	59.01	130.4	25 June 2015	135.5	2015
July	338.93	288.1	30 July 2014	607.9	2014
August	215.91	237.4	8 Aug 2010	534.3	2010
September	145.96	80.8	25 Sep 2013	343.3	2019
October	21.98	36.9	9 Oct 2016	99.4	2016
November	3.6	12.8	23 Nov 2010	31.1	2010
December	1.37	11	6 Dec 2017	12	2017

Table 13. Average and Extremes of rainfall

Average number of days with different weather phenomena (2010 to 2019)

Weather phenomenon							
Month	Rain	Hail	Thunder	Squall	Dust storm	Gale	Fog
January	0.3	0.0	0.1	0.0	0.0	0.0	0.3
February	0.0	0.0	0.2	0.1	0.0	0.0	0.1
March	0.3	0.0	0.8	0.0	0.0	0.0	0.0
April	0.5	0.0	1.1	0.1	0.0	0.0	0.0
May	0.1	0.0	1.5	0.2	0.0	0.0	0.1
June	2.9	0.0	4.8	0.3	0.2	0.0	0.0
July	11.0	0.0	7.1	0.2	0.0	0.0	0.0
August	10.7	0.0	5.1	0.0	0.0	0.0	0.1
September	7.3	0.0	5.8	0.2	0.0	0.0	0.0
October	1.2	0.0	1.1	0.0	0.0	0.0	0.0
November	0.5	0.0	0.4	0.0	0.0	0.0	0.1
December	0.1	0.0	0.1	0.0	0.0	0.0	0.0

Table 14. Average number of days with different weather phenomena

Highest magnitude of rise in temperature in 24 hours (≥4°C)

Month	Maximum temperature		Minimum temperature	
	Date and Year	Temperature rise(°C)	Date and Year	Temperature rise (°C)
January	04-Jan-14	6.2	07-Jan-14	4.2

February	13-Feb-2019	4.1	22-Feb-10	5.9
March	12-Mar-2015	4.5	25-Mar-16	6
April	22-Apr-12	6.4	22-Apr-14	4.6
May	-	-	-	-
June	12-Jun-11	6.1	05-Jun-11	5.4
July	06-Jul-18	7	-	-
August	14- Aug-2011	5.8	-	-
September	13 sep 2011	5.8	-	-
October	08-Oct-16	5.1	-	-
November	26-Nov-10	4.9	28-Nov-11	4.9
December	08-Dec-17	5.7	10-Dec-15	5.8

Table 15. Highest magnitude of rise in temperature

Highest magnitude of fall in temperature in 24 hours (≤-4°C)

Month	**Maximum temperature**		**Minimum temperature**	
	Date and Year	**Temperature fall(°C)**	**Date and Year**	**Temperature fall (°C)**
January	01-Jan-15	-10.2	18-Jan-12	-7
February	08-Feb-19	-5.1	22-Feb-10	-5.9
March	01-Mar-15	-6.3	12-Mar-17	-7.5
April	21-Apr-12	-6.4	17-Apr-19	-6.5
May	-	-	-	-
June	08-Jun-10	-7.8	24-Jun-18	-5.8
July	11-Jul-12	-9.8	04-Jul-12	-5.8
August	18-Aug-18	-9.6	-	-
September	09-Sep-14	-5.9	-	-
October	12-Oct-17	-5.5	23-Oct-15	-4.2
November	22-Nov-10	-5.1	27-Nov-15	-6
December	06-Dec-18	-7.2	11-Dec-15	-6.9

Table 16. Highest magnitude of fall in temperature

Conclusions:

It is observed that both maximum and minimum temperature fall during December, January and February and both of them increases during March, April, May and till mid of June. After mid of June, maximum temperature goes down but there is not much change in minimum temperature till September. Maximum temperature increases during October but there is gradual fall in minimum temperature. It is also observed that there is gradual fall in both maximum and minimum temperature in the month of November. It is also observed that minimum temperature varies from 5.2°**C** (February) to 31.5°**C**(June) and Maximum temperature varies from 19°**C** (December) to 48 °**C(**May) during the study period. Highest Maximum temperature is recorded in the month of May and highest Minimum temperature recorded in the month of June. Lowest maximum temperature recorded in the month of December and lowest minimum temperature in month of February during study period. Average of maximum temperature is highest in May and average minimum temperature is lowest in January. Wind direction over Ahmedabad is mostly northwesterly to northeastely during winter season.

The dates of progress of southwest monsoon to Ahmedabad is highly variable and the date varies from 7th June to 28th June. Most of the rain occurs over Ahmedabad during July and August. During the 10 years period highest daily rainfall recorded over Ahmedabad was 288.1 mm (30-July-2014). Highest Average number of rainy day (≥2.5mm) is 11 days and thunderstorm is 7.1 days reported in July. Heavy rain days (≥64.5mm) is maximum in july followed by August, average number of days is 1.4 days and 0.9 days respectively. It is also observed that the occurrences of thunderstorm are in the afternoon (15-18 IST) and in evening (18-21). Wind direction over Ahmedabad is mostly sothwesterly and westerly during monsoon season.