



Climate of Jaipur



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Preface

Climate and weather are playing a very vital role in day to day and short to long term activities of human being. Although, day to day activities in any field are not affected by the climate of that place and nearby region. They are governed by weather of that place and surroundings. But medium to long term activities are broadly effected by climate of any place/region. In the present age when technology is advancing rapidly and we are progressing with a GDP between 8 to 9%, it becomes very much needful to know the climatic and past weather information of a place and a region in deep for planning purposes in different field viz. Tourism, Industry, Agriculture, Medical sciences, Irrigation projects, town planning etc. Present booklet is an effort to achieve this goal for the Jaipur city, the state capital of Rajasthan (largest state of India). Jaipur is at present is the most growing city of the country having a population of more than 3.9 millions.

The book contains daily / weekly and monthly summaries of four seasons and also the annual summaries. In each season the diurnal variation, averages and extremes of temperatures, rainfall and humidity have been included . The probability of occurrence of various weather phenomena are also described in detail. Year to year seasonal / annual rainfall variability has also been included.

We are thankful to Shri Mukesh Chauhan, Shri Roop Narayan Kumawat, Shri Ashok Kumar Sharma and Shri Alok Kulshrestha for their help in compilation of data and bringing out this publication.

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Geographical location and Physiography of Jaipur

Jaipur is one of the first planned city of India, located in the semi-desert land of Rajasthan. It is first planned city of India and have a place in world heritage monuments, situated in the foot hills of Aravali range, surrounded by hillock in northern and eastern sides and Plains in western and southern sides. The city once had relished the glory of being capital of royal Kachawaha dynasty, now is capital of Rajasthan state. It was founded on 18th November, 1727 by Maharaja Sawai Jai Singh II, the ruler of Amber. During the visit of Prince of Vales in 1876 the roadside buildings and parapets were painted in pink colour and thereafter, it is popularly known as 'Pink City'. The city today has a population of more than 3.9 million. Its geo-coordinate s are latitude 26° 1' 36" North and longitude 75° 4' 32" East. The height above mean sea level is 390 m. Total length of Jaipur from East to West is about 60 km and total width from North to South is about 75 Km . It is situated in the east of Rajasthan state. In the North of it is Sikar, in the South Tonk, in the East Alwar, Dausa, Sawai Madhopur, and in the West Nagaur and Ajmer districts. East and North area of Jaipur district is surrounded by Aravali hills. Very close to Jaipur, there is a single natural lake named Sambhar lake, the water of which is salty and is the largest source of good quality salt in India.

Old Jaipur



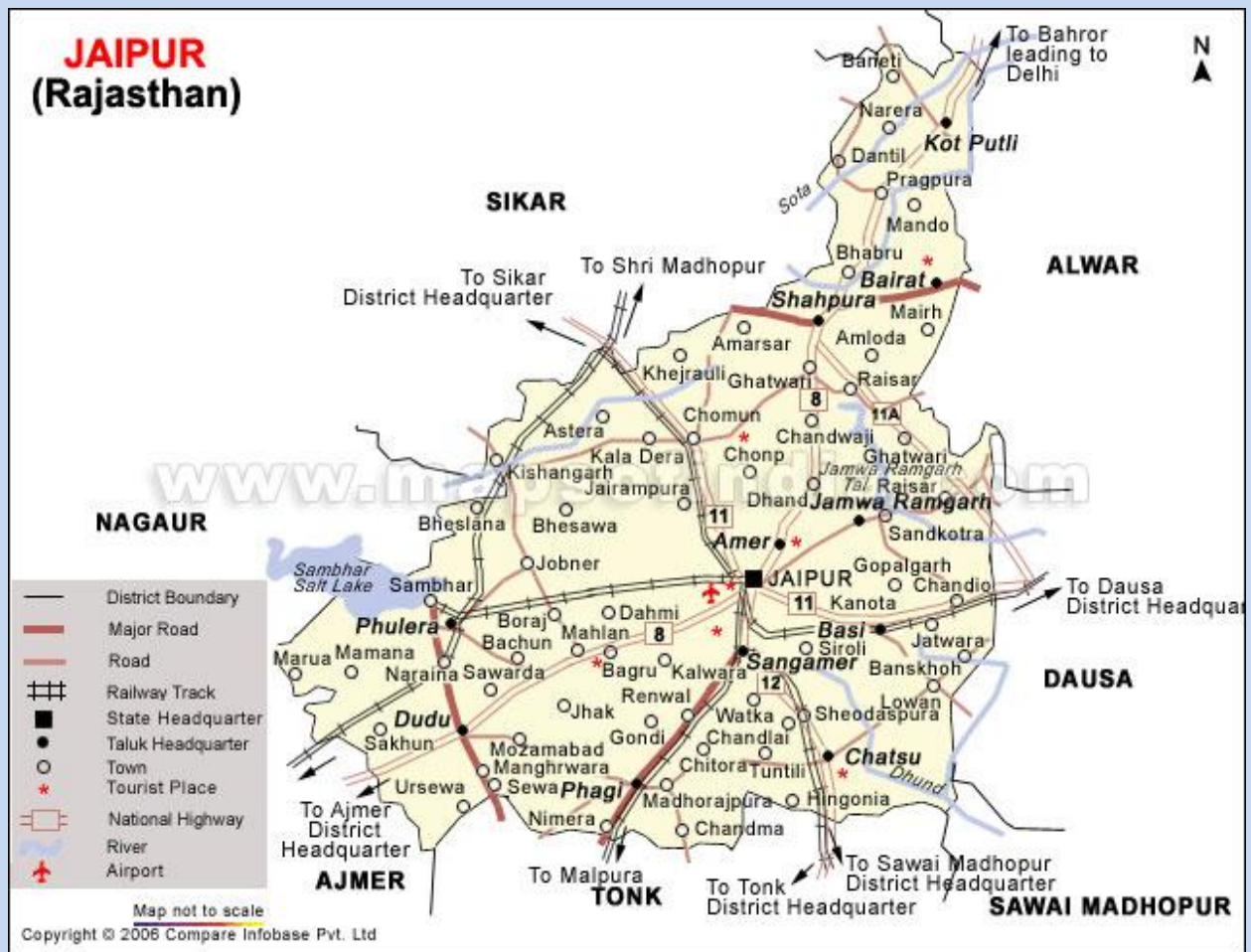


Fig. 1 . Grid map of Jaipur

General Climate of Jaipur

Jaipur - the capital of Rajasthan is situated on the eastern boundary of Thar desert- a semi arid land. A distant place from Arabian Sea as well as Bay of Bengal gives rise of continental climate. During monsoon period from July to September and occasionally during rest period of the year in the wake of western disturbances humidity, cloudiness and rainfall activities increase. The year is broadly divided into four seasons namely - the winter season starts from mid December to mid February, summer or hot weather season from March to May, monsoon season spread from end of June to mid September, and October and November are known as transit period or post monsoon period.

The summer in Jaipur are very hot while winters are extremely cold. The maximum temperatures hover at 40 °C to 47 °C in May. Heat wave prevails for a few days in the season, when day temperature rises to 4 – 6 °C

above normal. The winter minimum temperatures remain about 4 – 9 °C and fall below zero deg. Or so when chilly wind (northerly) blow from Himalayan region. Mist and fog occur in the morning hours after passage of western disturbances. The minimum temperature as low as -2.2 °C was recorded on 16th January, 1964 and 31st January, 1905.

The Maximum temperature's upward surge starts from April and reaches at peak in the month of May. The down ward trend in minimum temperatures commences in September and continues up to January. January is the coldest month. Rainfall increases from the month of June when thundery activities start and July and August are the rainiest months. Monsoon withdraws in the middle of September. Rainfall decreases sharply in October and November. These are the transit months.

Data used

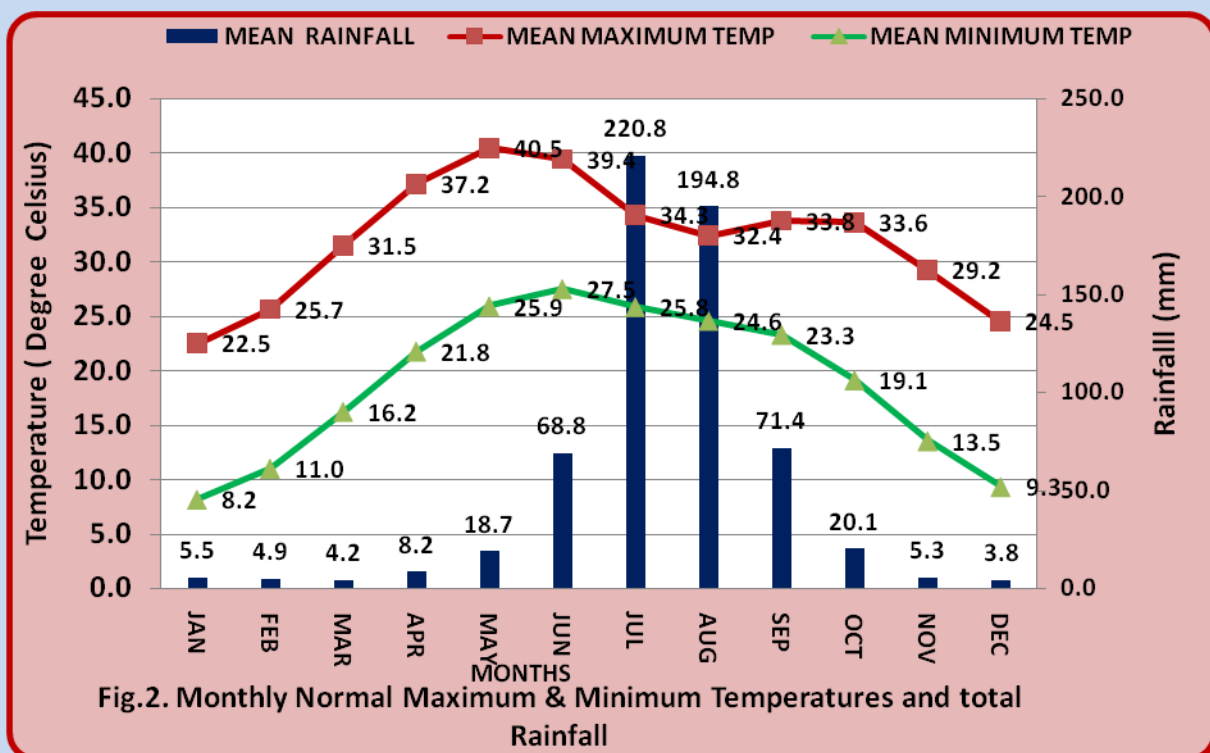
The meteorological observatory situated at Sanganer airport, Jaipur is functioning since 1948 and the data observed represents the climatic conditions of Jaipur city. Daily data of this observatory have been used to define the climatology of Jaipur . The climatology viz. Maximum, minimum, and extreme Temperature s, wind, rainfall and cloudiness etc. Described in the following section is based on 58 years period of 1952-2009. The rainfall climatology is based on 43 years (1969 to 2011) data. The extremes of rainfall and temperatures are based on long period data set from 1875 to 2011. The data on weather phenomena are for a 21 year 's period of 1985-2005

Annual march of Meteorological parameters

The annual march of maximum/minimum temperatures humidity, rainfall are given in Fig. 2 to Fig. 19 These show that maximum temperatures are at their peak in the month of May and June. These parameters start falling in the month of July and further falls in the month of August due to persistent rainfall. But after withdrawal of monsoon in the month of September these again show a rising tendency in the month of October . From November onward the maximum and minimum

temperatures start falling gradually up to the month of January. Afterward both these temperatures start rising and continue their march up to the month of May . The lowest mean maximum/minimum temperatures are realised in the month of January. The highest mean diurnal variation (14 to 15 °c) in temperatures is observed in all months except the monsoon season where it is in the range of 7 to 10 degree Celsius (Fig. 4).

The lowest total normal rainfall is observed in the month of December and the highest in the month of July . July and August are the main rainiest months. From October onward the rainfall decreases drastically which continues up to the month of April . From May onward the rainfall slightly picks up and reaches at its peak in the month of July. June to September are the main rainy months and this period is referred as the “ Monsoon Season “. Dry and hot weather is prevails from March to May months which is called the “ Summer season “. Temperatures are very low during the period of December to February, and is called “ Winter Season “. October and November months are the transit months between Monsoon and winter season . This period is referred as “Post Monsoon Season “.



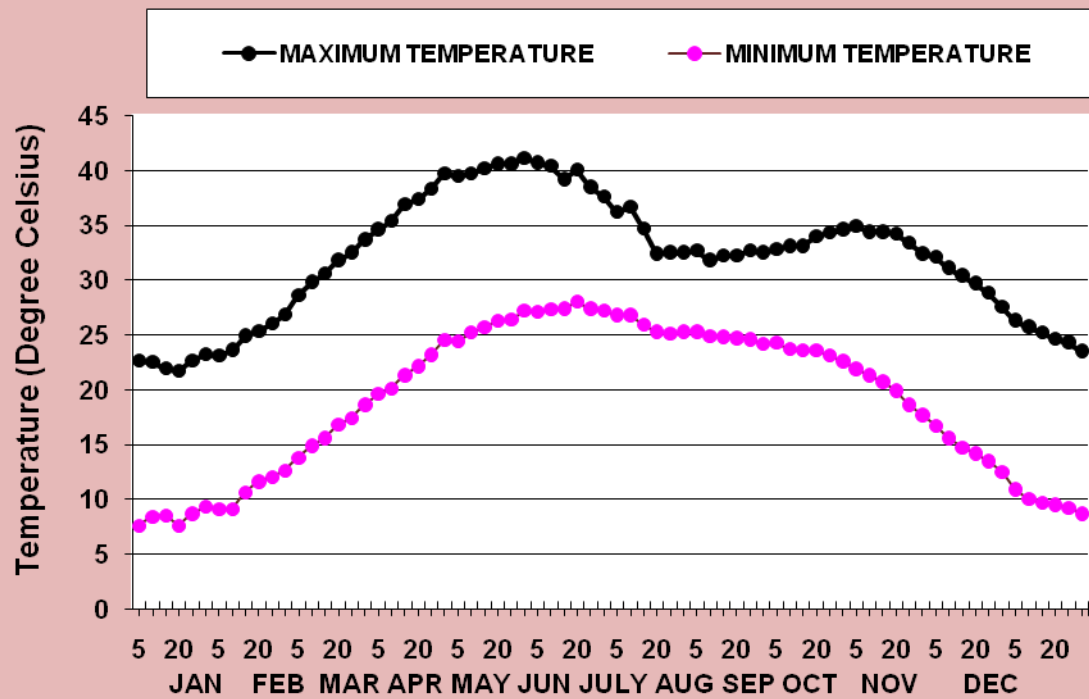


Fig.3. Daily Normal Temperatures Annual

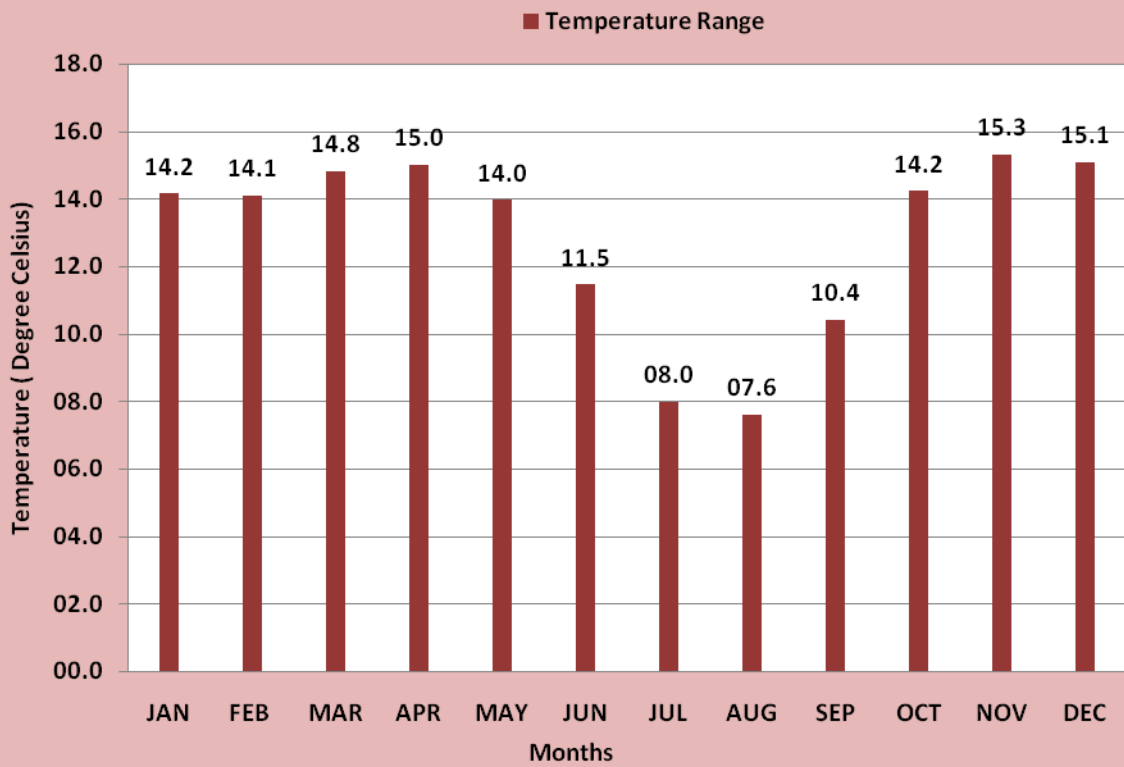


Fig.4. Normal Daily Temperature Range

The lowest humidity is observed in the month of April. May onward humidity picks up and increases gradually to have its highest values in the month of August. After this, it decreases slowly up to the month of November. But again shows an increasing tendency for two months namely December and January. From next month onward the humidity again shows a decreasing trend and attains its lowest value during the month of April (figures 5 &6).

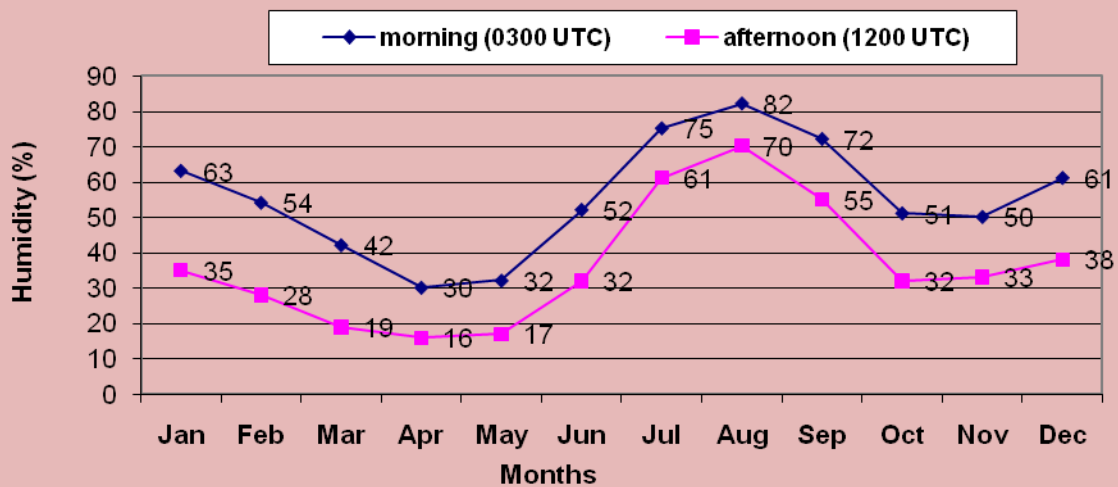


Fig.5. Monthly Normal Relative Humidity

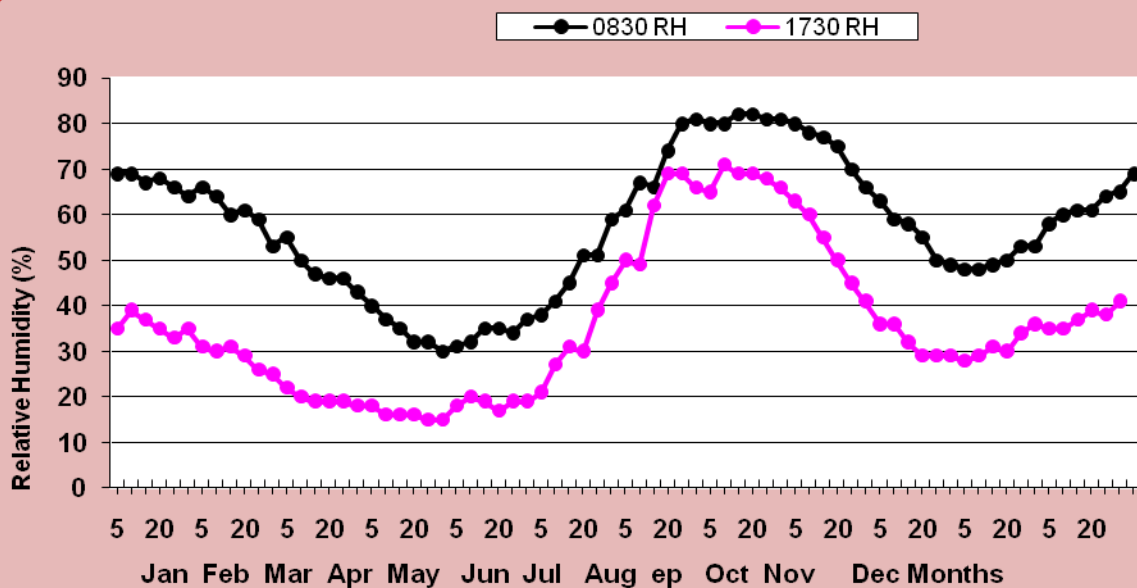


Fig. 6. Daily Normal Relative Humidity

Generally, the average monthly wind speed varies in between 3.0 to 10.0 kmph during the year. But in summer, there are dust storms, dust - raising winds prevailing and wind speed reaches up to 10 kmph (Fig. 7). Maximum wind speed recorded at Jaipur is 113 kmph on 31 May, 2001.

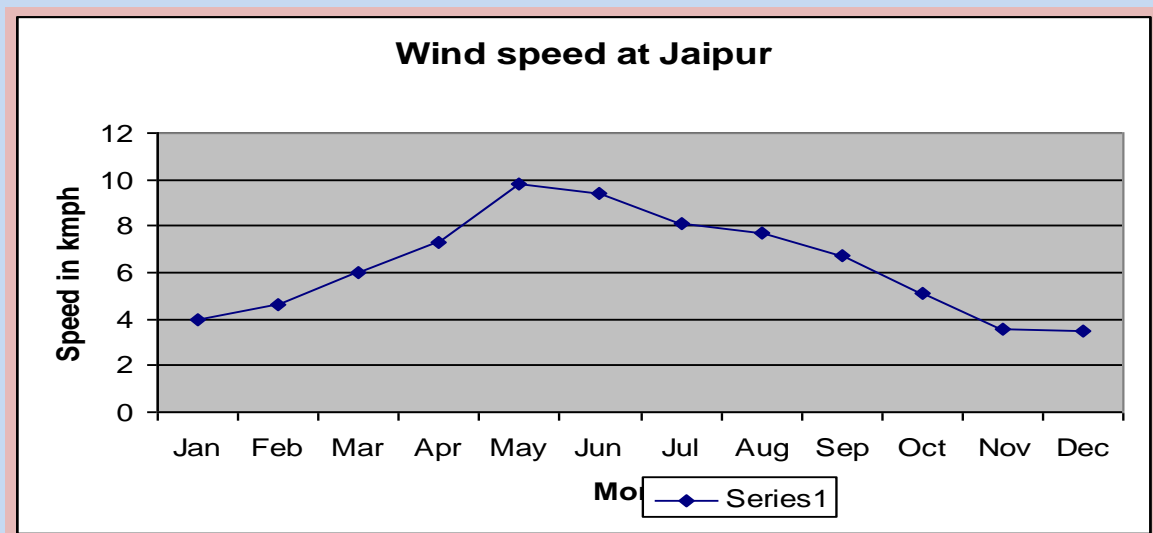


Fig. 7

Probability of mainly clear sky during winter and post monsoon season is 70 to 80 %. While the chances of overcast during these seasons are about 7 to 8 % only. Chances of 5-6 oktas clouds or overcast sky during July and August are more than 70% (figures 8 & 9).

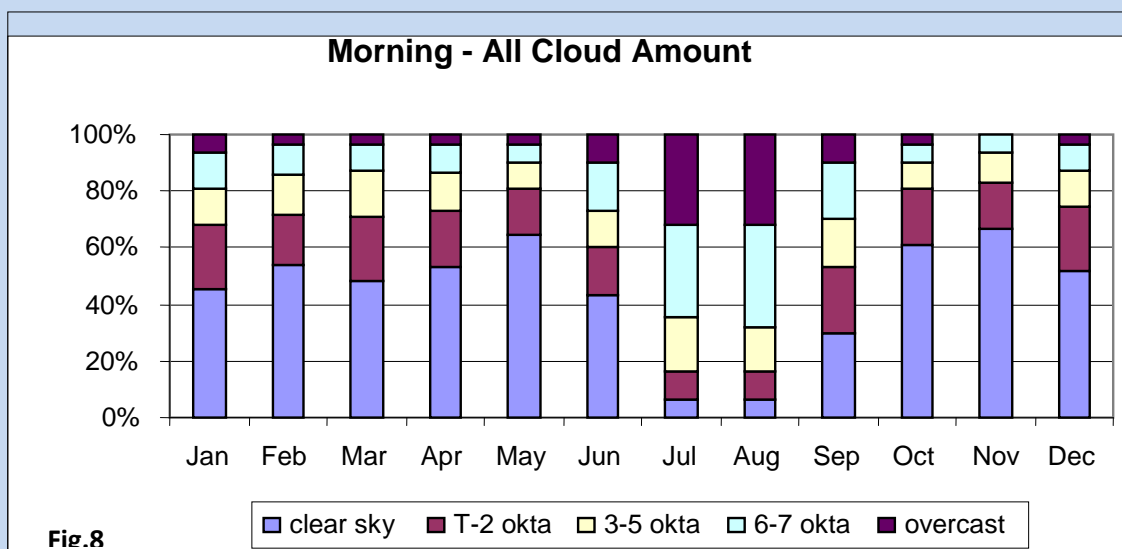
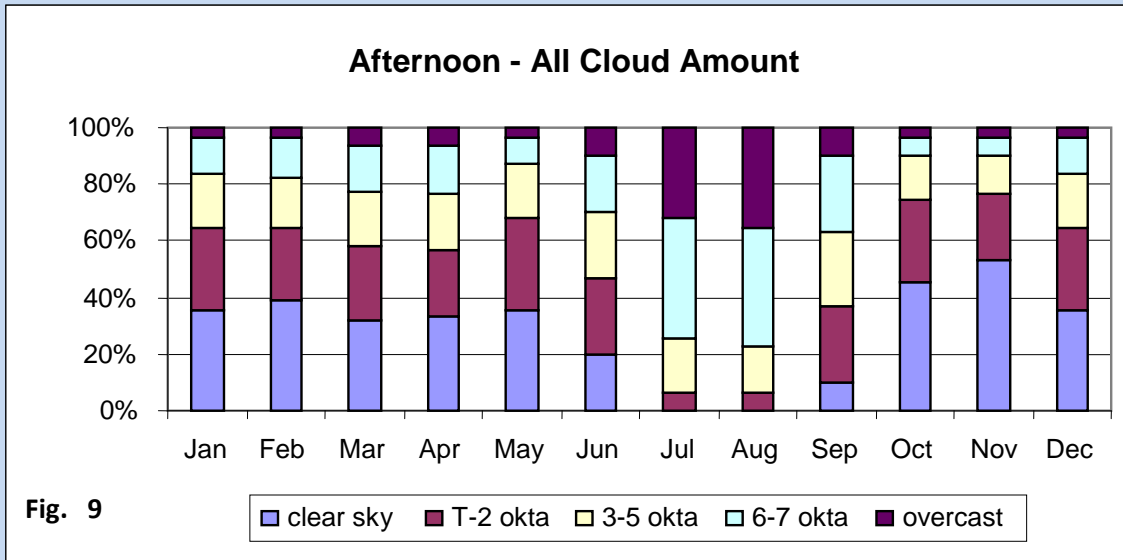


Fig.8



Visibility

Chances of poor visibility (visibility < 1 km) during morning hours is more in the months of, January, February and May in comparison to rest part of the year. During 2nd half of the year, probability of visibility more than 4 km during morning hours is maximum (> 90%) (Fig. 10).

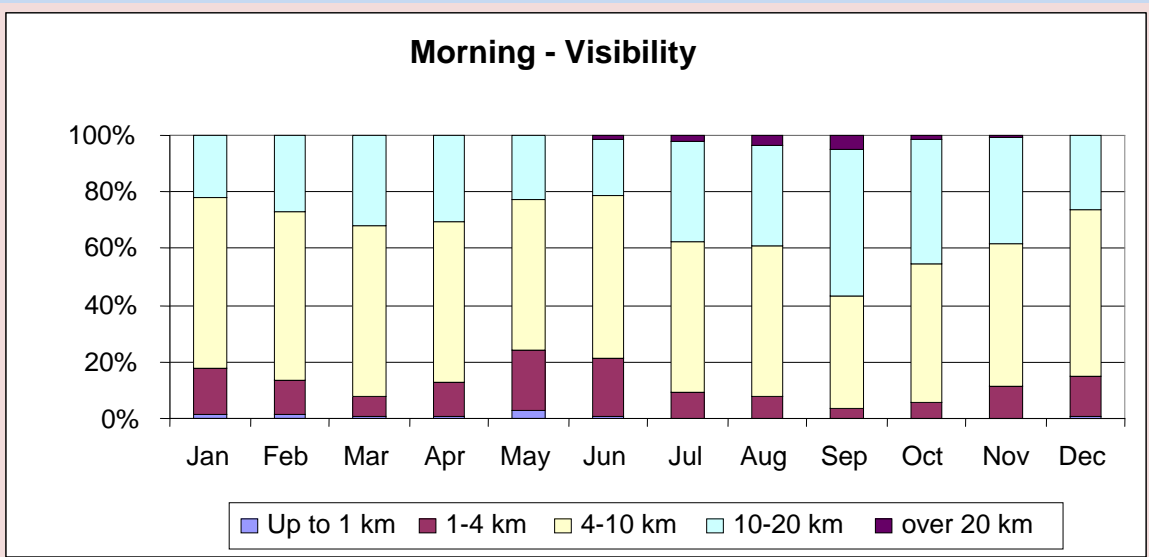
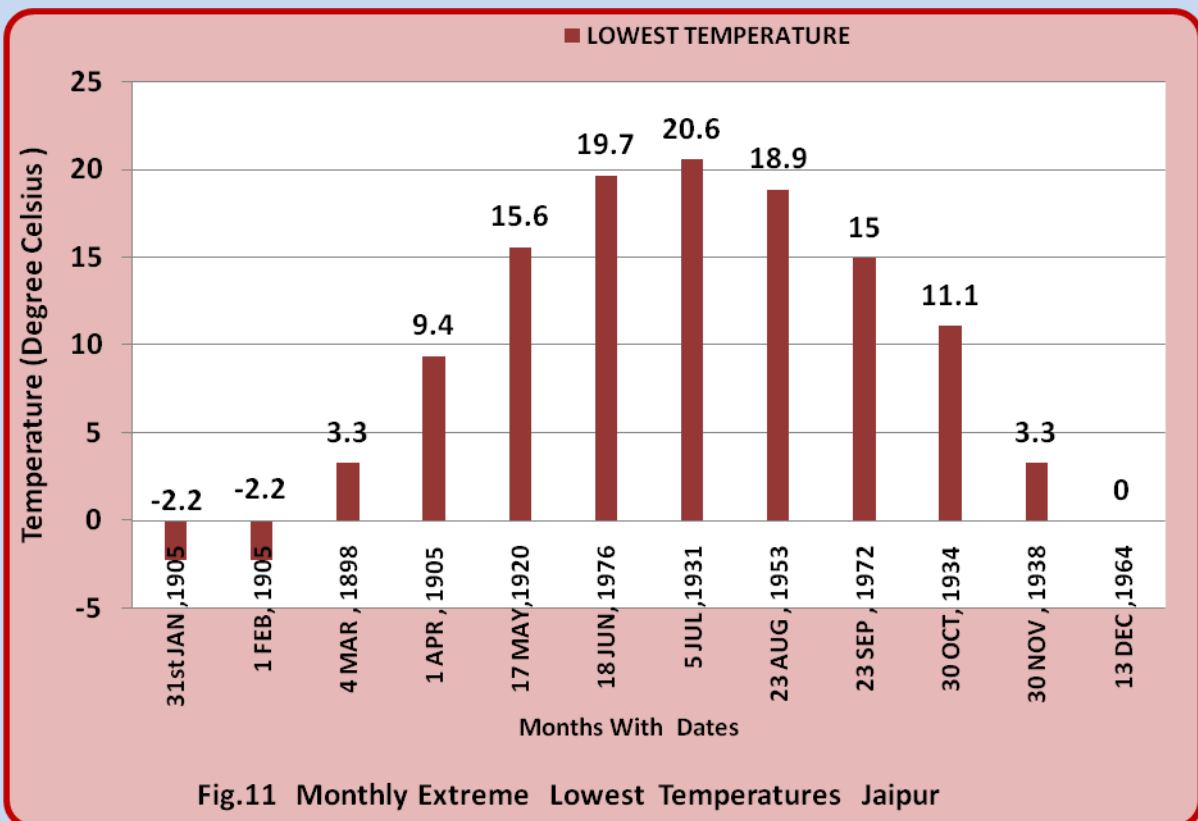
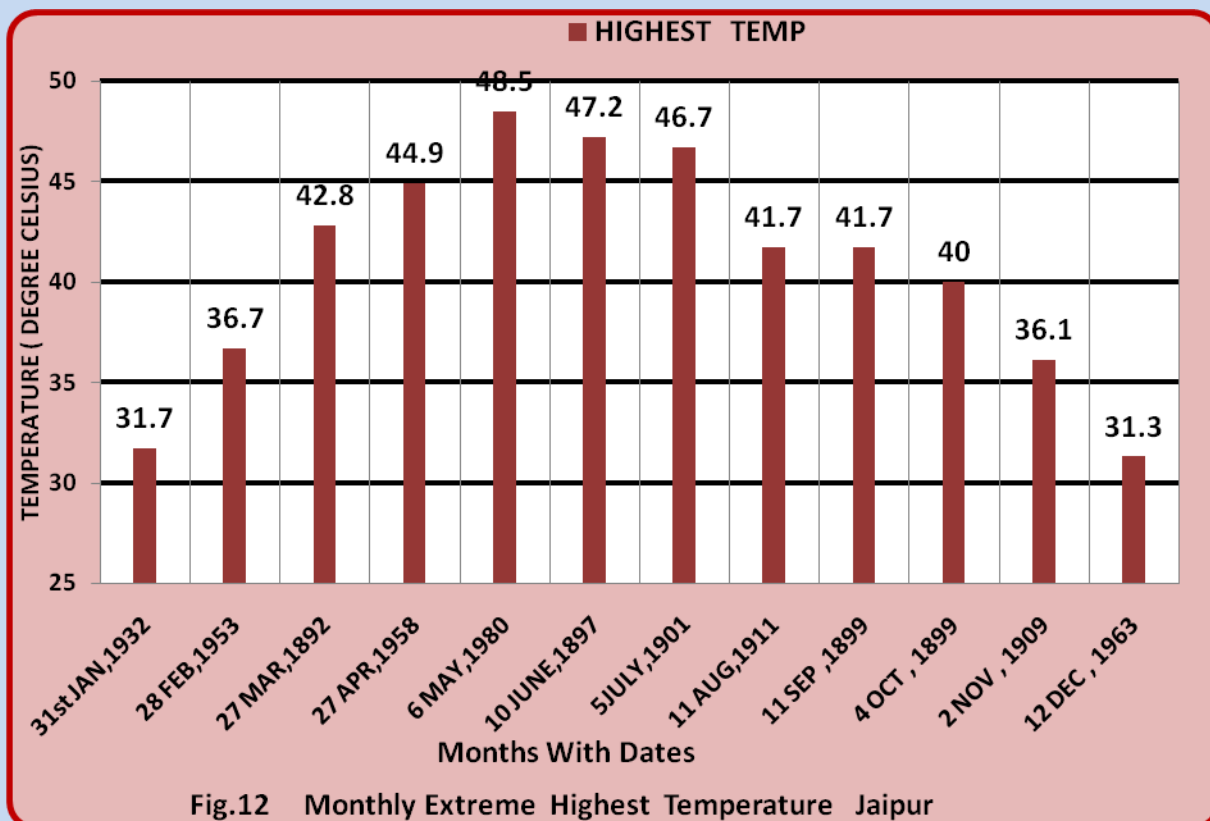


Fig. 10 Probability of visibility in different range

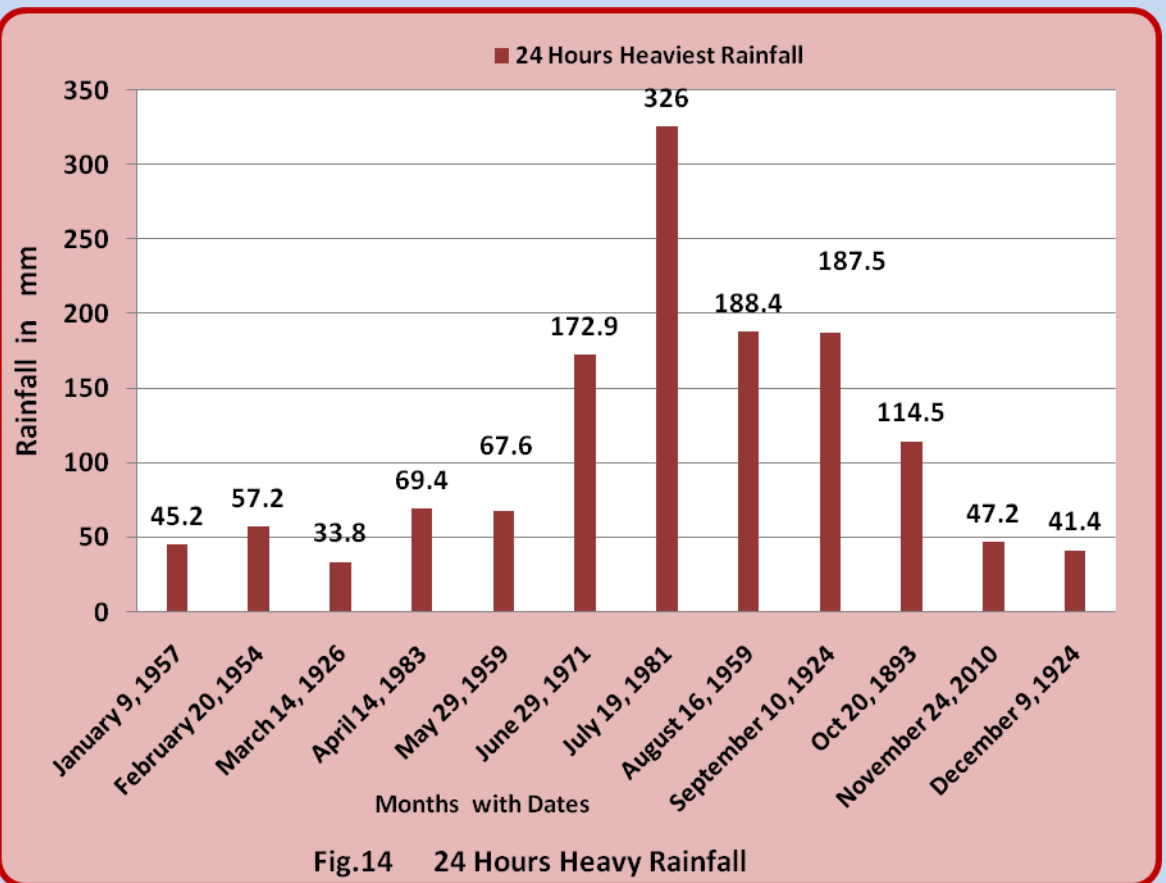
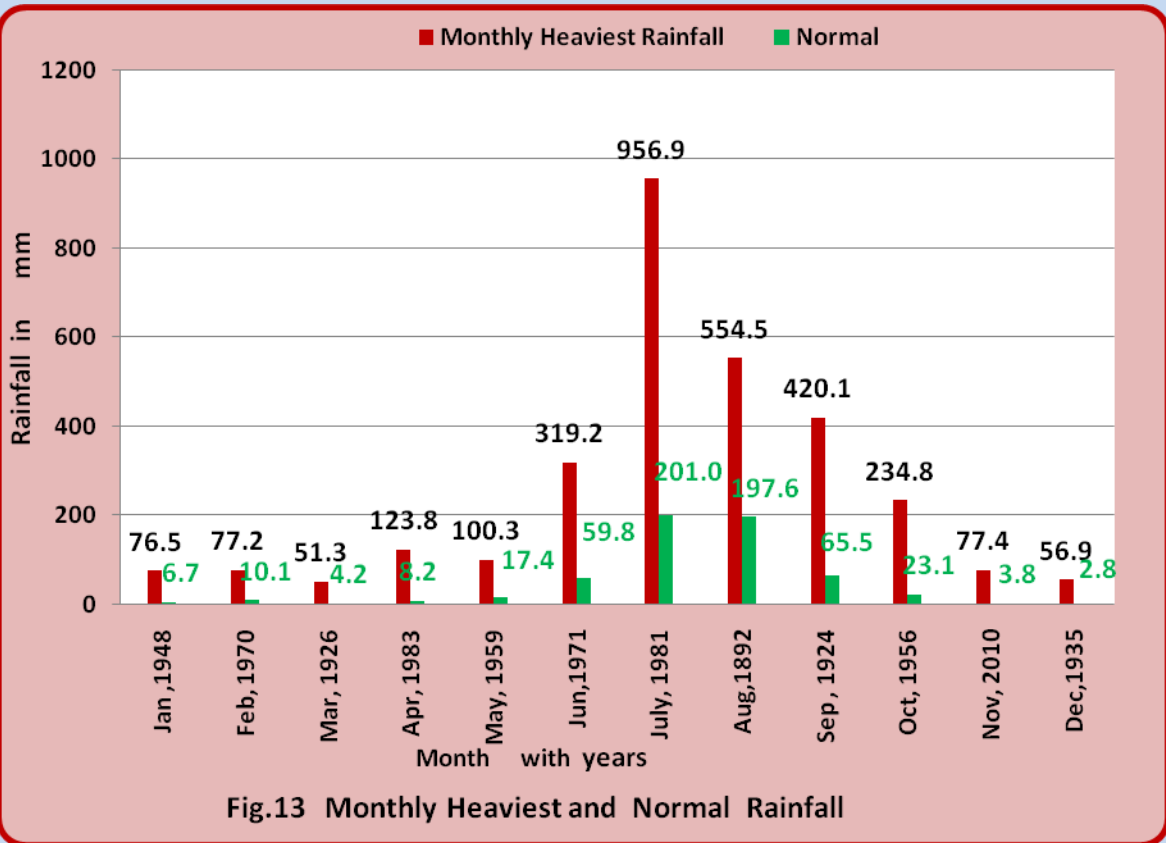
Extreme Temperatures

Extreme temperatures are shown in Fig.11 and Fig.12. These diagrams show that during winter months the lowest temperature even comes down below the freezing level (Zero degree Celsius). On 31st January, 1905 and 1st February 1905 it was recorded -2.2 °C. On the other hand the highest temperature during summer months touches the level of 48 °C. which indicates that summers are extremely hot as well winters are extremely cold. But practically, the duration of cold climate is short (maximum three months).The highest ever recorded temperature over Jaipur has been observed 48.5 °c on 6th May, 1980. Further, out of 12 months, the highest temperatures have been recorded 40 °C or above during 8 months (March to October) which reflects the warmer climate for longer period over the city. The lowest extreme temperatures shows an increasing tendency from January to July and a reverse tendency from August to January. On the other hand the highest maximum temperature on monthly scale shows a decreasing tendency from July to December while the reverse tendency from January to May.

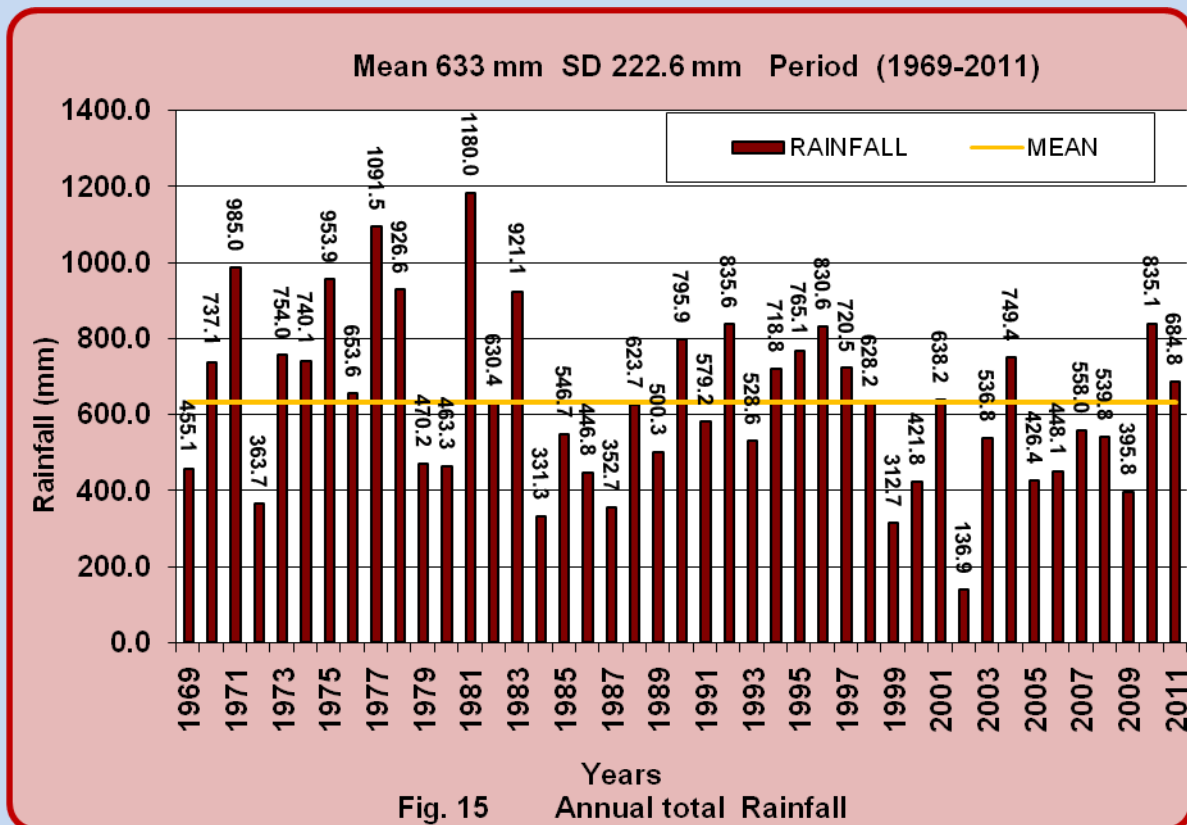




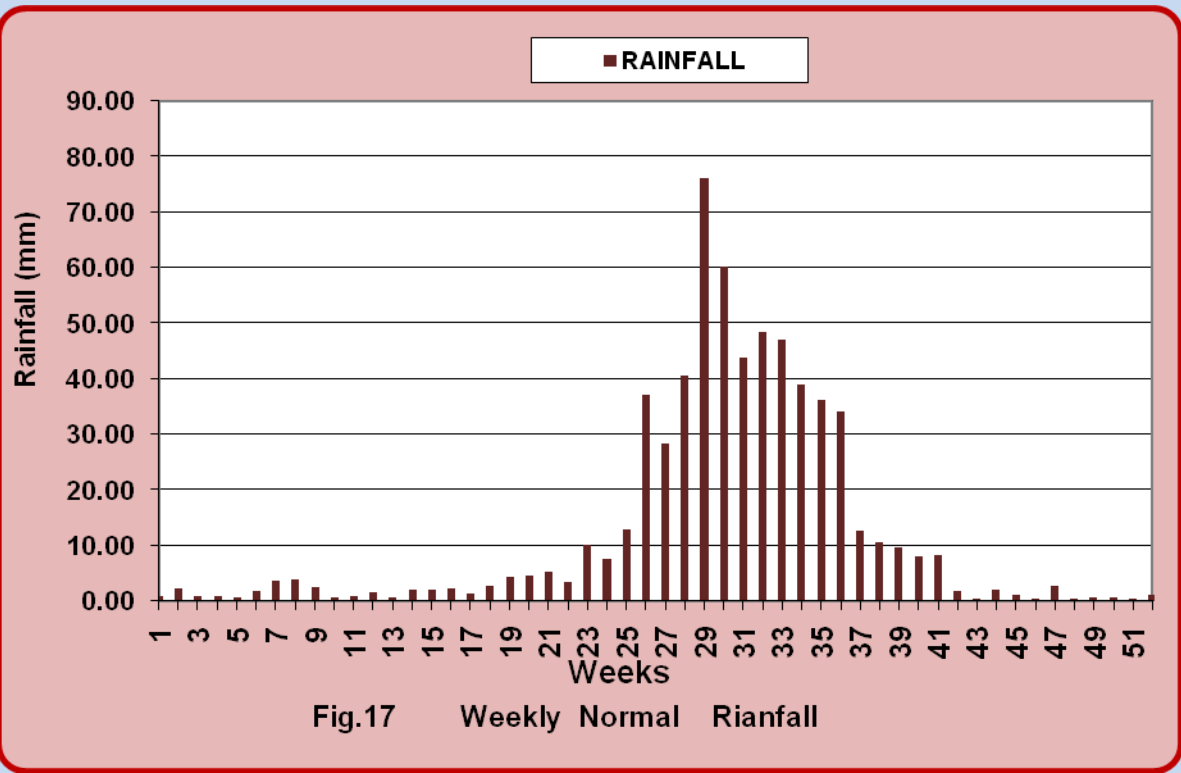
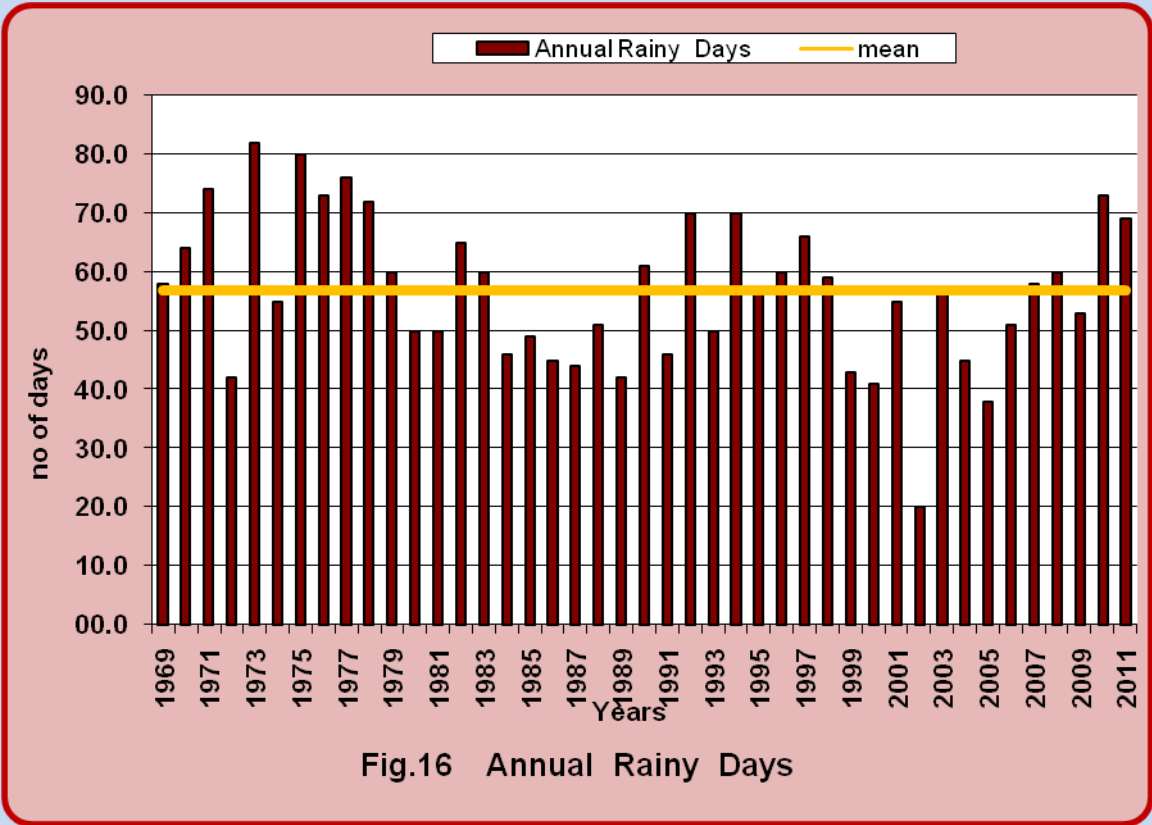
Monthly normal and highest total rainfall are given in Fig. 13 .The highest monthly rainfall (957 mm) has been observed in the month of July during 1981 which is about 350% more than of the normal (201 mm). The monthly highest rainfall during winter and post monsoon months are of the order of 55 to 77 mm . 24 hours highest rainfall values during various months are shown in Fig. 14 . Which shows that 326 mm rainfall was realised as the highest 24 hours rainfall over the city during the year 1981 on 19th July. This is also the ever recorded highest 24 hours rainfall. The one day highest rainfall during winter months are of the order of 40 to 60 mm only.



Annual total rainfall variation during the period 1969-2011 is shown in Fig. 15 which shows that the average annual rainfall is 633 mm with standard deviation (SD) 223 mm .The highest annual rainfall 1180 mm and the lowest 137 mm have been observed during the years 1981 and 2002 respectively.



The annual rainy days are shown in Fig. 16. The normal annual rainy days are 58 days. while the highest annual rainy days are 81 days (year 1973) and the lowest are 20 days (year 2002)



Normal weekly rainfall and rainy days are shown in Fig. 17 and Fig. 18. The heaviest weekly normal rainfall is 76.2 mm, observed in the 29th

week which is the 3rd week of July. Most of the weeks during post monsoon season have insignificant rainfall. However all weeks during the period 3rd week of July to last week of September may also have all days as rainy days while normal maximum rainy days during a week are 4. The average weekly rainy days during post monsoon, winter and summer season are less than 1 day. Maximum weekly rainy days during December and January months are only 2 to 3 days

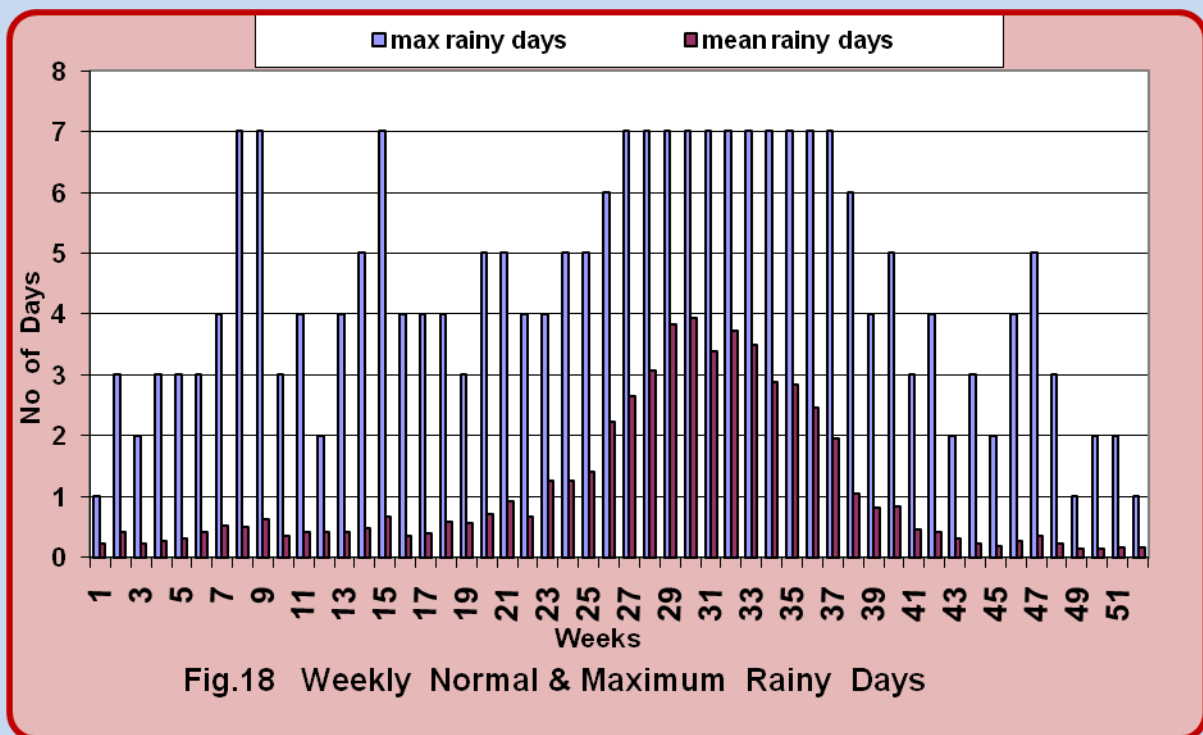
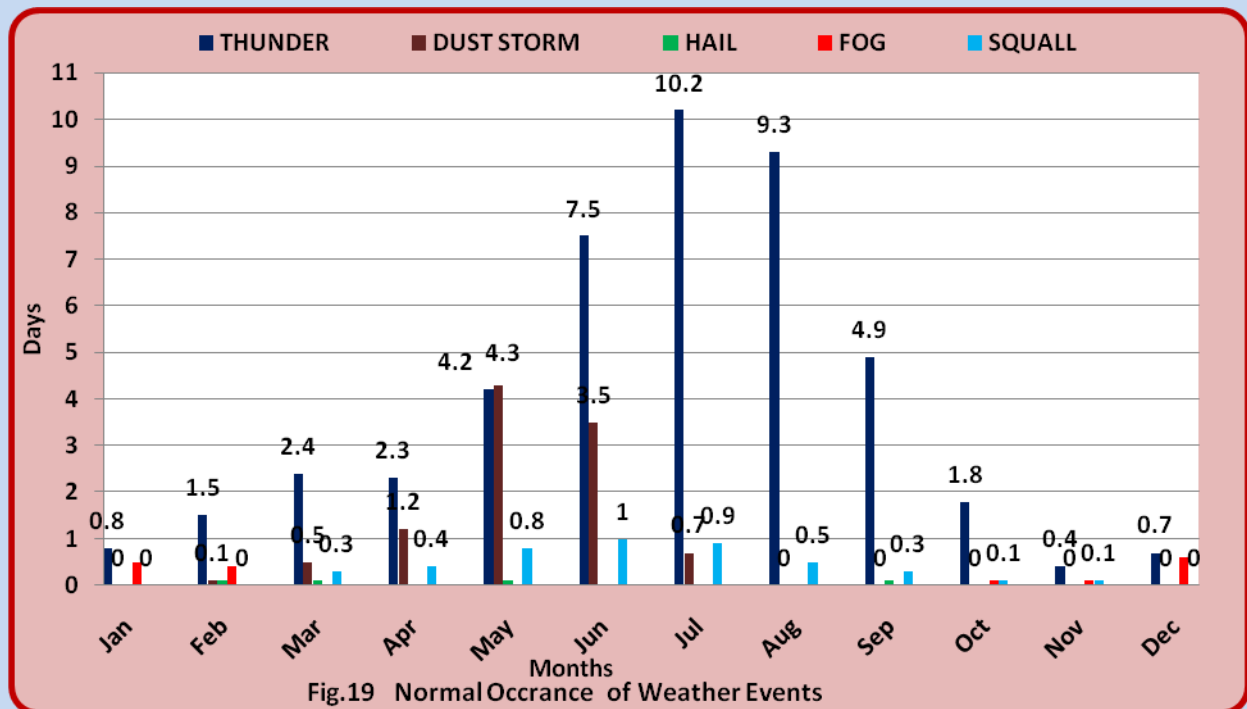


Fig.18 Weekly Normal & Maximum Rainy Days

Weather phenomena

The average frequency of various weather phenomena are shown in Fig. 19. An increasing tendency of thunder storm is observed from January to July while a reverse tendency during the rest period (August to December). Highest (10.2 days) thunder storms are observed in the month of July and the lowest (7 days) in December. Highest Dust storms are observed in the month of May. Dust storm activities are confined only to a limited period of summer and a part of monsoon season (March to July) with an increasing tendency from March to May and a reverse tendency from June to July. Highest (1 day) squall are

observed in the month of June . Practically no squall is recorded in winter season . An increasing tendency of squall from March to June and then reverse tendency from July to November. Average foggy days during the winter season are less than 2 days while the average hailstorm occurrence is only 4 days throughout the year .

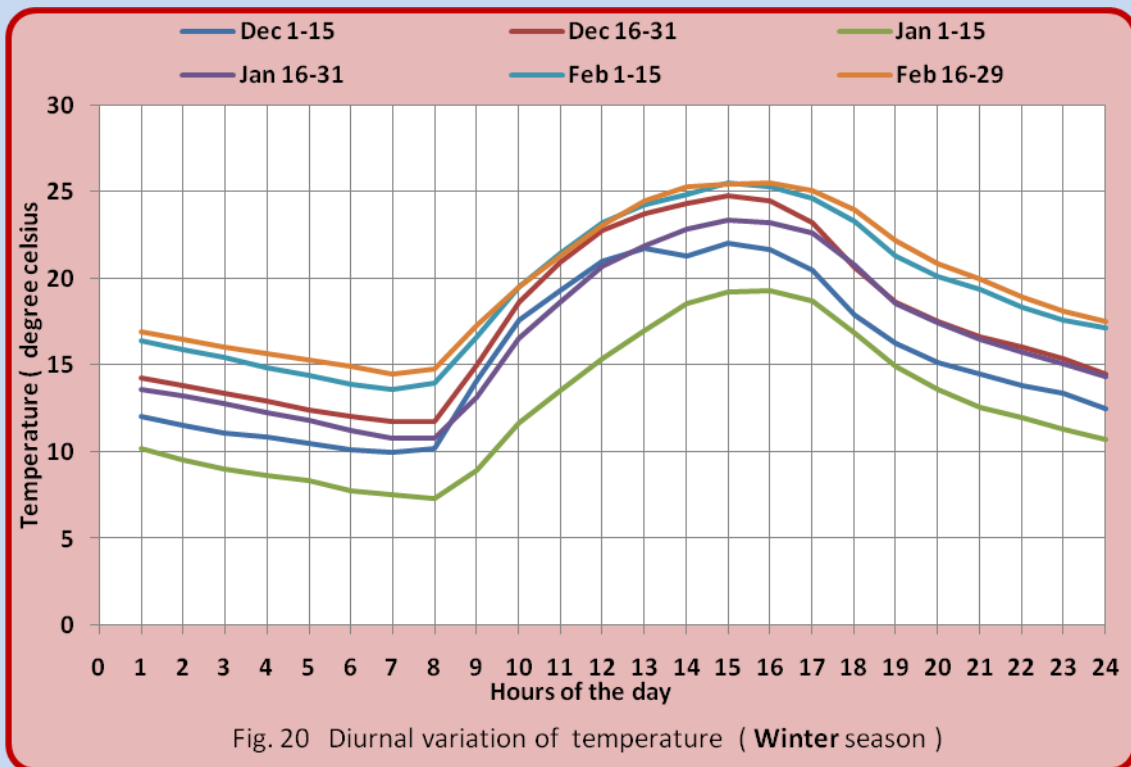


Winter Season

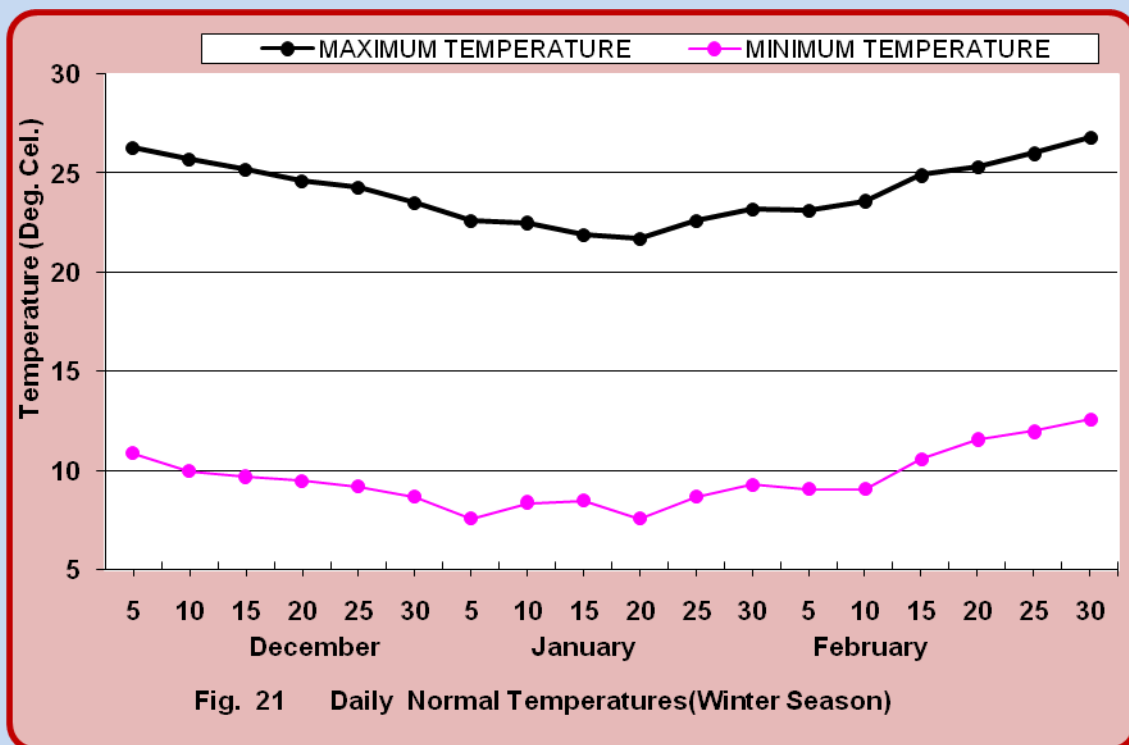
Winter season in Jaipur starts from mid December and lasts up to mid February . The winters are moderately cold and temperatures fall when the chilly northerly / northwesterly winds from Himalayan region prevail in the area. Mist or fog generally occurs in the rear of a western disturbance during morning hours. It lasts for 2 – 3 days.

Temperatures

Fig. 20 shows the diurnal variation of daily temperature during winter season. It can be seen that the minimum temperature of the day is observed during morning hours at around 7 to 8 AM and the maximum temperature between 3 to 4 PM.



Daily normal maximum and minimum temperatures during the season are shown in Fig. 21 which infer that both maximum and minimum temperatures fall gradually up to the end of January and rise gradually up to the end of season . Daily normal minimum temperature during January is about 7-8 °C Variability of mean maximum and minimum temperatures during different months of the season are shown in Fig. 21 .



Climate of Jaipur is also extreme with chilly winters. Daily maximum temperature during winter remains at about 22°C whereas it may dip down to 2°C to 3°C at night. At a few occasions it has dip down even to -2°C. The lowest night temperature has been recorded -2.2°C during 1964 on 16th January on 31st January, 1905. The daytime climate in Jaipur during winters are comparatively cool and pleasant but the nights are very cold with fog at few occasions during morning hours. January is the coldest month of the season with mean minimum and maximum temperatures 7.8°C and 22.5°C. respectively. The mean monthly minimum and maximum temperatures during rest two months viz. December and February are (9.1 & 24.4°C) and (10.7 & 25.7°C) respectively. However, the lowest minimum temperatures observed during different months, December, January and February of this season are 0.0°C (13th Dec, 1964) -2.2°C (16th January, 1964) and -1.6°C (7th Feb., 1974) respectively. Normally cold wave is observed on 6 days per season with highest 17 days (year 1972). During a few years viz. 1981, 1982, 1988, 1995 and 2009 no cold wave was observed (Fig. 23).

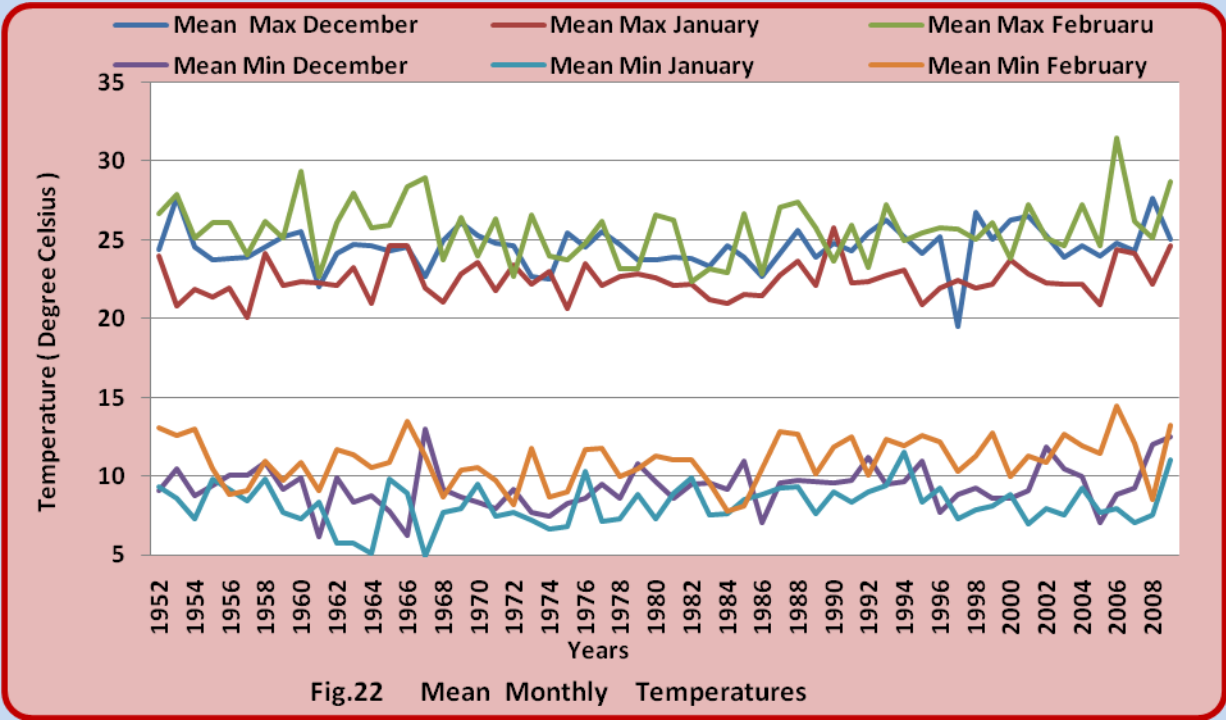


Fig.22 Mean Monthly Temperatures

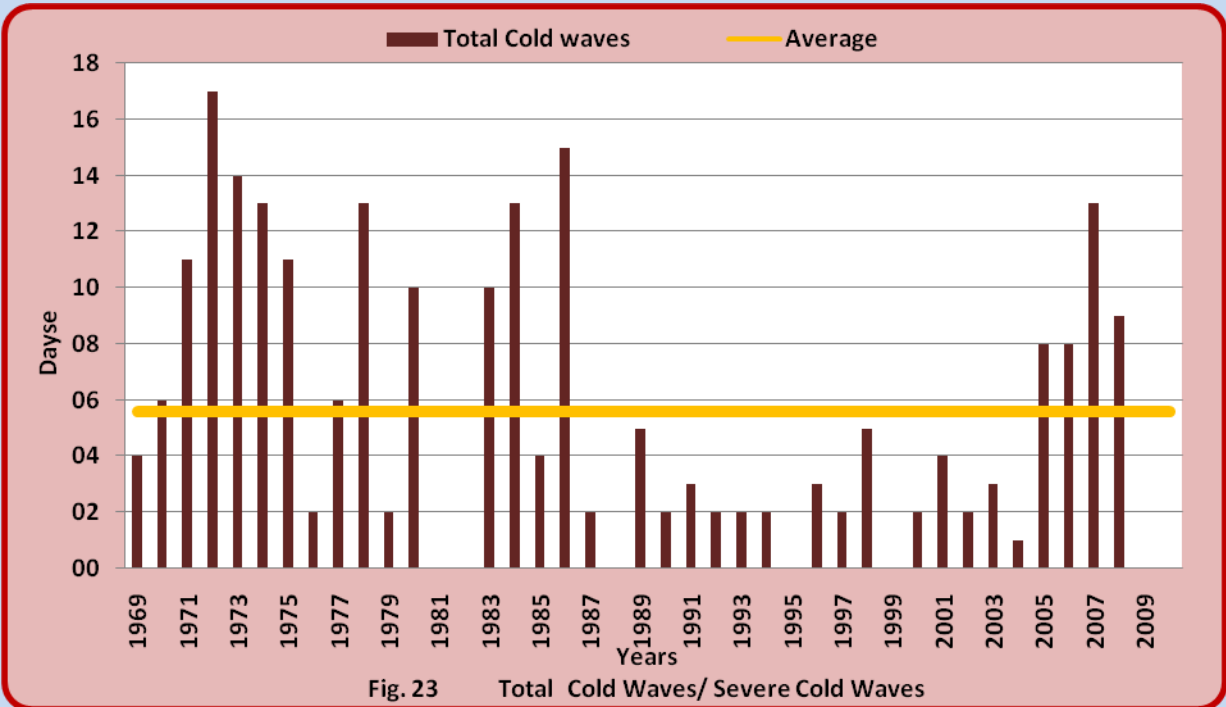
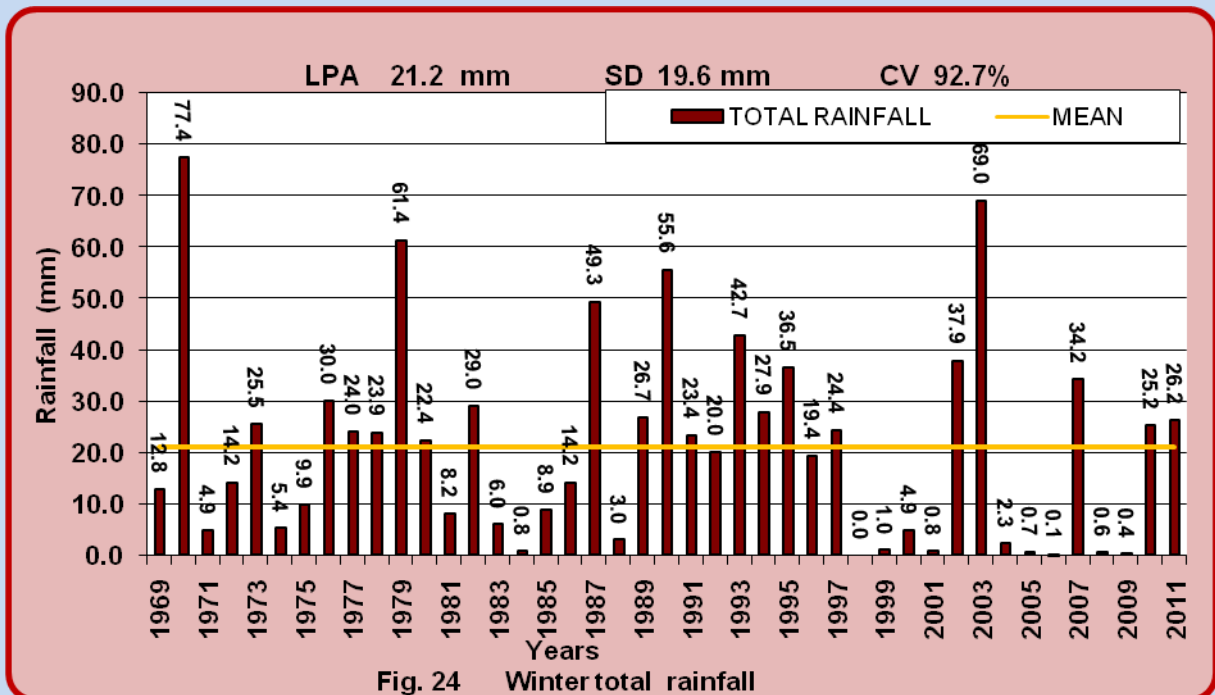


Fig. 23 Total Cold Waves/ Severe Cold Waves

Rainfall and clouds

During winters Jaipur gets a small amount (21.2 mm) of normal rainfall (3.4% of the annual rainfall) from western disturbances passing through the northern parts of the state from west to east . The average monthly rainfall for December, January and February are 3.8 mm, 5.5 mm and 11.9 mm respectively. The highest seasonal rainfall (77.4 mm) was observed during the year 1970 while nil rainfall during the year 1998 (Fig. 24). The weekly mean rainy days vary from .2 to .4 days. While the maximum weekly rainy days are 1 to 2 days in December, 2 to 3 days in January and 3 to 7 days in the month of February. There are 68 to 75 % chance of mainly clear sky (0 to 2 okta clouds) during the whole season. Possibility of Overcast sky in the months of January, February and December is 6%, 4% and 3% respectively.



Visibility/Fog/Hail/ Thunder

The possibility of reducing morning time visibility less than one km is about 2% in the month of December and January and only 1% in the

month of February. There are no chance of visibility to come down to 1 km during evening hours.

No hail storm in the month of December and January but it is likely at a few occasions (average =.1 days) in February.

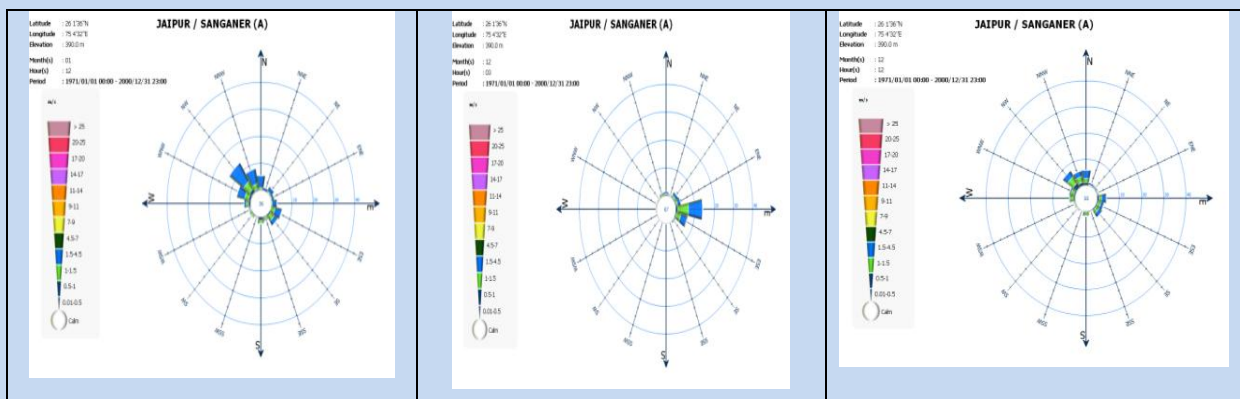
The mean thunder days vary as .7 days in December, .8 days in January and 1.5 days in February.

The highest foggy days (mean value .6) are observed in the month of December. The frequency of fog in other two months is .5 days in January and .4 days in February,

Wind

During the season, generally wind blows from East to North sector with speed 1 to 5 m/s . The maximum (15%) days it blows from Easterly direction.

Morning Hours



Evening Hours

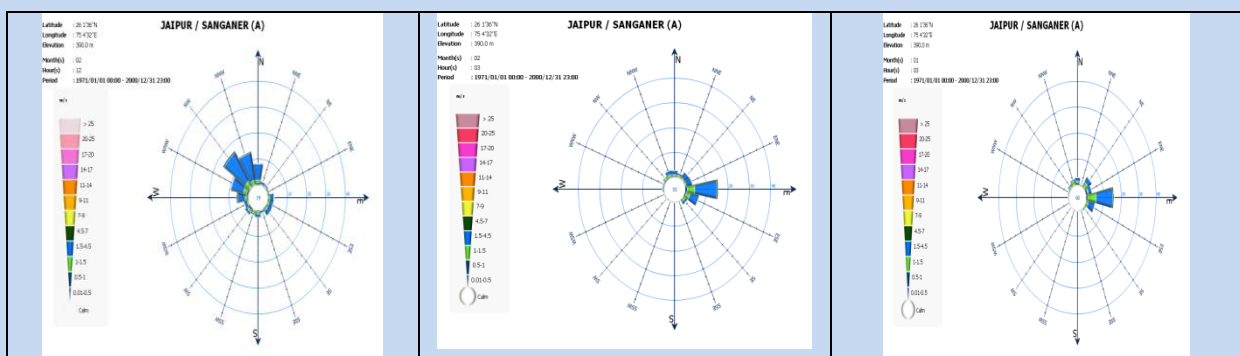


Fig.25 Wind rose diagrams of Jaipur - winter season

Humidity

The diurnal variation of the humidity during winter season is shown in Fig. 26. It can be seen that the humidity during morning hours is maximum and lowest during afternoon hours like other seasons. The average daily variability is of the order of 40%.

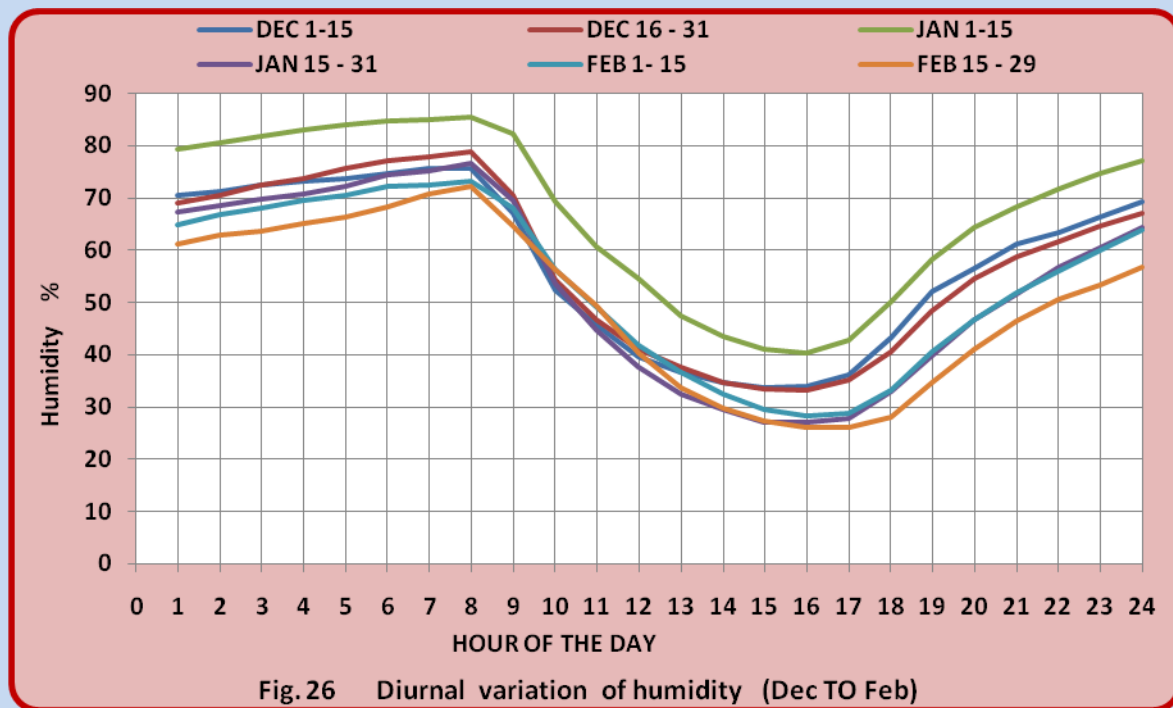
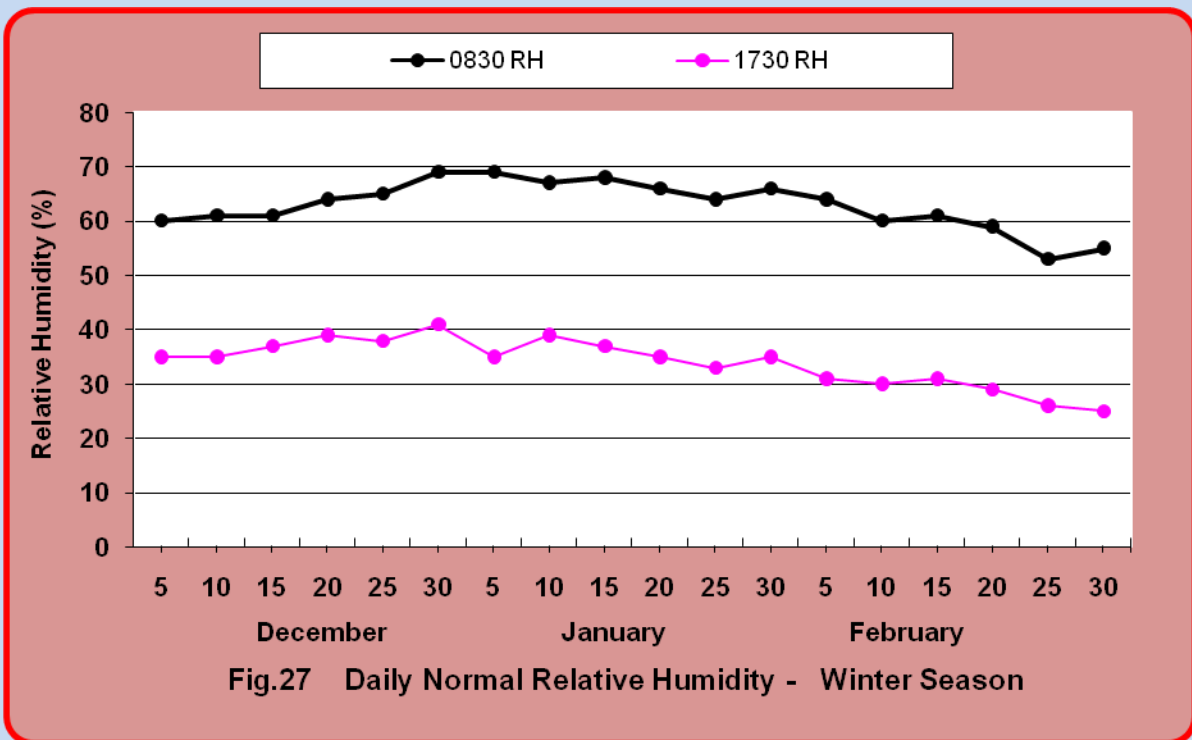


Fig. 26 Diurnal variation of humidity (Dec TO Feb)

The daily mean maximum and minimum humidity represented in the Fig, 27 shows an increasing trend up to mid January. It's value is 60% in the beginning of December and reaches 70 % in the beginning of January. As the season advances, temperature gradually increases and relative humidity decreases accordingly. The mean minimum humidity exhibit the similar tendency. In the beginning of December relative humidity is about 35% and at the beginning it reaches at 40% and then decreases steadily in January and February and about 24% in the end of the season.



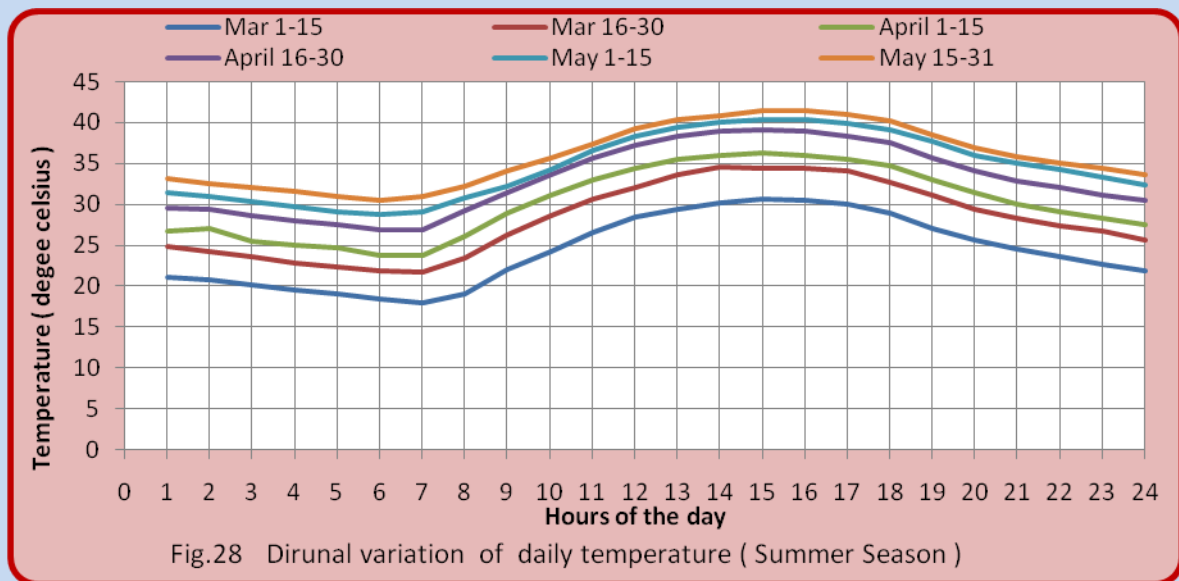
Summer Season

The month of March, April and May constitute the summer season. This season is customary called hot weather season in Jaipur. The city and its suburbs experience dry and hot weather conditions during these months. The increase in temperature starts after middle of March and the hot conditions prevail up to the end of May. Dry and hot air called loo paralyze the day time activities on many occasions. Rising day temperatures and convective weather phenomena viz. thunderstorms, dust storms, hailstorms, dust-devils and squalls are major characteristics during the 2nd half of this season. Dust storms are prominent weather vagaries of this season and are called “Andhi” in lingua franca. Western disturbances strike northwest India during this season. A little of moisture give rise to convective phenomena. A some of them prove very destructive in nature.

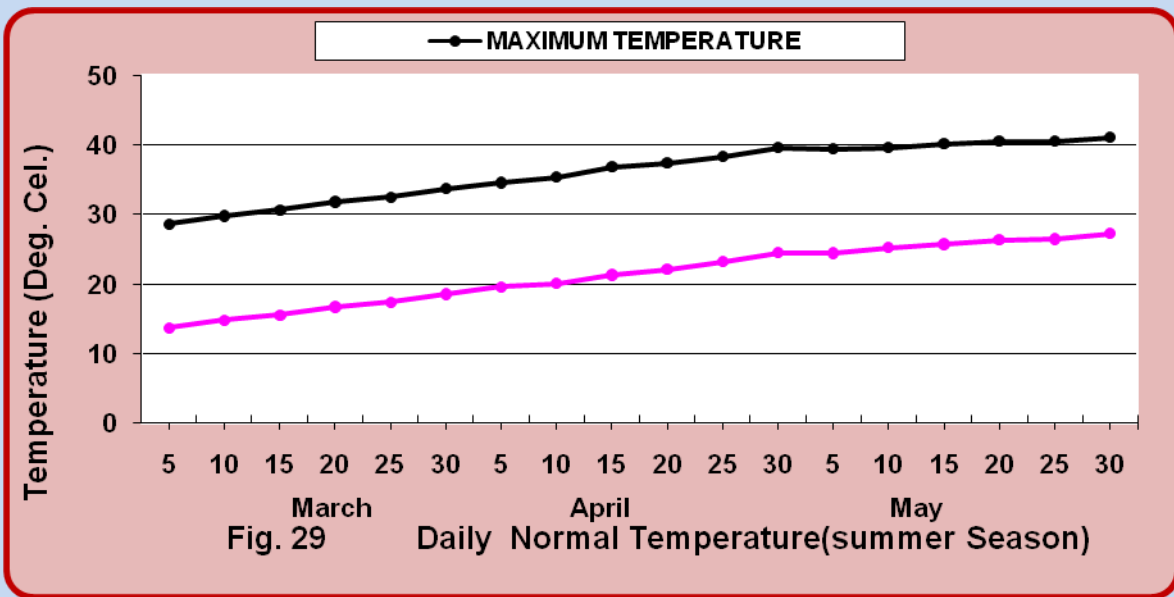
Temperatures

Diurnal variation

Diurnal variation of daily temperatures is shown in the Fig. 28 which shows that the temperature attains its minimum value at around 7 to 8 AM while its maximum value between 4 to 5 PM.



The daily normal minimum and maximum temperatures are given in the Fig. 29. Temperature rising trend commence in the beginning of March and continue up to May. The normal maximum temperatures is about 31 °C in the beginning of March and go up 40 °C at the end of May.



The minimum temperature also has a similar tendency. It marches from 16 °C in the beginning of the season to 27 °C at the end of May. The average minimum/maximum temperatures during March, April and May are 16.2 °C / 31.5 °C, 21.8°C / 37.2 °C and 27.5 °C / 40.5 °C respectively. However, the highest temperatures recorded during these months have been 42.8 °C on 27th March 1892, 44.9 °C on 27th April 1958, 48.5 °C on 6th May, 1980. The rising tendency of these temperatures are very slow or negligible in the month of May. Rise in temperatures is quite sharp from beginning of March to the end of April. In general May is the hottest month. Daytime temperatures during this month remains around 45 °C at many occasions. Year to year variation of mean minimum and mean maximum temperatures during the period (1952-2009) is shown in Fig. 30.

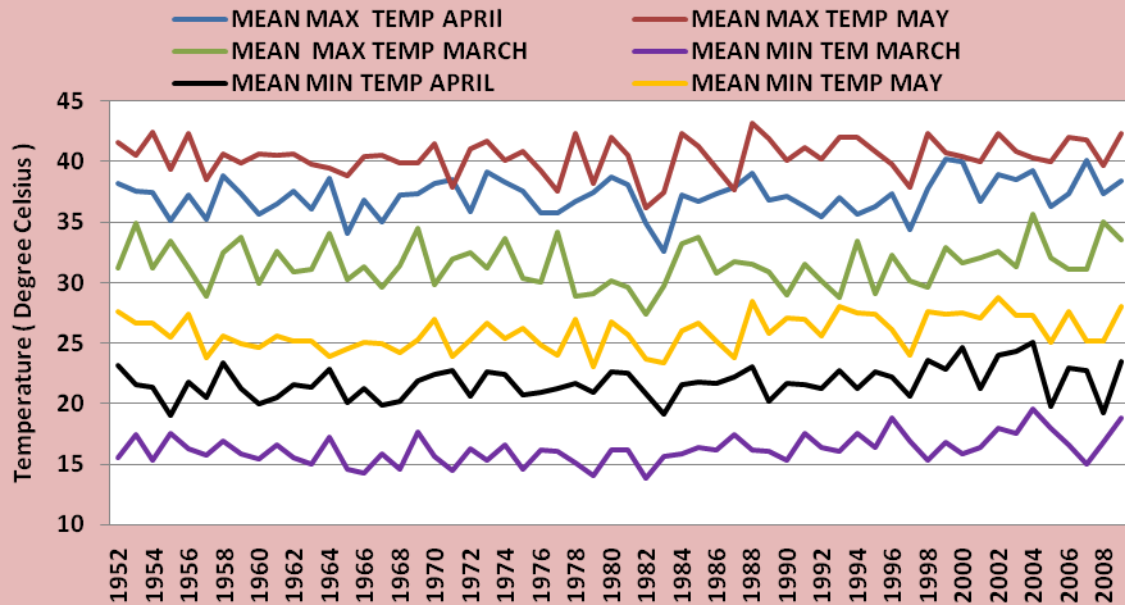


Fig.30 Mean Monthly Minimum & Maximum Temperatures Summer

The highest and lowest maximum temperatures recorded during the season are shown in the fig 11 & fig. 12 above. It can be concluded from the figures that highest maximum temperatures remain between 42-49 °C during the season. The highest maximum temperatures recorded are 42.6 °C (23rd March, 2004), 44.7 °C (29th April, 2009) and 48.5 °C (23rd May, 1994). Occasionally, maximum temperatures dip much below the normal value in the wake of western disturbance passage which brings thundershowers and dust storm in and around the city. The lowest maximum temperatures recorded during the period are 17.6 °C (5th March, 1982), 25.3 °C (4th April, 1994) and 29.0 °C (20th May, 2001).

Occasionally, heat wave to severe heat wave(Annexure) conditions are also experienced effecting the human activities in many folds. On an average heat wave/severe heat wave conditions prevail for 2 days in the season. However, its upper limit is 14 days (observed during 1999) (Fig. 31). The monthly upper limit distribution is 1, 9 and 5 days in March, April and May respectively .

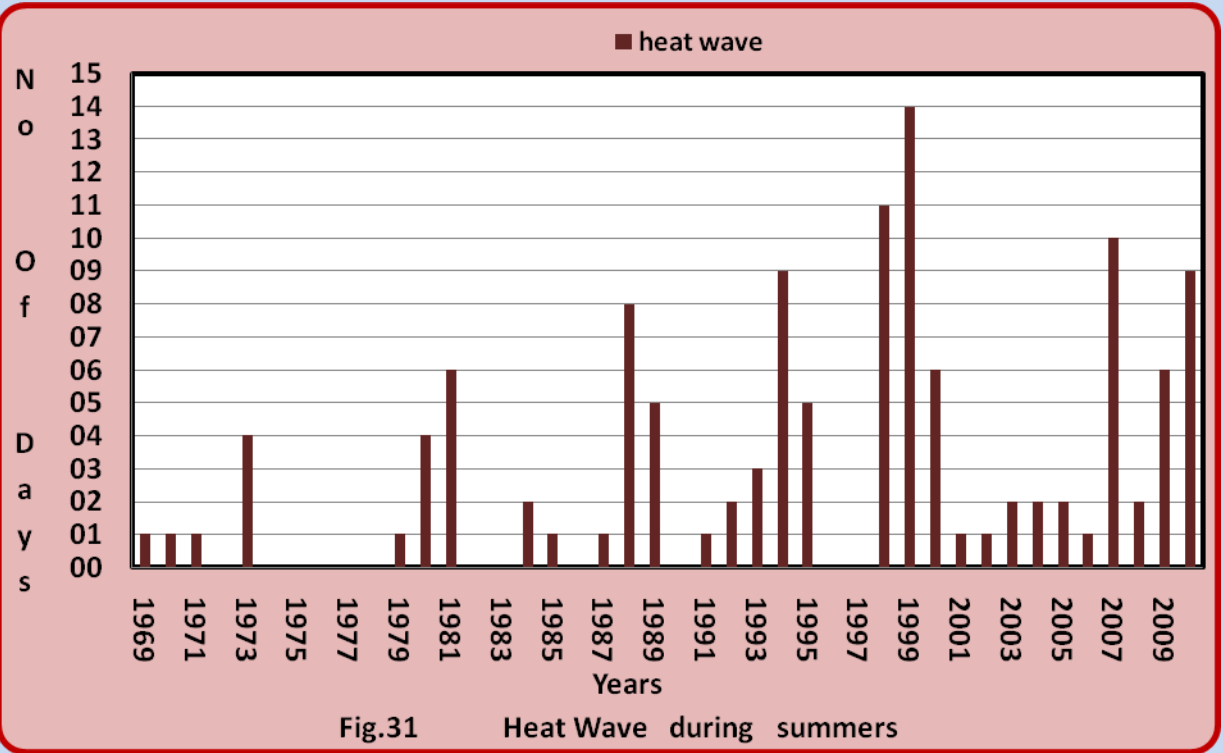
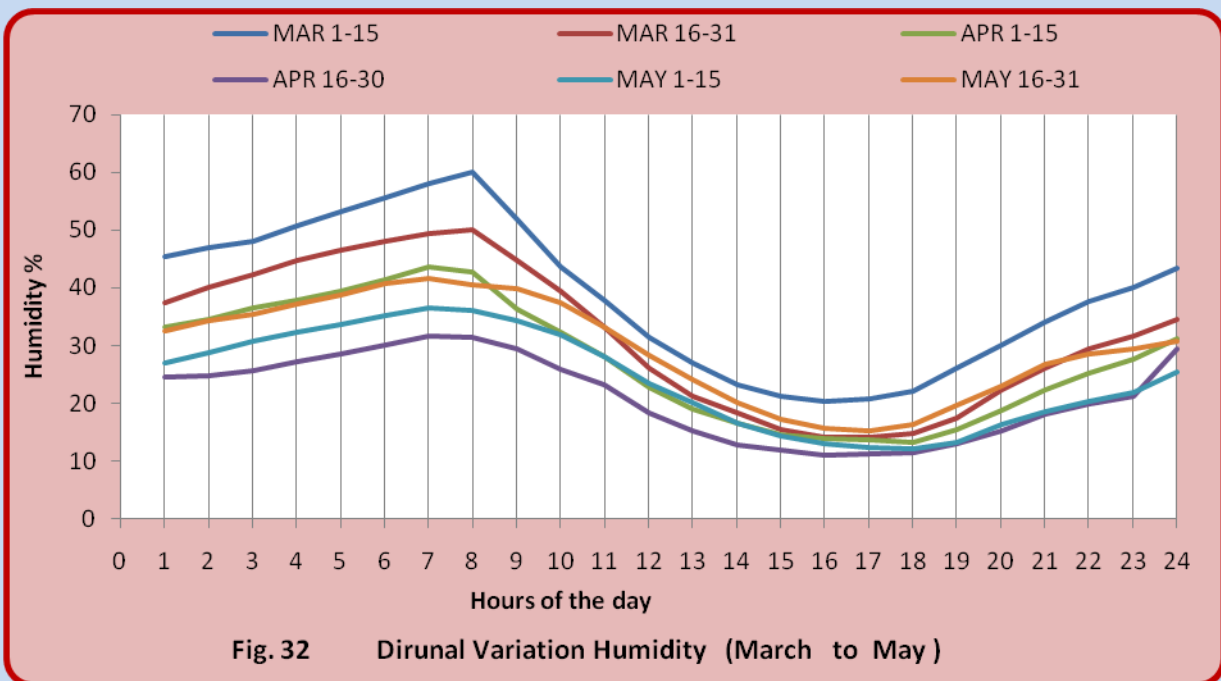


Fig.31 Heat Wave during summers

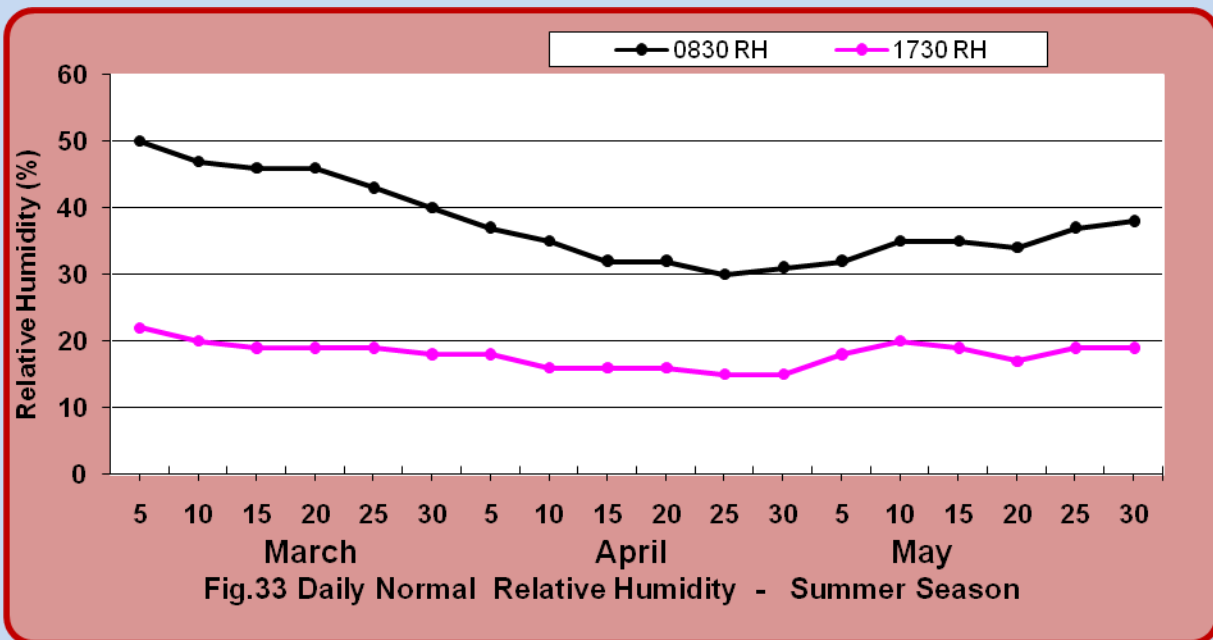
Humidity

Diurnal variation

Diurnal variation of humidity during summer season is shown in fig. 32. It can be seen that humidity during morning hours is highest and least during afternoon hours. The maximum humidity is observed around 8 AM and the minimum at around 5 PM during a day.

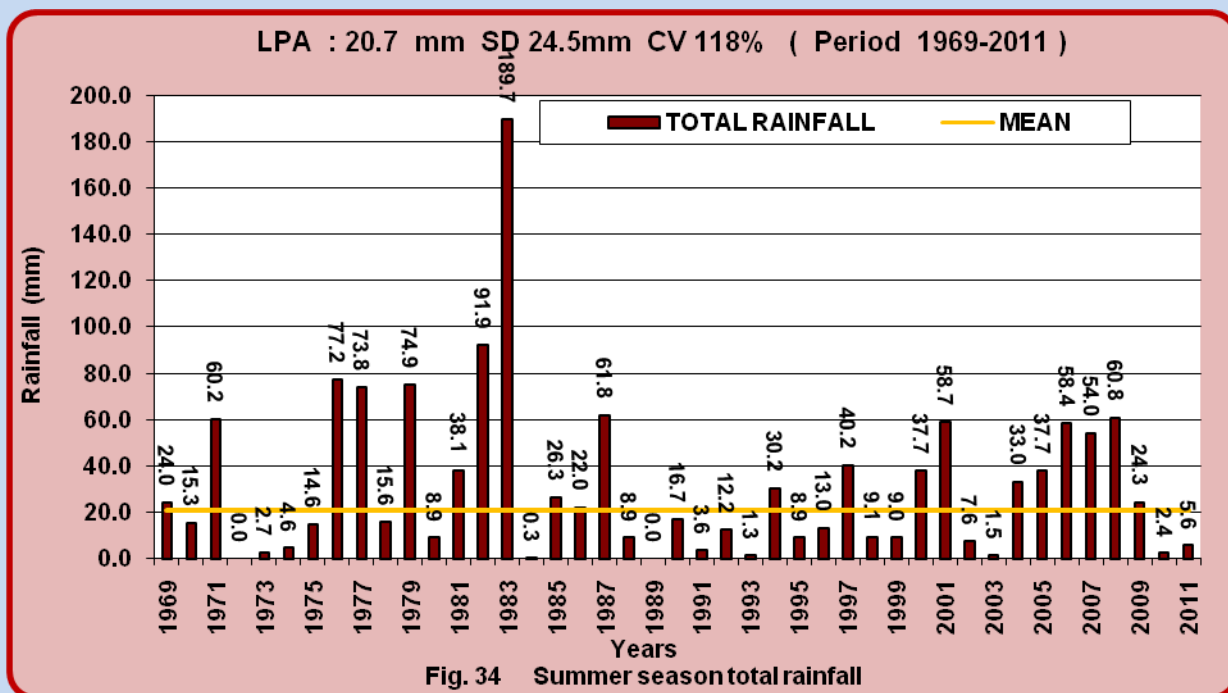


The daily mean maximum humidity falls rapidly in the first half of the season being 50 % in the beginning and 32 % in the middle of the season. Afterward a slow rise is observed up to the end of the season. Thus, an increase of 6% in the end of the season. The minimum humidity varies very less during the season being 20% in the beginning of March and about 17% in the end of May. Thus the range of daily RH varies 30 % in the beginning of the season to about 18% in the end of the season. The variability of minimum humidity is about 5% while it is about 20% in the maximum humidity (Fig. 33)



Rainfall

Summer season is characterized by hot and dry weather. Most of the rainfall is realized by western disturbances associated with thunderstorm / dust storm. Dust storms are common phenomena in this season. Dust storms generally strike in the afternoon or late in the night from north westerly direction. Due to convective activities, dust storms / thunder storms along with rain are also observed occasionally in the early part of the season during afternoon hours while these activities are vary frequent during fog end of the season. The normal monthly rainfall during March, April and May are 4.2mm, 8.2 mm and 18.7 mm respectively. However, weekly normal rainfall varies from .5 mm (first week of April) to 5 mm (May end). Highest monthly rainfall observed during March, April and May are 51.3 mm (year 1926), 123.8 mm (year 1983) and 100.3 mm (year 1959) respectively. Like winter season heavy rainfall rarely occur in summer season. The ever recorded heaviest rainfall are 33.8mm (14th March, 1926), 69.4 mm (14th April,1983) and 67.6mm (29th May, 1959). The average number of wet days during these months are 1.7days, 1.9 days and 2.3 days respectively. However normal weekly rainy days are less than 1 during this season. Highest (189.7 mm) seasonal rainfall has been observed during the year 1983 and there was no rainfall during 1972 summer. The normal rainfall of this season is 20.7 mm with standard deviation (SD) 24.5 mm and coefficient of variation(CV) 118%. Annual variation of the seasonal rainfall is shown in Fig. 34 which concludes that the highest rainfall (189.7 mm) was observed during the year 1983 and the lowest rainfall (0.0 mm) during the years 1972, and 1989.



Thunder/Dust Storm/ Squall/Hail

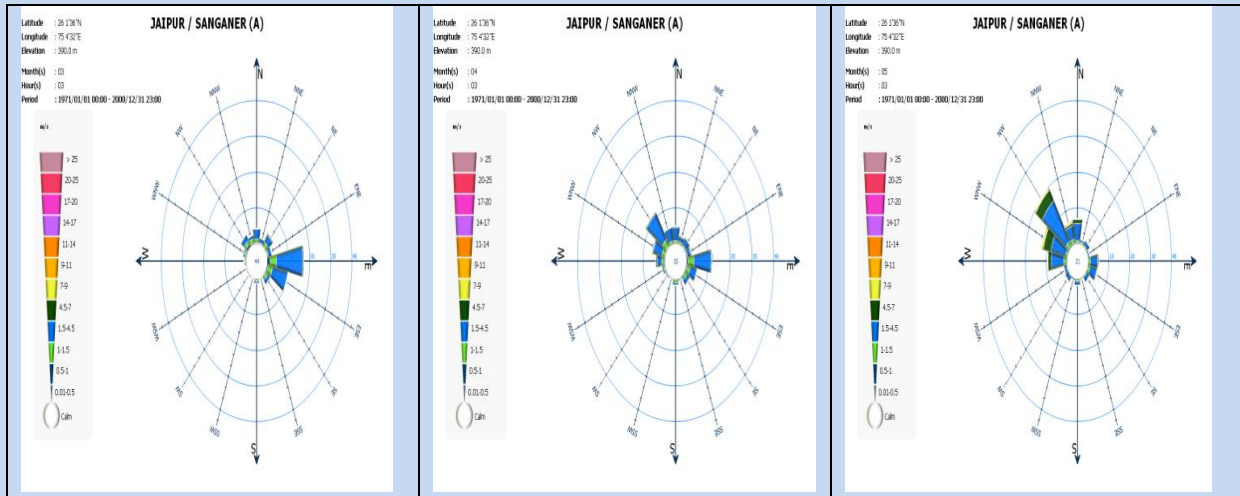
Thunderstorms, dust storms, hails storms and squalls are the common features of summer season. Thunder cloud develop ahead of a eastward moving trough in middle and upper troposphere westerly's, when adequate moisture available in the atmosphere. Down draft from cumulonimbus clouds give rise to convective dust storm and squalls. These generally occur in afternoon or late in the night. The average number of thunderstorm are 2.4, 2.3 and 4.2, dust storms 0.5, 1.2 and 4.3 and squalls 0.3, 0.4 and 0.8 in March, April and May respectively.

Dust storms and squalls cause great havoc to life and properties. Sometimes extensive damage have been reported. After the passage of a dust storm temperature drop suddenly about 5-7°C which give rise relief from scorching heat.

Wind

Summer season is windy season for Jaipur. The average wind speed is 6-10 kmph. During day time when Sun shines, the intense heating causing convective movements and the wind speed increases. In the month of March and April the wind direction is east to south-easterly during morning hours and northwesterly in all the three months of season during evening hours. Also the wind speed increases from morning to evening (Table 3 & Fig. 35)

Morning Hours



Evening Hours

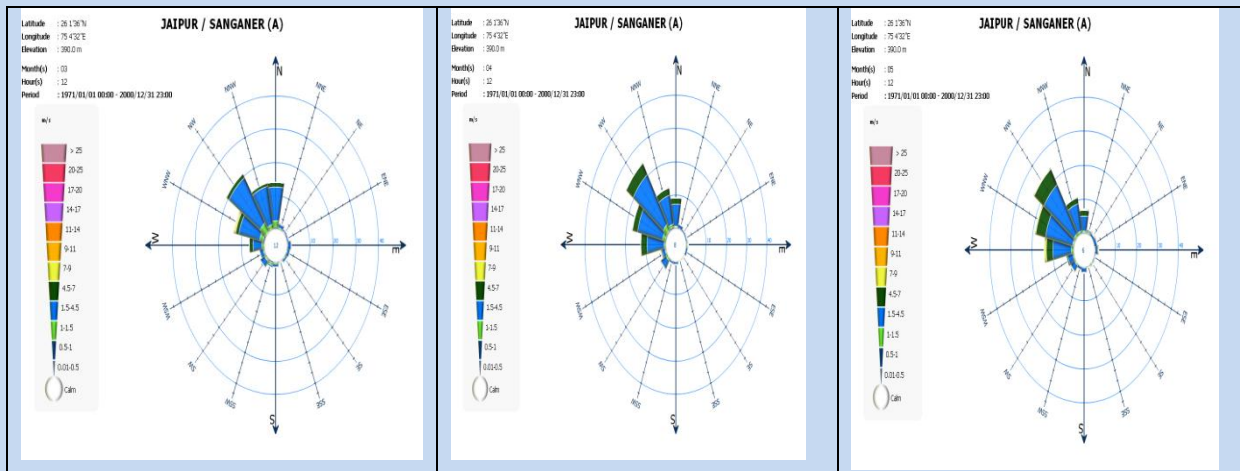


Fig.35 Wind rose diagrams of Jaipur – Summer Season

Monsoon Season

The monsoon season generally starts from last week of June to mid September. Monsoon season is boon of nature to this water scarce land. Rainfall, thunderstorms and occasional heavy downpour are the characteristics features of this season.

Onset and withdrawal of Monsoon

SW Monsoon commence its presence on 20th June in Andaman Sea, arrives on 1st June at Trivendrum (Kerala). It advances further and reach Mumbai on 10th of June and enter Rajasthan state on 17th June (South East parts of Rajasthan). After a week's time it reaches at Jaipur on 25th June. This is normal date of onset of monsoon over the city. The onset may be earlier or inordinately delayed depending on the strength of monsoon current and movement. It has set over Jaipur much before normal date on 16th June 2008 and delayed as on 11th July 2006. The normal variability is of one week . It influence the city for about 2-3 months and withdraws around 15th September with variability of 9 days . On some occasions withdrawal date is much ahead of normal date i.e. 8th October, 2004. Onset & Withdrawal date over the city during the period 1972-2011 are shown in Fig. 36 below.

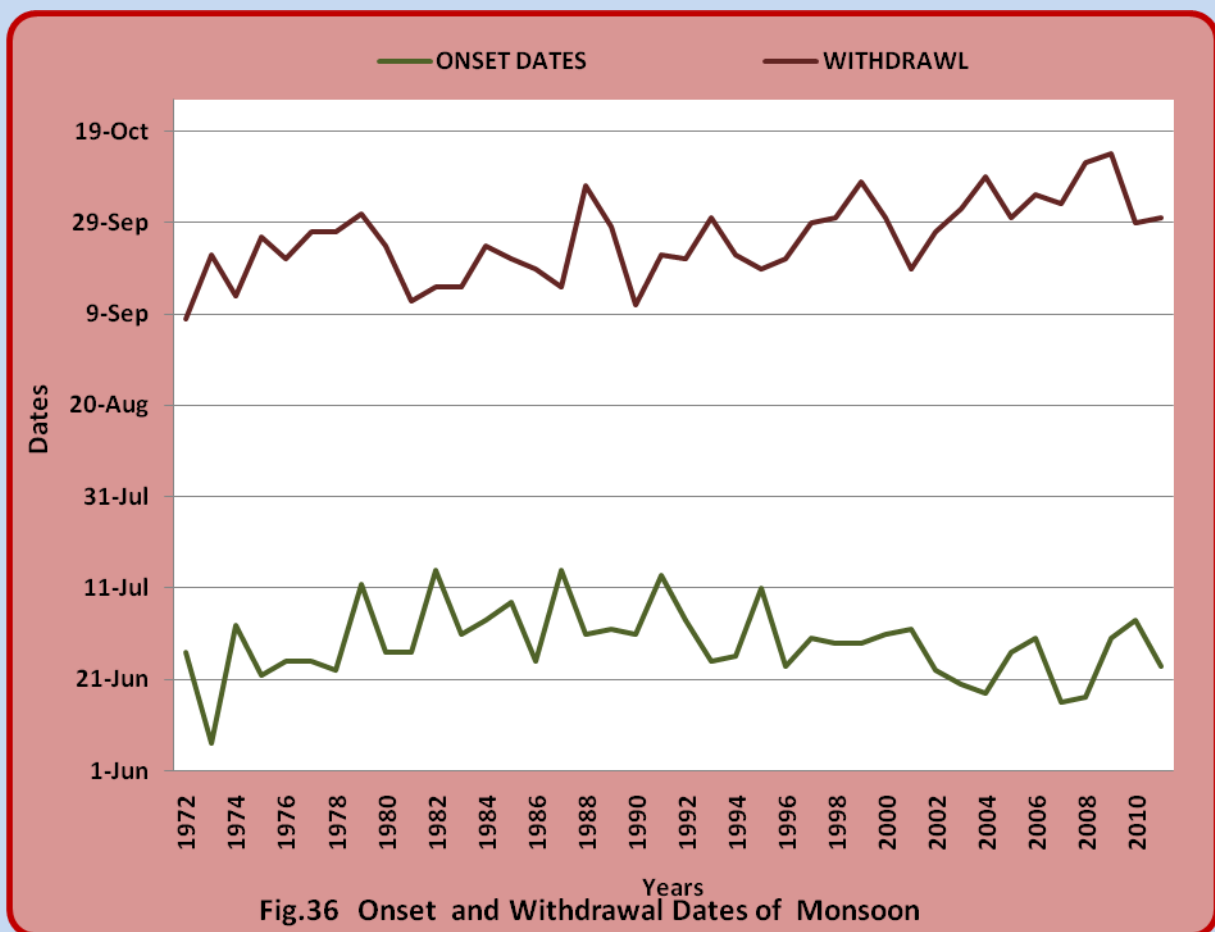


Fig.36 Onset and Withdrawal Dates of Monsoon

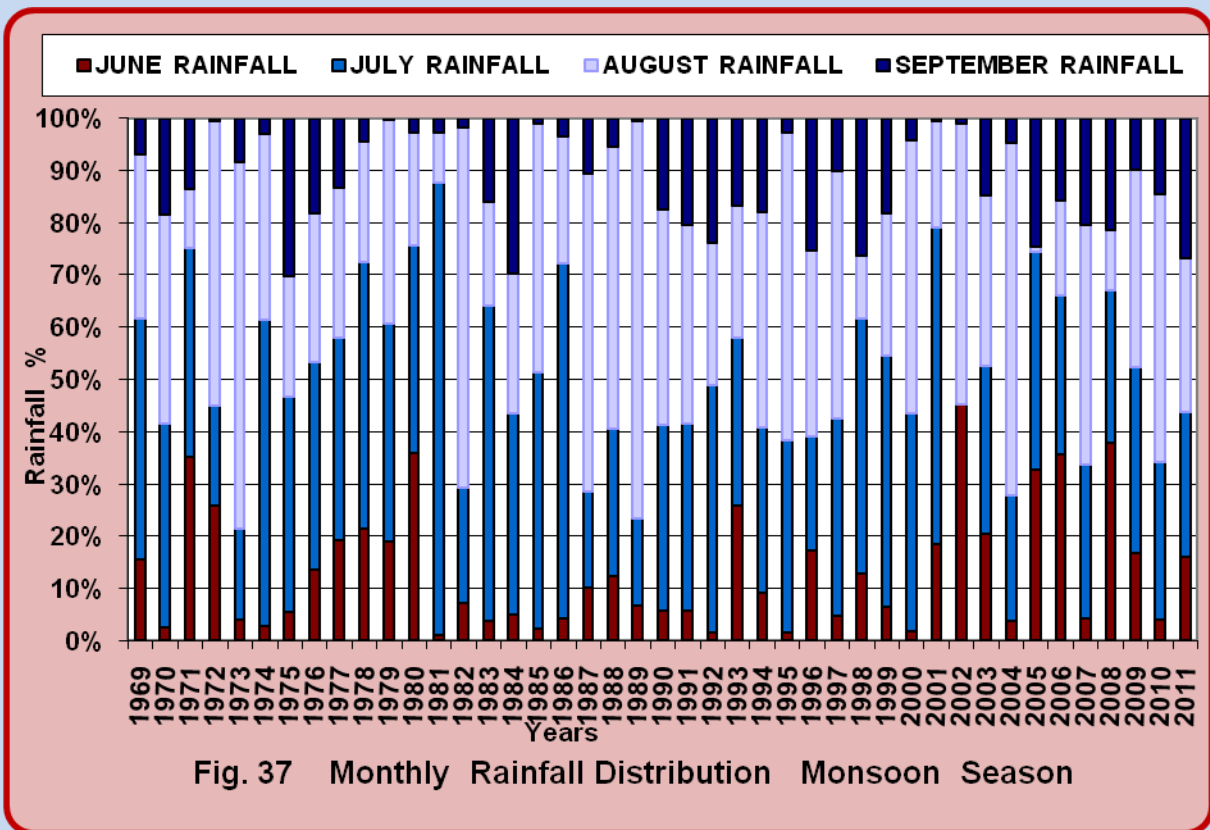
Rainfall

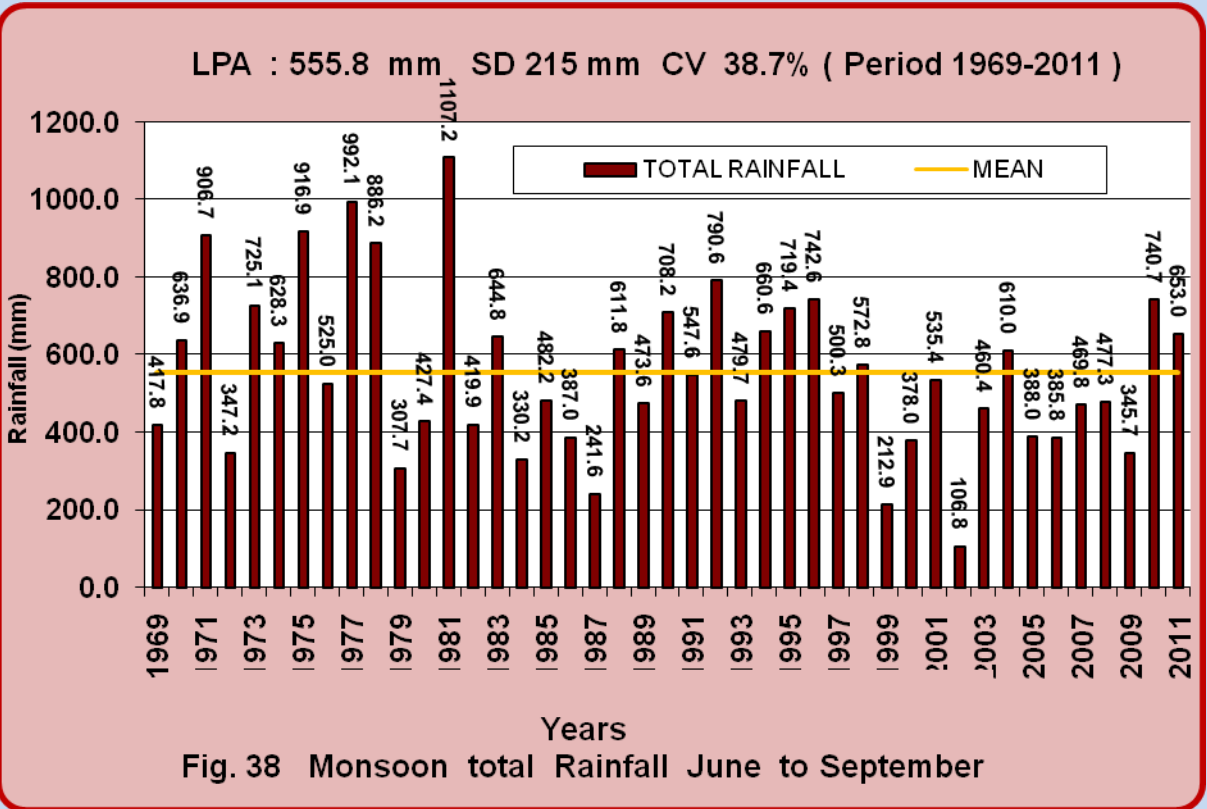
Monsoon sets over Jaipur in the last week of June. Though thundershowers activities commences after 10th June. On outset the daily normal rainfall is 1-2 mm and in July it reaches 5-10mm and at the end decreases. July and August are the main rainiest months. The number of rainy days are 3.9 in June, 11.2 in July, 10 in August and 3.8 in September. About 88% of normal rainfall is realized in this season and rest 12% is realized in remaining period of the year. The normal seasonal rainfall (June to September) is 555.8 mm with SD 215 mm and CV 38.7 % . During past 43 years the highest rainfall recorded during the monsoon season is 1107.2 mm during the year 1981. And the least (106.8 mm) rainfall during the year 2002 (Fig. 38). Monthly average rainfall during June, July, August and September are 69mm, 221 mm, 195 mm and 71 mm respectively. July 1981 is the wettest month in the annals of Jaipur City with total monthly rainfall of 956.9 mm and seasonal is 1107.2 mm. The 24 hours heaviest rainfall was also occurred is 326 mm on 19th July, 1981.

The average rainy days in the month of June, July, August & September are 5.3 days, 14.6 days, 15.9 days and 7.8 days respectively. During this season weekly normal rainy days are of the order of 2-4 days. However, the maximum number of rainy days observed are even up to 7 days in a week. The weekly rainfall varies from 5.33mm to 76.2mm during this season. The highest weekly normal rainfall is 76.2mm in 29th week (first week of August). The highest weekly rainfall recorded is 727mm in 26th week in 1981.

Jaipur City witnesses heavy to very heavy rainfall occasionally. The prime reason for this is westward moving depressions, well marked low pressure areas, low pressure areas and cyclonic circulations, which move along the monsoon trough in west north westwards when seasonal trough in its normal position. Sometimes westward moving systems over south Rajasthan takes northerly turn also causes heavy rainfall over the city. At some occasions these west ward moving weather systems interact with eastward moving trough or western disturbances in westerly's over northern parts of the state and nearby northern parts of the country . 24 hours heavy rainfall during different month in the season is shown in the Fig. 13 . The ever recorded heaviest rainfall is 172.9mm (29th June, 1971), 326.0 mm (19th July, 1981),188.4mm (16th August, 1959) and 187.5 mm (10th

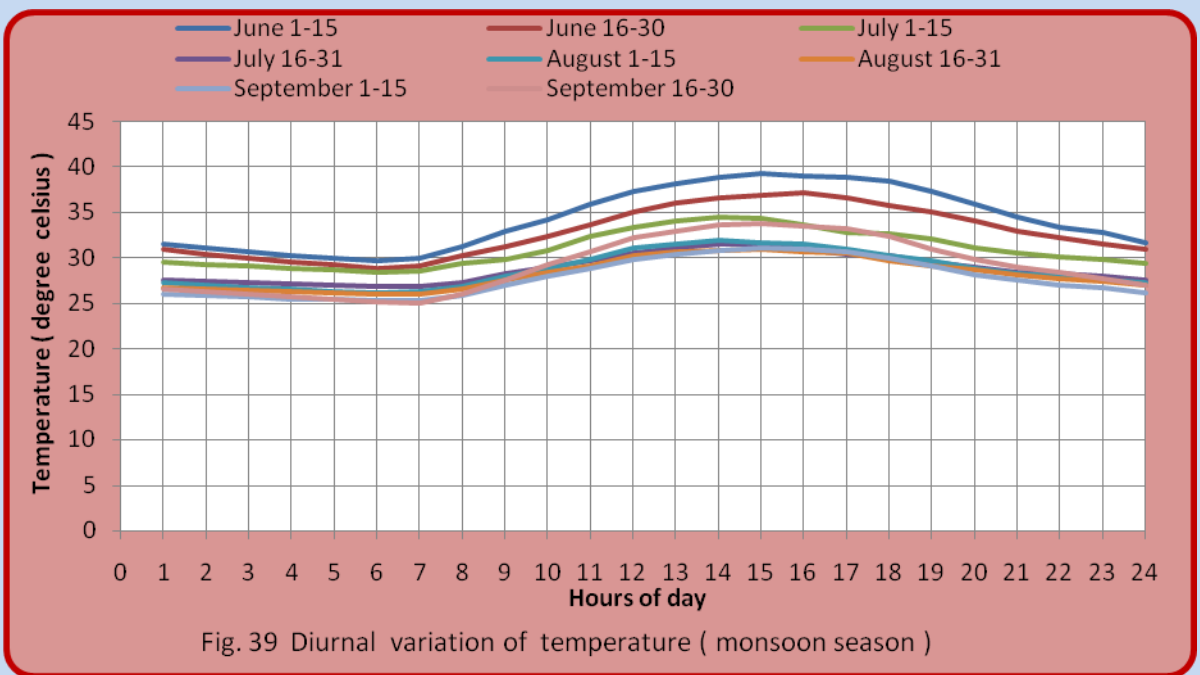
September, 1924) during the season. Year to year, Monthly rainfall distribution during past 43 years of this season is shown in Fig. 37 below.



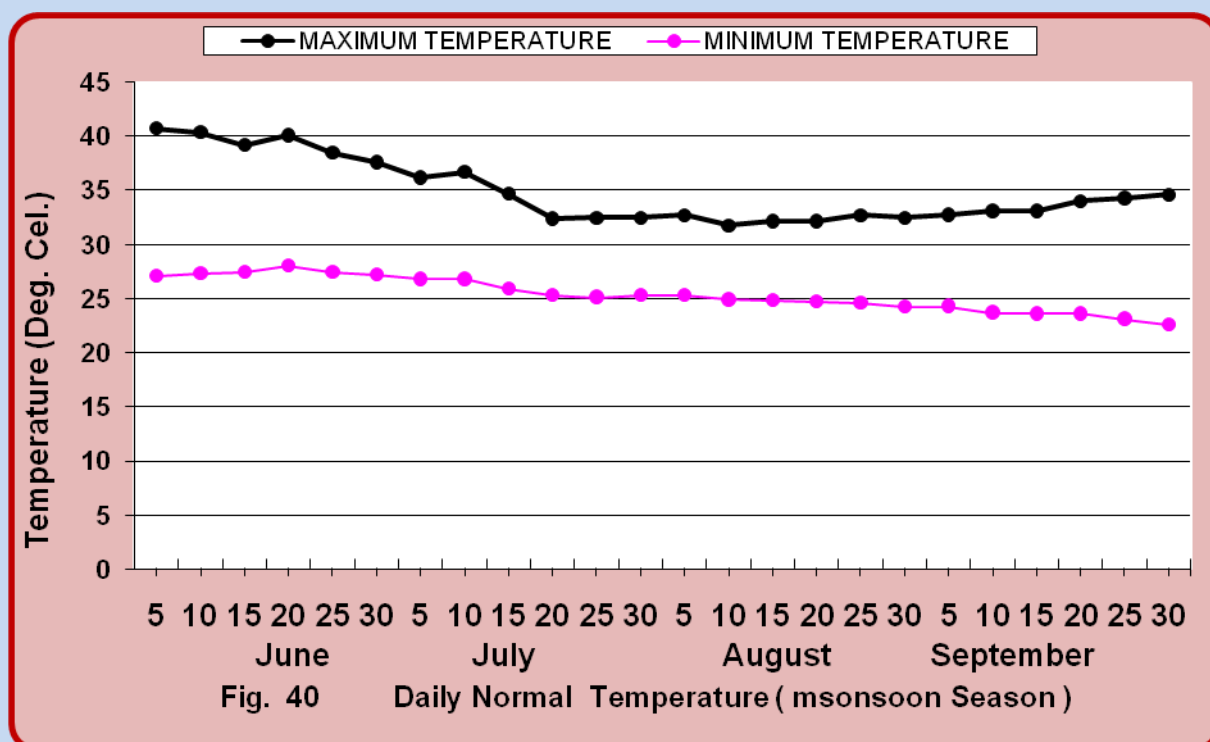


Temperature

Diurnal variation of day temperatures are shown in the Fig. 39 below which shows that minimum temperatures are observed between 6 to 7 AM while the maximum between 2 & 4 PM. The variation in daily temperatures is least during this season.



Warm day conditions prevail in the beginning of the season normal maximum temperature being 40 °C. The downward trend commences only after 25th June and reaches at 33 °C at the end of July. During August and September downward trend become very slow and maximum temperature remains between 32-33 °C. A slight warming is experienced in the beginning of September. The normal minimum temperatures does not show any abrupt fall up to August being 27 °C in the beginning of June to 24 °C up to 1st week of September and thereafter falling tendency starts and at the end of September reaches at 21 °C. (Fig. 40)



The average minimum temperature during monsoon months (June to September) are 27.2, 25.7, 24.5 and 23.0 °C respectively While the average maximum temperatures are 39.3, 34.2, 32.3 and 33.7 °C respectively . Variability of these temperatures over a period of 58 years (1952-2009) is shown in Fig. 41.

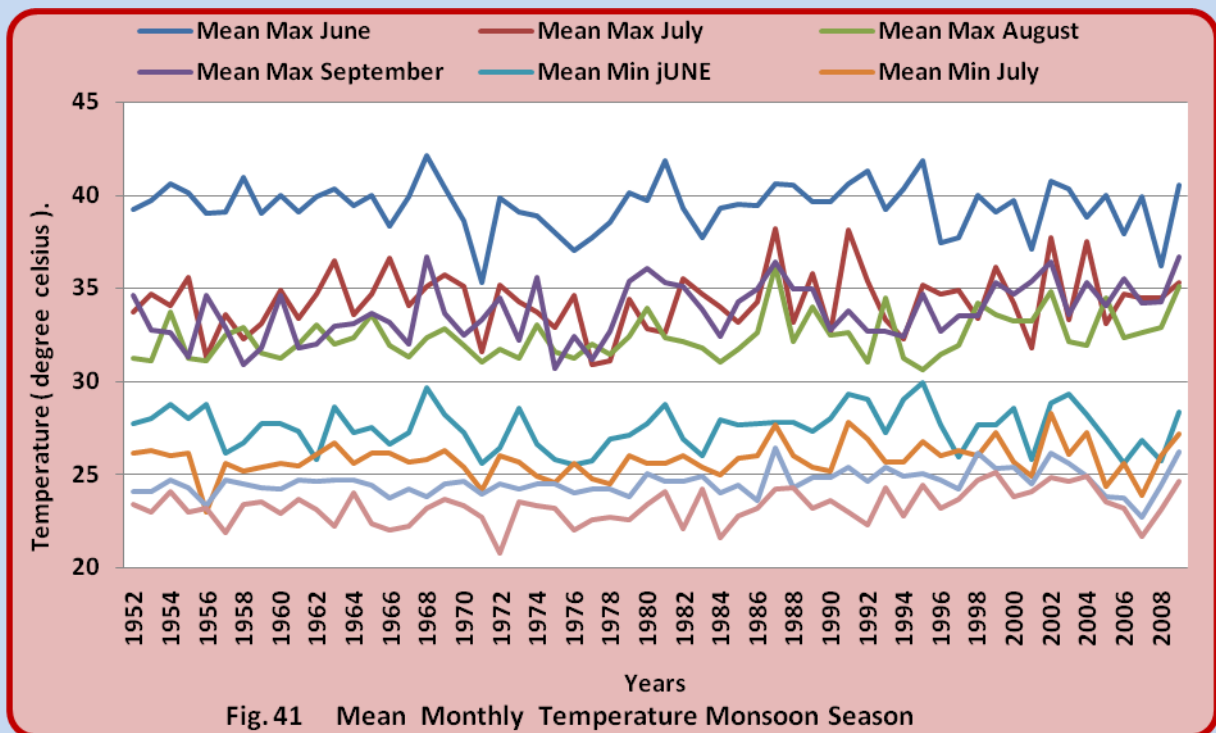


Fig. 41 Mean Monthly Temperature Monsoon Season

Extreme Temperatures

Mostly, the maximum temperatures range between 35-44 °C in June, 28-40 °C in July, 28-37 °C in August and 28-37 °C in September. However, the highest value recorded during different months are 46.0 °C (5th June, 2003), 43.6 °C (1st July, 1995), 40.0 °C (11th August, 1987) and 40.3 °C (20th September, 2009). The maximum temperatures come down whenever; there is widespread rainfall in and around the city. The temperatures fall and this creates comfortable weather conditions. The value of lowest maximum temperatures in different months of the season is 25.0 °C (23rd June, 1996), 24.6 °C (19th July, 1974), 24.2 °C (29th August, 1991), and 24.4 °C (14th September, 1975).

Normally, the range of minimum temperature is between 25-32 °C during the season. However, minimum temperature on a few occasion fall below 25 °C in the month of June and July. The lowest minimum temperatures recorded in the season are 19.1 °C (8th June, 2010), 20.6 °C (6th July, 2005), 19.0 °C (3rd August, 2007) and 15.0 °C (23rd September, 1972). These lowest minimum temperatures are caused by widespread rainfall and thereby cooling of the atmosphere. On certain occasion during cloudy conditions when there is little nocturnal cooling occur, minimum temperatures does not fall largely. They mostly range between 25-30 °C in June and July and 25-28 °C in August and September. The value of highest

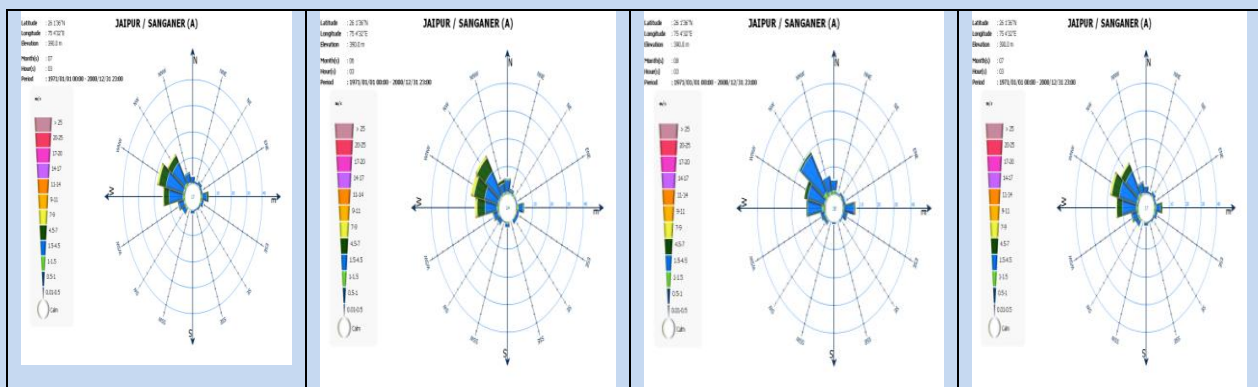
minimum temperatures are 33.8 °C (9th June, 1994), 32.2 °C (8th July, 2009), 29.8 °C 11th August, 1987) and 29.7 °C (11th September, 1995).

The highest ever recorded maximum temperatures during these months have been 47.2°C (10th June, 1897), 46.7°C (5th July,1901), 41.7°C (1st August,1911) and 41.7°C (11th September, 1899) respectively while the least minimum temperatures observed are 19.7°C (18th June, 1976), 20.6°C (5th July, 1931), 18.9°C (23rd August, 1953), 15.0°C (23rd September, 1972) respectively. (Fig. 13)

Wind

The surface wind speed decreases in monsoon season as compared to summer season. The decrease continue as the season progresses. The average wind speed is 7-8 Kmph. The wind rose diagrams (Fig. 42) show that during most part of the season northwesterly to west north westerly component of wind direction remain prominent while easterly component remains about 5% in all the months of the season. In morning and evening westerly's wind component remains predominated. The frequency of calm wind is lowest in June and highest at the end of the season (September)

Morning hours



Evening Hours

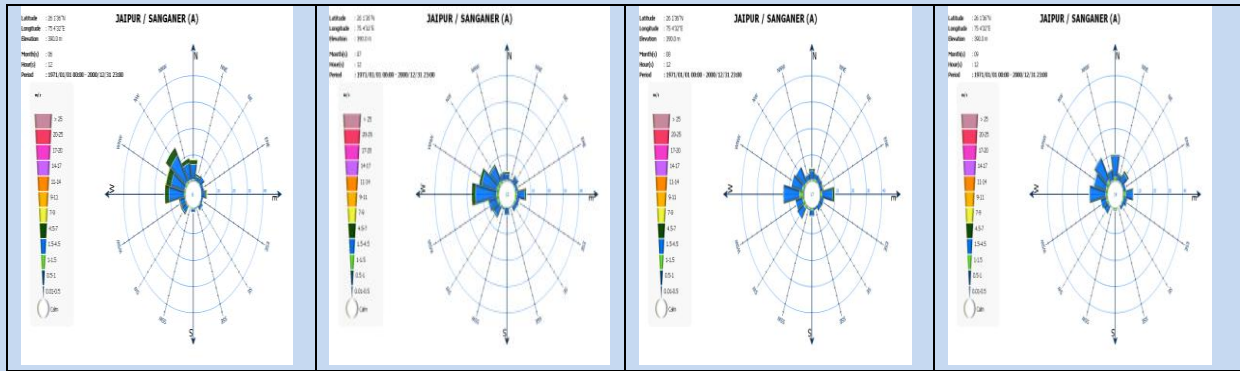


Fig.42 Wind rose diagram of Jaipur - monsoon season

Humidity Diurnal Variation

The diurnal variation of humidity is shown in Fig. 43 . It can be concluded that humidity like other seasons, is maximum during morning hours and lowest during afternoon hours .The daily range of humidity is lowest during this season .

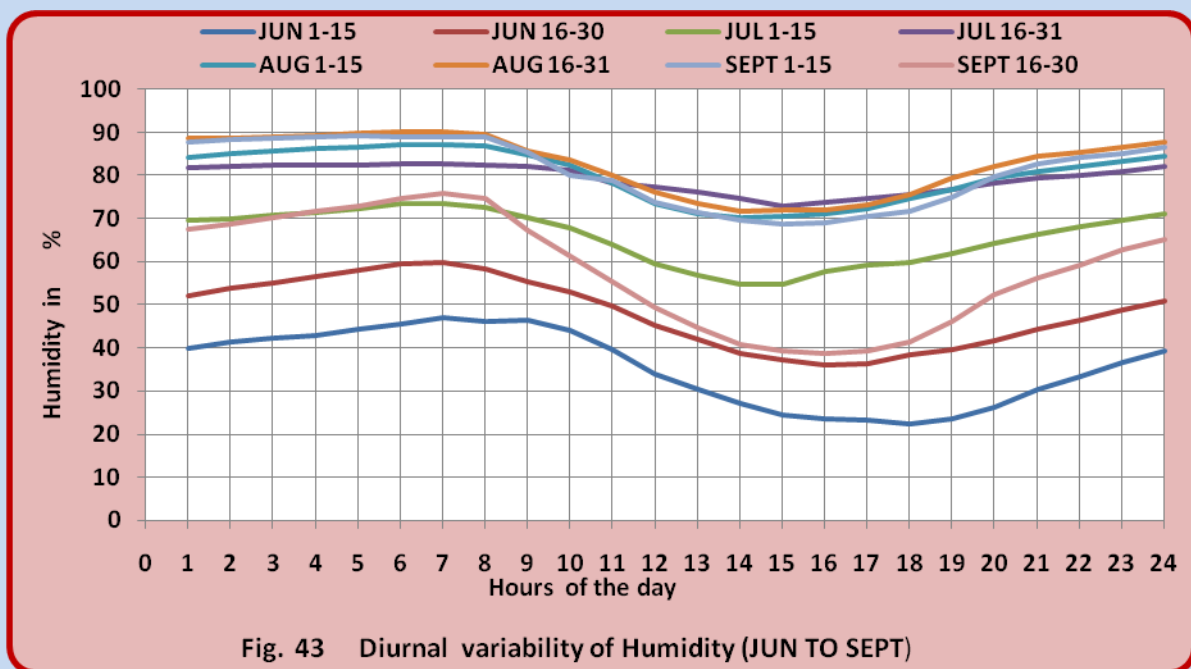
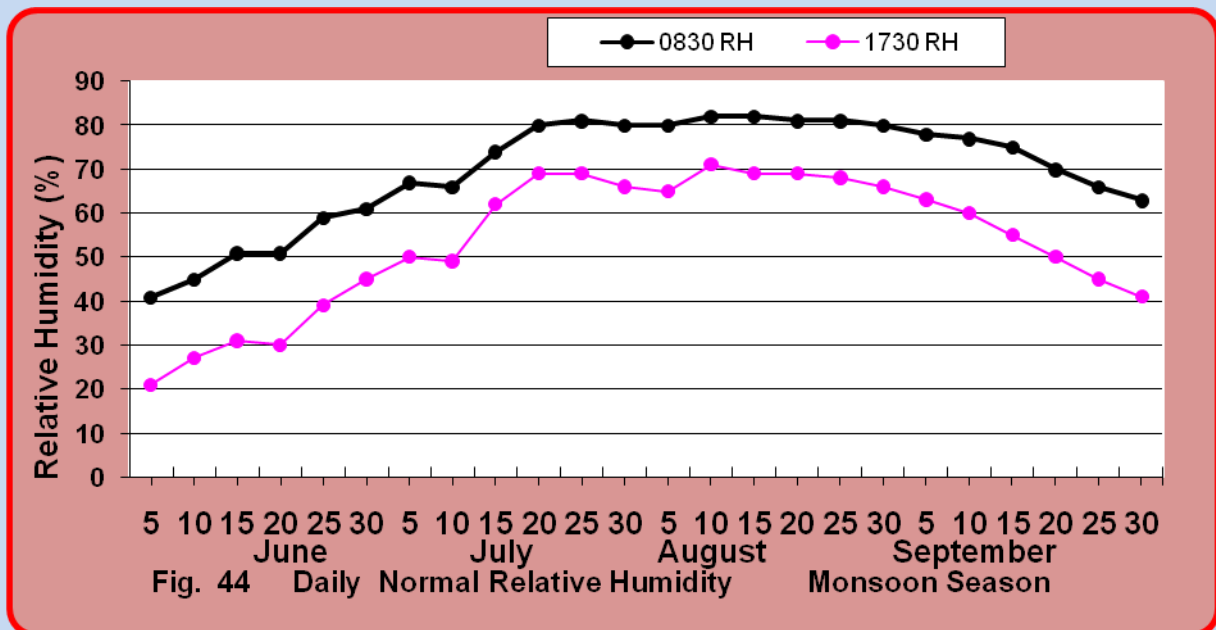


Fig. 43 Diurnal variability of Humidity (JUN TO SEPT)

It is a most humid season with August as a most humid month . The daily mean maximum and minimum relative humidity (RH) shown in the Fig.44 shows that maximum humidity is very low in the beginning of the season 50% up to middle of June. It increases to 70% in the end of June and reaches at 78% in the middle of July and reaches at 80% in mid August. It

starts falling from third week of August and continue to fall in September. The daily mean minimum RH exhibit similar trend to that of maximum rising from 28% in the beginning of the season and reaches its maximum value of 70% in the mid August and reaches at 32% in the end of the season.



Dust storm (DS)/ Thunder / Squall/ Hail

The weather characteristics of summer season prevails up to third week of June and at the advent of SW monsoon dust storms and hails ceases to occur and only rainfall and thunderstorms remain as prominent weather phenomena. The average number of thunderstorms are 7.5 in June, 10.2 in July, 9.3 in August and 4.9 in September. Most of these thunderstorms occur in the afternoon and a fewer number in night period during the season. The average number of various weather phenomena are given in the table appended at the end.

The frequency of Dust storm is slightly decreases in this season as compared to earlier season (pre monsoon). The DS activities are observed in the beginning of the monsoon season only. The mean Dust storm days during June and July are 3.5 days and .7 days respectively. DS is not observed in the later part of the monsoon season (August and September).

The average frequency of Squall is also maximum in the months of June (1 day) and July (.8 day). It gradually decreases to .5 days in the month of August and .3 days in September.

Hailstorms are not observed in the month of June, July and August. But at the fag end of the season the average number is 0.1 in September.

Post Monsoon

The months of October and November constitutes the post monsoon or transit season. The weather generally remains dry and pleasant . Maximum and minimum temperatures show slow and steady fall.

Temperatures

Diurnal variation of temperature is shown in Fig. 45. Which shows that the day temperature attains its minimum value at about 7 AM and the maximum value at about 2 PM . The total daily variation in temperature is not much in the month of October. But it slightly increases in the month of November.

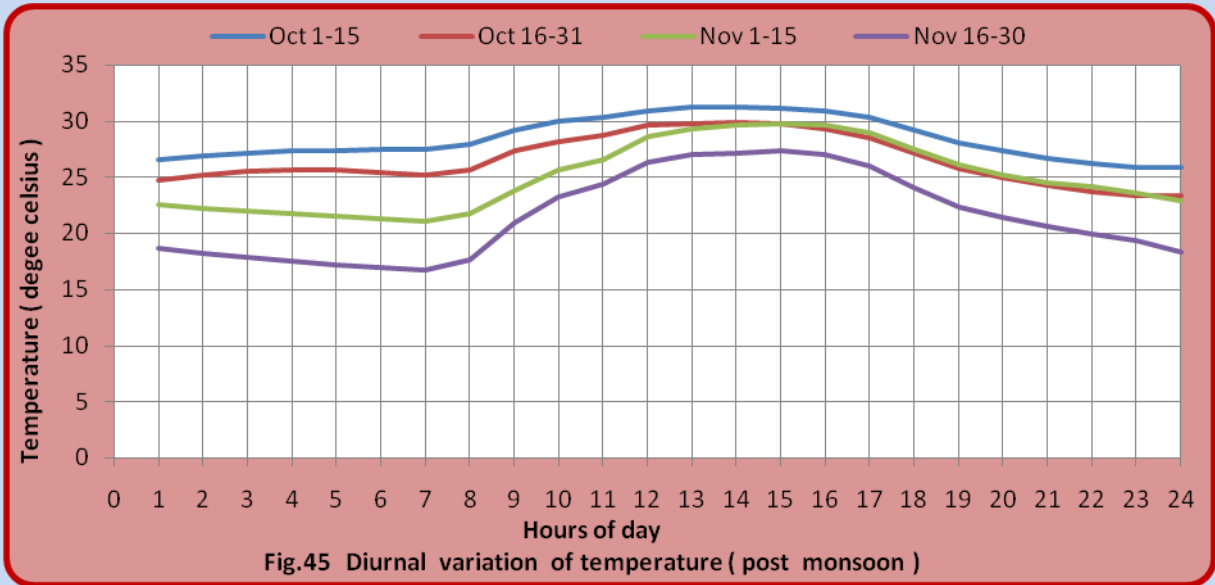


Fig.45 Diurnal variation of temperature (post monsoon)

The daily normal maximum and minimum temperatures are shown in Fig. 46 .The normal maximum temperature shows little change in the month of October being 35 °C at the beginning of the month and 32 °C at the end. However, there is considerable fall in the month of November being 32 °C in the beginning and 27 °C. at the end. The normal minimum temperature fall from 21 °C in the beginning and 11°C in the end of the season. The decrease in maximum and minimum is relatively smooth in the season.

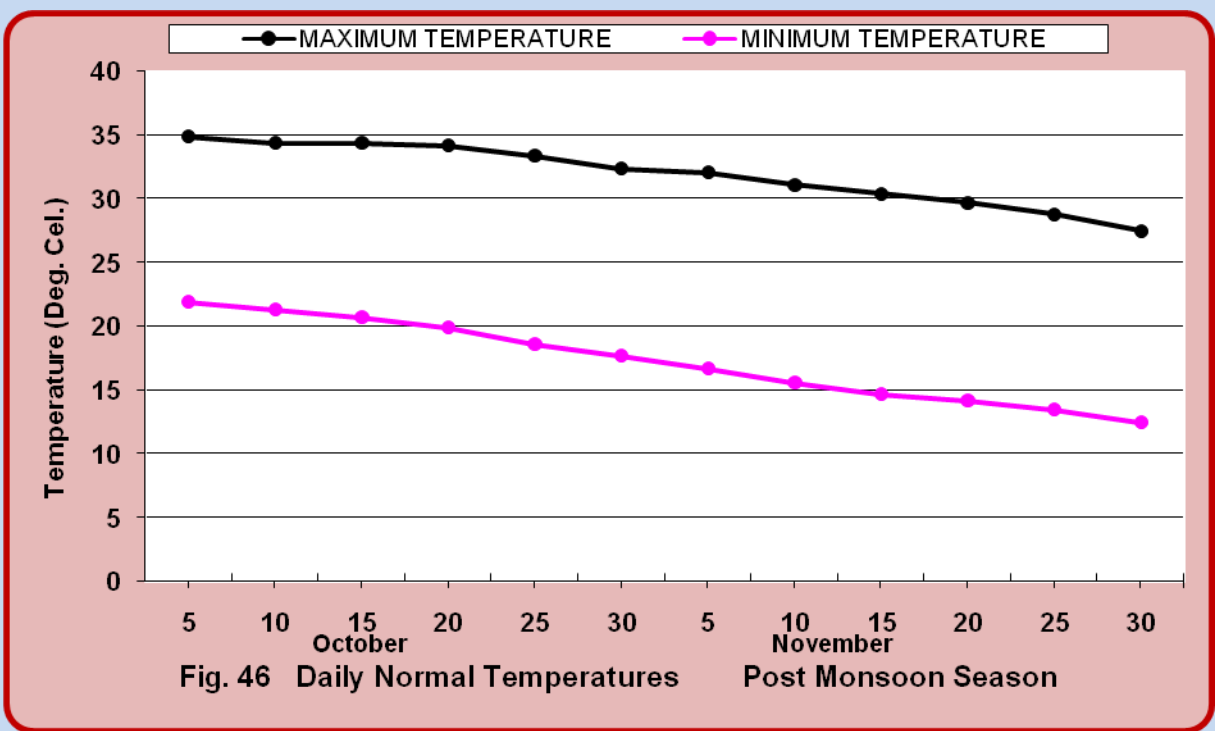


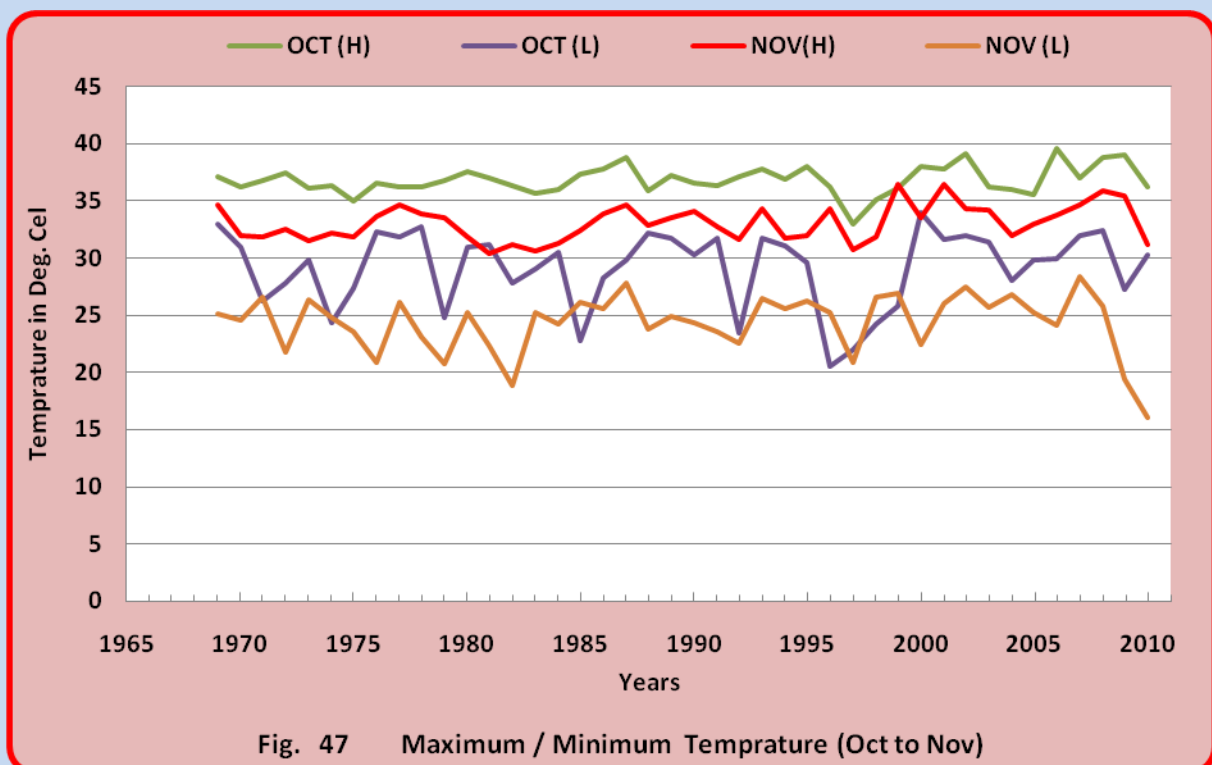
Fig. 46 Daily Normal Temperatures Post Monsoon Season

Extreme Temperatures

The highest maximum and lowest maximum temperature (Fig. 47) during October and November 1969-2010 shows that the highest maximum temperature during October ranges between 35-37 °C and November 33-35 °C. The highest maximum temperatures attained during the study period are 39.6 °C (4th October 2006) and 36.4°C (1st November 1999). While the ever recorded maximum temperatures in both the months are 40.0 °C (4th October 1899) and 36.4 °C (1st November 1999) respectively.

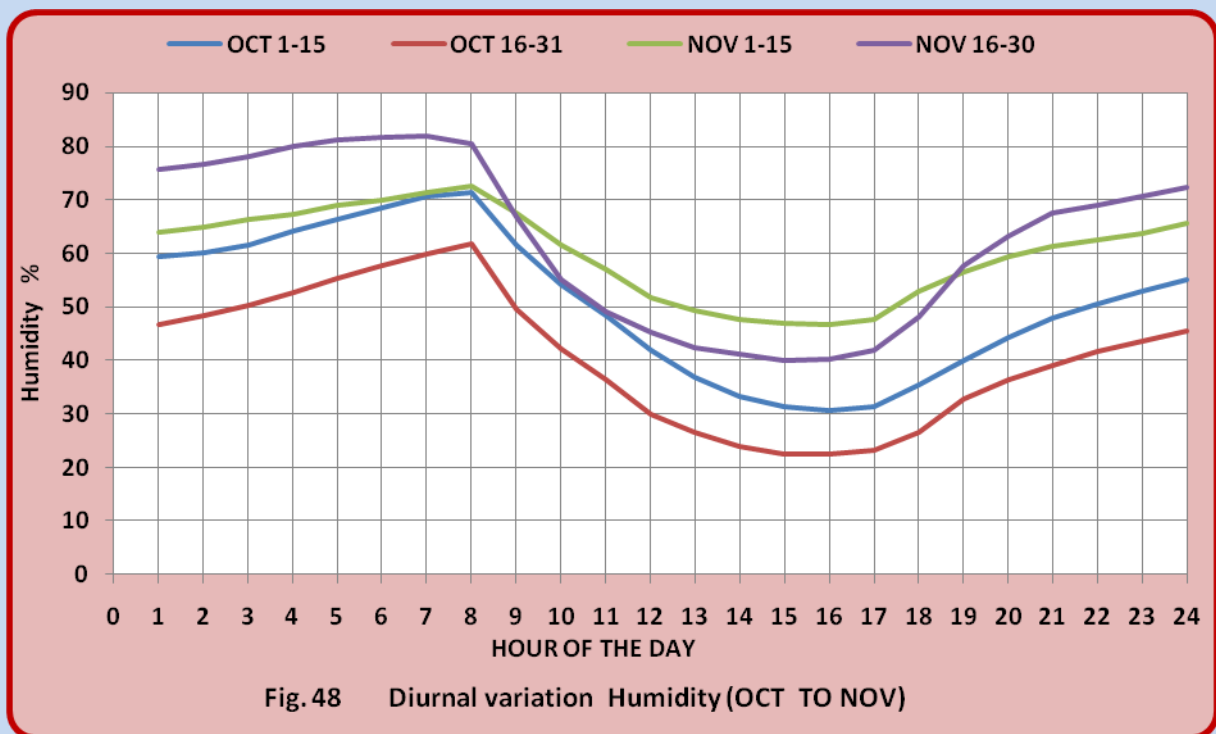
The lowest maximum temperatures during October and November 1969-2010 shows that the lowest maximum ranges from 25-30 °C in October and 22-25 °C .in November. However, lowest value of this parameter is 20.5 °C (25th October 1996) and 16 °C (23rd November 2010).

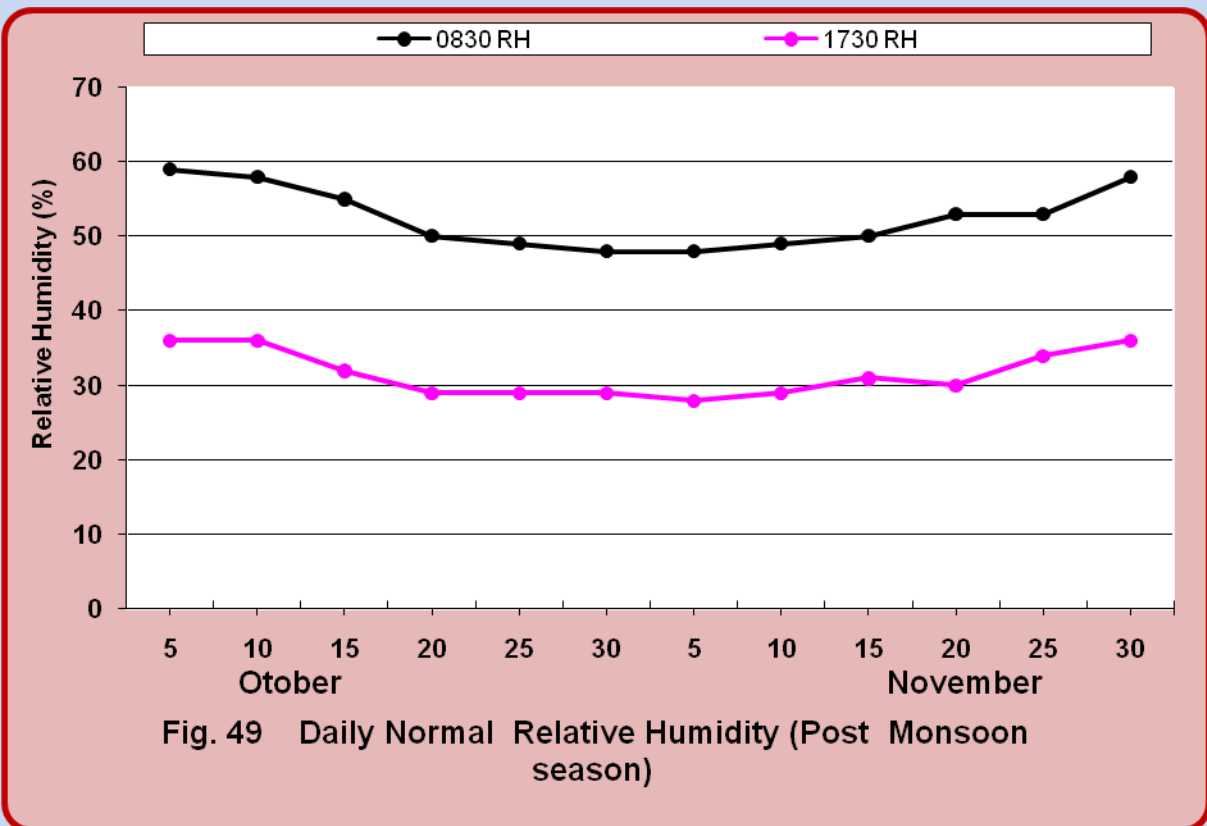
The lowest and highest minimum temperature during the period 1969-2010 in both these months shows that lowest minimum temperature ranges between 14-16 °C in October and 7-9 °C in November. All time record of lowest temperature during these months are 11.1 °C (30th October 1934) and 3.3 °C (30th November 1938).



Relative Humidity

The post monsoon season is characterized by fair weather conditions as the rainfall and other weather phenomena practically ceases in this period. The humidity is maximum during morning hours (around 8 AM) and lowest during evening hours (around 4 PM). The diurnal variation is shown in Fig. 48 The morning hour's humidity remains between 48-60 % and the evening period between 30-40 % during the season. Thus there is no large increase and decrease in relative humidity during the whole season. Both minimum and maximum Daily humidity decrease slowly up to the end of October than again show a rising tendency up to the end of the season. The variation in these humidity is very little throughout the season. The normal daily range is almost uniform throughout the season (Fig. 49).





Rainfall

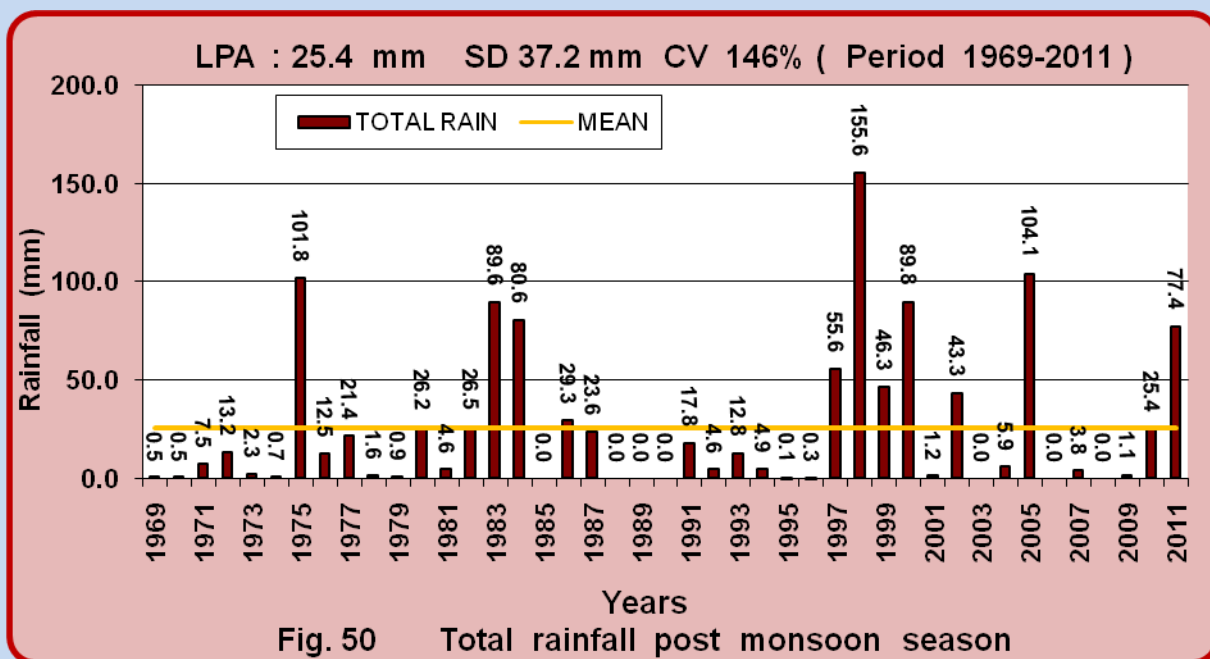
South west monsoon withdraws from the state after first fortnight of September. Thundershowers activities cease to act. Rainfall does occur in this season by eastward moving western disturbances. The normal rainfall is 1 to 1.5 mm. in the first week of October and then reduces drastically to less than 0.5 mm to zero throughout the season.

The average monthly rainfall is 25.0 mm for October and 3.9mm for November. The mean number of days is 1.3 and 0.4 for October and November respectively.

The highest monthly total rainfall is 234.8mm in October, 1956 and 61.0 mm in November, 1893 whereas, 24 hours ever recorded highest rainfall is 114.3mm (14th October, 1924) and 32.3mm (20th November,1893).

Heavy rainfall generally not occurs in this season. Rainfall of 1cm or less is not uncommon while instances of heavy rainfall are there during the period 1969-2011. During 43 year heavy rainfall of 75.6mm (11th October, 2004) and 47.2mm (24th November, 2010) was realized in the season.

Seasonal variability of the total rainfall during the period 1969-2011 is shown in Fig. 50. The normal rainfall of the season is 25.4 mm with standard deviation (SD) 37.2 mm and coefficient of variation 146%. The highest seasonal rainfall (155.6 mm) was observed during the year 1998 and the lowest (0.0 mm) during 1985, 1988, 1989, 1990, 2003, 2006 and 2008 years.



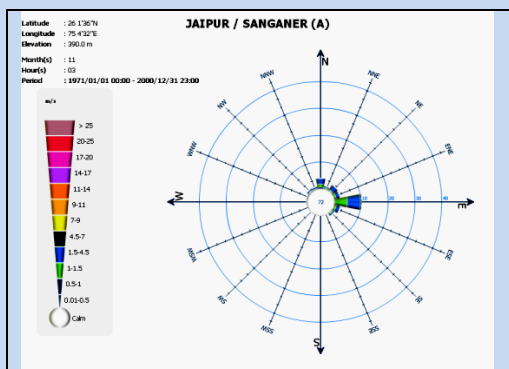
Thunderstorms and other Weather Phenomena

The rainfall activity is very much less in this season. Thus, thunderstorms activity also diminishes. The average numbers of thunderstorms are 0.7 in October and 0.3 in November. These generally occur in the afternoon or early in the nights.

Wind

This season is not windy like summer and monsoon season. The monthly wind rose diagram of the season are shown in Fig. 51 below. The average wind speed ranges between 2-4 kmph. The light winds blow during day time and become calm during night time. During morning hours wind direction remains easterly while in evening become northerly to northwesterly. The percentage number of calm conditions is also high in this season.

Morning hours



Evening hours

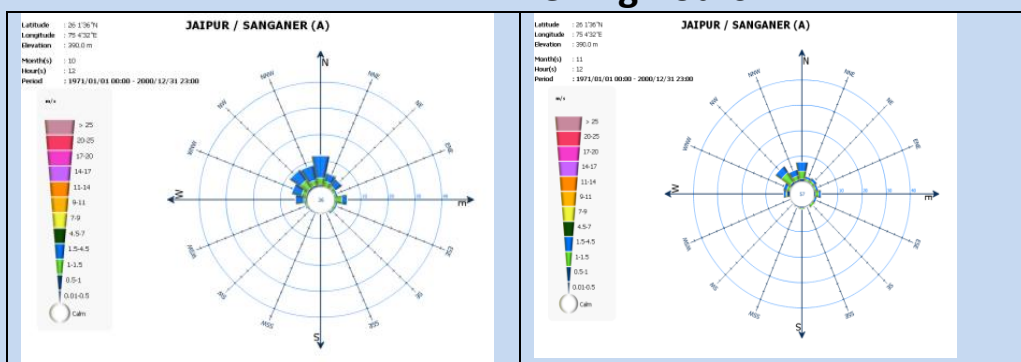


Fig. 51 Wind rose diagram of Jaipur - post monsoon season

Tables

Table 1. Extreme Temperatures for Jaipur:

Month	Highest temp. in month	Date & Year	Lowest temp. in month	Date & Year
January	31.7	31,1932	-2.2	31,1905
February	36.7	28,1953	-2.2	01,1905
March	42.8	27,1892	3.3	04,1898
April	44.9	27,1958	9.4	01,1905
May	48.5	06,1980	15.6	17,1920
June	47.2	10,1897	19.7	18,1976
July	46.7	05,1901	20.6	05,1931
August	41.7	01,1911	18.9	23,1953
September	41.7	11,1899	15.0	23,1972
October	40.0	04,1899	11.1	30,1934
November	36.1	02,1909	3.3	30,1938
December	31.3	12,1963	0.0	13,1964

Table 2. Rainfall Features of Jaipur

Month	Highest monthly rainfall (mm)	Year	Heaviest rainfall in 24 Hours	Date & Year	Average no. of Wet Days
January	076.5	1948	045.2	09,1957	0.5
February	077.2	1970	057.2	20,1954	1.1
March	051.3	1926	033.8	14,1926	0.6
April	123.8	1983	069.4	14,1983	0.6
May	100.3	1959	067.6	29,1959	1.7
June	319.2	1971	172.9	29,1971	3.6
July	956.9	1981	326.0	19,1981	10.4
August	554.5	1892	188.4	16,1959	10.6
September	420.1	1924	187.5	10,1924	4.2
October	234.8	1956	114.5	20,1893	0.8
November	077.4	2010	047.2	24, 2010	0.4
December	056.9	1935	041.4	09,1924	0.4

Table 3. Mean wind speed (kilometer / hour)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.0	4.6	6.0	7.3	9.8	9.4	8.1	7.7	6.7	5.1	3.6	3.5

Annexure

Criteria for Heat Wave and Cold wave

b) When normal maximum temperature of a station is more than 40° C

Heat Wave: Departure from normal is 4° C to 5° C

Severe Heat Wave: Departure from normal is 6° C or more

c) When actual maximum temperature remains 45°C or more irrespective of normal maximum temperature, heat wave should be declared.

Note: Heat wave need not be considered till maximum temperature of a station reaches at least 40° C for Plains and at least 30° C for Hilly regions.

Cold wave

Wind chill factor plays an important role and brings down the actual minimum **Heat Wave**

a) When normal maximum temperature of a station is less than or equal to 40 °C

Heat Wave : Departure from normal is 5°C to 6°C

Severe Heat Wave : Departure from normal is 7° C or more

temperature depending upon the wind speed. The actual minimum temperature of a station is reduced to 'WCTn' as per WMO technical note No. 123.

For declaring 'Cold Wave' WCTn is used. If WCTn is 10 °C or less, then only the conditions for cold wave should be considered.

a) When normal minimum temperature is equal to 10°C or more.

Cold Wave: Departure from normal is -5°C to -6°C.

Severe Cold Wave: Departure from normal is -7°C or less

b) When normal minimum temperature is less than 10°C.

Cold Wave: Departure from normal is -4°C to -5°C.

Severe Cold Wave: Departure from normal is -6°C or less.

When Wind chill effective minimum temperature (WCTn) is 0°C or less, Cold Wave should be declared irrespective of normal minimum temperature of the station. However, this criterion is not applicable for those stations whose normal minimum temperature is below 0°C.