Climate of Shimla

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Preface

Weather and Climate affect all aspect of life.

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Geographic

Geographical Location of Shimla

Shimla is the capital city of Himachal Pradesh. In 1864, Shimla was declared the summer capital of the British Raj in India. A popular tourist destination, Shimla is often referred to as the "Queen of Hills," a term coined by the British.

It is located in the north-west Himalayas at an average altitude of 2,205 metres (7,234 ft), the city of Shimla, draped in forests of pine, rhododendron, and oak, experiences pleasant summers and cold, snowy winters. The coordinates of Shimla are 31°6'12" North and 77°10'20" East. It has an area of 31.60 sq. km

Physiographic setting of Shimla

Shimla district of Himachal Pradesh, lies between the longitude 77.00" and 78.19" east and latitude 30.45" and 31.44" north, has its headquarters at Shimla city. It is surrounded by Mandi and Kullu in the north, Kinnaur in the east, Uttrakhand in the south, Sirmaur in the west. The elevation of the district ranges from 300 meters (984 ft) to 6,000 meters (19,685 ft).

Shimla is located in the north-western ranges of the Himalayas. At an average altitude of 2397.59 meters (7866.10 ft) above mean sea level, the city is spread on a ridge and its seven spurs. The city stretches nearly 9.2 km from east to west. The highest point in Shimla, at 2454 meters (8051 ft), is the Jakhu hill. Shimla is a Zone IV (High Damage Risk Zone) per the Earthquake hazard zoning of India. There are no bodies of water near the main city and the closest river, Sutlej, is about 21 km (13 mi) away. Other rivers that flow through the Shimla district, although further from the city, are Giri, and Pabbar (both are tributaries of Yamuna). The main forests in and around the city are that of pine, deodar, oak and rhododendron. Environmental degradation due to the increasing number of tourists every year without the infrastructure to support them has resulted in Shimla losing its popular appeal as an ecotourism spot. Another rising concern in the region is the frequent number of landslides that often take place after heavy rains.

General Climate of Shimla

Shimla – the capital of Himachal Pradesh is draped in forests of pine, rhododendron, and oak, experiences pleasant summers and cold, snowy winters. The city is famous for its buildings styled in Tudorbethan and neo-gothic architecture dating from the colonial era.

Shimla features a subtropical highland climate under the Koppen climate classification. The climate in Shimla is predominantly cool during winters and moderately warm during summer. Temperatures typically range from −4 °C to 31 °C over the course of a year. The average temperature during summer is between 19 °C and 28 °C and between −1 ° C and 10 °C in winter. Monthly precipitation varies between 15mm in November to 434 mm in August. It is typically around 45 mm per month during winter and spring and around 175 mm in June as the monsoon approaches. The average total annual precipitation is 1,575 mm, which is much less than most other hill stations but still greatly heavier than on the plains.

Snowfall in the region, which historically has taken place in the month of December, has lately (over the last fifteen years) been happening in January or early February every year.

Winters in Shimla are chilling. December, January and February are the months when Shimla experiences heavy chilling cold, with chilly winds coming from Himalayan snow peaks. During winters, the temperature goes below freezing point and nights are bone chilling. Snowfall is also very common. Maximum temperature during winters is 8 -10 degree Celsius.

Summer is the season when Shimla offers respite to people, from severe heat and heat waves of the plains. The summer season starts from April and lasts until June. During this season temperature, fluctuates between 15 deg C to 28 deg C.

Data Used

A meteorological observatory of IMD situated at Central Potato Research Institute (CPRI) at Bemloe since June 1989 represents the weather of Shimla city at present. Before June 1989, observatory was located at CTO (Central Telegraph Office), Shimla. Daily meteorological weather data of this observatory have been used to prepare the climatology of Shimla. The climatology of weather parameter like rainfall, temperature, humidity and wind described in the following section based on weather data from 1969 to 1989 at CTO and from 1989 to 2010 of the data recoded at CPRI. There is a difference in the temperature at both the places due the difference in the altitude. The extremes of rainfall are described here by using the weather data for the period from 1984 and temperature from 1901 to 2010.

The data on weather phenomena are of 22 years' period from 1989 to 2010.

Monthly maximum/minimum temperatures and rainfall are given in Fig 2.

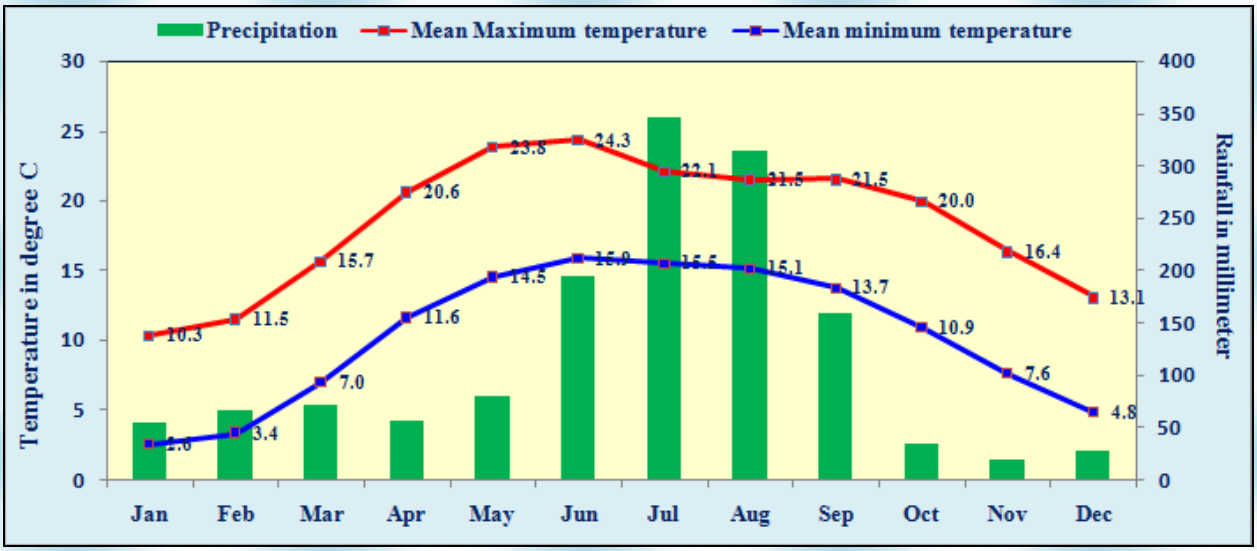


Fig. 2 Monthly Normal Maximum & Minimum Temperatures and total Rainfall

The annual values of maximum/minimum temperatures and precipitation is given in the Figure 2. It shows that the maximum and minimum temperatures are at their peak during the month of June. After the arrival of the South-west monsoon in the state, temperatures falls in the months of July and thereafter gradual change and almost same in the month of August and September. Both minimum and maximum temperatures further fall in the month of October and then sharply fall in the month of November by 3-4 deg Celsius. Temperatures continue fall till January being the coldest month.

The normal rainfall increases from the month of June with the onset premonsson rainfalla ctivity toward the middle and set up of the south west monsoon normally during the third week of June. July and August are the rainiest months. Monsoon withdras toward the end of the September. The rainfall decreases drastically from the month of the October with November having the lowest precipitation of the year and Again start increasing from the month of Decenber with the arrival of the westeren distirbance passing along the north of the Himalayas.

Monthly means/ exteams of the maximum and minimum temratures, snowfall days, monthly total/extreame rainfall and the avaergae number of days with the different weather phenomon are given in Table 1, 2, 3 and 4 respectively.

Winter Season

Winter season in Shimla starts in the month of November and last till March. India is a land of many festivals. All over this sub-continent there are different kinds of festivals. These festivals reflect the diversity of culture that this Asian country has. Himachal Pradesh is a state of India and it has many mountains. This place experiences low temperature during the winter months. The true spirit of Christmas is experienced over here, as the place is famous for a beautiful church that is decorated beautifully during Christmas. Shimla is India's favorite winter destination and what makes it truly special is the snowfall that it receives during the winters. Most tourists visit Shimla during the months of December, January and February to indulge in the lively ice sports like skiing, ice-skating or simple throwing snowballs!

Winters in Shimla are chilling. December, January and February are the months when Shimla experiences heavy chilling cold, with chilly winds coming from Himalayan snow peaks. During winters, the temperature goes below freezing point and nights are bone chilling. Snowfall is also occurred in Shimla during January and February. During fare weather days, days are sunny. Maximum temperature during winters is 10 -12 degree Celsius.

Temperatures

The daily normal temperature maximum and minimum temperatures for the season are given in Figure 3 below. The maximum temperatures register a gradual fall though the month of November. They fall from 18 deg. C in the beginning of the month to about 14 Deg. C by the end of the month. They continue to fall to 10 Deg. C by the end of the December remain around 10-11 Deg C till mid of February. Thereafter, they gradually rise and reach to 18 Deg. C by the end of the season from there it were started to fall.

The minimum temperatures also have a similar march thought the season falling from 9 Deg. C in the beginning of November to about 3 Deg. C by the end of the December month. They remain around 3 deg C or below till the middle of February. The upward trends start from the third week of February. The minimum temperatures reach to about 9 Deg C by the end of the season.

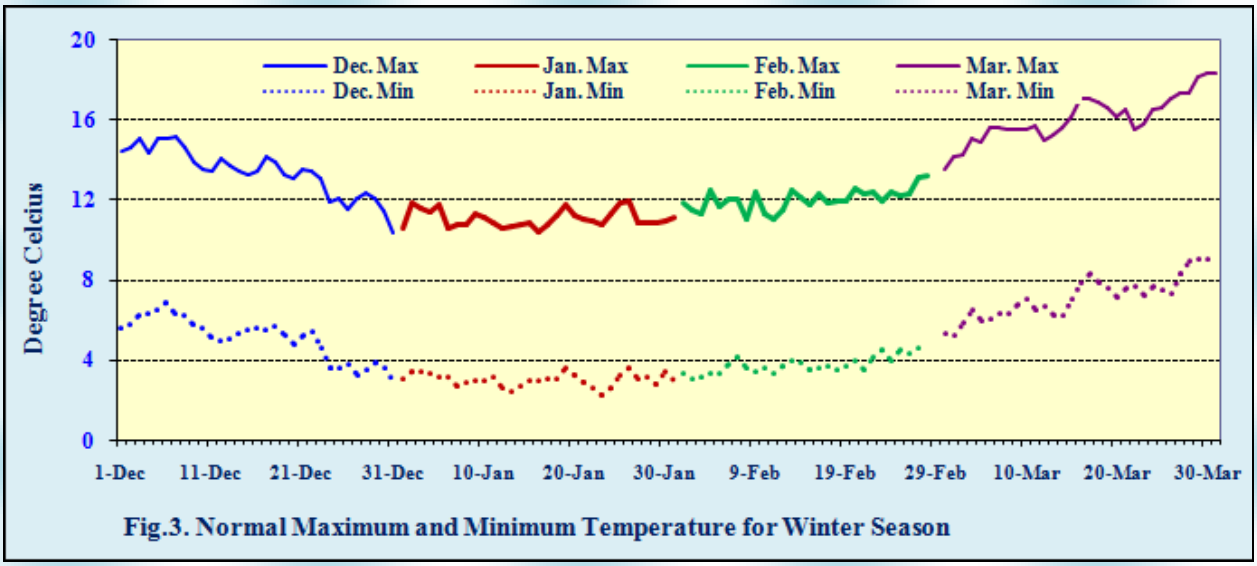


Fig.3. Normal Maximum and Minimum Temperature for Winter Season

Diurnal Variation of Temperature

The day temperature shows a diurnal variation of about 5 Degree Celsius during the season. Due to the inversion layer, diurnal variation in the temperature is low. Figure 4 shows the diurnal variation of temperature over Shimla during winter months from November to March (1991-2008) by using the autographic hourly analyzed data. Lowest temperature is recoded around 08 hours IST during January and February when the sun is at its southern most position; and around 07 around rest of the during rest of the season. A steep rise in the temperature is experiences from 0800 hours IST to 1200 hours IST. Afterward, they continue to rise till 1400 hours IST. The temperatures are lower by about 5-6 degree Celsius at all the hours of the day during all the winter months.

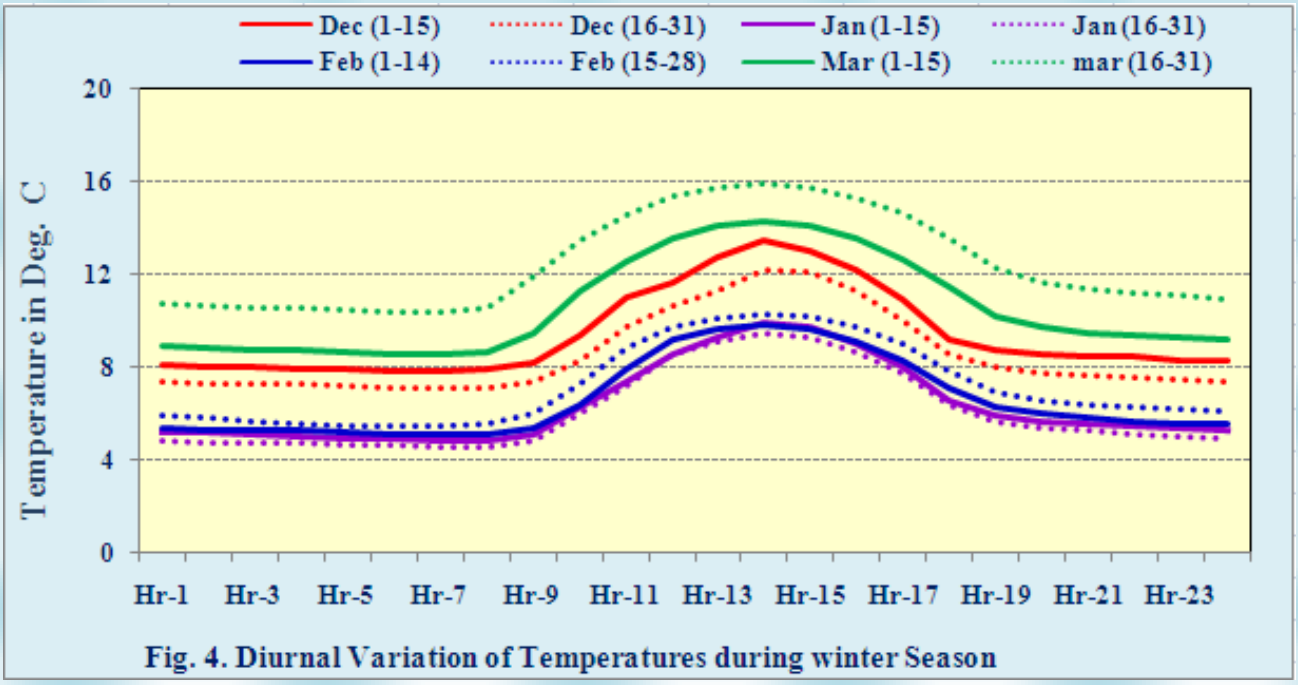


Fig. 4. Diurnal Variation of Temperatures during winter Season

Extreme Maximum Temperatures

The highest and lowest maximum temperature recorded during the winter season (Nov ember to March) during the period 1971-2010 given in Fig. 5. It shows that the maximum temperatures in the month of December range around 16-19 Deg. C during most of the years. The range is 12-15 Deg. C during January and around 13-16° C in February and around 17-20 Deg. C during the month of March.

The highest maximum temperatures recorded during the period are 20.5 Deg. C for December (15th December 2006 and 8th December 2008), 21.4 Deg. C for January (30th January 2006), 22.6 Deg. C for February (19th February 2006) and 27.2 Deg. C for March (27th March 2004). These values are also the all time records for these months since 1901.

Quite low values of the maximum temperatures can be recorded on the individual days, especially on snowfall days when the days have continue falling of snow. The lowest maximum temperature recorded in the city for different months during the seasons are 0.4 Deg. C December (29th December 1982), -1.4 Deg. C for January (27th January 1982), 1.7 Deg. C for February (14th February 1972) and 0.4 Deg. C for March (7th March 1982). The highest number of cold waves were 11 in December, 12 in January (1972), 12 in February (1973) and 17 in April (1982).

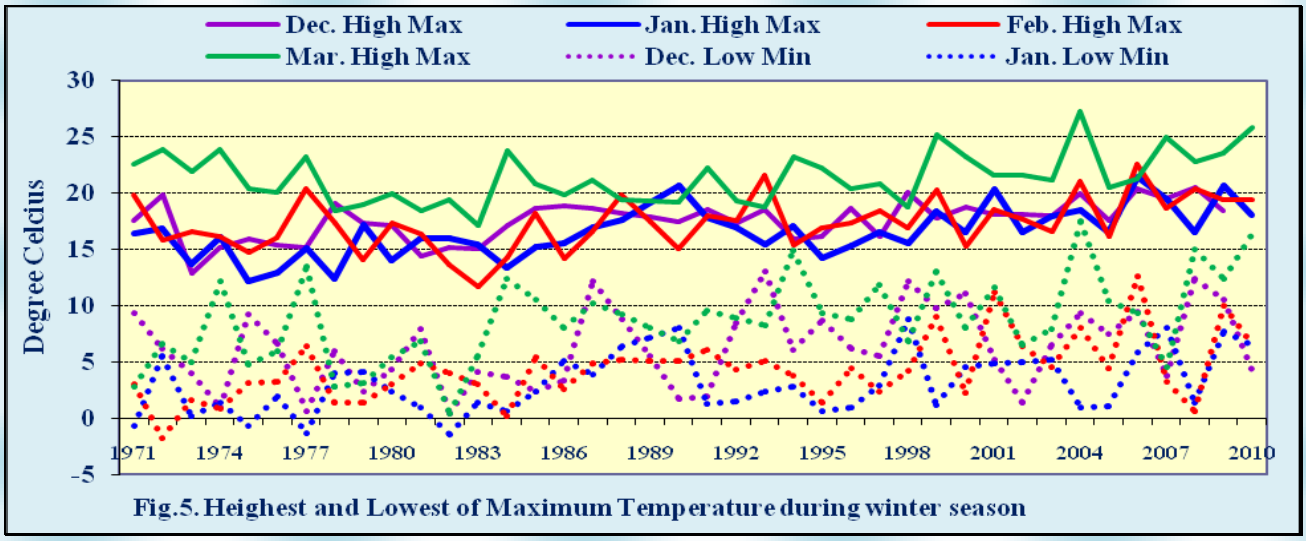


Fig.5. Heighest and Lowest of Maximum Temperature during winter season

Extreme Minimum Temperatures

The lowest and highest minimum temperature recorded during the winter season (December to March) during the period 1971-2010 given in Fig. 6. During most of the years, the lowest minmum temepratures recoded around 0 to 4 Deg. C during during December, -5 to -1 during January, -4 to 0 Deg. C during February and -2 to 2 Deg. C during the month of March. However, quite low temepratures are recorded during the season i.e. -4.0 Deg. C (15th December 1986), -6.4 Deg. (28th January 1972), -8.5 Deg. C (14th February 1972) and -6.1 Deg. C (9th March 1979). The lowest ever temprature for the month of December is -12.2 Deg. C on 13th December 1963 and -10.6 Deg. C on 11th January 1945. Such low temepratures are recodred on the clear nights after the snowfall days when a western disturbances across the northern parts of the country.

Minmum temepratures can be quite high (14-16 Deg. C) on the indiviuals days during the season, especially ahead of an approaching western disturbance, when warm moist air from south penetrate into the sate and nights are cloudy allowing little nocturnal cooling. The highest minmum temepratures recoded in the city for different months during the seasons are 13.3 Deg. C (17th December 1991), 12.7 Deg. (9th January 1993), 14.2 Deg. C (9th February 1993) and 16.5 Deg. C (22nd March 2010).

Low minimum temepratures leads to cold wave conditions (cold wave/sever cold wave condition) in the sate – when minmum temepratures of Shimla is 5 to 6 Deg C from its normal values (Annexutre 1). The average number of days with the cold wave conditions is 1.9 in December & January, 2.7 in February and March in 3.5 The highest number of days with cold wave/severe cold waves conditionas in any month has been 17 for March 1982 (Table 2).

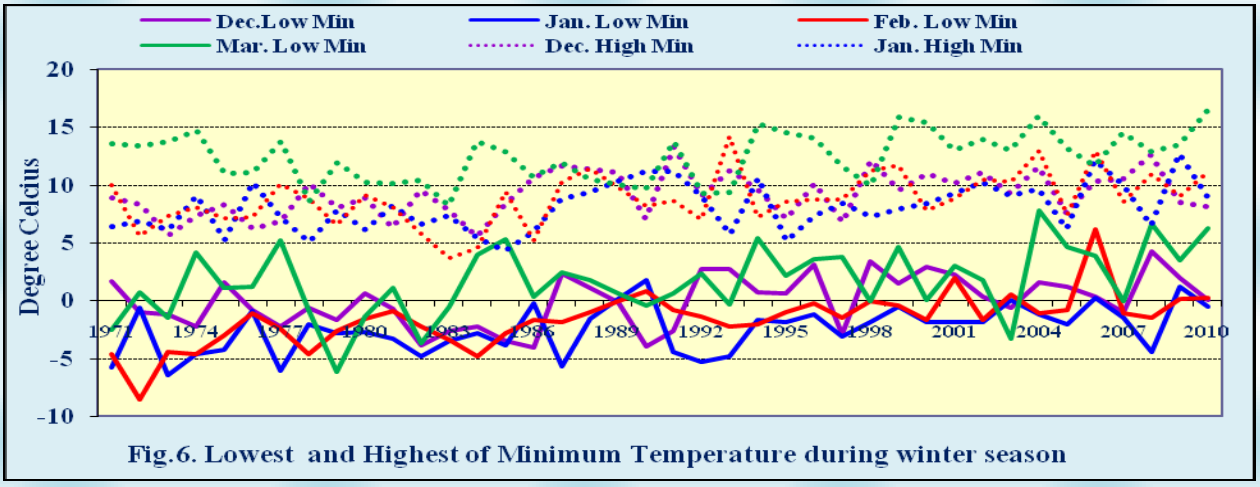


Fig.6. Lowest and Highest of Minimum Temperature during winter season

The rise in temepratures on the approach of western disturbance is a relatively slow process where as the fall is steeper as they move away accorss the area. These rise /fall are beaise pf the

change in the air mass on approach and in rear of these disturbances. The highest fall in the maximum and minmum temepratures during different winter months are given in Table 5. The highest fall in the maximum temeprature i.e. 11.8 Deg C was recorded on 8th February 1996. Also the night of 12th December, 1987 was 11.7 Dec C cooler than the previous night.

Table 5. Highest magnitude of fall in temperatures (°C) in 24 hours in Winter Season

Month	Maximum temeprature		Minmum temepratures	
	Temperature Fall	Date, Year	Temperature Fall	Date, Year
December	-10.7	30' 1997	-11.7	12, 1987
January	-11.2	13, 2010	-08.3	17. 1987
February	-11.8	10, 1996	-07.6	24, 1981
March	-08.9	21, 2001	-08.9	03, 2003

The probability of minimum temperatures to fall below 1 and 5 deg. C is given in Figure 7. It shows probability of falling of temperature below 1 Deg. C in the beginning of December is very low. However, it is gradually increases and reaches up to 20% by the end of the December till the month of February. From the last week of the February, probability of falling of minimum temperature below 1 Deg. C again starts decreasing from 20% and reaches to the lowest minimum value after the mid of the March.

However, the probability of the temperature to fall below 5 Deg. C is very high (80%) from the first week of January to second week February. First week of December month has the probability below 40% for falling the temperature below 5 Deg. C and reach to 65% by the end of December and March have 10-40%.

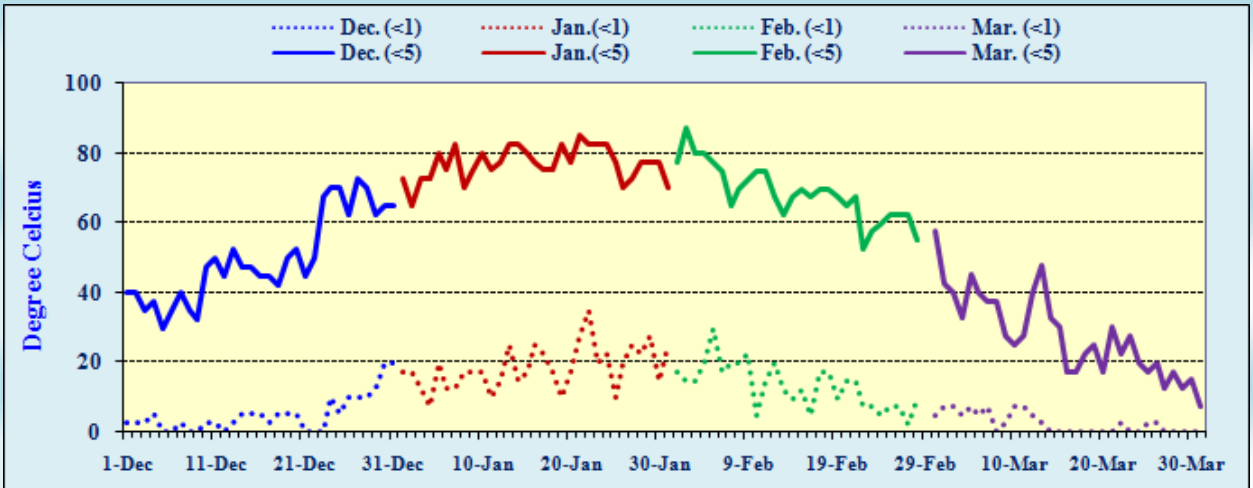


Fig.7. Probabilty of maximum and minimum temperature to fall below 1 and 5 deg. C during Winter Season

Humidity

The daily means maximum and minimum Relative Humidity (RH) given in Fig 8 shows that maximum RH has fall in the RH about 10% during the first week and then it has increasing trend from beginning of the season (60-70%). It gradually increases till the end of the February month and fluctuate between 80-85%. Warming during the beginning of the March causes maximum RH gradual decrease from first week of March. It falls to 70% by the end of the March. The minimum RH also shows a similar tendency during the season- a fall of about 10% from the beginning of the season and then it rise of about 20-30% by the end February month and again fall by 20% for the end of the season.

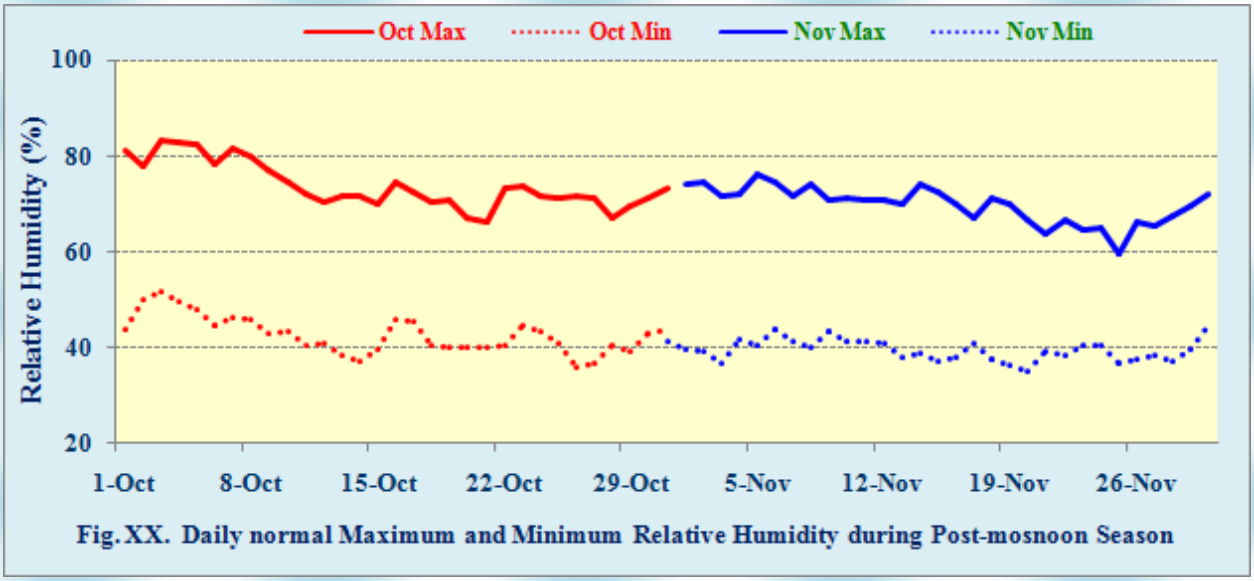


Fig. XX. Daily normal Maximum and Minimum Relative Humidity during Post-mosnoon Season

Diurnal Variation of Relative Humidity

The diurnal variation of Reltive Humidity (RH) in Figure 9 shows that the highest RH in Shimla during winter season is observed between 1800-2000hrs IST and then continue gradual fall through out the night and till noon time. Thereafrer, it shows a sharp incresing trend from 1300 hrs IST to 1800 to 2000hrs ISt during the different months of the season. . Throughput the season the average RH is below 75%, however, it reaches upto 100% at the time of arrival of westeren disturbances.

Average highest RH 62% register in during the second fortnight of December around 1800hrs IST, 68% in January & March around 1700hrs and 72% in Feburary around 2000hrs. The minimum RH is around 43% in the month of December at about 1400hrs, 50% in the month January between 1200 to 1400hrs, 52% in February at about 1400hrs and 44% in the month of March at 1300hrs IST.

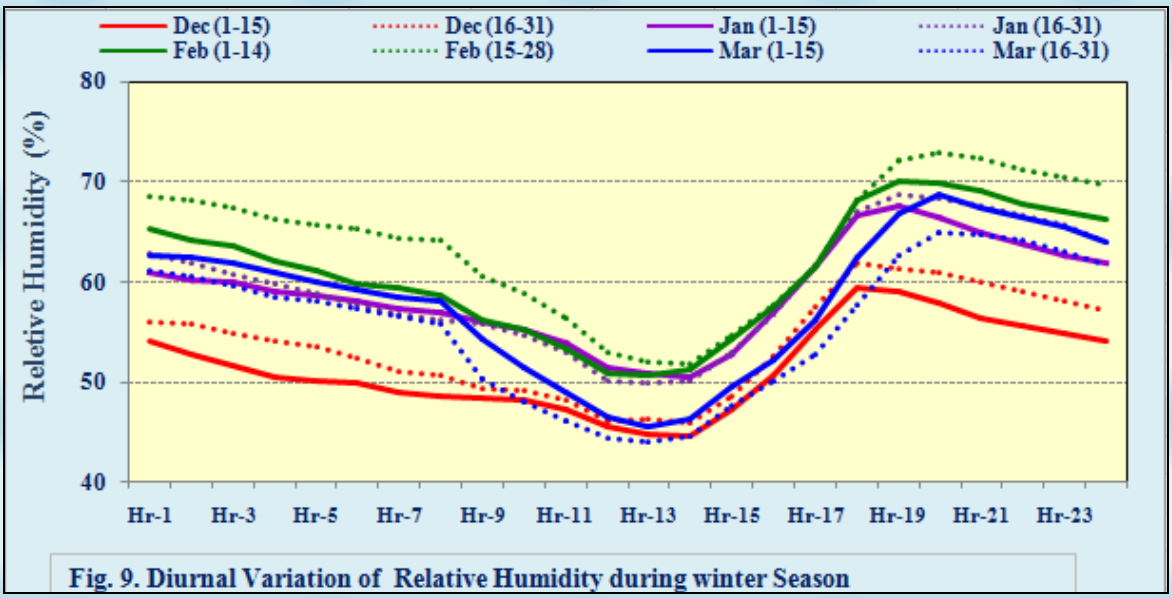


Fig. 9. Diurnal Variation of Relative Humidity during winter Season

Precipitation

Winter in Shimla receive 17% of the total annual precipitation. Precipitation occurs in Shimla is in association with the eastward moving mid-latitude weather system generally known as Western Disturbances. Mean monthly precipitation is 18.1mm for the month of November, 25.4 mm for the month of December, 54.1 mm for the month of January, 64.7 mm for the month of February and 72.0 mm for the month of March. The daily normal rainfall for each day during the winter season is shown in figure 10. It shows that the precipitation activity increases as the season progresses. Average number of rainfall days is also increasing in the preceding months of the season. They were 2.3 for the month of November and then reach to 5 for the month of December, 7 for the month of January, 9 for the month of February and 11 for the month of March. The probability of rainfall for each day in the season (Figure 11) shows that the probability of rainfall increases from less than 10% in the beginning of November to 30-40% from January to March.

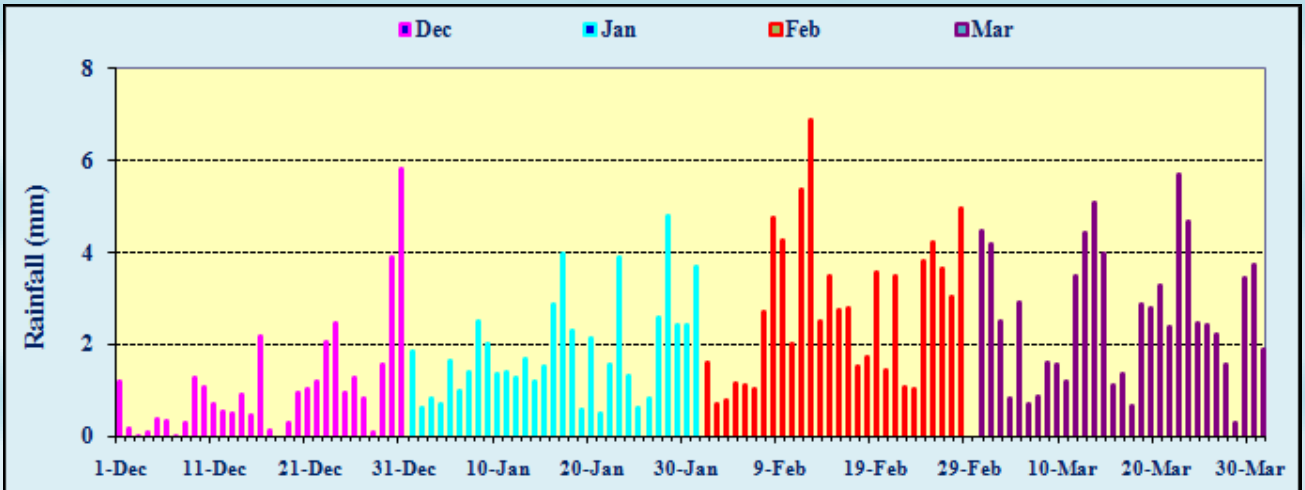


Fig.10. Daily normal Rainfall for the winter Season

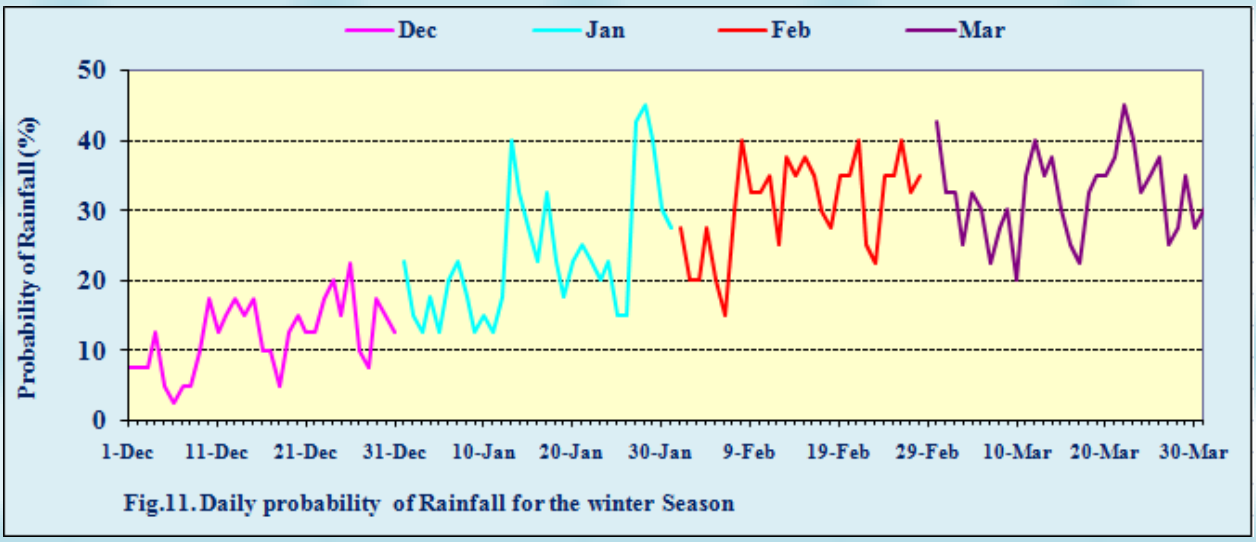


Fig.11. Daily probability of Rainfall for the winter Season

HEAVY RAINFALL

Heavy Rains are not so frequesnt in Shimla during the winter seasons. The heaviest 24hrs rainfall of winte precipiciptation months (1971-2010) in Figure 12 shows that a precipitation of 20-30mm in 24 hours is not uncoomon during the season. The all time records for 24 hrs heavy rainfall are 104mm (31st Dec 1990), 78.5mm (26 January, 1888), 63.5mm (02 Febuary, 1908) and 66.6mm (01 March, 2007) and wettest months have 206.5mm (December, 1883), 255.0mm (January, 1911(), 229.6mm (February 1901) and 231.4mm (March 1911).

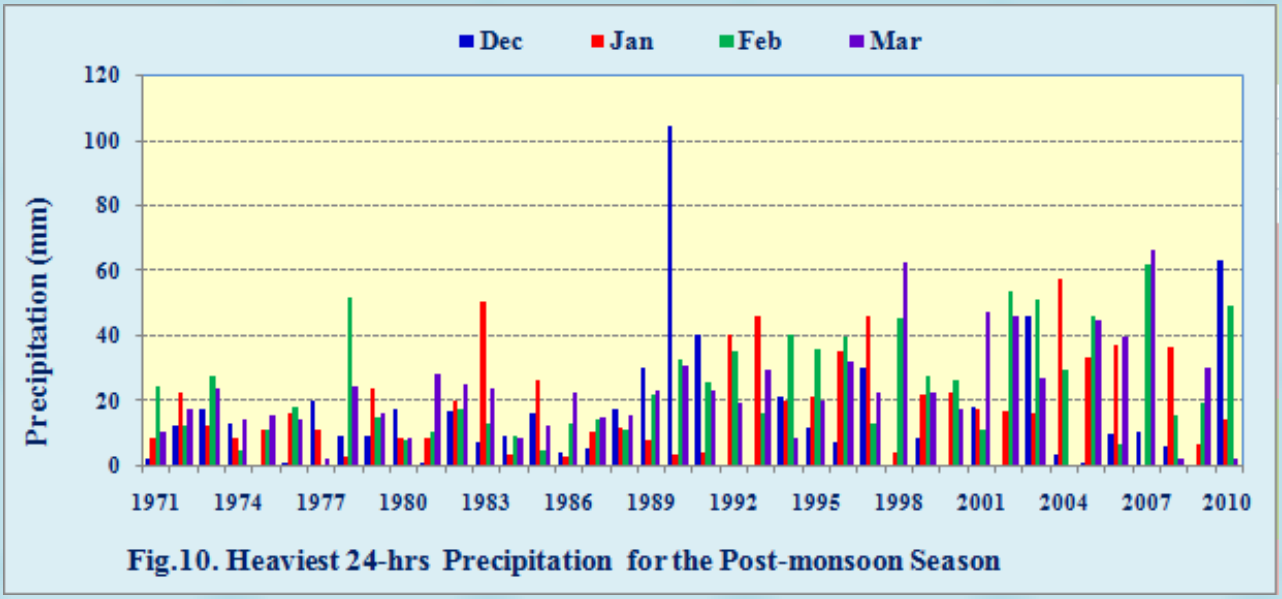


Fig.10. Heaviest 24-hrs Precipitation for the Post-monsoon Season

Snowfall

Shimla generally experience snowfall from the swecond fortnight of December to first fort nigth of March. Average monthly snowfall is given in Table 13 by using the 20 winter season (1990-91 to 2010-2011) snowfall data recorded at IMD Observatory in Shimla. Average snowfall for the month of December is 7cm; snowfall for the month of January is 38cm , Feburary-39cm and Mrach;7 cm. Monthly highest snowfall was 205cm in December 1990, 109 cm during January 1993, 113cm during February 2007 and 63cm in the March 1998. Highest snowfall during 24 hours during the period from 1990 to 2010 for the month of December, January, February and March are 104cm on 31st Dec (1990), …… respectively.

Percentage distribution of the snowfall with respect to the total precipitation during the month of December, January, February and March is 7%, 42%, 43% and 7% respectively. Seasonal snowfall days (Figure XX) from 1971 to 2010 shows significant decreasing trends. The disapeance of snowfall days is probabily due to rise in the of the temprature. Snowfall at places generally occur when the minimum temeprature is below 1°C.

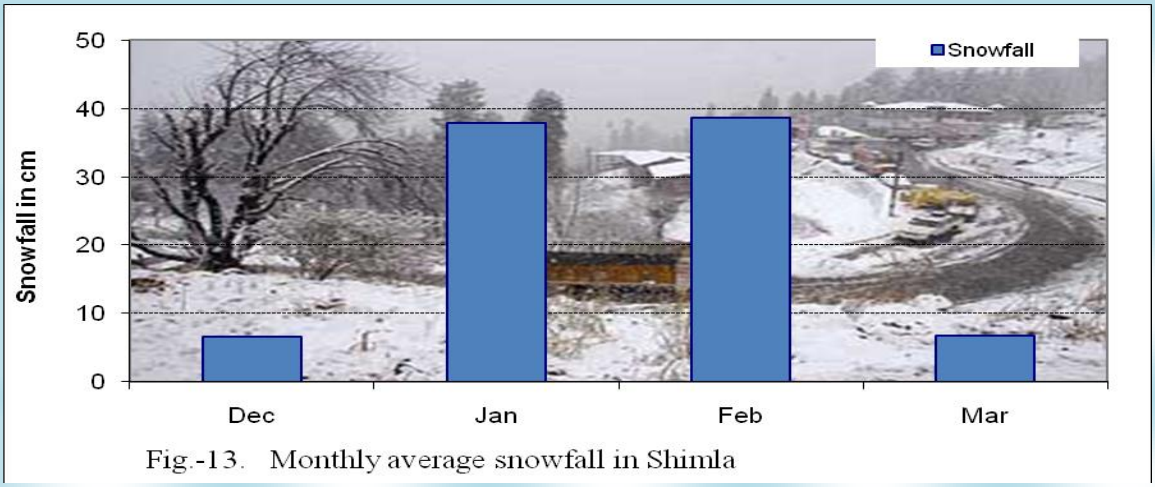


Fig.-13. Monthly average snowfall in Shimla

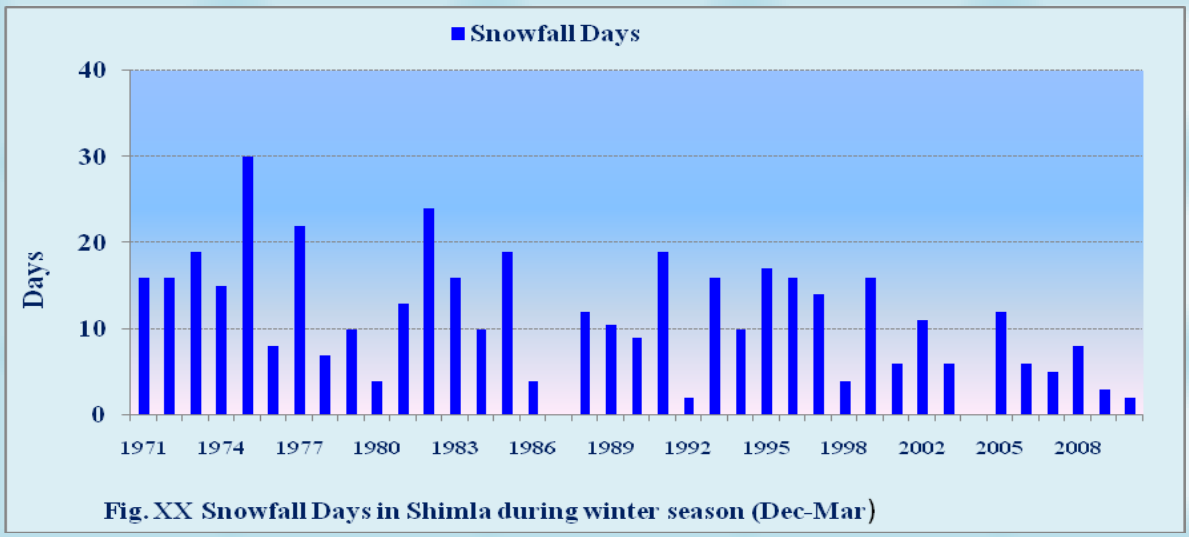


Fig. XX Snowfall Days in Shimla during winter season (Dec-Mar)

Thunderstorm and other weather phenomena

Thunderstom (TS) activity is not very high during the begning of the season and increases with the season. Average number of thunderstorms days (1990-2010) are 1.1 in December, 2.1 in Januarary, 3.8 in February and 6.0 days of thunderstorm in the month of March. There is a large inter-annual variaion in the number of days with thunderstorms ranging from zero in few years to maximum of 4 in December (1991), January (1996 & 2002), 7 in February (1994) and 10 in March (2004). Total number of thunderstroms days during the seasion from 1990 to 2010 are presented in Figure 13. Hailstorm activity decreases in the month of December and therafter, it again start increases. 47% of the days with hails fall in winer season (Dec-Mar). Average number of hail days for the period (1990-2010) were 0.4 in December, 0.9 in January, 1.3 in February and 1.9 in the month of March.

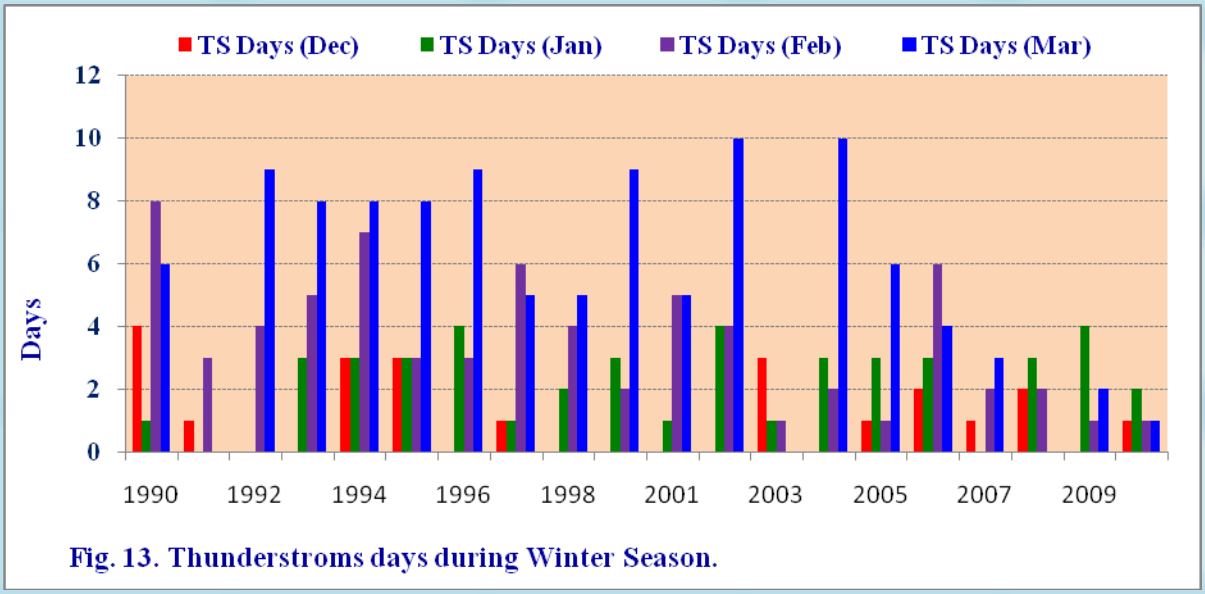


Fig. 13. Thunderstroms days during Winter Season.

Fog and Visibility

Clear days, cold and dry winds results the fog free Shimla during most of the days in Shimla. On an averare there are hardly any day when the visibilty in Shimla reduce below 1km. Average number of days with the visibility below less than 1km are 0.3 in December, 0.9 in January, 0.8 in February and 0.5 in the month of March. However, maximum number of days within this range of visibity are upto 3, 3, 4, 2 respectively in the month of december, January, Febuary and March. The days with the visibility between 1-4kms are 1.1 in December, 1.4 in January, 2.5 in February and 1.6 during the month of March. Most of the days i.e. 11-14 days durine each months of the season have th visibity range from 4-10km and 13-15 days have the visibility range between 10-20kms during each months of the winter season (Figure XX), howver, maximum days with visibity range 10-20kmrs reaches upto 31days.

Fog occasionally sets at the time of arrival of the WDs when it results to low clouds and rainfall or snowfall etc. Monthly number of days during morning hours are shown in Figure XX. Average number of Fog days are 1.1 in December, 2.5 in January, 2.8 in February and and 1.0 in March. Maximum number of Fog days observered in Shimla are 7 each during December (1991) and Mrach (1992) and 9 each during January (1995) and February (1995).

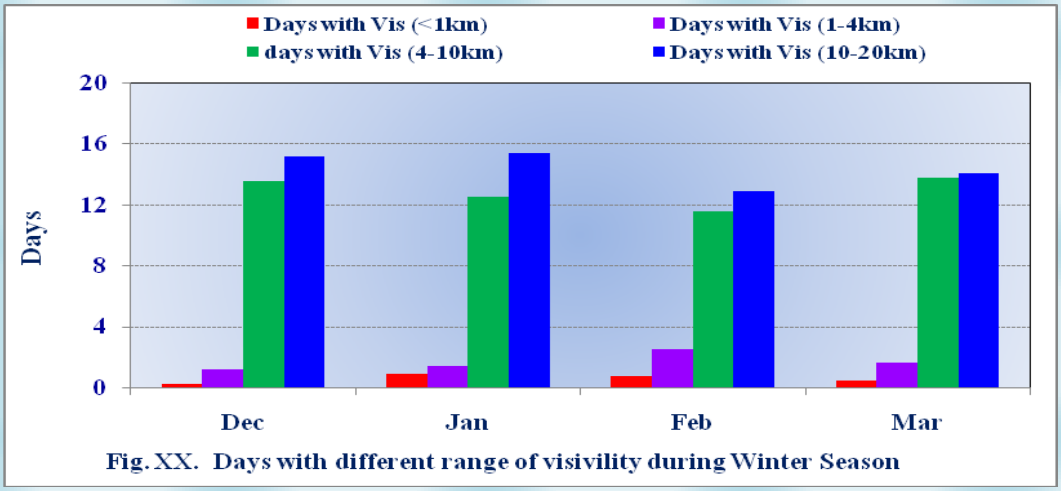


Fig. XX. Days with different range of visivility during Winter Season

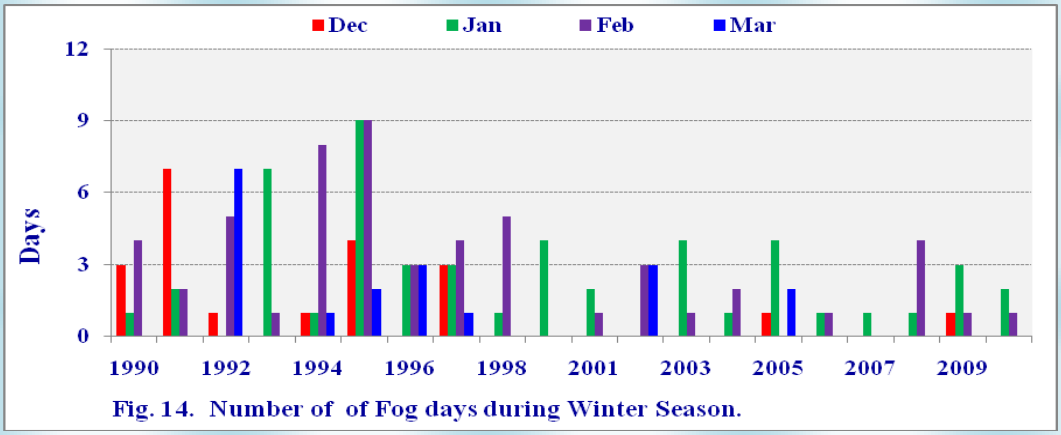


Fig. 14. Number of of Fog days during Winter Season.

Wind

Winter is not very windy season for Shimla. The average wind speed during winter period is 3.2 kmph. Average monthly wind spead incrases as the season progeress and become maximim in the month of March. Avrage monthly wind in the month of December, January, Febuary and March is 2.9, 3.1, 3.4 and 3.5kmph respectively. There is large inter-momthly variation with maximim wind only 6.9 kmph in December (1984), 7.5 in January (1982), 8.8kmph in Feburary (1983) and 14.8 kmph in the month of March (2003). Wind speed recorded at 0830hrs and 1730 hrs ISt is shown in Figure XX shows that on an avaerage wind speed is more during 1730hrs except the February month.

The mean monthly wind roses for morning (0830IST) and evening (1730IST) given in Figure 17 shows that the most prominent wind direction during the season is south-east in the morning. During the evening hours, southerly direction become more prominent in Shimla, which may the cause of the warm nights in Shimla during winter period as compared to the nearby plains.

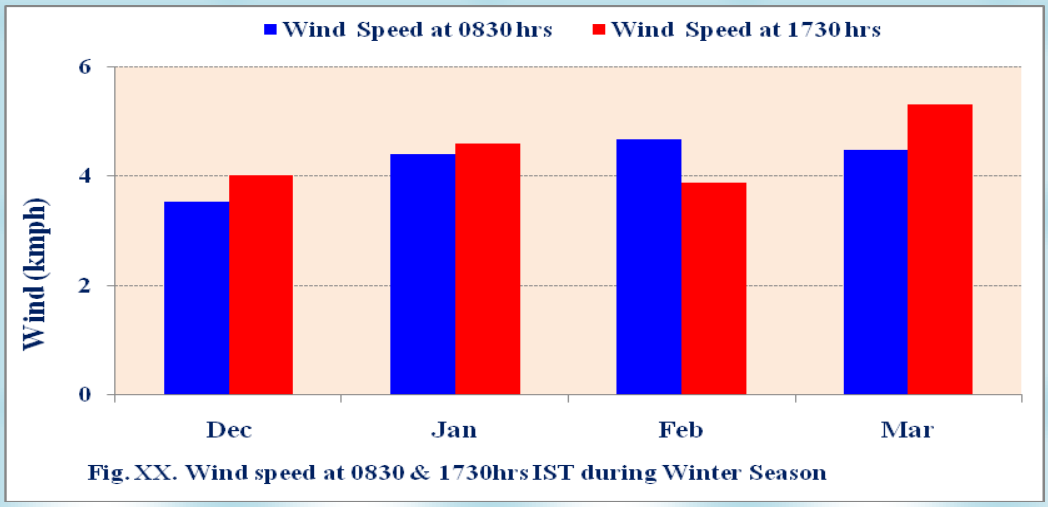
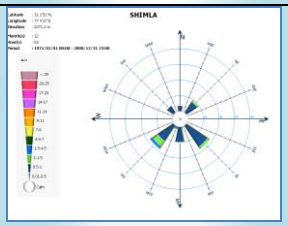
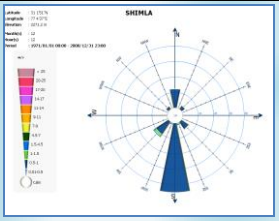


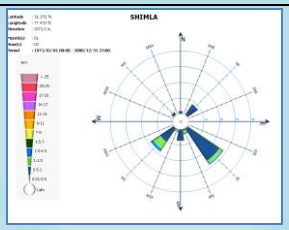
Fig. XX. Wind speed at 0830 & 1730hrs IST during Winter Season

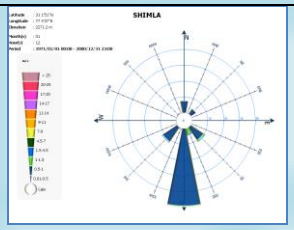




Monrning **Evening**

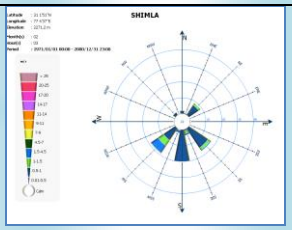
Decemeber

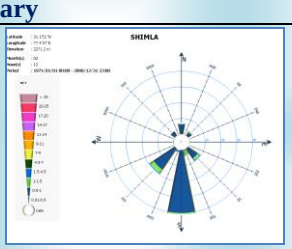




Monrning **Evening**

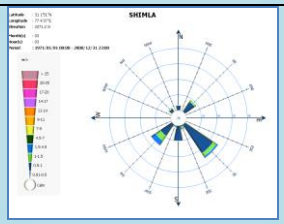
January

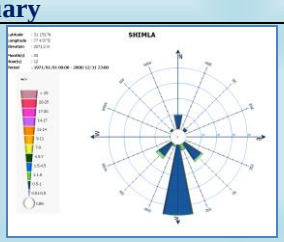




Monrning **Evening**

Febuary





Monrning **Evening**

March

Fig. XX. Windrose at 0830 and 1730 hrs ISt at Shimla during Winter Season

The months of April and May costitude the summer season in Shimla. Climate of Shimla is moderately warm during summer season. Summer is the season when Shimla offers respite to people, from severe heat and heat waves of the plains. The summer season starts from April and lasts until the arrival of pre-monsoon shower during June. During this season temperature, fluctuates between 15 deg C to 28 deg C.

The summer festival of Shimla is a gay time for the people of Shimla. It is celebrated with much of pomp and grandeur in the month of May every year in Shimla. The Shimla summer festival is a major festival of Shimla. It projects the rich tradition and culture of the state of Himachal Pradesh. Shimla assumes the color of festivity during the month of summer.

Daily Temperatures

Continues rise in the temperature is the main feature of the season. The daily normal temperatures for the season for the season are given in Fig 19 below. The maximum temperatures register a sharp increase from 18 deg. C in the beginning of April to about 23 Deg. C by the l end of April. Afterward it gradually rises in the month of May till it reaches to 26 Deg. C. The minimum temperatures also have a similar tendency rosining from about 9 Deg. C in the beginning of April to about 16 Deg. C by the end of May.

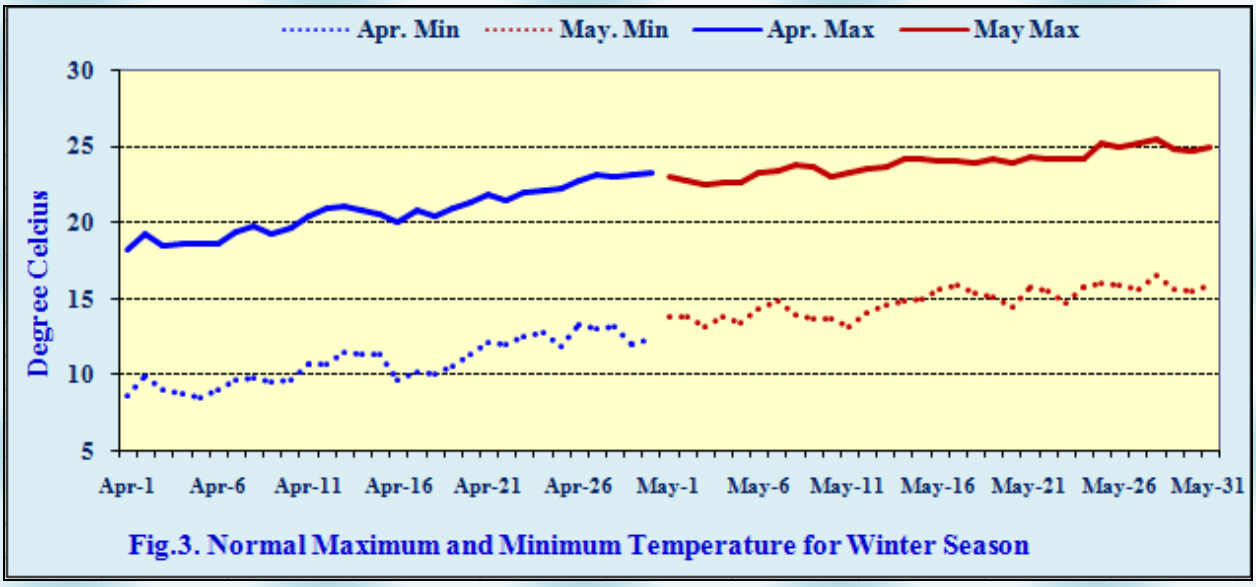


Fig.3. Normal Maximum and Minimum Temperature for Winter Season

Diurnal Variation of Temperature

Diurral variation of temperature during the perios (1991-2007) by using the hourly data from the autographic charts is shown in Figure. 20. The lowest temeprature during the day are recorded around 0700 hours IST in during the season. The temperatures increase sharply from 0800 to 1300 hours IST and reach to their peak values around 1400 hours. The decrease from the afternoon to night is slightly gradual as compared to winter season. The difference in the temprature of two fortnight of April is about 2 degree Celcius and and about 1 Deg. C for May indicating the the slower increase in temeprature durng the month of May.

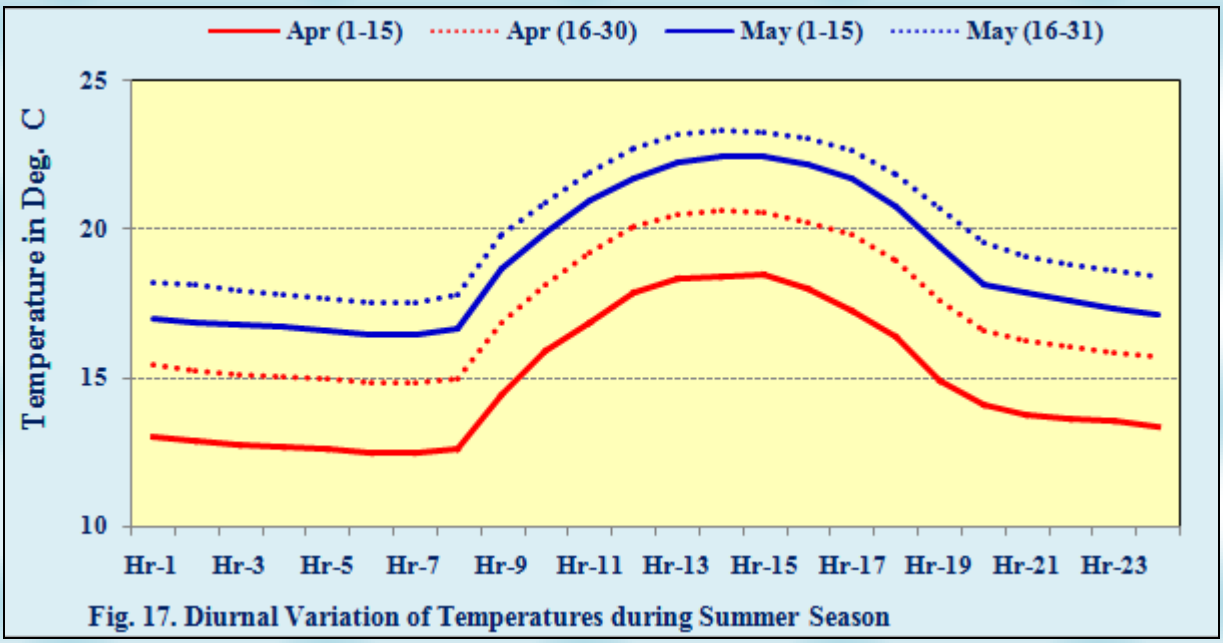


Fig. 17. Diurnal Variation of Temperatures during Summer Season

Extreme Maximum Temperatures

The highest and l0west temperatures recorded during the season (1971-2010) given in Fig 22 shows that the maximum temepratures attained during most of the the years in around 24-26 Deg. C during April and 28-30 Deg. C during May. The highest maximum temperature reached during the period have been 29.6 Deg. C in April (17th April 2010), 32.4 Deg. C in May (27th May 2010). However, the maximum temperature remain significantly lower at the time of persistent cloudiness and rainfall/thunderstorm occur in the hilly region in association with the western disturbance of local convection.

The lowest maximum temperature recorded during the period have been as low as 7.1 Deg. C 3rd Apr 1997) and 9.4 Deg. C (15th May 1982) indicating that the day temperature in Shimla during summer on indiviual days could be quite cold like the winter months.

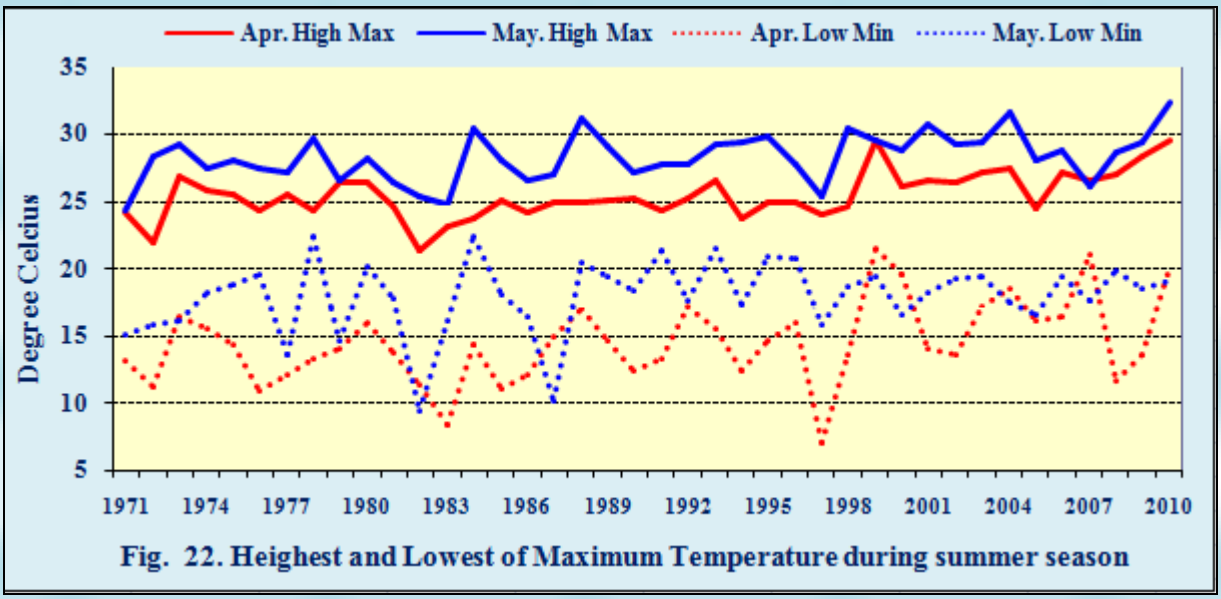


Fig. 22. Heighest and Lowest of Maximum Temperature during summer season

Extreme Minimum Temperatures

The lowest and highest of minimum temperatures (1971-2010) for different months given in Figure 23 shows that the lowest minimum tempratures reached about 4-6 Deg. C in April and 6-8 Deg. C in May during most of the the years. However, they have fallen to as low as -1.3 Deg. C in the month of Apri (17th PAril 1987) and 1.4 Deg. C in the month of May (3rd May 1987) during the period of the study. The highest minimum tempratures reached about 14-16 Deg. C in April and 18-22 Deg. C in May during most of the the years. The highest minmum temepratures on the indiviual temperatures remains as high 20.1 Deg. C in the month of April (30th April 1999) and 23.6 in May (25th May 1984) during the period of study. The mean maximum and mean minmum temeprarures ever recorded during the season are given in Table 1.

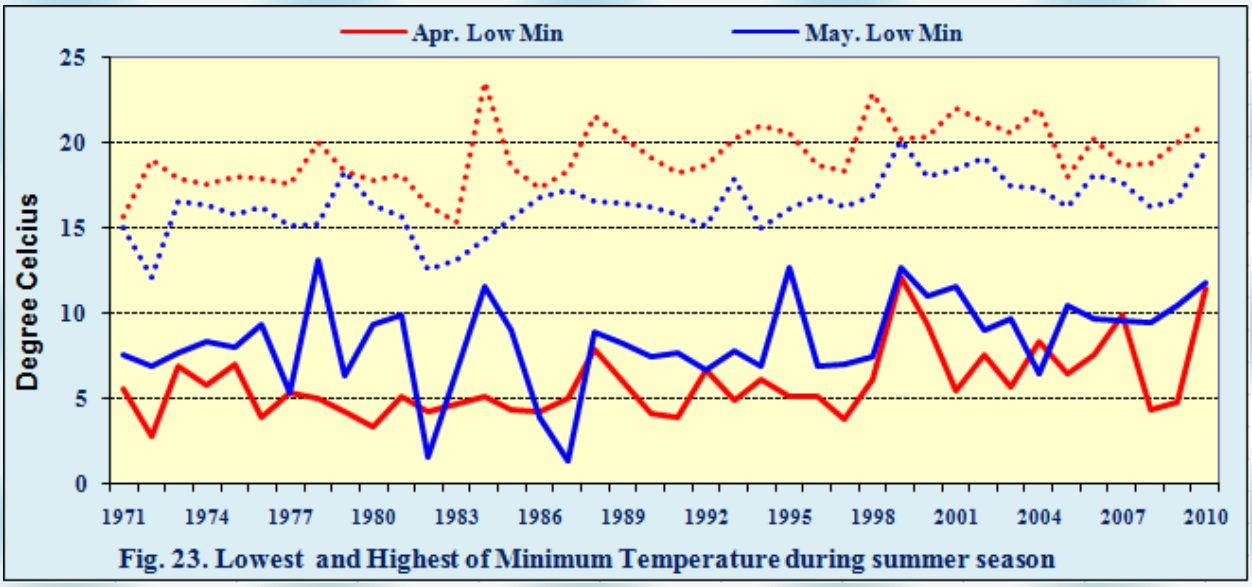


Fig. 23. Lowest and Highest of Minimum Temperature during summer season

The probaility of the maximum tempratures exceeding 25 degree and 30 Deg. C during the month of April and May are given in Figure 24. It shows that there is no probalinty for rising the temperature more than 30 Deg. C in the month os April,however, there is very least probabilty (below 10%) that temprature would rise above 30 Deg. C after the 10th May.

The probaility of the maximum temperatures is negligible for rising of more than 25 Deg. C in ther begning of the season and it gradually increases with the proceeding of the season and it lies between 10-30% in the month of April and 30-60% in the month of May. There is no chance of heat waves in Shimla as the normal temepratures of Shimla quite below than the heat wave conditions.

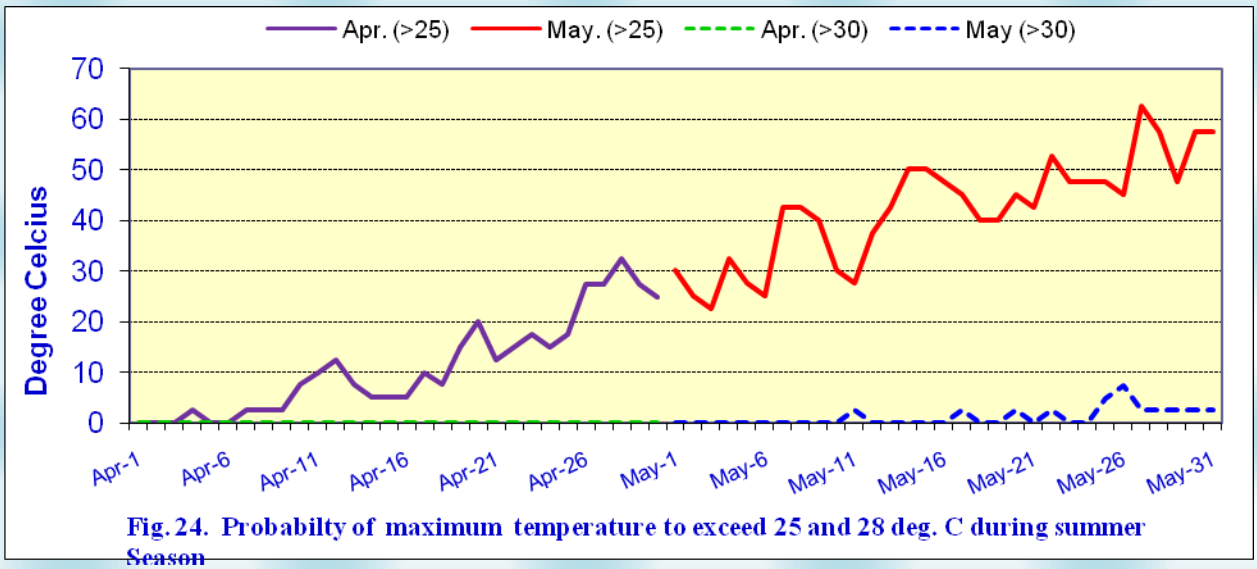


Fig. 24. Probabilty of maximum temperature to exceed 25 and 28 deg. C during summer Season

Humidity

The daily means maximum and minimum Relative Humidity (RH) given in Fig 8 shows that Maximum RH has decreasing trend in the beginning of the season (70%) till second week of April (55%). Thereafter, it exhibits a very slight increasing trend till the first week of May and it remain fluctuate between 60-70% during this period. Subsequently, further little increase of around 10% is recorded by the end of the season. Similar trend is observed in minimum RH, though the fall in the first few days of the season and rise in the later part of the season are much gradual. Minimum RH recorded around 30% in the beginning of the season and it then fluctuate between 35 to 45% during the rest of the season.

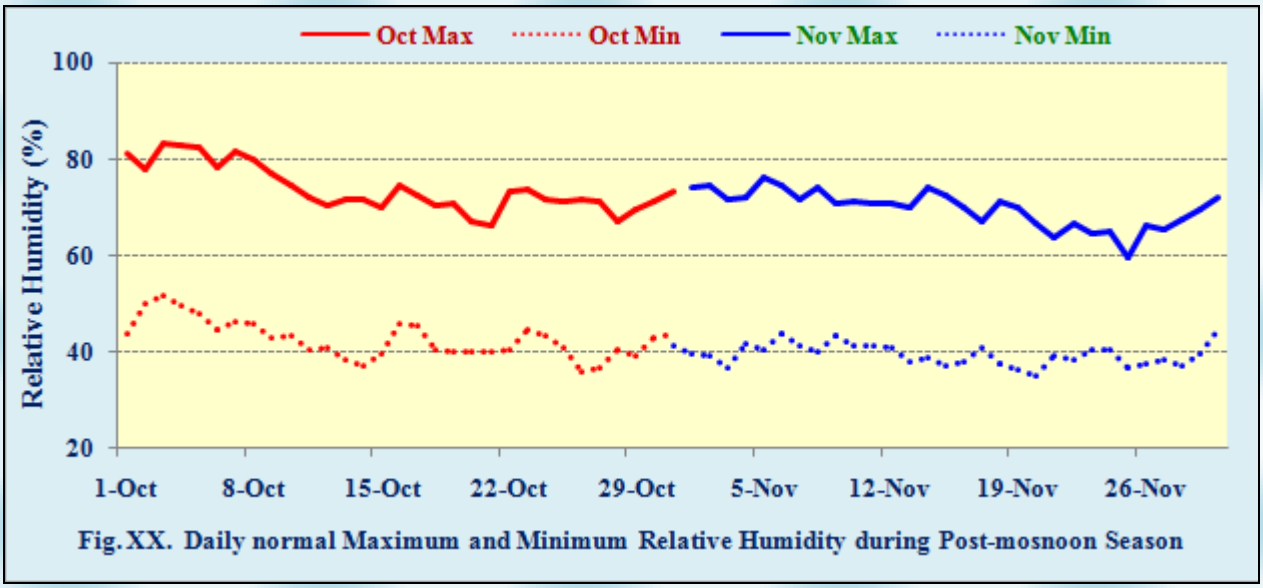


Fig. XX. Daily normal Maximum and Minimum Relative Humidity during Post-mosnoon Season

Diurnal Variation of Relative Humidity

The air is quite dry in the season, particularly during the day hours. The minimum RH in the in the noon hors may fall to as low as 40% in the month of April and 50% in May. The diurnal variation of RH (Figure XX) shows that the highest RH is recorded around 0800 hours IST in the morning. This is entirely opposite than the winter season. There is steep fall from 0800 hours till 1300 hours and the RH reached from its minimum value. Drop in RH between maximum and minimum is only between 15-20% during the season. For both April and May months.

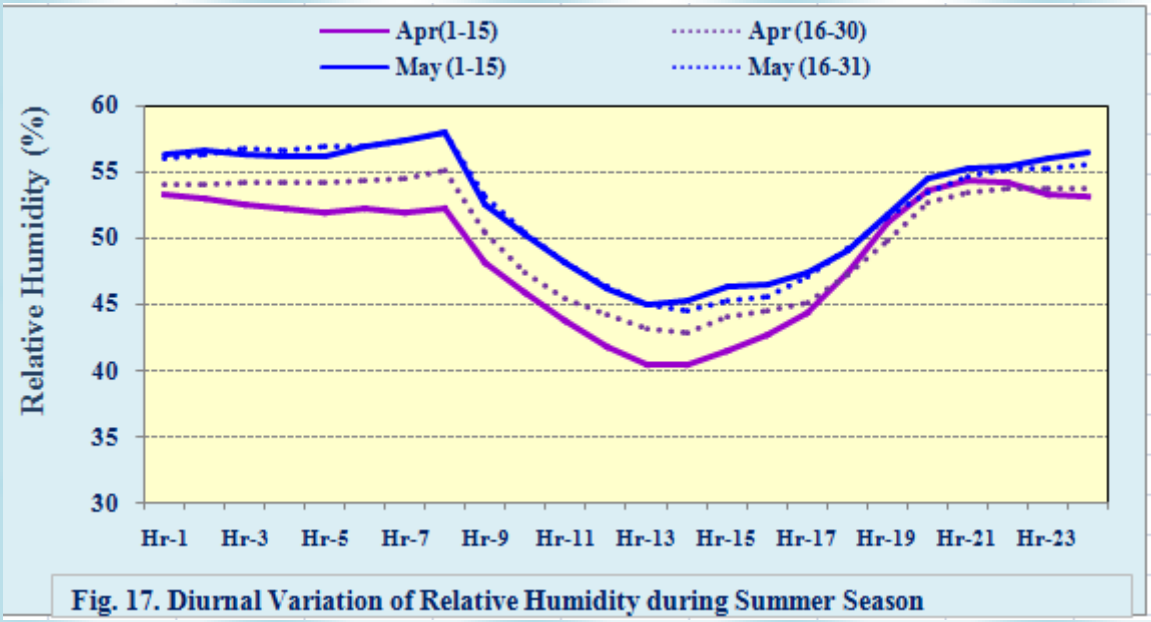


Fig. 17. Diurnal Variation of Relative Humidity during Summer Season

Rainfall

Summer in Shimla is compritavily dry season as compatred to the winter season. Most of the rainfall is cuased by the eastward moving systems (Wsetern Disturbances) and is associated with thunderstorms on most of the days. On some occasions thunderstorms are also induced by the thermal convenction when incursion of moisture takes placve from Arabian Sea in association with the south westerly winds. April is driest as compared to May month during the season woth total monthly rainfalls of 57.7 and 79.7mm respectively. The daily normal of rainfall for the season (Figrure) shows a a gradual increase as the season advances.

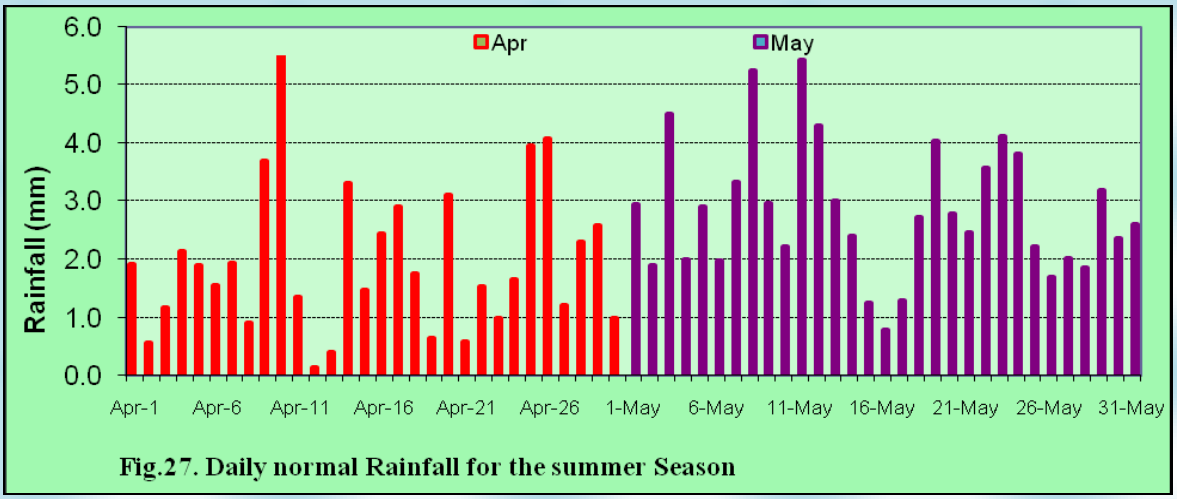


Fig.27. Daily normal Rainfall for the summer Season

Average number of days with the rain are …….for April and … for May. The probability of rainfall for each day in the season (Fig 28) shows the probality of of rainfall for each day is arouund 25% in April and there is large variation of from 20-40 % in the month of May.

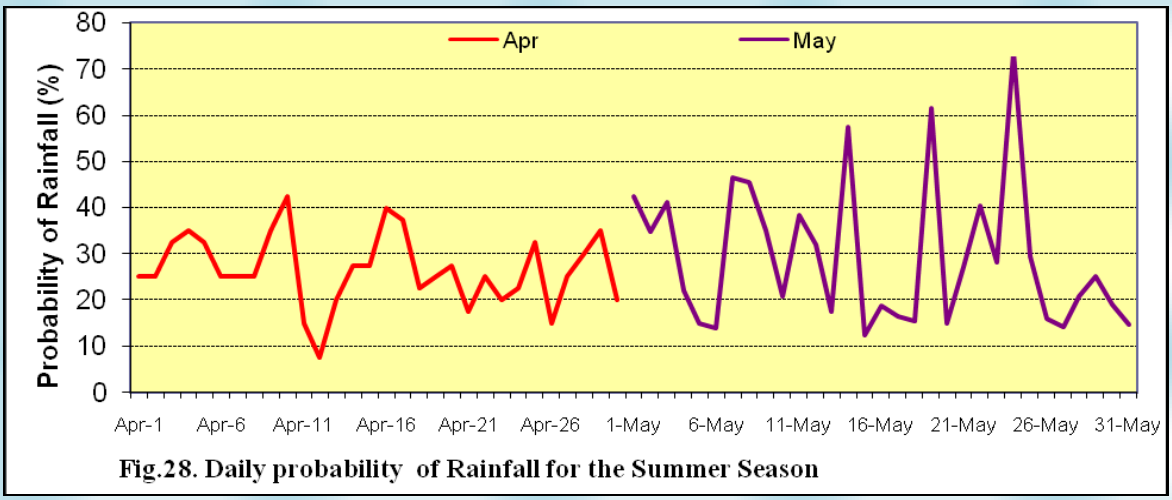


Fig.28. Daily probability of Rainfall for the Summer Season

Like the winter season, summer also do not normally experience heavy rains. The heaviest 24 hours rainfall during April and May in the seasion (Figure 29) shows that the most frequently occuring heavieast 24 hours rain in the season is 30-40mm. the all time record of heavy rainfall for April and March have been …. and …….

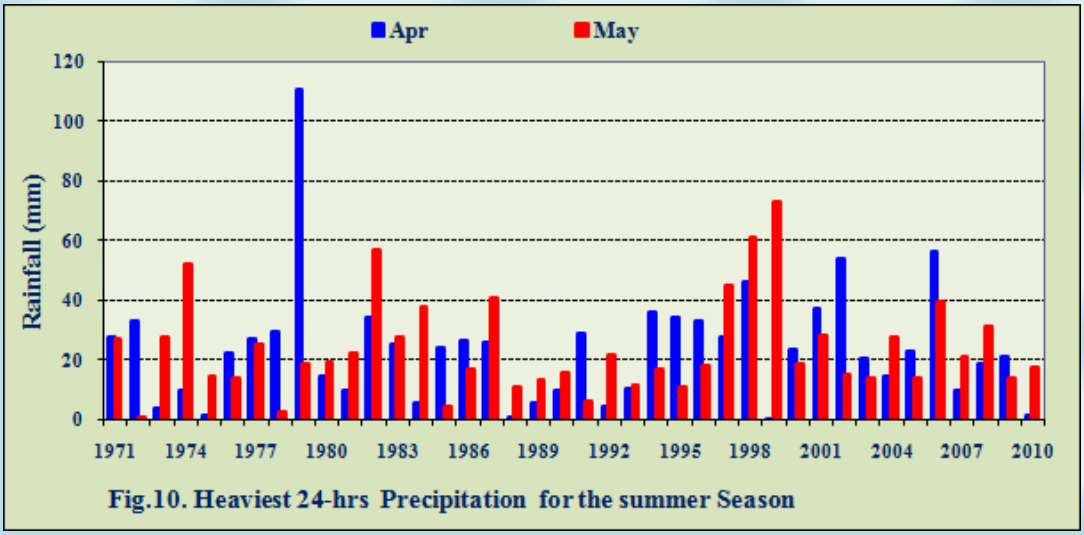


Fig.10. Heaviest 24-hrs Precipitation for the summer Season

Thunderstorm and other weather phenomena

Summer season ischaractrised by more thunderstom (TS), hails and squalls. These phenomenas are associated cumulonimbus (cb) clouds which firm in the field of upper air divergence ahead of the eastward moving troughs in middle and upper troposheric westerlies. Ans also due to thermal convection and orographic lifting of the warm and moist air cause thunderstroms in the afternoon/evenings when suffucent moisture is available in the atomosphere. The severe downdraft from the Cb clouds results in convetive duststorms/squalls. For the 21 years (1990-2010) period for which the data were analysed, the average number of thunderstorms days are 6.5 in April, 11.1 days of thunderstorm in in the month of May. There is a large inter-annual variaion in the number of days with thunderstorms maximum reaches uptp 13 in April (1996) and 18 in May (1994). Total number of thunderstroms days during the seasion from 1990 to 2010 are presented in Figure xx. Hails stroms are very common in Shimla during the summer months. They damage the apple crop at large scale every year, when the crops is at the stage of fruit development stage. 37% of the days with hails fall in summer season (April-May). On an average for the period (1990-2010) 1.6 days of hails fall in April and 1.9 in May. There is very large inter-annual variation in the hail days with maximum days 8 in April (1996) and 7 in May (1990).

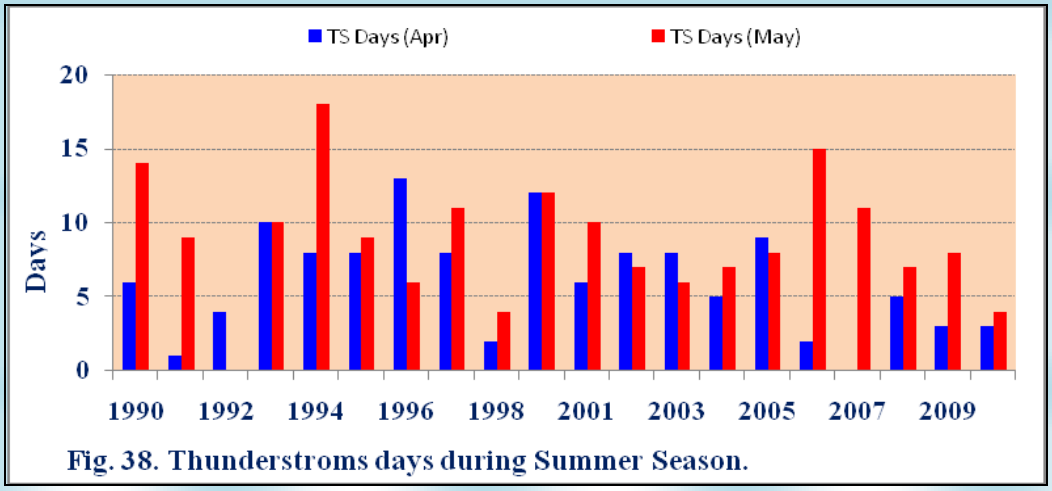


Fig. 38. Thunderstroms days during Summer Season.

Wind (summer)

Summer is also not very windy like winter season for Shimla. The average wind speed during winter period is 3.6 kmph. There is large inter-momthly variation with maximim wind only 7.3kmph in April (1982) and and 6.2 kmph in the month of May (1982).

Wind speed recorded at 0830hrs and 1730 hrs ISt is shown in Figure XX shows that comparitively wind speed is more during 1730hrs. The most prominent wind direction in the morning is south-easterly and it become southly during the evening hours (Figure 32).

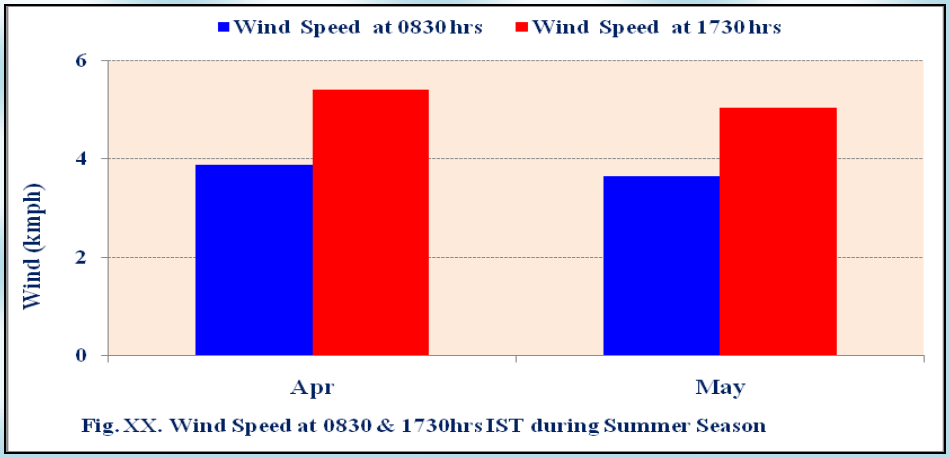


Fig. XX. Wind Speed at 0830 & 1730hrs IST during Summer Season

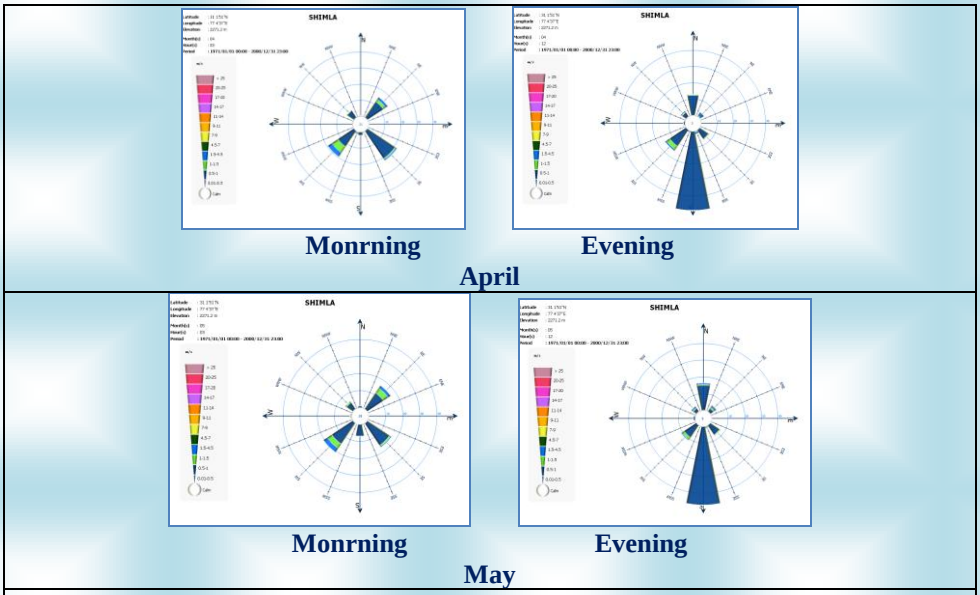


Fig. XX. Windrose at 0830 and 1730 hrs ISt at Shimla during Summer Season

Monsoon Season

Monsoon comes to Shimla in the last week of June and lasts until September. During monsoon, the entire Shimla beams with a green hue. The temperature during monsoons drops considerably during this time. This is the time to enjoy the lush greenery of Shimla. One can often see clouds floating the valley below and one is above the clouds. These scenes are frequently visible during the rainy season. The arrival of monsoon brings the cheers to people of Shimla because it fulfills the requirement of the water domestic and commercial use, as all the natural water resources recharged.

It is the main rainy season for most part of the state including Shimla. Frequent rainfall/thunderstorms, occasionally heavy rainfall, landslides, cloud bust, floods are the main characteristics of this season.

Onset and withdrawal of Monsoon

The south-west monsoon sets in over mainland of the country (Kerala) around 01 June. It takes about three weeks for the monsoon to travel through the peninsula and central parts of the country before it reaches Shimla. The average date of onset of southwest monsoon over Shimla is 21 June. As Southwest Monsoon is the rainy season for Shimla. Though the monsoon sets

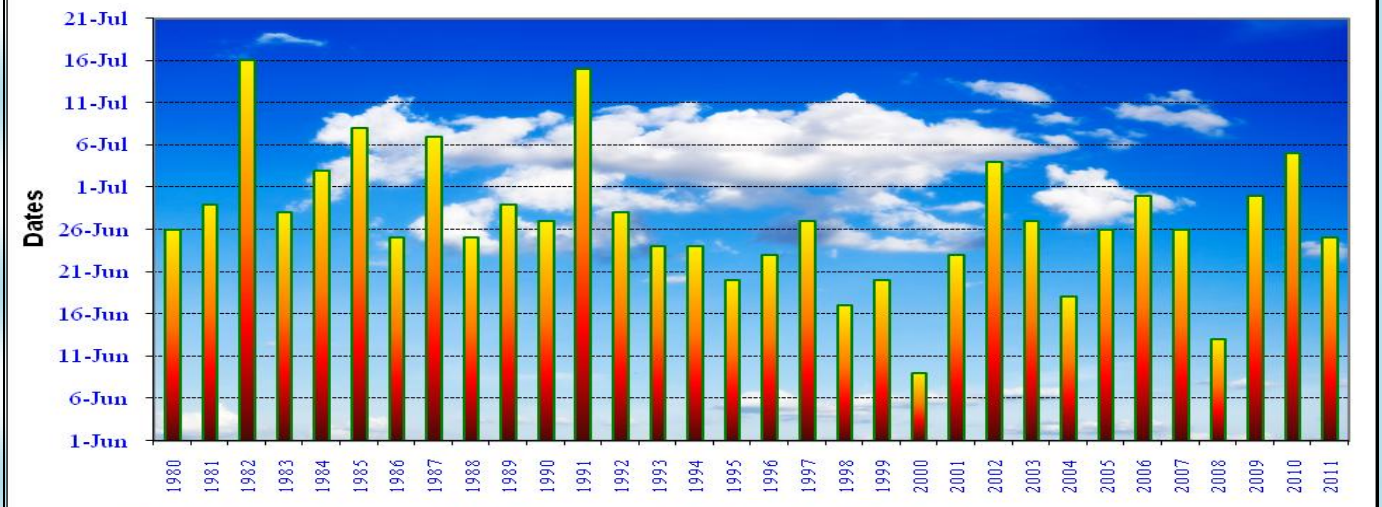


Fig. 2. Onset dates on SW Monsoon in Himachal Pradesh

Rainfall

Monsoon is the rainy season in Shimla. Though the monsoon sets during last week of June, the pre-monsoon shower starts from middle of June. With this, the daily normal rainfall picks up and reaches to about 8mm per day. From the first week of the July to week to the third week of August is the rainiest period with daily normal fall rainfall around 10-15mm. Thereafter, there is gradual decrease and the rainfall decreases sharply after 20th September. The daily normal rainfall given in figure 36 show that it does not increase or decrease constantly. This indicates the fluctuating behaviors of rainfall over the region which is governed by the migratory monsoon systems and oscillation of the monsoon trough. July and August are the rainiest months which together contribute about 65% to the total rainfall seasonal rainfall of 1001mm.

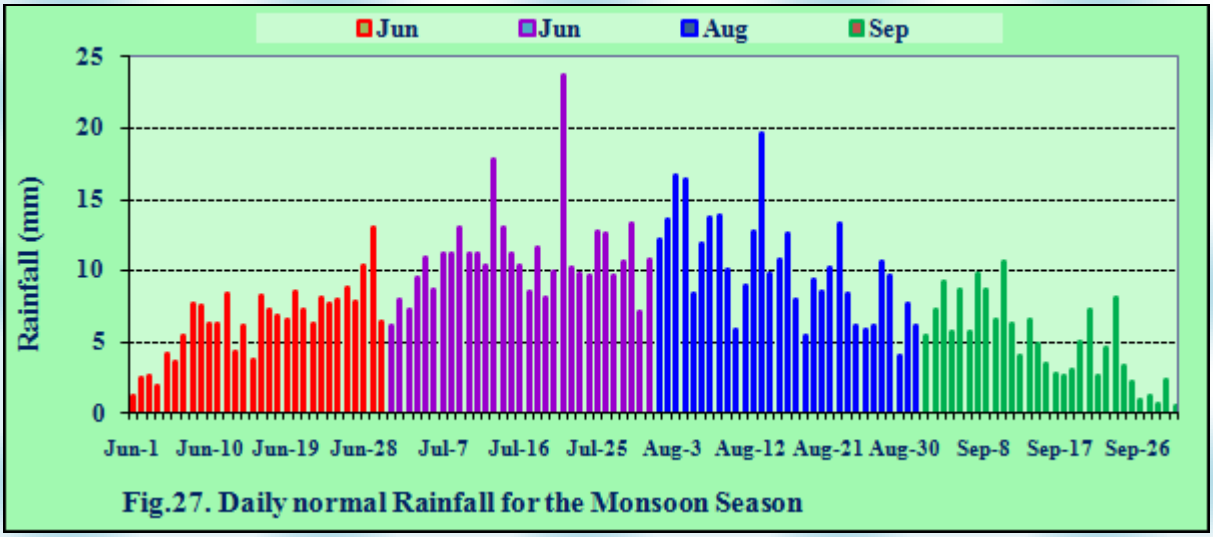


Fig.27. Daily normal Rainfall for the Monsoon Season

The daily probability of rainfall increase from 30-40% in the begning of June to about 60% by the end of the June month (Figure 39. It further increase to 60-70% from 1 July to 10 July and thereafter it reaches 80% or more till 15 August. IT decreses graduaally from 15 August to 10 September and raeches 50% and then shrply and drops to 20-25% by the end of the season. Average number of raniy days are 15 for June, 23 for July , 22 for August and 12 for Sepetmber. However, there is a large interannual variability in the number of rainy days. They have ranged from 6-25 in Jume, 13-25 in July, 13-31 in August and 4 to 23 in Spetember.

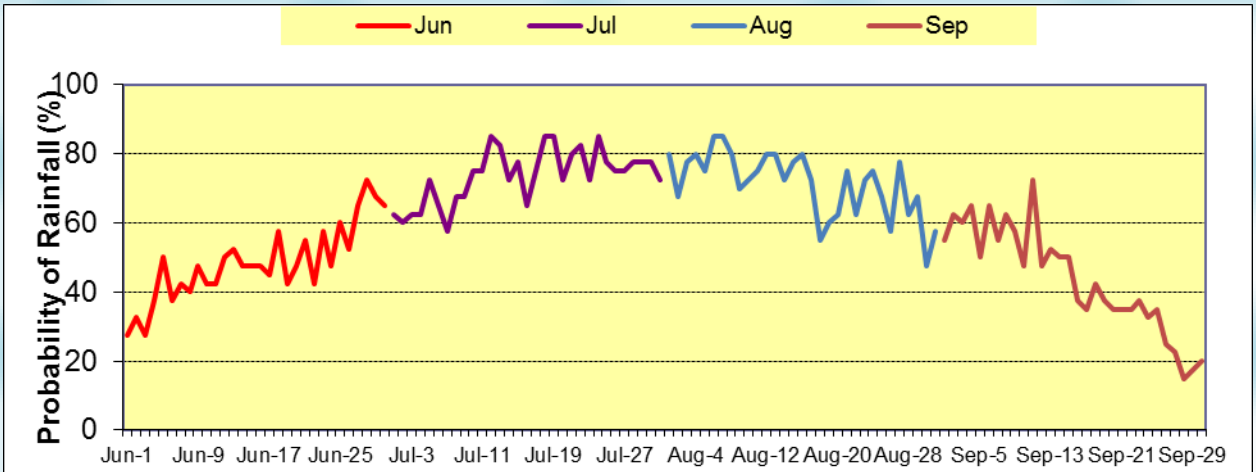


Fig.28. Daily probability of Rainfall for the Monsoon Season

Shimla receives very heavy rainfall on some occasions during the season. The heavy rains are caused by the eastward moving monsoon disturbances (cyclonic circulations, low pressure area or monsoon depressions) which moves west-northwestwards along the monsoon trough. Sometimes eastward moving troughs in middle and upper tropospheric mid-latitude westerlies penetrate up Himachal Pradesh and if these troughs happen to interact with the monsoon disturbances close to Shimla, very heavy rains are experiences over the region. Orographic of the place play important role in lifting moist air. The heaviest 24 hours rainfall during different months in the season (Fig 29…below) shows that the most frequently occurring heaviest 24 hours rainfall

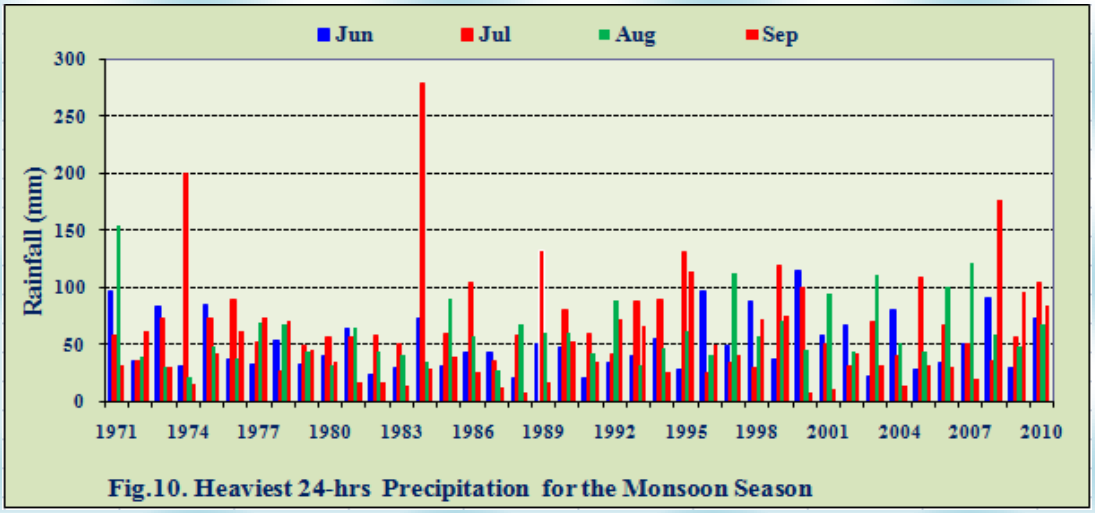


Fig.10. Heaviest 24-hrs Precipitation for the Monsoon Season

Thunderstorm and other Weather Phenomena

The sevior weather phenomena of summer season thunderstom (TS), hails and squall continue to occur during the months of June. However, the frequesny of these phenomena except thunderstorms, goes down drastically from July onwards. For the 21 years (1990-2010) period for which the data were analysed, the average number of thunderstorms days during the season were 11.1 in June, 8.1 in July, 6.8 in August and 6.4 days of thunderstorm in in the month of September. There is a large inter-annual variaion in the number of days with thunderstorms maximum reaches uptp 13 in April (1996) and 18 in May (1994). Total number of thunderstroms days during the seasion from 1990 to 2010 are presented in Figure xx. 50% of the annual thunderstrons days occurred during monsoon season, with 17% of days falls in June, 13% in July, and 10% each in August and September.

The thunderstroms, on many occasions are associated with heavy rainfall and suqalls. As the atmosphere become more stable woth progress of the season, their occurrence goes down. Average number of days during the seasion from 1990 to 2010 are 0.3 in June and very occasionally in the rest of the months of the season. Only 6% of the anuuals days with hail occur in the monsoon season. Maximum number of days in a months are repoted only two in the June (1993).

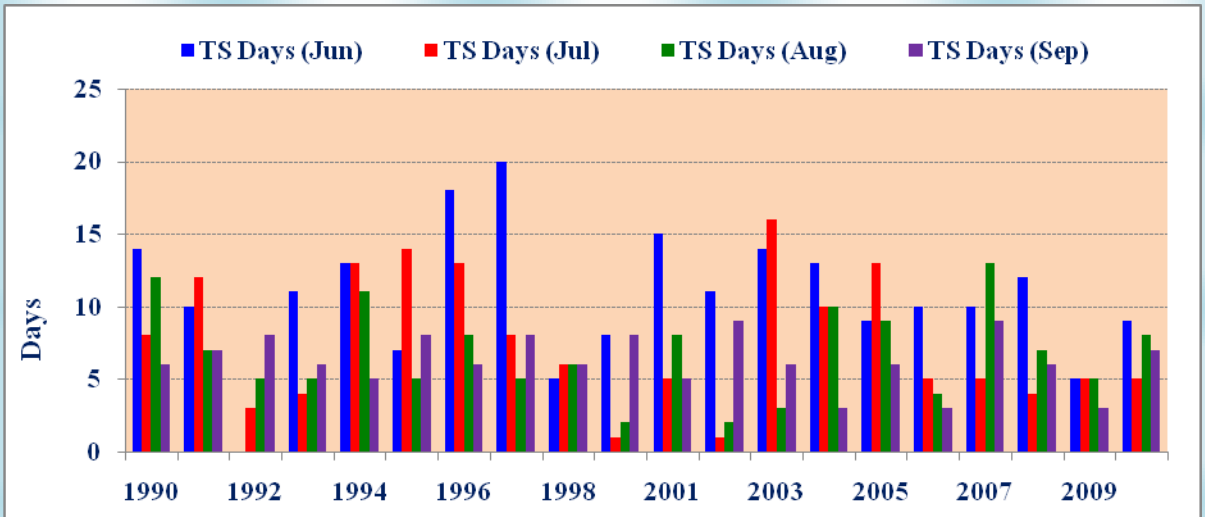


Fig. 38. Thunderstroms days during Monsoon Season.

Temperatures

The season begins on a very little warm note with daily normal maximum tempratures around 26 deg C in the begning of June (Figure 40). They gradually start falling after the first week of June: and they drop 2˚C by the end of June and further continue to fall mid of July and reach arounf 22˚ C and then fluctuate aroung 22˚ till middle og August. A slight rise in temperature is notice after the mid of the Spetember as the monsoon become week during this period and comparitive less rain. The minimum temepratures, however, do not show any drop and are aroung 16-17˚C till end of June. The drop is also not appriciable further into the season as they reach to only around 15˚C till end of August. The slow decrease continues through the month of September and they reach around 13˚ C by the end of the season.

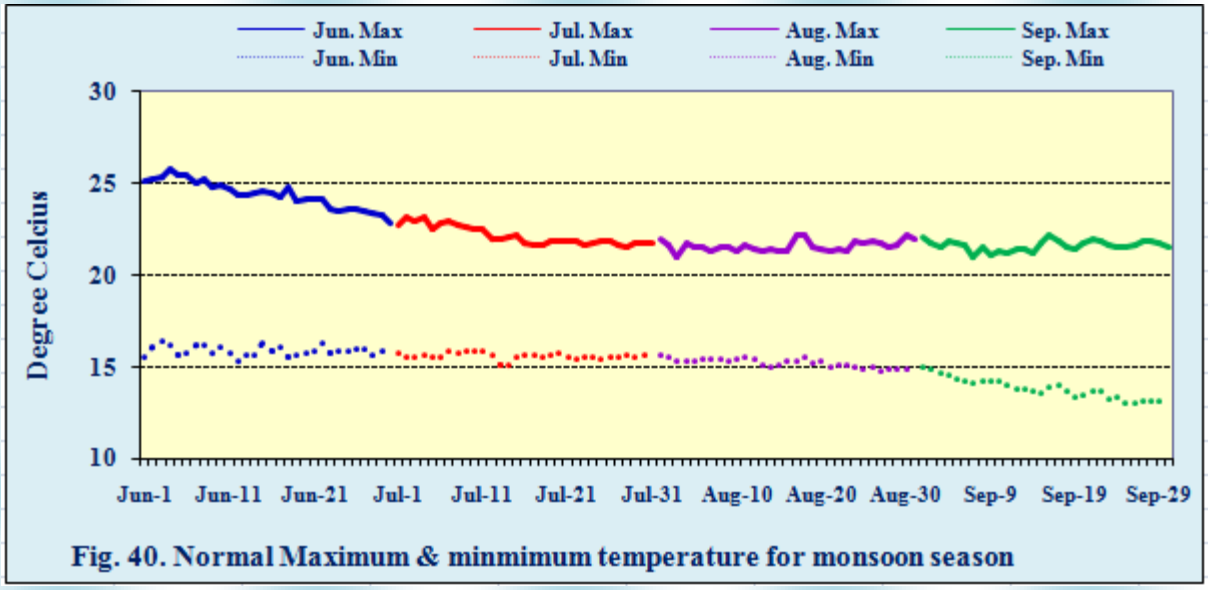


Fig. 40. Normal Maximum & minmimum temperature for monsoon season

Diurnal Variation of Temperature

The diurnal varition in temperatures are given in Figure 42 shows that the lowest temperatures in the day are realised around 0700 hours IST during June and first half of July. Subsequently, the lowest temepratures are relised around 0730 hours IST as the Sun starts rising later. The highest temepratures in the day are realised around 1500 hours IST all through the season. Monsoon season is the season of least diurnal variation in temperature as the monsoon approaches. It decreases from 5.4˚ C during the first half of June to 4.1˚ C in the second half further to 3.7 deg C in first half of July. It remains around 3.3 C during second fortnight of July till end of August and is about 4.2 deg. C untill first falf of September. The diuranal rtange increases to 5.9 deg. C in second half of September with the withdrawal of monsoon. The rise in temprature during the day is much steeper in the first half of June and the the second half of September. Increased rainfall in rest of the season keeps the range lower. The peak hours temperatures during the two months period of mid June to mid Spetember are about 5 degree cooler than those of the first fortnight of June.

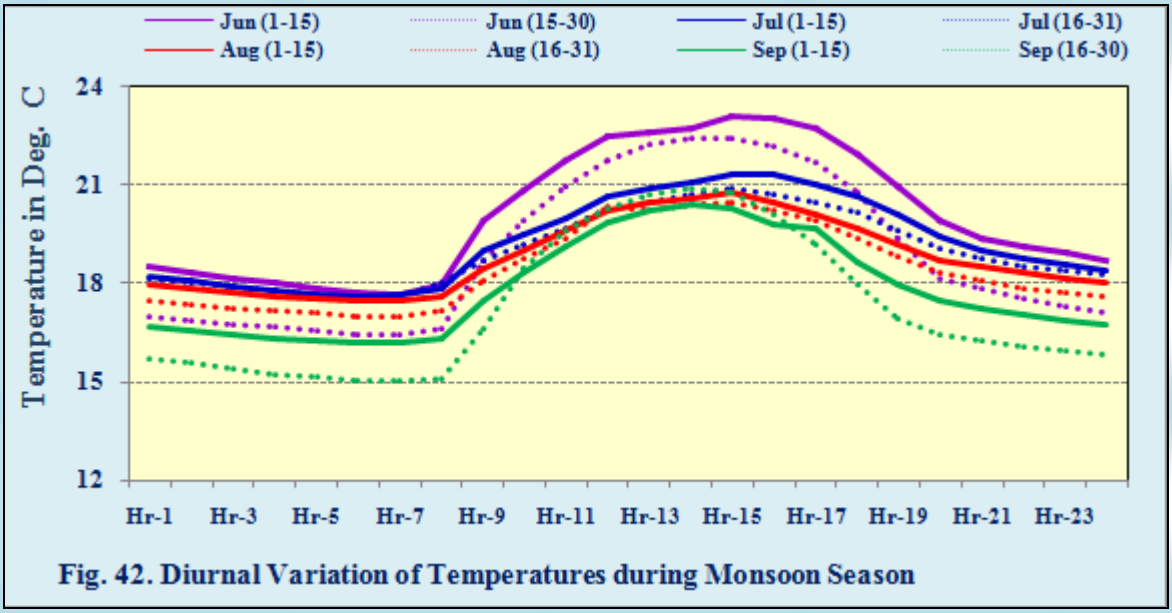


Fig. 42. Diurnal Variation of Temperatures during Monsoon Season

Extreme Temperature

The highest maximum and lowest maximum temperatures recorded in the month of June to September during the period of 1971-2010 given in Figure xx show that highest maximum temperatures during June reach 30-31Deg. C during some of the years. However, the maximum temperature reached during 2008 was 24.4 Deg. C (4 June, 2008). However, the maximum temperatures attained during July are more variable – mostly ranging from 23-27 Deg. C. They have reached 28.4 Deg C (4 July, 1987), which was the deficient monsoon year. These temperatures, during most of the years have ranged between 24-26 Deg. C during August and September. However, the weather on individual days could become quite cold with quite low maximum temperatures. This normally happens on the days of widespread rains in the state. The lowest maximum temperatures recorded in different months have been 13.4 Deg C (8, June, 2010), 16.0 Deg. C (23, July, 1975), 15.4 Deg. C (28, August, 1971) and 13.0 Deg. C (3, September, 1978).

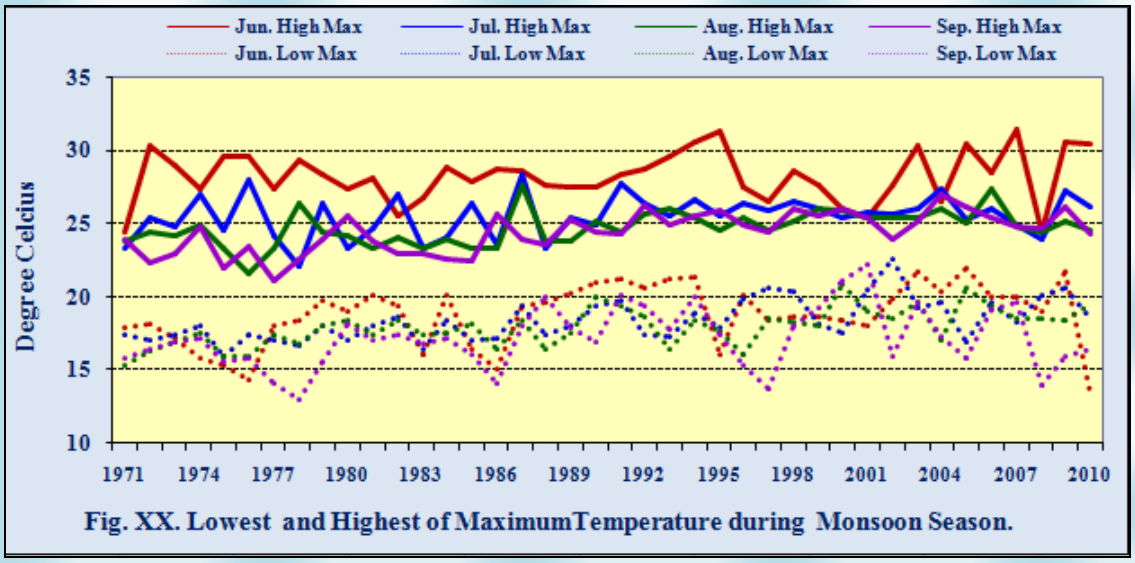


Fig. XX. Lowest and Highest of MaximumTemperature during Monsoon Season.

The lowest minimum temperatures for the season given in Figure XX show that the most frequently occurring lowest minimum temperature is between 8-10 Deg C in the month of June (1971-1988) and 10-12 deg. C (1989-2010) for the month of June and September. However, due to the cloudy night in the month of July and August lowest minimum temperature on the higher side by 2 Degree C in these months. The lowest minimum temperature ever

recorded in the season have been 8.4 Deg C (1 June, 1986), 9.4 Deg C (2 July, 1989), 11.7 Deg C (28 August, 1971, and 19 August 1972), 6.7 Deg C (23 September, 1982). Persistent widespread rains and the consequents cooling of the atmosphere are the results these abnormally low minimum temperatures. However, the minimum temperatures could remain significantly high on certain days. This normally happen due to either cloudy nights. The highest minimum temperatures have exceeded 20 Deg. C almost every year during June. During July, highest minim temperatures remain below 20 Deg C and is around 16-17 Deg C. There is further 2 degree less temperature during the month of August and September.

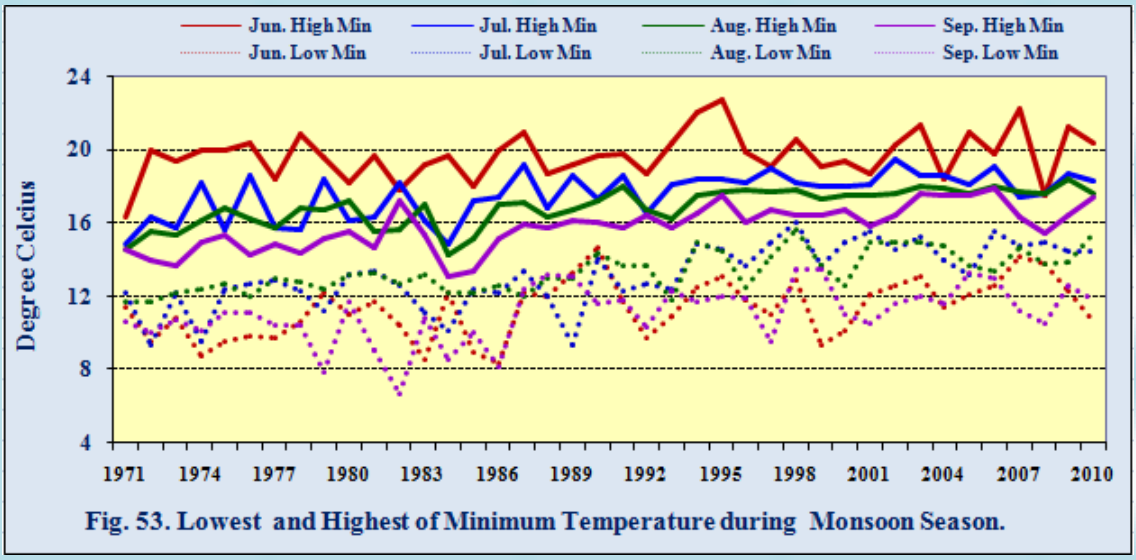


Fig. 53. Lowest and Highest of Minimum Temperature during Monsoon Season.

The probability of maximum temperature to exceed 25 and 30° C during monsoon season is given in Figure xx show that the probability of maximum temperature to exceed 25 degree C is around 60% during the first week of June and then fall to 40% by the mid of June. As the frequency of the pre-monsoon showers increases during this time, there, it further steeply fall and reach down to 20% or below by the end of June. There is again a steep fall as the monsoon gear up gear up and it falls to 0-5% in the mid of July. It remains around 0-5% till the end of the season, however, a slight in is noticed during the last week of August and first week of September. The probability of maximum temperature exceed 30° C is very less. It is only between 0-5percent during the first three weeks of June and thereafter, there is hardly any chance of rising of the temperature more than 30° C during the season because of the often cloudy days or rainy days.

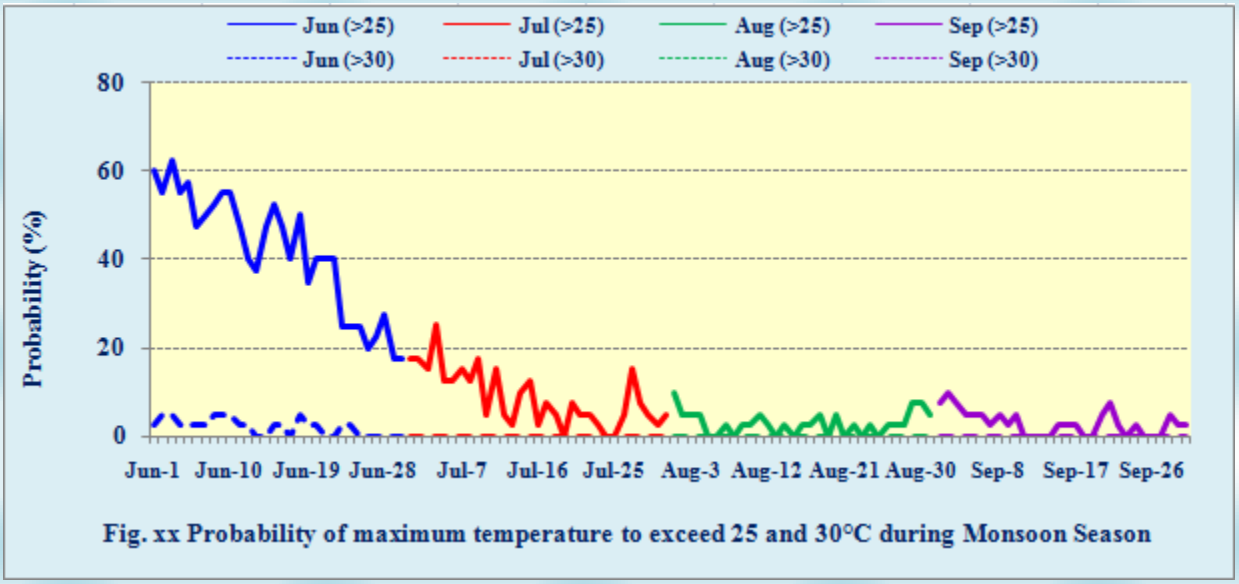


Fig. xx Probability of maximum temperature to exceed 25 and 30°C during Monsoon Season

Humidity (Monsoon)

The daily mean and maximum Relative Humidity (RH) given in Figure 45 shows that the maximum RH is quite low in the begninng of the season (65%) due to mosrtly dry weather conditions in the first week of the June. It exhibits a sharp increase in the second week of June and reaches to about 90% end of the month as the wet season begings. It continue to rise more than 90% and and fluctute between 90 to 100% till the first half of September. The daily mean minmum RH also shows almost similar trends rising from 45% in the begnining of the seasonn to 75% in the first wqeek of the July and then remain around 80% till last week of August. However, the fall start from the last week August and sharp fall from mid of the september and again reaches to about 45% by the end of the season.

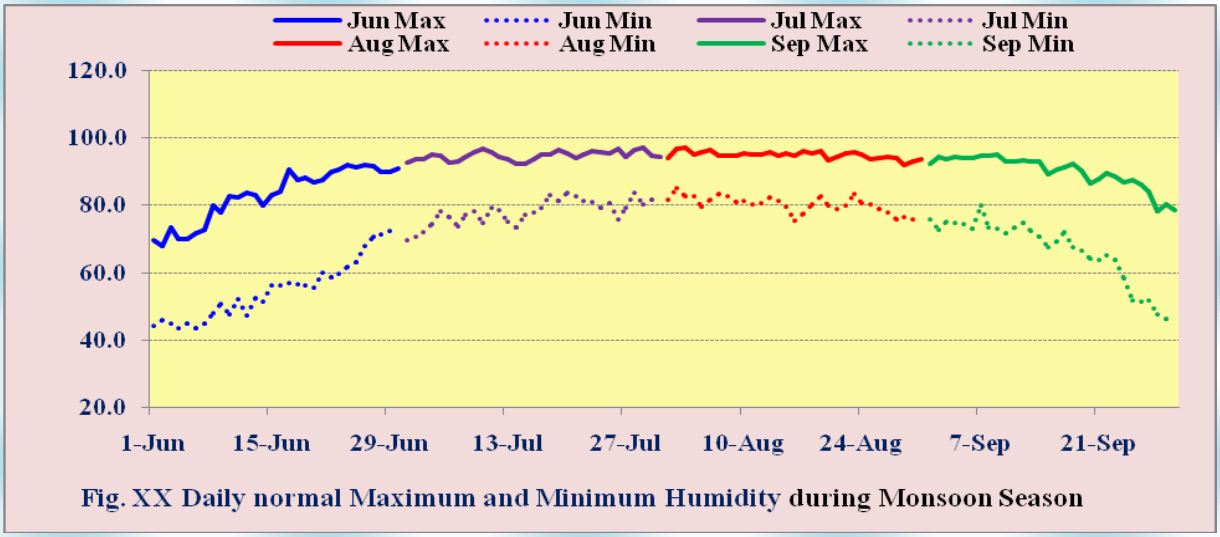


Fig. XX Daily normal Maximum and Minimum Humidity during Monsoon Season

Diurnal Variation of Relative Humidity (Monsoon)

The diurnal variation of RH (Figure xx) shows that the highest RH is recorded 0800 hours IST in the season. It declines from 0800 to 1300 hrs IST with a gradual fall afterwards till 1500 hrs IST. The lowest RH at is recorded in the first fortnight of June: and the highest in the second fortnight of July to second fortnight of August. The decrese in RH from morning to afternoon is steepest during the month of June and second fortnight of Spetember indicating large diurnal variation. The least diuranal variation of humidity id in the second fortnight of July and the entire August month.

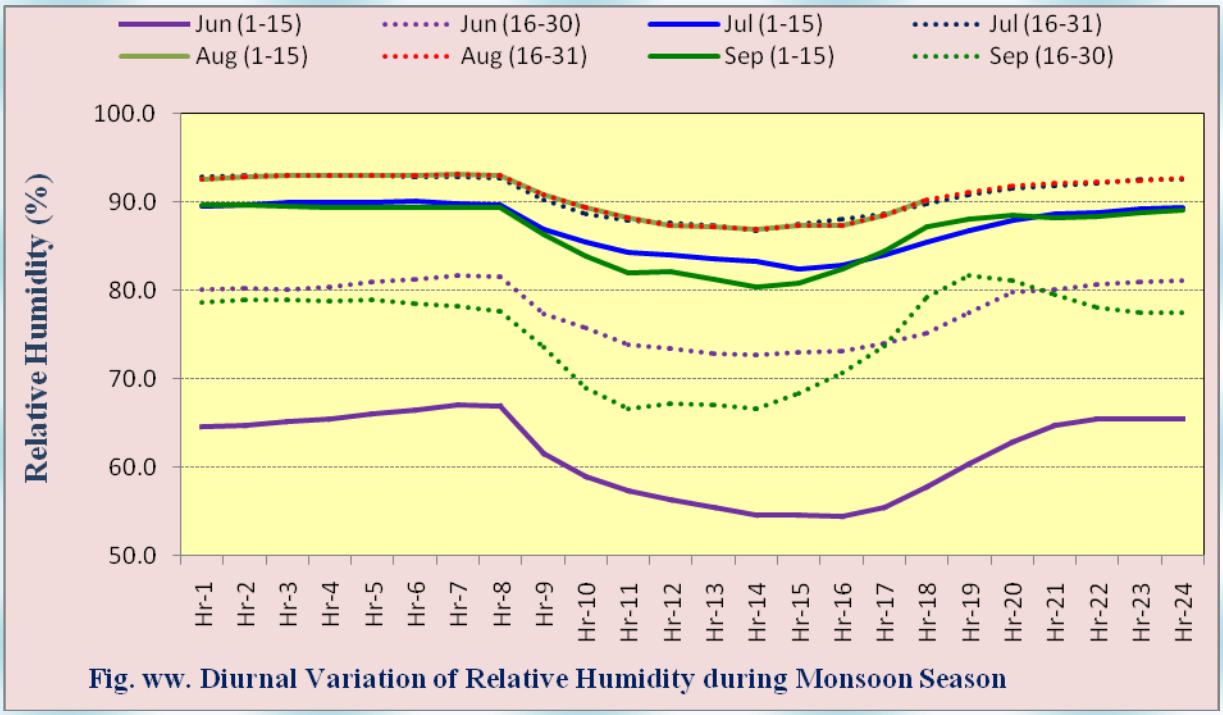


Fig. ww. Diurnal Variation of Relative Humidity during Monsoon Season

Fog and Visibility (Monsoon)

Fog and poor visibility is very common in Shimla during the monsoon specially after the arrival of the pre-monsoon shower. Often Valley fog forms in mountain valleys, during monsoon. It is the result of a temperature inversion caused by heavier cold air settling into a valley, with warmer air passing over the mountains above and visibility sometime reduce less than 50m. Monthly foggy days in Figure XX show that maximum numbers of days are in the month of July and August. Average numbers of fog days are 5.3 in June, 12.7 in July, 17.8 in

August and 8.2 in September. Maximum number of foggy days 27 in July (1995) and 29 days were in August (1996) during the period of study

Average number of days with the visibility below less than 1km are 2.0 in June, 6.5 in each July & August, and 2.0 again in the month of September. However, maximum number of days within this range of visibity are upto 7, 12, 16 and 6 respectively in the month of June, July, August and September. The days with the visibility between 1-4 kms are 5.7 in June, 6.7 in July, 6.8 in August and 3.4 during the month of September. The days are 10- during each months of the season have the visibity range from 4-10km. Foggy days reduce in the month of September and visibity also improve significatly (Figure XX), howver, maximum days with visibity range < 1 kmp are 12days in 7 in June, July, 16 in August and 6 in September.

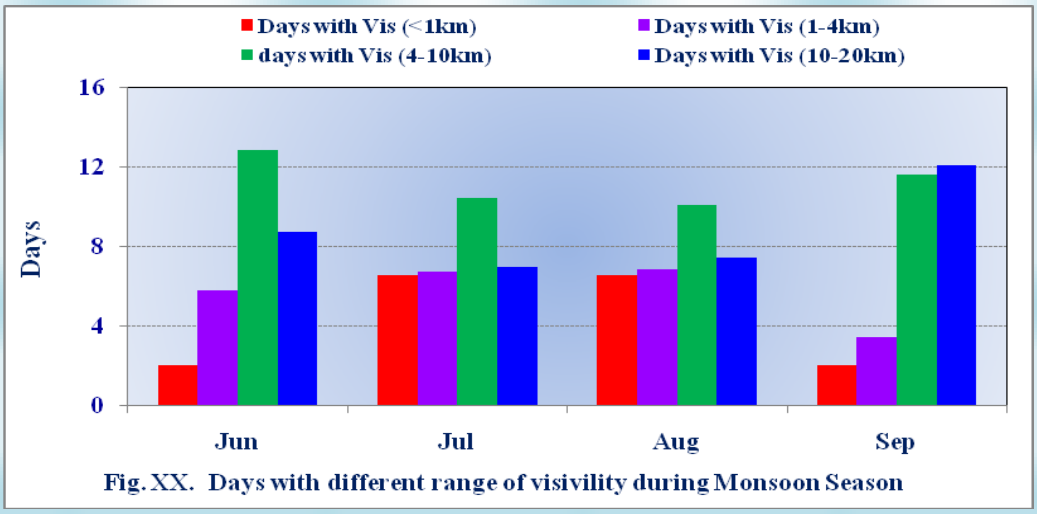


Fig. XX. Days with different range of visivility during Monsoon Season

Thunderstom and other weather phenonmenon (Monsoon)

The sevior weather phenomena of summer season thunderstom (TS), hails and squall continue to occur during the months of June. However, the frequesny of these phenomena except thunderstorms, goes down drastically from July onwards. For the 21 years (1990-2010) period for which the data were analysed, the average number of thunderstorms days during the season were 11.1 in June, 8.1 in July, 6.8 in August and 6.4 days of thunderstorm in in the month of September. There is a large inter-annual variaion in the number of days with thunderstorms maximum reaches uptp 13 in April (1996) and 18 in May (1994). Total number of thunderstroms days during the seasion from 1990 to 2010 are presented in Figure xx. 50% of

the annual thunderstrons days occurred during monsoon season, with 17% of days falls in June, 13% in July, and 10% each in August and September.

The thunderstroms, on many occasions are associated with heavy rainfall and suqalls. As the atmosphere become more stable woth progress of the season, their occurrence goes down. Average number of days during the seasion from 1990 to 2010 are 0.3 in June and very occasionally in the rest of the months of the season. Only 6% of the anuuals days with hail occur in the monsoon season. Maximum number of days in a months are repoted only two in the June (1993).

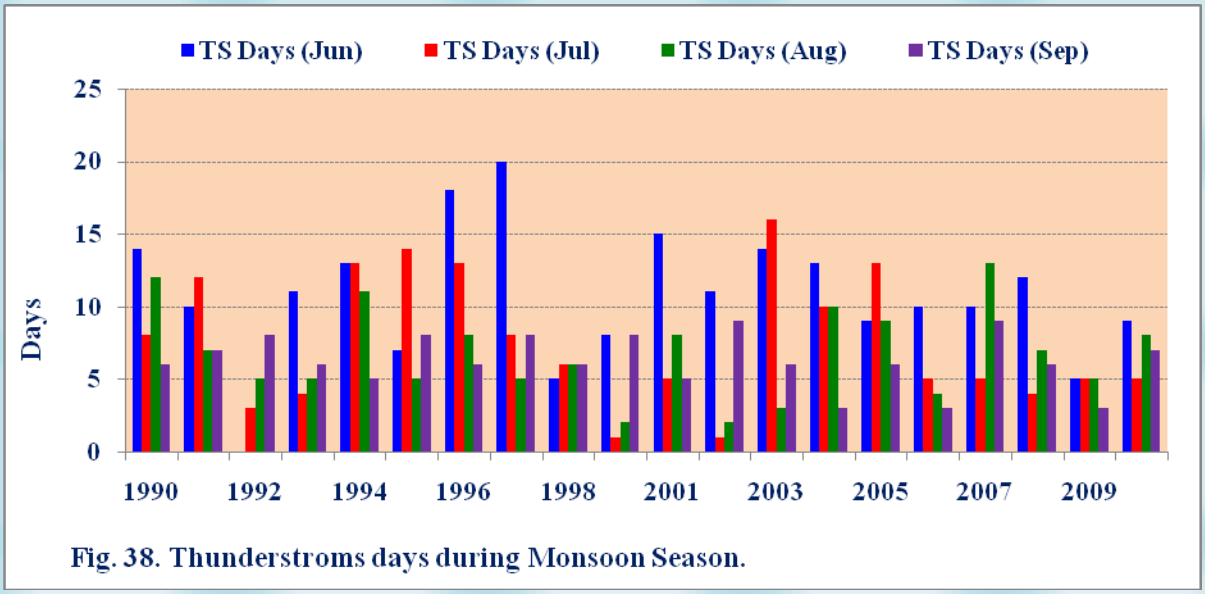


Fig. 38. Thunderstroms days during Monsoon Season.

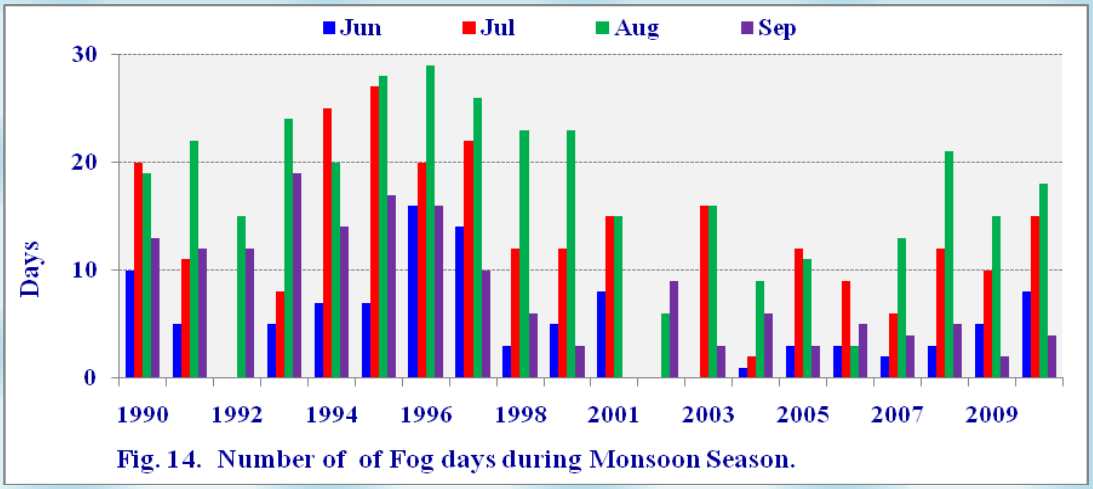


Fig. 14. Number of of Fog days during Monsoon Season.

Post Monsoon Season

The post monsoon season (October-November) is a transit season between monsoon and winter. The season is characterized by generally dry and pleasant weather constant decrease in both day and night temperatures. With the retreat of southwest monsoon from the state in the later fortnight of September, weather becomes fairly dry. Gandhi Jayanti is celebrated on the second day of this season every year as the birthday of Mahatma Gandhi, Father of the Nation who was born on 2nd October, 1869. This season is also the major festival season for Shimla with the main Hindu festival Dusshera and Diwali falling during the months of this season.

Temperatures:

The season is marked by decreasing temperatures (Figure XX) due to continue southward march of the Sun. The mean maximum temperatures (1989-2010) fall from 23° C in the beginning of the October to 18° C towards the end of the month. The month November starts with the average maximum temperature of 18° C and reached up to 15° C by the end of the month. The mean minimum temperature fall from 13° C in the beginning of the season to 8° C by the middle of the November month which is official beginning of the winter set up in Shimla. Minimum temperatures reach to 7° C or below by the end of the season. The decrease in both maximum and minimum temperatures is relatively knocking the winter season from the mid of the November.

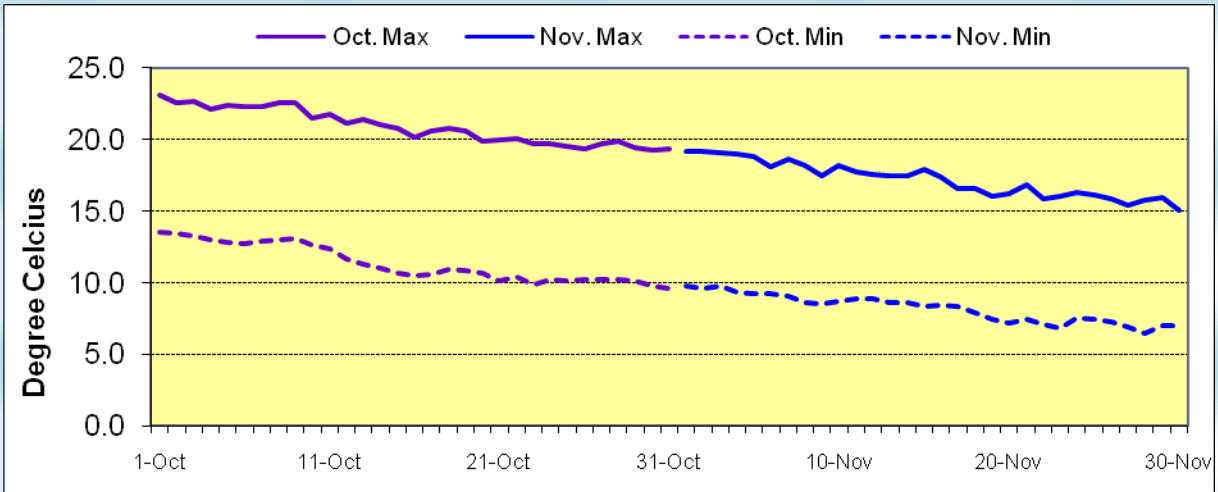
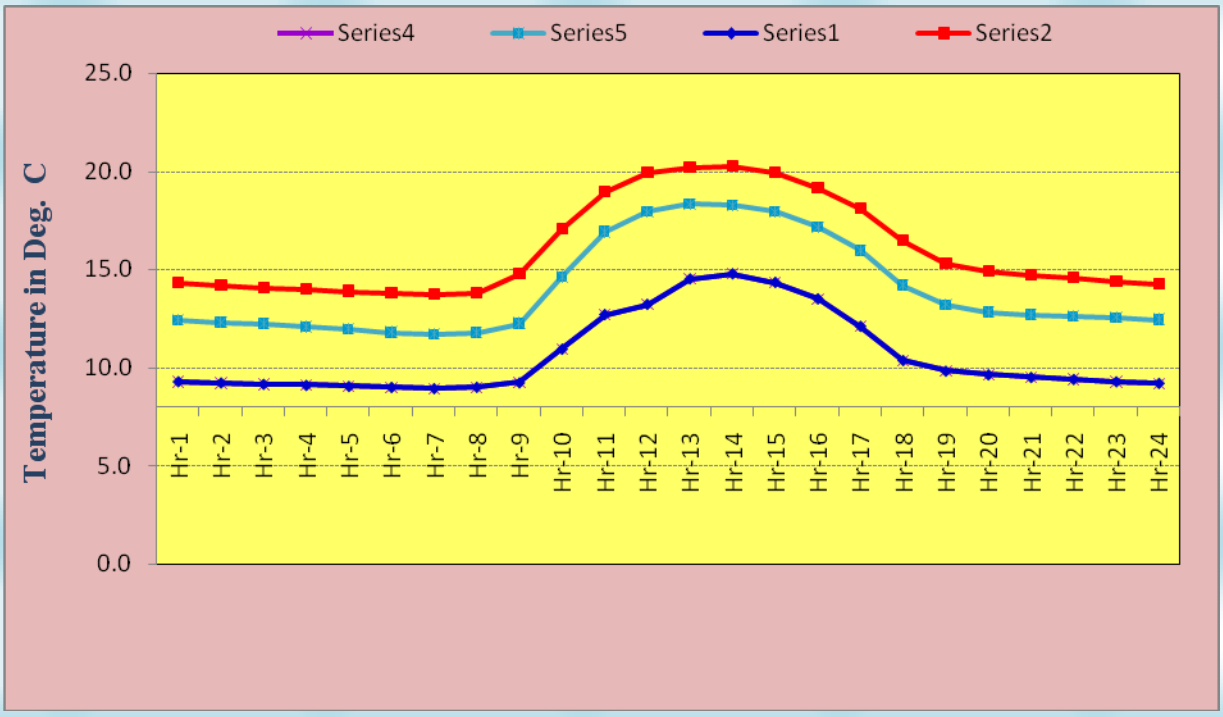


Fig. 50. Normal Maximum and Minimum Temprature for Post-Monsoon Season.

Diurnal Variation of temperatures

The diurnal variation of the temperatures in the season (Figure XX) is similar to many other months in the year with the lowest temperature in the day occurring around 0700 hours IST. A sharp increase is noticed from 0800 to 1200hrs IST before they reach peak around 1400hrs IST. The fall in temperatures from afternoon to evening becomes steeper as season progress. The sharp fall in temperature is between 1500 to 1800 hours IST; thereafter there is gradual drop in temperatures. The drop in temperature from 1600hurs to mid night or till it reaches to the lowest value is only around 2-3 degree C.



Extreme Temperatures

The highest maximum and lowest maximum temperatures recorded in the month of October and November during 1971-2010 given in Figure 52 show that highest maximum temperature during October are realized between 21-23° C and those during November between 18 and 21° C. However, they touched 25.6° C in 2009 (2nd October) during October. It rarely touches 20.6° C in 1986 (6th October) - the day was marked as rainy day with total precipitation 46.8mm with total monthly rainfall 84.5 during the same month(against a normal of 34mm for October). During November, the maximum reaches up to 23.5° C on 14th November in 1995. The lowest maximum temperature touched to 5.7° C on 28th November 1972.

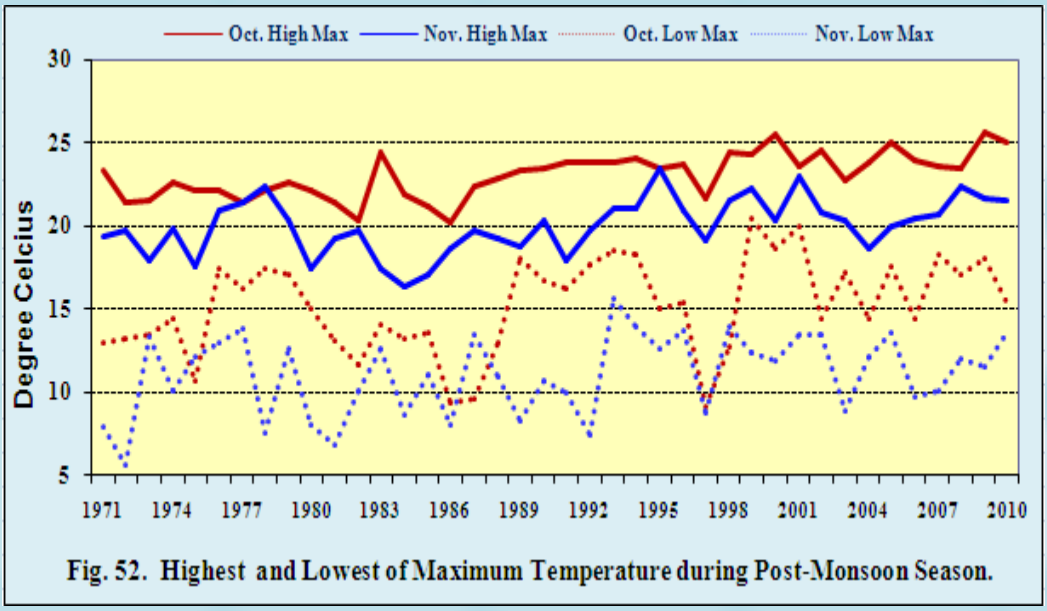


Fig. 52. Highest and Lowest of Maximum Temperature during Post-Monsoon Season.

The lowest and highest minimum temperatures for the months October and November given in Figure 53 show that the most frequently occurring lowest minimum temperature is 6-8° C during October 3-5° C during November. However, minimum temperatures have reached as low as 2.2º C on 24 October 1983 and -1.2º C on 23rd November, 1992. The minimum temperatures could also remain significantly high on certain days.

The highest minimum temperatures during the study period have been 11.3º C on 16 October 2001 and 6.8º C on 19 November, 1987. Like the winter season, the high minimum temperatures are caused by cloudy nights and warm air incursion ahead of an approaching western disturbance: and the significantly low minimum temperatures are caused by cold northerly winds from the Himalayas after the passage of a western disturbance.

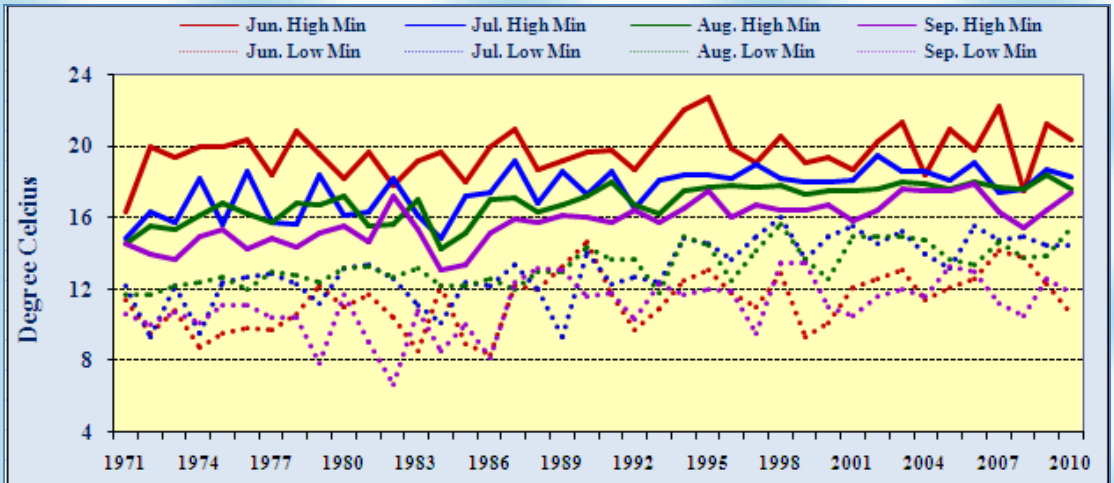


Fig. 53. Lowest and Highest of Minimum Temperature during Monsoon Season.

The probability of Maximum Temperature to exceed 20º C (Figure XX) is more than 60% during the first fortnight of October. It decreases as the season proceeds and drop to 20% by the end of the October. During the second fortnight of November, the probability is very less lies between 0-5percent. This is the indication of knowing of the winter season in Shimla. The probability of the minimum temperature to fall below 5˚ C starts from the second fortnight but it is very less (below 5%) till 10th November. It starts increasing thereafter and reaches to 40% by the end of the season.

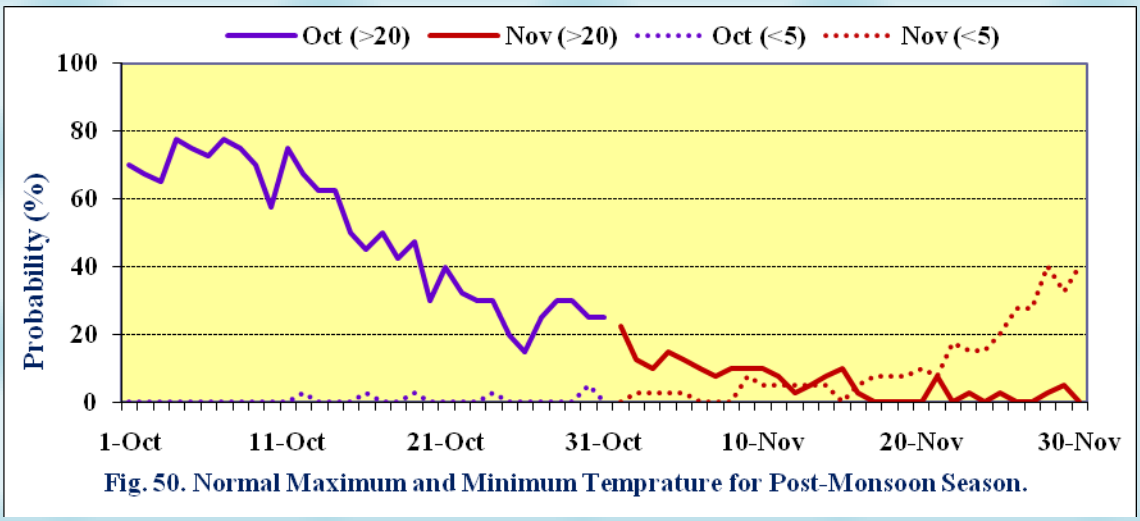


Fig. 50. Normal Maximum and Minimum Temprature for Post-Monsoon Season.

Humidity (Post-monsoon)

Because of the dry weather and ciontinue fall in both maximum and minum temeprature, the maximum RH continue decrese till the end of the first forntnight of October and reaches to 70%. It continue around 70% till the mid of November and there after decraese further 10% by the end of the season. Large changes are not experianced in the middle of the season. Maximum RH is around 80% in the begnining of the season. The minimum RH is around 40% through out the season except in the first fortnight of October when RH is around 45-50%.

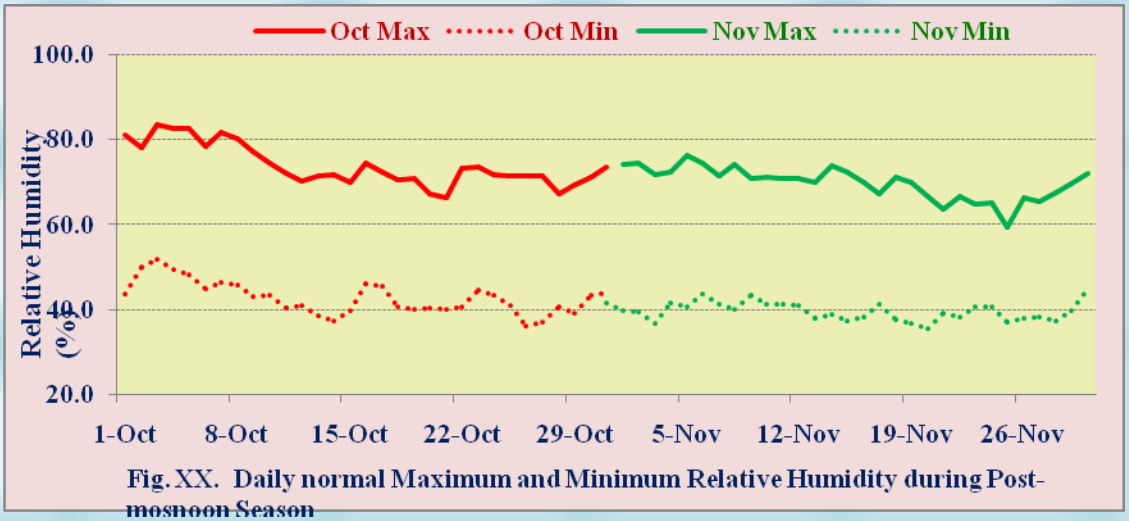


Fig. XX. Daily normal Maximum and Minimum Relative Humidity during Post-mosnoon Season

Diurnal Variation of Relative Humidity (Post-Monsoon)

The RH has the maxima around 1900 hours in the month of October and around 2000 hrs IST in the month of November. Thereafter, there is gradual fall in RH through out the night till 0800hrs and after this there is steep fall in RH till noon times and reaches to the minmium value of 42% during the month of November. After 1300hrs, there is steep rise in RH till 2000 hrs and reaches to the maxima i.e. 70%.

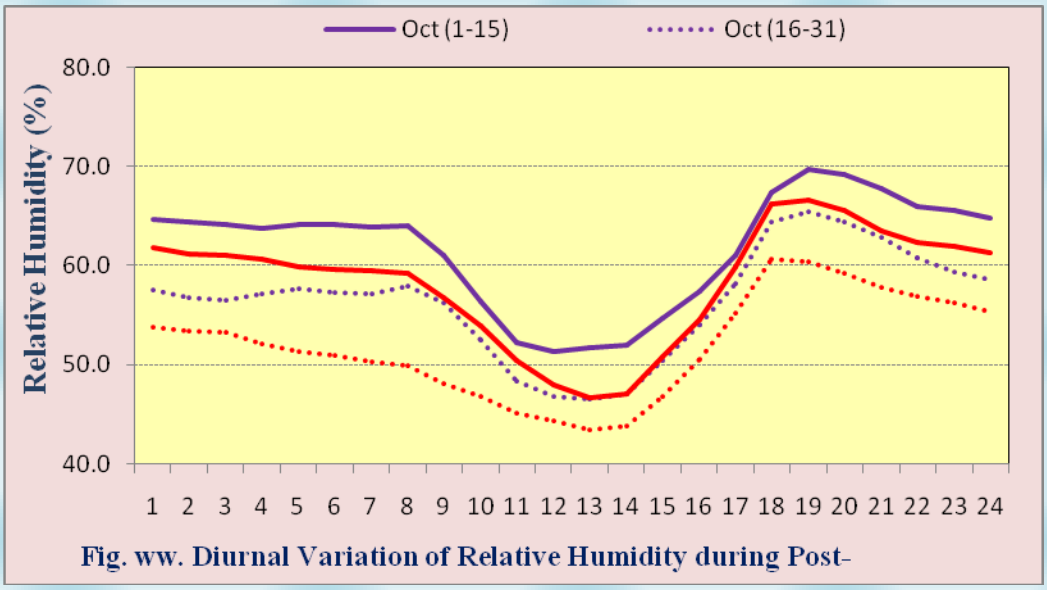


Fig. ww. Diurnal Variation of Relative Humidity during Post-

Rainfall

Southwest monsoon withdraws from northwest India during the second half of September. However, the season is not completely devoid of rain/thundershower activity as they occur in association of both the eastward moving mid-latitudes weather systems which sometimes penetrate to Himachal Pradesh and the westward moving tropical disturbances which cause incursion of moisture towards North India. The daily normal rainfall is 1-2mm during the first three week of October (Figure 57). Subsequently, there is a decrease and the normal rainfall is <1mm for most of the days. The average monthly total rainfall is 33.2mm for October and 19.3mm for November.

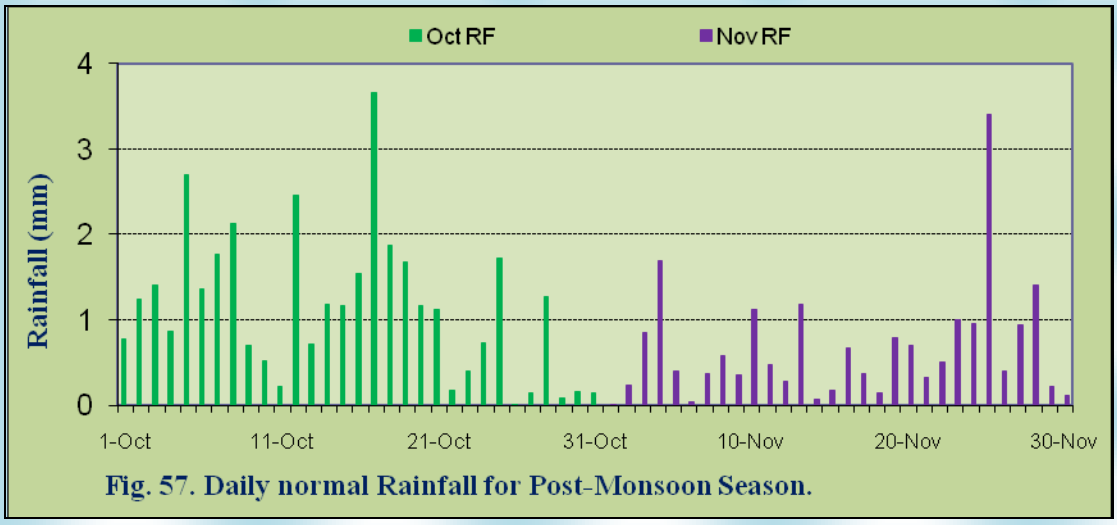


Fig. 57. Daily normal Rainfall for Post-Monsoon Season.

The probability of rainfall for individual days shows large fluctuations indicating uncertain behavior of rainfall in the season (Figure 58). There is a decrease from 15-25% in the beginning of October to 5% or less in the middle of the season. The marginal increase is noticed in the second half of November. Average number of rainy days (with rainfall amount >0.0mm) are 4.8 in October and 3.4 in November.

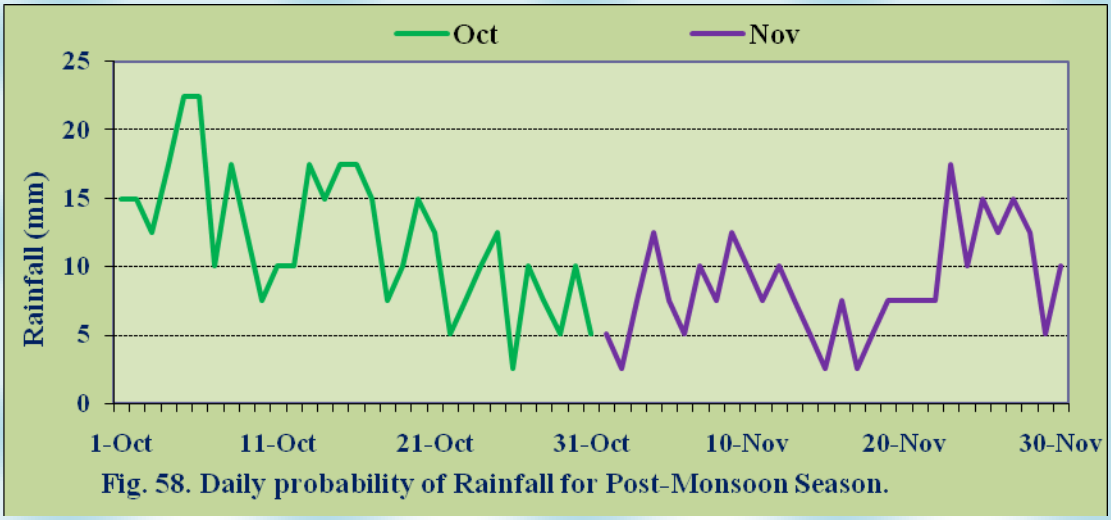


Fig. 58. Daily probability of Rainfall for Post-Monsoon Season.

Heavy Rainfall

Generally, heavy rains are not experienced during the season. The heaviest rainfall of 24hrs during October and November for the period 1971-2010 given in Figure 59 show that it is less than 1cm in majority of the years. However, 24 hrs rainfall amount of 1-2cm is not uncommon. During the above 40 years period there has been one occasion of heavy rainfall each for the months of October and November (104.1mm on 17 Oct 1998 and 77.0 mm on 25 Nov, 1989). These are also the all time records for heavy rainfall for these months.

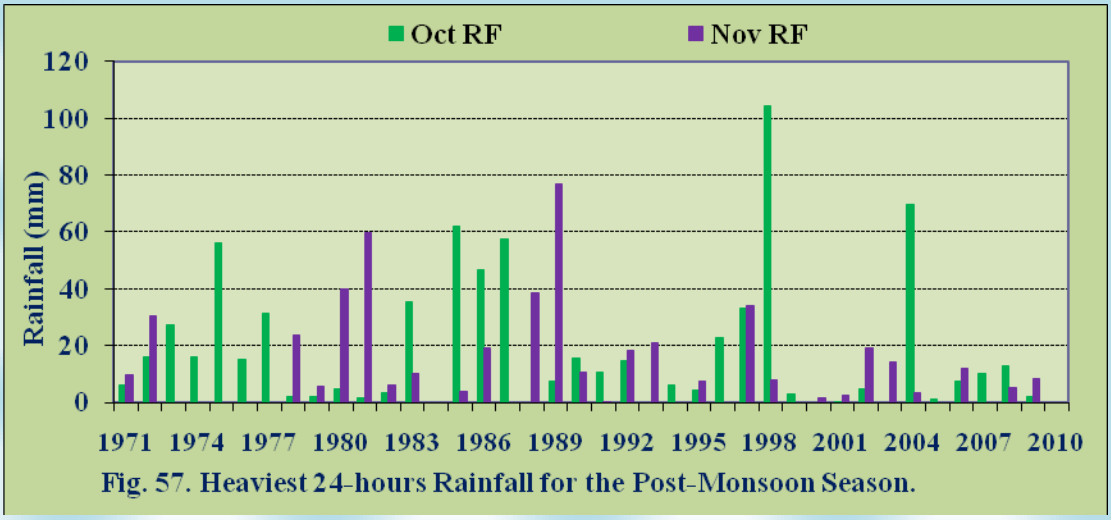


Fig. 57. Heaviest 24-hours Rainfall for the Post-Monsoon Season.

Thunderstom and other weather phenonmenon (Post-Monsoon)

As the normal rainfall rainfall activity is very less, thunderstrom activity is also ceases during this season. The avarage number of thundersroms are only 0.6 in the season as well as for the month of October. Maximum thunderstroms were recorded in a month as 4 in October (1997). Frequency of hailstrom also not pronuced during this season. Only 6% of the annual hails falls in this season. The most preffered time for occurrence of thunderstroms is from noon to evening (1200-2100IST) during this season.

Total number of thunderstroms days during the seasion from 1990 to 2010 are presented in Figure xx.

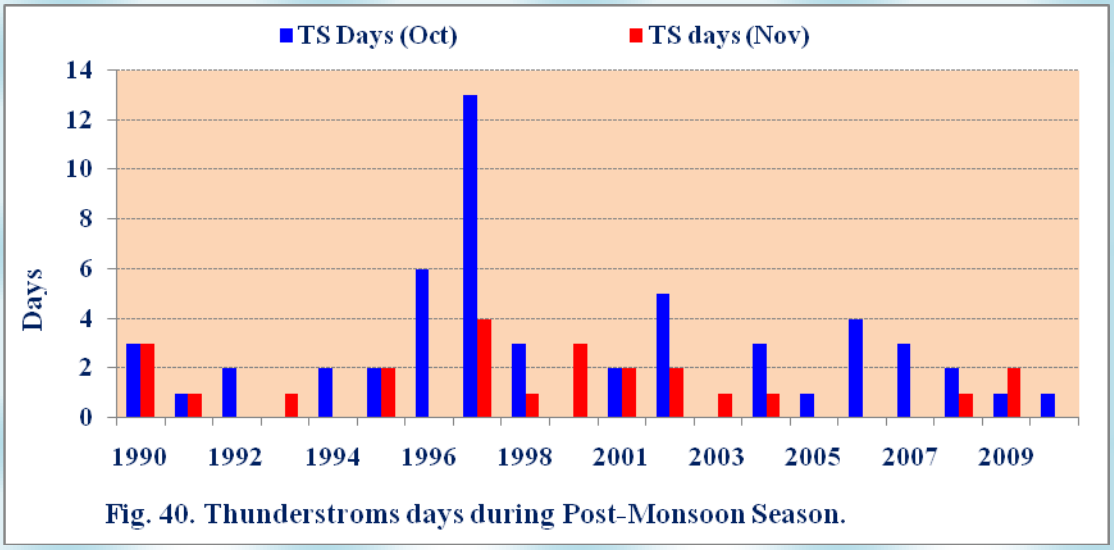


Fig. 40. Thunderstroms days during Post-Monsoon Season.

Wind (Post-Monsoon)

Wind speed comparitively increases during this season than the monsoon season. Average wind speed during this season in the month of October and November is 2.3, 2.5, kmph respectively with the windiest month having 4.5kmph in October 1982 and 5.3kmph in November (1980). Prominet wind direction is southerly during evening times. Figure XX shows that wind speed is more at 1730 hours IST which chilled the Shimla during evening.

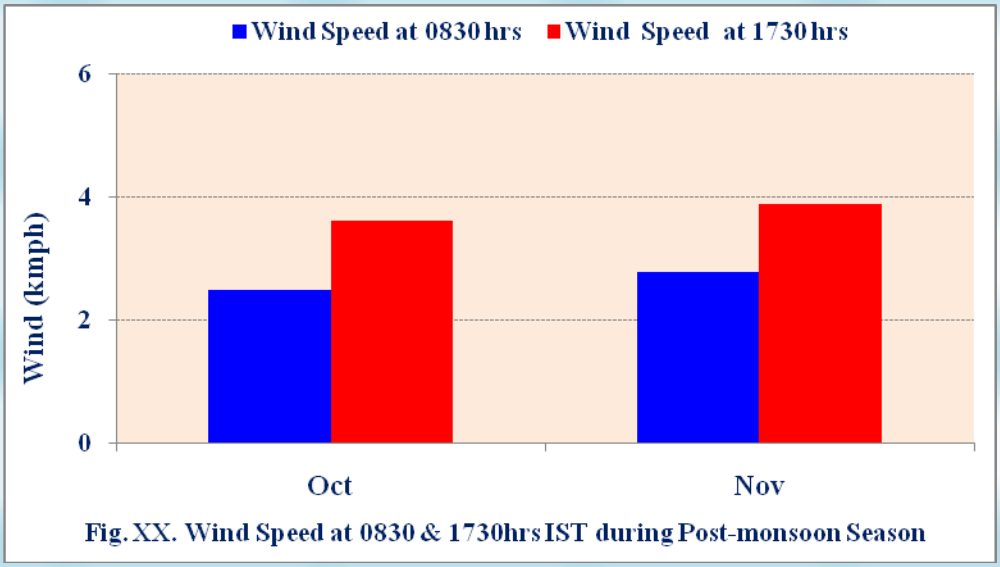
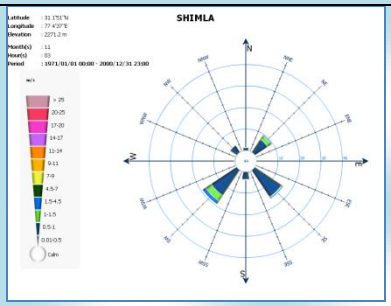
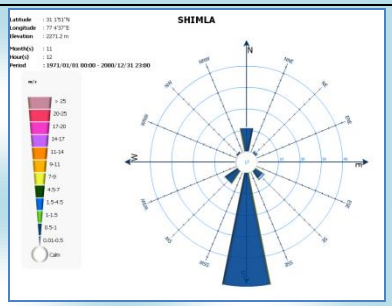


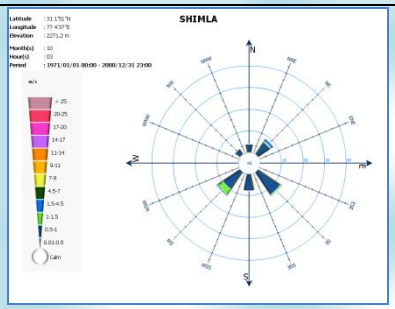
Fig. XX. Wind Speed at 0830 & 1730hrs IST during Post-monsoon Season

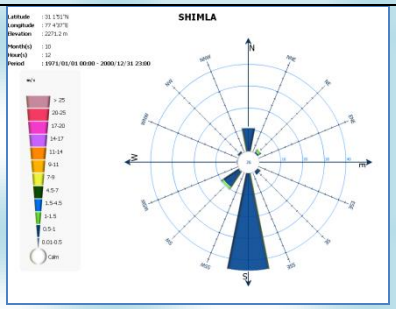




Monrning Evening

October





Monrning Evening

November

Fig. XX. Windrose at 0830 and 1730 hrs ISt at Shimla during Post Monsoon Season

Weather on some Important Days in Shimla

Three national holidays days i.e. Republic Day (26 January), Gandhi Jayanti (2 October) Independence Day (15 August), and other festival i.e. Himachal Day (15 April), Christmas Day (25 December) and New Year (31 December) are some of the many festival which are celebrated in the city with great curiosity. The general weather conditions of these days are described in the following section.

Independent Day

Himachal Pradesh, the most wonderful state nestled between the Western Himalayas and is often referred to as the magical showcase of nature's splendors. Fairs and festival is another major reason to visit Himachal. To see the exclusive event that has earned great tribute from the tourists all over the world, festivals are the best time to visit Himachal Pradesh. Himachal reunite to celebrate the most important day in the Indian history, 15th August the day when India achieved its freedom, the Independence Day. The **Independence Day of India** is celebrated on the fifteenth of August to commemorate its independence from British rule and its birth as a sovereign nation in 1947. The day is a national holiday in India. All over the country, flag-hoisting ceremonies are conducted by the local administration in attendance.

This day has its own importance and is celebrated with full enthusiasm and feel of patriotism in Shimla. One can see a sudden burst of saffron, purple and white, the Indian tri-colors throughout the city. The Chief Minister of Himachal Pradesh hoists the national flag and address the state. In the morning around 10:00 am watch out the young soldiers, well dressed with pride marching through the Mall Road, which is then followed by cultural programs by students of various schools and colleges on the Ridge Maidan where people apparel in their colorful best assemble in huge number.

The weather of the Independent Day in Shimla is marked by cloudy, low visibility due to fog/low clouds, high probability of rainfall are the main features. The maximum/minimum temperatures and rainfall of 15 August during last 40 years (1971-2010) is given in Figure xx shows that the maximum temperature during most of years of the Independence Day ranges between 20 and 24° C. However, it has been as high as 24.7° C in 1993. The minimum temperatures during most of the years range between 14-16° C (Figure xx). The lowest minimum temperature during last 40 year has been 11.8° C in 1972. The probability of rainfall is around 80% as rainfall was recorded in Shimla on 32 years on 15 August out of the least 40 years, the highest being 65.9 mm recorded on 15 August, 1981

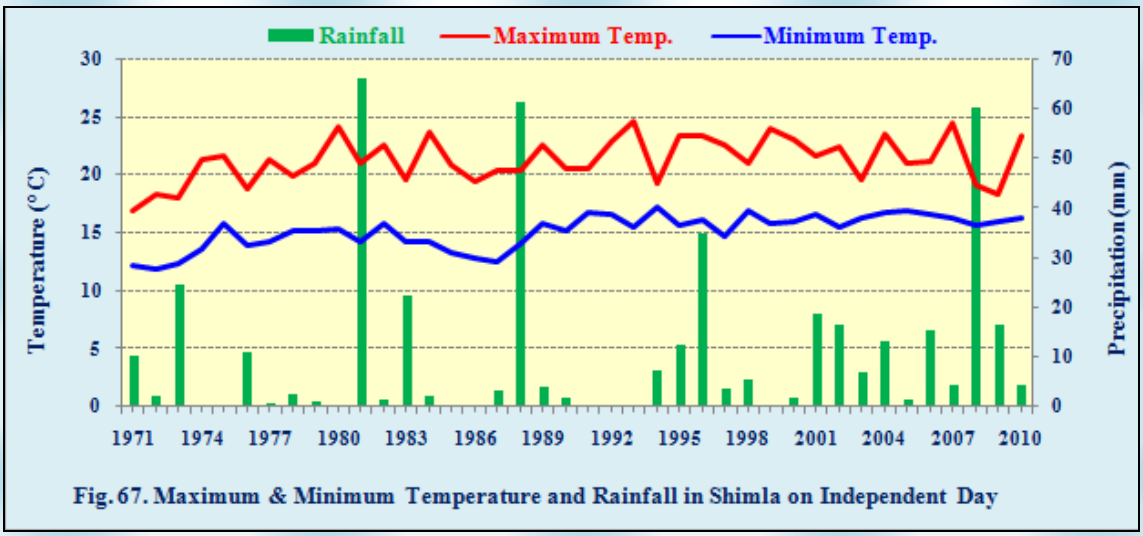


Fig. 67. Maximum & Minimum Temperature and Rainfall in Shimla on Independent Day

Diurnal Variation of Temperature on Independence Day

The diurnal variation of temperature on the Indendence day is given in Figure 68. The purple line shows the average temperature of different hours of the day. The red and blue line shows the highest and lowest temperatures, respectively, recorded at different hours of the day. The figure shows that on an average, the lowest temperature of about 17° C is recoreded around 0600 IST in the morning. It gradually increase with slow rate. The temprature increases at the rate of about ½° C per hour from about 18° C at 0800hrs to 21° C at 1500hrs IST. After 1500 IST it start decreasing reach 19° C 1900 hrs. from 2100 to mid night it remain around 18° then further fall by about 1° C till it reaches to the minimum valuale. Average dirural variation is only about 4° C. High tempratures in excess of 24° C have also been recorded on the Independence Day from 1200hrs to 1400hrs IST. However, cold uncomfort low temperatures (less than 14° C) have also been realised all through the Independence Day in certain years.

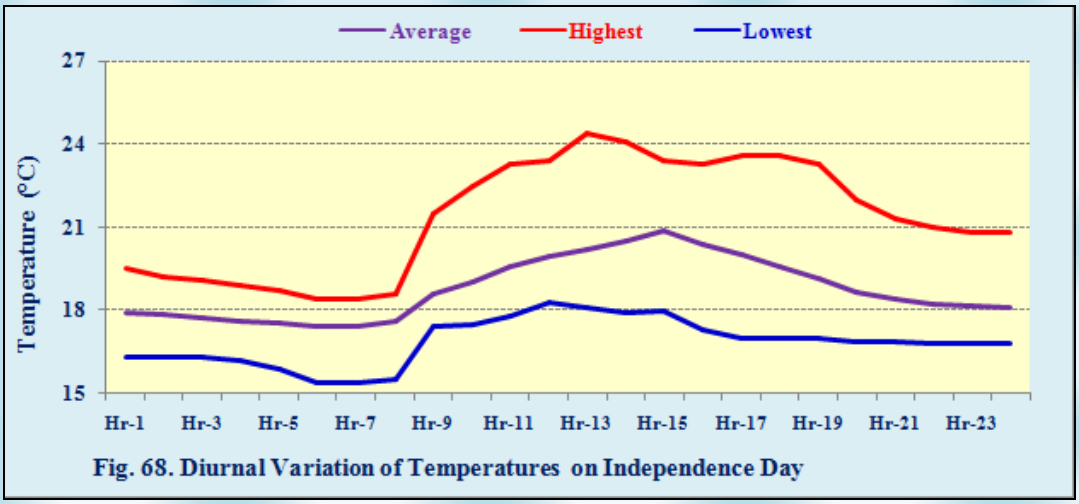


Fig. 68. Diurnal Variation of Temperatures on Independence Day

Republic Day

The **Republic Day of India** commemorates the date on which the Constitution of India came into force replacing the Government of India Act 1935 as the governing document of India on 26 January 1950. The 26th of January was chosen to honor the memory of the declaration of independence of 1930. It is one of the three national holidays in India.

The weather on Republic Day is marked by misty and cold mornings and pleasant noon because of the sunny days. The minimum temperatures during most of the years range between 0 and 5° C (Figure xx). The lowest minimum temperature during last 10 years has been -4.0° C in 1982 and the highest 10.6° C in 1994. Incidence of rainfall or snowfall is not very common as it precipitation has been recorded on 6 years only, with highest amount of 22.6mm in 2000. Sunny days with chilling winds are most common weather phenomena of Republic day in Shimla.

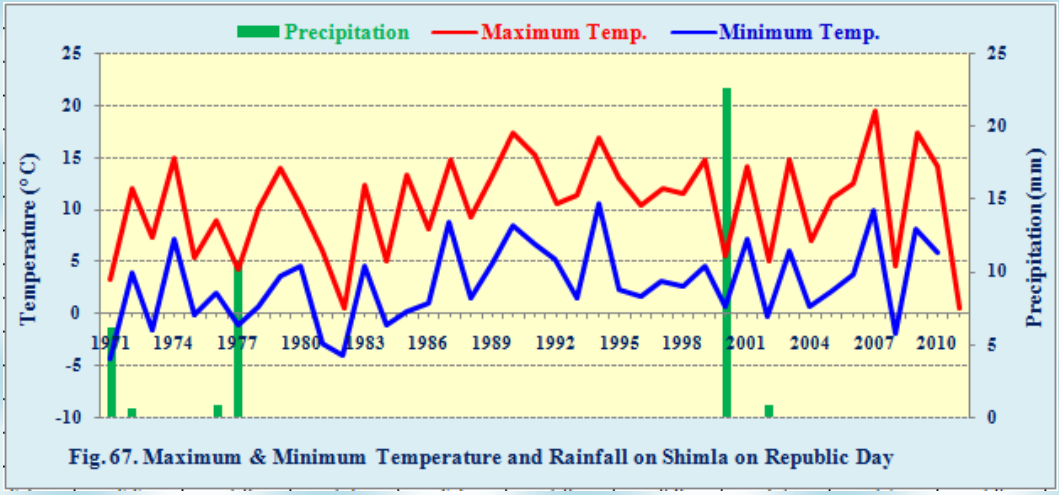


Fig. 67. Maximum & Minimum Temperature and Rainfall on Shimla on Republic Day

Diurnal Variation of Temperature on Republic Day

The diurnal variation of temperatures on the republic Day is given in Figure 68. The purple line shows the average temperature of differenrt hours of the day. The red and blue lines shows the highest lowest temperatures, respectively, recorded at different hours of the day. The figure shows that the average temperatures are around 5˚ C till 0800 IST. The temperatures then gradually increase to 8˚C by 1000 IST and further to 10˚ C by 1200 IST. They remain around 10˚ C till 1500 IST. Thereafter, they start falling with the same rate as they rose and fall down to 6˚ C around 1800 hours IST and remain same through out the night with a little farther fall. The high temprature on some of the years on Republic Day also touches upto 18˚C around 1400 hours IST, make the day comforts. However, quite low temperatures were below 0˚C also noticed from the evening hours 2000 IST to till the morning hours i.e. 0800 IST. During last 40

years, five years were such when maximim temprature during day was 5° C or below and 17 years when maximum temprature was eaqual of less than 10° C. However, during 9 years, minim temperature was 0 deg. C or below and 22 such occasions when minimum tempratures was below 3 deg. C.

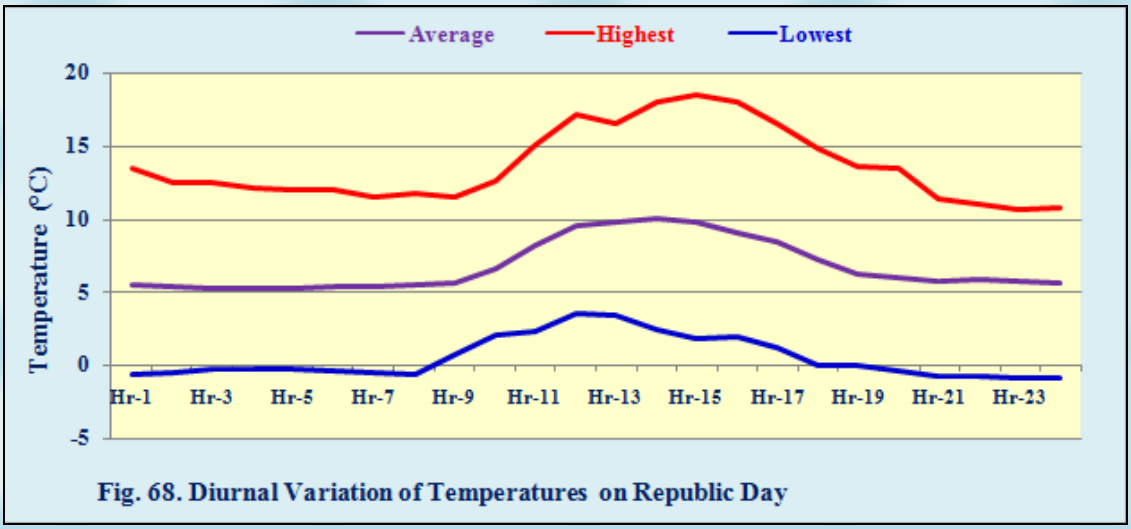


Fig. 68. Diurnal Variation of Temperatures on Republic Day

Gandhi Jayanti

Gandhi Jayanti is a National Holiday celebrated in India to mark the occasion of the birthday of Mohandas Gandhi, the "Father of the Nation." He was born on October 2, 1869. Hence Gandhi Jayanti is celebrated every year on the 2nd of October. It is one of the three official declared National Holidays of India and is observed in all Indian states and union territories.

Generally dry weather, pleasant days and cold morning and evening are main weather characteristics of weather of Shimla on Gandhi Jayanti. The temperatures and rainfall on the day of Gandhi Jayanti Day presented in Figure xx shows that during most of the last 40 years has the minimum ranged between 10-14 deg. C. The lowest minimum temperature recorded during the period was 9° C (1986) and the highest was 16.1° C (2009). The maximum temperature most frequently is between 22-24° C. The highest and lowest maximum temperatures realized on Gandhi Jayanti during last 40 years in Shimla have been 25.9° C (2009) and 18°C (1986) respectively. Incidence of rainfall on this day is not very common on Shimla. During last 40 years there have been only 4 years have rainfall (>2.5mm) and two more year when there was rainfall less than 2.5mm.

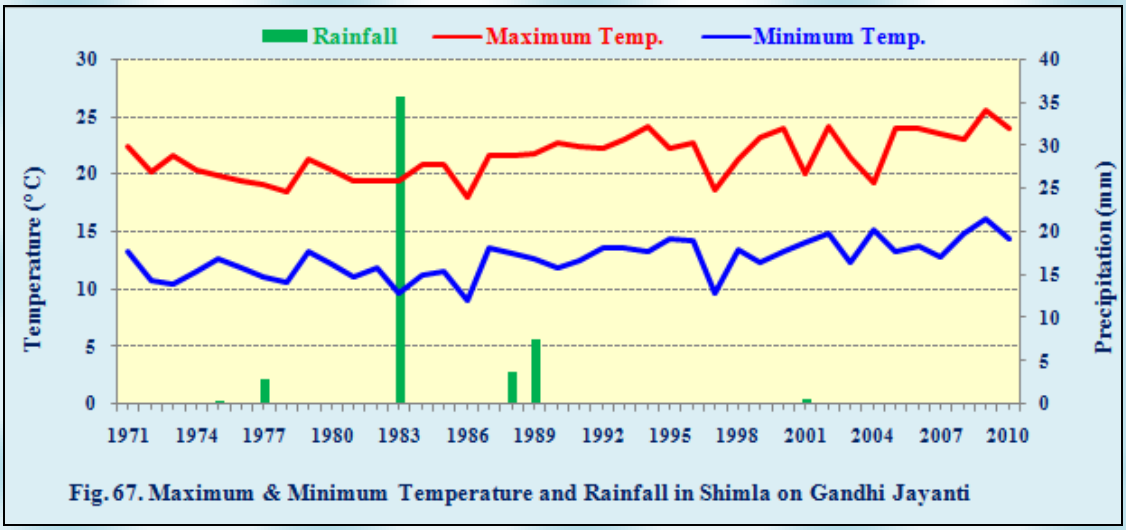


Fig. 67. Maximum & Minimum Temperature and Rainfall in Shimla on Gandhi Jayanti

Diurnal Variation of Temperature on Gandhi Jayanti

The diurnal variation of temperature on Gandhi Jayanti is given in Figure 70 by using the data from the autographic charts (1990-2007). The violet line shows the average temperature of different hours of the day. Red and blue lines show the highest and lowest temperatures, respectively, recorded at different hours of the day. The figure shows that on an average, the lowest temperature of about 14° C is recorded around 0730 IST in the morning. The temperatures then increase rapidly to about 20° C by 1100 IST. It then rise with very slow rate and remain between 20-21° C till 1400 IST. Thereafter, temperatures start falling and reach down to 16° C by 1800 IST. Further cooling throughout the night is very slow and fall only 2°C by 0700hrs of the next morning. Gandhi Jayanti, during certain years, has been more comfort with day marginal rise in temperatures. Temperatures on 2nd October, of 1992 was 23.1°C and during the years 2002, 2006 and 2007 temperatures were around 22-23° C between 1200 to 1600 IST. However, quite low temperatures have also been recorded in past all through day. On 02 October 1994, a temperature was around 9.2°C between 0400 to 0900 IST. The temperature could cover to 17.5° C by 1200 IST in the noon time.

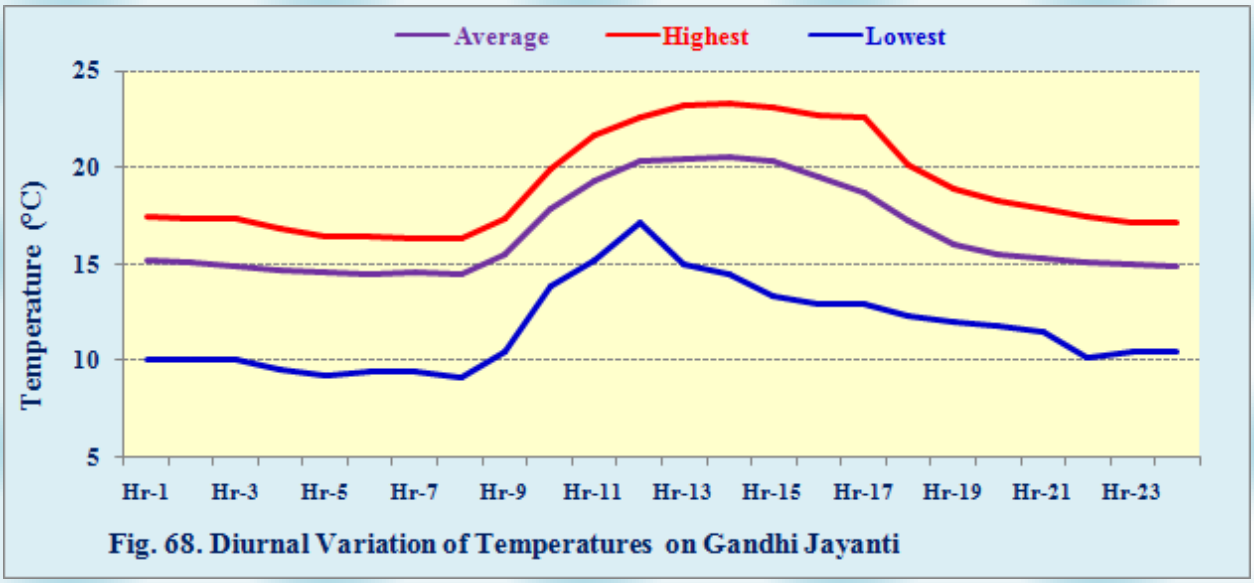


Fig. 68. Diurnal Variation of Temperatures on Gandhi Jayanti

Himachal Day

After independence the Chief Commissioner's province of H.P. came into being on 15th April, 1948. Every year, on 15th April, Himachal Day is celebrated at Shimla and throughout the State with great enthusiasm. Since then Himachal day is celebrated every year on 15th April. District Level function celebrated with great enthusiasm at Historic Ridge Maidan of Shimla. National flag unfurled, contingents of the Himachal Pradesh Police, Himachal Pradesh Home Guards, N.C.C. cadets etc. take part in the parade and the celebrations were witnessed by large number of people from all walks of life, who thronged the venue in their traditional costumes. Variety cultural programmes were presented to mark the celebration.

Generally dry weather, pleasant days and little cold morning and evening are main weather characteristics of weather of Shimla on **Himachal Day**. The temperatures and rainfall on the day of Himachal Day presented in Figure xx shows that during most of the last 40 years has the minimum temperatures ranged between 08-12°C. The lowest minimum temperature recorded during the period was 2.9° C (1983) and the highest was 17.8° C (2010). The maximum temperature most frequently is between 22-24° C. The highest and lowest maximum temperatures realized on Himachal Day during last 40 years in Shimla have been 28.9° C (2010) and 9°C (1983) respectively. Incidence of rainfall on this day is not very common on Shimla. During last 40 years there have been only 9 years have rainfall recorded in the city. 111.1mm of rainfall was recorded on Himachal day during 1979.

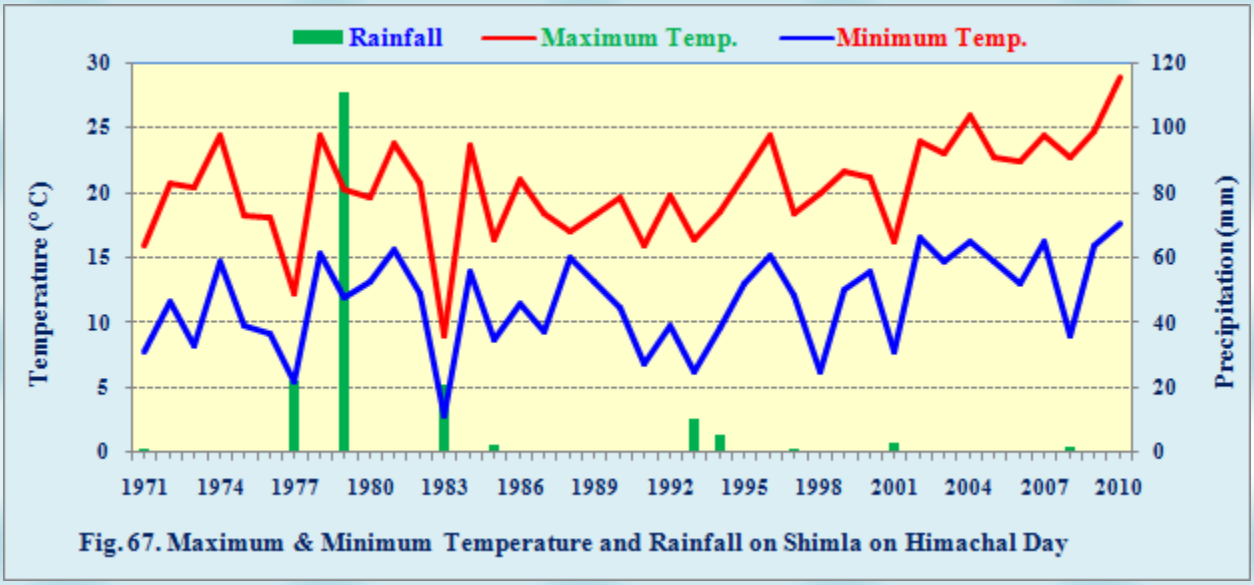


Fig. 67. Maximum & Minimum Temperature and Rainfall on Shimla on Himachal Day

Diurnal Variation of Temperature on Himachal day

The diurnal variation of temperatures on the Himachal Day is given in Figure xx. In this figure, e purple line shows the average temperature of differenrt hours of the day. The red and blue lines shows the highest lowest temperatures, respectively, recorded at different hours of the day. The figure shows that the average temperatures are around 14˚ C till 0700 IST. The temperatures then gradually increase to 16˚C by 1000 IST and further near to 20˚ C by 1200 IST. They remain near 20˚ C till 1500 IST. Thereafter, they start falling with the same rate as they rose and fall down to 15˚ C around 1900 hours IST and remain same through out the night with a farther fall by 1-2˚C. The high temprature on some of the years on Himachal Day also touches upto 25˚C around 1400 hours IST, make the day little warmer. However, quite low temperatures were below 6˚C also noticed from the evening hours 2000 IST to till the morning hours i.e. 0800 IST. During last 40 years, there was only 2 years when maximim temprature during day was more 25˚ C and only one year when it was below 10˚ C. However, during 15 years, minimun temperature was below10 deg. C and and only one year when temprature was below 5 deg. C.

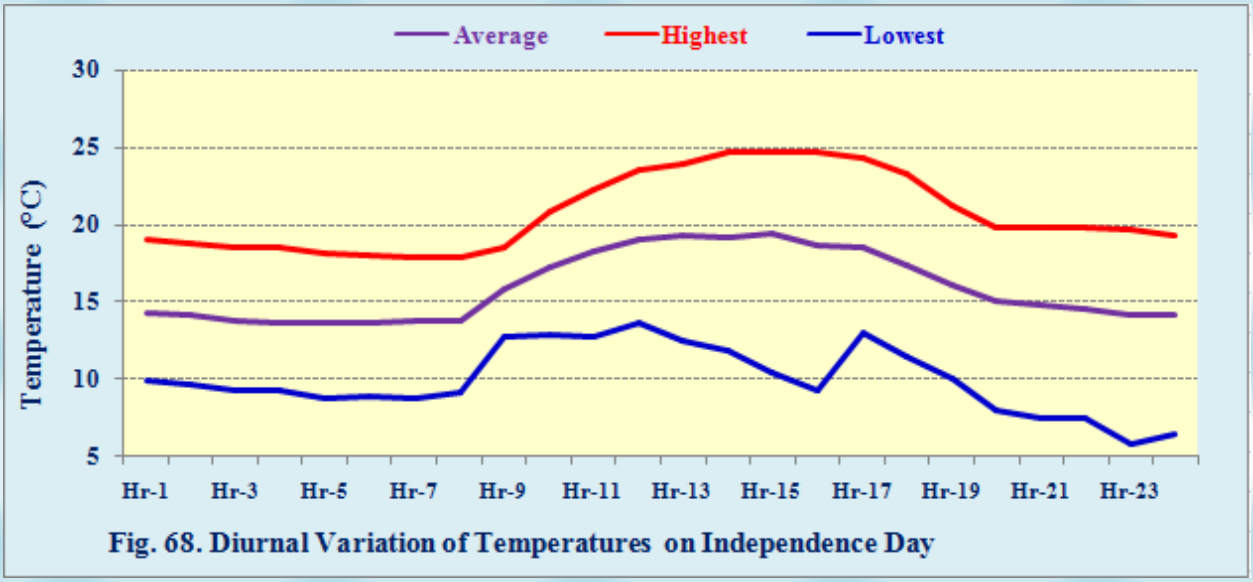


Fig. 68. Diurnal Variation of Temperatures on Independence Day

Christmas Day

Number of Tourist starts gather in Shimla two three days in advance to enjoy

The weather of the Christmas Day in Shimla is marked by low temperature, partly cloudy sky, moderate wind during evening/night are the main features. The maximum/minimum temperatures and rainfall/snowfall of 25 December during last 40 years (1971-2010) is given in Figure xx shows that the maximum temperature during most of years of the Christmas Day ranges between 10 and 12° C. However, it has been as high as 17.6° C in 1998 and as cold as 2.0°C (1991). The minimum temperatures during most of the years range between 2-4° C (Figure xx). The lowest minimum temperature during last 40 year has been -01° C in 1991 and high as 8.0°C (1987). The probability of rainfall/snowfall is around 23% as rain/snow was recorded in Shimla for 9 years on 25 Christmas Day out of the least 40 years, the highest being 20.1 mm recorded on 25 December, 1977.

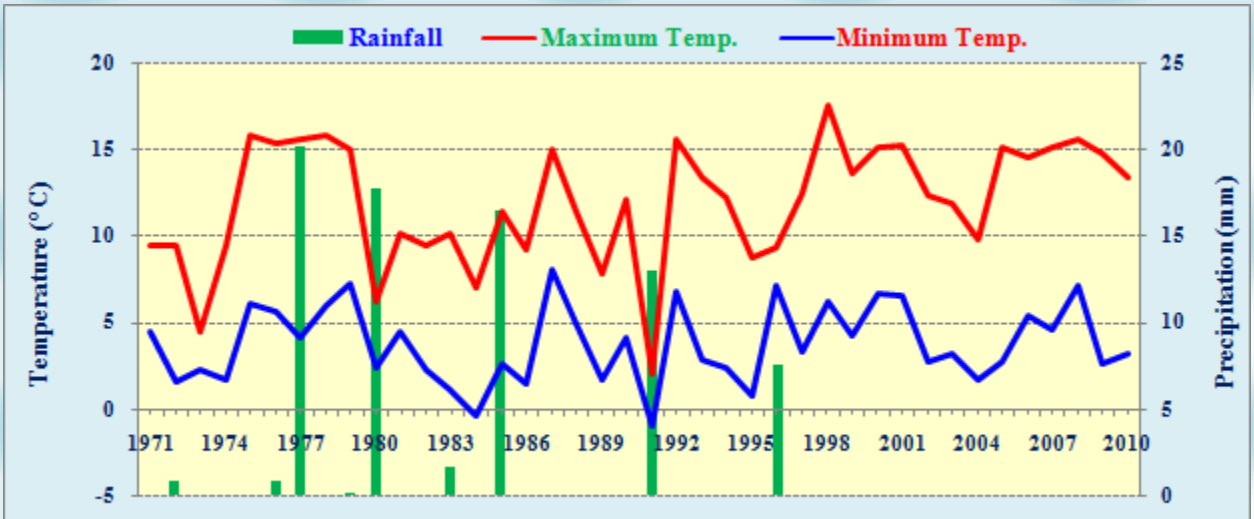


Fig. 67. Maximum & Minimum Temperature and Rainfall on Shimla on Cristmas Day

Diurnal Variation of Temperature on Christmas Day

The diurnal variation of temperatures on the Charistmas Day is given in Figure xx. The purple line shows the average temperature of differenrt hours of the day. The red and blue lines shows the highest lowest temperatures, respectively, recorded at different hours of the day. The figure shows that the average temperatures are around 6˚ C till 0800 IST. The temperatures then gradually increase to 8˚C by 1000 IST and further to 10˚ C by 1200 IST and reach upto 11˚C by 1300 IST. Thereafter, they start falling steeply and fall down to 7˚ C around 1700 hours IST and they further fall by 1-2˚ C through out the night till they reach to the loest minmim value at between 0700-0800hrs. The high temprature on some of the years on Charistmas Day also touches upto 16˚C around 1400 hours IST, make the day little comfort. However, quite low temperatures were below 1˚C also noticed during day time evening hours 2000 IST to till the morning hours i.e. 0800 IST. During last 40 years, 2 years were such when minimum temprature during day was 0˚ C or below and 28 years when maximum temprature was eaqual of less than 5˚ C. However, during 11 years, maximum temperature was more than 15˚C on the Christmas Day from 1971-2010.

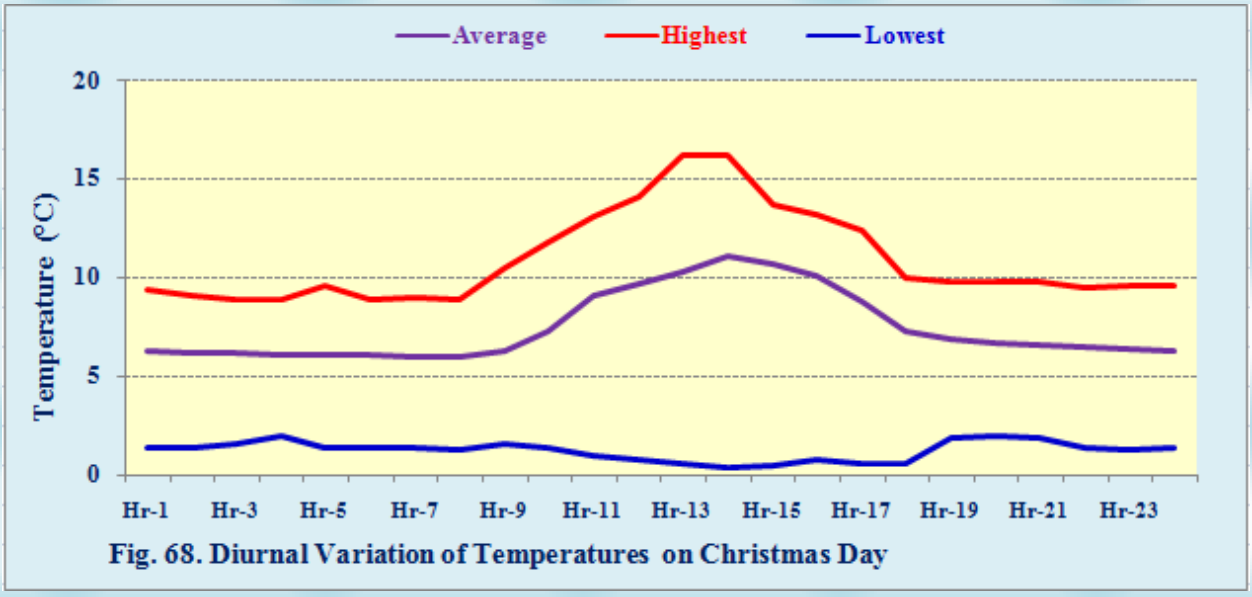


Fig. 68. Diurnal Variation of Temperatures on Christmas Day

New Year

The New Year celebration in Shimla is well-known for its tremendous views and appealing climate. The celebration of New Year Eve in Shimla promises get a wonderful memory that will be cherished the whole life. It is a place which is blessed with spectacular scenic beauty and a to-die-for weather.

During Near Year Eve, Shimla is assembled with people from all over the world. Additionally, the place of party is decorated with plenty of flowers especially red roses and with lighting which will seem like a bride. Stepping in to New Year carnivals, parties, fairies, it makes Shimla a fascinating rapture of India.

Generally dry weather, cold days and chilled morning and evening are main weather characteristics of weather of Shimla at the time of New Year. The temperatures and rainfall on the day of 31 December are presented in Figure xx shows that during most of the last 40 years have the minimum ranged between 2-4° C. The lowest minimum temperature recorded during the period was -3.9° C (1990) and the highest was 9.0° C (2004). The maximum temperature most frequently is between 10-12° C. The highest and lowest maximum temperatures realized on 31 December during last 40 years in Shimla have been 16.9° C (1971) and 1.4°C (2002) respectively. Incidence of rainfall/snowfall on 31 December and 1 January are not very common on Shimla. During last 40 years there have been only 4 years when the rainfall/snowfall was recorded in the morning of 31st December and 8years when it was recorded in the proceeding 1st January. The probability of occurrence of precipitation on either of these days is only 30%.

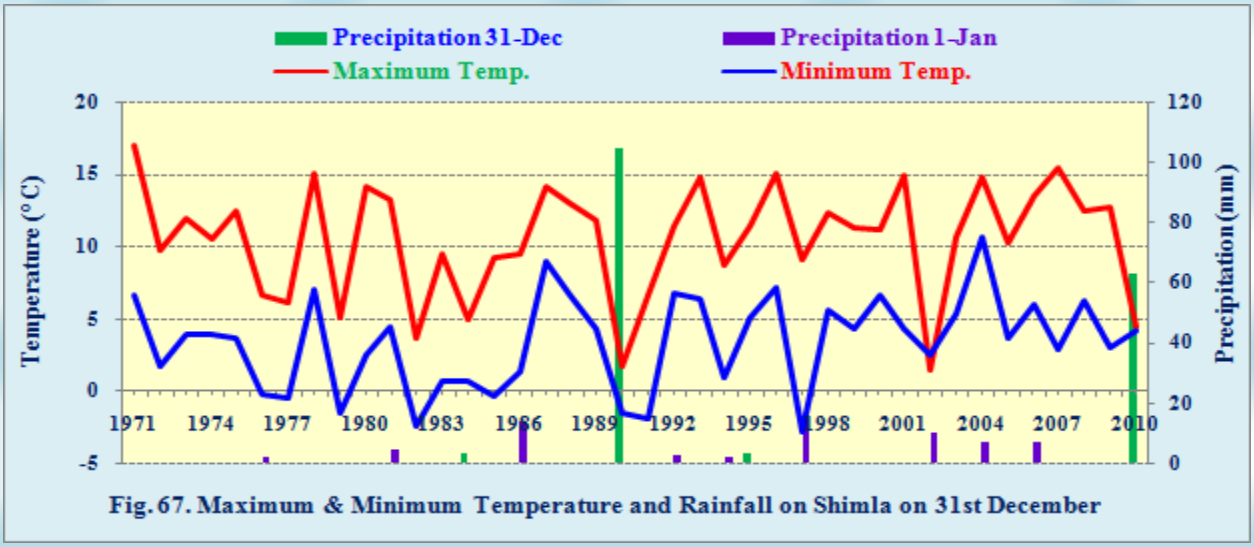


Fig. 67. Maximum & Minimum Temperature and Rainfall on Shimla on 31st December

Diurnal Variation of Temperature on New Year

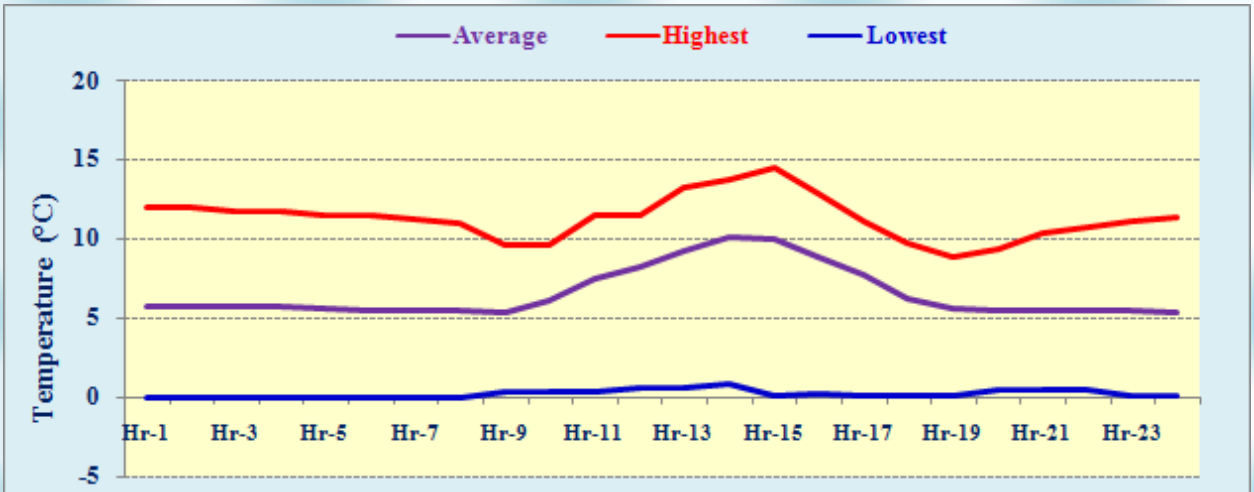


Fig. 68. Diurnal Variation of Temperatures on 31st December Day

The diurnal variation of temperature on 31 December is given in Figure 70 by using the data from the autographic charts (1990-2007). Red and blue lines show the highest and lowest temperatures, respectively, recorded at different hours of the day. The violet line shows the average temperature of different hours of the day. The figure shows that on an average, the lowest temperature of about 5° C is recorded around 0800 IST in the morning. The temperatures then increase rapidly to about 10° C by 1300IST. Temperatures almost remain same for 1-2

hours. Thereafter, temperatures start falling and reach down near to 5° C by 1800 IST. Further cooling throughout there is hardly any fall in the temperature during whole night 31 December, during certain years, has been little more comfort with marginal rise in temperatures near to 15°C. However, quite low temperatures have also been recorded in past all through day near below 0°C.

Table 1: Average and Extremes of Temperatures over Shimla						
Month	Maximum Temperature (˚C)			Minimum Temperature (˚C)		
	Mean	Maximum ever	Date and Year	Mean	Lowest ever	Date and Year
January	10.3	21.4	30, 2006	2.5	-11.6	11, 1945
February	11.5	22.6	19, 2006	3.3	-08.5	14, 1972
March	15.7	25.8	23, 2010	6.9	-06.1	09, 1979
April	20.6	29.6	17, 2010	11.5	-01.1	01, 1905
May	23.8	32.4	27, 2010	14.5	01.4	03, 1987
June	24.3	31.5	10, 2007	15.9	07.8	02, 1922
July	22.1	28.9	06, 1901	15.5	09.4	02, 1989
August	21.5	27.8	29, 1951	15.1	10.6,	01, 1957
September	21.5	27.0	09, 2004	13.7	05.0	29, 1940
October	20.0	25.6	02, 2009	10.9	00.2	30, 1961
November	16.4	23.5	14, 1995	7.6	-01.2	23, 1992
December	13.1	20.5	15, 2006 08, 2008	4.8	-12.2	13, 1963
Annual	18.4			10.2	-11.6	

Table. 2 Average and maximum number of days with cold waves in Shimla				
Month	Average number of days with		Maximum number of days with cold wave/sever cold wave	
	Cold Wave	Severe Cold Wave	Number	Year
December	2.7	0.9	11	1986
January	3.5	0.7	12	1972
February	3.4	1.0	12	1973
March	4.7	1.6	17	1982

Table 3: Average and Extremes of Rainfall over Shimla					
Month	Monthly Total (mm)	Ever heaviest in 24		Total in wettest month	
		Rainfall (mm)	Date & Year	Rainfall (mm)	Year
January	53.4	78.5	11, 1945	225.0	1911
February	65.1	63.5	14, 1972	229.6	1901
March	70.3	66.6	09, 1979	231.4	1911
April	56.4	111.1	01, 1905	201.4	1982
May	78.8	97.8	03, 1987	250.3	1983
June	193.7	122.2	02, 1922	535.8	2008
July	346.0	279.1	02, 1989	757.9	1894
August	313.6	227.1	01, 1957	1080.3	1906
September	159.4	177.1	29, 1940	453.6	1924
October	33.5	11.3	30, 1961	263.1	1956
November	18.1	77.0	23, 1992	125.0	1883
December	26.8	104.3	31, 1990	206.5	1893
Annual	1415.1	279.1	02 Jul, 1989		

Table 4. Average number of days with different weather phenomena						
Month	**Rain**	**Drizzle**	**Snowfall**	**Hail**	**Thunder**	**Fog**
Jan			4.2	0.9	2.1	2.7
Feb			4.2	1.3	3.7	2.9
Mar			1.4	1.9	5.7	1.1
Apr			0.0	1.6	6.3	0.3
May			0.0	1.9	9.2	0.8
Jun			0.0	0.3	11.3	5.9
Jul			0.0	0.0	8.1	14.1
Aug			0.0	0.1	6.7	18.6
Sep			0.0	0.2	6.7	9.0
Oct			0.0	0.6	2.7	1.2
Nov			0.1	0.8	1.3	0.8
Dec			1.3	0.4	1.1	1.4

Table 6: Average and Extremes of Snowfall over Shimla (1990-2010)					
Month	Monthly Total (cm)	Ever heaviest in 24		Total in wettest month	
		Snowfall (cm)	Date & Year	Snowfall (cm)	Year
December	7			203.9	1990
January	42			109	1993
February	43			113	2007
March	7			63	1998

Table 5. Highest magnitude of fall in temperatures (°C) in 24 hours in Winter Season				
Month	Maximum temeprature		Minmum temepratures	
	Temperature Fall	Date, Year	Temperature Fall	Date, Year
December	-10.7	30, 1997	-11.7	12, 1987
January	-11.2	13, 2010	-08.3	17. 1987
February	-11.8	10, 1996	-07.6	24, 1981
March	-08.9	21, 2001	-08.9	03, 2003