The Rainfall Activity and Temperatures Distribution Over NWFP during the Pre- Monsoon Season (April to June) 2009

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Abstract

In this report, changes in the rainfall activity, minimum, maximum and mean temperatures have been studied on monthly as well as on seasonal basis during the pre-monsoon season (April-June) 2009. The data was collected from 11 meteorological observatories located in NWFP. By comparing with the climatic normal values of 1971-2000 , it has been found that the rainfall was largely above normal during April, slightly below normal during May and normal in June. As a whole, it remained slightly above normal during the pre monsoon season across the region.

The minimum temperature remained slightly below normal during April and June and normal during May throughout the region. As a whole, it remained normal during the season in the area.

The maximum temperature remained slightly below normal during April and normal during the months of May and June respectively. As a whole, it remained normal throughout the season across the region.

As a result, the mean temperature remained normal during the study period across the region.

Introduction:

Pre monsoon season (April-June) is a transition period from the winter circulation to the monsoon circulation in the region. During the season, westerly waves shift northwards and relatively the frequency of western disturbances become less. It remains active over the northern parts of the region with the decreasing frequency of occurrence as compared to the peak winter months. Sometimes, due to intense solar heating, mesoscale convective systems dominate over the plains and mountainous areas. As a result, heavy downpour associated with hailstorm and thunderstorms occur.

Heat lows or troughs are a prominent climatologically features of many arid land areas of the country during the warmer months, especially in low latitudes where insulation is at its peak, for example in Balochistan and adjoining areas. They are shallow disturbances, generally confined below 700 mb. Heat troughs are important for day-to-day weather forecasting as they influence the location of regions of low-level convergence, which in turn are likely at places where convective storms will be triggered if the converging air happens to be sufficiently moist.

The study has been conducted regarding the analysis of rainfall, minimum, maximum and mean temperature data for the pre monsoon period 2009. The data was collected from the 11 stations of meteorological observing network of Pakistan Meteorological Department (Chitral, Drosh, Mir Khani, Dir, Balakot, Kakul, Cherat, Peshawar, Kohat, Parachinar, Bannu and D.I.Khan) located in the North West Frontier Province (N.W.F.P.). Two meteorological observatories, Kalam and Saidu Sharif remained close due to law and order situation in the area.

The climatic normal value for Bannu meteorological observatory was calculated on the basis of available data for 13 years (1997-2009).

Methods & Materials:

Mean monthly rainfall data (Table-1), minimum, maximum and mean temperatures data (Tables-2, 3 and 4) for the months April through June from all observatories, situated in NWFP was collected and used for the analysis. Percentage departures of the rainfall and departures of minimum, maximum and mean temperatures were calculated for each month as well as for the season as a whole and the graphs were also drawn.

1 Pakistan Meteorological Department

Result and Discussions:

Monthly Features of Rainfall Distribution:

3.1.1. April, 09:

During the month rainfall was in large excess at six meteorological observing stations (Kakul, Cherat, Peshawar, Parachinar, Kohat and Bannu); moderate excess at two stations (Chitral and Balakot); slightly excess at one station (Dir); normal at one station (Drosh) and slight deficit at one station (D.I.Khan).

As a whole, the rainfall was largely above normal at a number of places across the region during the month. The heaviest amount of rainfall was recorded 71.0 mm on 17th April, 2009 at Dir.

Figure 1 shows normal and actual whereas Figure 2 illustrates percentage departures from the normal.

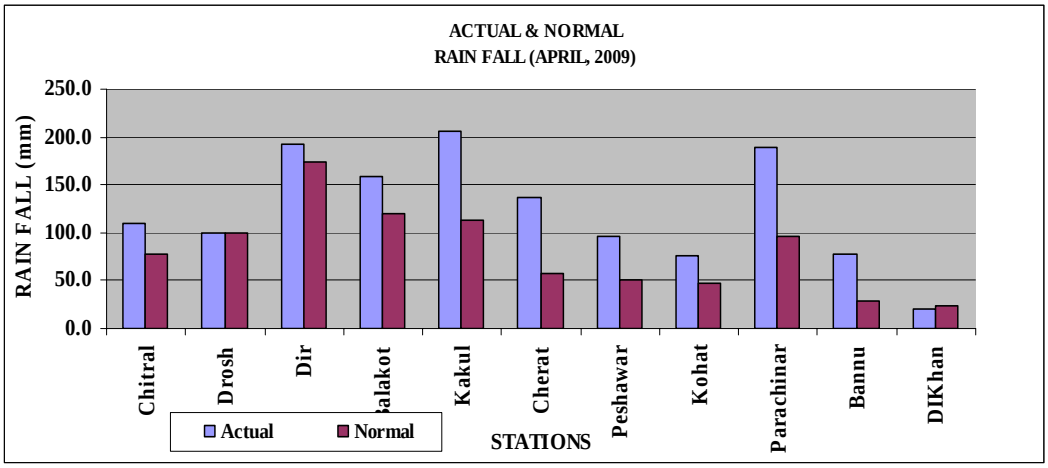

Figure 1

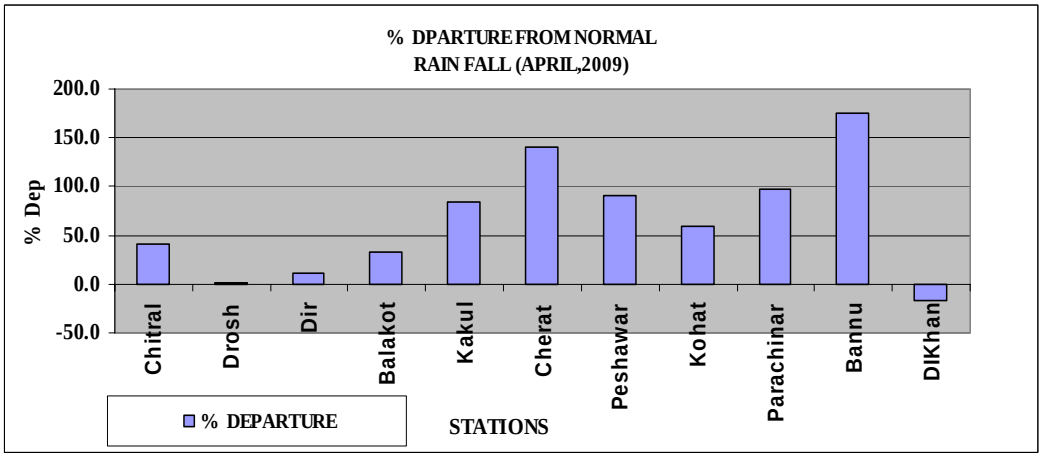

Figure 2

May, 09:

The Rainfall was in large excess at one station (Peshawar); slight excess at one station (Parachinar); normal at one station (Cherat); slight deficit at two stations (Chitral and Dir); moderate deficit at four stations (Drosh, Balakot, Kohat and Bannu) and in large deficit at two stations (Kakul and D.I.Khan).

As a whole, the rainfall was slightly below normal throughout the region during the month.

The heaviest amount of rainfall was recorded 41.0 mm on 5th May, 2009 at Dir. Figure 3 shows normal and actual whereas Figure 4 illustrates percentage departures from the normal.

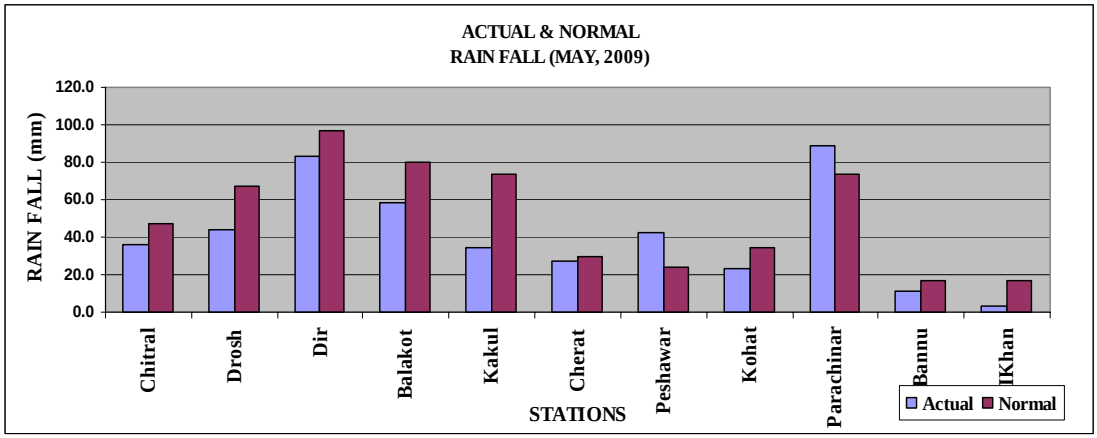

Figure 3

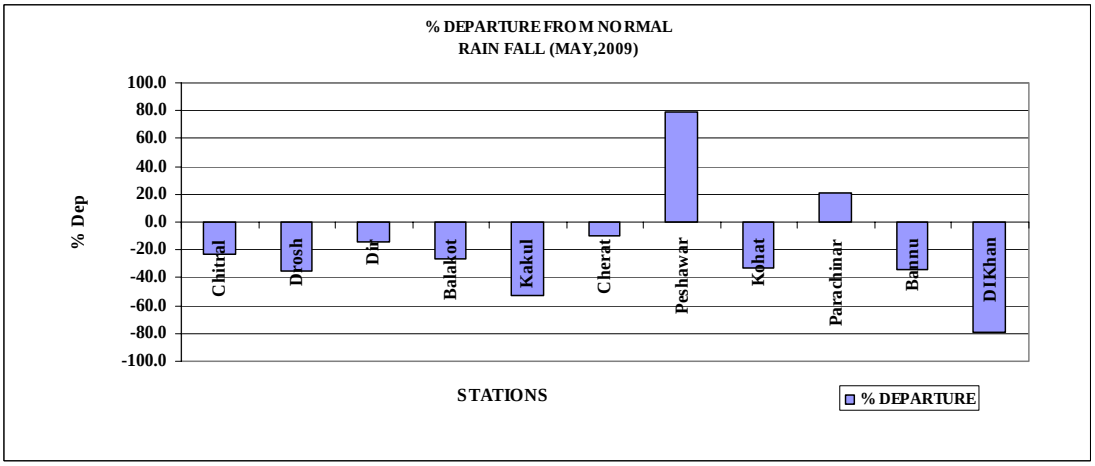

Figure 4

June, 09

The Rainfall was in large excess at two meteorological stations (Chitral and Parachinar); moderate excess at two stations (Drosh and Kohat); normal at one station (Dir); slight deficit at two stations (Balakot and Kakul); moderate deficit at one station (Cherat) and in large deficit at three stations (Peshawar, Bannu and D.I.Khan).

As a whole, the rainfall was normal during the month throughout the region.

The heaviest amount of rainfall was recorded 25.0 mm on 2nd June, 2009 at Parachinar.

Figure 5 shows normal and actual, whereas Figure 6 illustrates percentage departures from the normal.

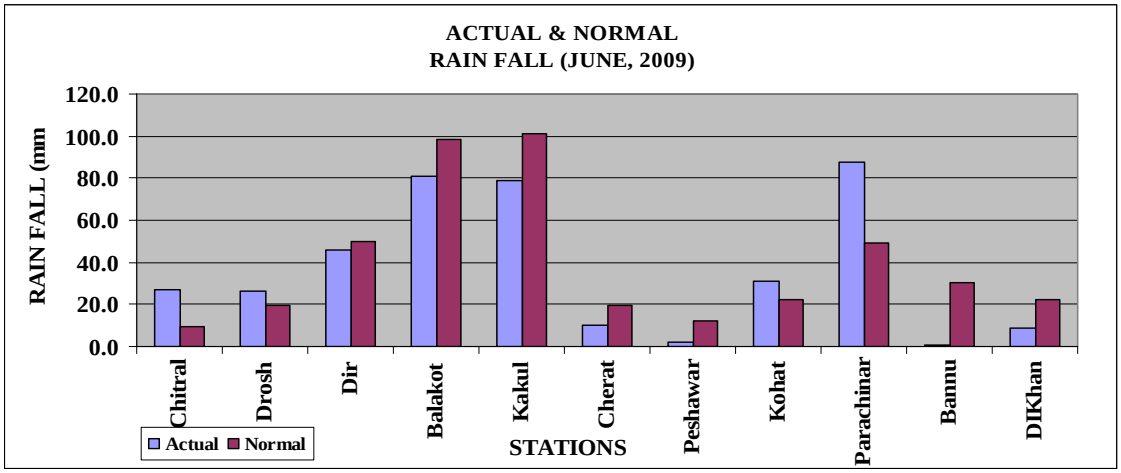

Figure 5

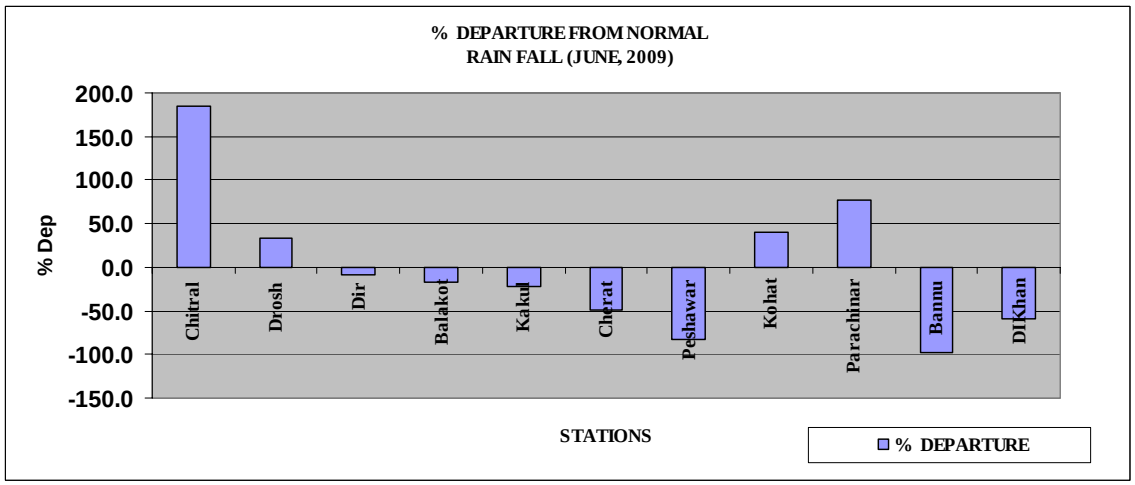

Figure 6

Seasonal Rainfall (April-June, 2009):

During the season, rainfall was in large excess at three meteorological observing stations (Peshawar, Cherat and Parachinar); moderate excess at one stations (Chitral); slight excess at four stations (Kakul, Kohat and Bannu); normal at three stations (Drosh, Dir and Balakot) and in moderate deficit at one station (D.I.Khan).

As a whole, Precipitation was slightly above normal over the region during the pre-monsoon season.

The heaviest amount of rainfall was recorded 367.0 mm at Parachinar during the season. The mean monthly rainfall data with normal and percentage departures from the normal are shown in Figures 7 & 8.

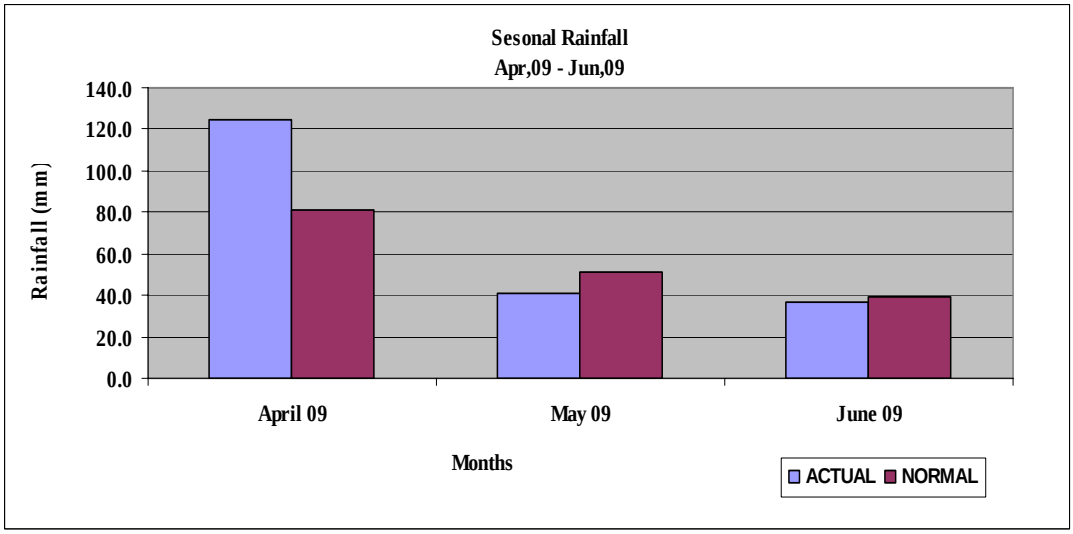

Figure 7

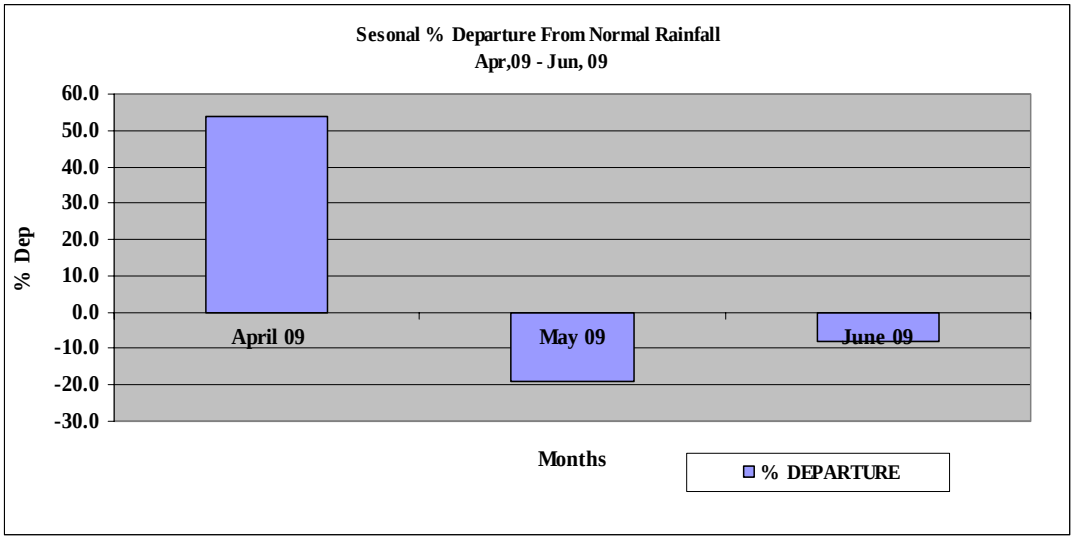

Figure 8

Monthly features of Minimum Temperature Distribution:

April, 09:

During the month, minimum temperature remained slightly below normal at one station (Parachinar), and normal at eleven stations (Chitral, Drosh, Dir, Balakot, Kakul, Cherat, Peshawar, Kohat, Bannu and D.I.Khan). As a whole, it remained normal almost at all places of the region during the month. The month's lowest minimum temperature was 3.0° C recorded at Parachinar on 8th April, 2009.

Figure 09 shows normal & actual, whereas figure 10 illustrates departures from the normal.

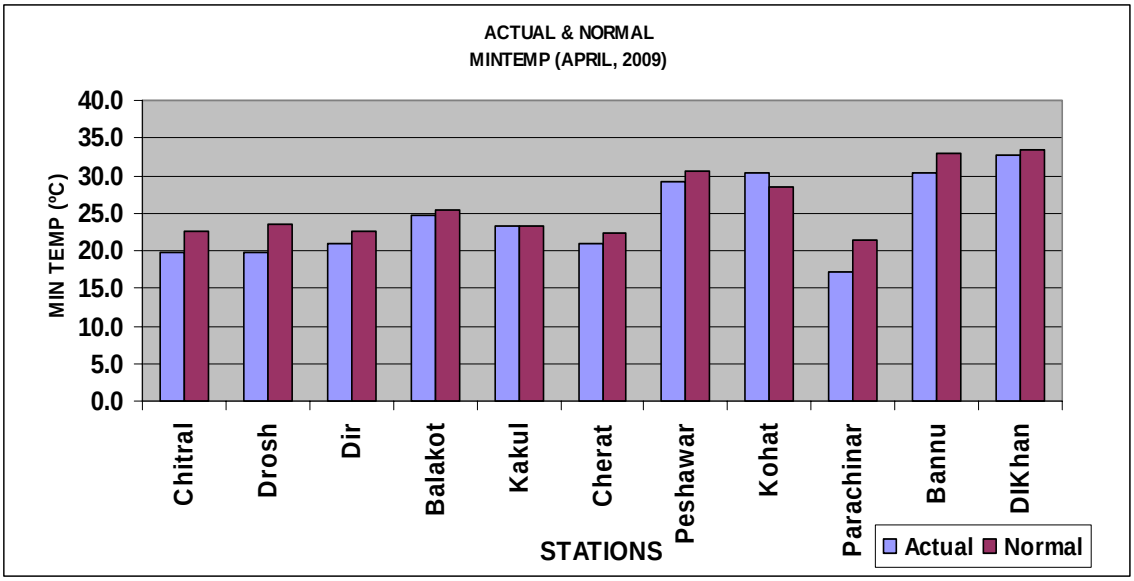

Figure 9

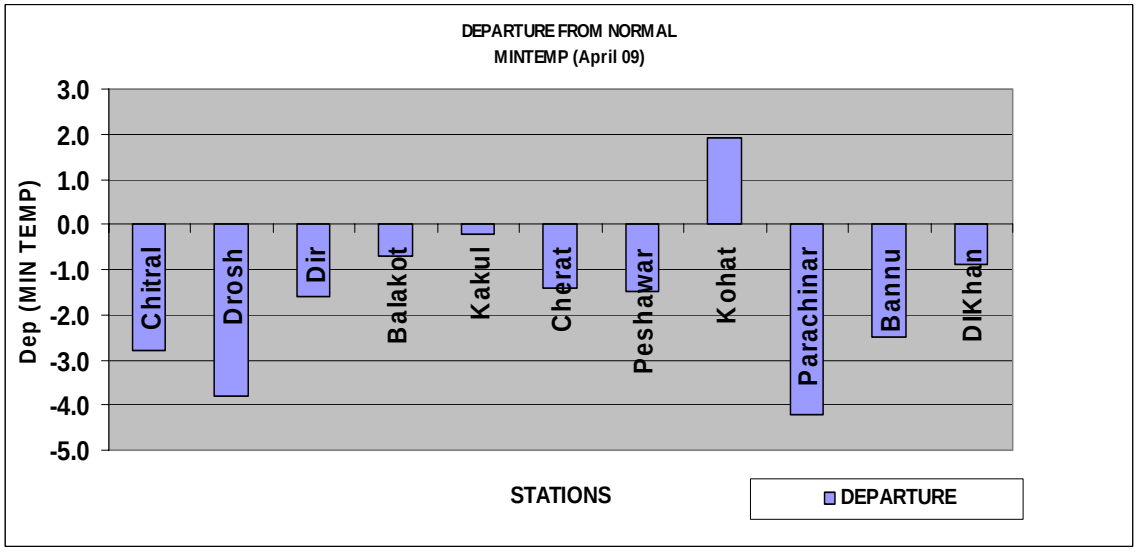

Figure 10

May, 09:

During the month, minimum temperature remained normal at ten stations (Chitral, Drosh, Dir, Balakot, Kakul, Cherat, Peshawar, Bannu and D.I.Khan); slightly above normal at Kohat and appreciably above normal at Parachinar. As a whole, it remained normal almost at all places of the region during the month. The month's lowest minimum temperature was 5.0 °C recorded at Chitral on 6th May, 2009.

Figure 11 shows normal & actual, whereas figure 12 illustrates departures from the normal.

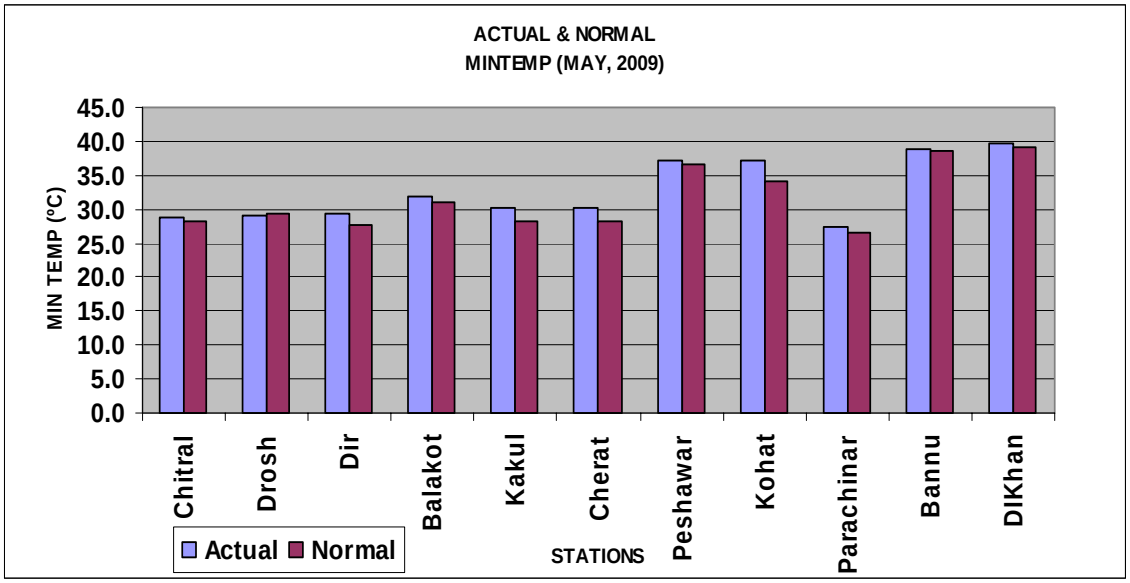

Figure 11

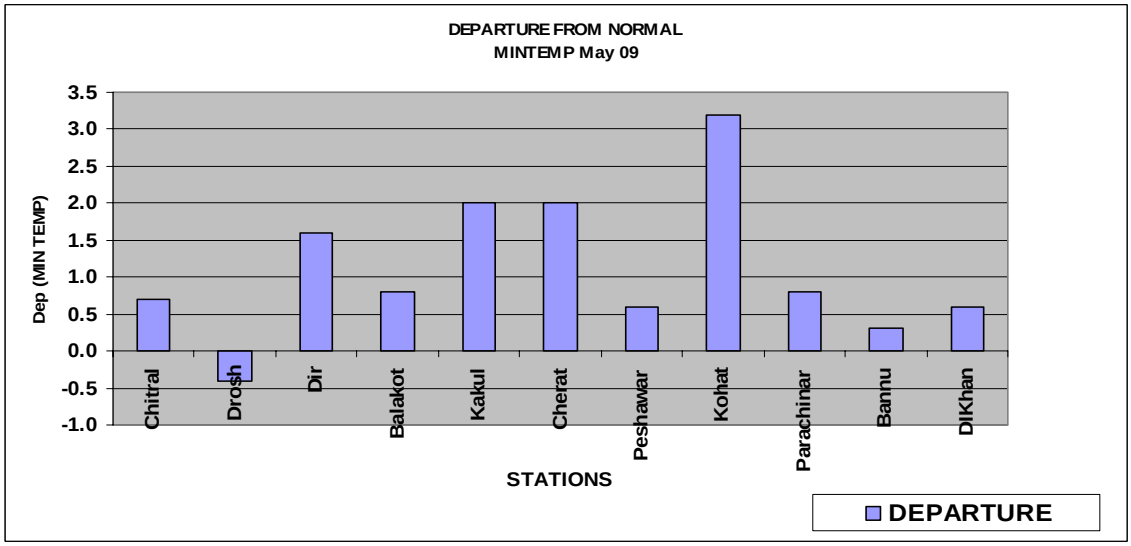

Figure 12

June, 09:

During the month, minimum temperature remained appreciably below normal at one station (Drosh); slightly below normal at seven stations (Chitral, Dir, Kakul, Cherat, Peshawar and Bannu), normal at three stations (Balakot, Kohat and D.I.Khan) and slightly above normal at one station (Parachinar). As a whole, it remained slightly below normal at a number of places across the region during the month. The month's lowest minimum temperature was recorded 9.0 °C at Dir on 7th June, 2009.

Figure 13 shows normal & actual, whereas figure 14 illustrates departures from the normal.

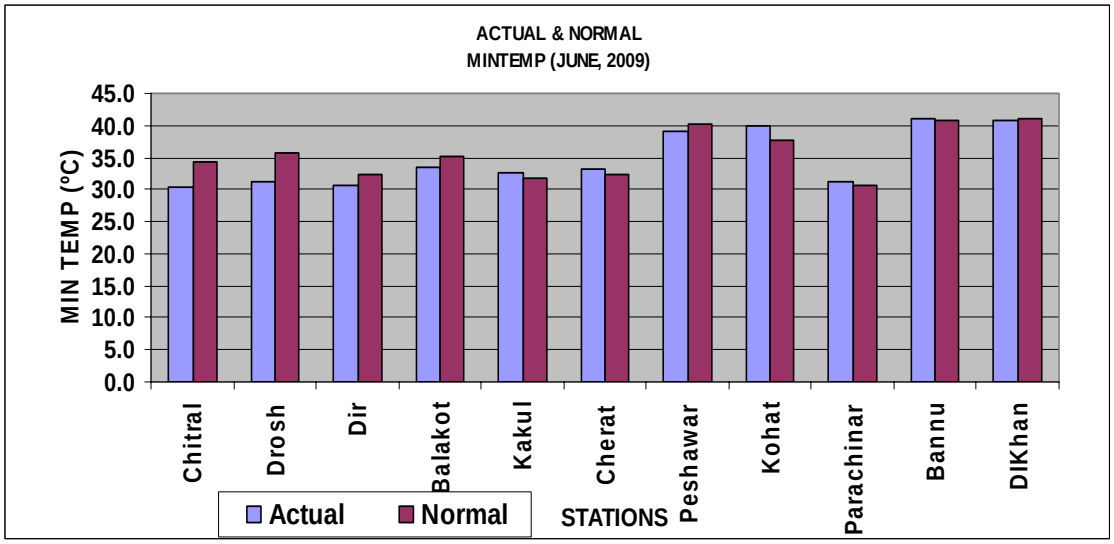

Figure 13

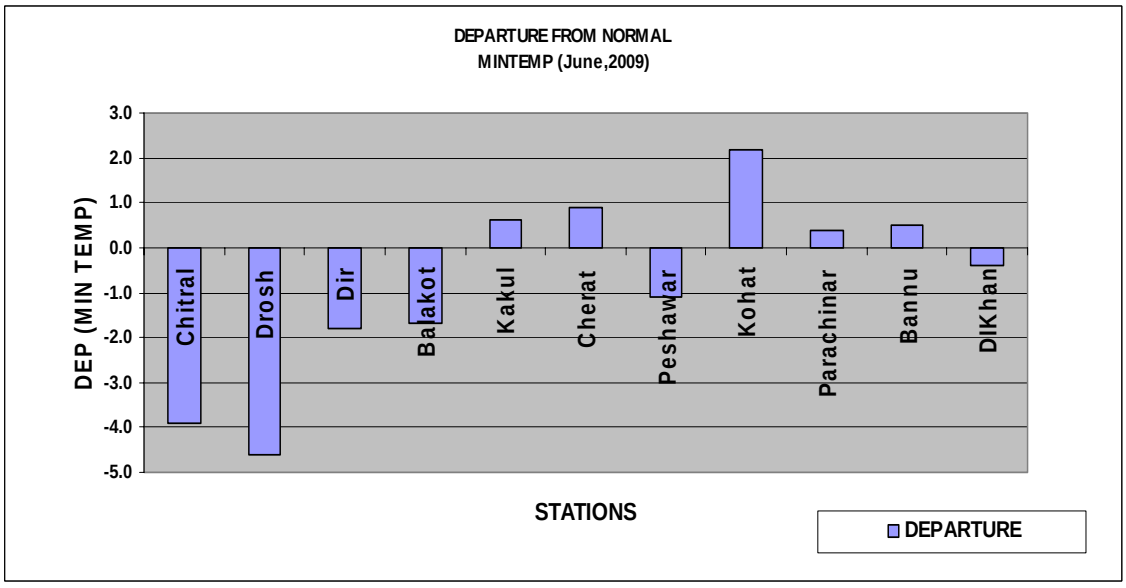

Figure 14

Seasonal Minimum Temperature (April-June, 2009):

During the season, minimum temperature remained normal at eleven stations (Chitral, Drosh, Dir, Balakot, Cherat, Peshawar, Kohat, Parachinar, Bannu and D.I.Khan) and slightly below normal at one station (Kakul). As a whole, it remained normal almost at all places across the region during the season.

The season's lowest minimum temperature was 3.0° C recorded at Parachinar on 8th April, 2009. Mean monthly minimum temperatures with normal & departures are shown in Figures 15 & 16.

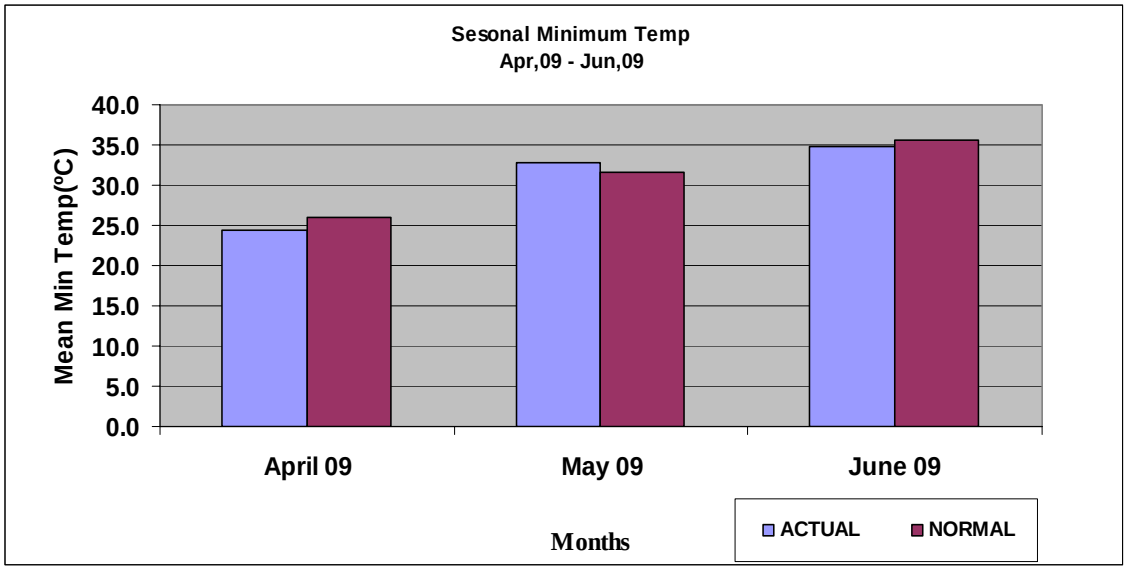

Figure 15

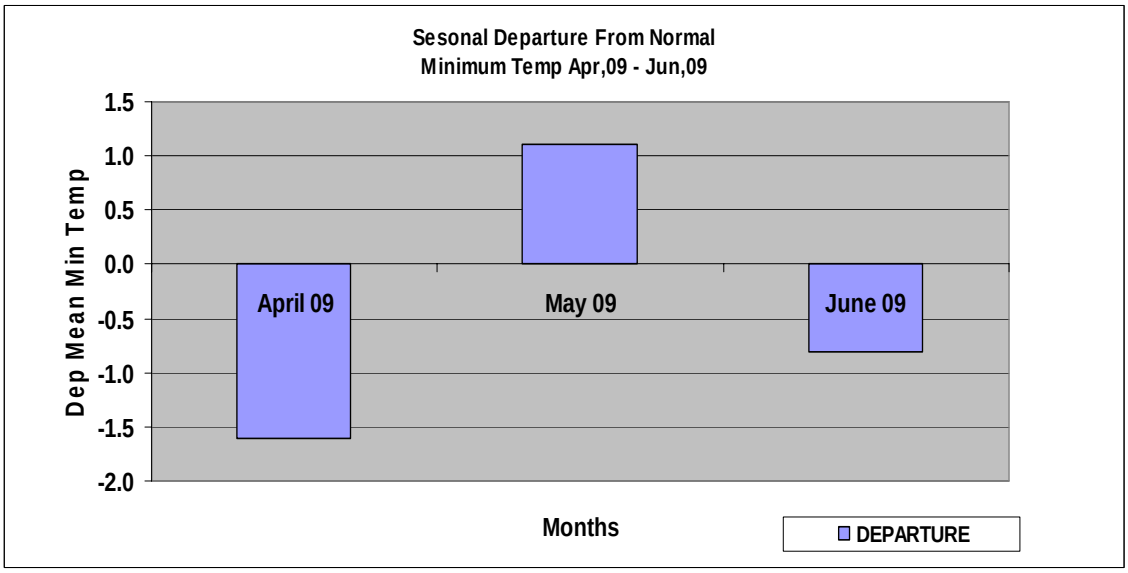

Figure 16

Monthly features of Maximum Temperature Distribution:

April, 09:

During the month, maximum temperature remained slightly above normal at one station (Kohat); normal at four stations (Balakot, Kakul, Cherat and D.I.Khan); slightly below normal at four stations (Chitral, Dir, Peshawar and Bannu); appreciably below normal at two stations (Drosh and Parachinar). As a whole, it remained slightly below normal during the month throughout the region. The month's highest maximum temperature was 38.5° C recorded at Kohat on 30th April, 2009.

Figure 17 shows normal & actual, whereas figure 18 illustrates departures from the normal.

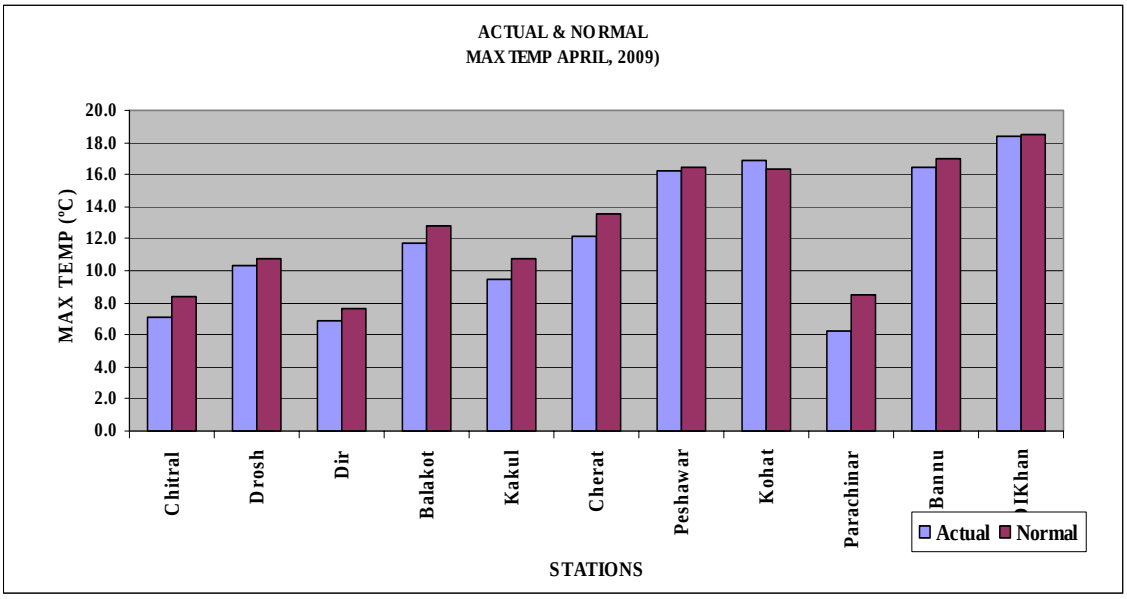

Figure 17

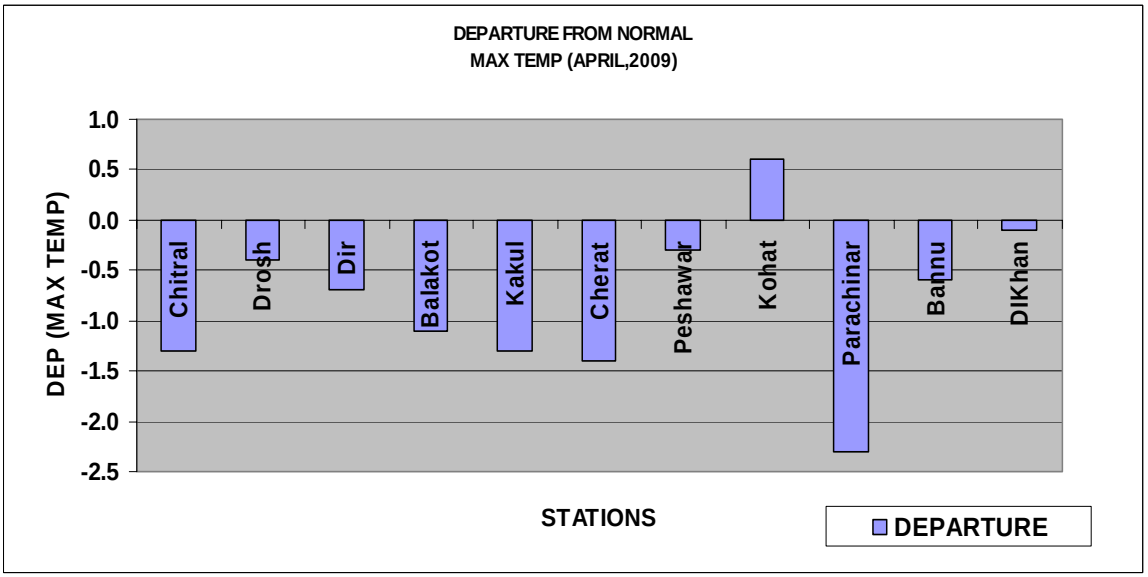

Figure 18

May, 09:

During the month, maximum temperature remained slightly above normal at four stations (Dir, Kakul, Cherat and Kohat); normal at seven stations (Chitral, Drosh, Balakot, Peshawar, Parachinar, Bannu and D.I.Khan). As a whole, it remained normal in the area during the month. The month's highest maximum temperature was 44.5 °C recorded at D.I.Khan on 18th May, 2009.

Figure 19 shows normal & actual, whereas figure 20 illustrates departures from the normal.

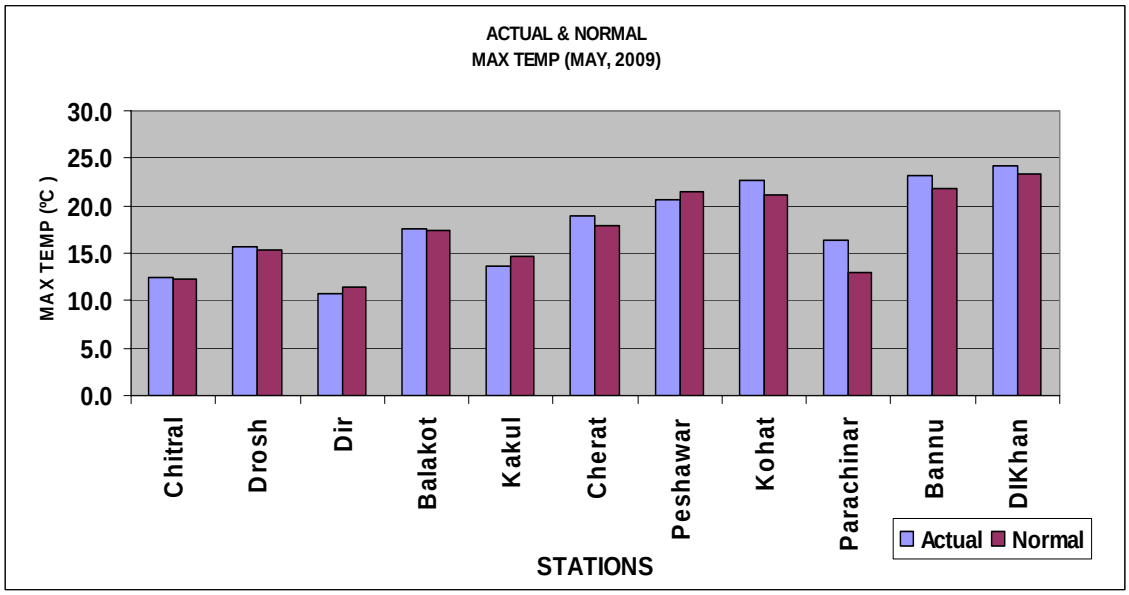

Figure 19

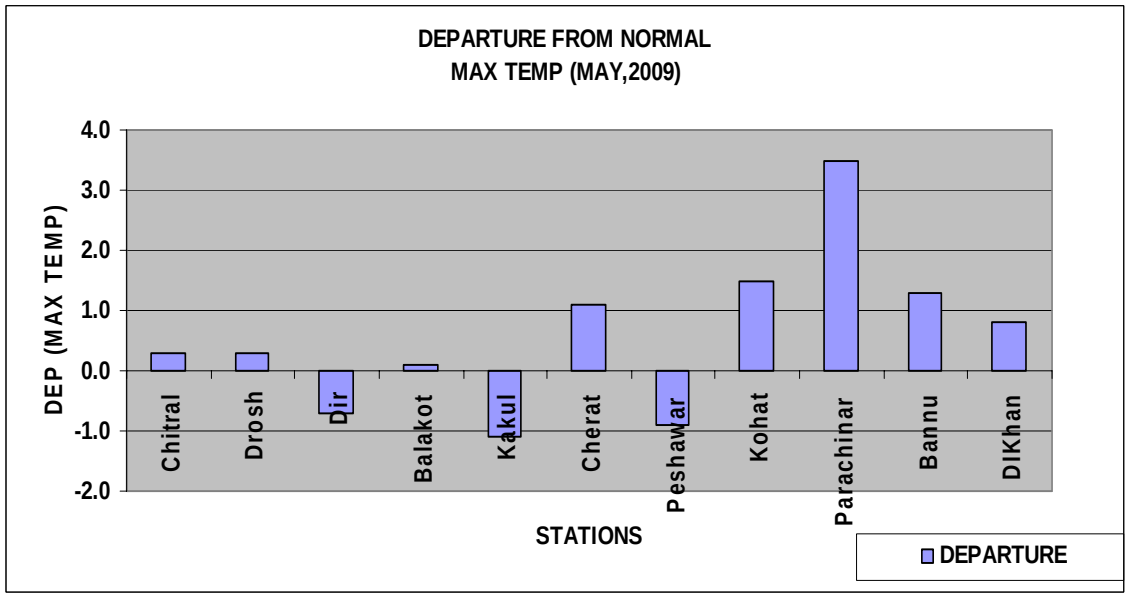

Figure 20

June, 09:

During the month, maximum temperature remained slightly above normal at one station (Kohat); normal at six stations (Kakul, Cherat, Peshawar, Parachinar, Bannu and D.I.Khan); slightly below normal at two stations (Dir and Balakot) and appreciably below normal at two stations (Chitral and Drosh). As a whole, it remained normal throughout the region during the month. The month's highest maximum temperature was recorded 47.5 °C at Kohat on 27th June, 2009.

Figure 21 shows normal & actual, whereas figure 22 illustrates departures from the normal.

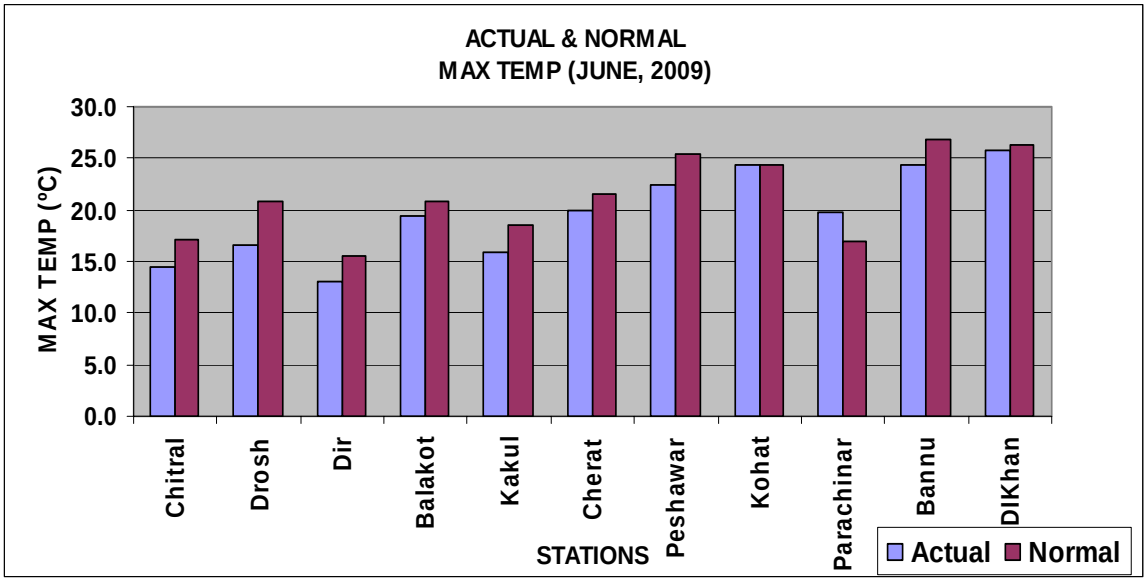

Figure 21

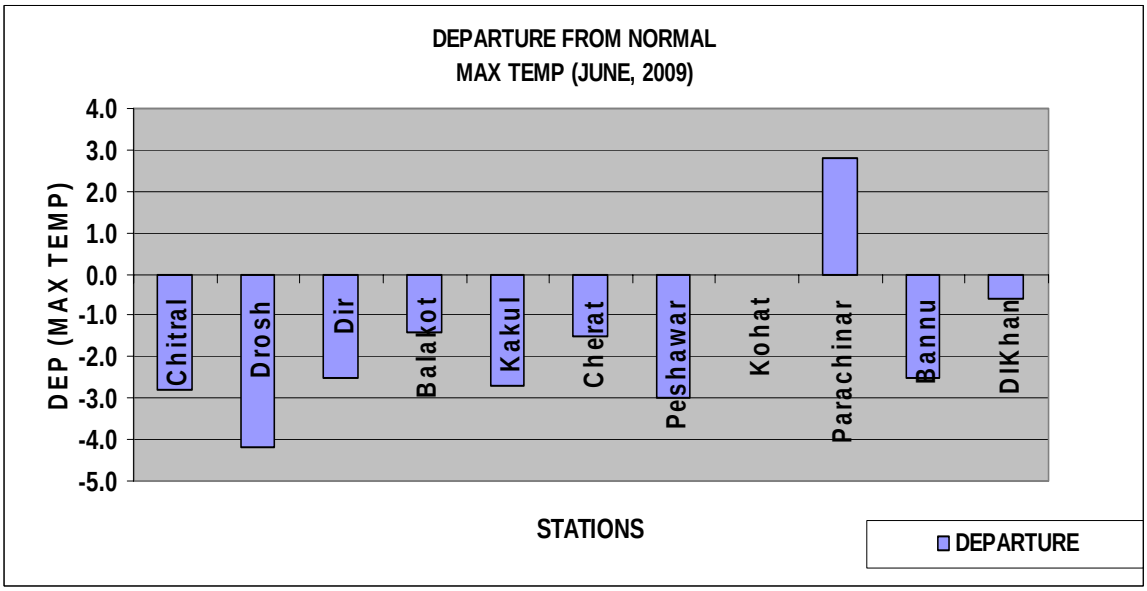

Figure 22

Seasonal Maximum Temperature (April-June, 2009):

During the season, maximum temperature remained slightly above normal at one station (Kohat); normal at seven stations (Dir, Balakot, Kakul, Cherat, Peshawar, Parachinar, Bannu and D.I.Khan) and slightly below normal at two stations (Chitral and Drosh). As a whole, it remained normal across the region during the month.

The season's highest maximum temperature was 47.5 °C recorded at Kohat on 27th June, 2009. Mean monthly maximum temperatures with normal & departures are shown in Figures 23 & 24.

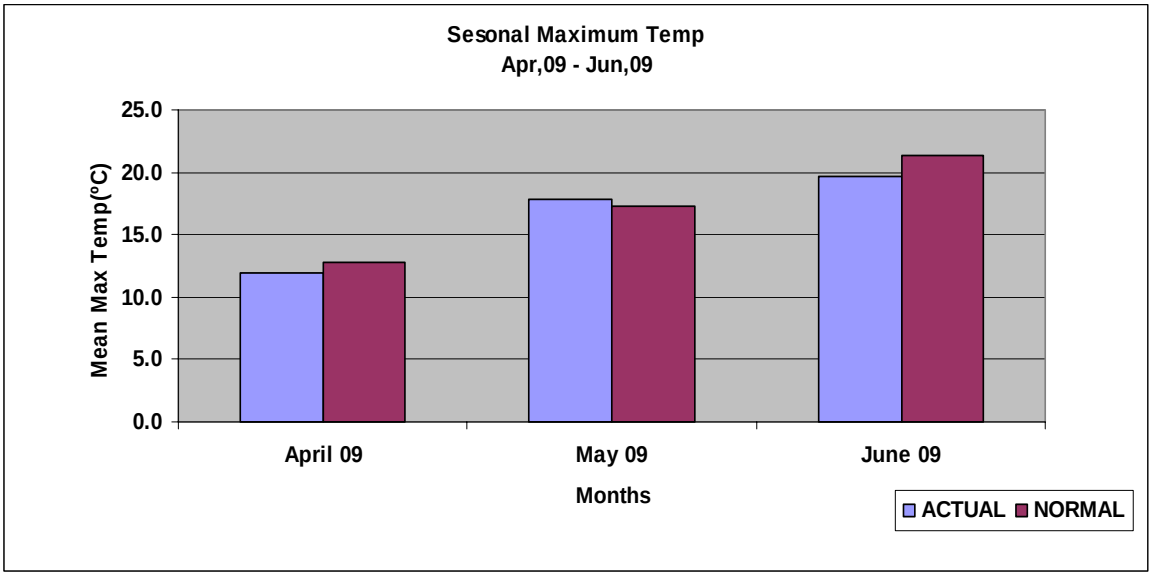

Figure 23

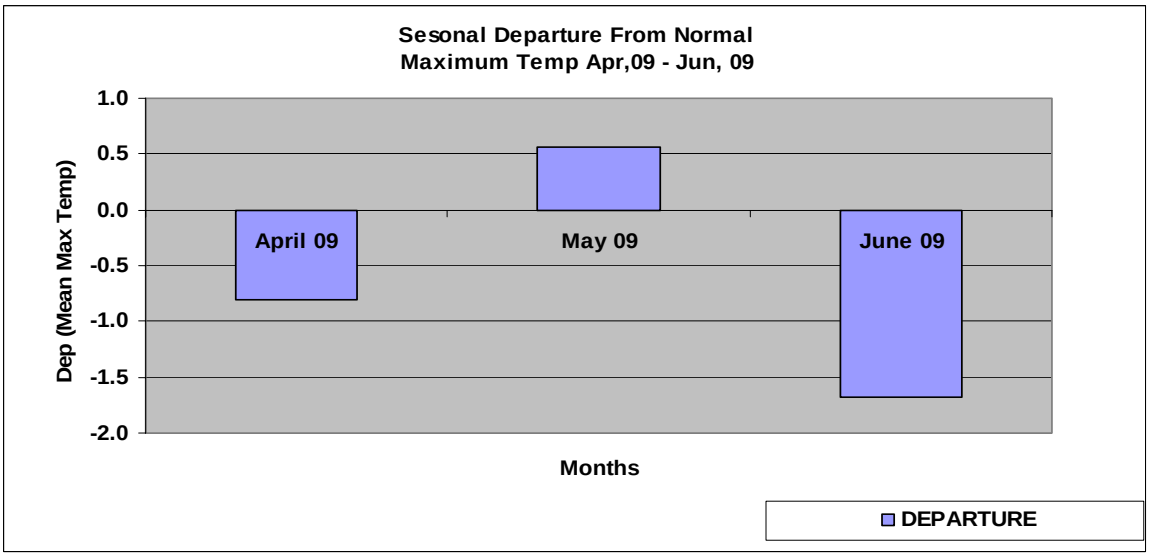

Figure 24

Monthly Features of Mean Temperature Distribution:

April, 09:

During the month, mean temperature remained normal at six observing stations (Balakot, Kakul, Dir, Cherat, Peshawar, and Kohat); slightly below normal at five stations (Chitral, Drosh, Mir Khani, Parachinar and Bannu) and appreciably below normal at one station (D.I.Khan). As a whole, it remained slightly below normal throughout the region during the month. Figure 25 shows normal and actual whereas figure 26 illustrates departures from the normal.

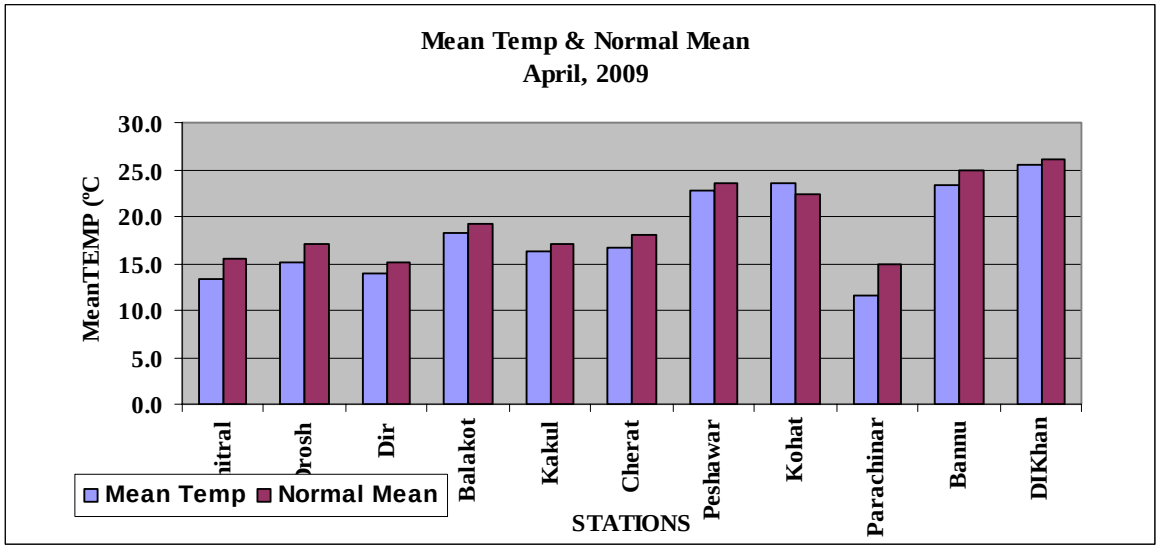

Figure 25

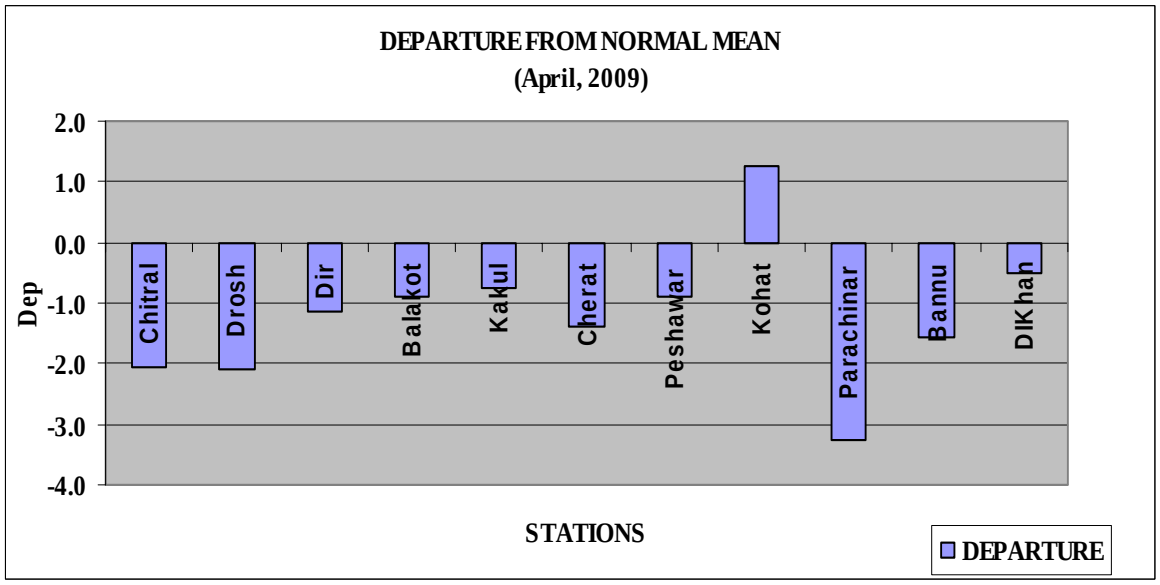

Figure 26

May, 09:

During the month, mean temperature remained slightly above normal at three observing stations (Cherat, Parachinar and Kohat); normal at eight stations (Chitral, Drosh, Dir, Balakot, Kakul, Peshawar, Bannu and D.I.Khan) and slightly below normal at one station (Mir Khani).As a whole, it remained normal throughout the region during the month. Figure 27 shows normal and actual whereas figure 28 illustrates departures from the normal.

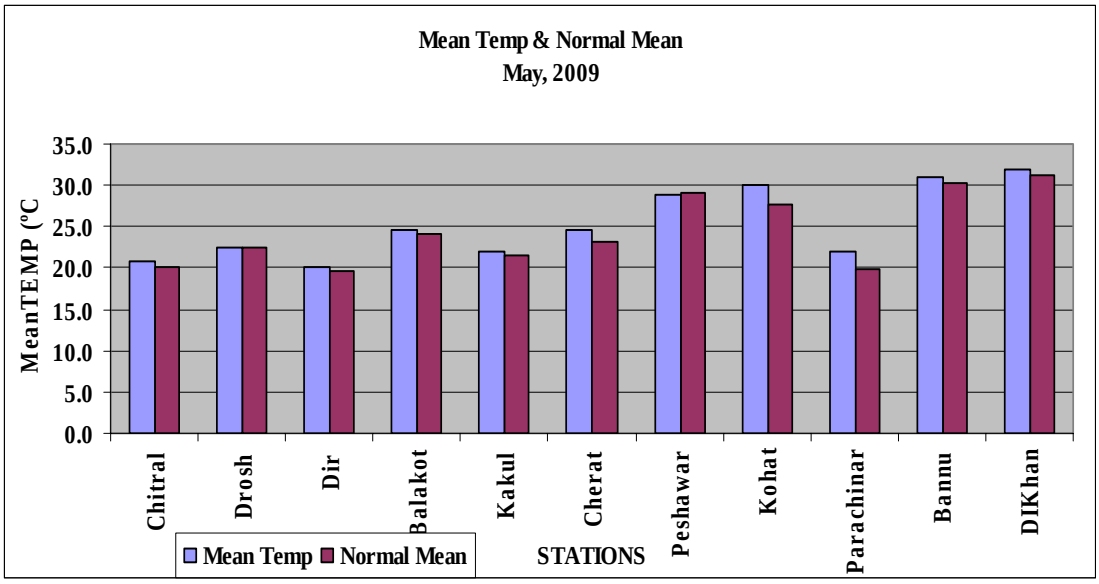

Figure 27

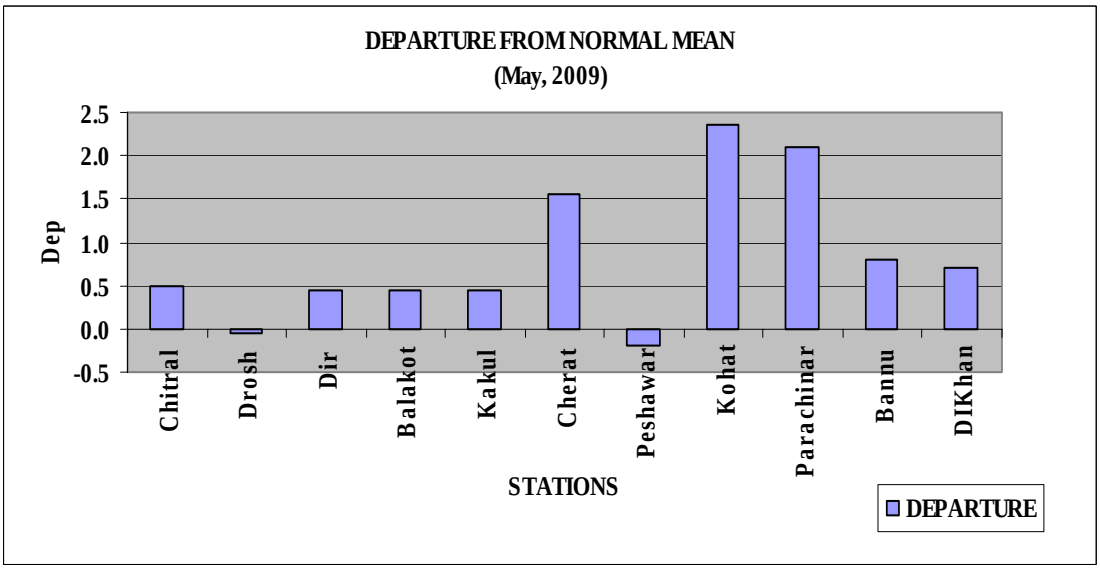

Figure 28

June, 09:

During the month, mean temperature remained slightly above normal at one observing station (Parachinar); normal at five stations (Kakul, Cherat, Kohat, Bannu and D.I.Khan); slightly below normal at five stations (Chitral, Mir Khani, Dir, Balakot and Peshawar) and appreciably below normal at one station (Drosh). As a whole, it remained normal throughout the region during the month. Figure 29 shows normal and actual whereas figure 30 illustrates departures from the normal.

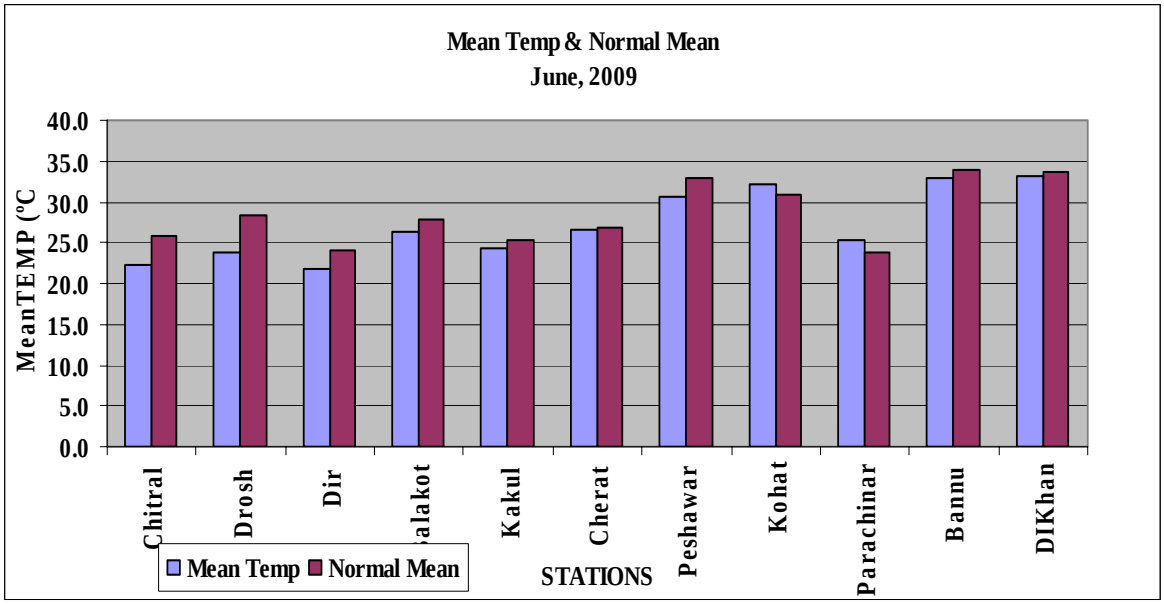

Figure 29

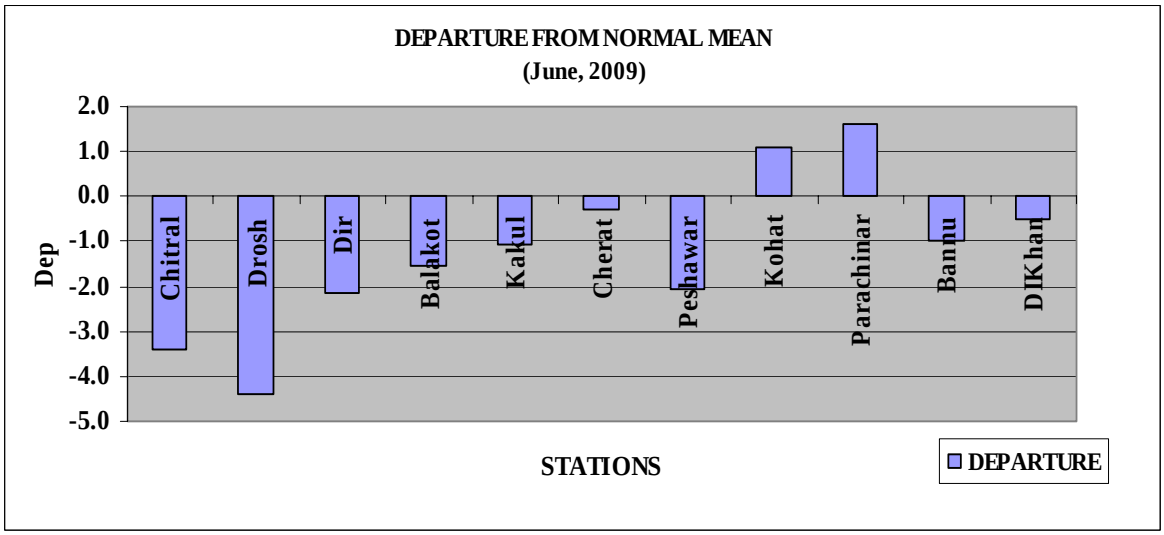

Figure 30

Seasonal Mean Temperature (April-June, 2009):

During the season, mean temperature remained slightly above normal at one station (Kohat); normal at seven observing stations (Dir, Balakot, Kakul, Cherat, Peshawar, Parachinar and Bannu) and slightly below normal at four stations (Chitral, Drosh, Mir Khani and D.I.Khan). As a whole, it remained normal throughout the region during the season. Figure 31 shows normal and actual whereas figure 32 illustrates departures from the normal.

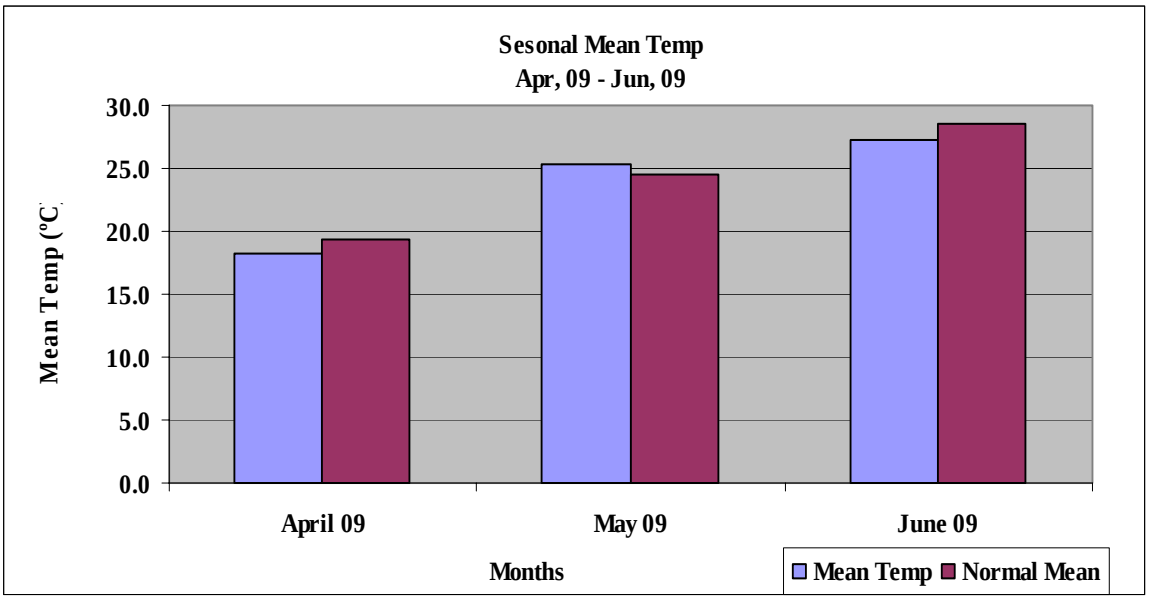

Figure 31

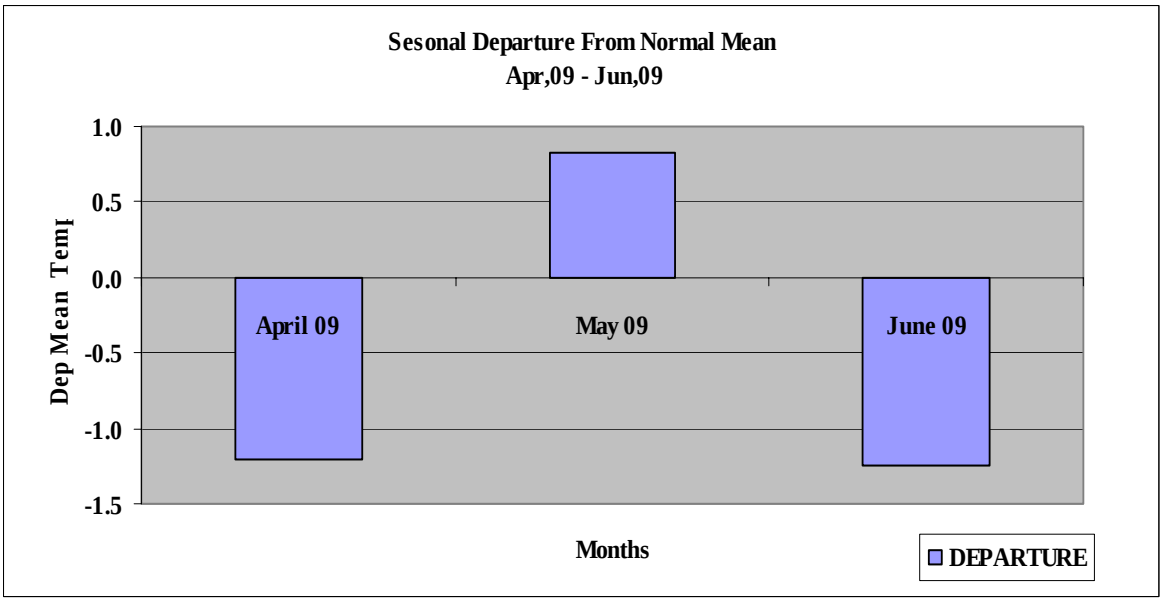

Figure 32

Conclusion

During the month of April, moderate to heavy precipitation occurred in the region causing drop in the mean temperature during the month. As a result the month remained relatively cooler than normal.

Below normal precipitation was received in most parts of the province during the month of May causing no change in the mean temperature and was remained normal across the region.

Variable amount of rainfall was received over the region during the month of June and consequently mean temperature remained normal over most parts of the region.

Consequently, during the pre-monsoon (April-June) 2009 season, NWFP received slightly above normal rainfall and also the mean temperature remained normal during the study period across the region.

Recommendations

Accurate prediction of weather during the pre-monsoon season (April-June) is essential for human activities such as construction, aviation and agriculture. For this purpose, it is recommended that further study is required to correlate the regional weather parameters with that of the global parameters for good prediction of weather.

References:

Lutgens, F.K. and Edward J. Tarbuck, 2004. The Atmosphere, an introduction to Meteorology, Prentice Hall, USA.

Shamshad, K.M., 1988. The Meteorology of Pakistan, Royal Book Company, Karachi,

Pakistan,

Table 1: Station Wise Rain Fall (mm) for each month & Season as a whole (April to June, 2009)

Stations	April, 2009			May, 2009			June, 2009			Season (Apr – Jun)		
	Actual	Normal	Dep %	Actual	Normal	Dep %	Actual	Normal	Dep %	Actual	Normal	Dep %
Chitral	110.3	78.3	40.9	36.4	47.1	-22.7	26.8	9.4	185.1	173.5	134.8	28.7
Drosh	100.3	99.2	1.1	43.8	67.0	-34.6	26.4	19.7	34.0	170.5	185.9	-8.3
Dir	193.0	173.7	11.1	83.0	97.1	-14.5	46.0	50.0	-8.0	322.0	320.8	0.4
Balakot	159.0	119.4	33.2	58.8	79.8	-26.3	81.0	98.3	-17.6	298.8	297.5	0.4
Kakul	206.9	112.6	83.7	34.5	73.8	-53.3	78.9	101.4	-22.2	320.3	287.8	11.3
Cherat	137.5	57.3	140.0	27.0	29.9	-9.7	10.0	19.6	-49.0	174.5	106.8	63.4
Peshawar	96.1	50.4	90.7	42.7	23.8	79.4	2.1	12.1	-82.6	140.9	86.3	63.3
Kohat	76.0	47.9	58.7	23.0	34.1	-32.6	31.0	22.1	40.3	130.0	104.1	24.9
Parachinar	190.0	96.5	96.9	89.1	73.5	21.2	87.7	49.3	77.9	366.8	219.3	67.3
Bannu	78.0	28.3	175.6	10.9	16.5	-33.9	0.6	30.1	-98.0	89.5	74.9	19.5
DIKhan	20.2	24.1	-16.2	3.5	17.0	-79.4	9.0	22.2	-59.5	32.7	63.3	-48.3

Table 2: Station Wise Minimum Temperature (°C) for each month & Season as a whole (April to June, 2009)

Stations	April, 2009			May, 2009			June, 2009			Season (Apr – Jun)		
	Actual	Normal	Dep	Actual	Normal	Dep	Actual	Normal	Dep	Actual	Normal	Dep
Chitral	7.1	8.4	-1.3	12.5	12.2	0.3	14.4	17.2	-2.8	11.3	12.6	-1.3
Drosh	10.3	10.7	-0.4	15.7	15.4	0.3	16.6	20.8	-4.2	14.2	15.6	-1.4
Dir	6.9	7.6	-0.7	10.8	11.5	-0.7	13.0	15.5	-2.5	10.2	11.5	-1.3
Balakot	11.7	12.8	-1.1	17.5	17.4	0.1	19.4	20.8	-1.4	16.2	17.0	-0.8
Kakul	9.5	10.8	-1.3	13.6	14.7	-1.1	15.9	18.6	-2.7	13.0	14.7	-1.7
Cherat	12.2	13.6	-1.4	19.0	17.9	1.1	20.0	21.5	-1.5	17.1	17.7	-0.6
Peshawar	16.2	16.5	-0.3	20.6	21.5	-0.9	22.4	25.4	-3.0	19.7	21.1	-1.4
Kohat	16.9	16.3	0.6	22.6	21.1	1.5	24.4	24.4	0.0	21.3	20.6	0.7
Parachinar	6.2	8.5	-2.3	16.4	12.9	3.5	19.7	16.9	2.8	14.1	12.8	1.3
Bannu	16.4	17.0	-0.6	23.2	21.9	1.3	24.4	26.9	-2.5	21.3	21.9	-0.6
DIKhan	18.4	18.5	-0.1	24.2	23.4	0.8	25.7	26.3	-0.6	22.8	22.7	0.0

Table 3: Station Wise Maximum Temperature (°C) for each month & Season as a whole (April to June, 2009)

Stations	April, 2009			May, 2009			June, 2009			Season		
	Actual	Normal	Dep	Actual	Normal	Dep	Actual	Normal	Dep	Actual	Normal	Dep
Chitral	19.7	22.5	-2.8	28.9	28.2	0.7	30.4	34.3	-3.9	26.3	28.3	-2.0
Drosh	19.8	23.6	-3.8	29.0	29.4	-0.4	31.2	35.8	-4.6	26.7	29.6	-2.9
Dir	20.9	22.5	-1.6	29.4	27.8	1.6	30.6	32.4	-1.8	27.0	27.6	-0.6
Balakot	24.8	25.5	-0.7	31.8	31.0	0.8	33.4	35.1	-1.7	30.0	30.5	-0.5
Kakul	23.2	23.4	-0.2	30.3	28.3	2.0	32.5	31.9	0.6	28.7	27.9	0.8
Cherat	21.0	22.4	-1.4	30.3	28.3	2.0	33.2	32.3	0.9	28.2	27.7	0.5
Peshawar	29.1	30.6	-1.5	37.2	36.6	0.6	39.1	40.2	-1.1	35.1	35.8	-0.7
Kohat	30.3	28.4	1.9	37.3	34.1	3.2	39.8	37.6	2.2	35.8	33.4	2.4
Parachinar	17.1	21.3	-4.2	27.4	26.6	0.8	31.1	30.7	0.4	25.2	26.2	-1.0
Bannu	30.4	32.9	-2.5	38.8	38.5	0.3	41.2	40.7	0.5	36.8	37.4	-0.6
DIKhan	32.6	33.5	-0.9	39.6	39.0	0.6	40.7	41.1	-0.4	37.6	37.9	-0.2

Table 4: Station Wise Mean Temperature (°C) for Each Month (April to June 2009)

Stations	April, 2009			May, 2009			June, 2009			Season		
	Mean	Normal	Dep	Mean	Normal	Dep	Mean	Normal	Dep	Mean	Normal	Dep
Chitral	13.4	15.5	-2.1	20.7	20.2	0.5	22.4	25.8	-3.4	18.8	20.5	-1.7
Drosh	15.1	17.2	-2.1	22.4	22.4	0.0	23.9	28.3	-4.4	20.4	22.6	-2.2
Dir	13.9	15.1	-1.2	20.1	19.7	0.5	21.8	24.0	-2.2	18.6	19.6	-1.0
Balakot	18.3	19.2	-0.9	24.7	24.2	0.4	26.4	28.0	-1.6	23.1	23.8	-0.7
Kakul	16.4	17.1	-0.8	22.0	21.5	0.4	24.2	25.3	-1.1	20.8	21.3	-0.5
Cherat	16.6	18.0	-1.4	24.7	23.1	1.6	26.6	26.9	-0.3	22.6	22.7	-0.1
Peshawar	22.7	23.6	-0.9	28.9	29.1	-0.2	30.8	32.8	-2.1	27.4	28.5	-1.1
Kohat	23.6	22.4	1.3	30.0	27.6	2.4	32.1	31.0	1.1	28.6	27.0	1.6
Parachinar	11.7	14.9	-3.3	21.9	19.8	2.1	25.4	23.8	1.6	19.7	19.5	0.1
Bannu	23.4	25.0	-1.6	31.0	30.2	0.8	32.8	33.8	-1.0	29.1	29.7	-0.6
DIKhan	25.5	26.0	-0.5	31.9	31.2	0.7	33.2	33.7	-0.5	30.2	30.3	-0.1