Monthly Weather Report

February 2019

Director General

Pakistan Meteorological Department

Prepared by: National Weather Forecasting Center
Islamabad

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SUMMARY

1. In February 2019 area weighted rainfall of the country remained above normal +61%.
2. On regional basis rainfall was above normal in Khyber Pakhtunkhwa +22%, Punjab +92%, Azad Jammu and Kashmir +54%, Sindh +201%, Gilgit Baltistan +133% and Balochistan +48%.
3. Highest accumulated precipitation during the whole month was recorded in Malamjaba, Khyber Pakhtunkhwa (250 mm).
4. Highest amount of rainfall during 24 hours was recoded in Narowal, Punjab (85 mm).
5. On all Pakistan basis near normal average minimum temperatures were recorded.
6. Lowest minimum temperature was recorded in Kalam (-14℃).
7. Foggy conditions were more prolonged in southeastern and central parts of Punjab.
8. Mountainous areas of Pakistan continued to received good snowfall.

INTRODUCTION

February is the second coldest month in Pakistan with mean minimum temperature varying from -5.1℃ in Astore to 15℃ in Jiwani. Normal area weighted rainfall in February for Pakistan is 25 mm, For Azad Jammu and Kashmir it is 39.0 mm, Gilgit Baltistan 15.5 mm, Khyber Pakhtunkhwa 70.5 mm, Sindh 5.3 mm, Punjab 23.2 mm and Balochistan 18.8 mm. In February 2019 area weighted rainfall of Pakistan remained above normal +61%. In this month lowest minimum temperature was recorded in Kalam (-14℃), while highest minimum temperature was recorded in Karachi (21℃). Highest accumulated precipitation during the whole month was recorded in Malamjaba, Khyber Pakhtunkhwa (250 mm). While highest amount of rainfall during 24 hours was recoded in Narowal, Punjab (85 mm). Bahawalpur, Jhang, Kasur, Kot Addu, Gujranwala, Gujrat and Toba Tek Singh in Punjab, Larkana, Padidan and Mohenjo-Daro in Sindh all recorded highest amount of rainfall in 24 hours, more than ever before.

Four rainy spells entered Pakistan during this month. Their detail is appended below.

FIRST SPELL

First rainfall spell of February produced rainfall from 5th to 9th February. Synoptic situation during these days as obtained by NCEP/NCAR reanalysis dataset (Kalnay 1996) is shown in figure 1. Strong anticyclonic circulation is seen gripping most parts of the country on 6th and 7th. This is accompanied by strong south westerly flow at 850 hPa. Thus, enabling abundance of moisture supply to upper and central parts of the country. This spell produced rainfall in parts of Balochistan, Punjab, Khyber Pakhtunkhwa Gilgit Baltistan and Kashmir. Sindh remained mostly dry, except for Jacobabad. This weather system became less intense on 9th February.

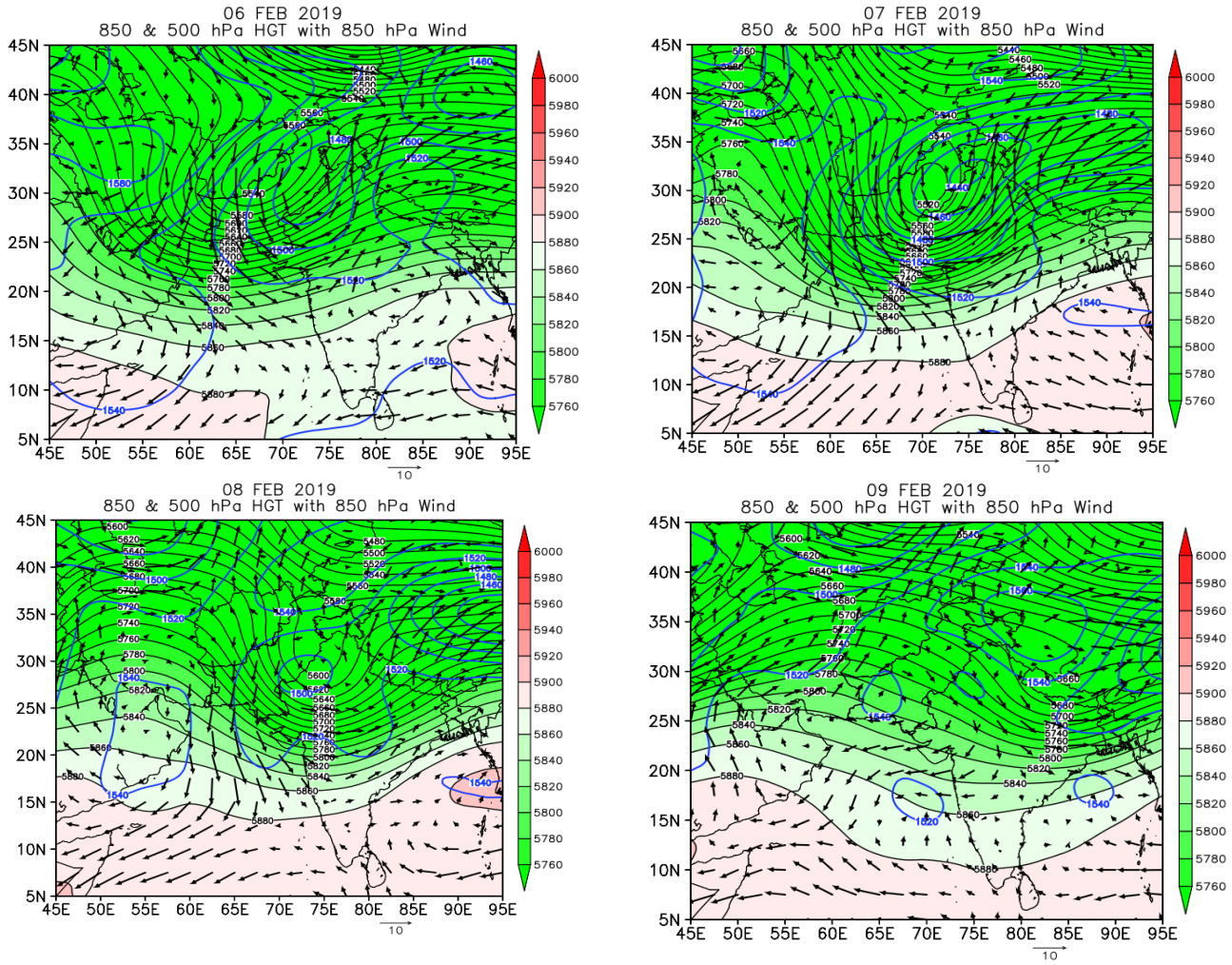

Figure 1 Synoptic situation on 6th to 9th February 2019. Shaded portion represents the geopotential height pattern at 500 hPa, solid line represents the geopotential height pattern at 850 hPa, while arrows indicate 850 hPa winds.

Rainfall distribution during the first spell is shown in figure 2. This spell produced rainfall in parts of Balochistan, Punjab, Khyber Pakhtunkhwa Gilgit Baltistan and Kashmir. Sindh remained mostly dry, except for Jacobabad. This weather system became less intense on 9th February. Maximum rainfall of 48 mm was reported from Jhelum, on 8th February at 0300 UTC during 24 hours.

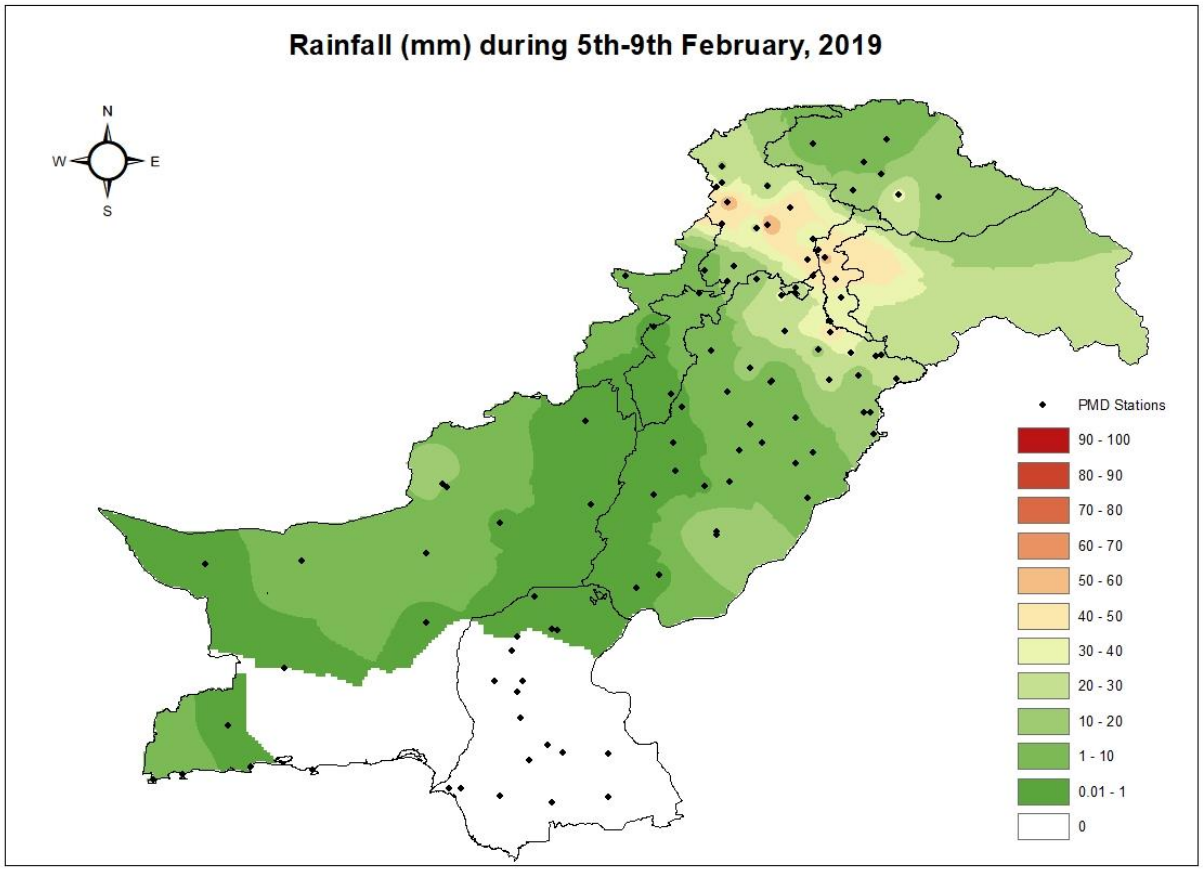

Figure 2 Rainfall (mm) distribution during 5th to 9th February 2019.

SECOND SPELL

Second wet spell of the month was from 13th to 15th February. The synoptic situation in these days is shown in figure 3. During this period a westerly wave is seen affecting upper and central parts of the country a closed circulation is also present on the eastern parts of the country at 850 hPa. On 14th February winds at 850 hPa became predominantly south westerly converging in upper parts of the country. Due to this rainfall occurred in most of upper and western parts of the country.

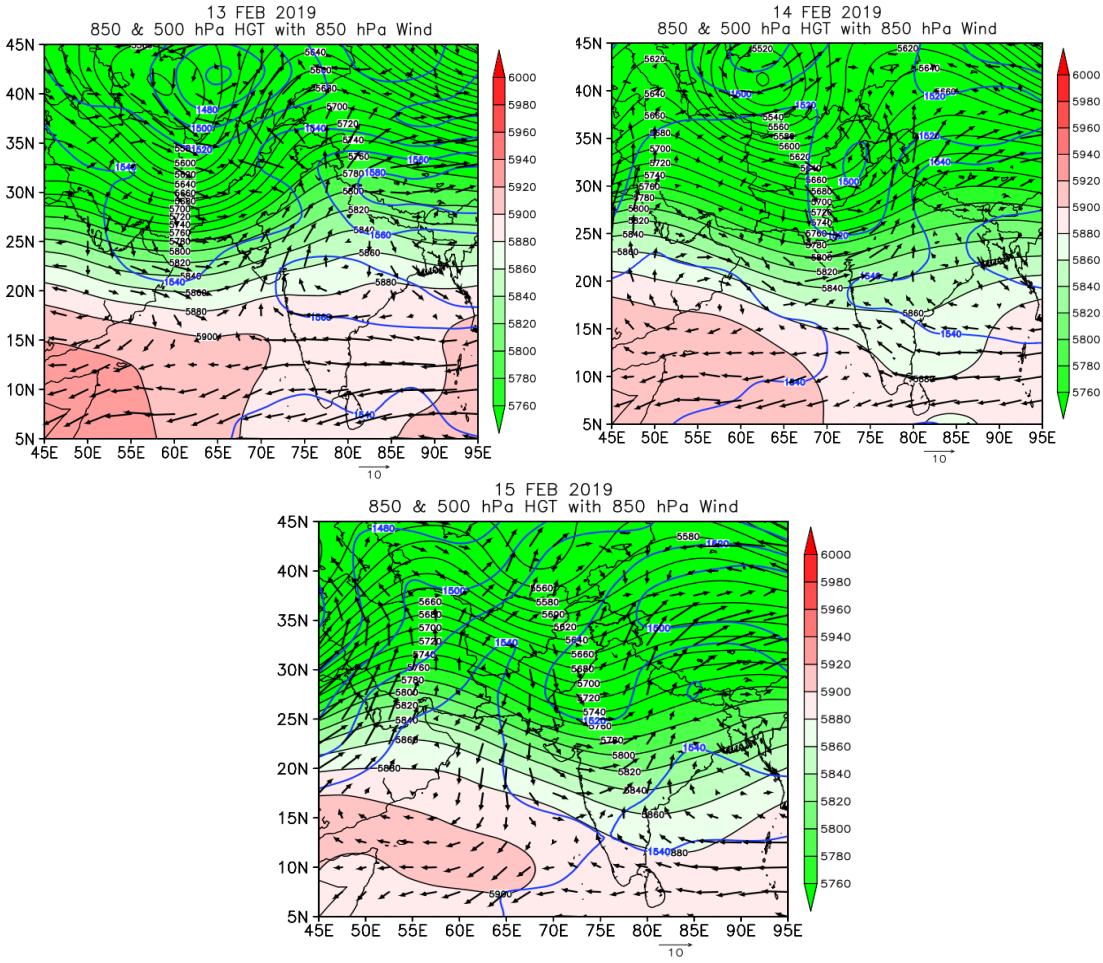

Figure 3 Synoptic situation from 13th to 15th February 2019. Shaded portion represents the geopotential height pattern at 500 hPa, solid line represents the geopotential height pattern at 850 hPa, while arrows indicate 850 hPa winds.

Spatial distribution of rainfall from 13th to 15th February is shown in figure 4. It shows parts of southern Sindh and some parts of south Punjab remained dry while rest of the country received

precipitation. Heavy rain was reported from northwestern parts of the country. Dir reported maximum precipitation of 49 mm on 14th February at 0300 UTC during 24 hours.

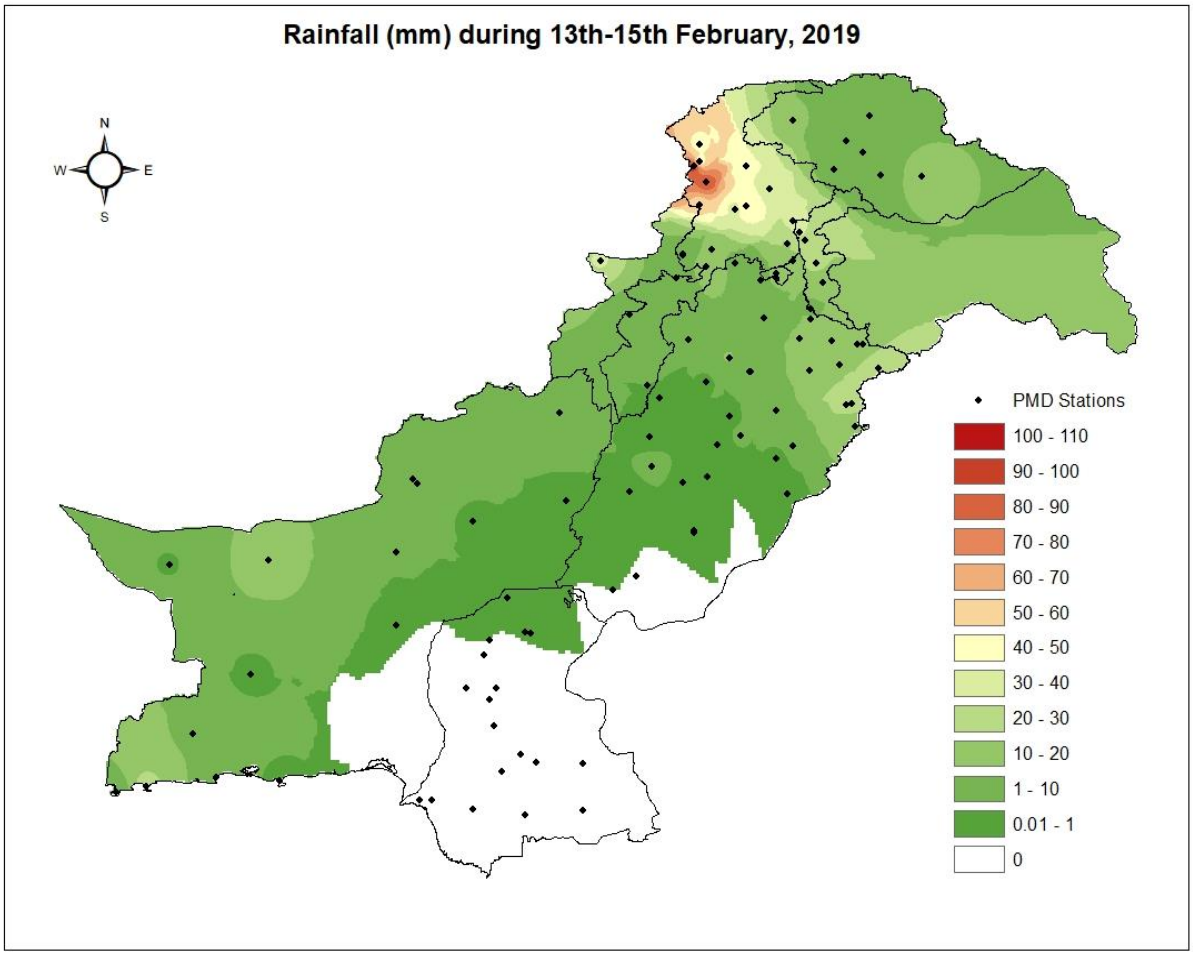

Figure 4 Rainfall (mm) distribution during 13th to 15th February 2019.

THIRD SPELL

Third wet spell of February was from 18th to 22nd. The synoptic situation during these days is shown in figure 5. On 19th most of the western parts of the country were under the influence of this westerly wave. On 20 and 21st it gripped most parts of the country. Closed circulation and strong southwesterly flow can be seen on 21st February. On 22nd this weather system started to weaken as cold dry air from north started penetrating most parts of the country. It was strongest of all the four weather systems that entered Pakistan. It persisted for almost five days giving wide spread rains in most parts of the country.

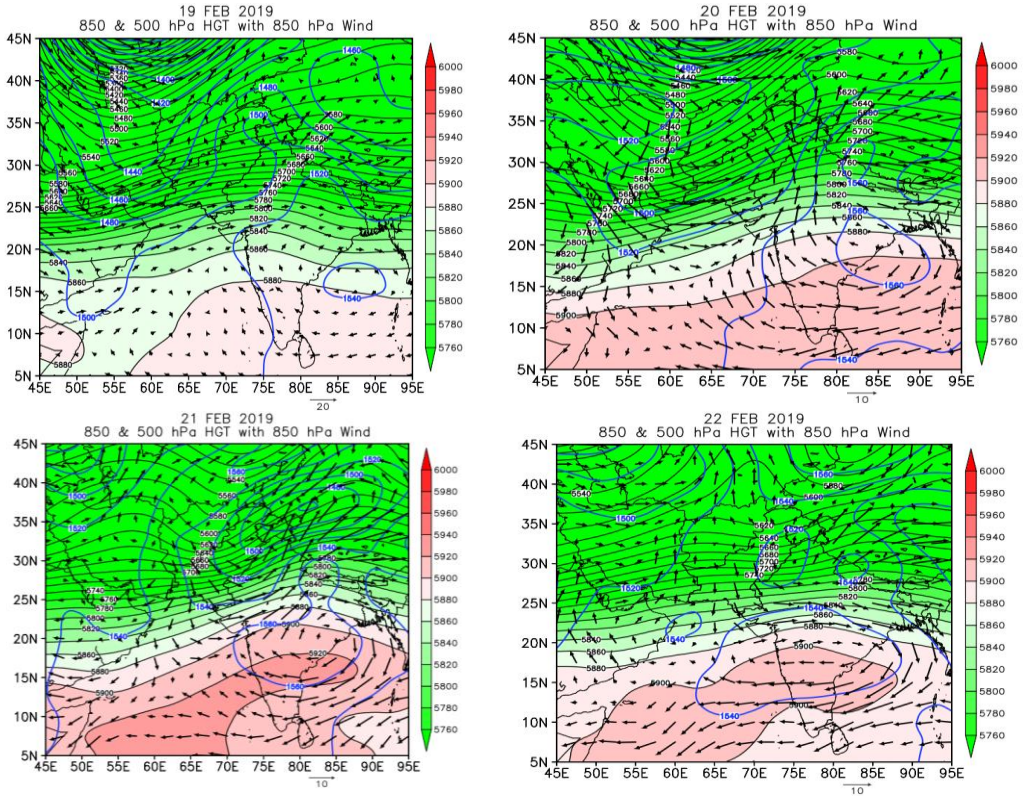

Figure 5 Synoptic situation from 18th to 22nd February 2019. Shaded portion represents the geopotential height pattern at 500 hPa, solid line represents the geopotential height pattern at 850 hPa, while arrows indicate 850 hPa winds.

Figure 6 represents the spatial distribution of rainfall during the spell. In this spell maximum rainfall of 85 mm was reported, from Narowal at 03000 UTC during 24 hours. Parts of Sindh and Balochistan also received abundant amount of rainfall. While upper parts received most of the rainfall.

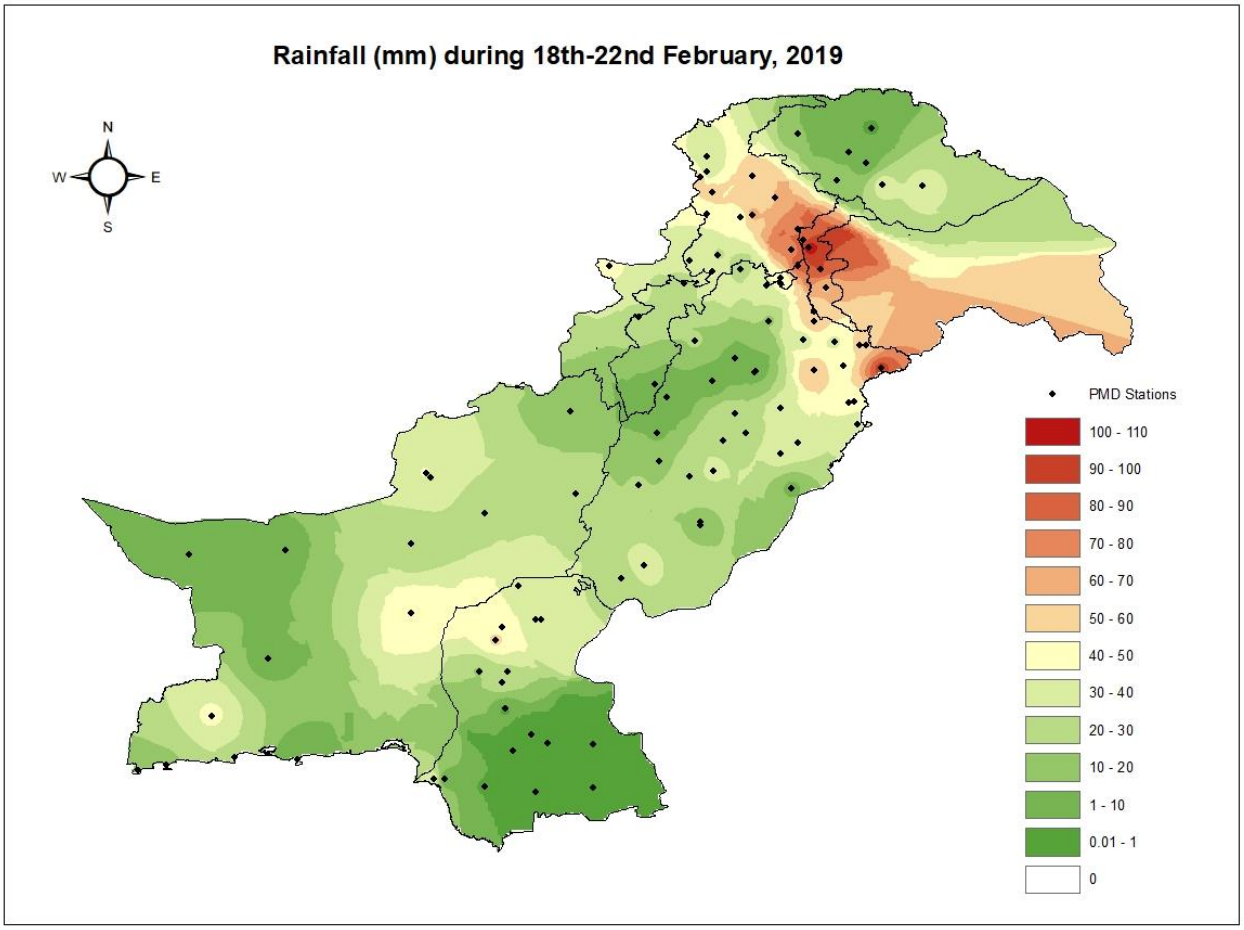

Figure 6 Rainfall (mm) distribution during 18th to 22nd February 2019.

FOURTH SPELL

Fourth and final wet spell was on 26th and 27th February. The synoptic situation in these days is shown in figure 7. It indicates that most parts of the country remained in the grip of a westerly wave during the two days. Closed cyclonic circulation is present at 850 hPa on 26th February. This weather system gradually weakened on 27th. Spatial distribution of rainfall during the spell is shown in figure 8.

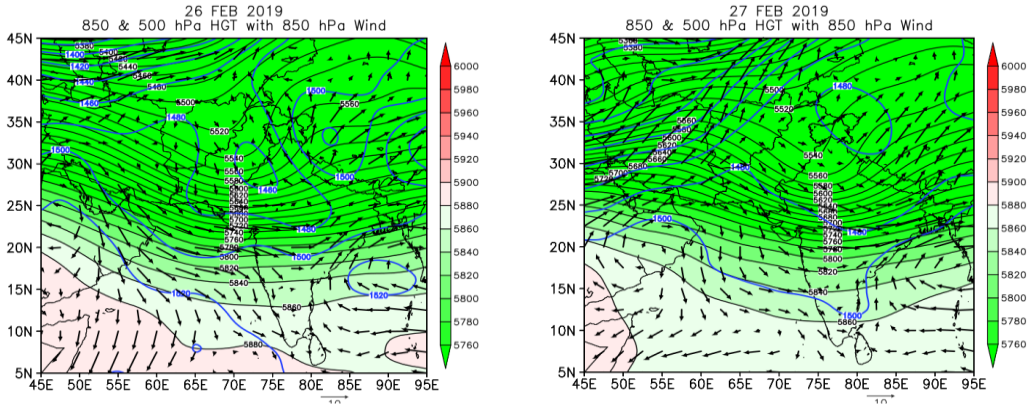

Figure 7 Synoptic situation on 26th and 27th February 2019. Shaded portion represents the geopotential height pattern at 500 hPa, solid line represents the geopotential height pattern at 850 hPa, while arrows indicate 850 hPa winds.

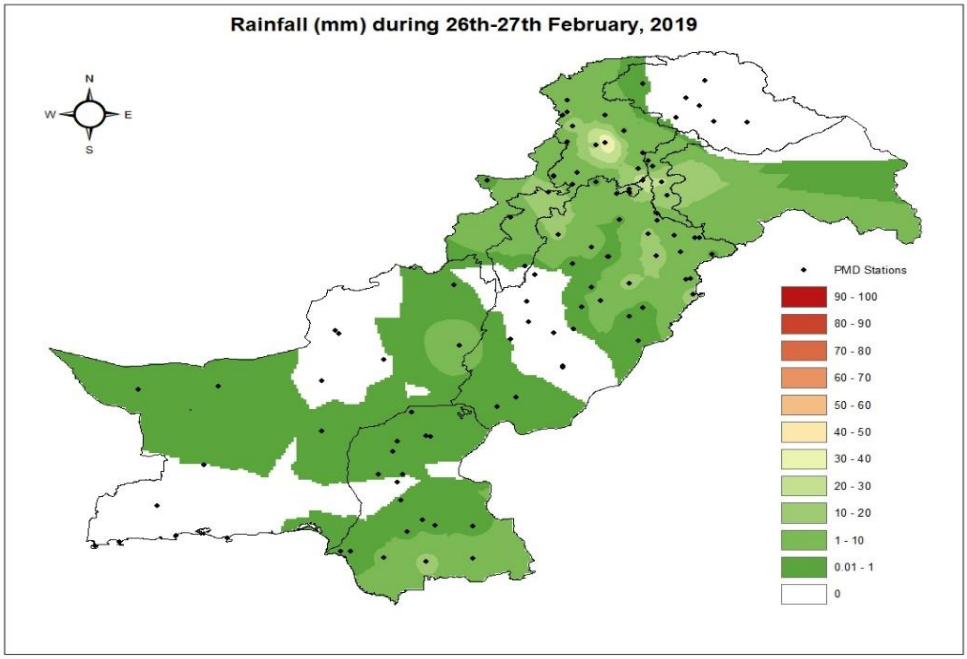

Figure 8 Rainfall (mm) distribution during 26th and 27th February 2019.

ACCUMULATIVE RAINFALL

In February country as a whole received widespread rainfall as represented in figure 11. The center of maximum rainfall is near Malamjaba, Khyber Pakhtunkhwa. Upper and northeastern parts of the country received good rainfall. Details of rainfall are appended in annexure I.

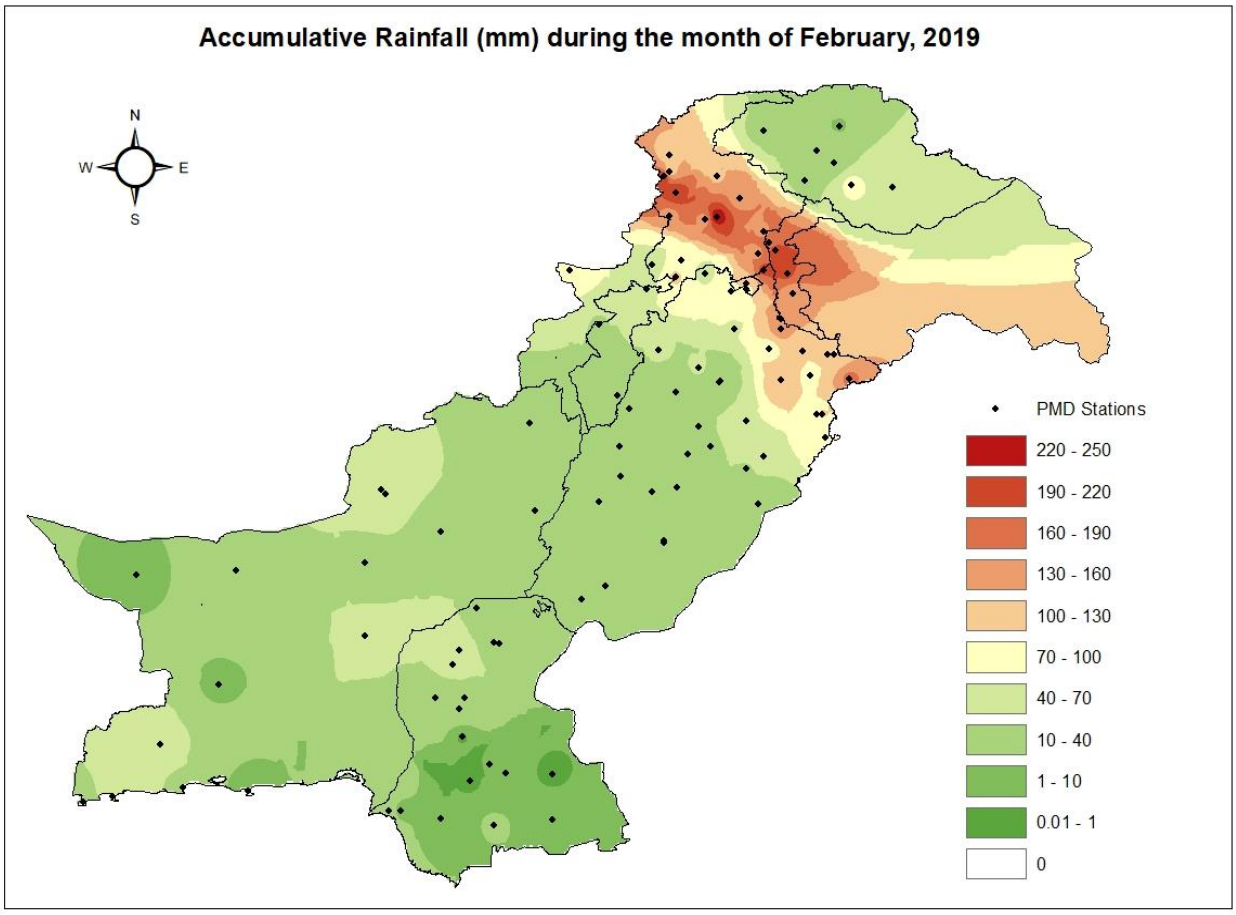

Figure 9 Rainfall (mm) distribution during February 2019.

RAINFALL DEPARTURE

During this month area weighted rainfall of the country remained above normal +61%. On regional basis rainfall was above normal in Khyber Pakhtunkhwa +22%, Punjab +92%, Azad Jammu and Kashmir +54%, Sindh +201%, Gilgit Baltistan +133% and Balochistan +48% (CDPC 2019) represented in figure 12. Above normal rainfalls were also forecasted in the monthly weather outlook for February issued by Pakistan Meteorological Department (PMD 2019). Figure 13 represents the spatial distribution of rainfall departure in the month of February with respect to the base period of 1961-2010. It shows excess rainfall in north eastern parts and in upper Sindh of the country.

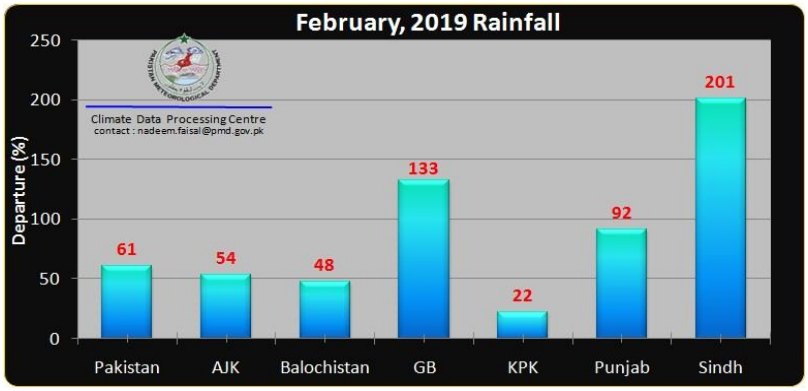

Figure 10 Rainfall departure in February 2019

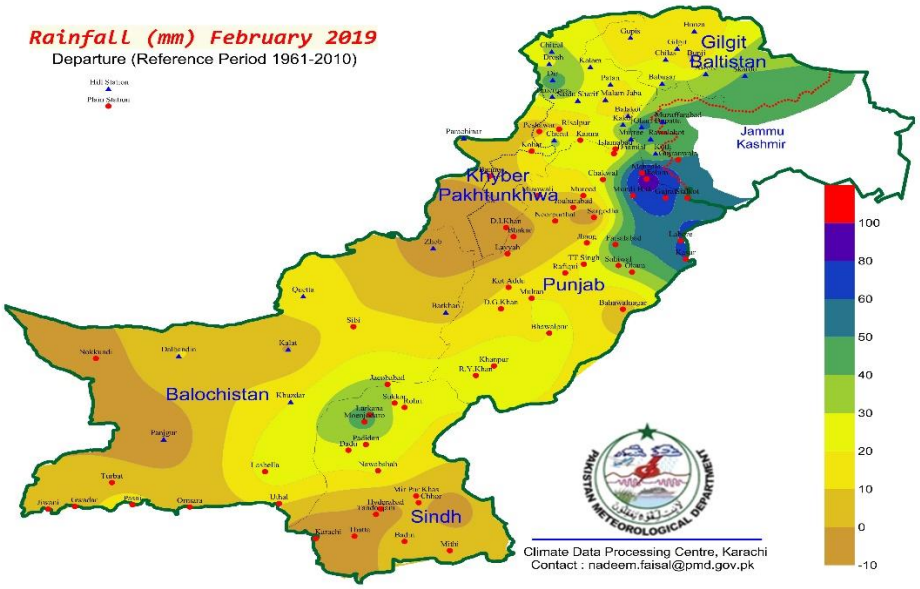

Figure 11 Spatial distribution of rainfall (mm) departure in February 2019

FORECAST VALIDATION

An attempt is made to substantiate the accuracy of precipitation forecasts issued in February. This is done by using the contingency table 1, for each of the rainy spells. This table is used to find out the level of agreement between forecast and actual observation. The difference between forecast and observation is the error. The lower the errors, the greater the accuracy.

Table 1 Forecast verification contingency table

		Observed		
		Yes	**No**	Total
Forecast	**Yes**	Hits	False Alarms	Forecast Yes
	No	Misses	Correct Negatives	Forecast No
Total		Observed Yes	Observed No	Total

Hits means when the precipitation was forecasted and it occurred. *Miss* is used when the precipitation was not forecasted and it occurred. *False alarm* means when the precipitation was forecasted and it did not occur. *Correct negatives* are when the precipitation was not forecasted and also it did not happen. Accuracy of forecast is calculated by using formula in equation 1. Table 2 describes the accuracy in each of the spells

$$Accuracy = Hits + correct\ negatives/Total \quad (1)$$

Table 2 Percentage accuracy of each spell

Rainfall spells	**Percentage accuracy**
First Spell	90
Second Spell	94
Third Spell	88
Fourth Spell	91
Average	91

FOG SITUATION

A graph representing number of foggy days during the month of February is shown in figure 14 (FFD 2019). Bahawalpur recorded maximum fifteen foggy days in this month. Fog was more persistent in southeastern and central Punjab as compared to other parts of the country as indicated by figure 15. Some stations from upper Sindh also reported fog during the period.

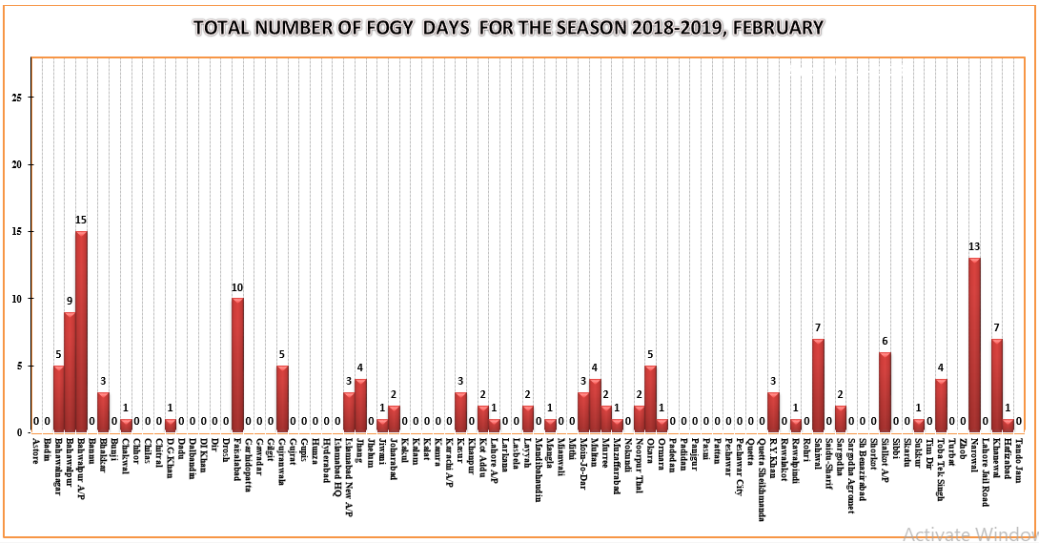

Figure 12 Number of foggy days in February 2019

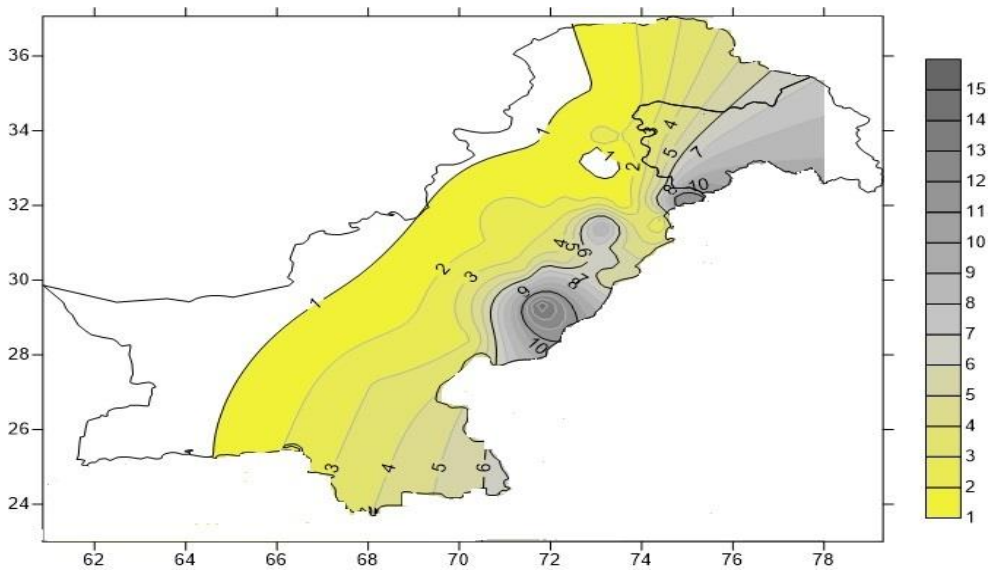

Figure 13 Spatial distribution of number of foggy days

SNOW

In February good snowfall was reported from the mountainous areas of Pakistan. Murree has received eleven feet of accumulated snowfall in January and February. Snowfall in feet of some selected stations during 2004-05 to 2017-20018 and accumulated snow of January and February 2019 is shown in figure 16.

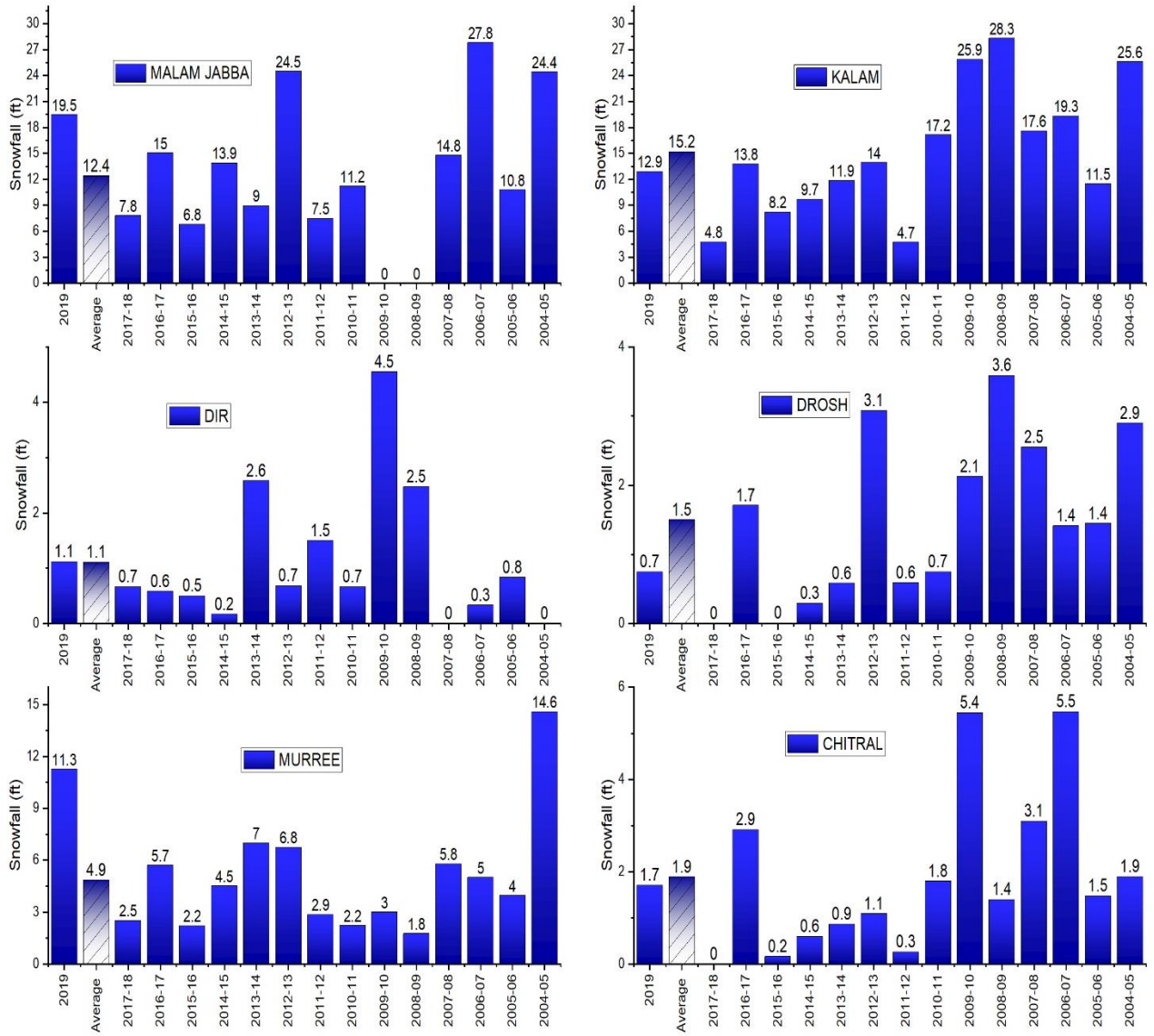

Figure 14 Snowfall (ft) in Jan & Feb 2019 and from 2004-05 to 2017-18

TEMPERATURE

During this month below normal average minimum temperatures were recorded in Gilgit Baltistan, Azad Jammu, Kashmir, Khyber Pakhtunkhwa. While close to normal temperatures were recorded in Punjab, Balochistan and Sindh. Overall average minimum temperatures of the country remained close to normal. Figure 15 represents the comparison of February 2019 and mean minimum temperatures over the country. However mean temperatures of the country remained below normal in most parts of the country. Spatial distribution of anomaly of mean temperature is shown in figure 16

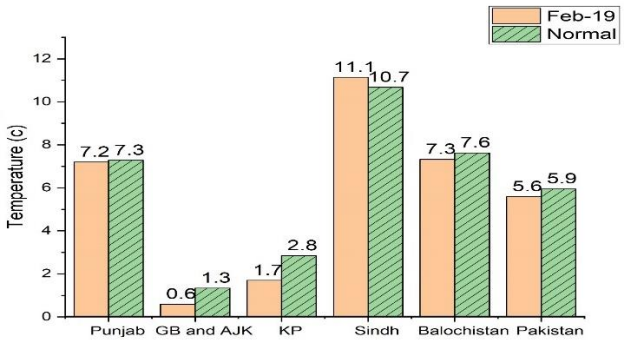

Figure 15 Temperature comparison between normal and February 2019 temperatures.

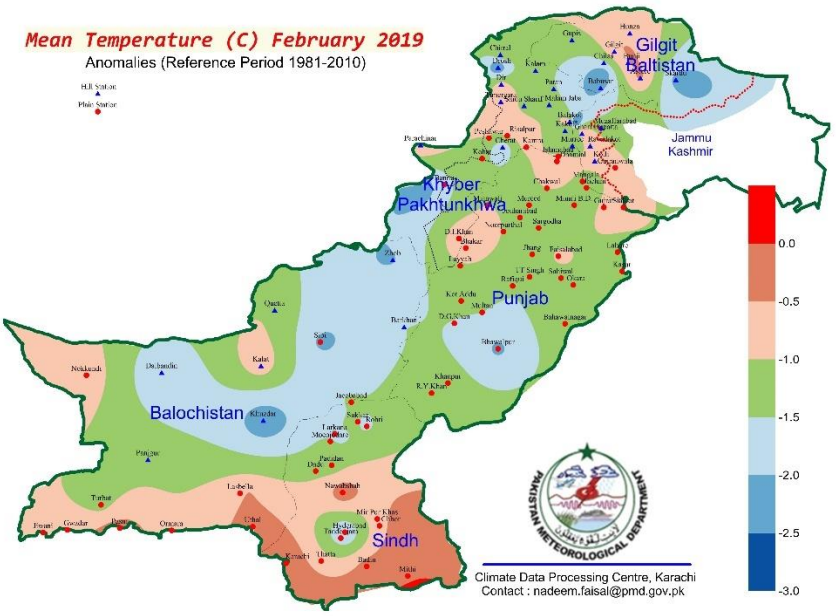

Figure 16 Temperature anomaly in February w.r.t 1981-2010

DROUGHT CONDITION

According to the latest drought analysis at National Drought Monitoring Center of PMD, drought conditions have eased through most parts of the country. However, in some parts of south Balochistan and south eastern Sindh drought like conditions are still persisting. Northern parts of the country have wet conditions. This is indicated in figure 17.

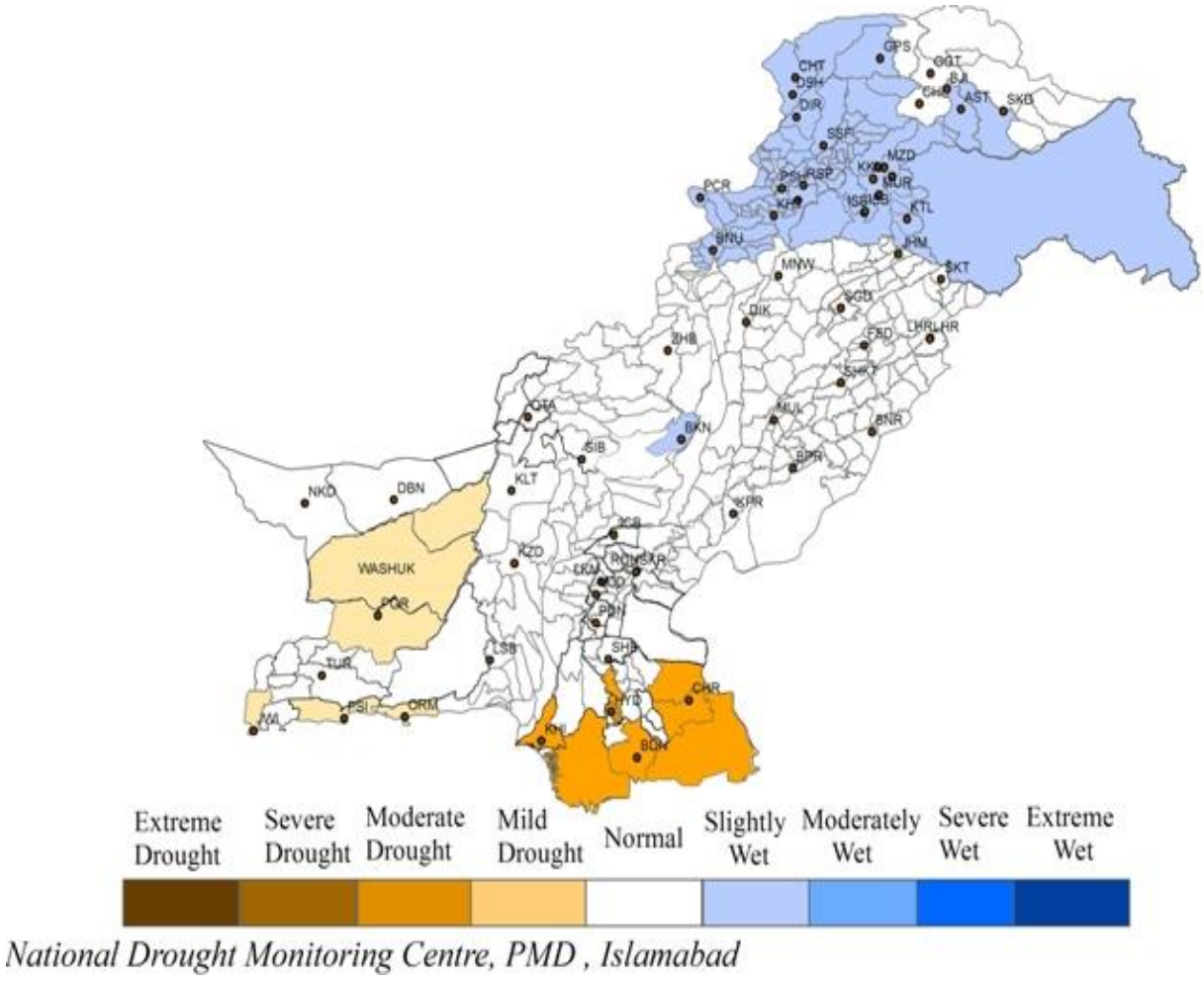

Figure 17 Drought outlook during the month of February.

WEATHER OUTLOOK FOR MARCH

Equatorial sea surface temperatures are above average across most of the Pacific Ocean and shows decreasing trend in coming months. North Atlantic Oscillation is also in positive phase whereas Indian Ocean Dipole is in neutral phase. Based on regional and global forcing factors following would be the main features of the weather during the month:

- Near normal rainfall is expected over the country with slightly above normal over northern half of the country.
- Possibility of hailstorm/thunderstorm cannot be ruled out with weather system.
- Surface temperature will gradually increase during March and are expected to remain 1-2 degree above normal over plain areas of the country. However normal temperatures are expected over mountainous region of the country.

ACKNOWLEDGMENT

This work is the combined effort of all the forecasting team. Special thanks to Mr. Farooq Dar, Ms. Ruqiya Mehmood, Mr. Muhammad Safdar, National Weather Forecasting Center (NWFC), Islamabad. Mr. Nadeem Faisal, Climate Data Processing Center (CDPC), Karachi and Mr. Ibrar Qureshi, Flood Forecasting Division (FFD), Lahore.

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ANNEX I

Accumulative rainfall (mm) in February 2019, and their deviation from the normal rainfall.

Punjab				
S. No	**Stations**	**Total Feb 2019**	**Normal**	**Deviation**
1.	Murree	201.44	166.5	34.9
2.	Narowal	169.71	**	**
3.	Jhelum	151.12	56.7	94.4
4.	Mangla	134.73	**	**
5.	Hafizabad	125.41	**	**
6.	Islamabad, Zeropoint	113.44	89	24.4
7.	Sialkot Airport	110.42	**	**
8.	Lahore, Airport	105.12	39.3	65.8
9.	Gujrat	102.4	**	**
10.	Sialkot Cantt	96.74	49.6	**
11.	Islamabad, Old Airport	93.93	84.1	9.8
12.	Gujranwala	92.81	**	**
13.	Islamabad, New Airport	91.62	**	**
14.	Lahore, City	83.73	35.3	48.4
15.	Mandibahauddin	81.73	**	**
16.	Attock	74.13	102.3	-28.2
17.	Kasur	71.83	**	**
18.	Faisalabad	69.03	19.1	49.9
19.	Chakwal	65.11	**	**
20.	Okara	48.01	**	**
21.	Joharabad	45.3	**	**
22.	Mianwali	44.05	40.2	3.8
23.	Khanewal	40	**	**
24.	Sahiwal	39.23	**	**
25.	Bahawalpur, City	38.01	10	28
26.	T.T. Singh	37.92	**	**
27.	Shorkot	35.04	18.2	16.8
28.	Khanpur	33.8	7.9	25.9
29.	Jhang	33.25	**	**
30.	Multan	32.92	15.5	17.4
31.	Bahawalpur, Airport	30.1	**	**
32.	Rahim Yar Khan	25.81	**	**
33.	D.G. Khan	20.53	**	**
34.	Sargodha, Airport	20.05	29.8	-9.8

35.	Sargodha City	19.64	**	**
36.	Kot Addu	19.41	**	**
37.	Bahawalnagar	16.82	17.3	-0.5
38.	Noorpur Thal	16.81	**	**
39.	Bhakkar	11.31	**	**
40.	Layyah	9.93	**	**
Kashmir and Gilgit Baltistan				
41.	Garidopatta	208.91	147.6	61.3
42.	Rawalakot	195.91	**	**
43.	Muzaffarabad	165.5	145.3	20.2
44.	Kotli	135.2	102.5	32.7
45.	Astore	80.33	45.8	34.5
46.	Skardu	69.76	29.1	40.7
47.	Chilas	43.82	16.3	27.5
48.	Bagrote	38.94	**	**
49.	Gupis	24.8	14.7	10.1
50.	Gilgit	19.13	6.6	12.5
51.	Bunji	16.35	8.7	7.7
52.	Hunza	8.52	**	**
Khyber Pakhtunkhwa				
53.	Malamjabba	250	**	**
54.	Mirkhani	230.2	**	**
55.	Dir	222	176	46
56.	Balakot	155	143.3	11.7
57.	Abbottabad	149.52	104.4	45.1
58.	Lower Dir	147	**	**
59.	Pattan	143	**	**
60.	Saidu Sharif	141.5	120	21.5
61.	Kalam	123	**	**
62.	Cherat	108	72.7	35.3
63.	Chitral	99.2	65.1	34.1
64.	Drosh	96	72.1	23.9
65.	Parachinar	96	83.4	12.6
66.	Risalpur	72.03	68.2	3.8
67.	Kohat	64.04	50.2	13.8
68.	Peshawar Airport	59.31	60.1	-0.8
69.	Peshawar City	57.54	**	**
70.	Bannu	37.61	35.6	2
71.	D.I. Khan	12.03	21	-9

Sindh				
72.	Mohenjo-Daro	53.02	5.8	47.2
73.	Larkana	48.11	5.1	43
74.	Jacobabad	38.01	7.3	30.7
75.	Sukkur	35	7	28
76.	Rohri	30	5.5	24.5
77.	Padidan	29.71	4.3	25.4
78.	Shaheed Benazirabad	25.3	3.3	22
79.	Dadu	19	**	**
80.	Badin	12.01	6.6	5.4
81.	Mithi	6.5	**	**
82.	Mirpur Khas	3	**	**
83.	Tando Jam	2	**	**
84.	Thatta	1.3	**	**
85.	Karachi A/P	0.02	7.4	-7.4
86.	Chhor	0	4.1	-4.1
87.	Hyderabad	0	6.8	-6.8
Quetta				
88.	Quetta, Airport	67.05	53.3	13.8
89.	Turbat	57	22.1	34.9
90.	Gwadar	55.2	**	**
91.	Khuzdar	46	28.2	17.8
92.	Lasbela	40	11.7	28.3
93.	Quetta City	39.82	**	**
94.	Pasni	35.01	18.9	16.1
95.	Kalat	31	37.3	-6.3
96.	Barkhan	27.03	20.7	6.3
97.	Dalbandin	26.81	16.7	10.1
98.	Jiwani	26	27.7	-1.7
99.	Sibbi	25.01	16.7	8.3
100.	Zhob	21	27.3	-6.3
101.	Ormara	13.4	12.9	0.5
102.	Panjgur	6.01	16	-10
103.	Nokkundi	3.51	9.7	-6.2