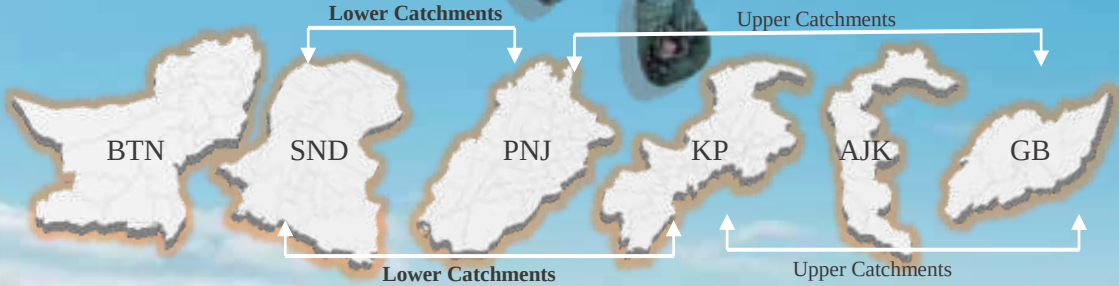
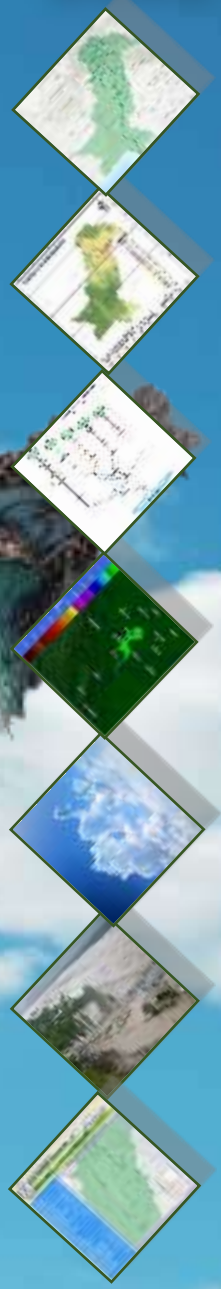




FLOOD REPORT 2022

فلڈ فور کاسٹنگ ڈویژن لاہور



Flood Forecasting Division Lahore

46-Jail Road | Ph: +92-42-99200208 | WhatsApp: +92-42-99200139 | Fax: +92-42-99200209



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List of Acronyms

• AJK	Azad Jammu & Kashmir
• CDPC	Climate Data Processing Centre
• DCO	District Coordination Officer
• FFC	Federal Flood Commission
• FFD	Flood Forecasting Division
• IFAS	Integrated Flood Analysis System
• IRSA	Indus River System Authority
• KPK	Khyber Pakhtunkhwa
• MAF	Million Acre Feet
• NCAR	National Centre for Atmospheric Research
• NCEP	National Centre for Environmental Prediction
• NDMA	National Disaster Management Authority
• PCIW	Pakistan Commissioner for Indus Water
• PDMA	Provincial Disaster Management Authority
• PMD	Pakistan Meteorological Department
• SDMA	State Disaster Management Authority
• WAPDA	Water And Power Development Authority
• XEN	Executive Engineer
• BoB	Bay of Bengal



1 Preface

Floods are quite common in low-lying areas and areas that are near water bodies. Floods mostly happen when rivers overflow due to heavy or incessant rain. Areas that get submerged in water don't have adequate dams built to hold the flowing water. Almost every year, many areas and farming lands go under water. Hundreds of people get affected and either lose their livelihoods or homes during this situation. Flash floods are caused by rapid and excessive rainfall that raises water heights quickly, and rivers, streams, channels or roads may be overtaken while river floods are caused when consistent rain or snow melt forces a river to exceed capacity and Coastal floods are caused by storm surges associated with tropical cyclones and tsunami. Flooding in urban areas is caused by intense and/or prolonged rainfall, which overwhelms the capacity of the drainage system.

Between 80-90% of all documented disasters from natural hazards during have resulted from floods, droughts, tropical cyclones, heat waves and severe storms. Floods are also increasing in frequency and intensity, and the frequency and intensity of extreme precipitation is expected to continue to increase due to climate change. flooding in urban areas is caused by intense and/or prolonged rainfall, which overwhelms the capacity of the drainage system.

Pakistan has unique meteorological causes of the floods. During summer, although monsoon is the dominating weather system, the westerly waves also continue to affect the country. Intensification of the monsoon weather system and northward recurving of the monsoon depressions is predominantly due to the westerly waves. Floods in Pakistan are mainly caused by the heavy monsoon rains during July to September.

During monsoon 2022, no major riverine flood generating rainfall event was observed over the upper catchments of all the major rivers except one spell over the upper catchments of river Kabul which generate the devastating flash flood in the tributaries of river Kabul which further accumulate to more than 300000 cusecs at Nowshera.

The formation of a greater number of low-pressure systems (LPS) in July and August compared to the climatology and their longer westward movements during monsoon and shift of the seasonal low towards west Balochistan and adjoining Iran during 2022, 6 major weather system contributed over the parts of the country. The ongoing disaster demonstrates once again the need for climate change mitigation and adaptation.

Chief Meteorologist
Flood Forecasting Division
Lahore



2 Executive summary

- Quantitatively, the 2022 All Pakistan monsoon seasonal rainfall during 01st July to 30th September 2022 has been 387.2 mm against the Long Period Average (LPA) of 140.9 mm.
- This year monsoon season set on 30th June 2022 over Pakistan, a day earlier of its normal date (1st July) and withdrew during third week of September 2022 however, Significant continuous rainfall occurred from 4th July onwards.
- Pakistan rainfall, for the country as a whole, during the period remained extremely above average (+175%) . On regional scale, the rainfall during the period has also been excessively above average over Sindh (+426%) & Balochistan (+450%), largely above average over Punjab (+70%) & GB (+104%), above average over KP (+33%) and near average over AJK .
- Nine rain-bearing spells occurred during the monsoon season 2022.
- 10 monsoon lows/Depressions developed in the season however 6 of them affected the country.
- The supply of hydro-meteorological data from WAPDA, Punjab, Sindh & Khyber Pakhtunkhwa irrigation departments remained satisfactory.
- All the concerned federal and provincial authorities, the general public, along with print and electronic media were kept in touch with the prevailing weather/flood conditions through phone, fax & other electronic sources.
- The overall accuracy of forecast issued by FFD during the Monsoon Season 2022 was up to the mark.

3 Tracks of Monsoon Lows during Monsoon Season-2022

During the monsoon season 2022 (15th June to 15th October) ten Monsoon Lows/Depressions were developed in the Bay of Bengal. The paths followed by each low/depression are shown in figure 1.

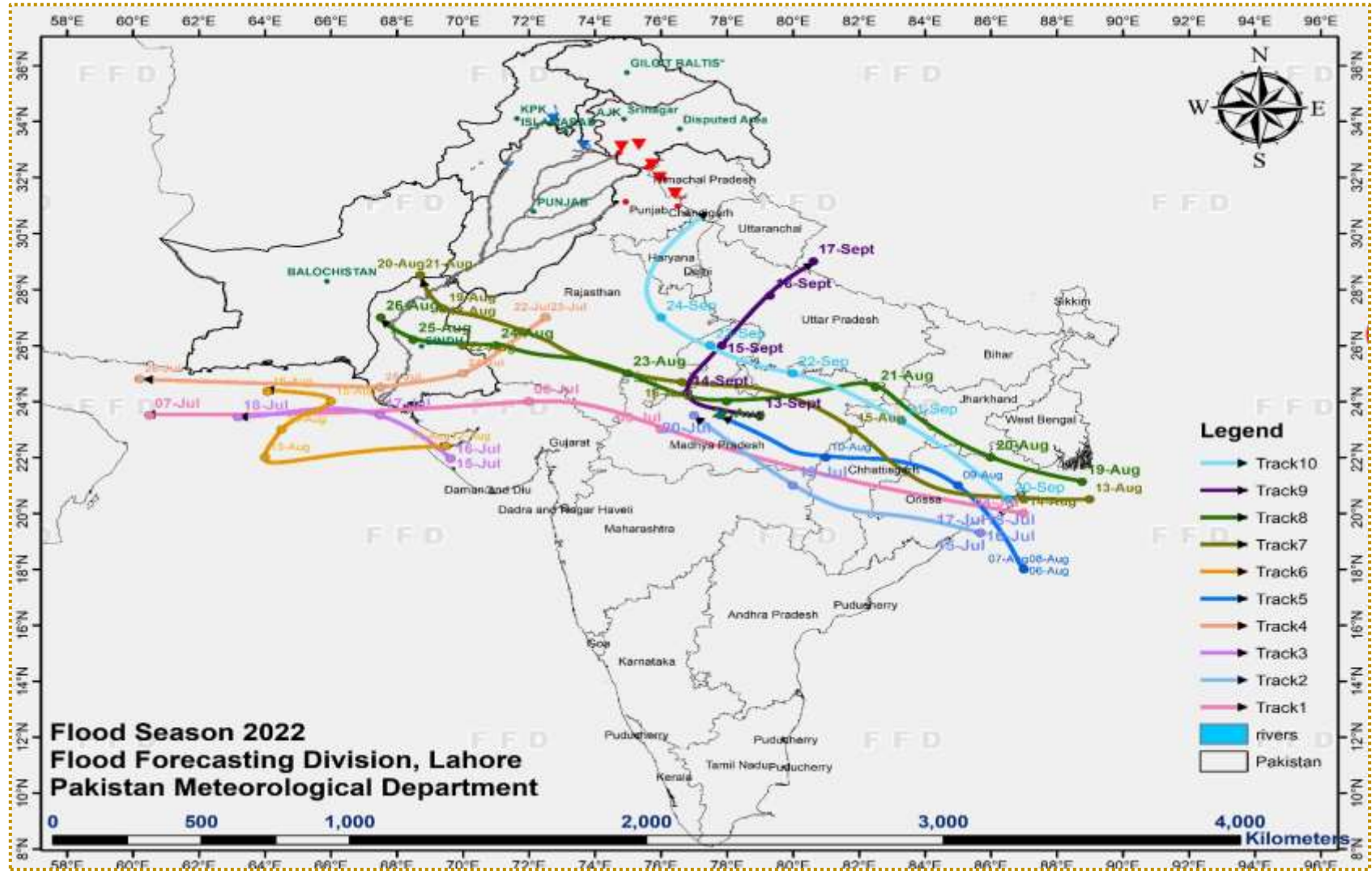
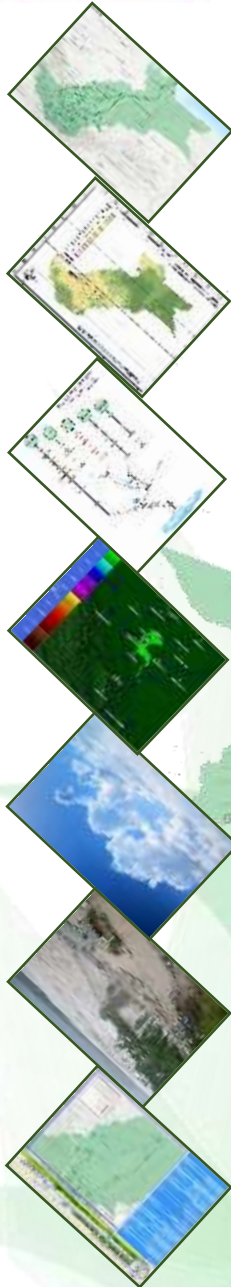
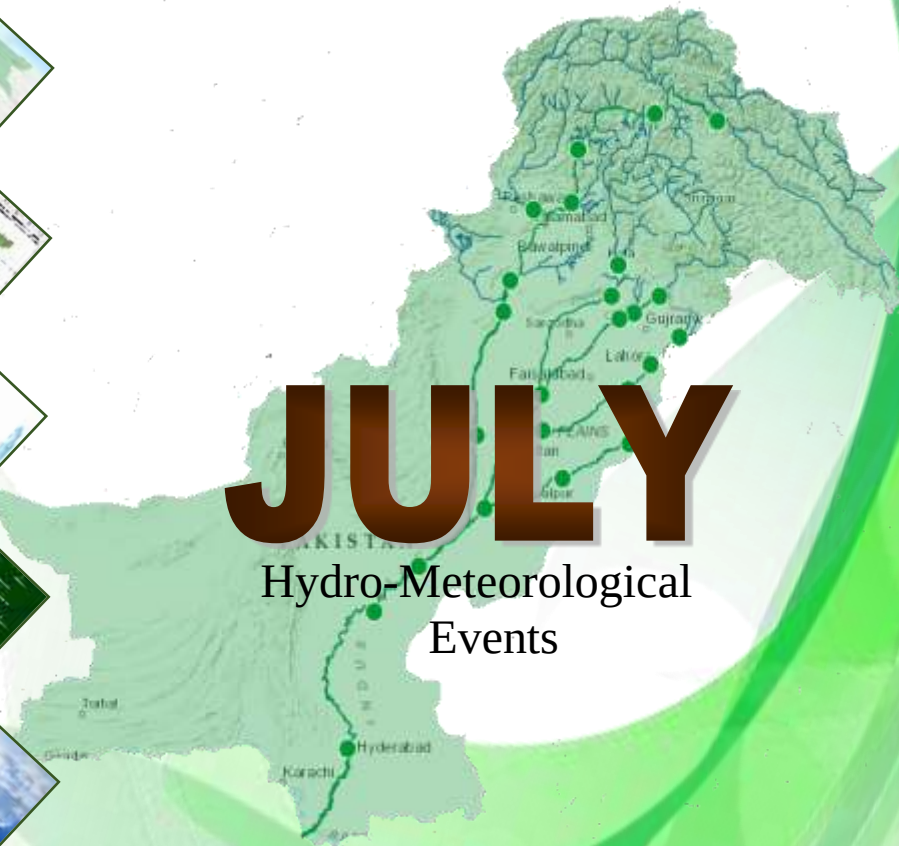


Figure 1: Tracks of Rain Producing System in Monsoon Season 2022



JULY

Hydro-Meteorological Events



4 Significant Hydro-Meteorological events during the month of July 2022

Three rainfall spells were reported during the month of July 2022 over Pakistan. Maximum Rivers flow observed at upstream, during the month is shown in Table -1.

4.1 Meteorological events

Three Monsoon lows were developed during the month of July 2022. The rainfall mostly occurred across the country during the month of July 2022 was due to the accentuation of seasonal low over west Balochistan & adjoining Iran and passing of a westerly wave to the north of the country along with the monsoon Lows.

4.2 1st wet spell of July 2022 (05th – 08th)

The first wet spell of July 2022 which remained active for four days was mainly due to the presence of a westerly trough accompanied by moderate to strong moist currents from the Arabian Sea as well as Bay of Bengal. Figures 2 represents 500 hPa and 850 hPa geopotential height patterns along with 925 hPa wind flow during the spell. Southwesterly winds at 925 hPa are also present ensuring enough moisture supply from the Arabian Sea and Bay of Bengal.

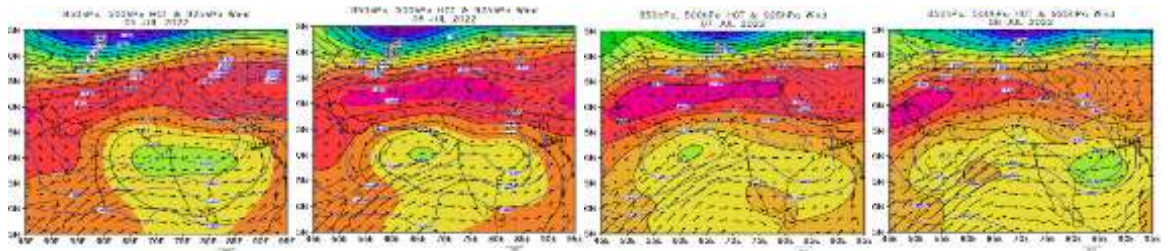


Figure 2: hPa geopotential Height & winds map July 2022 (05th – 08th)

Figure 3 & 4 shows the spatial distribution of significant rainfall during this spell in PMD Observatories, WAPDA & Telemetric Network. Maximum rainfall of 175 mm occurred over Padidan. Another spell of more than 161 mm rainfall occurred over Gujranwala. Significant rainfall recorded rest of the country is shown below in Figure 3.

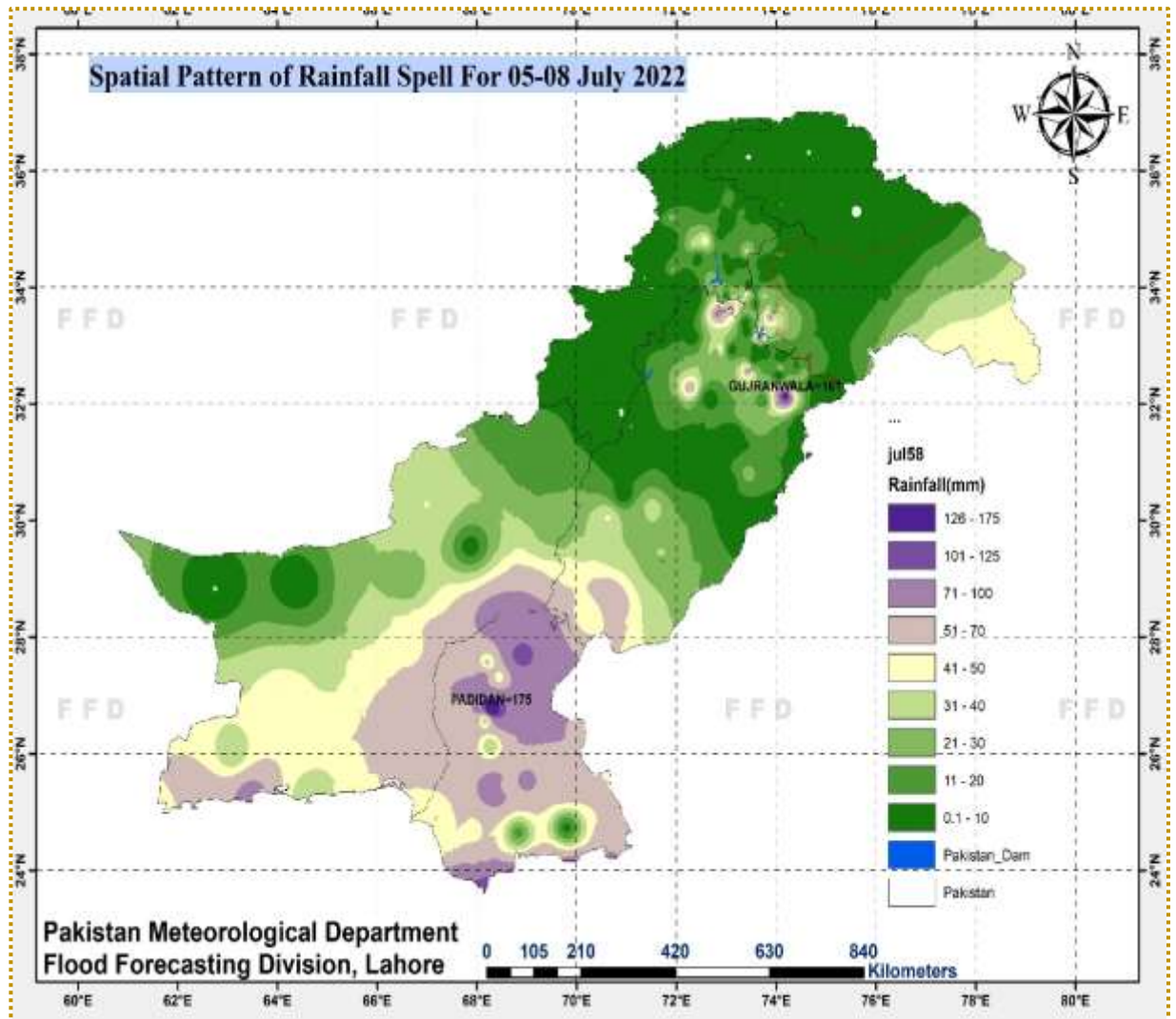


Figure 3: Spatial distribution of rainfall July 2022 (05th – 08th)

1st Rainfall Spell | 05-08 | July-2022

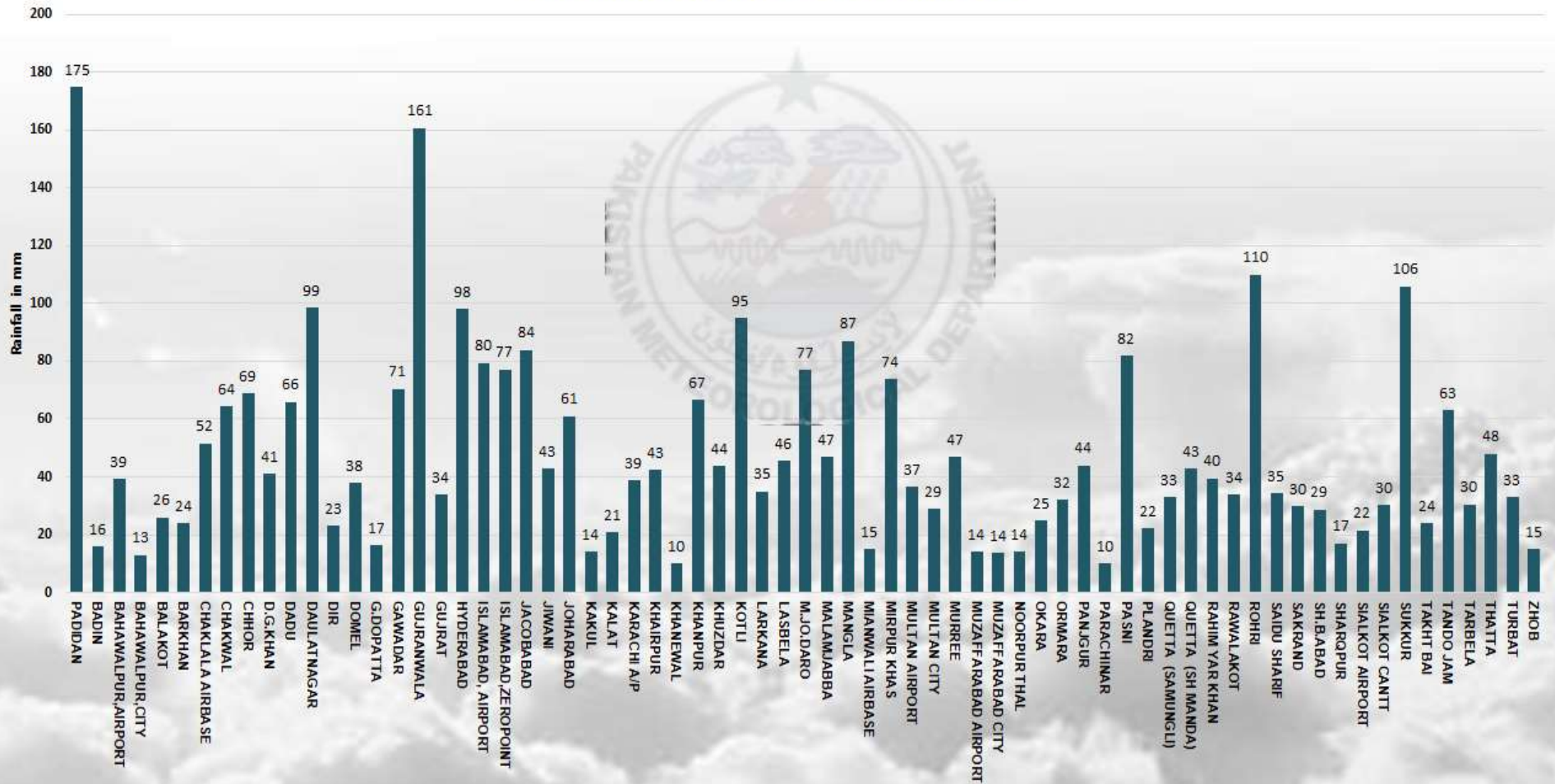


Figure 4: 01st Wet Spell of July 2022 (05th – 8th)

Satellite/Radar images in figure 5 showing dense clouds over Sindh, Balochistan, parts of Khyber-Pakhtunkhwa and south Punjab during the spell of 5th – 8th July-2022. No significant cloud formation was observed over the upper catchments of all the major rivers.

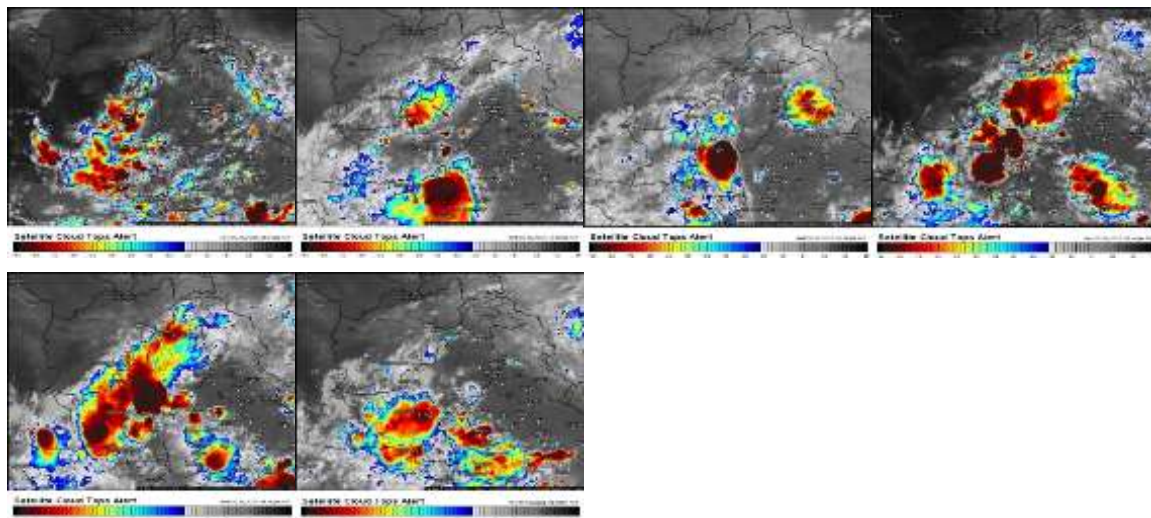


Figure 5: Satellites Images of July 2022 (5th – 8th)

4.3 Hill Torrents position during the first spell of July-2022

High Flood level recorded at Vehova & Kaha and Medium Flood at Kaura & Sori Janubi . While other Hill Torrents remained in normal position.

4.4 Rivers position during the first spell of July-2022

During the spell river Indus Tarbela and River Kabul at Nowshera attained the low flood peaks.

4.5 2nd wet spell of July 2022 (13th-16th)

The Second wet spell of July 2022 which remained active for four days was mainly due to the presence of a westerly trough and a low-pressure area over northeast Arabian Sea and adjoining Gujarat (India), accompanied by moist laden winds from the Bay of Bengal and Arabian Sea. Figures 6 represents 500 hPa and 850 hPa geopotential height patterns along with 925 hPa wind flow during the spell. It indicates that parts of Pakistan are under the influence of the westerly wave. Southeasterly winds at 925 hPa are also present ensuring moderate to strong moisture supply from the Bay of Bengal.

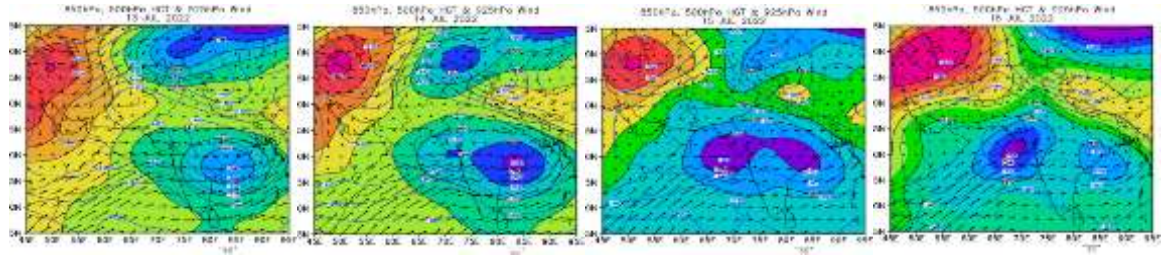


Figure 6: hPa Geopotential Height & winds map of July 2021 (13th -16th).

Figures 7 & 8 show the spatial distribution of significant rainfall during this spell. Maximum rainfall of more than 236 mm occurred over Islamabad Airport. Other maxima of more than 173 & 168-mm rainfall recorded over GS Wala & Mangla. Southeastern Sindh and Eastern Parts of Balochistan also received moderate rainfall during the period. Significant rainfall recorded rest of the country is also shown below.

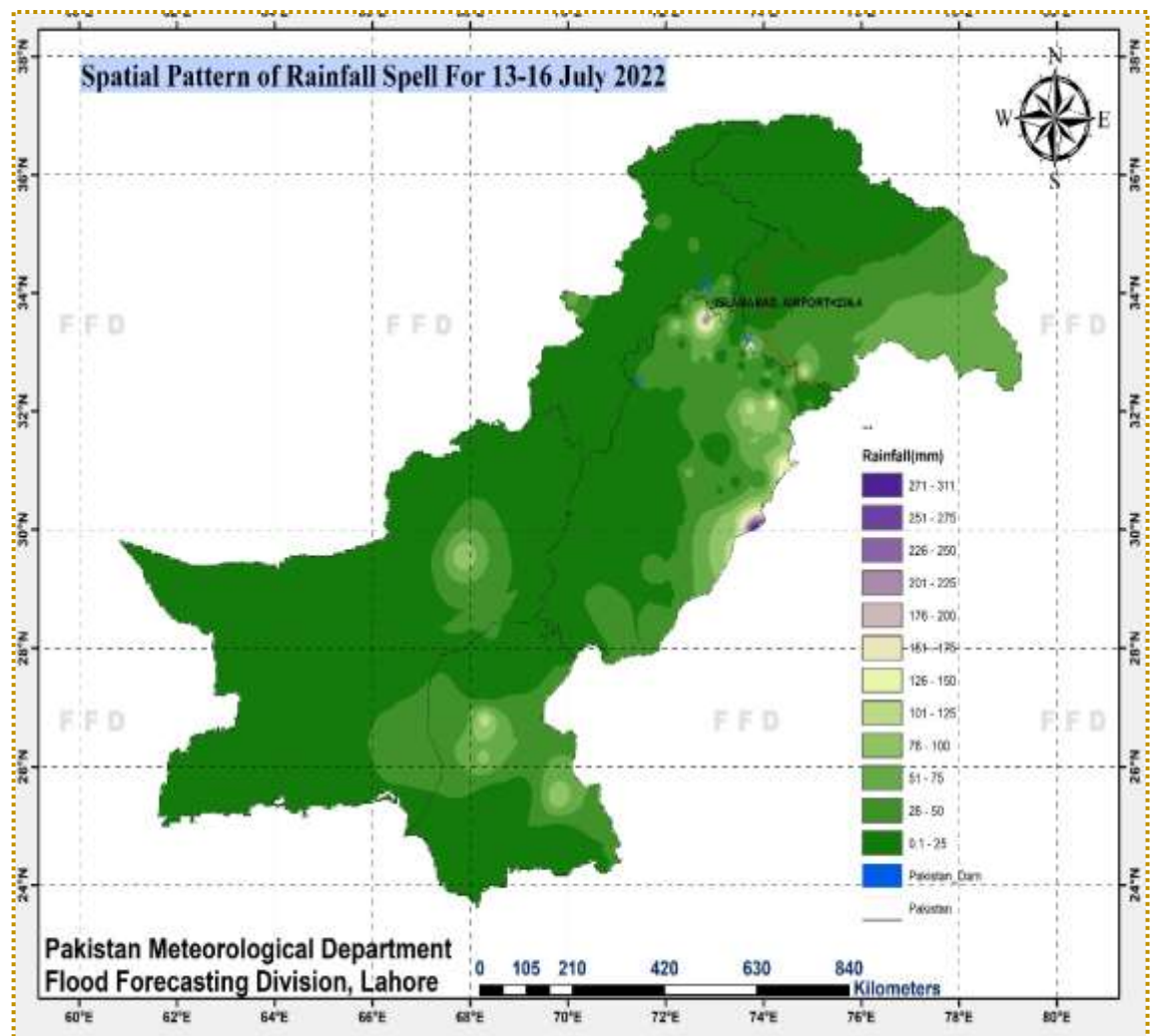


Figure 7: Spatial distribution of rainfall July 2022 (13th -16th)

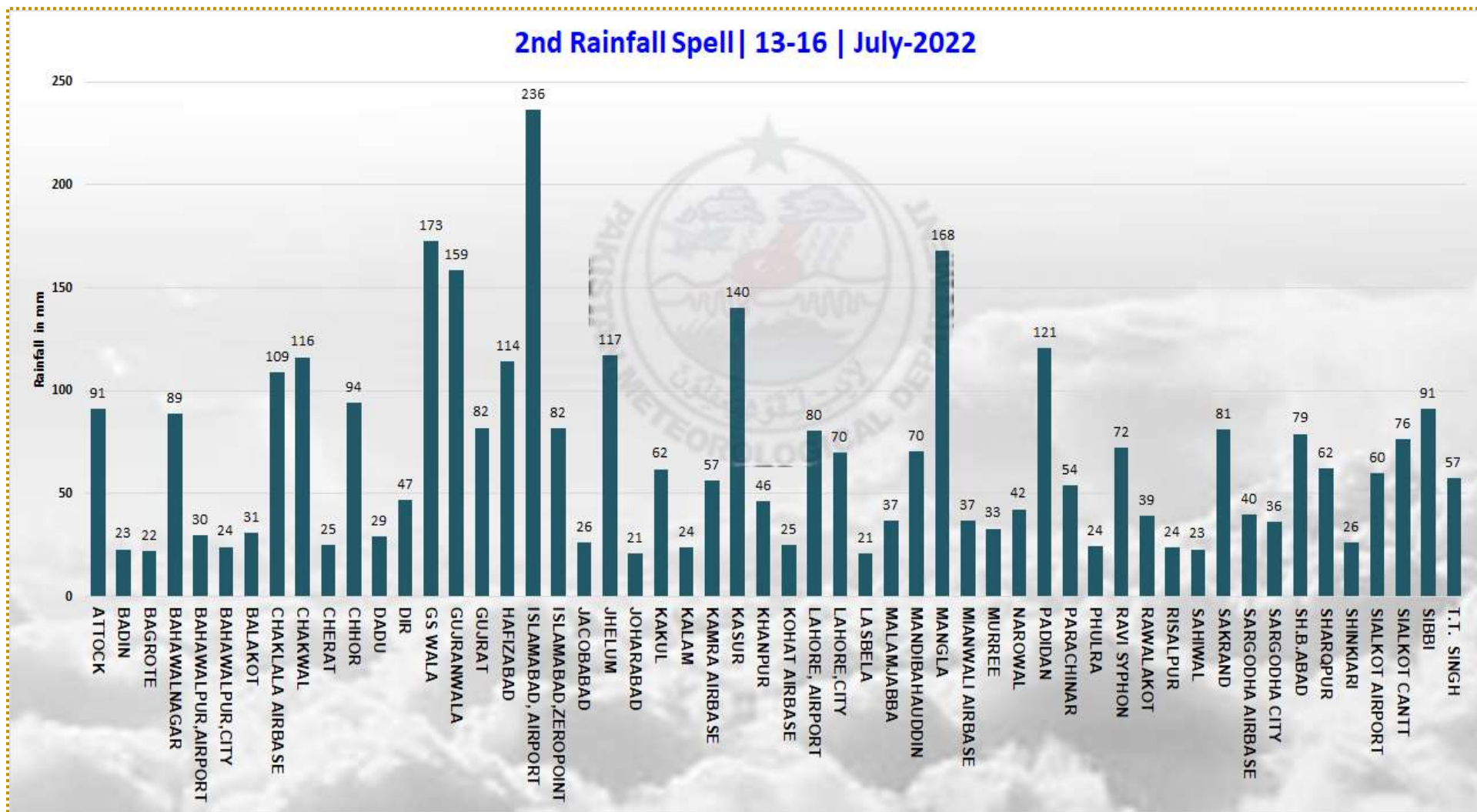


Figure 8: 02nd Wet Spell of Rainfall July 2022 (13th -16th)

Satellite/Radar images in figure 9 showing dense clouds over Punjab, along with south Sindh, parts of Balochistan during the spell of 13th -16th July-2022.

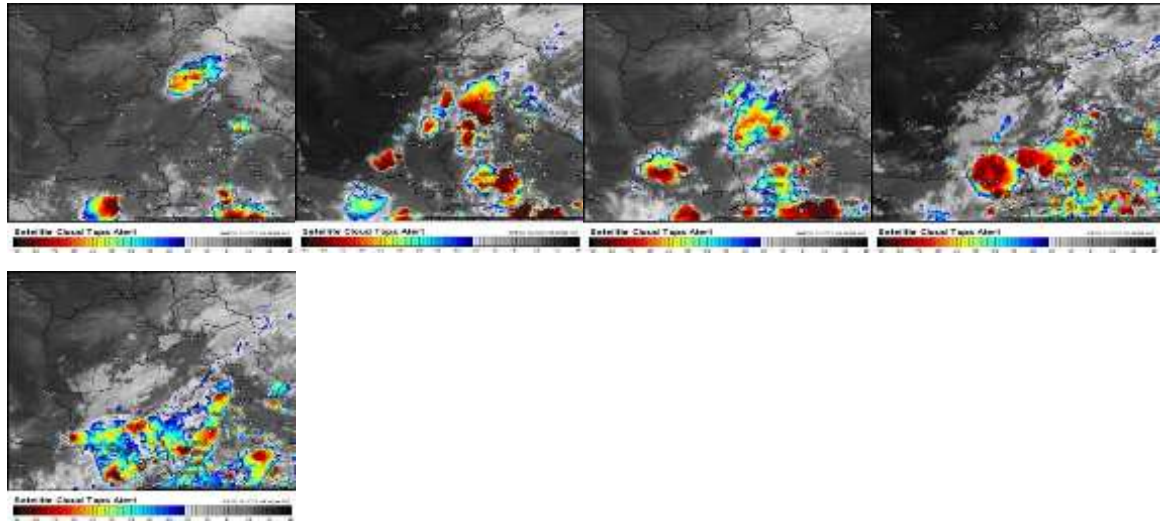


Figure 9: Satellites Images of July 2022 (13th -16th)

4.6 Hill Torrents position during the second spell of July-2022

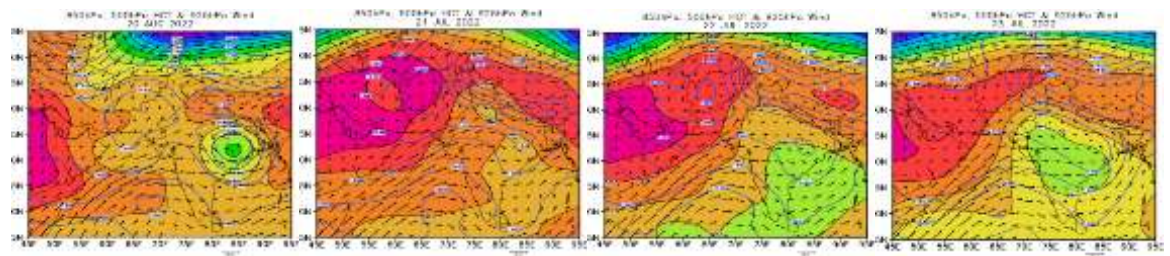
Medium level Flood peaks at Vidore, Sakhi Sarwar, Mithnawa, Kaha & Zangi and Low Flood level at Sori Shumali, Sori Janubi & Kala Bagha Khosra were observed.

4.7 Rivers position during the second spell of July-2022

River Indus at Chashma & Guddu and river Kabul at Nowshera registered low flood level.

4.8 3rd wet spell of July 2022 (20th – 27th)

The third and final wet spell of July 2022 which remained active for eight days was mainly due to the formation of well-marked monsoon low over Southern Sindh accompanied by strong moist currents from the Arabian Sea and Bay of Bengal along with accentuated seasonal low over west Balochistan. Figures 10 represents 500 hPa and 850 hPa geopotential height patterns along with 925 hPa wind flow during the spell. It indicates that most parts of Sindh are under the influence of monsoon low. Southwesterly winds at 925 hPa are also present ensuring moderate to strong moisture supply from the Arabian Sea.



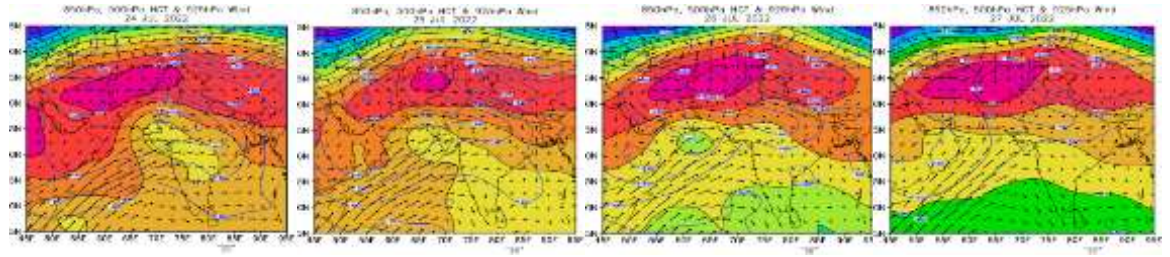


Figure 10: hPa Geopotential Height & winds map of July 2022 (20th – 27th)

Figure 11 & 12 shows the spatial distribution of significant rainfall during this spell. Maximum rainfall of more than 250 mm occurred over Badin in Sindh. Other maxima of more than 237 mm rainfall were recorded over Lasbela. Significant rainfall recorded rest of the country is shown below in Figures 11 & 12.

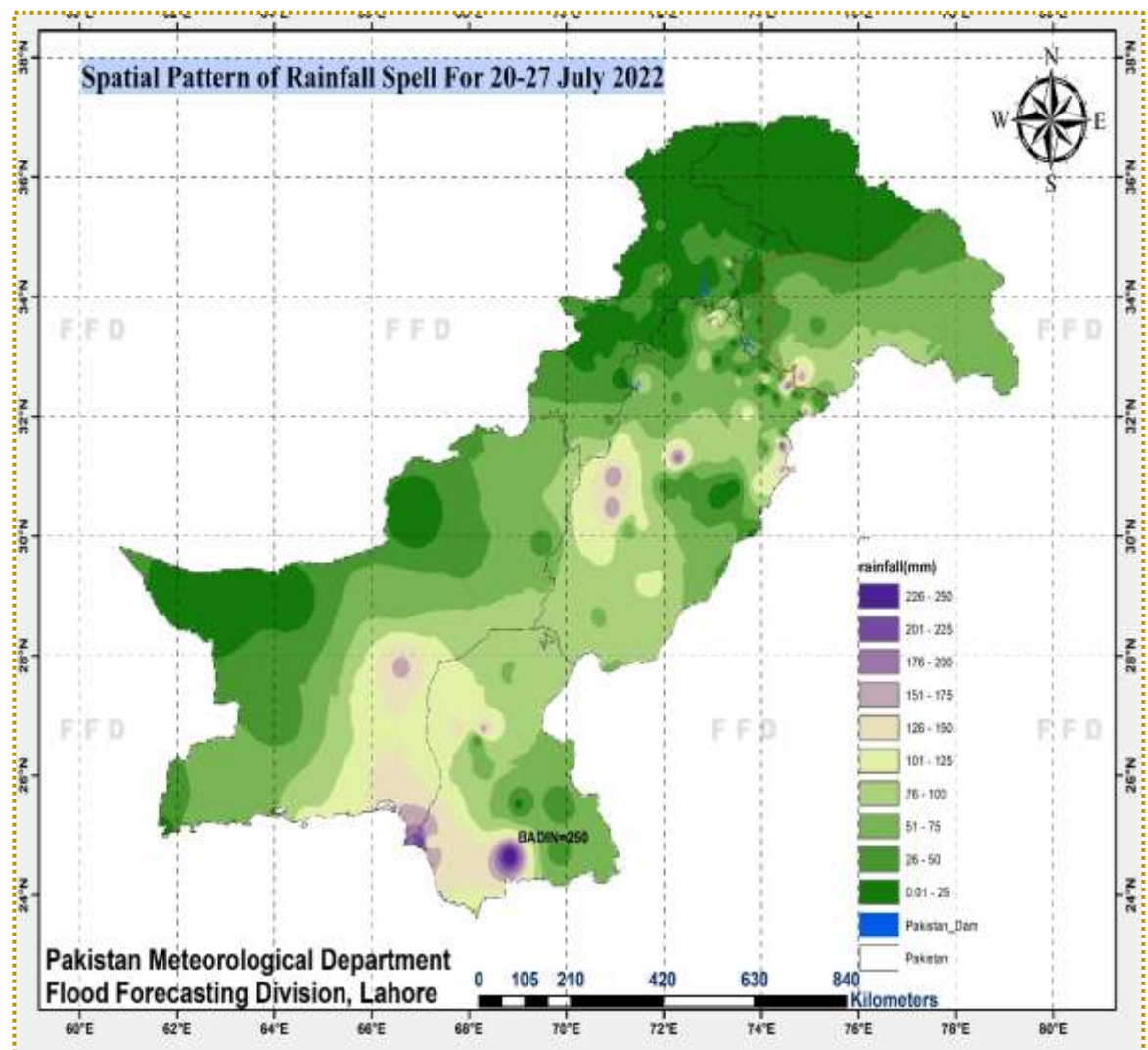


Figure 11: Spatial distribution of rainfall July 2022 (20th – 27th)

3rd Rainfall Spell | 20-27 | July-2022

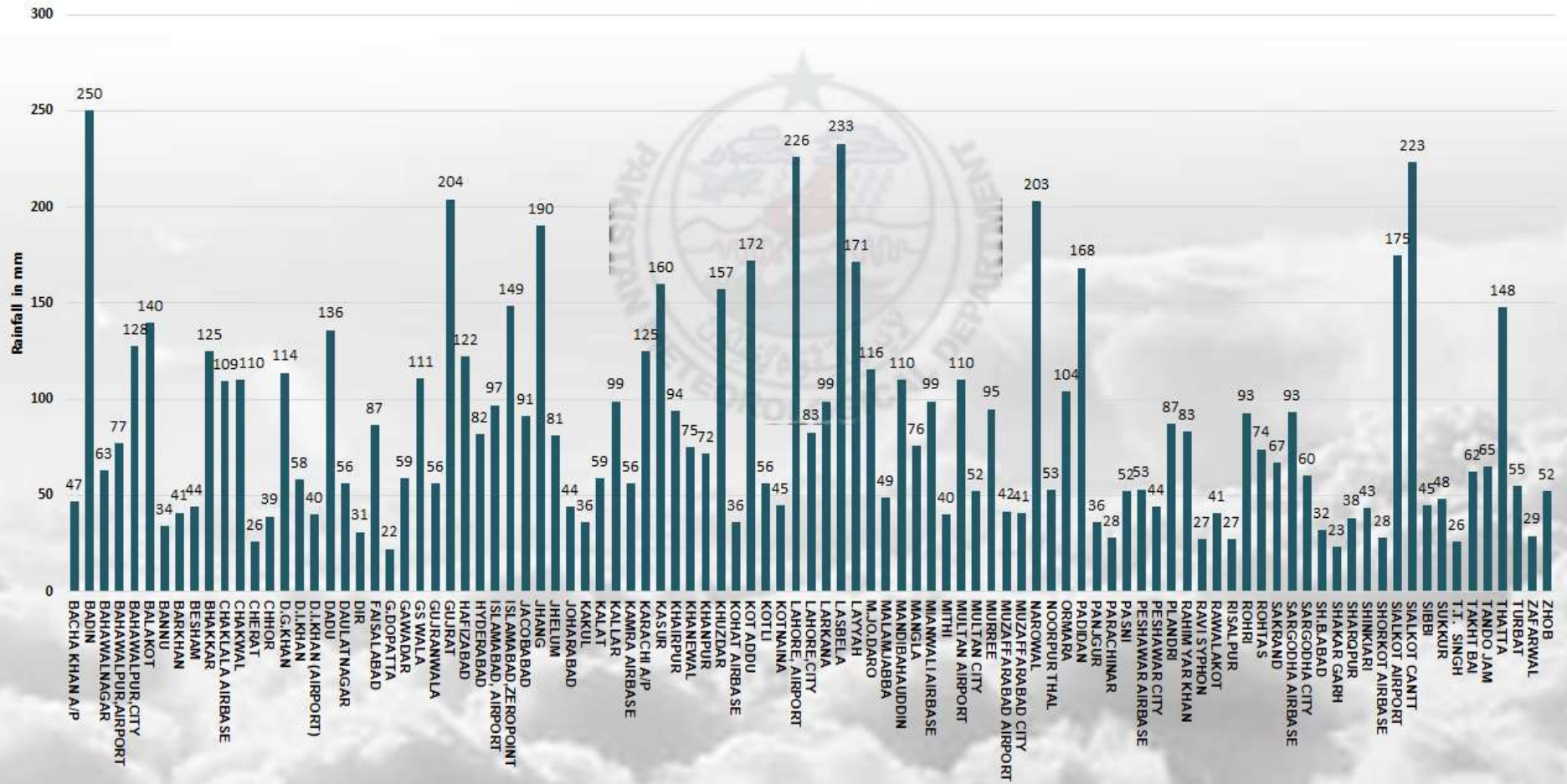


Figure 12: 3rd Wet Spell of Rainfall July 2022 (20th – 27th)

Satellite/Radar images in figure 13 showing dense clouds during the spell of 20th – 27th July-2022 over north Punjab, along with Khyber Pakhtunkhwa and Kashmir during the spell of 20th – 27th July-2022.

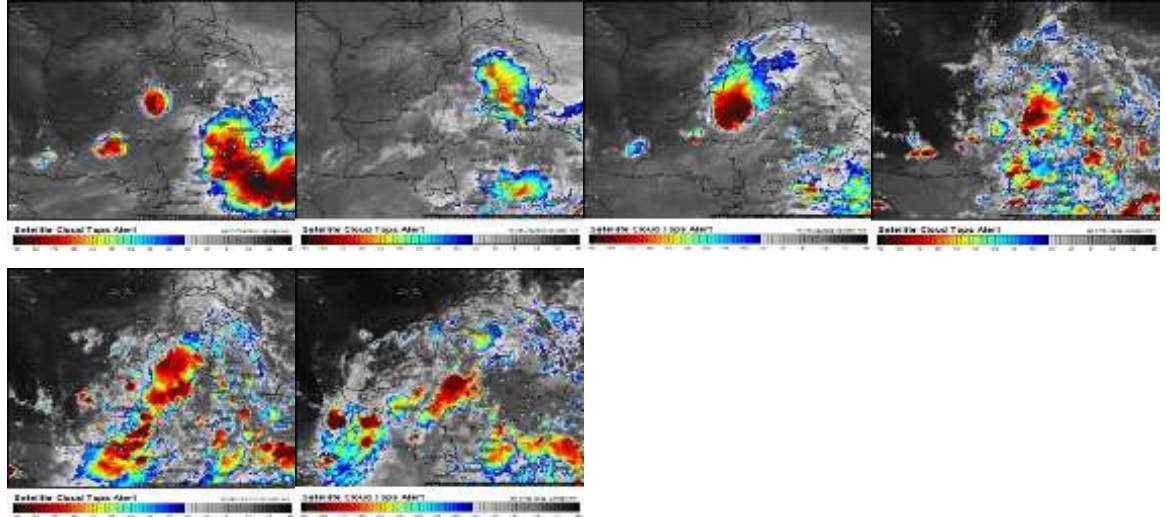


Figure 13: Satellites Images of July 2022 (20th – 27th)

4.9 Rivers position during the third spell of July-2022

During the spell flood peaks recorded are shown in figure 20.

4.10 Spatial distribution of rainfall during the month of July 2022

The precipitation during the month of July is shown in figure 14,15 & 16 which indicate that monsoon activity remained active over North & Northeast Punjab and Sindh. Center of maximum rainfall exceeding 500 mm were recorded at Islamabad Airport and other at Padidan in Sindh. While another maximum more than 490 mm occurred over Gujranwala. Rainfall recorded over rest of the country is also shown below.

Monthly Rainfall for the month of July-2022

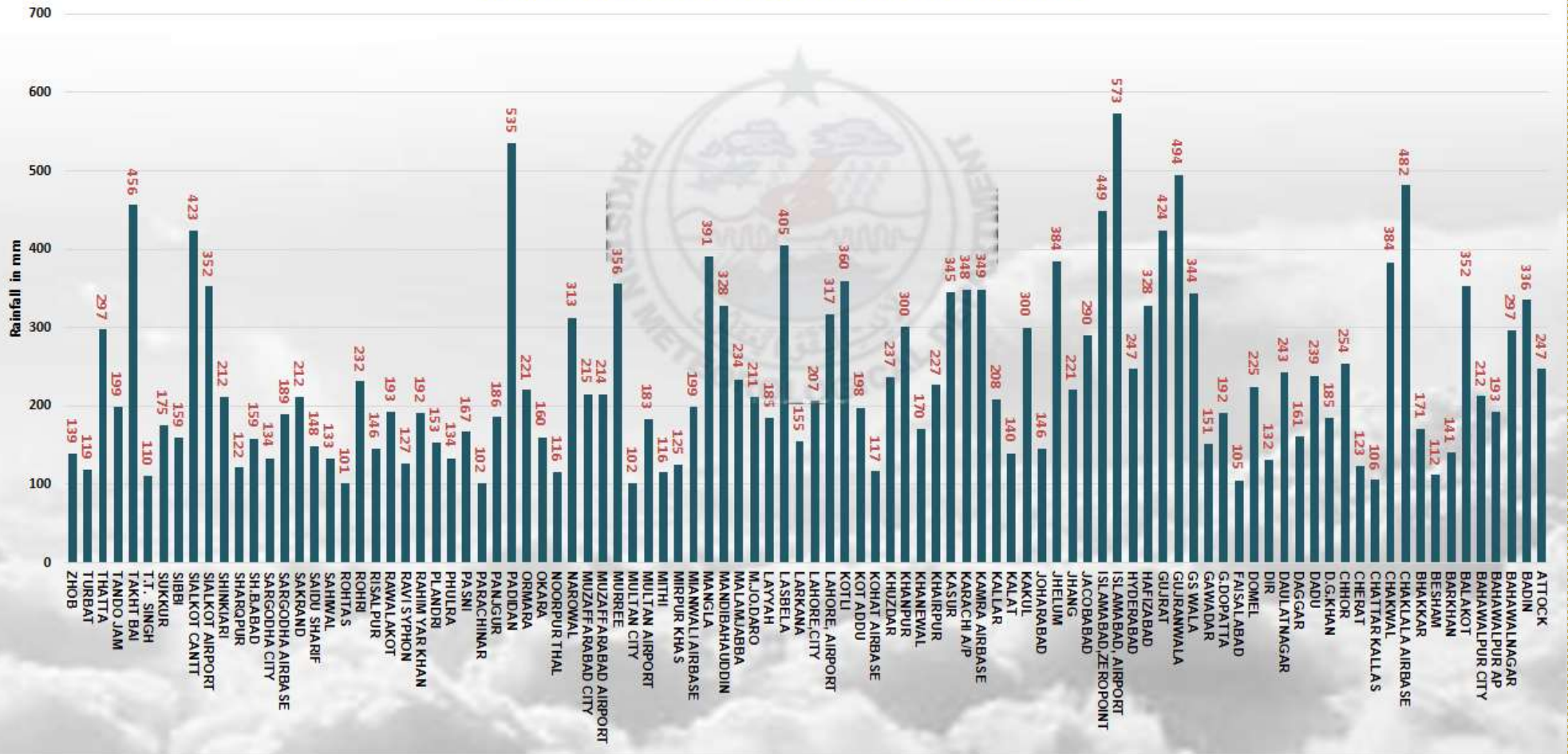


Figure 14: Total Rainfall for the month of July 2022.

TOTAL RAINFALL OF JULY 2022								
PMD OBSERVATORIES, WAPDA & TELEMETRIC NETWORK RAINFALL								
Sr#	Stations	Rainfall	Sr#	Stations	Rainfall	Sr#	Stations	Rainfall
1	ISLAMABAD, AIRPORT	573.3	34	DAULATNAGAR	242.9	67	DAGGAR	160.5
2	PADIDAN	535.5	35	DADU	239.0	68	OKARA	160.1
3	GUJRANWALA	494.0	36	KHUZDAR	237.1	69	SIBBI	159.0
4	CHAKLALA AIRBASE	481.9	37	MALAMJABBA	234.0	70	SH.B.ABAD	158.8
5	TAKHT BAI	456.2	38	ROHRI	232.0	71	LARKANA	155.1
6	ISLAMABAD,ZEROPOINT	449.0	39	KHAIRPUR	227.0	72	PLANDRI	153.2
7	GUJRAT	424.0	40	DOMEL	224.5	73	GAWADAR	151.2
8	SIALKOT CANTT	423.1	41	ORMARA	221.0	74	SAIDU SHARIF	148.3
9	LASBELA	404.7	42	JHANG	220.6	75	RISALPUR	146.1
10	MANGLA	391.2	43	MUZAFFARABAD CITY	215.1	76	JOHARABAD	145.9
11	JHELM	383.7	44	MUZAFFARABAD AIRPORT	214.0	77	BARKHAN	141.0
12	CHAKWAL	383.6	45	BAHAWALPUR CITY	212.3	78	KALAT	140.0
13	KOTLI	360.0	46	SHINKIARI	212.1	79	ZHOB	139.0
14	MURREE	356.0	47	SAKRAND	212.0	80	PHULRA	133.6
15	SIALKOT AIRPORT	352.4	48	M.JO.DARO	211.0	81	SARGODHA CITY	133.5
16	BALAKOT	352.4	49	KALLAR	207.8	82	SAHIWAL	132.8
17	KAMRA AIRBASE	349.0	50	LAHORE,CITY	207.0	83	DIR	132.0
18	KARACHI A/P	348.4	51	MIANWALI AIRBASE	199.1	84	RAVI SYPHON	127.4
19	KASUR	344.5	52	TANDO JAM	198.9	85	MIRPUR KHAS	125.0
20	GS WALA	343.6	53	KOT ADDU	198.0	86	CHERAT	123.0
21	BADIN	335.8	54	BAHAWALPUR AP	192.9	87	SHARQPUR	121.8
22	HAFIZABAD	328.2	55	RAWALAKOT	192.5	88	TURBAT	119.0
23	MANDIBAHAUDDIN	327.6	56	RAHIM YAR KHAN	191.8	89	KOHAT AIRBASE	117.1
24	LAHORE, AIRPORT	317.4	57	G.DOPATTA	191.8	90	NOORPUR THAL	116.3
25	NAROWAL	312.7	58	SARGODHA AIRBASE	189.1	91	MITHI	116.0
26	KHANPUR	300.4	59	PANJGUR	186.0	92	BESHAM	112.2
27	KAKUL	300.0	60	D.G.KHAN	184.8	93	T.T. SINGH	110.4
28	THATTA	297.3	61	LAYYAH	184.7	94	CHATTAR KALLAS	106.2
29	BAHAWALNAGAR	297.0	62	MULTAN AIRPORT	183.1	95	FAISALABAD	105.1
30	JACOBABAD	290.0	63	SUKKUR	175.0	96	MULTAN CITY	102.0
31	CHHOR	254.0	64	BHAKKAR	171.0	97	PARACHINAR	102.0
32	ATTOCK	247.4	65	KHANEWAL	170.1	98	ROHTAS	101.2
33	HYDERABAD	247.0	66	PASNI	167.3	99		
More than 100 MM Rainfall								

Figure 15: Total Rainfall for the month of July 2022.

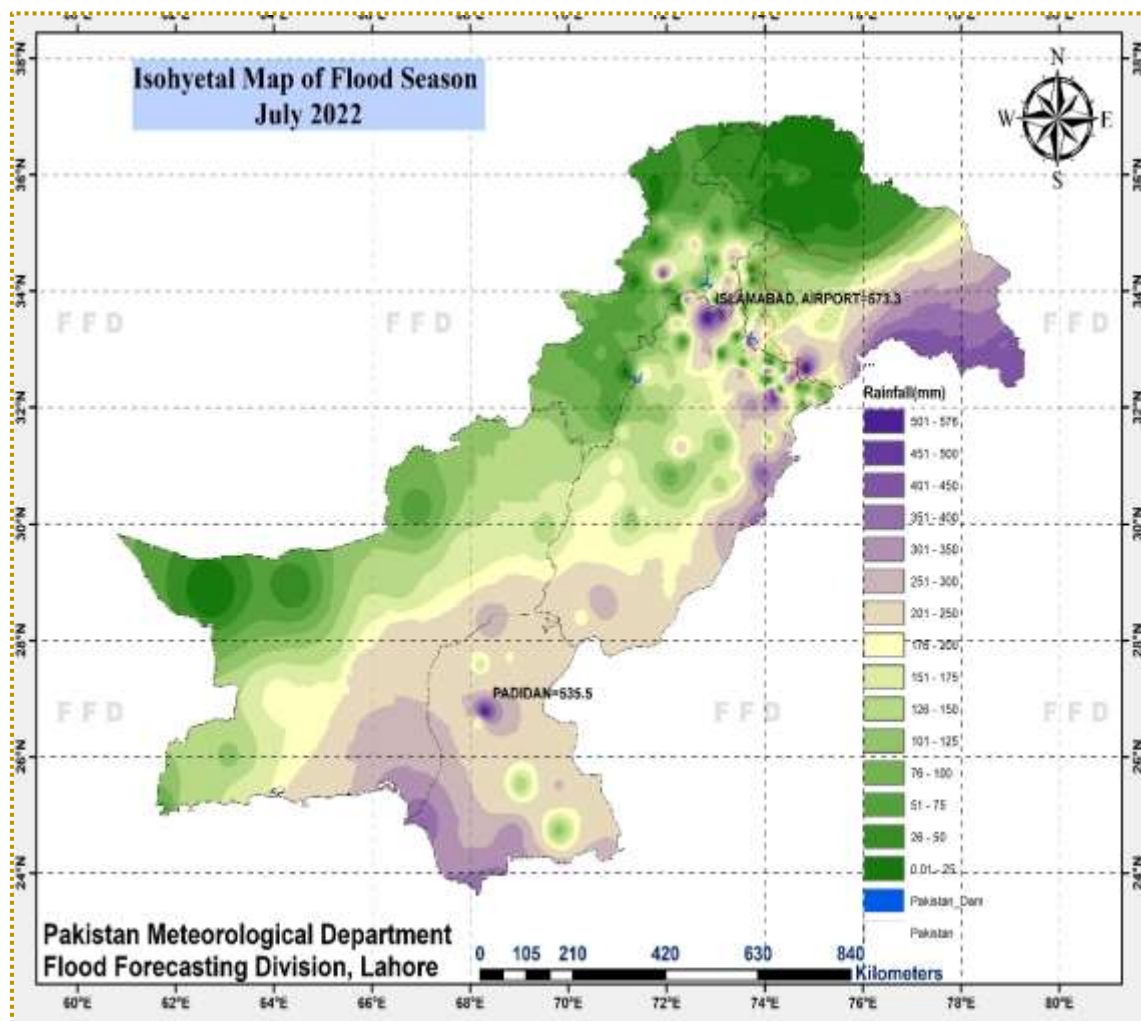


Figure 16: Spatial distribution of significant rainfall map of July 2022.

4.11 Rainfall Departure during the month of July 2022

Rainfall Departure map for the month of July 2022 indicates that most parts of the Sindh and East Balochistan received above normal rainfall. Most parts of Kashmir, Gilgit Baltistan, Punjab and Khyber-Pakhtunkhwa Along with west Balochistan received Below Normal Rainfall. Padidan received 496 mm more rain than normal. Badin, Bahawalnagar, Chaklala-Rawalpindi, Hyderabad, Jacobabad, Karachi Airport, Khanpur, Lasbela, Ormara received more than 200 mm rain than their normal. Rainfall Departure map of July 2022 is shown in Figure 17 & 19.

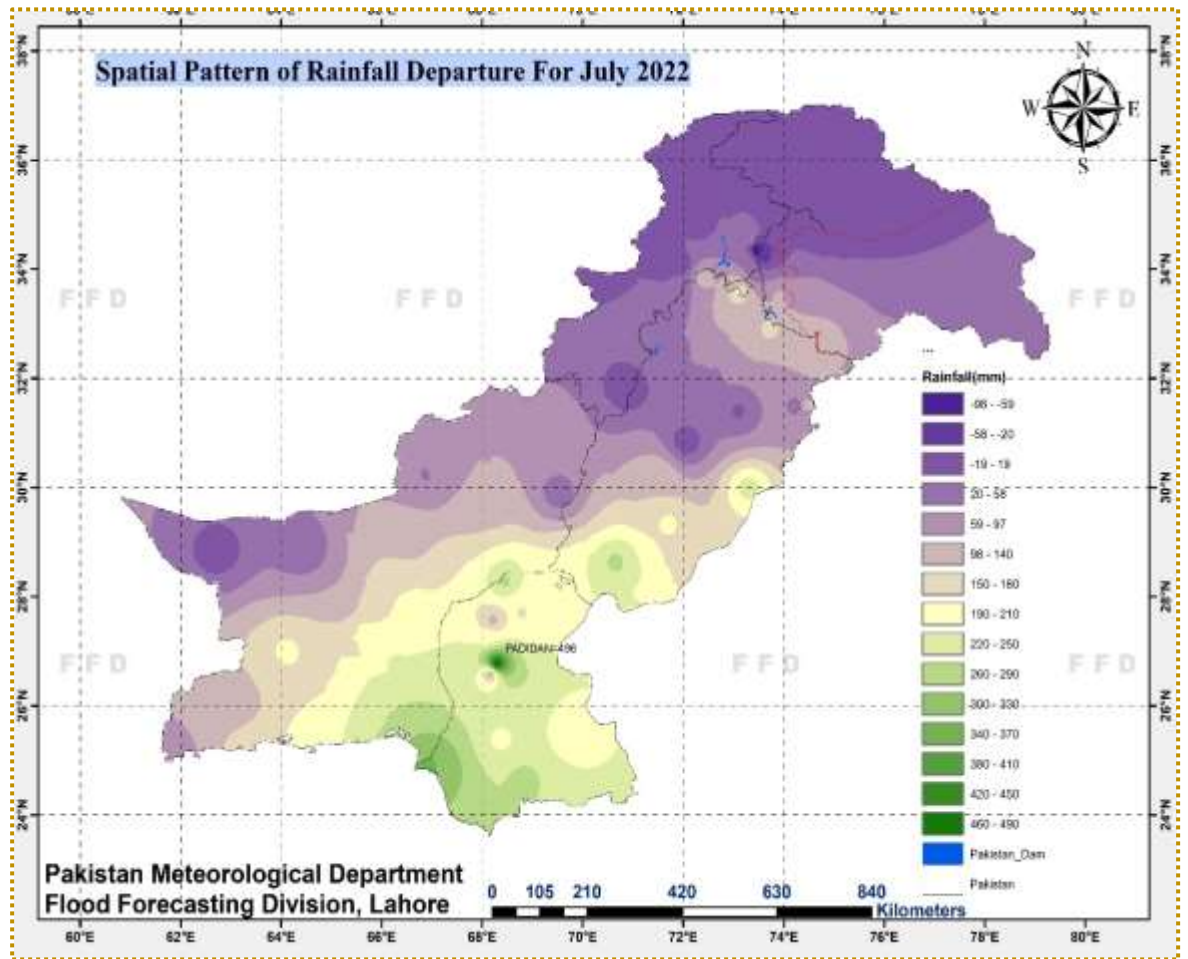


Figure 17: Percentage Anomaly rainfall map of July 2022.

4.12 Temporal Distribution during the month of July 2022

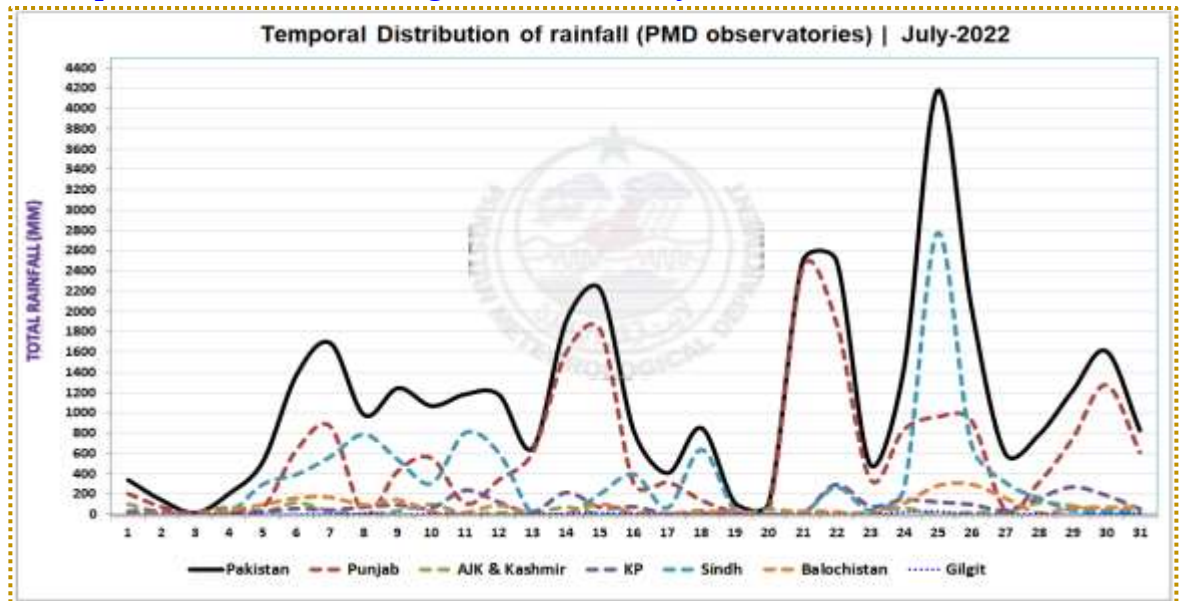


Figure 18: Temporal distribution of rainfall during July 2022.

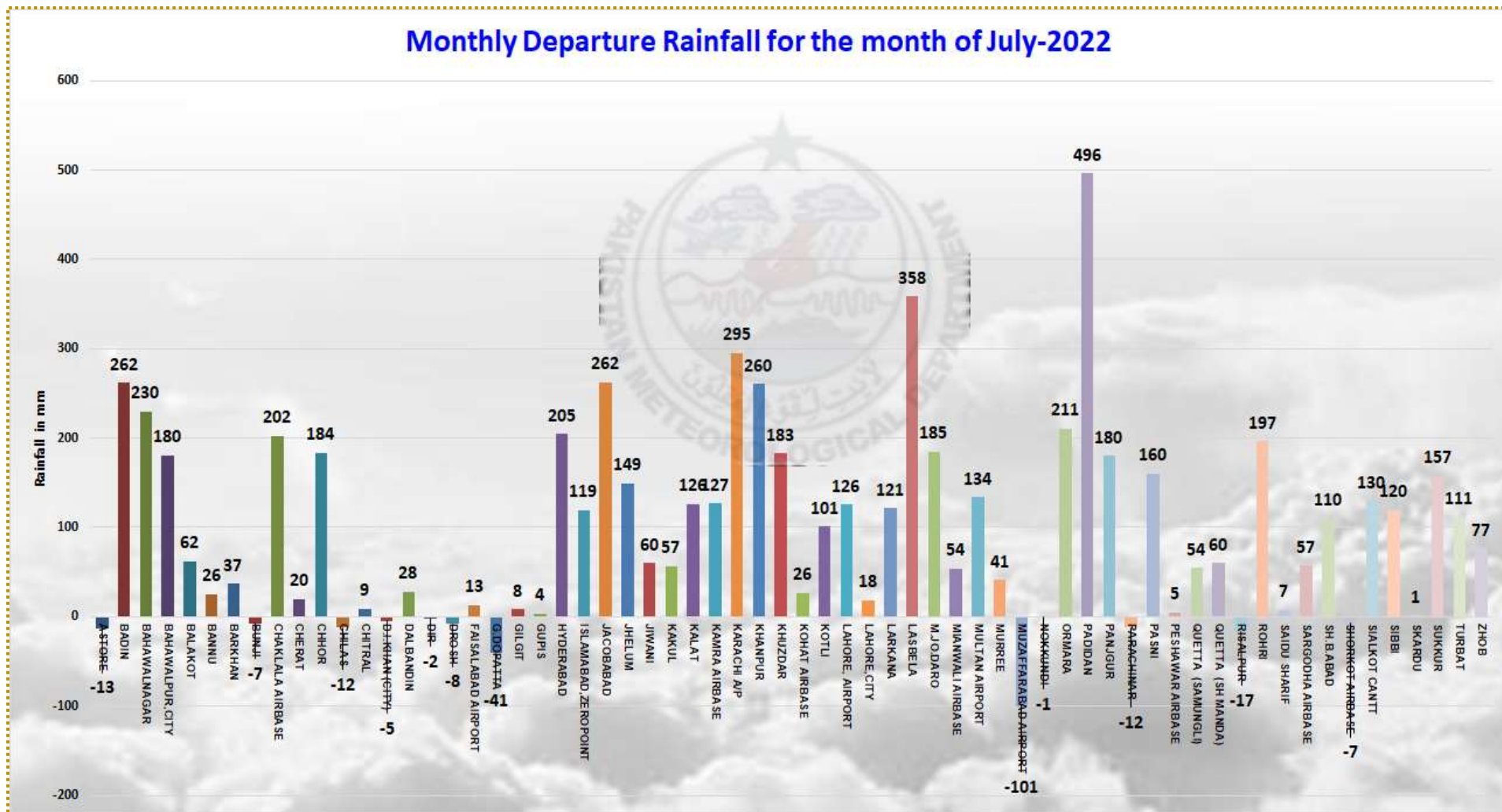


Figure 19: Rainfall Departure for July 2022.

4.13 Hydrographs during Significant event of July 2022





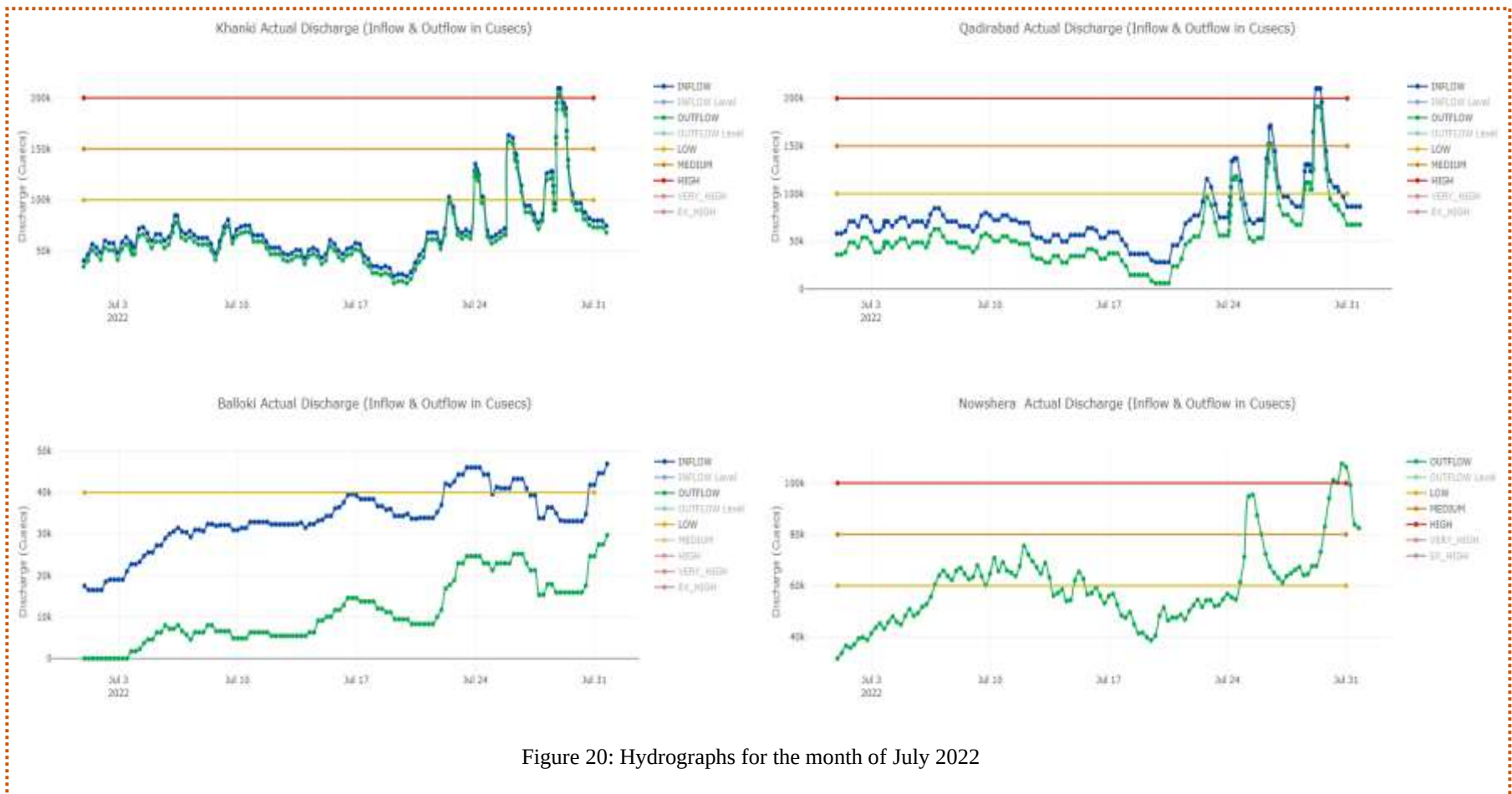
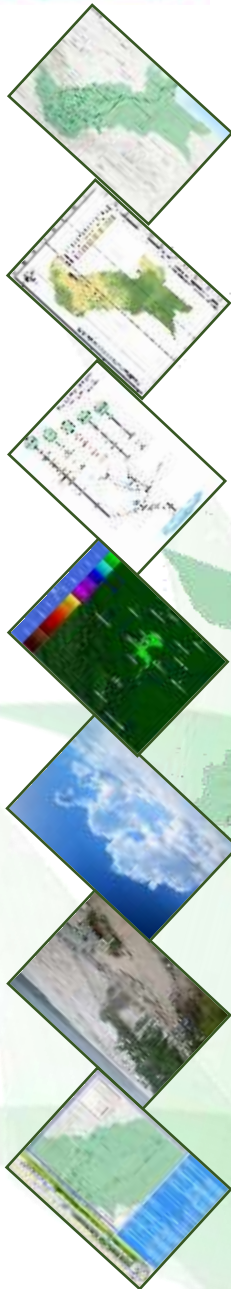


Figure 20: Hydrographs for the month of July 2022

4.14 Rivers position/ Observed Peaks during July 2022

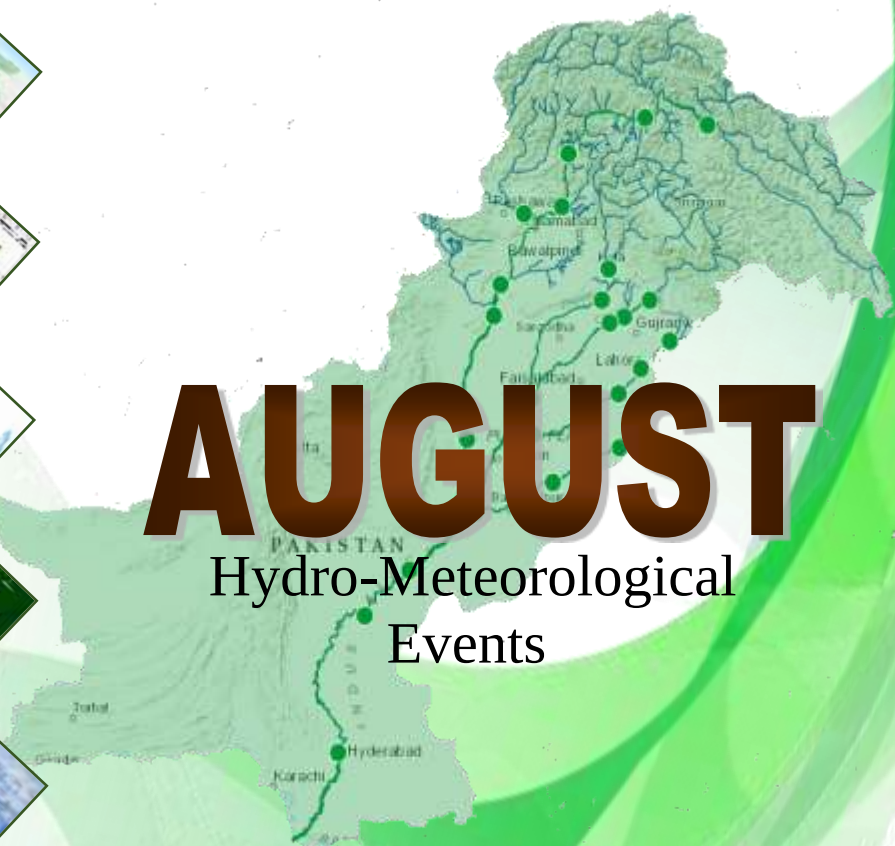
MAXIMUM OBSERVED FLOOD PEAKS JULY_2022				
River	Sites	Inflow	Flood Level	Date & Time
Indus	Tarbela	325000	Low	30/07/2022 12
	Kalabagh	278766	Low	31/07/2022 12
	Chashma	380744	Medium	31/07/2022 18
	Taunsa	324463	Low	31/07/2022 18
	Guddu	332469	Low	31/07/2022 18
	Sukkur	280055	Low	30/07/2022 00
	Kotri	146460	Normal	31/07/2022 18
Jhelum	Mangla	123000	Medium	28/07/2022 15
	Rasul	33640	Normal	02/07/2022 00
Chenab	Marala	225837	High	28/07/2022 16
	Khanki	209181	High	28/07/2022 22
	Qadirabad	210281	High	29/07/2022 04
	Cheniot Bridge	162747	Medium	29/07/2022 22
	Trimmu	116366	Normal	31/07/2022 12
	Punjnad	103158	Normal	30/07/2022 18
Ravi	Jassar	30690	Normal	29/07/2022 18
	Shahdara	28666	Normal	30/07/2022 12
	Balloki	46940	Low	31/07/2022 18
	Sidhnai	24393	Normal	30/07/2022 06
Sutlej	GS Wala	3620	Normal	23/07/2022 12
	Sulemanki	24785	Normal	20/07/2022 12
	Islam	13326	Normal	23/07/2022 18
Kabul	Nowshera	109700	High	30/07/2022 18
Nullahs	Bein	5722	Medium	31/07/2022 18
	Deg	8613	Normal	31/07/2022 18
	Ura	8670	Low	22/07/2022 12
	Basantar	5014	Medium	29/07/2022 12
	Palku	4200	Medium	25/07/2022 12

Table 1: Maximum Peaks recorded during the month of July 2022



AUGUST

Hydro-Meteorological
Events



5 Significant Hydro-Meteorological events during the month of August-22

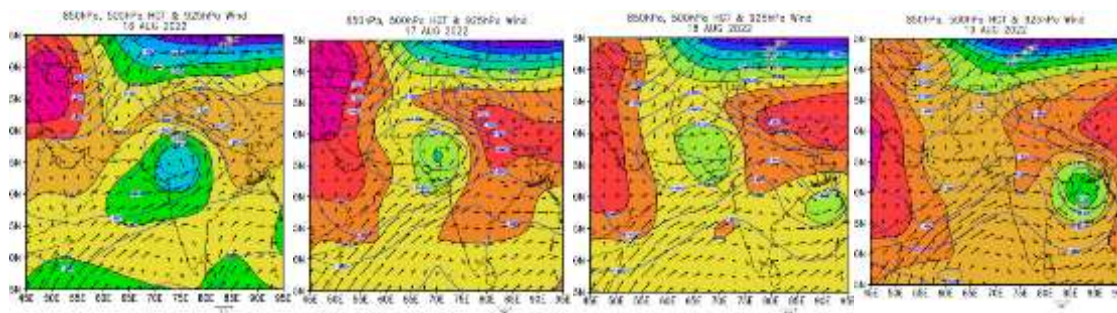
Four monsoon lows developed during the month of August, however two of them affected the country, resulting two significant rainfall spells occurred during the month of August 2022. Flood peaks of Very High in River Kabul, medium to high in river Indus & Chenab and Low Flood Peaks in River Jhelum & Ravi were recorded.

5.1 Meteorological events

The first spell which occurred from 16th to 20th August 2022 was the result of penetration of intense moist currents from Arabian Sea, also due to the effect of westerly wave passing over northern parts of the country and the presence of DEPRESSION over South Sindh. The second spell of August was observed from 24th to 27th August 2022. It was caused by the interaction of westerly wave passing over northern parts of the country and the moist influx from Arabian Sea, under the effect of well-marked low-pressure area over central Sindh.

5.2 01st wet spell of August 2022 (16th to 20th)

The first wet spell of August 2022 which remained active for five days was result of penetration of intense moist currents from Arabian Sea, the effect of westerly wave passing over northern parts of the country and the presence of DEPRESSION over South Sindh. Figure 21 represents 500 hPa and 850 hPa Geopotential height patterns along with 925 hPa wind flow during this spell. It indicates that many parts of Pakistan are under the influence of Depression and westerly wave, Southwesterly winds at 925 hPa are also present ensuring enough moisture supply from Arabian Sea.



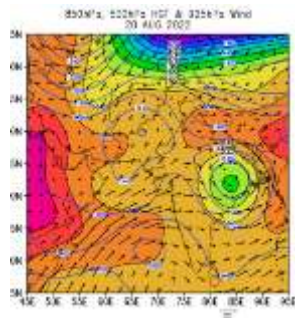


Figure 21: hPa Geopotential Height & winds map August 2022 (16th to 20th)

Figure 22 & 23 indicate the spatial distribution of significant rainfall during the spell. Maximum more than 780 mm at Padidan while other maxima more than 300 mm at Larkana, Moenjo Daro & Tando Jam were reported in Sindh.

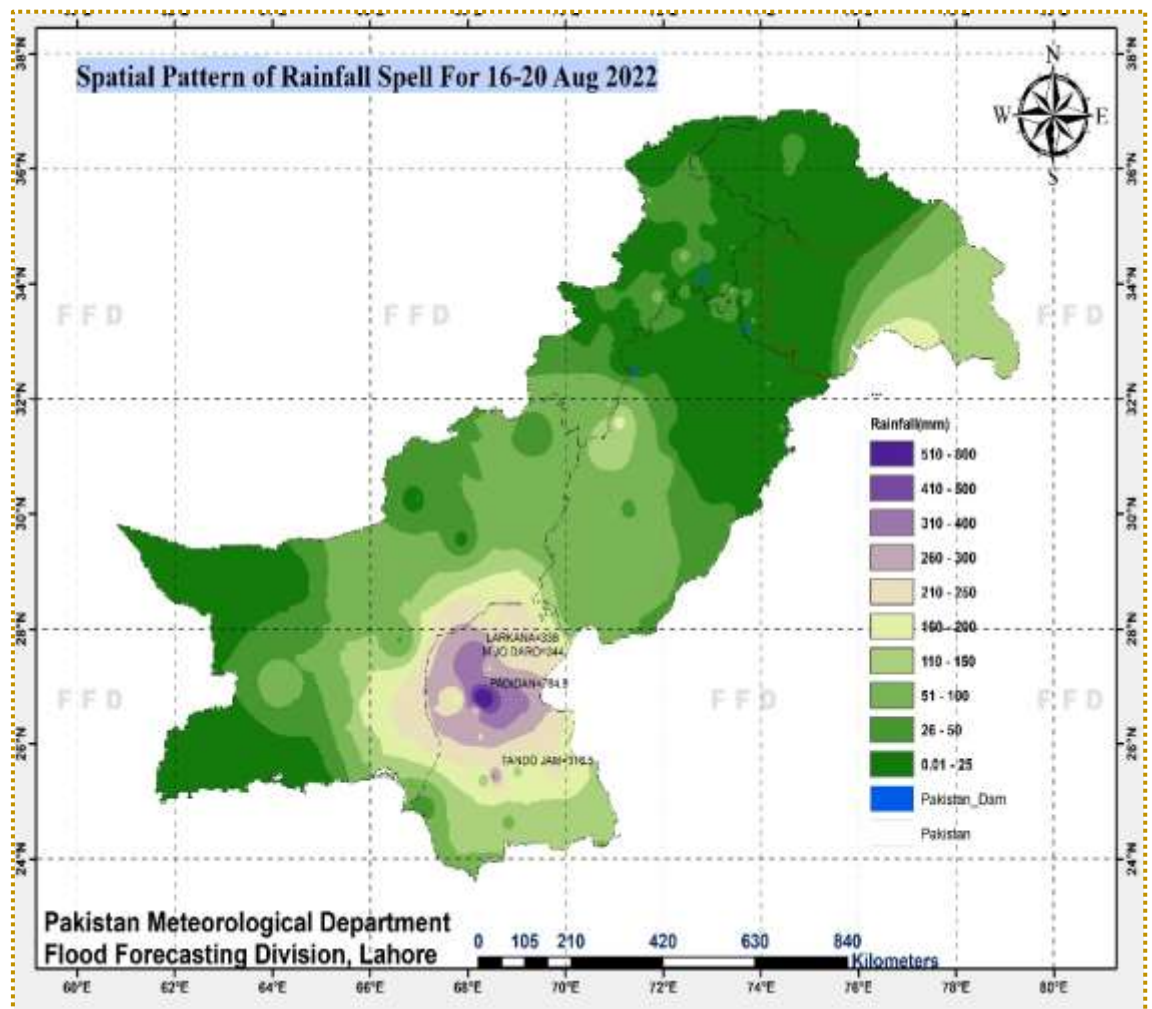


Figure 22: Spatial distribution of significant rainfall August 2022 (16th to 20th)

1st Rainfall Spell | 16-20 | August-2022

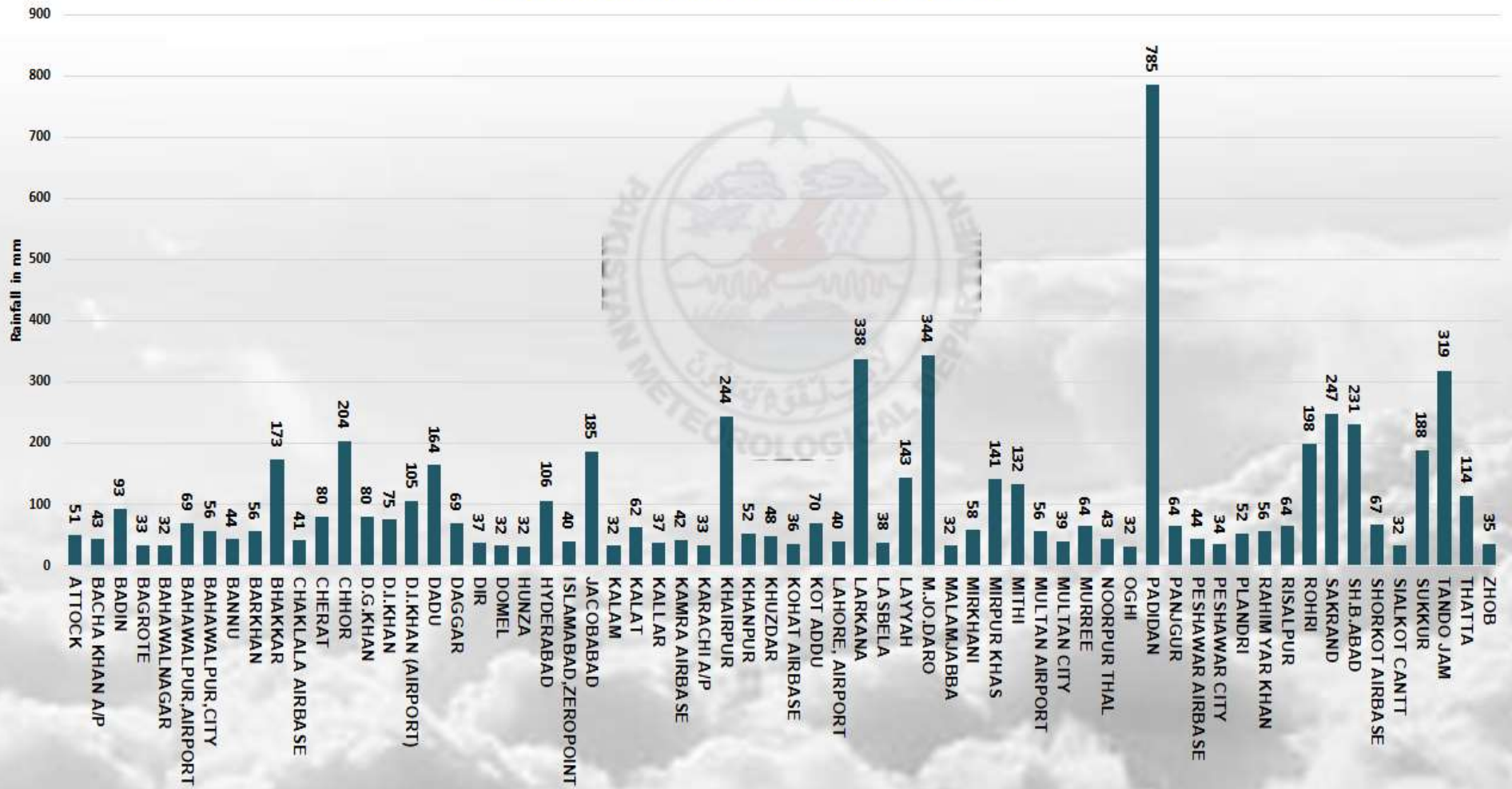


Figure 23: 1st Wet Spell Rainfall of August 2022 (16th to 20th)

Figure 24 is showing dense clouds over Sindh and parts of Balochistan during the spell.

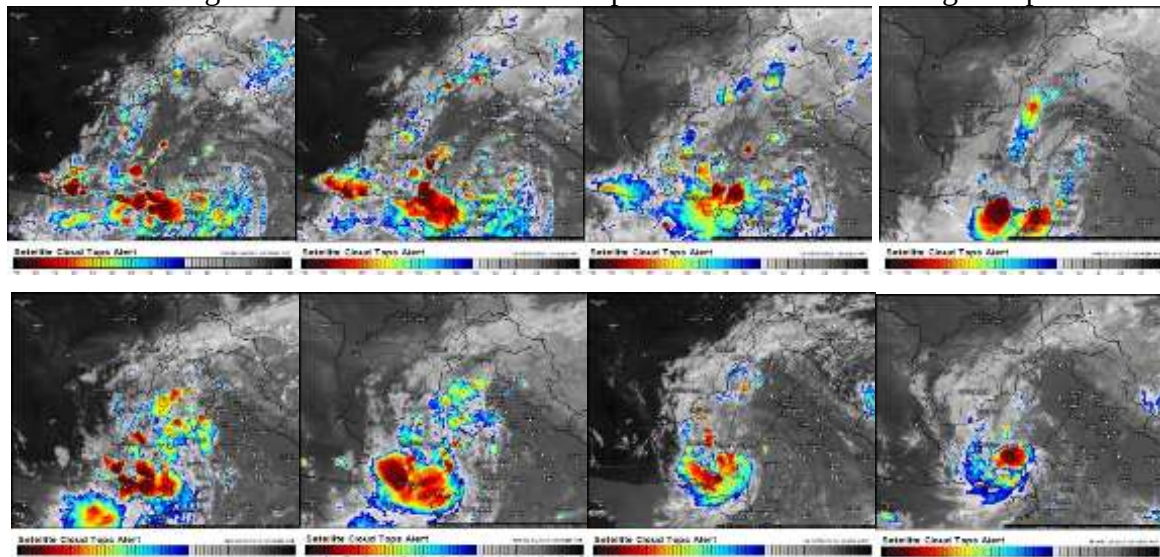


Figure 24: Satellites Images of August 2022 (16th to 20th)

5.3 Hill Torrents position during the first spell of August-2022

Exceptionally High-level Flood at Vehova, Sanghar, Vidore, Chachar & Kala Bagha Khosra, High Flood level at Kaura, Sori Lund & Kaha and Medium level Flood at Sakhi Sarwar & Mithnawa were observed.

5.4 Rivers position during the first spell of August-2022

During the spell High flood peak was recorded in river Indus at Taunsa. Medium flood in river Indus at Chashma & Guddu and also in river Kabul at Nowshera along with river Chenab at Marala, Khanki, and Qadirabad. Low flood peaks were recorded in River Indus at Tarbela, Kalabagh, Sukkur and Kotri and River Ravi at Jassar & Balloki while Palku Nullah attained the medium Flood level also.

5.5 2nd wet spell of August 2022 (24th to 27th)

The second wet spell of August 2022 which remained active for four days was mainly due to the interaction between well marked low over south Sindh and westerly trough over northern parts of the country accompanied by moist currents from the Arabian Sea. Figure 25 represents 500 hPa and 850 hPa Geopotential height patterns along with 925 hPa wind flow during this spell. It indicates that upper parts of Pakistan are under the influence of westerly

waves and under the effect of well-marked monsoon low, Southwesterly winds at 925 hPa are also present ensuring enough strong moisture supply from the Arabian Sea.

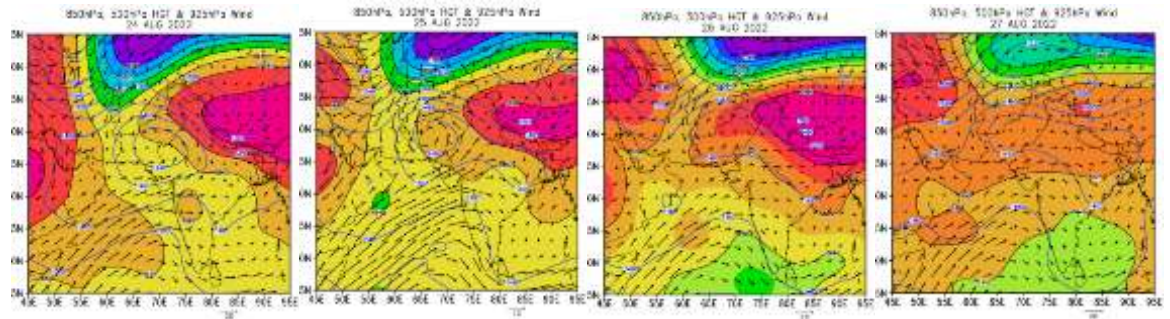


Figure 25: hPa Geopotential height & winds of August 2022 (24th to 27th)

Figure 26 & 27 indicates the spatial distribution of significant rainfall during the event which shows that maximum rainfall of more than 200 mm occurred over Sakrand, Besham, Kalat & Padidan.

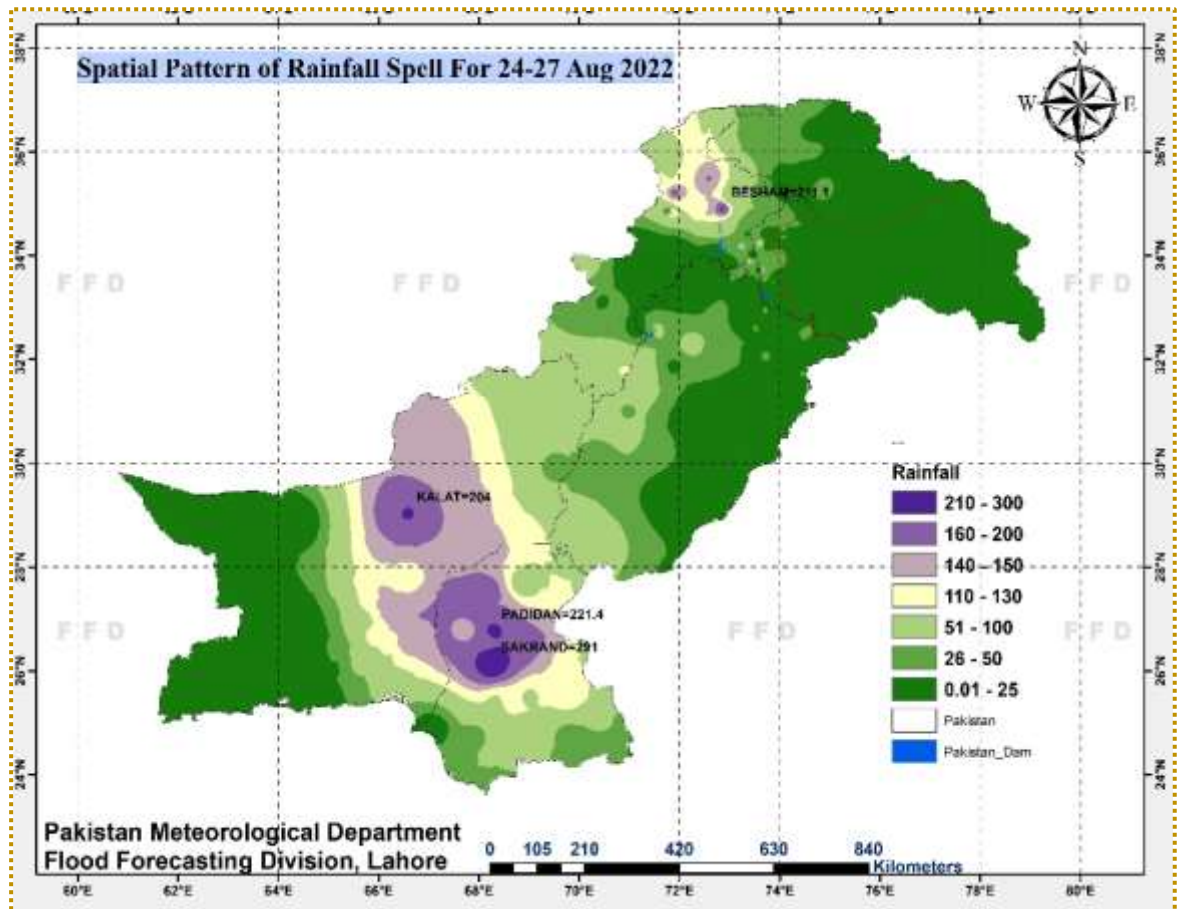


Figure 26: Spatial distribution of significant rainfall of August 2022 (24th to 27th)

2nd Rainfall Spell | 24-27 | August-2022

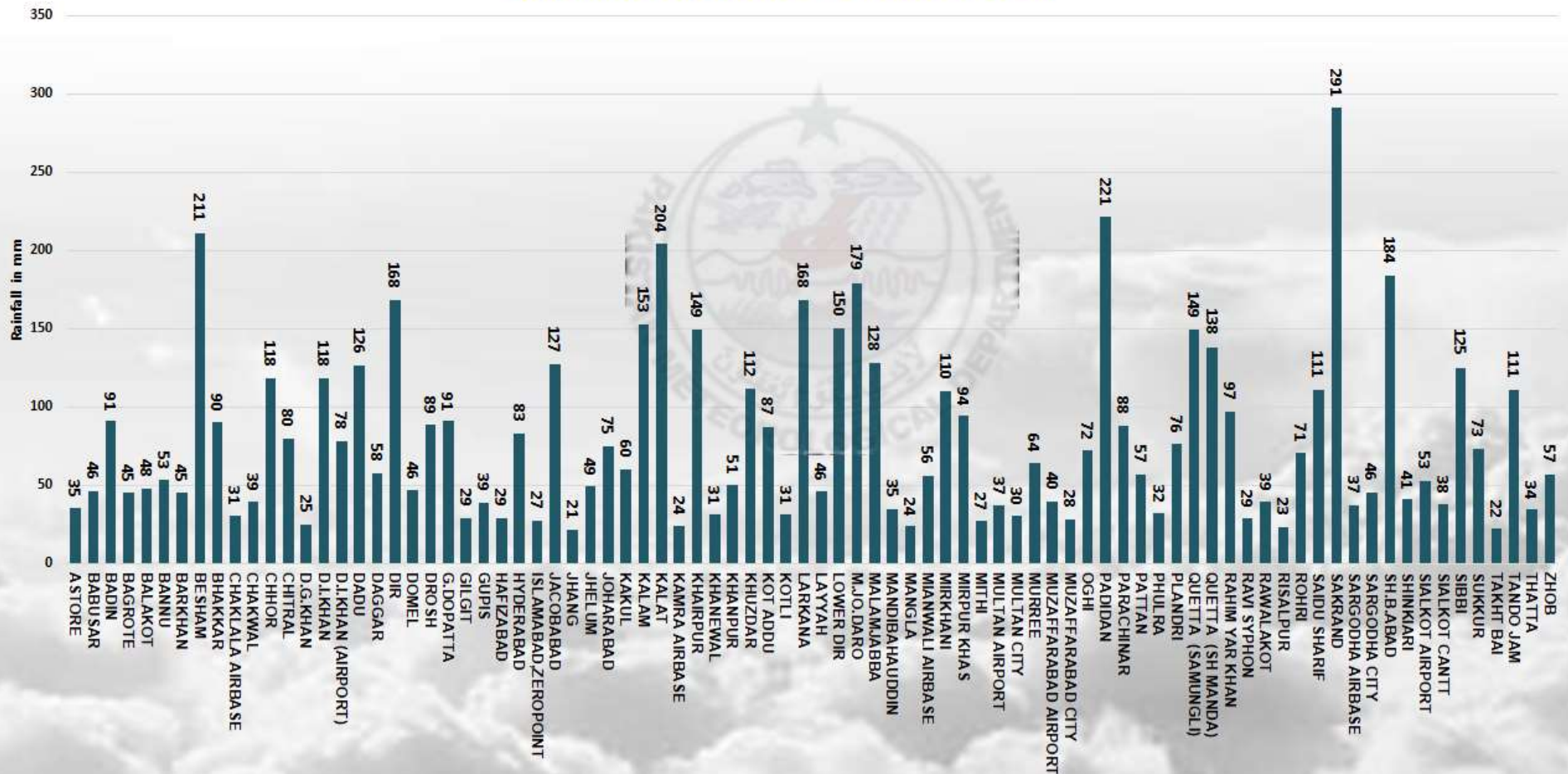


Figure 27: 2nd Wet spell rainfall of August 2022 (24th to 27th)

Figure 28 is showing rainfall/clouds over parts of the country during the period.

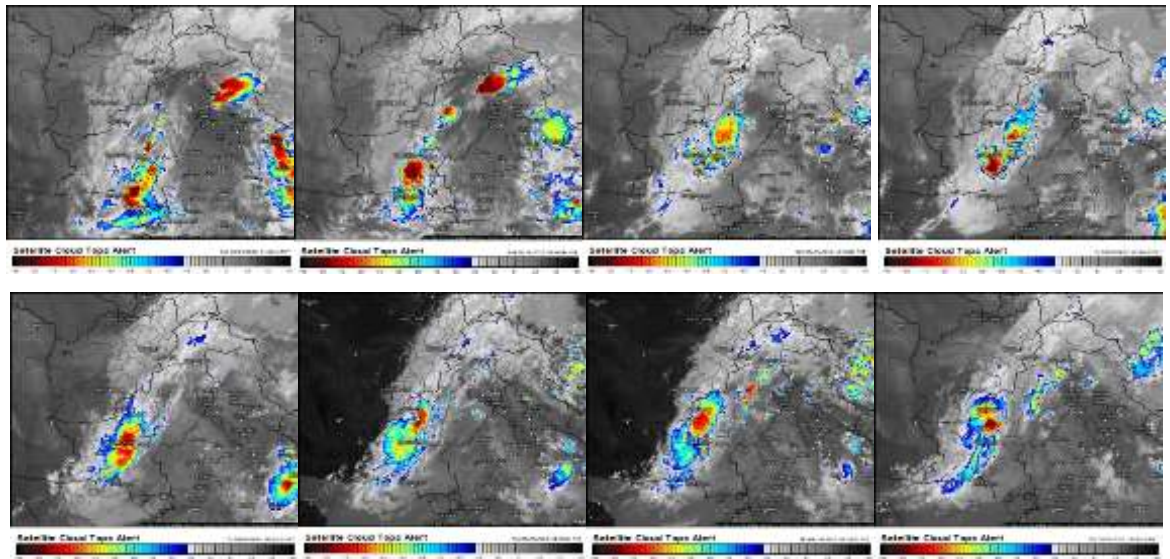


Figure 28: Satellites Images of August 2022 (24th to 27th)

5.6 Hill Torrents position during the second spell of August-2022

Ex. High Flood level at Kaura & Vidore, Very High Flood level at Kaha & Chachar, High Flood level at Vehova, Sori Lund, Sori Janubi, Zangi & Kala Baga Khosra, Medium Flood level at Sakhi Sarwar & Sori Shumali were observed.

5.7 Rivers position during the Second spell of August-2022

During the spell the Rivers position observed is shown in figure 29.

5.8 Hydrographs during August 2022







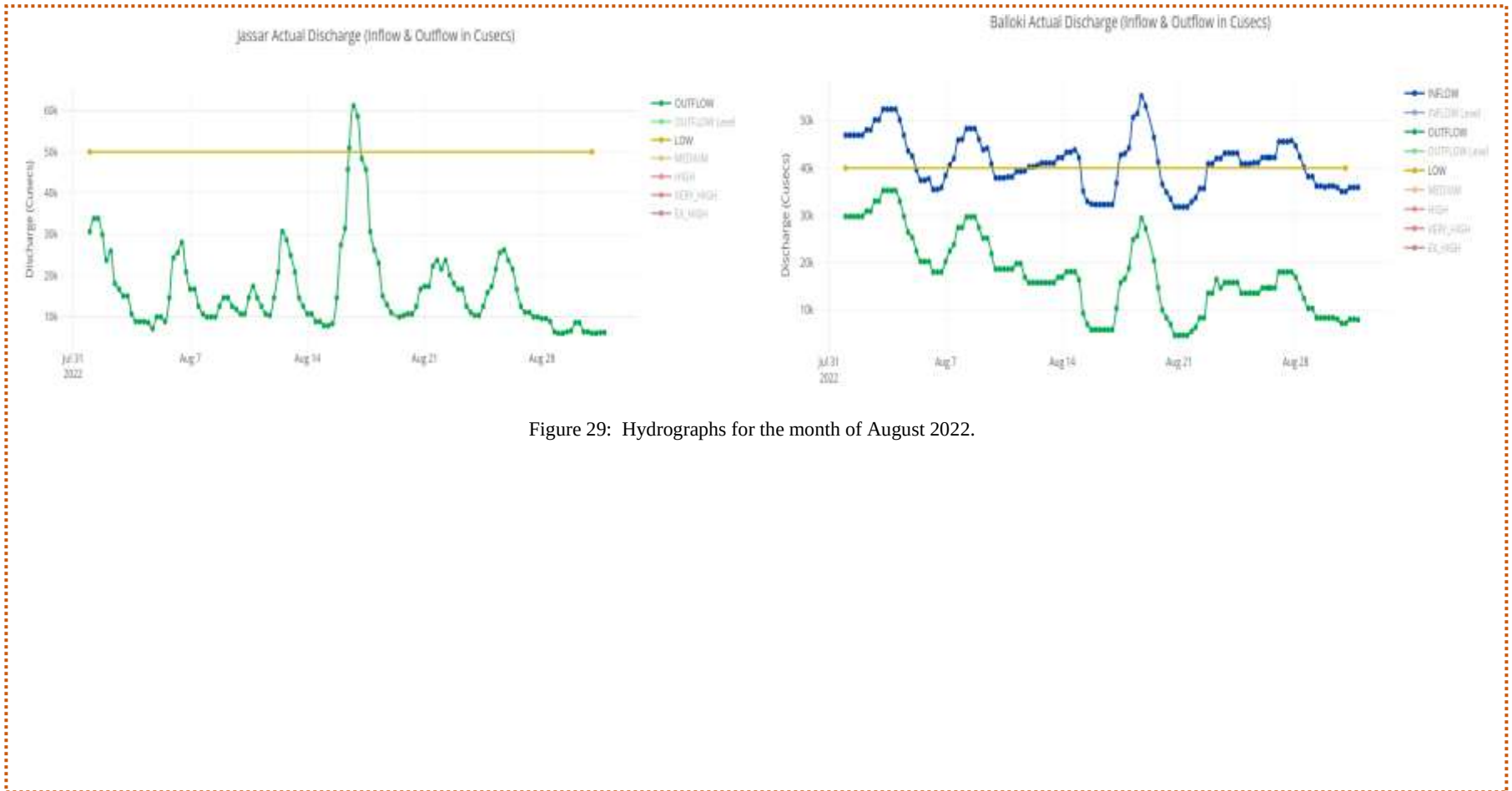


Figure 29: Hydrographs for the month of August 2022.

5.9 Rivers position/ Observed Peaks during August 2022

MAXIMUM OBSERVED FLOOD PEAKS Aug-22				
River	Sites	Inflow	Flood Level	Date & Time
Indus	Tarbela	407000	Medium	26/08/2022 23
	Kalabagh	512643	High	28/08/2022 17
	Chashma	542765	High	29/08/2022 15
	Taunsa	624159	High	31/08/2022 15
	Guddu	576076	High	23/08/2022 18
	Sukkur	579754	High	25/08/2022 06
	Kotri	387992	Medium	31/08/2022 12
Jhelum	Mangla	87000	Low	01/08/2022 12
	Rasul	16316	Normal	12/08/2022 06
Chenab	Marala	190833	Medium	11/08/2022 16
	Khanki	216908	High	12/08/2022 05
	Qadirabad	221150	High	12/08/2022 13
	Cheniot Bridge	155228	Medium	17/08/2022 06
	Trimmu	144147	Normal	01/08/2022 00
	Punjnad	121764	Normal	03/08/2022 12
Ravi	Jassar	63740	Low	16/08/2022 15
	Shahdara	31415	Normal	02/08/2022 06
	Balloki	55245	Low	18/08/2022 18
	Sidhnai	26552	Normal	13/08/2022 06
Sutlej	GS Wala	4755	Normal	27/08/2022 06
	Sulemanki	21335	Normal	28/08/2022 12
	Islam	12116	Normal	09/08/2022 18
Kabul	Nowshera	336600	V.High	28/08/2022 18
Nullahs	Bein	5214	Medium	01/08/2022 00
	Deg	31556	V.High	11/08/2022 15
	Ura	18327	V.High	12/08/2022 06
	Basantar	4783	Medium	01/08/2022 18
	Palku	3600	Medium	19/08/2022 18

Table 2: Maximum Peaks recorded during the month of August 2022.

5.10 The spatial pattern of rainfall during the month of August 2022

Isohyetal map of August 2022 indicates that first maxima rainfall more than 1200 mm, one over Padidan, Sindh & other more than 700 mm over Larkana & Moin Jo Daro while more than 500 over Khairpur, Sakrand, Tendo Jam and Chhor. The spatial distribution of rainfall map of August 2022 rest of the country is shown in figure 30 & 31.

TOTAL RAINFALL OF AUGUST 2022								
PMD OBSERVATORIES, WAPDA & TELEMETRIC NETWORK RAINFALL								
Sr#	Stations	Rainfall	Sr#	Stations	Rainfall	Sr#	Stations	Rainfall
1	PADIDAN	1228.5	31	DAGGAR	255.8	81	RISALPUR	156.0
2	M.JO.DARO	779.5	32	HYDERABAD	243.0	82	G.G.KHAN	155.0
3	LARKANA	758.3	33	SIBBI	243.0	83	ATTOCK	154.2
4	SAKRAND	617.0	34	LAHORE, CITY	240.3	84	JOHANEWAL	154.0
5	KHAIKPUR	615.3	35	LAYYAH	237.5	85	BAGROTE	150.0
6	TANDO JAM	603.0	36	D.I.KHAN (AIRPORT)	237.0	86	CHERAT	146.7
7	CHHOR	503.5	37	KHUZDAR	227.1	87	LAHORE, AIRPORT	145.7
8	JACOBABAD	493.0	38	KOT ADDU	225.0	88	CHAKALA AIRBASE	143.1
9	SH.B.ABAD	488.2	39	RAHM YAR KHAN	224.4	89	DROSH	142.3
10	ROHRI	420.0	40	D.I.KHAN	223.0	90	OKARA	139.9
11	MURREE	402.5	41	KOTLI	218.4	91	PHULWA	134.9
12	SUKKUR	377.5	42	MIRKHANI	211.8	92	LASBELA	131.5
13	DIR	361.0	43	SHINKARI	211.8	93	KARACHI A/P	128.0
14	KALAT	361.0	44	THATTA	208.8	94	TAKHT BAI	123.6
15	PLANDRI	342.4	45	QUETTA (SAMUNGLI)	208.0	95	ISLAMABAD, ZEROPOINT	122.1
16	DADU	337.0	46	SIALKOT AIRPORT	207.4	96	SIDDIKOT AIRBASE	121.9
17	BARKHAN	312.0	47	QUETTA (SH MANDA)	207.0	97	GUJRAT	115.0
18	BADIN	307.5	48	RAWALAKOT	198.1	98	BANNU	113.5
19	MIRPUR KHAS	304.0	49	KHANPUR	189.8	99	NAROWAL	112.8
20	KAKUL	297.0	50	OGHI	188.2	100	PATTAN	112.0
21	MUZAFFARABAD AIRPORT	289.3	51	HAFIZABAD	185.0	101	MANGLA	110.5
22	BHAKKAR	284.2	52	KASUR	180.0	102	BAHAWALPUR AIRPORT	110.2
23	G.DOPATTA	278.3	53	SAIDU SHARIF	178.0	103	CHITRAL	110.0
24	LOWER DIR	278.0	54	DOMEL	173.0	104	CHAKWAL	108.1
25	MITHI	273.0	55	MANDIBAHALUDHIN	169.5	105	PESHAWAR AIRBASE	106.8
26	MUZAFFARABAD CITY	272.9	56	PARACHINAR	166.1	106	TABEELA	106.2
27	KALAM	268.1	57	ZHOB	163.0	107	MUNZA	105.1
28	BESHAM	256.0	58	SIALKOT CANTT	158.2	108	JOHARABAD	103.0
29	DAULATNAGAR	256.4	59	BALAKOT	157.0	89		
30	MALAMJARBA	256.0	60	RAVI SYPHON	156.9	90		

More than 100 MM Rainfall

More than 100 MM Rainfall

Figure 30: Total Rainfall for the month of August 2022.

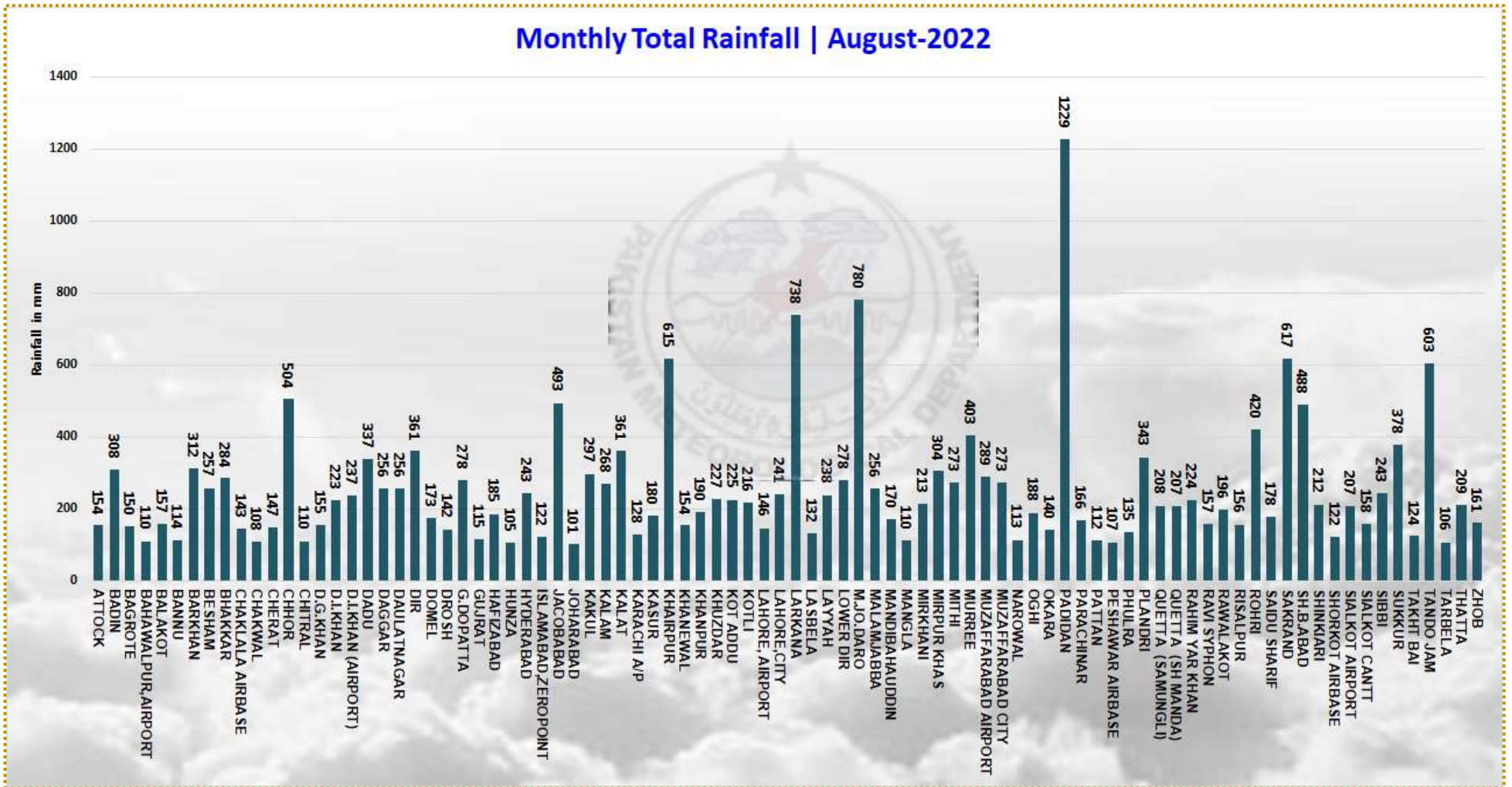


Figure 31: Total Rainfall for the month of August 2022.

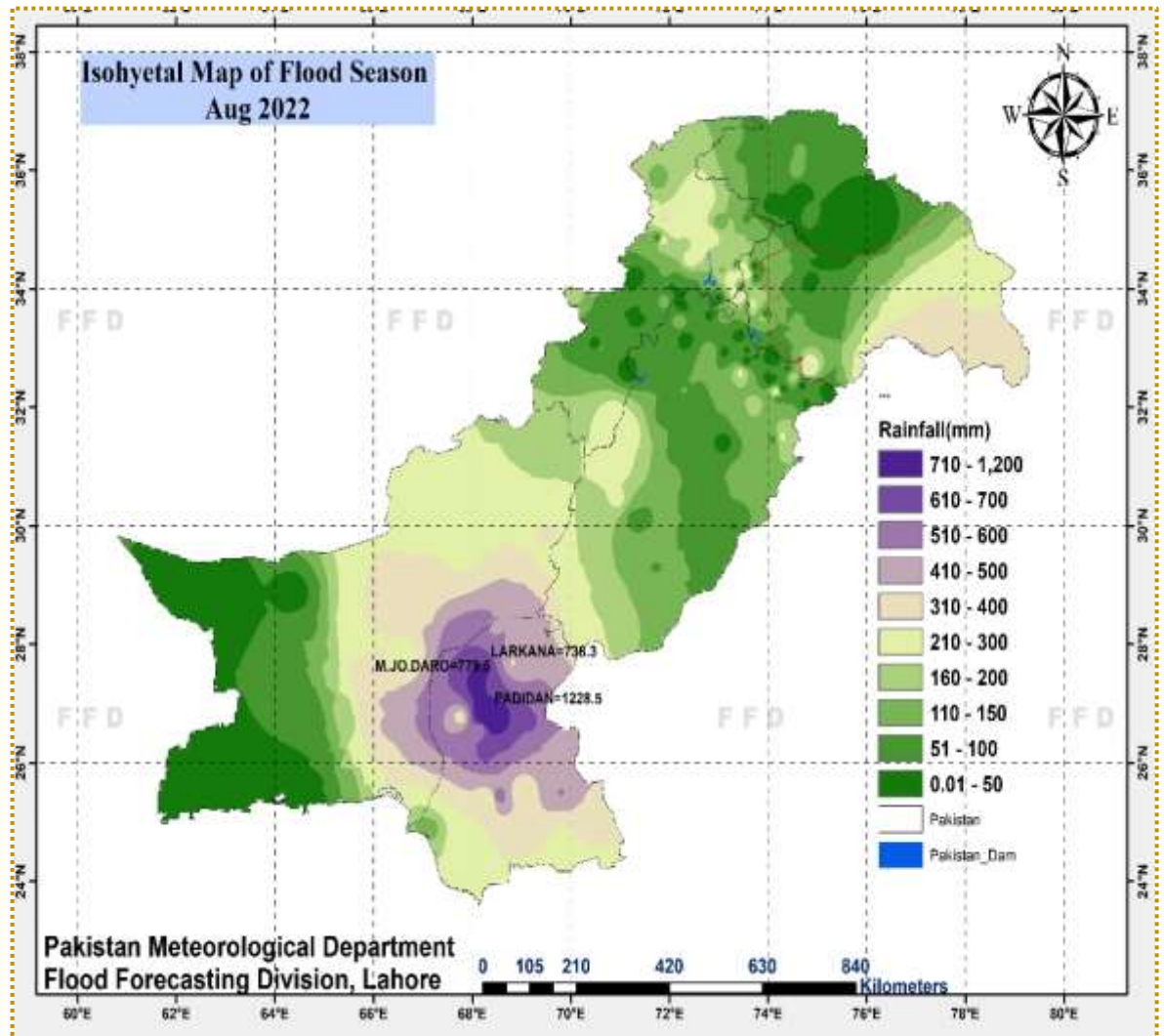


Figure 32: Spatial distribution rainfall map of August 2022.

5.11 Departure Anomaly during the month of August 2022

Departure Anomaly map for the month of August 2022 indicates that Most parts of the country received above normal rainfall. Departure Anomaly map of August 2022 for the country is shown in Figure 33 & 35.

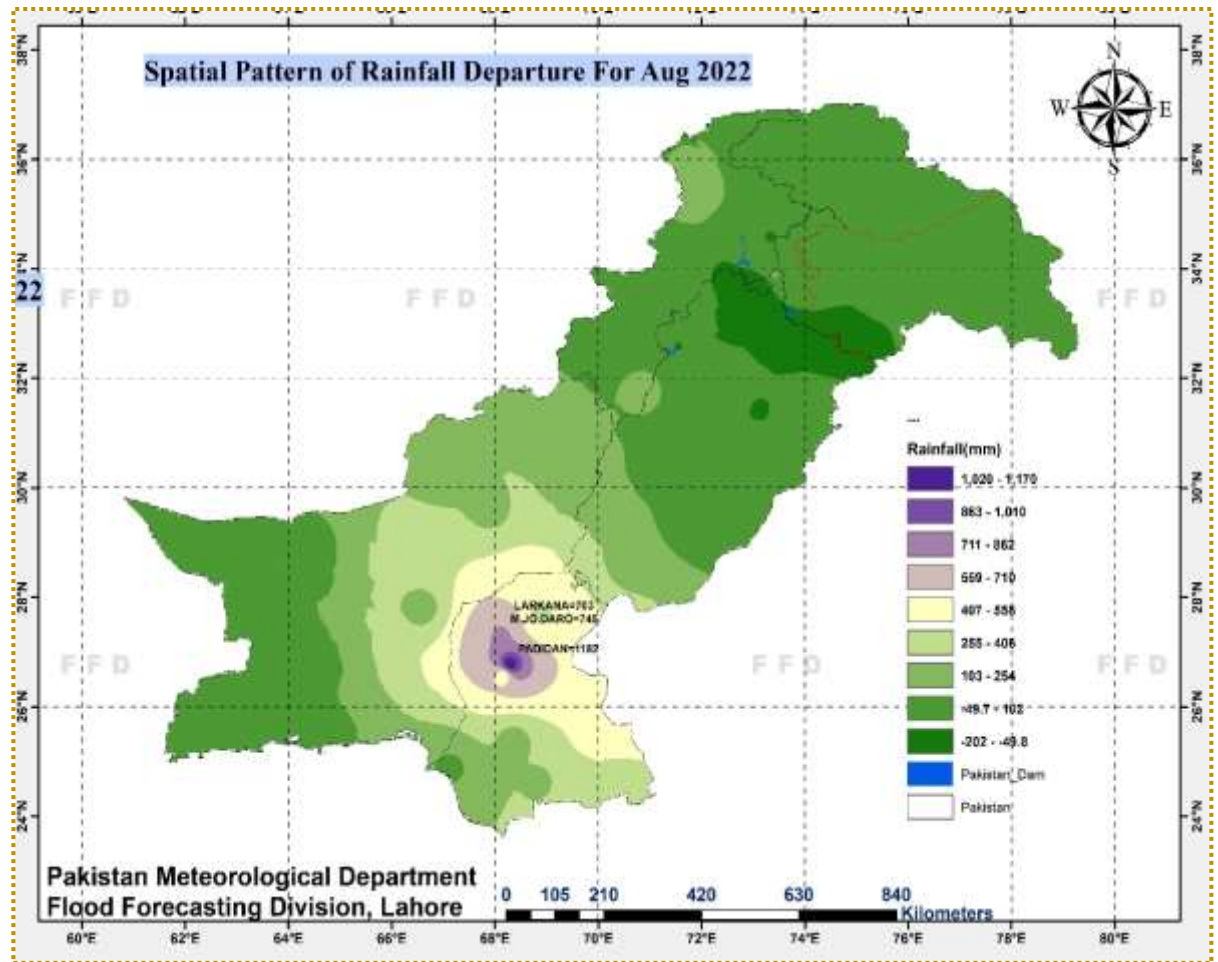


Figure 33: Percentage Anomaly rainfall map of August 2022.

5.12 Temporal Distribution during the month of August 2022

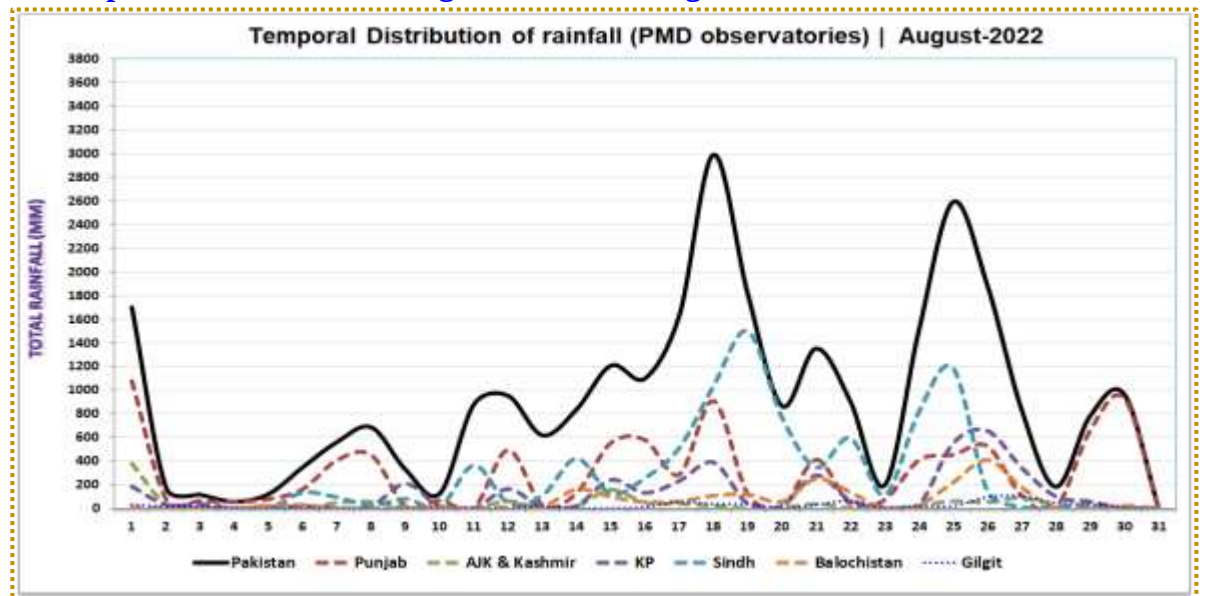


Figure 34: Temporal distribution of rainfall August 2022.

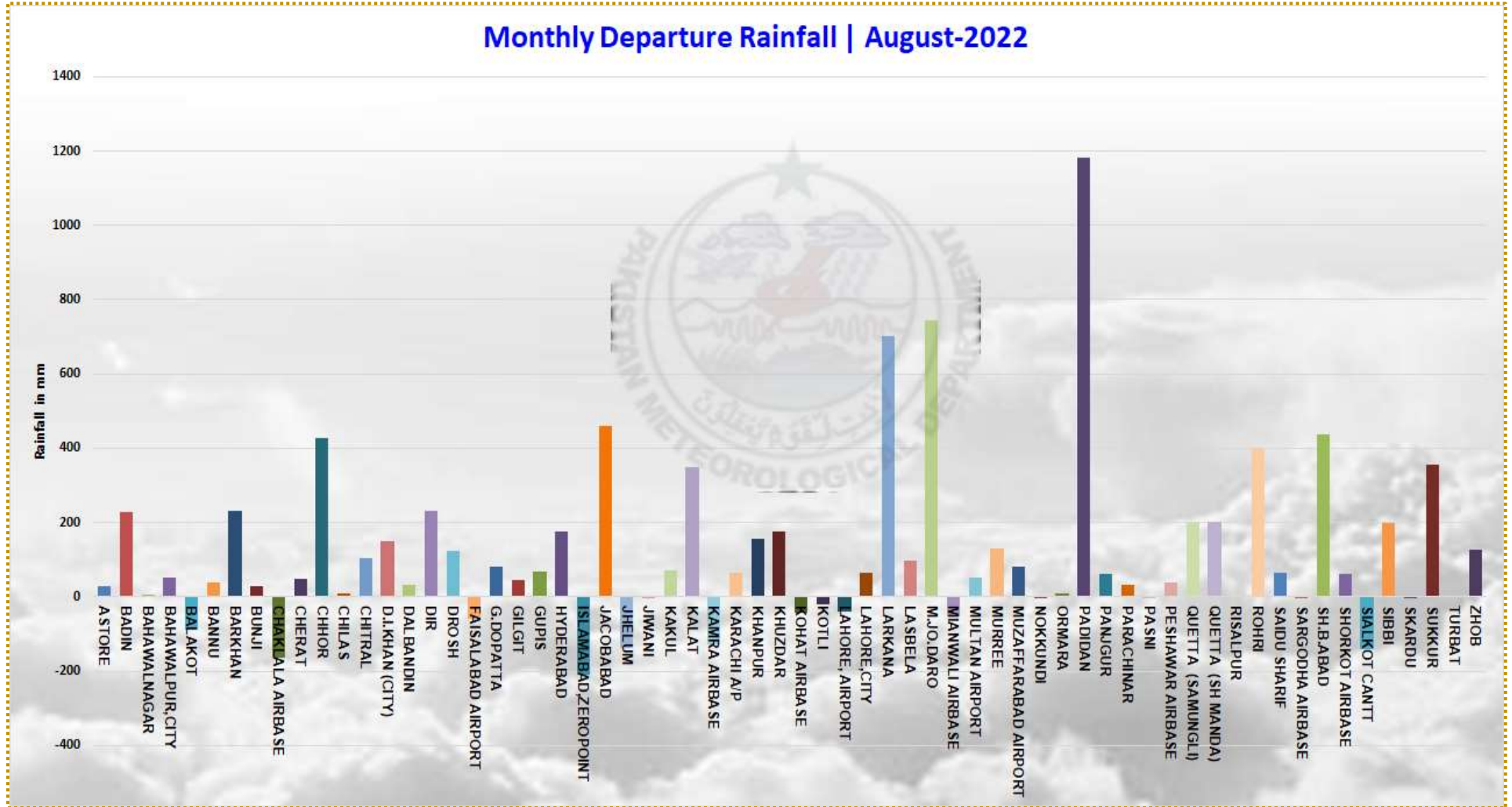
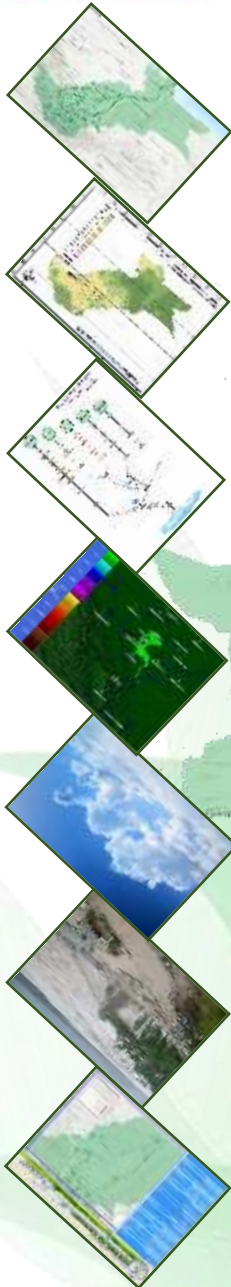
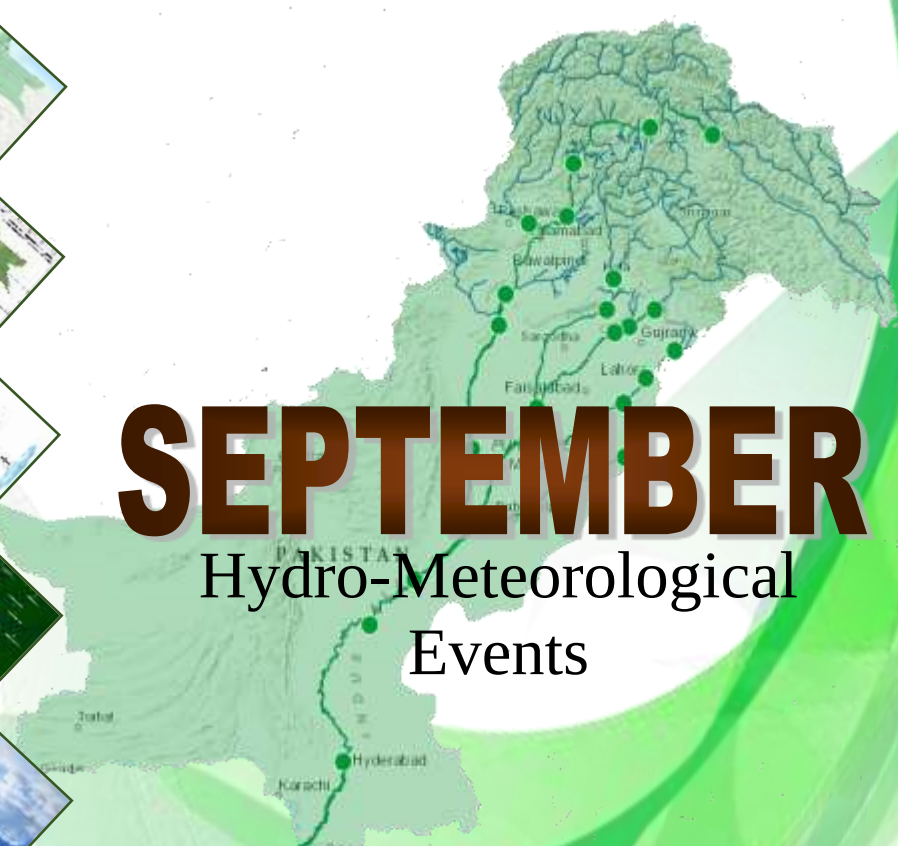


Figure 35: Rainfall Departure for of August 2022.



SEPTEMBER

Hydro-Meteorological Events



6 Significant Hydro-Meteorological events during the month of Sep-2022

During the month of September, four wet spells were observed. High flood situation was recorded in river Indus at Taunsa & Kotri. Medium Flood in River Kabul at Nowshera, low flood in river Indus at Kalabagh and Chashma were also enumerated.

6.1 1st wet spell of September 2022 (04th to 06th)

This spell occurred from 04th to 06th September 2022 which remained active for three days. During this event light to moderate rain was reported to north & northeast Punjab, Khyber-Pakhtunkhwa and Kashmir. Rest of the country remained generally cloudless during the spell. This situation was created by the presence of a westerly wave over north of Pakistan, interacting with the necessary moisture available as shown in Figure 36.

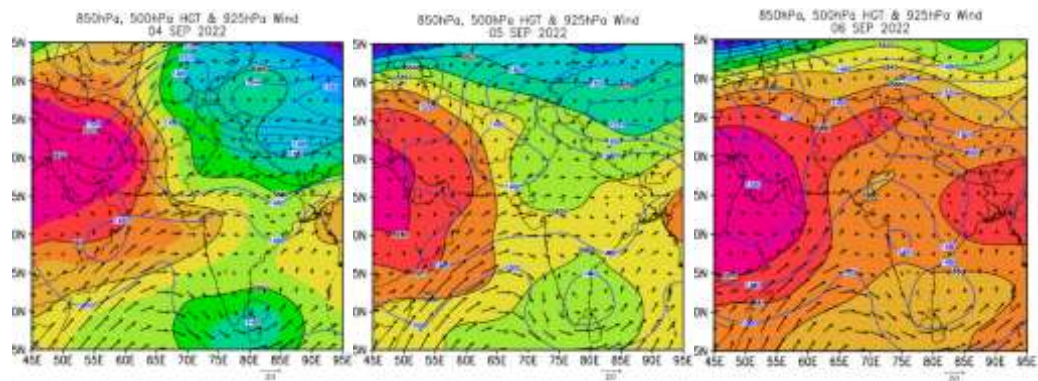


Figure 36: hPa geopotential height & hPa winds map of September 2022 (04th to 06th)

Figure 37 & 39 shows the spatial distribution of significant rainfall more than 100 mm recorded over Kakul & other maxima of rainfall more than 60 mm observed around Kotli & Muzaffarabad.

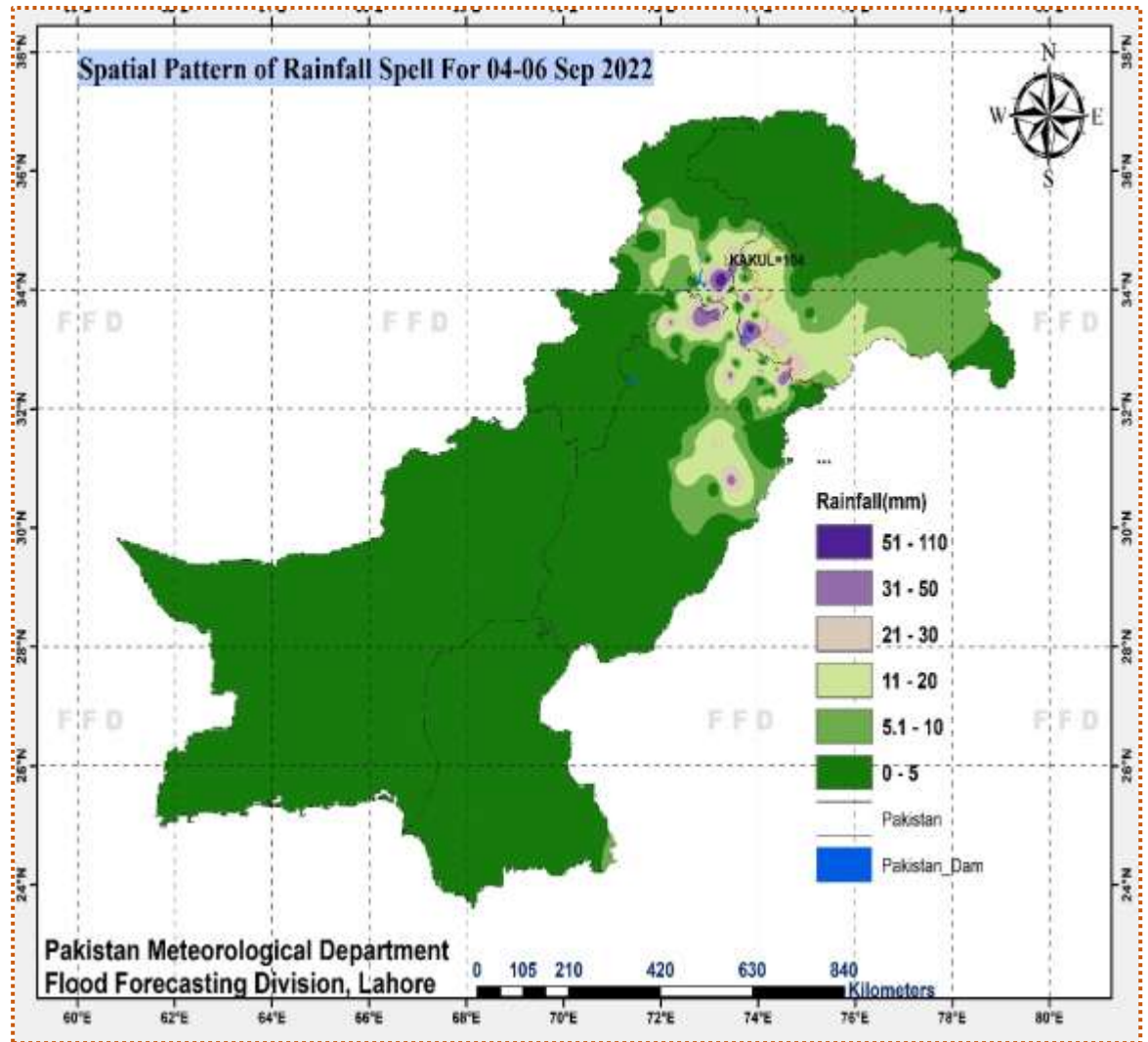


Figure 37: Spatial distribution of significant rainfall of September 2022 (04th to 06th)

The satellite image in figure 38 shows light to moderate clouds over North & northeast Punjab, Khyber-Pakhtunkhwa and rest of the country remained sunny during the period.

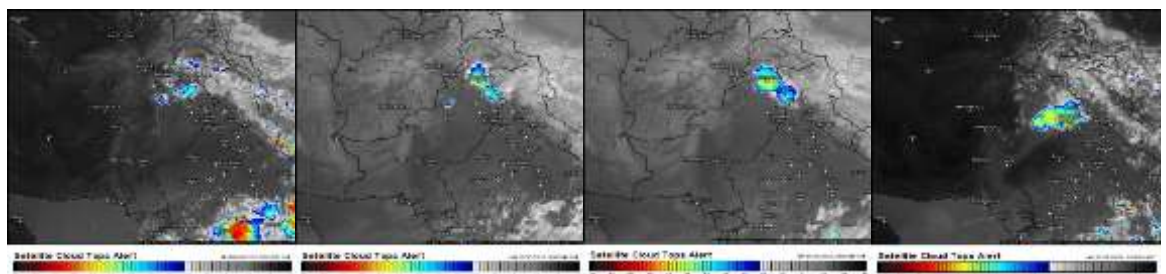


Figure 38: Satellites Images of September 2022 (04th to 06th)

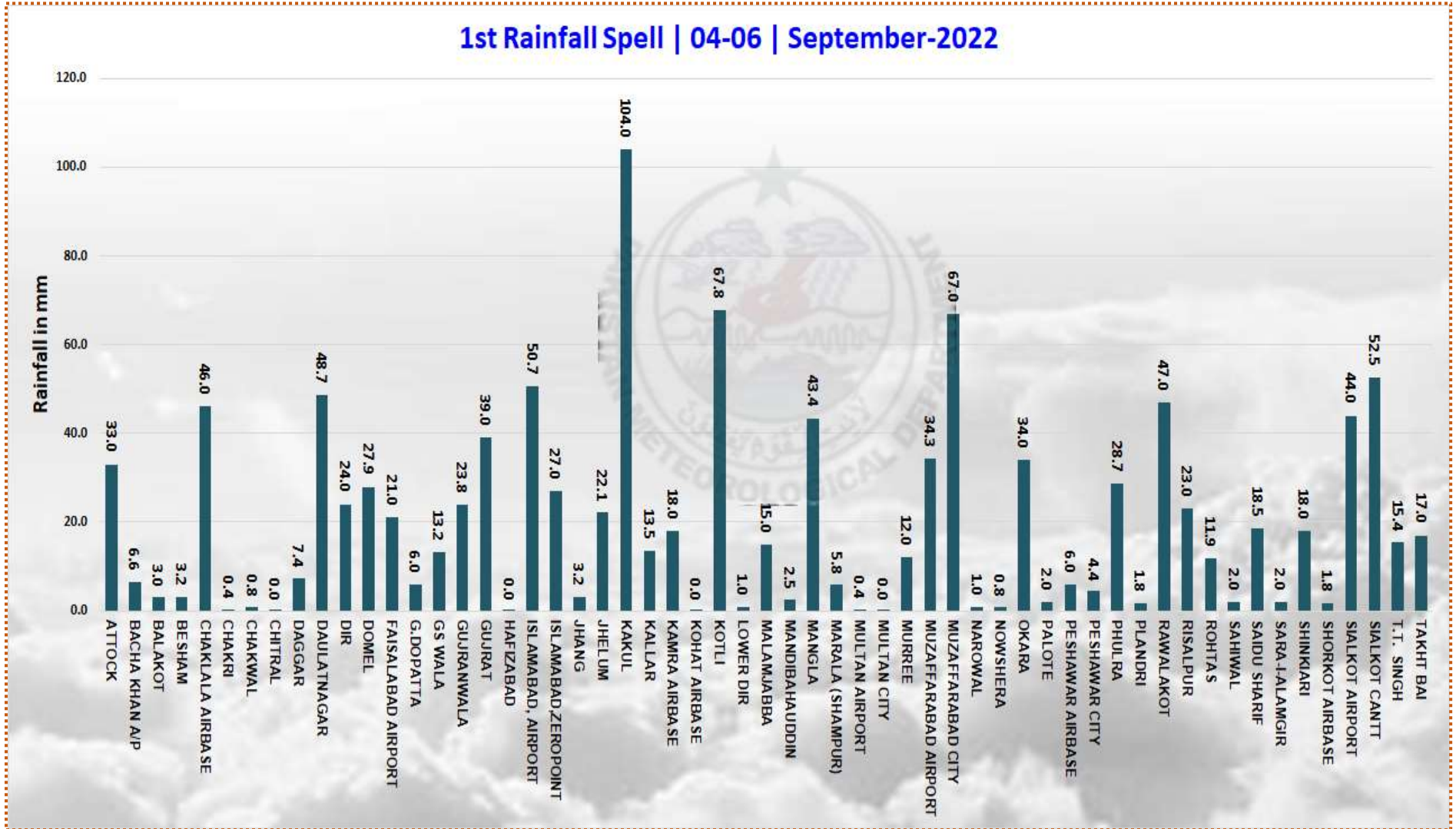


Figure 39: 1st Wet Spell of Rainfall September 2022 (04th to 06th)

6.2 Rivers position during the first spell of September-2022

During the rainy spell no flood situation arises in any of the major rivers. However due to remnants of the rainfall during end of August in the catchments of river Indus and Kabul River Indus at Sukkur attained the High Flood.

6.3 2nd wet spell of September 2022 (10th to 14th)

The second rainy spell occurred from 10th to 14th September 2022 which remained active for five days. During this event light to moderate rainfall was reported to the Punjab, northeast KPK and southeast Sindh. Situation occurred by the interaction of a westerly wave over the north of Pakistan with the sufficient moisture available as shown in Figure 40.

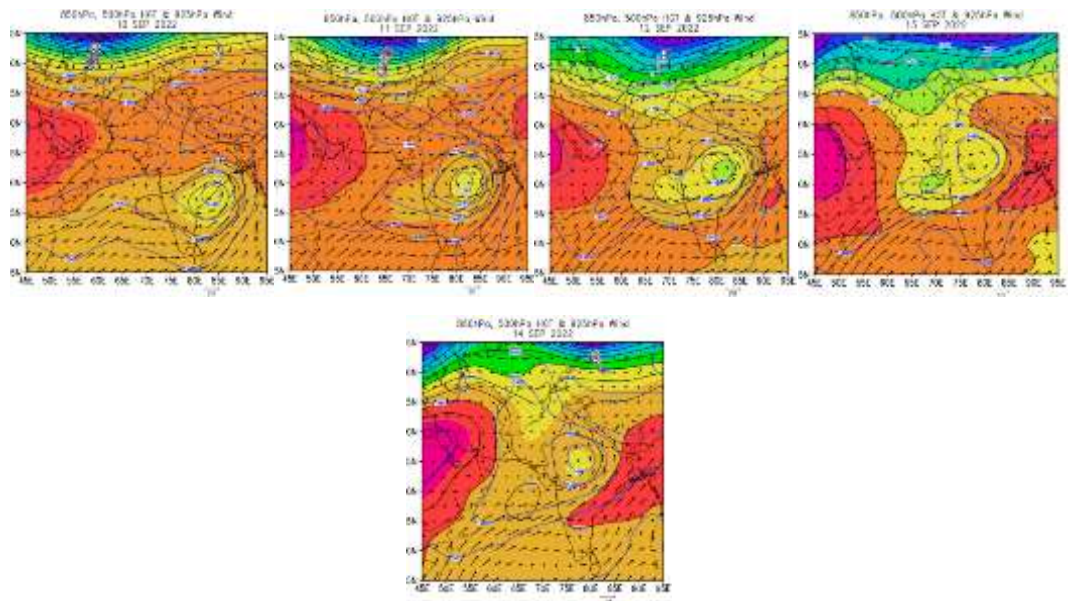


Figure 40: hPa geopotential height & hPa winds map of Sep-2022 (10th to 14th)

Figure 41 & 43 show the spatial distribution of significant rainfall. More than 100 mm recorded over Kakul and more than 50 mm over Islamabad Airport, Jhelum, Kotli, Kamra & Sargodha. More than 10 mm rainfall recorded over rest of the country is shown below in Figure 43.

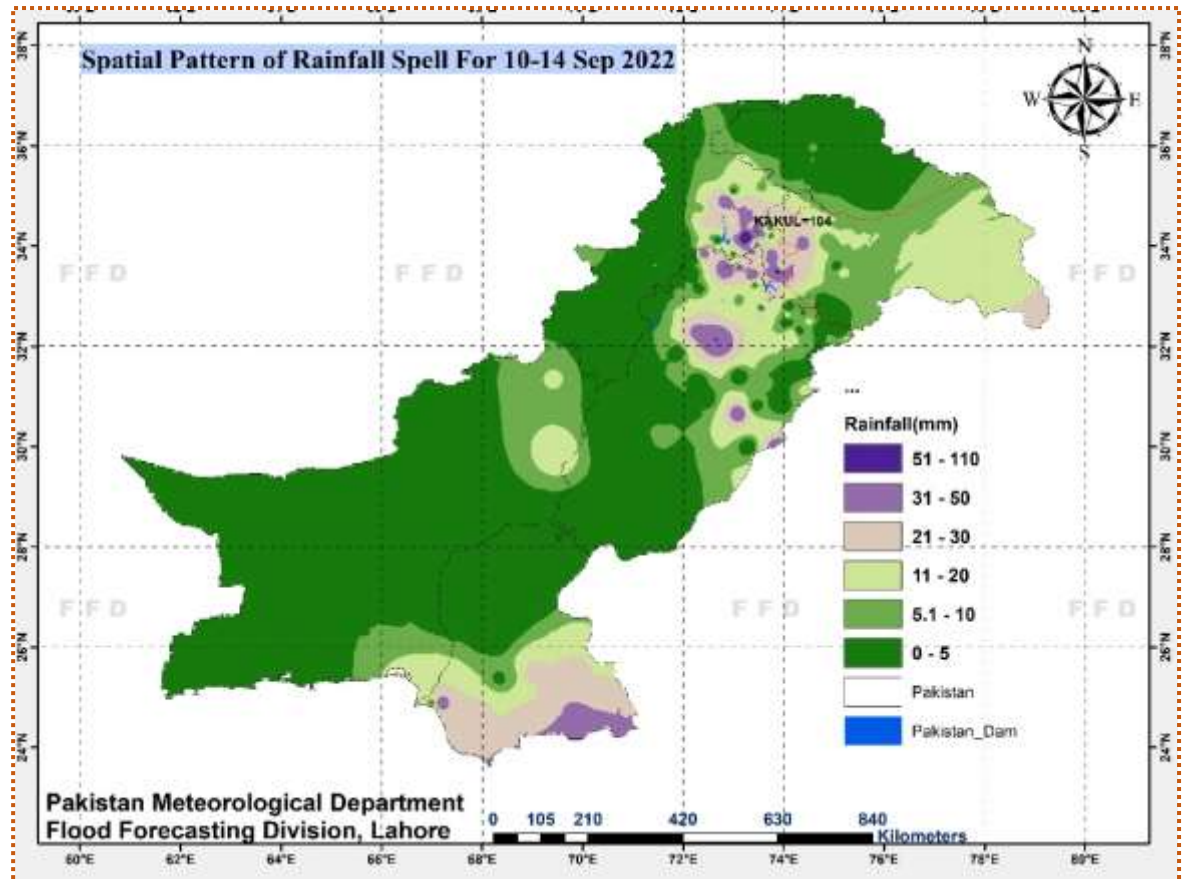


Figure 41: Spatial distribution of significant rainfall map of Sep-2022 (10th to 14th)

Satellite images in figure 42 show moderate clouds over Punjab & Kashmir.

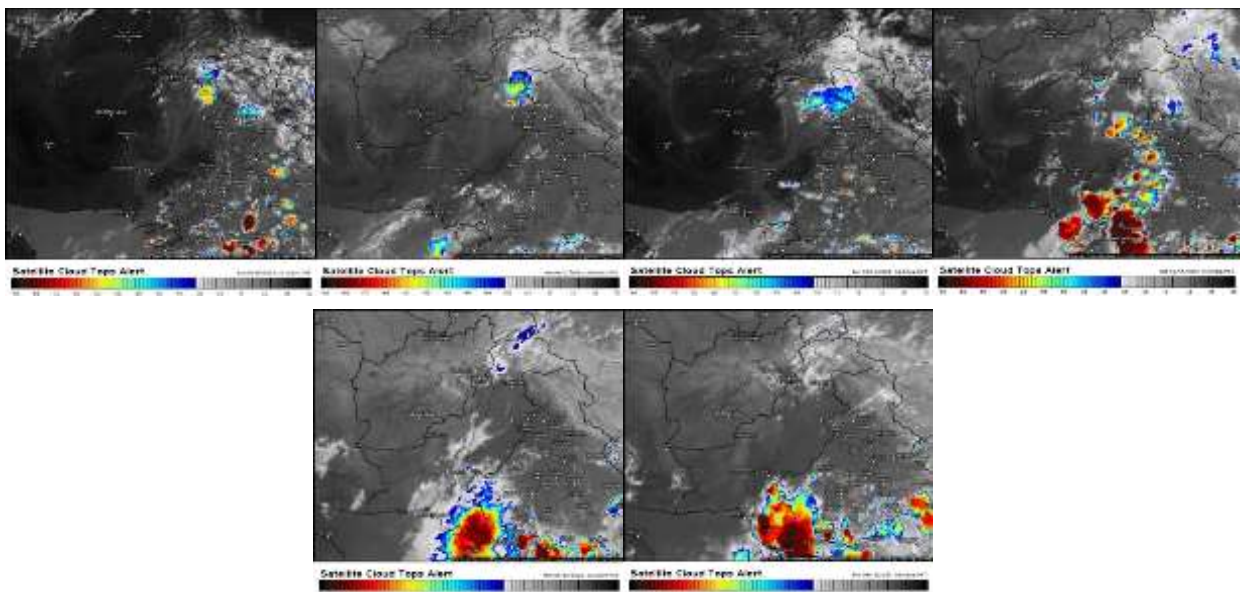


Figure 42: Satellites Images of Sep-2021 (10th to 14th)

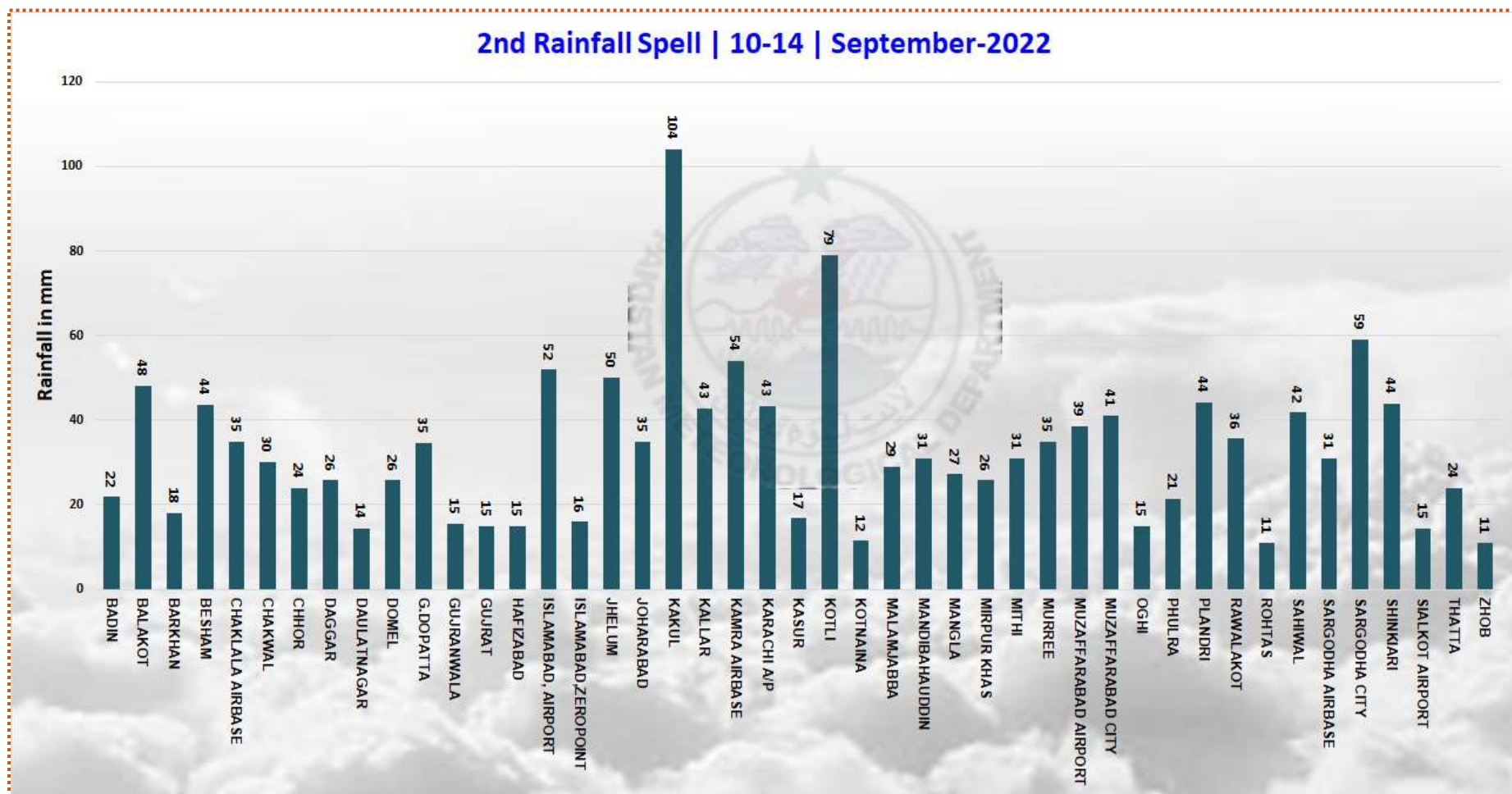


Figure 43: 02nd Wet Spell Rainfall of Sep-2022 (10th to 14th)

6.4 Rivers position during the second spell of September-2022

Due to the spell no flood situation observed in any of the River. As a result of flood wave generated at Tarbela and Kabul along with accumulated rainfall of Hill torrents of D.G.Khan, River Indus at Kotri registered the High Flood peak.

6.5 3rd wet spell of September 2022 (17th to 19th)

The third rainy spell occurred from 17th to 19th September 2022 which remained active for three days. During this event light to moderate rainfall was reported as shown in figure 46. Situation occurred by the interaction of a westerly wave over the north of Pakistan with the enough moisture available as shown in Figure 44.

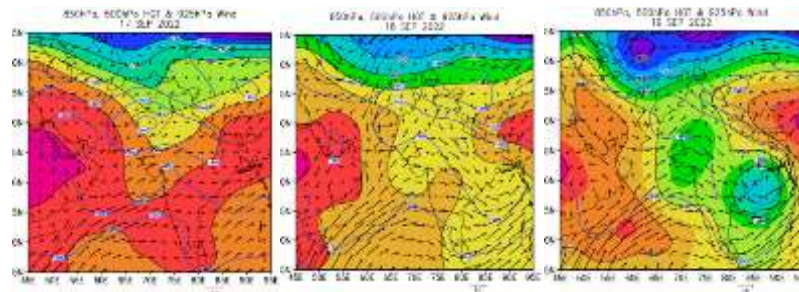


Figure 44: hPa geopotential height & hPa winds map of Sep-2022 (17th to 19th)

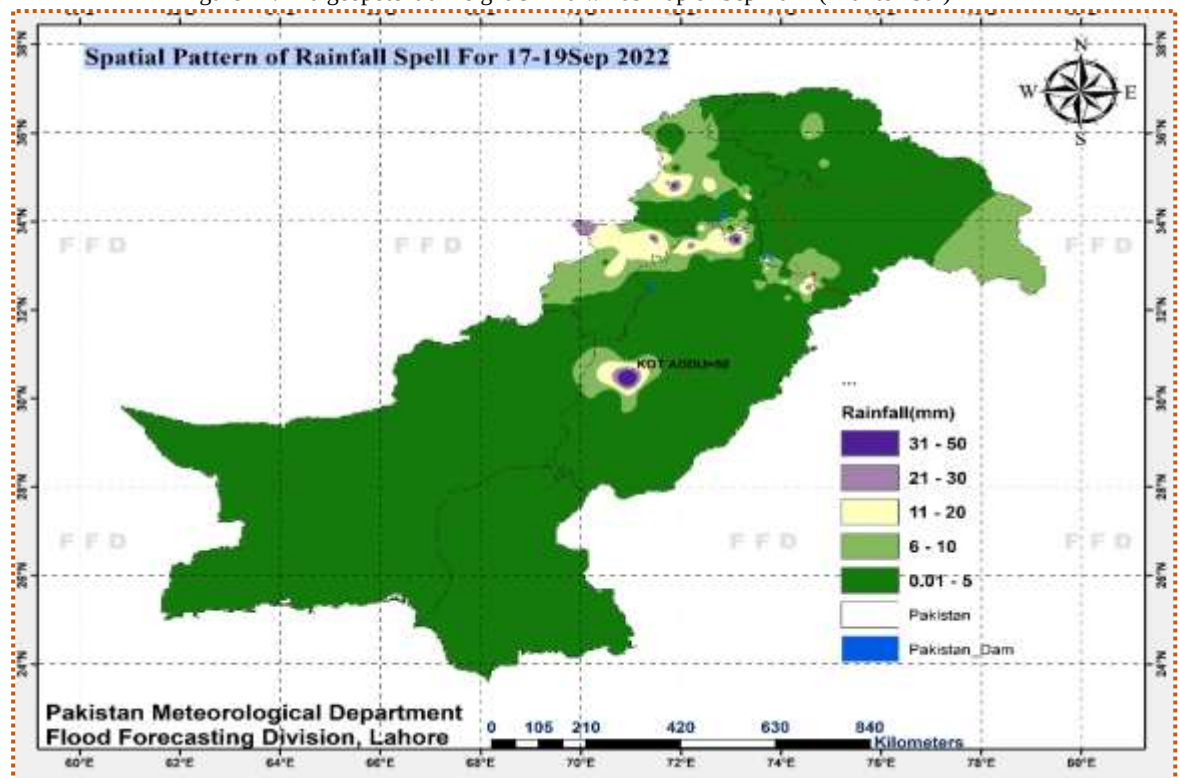


Figure 45: Spatial distribution of significant rainfall map of Sep-2022 (17th to 19th)

Figure 45 & 46 shows the spatial distribution of rainfall of 50 mm recorded over Kot Addu and more than 30 mm over Kohat, Lower Dir, Islamabad Airport and Sialkot.

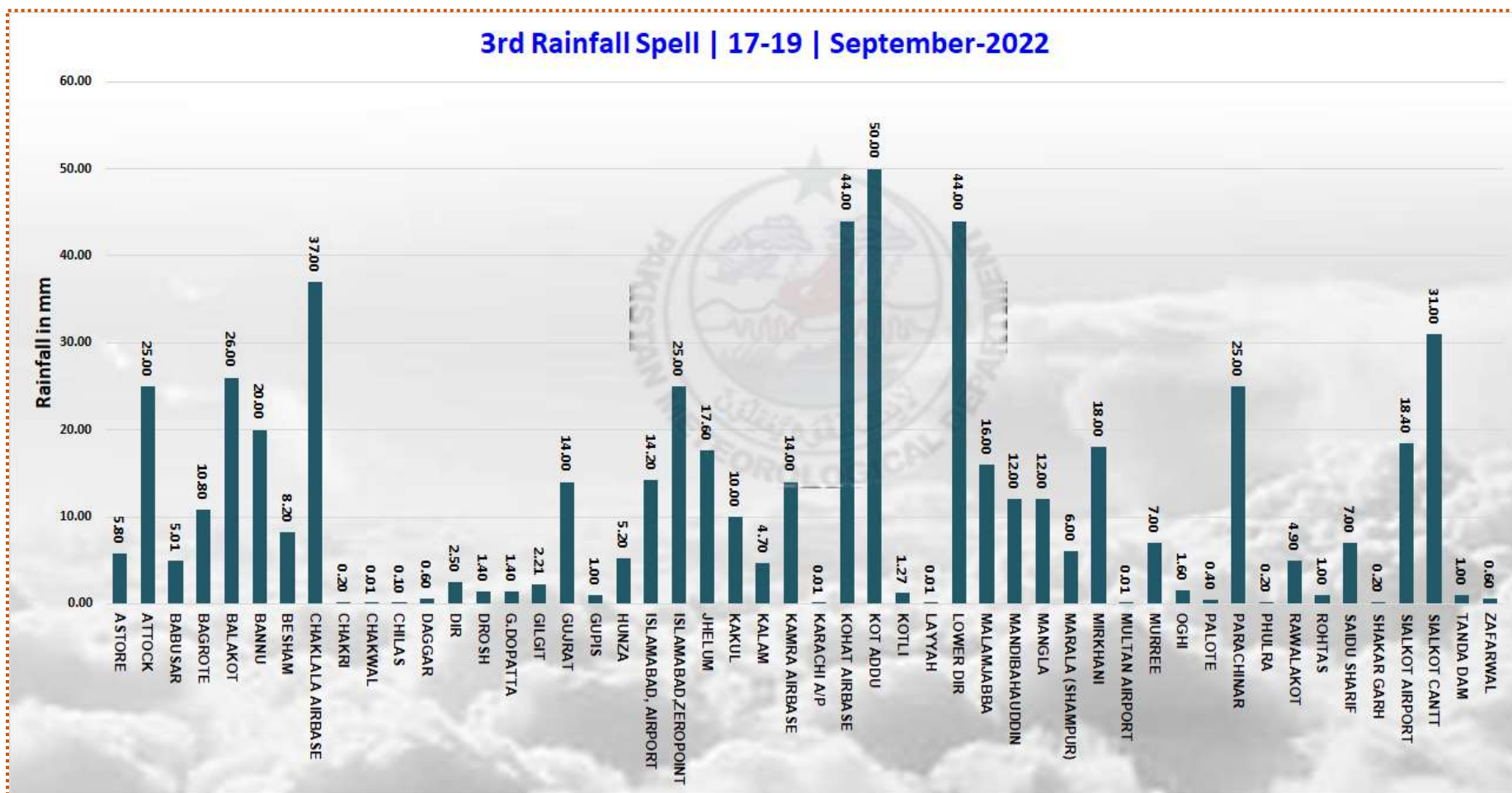


Figure 46: 02nd Wet Spell Rainfall of Sep-2022 (17th to 19th)

Satellite images in figure 47 show moderate clouds over Punjab & Kashmir.

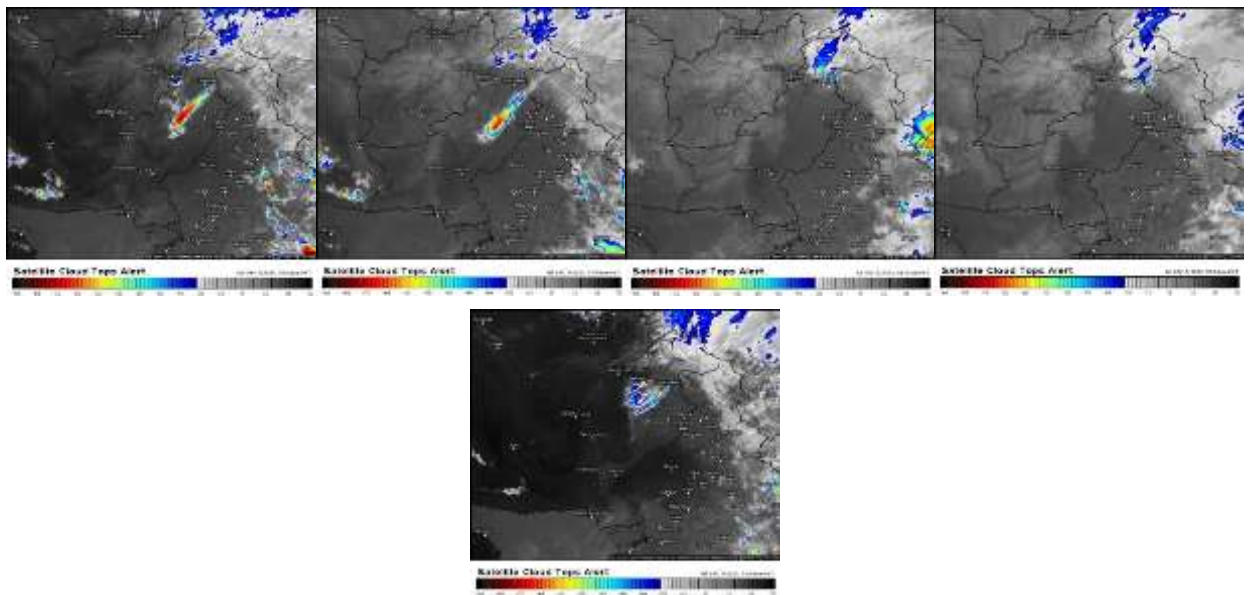


Figure 47: Satellites Images of Sep-2022 (17th to 19th)

6.6 Rivers position during the third spell of September-2022

No flood situation developed during the spell.

6.7 4th wet spell of September 2022 (23rd to 26th)

The fourth rainy spell occurred from 23rd to 26th September 2022 which remained active for four days. During this event light to moderate rainfall was reported at the upper half of the country. situation occurred by the interaction of a westerly wave over the north of Pakistan with the adequate moisture available as shown in Figure 48.

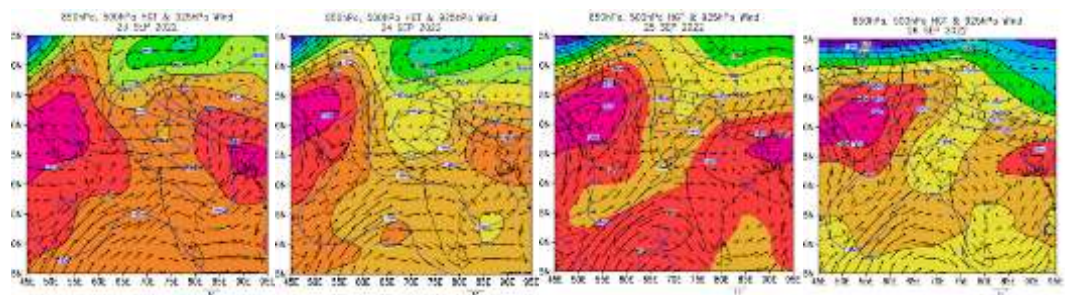


Figure 48: hPa geopotential height & hPa winds map of Sep-2022 (23rd to 26th)

Figure 49 & 50 shows the spatial distribution of rainfall of more than 70 mm recorded over Muzaffarabad Airport.



Figure 49: 04th Wet Spell Rainfall of Sep-2022 (23rd to 26th)

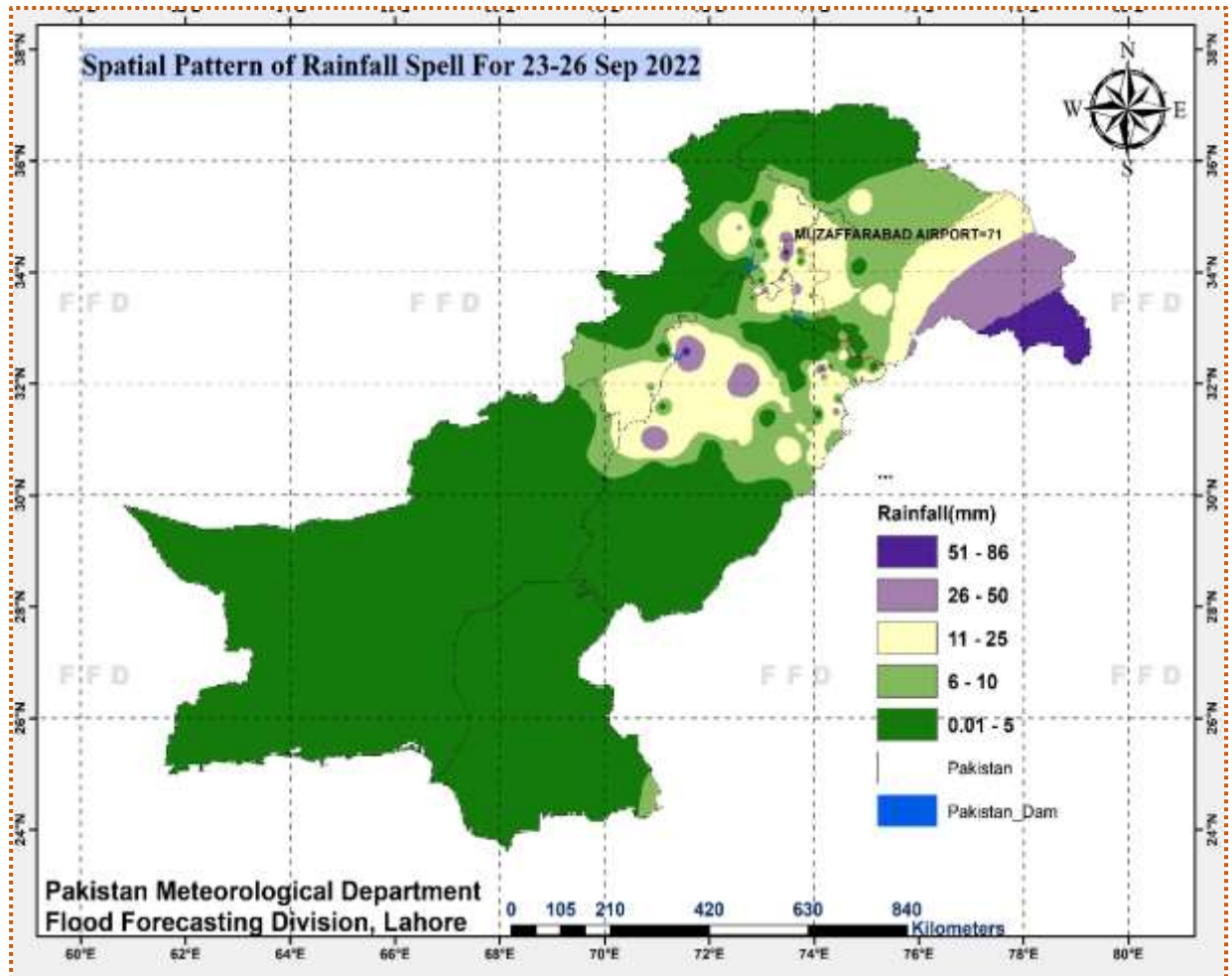


Figure 50: Spatial distribution of significant rainfall map of Sep-2022 (23rd to 26th)

Satellite images in figure 51 shows moderate clouds formation during the spell.

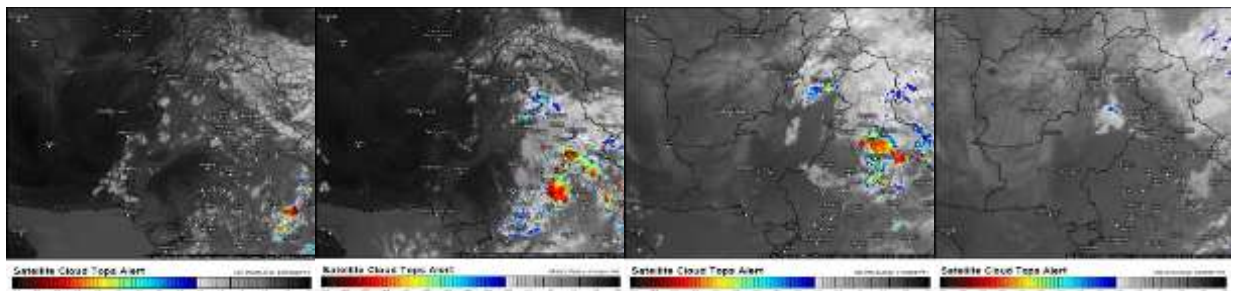


Figure 51: Satellites Images of Sep-2022 (23rd to 26th)

6.8 Rivers position during the fourth spell of September-2022

During the spell no flood recorded.

6.9 Hydrographs recorded during the month of September 2022 are as below



Figure 52: Hydrograph for the month of September 2022.

MAXIMUM OBSERVED FLOOD PEAKS SEPTEMBER_2022				
River	Sites	Inflow	Flood Level	Date & Time
Indus	Tarbela	185000	Normal	01/09/2022 00
	Kalabagh	261450	Low	01/09/2022 00
	Chashma	299077	Low	01/09/2022 00
	Taunsa	596121	High	01/09/2022 00
	Guddu	561118	High	03/09/2022 00
	Sukkur	559998	High	04/09/2022 00
	Kotri	626193	High	11/09/2022 06
Jhelum	Mangla	47000	Normal	11/09/2022 12
	Rasul	30195	Normal	27/09/2022 06
Chenab	Marala	74130	Normal	04/09/2022 18
	Khanki	49723	Normal	05/09/2022 12
	Qadirabad	43147	Normal	27/09/2022 12
	Cheniot Bridge	10343	Normal	07/09/2022 18
	Trimmu	41725	Normal	01/09/2022 12
	Punjnad	44381	Normal	01/09/2022 06
Ravi	Jassar	12571	Normal	27/09/2022 06
	Shahdara	19496	Normal	28/09/2022 12
	Balloki	39420	Normal	07/09/2022 00
	Sidhnai	26395	Normal	10/09/2022 12
Sutlej	GS Wala	2324	Normal	27/09/2022 06
	Sulemanki	21522	Normal	29/09/2022 12
	Islam	8442	Normal	02/09/2022 06
Kabul	Nowshera	85200	Medium	01/09/2022 00
Nullahs	Bein	1531	Normal	05/09/2022 06
	Deg	14525	Low	04/09/2022 06
	Ura	204	Normal	12/09/2022 12
	Basantar	52	Normal	05/09/2022 12
	Palku	720	Normal	02/09/2022 06

Figure 53: Rivers position during the month of September 2022.

6.10 Spatial distribution of rainfall during the month of September 2022

The precipitation during the month of September is shown in figures 54-56, these indicate Monsoon activity remained over North & Northeast Punjab, Khyber Pakhtunkhwa and Kashmir along with Southeast Sindh. One center of maximum rainfall exceeding 200 mm is observed at Kakul while more than 170 mm recorded at Domel & Kotli as shown in figure 54.

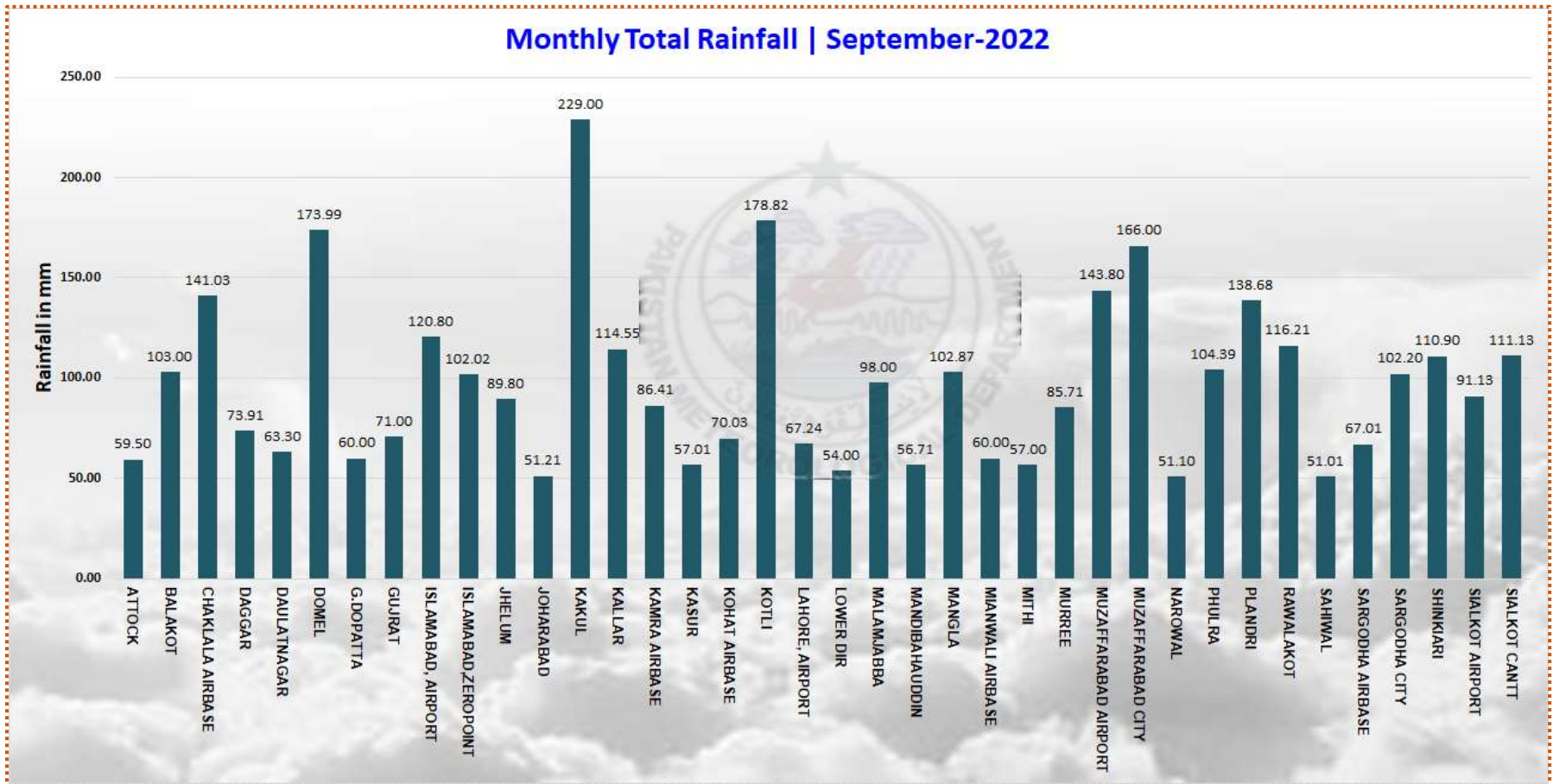


Figure 54: Total Rainfall for the month of September 2022.

TOTAL RAINFALL OF SEPTEMBER 2022

PMD OBSERVATORIES, WAPDA & TELEMETRIC NETWORK RAINFALL

Sr#	Stations	Rainfall	Sr#	Stations	Rainfall	Sr#	Stations	Rainfall
1	KAKUL	229.0	29	GUJRAT	71.0	57	PARACHINAR	36.7
2	KOTLI	178.8	30	KOHAT AIRBASE	70.0	58	CHAKWAL	35.8
3	DOMEL	174.0	31	LAHORE, AIRPORT	67.2	59	ASTORE	33.8
4	MUZAFFARABAD CITY	166.0	32	SARGODHA AIRBASE	67.0	60	OGHI	31.2
5	MUZAFFARABAD AIRPORT	143.8	33	DAULATNAGAR	63.3	61	D.I.KHAN (CITY)	31.0
6	CHAKLALA AIRBASE	141.0	34	G.DOPATTA	60.0	62	BESHAM	30.5
7	PLANDRI	138.7	35	MIANWALI AIRBASE	60.0	63	RISALPUR	28.0
8	ISLAMABAD, AIRPORT	120.8	36	ATTOCK	59.5	64	MIRPUR KHAS	28.0
9	RAWALAKOT	116.2	37	KASUR	57.0	65	DIR	27.5
10	KALLAR	114.6	38	MITHI	57.0	66	LAHORE,CITY	27.4
11	SIALKOT CANTT	111.1	39	MANDIBAHAUDDIN	56.7	67	T.T. SINGH	25.2
12	SHINKIARI	110.9	40	LOWER DIR	54.0	68	ROHTAS	24.5
13	PHULRA	104.4	41	JOHARABAD	51.2	69	CHHOR	24.0
14	BALAKOT	103.0	42	NAROWAL	51.1	70	THATTA	24.0
15	MANGLA	102.9	43	SAHIWAL	51.0	71	FAISALABAD AIRPORT	22.0
16	SARGODHA CITY	102.2	44	OKARA	50.1	72	BADIN	22.0
17	ISLAMABAD,ZEROPOINT	102.0	45	KOT ADDU	50.0	73	JHANG	21.6
18	MALAMJABBA	98.0	46	GUJRANWALA	45.4	74	GS WALA	21.0
19	SIALKOT AIRPORT	91.1	47	KOTNAINA	44.8	75	BAGROTE	20.9
20	JHELMUM	89.8	48	SAIDU SHARIF	43.5	76	SHARQPUR	20.6
21	KAMRA AIRBASE	86.4	49	KARACHI A/P	43.4	77	BANNU	20.0
22	MURREE	85.7	50	LAYYAH	42.0	78		
23	DAGGAR	73.9	51	BABUSAR	40.0	79		
More than 20 MM Rainfall								

Figure 55: Total Rainfall for the month of September 2022.

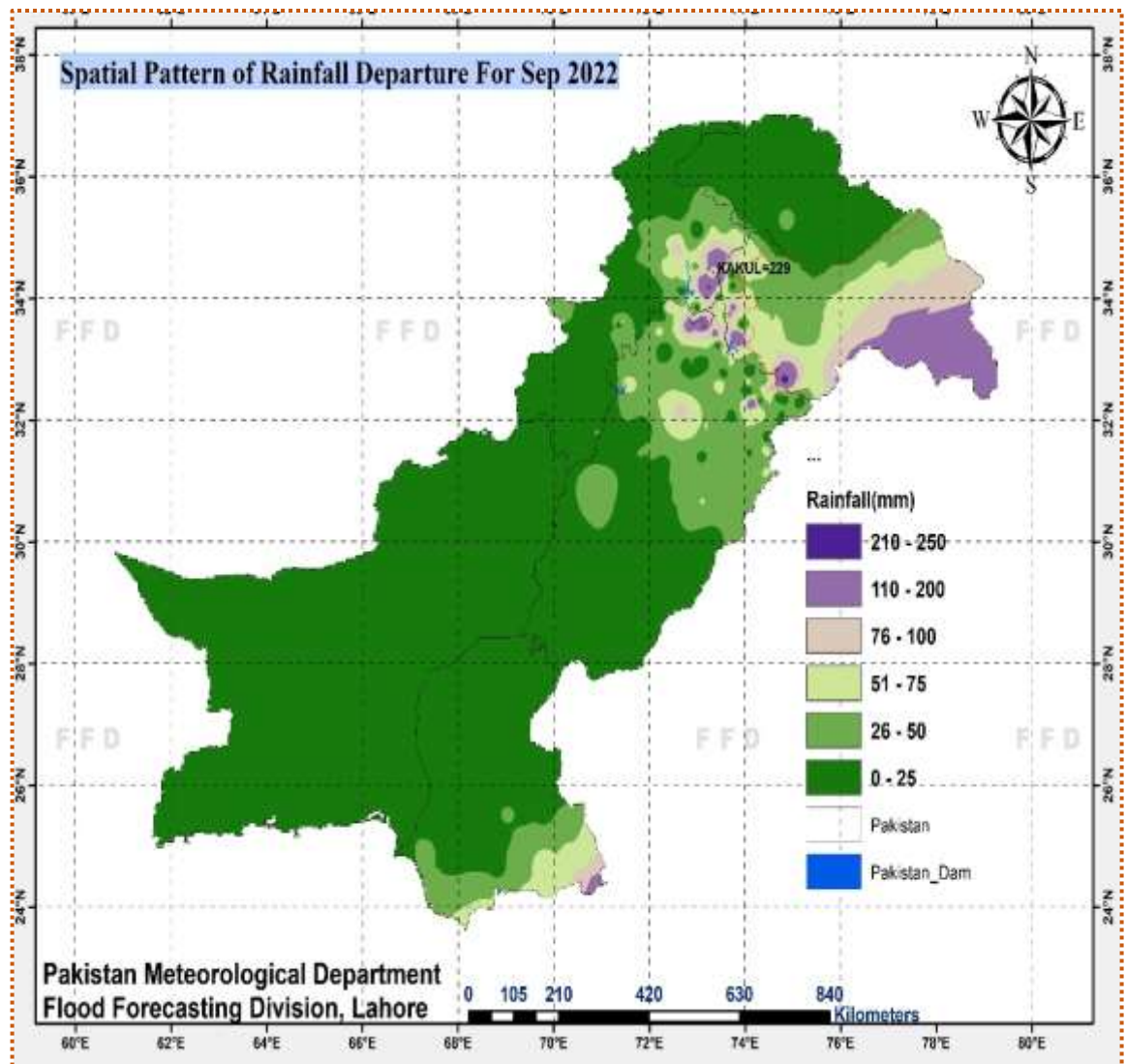
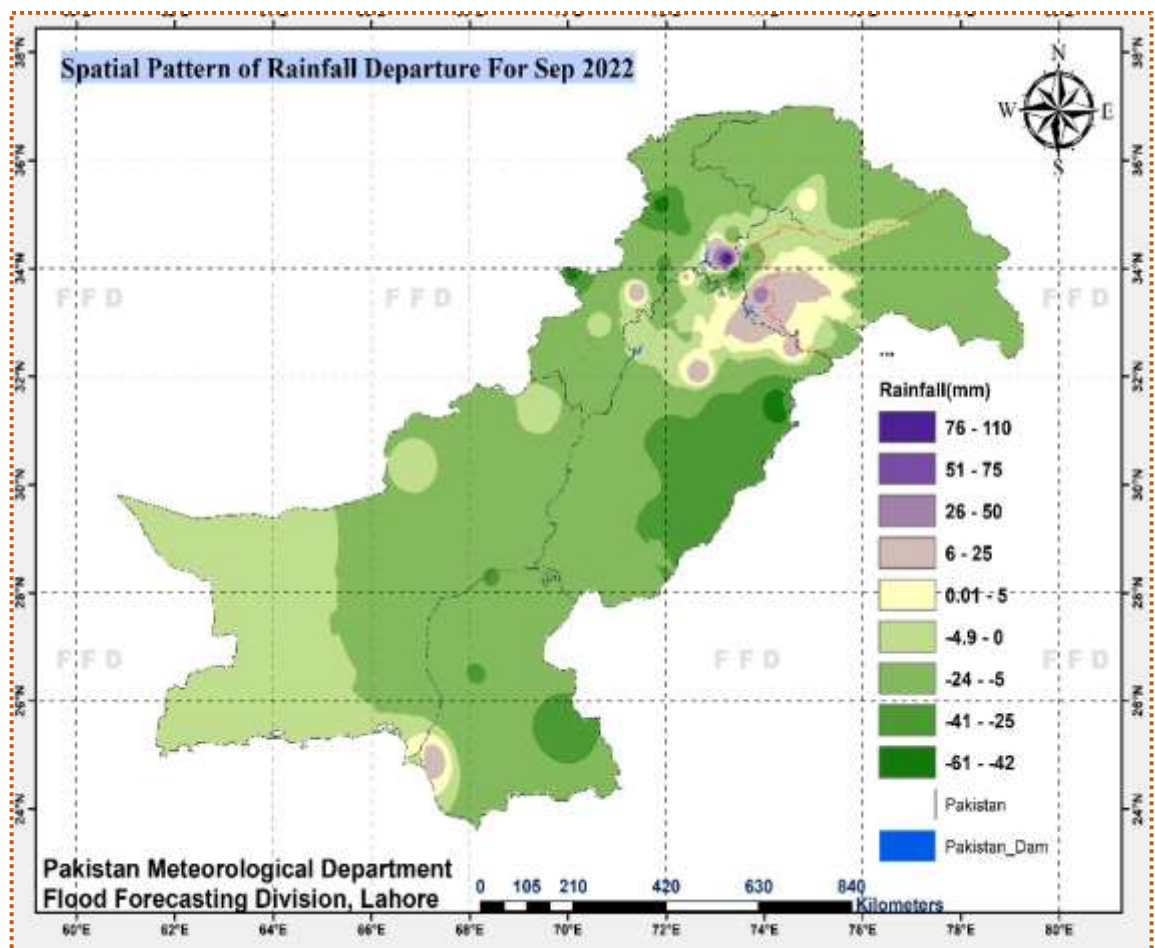
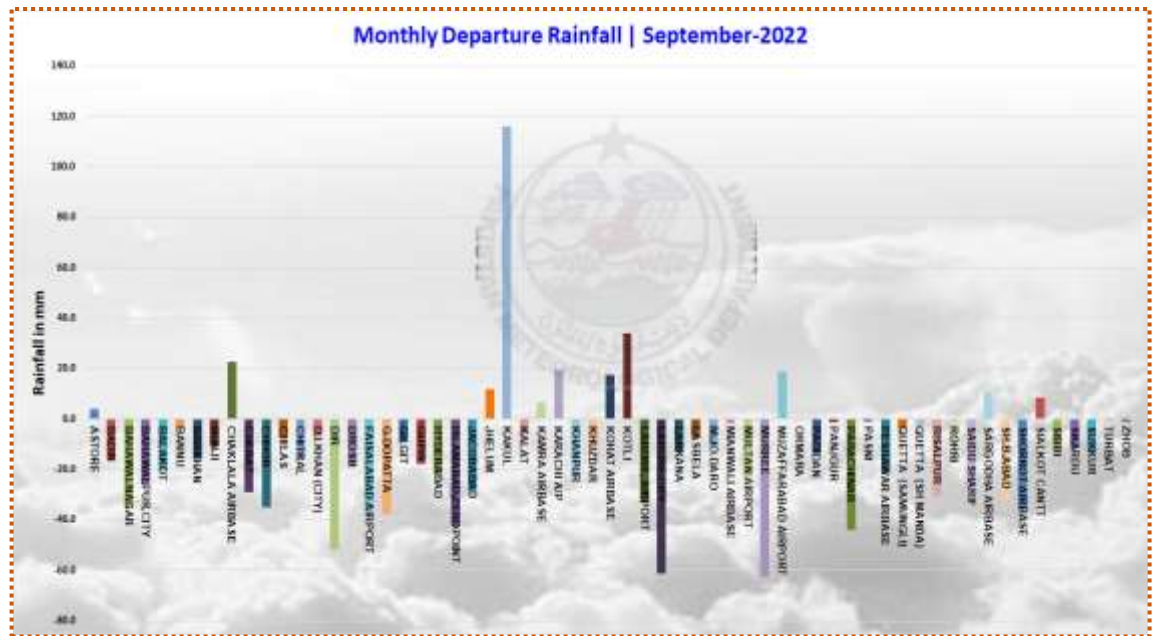


Figure 56: Spatial distribution of significant rainfall of September 2022.

6.11 Departure Anomaly during the month of September 2022

Departure anomaly map for the month of September 2022 indicates that most parts of the country received below normal rainfall. However, Kakul received the significantly above normal rainfall. Percentage Anomaly map of September 2022 is shown in Figures 57 & 58.



6.12 Temporal Distribution during the month of September 2022

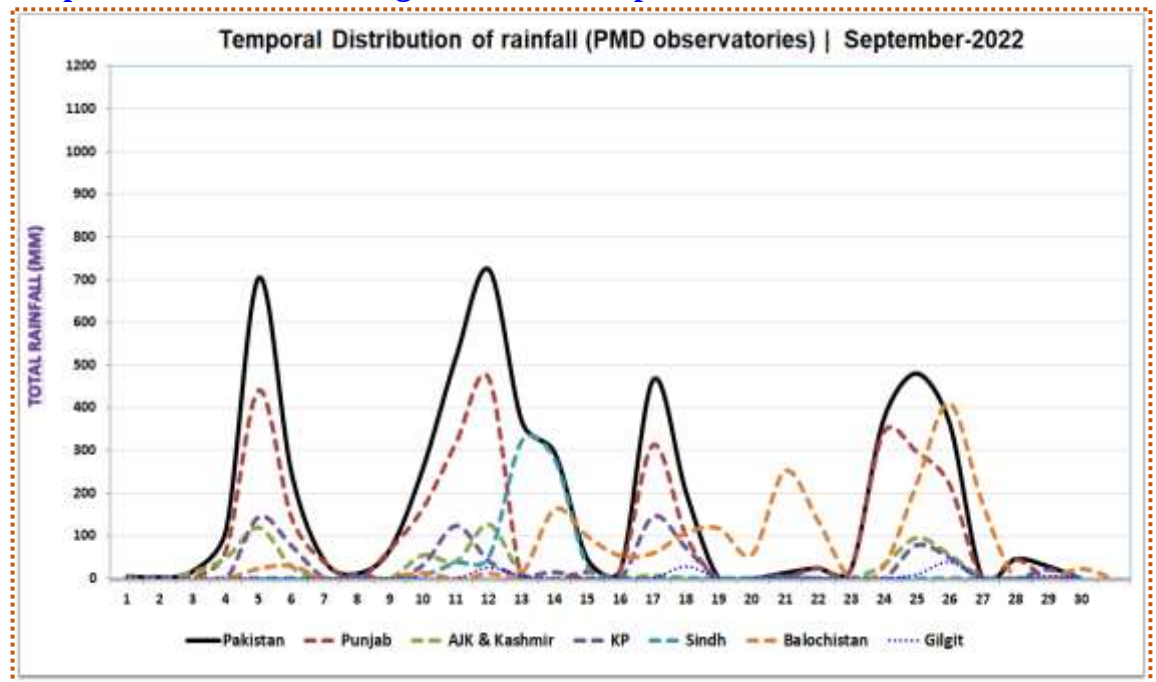
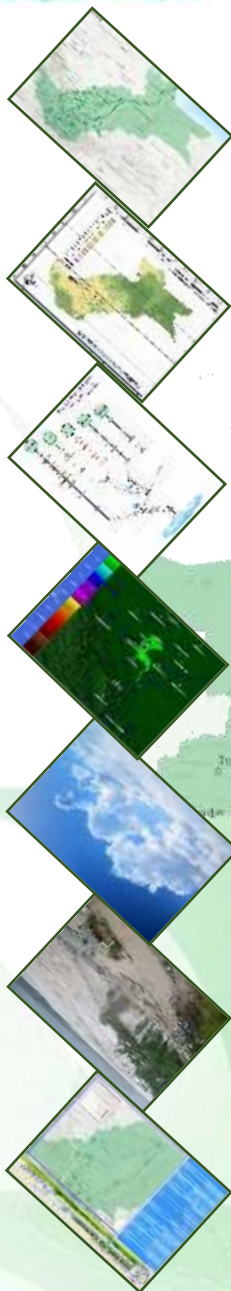


Figure 59: Temporal distribution of rainfall during September 2022.



SEASONAL

Departure Anomaly, Total Rainfall
& Area Weighted



7 Seasonal rainfall pattern July to September 2022

Seasonal rainfall distribution during the season is shown in figure 60-62. Region of maximum precipitation (more than 1700 mm) is located over Padidan in Sindh. Other extreme rainfall of more than 990 mm is located over, Moenjo Daro. Rainfall recorded over rest of the observatories during the season is also shown in the Figures 60 & 61.

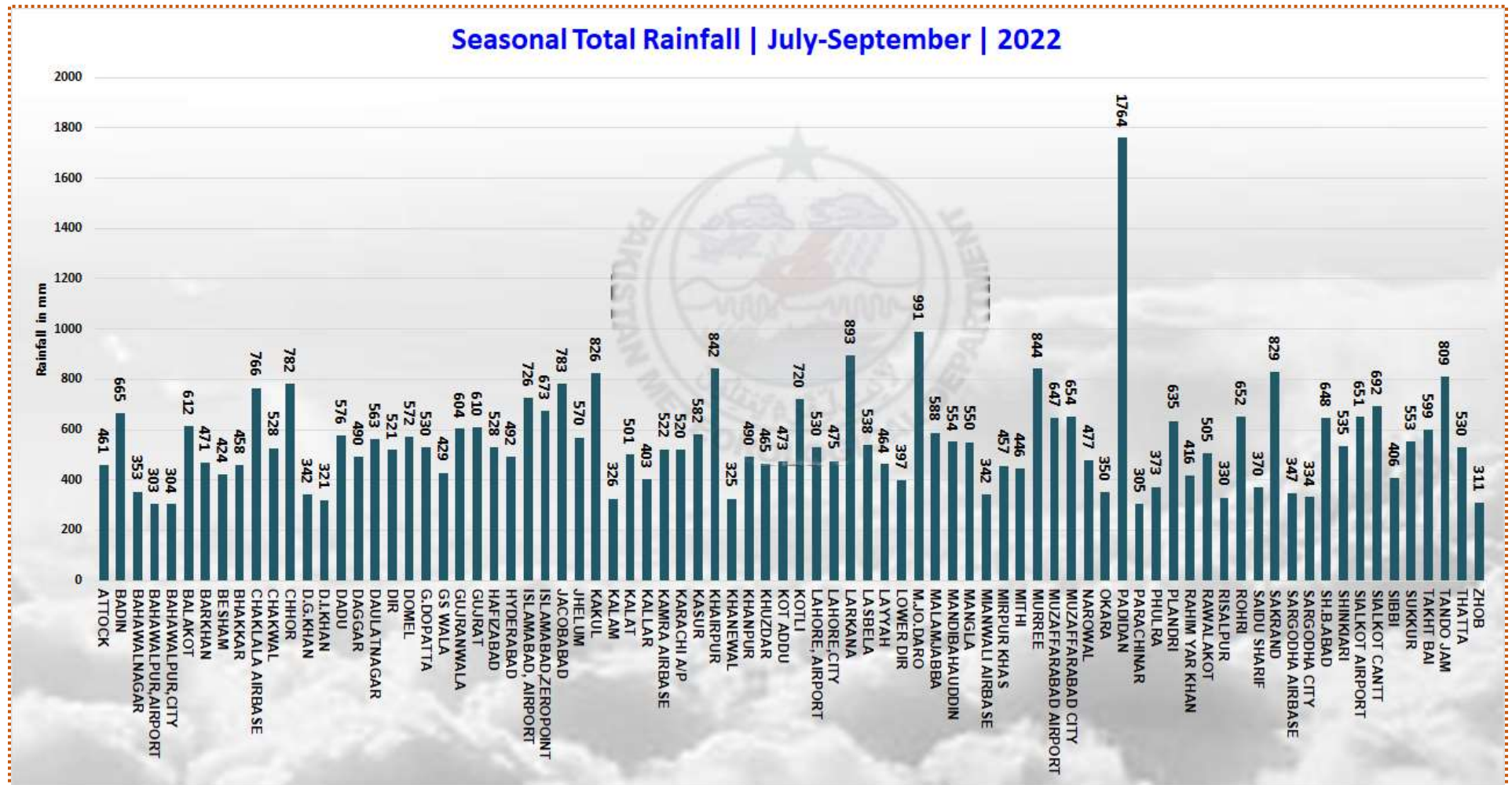


Figure 60: Seasonal total Rainfall July- September 2022.

SEASONAL TOTAL RAINFALL (MM)

JULY-SEP, 2022 | PMD OBSERVATORIES, WAPDA & TELEMETRIC NETWORK RAINFALL

Sr#	Stations	Rainfall	Sr#	Stations	Rainfall	Sr#	Stations	Rainfall
1	PADIDAN	1764.0	29	DADU	576.0	57	ATTOCK	461.1
2	M.JO.DARO	990.5	30	DOMEL	571.5	58	BHAKKAR	458.3
3	LARKANA	893.4	31	JHELM	569.5	59	MIRPUR KHAS	457.0
4	MURREE	844.2	32	DAULATNAGAR	562.6	60	MITHI	446.0
5	KHAIRPUR	842.3	33	MANDIBAHAUDDIN	553.8	61	GS WALA	428.9
6	SAKRAND	829.0	34	SUKKUR	552.5	62	BESHAM	424.0
7	KAKUL	826.0	35	MANGLA	550.0	63	RAHIM YAR KHAN	416.3
8	TANDO JAM	808.9	36	LASBELA	538.2	64	SIBBI	406.0
9	JACOBABAD	783.1	37	SHINKIARI	534.6	65	KALLAR	403.1
10	CHHOR	781.9	38	LAHORE, AIRPORT	530.3	66	LOWER DIR	397.0
11	CHAKLALA AIRBASE	766.1	39	THATTA	530.1	67	PHULRA	372.9
12	ISLAMABAD, AIRPORT	726.2	40	G.DOPATTA	530.1	68	SAIDU SHARIF	369.8
13	KOTLI	720.4	41	HAFIZABAD	528.3	69	BAHAWALNAGAR	353.1
14	SIALKOT CANTT	692.5	42	CHAKWAL	527.5	70	OKARA	350.2
15	ISLAMABAD,ZEROPOINT	673.2	43	KAMRA AIRBASE	521.9	71	SARGODHA AIRBASE	347.2
16	BADIN	665.3	44	DIR	520.5	72	MIANWALI AIRBASE	342.1
17	MUZAFFARABAD CITY	654.0	45	KARACHI A/P	519.7	73	D.G.KHAN	341.9
18	ROHRI	652.0	46	RAWALAKOT	504.8	74	SARGODHA CITY	333.8
19	SIALKOT AIRPORT	651.0	47	KALAT	501.0	75	RISALPUR	330.1
20	SH.B.ABAD	648.0	48	HYDERABAD	492.0	76	KALAM	326.0
21	MUZAFFARABAD AIRPORT	647.2	49	DAGGAR	490.2	77	KHANEWAL	325.1
22	PLANDRI	634.7	50	KHANPUR	490.2	78	D.I.KHAN	320.9
23	BALAKOT	612.4	51	NAROWAL	476.7	79	ZHOB	311.0
24	GUJRAT	610.0	52	LAHORE,CITY	475.4	80	PARACHINAR	304.8
25	GUJRANWALA	603.8	53	KOT ADDU	473.0	81	BAHAWALPUR,CITY	303.6
26	TAKHT BAI	599.0	54	BARKHAN	471.0	82	BAHAWALPUR,AIRPORT	303.1
27	MALAMJABBA	588.0	55	KHUZDAR	464.6			
28	KASUR	581.5	56	LAYYAH	464.3			

More than 300 MM Rainfall

Figure 61: Seasonal total Rainfall July- September 2022.

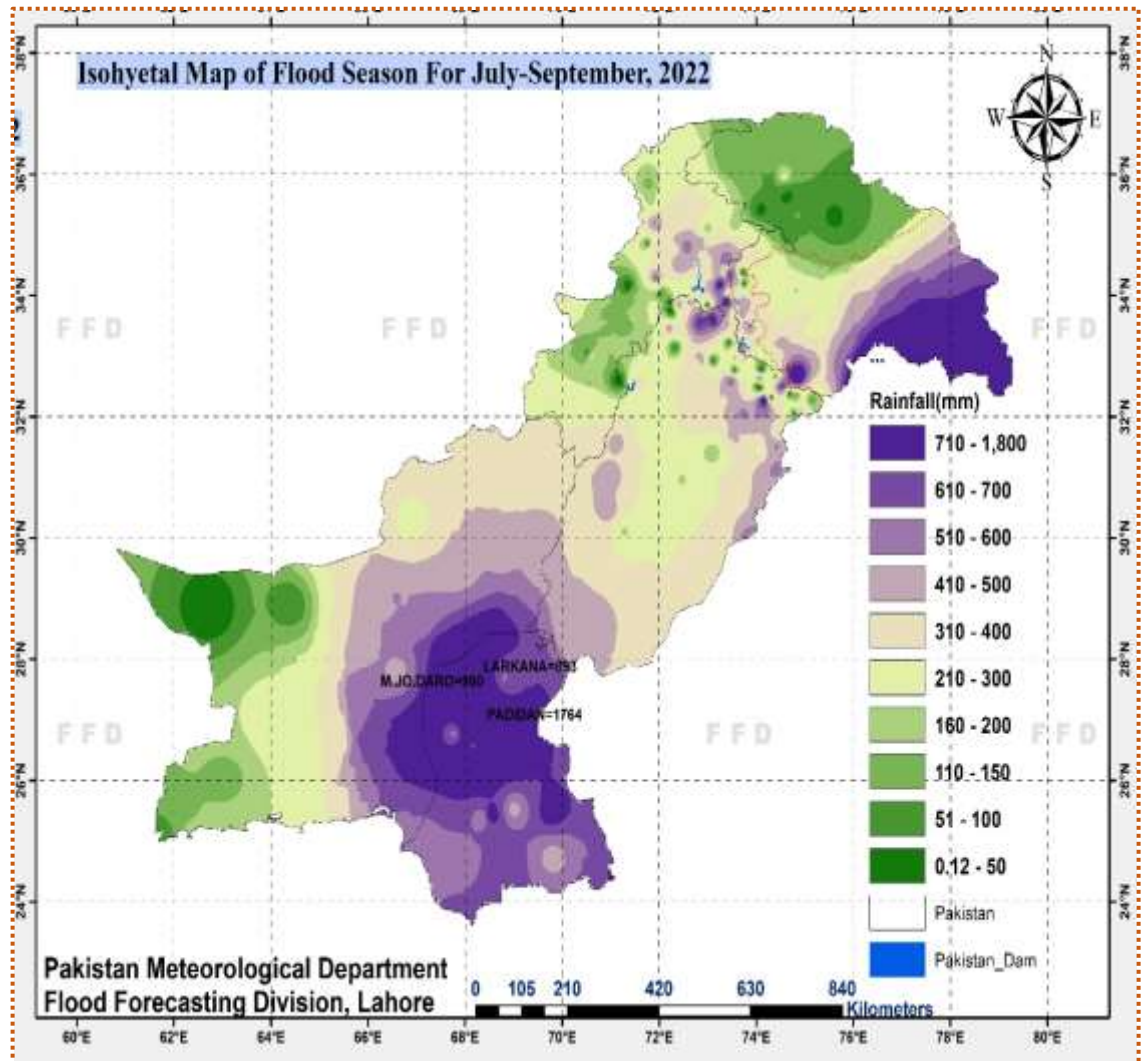


Figure 62: Spatial distribution of significant rainfall map of July-Sep-2022.

7.1 Departure Anomaly during the Season July-September 2022

Departure Anomaly map for the months of July-September 2022 indicates that above normal Rainfall recorded over the most parts of the country. However, Padidan in Sindh received more than 1700 mm significantly above normal rainfall while Larkana and Moenjo Daro recorded 800 mm above normal rainfall. Departure Anomaly map of July-September over the country 2022 is shown in Figures 63-65.

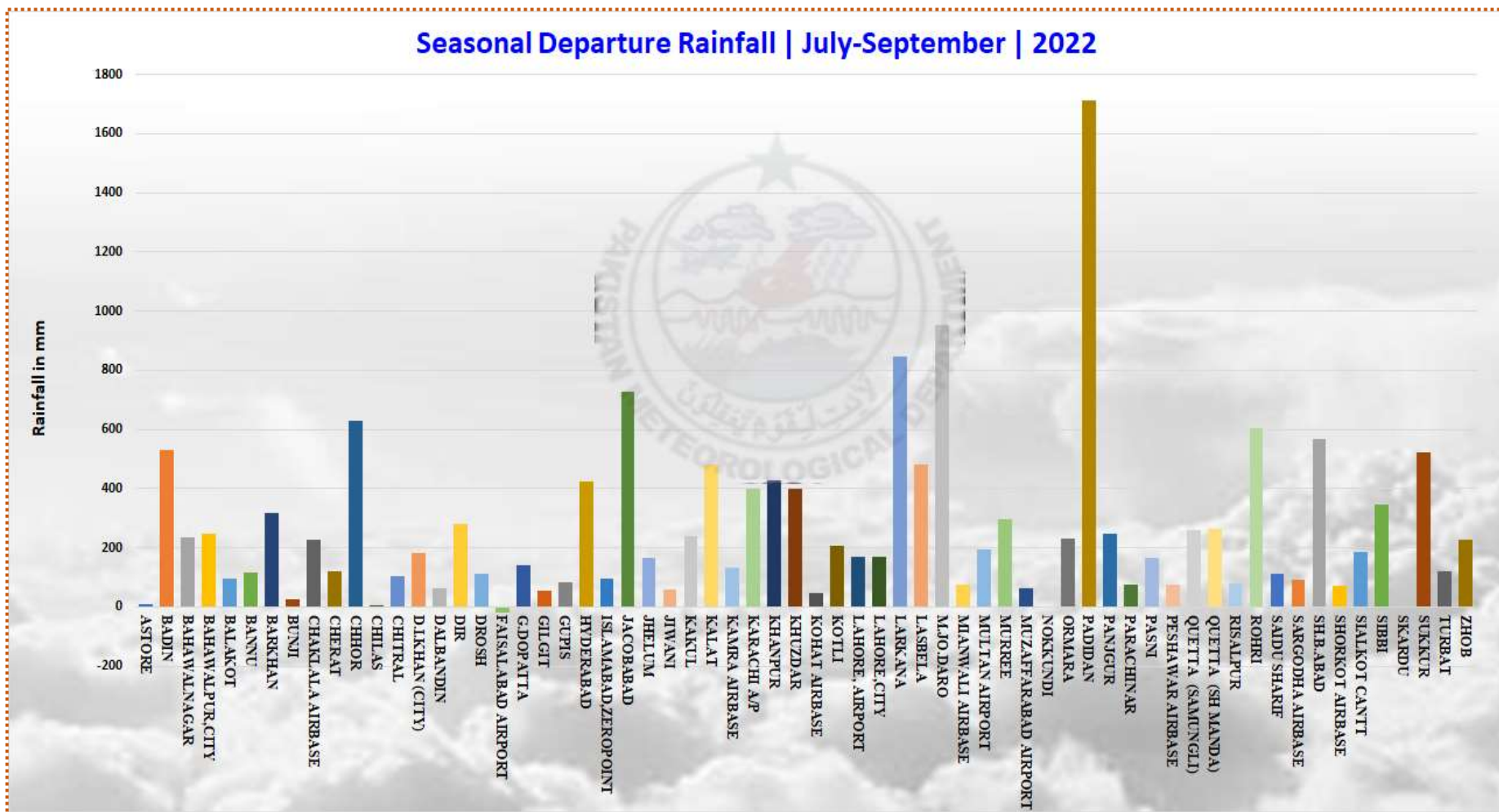


Figure 63: Seasonal Rainfall departure for July- Sep-2022

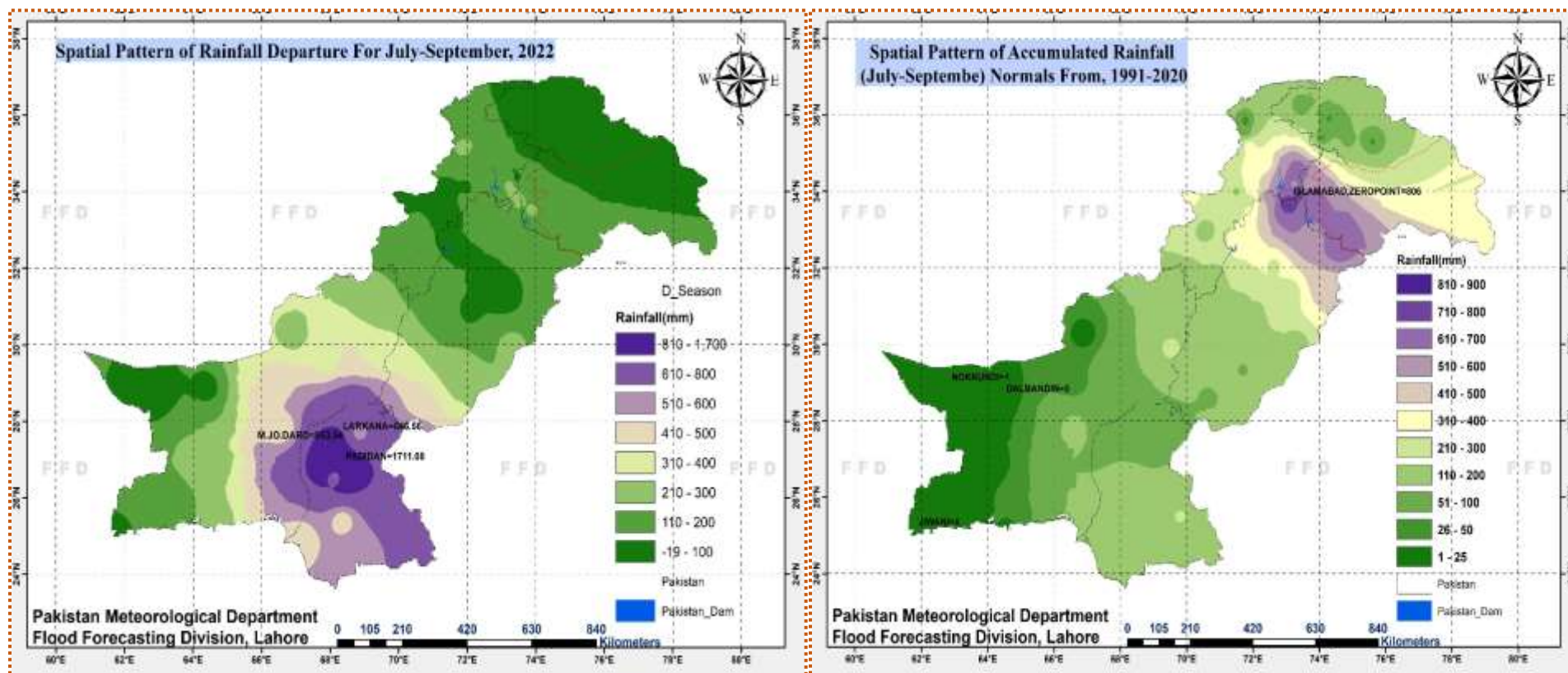


Figure 64: Departure Anomaly rainfall map for Season July-Sep-22.

Figure 65: Accumulated Rainfall Normal from 1991-2020 (July-Sep)-22.

8 Pakistan Based Temporal Rainfall Distribution (July-September) 2022

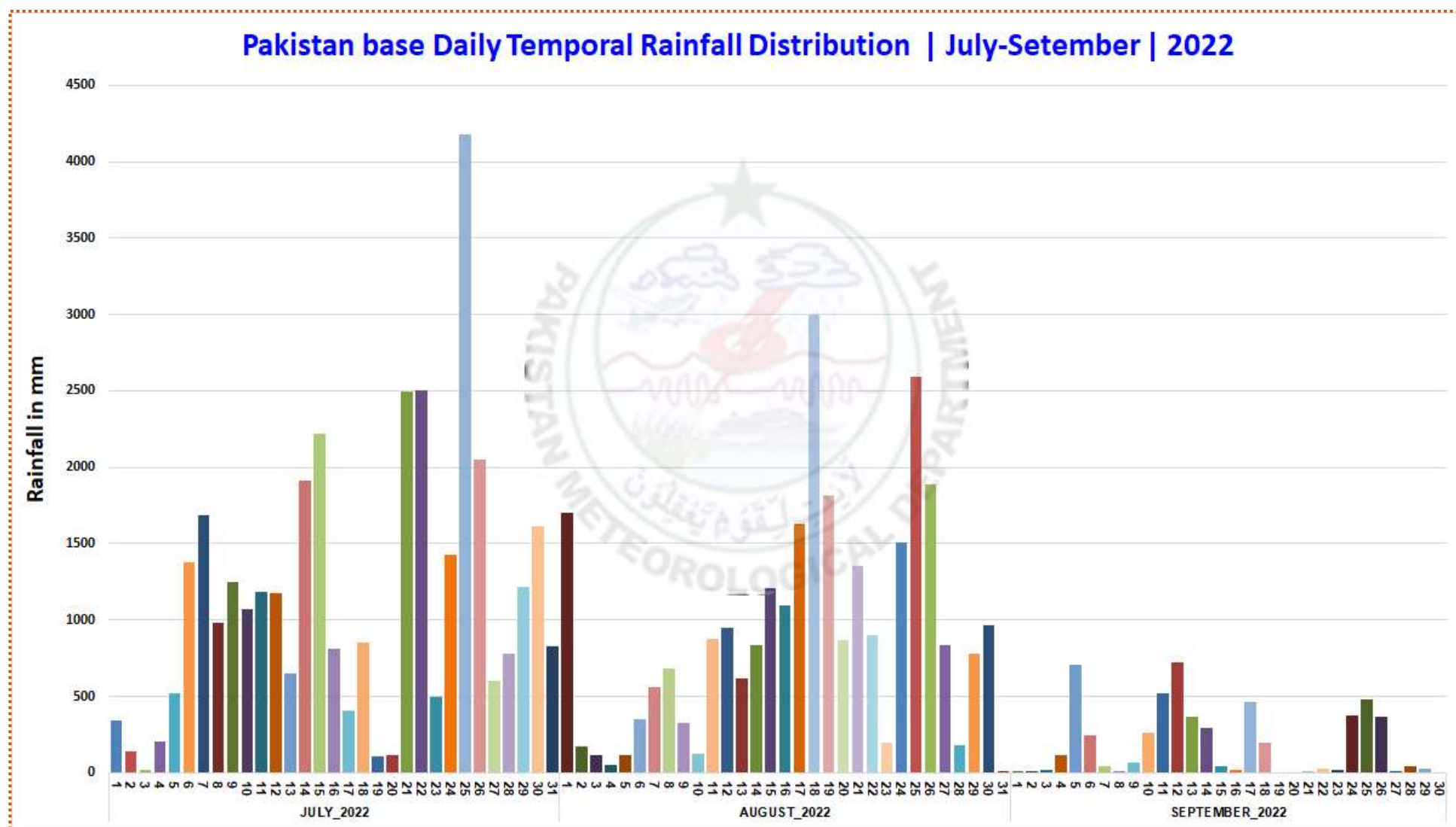


Figure 66: Pakistan Based Temporal Rainfall Distribution July-Sep-2022.

9 Reason for Significant Weather System over Sindh, South Punjab and Balochistan during Monsoon 2022

- During Monsoon 2022, Lower half of the country received significantly above normal rainfall was due to formation of more number of low-pressure systems (LPS), more number of days compared to the climatology and also shift of seasonal low towards west Balochistan and adjoining Iran because of above normal temperature at Nokundi (West Balochistan).
- The mean monthly temperature of May 2022 for Pakistan as a whole was 30.93 °C, against the average of 28.77 °C and observed as the fifth warmest May on record since 1961.
- Deepened Heat/seasonal-low pressure area, resulted by abnormally high temperatures during Apr-Jun, over south Pakistan that caused vigorous Monsoon currents pull towards the heat-low center.
- Persistence of triple-dip La Nina.
- Negative IOD (Indian Ocean Dipole)
- Most of the days Monsoon trough remained south of its normal position which caused subdued rainfall over upper half of the country.
- Winter snow/rainfall remained below normal during winter 2021-22 causing subdued base flows.

10 Seasonal area weighted precipitation during July-September 2022.

This year Monsoon season set on 30th June 2022 over Pakistan, a day earlier of its normal date (1st July) and withdrew during third week of September 2022. However, significant continuous rainfall occurred from 4th July onwards. Pakistan rainfall, As a whole, during the period remained extremely above average (+175%) (Fig. 1a). On regional scale, the rainfall during the period also observed excessively above average over Sindh (+426%) & Balochistan (+450%), largely above average over Punjab (+70%) & GB (+104%), above average over KP (+33%) and near average over AJK (Fig. 1b). A comparative cumulative rainfall of the years 2022 & 2021 versus ‘normal’ is shown in Fig. 2. The torrential rain caused massive devastating flash floods in eastern & southern Balochistan, Sindh, southwest Punjab and Khyber Pakhtunkhwa (KP) inflicting over 1700 deaths & unbearable huge loss of crops and properties.

Mass curve of the area weighted rain fall during the Monsoon is shown below.

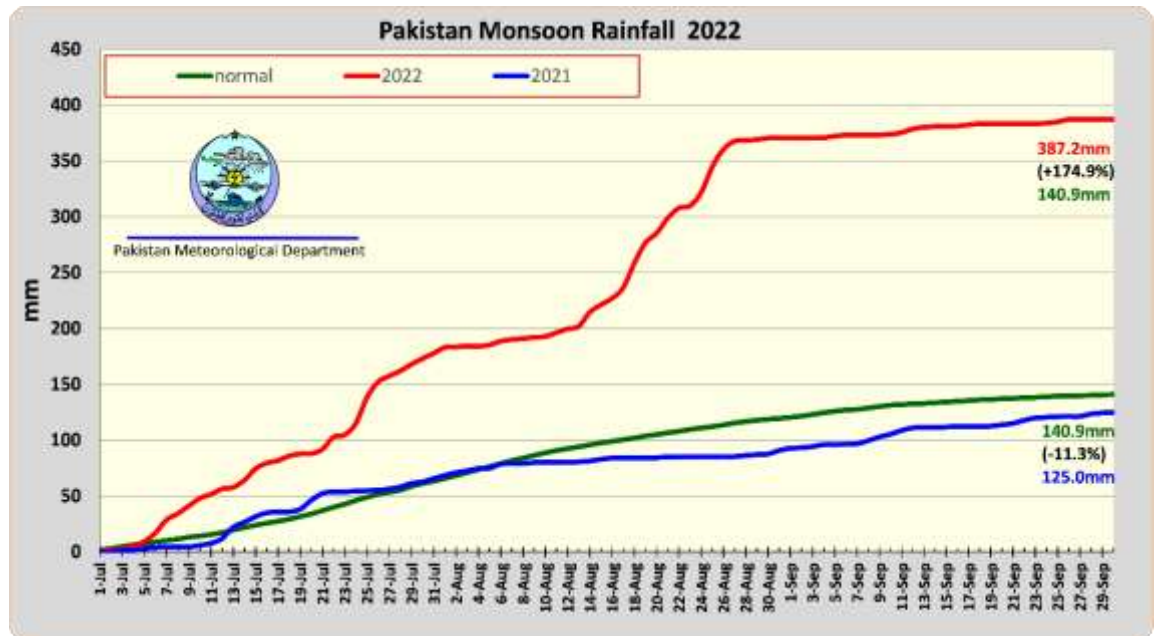
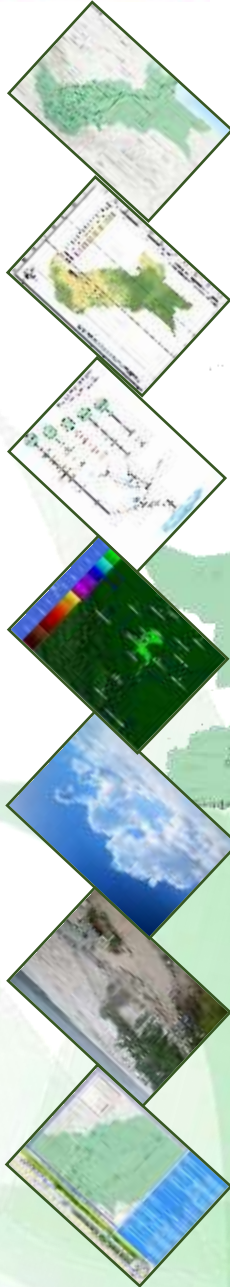


Figure 67: Monsoon July-Sept (JAS) 2022 rainfall.

MONSOON 2022 RAINFALL UPDATE				
	Rainfall (% Deviation)			
	Jul	Aug	Sep	Jul to Sep
Pakistan	181	243	-21	175
Azad J&K	-7	-3	16	-2
Balochistan	450	590	-59	450
Gilgit-B	32	233	-19	104
Khyber-PK	30	58	-16	33
Punjab	116	52	-21	70
Sindh	307	726	-22	426

Table 3: Monsoon July-Sept (JAS) 2022 rainfall

Source: CDPC Karachi



OTHER

- Kharif & Rabi Season
- Forecasts Dissemination System
- Internship at FFD Lahore
- Season 2022 Damages/Losses
- Flood Limits
- Flood Season 2022 Peaks
- Revised Lag Times Routing Map
- Lag Times Comparison with 2022
- Forecast Accuracy 2022

11 Kharif Season Forecast

The water availability (in MAF) forecast on the basis of prevailing hydrometeorological conditions was issued on 24th March 2022 for Tarbela River Indus & for Mangla River Jhelum. A comparison of forecasted and observed volume (in MAF) is shown below fig 68.

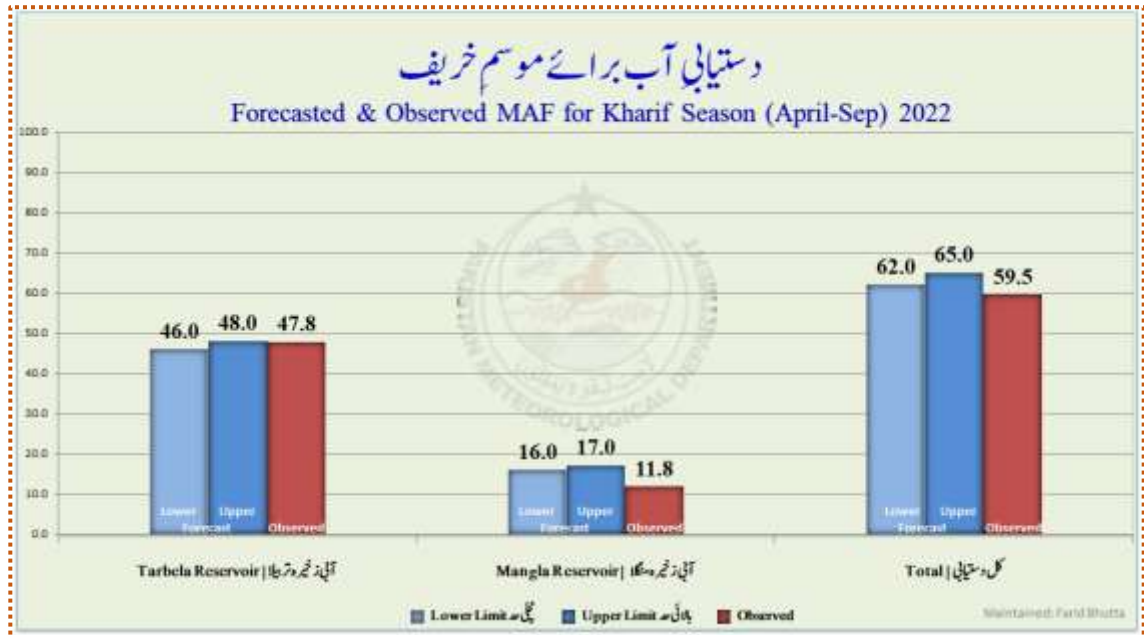


Figure 68: Kharif Season forecasted & Observed MAF (April-Sep-22).

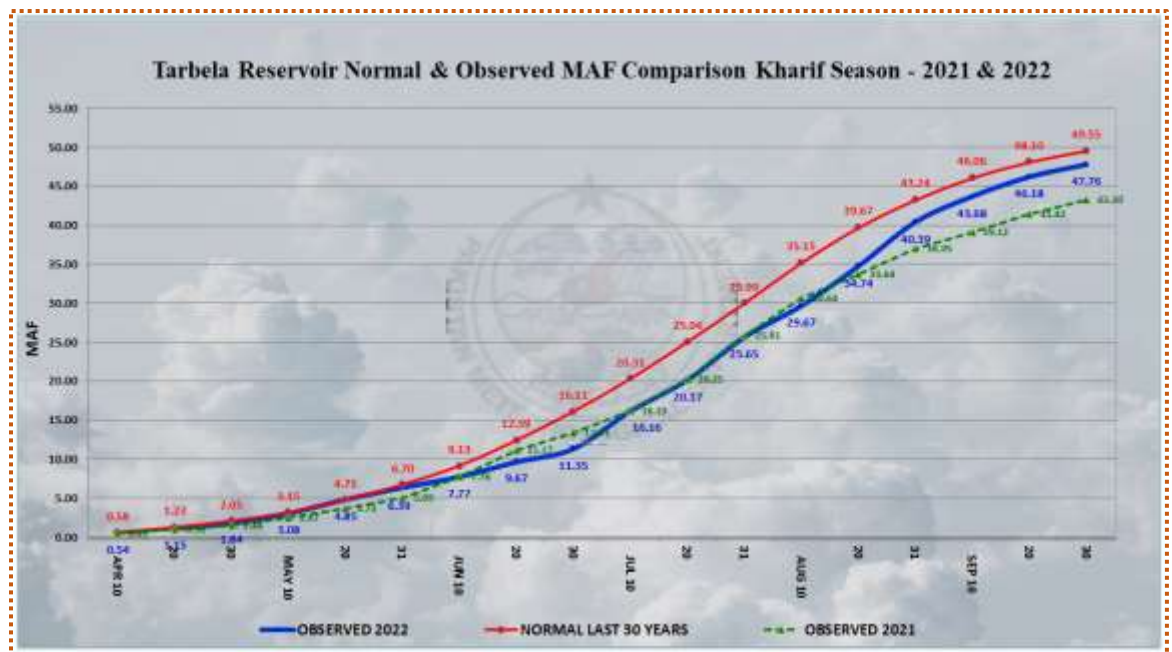


Figure 69: Tarbela Reservoir Kharif Season Observed MAF 2022 & Comparison (April-Sep-22).

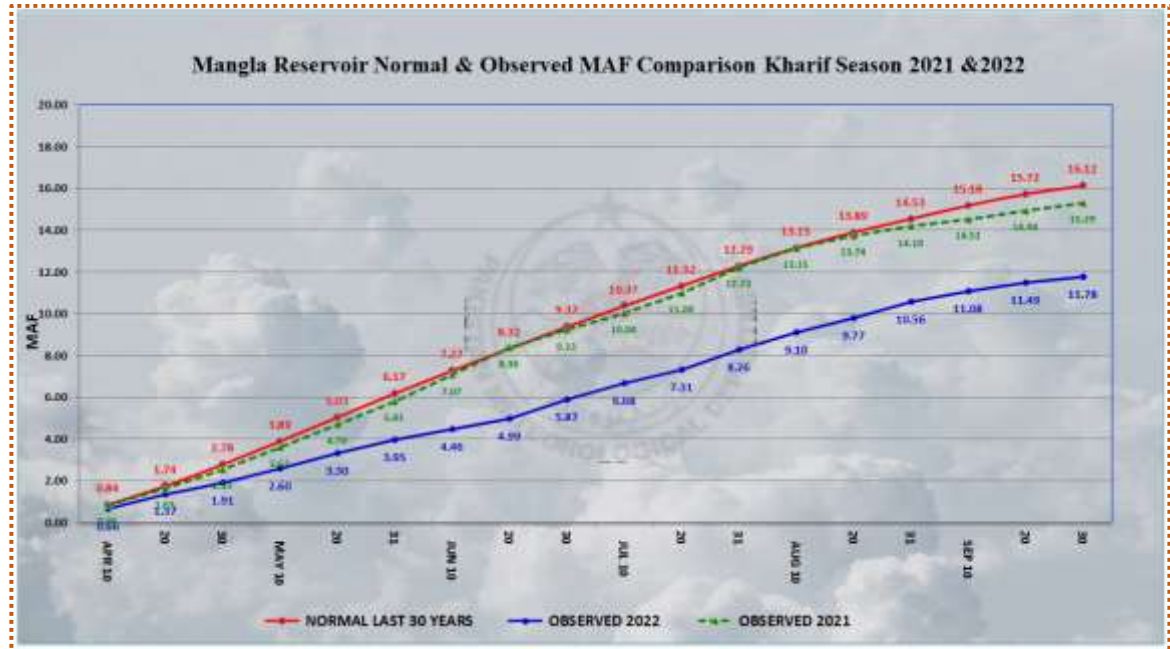


Figure 70: Mangla Reservoir Kharif Season Observed MAF 2022 & Comparison (April-Sep-22).

12 Rabi Season Forecast

Similarly, the water availability forecast for Rabi season was issued on 30th September 2022 for Tarbela River Indus & for Mangla River Jhelum is shown in fig 71.

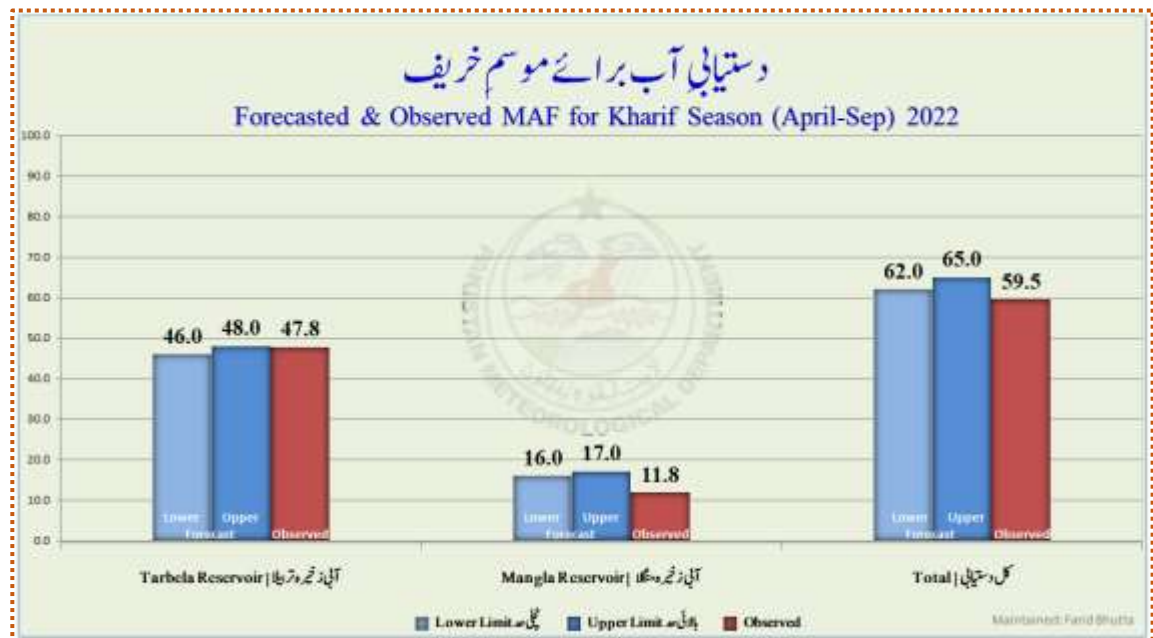


Figure 71: Rabi Season forecast MAF (Oct-2022 to March-2023)

13 Flood Forecast Dissemination

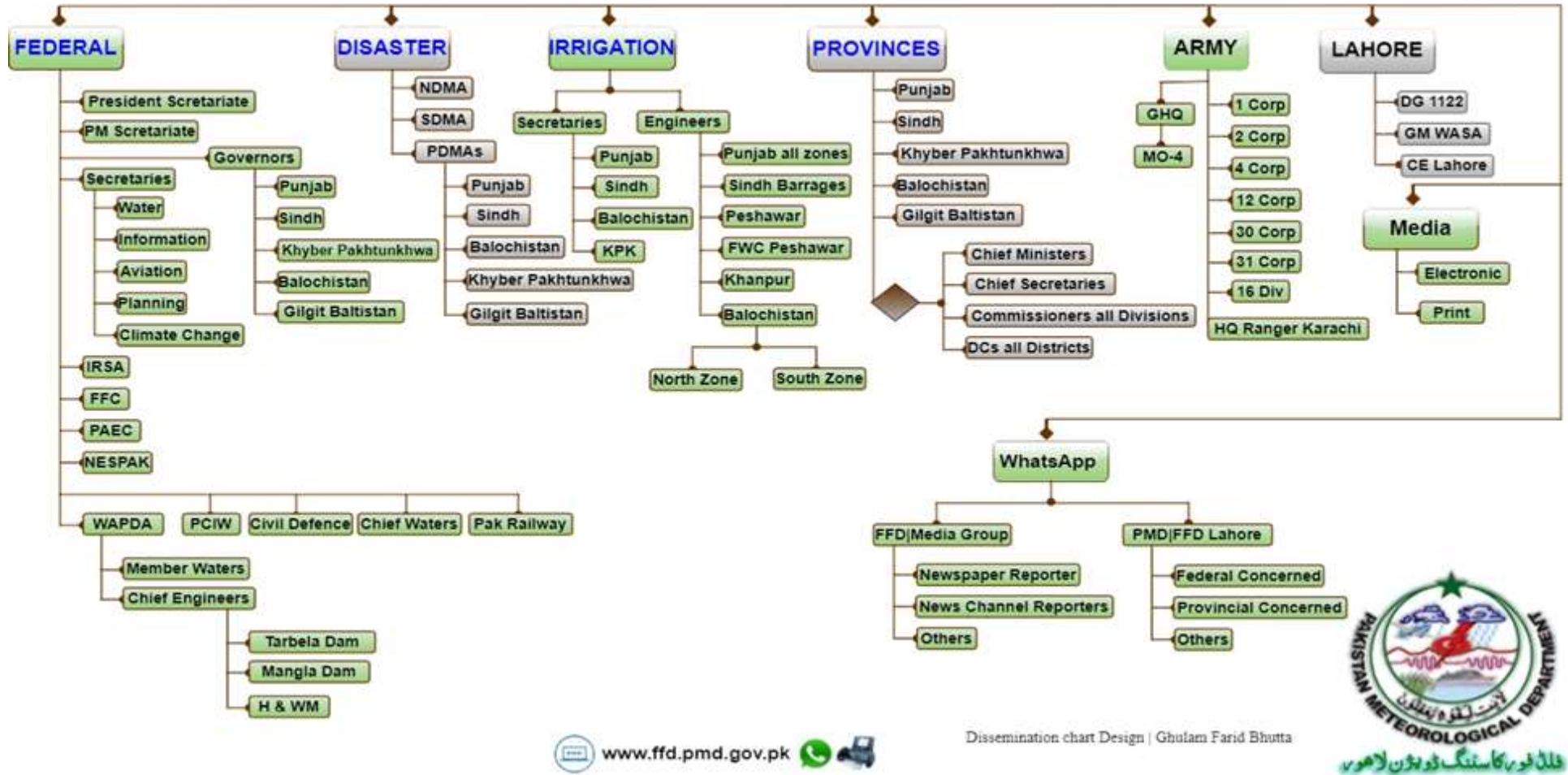


Figure 72: Flood report dissemination chart

14 Internship at Flood Forecasting Division Lahore

FFD Lahore offers an Internship program for the young students of different Universities & Colleges providing a hands-on opportunity to work in the field of Meteorology, Hydrology, Seismology, GIS and Weather Radar. They can learn how theory applies in the practical field and also provides a valuable experience which makes them a strong candidate in practical life. The chart of internee students during 2022 is shown in table 4.

University/College		Students
	Punjab University Lahore	11
	Lahore College for Women University, Lahore	14
	University of Lahore, Lahore	03
	Govt College University Lahore	20
	University of Engineering & Technology Lahore	05
	The Superior College Lahore	45
	University of Central Punjab Lahore	01
	Kinnaird College for Women University Lahore	09
	University of Management & Technology Lahore	01
	University of Veterinary and Animal Sciences Lahore	02

Table 4: List of internees

15 Monsoon Season 2022 Damages/Losses

No of Deaths, Injured Persons and Houses Damaged during the Flood 2022 are shown in table 5.

14th June to 1st November-2022

Cumulative Deaths and Injured (14 June to date)

Province /Region	Deaths				Injured			
	M	F	C	T	M	F	C	T
AJ&K	31	17	0	48	15	9	0	24
Balochistan	149	80	107	336	97	40	50	187
GB	5	12	6	23	3	0	3	6
ICT	1	0	0	1	0	0	0	0
KP	151	42*	116	309*	157	79	134	370
Punjab	92	51	80	223	2173	1113	572	3858
Sindh	309	150	337	796	2964	2211	3247	8422
Total	738	352	646	1736	5409	3452	4006	12867

* **Data reconciliation**:- PDMA KP has added 1x Female death.

Cumulative Report (14 June to date)

Province /Region	Roads (km)	Bridges	Houses			Livestock
			PD	FD	Total	
AJ&K	19	33	228	327	555	792
Balochistan	2,222	58	125,837*	115,822*	241,659	500,000^
GB	33	61	1,126	667	1,793	609
ICT	-	-	-	-	-	-
KP	1,575	107	53,939	37,525	91,464	21,328
Punjab	877	15	42,127	25,854	67,981	205,106>
Sindh	8,389	165	1,168,210	716,819	1,885,029	436,435
TOTAL	13,115	439	1,391,467	897,014	2,288,481	1,164,270

Table 5: Flood Losses & Damages 2022

Source: NDMA Islamabad

16 Flood limits (in thousands of cusecs)

River	Site	Design Capacity	Low	Med	High	V.high	Ex.high
Kabul	Nowshera	-	0.75	1.0	1.5	2.0	4.5
	Warsak	15.0	0.30	0.45	1.0	2.0	4.0
Indus	Tarbela	15.0	2.5	3.75	5.0	6.5	8.0
	Attock	-	2.5	3.75	5.0	6.5	8.0
	Kalabagh	9.5	2.5	3.75	5.0	6.5	8.0
	Chashma	9.5	2.5	3.75	5.0	6.5	8.0
	Taunsa	10.0	2.5	3.75	5.0	6.5	8.0
	Guddu	12.0	2.0	3.5	5.0	7.0	9.0
	Sukkur	9.0	2.0	3.5	5.0	7.0	9.0
	Kotri	8.5	2.0	3.0	4.5	6.5	8.0
Jhelum	Kohala	-	1.0	1.5	2.0	3.0	4.0
	Mangla	10.6	0.75	1.1	1.5	2.25	3.0
	Rasul	8.5	0.75	1.1	1.5	2.25	3.0
Chenab	Marala	11.0	1.0	1.5	2.0	4.0	6.0
	Khanki	8.0	1.0	1.5	2.0	4.0	6.0
	Qadirabad	8.07	1.0	1.5	2.0	4.0	6.0
	Trimmu	6.45	1.5	2.0	3.0	4.5	6.0
	Panjnad	7.0	1.5	2.0	3.0	4.5	6.0
Ravi	Jassar	2.75	0.5	0.75	1.0	1.5	2.0
	Ravi syphon	4.5	0.4	0.65	0.9	1.35	1.8
	Shahdra	2.5	0.4	0.65	0.9	1.35	1.8
	Balloki	2.25	0.4	0.65	0.9	1.35	1.8
	Sidhnai	1.5	0.3	0.46	0.6	0.9	1.3
Sutlej	Sulemanki	3.25	0.5	0.8	1.2	1.75	2.25
	Islam	3.0	0.5	0.8	1.2	1.75	2.25

Table 6: Flood limit

17 Maximum Flood Peaks Discharge (Cusecs) during Flood Season-2022.

Maximum Flood Peaks recorded during Flood Season-2022 is shown below

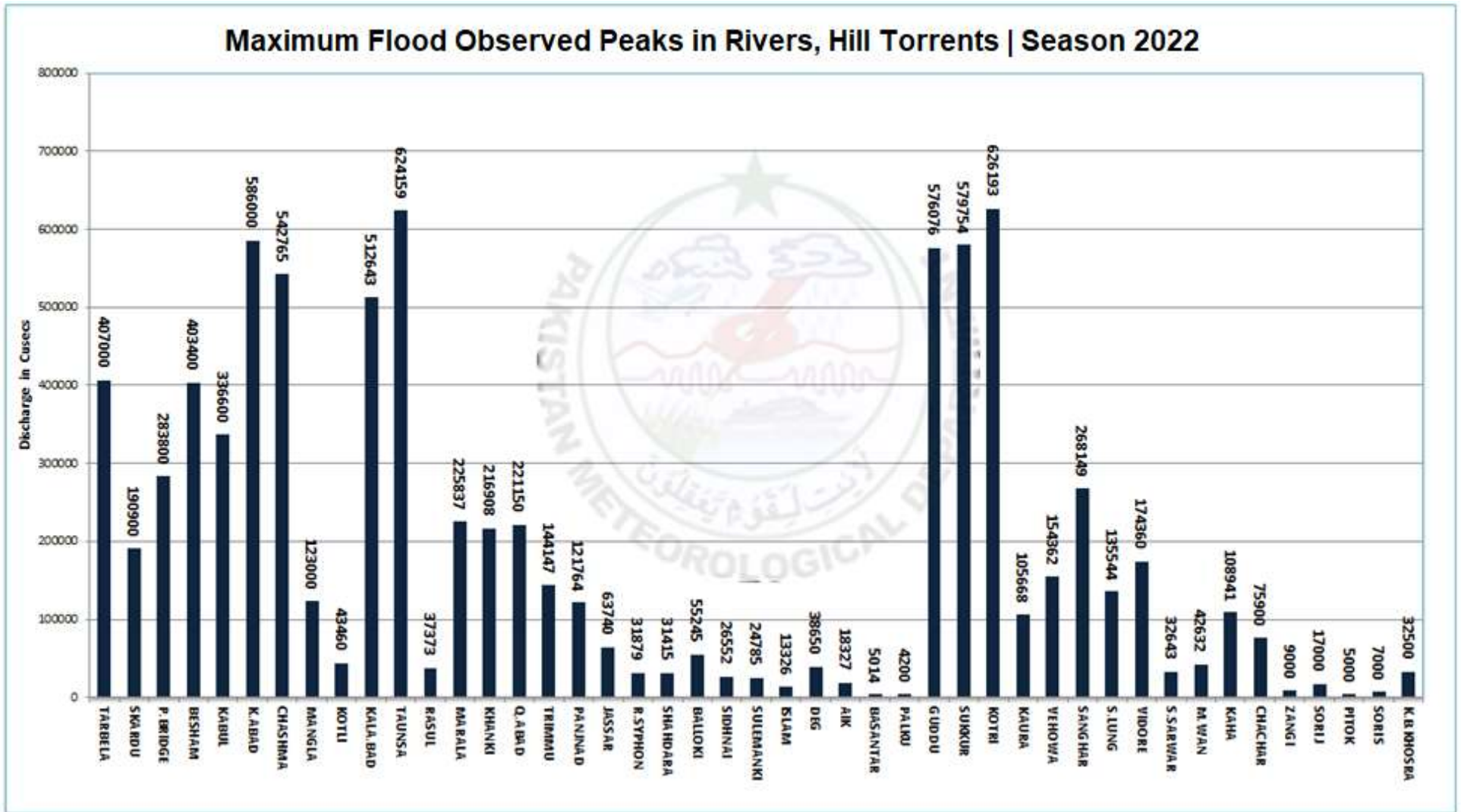


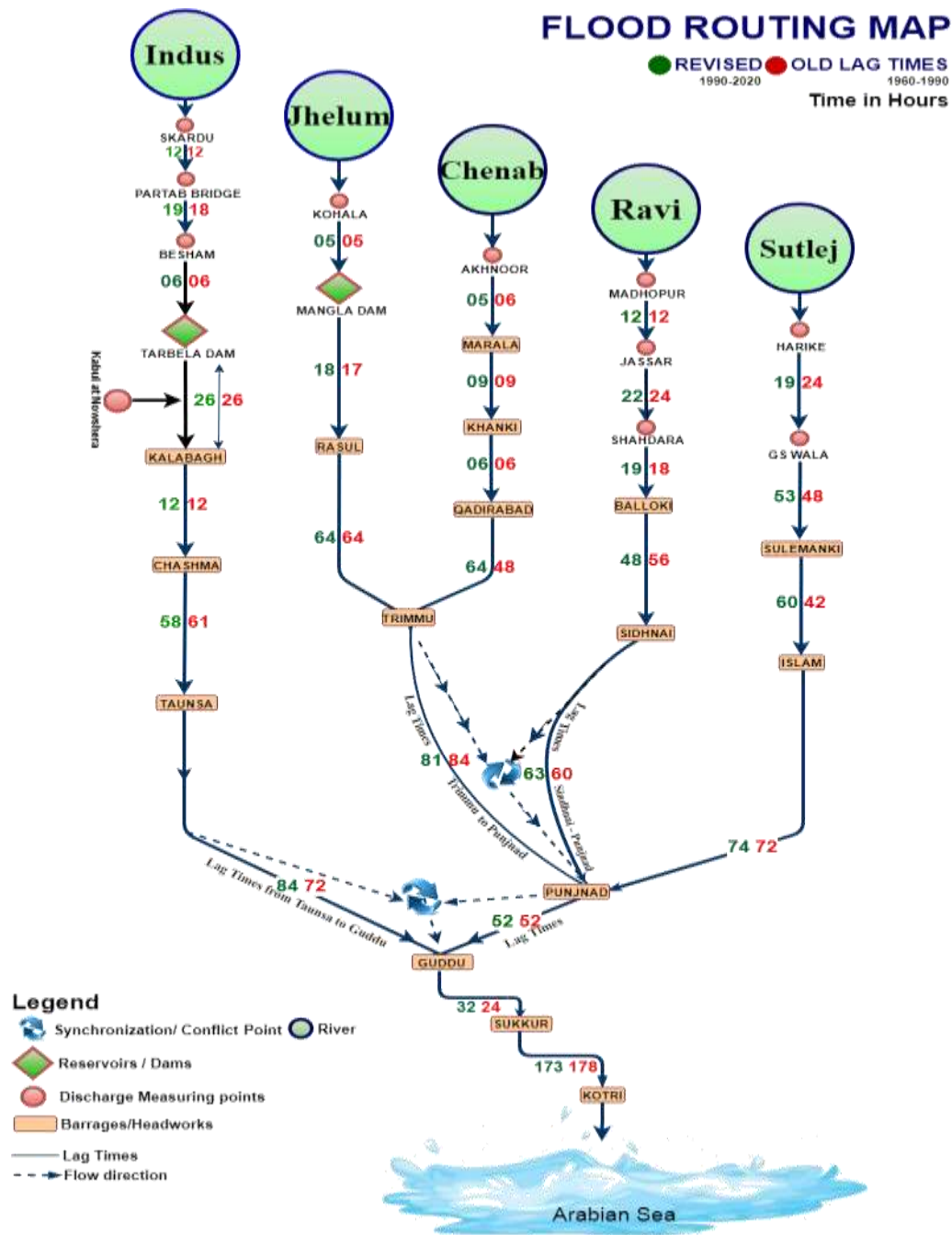
Figure 73: Maximum flood peaks recorded during the season 2022



18 Facilities Provided by FFD Lahore during the Flood Season

- Flood Forecasting Division Lahore provides semi-furnished accommodation facilities to the Police, Tele Communication staff & officials in the office premises.
- Flood Forecasting Division Lahore has provided space & facilities to the Environment Protection Department (EPD), Punjab to install their instruments to monitor air quality Index.
- Sports facilities were also provided to the flood related agencies working in FFD during the flood season.
- Flood Forecasting Division Lahore also provided facilities to media for live coverage regarding Flood/Weather events.

19 Revised Lag Times (Maximum Observed Flood Peaks level) | Flood Routing Map



Chief Met FFD Lahore | Head of team: Sahibzad Khan

Flood Routing Map | Revised Lag Time Team

Team member: Akhtar Mahmood, Saqib Hussain, Mamoon, Ghulam Farid

Routing Map designed | Ghulam Farid

Figure 74: Revised Lag Times

20 River Indus & Chenab Significant Event's Flood Forecast Accuracy Season 2022

FORECAST ACCURACY | SEASON 2022

River Indus & Chenab Significant Flood Event

Quantitative Forecast | Bulletin-B

Forecast | Upstream in thousands of Cusecs

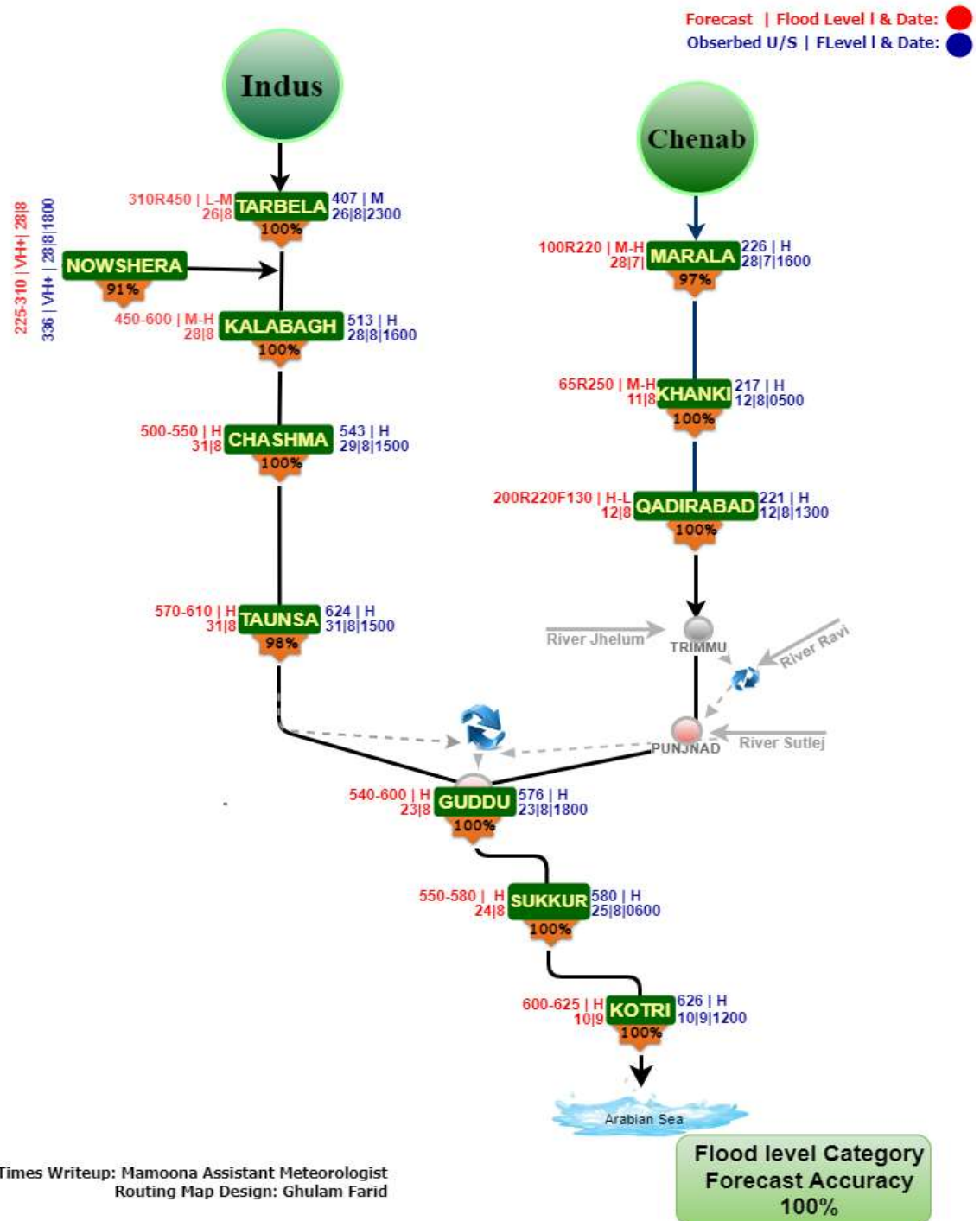
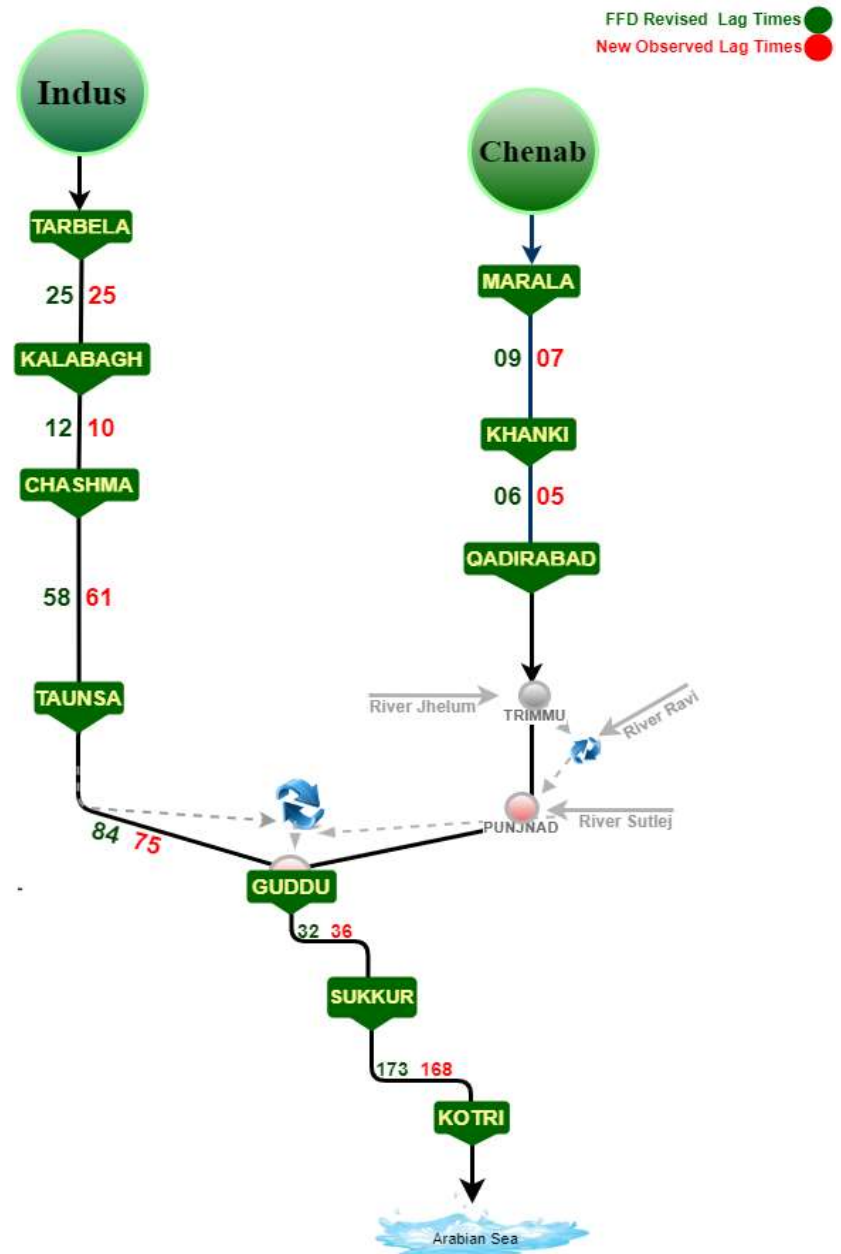


Figure 75: Forecast Accuracy 2022

21 Revised Lag Times Comparison with Flood Season 2022 Observed Lag Times (Flood Category Level) | Flood Routing Map

LAG TIMES (HRS) COMPARISON COMPARATIVE VIEW

River Indus & Chenab Significant Flood Event
Flood Season 2022



Lag Times Writeup: Mamoon Assistant Meteorologist
Routing Map Design: Ghulam Farid

Figure 76: Lag Times Comparison 2022



22 Achievements

- 1) WMO acknowledged to PMD for its accurate, timely repeatedly forecasts, also real time updates to hydrometeorological disasters, which helped in boosting the confidence of the top management as well as other forecasters.
- 2) Accurate seasonal forecast of above normal Rainfall along with the probability of extreme hydrometeorological events in hilly areas producing flash floods along with urban flooding.
- 3) Medium to short range precise and timely Weather and Flood forecasts repeatedly especially for Sindh, Balochistan and D.G.Khan division.
- 4) Accurate and well before the occurrence, forecasts issued for the catchments of rivers Kabul and Indus and their tributaries.
- 5) Chief Engineer Tarbela praised and thanked to FFD/PMD for providing the real time and accurate guidelines to dam operation to avoid the synchronization of flood peaks from river Indus at Tarbela and river Kabul at Nowshera.
- 6) DG Met. got appreciation at different high-level meetings on timely and accurate analysis of the hydrometeorological events and dissemination.
- 7) Information's gathered through Indian media, PCIW and with scientific approach no major threat was issued for river Ravi.