



Ministry of Earth Sciences (MoES)
India Meteorological Department

Monsoon of 2024 so far

21st August 2024

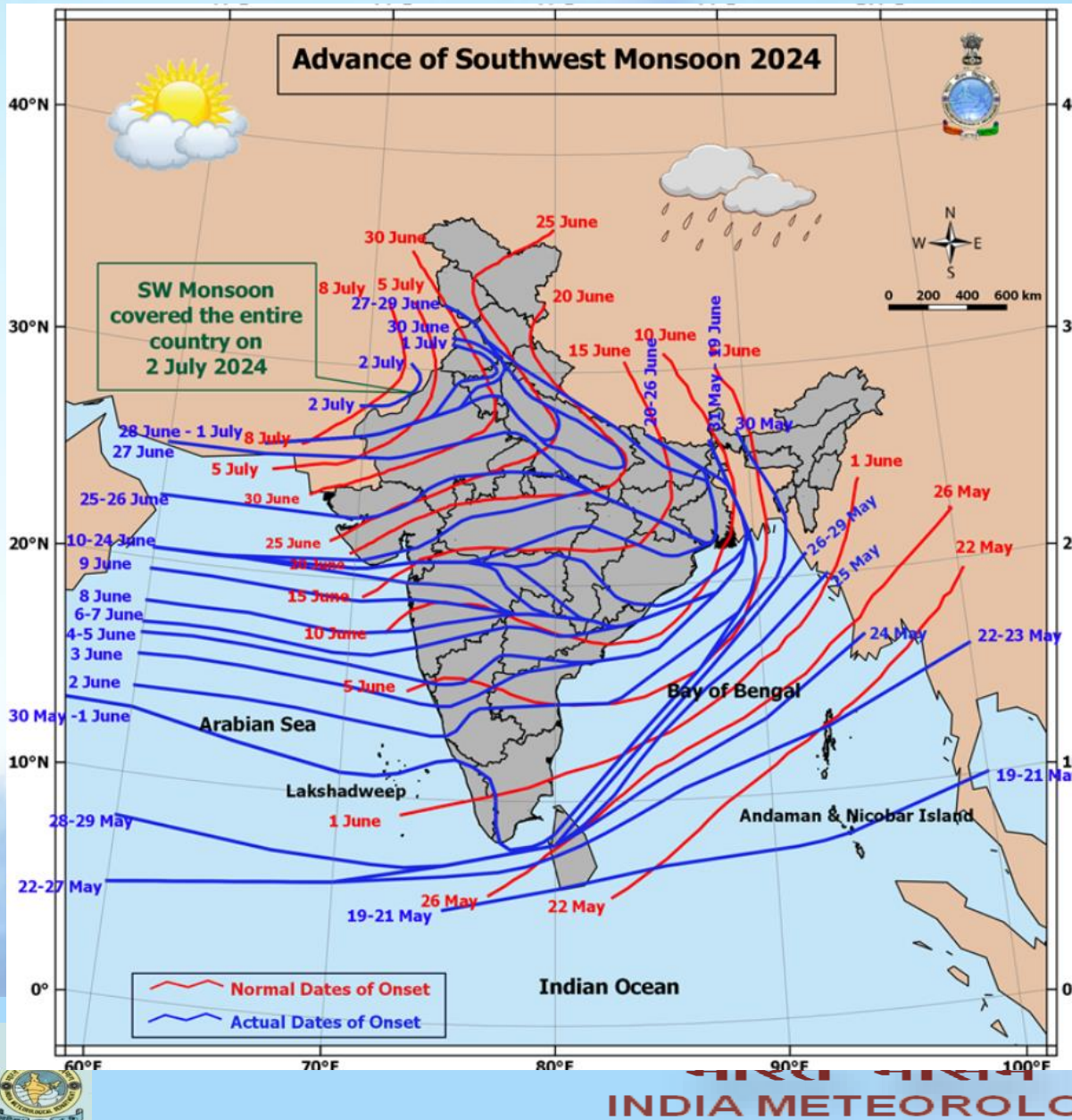
भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

Discussion Points

- Onset and advance
- Rainfall and Associated Synoptic Systems
- Monthly, weekly and Daily
- Forecast Performance Status so far
- ✓ Seasonal and Monthly forecasts
- ✓ ERF and Heavy rainfall Forecast
- Model verification
- Operational Forecast verifications
- Summery and Discussion



Onset and advance Monsoon 2024



- Southwest Monsoon has set in over Kerala on 30th May 2024 against the normal date of 1st June and
- It covered the entire country on 2nd July, against the normal date of 08th July (6 days before the normal date of covering the entire India)
- Arabian Sea branch was dominated during advance phase of Monsoon over main land of India (1-19 June)
- The Bay of Bengal branch had hiatus of about 3 weeks (31 May-19 June) over Sikkim after covering NE states. But, Arabian Sea branch till then covered west coast and South Peninsular India

2. Forecast for the 2024 Monsoon Onset over Kerala

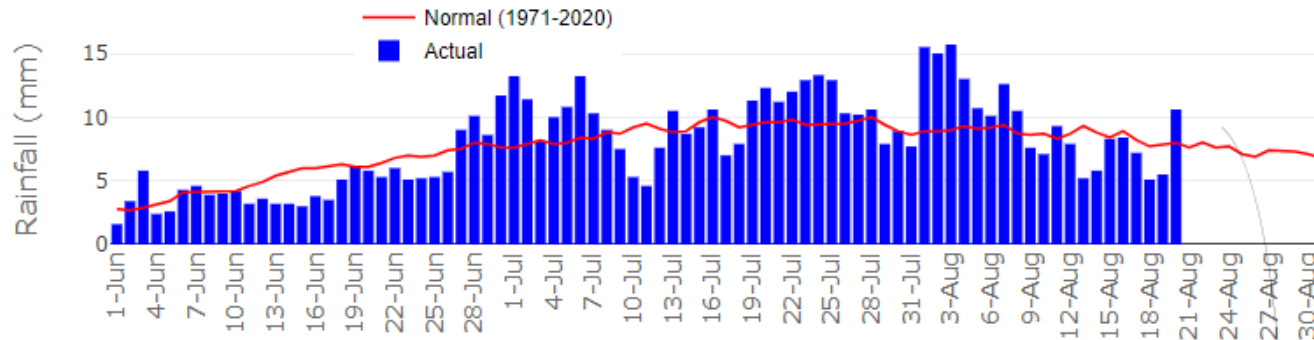
This year, the southwest monsoon is likely to set in over Kerala on 31st May with a model error of ± 4 days.

Issued on 15 May 2024

Current Status of Monsoon 1 June till 20 Aug 2024

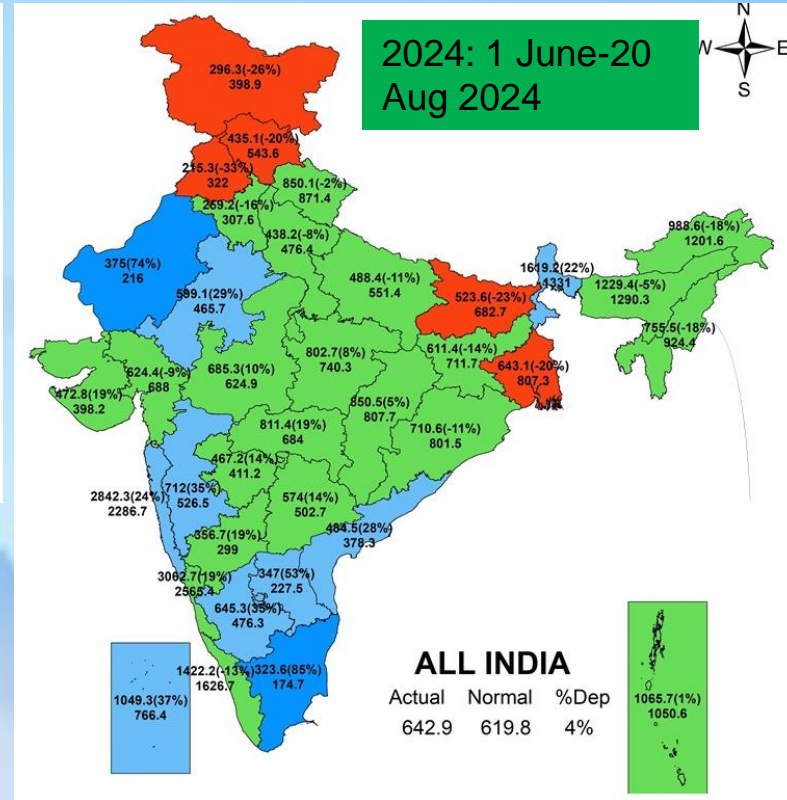
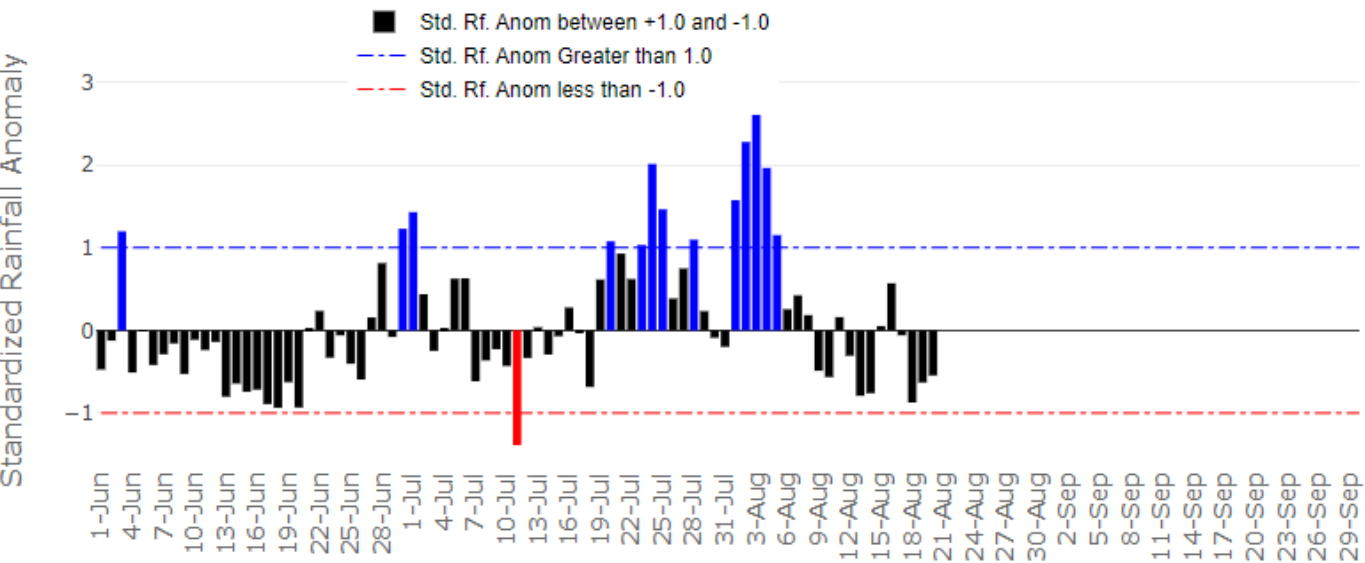
All India Summer Monsoon Rainfall

Daily Mean Rainfall (mm) over The Country As A Whole 2024

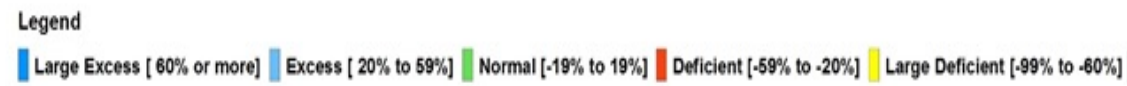


Rainfall Anomaly over Core Monsoon Zone

Standardized Rainfall Anomaly over the Core Monsoon Zone Region 2024



- ✓ Punjab(-33%), J and K and Ladak(-26%), Bihar(-23%), HP(-20%), GWB(-20%)
- ✓ All other Sub-divisions had normal to excess rainfall(Raj, AP, M. Mah and K and Goa, Int Karnataka, TN are excess by 28-85%)



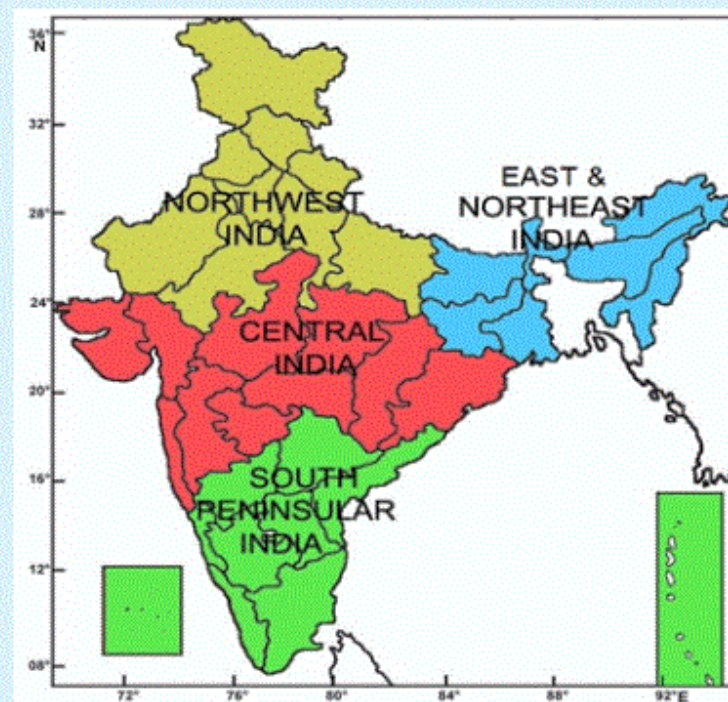
RAINFALL STATISTICS - MONSOON 2024

JUNE 2024		1- Jun	TO	30-Jun
REGION	ACTUAL	NORMAL	% DEP	
COUNTRY AS A WHOLE	147.2	165.3	-10.9	
NORTHWEST INDIA	52.6	78.1	-32.6	
EAST & NORTHEAST INDIA	284.9	328.4	-13.3	
CENTRAL INDIA	147.0	170.3	-13.7	
SOUTH PENINSULA	183.9	161.0	14.2	

JULY 2024		1- Jul	TO	31-Jul
REGION	ACTUAL	NORMAL	% DEP	
COUNTRY AS A WHOLE	305.8	280.5	9.0	
NORTHWEST INDIA	179.7	209.7	-14.3	
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SOUTH PENINSULA	279.2	204.5	36.5	

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CENTRAL INDIA	191.6	211.4	-9.4	
SOUTH PENINSULA	136.0	129.1	5.3	

CUMULATIVE SEASONAL RAINFALL		1- Jun	TO	20-Aug
REGION	ACTUAL	NORMAL	% DEP	
COUNTRY AS A WHOLE	642.9	619.8	3.7	
NORTHWEST INDIA	426.9	426.7	0.1	
EAST & NORTHEAST INDIA	853.9	971.0	-12.1	
CENTRAL INDIA	765.7	703.0	8.9	
SOUTH PENINSULA	599.1	494.6	21.1	



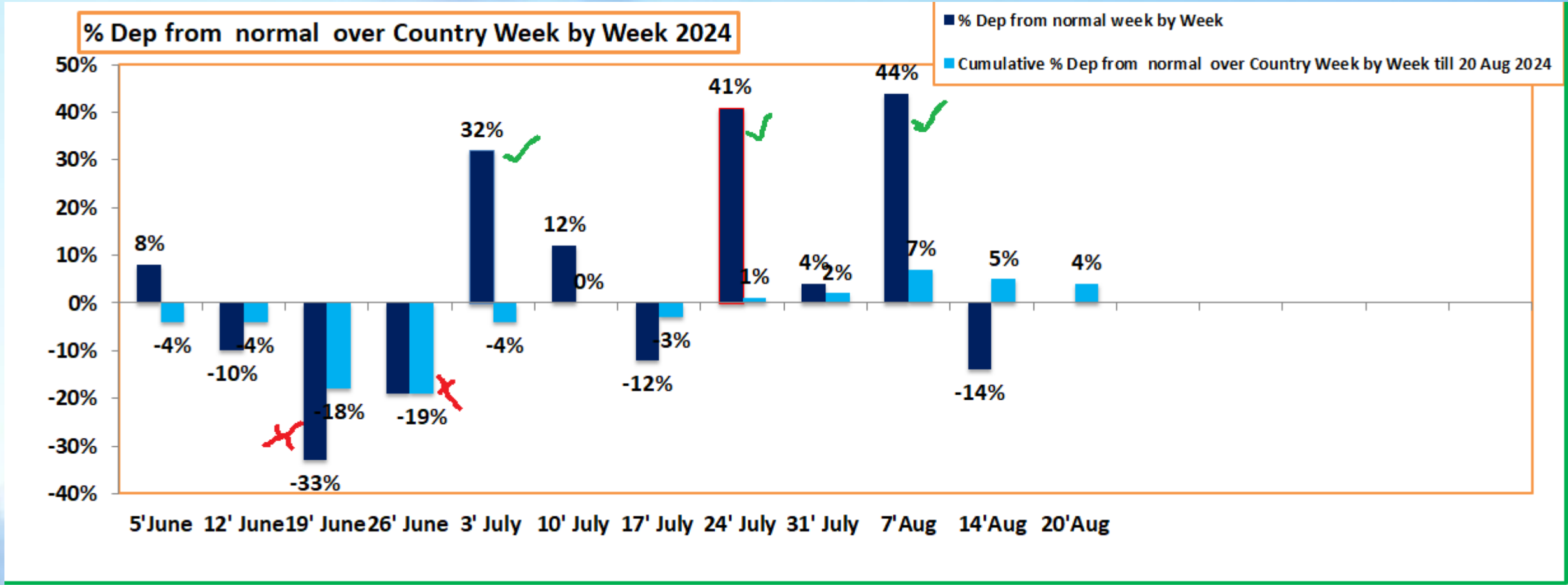
FOUR HOMOGENEOUS REGIONS OF INDIA



(Based on real time data)



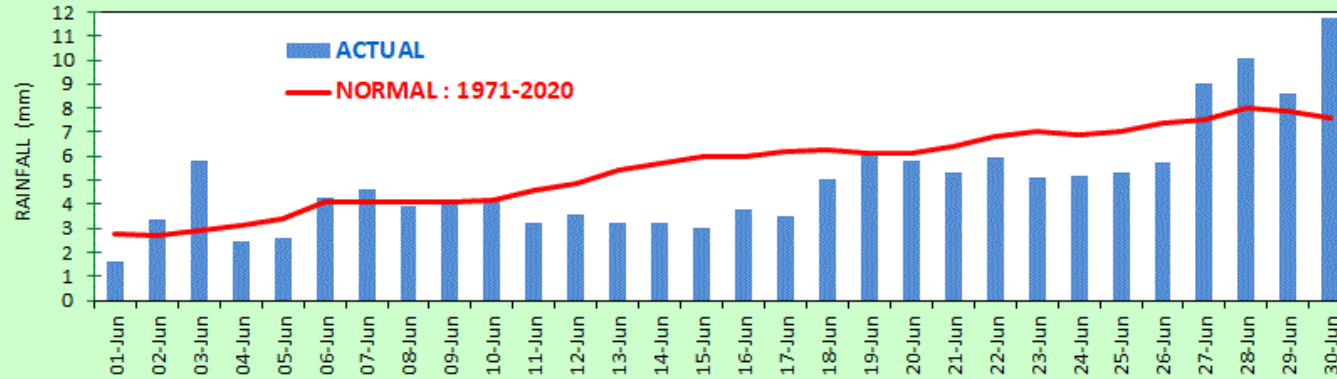
Week by Week progress of monsoon 2024 till 20 Aug 2024



Monsoon – June 2024

All India Summer Monsoon Rainfall

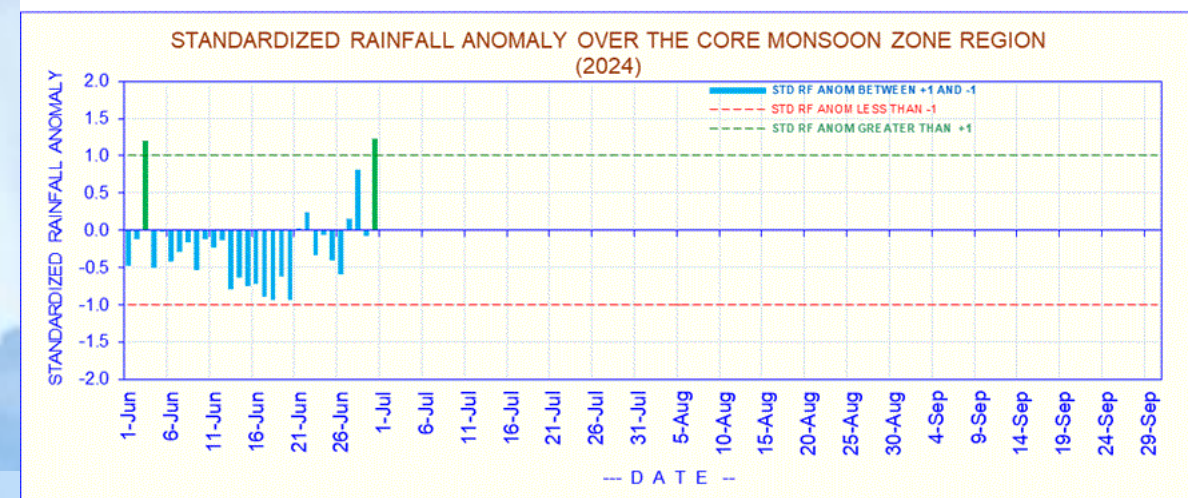
DAILY MEAN RAINFALL (mm) OVER THE COUNTRY AS A WHOLE (2024)



Rainfall Statistics

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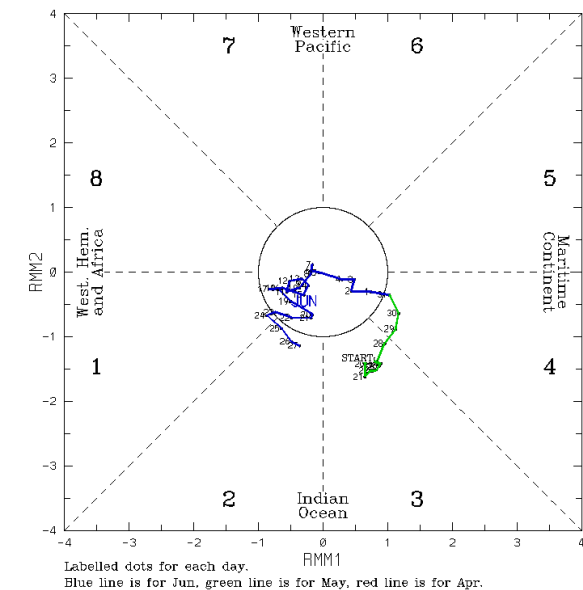


Factors which influence June rainfall activity

- During June 2024, subdued rainfall activity observed during many days especially during 10th to 18th June.
- Rainfall activity improved after 19th June and 27-30 June, rainfall overall was very good over the country
- The MJO was in weak phase during most of the initial days of the June and strength of MJO increase during end of June and move to Indian Ocean region, which helped for the formation of Low Pressure System over Head Bay of Bengal.
- The formation of a low pressure system (LPS) on 28th June 2024 over Head Bay of Bengal helped to improve the monsoon flow and hence increase in rainfall activity over most part of the country.

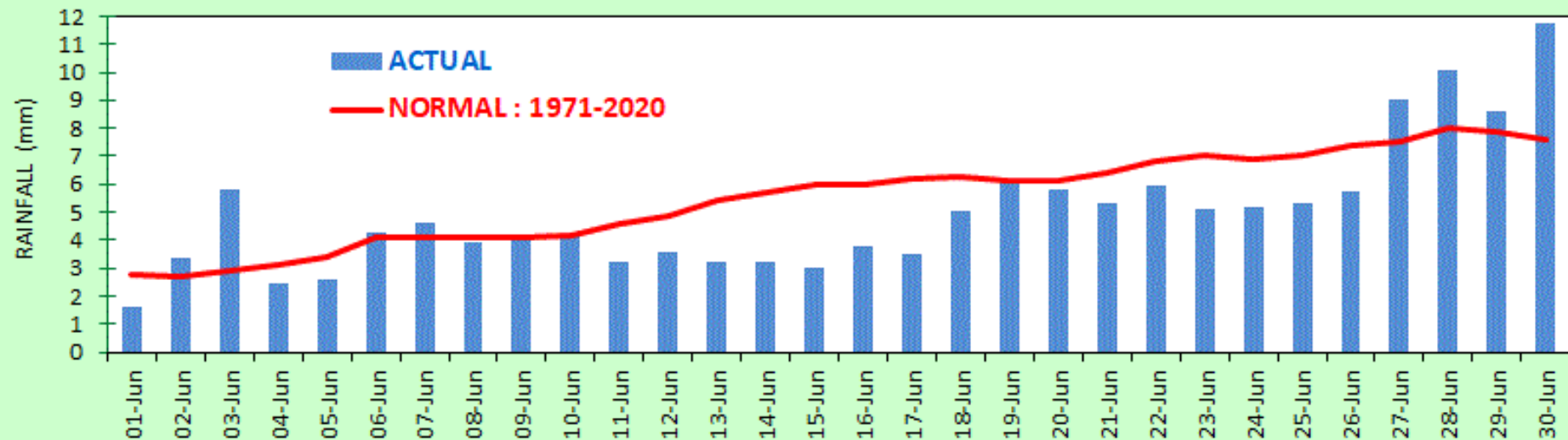
MJO Phase June 2024

(RMM1, RMM2) phase space for 19-May-2024 to 27-Jun-2024



All India Rainfall during June 2024

DAILY MEAN RAINFALL (mm) OVER THE COUNTRY AS A WHOLE (2024)



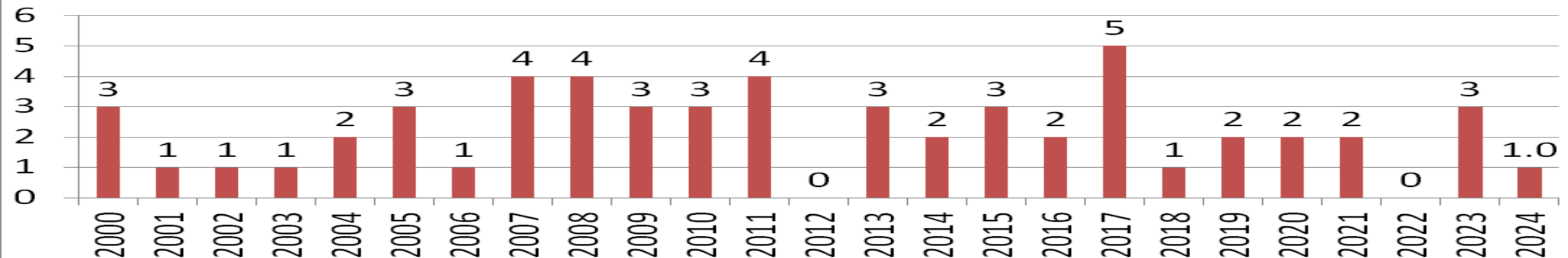
Major Synoptic Systems June 2024

- **Low pressure system(LPS) : Only 1 LPS of 3 days formed against normal of 3 LPS of 11 days.**
- **BoB branch was very weak till last 20 june. So eastern branch of Monsoon did not advance during 31 May till 19 June- almost 3 weeks.**
- **WDs: Only 3 WD against normal of 4-5 WD was observed across north India(5-10, 19-25 and 26-28 June). Absence of active WD mainly during 10 June till 19 June also reason for longer dry spell and heat wave prevailing over NW and adjacent central India.**

LPS during June 2024

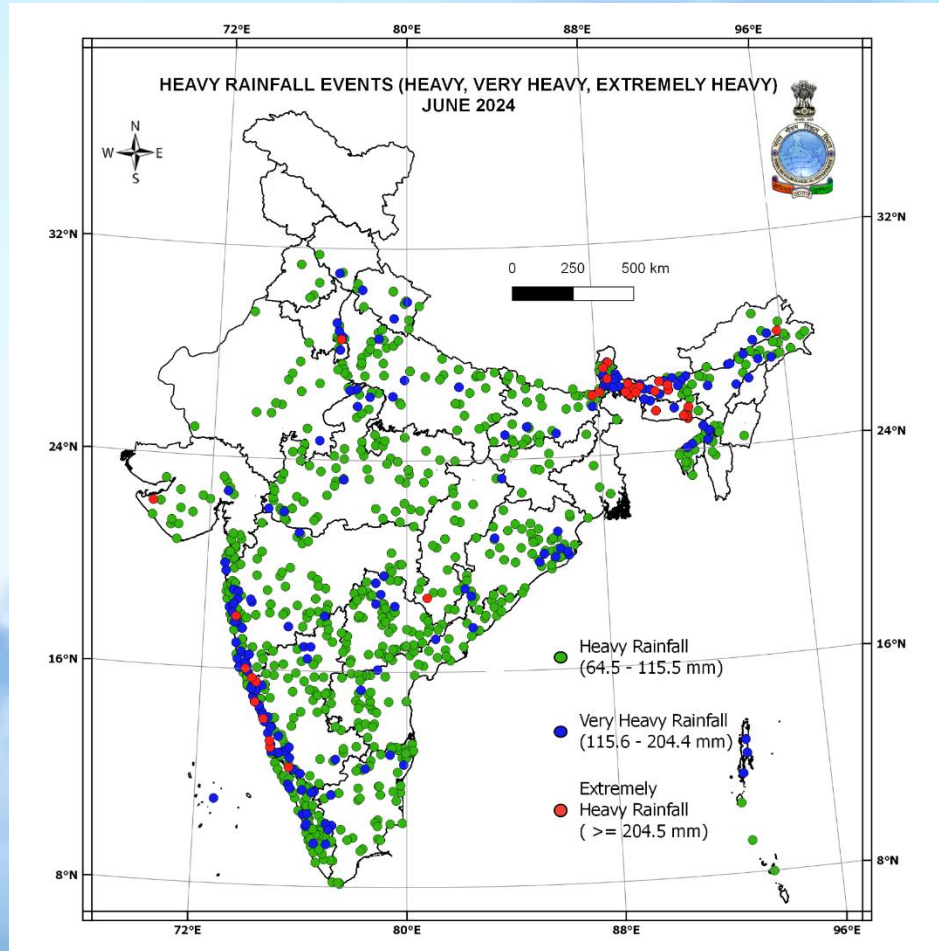
Category	CS	DD	D	WML	L	Total LPS	Total LPS days	Long period Average of Total monsoon systems /Days	
June 2024	0	0	0	0	0	1	3	3	11

Total number of LPS during 2000-2024 for the month of June



Heavy Rainfall Events in June 2024

Location of Heavy Rainfall events occurred in June 2024



Number of Heavy,very Heavy/Ext. Heavy Rainfall events occurred in the month of June during last 5 years.

YEAR	Rainfall Category	Number of stations reported Events
2020	V. Heavy (115.6 to 204.5)	262
	Ext Heavy (more than 204.5)	36
2021	V. Heavy (115.6 to 204.5)	277
	Ext Heavy (more than 204.5)	35
2022	V. Heavy (115.6 to 204.5)	178
	Ext Heavy (more than 204.5)	72
2023	V. Heavy (115.6 to 204.5)	377
	Ext Heavy (more than 204.5)	62
2024	V. Heavy (115.6 to 204.5)	284
	Ext Heavy (more than 204.5)	51



Extremely Heavy rainfall spell over northeast India and and Sub-Himalaya West Bengal during 12-20 June 2024 and Floods

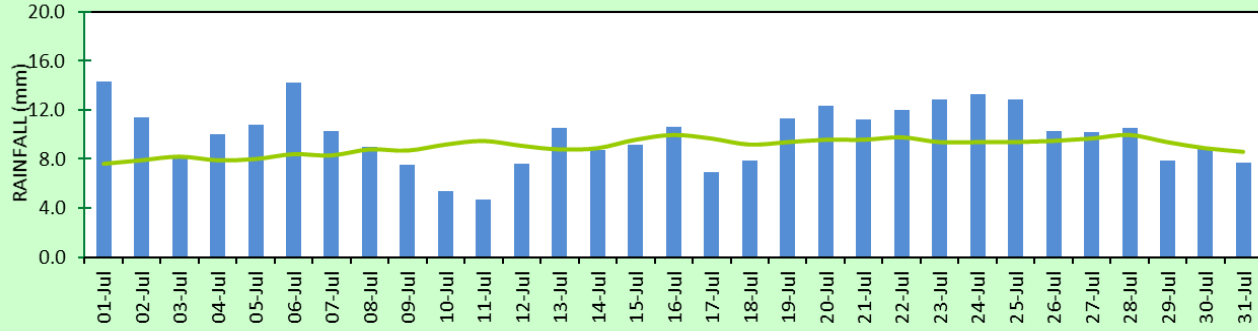
- **During 12-20 June- Heavy to very heavy rainfall with Isolated Extremely heavy rainfall** observed in most dates over north-eastern states and Sub-Himalaya West Bengal during 13-20 June and over Assam on 13th and 17th June,
- Exceptionally heavy rainfall was also observed over Meghalaya on 15th and 18th June with **Mawsynram-64cms, Cherrapunji-51cm and Shella-40 cm** on 15th June and **Mawsynram-78, Cherrapunji (Rkm)-43, Cherrapunji-39, Mawkyrwat-30, Mawkyrwat-Arg-28** reported on 18th June.
- Such extremely heavy rainfall spells also caused flood like scenario and impacted lives in the region. Such extreme and exception heavy rainfall were due to:
 - ✓ a) Presence of cyclonic circulation over these areas and adjoining Bangladesh in lower tropospheric level and east-west trough from Bihar towards Nagaland.
 - ✓ b) Strong southwesterly/southerly winds and moisture incursion from Bay of Bengal to northeast India in lower tropospheric levels.



Monsoon – July 2024

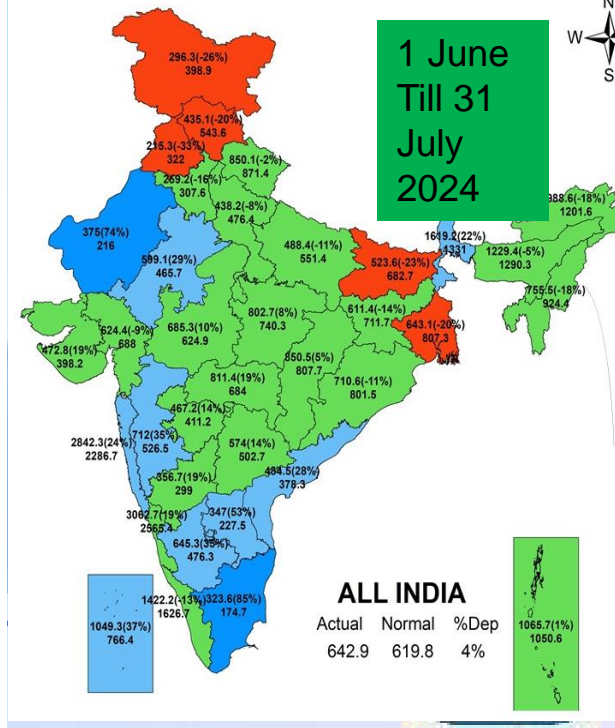
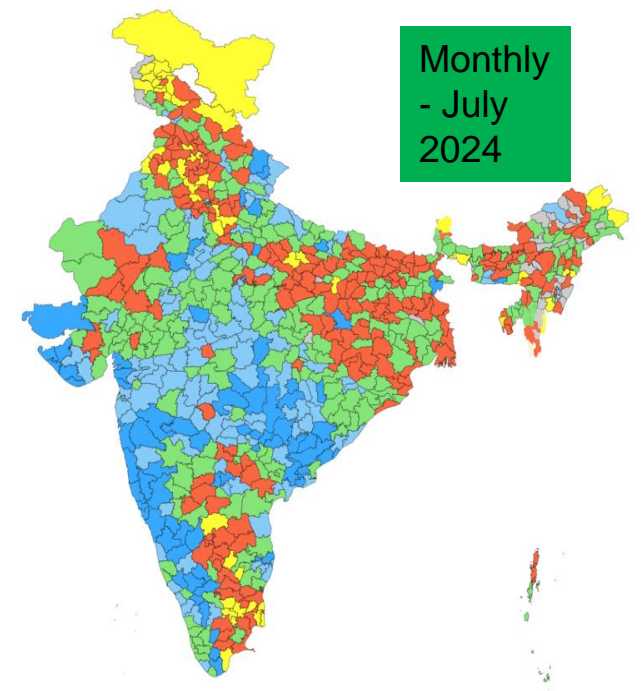
All India Summer Monsoon Rainfall

DAILY MEAN RAINFALL (mm) OVER COUNTRY(July 2024)



Rainfall Statistics

JULY 2024	1-Jul	TO	31-Jul
REGION	ACTUAL	NORMAL	% DEP
COUNTRY AS A WHOLE	305.8	280.5	9.0
NORTHWEST INDIA	179.7	209.7	-14.3
EAST & NORTHEAST INDIA	325.3	424.1	-23.3
CENTRAL INDIA	427.2	321.3	33.0
SOUTH PENINSULA	279.2	204.5	36.5



Extremely heavy rainfall spells in July 2024

➤ Exceptional heavy rainfall

- West UP and Uttarakhand - 8th July (Baheri (dist Bareilly):46cm and Banbasa (Champawat)-43cm)
- Saurashtra- 19th and 20th July: 19th July(Porbandar (dist Porbandar)- 49, Kalyanpur (dist Devbhoomi Dwarka)- 29 and also on 20th July (dist Devbhoomi Dwarka -Devbhoomi Dwarka-42 cm)
- Madhya Mahasrashtra- 25thJuly Pune Dist-Tamini-56, Lavasa-45; Lonavala_agri (dist Pune) 35

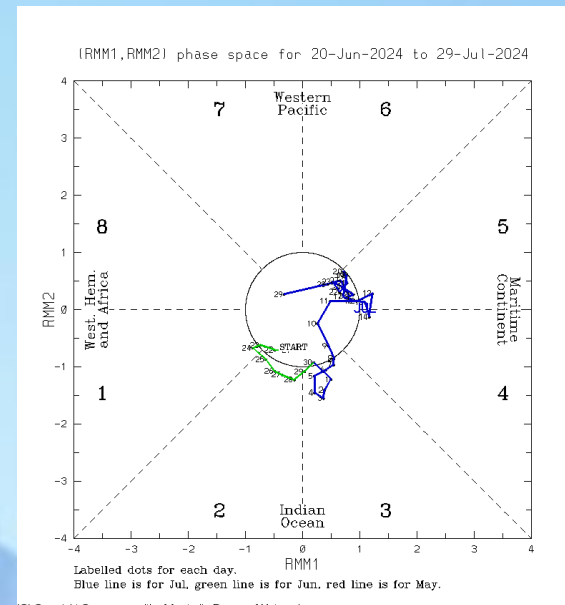
➤ Extremely heavy rainfall

- ✓ Uttarakhand-6-8 July, West Uttar Pradesh-5-8 July
- ✓ Konkan & Goa: 7-9, 19-25 July, Madhya Maharashtra: 21-26 July
- ✓ Gujarat Region: 16 and 21-26 July, S and K: 18-20 and 22-24 July
- ✓ Urban areas Very heavy to Extremely heavy rainfall City:
- ✓ Mumbai-7-9, 11-12, 13-14 and 18-22 July Pune- 24-26 July 2024
- ✓ Goa-7-9 and 12-19 July(Panjim- 36cm on 14 July)
- ✓ Surat 25th -26 July : 29.8cm 26th July: 18cm Baroda 25th July : 320.2cm, 26th July: 12cm
- ✓ Kerala : 29-30 July: highest 34 cm



Factors for good rainfall activity during July Month

- Both ENSO and the IOD were in the neutral condition.
- Most of the days monsoon trough was in south of its normal position, which helps to get good rainfall over Central and Peninsular India and below normal rainfall over Gangetic Plain and Northeast India.
- Formation of three low-pressure systems (LPS) during July (15 -17, 18-23 and 26-28 Jul). One system intensified into Depression (18th to 23rd Jul).
- These LPS helped to get a good amount of rainfall over the central Indian region and the west coast of India.
- Total number of LPS days was 11 against the normal of about 13.5 days in July
- MJO phase was favourable for monsoon rainfall over Indian region.



MJO Phase: JUL 2024

Year	Depressio n	Low	Total LPS		LPS days
2017	1	5	6		12
2018	1	2	3		19
2019	-	4	4		15
2020	-	2	2		7
2021	-	4	4		15
2022	1	3	4		22
2023	-	4	4		12
2024	1	2	3		11
climatolog y	1.45	1.83	3.27		13.56



Depression over Northwest and adjoining Westcentral Bay of Bengal (19-20 July)



- Low Pressure Area: 15th July over Northwest & adj Westcentral Bay of Bengal
- Depression over Northwest & adj Westcentral BoB on 19th July
- Crossed Odisha coast in the morning (0530 hrs IST) of 20th July
- Weakened into a well marked low pressure area over coastal Odisha in the evening (1730 IST) of 20th and Low Pressure Area on 22nd (0530 IST) and less marked over East MP & adj. Chhattisgarh on 23rd (0830 hrs

- Caused vigorous rainfall activity over east and central parts of India (Odisha, Andhra Pradesh, Chhattisgarh, Telangana and Madhya Pradesh, Gangetic West Bengal during 19th to 23rd August).



Other weather systems during July 2024

➤ Synoptic Systems-

- ✓ **WD activities were very weak and no major interaction with tropical easterly.**
- ✓ **Total 3 WDs(6-8, 15-19, 20-22 July) but observed in-situ and north of 30degN). Not favorable for rainfall.**
- ✓ **Off-shore trough was active in most dates and observed mainly off south Gujarat- north Kerala coasts.**
- ✓ **East-west Shear line at Mid-troposphere in most dates.**
- ✓ **In addition, a cyclone in most dates over Gujarat region and S & K**

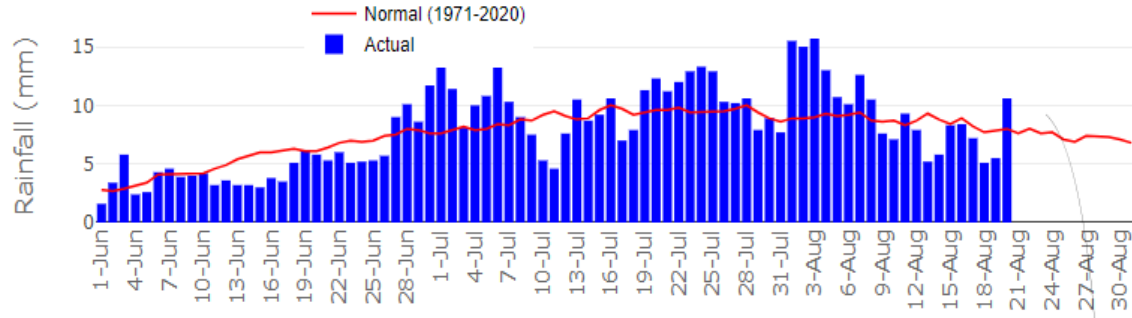
➤ Semi-permanent System and MJO

- ✓ **Arabian Sea branch was very active in most dates while BoB branch was active during 1st week and then during 3rd and 4th week**
- ✓ **In contrast to June when MJO was in phase 6 to 1, In July it was in phase 3 to 5, which was highly favourable for active monsoon over Indian region**
- ✓ **Monsoon trough south of the normal position, vertically extended in the lower levels and was active.**
- ✓ **Heat low was intense than normal with average MSLP as 992 hpa against normal of 995 hpa and was west of normal position over Pakistan(normal position Pakistan and adjoining NW Raj)**
- ✓ **Tropical Easterly Jet (TEJ) was stronger than normal (92kts at 100 hpa while normal is 70kt for July). It was seen north of the normal position in most dates. Normal is Kochi but was seen north of Kochi**

Monsoon –Aug 2024

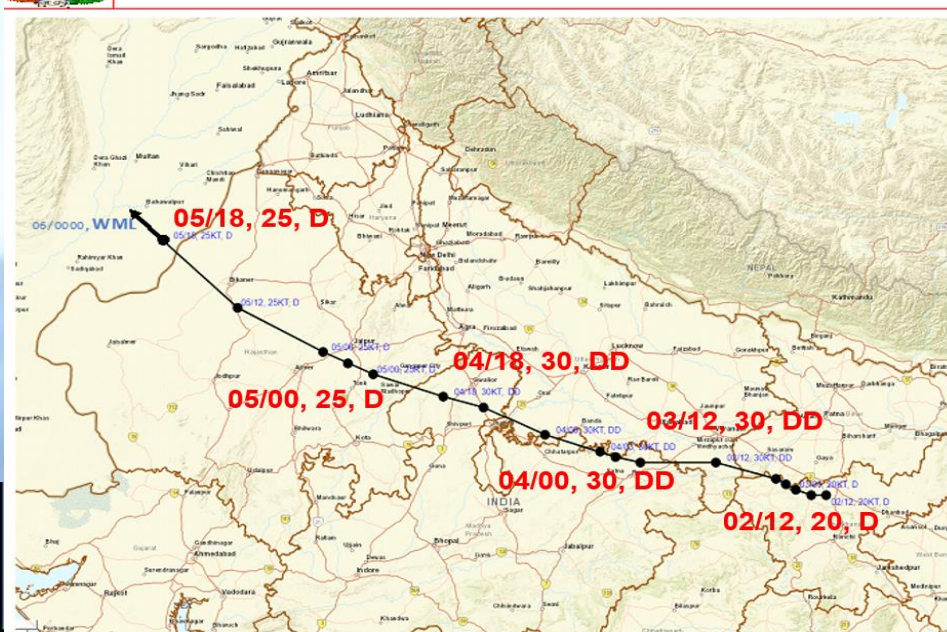
All India Summer Monsoon Rainfall

Daily Mean Rainfall (mm) over The Country As A Whole 2024



Rainfall Statistics

OBSERVED TRACK OF DEEP DEPRESSION OVER INDIA DURING 02ND AUGUST TO 06TH AUGUST, 2024.



SUBDIVISION RAINFALL MAP

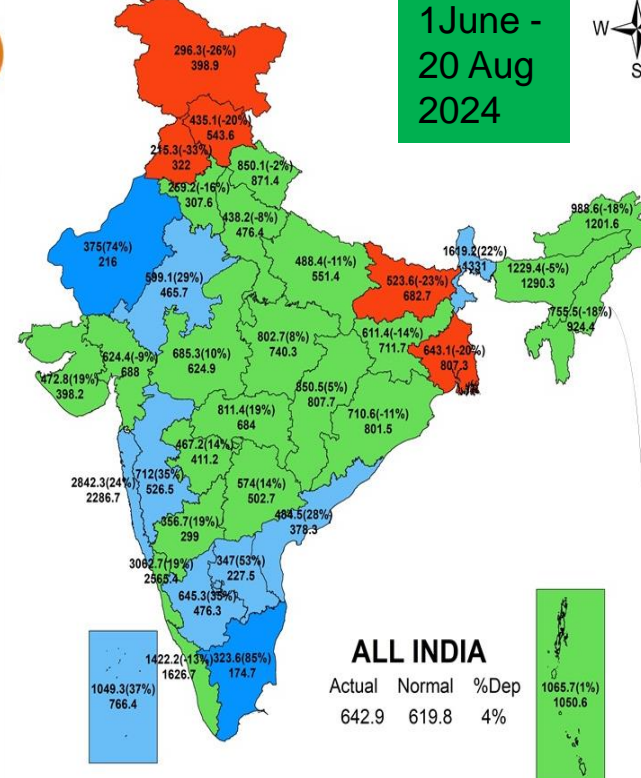
Monthly: 01-08-2024 to 20-08-2024



Month
1-20 Aug
2024



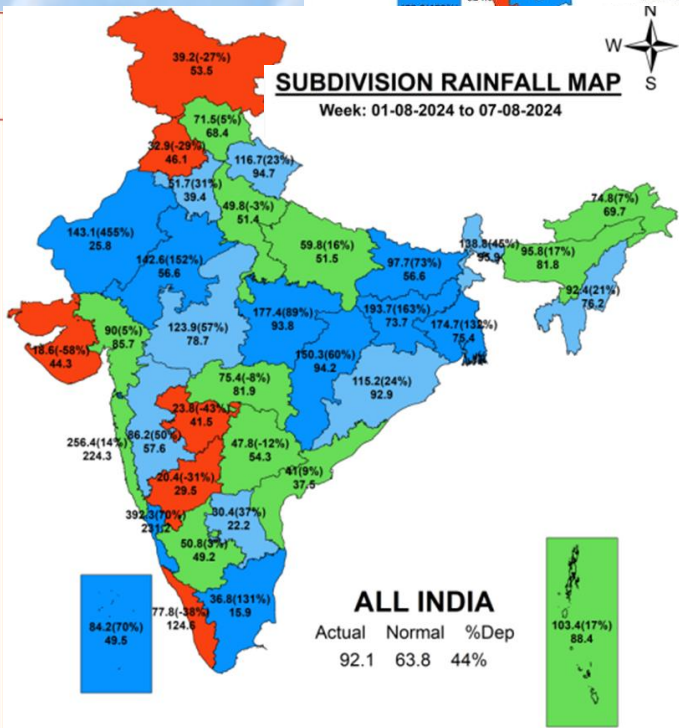
ALL INDIA
Normal %Dep
74.0 8%



ALL INDIA
Actual Normal %Dep
642.9 619.8 4%

SUBDIVISION RAINFALL MAP

Week: 01-08-2024 to 07-08-2024



ALL INDIA
Actual Normal %Dep
92.1 63.8 44%

Aug 2024
3.8 mm
74.0 mm
8%

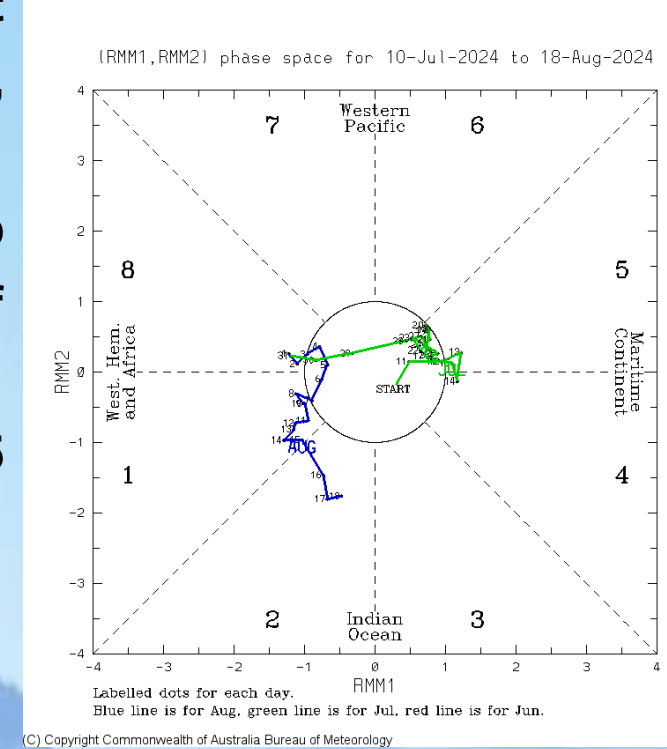
1 June-20 AUG 2024
Actual: 642.9 mm
Normal: 619.8 mm
Departure: 4%

AUGUST 2024	1- Aug	TO	20-Aug
REGION	ACTUAL	NORMAL	% DEP
COUNTRY AS A WHOLE	188.4	174.0	8.2
NORTHWEST INDIA	189.1	138.9	36.2
EAST & NORTHEAST INDIA	244.6	218.5	12.0
CENTRAL INDIA	191.6	211.4	-9.4
SOUTH PENINSULA	136.0	129.1	5.3

Factors for good rainfall activity during Aug Month till 20 Aug 2024

MJO Phase: Aug 2024

- Both ENSO and the IOD continued in neutral condition.
- 1-7 Aug, monsoon trough was south of the normal position. But during 10-21 Aug, monsoon trough remained along its normal position, which helps to get good rainfall over North and adjoining Central India, parts of eastern India, extreme south Peninsular especially Tamil Nadu.
- Formation of three low-pressure systems (LPS) during Aug (2-6 Aug (a Dep with long west ward track in the season, moved from GWB to Central parts of Pak), 3-4 (SW Raj) and 16-21 Aug over Bangladesh).
- Total number of LPS /LPS days are 3/10 days against the normal of about 15 days in July
- MJO phase was not favourable for monsoon rainfall over Indian region.

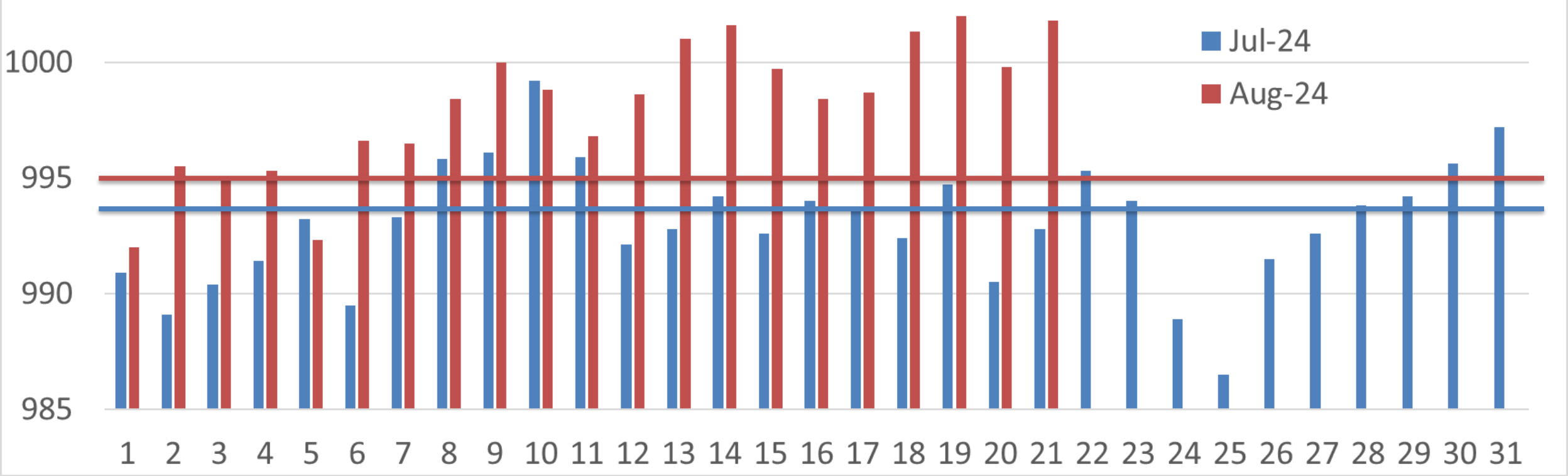


LPS IN MONSOON 2024

LPS during June-July 2024									
Category	CS	DD	D	WML	L	Total LPS	Total LPS days	Long period Average of Total monsoon systems /Days	
June 2024	0	0	0	0	0	1	3	3	11
July 2024	0	0	1	0	2	3	11	3	14
Aug 2024	0	0	1	0	2	3	10	4	17
Sept 2024								3	12
Season	0	0	2	0	4	7	24	13	55

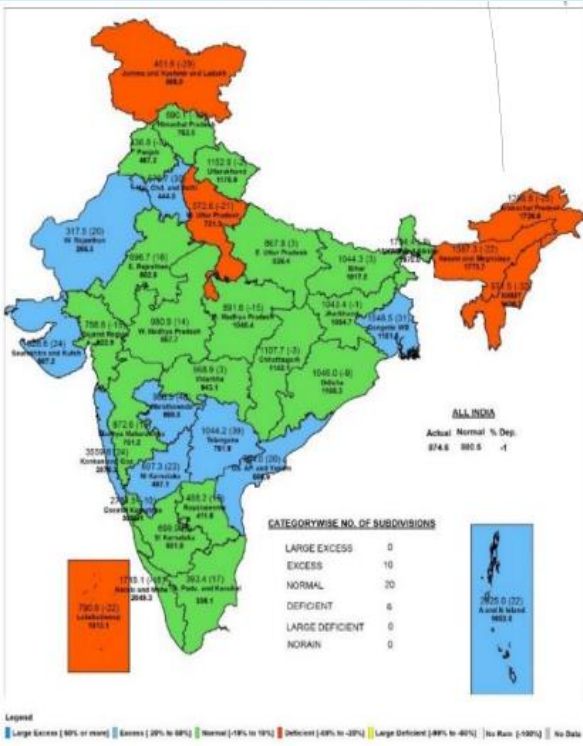


Actual/Normal mean-July(994/995 hpa) and Aug 2024(998/995 hpa) Heat Low (MSLP)

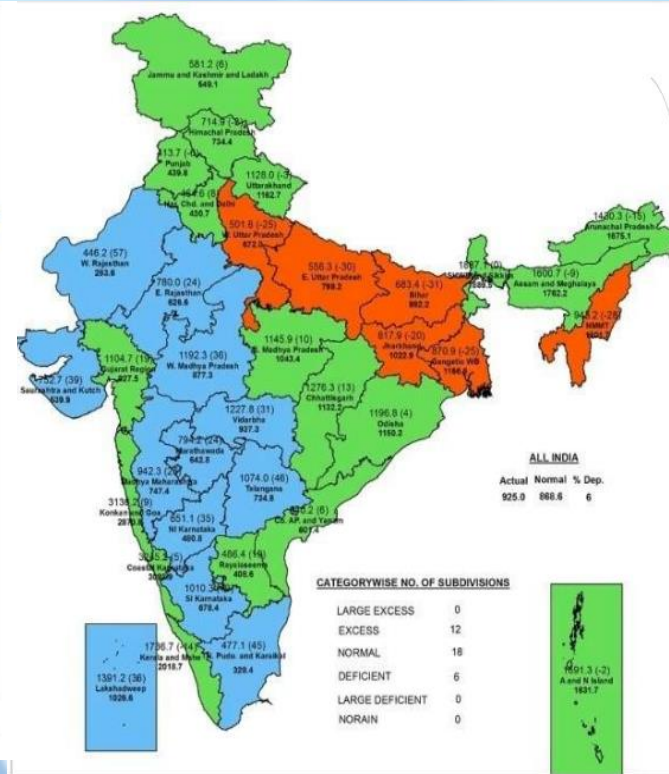


All India Summer Monsoon Rainfall 2021-2023 vs 2024(Monsoon 2024 is 1 June till 20 Aug 2024)

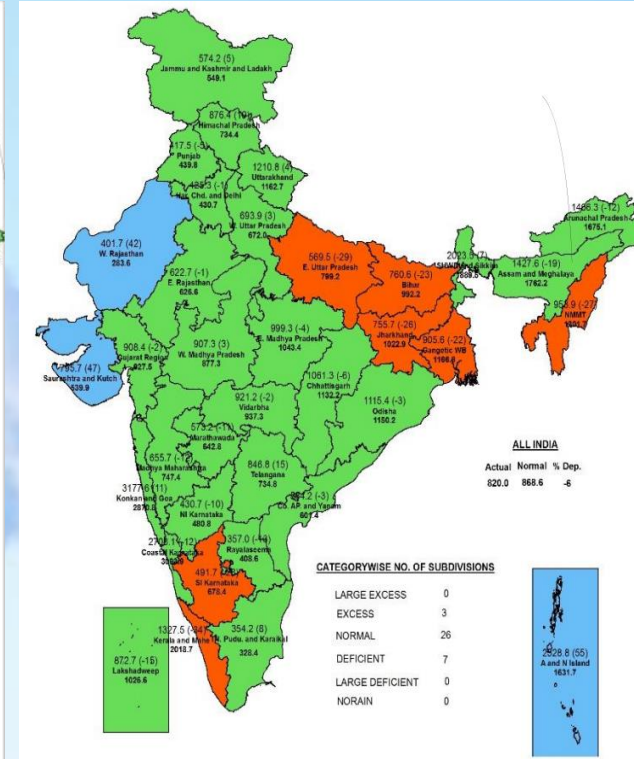
2021



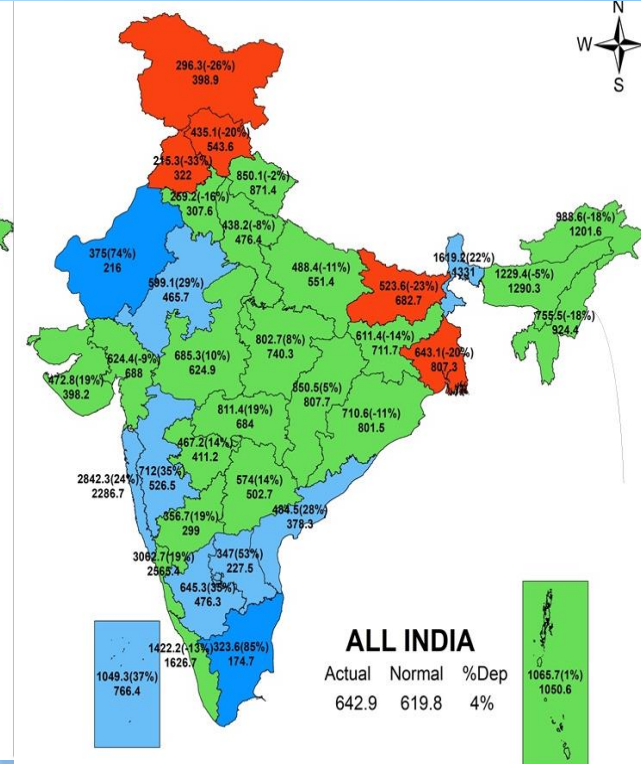
2022



2023



2024(1 June-20 Aug 2024)



Year	Rainfall in % Dep for the season
2021	-1
2022	6
2023	-4.5
2024	4

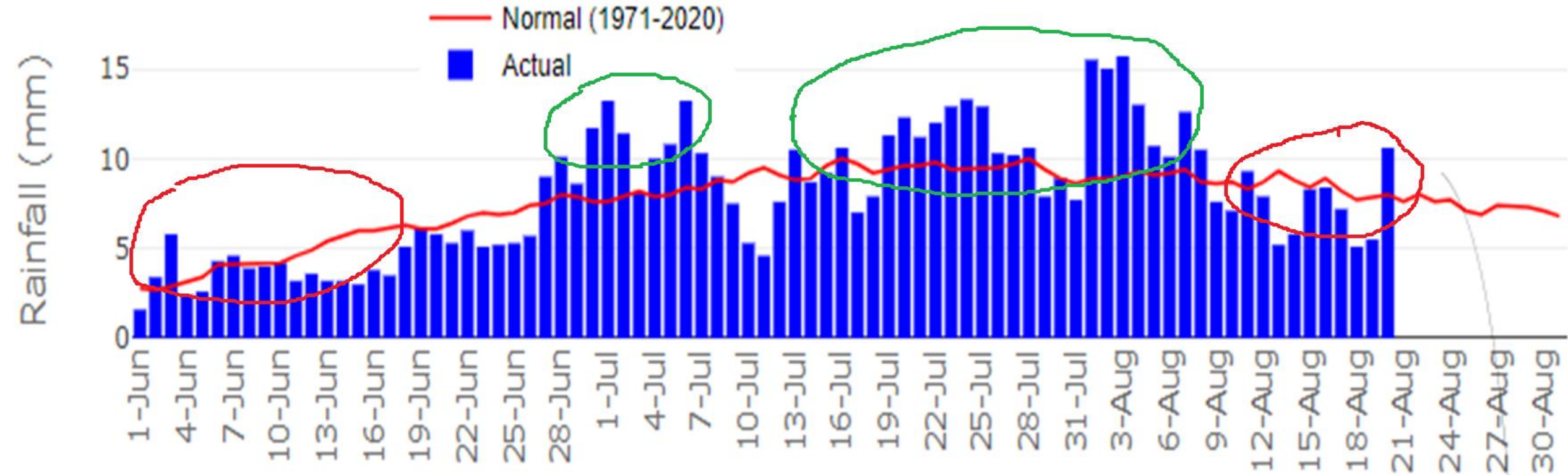


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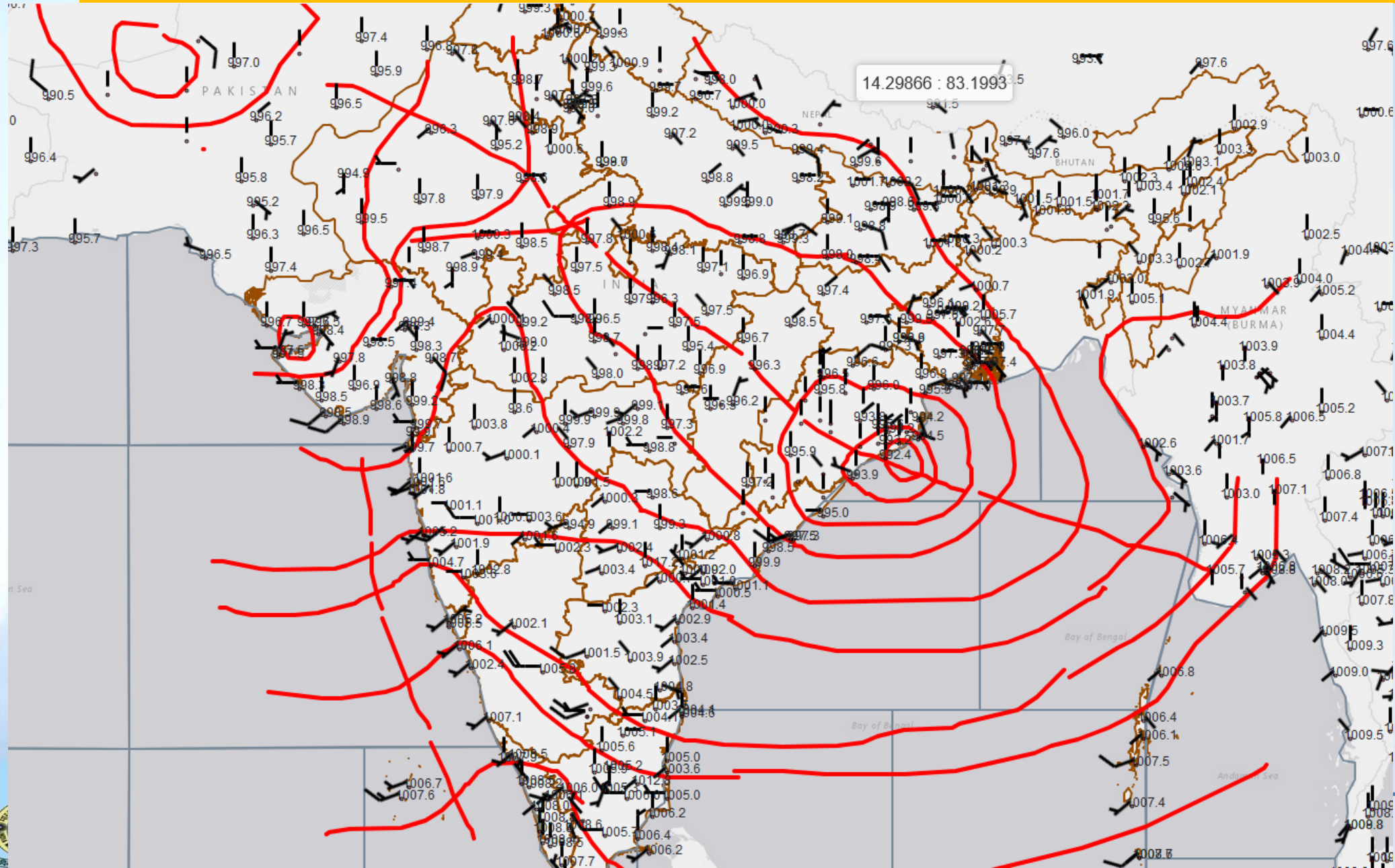


Intra-seasonal Variation monsoon 2024

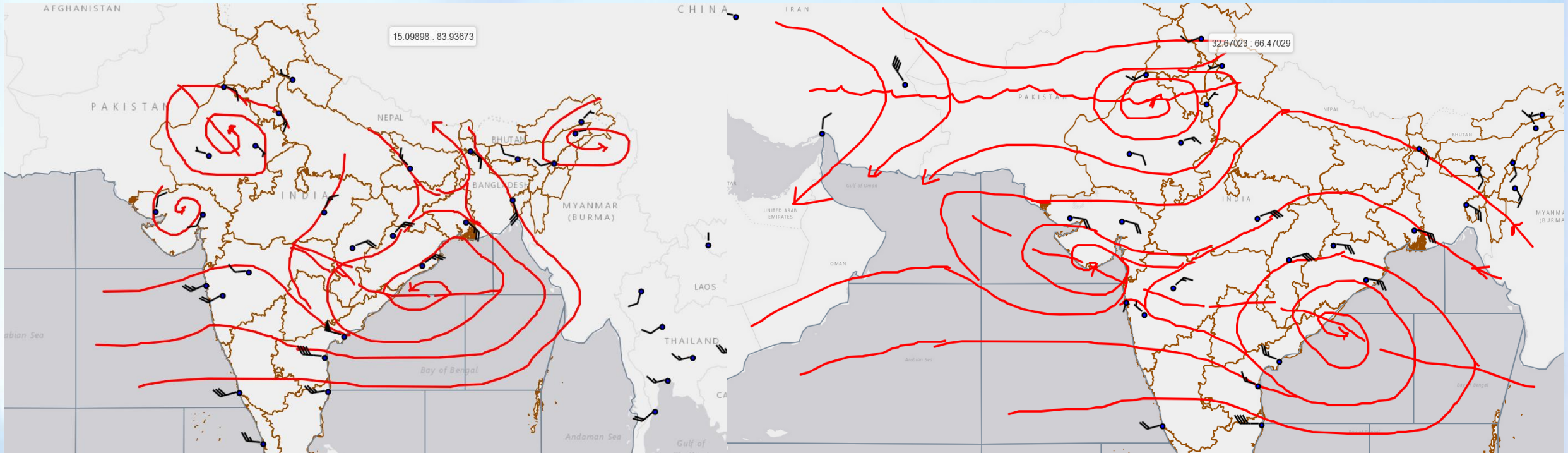
Daily Mean Rainfall (mm) over The Country As A Whole 2024



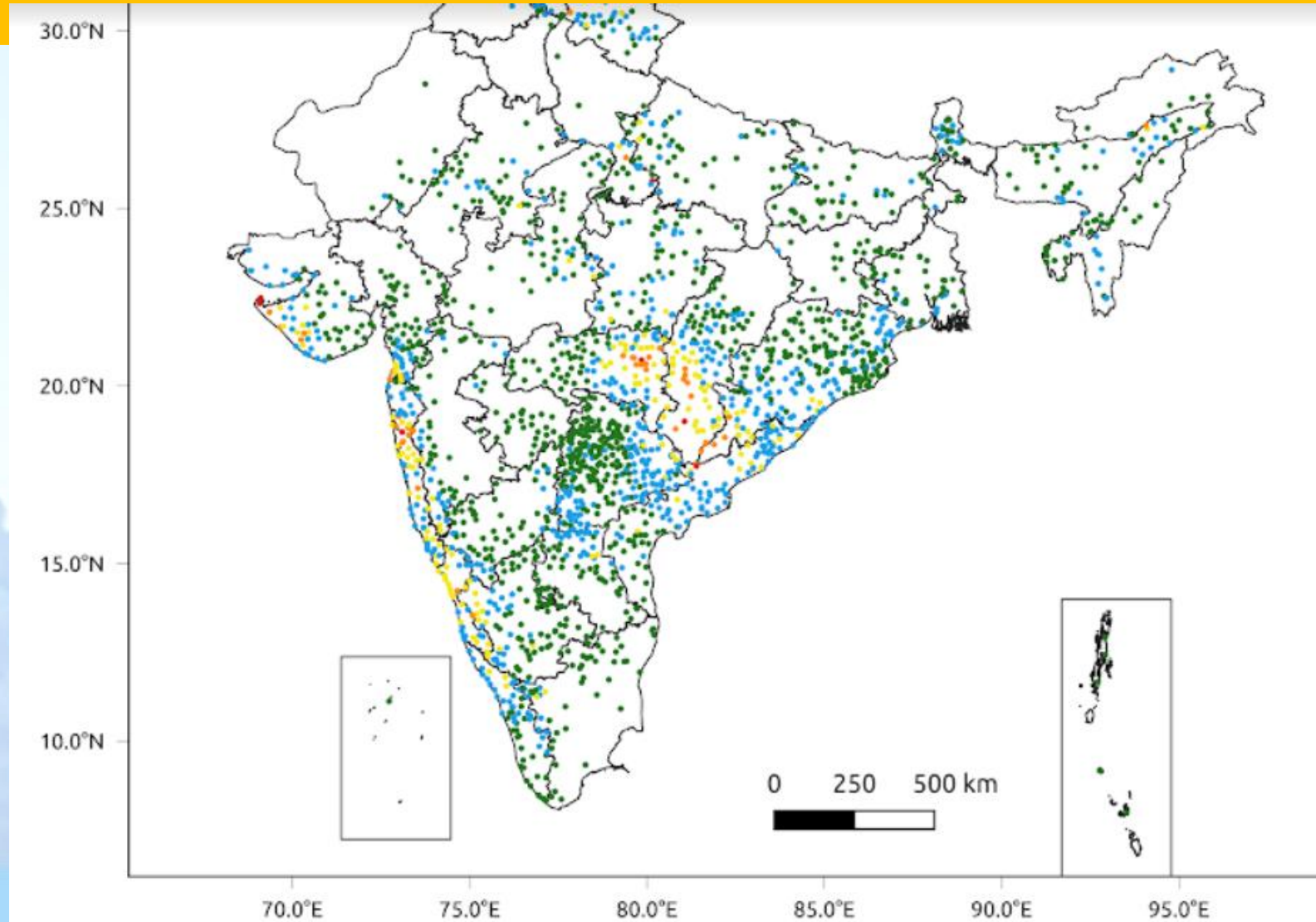
0300 UTC of 20th July 2024



20th July 2024 -925 and 500 hpa



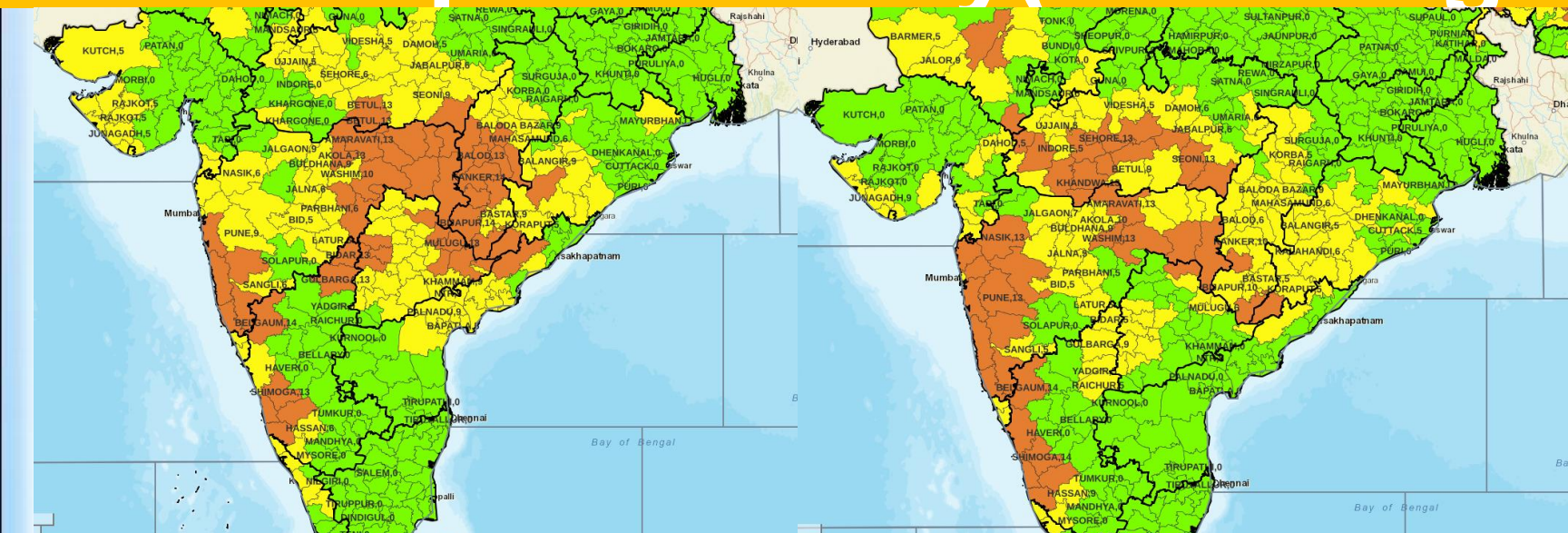
Rainfall till 0830am of 20 July



Legends

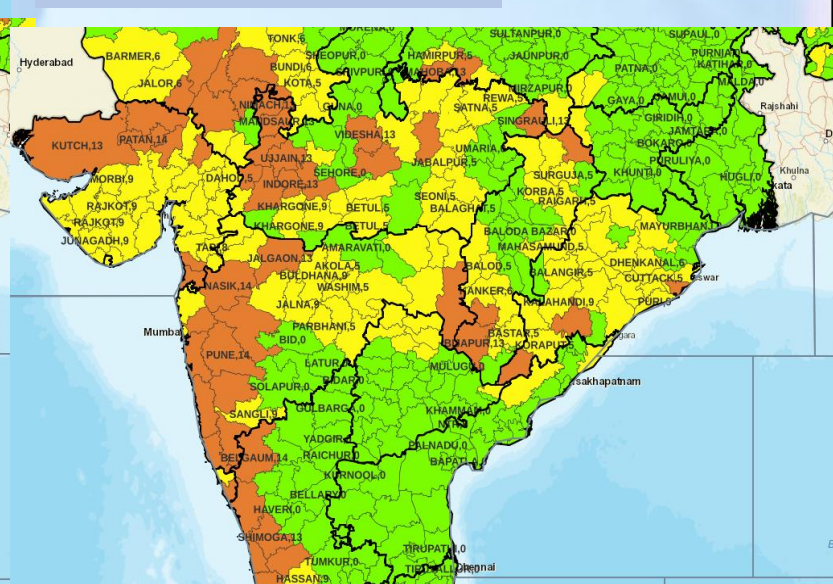
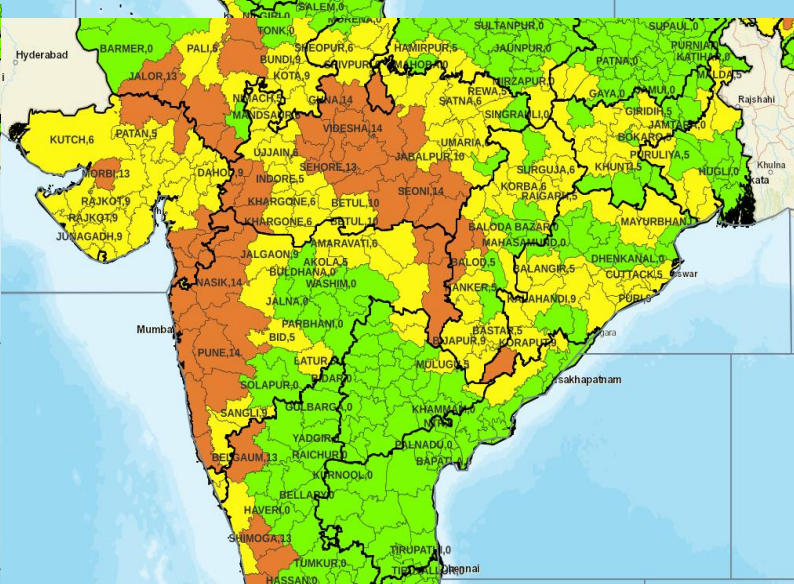
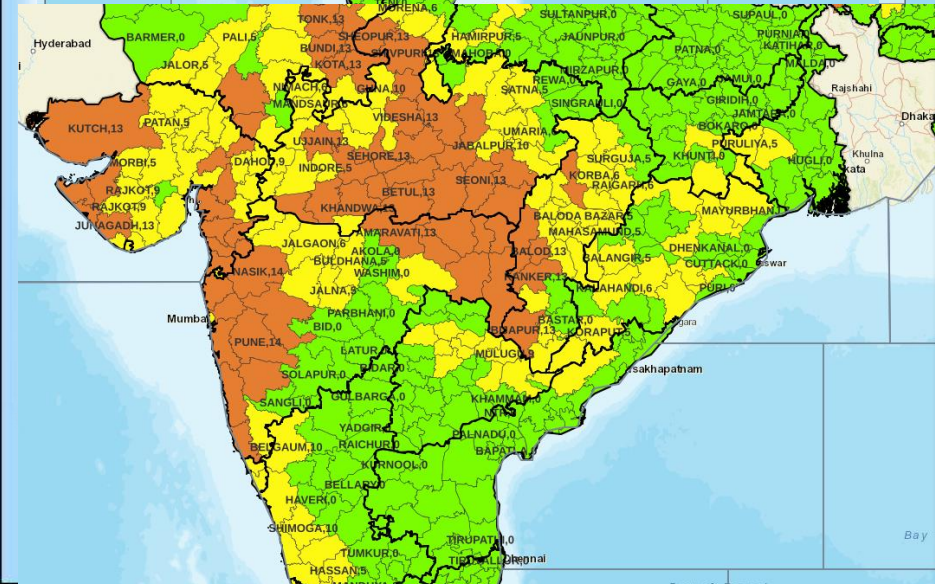


From left to right 20 to 25 July based upon 20 July(left to right)



	NHR	HR	VH	EH
>90%	4	8	12	16
60-90%	3	7	11	15
30-60%	2	6	10	14
00-30%	1	5	9	13

NHR: NO HEAVY RAINFALL
 HR: HEAVY RAINFALL
 VH: VERY HEAVY RAINALL
 EH: EXTREMELY HEAVY RAINFALL



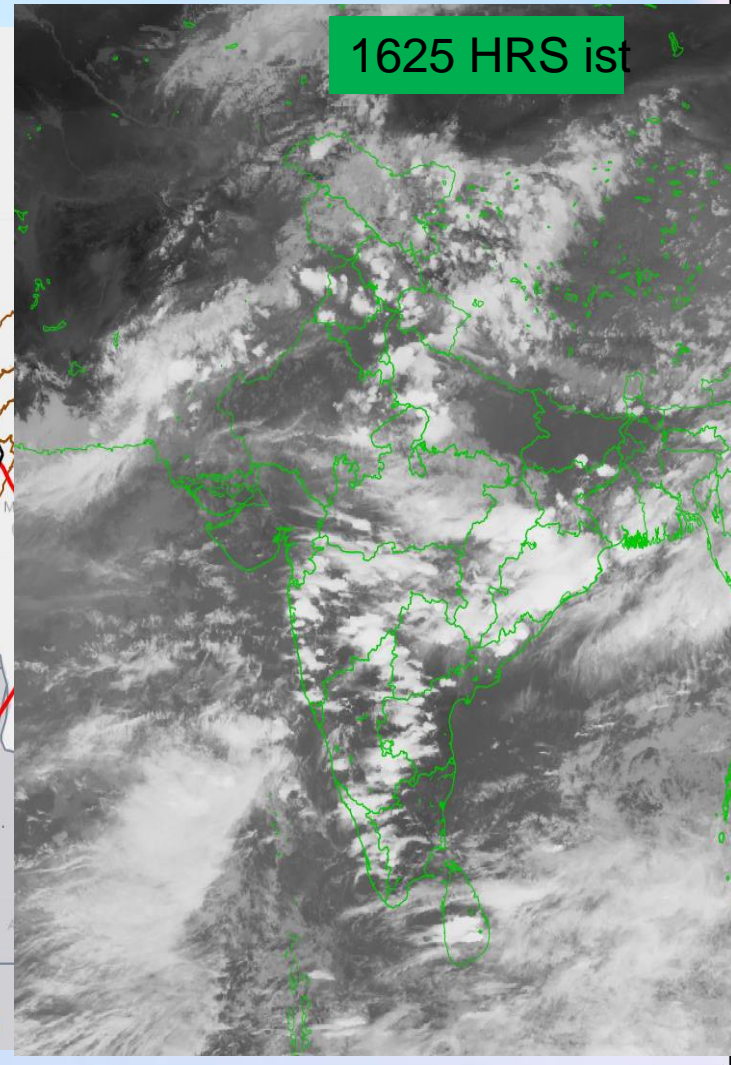
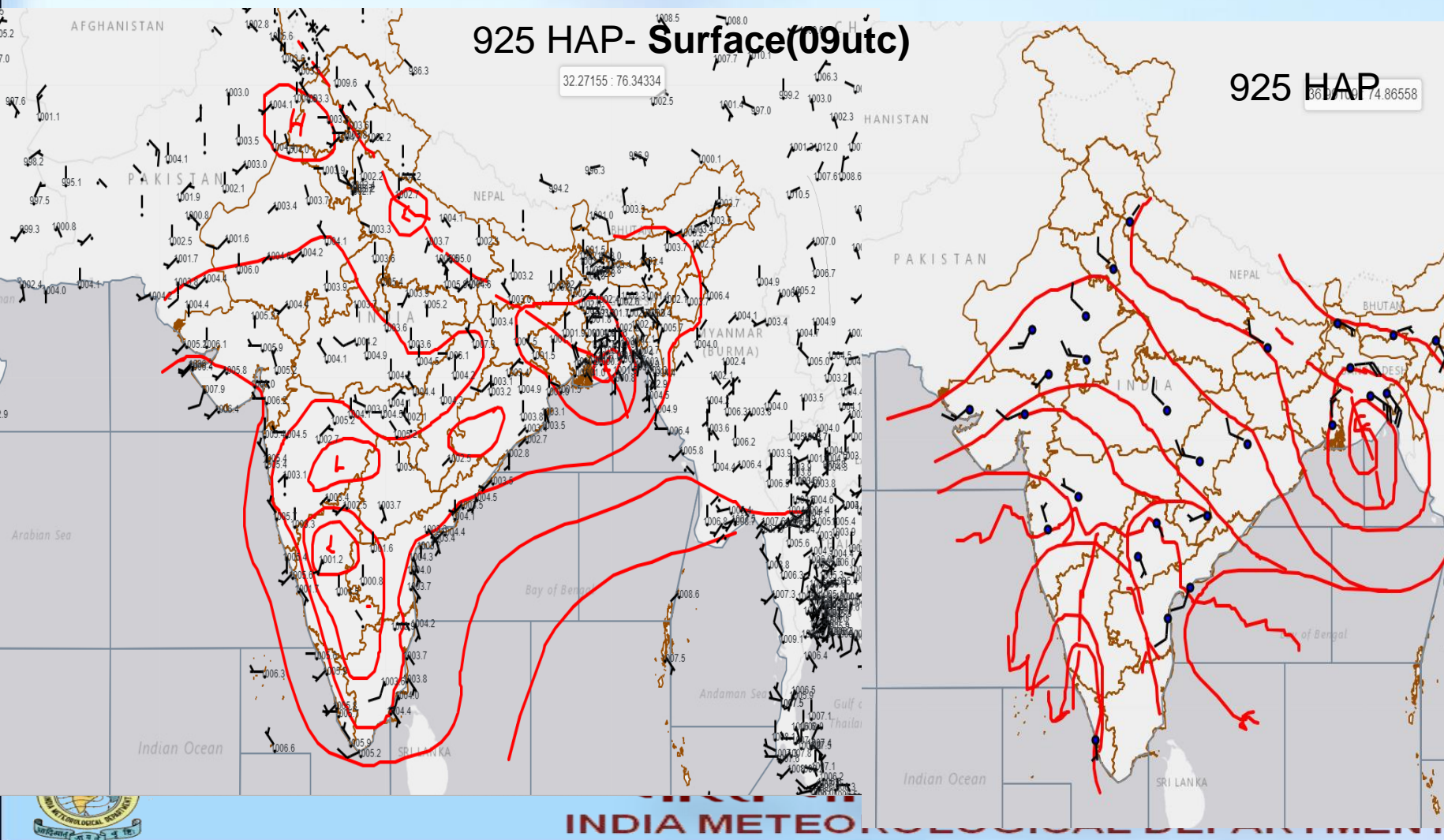
Subdivisional Daily Rainfall Intensity from 16th July to 29th July 2024(Realised from 0830 hrs IST of the date to 0830 hrs IST of next date.

Date	Konkan & Goa	Madhya Maharashtra	Gujarat region	Saurashtra & Kutch
16-July	VH	H	H	VH
17-July	VH	VH	H	-
18-Jul	VH	VH	H	EXC H
19-Jul	EH	H	VH	EXC H
20-Jul	EH	VH	-	VH
21-Jul	EH	EH	EH	H
22-Jul	VH	VH	VH	EH
23-Jul	VH	EH	EH	EH
24-Jul	EH	EXC H	EH	-
25-Jul	EH	EH	VH	-
26-Jul	H	VH	-	-
27-Jul	H	H	-	-
29-Jul	VH	VH	VH	H
30-Jul	VH	H	H	H

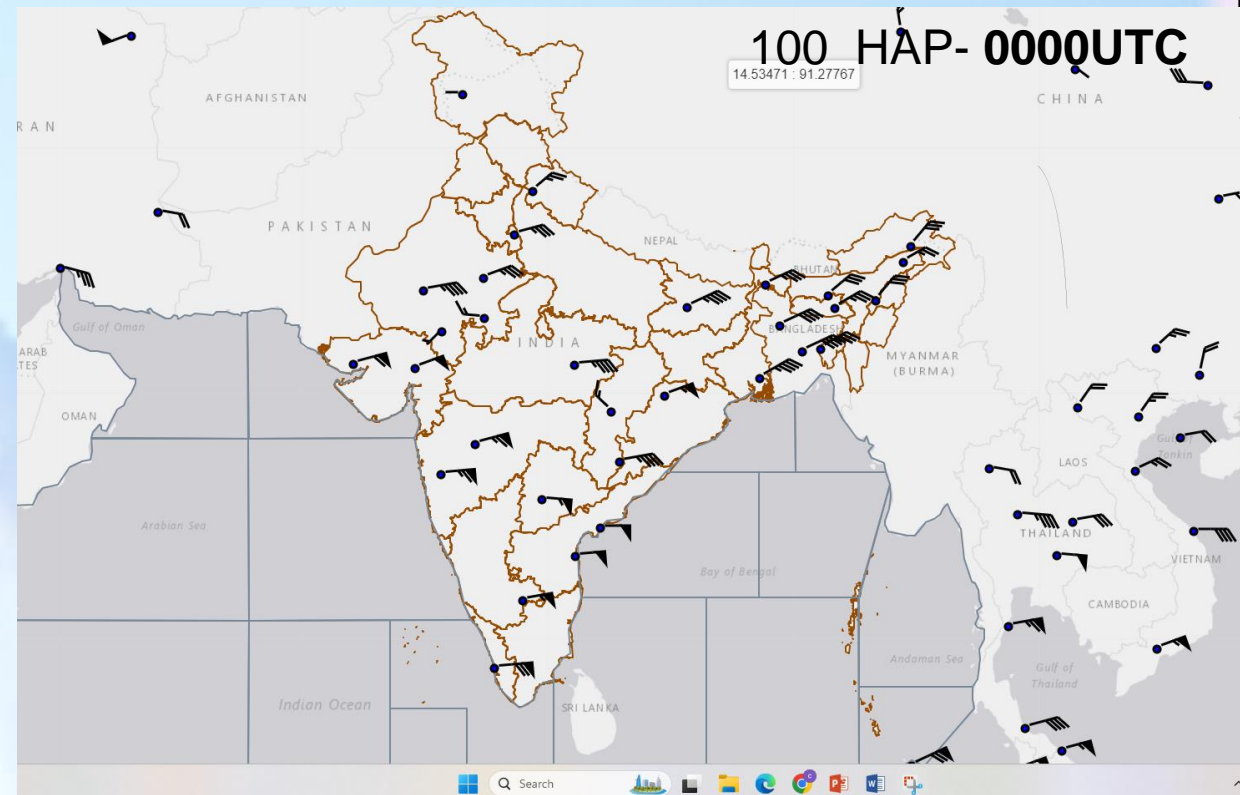
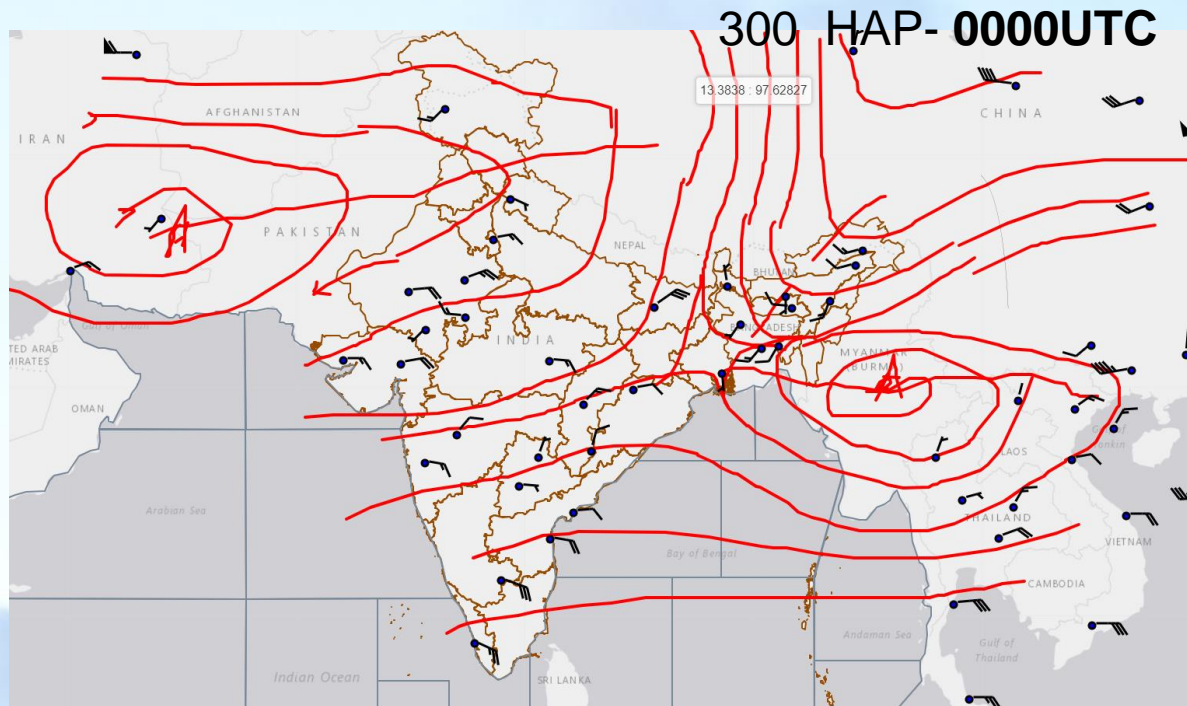
H-HEAVY RAINFALL
 VH-VERY HEAVY RAINFALL
 EH-EXTREMELY HEAVY RAINFALL
 EXC-EXCEPTIONALLY HEAVY RAIN



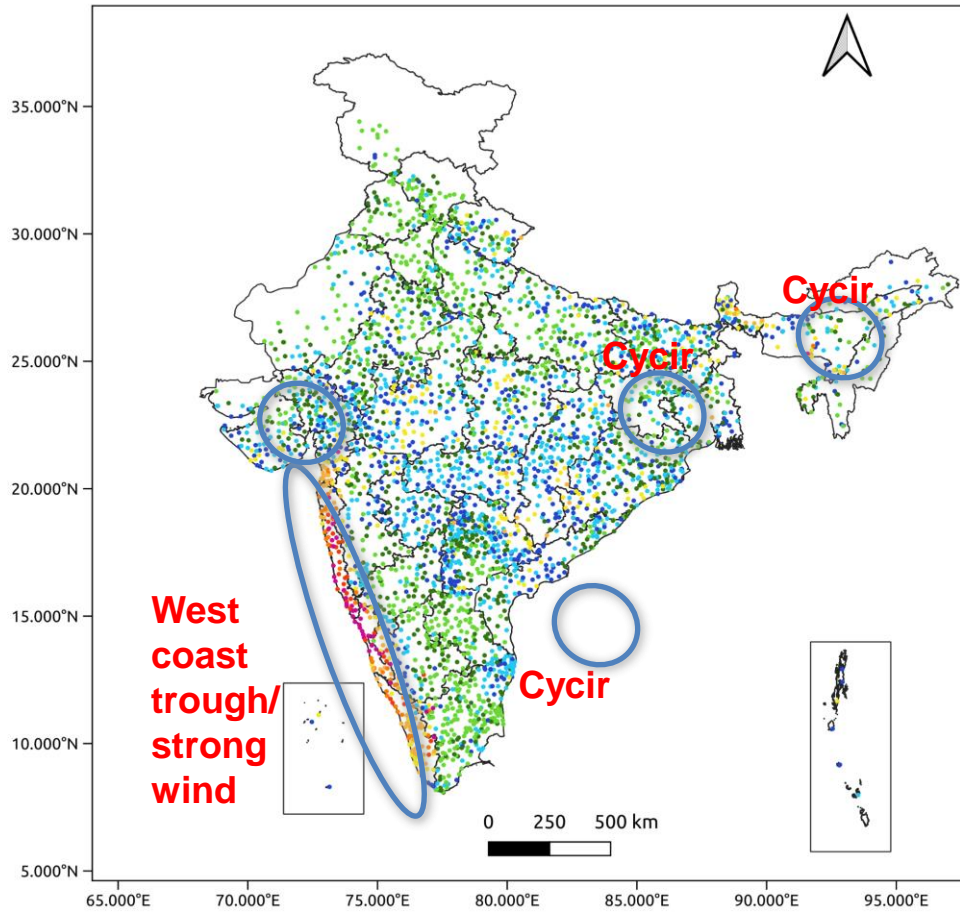
18 Aug 2024- Surface(09utc) and Outc Winds 925 and 300 hpa and 100 hpa-Very Weak Monsoon PG WEST COAST 1000.9 hpa at TRV with MUMBAI COLABA -1005.4, AHM 1005.9 –Almost PG is 0.5-1 HPA TODAY, Western end MT very weak –Hardly easterly at lower levels at Western end.



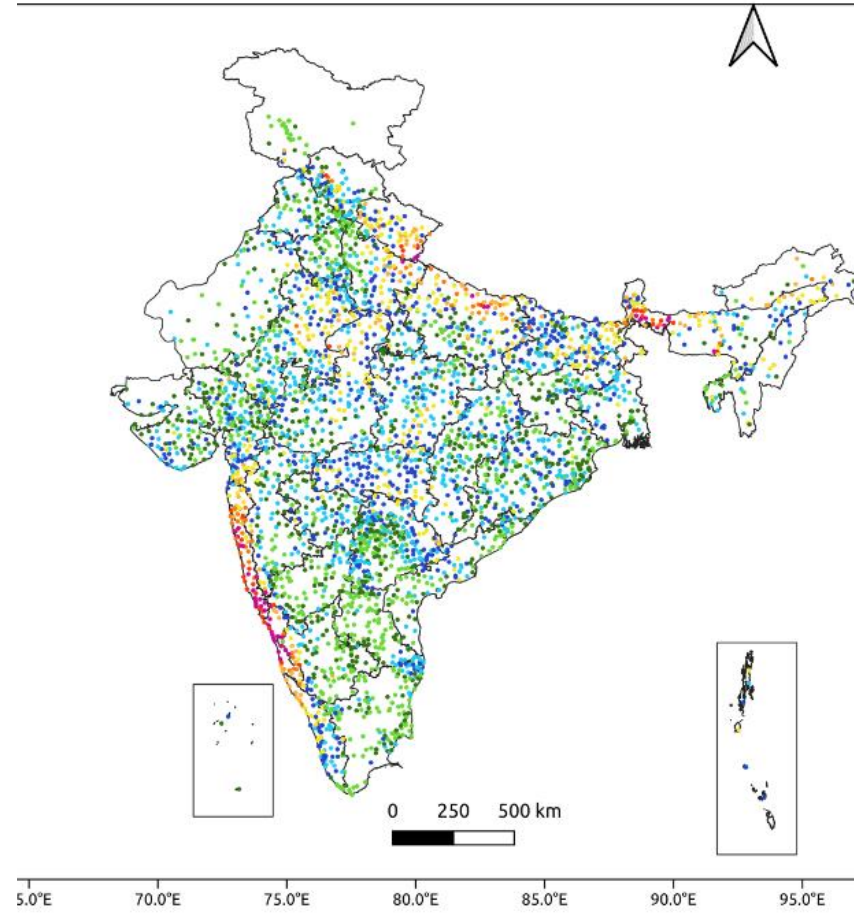
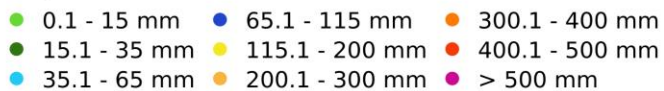
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PG WEST COAST 1000.9 hpa at TRV with MUMBAI COLABA -1005.4, AHM 1005.9 –Almost PG is
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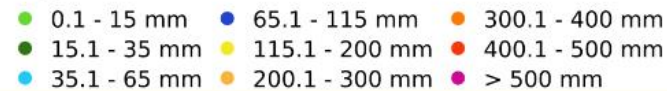
Synoptic Systems and Rainfall during 03-10 & 11-17 July



Legends



Legends

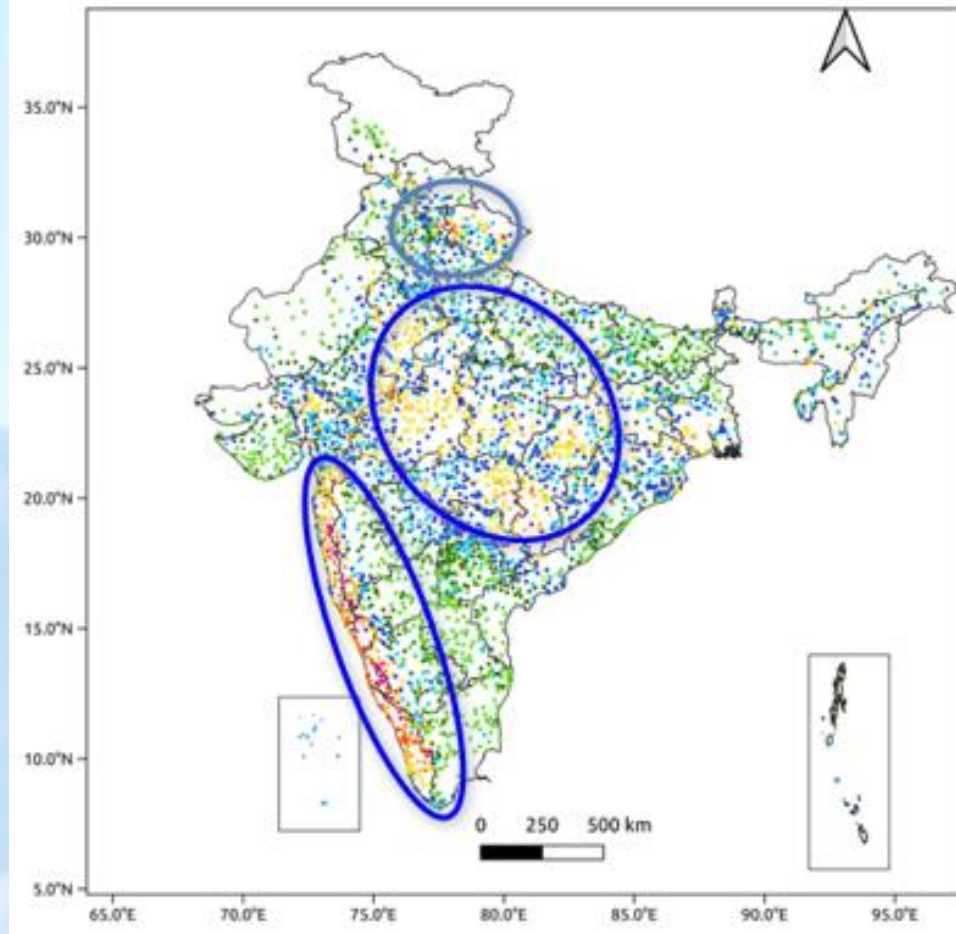
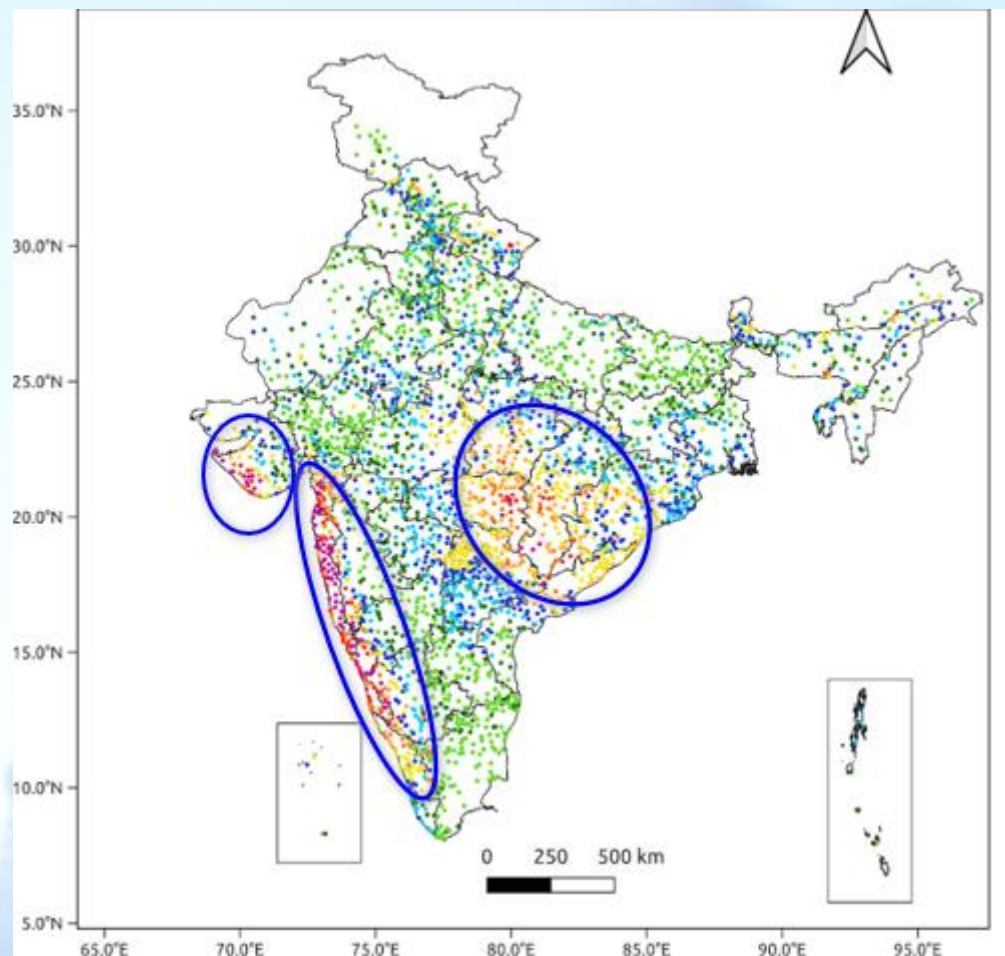


03-10 July: Exceptional heavy rainfall also observed over West Uttar Pradesh and Uttarakhand on 8th July (Baheri (dist Bareilly):46cm and Banbas (Champawat)-43cm) which caused flash floods over the region and impacted lives of people

11-17 July: Excess rainfall over western parts of the country and Southern Peninsular region. Deficient Rainfall over Northern Parts of country
Floods in Uttar Pradesh, Konkan & Goa.



Synoptic Systems and Rainfall 18-24 July (left): and 25 July -31 July 2024 (right)(only two consecutive active weeks of monsoon 2024 over central India and west coasts)



25 July:
Exceptionally heavy rainfall also reported in Ghat areas of **Pune Dist-** (rainfall in cm, Tamini-56 and Lavasa-45).

**Formation of three low-pressure systems (LPS) during July (15 -17, 18-23 and 26-28 Jul).
Formation of Season's 1st monsoon depression over Northwest and adjoining Westcentral Bay of Bengal off Odisha and adjoining north Andhra Pradesh coasts on 19th July.**



Weekly (18-24 July-Once system started formed) and Weekly (11-17 July-No System) Rainfall Departures



Actual: 80.5 mm
Normal: 57.2 mm
Departure: 41%



Actual: 68.3 mm
Normal: 65.5 mm
Departure: 4%

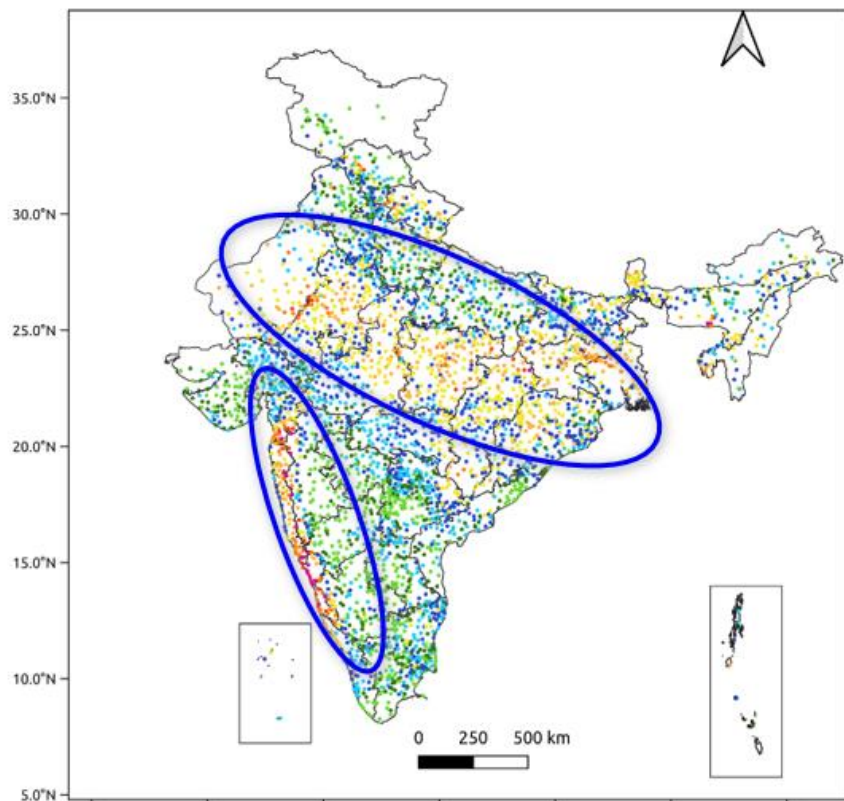


Cumulative rainfall (mm)	Actual (mm)	Normal (mm)	Departure (%)
EAST & NORTH-EAST INDIA	46.6	83.3	-44%
NORTH-WEST INDIA	34.1	43.2	-21%
CENTRAL INDIA	137.8	66.6	+107%
SOUTH PENINSULA	82.6	42.0	+97%
Country as a whole	80.5	57.2	+41%

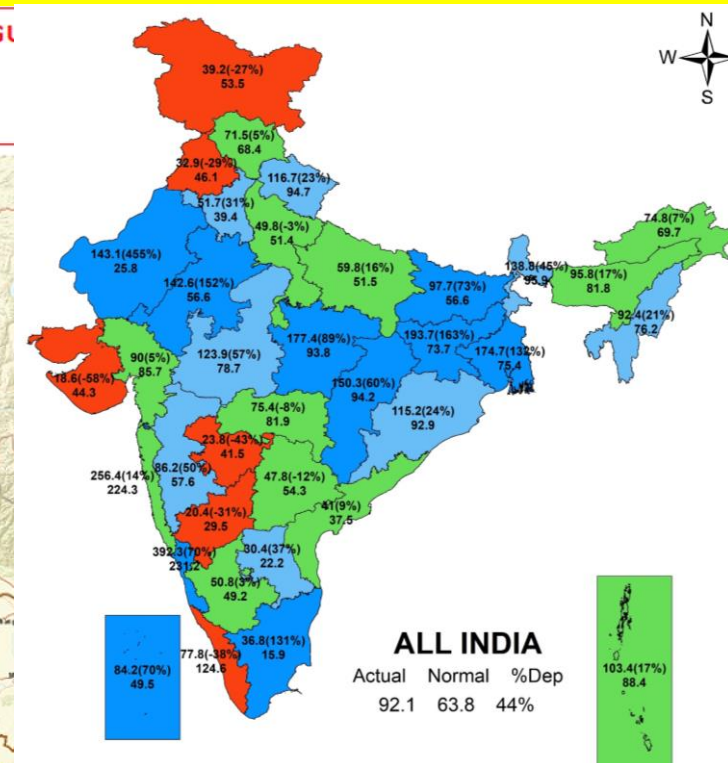
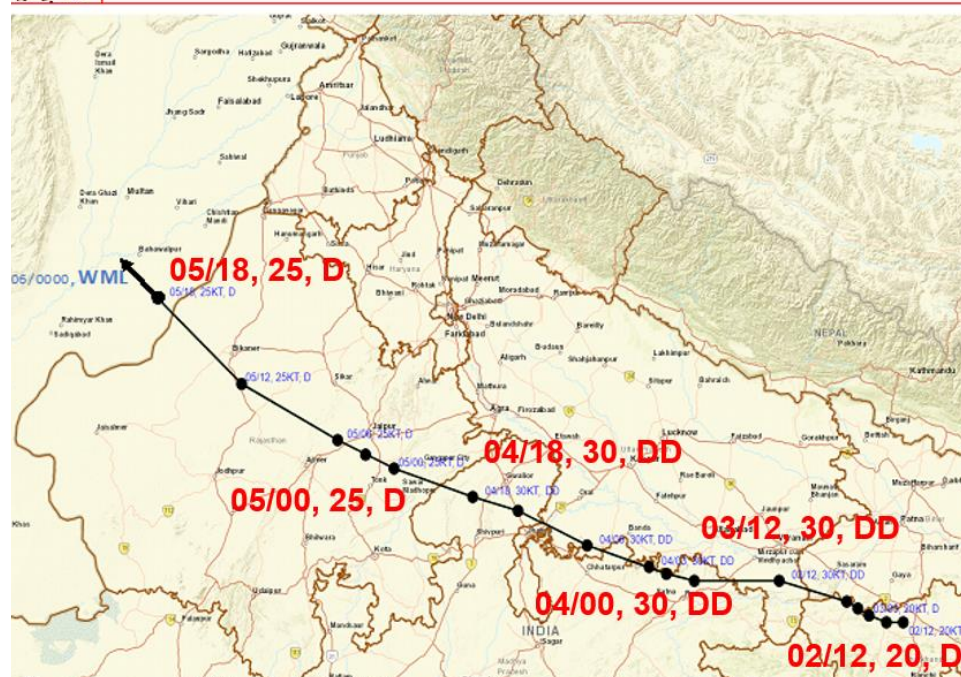
■ Large Excess [60% or more]
 ■ Excess [20% to 59%]
 ■ Normal [-19% to 19%]
 ■ Large Deficient [-99% to -60%]
 No Rain [-100%]
 No Data



Synop features and Rainfall 1-8 Aug 2024

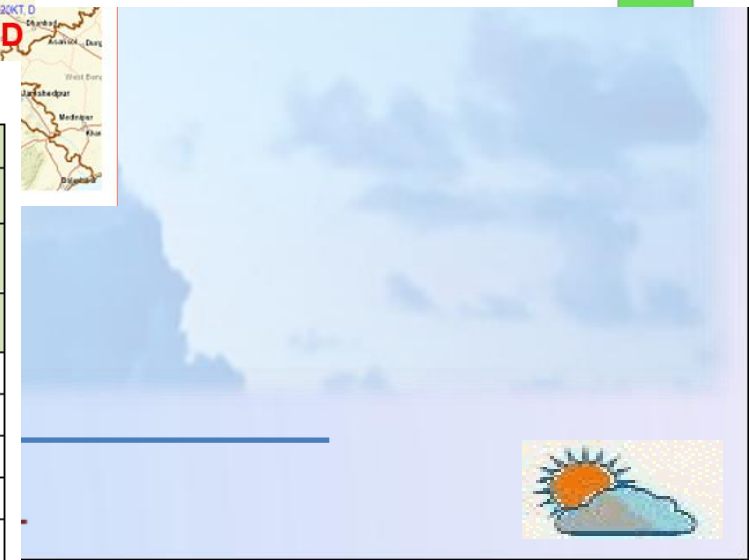


OBSERVED TRACK OF DEEP DEPRESSION OVER INDIA DURING 02ND AUG TO 06TH AUGUST, 2024.

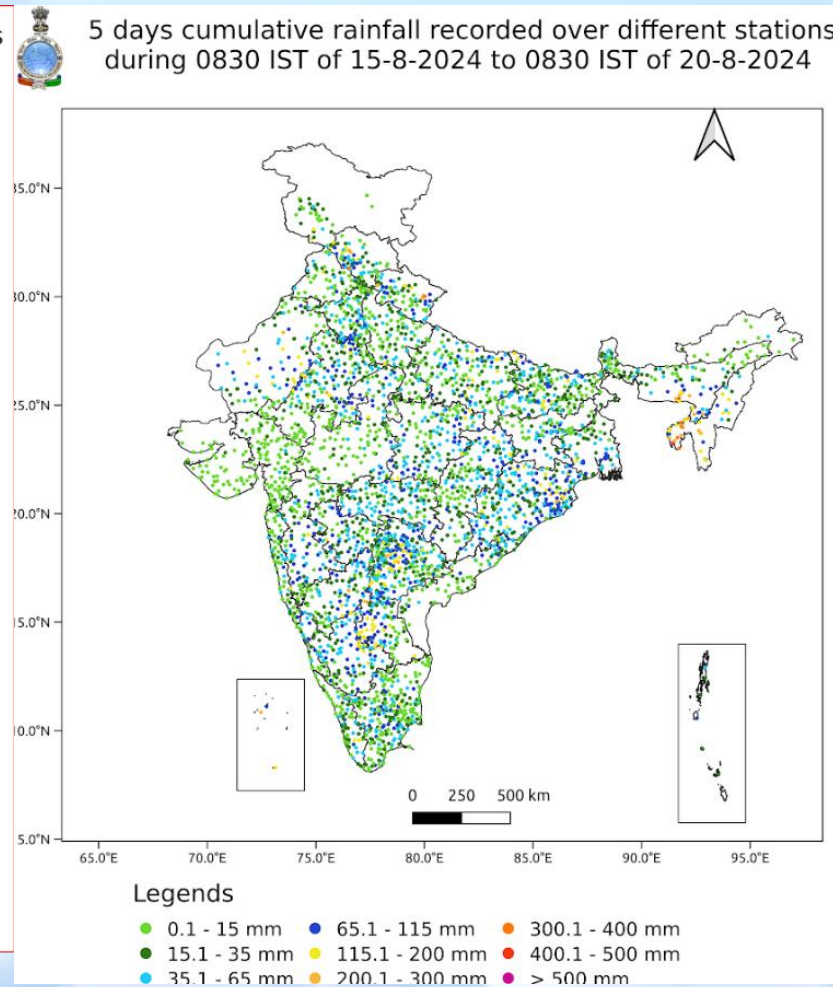
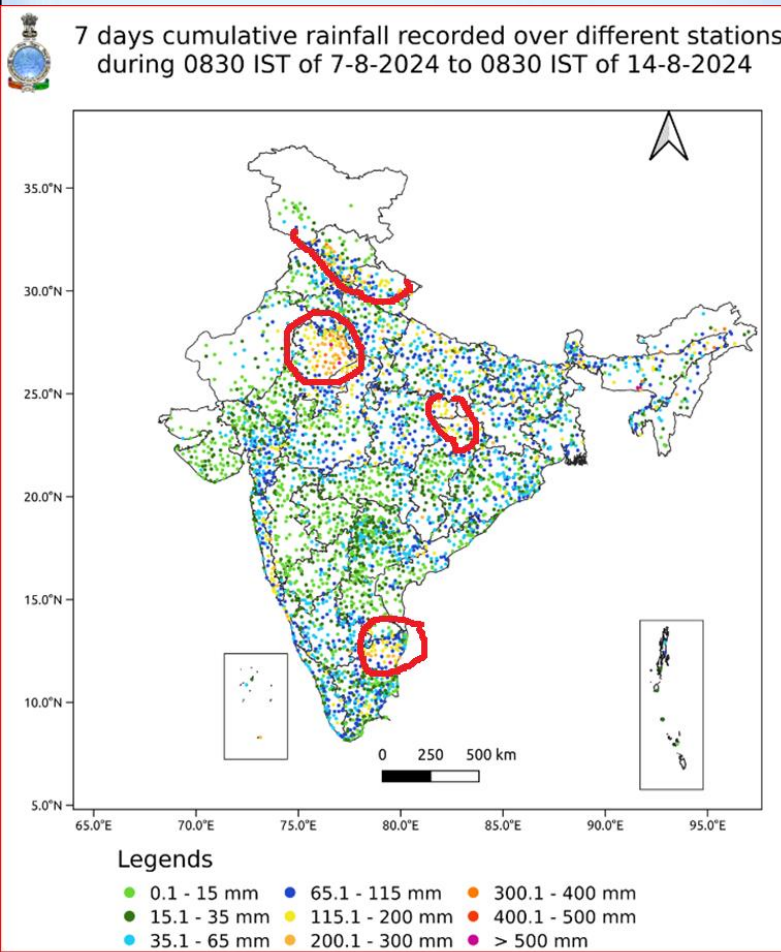


RAINFALL SUMMARY

Category of the rainfall	WEEK				SEASON			
	01.08.2024 TO 07.08.2024				01.06.2024 TO 07.08.2024			
	Number of Sub-divisions		Sub-divisional % Area of Country		Number of Sub-divisions		Sub-divisional % Area of Country	
Cumulative rainfall (mm)	Actual (mm)	Normal (mm)	Departure (%)	Category	Actual (mm)	Normal (mm)	Departure (%)	Category
EAST & NORTH-EAST INDIA	15.6	10.3	+51%	E	729.8	825.8	-12%	N
NORTH-WEST INDIA	9.1	7.6	+20%	E	319.2	337.8	-5%	N
CENTRAL INDIA	13.9	12.4	+12%	N	683.6	573.7	+19%	N
SOUTH PENINSULA	13.3	6.4	+108%	LE	515.4	412.2	+25%	E
Country as a whole	12.6	9.4	+34%	E	545.9	509.6	+7%	N



Synoptic Systems during the week (08th-14th August 2024 and 15-21 Aug)-No off-shore trough for 2 weeks, no Major heavy rainfall spell over west coast, Gujarat and PS India



➤ 7-14 Aug

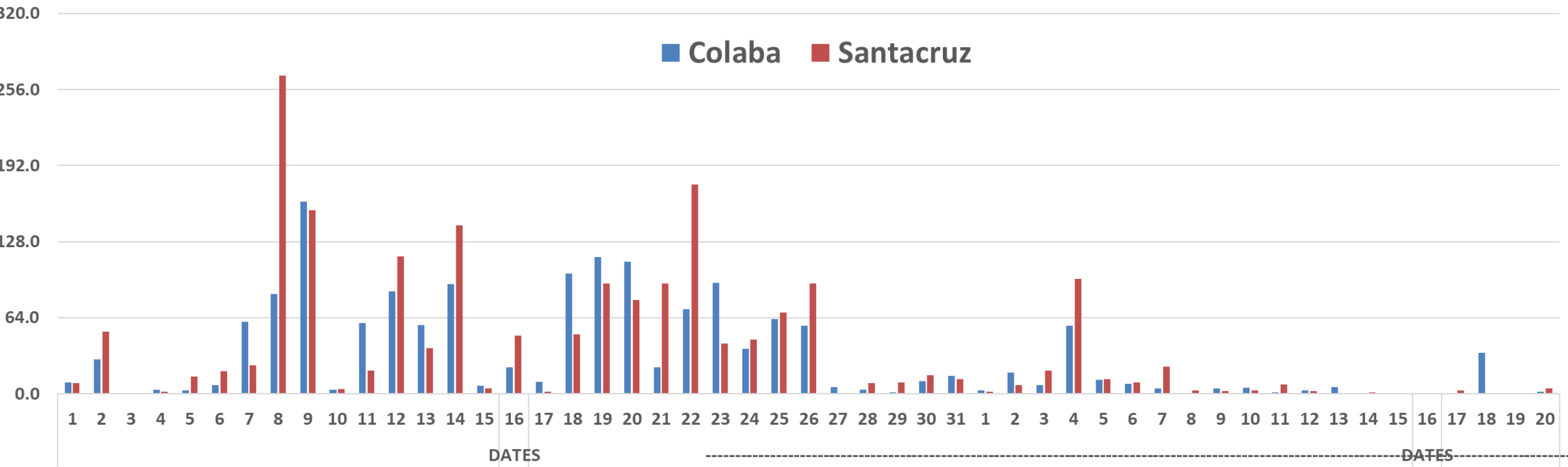
- **No LPS during the week**
- The Western end of the monsoon trough was near normal position at lower levels .
- CYCIR seen along MT
- Exceptionally heavy rainfall**
- Karauli (38cm) (dist Karauli) in East Rajasthan on 11th August;
- Extreme Heavy Rainfall reported**
- East Rajasthan on 11th and 12th;
- Sub-Himalayan West Bengal & Sikkim on 9th;
- Meghalaya and north Tamil Nadu on 11th August;
- Arunachal Pradesh on 11th and 12th
- Lakshadweep on 14th August.

➤ 15-21 Aug

- **A LPS was during the week, But over Bangladesh, not moved much**
- **MT was north of the of the normal postion. No off-shore trough**



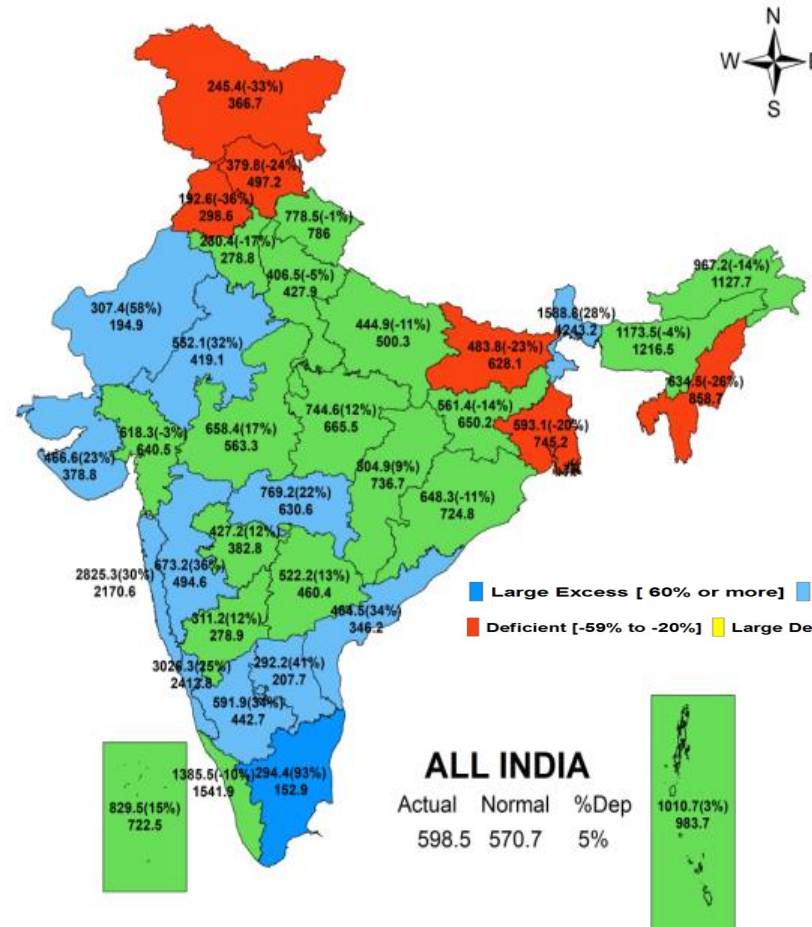
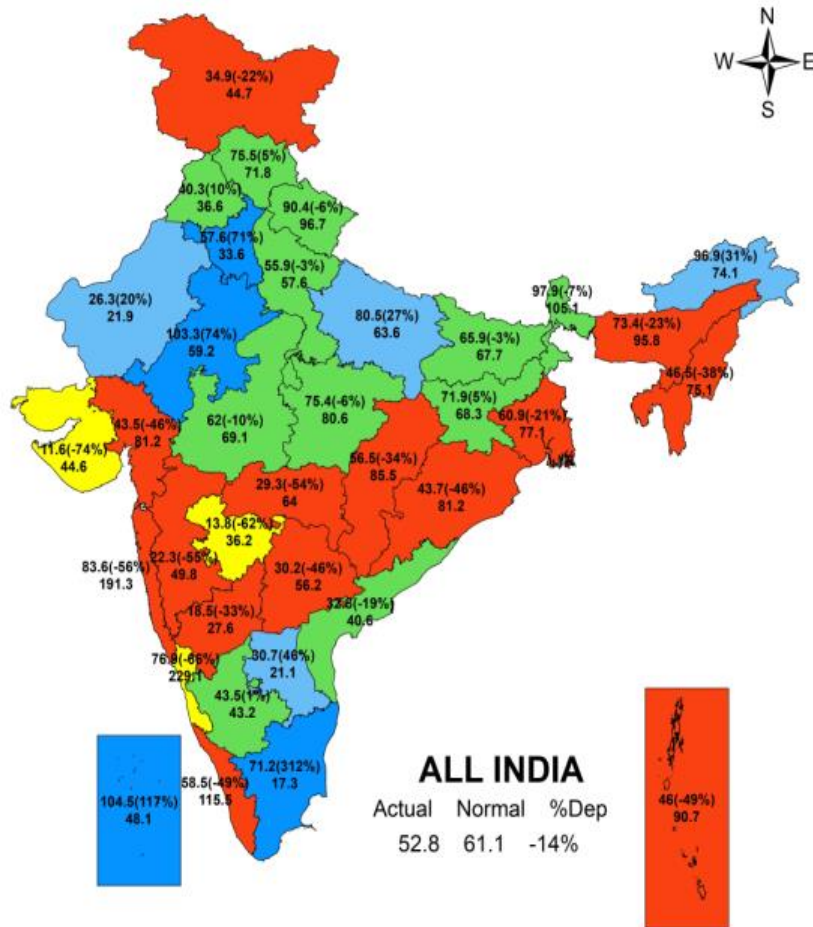
Mumbai Rainfall Daily 1 June till 20 Aug 2024



	Maximum	Departure	Minimum	Departure	At 08:30Hrs	Departure	hours	01/06/2024	Departure	Annual Total
KONKAN & GOA										
Alibag	31.4	1.0	23.8	-1.5	76	-11	0	2189.1	485	2189.1
Dahanu	31.4	0.8	24.9	-0.8	97	10	1.8	1686.3	169.6	1686.7
Goa (Panjim)	32.0	2.2	26.5	2.2	89	-3	0.0	3313.7	1069	3479.2
Harnai	30.2	1.1	25.4	0.9	92	4	0.0	2383.5	373.8	2390.4
Mumbai (CLB)	30.4	0.3	25.7	0.4	86	-5	1.6	2075.5	466.2	2079.1
Mumbai (SCZ)	31.1	0.7	24.8	-0.4	86	0	2.6	2248.6	457.8	2270.91
Ratnagiri	31.0	1.8	24.8	0.6	86	-4	0.0	3141.8	766.2	3216.7



Weekly (08th-14th August 2024) Rainfall Departures



RAINFALL SUMMARY

Category of the rainfall	WEEK				SEASON			
	08.08.2024 TO 14.08.2024				01.06.2024 TO 14.08.2024			
	Number of Sub-divisions		Sub-divisional % Area of Country		Number of Sub-divisions		Sub-divisional % Area of Country	
Cumulative rainfall (mm)	Actual (mm)	Normal (mm)	Departure (%)	Category	Actual (mm)	Normal (mm)	Departure (%)	Category
EAST & NORTH-EAST INDIA	71.7	78.5	-9%	N	800.7	904.3	-11%	N
NORTH-WEST INDIA	58.2	49.6	+17%	N	377.4	387.4	-3%	N
CENTRAL INDIA	44.7	72.1	-38%	D	728.3	645.8	+13%	N
SOUTH PENINSULA	42.6	46.0	-7%	N	558.0	458.2	+22%	E
Country as a whole	52.8	61.1	-14%	N	598.5	570.7	+5%	N

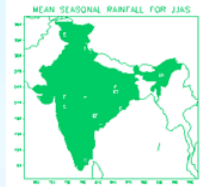


New Strategy for Long Range Forecast Based on MME of Dynamical models

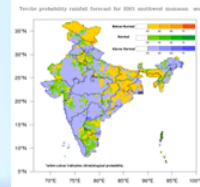
1st Stage Forecast

April

All India averaged Season (June – September) Rainfall



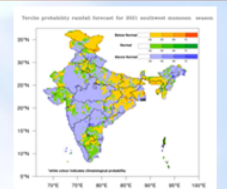
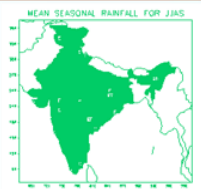
Spatial pattern of probability forecast for the Season Rainfall over the country



2nd Stage Forecast

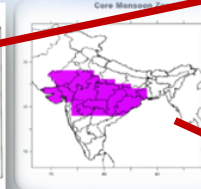
May

Update for the April forecast for the All India averaged Season Rainfall and spatial pattern of probabilistic forecast over the country



Forecast for Season Rainfall: for the Four Homogeneous Regions & Monsoon Convergence Zone (MCZ)

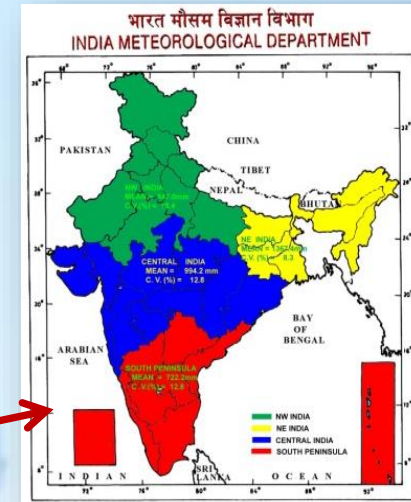
- NW India
- NE India
- Central India
- S. Peninsula



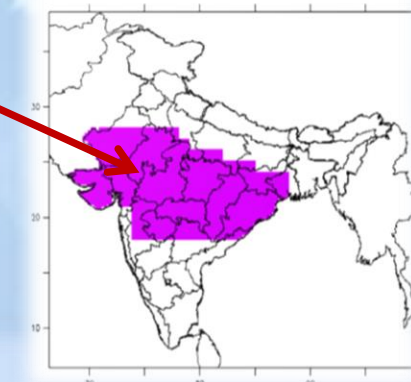
Monthly Forecast

End of May, June, July & August for subsequent one month

Probabilistic Forecast for Monthly Rainfall and Temperatures



Core Monsoon Zone



In addition, Forecast for Date of Monsoon Onset over Kerala in May



Forecast for the 2024 Southwest Monsoon Rainfall over The Country as a Whole

Quantitatively, the southwest monsoon seasonal rainfall over the country as a whole is likely to be **106% of the long period average (LPA)** with a model error of $\pm 4\%$. (TILL 20 AUG, 2024 MONSOON-ACTUAL 104% -NORMAL RANGE)

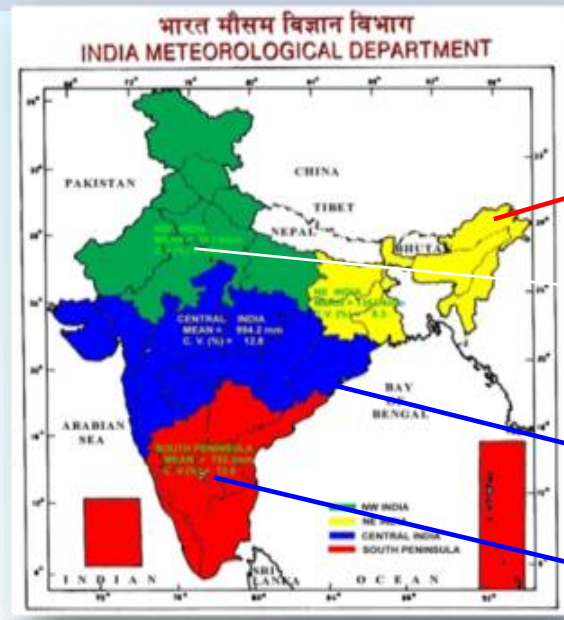
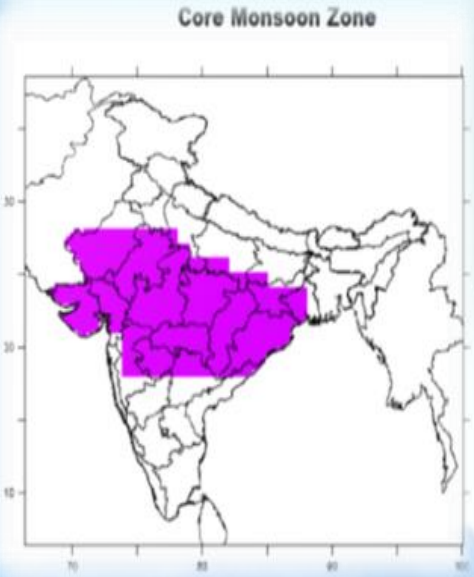
Thus **Above Normal rainfall** is most likely over the country as a whole during the monsoon season (June to September), 2024.

The 5 category probability forecasts for the Seasonal (June to September) rainfall over the country as a whole

Category	Rainfall Range (% of LPA)	Forecast Probability (%)	Climatological Probability (%)
Deficient	< 90	2	16
Below Normal	> 90 - 95	8	17
Normal	96 -104	31	33
Above Normal	> 105 -110	32	16
Excess	> 110	29	17



Forecast for the 2024 Southwest Monsoon Season Rainfall Over the Homogeneous Regions (ACTUAL TILL 20 AUG 2024-All categorically correct)



- **Below normal:**
 - Northeast India (<94% of LPA/**ACT-88% of LPA**)
- **Normal:**
 - Northwest India (92-108% of LPA- **ACT-100% LPA**)
- **Above Normal**
 - Central India (>106% of **LPA- ACT-109% LPA**),
 - South Peninsular India (> 106% of LPA **LPA- ACT-121% LPA**).

Monsoon Core Zone consisting of most of the rainfed agriculture areas in the country is most likely to be **Above Normal (>106% of LPA)**.



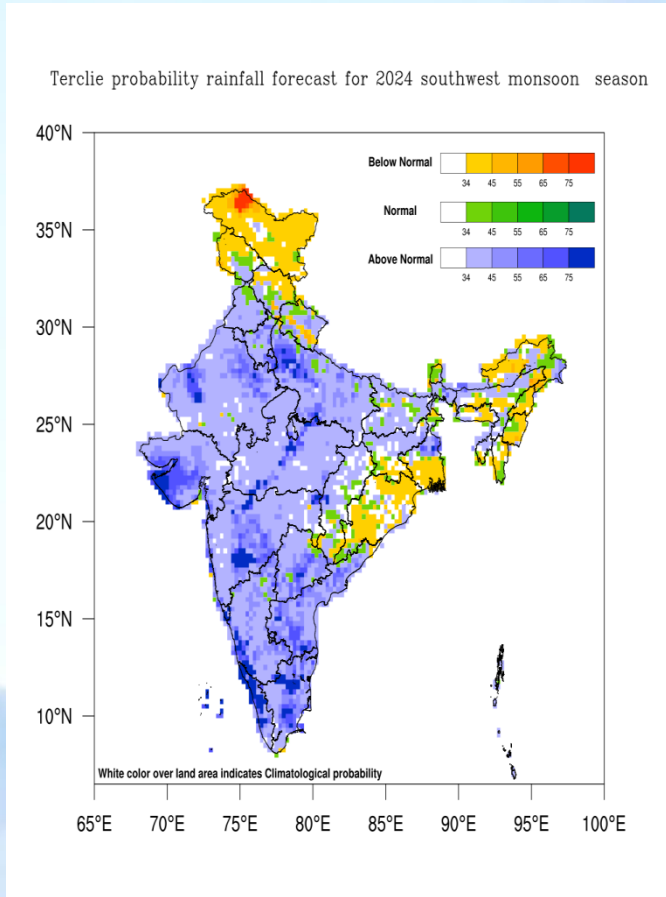
Probability Forecast of the 2024 SW Monsoon Seasonal (June- Sept)

Rainfall over India:

**Normal to above normal rainfall:
Most part of the country.**

**Normal to below normal rainfall:
Many areas of northern part of
Northwest India, Northeast India and
eastern part of the Central India**

**The white shaded areas within the
land areas represent climatological
probabilities.**

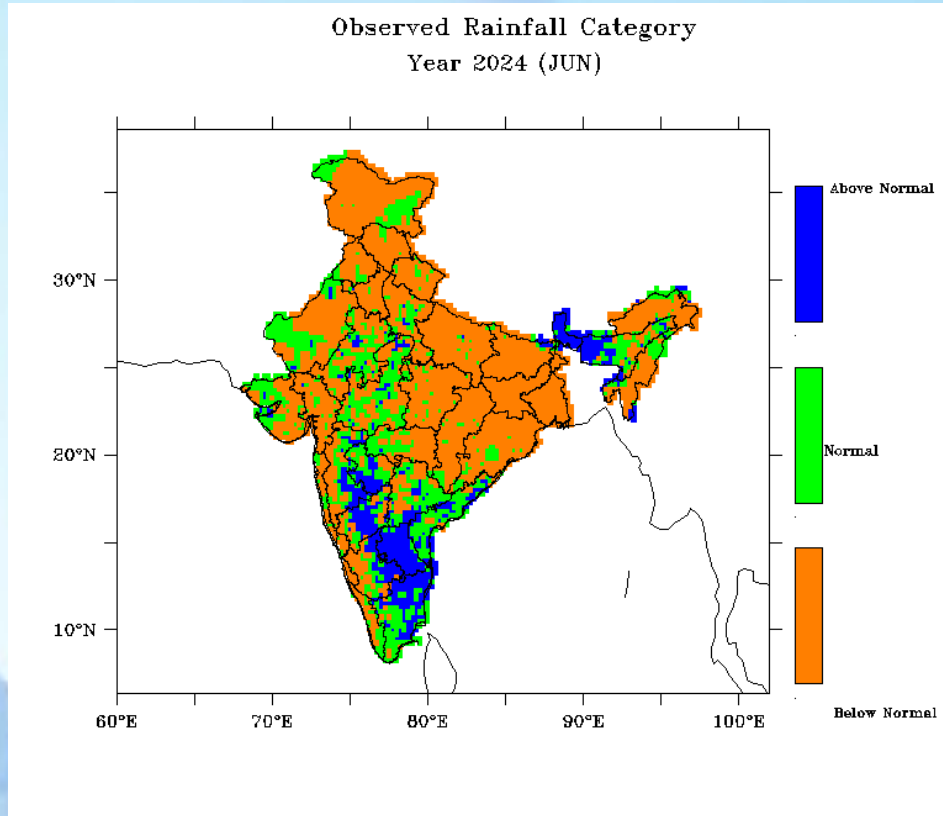


Probability forecast of tercile categories* (below normal, normal, and above normal) for the seasonal rainfall over India during the 2024 southwest monsoon season (June - September). The figure illustrates the most likely categories as well as their probabilities. The white shaded areas within the land area represent climatological probabilities. The probabilities were derived using the MME forecast prepared from a group of coupled climate models. (*Tercile categories have equal climatological probabilities, of 33.33% each).

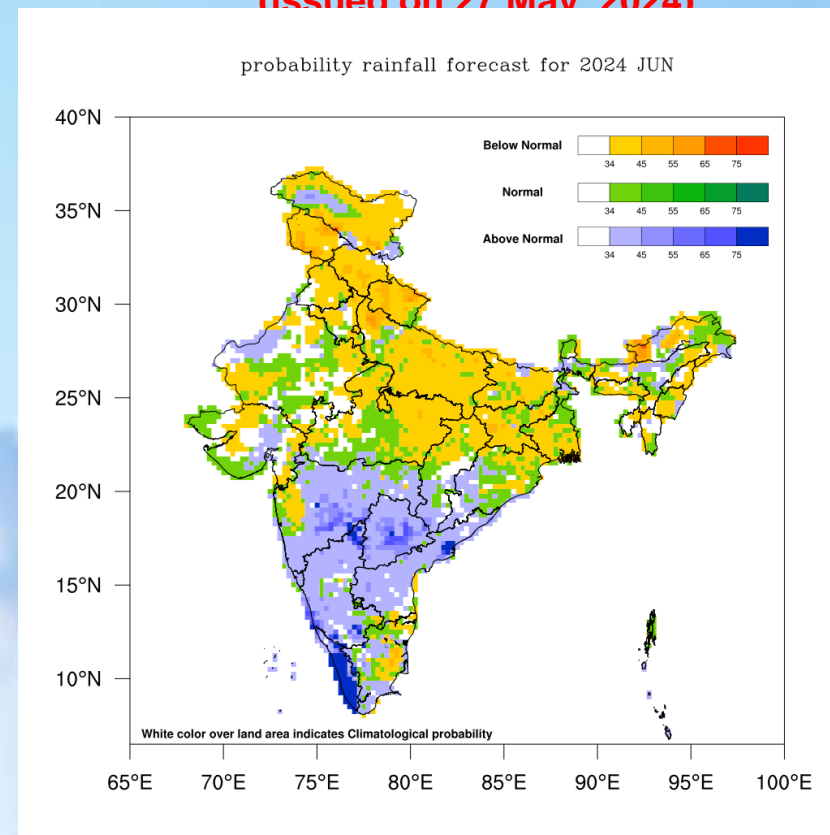


Verification of JUN 2024 rainfall forecast

Observed Rainfall Category (Jun 2024)



Rainfall forecast for Jun Month (issued on 27 May 2024)

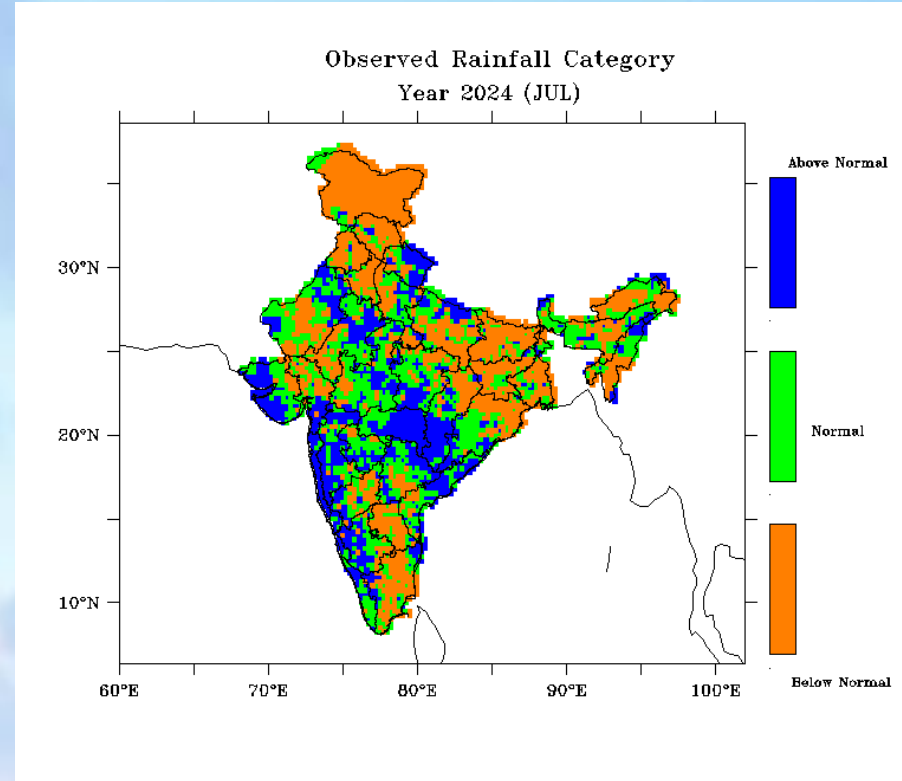
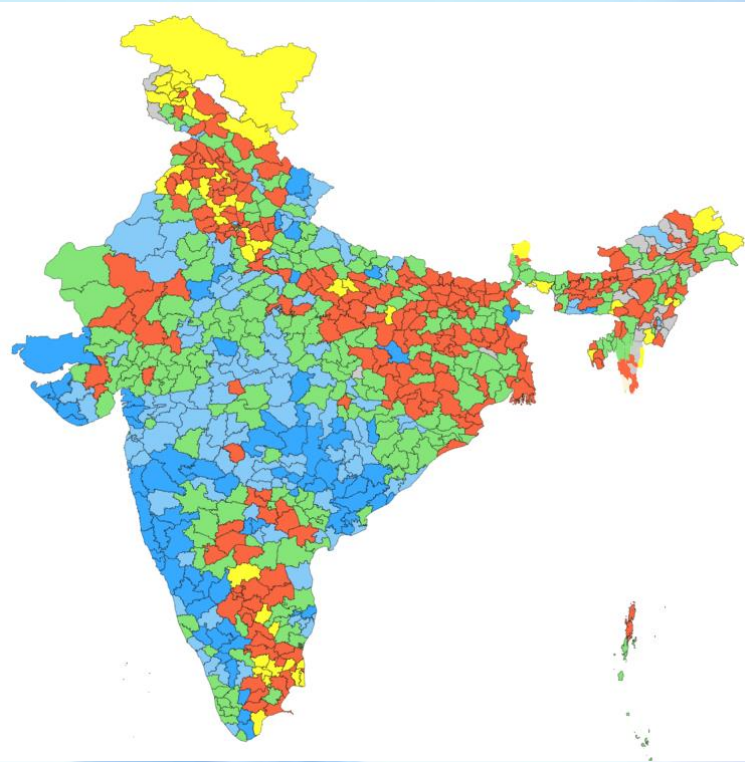


- Above normal rainfall over many parts of Peninsular India and some areas of NE India were correctly predicted.
- Below normal rainfall over many regions of Northwest India and Gangetic plains is also correctly indicated in the outlook.

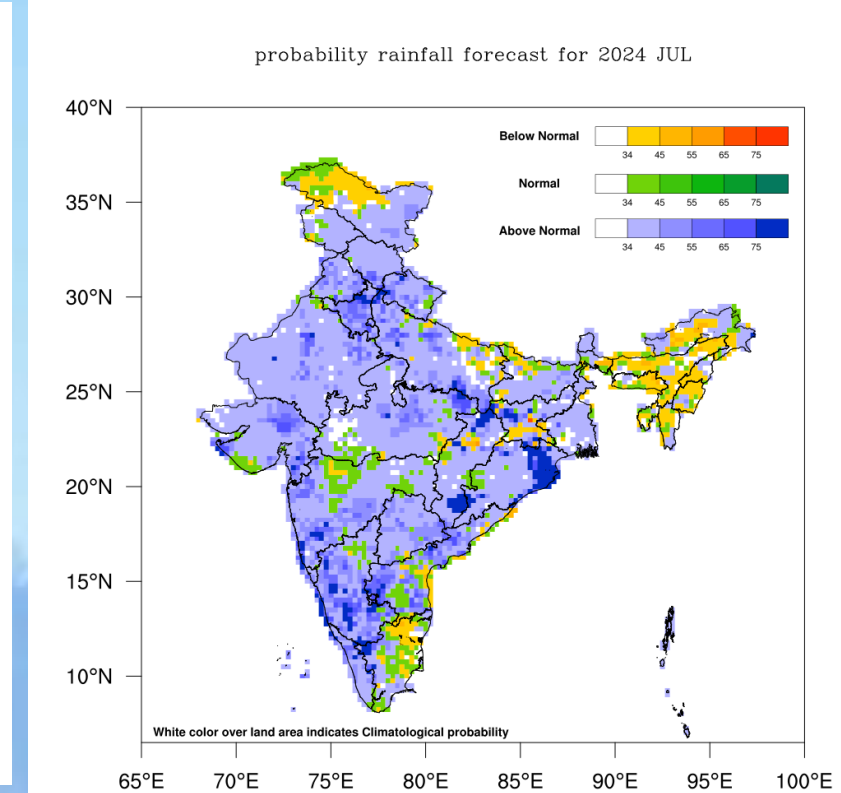


Verification of JUL 2024 rainfall forecast

Observed Rainfall Category (Jul 2024)



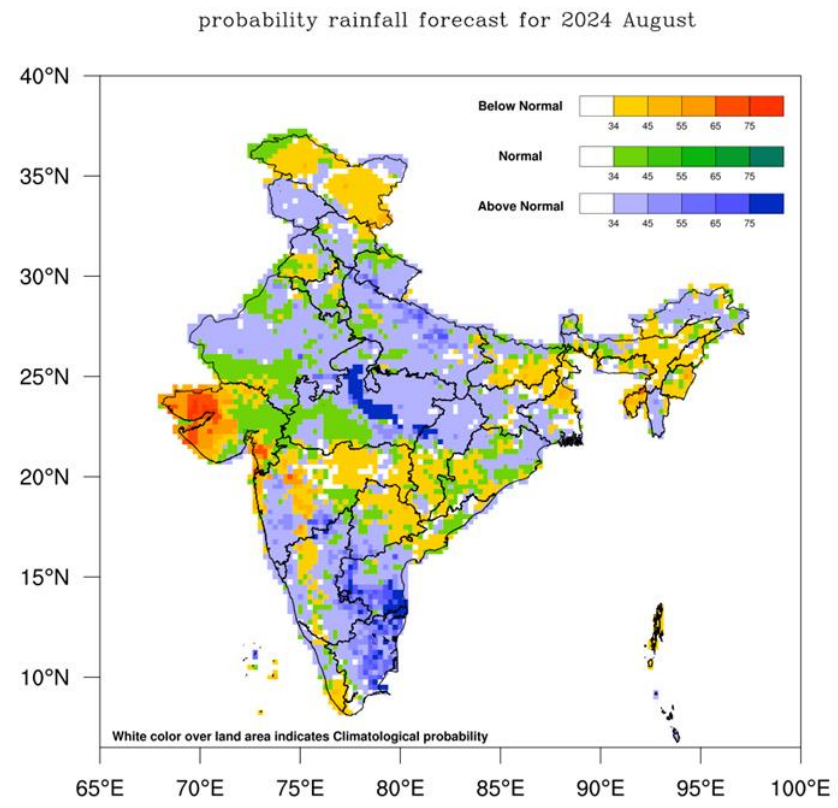
Rainfall forecast for Jul Month (issued on 1 July 2024)



- Above-normal rainfall over many parts of the country was correctly predicted in the outlook.
- Below-normal rainfall over many regions of Northeast India and Southeast Peninsular India was also correctly predicted.
- However, below-normal rainfall over Gangetic plains and some areas over northwest India could not be correctly indicated in the outlook.



Probability Forecast of the 2024 August Rainfall over India

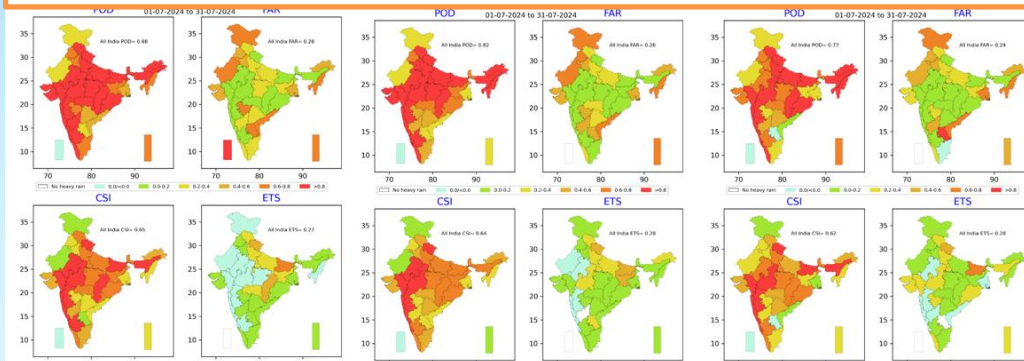


- ❖ The rainfall averaged over the entire country for August 2024 is most likely to be normal (94 to 106 % of LPA). The LPA of the rainfall during August: 254.9mm (base period: 1971-2020).
- ❖ Normal to above normal rainfall: over many parts of the country,
- ❖ Below normal rainfall: many areas in southern parts of central and adjoining northern peninsular India, northeast and adjoining areas of east India, some parts of northwest and south peninsular India

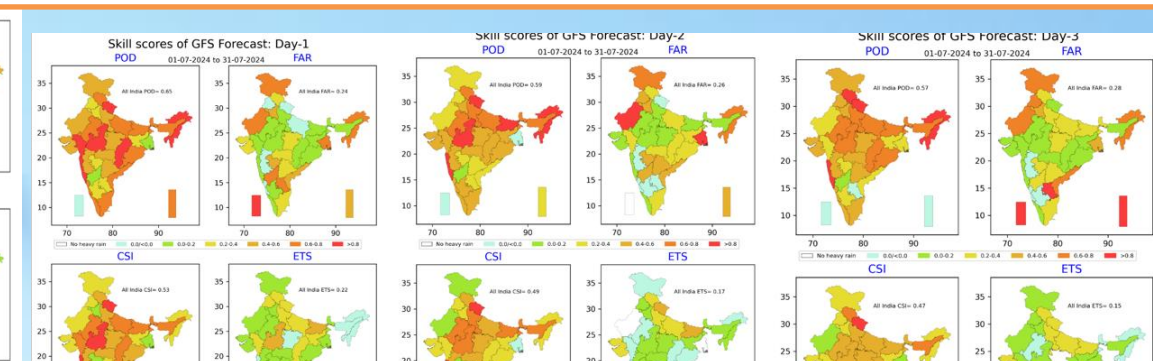
Probability Forecast of Tercile Categories of Rainfall over India during August, 2024. The figure illustrates the most likely tercile categories (below normal, normal, and above normal) of rainfall over India during the month of August, along with their corresponding probabilities. The model has no forecasting signal over the white shaded areas within the land region of the country. The probability is equally distributed among the tercile categories (33.33% each).



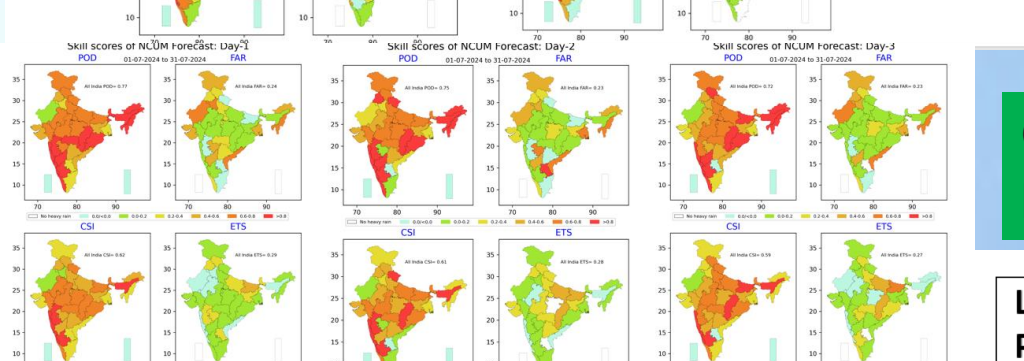
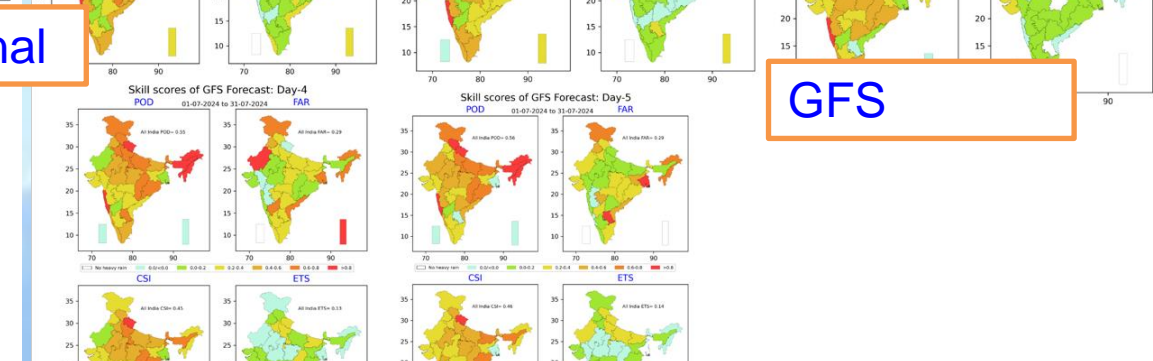
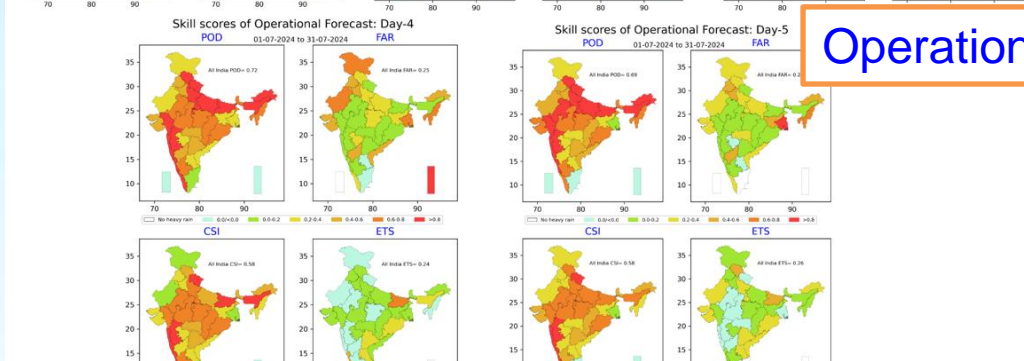
July 2024: Verification of Heavy rainfall Warnings(Operational, GFS, NCUM) –Day 1 to Day 5



Operational



GFS



NCUM

Operational Heavy rainfall warning skill over India vis-à-vis Model forecasts July 2024: POD(CSI)

Lead Period	IMD OPs	GFS	ECMWF	NCUM	NCEP	GEFS	JMA
Day 1	0.88(0.65)	0.65(0.53)	0.62(0.54)	0.77(0.62)	0.3-0.38	0.2-0.3	0.2-0.3
Day 2	0.82(0.64)	0.59(0.49)	0.58(0.51)	0.75(0.67)			
Day 3	0.77(0.62)	0.57(0.47)	0.59(0.51)	0.72(0.59)			
Day 4	0.72(0.58)	0.55(0.45)	0.60(0.52)	0.70(0.57)			
Day 5	0.69(0.58)	0.56(0.46)	0.6(0.51)	0.7(0.58)			



Thank you



**भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT**

