

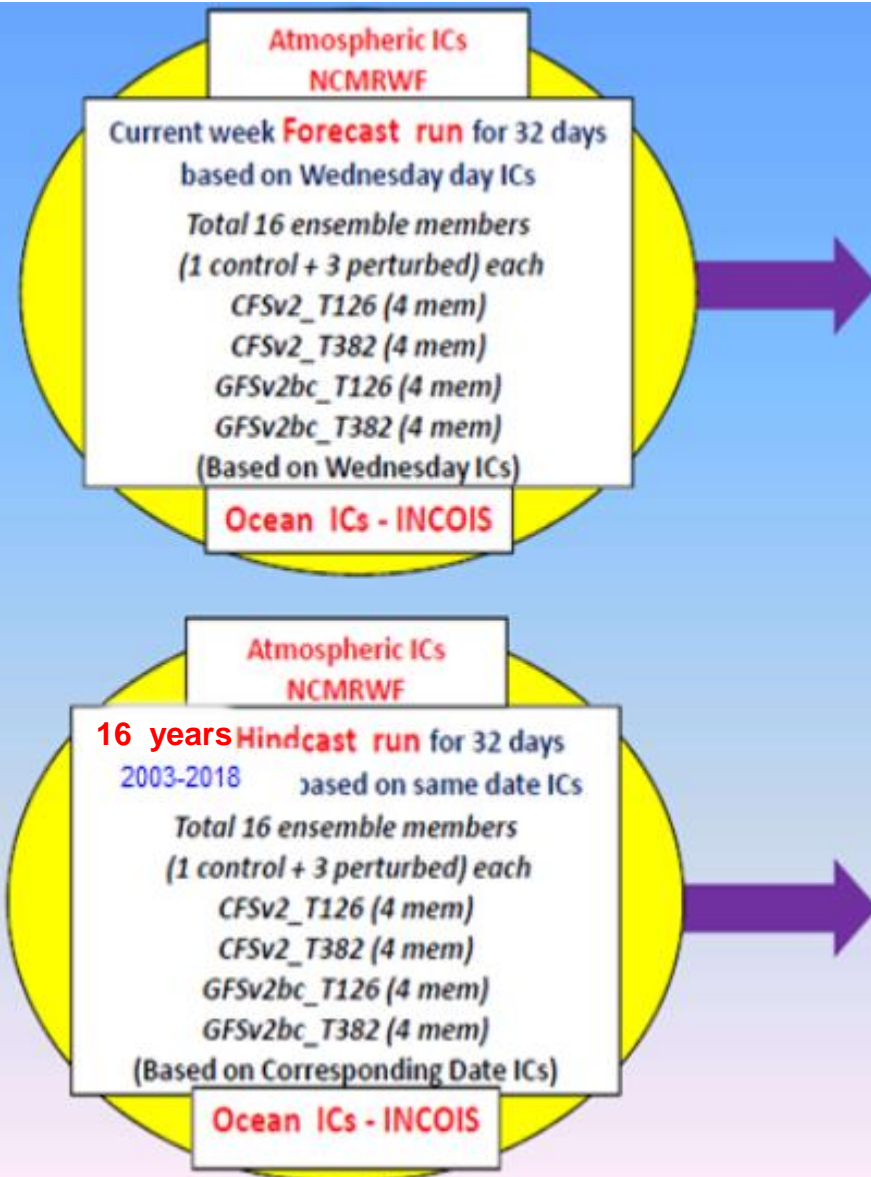


IMD Operational Extended Range Forecast During 2023

**Johny C J, D R Pattanaik, Ashish Alone and
Bushair M T**

**भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT**

IMD's Operational Extended Range Forecast (ERF) System

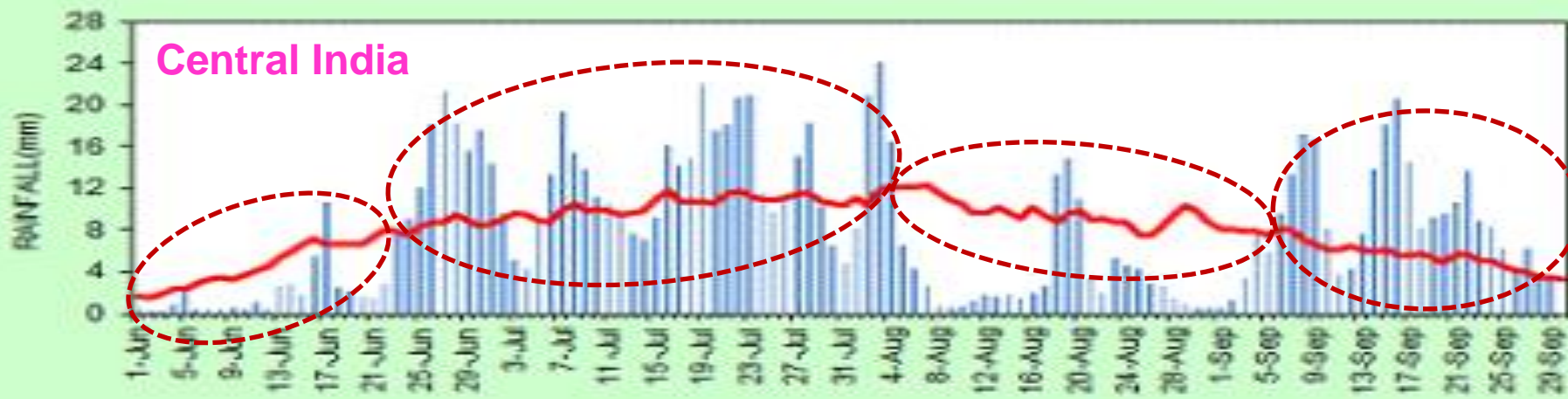
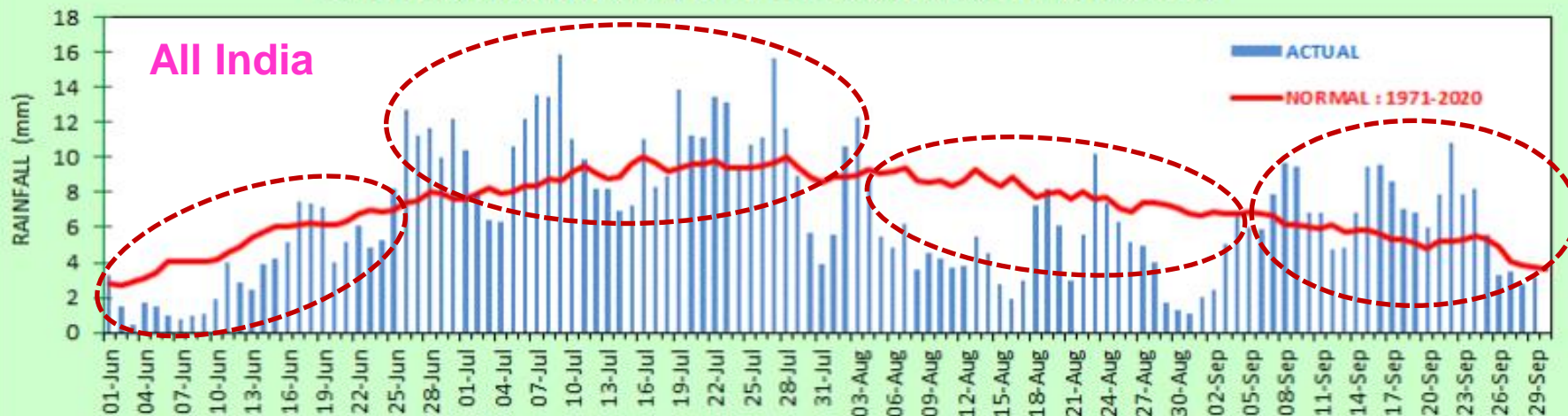


Forecasts for 4 Week
(Wind,Rainfall,Tmax,Tmin)
And its anomaly
Friday to Thursday



Daily All India and Central India Rainfall Time Series (Jun to Sep, 2023)

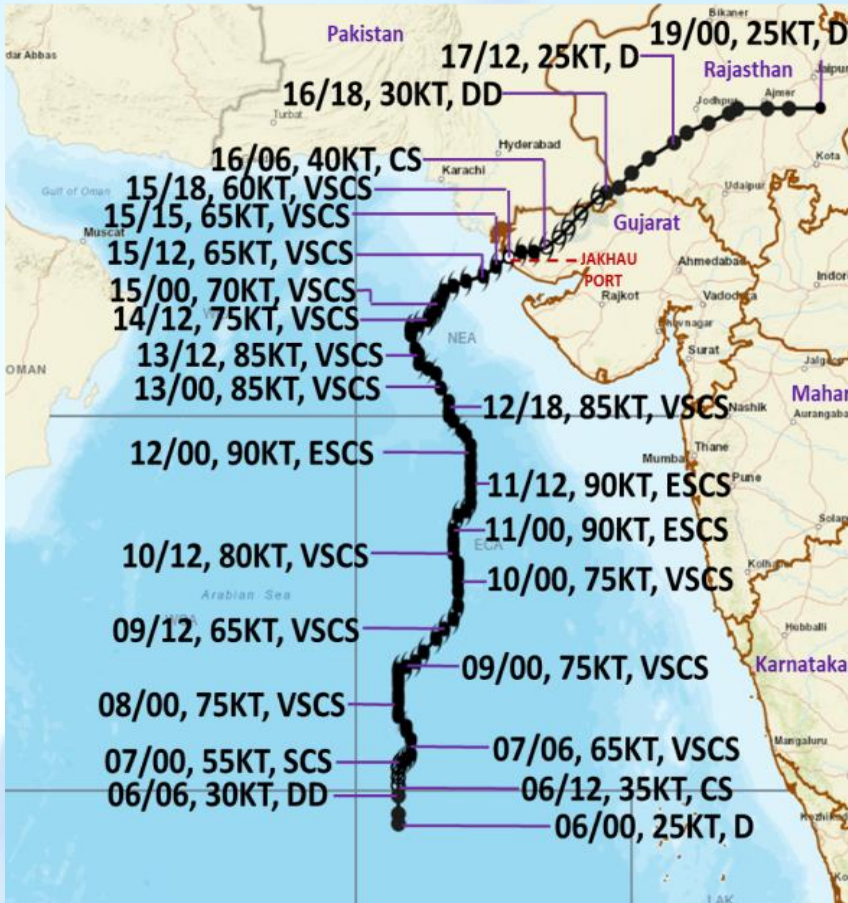
DAILY MEAN RAINFALL (mm) OVER THE COUNTRY AS A WHOLE (2023)



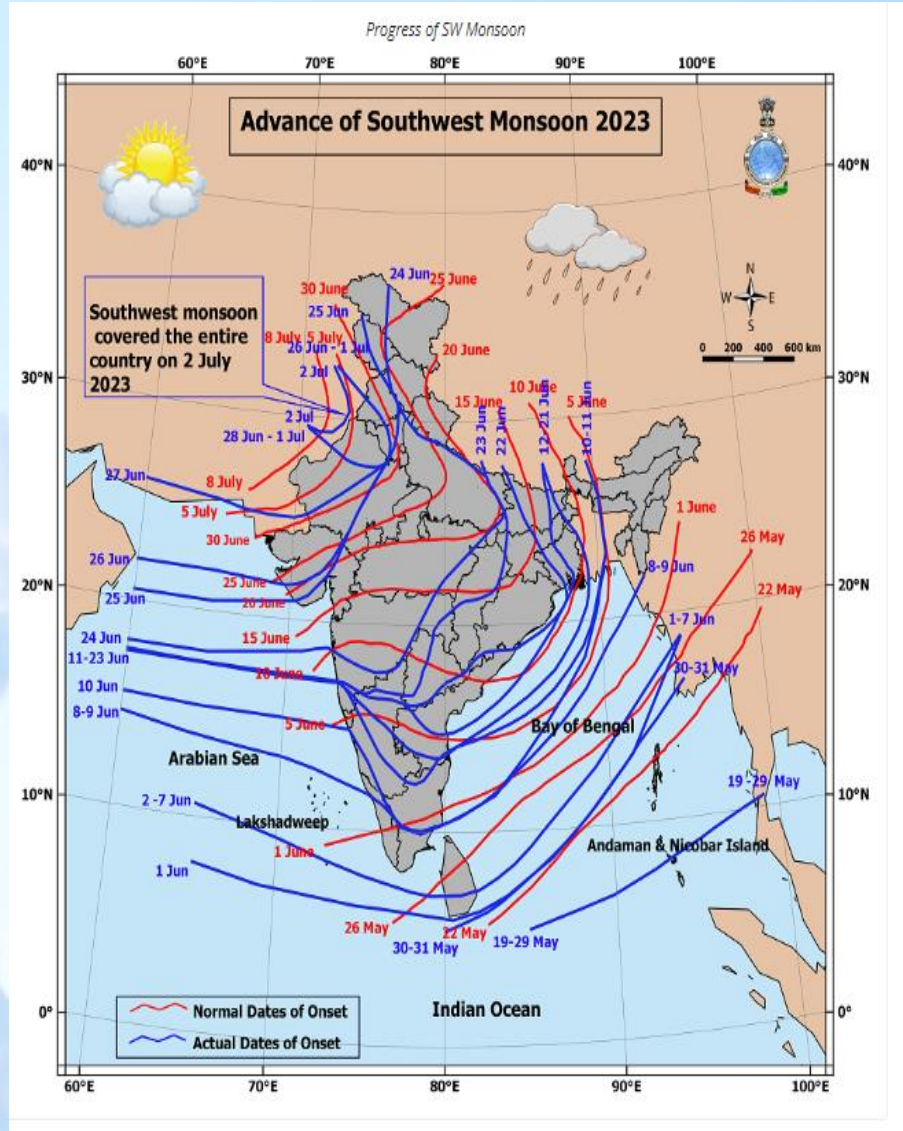
Intra-seasonal variability of monsoon is characterised by : Delayed and weak onset; Weak June, Active July, Weak August; Active September associated with delayed withdrawal of monsoon from many parts of northwest India



Forecast Accuracy (Genesis, Track, Landfall, Intensity)

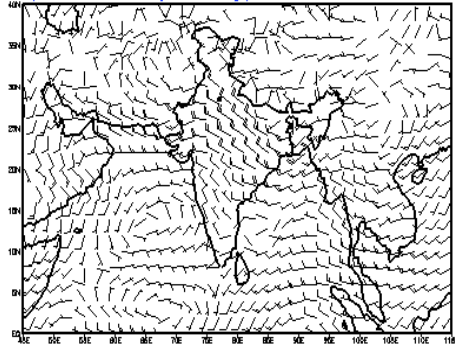


Observed Track of "Biparjoy" (05-18 June), 2023

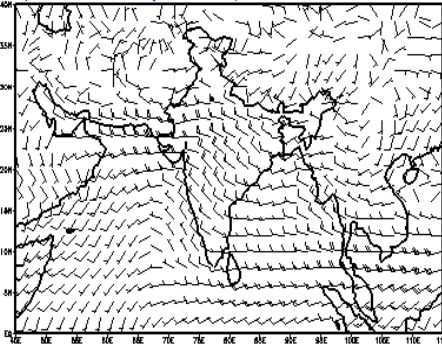


850 hPa mean wind and anomaly for 4 weeks (IC : 17 May, 2023)

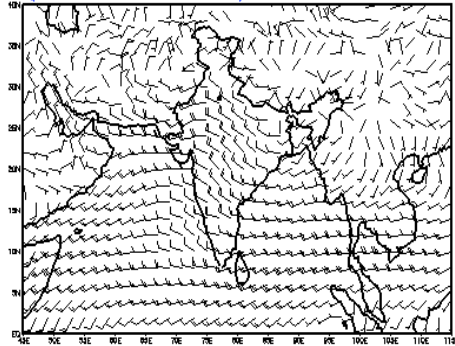
MME Weekly mean 850 hPa wind
(Week1: 19May-25May)



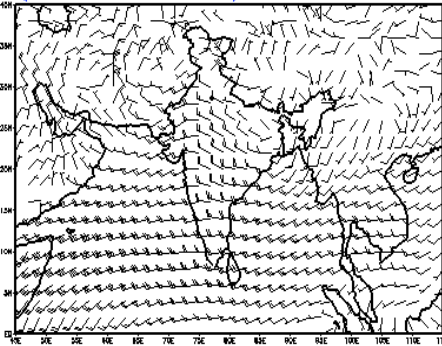
(Week2: 26May-01Jun)



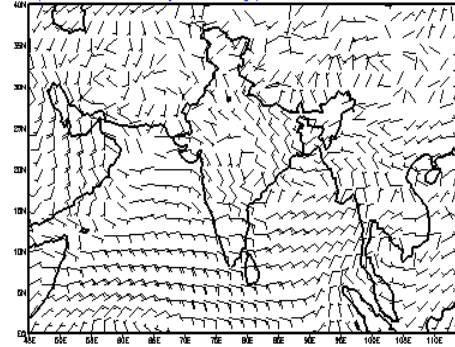
(Week3: 02Jun-08Jun)



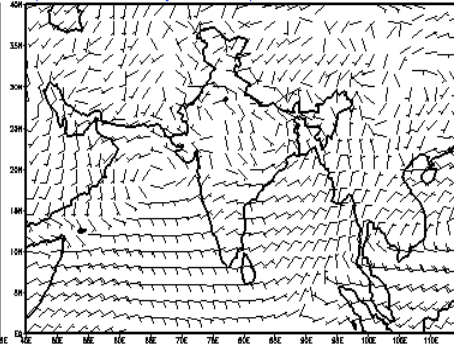
(Week4: 09Jun-15Jun)



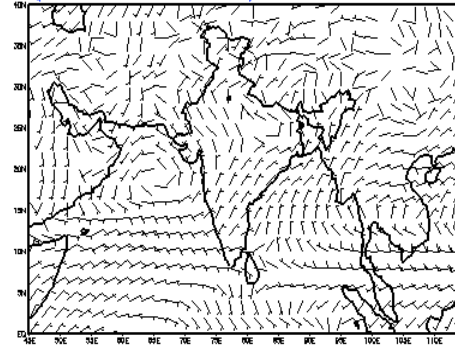
MME weekly 850 hPa wind anomaly
(Week1: 19May-25May)



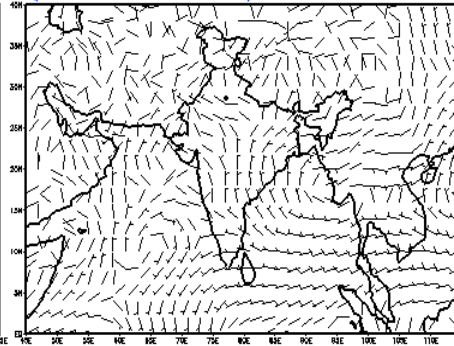
(Week2: 26May-01Jun)



(Week3: 02Jun-08Jun)



(Week4: 09Jun-15Jun)



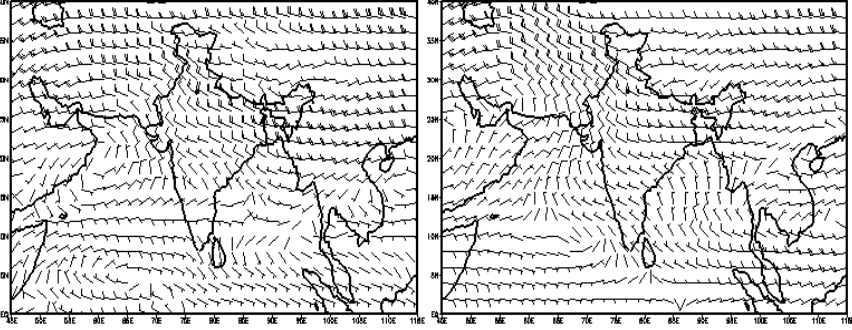
Likely delayed onset and weak monsoon till first half of June was very well captured in the ERF forecast based on IC of 17th May, 2023



MME Weekly mean 500 hPa wind

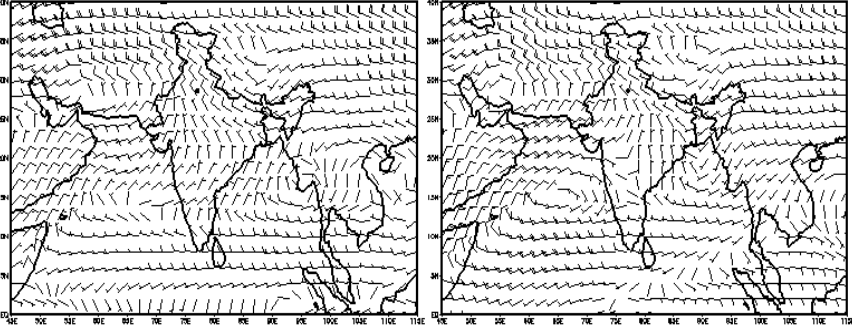
(Week1: 19May-25May)

(Week2: 26May-01Jun)



(Week3: 02Jun-08Jun)

(Week4: 09Jun-15Jun)

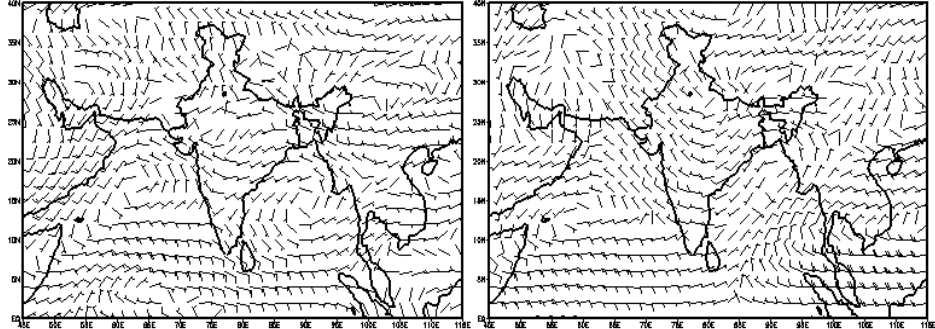


500 hPa mean wind and anomaly for 4 weeks based on ERF of 17 May 2023 also indicated Weak initial phase of monsoon

MME weekly 500 hPa wind anomaly

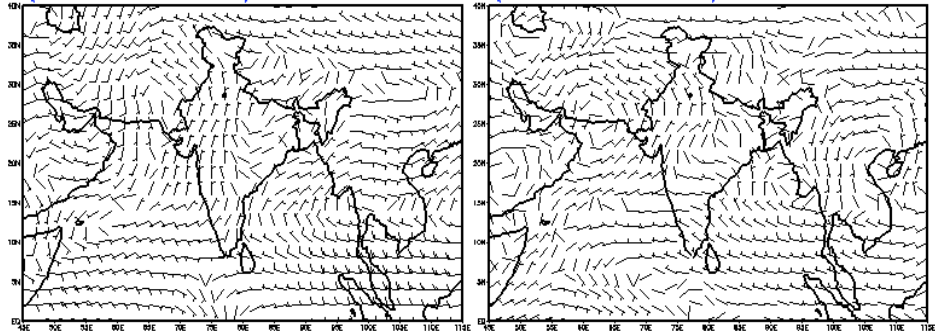
(Week1: 19May-25May)

(Week2: 26May-01Jun)



(Week3: 02Jun-08Jun)

(Week4: 09Jun-15Jun)

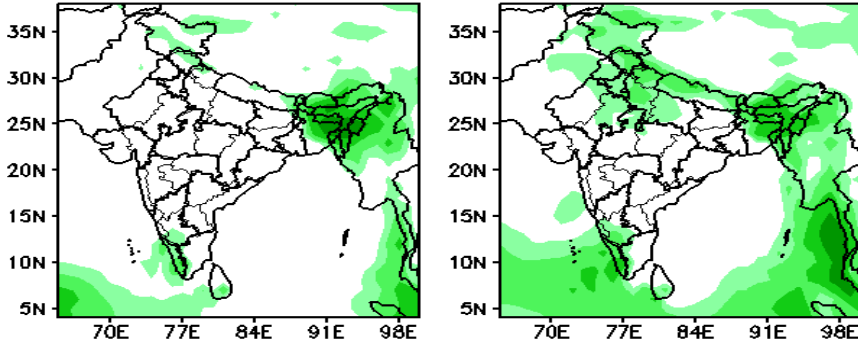


Mean rainfall and its anomaly for 4 weeks (IC : 17 May, 2023)

Forecast Rainfall (mm/day)

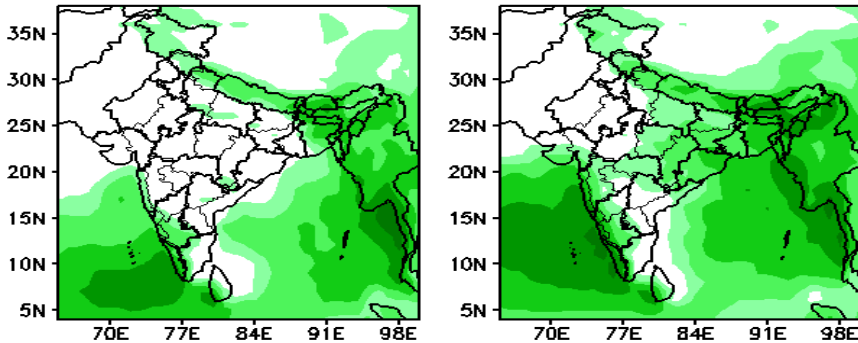
(Week1: 19May-25May)

(Week2: 26May-01Jun)



(Week3: 02Jun-08Jun)

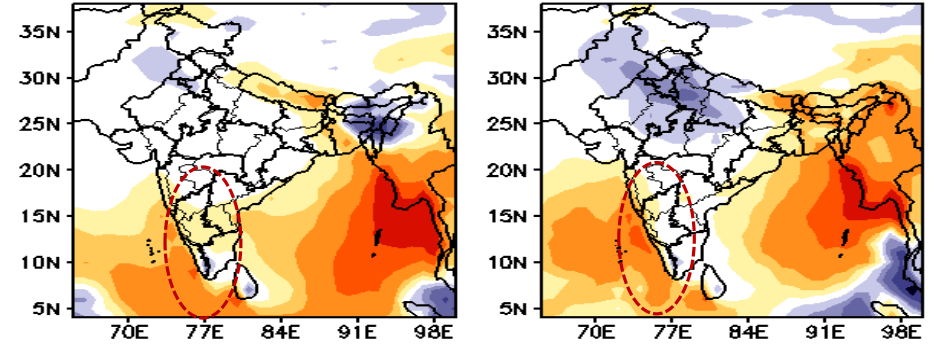
(Week4: 09Jun-15Jun)



Forecast Rainfall Anomaly (mm/day)

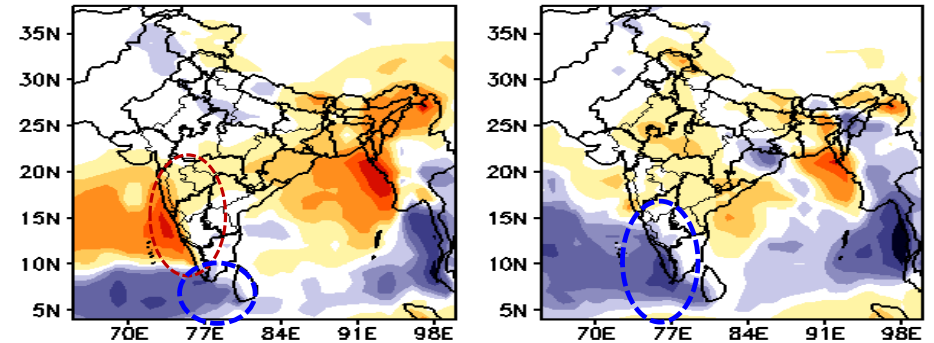
(Week1: 19May-25May)

(Week2: 26May-01Jun)



(Week3: 02Jun-08Jun)

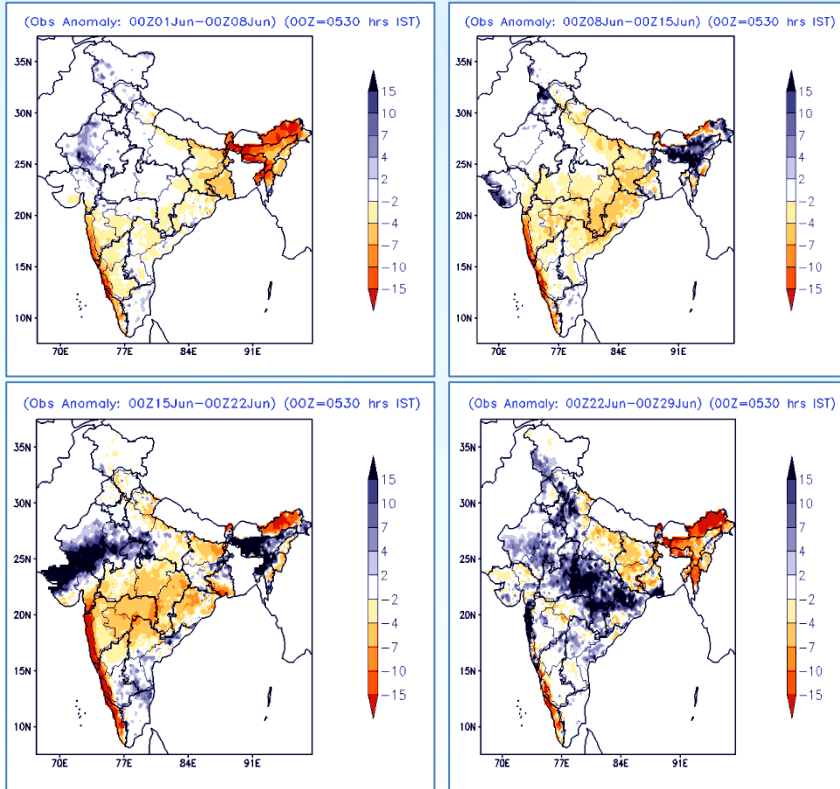
(Week4: 09Jun-15Jun)



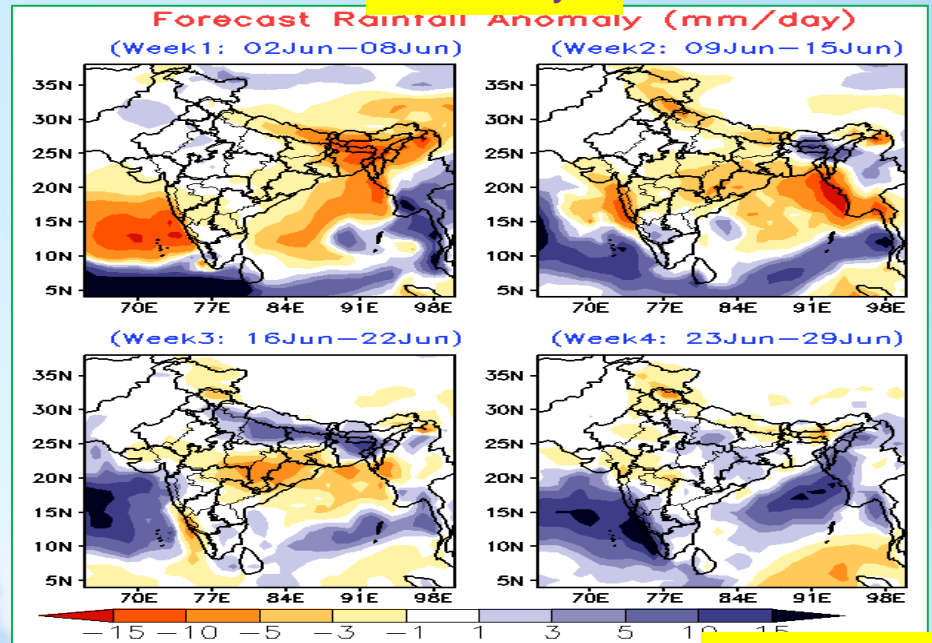
- ❖ Indicated likely delay in onset of monsoon over Kerala about 3 weeks in advance.
- ❖ Also indicate weak phase of monsoon during 1st half of June.



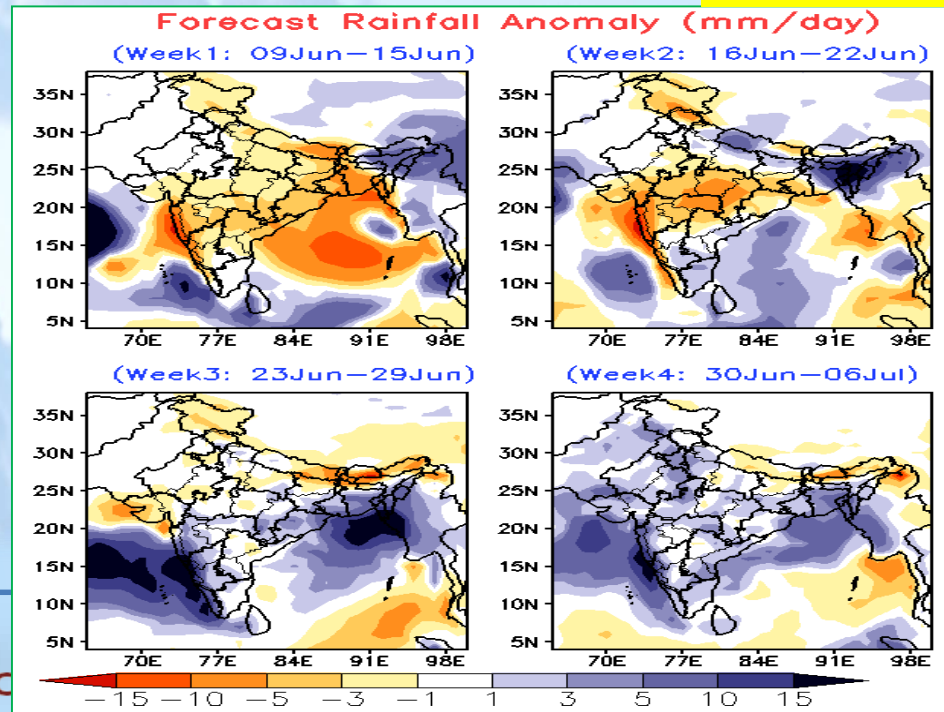
Observed Anomaly 2-29 June, 2023 (weak June)



ERF- 31 May



ERF- 7 June

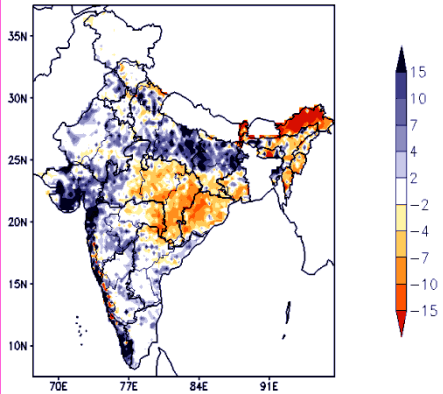


Revival of Monsoon in July, 2023 well captured in ERF

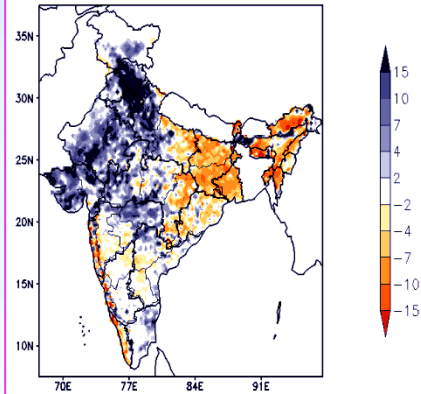
Observed Anomaly 30 June-27 July, 2023

ERF- 28 June, 2023

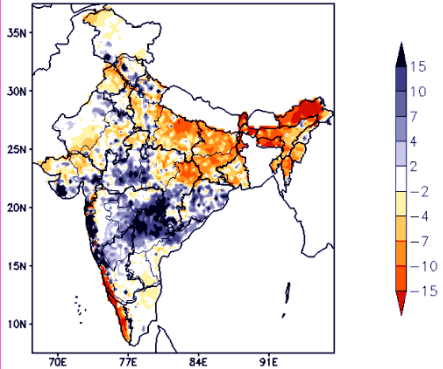
(Obs Anomaly: 00Z29Jun-00Z06Jul) (00Z=0530 hrs IST)



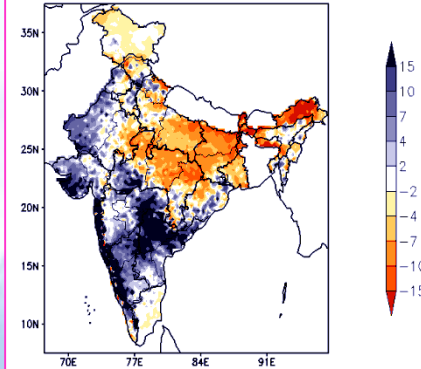
(Obs Anomaly: 00Z06Jul-00Z13Jul) (00Z=0530 hrs IST)



(Obs Anomaly: 00Z13Jul-00Z20Jul) (00Z=0530 hrs IST)

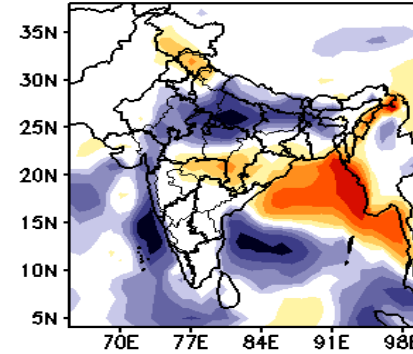


(Obs Anomaly: 00Z20Jul-00Z27Jul) (00Z=0530 hrs IST)

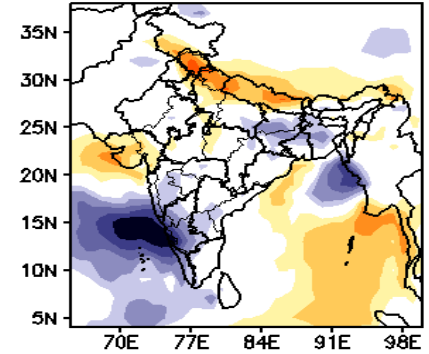


Forecast Rainfall Anomaly (mm/day)

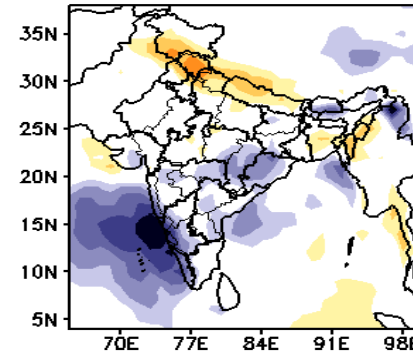
(Week1: 30Jun-06Jul)



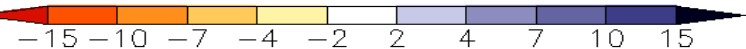
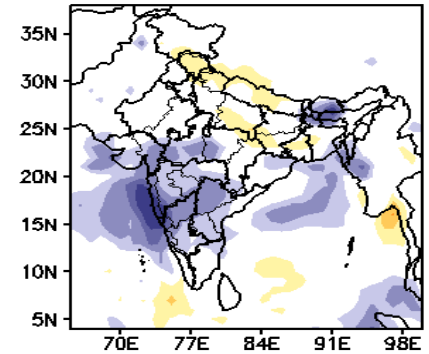
(Week2: 07Jul-13Jul)



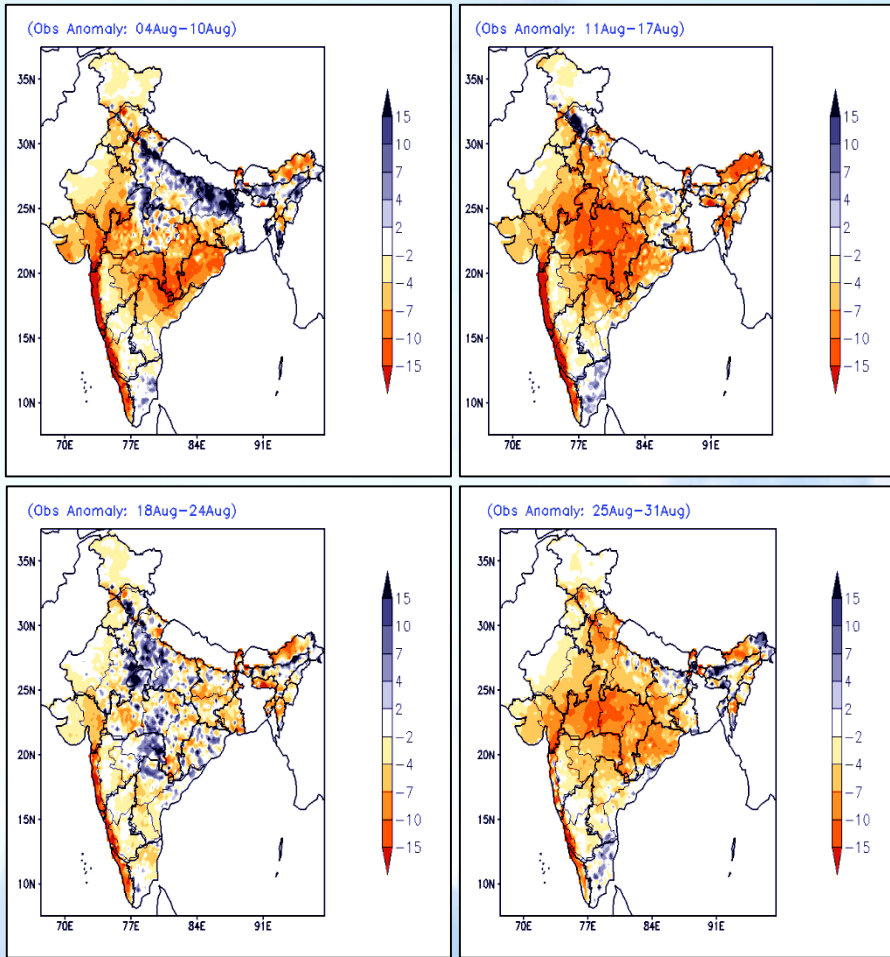
(Week3: 14Jul-20Jul)



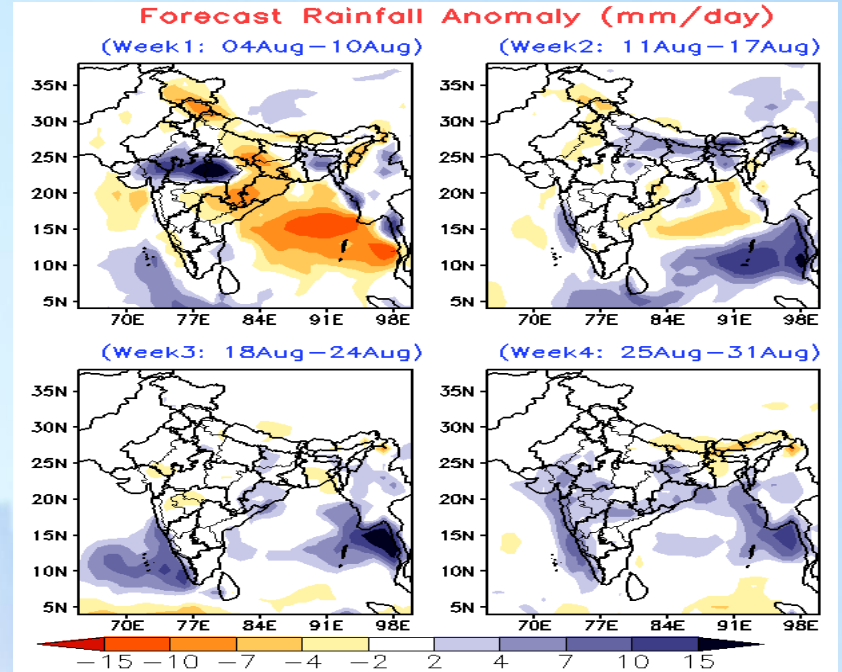
(Week4: 21Jul-27Jul)



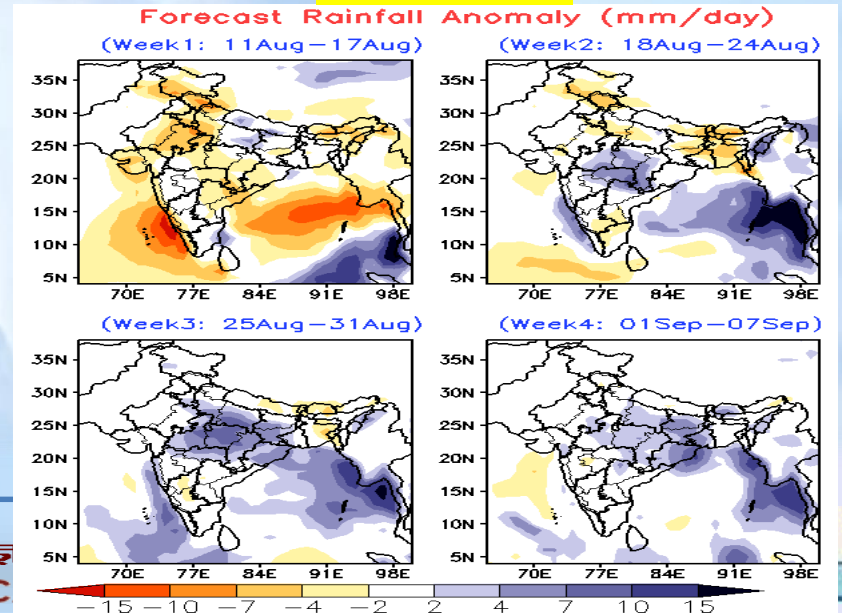
Observed Anomaly 04-31 August, 2023



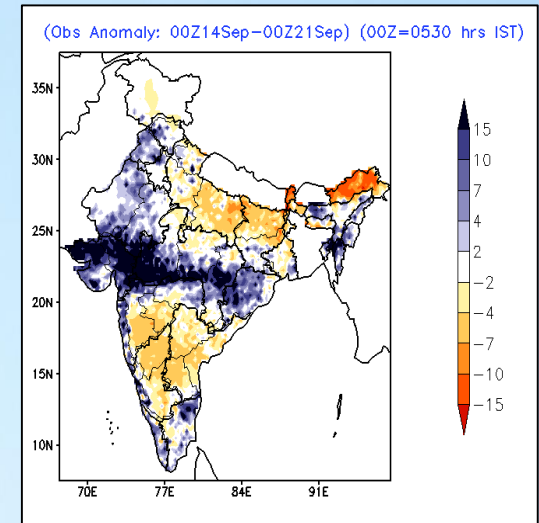
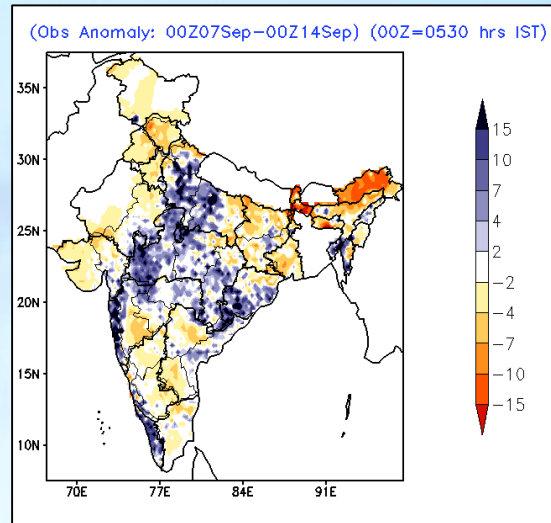
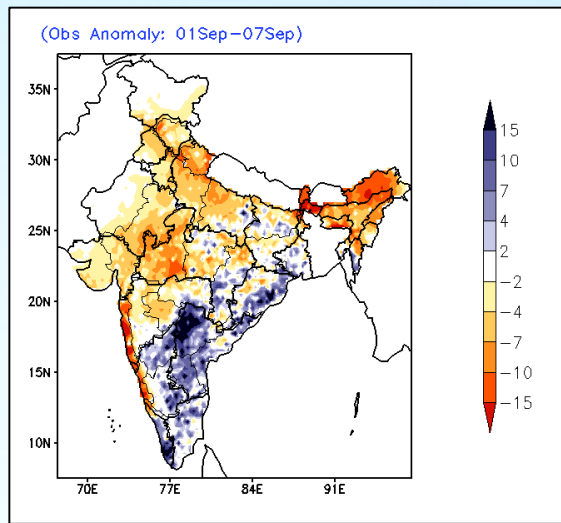
ERF- 2 Aug



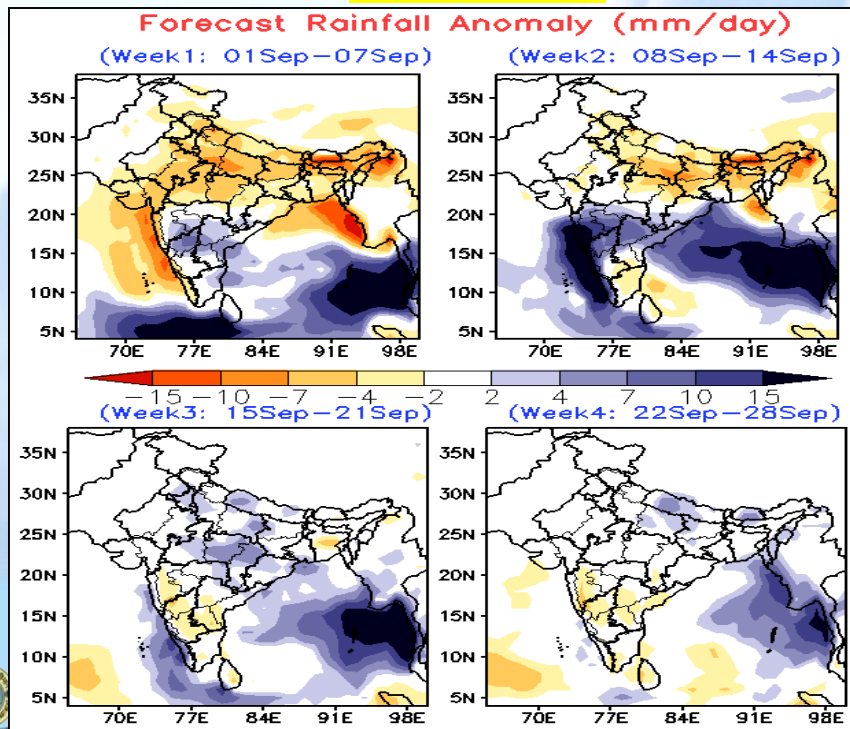
ERF- 9 Aug



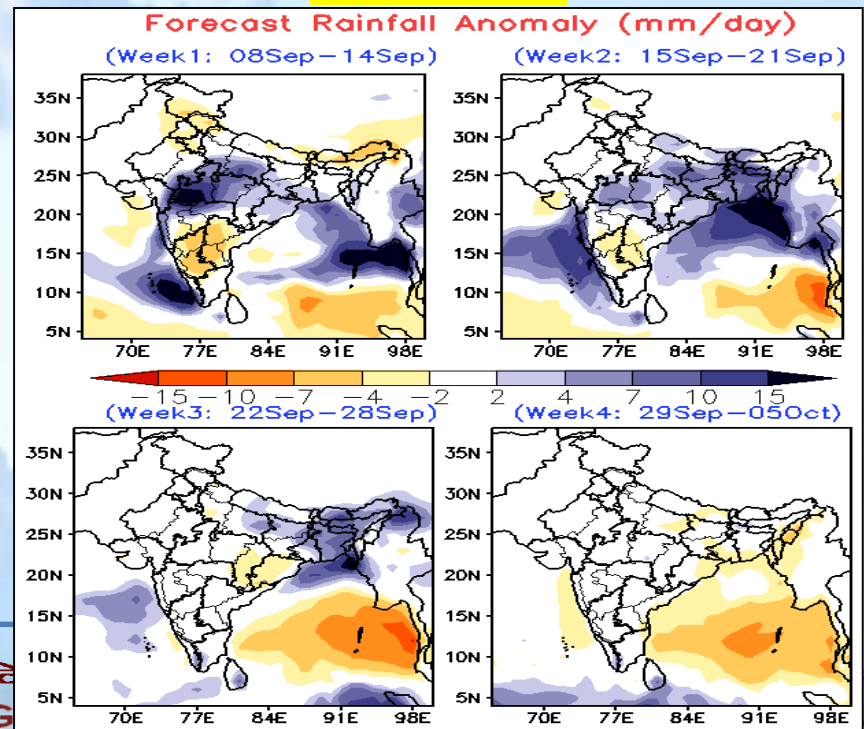
Observed Anomaly 01-21 Sep 2023 (Delayed withdrawal) DOW :25 Sep, 2024



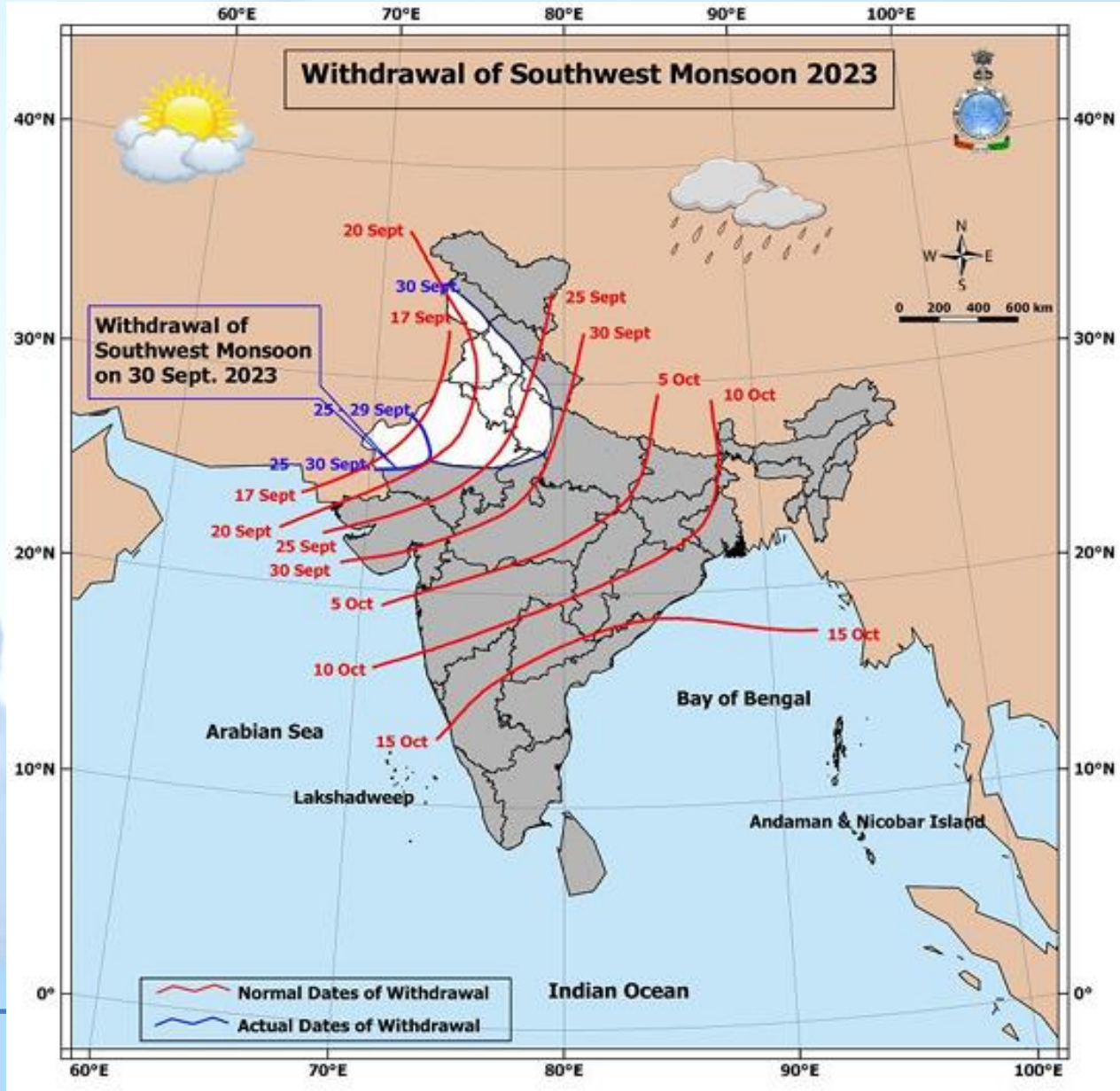
ERF- 30 Aug



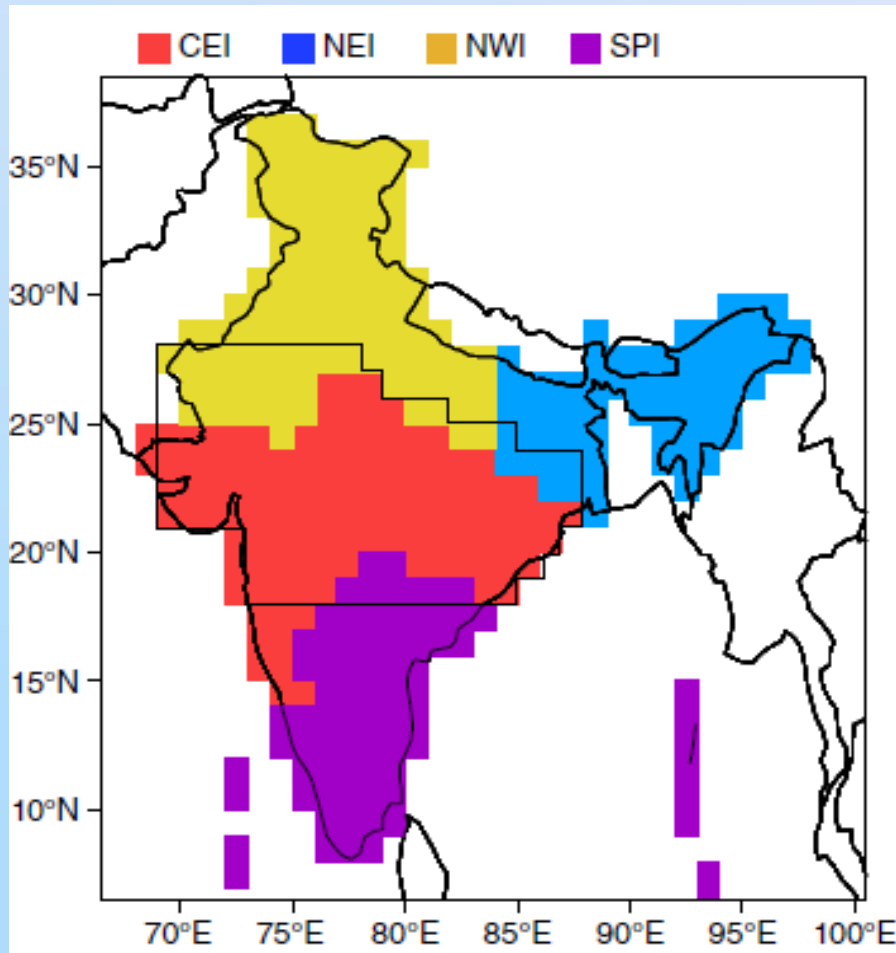
ERF- 6 Sep



Withdrawal of monsoon - 2023



Forecast Skill over Smaller domains



Homogeneous regions of India

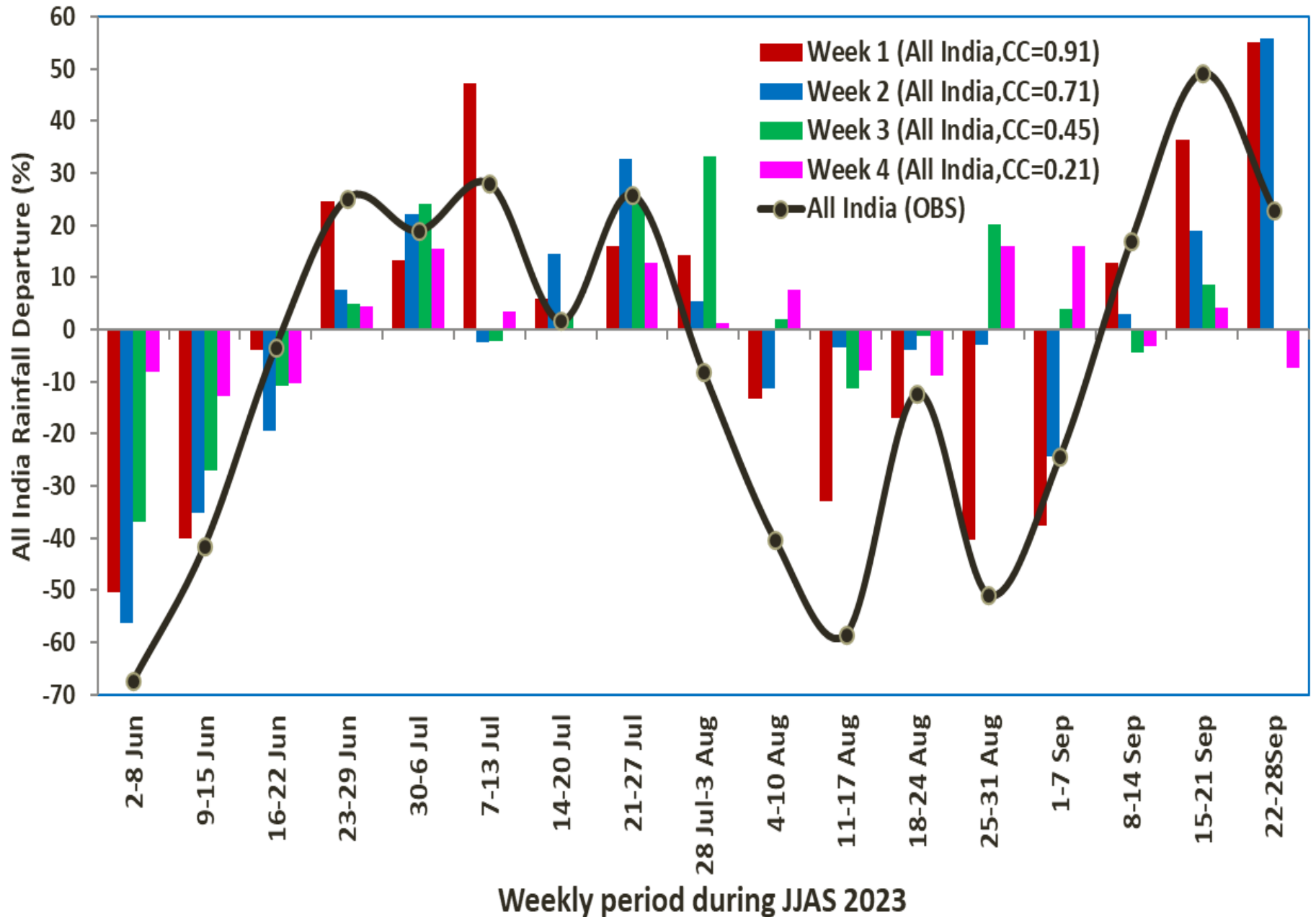
NEI - Northeast India

NWI – Northwest India

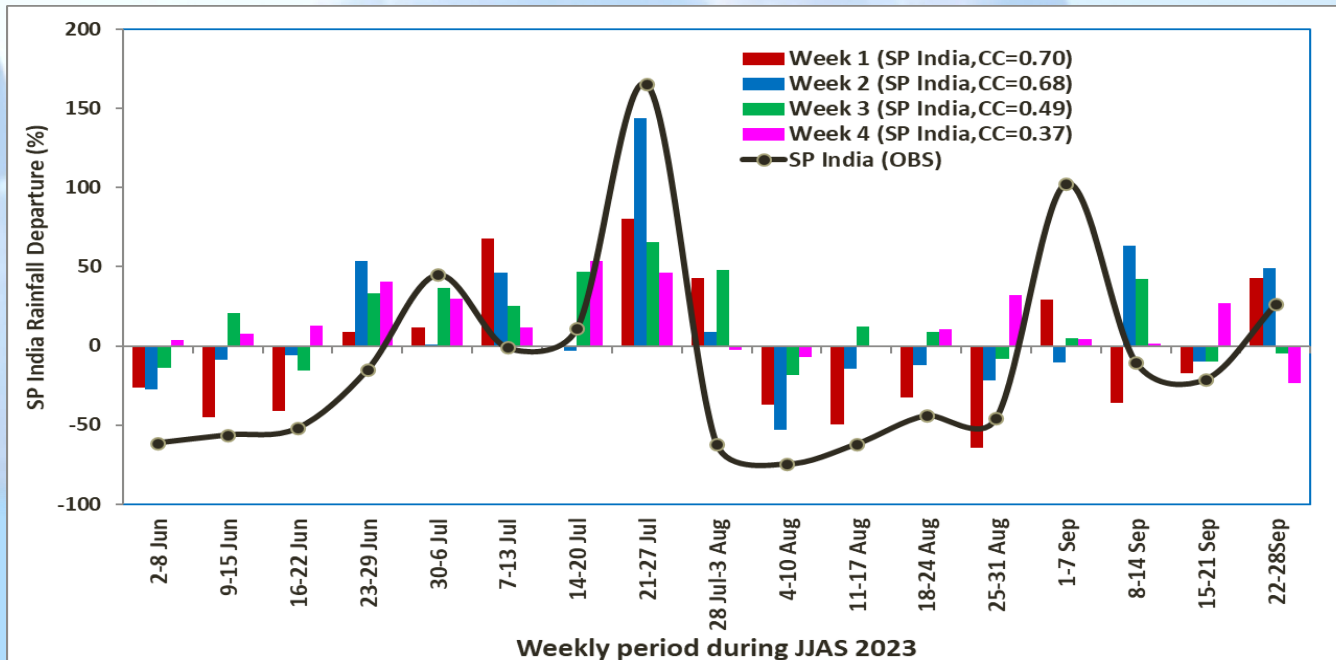
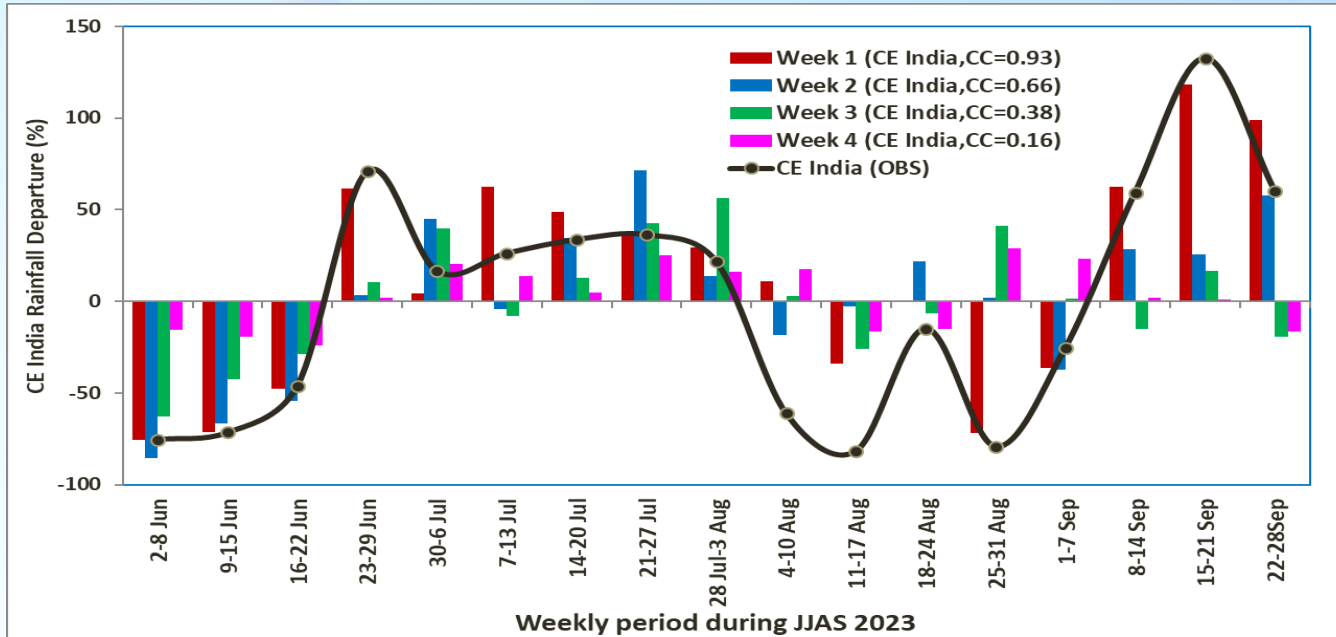
CEI – Central India

SPI – South Peninsular India

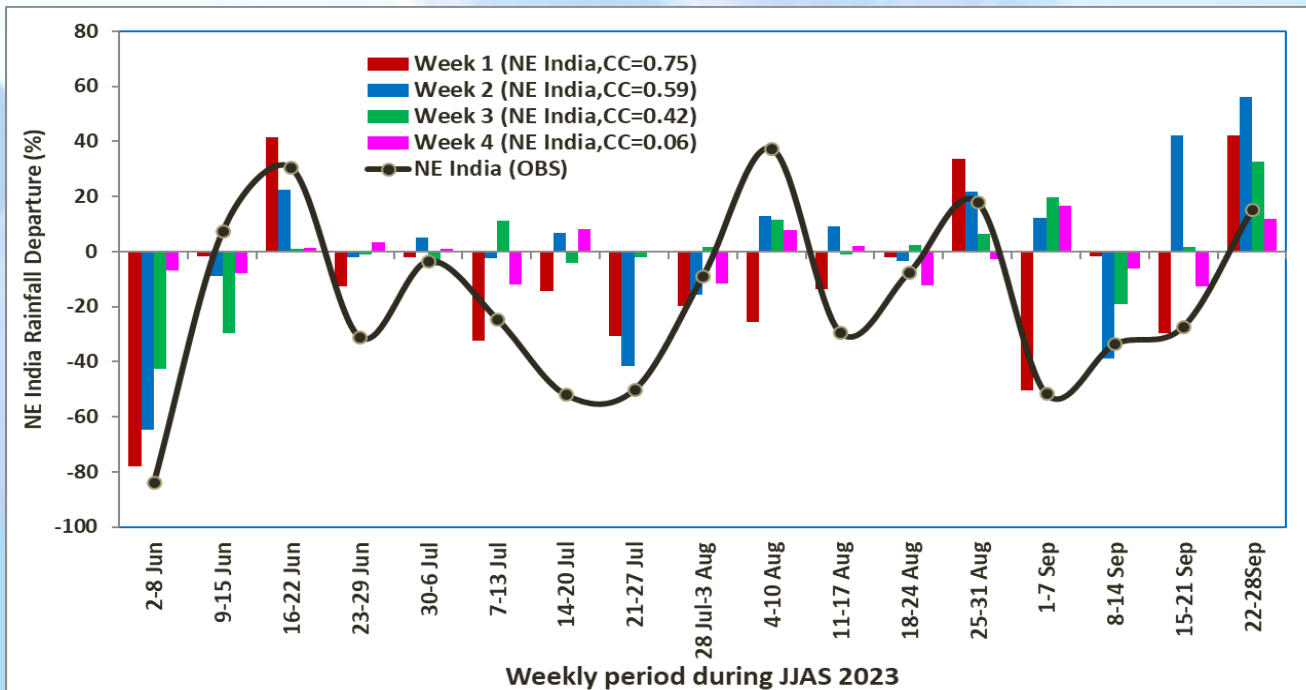
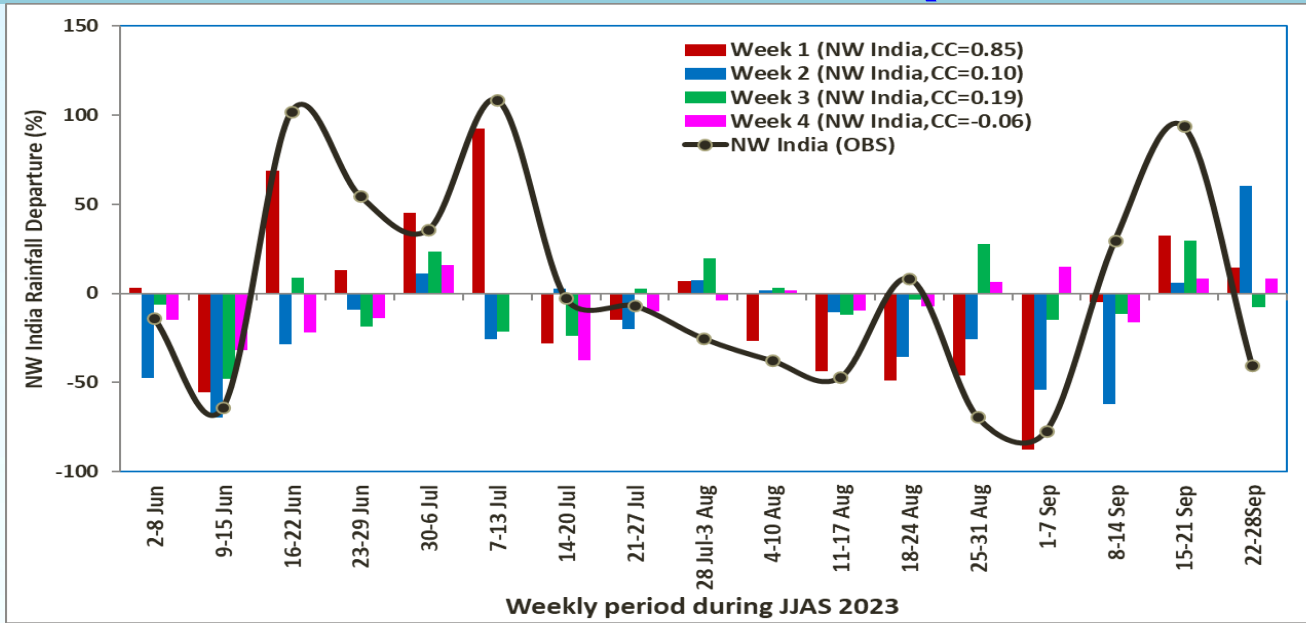
Quantitative Verification (All India)



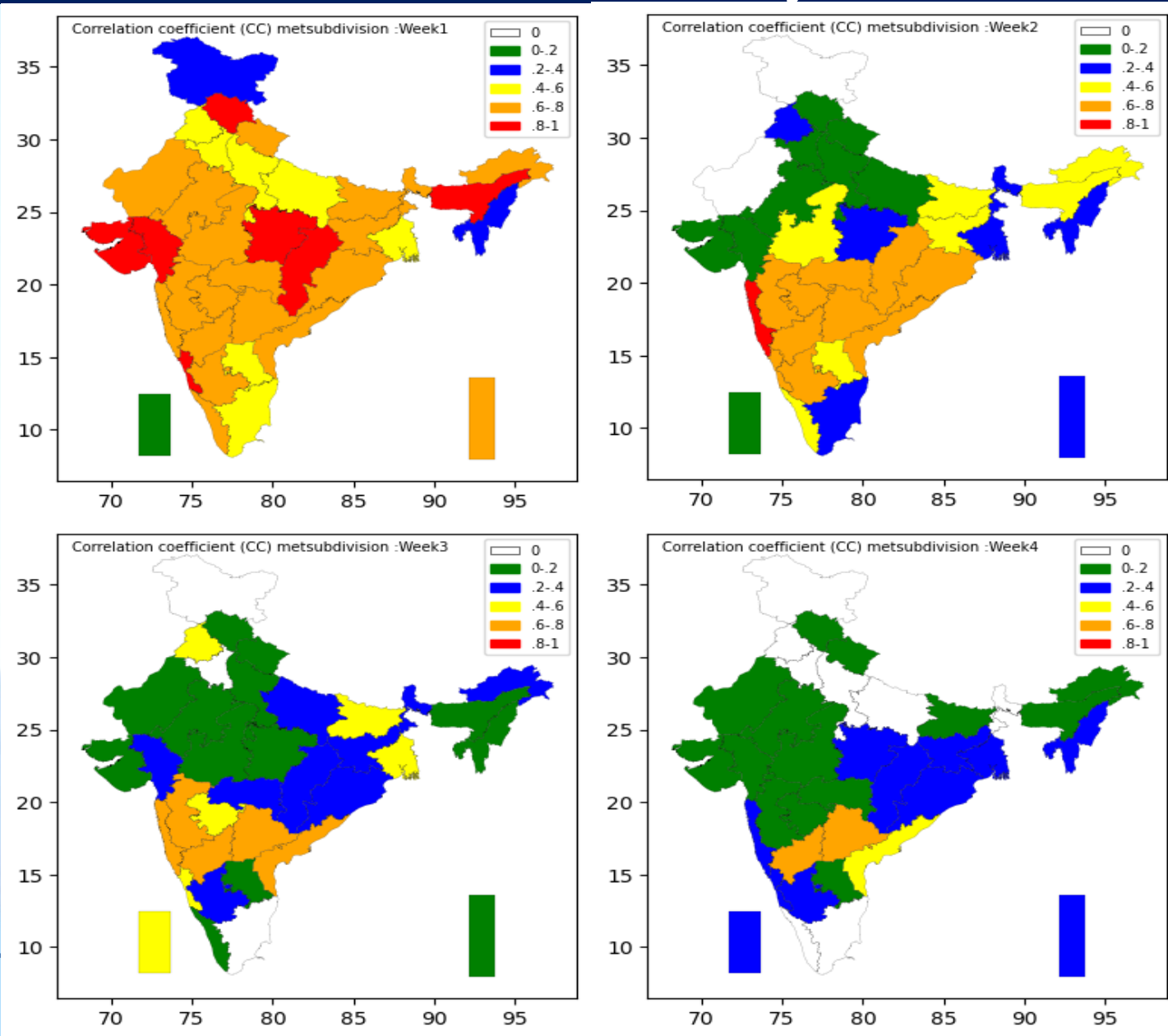
Quantitative Verification (CE & SP India)



Quantitative Verification (NW & NE India)



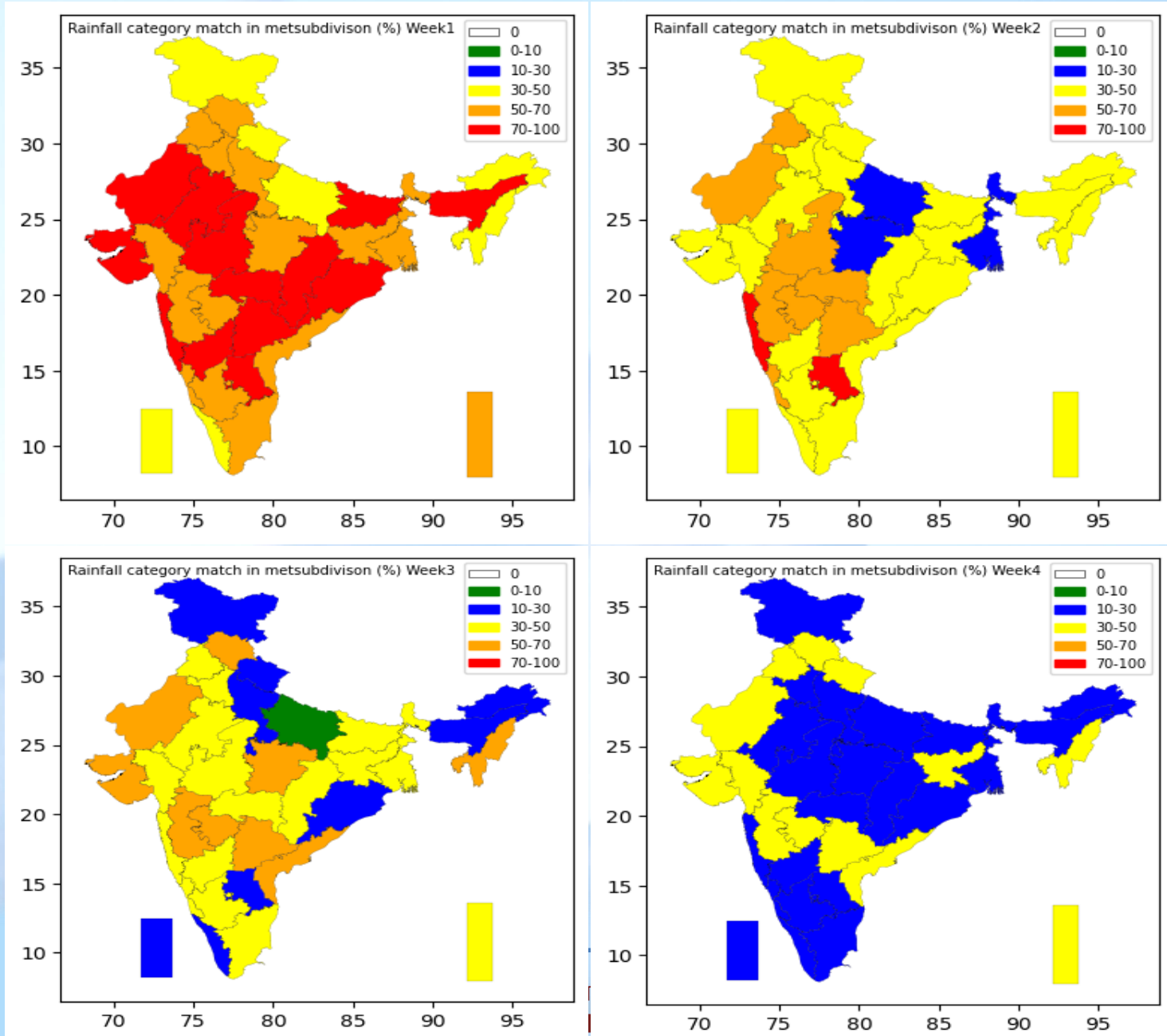
Correlation co-efficient between forecast anomaly and observation anomaly



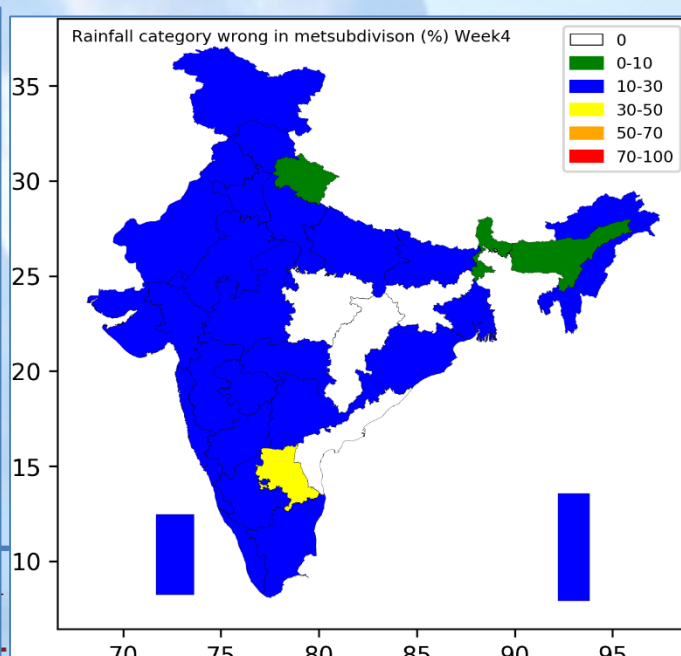
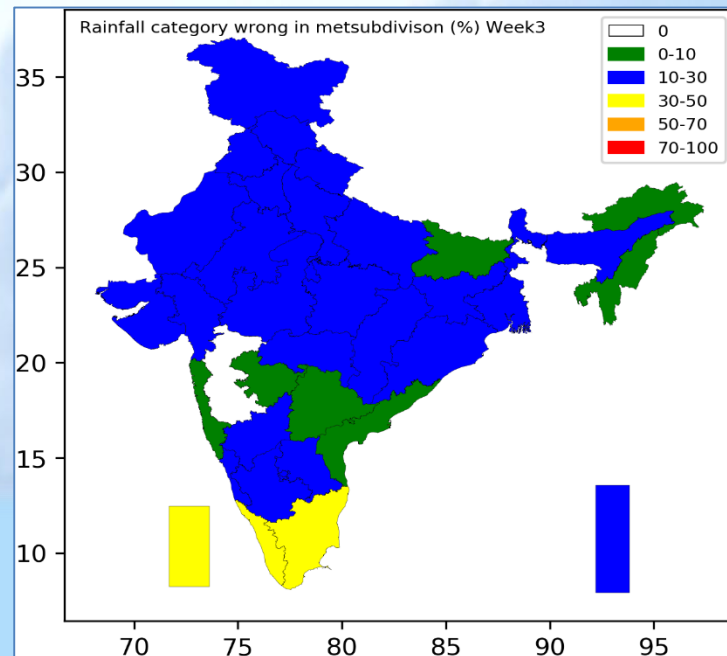
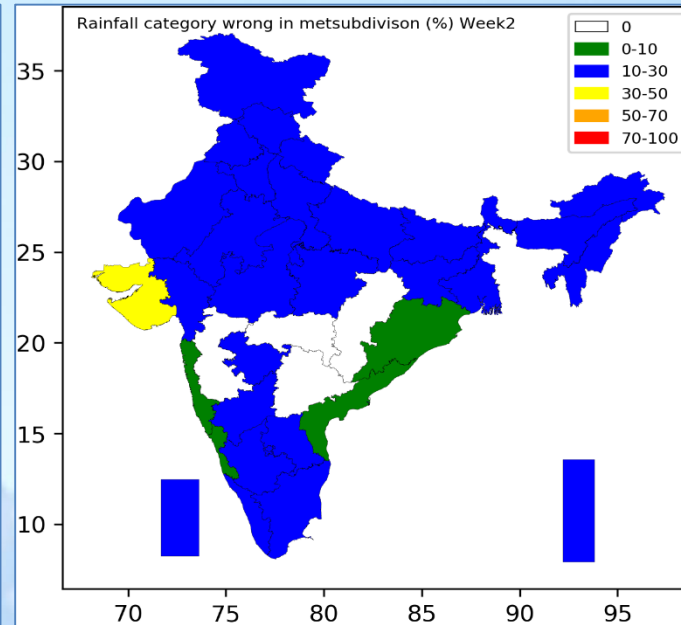
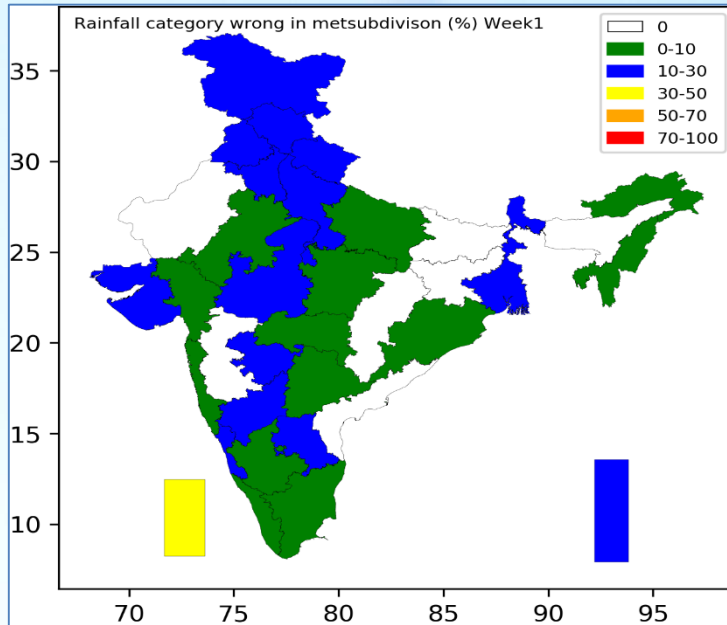
Category for verification of Met-Subdivision level forecast

Categories	Hydrological	Agriculture
Large Excess (LE)	+60% or more	Above Normal
Excess (E)	+20% to +59%	(AN)
Normal (N)	+19% to -19%	Normal (N)
Deficient (D)	-20% to -59%	Below Normal
Large Deficient (LD)	-60% to -99%	(BN)
No Rain (NR)	-100%	

Percentage of correct category subdivisions



Percentage of Wrong Category



Percentage of category matching

Week 1

Category	% of Met Sub	No of Met. Sub
Correct (C)	62.7%	22-23
Partially C (PC)	27.6	9-10
Wrong (W)	9.6	3-4

Week 2

Category	% of Met Sub.	No of Met. Sub
Correct (C)	45.7	16-17
Partially C (PC)	34.4	12-13
Wrong (W)	15.8	5-6

Week 3

Category	% of Met Sub	No of Met. Sub
Correct (C)	40	14-15
Partially C (PC)	43.1	15-16
Wrong (W)	16.8	6-7

Week 4

Category	% of Met Sub	No of Met. Sub
Correct (C)	29.4	10-11
Partially C (PC)	54.7	19-20
Wrong (W)	15.8	5-6



Some Challenging Issues

IMD NWP RESEARCH REPORT No.: 02/2023



Government of India
Ministry of Earth Sciences
India Meteorological Department

A Report
on
Assessment of NWP Models Forecast of the
Unprecedented Rainfall over North India
During 8-13 July, 2023



July 2023

D. R. Pattanaik, M. T. Bushair, C. J. Johny, Akhil Srivastava,
Amit Bhardwaj, Trisanu Banik, T. Arulalan, D.S. Pai and M. Mohapatra

Numerical Weather Prediction division
India Meteorological Department
Ministry of Earth Sciences
Government of India

Though the ERF has got useful skill upto 2 to 3 weeks, there are occasions when the lead period is only one week.

The unprecedented rainfall over North India during 8-13 July associated with westerly-monsoon interaction could predict the active phase of monsoon with one week lead.

विभाग

INDIA METEOROLOGICAL DEPARTMENT



Leadtime of this event was small

ERF – 5th July, 2023

ERF – 28 June, 2023

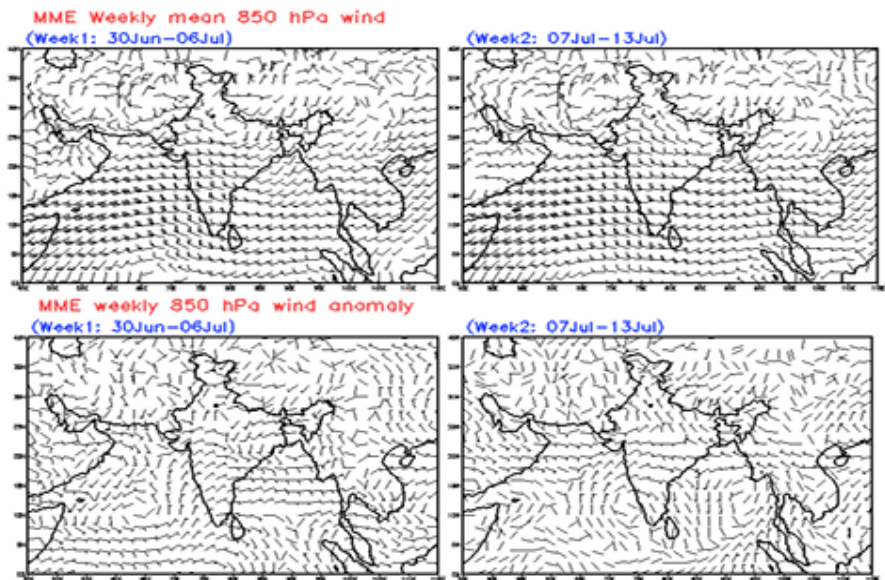
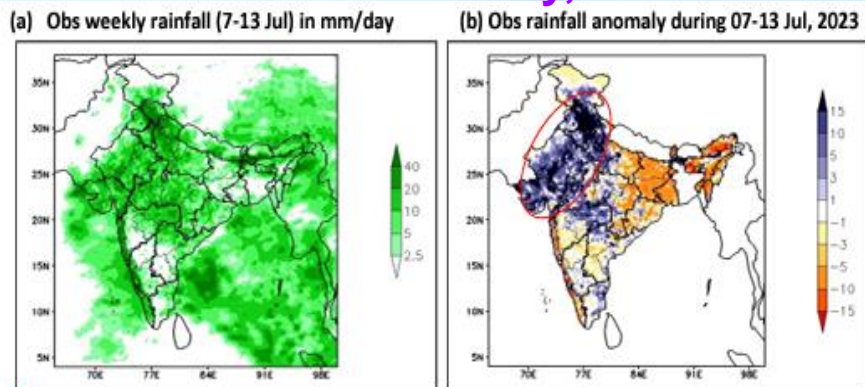
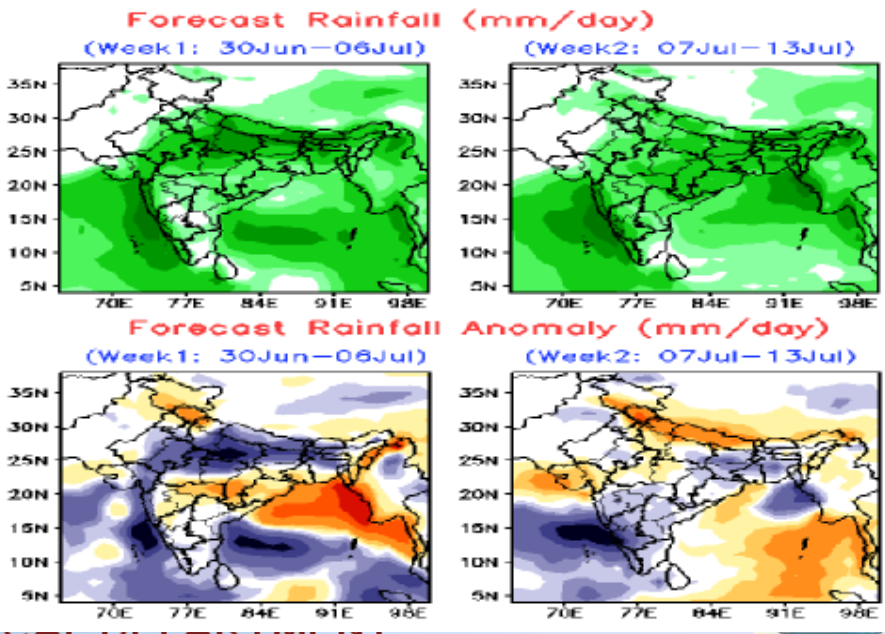
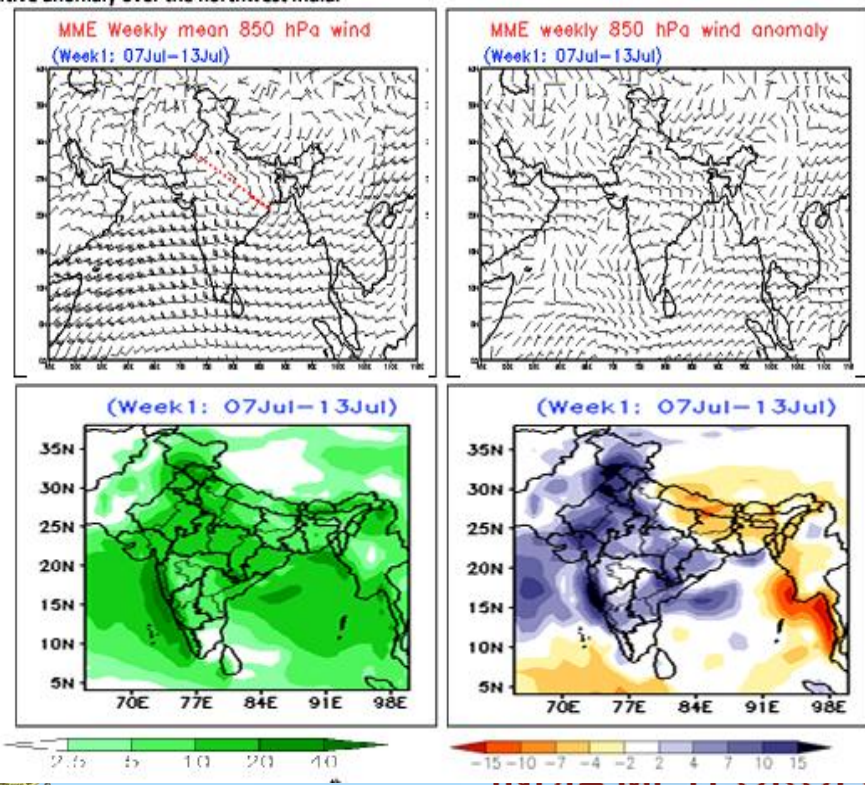


Fig. 17 : The weekly mean rainfall and its anomaly for the period from 07-13 July, 2023. It indicates a large positive anomaly over the northwest India.



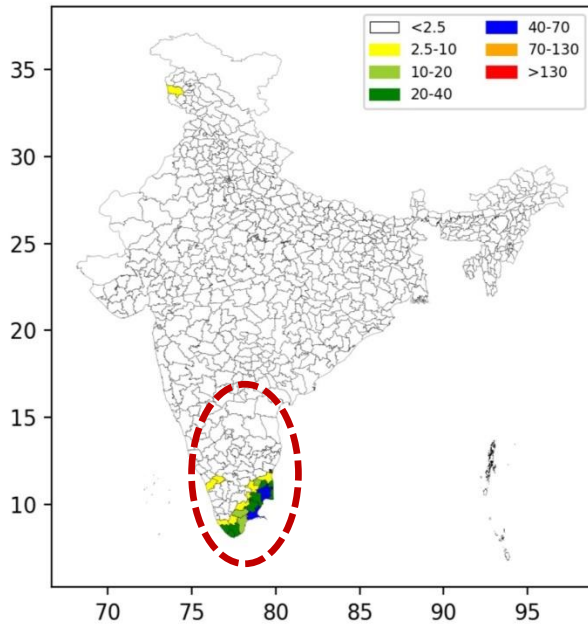
Rainfall Event

16-19 December 2023

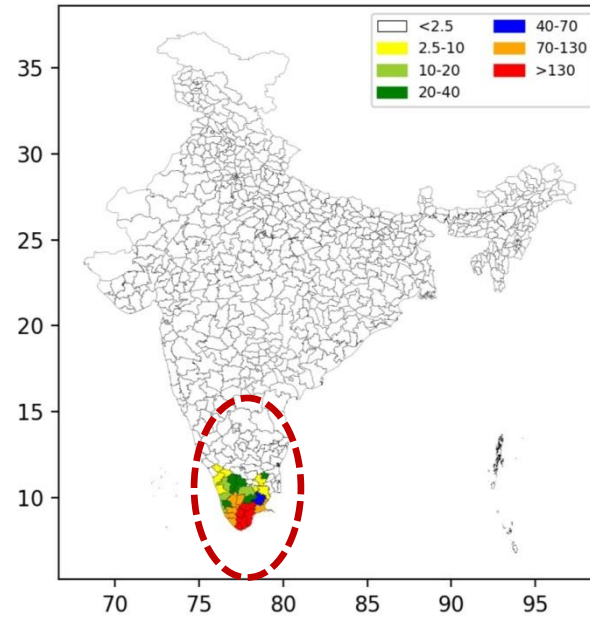


24 hr Rainfall recorded on 17, 18 and 19 December, 2023

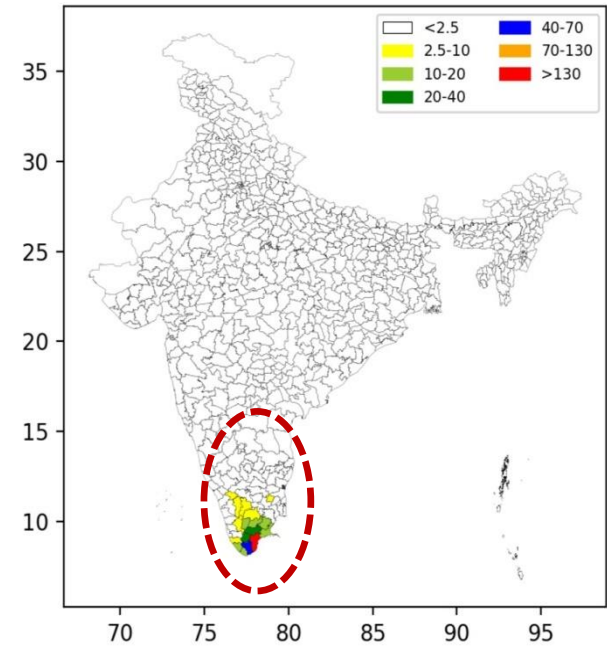
IMD Observed Rainfall (mm) 17-12-2023



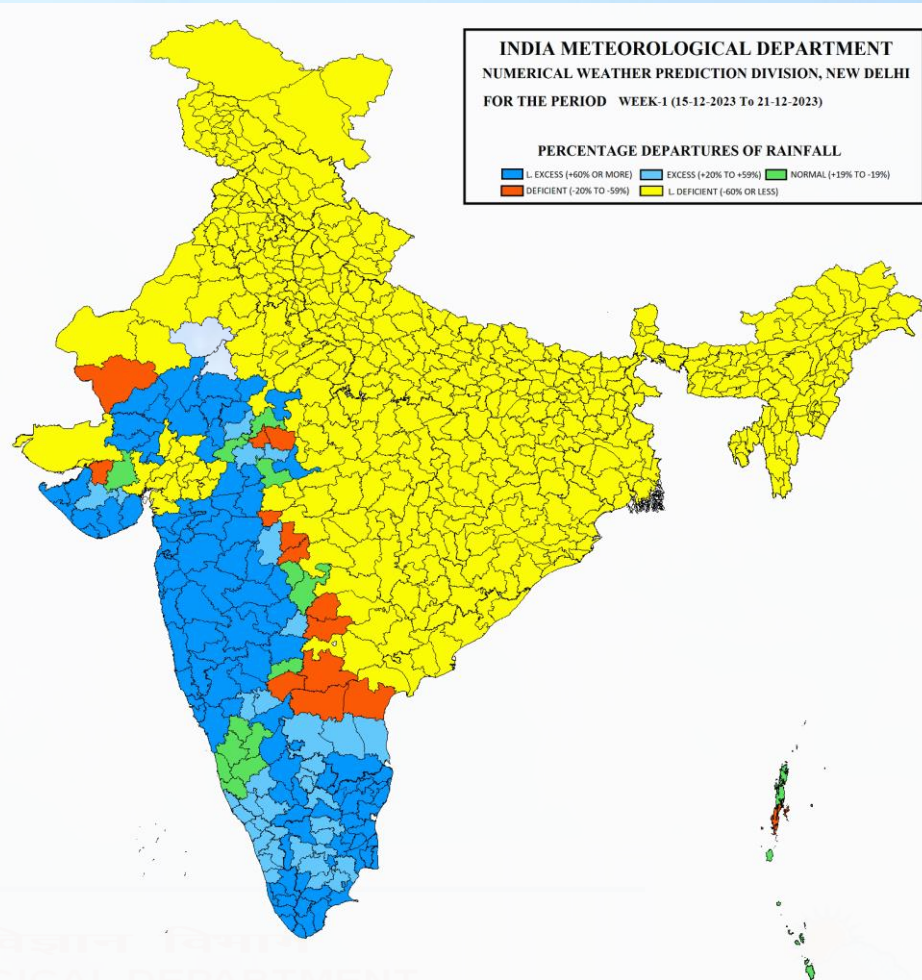
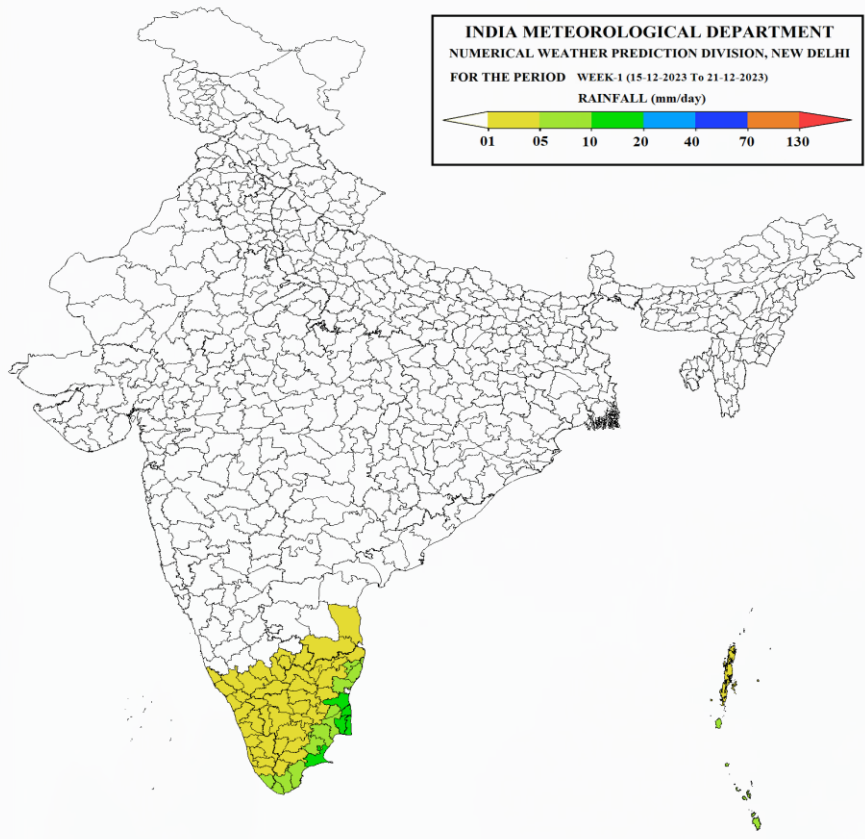
IMD Observed Rainfall (mm) 18-12-2023



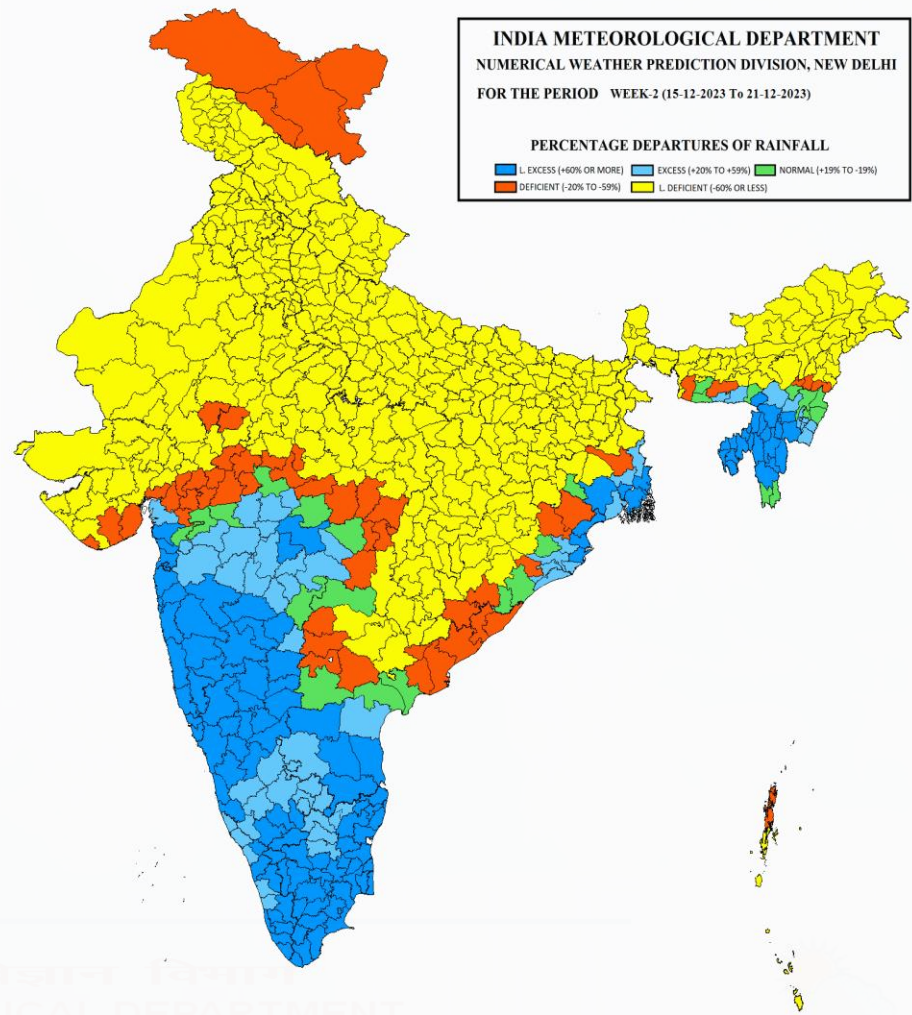
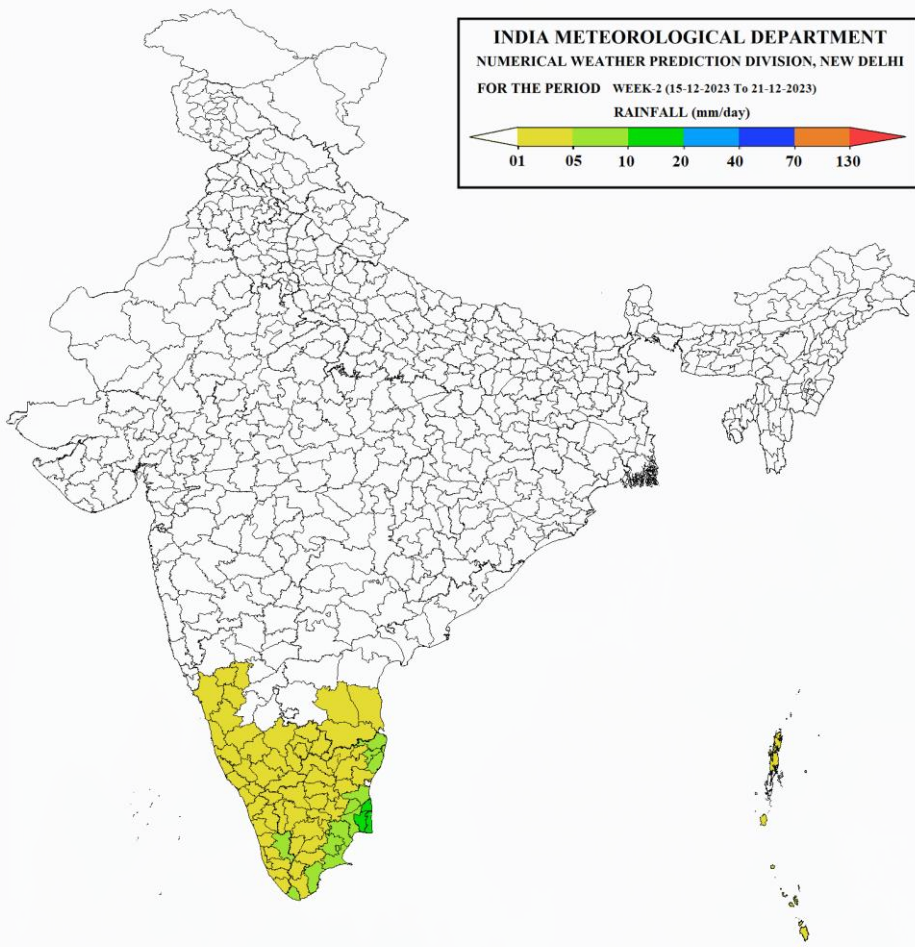
IMD Observed Rainfall (mm) 19-12-2023



District level Predicted Percentage Departure (RAINFALL) for week 1 (15 – 21 Dec 2023)

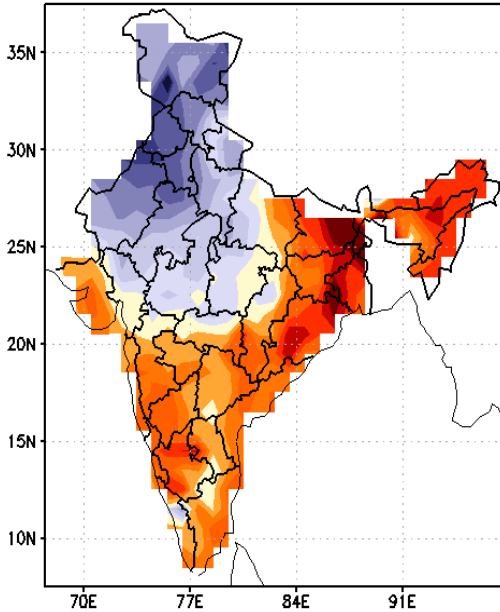


District level Predicted Percentage Departure (RAINFALL) for week 2 (15 – 21 Dec 2023)

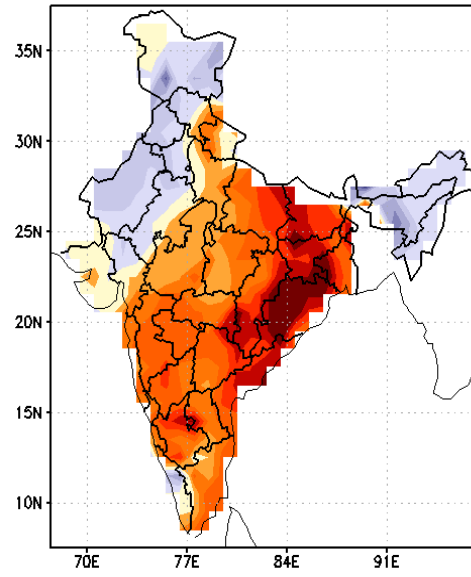


OBS Tmax anomalies : (2-22 June, 2023)

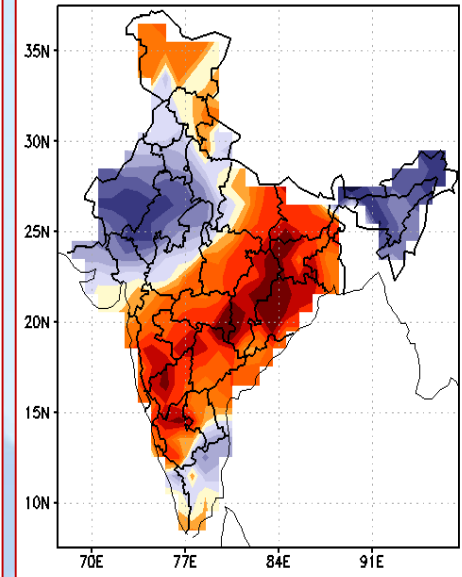
(Obs : 02Jun-08Jun)



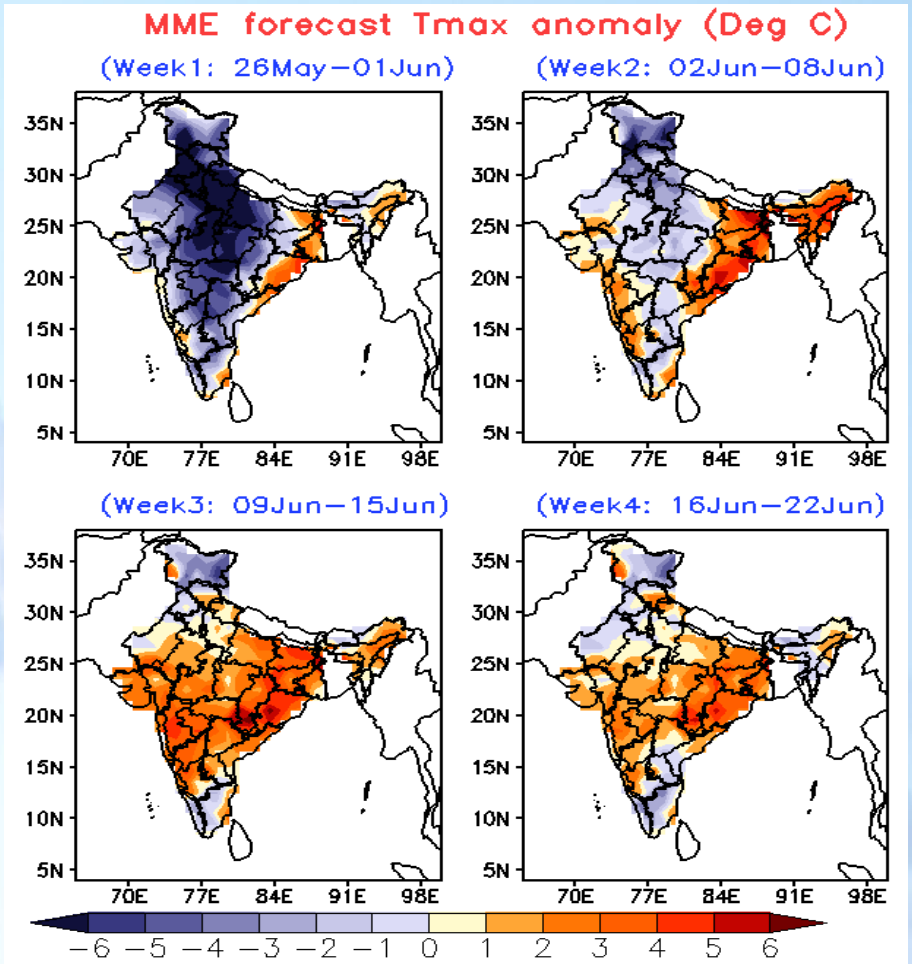
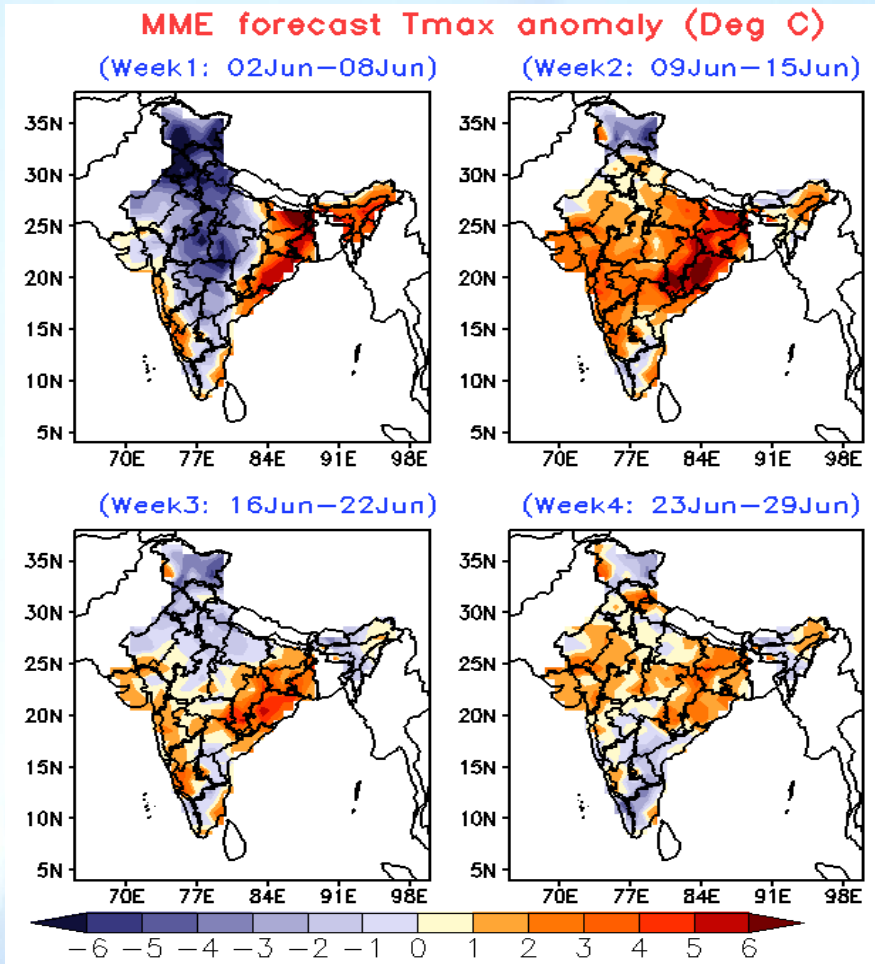
(Obs : 09Jun-15Jun)



(Obs : 16Jun-22Jun)



ERF Tmax anomalies : (IC : 31 May and 24 May 2023)



Summary :

- ❑ Forecast of wind, rainfall, temperature (Tmax & Tmin), cyclogenesis potential etc are being generated at different spatial and temporal scales.
- ❑ ERF has very good potential for applications in various sectors with useful skill upto 2 to 3 weeks.
- ❑ All customised ERF products are being generated for applications in different sectors covering Agriculture, Water, Power, Health and many more.
- ❑ The real time ERF forecast data is available in our ftp server for all members countries to use and prepare the customized products.



THANK YOU

