Use of NWP models in Weather Forecasting
मौसम पूर्वानुमान में एन डब्लू पी मॉडल का प्रयोग

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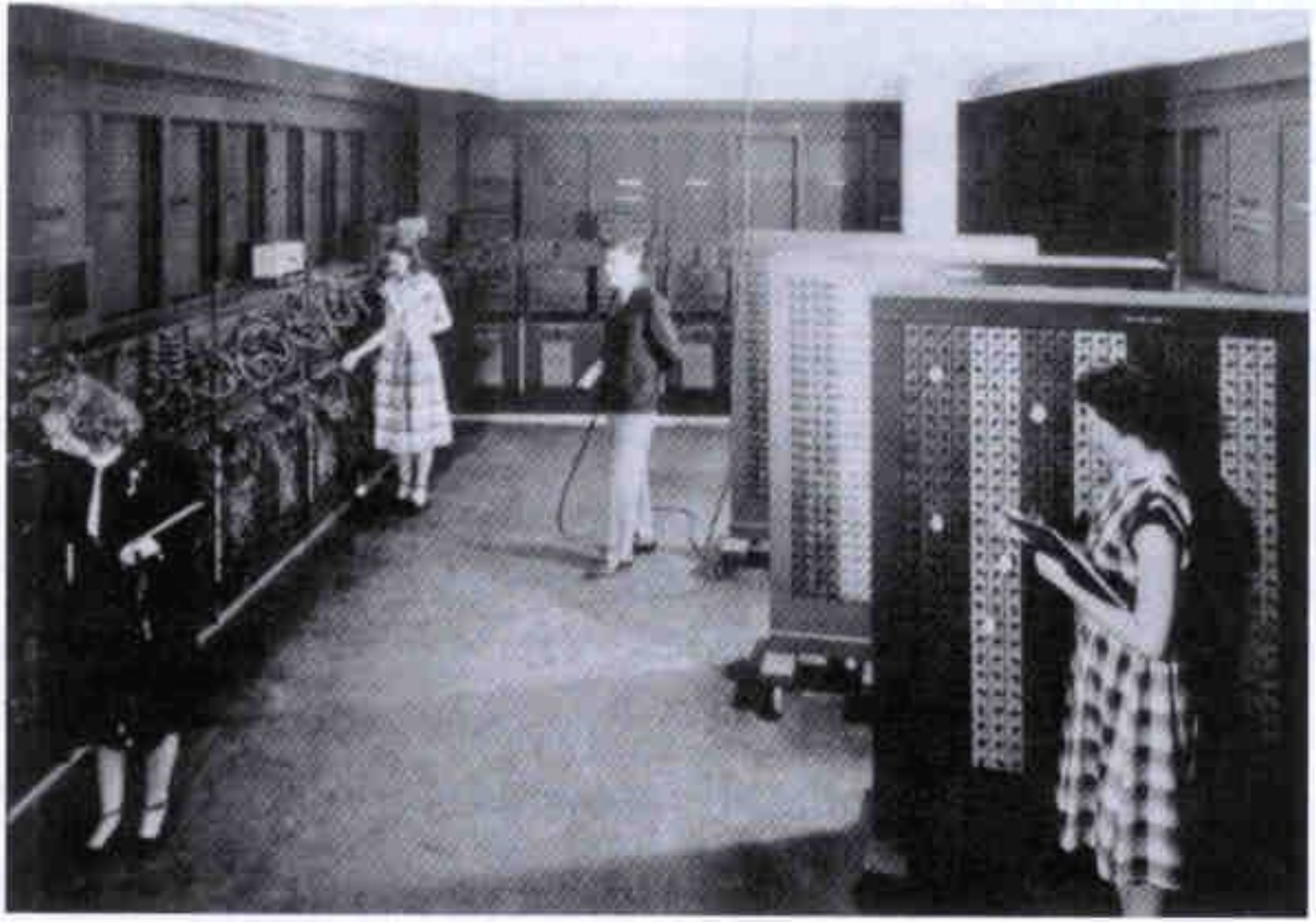
शिलाँग , 4 से 5 दिसम्बर 2017

What is Numerical Weather Prediction?

संख्यात्मक मौसम पूर्वानुमान क्या है ।

- The technique used to obtain an objective forecast of the future weather by solving a set of governing equations that describe the evolution of variables that define the present state of the atmosphere.
- **इस तकनीक का प्रयोग शासकीय समीकरणों के एक सेट को सुलझाने के द्वारा भविष्य के मौसम के उद्देश्य पूर्वानुमान को प्राप्त करने के लिए किया जाता है जो कि चर वस्तुएं के विकास का वर्णन करता है तथा वातावरण की वर्तमान अवस्था को परिभाषित करता है।**
- Feasible only using computers

केवल कम्प्यूटर का प्रयोग करके संभव



Electronic Numerical Integrator and Computer

Figure 3: The ENIAC computer in 1948. The operators are changing the plug-in wiring. (PLATZMAN, 1979).

MoES AADITYA (790 TF) at IITM, Pune
Presently being used by IMD Delhi

Courtesy, IITM Pune)

Components of an NWP *model*
एन डब्लू पी मॉडल के उत्पाद

1. Governing equations समीकरणों संचालन
   - *F=ma*, conservation of mass, moisture, and thermodynamic eqn., gas law

   एफ = एम ए, द्रव्यमान, नमी और थर्मोडायनामिक समीकरण का संरक्षण, गैस नियम
2. Numerical procedures: संख्यात्मक प्रक्रियाएं
   - approximations used to estimate each term (especially important for advection terms)

     प्रत्येक शब्द का अनुमान लगाने के लिए उपयोग किए गए अनुमानों (विशेषकर अभिवहन शब्दों के लिए विशेष रूप से महत्वपूर्ण) ।
   - approximations used to integrate model forward in time

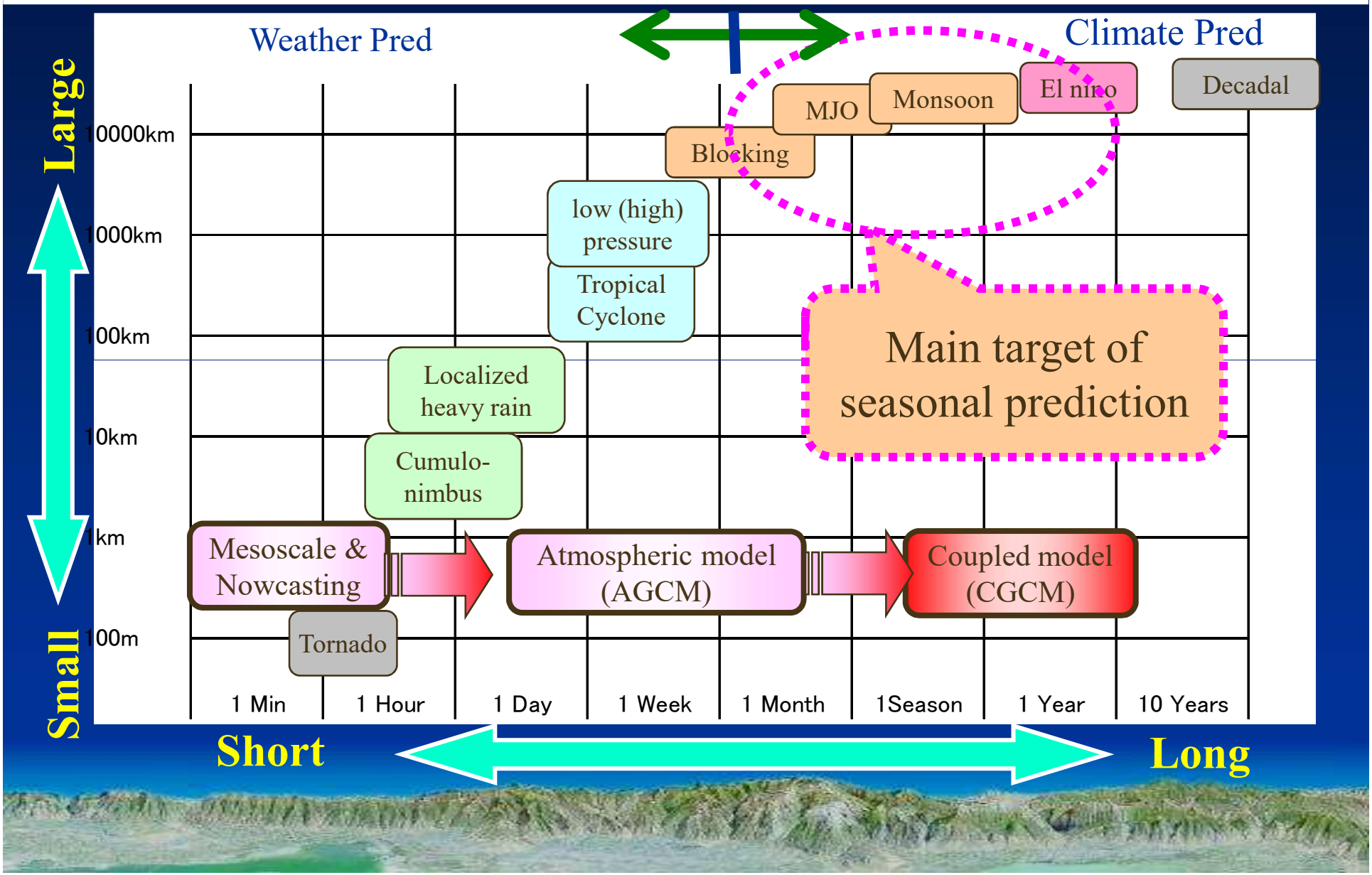
     समय में अग्रेषित मॉडल को एकीकृत करने के लिए प्रयोग किए गए अनुमान
   - boundary conditions सीमा की स्थितियां
3. Approximations of physical processes भौतिक प्रक्रियाओं का आकलन (parameterizations)
4. Initial conditions/Boundary Conditions: प्रारंभिक स्थितियाँ / सीमा की स्थितियाँ :
   - Observing systems, objective analysis, initialization, and data assimilation

     प्रणालियों का अवलोकन, उद्देश्य विश्लेषण, प्रारंभ, और डेटा एकीकर

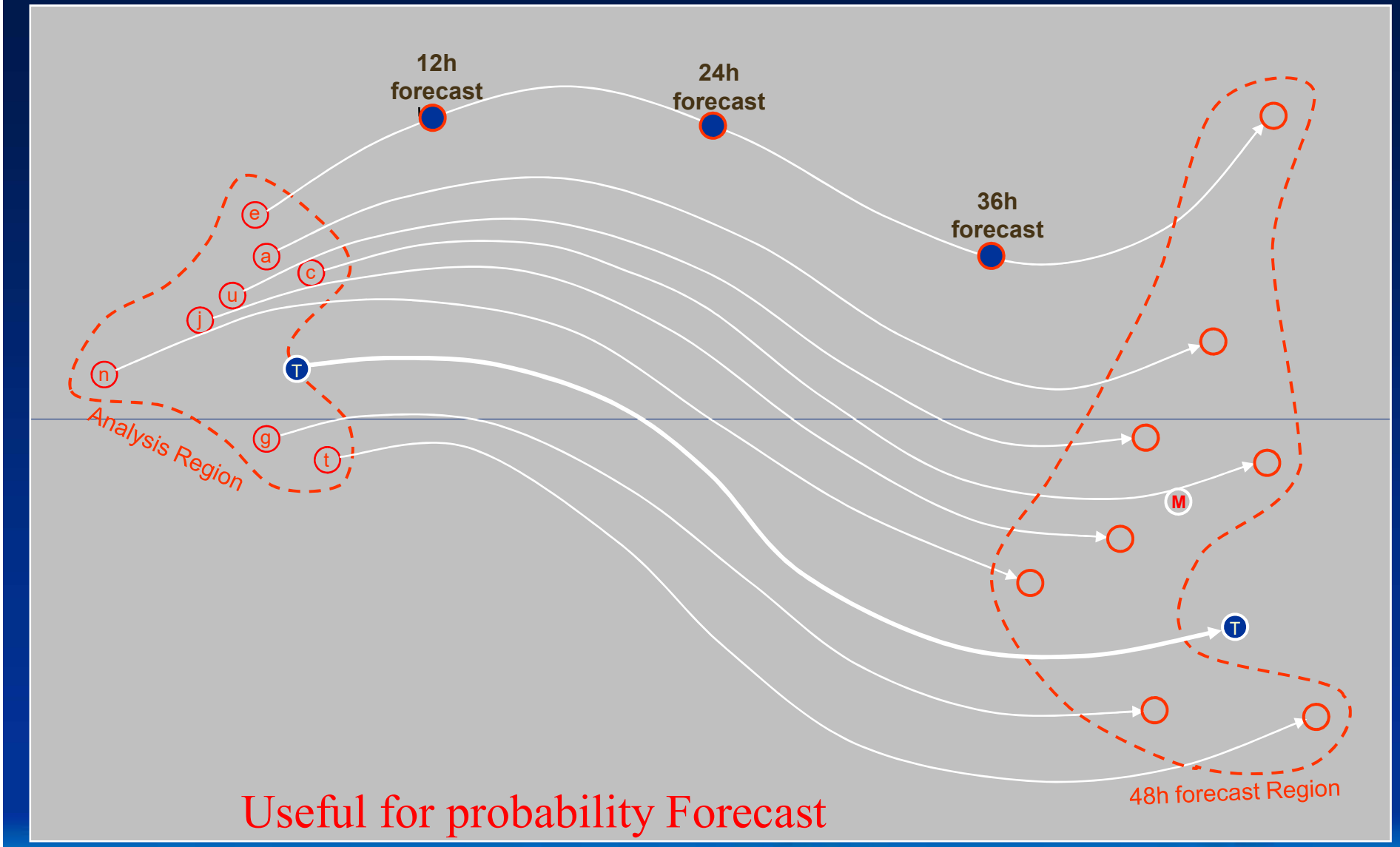
Classification of weather forecasting
मौसम पूर्वानुमान का वर्गीकरण

- Depending on the time-scale the monsoon prediction can be classified in to following four categories viz.,
- समय -सीमा पर निर्भर करते हुए मानसून की भविष्यवाणी को निम्नलिखित चार श्रेणियों में वर्गीकृत किया जा सकता है ।
- *Short range - Up to 3 days* लघु अवधि - 3 दिन तक
- *Medium range (up to 10 days in mid latitudes but can be upto 7 days in tropics)*
- मध्यम अवधि (मध्य अक्षांश में 10 दिन तक, लेकिन उष्णकटिबंधीय में 7 दिन तक हो सकता है)
- *Extended range or intra-seasonal (Beyond 7 days up to a month)* विस्तारित रेंज या इंट्रा-मौसमी (7 दिन से एक महीने तक का समय)
- *Long range or seasonal (one season)* दीर्घ अवधि या मौसमी (एक सीजन)

Tempo-spatial diagram of climatic phenomena and corresponding models



Single Model Ensemble Forecasting



Useful for probability Forecast

NWP model forecast products available in IMD
आई एम डी में एन डब्लू पी मॉडल पूर्वानुमान उत्पाद की उपलब्धता

NUMERICAL WEATHER PREDICTION DIVISION

HOME | SHORT RANGE FORECAST >> | MEDIUM RANGE FORECAST >> | EXTENDED RANGE FORECAST >> | SEASONAL FORECAST >>

CFSv2 >

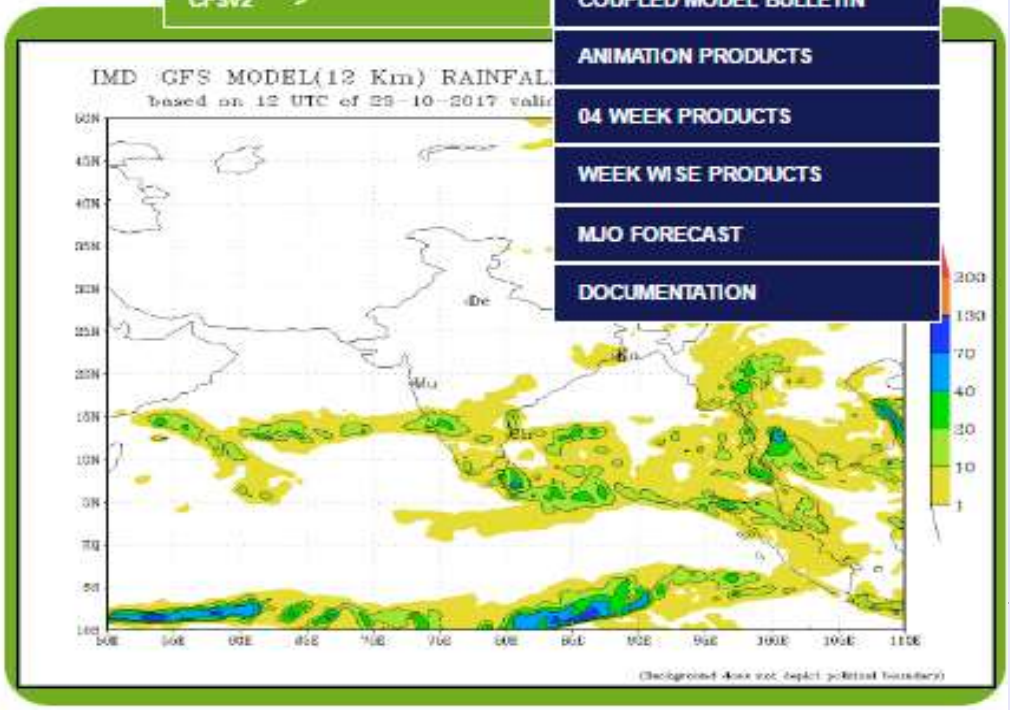
- COUPLED MODEL BULLETIN
- ANIMATION PRODUCTS
- 04 WEEK PRODUCTS
- WEEK WISE PRODUCTS
- MJO FORECAST
- DOCUMENTATION

NEW ...

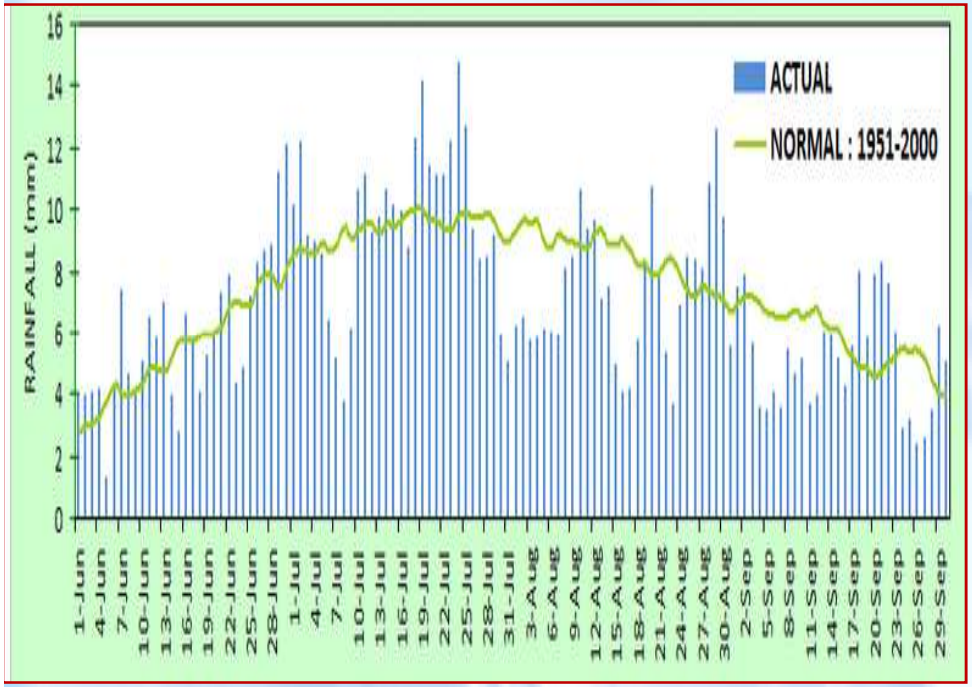
GFS RAINFALL DISTRIBUTION FORECAST new

GFS RAINFALL INTENSITY FORECAST new

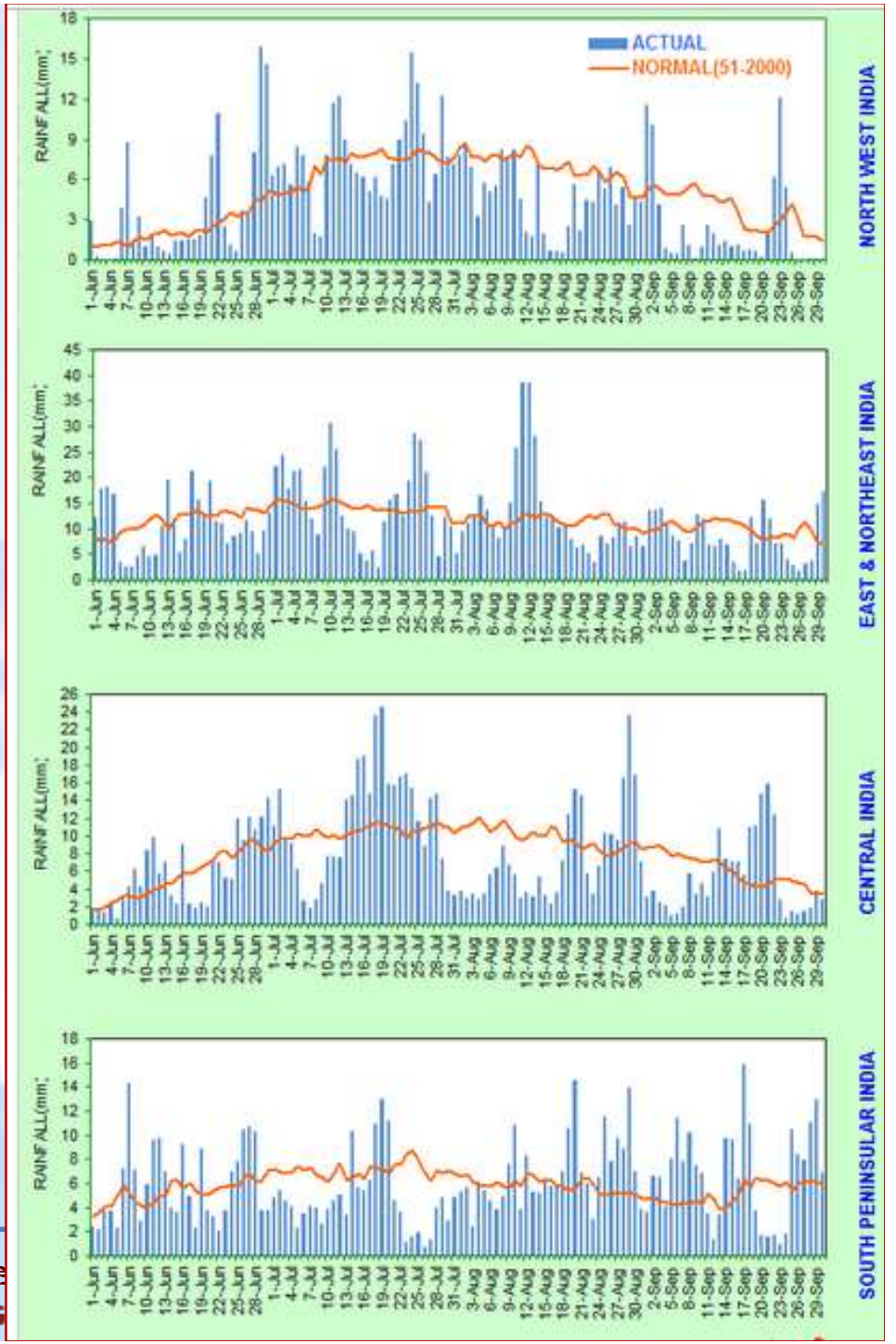
WRF HYSPLIT PRODUCTS new



Daily mean rainfall over India for the country as a whole and 4 homogeneous regions of India. (June to September 2017)



Country as a whole



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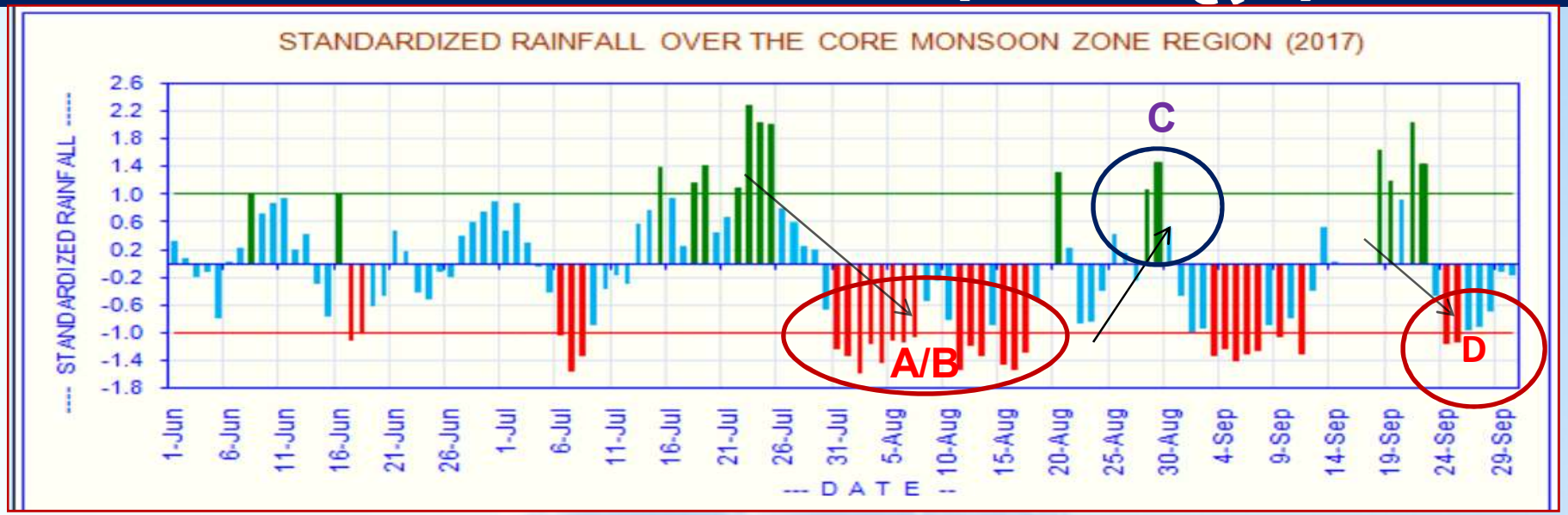
2017 Monsoon(मानसून)



- Transition from Active to Break Monsoon (From last week of July to 1st half of August) (A)
- Long dry spell of August (B) = 28 July to 17 August, 2017
- Weak to active transition - Heavy rainfall over Mumbai and adjoining region during last week of August (C)
- Dry spell of 1st half of September (D)

Active to Weak Transition (A)

❖ Based on 19th July, 2017

21-27 Jul (w1), 28 July -03 Aug (W2)

04-10 Aug (w3) 11-17 Aug (w4)

Based on 26 July, 2017

28 Jul -03 Aug (W1); 04-10 August (W2)

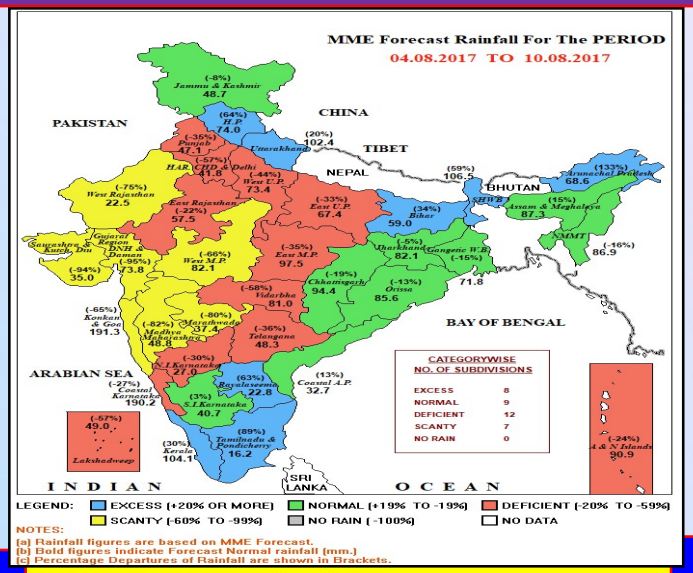
11-17 Aug (w3) ; 18-24 August (w4)

Based on 02 August, 2017

04-10 August (W1) ; 11-17 Aug (w2) ;

18-24 August (w3) ; 25-31 August (w4)

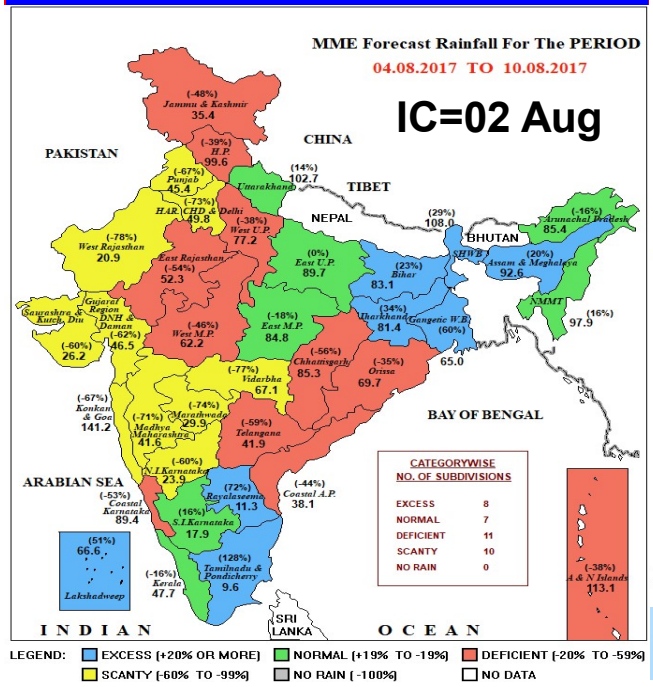
OBSERVED	(AISMR,	NE,	NW,	CE &	SP (%)
	-20.4	+25.8	-19.4	-49.8	3.1



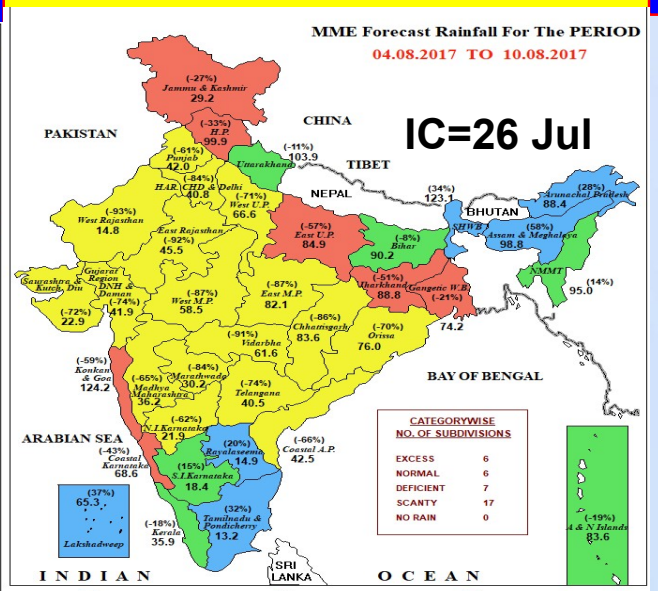
Observed Rainfall 04-10 Aug, 2017)

ERF FORECASTS

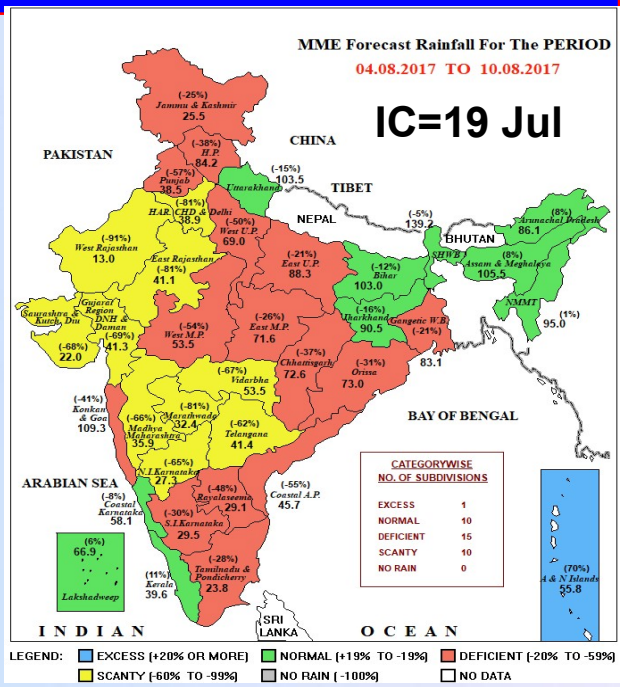
AISMR,	NE,	NW,	CE &	SP (%)
-25.7	20.8	-33.6	-49.6	-25.3



AISMR,	NE,	NW,	CE &	SP (%)
-45.4	9.8	-55.1	-79.7	-38.7



AISMR,	NE,	NW,	CE &	SP (%)
-32.5	-4.4	-41.8	-45.8	-40.5



Long dry spell of August (B)
अगस्त का दीर्घ शुष्क दौर
28 July to 17 August, 2017

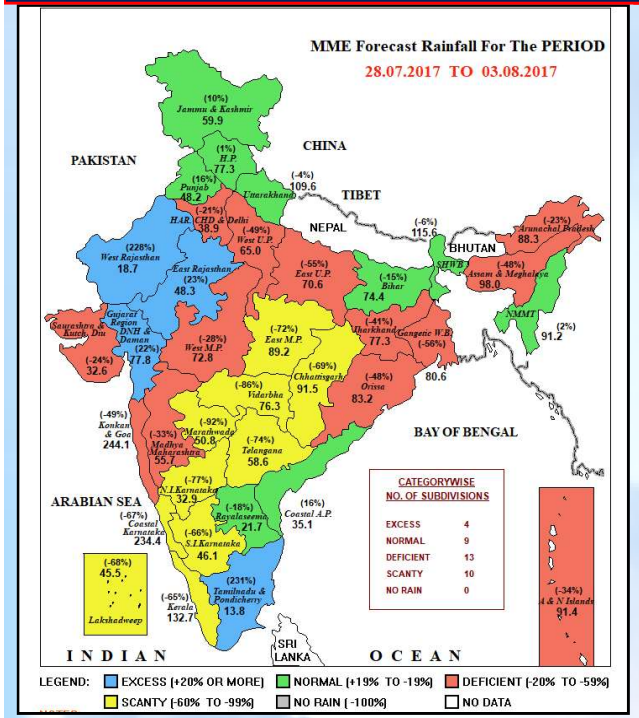
Based on 26 July, 2017

28 Jul -03 Aug (W1); 04-10 August (W2)

11-17 Aug (w3) ; 18-24 August (w4)

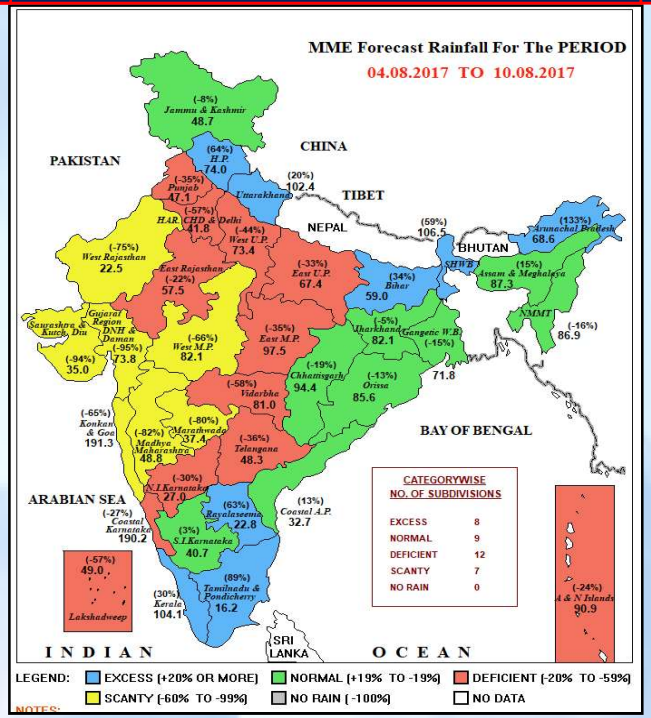
Observed Dry Spell (28 Jul-17 Aug)

AISMR	NE	NW	CE &	SP (%)
-29.9	-28.8	-4.2	-49.1	-39.2



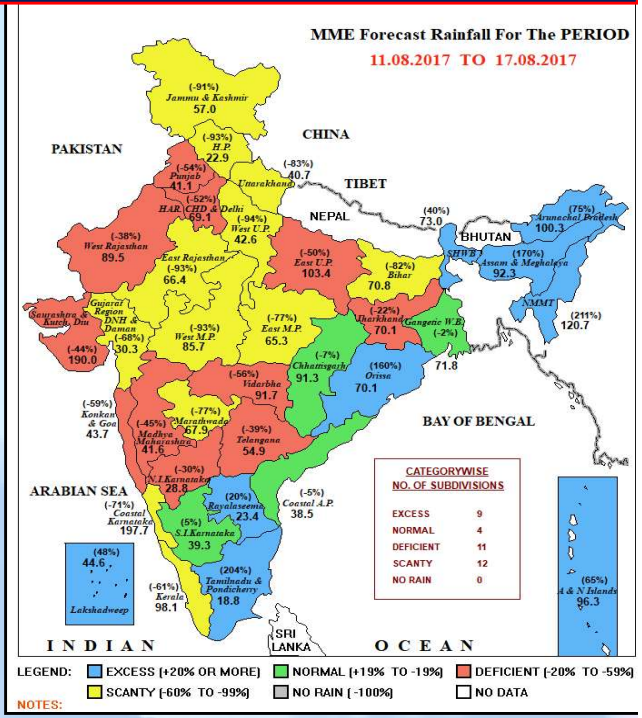
OBS
28 Jul-03 Aug

AISMR	NE	NW	CE &	SP (%)
-20.4	25.8	-19.4	-49.8	3.1



OBS
04-10 Aug

AISMR	NE	NW	CE &	SP (%)
-16.6	75.3	-65.4	-28.9	-8.0



OBS
11-17 Aug

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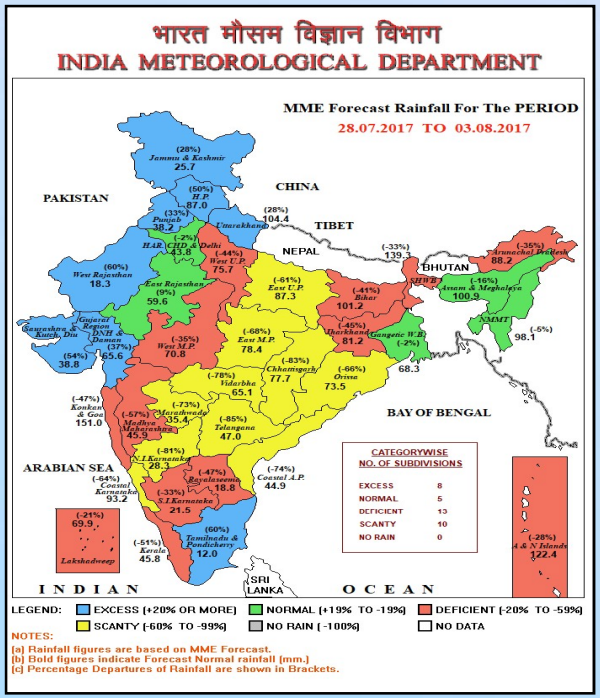
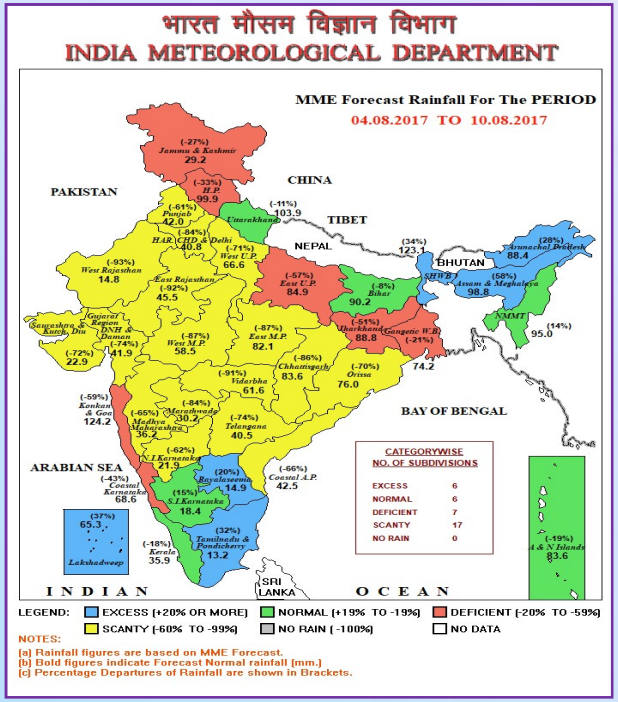
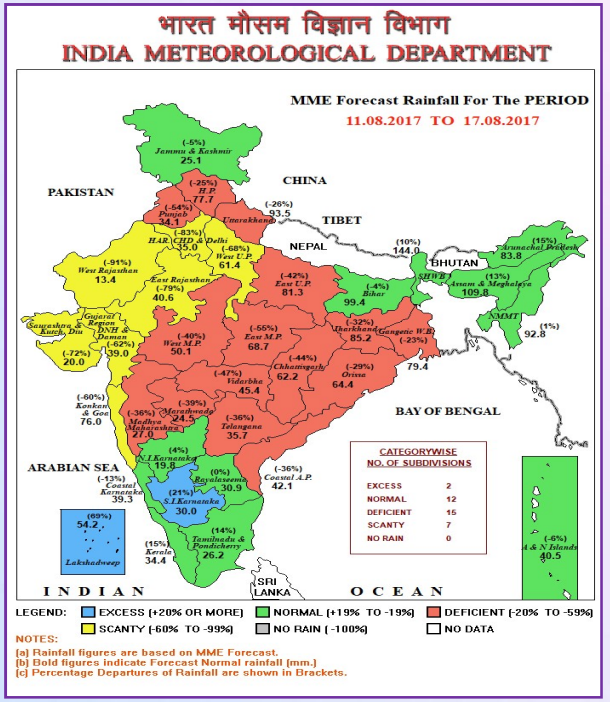
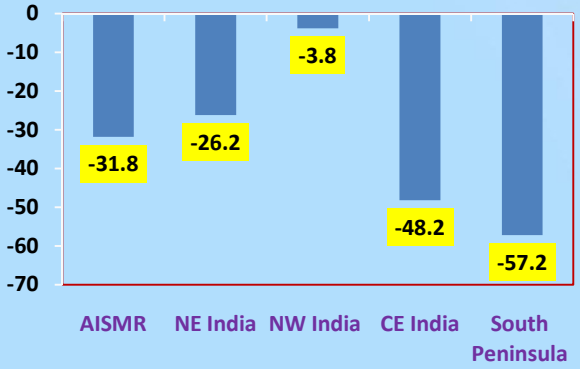
ERF Week 1 to Week 3 forecasts
based on IC : 26 July, 2017 (28 Jul-03 Aug, 04-10Aug, 11-17Aug)



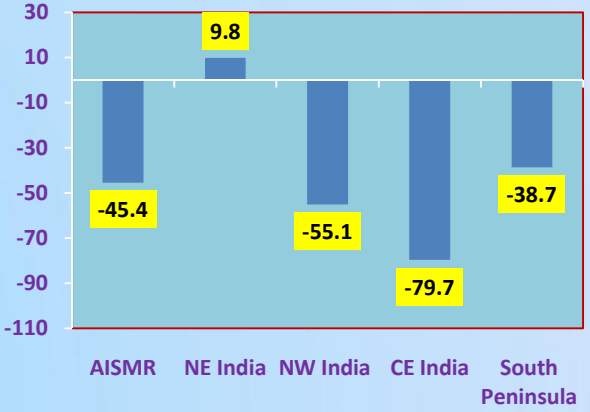




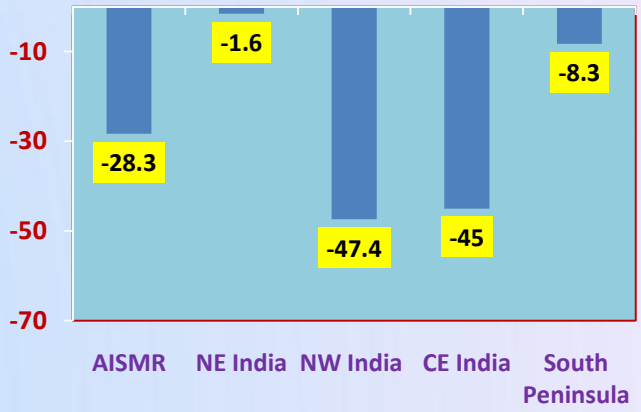
Week 1 (28 Jul-03 Aug)



Week 2 (04-10 Aug)



Week 3 (11-17 Aug)



Weak to Active Transition (C)

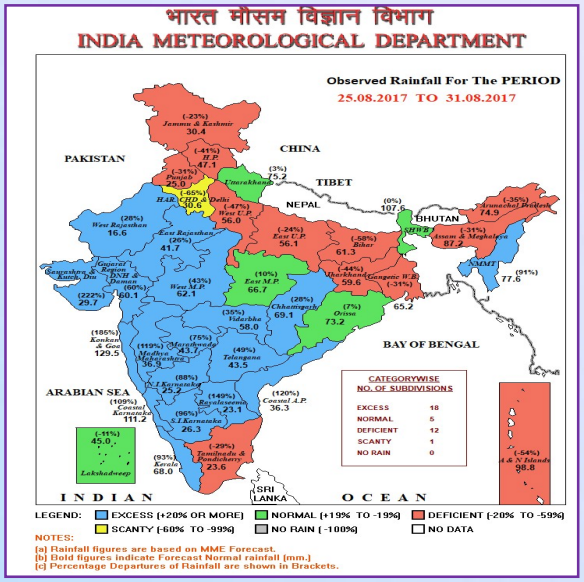
IC 23 August (Week 1 forecast)
25 Aug-31 Aug

IC 16 August (Week 2 forecast)
25 Aug-31 Aug

IC 09 August (Week 3 forecast)
25 Aug-31 Aug

IC 02 August (Week 4 forecast)
25 Aug-31 Aug

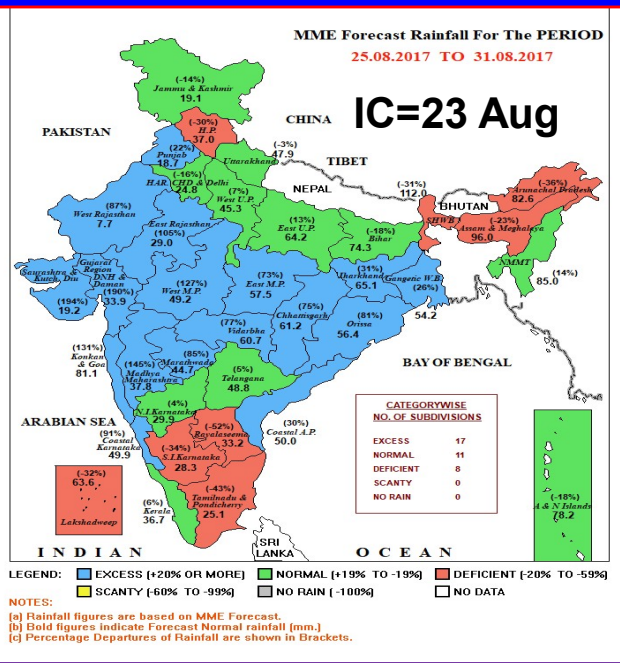
OBSERVED	(AISMR,	NE,	NW,	CE &	SP(%))
24.2		-17.6	-15.0	55.2	71.0



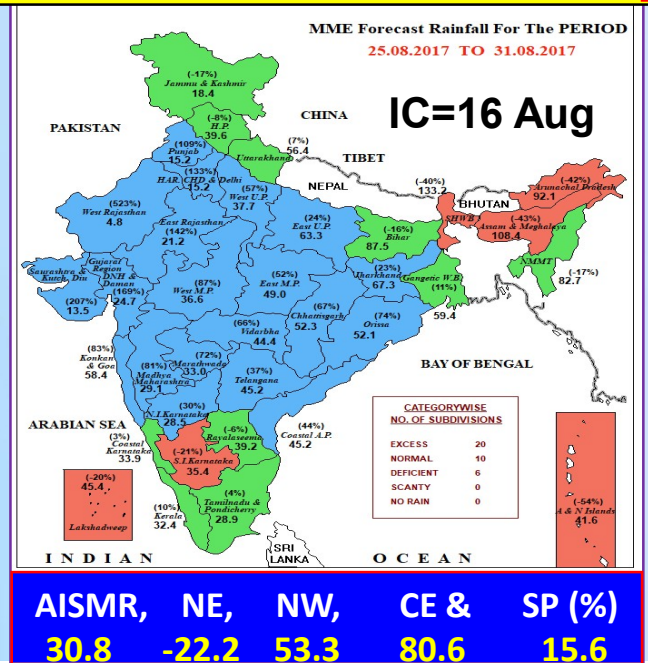
Observed Rainfall (25 – 31 Aug, 2017)

ERF FORECASTS

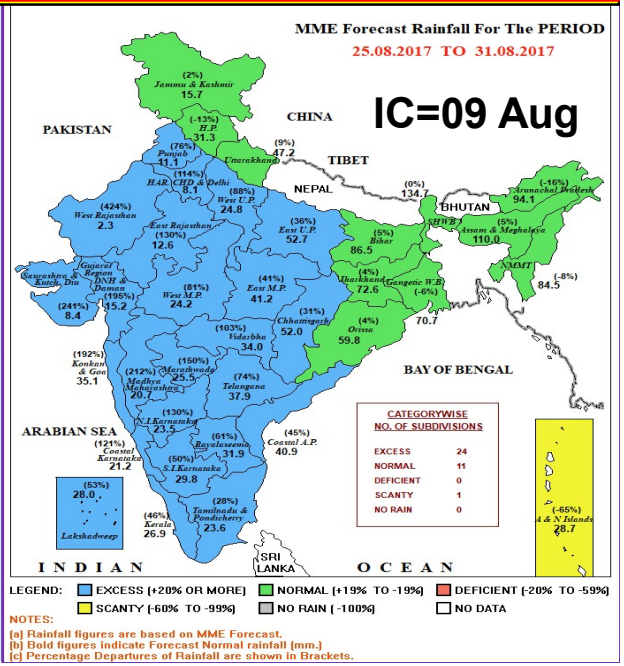
AISMR,	NE,	NW,	CE &	SP (%)
38.5	-8.6	19.7	103.6	-3.7



AISMR,	NE,	NW,	CE &	SP (%)
30.8	-22.2	53.3	80.6	15.6



AISMR,	NE,	NW,	CE &	SP (%)
37.7	-1.7	48.1	70.9	59.5



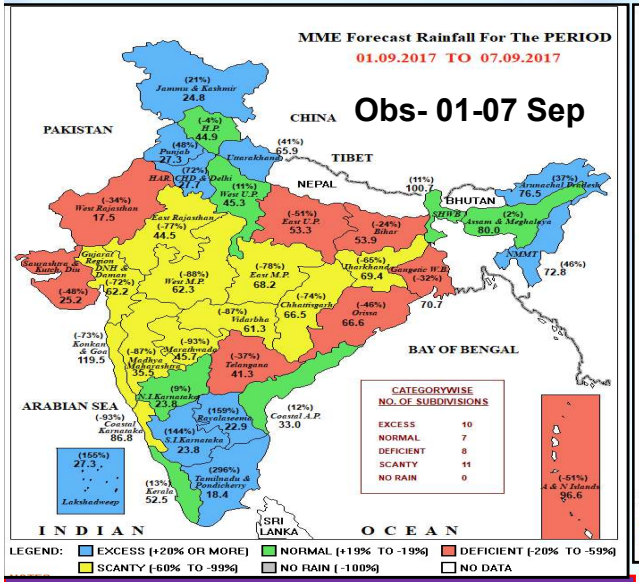
Dry spell of September (first half)
IC 30 August, 2017

ERF Forecast based on 30 August 2017

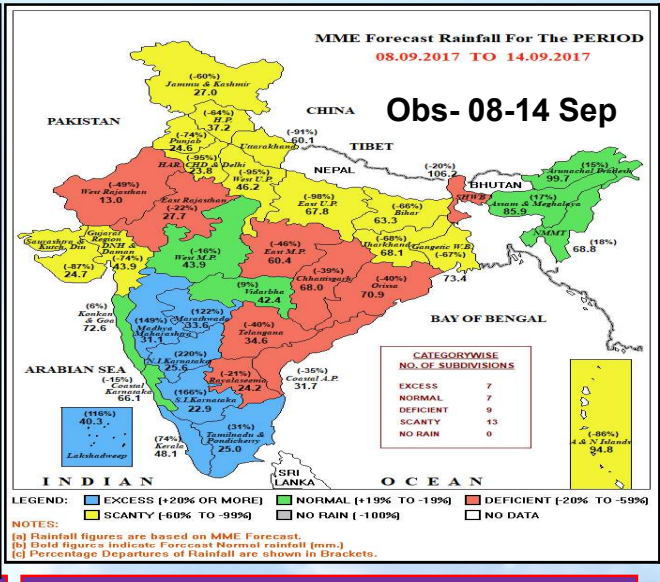
Model could predict the dry spell for first half of September, 2017 .
However, week 3 forecast valid for 15-21 September, 2017 could not capture the reviv

Met subdivision wise Predicted rainfall for 3 weeks (01-21 September), IC 30 August

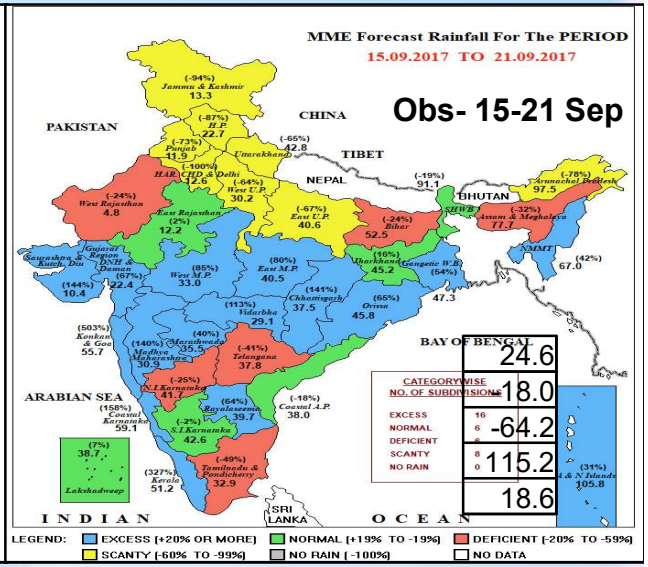
AISMR,	NE,	NW,	CE &	SP (%)
-28.0	-2.8	-15.8	-73.8	48.9



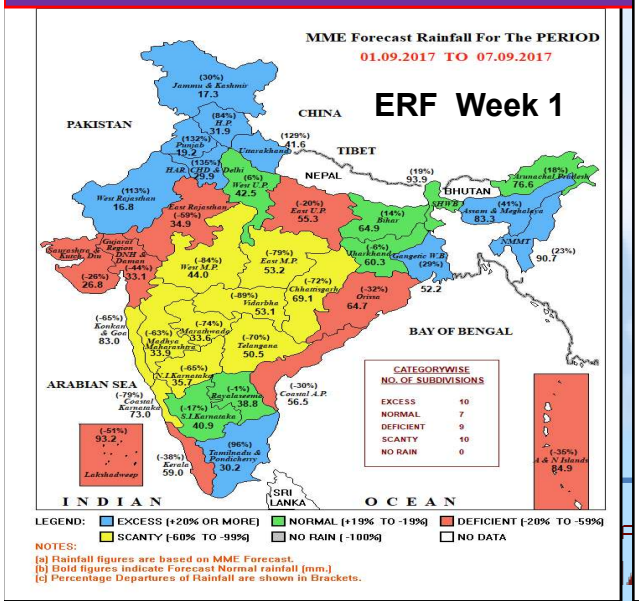
AISMR,	NE,	NW,	CE &	SP (%)
-24.4	-19.1	-74.8	-17.8	33.2



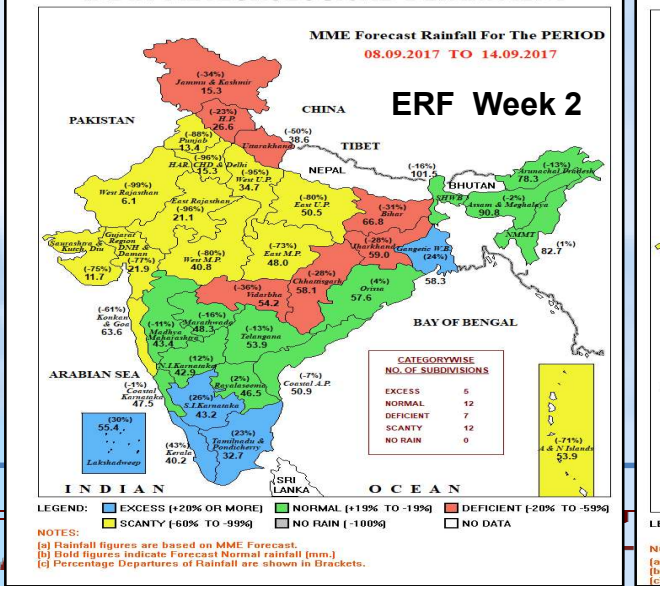
AISMR,	NE,	NW,	CE &	SP (%)
24.0	-18.0	-64.2	115.2	18.6



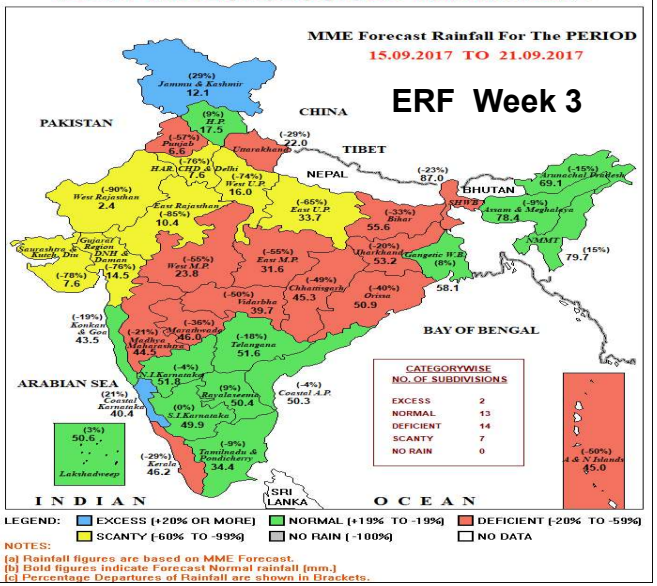
AISMR,	NE,	NW,	CE &	SP (%)
-16.5	21.2	25.5	-63.7	-22.9



AISMR,	NE,	NW,	CE &	SP(%)
-27.0	-9.5	-73.1	-38.2	5.7



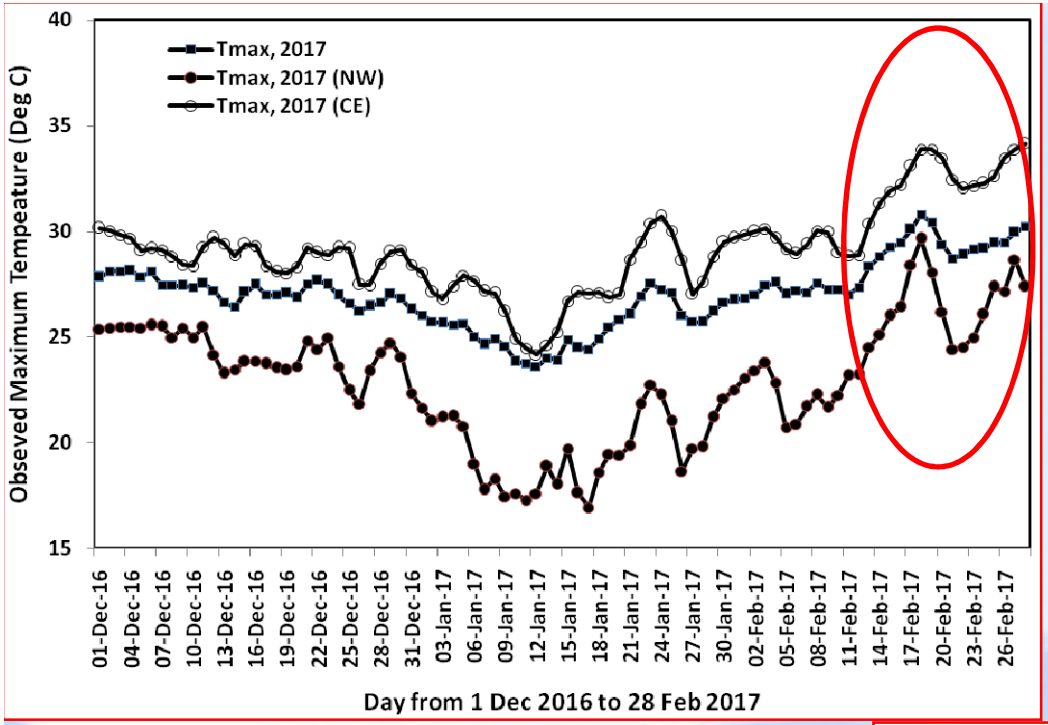
AISMR,	NE,	NW,	CE &	SP(%)
-24.1	-10.1	-43.1	-43.9	-6.7

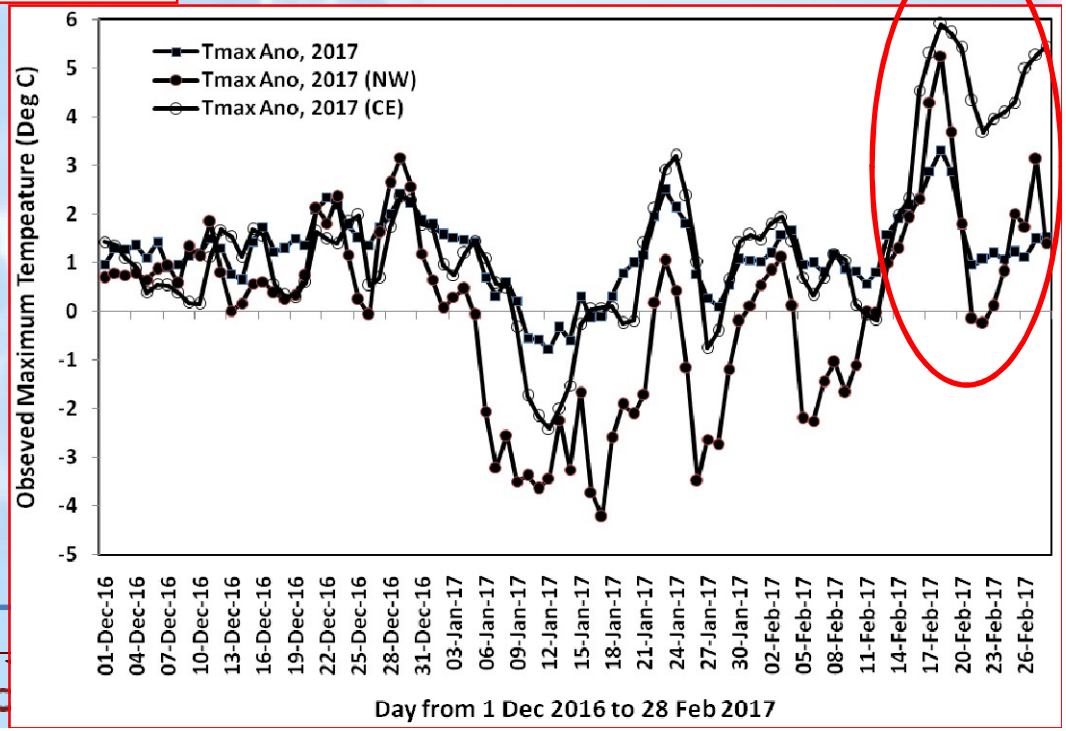


ABNORMAL WARMING DURING WINTER 2017
शीतकालीन 2017 के दौरान असाधारण वार्मिंग2017 के दौरान असाधारण गर्मी

Observed Winter Tmax

1 Dec 2016 -28 Feb, 2017





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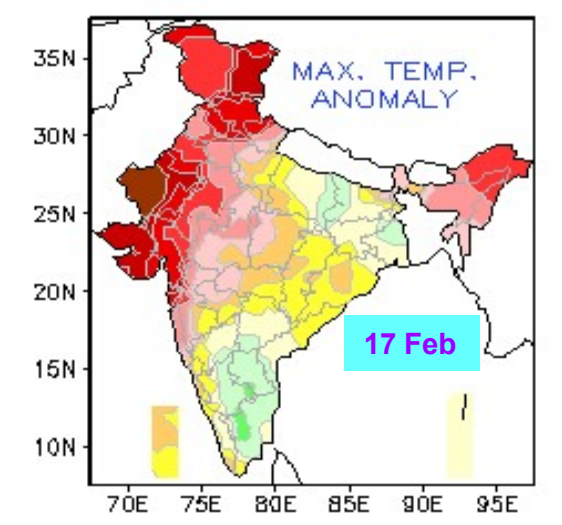
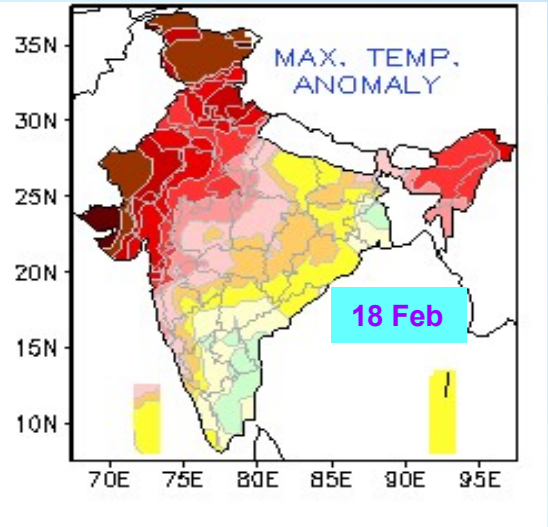
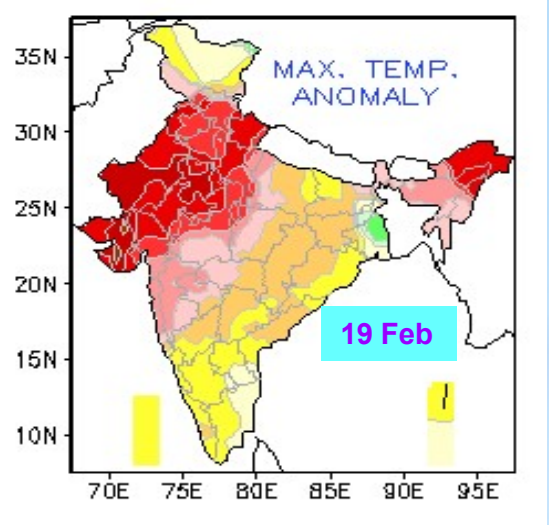
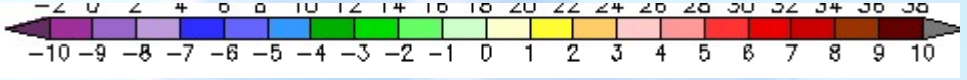
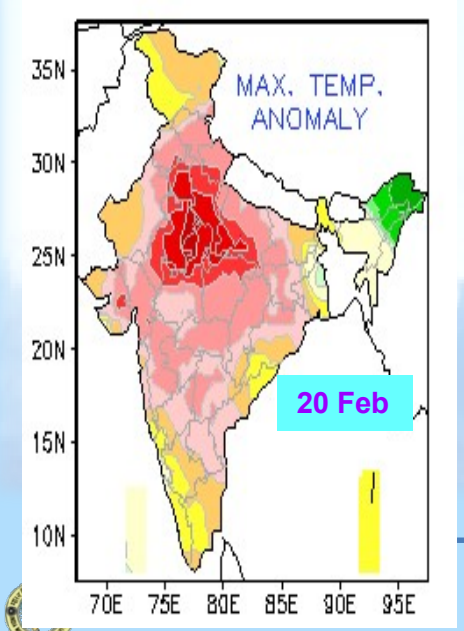
Observed Tmax anomalies (17 to 23 February, 2017)

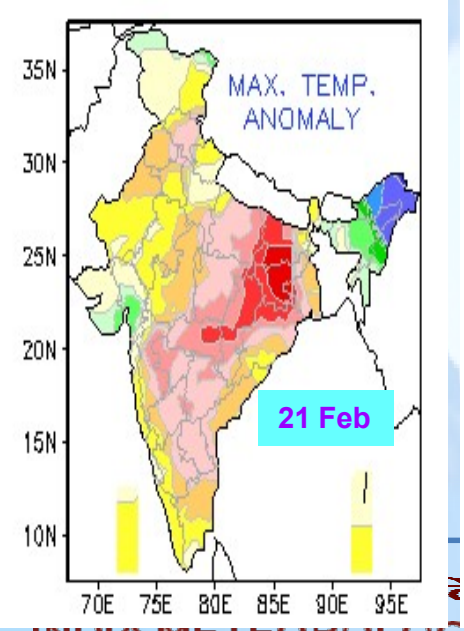


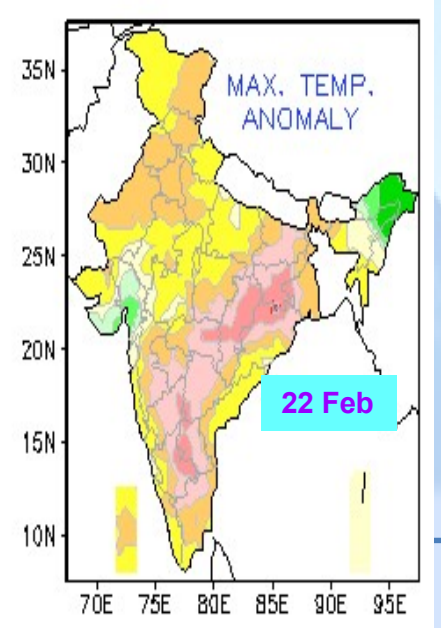


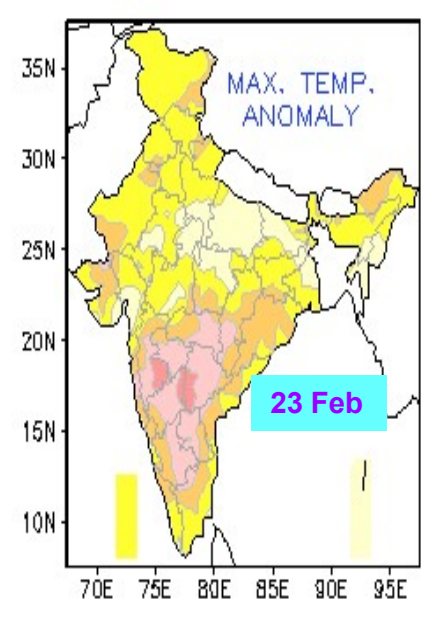


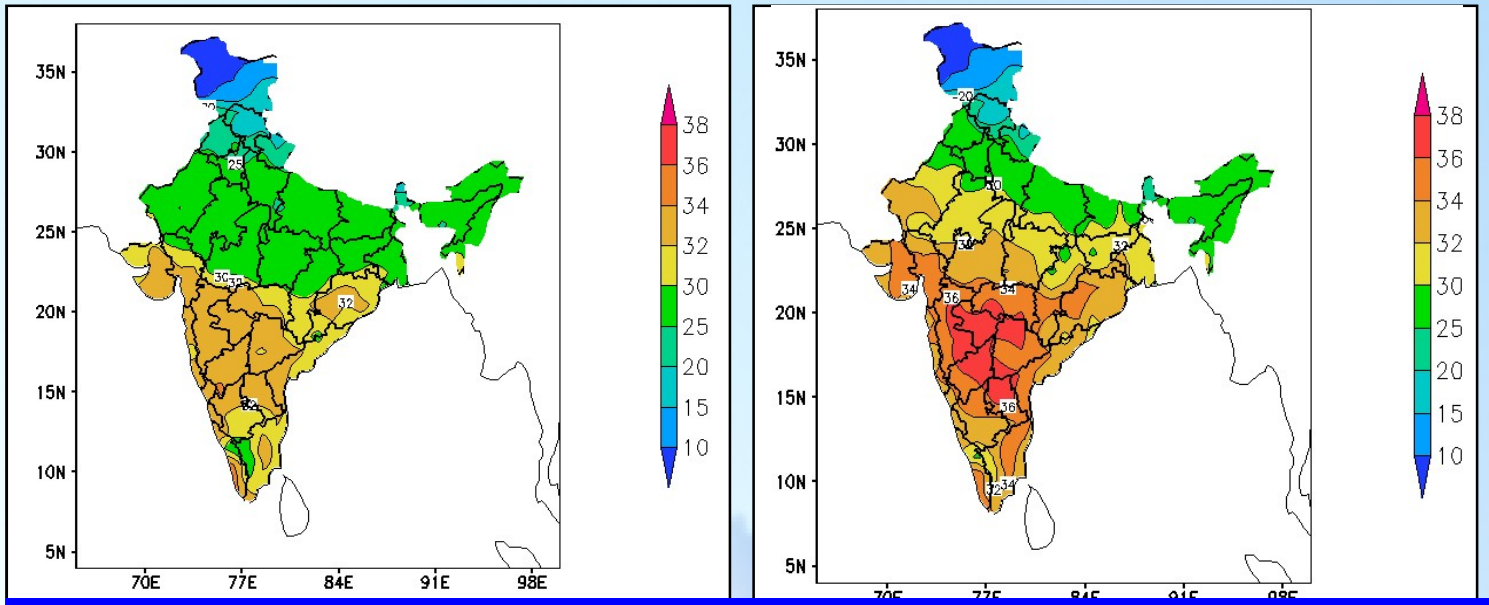




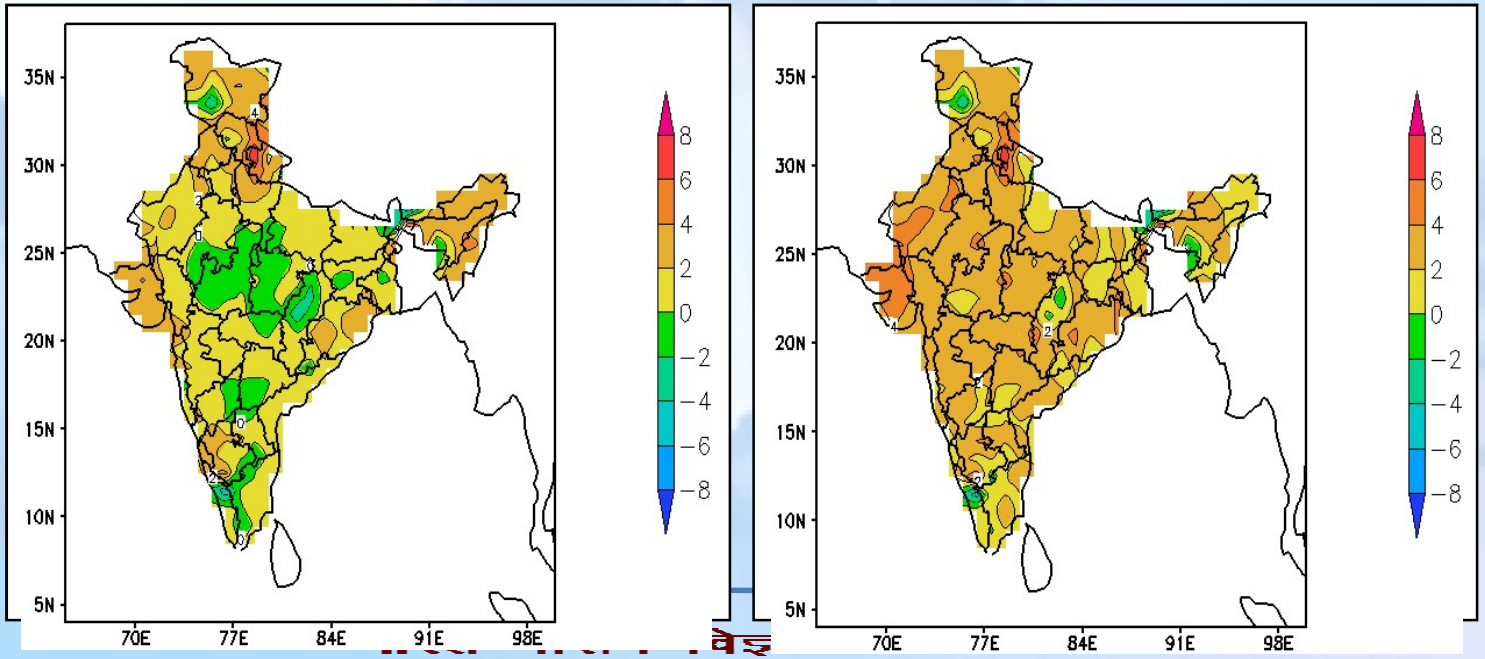




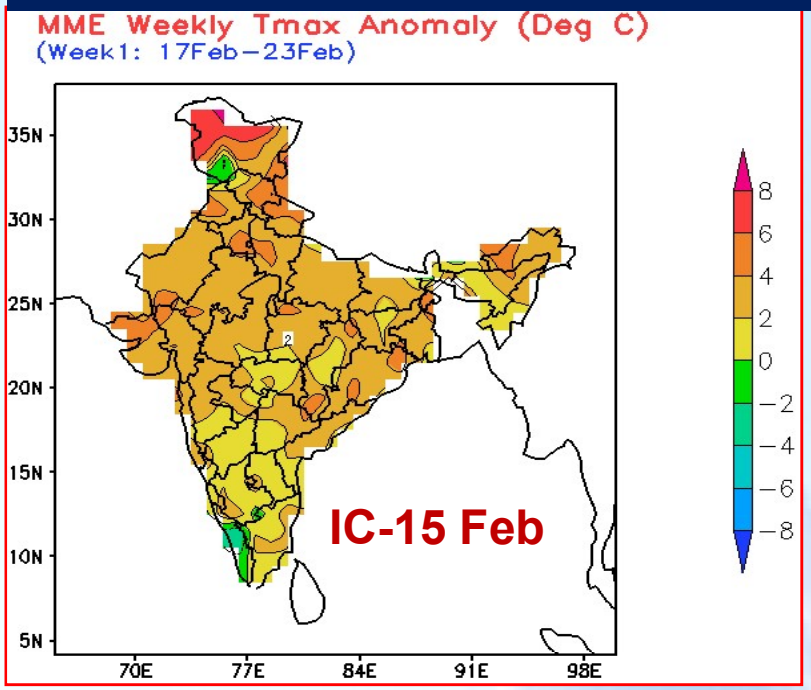


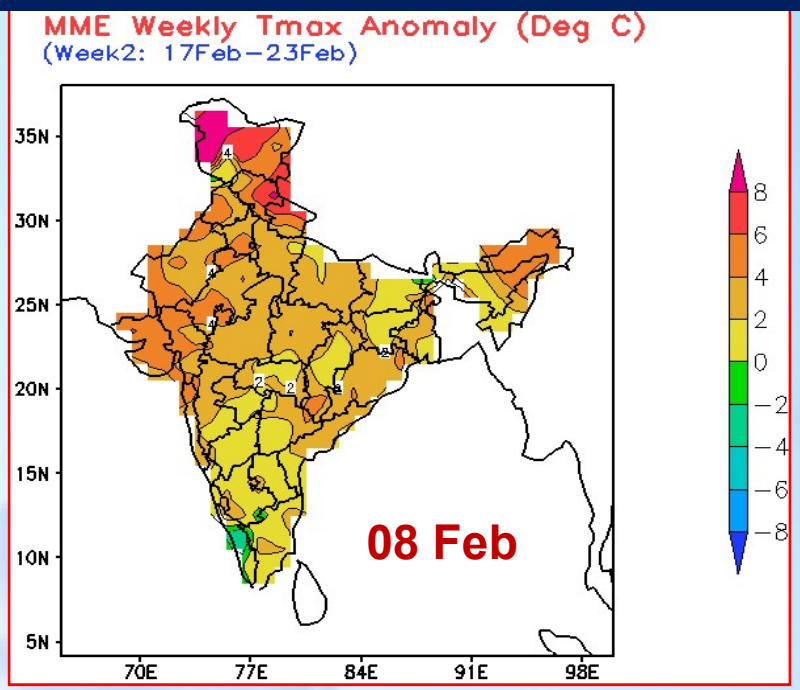


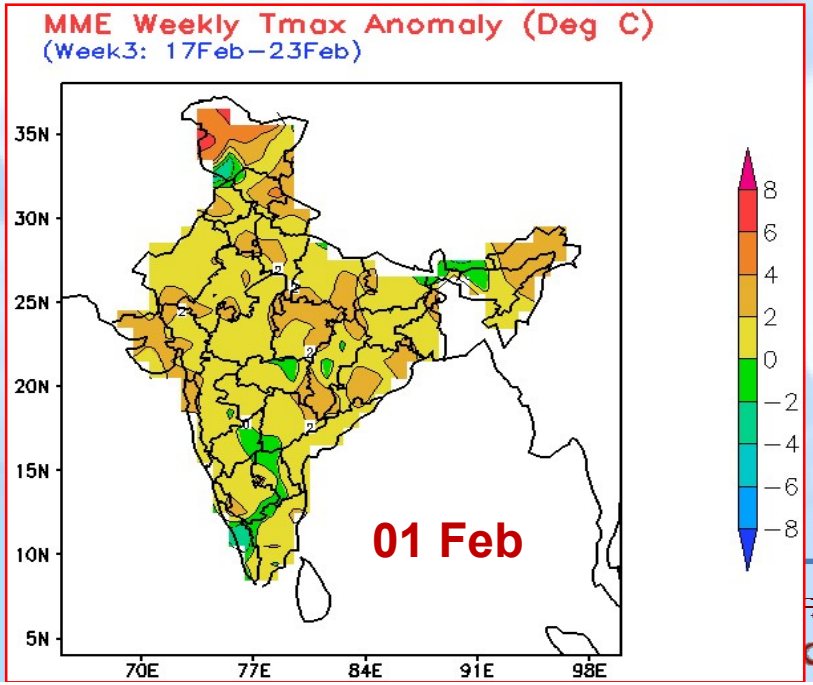
Observed Tmax and its anomaly (10-16 Feb, 17-23 Feb), 2017

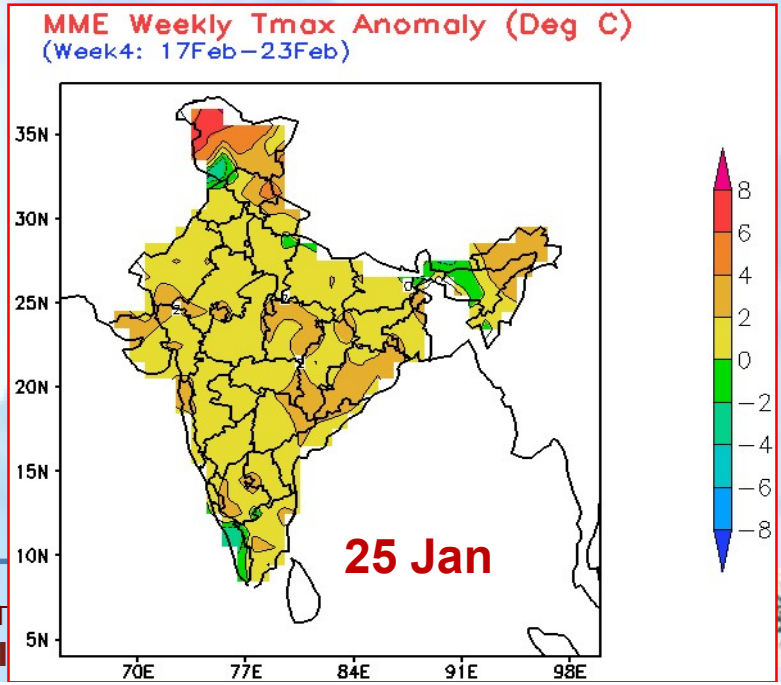


Operational Extended Range Forecast with different lead time









Summary
सारांश

- NWP and Coupled models are gradually improving : Thus, Increased use of dynamical model forecast (downscaling, multi-model ensemble) for operational use.

- Medium and Extended range forecast can provide useful guidance for various sectors (Hydrometeorology, Agriculture, Power etc) .

THANK YOU

धन्यवाद