

Extended Range Prediction of Monsoon 2015



Presented By

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N. Borah, Saranya. G**

Highlights:

- 1. Development of the IITM CGEPS System.**
- 2. Performance of CGEPS during 2015 Summer Monsoon Season.**
- 3. Hindcast skill for NEM regions.**

**IITM strategy for Extended Range Prediction
using NCEP CFSv2**

(15-20 day prediction/3-4 pentad prediction)

Time Line of development of IITM ERPS using CFSv2

2011: EPS developed, [Abhilash etal., 2014, IJOC]



2012: Bias Correction of CFS forecasted SST implemented

[Abhilash etal., 2014, ASL; Sahai etal., 2013, Cur. Sci.]



2013: High Resolution CFST382 implemented

[Sahai etal., 2014, CD; Borah etal, 2014, IJOC]



2014: CFS based Grand EPS Implemented

[Abhilash etal., 2015, JAMC; Sahai etal., 2015, Cur. Sci]



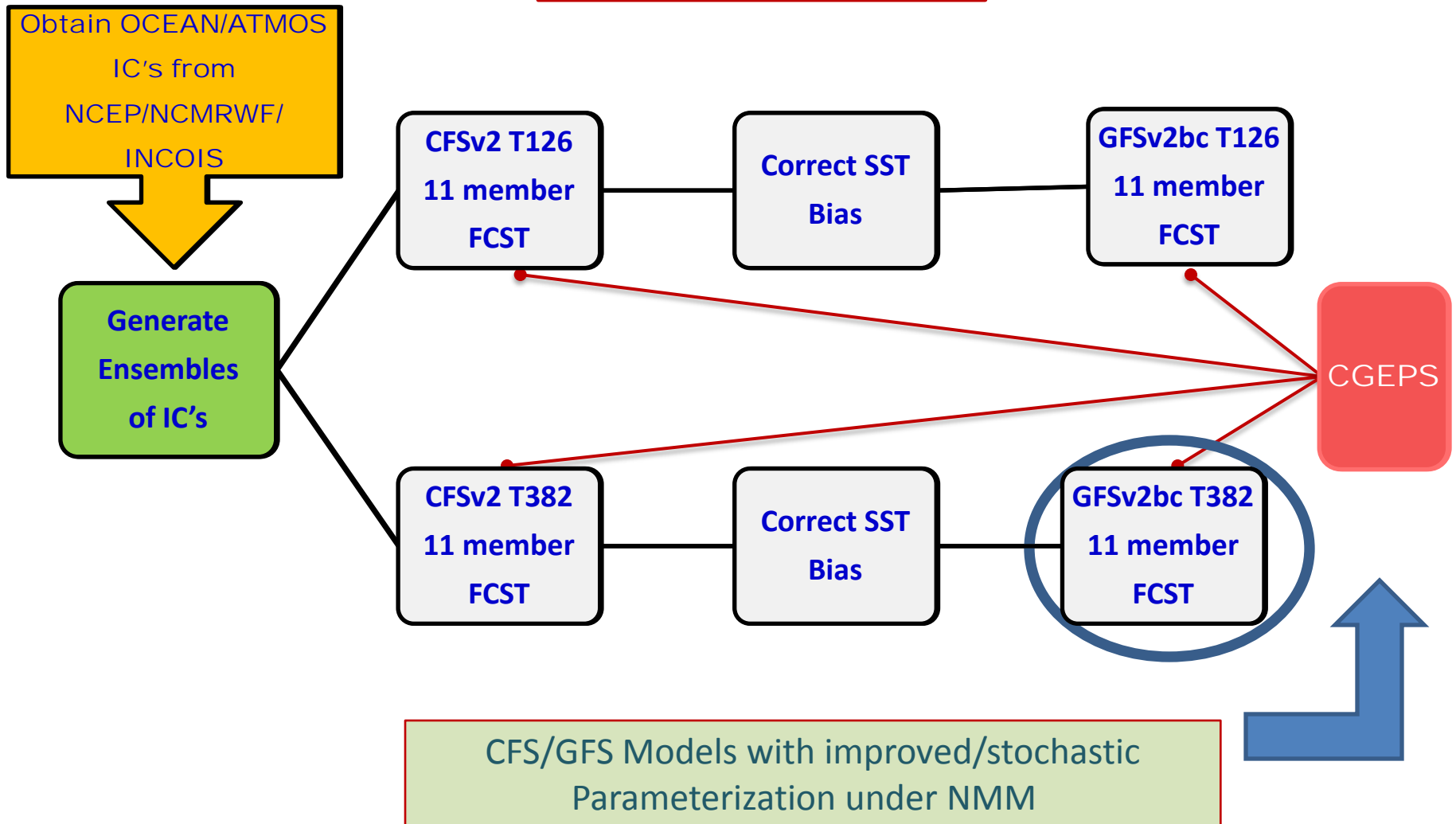
2015: Forecast for winter and other seasons started



[Applications: **Onset Prediction:** Joseph etal, 2014, JC; **Uttrakhand Heavy Rainfall:** Joseph etal, 2014, CD; **Skill of CFST126:** Abhilash etal., 2014, CD; **Comparison 2013 and 2014 June extremes:** Joseph etal., QJRMS, 2015]

Towards the development of CFS Grand Prediction System (CGEPS) (Abhilash et al., 2015, JAMC)

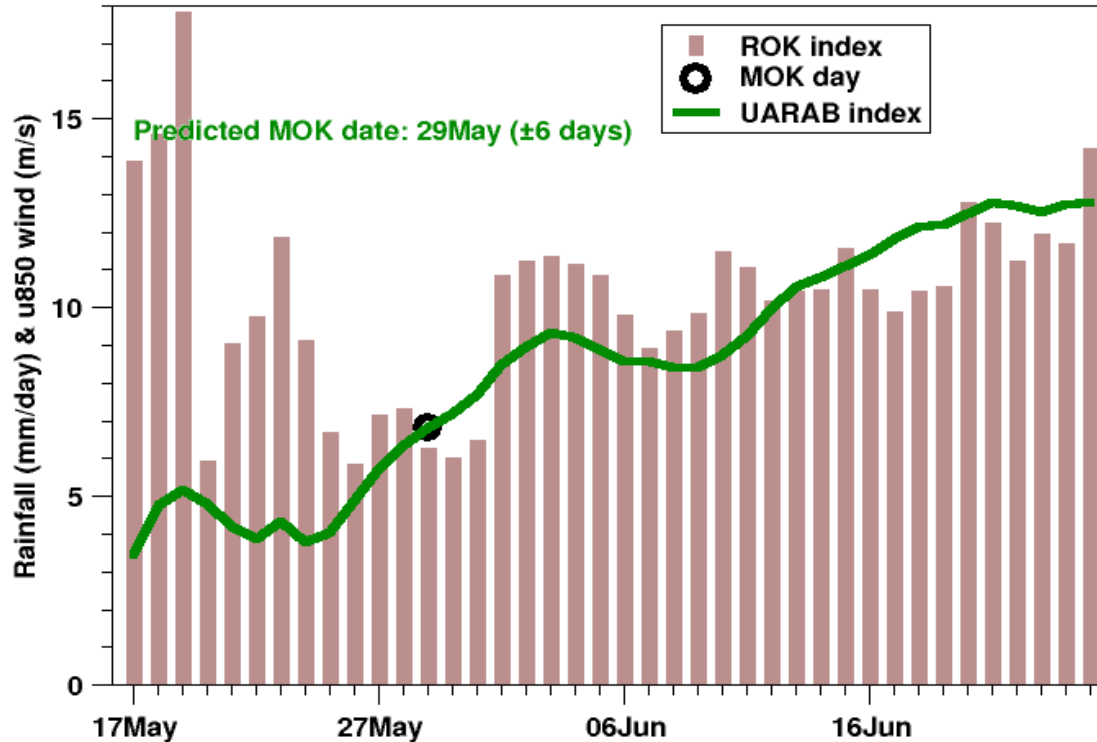
Forecast Strategy for 2015



Highlights ERP during of 2015 Summer Monsoon

The evolution of rainfall and low level wind indices used for predicting the MOK date

2015

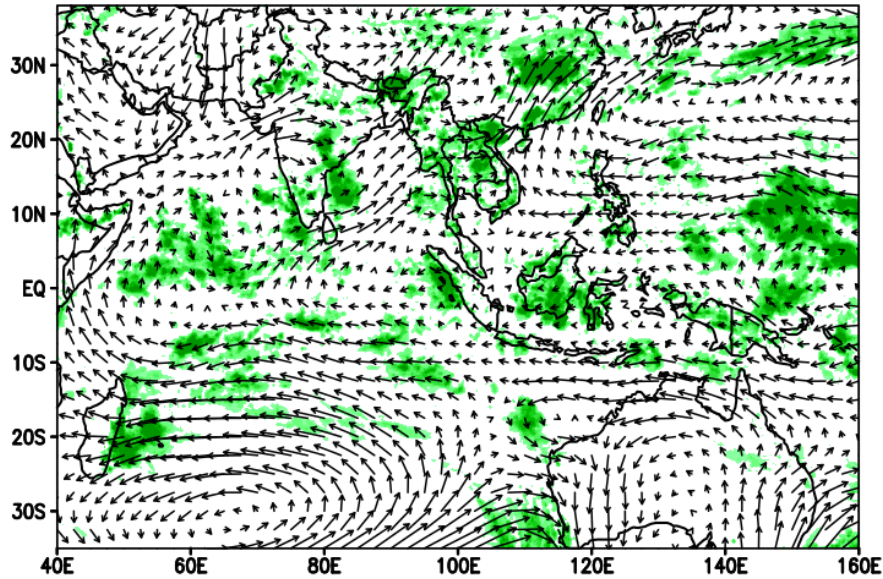


- **ERPAS predicted the MOK date from 16 May initial conditions to be 29 May**
- **ISM made its onset over Kerala on 04 June, 4 days after its normal date**

This may be attributed to the increased rainfall over Kerala due to the pre-monsoon thundershowers, which the model predicted realistically.

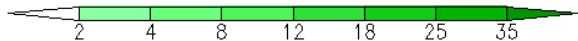
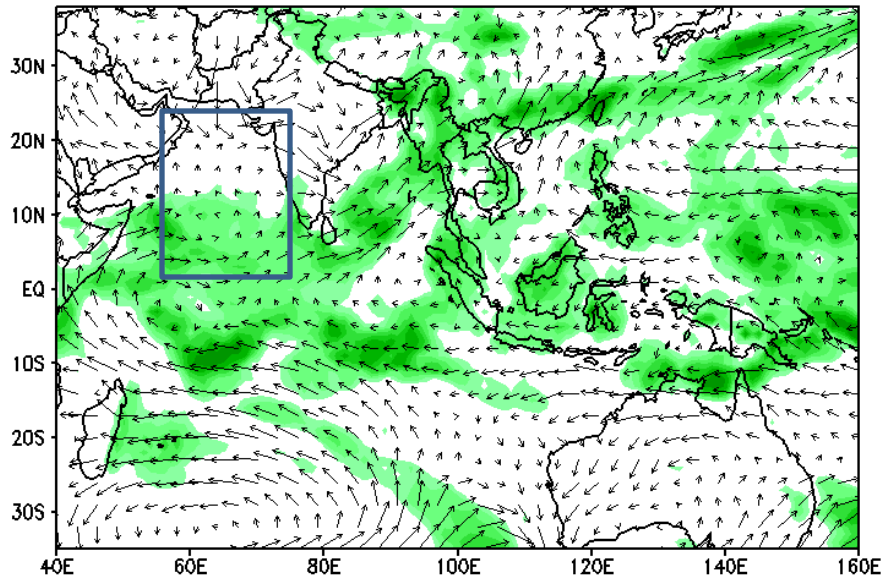
OBS, Time = 00Z01JUN2015

Rainfall (shaded, mm/day) & 850hPa winds (vector, 20°)



MME, Forecast Valid Time = 00Z01JUN2015

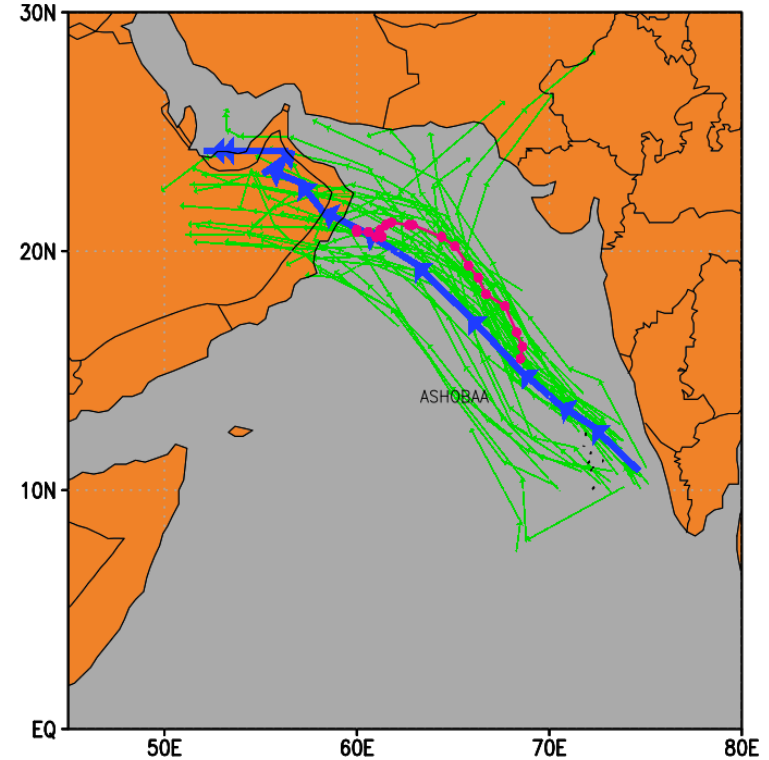
Rainfall (shaded, mm/day) & 850hPa winds (vector, 20°)



Movement of Cyclone “Ashobaa” during Onset phase

IC: 0531

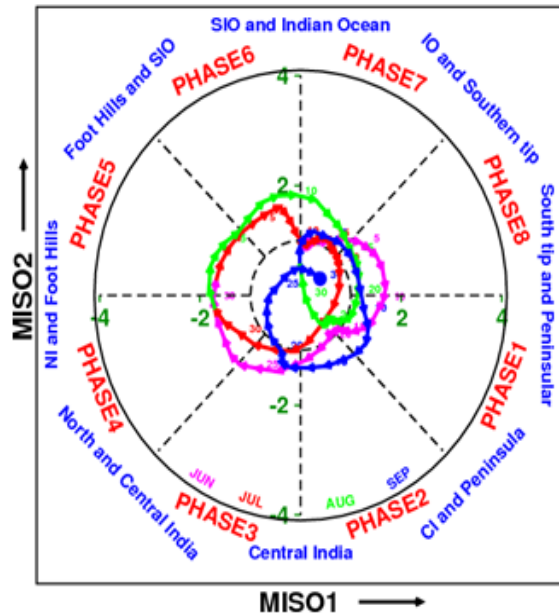
Fcst from IC=20150531



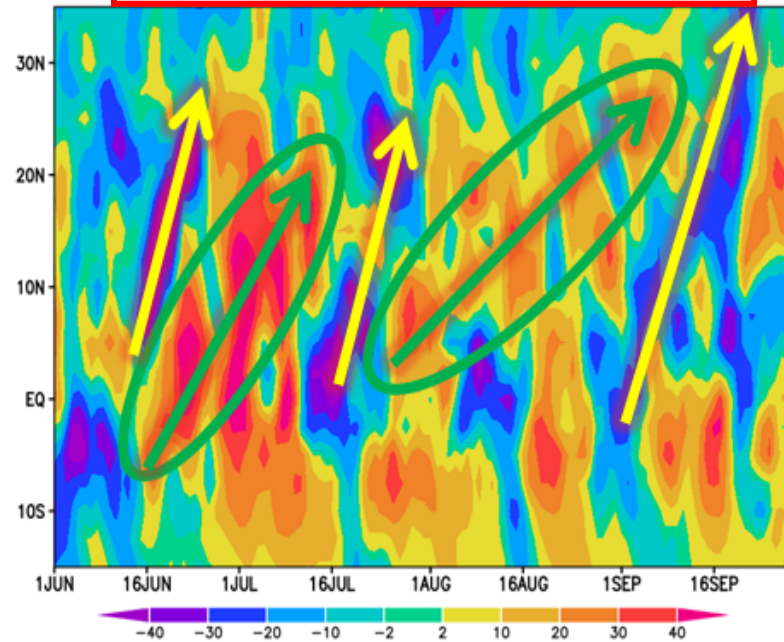
Low Pressure System (LPS) over southern tip of peninsula is likely to intensify and move towards Oman coast. This system may dissipate around 11th June and till then the monsoon activity will be weaker than normal over India.

N-S Propagation

(a) Real Time monitoring of 2015



(b) OLR* Anomaly <60-95E>



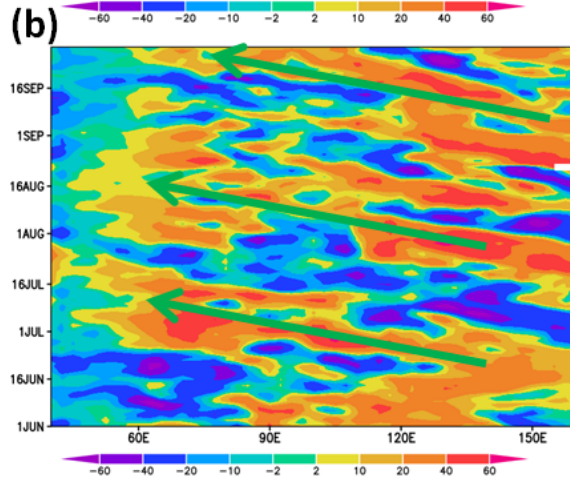
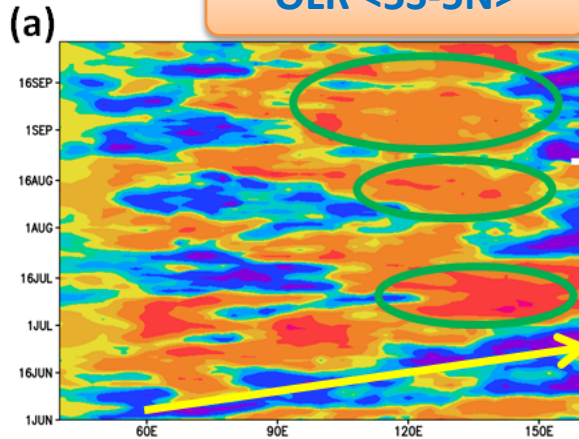
Fast Propagation of enhanced Convection anomalies of short duration during WM

REF: Asymmetry in space-time characteristics of Indian summer monsoon intraseasonal oscillations during extreme years - Role of seasonal mean state
(Sharmila et al. 2015)

SM → Slow (fast) propagation during active (break) phase
WM → Fast (slow) propagation during active (break) phase

E-W Propagation and MJO

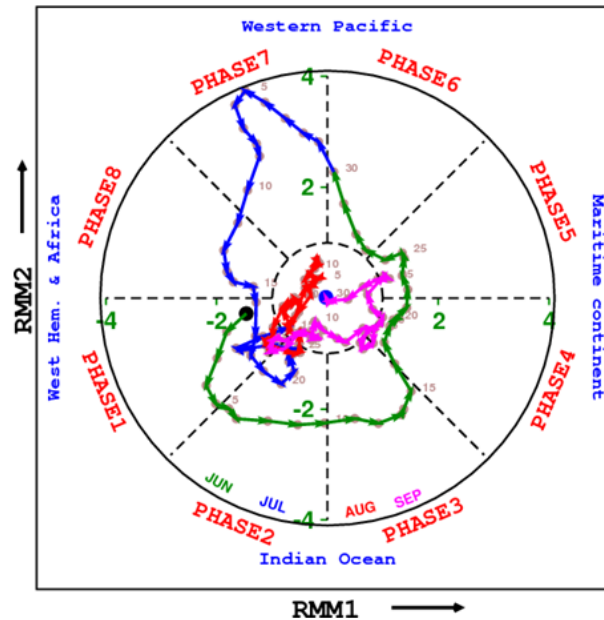
OLR <5S-5N>



OLR <10-25N>

**MJO Phase and Monsoon: 70% Active (Phase 3-6)
83% Break(Phase 7,8,1,2) Pai et al, 2011**

(c) Real Time MJO monitoring of 2015 JJAS

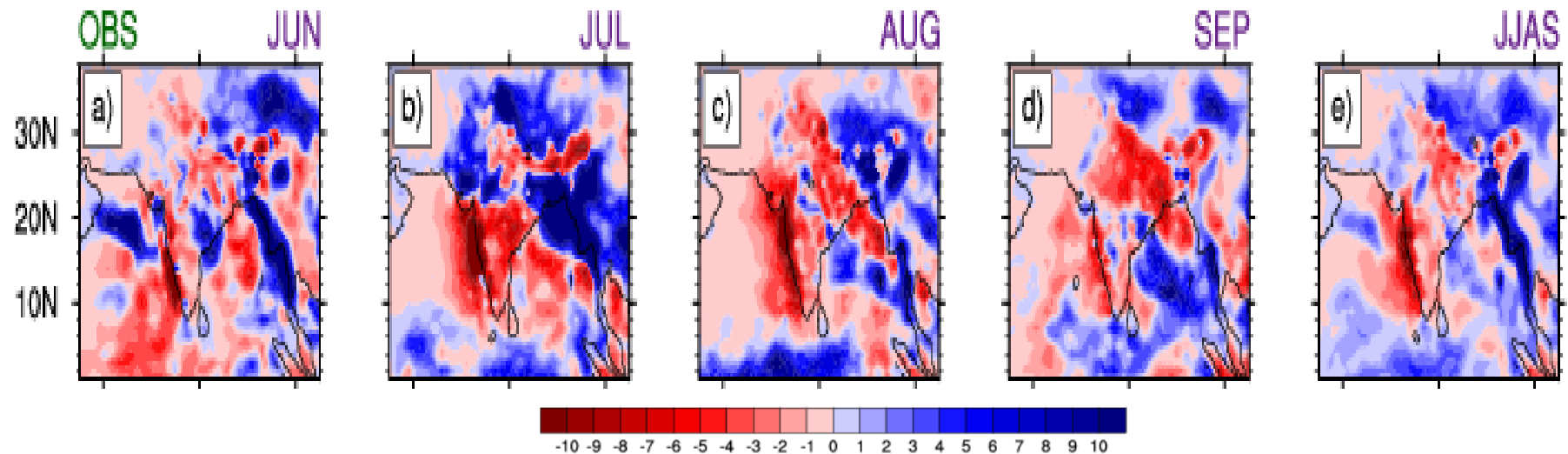
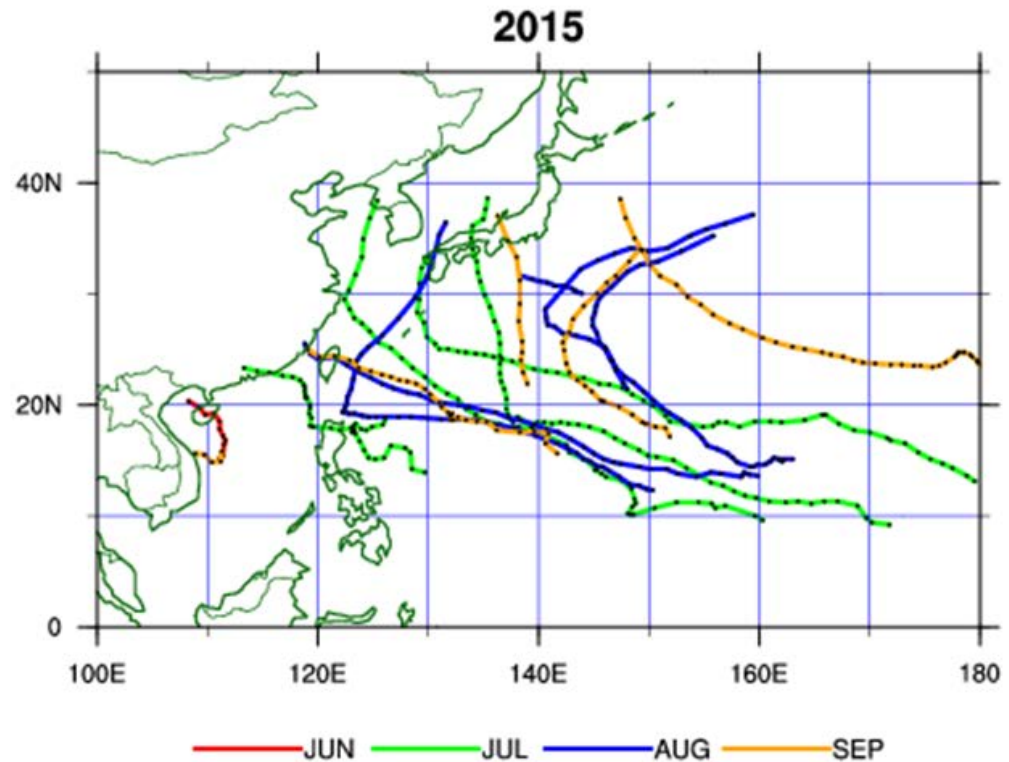


During very long breaks, eastward propagating MJO is strong in the equatorial region during VLB, similar to the one present in winter; and this eastward propagating MJO seems to generate westward moving divergent Rossby waves between 10° and 25° N, which in turn couple with the northward propagating break anomalies and in turn leads to the sustenance of breaks.

Suppressed convection phase of MJO was prevalent in the equatorial region, favouring/enhancing the break situation over Central India, as proposed by Joseph et al. (2009).

Linkage of WP storms and Indian Monsoon

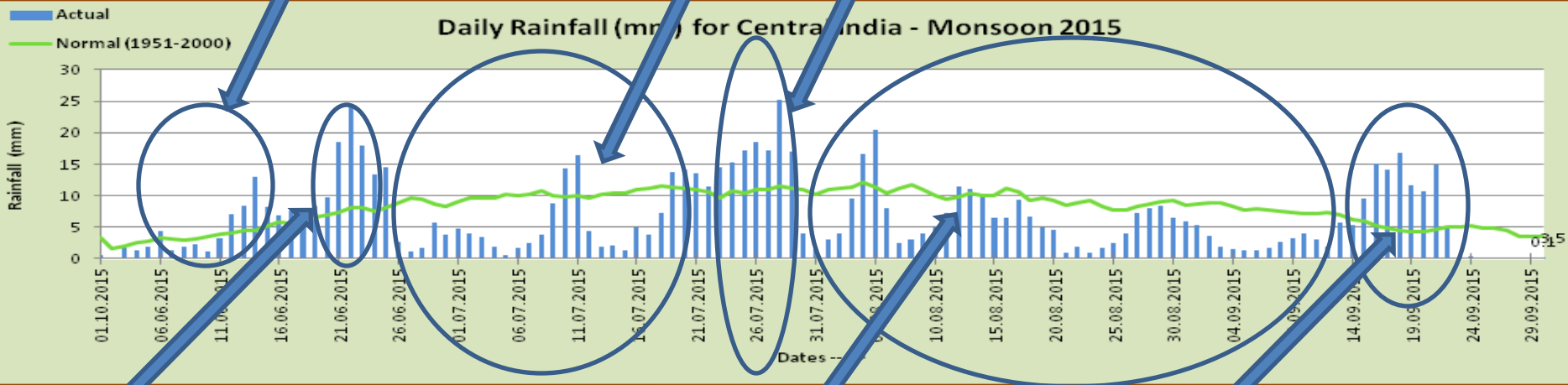
Ref:
Krishnamurti et al (1977)
Rajeevan (1993)
Vinay Kumar et al (2005)
Mujumdar et al (2007)
Pattnaik and Rajeevan (2007)



0531: Low Pressure System (LPS) over southern tip of peninsula is likely to intensify and move towards Oman coast. This system may dissipate around 11th June and till then the monsoon activity will be weaker than normal over India.

0620: There will be a large scale reduction of rainfall during 1st half of July.

0710: Large scale monsoon activity is expected to increase by the end of July resulting in revival of monsoon.

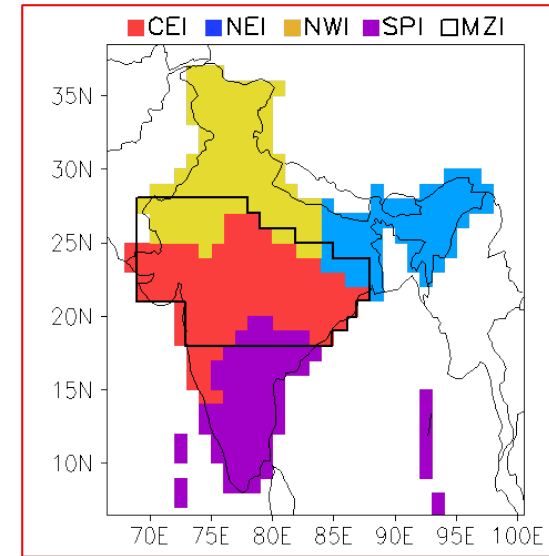
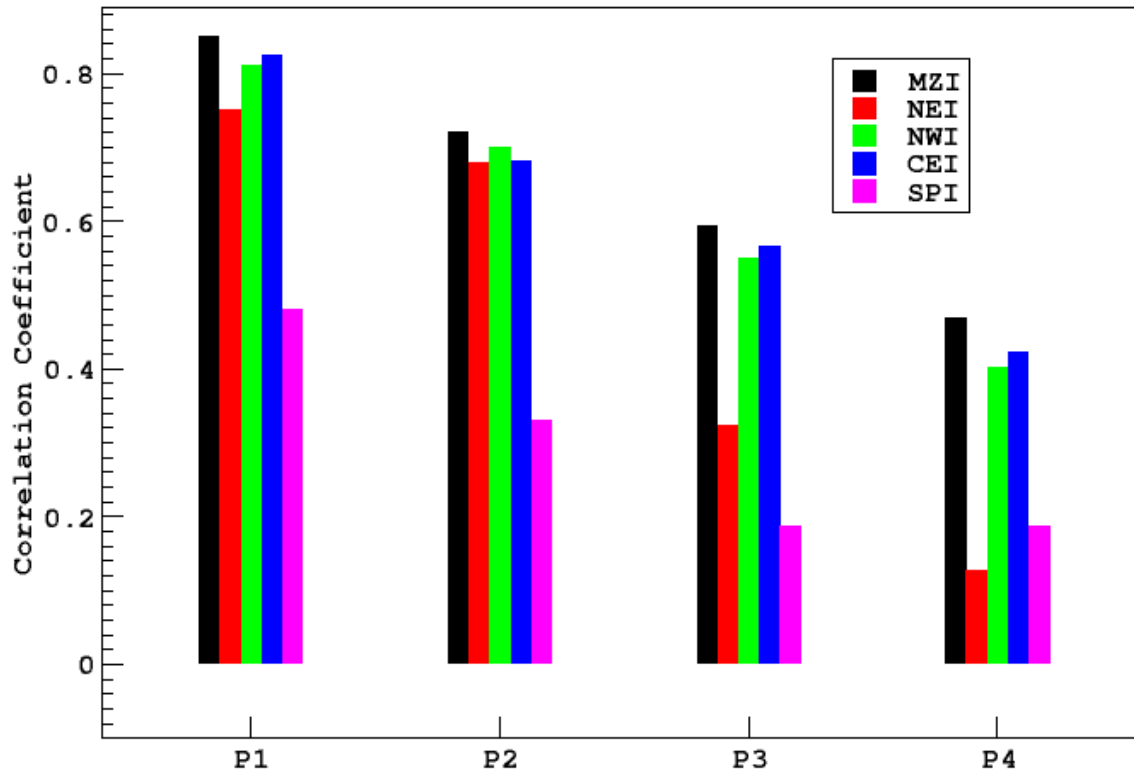


0605: It is likely that by 17th June the offshore trough along the west coast will be established and within one week after that, monsoon may reach central India as a feeble current.

0903: A fresh spell of good rainfall will propagate from Indian ocean to southern peninsula around 20th September and may reach central India around 25th September.

0725: It was forecasted that Monsoon activity will be normal and there is a possibility that it may enter in the break phase around 10th Aug.

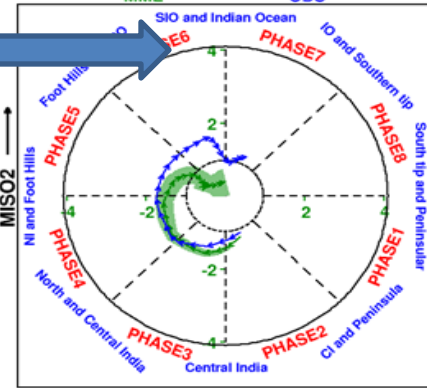
Overall Skill over 5 Homogeneous regions



Lower skill may be associated with the absence of Strong large scale ISO signal when dominated by High frequency synoptic Activity.

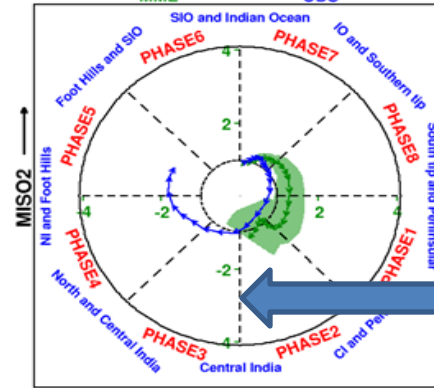
MISO predictions and comparison from selected ICs

(a) MISO verification of 0620 2015 forecast



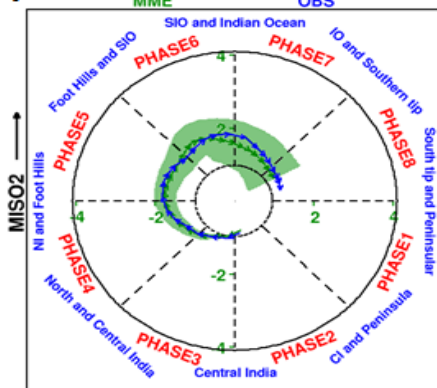
Prediction of enhanced Rainfall activity over Central India during June

(b) MISO verification of 0710 2015 forecast



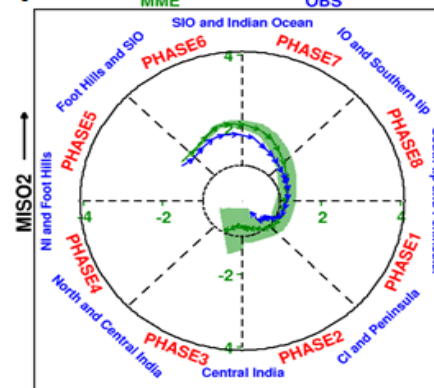
Slow Phase propagation

(c) MISO verification of 0725 2015 forecast



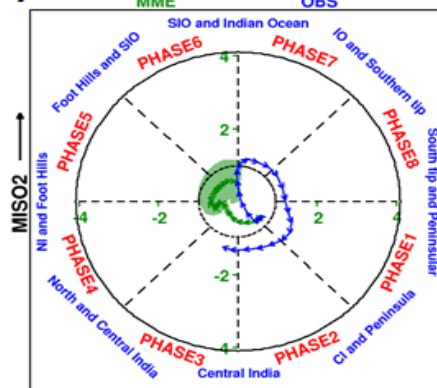
Extended Break During August

(d) MISO verification of 0804 2015 forecast



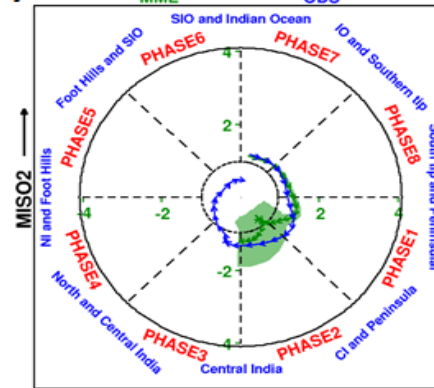
Extended Break During August

(e) MISO verification of 0824 2015 forecast



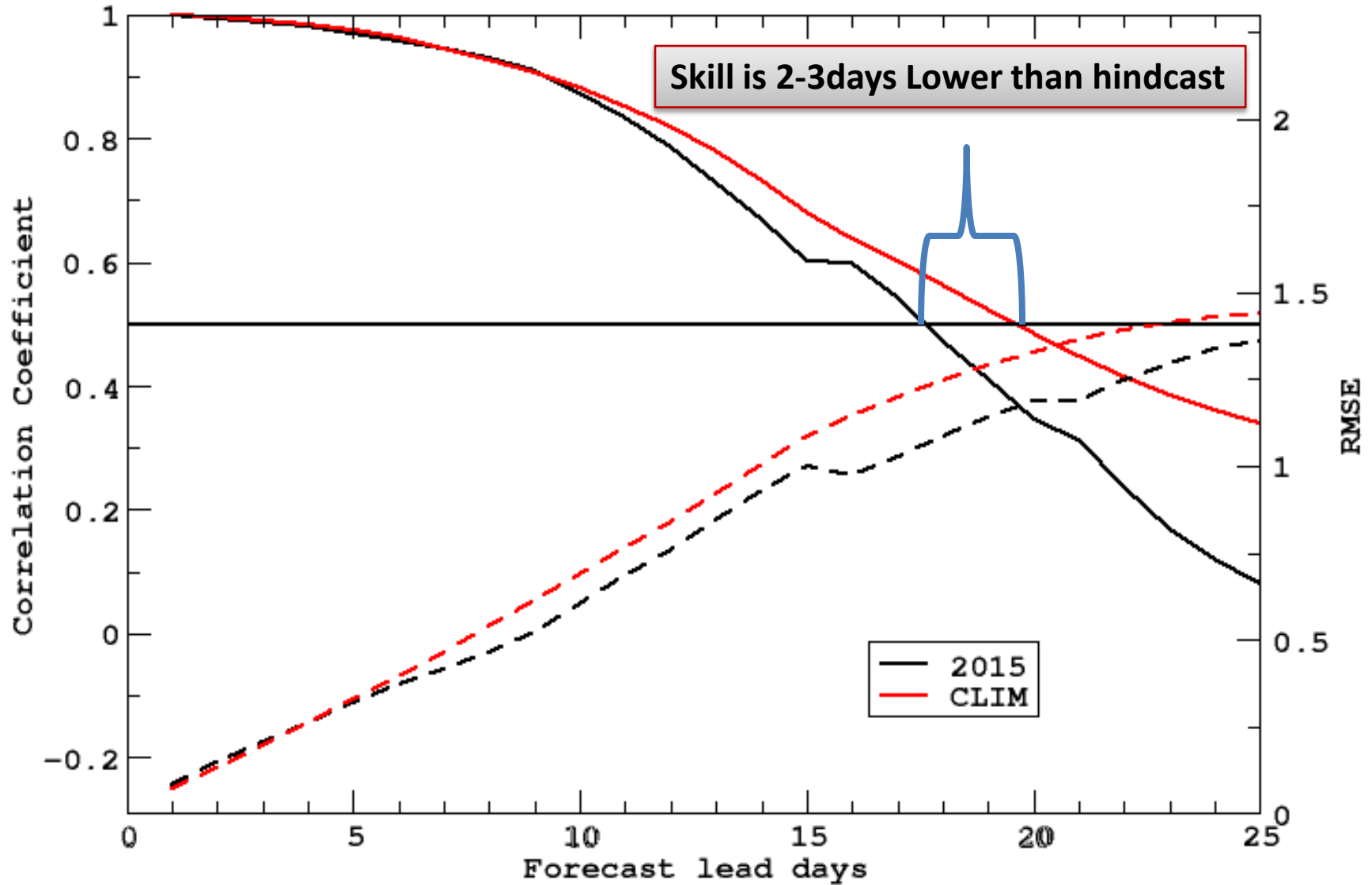
Out-of phase Prediction

(f) MISO verification of 0903 2015 forecast



Revival During September

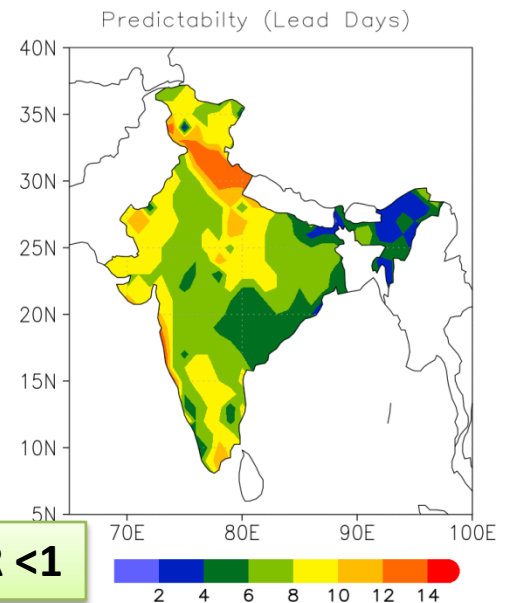
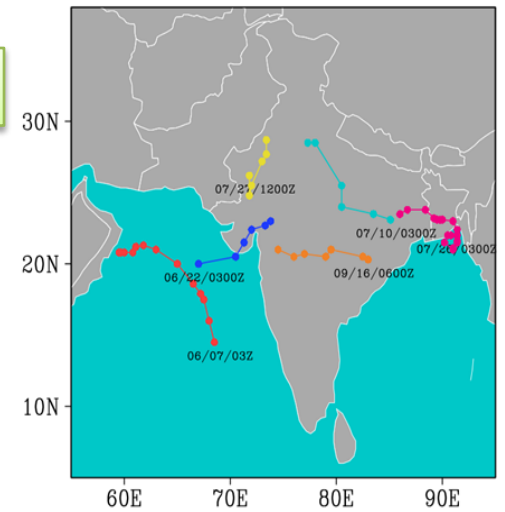
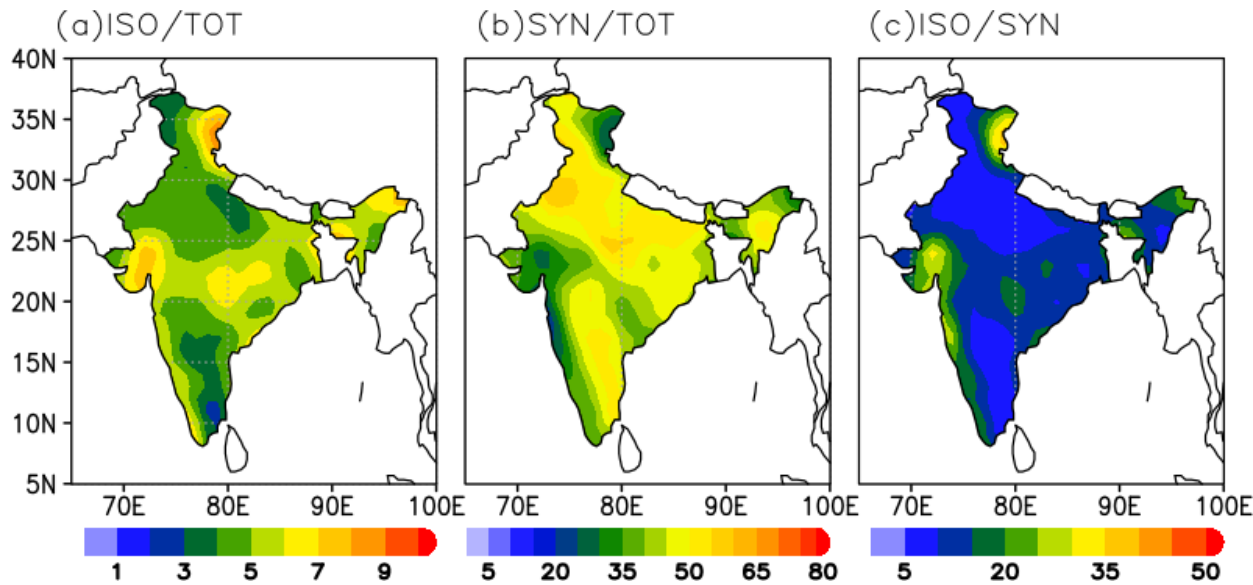
Bivariate CC & RMSE of MISO prediction 2015



Why ERP skill was lower during 2015

Synoptic Systems

Observed Syn/Isv Variance

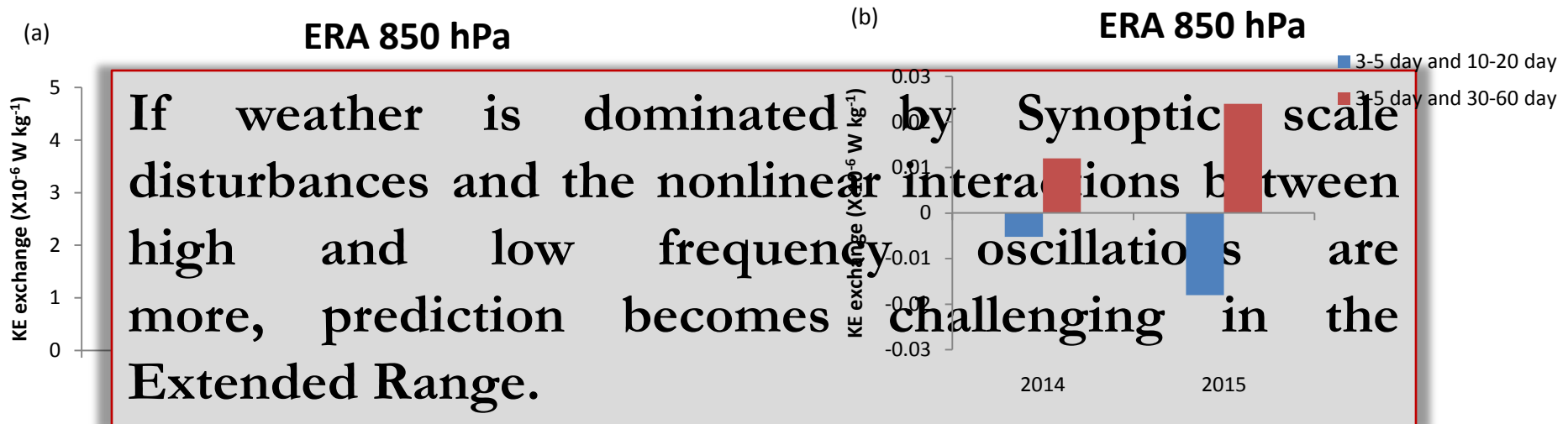


Lead at SNR < 1

We can only predict the Low frequency large scale component of the ISO after 10 days. In the absence of strong ISO signal and weather is dominated by Synoptic scale disturbances, prediction becomes challenging in the Extended Range.

Scale interaction and energy exchange

The positive (negative) value of the mean-wave interaction implies that the seasonal mean is losing (gaining) KE to (from) low and high frequency waves whereas the same of the wave-wave interaction represents the 3-5day wave losing (gaining) KE to (from) 30-60 and 10-20day modes



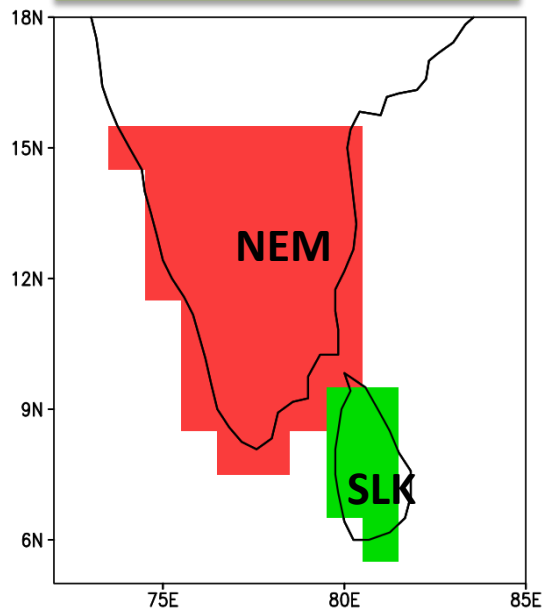
Seasonal mean has no positive contribution to the variability of synoptic scales.

KE exchanges between synoptic scale and low frequency oscillations are stronger during 2015 compared to 2014 that make the Indian monsoon transients prone to intensify more during 2015.

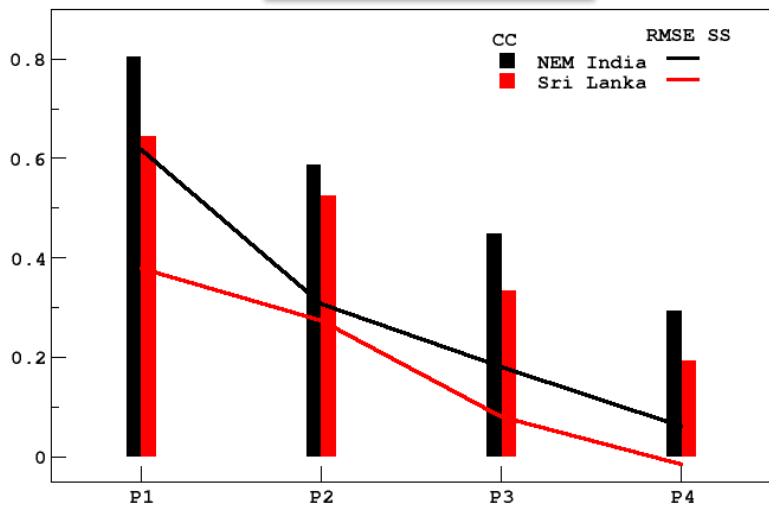
Prediction of NEM

Hindcast Skill for Post Monsoon/NEM

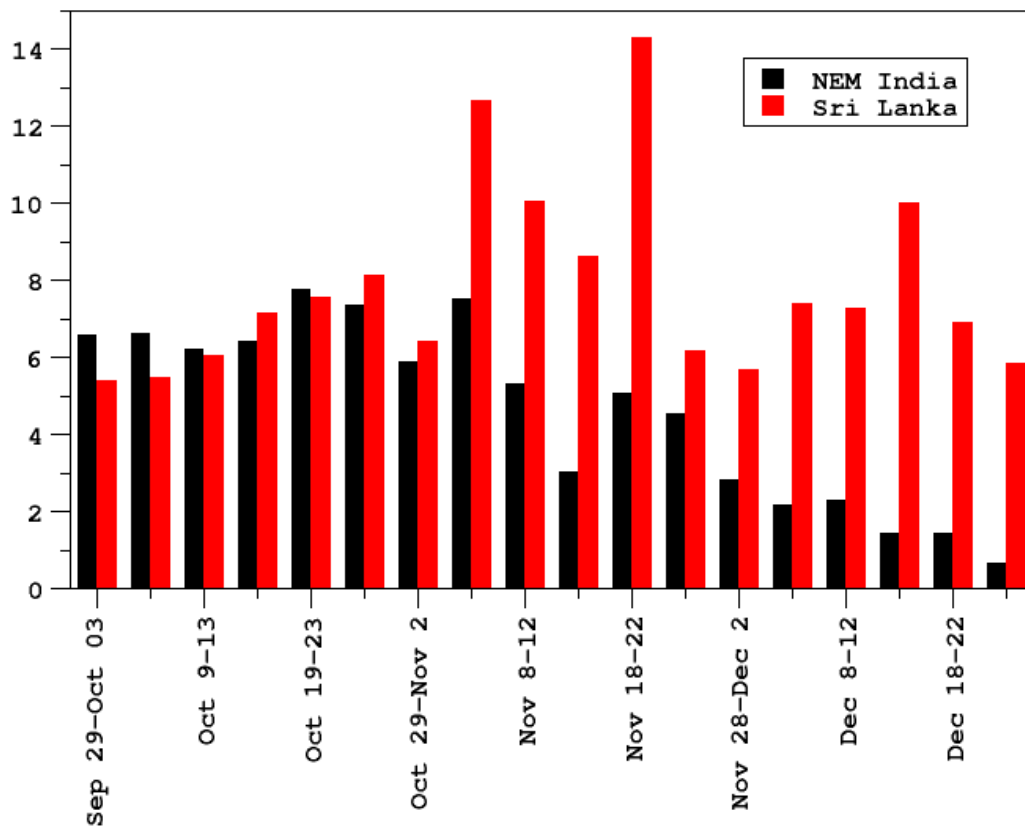
NEM and SLK region



Hindcast Skill



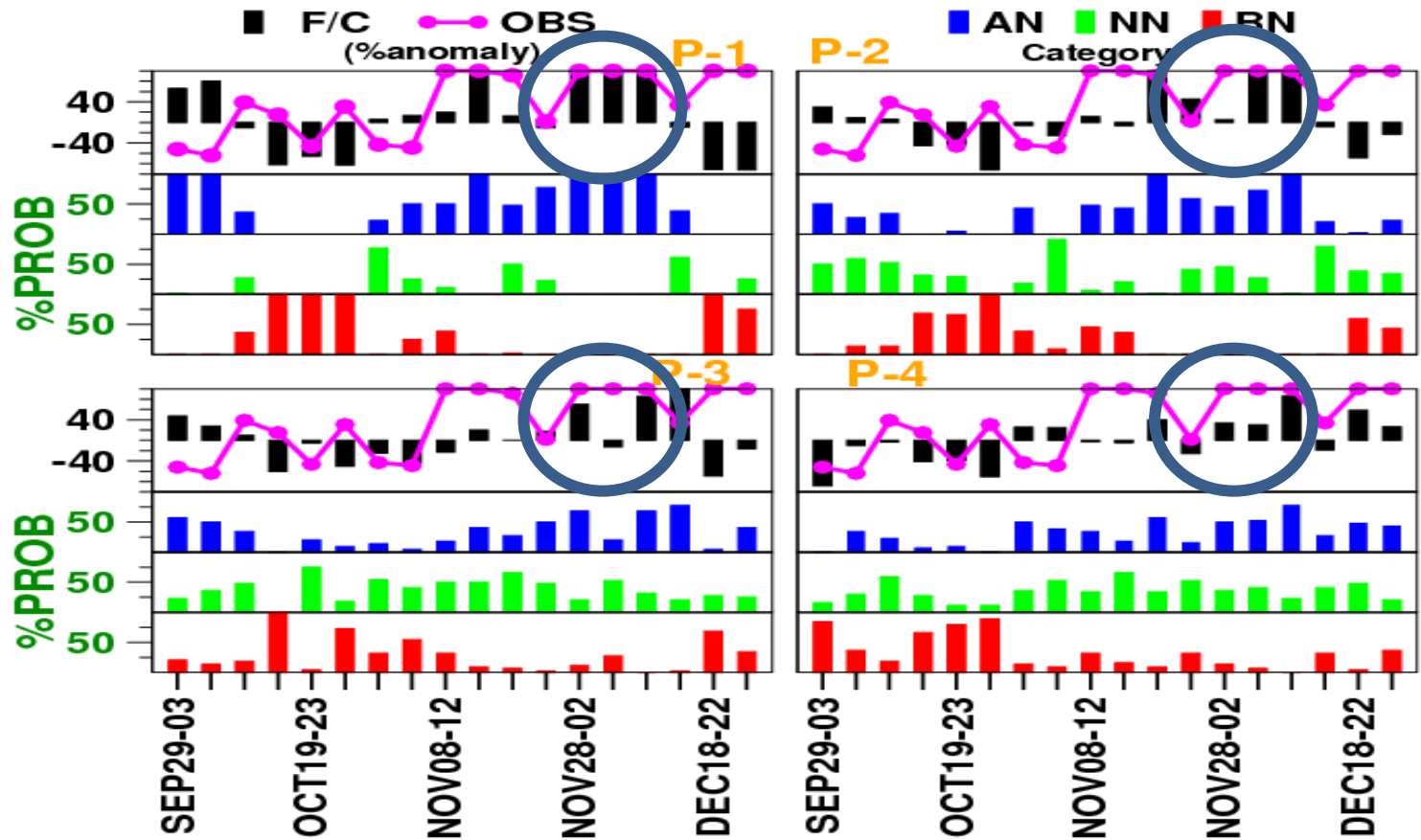
Climatological rainfall



NEM (SLK) region exhibits useful skill up to 3(2) Pentad

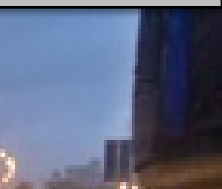
Area averaged rainfall over NEM region during 2015 predicted by MME

1127: especially east coast (Andhra & Tamilnadu) is likely to receive above normal rainfall during the first pentad

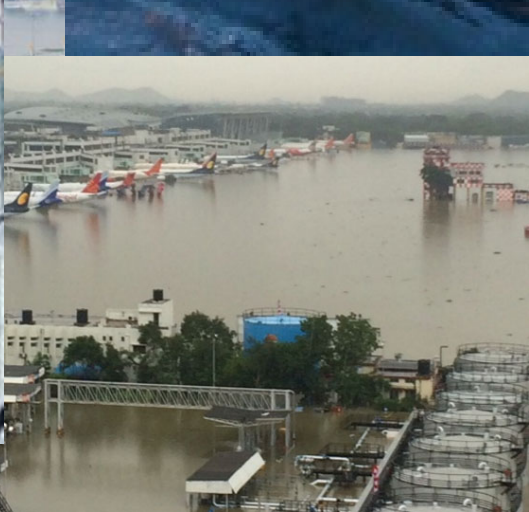


1202: Southeast coast is likely to receive above normal rainfall due to low pressure systems in easterlies during the first two pentads and near normal rainfall afterwards.

Rains create havoc in Chennai, rail, road, air traffic disrupted (29 Nov to 02 Dec 2015)



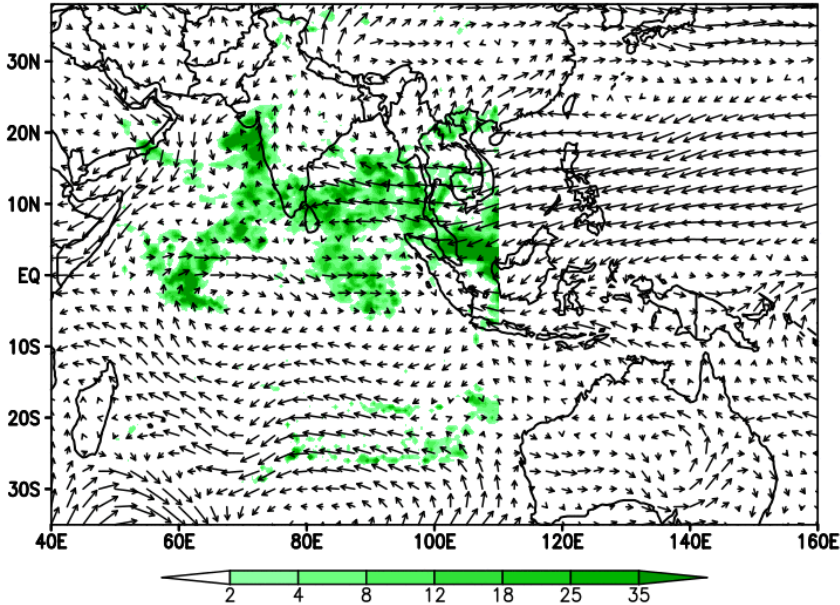
THIS PHOTO WAS TWEETED BY @Ahmedshabbir20



Fcst Valid for 28Nov-02Dec from IC=17Nov2015(P3Lead)

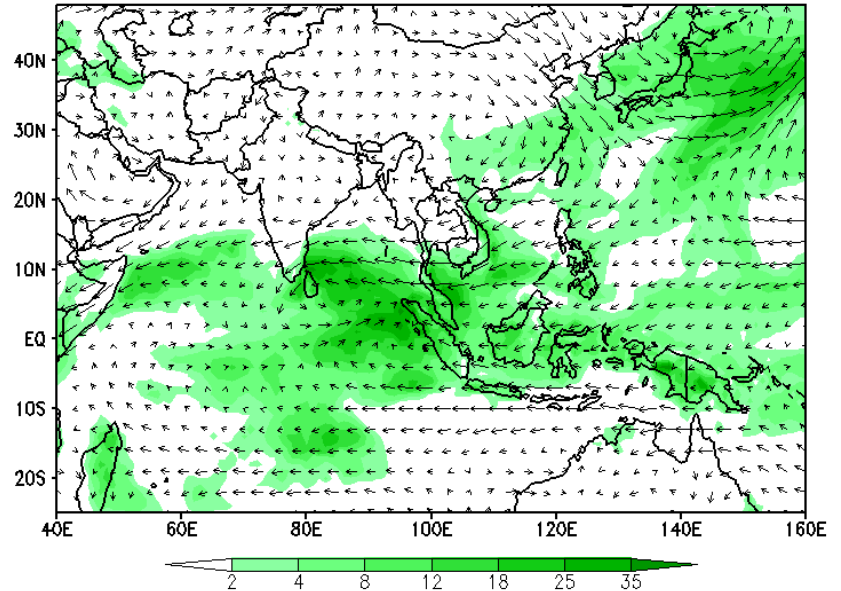
OBS, Time = 00Z28NOV2015

Rainfall (shaded, mm/day) & 850hPa winds (vector, 20°)



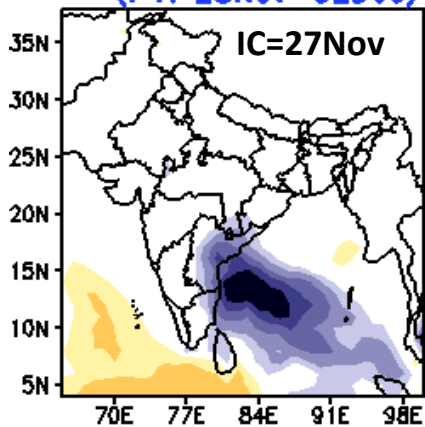
MME, Forecast Valid Time = 00Z28NOV2015

Rainfall (shaded, mm/day) & 850hPa winds (vector, 20°)

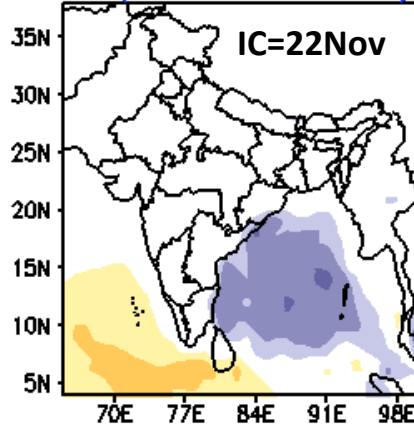


Predicted pentad wise rainfall (by IITM-CGEPs)

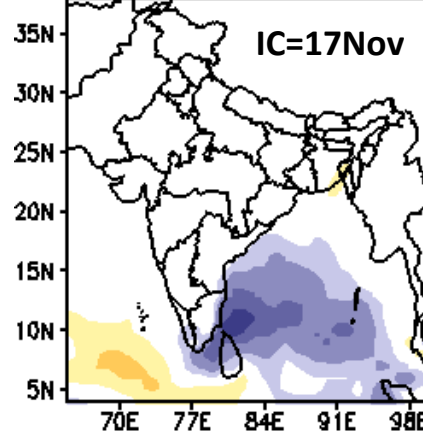
(P1: 28Nov-02Dec)



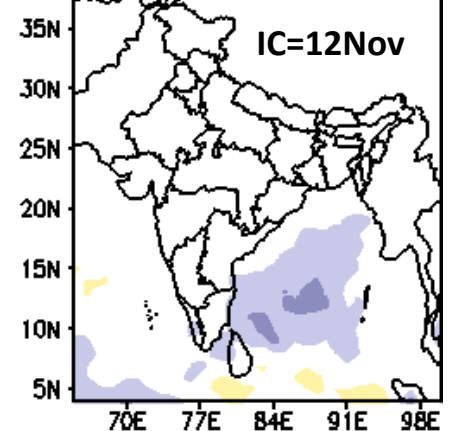
(P2: 28Nov-02Dec)



(P3: 28Nov-02Dec)



(P4: 28Nov-02Dec)



The CGMME system well predicted the above normal rainfall activity over Chennai and NEM region well in advance.



EXTENDED RANGE PREDICTION OF INDIAN SUMMER MONSOON

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- Actual**
- Rainfall
- Vorticity
- Max Temp
- Min Temp
- Anomalies**
- Rainfall
- Max Temp
- Min Temp
- Pentad**
- Rainfall
- Max Temp
- Min Temp

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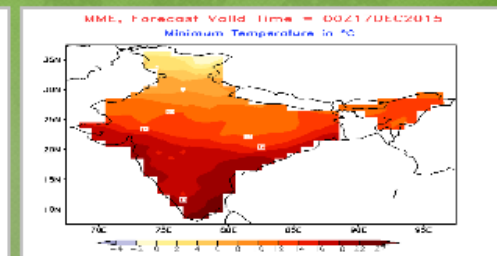
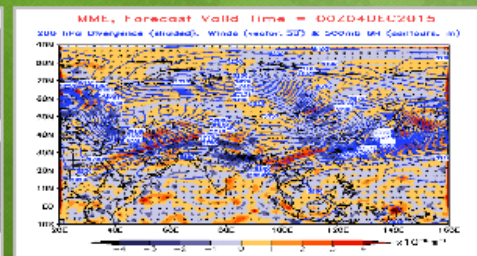
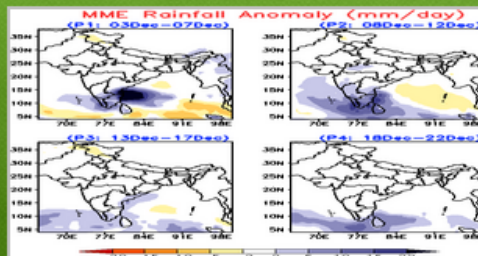
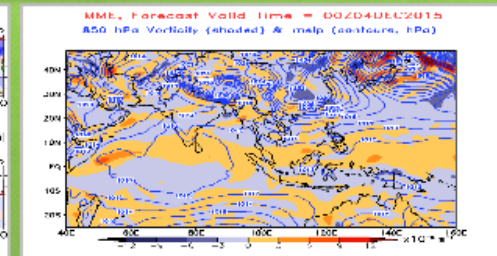
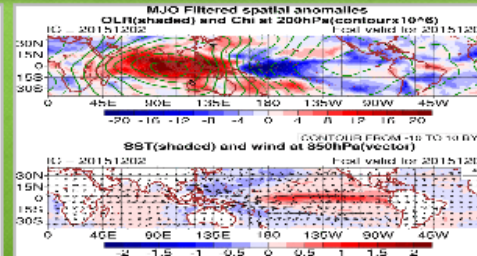
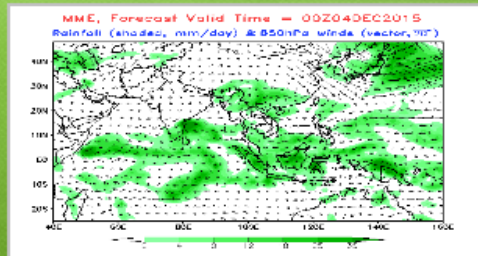
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