NCMRWF
Ensemble Forecast Products
at
Extended & Seasonal Scales

Workshop on
Use of Products from Ensemble Prediction Systems
20-22 January, 2021

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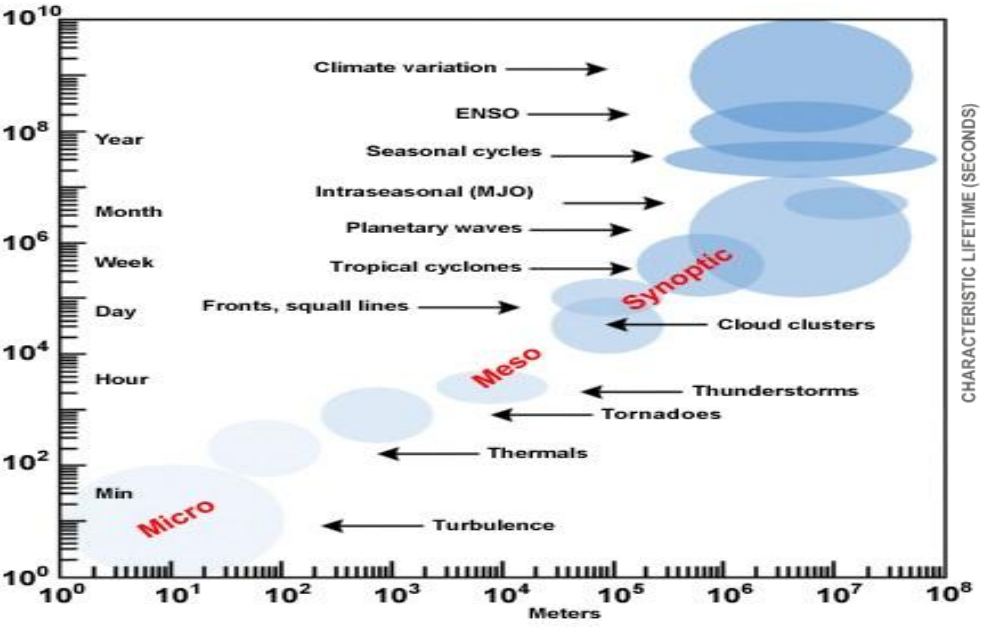
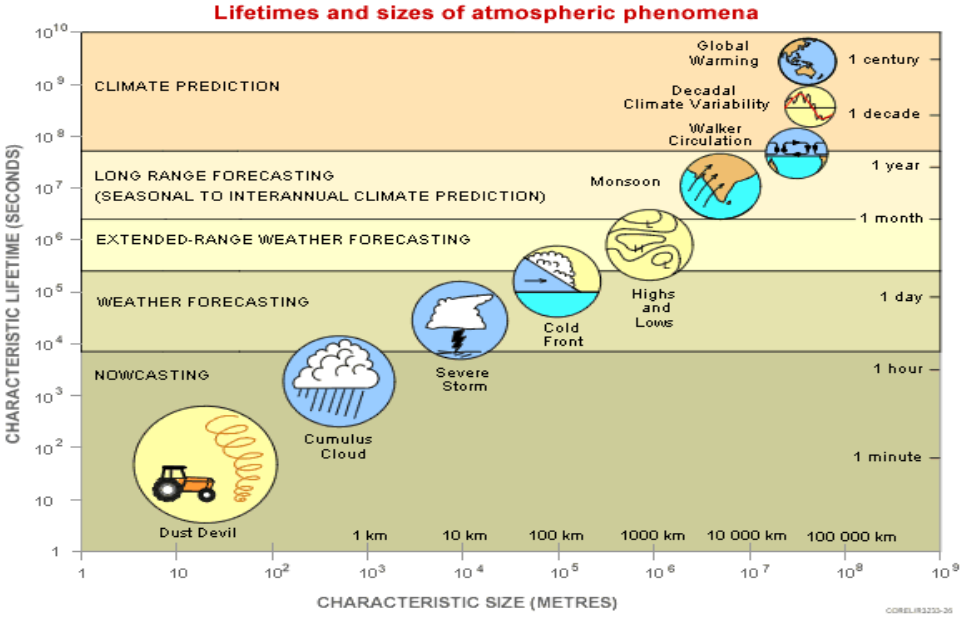
Outline

- NCMRWF Extended Range Ensemble Forecast System
- Need for ensemble forecasts
- Sample forecasts and verification
- A case for multi-model ensemble
- NCMRWF Probabilistic Seasonal Forecast System
- Sample forecasts and verification

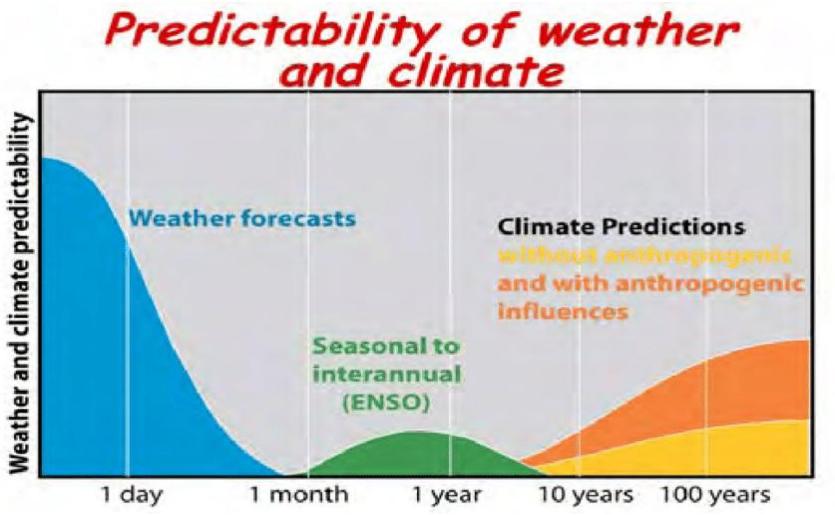
Multi-range nature of weather and climate

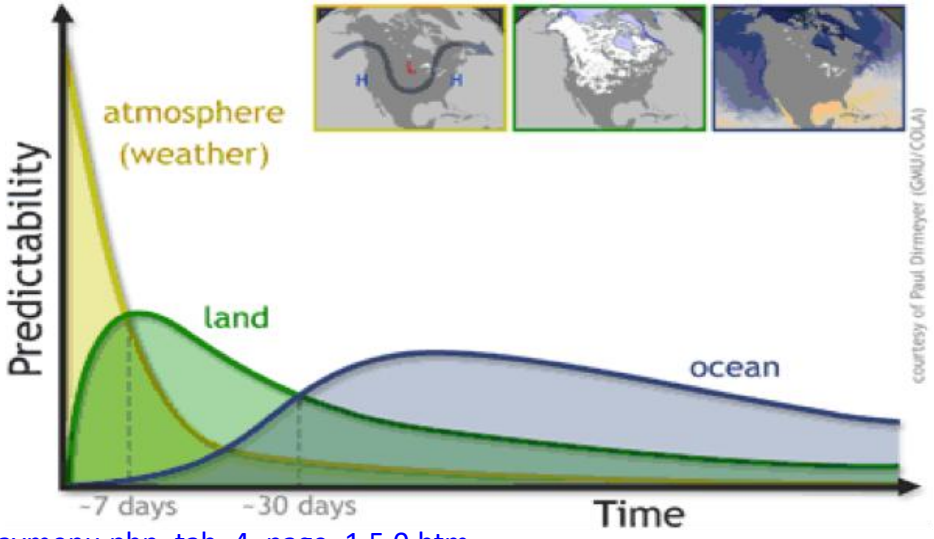
Systems and processes in weather and climate exists at a variety of time and spatial scales





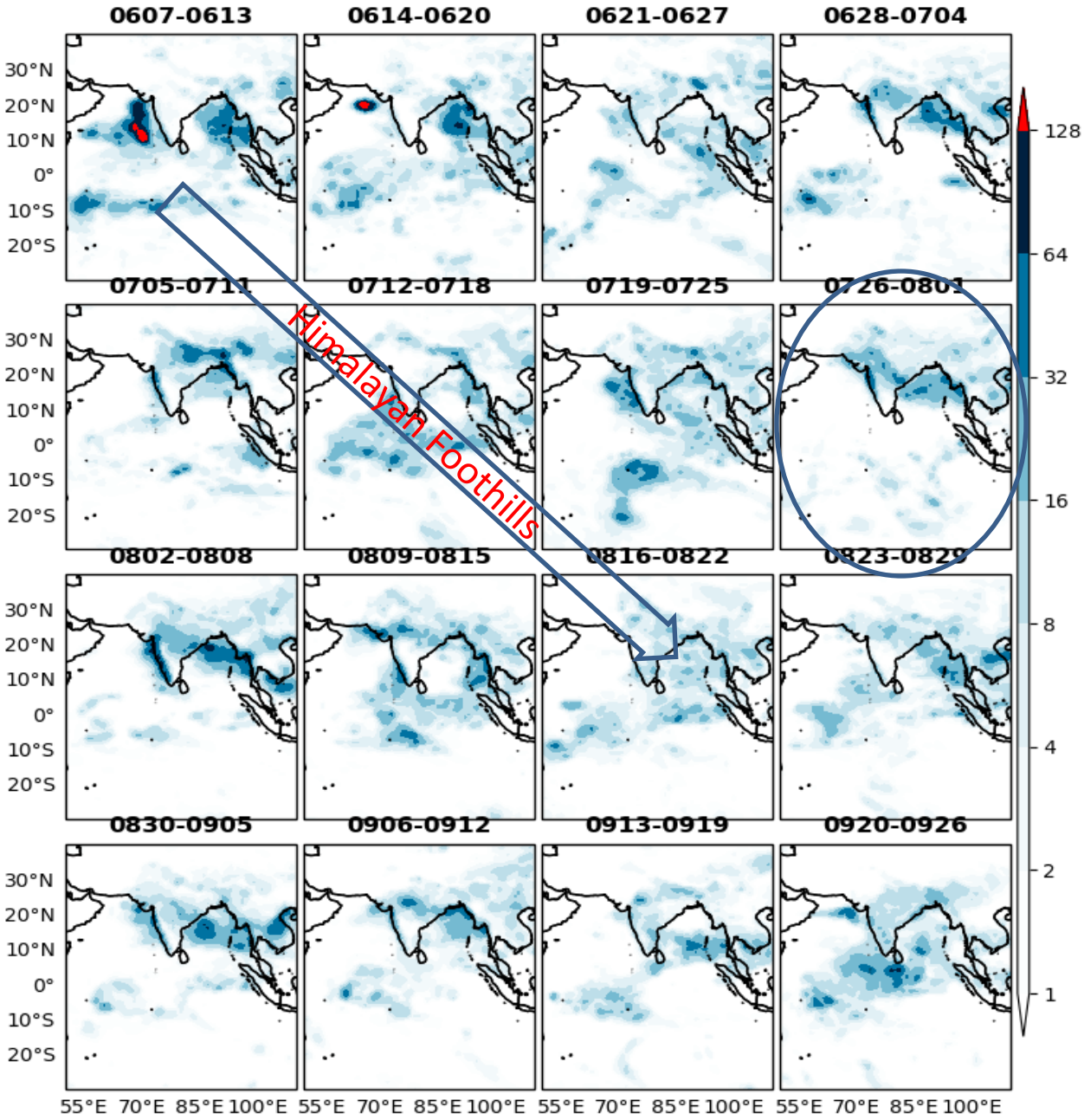
To identify what is predictable



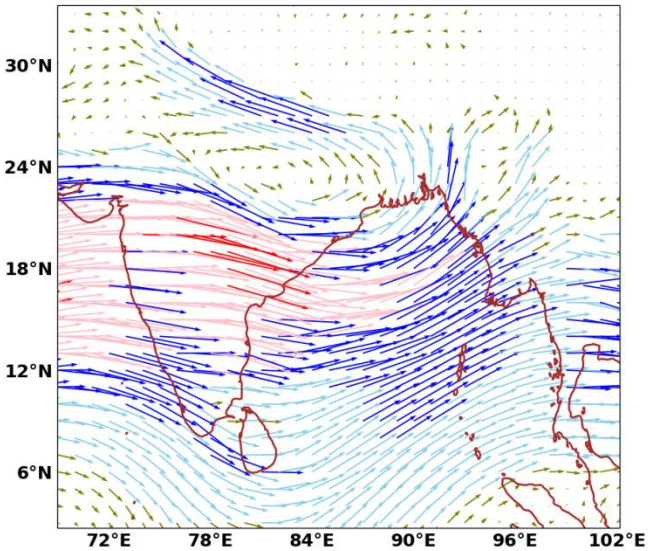


http://kejian1.cmatc.cn/vod/comet/tropical/textbook_2nd_edition/navmenu.php_tab_4_page_1.5.0.htm
http://www.bom.gov.au/watl/about-weather-and-climate/risk/

2019 JJAS. Rainfall (mm/day)



0726-0801 (ERA5, 850 hPa)



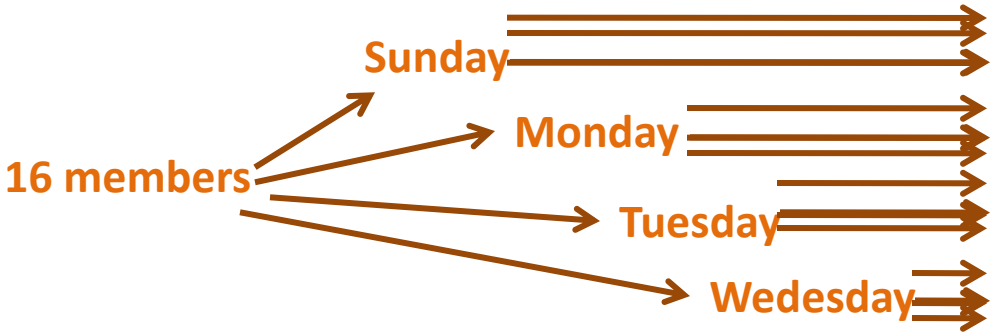
- Orientation of rainfall in certain pattern
- Skill of model falls sharply after 7-10 days for any district/grid-point
- Forecasting pattern of rainfall is still immensely useful
- Can we use ensembles to forecast such events

Extended Range Predictions from NCMRWF Coupled Model

- NCMRWF Coupled Model Runs with 60 km (NCUM) and 25 km (NEMO)
- **Model Climatology** 23 years (1993-2015) Hindcast data used
- **Ensemble Strategy**: lagged ICs + stochastic physics
- **7 members hindcast**. Hindcasts initialized on 1st, 9th, 17th & 25th of each month.
- **16 Members forecast**: 4 members per day. 4-startdates.
- **Stochastic physics scheme**:
- Stochastic Kinetic Energy Backscatter scheme of Bowler et al., 2009 is used to represent unresolved processes and provide small grid-level perturbations during model integration.
- Nearest hindcast date is used to compute weekly anomalies

Hindcasts are run:

- To compute model climatology (for computing forecast anomalies)
- To generate a distribution of forecasts for a given validity period (essential in generating long range probabilistic forecasts)



Forecast Preparation Date:

Thursday

Validity: Friday-Thursday

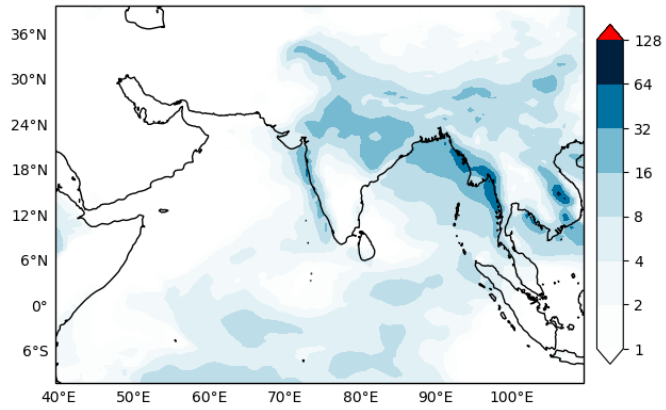
Upto 4-weeks

Week-2 Forecast issued on 20190718
IC: 15,16,17 July
Validity: 26th July-1st August

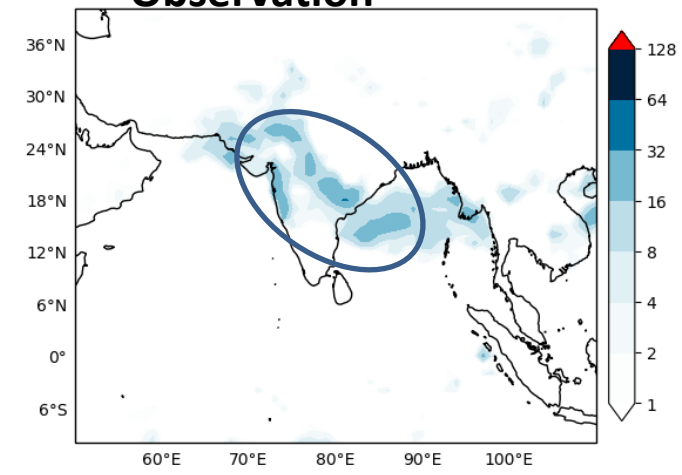
Not probabilistic but using the value of model mean itself

Subject Expertise and knowledge about synoptic conditions is needed to interpret the forecasts. Some objectively defined indices such as MJO are present to identify the signal (most predictable component)

Model Mean

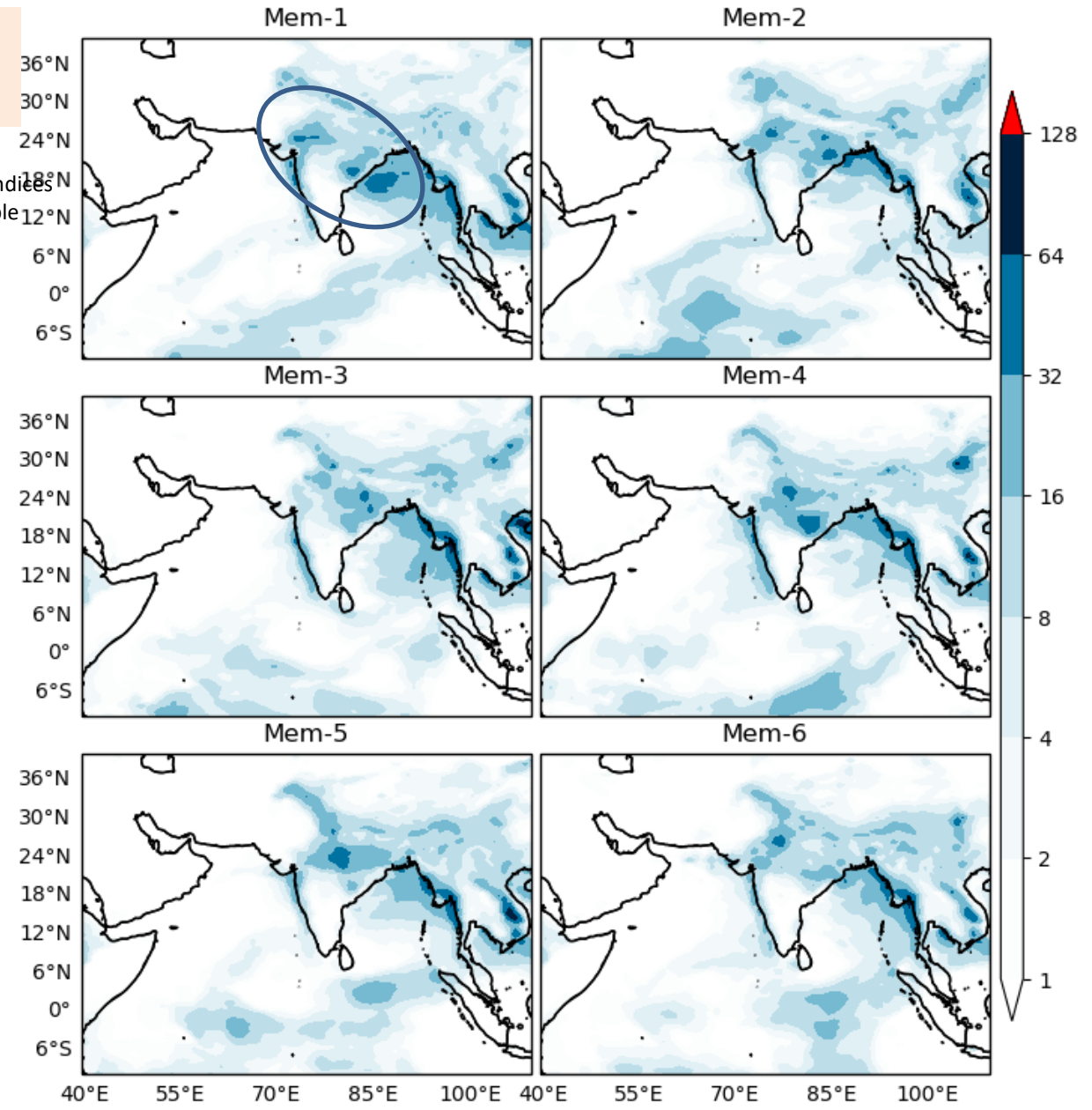


Observation



Impact of ICs and perturbed physics

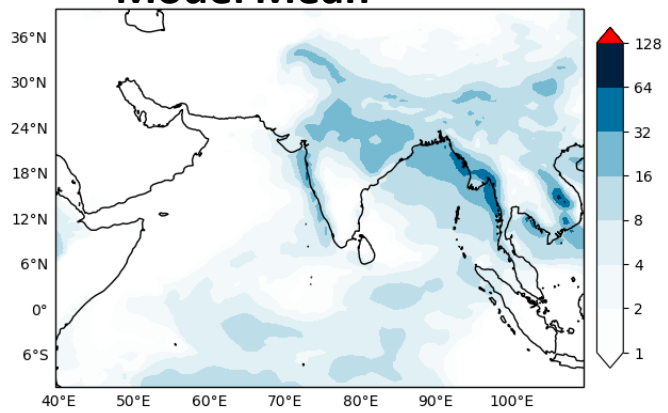
Model Rainfall, different members



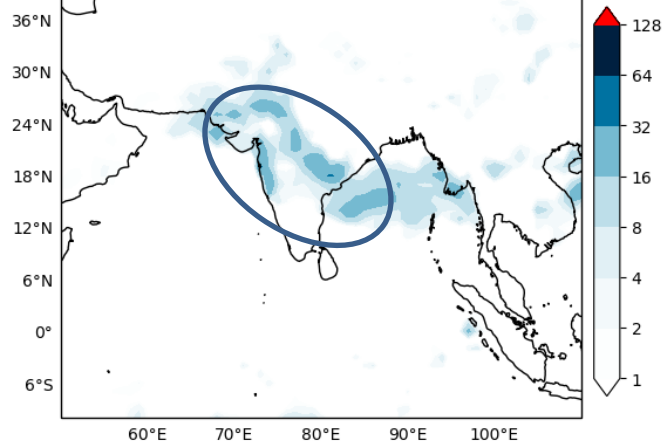
Week-2 Forecast issued on 20190718
IC: 15,16,17 July
Validity: 26th July-1st August

Only one member picks up the BoB rainfall. It shows importance of each of these members.
So one has to run many members.

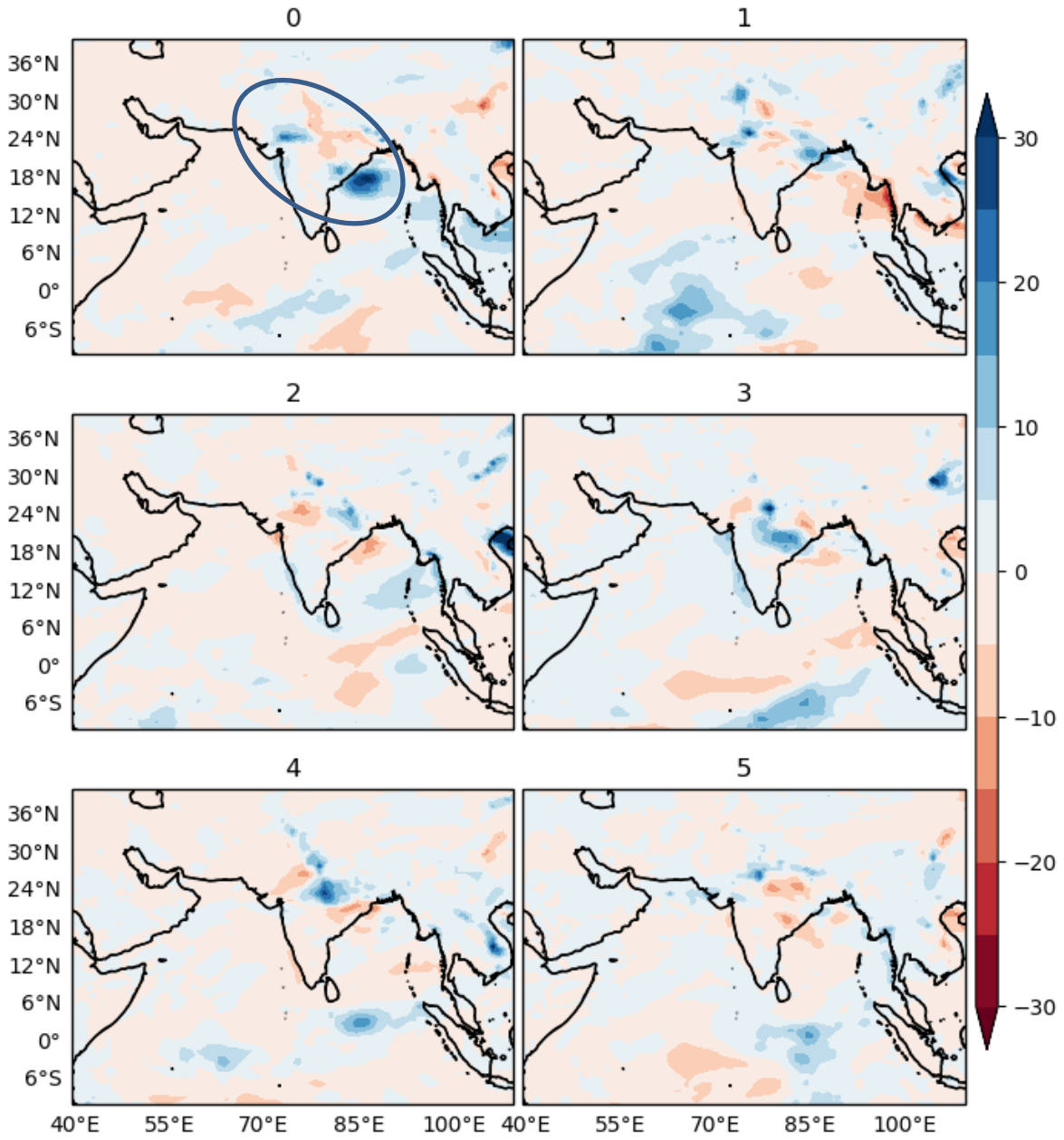
Model Mean



Observation (Merged)



(Model_Member – Model_Mean)

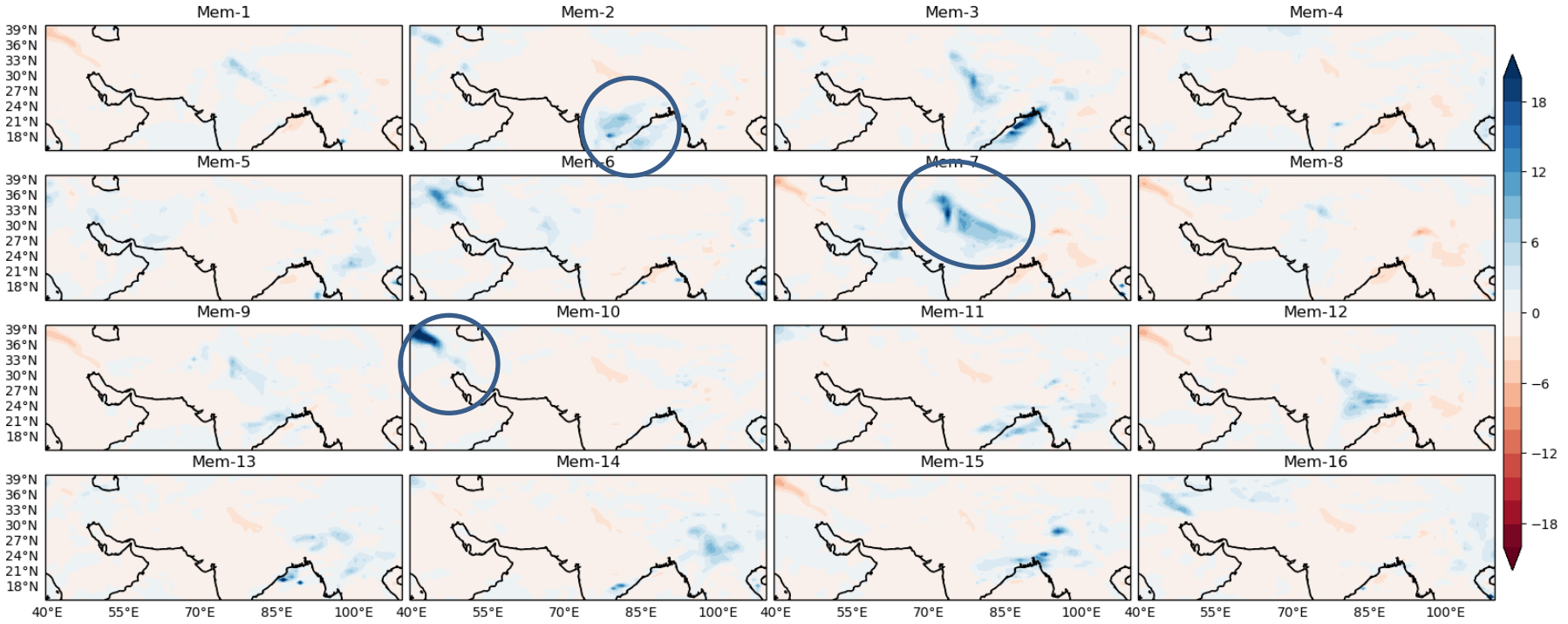


Week-2 Forecast issued on 20200124
IC: 19,20,21,22 Jan
Validity: 31st January – 6th Februaray

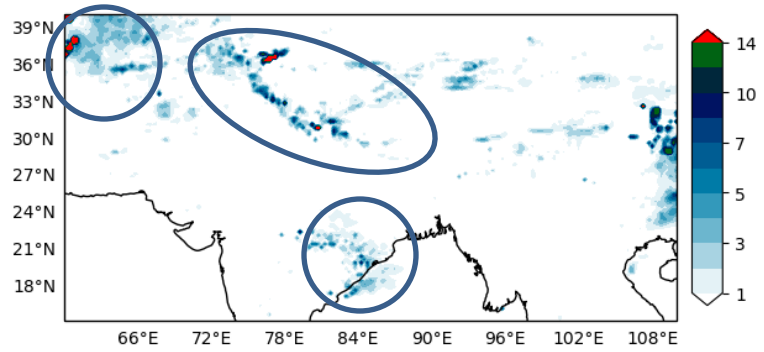
Vastly different forecasts

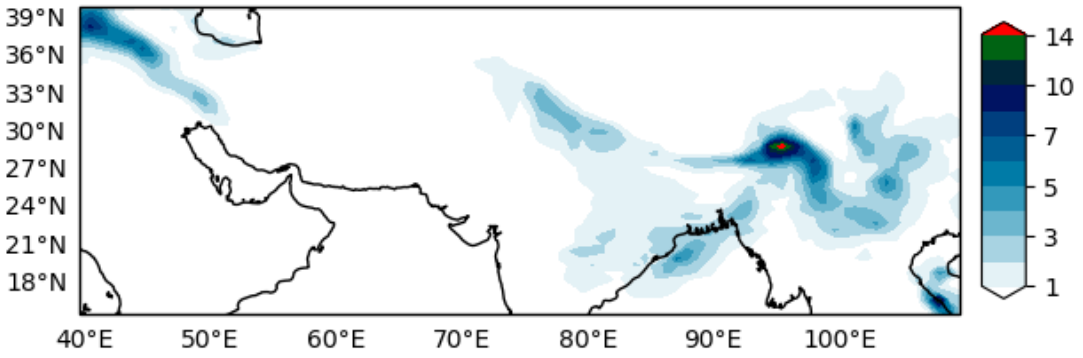
Imagine running a single member here.

(Model_Member – Model_Mean)



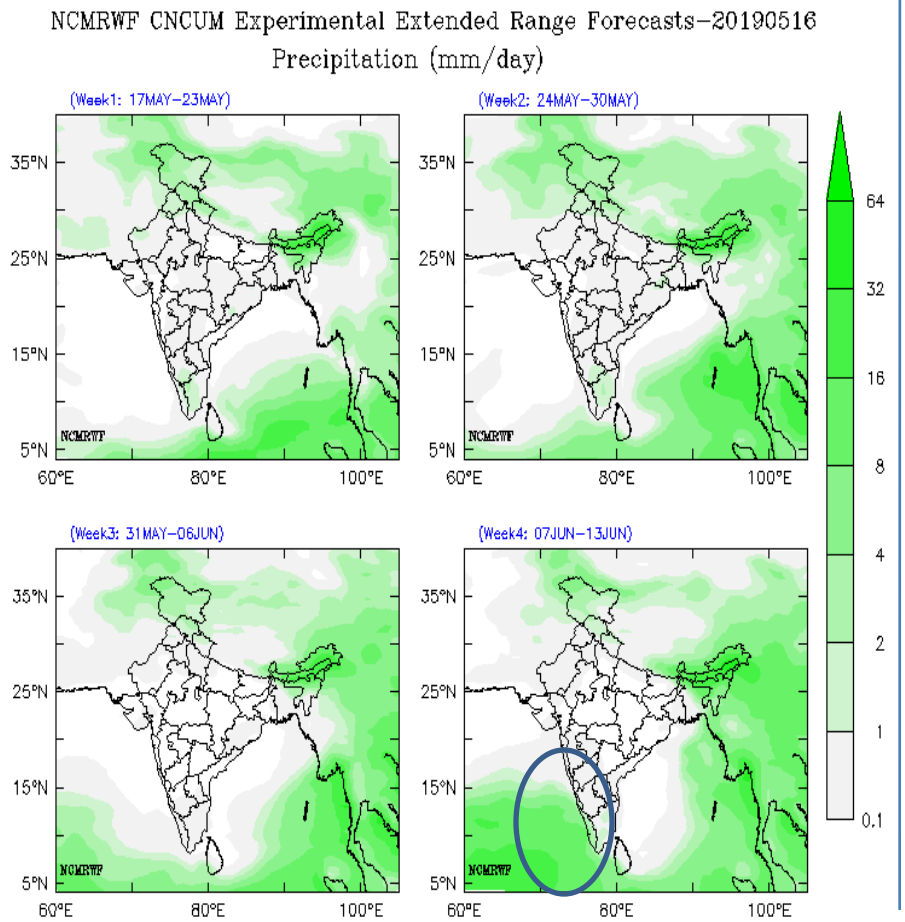
Observation





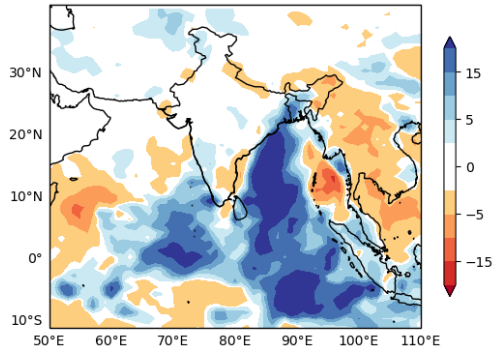
Delayed Onset Monsoon 2019

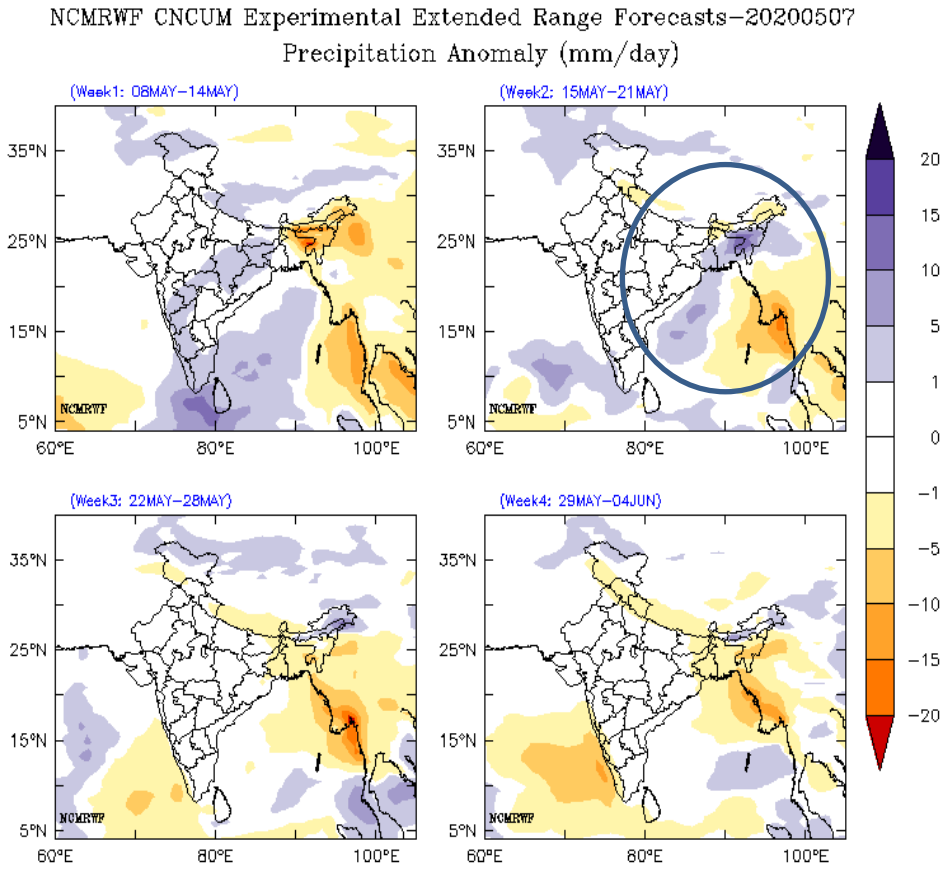
- Onset by delayed by 7 days. IMD declared it on 8th June.
- Model showed dry conditions in 3 preceding weeks till 6th of June.
- Week-4 forecast shows sudden onset near Kerala coast.



Cyclone Amphan: 16-21 May,2020

15th May-21st May.
Merged Rainfall

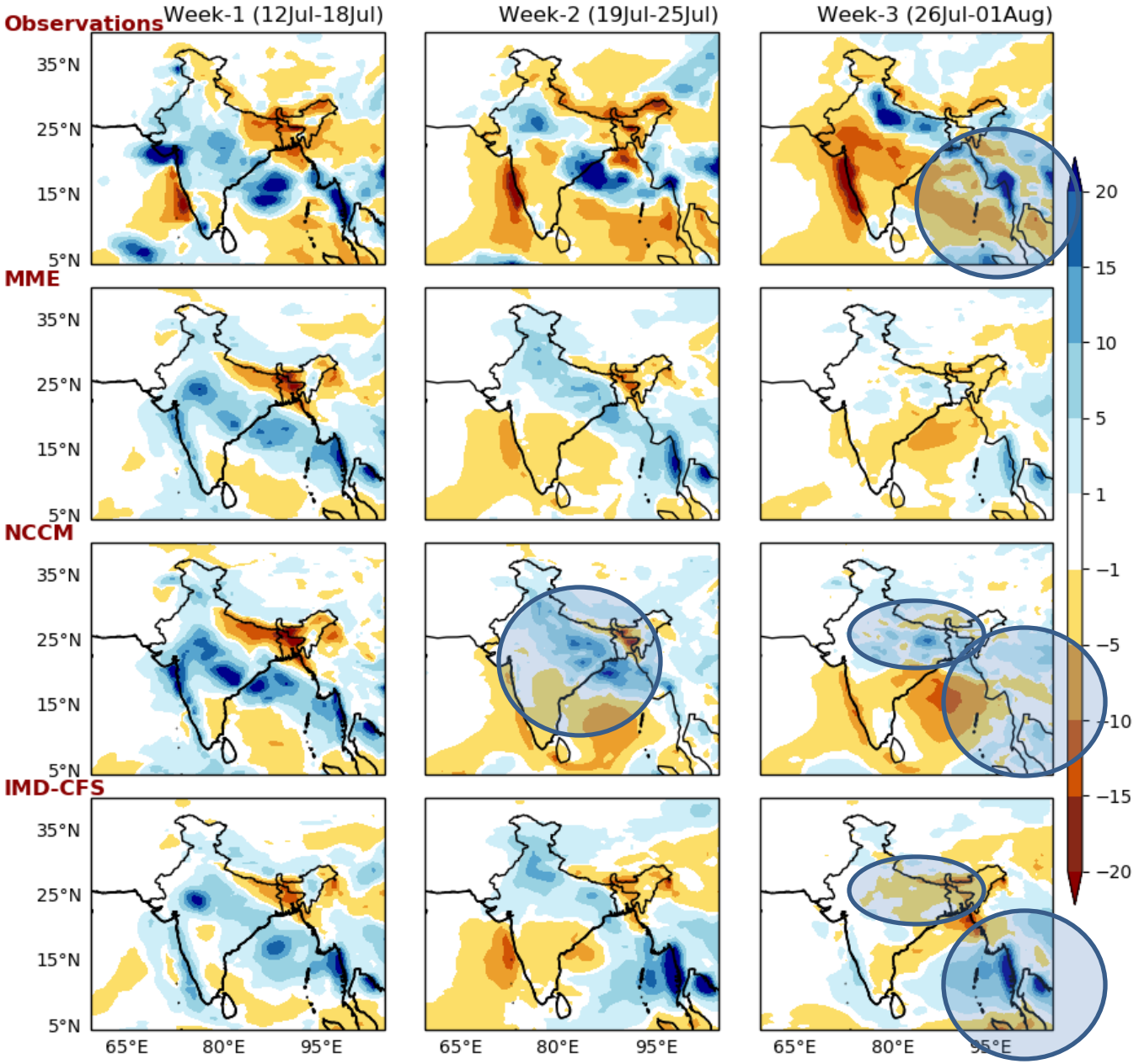




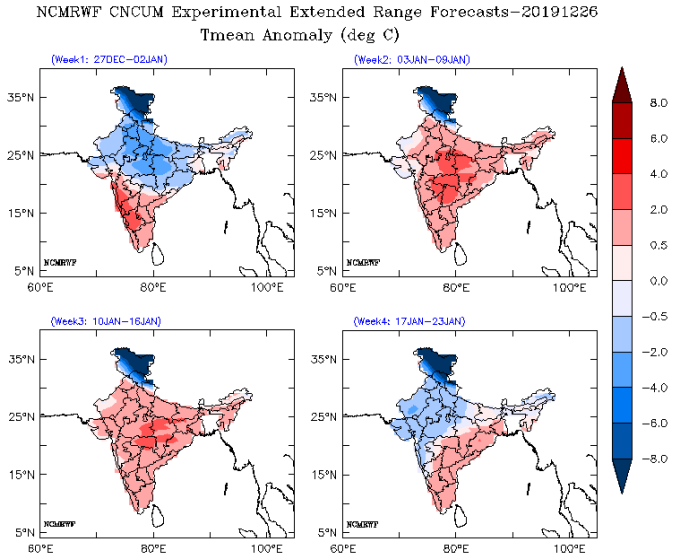
Multimodel Mean

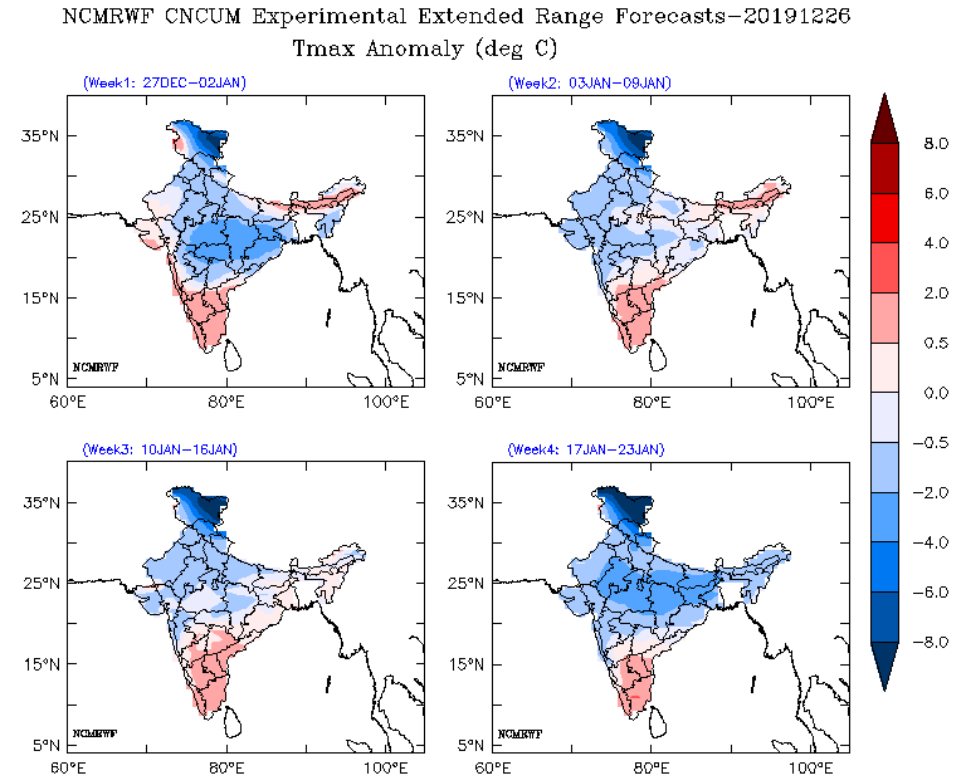
2018

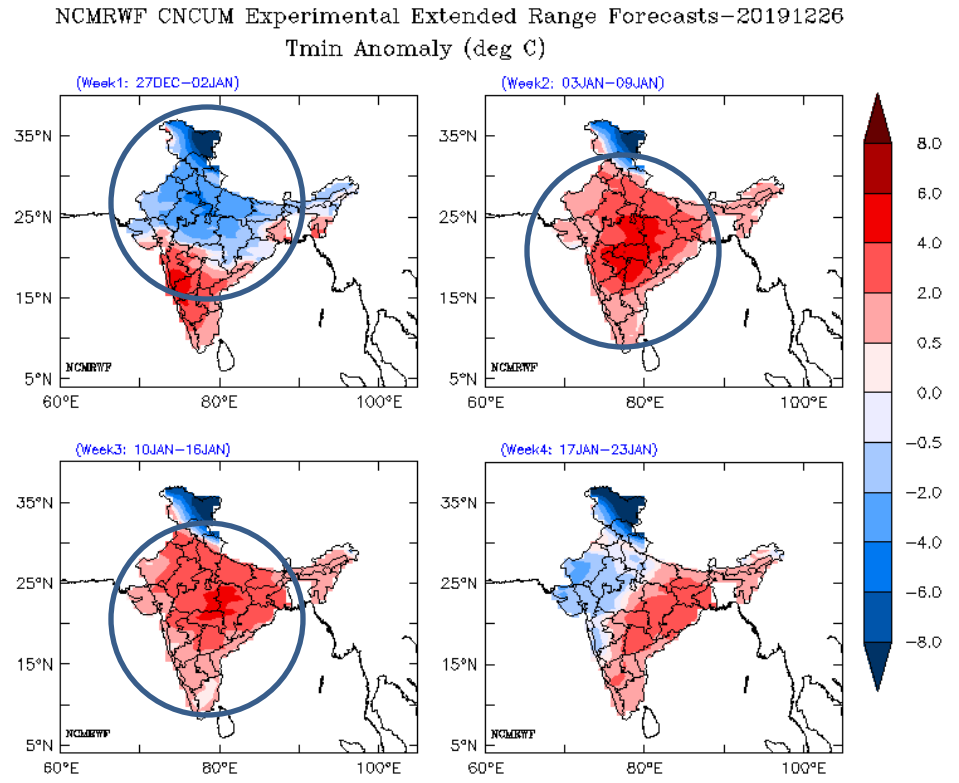
Northward movement of MISO is better in NCMRWF model. But with presence of systematic biases in week-3



Cold wave/Cold day







Ensemble based Seasonal Forecast

NCMRWF Coupled Model Runs with 60 km (NCUM) and 25 km (NEMO)

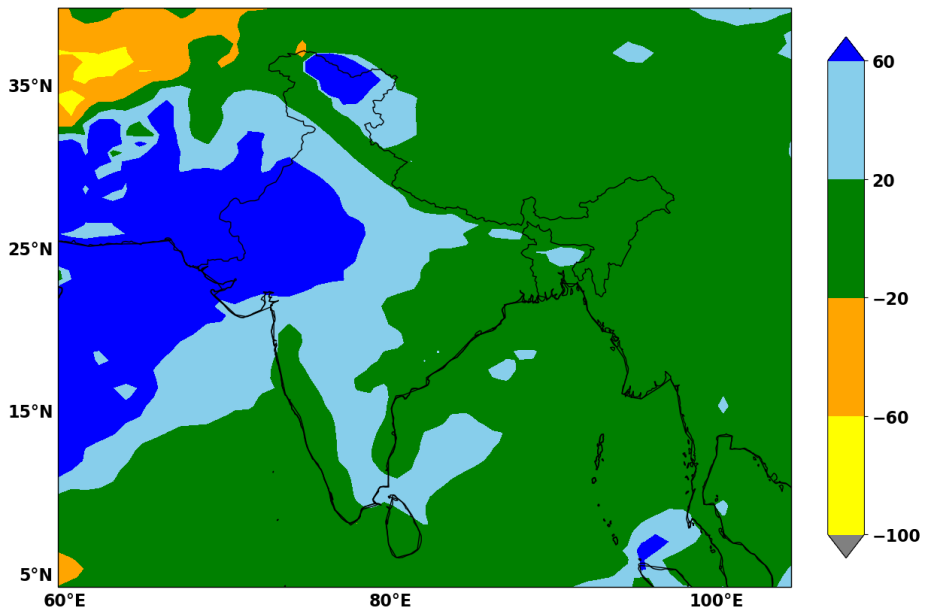
- **Number of Forecast members: 55**
- **Startdates: 12th to 22th of each month. 5 member per startdate**
- **Number of hindcast members: 23 years*6 per year (1993-2015)**
- **Hindcasts are used to defined the normal for percentage departures**
- **Hindcasts are used to define threshold for tercile categories for probabilistic forecasts**

2020 JJAS, IC: May

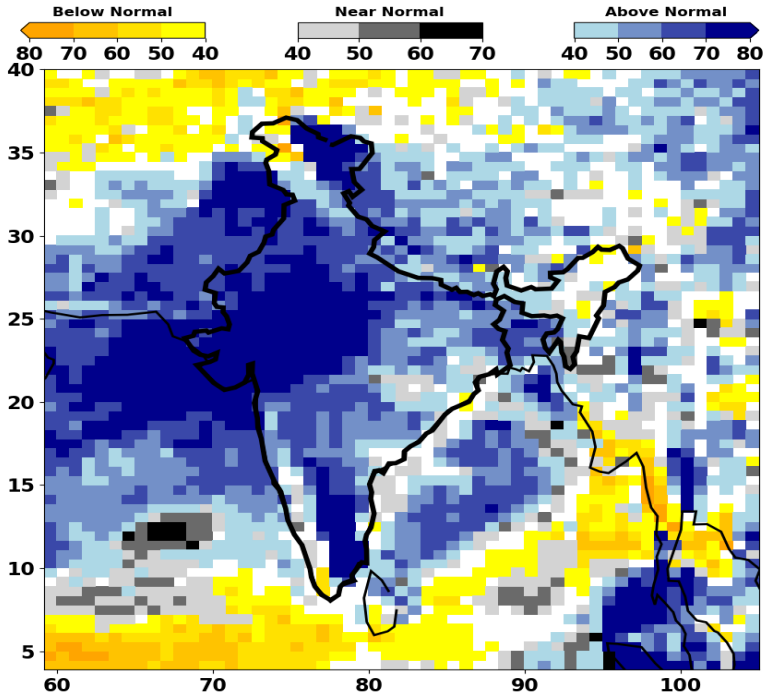
Seasonal

- Compute percentiles: At each grid point, the value at which 1/3rd and 2/3rd of all hindcast realizations are smaller is identified. These are called upper and lower terciles for that grid point.
- The number of forecast members in a given tercile is computed.
- The tercile which has the highest number of members is identified as the forecast category.
- The probability is computed by dividing the number of forecasts in each category by total number of forecasts.

Percentage Departure

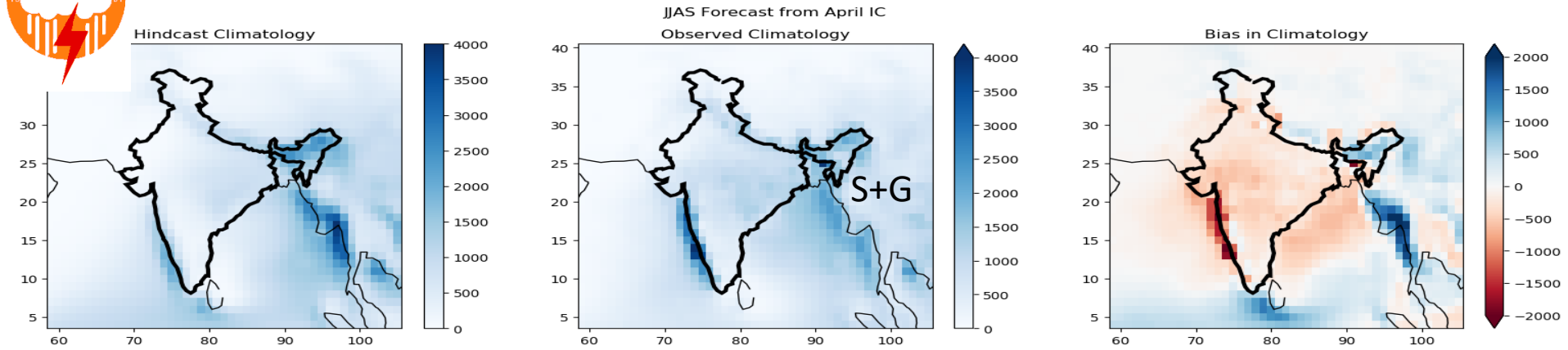


Probabilistic Forecast

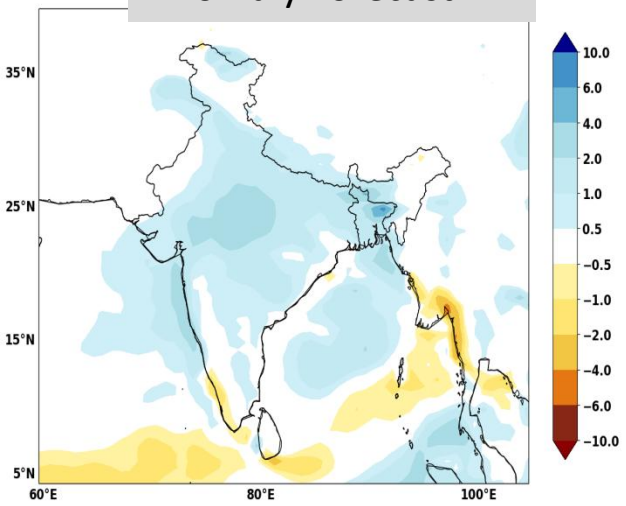


Hindcast : 1998-2016

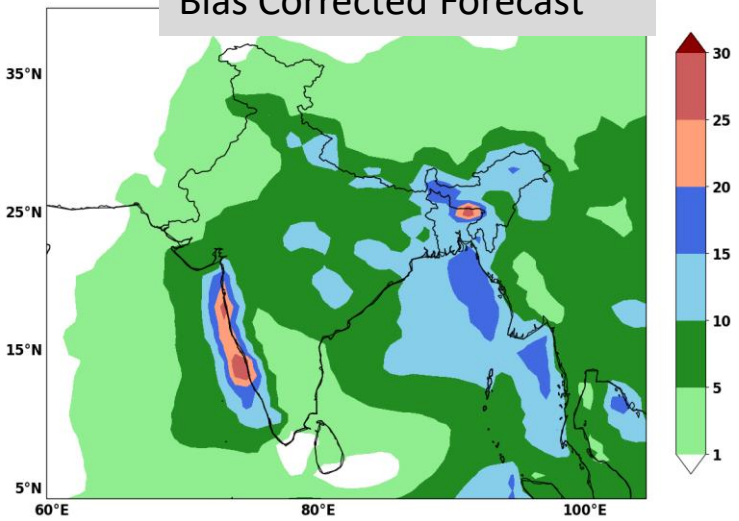
Monsoon (JJAS) Rain in mm



Anomaly Forecast

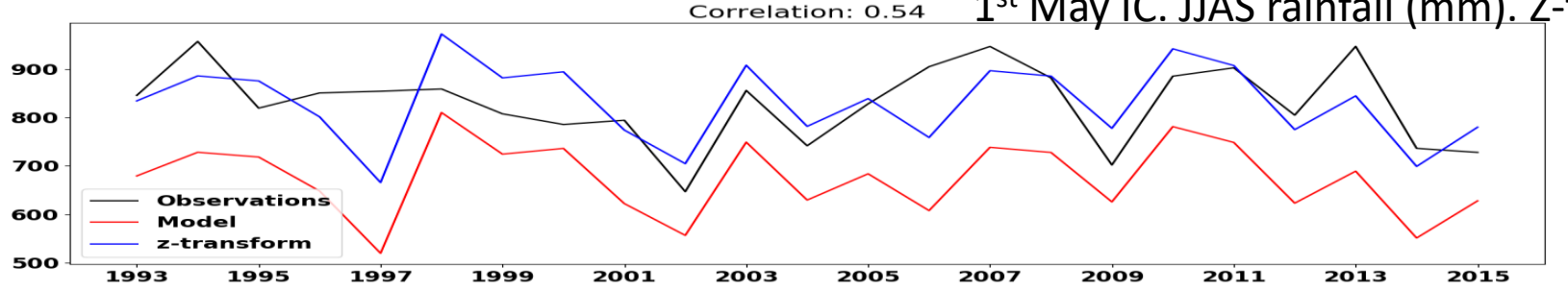


Bias Corrected Forecast



2020 JJAS, IC: May

1st May IC. JJAS rainfall (mm). Z-transform



Thank You