



**Workshop on Seasonal Climate Forecasts Mechanism in the Region  
SAARC Disaster Management Center (IU), Gandhinagar, Gujarat, India**

**Global Source of Climate Monitoring and  
Climate Prediction Products**

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**Climate Prediction Group, CRS**

***India Meteorological Department, Pune.***

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**भारत मौसम विज्ञान विभाग  
INDIAMETEOROLOGICAL DEPARTMENT**

# Outline

## Climate Monitoring Products:

**ENSO**

**IOD**

**MJO**

## Climate Prediction Products:

**Elnino Forecast**

**IOD Forecast**

**Monthly & Seasonal Forecast**

## Online Data source & customising tools:

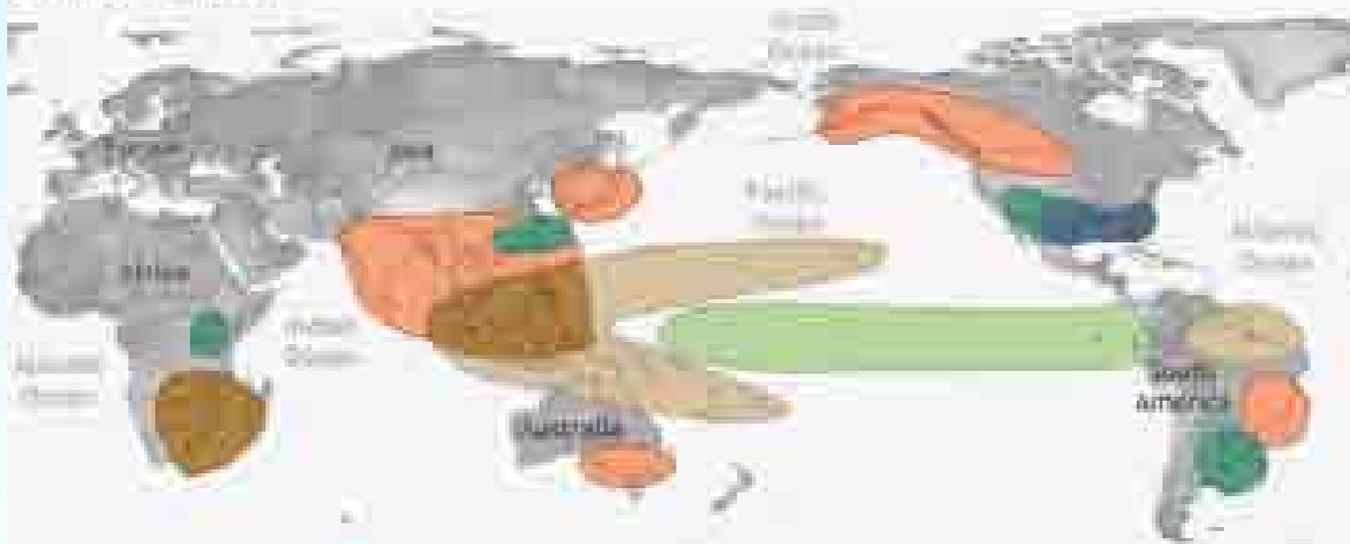
**Climate Data Library, CLIK, Climate Prediction Tool**



# El Niño impact

## EL NIÑO CLIMATE IMPACTS

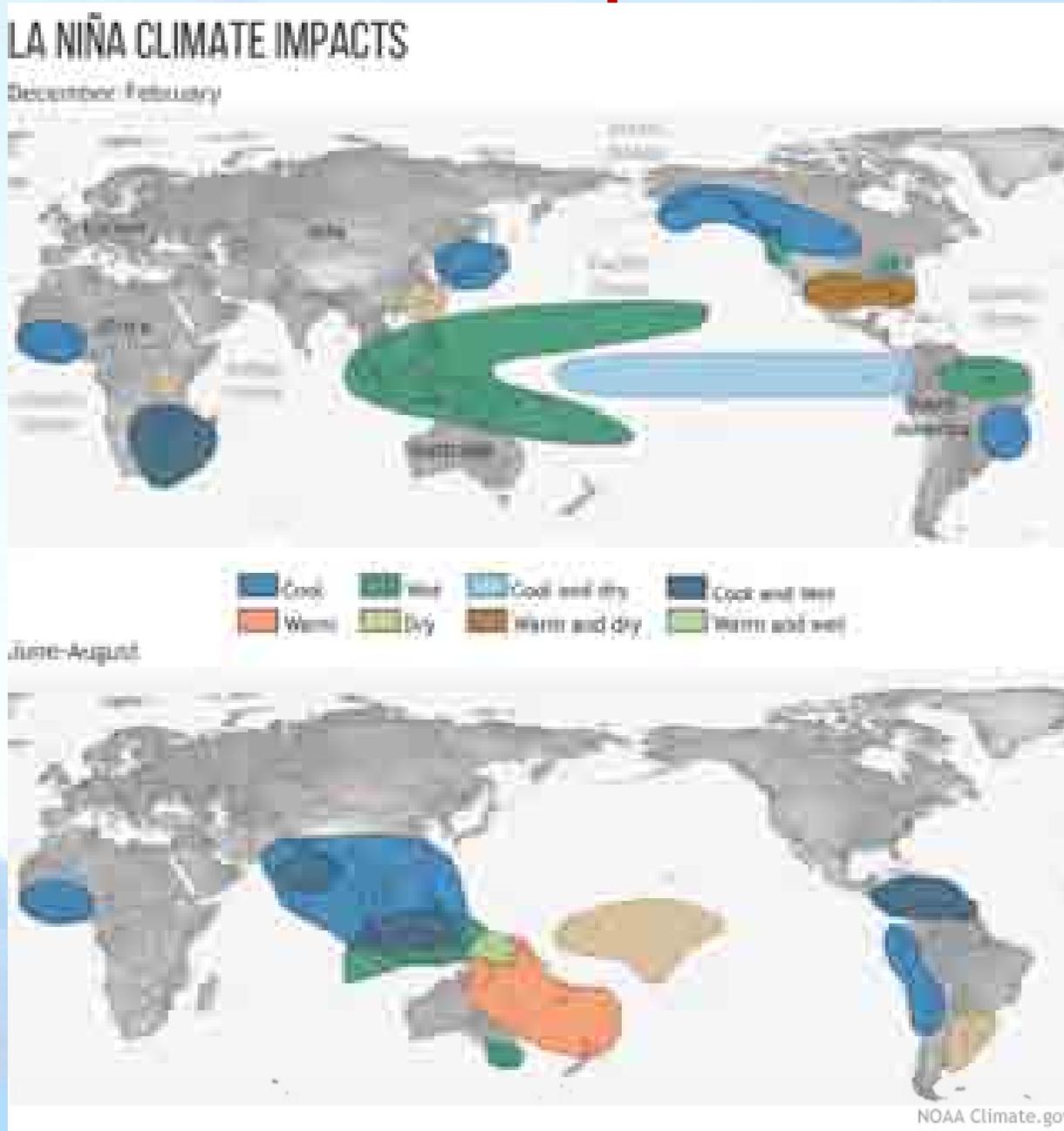
December-February



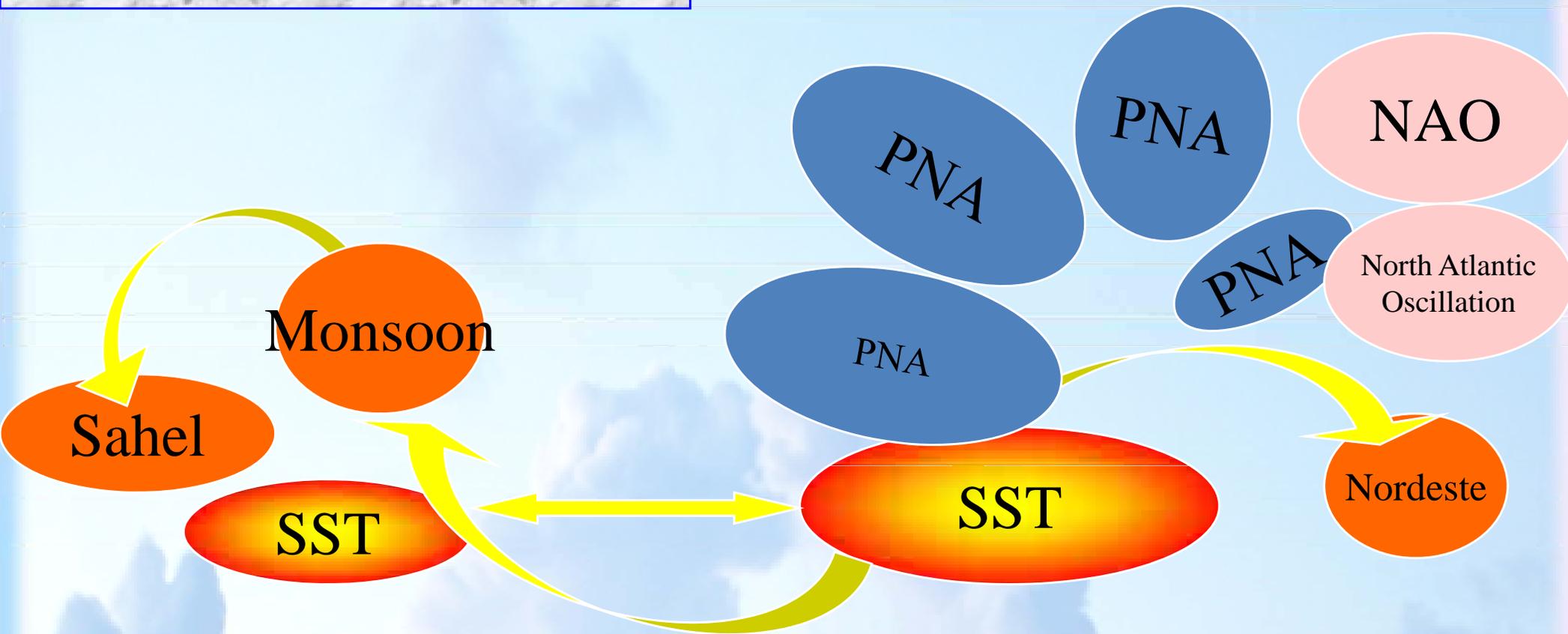
June-August



# La Niña impact



# Teleconnections



The interactions between atmosphere and oceans in the tropics dominate the variability at interannual scales. The main player is the variability in the equatorial Pacific. Wavetrains of anomaly stem from the region into the mid-latitudes, as the Pacific North American Pattern (PNA). The tropics are connected through the Pacific SST influence on the Indian Ocean SST and the monsoon, Sahel and Nordeste precipitation. It has been proposed that in certain years the circle is closed and a full chain of teleconnections goes all around the tropics. Also shown is the North Atlantic Oscillation a major mode of variability in the Euro-atlantic sector whose coupled nature is still under investigation.



# ENSO Diagnostic Discussion

Climate Prediction Center

## EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION

Issued by  
CLIMATE PREDICTION CENTER/NOAA  
and the International Research Institute for Climate and Society  
09 November 2017

ENSO Alert System Status: [ENSO Alert System Status](#)

Current ENSO Condition  
ENSO Evolution  
ENSO Index

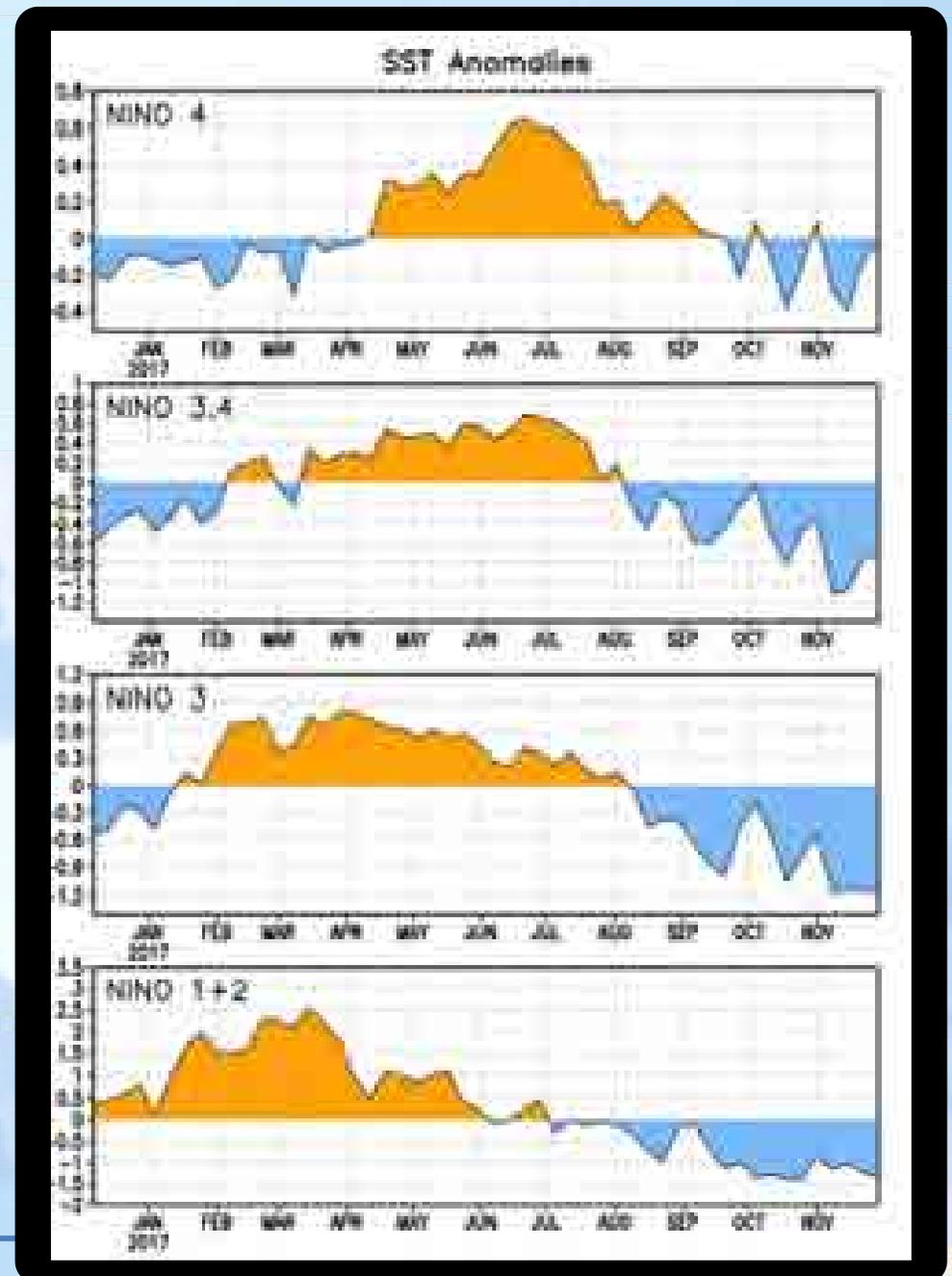
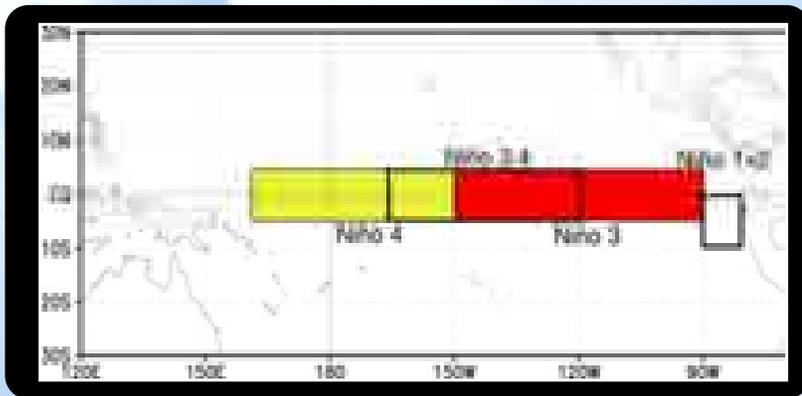
Sea Surface Temperature

Sub surface Temperature

# Niño Region SST Departures (°C) Recent Evolution

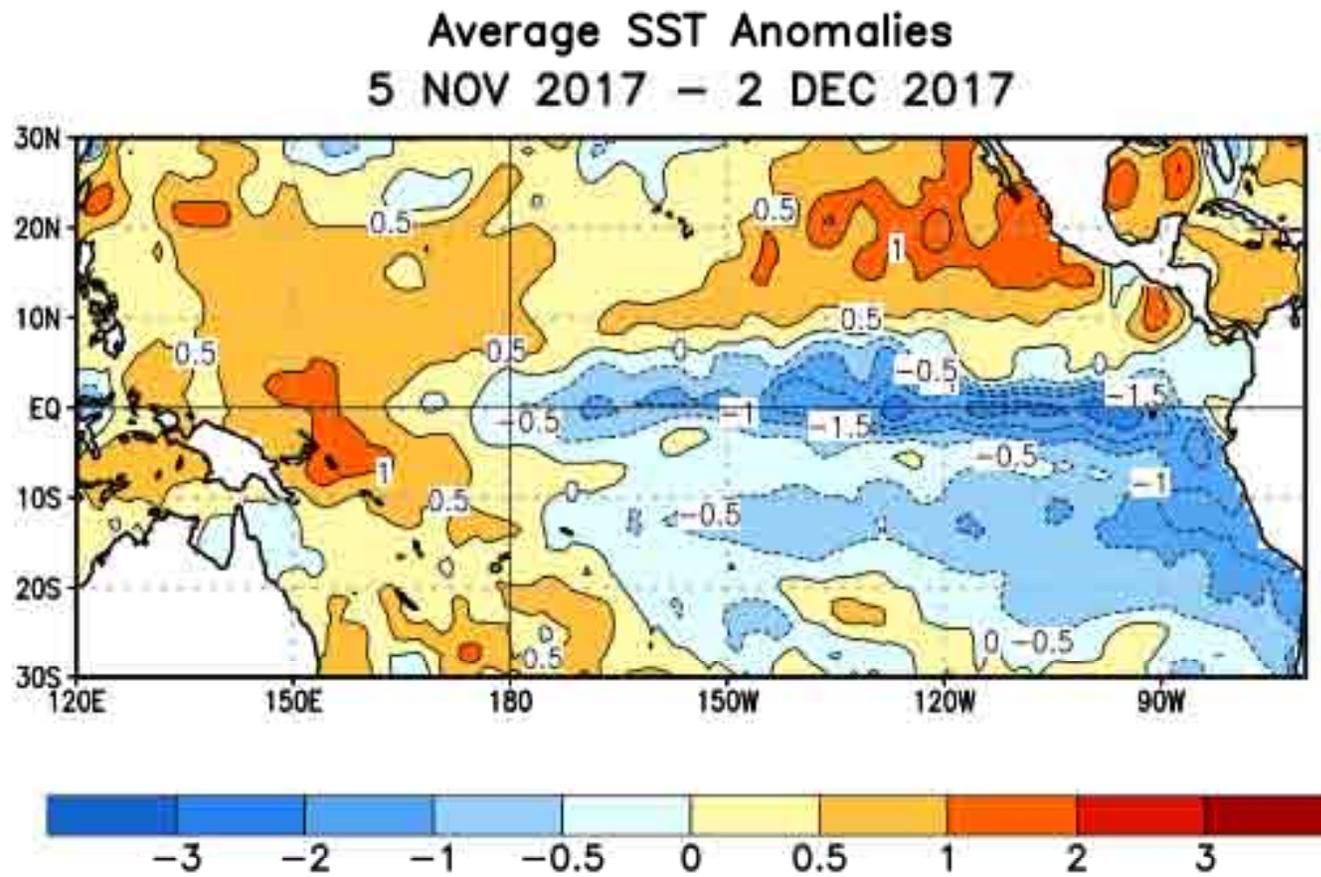
The latest weekly SST departures are:

Niño 4	0.0°C
Niño 3.4	-0.7°C
Niño 3	-1.1°C
Niño 1+2	-1.3°C



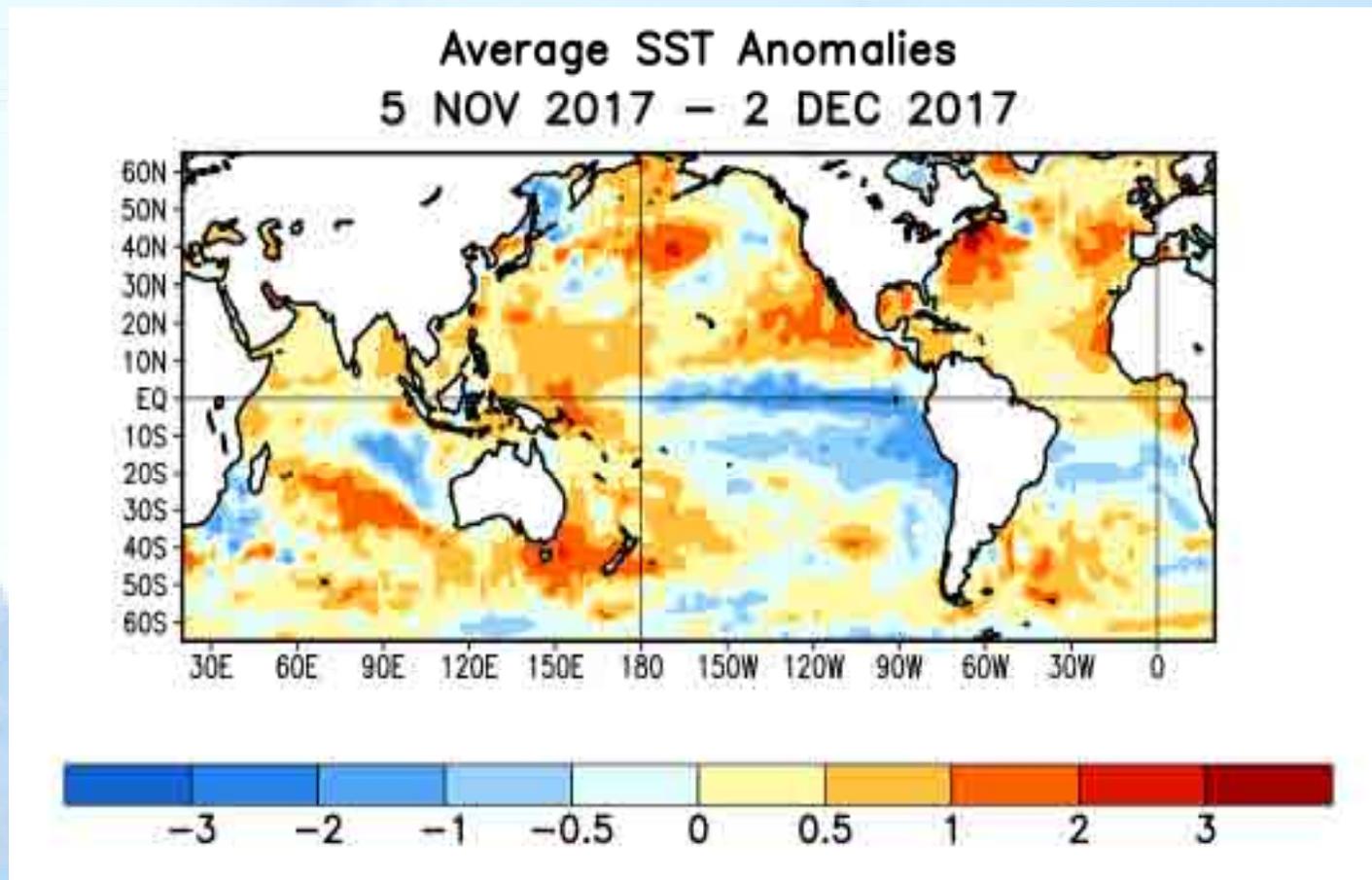
# SST Departures ( $^{\circ}\text{C}$ ) in the Tropical Pacific During the Last Four Weeks

During the last four weeks, equatorial SSTs were below average across the central and eastern Pacific Ocean, and above average in the far western Pacific.



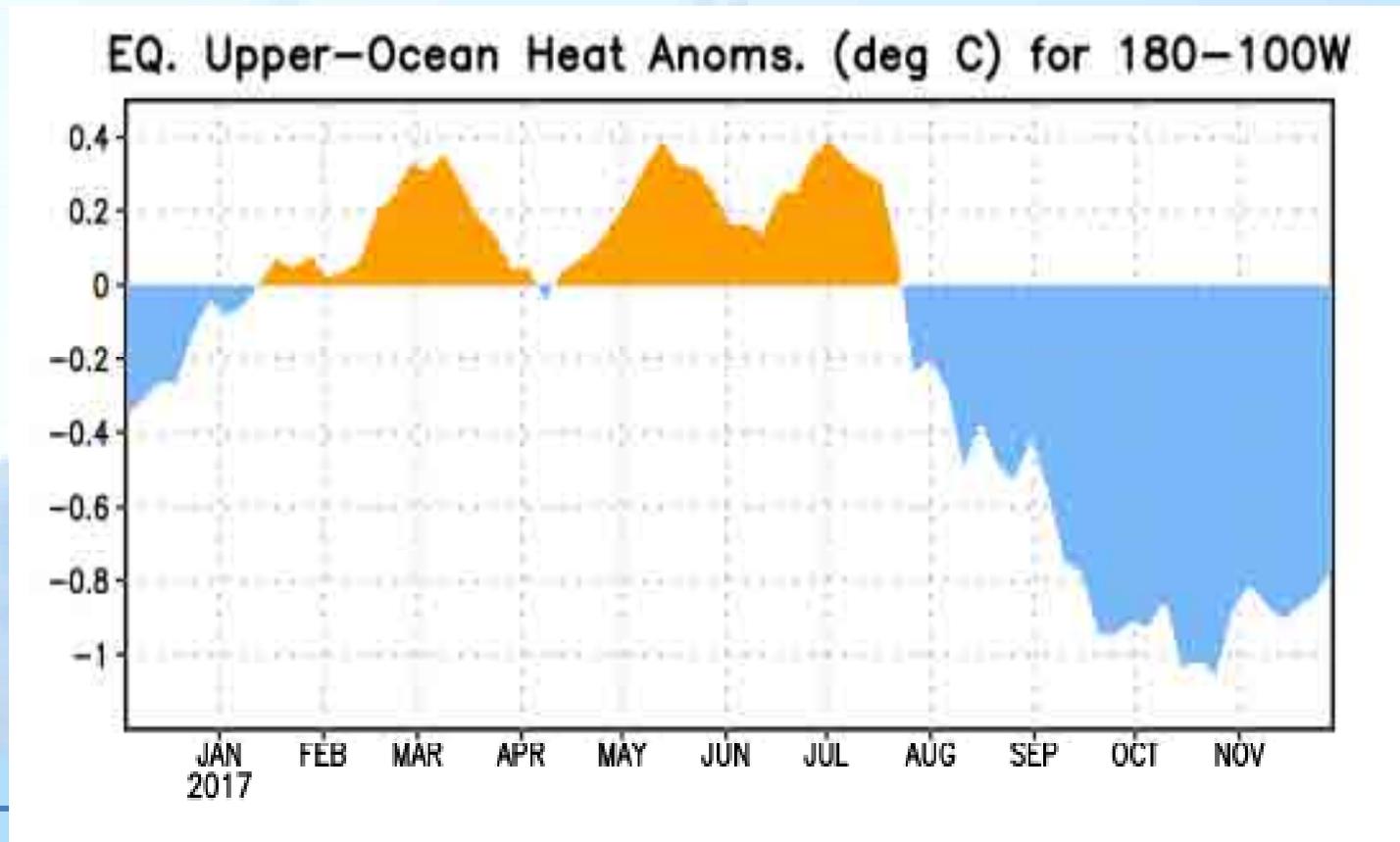
# Global SST Departures (°C) During the Last Four Weeks

During the last four weeks, equatorial SSTs were above average in the far western Pacific, eastern Atlantic, and eastern Indian Oceans. SSTs were below average in the central and eastern Pacific Ocean.



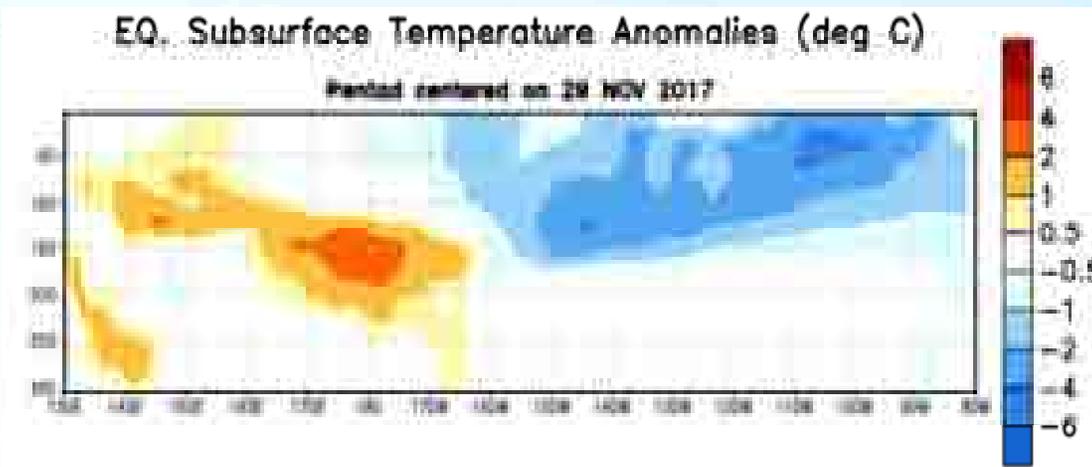
# Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

Negative subsurface temperature anomalies were present through December 2016. Positive anomalies with large fluctuations in amplitude were present from mid-January through mid-July 2017. Since mid-July, anomalies decreased and have remained negative.



# Sub-Surface Temperature Departures in the Equatorial Pacific

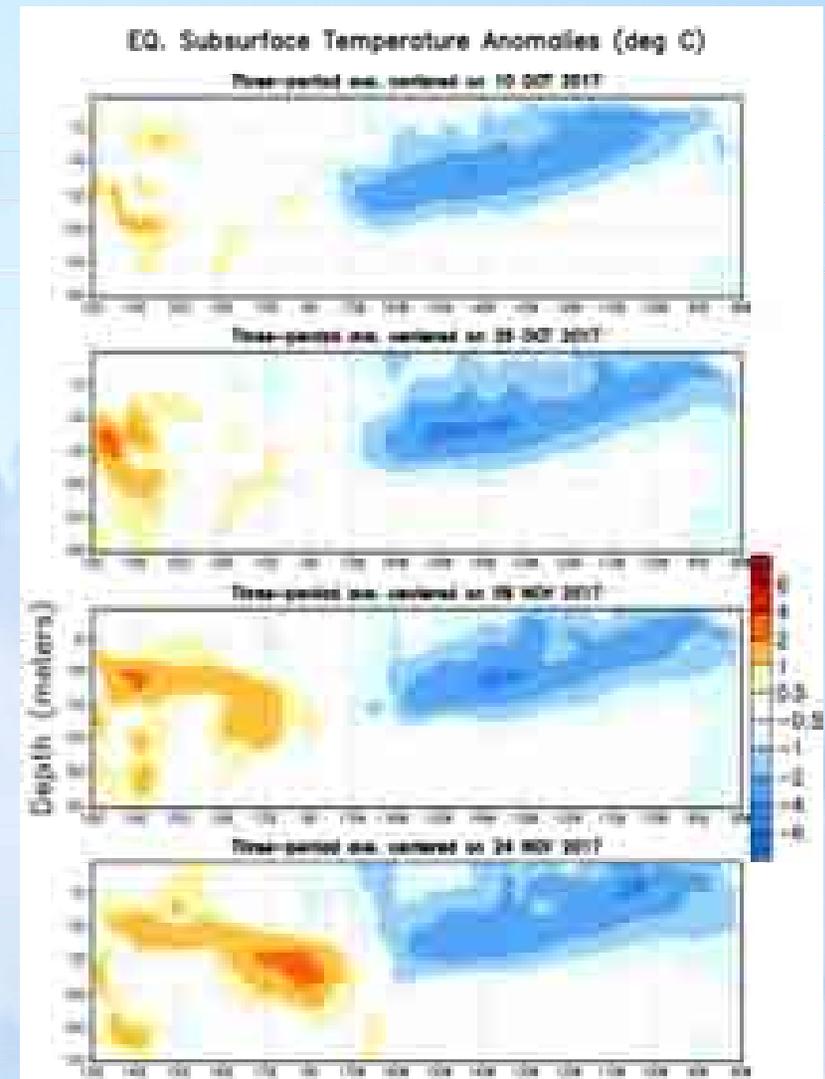
In the last two months, negative subsurface temperature anomalies have persisted across the central and eastern Pacific Ocean.



Most recent pentad analysis

Also, positive anomalies have increased in the western Pacific Ocean.

Recently, the strongest negative anomalies are between 160°W-80°W.



# Historical El Niño and La Niña Episodes Based on the ONI computed using ERSST.v5

Recent Pacific warm (red) and cold (blue) periods based on a threshold of +/- 0.5 °C for the Oceanic Nino Index (ONI) [3 month running mean of ERSST.v5 SST anomalies in the Nino 3.4 region (5N-5S, 120-170W)]. For historical purposes, periods of below and above normal SSTs are colored in blue and red when the threshold is met for a minimum of 5 consecutive over-lapping seasons.

The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found [here](#).

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2005	0.6	0.6	0.4	0.4	0.3	0.1	-0.1	-0.1	-0.1	-0.3	-0.6	-0.8
2006	-0.8	-0.7	-0.5	-0.3	0.0	0.0	0.1	0.3	0.5	0.7	0.9	0.9
2007	0.7	0.3	0.0	-0.2	-0.3	-0.4	-0.5	-0.8	-1.1	-1.4	-1.5	-1.6
2008	-1.6	-1.4	-1.2	-0.9	-0.8	-0.5	-0.4	-0.3	-0.3	-0.4	-0.6	-0.7
2009	-0.8	-0.7	-0.5	-0.2	0.1	0.4	0.5	0.5	0.7	1.0	1.3	1.6
2010	1.5	1.3	0.9	0.4	-0.1	-0.6	-1.0	-1.4	-1.6	-1.7	-1.7	-1.6
2011	-1.4	-1.1	-0.8	-0.6	-0.5	-0.4	-0.5	-0.7	-0.9	-1.1	-1.1	-1.0
2012	-0.8	-0.6	-0.5	-0.4	-0.2	0.1	0.3	0.3	0.3	0.2	0.0	-0.2
2013	-0.4	-0.3	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.3	-0.2	-0.2	-0.3
2014	-0.4	-0.4	-0.2	0.1	0.3	0.2	0.1	0.0	0.2	0.4	0.6	0.7
2015	0.6	0.6	0.6	0.8	1.0	1.2	1.5	1.8	2.1	2.4	2.5	2.6
2016	2.5	2.2	1.7	1.0	0.5	0.0	-0.3	-0.6	-0.7	-0.7	-0.7	-0.6
2017	-0.3	-0.1	0.1	0.3	0.4	0.4	0.1	-0.2	-0.4	-0.7		

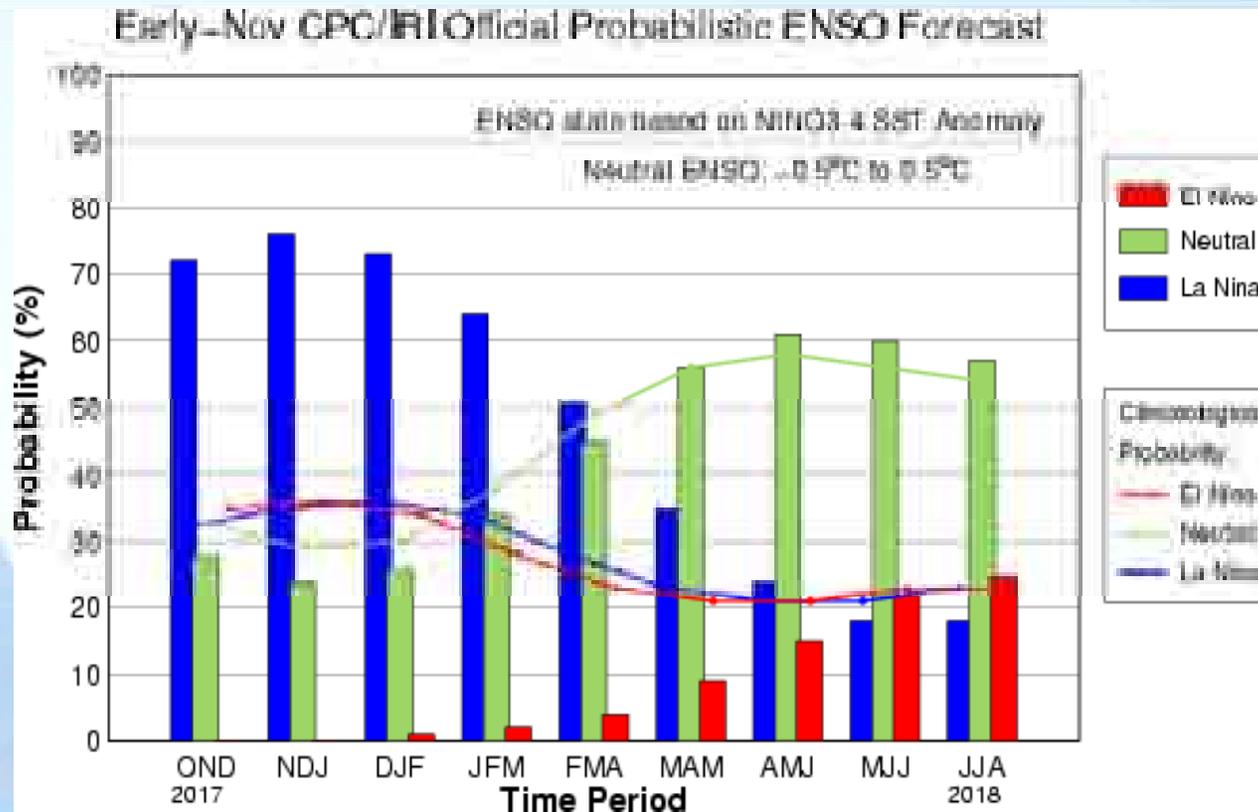




# CPC/IRI Probabilistic ENSO Outlook

Updated: 9 November 2017

La Niña conditions are predicted to continue (~65%-75% chance) at least through the Northern Hemisphere winter 2017-18, with a 51% chance of continuation through February-April 2018.





# ENSO Wrap-Up

**ENSO Wrap-Up**  
Current state of the Pacific and Indian oceans

La Niña established in tropical Pacific

Significant rise in the equatorial Indian Ocean sea level pressure during January 2016

The Indian Ocean Dipole (IOD) is established with a positive phase during the first half of April

**ENSO & IOD Forecast**

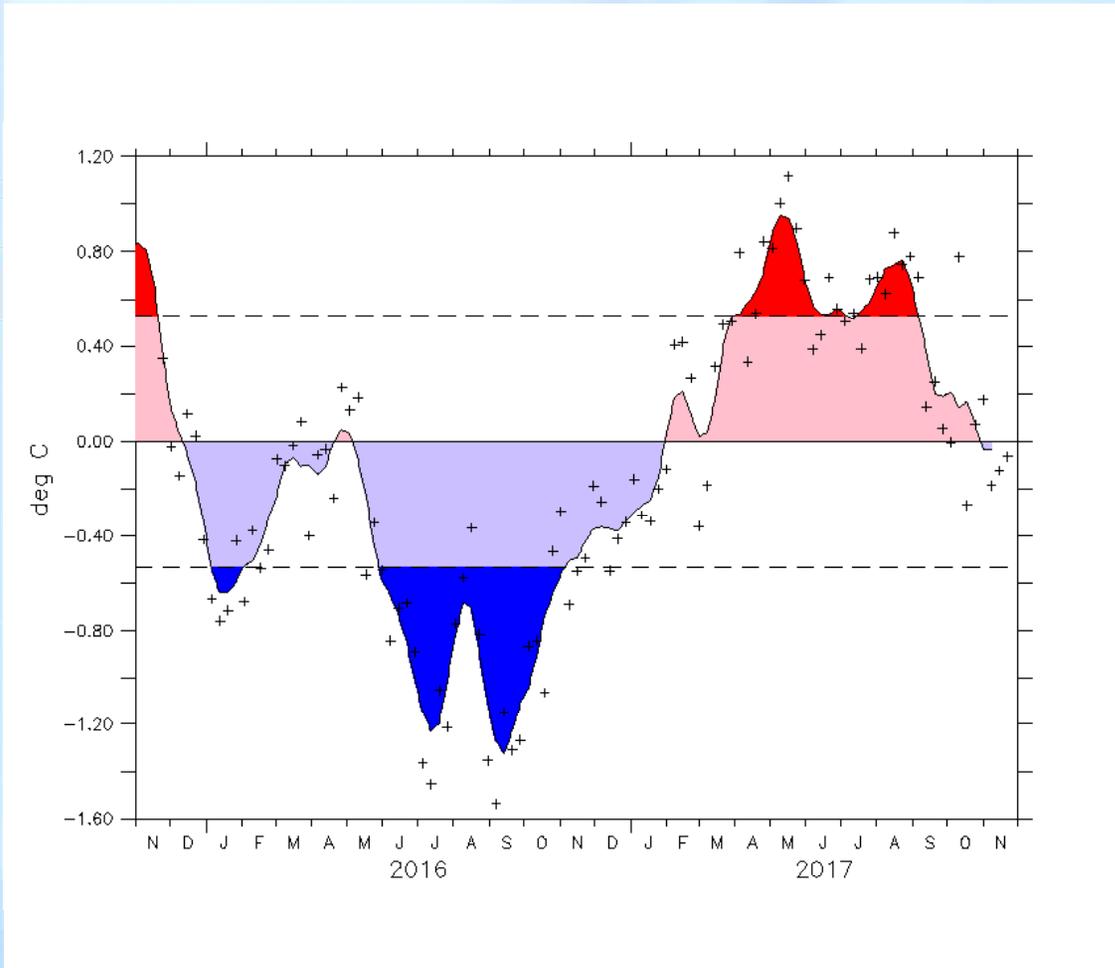
**Sea Surface Temperature**

**MJO**

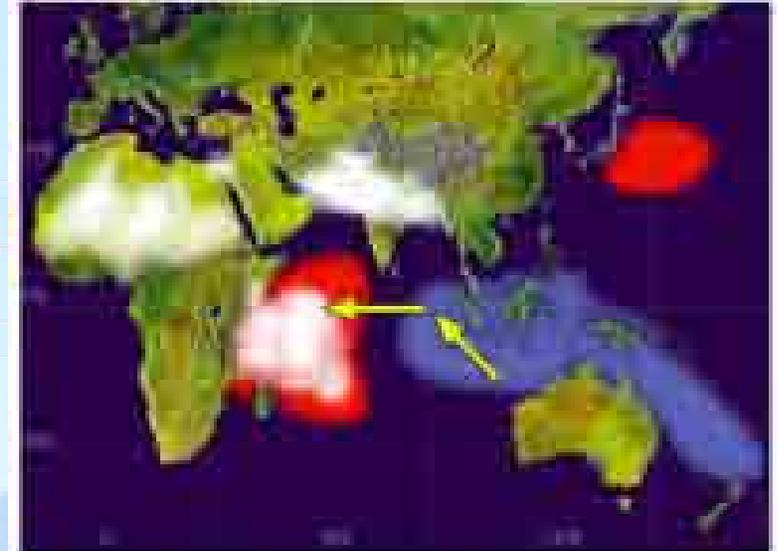
**SOI**



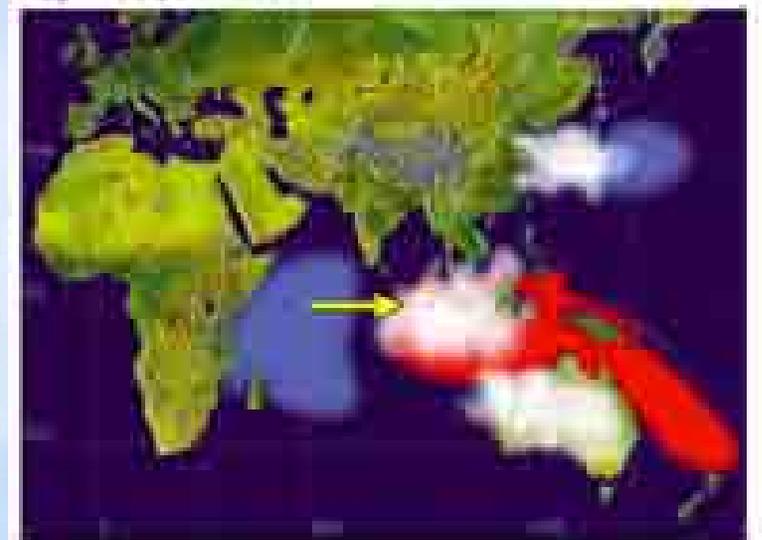
# Indian Ocean Dipole



Positive Dipole Mode



Negative Dipole Mode



# MJO Monitoring NCEP

The screenshot displays the NCEP Climate Prediction Center's MJO monitoring page. The page title is "Madden / Julian Oscillation (MJO)". It features a navigation menu on the left and a main content area with the following sections:

- Current Conditions**: A section with a table of data, including columns for "MJO Phase", "MJO Amplitude", and "MJO Index".
- Forecast**: A section with a table of data, including columns for "MJO Phase", "MJO Amplitude", and "MJO Index".
- Additional MJO Products**: A section with a table of data, including columns for "MJO Phase", "MJO Amplitude", and "MJO Index".
- Expert Discussion**: A section with a table of data, including columns for "MJO Phase", "MJO Amplitude", and "MJO Index".
- Composites**: A section with a table of data, including columns for "MJO Phase", "MJO Amplitude", and "MJO Index".
- Education Material**: A section with a table of data, including columns for "MJO Phase", "MJO Amplitude", and "MJO Index".
- Evolution**: A section with a table of data, including columns for "MJO Phase", "MJO Amplitude", and "MJO Index".

At the bottom of the page, there is a map of the Indian subcontinent showing the MJO phase and amplitude over the region.

Current status of MJO  
MJO Prediction



# MJO Monitoring Bureau of Meteorology Australia

**Madden-Julian Oscillation (MJO)**

The MJO phase diagram illustrates the progression of the MJO through eight phases, which generally alternate with weather along the equator. The diagram shows the progression of the MJO through eight phases, which generally alternate with weather along the equator. The diagram shows the progression of the MJO through eight phases, which generally alternate with weather along the equator.

**MJO phase diagram**  
Current Phase: 4th (MJO 4)

The MJO phase diagram illustrates the progression of the MJO through eight phases, which generally alternate with weather along the equator. The diagram shows the progression of the MJO through eight phases, which generally alternate with weather along the equator.

Updated date: 14th 2012 (14th 2012)

Current  
status  
Prediction



# Various Approaches used in Seasonal Prediction

## ❖ Empirical/ Statistical model

- Multiple Regression
- Canonical Correlation Analysis
- Artificial Neural Network
- Discriminant Analysis
- Ex: IMD Operational LRF

## ❖ Dynamical/ Numerical Model

- SST Forced Atmospheric General Circulation models (AGCMs)
- Ex: IMD SFM
- Coupled General Circulation Models (CGCMs)
- Ex: MMCFS

## ❖ Hybrid Model (Statistical + Dynamical)

- Statistical rescaling of dynamical model simulations

– based on historical observed data for the predictand (e.g. rainfall, temperature) and for relevant predictors (e.g. SST, atmospheric pressure)

– using prognostic physical equations

2-tiered systems (first predict SST, then climate).

1-tiered systems (predict ocean and atmosphere together)

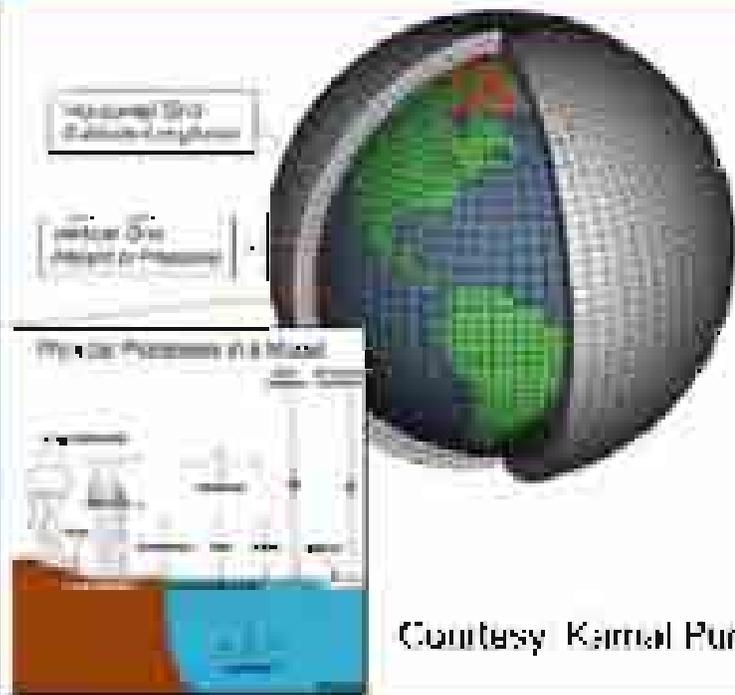
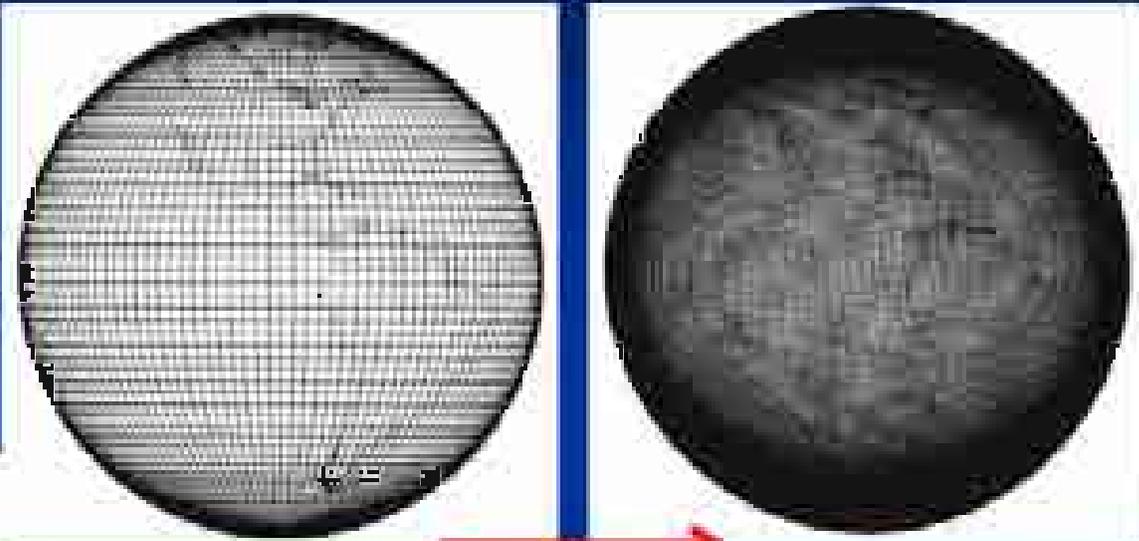


# Basis of a weather / climate model

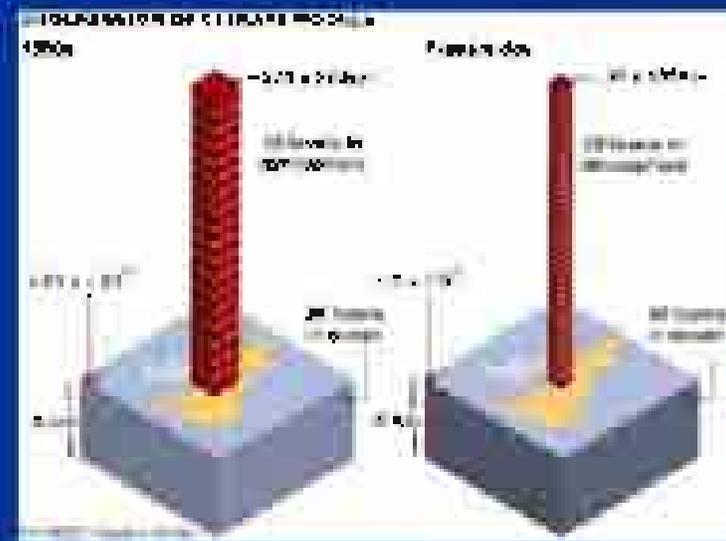
Representation of atmosphere temperature, wind, moisture, pressure on a grid

Equations of motions and laws of thermodynamics to predict rate of change of  $T, P, V, q, etc.$

10 Million equations  
100,000 Points  $\times$  100 Levels  $\times$  10 variables  
Time step - 10 minutes



Courtesy Karan Puri



# What should be parameterized ?

## Model Physics include:

- Radiation transfer.
- Surface processes.
- Vertical turbulent processes.
- Clouds and large-scale condensation.
- Cumulus convection.
- Gravity wave drag.



16 major physical processes in climate system. (from <http://www.meted.ucar.edu/nwp/pcu1/ic4/frame1.htm>)



# Probabilistic-Ensemble NWP

- ❖ There are several ways to produce probabilistic information but the most viable and popular is ensemble prediction.
- ❖ Instead of running one forecast, run a collection (ensemble) of forecasts, each starting from a different initial state or with different physics.
- ❖ The variations in the resulting forecasts can be used to estimate the uncertainty of the prediction.
- ❖ The ensemble mean is on average more skillful than any individual member.



# MoES AADITYA (790 TF)



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**INDIA METEOROLOGICAL DEPARTMENT**



# WMO Global Producing Centers



- Melbourne: Bureau of Meteorology (BoM), Australia
- Beijing: China Meteorological Administration (CMA)/  
Beijing Climate Center (BCC)
- Washington: Climate Prediction Center (CPC), NOAA,  
United States of America
- ECMWF: European Centre for Medium-Range Weather Forecasts
- Tokyo: Japan Meteorological Agency (JMA)/  
Tokyo Climate Centre (TCC)
- Seoul: Korea Meteorological Administration (KMA)
- Toulouse: Meteo-France
- Exeter: Met Office, United Kingdom
- Montreal: Meteorological Service of Canada (MSC)
- Pretoria: South African Weather Services (SAWS)
- Moscow: Hydrometeorological Centre of Russia
- CPTec: Center for weather forecasts and climate studies/  
National institute for space research (INPE)



# Regional Climate Centres

- ❖ **WMO RCCs are Centres of Excellence** intended to perform regional-scale climate functions
- ❖ Established at the request of the **Members of the Regional Associations**
- ❖ Official accreditation given by WMO after a successful 2- 4 yr demonstration phase
- ❖ Primary users are the **National Meteorological and Hydrological Services (NMHS)**
- ❖ RCCs are complementary to and supportive of NMHSs, who will deliver all warnings and national-scale products in the appropriate language.



# Regional Climate Centre (IMD, Pune)



Regional Climate Centre (RA II Region)  
India Meteorological Department, Pune



Home | Climate Monitoring | Climate Prediction | Climate of South Asia | Regional Products | Training | SASCOF

## What are WMO RCCs

WMO Regional Climate Centers (RCCs) are centres of excellence that create regional products including long-range forecasts that support regional and national climate activities, and thereby strengthen the capacity of WMO Members in a given region to deliver better climate services to national users.

## Mandatory RCC Functions

WMO RCCs perform the following set of mandatory functions covering the domains of long-range forecasting, LPTs, climate monitoring, data services and training.

## Forecast



### CFS Forecasts

Climate Forecast System for India and South Asia Region...

## Hindcast Verification



### CFS Hindcast

CFS Hindcast Verification for India and South Asia Region...

## SASCOF

IMD has taken responsibility for the preparation of annual regional forecast outlook for the SW Monsoon Season (April) under the regional forum known as the [SASCOF](#).

## ABOUT NCC

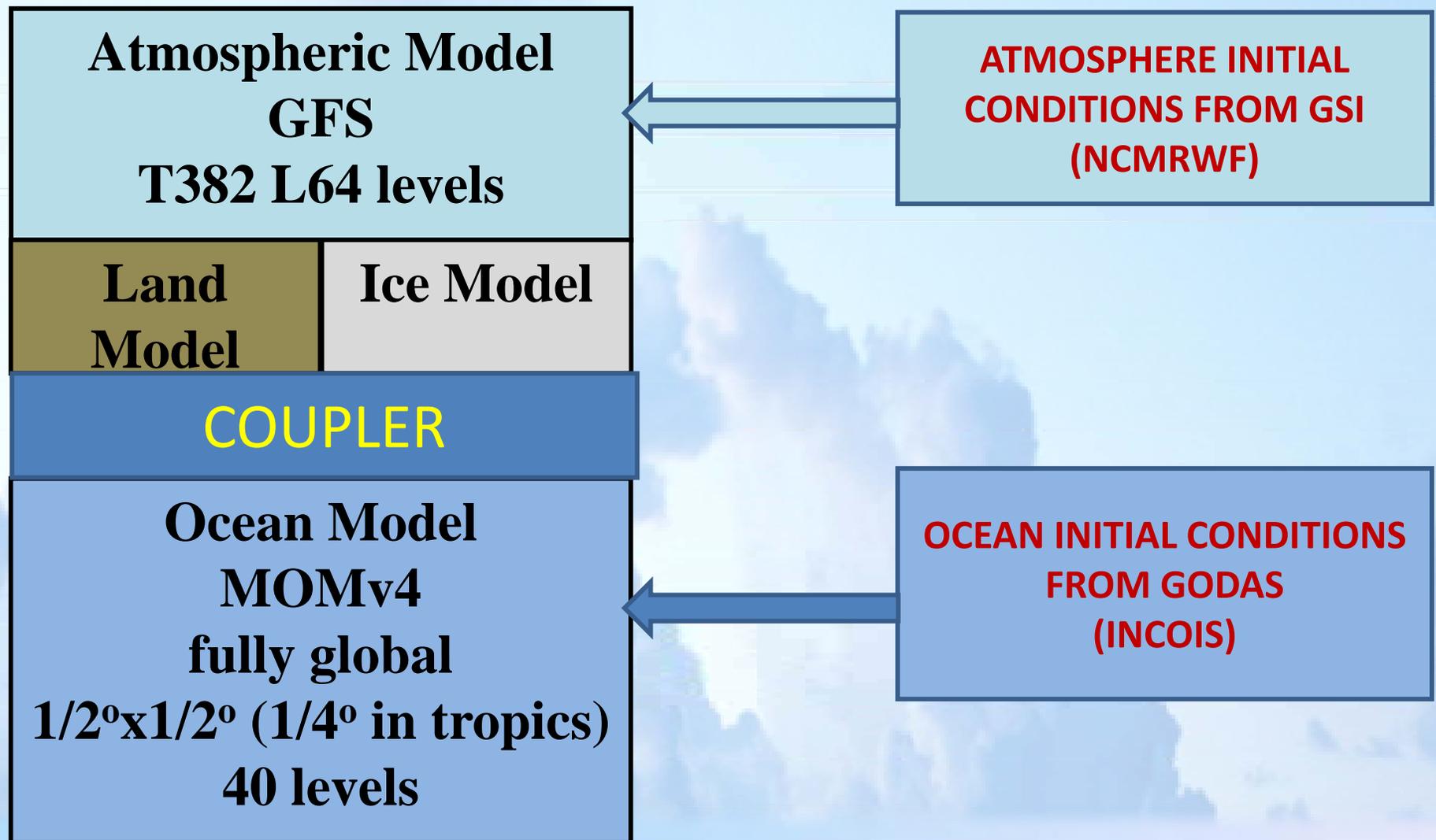
National Climate Centre (NCC), Pune which was established in 1995 by India Meteorological Department (IMD) with an objective to provide various climate related [... \(read more\)](#)



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INDIA METEOROLOGICAL DEPARTMENT



# Monsoon Mission CFS Model:





# Seasonal Climate Outlook for South Asia



Ministry of Earth System Science  
 Earth System Science Organization  
 India Meteorological Department  
 World Health Organization  
 (Demonstration Phase)  
 Pune, India

मौसम विज्ञान विभाग, भारत सरकार

(September to December 2014)

Issued on September 2014

- 1. The 2014-2015 season (September to August) is expected to be a normal to slightly above-normal one with respect to rainfall for the region. There is a high degree of inter-annual variability in the amount of rainfall over the region.
- 2. The 2014-2015 season (September to August) is expected to be a normal to slightly above-normal one with respect to rainfall for the region. There is a high degree of inter-annual variability in the amount of rainfall over the region.
- 3. The 2014-2015 season (September to August) is expected to be a normal to slightly above-normal one with respect to rainfall for the region. There is a high degree of inter-annual variability in the amount of rainfall over the region.
- 4. The 2014-2015 season (September to August) is expected to be a normal to slightly above-normal one with respect to rainfall for the region. There is a high degree of inter-annual variability in the amount of rainfall over the region.

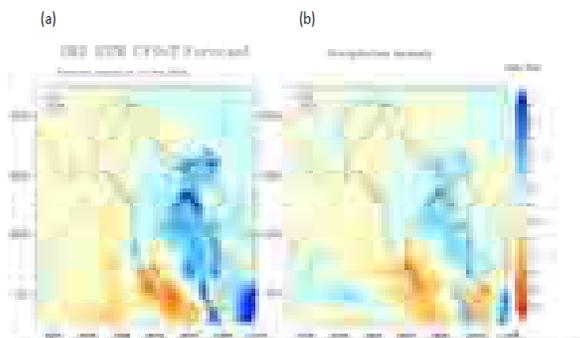


Fig. 1. Seasonal rainfall anomalies (mm) (a) ISM 2014-2015 Forecast (September to August) and (b) September season.

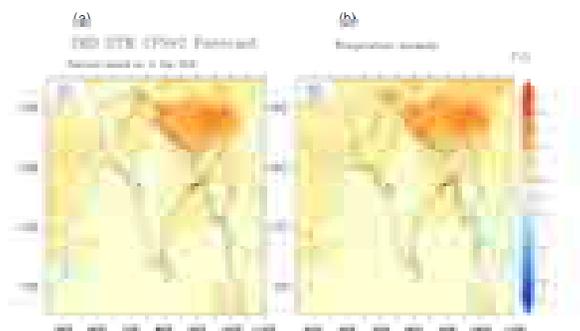


Fig. 2. Monthly rainfall anomalies (mm) (a) ISM 2014-2015 Forecast (September to August) and (b) August season.

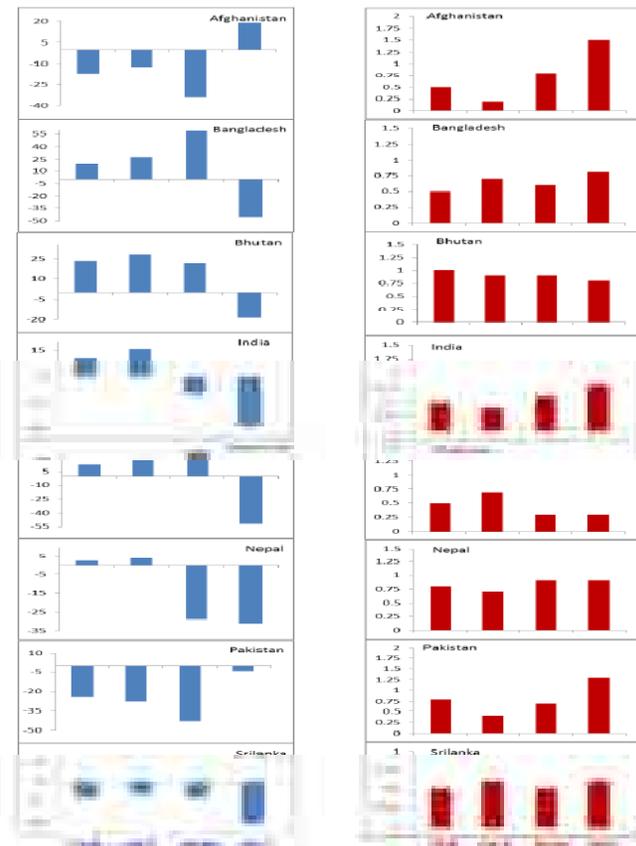
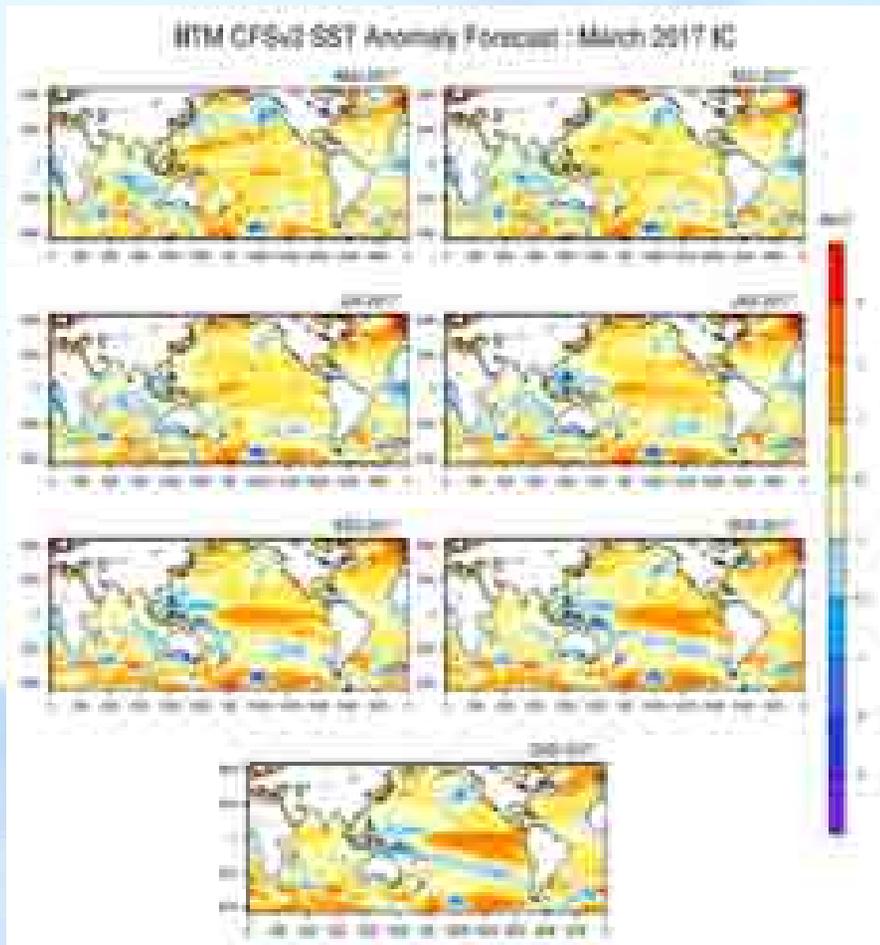


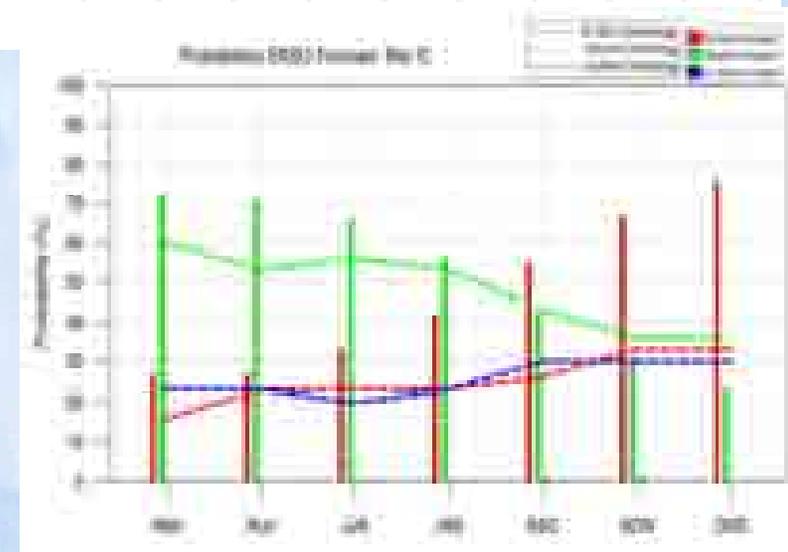
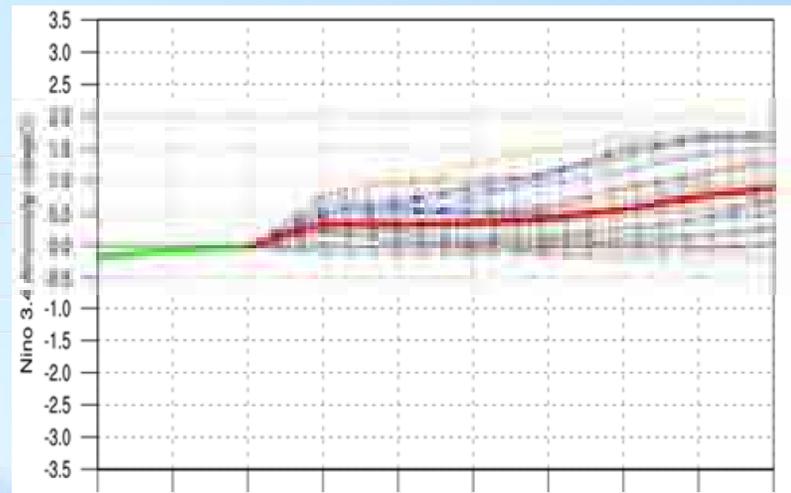
Fig. 3. Monthly rainfall anomalies (mm) (a) ISM 2014-2015 Forecast (September to August) and (b) 2014-2015 actual data (September to August) for various South Asian countries.



# ENSO Forecast - MMCFS: March IC



Plume of Nino 3.4 PDF Corrected Model Forecast – Mar IC



**Enso Neutral conditions are likely till mid -2017 with increased probability (>50%) for the development of El Nino from ASO onwards**

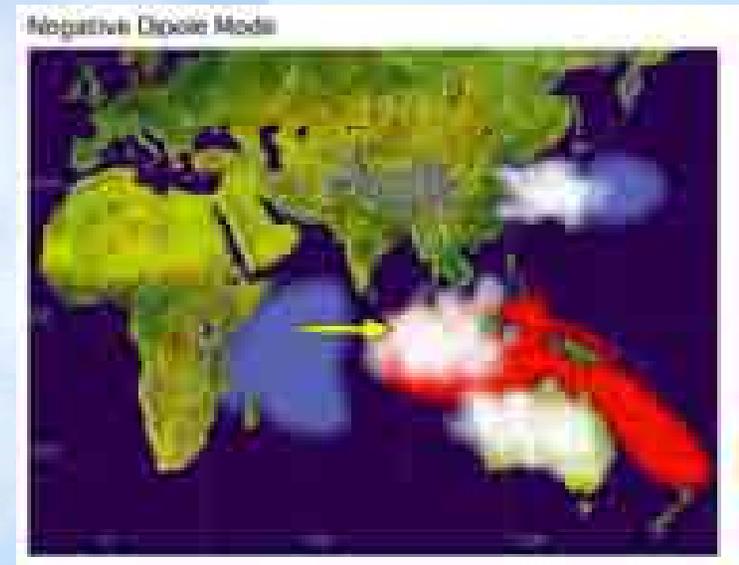
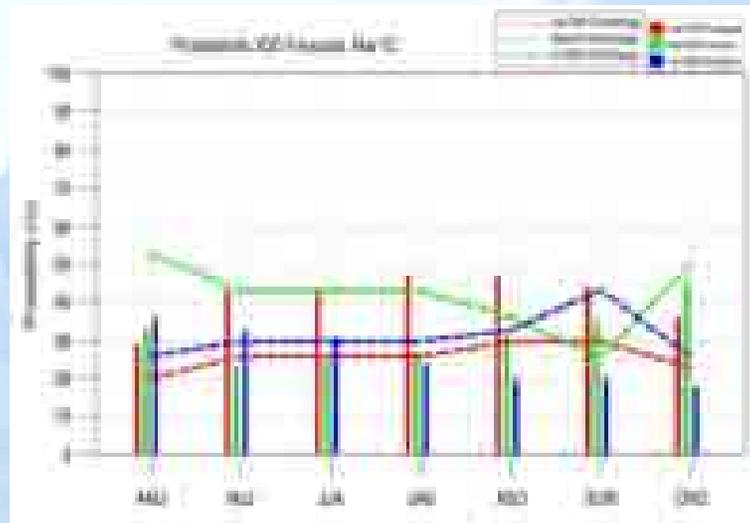
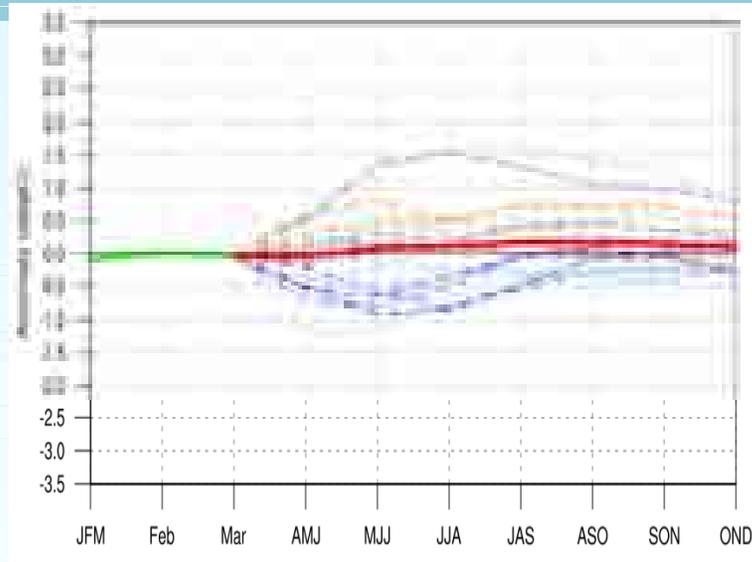


14-Nov-19

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INDIA METEOROLOGICAL DEPARTMENT



# Indian Ocean Dipole: IMD-IITM CFS

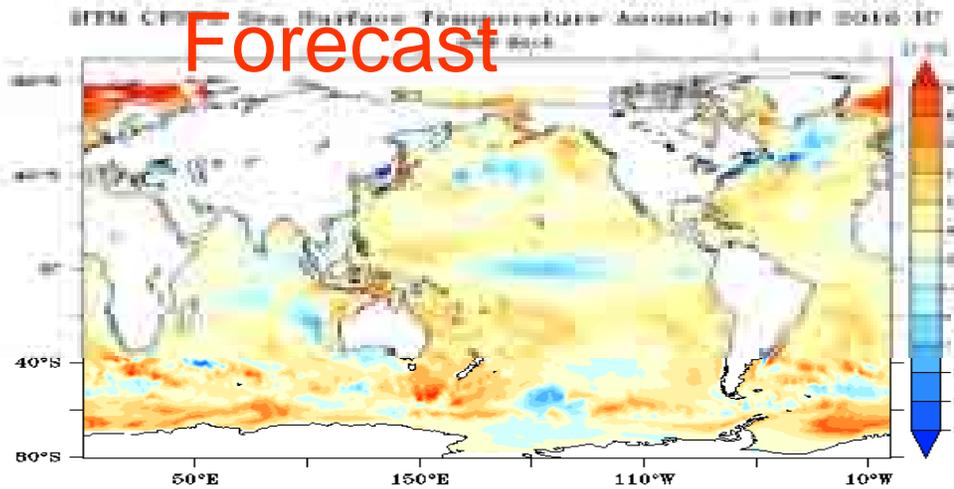


**IOD forecast: The current neutral conditions are likely to turn to positive IOD conditions during the later part of the monsoon season.**

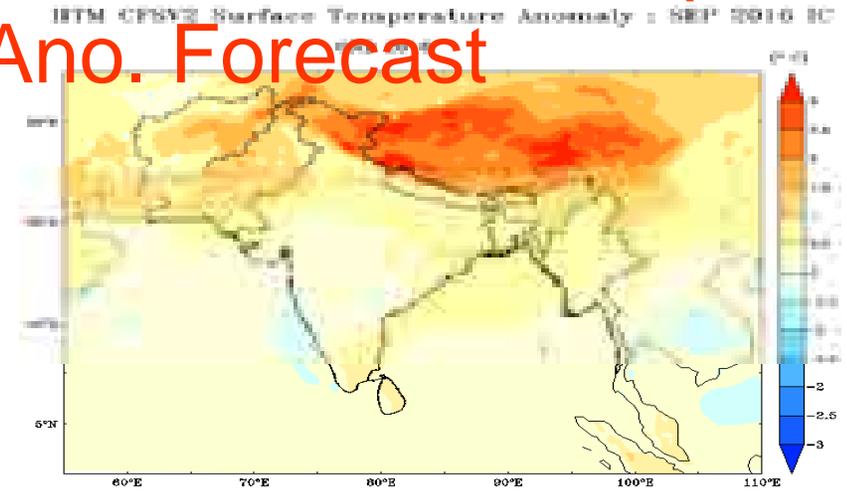


# Products based on CFS: LRF Maps

Global SST Ano.  
Forecast

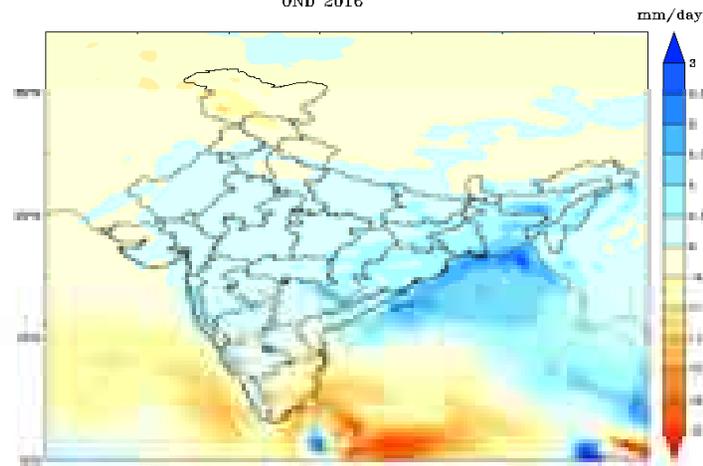


South Asia 2m Temp.  
Ano. Forecast



IITM CFSV2 Rainfall Anomaly : SEP 2016 IC

OND 2016

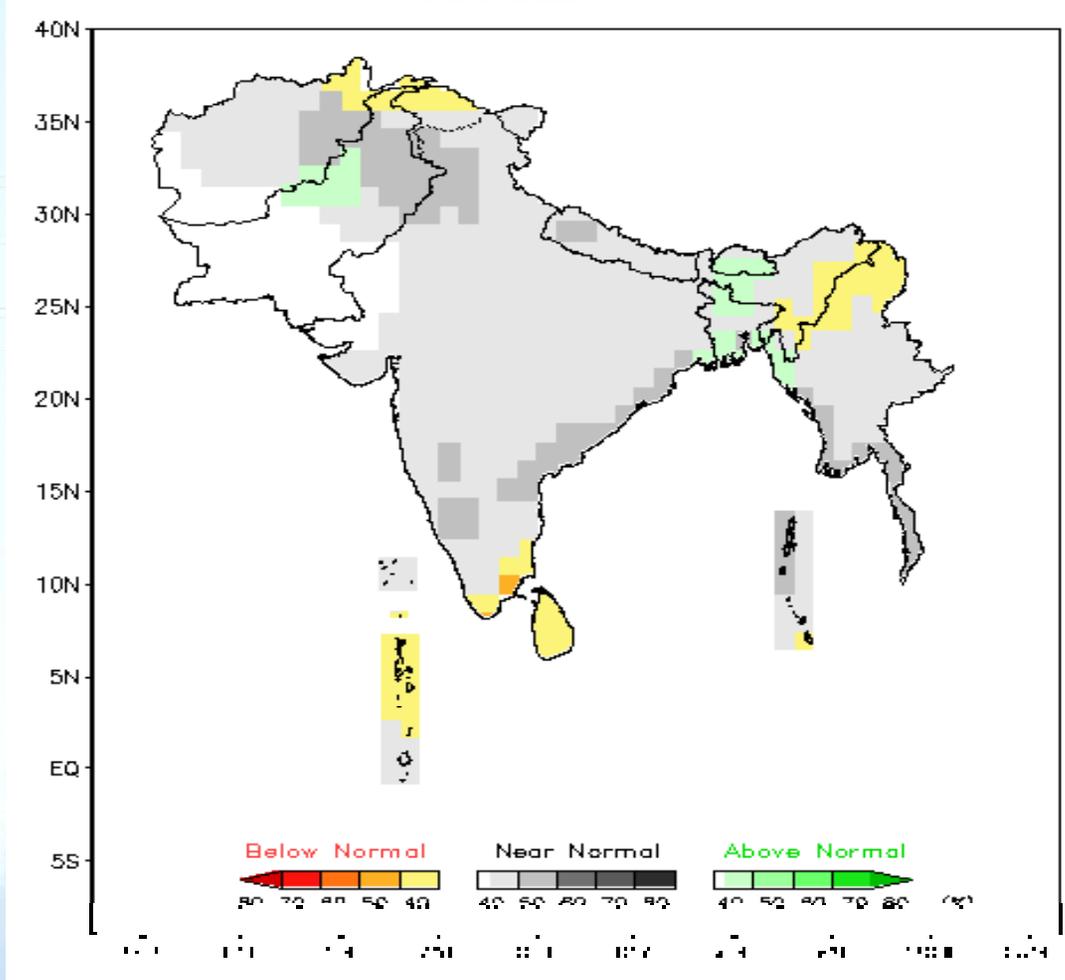


India Rainfall  
Ano. Forecast



# Consensus Forecast Map: 2016 Northeast Monsoon Season (OND)

## OND

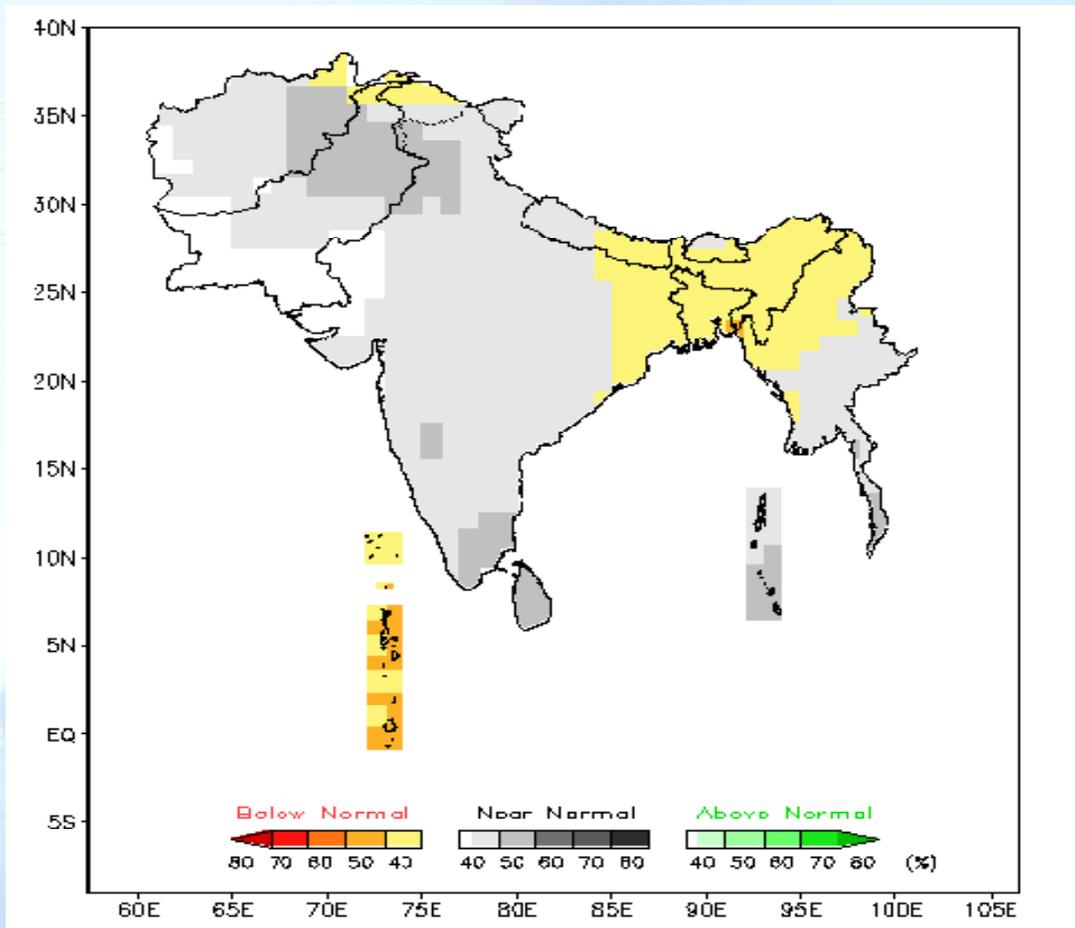


Normal rainfall is most likely over most parts of south Asia during the 2016 Northeast monsoon season (October – December). However, below normal rainfall is likely over some areas of southeast peninsular India, Sri Lanka and Maldives. Below normal rainfall is also likely over some areas of north and eastern parts of the region. Above normal rainfall is likely over western and northwestern parts of Pakistan and some northeastern parts of the region.

During the season, normal to slightly above normal temperatures are likely, over most parts of the region.



# Consensus outlook for DJF 2016/2017 over South Asia



Below normal precipitation is likely during the Winter Season (December 2016 to February 2017) over northern most parts of the south Asia, Maldives & neighboring Lakshadweep, and northeastern parts of South Asia including northeast India, east Nepal, Bhutan, and northern parts of Myanmar. Normal precipitation is likely over the remaining parts of the region.

During the season, normal to above normal temperatures are likely, over most parts of the region.



# Beijing Climate Center (BCC)



Beijing Climate Center

Climate | 1638

About BCC

Services

Infrastructure

Monitoring

Training

## FOCRAII 2017 Successfully Convened



Sponsored by World Meteorological Organization (WMO) and China Meteorological Administration (CMA), co-sponsored by WMO East Asian Monsoon Activity Centre (EAMAC) and hosted by the Beijing Climate Center of CMA, the Twelfth Session of the Forum on Regional Climate Monitoring Assessment (FOCRAII) was successfully convened during 24-28 April 2017 in Beijing, China. During the opening ceremony, Dr. Chai Jingnan, Deputy Director General of Beijing Climate Center (BCC), and Ms. Anshu Chowdhury, Representative of WMO (Switzerland), made speeches respectively. Dr. Chai introduced the programme of the opening event. [Read More »](#)



- WMO: Global Precipitation Climate Monitoring through Forecast
- IAWQ: East Asian Monsoon Activity Centre
- CEMA: Global for the Monitoring and Assessment of Climate Warming and Climate Change Impact
- BCC: Forum on Regional Climate Monitoring Assessment and Prediction for Asia



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# Tokyo Climate Center (TCC)



# WMO Lead Center for LRFMME



WMO Lead Centre for  
Long-Range Forecast Multi-Model Ensemble

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WMO Lead Centre for LRFMME

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## Global Forecast data



## Global Forecast data

### News / News

- Global Forecast** - A new forecast of LC-LRFMME is published. 2018-08-10
- Latest update of the LC-LRFMME website is published.** 2018-08-10
- All IPCC(1.0) for 1980-2017 are submitted.** 2017-10-24
- All IPCC(1.0) for 2010-2017 are submitted.** 2017-10-24

### WMO Global Forecast Centre

Global Forecast Centre

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INDIA METEOROLOGICAL DEPARTMENT



# List of GPCs : system configuration information

	Beijing (BCC)	CPTEC (CPTEC)	ECMWF (ECMWF)	EXETER (EXETER)	Melbourne (POAMA)	Montreal (MSC)	Moscow (HMC)	Pretoria (SAWS)	Seoul (GDAPS)	Tokyo (TCC)	Toulouse (Toulouse)	Washington (NCEP)
<b>Model Res.</b>	T63/L16	T62/L28	T255/L91	0.83 <sup>q</sup> x 0.56 <sup>e</sup> /L85	T47L17	T63	1.125 <sup>q</sup> x 1.40625 <sup>e</sup> /L28	T42/L19	T106/L21	1.875 <sup>e</sup> x1.875 <sup>e</sup> /L40	T63L91	T126/L64
<b>Forecast</b>												
<b>Forecasting range</b>	5 months	6 months	6 months	5 months	8 months	11 months	3 months	4 months	5 months	6 months	6 months	8 months
<b>Data</b>	Mean, Climate	Mean, Climate	Anomaly	Mean	Mean, Anomaly	Mean, Climate	Mean	Anomaly	Mean, Climate	Mean, Anomaly	Mean, Anomaly	Anomaly
<b>Members</b>	48	15	41	42	30	20 (2model x 10)	20	6	20	51	41	40
<b>Hindcast</b>												
<b>Hindcast Period</b>	1983~2004	1979~2001	1981~2010	1996~2009	1960~2010	1981~2010	1981~2010	1981~2001	1979~2012	1979~2010	1979~2007	1981~2010
<b>Data</b>	O	O	X	O	O	O	O	X	O	O	X	O
<b>Members</b>	48	10	15	12	10	20 (2model x 10)	10	6	20	10	11	20

- Variable: T2m, SST, PREC, MSLP, T850, Z500
- Resolution: 2.5° x 2.5° (144 x73 grids)

: 2-Tier GCM  
 : 1-Tier GCM (coupled)





# Seasonal Forecast : IRI

Seasonal Forecast

Precipitation

Temperature

Global & Regional

International Research Institute for Climate and Society

Seasonal Climate Forecast

IRI Multi-Model Probability Forecast for Precipitation for December-January-February 2017, Issued November 2017

Probability (%) of Most Likely Category

Wetter (Yellow to Red) Drier (Green to Blue)

Discussion

November 2017 Small-Forecast Discussion for Asia

For more information, visit the IRI website at [www.iri.columbia.edu](http://www.iri.columbia.edu) or contact IRI at [iri@iri.columbia.edu](mailto:iri@iri.columbia.edu).

वेसाग



# APEC Climate Center : Seasonal Forecast

**Climate Outlook for December 2017 - May 2018**

**Temperature and Precipitation Outlook**

**Forecast for December 2017 - February 2018**

Strongly enhanced probability for above normal temperatures is predicted for the subtropical North Pacific, western South Pacific, Bering Sea, maritime continent, most of North Atlantic spanning Gulf of Guinea, Caribbean and Arabia Seas, western, southern, and eastern Indian Ocean, and Norwegian and Barents Seas. Enhanced probability for above normal temperatures is expected for the Arctic and Antarctic, China, Russia, India, Saudi Arabia, most countries of Europe, and USA. Enhanced probability for below normal temperatures is expected for the eastern equatorial Pacific, southeastern Indian Ocean, and some parts of the austral seas. Strongly enhanced probability for above normal precipitation is predicted for the off-equatorial North Pacific. Enhanced probability for above normal precipitation is predicted for the Arctic and southern Philippine Sea. Strongly enhanced probability for below normal precipitation is expected for the western and central equatorial Pacific. Enhanced probability for near normal precipitation is predicted for the eastern equatorial Pacific.

Seasonal Forecast

Precipitation

Temperature

Global & Regional



# Decision-making across timescales



- Begin planning and monitoring of forecasts
- Update contingency plans
- Sensitize communities
- Enable early-warning systems
- Continue monitoring
- Adjust plans
- Warn communities
- Local preparation activities
- Activate response
- Instruction to communities to evacuate, if needed



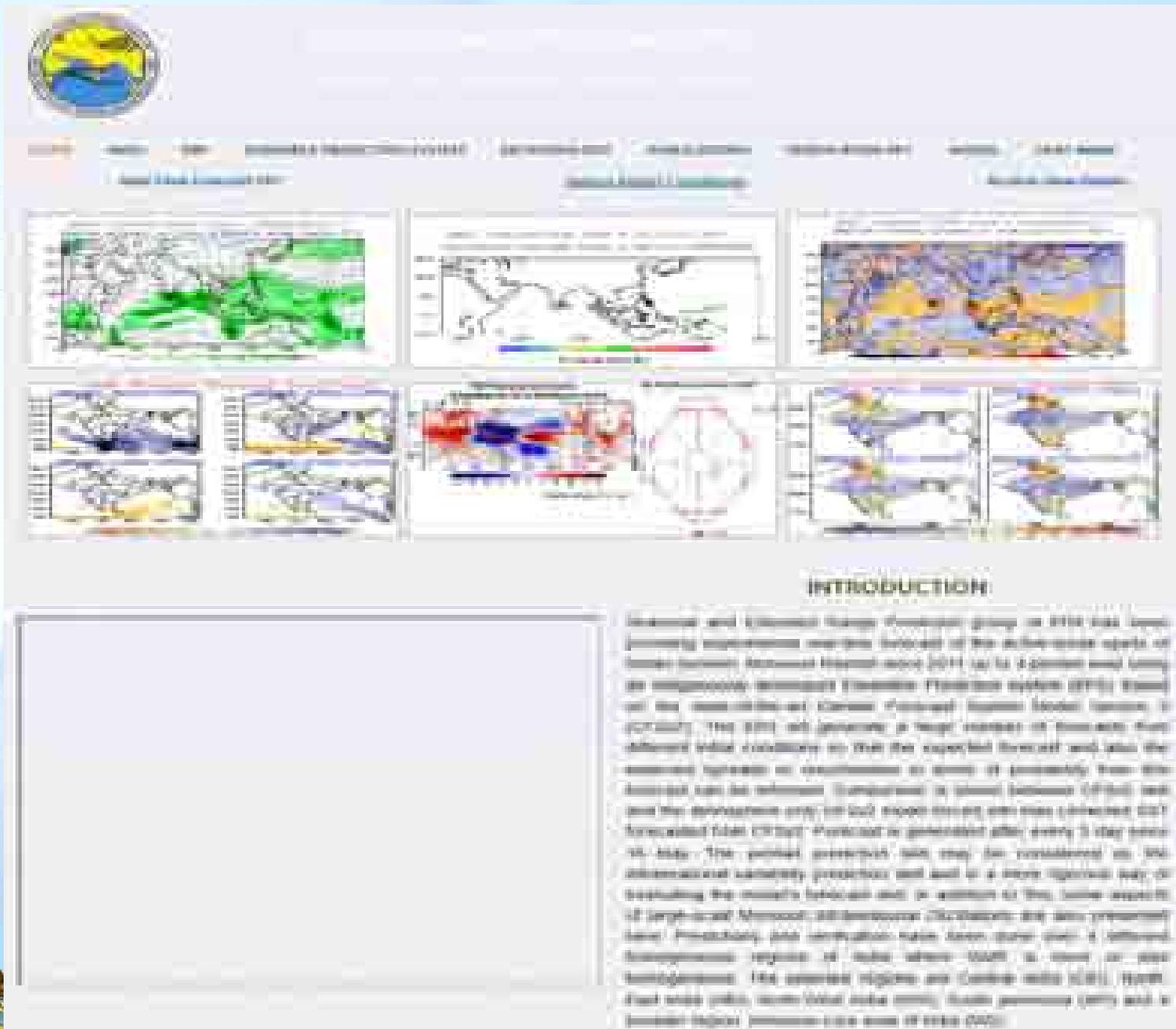
# Prediction systems for other time scales

**Extended range dynamical forecasting systems (four weeks)**

**Short range dynamical systems (5 days)**



# Extended Range Prediction IITM



Forecast for:  
Rainfall

Temperature

Wind

Soil Moisture

Cyclogenesis  
Potential  
MJO



# Extended Range Prediction IMD



Operational Extended Range Forecast For 54 Weeks

Forecast for:  
Rainfall  
Temperature  
Wind

Over the years, there have been some efforts by various research groups to predict the monsoon and tropical weather on extended range time scale. The extended range forecasting (forecast between 7 and 30 days) fills the gap between mid-range weather forecasting and seasonal forecasting. It is often considered a difficult time range for weather forecasting, since the time scale is sufficiently long so that much of the memory of the atmosphere initial conditions is lost, and it is generally too short so that the variability of the ocean is not large enough, which makes it difficult to deal perturbations. Since the Monsoon Joint Institute (MJI) is the most important mode of tropical ocean-atmosphere coupling with potentially important influences on the monsoon activity in the Asian region, the capability of statistical or empirical models in capturing MJO signal is very crucial in capturing the inter-annual cycle of monsoon. Recently, with the efforts from the Ministry of Earth Sciences (MoES), operational implementation of coupled model with a suite of models from CFSv2 coupled model has been implemented in IMD during July 2016. This dynamical predictive system developed at ITM has been transferred to IMD and the same has been implemented by IMD for generating operational Extended Range Forecast products. This suite of models at different resolutions with atmosphere and ocean initial conditions obtained from NCEP2000 and 2000C2 reanalysis system respectively are (i) CFSv2 at T382 (2.8 deg), (ii) CFSv2 at T126 (2.25 deg), (iii) CFSv2 (sea-ice-coupled SST from CFSv2) at T382 and (iv) CFSv2 at T126. The operational suite is posted in AGITCA NPCC at ITM Pune for day-to-day operational use. The Multimodel ensemble (MME) out of the above 4 suite of models are run operationally for 28 days based on every Wednesday initial condition with 4 ensemble members (sea control and 3 perturbed) each for CFSv2T382, CFSv2T126, CFSv2T382 and CFSv2T126. The same suite of model are also run on historical mode for 18 years (2003-2020). The average ensemble forecast accuracy of all the 4 suite of model runs at a forecast lead of 15-days each is calculated by substituting corresponding 15-days model historical atmospheric. For the preparation of mean and anomaly forecast on every Thursday, month is held for 4 weeks for days 1- 4 (week), Friday to Thursday, days 5-8 (week), Friday to Thursday, days 9-12 (week), Friday to Thursday, days 13-16 (week), Friday to Thursday, days 17-20 (week), Friday to Thursday, days 21-24 (week), Friday to Thursday, days 25-28 (week).

OPERATIONAL & HISTORICAL

Week 1 (01-07 Dec) Week 2 (08-14 Dec), Week 3 (15-21 Dec) and week 4 (22-28 Dec)

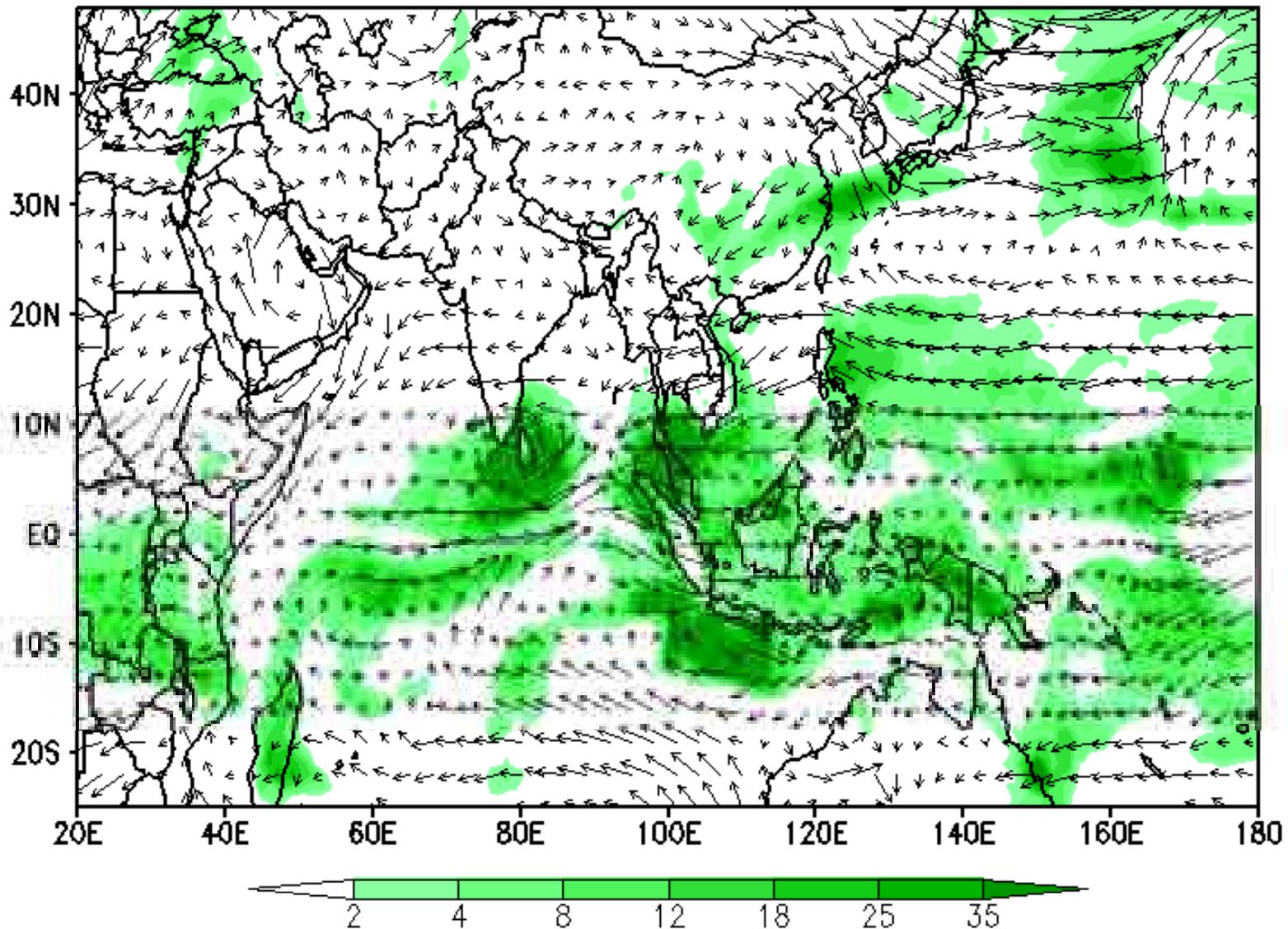
Week 1: Associated with the system the Arabian Sea, Bay of Bengal along with eastern equatorial states and north pacific will get above normal signal. The Northwest monsoon will reach perturbations including Tamil Nadu (Tamil Nadu, Rajasthan, UP, Kerala and Coastal Andhra Pradesh) will be very active with above normal rainfall during the week.



# Daily evolution of rainfall and wind at 850hPa (by MME)

MME, Forecast Valid Time = 00Z30NOV2017

Rainfall (shaded, mm/day) & 850hPa winds (vector,  $20^\circ$ )



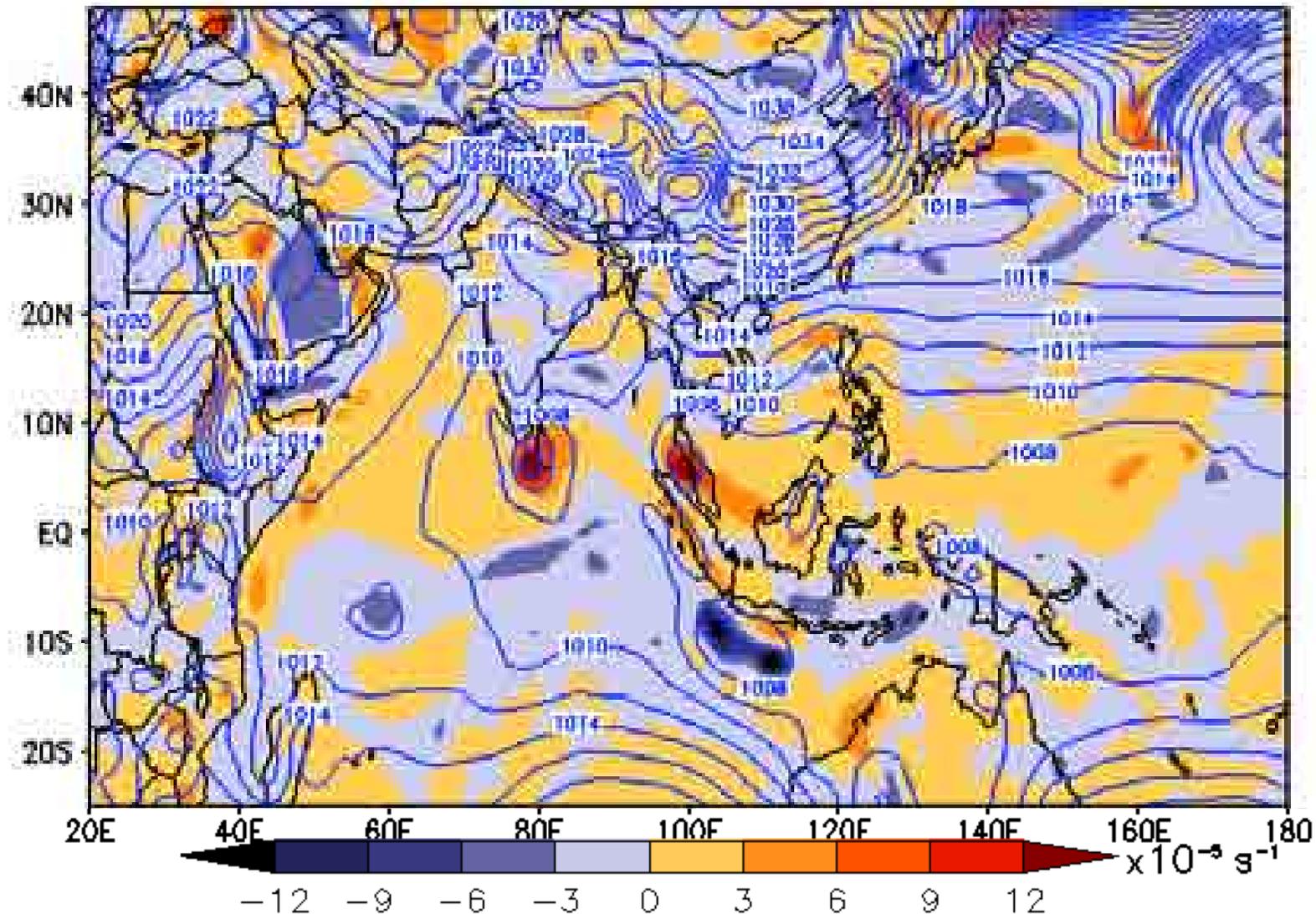
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# Daily evolution of vorticity at 850hPa and mean sea level pressure (by MME)

MME, Forecast Valid Time = 00Z30NOV2017

850 hPa Vorticity (shaded) & mslp (contours, hPa)



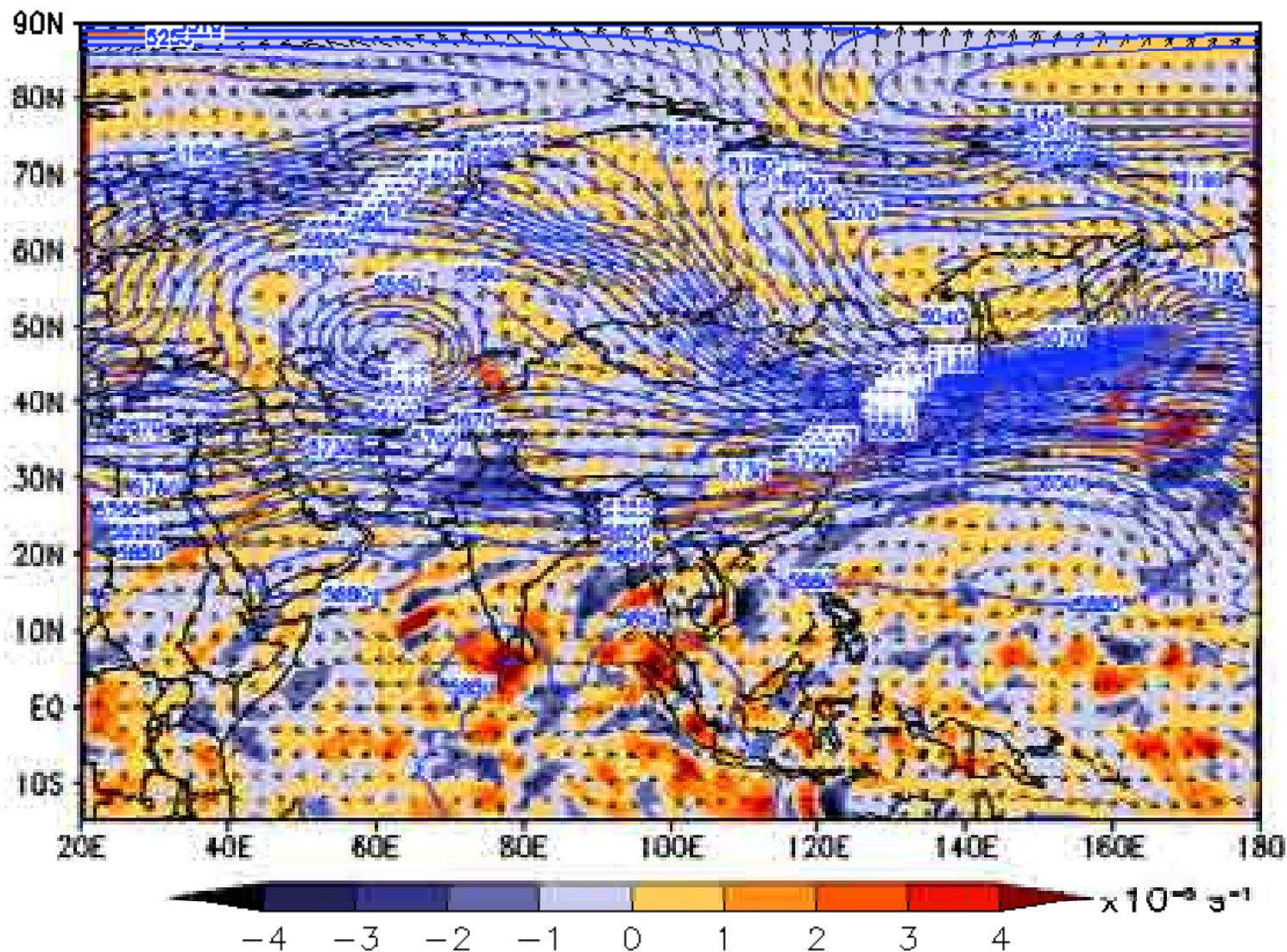
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# Daily evolution of divergence and winds at 200hPa and 500mb Geopotential Height

MME, Forecast Valid Time = 00Z30NOV2017

200 hPa Divergence (shaded), Winds (vector,  $\bar{50}$ ) & 500mb GH (contours, m)



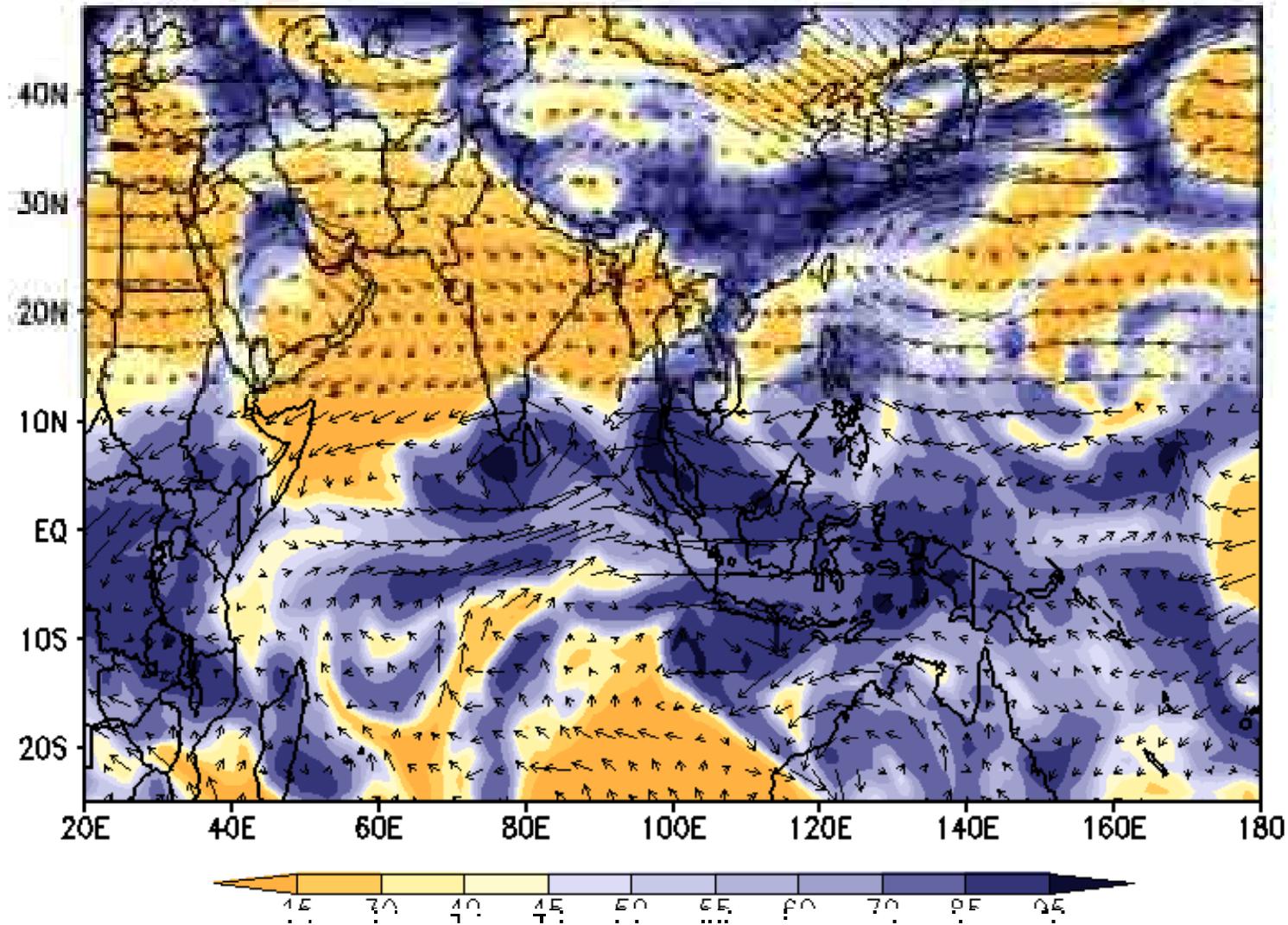
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# Daily evolution of RH and winds at 700hPa (by MME)

MME, Forecast Valid Time = 00Z30NOV2017

700hpa Relative humidity (%) & 700hPa winds (vector, 20°)



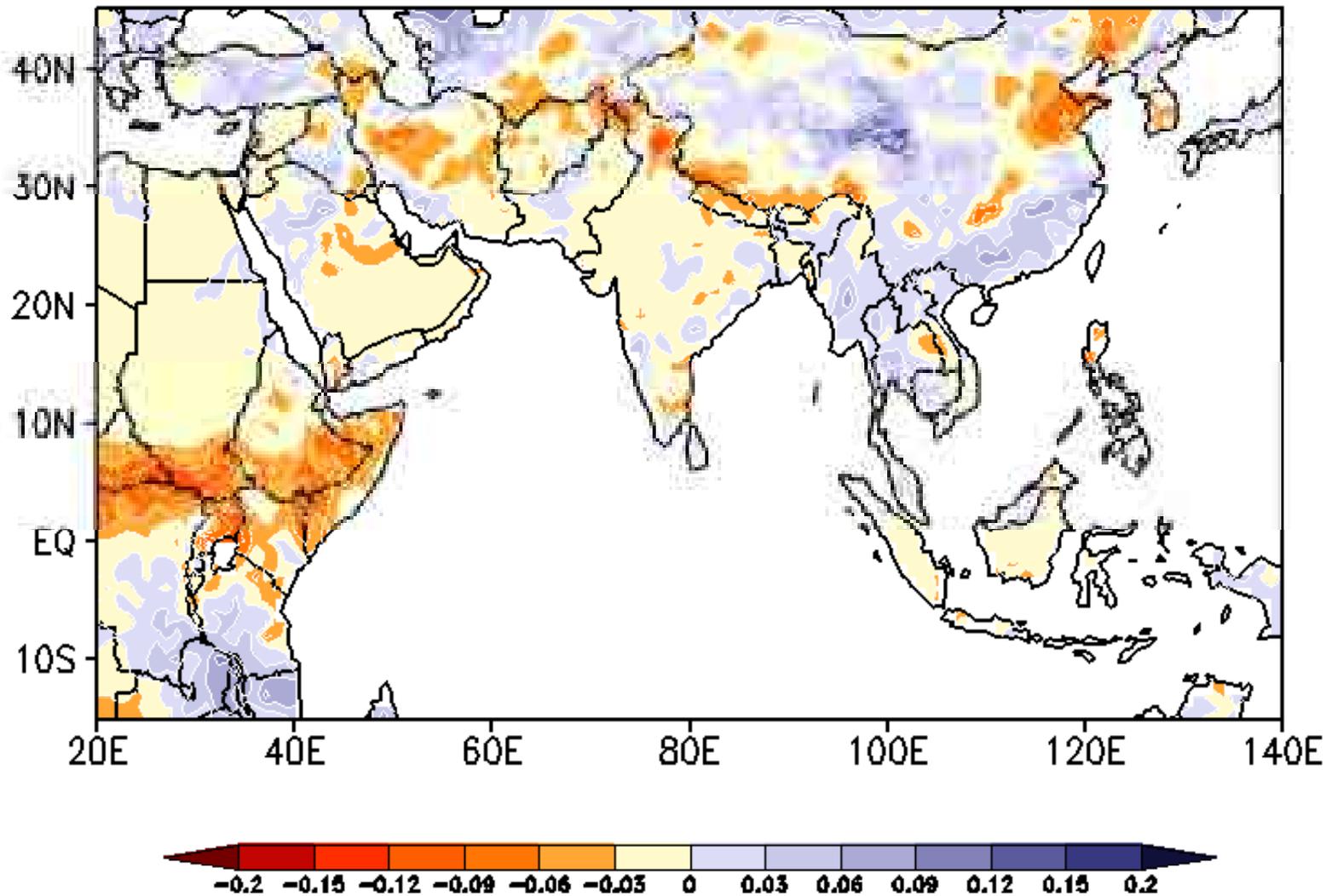
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# Daily evolution of Soil Moisture (top 10cm) Anomaly (by MME)

MME, Forecasted Soil Moisture (0-10cm) Anomaly, Valid Time=00Z30NOV2017

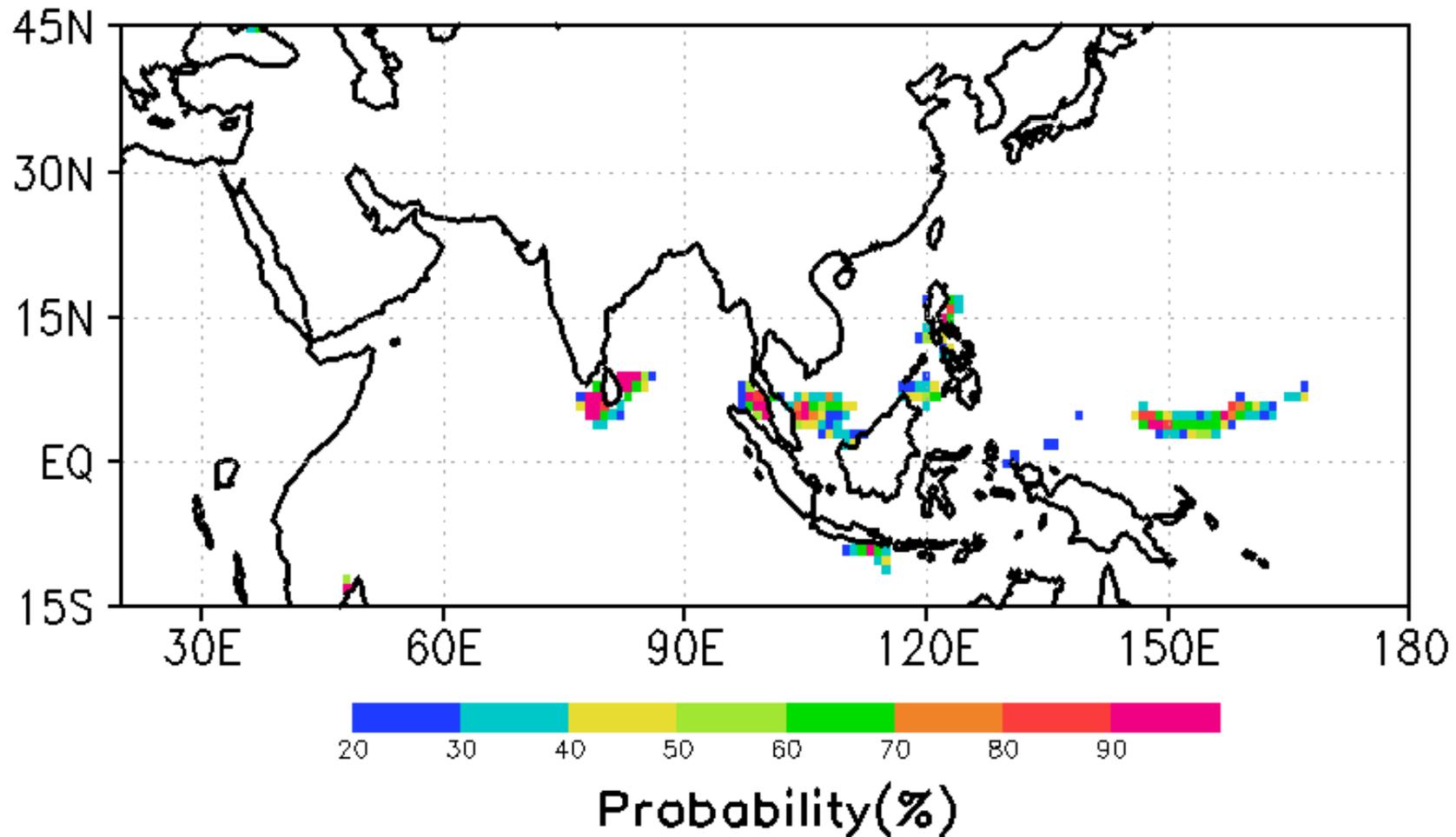
Volumetric Soil Moisture (0-10cm) Anomaly (fraction)



# Forecast of Cyclogenesis probability based on GPI from

MME, Forecast Valid Time = 00Z30NOV2017

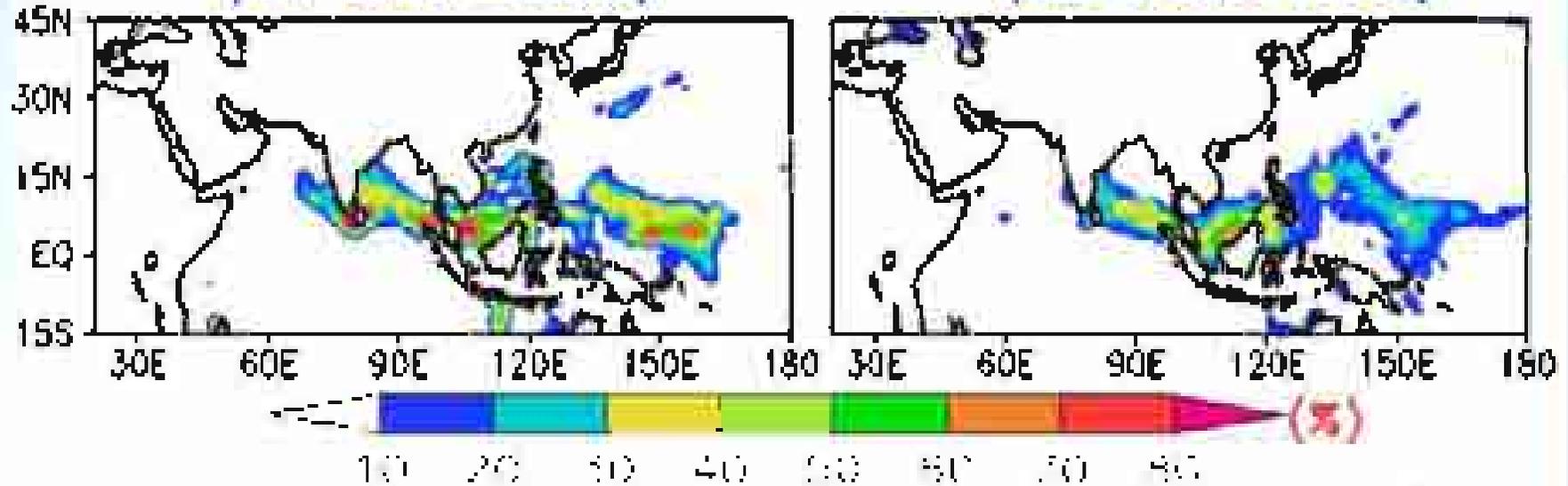
Cyclogenesis probability based on GPI from CGEPS(MME)



## Cyclogenesis Probability (%) from MME

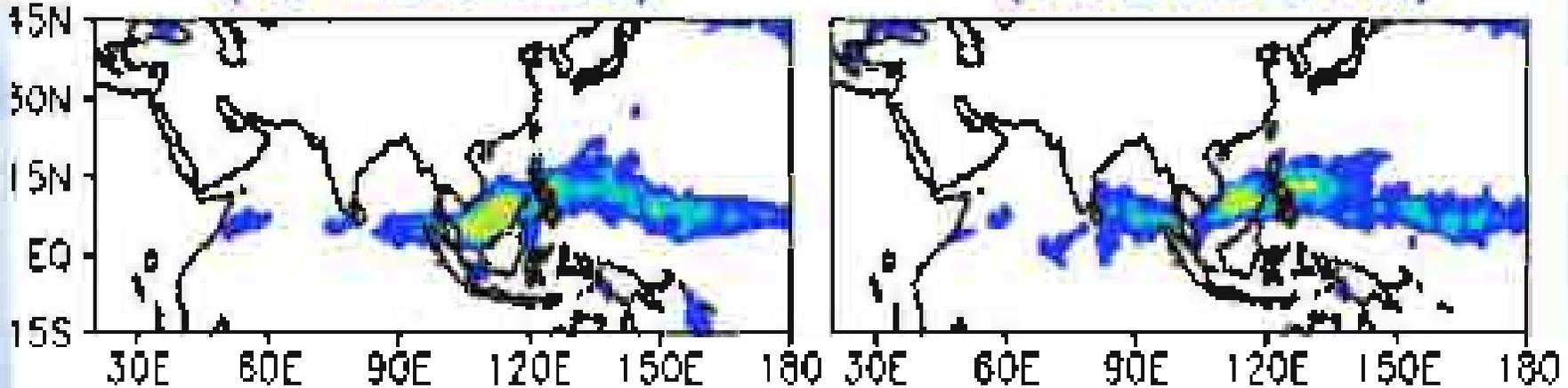
(W1: 30Nov-06Dec)

(W2: 07Dec-13Dec)

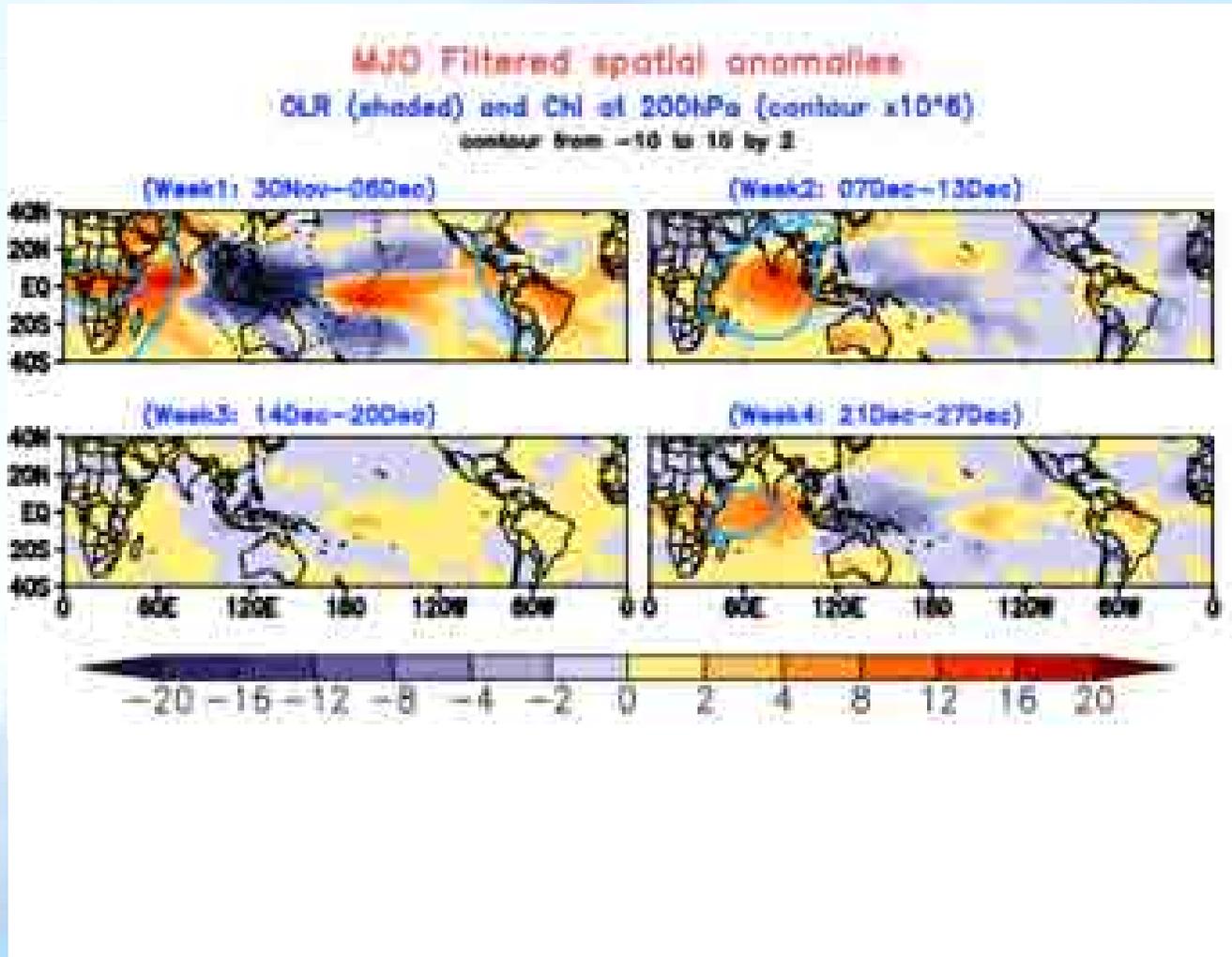


(W3: 14Dec-20Dec)

(W4: 21Dec-27Dec)



# MJO Forecast



# Climate Data Library: IRI

The screenshot displays the IRI Climate Data Library website. The header includes the IRI logo and the text "Climate Data Library". The main content is organized into several columns and sections:

- IRI/LEO Climate Data Library:** A introductory section describing the library as a powerful and freely accessible online data repository and analysis tool. It lists features such as: access to any number of datasets, creation of analysis of data ranging from simple averaging to more advanced EOF analysis using the Irida Data Analysis Language, monthly present climate conditions with maps and analysis in the [Map Room](#), creation of visual representations of data including animations, and download data in a variety of commonly used formats, including GIS-compatible formats.
- Latest from our [Twitter](#) Blog:** A section featuring a world map with a color-coded overlay, likely representing climate data.
- IRI Climate and Society Map Room:** A section describing a collection of maps and other figures that monitor climate and societal conditions. It includes a small map of the United States.
- Data by Source:** A section for datasets organized by source, with a small tree diagram icon.
- Data By Category:** A section for datasets organized by category.
- Dataset and Map Room Browser:** A section for finding datasets and maps organized by many criteria, including a colorful word cloud graphic.
- Navigating Through the IRI Data Library: A Tutorial:** A section explaining the goal of the tutorial is to introduce you to the structure of the Data Library and the many ways to navigate through it.
- Statistical Techniques in the Data Library: A Tutorial:** A section explaining that statistical techniques are essential tools for analyzing large datasets, and this tutorial covers essential skills for many data library users.
- Function Index:** A section providing an index to functions that can be used to analyze data within the Data Library, accompanied by a small icon of a person at a computer.
- Help Resources:** A section providing help resources, including help and guides, support, feedback, documentation, and other resources to help you get the maximum utility out of the Data Library.

At the bottom of the page, there is a footer with the IRI logo and contact information for the IRI/LEO Climate Data Library.



# Climate Explorer: KNMI

The image shows a screenshot of the KNMI Climate Explorer website. The interface is primarily in Dutch. At the top, there is a navigation bar with the text "KNMI Climate Explorer" and a search bar. Below this, the main content area is divided into several sections. On the left, there is a sidebar with various options. The central part of the page contains a large form with multiple input fields and dropdown menus, likely used for selecting a location and time period. On the right side, there is a sidebar with additional information, including a section for "Further information" and a "Feedback" section. The bottom of the page features a list of questions or topics, each with a corresponding icon and a brief description. The overall design is clean and professional, typical of a government or research institution website.



# APEC Climate Centre: CLIK

**Background**

The APEC Climate Centre (ACC) was established in 2001 as a regional climate change centre of excellence for the Asia-Pacific region. It is a multi-disciplinary organization that provides a platform for regional climate change scientists and policy-makers to interact and share information. The ACC is a key component of the APEC Climate Centre (ACC) and is responsible for providing a platform for regional climate change scientists and policy-makers to interact and share information.

**Product Description**

The ACC provides a range of products and services to its members. These include:

- Regional climate change assessments
- Regional climate change action plans
- Regional climate change policy development
- Regional climate change capacity building
- Regional climate change information systems

**User Manual**

The user manual provides detailed information on how to use the CLIK system. It includes:

- Introduction to the CLIK system
- How to access the CLIK system
- How to use the CLIK system
- How to manage your data
- How to generate reports



# Climate Predictability Tool (IRI): CPT

International Research Institute  
for Climate and Society  
1997 Williamstown, MA 01897

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## CPT

### The Climate Predictability Tool



The Climate Predictability Tool (CPT) is a software package for examining a seasonal climate forecast model, performing model validation, and producing forecasts, from weather data. It might be used to produce seasonal climate forecasts using model output results (such as anomalies in climate variables from general circulation models (GCMs) or the (forecast) output) along with a set of sea surface temperatures or other predictors. Although the software is specifically tailored for these applications, it can be used in other general settings to perform statistical operations (within 2000) on gridded temperature, precipitation, or other climate variables (such as any data) and for any statistics.

**Important Links**

- Home
- News
- Publications
- Products
- Services
- Contact Us
- FAQ
- Privacy Policy
- Terms of Use
- Disclaimer
- Site Map
- Feedback





# Thank You All



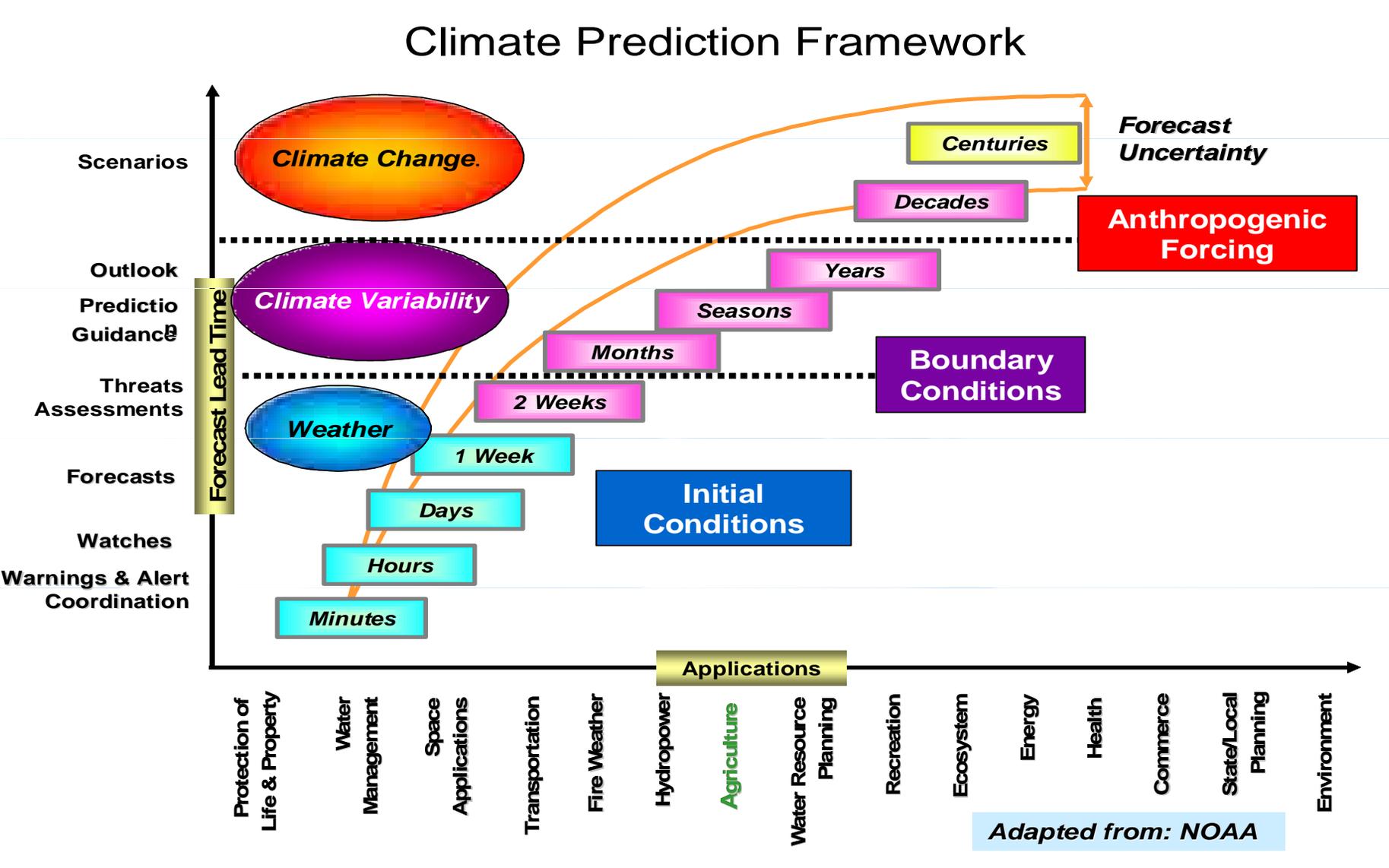
11/14/2019

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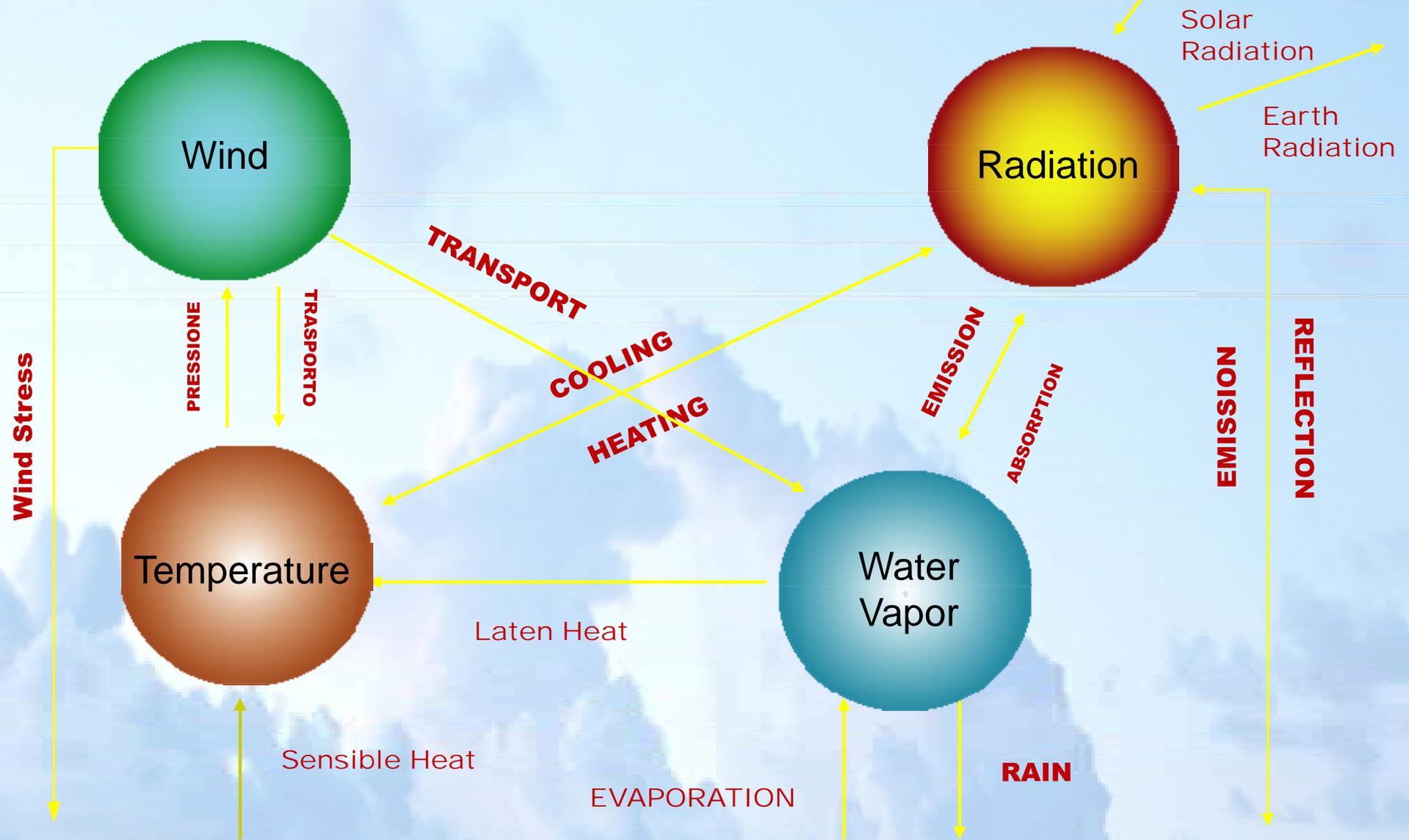


# What are key elements to Climate Services?



**Seamless climate services**

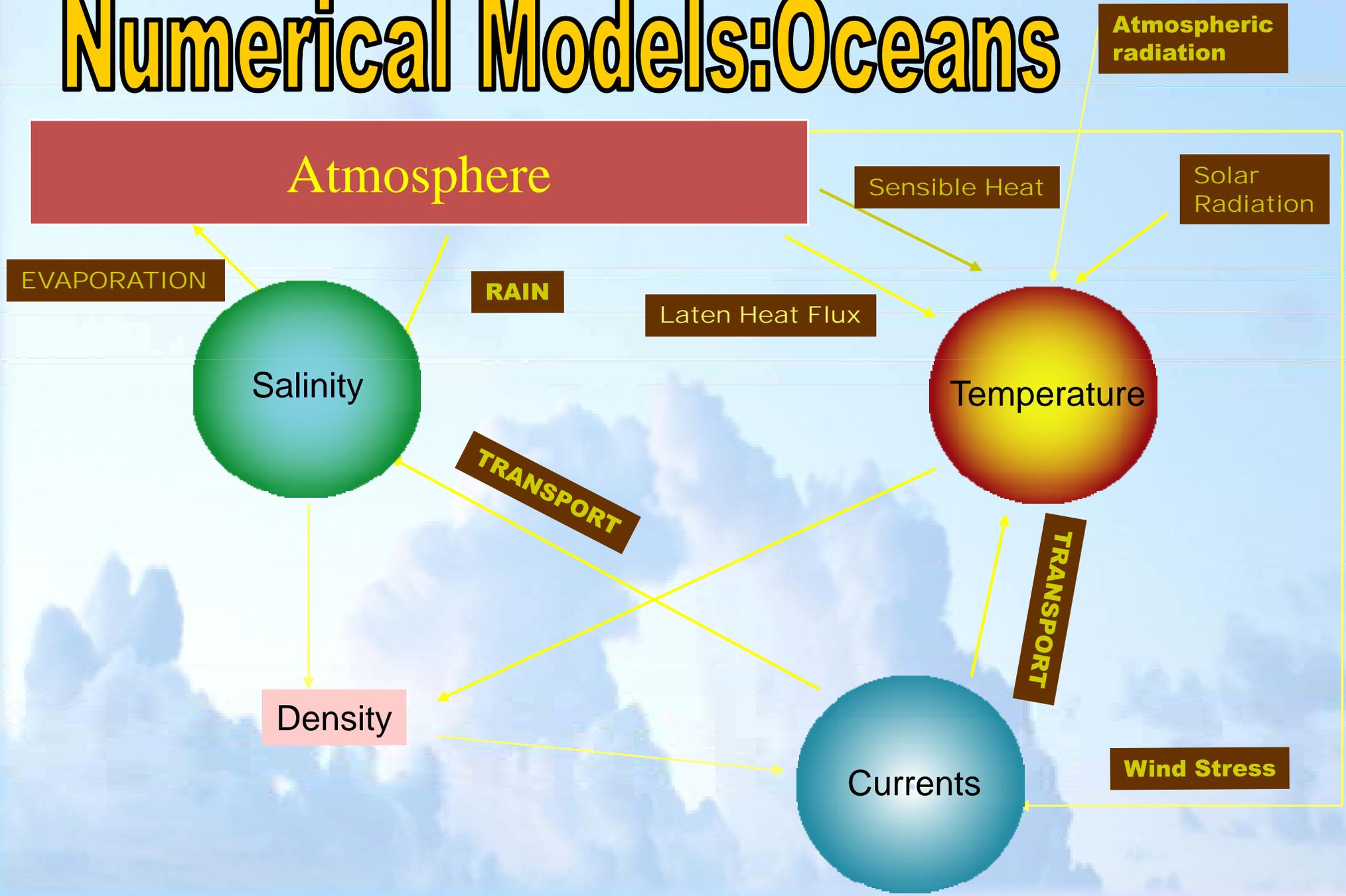
# Numerical Models: Atmosphere



Oceans -- Soil -- Cyosphere -- Biosphere



# Numerical Models: Oceans



# Numerical Models: Coupling

## Atmosphere

Wind Stress

Precipitation

Solar Radiation

Atmospheric Radiation

Air Temperature

Surface Temperature

### COUPLER:

- (1) Interpolate from the atmospheric grid to the ocean grid and viceversa.
- (2) Compute fluxes

Wind Stress

Fresh Water Flux

Sensible Heat Flux

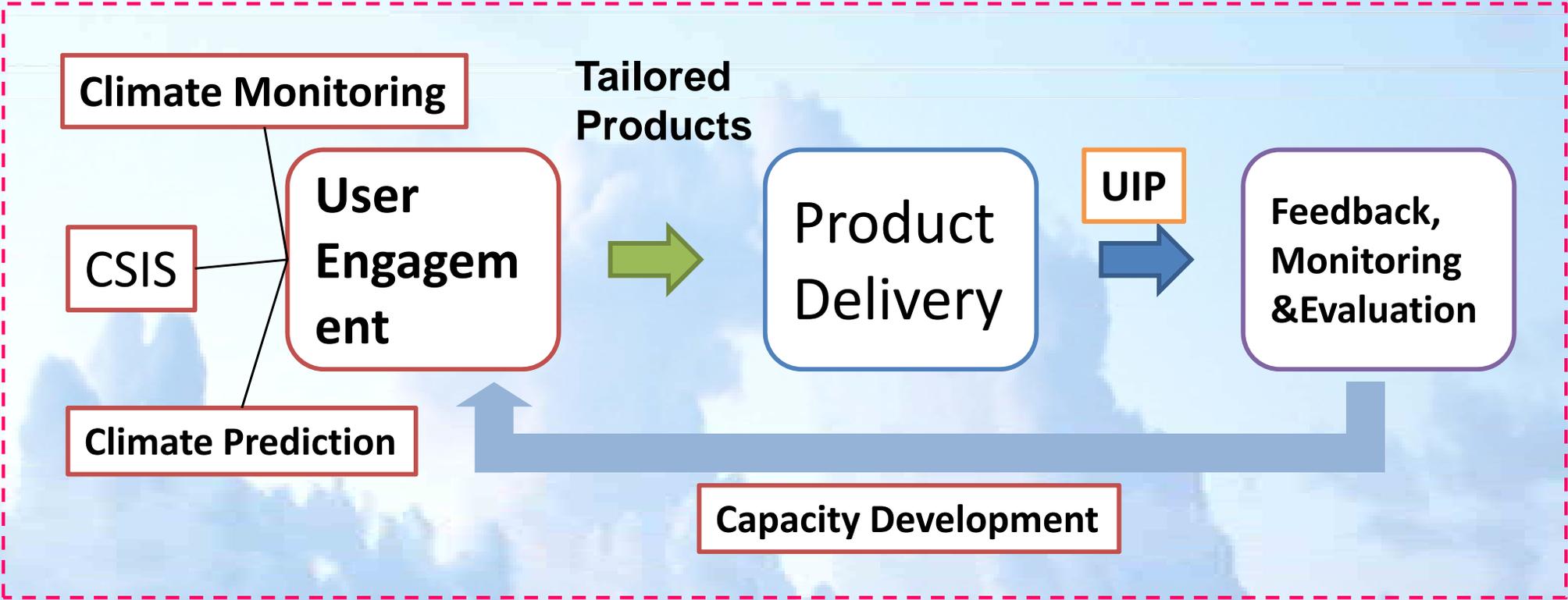
Latent Heat Flux

Sea Surface Temperature

## Oceans -- Sea Ice

# Method to Transfer from Climate to Services

Understanding the benefits of climate services



## Process of developing climate services

Services are developed through ongoing engagement between providers and users.



# **Dynamical Predictions (Tier-2 or Tier-1?)**

- ❖ **Tier-Two Models: Atmospheric General Circulation Models**
  - Integration with prescribed SST boundary conditions
  - Atmospheric Initial Conditions
- ❖ **Tier-One Models: Coupled Ocean-Land-Atmosphere Models**

