



# Interpretation of Outputs from Numerical Prediction System



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# Procedure of Seasonal Forecast (1)

1. Understand the current status of ocean and atmosphere
2. Check the numerical model results **Exercise on Thursday**
  - SST in the tropics (ENSO, Indian Ocean,...)
  - Convective activity (Precipitation)
  - Atmospheric circulation (response to the convection)
3. Check the prediction skill of the numerical model
  - Which model results should be taken to the forecast?

## Products for seasonal forecast provided at TCC-HP

**Forecast Map**

**Monthly Discussion**

**Hindcast Verification Charts**

**El Nino Outlook**

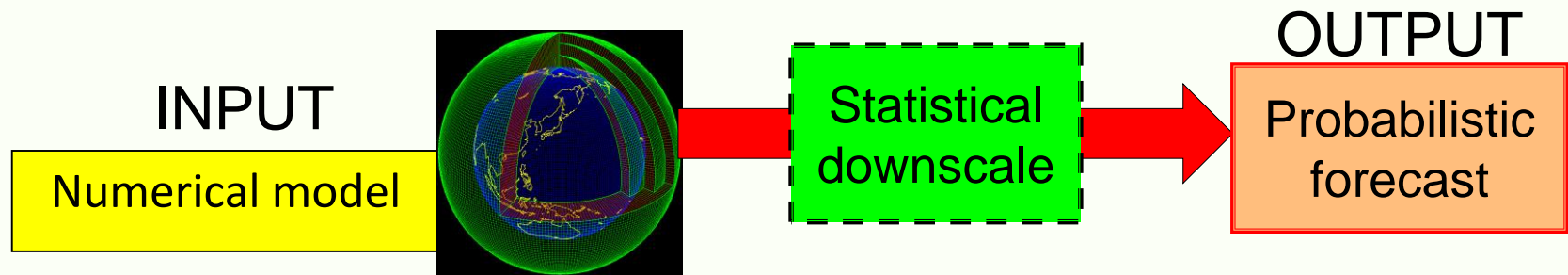
These will be introduced during the seminar...

# Procedure of Seasonal Forecast (2)

4. Check the **guidance** to estimate probability
5. Decide forecast **Goal of this seminar**
  - Modify the guidance based on the prediction skill of the model results and the guidance

**Exercise on Wednesday**

**Guidance** is an application to translate model output values into target of forecasting with statistical relationship between forecast and observation



# Contents

- Access to the forecast/verification maps from TCC-HP
- Interpretation of the outputs from EPS for seasonal forecast (FMA 2018)

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# Access to the EPS Products on TCC-HP

NWP Model Prediction

The screenshot shows the Tokyo Climate Center website with the following elements:

- Header:** Tokyo Climate Center, WMO Regional Climate Center in RA II (Asia), WMO logo, and navigation links (TCC home, About TCC).
- Navigation Menu:** Home, World Climate, Climate System Monitoring, El Niño Monitoring, **NWP Model Prediction** (highlighted with a red box), Global Warming, Climate in Japan, Training Module, Press release.
- Breadcrumbs:** HOME > Ensemble Model Prediction
- Section:** JMA's Ensemble Prediction System (Products of GPC Tokyo)
- Notice:** 29 September 2017 (account inactive over 3 months), 14 March 2018 (announcement of the JMA's Global Ensemble Prediction System), 29 May 2015 (seasonal ensemble prediction system upgrade), 28 August 2014 (provision of "Forecast Products in Support of Early Warnings for Extreme Weather Events").
- Main Products:**
  - One-month Prediction** (11 Jan 2018): Z500, T850 & SLP (Northern Hemisphere), Stream Function, Velocity Potential & Surface Air Temperature (60N-60S), Verification, Hindcast Verification (NEW), One-month Probabilistic Forecasts at station points.
  - Three-month Prediction** (12 Dec 2017): Three-month Prediction, Z500, T850 & SLP (Northern Hemisphere), Stream Function, Velocity Potential & Surface Air Temperature (60N-60S), Verification, Hindcast Verification (JMA/MRI-CPS2), Probabilistic Forecast and Verification, SST Index Time-series Forecast.
  - Warm/Cold Season Prediction** (18 Oct 2017): Warm/Cold Season Prediction, Z500, T850 & SLP (Northern Hemisphere), Stream Function, Velocity Potential & Surface Air Temperature (60N-60S), Verification, Hindcast Verification (JMA/MRI-CPS2), Probabilistic Forecast and Verification.
  - Model Descriptions:** Model Outlines (NEW), Operations for Extended-range Forecast Model (NEW), Operations for Long-range Forecast Model.
- Other Links:** Monthly Discussion on Seasonal Climate Outlooks, Forecast Products in Support of Early Warnings for Extreme Weather Events, Download GPC Long-range Forecast (LRF) Products.

Monthly Discussion (support material of seasonal forecast)

Forecast maps

Verification maps (hindcast)

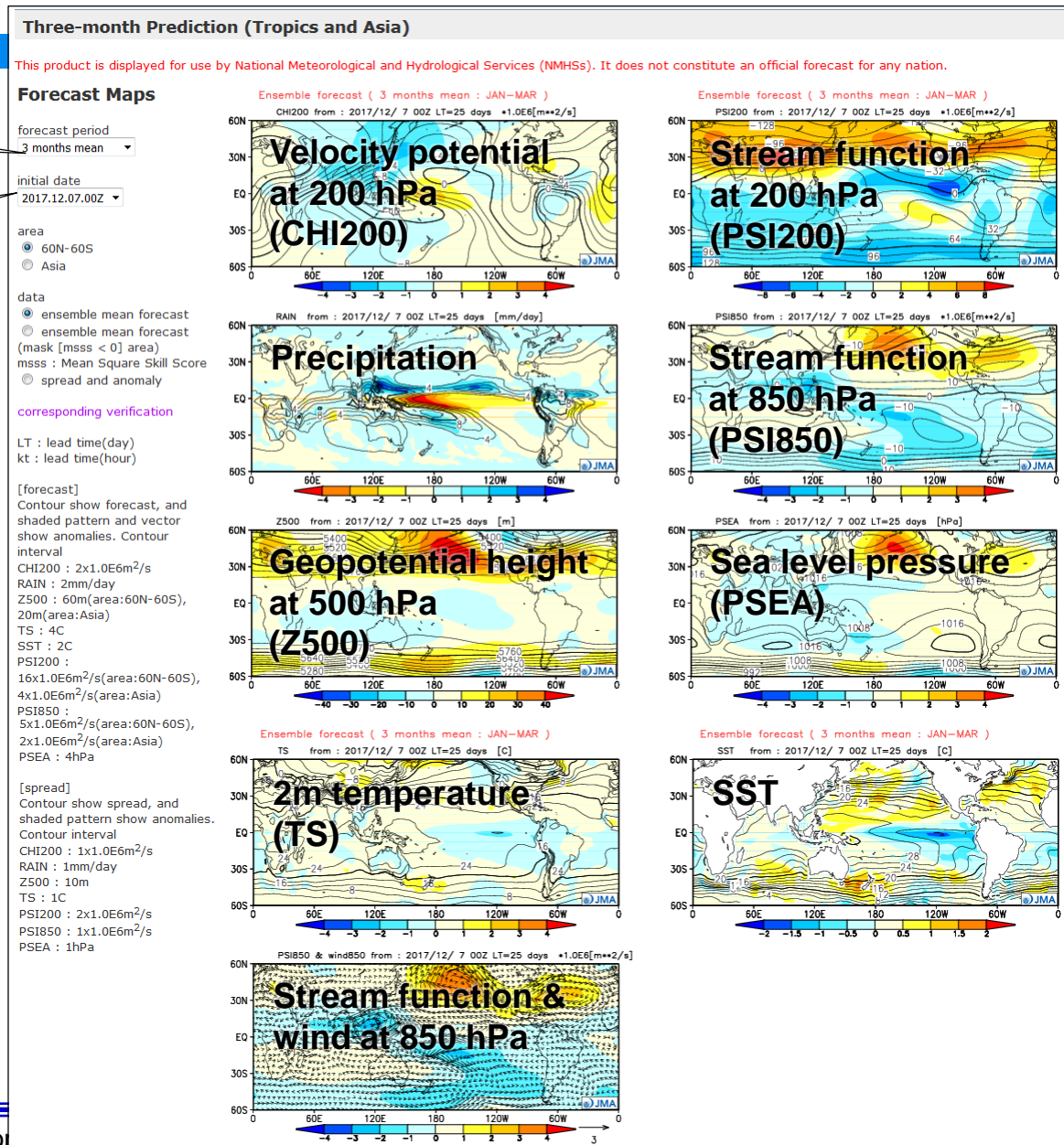
<http://ds.data.jma.go.jp/tcc/tcc/products/model/index.html>

# Forecast Map (Tropics)

3 months mean

Initial date  
In this seminar,  
**2018.01.11.00Z**

- ✓ 3-month mean prediction for FMA 2018
- ✓ Initial date: 11 Jan.
- ✓ Ensemble mean
- ✓ **Contour: Actual field**
- ✓ **Shading: Anomaly**



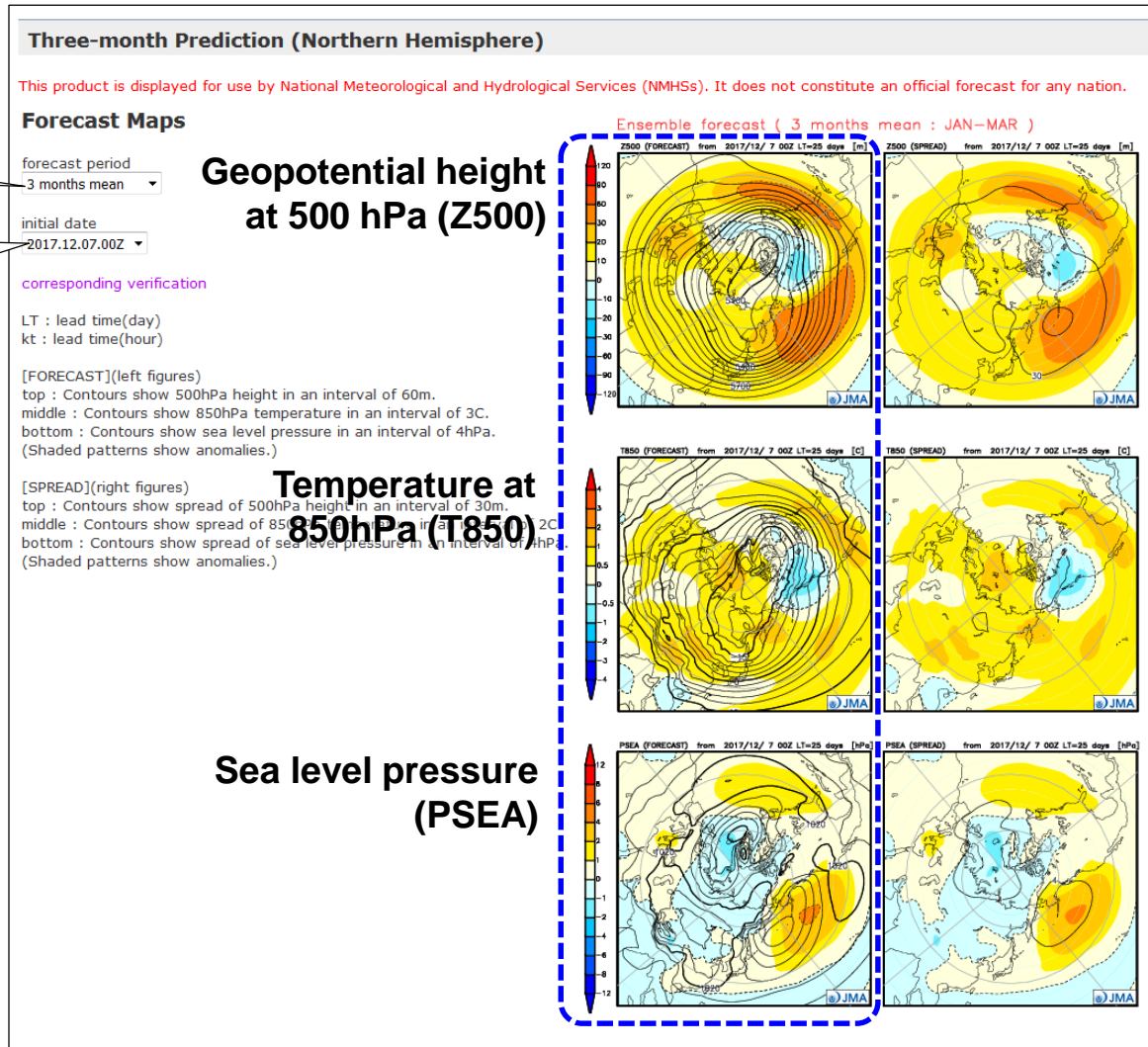


# Forecast Map (Northern Hemisphere)

**3 months mean**

Initial date.  
In this seminar,  
**2018.01.11.00Z**

- ✓ 3-month mean prediction for FMA 2018
- ✓ Initial date: 11 Jan.
- ✓ Ensemble mean
- ✓ **Contour: Actual field**
- ✓ **Shading: Anomaly**





# Verification Map (Hindcast)

## Hindcast(JMA/MRI-CPS2)

### Hindcast Configuration

› JMA/MRI-CPS2

### Hindcast Verification

#### › Deterministic score Maps

- › Variables to be Assessed: T2m, PSEA, SST, RAIN, Z100, Z200, Z300, Z500, Z850, T850, U2
- › Diagnostic Measures:
  - › Mean Square Skill Score(MSSS)
  - › Anomaly Correlation(ACOR)
  - › Root Mean Squared Error(RMSE)
  - › Ratio of Standard Deviation(SD)
  - › Analysis Standard Deviation
  - › Model Standard Deviation
  - › Bias
  - › Analysis Climatology
  - › Model Climatology

#### › Probabilistic score Diagrams

- › Variables to be Assessed: T2m, PSEA, SST, RAIN, Z100, Z200, Z300, Z500, Z850, T850, U2
  - › Diagnostic Measures:
    - › Reliability diagrams (Aggregated verification)
    - › Relative Operating Characteristics(ROC) curve (Aggregated verification)
  - › Event: Anomaly > 0, Below Normal, Near Normal, Above Normal
- The 3 categories(above-normal, near-normal, below-normal) are defined by standard deviation

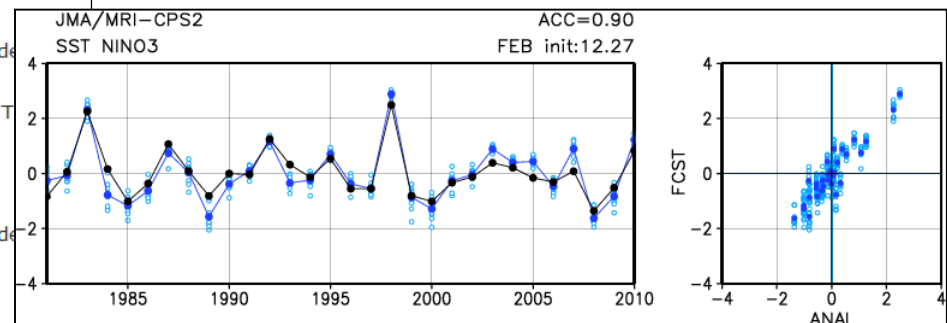
#### › Probabilistic score Maps

- › Variables to be Assessed: T2m, PSEA, SST, RAIN, Z100, Z200, Z300, Z500, Z850, T850, U2
  - › Diagnostic Measures:
    - › Relative Operating Characteristics(ROC) curve (Grid point verification)
  - › Event: Anomaly > 0, Below Normal, Near Normal, Above Normal, All
- The 3 categories(above-normal, near-normal, below-normal) are defined by standard deviation

#### › Time-series Circulation Index

This product shows the model's prediction skill evaluated from hindcast data. i.e., comparison between observation data and model output for 1981-2010.

### Verification of each predictor



# Verification Map (Hindcast)

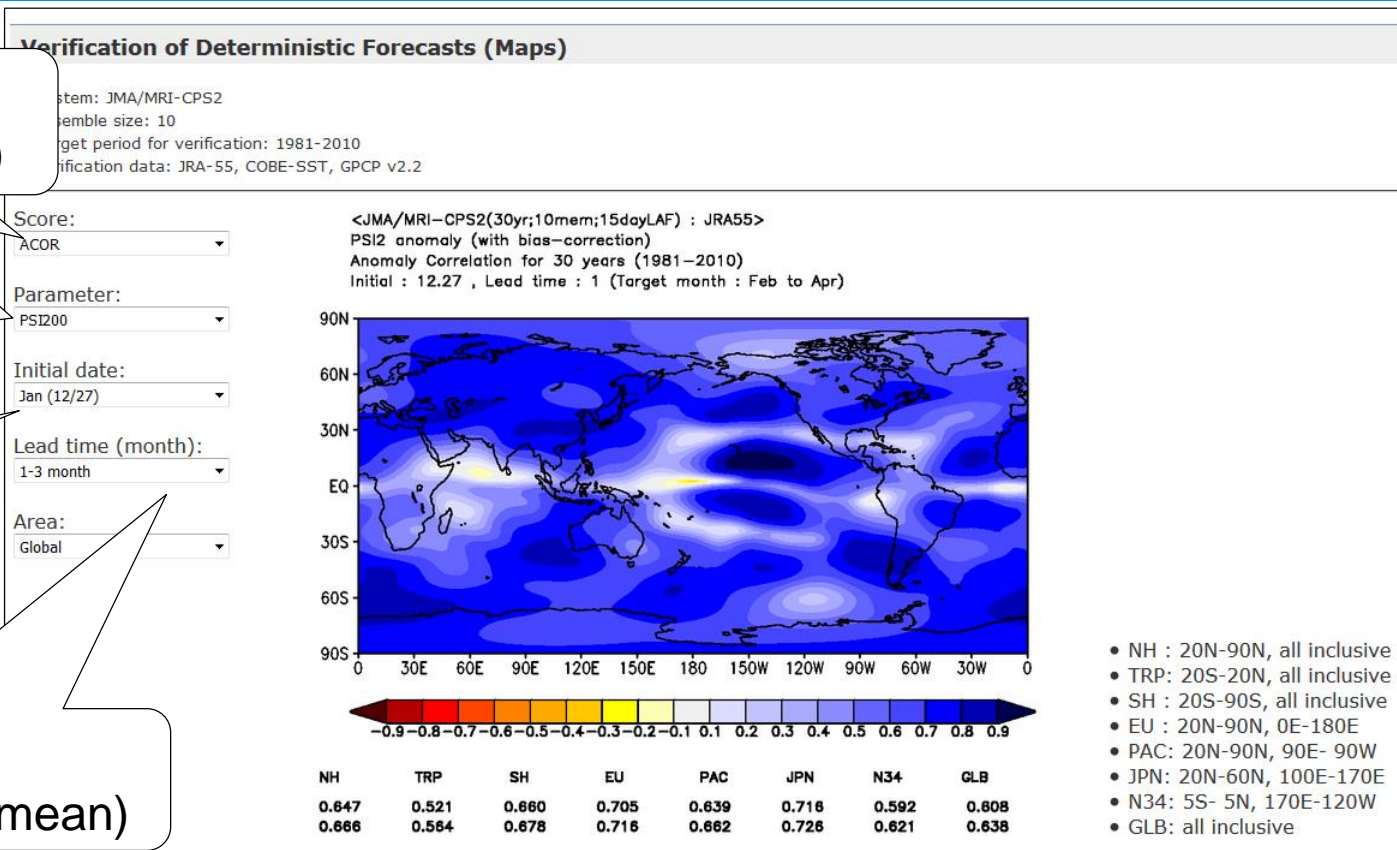
**ACOR**

(anomaly correlation)

You should select a parameter

Initial date.  
In this seminar,  
**Jan (12/27)**

**1-3 month**  
(indicating Feb.-Apr. mean)



Each map shows correlation between observation and model output for 1981-2010  
 Model's initial date is every year's 27 Dec. and forecast period is Feb. -Apr.  
**Blue color indicates positive correlation (high prediction skill)**

# Monthly Discussion

Material issued every month (around 25<sup>th</sup>) in order to assist NMHSs in interpreting season prediction products.

Latest state of the climate system

**Monthly Discussion on  
Seasonal Climate Outlook**

(25 December 2017)

Tokyo Climate Center  
Japan Meteorological Agency

Latest one was issued  
on 24 Jan., so you can  
refer to it.

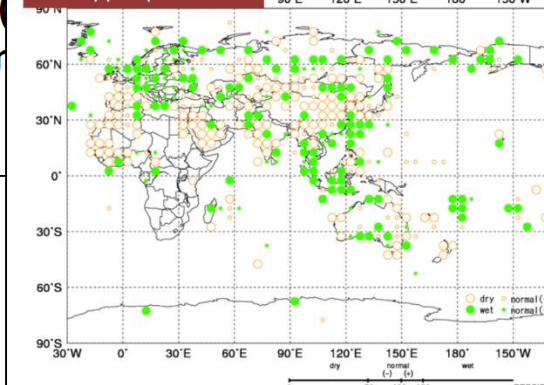
[http://ds.data.jma.go.jp/tcc/tcc/products/model/monthly\\_discussion/latest.pdf](http://ds.data.jma.go.jp/tcc/tcc/products/model/monthly_discussion/latest.pdf)

Explanatory comments  
on the latest model's  
output

## <November 2017> Precipitation

- Precipitation amounts were above normal over Southeast Asia and the eastern part of Europe.
- Precipitation amounts were below normal over the eastern part of East Asia, Middle East, the western part of Europe, Western Africa, the southern part of North America, the northern part of Central America, and the southern part of South America.

### Monthly precipitation ratio



## <JFM 2018 > Global Circulation

- In the 200-hPa velocity potential field, negative (large-scale divergence) anomalies are predicted from the northern part of the Bay of Bengal to the seas east of Japan, and over South America, while positive (large-scale convergence) anomalies are predicted from the western equatorial Pacific to the area east of the dateline.
- In the 200-hPa stream function field, anti-cyclonic circulation anomalies straddling the equator from the Indian Ocean to the Maritime Continent are predicted, while cyclonic circulation anomalies straddling the equator are predicted from the seas west of the dateline to the eastern tropical Pacific.
- These patterns of circulation anomalies are consistent with common patterns observed in past La Niña events.

### Three month mean 200-hPa velocity potential

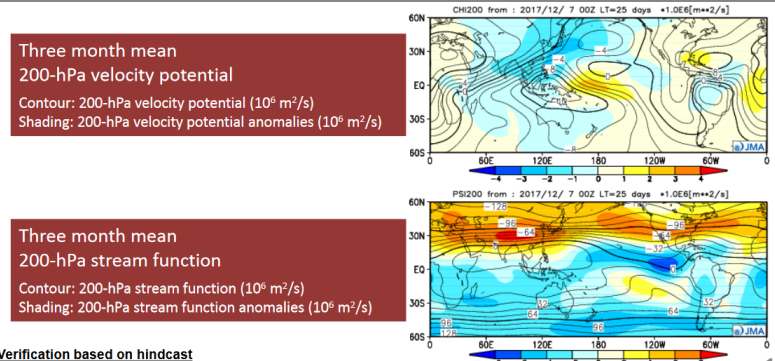
Contour: 200-hPa velocity potential ( $10^6 \text{ m}^2/\text{s}$ )  
Shading: 200-hPa velocity potential anomalies ( $10^6 \text{ m}^2/\text{s}$ )

### Three month mean 200-hPa stream function

Contour: 200-hPa stream function ( $10^6 \text{ m}^2/\text{s}$ )  
Shading: 200-hPa stream function anomalies ( $10^6 \text{ m}^2/\text{s}$ )

Verification based on hindcast

[http://ds.data.jma.go.jp/tcc/tcc/products/model/verification/20180124/20180124\\_20171225\\_20180124.pdf](http://ds.data.jma.go.jp/tcc/tcc/products/model/verification/20180124/20180124_20171225_20180124.pdf)

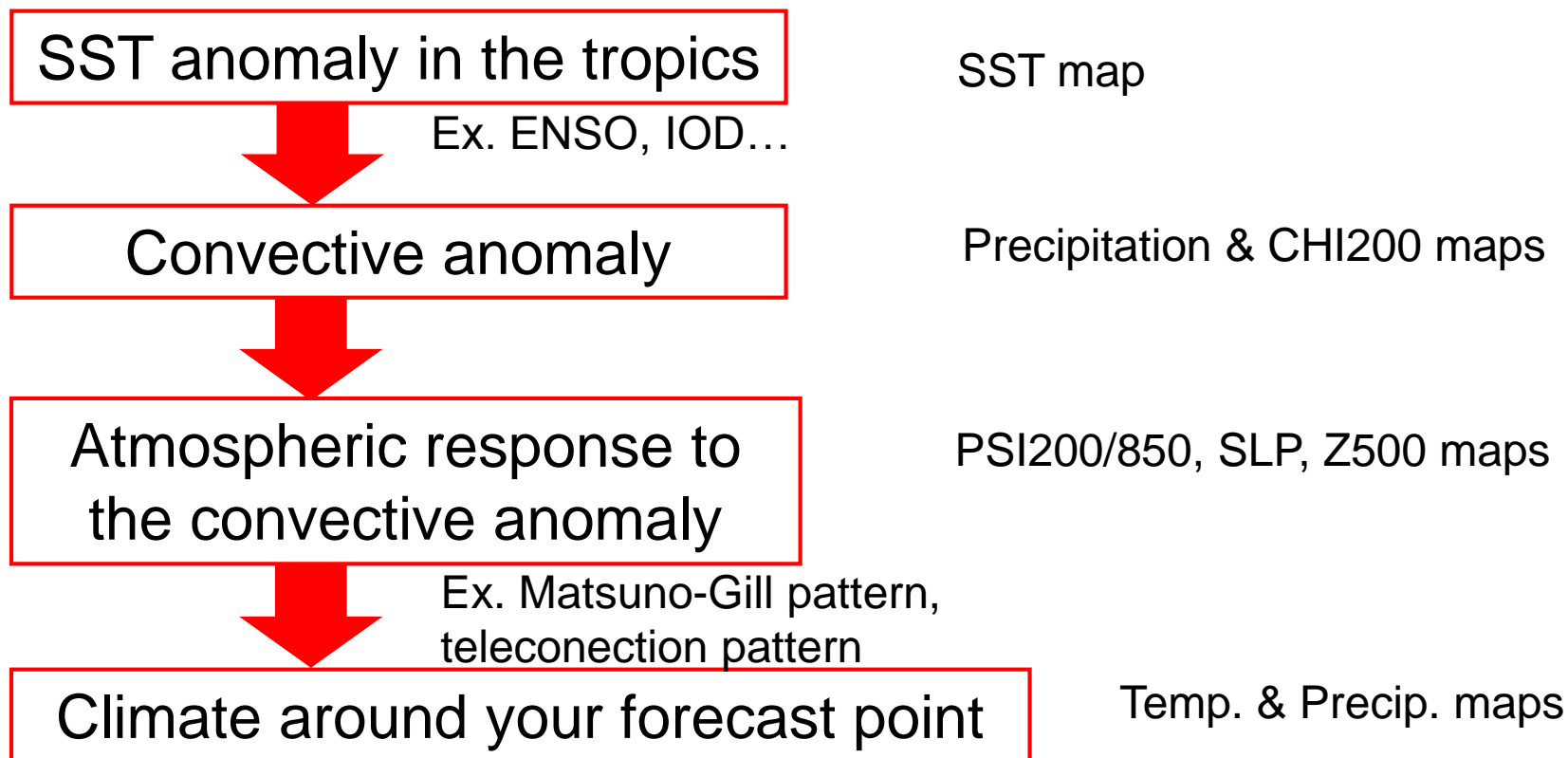


# Contents

- Access to the forecast/verification maps from TCC-HP
- Interpretation of the outputs from EPS for seasonal forecast (FMA 2018)

# Interpretation of the EPS outputs

- It is necessary to interpret the output from seasonal forecast EPS by checking **forecast maps**.



# Verification of the EPS outputs

- It is necessary to check the prediction skill of the model and judge which anomaly pattern can/cannot be adopted into your forecast.
- Prediction skill can be checked from **verification maps** such as **Anomaly Correlation Coefficient (ACC)**.

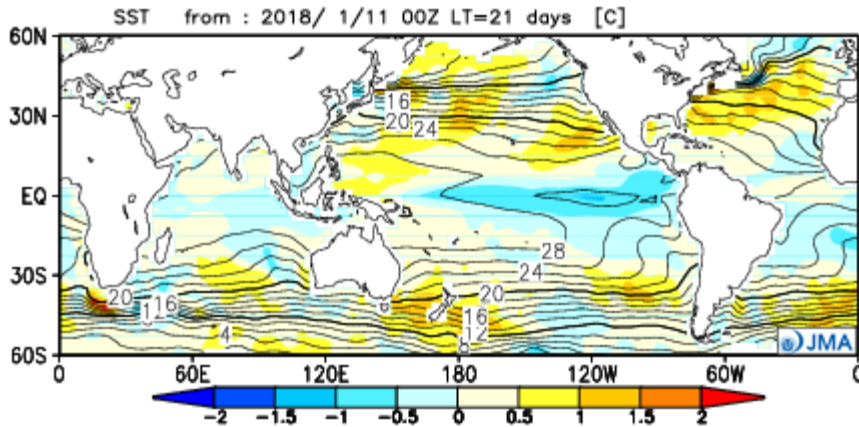
Utilized model output in this seminar

- Initial date: 11 Jan. 2018
- Forecast period: Feb. – Apr. 2018 (3-month mean)

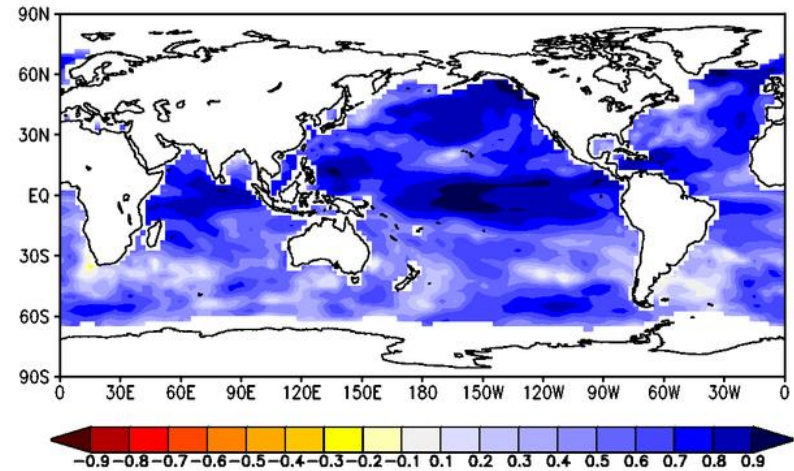


# SST

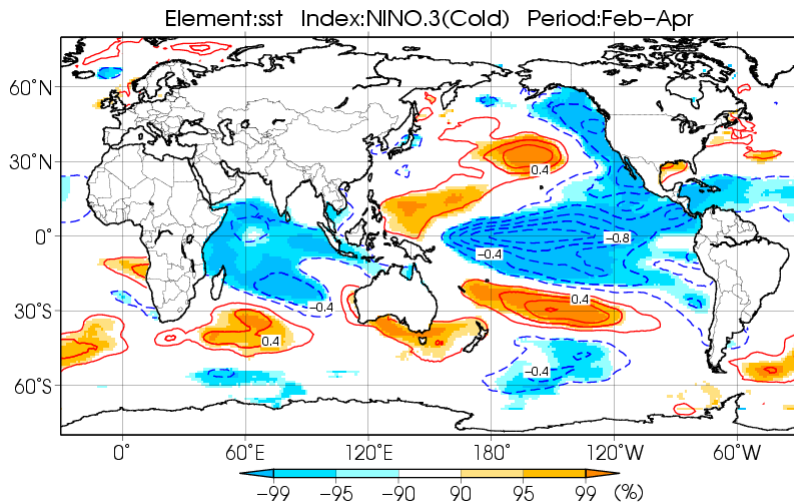
## Forecast Map for FMA 2018



## Anomaly Correlation for FMA (Hindcast; Initial: Jan.)



## FMA Composite map for La Nina years

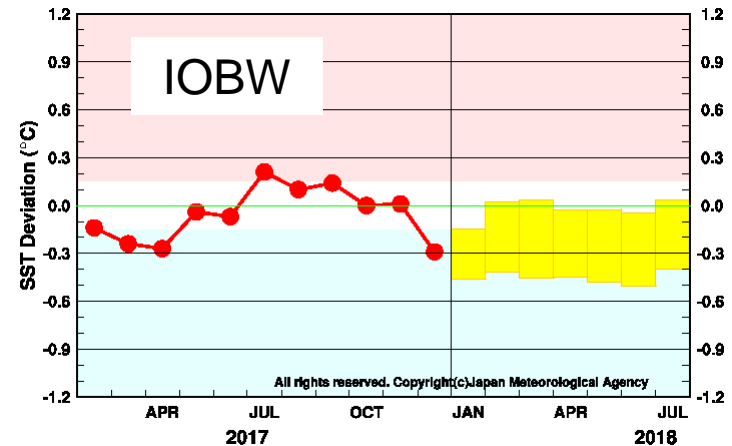
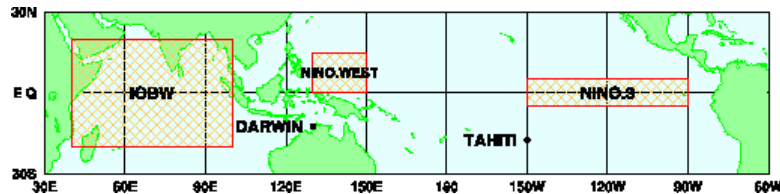
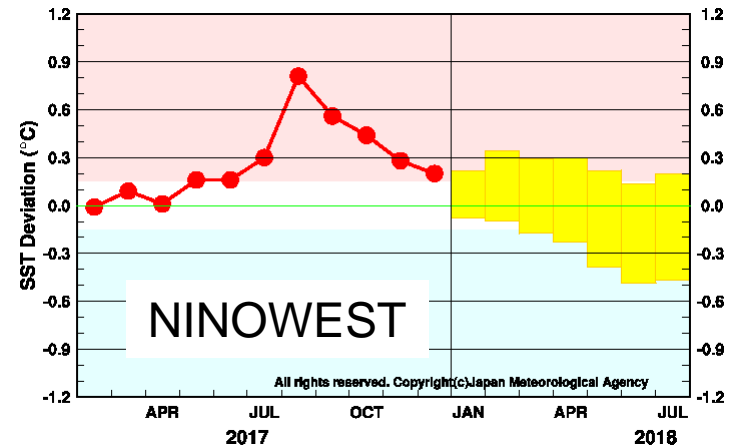
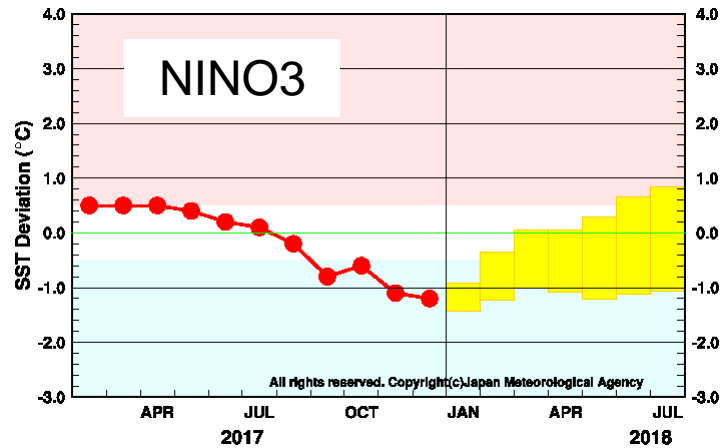


- La Nina like pattern over the Pacific is predicted.
- Prediction skill over the Pacific is high.



# El Nino Outlook (issued on 11 Jan.)

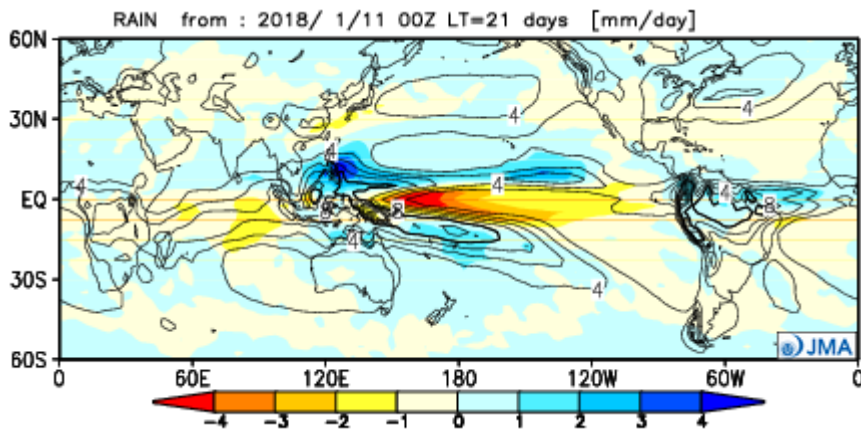
- It is considered that La Niña conditions continue in the equatorial Pacific.
- It is likely that La Niña conditions will persist through to boreal spring (70%).



- It is likely that the NINO.WEST SST will come gradually closer to normal until boreal spring.
- It is likely that the IOBW SST will be below normal until boreal spring.

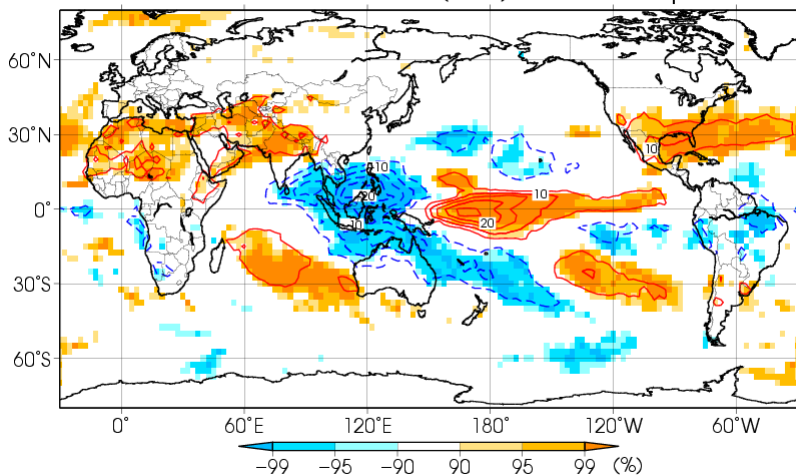
# Precipitation

## Forecast Map for FMA 2018

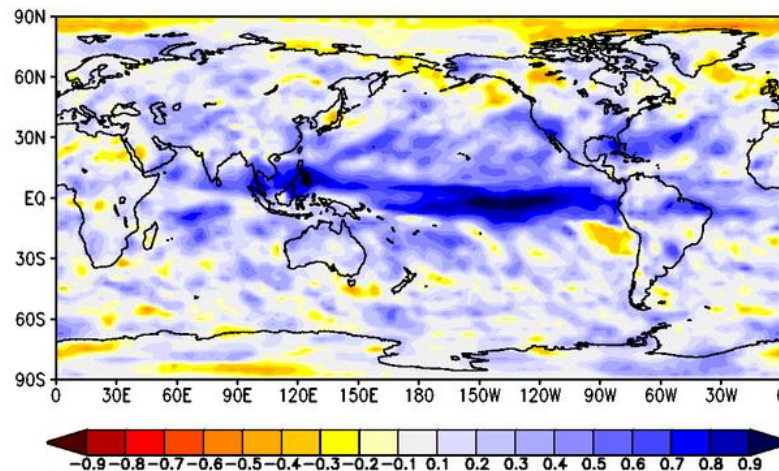


## FMA Composite map (OLR)

Element:olr Index:NINO.3(Cold) Period:Feb-Apr



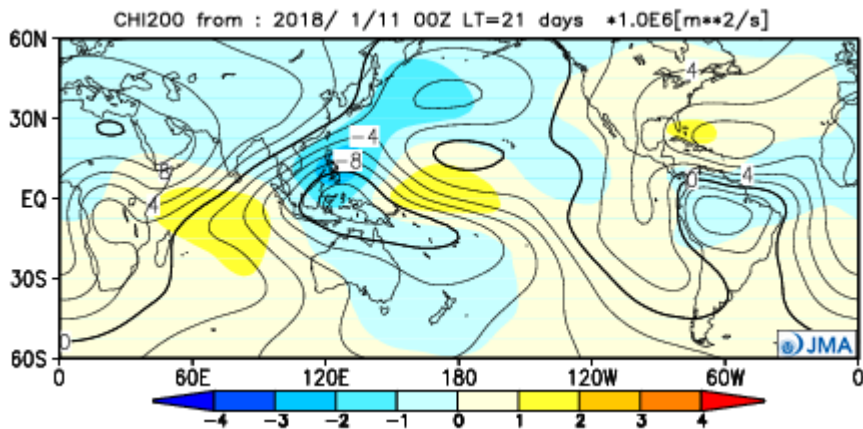
## Anomaly Correlation for FMA (Hindcast; Initial: Jan.)



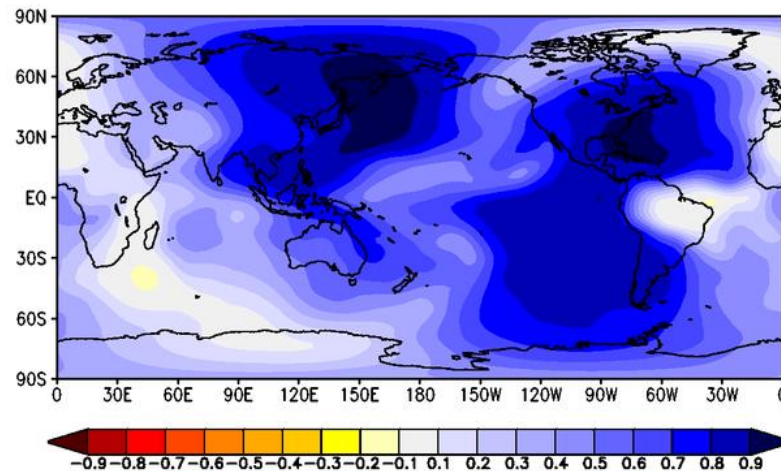
- Above-normal precipitation is predicted around the Philippines and below-normal is around DL and over the tropical South Indian Ocean. (La Nina like pattern)
- Prediction skill from Southeast Asia to the Pacific is high.

# Velocity Potential at 200hPa (CHI200)

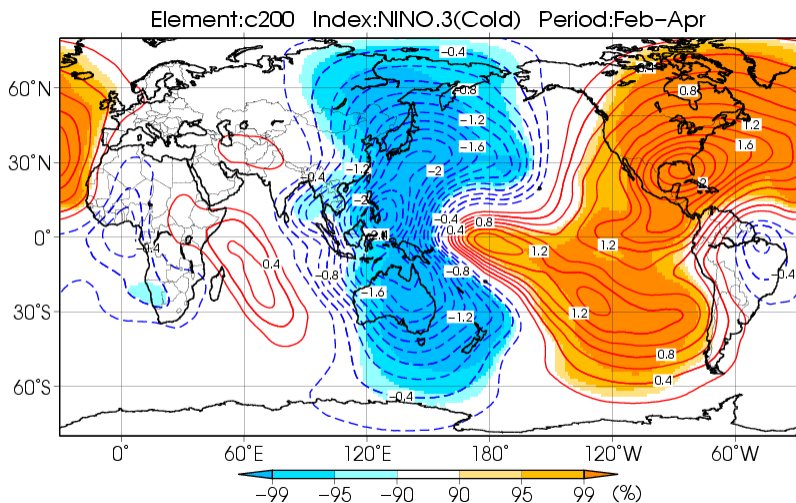
## Forecast Map for FMA 2018



## Anomaly Correlation for FMA (Hindcast; Initial: Jan.)

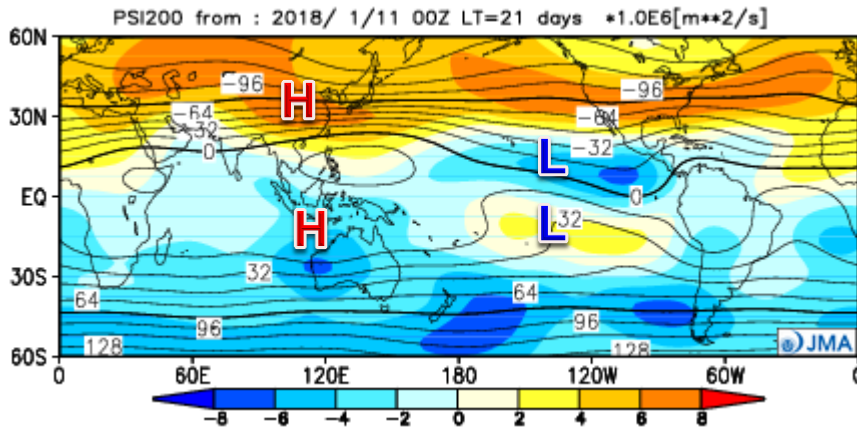


## FMA Composite map for La Nina years

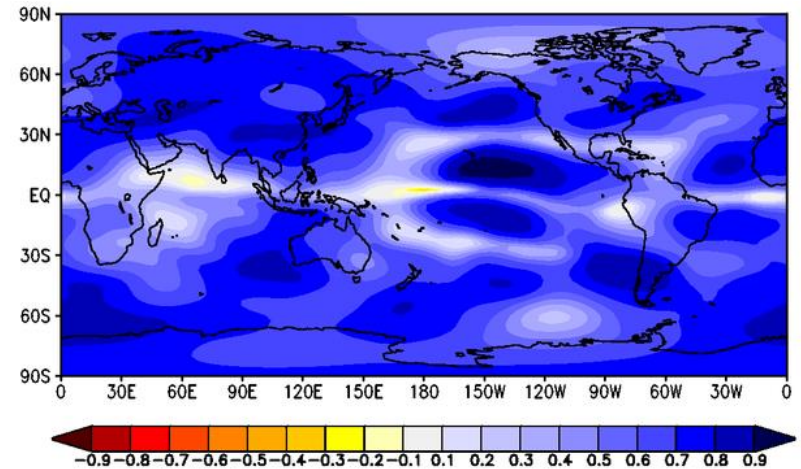


# Stream Function at 200hPa (PSI200)

## Forecast Map for FMA 2018

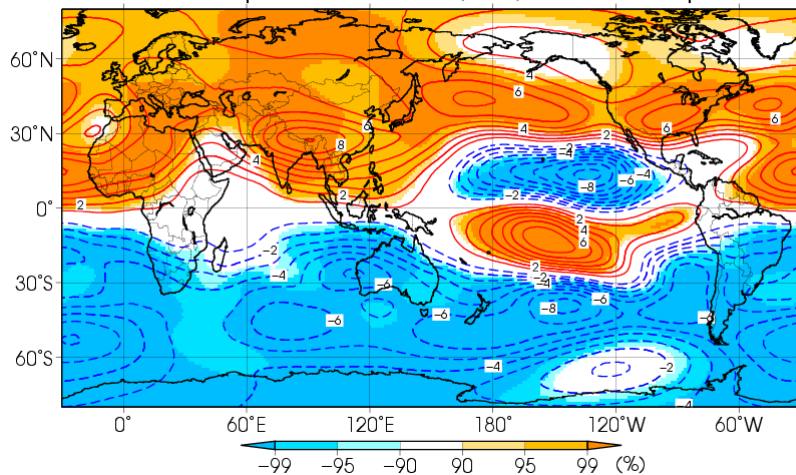


## Anomaly Correlation for FMA (Hindcast; Initial: Jan.)



## FMA Composite map for La Nina years

Element:p200 Index:NINO.3(Cold) Period:Feb-Apr

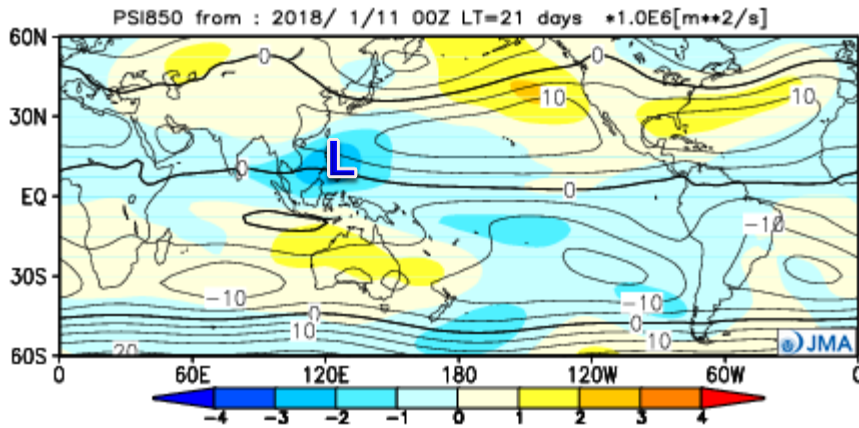


- Anti-cyclonic anomalies straddling the equator over the Maritime Continent and cyclonic anomalies over the eastern tropical Pacific.
- This pattern is considered as the response to the La Nina like precipitation anomaly.
- Prediction skill is also high.

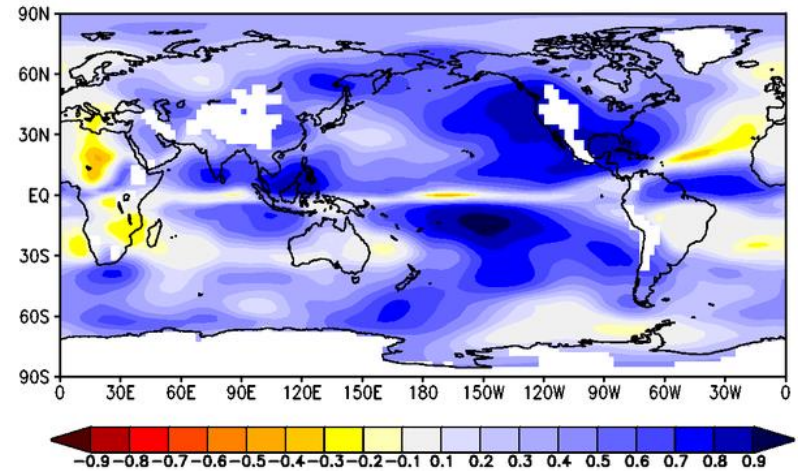


# Stream Function at 850hPa (PSI850)

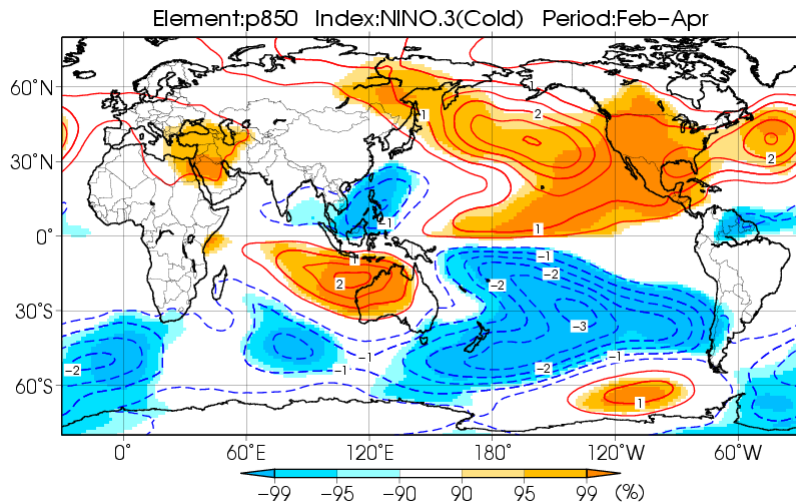
## Forecast Map for FMA 2018



## Anomaly Correlation for FMA (Hindcast; Initial: Jan.)



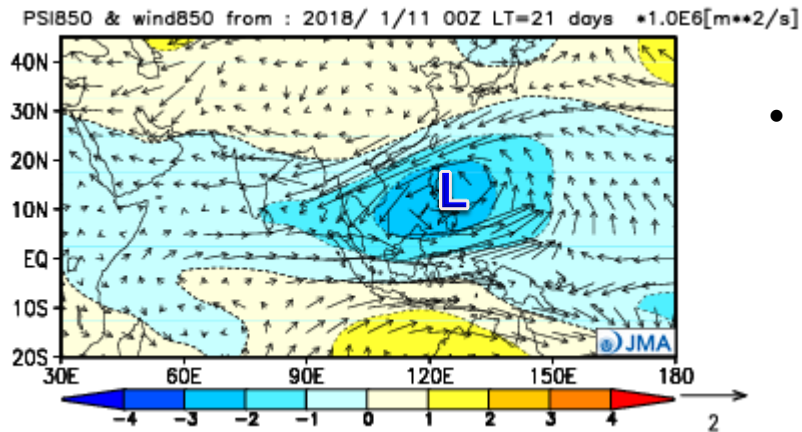
## FMA Composite map for La Nina years



- Cyclonic circulation anomalies are predicted around the Philippines.
- This is caused by active convection around the Philippines.
- Prediction skill is high.

# Stream Function at 850hPa (PSI850)

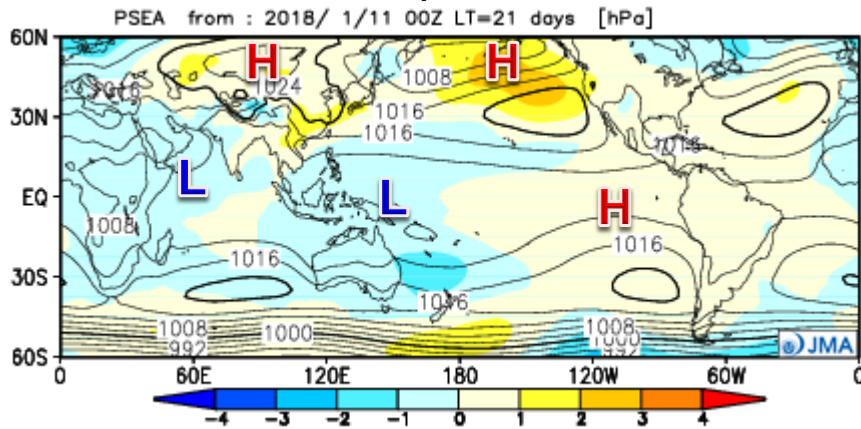
## PSI850 and 850hPa wind anomaly



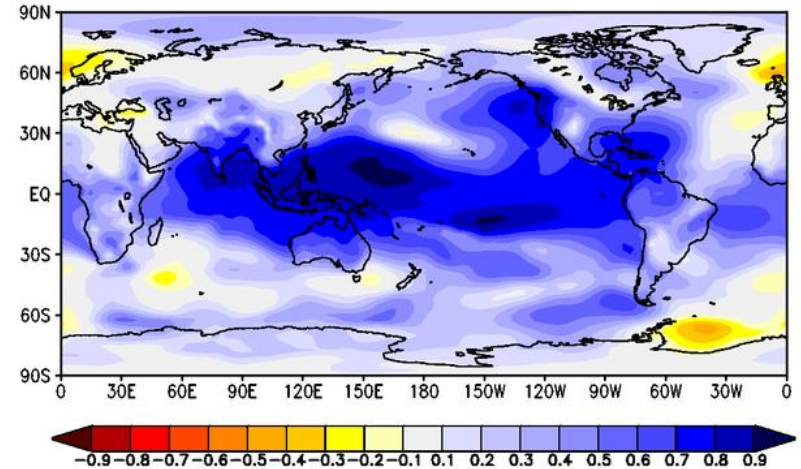
- Northeasterly wind anomaly is predicted from south of Japan to the Bay of Bengal.

# Sea Level Pressure (PSEA)

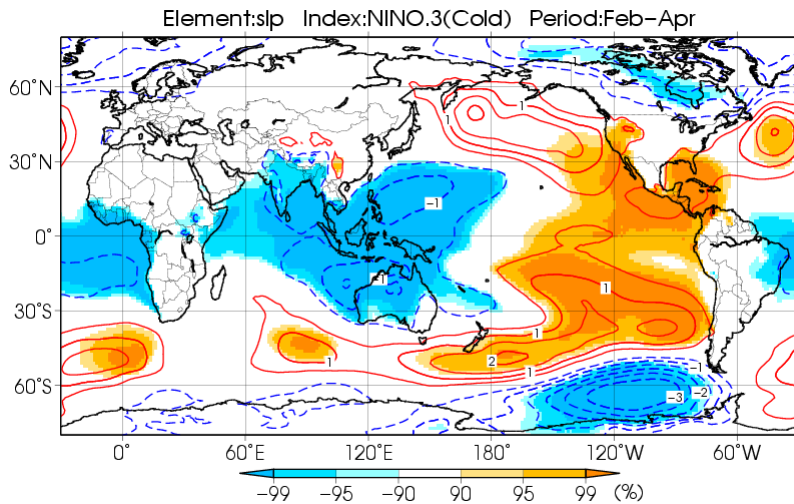
## Forecast Map for FMA 2018



## Anomaly Correlation for FMA (Hindcast; Initial: Jan.)



## FMA Composite map for La Nina years

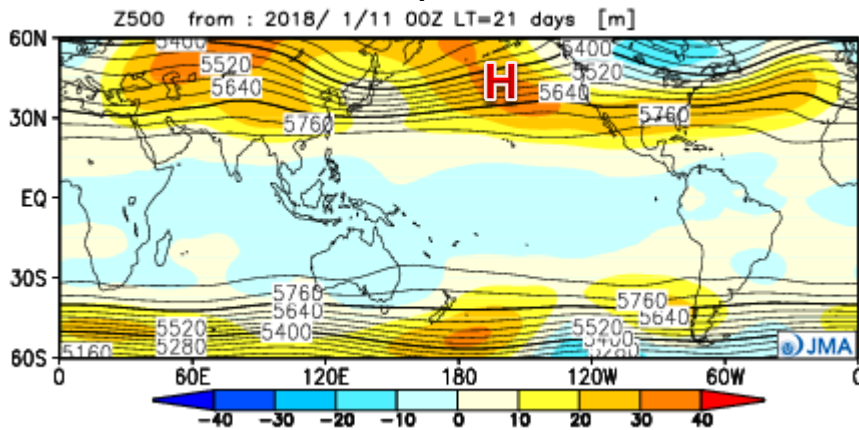


- Negative anomalies are around the Maritime Continent and the western Indian Ocean. (Prediction skill is high)
- Siberian High is stronger than normal, but the prediction skill is low.

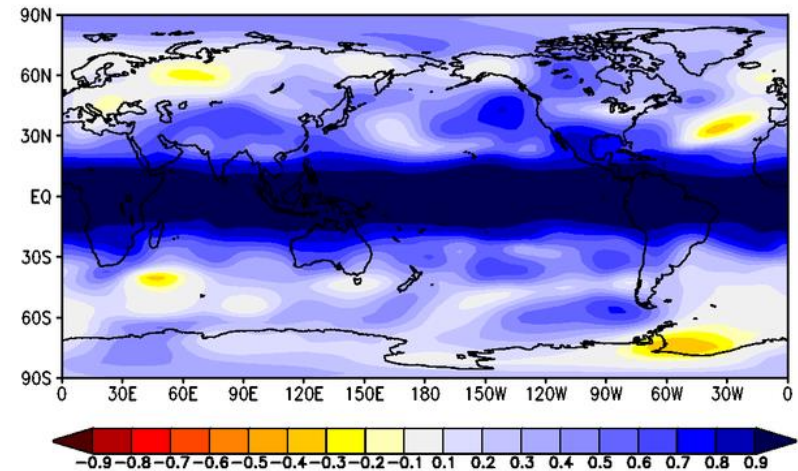


# Geopotential Height at 500hPa (Z500)

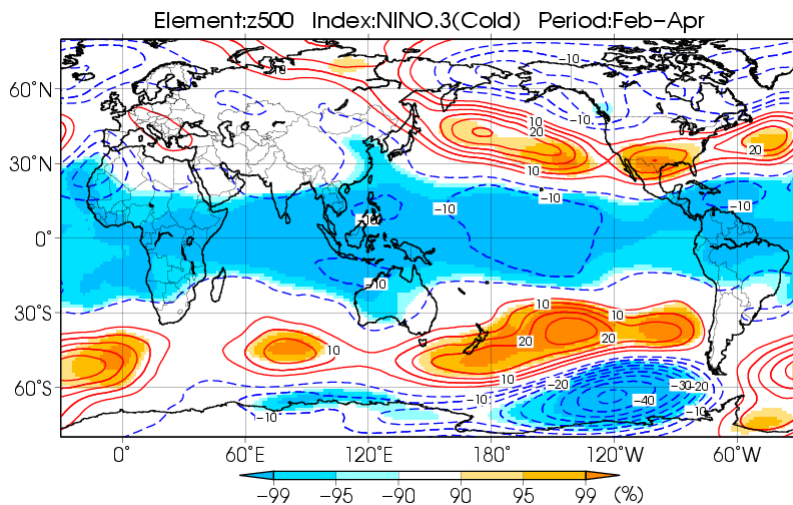
## Forecast Map for FMA 2018



## Anomaly Correlation for FMA (Hindcast; Initial: Jan.)



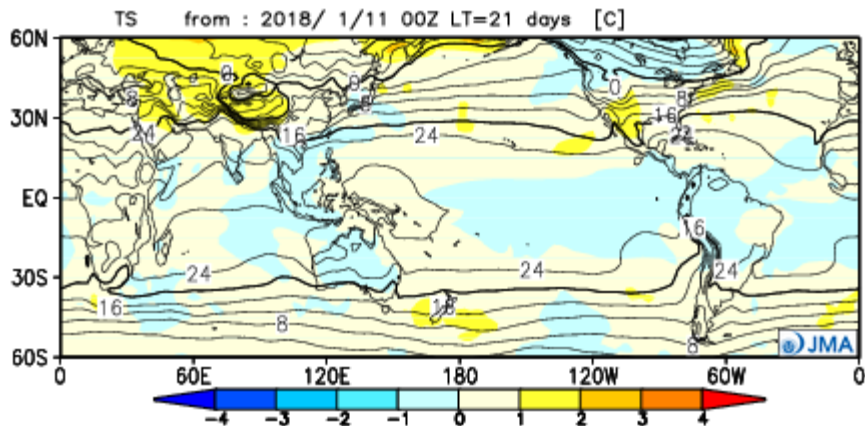
## FMA Composite map for La Nina years



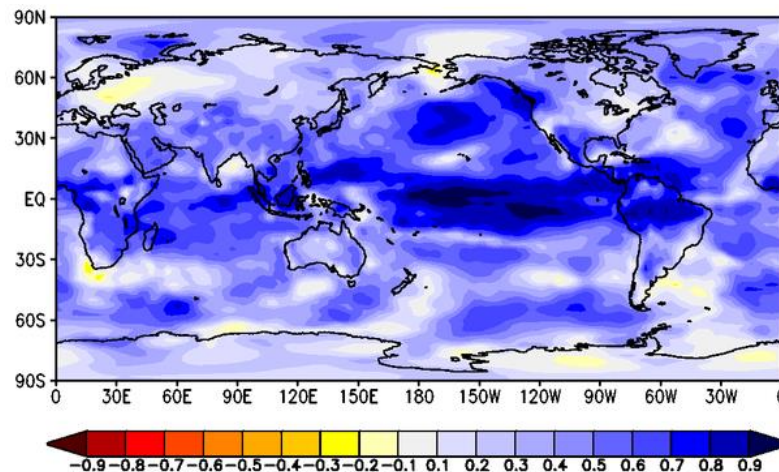
- Positive anomalies are dominantly predicted over the Northern Hemisphere with significant one over the North Pacific (negative PNA pattern).
- Negative PNA pattern tends to appear during La Nina
- Prediction skill is relatively high.

# 2m Temperature (TS)

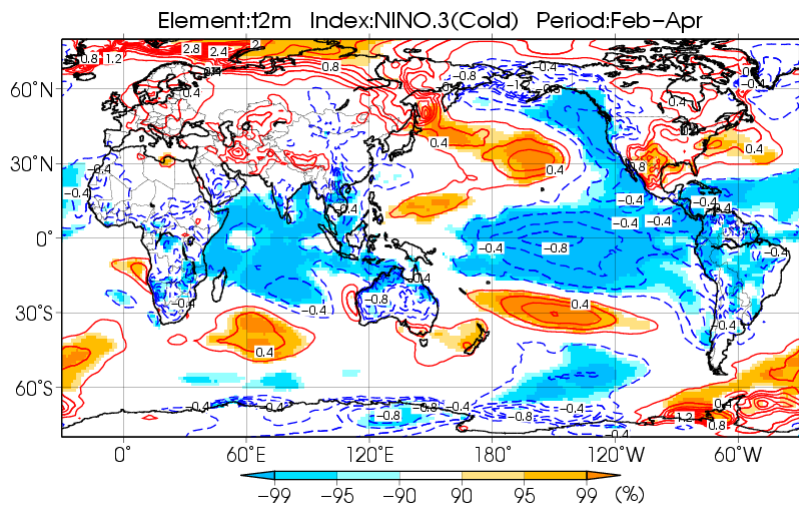
## Forecast Map for FMA 2018



## Anomaly Correlation for FMA (Hindcast; Initial: Jan.)



## FMA Composite map for La Nina years



- Cold anomaly is seen around Southeast Asia and the central – eastern tropical Pacific.
- Prediction skill around tropical Pacific is high.

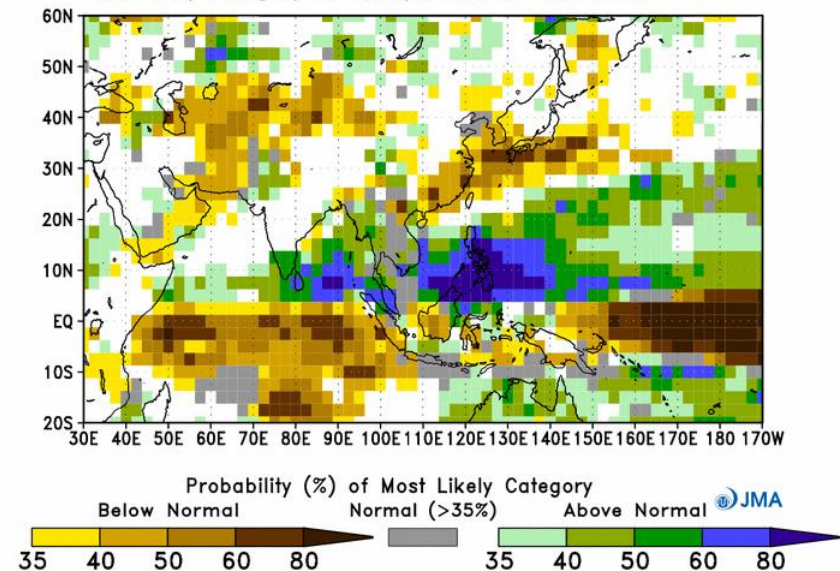
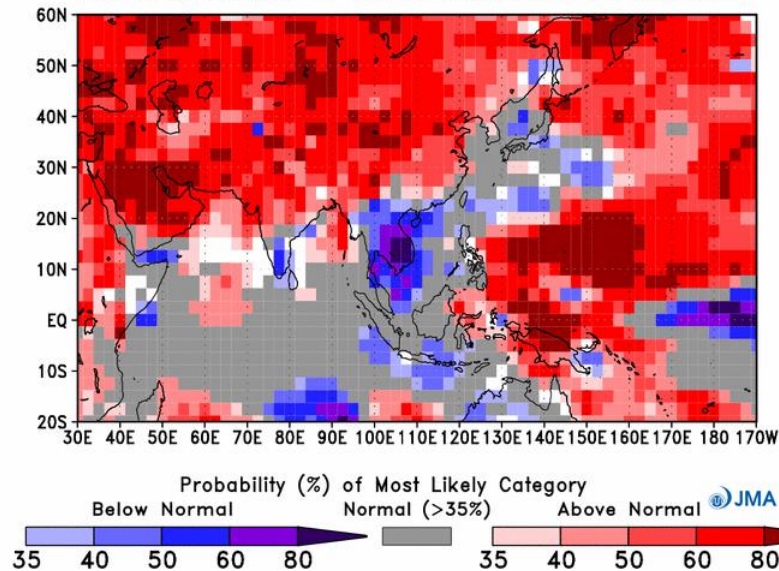
# Global Probability for Temp. and Precip.

## Surface Temperature

## Precipitation

JMA Seasonal Forecast (Forecast initial month is 01 2018)  
Most likely category of Surface Temperature for FMA 2018

JMA Seasonal Forecast (Forecast initial month is 01 2018)  
Most likely category of Precipitation for FMA 2018



Gray: Near Normal  
White: Masked because the prediction skill is low.

These charts show probability of temp. and precip. based on the model output and the simple statistical model.  
(Small scale climatic feature is not considered)



# General Summary of Model Output for FMA 2018

- It is likely that La Niña like SST anomaly pattern will persist through to the boreal spring.
- Above-normal and below-normal precipitation anomaly are predicted around the Philippines and around the Date Line.
- Atmospheric and climate anomaly over (sub)tropics generally shows the pattern that tends to be seen during La Niña years.
- This anomaly pattern has relatively high prediction skill, indicating that it may be possible to adopt it into forecast.
- Prediction skill over mid-latitude is relatively small, so it is necessary to judge what pattern can be adopted into forecast.