Interpretation of Outputs from Numerical Prediction System

Hiroshi OHNO
Tokyo Climate Center (TCC)/
Climate Prediction Division of
Japan Meteorological Agency (JMA)

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?

These will be introduced during the seminar…

Products for seasonal forecast provided at TCC-HP

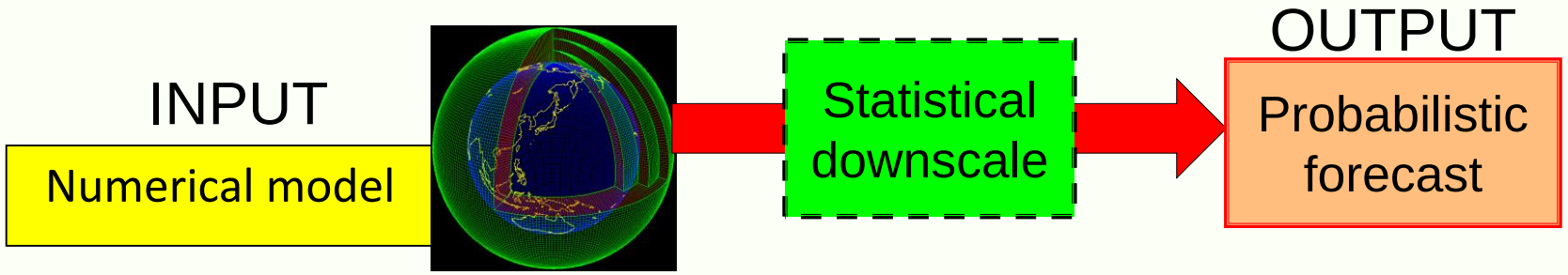
- **Forecast Map**
- **Monthly Discussion**
- **Hindcast Verification Charts**
- **El Nino Outlook**

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
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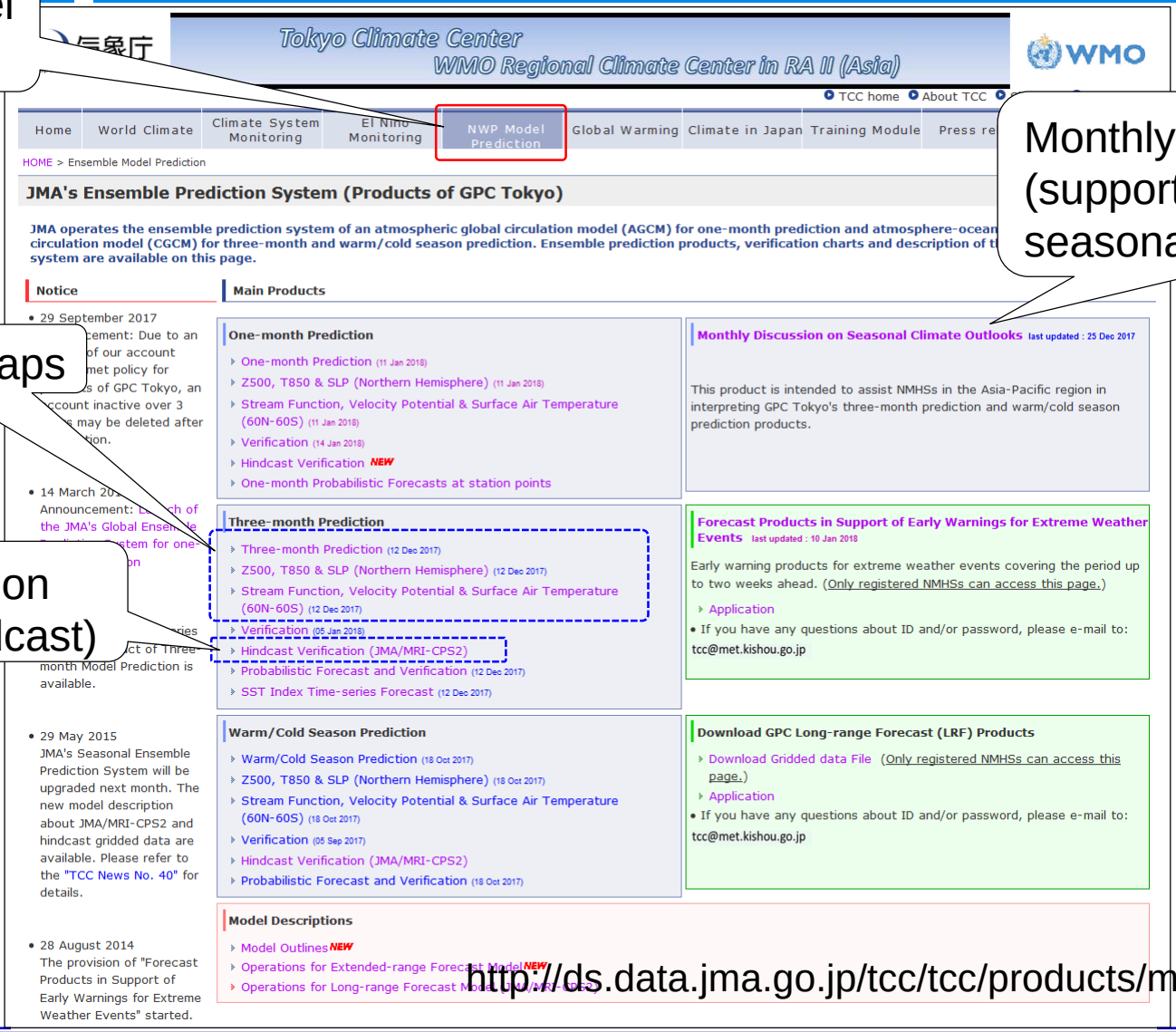
Access to the EPS Products on TCC-HP

NWP Model Prediction

Forecast maps

Verification maps (hindcast)

Monthly Discussion (support material of seasonal forecast)



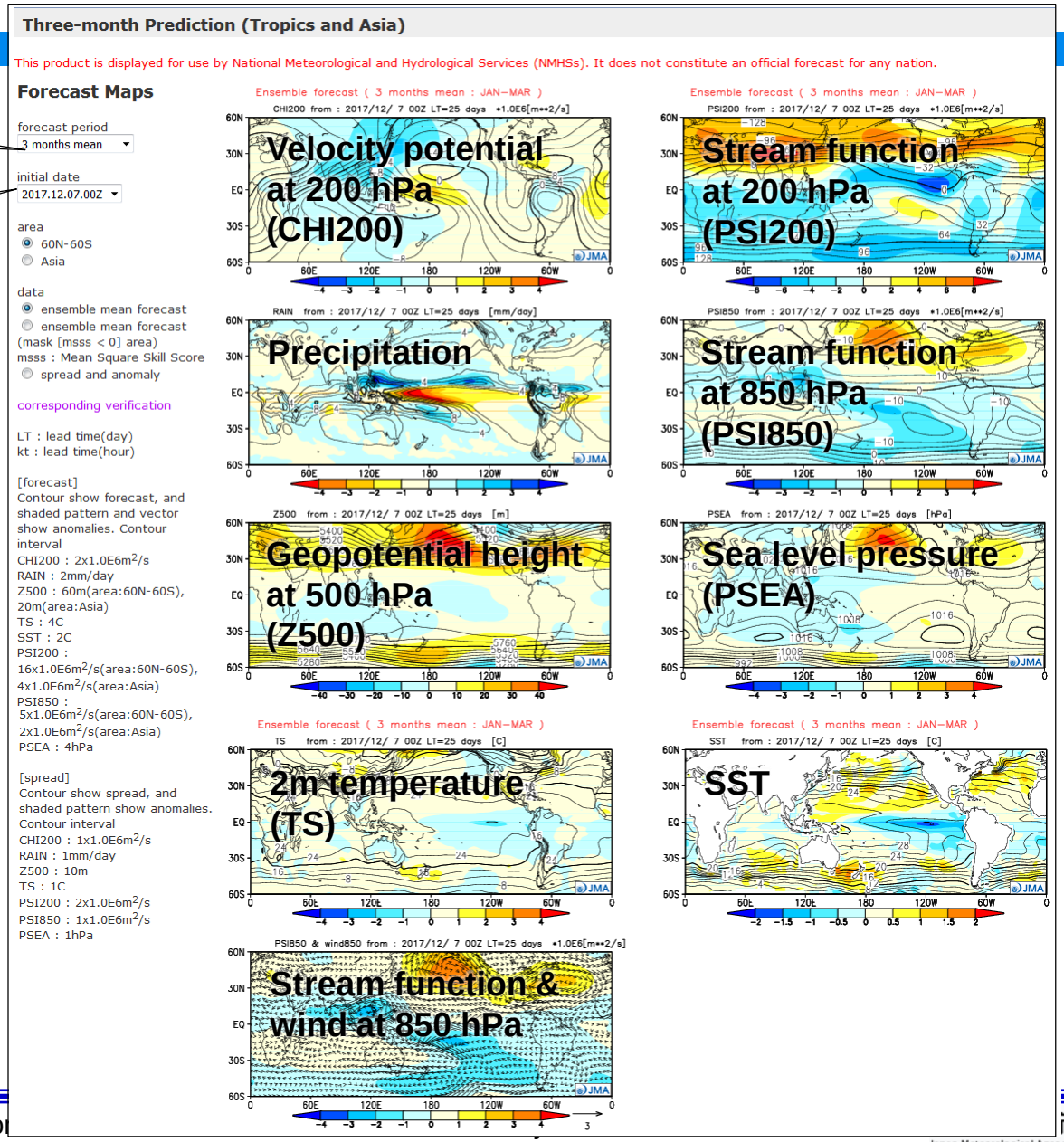
http://ds.data.jma.go.jp/tcc/tcc/products/model/index.html

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**

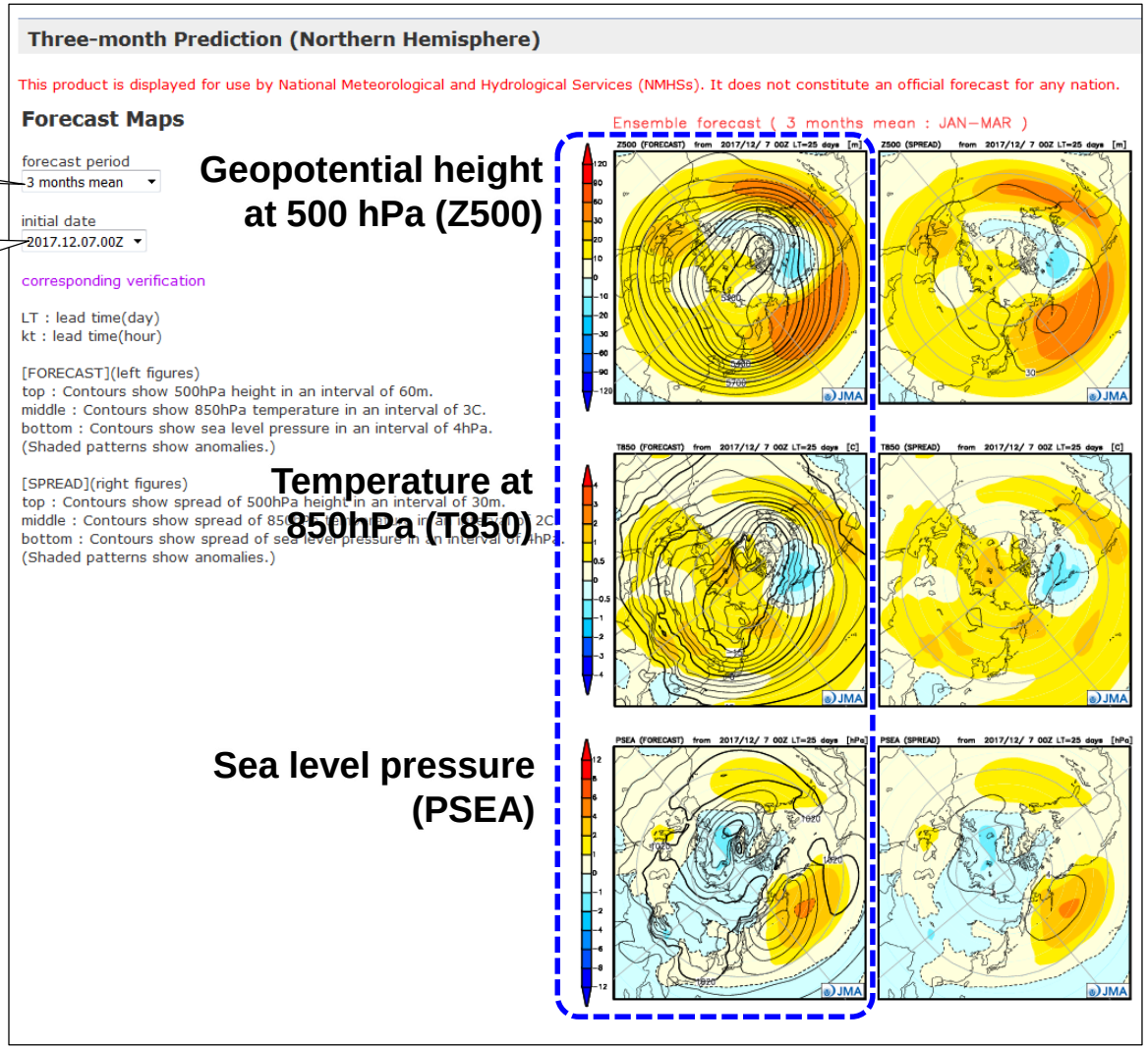


Forecast Map (Northern Hemisphere)

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

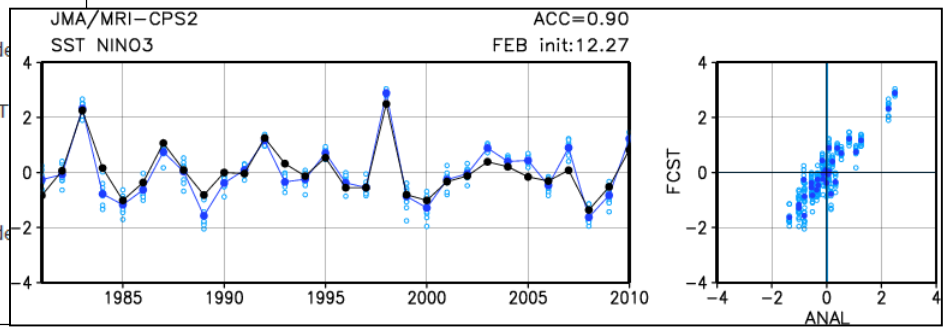
- JMA/MRI-CPS2

Hindcast Verification

- Deterministic score Maps
  - Variables to be Assessed: T2m, PSEA, SST, RAIN, Z100, Z200, Z300, Z500, Z850, T850, U2
  - Diagonostic Measures:
    - Mean Square Skill Score(MSSS)
    - Anomaly Correation(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
  - Diagonostic Measures:
    - Reliability diagrams (Aggregated verification)
    - Relative Operating Characteristics(ROC) curve (Aggregat
  - Event: Anomaly > 0, Below Normal, Near Normal, Above
  - The 3 categories(above-normal, near-normal, below-no ned by standard de
- Probabilistic score Maps
  - Variables to be Assessed: T2m, PSEA, SST, R , Z200, Z300, Z500, Z850, T
  - Diagonostic Measures:
    - Relative Operating Characteristics(RO as (Grid point verification)
  - Event: Anomaly > 0, Below Normal, Normal, Above Normal, All
  - The 3 categories(above-normal, ne normal, below-normal) are defined by standard de
- 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



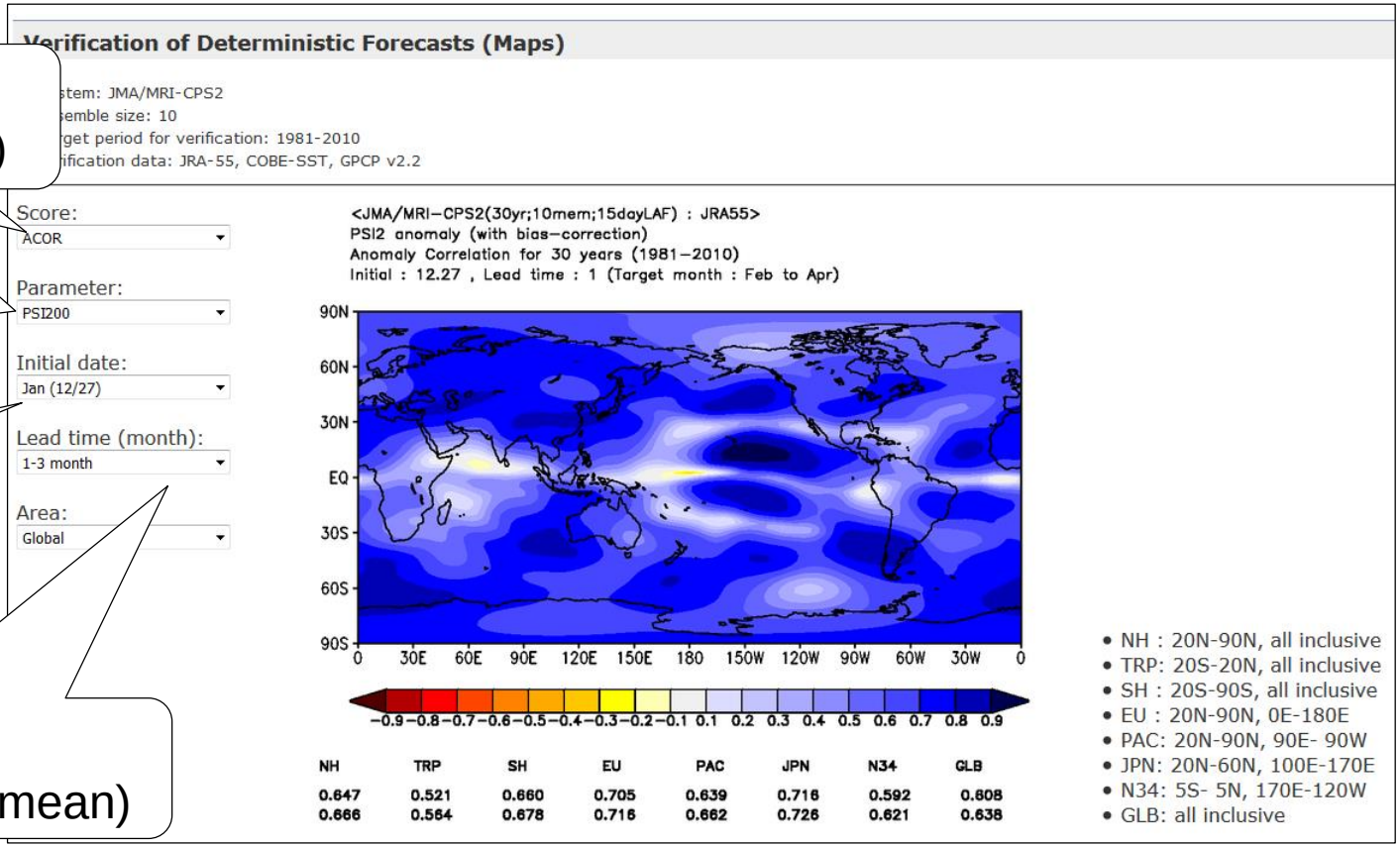
Verification Map (Hindcast)

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

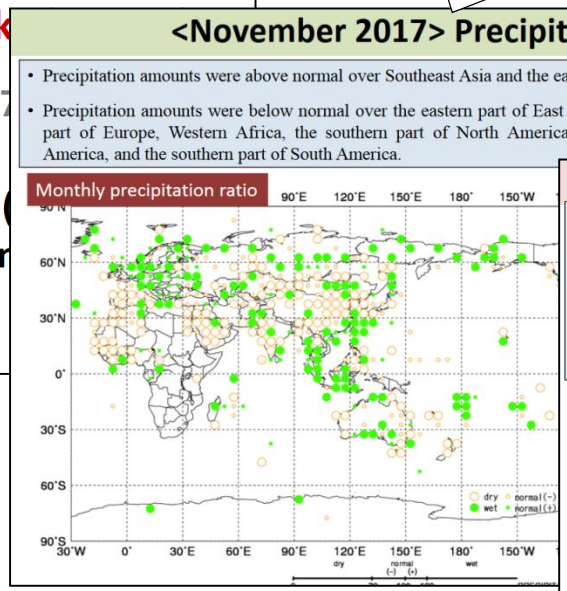
Material issued every month (around 25th) in order to assist NMHSs in interpreting season prediction products.

Monthly Discussion on Seasonal Climate Outlook

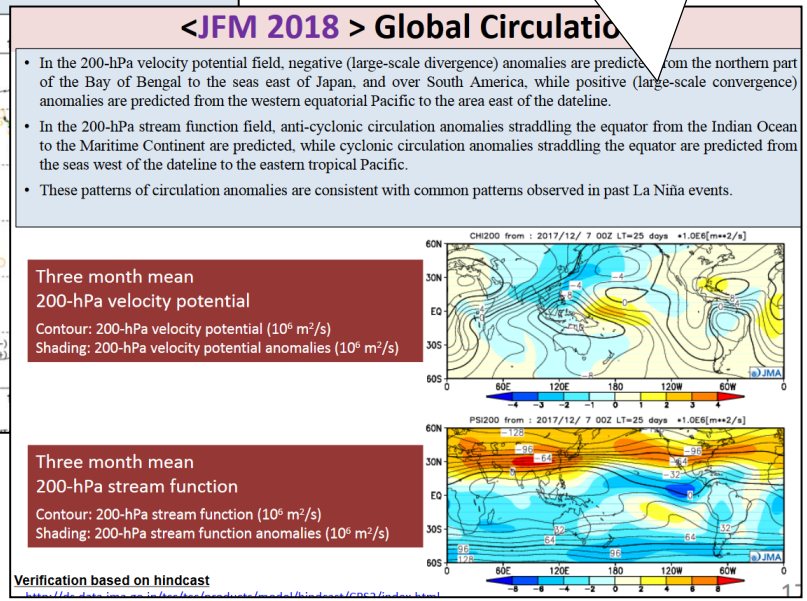
(25 December 2017)

Tokyo Climate Center (
Japan Meteorological Ager

Latest state of the climate system



Explanatory comments on the latest model's output



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

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- 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**.

SST anomaly in the tropics → SST map

Ex. ENSO, IOD…

Convective anomaly → Precipitation & CHI200 maps

Atmospheric response to the convective anomaly → PSI200/850, SLP, Z500 maps

Ex. Matsuno-Gill pattern, teleconection pattern

Climate around your forecast point → Temp. & Precip. maps

Verification of the EPS outputs

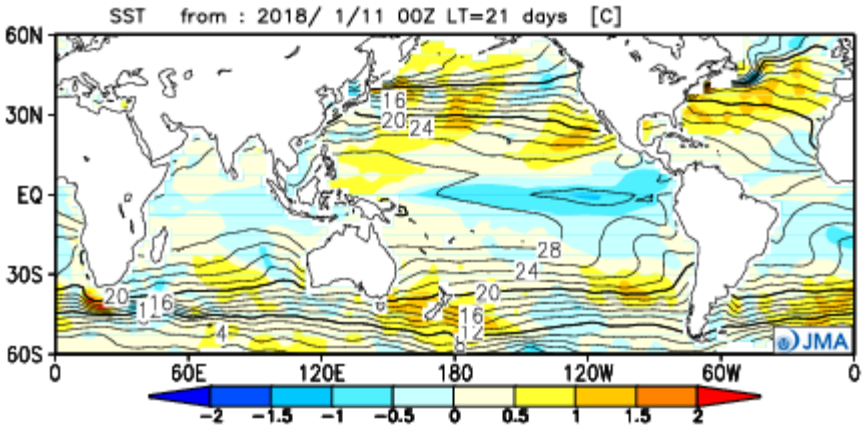
- It is necessary to check the prediction skill of the model and judge which anomaly pattern can/cannot be adopted into your forecast.
- Prediction skill can be checked from **verification maps** such as **Anomaly Correlation Coefficient (ACC)**.

Utilized model output in this seminar

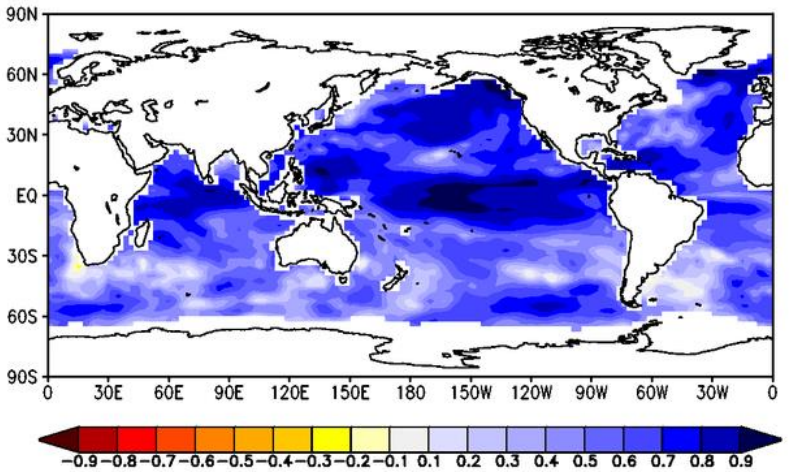
- Initial date: 11 Jan. 2018
- Forecast period: Feb. – Apr. 2018 (3-month mean)

SST

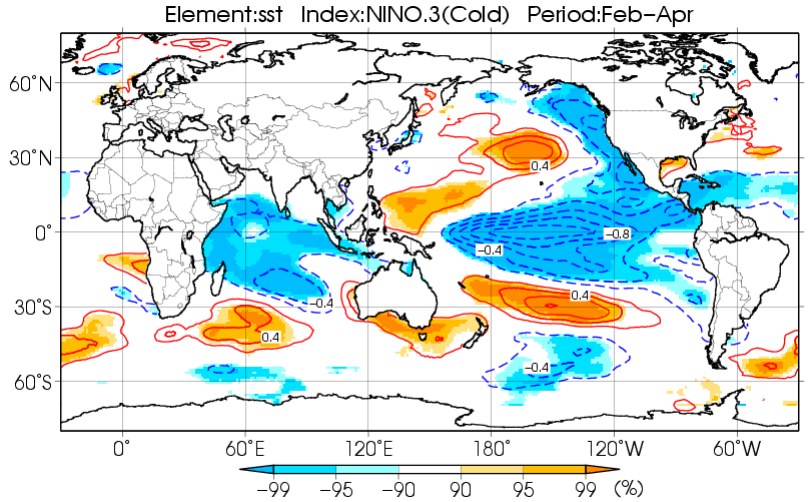
Forecast Map for FMA 2018



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



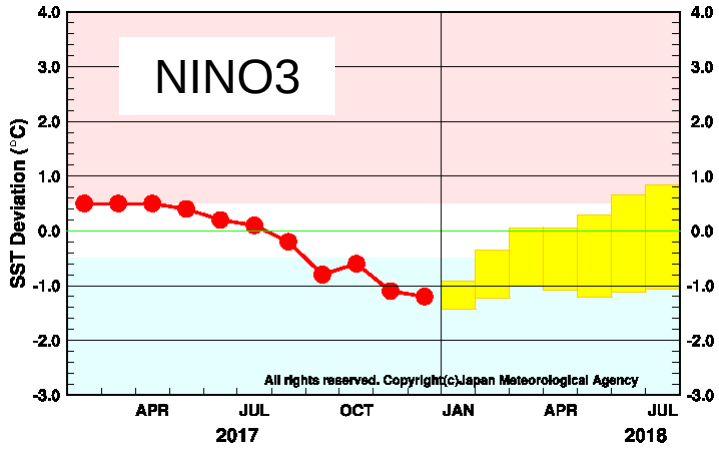
FMA Composite map for La Nina years

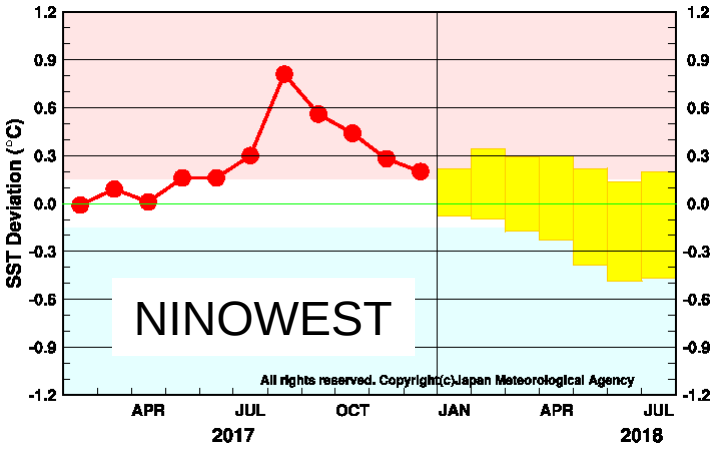


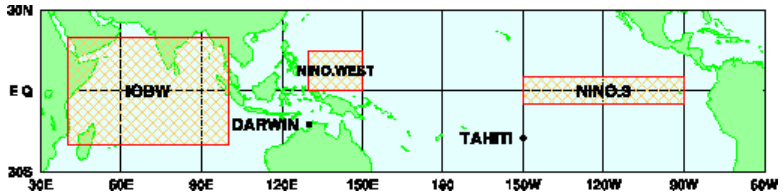
- La Nina like pattern over the Pacific is predicted.
- Prediction skill over the Pacific is high.

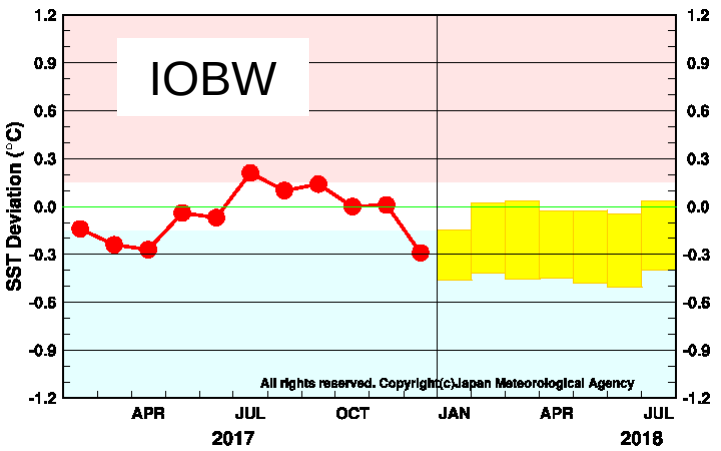
El Nino Outlook (issued on 11 Jan.)

- 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%).





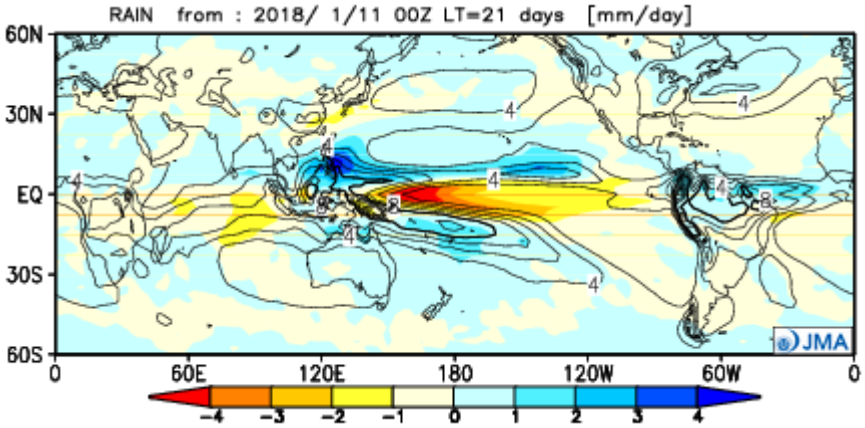




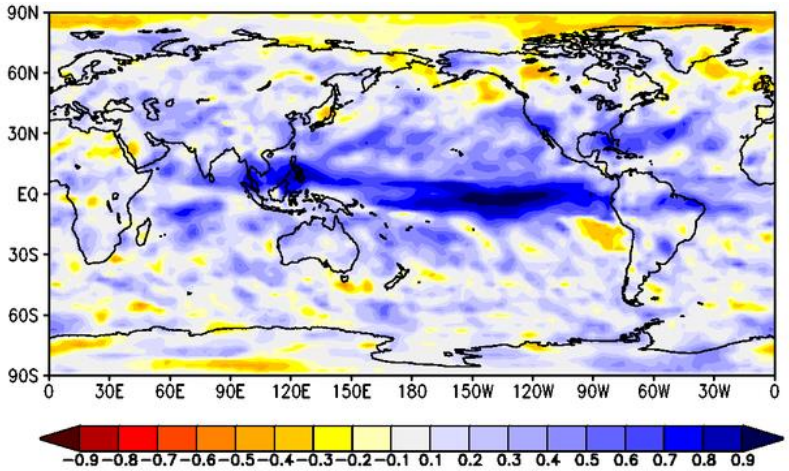
- It is likely that the NINO.WEST SST will come gradually closer to normal until boreal spring.
- It is likely that the IOBW SST will be below normal until boreal spring.

Precipitation

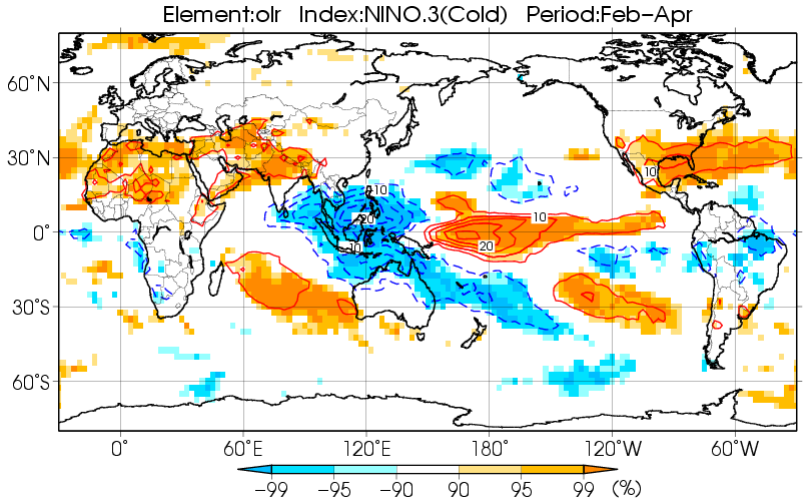
Forecast Map for FMA 2018



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



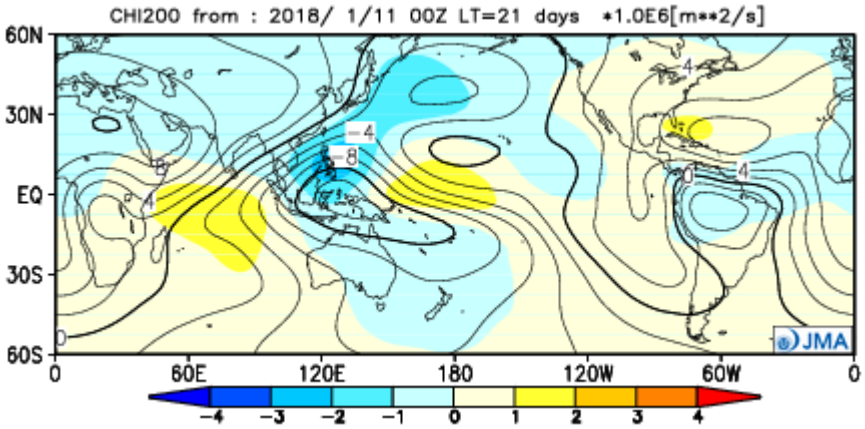
FMA Composite map (OLR)



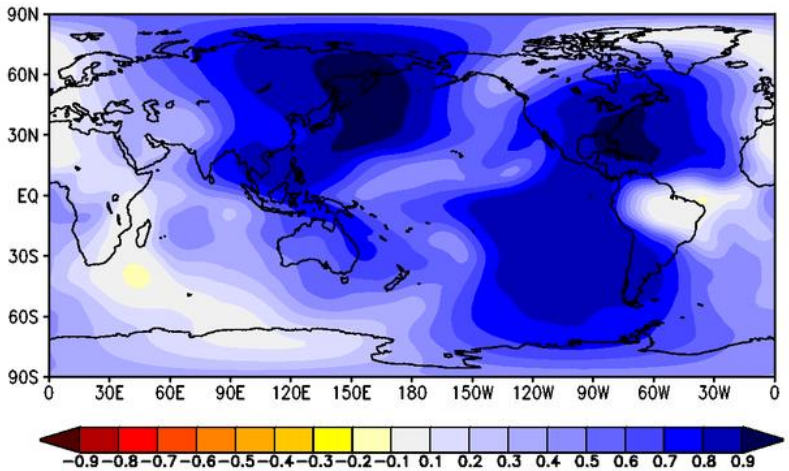
- Above-normal precipitation is predicted around the Philippines and below-normal is around DL and over the tropical South Indian Ocean. (La Nina like pattern)
- Prediction skill from Southeast Asia to the Pacific is high.

Velocity Potential at 200hPa (CHI200)

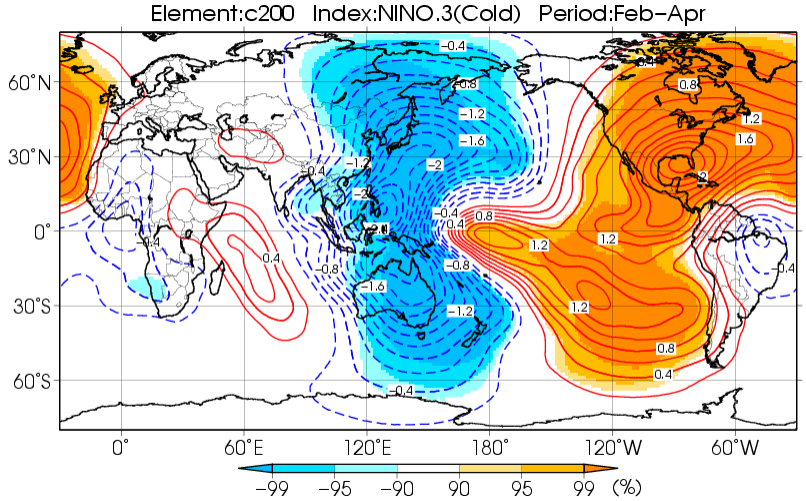
Forecast Map for FMA 2018



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

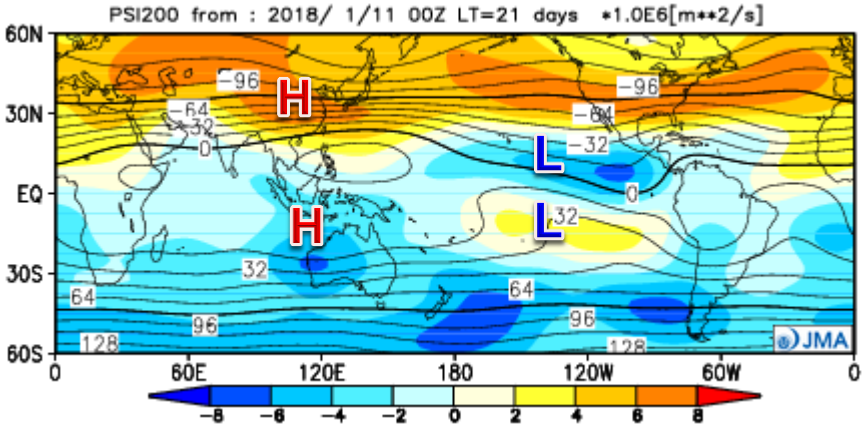


FMA Composite map for La Nina years

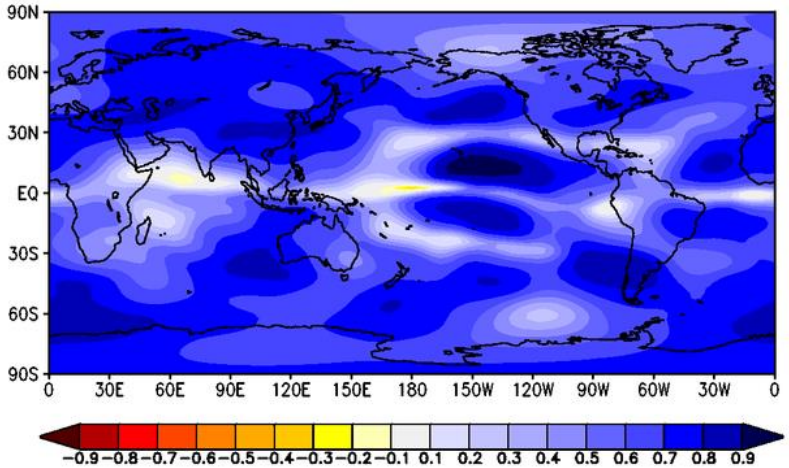


Stream Function at 200hPa (PSI200)

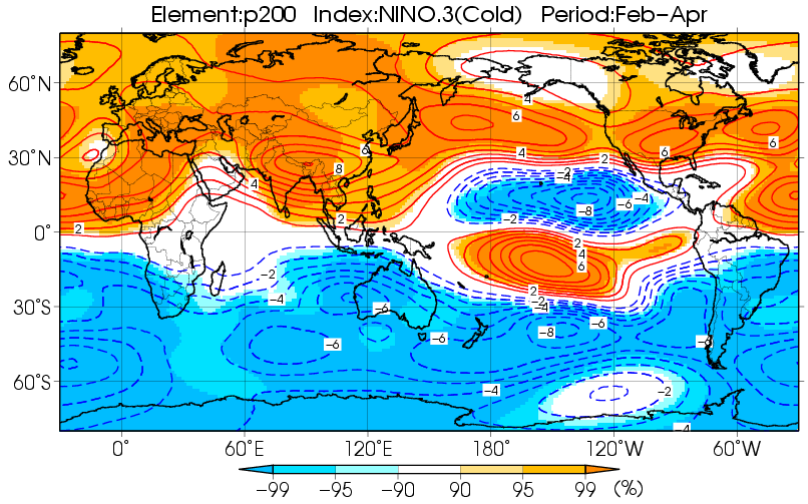
Forecast Map for FMA 2018



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



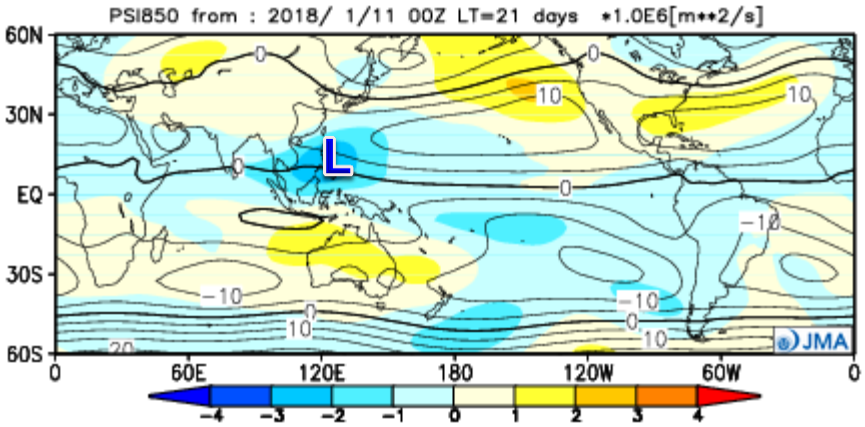
FMA Composite map for La Nina years



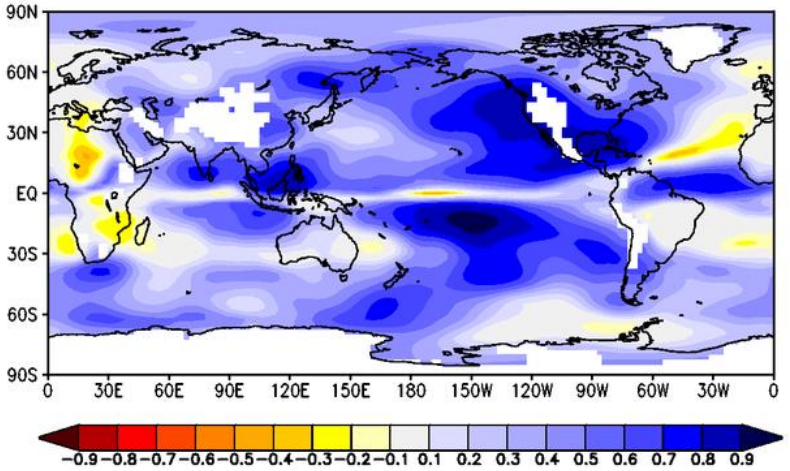
- Anti-cyclonic anomalies straddling the equator over the Maritime Continent and cyclonic anomalies over the eastern tropical Pacific.
- This pattern is considered as the response to the La Nina like precipitation anomaly.
- Prediction skill is also high.

Stream Function at 850hPa (PSI850)

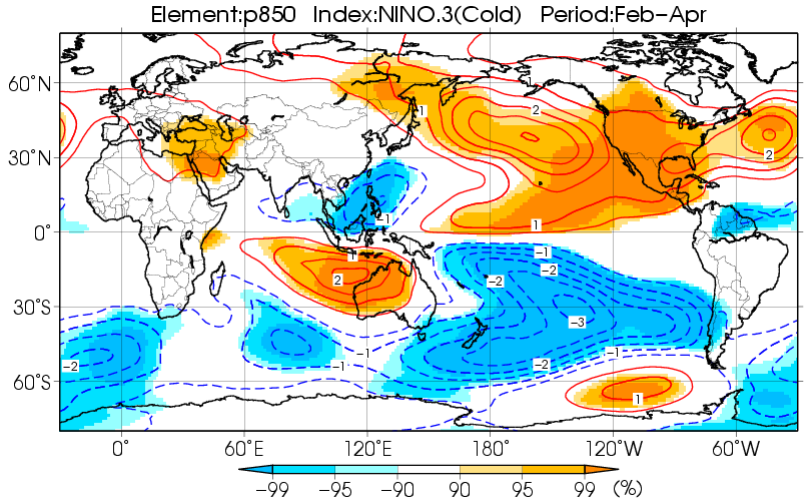
Forecast Map for FMA 2018



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



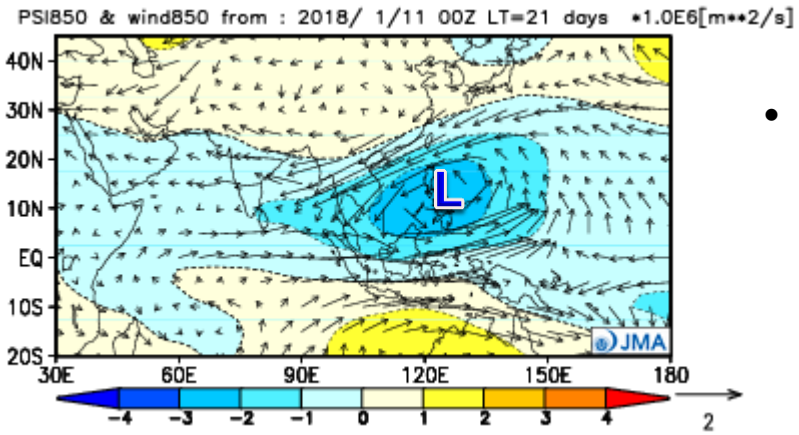
FMA Composite map for La Nina years



- 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)

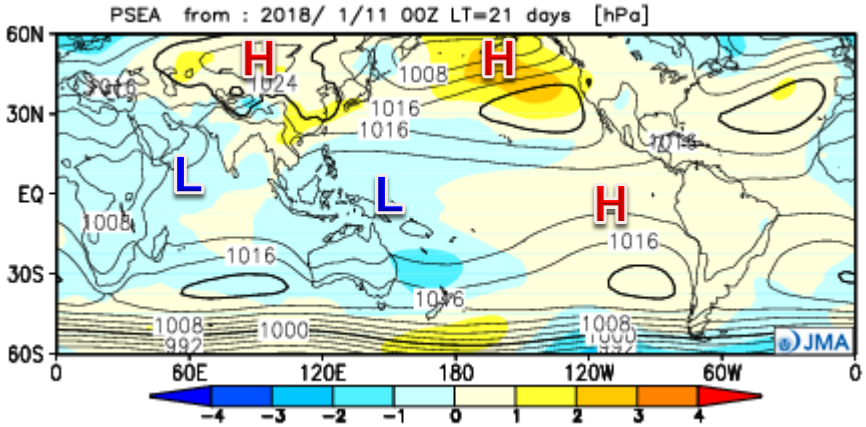
PSI850 and 850hPa wind anomaly



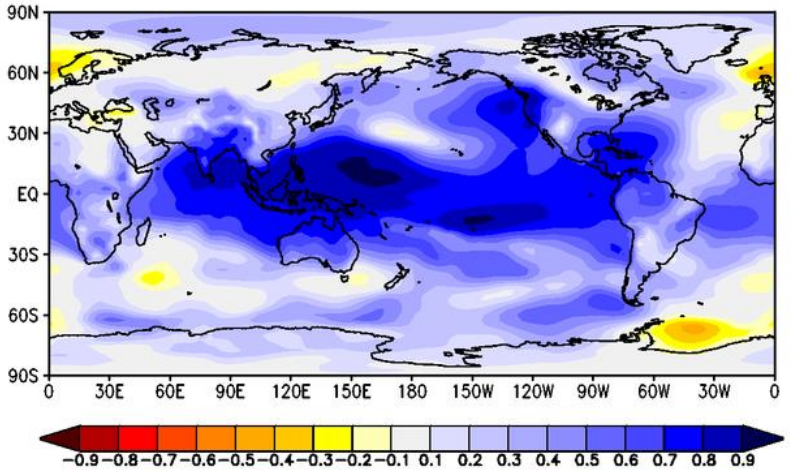
- Northeasterly wind anomaly is predicted from south of Japan to the Bay of Bengal.

Sea Level Pressure (PSEA)

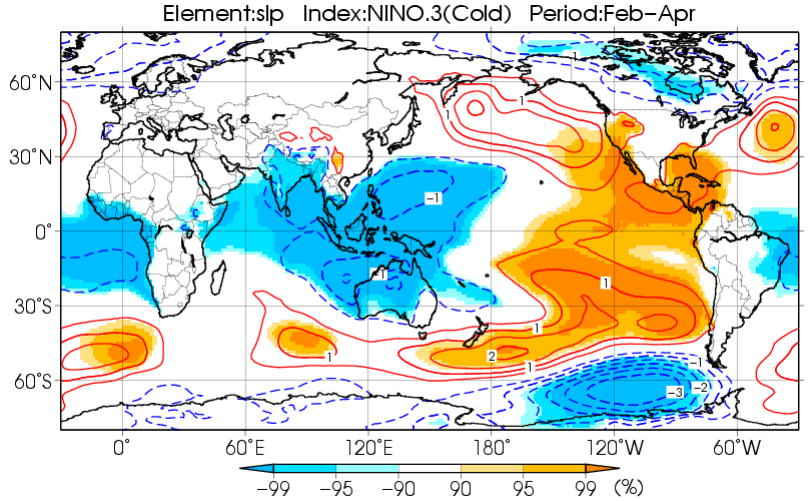
Forecast Map for FMA 2018



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



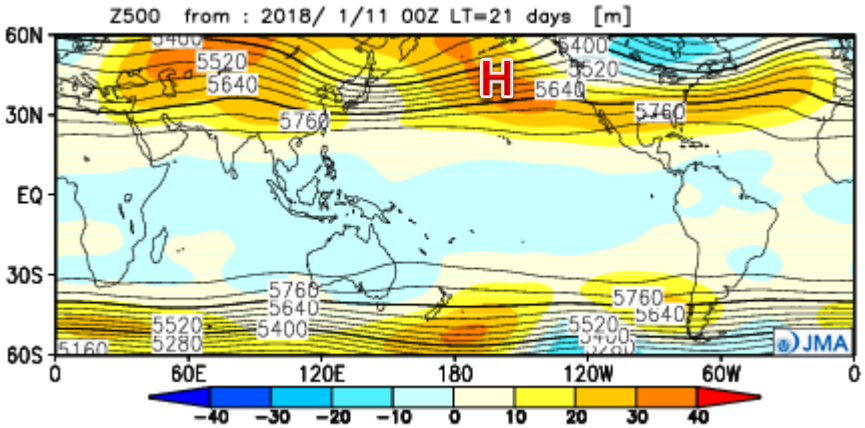
FMA Composite map for La Nina years



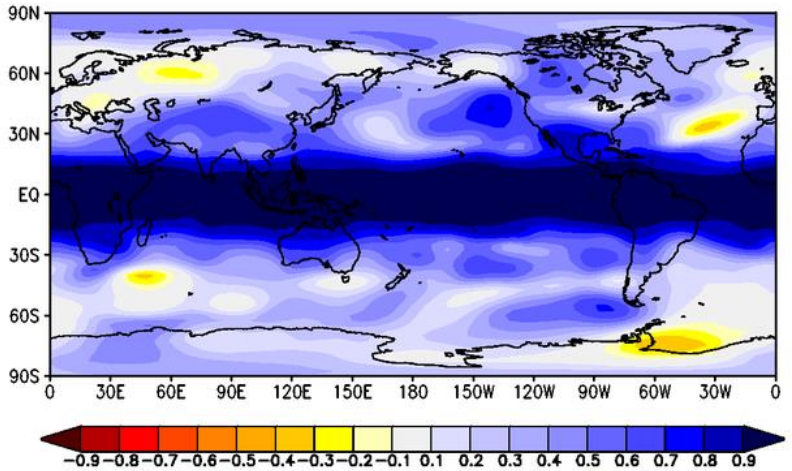
- Negative anomalies are around the Maritime Continent and the western Indian Ocean. (Prediction skill is high)
- Siberian High is stronger than normal, but the prediction skill is low.

Geopotential Height at 500hPa (Z500)

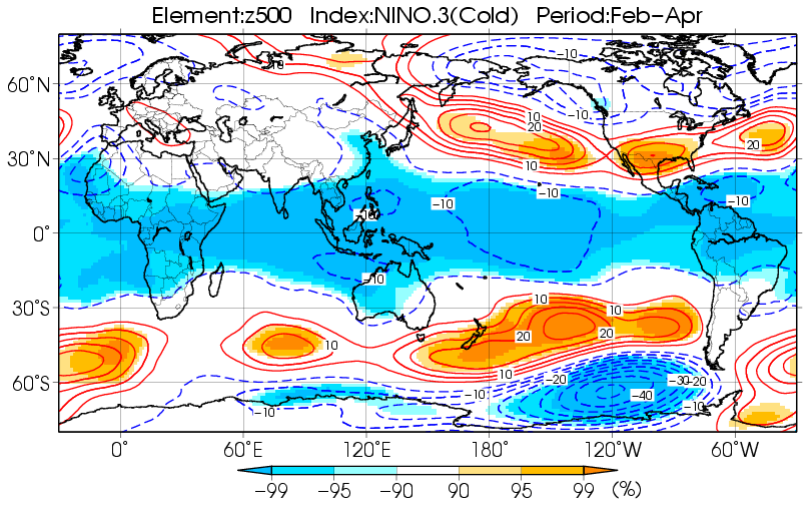
Forecast Map for FMA 2018



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



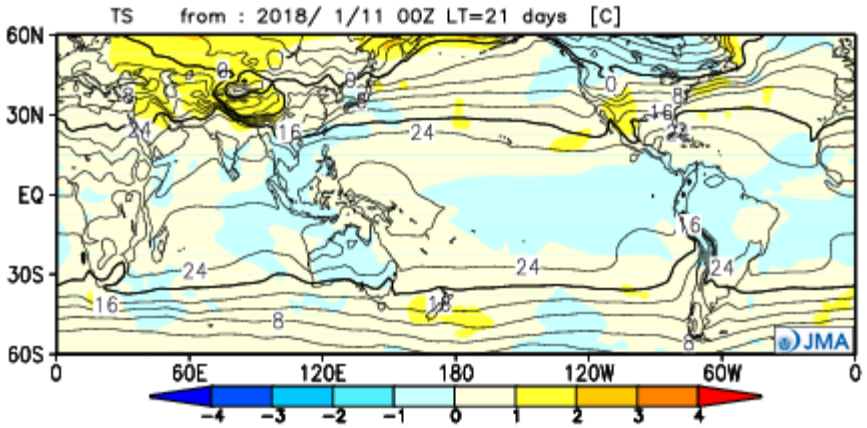
FMA Composite map for La Nina years



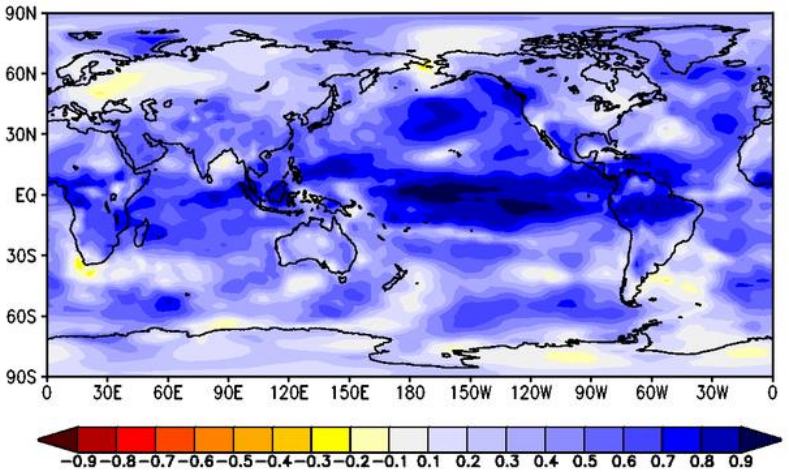
- Positive anomalies are dominantly predicted over the Northern Hemisphere with significant one over the North Pacific (negative PNA pattern).
- Negative PNA pattern tends to appear during La Nina
- Prediction skill is relatively high.

2m Temperature (TS)

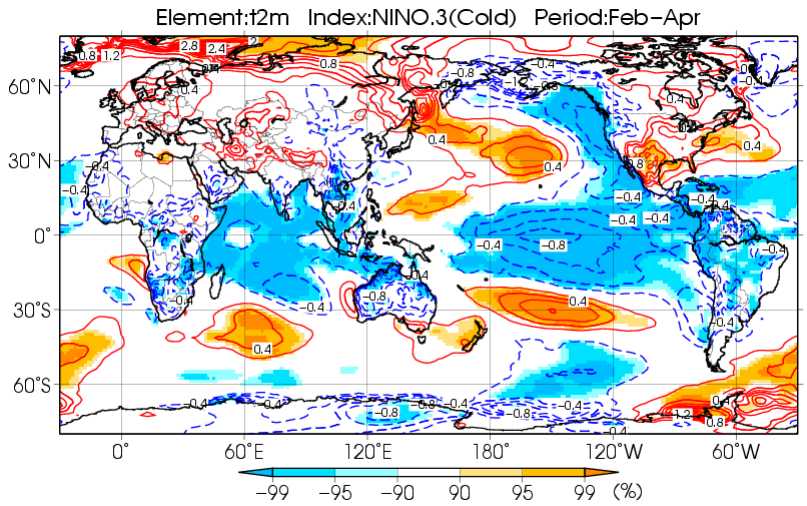
Forecast Map for FMA 2018



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



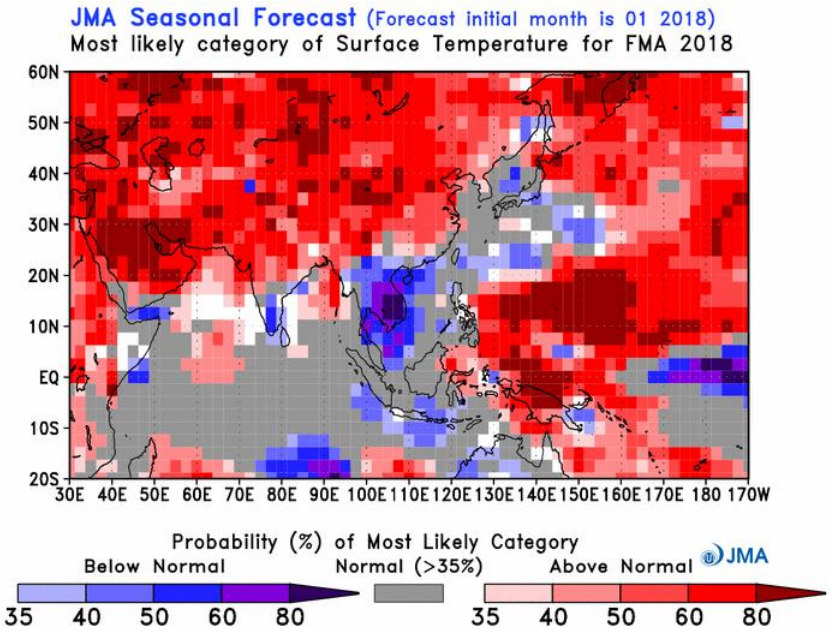
FMA Composite map for La Nina years



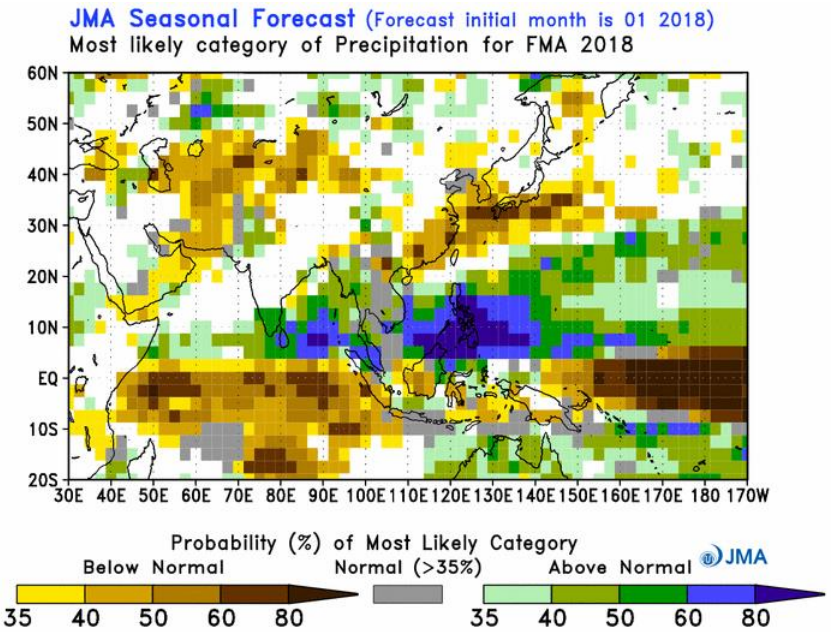
- Cold anomaly is seen around Southeast Asia and the central – eastern tropical Pacific.
- Prediction skill around tropical Pacific is high.

Global Probability for Temp. and Precip.

Surface Temperature



Precipitation



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.