

# Making Seasonal Forecast Example

**DISCLAIMER:** This example is only for use in training. The opinions in this example are should not be regarded as official forecast of JMA.

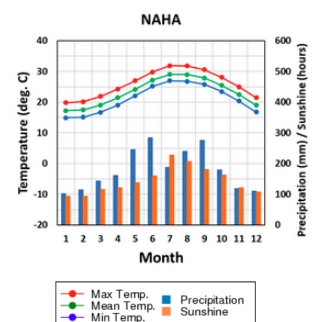
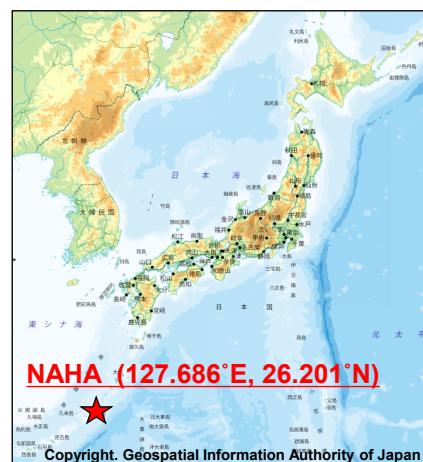
UESAWA Daisaku  
Senior Forecaster  
Japan Meteorological Agency

TCC Training Seminar on Seasonal Forecast, 29 January-2 February 2024, JMA, Tokyo, Japan

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## Setting

- Initial date: Jan 2024
- Target period: FMA 2024
- Target forecast: 3-category probabilities of Temperature and Precipitation
- Target point: NAHA, Okinawa, Japan
- Forecaster: UESAWA Daisaku



NAHA is located in Okinawa Island, which has a subtropical oceanic climate.

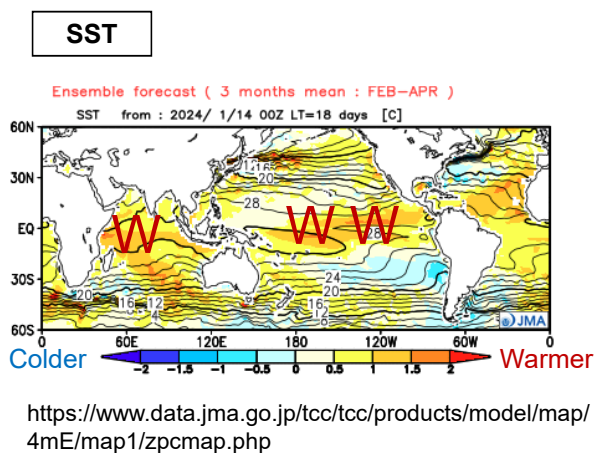
2

# Workflow

1. Check global circulation prediction by CPS3
  - ① Tropical ocean, particularly ENSO
  - ② Tropical circulation, particularly as response to ENSO
  - ③ Extra-tropical circulation (if necessary)
    - Be sure to check prediction skills
2. Check guidance output
  - Be sure to check prediction skills
3. Synthesize model and guidance output to decide forecast
  - Think about how to explain forecast
4. Issue forecast

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## Tropical ocean prediction

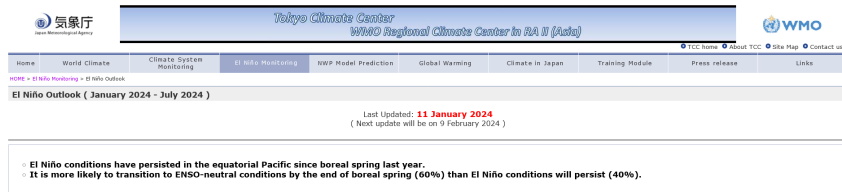


- Equatorial Pacific
  - In transition from El Niño to ENSO neutral (adopted from TCC El Niño Outlook)
  - Central and Eastern part: Positive anomaly
  - Western Pacific: near Normal
  - Influence of El Niño remains
- Tropical Indian Ocean
  - Positive anomaly all over the area
    - Basin-wide warming (positive IOBW) as delayed response to El Niño
  - Western part > Eastern part
    - Influence of positive IOD remains
- Decaying phase of El Niño

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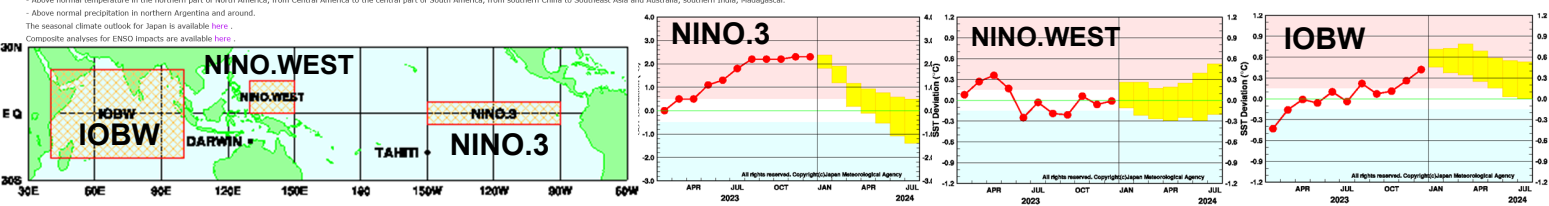


# TCC El Nino Outlook as a reference



## TCC El Nino Outlook (Issued: 11Jan2024)

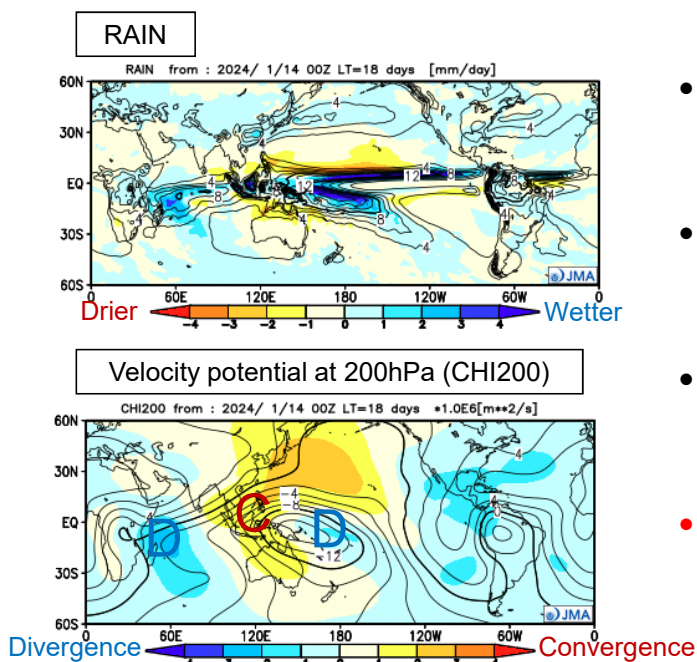
- El Niño conditions have persisted in the equatorial Pacific since boreal spring last year
- It is more likely to transition to ENSO-neutral conditions by the end of boreal spring (60%) than El Niño conditions will persist (40%)
- The IOBW index is likely to be above normal into boreal summer



<https://www.data.jma.go.jp/tcc/tcc/products/elnino/outlook.html>

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# Tropical convection prediction



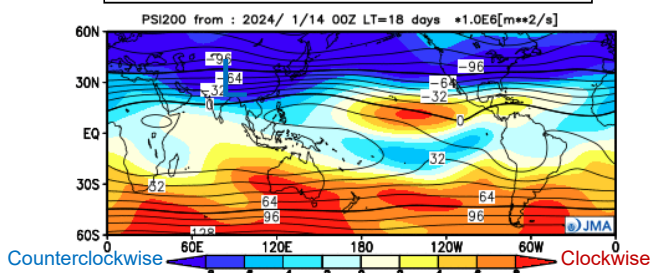
- Western Indian Ocean
  - Enhanced convection anomaly (Divergence anomaly at upper level)
- Western Pacific (Maritime Continent)
  - Suppressed convection anomaly (Convergence anomaly at upper level)
- Central Pacific (near DL)
  - Enhanced convection anomaly (Divergence anomaly at upper level)
- These convective activity anomalies correspond to SST anomalies

<https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/zpcmap.php>

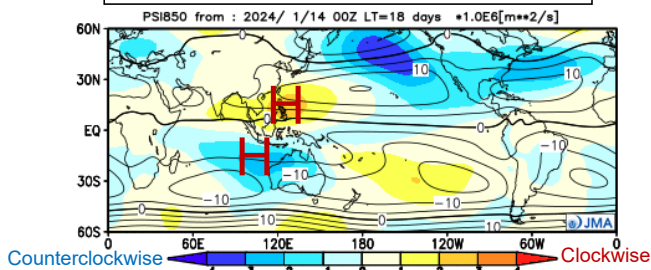
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# Tropical circulation prediction

Stream function at 200hPa (PSI200)



Stream function at 850hPa (PSI850)



- Upper level circulation
  - Cyclonic anomalies zonally in mid-latitude in both hemispheres; corresponds to **southward shift of subtropical jets as response to El Niño**
  - Cyclonic circulation anomaly from northern India to southern China (stamped 'L')
- Lower level circulation
  - Anti-cyclonic anomaly around the Philippines (stamped 'H')
  - **Corresponds to suppressed convection anomaly over the Maritime Continent**

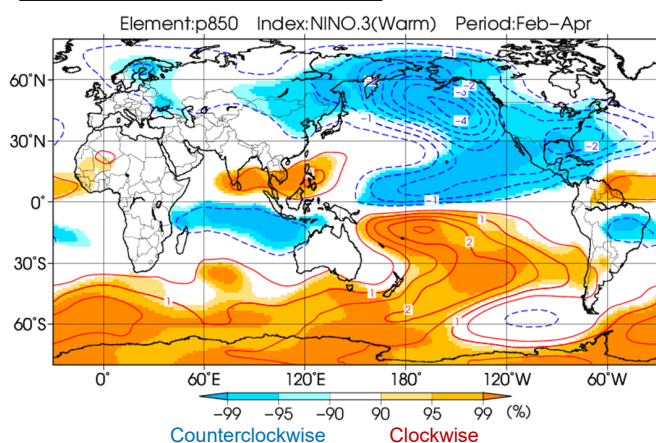
<https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/zpcmap.php>

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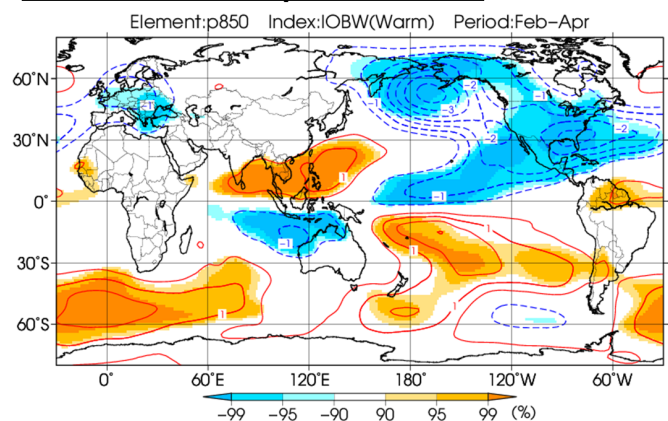
## Statistics as a reference

Statistically significant anti-cyclonic anomaly at lower-level around the Philippines both in the phase of El Niño and in the positive phase of IOBW on February-March-April

PSI850 for FMA in El Niño



PSI850 for FMA in positive IOBW

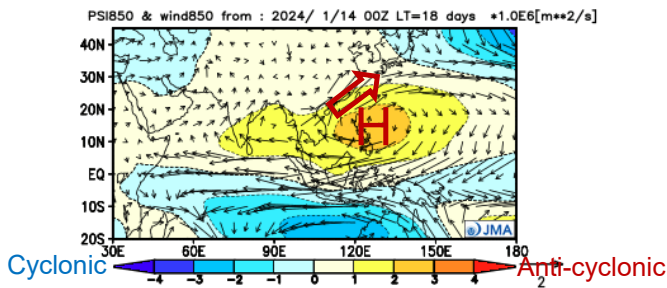


3-month mean composite of 850-hPa stream function anomalies (TCC website)  
[https://www.data.jma.go.jp/tcc/tcc/products/clisys/enso\\_statistics/index.html](https://www.data.jma.go.jp/tcc/tcc/products/clisys/enso_statistics/index.html)

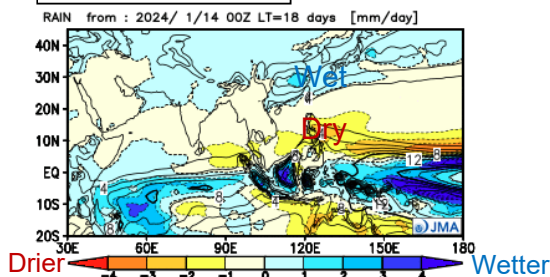
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# Tropical circulation prediction (Asia)

Stream function and wind at 850hPa



Rainfall (RAIN)



<https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/zpcmap.php>

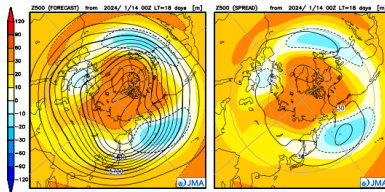
- Southwesterly wind anomalies around the East China Sea, accompanied with anti-cyclonic anomaly at lower level around the Philippines (stamped 'H')
- Wetter-than normal (more precipitation than normal) condition around the East China Sea, brought by southwesterly anomalies (advection of humid air)

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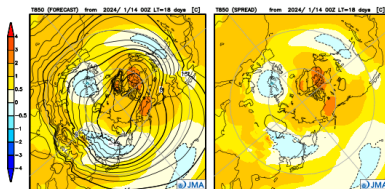
## Extra-tropical circulation prediction

Ensemble forecast ( 3 months mean : FEB-APR )

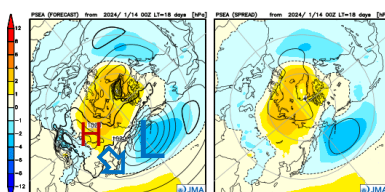
Z500



T850



PSEA



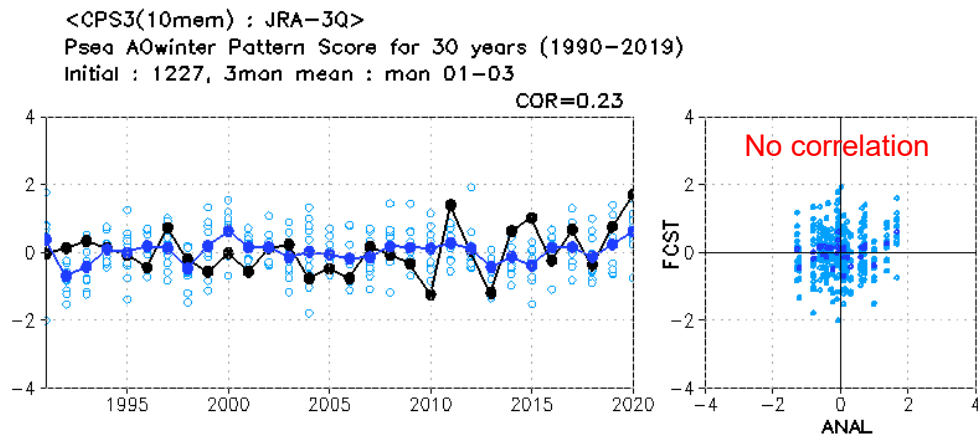
- East Asian Winter Monsoon: weaker than normal
  - Aleutian Low: stronger than normal
  - Siberian High: weaker than normal
- Negative phase of Arctic Oscillation (AO)
  - Arctic region: Positive anomaly
  - Mid-latitude: Annularly Negative anomaly
  - Predictability of AO is not high

<https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/pztmap.php>

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# Check predictability of Arctic Oscillation

Predictability of AO index is not high



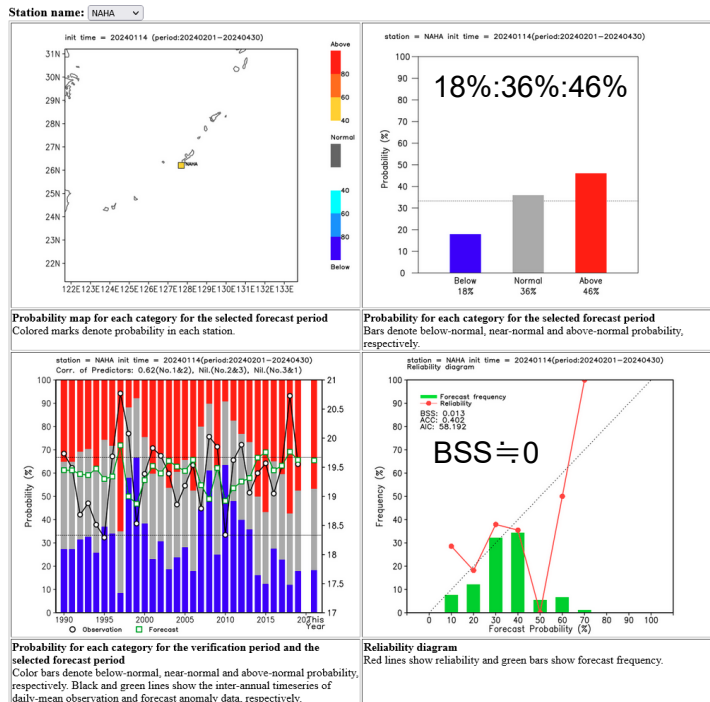
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## Workflow

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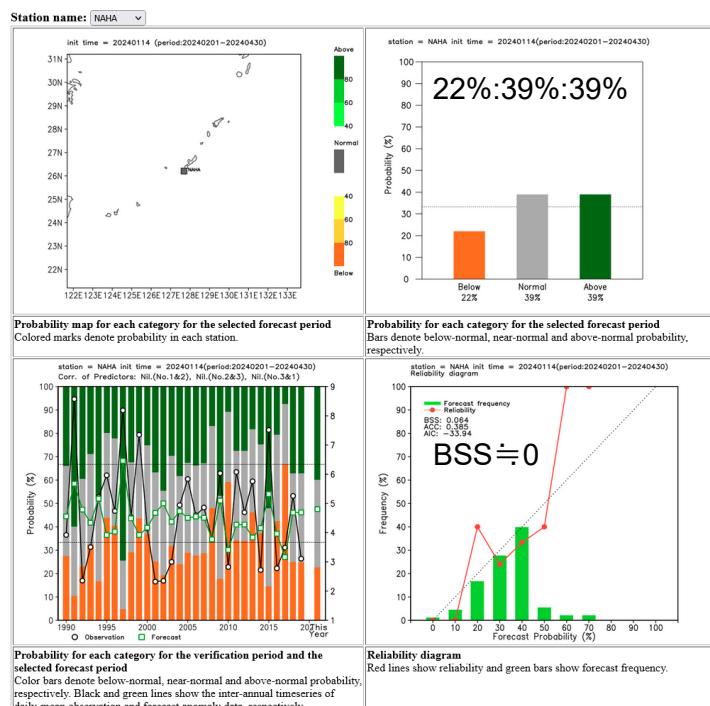
# Check Guidance output (Temperature)



- T850 and V850 (meridional wind at 850hPa) as predictors
  - Meridional wind thought to be an additional factor that determines temperature of NAHA (advection of hot air)
- Above-normal temperature
- No skill compared to climatology

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# Check Guidance output (Precipitation)



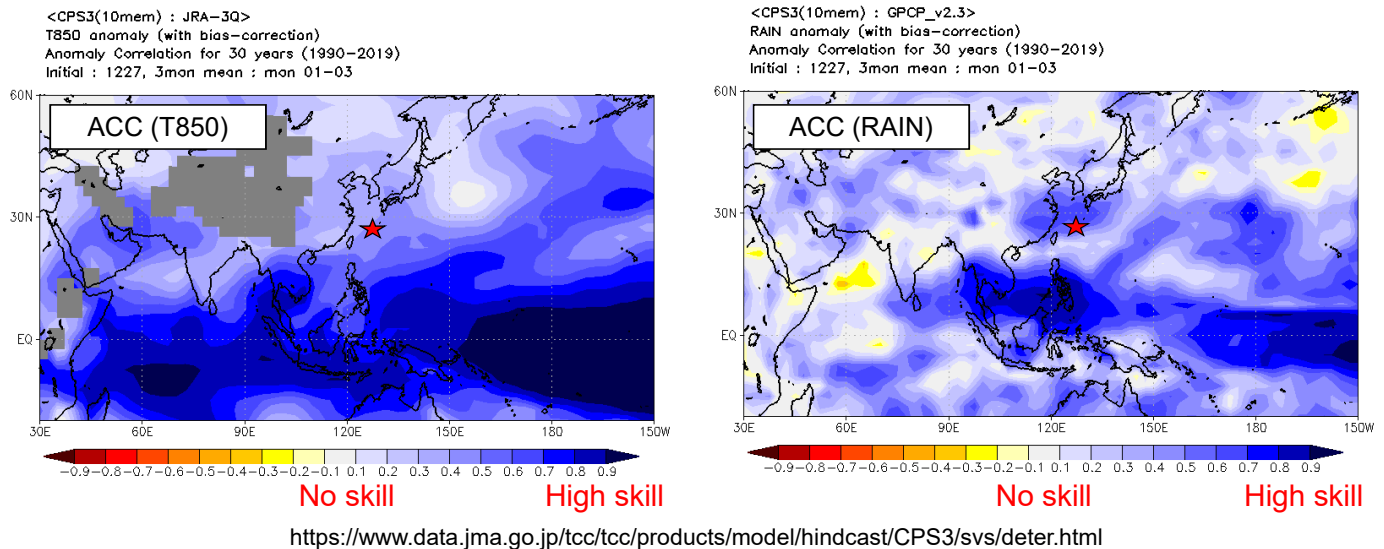
- RAIN as a predictor
- Above- or near-normal precipitation
- No skill compared to climatology

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# Prediction skills of predictors

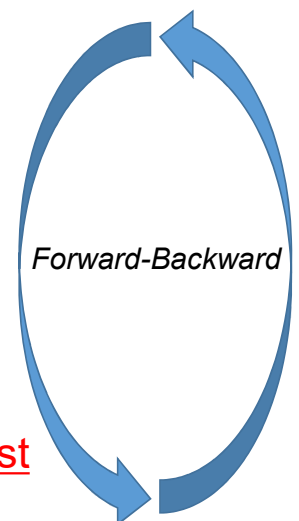
*Particularly for extra-tropics, predictability of guidance predictors is not high*



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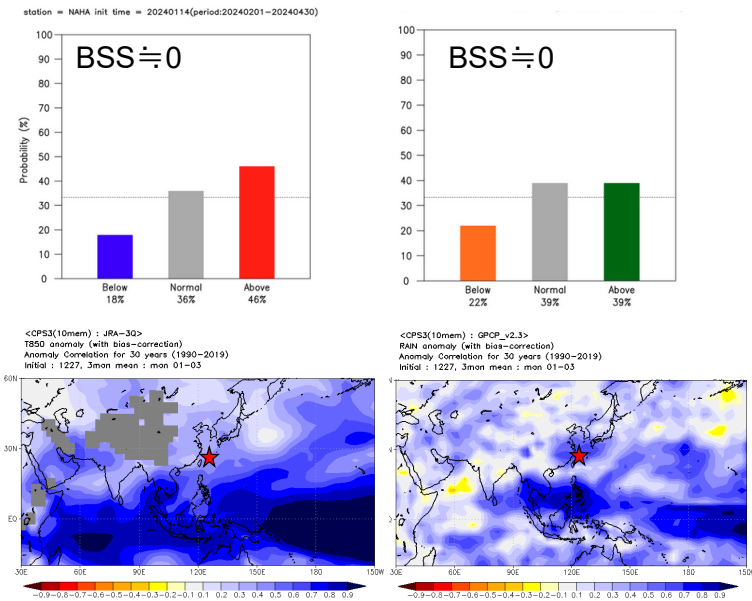
## Workflow

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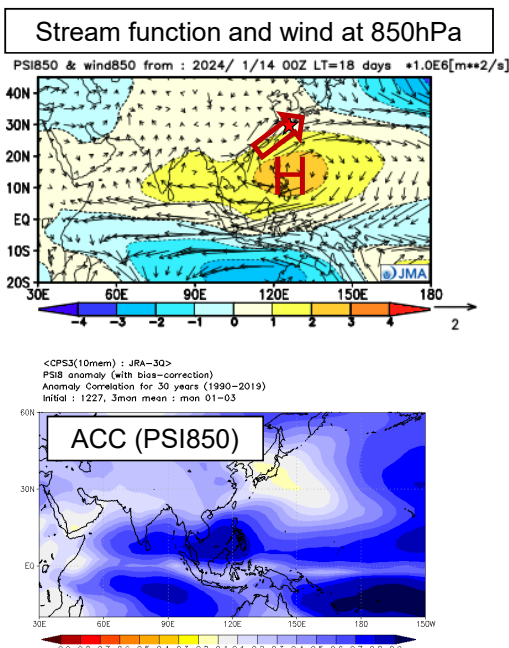
# Synthesize all data available 1/3



- Guidance forecast
  - Above-normal temperature
  - Above- or near-normal precipitation
  - No skill compared to climatology (33%:33%:33%)

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# Synthesize all data available 2/3



## [Interpretation]

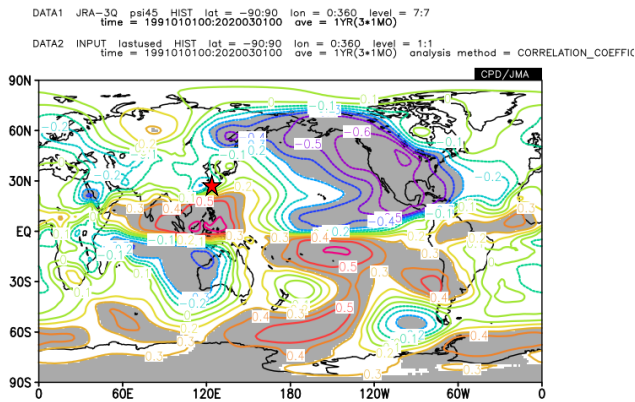
- Southwesterly wind anomaly by anti-cyclonic circulation anomaly around the Philippines can cause hotter and wetter condition around NAHA
- Probably the anti-cyclonic circulation anomaly is a response to El Niño, so it's prediction skill is high.
- Though guidance forecast has no skill, it can be reliable because influence of El Niño will remain during FMA 2024 with high confidence

*This interpretation is just an example.  
There may be a better interpretation.*

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# Synthesize all data available 3/3



Correlation coefficient map of PSI850 with NAHA's rainfall for FMA 1991-2020. Created by using iTacs.

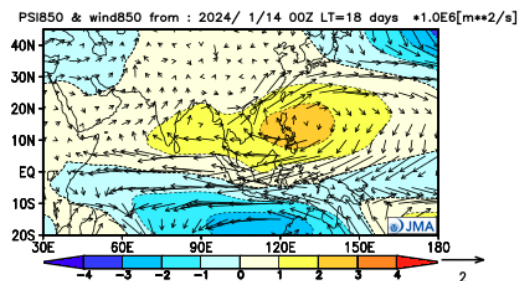
- NAHA's rainfall correlates well with PSI850 around Philippines
  - Positive rainfall anomaly at NAHA corresponds to positive PSI850 anomaly (i.e. anti-cyclonic circulation anomaly) around the Philippines and vice versa
- Guidance forecast is consistent with this statistical relationship

*Statistical relationship is very useful for forecast interpretation (and predictor selection too). We can find various statistics on TCC website. Also we can analyze for ourselves using iTacs.*

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## Summary

### Key Chart



### Forecast

- Anti-cyclonic anomaly is predicted around the Philippines as a response to El Niño
- The anti-cyclonic anomaly around the Philippines can be predicted well by CPS3
- Southwesterly wind anomaly by the anti-cyclonic anomaly around the Philippines will flow hot and humid air into NAHA
- Therefore, above-normal temperature and near- or above-normal precipitation forecast can be reliable, even though guidance tool has no skill
- Major change of guidance output is unnecessary

*This explanation is just an example.*

	Temperature			Precipitation		
	Below Normal	Near Normal	Above Normal	Below Normal	Near Normal	Above Normal
NAHA	20%	35%	<b>45%</b>	20%	<b>40%</b>	<b>40%</b>
(Guidance)	18%	36%	46%	22%	39%	39%

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# Workflow

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## Seasonal Outlook for FMA 2024 on NAHA

	Temperature			Precipitation		
	Below Normal	Near Normal	Above Normal	Below Normal	Near Normal	Above Normal
NAHA	20%	35%	<b>45%</b>	20%	<b>40%</b>	<b>40%</b>
(Guidance)	18%	36%	46%	22%	39%	39%

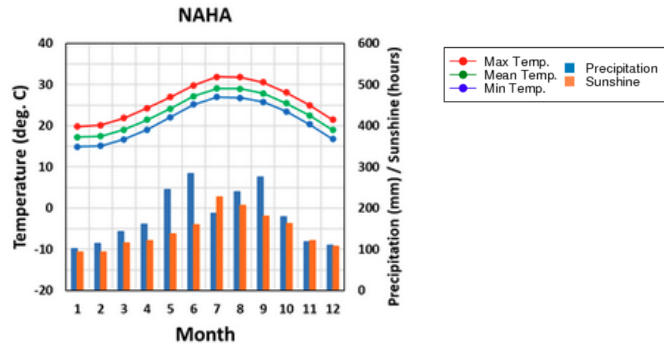
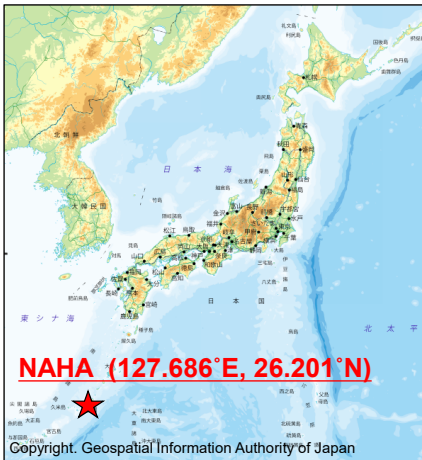
- In response to suppressed convective activities, an anti-cyclonic anomaly is expected to develop around the Philippines. Southwesterly wind anomalies will cause hotter and wetter condition around Okinawa Island.
- Consequently, above-normal temperature and above- or near-normal precipitation are expected for NAHA.

*We can verify our forecast in May!*

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# Climate of Japan and NAHA

Sample

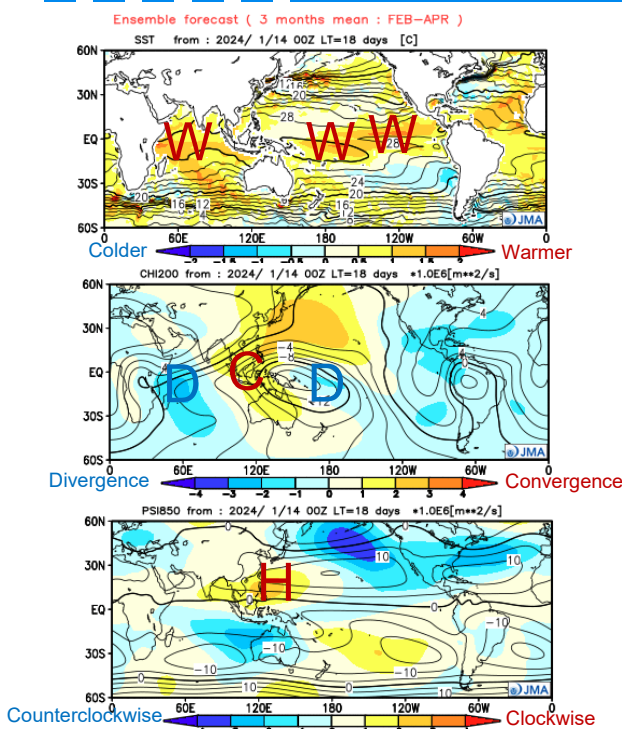


NAHA is located in Okinawa Island, which has a subtropical oceanic climate.

In winter, prevailing northwesterly winds cause the advection of cold air from Siberia to Japan and bring heavy snowfall to Japan's Sea of Japan side and sunny weather to its Pacific. Early summer is the rainy season, known as the Baiu, in Japan. In the second half of summer, the North Pacific High extends northwestward around Japan, bringing hot and sunny conditions to the country. Precipitation amounts are large in autumn due to the active rain front and tropical cyclones.

## Forecast for FMA 2024

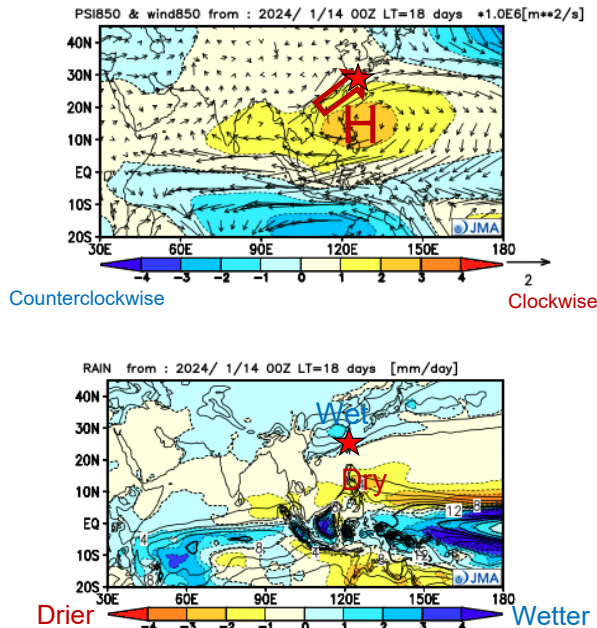
Sample



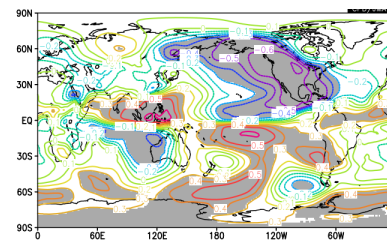
- It will be in transition from El Niño to ENSO neutral. The influence of El Niño and the positive IOD will remain in the equatorial Pacific and Indian Ocean.
- Corresponding to SST anomalies over the equatorial Pacific and Indian ocean, convective activities will be suppressed over the Maritime Continent.
- In response to suppressed convective activities, anti-cyclonic anomalies will be developed at lower level around the Philippines.

# Forecast for FMA 2024

Sample



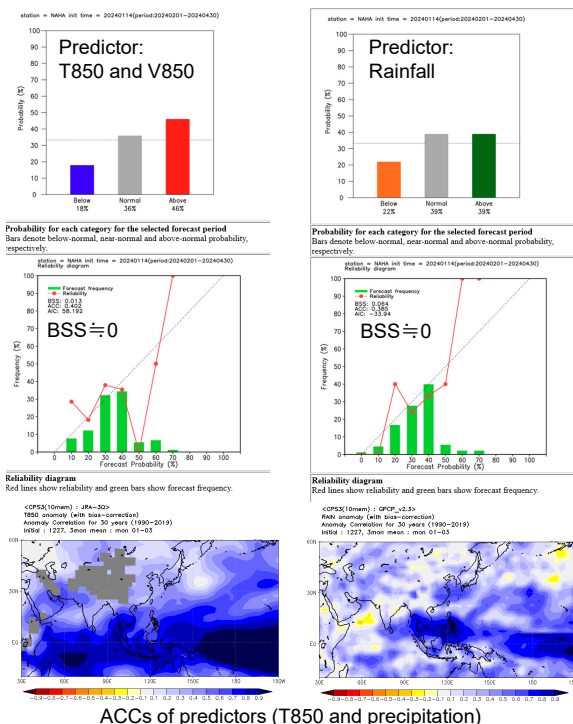
- Due to the anti-cyclonic circulation anomalies around the Philippines, southwesterly wind anomalies will bring hotter and wetter condition around Okinawa Island.
- This is consistent with statistical relationship.



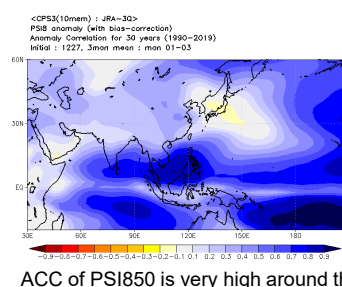
Correlation coefficient map of PSI850 with NAHA's rainfall for FMA 1991-2020. Created by using iTacs.

## Guidance forecast

Sample



- Guidance forecast has no skill.
- However, hotter and wetter condition around Okinawa can be reliable because it is caused by anti-cyclonic circulation around the Philippines, which is thought to be a response to El Niño and predicted with high accuracy.



# Seasonal Outlook for FMA 2024 on NAI

Sample

	Temperature			Precipitation		
	Below Normal	Near Normal	Above Normal	Below Normal	Near Normal	Above Normal
NAHA	20%	35%	45%	20%	40%	40%
(Guidance)	18%	36%	46%	22%	39%	39%

- In response to suppressed convective activities over the Maritime Continent, an anti-cyclonic anomalies is expected to develop around the Philippines. Southwesterly wind anomalies will cause hotter and wetter condition around Okinawa Island.
- Consequently, above-normal temperature and above- or near-normal precipitation are expected for NAHA.

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Example

## Appendix

Significant features in the CPS3 predictions for FMA 2024 with examples of explanation

*Maeda-san's lecture explains how we can interpret CPS3 prediction for FMA*

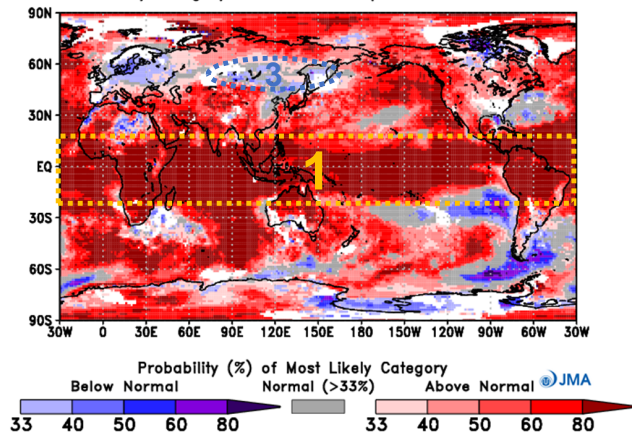


# Significant features in the CPS3 prediction for FMA 2024

1. Significant warming in the tropical belt
2. Drier condition from the northeastern Indian Ocean to the tropical western North Pacific
3. Colder than normal condition around Northeast Asia

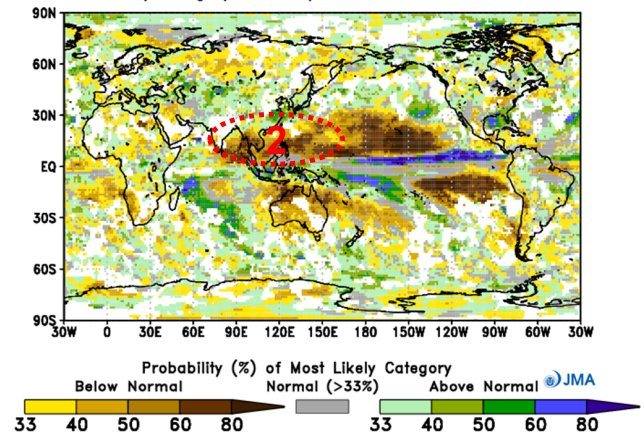
## Temperature

JMA Seasonal Forecast (Forecast initial month is 01 2024)  
Most likely category of Surface Temperature for FMA 2024



## Precipitation

JMA Seasonal Forecast (Forecast initial month is 01 2024)  
Most likely category of Precipitation for FMA 2024



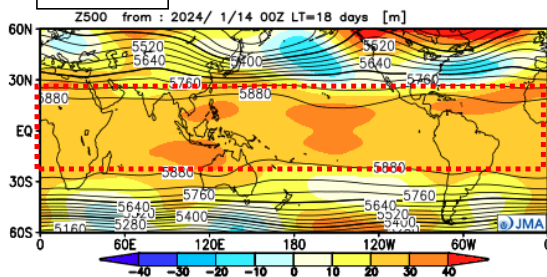
TCC probabilistic forecast on TCC website

<https://www.data.jma.go.jp/tcc/tcc/products/model/probfcst/3-mon/index.html>

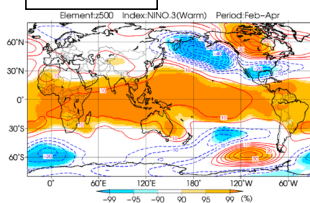
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# Significant warming in the tropical belt

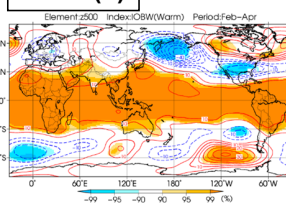
## Z500



## El Niño

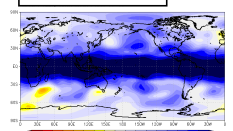


## IOBW(+)



- Significant warming is predicted in the tropical belt
- Consistent with statistical characteristics of El Niño and positive IOBW
- Warmed tropical Pacific and Indian Ocean will increase atmospheric temperature and atmospheric warming may spread the tropics by equatorial waves
- Prediction skill is high

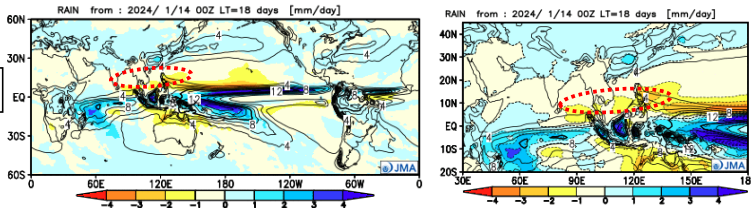
## ACC of Z500



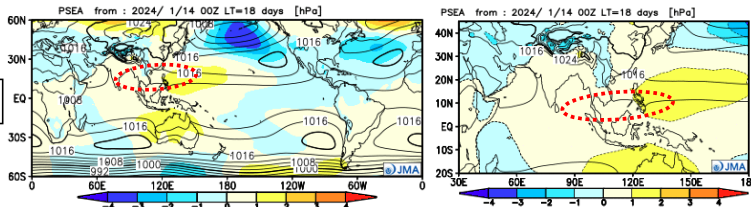
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# Drier condition from the northeastern Indian Ocean to the tropical western North Pacific

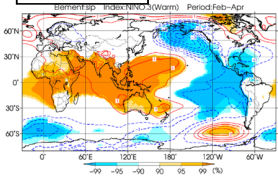
RAIN



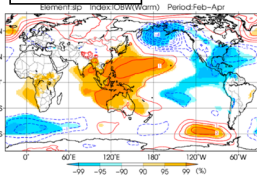
PSEA



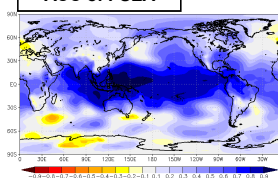
El Niño



IOBW(+)



ACC of PSEA

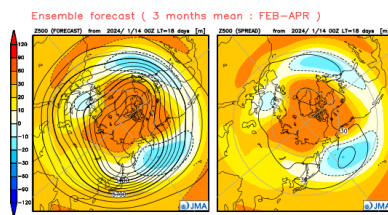


- Drier condition is predicted from the northeastern Indian Ocean to the tropical western North Pacific
- Those areas will be covered by higher sea level pressure
- Consistent with statistical characteristics of El Niño and positive IOBW
- Thought to be a response to convection anomaly over the Pacific and the Indian Ocean
- Prediction skill is high

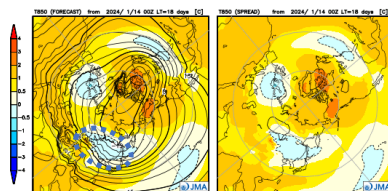
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# Colder than normal condition around Northeast Asia

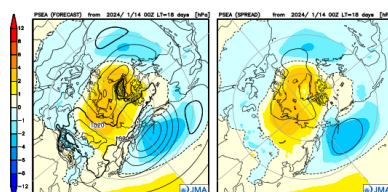
Z500



T850



PSEA



- Resembles to Negative phase of Arctic Oscillation (AO) pattern
  - Arctic region: Positive anomaly
  - Mid-latitude: Annularly Negative anomaly
- Predictability of AO is not high
- On the other hand, a research shows that stratosphere and troposphere tend to couple deeply in FMA in the phase of El Niño. Current situation of stratosphere may lead negative phase of AO.
  - Takemura and Maeda, Influence of Enhanced Variability with Zonal Wavenumber 1 on Arctic Oscillation in Late Winter to Early Spring in El Niño Conditions, SOLA, 2016

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