

# Making Seasonal Forecast

## Introduction to Exercise

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

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## What we do in the exercise

- We learn how to make seasonal forecast
  - **Step by step**
  - **Following the essence of JMA's procedure**
  - Some simplifications
    - We use JMA's CPS3 ensemble model only
      - *cf.* JMA uses also other NWP's for comparison
      - Multi-model ensemble is *NOT* covered in the exercise
    - We use a ready-made simple guidance tool for translating CPS3 ensemble GPVs to probability forecast of temperature and precipitation for stations
      - *cf.* JMA uses a guidance specialized for seasonal forecast over areas in Japan
      - Development of guidance is *NOT* covered in the exercise
  - Forecast Target
    - Temperature and Precipitation at points we choose
    - 3-category probabilities (below-, near-, and above-normal)
    - February-March-April 2024 (3-month mean)

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# Schedule

## Jan 31 (Wed)

- AM: Introduction & Example
- PM: **Exercise**

## Feb 1 (Thurs)

- AM: **Exercise (continue)**
- PM: **Presentation**

## Feb 2 (Fri)

- AM: **Presentation (continue)**

## • Note

- **TCC staff members always welcome any questions during the exercise**
- Take your coffee break anytime during the exercise
- Presentation Time: **20 minutes**
  - **Including Q&A session**

**Order of presentation: Alphabetical order by country name**

Bangladesh, Bhutan, Hong Kong, Indonesia, Lao PDR, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, Viet Nam

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# What we should always keep in mind

- Predictability of seasonal forecast is lower than those of short- and middle-range forecasts (particularly for extra-tropics)
- Seasonal forecast is mainly based on slowly changing global scale phenomena (particularly ENSO)

So when we make a seasonal forecast,

- Take care about **predictability**
  - Global > Local, Low latitude > High latitude, Temperature > Rainfall
- Consider **tropical ocean and atmosphere and their effect** (particularly ENSO)
- Forecast **probabilities** of deviation from normal (i.e. **anomaly**)

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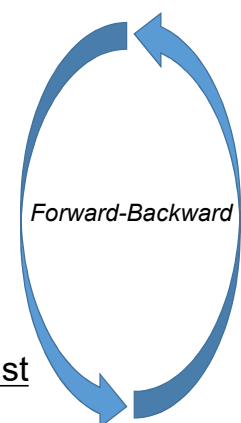
## Basic Concept of JMA's seasonal forecast procedure

- Based on the ensemble prediction by atmosphere and ocean coupled model (CPS3)
- Use guidance (statistical post-processing or down-scaling) to translate model output to forecast (probabilities of below-, near-, and above- normal of temperature etc. for areas)
- After **synthesizing** these results, forecasters decide forecast
  - Think carefully about meteorological interpretation of model and guidance prediction
  - Think about how to explain forecast
- Besides probability forecast, JMA provides **explanation of forecast** to users

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## Workflow (JMA's procedure)

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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# Data & Tools for the exercise

- CPS3 prediction
  - <https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/zpcmap.php>
  - <https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/pztpmap.php>
- CPS3 hindcast verification
  - <https://www.data.jma.go.jp/tcc/tcc/products/model/hindcast/CPS3/index.html>
- El Nino Outlook
  - <https://www.data.jma.go.jp/tcc/tcc/products/elnino/outlook.html>
- El Nino impact (composite analysis)
  - [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)
- iTacs (registered NMHSs only)
  - <https://extreme.kishou.go.jp/tool/itacs-tcc2015/>
- Guidance tool (this exercise only)
  - [https://extreme.kishou.go.jp/cgi-bin/simple\\_guidance\\_3mon/index\\_3mon.cgi](https://extreme.kishou.go.jp/cgi-bin/simple_guidance_3mon/index_3mon.cgi)

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## CPS3 ensemble prediction on TCC website

Home World Climate Climate System Monitoring El Niño Monitoring **NWP Model Prediction** Global Warming Climate in Japan Training Module Press release Links

HOME > Ensemble Model Prediction

**JMA's Ensemble Prediction System (Products for Long-Range Forecasting of WMC Tokyo)**

JMA, as a WMO World Meteorological Centre (WMC), operates the ensemble prediction system of an atmospheric general circulation model (AGCM) for one-month prediction and atmosphere-ocean coupled general circulation model (CGCM) for one-month, three-month and warm/cold season prediction. Ensemble prediction products, verification charts and specification of the ensemble prediction system are available on this page. JMA was designated as a WMC in 2017 and, as a part of its activities, the Centre conducts global numerical long-range prediction (Global Producing Centre for Long-Range Forecast; GPC-LRF)

**Notice**

- 16 May 2022  
Announcement: Terminating the data provision of CPS2 six-month forecasts
- 14 March 2022  
Announcement: Upgrade of Global EPS for one-month prediction
- 14 February 2022  
Announcement: Upgrade of the JMA's Seasonal Ensemble Prediction System
- 28 December 2021  
Announcement: Schedule for terminating the data provision of CPS2
- 15 March 2021  
Announcement: Upgrade of the Global Ensemble Prediction System for One-month Forecasts

**Main Products**

- One-month Prediction(GEPS : Global Ensemble Prediction System)**
  - One-month Prediction (15 Jan 2024)
  - Z500, T850 & SLP (Northern Hemisphere) (15 Jan 2024)
  - Stream Function, Velocity Potential & Surface Air Temperature (60N-60S) (15 Jan 2024)
  - Verification (15 Jan 2024)
  - Hindcast Verification (15 Jan 2024)
  - One-month Guidance Tool, Commentary (Only registered NMHSs can access this guidance tool.)
- Monthly Discussion on Seasonal Climate Outlooks** last updated: 19 Dec 2023

This product is intended to assist NMHSs in the Asia-Pacific region in interpreting WMC Tokyo's three-month prediction and warm/cold season prediction products.
- One-month Prediction(CPS : Coupled Prediction System) : Demonstration**
  - One-month Prediction
  - Probabilistic Forecast
  - Hindcast Verification
- Three-month Prediction(CPS : Coupled Prediction System)**
  - Three-month Prediction (15 Jan 2024)
  - Z500, T850 & SLP (Northern Hemisphere) (15 Jan 2024)
  - Stream Function, Velocity Potential & Surface Air Temperature (60N-60S) (15 Jan 2024)
  - Verification (08 Jan 2024)
  - Hindcast Verification (JMA/MRI-CPS3)
  - Probabilistic Forecast and Verification (15 Jan 2024)
  - SST Index Time-series Forecast (15 Jan 2024)
- Forecast Products in Support of Early Warnings for Extreme Weather Events** last updated: 17 Jan 2024

Early warning products for extreme weather events covering the period up to two weeks ahead. (Only registered NMHSs can access this page.)

  - Application
  - If you have any questions about ID and/or password, please e-mail to: [tcc@met.kishou.go.jp](mailto:tcc@met.kishou.go.jp)

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

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**Three-month Prediction (Tropics and Asia)**

This product is displayed for use by National Meteorological and Hydrological Services (NMHSs). It does not constitute an official forecast for any nation.

**Forecast Maps**

forecast period  
3 months mean

initial date  
2024.01.14.00Z

area  
60N-60S

data  
ensemble mean forecast

spread and anomaly

corresponding verification

LT : lead time(day)  
LC : lead time(hour)

[forecast]  
Contour show forecast, and shaded pattern and vector show anomalies. Contour interval

CH200 : 2x1.0E6m<sup>2</sup>/s  
RAIN : 1mm/day  
Z500 : 60m(area:50N-50S), 20m(area:Asia)

TS : 4C  
SST : 2C  
PS200 : 16x1.0E6m<sup>2</sup>/s(area:50N-60S), 4x1.0E6m<sup>2</sup>/s(area:Asia)

PS180 : 2x1.0E6m<sup>2</sup>/s(area:50N-60S), 2x1.0E6m<sup>2</sup>/s(area:Asia)

PSBA : 40Pa

[spread]  
Contour show spread, and shaded pattern show anomalies.

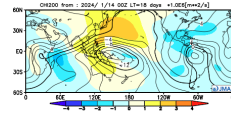
Contour interval

CH200 : 1x1.0E6m<sup>2</sup>/s  
RAIN : 1mm/day  
Z500 : 10m

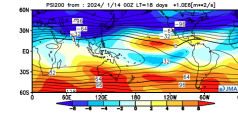
TS : 3C  
PS200 : 2x1.0E6m<sup>2</sup>/s  
PS180 : 2x1.0E6m<sup>2</sup>/s  
psca : 40Pa

**Three-month Prediction(CPS : Coupled Prediction System)**

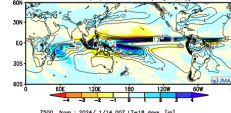
- Three-month Prediction (15 Jan 2024)
- Z500, T850 & SLP (Northern Hemisphere) (15 Jan 2024)
- Stream Function, Velocity Potential & Surface Air Temperature (60N-60S) 15 Jan 2024**
- Verification (05 Jan 2024)
- Hindcast Verification (JMA/MRI-CPS3)
- Probabilistic Forecast and Verification (15 Jan 2024)
- SST Index Time-series Forecast (15 Jan 2024)



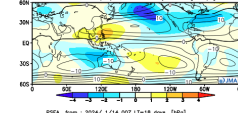
Velocity potential at 200hPa (convection)



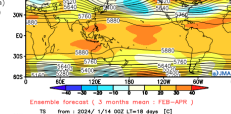
Stream function at 200hPa (Upper-level circulation)



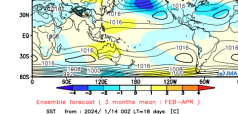
Rainfall



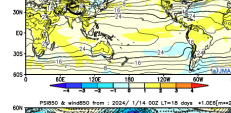
Stream function at 850hPa (Lower-level circulation)



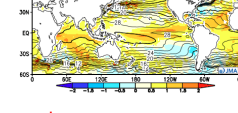
Geopotential height at 500hPa



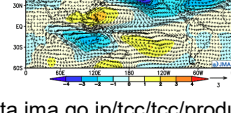
Sea Level Pressure



Surface Temperature



Sea Surface Temperature



Stream function and wind at 850hPa (Lower-level circulation)

**Ensemble Mean**

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

**Three-month Prediction (Northern Hemisphere)**

This product is displayed for use by National Meteorological and Hydrological Services (NMHSs). It does not constitute an official forecast for any nation.

**Forecast Maps**

forecast period  
3 months mean

initial date  
2024.01.14.00Z

corresponding verification

LT : lead time(day)  
LC : lead time(hour)

[FORECAST](left figures)

top : Contours show 500hPa height in an interval of 60m.

middle : Contours show 850hPa temperature in an interval of 3C.

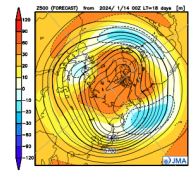
bottom : Contours show sea level pressure in an interval of 4hPa. (Shaded patterns show anomalies.)

[SPREAD](right figures)

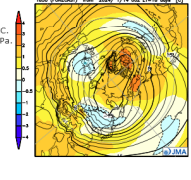
top : Contours show spread of 500hPa height in an interval of 30m.

middle : Contours show spread of 850hPa temperature in an interval of 2C.

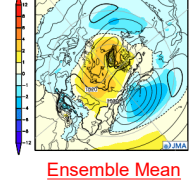
bottom : Contours show spread of sea level pressure in an interval of 4hPa. (Shaded patterns show anomalies.)



Geopotential height at 500hPa



Temperature at 850hPa



Sea Level Pressure

**Three-month Prediction(CPS : Coupled Prediction System)**

- Three-month Prediction (15 Jan 2024)
- Z500, T850 & SLP (Northern Hemisphere) 15 Jan 2024**
- Stream Function, Velocity Potential & Surface Air Temperature (60N-60S) (15 Jan 2024)
- Verification (05 Jan 2024)
- Hindcast Verification (JMA/MRI-CPS3)
- Probabilistic Forecast and Verification (15 Jan 2024)
- SST Index Time-series Forecast (15 Jan 2024)

Ensemble Mean

Spread

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

# CPS3 hindcast verification on TCC website

Based on 30-year (1991-2020) hindcast (retrospective forecast)

Home > Ensemble Model Prediction > Hindcast(JMA/MRI-CPS3)

**Hindcast(JMA/MRI-CPS3)**

Hindcast Configuration

JMA/MRI-CPS3

Hindcast Verification

- Diagnostic score Maps
  - Variables to be Assessed: T2m, PSEA, SST, RAIN, Z500, T850, PS1200, PS5850, CH200, CH850
  - Diagnostic Measures:
    - Mean Square Skill Score(MSSS)
    - Anomaly Correlation(ACOR)
    - Root Mean Squared Error(RMSE)
    - Bias
    - Model Climatology
- Probabilistic score Diagrams
  - Variables to be Assessed: T2m, PSEA, SST, RAIN, Z500, T850
  - Diagnostic Measures:
    - Reliability diagrams (Aggregated verification)
    - Relative Operating Characteristics(ROC) curve (Aggregated verification)
  - Event: Anomaly > 0, Below Normal, Near Normal, Above Normal, All
  - The 3 categories(above-normal, near-normal, below-normal) are defined by standard deviations of the analyzed 30 years time series at each grid point.
- Probabilistic score Maps
  - Variables to be Assessed: T2m, PSEA, SST, RAIN, Z500, T850
  - Diagnostic Measures:
    - Relative Operating Characteristics(ROC) areas (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 deviations of the analyzed 30 yr
- Time-series Circulation Index
- SST Index score
- ENSO Index time-series
- Hindcast Maps

**Three-month Prediction(CPS : Coupled Prediction System)**

- Three-month Prediction (1st Jan 2024)
- Z500, T850 & SLP (Northern Hemisphere) (1st Jan 2024)
- Stream Function, Velocity Potential & Surface Air Temperature (60N-60S) (1st Jan 2024)
- Verification (09 Jan 2024)
- Hindcast Verification (JMA/MRI-CPS3)**
- Probabilistic Forecast and Verification (1st Jan 2024)
- SST Index Time-series Forecast (1st Jan 2024)

Home World Climate Climate System Monitoring El Niño Monitoring NWP Model Prediction Global Warming

HOME > Ensemble Model Prediction > Hindcast(JMA/MRI-CPS3) > Verification of Deterministic Forecasts (Maps)

**Verification of Deterministic Forecasts (Maps)**

Score: ACOR

Parameter: RAIN

Initial date: Jan(12/27)

Lead time (month): 12 month

Area: date

<CPS3(10mem) : <PCP\_v2.3>  
RAIN anomaly (with bias-correction)  
Anomaly Correlation for 30 years (1990-2019)  
Initial : 1227, 3mon mean : mon 01-03

90N  
60N  
30N  
EQ  
30S  
60S  
90S

30E 60E 90E 120E 150E 180 120W 90W 60W 30W 0

-0.9 -0.8 -0.7 -0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9

No skill High skill

**Anomaly Correlation (ACC or ACOR) is a metric of prediction skill**  
ACC = 1 perfect prediction

HOME World Climate Climate System Monitoring El Niño Monitoring

HOME > Ensemble Model Prediction > Hindcast(JMA/MRI-CPS3) > Verification of SST Index

**Verification of SST Index**

Parameter: SST NIÑO3.4  
SST NIÑO4  
SST NIÑO.4  
SST NIÑO.3EPT  
SST TNA  
SST T8A  
SST T8D  
SST D0W  
SST T7D

Initial date: Jan(12/27)

Score: ACOR RMSE

SST ACC NIÑO3(150W-90W.5S-5N)  
period: 1990-2019 init: 1227 mean: 1mon

0.9  
0.8  
0.7  
0.6  
0.5  
0.4  
0.3  
0.2  
0.1  
0

Forecast Time (mon)

<https://www.data.jma.go.jp/tcc/tcc/products/model/hindcast/CPS3/index.html>

# El Niño impact (composite analysis) on TCC website

気象庁 Japan Meteorological Agency

Tokyo Climate Center WMO Regional Climate Center in RA II (Asia)

TCC home About TCC Site Map Contact us

Home World Climate Climate System El Niño Monitoring NWP Model Prediction Global Warming Climate in Japan Training Module Press release Links

HOME > Climate System Monitoring > Composite map for El Niño/La Niña and Indian Ocean Dipole events

**Composite map for El Niño/La Niña and Indian Ocean Dipole events**

Commentary (data and methods, statistical characteristics)

Elements: 200-hPa velocity potential Index: IOBW Phase: positive (warm)

Month: 3 Mean: 3-month mean

Element:c200 Index:IOBW(Warm) Period:Feb-Apr

60°N  
30°N  
0°  
30°S  
60°S

0° 60°E 120°E 180° 120°W 60°W

-99 -95 -90 90 95 99 (%)

Various statistics including El Niño impact are provided on TCC website. These are very useful for seasonal forecast.

3-month mean composite of 200-hPa velocity potential anomalies in the positive (warm) phase of IOBW (Feb. - Apr.).  
Contours show composite anomalies at intervals of  $0.2 \times 10^6 \text{ m}^2/\text{s}$ .  
Shading indicates the confidence level.  
The base period for composite analysis is 1948 - 2021, while that for the three-month means of November-December-January and December-January-February is 1947/48 - 2020/21.

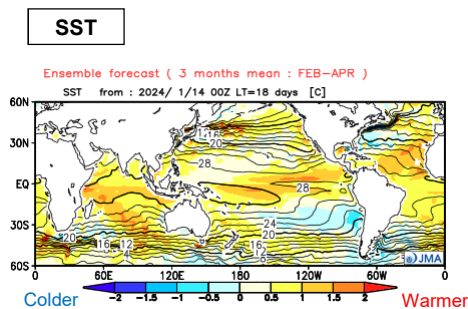
[https://www.data.jma.go.jp/tcc/tcc/products/clisys/enso\\_statistics/index.html](https://www.data.jma.go.jp/tcc/tcc/products/clisys/enso_statistics/index.html)

# What we should note at each step

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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## Check Tropical ocean prediction

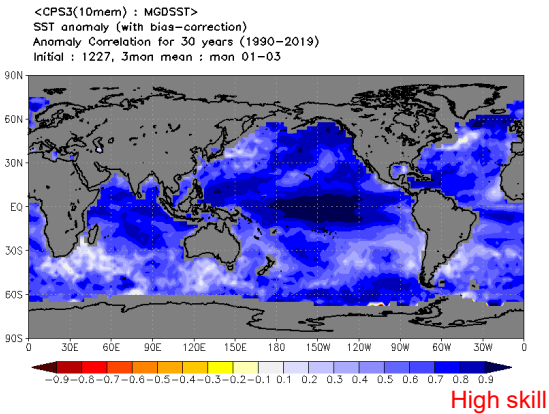


Map is available at TCC website  
<https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/zpcmap.php>

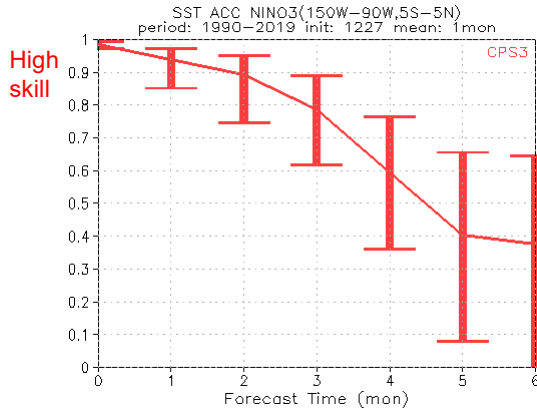
- Tropical ocean is major climate driver
  - Large impact on climate in the tropics and extra-tropics
- High prediction skill
- **POINT: How is tropical ocean predicted?**
  - SST anomaly pattern
  - Pacific
    - ENSO (El Niño/La Niña)
  - Indian Ocean
    - IOBW (as delayed response to ENSO)
    - IOD

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# Tropical ocean prediction skill is high



CPS3 Hindcast verification (Map)  
<https://www.data.jma.go.jp/tcc/tcc/products/model/hindcast/CPS3/svs/deter.html>



CPS3 Hindcast verification (SST Indices Score)  
<https://www.data.jma.go.jp/tcc/tcc/products/model/hindcast/CPS3/score/index.html>

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# Use TCC El Nino Outlook as a reference

気象庁 | TCC Climate Center | WMO Regional Climate Center in Tokyo (Japan) | WMO

Home | World Climate | Climate System Monitoring | El Niño Monitoring | WRF Model Prediction | Global Warming | Climate in Japan | Training Module | Press Release | Links

El Niño Outlook (January 2024 - July 2024)

Last Updated: 11 January 2024  
 (Next update will be on 9 February 2024)

- 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%).

[El Niño / La Niña]

In December 2023, the sea surface temperature (SST) for the NINO.3 region was above normal with a deviation of +2.3°C, which was almost the same since it became +2.2°C in August (Fig. 1 and Table). The five-month running mean value of the NINO.3 SST deviation for October was +2.2°C, and the value was above +0.5°C for seven consecutive months since last April (Fig. 1 and Table). SSTs in the equatorial Pacific were above normal from near the date line to the western part (Fig. 4 and Fig. 5). Subsurface temperatures were above normal in the central and eastern equatorial Pacific, and below normal in the western equatorial Pacific (Fig. 6 and Fig. 7). In the atmosphere, convective activity over the central equatorial Pacific was above normal and cluster index in the lower troposphere (i.e., 850hPa winds) over the central equatorial Pacific were weaker than normal (Fig. 8, Fig. 9, Fig. 10). These oceanic and atmospheric conditions over the equatorial Pacific indicate mature El Niño conditions. From the above, it is concluded that El Niño conditions have persisted in the equatorial Pacific since boreal spring last year.

The warm subsurface water volume in the central and eastern equatorial Pacific (Fig. 5) has kept the warm SST in the NINO.3 region. JMA's seasonal ensemble prediction system predicts that the NINO.3 SST is near at its peak, then will gradually decrease in the second half of boreal winter as cold water volume in the western equatorial Pacific moves eastward, and approach near normal values by the end of boreal spring (Fig. 11). In conclusion, it is more likely to transition to ENSO-neutral conditions by the end of boreal spring (60%) than El Niño conditions will persist (40%) (Fig. 1 and Fig. 2).

[Western Pacific and Indian Ocean]

The area-averaged SST in the tropical western Pacific (NINO.WEST) region was near normal in December (Fig. 3). The index is likely to be near or below normal beginning of the prediction duration and to be near normal into boreal spring (Fig. 12).

[the area-averaged SSI in the tropical Indian Ocean (I.N.W)] region was above normal in December (Fig. 4). The index is likely to be above normal into boreal spring (Fig. 13).

[Impacts]

The following weather conditions observed in December were consistent with those in the months of December during the past El Niño events.

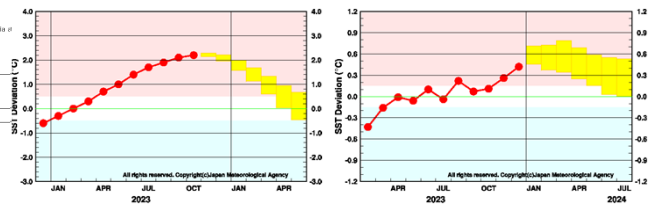
- Above normal temperature in the northern part of North America, from Central America to the central part of South America, from southern China to Southeast Asia
- Above normal precipitation in northern Argentina and around.

The seasonal climate outlook for Japan is available here.

Composite analyses for ENSO impacts are available here.

Produced by Climate Prediction Division, Japan Meteorological Agency  
 E-mail: tcc@met.kishou.go.jp

- Current condition
- Outlook
- Explanation and Figures

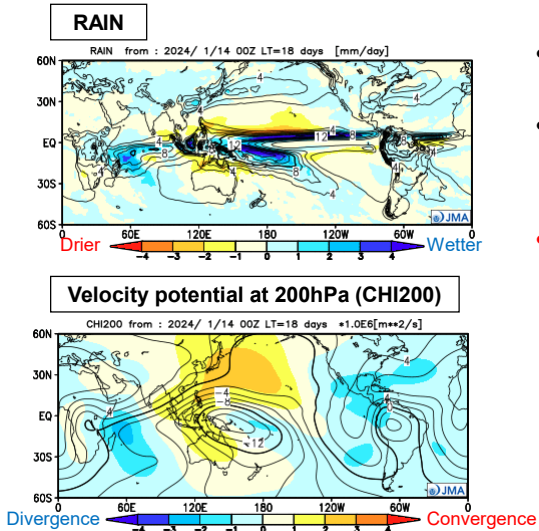


El Niño Outlook is available at TCC website (Updated Monthly)  
<https://www.data.jma.go.jp/tcc/tcc/products/elnino/outlook.html>

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# Check Tropical convection prediction

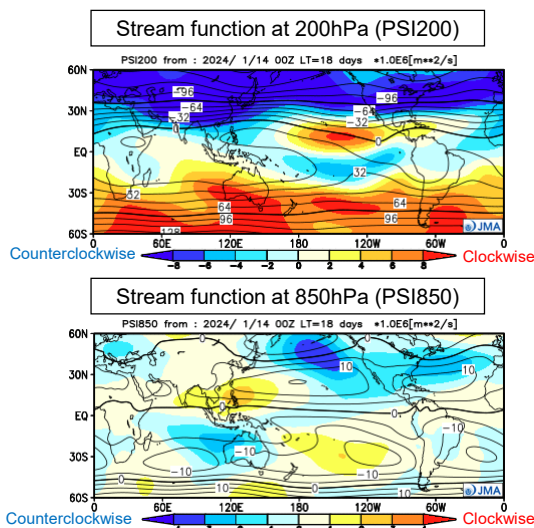


Maps are available at TCC website  
<https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/zpcmap.php>

- Tropical ocean drives atmospheric circulation by altering convection pattern
- Tropical convection can be inferred from rainfall and velocity potential
- **POINT: How is tropical convection predicted?**
  - Anomaly pattern
  - Enhanced convection anomaly (Wetter; Divergence anomaly at upper level)
  - Suppressed convection anomaly (Drier; Convergence anomaly at upper level)
  - Does the convection anomaly pattern correspond to SST anomaly pattern by ENSO and/or IOD?

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# Check Tropical circulation prediction

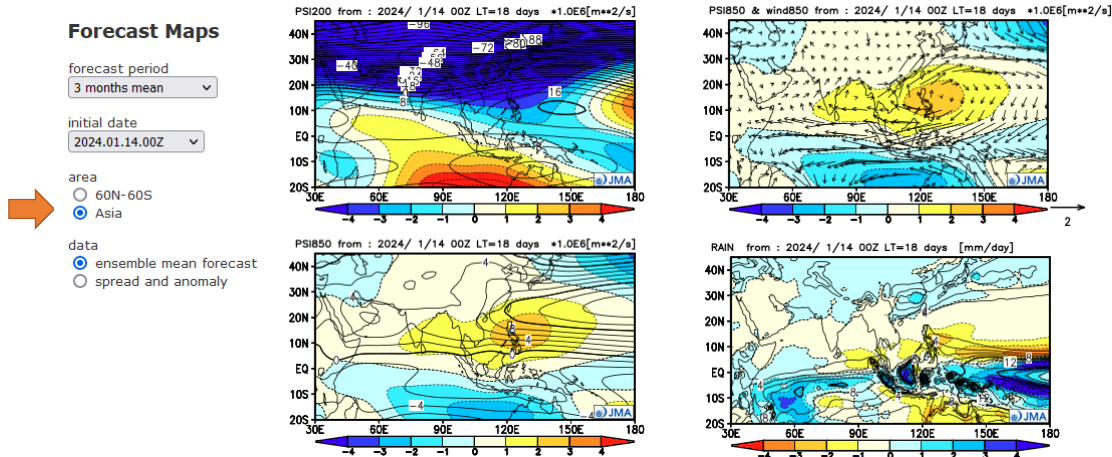


Maps are available at TCC website  
<https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/zpcmap.php>

- Atmospheric circulation can be changed by tropical convection anomaly
- **POINT: How is tropical circulation predicted?**
  - Cyclonic/Anti-cyclonic anomaly pattern
    - Corresponds to Low/High pressure anomaly
  - Is the pattern excited by tropical convection anomaly?
- Useful knowledge
  - Tropical convection can excite Rossby waves along subtropical jet
  - Equivalent barotropic Low/High pressure anomaly corresponds to Warm/Cold temperature anomaly
  - Wind anomaly accompanied with Cyclonic/Anti-cyclonic anomaly can cause wetter or drier condition

18

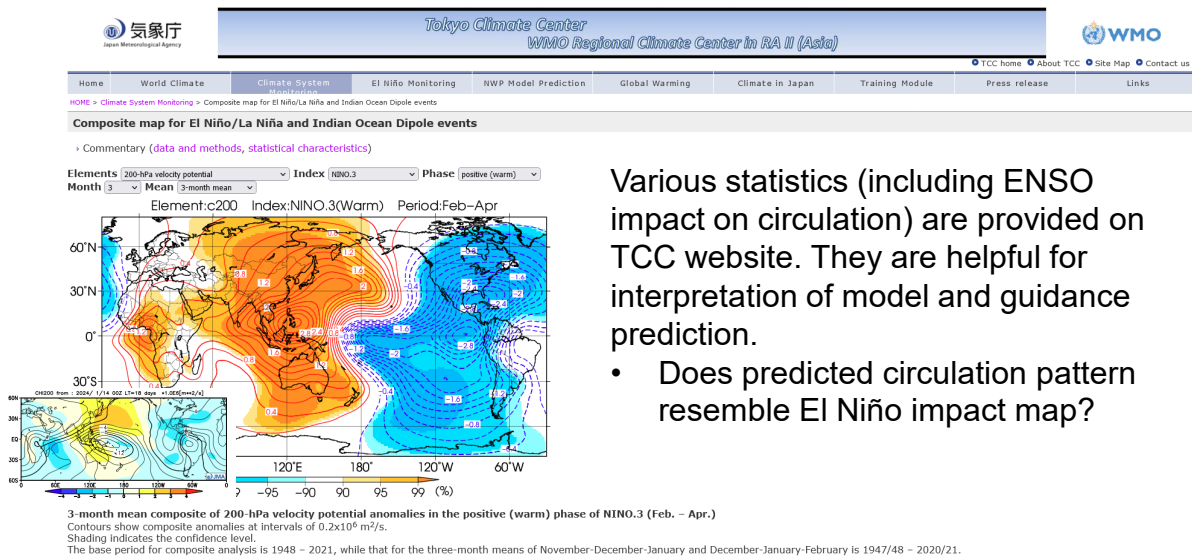
# Use Asia enlarged CPS3 prediction maps



Maps are available at TCC website  
<https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/zpcmap.php>

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# Use statistics as a reference



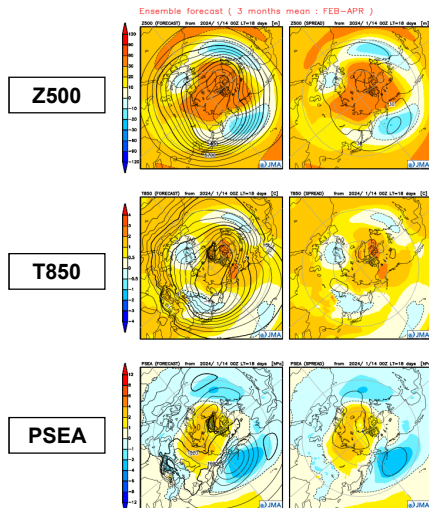
Various statistics (including ENSO impact on circulation) are provided on TCC website. They are helpful for interpretation of model and guidance prediction.

- Does predicted circulation pattern resemble El Niño impact map?

[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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# Check Extra-tropical circulation prediction



• **POINT: How is extra-tropical circulation predicted?**

- East Asian monsoon
- Siberian High: Stronger/Weaker than normal
- Aleutian Low: Stronger/Weaker than normal

• Keep in mind

- Predictability of extra-tropical circulation is lower than that of tropical circulation

Maps are available at TCC website  
<https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/pzmap.php>

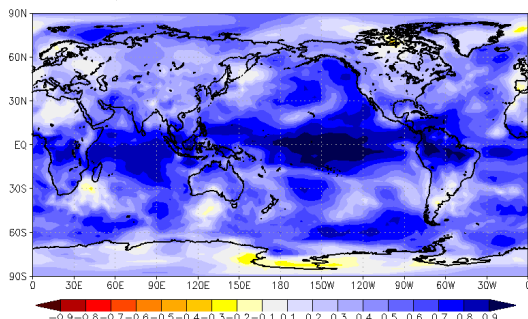
21

## Predictability: Extra-tropics < Tropics

For extra-tropics, it is difficult to forecast only based on model prediction 'above the head'  
 We need to make forecast based on prediction of tropics too

**Surface Temperature**

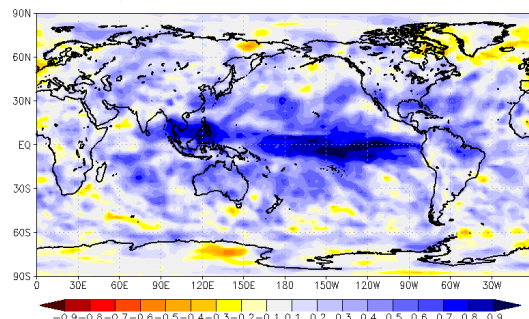
<CPS3(10mem) : JRA-3Q>  
 TS anomaly (with bias-correction)  
 Anomaly Correlation for 30 years (1990-2019)  
 Initial : 1227, 3mon mean : mon 01-03



No skill High skill

**Rainfall**

<CPS3(10mem) : GPCP\_v2.3>  
 RAIN anomaly (with bias-correction)  
 Anomaly Correlation for 30 years (1990-2019)  
 Initial : 1227, 3mon mean : mon 01-03



No skill High skill

CPS3 Hindcast verification (Map)

<https://www.data.jma.go.jp/tcc/tcc/products/model/hindcast/CPS3/svs/deter.html>

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## Optionally Use Monthly Discussion on Seasonal Climate Outlooks as a reference

**Tokyo Climate Center**  
WMO Regional Climate Center in RA II (Asia)

Home | World Climate | Climate System Monitoring | El Niño Monitoring | **IWP Model Prediction** | Global Warming | Climate in Japan | Training Module | Press release | Links

**JMA's Ensemble Prediction System (Products for Long-Range Forecasting of WMC Tokyo)**

**Notice**

- 16 May 2022  
Announcement: Terminating the data provision of CPS2 six-month forecasts
- 14 March 2022  
Announcement: Upgrade of Global EPS for one-month prediction
- 14 February 2022  
Announcement: Upgrade of the JMA's Seasonal Ensemble Prediction System
- 28 December 2021  
Announcement: Schedule for terminating the data provision of CPS2
- 15 March 2021  
Announcement: Upgrade of the Global Ensemble

**Main Products**

- One-month Prediction(GEPS : Global Ensemble Prediction System)**
  - One-month Prediction (11 Jan 2024)
  - Z500, TB50 & SLP (Northern Hemisphere) (11 Jan 2024)
  - Stream Function, Velocity Potential & Surface Air Temperature (60N-60S) (11 Jan 2024)
  - Verification (14 Jan 2024)
  - Hindcast Verification **BW AI**
  - One-month Guidance Tool, Commentary (Only registered NMHSs can access this guidance tool.)
- Monthly Discussion on Seasonal Climate Outlooks** *last updated: 19 Dec 2022*

This product is intended to assist NMHSs in the Asia-Pacific region in interpreting WMC Tokyo's three-month prediction and warm/cold season prediction products.
- One-month Prediction(CPS : Coupled Prediction System) : Demonstration**
  - One-month Prediction
  - Probabilistic Forecast
  - Hindcast Verification
- Three-month Prediction(CPS : Coupled Prediction System)**
  - Three-month Prediction (15 Jan 2024)
  - Z500, TB50 & SLP (Northern Hemisphere) (15 Jan 2024)
  - Stream Function, Velocity Potential & Surface Air Temperature (60N-60S) (15 Jan 2024)
  - Verification (28 Jan 2024)
  - Hindcast Verification (JMA/MRI-CPS3)
  - Probabilistic Forecast and Verification (15 Jan 2024)
- Forecast Products in Support of Early Warnings for Extreme Weather Events** *last updated: 17 Jan 2024*

Early warning products for extreme weather events covering the period up to two weeks ahead. (Only registered NMHSs can access this page.)

  - Application
  - If you have any questions about ID and/or password, please e-mail to: [tcc@met.kishou.go.jp](mailto:tcc@met.kishou.go.jp)

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

**Monthly Discussion on Seasonal Climate Outlooks will be helpful as a reference!**

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## What we should note at each step

### 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

*NOTE: JMA uses its own guidance for the official forecast instead of the guidance tool. However, the points to check are the same.*

### 3. Synthesize model and guidance output to decide forecast

- Think about how to explain forecast

### 4. Issue forecast

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# Guidance tool for this exercise

- In the exercise, we use **a guidance tool** for forecasting seasonal temperature and precipitation on stations
  - ① Input csv file (30-year observation of temperature/precipitation at stations)
  - ② Select predictor(s)
  - ③ The tool makes a simple statistical model between observations and CPS3 predictions over 30 years (1991-2020). Then it calculates forecast by entering the CPS3 prediction into the statistical model.
    - 3-category probability forecast (below-, near-, above-normal)
    - Skill scores
- **Assumption of the guidance tool**
  - 'Point' forecast by using single model grid point data (GPV) at the same location
    - cf. 'Area' forecast is common for seasonal forecast to increase accuracy
      - ex. JMA uses a guidance specialized for seasonal forecast over areas in Japan
  - Predictor choices are limited
    - The guidance tool should be used only for training purposes
- For details of the guidance tool, see the manual

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# How to use guidance tool

[https://extreme.kishou.go.jp/cgi-bin/simple\\_guidance\\_3mon/index\\_3mon.cgi](https://extreme.kishou.go.jp/cgi-bin/simple_guidance_3mon/index_3mon.cgi)

*NOTE: The guidance tool is exclusive to TCC seminar 2024*

JMA's Three-month Guidance Tool ([Commentary](#))

The screenshot shows the JMA's Three-month Guidance Tool interface. It includes several input fields and a text area for data. Red boxes and arrows highlight key areas:

- Determine the settings:** A red box highlights the 'Initial date' and 'Forecast period' dropdown menus.
- Select predictor(s):** A red box highlights the 'Predictor' dropdown menu.
- Input csv file (Load csv file):** A red box highlights the 'Station and observation data' text area, which contains a sample CSV file. A '参照...' button is visible above the text area.
- Use corrected csv files (original file name)+JMA:** A red box highlights the 'Submit' button.

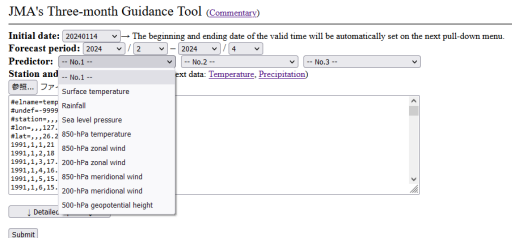
Additional annotations include:

- A red arrow pointing to the 'Detailed Options' button.
- A red arrow pointing to the 'Submit' button with the text 'Click 'Submit' button'.

For any questions about the guidance tool, see the manual or ask TCC staff members

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# How to select predictors of the guidance tool



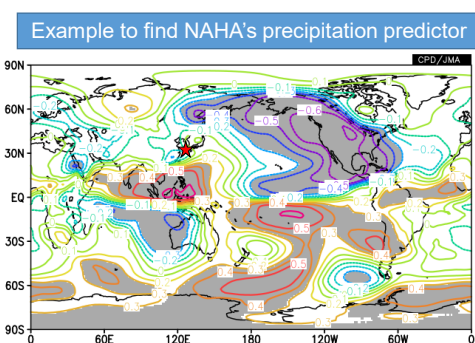
**Tips**

- We can select multiple predictors (up to 3) but **single predictor may be enough**.
- **DON'T select similar predictors at the same time (ex. surface temperature and 850hPa temperature)**. Inappropriate guidance model can be resulted.

- Select variables that determine temperature/precipitation at the target station
- Temperature
  - Surface temperature or 850hPa temperature is recommended as a first choice
- Precipitation
  - Rainfall is recommended as a first choice
- **Use meteorological knowledge!**

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# Use diagnostic relationship for choosing guidance tool predictors

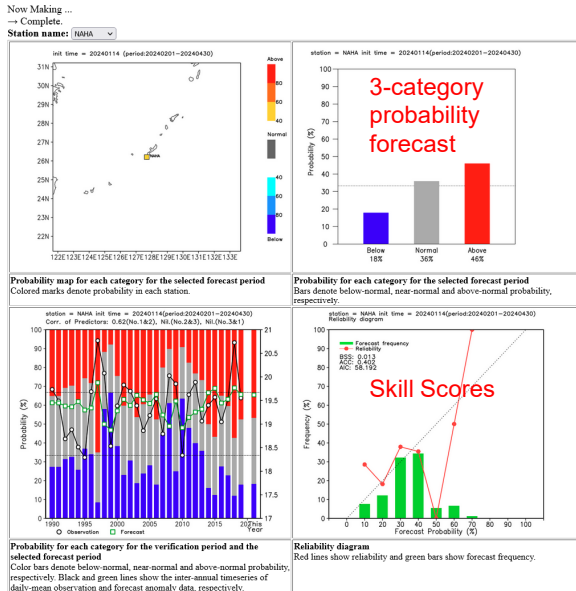


**Example**  
Correlation coefficient map of PSI850 with NAHA's rainfall for FMA 1991-2020. We can see that NAHA's rainfall correlates well with anti-cyclonic anomaly around Philippines. Probably southwesterly anomaly advects humid air into NAHA. Created by using iTacs and NAHA's rainfall observation data.

- To find variables that determine temperature/precipitation at the target station, we can use diagnostic relationship between the station's observation data and atmospheric circulation field
- We can find such relationship using **iTacs**
  - Already learned in iTacs exercise!

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# Check Guidance output

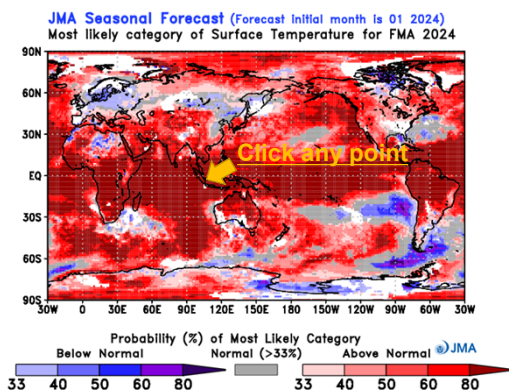


- **POINT: Is forecast as expected?**
  - Reasonable or not
- **POINT: Is skill enough?**
  - BSS > 0 desirable at least
  - Reliability curve close to 45-degree line as possible
- *In the exercise, we can re-select predictors, if the skill is not enough*

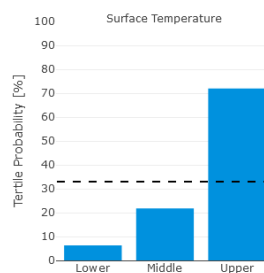
**Brier Skill Score (BSS)** measures the relative skill of the forecast compared to climatology  
 BSS = 1 perfect skill compared to climatology  
 BSS = 0 no skill compared to climatology

## Optionally Use TCC probabilistic forecast as a reference

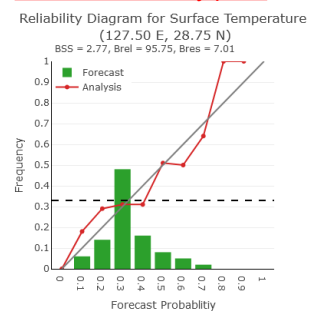
Use of TCC probabilistic forecast is optional in the exercise, but it can be helpful to forecast



### Probabilities at any point



### Skill scores at any point

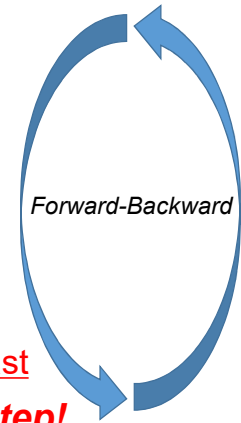


TCC probabilistic forecast is publicly available at TCC website  
<https://www.data.jma.go.jp/tcc/products/model/probfcst/3-mon/index.html>

## What we should note at each step

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

**Most important step!**
4. Issue forecast



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## Synthesize all data

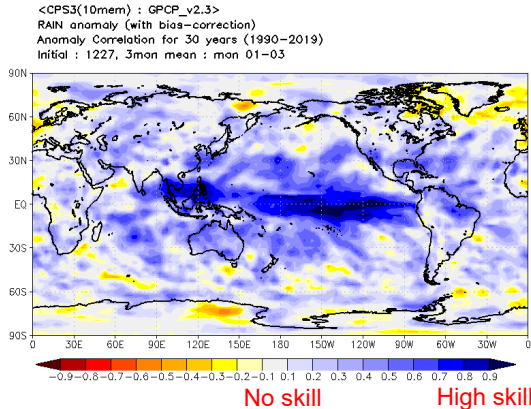
- Don't just believe guidance, particularly for precipitation forecast
- **Think about the meteorological reason of guidance output**
- **Think about how to explain forecast**
  - Why is above-normal temperature predicted?
  - Why is above-normal precipitation predicted?
  - Is there any impact of global circulation, particularly by ENSO?
- If necessary, adjust guidance output
- Decide forecast
  - reasonable explanation of forecast is necessary to users

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# Don't just believe guidance output!

*This is especially true for the guidance tool for the exercise because it uses single point data alone, so that small difference in location can cause large difference in forecast.*



- Don't make forecast from guidance output alone
  - Particularly for extra-tropics
- Try to explain the guidance result from a meteorological point of view
  - Any connection with tropics?
- So that we can believe model and guidance prediction

CPS3 Hindcast verification (Map)

<https://www.data.jma.go.jp/tcc/tcc/products/model/hindcast/CPS3/svs/deter.html>

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# Think about how to explain forecast

Example to forecast NAHA's precipitation

Guidance output

Predicted circulation

PSI850 & wind850 from : 2024/ 1/14 00Z LT=18 days +1.0E6[m\*\*2/s]

Prediction skills

An explanation by a forecaster

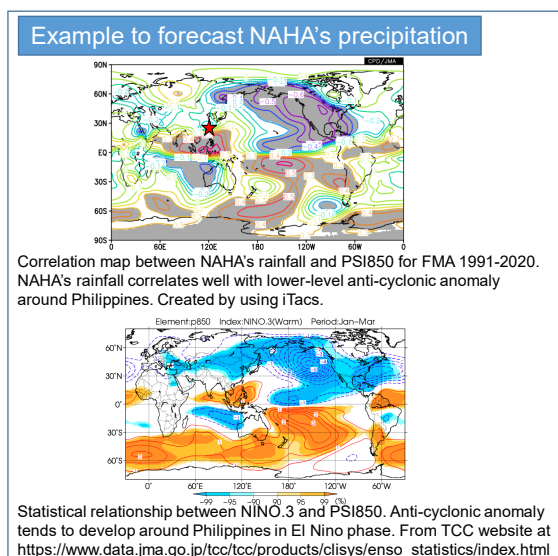
Above- or near-normal precipitation for NAHA is predicted by guidance tool. An interpretation is that it's caused by anti-cyclonic circulation anomaly around Philippines. The anti-cyclonic circulation anomaly may be a response to El Niño, so the prediction skill is high. Above- or near-normal precipitation can be reliable.

• **POINT: Synthesize all data so as not to contradict**

- Model predictions
  - Guidance output
  - Prediction skills
  - Diagnostic relationship
- Consider forecast based on tropical phenomena (e.g. ENSO) as possible to increase forecast accuracy
- If necessary, adjust guidance probabilities

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# Use diagnostic relationship for forecast



- For interpretation of model and guidance output, we can use diagnostic relationship between observation and atmospheric circulation
- We can find such relationship using **iTacs**
- We can use also **various statistics provided on TCC website**

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## What we should note at each step

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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# Forecast

*In the exercise, we will consider not only forecast but also explanation of forecast*

	Temperature			Precipitation		
	Below Normal	Near Normal	Above Normal	Below Normal	Near Normal	Above Normal
NAHA	10%	30%	<b>60%</b>	20%	<b>40%</b>	<b>40%</b>
(Guidance)	15%	25%	60%	17%	40%	43%

## Explanation of forecast

- In response to suppressed convective activities over the Maritime Continent by El Nino, 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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# Schedule (again)

## Jan 31 (Wed)

- AM: Introduction & Example
- PM: **Exercise**

## Feb 1 (Thurs)

- AM: **Exercise (continue)**
- PM: **Presentation**

## Feb 2 (Fri)

- AM: **Presentation (continue)**

## • Note

- **TCC staff members always welcome any questions during the exercise**
- Take your coffee break anytime during the exercise
- Presentation Time: **20 minutes**

### Order of presentation: Alphabetical order by country name

Bangladesh, Bhutan, Hong Kong, Indonesia, Leo PDR, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, Viet Nam

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## Data & Tools for the exercise (again)

- CPS3 prediction
  - <https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/zpcmap.php>
  - <https://www.data.jma.go.jp/tcc/tcc/products/model/map/4mE/map1/pztmap.php>
- CPS3 hindcast verification
  - <https://www.data.jma.go.jp/tcc/tcc/products/model/hindcast/CPS3/index.html>
- El Nino Outlook
  - <https://www.data.jma.go.jp/tcc/tcc/products/elnino/outlook.html>
- El Nino impact (composite analysis)
  - [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)
- iTacs (registered NMHSs only)
  - <https://extreme.kishou.go.jp/tool/itacs-tcc2015/>
- Guidance tool (this exercise only)
  - [https://extreme.kishou.go.jp/cgi-bin/simple\\_guidance\\_3mon/index\\_3mon.cgi](https://extreme.kishou.go.jp/cgi-bin/simple_guidance_3mon/index_3mon.cgi)

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## Exercise Setting

- Forecast Target
  - Target period: **February-March-April 2024 (3-month mean)**
  - Target forecast: **3-category probabilities** (below-, near-, and above-normal) of **Temperature and Precipitation for points**
    - We prepared and brought observation data of forecast points in advance
- Data
  - We use prediction data initialized on January 2024
  - URLs are given (previous slide)
- Presentation
  - **Forecast with explanation** (meteorological interpretation)
  - **20-minute presentation time**

*Use corrected csv files  
(original file name)+JMA*

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# Exercise Setting

## CPS3 prediction map on TCC website

CPS3 prediction

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

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

Forecast Maps

forecast period  
3 months mean

initial date  
2024.01.14.00Z

3 months mean  
2024.01.14.00Z

data  
ensemble mean forecast  
spread and anomaly

corresponding verification  
LT : lead time(day)  
kt : lead time(hour)

[forecast]  
Contour show forecast, and shaded pattern and vector show anomalies. Contour interval  
CH200 : 2x1.0E6m<sup>2</sup>/s  
RAIN : 2mm/day

Forecast Maps

forecast period  
3 months mean

initial date  
2024.01.14.00Z

3 months mean  
2024.01.14.00Z

Click drop-down list

Select '3 months mean'

**Make sure your settings are correct!**

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# Exercise Setting

## CPS3 verification map on TCC website

CPS3 hindcast verification

<https://www.data.jma.go.jp/tcc/tcc/products/model/hindcast/CPS3/index.html>

Score:  
ACOR

Parameter:  
T2m

Initial date:  
Jan (12/27)

Lead time (month):  
1-3 month

Area:  
Global

Jan (12/27)  
1-3 month

Score:  
ACOR

Parameter:  
T2m

Initial date:  
Jan (12/27)

Lead time (month):  
1-3 month

Area:  
Global

<CPS3(10mem) : JRA-3Q>  
TS anomaly (with bias-correction)  
Anomaly Correlation for 30 years (1990-2019)  
Initial : 1227, 3man mean : mon 01-03

**Make sure your settings are correct!**

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# Exercise Setting Guidance Tool

Guidance tool (this exercise only)  
[https://extreme.kishou.go.jp/cgi-bin/simple\\_guidance\\_3mon/index\\_3mon.cgi](https://extreme.kishou.go.jp/cgi-bin/simple_guidance_3mon/index_3mon.cgi)

JMA's Three-month Guidance Tool ([Commentary](#))

**20240114**  
**2024 2 - 2024 4**

**Initial date:** 20240114 → The beginning and ending date of the valid time will be automatically set on the next pull-down menu.  
**Forecast period:** 2024 / 2 - 2024 / 4  
**Predictor:** 850-hPa temperature / 850-hPa meridional wind / -- No.3 --

**Station and observation data:** (Sample text data: [Temperature](#), [Precipitation](#))

参照... ファイルが選択されていません。

```
#lname=temperature,,,  
#undef=-9999,,,  
#station=,,,NAHA  
#lon=,,,127.686  
#lat=,,,26.206  
1991,1,1,21  
1991,1,2,18  
1991,1,3,17.4  
1991,1,4,16.4  
1991,1,5,15.4  
1991,1,6,15.2
```

↓ Detailed Options ↓

Submit

Initial date: -----  
Forecast per: -----  
Predictor: 20240121  
Station: 20240114  
参照... ファイル

Click drop-down list  
Select '20240114'

**Make sure your settings are correct!**

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## Contents of Presentation

- Presentation time is 20 minutes including Q&A session
- About 5-10 pages in order to finish in 20 minutes
- First page
  - Climate of the country
  - Location of forecast target station (point)
- Second page onwards
  - **Explanation of forecast** (Why that forecast?)
- Last page
  - **Forecast with summary of explanation**
- Example is given

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## Tips for exercise

- **Apply what we have already learned in the seminar!**
  - Lecture on seasonal forecast
  - Lectures on ENSO and its impact on seasonal climate
  - Lecture and exercise on iTacs *Maeda-san's lecture is highly relevant.  
It shows how we can interpret CPS3 prediction for FMA*
- **Start from the guidance tool, if you don't know what to do.**  
**Then, think about how to explain the guidance output.**
- **Don't hesitate to ask any questions to TCC staff members!**
- ***Enjoy exercise!***