Seasonal outlook for Japan for the upcoming winter 2022/23

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Specifications of JMA seasonal EPS

JMA's Seasonal ensemble prediction system upgraded early this year

| Model	JMA/MRI-CPS3 (in operation since Feb 2022)	JMA/MRI-CPS2 (previous model)
Horizontal Resolution	Atmosphere: TL319 (approx. 55km) **New** Ocean：0.25°(lon)×0.25°(lat)	Atmosphere：TL159 (approx. 110km) Ocean：1.0°(lon)×0.5-0.3°(lat)
Vertical Layers	Atmosphere：100 levels (up to 0.01hPa) Ocean：60 levels	Atmosphere：60 levels (up to 0.1hPa) Ocean：52 levels and Bottom Boundary Layer
Initial Condition for Forecast	Atmosphere：Global Analysis Land：Offline Land Analysis (*) Ocean：4DVAR(coarse res) + IAU(eddy permitting res), daily (*) Sea Ice：3DVAR, daily (*) * Same forcing as atmosphere	Atmosphere：JRA-55 Land：JRA-55 Ocean：3DVAR at 5-day interval (*) Sea Ice：Climatology * JRA-55 forcing
Forecast Range	7 months (240 days)	7 months (240 days)
Number of Ensemble members	5 members per an initial (51 members with LAF)	13 members per an initial (51 members with 4-initial LAF)
Frequency of Forecast run	Every day	Every 5 days
Re-forecast (Hindcast)	24 initials x 5 members x 30 years (1991-2020)	24 initials x 5 members x 41years (1979-2019)
Initial Condition for Re-forecasts	Atmosphere：JRA-3Q Ocean：4DVAR (JRA-3Q Forcing）	Atmosphere：JRA-55 Ocean：3DVAR (JRA-55 forcing）
Horizontal Resolution for Products	1.25 x 1.25 degree	2.5 x 2.5 degree

Improved prediction of tropical dynamics

The performance of the current seasonal prediction system (CPS3) was notably improved as compared with the previous one (CPS2) in several aspects.

Forecast skill for NINO.3 SST anomalies
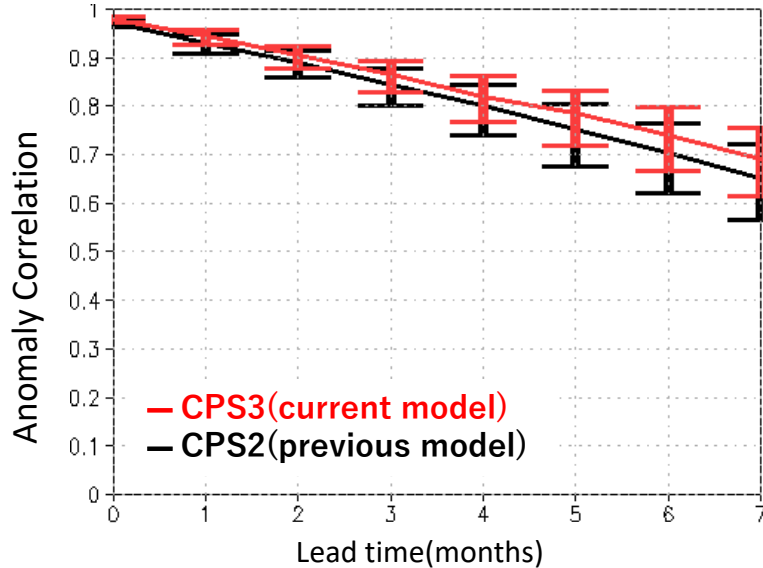
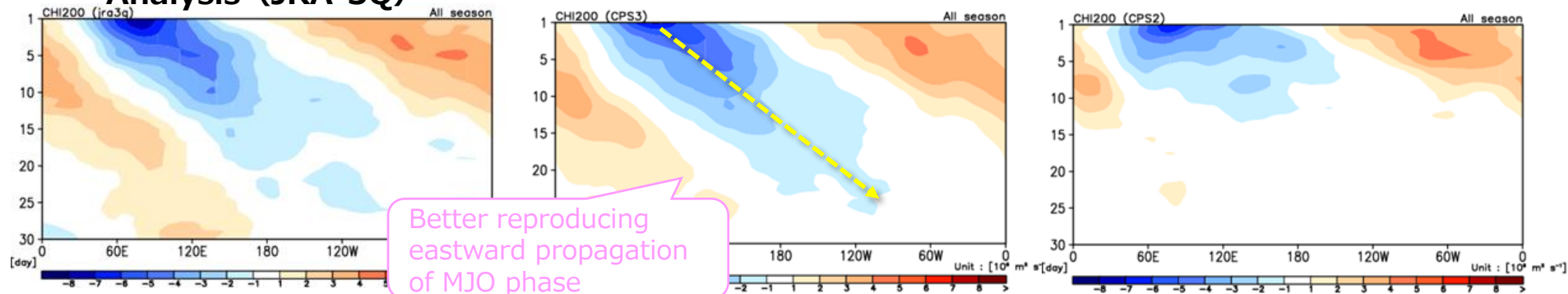## Forecast skill for 2m-level temperature over the northern hemisphere
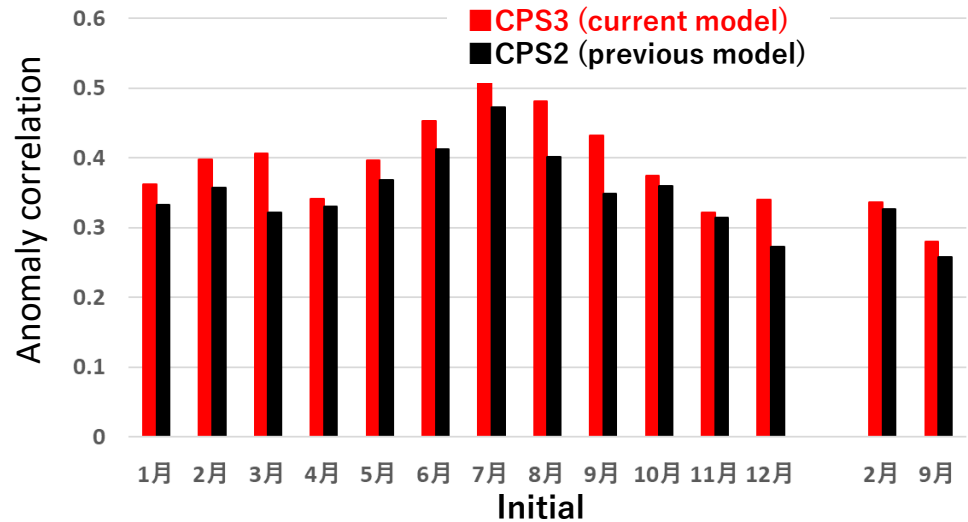
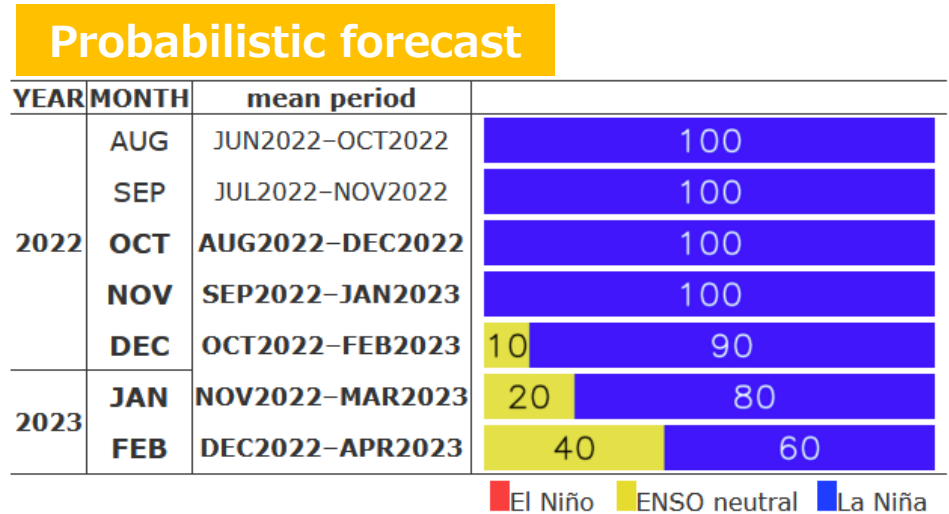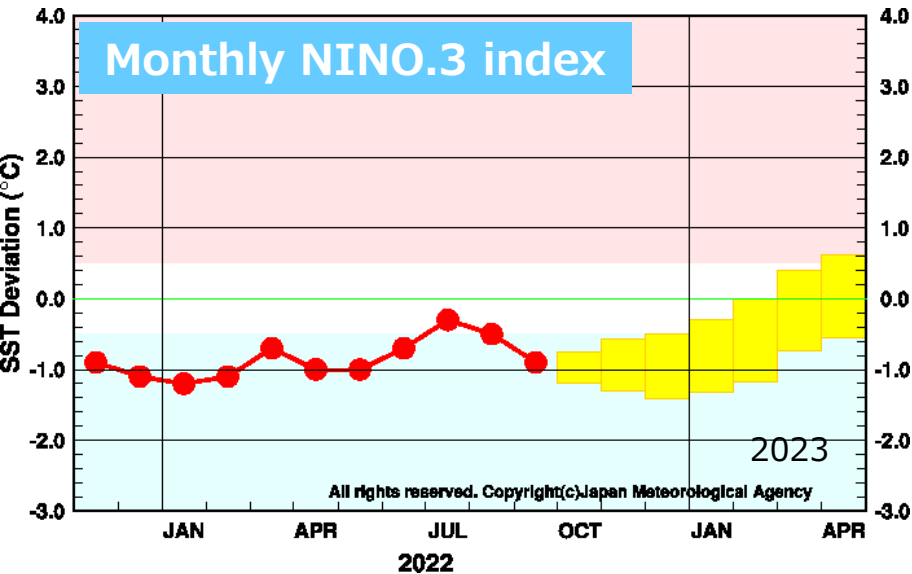## Composite Hovmöller diagram for velocity potential @200hPa

Analysis（JRA-3Q）   **CPS3**   **CPS2**

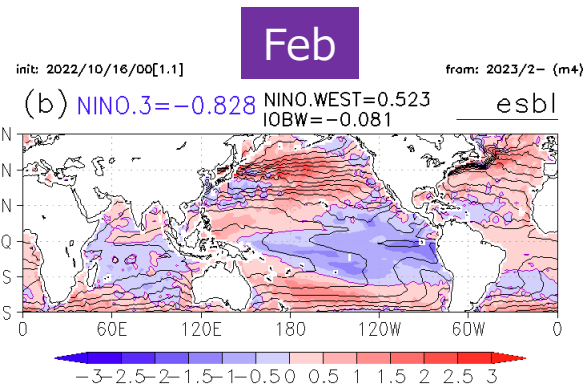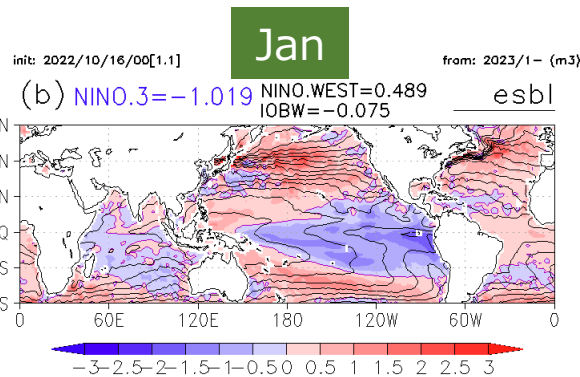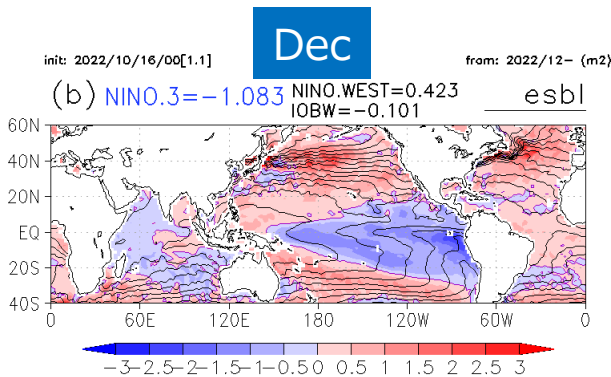Better reproducing eastward propagation of MJO phase

ENSO outlook

- The ongoing La Niña conditions are very likely (90%) to continue until early boreal winter, and likely (60%) to continue towards the end of the winter.
- Regardless of whether the NINO.3 index exactly satisfies our criteria, **La Niña conditions will remain a dominant driving force** through the coming winter.

Monthly NINO.3 index

Probabilistic forecast

YEAR	MONTH	mean period	El Niño	ENSO neutral	La Niña
2022	AUG	JUN2022–OCT2022			100
	SEP	JUL2022–NOV2022			100
	OCT	AUG2022–DEC2022			100
	NOV	SEP2022–JAN2023			100
	DEC	OCT2022–FEB2023		10	90
2023	JAN	NOV2022–MAR2023		20	80
	FEB	DEC2022–APR2023		40	60

■El Niño ■ENSO neutral ■La Niña

Predicted probabilities of 5-month running mean of NINO.3 index satisfying La Niña criteria

Predicted global SST anomalies

Dec — init: 2022/10/16/00[1.1] from: 2022/12– (m2) (b) NINO.3=−1.083 NINO.WEST=0.423 IOBW=−0.101 esbl

Jan — init: 2022/10/16/00[1.1] from: 2023/1– (m3) (b) NINO.3=−1.019 NINO.WEST=0.489 IOBW=−0.075 esbl

Feb — init: 2022/10/16/00[1.1] from: 2023/2– (m4) (b) NINO.3=−0.828 NINO.WEST=0.523 IOBW=−0.081 esbl

SST anomalies

Ensemble forecast (3 months mean : DEC−FEB)

SST   from : 2022/10/16 00Z LT=46 days [C]

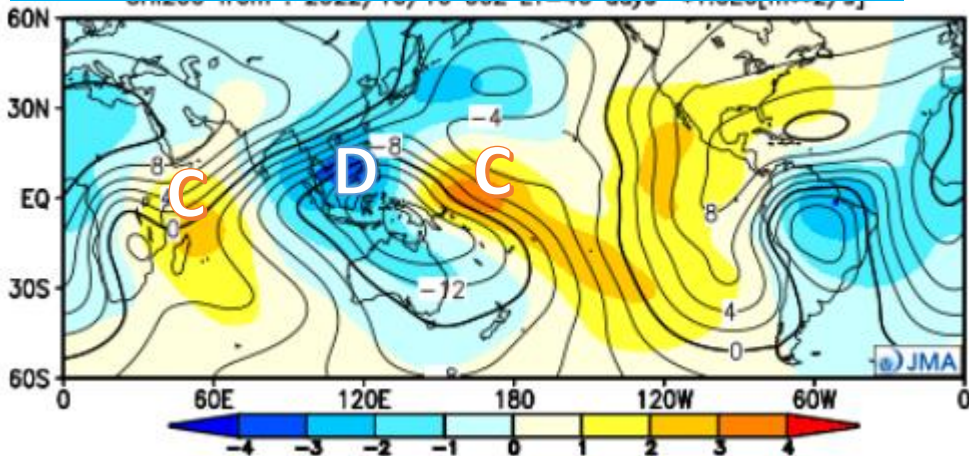## Convection anomalies (velocity potential @**200hPa**)
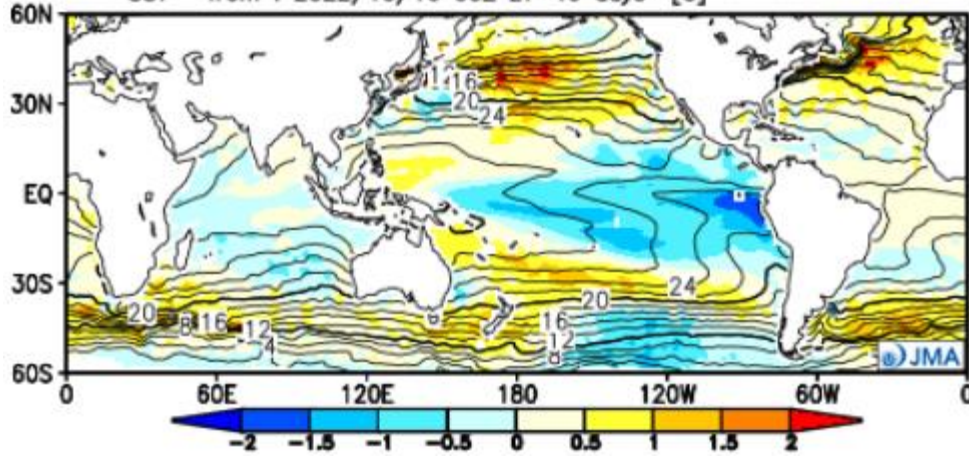
SSTs will remain below normal in central to eastern Pacific and in the western Indian Ocean, above normal around the Maritime Continent.

In response to the dragging-on La Niña conditions,
- **_Enhanced_** convective activity (divergence in the upper troposphere) is predicted over and around the Maritime Continent.
- **_Suppressed_** convective activity (convergence in the upper troposphere) over the western Indian Ocean and the central to eastern Pacific.

Circulation anomalies in tropics for DJF

Stream function & anomalies @200hPa

PSI200 from : 2022/10/16 00Z LT=46 days •1.0E6[m••2/s]

Stream function & anomalies @850hPa

PSI850 from : 2022/10/16 00Z LT=46 days •1.0E6[m••2/s]
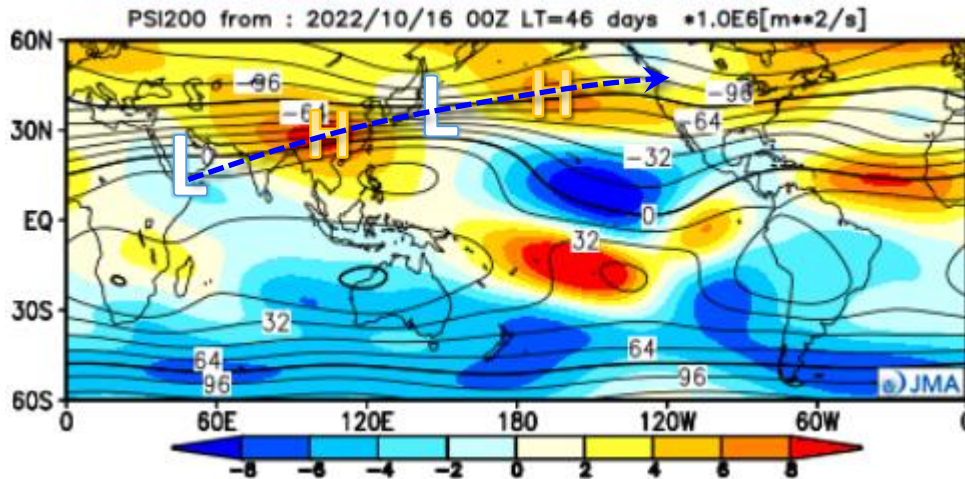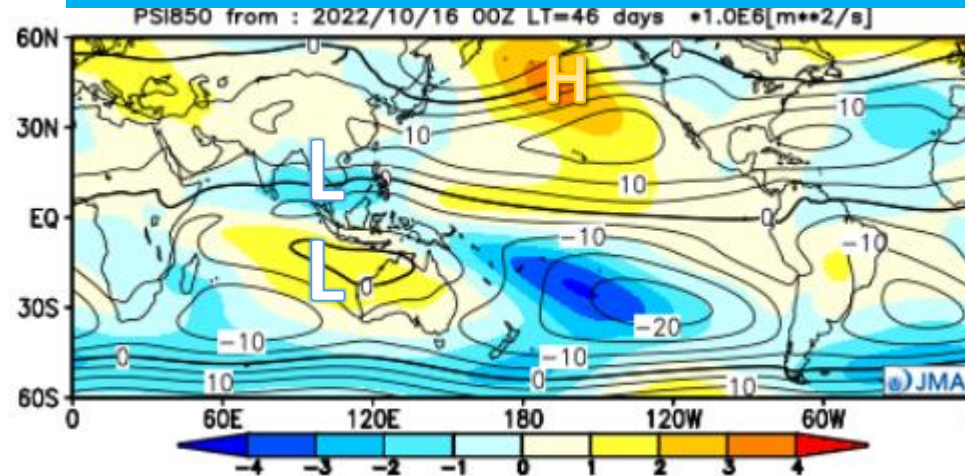
Responding to convection anomalies in the tropics,

- *Rossby wave train in the upper troposphere* is predicted to extend from West Asia to the northeast Pacific, with cyclonic anomalies over the Arabian Peninsula and Japan, anti-cyclonic anomalies over China and the NE Pacific

- In the lower troposphere, *twin cyclonic anomalies* straddling the equator are predicted over the Indian Ocean, and anti-cyclonic anomalies around the eastern part of the climatological Aleutian Low

- In 500hPa geopotential height field, a Rossby wave train, similar to the 200hPa stream function field, is predicted extending from China through Japan to the northeast Pacific.
- In SLP field, positive anomalies are predicted over southern China and negative anomalies over Japan, indicating *stronger than normal northwest monsoon*.
- Consistent with these anomalies, temperature at 850hPa for western to eastern Japan will be below normal.
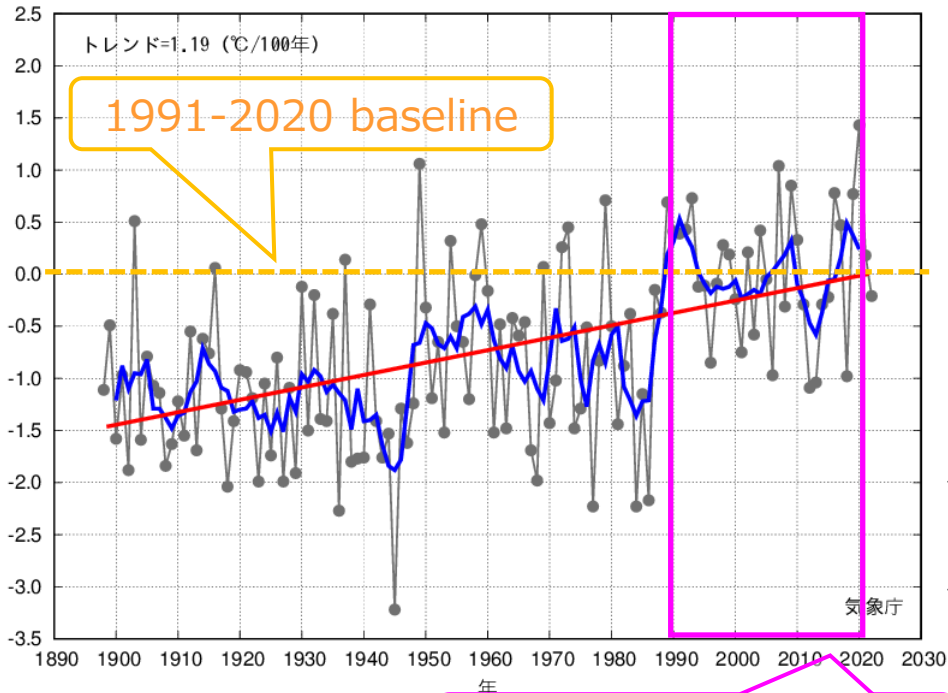

Geopotential height @500hPa

Sea level pressure

Temperature @850hPa
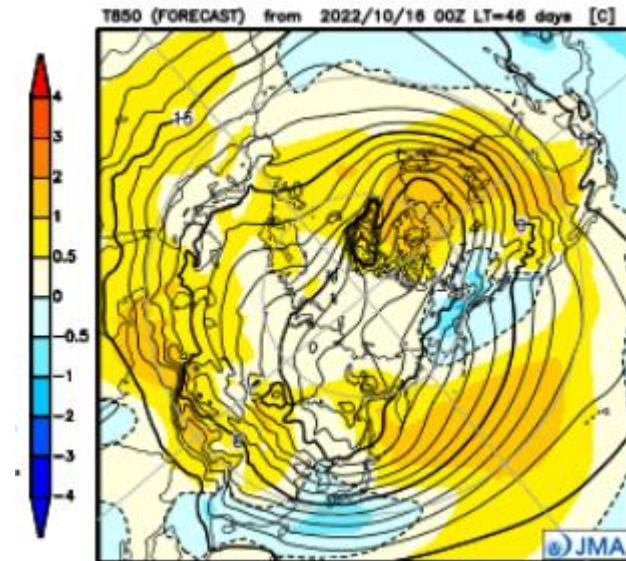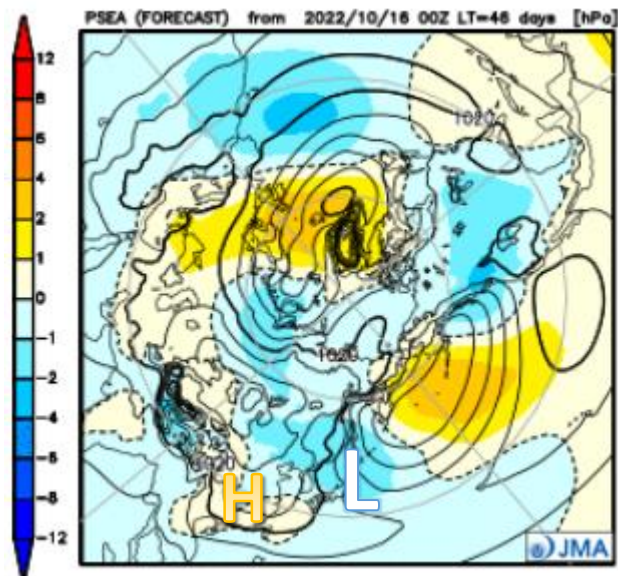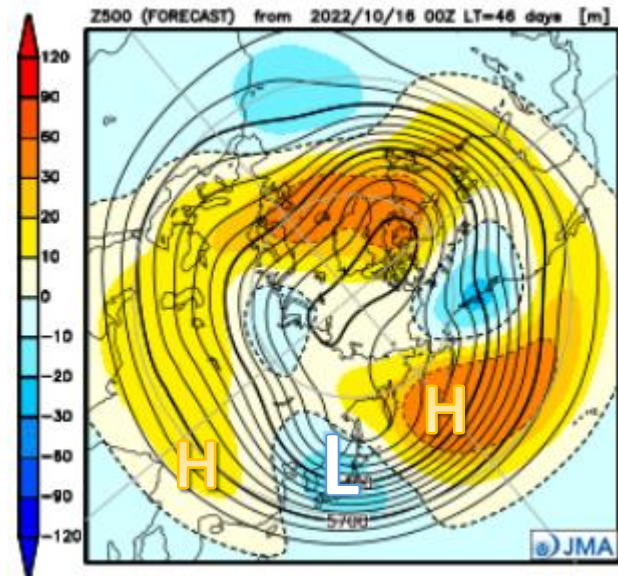
Long-term and large-scale temperature trend

Long-term changes for Japan nationwide surface temperature for winter

1991-2020 baseline

Current climatological normal period

Predicted **thickness temperature** anomalies averaged over the NH troposphere for next winter
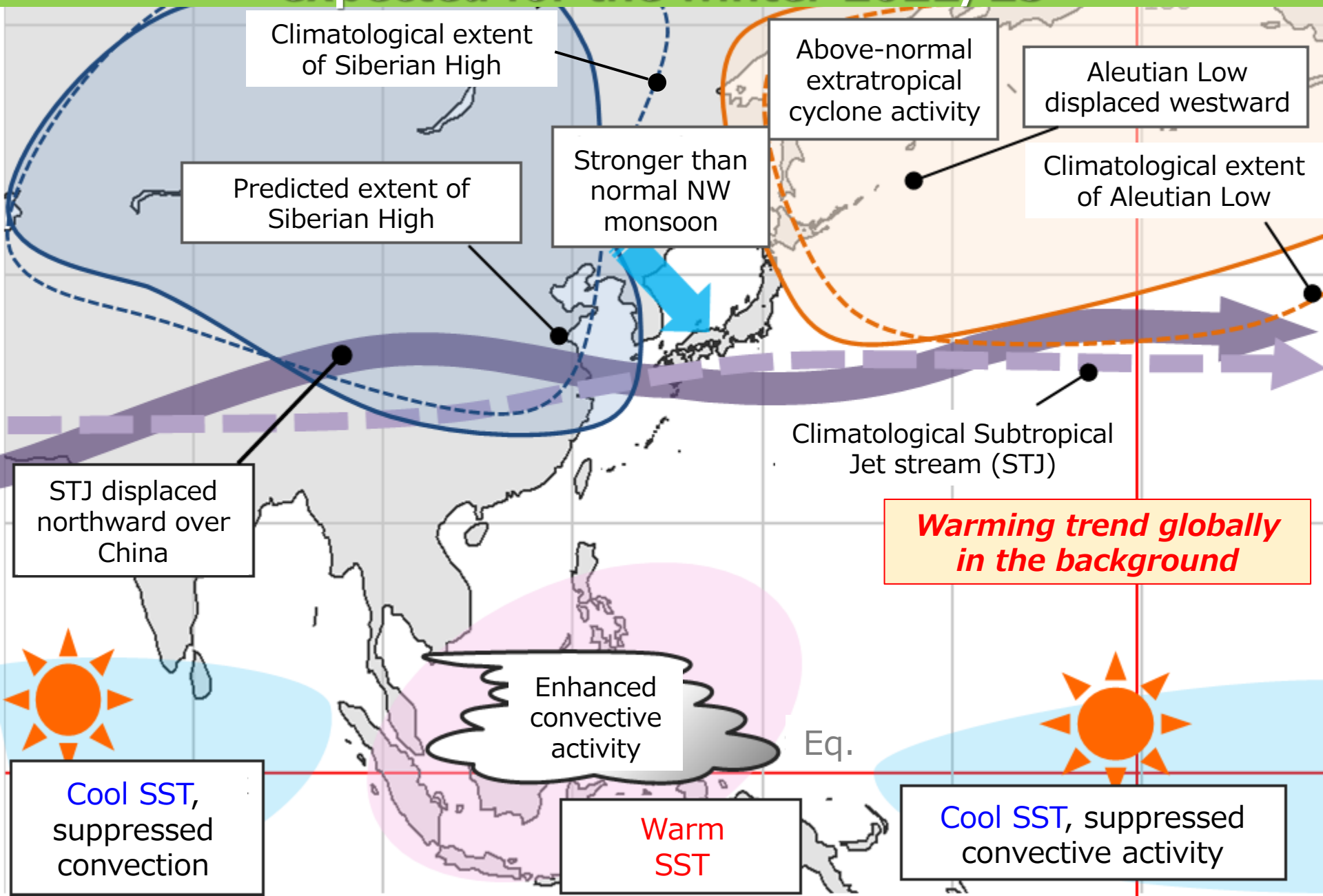
北半球層厚換算温度 (300-850hPa) 30N-90N

- National average temperatures over Japan have been rising at about 1.2 °C / century.
- Notwithstanding, the recent 30 year period has seen no significant warming trend, partly related to mild winters in 1990s
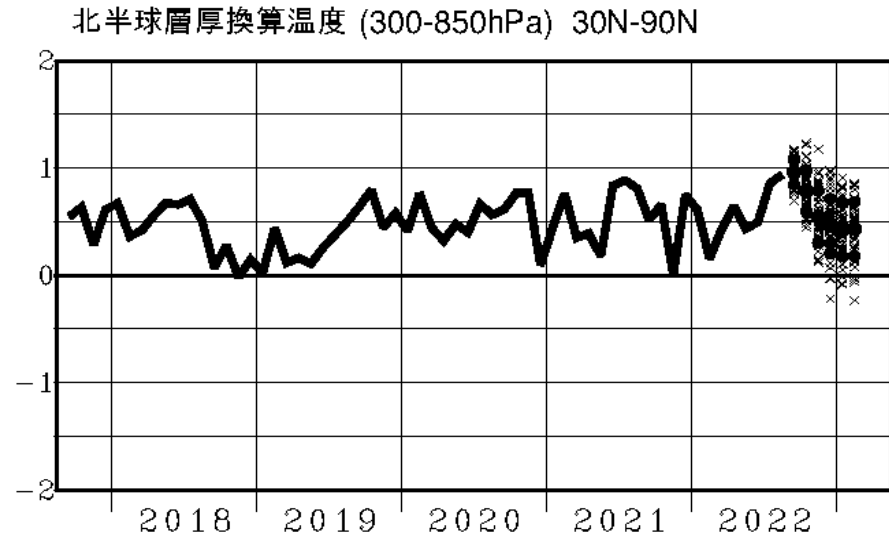
- On large-scale, temperatures are predicted about 0.5°C above normal for the coming summer

Illustration of large-scale circulation anomalies expected for the winter 2022/23

Climatological extent of Siberian High

Predicted extent of Siberian High

Stronger than normal NW monsoon

Above-normal extratropical cyclone activity

Aleutian Low displaced westward

Climatological extent of Aleutian Low

Climatological Subtropical Jet stream (STJ)

STJ displaced northward over China

Warming trend globally in the background

Enhanced convective activity

Eq.

Cool SST, suppressed convection
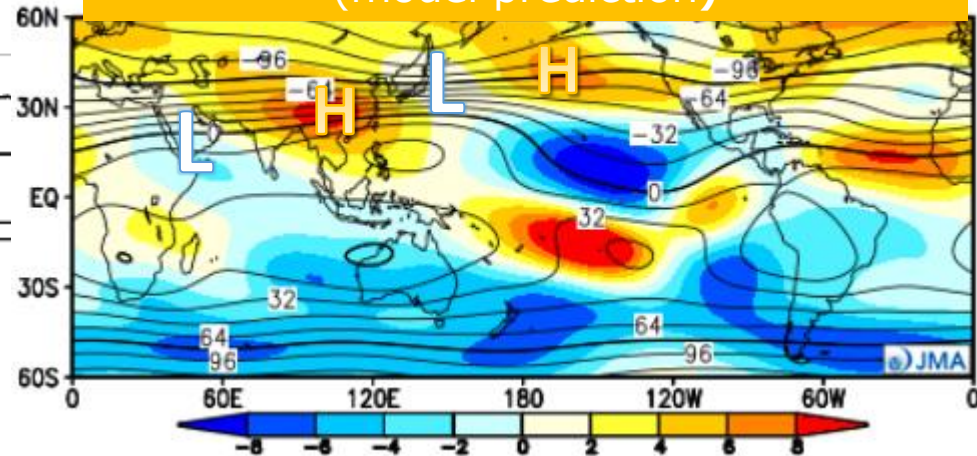
Warm SST

Cool SST, suppressed convective activity

Statistics between ENSO and climate in Japan

The predicted circulation pattern in the upper troposphere resembles that composed of past La Niña events.

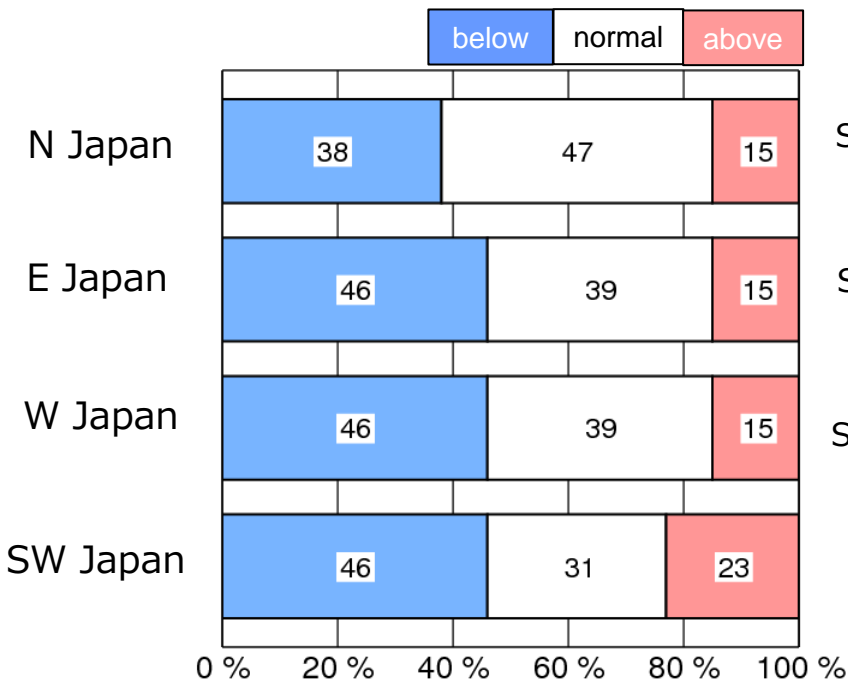Stream function & anomalies @**200hPa** (La Niña composite**)**
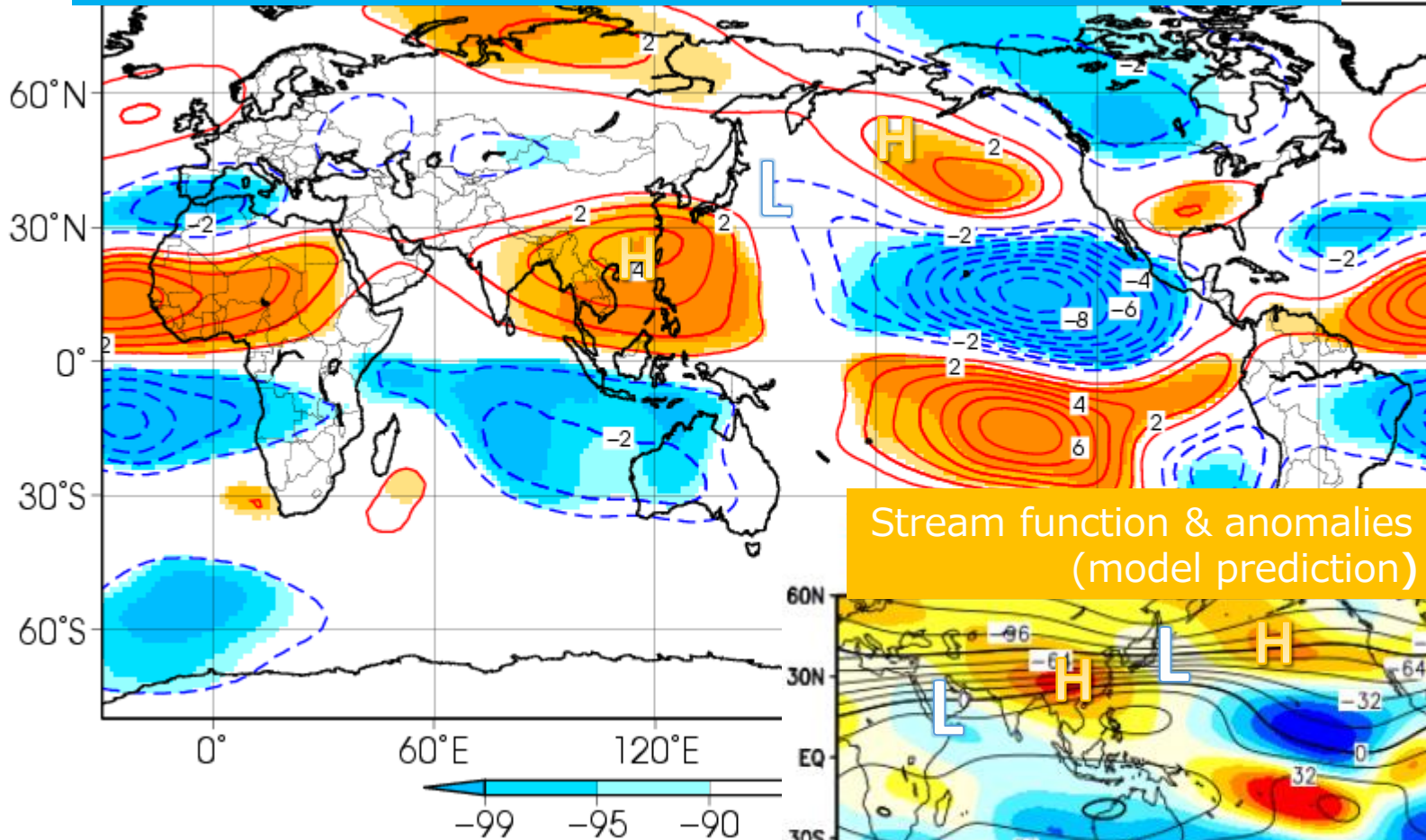
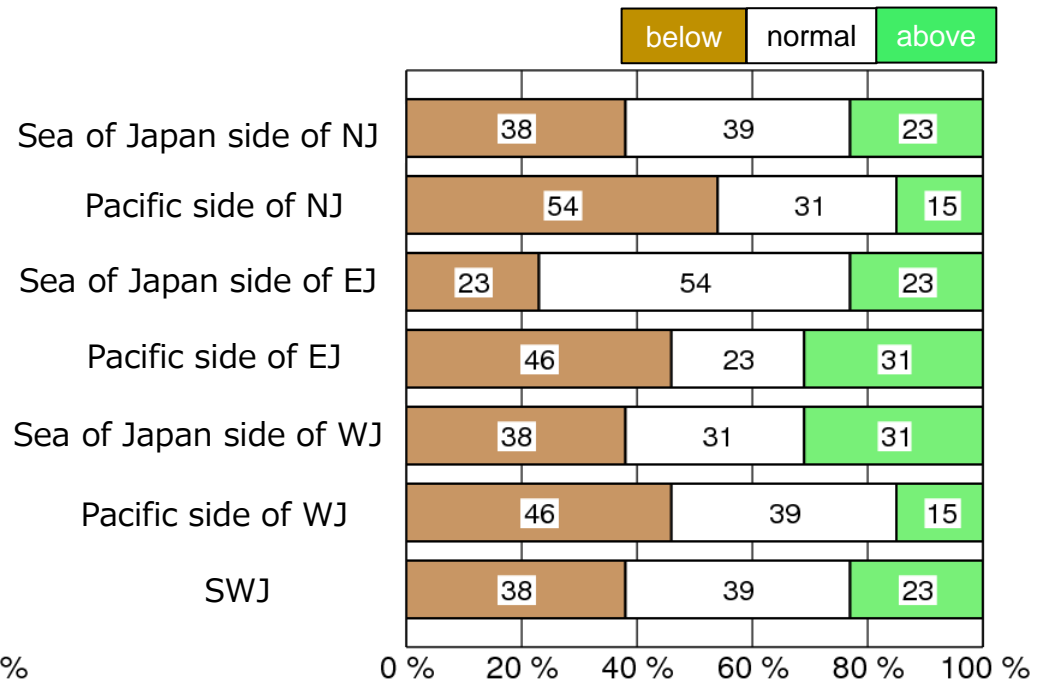Stream function & anomalies @**200hPa** (model prediction**)**

Statistics between ENSO and climate in Japan

From statistics composed of past La Niña winters, probability is in favor of N/B temperature across Japan, and N/B precipitation for regions of the Pacific side.

| Tercile **temperature** probability during past La Niña events	Tercile **precipitation** probability during past La Niña events

Temperature chart (below / normal / above):

	below	normal	above
N Japan	38	47	15
E Japan	46	39	15
W Japan	46	39	15
SW Japan	46	31	23

Precipitation chart (below / normal / above):

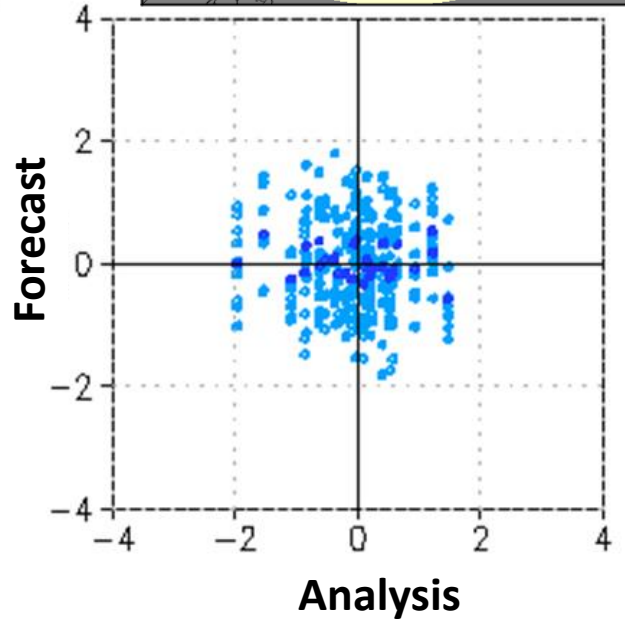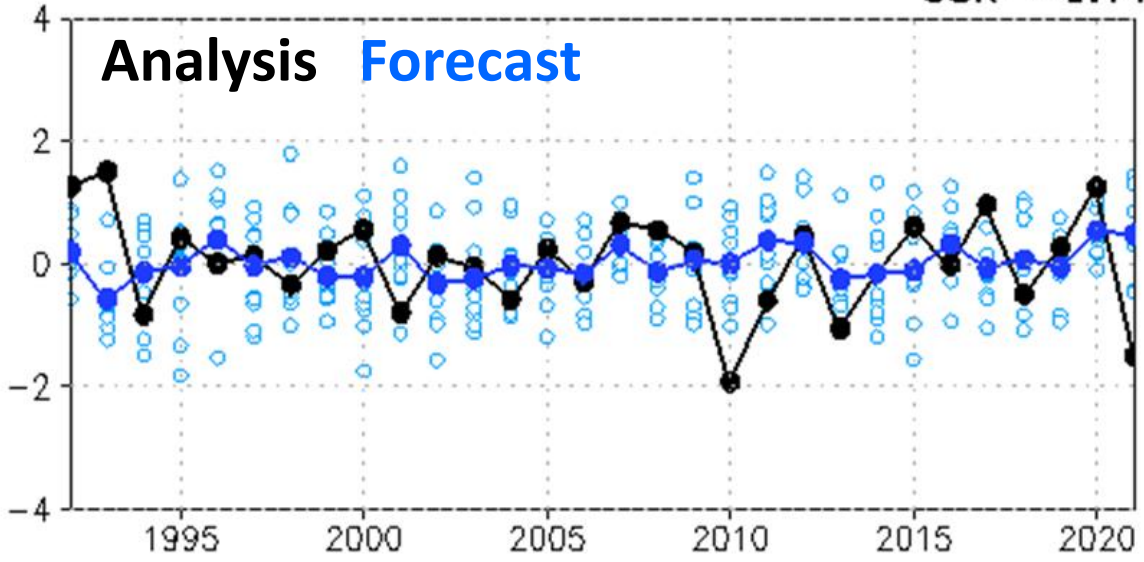|	below	normal	above
Sea of Japan side of NJ	38	39	23
Pacific side of NJ	54	31	15
Sea of Japan side of EJ	23	54	23
Pacific side of EJ	46	23	31
Sea of Japan side of WJ	38	31	31
Pacific side of WJ	46	39	15
SWJ	38	39	23

- Arctic Oscillation (AO) is another dominant driver that determines winter climate in East Asia.
- Predictability of AO is still to be improved, even with the latest seasonal prediction model
- Uncertainty arising from the limited predictability of AO needs to be accounted for in our prediction.
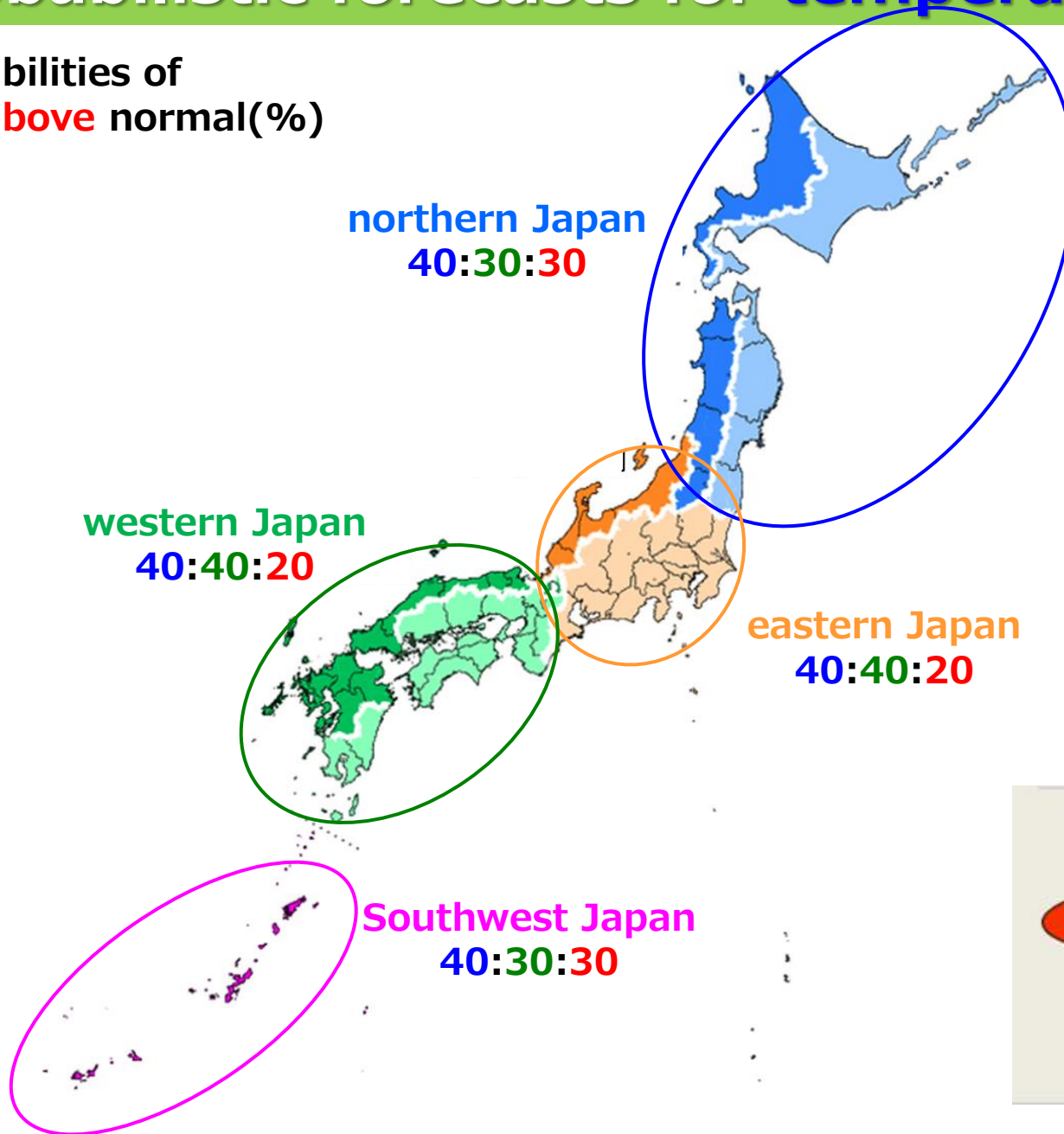
Arctic Oscillation represented in SLP
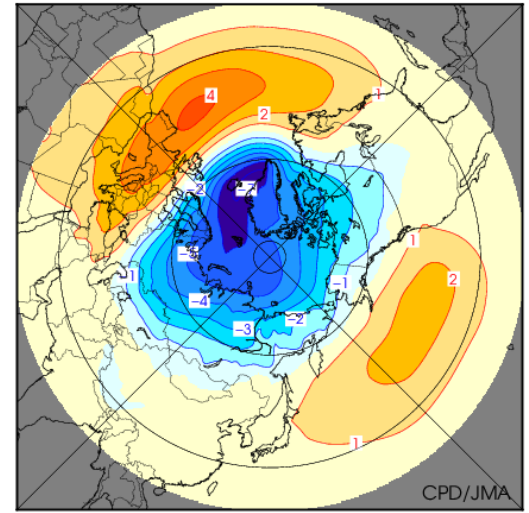
Correlation between hindcast and observed AO index
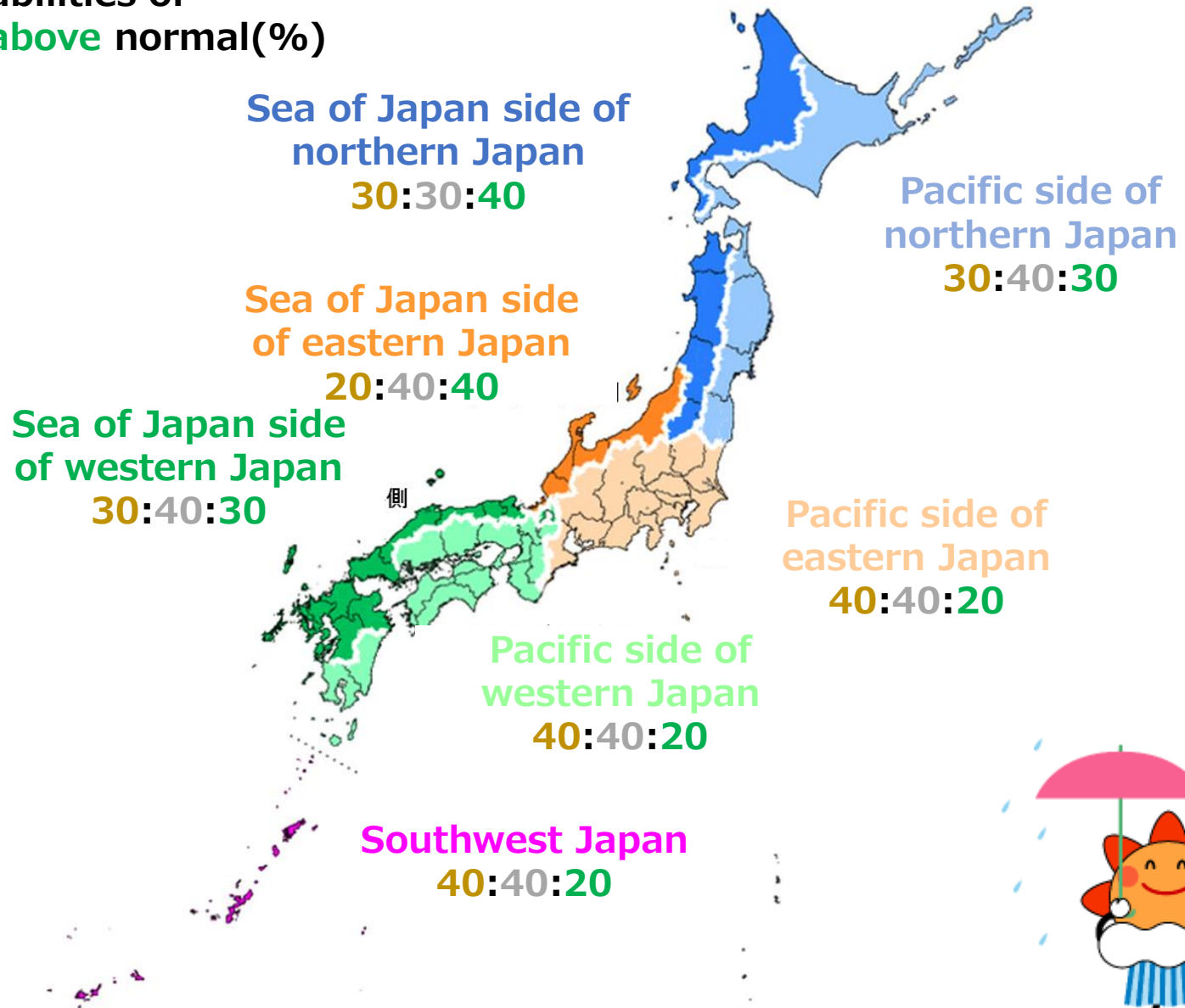
years (1991–2020)
–05

COR=−0.14

Analysis Forecast

CPD/JMA

Forecast

Analysis

Probabilistic forecasts for temperature

Probabilities of
below:near:above normal(%)

northern Japan
40:30:30

western Japan
40:40:20

eastern Japan
40:40:20

Southwest Japan
40:30:30

Probabilistic forecasts for precipitation

Probabilities of
below:near:above normal(%)

Sea of Japan side of northern Japan
30:30:40

Pacific side of northern Japan
30:40:30

Sea of Japan side of eastern Japan
20:40:40

Sea of Japan side of western Japan
30:40:30

Pacific side of eastern Japan
40:40:20

Pacific side of western Japan
40:40:20

Southwest Japan
40:40:20

側

Probabilistic forecasts for snowfall amount

**Probabilities of
below:near:above normal(%)**
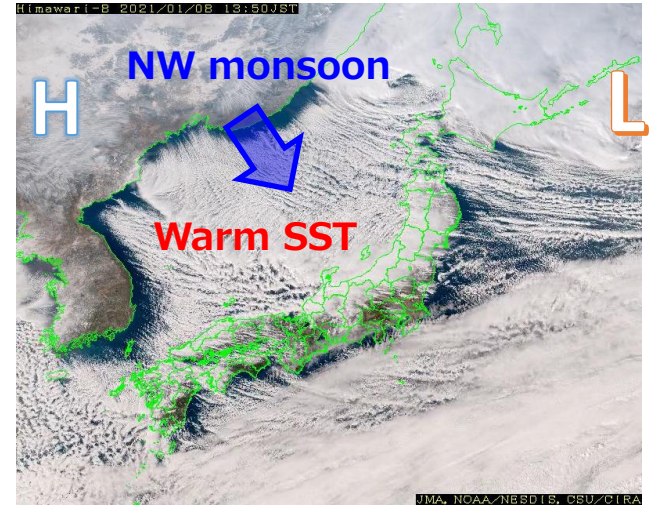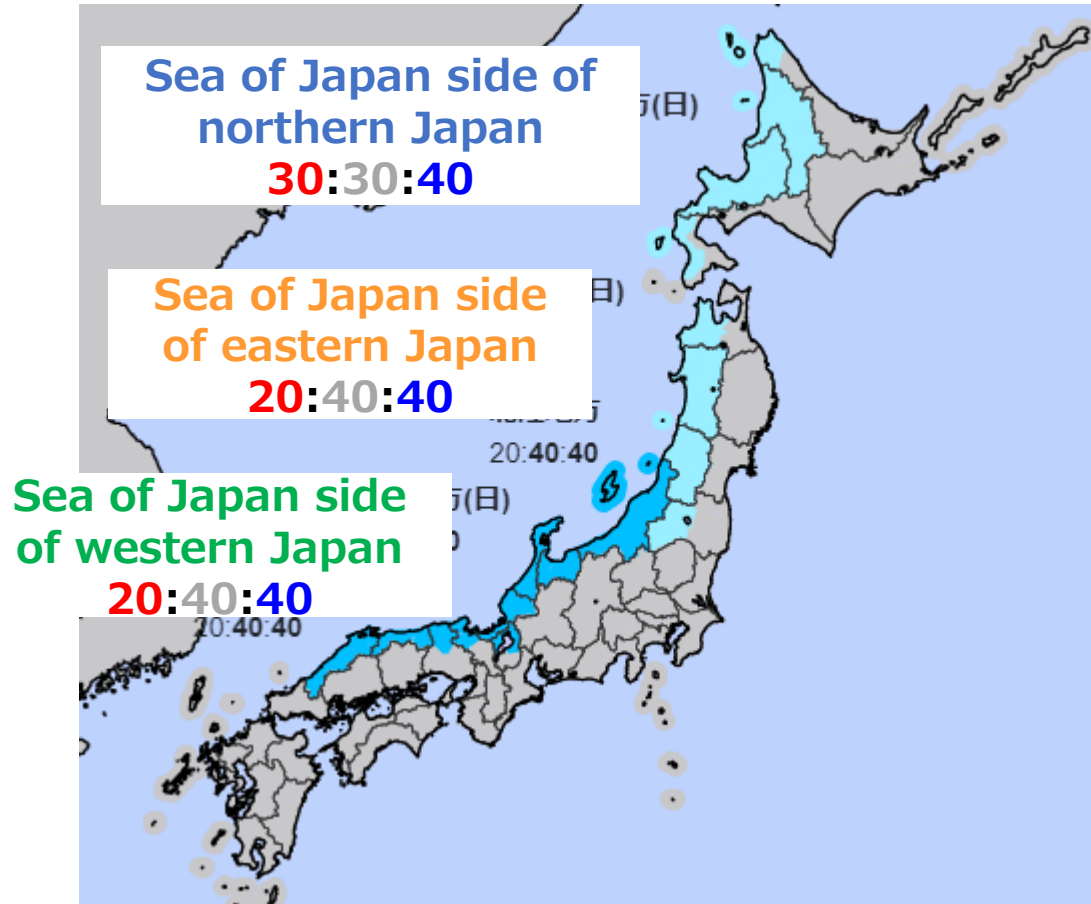
**Sea of Japan side of
northern Japan
30:30:40**

**Sea of Japan side
of eastern Japan
20:40:40**

**Sea of Japan side
of western Japan
20:40:40**

NW monsoon

H   L

Warm SST

- Regions on the Sea of Japan side receive a huge depth of snowfall. In fact they are home to the heaviest snowfall in the world.
- Seasonal snowfall amount is predictable thanks to its correlation with the intensity of NW monsoon.

Thank you