Seasonal outlook for winter 2021/2022 over Japan

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JMA seasonal ensemble prediction System

Model	JMA/MRI-CPS2 (Coupled atmosphere-ocean General Circulation Model)
Resolution	•Atmospheric component 　　　Resolution: **T_L159 L60** •Oceanic component 　　　Resolution: Horizontal 1.0º longitude, 　　　　　　　　　　　　　0.3º–0.5º latitude 　　　　　Vertical: 52 levels + bottom boundary layer
Ensemble method	•Method: 　Combination of Breeding of Growing Modes (BGM), 　　　　　　　　stochastic physics scheme and 　　　　　　　　Lagged Average Forecast (LAF) •Size: **51** (13 member & 4 initial date with 5-day LAF)
Frequency of forecast issuance	Once a month

In this presentation,
  •Initial month: **October 2021** (Ensemble base date: 8 Oct. 2021)
  •Climate base period is 1991-2020 for prediction
  •SST and OLR data are referred to provided COBE-SST and NOAA, respectively.
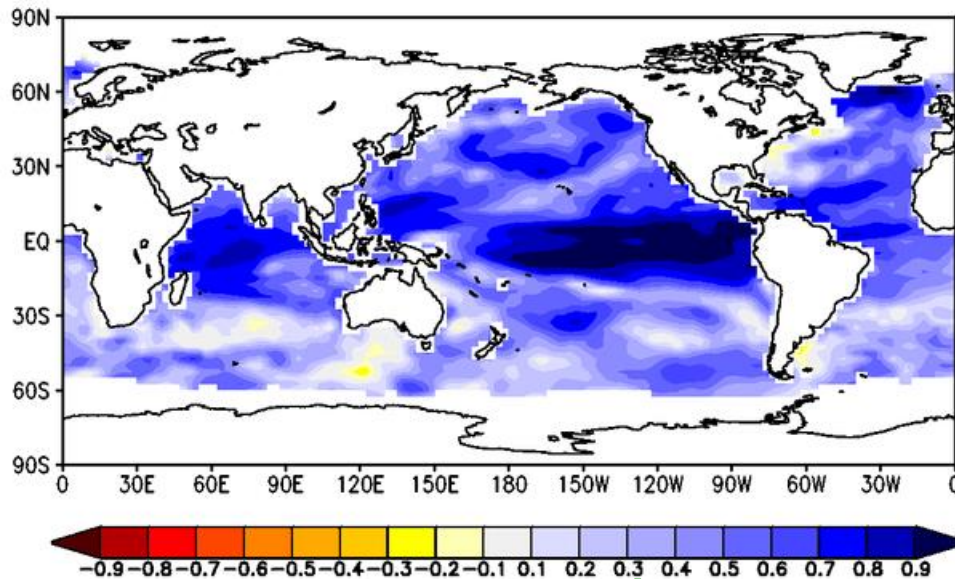
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Prediction Skill of JMA Seasonal EPS (1)
(Anomaly Correlation for DJF with initial-October)
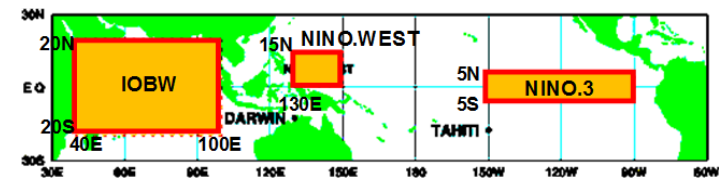
Hindcast experiments for 30 years (1981 – 2010)

• Prediction skill of SST and precipitation in the tropics are generally as high as significant level.

SST

(over 0.31; 95% significance level)

	Anomaly correlation
NINO.3 (150W-90W, 5S-5N)	0.91
NINO.3.4 (150W-90W, 5S-5N)	0.91
NINO.WEST (130E-150E, EQ-15N)	0.78
IOBW (40E-100E, 20S-20N)	0.86

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Prediction Skill of JMA Seasonal EPS (2)
(Anomaly Correlation for DJF with initial-October)

Hindcast experiments for 30 years (1981 – 2010)

Precipitation

500 hPa geopotential height
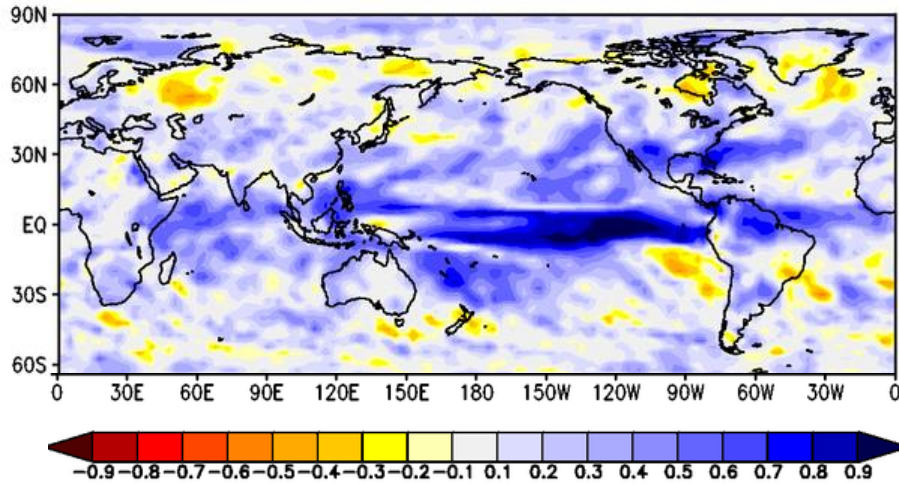
- Prediction skill of precipitation is high in the tropics.
- In the East Asia, AC is slightly positive in the southern part, while near-zero in the northern-part.
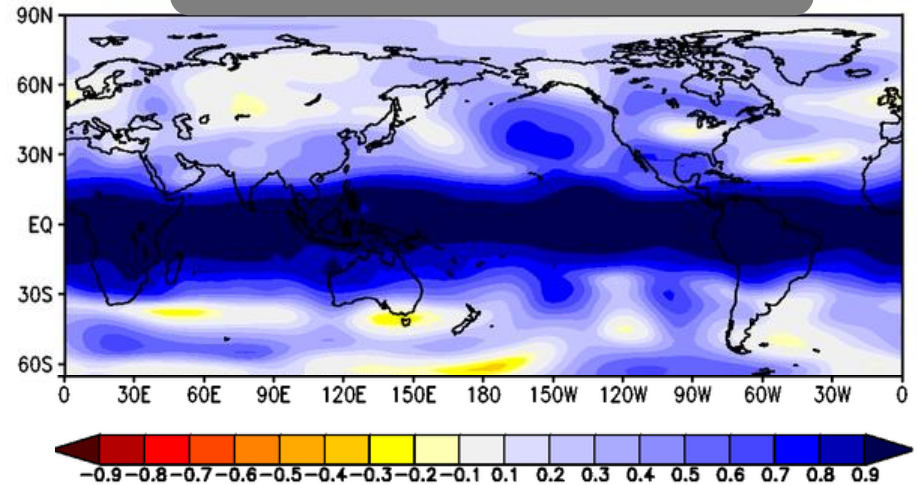
- In the tropics and some regions of the mid-latitudes, prediction skill of atmospheric field is high, which is owing to high predictability of ENSO and associated teleconnections.
- As for the high-latitudes, prediction skill is insufficient.

ENSO reproducibility with model

- The model has some biases of excessive westward extension of the equatorial Pacific cold tongue, which bring westward shift of the atmospheric response around the Asian region.
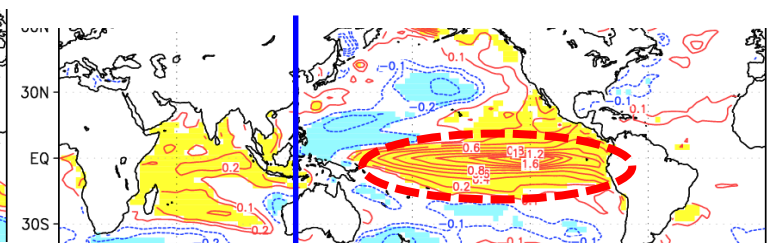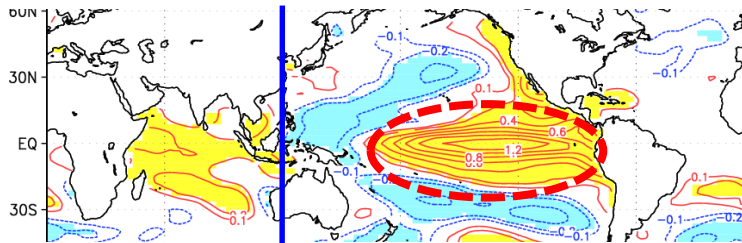
Regression coefficient with NINO.3-SST in DJF
(model initial month of October)
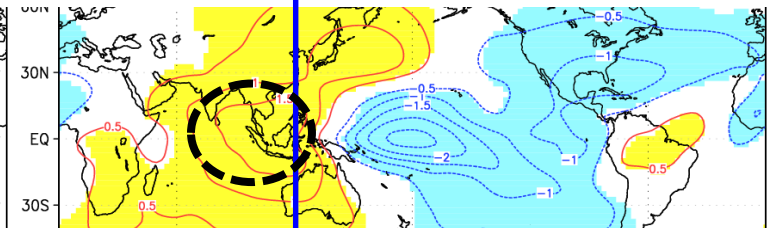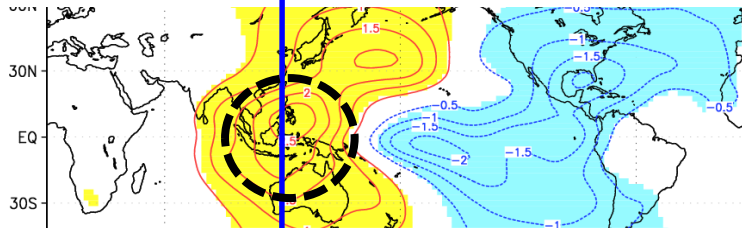
Shading; over 0.31; 95% significance level
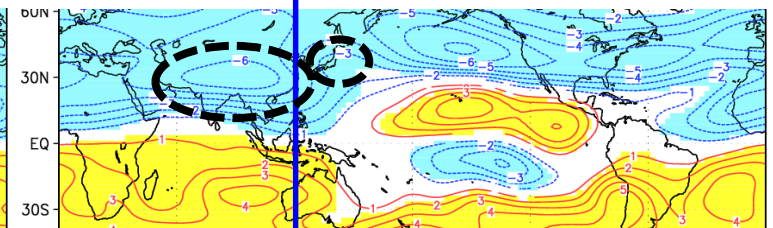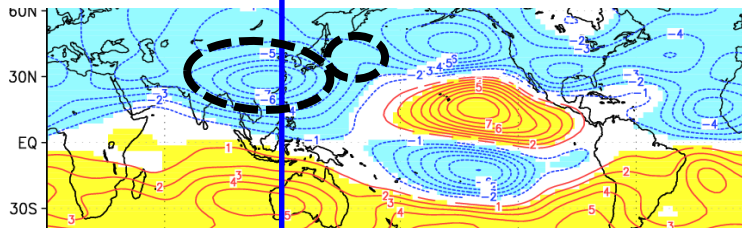
	Analysis (JRA-55)	Model (JMA/MRI-CPS2)
SST		
200 hPa velocity potential		
200 hPa stream function	120°E	120°E

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<DJF 2021/22> SST

- **SSTs over the equatorial Pacific**
  - Below-normal from central to eastern part
  - Above-normal in the western part
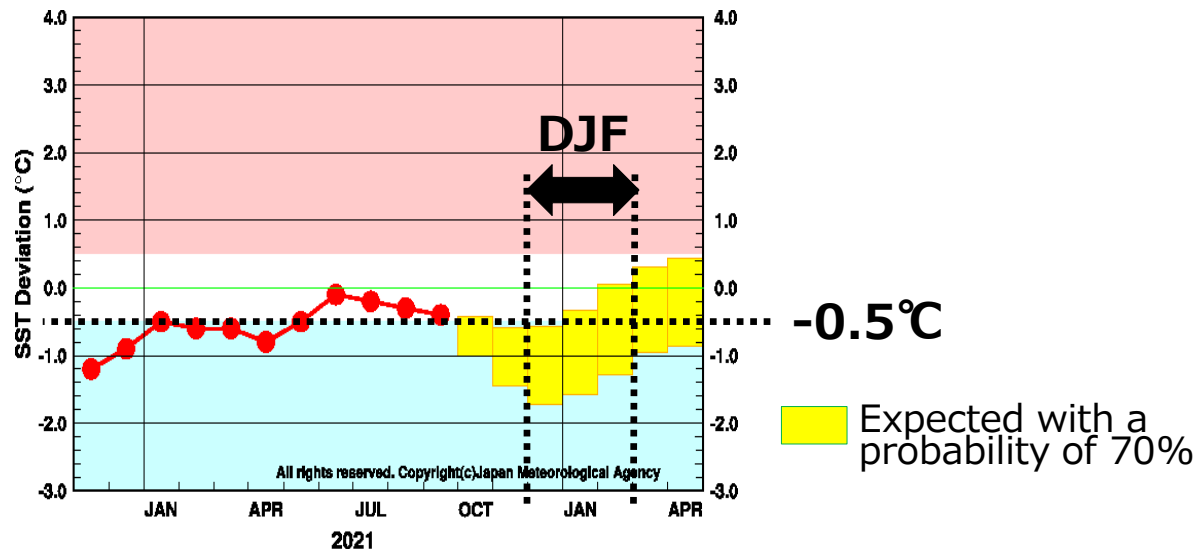 - ➢ indicating La Niña–like conditions

SST(contour) and anomalies(shade)
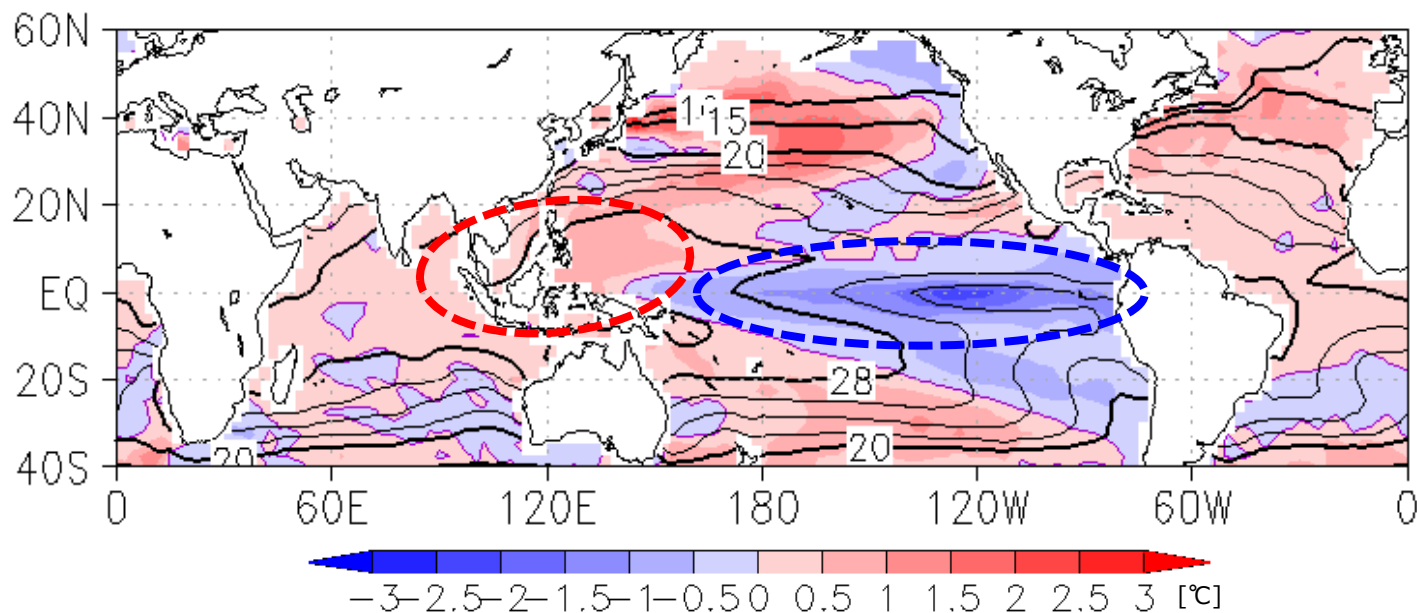
<DJF 2021/22> ENSO outlook

- Although NINO.3-SST index is predicted to be below -0.5°C early to mid-winter, there is some uncertainty about whether JMA's definition of La Niña event (5-month moving average below -0.5°C for 6 consecutive months) will be satisfied.
- However, regardless of whether the exact definition of La Niña is eventually met or not, **La Niña-like conditions** are very likely to last through the months ahead and **key to constructing forecasts for the winter**.
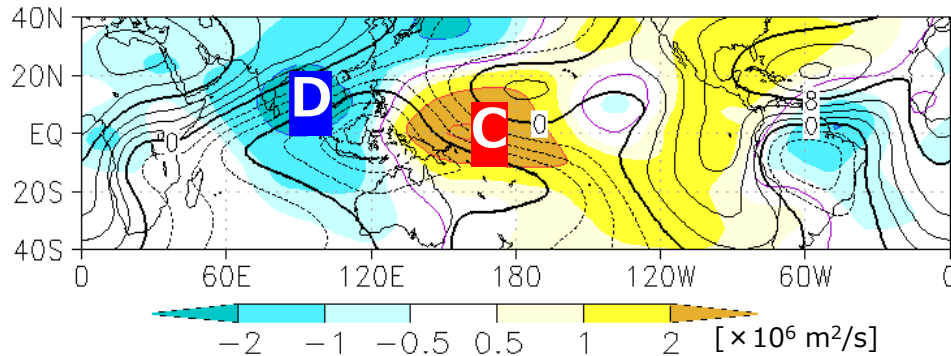
NINO.3-SST index

DJF

-0.5℃

☐ Expected with a probability of 70%

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<DJF 2021/22> Convective activities over the tropics

200 hPa velocity potential (contour) and anomaly(shade)

$[\times 10^6 \ \mathrm{m^2/s}]$

- Convective activities over the tropics are predicted to be enhanced from the Bay of Bengal to around the Philippines, corresponding to the expected SST anomalies in the tropics.
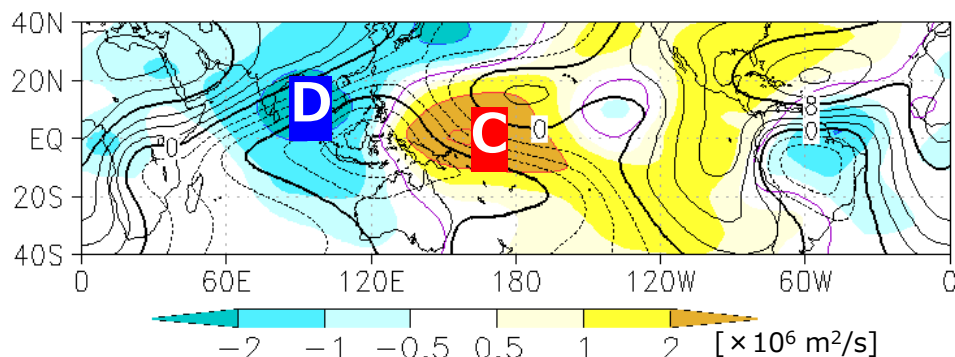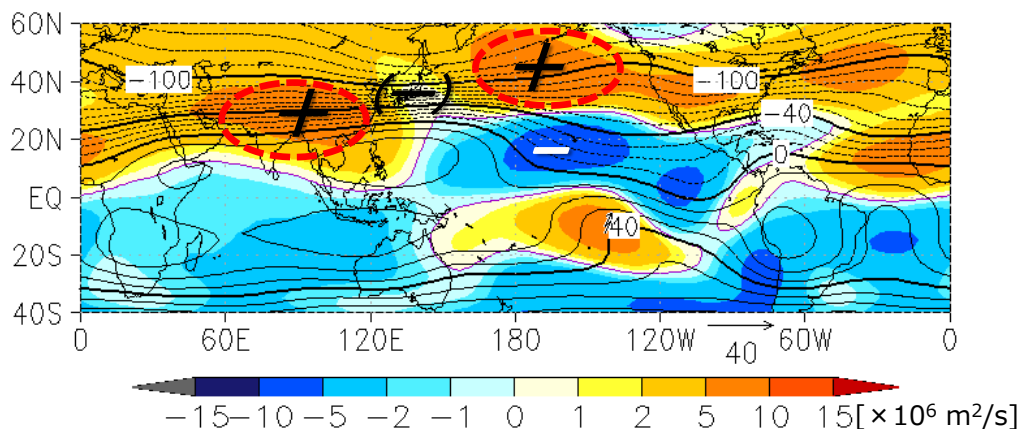
Precipitation (contour) and anomaly(shade)

[mm/day]
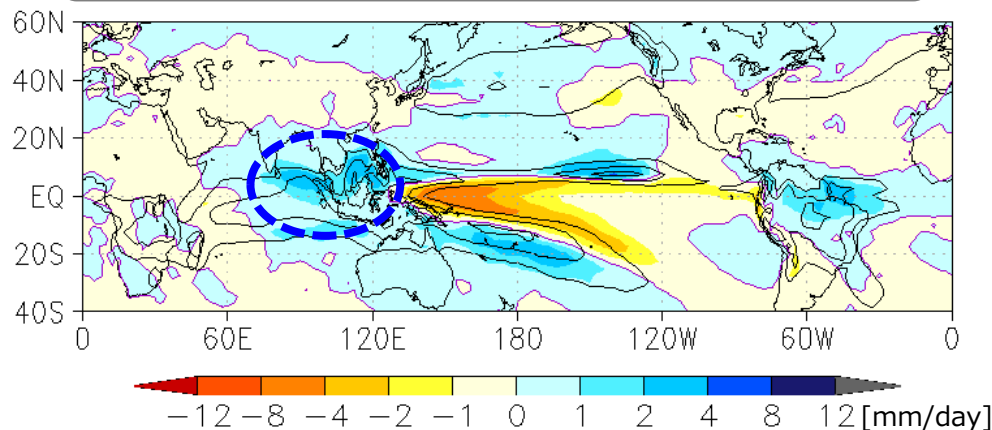
\<DJF 2021/22\> Upper circulation fields

200 hPa velocity potential (contour) and anomaly(shade)

$[\times 10^6 \ m^2/s]$

200 hPa stream function (contour) and anomaly(shade)


$[\times 10^6 \ m^2/s]$

- In association with convection activities over the tropics, upper anti-cyclonic circulation anomalies are predicted over the southern part of China and over the mid-latitude North Pacific, and cyclonic anomalies in between centered over Japan.

  ➤ Suggesting southward meandering of the subtropical jet stream over Japan

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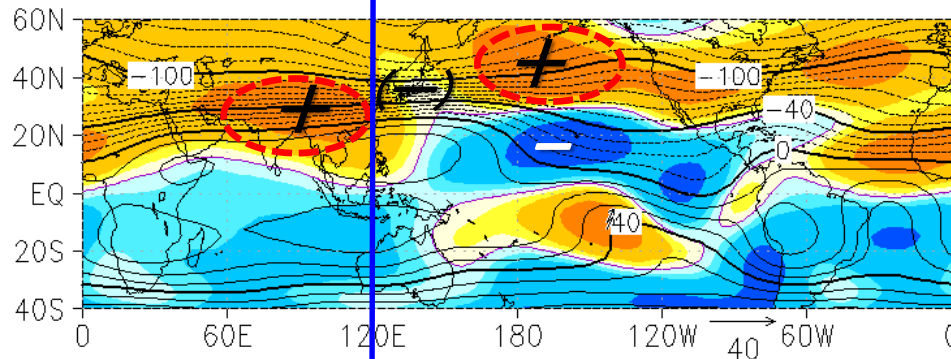Japan Meteorological Agency

Comparison with the ENSO response in the model climate

- The above patterns of upper circulation field are similar to the La Niña-like patterns for model climate.

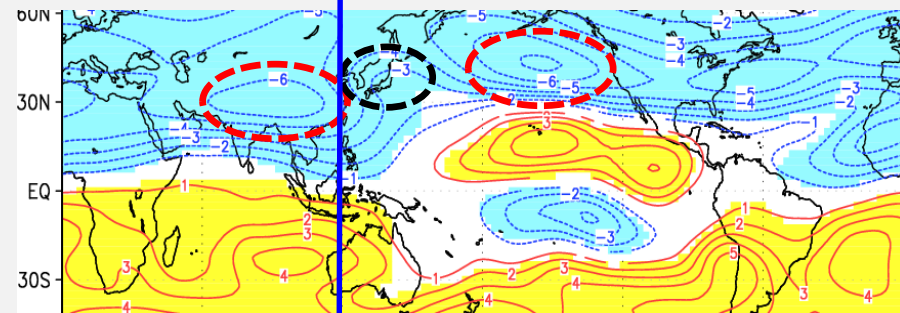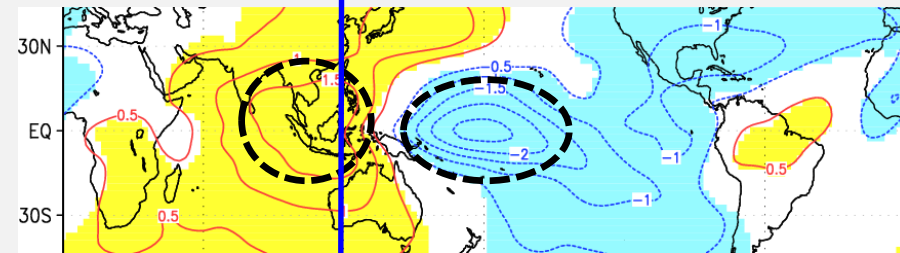**200 hPa velocity potential** (contour) and anomaly(shade)

[×10⁶ m²/s]
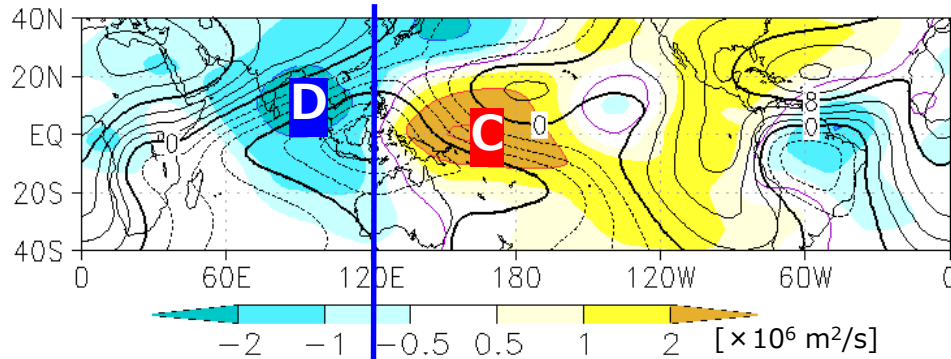
200 hPa stream function (contour) and anomaly(shade)

120ºE

(Model)
Regression coefficient with NINO.3-SST

120ºE

<DJF 2021/22> Northern hemisphere circulation

500 hPa geopotential height (contour) and anomaly(shade)

200 hPa stream function (contour) and anomaly(shade)

- In the 500-hPa height field over high-latitudes, positive anomalies are predicted west of Baikal, and negative anomalies are predicted around Japan, in association with northward and southward meandering of the polar jet stream, respectively.

➤ Predicted negative anomalies around Japan come from southward meanderings of **both the subtropical and the polar jet stream** over the regions.

(Consideration)
Predicted the wave train along the polar jet stream

- The predicted wave train pattern along the polar jet stream from Siberia to around Japan is similar to that seen in the La Niña composite.
- According to the inter-ensemble correlation analysis, the members predicted negative anomalies around Japan tend to southward meanderings of both the subtropical and the polar jet stream over the region.

➤ Considering the above, *although prediction skill is insufficient over the high-latitudes*, wave train along the polar jet stream partially lead the predicted negative anomalies around Japan.

Composite map of 500 hPa geopotential height anomalies for La Niña events
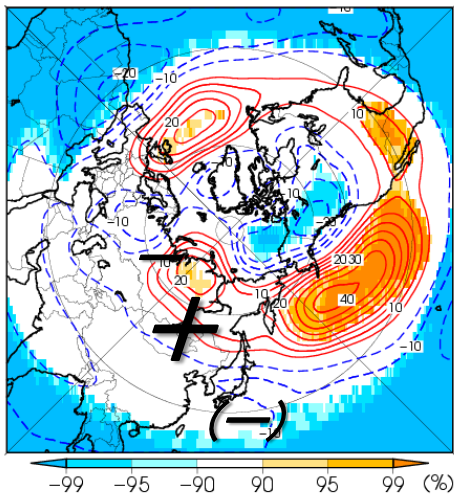
Inter ensemble correlation coefficient of 500 hPa geopotential height between its area-average around Japan (130-140E, 30-45N)
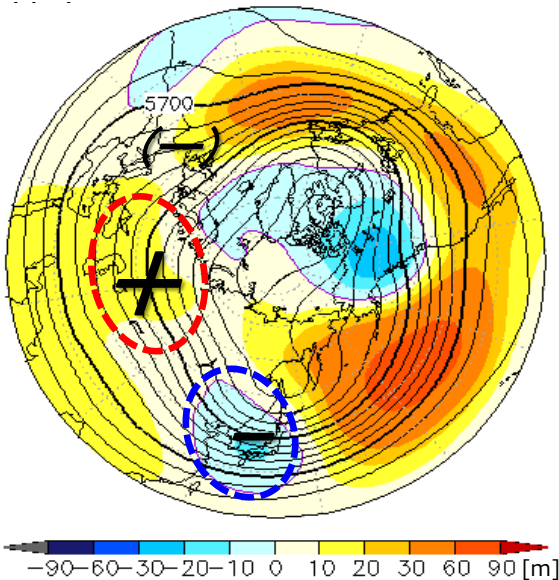

−99 −95 −90 90 95 99 (%)

−0.5 −0.24 0.24 0.5

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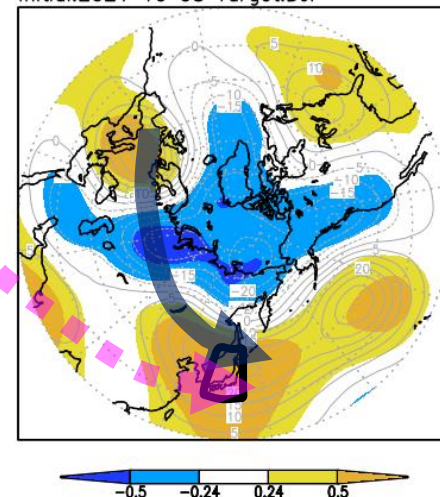
<DJF 2021/22> Focusing on East Asia

- Initial month is **Oct. 2021**.
- Base period for normal is **1991-2020**.

- The Siberian high is predicted to expand southeastward toward the western and southern part of Japan (i.e., western Japan and Okinawa/Amami),which bring stronger than normal winter monsoon over these regions.

- Meanwhile, negative anomalies of sea level pressure (SLP) are predicted over and around northern Japan. The winter monsoon is expected to be near-normal in this region.

500 hPa geopotential height (contour) and anomaly(shade)

Sea level pressure (contour) and anomaly(shade)

850hPa temperature (contour) and anomaly(shade)

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<DJF 2021/22> Focusing on East Asia

500 hPa geopotential height (contour) and anomaly(shade)

Sea level pressure (contour) and anomaly(shade)

850hPa temperature (contour) and anomaly(shade)
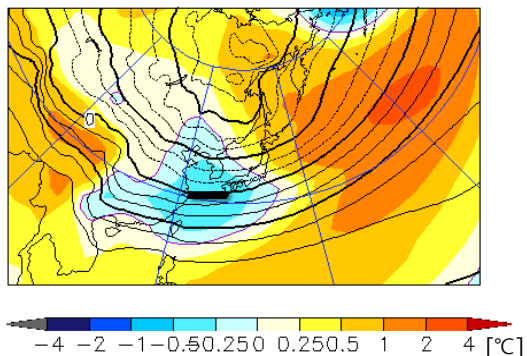
- The Siberian high is predicted to expand southeastward toward the western and southern part of Japan (i.e., western Japan and Okinawa/Amami),which bring cold air in these regions.

  (These tendencies are consistent with the La Niña composite)

- Meanwhile, negative anomalies of sea level pressure (SLP) are predicted over and around northern Japan. The winter monsoon is expected to be near-normal in this region.
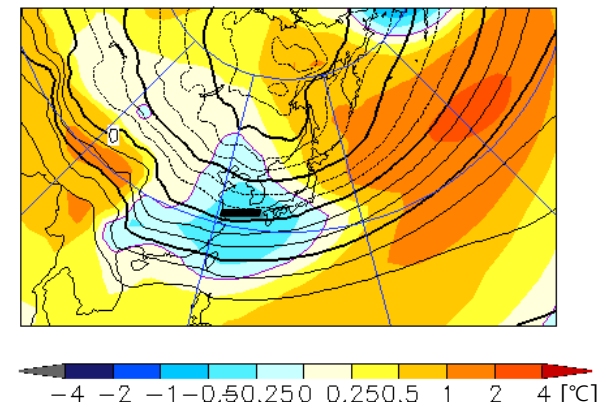
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Expected atmospheric circulation and ocean conditions for winter 2021/22

Globally warm troposphere

180°

Siberian high
- More expansion toward southeastward
- Bring stronger winter monsoon across western and southern Japan

Climatological location

More active
Low pressure systems

Climatological location

Subtropical Jet Stream
- **S**hift northward over the Asian continent
- Shift southward over Japan

More active convections

EQ.

Warmer SSTs

Colder SSTs

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The 9TH EASCOF, 4 November 2021, Seoul, Republic of Korea (Online)

Conclusion (JMA's cold season outlook)

		Temperature			Precipitation		
	Category	−	0	+	−	0	+
Northern Japan	Sea of Japan side	30	30	**40**	30	30	**40**
Northern Japan	Pacific side				30	30	**40**
Eastern Japan	Sea of Japan side	**40**	30	30	30	30	**40**
Eastern Japan	Pacific side				40	30	**30**
Western Japan	Sea of Japan side	**40**	**40**	20	20	40	**40**
Western Japan	Pacific side				40	40	**20**
Okinawa/Amami		**40**	**40**	20	40	**40**	20

− : Below normal
0 : Near normal
+ : above normal)
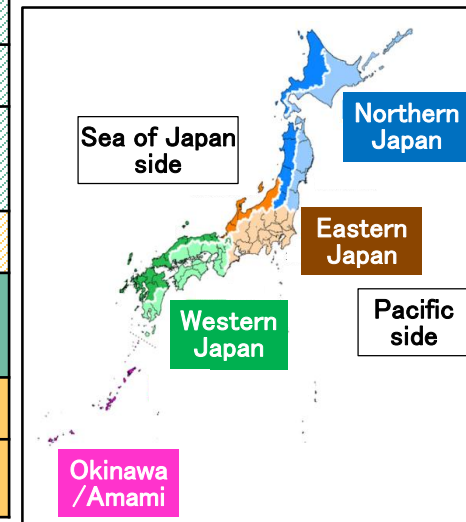
- In western Japan and Okinawa/Amami, colder than normal conditions are expected, in consideration of stronger than normal winter monsoon. In eastern Japan, these tendencies are slightly expected.

- In northern Japan, slightly wetter-than-normal conditions are expected, because of more frequent passage of low pressure systems in the vicinity.

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Thank you

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