Seasonal Outlook for winter 2016/17 over Japan

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Outline

- Numerical prediction
- Cold season forecast in Japan

In this presentation,

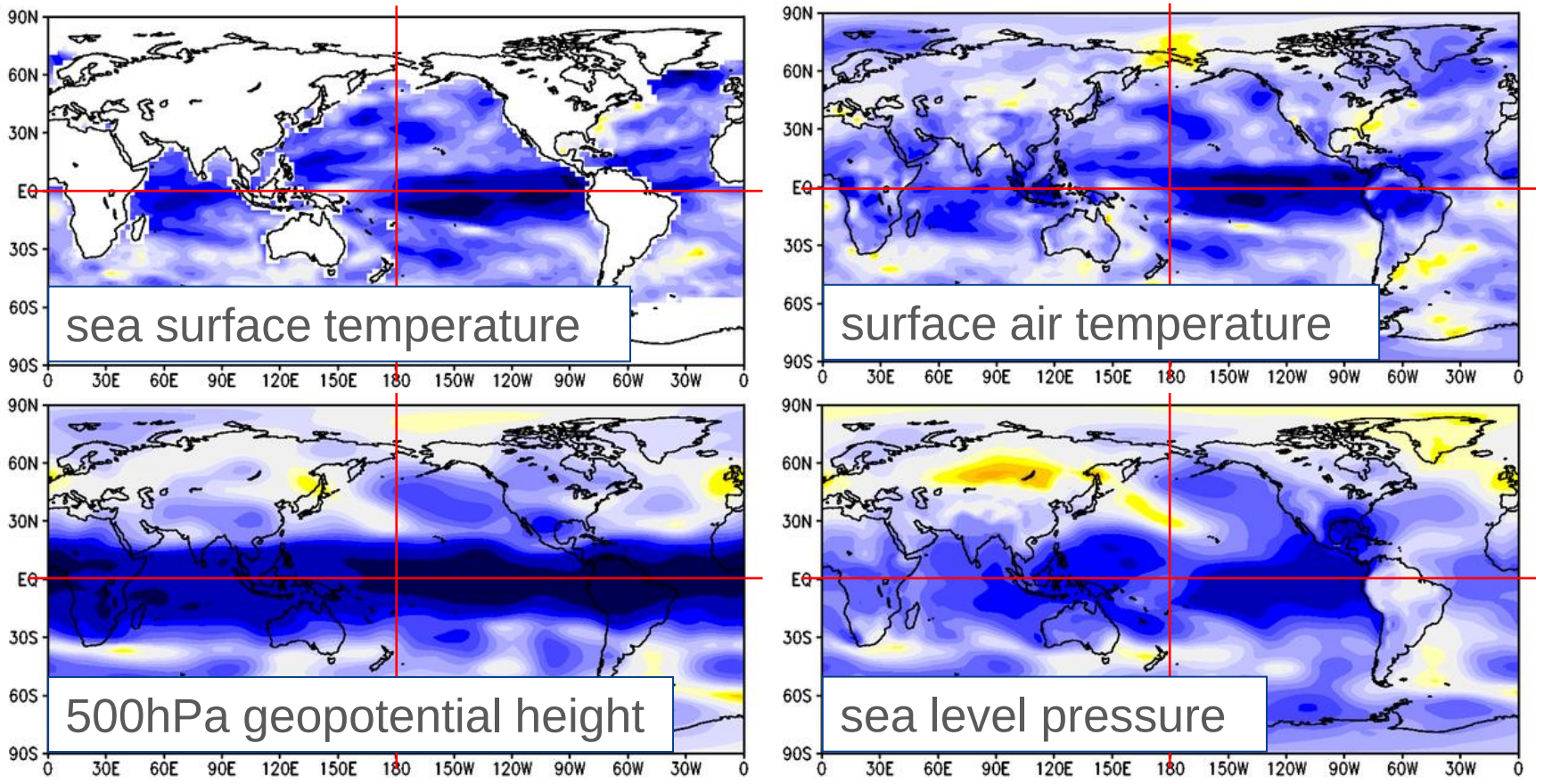
* Base period for normal is 1981-2010.
* Atmospheric analysis data are JRA-55.
* SST data are COBE-SST and OLR data are provided by NOAA.

Numerical prediction

Numerical Prediction Reliability

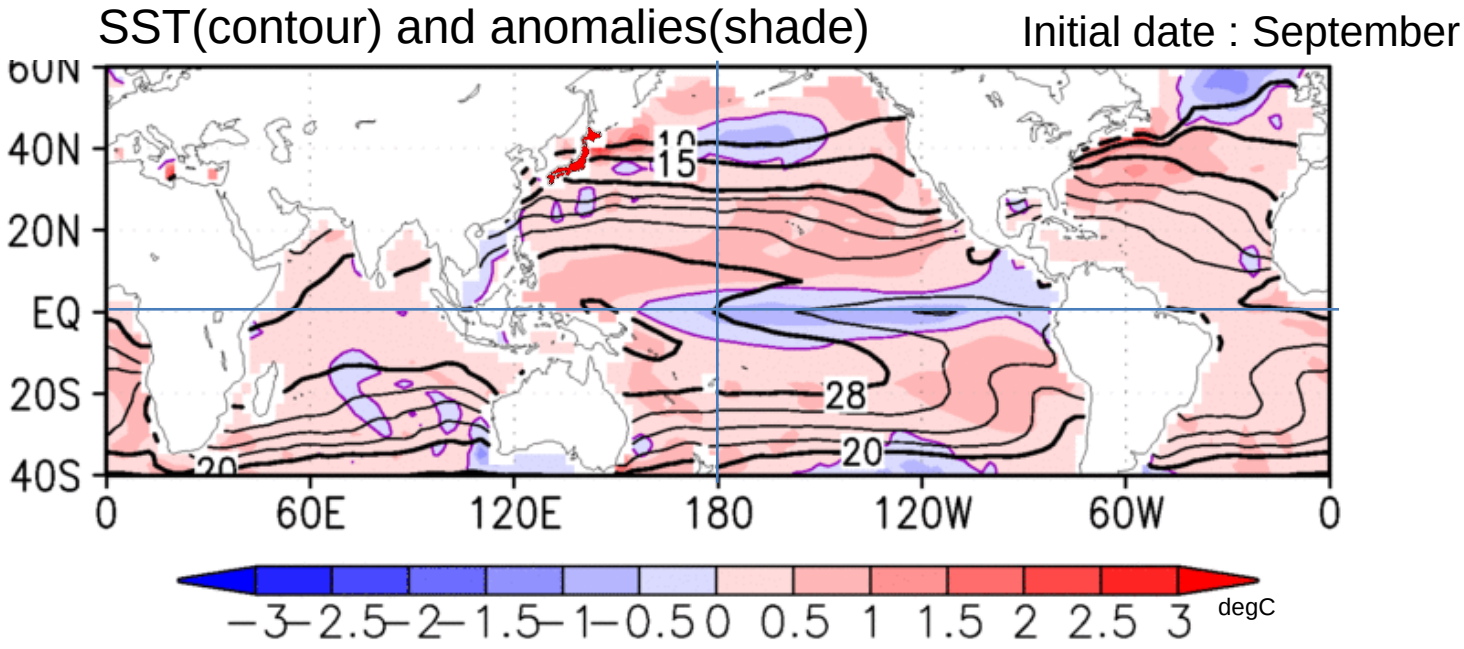
Anomaly Correlation for DJF initial : Sep.

Our seasonal forecasts are mainly based on the signals from the tropical regions due to the high predictability. Predicted characteristics in mid-high latitudes are reliable when they are understood as the response of those in low-latitudes.

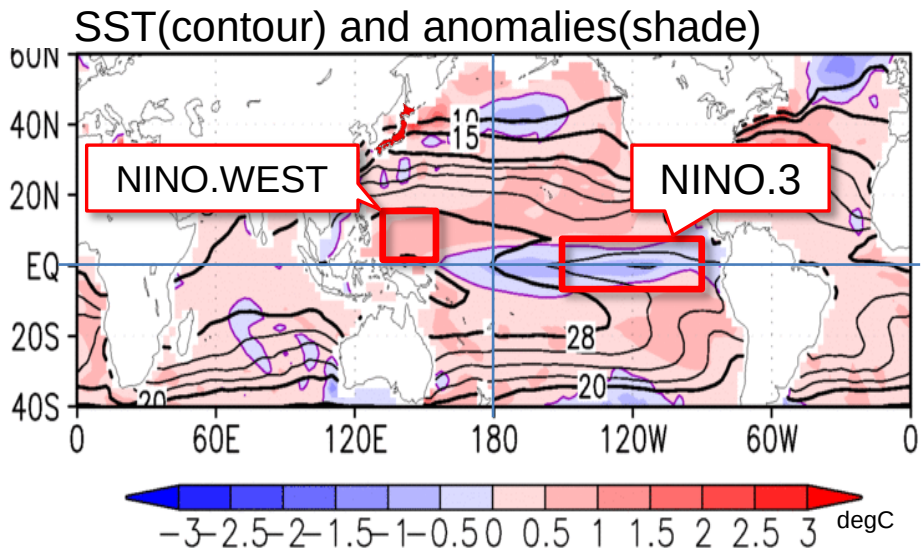


Oceanic conditions in DJF 2016/17

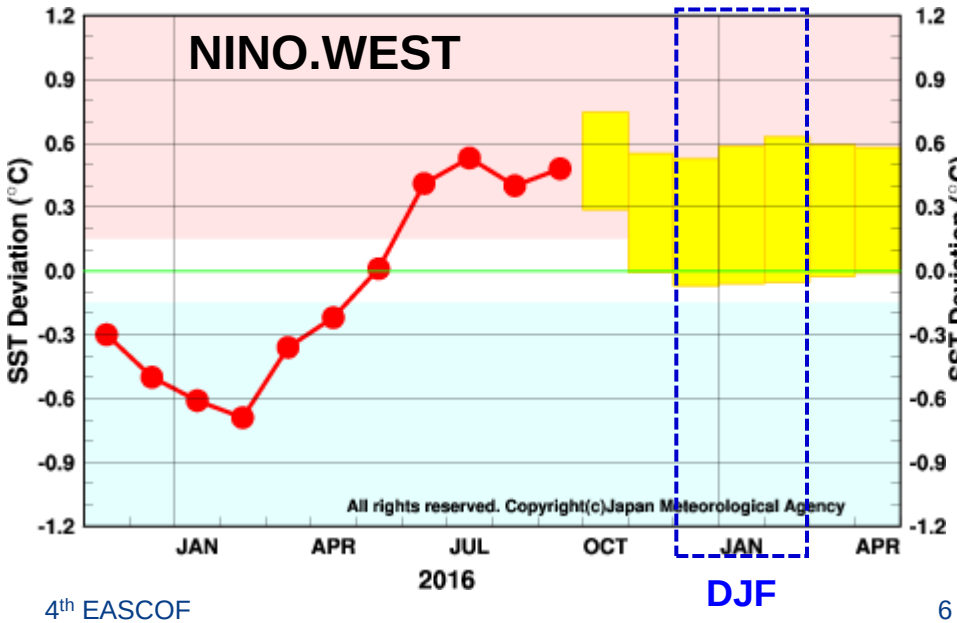
In the equatorial Pacific, negative SST anomalies are expected from the central to eastern parts, and positive anomalies are expected in the western part.

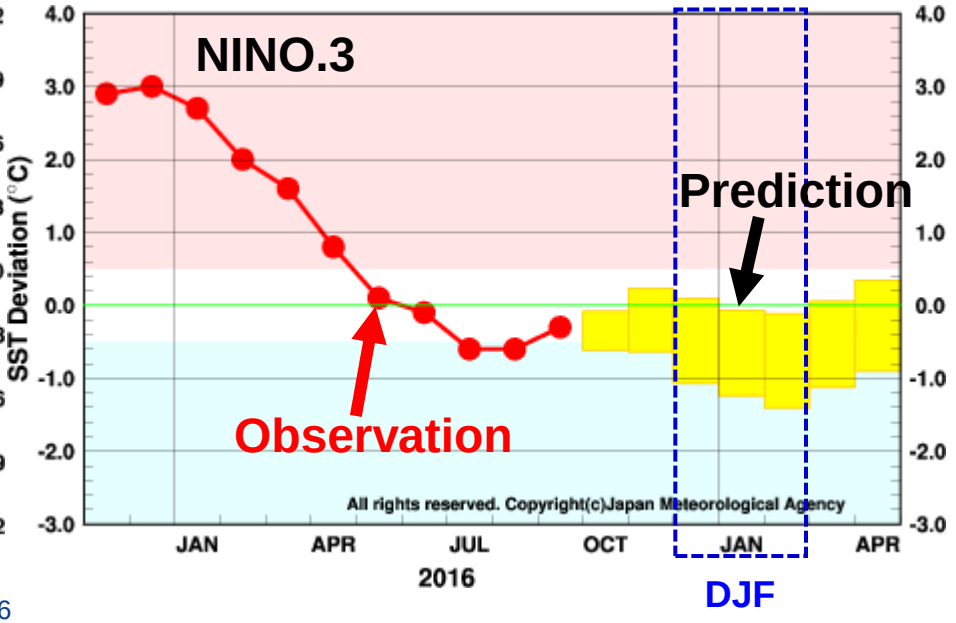


Oceanic conditions in DJF 2016/17



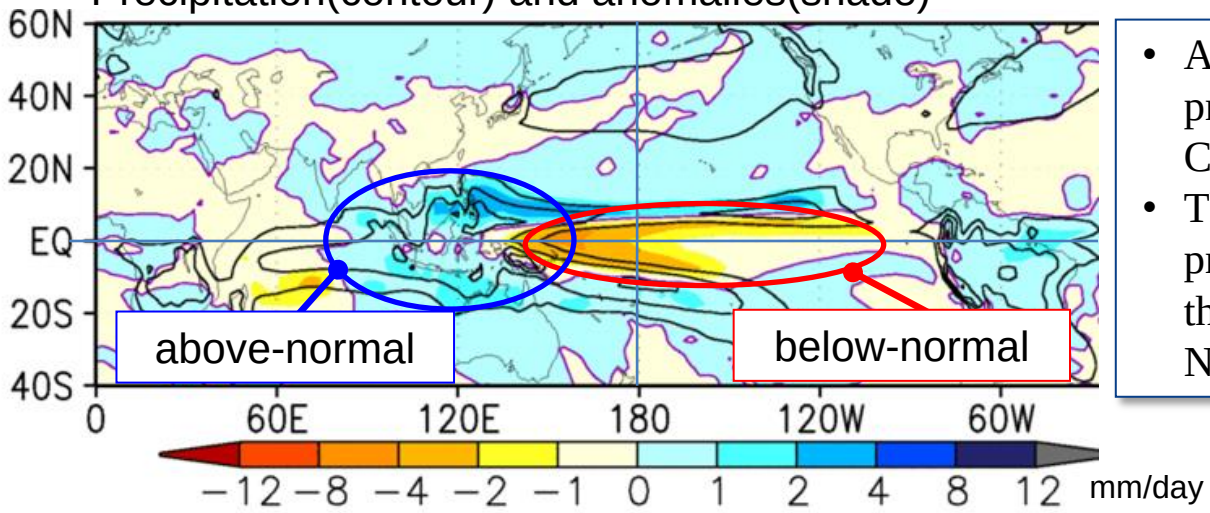
- JMA's CGCM predicts that the NINO.3 Sea Surface Temperature (SST) will be near or below normal and the area-averaged SST in the tropical western Pacific (NINO.WEST) will be above normal this winter.
- It is likely that La Niña conditions will persist (60%).





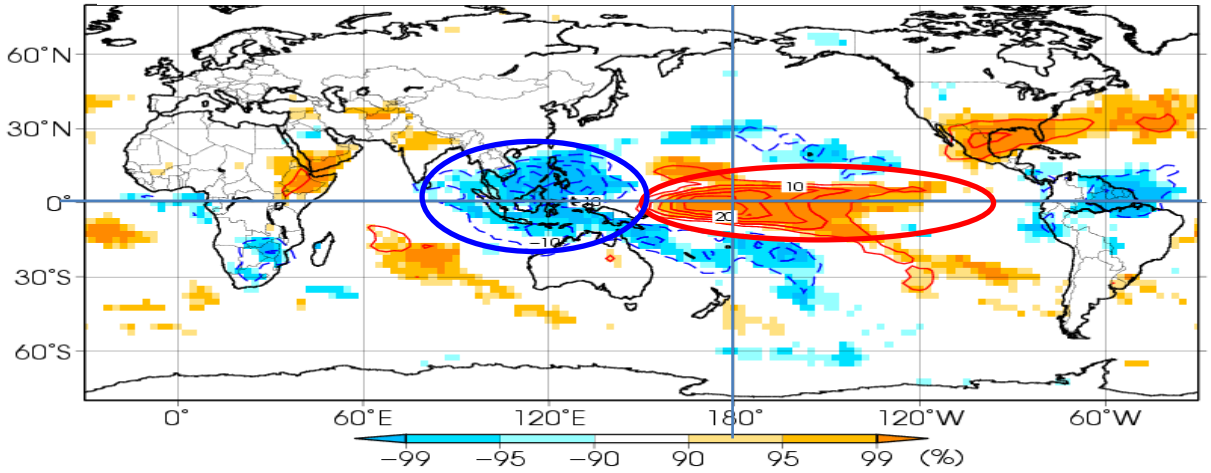
Global Circulation in DJF 2016/17

Precipitation(contour) and anomalies(shade)



- Above-normal precipitation is predicted over the Maritime Continent.
- The predicted pattern of precipitation anomalies resembles those observed during the past La Niña events.

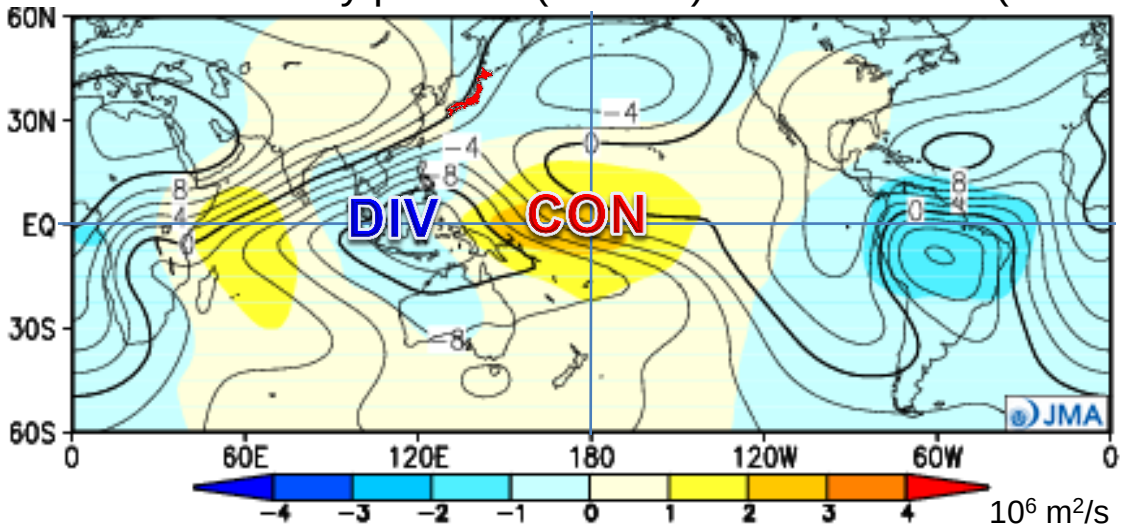
Composite map of OLR anomalies for La Niña events



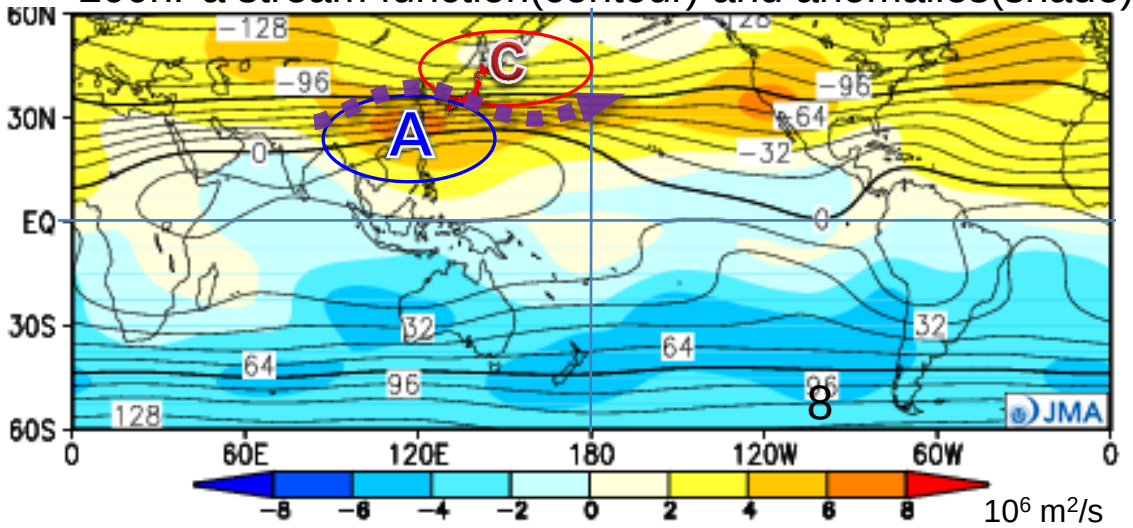
Contours : anomalies at intervals of 5 W/m^2.
Shading : the confidence level.
The base period for composite analysis is 1979 - 2012, while that for the three-month means of November-December-January and December-January-February is 1979/80 - 2012/13.

Global Circulation in DJF 2016/17

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



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



In the 200-hPa velocity potential field,

- divergence anomalies(**DIV**) are predicted over the Maritime Continent.
- convergence anomalies(**CON**) are predicted over the western to central Pacific.

In the 200-hPa stream function field,

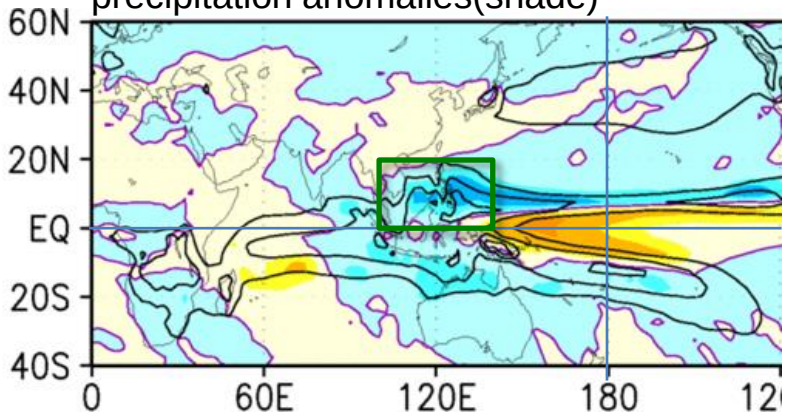
- anticyclonic circulation anomalies(**A**) are predicted over southern China in response to the divergence anomalies over the Maritime Continent.
- the relative cyclonic anomalies(**C**) are predicted around northern Japan, the northeastern side of **A**.
- these **A** and **C** patterns indicate that the subtropical jet stream will shift northward over the Asian continent and shift southward over the sea east of Japan.

Evaluation of the tropical convection and its effect to the mid-high latitude

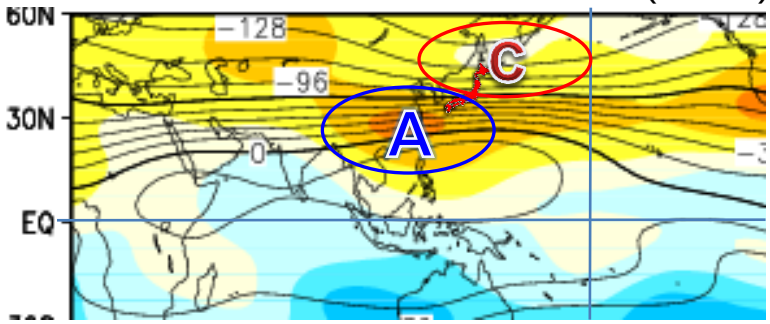
Positive precipitation anomalies over the Maritime Continent (▭) cause the anticyclonic circulation anomalies over southern China and the cyclonic circulation anomalies in and around northern Japan.

Prediction

precipitation anomalies(shade)

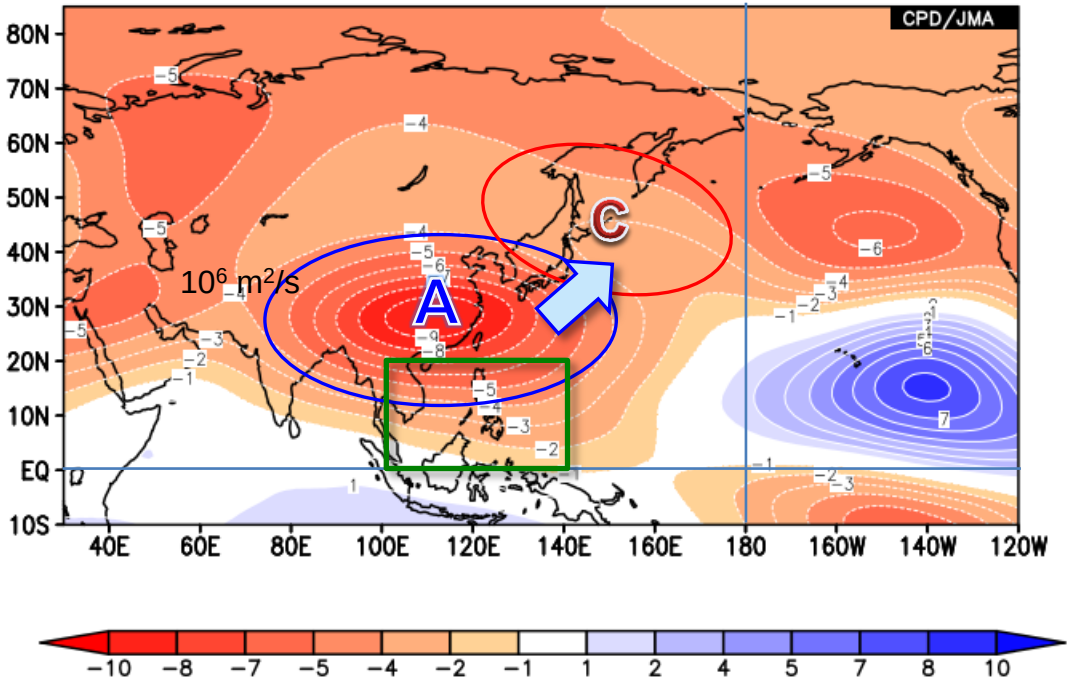


200hPa stream function anomalies(shade)



Analysis(JRA-55)

Regression coefficient
between OLR anomalies(100-140E,0-20N) and
200hPa stream function anomalies（DJF : 1980/81-2015/16 ）

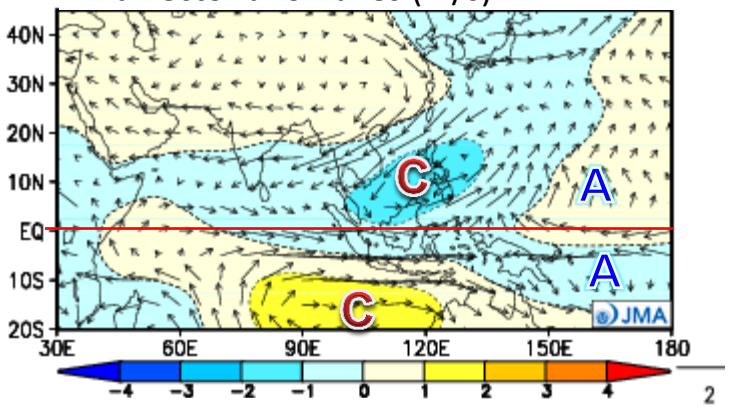


shade : regression coefficients

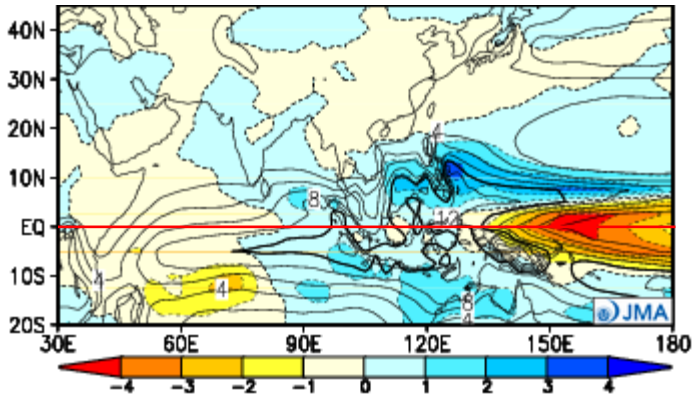
Asian Monsoon Circulation in DJF 2016/17

- The cyclonic circulation anomalies are predicted mainly over the South China Sea in response to the active convection(the Mastuno-Gill Pattern).
- The northeast monsoon will be stronger than normal along the northern edge of the cyclonic circulation anomalies, which will bring colder air from the continent to South East Asia including southern Japan.

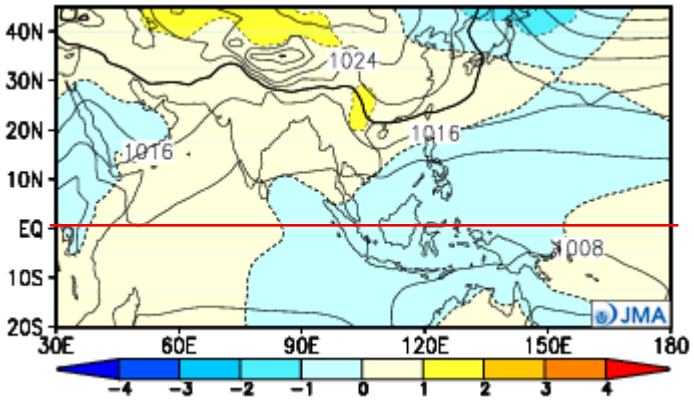
850-hPa stream function (10^6 m^2/s)
wind vector anomalies (m/s)



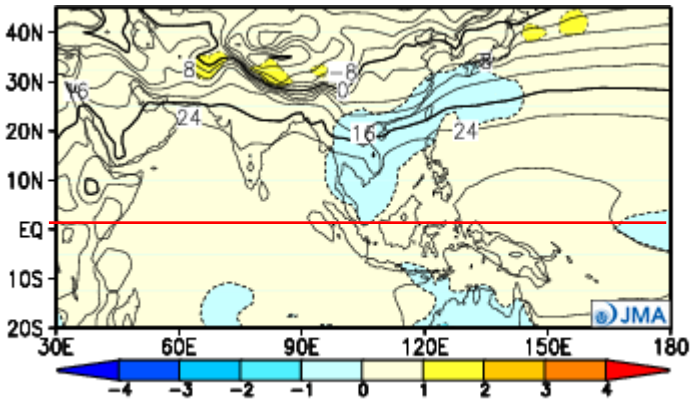
rainfall amounts (mm/day)



sea level pressure (hPa)

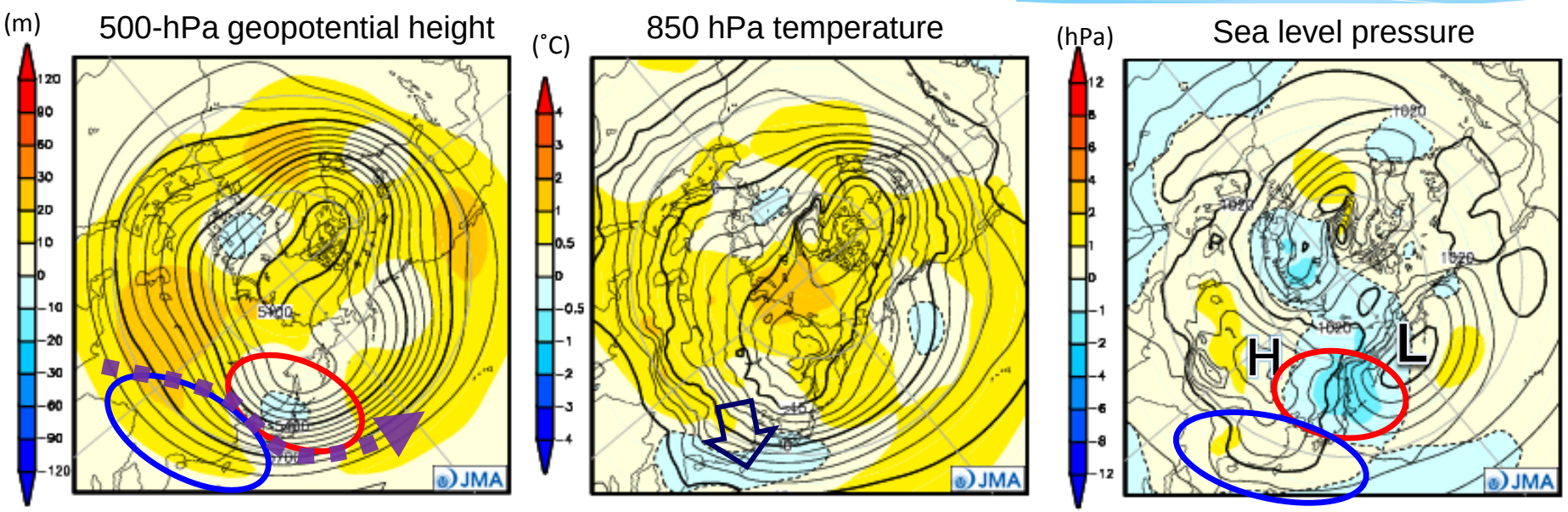


surface air temperature (˚C)



Contour: three-month average; Shading: anomalies. A and C indicate the centers of anti-cyclonic and cyclonic circulation anomalies, respectively.

Northern Hemisphere circulation in DJF 2016/17

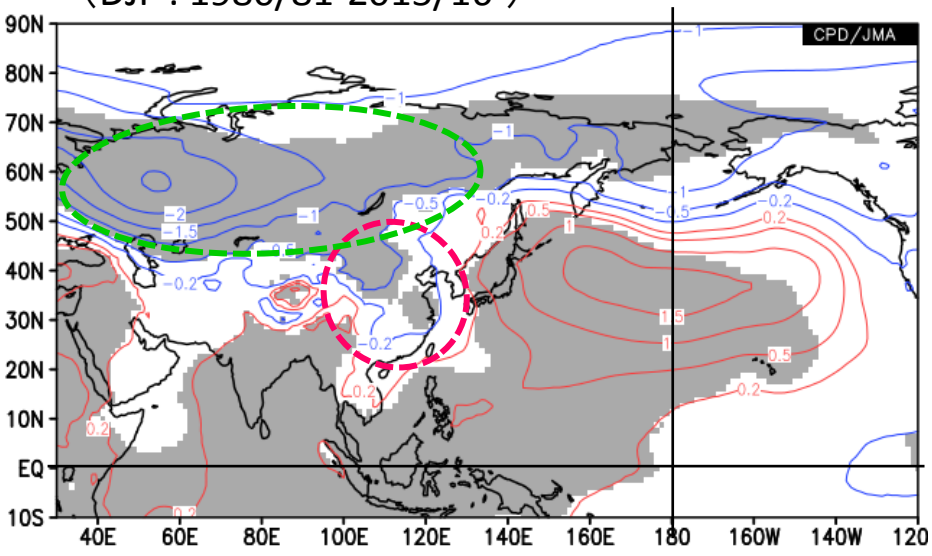


- In the 500-hPa height field, positive and negative anomalies are predicted in southern East Asia and in and around northern Japan respectively in response to the active convection over the Maritime Continent.
- In the 850-hPa temperature field, negative anomalies are predicted for parts of southern East Asia.
- In the sea level pressure field, negative anomalies are predicted in and around northern Japan. Positive anomalies are predicted over the southern eastern part of the Siberian High. Positive anomalies are also predicted over the central part of the Siberian High, but the prediction reliability of the model is relatively low for this area.

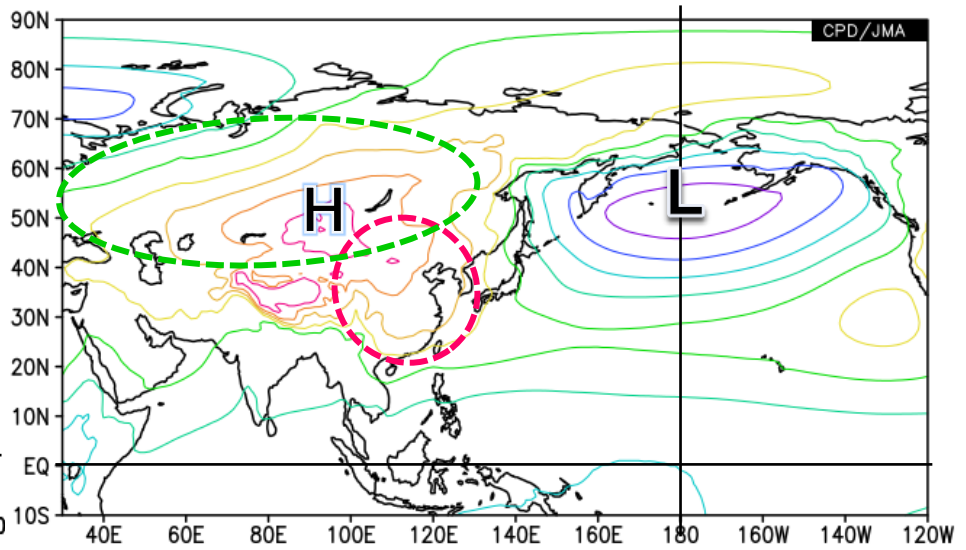
Siberian High
based on the climatological statistics

- There is a statistically significant correlation between Japan's temperature and the strength of the Siberian High.
- The statistically significant area of the Siberian High are divided into two parts, mainly northwestern part and southeastern part.

Regression coefficient
between Western Japan temp. and SLP
（DJF : 1980/81-2015/16 ）



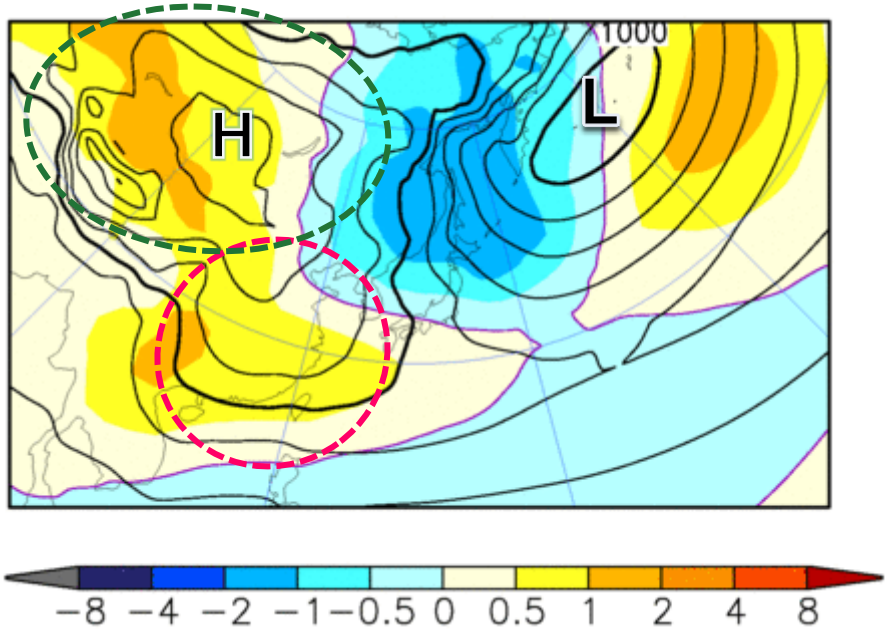
SLP for DJF（normal: the 1981-2010 average）



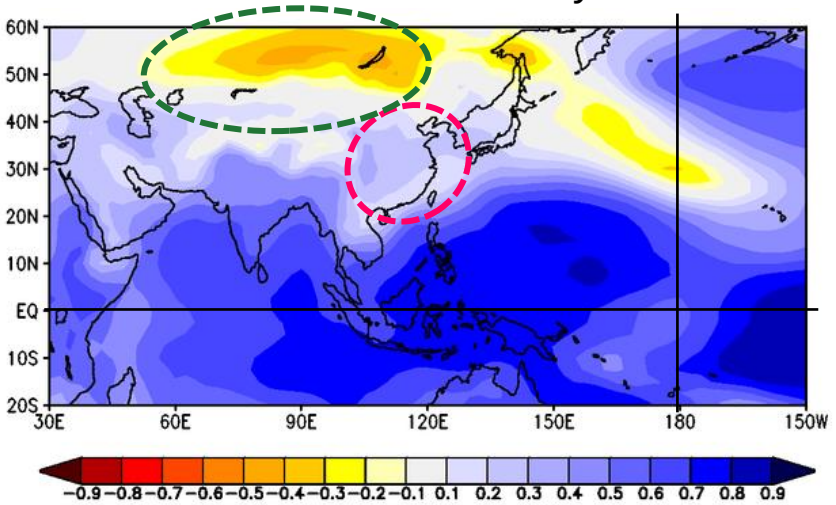
Interpretation of the predicted Siberian High

The Siberian High will be stronger in the southeastern part, but there is no signal in the other area, considering its predictability.

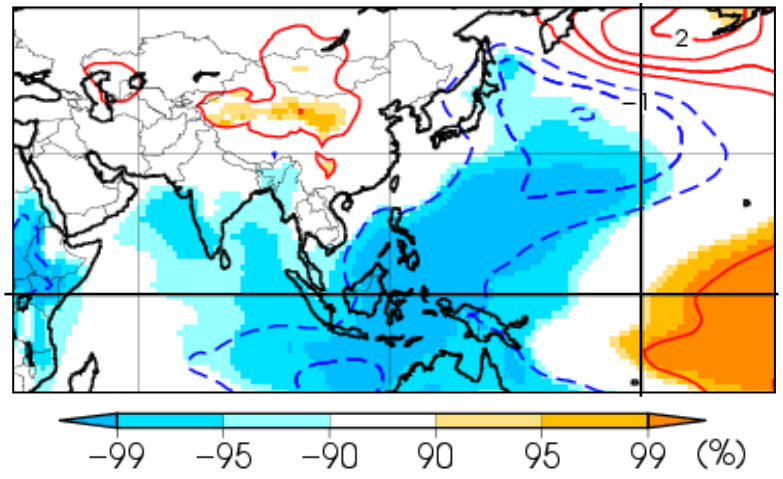
Sea level pressure



Prediction accuracy

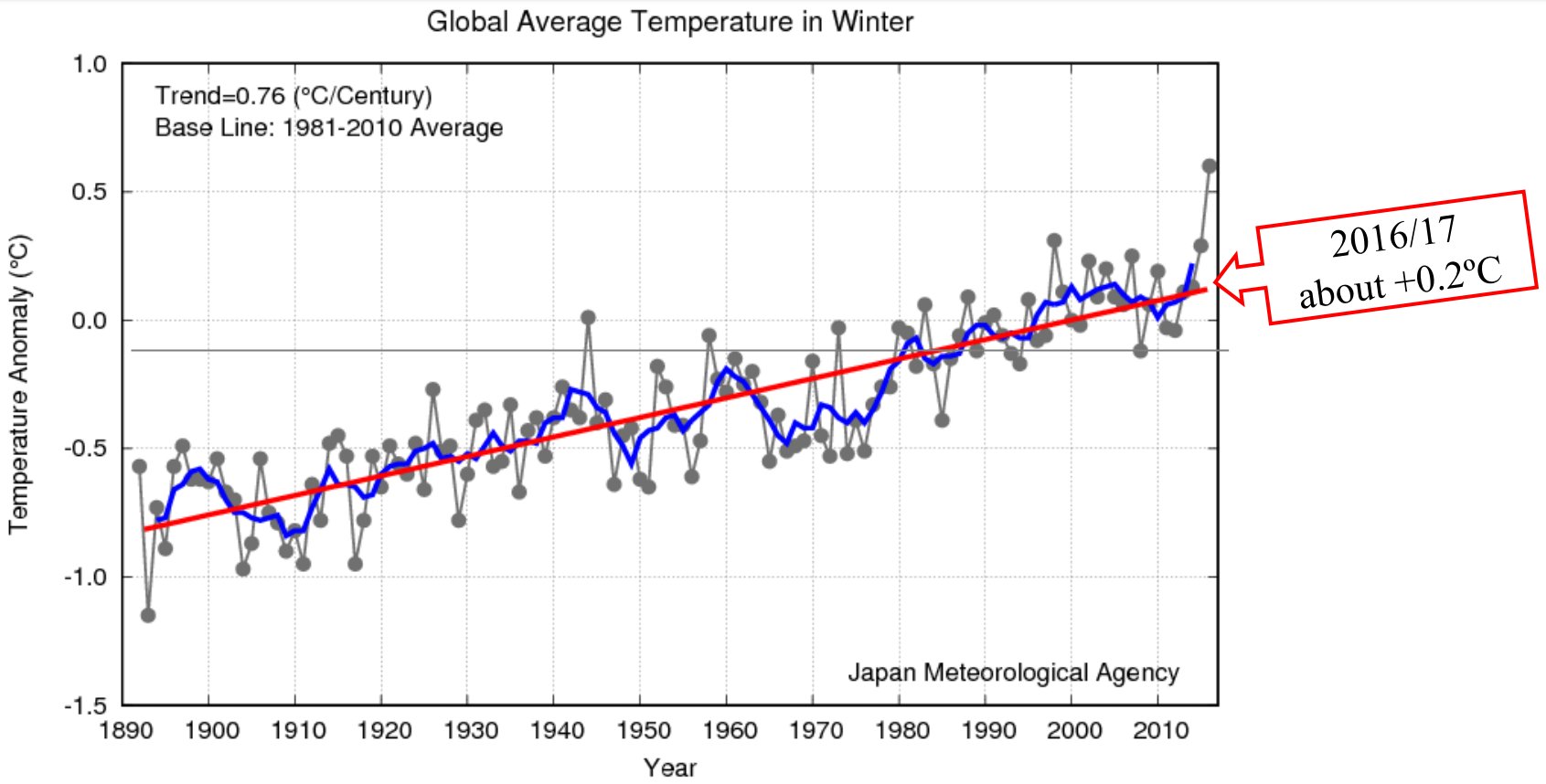


Composite map of SLP anomalies for La Niña events



Recent warming trend in winter

On a longer time scale, the global average temperatures in winter have risen at a rate of about 0.76ºC per century. If we apply this trend to the coming winter, it will be about +0.2ºC above the baseline (1981-2010).

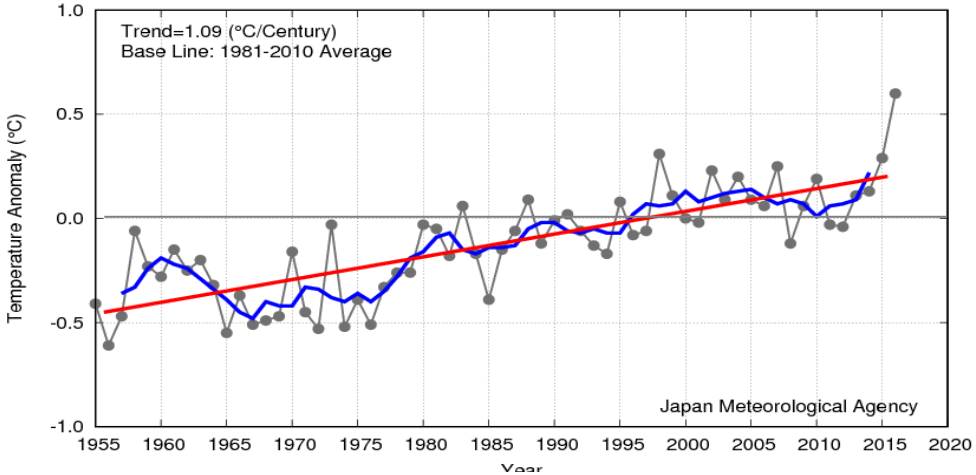


Anomalies are deviation from baseline (1981-2010 Average).
The black thin line indicates surface temperature anomaly of each year.
The blue line indicates their 5-year running mean.
The red line indicates the long-term linear trend.

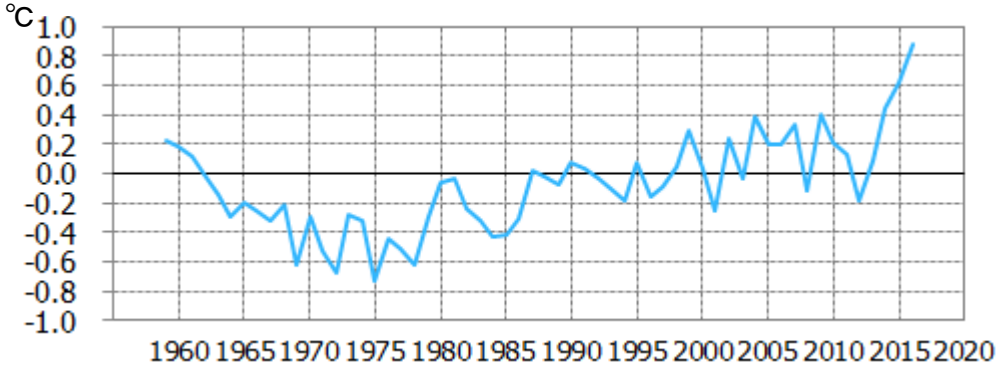
Tropospheric temperature in DJF 2016/17

- There is a statistically significant positive correlation between the global average surface temperature and the tropospheric thickness temperature of the Northern Hemisphere.
- The tropospheric thickness temperature is predicted to be above normal this winter.

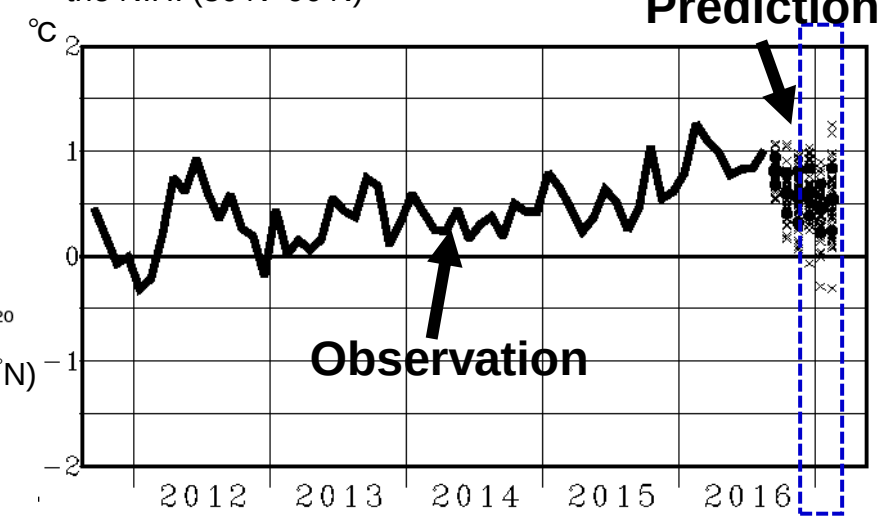
Global Average Temperature in Winter



Tropospheric thickness temp.(300-850hPa) of the N.H. (30˚N–90˚N) in Winter



Predicted Tropospheric thickness temp.(300-850hPa) of the N.H. (30˚N–90˚N)



Black line : observed anomalies

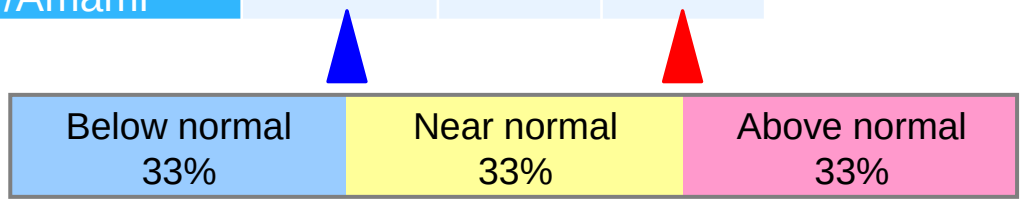
Black dots(center) : predictions (ensemble mean)

x : predictions (51 ensemble member)

Effect of the recent warming trend

This warmer tropospheric temperature is likely to decrease probabilities of below normal temperatures.

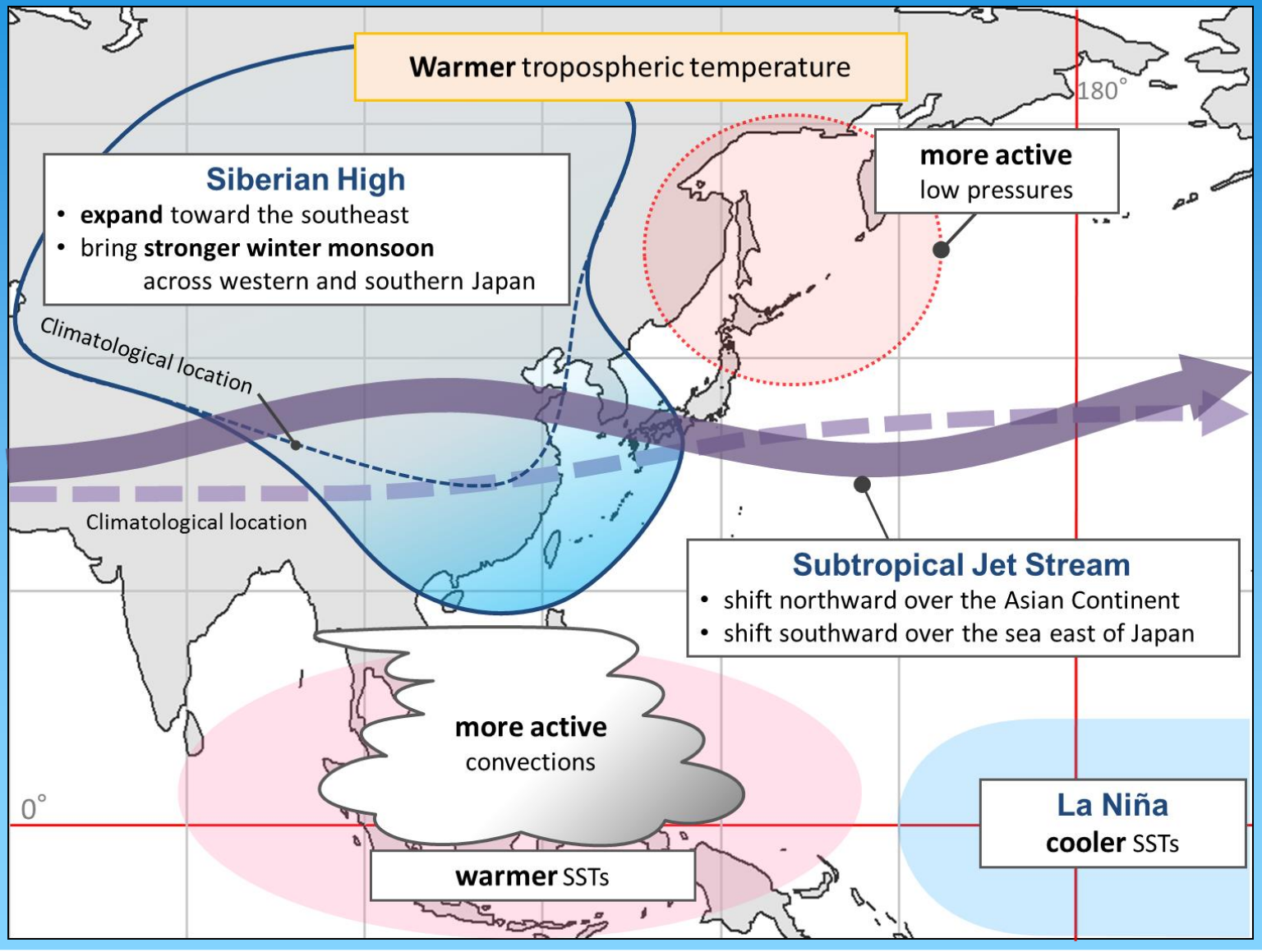
3-month mean temp. anomaly (DJF) range of "near normal" (ºC)			
Northern Japan	-0.3	~	0.4
Eastern Japan	-0.1	~	0.4
Western Japan	-0.1	~	0.5
Okinawa /Amami	-0.1	~	0.2



Climatology

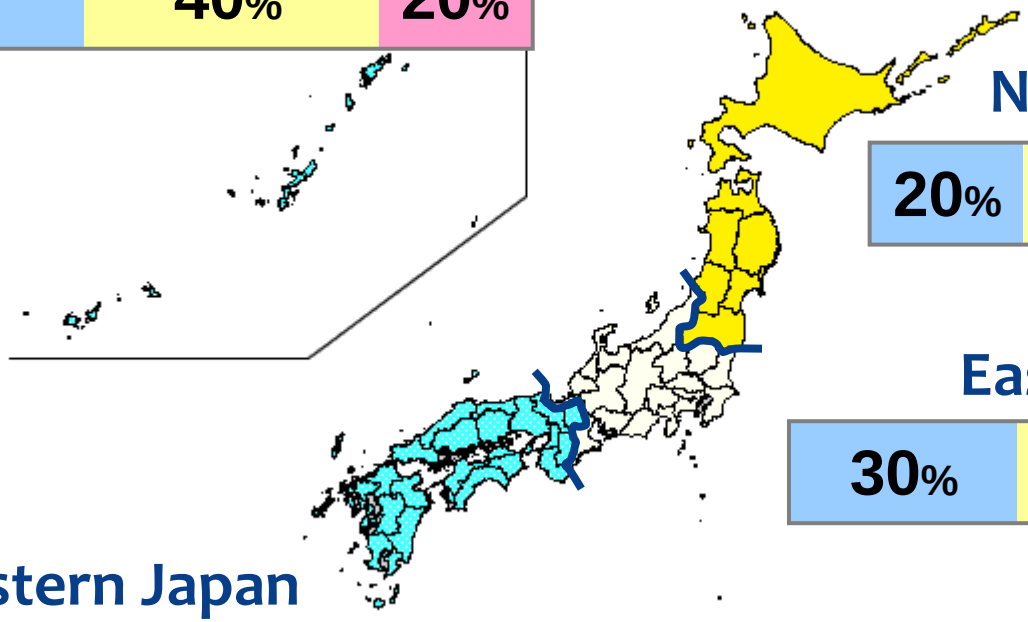
- Forecasts are given in the three categories of below normal, near normal and above normal. .
- The thresholds of each category are determined so that the climatological chance of occurrence for each category is 33.3% for the period from 1981 to 2010.

Conceptual diagram for East Asian circulation in DJF 2016/17



Cold season forecast in Japan

Seasonal mean temperature for DJF 2016/17 in Japan



Okinawa/Amami

40%	40%	20%

Northern Japan

20%	40%	40%

Eastern Japan

30%	40%	30%

Western Japan

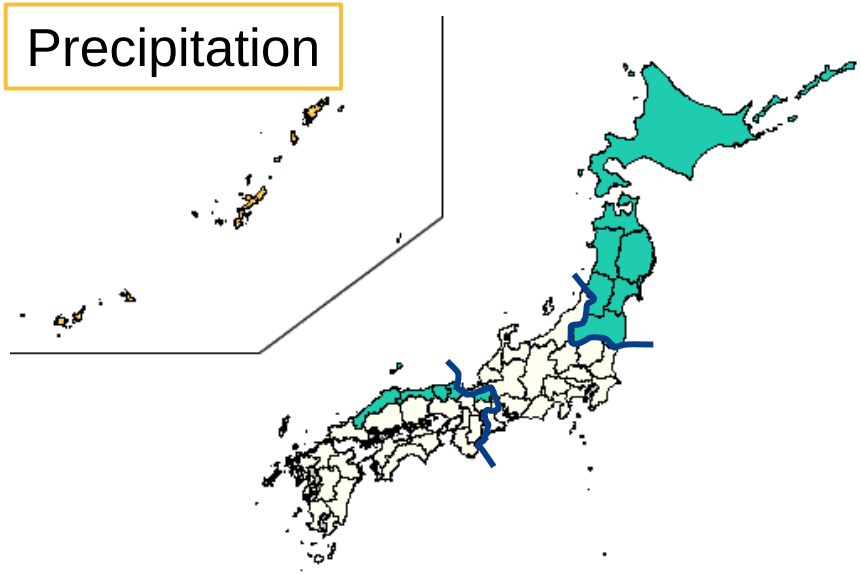
40%	40%	20%

Climatology

Below normal 33%	Near normal 33%	Above normal 33%

Seasonal precipitation/snowfall for DJF 2016/17 in Japan

Precipitation



Northern Japan

20%	40%	40%

Sea of Japan side of Western Japan

20%	40%	40%

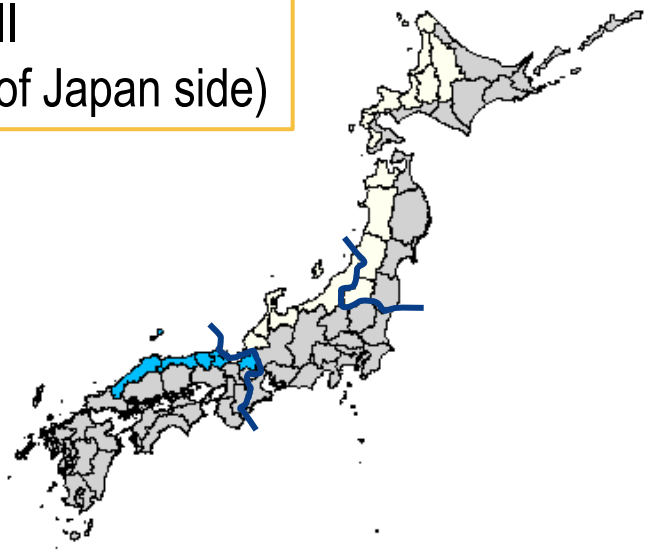
Okinawa/Amami

40%	40%	20%

Eastern Japan/Pacific side of Western Japan

30%	40%	30%

Snowfall
(the Sea of Japan side)



Western Japan

20%	40%	40%

Northern/Eastern Japan

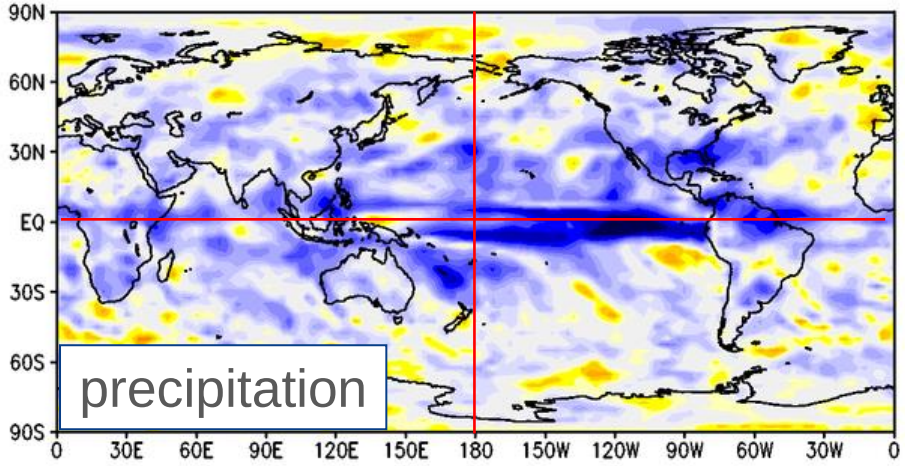
30%	40%	30%

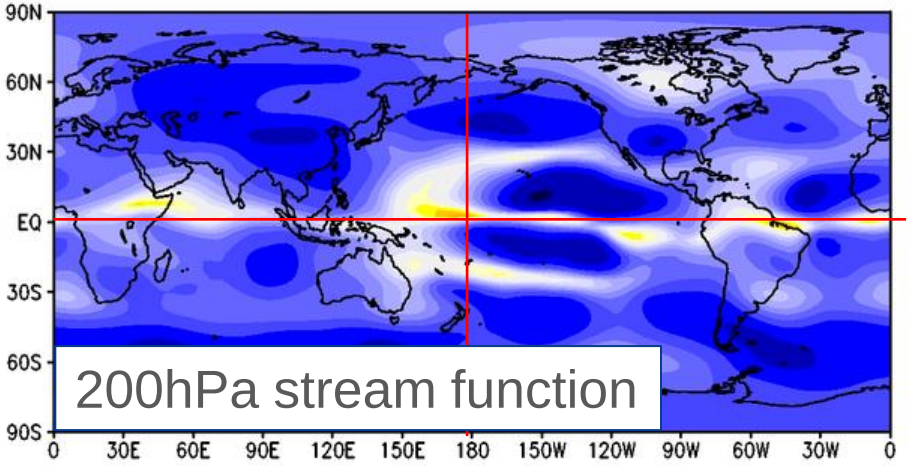
Thank you

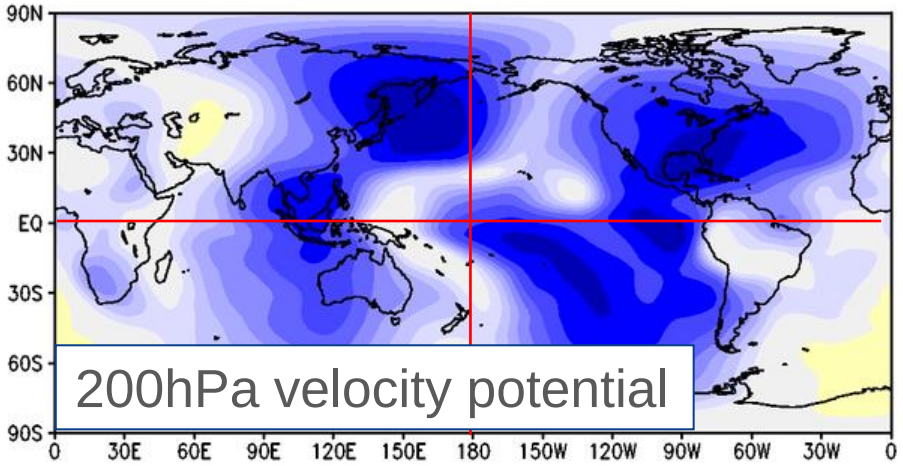
Backup

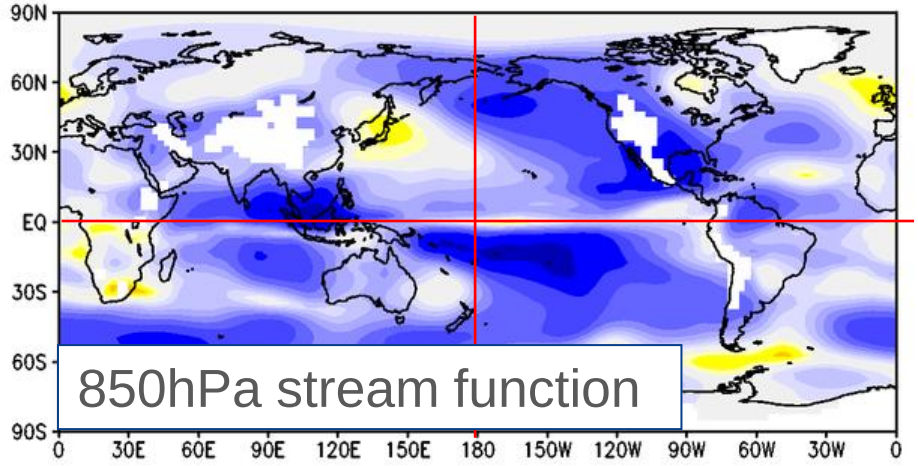
Numerical Prediction Reliability

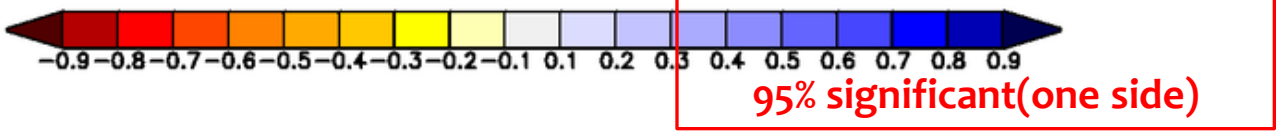
Anomaly Correlation for DJF initial : Sep.





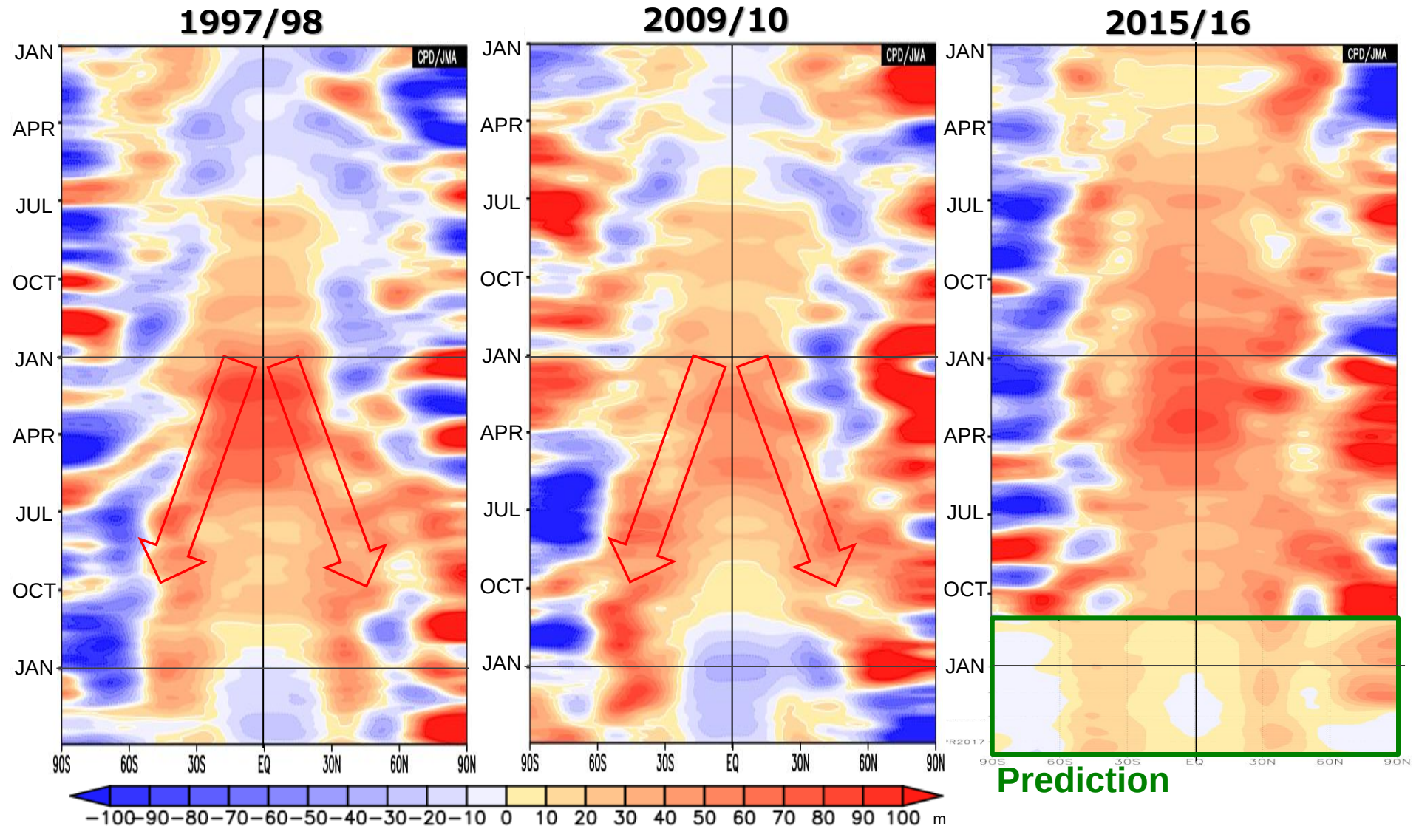






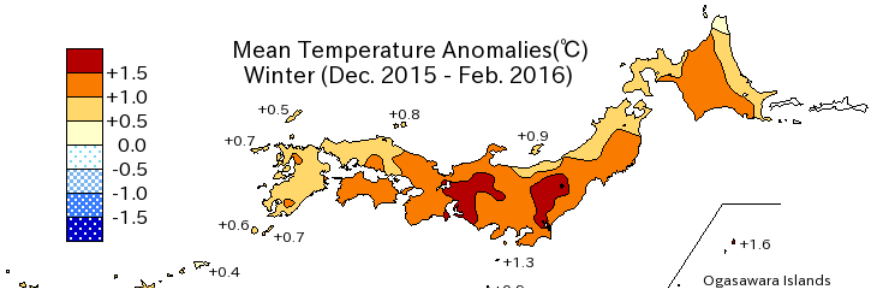
In Post-El Niño, High-temperature range is spread to higher latitudes from lower latitude

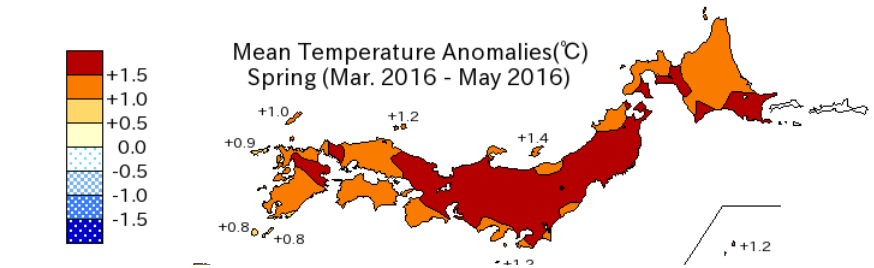
200hPa zonal mean geopotential height anomaly

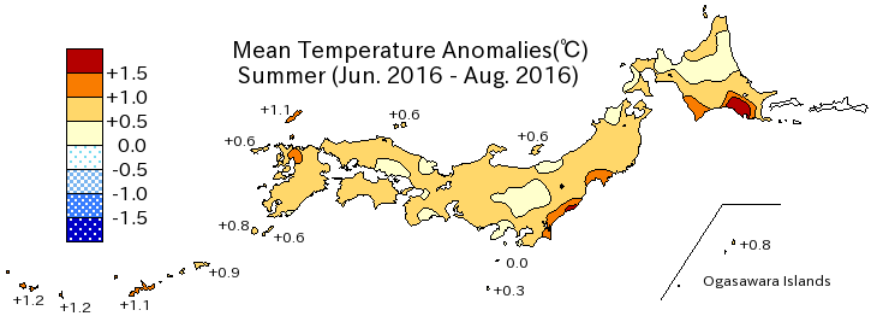


Seasonal mean temperatures in Japan this year

The warmer tropospheric temperature seems to favor the higher seasonal mean temperatures in Japan. This summer, seasonal mean temperature was the highest on record since 1946 in Okinawa/Amami.







Seasonal mean temperature in Japan

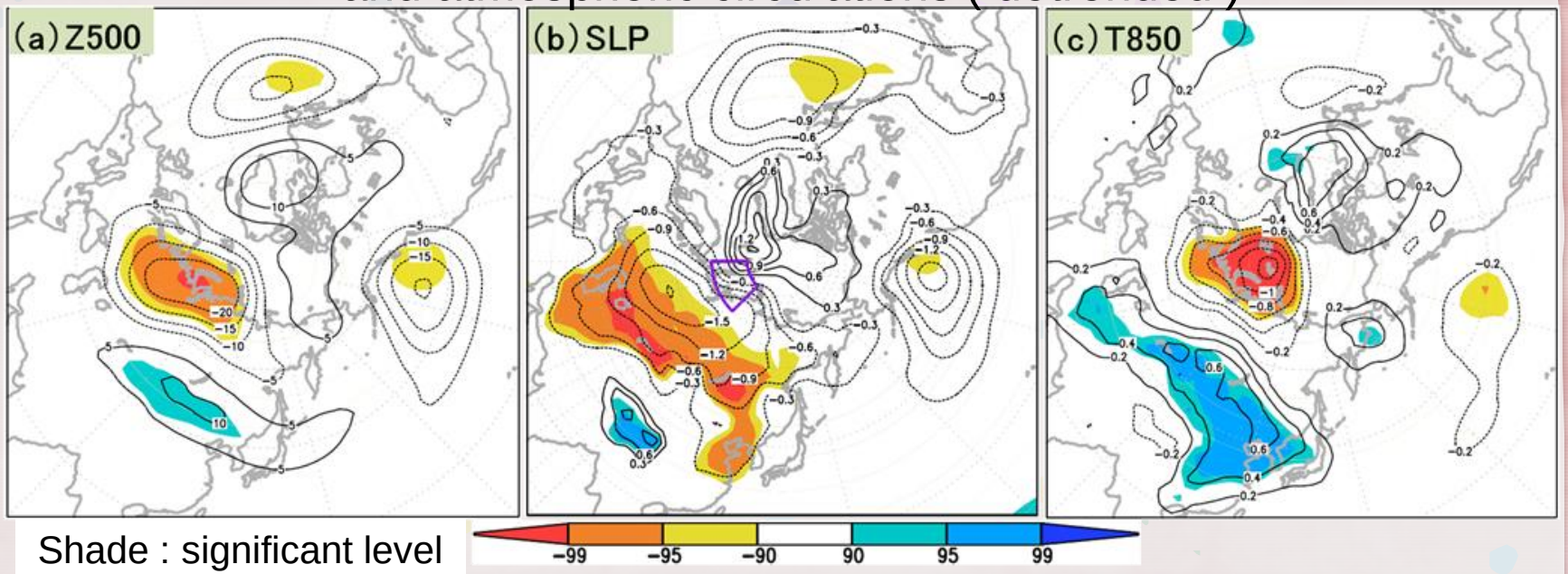
	Northern Japan	Eastern Japan	Western Japan	Okinawa /Amami
15/16 Winter	1.0	1.4 (2)	1.0 (3)	0.6
Spring	1.5(2)	1.6(2)	1.3(2)	0.9(3)
Summer	0.7	0.6	0.7	1.1(1)

(℃)

Yellow: above normal
Orange: significantly above normal
(number) : ranking since 1946

Effect of Arctic sea ice to EAWM

Relationship between sea ice concentration in the Barents sea and atmospheric circulations (detrended)



Shade : significant level

Contour: regression coefficients (1980-2013)

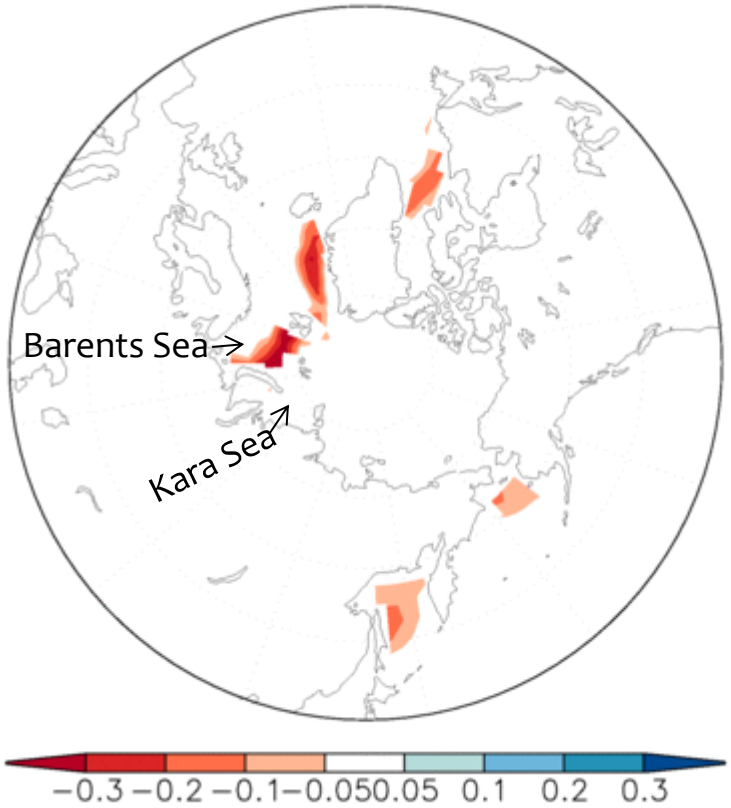
Is the dominant Siberian high in less sea ice years a cause or an effect or both (positive feedback)?

Fujikawa.N,EASCOF-1,2013:Recent variabilities of East Asian winter monsoon

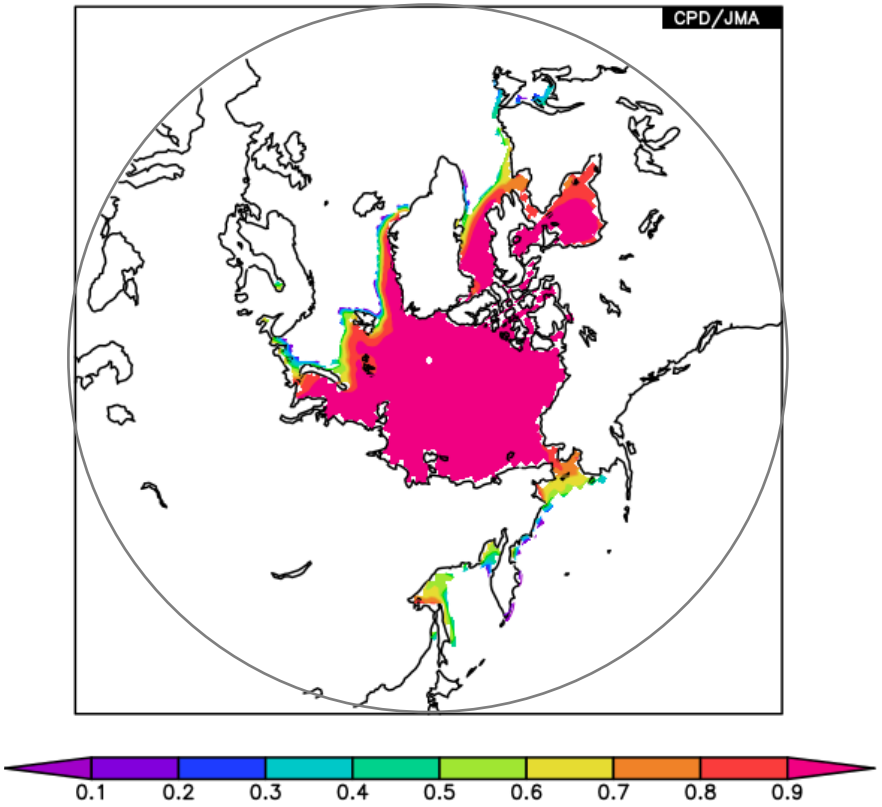
Arctic Sea Ice in DJF 2016/17

The sea ice in the Barents Sea is predicted to be less than normal.

Predicted Sea Ice anomaly for DJF

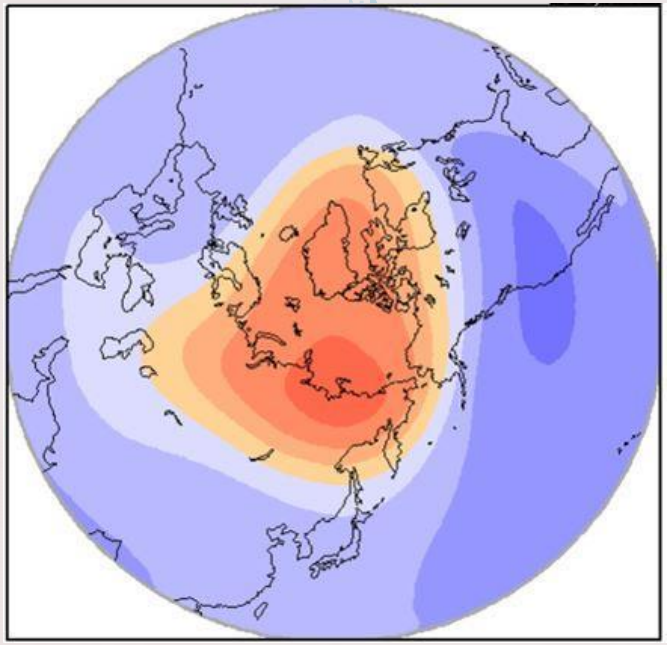


Sea Ice concentration for DJF
（normal: the 1981-2010 average）

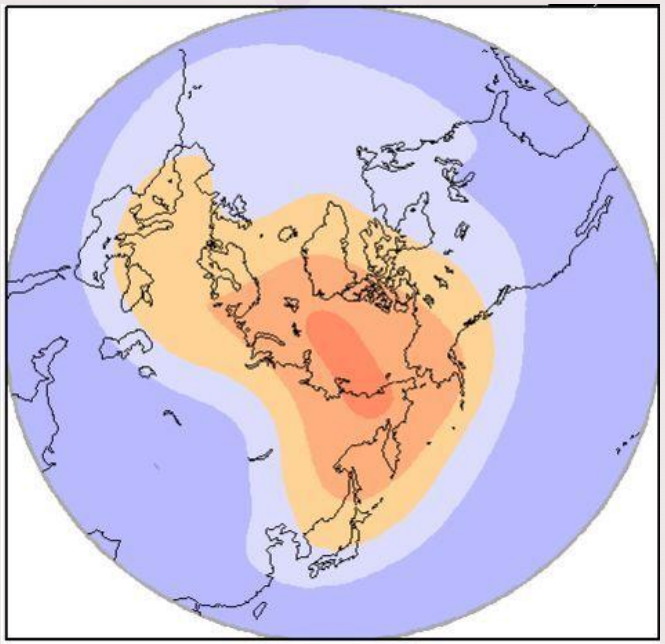


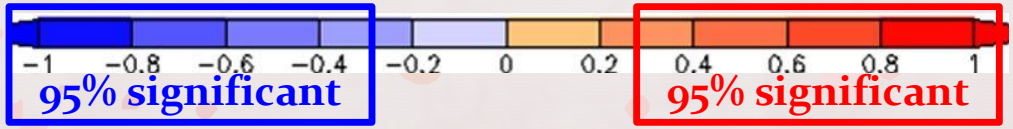
Effect of stratosphere to AO

Correlation coefficient between AO-index and 30hPa height (DJF)



Lag correlation coefficient between AO-index (**DJF**) and 30hPa height (**Nov.**)



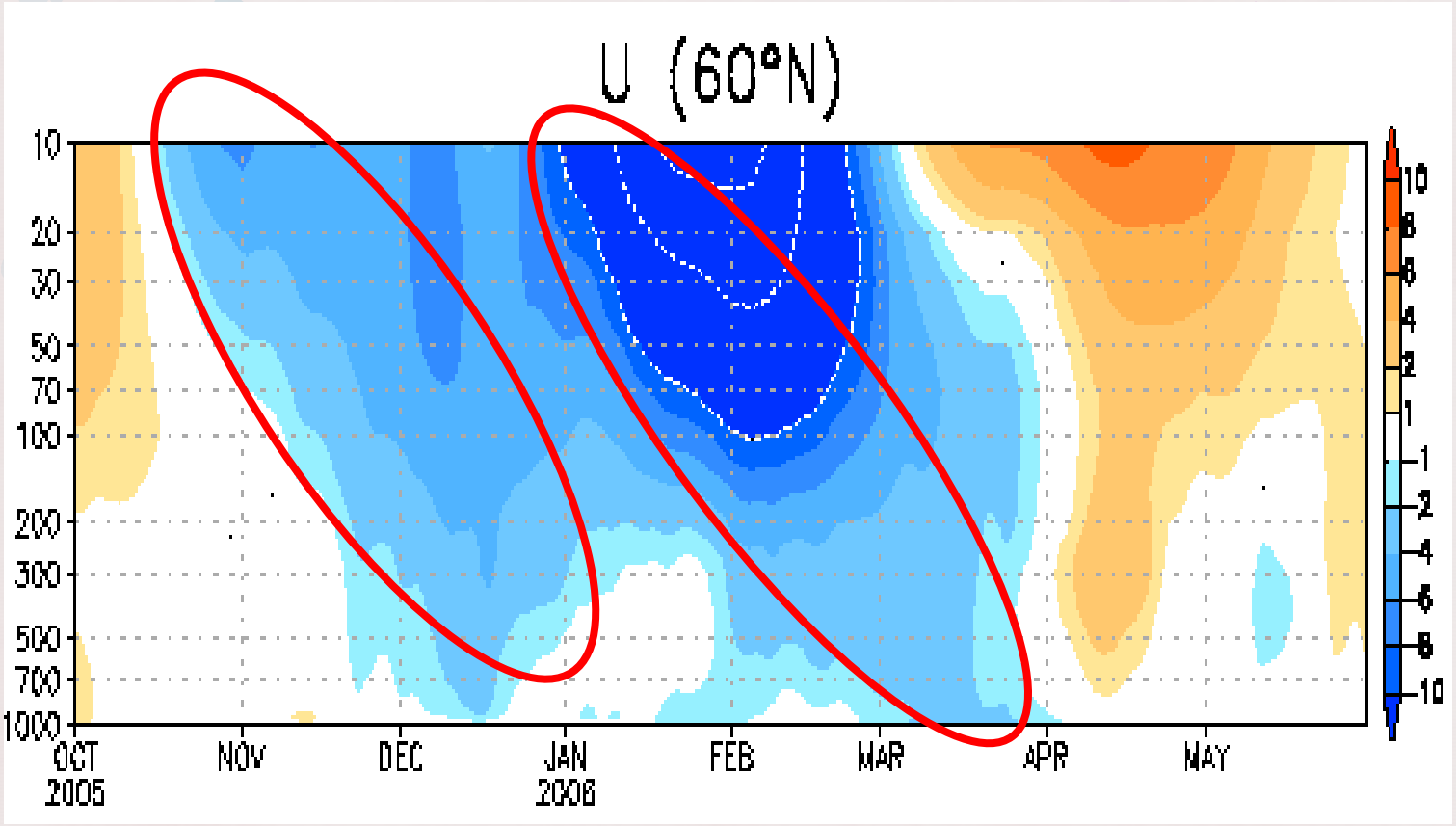


Correlation coefficient in 1958-2012 winter by JRA-55

Fujikawa.N,EASCOF-1,2013:Recent variabilities of East Asian winter monsoon

Effect of stratosphere to AO

Typical downward evolution of deceleration of westerlies in the dominant AO(-) winter (2005/06 winter)

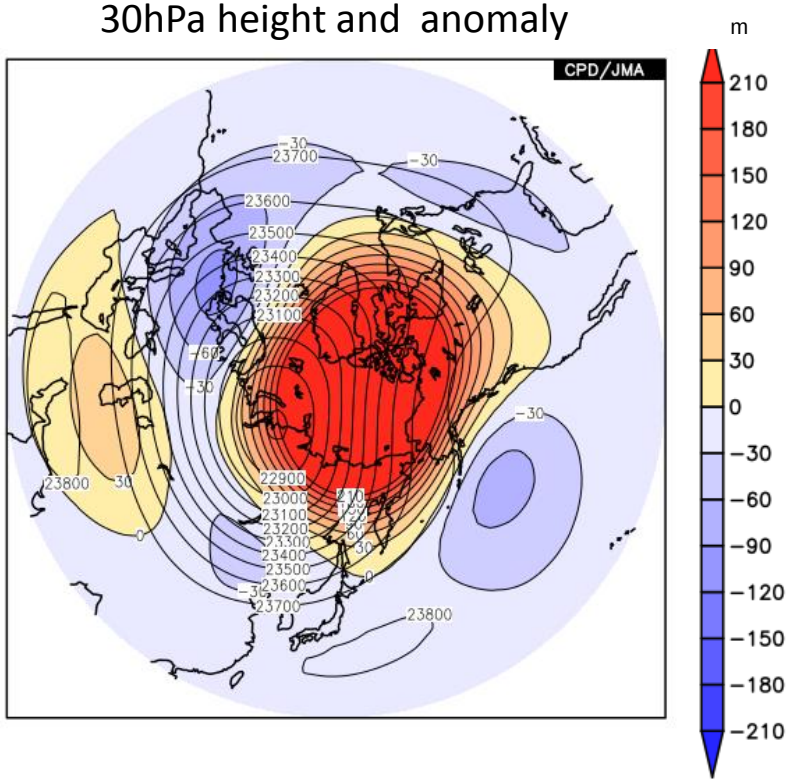


Fujikawa.N,EASCOF-1,2013:Recent variabilities of East Asian winter monsoon

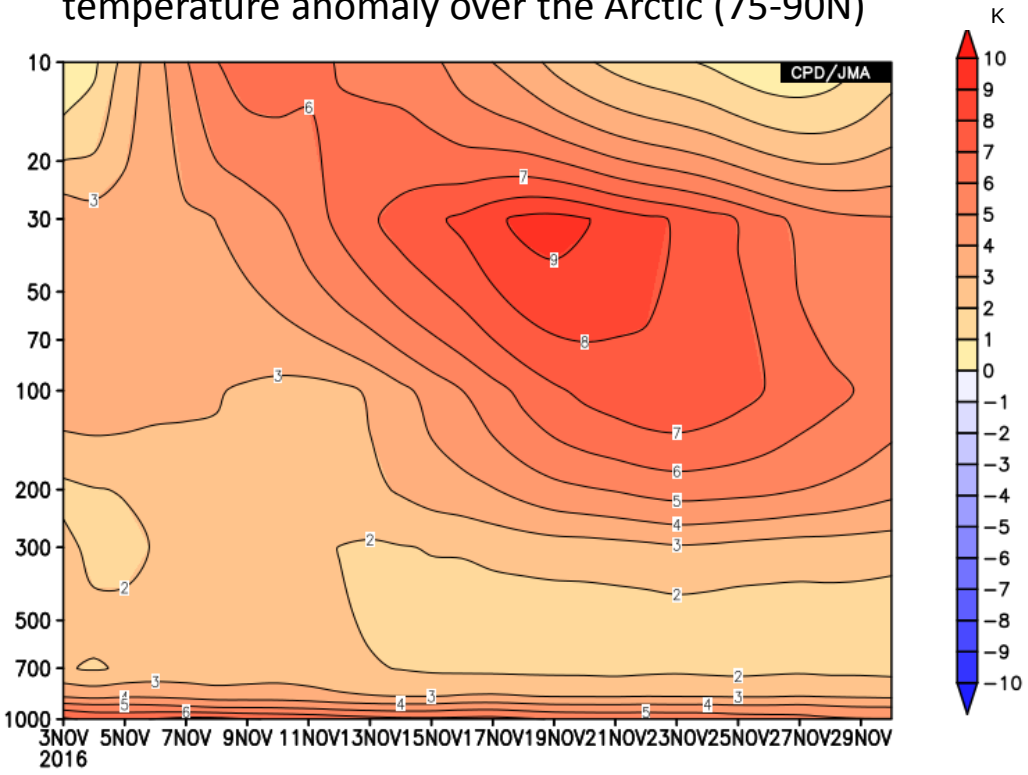
Latest forecast of stratosphere in Nov 2016.

the result of JMA's one-month prediction model from 2nd Nov.

30hPa height and anomaly



Height-time cross section for zonally averaged temperature anomaly over the Arctic (75-90N)



JMA's Seasonal Prediction System

Last upgrade	June 2015
Model	Coupled ocean-atmosphere general circulation model (JMA/MRI-CGCM2)
Resolution	•Atmospheric component Resolution: about 110 km, 60 vertical levels (**T_L159 L60**) •Oceanic component Resolution: Horizontal 1.0° longitude, 0.3°–0.5° latitude, Vertical 52 levels
Ensemble size	**51**
Frequency of forecast issuance	Once a month
Hindcast	1979-2014 (36 years)