Seasonal Outlook for summer 2013 over Japan

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Outline

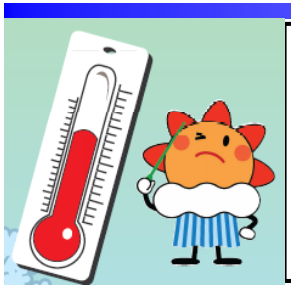
- **Warm Season Forecasts in Japan**
- **Oceanic Condition and Outlook**
- **Atmospheric Circulation Outlook**

Summary

Warm Season Forecasts in Japan

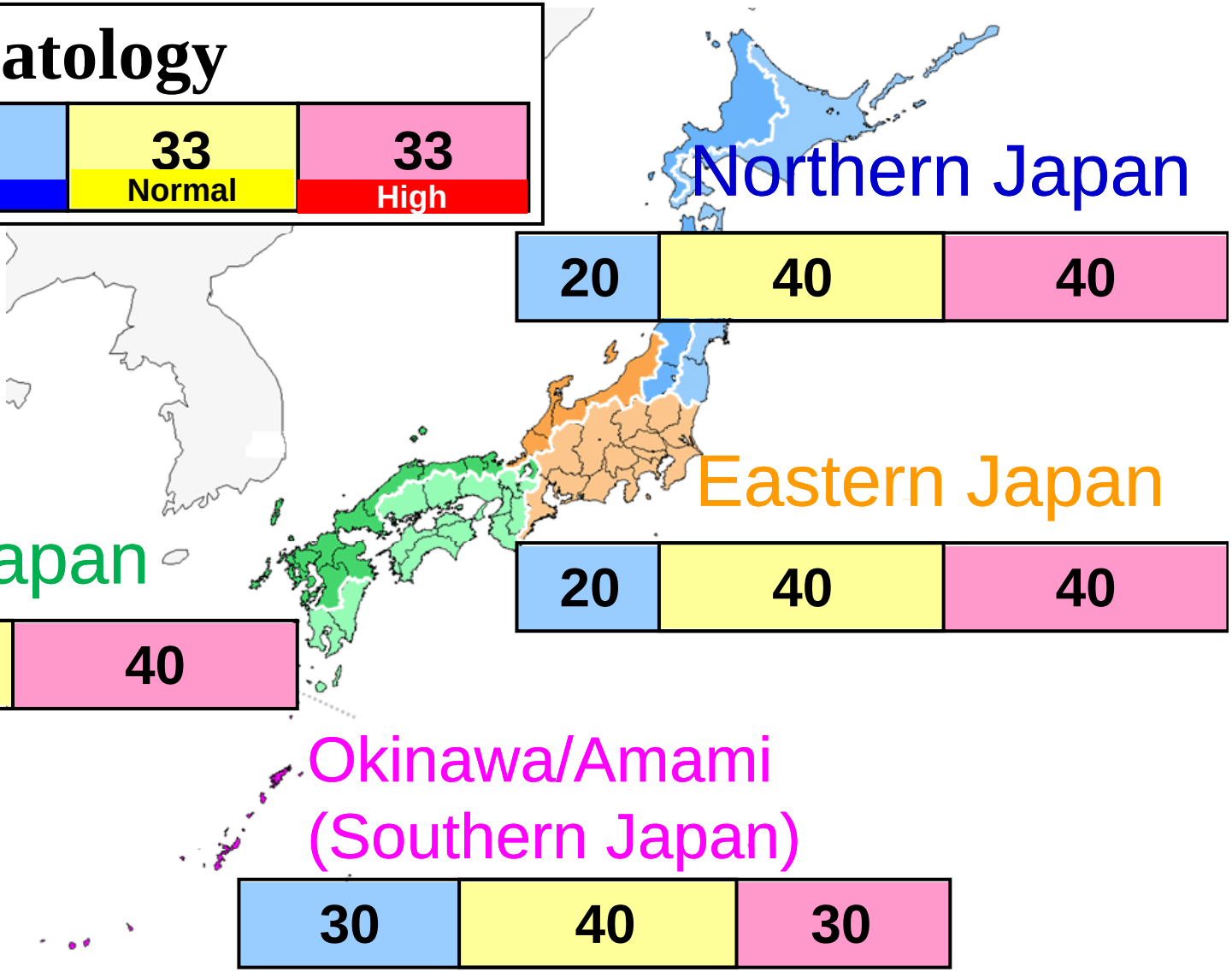
--- Summer (June July August) 2013 ---

Probability of seasonal mean temperature for summer (June – August) 2013



Climatology

33	33	33
Low	Normal	High



Northern Japan

20	40	40

Eastern Japan

20	40	40

Western Japan

20	40	40

Okinawa/Amami
(Southern Japan)

30	40	30

Probability of seasonal mean precipitation for summer (June – August) 2013

Climatology

33	33	33
Below normal	Normal	Above normal

Northern Japan

40	30	30

Western Japan

30	40	30

Eastern Japan

40	30	30

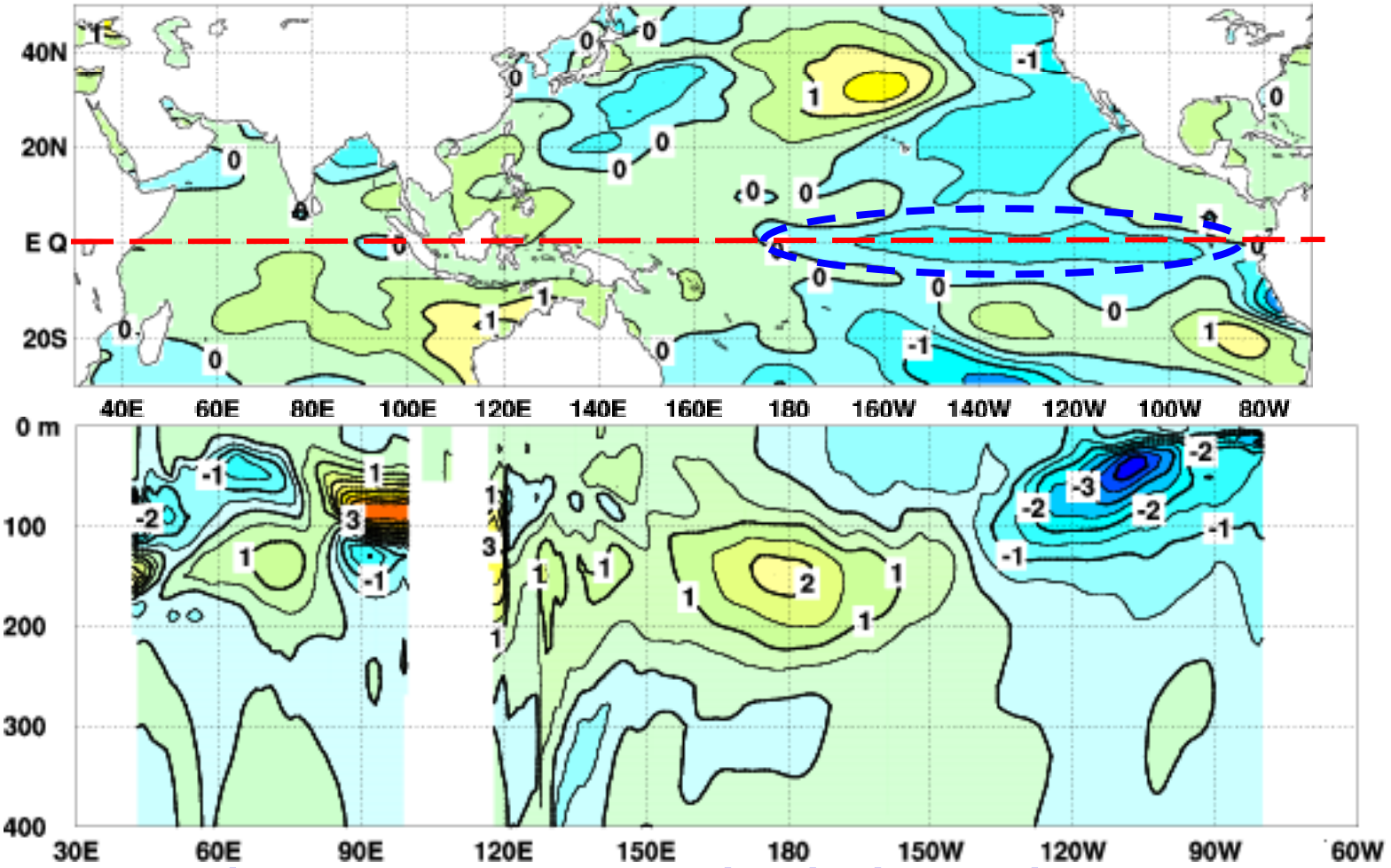
Okinawa/Amami (Southern Japan)

20	40	40

Oceanic Condition and Outlook

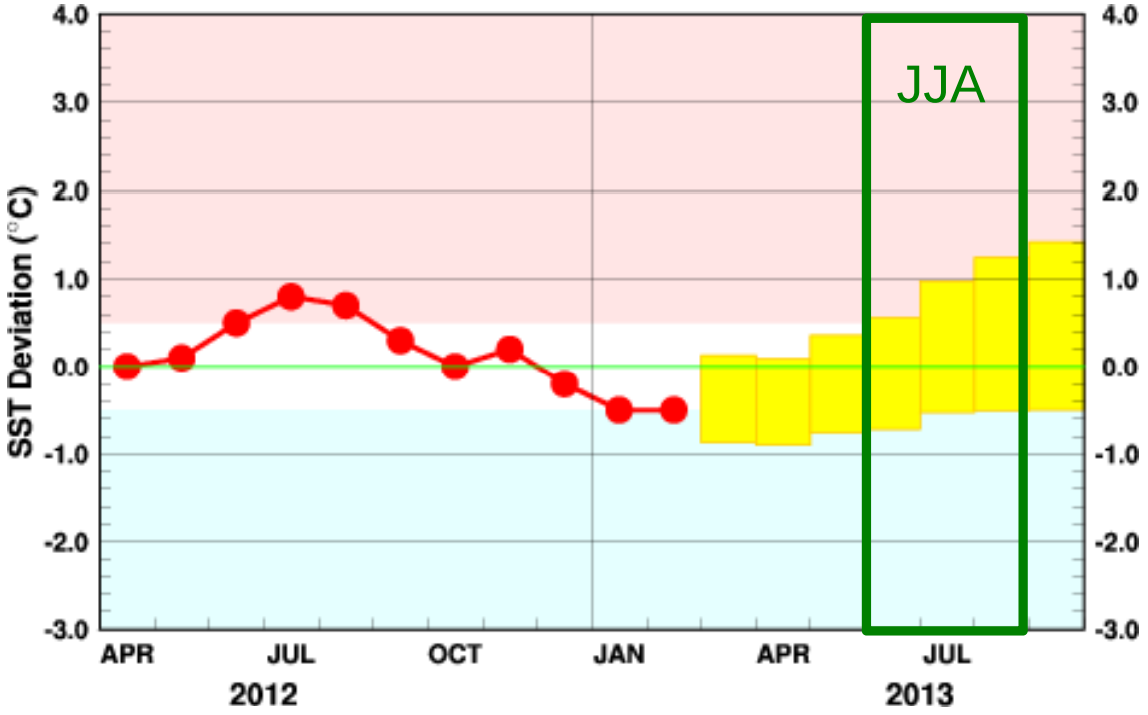
http://ds.data.jma.go.jp/tcc/tcc/products/elnino/outlook.html

Oceanic Condition and Outlook (1)
Current Condition in February 2013



upper : Monthly mean SST Anomalies (Feb. 2013)
lower : Depth-longitude cross sections of monthly mean temperature anomalies(Feb. 2013)

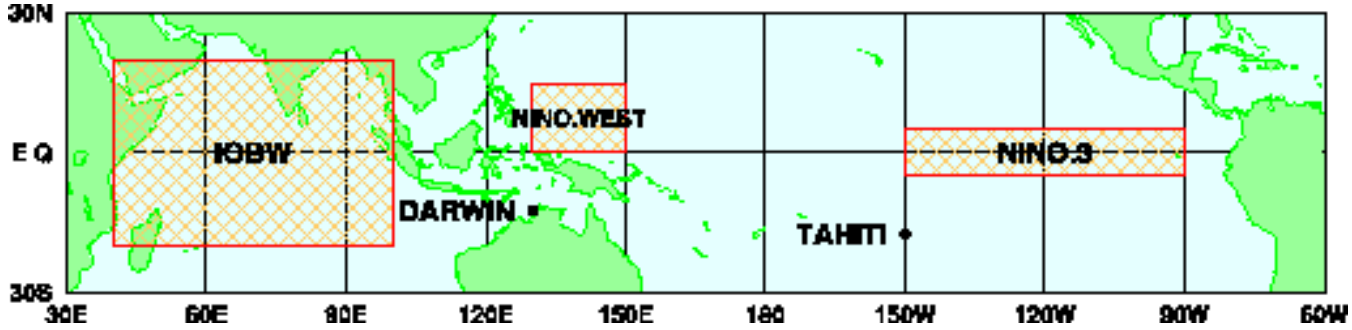
Oceanic Condition and Outlook (2)
NINO.3 SST forecast



Monthly SST deviation in NINO.3

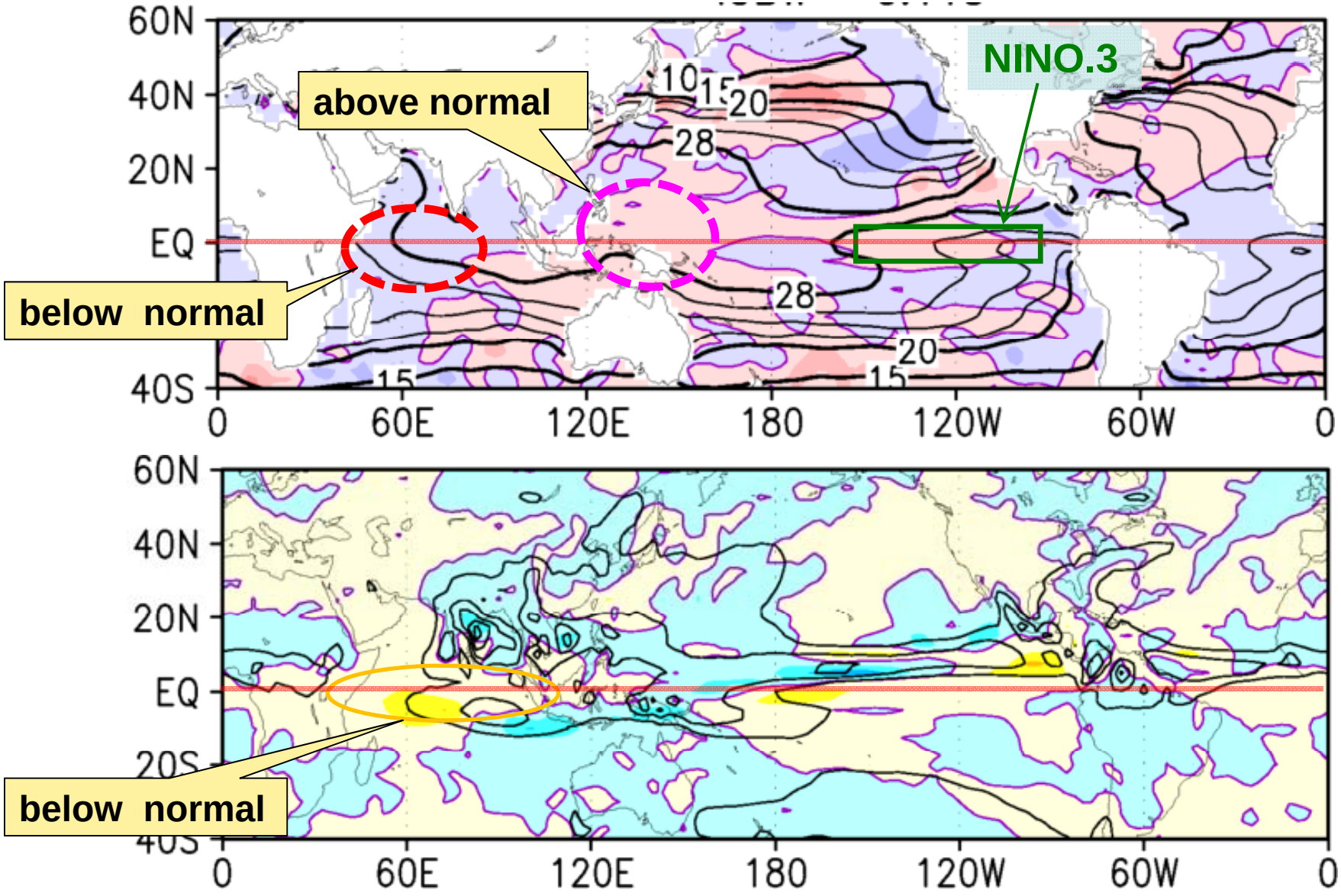
El Niño Outlook

ENSO neutral conditions are likely to continue during the northern hemisphere summer 2013.

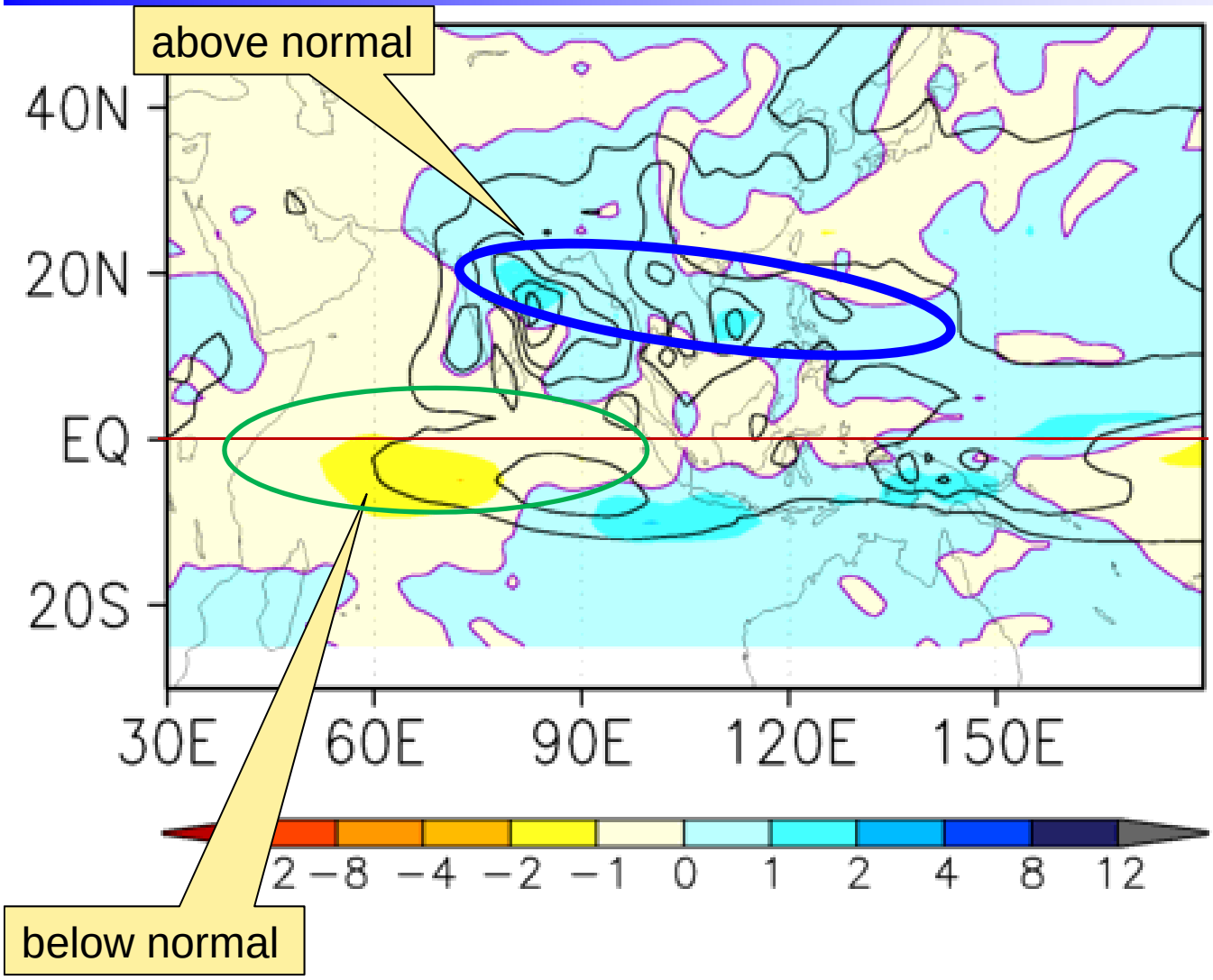


Atmospheric Circulation Outlook

Numerical Prediction (1)
SST & Precipitation anomaly JJA

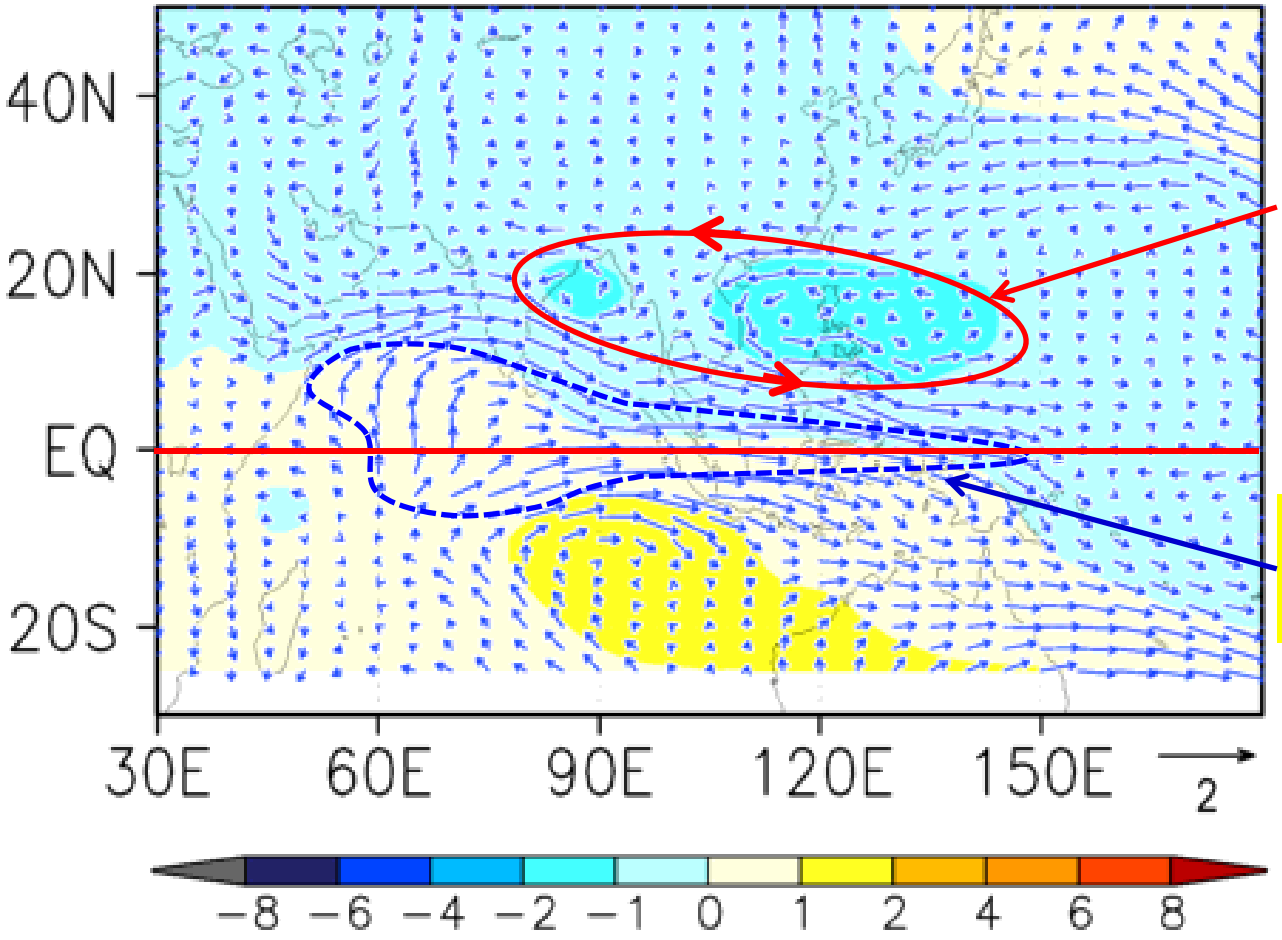


Numerical Prediction (2)
Precipitation anomaly JJA



Numerical Prediction (3)

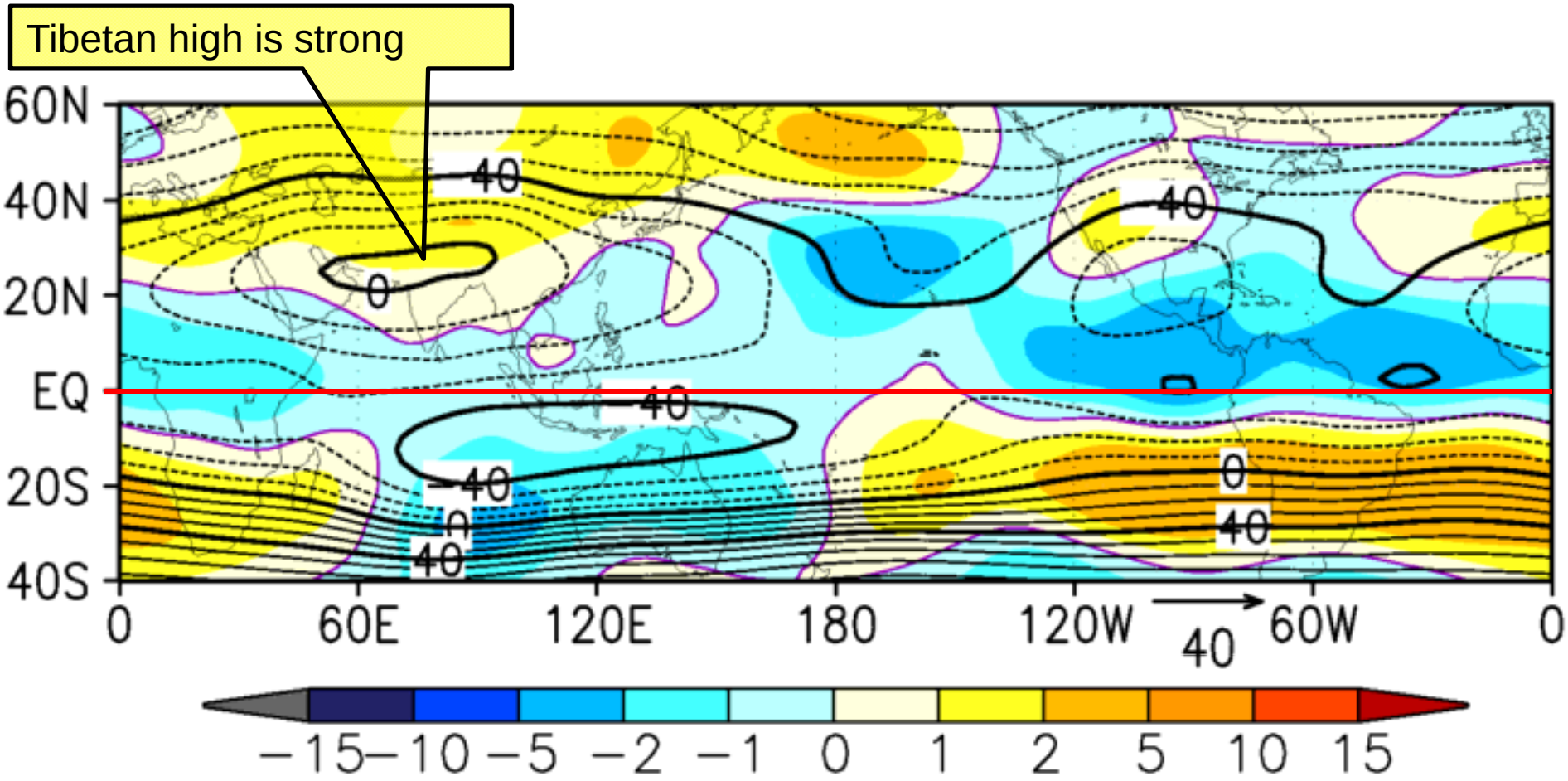
wind anomaly(vectors) and stream function anomaly (color) 850hPa JJA



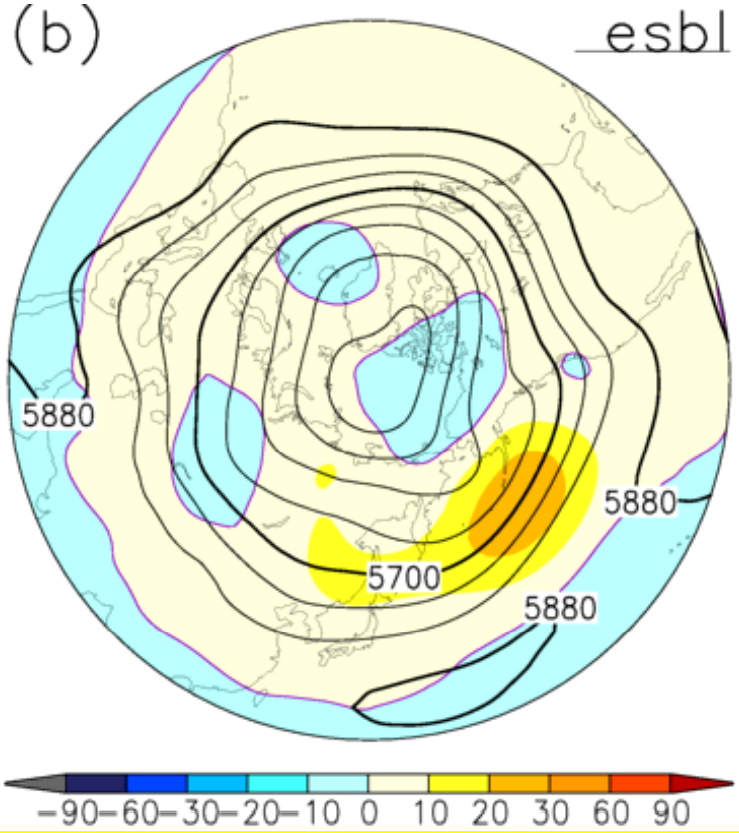
cyclonic rotation

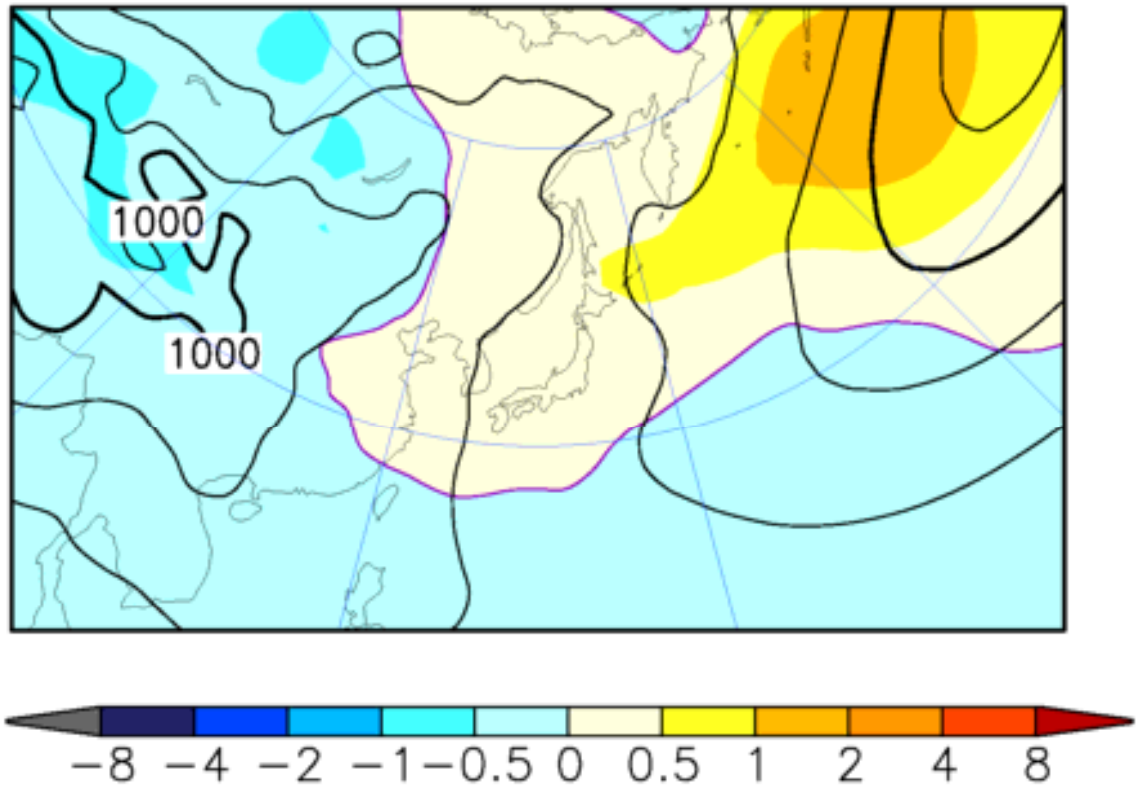
Matsuno-Gill response (cold source)

Numerical Prediction (4)
stream function and anomaly (200hPa) JJA



Numerical Prediction (5)
500hPa height and Sea Level Pressure anomaly JJA

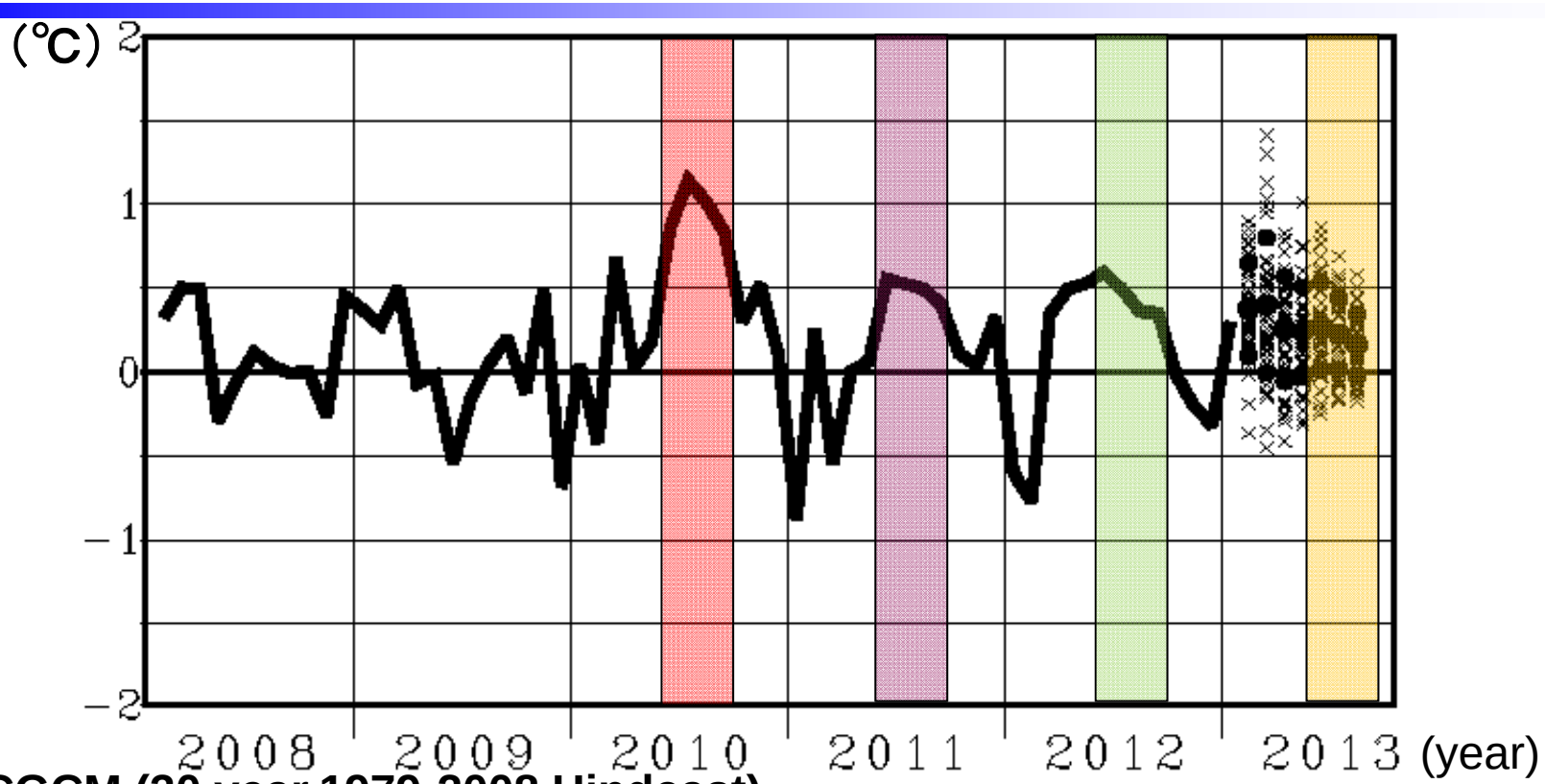




500hPa height anomalies are predicted to be positive over mid and high-latitudes Northern Hemisphere.

The North Pacific high is likely to shift northward from its normal position. Okinawa/Amami is expected to be influenced by moist southerly flow more frequently than normal.

Numerical Prediction (6)
Tropospheric thickness temperature

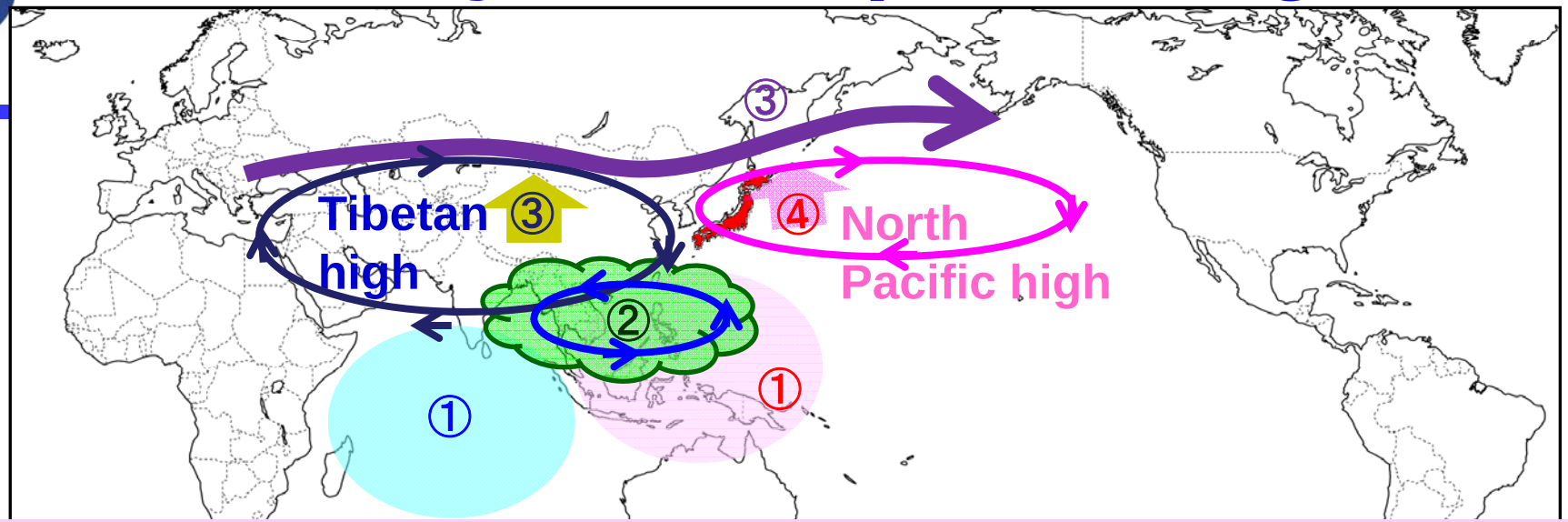


CGCM (30 year,1979-2008 Hindcast) anomaly correlation

Valid period	JJA
Initial month	Feb.
tropospheric thickness (300-850hPa) 30°N – 50°N	0.64

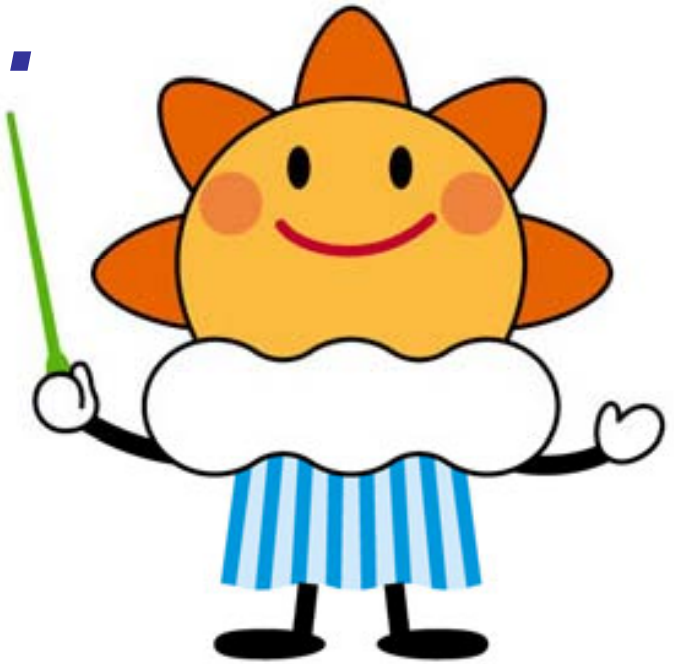
The tropospheric thickness temperature averaged over the mid-latitudes of the Northern Hemisphere (30°N – 50°N), which is predicted to be slightly above normal.

Summary（Conceptual diagram）



① The SST in IOBW will be below normal, the SST in NINO.WEST will be slightly above normal during the summer.
② Three-month precipitation anomalies are predicted to be above normal from the Bay of Bengal to the east of the Philippines.
③ The Tibetan high is predicted to be stronger than normal, and the subtropical jet is likely to shift northward from its normal position
④ From②and③The North Pacific high is likely to shift northward from its normal position.
※ The tropospheric thickness temperature averaged over the mid-latitudes of the Northern Hemisphere (30˚N – 50˚N), which is predicted to be slightly above normal.

Thank you.



JMA's mascot is named Harerun (in the hope of hare, the Japanese word for “fine weather”), and is designed with elements of sun, cloud and rainfall. Harerun holds a green baton in prayer for a disaster-free, peaceful world.

Temperature

Category	−	0	+
Northern Japan	20	40	40
Eastern Japan	20	40	40
Western Japan	20	40	40
Okinawa and Amami	30	40	30

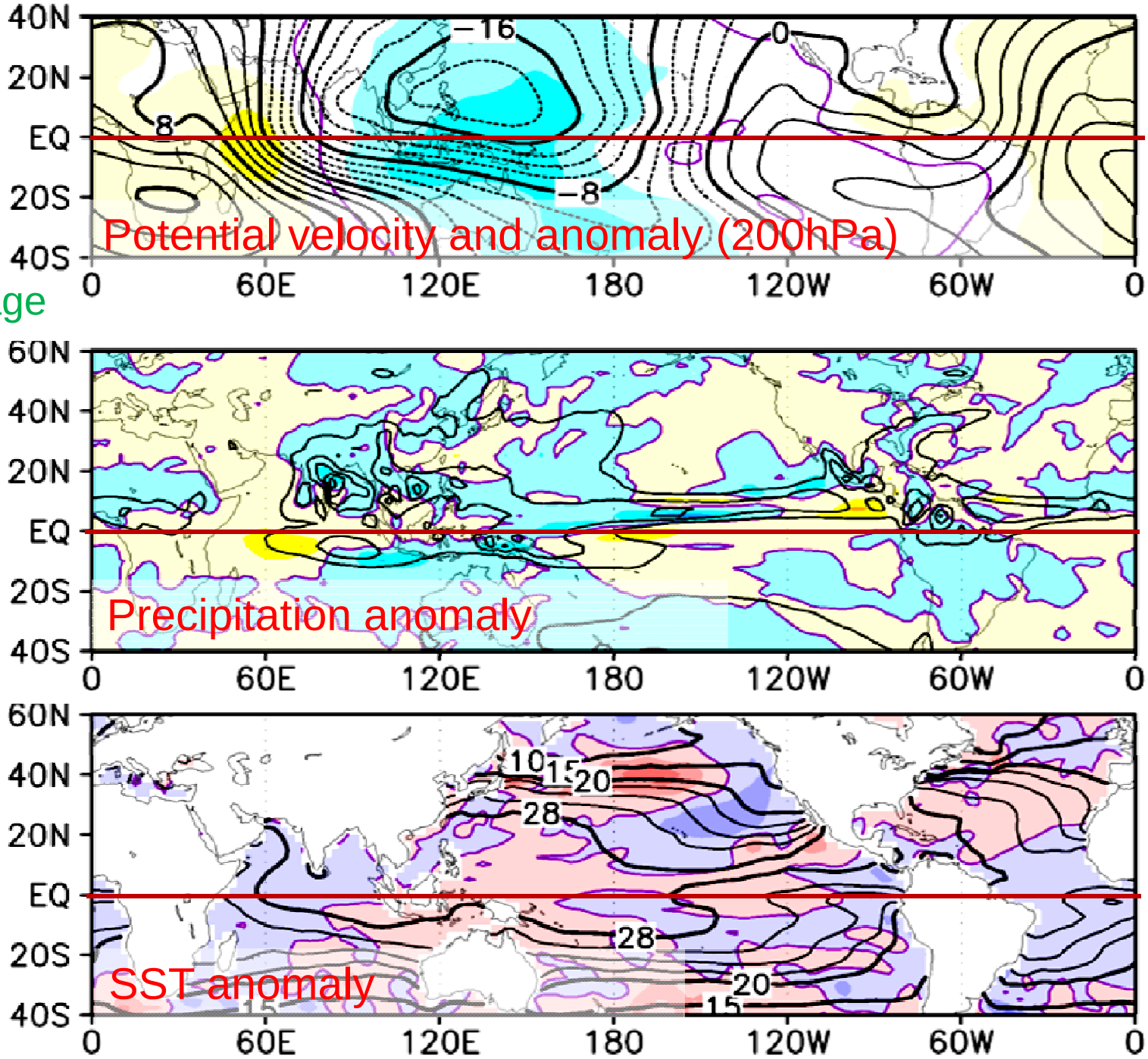
Precipitation

Category	−	0	+
Northern Japan	40	30	30
Eastern Japan	40	30	30
Western Japan	30	40	30
Okinawa and Amami	20	40	40

(Category −: below normal, 0 : normal, + : above normal, Unit : %)

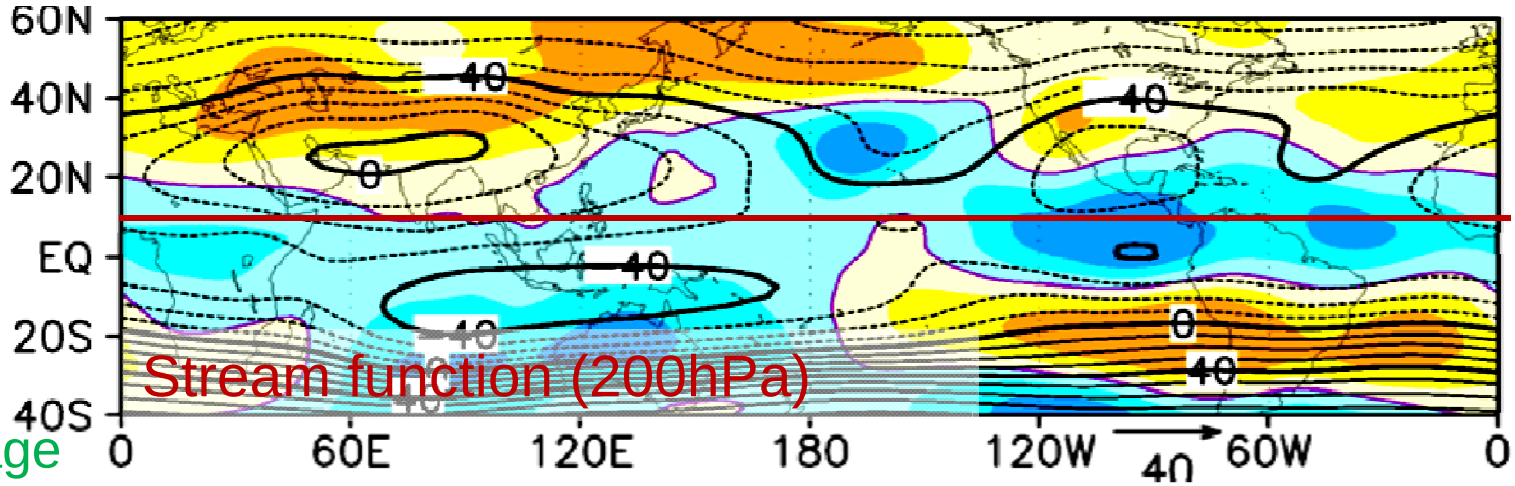
JJA

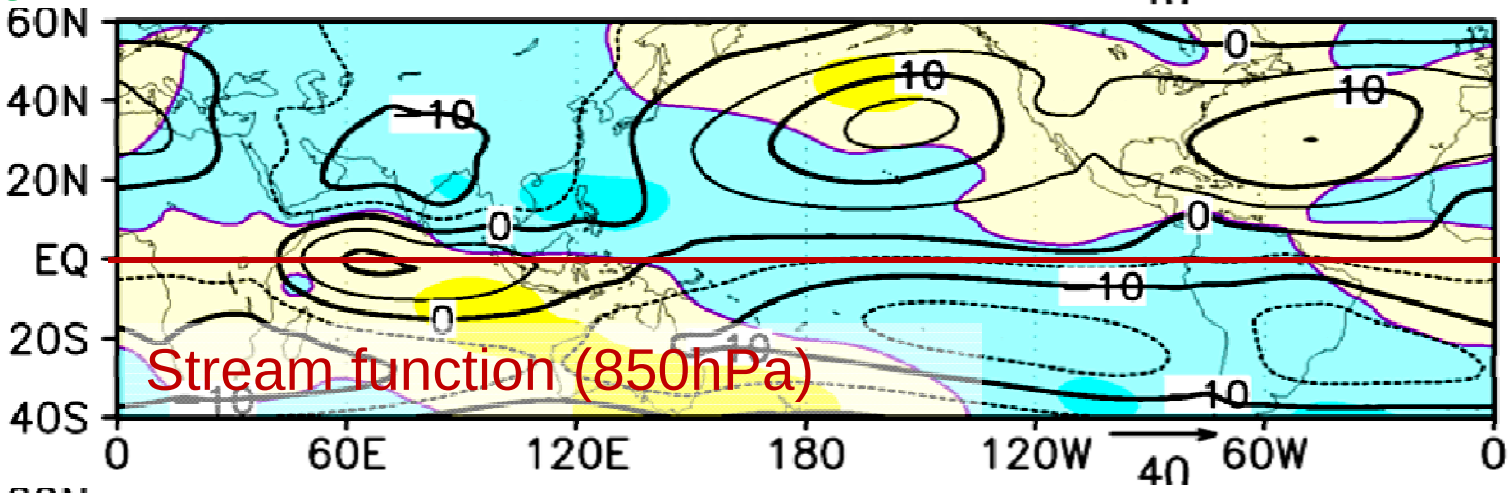
3-month average

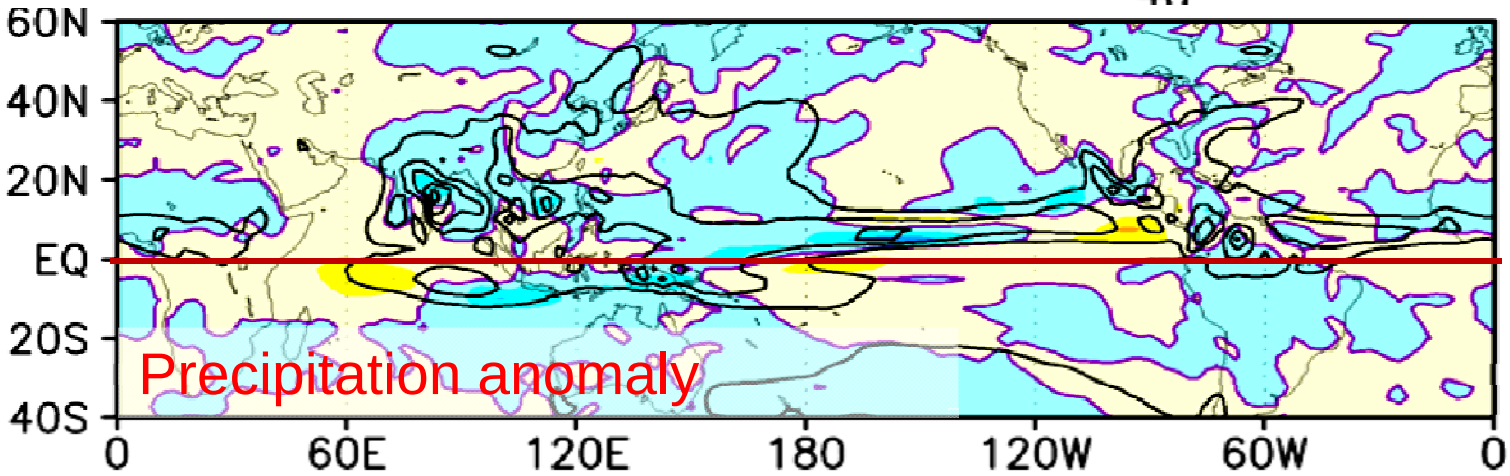


JJA

3-month average



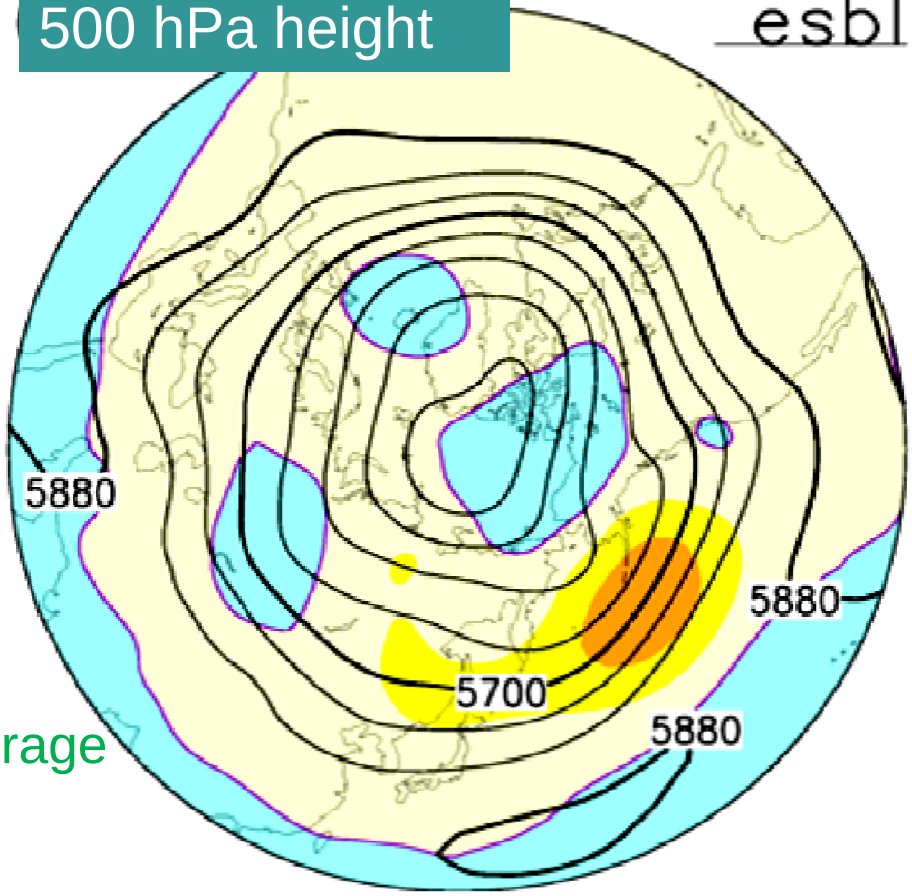




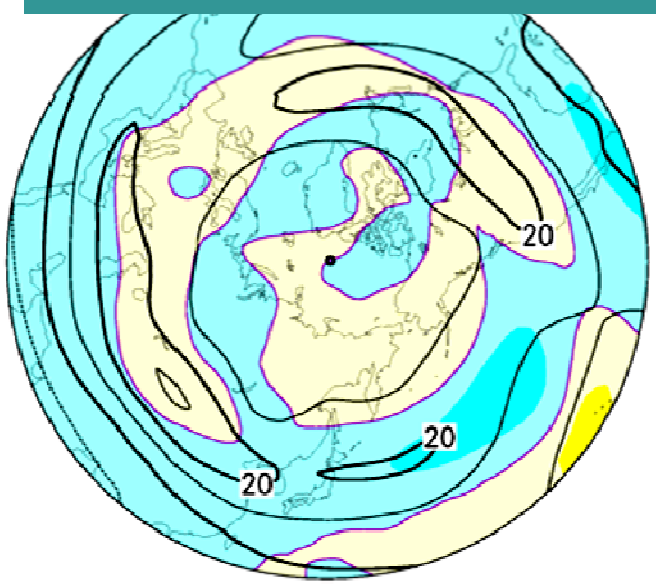
JJA

3-month average

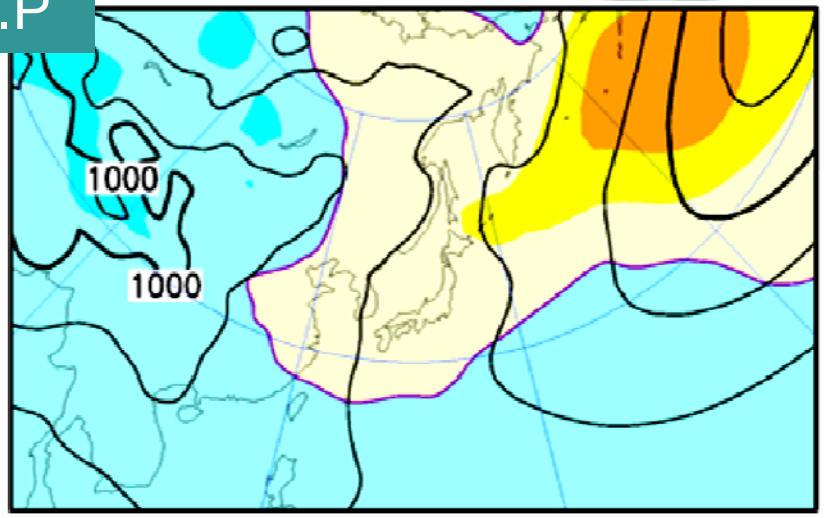
500 hPa height



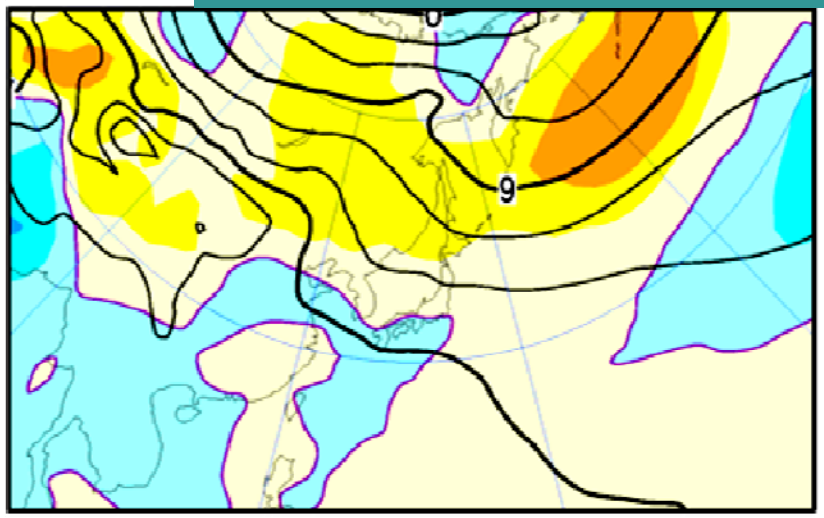
200hPa Zonal wind



S.L.P



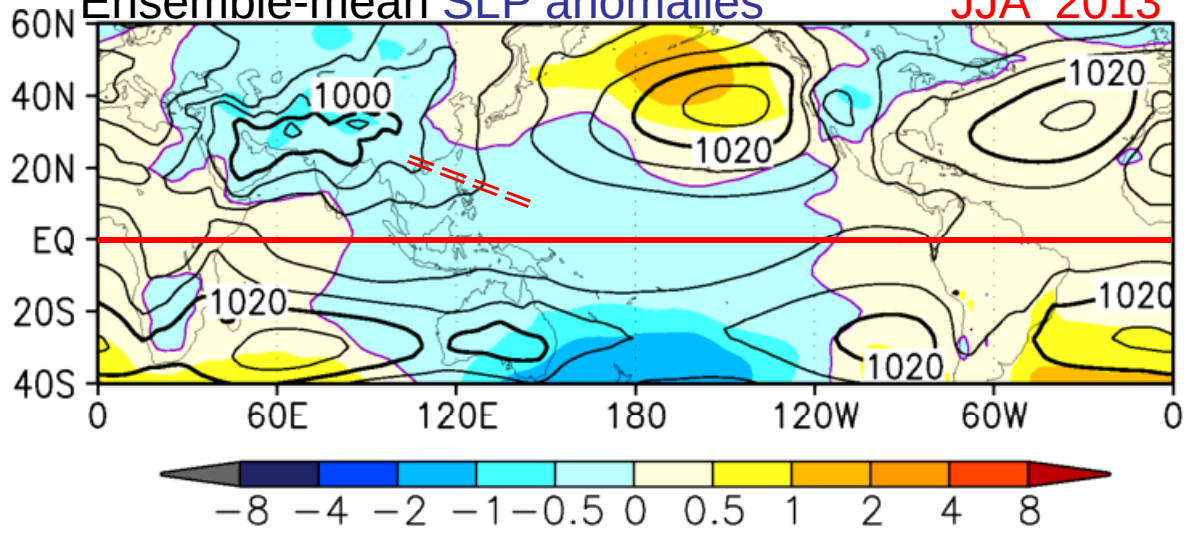
850hPa Temperature



JMA seasonal forecast
SLP & Surface temperature

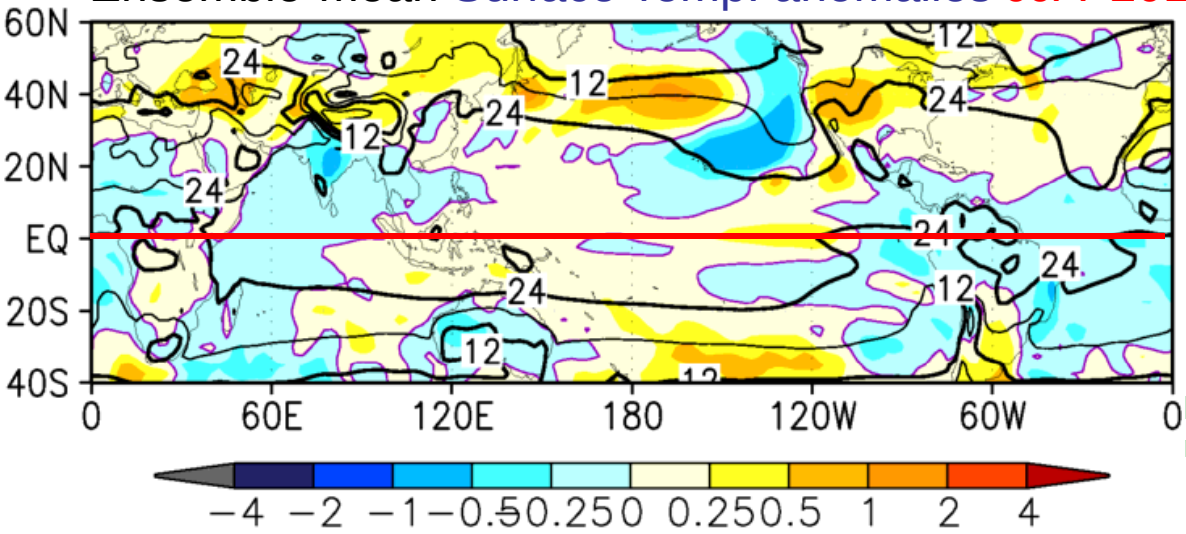
initial date: February 2013

Ensemble-mean SLP anomalies JJA 2013



The Monsoon Trough would be strong.

Ensemble-mean Surface Temp. anomalies JJA 2013

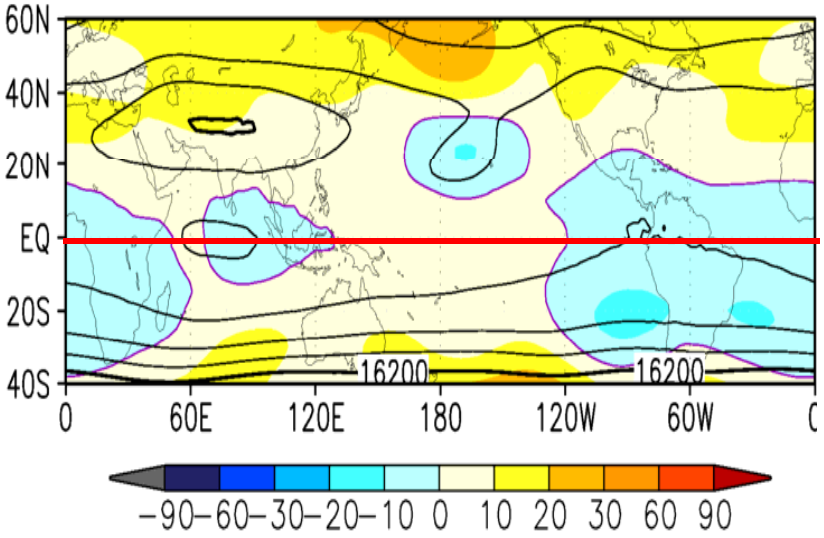


The slightly below-normal temperature are predicted around the Philippines.

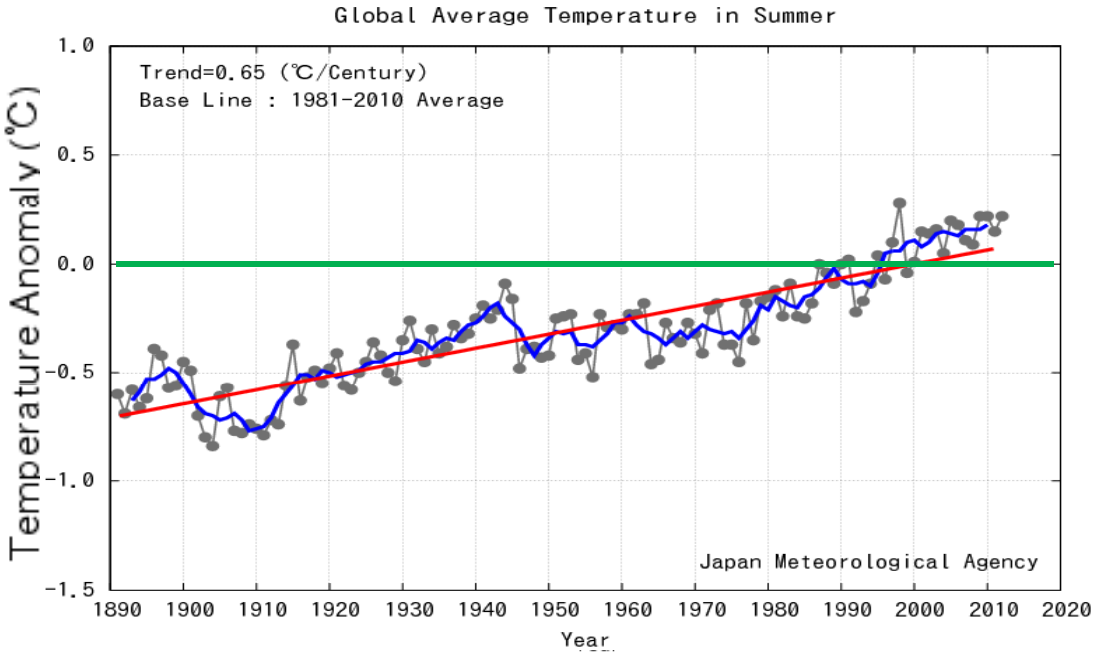
http://ds.data.jma.go.jp/tcc/tcc/products/model/map/7mE/map1/zpcmap.php

100 hPa Height and Anomalies and Global Average Surface Temperature in Summer

100hPa Height Forecast and Anomalies JJA



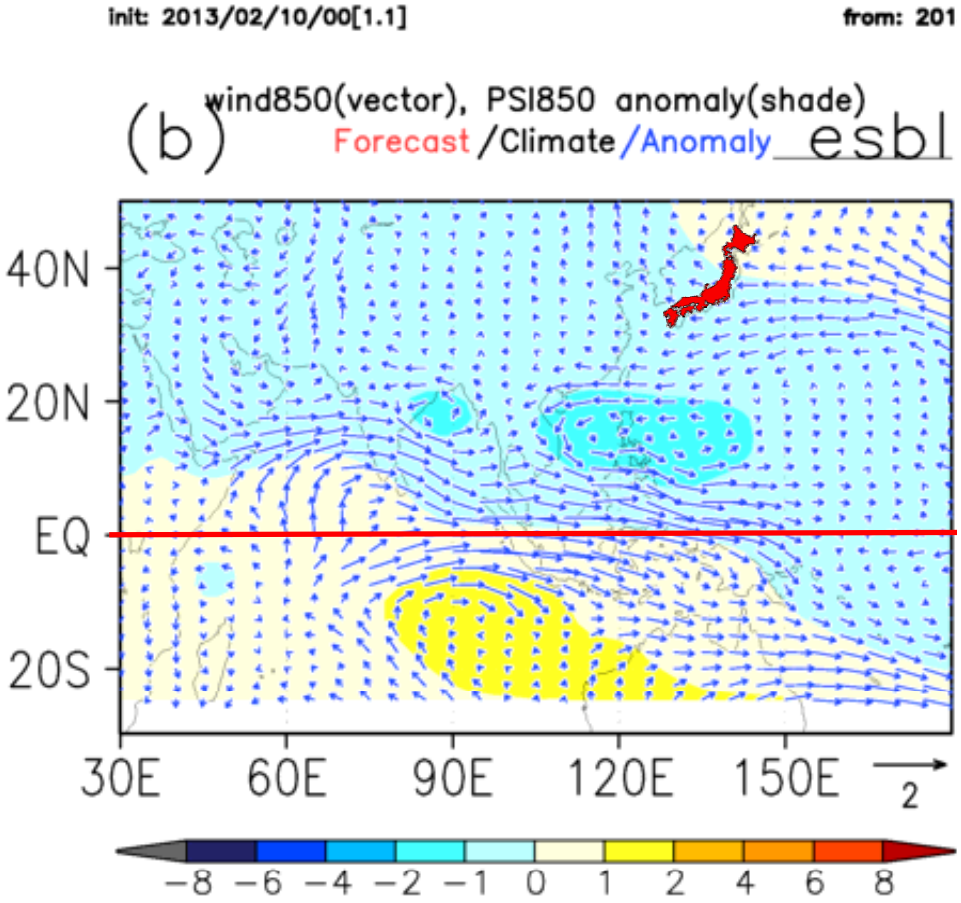
Global Average Temperature in June – August



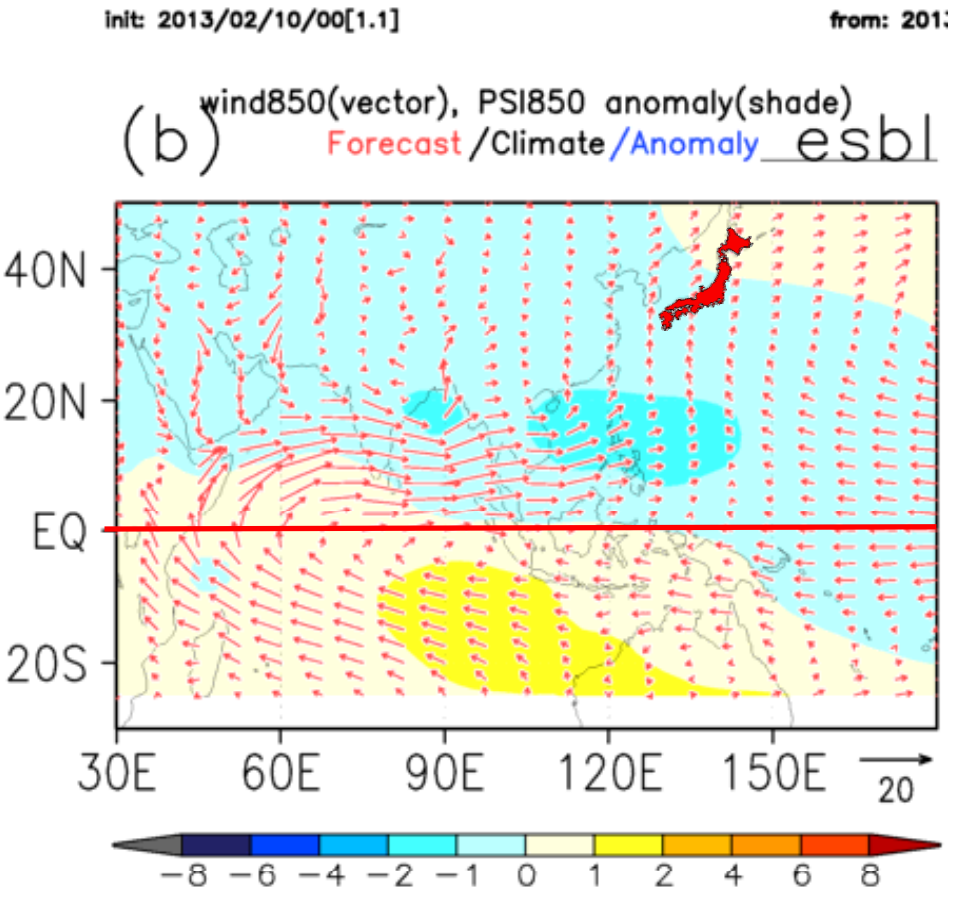
Anomalies are deviations from baseline(1981-2010 Average).
The black thin line indicates surface temperature anomaly of each year.
The blue line indicates their 5-year running mean.
The redline indicates the long-term linear trend.

100hPa height anomalies are predicted to be positive over the mid-high latitude in Northern Hemisphere. Furthermore, in these ten years, above normal temperature tend to appear in all regions. These tendencies indicate that this summer-averaged temperature tends to be above normal in Japan.

wind anomaly(vectors) and stream function anomaly (color) 850hPa JJA

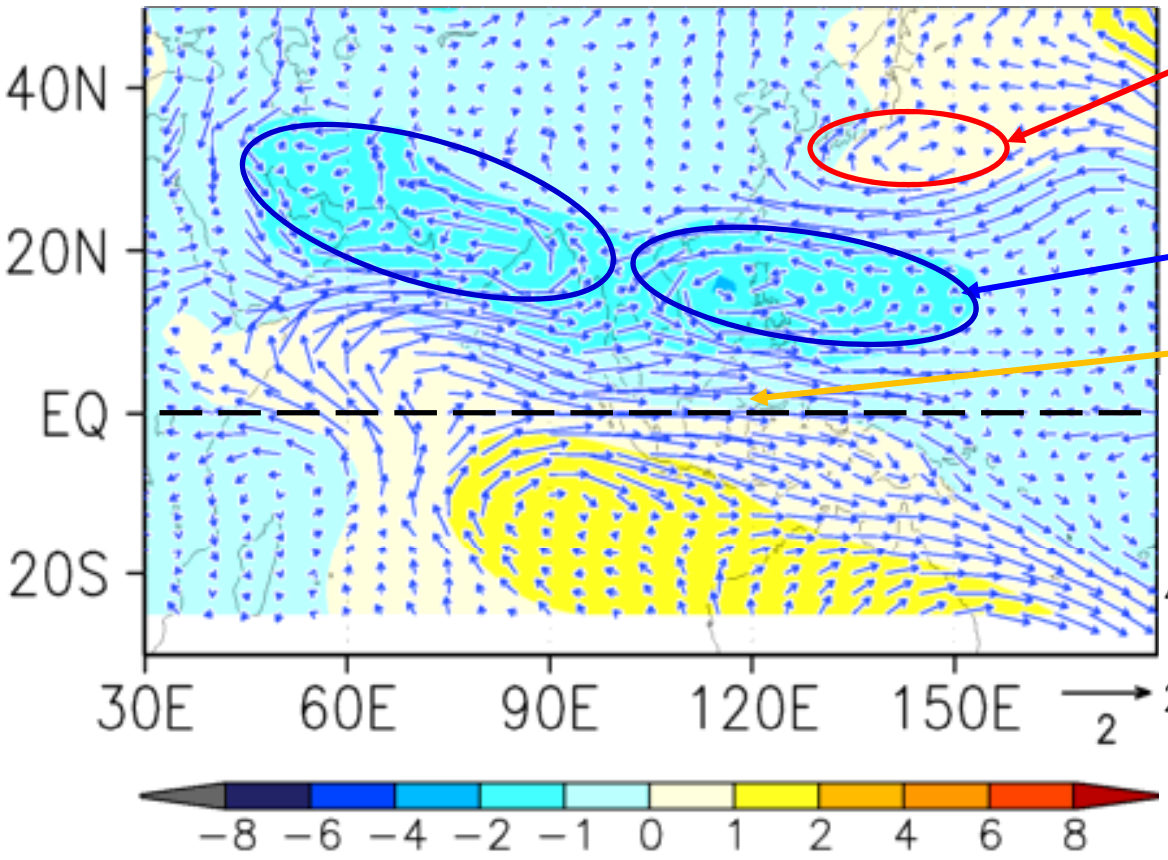


wind anomaly(vectors) and stream function anomaly (color) 850hPa JJA



Wind (vectors) and stream function anomaly (color) 850hPa JJA

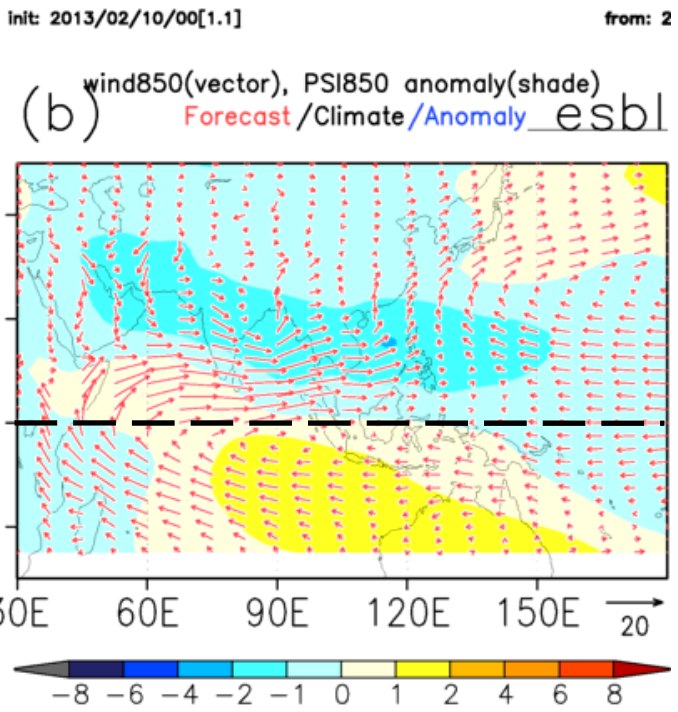
Numerical Prediction
wind anomaly(vectors) and
stream function anomaly (color) 850hPa (June)



Anti-Cyclonic circulation anomalies around Philippines.

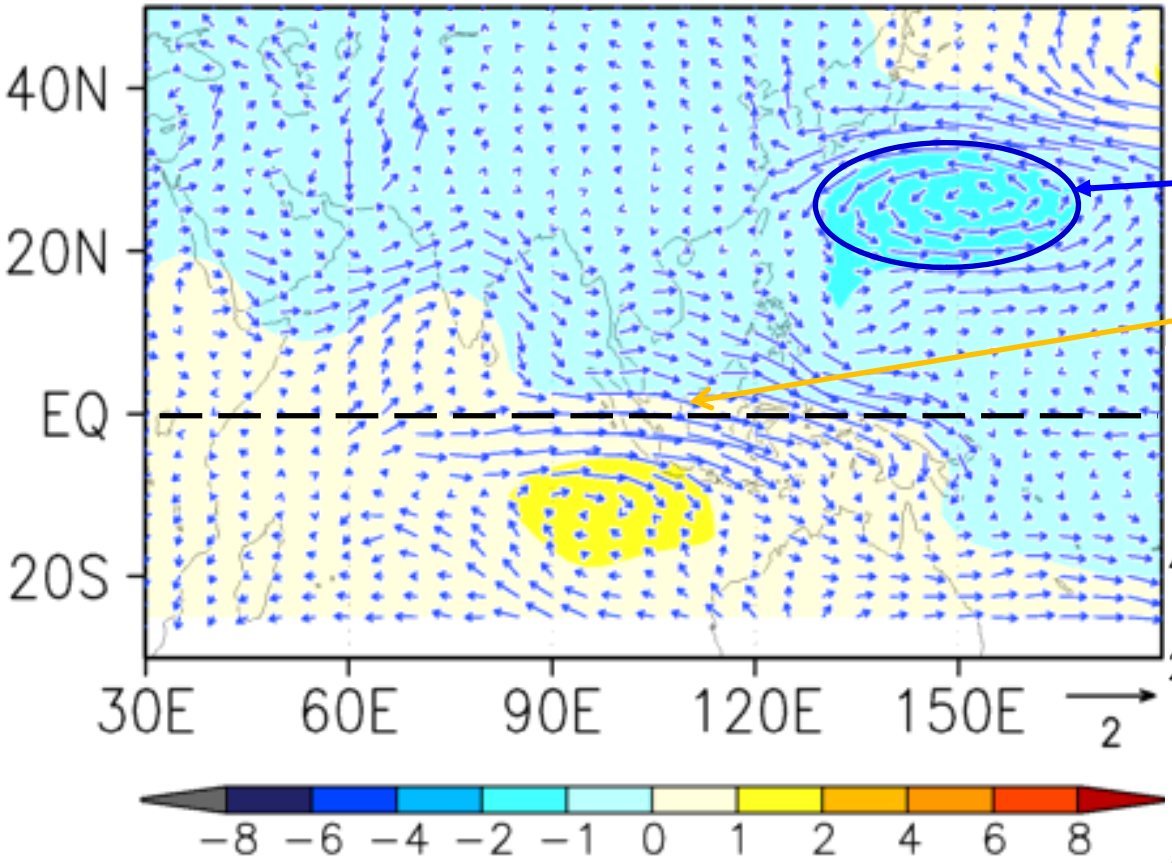
Cyclonic circulation anomalies around Philippines.

Westerly Wind anomalies



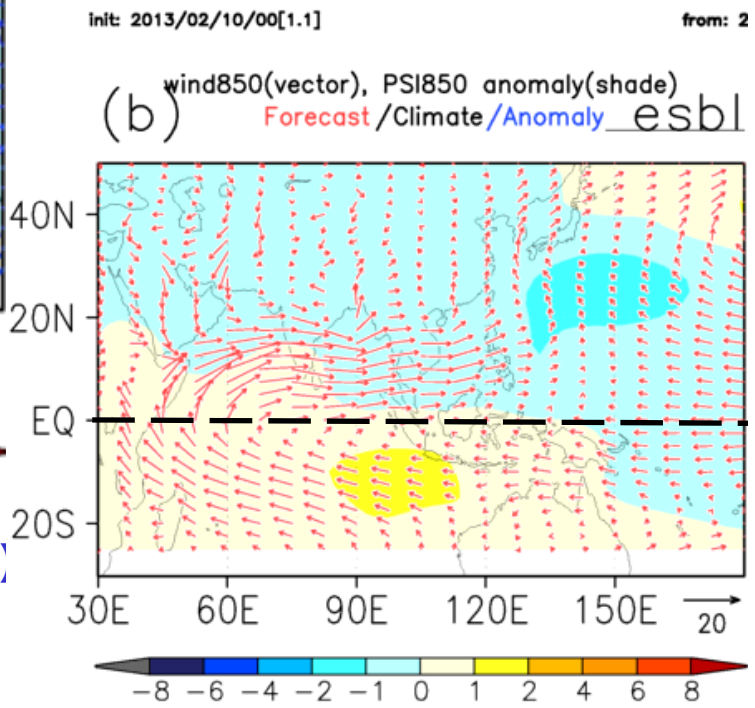
850hPa Wind and Stream Function Anomalies (June 201

Numerical Prediction
wind anomaly(vectors) and
stream function anomaly (color) 850hPa(July)



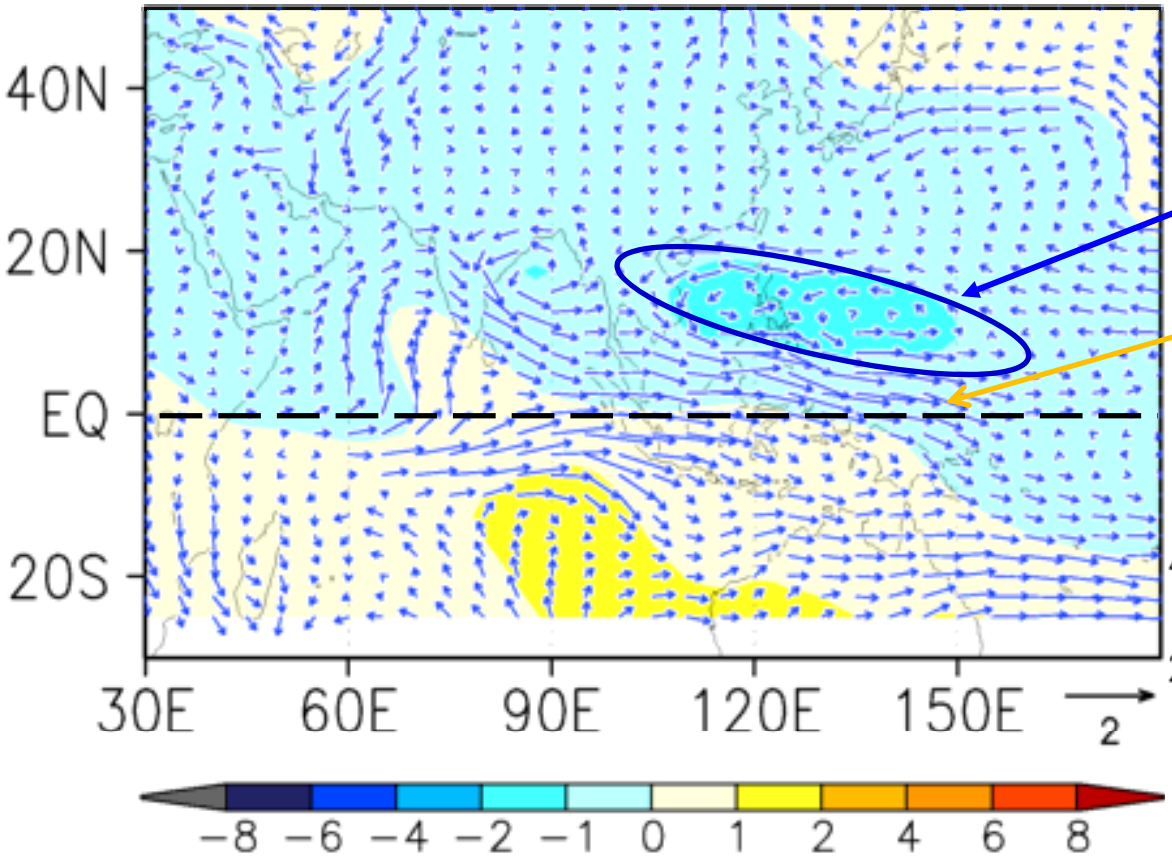
Cyclonic circulation anomalies around Philippines.

Westerly Wind anomalies



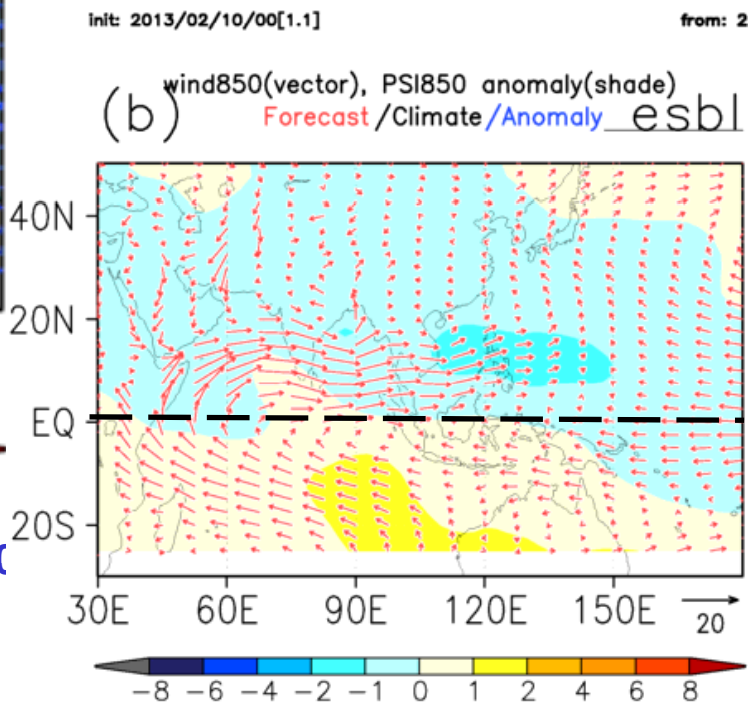
850hPa Wind and Stream Function Anomalies (July 2013)

Numerical Prediction
wind anomaly(vectors) and
stream function anomaly (color) 850hPa (August)



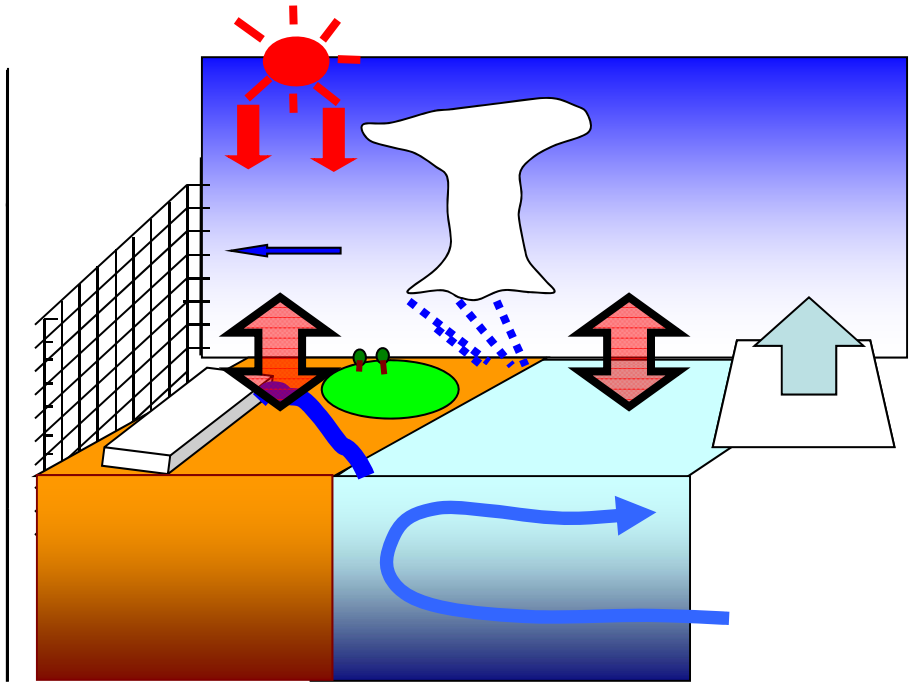
Cyclonic circulation anomalies around Philippines.

Westerly Wind anomalies



850hPa Wind and Stream Function Anomalies (August 2(

Outline of the EPS for seasonal forecast



ENSEMBLE: BGM&LAF

- Combination of BGM and LAF
- 9 members for each initial date
- Size: 51 (ENSO forecast: 30)
- Once a month

CGCM: JMA/MRI-CGCM

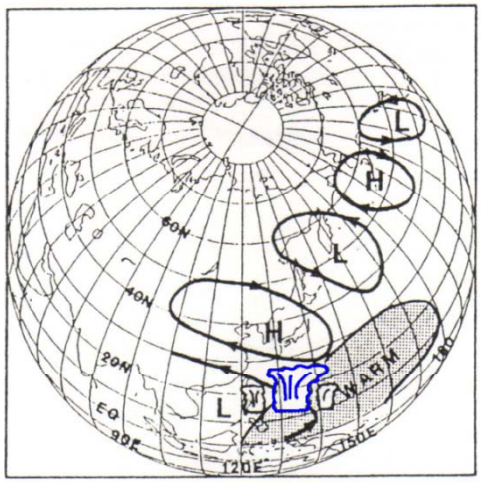
AGCM: JMA-GSM based on JMA/MRI unified model

- TL95: 1.875 deg ~ 180km
- L40: model top = 0.4hPa
- Land: SiB
- Sea ice: climatology
- Initial condition: JRA-25/JCDAS
- Initial perturbation: BGM (TRO, NH)

CGCM: MRI.COM

- 1.0deg in lon. X 0.3-1.0 deg in lat.
- 75N-75S, 0-360E
- L50
- Initial condition: MOVE/MRI-COM-G
- Initial perturbation: driven with BGM (TRO) of AGCM

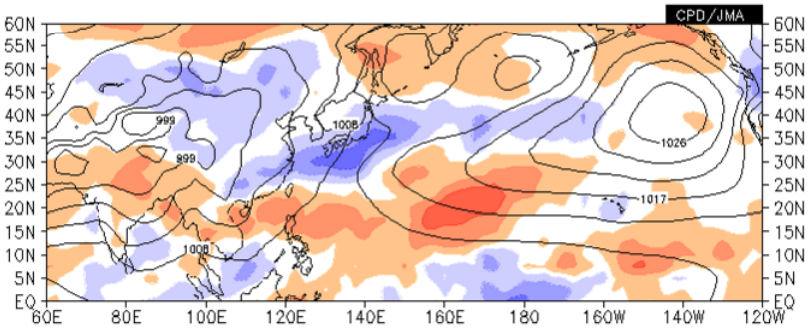
Pacific-Japan pattern



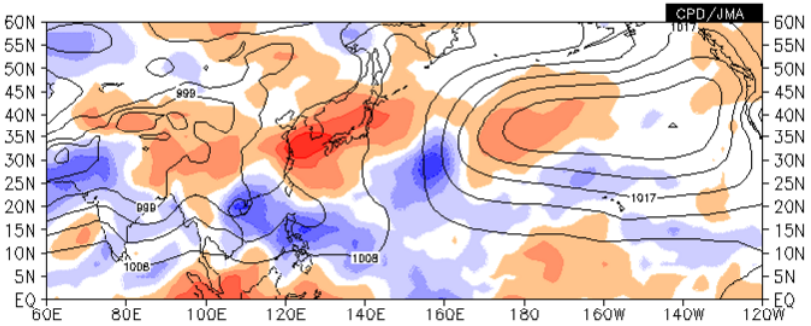
（Nitta, 1987）

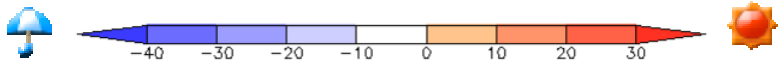
Contour: SLP
Shade: OLR anomaly

July 1993

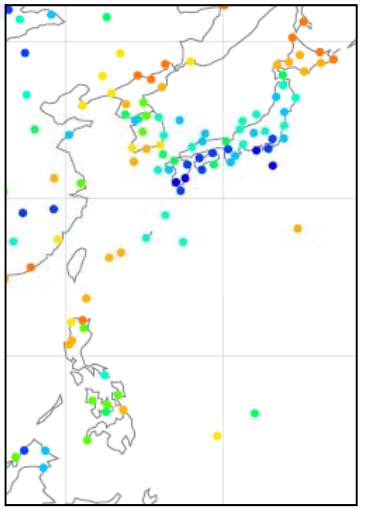


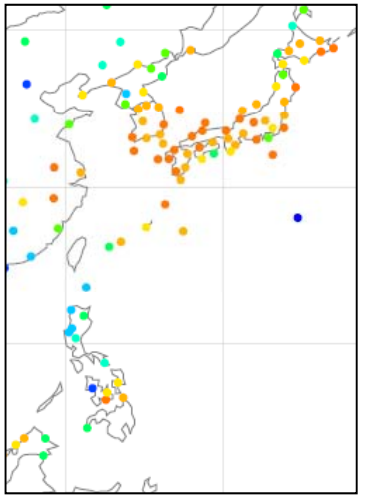
July 1994





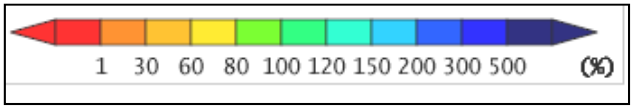
Precipitation Ratio (CLIMAT)





Below-Normal

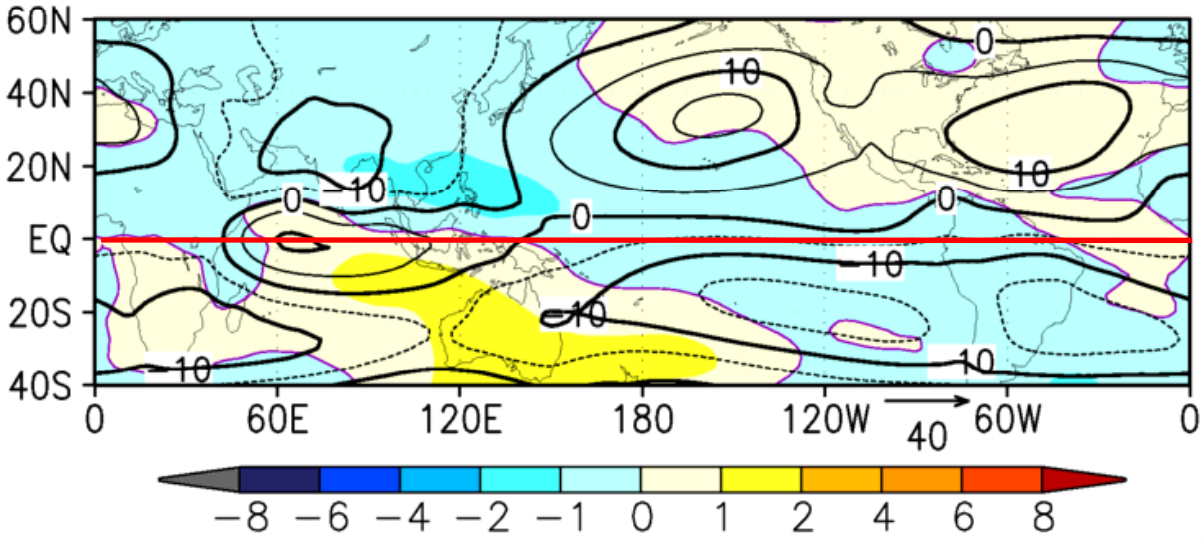
Above-Normal



The summer climate of East Asia is known to be deep relation with the convective activity around the Philippines through the propagation of the Rossby wave.

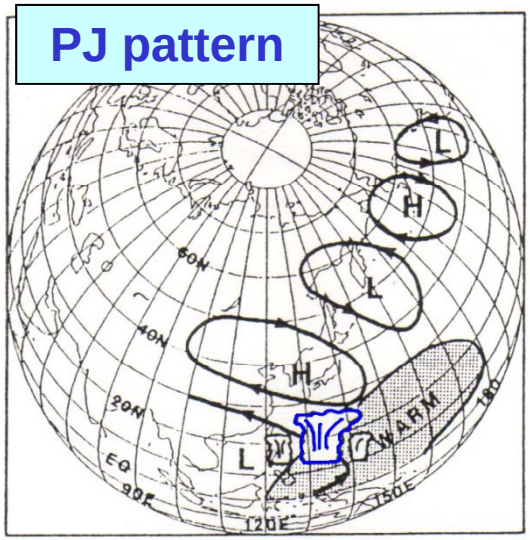
850hPa Stream Function and Anomalies JJA and Extension of the North Pacific High

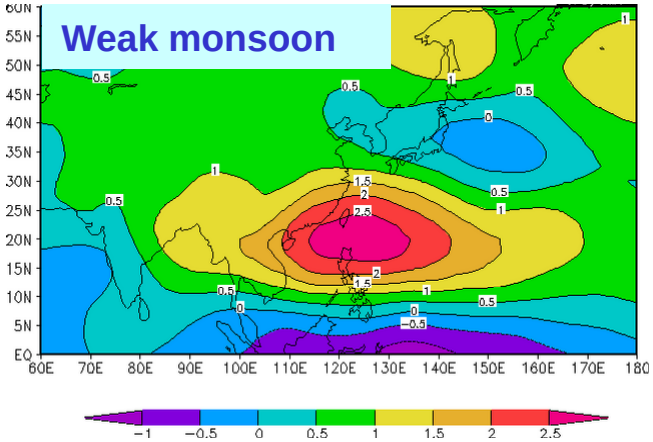
850hPa Stream Function and Anomalies JJA 2013



Nitta (1987)

PJ pattern





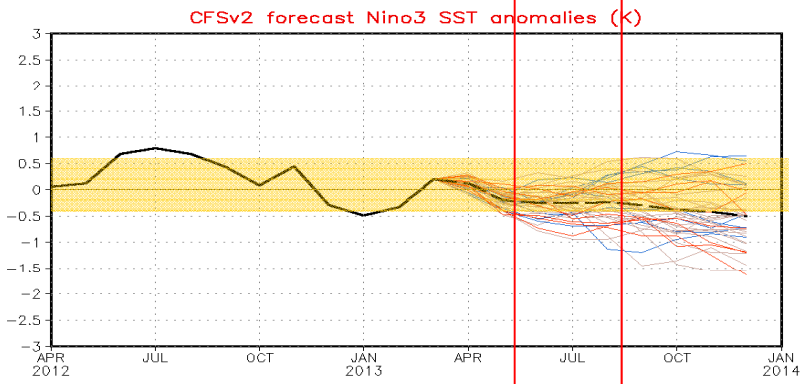
Composites of 850hPa Stream Function fields for weak monsoon years.

(1980,1983,1993,1996,1998,2007)

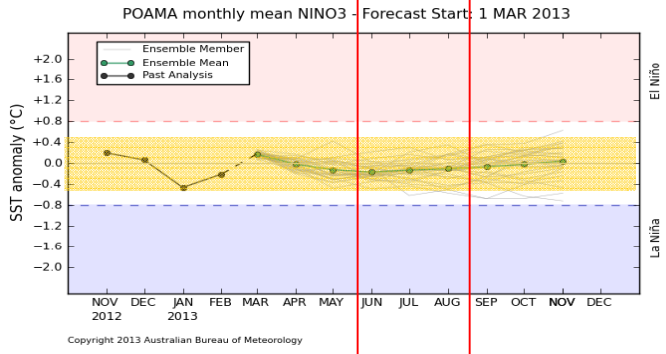
Hot summer hit southern Japan in all of those years.

Data Source: JRA-25

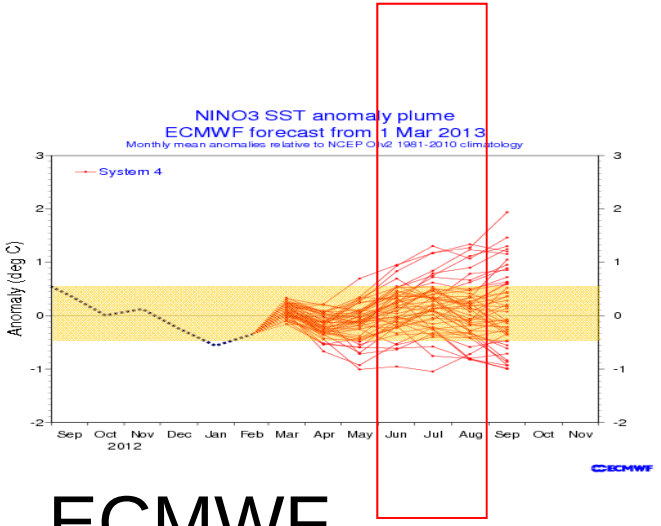
Oceanic Condition and Outlook
NINO3 SST predictions of other centers



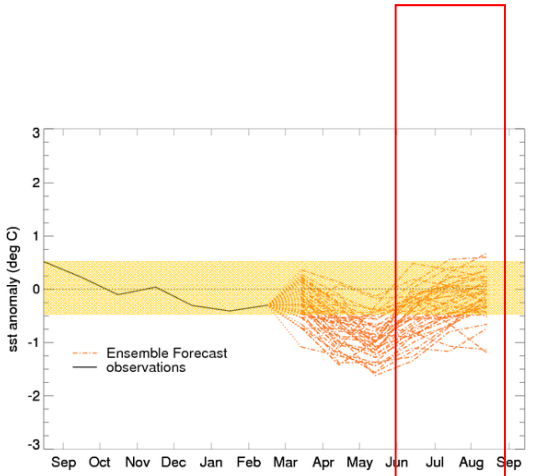
NOAA/CPC summer



AUS/BoM summer



ECMWF summer



UKMet summer

Summary and interpretation for June – August 2013

Numerical prediction

・The JMA's coupled global circulation model predicts that the NINO.3 SST will be below normal into the northern hemisphere spring, and become near normal thereafter. Therefore, ENSO neutral conditions are likely to continue during the northern hemisphere summer 2013. The SST in the tropical Indian Ocean region (IOBW) will be near normal or below normal during the northern hemisphere spring and summer. The SST in the tropical western Pacific region (NINO.WEST) will be near normal during the northern hemisphere spring and summer.

・The predicted atmospheric circulation anomaly pattern in the tropics and the sub-tropics is similar to that seen in the case of negative SST anomaly in the IOBW as stated below.

・Three-month precipitation anomalies are predicted to be below normal in the equatorial Indian Ocean. On the other hand, they are predicted to be above normal from the Bay of Bengal to the east of the Philippines. The Tibetan high is predicted to be stronger than normal, and the subtropical jet, which flows along the northern edge of the Tibetan high, is likely to shift northward from its normal position. As a result, the North Pacific high is predicted to be stronger than normal over northern, eastern and western Japan. On the other hand, it is predicted to be weaker than normal over Okinawa/Amami.

・The tropospheric thickness temperature averaged over the mid-latitudes of the Northern Hemisphere (30° N – 50° N), which is correlated with temperatures over Japan, is predicted to be slightly above normal.

Summary and interpretation for June – August 2013

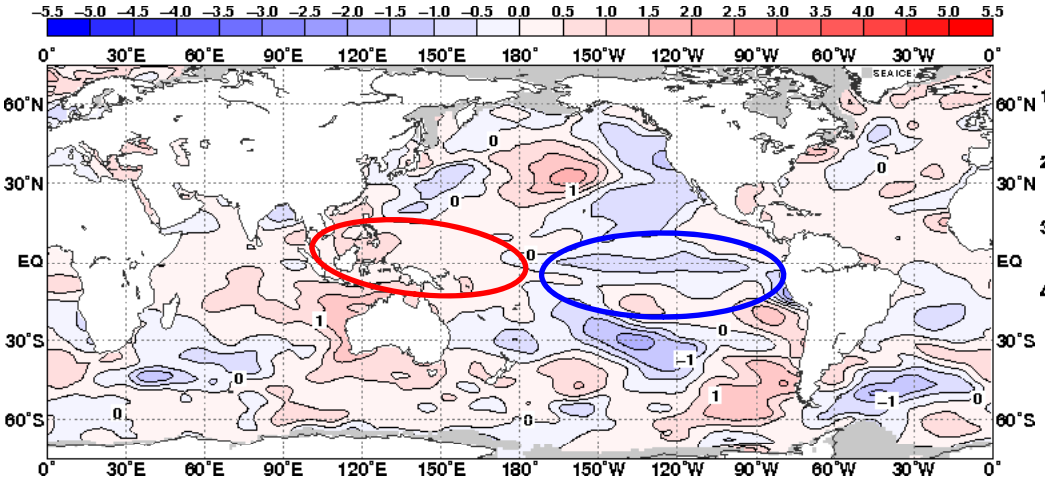
Conclusion

・As the characteristics of the atmospheric circulation around Japan, the North Pacific high is likely to shift northward from its normal position. Northern, eastern and western Japan are expected to experience above normal or near normal temperatures covered by the North Pacific high. Okinawa/Amami is expected to be influenced by moist southerly flow more frequently than normal.

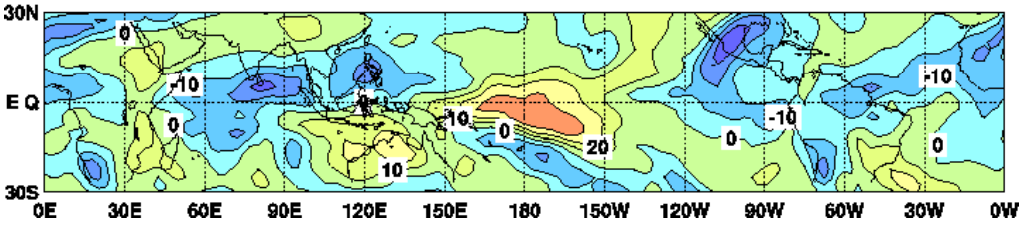
Summary of the Outlook

・Summer mean temperatures are expected to be both near normal and above normal with 40% probabilities in northern, eastern and western Japan. Summer precipitation amounts are expected to be both near normal and above normal with 40% probabilities in Okinawa/Amami. Precipitation anomalies during the Baiu period (rainy season) have no particular features for all regions.

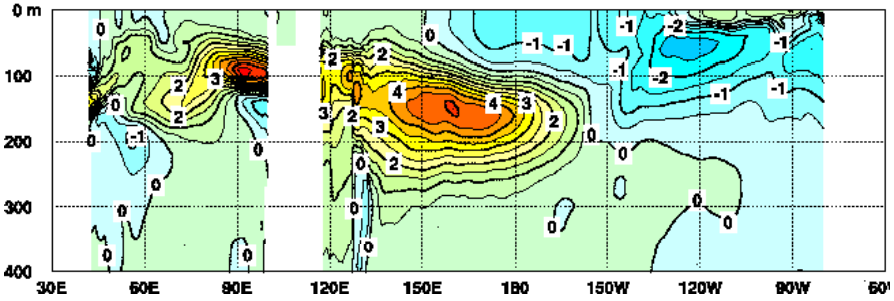
Oceanic Condition and Outlook (1)
Oceanic Condition in February 2013



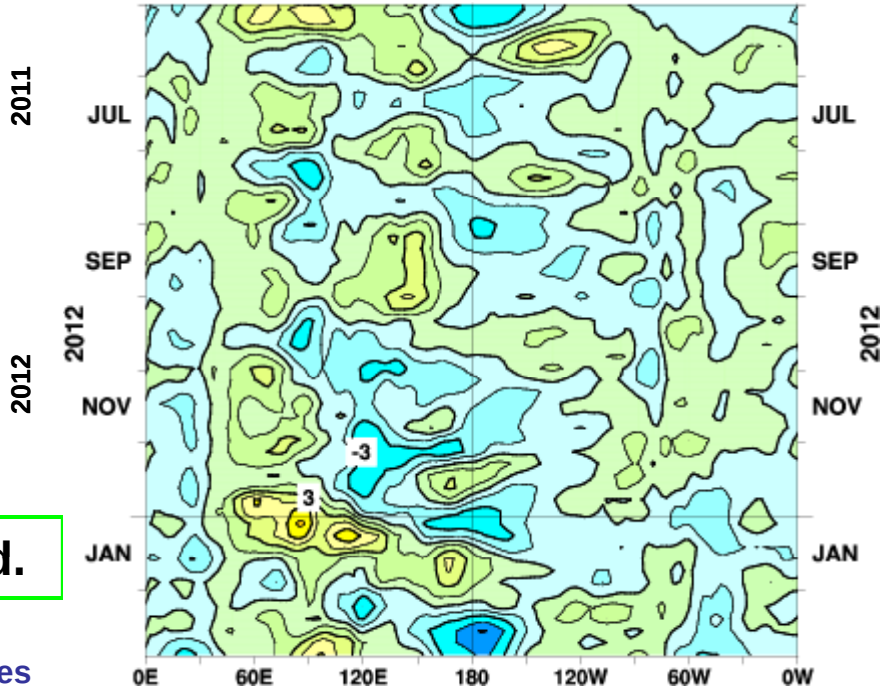
Monthly SST Anomalies



Monthly mean outgoing longwave radiation (OLR) and anomalies



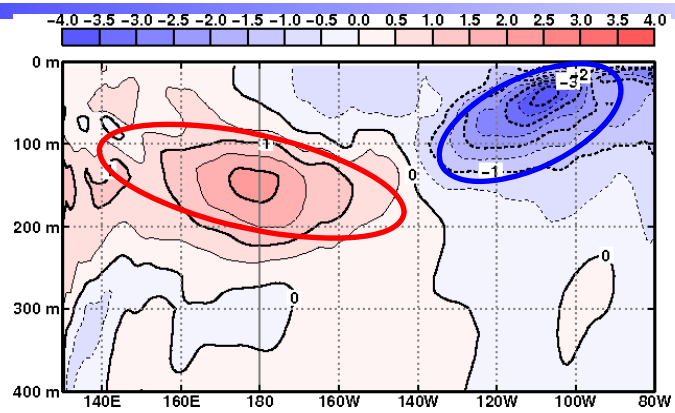
Depth-longitude cross section of temperature and anomalies along the equator in the Indian and Pacific Oceans.



La Niña conditions are likely to have decayed.

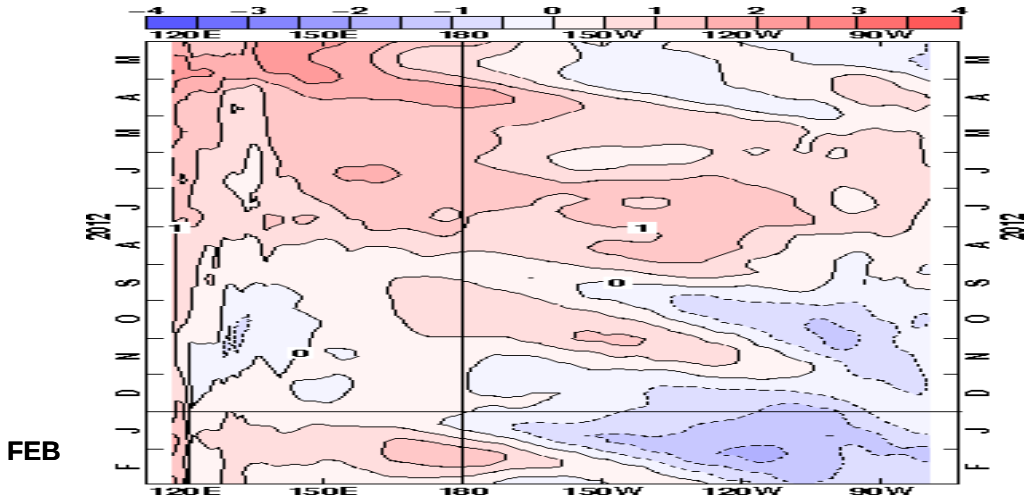
Time-longitude cross sections of zonal wind anomalies at 850 hPa along the equator.

Oceanic Condition and Outlook
Ocean Heat Content along the equator



Depth-longitude cross section of temperature and anomalies along the equator in the Indian and Pacific Oceans. (Feb. 2013)

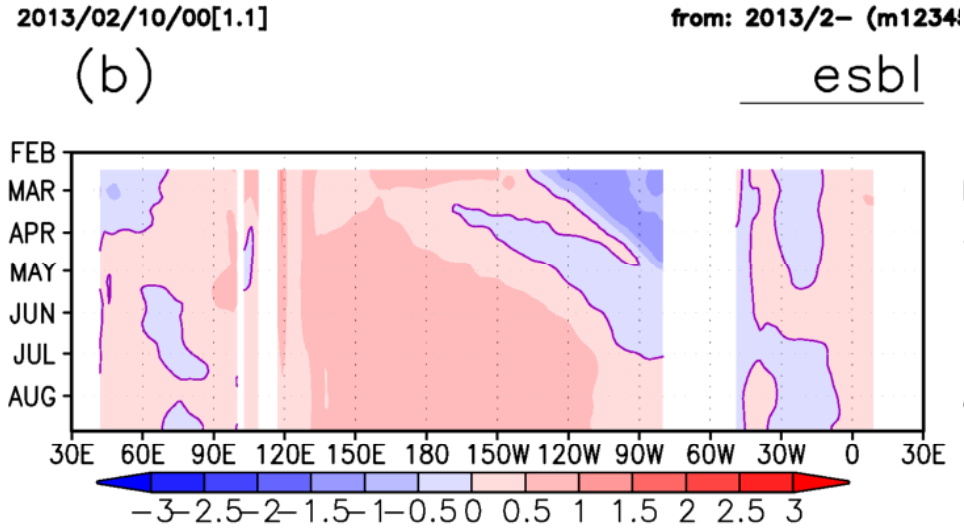
Positive subsurface temperature anomalies were found in the western equatorial Pacific, while negative subsurface temperature anomalies were found in the central and eastern parts.



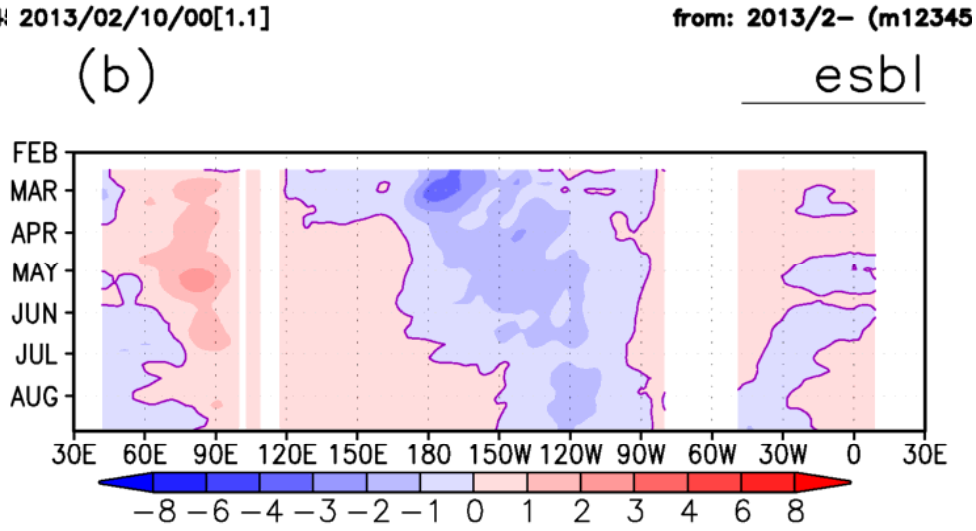
Time-longitude cross section of ocean heat content (OHC; vertically averaged temperature in the top 300 m) anomalies along the equator in the Pacific Oceans. (Jan. 2013)

The positive anomalies expanded from the western part to the central part in February. Migration of the positive anomalies would weaken negative SST anomalies in the eastern equatorial Pacific.

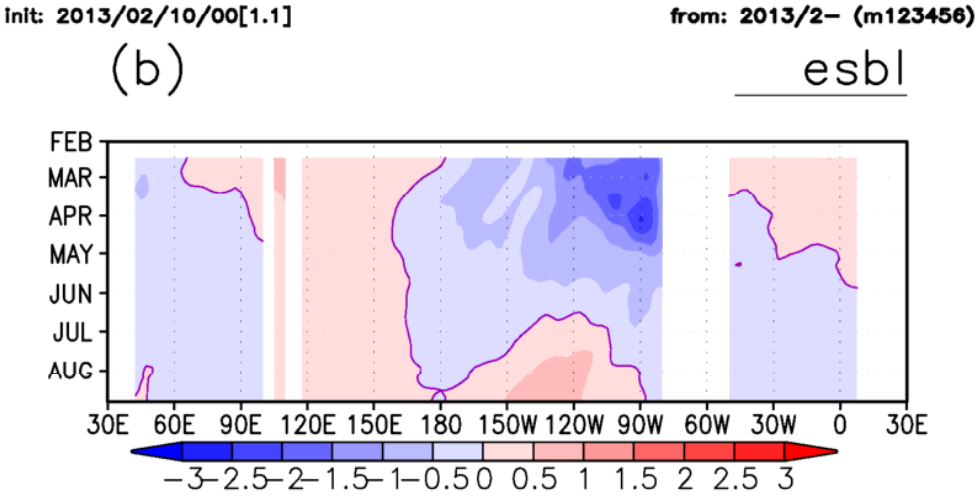
Oceanic Condition and Outlook



OHC(ocean heat content)



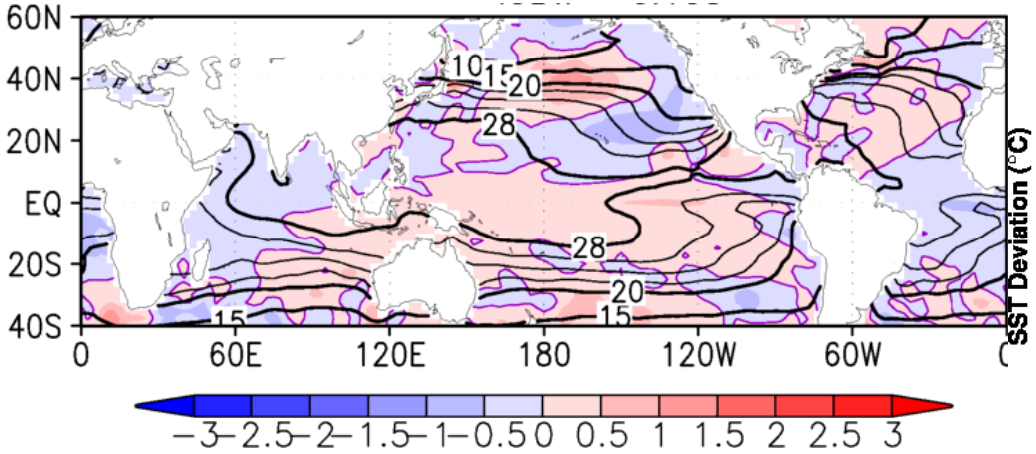
WSX(Wind stress zonal wind)



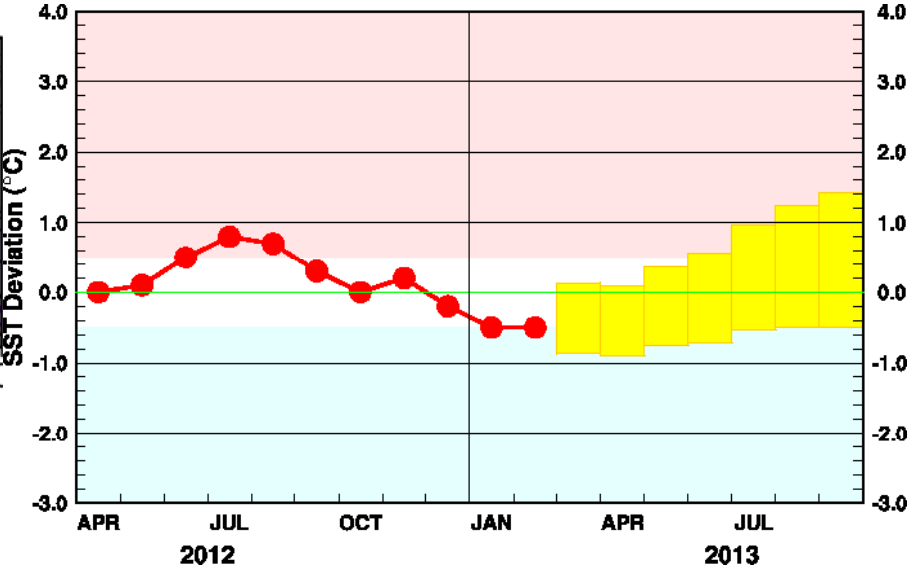
SST(sea surface temperature)

SST forecast

The JMA's El Niño prediction model predicts that the current below-normal NINO.3 SST will gradually come closer to normal during the northern hemisphere spring. Although the model predicts above-normal NINO.3 SST in summer, uncertainties in the prediction is large for the later half of the prediction period . It is likely that current La Niña conditions will decay during the northern hemisphere spring. While development of El Niño conditions in summer may be possible, it is more likely that ENSO-neutral conditions will persist, considering bias characteristics in the model prediction.



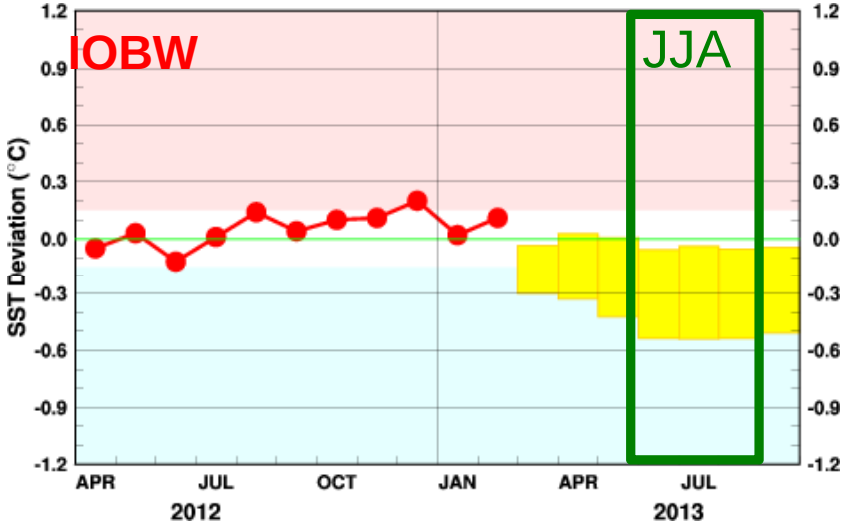
SST Forecast and Anomalies (Jun-Aug mean)

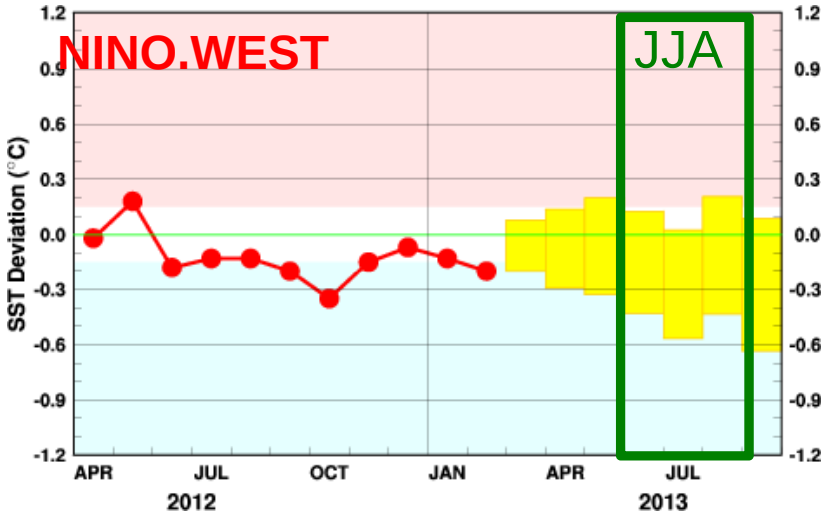


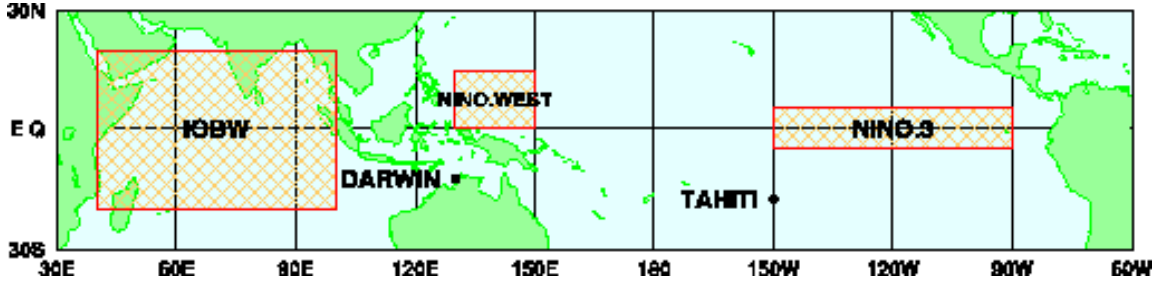
The monthly SST deviation in NINO.3.

Oceanic Condition and Outlook (3)
NINO.WEST and IOBW SST forecast

The SST in the tropical Indian Ocean region (IOBW) will be near normal or below normal during the northern hemisphere spring and summer.
The SST in the tropical western Pacific region (NINO.WEST) will be near normal during the northern hemisphere spring and summer.





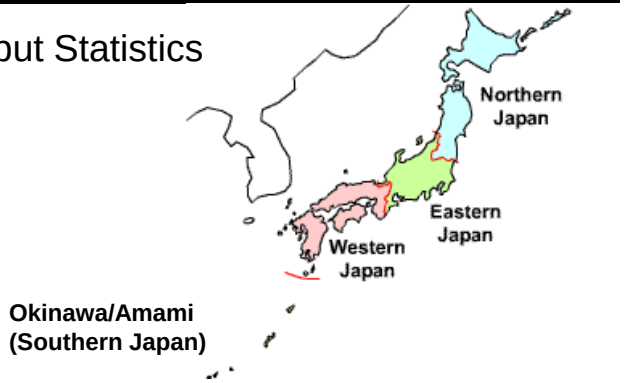


Numerical Prediction
MOS products（Guidance)

Summertime Temperature 2013

MOS products	Probability(%)		
	Below Normal	Near Normal	Above Normal
Northern Japan	17	33	50
Eastern Japan	26	26	48
Western Japan	21	34	45
Okinawa/Amami(Southern Japan)	28	29	43

The numerical guidance are generated using Model Output Statistics (MOS) technique based on hindcast experiments.

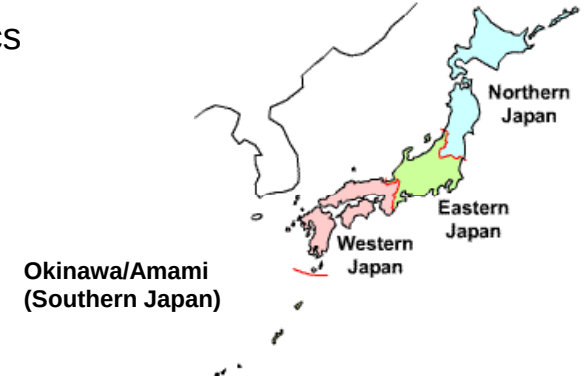


Numerical Prediction
MOS products（Guidance)

Summertime Temperature 2013

MOS products	Probability(%)		
	Below Normal	Near Normal	Above Normal
Northern Japan	34	25	41
Eastern Japan	25	43	32
Western Japan	35	28	37
Okinawa/Amami(Southern Japan)	34	29	37

The numerical guidance are generated using Model Output Statistics (MOS) technique based on hindcast experiments.

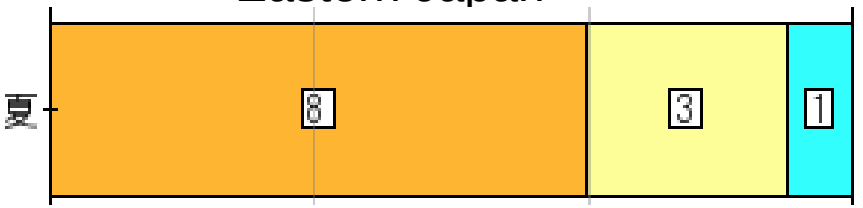


Relationship between temperature and precipitation

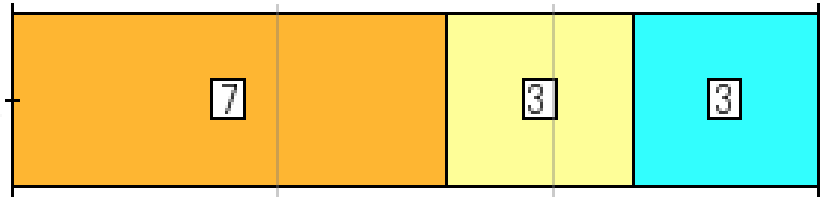
Relationship between the amount of precipitation at high temperatures (1981-2012)

Northern Japan

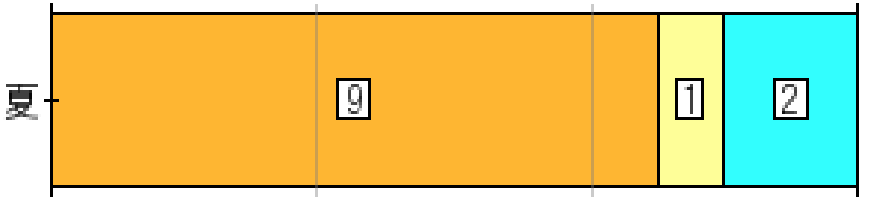
Eastern Japan



Western Japan



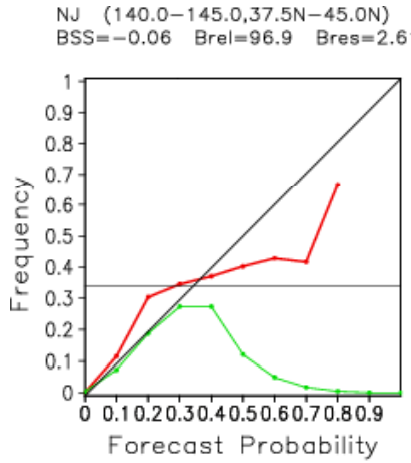
Okinawa/Amami

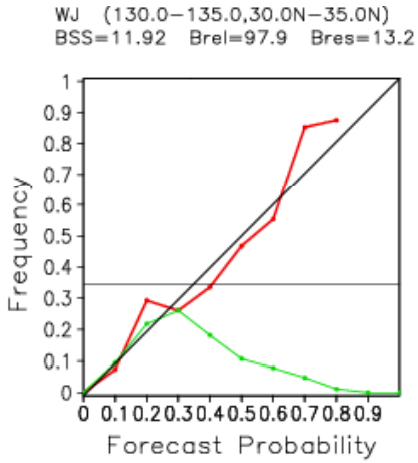


Numerical Prediction (7)
Skill of the Numerical Guidance

Reliability Diagram for temperature

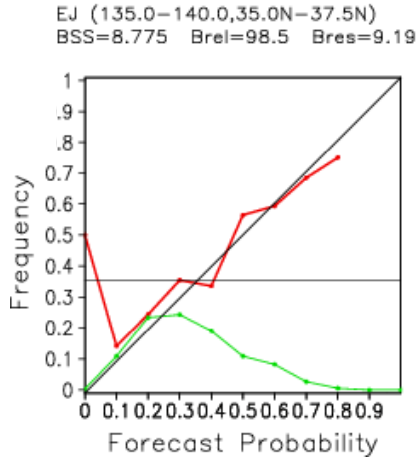
Northern Japan

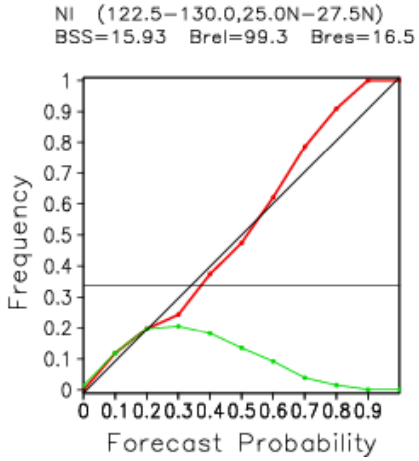




Western Japan

Eastern Japan





Southern Japan

History of seasonal forecasting in Japan

1942： Official announcement of 1 month forecast
(forecast section long range forecast staff)

49： Long range forecast section abolished

74： Long range forecast section established （17 staff members）

95： Begin assimilation of marine dat

96： Start of probabilistic forecast and introduction of forecasting one month ensemble numeric values

99： Start of El Nino prediction based on combined atmospheric and marine models

Start of long term atmospheric re-analysis

2001： Begin assimilation of land surface data

02： Begin 3 month warm/cold season forecasts based on numeric prediction model

03： Completion of long term atmospheric re-analysis

06： Improvement of numeric forecast guidance and start providing early warning

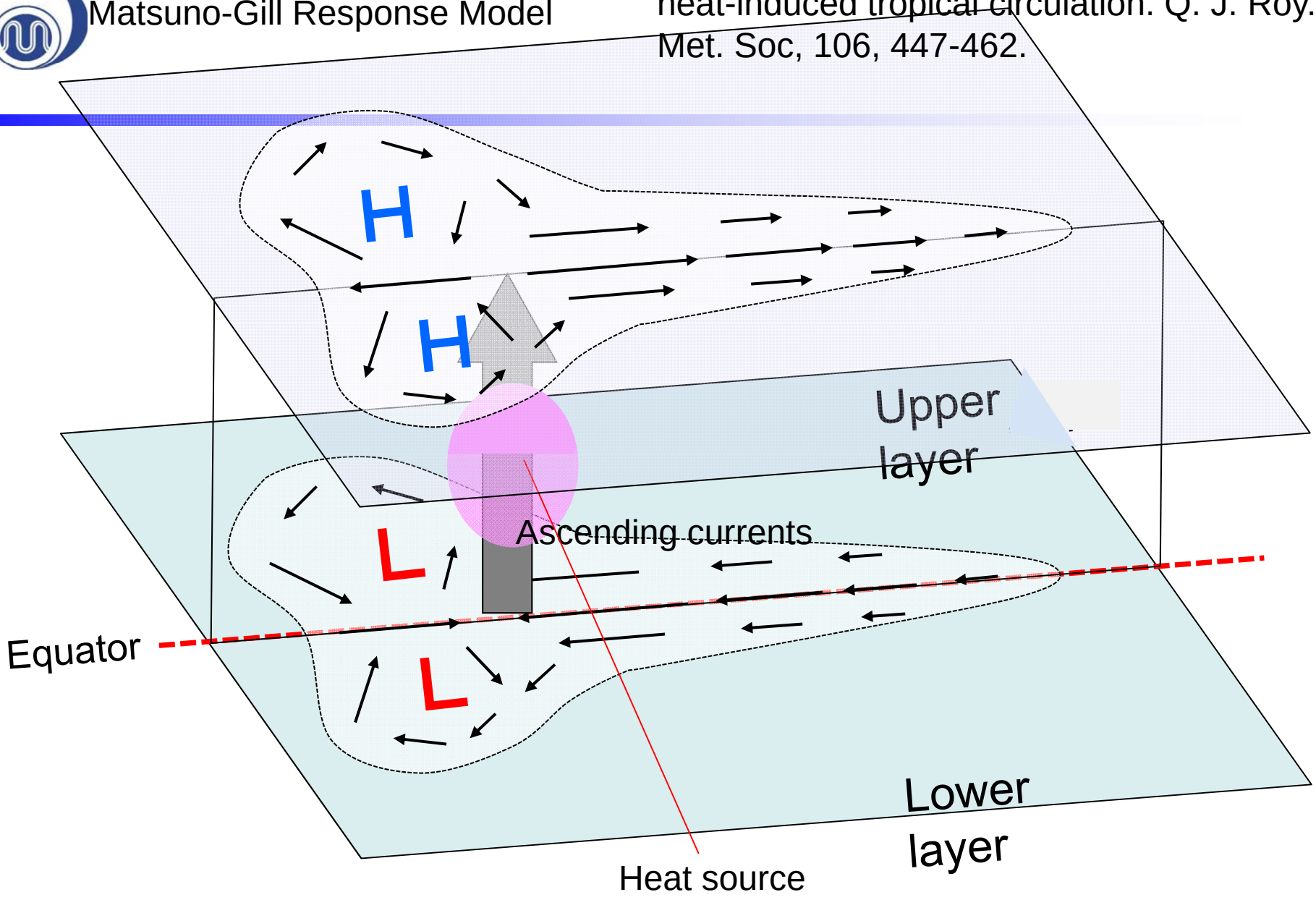
08： information on extreme weather

10： **Begin seasonal forecast from combined atmospheric and marine model (CGCM:coupled global circulation model)**

●Supplementary information

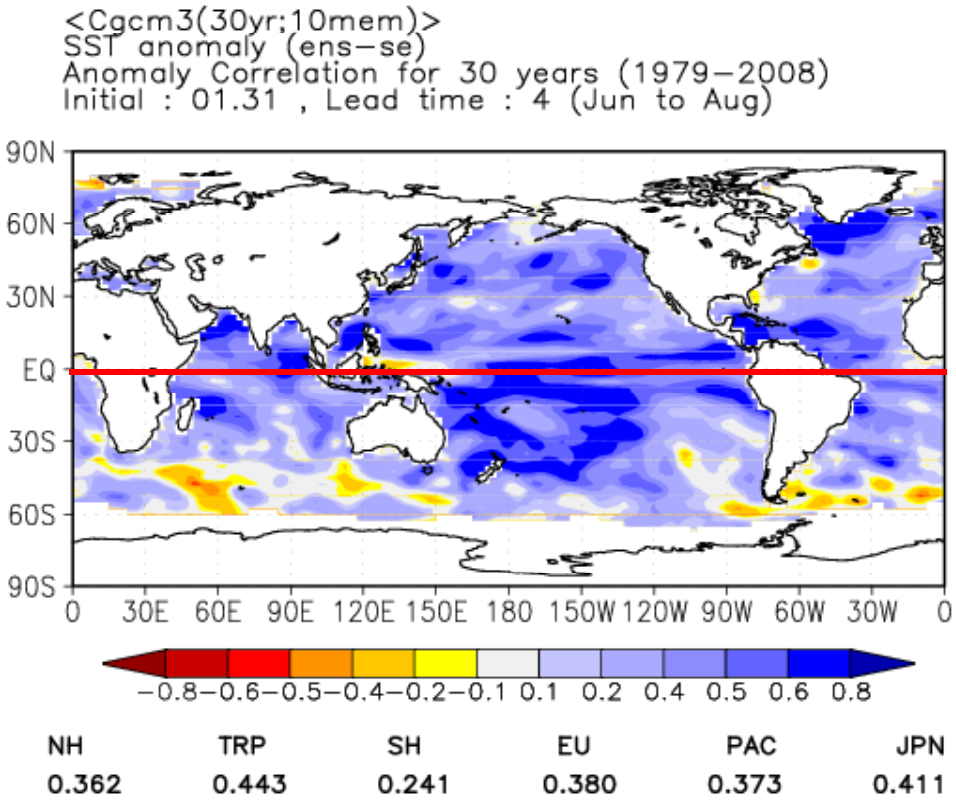
Matsuno-Gill Response Model

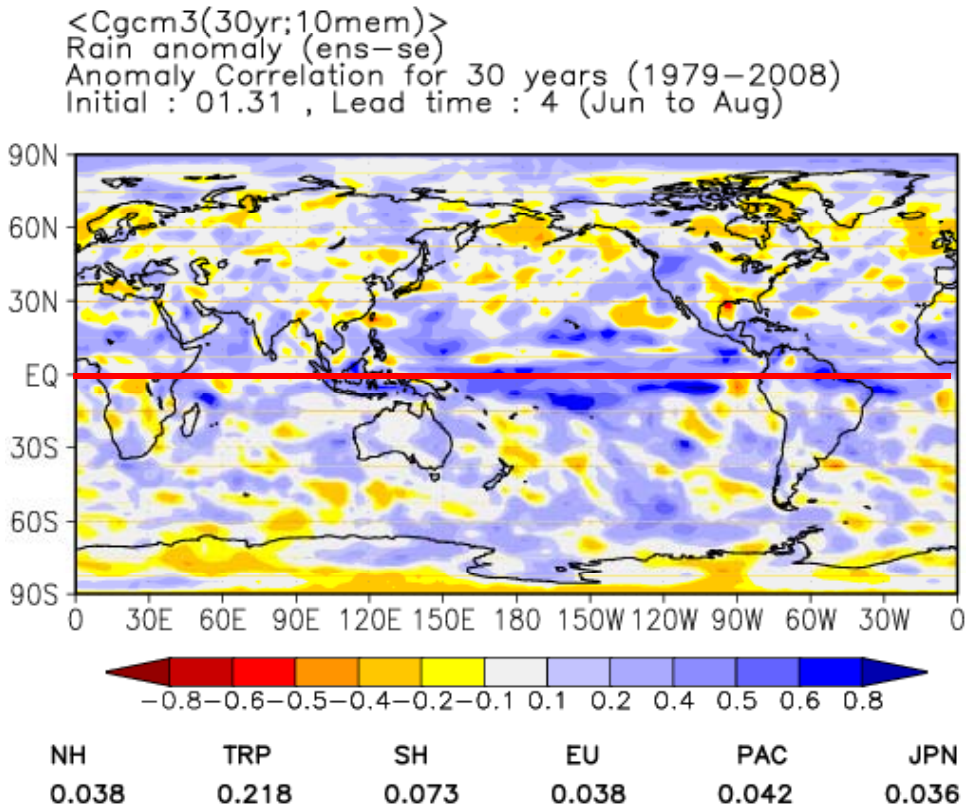
Gill, A.E., 1980: Some simple solutions for heat-induced tropical circulation. Q. J. Roy. Met. Soc, 106, 447-462.



Heated by emission of latent heat (steam → raindrops)

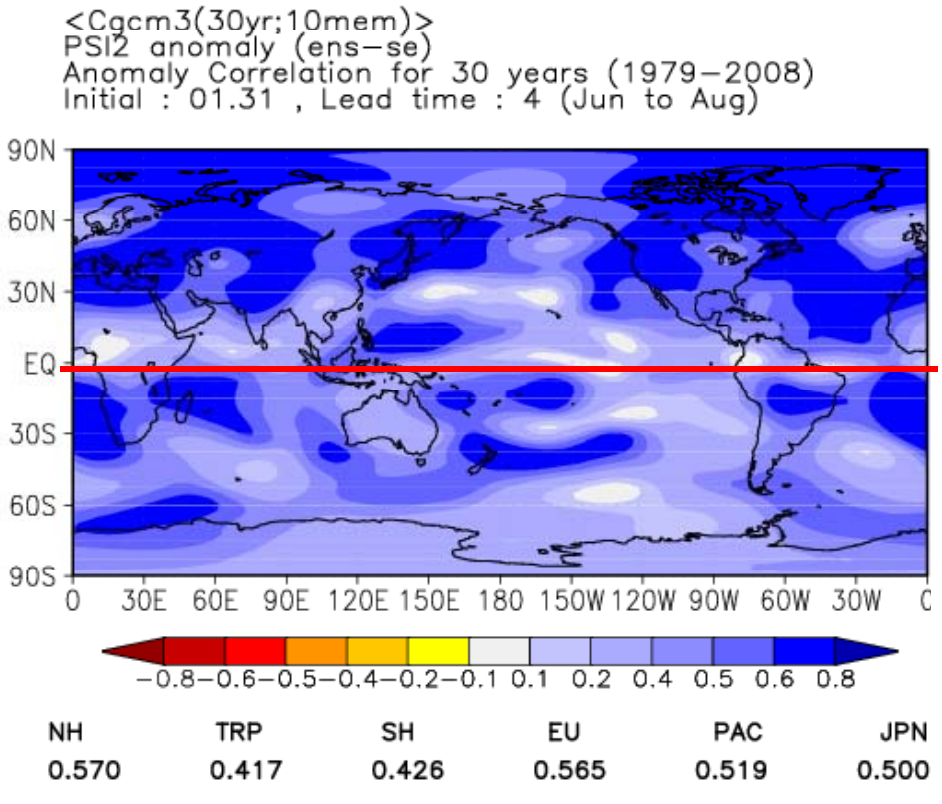
Prediction accuracy

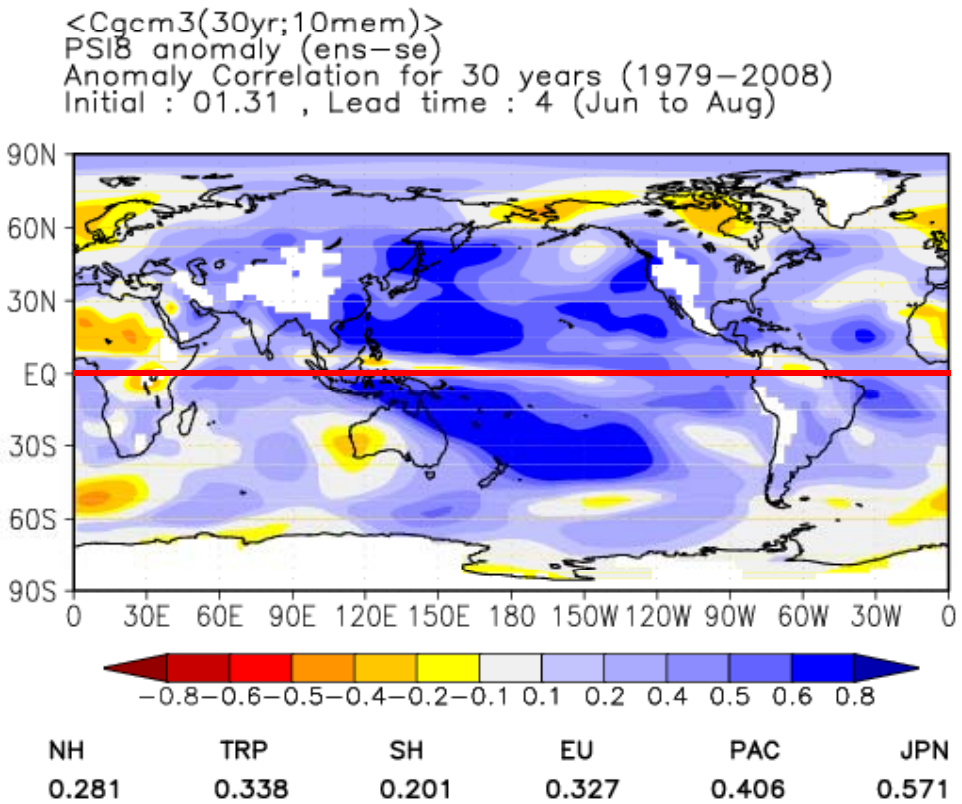




left : SST anomaly correlation initial 31Jan. Lead time 4 month
light : Rain anomaly correlation initial 31Jan. Lead time 4 month

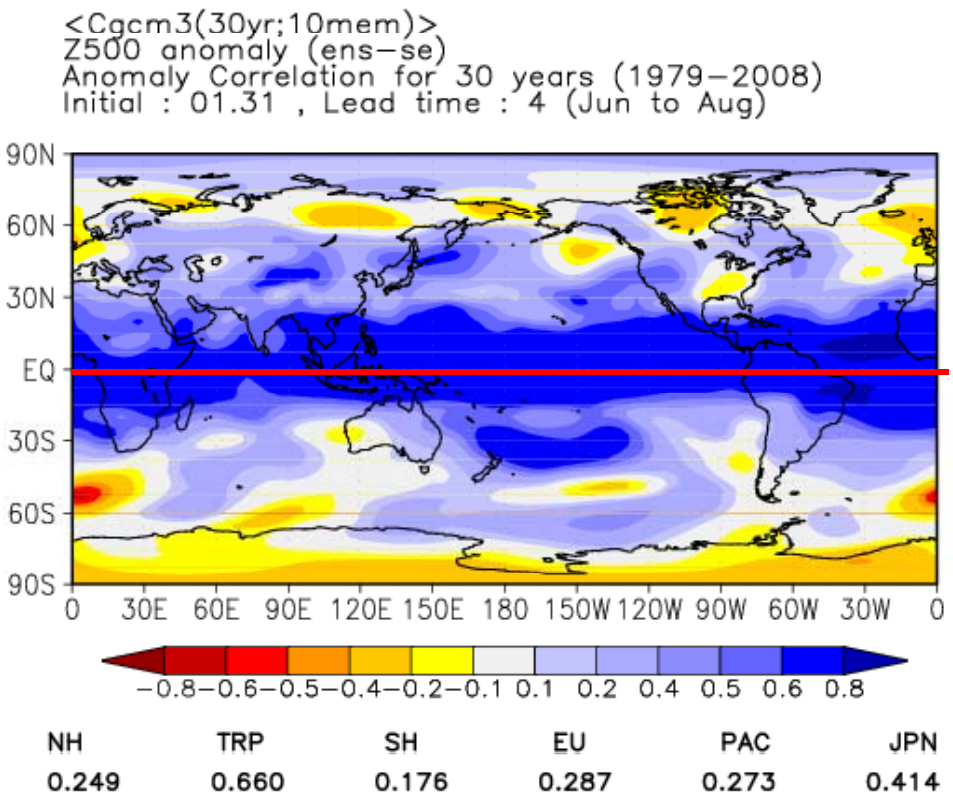
Prediction accuracy

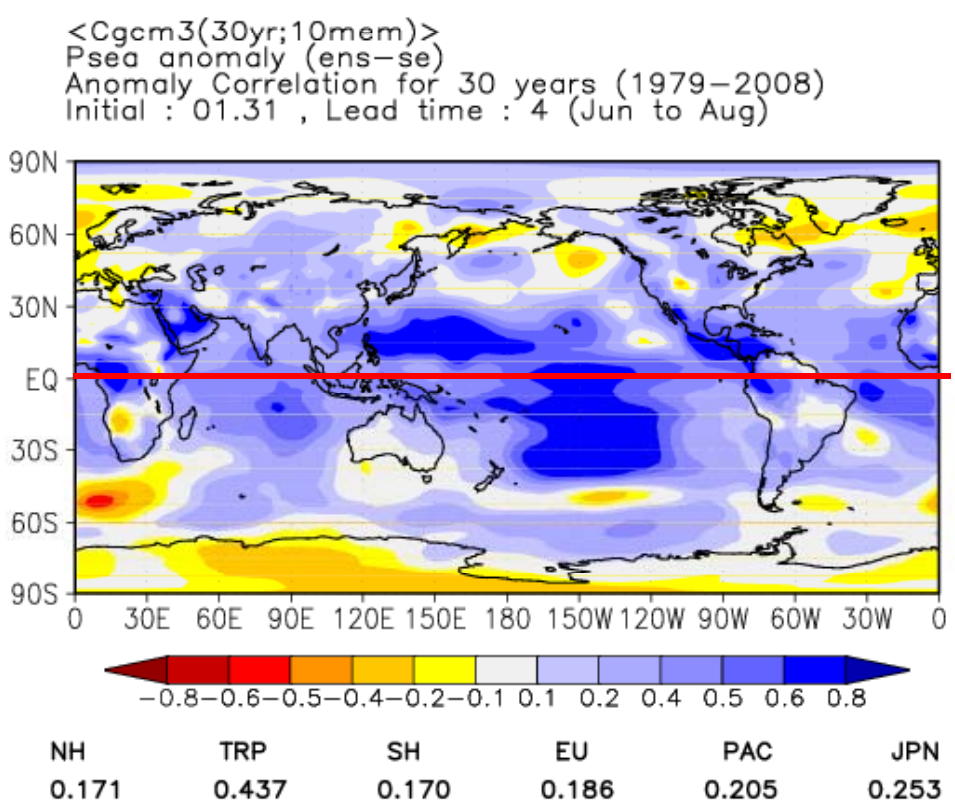




left : 200hPa stream function anomaly correlation initial 31Jan.
Lead time 4 month
light : 850hPa stream function anomaly correlation initial 31Jan.
Lead time 4 month

Prediction accuracy

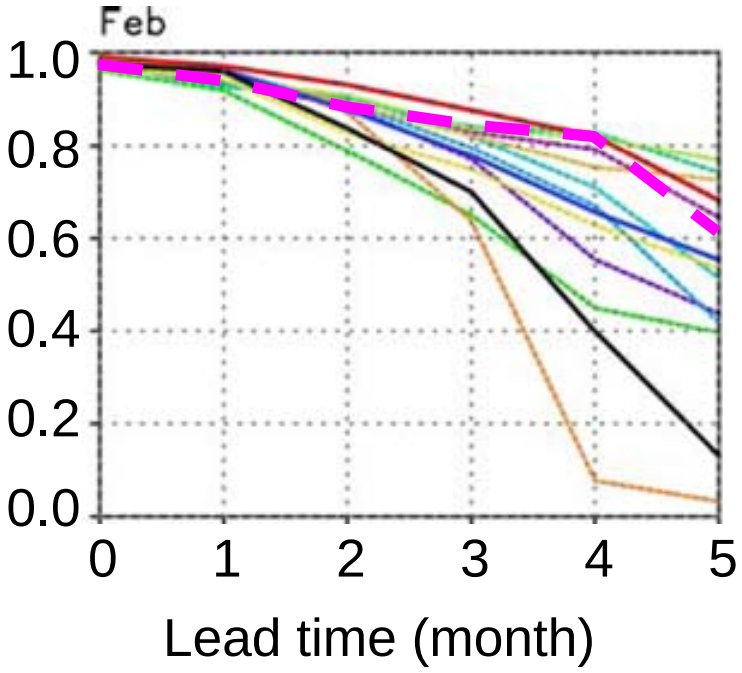




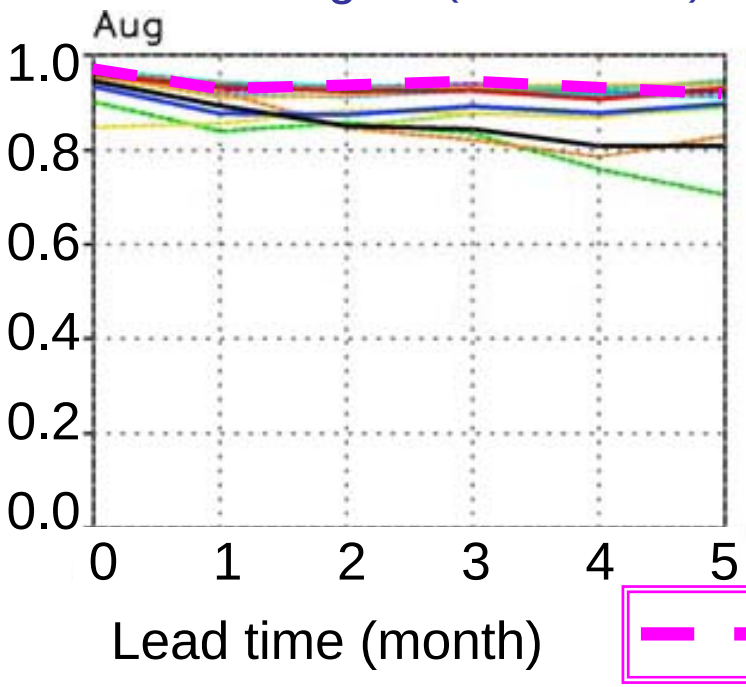
left : 500hPa height anomaly correlation initial 31Jan. Lead time 4 month
light : S.L.P anomaly correlation initial 31Jan. Lead time 4 month

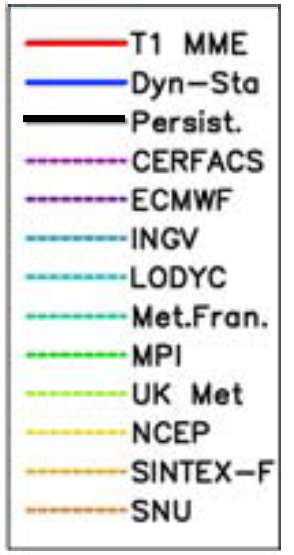
Skill of NINO3.4 SST

Initial: February (1980-2001)



Initial: August (1980-2001)





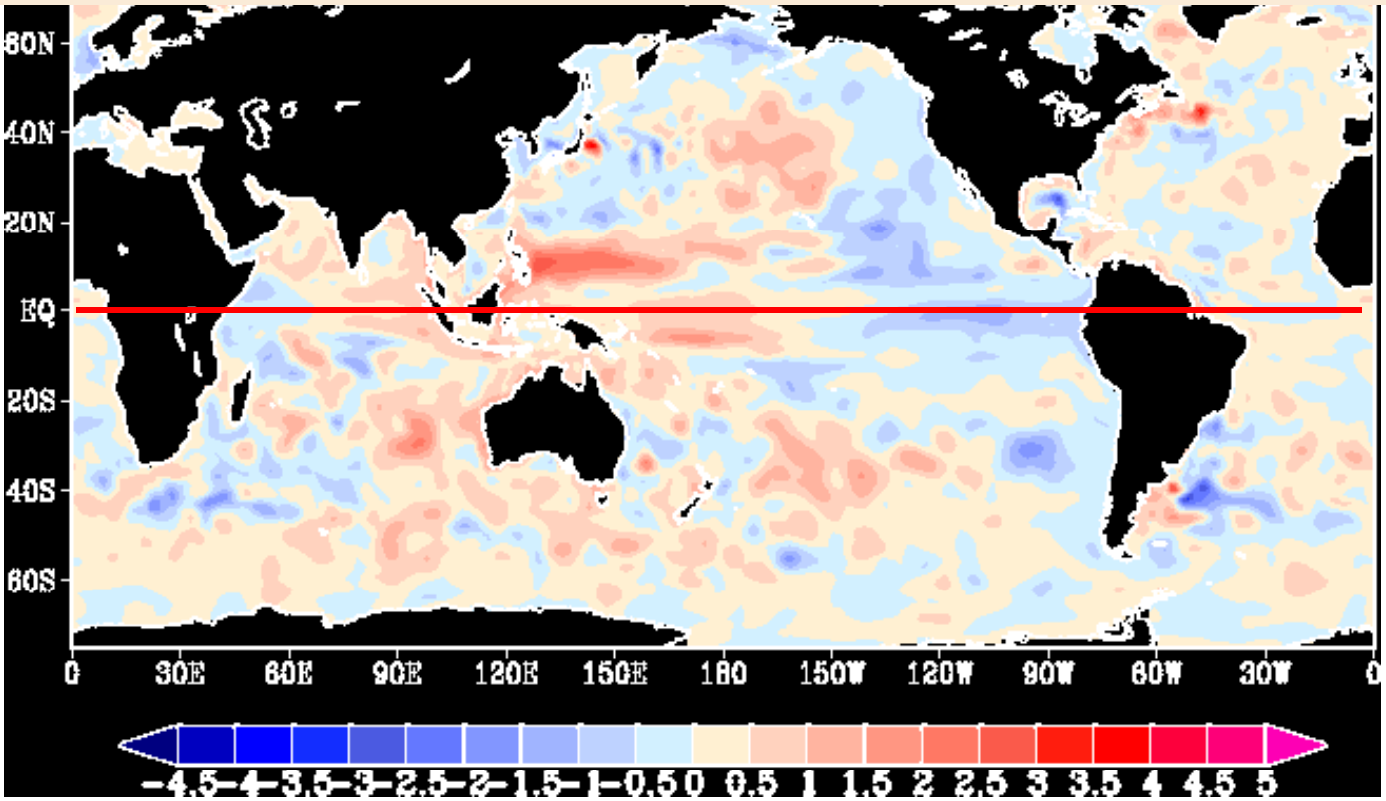
(JMA/MRI-CGCM)

NINO3.4 region: 120W-170W, 5S- 5N

(quote from Fig. 8 of Jin et al. 2008)

Oceanic Condition and Outlook
Current Condition in February 2013

Subsurface temperatures were above normal in the western equatorial Pacific, and below normal from the central part to the eastern part, and below normal in the western equatorial Indian Ocean.



Monthly mean ocean heat content (OHC; vertically averaged temperature in the top 300 m) anomalies (Feb.2013)