

JMA's seasonal forecast for 2008/09 winter

~ Winter forecast without El Niño or La Niña ~

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Outline

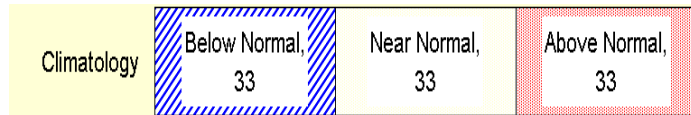
1. Introduction
2. Grounds for JMA's seasonal forecast for 2008/2009 winter
 - 2.1 Long-term trend including decadal variation
 - 2.2 Current Oceanic Condition and El Niño Outlook
 - 2.3 Numerical Prediction
3. Summary

1. Introduction

JMA's cold season forecast

Main forecast elements

Probabilities of 3 categories (below, near, above normal) of DJF mean temperature, precipitation, and snowfall (only Sea of Japan side)

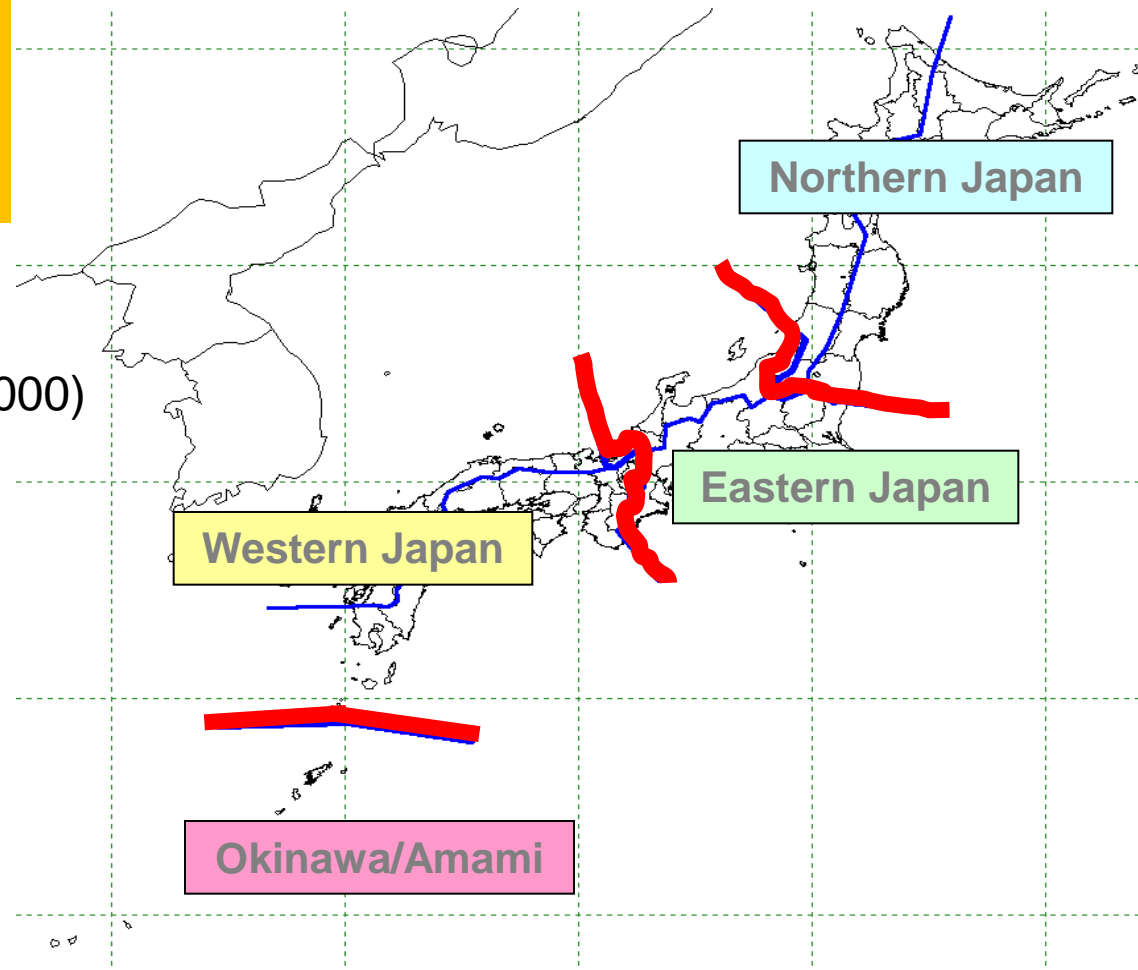


(Base period of normal is 1971-2000)

Issue date

About 25th September
(revision about 25th October)

Geographical subdivisions of Japan



Forecast tools

- **Numerical Prediction Model**

- AGCM (TL95L40) with prescribed SST

- SST is statistically predicted based on the observed anomalies and El Niño prediction by JMA-CGCM3

- Ensemble size is 51

- Evaluated by 22-years hindcast

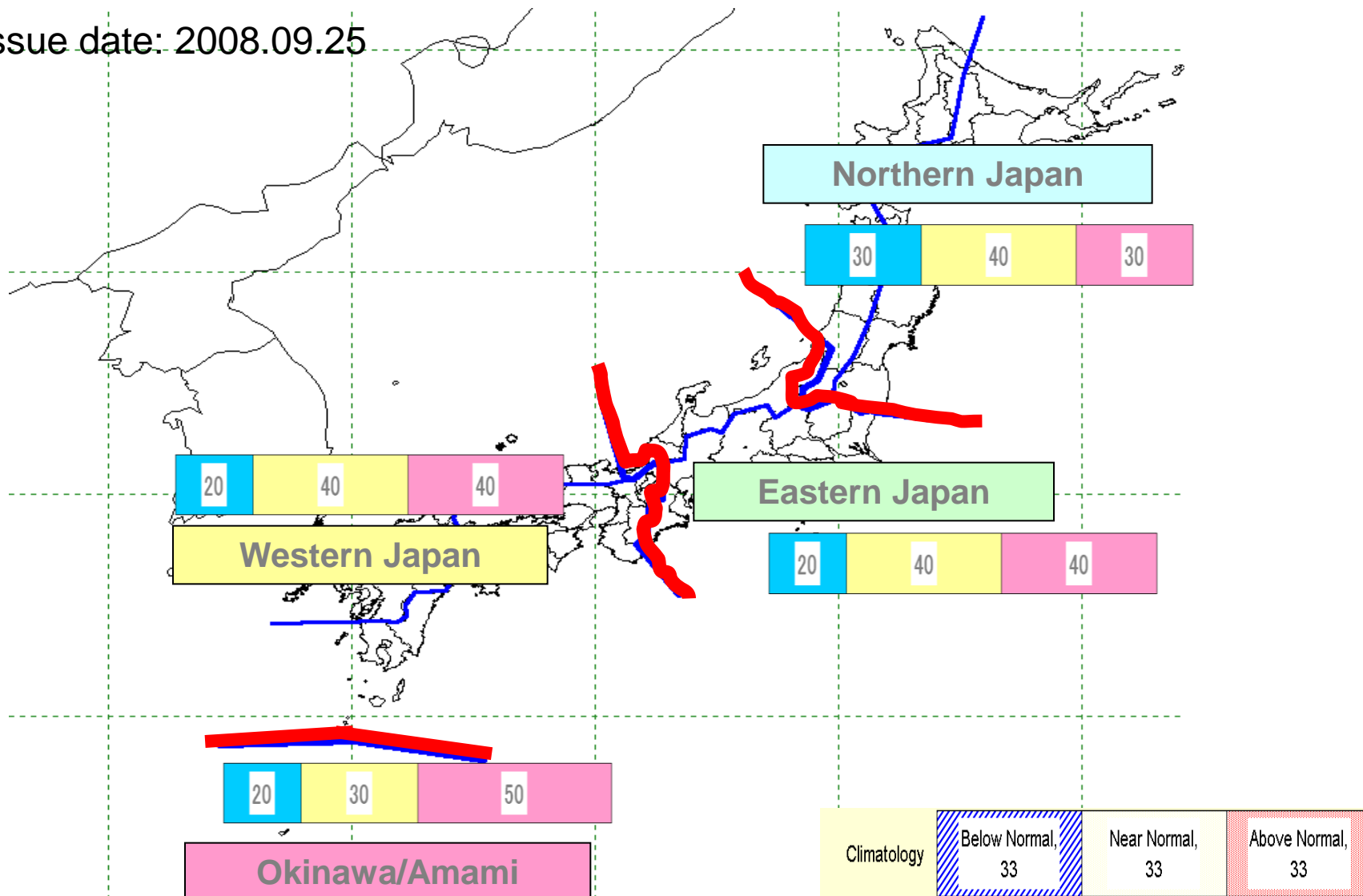
- **Statistical Models**

- OCN (Recent 10-years mean) : Long-term trend & Decadal variation signal

- OCCA (Lag relation between large scale SST pattern and Temp.&Prec. in Japan) : ENSO and Long-term trend & Decadal variation signal

Probabilities of 2008/09 DJF Temperature

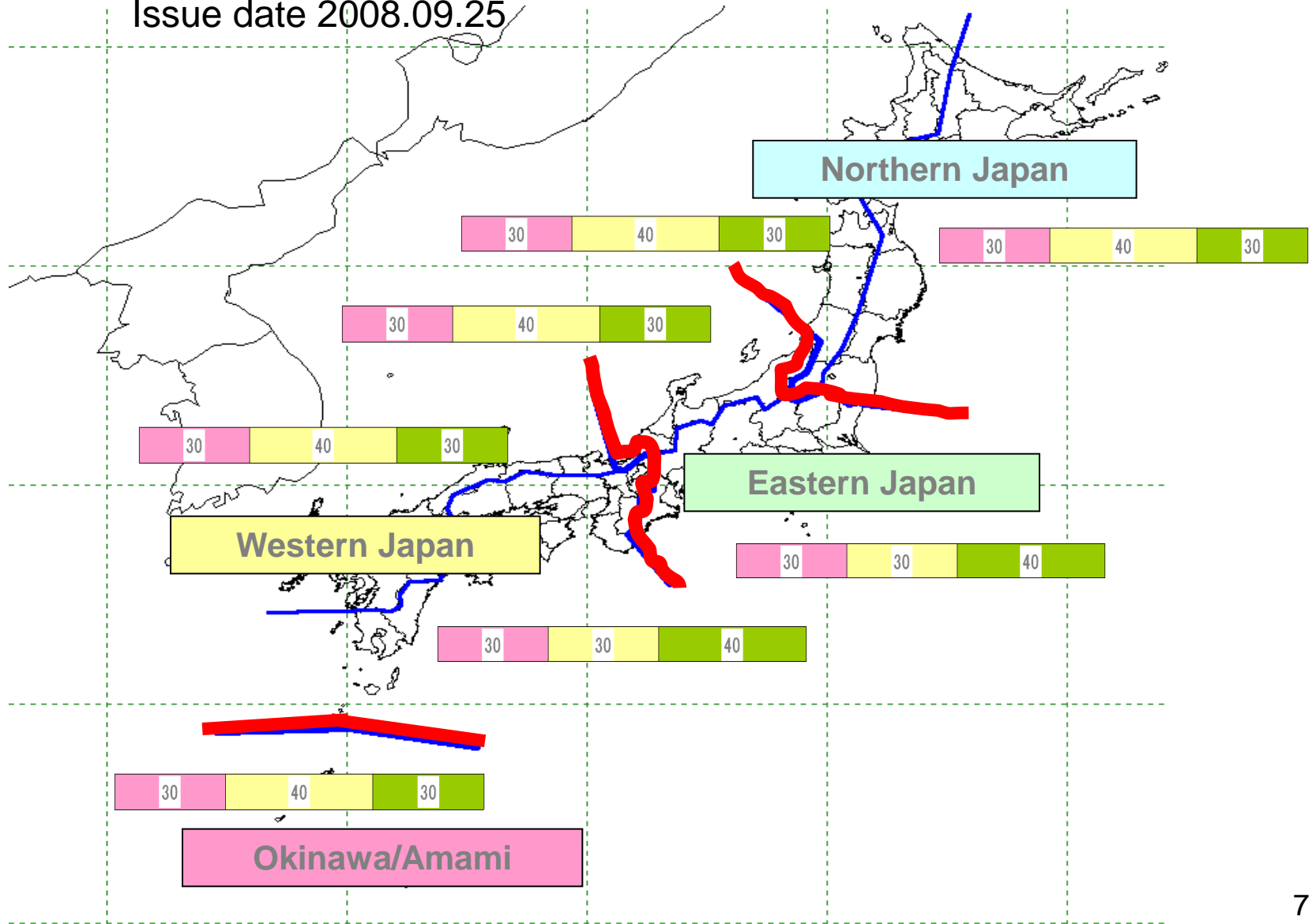
Issue date: 2008.09.25



(Base period of normal is 1971-2000)

Probabilities of 2008/09 DJF Precipitation

Issue date 2008.09.25



2. Grounds for JMA's seasonal forecast for 2008/2009 winter

2.1 Long-term trend including decadal variation

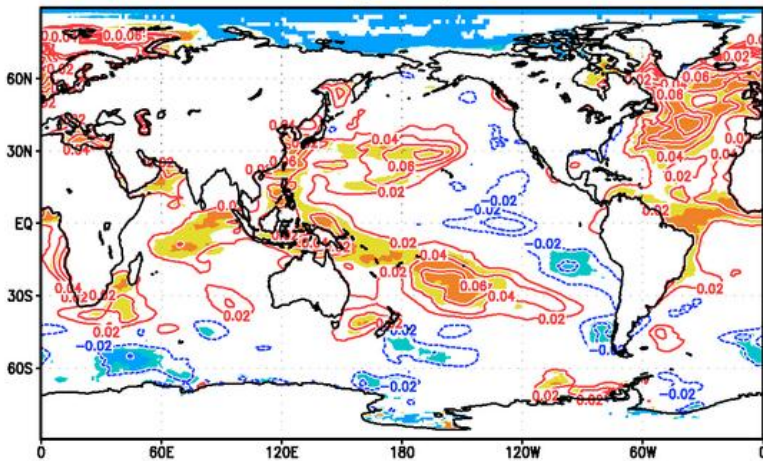
2.2 Current Oceanic Condition and El Niño
Outlook

2.3 Numerical Prediction

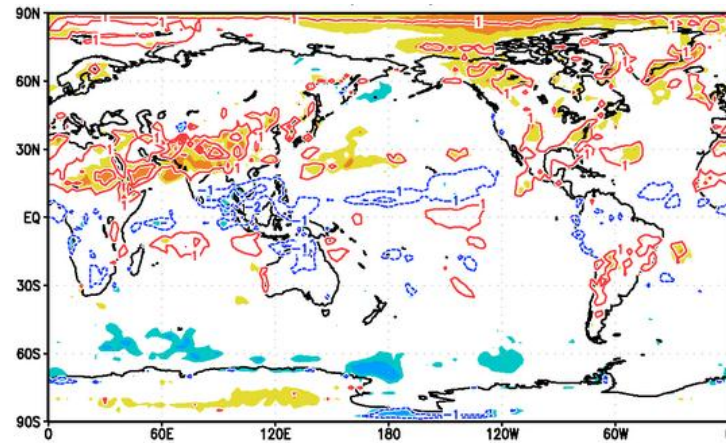
DJF Oceanic and Atmospheric fields

--linear trend from 1979 to 2006--

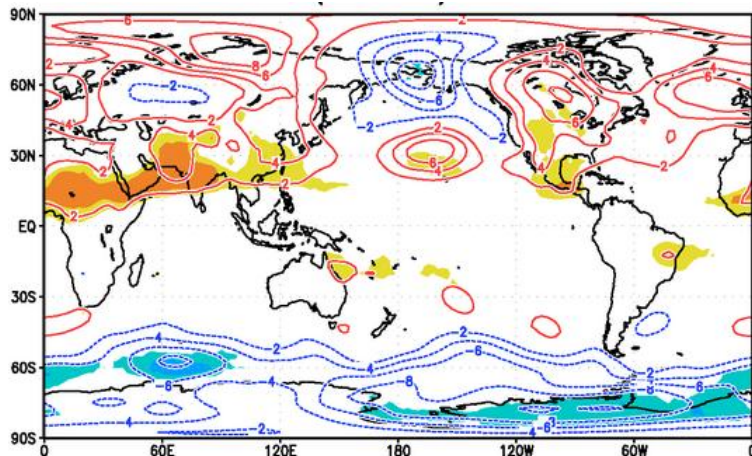
SST °C/10years



OLR W/m² /10years

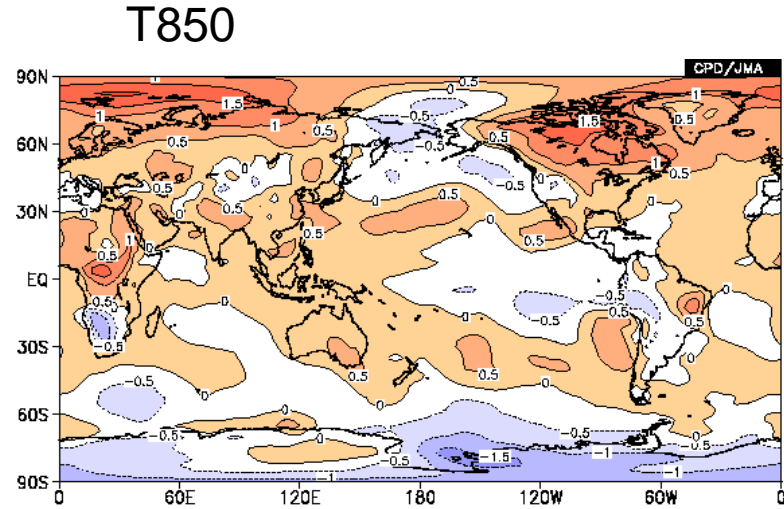
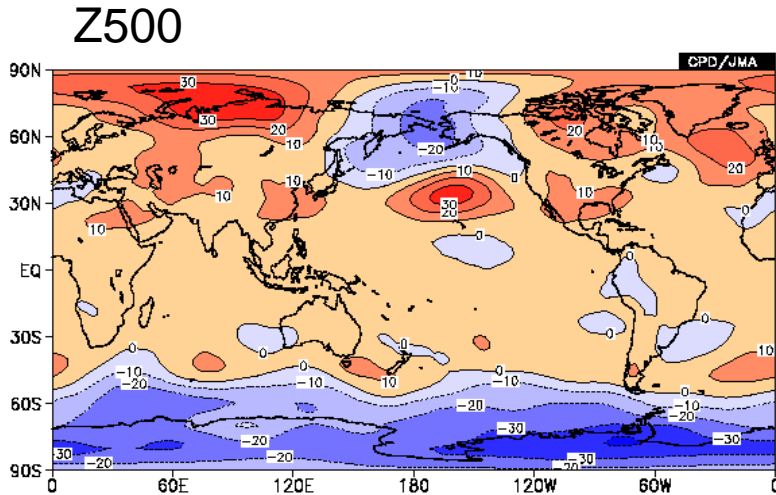
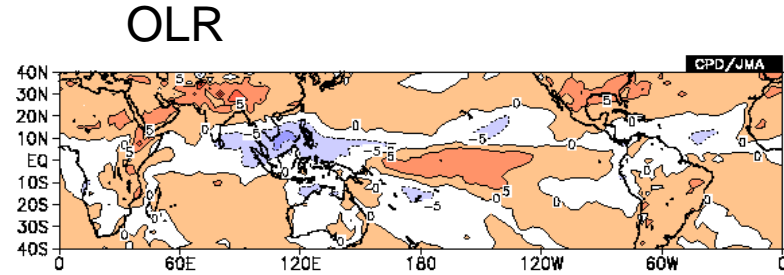
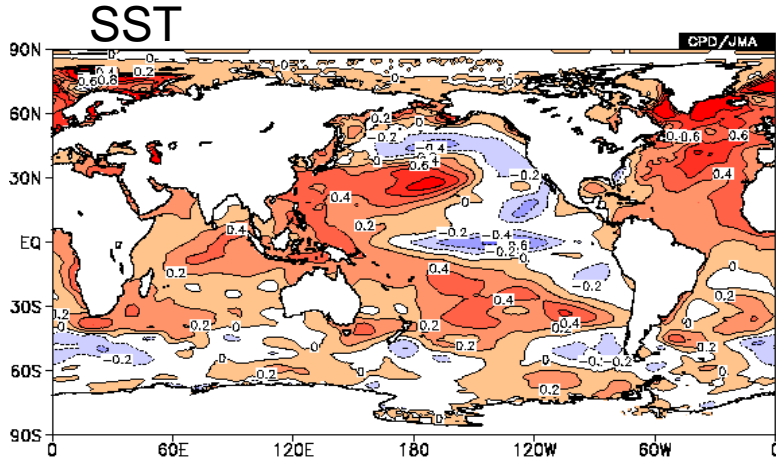


Z500 m/10years



- La Niña like trend in SST
- Active convection over the Maritime Continent
- Negative trend in Z500 over the northern part of the North Pacific

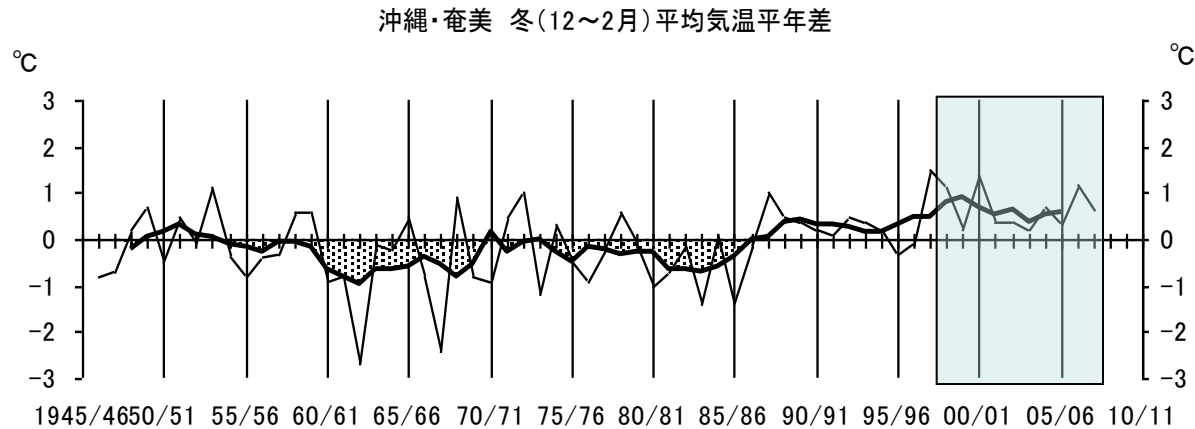
The recent decade DJF mean 1998/99 – 2007/08



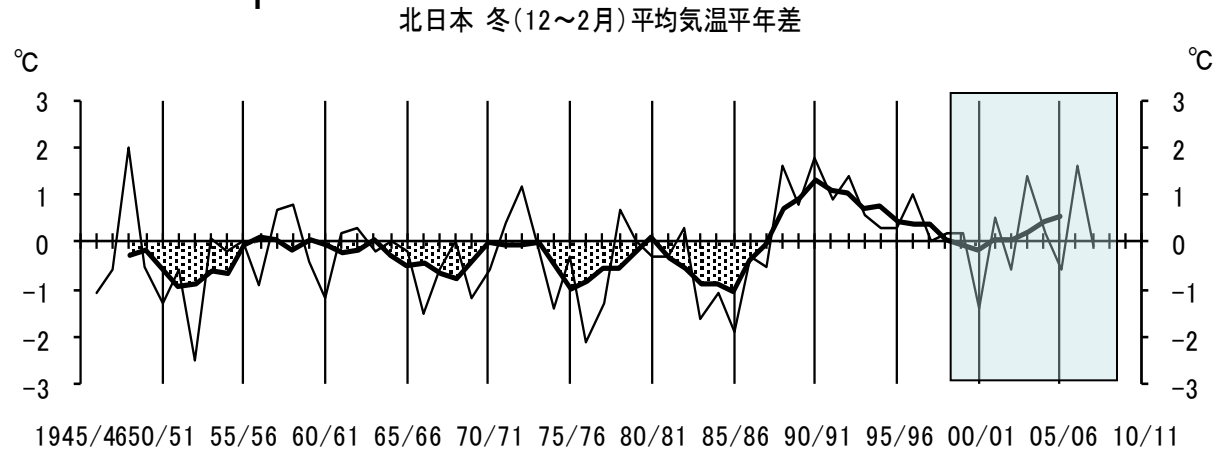
- Linear trend (1979-2006) patterns are clearer in the recent decade winters mean
- Negative Z500 anomalies in the Northern Japan

DJF mean temperature in Japan

Okinawa/Amami



Northern Japan



(Base period of normal is 1971-2000)

Statistical guidance :OCN

OCN :Statistical guidance based on the recent 10-years climate

(Prediction based on Long-term trend & Decadal variation)

Temperature

	Temperature anomalies(°C)	Probabilities of three categories(%)		
		B	N	A
N. Japan	0.1	30	40	30
E. Japan	0.4	10	40	50
W. Japan	0.5	10	60	30
Okinawa/Amami	0.7	0	30	70

B: Below Normal N: Near Normal A: Above Normal
(Base period of normal is 1971-2000)

Prediction skill is marginal

2. Grounds for JMA's seasonal forecast for 2008/2009 winter

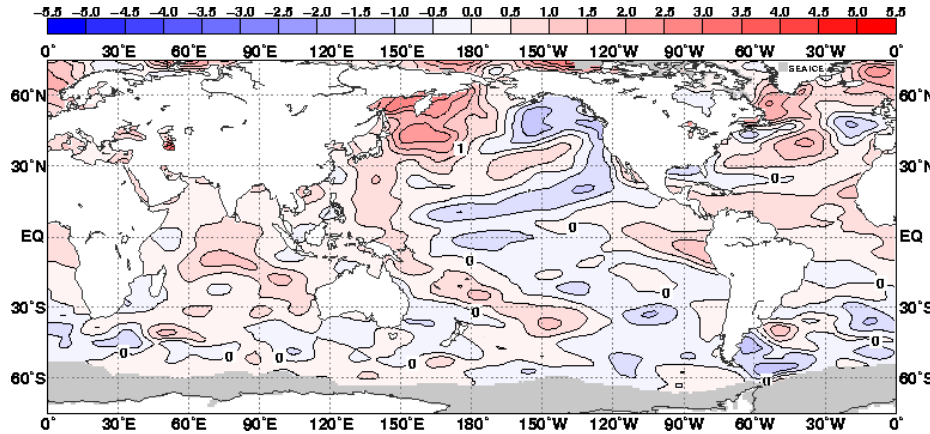
2.1 Long-term trend including decadal variation

2.2 Current Oceanic Condition and El Niño
Outlook

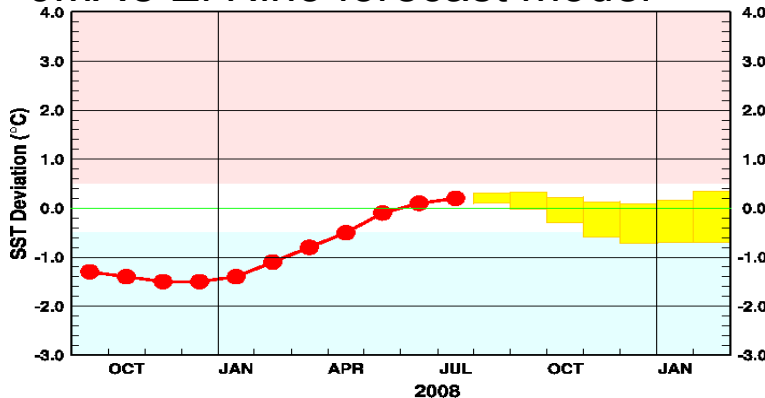
2.3 Numerical Prediction

Oceanic condition and outlook of El Niño

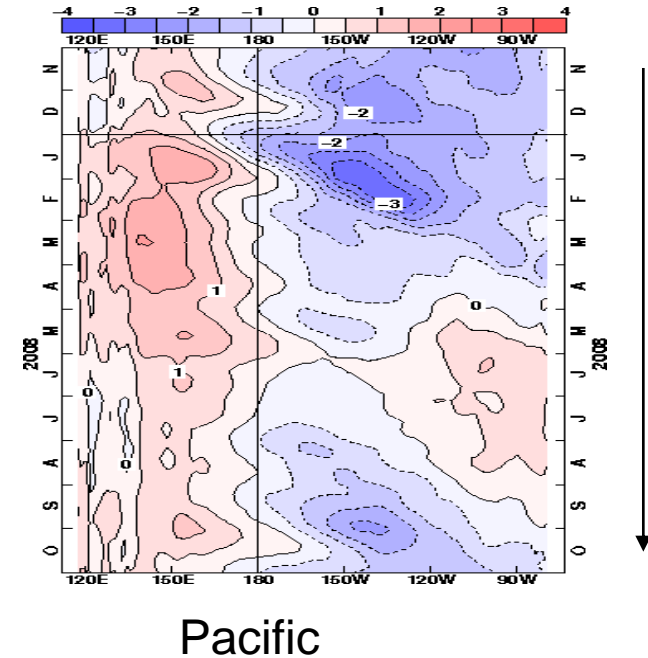
SST (2008.09)



5-month running mean Niño .3 by JMA's El Niño forecast model



Time-longitude cross section of OHC in the equatorial (5S-5N)

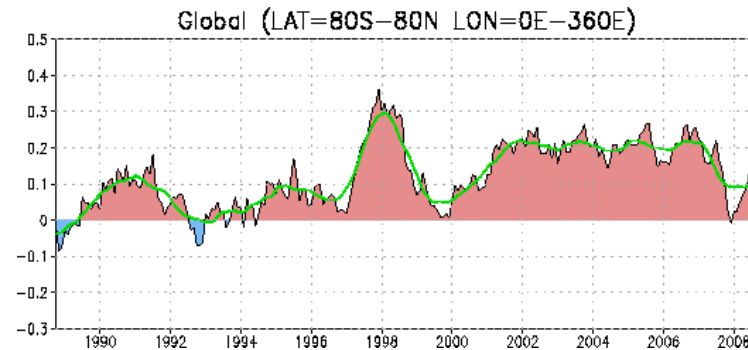


Pacific

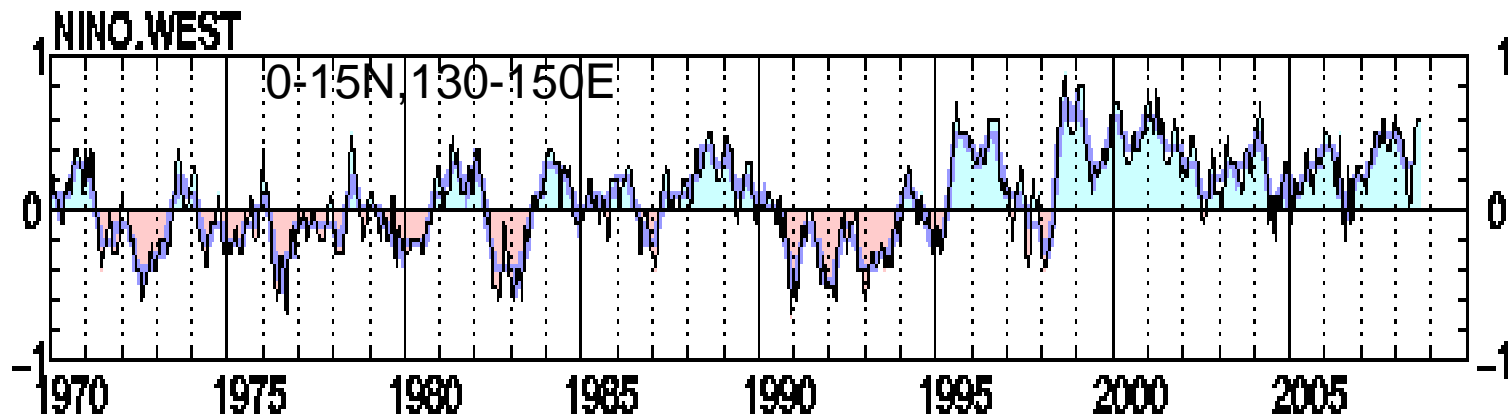
- SST anomaly pattern is similar to that of the long-term trend.
- In the equatorial Pacific, a cold Kelvin wave is propagating eastward. By the wave, above normal SST in the eastern equatorial Pacific will weaken.
- It is unlikely that an El Niño or a La Niña event will develop during the coming winter.

Time series of area averaged SST anomalies

Global mean

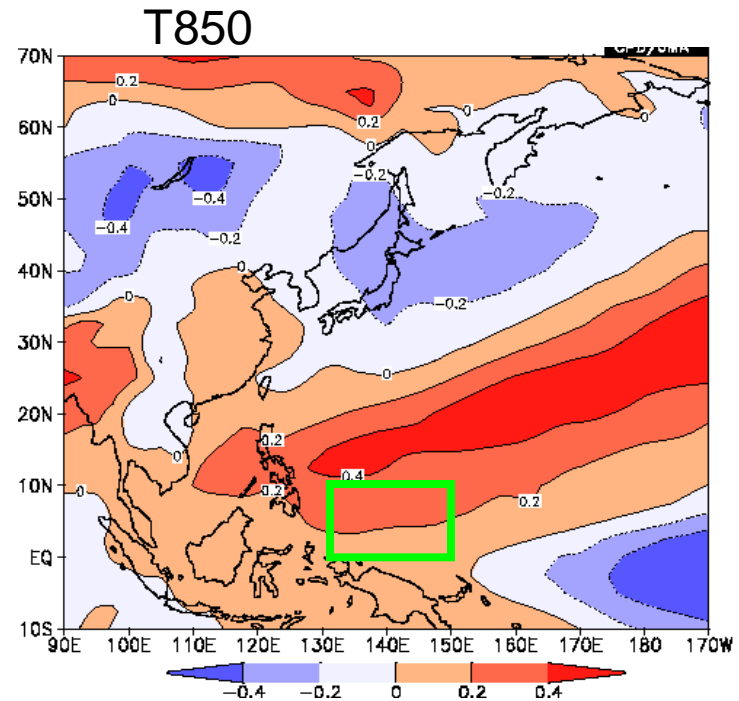
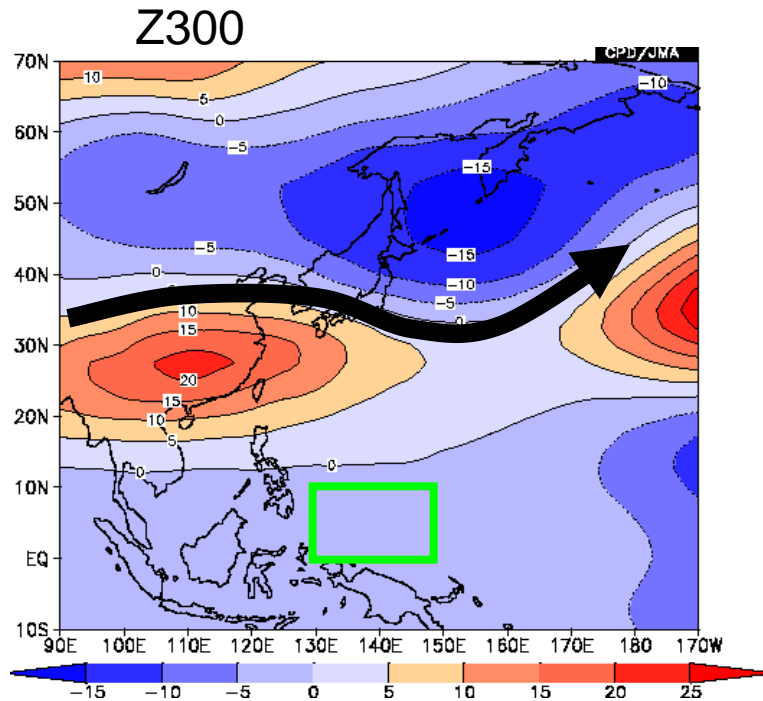


Tropical western Pacific



- Due to the La Niña which had faded in the last spring, the global mean SST was closed to normal during the last winter and spring. But, it is rapidly rising in these months. It is likely that the global mean SST will be above normal during the winter.
- In the tropical western Pacific, positive SST anomalies have persisted since 1998.

SST in the tropical western Pacific and air-temperature (DJF)



Z300 (left) and T850 (right) anomalies regressed on area (0-10N,130-150E) averaged SST

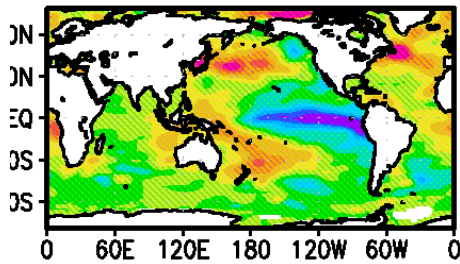
SST anomalies in the tropical western Pacific are negatively correlated with temperature anomalies in Japan through meandering of the sub-tropical jet stream

Statistical guidance :CCA

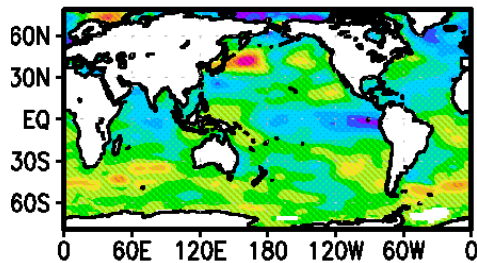
Statistical guidance based on lag relation between large scale SST pattern and temperature in Japan (Prediction based on ENSO signal and long-term trend & decadal variation in SST)

SST EOF pattern

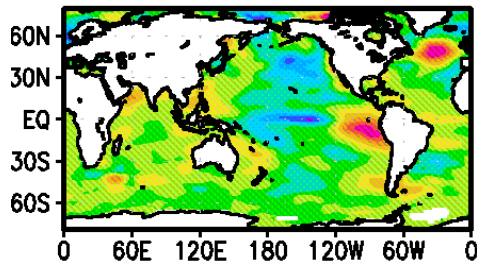
August



1st

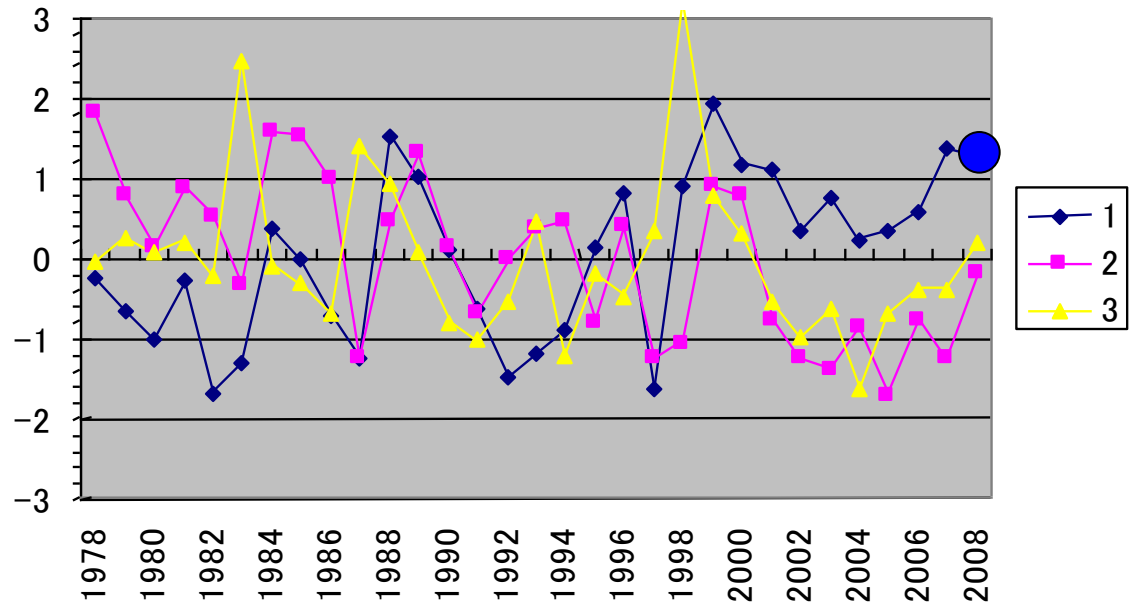


2st



3rd

SST EOF score



In 2008, EOF1 (global warming and La Niña like pattern) is prevailing. Positive EOF1 score is persisted since 1998.

Statistical guidance :CCA

Temperature

	Temperature anomalies(°C)	Probabilities of three categories(%)		
		B	N	A
N. Japan	0.4	23	22	55
E. Japan	0.4	20	30	50
W. Japan	0.4	21	36	43
Okinawa/Amami	0.5	16	23	61

B: Below Normal N: Near Normal A: Above Normal

(Base period of normal is 1971-2000)

Prediction skill is marginal

2. Grounds for JMA's seasonal forecast for 2008/2009 winter

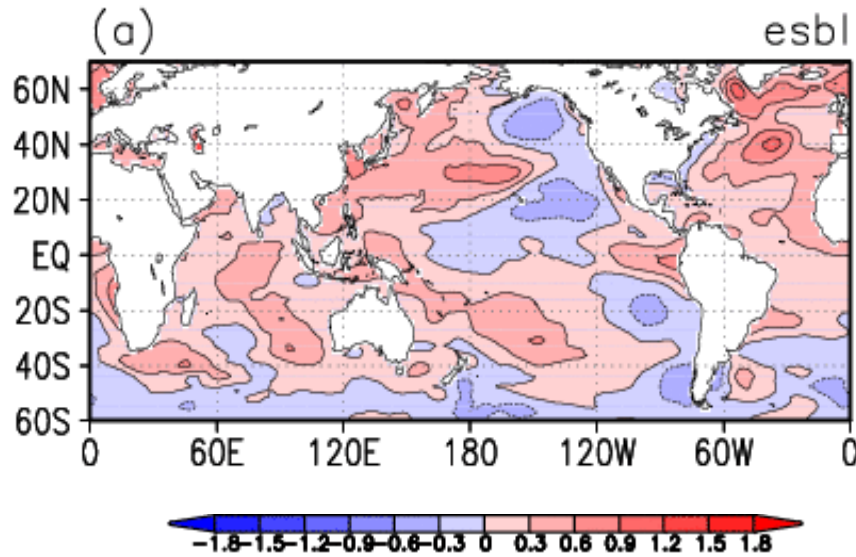
2.1 Long-term trend including decadal variation

2.2 Current Oceanic Condition and El Niño
Outlook

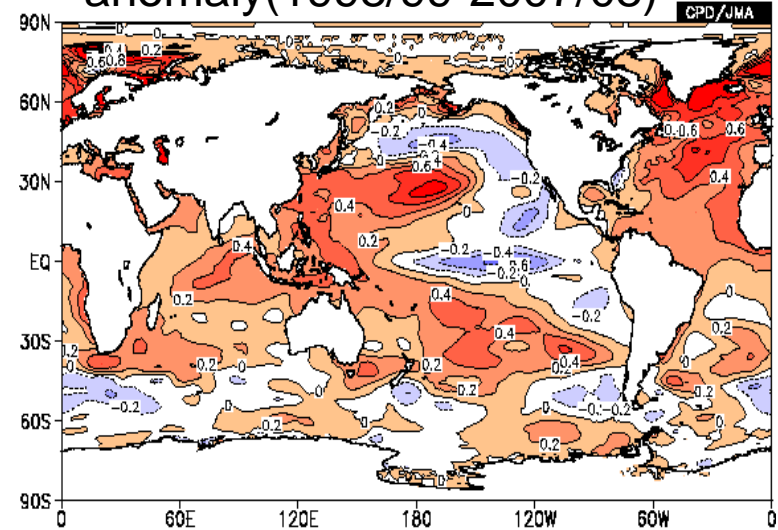
2.3 Numerical Prediction

SST anomalies fed to the model(DJF)

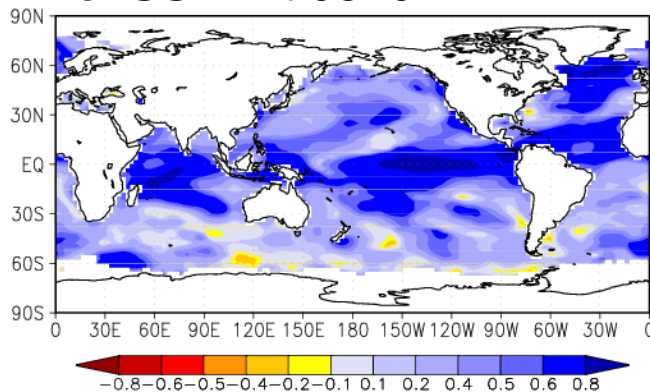
SSTA fed to the model



Recent decade winters mean SST anomaly(1998/99-2007/08)



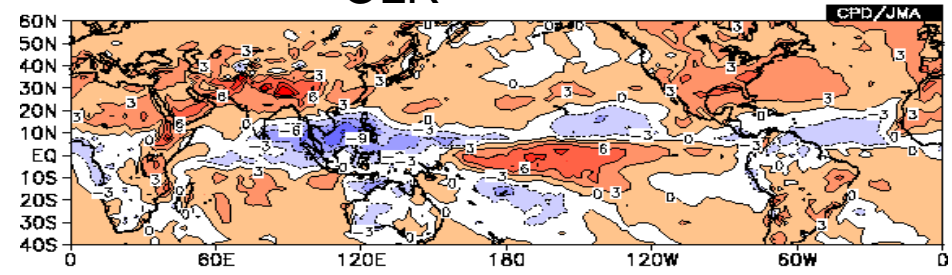
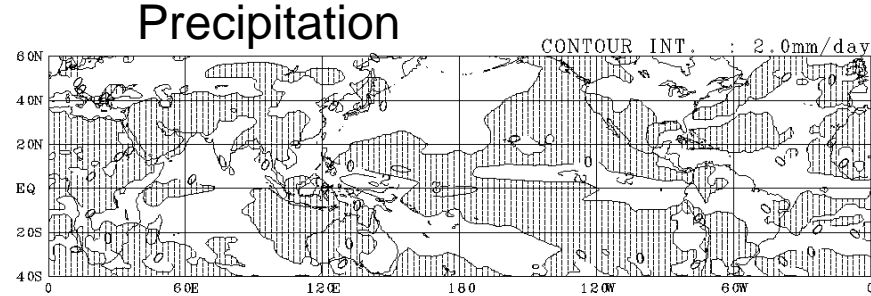
Prediction skill (ACOR)
of SST init:0810



- Not EL Nino, Not La Nina
- Negative (Positive) in the central (western) equatorial Pacific. In the Pacific, C shape SST anomaly pattern
- Positive in the Indian Ocean and the North Atlantic.
- Similar pattern and amplitudes to the recent decade DJF mean

Tropics and sub-tropics (DJF)

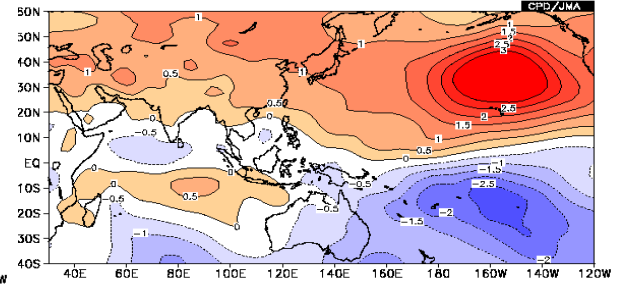
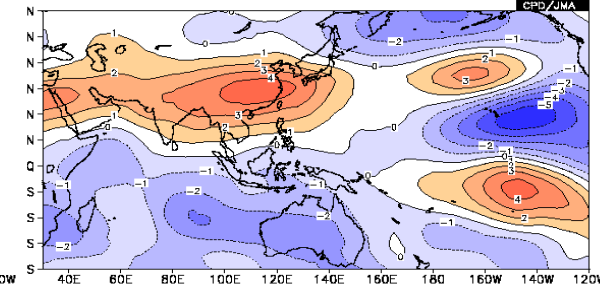
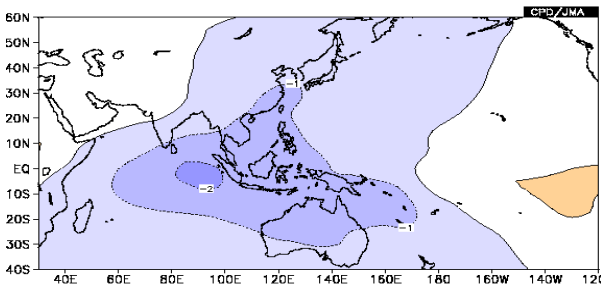
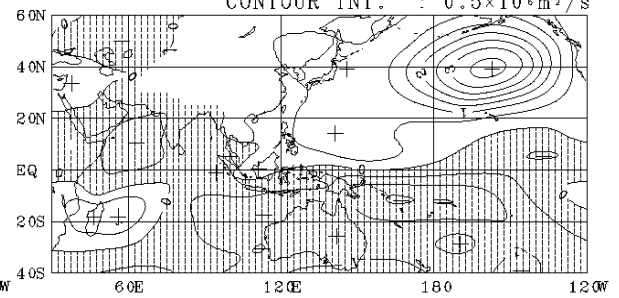
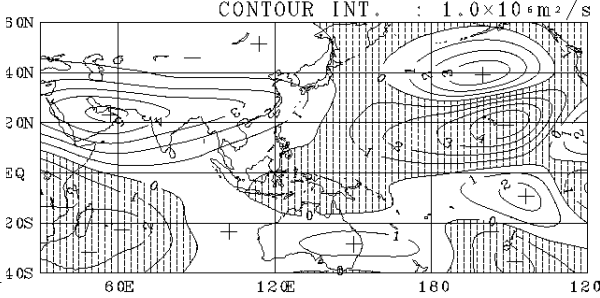
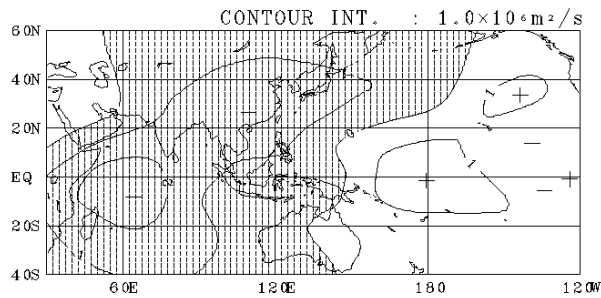
Black and white: numerical prediction, Color: recent decade winters mean



Velocity potential at 200hPa

Stream function at 200hPa

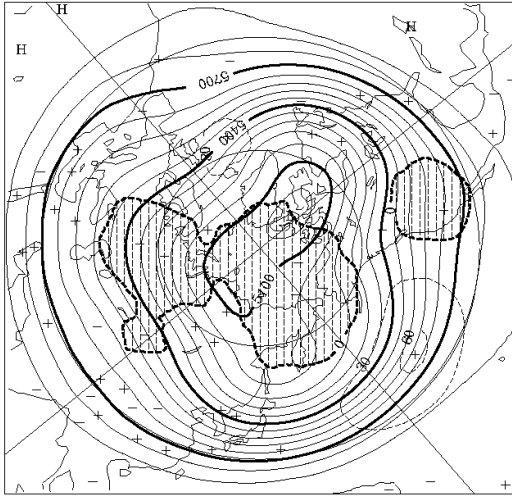
Stream function at 850hPa



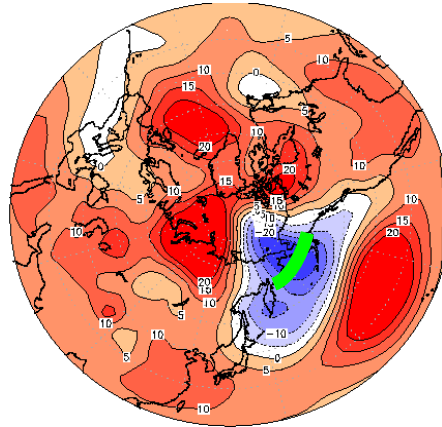
In the tropic and the sub-tropics, the predicted circulation anomaly patterns are similar to those of the recent decade winters mean (rather westward shift). La-Niña like pattern.

Mid- and High-latitudes (DJF)

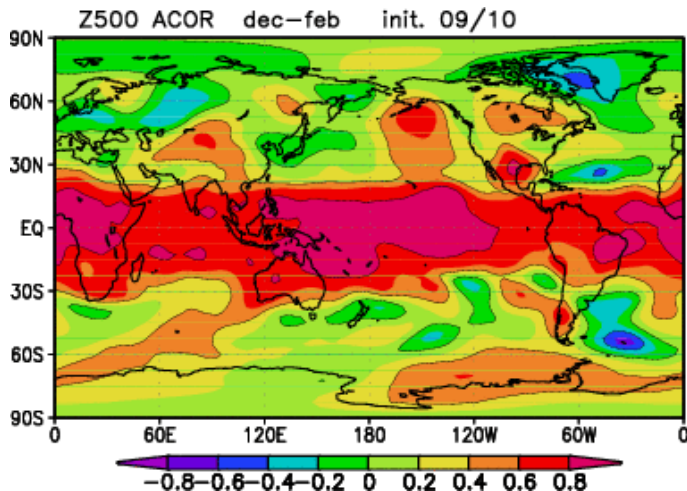
Z500 (ensemble mean)



The recent decade DJF mean Z500 anomalies (1998/99 – 2007/08)



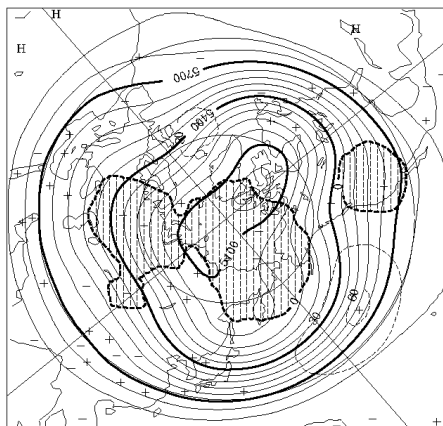
Prediction skill (ACOR) of DJF Z500 estimated by 22-years hindcast



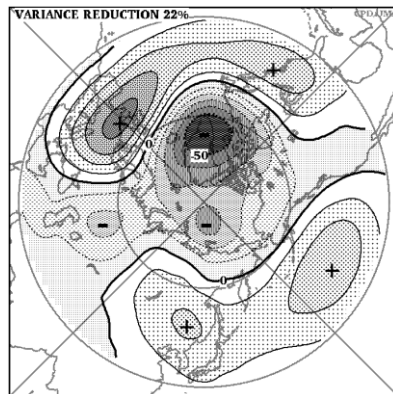
- In the mid- and high-latitudes, the positive phase of the Arctic Oscillation (AO) is predicted
- Prediction skill in the mid- and high-latitudes is not high

Prediction of the Arctic Oscillation (AO)

Z500 (ensemble mean)

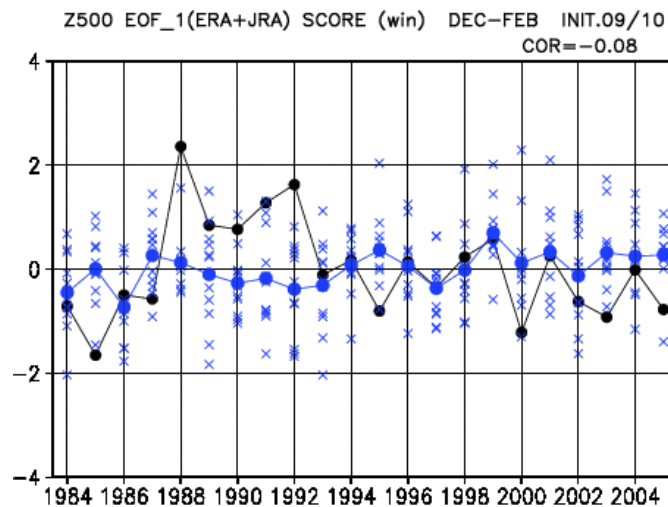


EOF1 of Z500 in DJF (AO pattern)

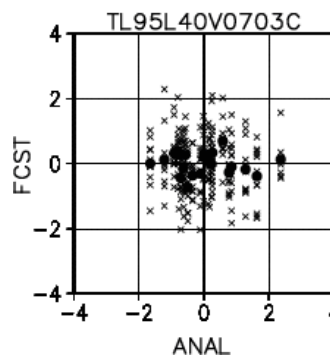
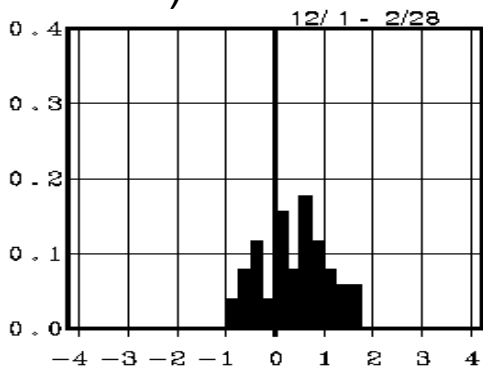


Observed and predicted DJF mean AO index.

Initial:0910 from 1984 to 2005



Prediction of EOF1 score (AO index) for 2008/2009 DJF



Positive phase of AO is predicted. But, 22-years hindcast shows that it is difficult to predict AO in DJF from September

Numerical Prediction guidance

Temperature

	Temperature anomalies(°C)	Numerical		
		B	N	A
N. Japan	0.5	17	19	64
E. Japan	0.5	5	36	59
W. Japan	0.6	10	39	51
Okinawa/Amami	0.6	7	23	70

B: Below Normal N: Near Normal A: Above Normal

(Base period of normal is 1971-2000)

By the numerical model guidance, above normal temperatures are predicted in whole Japan. But it should be noted that the guidance is influenced by the predicted positive AO of which prediction skill is very low.

Prediction skill is marginal

3. Summary

1) Long-term trend and decadal variation

- Long-term upward trends are clear in the winter mean temperatures over Japan except for Northern Japan
- Linear trend (1979-2006) in atmospheric and oceanic fields are consistent with above mentioned temperature trend in Japan
- Linear trend patterns, including La Niña like pattern, are clearer in the recent decade winters mean

2) Current oceanic condition and El Niño outlook

- It is unlikely that an El Niño or a La Niña event will develop during the coming winter
- Without El Niño or La Niña, it is difficult to make a winter season prediction from the viewpoint of inter-annual variation
- SST anomaly pattern in September 2008 is similar to that of the recent decade mean
- In recent years, above normal SST anomalies have persisted in the western tropical Pacific. SST anomalies in the region are negatively correlated with temperature anomalies in Japan

3) Numerical prediction

- The SST anomaly pattern fed to the JMA atmospheric global model is similar to that of the recent decade winters mean SST anomaly pattern
- The predicted atmospheric circulation anomaly pattern by the model is also similar to that of the recent decade winters mean circulation anomaly pattern in the tropics and the subtropics
- In the mid- and high-latitudes, the positive phase of the Arctic Oscillation (AO) is predicted. However, the spread among each ensemble member is large and the hindcast shows low prediction skill in the AO

4) Conclusion

- The greatest signal for the coming winter prediction comes from the long-term trend including decadal variation (global warming + La Niña like pattern)
- From the numerical prediction, above-normal temperature is expected in the coming winter in whole Japan
- However, considering the long-term trend and prediction skill in the extra-tropical circulations including the AO, it is likely that temperature will be lower than the result of the numerical prediction especially in Northern Japan
- The positive SST anomaly in the western tropical Pacific supports this modification

5) Forecast

DJF Temperature	Probabilities of three categories(%)		
	B	N	A
N. Japan	30	40	30
E. Japan	20	40	40
W. Japan	20	40	40
Okinawa/Amami	20	30	50

DJF Precipitation	Probabilities of three categories(%)		
	B	N	A
N. Japan/Japan–Sea Side	30	40	30
N. Japan/Pacific Side	30	40	30
E. Japan/Japan–Sea Side	30	40	30
E. Japan/Pacific Side	30	30	40
W. Japan/Japan–Sea Side	30	40	30
W. Japan/Pacific Side	30	30	40
Okinawa/Amami	30	40	30

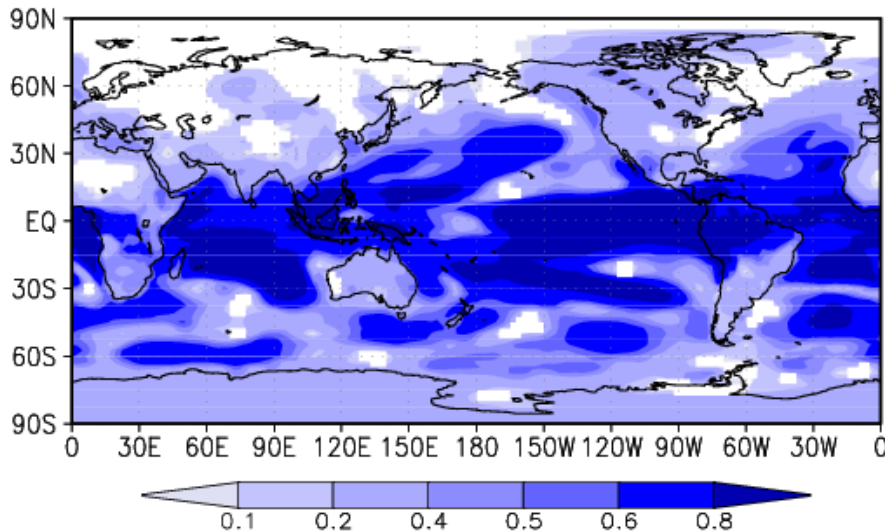
(Base period of normal is 1971-2000)

- Above-normal temperature is predicted with the highest probability of 50% in Okinawa/Amami. Both near-normal and above-normal temperatures with 40% probabilities in Western and Eastern Japan. However, in the Northern Japan, there is no significant signal because the probabilities of above-normal and below-normal are both 30%.
- For precipitation, there is no significant signal in whole Japan

Back up slides

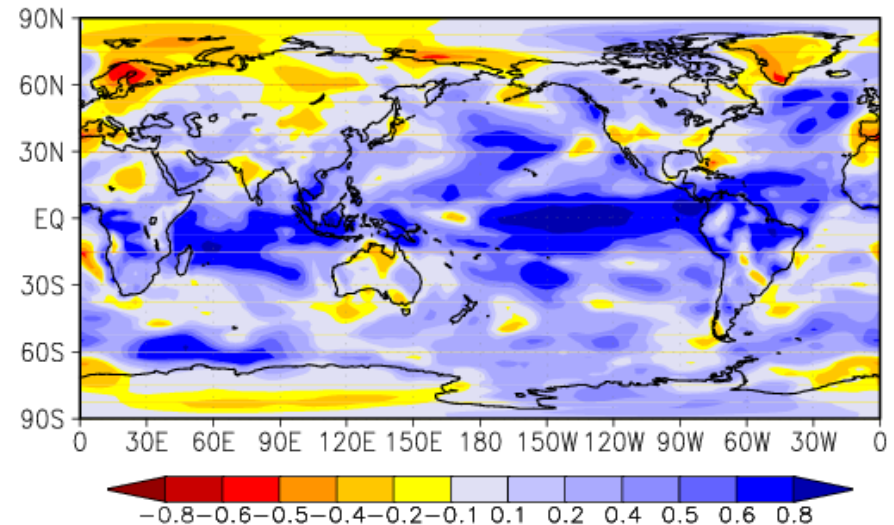
Predictability and Predication Skill of JMA's seasonal numerical prediction model

Upper limit of prediction skill (ACOR) of DJF T2m estimated by 22-years hindcast



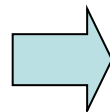
$\text{Sqrt}(R) = \text{Sqrt}\{S^2 / (S^2 + N^2)\}$.
DJF mean T2m. Init:0810.

Prediction skill (ACOR) of DJF T2m estimated by 22-years hindcast



Anomaly correlation of Ensemble mean. DJF mean T2m. Init:0810.

Prediction skill of the current JMA's seasonal numerical prediction model is much lower than the estimated upper limit of prediction skill



Statistical models are also used

DJF Temperature

	Statistical: OCN			Statistical: CCA			Numerical		
	B	N	A	B	N	A	B	N	A
N. Japan	30	40	30	23	22	55	17	19	64
E. Japan	10	40	50	20	30	50	5	36	59
W. Japan	10	60	30	21	36	43	10	39	51
Okinawa/Amami	0	30	70	16	23	61	7	23	70

Although prediction skills are marginal, every guidance predicts low probability of below normal except for N. Japan by OCN and CCA.

DJF Precipitation

	Statistical: OCN			Statistical: CCA			Numerical		
	B	N	A	B	N	A	B	N	A
N. Japan/Japan–Sea Side	20	30	50	25	36	39	37	40	23
N. Japan/Pacific Side	20	40	40	17	43	40	22	55	23
E. Japan/Japan–Sea Side	40	20	40	42	25	33	39	31	30
E. Japan/Pacific Side	30	10	60	16	38	46	14	49	37
W. Japan/Japan–Sea Side	40	10	50	25	35	41	27	37	36
W. Japan/Pacific Side	30	20	50	21	43	42	10	54	36
Okinawa/Amami	20	60	20	21	45	34	16	47	37

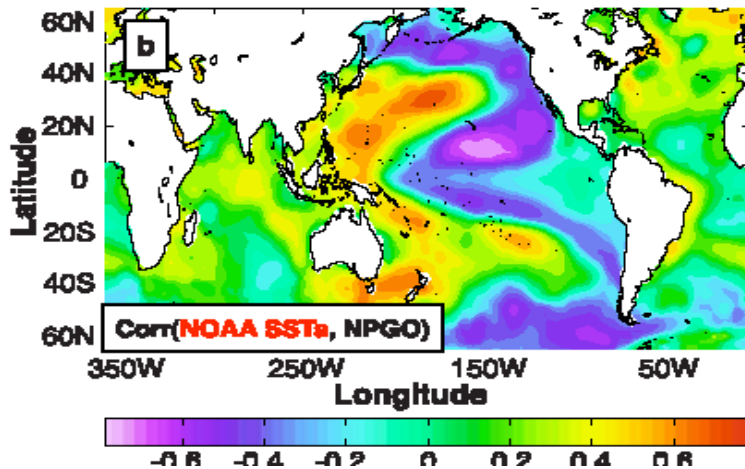
Although prediction skills are marginal, statistical guidance tends to predict near or above normal precipitation mainly in Pacific side, and numerical guidance tends to predict maximum probabilities in near normal category.

Decadal Mode in the North Pacific

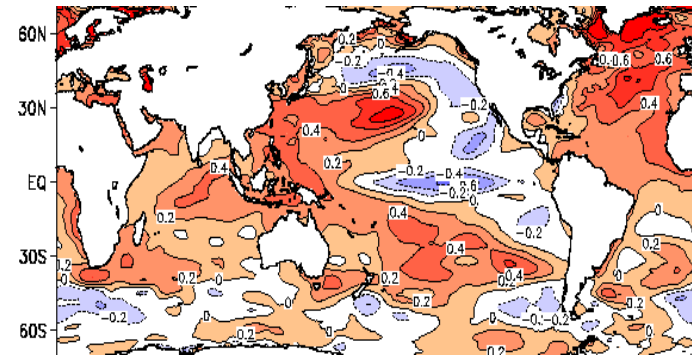
1st Mode: Pacific Decadal Oscillation (PDO)

2nd Mode: North Pacific Gyre Mode(NPGO) (Di Lorenzo et al.,2008)

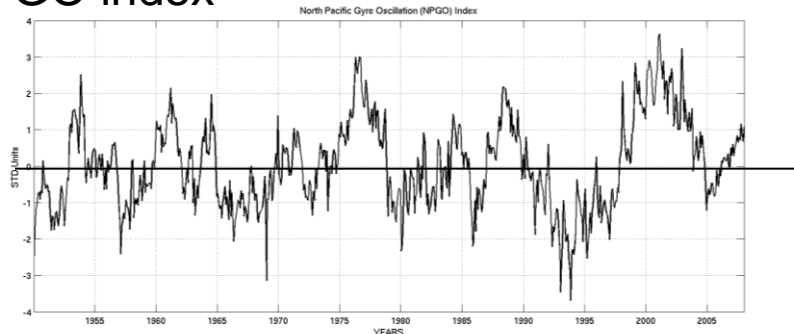
Correlation between NPGO index and SST



SST (decade DJF mean (1998/99 – 2007/08)



NPGO index



OSST pattern in the recent decade winters mean resembles the 2nd decadal mode in the North Pacific
Positive phase of NPGO has persisted