Seasonal Outlook for summer 2009 over Japan

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Probability of seasonal mean temperature for summer (June – August) 2009

Climatology	Below Normal, 33	Near Normal, 33	Above Normal, 33

Western Japan

20	30	50

Okinawa/Amami

20	30	50

Northern Japan

30	30	40

20	40	40

Eastern Japan

Northern Japan

Eastern Japan

Western Japan

Okinawa and Amami
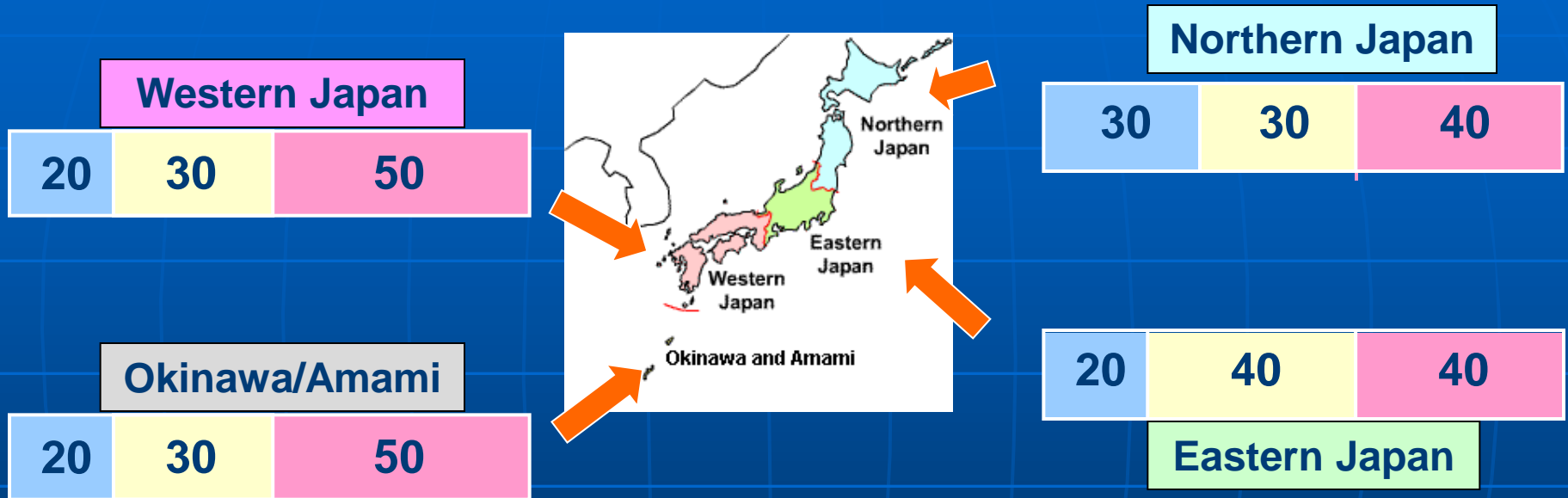
Temperature anomalies are divided into three categories with the same appearance frequency, 33% in climatology.
According to the latest JMA's outlook, above-normal temperature is predicted with the highest probability of 50% for Western Japan and Okinawa/Amami.
A hot summer is also predicted in Northern and Eastern Japan with a little higher probability of 40%. However, Northern Japan is expected to experience a cold summer with no little probability of 30%.

Probability of seasonal mean **precipitation** for summer (June – August) 2009

Climatology	Below Normal, 33	Near Normal, 33	Above Normal, 33

Northern Japan

30	40	30

Western Japan

30	40	30

Okinawa/Amami

30	40	30

30	40	30

Eastern Japan
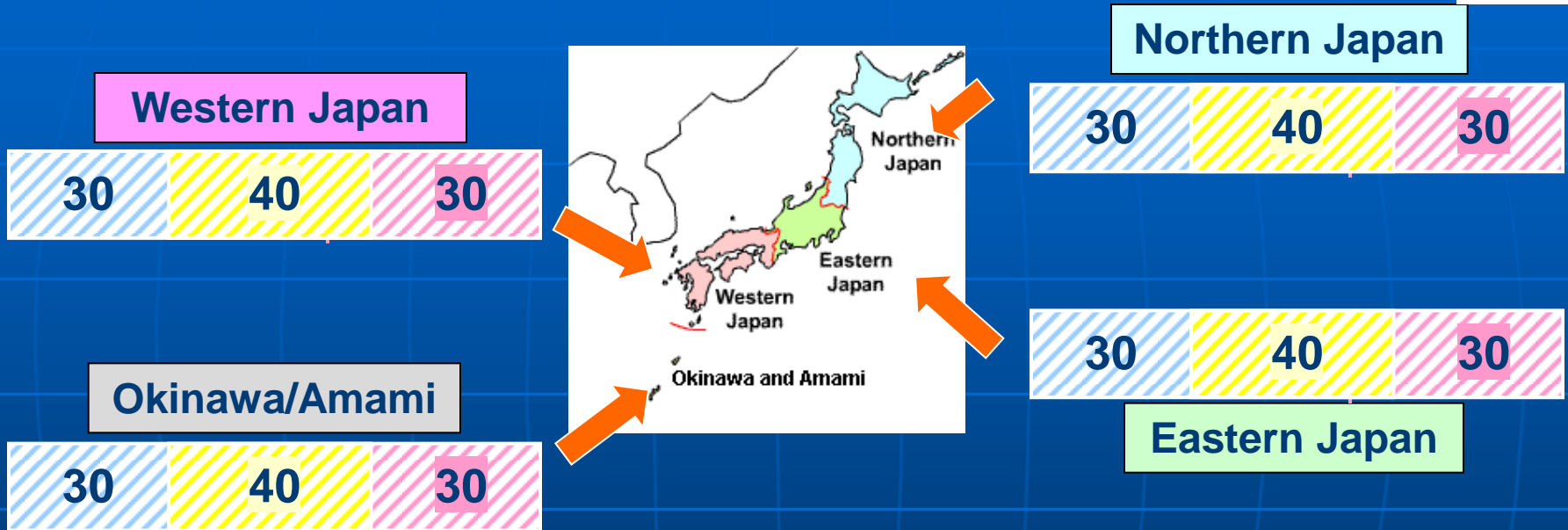
Summer and rainy season (Baiu) precipitation have no particular features for all regions.
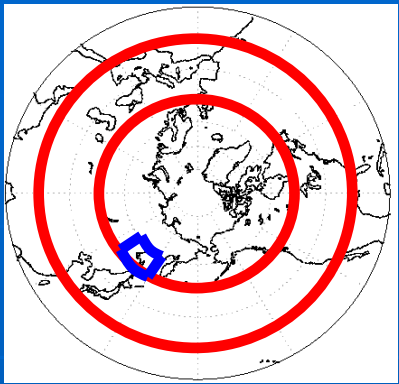
Part I

Long-term Trend

Long-term Trend (1)

## Summertime Area-averaged Temperature Anomalies
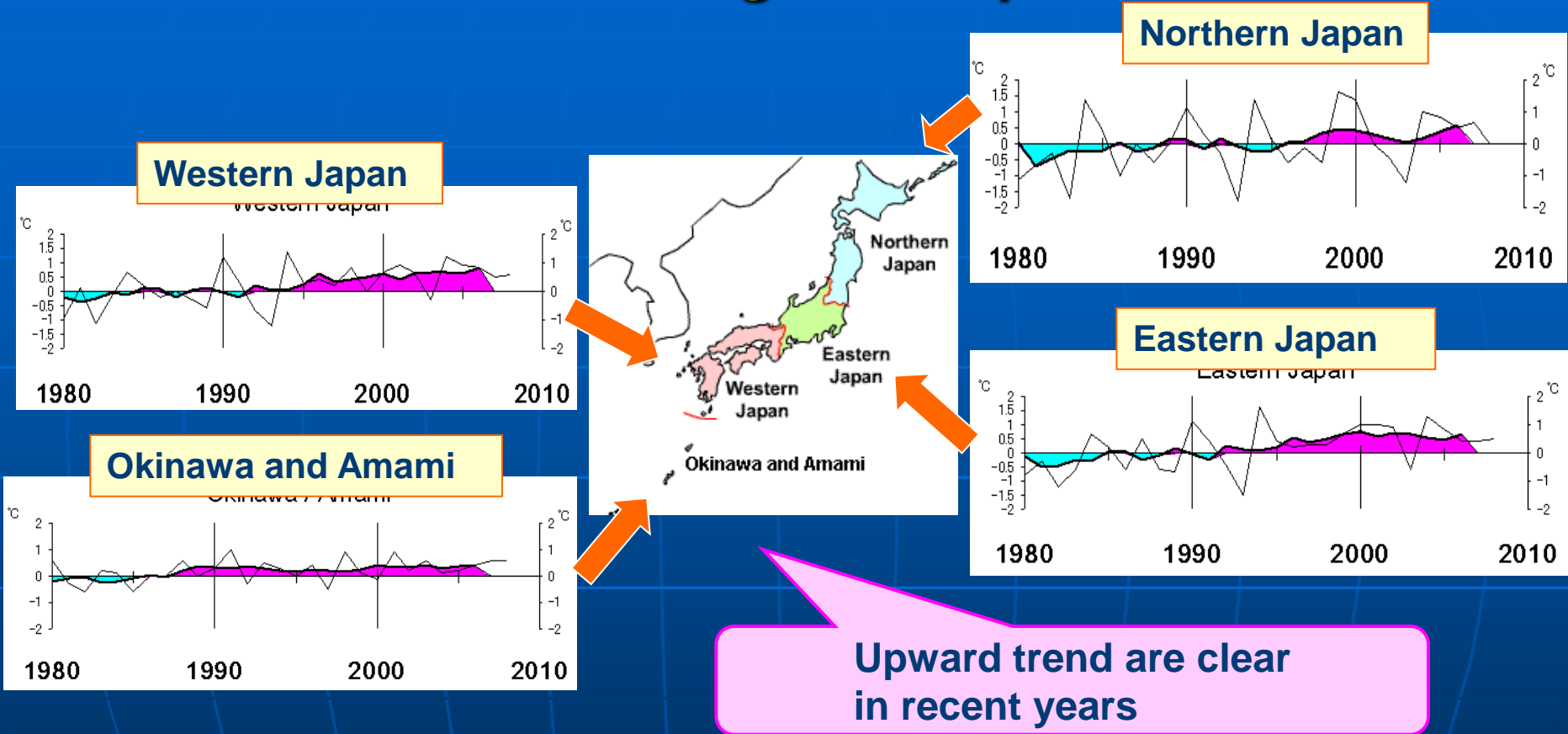
Long-term upward trends are clear in the summer mean temperatures (June-July-August) over Japan except for Northern Japan. In Northern Japan, the summer mean temperature has large year-to-year fluctuations though it tends to be above normal in recent years.

Long-term trend (2)
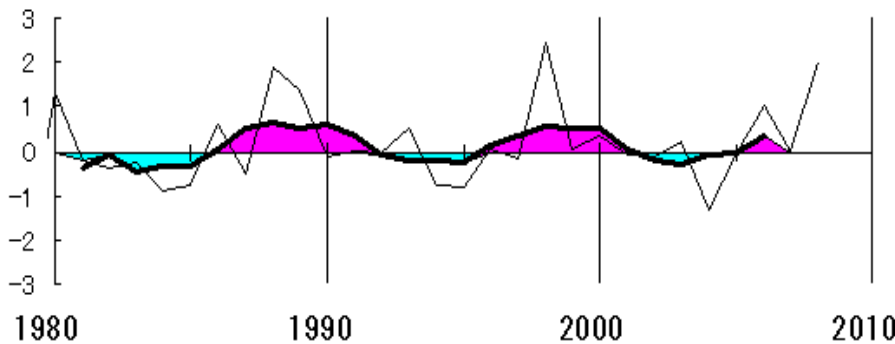## Summertime General Circulation Indices

Mid-latitude tropospheric temperature Index (30-50N, Z300-Z850)
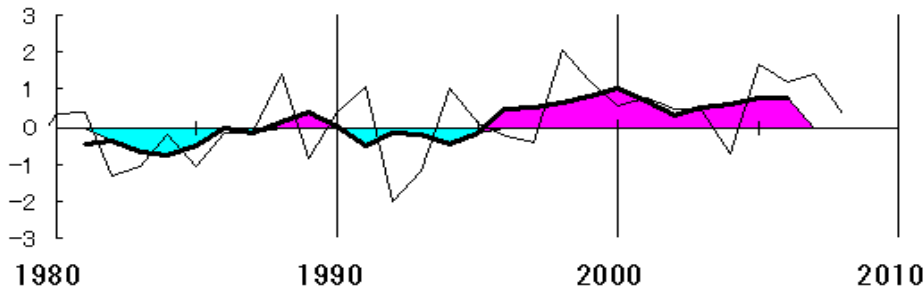
Positive anomaly is dominant in recent years

Mid-latitude height index tends to be positive from mid 1990s, reflecting frequent hot summers in eastern and western Japan.

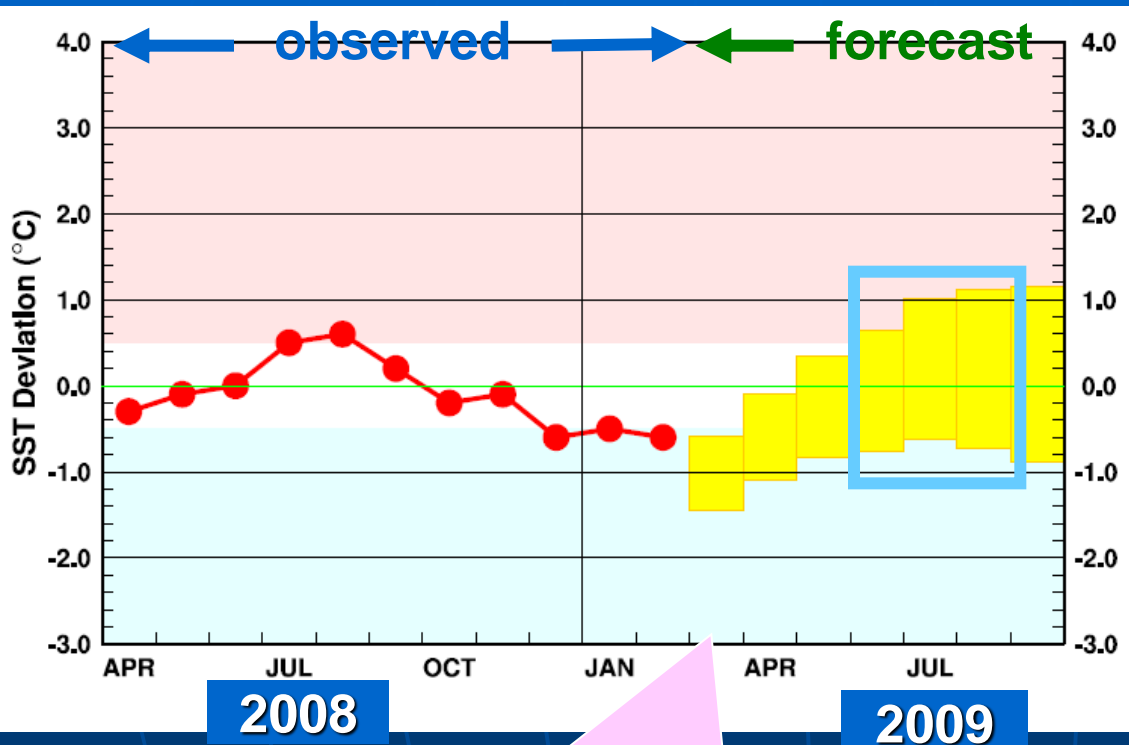**Okhotsk high index (130-150E, 50-60N, Z500)**

Positive in recent years

Okhotsk high index tends to be positive from late 1980s, reflecting occasional cool summers in Northern Japan.

Part II

Oceanic Condition and Outlook

Monthly NINO.3 SST forecast by JMA's El Niño forecast model

observed ← → **forecast**

2008   2009

Closer to normal in the coming summer.

model spec.

CGCM
  Atmosphere : T_L95L40
  Ocean : 1.0x0.3-1.0deg
              L50
Ensemble
  method : LAF
                (5days interval)
  size : 30 members

Each yellow box denotes the range where the SST deviation will be included with the probability of <u>70%.</u>

◆ **La Niña conditions hit its peak last winter and will proceed to termination during spring. It is likely to be ENSO neutral conditions in the coming summer.**

◆ **Ensemble mean NINO.3 anomaly is predicted to be slightly higher than normal in the coming summer.**

Part III

Numerical Prediction

Numerical Prediction

Initial date : Mar. 16th

Specification of seasonal forecast model

AGCM
Atmosphere : TL95L40
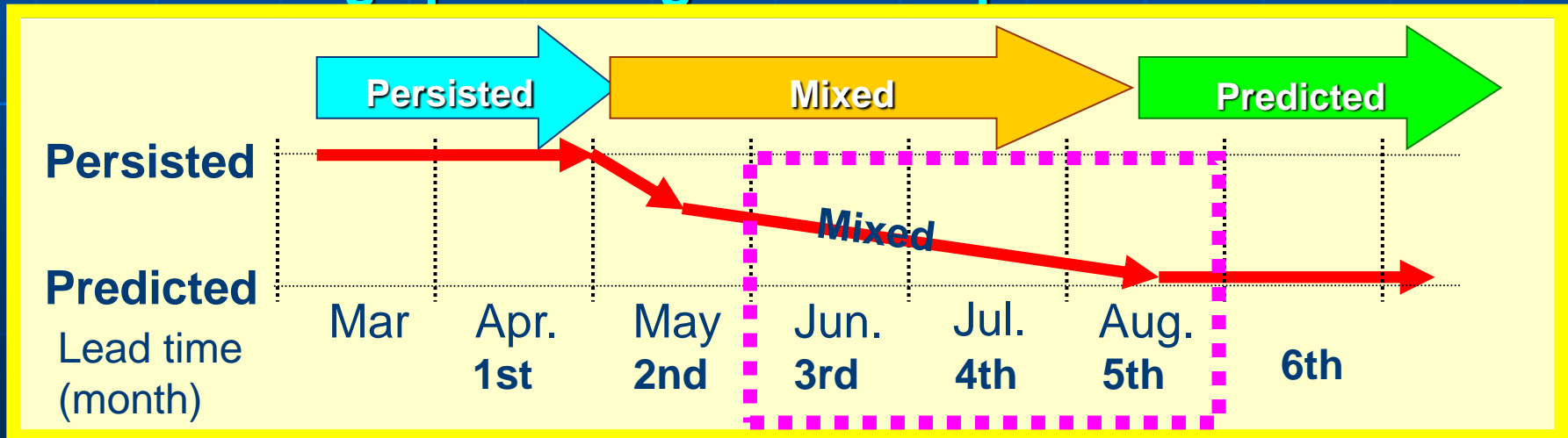**SST : refer to the chart below**

Ensemble method :
Singular Vector
Ensemble size :
51 members

How to merge persisting SSTs and predicted SSTs

Persisted → **Mixed** → **Predicted**

	Mar	Apr. 1st	May 2nd	Jun. 3rd	Jul. 4th	Aug. 5th	6th

Persisted

Predicted

Lead time (month)

Climatology + long-term trend + statistically estimated SST field using dynamically forecasted NINO.3 SSTA using El Nino forecast model.

Numerical Prediction (1)
Lower Boundary Condition and precipitation

Strong rising trend + weak El Nino-like pattern

SST anomaly

Positive anomalies are dominant in the NH mid-latitudes
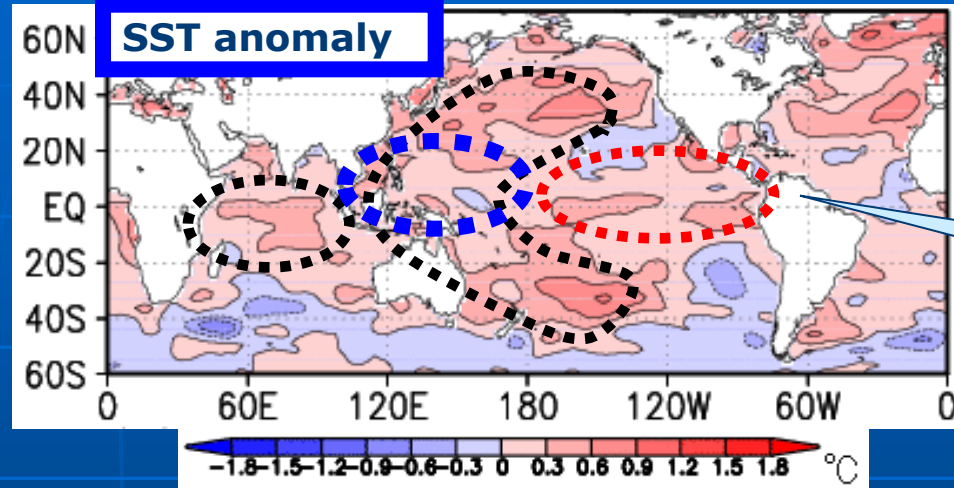
El Nino-like east-west contrast
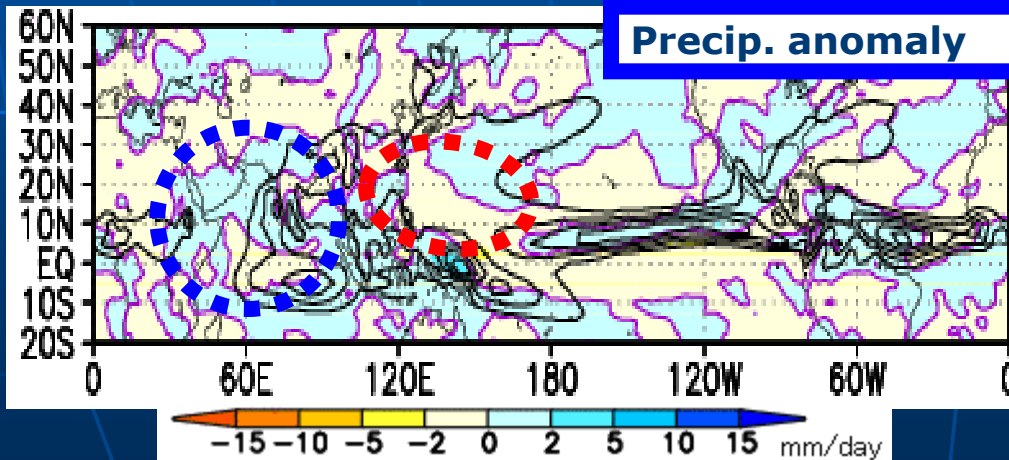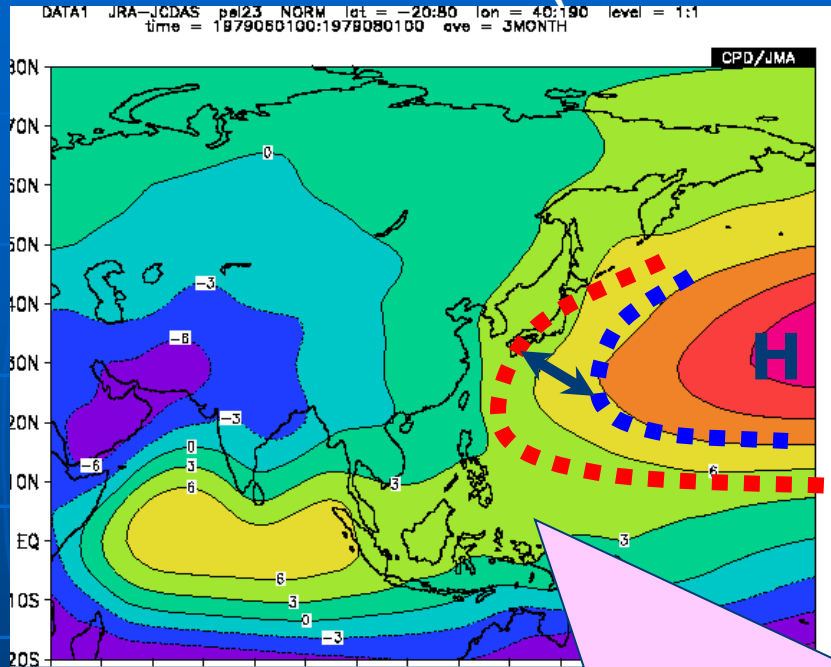
Precip. anomaly

◆ **No significant precipitation anomalies**

Positive anomalies: North Indian Ocean

Negative anomalies: East of Philippines

**Sea Surface Temperature Anomalies in JJA (Upper)**
Precipitation and Anomalies in JJA (Lower)

One of the key teleconnection patterns that dominates summertime climate in Japan

850hPa Stream Function (JJA Normal)

Nitta (1987)

PJ pattern

- Active convection in WNPM area
- Northward/westward extension of North Pacific Subtropical High around Japan due to the positive phase of PJ pattern
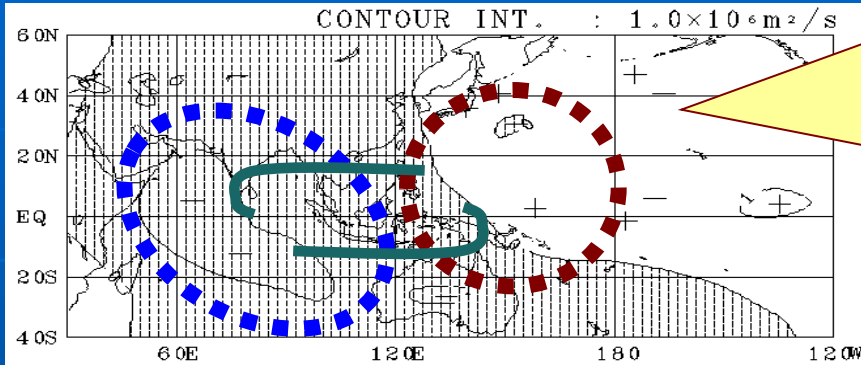- Dry and hot summer in Japan
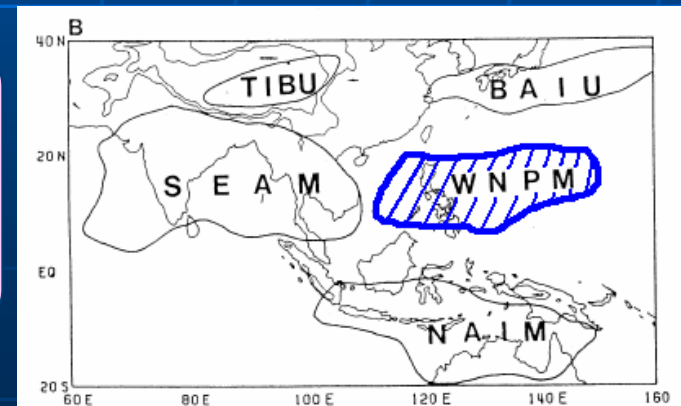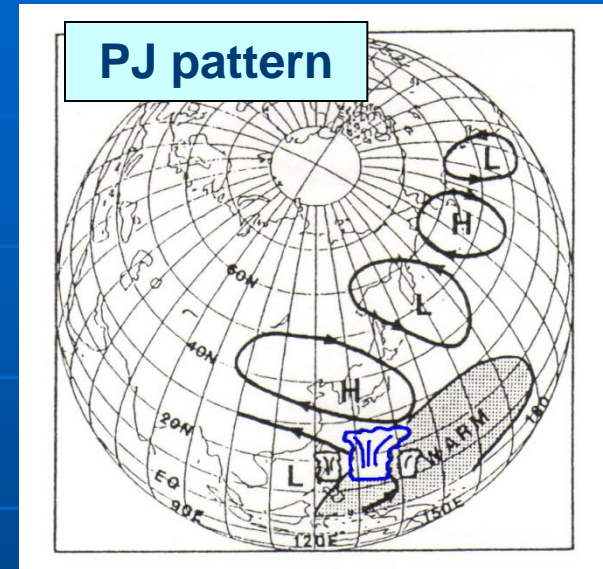
* WNPM : Western North Pacific Monsoon

Numerical Prediction (2)
## (Atmospheric general circulation)

200hPa Velocity Potential Anomalies (JJA)

In association with the warm Indian Ocean SST due to the considerable upward trend fed to the AGCM as a lower boundary condition, divergence anomaly emerges in the upper troposphere and it induces reversed Walker circulation , which then suppresses the convective activities near Philippines.

850hPa Stream Function Anomalies (JJA)
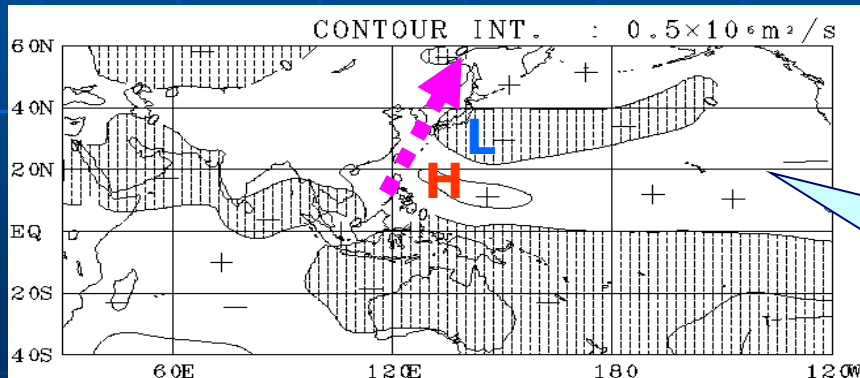
The low-level **negative** PJ pattern contributes to the cyclonic anomalies around Japan

➡ Northward extension of subtropical high is predicted to be weaker than normal a little.
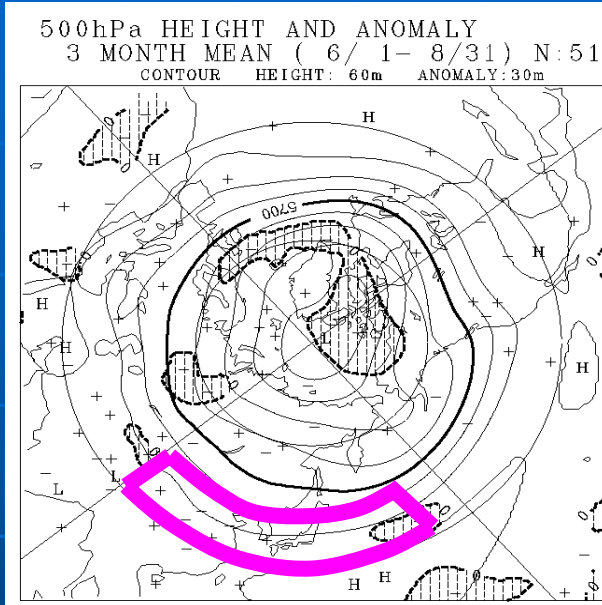
➡ Suppressed convection near the Philippines is reliable or not ? → discussion

Numerical Prediction (3)

(Far East Mid-latitude height Index)

Far East Mid-latitude height Index

500hPa HEIGHT AND ANOMALY
3 MONTH MEAN (6/ 1- 8/31) N:51
CONTOUR HEIGHT: 60m ANOMALY:30m

90E-170E 30N-40N   6/ 1 - 8/31
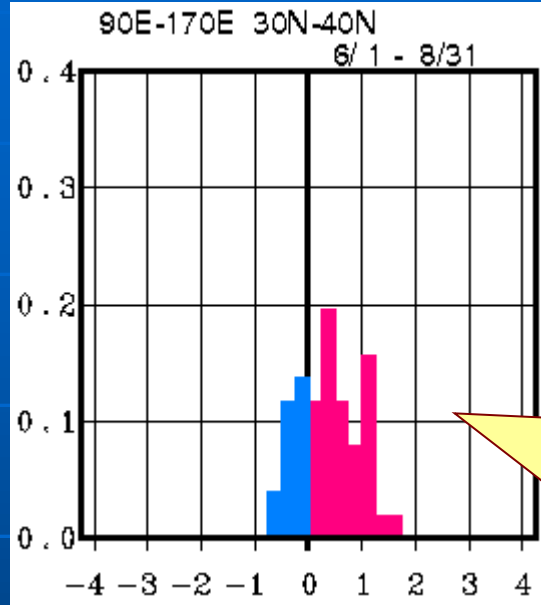
Majority of 51 ensemble members falls into the above-normal side of Far East Mid-latitude height index.

Anomaly correlation of Z500 between ensemble mean and reanalysis dataset

MIDH 90-170E 30-40N   JUN-AUG   INIT.02/10   COR=0.59
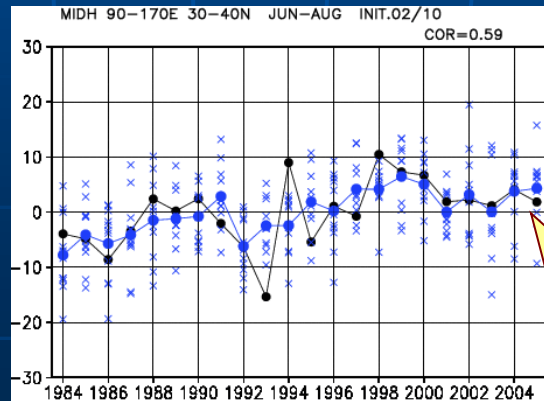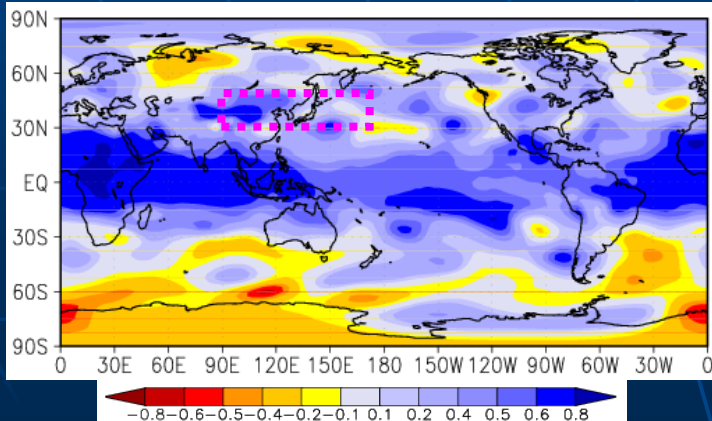
Not only trend components but also interannual fluctuations of zonal mean anomaly were well forecasted in the hindcast experiment.
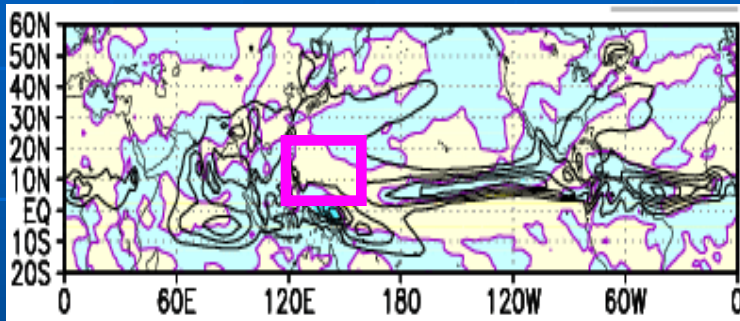
Part IV

Discussion

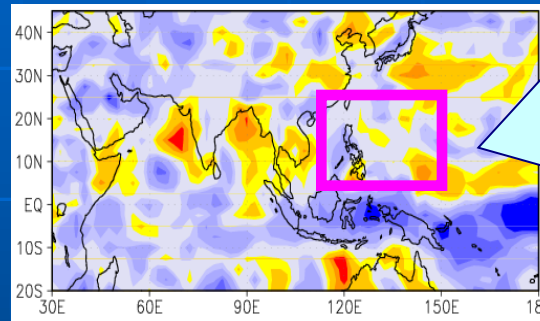# On the precipitation anomalies in the western tropical Pacific

Contrary predictions between 2-tier AGCM and CGCM

Operational seasonal forecast system (AGCM)
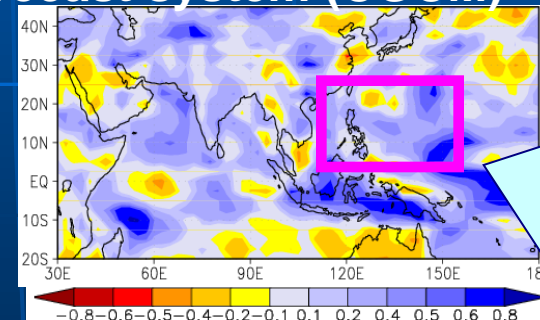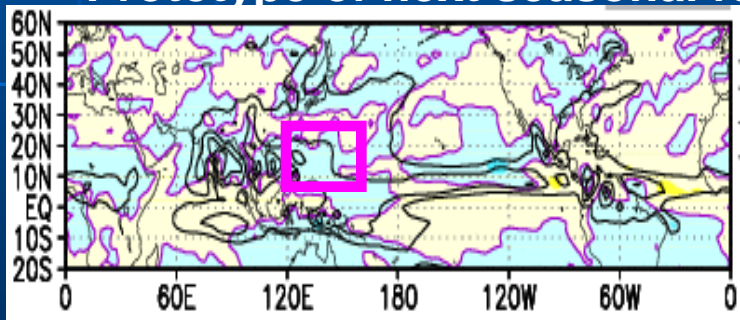
Forecasted Rainfall Anomalies


Anomaly Correlation with observation

According to the forecast skill based on the 22years of hindcast experiment,
There's room for doubt about inactive convections around the western North Pacific

Prototype of next seasonal forecast system (CGCM)

-0.8 -0.6 -0.5 -0.4 -0.2 -0.1 0.1 0.2 0.4 0.5 0.6 0.8

The experimental atmosphere-ocean coupled forecast system, which will serve as the operational system after Feb. 2010, is skillful around the western North Pacific.
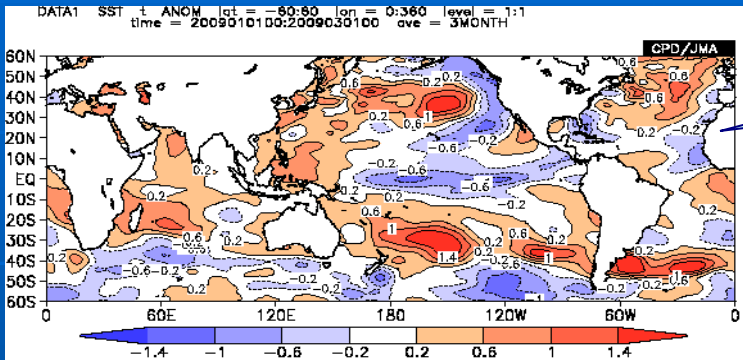
-15 -10 -5 -2 0 2 5 10 15 mm/day
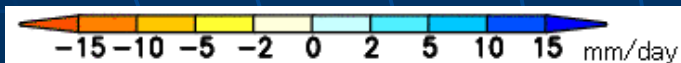
➡ The coupled forecast model indicates a contrary scenario. Convective activities near the Philippines would be stronger than normal.
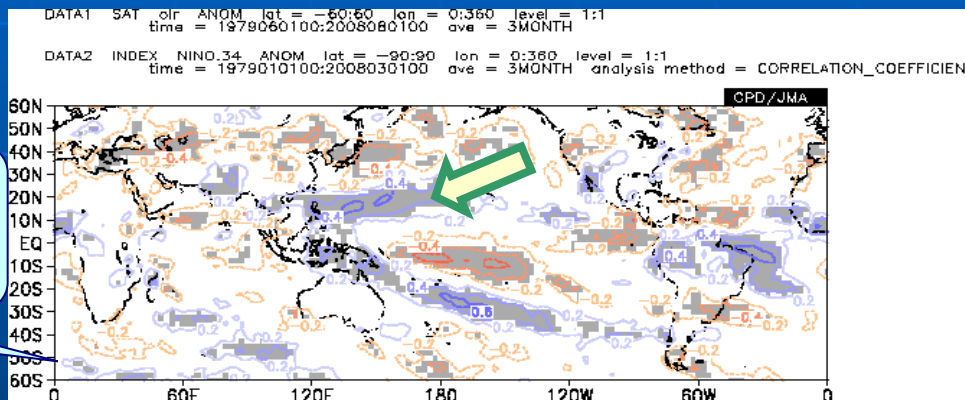
Lag relationship between WNPM precipitation and ENSO

SST anomaly (JFM 2009)

The SST anomaly in this winter shows La Nina condition.

5-month lag correlation coefficients between NINO3.4(previous JFM) and OLR(JJA)


Positive correlation coefficients are indicated by **blue** lines
(cold NINO3.4 – active convection)

shaded areas indicate coefficients are significant at 10% level.

NINO3.4(previous JFM) and Z500(JJA)

Negative correlation coefficients are indicated by **orange** lines
(cold NINO3.4 – positive height)

➡ Statistically, convective activities near the Philippines are likely to be strong in post La Nina years.
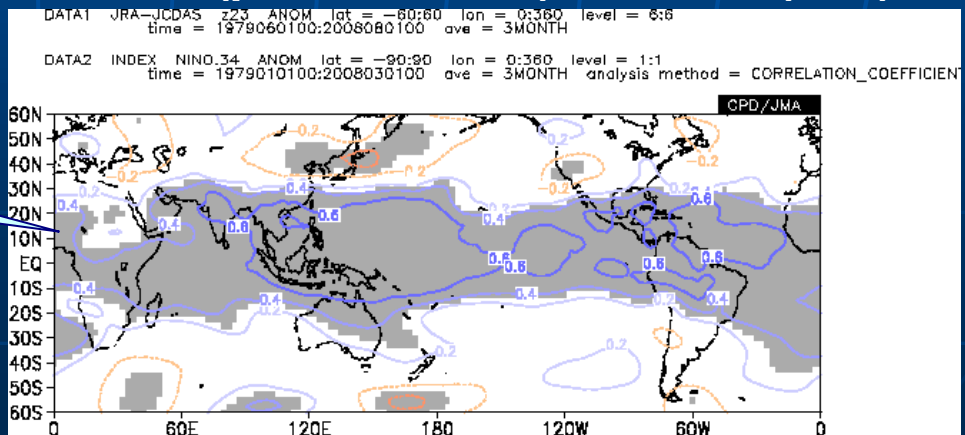
Summary

Long-term trend
● Surface temperatures and NH mid-latitude height show warming trends.
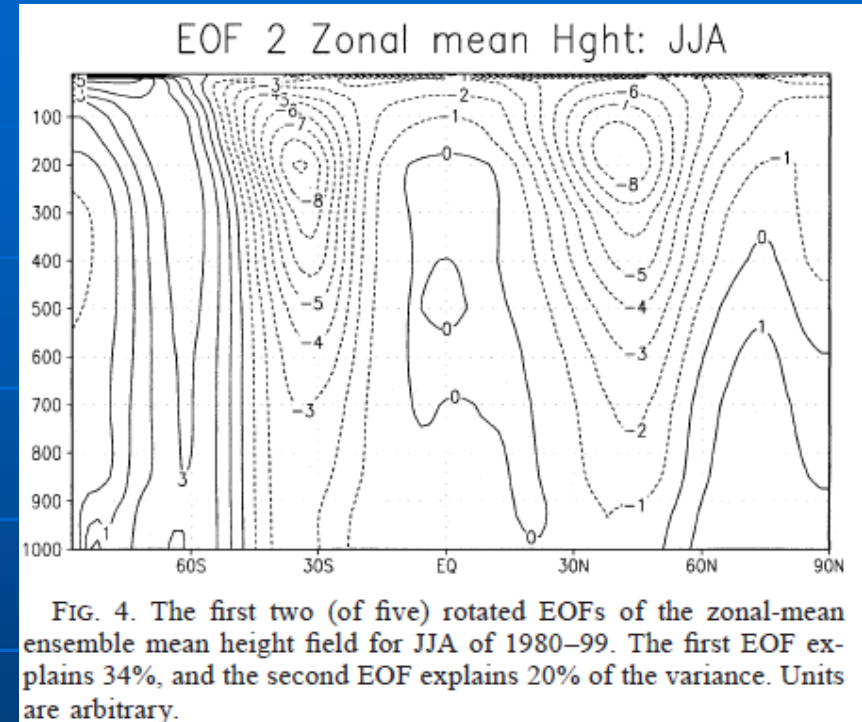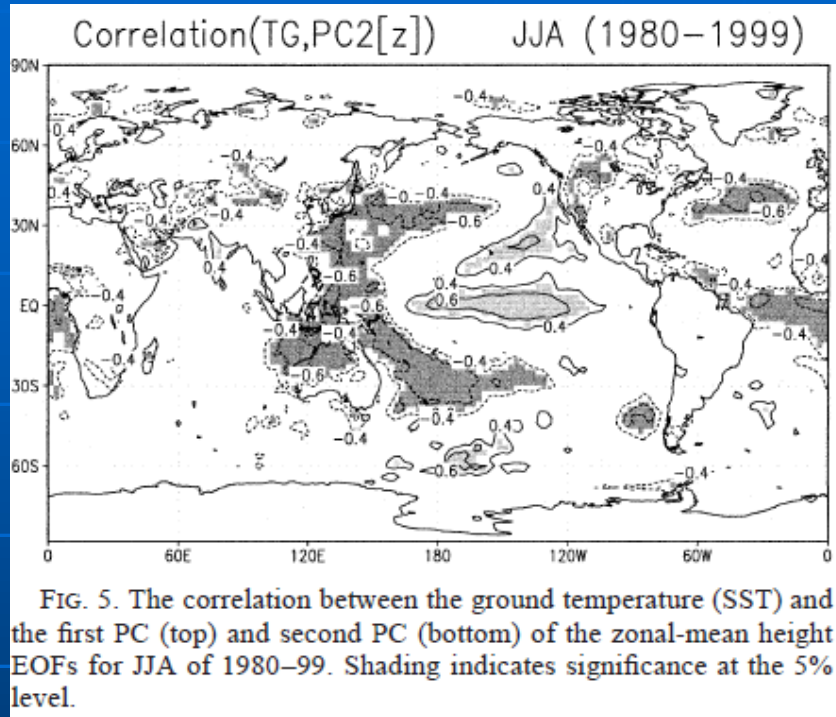→ Hot summer in Japan

ENSO outlook
● It is likely to be ENSO neutral conditions in the coming summer.

Numerical Prediction
● Reliable zonal mean height field is predicted to be higher than normal
● Northward extension of North Pacific subtropical high is weaker than normal
→ CGCM predicts a contrary scenario with respect to the convective activities around the Philippines
→ Statistically, convective activities near the Philippines tend to be stronger than normal in post La Nina years.
→ → normal westward extension of North Pacific subtropical high Summer and rainy season (Baiu) precipitation have no particular features for all regions.

Thank you for your attention

Schubert et al., 2002

FIG. 5. The correlation between the ground temperature (SST) and the first PC (top) and second PC (bottom) of the zonal-mean height EOFs for JJA of 1980–99. Shading indicates significance at the 5% level.

FIG. 4. The first two (of five) rotated EOFs of the zonal-mean ensemble mean height field for JJA of 1980–99. The first EOF explains 34%, and the second EOF explains 20% of the variance. Units are arbitrary.

On the strong upper tropospheric divergence anomaly in the Indian Ocean
One reason not to accept cold summer forecast of Japan

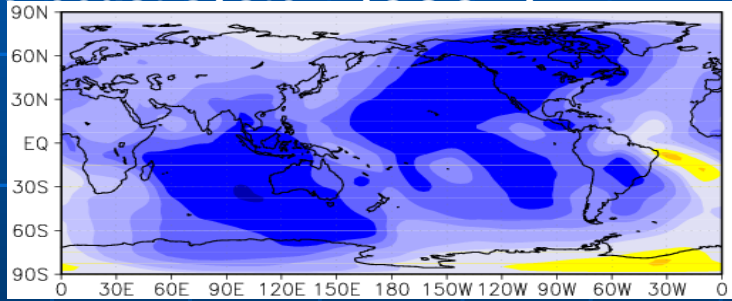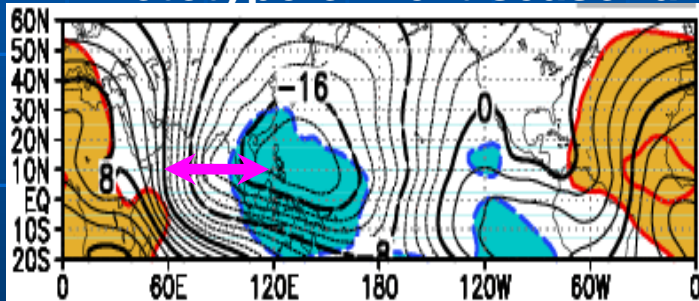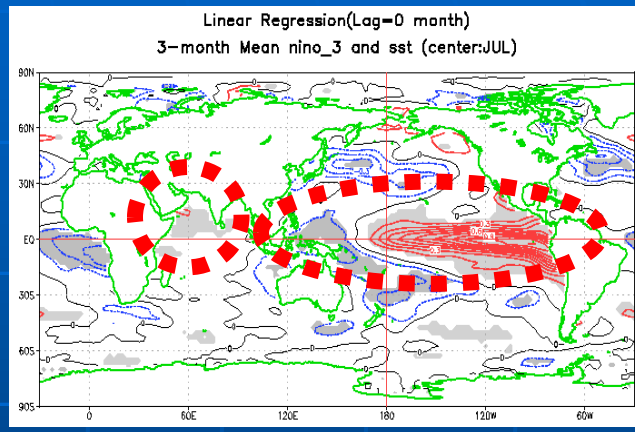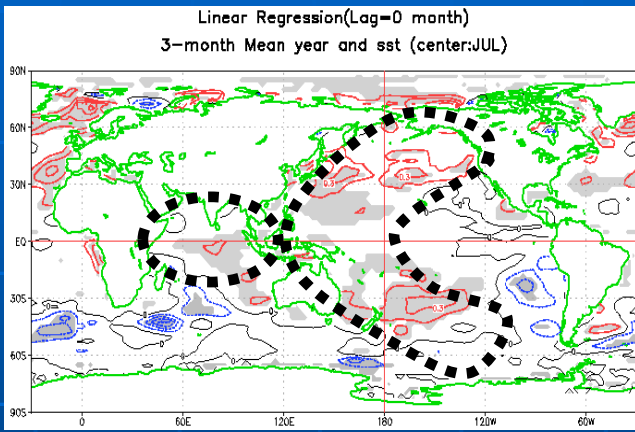**Operational seasonal forecast system (AGCM)**
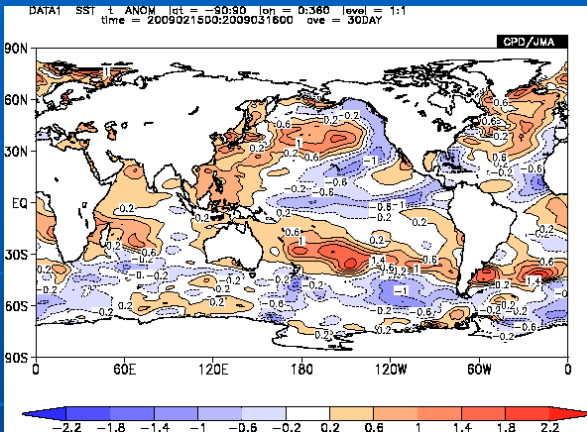
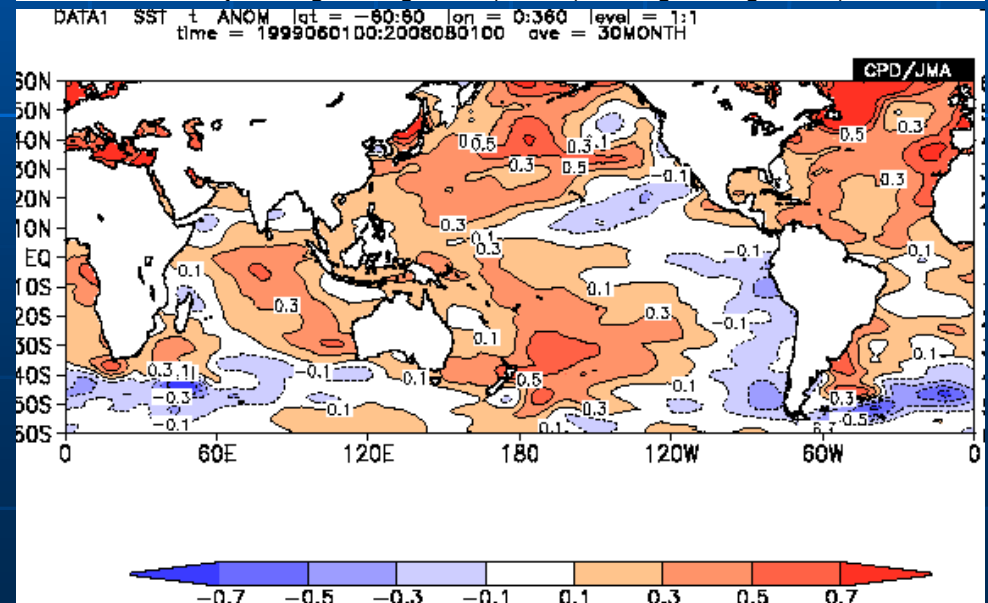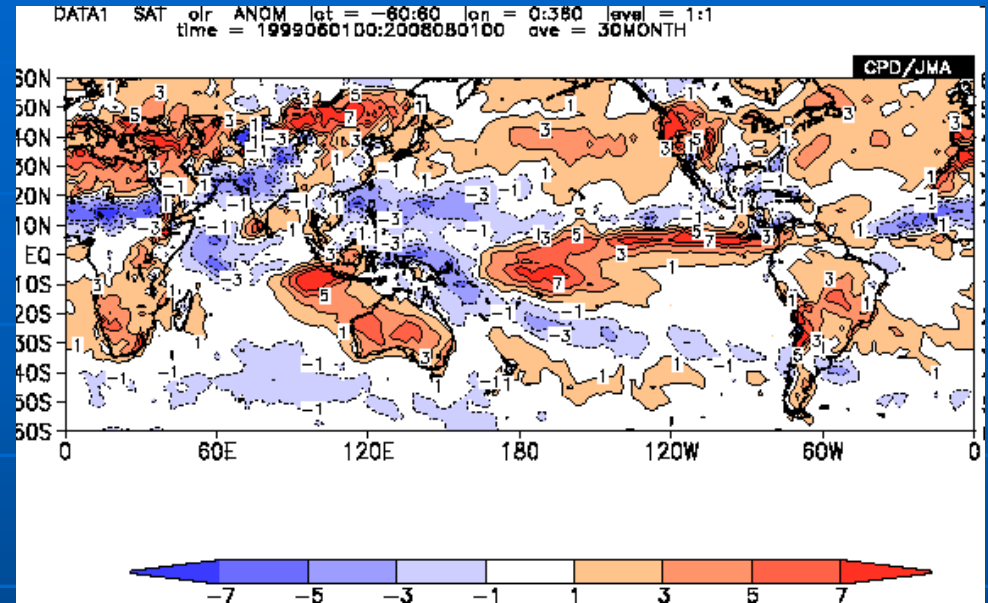**Forecasted Chi200 Anomalies**   **Anomaly Correlation with observation**
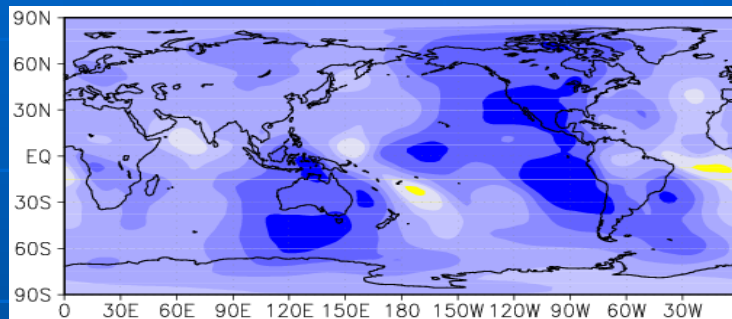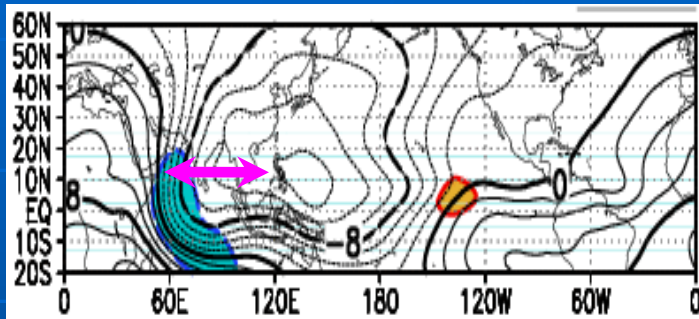
Prototype of next seasonal forecast system (CGCM)
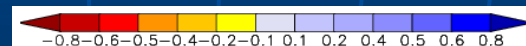
According to the forecast skill based on the 22years of hindcast experiment,
There's room for doubt about weak walker circulation pattern between the Indian Ocean and western tropical Pacific.

Linear Regression(Lag=0 month)
3-month Mean year and sst (center:JUL)

Linear Regression(Lag=0 month)
3-month Mean nino_3 and sst (center:JUL)
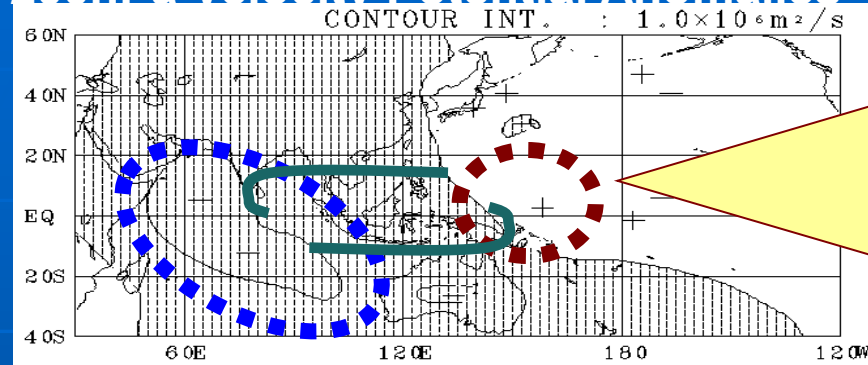
Recent 10 years

Numerical Prediction (2)
(Atmospheric general circulation)

**200hPa Velocity Potential Anomalies**

In association with the warm Indian Ocean SST due to the considerable upward trend fed to the AGCM as a lower boundary condition, divergence anomaly emerges in the upper troposphere and it induces reversed Walker circulation , which then suppresses the convective activities near Philippines. Also, it seems that convergence anomalies in the Western Pacific are emphasized by the excessive response of precipitation to local cool SST.

200hPa Stream Function Anomalies
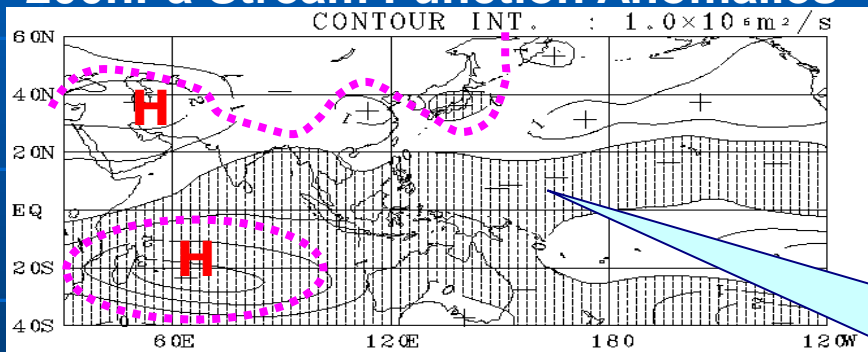
Anticyclonic and cyclonic anomalies on off-equatorial subtropical westerly jets in both NH and SH. Along the NH subtropical jet clearly exists barotropic stational Rossby wave train.

850hPa Stream Function Anomalies
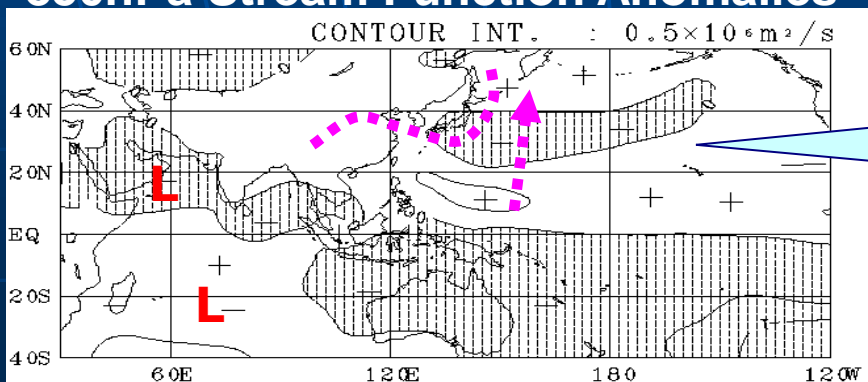
Both stational Rossby wave train and low-level teleconection pattern (P-J pattern) contributes to the cyclonic anomalies around Japan

Northward extension of subtropical high is forecasted to