



Background of Symposium/Workshop

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Japan Meteorological Agency*

Outline

- Background of Dynamical Seasonal Forecast
- Introduction of JMA Operational System
- Role of Indian Ocean and Western Pacific for Seasonal Forecast in Asian Region.
- Improvement of Asian Monsoon Forecast with CGCM. - JMA's practices -
- Required Research Activities for Future Seasonal Forecast System

Dynamical Seasonal Forecasting

Predictability of the Second Kind (Charney-Shukla Hypothesis)

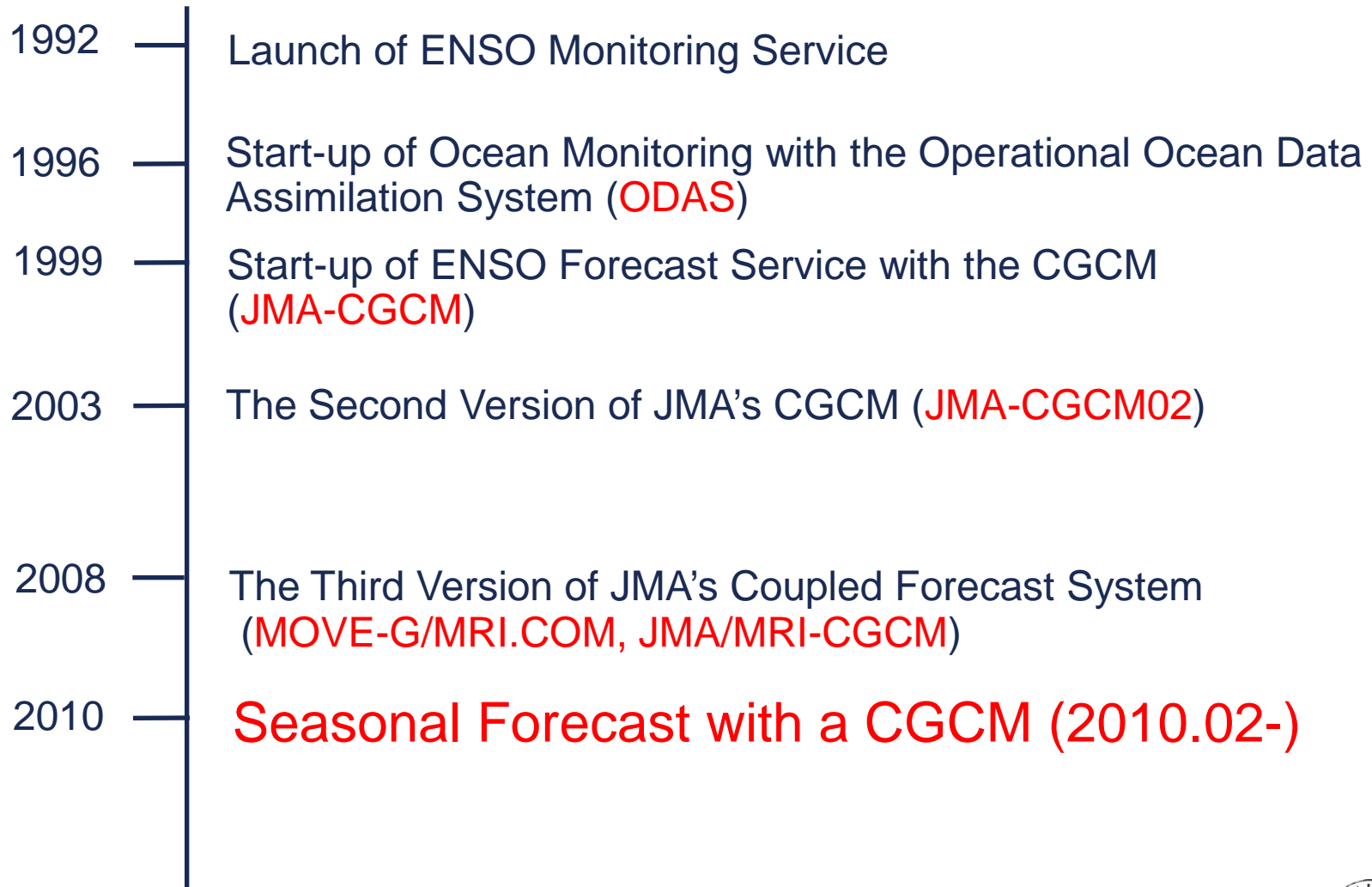
On the basis of the available evidence it is suggested that a large part of the low-latitude variability is due to **boundary anomalies** in such qualities as **sea-surface temperature**, **albedo** and **soil moisture**, which, having longer time constants, are more predictable than the flow instabilities. **Additional variability due to long-period natural fluctuations would likewise be more predictable.**

Charney and Shukla (1981) Monsoon Dynamics

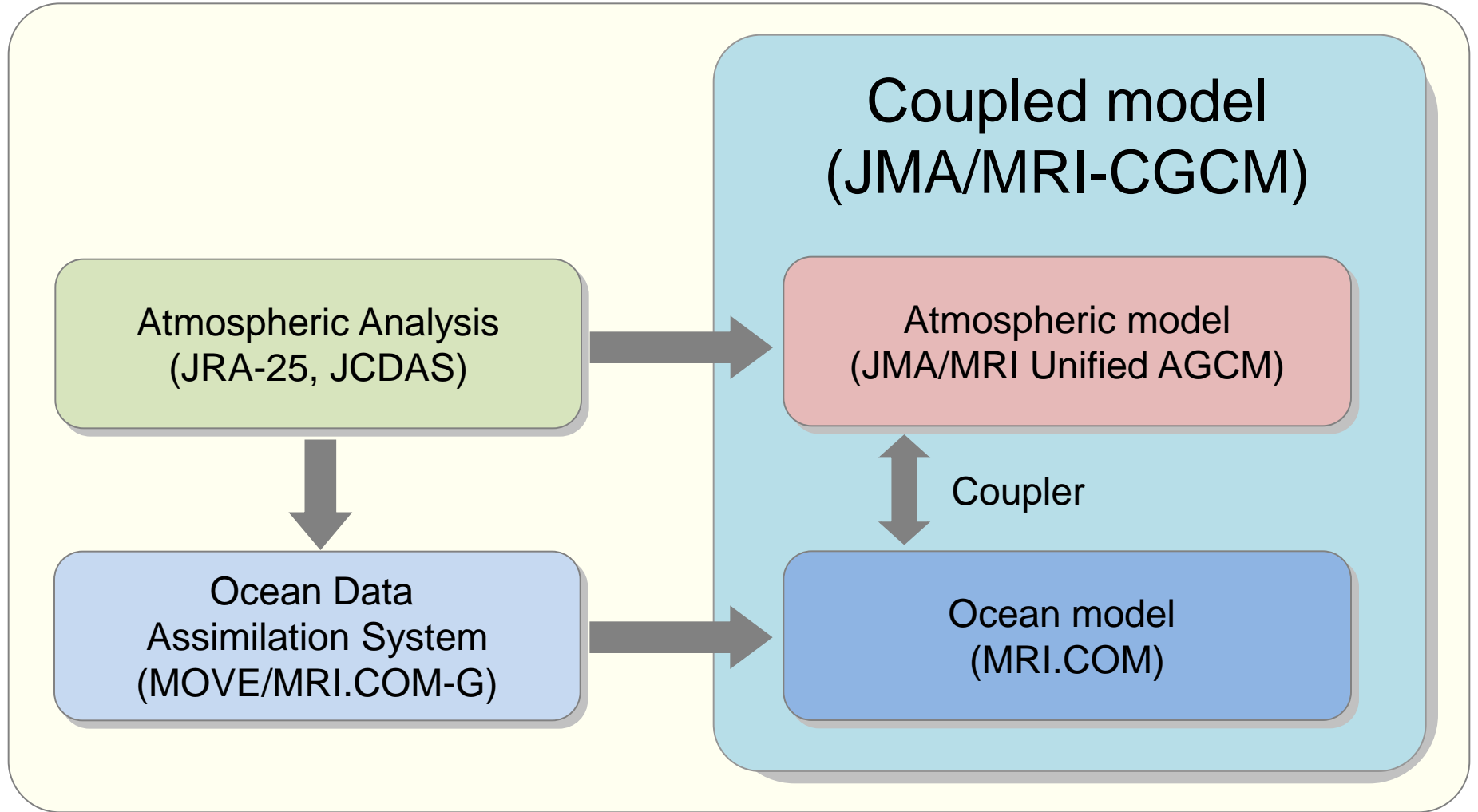
JMA Operational Monthly-Seasonal Forecast

Forecast systems	periods	descriptions
1-month ensemble forecast	34 days	JMA-GSM (AGCM), T _L 159L60, BGM+LAF (50 mem), Prescribed SST anomaly, Land surface analysis
3-month, seasonal ensemble, ENSO forecast model	7 months	JMA/MRI-CGCM with land surface analysis, some modified configurations T _L 95L40, LAF+BGM (trop)+prtb. Ocean analysis (50 mem/1 month)

History of Coupled Forecast System at JMA



JMA Coupled Forecast System



Coupled Model (JMA/MRI-CGCM)

AGCM	<p>JMA/MRI Unified AGCM</p> <ul style="list-style-type: none">• T_L95L40 (horizontal resolution ~ 180km)
OGCM	<p>MRI.COM</p> <p>Ishikawa <i>et al.</i> (2005)</p> <p>75S-75N, 0-360E</p> <ul style="list-style-type: none">• horizontal resolution: lon 1° , lat 0.3-1°• vertical resolution : 50 levels (23 levels in the upper 200m)
Coupler	<ul style="list-style-type: none">• coupling interval : 1 hour• flux adjustment for heat and momentum flux

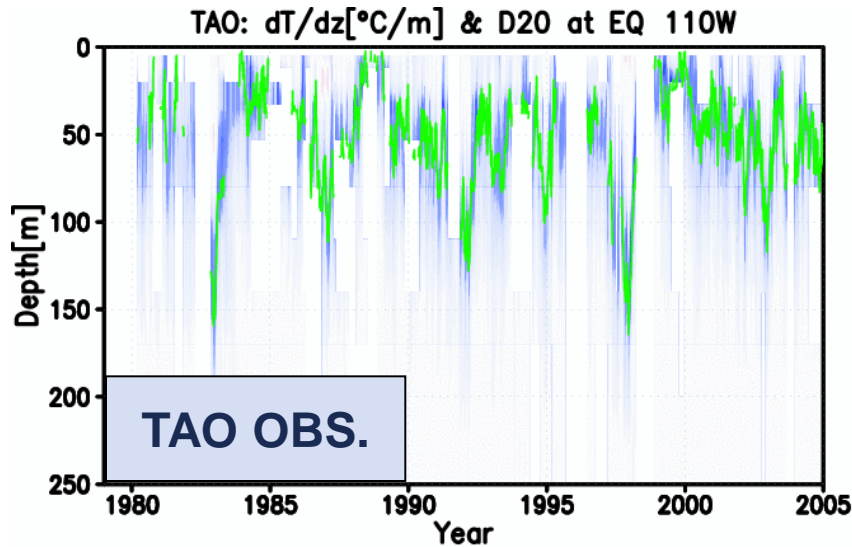
Ocean Data Assimilation System (MOVE/MRI.COM-G)

MOVE (Multivariate Ocean Variational Estimation) System

Usui et al. (2006)

- Ocean Model : MRI Community Ocean Model (MRI.COM)
- 3D-VAR(T,S)
Observation Data: T, S on GTS,
SST (COBE-SST, Ishii *et al.* 2005),
SSH (TOPEX/POSEIDON, JASON-1,
JASON-2, ERS-1&2, ENVISAT)
- Vertical Coupled Temperature-Salinity EOF modes
Fujii and Kamachi(2003)
- Incremental Analysis Update (IAU)

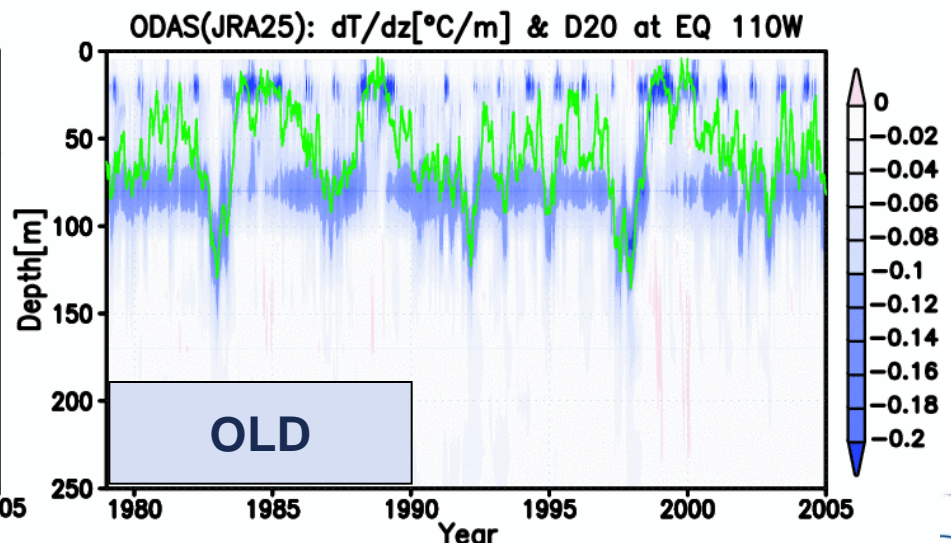
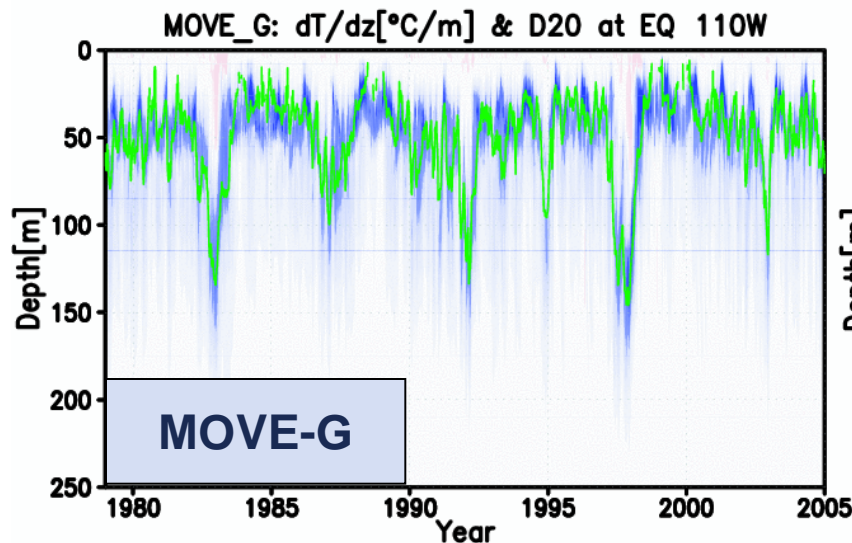
Improvement of the thermocline variability



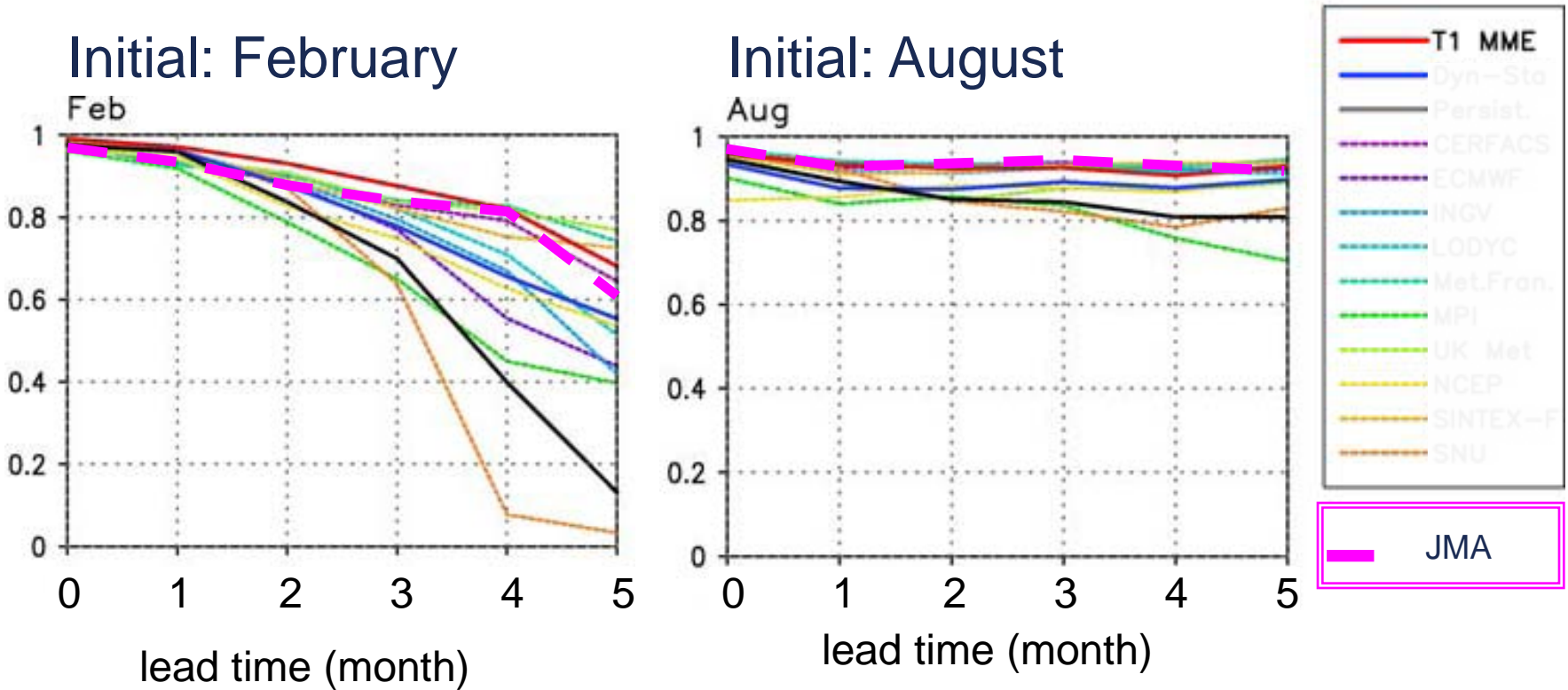
shade: dT/dz

lines: isotherms of 20°C

The MOVE system represents the more realistic interannual variability of the thermocline.



NINO.3.4 SST Correlation



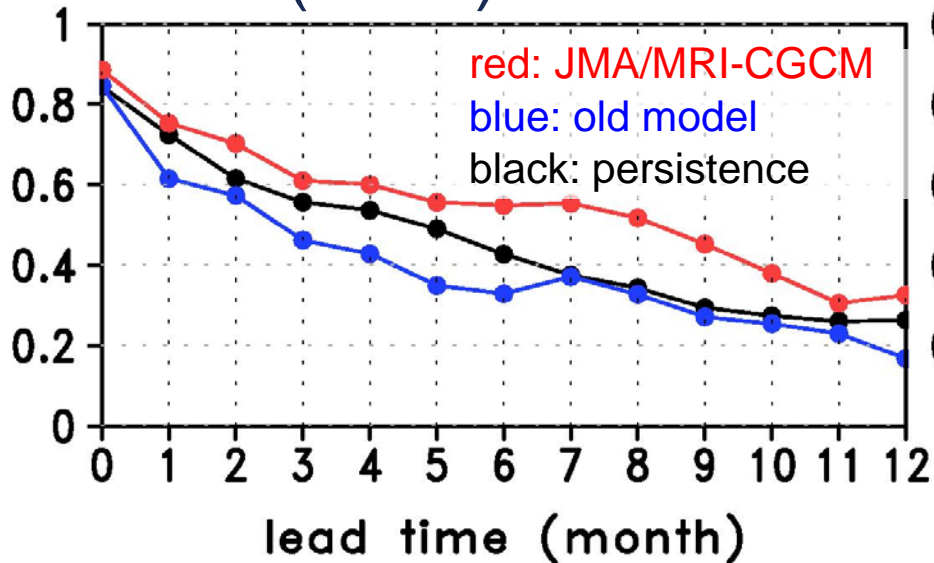
10 member ensemble, ref. COBE-SST
(Please note that Jin's verification used HadSST.)

Period: 1980-2001
Jin et al. (2008)

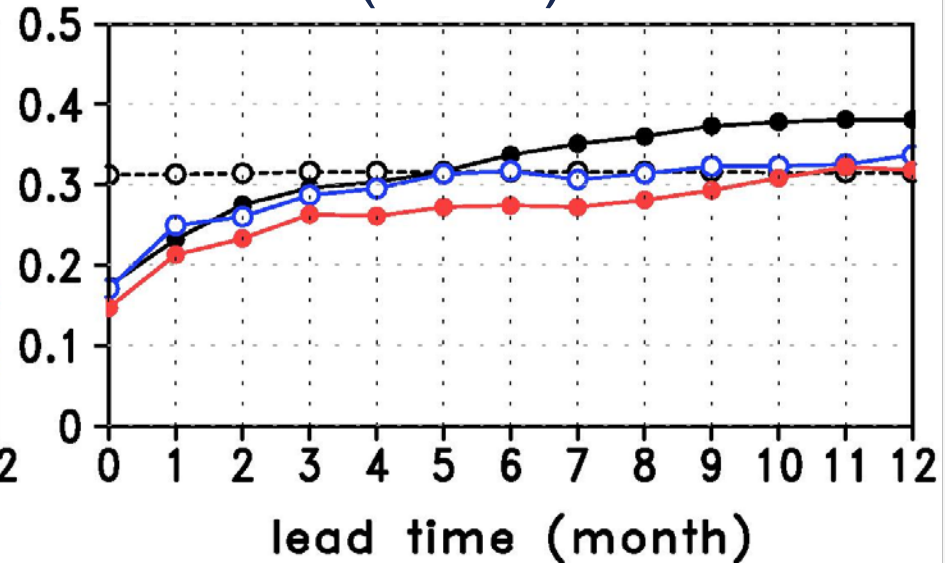
Hindcast with the new seasonal forecast system

Forecast Skill of SST in WTP

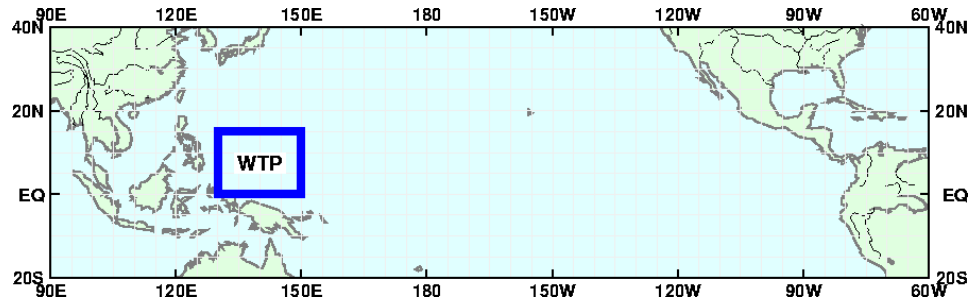
ACC (WTP)



RMSE (WTP)



Period: 1979-2005
1 member forecast started from the end of every month (NOT ensemble forecast)



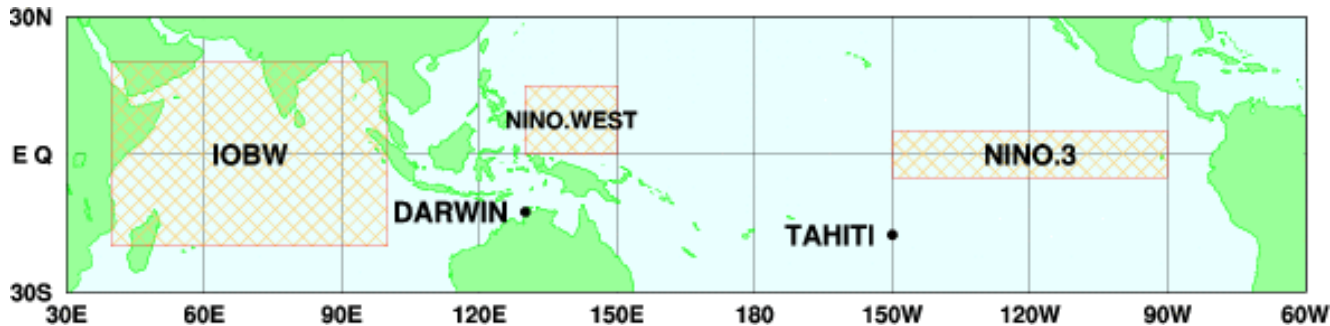
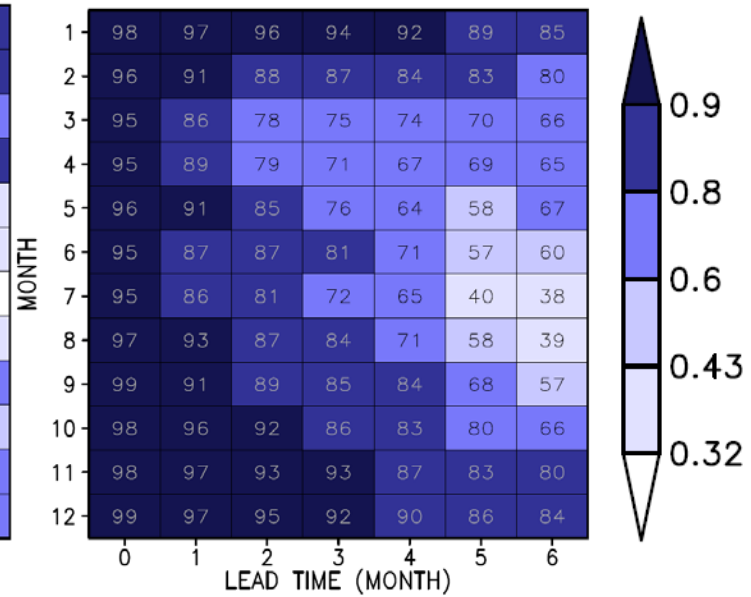
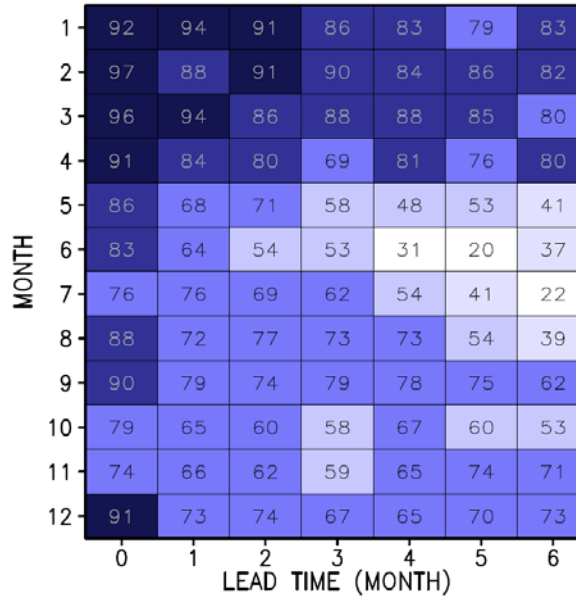
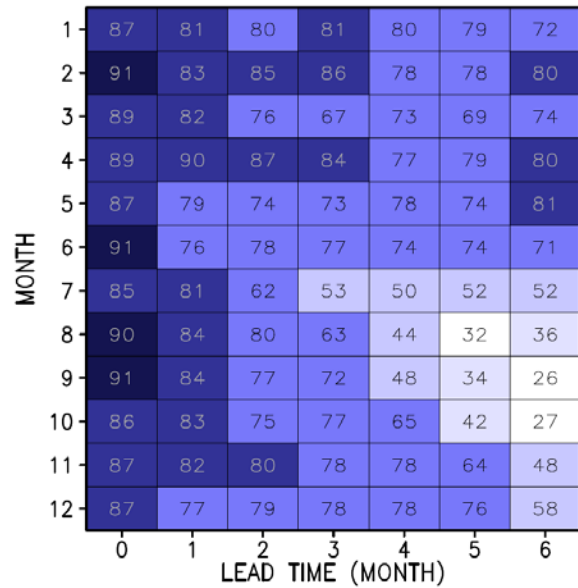
Tamaki Yasuda

SST Skill wrt Lead Time

ACC for IOBW

ACC for NINOW

ACC for NINO3

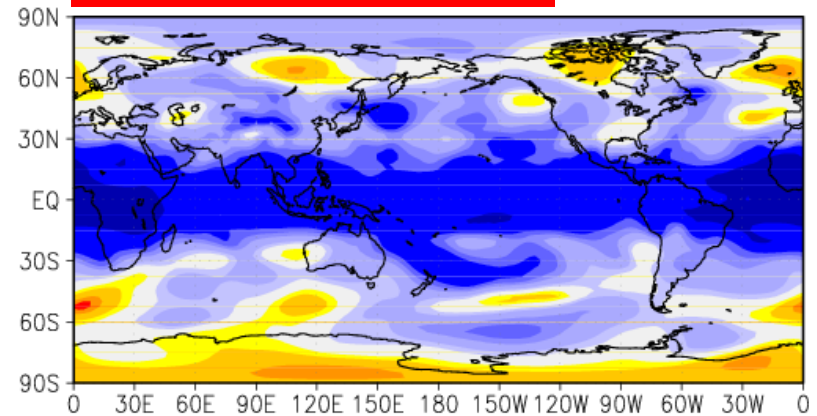
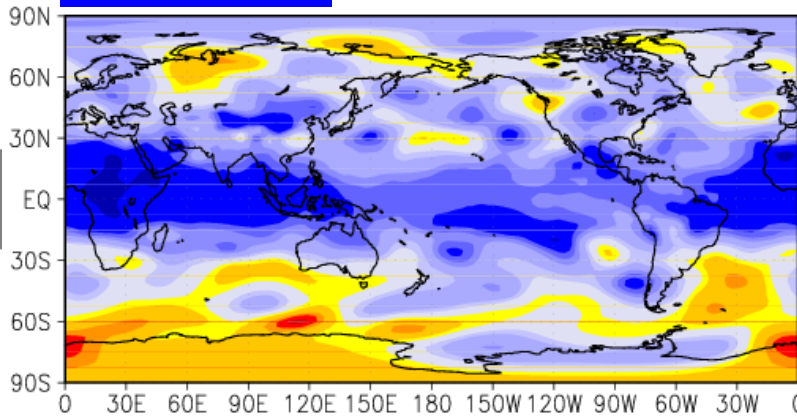


Forecast scores (ACC, JJA forecast starting from February)

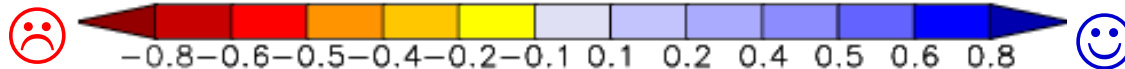
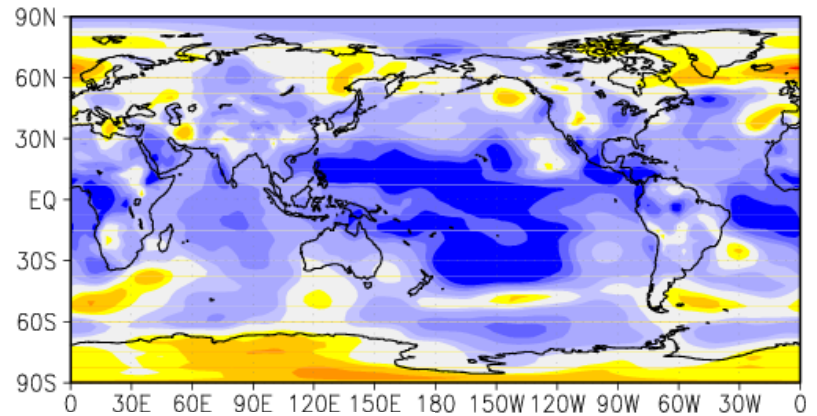
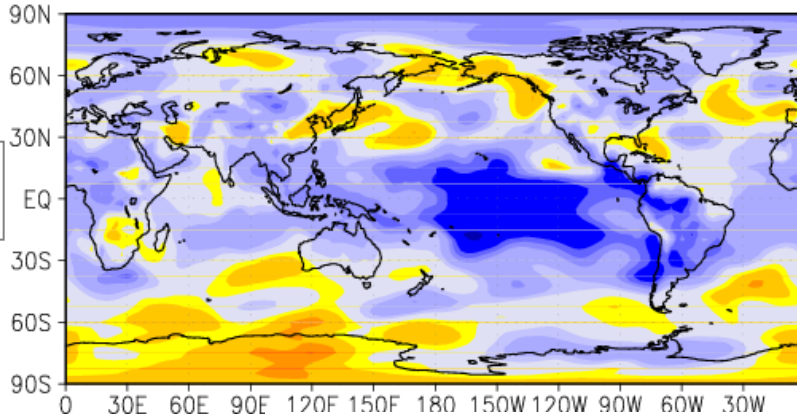
AGCM

JMA/MRI-CGCM

Z500



SLP



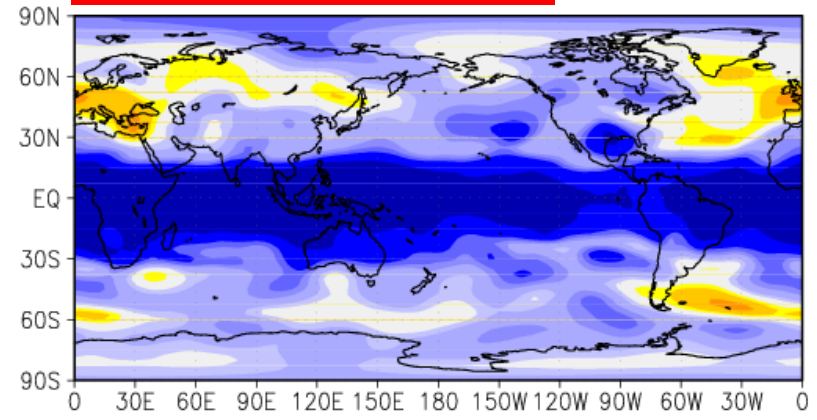
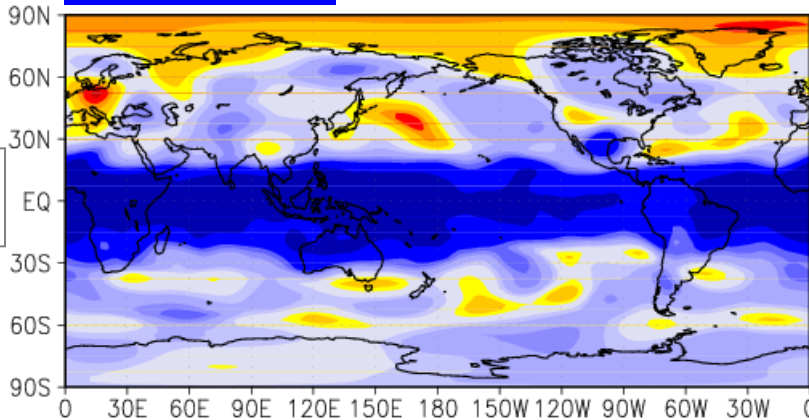
Based on hindcast with the new seasonal forecast system (1984-2005)

Forecast scores (ACC, DJF forecast starting from August)

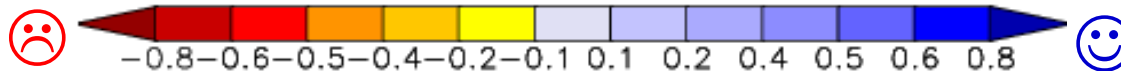
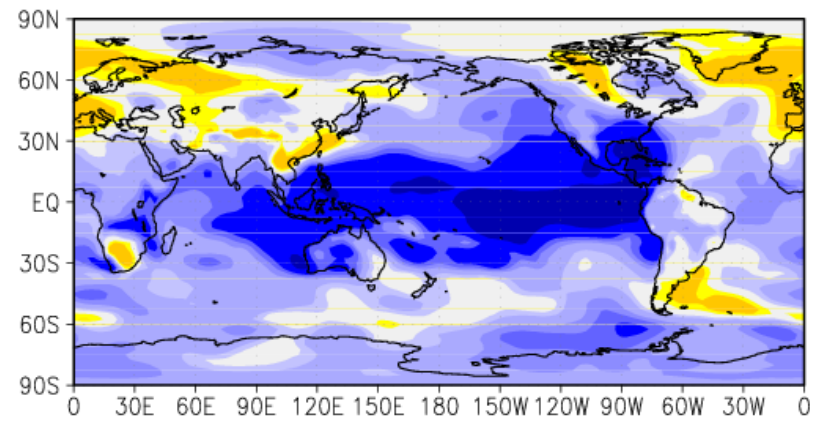
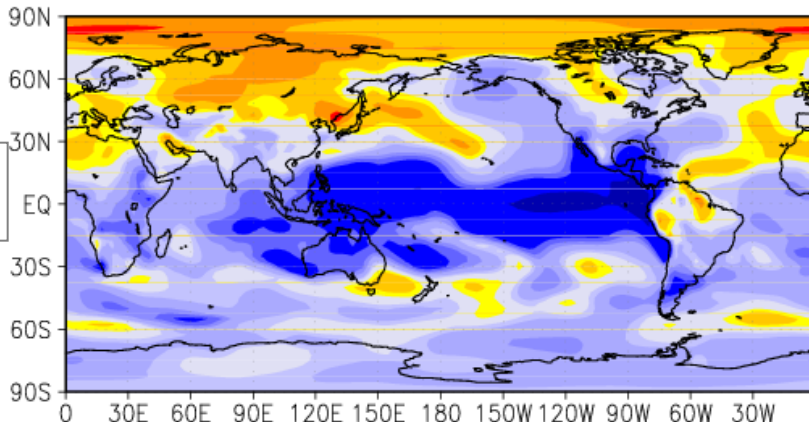
AGCM

JMA/MRI-CGCM

Z500



SLP



Based on hindcast with the new seasonal forecast system (1984-2005)

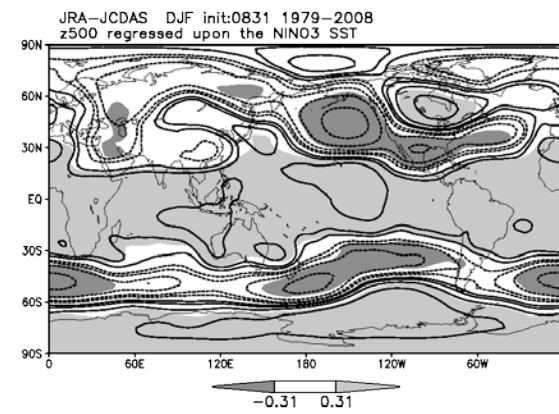
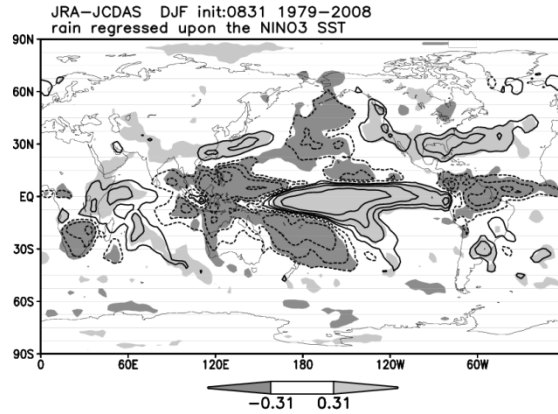
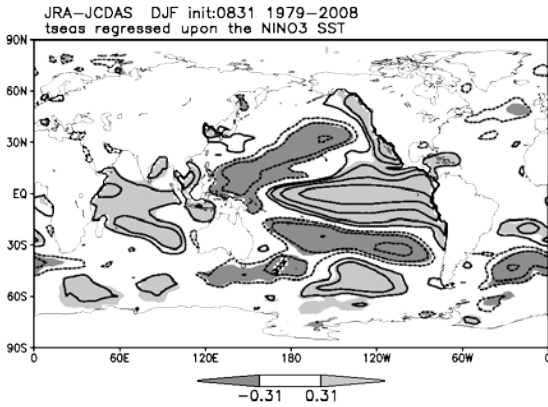
Teleconnection (Regression on Nino3 SST)

Analysis

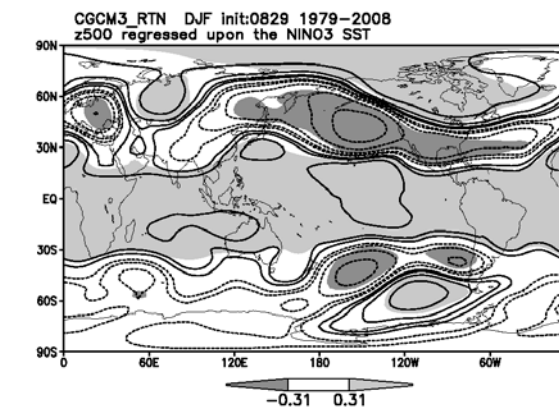
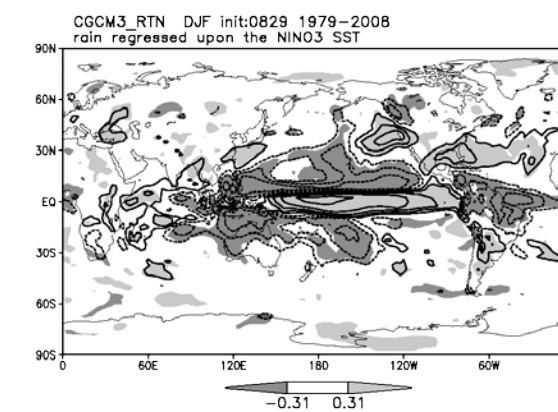
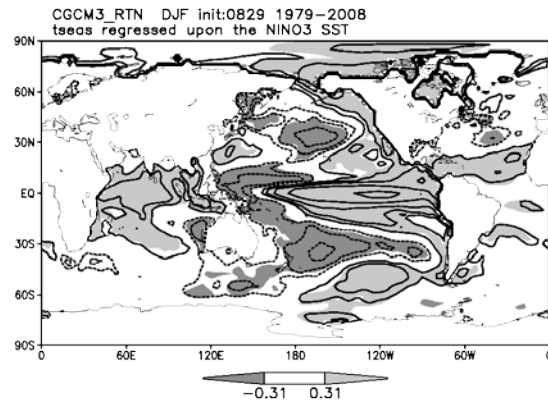
SST

Precipitation

Z500



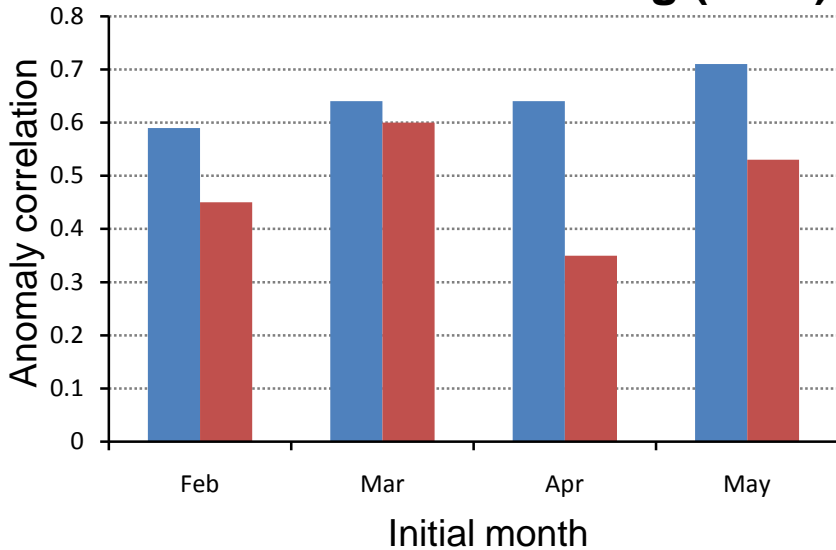
JMA/MRI-CGCM



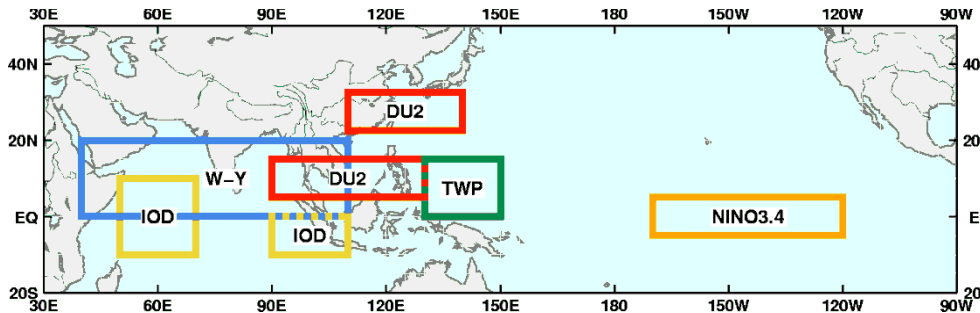
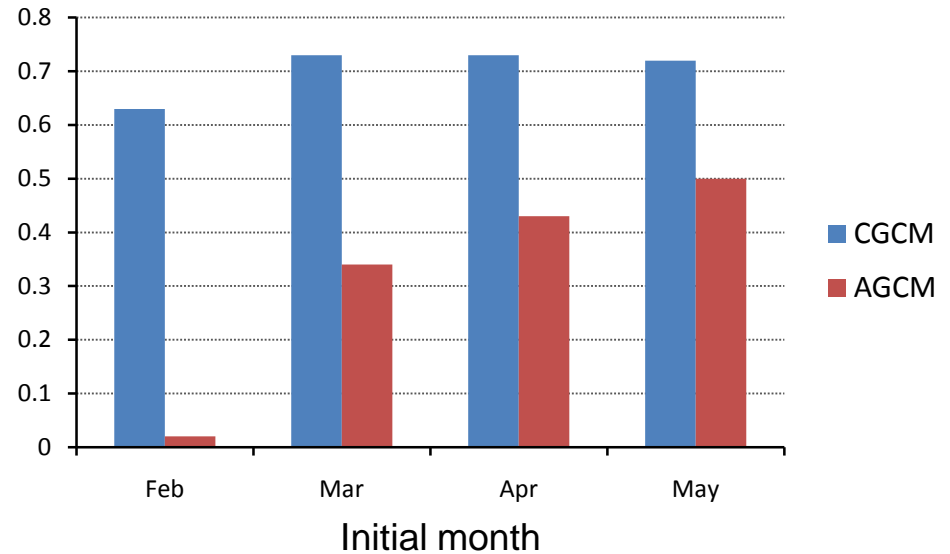
Improvement of Monsoon Forecast

Boreal Summer (JJA) Forecasts of Asian Monsoon Indices

W-Y : Webster and Yang (1992)



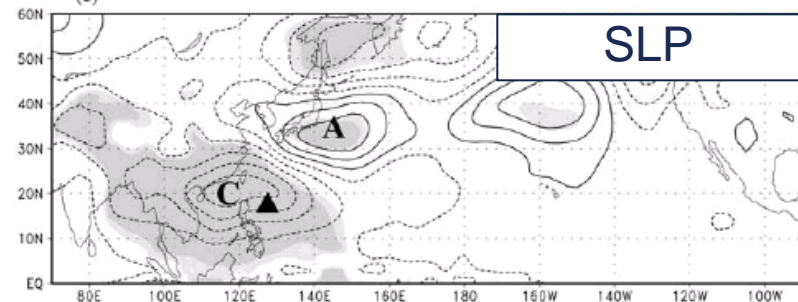
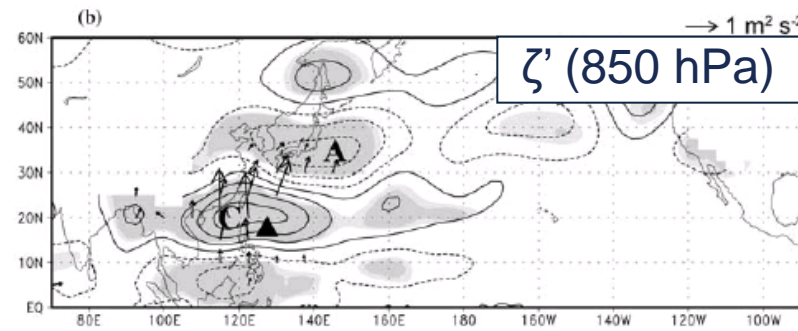
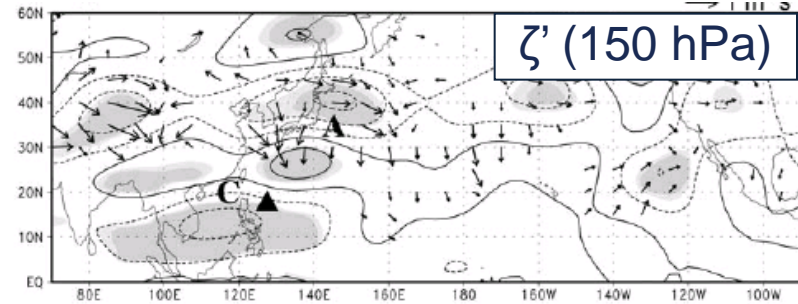
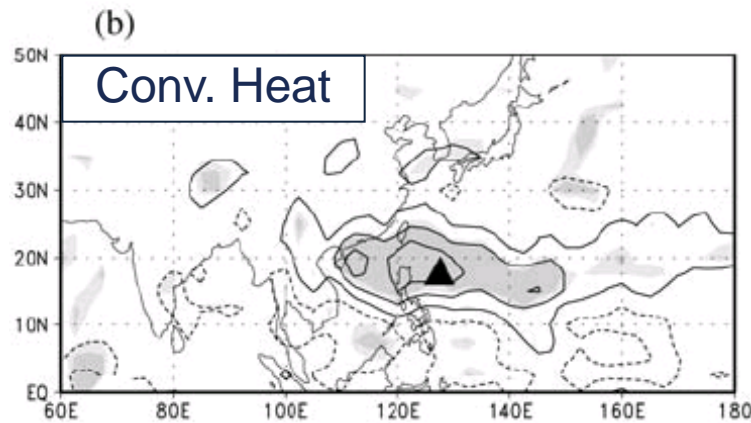
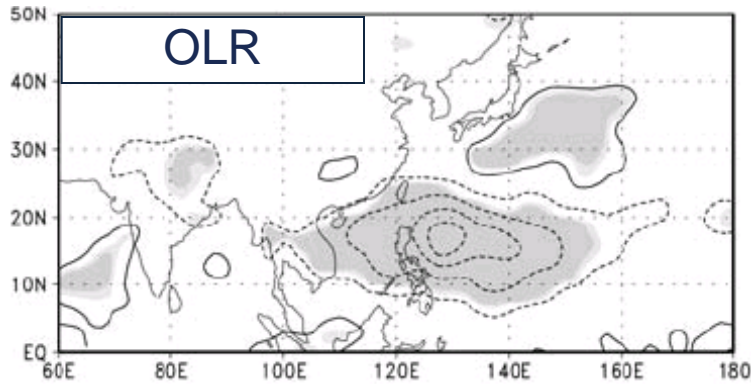
DU2 : Wang and Fan (1999)



W-Y index : U850-U200 (0-20N, 40-110E)
 DU2 index: U850 (5-15N,90-130E)
 – U850(22.5-32.5N,110-140E)

Based on hindcast with the new seasonal forecast system (1984-2005)

Predictability from the Teleconnection (Pacific-Japan Pattern, Nitta 1987)

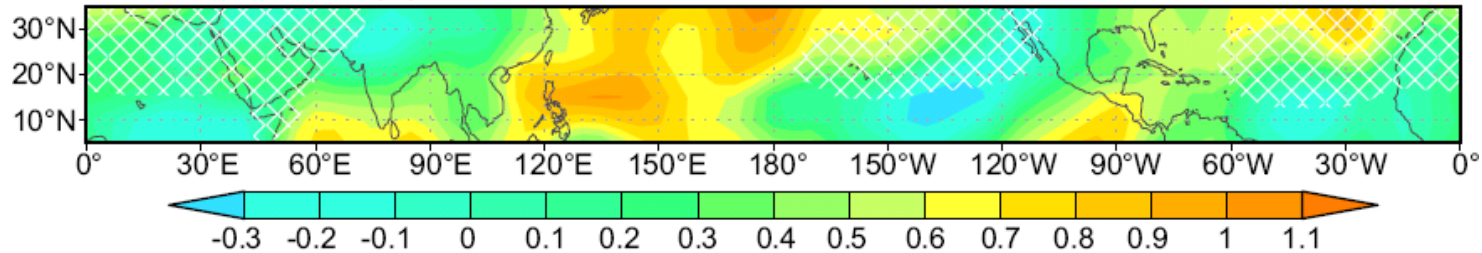


Kosaka and Nakamura 2008

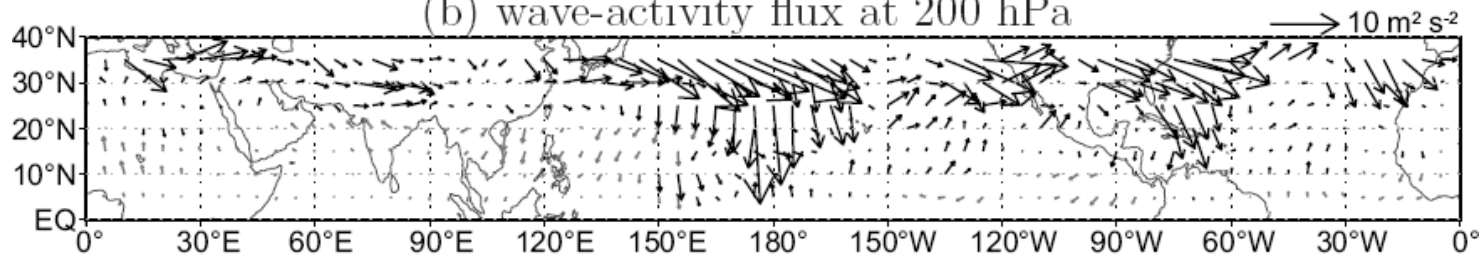
- Composited anomalies of 32 strongest monthly event in 1979-2003

Global View of Tropics-Extratropics Teleconnection in Boreal Summer

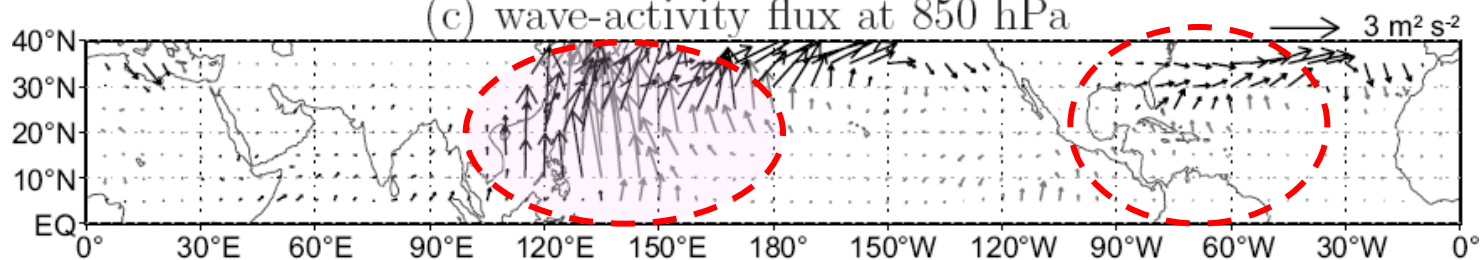
(a) meridional ζ' difference at 850 hPa



(b) wave-activity flux at 200 hPa



(c) wave-activity flux at 850 hPa



Kosaka and Nakamura 2009, J. Clim.

South China Flood in 2010



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China flood death toll 'over 500'

Summer floods in China have killed 567 people and forced over two million from their homes, the government has said.

Torrential rains in much of the country have left areas of southern China submerged beneath muddy waters in the deadliest early floods for a decade.

Heavy rains have come sooner than usual, leaving the city of Wuzhou, and the provinces of Guangxi and Guangdong seriously affected.

President Hu Jintao has ordered officials to increase emergency relief.

"Faced with a serious fight against the floods... we must quickly step up efforts at organising construction and inspections of major dykes, reservoirs and reserve flood

Guangdong is seeing its worst flooding for at least 90 years

BBC NEWS: VIDEO AND AUDIO
Residents try to cope as floods wreak havoc in China

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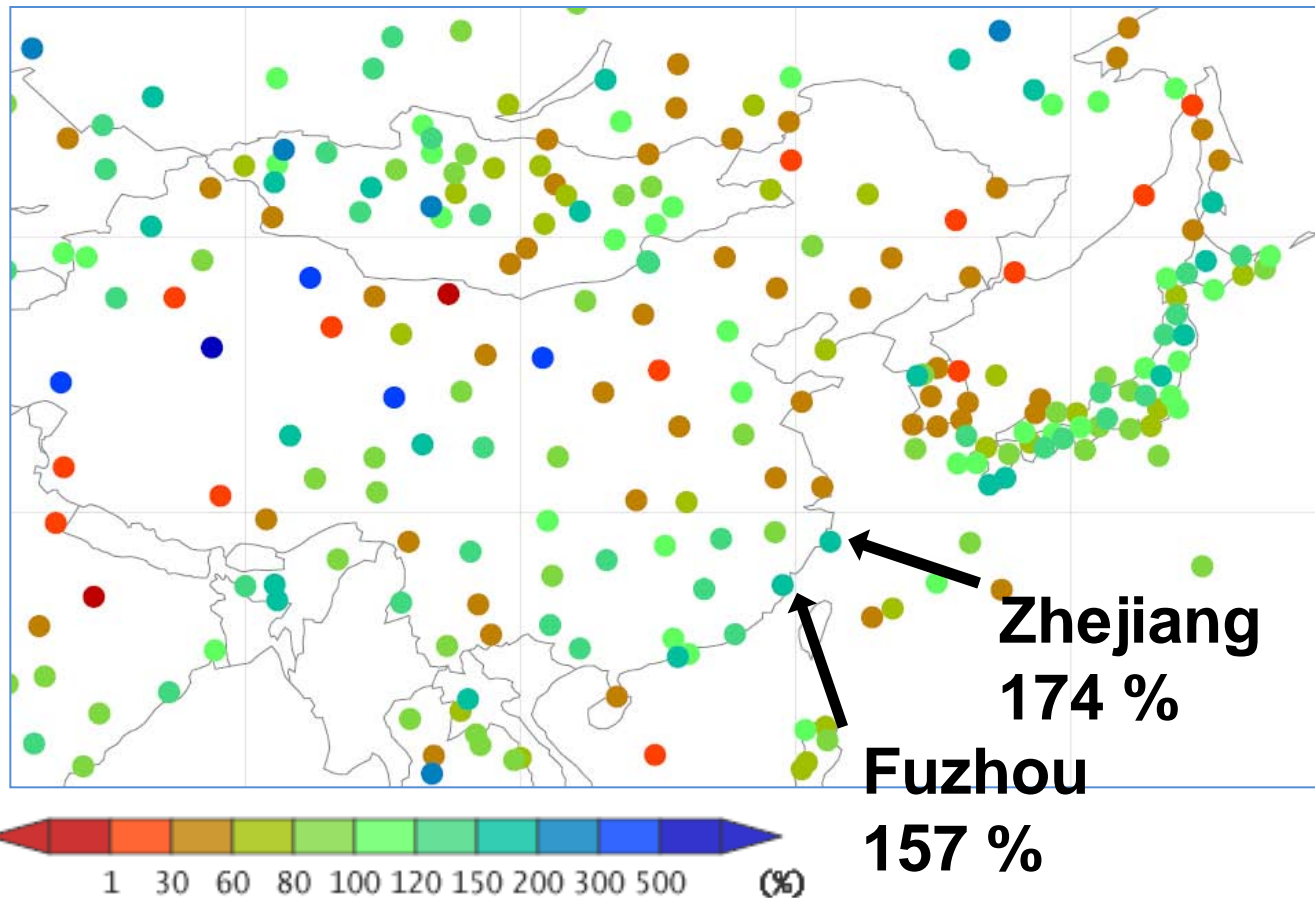
RELATED INTERNET LINKS:

- Chinese government
- Xinhua
- China Daily

BBC News <http://news.bbc.co.uk/2/hi/asia-pacific/4617891.stm>

Precipitation in June 2010

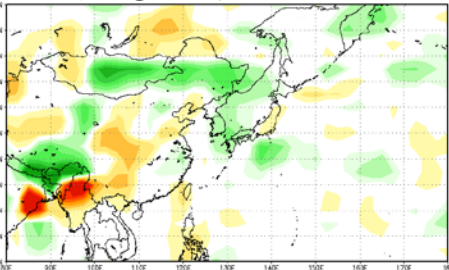
Ratio to Normals



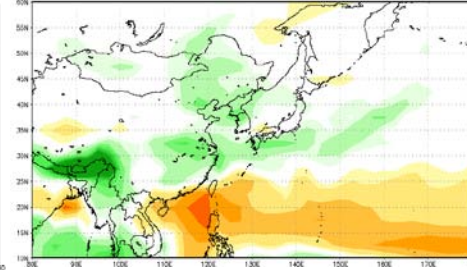
Based on CLIMAT reports

Precipitation Forecasts for June 2010 (I.C. : May)

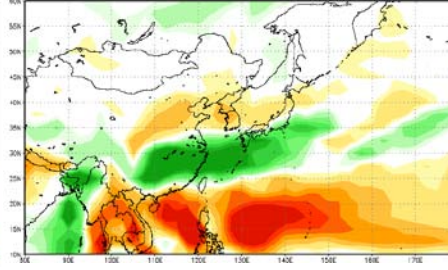
Beijing



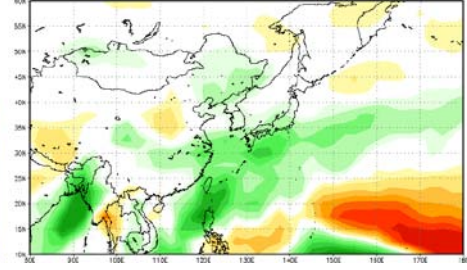
ECMWF



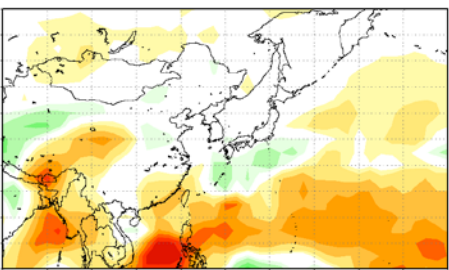
Exeter



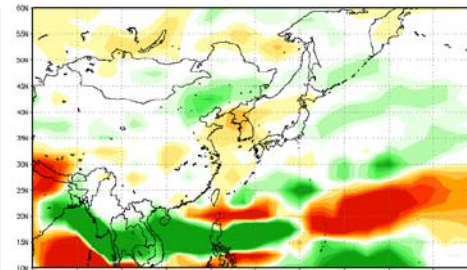
Melbourne



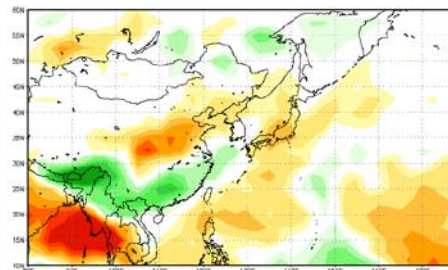
Montreal



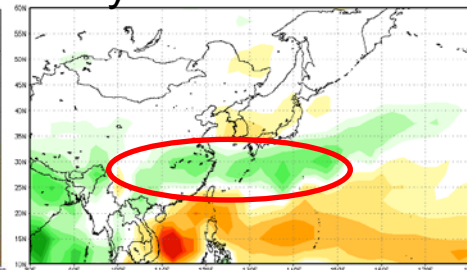
Moscow



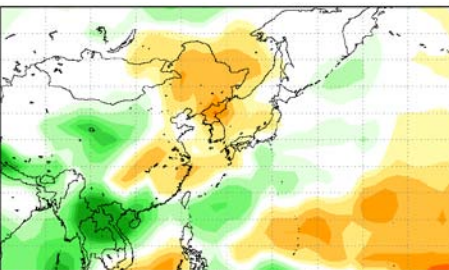
Seoul



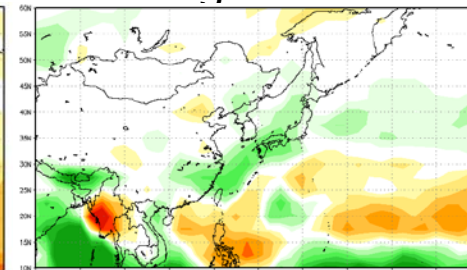
Tokyo



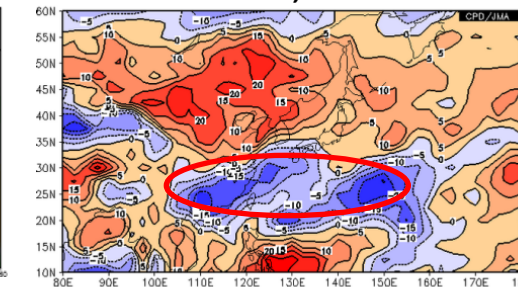
Toulouse



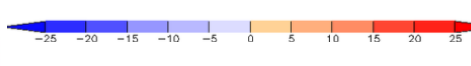
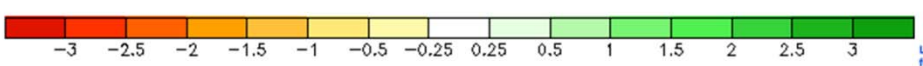
Washington



Observation; OLR anomaly

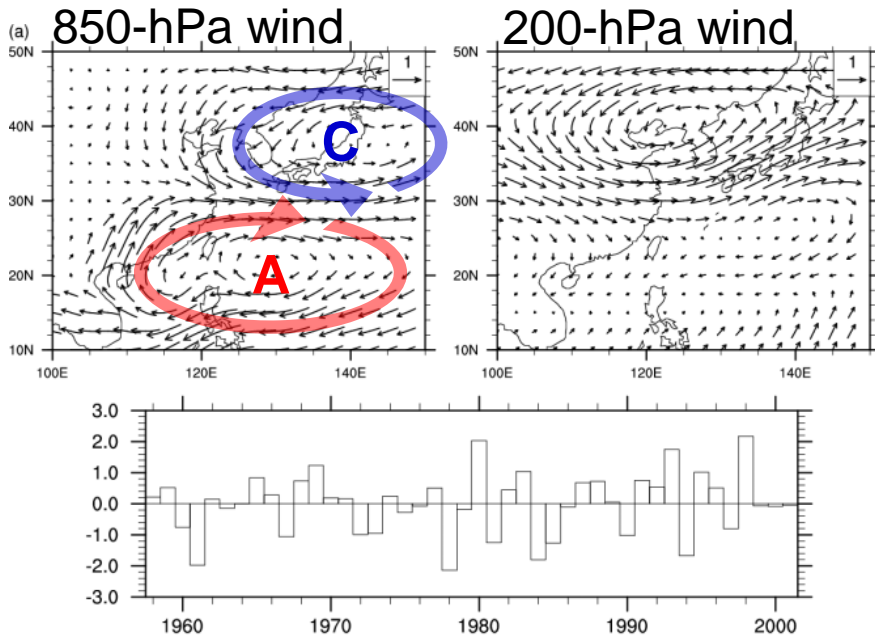


Original data are provided by NOAA.



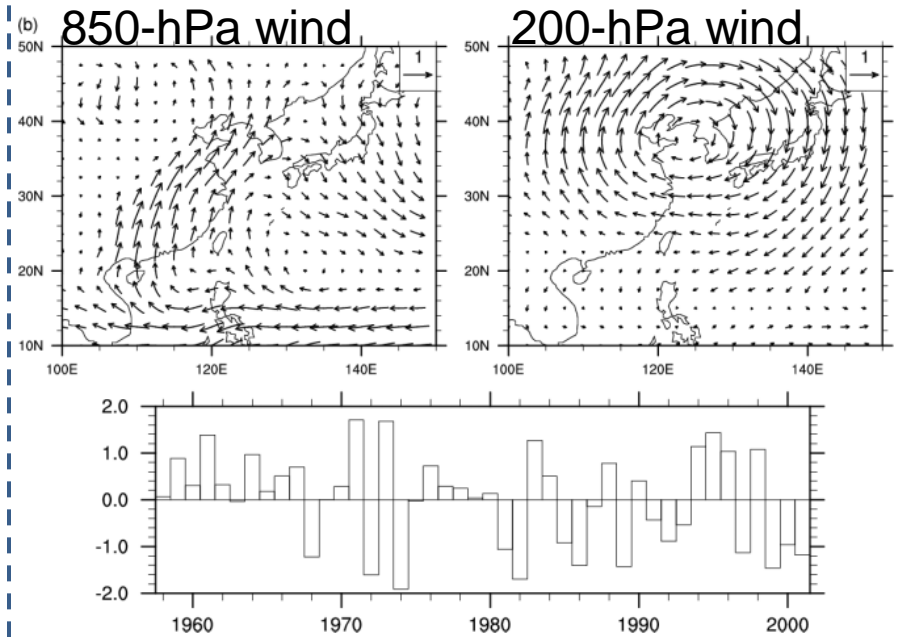
Major modes of East Asian Summer Monsoon

Mode1 (20.2%)



Pacific-Japan (PJ) Pattern
Nitta (1987)

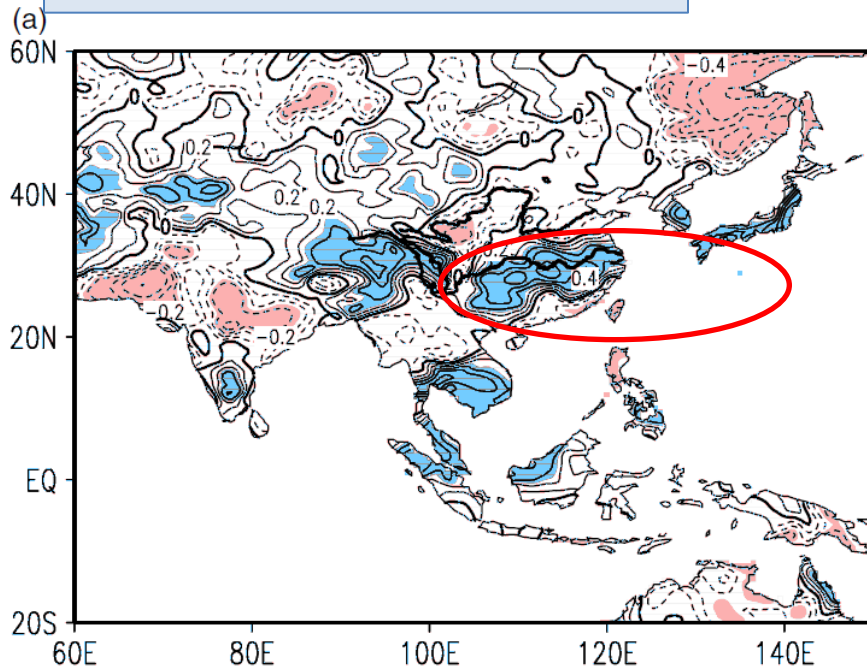
Mode2 (11.6%)



Sun et al. 2010 QJRMS
See also, Wang et al. 2008.

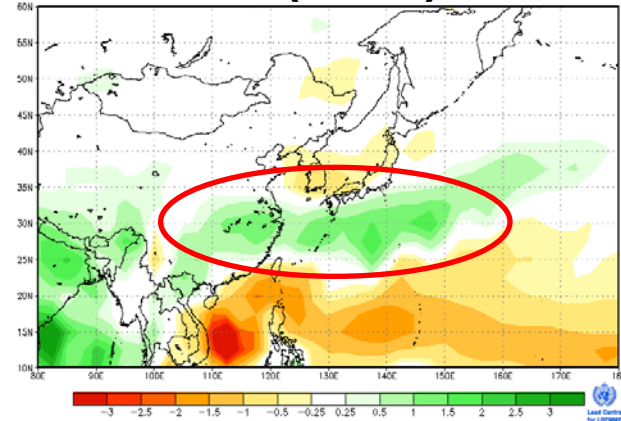
Major modes of East Asian Summer Monsoon

Correlation btw precipitaion and mode 1 time-series

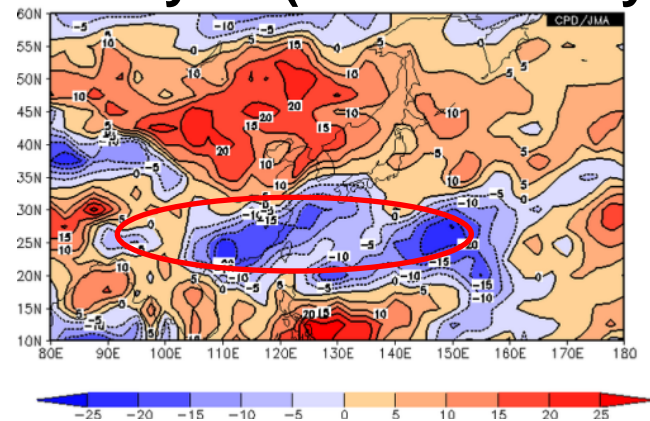


Sun et al. 2010 QJRM5

Forecast (JMA)

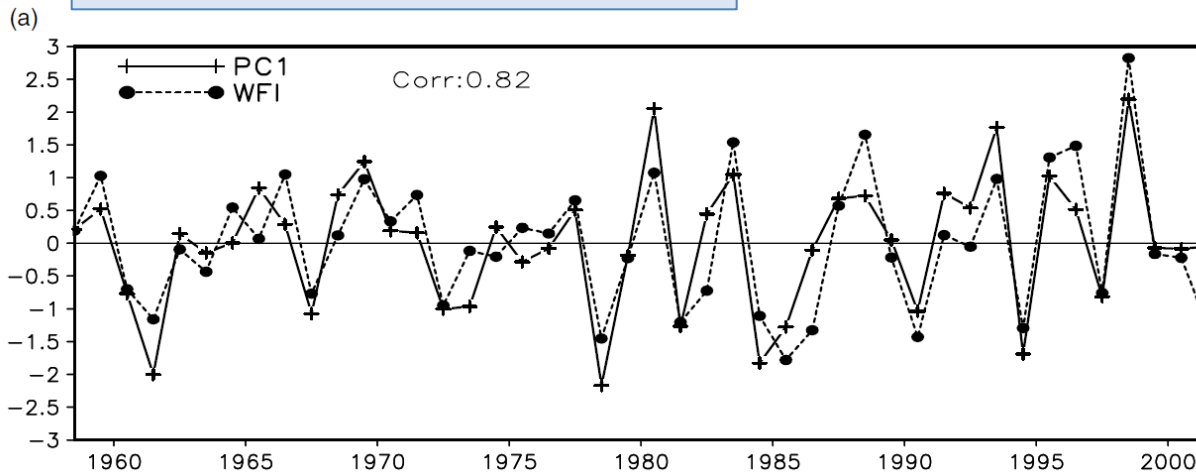


Analysis (OLR Anomaly)

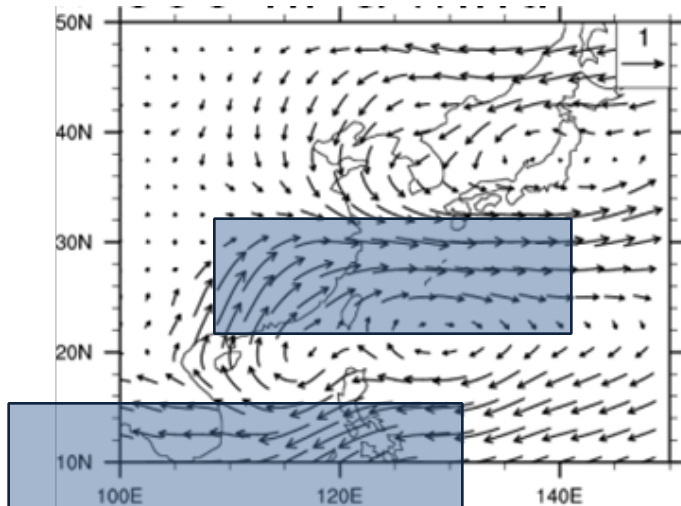


Index of 1st Mode

Index of the 1st Mode



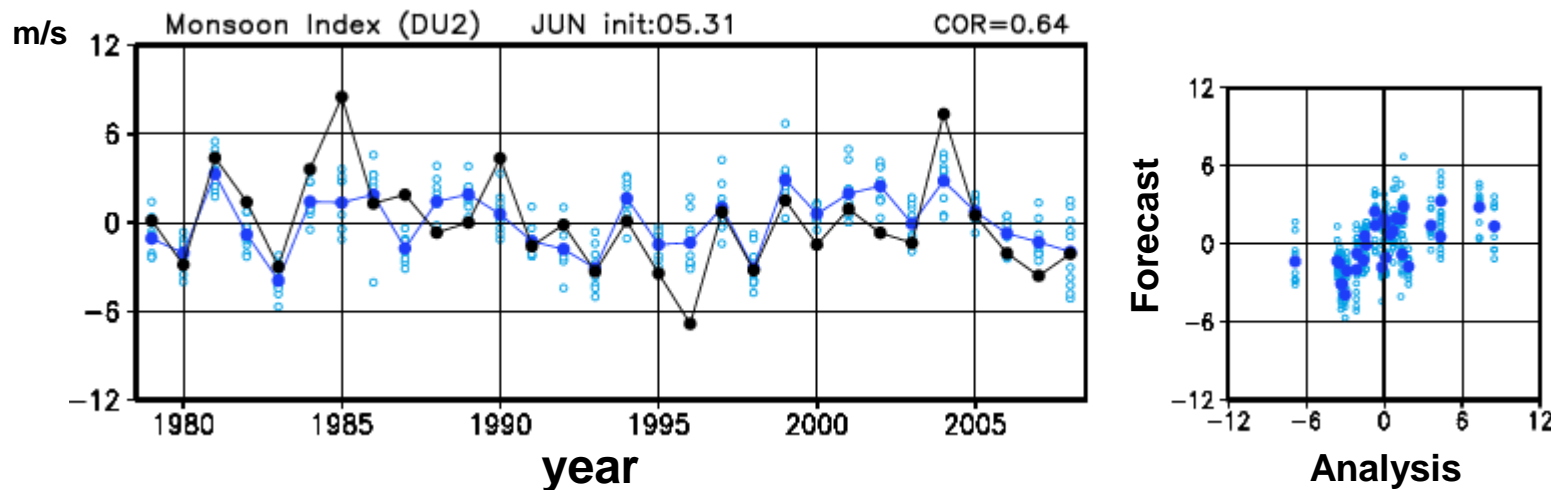
The 1st mode is well correlated with Wang and Fan Index (Wang and Fan, 1999).



Wang and Fan Index :
U850 (5-15N,90-130E) –
U850 (22.5-32.5N,110-140E)

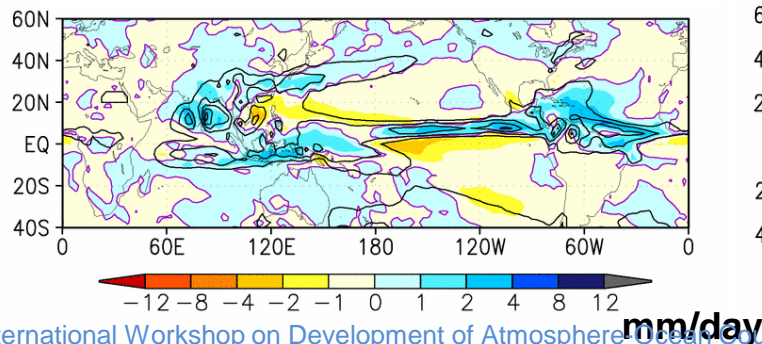
East Asian Summer Monsoon Forecast

Wang and Fan (1999) Index in June

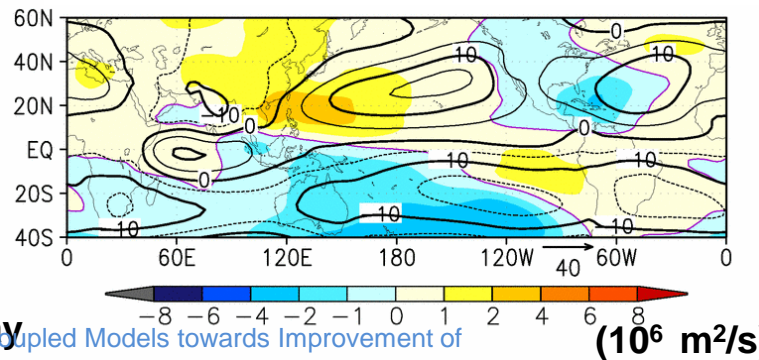


JMA forecast for June 2010 (init: May)

Precipitation anomaly



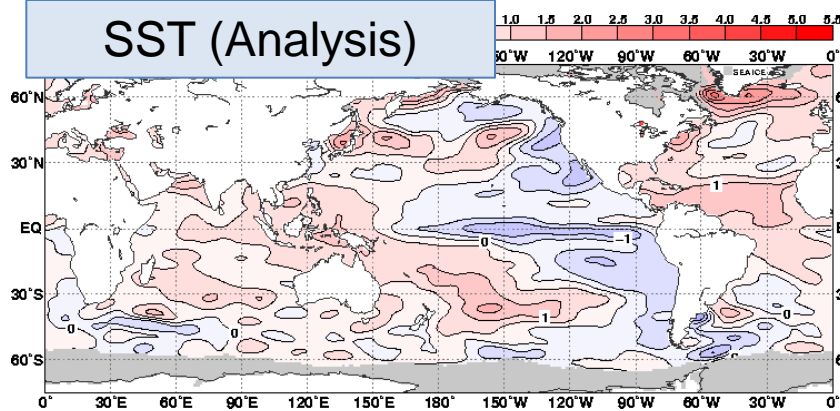
Stream function anomaly at 850 hPa



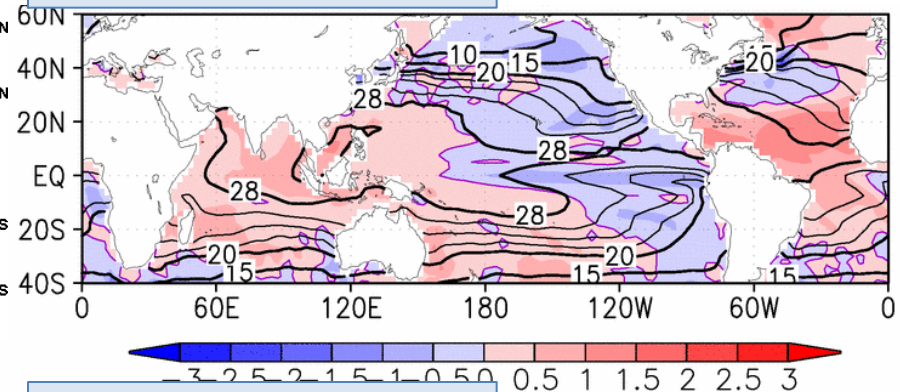
Indian Ocean Capacitor Effect

2010 JJA forecasts (Init: 2010/05/11)

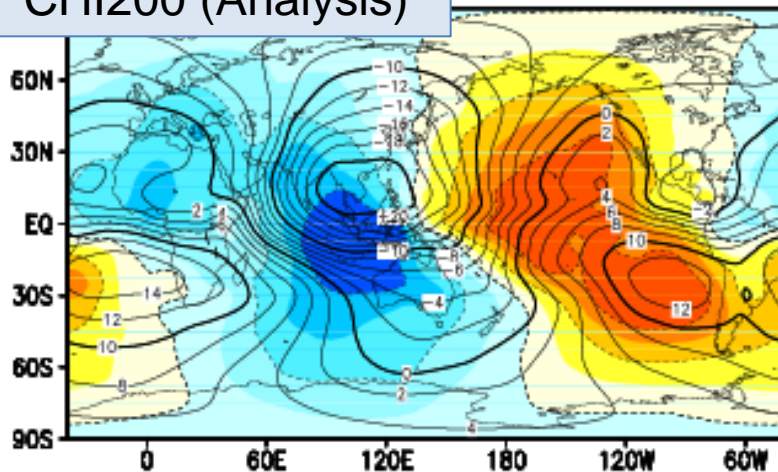
SST (Analysis)



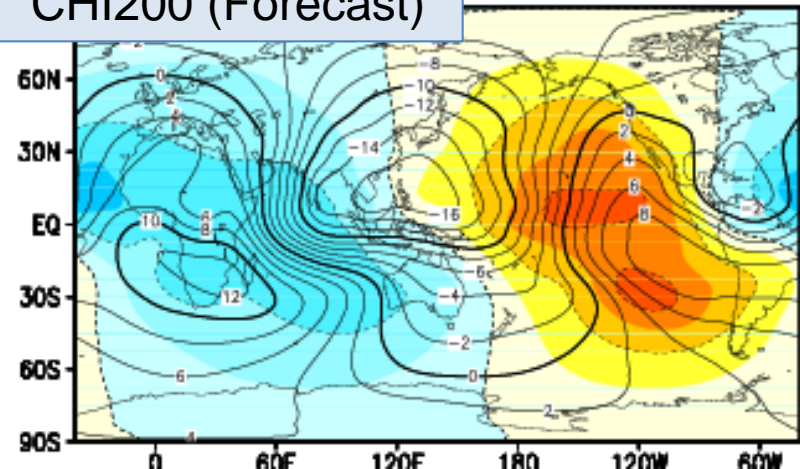
SST (Forecast)



CHI200 (Analysis)

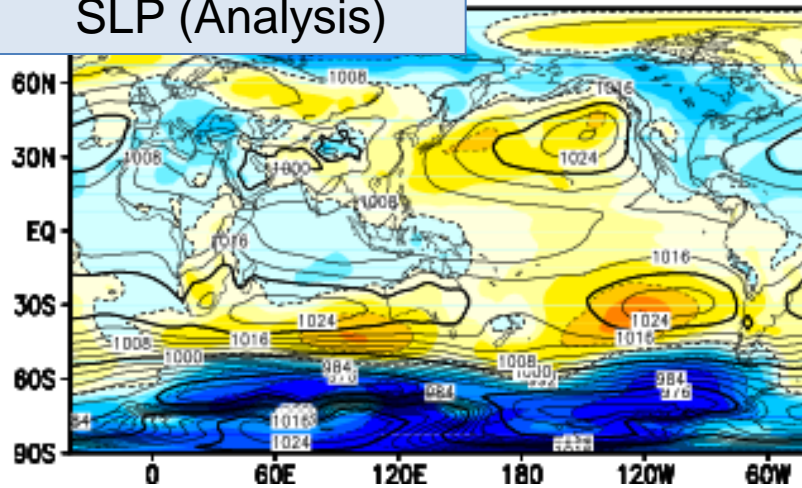


CHI200 (Forecast)

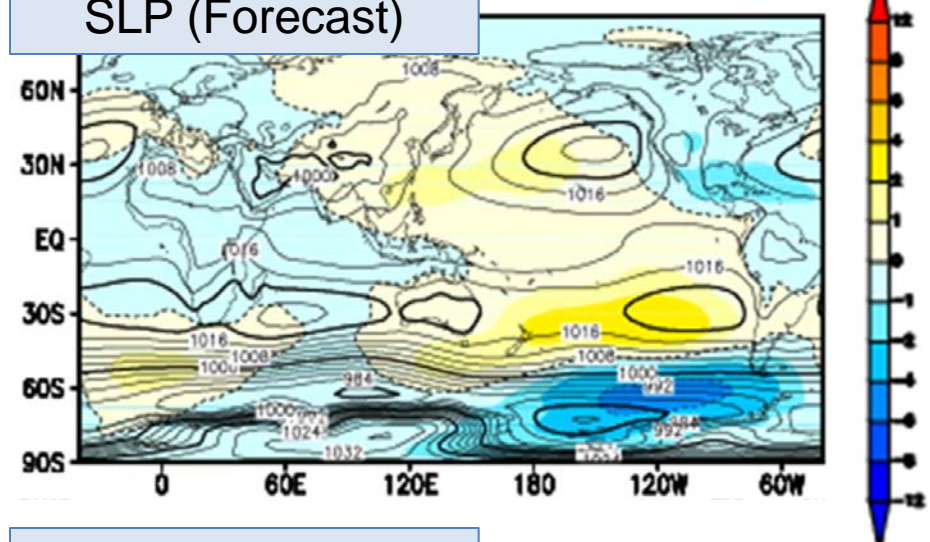


Indian Ocean Capacitor Effect

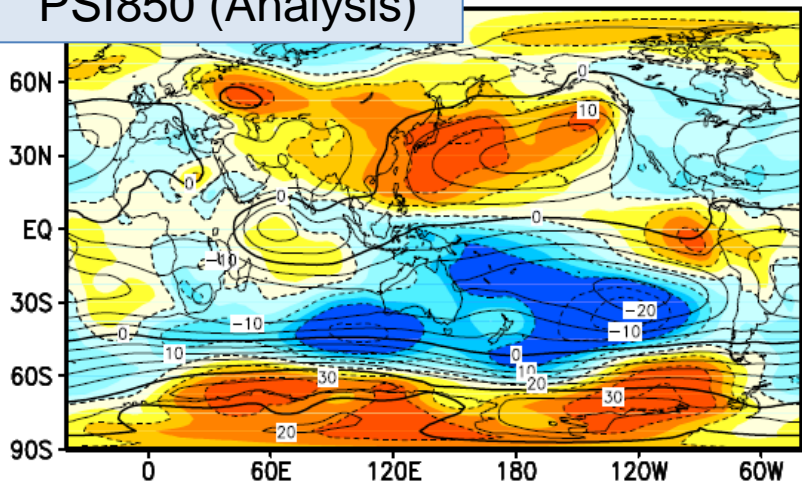
SLP (Analysis)



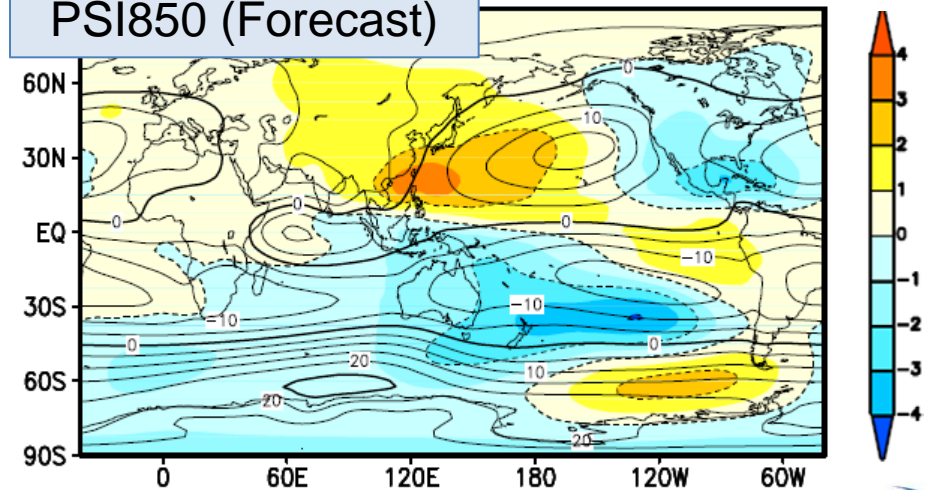
SLP (Forecast)



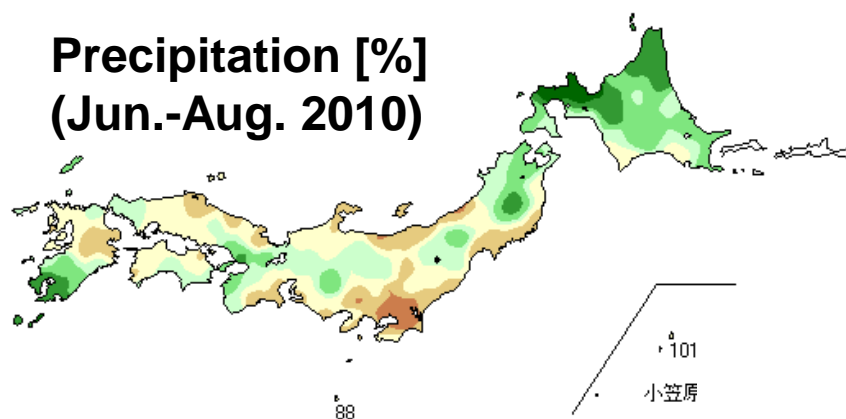
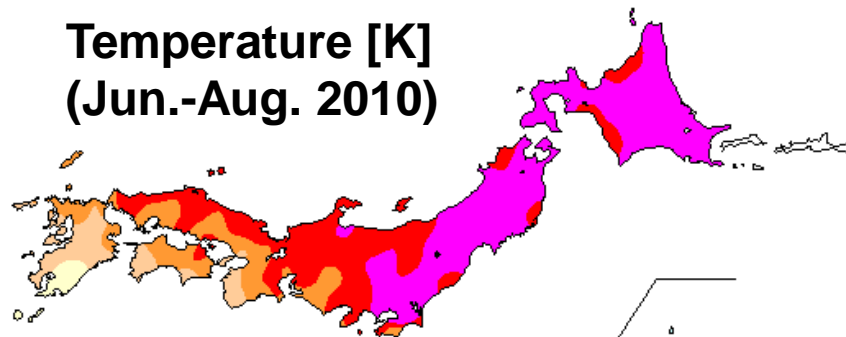
PSI850 (Analysis)



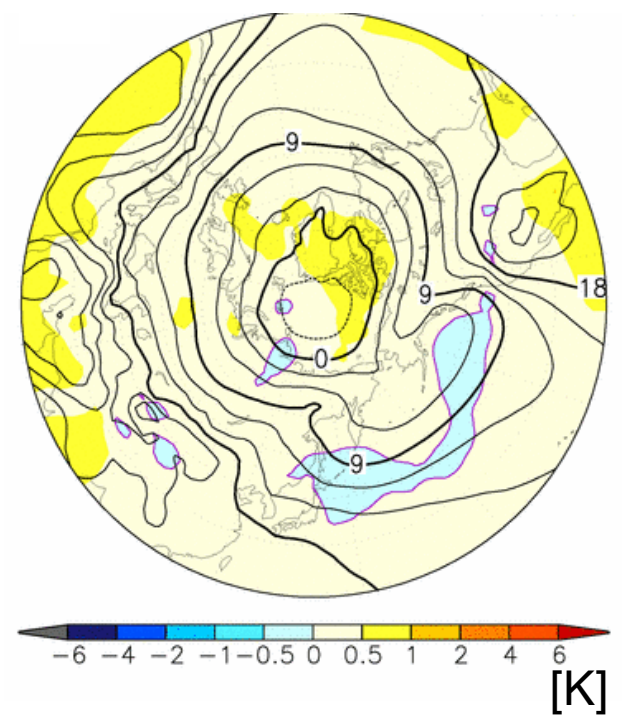
PSI850 (Forecast)



Hot 🌶️ Summer 2010



**850-hPa Temperature
Ensemble Forecast
(Init: 10th February 2010)**



Future best practices/prospects

- Representing the known sources of the predictability as accurately as possible
 - Improving components of the seasonal EPS.
ie. ocean assimilation, coupled model,
other analysis (atmosphere(stratosphere), land, sea-ice)
 - Enhancing/optimizing observations related to these sources.
 - ➡ **Narrowing the gap between the current skill and expected (potential) predictability**
- Exploring new additional sources of predictability
- Understanding processes/mechanism of the climate variability
 - Developing better metrics to evaluate the model behavior.
product to understand what model does.

Related component

- Processes

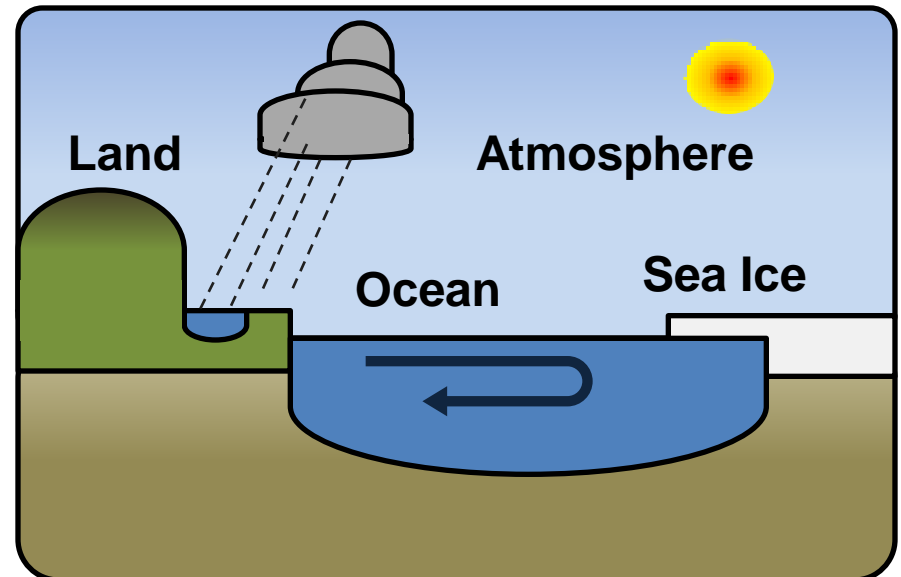
- Land Surface
- Snow, Land Analysis
- Sea-ice
- Stratosphere
- Ocean Wave
- ENSO
- Anything Else?

- Application

- ???

Plans for next seasonal EPS

- Dynamical sea-ice will be tested in our next system.
- Increase resolution (TL159L80 and higher model top.)



END

Thank you for your attention.

