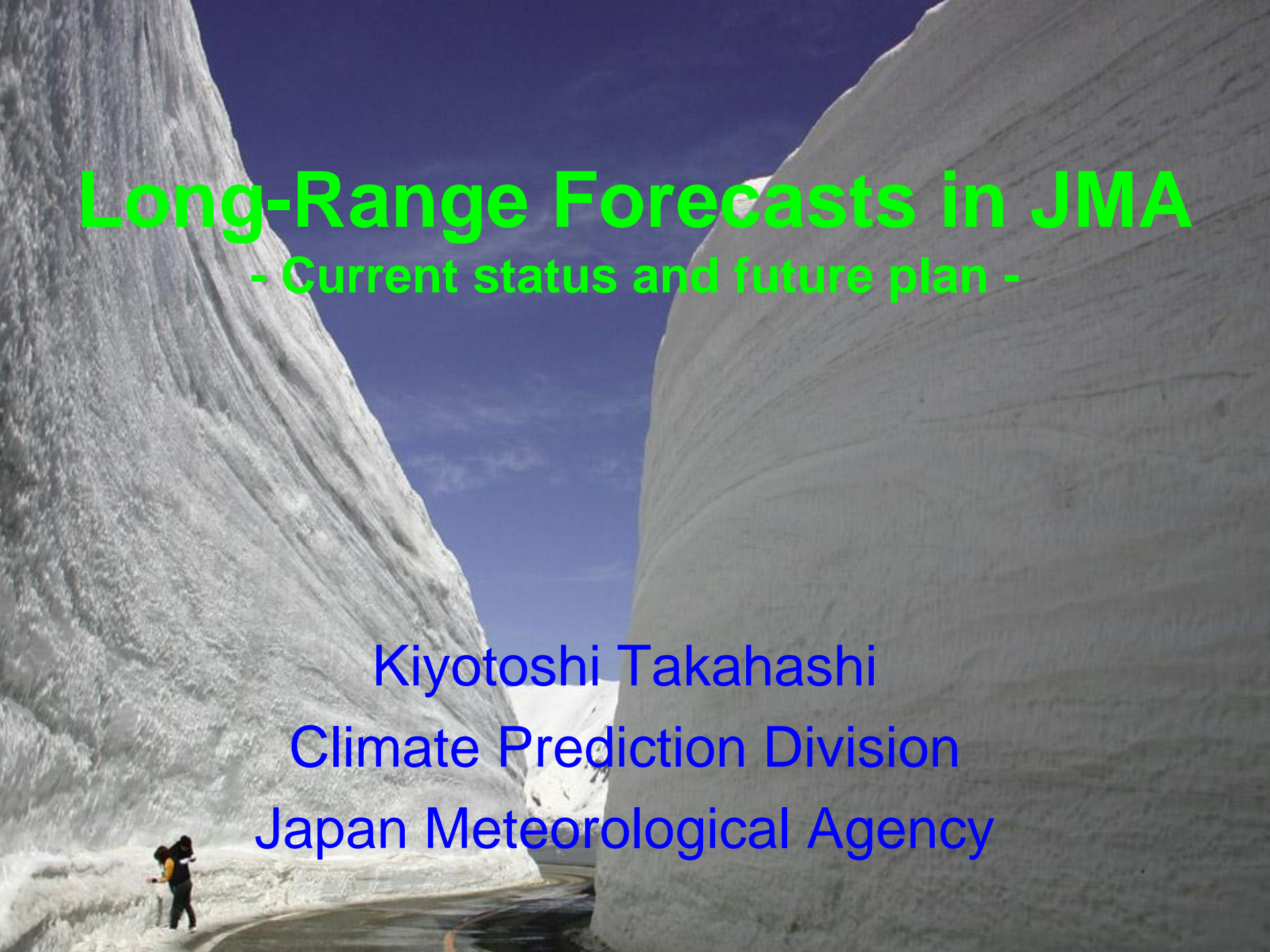# Long-Range Forecasts in JMA
- Current status and future plan -

Kiyotoshi Takahashi

Climate Prediction Division

Japan Meteorological Agency

Forecasts in CPD/JMA

CPD issues extended- and long-range forecasts operationally.

Extended-range forecast

One-month Forecast AGCM

- **One-month prediction**
- **Early Warning Information on Extreme Weather (within two-weeks)**

Long-range forecast

Three-month AGCM

OCN,CCA

- **Three-month prediction**
- **Warm/Cold seasonal prediction**

El-Niño Prediction CGCM

- **El- Niño Outlook**

Specification of current JMA's climate models

One-month	3-month/Seasonal	El Niño
One-month	**3-month/Seasonal**	**El Niño**
• TL159: 1.125deg	• TL95: 1.875deg	Atmosphere
• L60: top=0.1hPa	• L40: top=0.4hPa	• TL95: 1.875deg
• Ensemble size: **50**	• Ensemble size: **51**	• L40: top=0.4hPa
• I. Perturbation: **BGM/LAF**	• I. Perturbation: **SV**	
• Frequency: **Once a week on Thursday/Friday**	• Frequency: **Once a month**	Ocean
• Forecast period: **34 days**	• Forecast period: **120/210 days**	• 1º (lon) x 1º (lat), (1º (lon) x 0.3º (lat) near equator) 50 vertical levels
• Land: SiB	• Land: SiB	
• SST: **Persisted anomaly**	• SST: **Prescribed using persisted anomaly, climatology and ENSO prediction by CGCM**	• Ensemble size: **12**
Early Warning		• I. Perturbation: **LAF (5 days interval)**
• Forecast period: **17 days**		• Frequency: **once a month**
• Frequency: **Once a week on Sunday/Monday**		• Forecast period: **15 months**
		• Land: SiB

Model operation : annual

Jan. Feb. Mar. Apr. May. Jun. Jul. Aug. Sep. Oct. Nov. Dec. Jan. Feb. Mar.
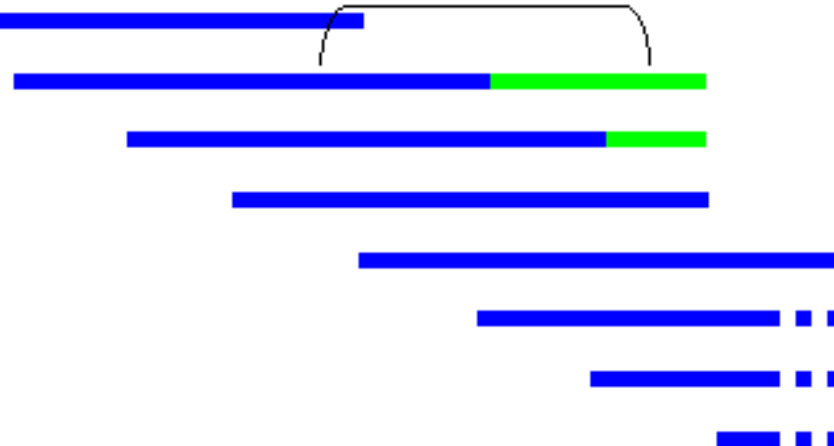
JJA
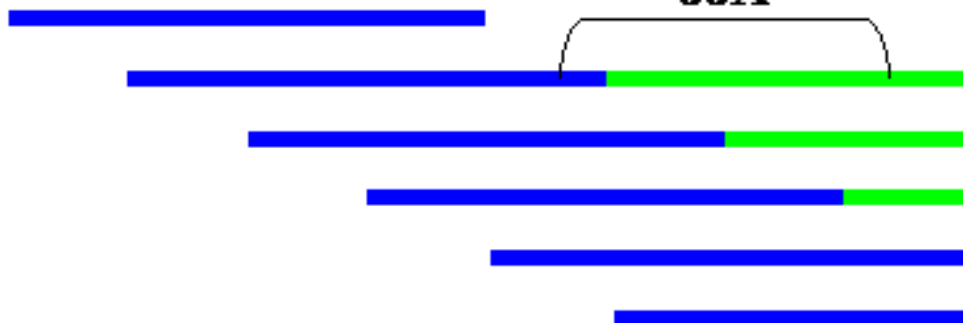
Prediction for summer season (JJA) is conducted on February, March and April.

DJF

Prediction for winter season (DJF) is conducted on September and October.

Verification with the SVS-LRF
Lead Center: http://www.bom.gov.au/wmo/lrfvs/

Standard **V**erification **S**ystem for **L**ong **R**ange **F**orecast (SVSLRF)

- WMO standard tool to verify skill in seasonal models
- Two kind of verification
  1) Deterministic : MSSS
  2) Probabilistic : ROC, Reliability diagram (BSS)
- Verification data recommended
  T2m(Surface 2m temp.) : CRU or ERA-40
  Precipitation : GPCP

  If recommended data is not available, the center can use the center own reanalysis. → **JRA-25 in the case of JMA**

Verification with the SVS-LRF
Lead Center: http://www.bom.gov.au/wmo/lrfvs/

	Parameters	Verification regions	Deterministic forecasts	Probabilistic forecasts
Level 1	T2m anomaly Precipitation anomaly (Nino3.4 Index)	Tropics(20S-20N) Northern extratropics(20N-90N) Southern extratropics(20S-90S) (N/A)	MSSS	ROC curves ROC areas Reliability diagrams Frequency histograms
Level 2	T2m anomaly Precipitation anomaly (SST anomaly)	Grid-point verification on a 2.5° by 2.5° grid	MSSS and its three-term decomposition at each grid-point	ROC areas at each grid-point
Level 3	T2m anomaly Precipitation anomaly (SST anomaly)	Grid-point verification on a 2.5° by 2.5° grid	3 by 3 contingency tables at each grid-point	ROC reliability tables at each grid-point

Development of a new three-month (Seasonal)/El-Nino forecast model

- **In February 2010**, a new version of CGCM will be introduced for the both purposes of the El-Nino outlook and seasonal forecasts.

- Now, development of the system based on the current CGCM (El-Nino) model is almost completed by replacing AGCM with the new one.

- The WCRP/TFSP experiment data with the current El-Nino model show improvements of forecast performance in many aspects.

Specification of current El-Niño forecast model	
AGCM	**JMA/MRI Unified AGCM (TL95L40)**
OGCM	**MRI.COM** Ishikawa *et al.* (2005) • 75S-75N, 0-360E • horizontal resolution: lon 1.0˚, lat 0.3-1.0˚ • vertical resolution : 50 levels (23 levels in the upper 200m)
Coupler	• coupling interval : 1 hour • flux adjustment for heat and momentum flux

Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled system

1-tier coupled system
Initial: 31 July
Forecast: **Dec.-Feb.**

Current 2-tier system
Initial: 10 August
Forecast: **Dec.-Feb.**

Psea anomaly
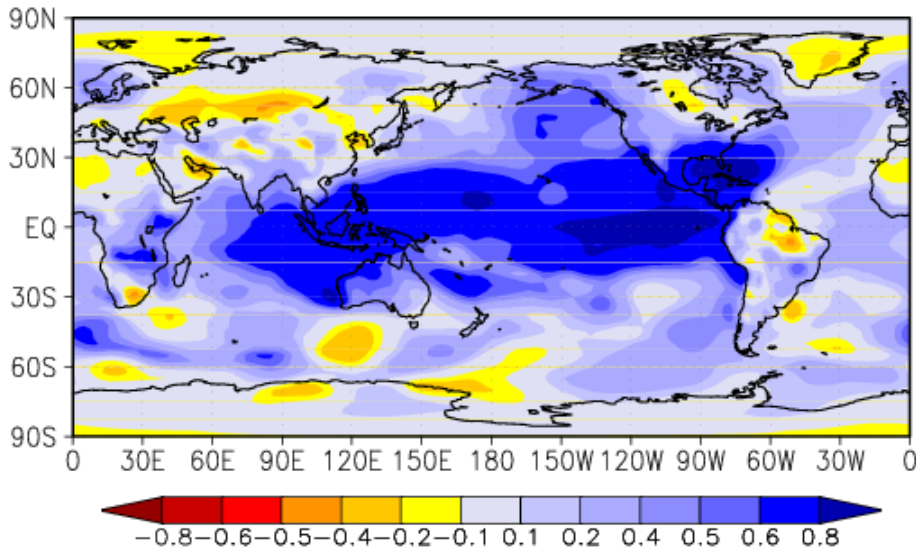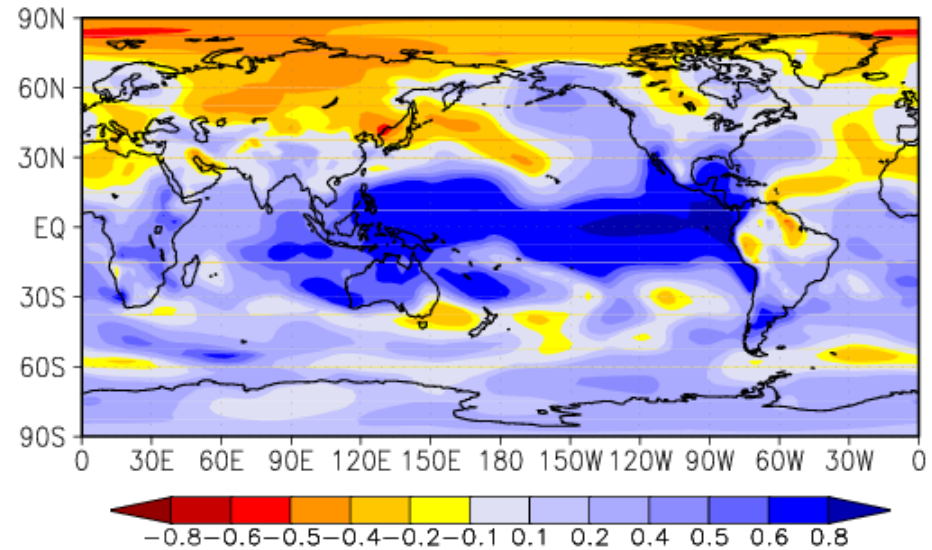
Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled system

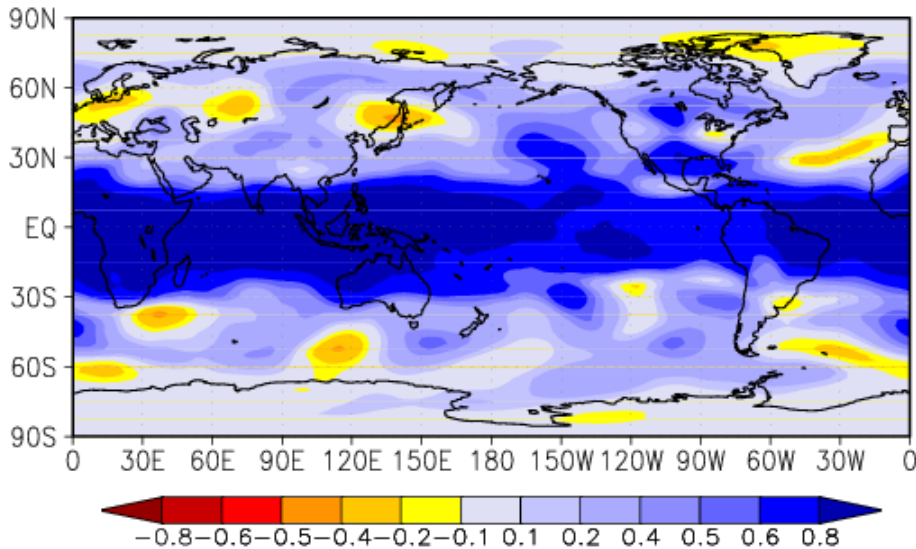1-tier coupled system
Initial: 31 July
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<Tfsp2007a(28yr;10mem)>
T2m anomaly (esbl−se)
Anomaly Correlation for 28 years (1979−2006)
Initial : 07.31 , Lead time : 4 (Dec to Feb)

<TL95L40V0703C(22yr;11mem)>
T2m anomaly (esbl−se)
Anomaly Correlation for 22 years (1984−2005)
Initial : 08.10 , Lead time : 4 (Dec to Feb)
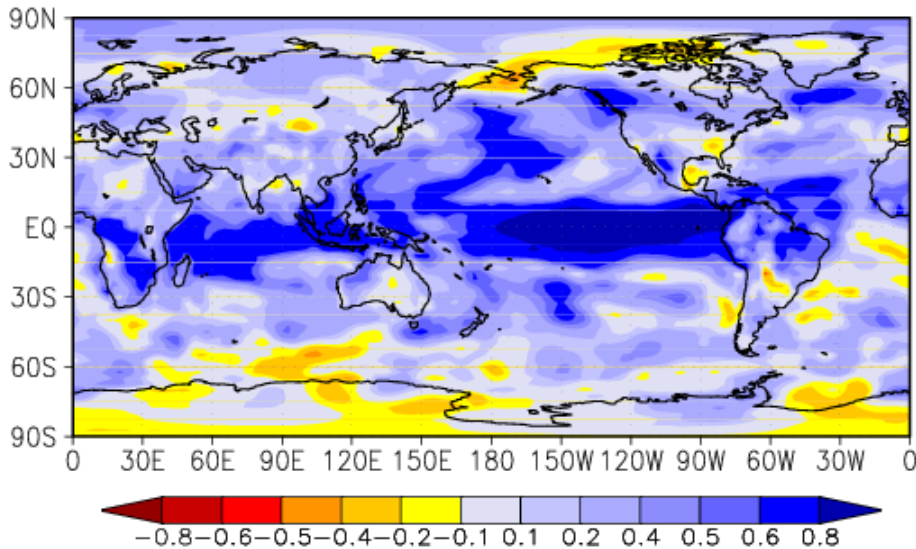
NH	TRP	SH	EU	PAC	JPN
0.242	0.496	0.164	0.215	0.273	0.265
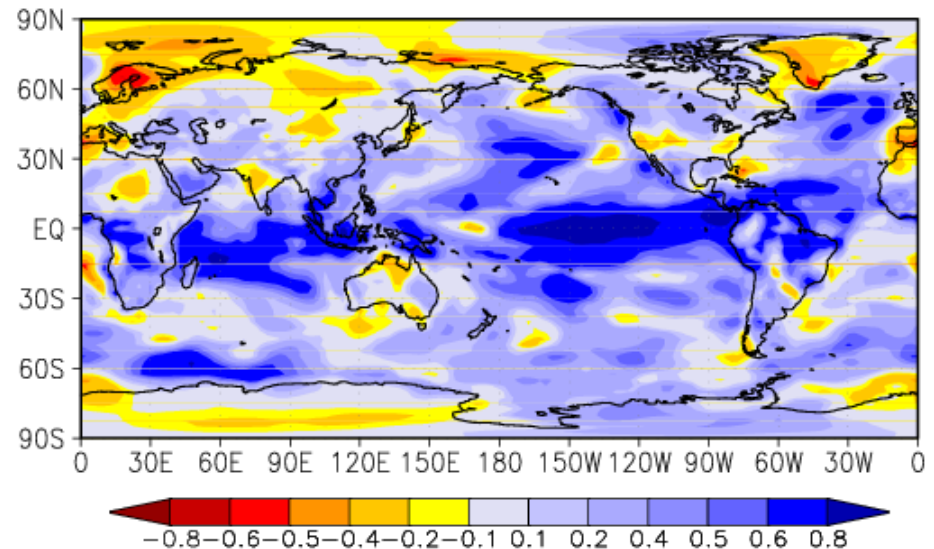
NH	TRP	SH	EU	PAC	JPN
0.115	0.437	0.208	0.041	0.162	0.119

T2m anomaly

Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled system

1-tier coupled system
Initial: 31 July
Forecast: **Dec.-Feb.**

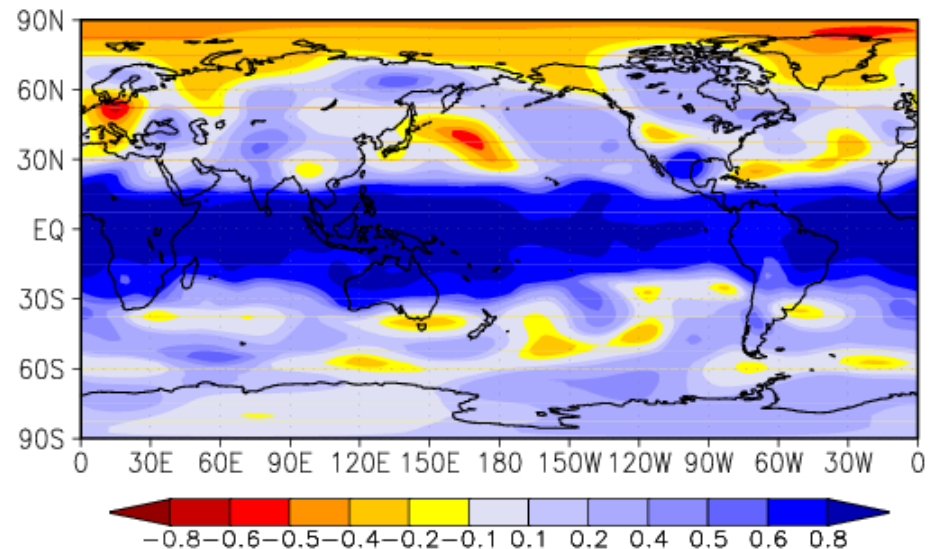Current 2-tier system
Initial: 10 August
Forecast: **Dec.-Feb.**

<Tfsp2007a(22yr;10mem)>
Z500 anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
Initial : 07.31 , Lead time : 4 (Dec to Feb)

<TL95L40V0703C(22yr;11mem)>
Z500 anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
Initial : 08.10 , Lead time : 4 (Dec to Feb)

NH	TRP	SH	EU	PAC	JPN
0.246	0.796	0.272	0.185	0.305	0.190

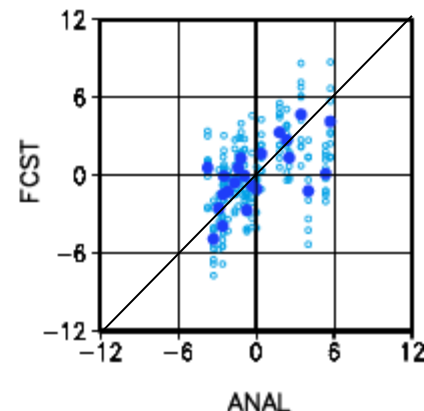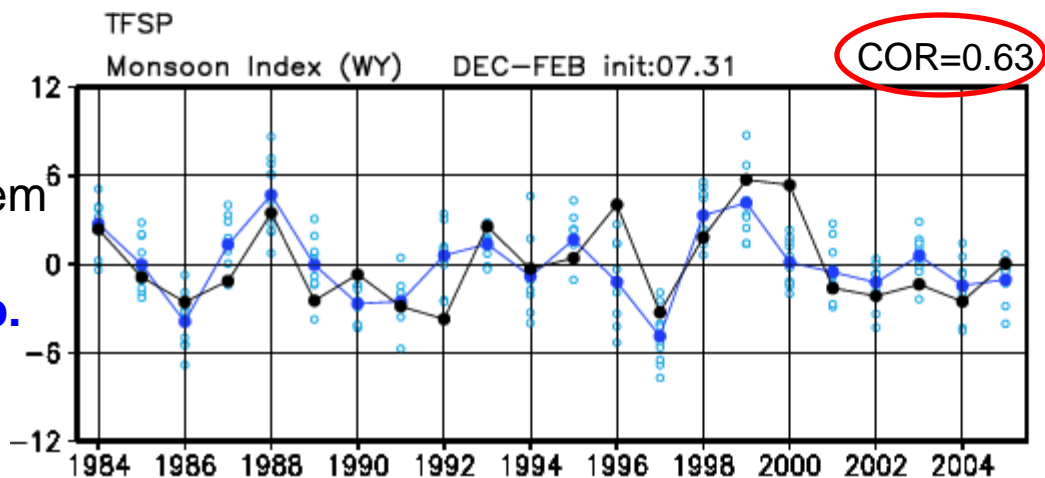| NH	TRP	SH	EU	PAC	JPN
0.073	0.774	0.243	0.044	0.099	0.025

Z500 anomaly

Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled system

Current 2-tier system
Initial: 10 August
Forecast: **Dec.-Feb.**
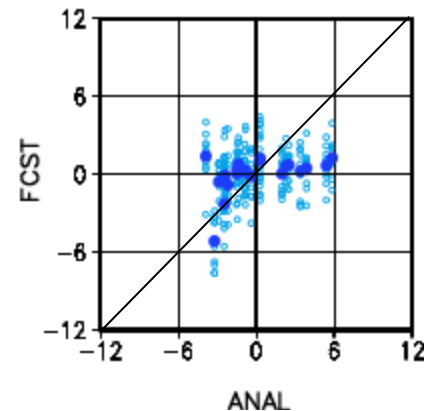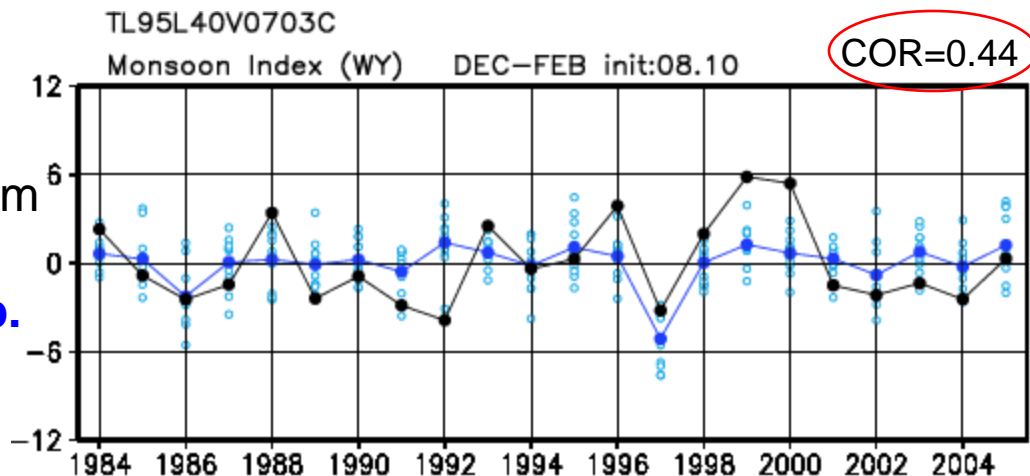
1-tier coupled system
Initial: 31 July
Forecast: **Dec.-Feb.**

Webster & Yang Monsoon Index：0-20N, 40-110EU(850hPa)-U(200hPa)

Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled system

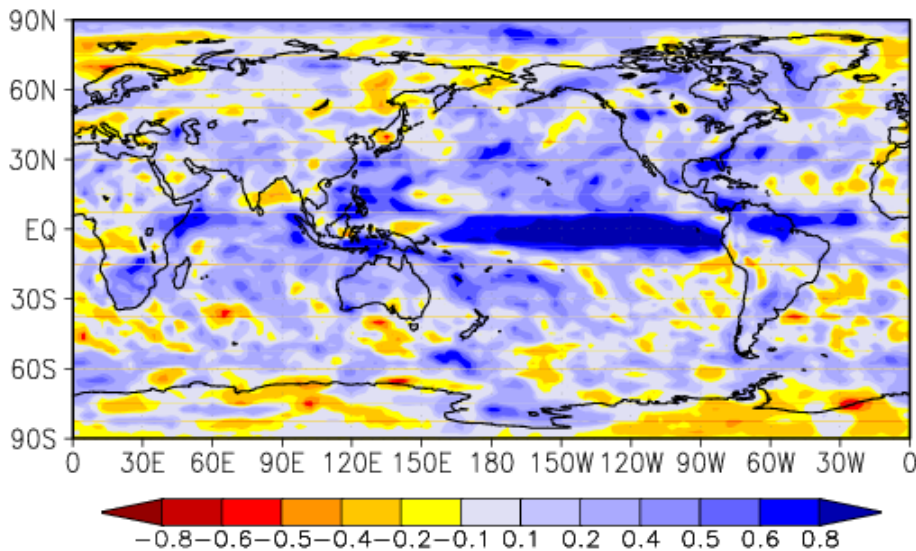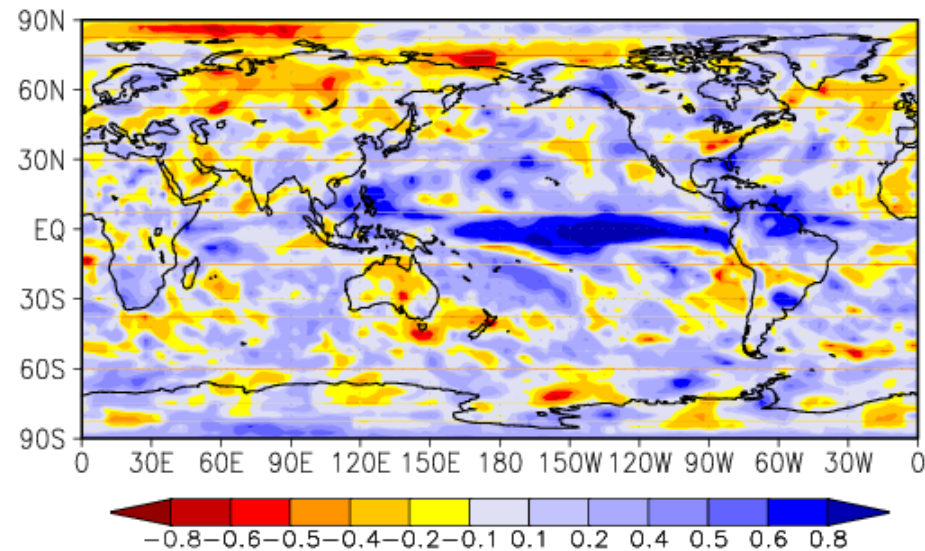1-tier coupled system
Initial: 31 July
Forecast: **Dec.-Feb.**

Current 2-tier system
Initial: 10 August
Forecast: **Dec.-Feb.**

<Tfsp2007a(22yr;10mem)>
Rain anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
Initial : 07.31 , Lead time : 4 (Dec to Feb)

<TL95L40V0703C(22yr;11mem)>
Rain anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
Initial : 08.10 , Lead time : 4 (Dec to Feb)

	NH	TRP	SH	EU	PAC	JPN
1-tier	0.154	0.305	0.093	0.111	0.186	0.136
2-tier	0.031	0.199	0.062	−0.015	0.060	0.042

Rain anomaly from GPCP

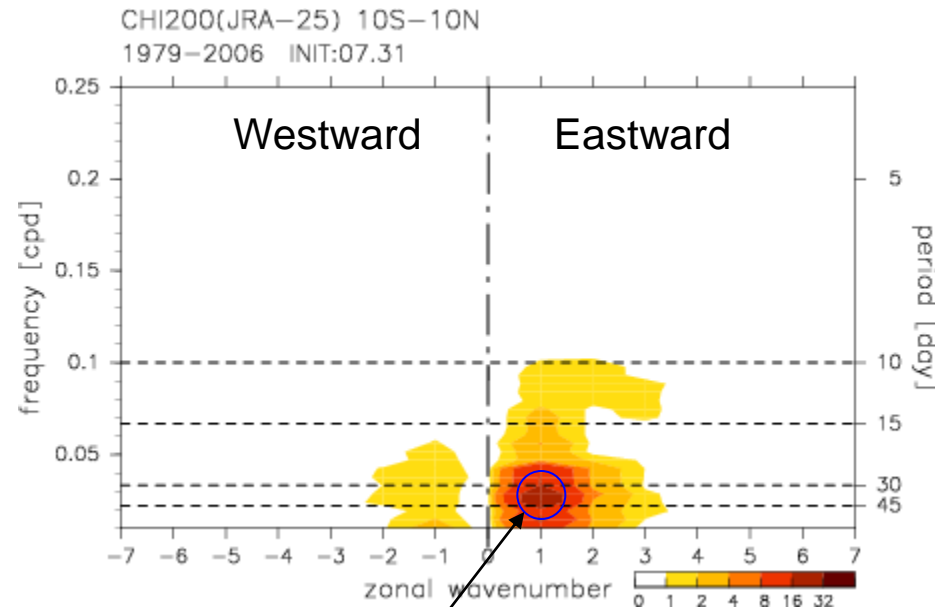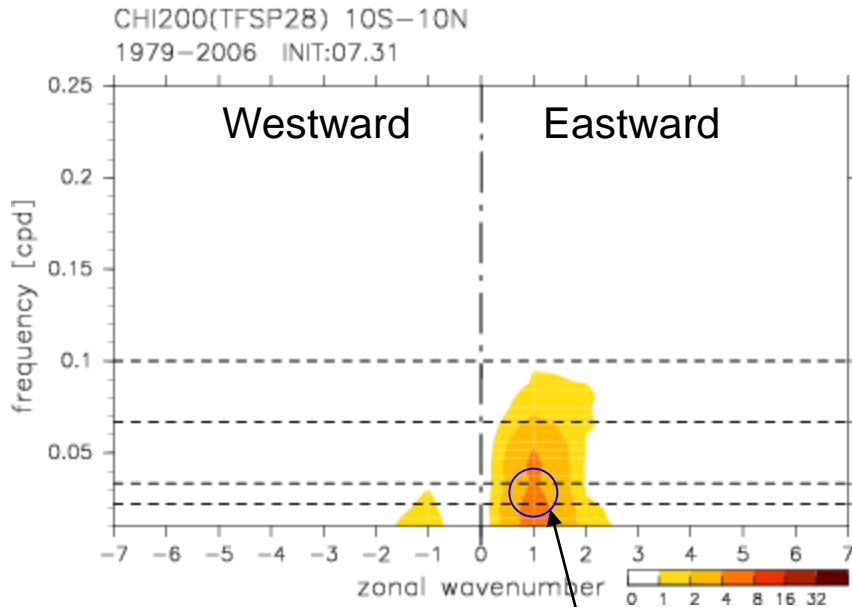# Time-Space Spectral Analysis of velocity potential anomaly at 200hPa over the Tropics (10S-10N)

1-tier coupled system
Initial: 31 July
Forecast: **Aug.-Feb.** (1979-2006)

JRA-25
Period: **Aug.-Feb.** (1979-2006)

30-45 days period and wave-number 1

Eastward moving signal with wave-number one is not so prominent in the ISV period.

Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled system

1-tier coupled system
Initial: 31 July
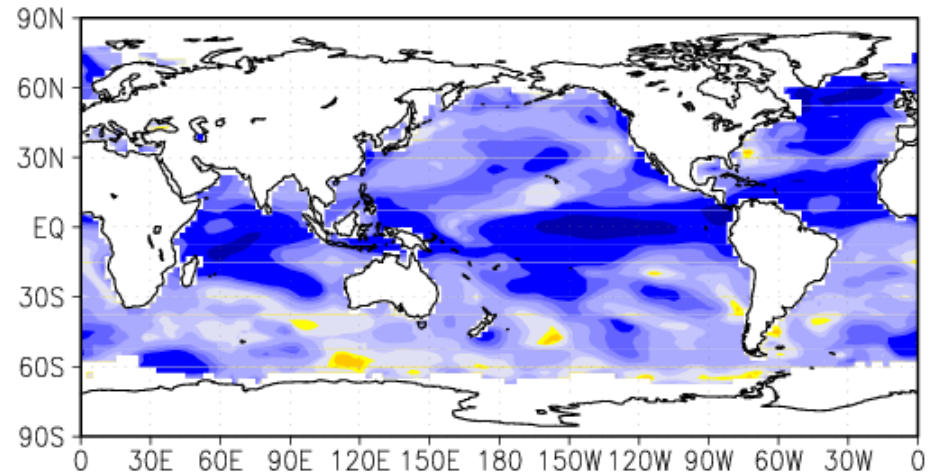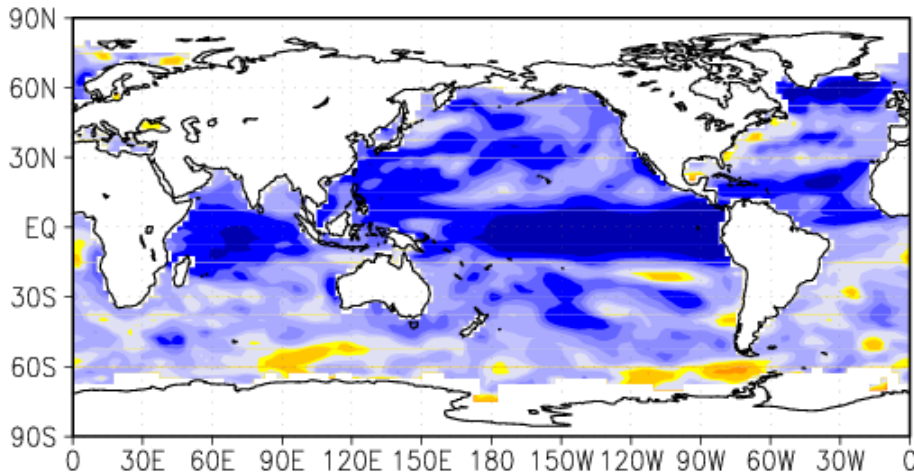Forecast: **Dec.-Feb.**

Current 2-tier system
Initial: 10 August
Forecast: **Dec.-Feb.**

<Tfsp2007a(22yr;10mem)>
SST anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
Initial : 07.31 , Lead time : 4 (Dec to Feb)

<TL95L40V0703C(22yr;11mem)>
SST anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
Initial : 08.10 , Lead time : 4 (Dec to Feb)
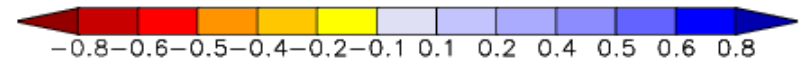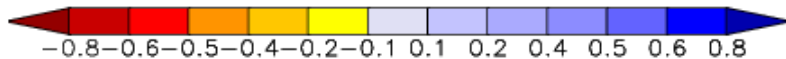
NH	TRP	SH	EU	PAC	JPN
0.418	0.564	0.245	0.402	0.488	0.488

NH	TRP	SH	EU	PAC	JPN
0.446	0.550	0.285	0.367	0.411	0.343

SST anomaly

Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled system

1-tier coupled system
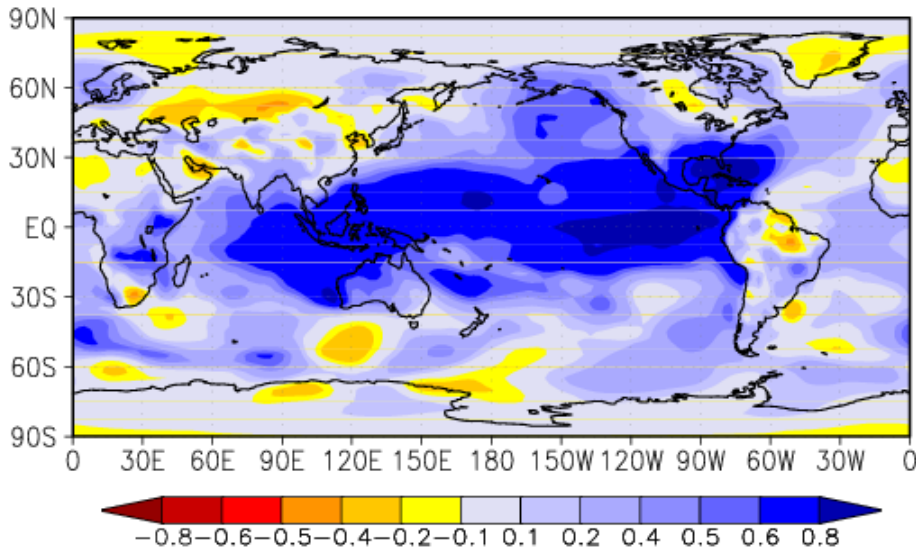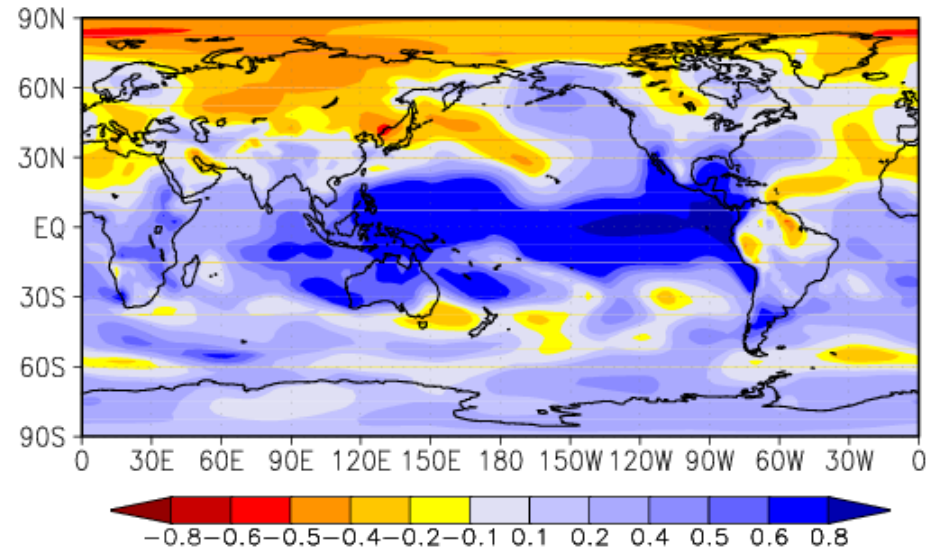Initial: 31 January
Forecast: **Jun.-Aug.**

Current 2-tier system
Initial: 10 February
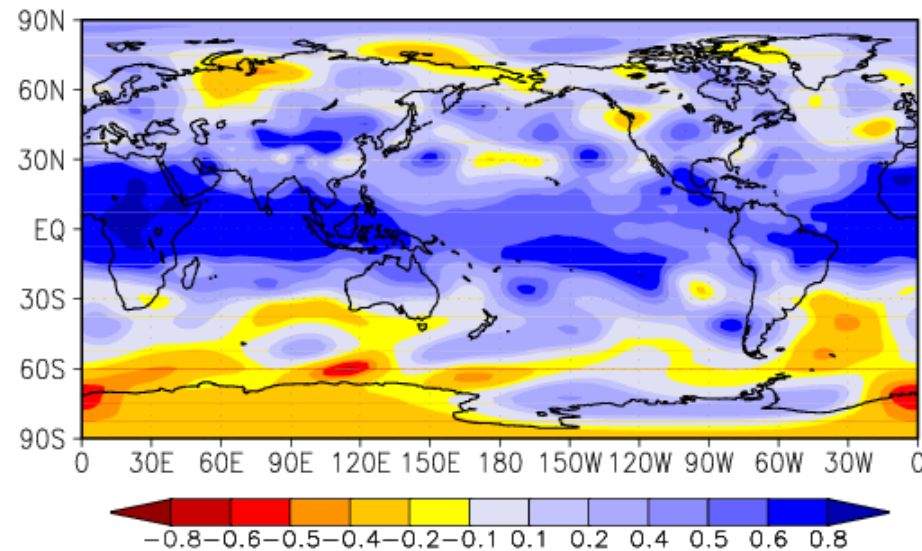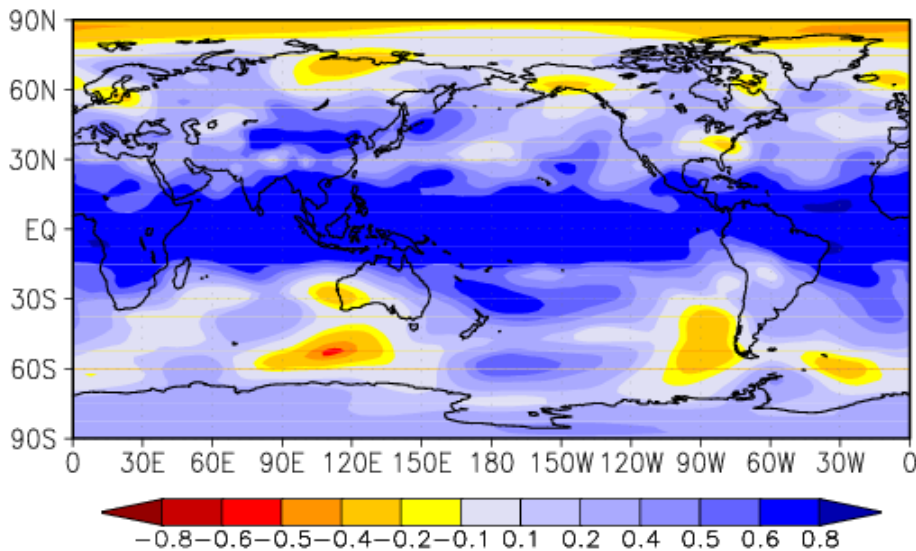Forecast: **Jun.-Aug.**

Psea anomaly

Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled system

1-tier coupled system
Initial: 31 January
Forecast: **Jun.-Aug.**

Current 2-tier system
Initial: 10 February
Forecast: **Jun.-Aug.**

<Tfsp2007a(28yr;10mem)>
Z500 anomaly (esbl-se)
Anomaly Correlation for 28 years (1979-2006)
Initial : 01.31 , Lead time : 4 (Jun to Aug)

NH	TRP	SH	EU	PAC	JPN
0.273	0.657	0.202	0.319	0.288	0.446

<TL95L40V0703C(22yr;11mem)>
Z500 anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
Initial : 02.10 , Lead time : 4 (Jun to Aug)

NH	TRP	SH	EU	PAC	JPN
0.239	0.578	0.035	0.253	0.225	0.286

Z500 anomaly

Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled system

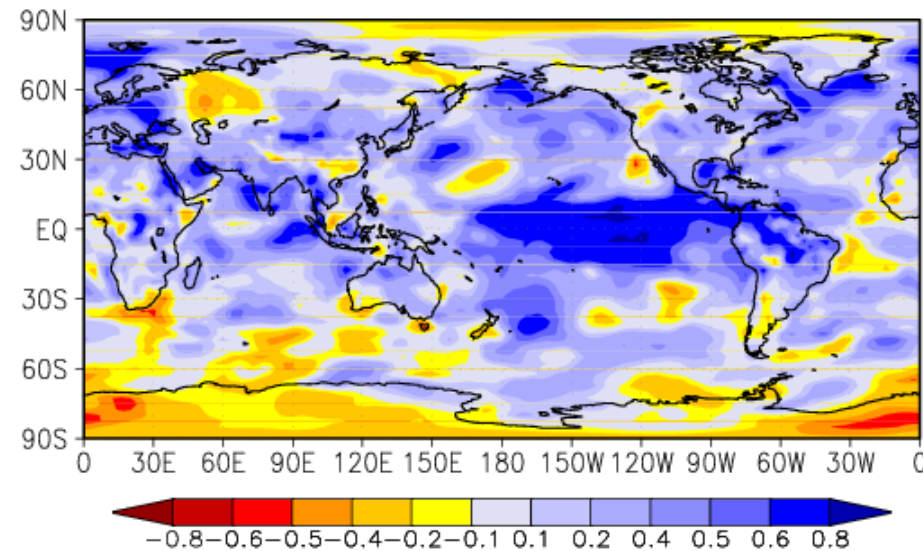1-tier coupled system
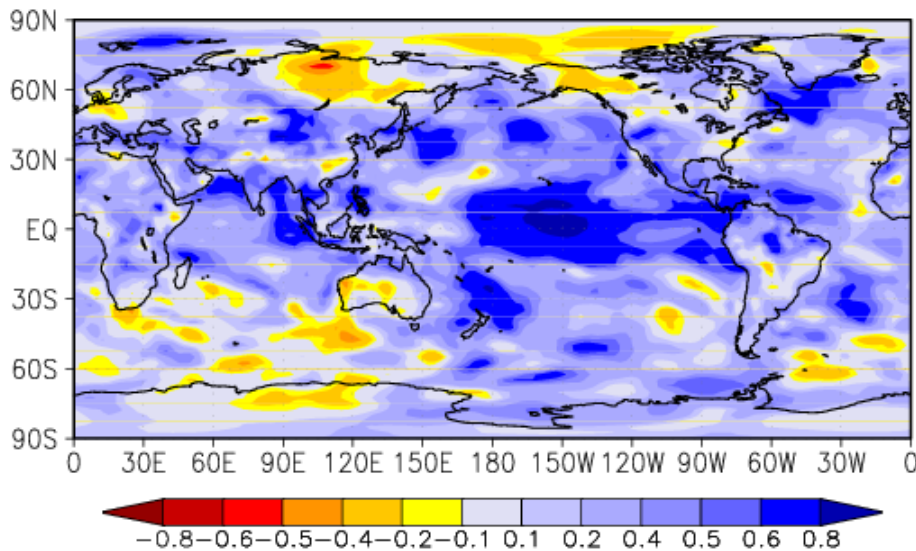Initial: 31 January
Forecast: **Jun.-Aug.**

Current 2-tier system
Initial: 10 February
Forecast: **Jun.-Aug.**

<Tfsp2007a(22yr;10mem)>
T2m anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
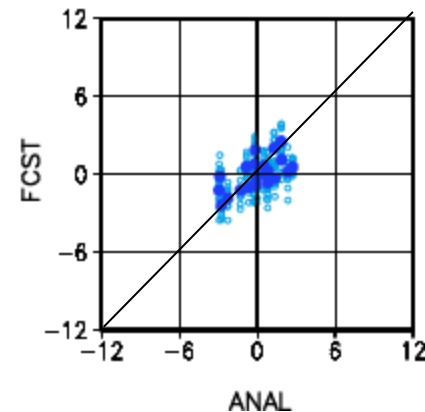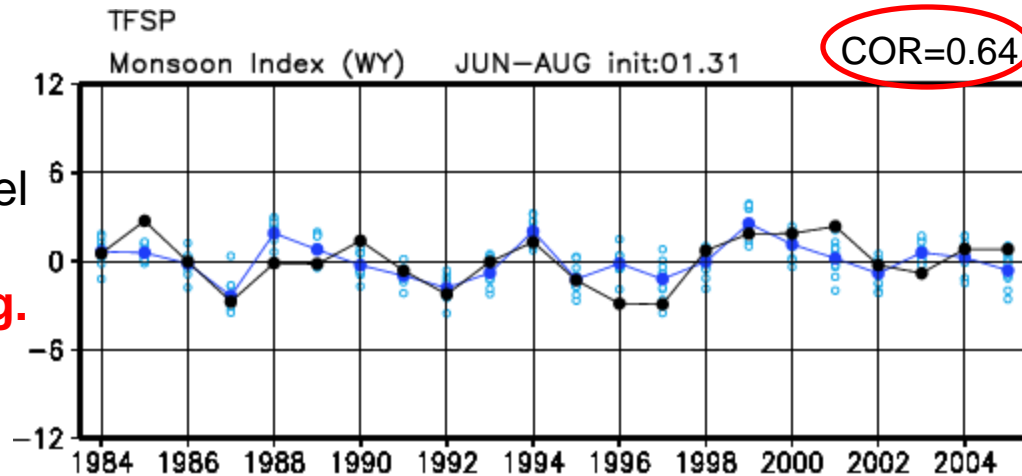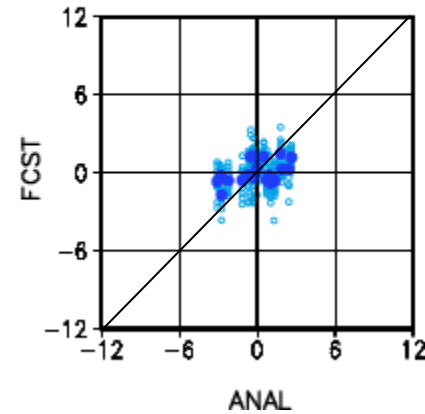Initial : 01.31 , Lead time : 4 (Jun to Aug)

<TL95L40V0703C(22yr;11mem)>
T2m anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
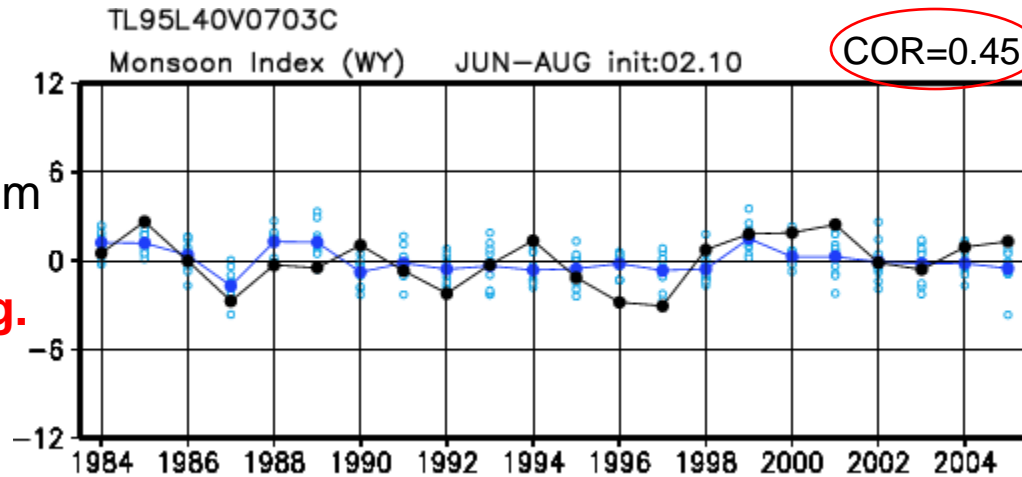Initial : 02.10 , Lead time : 4 (Jun to Aug)

NH	TRP	SH	EU	PAC	JPN
0.267	0.416	0.180	0.251	0.270	0.312

NH	TRP	SH	EU	PAC	JPN
0.238	0.348	0.075	0.228	0.210	0.224

T2m anomaly

Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled system

Current 2-tier system
Initial: 10 February
Forecast: **Jun.-Aug.**

1-tier coupled model
Initial: 31 January
Forecast: **Jun.-Aug.**

Webster & Yang Monsoon Index：0-20N, 40-110EU(850hPa)-U(200hPa)

Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled system

1-tier coupled system
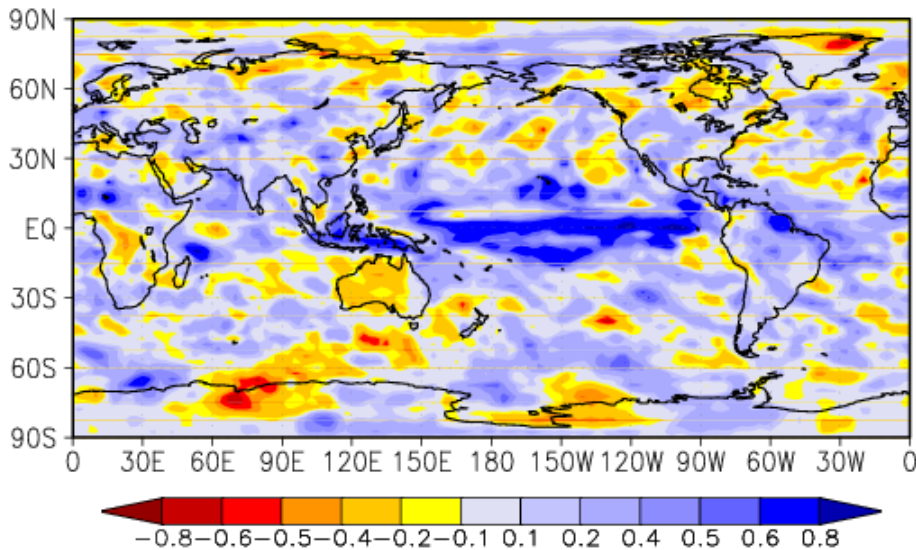Initial: 31 January
Forecast: **Jun.-Aug.**

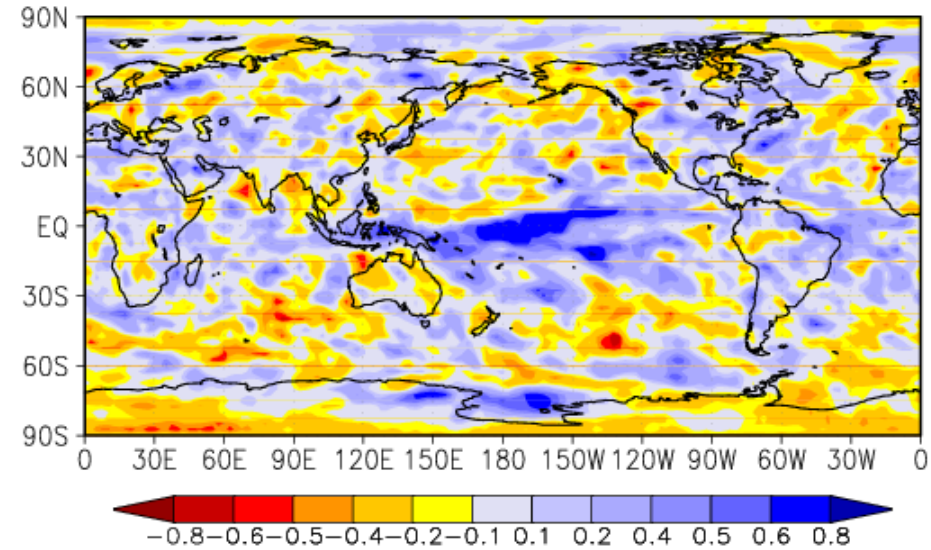Current 2-tier system
Initial: 10 February
Forecast: **Jun.-Aug.**

<Tfsp2007a(22yr;10mem)>
Rain anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
Initial : 01.31 , Lead time : 4 (Jun to Aug)

NH	TRP	SH	EU	PAC	JPN
0.058	0.248	0.043	0.062	0.070	0.083

<TL95L40V0703C(22yr;11mem)>
Rain anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
Initial : 02.10 , Lead time : 4 (Jun to Aug)

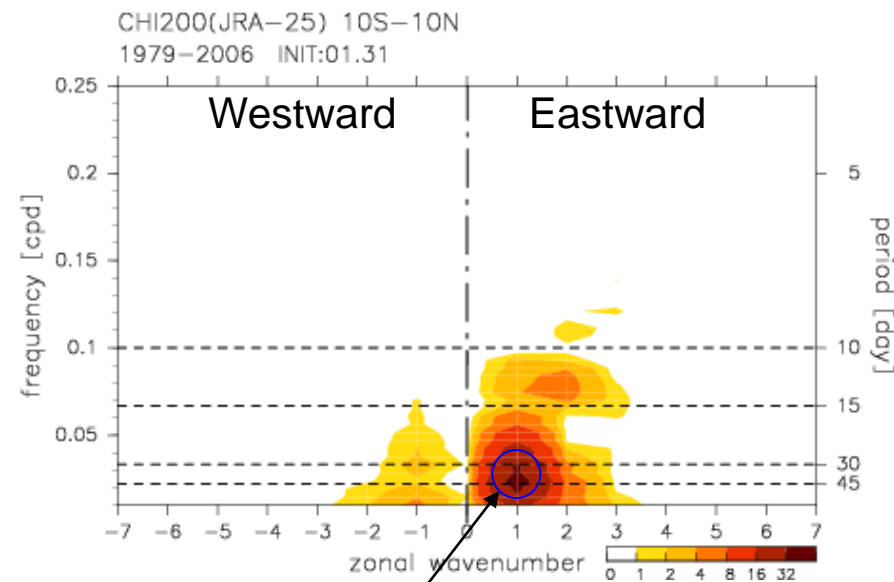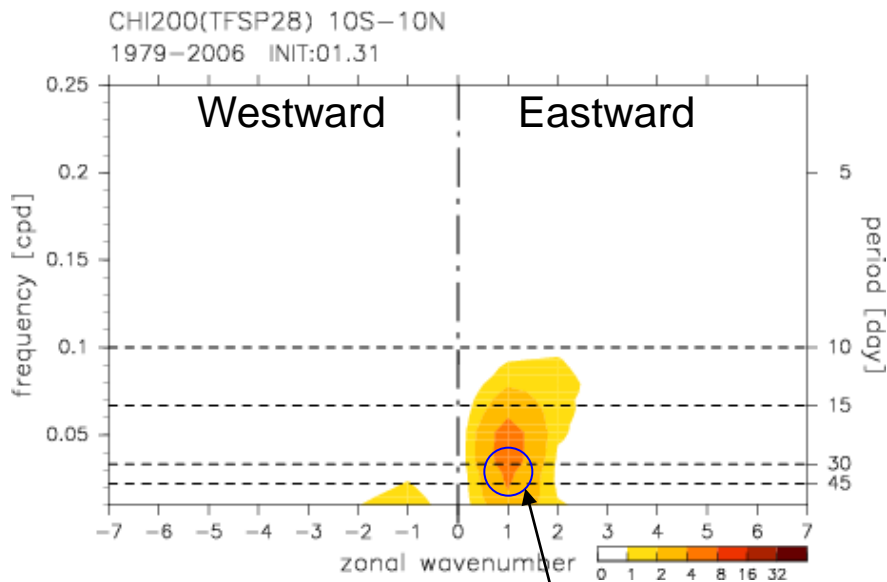| NH	TRP	SH	EU	PAC	JPN
0.019	0.126	−0.022	0.018	0.004	−0.036

Rain anomaly from GPCP

Time-Space Spectral Analysis of velocity potential anomaly at 200hPa over the Tropics (10S-10N)

1-tier coupled system
Initial: 31 January
Forecast: **Feb.-Aug.** (1979-2006)

JRA-25
Period: **Feb.-Aug.** (1979-2006)

30-45 days period and wave-number 1

Eastward moving signal with wave-number one is not so prominent in the ISV period.

Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled system

1-tier coupled system
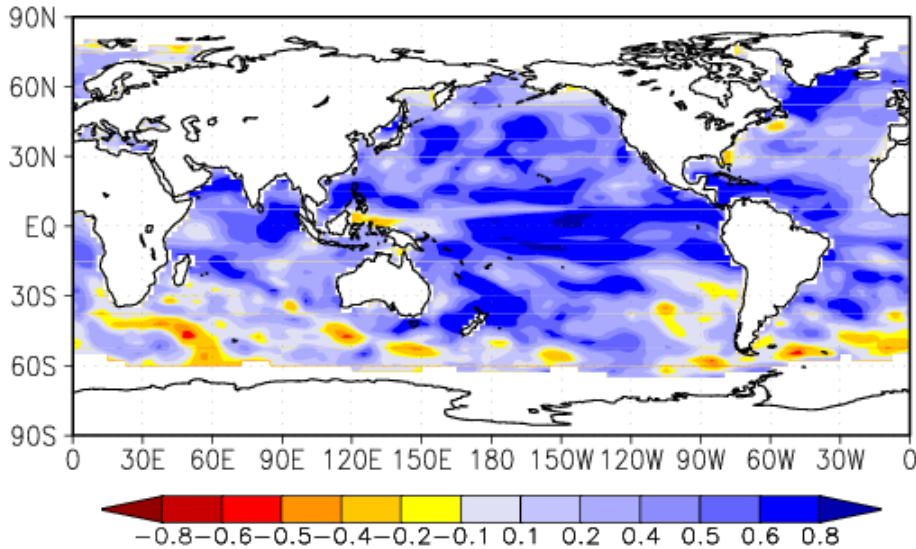Initial: 31 January
Forecast: **Jun.-Aug.**

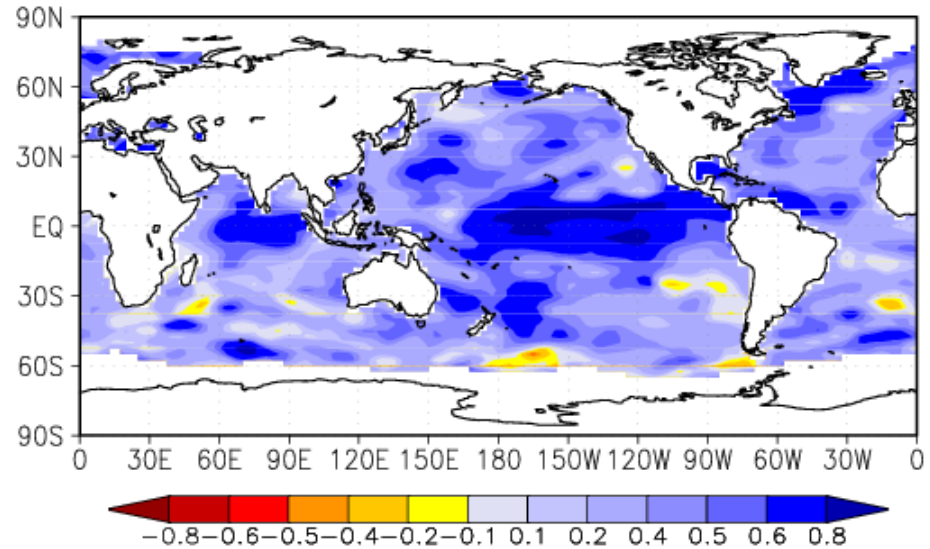Current 2-tier system
Initial: 10 February
Forecast: **Jun.-Aug.**

<Tfsp2007a(22yr;10mem)>
SST anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
Initial : 01.31 , Lead time : 4 (Jun to Aug)

<TL95L40V0703C(22yr;11mem)>
SST anomaly (esbl-se)
Anomaly Correlation for 22 years (1984-2005)
Initial : 02.10 , Lead time : 4 (Jun to Aug)

NH	TRP	SH	EU	PAC	JPN
0.370	0.487	0.224	0.348	0.422	0.408

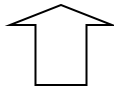| NH	TRP	SH	EU	PAC	JPN
0.432	0.482	0.317	0.429	0.408	0.408

SST anomaly

Comparison between the current 2-tier forecast system and the atmosphere-ocean coupled GCM
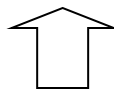
Evaluation of forecast performance in advance

⬇

Better performance of seasonal forecasts
with the coupled GCM for both of winter
and summer seasons,
particularly in the tropical region

⇧

Improvement of forecast performance
in tropical heat source activities

⇧

Improvements of forecast performance
in tropical SST

Thank you