Recent developments of JMA seasonal prediction system

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Contents

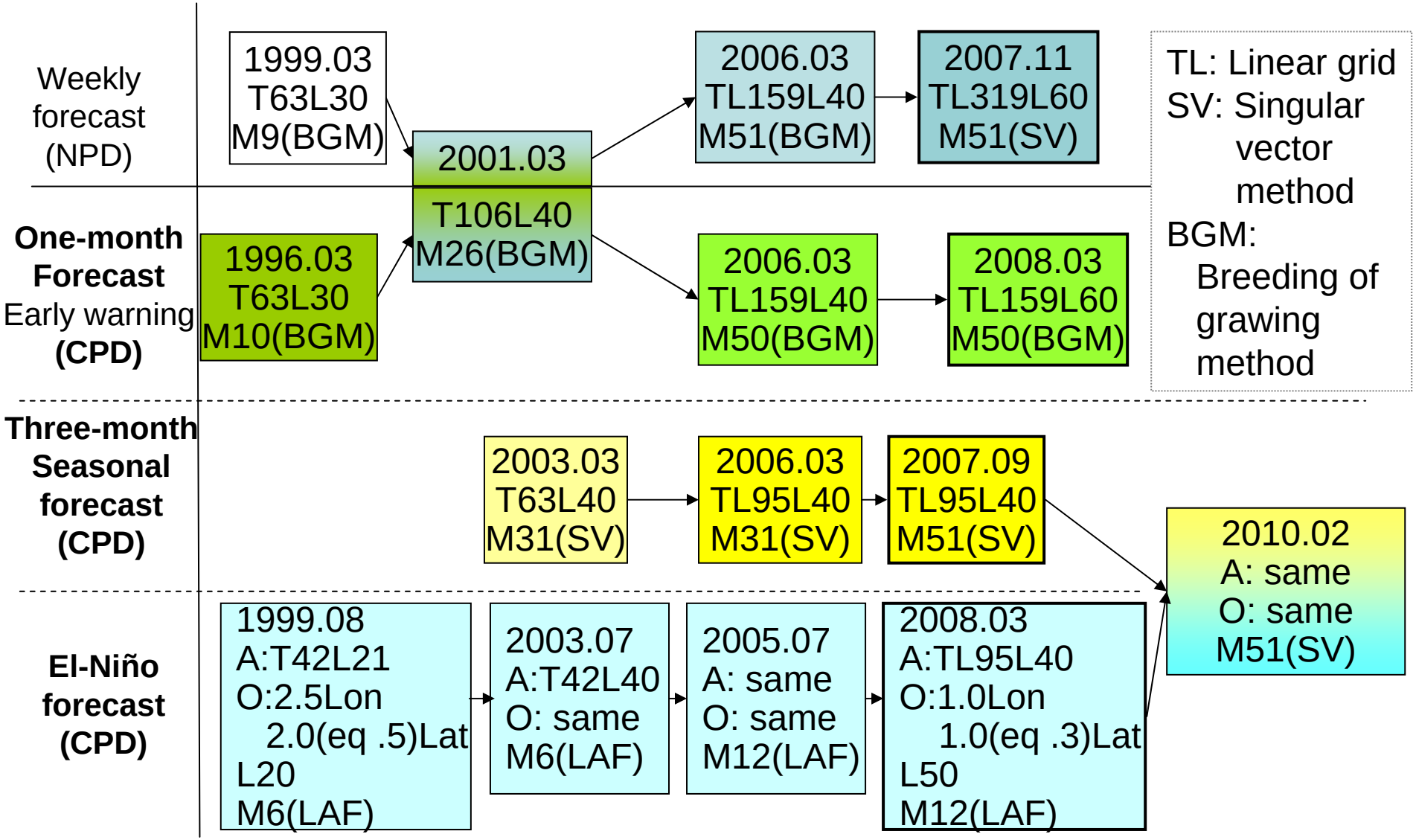
1. Outline of JMA's seasonal prediction system

2. Recent developments
   -Model physics
   -Initial perturbation for EPS

3. Future plan
   Introduction of a CGCM into seasonal forecast

4. Summary

1.Outline of JMA's seasonal prediction system
History of prediction model



2. Recent developments

- Model frame & physics

  - increase in vertical layers

- Initial perturbation for EPS

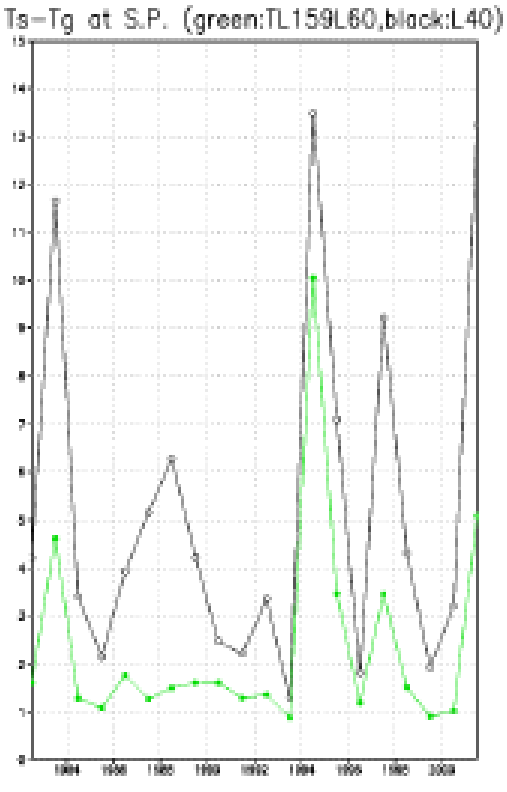
  - Improvement of BGM in one-month forecast system

- Incorporation of uncertainty in SST

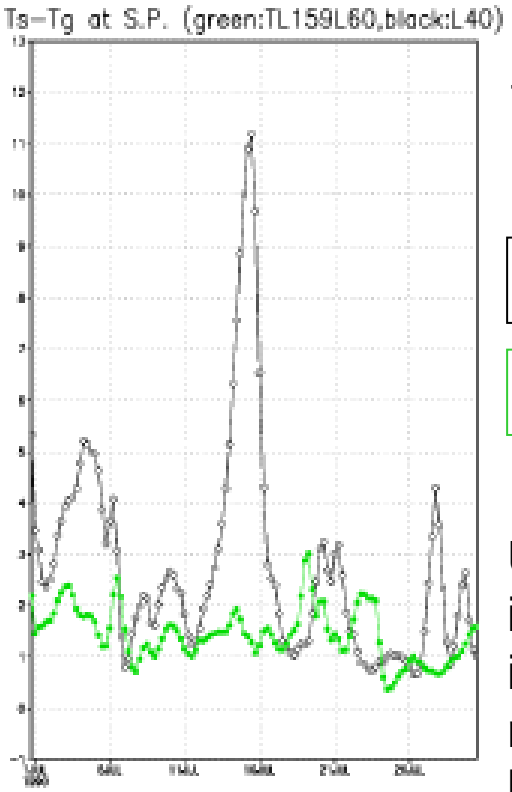
  - in seasonal (three-month) forecast system

2. Recent developments
Model frame & physics

increase in vertical layers (40 -> 60 layers)



24 hour forecast
with initial of 12UT
30 June for 1982-2001.



one month forecast
with initial of 12UT 30 June,
1990.

T2m-Tg at the South pole in July.

TL159L40

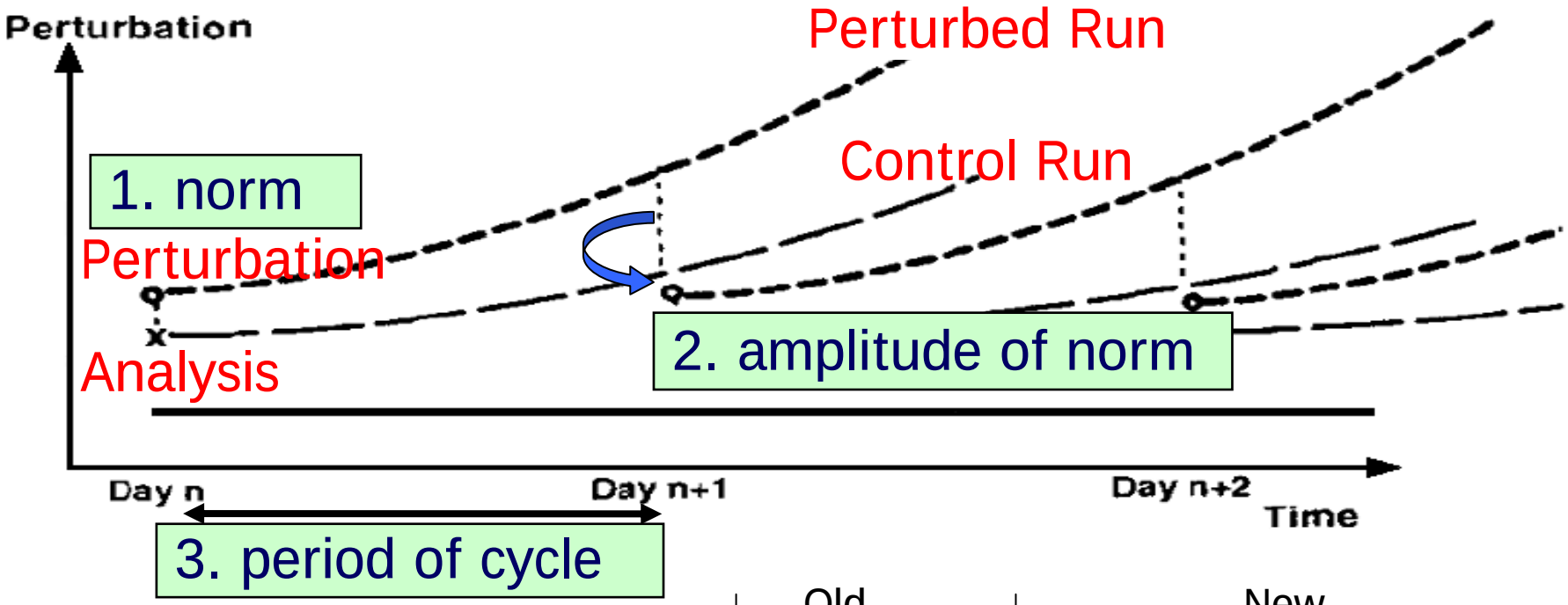
TL159L60

Unnatural large variations in forecasted temperature is reduced with the new model with 60 vertical layers.

2. Recent developments

Initial perturbation for EPS

Initial Perturbation (BGM; for one-month forecast)

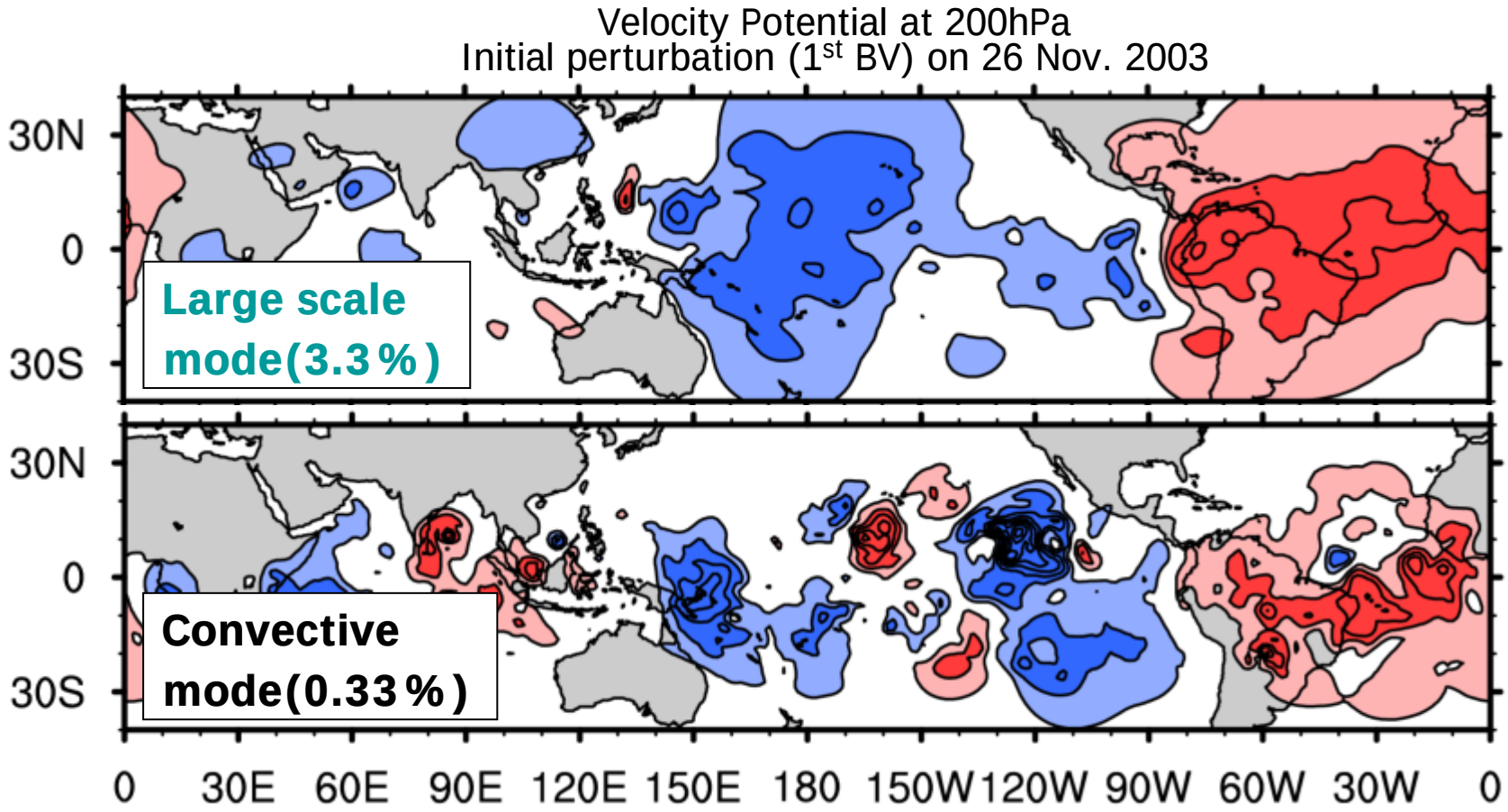


	Old	New	
Perturbation Area	20S-90N	20S-20N	20N-90N
Norm	Z500	χ 200	
Magnitude of norm	14.5 (%)	20 (%)	the same
Renormalization	every 12hr	every 24hr	as old
Orthogonalization	every 24hr	every 24hr	
Ensemble member	24	2	

2. Recent developments
Initial perturbation for EPS

Initial Perturbation (BGM; for one-month forecast)

– Extract growing mode associated with the instability of the MJO (Chikamoto *et al.* 2007)

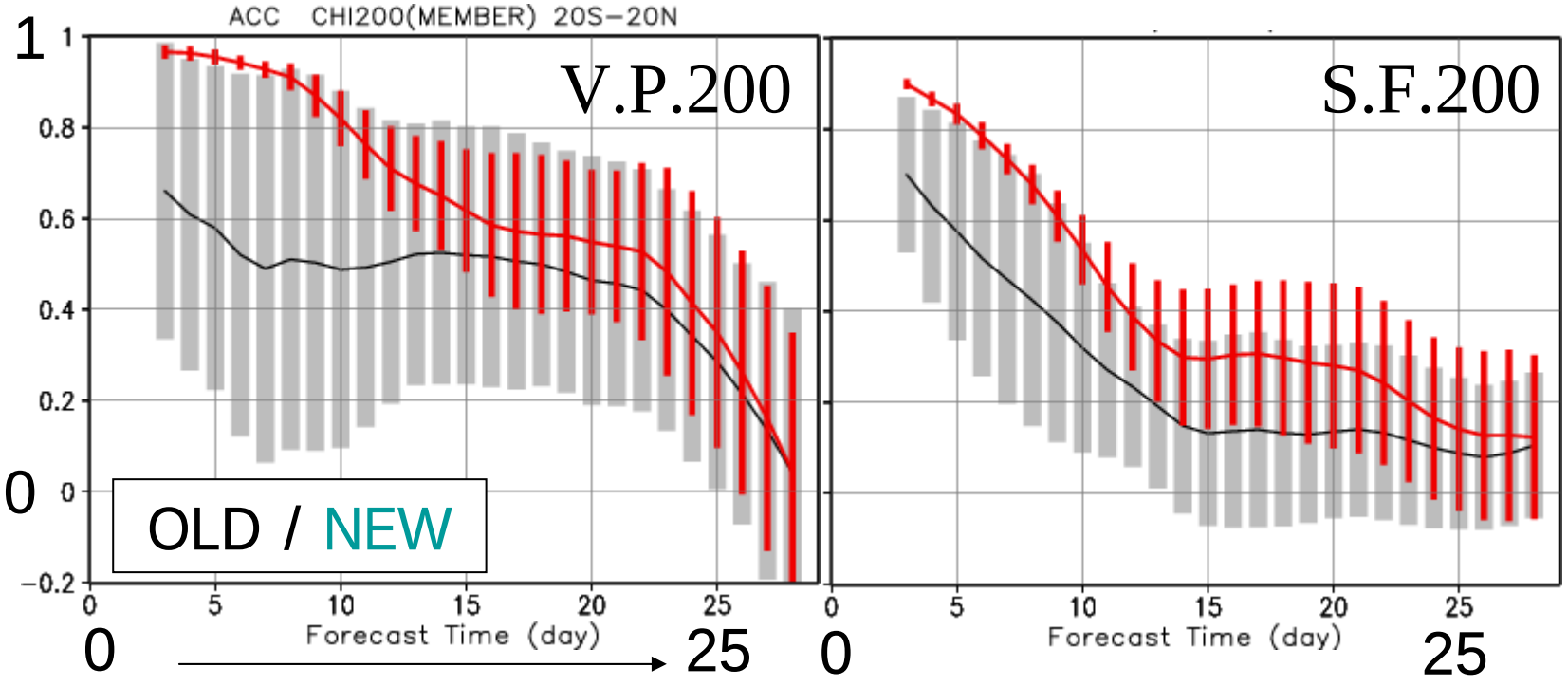


2. Recent developments

Initial perturbation for EPS

Forecast skill around equator using the new initial perturbations is better than that using the old perturbations.

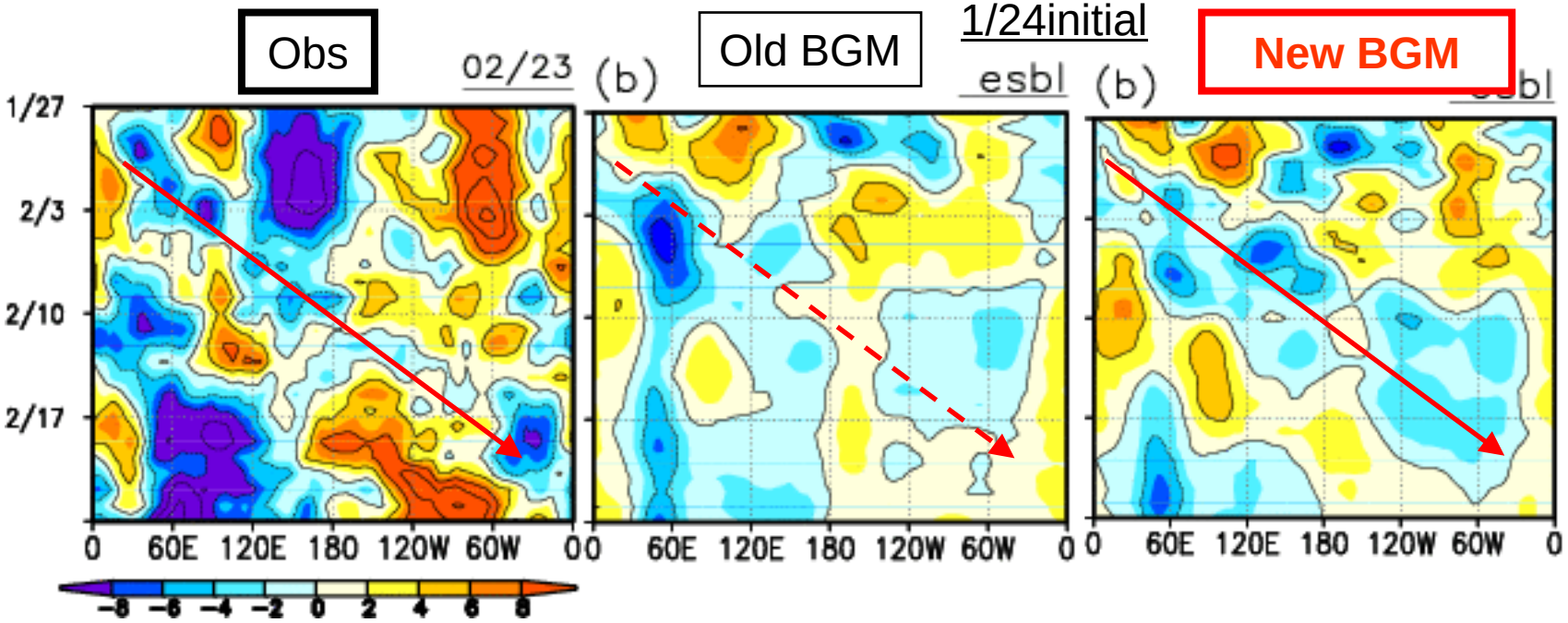
Anomaly correlation [20°S-20°N]



Initial date: 21 Dec, 2006
50 members

2. Recent developments
Initial perturbation for EPS

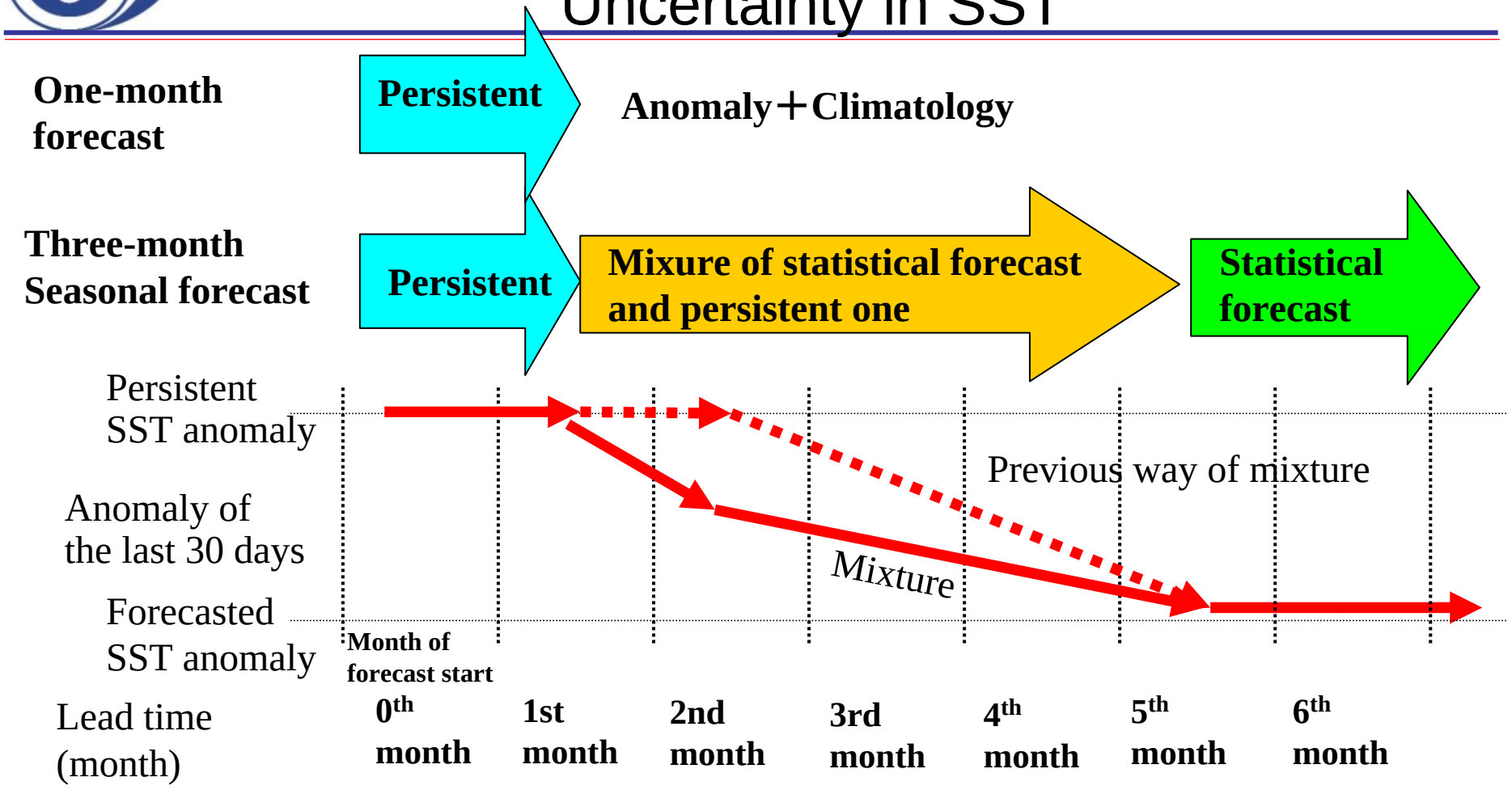
200hPa velocity potential anomaly averaged for 5S-5N



Forecast of MJO in ensemble mean is improved.

2. Recent developments

Uncertainty in SST

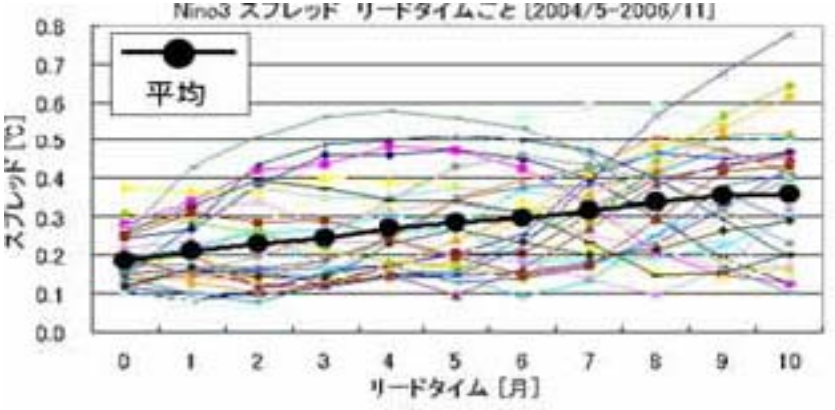


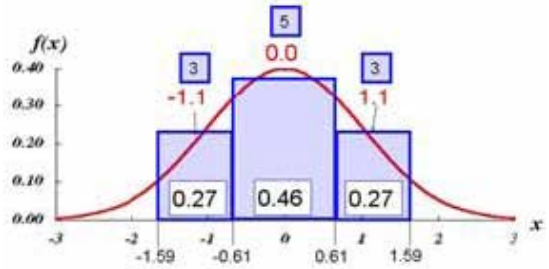
Persisted: SST=Anomaly at the initial time + climatology

Forecast : SST=forecasted statistically based on Nino-3 forecast with the El-Nino model

2. Recent developments
Uncertainty in SST

- Uncertainty of predicted NINO.3-SST

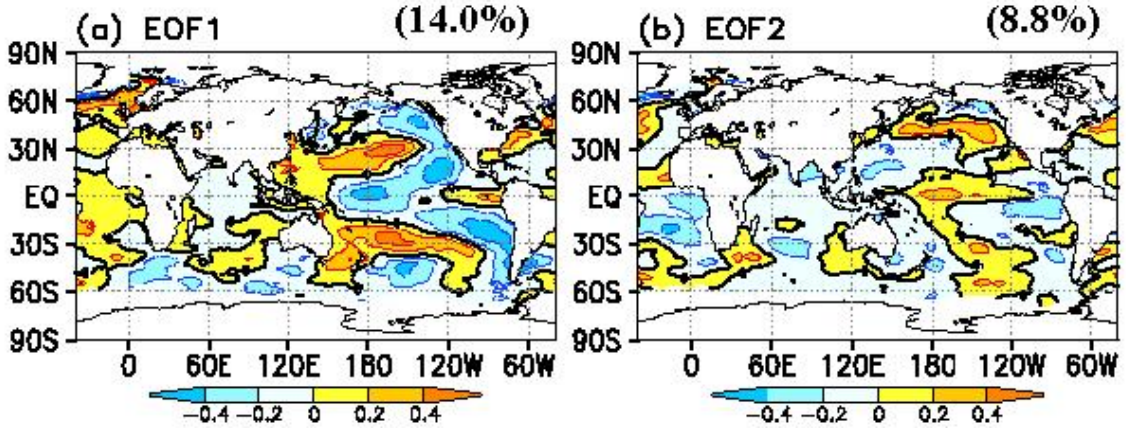




Errors follows the Gaussian Distribution.

- Uncertainty of SST which cannot be forecasted statistically from predicted NINO.3-SST

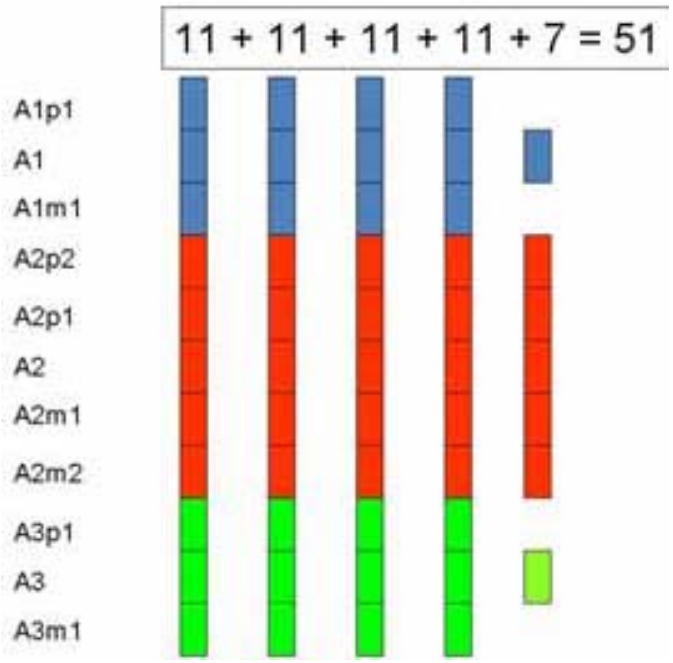
Extract two EOF components from anomaly of regression fields of SST with Niño.3-SST.

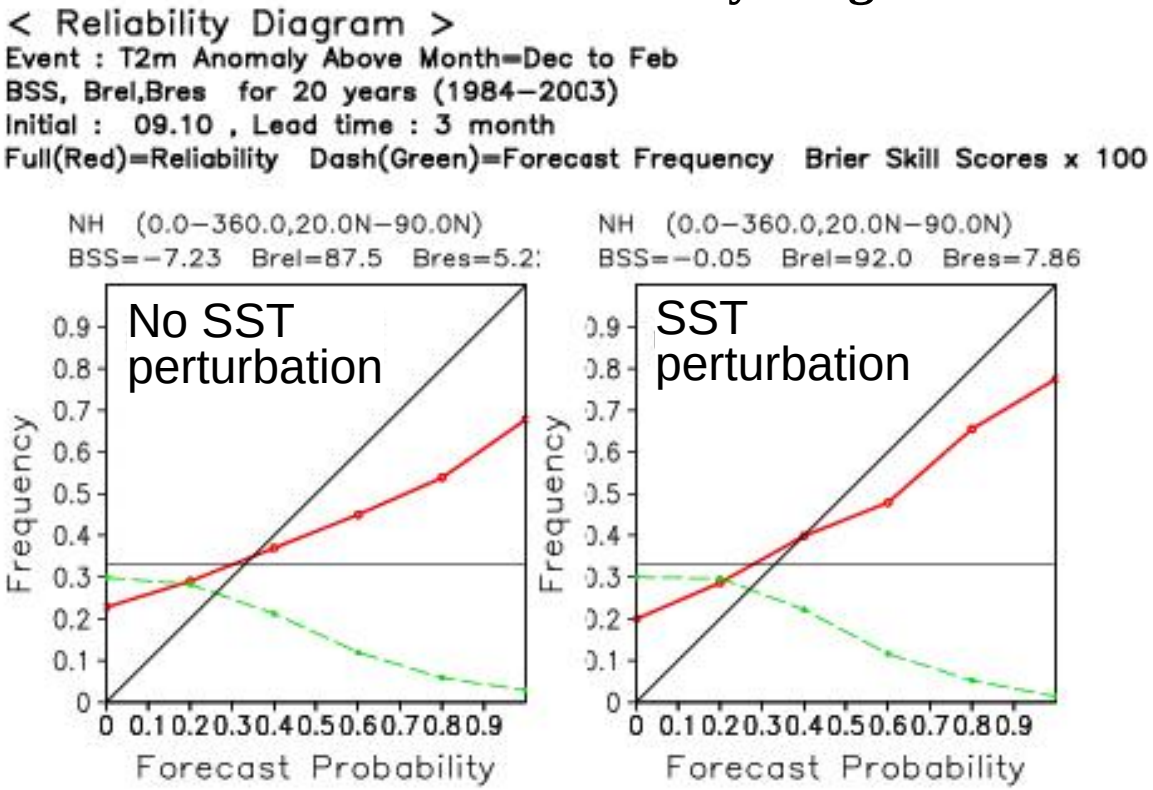


2. Recent developments

Perturbation in SST

Verification of the effect with Reliability Diagram





Ensemble=SST perturbation x Atmospheric perturbation

Improved

3. Future plan

Introduction of a CGCM into seasonal forecast

- In Feb. 2010, JMA will introduce a CGCM into seasonal forecast, which will be developed based on current JMA's operational El-Niño forecast model (from Mar 2008).

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

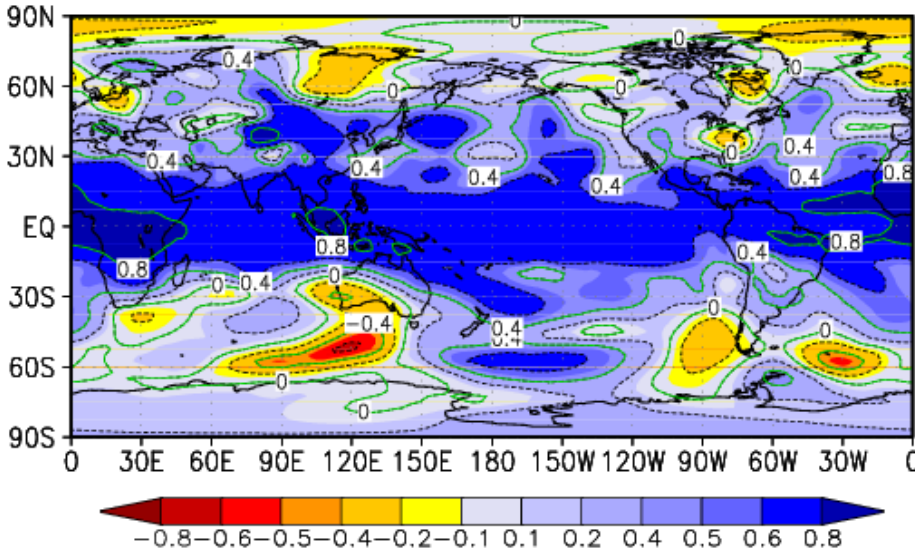
- Performance of this CGCM system with comparison to the current AGCM seasonal forecast system
  - ➢WCRP/TFSP experiment verification with JRA-25, COBESST, GPCP
  - ➢Hindcast data for 1984-2005

3. Future plan

Performance of CGCM

Z500 Anomaly Correlation Jun-Aug Lead time:4month

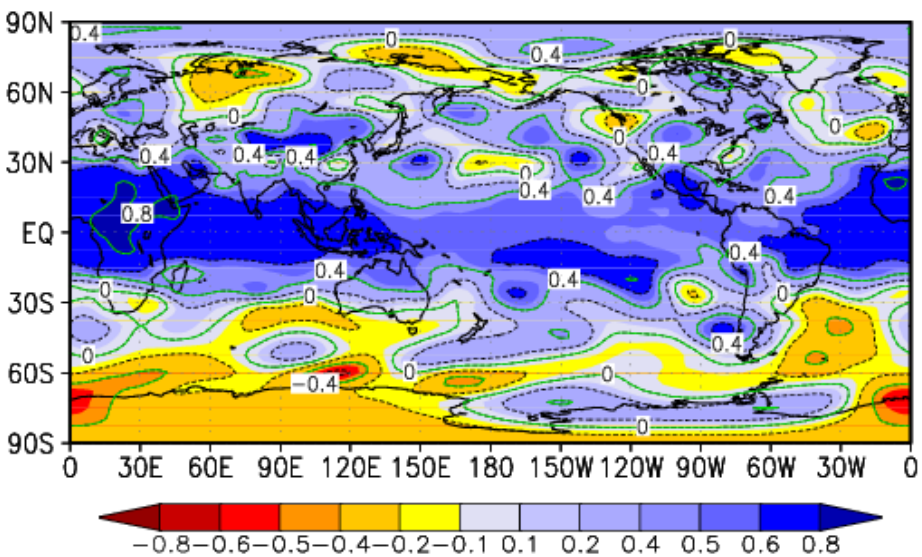
<Tfsp2007a(22yr;10mem)>
Z500 anomaly (esbl−se)
Anomaly Correlation for 22 years (1984−2005)
Initial : 01.31 , Lead time : 4 (Jun to Aug)



NH	TRP	SH	EU	PAC	JPN
0.295	0.691	0.177	0.336	0.319	0.466

CGCM

<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

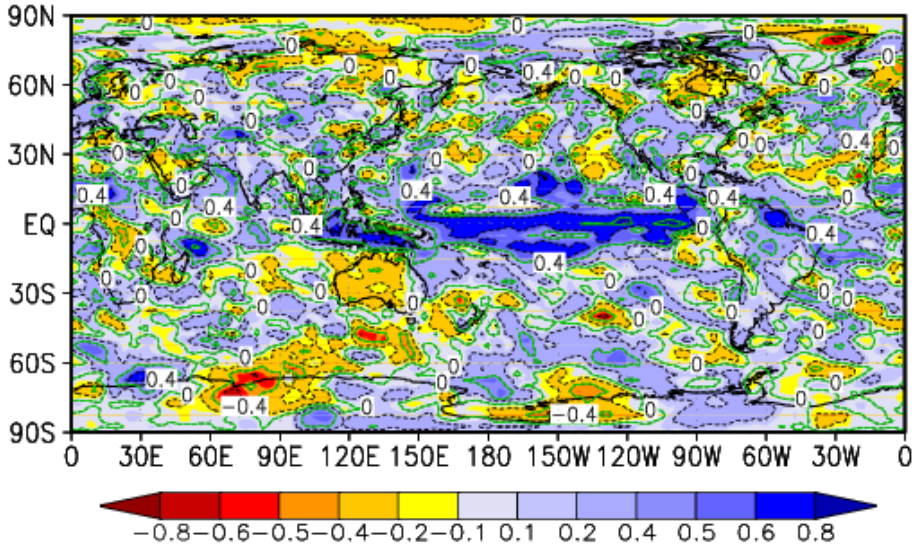
2-tier

3. Future plan

Performance of CGCM

Rain Anomaly Correlation Jun-Aug Lead time: 1 month

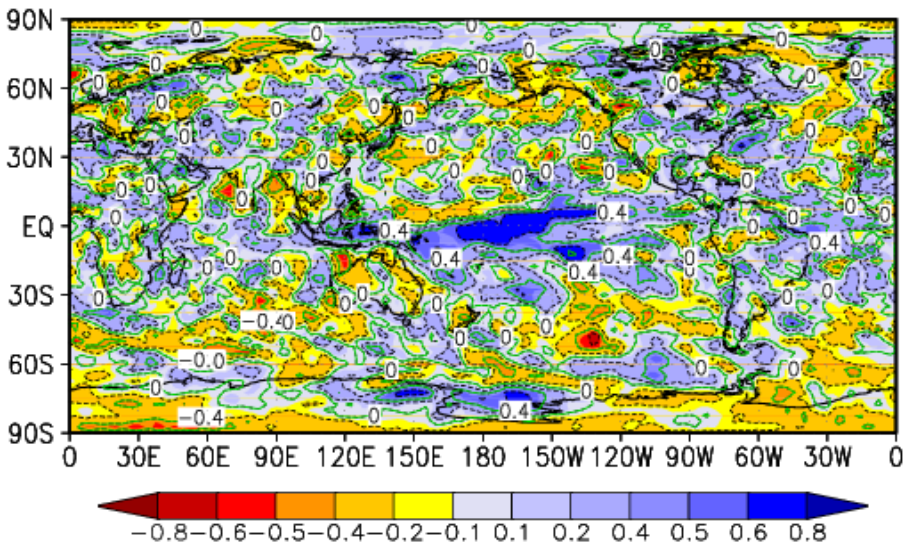
<Tfsp2007a(22yr;10mem)>
Rain anomaly (esbl−se)
Anomaly Correlation for 22 years (1984−2005)
Initial : 01.31 , Lead time : 4 (Jun to Aug)



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

CGCM

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



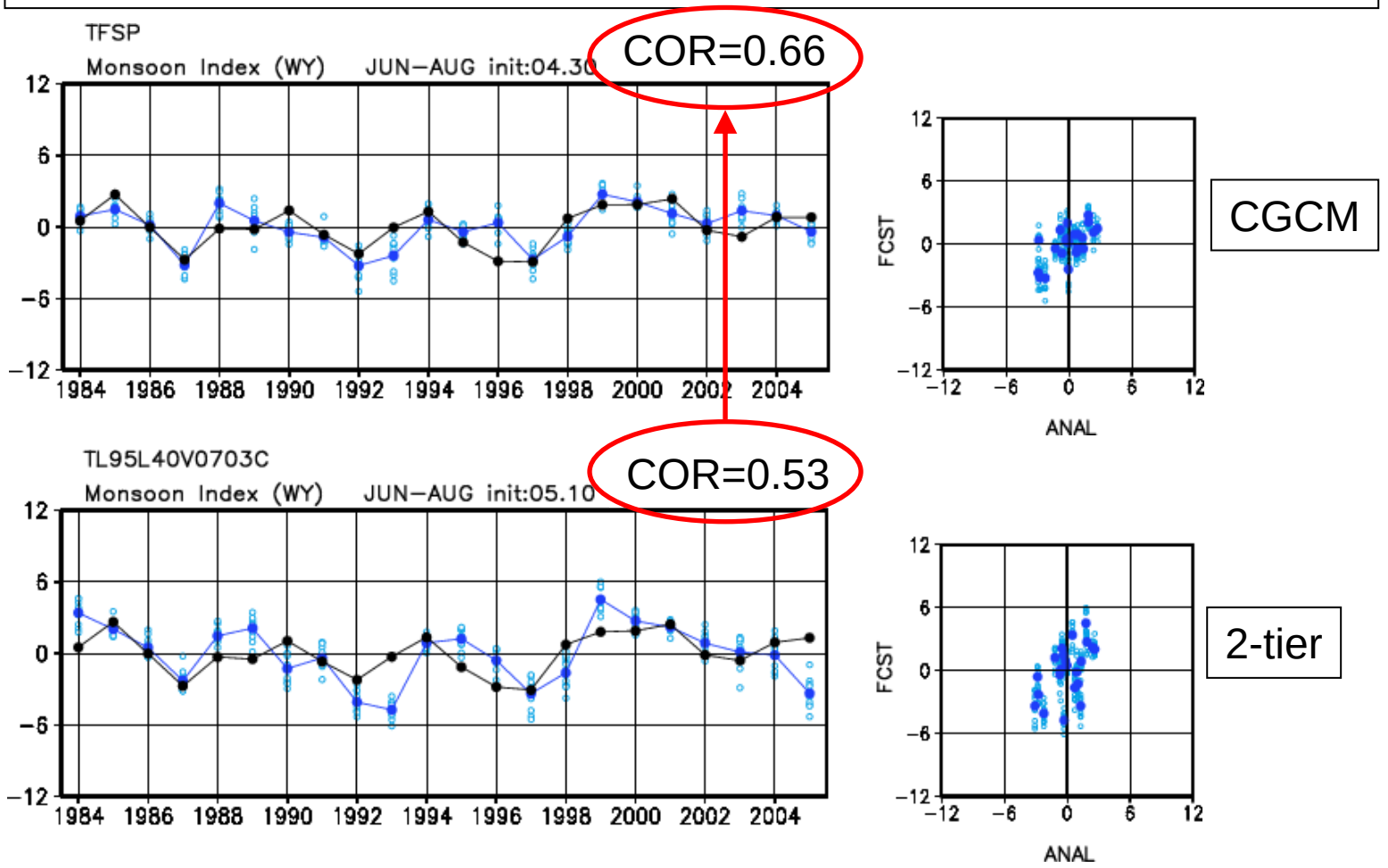
NH	TRP	SH	EU	PAC	JPN
0.019	0.126	−0.022	0.018	0.004	−0.036

2-tier

3. Future plan

Performance of CGCM

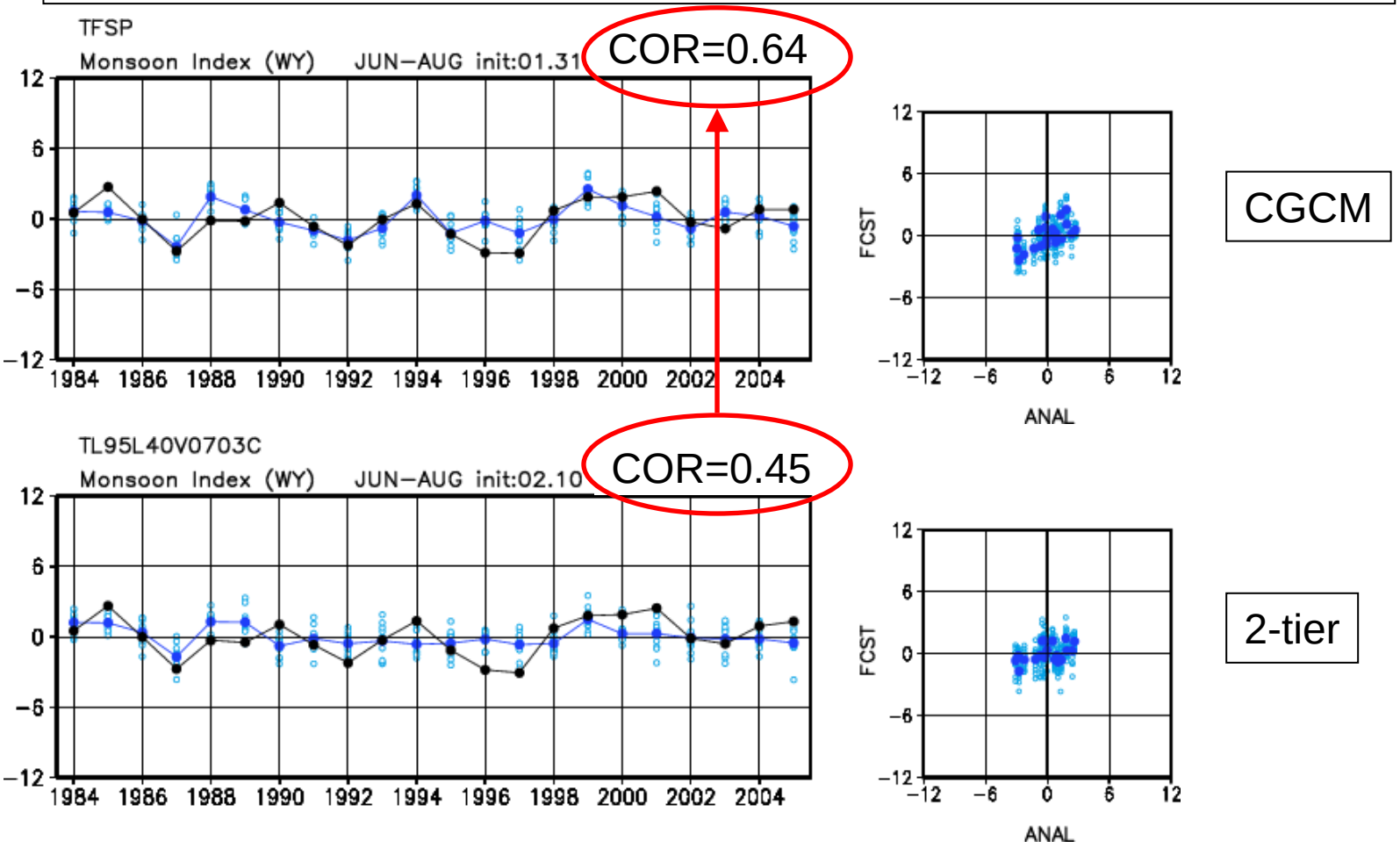
WY Index **Jun-Aug** **Lead time: 1 month**



3. Future plan

Performance of CGCM

WY Index **Jun-Aug** **Lead time: 4 month**



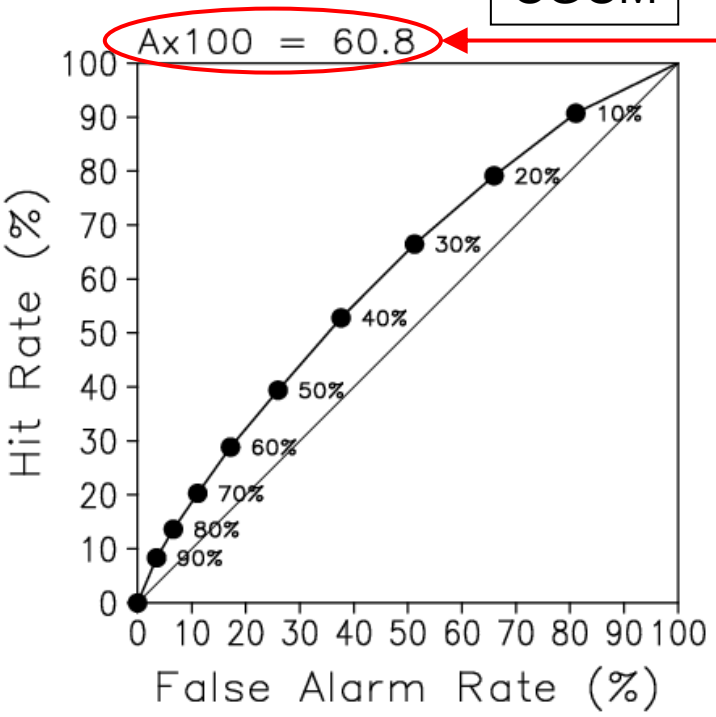
3. Future plan

Performance of CGCM

RAIN Anomaly Correlation Jun-Aug Lead time: 4 month

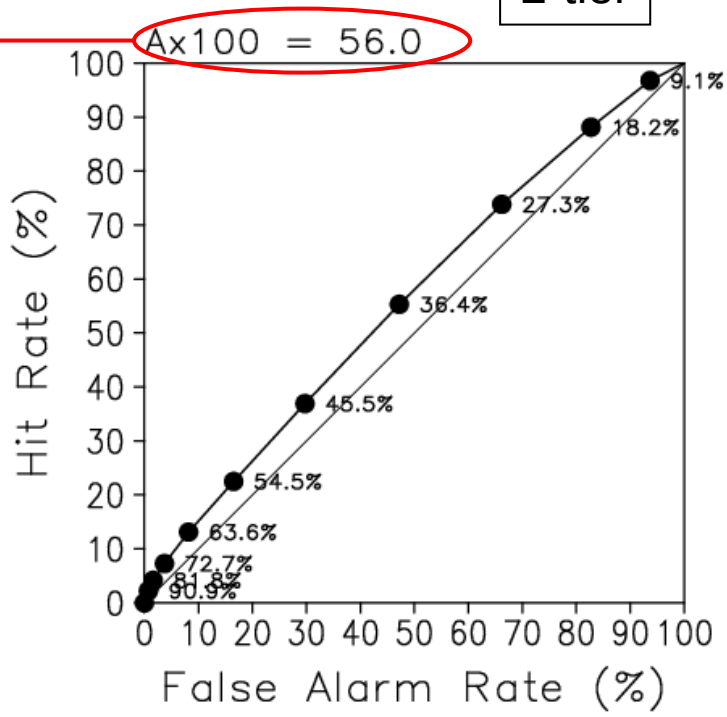
< Tfsp2007a(22yr;10mem) >
Event : Rain , Anomaly Upper Tercile
Region : TRP(0.0–360.0,20.0S–20.0N)
for 22 years (1984–2005)
Initial : 01.31 , Lead time : 4 month (Jun to Aug)
Anal : gpcp
ROC area x 100

CGCM



< TL95L40V0703C(22yr;11mem) >
Event : Rain , Anomaly Upper Tercile
Region : TRP(0.0–360.0,20.0S–20.0N)
for 22 years (1984–2005)
Initial : 02.10 , Lead time : 4 month (Jul to Sep)
Anal : gpcp
ROC area x 100

2-tier



4. Summary

- JMA continues improving seasonal prediction system basically based on the current JMA operational GCM .

- JMA will introduce a CGCM into the seasonal forecast in February 2010.

- The comparison shows better performance of JMA's CGCM system.

1.Outline of JMA's seasonal prediction system
Brief history of development

One-month forecast model

	Changes in Model Frame, B.C.		Changes in Model Physics, EPS
1996.03	T63L30M10	Operation start	
1997.01		Top layer (10hPa -> 1hPa)	
2001.03	T106L40M26	Enhance in resolution & size Top layer (1hPa -> 0.4hPa)	
2002.04		Use of Land-surface analysis	
2003.04		Use of SSM/I snow analysis	
2003.06			AS cumulus parameterization
2005.03			Albedo of snow & ice Cloud scheme
2006.03	TL159L40M50	Enhance in resolution & size Semi-Lagrange scheme Use of COBE-SST	Clear-sky radiation scheme Cloud radiation scheme BGM
2007.03			**Change in BGM (MJO mode)** Short Wave Radiation Aerosol climatology Cumulus convection scheme (DCAPE) Cloud scheme
2008.03	TL159L60M50	Increase of layers	Initial for land-surface Change in gravity wave drug

1.Outline of JMA's seasonal prediction system
Brief history of development

Three-month (Seasonal) forecast model

	Changes in Model Frame, B.C.		Changes in Model Physics
2003.03	T63L40M31	Operation start	
2004.04		Change in adjustment of systematic error	
2006.03	TL95L40M31	Semi-Lagrange scheme Use of COBE-SST	Clear-sky radiation scheme Cumulus convective scheme Cloud scheme Ground surface albedo
2007.09	TL95L40M51	**Incorporation of uncertainty in SST**	physics