JMA's New Seasonal Ensemble Prediction System: JMA/MRI-CPS2

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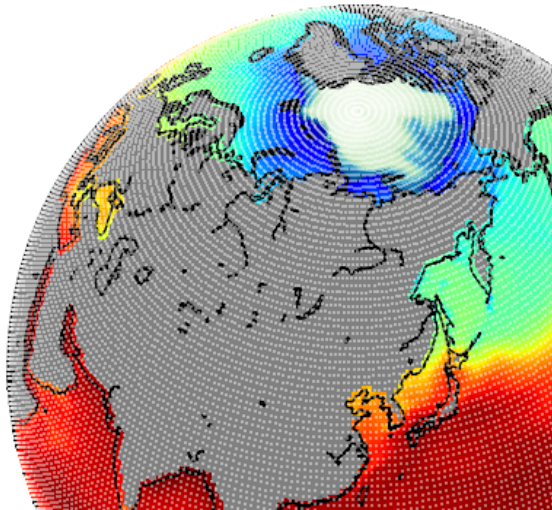
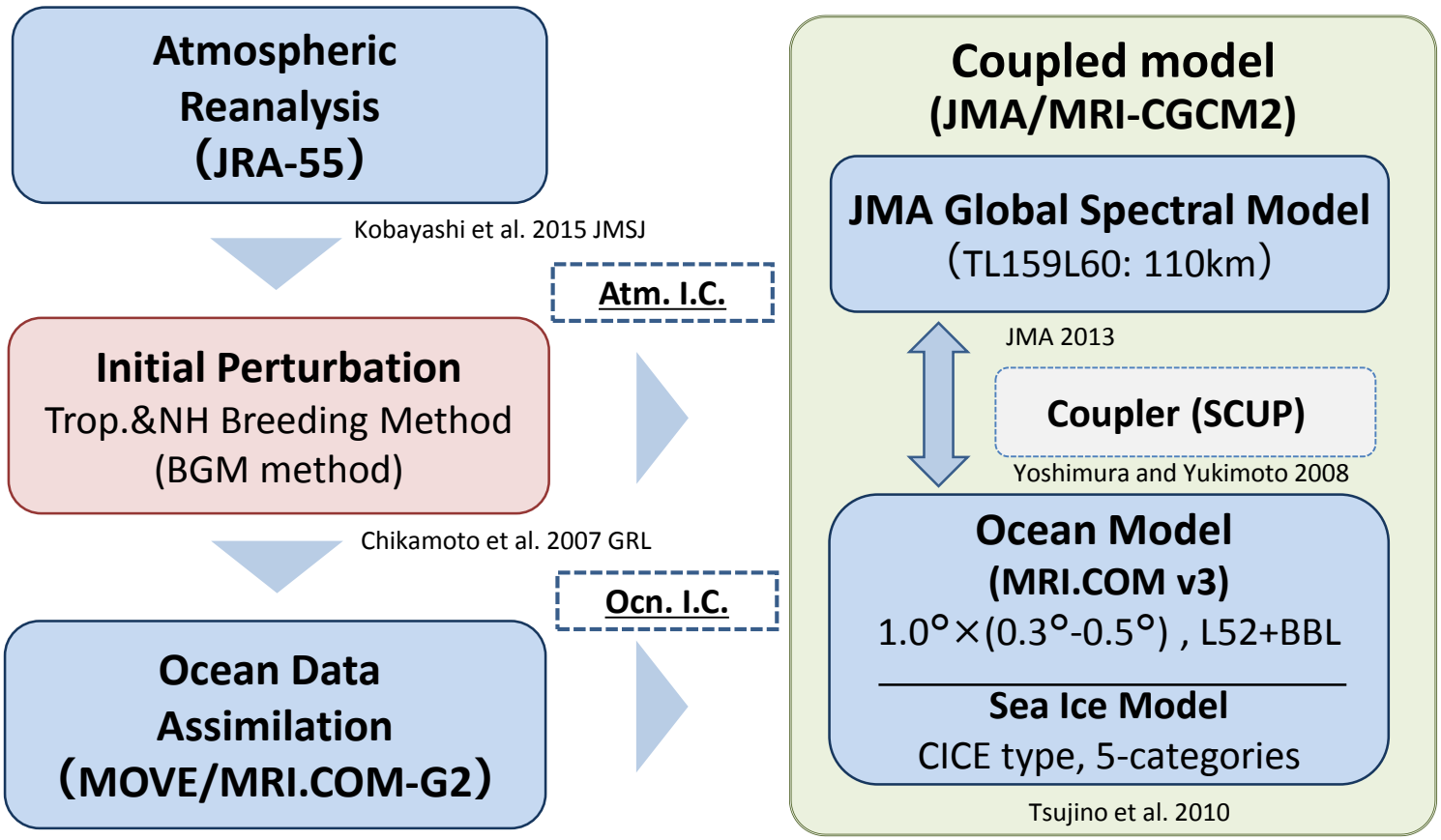


Outline

- Configuration of JMA's Seasonal EPS
- Evaluation of prediction skill
  - 3-month forecast
  - ENSO prediction
- East Asian Summer Monsoon

System components of JMA/MRI-CPS2

JMA/MRI-CPS2（Coupled Prediction System 2）



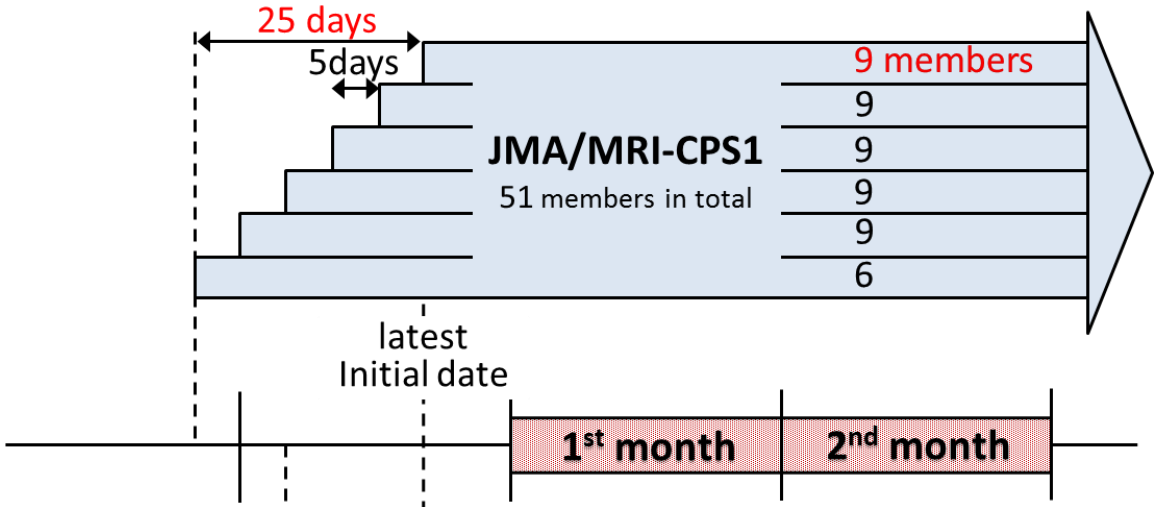
Configuration of JMA's seasonal EPS

	JMA/MRI-CPS1 (Previous)	JMA/MRI-CPS2 (since June 2015)
Atmosphere (JMA-AGCM)	***TL95L40***, ~180km, Up to ***0.4hPa***	***TL159L60*** , ~110km, up to ***0.1hPa*** ***Stochastic tendency perturbation*** ***GHG forcing*** from RCP4.5 scenario
Ocean (MRI.COM) (Tsujino et al 2010)	1.0° (lon) x ***0.3-1°*** (lat) ***L50*** 75°S-75°N Ocean ***Sea-ice climatology***	1.0° (lon) x ***0.3-0.5°*** (lat) ***L52+BBL*** ***Global ocean with tri-polar grid*** ***Sea-ice model***
Coupler (Scup) (Yoshimura and Yukimoto 2008)	1-hour coupling interval ***Momentum and heat flux adjustments***	1-hour coupling interval ***No flux adjustment***
Initial Condition	Atmosphere: ***JRA-25*** Land: ***Climatology with ERA-15 forcing*** Ocean: ***MOVE/MRI.COM-G*** T, S&SSH (Usui et al. 2006) ***Sea-ice climatology***	Atmosphere: ***JRA-55*** Land: ***JRA-55 land analysis*** Ocean: ***MOVE/MRI.COM-G2*** T, S & SSH ***Sea-ice model***
Ensemble Size	51 (***9*** BGMs, ***6*** days with 5-day LAF)	51 (***13*** BGMs, ***4*** days with 5-day LAF)

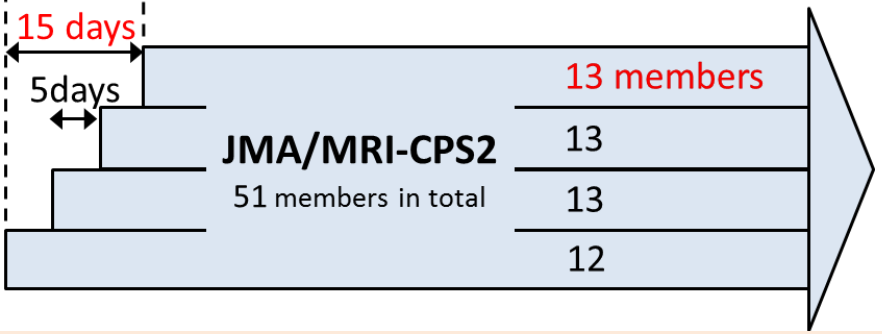
* re-forecast: 10 member ensemble (5 BGMs, twice a month, 1979-2014)

Operational ensemble method

Previous system
(JMA/MRI-CPS1)



New operational system
(JMA/MRI-CPS2)



The number of ensembles per initial date has been increased from 9 to 13.

- This enables the production of combined 51-member ensemble predictions starting from later initial dates compared to the previous system.

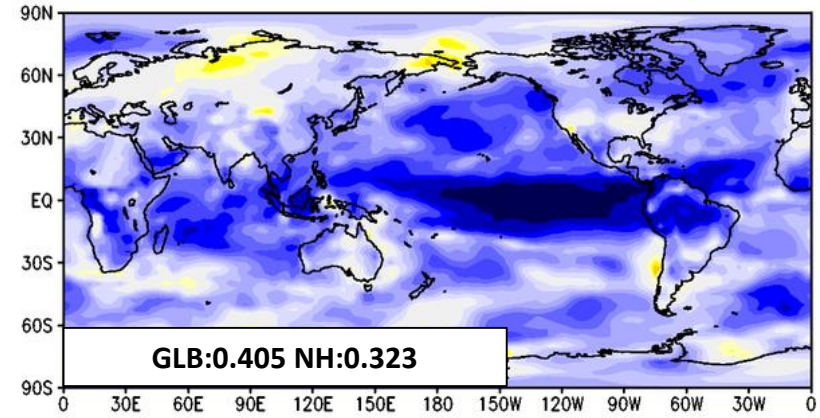
  ➔ The forecast lead time is shortened.

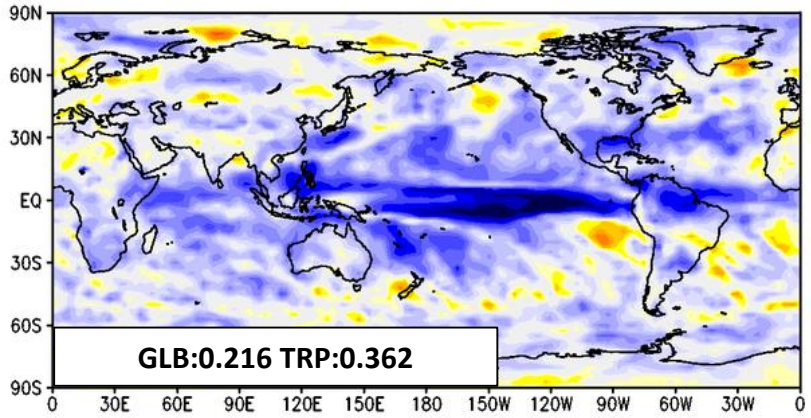
Anomaly correlation of the seasonal EPS

NH: 20N-90N,0E-360E
TRP: 20S-20N,0E-360E

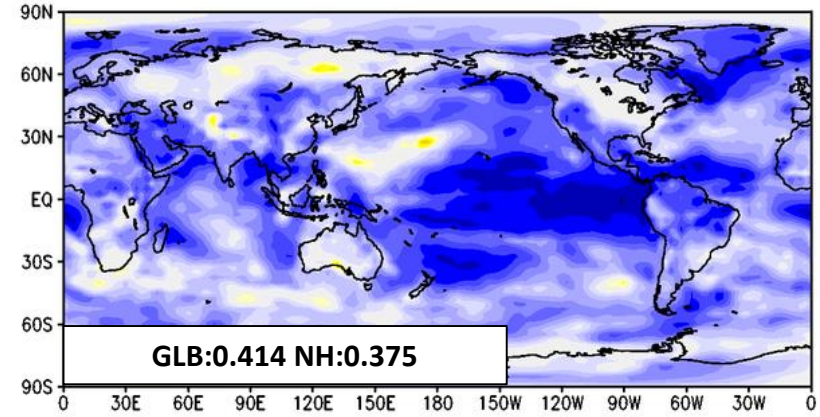
2m temperature | **Precipitation**

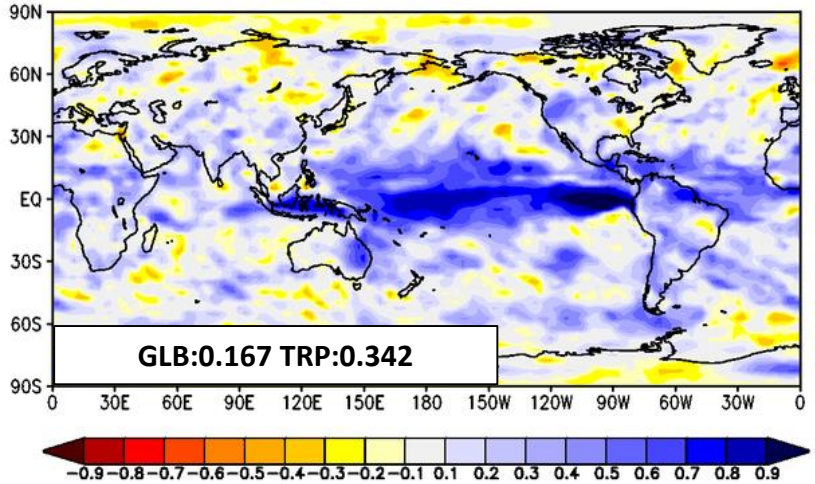
DJF (Initial: Nov.)





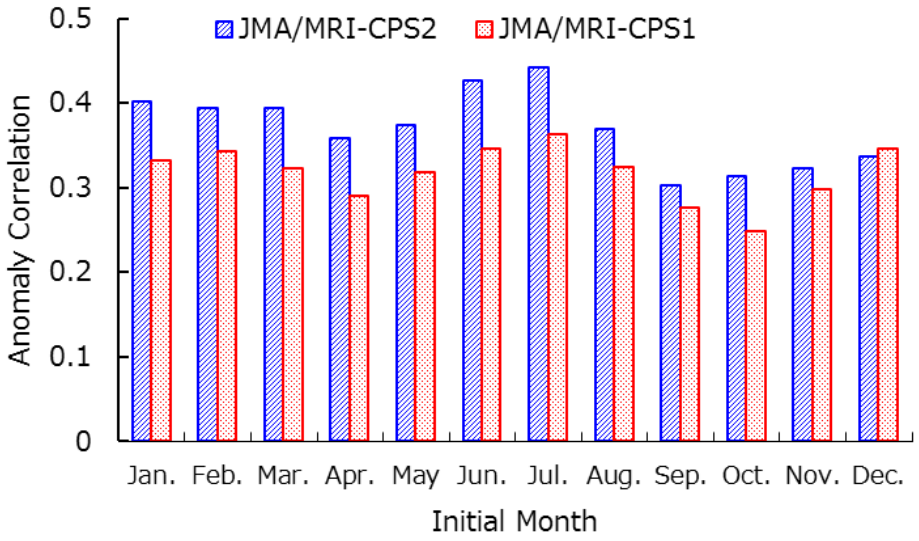
JJA (Initial: May)



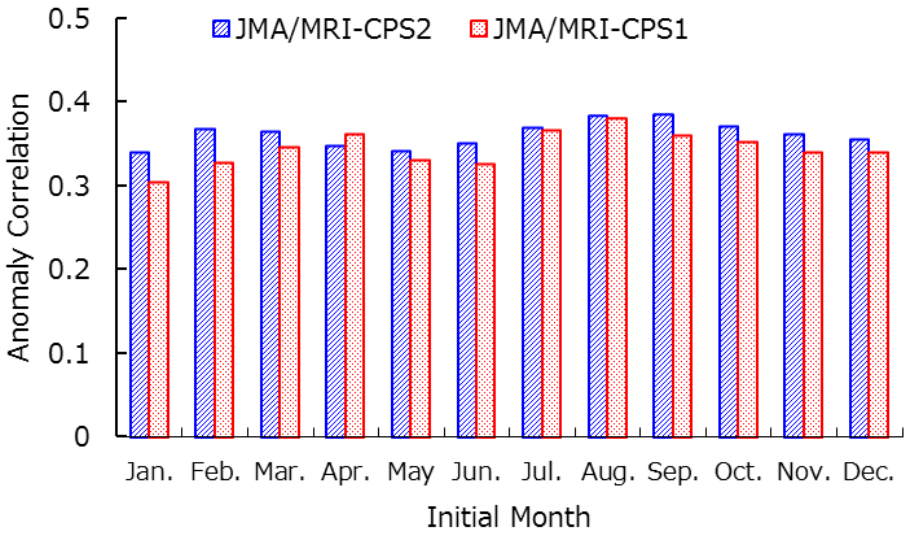


Improved ACC for 3-month forecast

2-m Temperature averaged in NH



Precipitation averaged in TRP



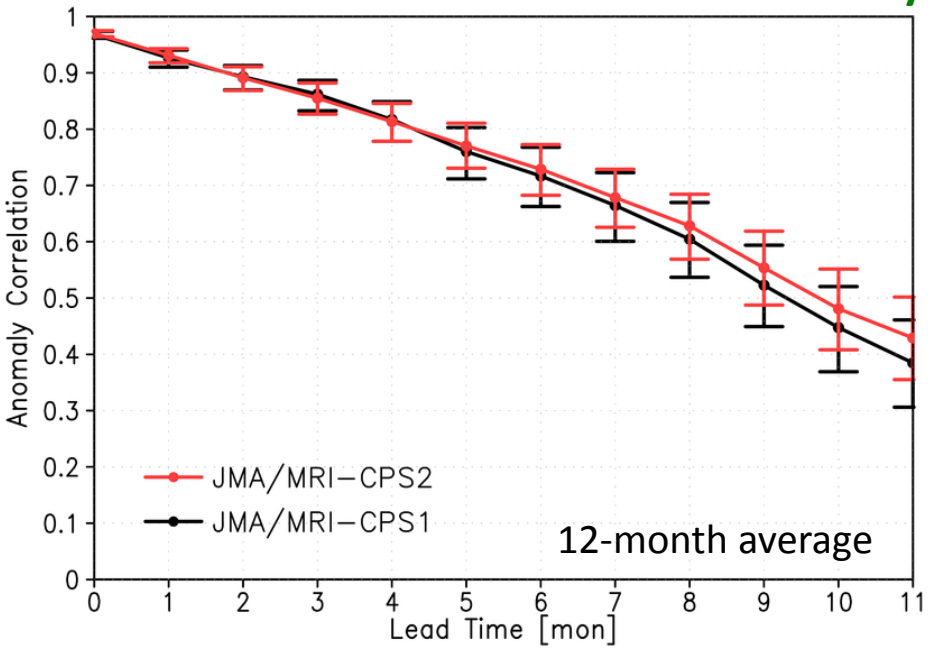
NH: 20N-90N,0E-360E
TRP: 20S-20N,0E-360E

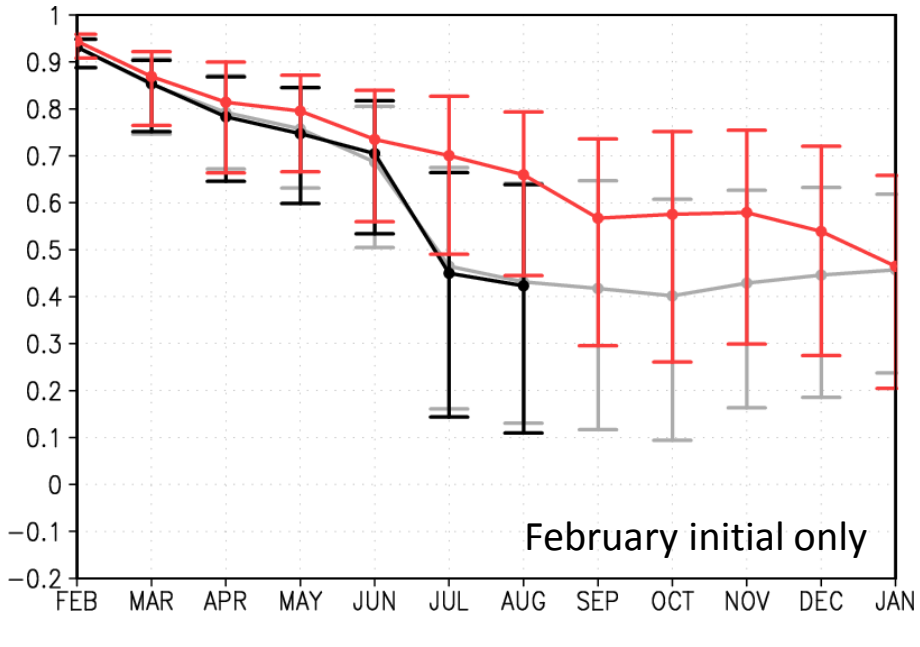
The performance of the next system is as follows:

- For 3-month forecast, anomaly correlation coefficient of 2m temperature (NH) and precipitation (TRP) is greater than the previous system in almost all initial months.

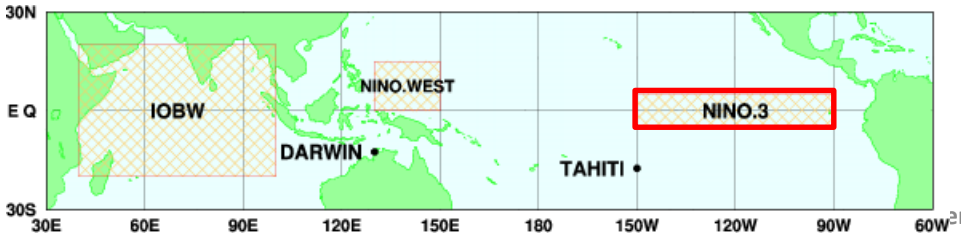
NINO3 SST prediction skill

Anomaly Correlation





- Improvement of ACC in longer lead time
- Improvement of ACC over the spring barrier

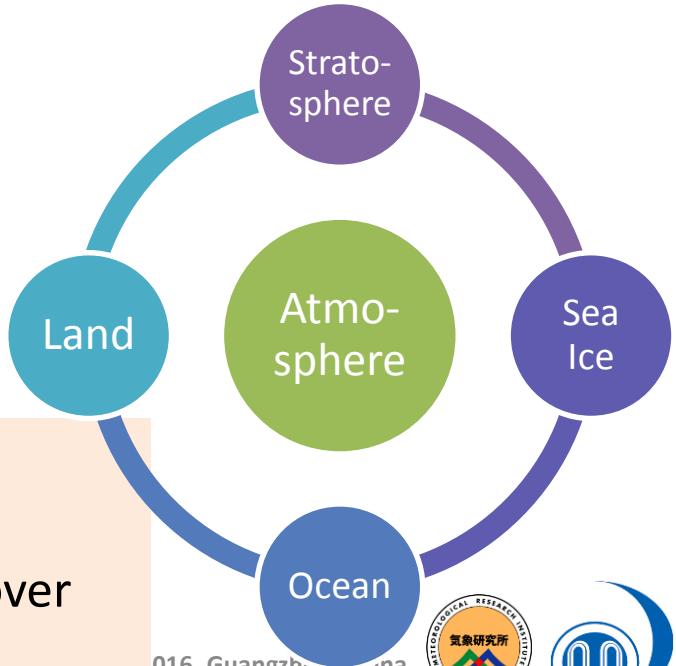


NINO.3 : 150W-90W, 5S-5N

Newly introduced sources of predictability

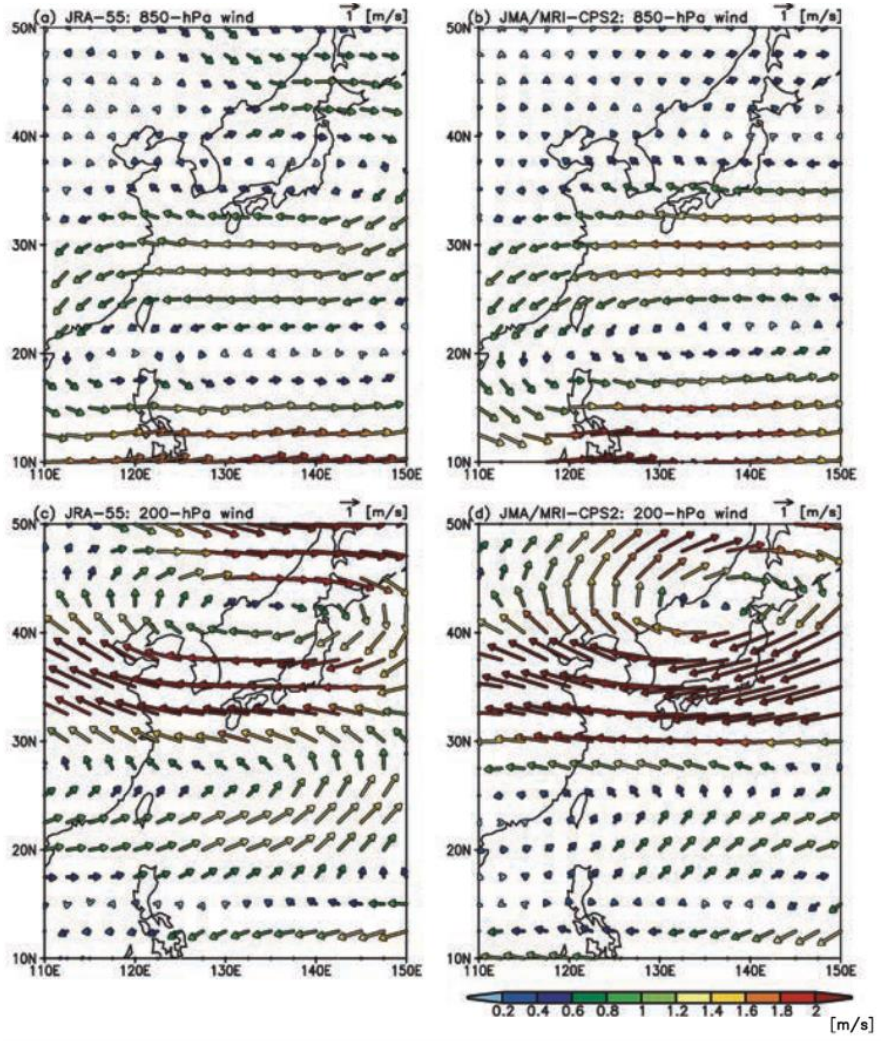
- Dynamical sea ice simulation
- Land initialization with JRA-55
- Fully covered stratosphere (Top: 0.1 hPa)
- Global ocean domain
- More sophisticated description of GHGs (6 gases prescribed with RCP4.5 scenario)

The new system is capable of incorporating a full range of potential sources of the predictability.



- Representation of sea-ice interannual variability and reduction trend is improved (not shown)
- Improvement of warming trend of 2-m temperature over land (not shown)

East Asian Summer Monsoon



1st mode of multivariate EOF analysis to 4 variables (200hPa zonal and meridional wind, 850hPa zonal and meridional wind) at 10N-50N, 110E-150E in JJA

(Left) JRA-55
(Right) JMA/MRI-CPS2
Initial: May. (1-month lead)

(top) horizontal wind at 850hPa
(bottom) horizontal wind at 200hPa

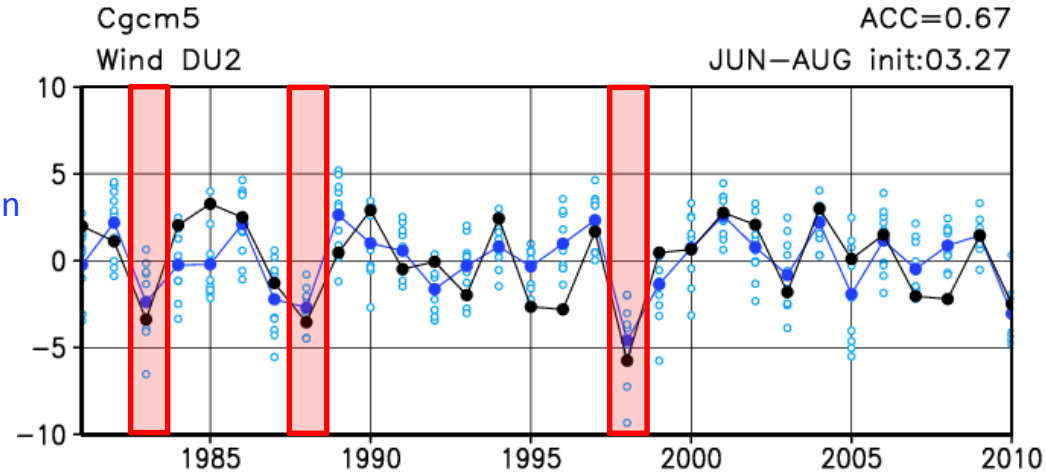
The following mode are extracted both in the analysis (21%) and re-forecast (23%):

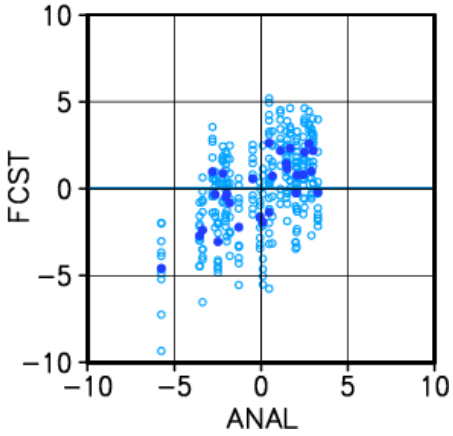
- Westerly wind anomaly over east of Philippines in 850hPa.
- Easterly wind anomaly at 30°N in 850hPa.
- Anti-cyclonic circulation centered at Japan in 200hPa.

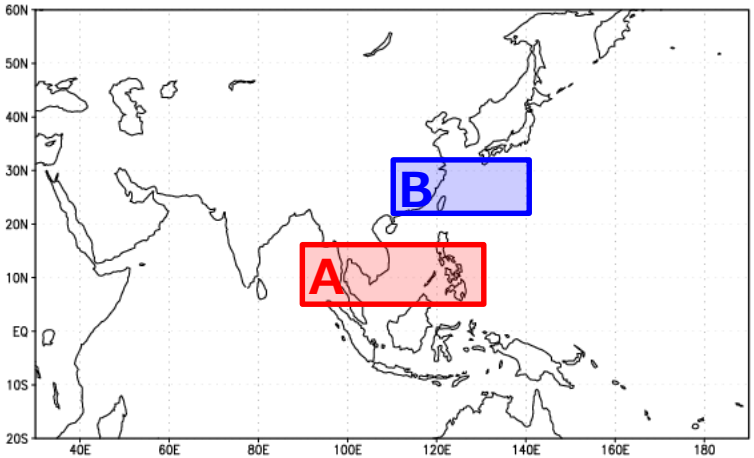
These features are corresponding to the response to active convection around Maritime Continent.

East Asian Summer Monsoon

- :Ensemble mean
- :Members
- :JRA-55







region A : 5°N-15°N,90°E-130°E
region B : 22.5°N-32.5°N,110°E-140°E

(Left) Time series of 3-month (JJA) averaged Northwestern Pacific Monsoon index (DU2) of JRA-55 and CPS2 (Lead time is 2 month) from 1981 to 2010.
(Right) Scatter diagram of DU2 of JRA-55 and CPD2.

DU2 is one of the widely used index representing activity of East Asian Monsoon (Wang et al. 2008). DU2 is defined as follow

$$\mathrm{DU2} = \overline{\mathrm{U_A}} - \overline{\mathrm{U_B}}$$

where $\overline{\mathrm{U_x}}$ is spatial averaged zonal wind at 850hPa in region x.

The relatively high prediction skill of DU2 is associated with the convection activity around Maritime Continent influenced by ENSO in previous winter through Indian Ocean capacitor effect.

Summary

- The new operational system JMA/MRI-CPS2 includes:
  - Enhanced horizontal / vertical resolution
  - New initial conditions for atmosphere, land surface, and ocean
  - Newly introduced sources of predictability

    sea ice, stratosphere, global ocean, GHGs, …

- The improvement in JMA/MRI-CPS2 is as follows:
  - 3-month forecast (2-m temperature, precipitation, …)
  - ENSO prediction skill

Thank you for your kind attention.