Introduction to JMA's one-month model

- focusing on an extreme rainfall event during Asian monsoon season -

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1. Specifications of JMA's one-month model and forecast skill for the Asian monsoon rainfall
2. A forecast example of the extreme event
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3. Recent development of TCC website
4. Renewal plan of RCC website

1-1. Specifications of JMA's one-month model

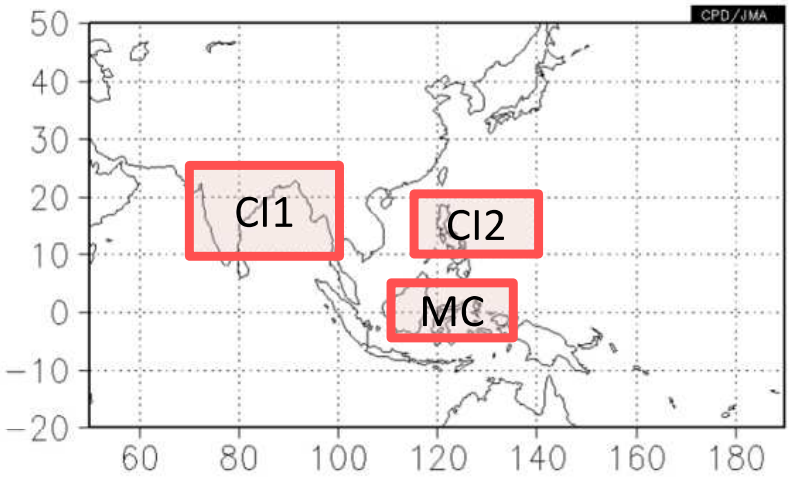
Model	Atmospheric General Circulation Model (AGCM)
Resolution	Horizontal: approx. 110 km (TL159) Vertical: 60 levels (up to 0.1 hPa)
Forecast range	Up to 34 days
Sea surface temperature	Persisted anomaly
Sea ice	Climatology
Ensemble method	Combination of Breeding of Growing Modes (BGM) and Lagged Average Forecast (LAF)
Ensemble size	50 (25 BGMs & 2 days with 1-day LAF)
Frequency of operation	Every Wednesday and Thursday
Frequency of model product creation	Once a week (Every Friday)

Horizontal resolution will be finer by next update. (110km -> 60km)

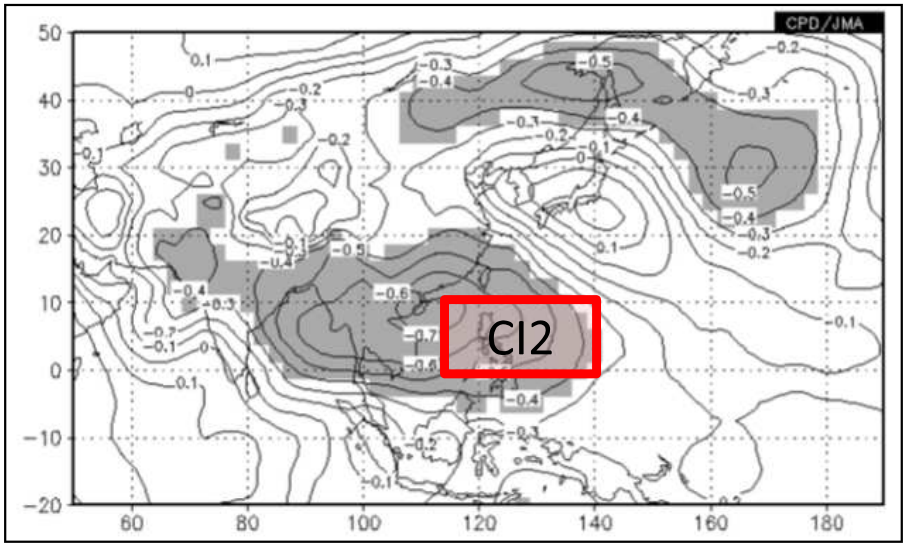
Debut; March 1996 / Last update; March 2011

1-2. Forecast skill for the Asian monsoon rainfall (1)

- The model forecast skill has been verified by hindcast experiment.
- Some indices related to the Asian monsoon were used to verify the model's forecast skill.
  - e.g.) CI2 index is related to the activity of the monsoon trough.



Indices calculated area.
Each indices are calculated by area-averaged one-month rainfall amounts anomaly



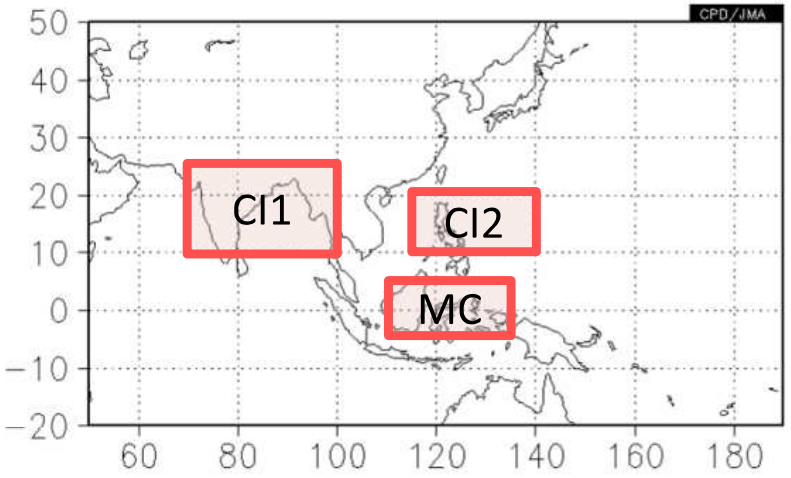
Correlation coefficient map of CI2 index with respect to 850hPa geo-potential height anomaly in Aug.
(Gray shading means statistical significance of 95%)
(CI2 : CMAP, Geo-potential height : JRA/JCADS, 1981-2010)

1-3. Forecast skill for the Asian monsoon rainfall (2)

- The model has forecast skill for indices.
- That means the model has forecast skill for the Asian monsoon activity.

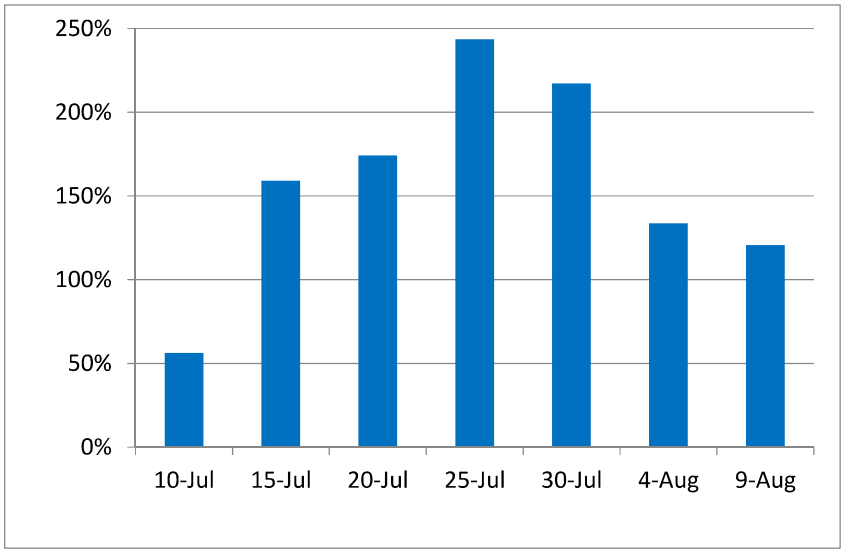
Valid time (Initial time)	Summer - JJA mean-	Jun. (End of May)	Jul. (End of Jun.)	Aug. (End of Jul.)
CI1	0.29	0.52	0.09	0.27
CI2	0.55	0.56	0.58	0.51
MC	0.56	0.48	0.53	0.68

Correlation coefficients of the Asian monsoon indices calculated by the model with respect to indices by analysis
(Yellow shading corresponds to above 0.31)

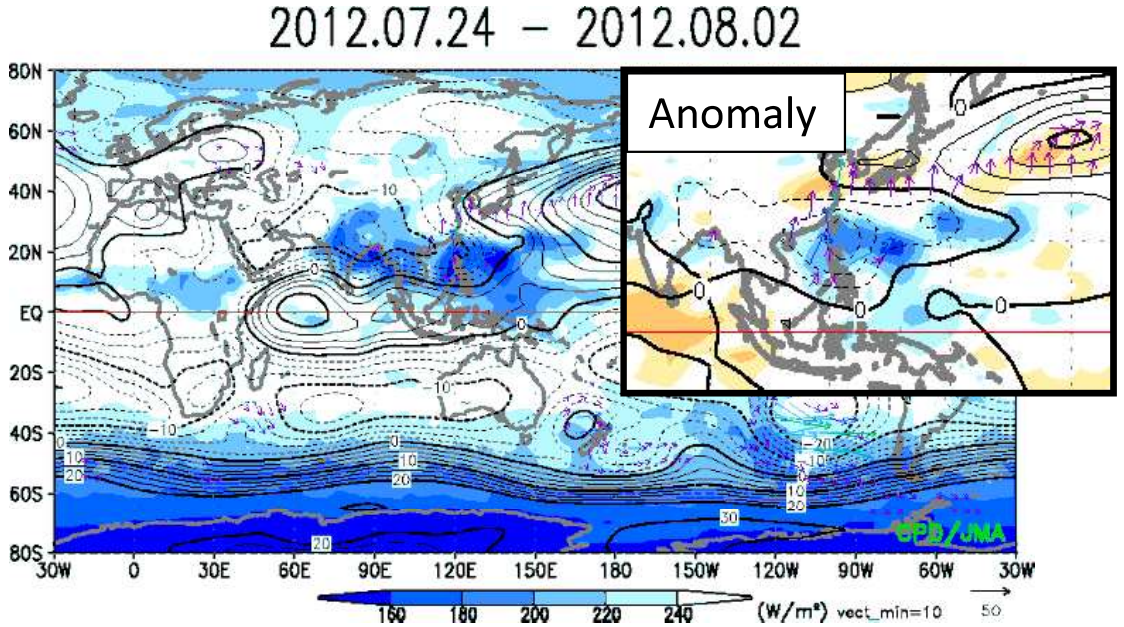


2. Heavy rainfall event around the Philippines in 2012

- The region around the Philippines and southern China experienced heavy rainfall from late July to early August 2012.
- The monsoon trough was enhanced, and there were active convection areas in this period.
  - This event also caused the end of rainy season in Japan.



Time series of 5-day averaged rainfall amounts ratio(%) at CI2 area (CMAP)



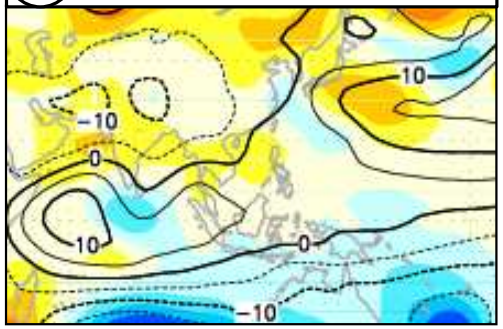
contour : 850hPa stream function (JRA/JCDAS)
shade : OLR (CPC/NOAA)

2-1. Comparing analysis with forecast (1) (7-day averaged charts)

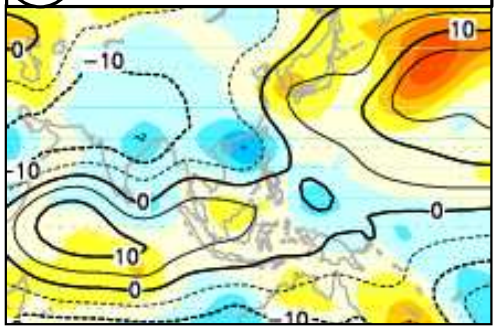
Analysis

Model (Jul.19 initial)

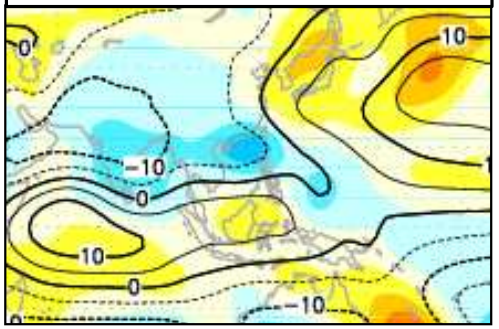
① Jul.13 – Jul.19



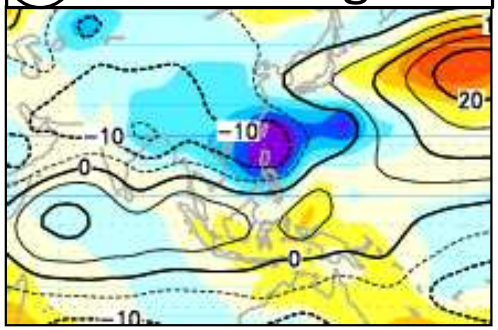
② Jul.20 – Jul.26



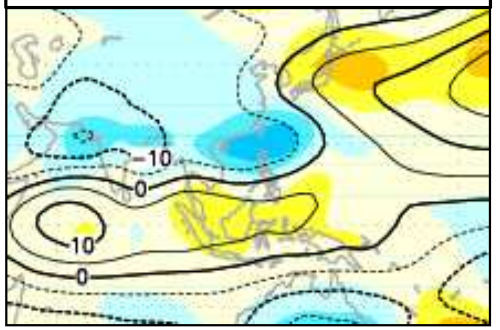
1st week



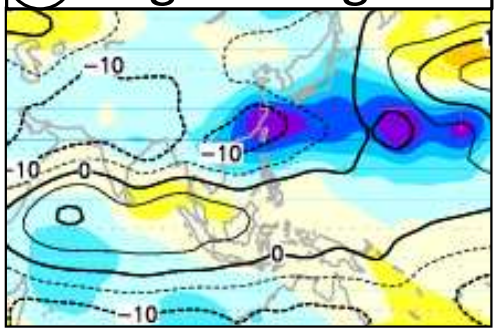
③ Jul.27 – Aug.2



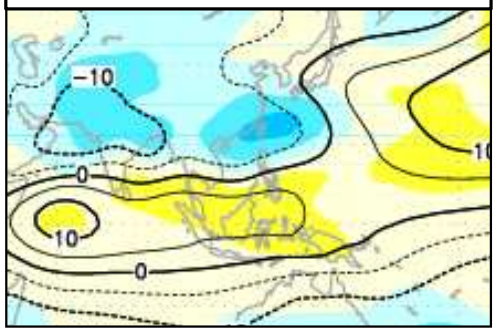
2nd week



④ Aug.3 – Aug.9



3rd week



850hPa Stream function
(cold color : cyclonic circulation anomaly)

① The monsoon trough stayed close to normal conditions.

② The trough begun to become enhanced.

③ The trough was more enhanced and its axis moved northward.

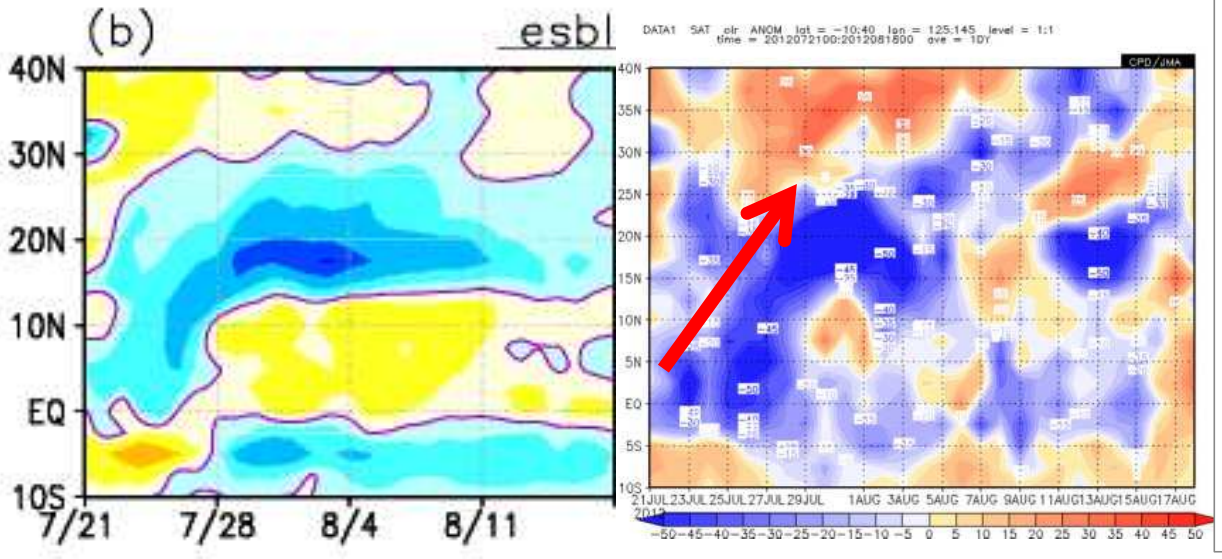
④ The trough still remained in active condition.

In this case, the model could forecast variation of the monsoon trough.

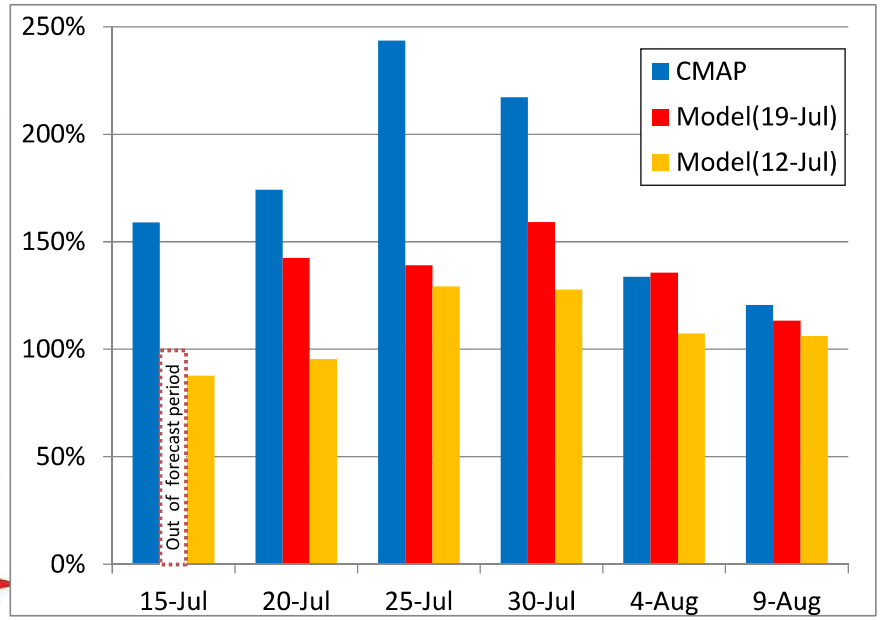
In late July, the Pacific High was enhanced by the active convection around the monsoon trough. (PJ-pattern)

2-2. Comparing analysis with model (2)

- The model could forecast the northward motion and enhancement of monsoon trough.
  - The active convection area moved from the equatorial western Pacific to around the Philippines.
- The model could forecast the changing trend of rainfall amounts.



Latitude-time cross section of zonal mean anomaly (115E – 145E)
(Left) Rainfall amounts anomaly of Jul.19 initial model
(Right) OLR anomaly of analysis (CPC/NOAA)



Time series of 5-day averaged rainfall amounts ratio(%) at CI2 area
(Blue)CMAP
(Red)Jul.19 initial, (Yellow)Jul.12 initial

2-3. Summary of the event

- From late July to early August 2012, the monsoon trough was enhanced and the axis of it moved northward.
- It caused extreme rainfall around the Philippines, and also affected Japan's climate by PJ-pattern.
- The model appropriately forecasted this extreme event.
  - It could forecast both monsoon trough variation and PJ-pattern.

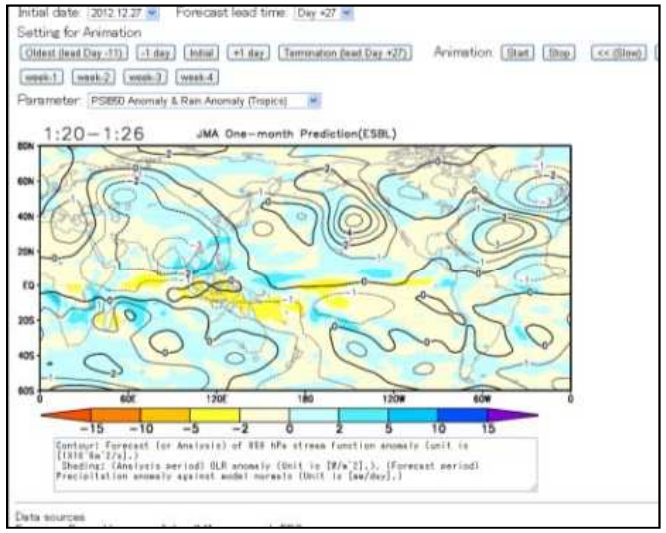
- In general, the model can forecast tropical originated intra-seasonal variation two or three weeks ahead.
- We can provide useful information to our society by using the one-month model.

3. Recent development of TCC website

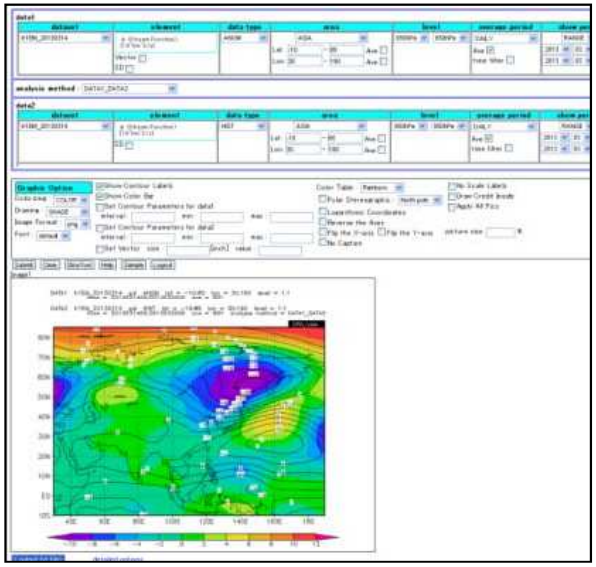
- JMA provides one-month forecast products through the TCC website for registered users.
- JMA has been improving this website by making new products available.

  < New products about one-month model >

  – Animated weather charts of one-month model.
  – The model gridded forecast data for the “Interactive Tool for Analysis of Climate System” (ITACS)



<Animation of one-month model forecast>

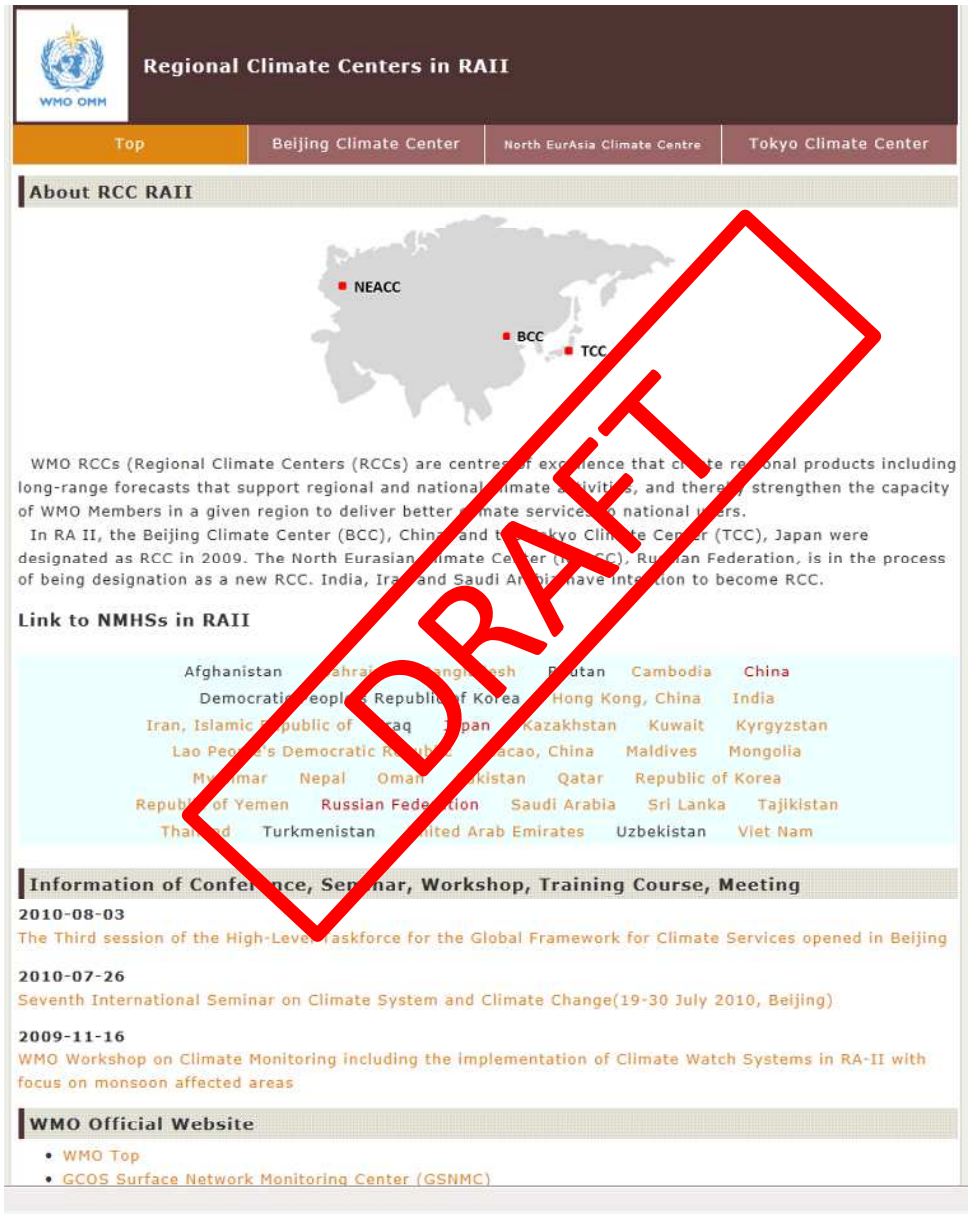


<ITACS>

For more details, please contact TCC. http://ds.data.jma.go.jp/tcc/tcc/index.html / tcc@met.kishou.go.jp

4. Renewal plan of RCC website of RAII

- The North Eurasian Climate Centre of Russia (NEACC) will be formally designated as a new WMO RCC at EC-65 to be held in May 2013.
- BCC and TCC are working together to renew the RCC website of RAII to add the NEACC.



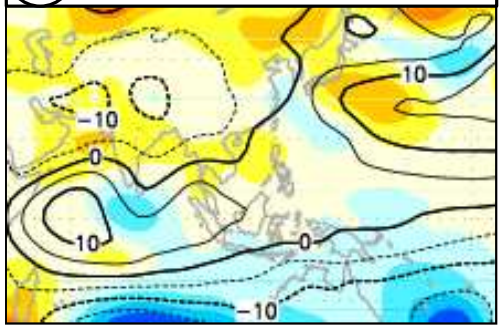
http://www.rccra2.org/detail/index.htm

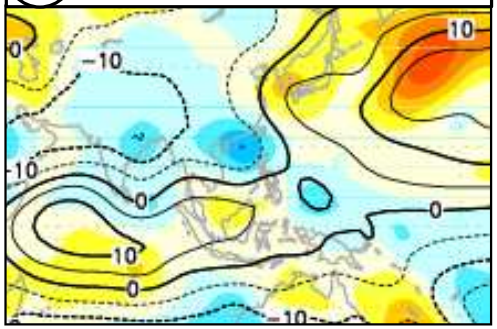
Thank you !

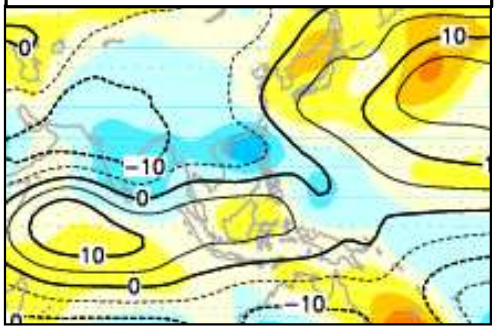
2-1. Comparing analysis with forecast (1) (appendix)

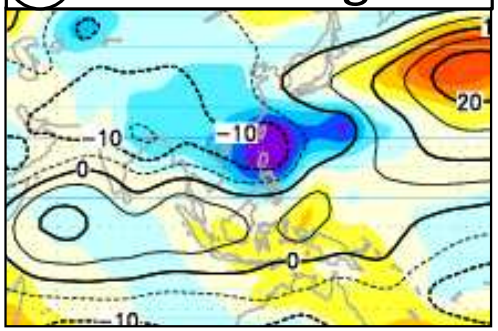
850hPa Stream function
(cold color : cyclonic circulation anomaly)

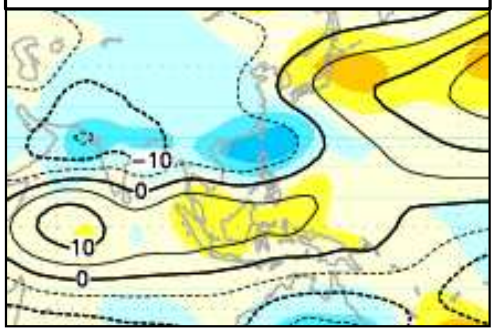
Analysis	Model (Jul.19 initial)
① Jul.13 – Jul.19	
② Jul.20 – Jul.26	1st week
③ Jul.27 – Aug.2	2nd week
④ Aug.3 – Aug.9	3rd week
⑤ Aug.10 – Aug.16	4th week

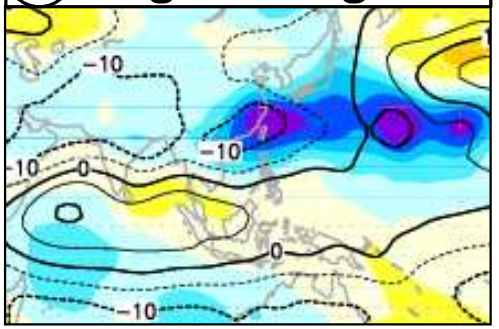


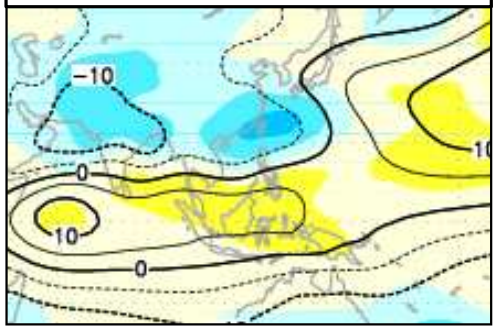


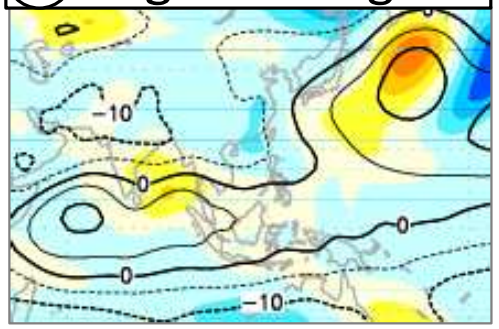


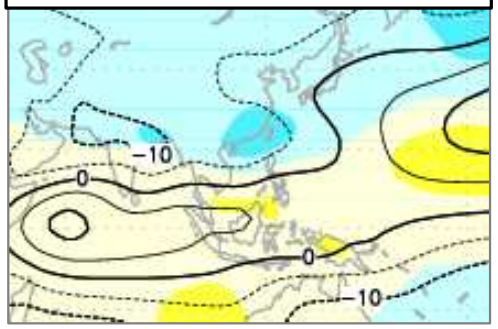






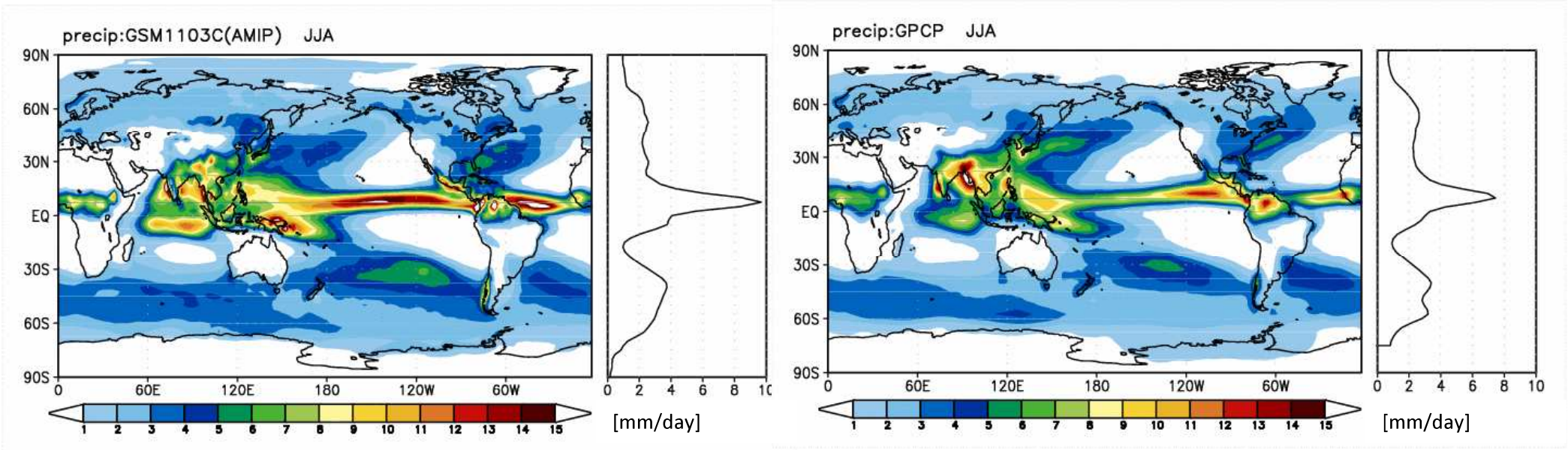






The model's characteristics of summer rainfall

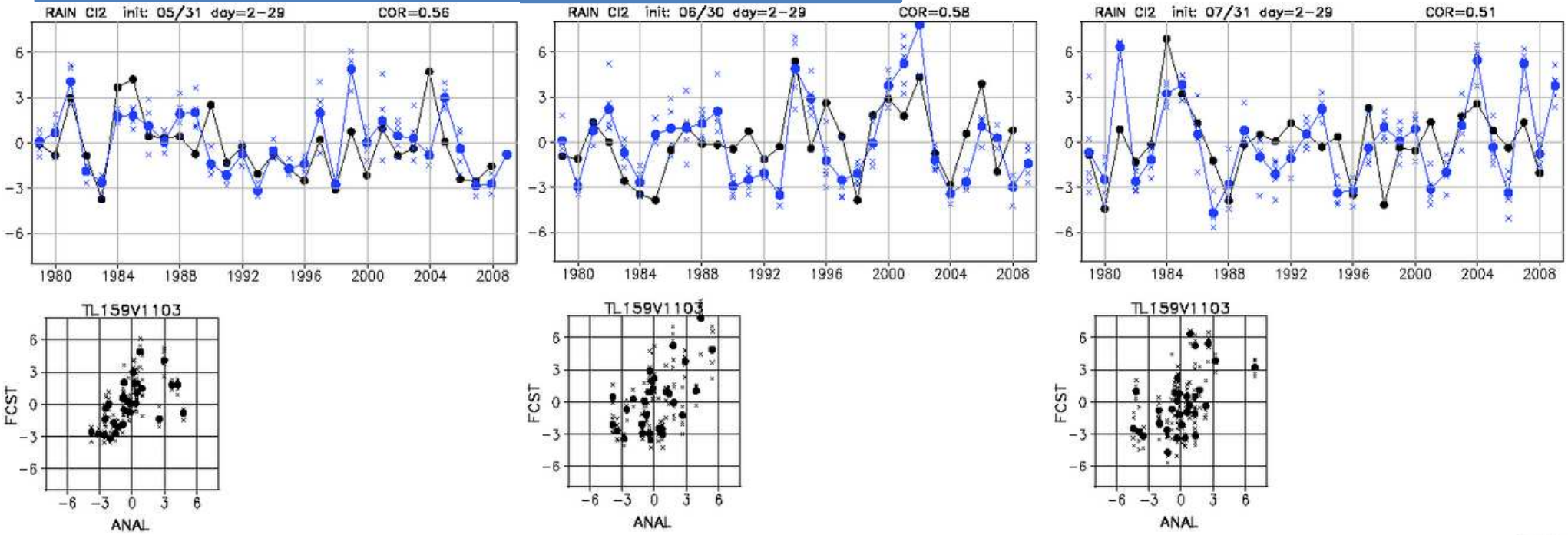
- The model's characteristics were verified by long-run experiment.
  - Long-run experiment indicates reproducibility of the model.
- The model spatial distribution of rainfall is similar to the analysis all over the world.
- Rainfall amounts are overestimated around the equator.



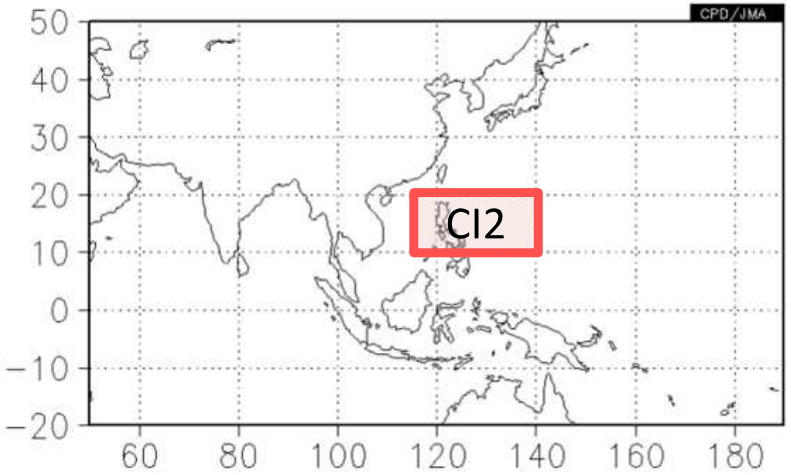
Normal rainfall amounts from June to August during 30-year
(Left) JMA's one-month model (1981-2010) (Right) Analysis (GPCP V2, 1979-2008)

Hindcast (CI2 by rainfall anomaly)

Calculated by 28-day averaged data

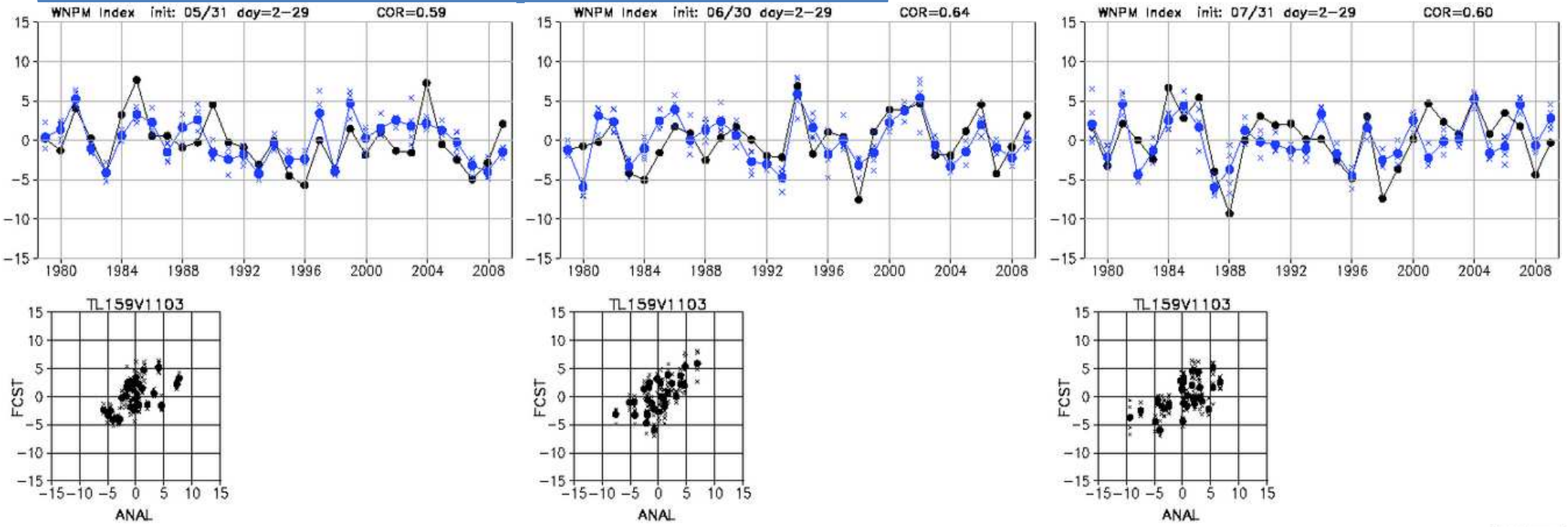


Valid time (Initial date)	Jun. (May 31)	Jul. (Jun. 30)	Aug. (Jul. 31)
Correlation coefficient	0.56	0.58	0.51

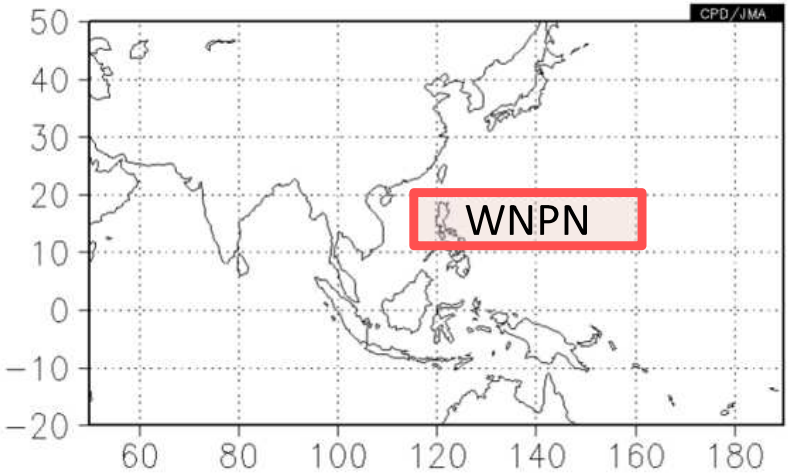


Hindcast (WNPN by zonal wind anomaly)

Calculated by 28-day averaged data

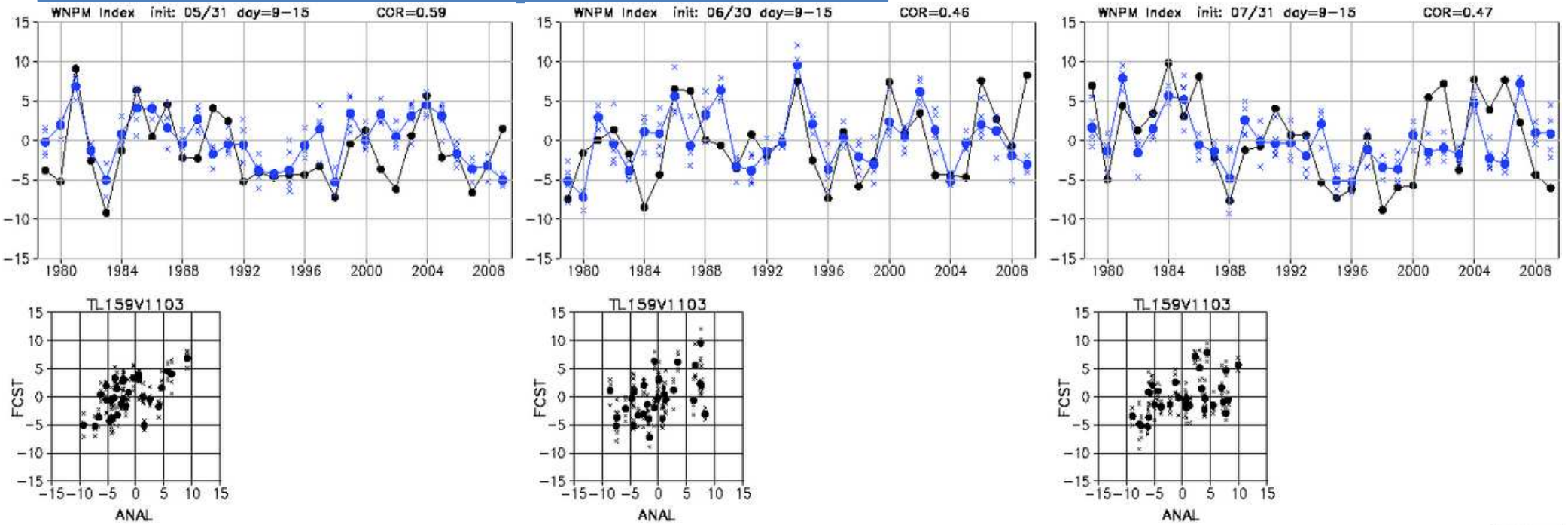


Valid time (Initial date)	Jun. (May 31)	Jul. (Jun. 30)	Aug. (Jul. 31)
Correlation coefficient	0.59	0.64	0.60

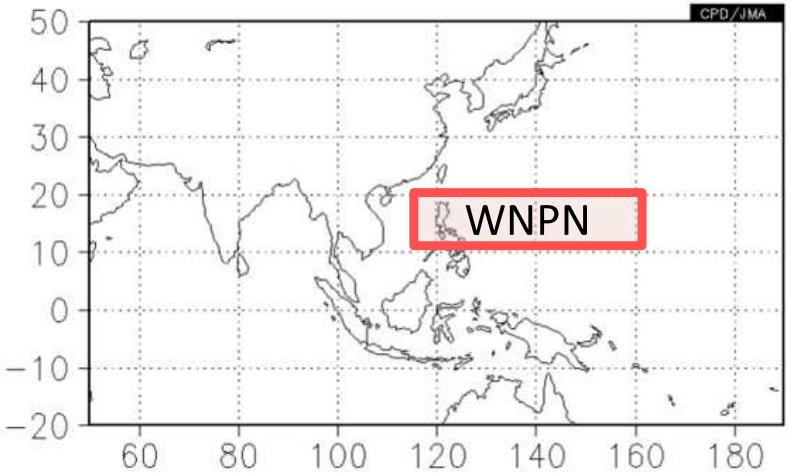


Hindcast (WNPN by zonal wind anomaly)

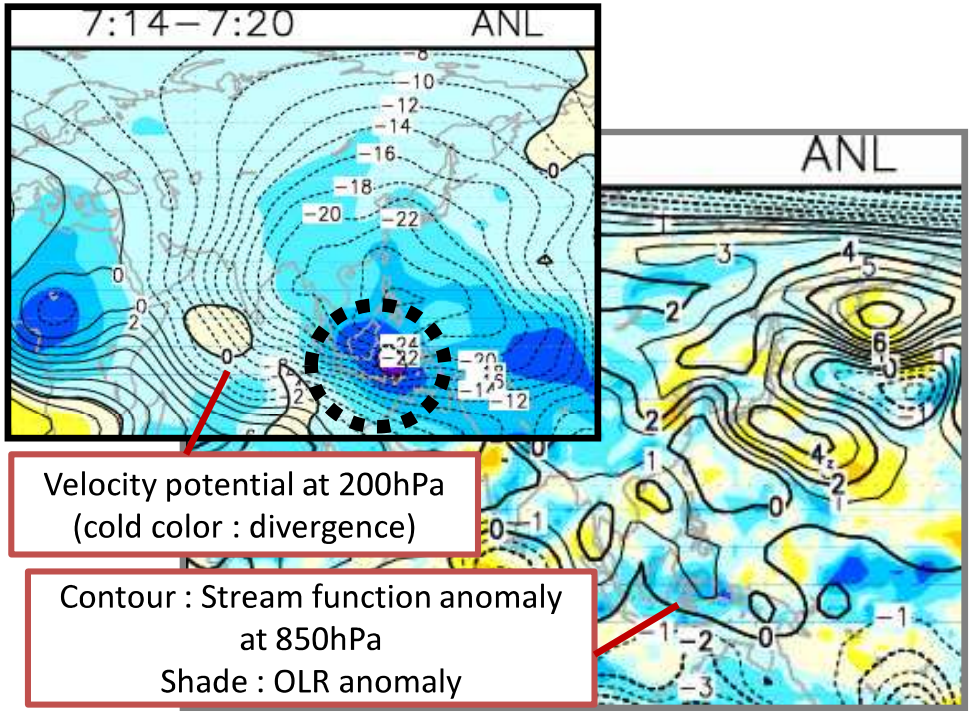
Calculated by second week averaged data



Valid time (Initial date)	Jun. (May 31)	Jul. (Jun. 30)	Aug. (Jul. 31)
Correlation coefficient	0.59	0.46	0.47

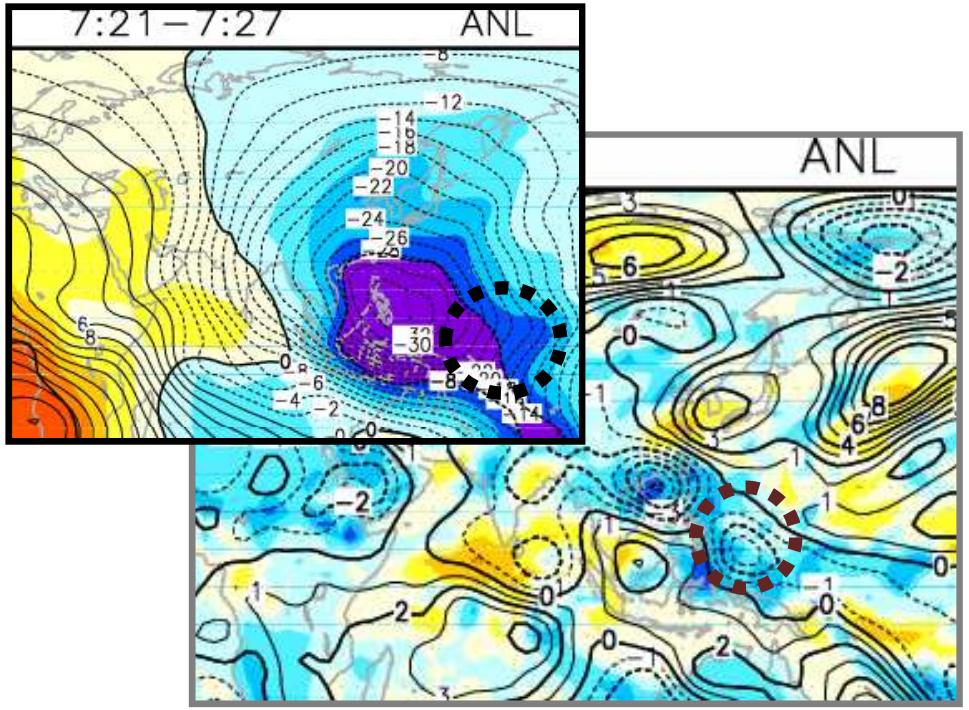


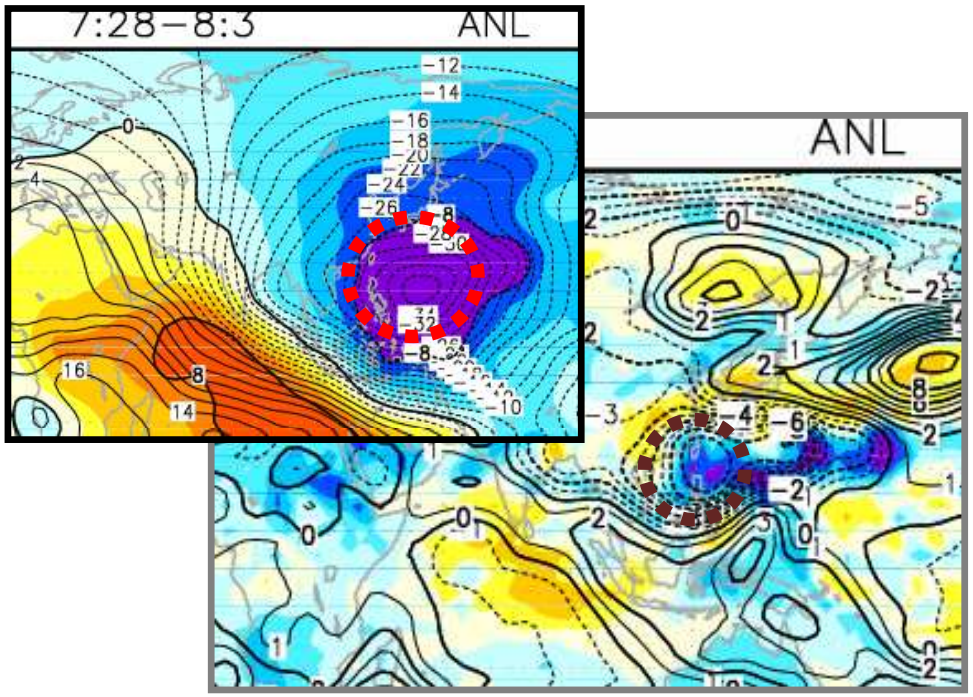
Analysis	At first, the MJO reached the maritime continent. Then, the MJO induced the westerly equatorial Rossby wave, and it caused the avtive convection (BSISO). Next, it moved northwestward and reached around the Philippines. On the other hand, the Pacific High was enhanced because of strong convection around the Philippines.

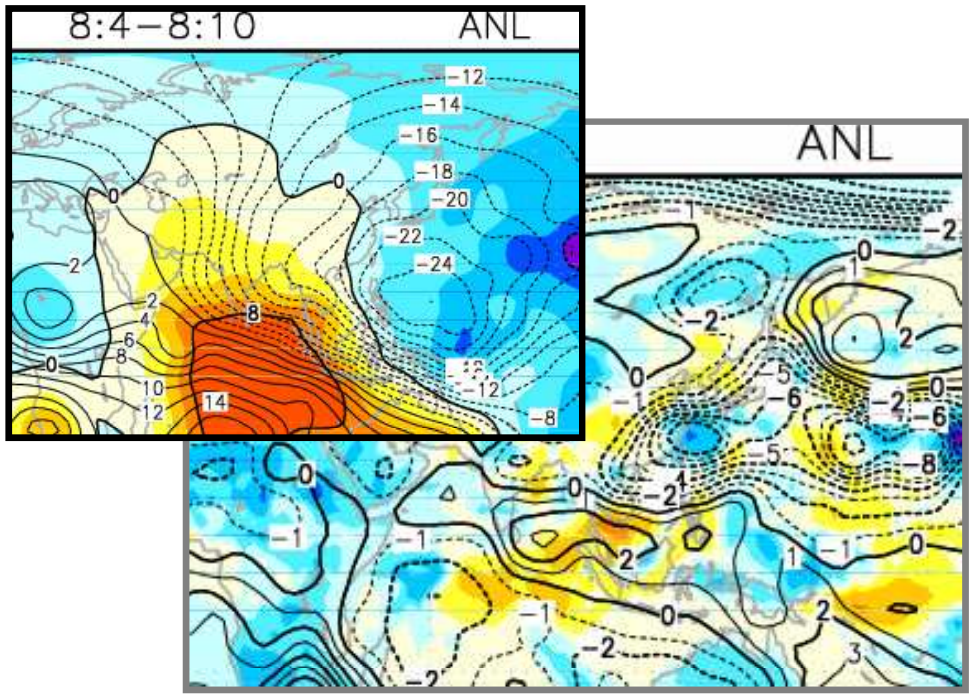


Velocity potential at 200hPa
(cold color : divergence)

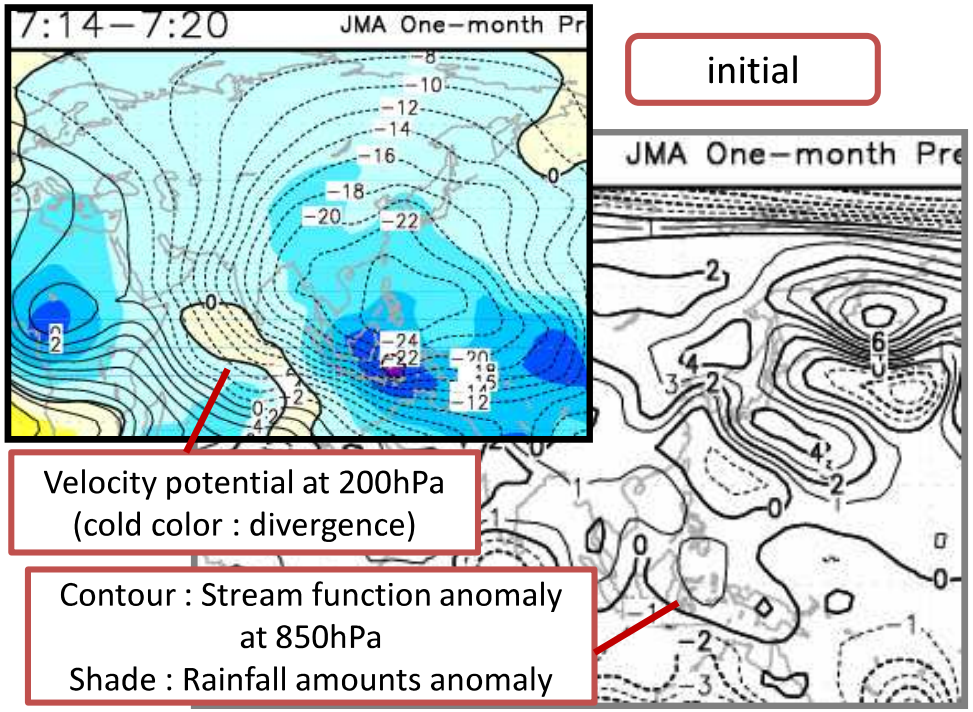
Contour : Stream function anomaly
at 850hPa
Shade : OLR anomaly







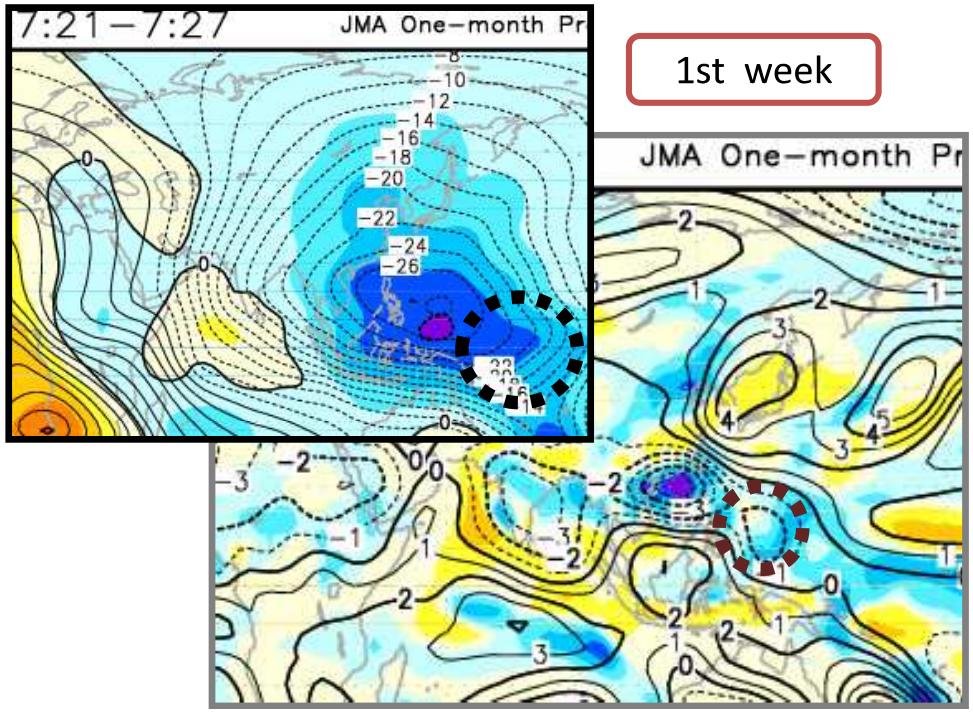
Forecast (Jul. 19)	As similar to the analysis, the MJO moves eastward from Indian Ocean to the West Pacific, and the BSISO was induced. Then the BSISO moved northwestward and reached around the Philippines. In addition, the model could forecast the enhancement of the Pacific High around Japan.



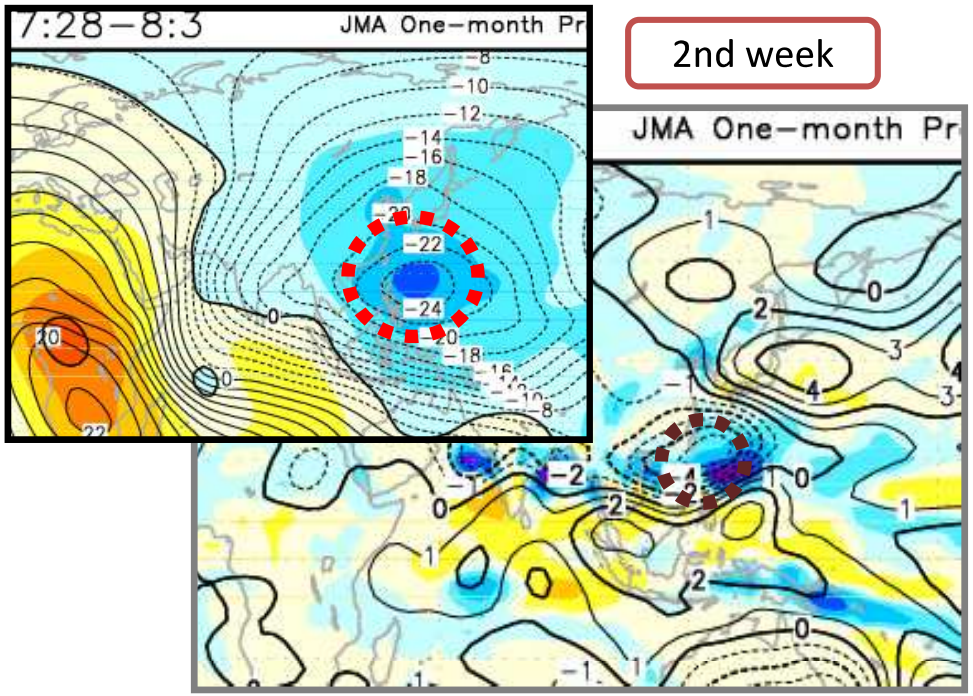
initial

Velocity potential at 200hPa
(cold color : divergence)

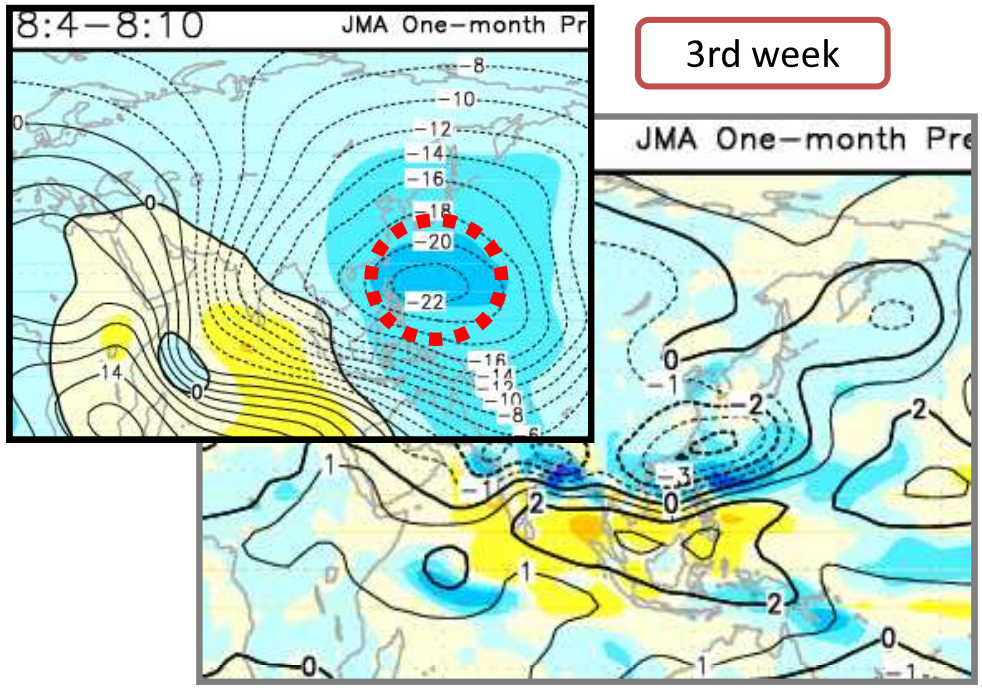
Contour : Stream function anomaly at 850hPa
Shade : Rainfall amounts anomaly



1st week

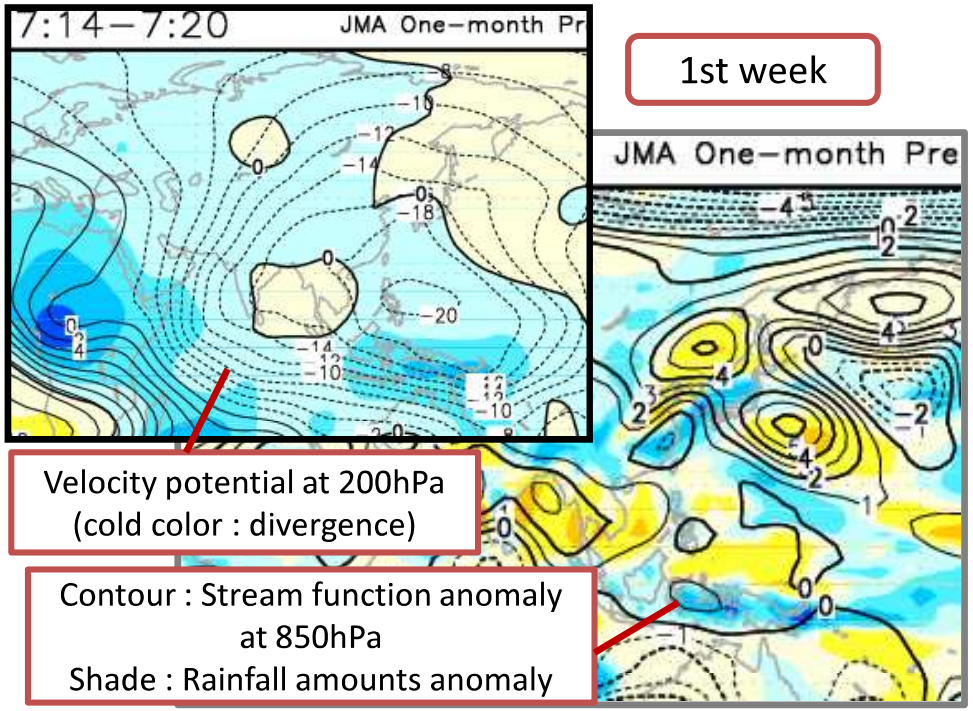


2nd week



3rd week

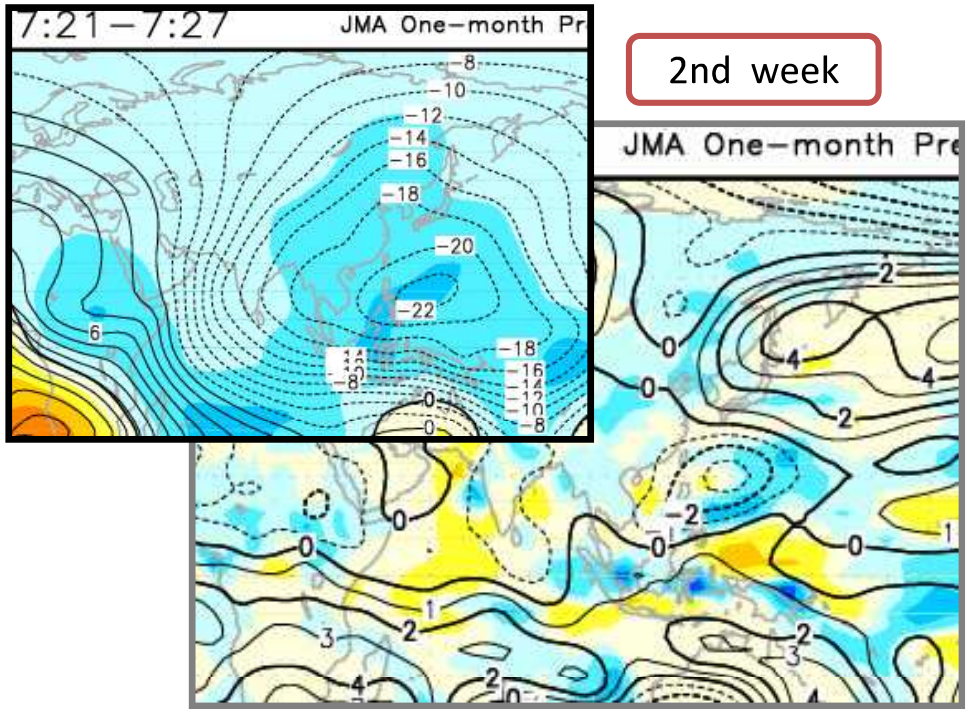
Forecast (Jul. 12)	From the second week, the model forecasted the enhanced monsoon trough, and it also forecasted that the active convection area moved northward. But the motion of this convection area was too slow.



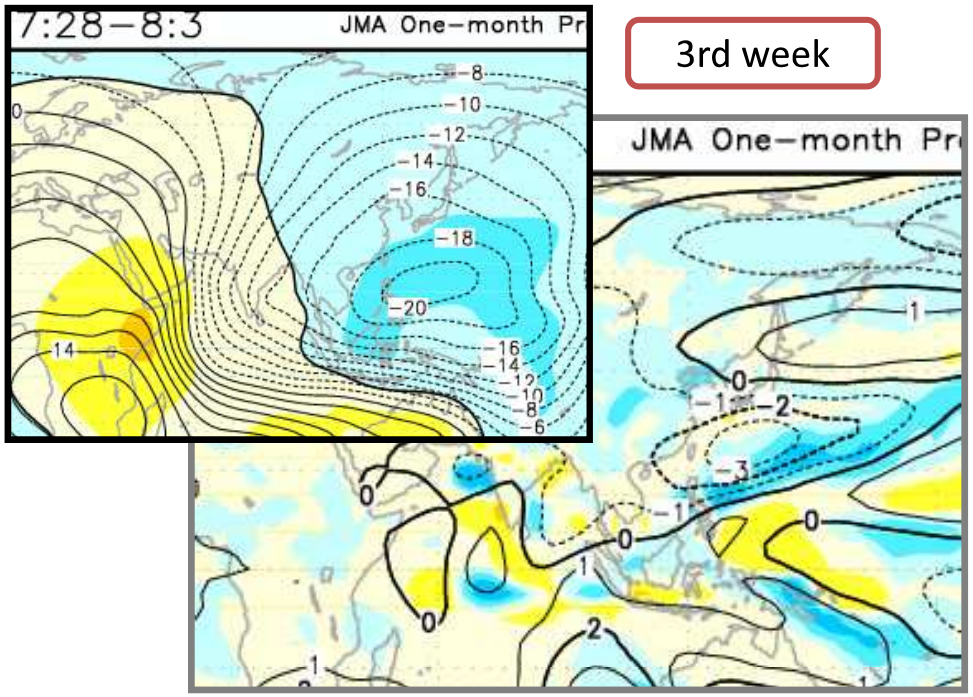
1st week

Velocity potential at 200hPa
(cold color : divergence)

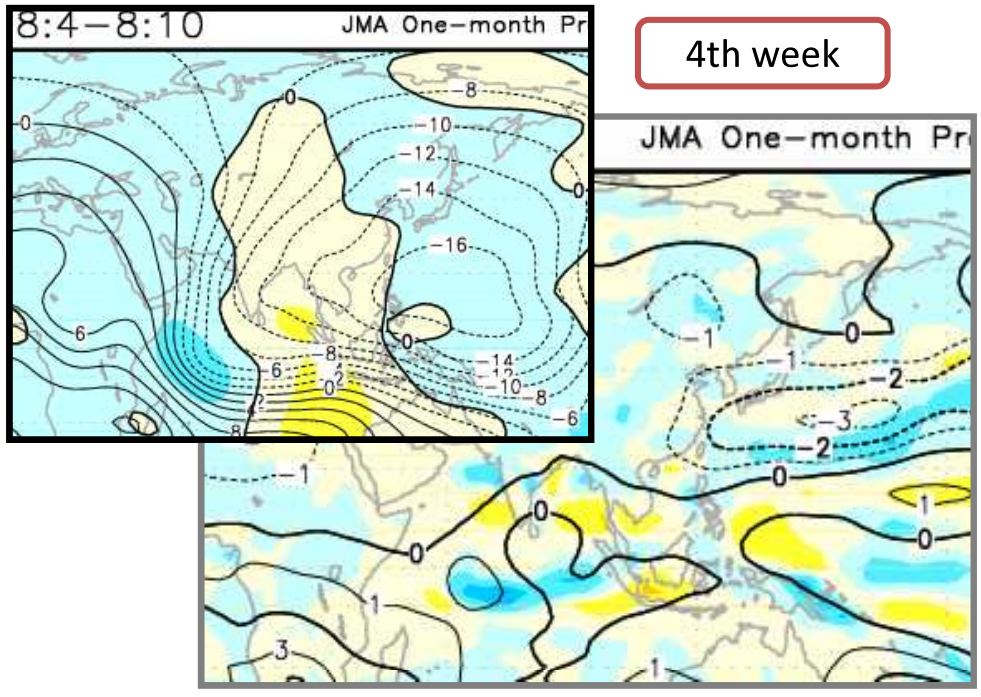
Contour : Stream function anomaly at 850hPa
Shade : Rainfall amounts anomaly



2nd week



3rd week



4th week

MJO phase monitor

Jul. 2012

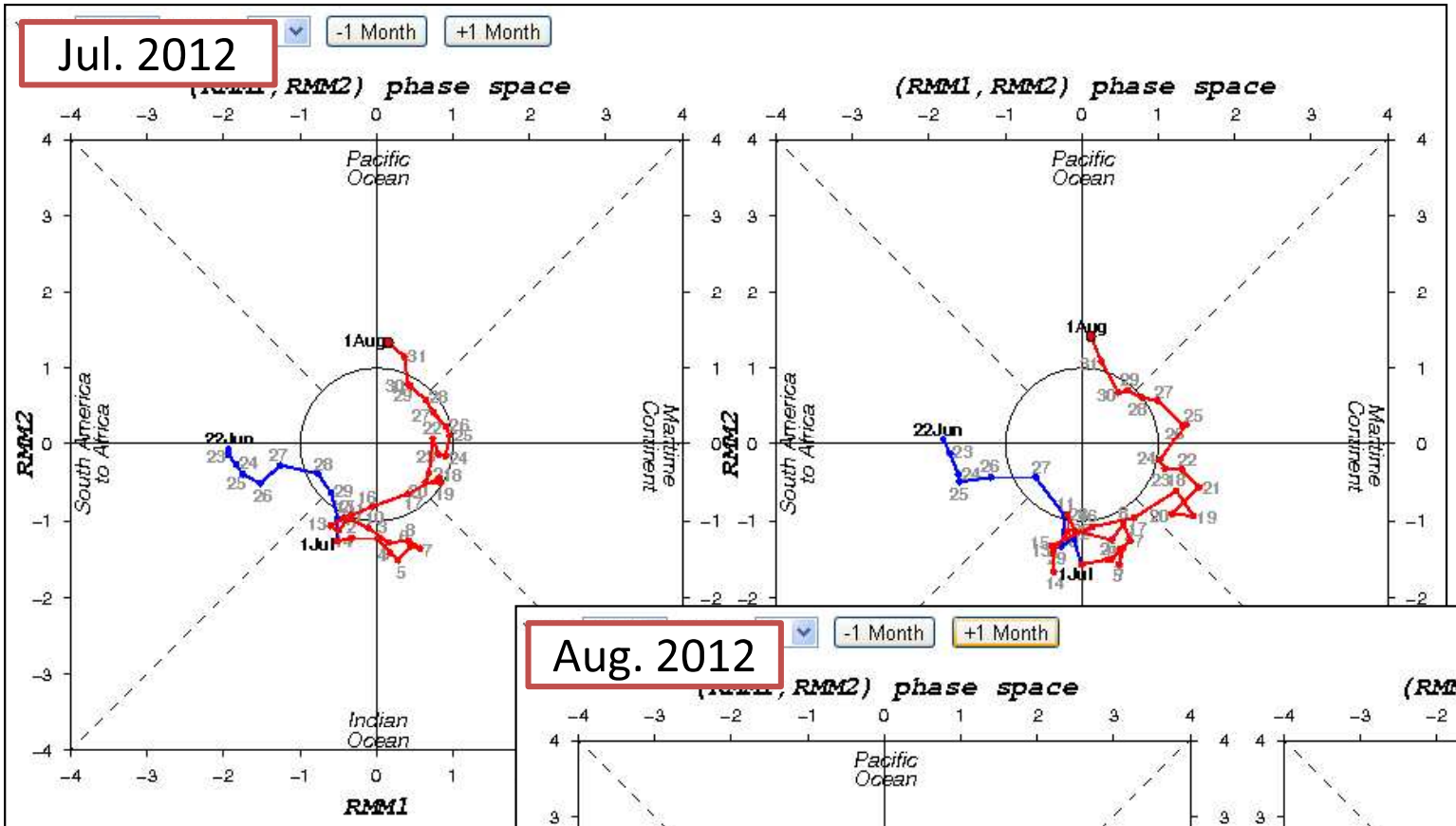


Fig. MJO phase monitor based on multivar

Aug. 2012

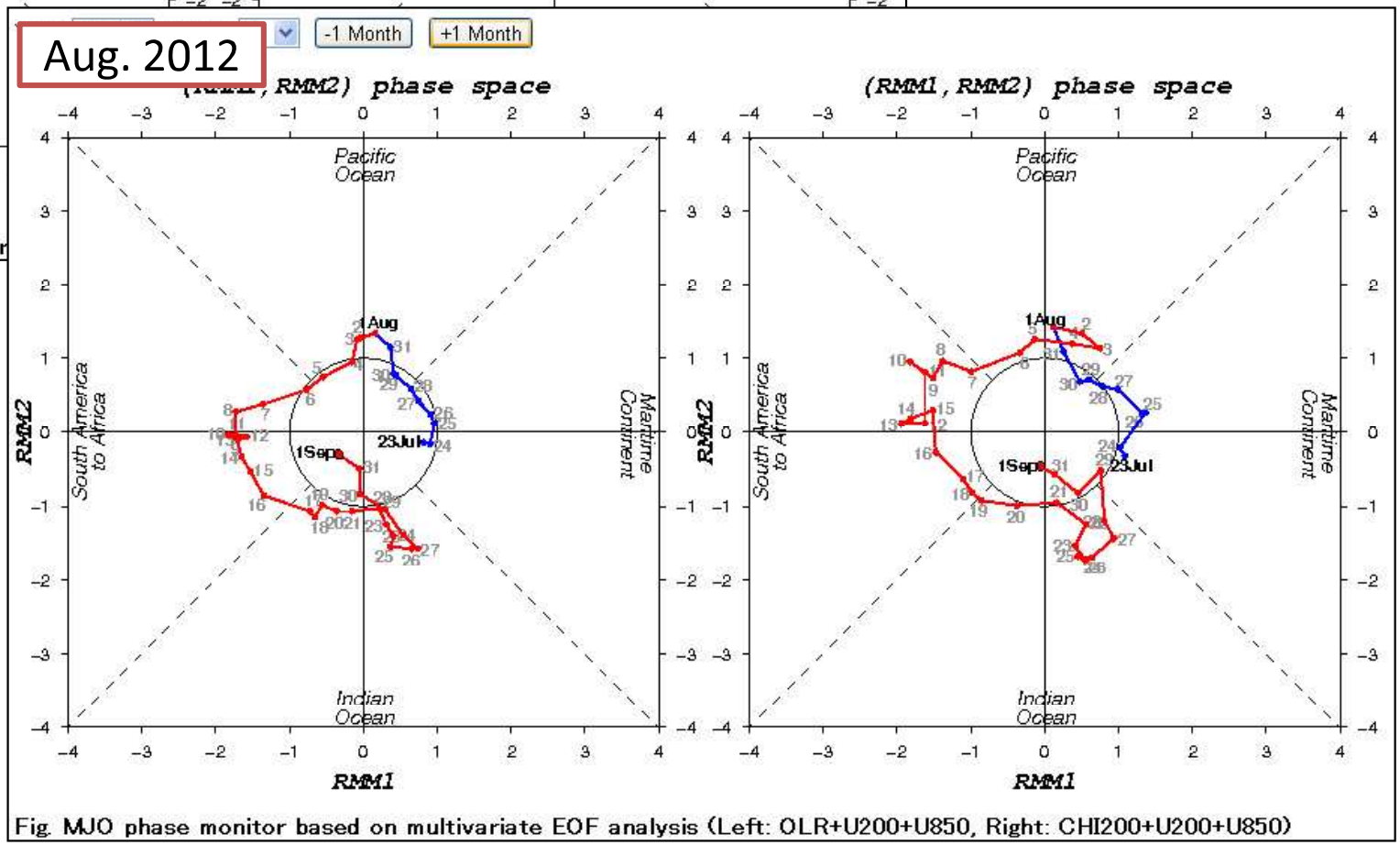
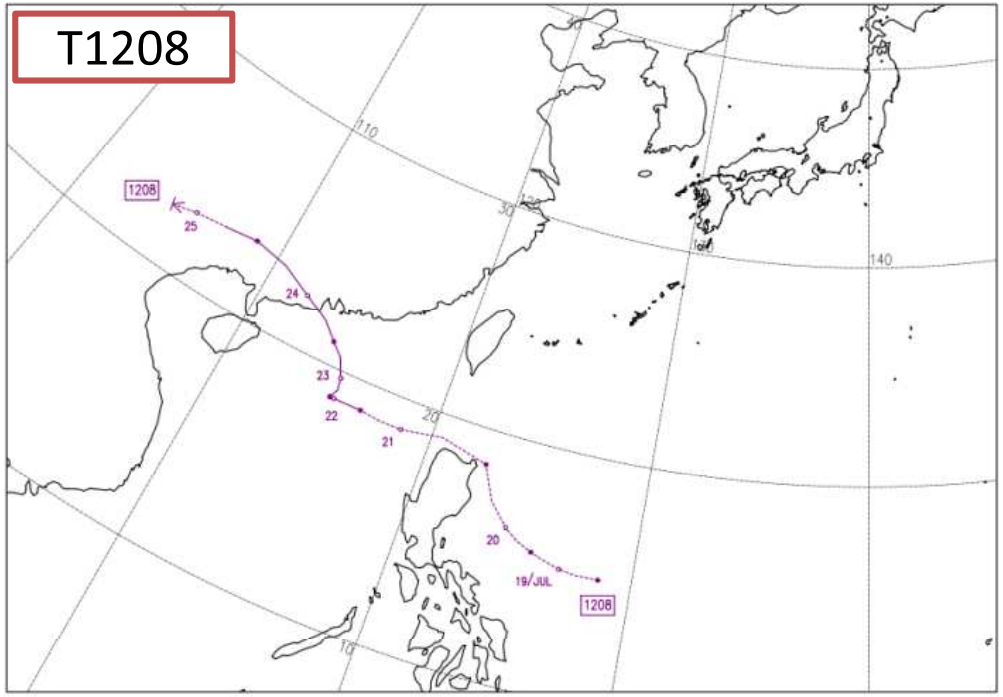
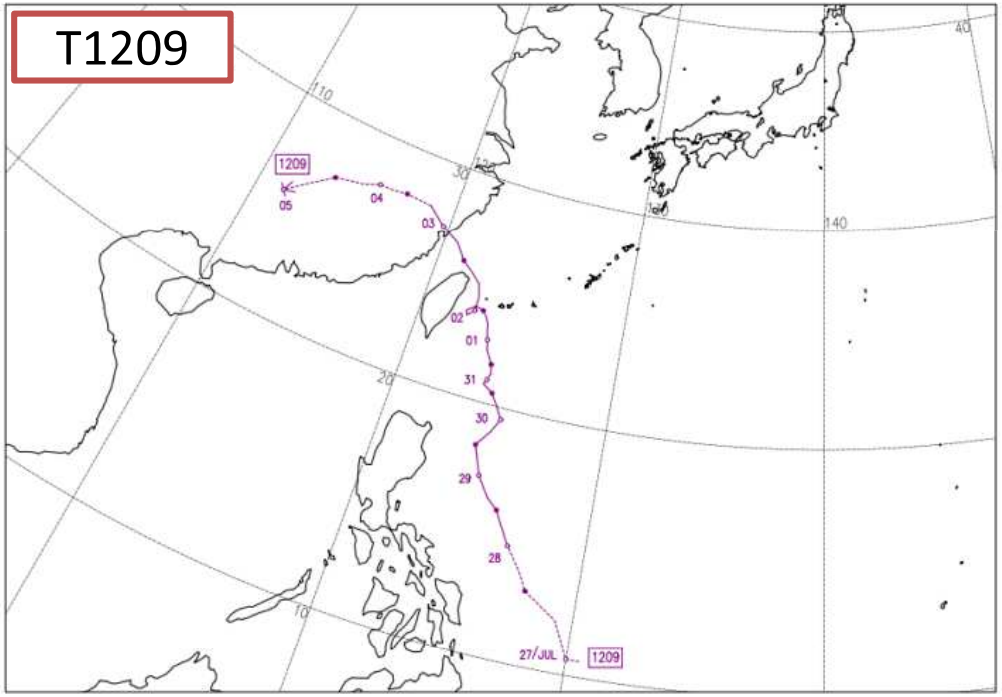
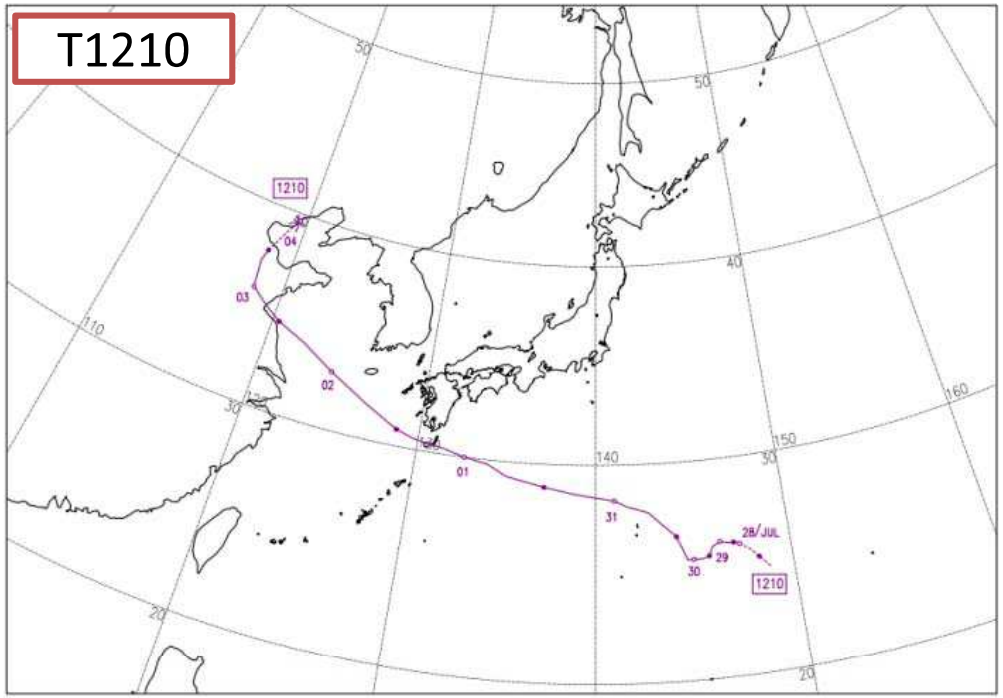


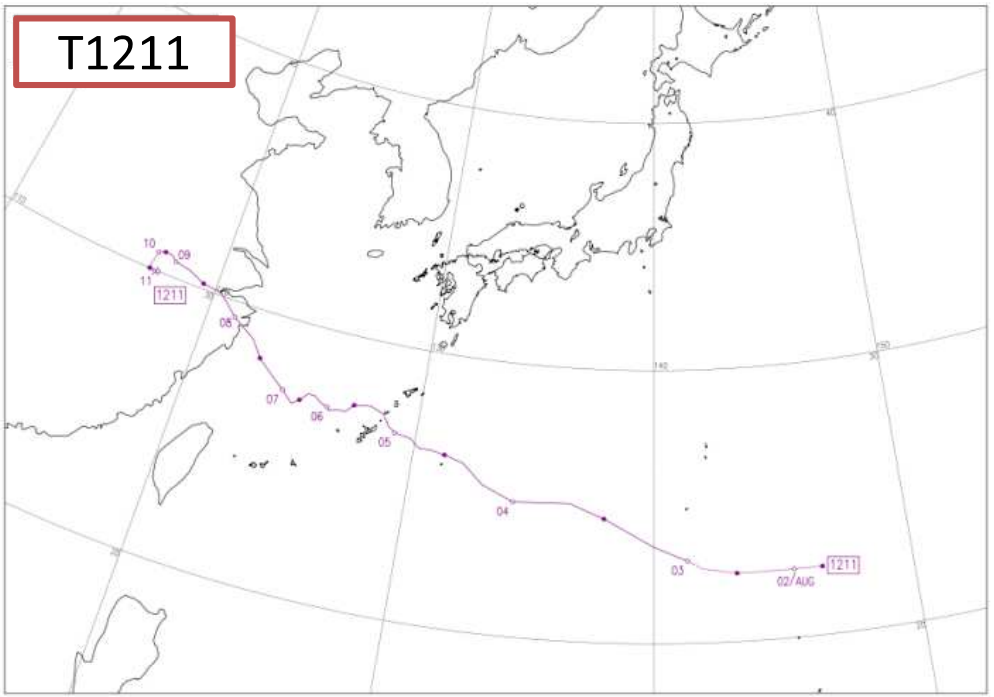
Fig. MJO phase monitor based on multivariate EOF analysis (Left: OLR+U200+U850, Right: CHI200+U200+U850)

Typhoon tracks









Time series of 5-day running mean temperature anomaly during summer in 2012