

Unseasonable weather conditions in East Asia in summer 2014

Yasushi MOCHIZUKI

Tokyo Climate Center

Japan Meteorological Agency

Outline of this presentation...

Overview of East Asian summer monsoon in 2014

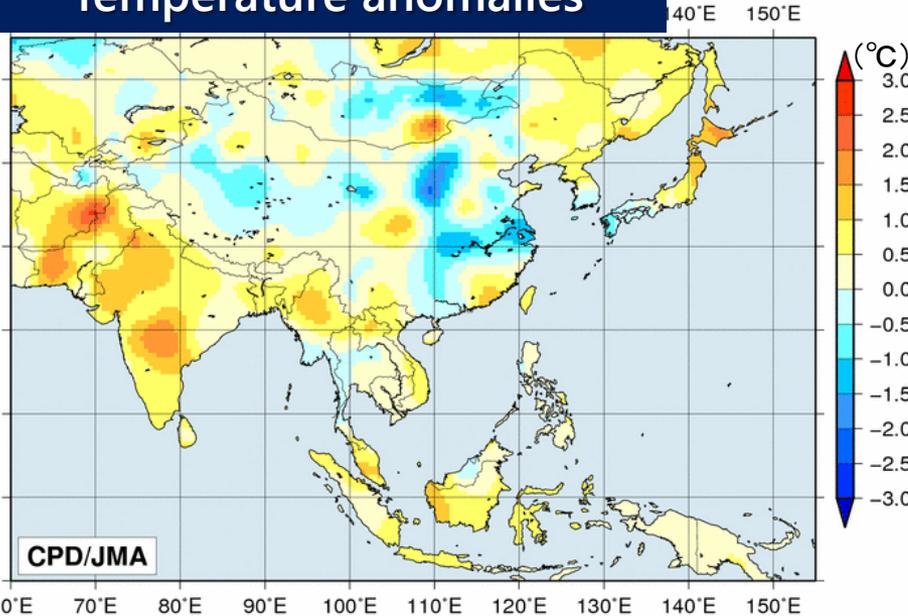
- Brief introduction about climatic conditions and atmospheric characteristics

Unseasonable weather conditions in East Asia in summer 2014

- East Asia, especially western Japan, experienced record-high precipitation and record-low sunshine durations.
 - Two typhoons moved northward at low speed.
 - Synoptic-scale fronts were situated around the mainland of Japan.
 - The pronounced southward meandering of the subtropical jet stream to the west of Japan.
 - Persistent moist air flow into western Japan to southeastern China.
- Suppressed cumulus convection over the Asian monsoon region in association with the tropical intra-seasonal oscillation is considered to have contributed to the southward shift and meandering of the jet stream.

Overview of East Asian summer monsoon in 2014

Temperature anomalies



Precipitation ratio against normal

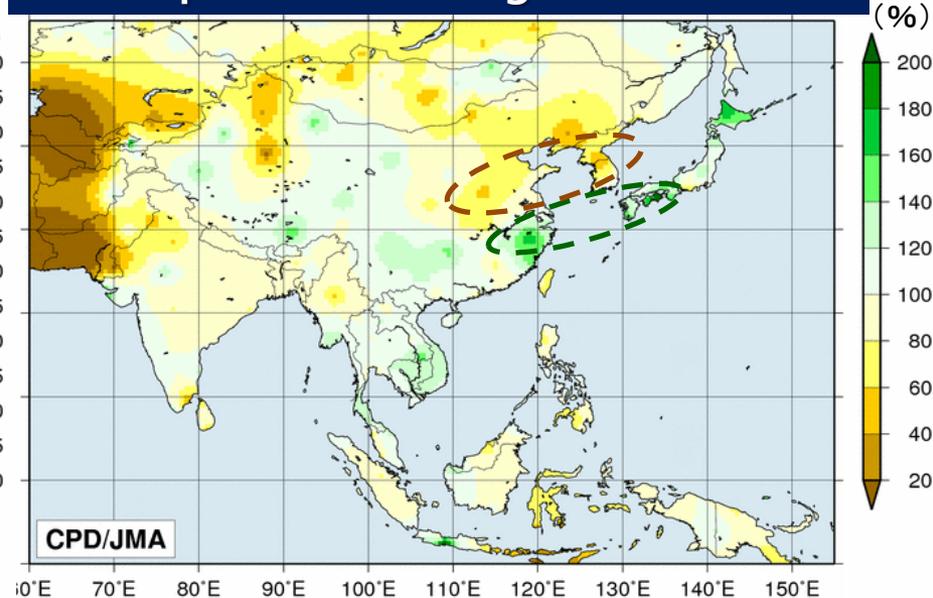


Fig.1 3-month mean temperature anomalies and precipitation ratios against normal for summer (JJA) 2014

Warmer than normal

northern Japan, northeastern China,
southeastern China and southeastern Mongolia

Wetter than normal

northern Japan, western Japan,
and eastern China

Colder than normal

western Japan, eastern China and
northern Mongolia

Drier than normal

northeastern China, western and
central parts of Mongolia

Characteristic Atmospheric Circulation for summer 2014

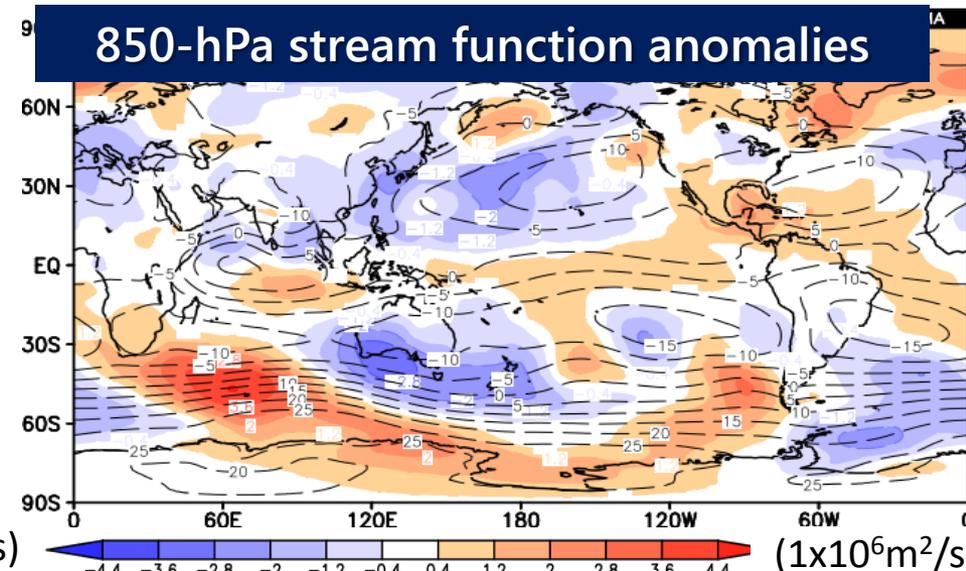
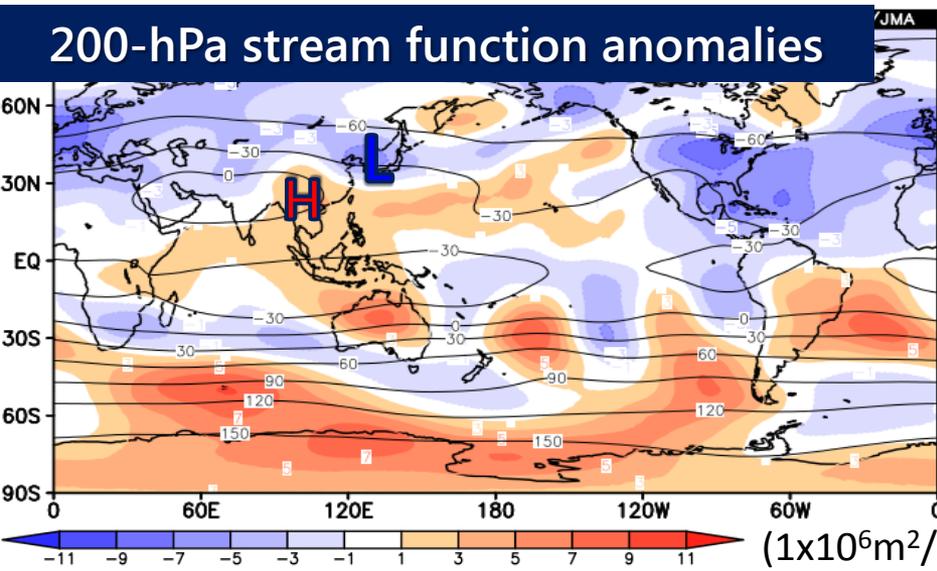
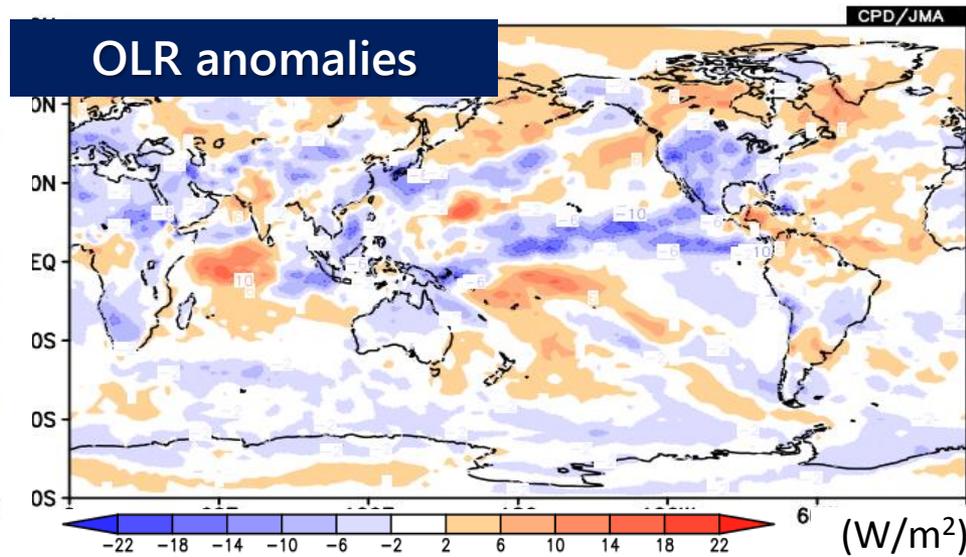
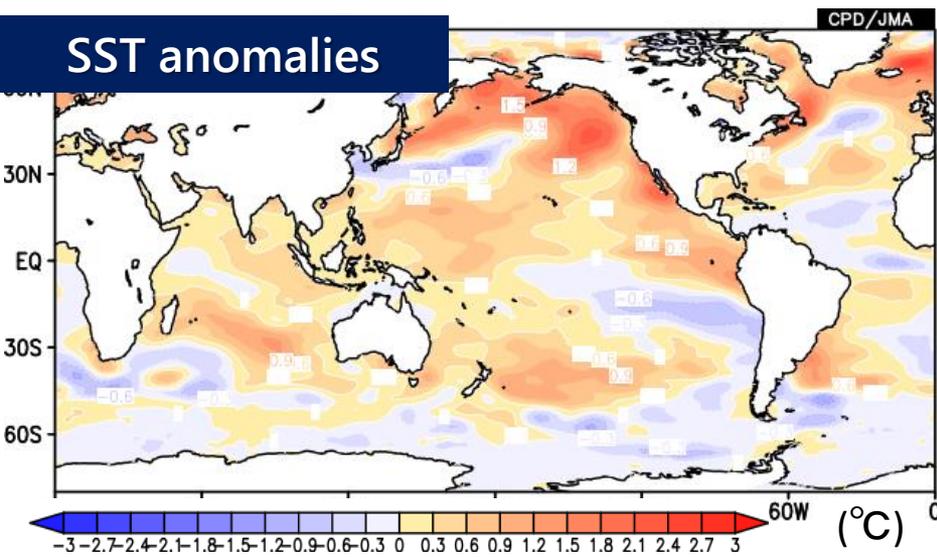
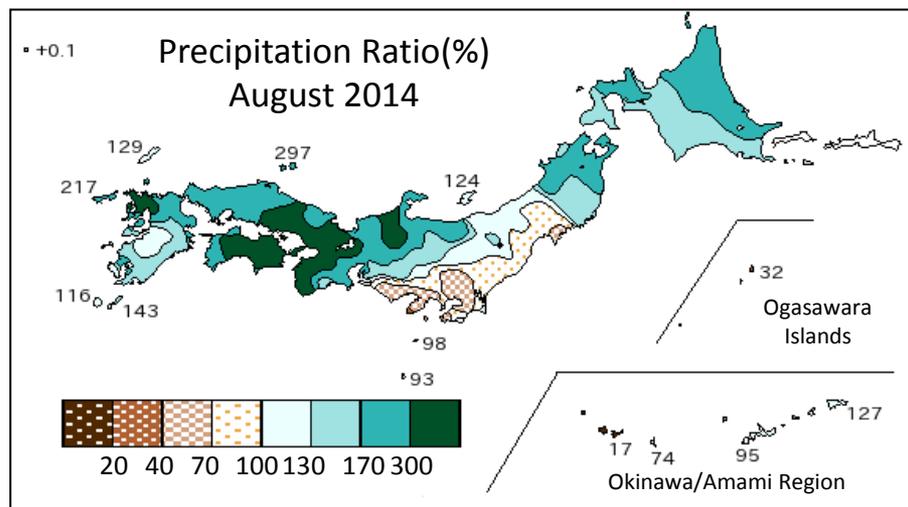


Fig.2 Oceanic conditions, convective activities and atmospheric circulations for summer (JJA) 2014

† Data used for this investigation is JRA-55, OLR(provided by NOAA) and COBE-SST.

Unseasonable weather conditions in Japan in August 2014

In August 2014, western Japan experienced record-high precipitation and record-low sunshine durations. From 30 July to 26 August, heavy rainfall events were observed throughout the country.



The TCC Advisory Panel on Extreme Climatic Events issued a statement on primary factors causing the cloudy and rainy conditions observed in Japan in August 2014



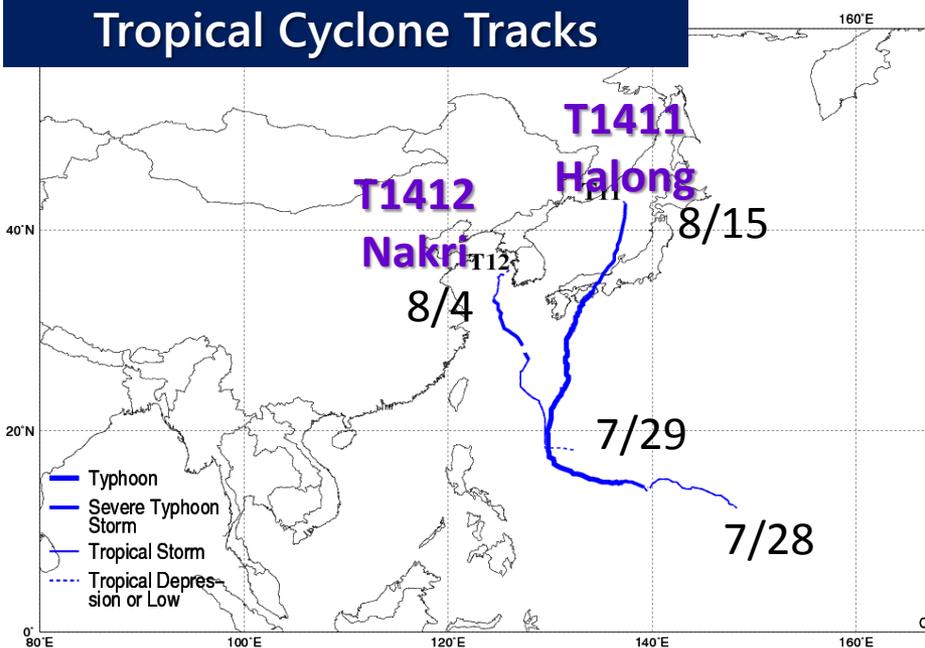
An extraordinary session held at the JMA on 3 Sep. 2014



Two typhoons in late July to early August

In this period, the subtropical jet stream was shifted northward of its normal position around East Asia. As a result, Typhoon Nakri didn't turn eastward after approaching Japan and Typhoon Halong moved slowly northward in the area to the south of western Japan, that made landfall over the western Japan.

Tropical Cyclone Tracks



200-hPa zonal wind speed

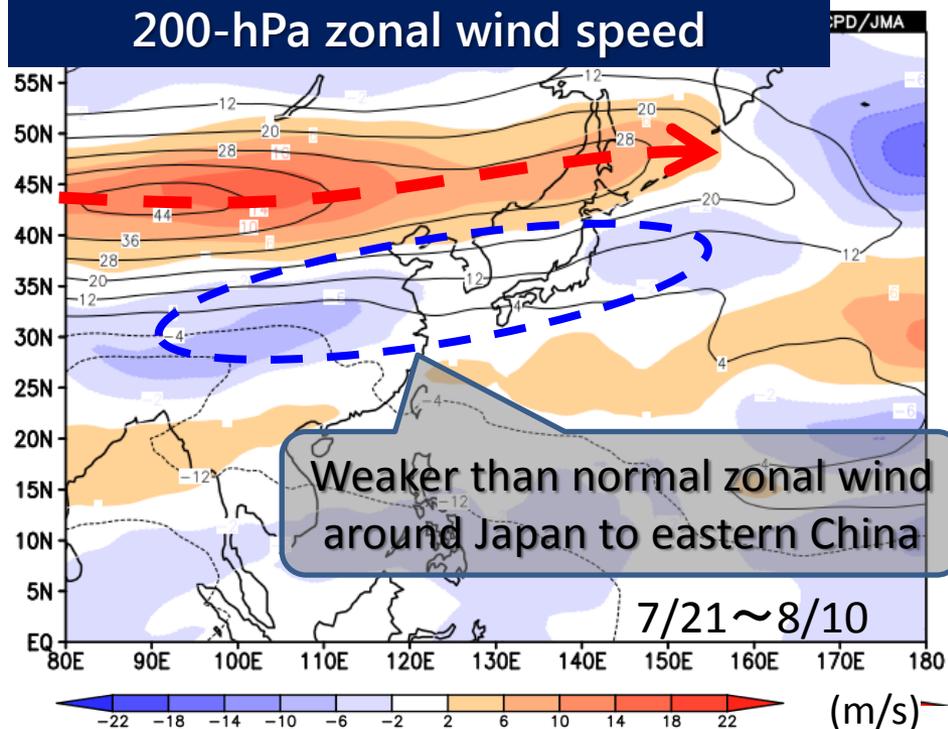


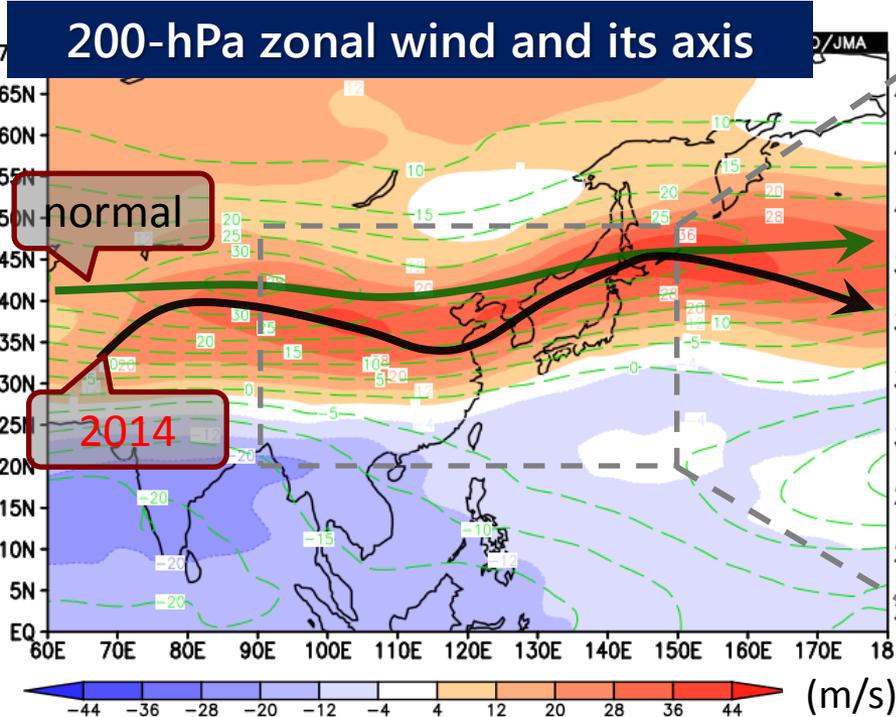
Fig.3 Tropical cyclone tracks on T1411(Halong) and T1412(Nakri), data from RSMC-Tokyo

Fig.4 21-days mean zonal wind speed anomalies at 200-hPa (shade) and observed (contour) for 21 July – 10 August 2014

Persistent fronts around Japan

After two typhoon passing over western Japan, around mid- to late August, synoptic-scale fronts were persistently situated around the mainland of Japan, likely in relation to the pronounced southward meandering of the subtropical jet stream to the west of Japan.

200-hPa zonal wind and its axis



850-hPa equivalent potential temperature

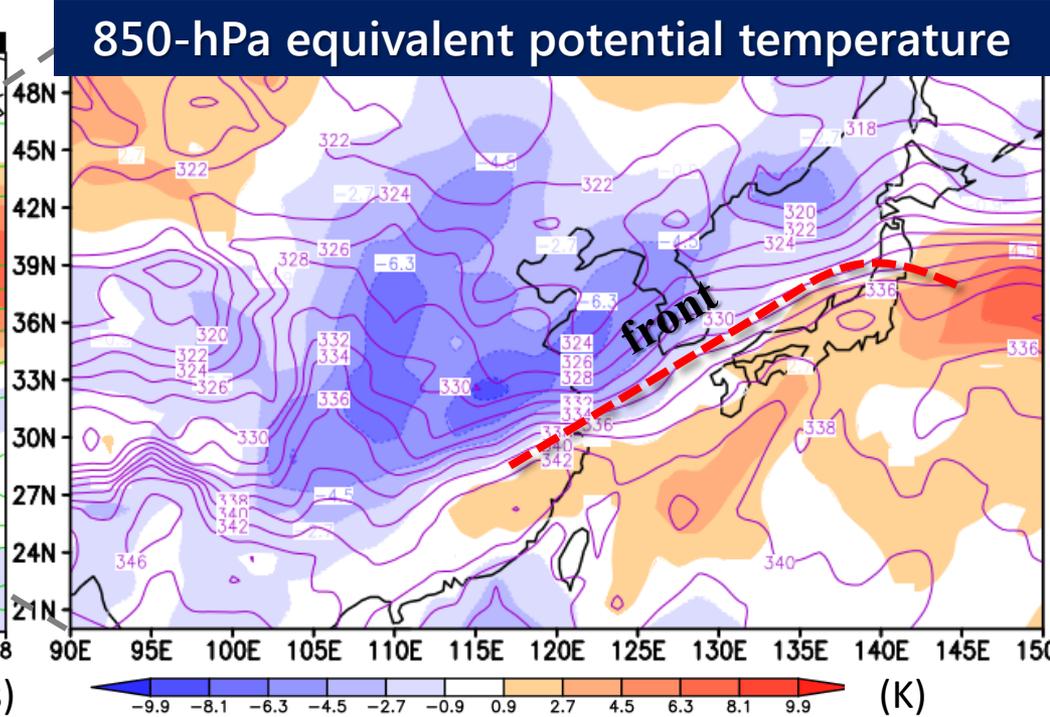


Fig.5 15-days mean zonal wind speed at 200-hPa (shade) and its normal (contour) for 11-25 August 2014

Fig.6 15-days mean equivalent potential temperature at 850hPa (contour) and its anomaly (shade) for 11-25 August 2014

Anti-cyclonic circulation anomalies in the lower troposphere

In mid- to late August, the Pacific High was enhanced to the southeast of Japan. At the same time, anti-cyclonic circulation anomalies in the lower-troposphere are seen over the South China Sea. These two factors contributed to the persistent moist air flow into western Japan to southeastern China.

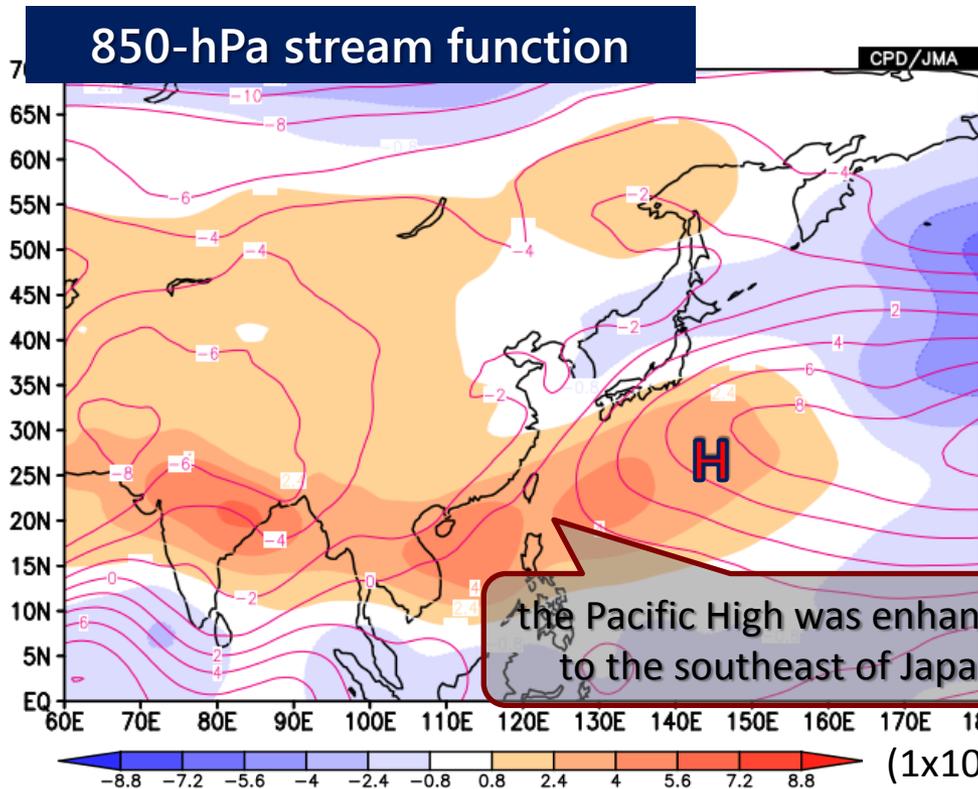


Fig.7 15-days mean stream function at 850-hPa (contour) and its anomalies (shade) for 11-25 August 2014

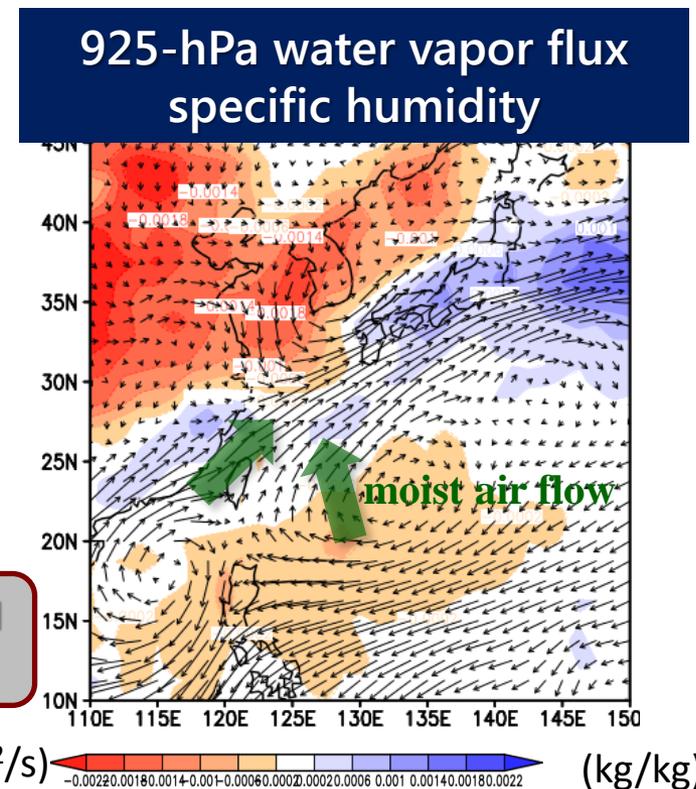


Fig.8 15-days mean water vapor flux anomalies at 925hPa (vector) and specific humidity anomalies (shade) for 11-25 August 2014

Phase propagation associated with intra-seasonal oscillation

In mid- to late August, the convective activities around the Philippines are suppressed, it is likely corresponding to the BSISO phase 2-3.

OLR anomalies

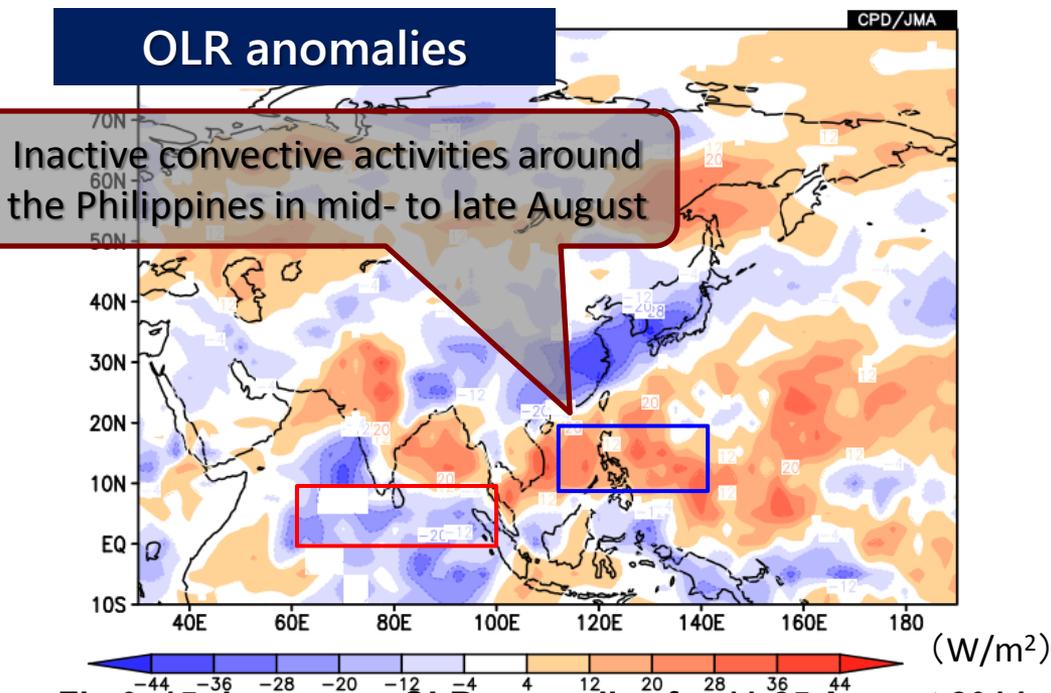


Fig.9 15-days mean OLR anomalies for 11-25 August 2014

BSISO regressed OLR and 850-hPa wind

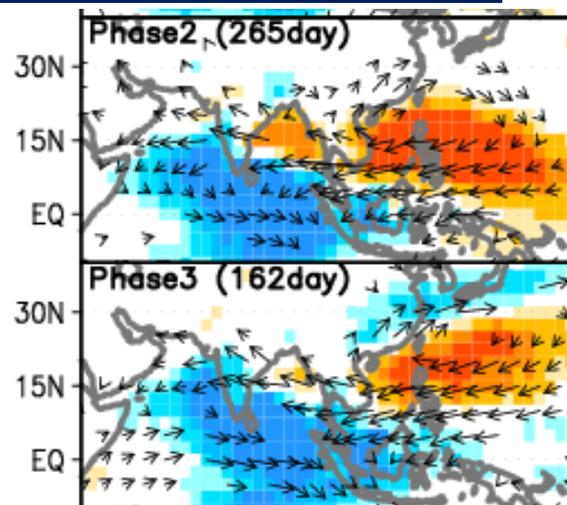


Fig.10 BSISO regressed OLR and 850-hPa wind

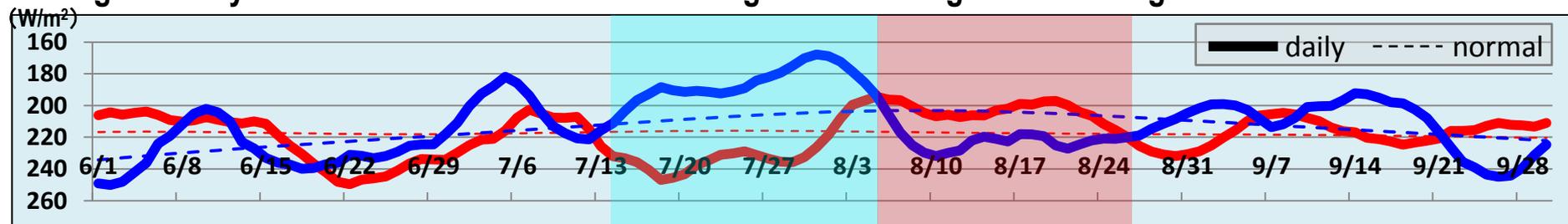
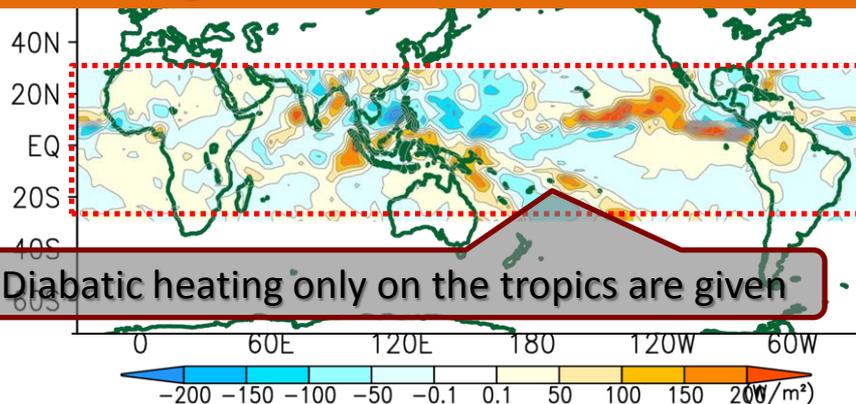


Fig.11 Area averaged OLR anomalies. The line color is corresponding to the rectangles shown in Fig.9

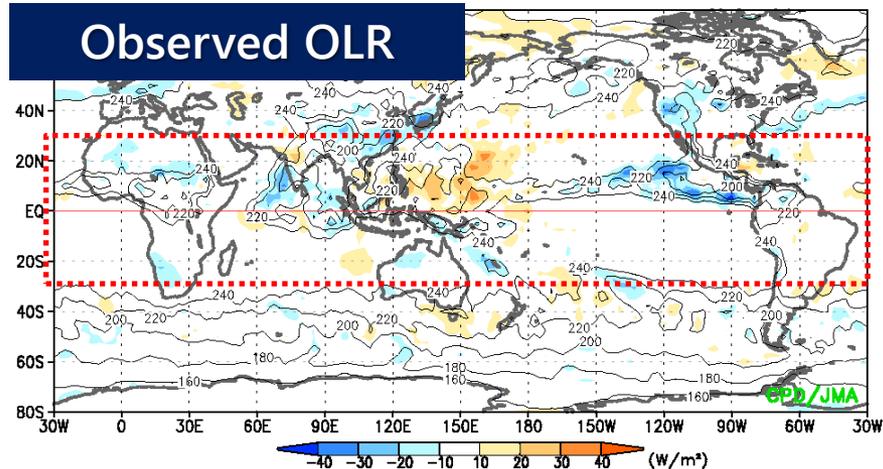
Attribution experiment by Linear Baroclinic Model (LBM)

In the LBM analysis, the convergence/divergence pattern emerged by the given heat anomalies only in the tropics are similar to that of observation.

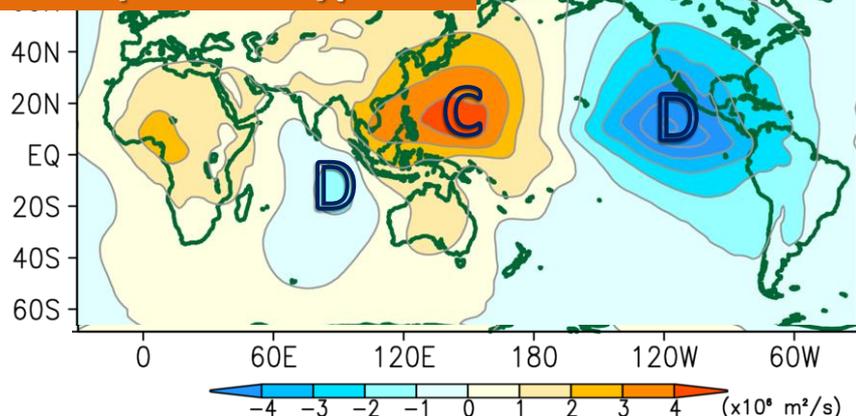
Forcing (observed heat anomalies)



Observed OLR



Response in χ_{200}



Observed χ_{200}

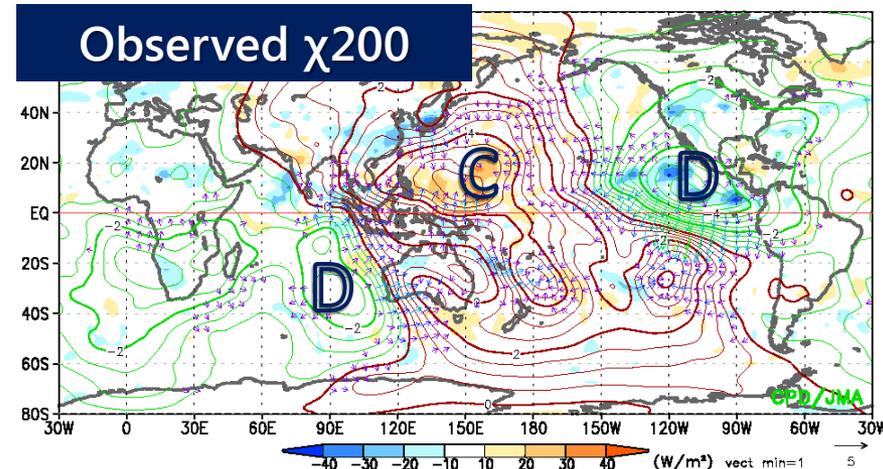
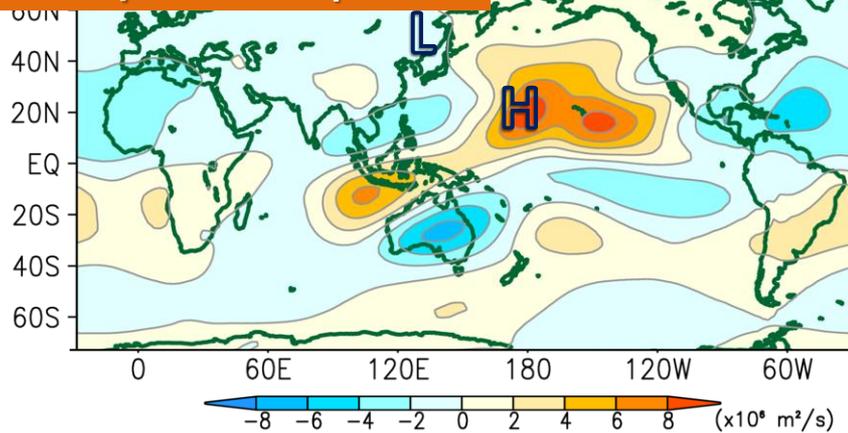


Fig.12 the given heat anomalies (upper left), the observed OLR (upper right), response in χ_{200} (bottom left) and observed χ_{200} (bottom right), the experiments are conducted for period 1-29 August.

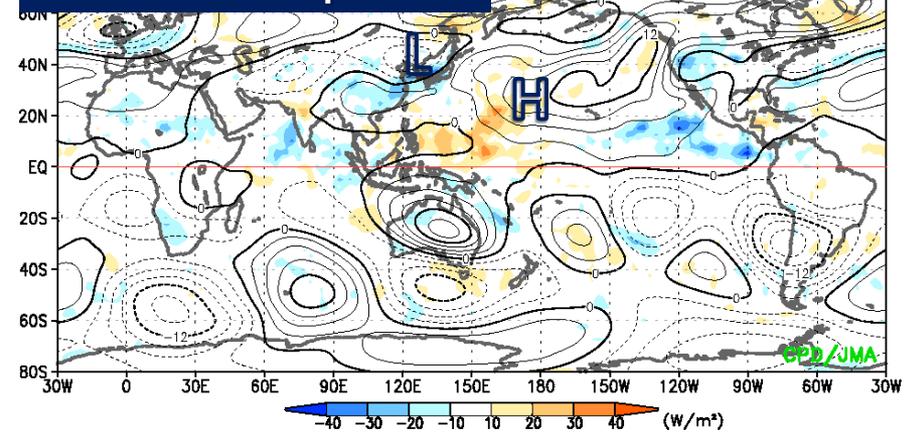
Attribution experiment by Linear Baroclinic Model (LBM)

In the LBM analysis, the circulation pattern driven by the given heat anomalies only in the tropics are similar to that of observation.

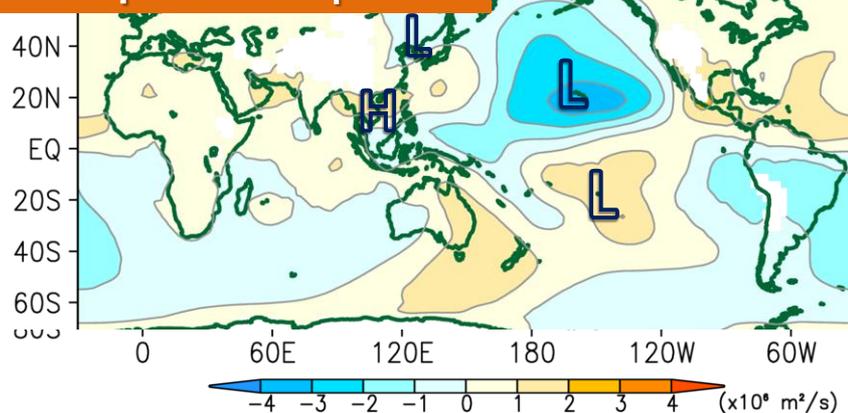
Response in ψ_{200}



Observed ψ_{200}



Response in ψ_{850}



Observed ψ_{850}

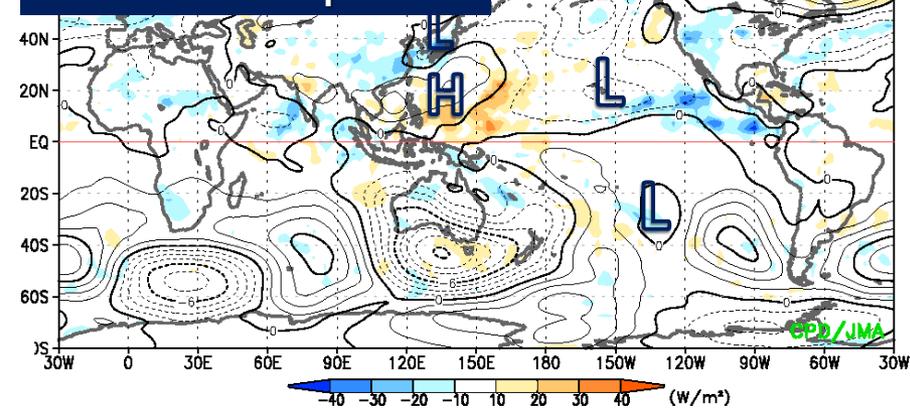
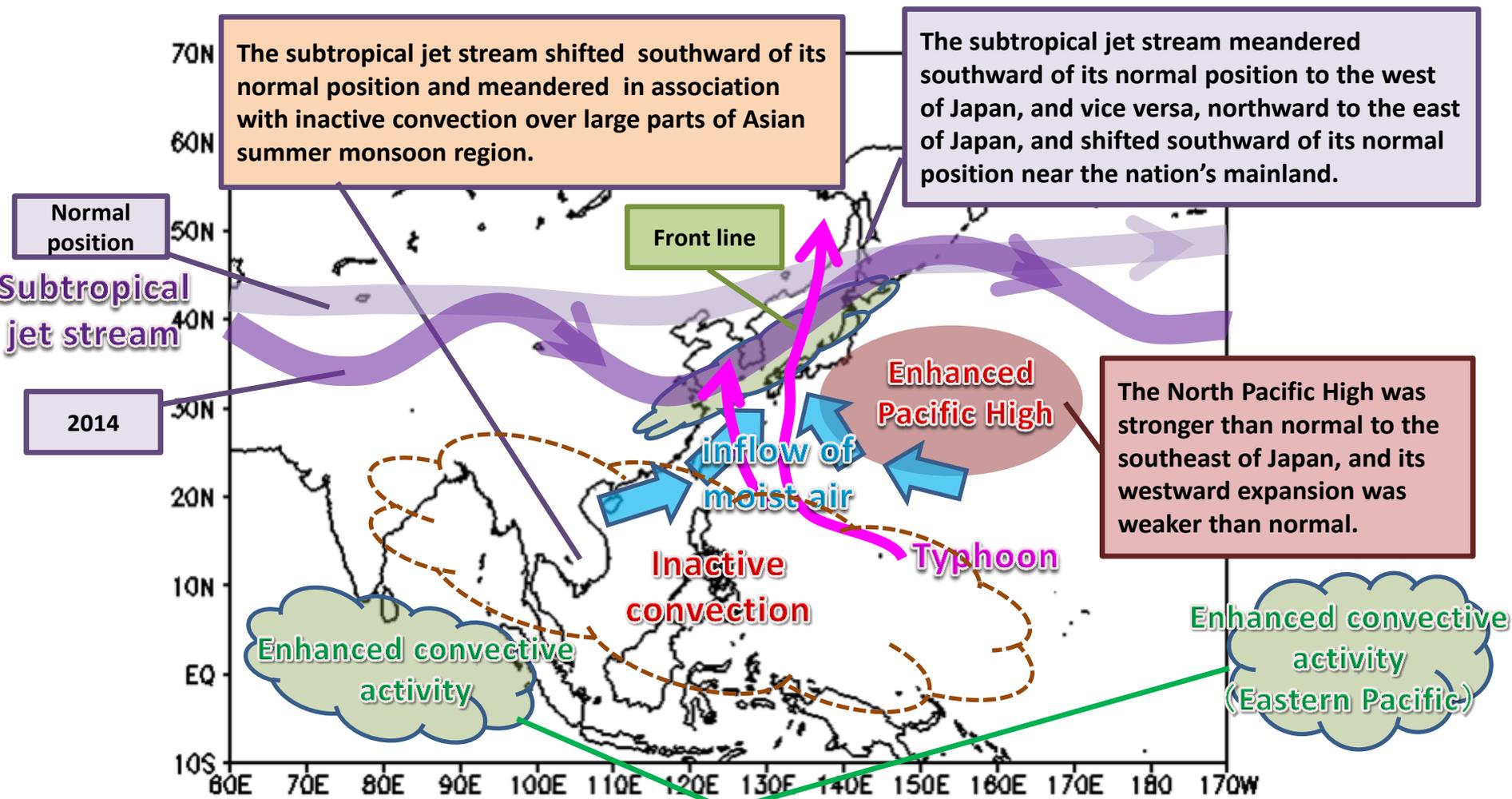


Fig.13 the response in ψ_{200} (upper left), the observed ψ_{200} (upper right), response in ψ_{850} (bottom left) and observed ψ_{850} (bottom right).

Conclusion – schematic figure –



The subtropical jet stream shifted southward of its normal position and meandered in association with inactive convection over large parts of Asian summer monsoon region.

The subtropical jet stream meandered southward of its normal position to the west of Japan, and vice versa, northward to the east of Japan, and shifted southward of its normal position near the nation's mainland.

Normal position

Subtropical jet stream

2014

Front line

Enhanced Pacific High

The North Pacific High was stronger than normal to the southeast of Japan, and its westward expansion was weaker than normal.

inflow of moist air

Inactive convection

Typhoon

Enhanced convective activity

Enhanced convective activity (Eastern Pacific)

Convective activity was enhanced over the eastern Pacific and eastern Indian Ocean in association with positive SST anomalies, contributing to the suppressing of convective activity around the Philippines and positive pressure anomalies were seen at the lower troposphere.

Thank you for your attention.

The JMA mascot



Harerun

JMA's mascot is named Harerun (from hare – the Japanese word for “fine weather”), and incorporates elements of sun, cloud and rainfall. Harerun holds a green baton representing hopes for a peaceful and disaster-free world. The mascot helps to raise public awareness of meteorological services as well as natural disasters and global environmental issues at various events.