

ENSO impact to atmospheric circulation system for summer

Motoaki Takekawa
Tokyo Climate Center,
Japan Meteorological Agency (JMA)

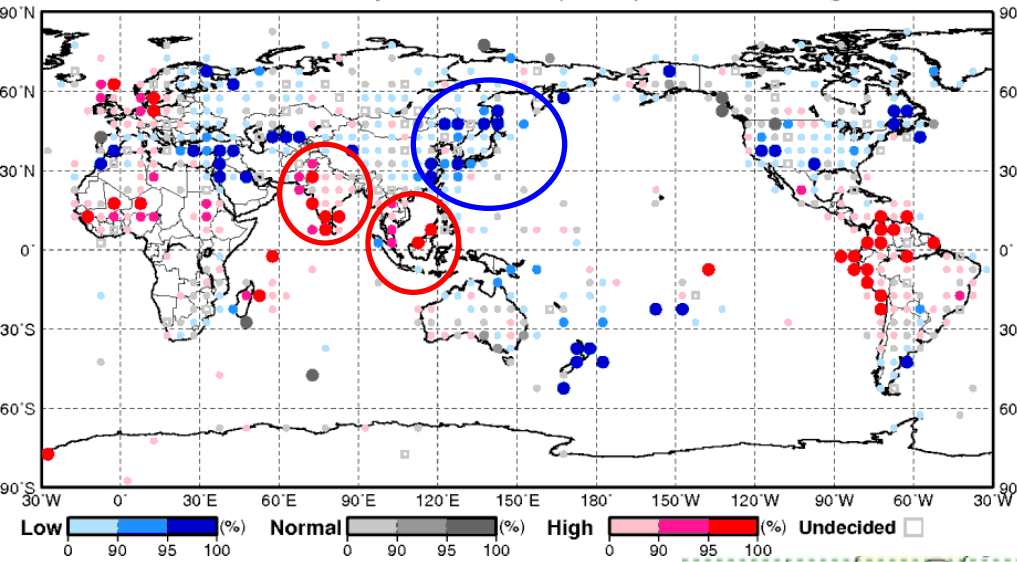
Introduction

- ENSO is the most dominant mode of the climate system and the most reliable signal for seasonal prediction.
- JMA is currently producing new ENSO statistical products using JRA-55 between 1958 and 2012 with discussion on the mechanism how ENSO affect atmospheric circulations.
- It is likely that El Niño conditions will redevelop by Northern Hemisphere summer 2015, so this presentation reports on the results of analysis for summer.

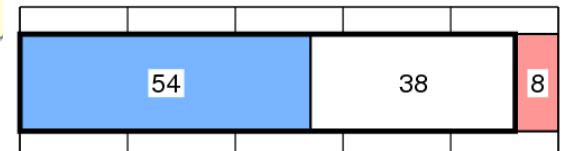
Temperatures

Summer(JJA) in **El Nino** events

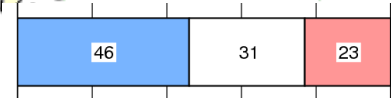
Element:Temp. Index:NINO3(Warm) Period:Jun-Aug



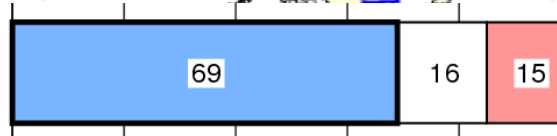
Northern Japan



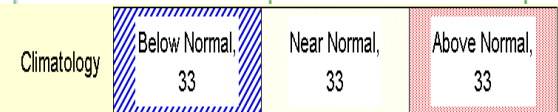
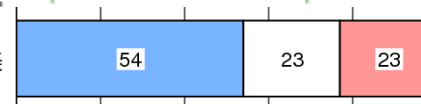
Eastern Japan



Western Japan



Okinawa & Amami

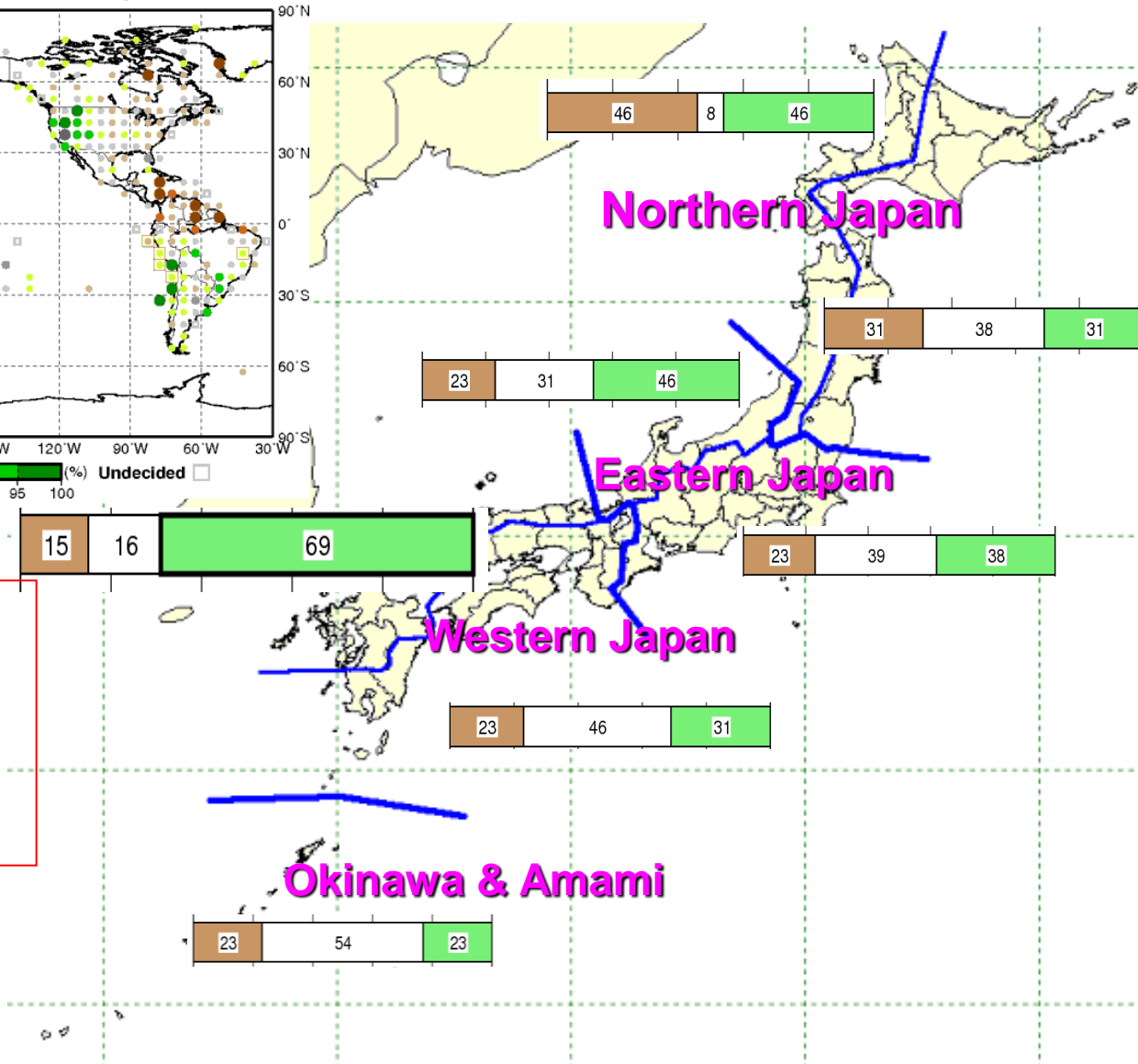
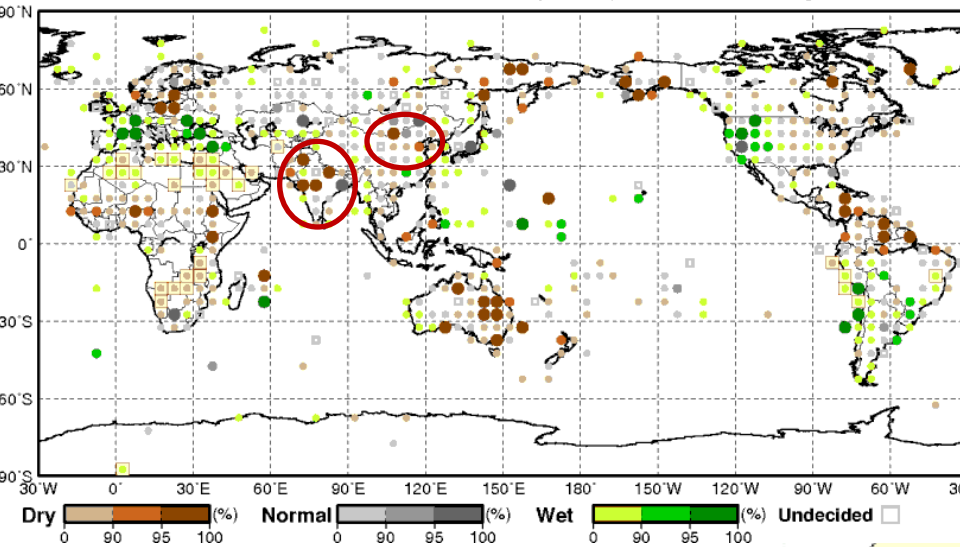


- below-normal temperatures are seen in northern and western Japan with 90% significant level.

Precipitation amounts

Summer(JJA) in **El Nino** events

Element:Prec. Index:NINO3(Warm) Period:Jun-Aug

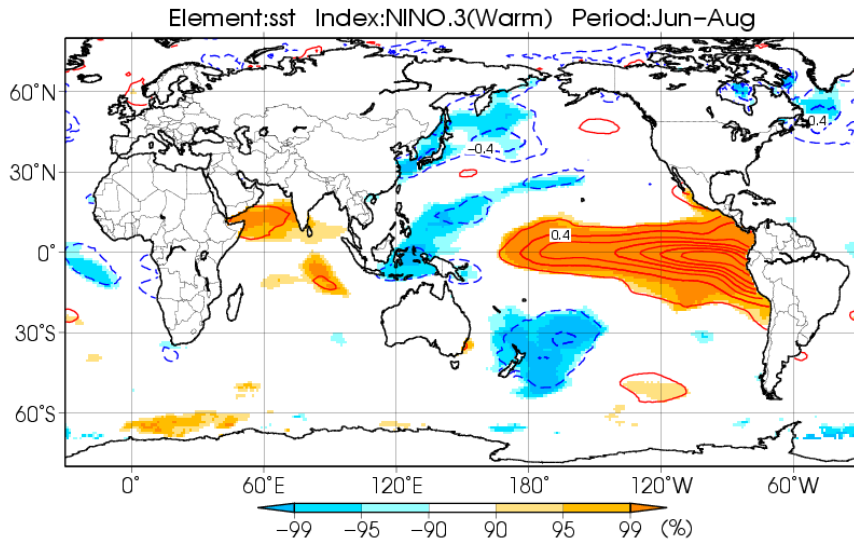


- above-normal precipitation amounts are seen in the sea of Japan side of western Japan with 90% significant level.

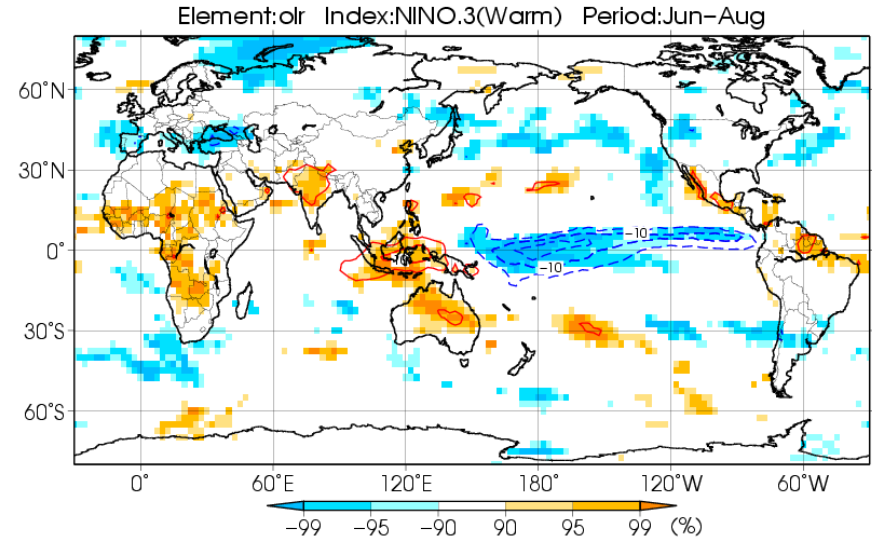
Composite map

summer(JJA) in **El Nino events**

SST anomalies



OLR anomalies

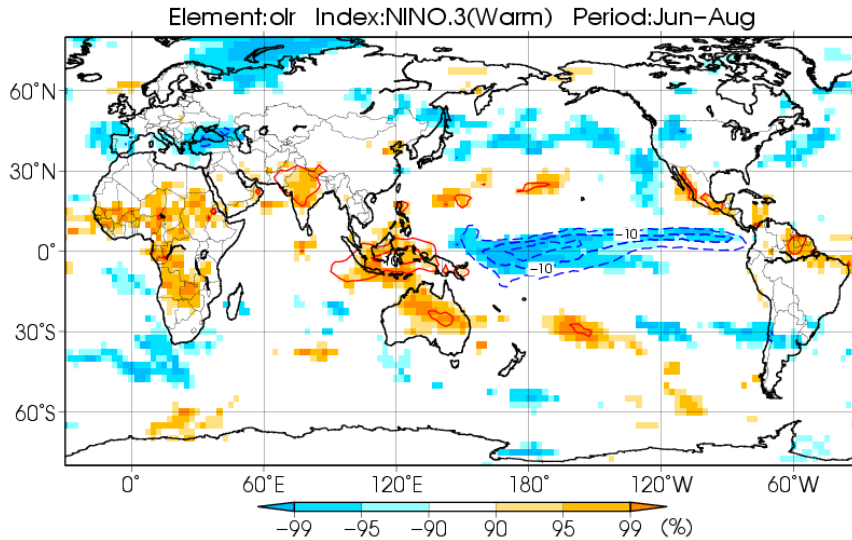


- Above-normal-SSTs are seen from central to eastern equatorial Pacific region, below-normal-SSTs are seen around maritime continent.
- Active convections anomalies are seen in from central to eastern equatorial Pacific region. Suppressed convections anomalies are seen around maritime continent and India.

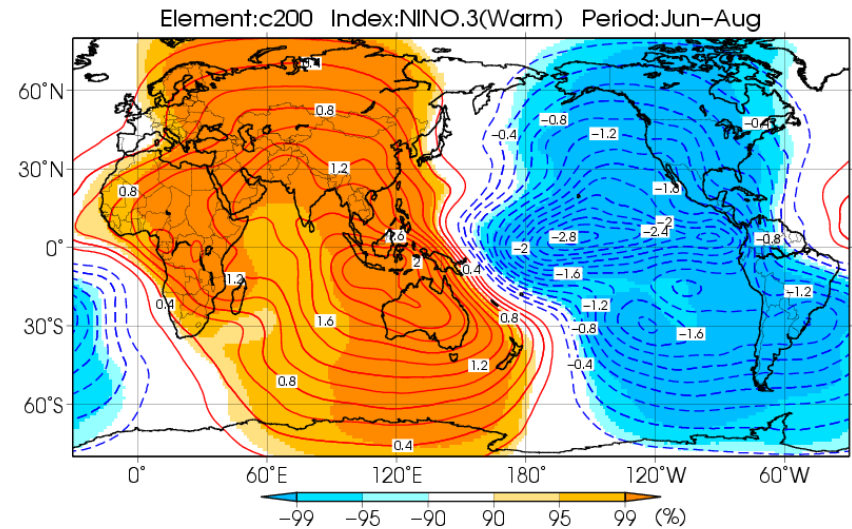
Composite map

Summer(JJA) in **El Nino events**

OLR anomalies



200hPa velocity potential anomalies



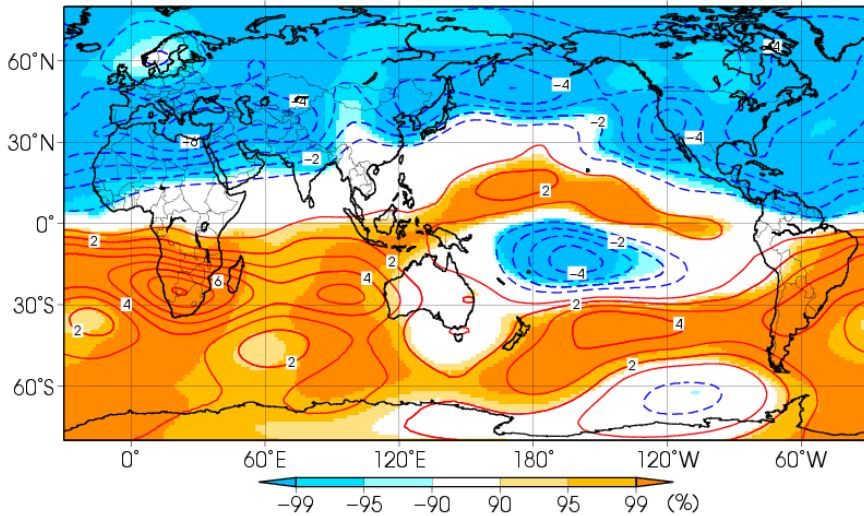
Corresponding to convective activities, large scale divergence anomalies are seen in tropics from central to eastern Pacific, large scale convergence anomalies are seen in tropics from Maritime continent to African continent.

Composite map

Summer(JJA) in **El Nino events**

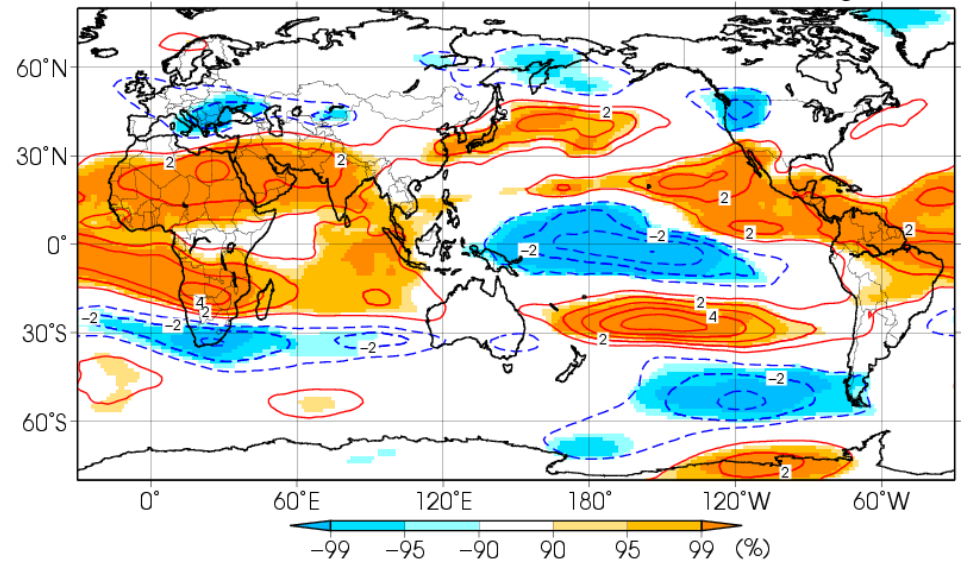
200hPa stream function anomalies

Element:p200 Index:NINO.3(Warm) Period:Jun-Aug



200hPa zonal wind anomalies

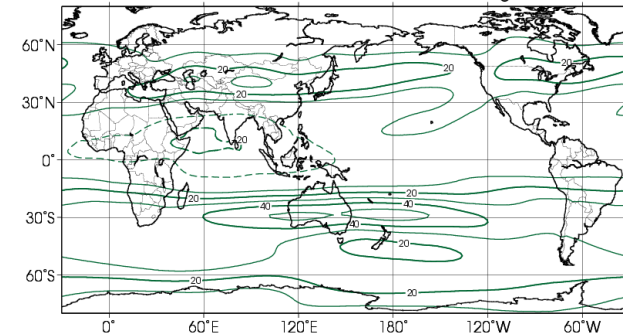
Element:u200 Index:NINO.3(Warm) Period:Jun-Aug



Cyclonic circulation anomalies are seen over mid-latitude over Eurasian continent. It means that Tibetan high is weaker than normal and subtropical jet shift southward of its normal. And wave trains are seen over Eurasian continent with a ridge over central China and a trough over the Korean peninsula.

normal

Element:u200 Normal Period:Jun-Aug

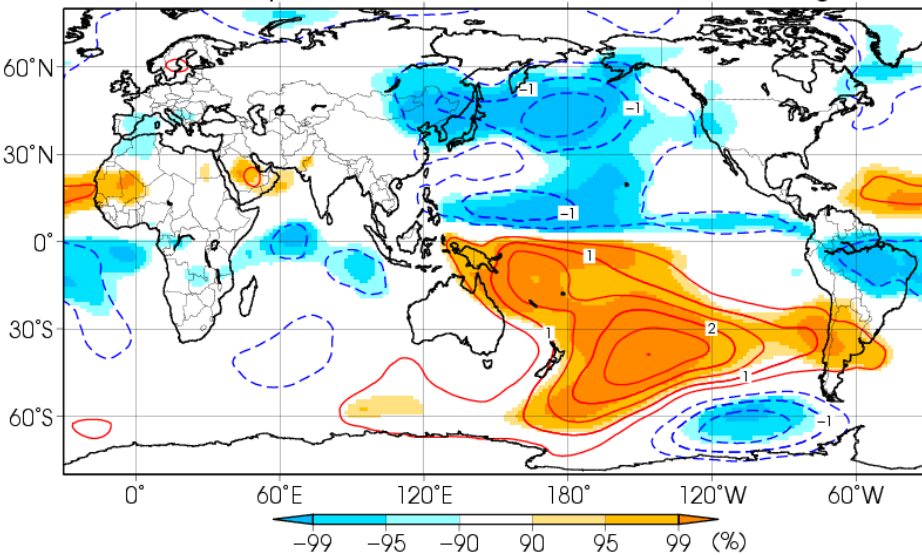


Composite map

Summer(JJA) in **El Nino events**

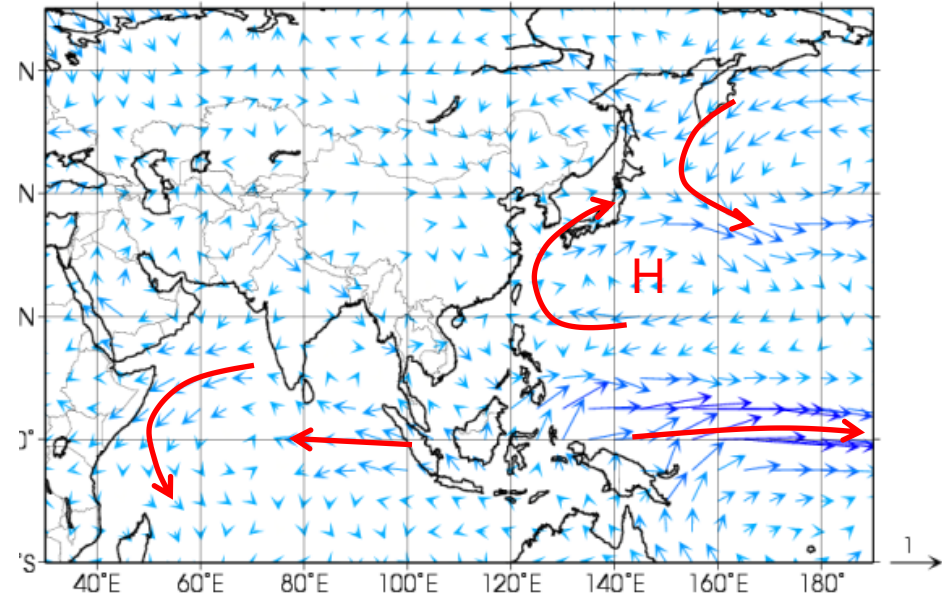
850Pa stream function anomalies

Element:p850 Index:NINO.3(Warm) Period:Jun-Aug



850Pa wind vector anomalies

Element:uv850 Index:NINO.3(Warm) Period:Jun-Aug



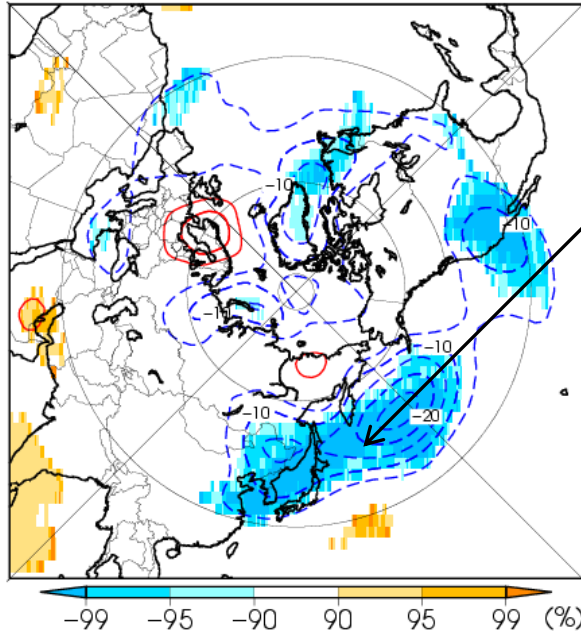
- Cyclonic circulation anomalies around Japan and east of the Philippines, and anti-cyclonic circulation anomalies to the southeast of Japan.
- Southwesterly wind anomalies are seen around Japan. **It indicates that wet air tend to flow into Japan.**

Composite map

Summer(JJA) in El Nino events

500hPa height anomalies

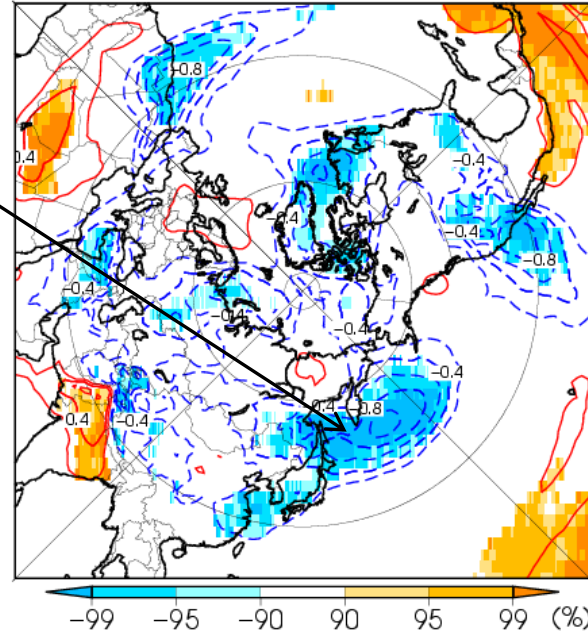
Element:z500 Index:NINO.3(Warm) Period:Jun-Aug



negative anomalies

850hPa temperature anomalies

Element:t850 Index:NINO.3(Warm) Period:Jun-Aug



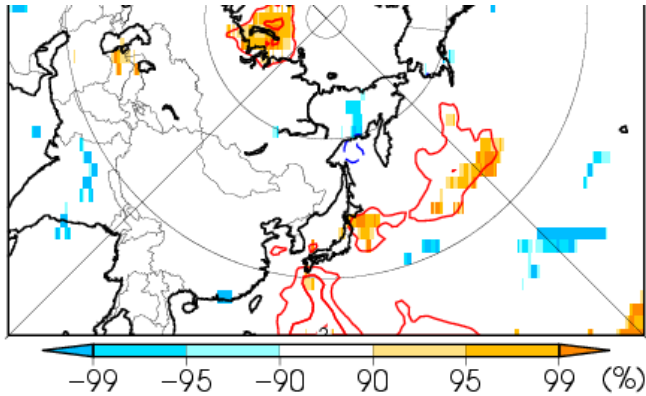
Negative anomalies are seen over the area zonally from northeastern East Asia to south of Alaska.

It indicates that cold air tend to flow into Japan.

Composite map

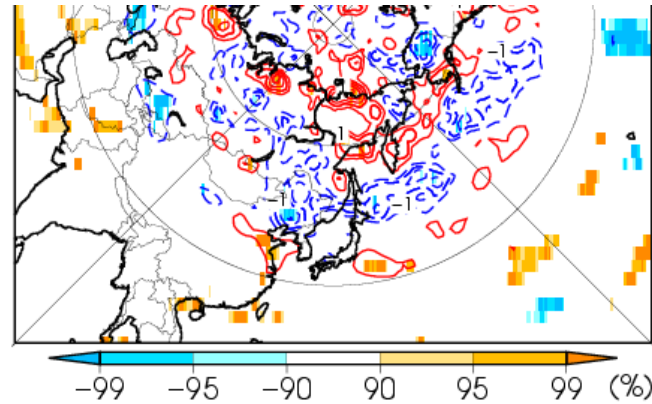
Summer(JJA) in El Nino events

850hPa eddy kinetic energy anomalies



Zonally positive anomalies are seen to the east of Japan.

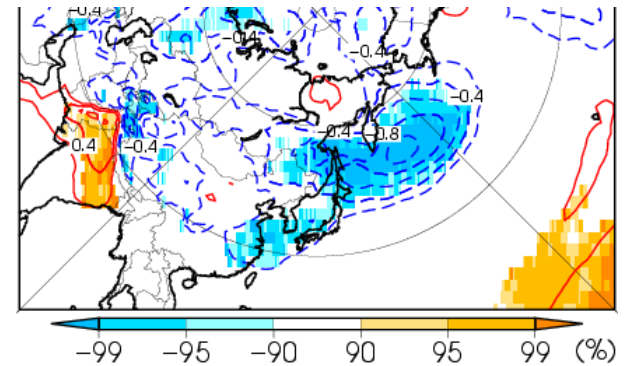
300hPa height tendency by eddy vorticity flux anomalies



Zonally negative anomalies are seen to the north of Japan.

Cold air mass around northern Japan are possibly associated with eddy feedback.

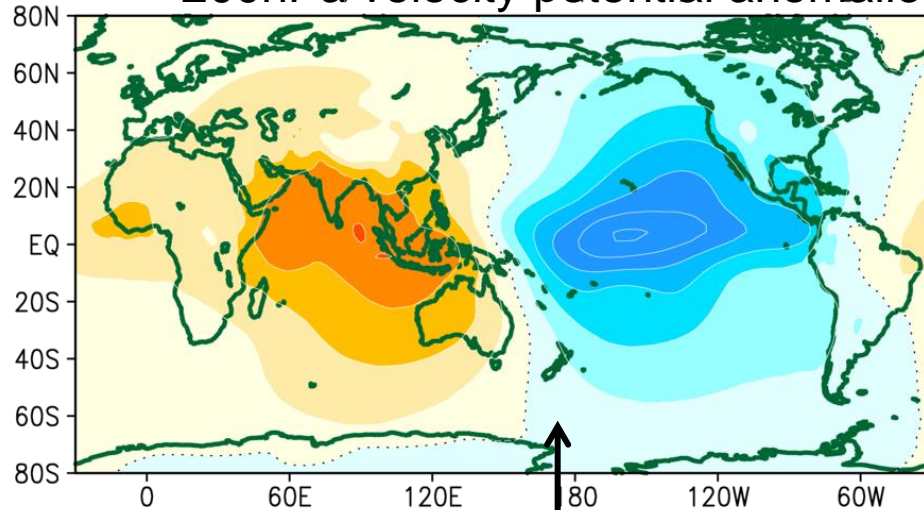
850hPa temperature



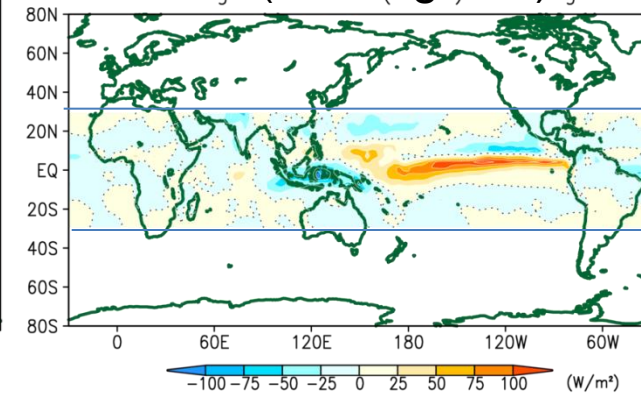
LBM

Summer(JJA) in **El Nino events**

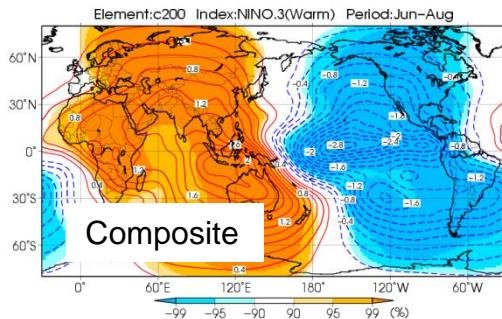
200hPa velocity potential anomalies



LBM(Heating rate)



-2 -1.5 -1 -0.5 0 0.5 1 1.5 2 ($\times 10^6$ m²/s)



The steady response to diabatic heating anomalies in the tropics using a Linear Baroclinic Model (LBM).

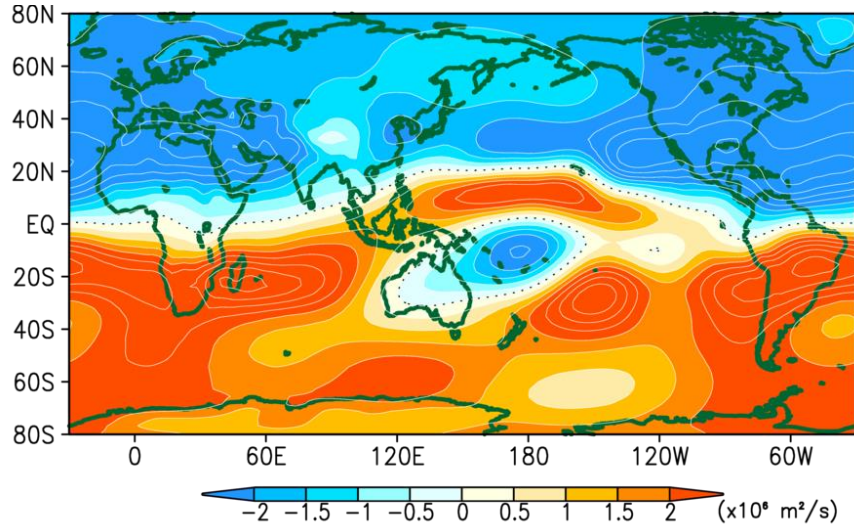
The characteristics are similar to composite map.

- Large scale convergence anomalies from central to eastern Pacific.
- Large scale divergence anomalies from Maritime continent to African continent.

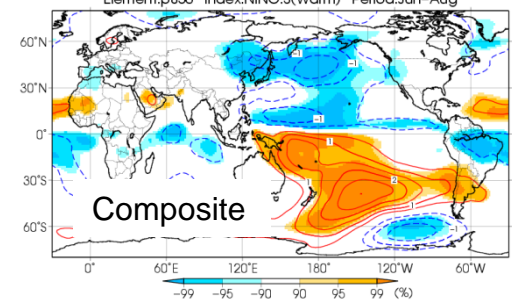
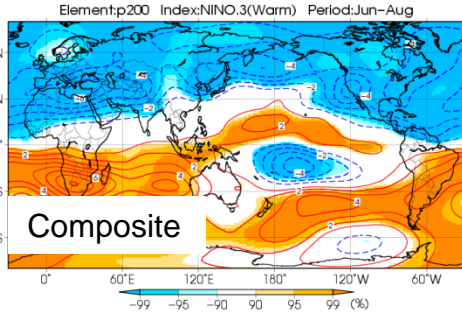
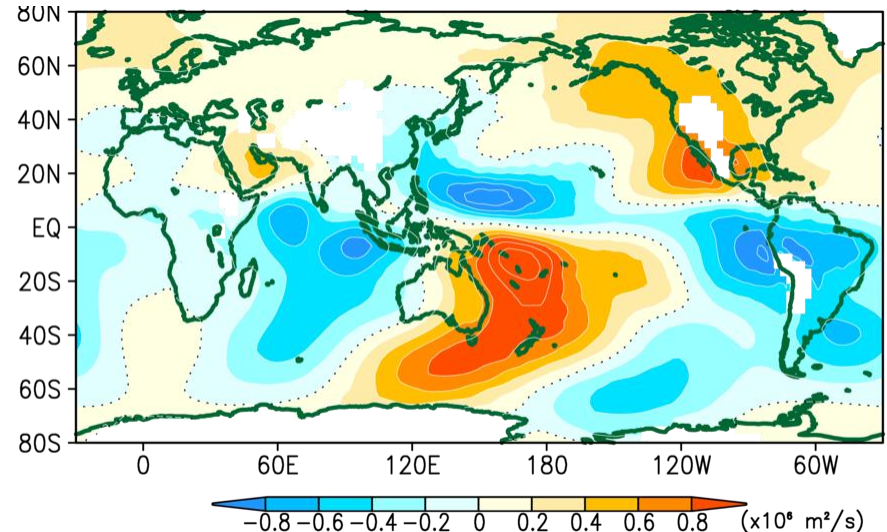
LBM

Summer(JJA) in El Nino events

200hPa stream function anomalies



850Pa stream function anomalies



These characteristics are possibly affected by tropical convection activities in El Niño events.

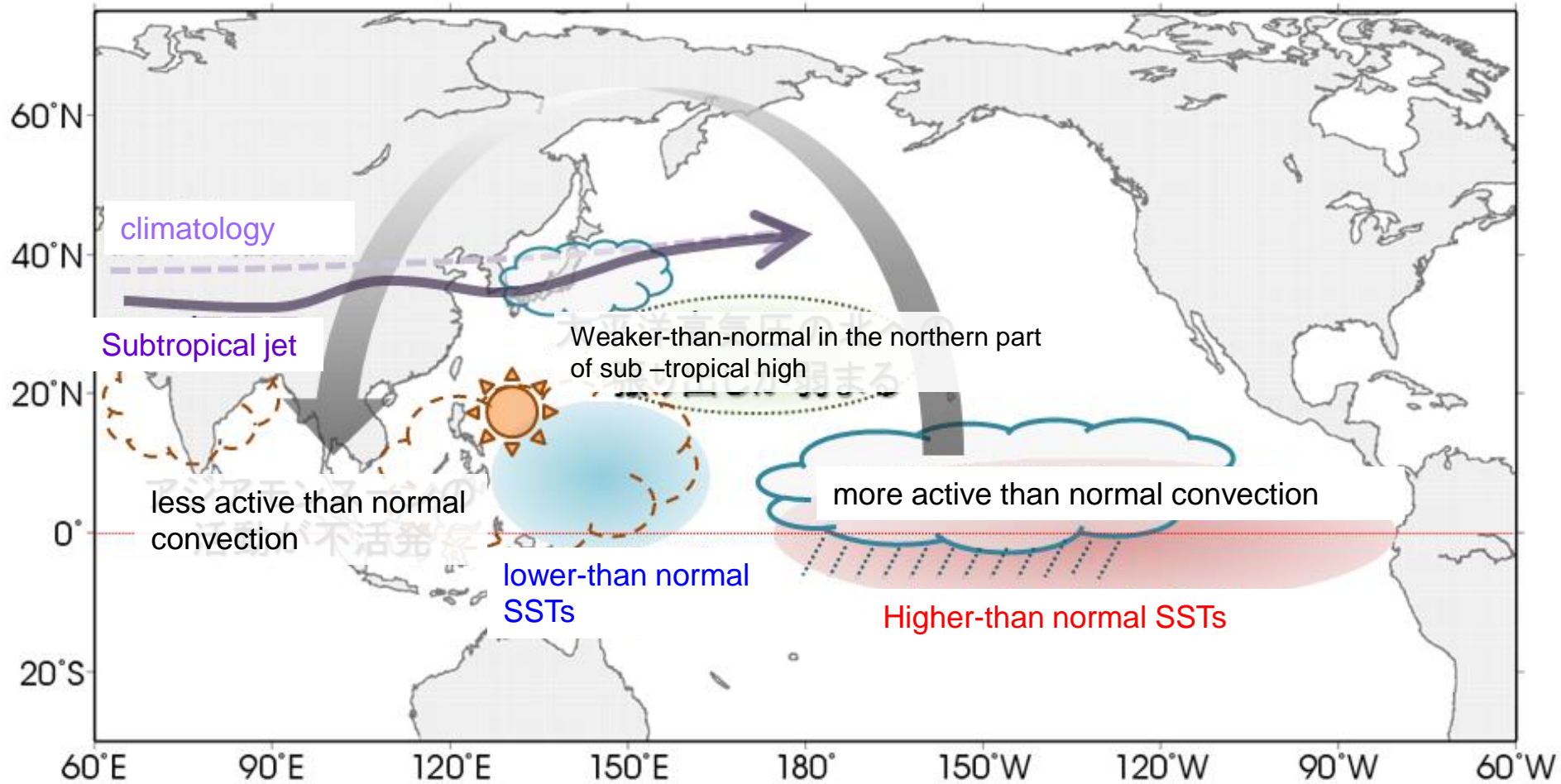
The characteristics are similar to composite map.

- In upper layer, cyclonic circulation anomalies over mid-latitude and wave trains over Eurasian continent.
- In lower layer, cyclonic circulation anomalies around Japan and east of the Philippines, and anti-cyclonic circulation anomalies to the southeast of Japan

Summary

- In the upper troposphere, subtropical jet stream shifts southward of its normal position and meanders over Eurasian continent with a ridge over central China and a trough over the Korean peninsula.
- In the lower troposphere, cyclonic circulation anomalies around Japan and east of the Philippines, and anti-cyclonic circulation anomalies to the southeast of Japan.
- In the 500hPa height field, negative anomalies are seen over the area zonally from northeastern East Asia to south of Alaska, which are possibly related to a positive feedback from high-frequency eddies.

Conceptual diagram



Thank you