

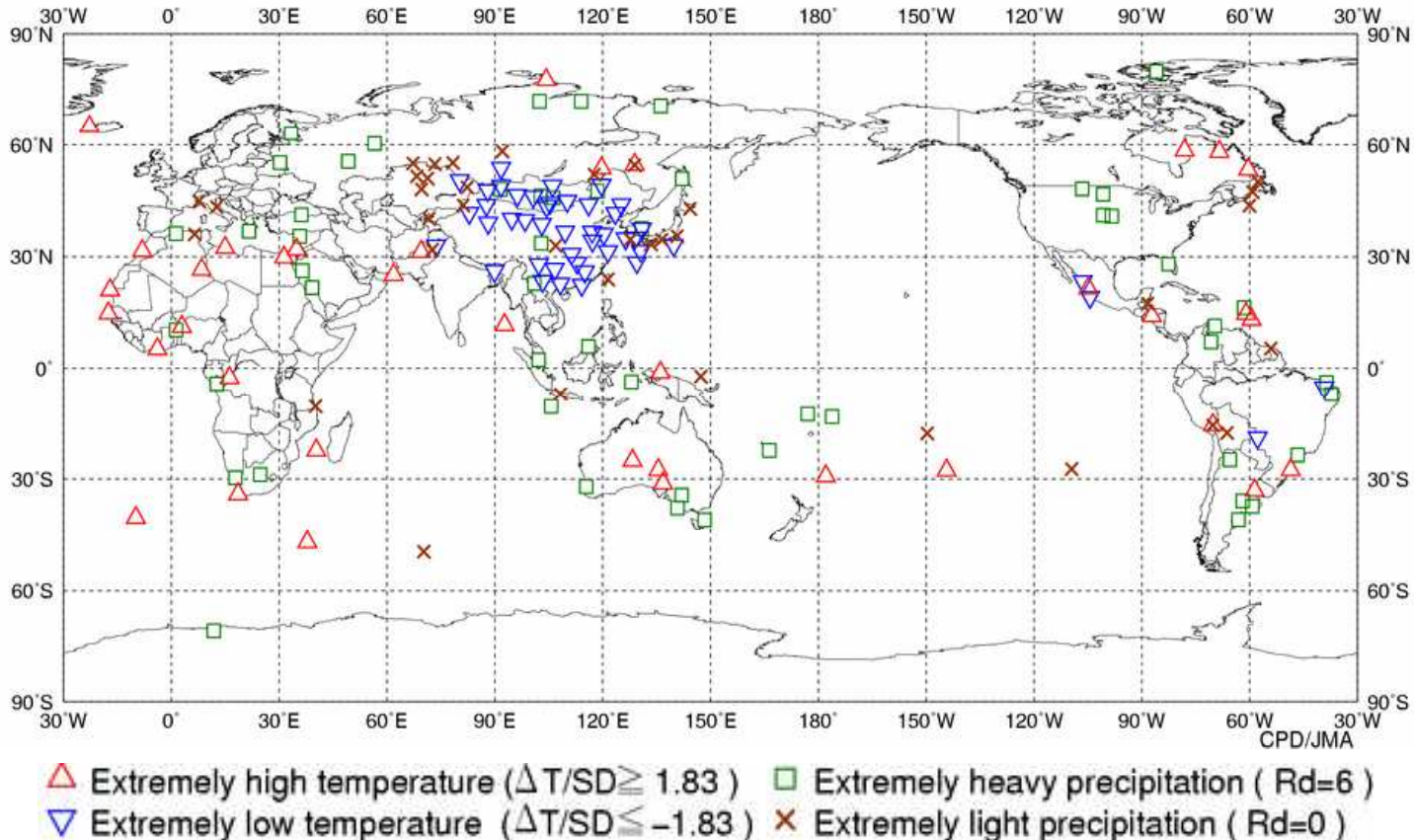
Strong East Asian Monsoon in January 2011

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Extreme climate events (January 2011)

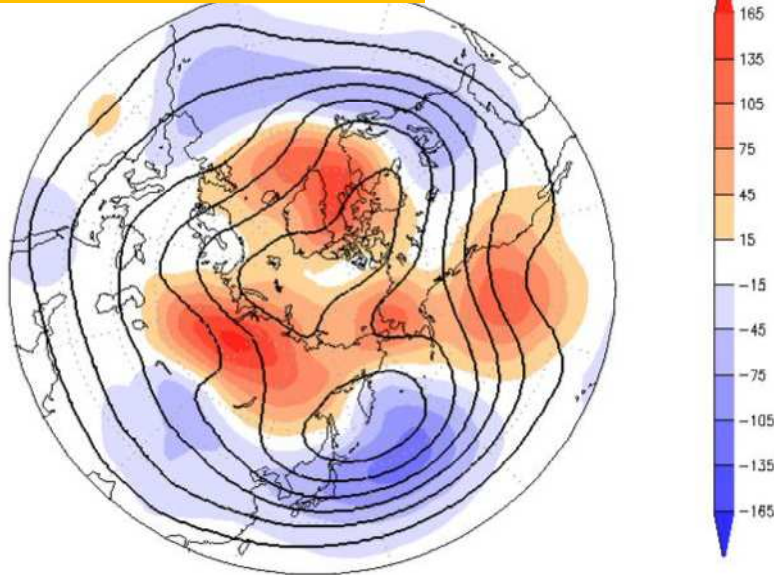
- Extremely low temperatures were observed broadly over East Asia.
- Temperatures were below normal all over Japan, and snowfall amounts were above normal on the Sea of Japan side of the country.



Atmospheric circulation in the N.H. (January 2011)

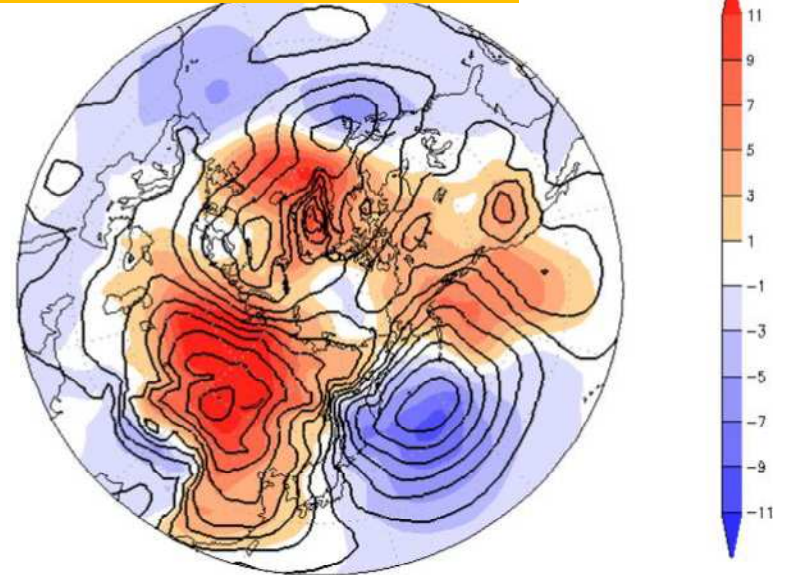
500-hPa height and anomaly

CPD/JMA



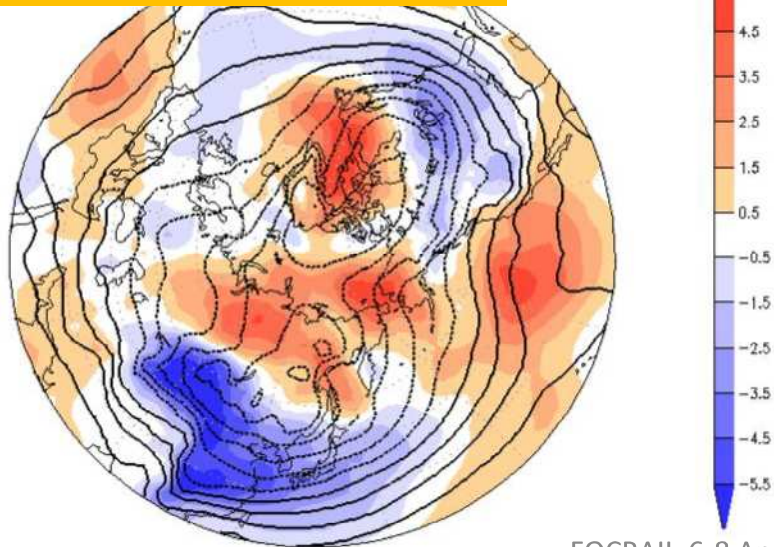
Sea level pressure and anomaly

CPD/JMA



850-hPa temperature and anomaly

CPD/JMA



- A ridge over western Siberia and a trough to the east of Japan.
- Both the Siberian High and Aleutian Low pronounced.
- Significantly below normal temperatures in the lower troposphere over East Asia.

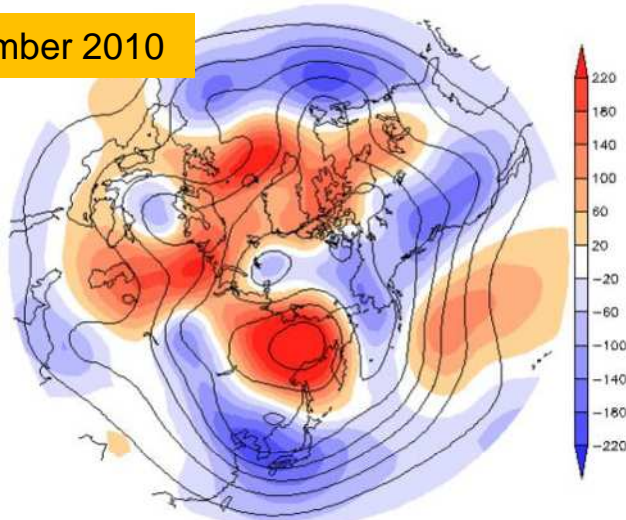


Strong winter monsoon

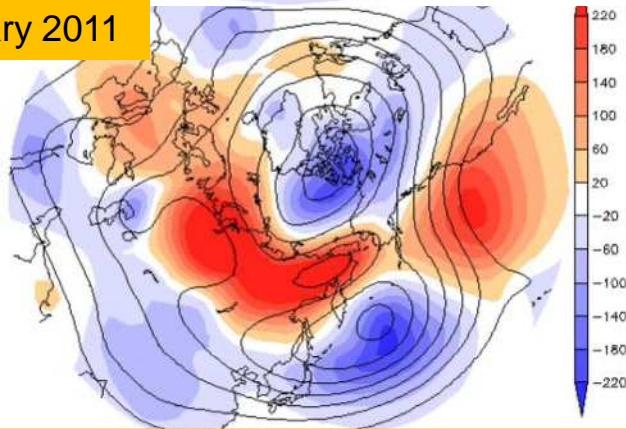
Blocking high over Siberia

- Blocking highs were developed over eastern Siberia from late December to early January and mid-January, and troughs covered the vicinity of Japan.
- Positive height anomalies propagated westward from the northern Pacific to Siberia.

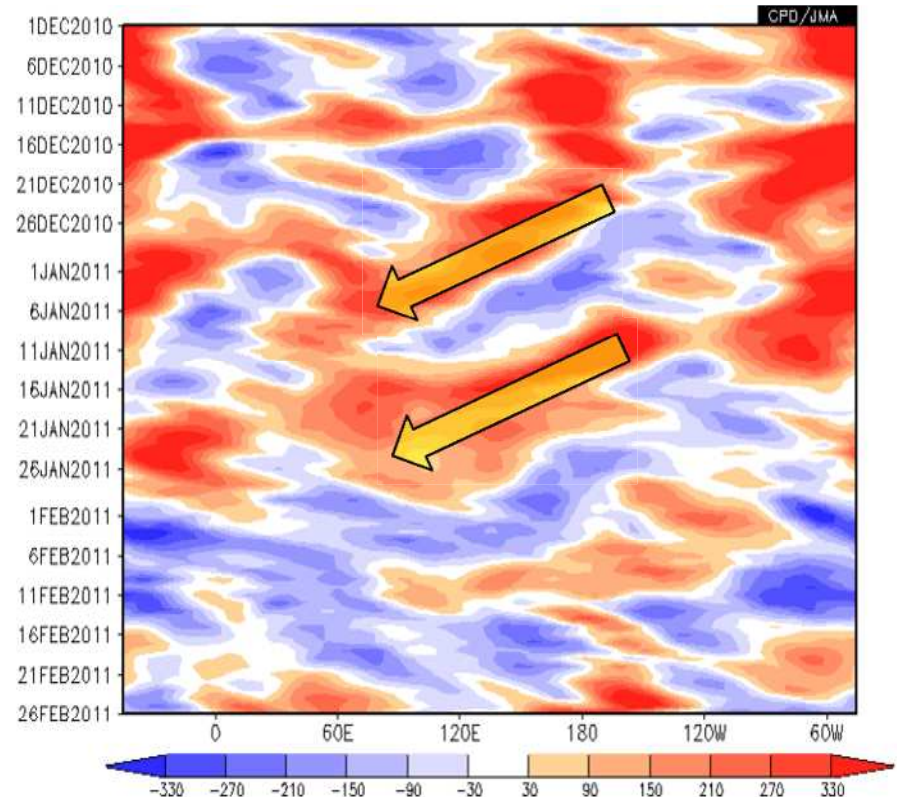
27-31 December 2010



16-20 January 2011



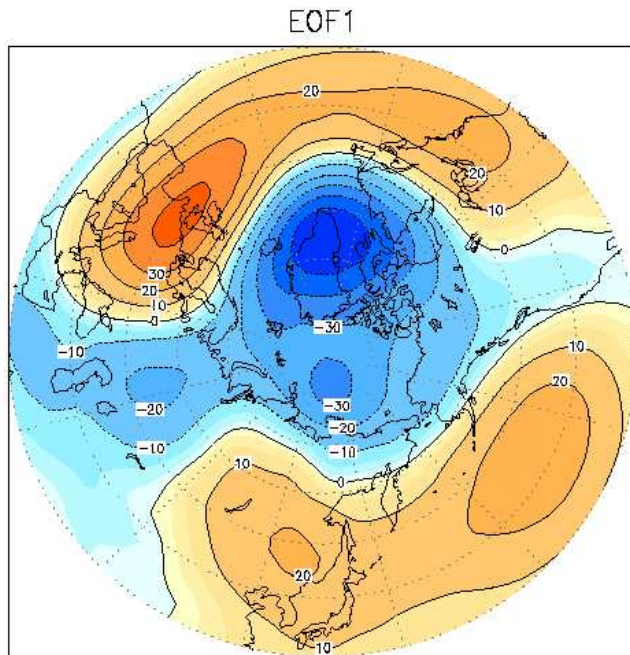
5-day average 500-hPa height and anomaly



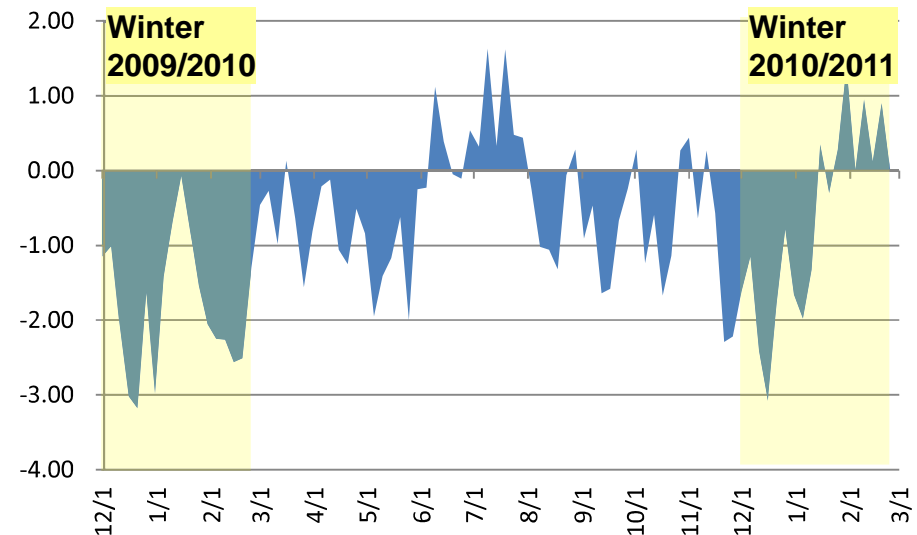
Time-longitude cross section of 500-hPa height anomaly along 60N

Arctic Oscillation (AO)

The AO remained in the significantly negative phase during the first half of winter 2010/2011, and turned to the positive phase in the second half.



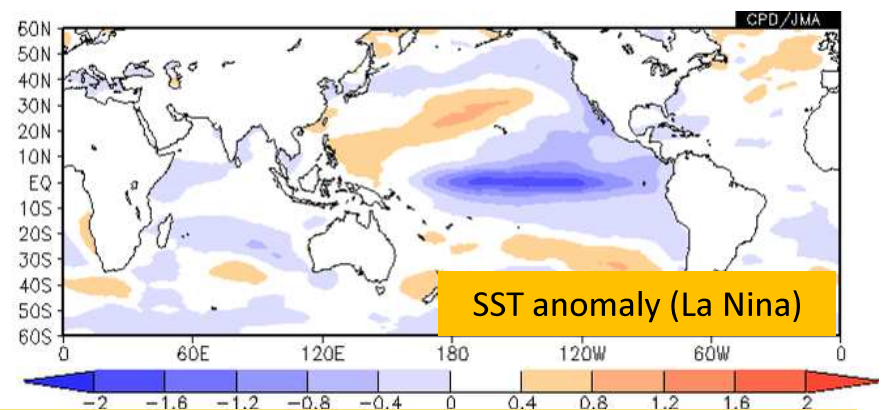
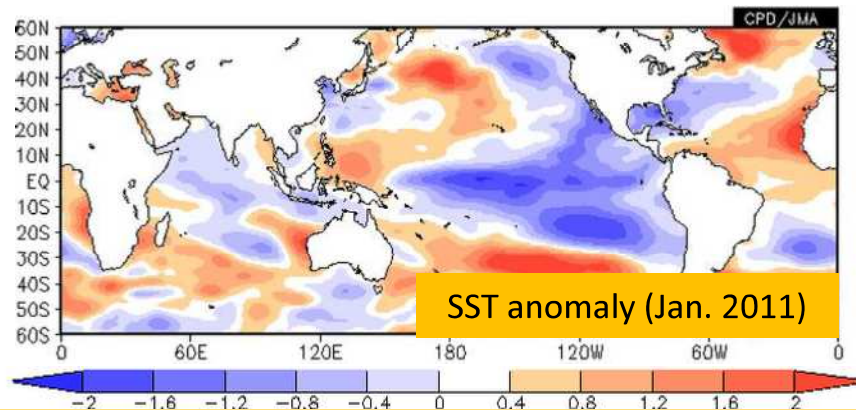
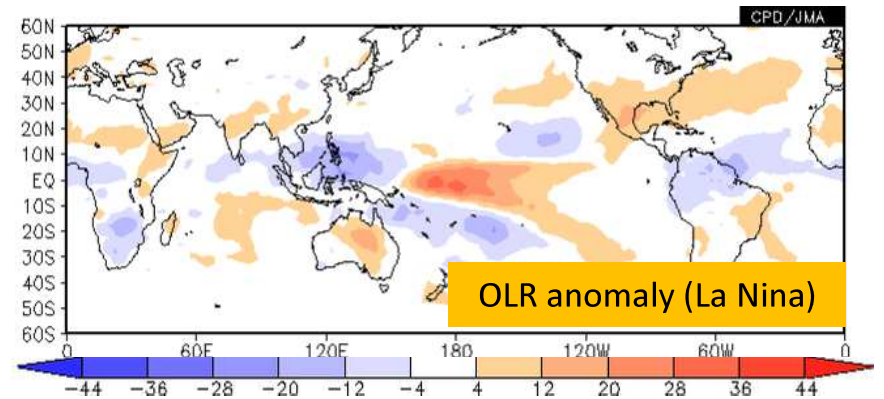
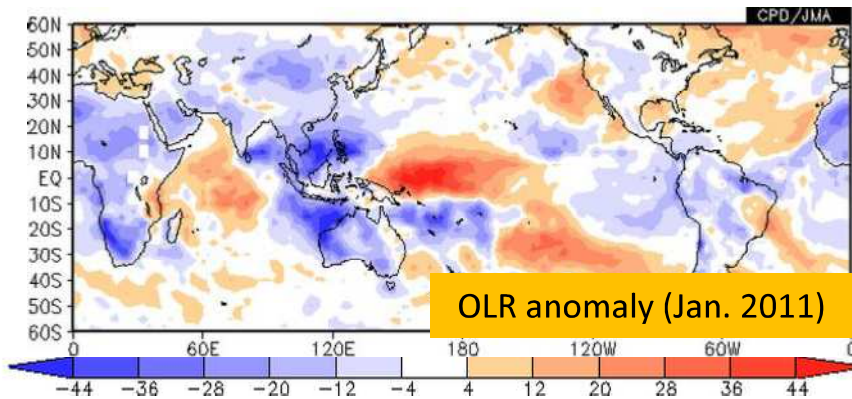
The first leading mode of 500-hPa height for winter (Z500 EOF-1)
Statistical term: 1958-2004



Time series of 5-day mean score of Z500 EOF-1
(December 2009 – February 2011)

SST and convective activity (January 2011)

- West-east contrast in SST and OLR anomalies associated with La Nina was clearly seen across the Maritime Continent and equatorial Pacific.
- The enhanced convection area was shifted westward of that in the corresponding La Nina composite.

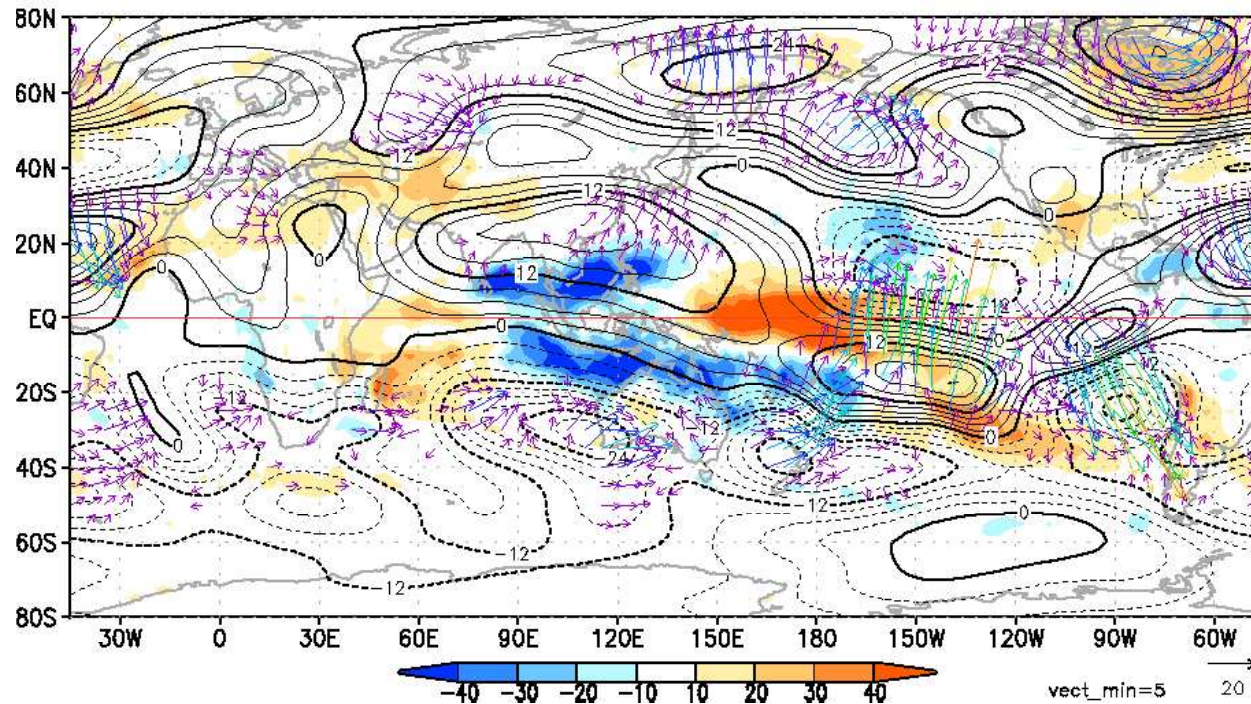


[upper] OLR anomaly and [lower] SST anomaly, and corresponding La Nina composites

La Nina years: 1985, 1989, 1996, 1999, 2000, 2006, 2008

200-hPa atmospheric circulation

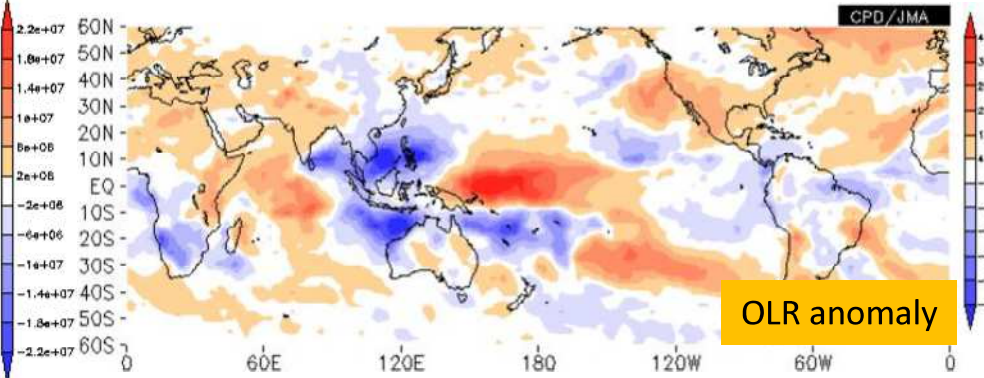
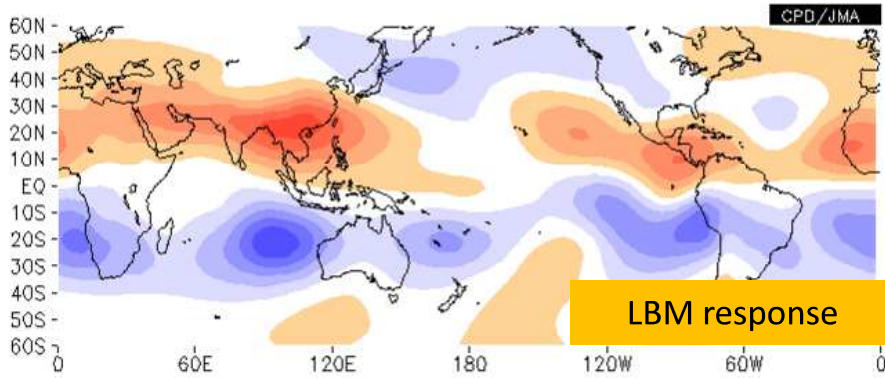
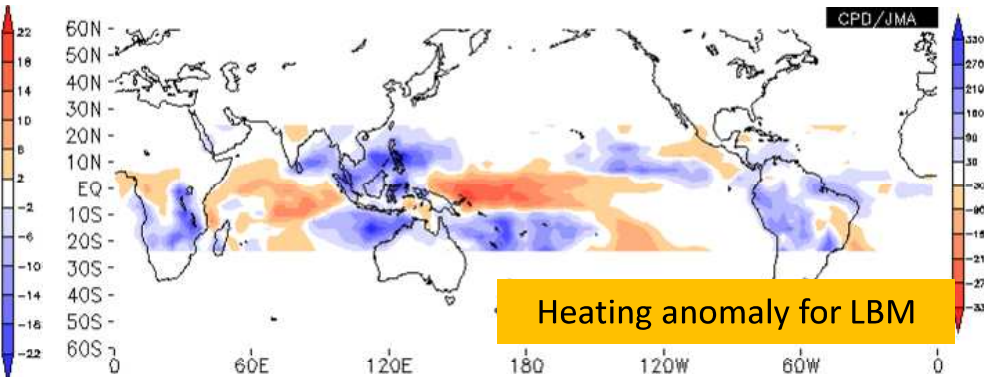
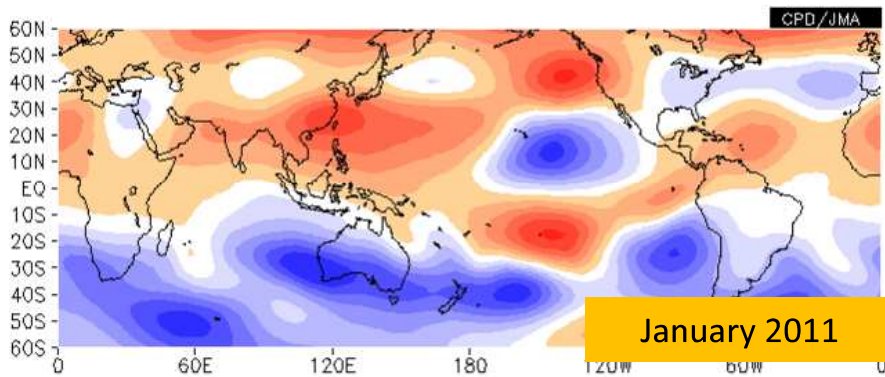
- Predominant anti-cyclonic circulation anomaly seen over southern Asia, responding to significantly active convection from the eastern Indian Ocean to the Philippines.
- Rossby wave packets propagated from the anti-cyclonic area to the east of Japan.



[shading] OLR anomaly, [contour] 200-hPa stream function anomaly and [vector] wave activity flux (20 December 2010 – 18 January 2011)
The wave activity flux was defined after Takaya and Nakamura 2001.

Response to tropical heating (upper troposphere)

At 200 hPa, anticyclonic circulation anomaly over southern Asia and cyclonic circulation anomaly to the east of Japan were well reproduced in a response experiment to tropical heating anomaly using Linear Baroclinic Model (LBM)*.



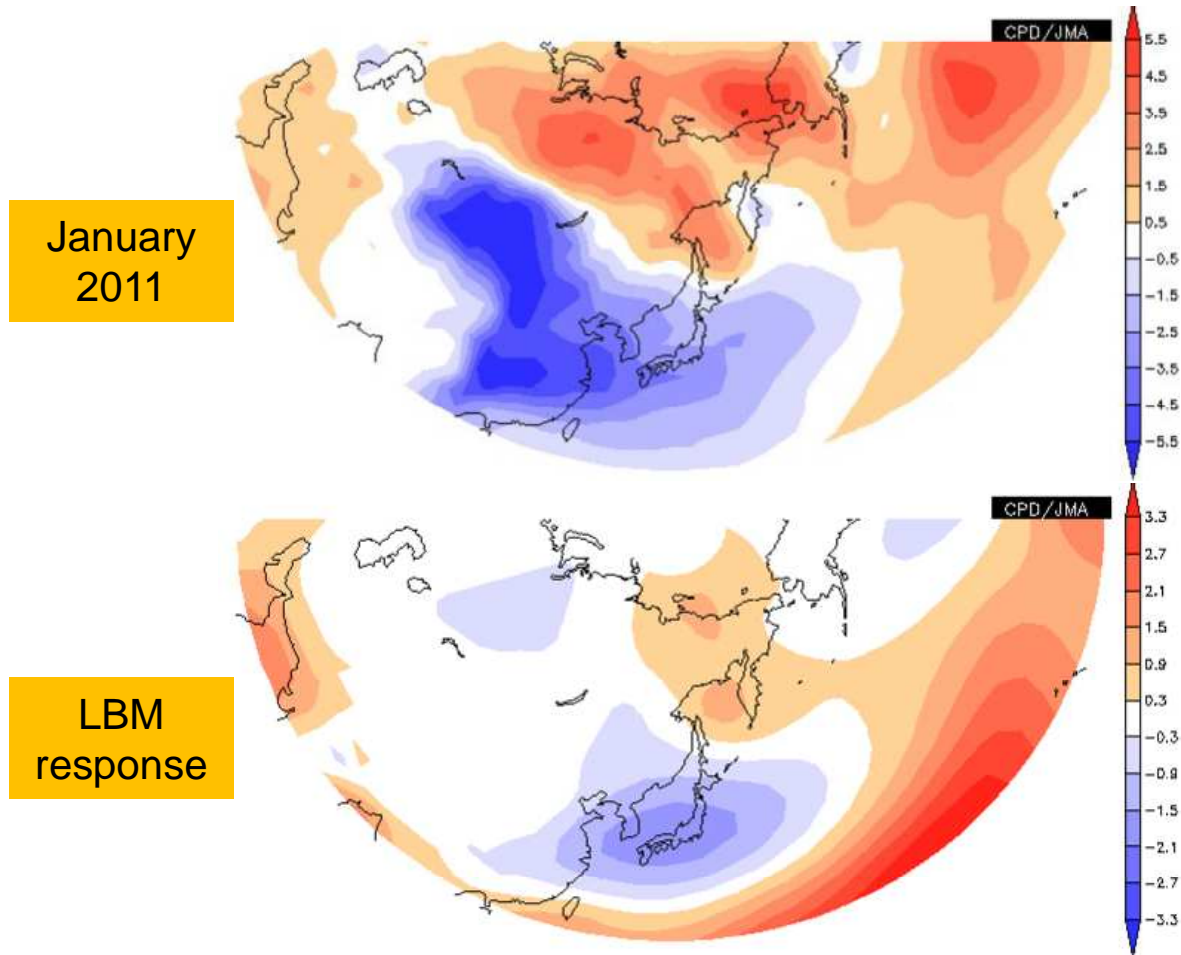
200-hPa stream function anomaly
[upper] analysis for January 2011 and
[lower] LBM response

[upper] Heating anomaly (25S-25N) and
[lower] OLR anomaly for January 2011

*LBM provided by Dr. Watanabe, Univ. of Tokyo

Response to tropical heating (lower troposphere)

At 850 hPa, low temperature anomalies around Japan were partly reproduced in a response experiment to tropical heating anomaly using LBM.



850-hPa temperature anomaly
[upper] analysis for January 2011 and [lower] LBM response

Summary

In January 2011, temperatures were extremely below normal over East Asia. The characteristics of atmospheric circulation associated with this strong East Asian winter monsoon are as follows.

- Negative AO prevailed until mid-January.
- Ridges and blocking highs developed over western and eastern Siberia, respectively.
- Rossby wave packets propagated from southern Asia to Japan, which was a response to active convection associated with La Nina.