2016/17 winter monsoon in East Asia

Shingo ITO

Assistant Forecaster, Tokyo Climate Center, Japan Meteorological Agency
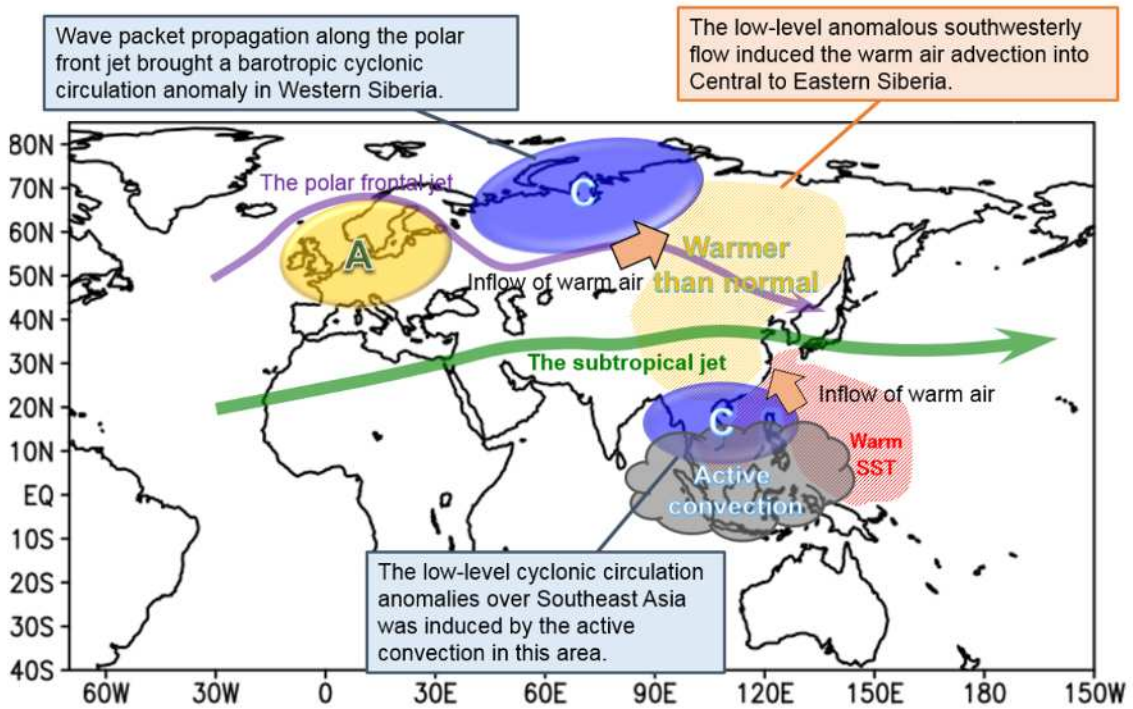
s_ito@met.kishou.go.jp

East Asia experienced warm winter 2016/17. In Japan, seasonal mean temperatures were above normal in most areas, and significantly above normal in Okinawa/Amami. However, the temperature fluctuation during this season was large, and especially western Japan experienced the significant cold surges in middle January and early February.

The causes of warm 2016/17 winter are thought to be a weaker Siberian High and cyclonic circulation anomalies in the lower troposphere over Southeast Asia. Wave packet propagation along polar front jet brought a barotropic cyclonic circulation anomaly in Western Siberia, and the low-level anomalous southwesterly flow in the east of it induced the warm air advection into Central to Eastern Siberia. This warmer-than-normal condition in Siberia led to a weaker Siberian High. As a result, the influence of cold air was weaker than normal in Japan. The low-level cyclonic circulation anomalies over Southeast Asia, which was induced by the active convection in this area, led to warm southeasterly flow anomalies in Okinawa/Amami. In addition, given that temperatures in the troposphere remained above normal for most of the latitudes through the winter, global warming acted as a background factor by increasing the probability of warm winter like 2016/17.

Meanwhile, significant cold surges flowed in middle January and early February, resulting in record-breaking heavy snowfall in western Japan. In these periods, the deep troughs were clearly seen over and around northern Japan associated with the blocking highs located over the Eastern Siberia, which emerged around the Bering Sea and moved westwards. The enhanced northerly flow in the west of the trough brought the significant cold surges into western Japan. The blocking highs over the Bering Sea were formed and sustained likely in association with enhanced convective activity over Southeast Asia mentioned above.

Possible primary factors contributing to (a) the warm winter 2016/17 and (b) the cold surge in middle January and early February 2017 are summarized below.

(a) Warm winter 2016/17

Wave packet propagation along the polar front jet brought a barotropic cyclonic circulation anomaly in Western Siberia.

The low-level anomalous southwesterly flow induced the warm air advection into Central to Eastern Siberia.

The polar frontal jet

Inflow of warm air

Warmer than normal

The subtropical jet

Inflow of warm air

Warm SST

Active convection

The low-level cyclonic circulation anomalies over Southeast Asia was induced by the active convection in this area.

(b) Cold surges in middle January and early February 2017

③ The blocking high emerged due to the wave packets, and moved westward.

④ The deep trough was formed in association with the blocking high.

Blocking High

Inflow of cold air

Trough

① The wave packets propagated from the west.

Active convection

② The subtropical jet meandered northward due to active convection around Philippines.