



The effects of the Arctic warming on the Mid-latitude winter temperature anomalies

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This study investigated the combined effects of the arctic warming and ENSO on winter temperature anomalies in the mid-latitudes of the Northern Hemisphere. First of all we identify two different influences of arctic warming leading to cold winter in East Asia or North America, based on daily observational analysis. The unusual cold winter in East Asia is related to the abnormal warmth of the Barents-Kara Sea area, but the severe winter in North America is related to the abnormal warmth in the East Siberia-Chukchi Sea region. In other word, owing to negative anomalies of MSLP over northern Korea, the cyclonic flow occurs over Manchurian region and acts as running cold flow to western Asia. The circulation occurs low-level flow in front of the circulation, and the cold air flows along the anticyclonic circulation. The cold advection flows into North America, so the continent goes through cold winter. Similarly, El Nino-Southern Oscillation (ENSO) has been found to affect temperature anomalies in East Asia or North America when notable sea surface temperature (SST) anomalies are present over tropical pacific. We have defined the four possible combinations using arctic warming signal and ENSO phase. Global warming in each region of the Arctic Ocean involves abnormal anti-cyclone rural development and downstream development of mid-latitude trough. The resulting cold air stream provides favorable conditions for serious winter in East Asia or North America. Furthermore, the circulation state with nearly the arctic warming and nino3.4 indices can cause considerably different responses in surface temperature anomalies over mid-latitudes of the Northern Hemisphere.