

# **The modulation effects of Pacific Decadal Oscillation on relation between Arctic Oscillation and mid-high latitude climate and evolution of weak polar vortex events in northern hemisphere winter**

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The relation between Arctic Oscillation and mid-high latitude winter climate in northern hemisphere is investigated under different Pacific Decadal Oscillation phase. Basic statistics show the occurrence frequencies ratio of negative and positive Arctic Oscillation month is clearly dependent on PDO phase: the month with negative AO anomaly is about two times as month with positive AO anomaly under PDO negative phase. Moreover, our results reveal that the amplitude of temperature anomaly in mid-high latitude is stronger during PDO negative phase. The months with AO negative anomaly under PDO negative phase have much weaker and larger polar vortex which is closer to Eurasia continent and stretches to Greenland and eastern Europe. Anomalous cold weather appears in eastern America, Europe and Siberia. When AO is positive and PDO is negative, warm anomaly exhibits in Europe and polar vortex gets more colder and stronger. Considering the high impacts of weak polar events on middle latitude region, we further analyzed the evolution of intra-seasonal circulation anomaly before and after weak polar vortex events under different PDO phase. Temperature anomaly in coastal region of eastern North America can hardly be found when PDO is under positive phase. Cold anomaly in Siberia which reaches its maximum before the peak phase of polar vortex is relatively weak and cold anomaly in Europe lasts only for a short period. Nevertheless, under the negative phase of PDO coastal region of eastern North America maintains cold from precursor phase to mature phase. The cold anomaly in Siberia shows up in onset phase and becomes significantly strong until mature phase while Northwest Europe experiences a longer cold period.

Key words: PDO, Arctic Oscillation, weak polar vortex event