



## **Influence of Northern Hemisphere snow cover on the sub-seasonal precipitation anomaly over northern China**

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One interesting feature of the northern China winter (December to February) precipitation, which has not drawn much attention, is the dramatic different total amount on sub-seasonal time scale. For instance, in winter of 2010/2011, northern China experienced severe drought with most areas receiving barely any precipitation in December and January. However, the region received above-normal precipitation in February, with the largest total precipitation nearly double of the climatology. Given such diversity of the monthly precipitation anomaly over northern China, this study investigates the atmospheric circulation anomaly and possible causative mechanisms on the sub-seasonal time scale. It is revealed that concurrent with above-normal precipitation anomalies over northern China in winter, the 500-hPa geopotential height generally shows a wave pattern with significant positive anomalies over Europe, negative anomalies over West Siberia and Central Asia, and positive anomalies over eastern China and Japan. Consequently, the East Asian Trough is significantly weakened and anomalous southeasterly wind as well as ascending motion are observed over northern China, providing favorable moisture and dynamic conditions for precipitation. Further analysis suggests that such wave patterns in December and January (February) are closely associated with the anomalous snow cover over North America and Europe (Europe), with apparent wave activity fluxes emitting from where the snow cover anomalies are located. Observation indicates that the sub-seasonal variability of upstream (e.g. North America, Europe) winter snow cover could explain 12–41% variance of the large-scale atmospheric circulation responsible for the winter monthly precipitation in northern China.