Predictable Climate Dynamics of Abnormal East Asian Winter Monsoon: Once-in-a-century Snowstorms in 2007/08 Winter

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In 2007/08 winter, East Asia (EA) experiences the most severe and long-persisting snowstorm in the past one hundred years. Results in this study show that 2007/08 winter is dominant by the third principal mode of the East Asian winter monsoon (EAWM). Significantly distinguished from the first two leading modes, the third mode positive phase features an increased surface pressure over the northwestern EA, an enhanced central Siberian high (CSH), a strengthened and northwestward extended western Pacific subtropical high (WPSH) and anomalously strong moisture transport from western Pacific, Arabian Sea and Bay of Bengal to EA. It also exhibits an intimate linkage with the sea surface temperature anomalies (SSTAs) in the Arctic Ocean areas adjacent to northern Eurasian continent, central North Pacific and northeastern Pacific. Such SSTAs emerge in prior autumn and persist through ensuing winter, signifying precursory conditions for the anomalous third EAWM mode.

Numerical experiments demonstrate that the Arctic SSTAs excite geo-potential height anomalies over northern Eurasian continent and impacts on the CSH, while the extra-tropical Pacific SSTAs deform the WPSH. Co-effects of them play crucial roles on origins of the third EAWM mode. Based on these results, an empirical model is established to predict the third mode of the EAWM. Hindcast is performed for the 1957-2008 period, which shows a quite realistic prediction skill in general and good prediction ability in the extreme phase of the third mode of the EAWM such as 2007/08 winter.