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The Role of Warm North Atlantic SST in the Formation of Positive Height Anomalies over the Ural Mountains during January 2008

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The most severe snowstorm and freezing-rain event in the past 50 years hit central and southern China in January 2008. One of the main reasons for the anomalous climate event was the occurrence of atmospheric circulation anomalies over middle and high latitudes, particularly the persistent blocking that occurred over the Ural Mountains. Along with atmospheric anomalies, a strong La Niña event in the Pacific and warm sea surface temperature anomalies (SSTAs) in the North Atlantic were the most significant in the lower boundary. Since a brief analysis suggests that La Niña exerts no significant impact on the Urals, the role of the warm SSTAs in the North Atlantic was focused on.

Based on an observational composite, North Atlantic SSTAs pattern when the height anomaly over the Urals was strongly positive was found similar to that in January 2008, but no significant SSTAs occurred elsewhere, such as the Pacific. Using two atmospheric general circulation models, MPI-ECHAM5 and GFDL-AM2.1, the impact of North Atlantic SSTAs on the extratropical atmosphere circulation in the event was investigated. First, the model's ability of simulating atmospheric response to mid-latitude SSTAs was examined. Two models can reproduce the observed wave-like low-frequency variability and strom track from North Atlantic to the Urals. This meant, to a large extent, the modeled atmospheric responses to mid-latitude SSTAs were believable. Then, model simulation and observation were compared. The geopotential height anomalies over the Urals were positive and significant. Besides, the local atmospheric response over North Atlantic was similar to the observation. Model results indicated the warm SSTAs can strengthen blocking high over the Urals, which favored a cold-air pile-up in the north that then broke out toward the south. Last, the mechanism by which the SSTAs influenced atmospheric circulations was analyzed, and we found that anomalous transient eddies played an important role for the maintenance of blocking. The consistency between the models and the observation indicated that the warm SSTAs in the North Atlantic were indeed an important factor in the formation of the snowstorm disaster of January 2008.