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Impact of northern Eurasian snow cover in autumn on the warm Arctic–cold Eurasia pattern during the following January and its linkage to stationary planetary waves

Xinping Xu (1), Shengping He (4,3,2), Fei Li (5,2,1), Huijun Wang (1,2,3)

(1) Collaborative Innovation Center on Forecast and Evaluation of Meteorological Disasters/Key Laboratory of Meteorological Disaster, Ministry of Education, Nanjing University of Information Science & Technology, Nanjing, China, (2) Nansen-Zhu International Research Center, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China, (3) Climate Change Research Center, Chinese Academy of Sciences, Beijing, China, (4) Geophysical Institute, University of Bergen and Bjerknes Centre for Climate Research, Bergen, Norway, (5) NILU-Norwegian Institute for Air Research, Kjeller, Norway

The connection between Eurasian snow cover (SC) in autumn and Eurasian winter mean surface air temperature (SAT) has been identified by many studies. However, some recent observations indicate that early and late winter climate sometimes shows an out-of-phase relationship, suggesting that the winter mean situation might obscure the important relationships that are relevant for scientific research and applications. This study investigates the relationship between October northern Eurasian SC (NESC; 58°–68°N, 30°–90°E) and Eurasian SAT during the winter months and finds a significant relationship only exists in January. Generally, following reduced October NESC, the East Asian trough and Ural high are intensified in January, and anomalous northeasterly winds prevail in mid-latitudes, causing cold anomalies over Eurasia. Meanwhile, anomalous southwesterly winds along the northern fringe of the Ural high favor warm anomalies in the Arctic.
The dynamical mechanism for the connection between NESC in October and the warm Arctic–cold Eurasia (WACE) anomaly in January is further investigated from the perspective of quasi-stationary planetary wave activity. It is found that planetary waves with zonal wavenumber-1 (ZWN1) play a dominant role in this process. Specifically, the ZWN1 pattern of planetary-scale waves concurrent with October NESC anomaly extends from the surface to the upper-stratosphere. It persists in the stratosphere through November–December and propagates downward to the surface by the following January, making the connection between October NESC and January climate possible. Additionally, the influence of October NESC on the January WACE pattern has intensified since the early-2000s.