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Processes and mechanisms of the initial formation of the Siberian High during the autumn-to-winter transition

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The Siberian High (SH), an important atmospheric system over Eurasia, exhibits notable seasonality—forming in autumn and peaking in the boreal winter. Many previous studies have revealed the characteristics of the SH in its peak phase; however, the SH formation process remains unclear. This study examined the climatological characteristics of SH formation with a cumulative sea-level-pressure series over the Siberian region based on observational data. First, the SH formation dates were objectively detected in both the climatology (October 1, 55th pentad) and individual years. Then, the thermodynamic processes around SH formation were investigated based on these formation dates. The results indicated that, in the lower troposphere, an anticyclonic circulation dominates over the Eurasian continent after SH formation. In the middle troposphere, an anomalous northeast-southwest-oriented ridge and trough appear over upstream of the SH and the coast of Northeast Asia, respectively. In the upper troposphere, the subtropical westerly jet, with its entrance located over the SH, intensifies and migrates southward, accompanying the amplification of its secondary circulation that features downward (upward) motion over Siberia (south of the Tibetan Plateau). The combined effects of the jet-associated circulation, negative vorticity advection and cold advection associated with the ridge and trough, and diabatic cooling contribute to high-level convergence and large-scale subsidence over the SH area, thereby resulting in SH formation. Further diagnosis reveals that dynamic processes play a more important role in SH formation than the thermal processes do.