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Extreme Heat Event Over Northwest China Driven By Silk Road Pattern Teleconnection And Its Possible Mechanism

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Introduction

Northwest China is located in the drylands of central Eurasia, where the climate and ecological environment are more vulnerable to global warming than in other parts of the world. Over the past few decades, the frequency of heat waves in Northwest China has increased significantly, and its causes remain unclear.

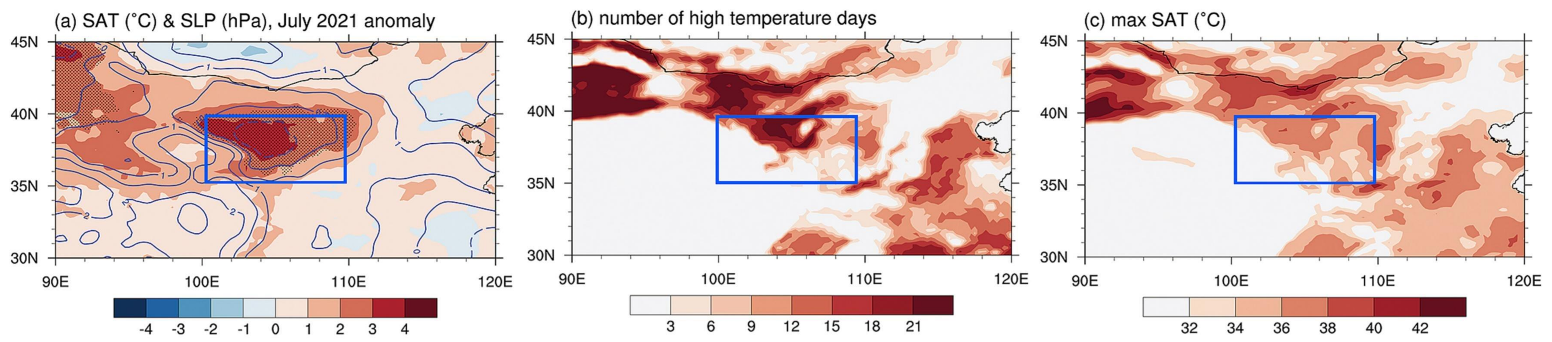


Fig. 1. Weather conditions for July 2021 in the eastern Northwest China (ENC), along with a comparison to the climatological mean states during 1981–2020.

- The maximum surface air temperature (SAT) anomaly exceeded 4 °C .
- The areas in which the longest hot days recorded were consistent with the highest surface temperature areas.

Results

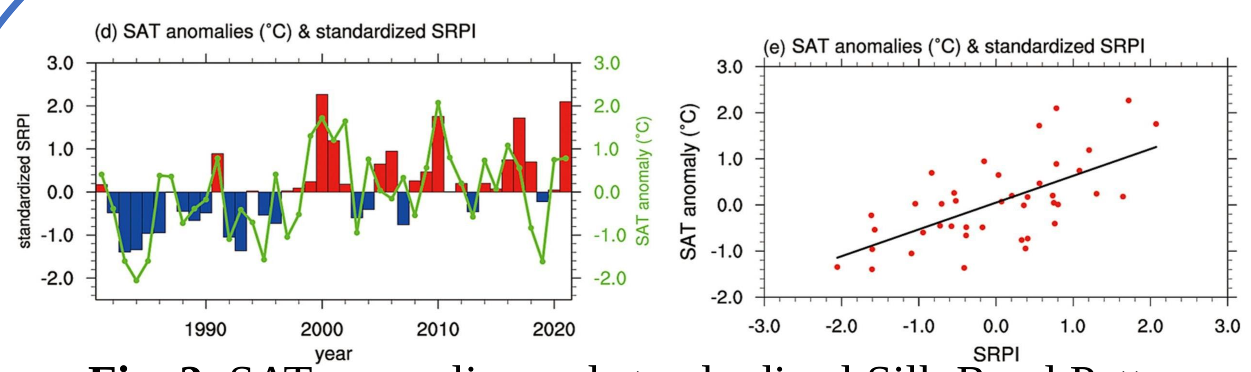


Fig. 2. SAT anomalies and standardized Silk Road Pattern Index (SRPI).

- The high values of SRP are often associated with the positive surface temperature anomaly, and the correlation index could reach 0.65.

- A significant "+ − +" structure of geopotential height anomaly crossed over West to East Asia, which is similar to the spatial structure of SRP.
- The positive anomaly was located over ENC. There is a barotropic structure in the whole troposphere.
- The primary wave source of SRP originated from the North Atlantic.

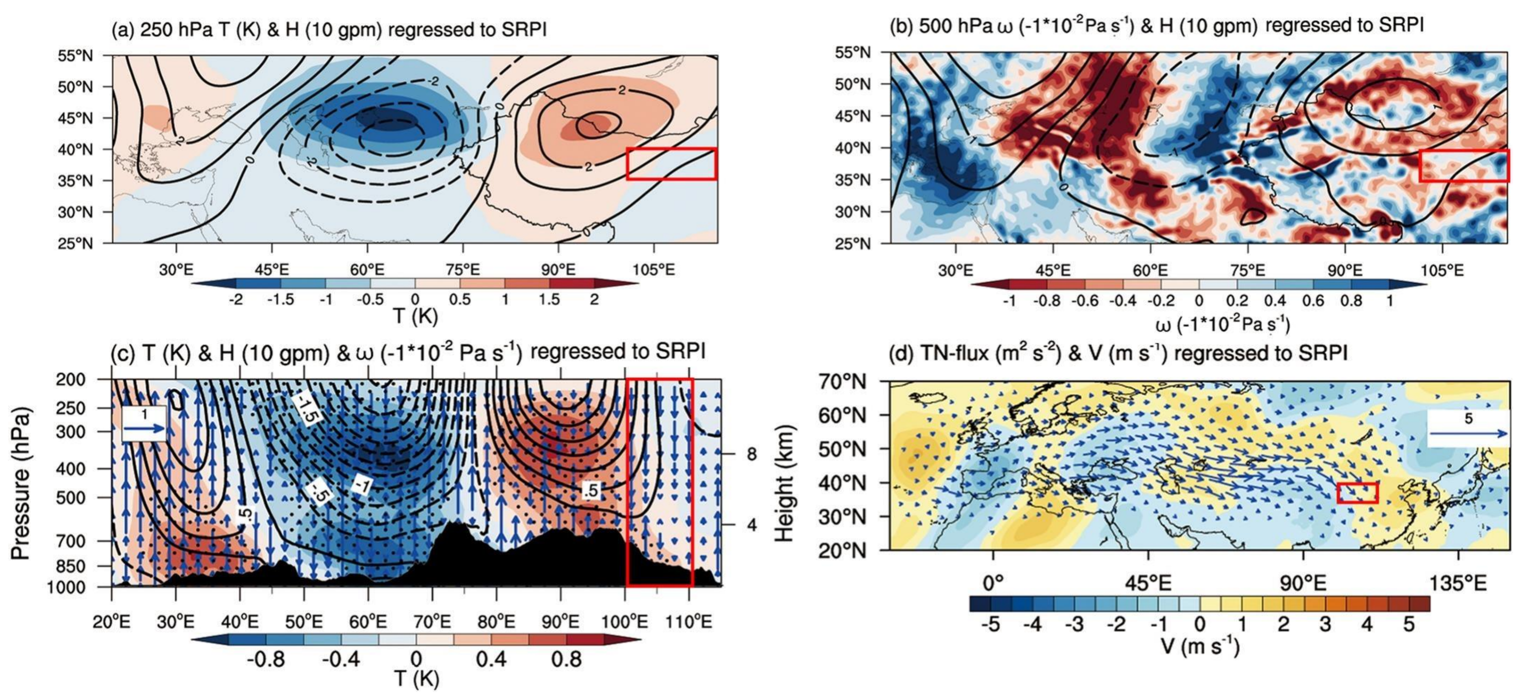


Fig. 2. SRP-regressed temperature, geopotential height, vertical velocity, meridional wind, and T-N wave activity flux at different pressure levels.

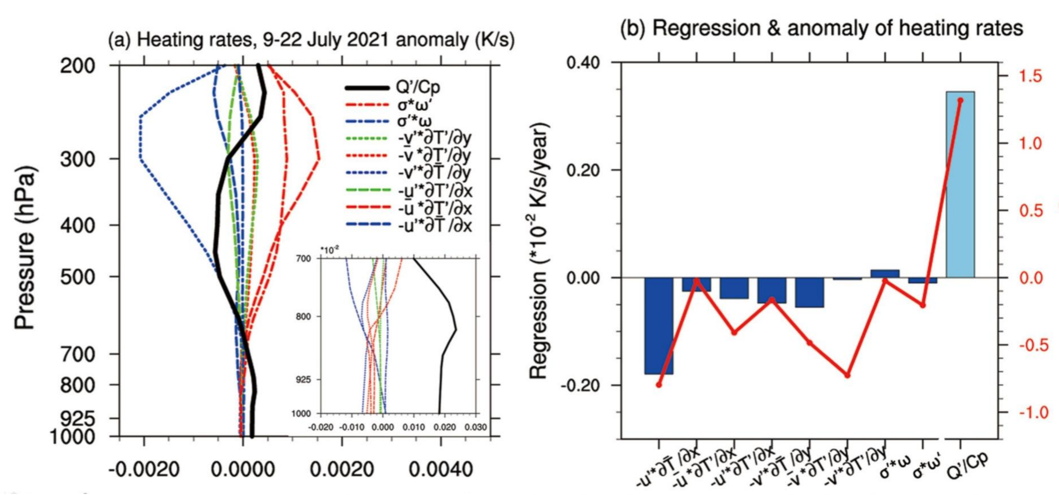


Fig. 3. Contributions of adiabatic and diabatic heat.

- Diabatic heating primarily affected the lower troposphere, whereas adiabatic heating primarily affected the upper troposphere.
- The diabatic heating showed a strong positive impact.

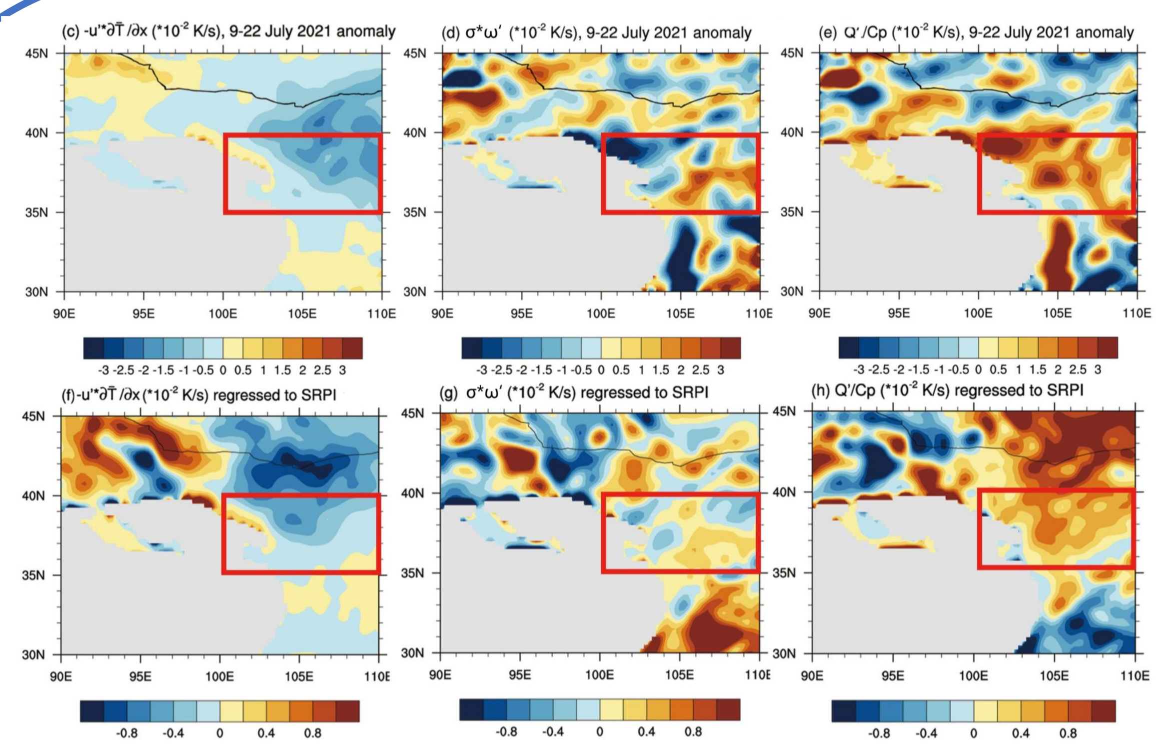


Fig. 4. Anomalies and SRP-regressed values of the adiabatic and diabatic heat during July 9–22, 2021 from surface to 700 hPa.

- The temperature positive anomaly in the lower troposphere is mainly caused by the vertical velocity anomaly in the adiabatic heating term and the diabatic heating term
- The results of regression SRP are highly consistent with the anomalies of the variables.

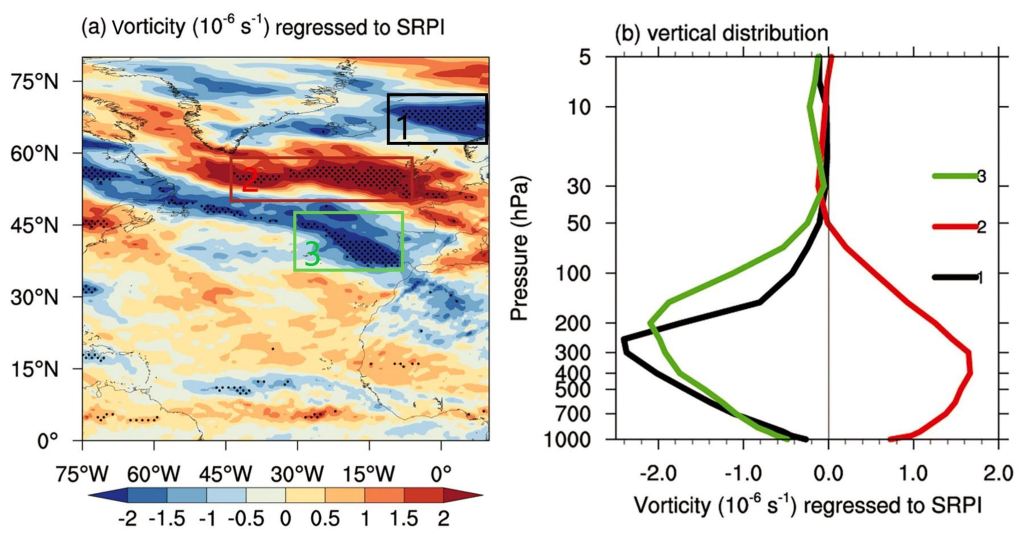


Fig. 5. Selection of the LBM vorticity sensitivity test.

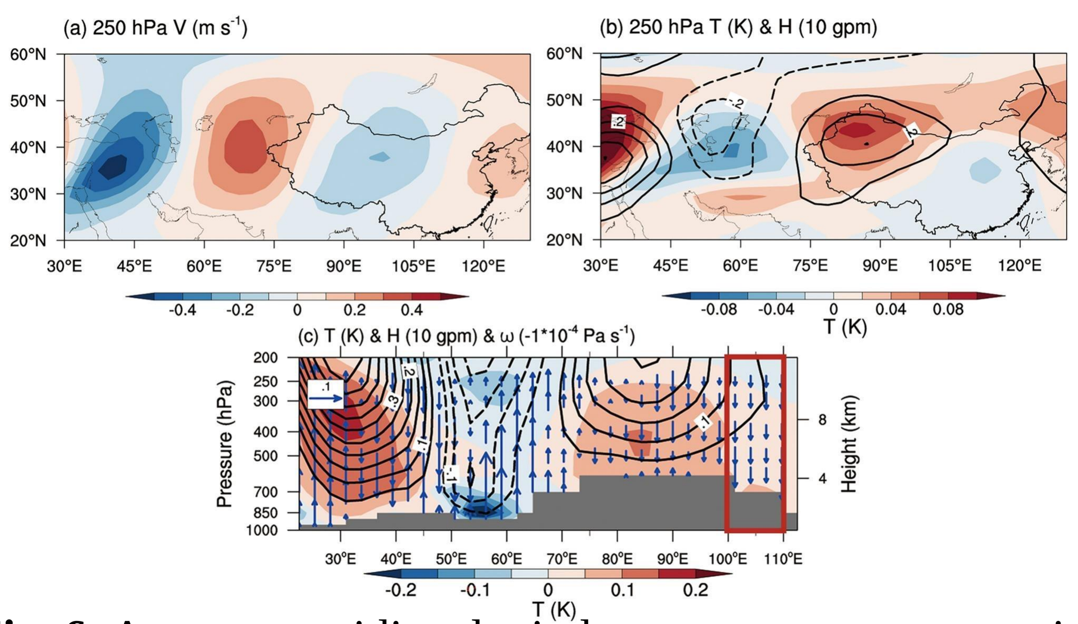
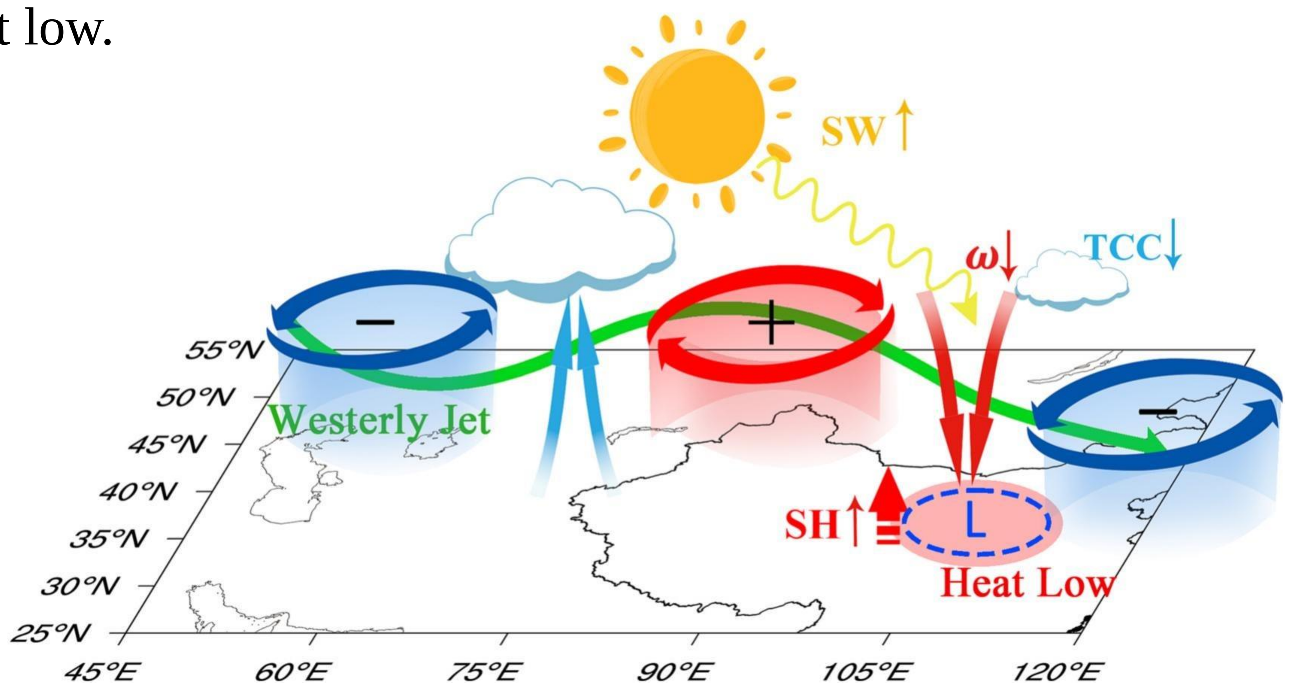


Fig. 6. Average meridional wind, temperature, geopotential height, and vertical velocity of the LBM vorticity sensitivity test at each level during days 24–49.

- The results of the LBM sensitivity test show that the source of the SRP is located in the North Atlantic Ocean and has a major influence on the high temperature in ENC.

Conclusion

The sinking motion provides the adiabatic dynamic conditions for heating air throughout the troposphere. Adiabatic subsidence lead to a decrease in total cloud cover and an increase in the downward solar shortwave radiation flux. This enhancement increases the surface temperature and heats the lower atmosphere through sensible heat transfer, forming a heat low.



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