Simulation of a torrential rainstorm and stratospheric gravity wave analysis

Rui Yang[1,2], Yi Liu[1], Lingkun Ran[1], Yuli Zhang[1]

[1] *Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China*
[2] *University of Chinese Academy of Sciences, Beijing, China*

Stratospheric gravity waves, as the important role of atmospheric dynamics for climate variability and change, which have dramatic effects on the circulation in planetary atmospheres through the wave drag and diffusion they induce. Because they have small scales compared to the resolution in global models, these effects are parameterized. The importance of including parameterized wave drag has long been recognized as critical to weather prediction, and now researchers are demonstrating new sensitivities to gravity wave drag in simulations. We used the Weather Research and Forecasting model to simulate a torrential rainstorm that occurred in Xinjiang, China from June 16–17, 2016. The model successfully simulated the rainfall area, precipitation intensity, and changes in precipitation. We identified a clear wave signal in the stratosphere using the two-dimensional fast Fourier transform method; the waves propagated westwards, with wavelengths between 45 and 120 km, periods between 50 and 120 min, and phase velocities mainly concentrated in the -25~-10 m/s range. The results of wavelet cross-spectral analysis further confirmed that the waves were gravity waves, peaking at 11:00 UTC, June 17, 2016. The gravity wave signal was identified along 79.17–79.93°E, 81.35‑81.45°E, and 81.5–81.83°E. Gravity waves detected along 81.5–81.83°E corresponded well with precipitation that accumulated in 1 h, indicating that gravity waves could be considered a rainstorm precursor in future precipitation forecasts.

Key words: Stratospheric gravity wave, rainstorm, spectral analysis methods, Weather Research and Forecasting model