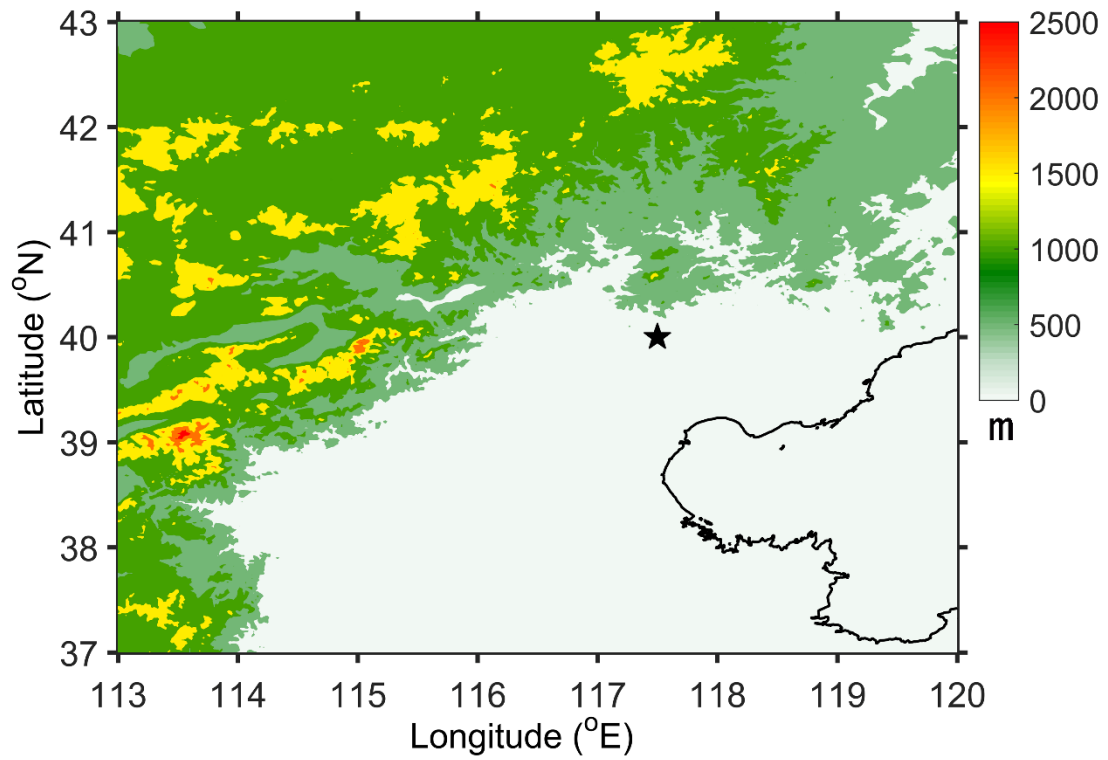
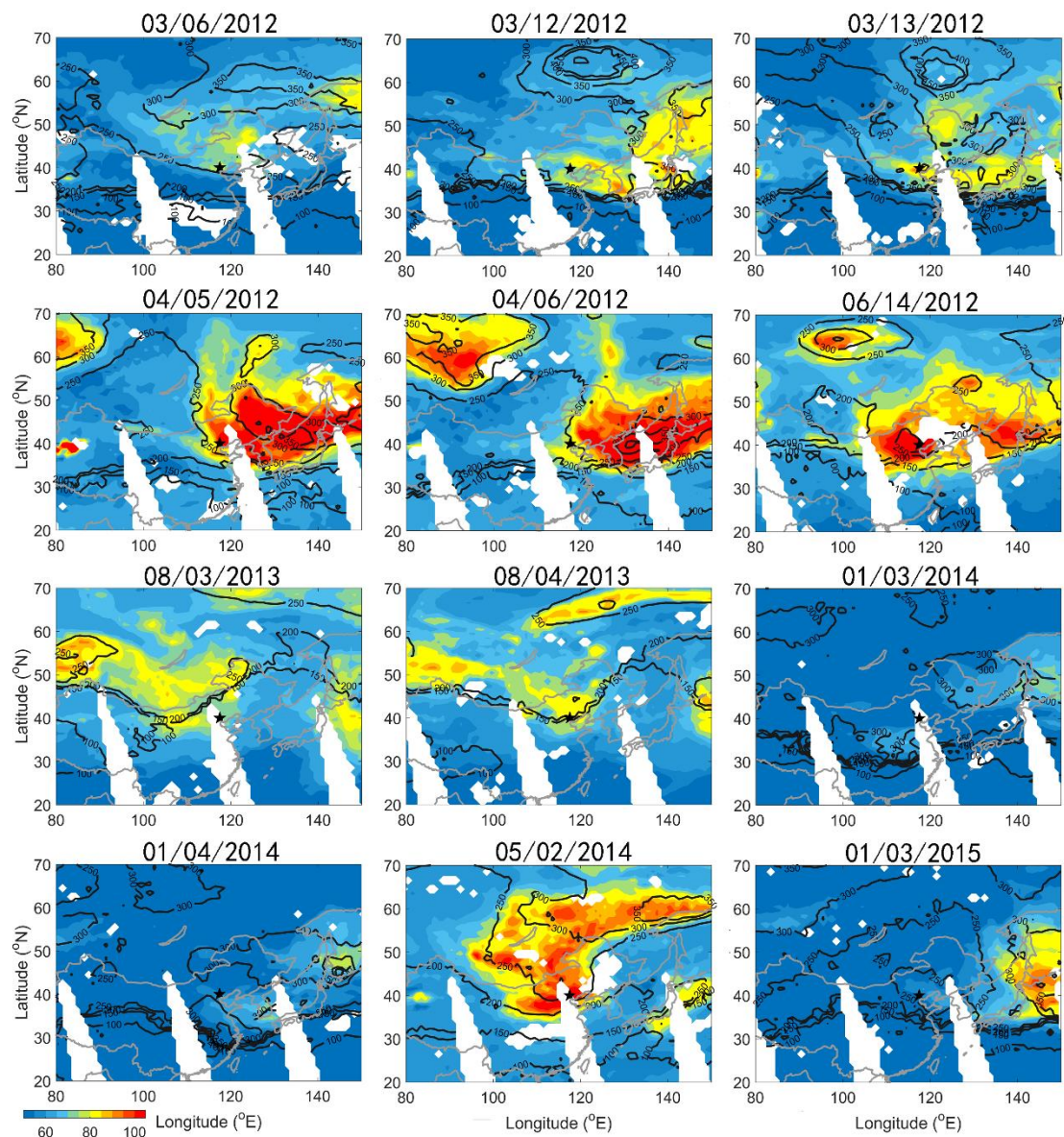
Supplementary material

There is relatively higher topography (~1000 m mountains) located in the north of the Beijing MST radar site (Supplementary figure S1). This topographic feature contributes to the production of mountain waves, especially when the winds become dominant northerly.

It is well established that AIRS retrieved ozone provides strong information for identifying a stratospheric intrusion event. Supplementary figure S2 shows the AIRS derived daily 500 hPa ozone distribution corresponding to the cases shown in Figure 12a, to assist to support the evidence of possible stratospheric intrusions closely associated with the strong downdrafts preceding RT ascent. Due to some of the cases occur close together, as well as due to the limited resolution in AIRS retrieved data (daily in fact), not every individual case in Figure 12a can be clearly checked from AIRS observations. Almost every case (except for the cases labeled by A, B, C, and D) is associated with some form of significant 500 hPa ozone enhancement, indicating the intrusions of stratospheric origin.

Supplementary figure S1. The topographic feature near the radar site (colors in m).

The black star shows the location of the Beijing MST radar.

Supplementary figure S2. AIRS retrieved daily 500 hPa ozone distribution along with the tropopause height contour corresponding to the 20 cases in Figure 12a. The black star shows the location of the Beijing MST radar.