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On the Role of Stratospheric Anomalies in Long-Range Propagation of Infrasound

The importance of atmospheric structures on the infrasonic waveguides has been illustrated in several works using asymptotic techniques. However, these techniques fail to describe the interactions between infrasounds and stratospheric changes, such as the sudden stratospheric warmings. In the present work, we study how breaking gravity waves in the stratosphere impact the long-range propagation of infrasounds. We consider the case in which the gravity waves break near their critical levels, producing a force on the large-scale flow. When the horizontal extension of the corresponding wave packet is around a few hundred kilometers or less, the large-scale atmosphere response contains inertial oscillations, inertio gravity waves, and balanced disturbances associated with potential vorticity anomalies. When the critical level is close enough to the ground, these perturbations can also trigger non-geostrophic baroclinic instabilities. The relative importance of these different processes on the tropospheric and stratospheric infrasound arrivals is analyzed with a numerical model based on the Finite Element Method. Our results can be used to study the resultant effect of localized stratospheric disturbances on the recorded signals. Determining how the waveforms are affected by stratospheric changes will provide insight into how reasonable comparisons between measured signals and purely numerical results may be made.

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