Special Program in Applied Mathematics and Applied Mechanics

A Numerical Study of Convectively Generated Gravity Waves atop thunderstorms

2013 - 04 - 24 (Wed.)
15:00 - 18:00
308, Mathematics Research Center Building (ori. New Math. Bldg.)

Deep convective clouds are known to generate gravity waves that can propagate upward and can transport momentum, energy and water vapor from the troposphere to the upper atmosphere. In this study, a high resolution 3-D numerical model has been utilized to simulate thunderstorms under various scenarios. Three main sensitivity factors considered here are the static stability, vertical wind shear and moisture which are manipulated and analyzed in this study. The results show the gravity wave properties largely conform with those predicted by the linear theory. The stability affects the gravity wave propagation direction in stratosphere. The phase lines are oriented more horizontally in a stable environment than in a less stable case. Vertical wind shear affects the gravity wave energy by propagating it mainly toward upstream of thunderstorm. The \"mean flow filter effect\" limits the gravity wave energy propagation in downstream of thunderstorm. Moisture can contribute a significant amount of energy to generate the gravity waves above the tropopause. Moisture also cause small-scale wave sources within the stratosphere. These can generate short-wavelength (high-frequency) gravity waves above the anvil of thunderstorm, of 3-5 km, close to that observed by meteorological satellites.