Convection Generated High-Frequency Gravity Waves: Comparison between MST Radar Observations & WRF Simulation

PRIYANKA GHOSH[1], T. K. RAMKUMAR[1], V. YESUBABU[1], SOM SHARMA[2] and C. V. NAIDU[3]

[1]National Atmospheric Research Laboratory, Gadanki-517112, India
[2]Physical Research Laboratory, Ahmedabad-380009, India
[3]Dept. of Meteorology and Oceanography, Andhra University, Visakhapatnam, India

Mesoscale convection events associated with deep cumulonimbus clouds transport moisture, sensible and latent heat to the upper troposphere and lower stratosphere, affecting the energetics and general circulation of the atmosphere. It is very crucial to understand the atmospheric dynamics during pre–monsoon periods during which strong mesoscale convective events occur. The present study attempts to study the characteristics of high frequency gravity waves generated over Gadanki, India during one such convection event in the pre–monsoon period. For this purpose, the MST radar (53 MHz) at Gadanki was operated continuously for 10 hours on 27–28 May 2015. Many different frequencies of gravity waves with different generation mechanisms are found during the convection time; their vertical propagation characteristics are found to satisfy governing dispersion relation of non-hydrostatic high frequency gravity waves. The temperature and wind data of ERA-interim reanalysis and GPS radiosonde, launched at Gadanki, are analyzed for ten days around the event day to determine the background atmospheric thermodynamic conditions. It is observed strong up and down drafts in the whole height range of 3.6-20 km (radar limited top height); the presence of which even up to 20 km height is quite rare. The WRF simulated meteogram on 27-28 May 2015 clearly depicts the mid tropospheric moisture intrusion at 700-500 hPa level (~3.2 km-6 km), which is generally observed near the surface level of 850 hpa (~1.5 km). Presence of moisture is also observed at the higher heights of 200-300 hPa levels (~10-12.5 km), which may be due to higher level divergence of deep cumulonimbus clouds or due to advection. During the present observation period of 10 hours, it is detected the convective gravity waves generated locally as well as in the remote location. From the height profiles of phase of some oscillations, it is found the source of these waves near ~20 km height, which is probably a first-time observation that is verified with high resolution WRF model simulation.

To compare the difference between mountain generated gravity waves and transient mountain generated gravity waves during convection (obstacle effect), similar type of study is planned to be carried out in the sub-tropical western Indian region using ground-based Rayleigh and Raman lidar combined with satellite observations and WRF model simulations.

Key words: convection, gravity waves, MST radar, WRF model, lidar