TROPOSPHERE/STRATOSPHERE GRAVITY WAVES AND RELATED MESOSPHERE TURBULENCE OBSERVED BY MST RADAR OVER GADANKI (13.5° N, 79.2ºE)

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The Indian Mesosphere Stratosphere Troposphere (MST) radar facility at Gadanki has been utilised to study the mesospheric backscatter signals from ionisation irregularities produced by the upward propagating gravity waves from troposphere/stratosphere. The observations were carried out during a few days in the summer of 2001-2002 using multiple beam switching at 10º, high spatial resolution (up to 150 m) and time interval between scans of 80 s simultaneously covering the heights between 4-20 km and 60-90 km. Sample height profiles of SNR of a typical summer day of 25 June 2002 show maximum values of ~15 dB below 18 km height with 3-4 prominent/continuous tropospheric scatter layers of ~3 km thickness and ~5 dB in the mesosphere with ~2 km thick intermittent layer around 70 km. Stronger echoes from all available tropospheric/ stratospheric layers sometimes correspond to occurrence of additional mesospheric layer(s) of scatter. Wind velocity contours on the same and other days show reversal around 8-10 km for zonal and meridional components. The time sequence of horizontal and vertical winds in the troposphere/stratosphere show both erratic behaviour pertaining to presence of turbulence as well as more systematic undulations due to typical gravity wave periodicities of 10-20 min. The amplitudes of these gravity waves grow with height unless these are filtered out lower down or reach breaking height earlier. The filtered and unobstructed waves are able to reach the mesospheric breaking height to generate mesospheric turbulence. The results of 25-28 June 2002 and 26 July 2001 show ample evidence of such phenomenon. While wave components and pattern in the lower stratosphere (18-20 km) are seen to be crucial in determining the occurrence of mesospheric turbulence, further variability may be attributed to the role played by the 30-50 km range of stratosphere not observable by the radar. Wavelet analyses of wind velocities provide more details of the turbulence/gravity wave scenario corresponding to mesospheric effects. Various parameters of gravity waves such as phase/group velocities, wave number spectra, amplitudes, periods, wave-wave interference, breaking altitudes inferred from these observations and their mesospheric influence are computed and discussed using theoretical models as reference.

MST radar, Mesospheric turbulence, Gravity wave coupling

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