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# Variability of the gravity wave forcing from troposphere to mesosphere: By momentum flux estimation

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Using long-term data (1998 to 2008) collected from Mesosphere-Stratosphere-Troposphere (MST) radar and Rayleigh Lidar located at a tropical station, Gadanki (13.5oN, 79.2oE), India, variability of the gravity wave forcing from troposphere to mesosphere is investigated by estimating the momentum flux associated with the gravity waves of periods 20 min. to 2 h, for the first time. The emphasis is on seasonal variability of mean zonal and meridional momentum fluxes in mesosphere and troposphere and vertical flux of zonal momentum in the stratosphere. An effort is made to examine the variations in momentum flux for different cases, viz., during the occurrence of mesospheric temperature inversion and convection events. At tropospheric altitudes of 11-16 km large enhancement in flux is noticed during equinoxes. In the stratosphere the maximum values of flux (˜2.8 m2/s2) are pragmatic in winter and spring at the altitude region 58-62 km. Interestingly, the vertical flux of zonal momentum estimated from lidar is in the range of those estimated from radar data in the overlap altitude region, though the estimates are from two different techniques. In the mesosphere, in summer large variations with altitude in zonal momentum flux are noticed with a magnitude ˜0- 4 m2/s2. The meridional fluxes in the mesosphere are higher in equinoxes (˜10-12 m2/s2). The two case studies showed that during mesospheric temperature inversion due to large wave breaking at mesosphere, momentum fluxes are raised up to ˜7-10 m2/s2 and during deep convection, large variations in troposphere momentum fluxes are noticed than in mesosphere and the variations in mesospheric momentum fluxes due to tropospheric convection are noticed at earlier times than overhead convection period in troposphere, the possible reasons are discussed.

Keywords: Mesosphere-Stratosphere-Troposphere, short-period gravity waves, Momentum flux, MST radar, Rayleigh lidar