0.1 MF radar studies of wave disturbances in the mesosphere

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The mesopause region plays a key role not only in coupling the different atmospheric layers, but also in transferring momentum into thermosphere even from the lithosphere. This is important for examining the role of Acoustic Gravity Waves, generated by outgassing, crustal shifts or other mechanisms leading up to the development of an earthquake, in the creation of ionospheric signatures of earthquake precursors. The aim of this study is to understand ionosphere-atmosphere coupling through wave propagation in the mesosphere (80 – 90 km) at mid latitudes and its dependence on the time of day, season, and geomagnetic activity. The techniques used in this study are based on spectral analysis of the statistical features of the received envelope amplitudes. The active radar observations are taken with the MF radar, and the passive radar observations utilize the broadcasts of MF radio stations. The polarimeter data were collected during 2000 – 2005 and spanned all times of the day, all seasons, and all geomagnetic activity levels (index Kp = 0 – 9). The total record duration exceeded 700 hr, the passive radar observations yielded more than 400 hr of data, and wavelet and Fourier decomposition of the data was carried out. The relative amplitude, period, and the duration of wave disturbances have been analyzed. Quasi-periodic processes with 5 – 25-min period, are apparently associated with local wave sources, such as wind shears, turbulence, topography, etc. Their total duration equals to 20 – 45% of the total record duration. The wave disturbances whose periods fall into the 30 – 120-min interval, which are apparently associated with global processes occurring at mid and high latitudes, are observed during 60 – 90% of the total record duration. The processes involved in generating these waves may include magnetospheric electric fields and energetic particle precipitation at high latitudes during storms, the moving solar terminator, and anticyclones, and consequently, the wave disturbances do not show seasonal variations. The relative amplitude of wave disturbances has a tendency to increase during nighttime and with geomagnetic activity level, while the mean relative amplitude is shown to be usually equal to 2 – 4% and to attain 7 – 15% in individual measurements. The detected periods and the duration of wave disturbances in the mesosphere and in the thermosphere are similar, which supports the idea that the upper mesosphere and the thermosphere is coupled via wave disturbances.