

Simultaneous Observations of MLT and Upper Thermosphere/Ionosphere Using the Mu Radar

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Simultaneous mesosphere/lower thermosphere (MLT), upper thermosphere, and ionospheric F region observations were made four times at solstices and equinoxes with a duration of about one week each using the MU radar (34.8N, 136.1E) in alternate meteor and incoherent scatter modes. This campaign (MTEC-S: mesosphere-thermosphere experiments for coupling studies) is a project aimed to study the dynamical coupling between upper atmospheric regions, and provides simultaneous zonal and meridional wind velocities at MLT altitudes (80-95 km), meridional wind velocity in the upper thermosphere (about 300 km), and electron density in the ionosphere with a time resolution of 1.5 hours. Diurnal and semi-diurnal tides and waves of periods 16-20 hours and 35-55 hours coexist at MLT and upper thermosphere altitudes, and waves become stronger than tides at mesopause at equinoxes. Comparison of mean winds, tides, and waves in these four campaign observations will be presented. Geomagnetic storms occurred during one of these observations (during 23 March to 2 April 2001), and the MU radar, MF radars at Wakkanai (45.36N, 141.81E) and Yamagawa (31.20N, 130.62E), OMTI (Optical Mesosphere Thermosphere Imagers) instruments located at the MU radar site, and GPS receivers spread out over Japan were in operation throughout the campaign. The wind changes and their effects on the different height regions caused by storms will be also presented. Following the major storm, the meridional wind in the upper thermosphere becomes weak (less poleward) during daytime and its diurnal amplitude reduces. In the ionosphere, following the onset of the major morning storm, the electron density increases at altitudes near and above the ionospheric peak, which is followed by large increase in density at all altitudes above about 200 km. On the following night, though the density is generally low, there is a large increase in density in the bottomside for about 3 hours centered at 02:30 LT. During this time, a rare intense optical activity has occurred at all wavelengths (557.7 nm, 630 nm and 777.4 nm) over the low-mid latitude location (35N), and an associated large scale travelling ionospheric disturbance (LSTID) has propagated from north to south at F region altitudes.