MLT and thermospheric F region observations and modelling

N. Balan(1), S. Kawamura(2), T. Nakamura(3), A. D. Aylward(4), M. E. Hagan(5), M. Yamamoto(3), S. Fukao(3), W. L. Oliver(6), and H. Alleyne(1)

(1)Automatic Control and Systems Engineering, University of Sheffield, Sheffield S1 3JD, UK. (2)NICT, Tokyo 184-8795, Japan. (3)RISH, Kyoto University, Japan. (4)APL, UCL, London, UK. (5)NCAR, Boulder, USA. (6)Center for Space Physics, Boston University, USA.

Observations of the mesosphere lower-thermosphere (MLT) region and thermospheric F region (upper thermosphere and embedded ionosphere) have been made by operating the MU radar (35°N, 136°E) in alternate meteor and incoherent scatter modes under a project called MTEC-S (Mesosphere-Thermosphere Experiments for Coupling Studies). The continuous MTEC-S observations provide simultaneous zonal and meridional wind velocities at MLT altitudes (80-95 km), meridional wind velocity in the upper thermospher e (220-450 km), and electron density and peak height in the ionosphere with a time resolution of 1.5 hours. Several continuous observations, each lasting more than a week, have been conducted at equinoxes and solstices. The data from a March equinox MTEC-S observation, conducted for 10 days when two geomagnetic storms occurred, have been used to study the storm-time changes in mean winds, tides and waves at MLT and upper thermosphere altitudes, and the results have been reported recently.

The present paper compares the mean winds, tides and waves at magnetically quiet March and September equinox conditions using the MU radar data from October 2000 and March 2001 MTEC-S observations. The MU radar data are also compared with those modeled using a Coupled Mesosphere and Thermosphere model (CMAT). In addition, the 24-hour and 12-hour tidal amplitudes and phases obtained from the MU radar data are compared with those predicted by the Global Scale Wave Model (GSWM). The study seem to suggest that the upper atmospheric regions could be dynamically coupled through mean winds, tides and waves. Diurnal (24-hour) and semi-diurnal (12-hour) tides and waves of periods 16-20 hours and 35-55 hours coexist at MLT and upper thermosphere altitudes, and the waves become stronger than tides at mesopause ($\approx$ 88 km) at both equinoxes. The MU radar data also show large differences between the two equinoxes in mean winds, tides and waves in the MLT region. The GSWM-02 model qualitatively predicts the observed growth of the tides with altitude but does not predict the 12-hour tide becoming stronger than the 24-hour tide at altitudes above mesopause at September equinox.