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Study of the vertical coupling of the atmosphere at Tromsoe, Norway

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We will present results of the vertical coupling at Tromsoe (69.6N, 19.2E) in northern Scandinavia. At the EISCAT Tromsoe site, we have operated the sodium LIDAR, the MF radar, and the meteor radar to study dynamics of the polar mesosphere and lower thermosphere. By combining these datasets together with EISCAT radar datasets, we can obtain wind data from 70 to 120 km. In this talk, we will present results of two topics: (1) altitude variation of the semidiurnal tide, and (2) response of the upper mesosphere/lower thermosphere to Sudden Stratospheric Warming (SSW) events.

The MF radar and the meteor radar at Tromsoe provide continually horizontal wind data between 70 and 91 km and 80 and 100 km since November 1998 and October 2003, respectively. The sodium LIDAR was installed in March 2010, and started observations of the neutral temperature and the sodium density between 80 and 110 km in October 2010. The sodium LIDAR started observations of five directions of the wind velocity (vertical, south, north, west, and east) in October 2012. In total, to date, we have obtained about 2800 hours of neutral temperature and sodium density data, and about 1700 hours of wind velocity data by using the sodium LIDAR.

We have investigated altitude variations of the semidiurnal tide using both wind and temperature data, whose temporal length is longer than or equal to 12 hours, obtained by the sodium LIDAR for 62 nights. There appear two typical altitude profiles of the amplitude: one is that the amplitude maximizes at around 90 km, and decreases above, and again increases with increasing altitude, and the other is that the amplitude gradually increases with increasing altitude up to 100 km or higher. We will discuss possible causes of the difference of the altitude profiles.

Sudden Stratospheric Warming (SSW) is a large disturbance phenomenon occurring in the stratosphere in winter due to breaking of planetary waves. The response of the upper mesosphere, thermosphere, and ionosphere to SSWs has been widely investigated by using observational data and model predictions. We have analyzed variations of the temperature and winds above Tromsoe using sodium LIDAR data, meteor radar data, and EISCAT radar data in the upper stratosphere, mesosphere, and lower thermosphere. We will present those results and discuss differences of timing of the changes at different altitudes.

Keywords: Vertical coupling of the atmosphere, Tromsoe, EISCAT, sodium LIDAR, SSW, tidal waves