Horizontal temperature gradients in the polar MLT region above Tromsoe using sodium LIDAR data

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We have analyzed 2700 hours of temperature data obtained with the Tromsoe sodium LIDAR over 7 winters between October 2012 and February 2018, and we have calculated horizontal temperature gradients in the polar mesosphere and lower thermosphere (MLT) region between 83 and 105 km. The sodium LIDAR operated at the EISCAT Tromsoe site (69.6 deg. N, 19.2 deg. E) has a capability of simultaneous five-directional measurements of temperature and sodium density with good (3 min/500 m) resolutions. Configurations of the sodium LIDAR observational directions are as follows: vertical position, south (Azimuth= 180 deg.), north (Azimuth = 0 deg.), west (Azimuth = 270 deg.), and east (Azimuth = 90 deg.). The elevation angle was set to be 77.5 degrees between 2013 and 2016 seasons, while it was 60 degrees for 2 seasons in 2012 and 2017. Here we call interval between October and March as season, since the LIDAR measurements were made only for the interval.

We made a statistical study of the temperature gradients. For the statistical study, we have used data sets with their length longer than 4 hours at each night, then we have 187 nights in total: winter (between October 21 and February 23) for 163 nights, and equinox for 24 nights. On average over the 163 nights, the northward temperature gradient is negative (i.e. it was warmer in the south than in the north), and about -0.004 K/km at maximum below 97 km in winter, while it was positive above 97 km. The positive meridional temperature gradient above 97 km is consistent with that of Maeda et al. (JGR, 2004JA010893, 2005) who derived temperature gradients utilizing ion temperature data obtained with two EISCAT radars at Longyearbyen (78.2 deg. N, 16.2 deg. E) and Tromsoe; the gradients were calculated in a much larger scale compared to that of this study. The averaged zonal temperature gradient was about zero between 85 and 96 km, and it was westward above 96 km. Year-to-year variations are also found: they are more significant above 97 km in the both directions. Southward temperature gradients below 97 km seem to be a common feature over the 6 years except for 2012 season.

Then, we have investigated variations of temperature gradients on nightly basis. In this talk, we will present results of case studies about the temperature gradients in the polar MLT region. In particular, we focus on effects of auroral activities as well as influence of Sudden Stratospheric Warming (SSW).