Lidar data analysis of the sodium atoms in the thermosphere observed at Tromsoe, Norway

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Distribution of low-density Na atoms in the thermosphere is interesting because of the capability of measuring neutral temperature and wind into the lower thermosphere up to 140 km. The thermospheric Na atoms significantly made the altitude range of Na lidar measurements expanded from the 80–105 km to 80–140 km, covering almost the entire E region (Liu et al., GRL, 2016).

The measurements of wind and temperature by a Na lidar in the northern mesosphere (80-105 km) at Tromsoe, Norway (69.6˚N, 19.2˚E) have been carried out in Polar winter season since 2010. However, thermospheric Na has not been seen in our data so far. This is because the automatic analysis program calculates the background signal level using the 140-150 km signals which possibly include a small amount of thermospheric Na signal. Deriving thermospheric Na is done by lowering the background signal level to emphasize thermospheric Na signals. The data at the new moon are selected which have a low background signal. Also, we calculated signal intensity from the Na atoms in the thermosphere based on our lidar parameters such as laser power, a telescope aperture area etc. by using the lidar equation. The results are summarized as follows. (1) Assuming that the Na density is 10 /cm^3, the signal from the Na atoms between 120 and 140 km is expected 300-400 photons, (2) The background signal observed is about 4,400 counts which means the noise level is about 220. So the signal intensity from the Na is nearly comparable to the noise level. (3) Thermospheric Na was not clearly seen in the re-calculated data. However, it depends on the smoothing technique to the original lidar data.

In this talk, we show the results derived by varying the binning time and discuss it.

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