

Statistical investigation on thermospheric Na based on Na lidar observations at Tromsø

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A number of observations of atmospheric metal layers, such as Na, Fe, and K layers, have been widely carried out by using resonance scattering lidars. These metal layers are normally distributed at 80-110 km altitudes, and it can be called normal layers or main layers. By contrast, metals extending from main layers to higher altitudes (above 110 km) are so-called thermospheric metals, which are one of the interesting subjects in the recent lidar studies. While its densities of metallic atoms/ions are quite low compared with those of main layers, such thermospheric metals have potentially an importance in the extension of height coverage by the lidar observations.

It is considered that the thermospheric metals appear intermittently to some extent (not always present). Concerning to Na, there are several reports in the thermospheric Na events at low-, mid-, and high-latitudes. In addition to such event studies, statistical investigation is needed for more comprehensive understanding in the thermospheric Na. Therefore, in this study, we have investigated statistical characteristics in the thermospheric Na (up to 140 km), based on Na lidar observations at Tromsø, Norway (69.6°N, 19.2°E). We have accumulated 274-nights of Na lidar data from 2015 to 2019, and have calculated Na density data with 4-km/60-min integration. After the calculations, we have examined significance in the Na density data based on evaluations of its observational uncertainty. Then, we have defined the significant Na density data above 110 km as the thermospheric Na. Finally, we have derived a probability of occurrence in the thermospheric Na from the number of events of the significant thermospheric Na data. From this data analysis, we have found that the thermospheric Na probabilities were ~95% at 113 km, ~78% at 121 km, and ~44% at 128 km. The results would indicate that the thermospheric Na is not so rare at 110-130 km. In the presentation, we will show these results, and discuss relationship between the thermospheric Na probabilities and the formation mechanism in the thermospheric Na.

Keywords: Thermospheric Na, Resonance scattering lidar, Tromsø