

## Statistical study of Sporadic Sodium Layers (SSLs) above Tromsø (2)

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This study is the first statistical study of SSLs differentiating in-situ generated SSLs from advected SSLs at high latitudes, and evaluates necessary conditions for generating a SSL. Based on about 3000 hours of sodium density data obtained with the Tromsø sodium LIDAR over 7 year seasons (October-March) between 2012 and 2018, we have identified 36 events of Sporadic Sodium Layer (SSL) in the polar mesosphere and lower thermosphere (MLT) region. A SSL is a thin sodium layer (about 1-2 km) with high sodium density (usually factor of 2 or more higher than that of a normal layer), and its life time is said to be about a few minutes to a few hours. Observational results of SSLs are summarized as follows: (1) SSLs appeared for shorter than 5 % of the overall observational time, confirming it is a rare event at high latitude. (2) The advent altitude distributed from 94 km to 106 km; no clear trend is found. (3) The advent time distributed from 18 LT to 1 UT: no events are found before 18 LT or later 1 UT. (4) No relationship is found between advent time and altitude. (5) The peak density tends to be lower as height increasing. (6) Lifetimes do not show a clear relationship with advent altitudes. We have investigated necessary conditions for a SSL to form in the polar MLT region. Auroral electron precipitation as well as appearance of a sporadic E layer would be one of necessary conditions to form a SSL.

By using an advantage of five directional measurements, we have derived movement velocities of SSLs using detection times (i.e., advent times) at five positions by assuming a SSL has a linear front perpendicular to the movement direction, and have compared wind velocity. The movement directions are dominantly from south-eastward to south westward except for 3 events: most SSLs moved southward in the meridional direction. Based on comparison of the velocities, we have found that 29 out of 36 events (81%) are likely classified to be advection events, while 7 events are left for candidates of in-situ generation events. We will discuss difference of “advection” and “in-situ” events in terms of height/horizontal structures of sodium densities.

Keywords: SSL, Tromsø, Coupling between plasma and neutral particles, Sodium LIDAR