Study on sodium atom layer variation induced by auroral particle precipitations

T. T. Tsuda[1], S. Nozawa[2], T. D. Kawahara[3], T. Kawabata[2], N. Saito[4], S. Wada[4], Y. Ogawa[1], S. Oyama[2], C. M. Hall[5], M. Tsutsumi[1], M. K. Ejiri[1], S. Suzuki[2], T. Takahashi[2], and T. Nakamura[1]

[1] *National Institute of Polar Research, Tachikawa, Japan.*
[2] *Solar-Terrestrial Environment Laboratory, Nagoya University, Nagoya, Japan.*
[3] *Faculty of Engineering, Shinshu University, Nagano, Japan.*
[4] *Photonics Control Technology Team, RIKEN Center for Advanced Photonics, RIKEN, Wako, Japan.*
5 Tromsø¸ Geophysical Observatory, University of Tromsø, Tromsø, Norway

e-mail: tsuda.takuo@nipr.ac.jp

Sodium atom layer is generally distributed at 80-100 km. One of mysterious subjects on high-latitude sodium layers is relationship between auroral particle precipitation and sodium atom layer variation. A previous study suggested a sodium column density decrease during a geomagnetic active period due to that the particle precipitation accompanied by electron density enhancement could induce ionization of sodium atom through their ion-molecule chemistry. Another study pointed a possibility of sodium density increase. For this reason, it is suggested that auroral precipitating particle bombardment on meteoric smoke particles can sputter sodium atoms from the smoke particles. On the other hand, ionospheric electric field, which may become more significant near auroral precipitating regions, could induce ion motions (i.e. can generate sodium ion convergence and/or divergence), and then also could affect generation and/or loss processes of sodium atoms through their ion-molecule chemistry. Thus, for the examination of the causality, it is vitally important to distinguish the effects of auroral particle precipitation and ionospheric electric field. Using a sodium lidar (which was installed in early 2010) and European incoherent scatter (EISCAT) radar at Tromsoe, Norway (69.6N, 19.2E), we have investigated, for the first time, that the actual effect of the particle precipitation to the sodium density variations without electric filed injection. In the nighttime observation on 24-25 January 2012, we detected a significant decrease of sodium atom density coincided with electron density enhancements (implying strong particle precipitations) and low ion temperatures (implying no electric field injections). These results strongly suggested that auroral particle precipitations induced sodium atom density decrease. Furthermore we discuss observed time response in the sodium density decrease.