Recent experiments of Lithium release and future experiment of Barium release from the sounding rocket in the cusp region

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Since luminous clouds of chemicals work as a tracer of thermospheric wind, chemical release experiments from the sounding rocket have been strenuously done since 1950's. Although Lithium (Li) has an advantage among chemicals because of brightness of resonance scattering light, Li release has not been done for a long time and the techniques had been lost. We have independently developed canister for Li release from the sounding rocket and system for optical observation from the ground/the airplane since 2007, and the released Li clouds were successfully observed under the evening condition in 2007, the morning condition in 2012, the daytime condition in 2013 and the night time condition in 2013 in middle latitude. Further, similar experiment was done at the magnetic equator under the evening condition in 2013. Since ionization rate of Li is not faster compared diffusion in the thermosphere, it is hard to observe both neutral and plasma simultaneously using Li. However, Barium (Ba) is immediately ionized (in about 20 s) and both neutral Ba and Ba+ emit resonance scattering light in different wavelength (Ba: 554 nm, Ba+: 455 nm). Therefore, Ba has an advantage to observe both neutral and plasma velocities simultaneously. Ba release experiment is planned in November 2014. The rocket will be launched from Andoya in Norway to North-West direction. Science target is to investigate neutral density anomaly in the cusp region. Since simultaneous observation of neutral and plasma velocities is necessary to understand cause of the anomaly, Ba is suitable material. Ba is released between 150 and 400 km altitude at 400 km away from Svalbard islands. Observation sites will be set at Hornsund, Longyearbyen, and Ny-Alesund. We has developed band-pass filters for Ba and Ba+, which were well evaluated with an integrating sphere at National Institute of Polar Research. We will set up 2 cameras (one for Ba and the other for Ba+) at two sites of three candidates. Although Ba release was done long time ago, absolute luminosity is not known. Therefore we also expect to estimate absolute luminosities of Ba and Ba+ using the evaluated filters.