Characteristics of optical aurora and precipitating particles observed from space and the ground: Small-scale aurora and auroral polarization

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We report two topics on the optical aurora and precipitating particles from space and the ground. Fist topic is small-scale aurora based on the simultaneous auroral image-particle observation with the Reimei satellite, focusing on the field-aligned acceleration processes which produce discrete aurora. Reimei is a polar orbiting satellite at altitudes of 640 km, which carries MAC for auroral emissions at N2 (670 nm), O (558 nm) and N2+ (428 nm) with a resolution of ~1 km by pointing to the magnetic footprint threading Reimei. Simultaneously, ESA and ISA on Reimei provide in-situ electron and ion data in the energy range of 10 eV - 12 keV with a resolution of 300 m. Reimei data showed the small-scale relationship between total energy flux of precipitating electrons and auroral emission even in a few km-scale structures. We also found that the field-aligned Alfvenic electrons happens at the edge of an inverted-V. In addition, Alfvenic electrons often occur in the inverted-V when the spatial variation of potential drop exists, and in this region we see auroral shear motion. This fact suggests the small-scale aurora is closely related with the variation of potential drop, i.e., contrast of inverted-V electron energy, and Alfvenic electrons are probably generated by shear instability in the acceleration region.

Second topic is ground-based observation of auroral polarization at Poker Flat, Alaska. Polarization theory predicts that only OI 630nm aurora can generate linear polarization depending on the energy and the pitch-angle anisotropy of electrons. Thus, it may be possible to measure the electron energy and the pitch-angle from auroral polarization. In the winter of 2013, we started the auroral polarization measurement using an imaging spectrograph covering 558nm and 630nm aurora with wide field-of-view (130 deg.) at Poker Flat. We report the preliminary result on the auroral polarization.