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A comparative study on the types and dynamics of auroras and the fine properties of auroral particles using Reimei

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The dynamic variations and numerous types of spatial distributions found in the auroral emissions have been well-known as one of the most remarkable and exciting phenomena in the Earth's polar magnetosphere. The Reimei satellite mission, starting the scientific observations at 650-km altitudes in the late 2005, has been providing us with the high-time/spatial resolution auroral data with the novel observation function realizing simultaneous conjunction measurements of the auroral emissions at the ionospheric altitudes and the auroral plasma particles in the topside ionosphere. The multi-spectral auroral camera (MAC) with 1.1-km resolution over a 70-km x 70-km area at the auroral altitudes (110 km) are imaging a number of spatial distributions and time variations of auroras simultaneously with energy spectra of the energetic (10 eV - 12 keV) plasma over the full-pitch angle range by auroral electron/ion energy spectrum analyzers (ESA/ISA). The geomagnetic field data are also investigated for elucidating the correlation of the transversely accelerated ions (TAIs) with the field-aligned currents carried by invisible thermal electron flows which could not be detected by the electrostatic plasma analyzer on Reimei due to the lowermost energy limitation. These features of the Reimei mission imply that the satellite observation dataset could reveal the closed correlation between the structures and variations of auroral arcs/bands and the precipitating electron components accelerated mainly by quasi-static field-aligned potential structures and kinetic (dispersive) Alfven waves above the Reimei orbit. We could also investigate the fine-scale relations among the auroral electron signatures, field-aligned current properties, and TAIs, by being mapped on the auroral emissions. The detailed comparisons based on these high-quality auroral image/particle data would derive the newest comprehensive knowledge which has not been obtained for several decades. For instance, Reimei firstly showed that rapidly varying inverted-V electron components are highly correlated with small-size active auroras like rotating auroral vortices, high-speed streaming shear-type arcs, flushing ray-type auroras, etc. It is also common that the downward electron conics and the associated upward wide-energy electron bursts are observed in association with dynamically changing auroras at the lower energy range than the inverted-V electrons. In this paper, we report several characteristic observational results from the comparative study on the types and dynamics of auroras and the fine properties of auroral particles using Reimei.

Keywords: auroral emission, auroral particle, fine structure, satellite observation, particle acceleration, auroral dyanamics