Observational results on downward electron/ion conics associated with rapidly varying upward/downward electric fields by Reimei

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We report the properties of the downward electron/ion conics observed by the auroral particle sensors onboard the Reimei satellite. The relative locations and sequence of the region and occurrence of these characteristic velocity distributions with the auroral forms are also examined based on the simultaneous observations using the auroral particle sensors and the auroral imaging camera. The auroral particle sensors on Reimei are based on principles of top-hat electron/ion energy spectral analyzers (ESA/ISA), which enable us to measure 12 eV - 12 keV electrons/ions over their full pitch-angle ranges with a high-time resolution (40 msec). It is also one of our advantages to utilize exactly or nearly simultaneous measurements of these auroral particles with auroral emission data with high-time and -spatial resolutions (120 msec, 1 km) from the mono-chromatic imaging camera (MAC), especially in the winner hemisphere. The altitude of Reimei in a sun-synchronous orbit is about 640 km, which is also suitable for the observations of downgoing electron/ion components associated with generation mechanisms produced in the polar magnetosphere of the dayside cusp and nightside auroral oval. We have already reported the observational results separately on the downgoing electron conics and the downgoing sporadic ion beam signatures in the nightside auroral oval, and the ion microbursts in the dayside cusp, which are discrete and intermittent. The peak energies of the downgoing electron conics are just up to several tens of eV, and it is highly plausible that these peculiar electron components are accelerated by the rapidly downgoing or growing upward electric fields above the Reimei path. On one hand, the characteristic energies of the downgoing ion beams distribute from tens of eV up to a few keV, higher than those of the electron conics. It should also be noted that the duration of the downgoing ion beams is very short, a few hundreds of msec to a few seconds. There is a significant energy dependence of these ions on the pitch angle, so-called angular V signatures, which indicates that these ion components are accelerated by the downward electric fields located at altitudes from several hundreds of km to about a ten thousand km. It is very frequent to observe the transversely accelerated ionospheric ions (TAIs) in the direction almost perpendicular to the local magnetic fields with energies up to a few hundreds of eV with the downgoing ion beams. In addition to these two ion components, the downgoing ion conics have often been measured at the energies between the energies of the downgoing ion beams with wide angular V distributions and the TAIs. We conclude that the generation mechanism causing the downgoing ion conics are consistently the same as that for the sporadic ion beams, namely, the downward electric fields in the vicinity of the discrete auroral emissions. These results imply that the downward electric fields are often produced in the adjacent regions to the auroral arcs or even on the same field lines through very quick polarity changes of the parallel electric fields occurring within a few seconds.