

## Coordinated Reimei and EISCAT Observations of Ion Upflows in the Polar Ionosphere

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We have conducted coordinated Reimei (INDEX) satellite and EISCAT radar observations to study ion upflow in the polar ionosphere. The Reimei satellite, launched on August 23, 2005, orbits the Earth at about 630 km altitude with 97.8 deg orbital inclination. In order to investigate the fine structure and variations of auroral phenomena, the Reimei satellite carries particle and optical instruments among them, top-hat-type auroral electron and ion energy spectrum analyzers (ESA/ISA) and a three channel monochromatic auroral imaging CCD camera (MAC). After configuring the instruments (for example the high voltage), we started coordinated observations with the Reimei satellite and the EISCAT radars. The EISCAT radars are located in the Northern Scandinavia and Svalbard. They measure ionospheric parameters, such as plasma density, temperature, and velocity between about 80 and 1000 km altitude. The radar data cover the height of the Reimei satellite (630 km). For the coordinated observations, we directed the EISCAT antenna to the nearest point of the satellite orbit from the radar, so that we were able to measure a common volume at the same time with both Reimei and EISCAT. The ESA/ISA on Reimei measures Supra-thermal (10 eV/q - 13 keV/q) ions and electrons every 20 ms (corresponds to a horizontal spatial scale of 150 m) in the EISCAT beam, which is about 7 km wide at 630 km altitude. In addition to the common volume observations, EISCAT observed electron density height profiles using a fast meridian scanning mode (cycle time of 128 sec), while the MAC on Reimei simultaneously observed the auroral emissions over a field of view intersected by the EISCAT beams. Using data obtained from these unique observations, we investigate the following: (1) Electron precipitation energies related to ion



upflow. Soft particle (< 500 eV) precipitation is believed to be one of sources of ion upflow. We examine the precipitation at these energies comparing the data obtained simultaneously by EISCAT and the ESA/ISA on Reimei. (2) Ion/electron heating and acceleration related to ion upflow. Most ion upflows are accompanied by an increase of the ion temperature due to Joule heating and/or an increase of the electron temperature due to auroral particle precipitations. In order to understand heating and acceleration of upflowing ions, in particular the relation between ion upflow and Transversely Accelerated Ions (TAIs), we compare the temperatures of the background ions and electrons seen by EISCAT with Supra-thermal ion and electron distributions derived from the ESA/ISA on Reimei. (3) Molecular ion (N2+) upflow. The MAC on Reimei images the N2+ auroral emission (427.8 nm). In order to investigate contributions of molecular ions to ion upflow, we estimate N2+ ion density profiles using the N2+ emission images taken with the MAC looking nearly horizontally, and compare them with the ion density and upflow distributions observed with the EISCAT antenna scan. We have conducted the coordinated Reimei-EISCAT observations for 90 hours between October 26 and December 7, 2005, and obtained 69 conjunction events around the dayside cusp, post-noon bright auroral spots, and nightside auroral oval. In this paper, we present initial results of the coordinated observations.