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Remote Sensing of Magnetospheric Dynamics Using Global Proton and Electron Aurora Image Data (Extended Abstract)

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Imaging of proton aurora is a unique probe to monitor magnetospheric dynamics since precipitating protons are free from field-aligned acceleration and keep information on magnetospheric hot plasma. The purpose of this study is to establish a remote sensing technique for monitoring magnetospheric dynamics and to understand the global response of the magnetosphere to solar wind plasma and interplanetary magnetic field variations.

Using the Tsyganenko 96 model, we mapped proton and electron aurora images obtained by the IMAGE satellite and electric potential distributions obtained by the SuperDARN network onto the various sections of the magnetosphere. We also calculated ExB drifts in the magnetosphere from the super DARN electric potential and the magnetic field of the Tsyganenko 96 model.

We performed a detailed analysis of an intense proton aurora event observed for the time interval 12-17 UT on November 26, 2000. Solar wind conditions were observed by ACE and WIND spacecraft as shown in Figure 1. It is found that IMF southward turning from 10 nT to -10 nT in the Bz component at 15 : 20 UT under high pressure conditions (>10 nPa) induced enhancements of proton aurora near the duskside magnetospheric boundary as shown in Figure 2. For the time interval 15 : 28-15 : 32 UT (about 10 minutes later from IMF southward turning), the enhanced proton aurora region was located near the duskside magnetospheric boundary and that this region was surrounded by fast plasma convection flows. Then the enhanced proton aurora region approached the Earth up to a distance of 7 Re where sunward fast plasma convection was dominative. The enhanced proton aurora and sunward fast plasma convection regions were simultaneously faded out. The DMSP satellite observed precipitating protons causing the duskside proton aurora during this interesting period. It reveals that the characteristic energy and energy flux of the precipitating protons are about 10 keV and 10 ($eV/cm^2 \cdot s \cdot sr$), respectively. These data suggest that the source region of proton aurora is the BPS/LLBL region. This result is in good agreement with the magnetos-

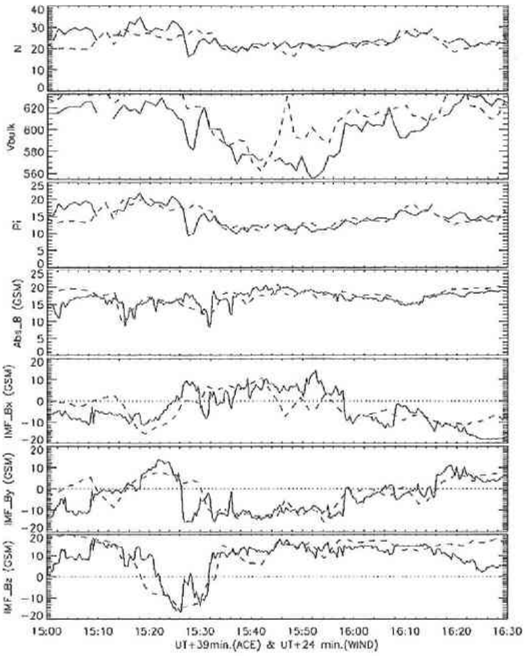

Fig. 1. Solar wind particle and IMF data obtined by ACE (solid line) and WIND (dashed line) spacecraft for the time interval of 15 : 00–16 : 30 UT on November 26, 2000.

pheric mapping of proton aurora images as mentioned above. Using the same magnetospheric imaging technique, we also investigated magnetospheric responses to solar wind shocks and substorms. Clear differences in the locations of the proton and electron aurora source regions are found in these events. When a rapid solar wind dynamic pressure increase at 11 : 58 UT on November 26, 2000, occurred the proton aurora source region was located on the dusk side near the magnetospheric boundary. On the other hand, the electron aurora source region was located on the dawn side near the magnetospheric boundary. This asymmetric distributions would be attributable to the different responses of energetic protons and electrons to solar wind dynamics pressure changes.

In summary, we have established a new remote sensing technique for imaging magnetospheric dynamics. This imaging technique is very useful to visually understand the global response of the magnetosphere to solar wind variations. This technique would also greatly contribute to space weather studies.

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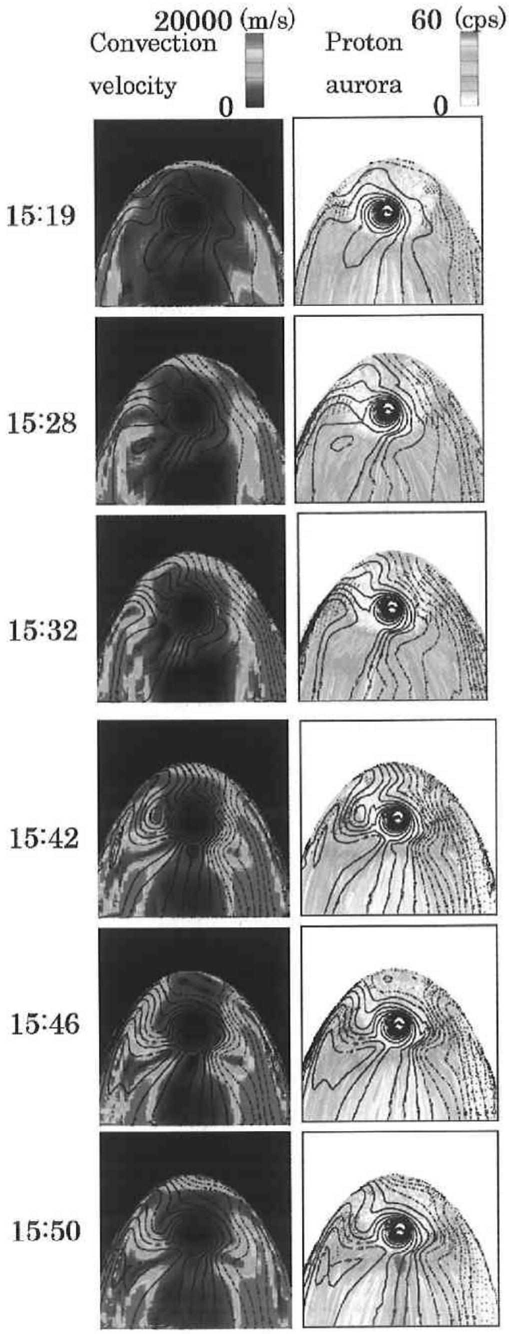

Fig. 2. Proton aurora intensity and E×B velocity mapped on the magnetospheric equatorial plane for the time interval 15 : 19–15 : 50 UT on November 26, 2000.