Asymmetries of Geomagnetic Cutoffs for the Solar Energetic Particles and Polar Cap Absorption Effects

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Experimental data from five low-altitude (~950 km) NOAA POES satellites were used for studying north-south, day-night and dawn-dusk asymmetries in penetration of the solar energetic particles (SEP) to the polar caps during long-lasting SEP events on December 5 to 15, 2006. Large number of satellites allowed deriving snap shots of the cutoff boundaries with 1-hour time resolution. We fit the boundaries by ellipses in the coordinate system of invariant co-latitude versus magnetic local time (MLT). The cutoff boundaries demonstrate different patterns in the northern and southern hemispheres. The north-south asymmetry is controlled by the dipole tilt angle *PS* and pronounced during solstice. In each hemisphere, the cutoff latitudes are modeled as a function of particle rigidity, MLT, geomagnetic indices *Dst*, *Kp*, *AE*, and dipole tilt angle *PS*. The model predicts tailward and duskward shifting of the cutoff boundaries in relation with intensification of the cross-tail current, field-aligned currents, and symmetrical and asymmetrical parts of the ring current. The model was applied for prediction of a polar cap absorption (PCA) effects observed at high latitudes by CADI network of ionosondes. The PCA demonstrated a prominent day-night asymmetry. It was found that the PCA effects are related mainly to intense fluxes of >2.5 MeV protons and >100 keV electrons, which contribute mostly to the ionization of ionospheric *D*-layer at altitudes of ~75 to 85 km. This finding was confirmed independently by FORMOSAT-3/COSMIC observations of the SEP-associated enhancements of electron content peaked at altitudes of ~80 km.