STATISTICAL DEPENDENCE OF AURORAL IONOSPHERIC CURRENTS ON SOLAR WIND AND GEOMAGNETIC PARAMETERS FROM 5 YEARS OF CHAMP SATELLITE DATA

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The effects of the solar wind dynamic pressure (P), the z component of the interplanetary magnetic field (B_z), the merging electric field (E_m), season and the K_p index on the R1 and R2 field-aligned currents are studied statistically using magnetic field data from the CHAMP satellite during 2001-2005. The ionospheric and field-aligned currents are determined from the magnetic field data by the 1-D Spherical Elementary Current System (SECS) method. During southward IMF, increasing $|B_z|$ is observed to clearly increase the total field-aligned current, while during northward IMF, the amount of field-aligned current remains fairly constant regardless of $|B_z|$. The dependence of the field-aligned current on B_z is given by $|I_r[\mathrm{MA}]| = 0.054\ B_z[\mathrm{nT}]^2 - 0.34\ B_z[\mathrm{nT}] + 2.4$. With increasing P, the intensity of the field-aligned current is also found to increase according to $|I_r[\mathrm{MA}]| = 0.62\ P[\mathrm{nPa}] + 1.6$, and the auroral oval is observed to move equatorward. Increasing E_m produces similar behaviour, described by $|I_r[\mathrm{MA}]| = 1.41\ E_m[\mathrm{mV/m}] + 1.4$. While the absolute intensity of the ionospheric current is stronger during negative than during positive B_z, the relative change in the intensity of the currents produced by a more intense solar wind dynamic pressure is observed to be approximately the same regardless of the B_z direction. Increasing K_p from 0 to ≥5 widens the auroral oval and moves it equatorward from between 66°-74° AACGM latitude to 59°-71° latitude. The total field-aligned current as a function of K_p is given by $|I_r[\mathrm{MA}]| = 1.1\ K_p + 0.6$. In agreement with previous studies, total field-aligned current in the summer is found to be 1.4 times stronger than in the winter.

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