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Solar zenith angle and merging electric field control of field aligned currents: A statistical study of the southern hemisphere

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High-resolution and precise vector magnetic field measurements of the CHAMP satellite are used to investigate the field-aligned currents (FACs) in the southern polar ionosphere. The period considered comprises two years providing a double coverage of the seasons and about a six-fold coverage of all local times. From more than 11,000 polar passes the average spatial pattern of FACs in the polar ionosphere is derived. The response of features like intensity and positions of large-scale field-aligned currents to normal (when merging electric field is less than 2mV/m) and disturbed (when merging electric field is greater than 2 mV/m) conditions in the southern hemisphere are investigated. The influence of the solar illumination-induced conductivity on the morphology features of field-aligned currents during normal conditions are also studied. It follows from this analysis that the intensity of field-aligned currents changes with the merging electric field at all MLT sectors but with the solar radiation-induced conductivity only at the dayside. Furthermore, a linear relation between the conductivity and the peak FAC density exists, which implies that the dayside FAC densities are directly controlled by the amount of solar radiation. Solar elevation does not affect the nightside FAC density. On the dayside a systematic difference of the footprint latitude between sun-lit and dark conditions emerges. Under dark conditions the auroral region retreats about 2 deg equatorward.