Statistical analysis of small-scale field-aligned currents

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Field-aligned currents (FACs) play the most important role in the magnetosphere-ionosphere coupling system. Magnetic field observations with spacecraft provide us information not only on large-scale FACs such as 'Region 1' and 'Region 2' currents but also on small-scale FACs. Although large-scale FAC structures have been investigated in detail, studies of small-scale FAC structures remain preliminary. The purpose of this study is to investigate the characteristics and polar distributions of small-scale FACs and to clarify their contributions to the magnetosphere-ionosphere coupling system. We analyzed the Akebono magnetometer data of 10,675 passes for 4 years with a new FAC analysis method using FFT. The results obtained on the dependences of small-scale FACs on interplanetary magnetic field (IMF) orientation and sunlit conditions are as follows. Firstly, the intense regions of small-scale FACs show a concentration from the dayside cusp to the polar cap region for positive Bz. In contrast, these FAC intense regions spread over the entire auroral oval for negative Bz. Secondly, the intense FAC regions shift to the afternoon sector for positive By, and to the morning sector for negative By. Thirdly, the intense FAC regions are concentrated in the dayside cusp region on dark conditions. In contrast, the intense regions spread over the dayside auroral oval in sunlit conditions. These results suggest that the small-scale FAC regions spread with increase in the ionospheric conductivity. Further, it is suggested that small-scale FAC densities also increase depending on the ionospheric conductivity, and that the averaged values of FAC densities on sunlit conditions are 1.5-2 times larger than those on dark conditions.