Flankside plasma sheet isolation in the ionosphere for northward interplanetary magnetic field

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During periods of northward interplanetary magnetic field (IMF), for the case of IMF $B_y<0$, the dawnside plasma sheet expands poleward in the northern ionosphere, while in the southern ionosphere the duskside plasma sheet expands poleward. At the same time, auroral arcs aligned to the auroral oval are often observed at the dawnside high latitudes in the northern hemisphere and at the duskside high latitudes in the southern hemisphere. The above-mentioned dawn-dusk relation reverses for the case of IMF $B_y>0$. Such an oval-aligned arc may simply indicate an arc that appears on the poleward boundary of the plasma sheet, or alternatively, an arc that has been detached from the main body of the plasma sheet by the intrusion of open magnetic flux (i.e., the lobe) to the equatorward of the arc. The purpose of this study is to investigate such plasma sheet isolation by numerical magnetohydrodynamic modeling. Using the REPPU (Reproduce Plasma Universe) code, we could successfully reproduce some cases of plasma sheet isolation. Figure 1 shows an example obtained by a simulation run with IMF conditions of B_x=0 nT, B_y=−12.2 nT, and B_z=4.4 nT (the total magnitude of 13nT and the clock angle of 70°) and solar wind conditions of N=10/cc (density), V=370 km/s (speed), and T=10^5 K (temperature). The gray area represents the open magnetic flux region, while the white area shows the closed magnetic flux region. The thin solid lines indicate the contours of electric potentials every 1 kV. Isolation of the plasma sheet is seen on the dawnside in the northern hemisphere and on the duskside in the southern hemisphere. The isolated plasma sheets on the two hemispheres are actually magnetically conjugate. The isolation is suggested to occur as a consequence of special reconnection in the magnetotail. We report the process of the plasma sheet isolation in detail by analyzing the simulation results.

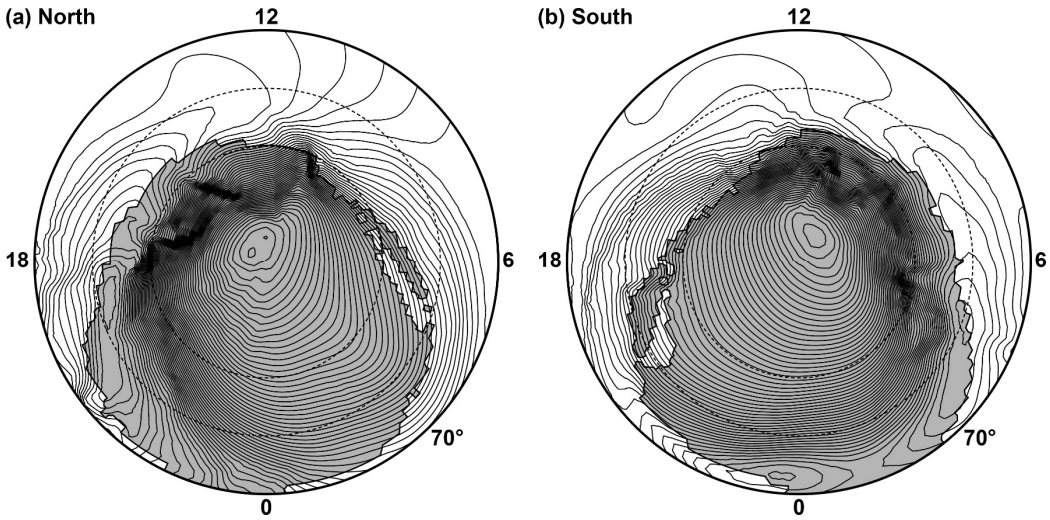

Figure 1. Ionospheric potentials (thin solid lines) imposed on open (gray) and closed (while) magnetic flux regions, obtained by a simulation run with conditions of B_x=0 nT, B_y=−12.2 nT, and B_z=4.4 nT, N=10/cc, V=370 km/s, and T=10^5 K.