TRANSPORT PROCESSES OF PLASMA SHEET PROTONS OF DIFFERENT ENERGIES AND THE RESULTING DISTRIBUTIONS OF ENTROPY AND PARTICLE CONTENT

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The spatial variations of plasma sheet plasma and fields resulting from transport of particles generate field-aligned currents that electrodynamically couple the plasma sheet with the ionosphere, which in turn modifies the transport within the plasma sheet. We have used 10 years of Geotail data to evaluate statistically the spatial distributions of plasma sheet ion plasma moments, magnetic fields, and associated entropy and particle content under different convection strengths and AE levels, and to determine if these distributions can be accounted for by large-scale adiabatic electric and magnetic drift transport of ions of different energies from the tail and flanks. We found that for high-energy ions that are near and above the thermal energy, the partial entropy and partial particle content of particles of a fixed energy invariant are approximately conserved along their combined electric and magnetic drift paths, indicating that adiabatic drift is the dominant transport for these particles. The strong duskward magnetic drift of these pressure-bearing particles, together with there being significantly fewer high-energy particles from the dawn flank than from the tail, results in the observed strong earthward decrease of total entropy. The distributions of total and partial particle content indicate that low-energy plasma is dominant when convection and AE are low, however, their transport cannot be explained by adiabatic drift. We simulated the spatial distributions of cold ions resulting from drift and diffusion of particles from the tail and flanks. The comparisons between the simulation results and Geotail distributions indicate that diffusion is as important as adiabatic drift in the transport of low-energy ions within the plasma sheet.

Plasma sheet, transport, entropy

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