Simulation of counter-streaming H^+ outflows during plasmasphere refilling

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Plasmasphere refilling is modeled using the Naval Research Laboratory Sami2 is Another Model of the Ionosphere (SAMI2) ionosphere/plasmasphere code[1]. In this implementation of SAMI2, two fluid species are used for H^+, each having a source in only one magnetic hemisphere. With two counter-streaming H^+ fluids, artificial discontinuities in density and velocity at high altitude are avoided during storms and during early-stage refilling. Modeled outflows are consistent with the Richards and Torr [1985] analytic expression for the limiting H^+ escape flux [2]. For late-stage refilling, runs with two-stream SAMI2 validate previous SAMI2 (one H^+ fluid) refilling rates. Results show that refilling is sensitive to the O density, a factor that is not explicit in the Richards and Torr [1985] formula. At ionospheric altitudes, where the single-fluid approximation is valid for each ion, two-stream SAMI2 results agree closely with SAMI2 results.

[1] Huba, J. D., G. Joyce, and J. A. Fedder (2000), SAMI2 (Sami2 is another model of the ionosphere): A new low-latitude ionosphere model, J. Geophys. Res., 105(A10), 23,035–23,053, doi:10.1029/2000JA000035.

[2] Richards, P. G., and D. G. Torr (1985), Seasonal, diurnal, and solar cyclical variations of the limiting H^+ flux in the Earth's topside ionosphere, Journal of Geophysical Research: Space Physics, 90(A6), 5261–5268, doi:10.1029/JA090iA06p05261.