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Solar wind control of magnetopause shape derived from MHD simulations

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The shape of the magnetopause is principally controlled by the solar wind ram pressure and the north-south component of the interplanetary magnetic field (IMF). Roelof and Sibeck (J. Geophys. Res., 1993) derived an empirical bivariate function of magnetopause shape through fitting an ellipsoid of revolution to observed magnetopause crossings. We carried out a series of MHD simulations to derive the shape of the magnetopause in an extended domain of the two control variables, including extreme storm-time solar wind conditions as well. The simulation results have been validated with the empirical bivariate function in the validity range of the Roelof-Sibeck method. We conclude that the Roelof-Sibeck function cannot be extrapolated to southward IMF values stronger than 5 nT, because the magnetopause can no longer be approximated with an ellipsoid of revolution. The asymmetry of the magnetopause is explained with field line merging and the related erosion of the magnetic field.