Supplementary Material to "Hybrid-Vlasov modelling of nightside auroral proton precipitation during southward interplanetary magnetic field conditions"

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1 Supplementary figures

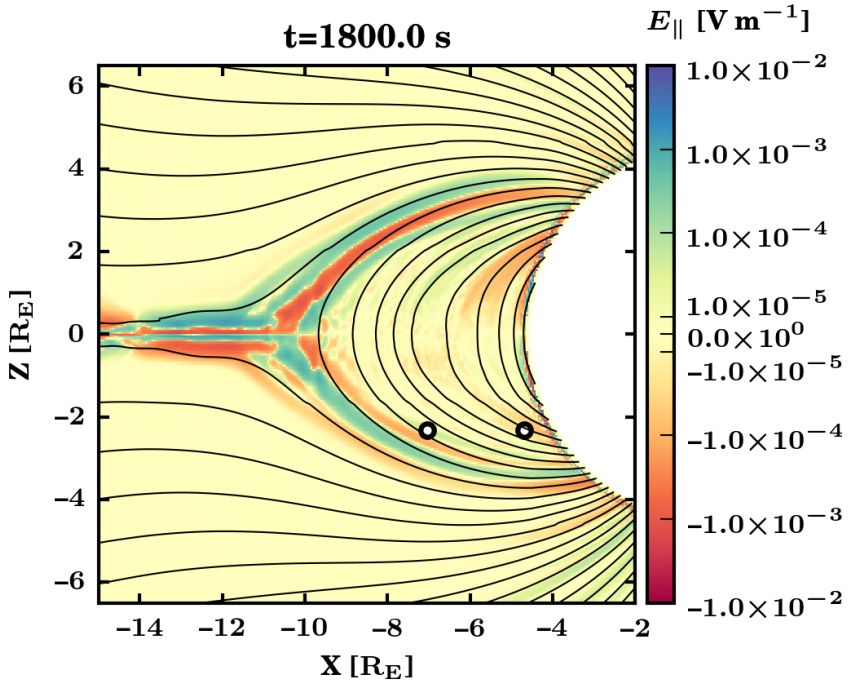

Figure S1. Simulated parallel component of the electric field in the nightside magnetosphere at $t = 1800$ s and averaged over 120 s. The Sun is located beyond the right boundary of the figure. The two black circles filled with white are virtual spacecraft S_1 and S_2. $R_E = 6371$ km.

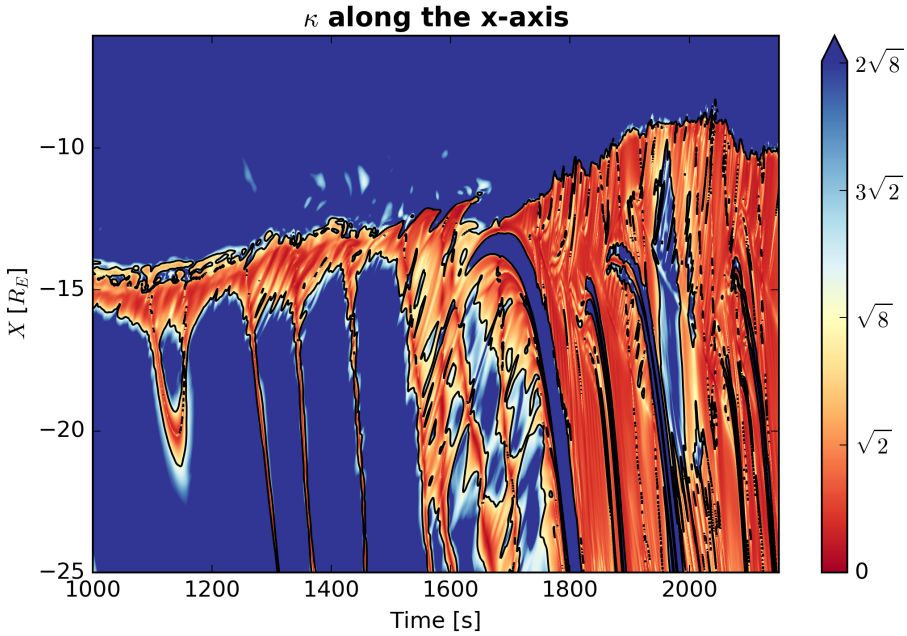

Figure S2. κ parameter along the x-axis between $-25R_E$ and $-6R_E$ as a function of time from $t = 1000\,\mathrm{s}$ until the end of the simulation. The black contour shows the critical value $\sqrt{8}$ below which the criterion for particle pitch-angle scattering is verified (orange and red area). Note: $\kappa = \sqrt{R_c/r_L}$, with R_c the curvature radius of the magnetic field and r_L the proton gyroradius (Sergeev et al., 1983).

2 Supplementary animations

Supplementary animation S1 gives an overview of the dynamics of the nightside magnetosphere within $-15R_E \leq X \leq -2R_E$ and $|Z| \leq 6.5R_E$ from $t = 1000\,\mathrm{s}$ until the end of the simulation at $t = 2150\,\mathrm{s}$. The background colour represents the simulated plasma temperature. The two black circles filled with white are virtual spacecraft S_1 and S_2 considered in the study, where velocity distribution function of protons are shown in the $(v_{\parallel}, v_{B\times V})$ plane. The velocity grid spacing is $1000\,\mathrm{km\ s^{-1}}$, and the magenta lines indicate the boundaries of the bounce loss cone.

Supplementary animation S2 shows the x-component of the plasma bulk velocity in the nightside part of the simulation plane from $t = 1920\,\mathrm{s}$ to $t = 2080\,\mathrm{s}$. The red circle indicates the location of virtual spacecraft S_1, and the eight coloured plus signs show additional virtual spacecraft for which the parallel velocity components are shown in Fig. 7 of the paper. Black lines represent magnetic field lines.