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Supporting Information for

Explicit IMF By-dependence of energetic protons and the ring current

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Figures S1 to S7 and Text S8 to Text S9

Introduction

This supporting material includes Figures S1-S7. Figure S1 is similar to Figure 1, but shows electron fluxes instead of proton fluxes. Figure S4 is similar to Figure 3 but calculated for negative and small dipole tilt angles. Figures S5 and S6 repeats the analysis of Figure 4 for negative dipole tilt angles and for the pressure-corrected Dst index. Figure S7 is similar to Figure 4, but sorts data by IMF Bx instead of IMF By.

Text S8 and Text S9 are input files for SWMF for negative and positive IMF By.

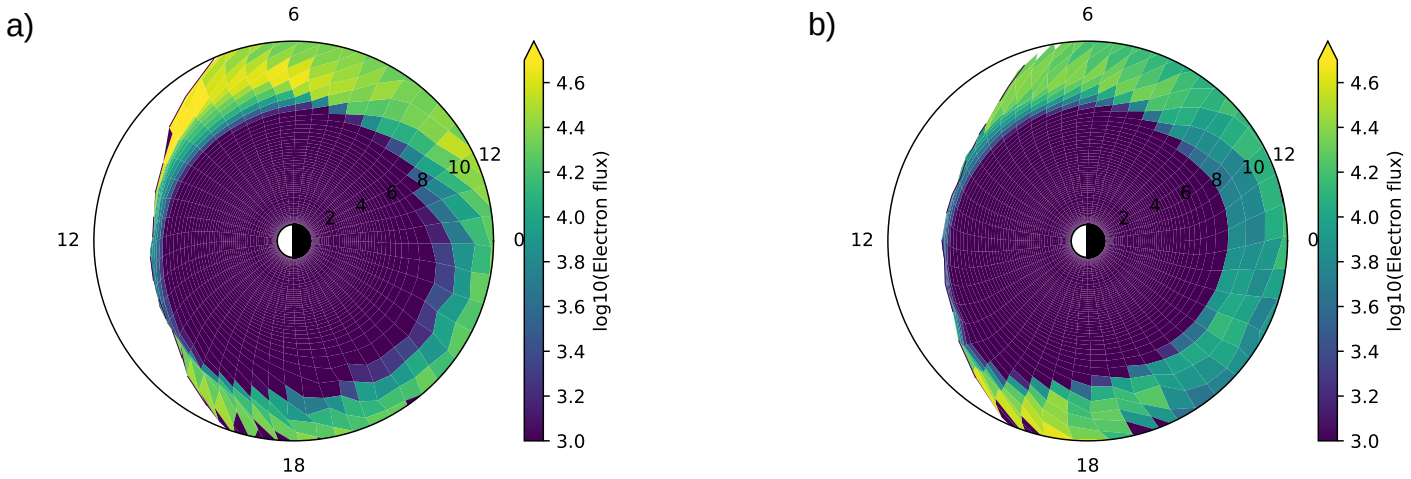

Figure S1. Equatorial omnidirectional fluxes of 56 keV electrons for a) the run with By=-5nT b) By = +5 nT. The fluxes are shown for the last timesteps (8.00 h) of the two runs. Sun is from the left. Labels indicate magnetic local time and radial distance (in Earth radii).

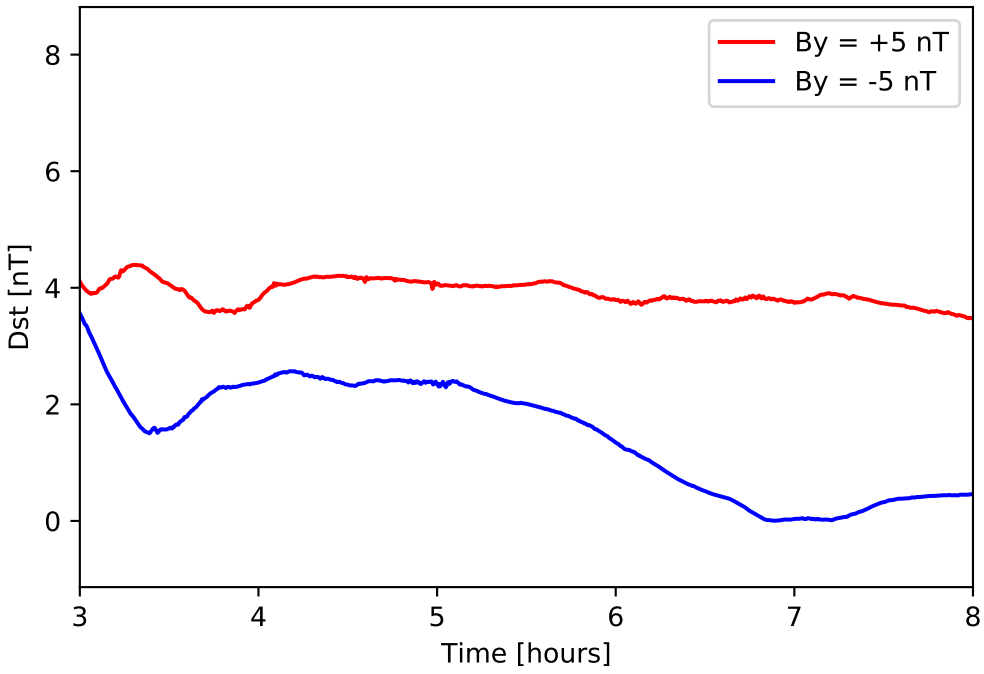

Figure S2. Dst indices for the two runs (By = +5 nT and By = -5 nT) calculated by Biot-Savart integrals from the global MHD output.

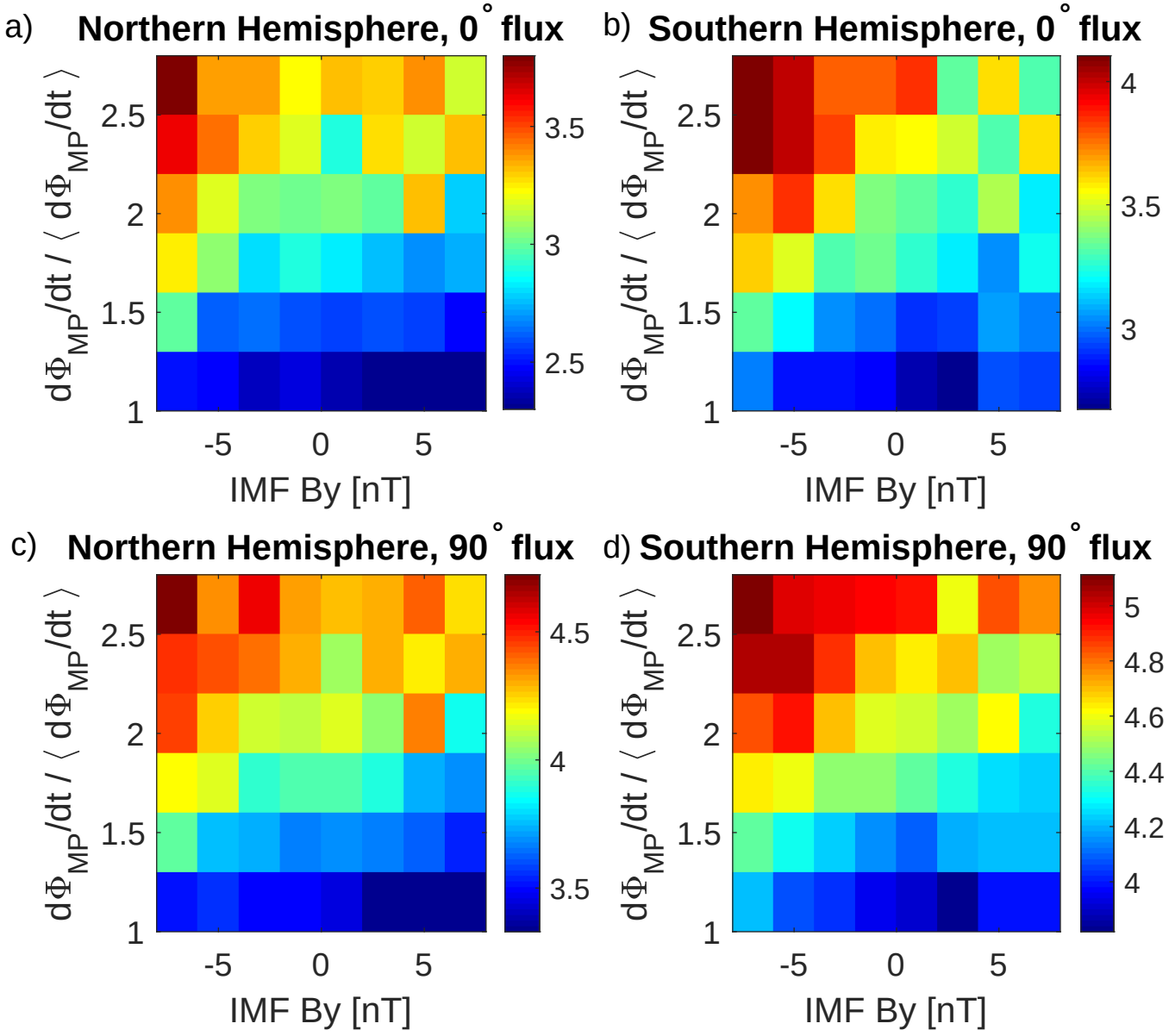

Figure S3. Flux of 30-80 keV protons measured by NOAA POES satellites as a function of 3-hour means of the Newell coupling function and IMF By during NH summer conditions (dipole tilt > +20 degrees). Panels a-b) show measurements of the 0-degree telescope in Northern Hemisphere (55...75 degrees corrected geomagnetic latitude) and Southern Hemisphere (55...-75 degrees corrected geomagnetic latitude). Panels c-d) are similar to panels a-b), but show measurements of the 90-degree telescope.

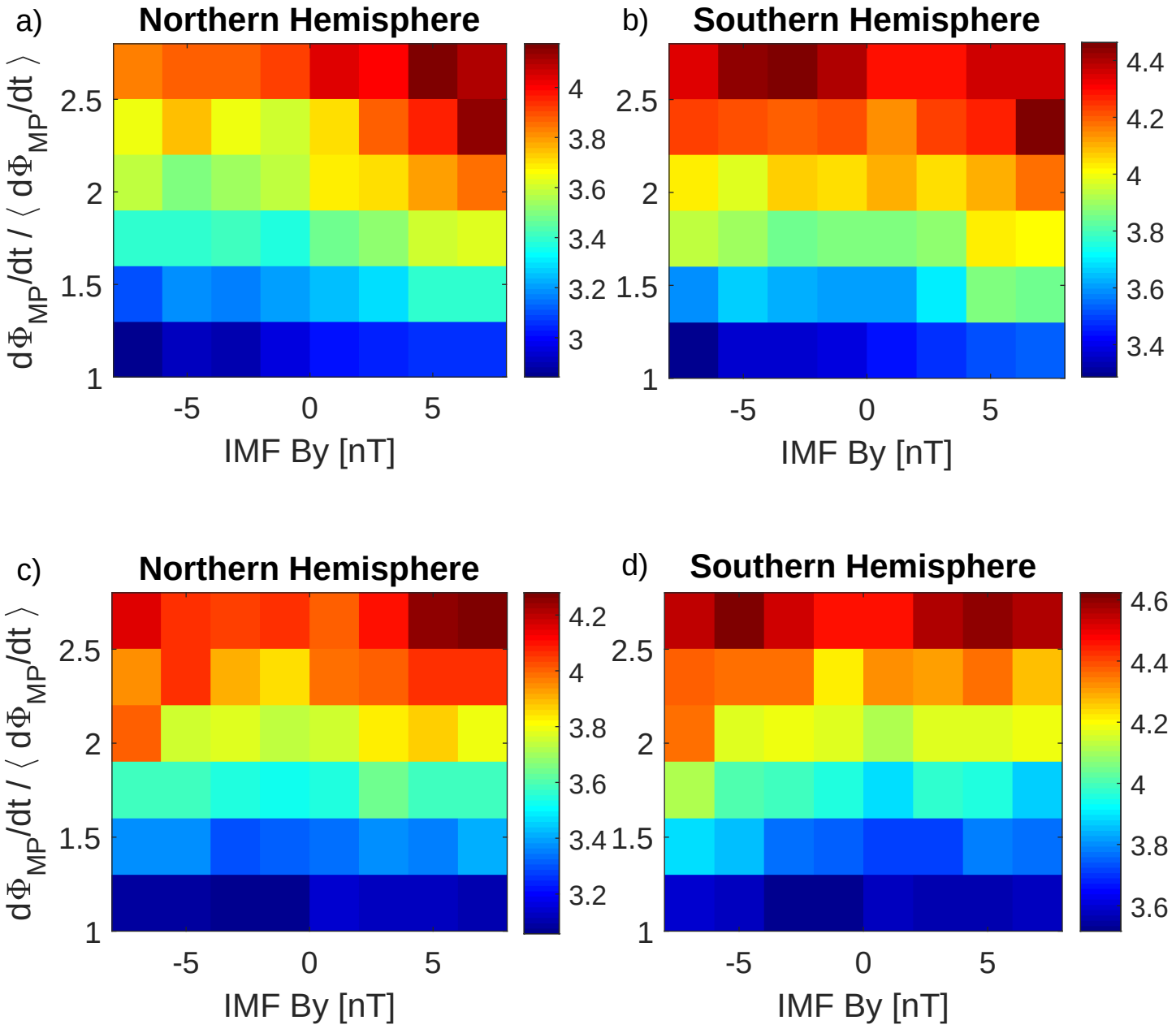

Figure S4. Flux of 30-80 keV protons measured by NOAA POES satellites as a function of of 3-hour means of the Newell coupling function and IMF By during a-b) NH winter conditions (dipole tilt < -20 degrees) c-d) equinox conditions (|dipole tilt| < 10 degrees).

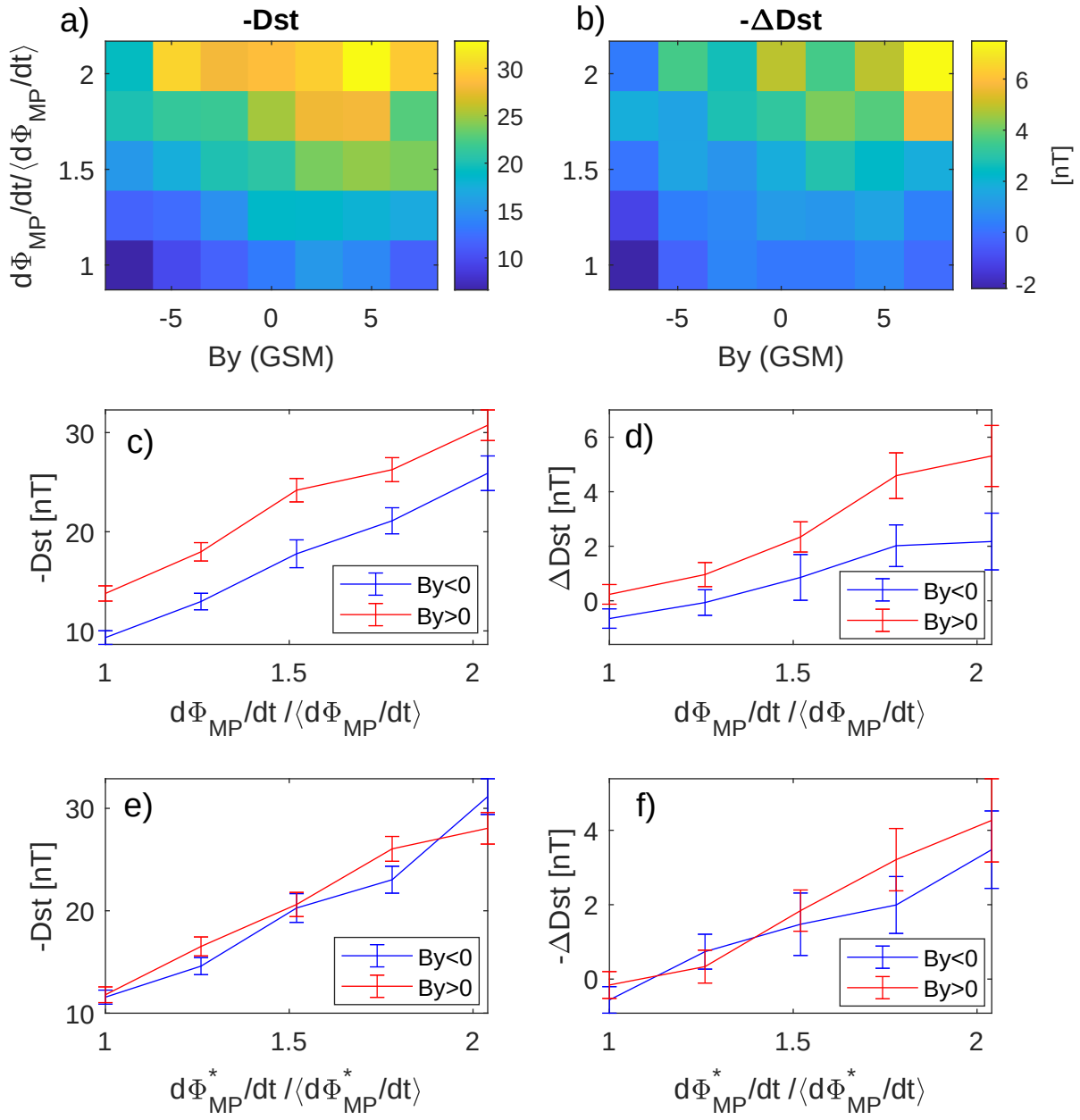

Figure S5. a) The Dst index as a function of 3-hour means of the Newell coupling function and IMF By in NH winter (dipole tilt < -20 degrees). b) The change of the Dst index during the same three-hour intervals as in the panel a). Bottom panels show c) Dst d) change of Dst averaged for By<0 (blue line) and By>0 (red line) as a function of Newell coupling function. e-f) Same as c-d), but using the modified coupling function. The vertical bars denote the standard errors of the means.

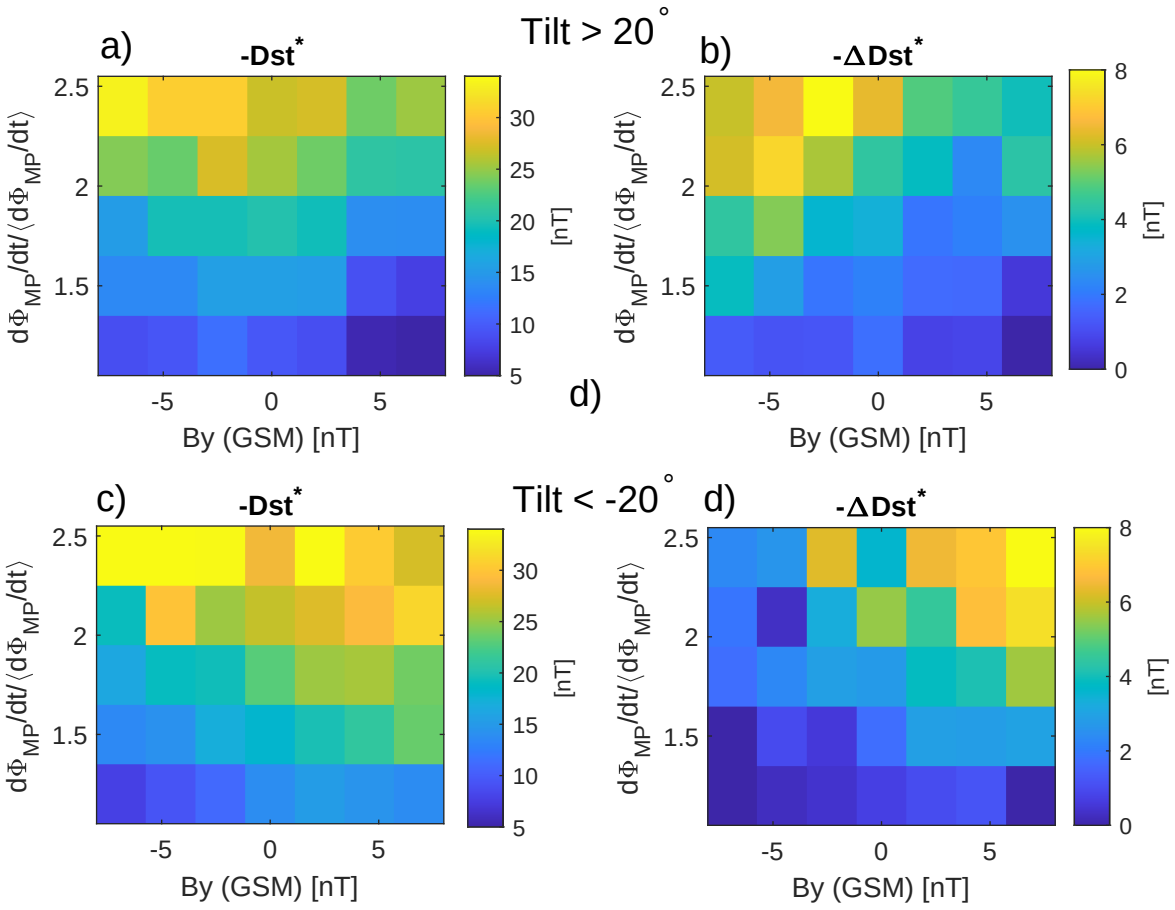

Figure S6. The pressure-corrected Dst index (Dst*) as a function of 3-hour means of the Newell coupling function and IMF By in NH winter (dipole tilt >20 degrees). b) The change of the Dst* index during the same three-hour intervals as in the panel a). Panels c-d) are similar to a-b) but are calculated for negative dipole tilt (<-20 degrees).

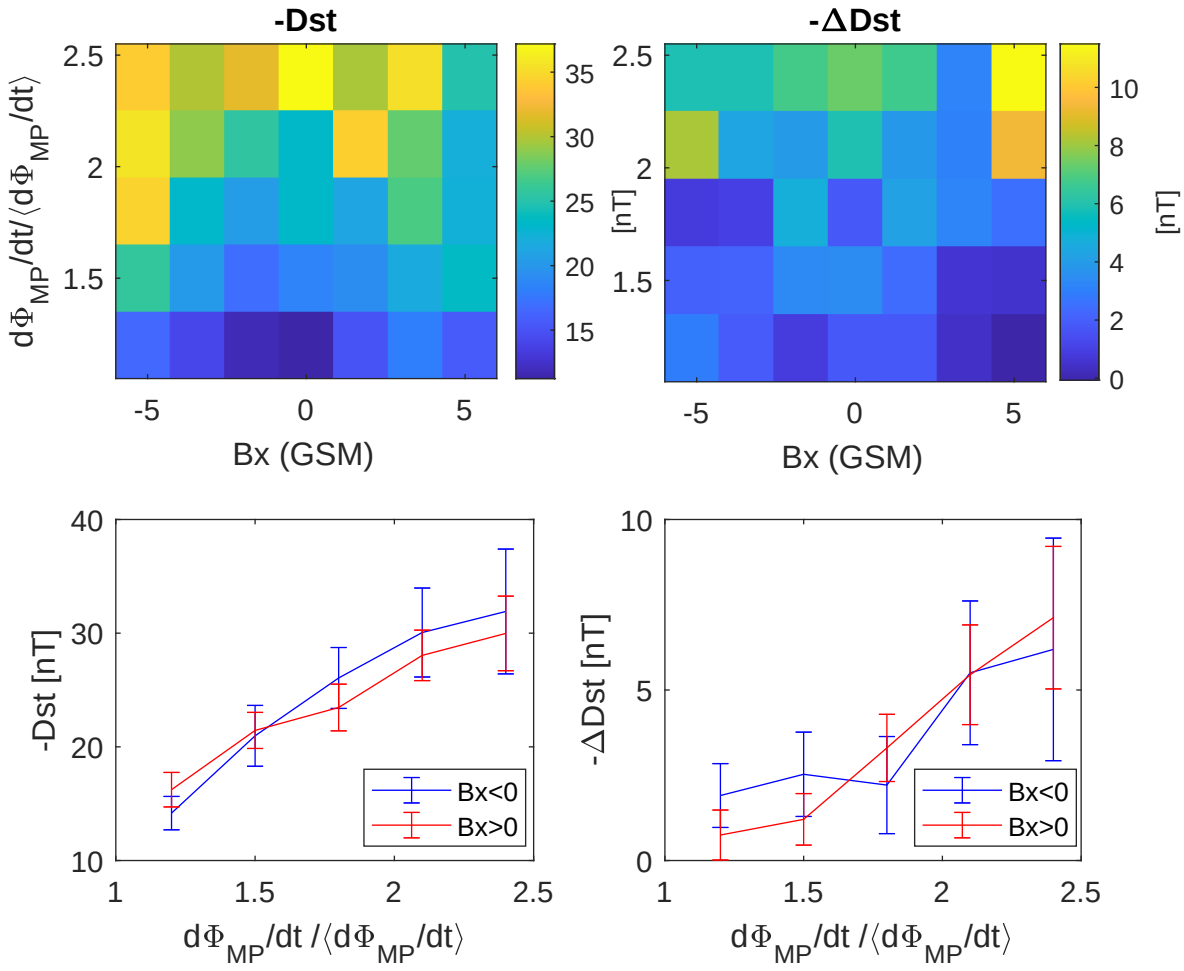

Figure S7. a) The Dst index as a function of 3-hour means of the Newell coupling function and IMF Bx in NH summer (dipole tilt > 20 degrees) during intervals when |By| < 2 nT. b) The change of the Dst index during the same three-hour intervals as in the panel a). Bottom panels show c) Dst d) change of Dst averaged for Bx<0 (blue line) and Bx>0 (red line) as a function of Newell coupling function.

```
#START
2000   1  1   0   0    0   0    0.    -5.     3.0  -500.   0.  0.    3.
200000.
2000   1  1   1   50   0   0    0.    -5.     3.0  -500.   0.  0.    3.
200000.
2000   1  1   2   0    0   0    0.    -5.    -5.0  -500.   0.  0.    3.
200000.
2000   1  1   12   0    0   0    0.    -5     -5.0  -500.   0.  0.    3.
200000.
```

Text S8. SWMF run input file for the run with By = -5nT.

```
                                  bx    by     bz     vx    vy   vz   den
temp
#START
2000   1  1   0   0    0   0    0.    5.     3.0  -500.   0.  0.    3.
200000.
2000   1  1   1   50   0   0    0.    5.     3.0  -500.   0.  0.    3.
200000.
2000   1  1   2   0    0   0    0.    5.    -5.0  -500.   0.  0.    3.
200000.
2000   1  1   12   0    0   0    0.    5    -5.0  -500.   0.  0.    3.
200000.
```

Text S9. SWMF run input file for the run with By = + 5nT.