Supplementary Material

The following tables summarise the proxies trialled as explanatory variables within the models, which of these were used within different versions of the models and the parameter estimates for these explanatory variables.

Table S1: Explanatory variables trialled within the statistical models. The Swarm data products are available at ftp://swarm-diss.eo.esa.int, the OMNI resolution data are available at https://spdf.gsfc.nasa.gov/pub/data/omni/, the Service International des Indices Géomagnétiques data are available at https://isgi.unistra.fr/geomagnetic_indices.php and the Laboratory for Atmospheric and Space Physics data are available at https://lasp.colorado.edu.

Parameter	Description	Origin	Use
aa	aa index (in nT)	Service International des Indices Géomagnétiques	Version 2 only
AE	AE index (in nT)	OMNI low resolution data	Version 2 only
Akasofu	The average value of the Akasofu solar wind coupling function, across a two-hour window, starting two hours before the observation to be updated	OMNI high resolution data	Versions 1 and 2
Akasofu_sd	The standard deviation of the Akasofu solar wind coupling function, across a two-hour window, starting two hours before the observation to be updated	OMNI high resolution data	Versions 1 and 2
AL	AL index (in nT)	OMNI low resolution data	Version 2 only
am	am index (in nT)	Service International des Indices Géomagnétiques	Version 2 only
Ap	Ap index (in nT)	OMNI low resolution data	Versions 1 and 2

ASY_D	ASY_D index (in nT)	OMNI high resolution data	Versions 1 and 2
ASY_H	ASY_H index (in nT)	OMNI high resolution data	Versions 1 and 2
AU	AU index (in nT)	OMNI low resolution data	Version 2 only
Density	The density of the thermosphere derived from GPS accelerations on Swarm (in kg m^{-3})	Swarm DNS/POD data product	Version 2 only
DOY_fn	A sine function based on the day of year, going from -1 at midwinter to +1 at midsummer in the northern hemisphere	NA	Versions 1 and 2
Dst	Dst index (in nT)	OMNI low resolution data	Versions 1 and 2
Elya_sd	As Akasofu_sd, but for the Elya solar wind coupling function	OMNI high resolution data	Versions 1 and 2
Elya	As Akasofu, but for the Elya solar wind coupling function	OMNI high resolution data	Versions 1 and 2
F107_27	27 day average of the F10.7cm solar flux (observed), centred on the day to be updated (in sfu)	Laboratory for Atmospheric and Space Physics	Versions 1 and 2
F107_81	81 day average of the F10.7cm solar flux (observed), centred on the day to be updated (in sfu)	Laboratory for Atmospheric and Space Physics	Versions 1 and 2
F107	The F10.7cm solar flux (observed) (in sfu)	Laboratory for Atmospheric and Space Physics	Versions 1 and 2
FAC	Field-aligned current observed by Swarm (in $\mu A/m^2$)	Swarm FAC_TMS_2F data product	Version 2 only
IEF_sd	As Akasofu_sd, but for the Interplanetary Electric Field (in mV m^{-1})	OMNI high resolution data	Versions 1 and 2

IEF	As Akasofu, but for the Interplanetary Electric Field (in mV m^{-1})	OMNI high resolution data	Versions 1 and 2
IMF_Abs_By_sd	As Akasofu_sd, but for the absolute value of the y-component of the Interplanetary Magnetic Field (in nT)	OMNI high resolution data	Versions 1 and 2
IMF_Abs_By	As Akasofu, but for the absolute value of the y-component of the Interplanetary Magnetic Field (in nT)	OMNI high resolution data	Versions 1 and 2
IMF_Bt_sd	As Akasofu_sd, but for the Interplanetary Magnetic Field (in nT)	OMNI high resolution data	Versions 1 and 2
IMF_Bt	As Akasofu, but for the Interplanetary Magnetic Field (in nT)	OMNI high resolution data	Versions 1 and 2
IMF_Bx_sd	As Akasofu_sd, but for the x-component of the Interplanetary Magnetic Field (in nT)	OMNI high resolution data	Versions 1 and 2
IMF_Bx	As Akasofu, but for the x-component of the Interplanetary Magnetic Field (in nT)	OMNI high resolution data	Versions 1 and 2
IMF_By_sd	As Akasofu_sd, but for the y-component of the Interplanetary Magnetic Field (in nT)	OMNI high resolution data	Versions 1 and 2
IMF_By	As Akasofu, but for the y-component of the Interplanetary Magnetic Field (in nT)	OMNI high resolution data	Versions 1 and 2
IMF_Bz_sd	As Akasofu_sd, but for the z-component of the Interplanetary Magnetic Field (in nT)	OMNI high resolution data	Versions 1 and 2
IMF_Bz	As Akasofu, but for the z-component of the Interplanetary Magnetic Field (in nT)	OMNI high resolution data	Versions 1 and 2
IMF_Clock_sd	As Akasofu_sd, but for the clock angle of the Interplanetary Magnetic Field (in nT)	OMNI high resolution data	Versions 1 and 2
IMF_Clock	As Akasofu, but for the clock angle of the Interplanetary Magnetic Field (in nT)	OMNI high resolution data	Versions 1 and 2
IRC	Ionospheric radial current observed by Swarm (in $\mu A/m^2$)	Swarm FAC_TMS_2F data product	Version 2 only

Kp	Kp index	OMNI low resolution data	Versions 1 and 2
LAT	Absolute value of latitude (in degrees)	Swarm IPIR data product	Versions 1 and 2
MLAT	Absolute value of magnetic latitude (in degrees)	Swarm LP_Extended data product (MLat)	Versions 1 and 2
MLT	A function based on the magnetic local time (in hr), to make it symmetric about local noon. If MLT<12, then the value of the MLT is used. If MLT> 12 then the value used is 24-MLT.	Swarm LP_Extended data product (MLT)	Versions 1 and 2
Newell_sd	As Akasofu_sd, but for the Newell solar wind coupling function	OMNI high resolution data	Versions 1 and 2
Newell	As Akasofu, but for the Newell solar wind coupling function	OMNI high resolution data	Versions 1 and 2
PCN	PCN index	OMNI high resolution data	Versions 1 and 2
ST_fn	A function based on the local solar time (in hr), to make it symmetric about local solar noon. If ST<12, then the value of the ST is used. If ST> 12 then the value used is 24-ST.	Swarm LP_Extended data product (ST)	Versions 1 and 2
Sunspot_27	27-day average of version 2 of the sunspot number, centred on the day to be updated	OMNI low resolution data	Versions 1 and 2
Sunspot_81	81-day average of version 2 of the sunspot number, centred on the day to be updated	OMNI low resolution data	Versions 1 and 2
Sunspot	Sunspot number (version 2)	OMNI low resolution data	Versions 1 and 2
SW_Den_sd	As Akasofu_sd, but for the solar wind density (in n cc^{-3})	OMNI high resolution data	Versions 1 and 2
SW_Den	As Akasofu, but for the solar wind density (in n cc^{-3})	OMNI high resolution data	Versions 1 and 2

SW_Press_sd	As Akasofu_sd, but for the solar wind pressure (in nPa)	OMNI high resolution data	Versions 1 and 2
SW_Press	As Akasofu, but for the solar wind pressure (in nPa)	OMNI high resolution data	Versions 1 and 2
SW_Vel_sd	As Akasofu_sd, but for the solar wind velocity (in km s^{-1})	OMNI high resolution data	Versions 1 and 2
SW_Vel	As Akasofu, but for the solar wind velocity (in km s^{-1})	OMNI high resolution data	Versions 1 and 2
SYM_D	SYM_D index (in nT)	OMNI high resolution data	Versions 1 and 2
SYM_H	SYM_H index (in nT)	OMNI high resolution data	Versions 1 and 2
SZA	Solar Zenith Angle (in degrees)	Swarm LP_Extended Data Product (SZA)	Versions 1 and 2