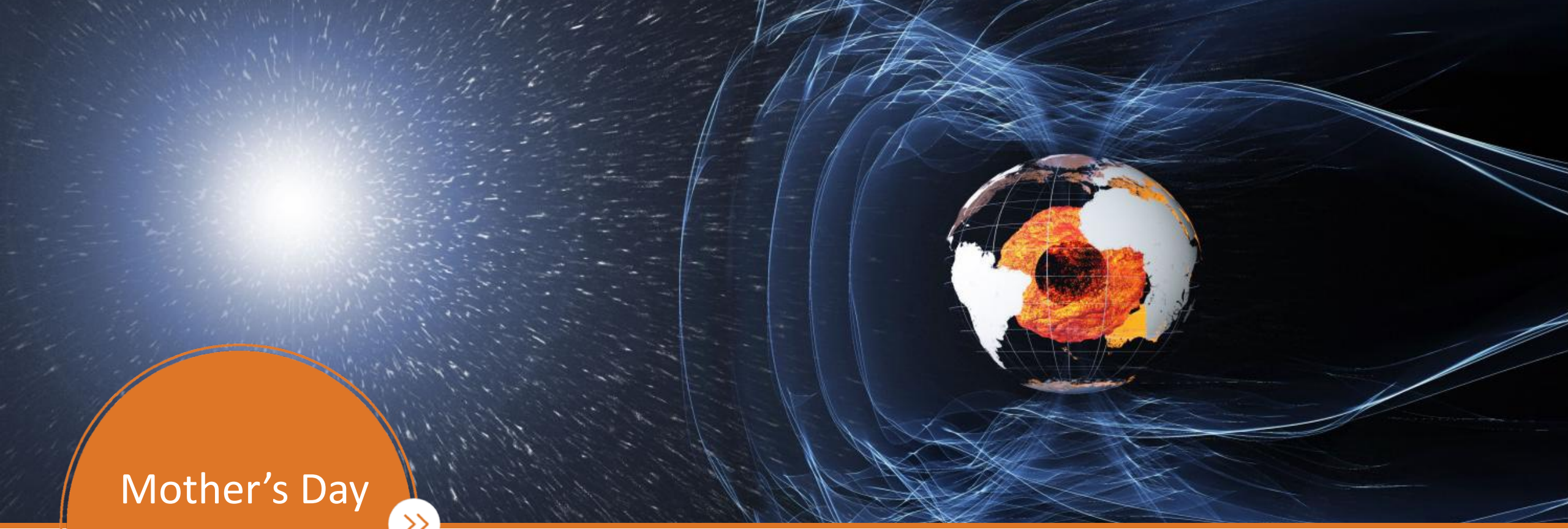


Mother's Day Storm 2024

Radiation impact through the eyes of the R-ESC

M. Dierckxsens, N. Crosby

STCE Annual Meeting, 27 June 2024

BIRA·IASB

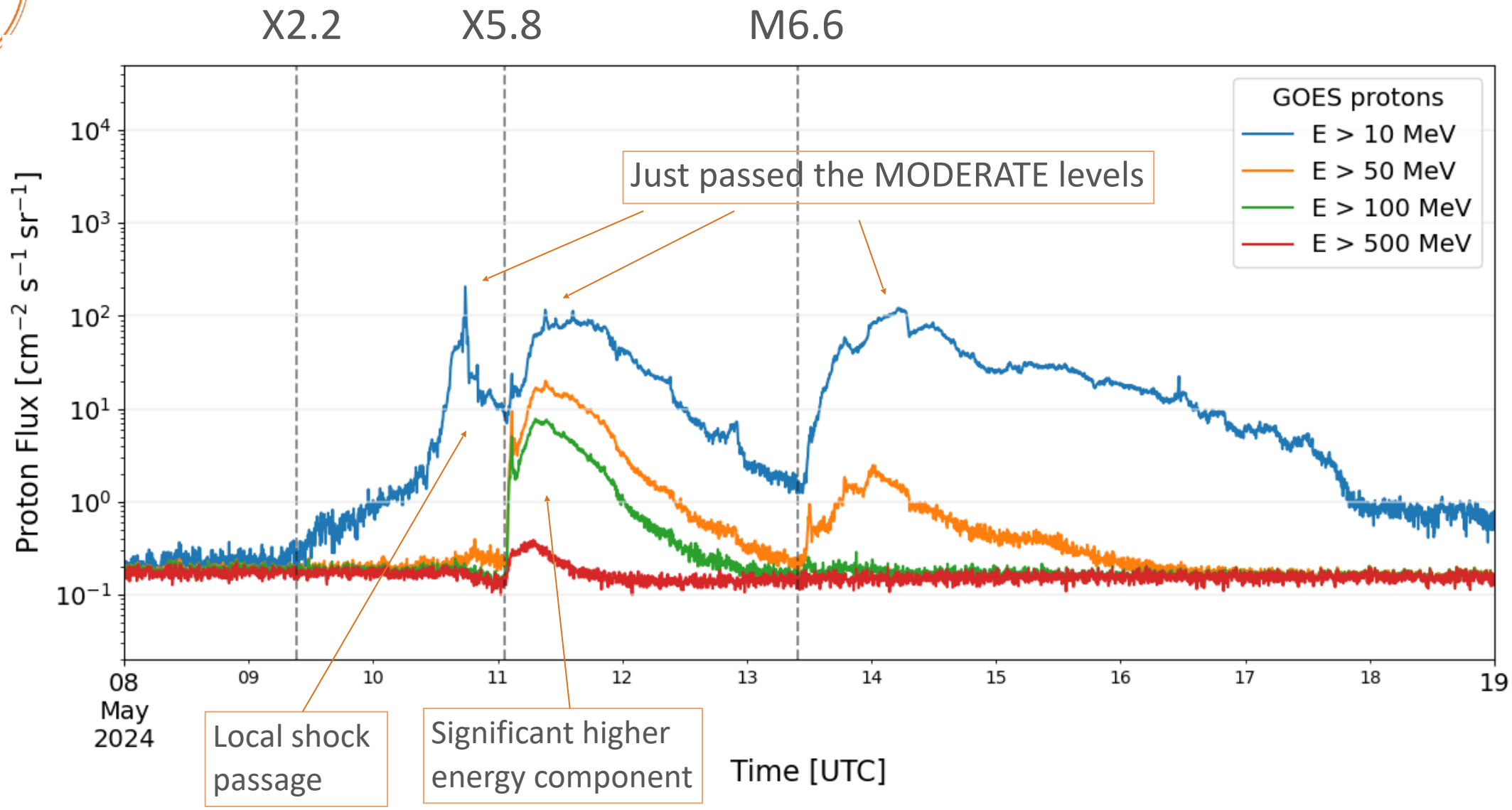
Outline

- A selection of predictions/warnings/observations from products available on ESA's SWE Portal as part of the R-ESC (+ some additional info)

- Covering the following environments:
  - Solar Energetic Particles
  - Radiation Belts
  - Plasmasphere

Solar Energetic Particles

Goes Proton Flux



R-ESC Forecasts

COMESEP Alert System (R.134)

SEP Forecast Alerts from COMESEP has issued the following SEP alert with impact risk evaluated as high.

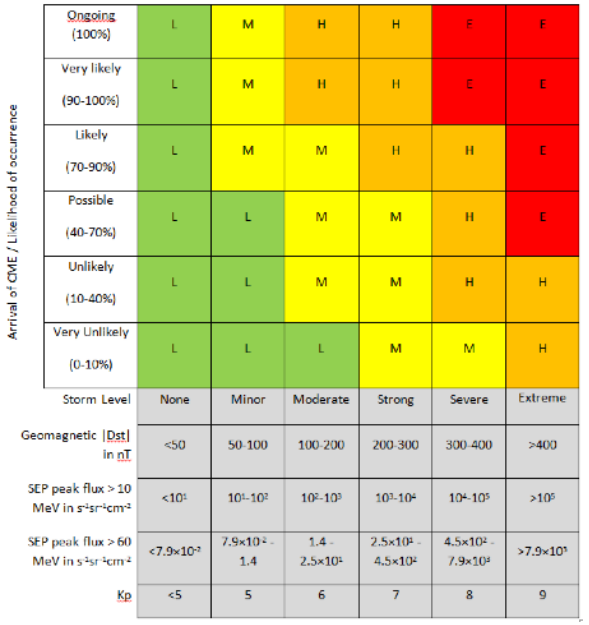
Details on the above alert can be found hereafter.

Best Regards,

COMESEP Alert system.

<
>=== COMESEP Alert Identity ===
20240511_021002_c97b4f61c1@SEPForecast.oma.be

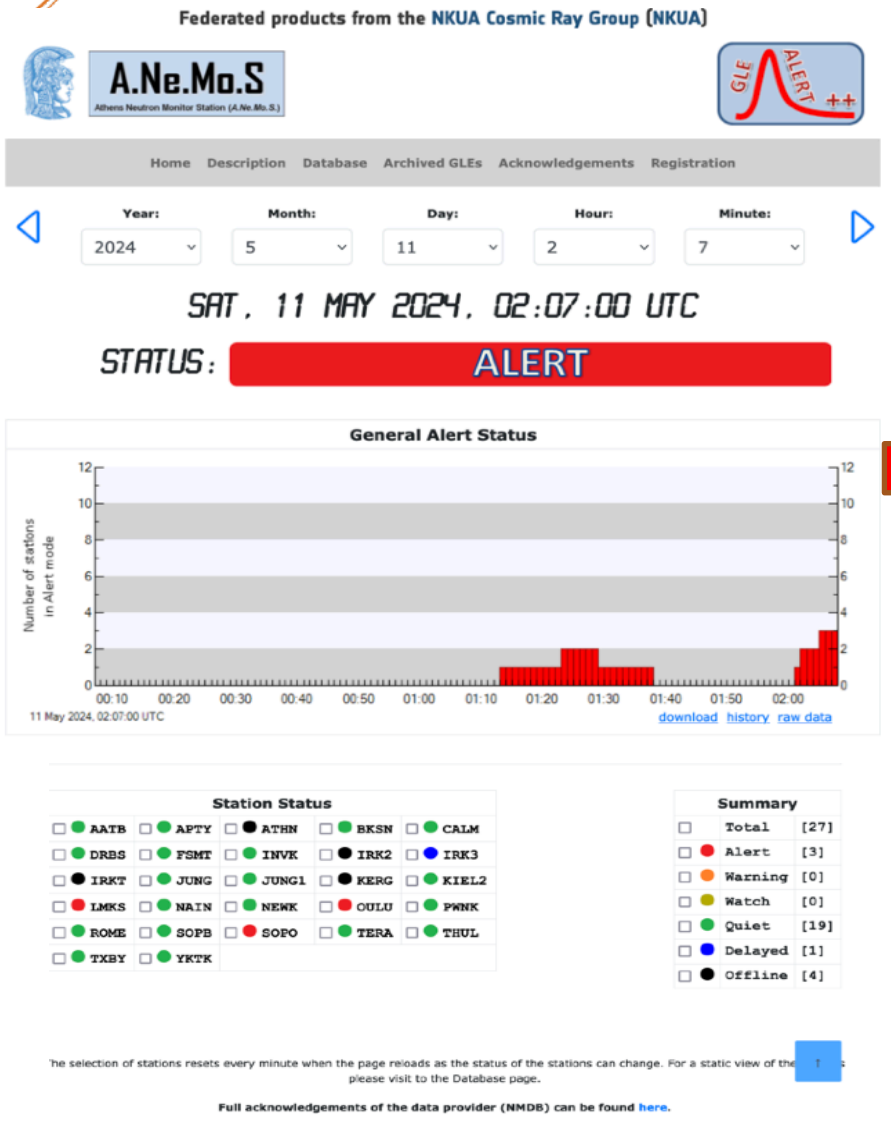
=== Comesep Alert Info ===
Alert id: 20240511_021002_c97b4f61c1@SEPForecast.oma.be
Status:normal
AlertIdAction: update
Emitter: SEP Forecast Alerts from COMESEP
Emitter HRef: http://www.comesep.eu/sepforecast
Emitter Version: 0.0.0
Subject: Forecast for a SEP radiation storm following a X5.8 flare with peak at 2024-05-11 01:23UT (protons > 10 MeV: STRONG, VERY LIKELY; protons > 60 MeV: STRONG, VERY LIKELY).
SubjectTopic: SEP



https://swe.ssa.esa.int/bira-comesep-federated, BIRA-IASB (BE)

R-ESC Warnings

GLE Alert++ (R.102)



GLE alert notification issued at 2:05UT

Product: R.102 GLE Alert++
Issued 2024 May 11 02:05 UT

A new GLE alert produced on 2024.05.11 at 02:05 UT based on ANeMoS server timestamp. The following Neutron Monitors detected this event.

LMKS OULU SOPO

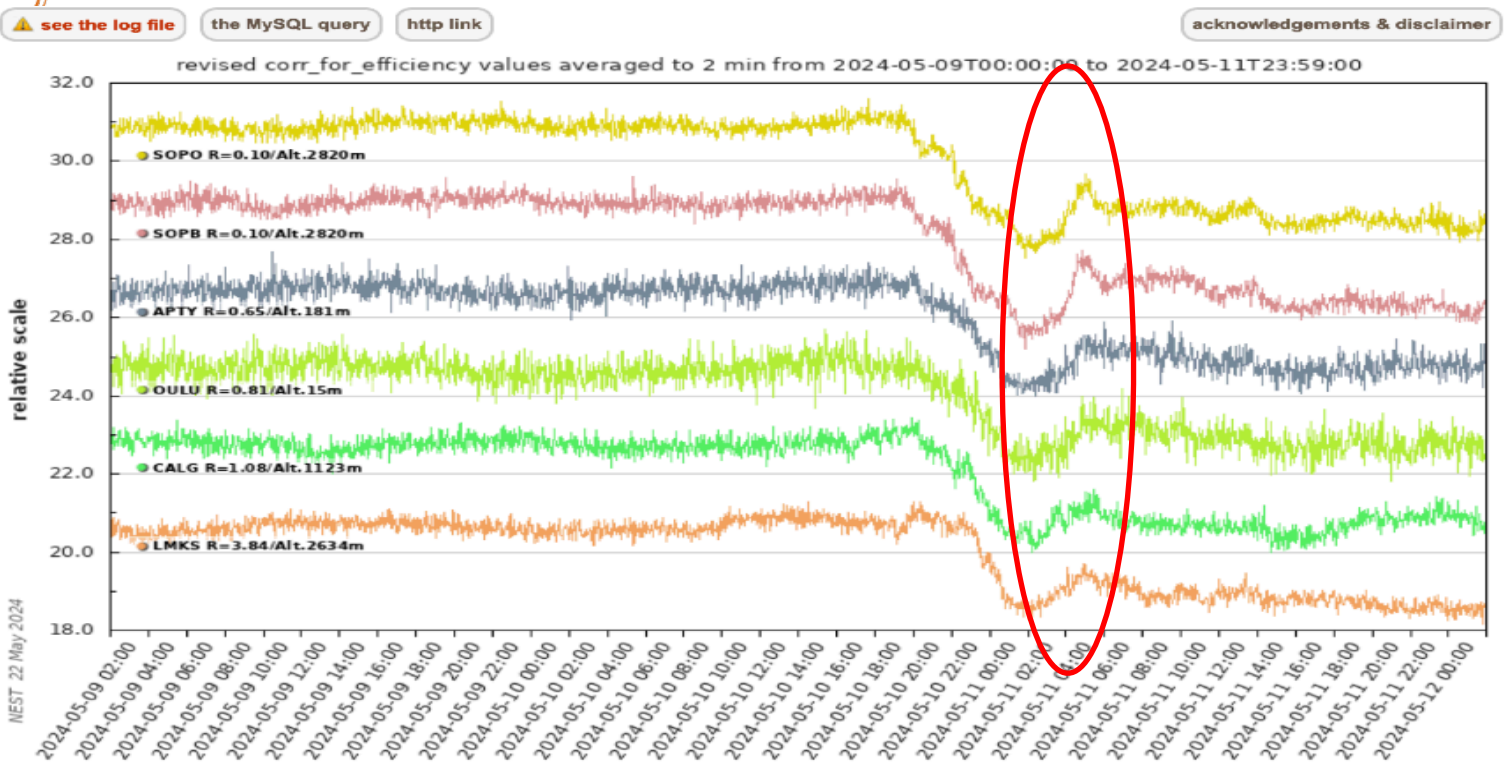
You can visit our official website to view more information about the event https://swe.ssa.esa.int/anemos-federated

Thank you for your trust in our automated system for getting email notification for GLE event.

If you want to unsubscribe, please visit our product page and select the unsubscribe field from the registration tab.

Kind Regards
Athens Neutron Monitor Station_ ANeMoS
Operated at National and Kapodistrian University of Athens

GLE 74 Details



Several Neutron Monitors detected enhancement in their recordings during a deep Forbush Decrease!

First stations detected the enhancement: OULU, SOPO and LMKS around 02:00 UT

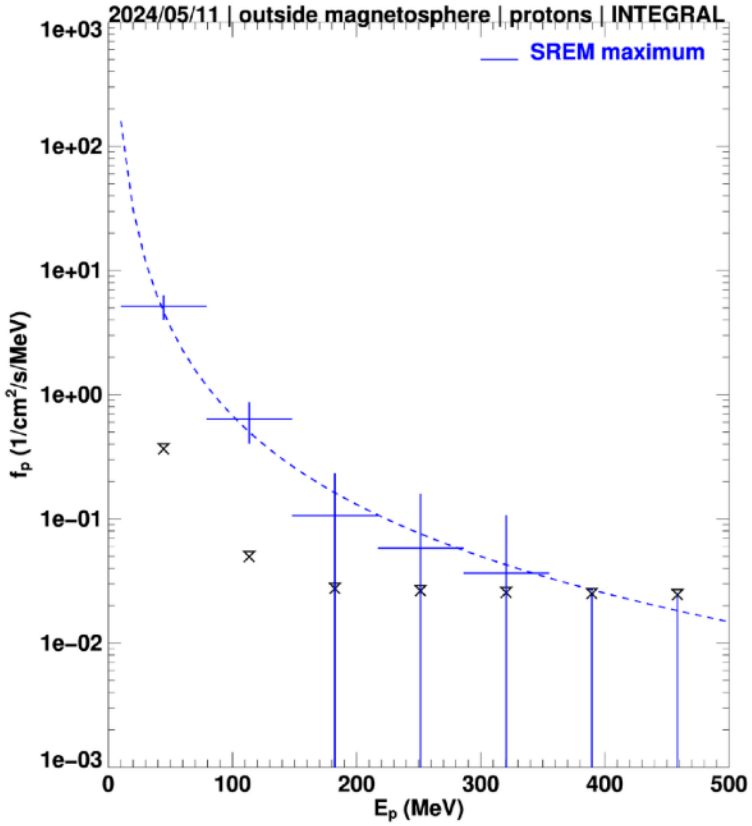
→ Increase in radiation at flight altitudes expected due to SEPs is less than decrease due to FD

R-ESC Observations

Integral/SREM radiation rates (R.119)

2024-05-10 | 20240511 | 2024-05-12

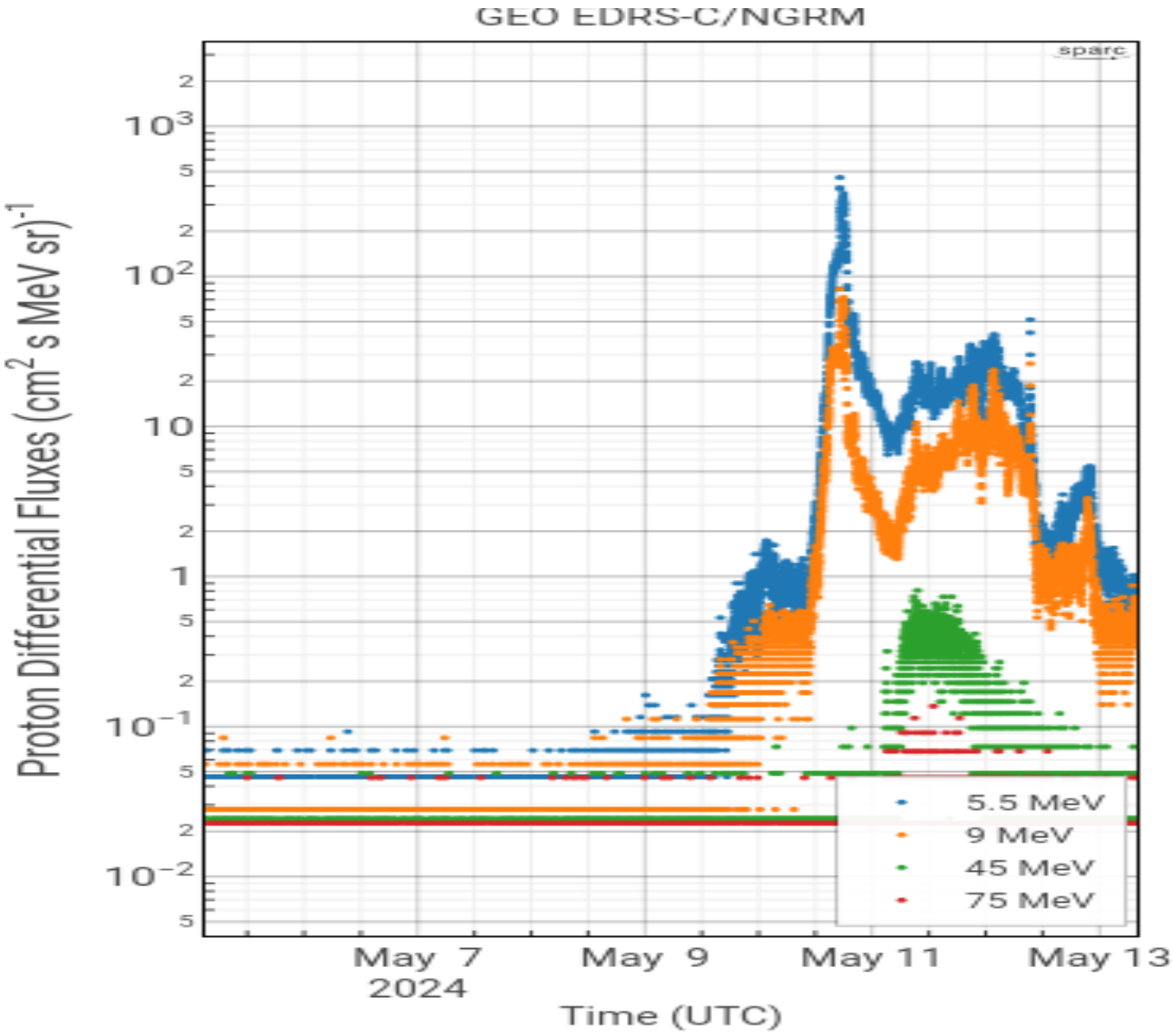
space region	#1	#2	#3	#4	#5	#6
	Proton belt	Proton belt	Slot region	Electron belt	Electron belt	Interplanetary
particle	protons	electrons	electrons	electrons	electrons	cosmics/ protons
satellite	PROBA1	PROBA1	PROBA1	PROBA1	Integral	Integral
L-range	1.2 ≤ L ≤ 1.3	1.6 ≤ L ≤ 1.7	2.5 ≤ L ≤ 3.0	4.0 ≤ L ≤ 5.0	6.0 ≤ L ≤ 7.0	see orbit
status	on-going	on-going	on-going	on-going	on-going	on-going
radiation levels relative to						
AE8/AP8 min	-	0.0	6.3	0.1	-	
AE8/AP8 max	-	0.0	1.7	0.1	-	
SREM average	-	0.0	0.4	0.0	-	13.0
SEP alarm						SEP



https://swe.ssa.esa.int/pb-srem-federated, Paul Buehler, (AU)

R-ESC Observations

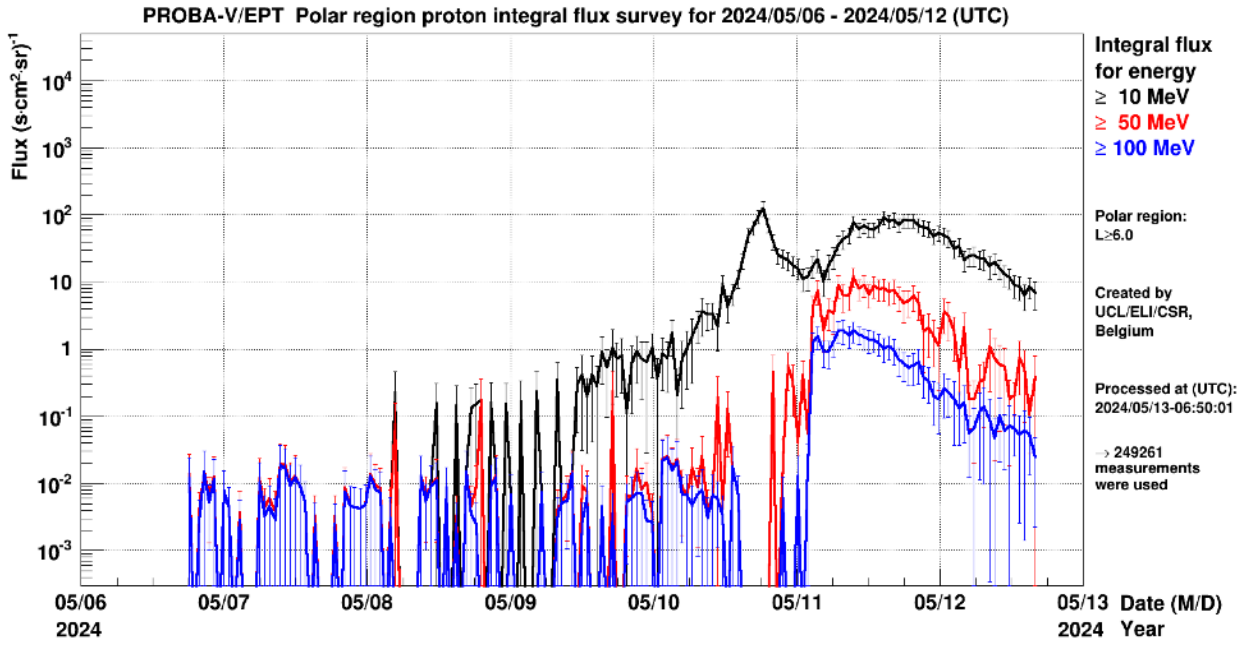
EDRS-C/NGRM L2 Proton differential fluxes (R.171)



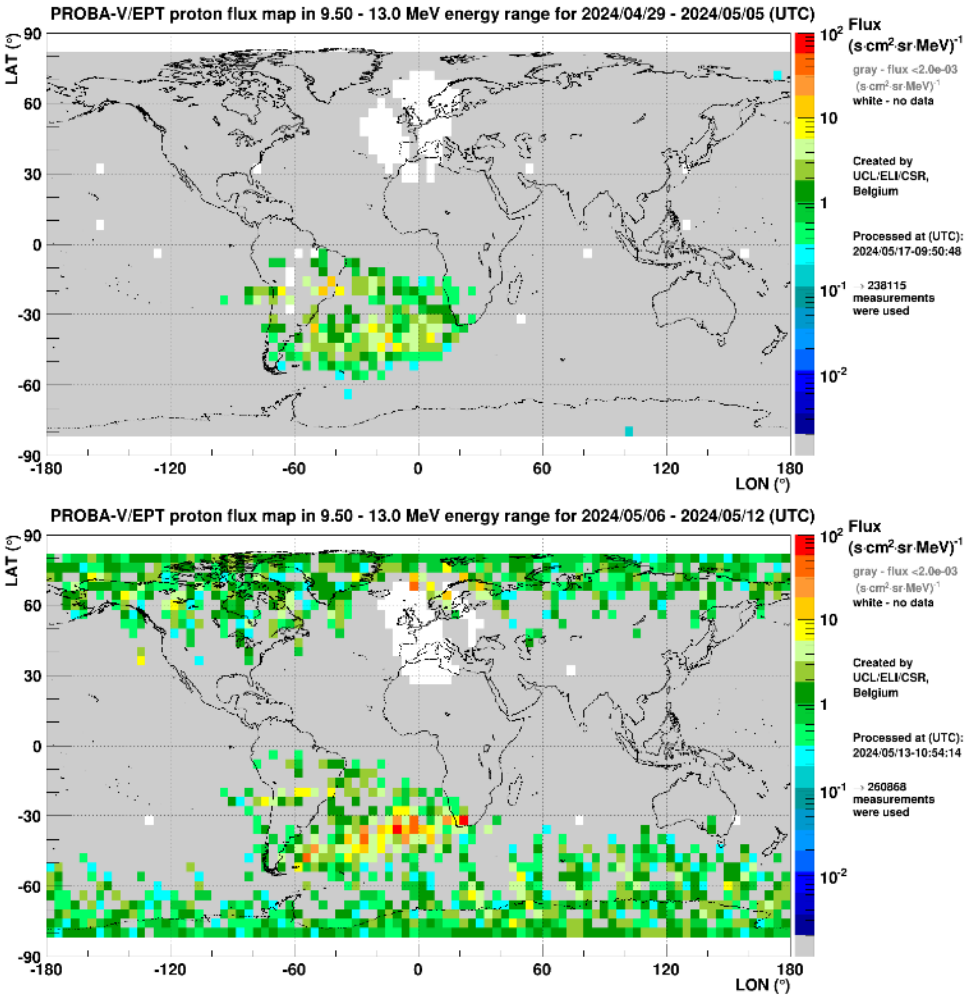
https://swe.ssa.esa.int/sparc-geo-ngrm-r171-federated, SPARC (GR)

R-ESC Observations

PROBA-V/EPT Polar region proton flux survey (R.161)

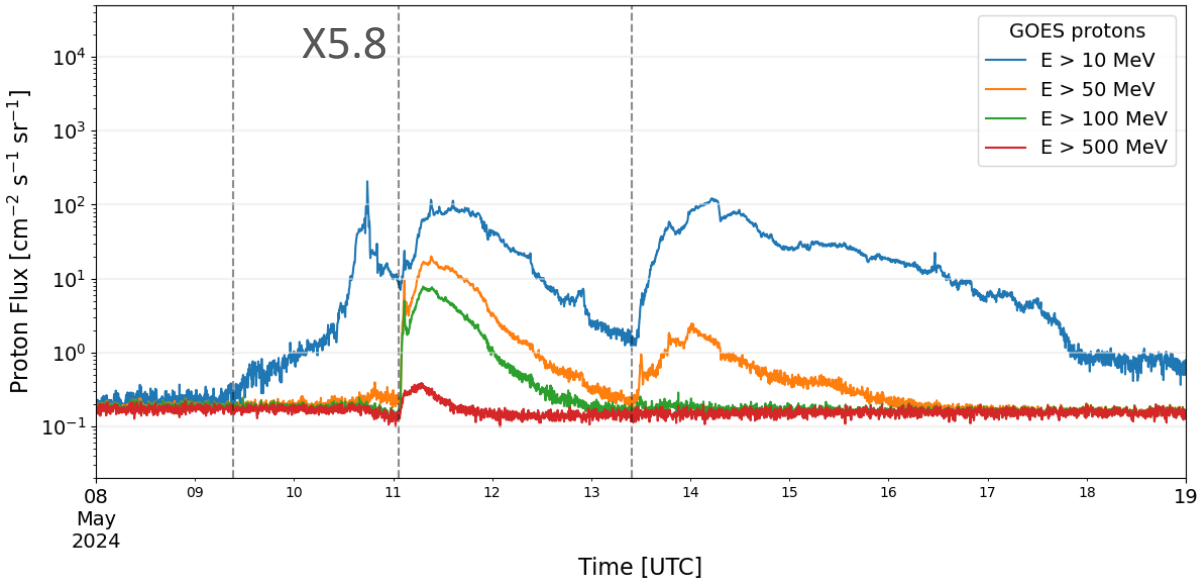


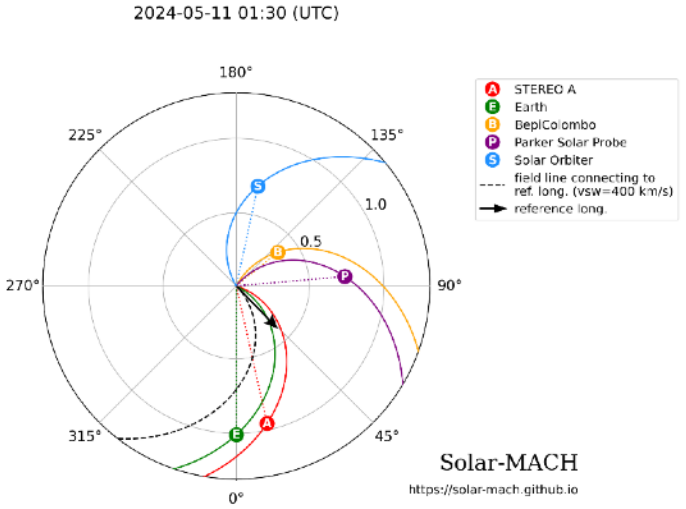
PROBA-V/EPT Proton flux geographical maps (R.113)

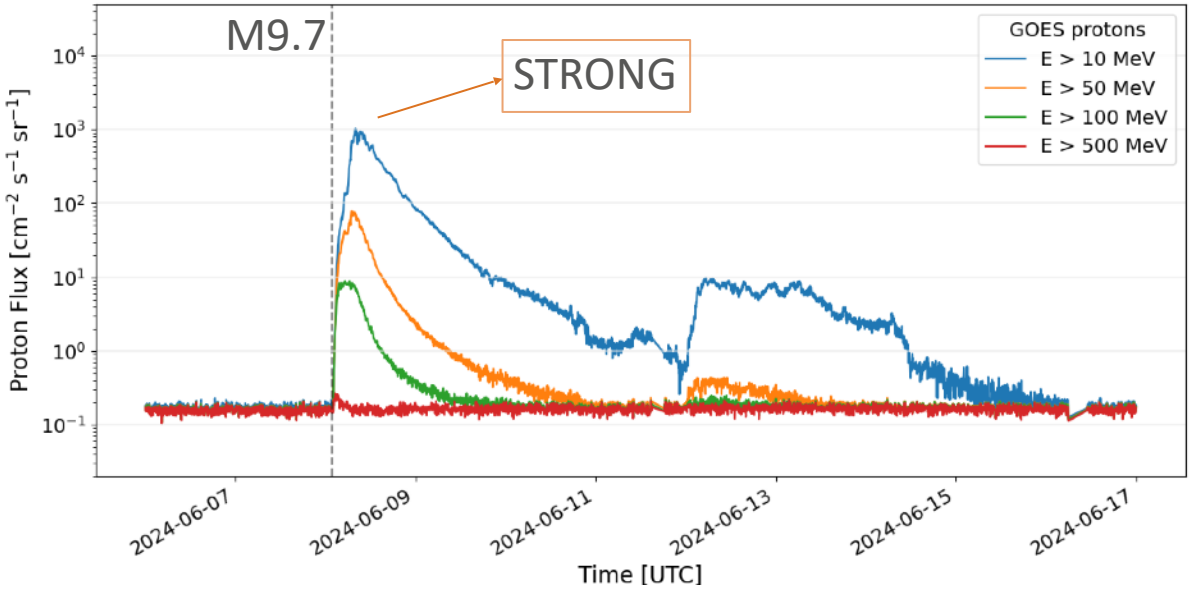


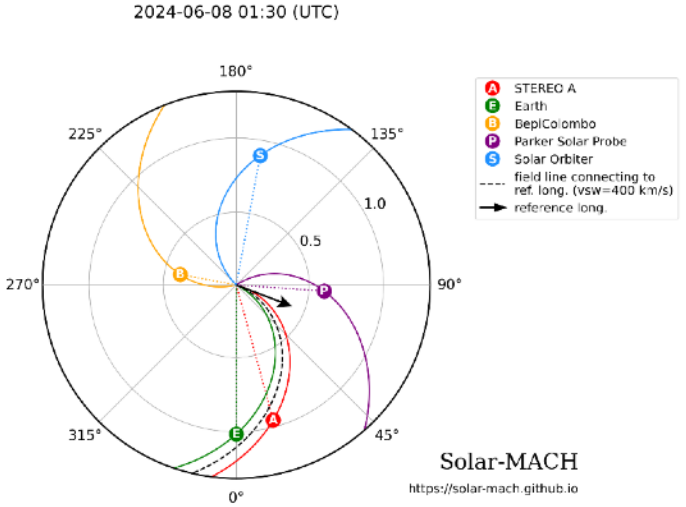
https://swe.ssa.esa.int/csr-ept-federated, UCL/CSR (BE)

One Carrington Rotation Later…

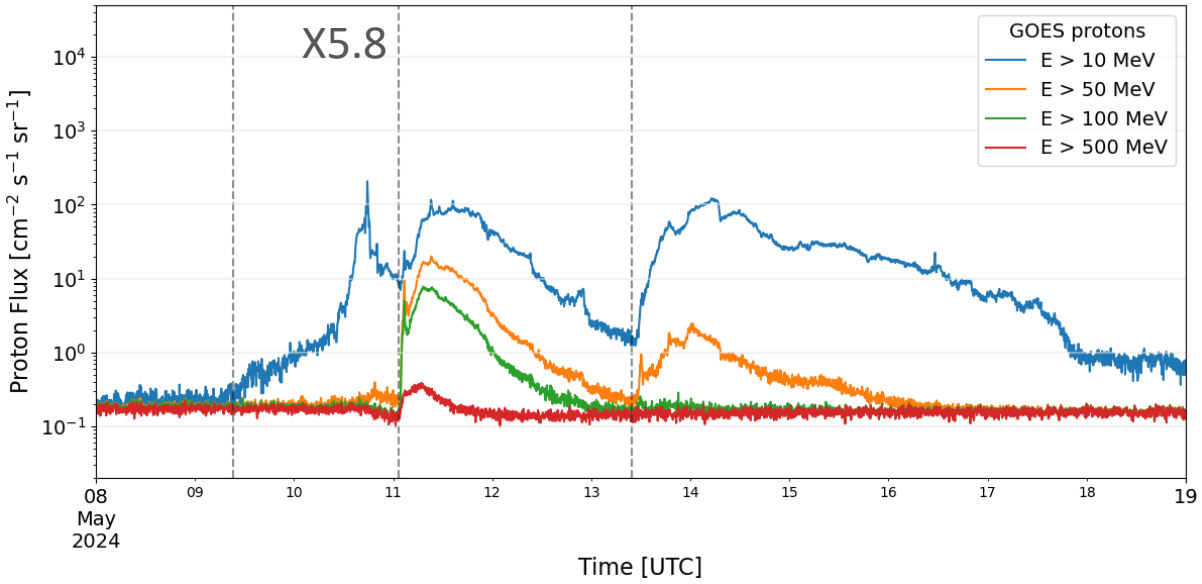


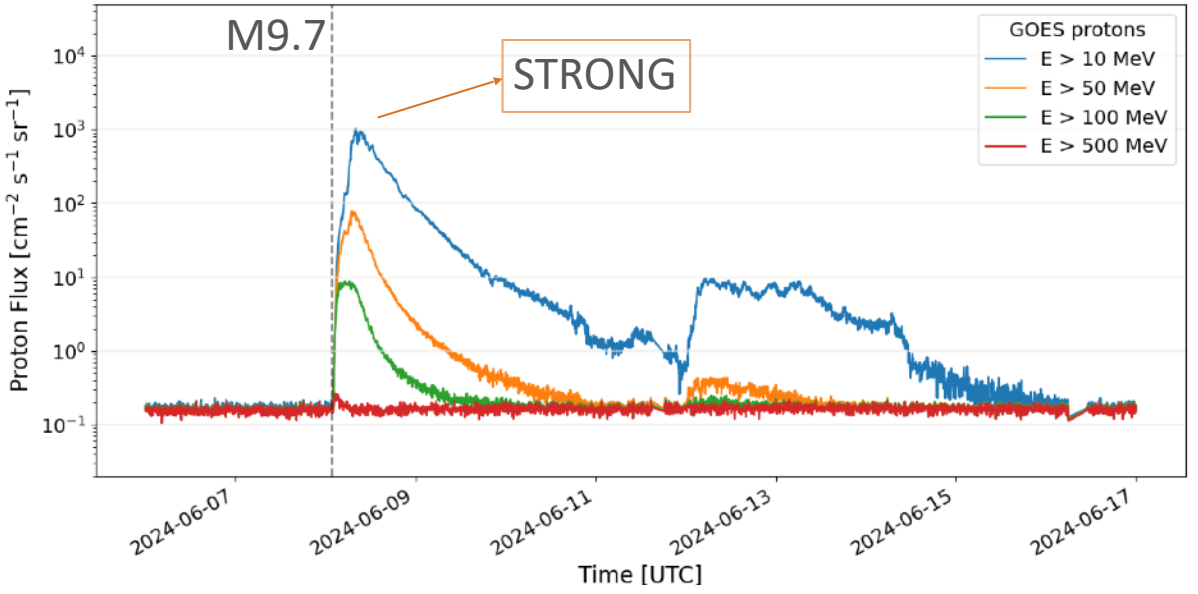


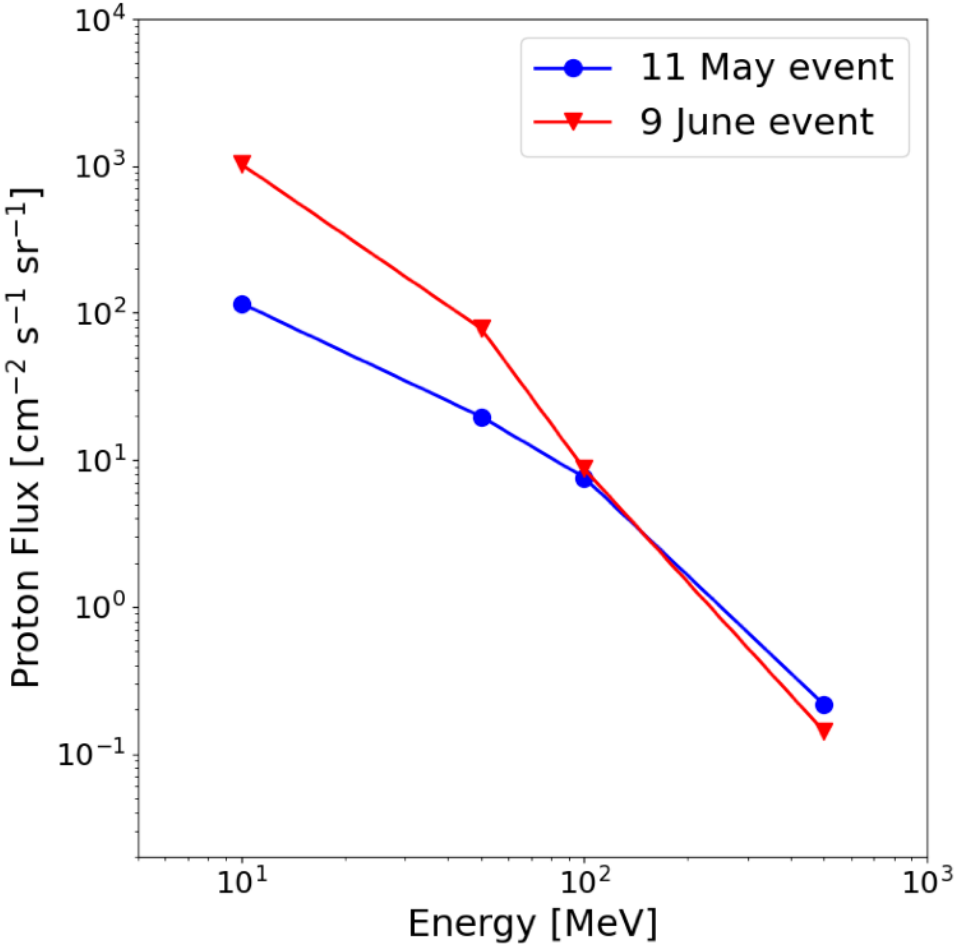




One Carrington Rotation Later…

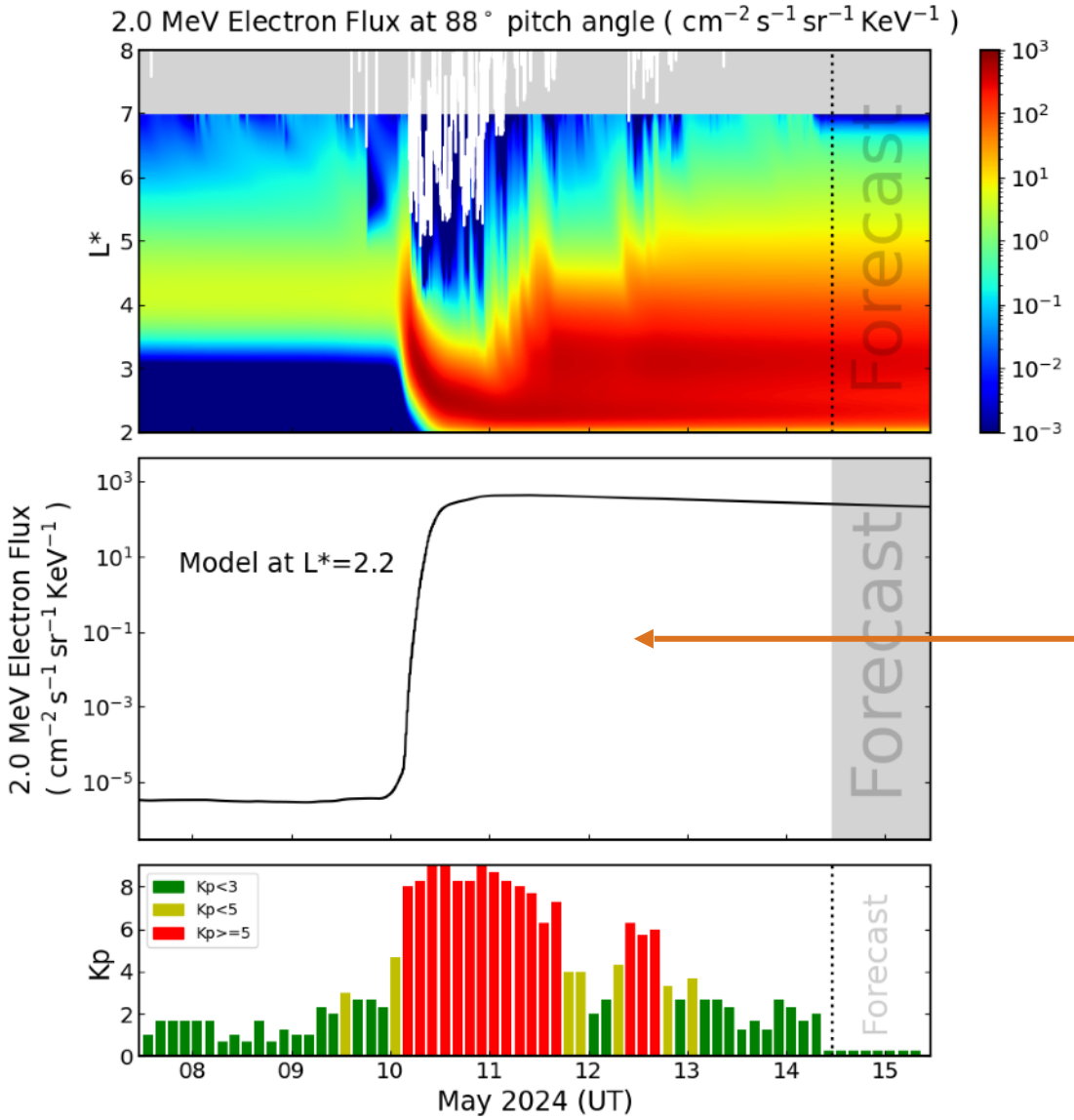






Radiation Belts

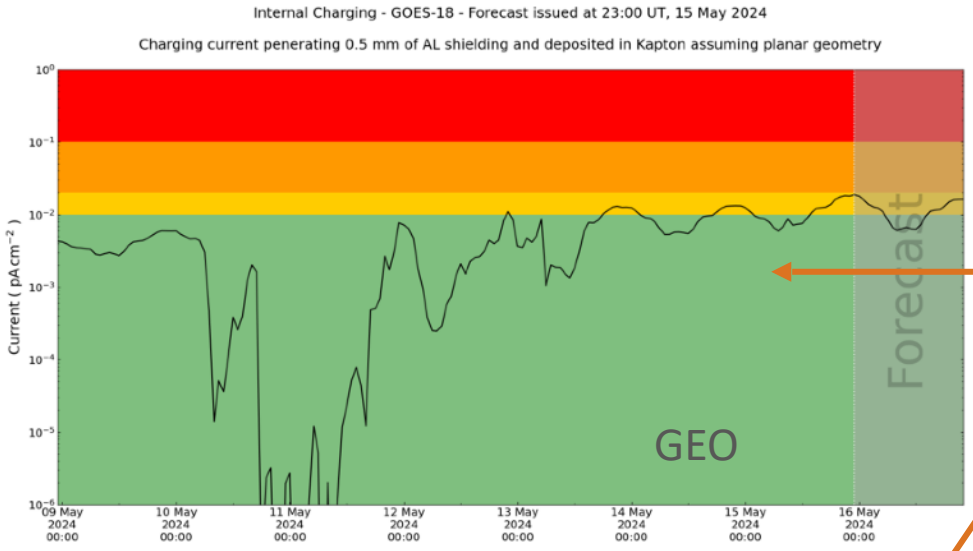
R-ESC Forecasts/Models

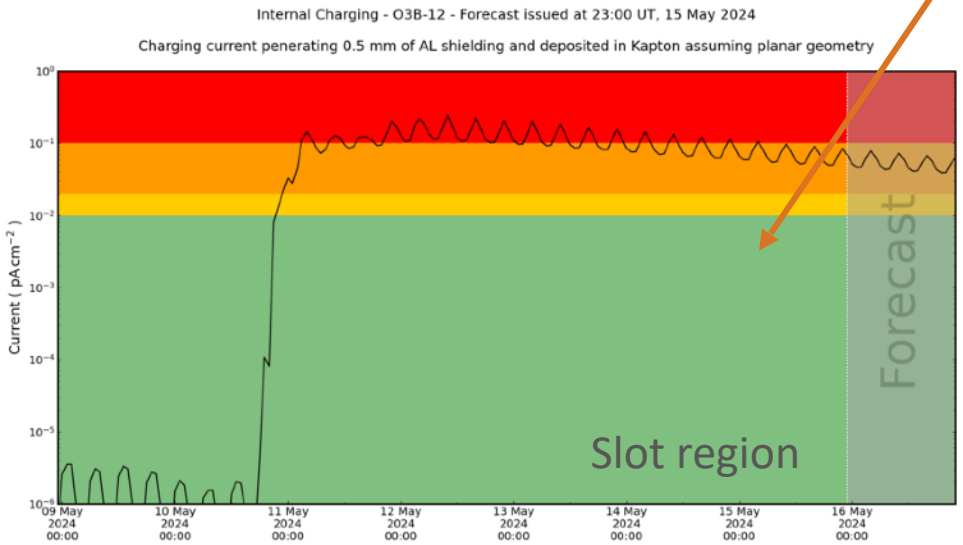


Satellite Risk Indicators Forecast (SaRIF, R.154)

A significant injection of electrons into the slot region expected

R-ESC Impact Risk Indicators

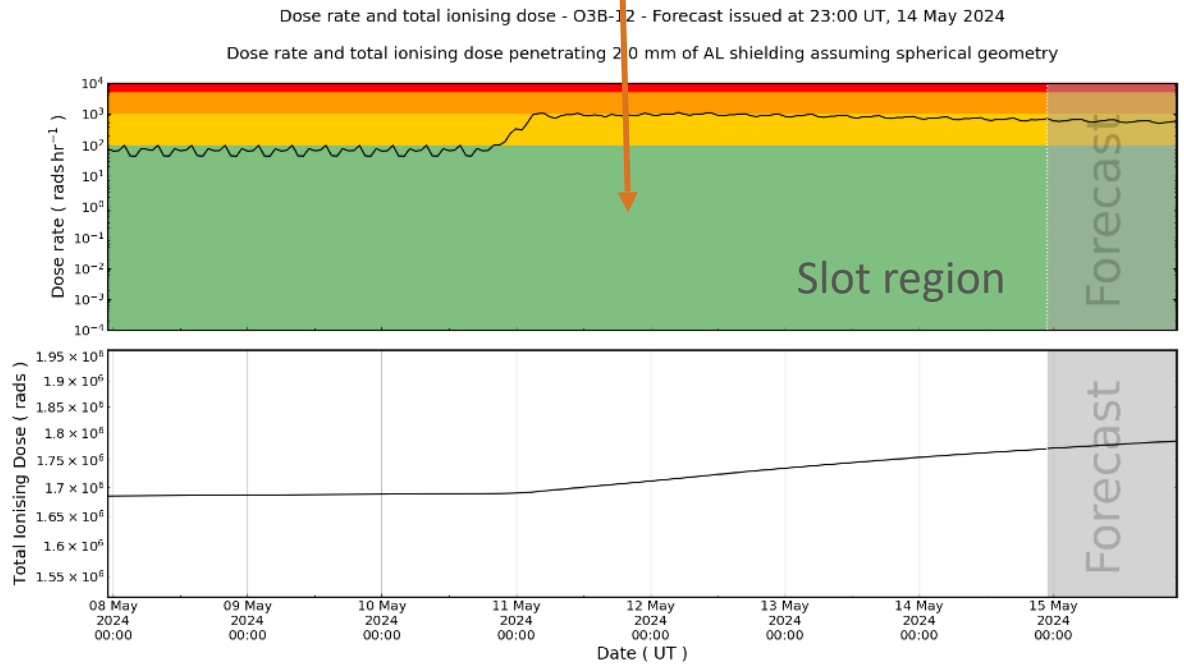




Satellite Risk Indicators Forecast (SaRIF, R.143, R.152, R.153)

Internal charging

Dose rate and total ionizing dose



https://swe.ssa.esa.int/sarif-federated, UKRI-BAS (UK)

R-ESC Impact Risk Indicators

Nowcast							
Date	09/05/2024	10/05/2024	11/05/2024	12/05/2024	13/05/2024	14/05/2024	15/05/2024
Kapton (0.0 mm)							
Polythene (0.0 mm)							
Teflon (0.0 mm)							
Kapton (0.5 mm)							
Polythene (0.5 mm)							
Teflon (0.5 mm)							

Internal charging environment nowcast (ICEA, R.179)

Forecast							
Date	09/05/2024	10/05/2024	11/05/2024	12/05/2024	13/05/2024	14/05/2024	15/05/2024
Kapton (0.0 mm)							
Polythene (0.0 mm)							
Teflon (0.0 mm)							
Kapton (0.5 mm)							
Polythene (0.5 mm)							
Teflon (0.5 mm)							

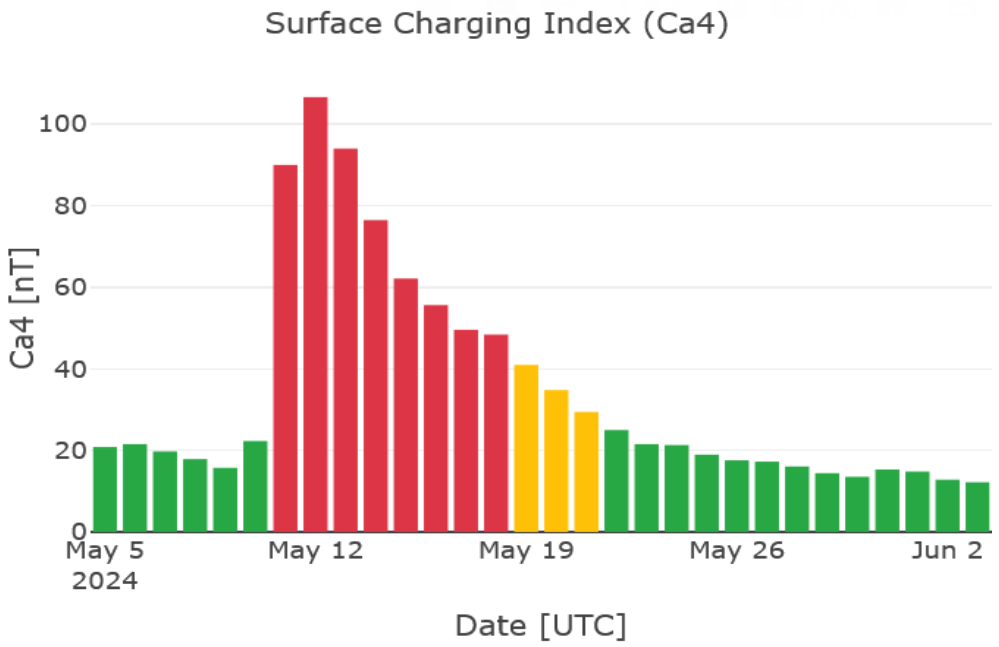
Internal charging environment forecast (ICEA, R.180)

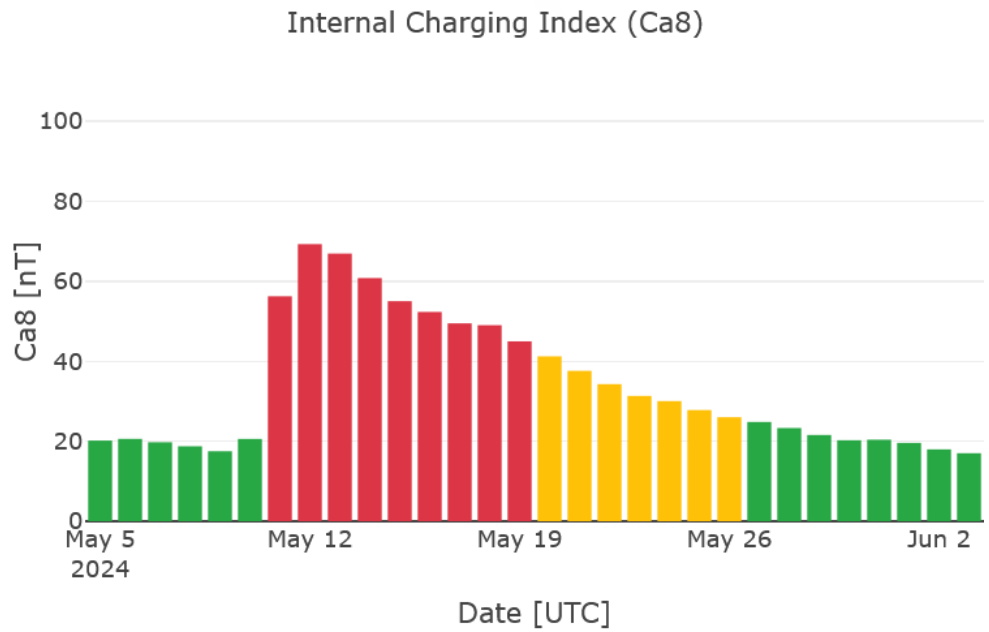
Electrostatic Discharge Risk at GEO for various shielding and dielectric materials

https://swe.ssa.esa.int/bira-icea-r178-federated, BIRA-IASB (BE)

R-ESC Impact Risk Indicators

Radiation belt activity indices for surface and internal charging (RB-IND, R.177)

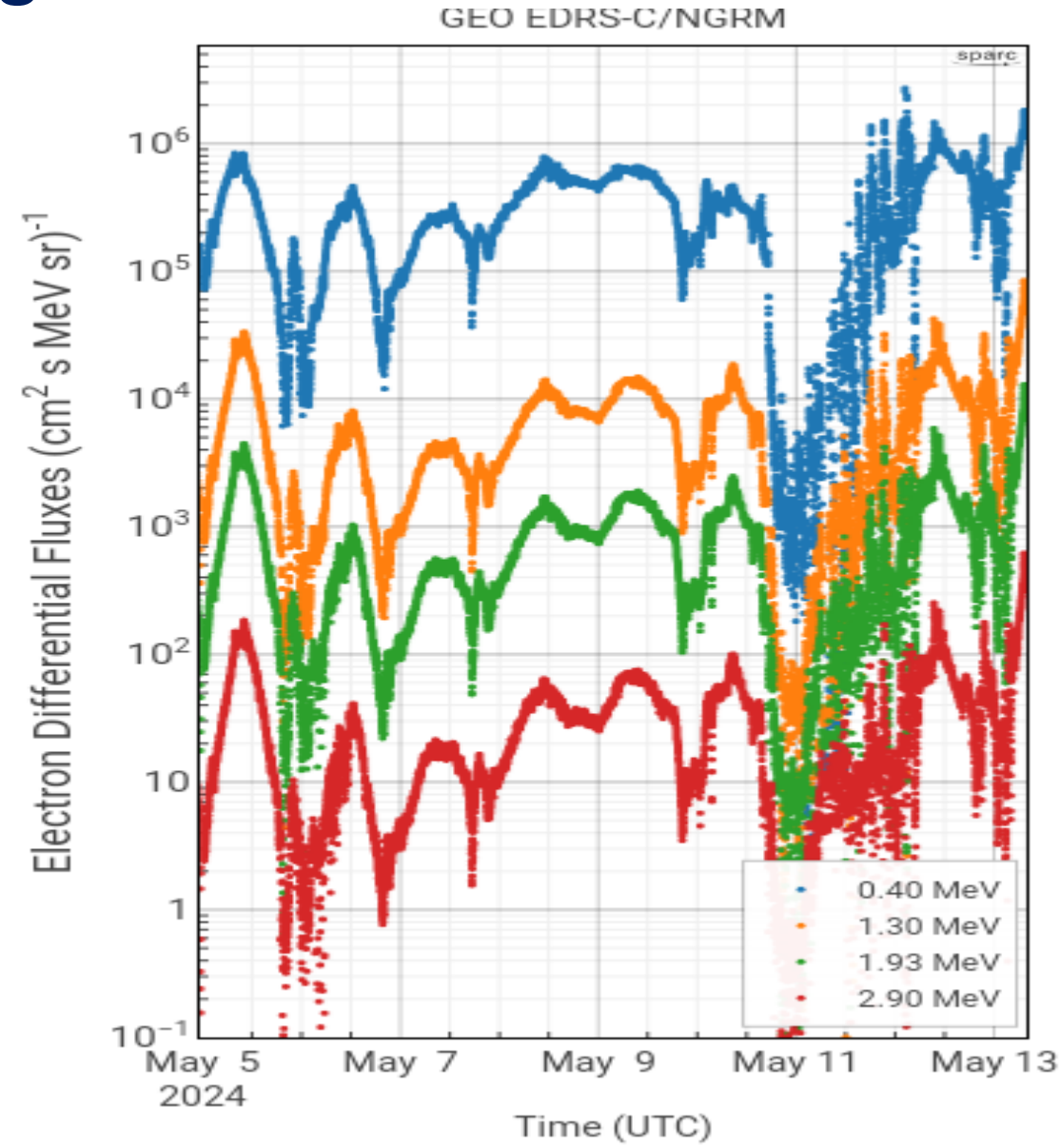




https://swe.ssa.esa.int/onera-rb-ind-federated, ONERA (FR)

R-ESC Observations

EDRS-C/NGRM L2 Electron differential fluxes (R.170)



https://swe.ssa.esa.int/sparc-geo-ngrm-r171-federated, SPARC (GR)

R-ESC Observations

Proba-1/SREM (R.118) and Integral/SREM (R.119) radiation rates

11/05/2024

2024-05-10 | 20240511 | 2024-05-12

space region	#1	#2	#3	#4	#5
	Proton belt	Proton belt	Slot region	Electron belt	Electron belt
particle	protons	electrons	electrons	electrons	electrons
satellite	PROBA1	PROBA1	PROBA1	PROBA1	Integral
L-range	1.2 ≤ L ≤ 1.3	1.6 ≤ L ≤ 1.7	2.5 ≤ L ≤ 3.0	4.0 ≤ L ≤ 5.0	6.0 ≤ L ≤ 7.0
status	on-going	on-going	on-going	on-going	on-going
radiation levels relative to					
AE8/AP8 min	-	0.0	6.3	0.1	-
AE8/AP8 max	-	0.0	1.7	0.1	-
SREM average	-	0.0	0.4	0.0	-
SEP alarm					

12/05/2024

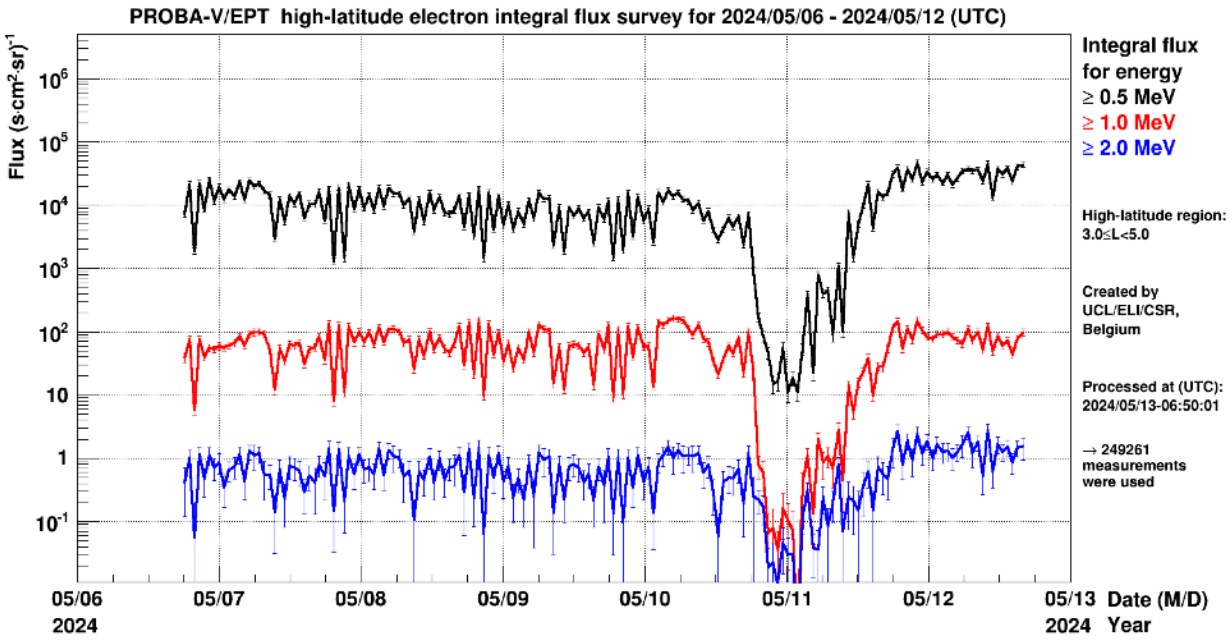
2024-05-11 | 20240512 | 2024-05-13

space region	#1	#2	#3	#4	#5
	Proton belt	Proton belt	Slot region	Electron belt	Electron belt
particle	protons	electrons	electrons	electrons	electrons
satellite	PROBA1	PROBA1	PROBA1	PROBA1	Integral
L-range	1.2 ≤ L ≤ 1.3	1.6 ≤ L ≤ 1.7	2.5 ≤ L ≤ 3.0	4.0 ≤ L ≤ 5.0	6.0 ≤ L ≤ 7.0
status	on-going	on-going	on-going	on-going	on-going
radiation levels relative to					
AE8/AP8 min	0.3	0.0	803.3	0.6	-
AE8/AP8 max	0.5	0.0	217.0	0.4	-
SREM average	1.0	0.0	50.1	0.2	-
SEP alarm					

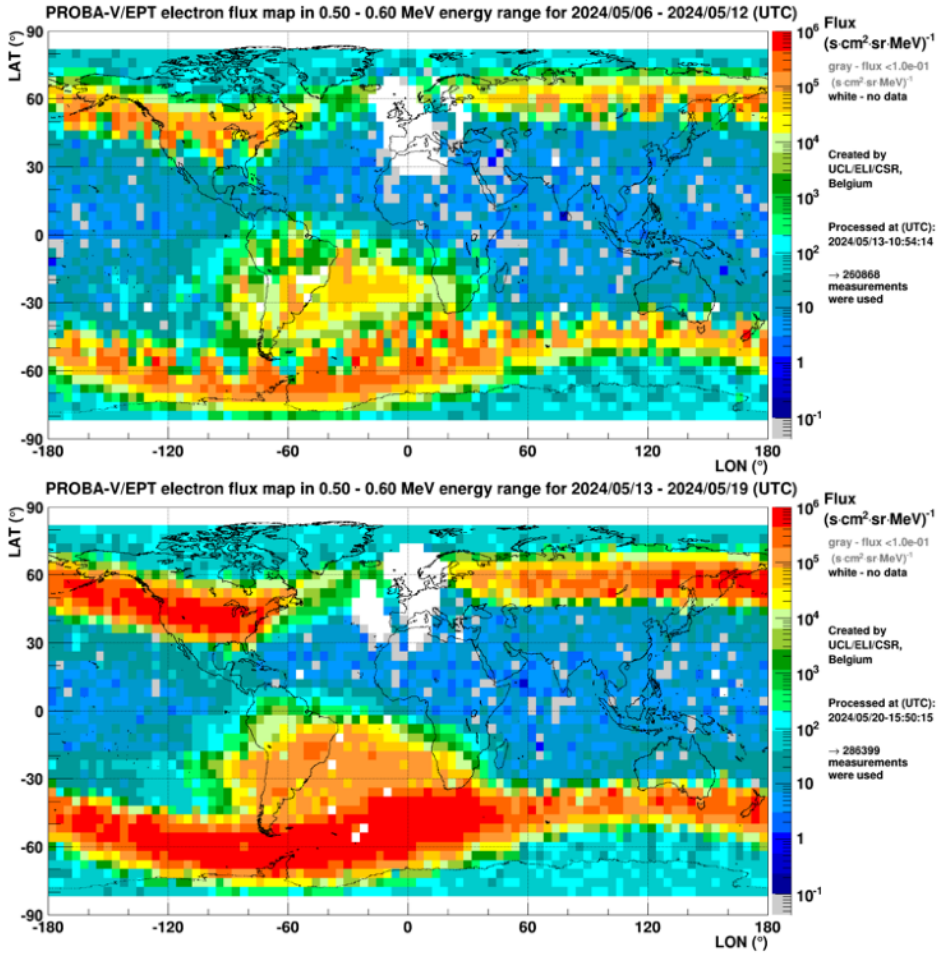
https://swe.ssa.esa.int/pb-srem-federated, Paul Buehler (AU)

R-ESC Observations

PROBA-V/EPT High-latitude electron flux survey (R.160)



PROBA-V/EPT Electron flux geographical maps (R.112)



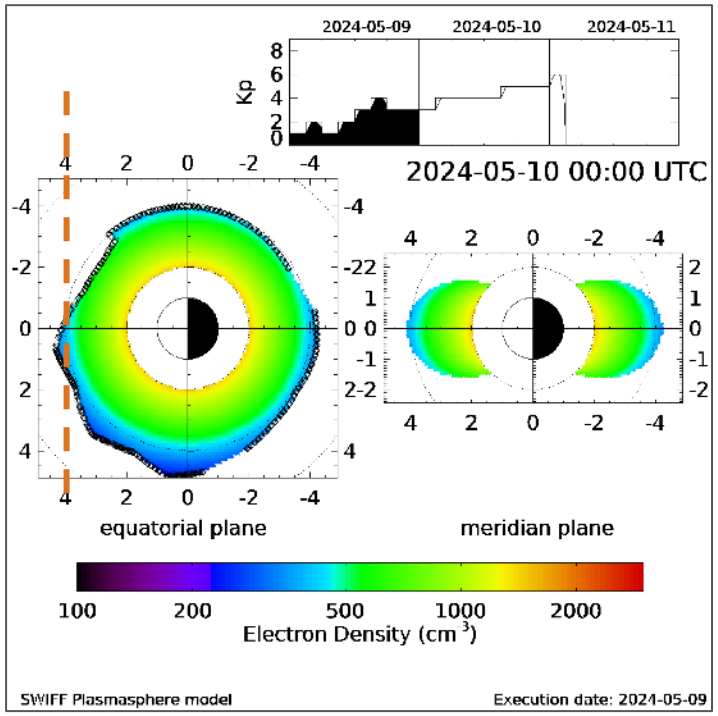
https://swe.ssa.esa.int/csr-ept-federated, UCL/CSR (BE)

Plasmasphere

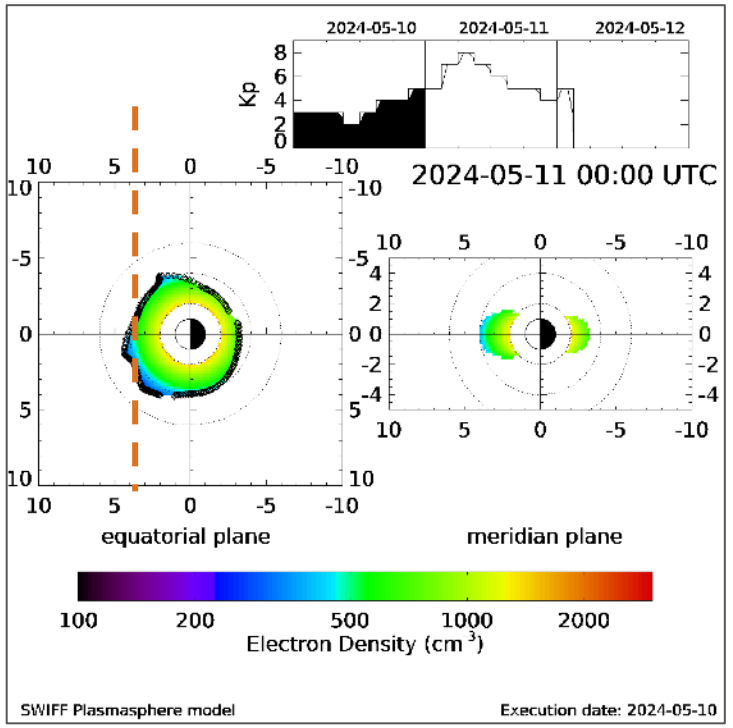
R-ESC Forecasts

SWIFF Plasmasphere model (SPM, R.136)

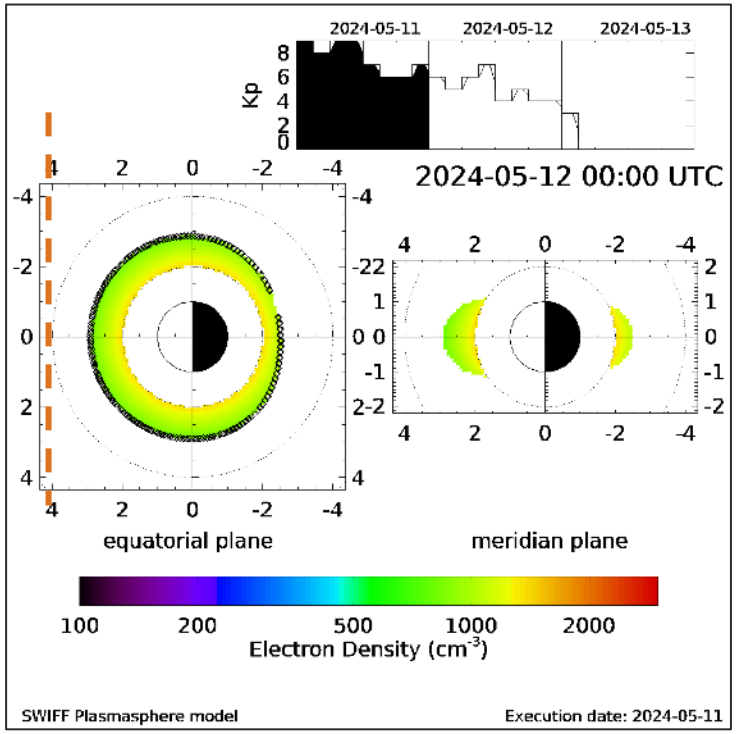
Forecast for 10/05/2024



Forecast for 11/05/2024



Forecast for 12/05/2024

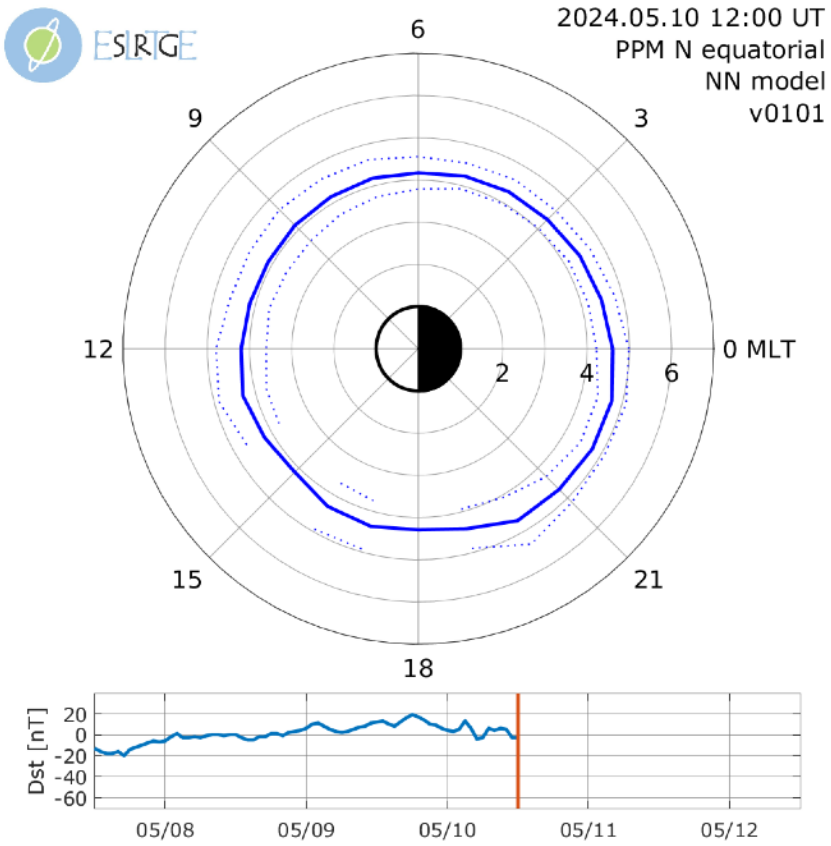


https://swe.ssa.esa.int/bira-swiff-federated, BIRA-IASB (BE)

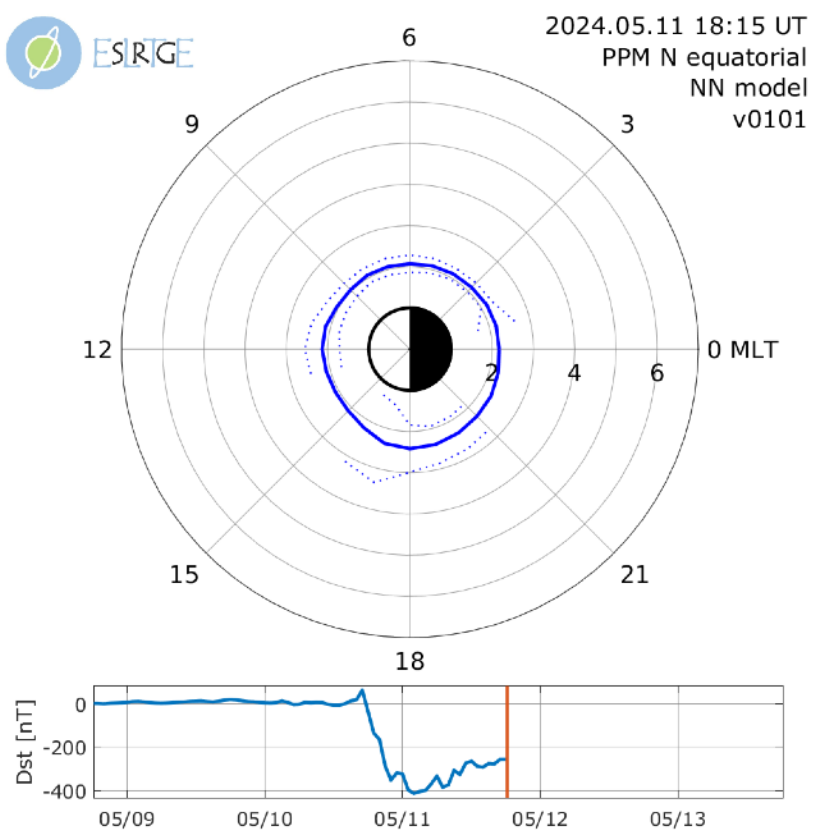
R-ESC Nowcasts

Empirical Plasmapause Maps/plasmapause limits (PLASMA, R.223)

10/05/2024



11/05/2024



https://swe.ssa.esa.int/elte-plasma-federated, ELTE (HU)



THANK YOU!

MORE INFO?

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Norma.Crosby@aeronomie.be