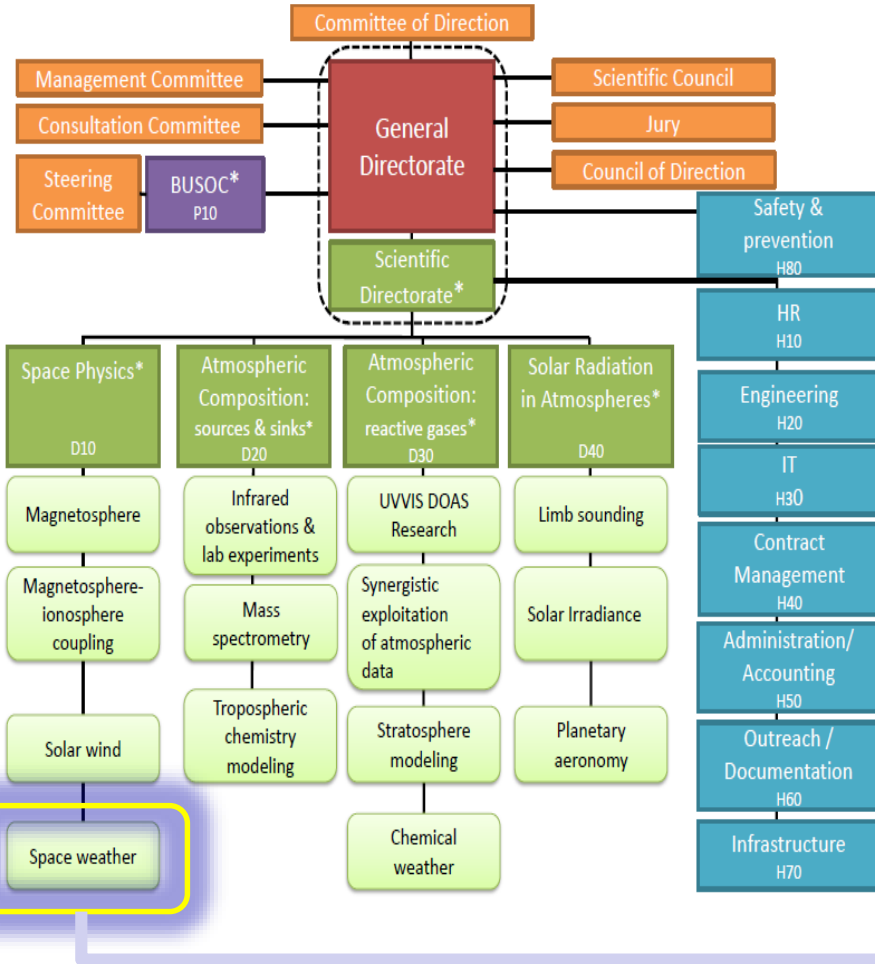
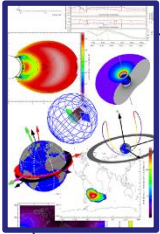


Organigram



- ▣ Applied research
- ▣ Service development and operation
- ▣ Training / Outreach

Key projects



SPENVIS

(<https://spenvis.ssa-swe.eu/>)

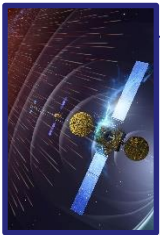
- Simulation space environment and effects on s/c and humans
- Energetic particles, plasmas, gases, and micro-particles



SSCC

(helpdesk.swe@ssa.esa.int)
([@esaspaceweather](#))

- Network performance: monitoring and operation
- User support:
 - Helpdesk
 - tailored SWE bulletins



R-ESC

(<http://swe.ssa.esa.int/space-radiation>)

- Coordination space radiation expert groups
- Development and definition plan
- Service coordination for s/c design – operation – launch, human spaceflight, aviation



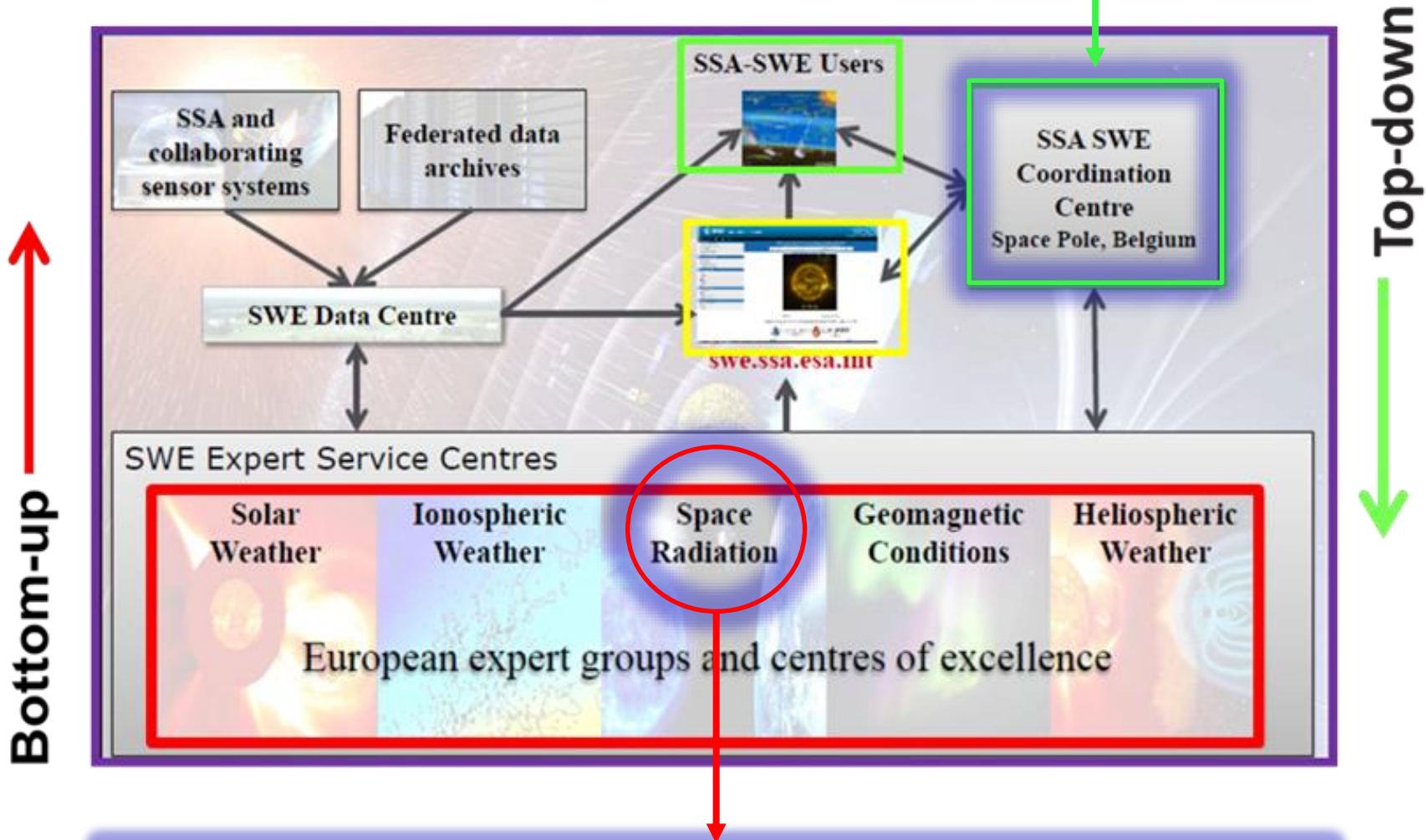
PECASUS

(<http://pecasus.eu>)

- Coordination EG-RAD
- Scientific support for Advisories on radiation

SSA Space Weather Coordination Centre

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SSA Expert Service Centre for Space Radiation

Space particle radiation environment and effects

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Sources

(Extra) Galactic and anomalous Cosmic Rays

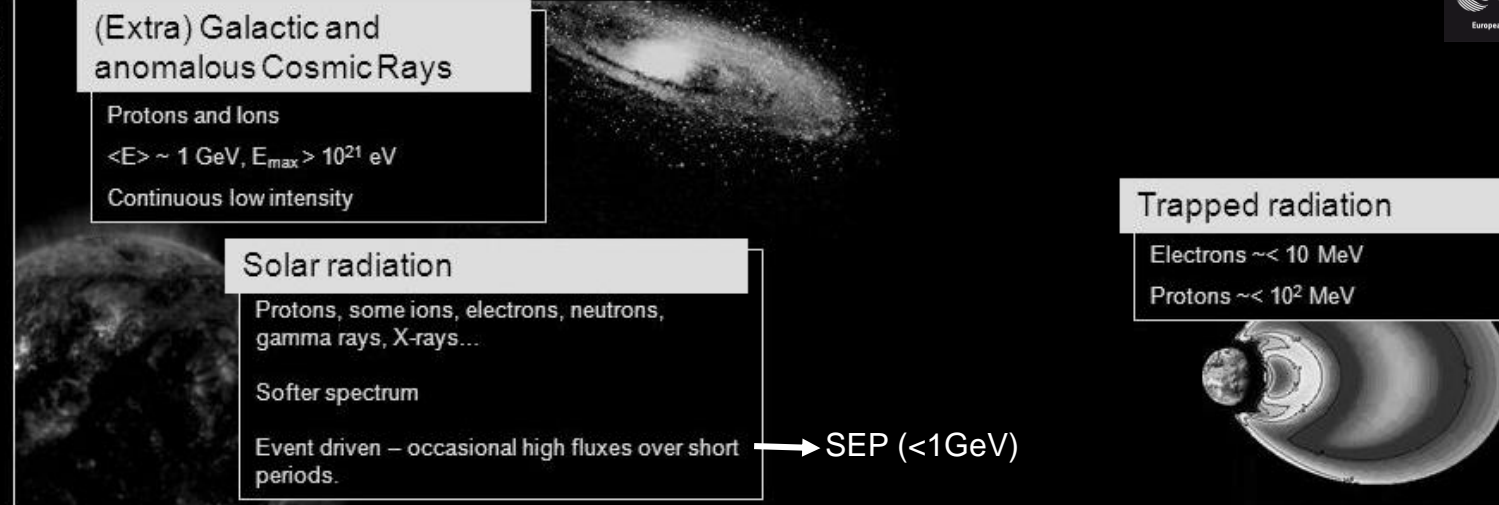
Protons and Ions
 $\langle E \rangle \sim 1 \text{ GeV}$, $E_{\text{max}} > 10^{21} \text{ eV}$
 Continuous low intensity

Solar radiation

Protons, some ions, electrons, neutrons, gamma rays, X-rays...

Softer spectrum

Event driven – occasional high fluxes over short periods.



Trapped radiation

Electrons $\sim < 10 \text{ MeV}$
 Protons $\sim < 10^2 \text{ MeV}$

Effects

Effects in components

- Single Event Effects
(SE Upset, SE Latchup, ...)
- Degradation
(Ionisation, displacement,...)

Effects to science detectors

Signal, Background
(Spurious signals, Detector overload,...)

Charging
(internal, interferences, ...)

Threats to life

Dose (dose equivalent) and dose rate in
manned space flights

Radiobiological effects

2000/07/14 11:42

Snow on SOHO/LASCO C3 imager

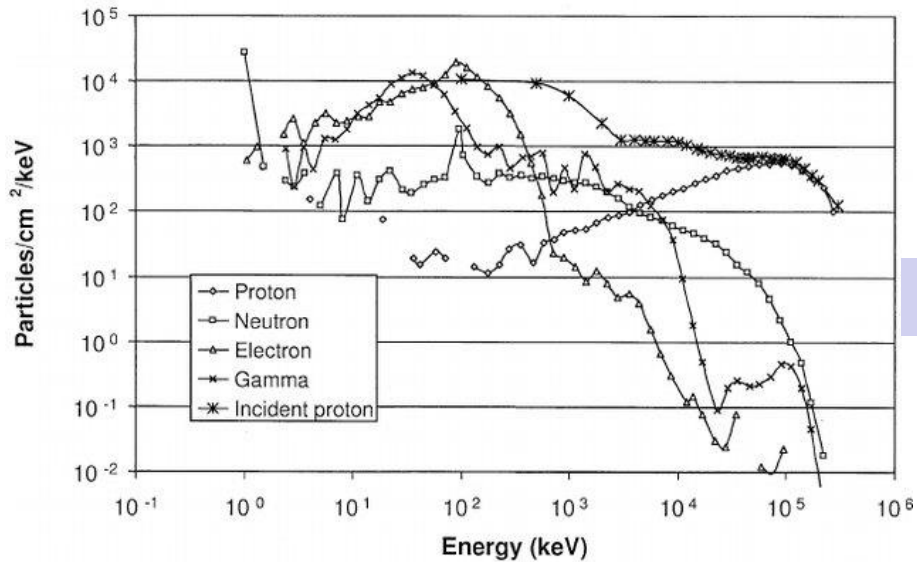
Degradation ACE solar cell panel ($<1\%/yr$) (NASA)

Surface damage in a C2 MOS Capacitor (Image from JPL)

belspo .be

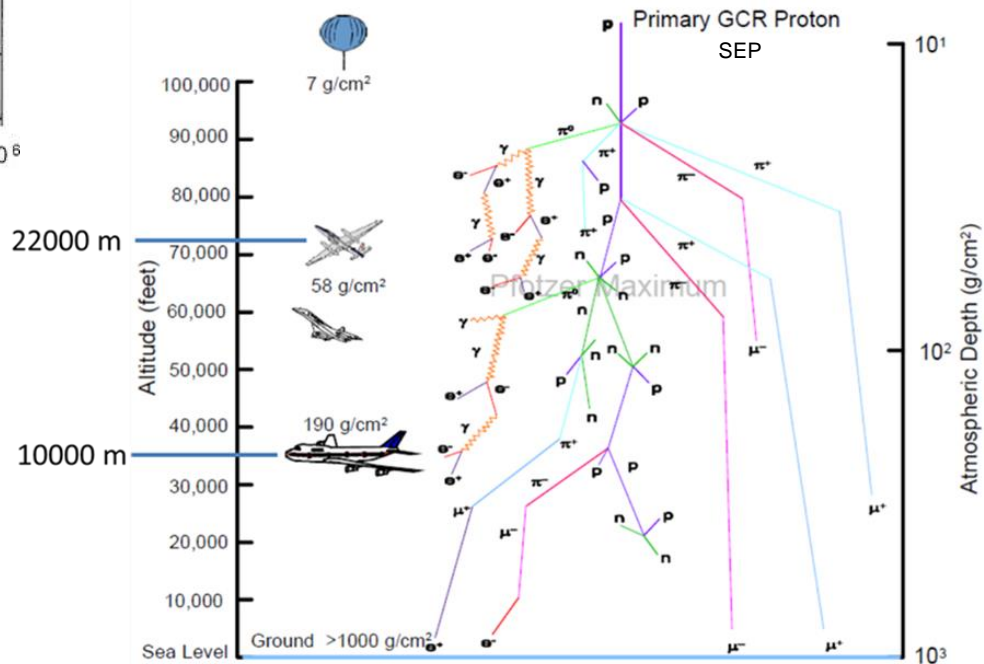
Secondary particles

Al shielding



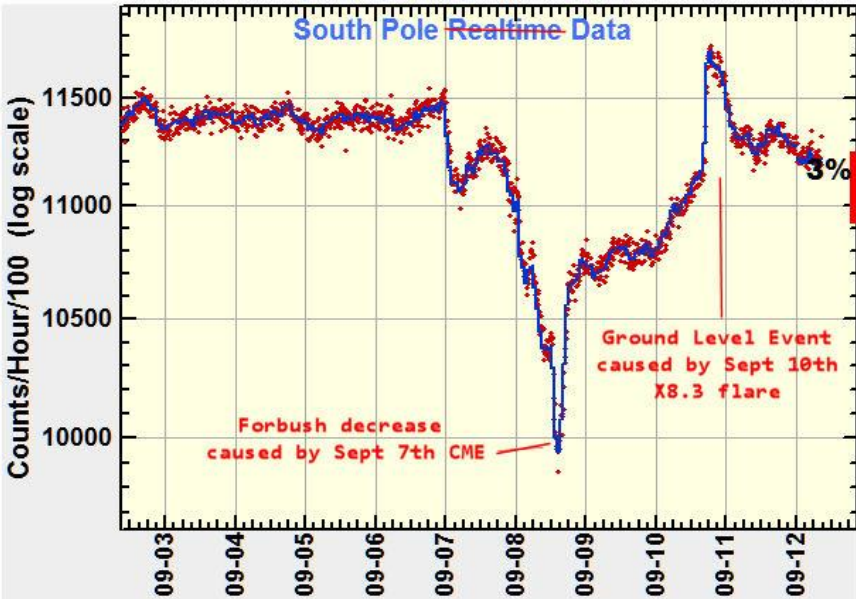
Secondary particle fluence energy spectra after 20-mm aluminum shield, calculated with SPENVIS for an incident trapped proton spectrum accumulated over one year.

Atmosphere

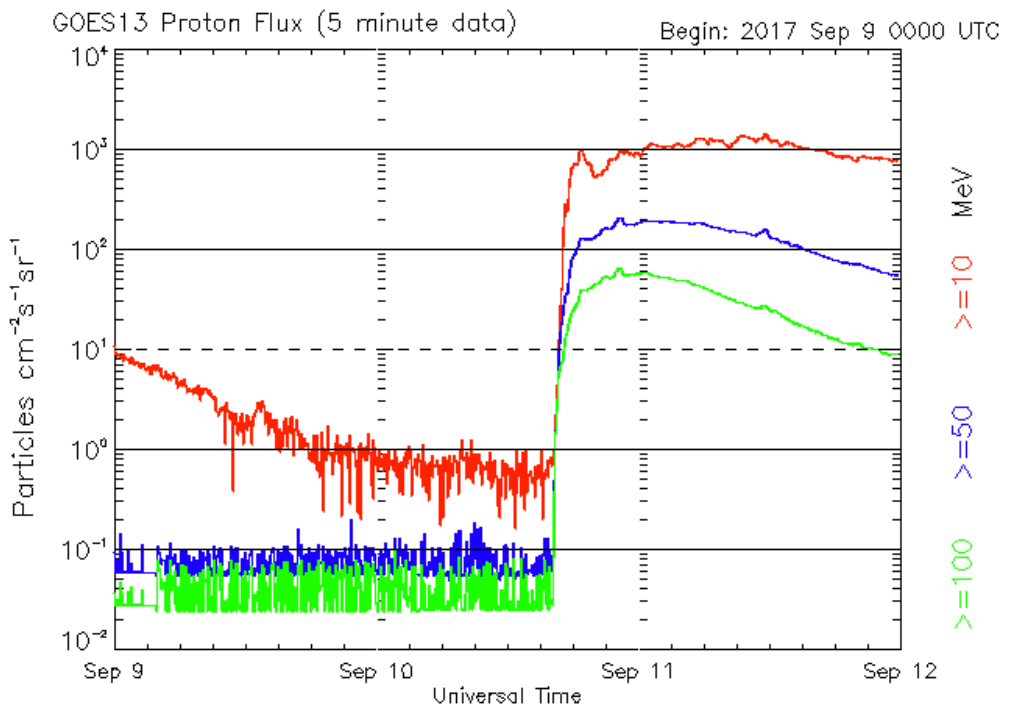


Forbush decrease & Ground Level Enhancement (GLE)

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Forbush decrease followed by minor Ground Level Event (Sept 2017)



Updated 2017 Sep 11 23:56:02 UTC

NOAA/SWPC Boulder, CO USA



PECASUS – radiation products (I)

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COMESSEP Alert viewer 06-11-2013 09:16

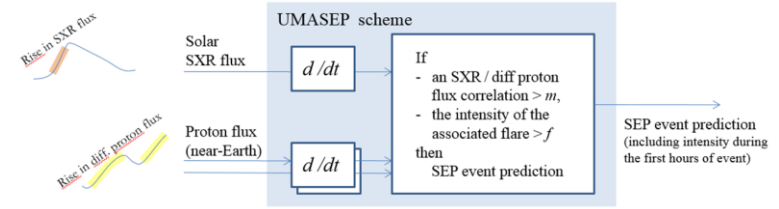
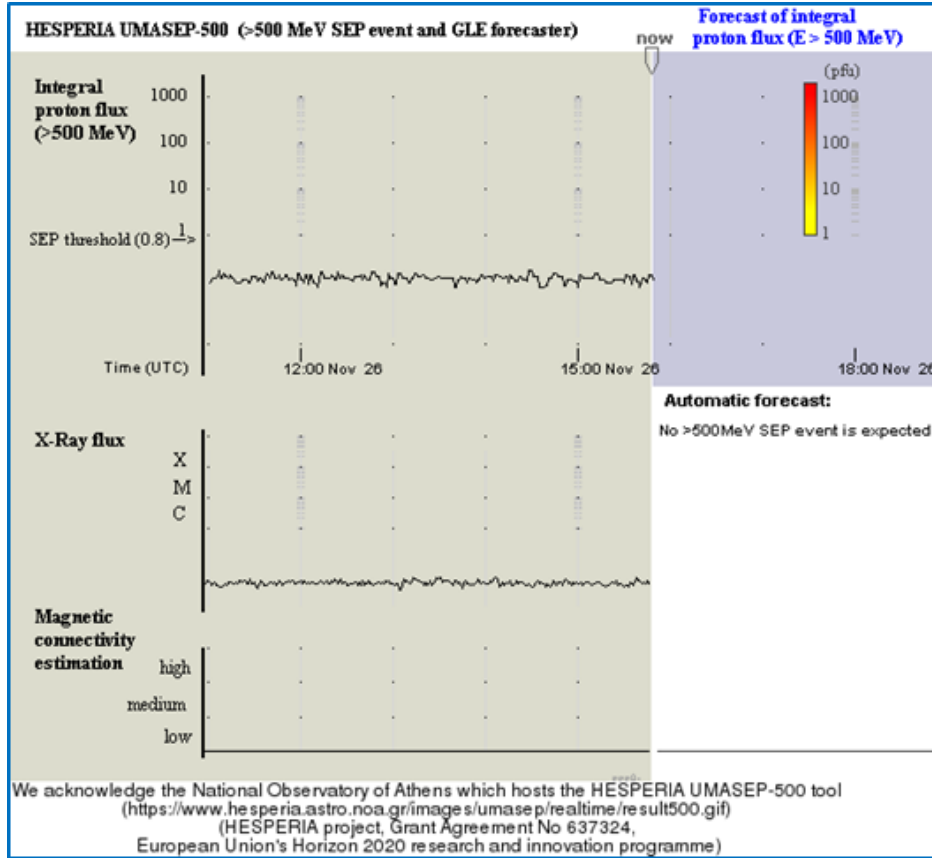
	Latest alert	Impact risk
Geomagnetic Storm Alert	04/11/13 13:14	<ul style="list-style-type: none"> The risk level for a CME geomagnetic storm is MODERATE following the observation of a CME that erupted at 05:12 on 2013-11-04 UTC. The risk level results from the following forecasted parameters: 1) occurrence probability: VERY UNLIKELY 2) storm level: STRONG
SEP Proton Storm Alert > 10 MeV	06/11/13 09:15	<ul style="list-style-type: none"> Forecast for a SEP radiation storm following a X3.3 flare with peak at 2013-11-05 22:12UT (protons > 10 MeV: MODERATE, POSSIBLE; protons > 60 MeV: MINOR, POSSIBLE). Forecast for a SEP radiation storm following a M2.5 flare with peak at 2013-11-05 08:18UT (protons > 10 MeV: MINOR, VERY UNLIKELY; protons > 60 MeV: NONE, VERY UNLIKELY).
SEP Proton Storm Alert > 60 MeV	06/11/13 09:15	<ul style="list-style-type: none"> Forecast for a SEP radiation storm following a X3.3 flare with peak at 2013-11-05 22:12UT (protons > 10 MeV: MODERATE, POSSIBLE; protons > 60 MeV: MINOR, POSSIBLE). Forecast for a SEP radiation storm following a M2.5 flare with peak at 2013-11-05 08:18UT (protons > 10 MeV: MINOR, VERY UNLIKELY; protons > 60 MeV: NONE, VERY UNLIKELY).

Wed 06 Nov 2013

	05 NOV 00:00	05 NOV 12:00	06 NOV 00:00	06 NOV 12:00	07 NOV 00:00	07 NOV 12:00	08 NOV 00:00	08 NOV 12:00
Flare		★ ★	★ ★ ★	★				
CME			★					
SEP		★					★	
Geomagnetic activity								

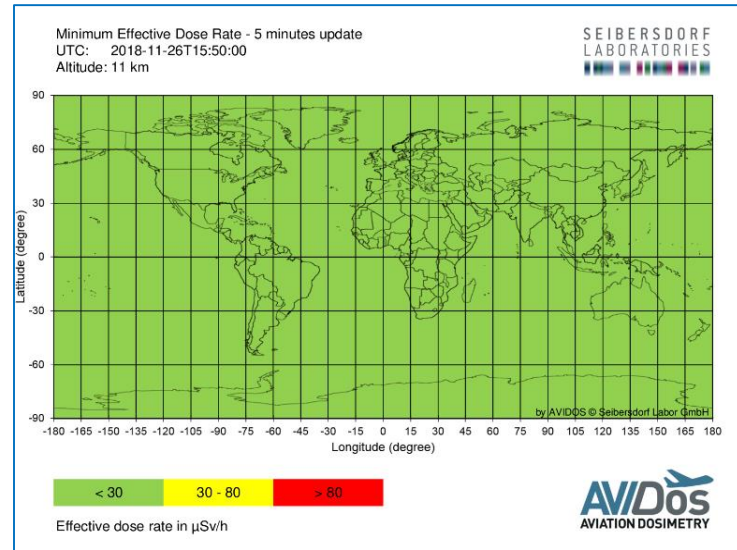
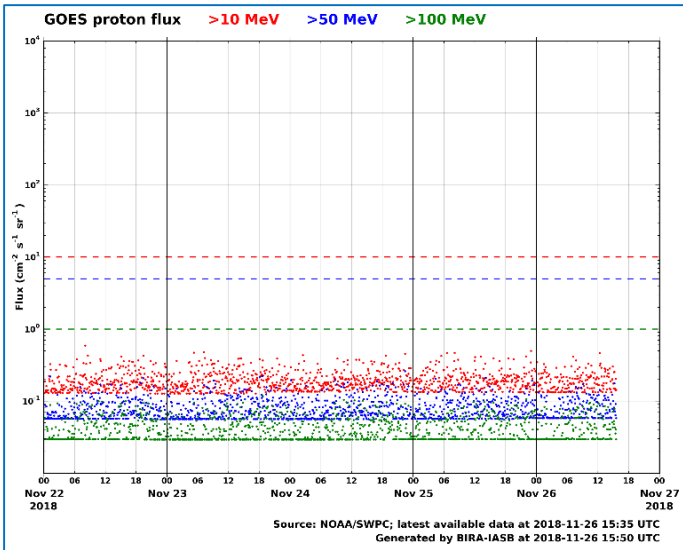
Arrival of CME / Likelihood of occurrence

Ongoing (100%)	L	M	H	H	E	E
Very likely (90-100%)	L	M	H	H	E	E
Likely (70-90%)	L	M	M	H	H	E
Possible (40-70%)	L	L	M	M	H	E
Unlikely (10-40%)	L	L	M	M	H	H
Very Unlikely (0-10%)	L	L	L	M	M	H
Storm Level	None	Minor	Moderate	Strong	Severe	Extreme
Geomagnetic Dst in nT	<50	50-100	100-200	200-300	300-400	>400
SEP peak flux > 10 MeV in s ⁻¹ sr ⁻¹ cm ⁻²	<10 ²	10 ² -10 ³	10 ³ -10 ⁴	10 ⁴ -10 ⁵	10 ⁵ -10 ⁶	>10 ⁶
SEP peak flux > 60 MeV in s ⁻¹ sr ⁻¹ cm ⁻²	<7.9×10 ⁻²	7.9×10 ⁻² - 1.4	1.4 - 2.5×10 ¹	2.5×10 ¹ - 4.5×10 ²	4.5×10 ² - 7.9×10 ³	>7.9×10 ³
Kp	<5	5	6	7	8	9



PECASUS – radiation products (II)

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GLE plus Alert Real Time GLE ALERT System
National & Kapodistrian University of Athens / Cosmic Ray Group
ISNet Company

powered by ISNet

DATA UPDATED EVERY MINUTE

Service Description Disclaimer Acknowledgement Archived GLEs Get GLE Email

General Alert Status **Stations Summary**

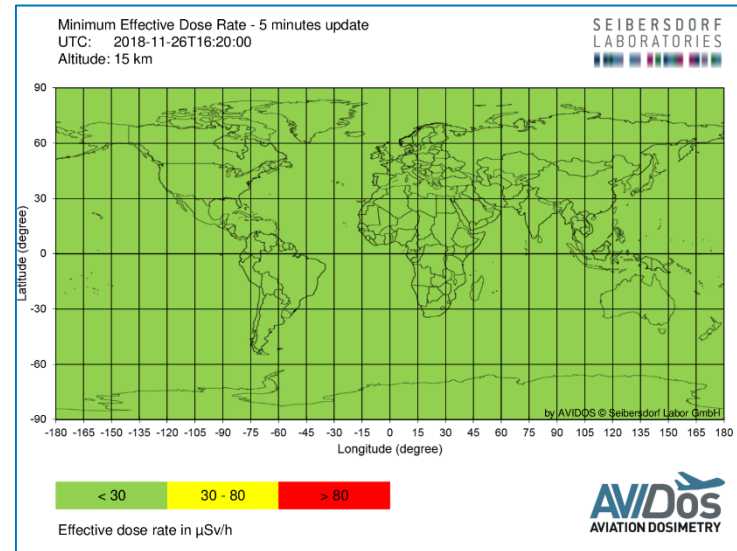
QUIET

ALERT	[00]	Total [34]
WARNING	[00]	● Real Time [24]
WATCH	[00]	● Near Real Time [04]
QUIET	[34]	● Not in Real Time [06]

Number of stations in Alert mode

14:48 14:53 14:58 15:03 15:08 15:13 15:18 15:23 15:28 15:33 15:38 15:43 15:48

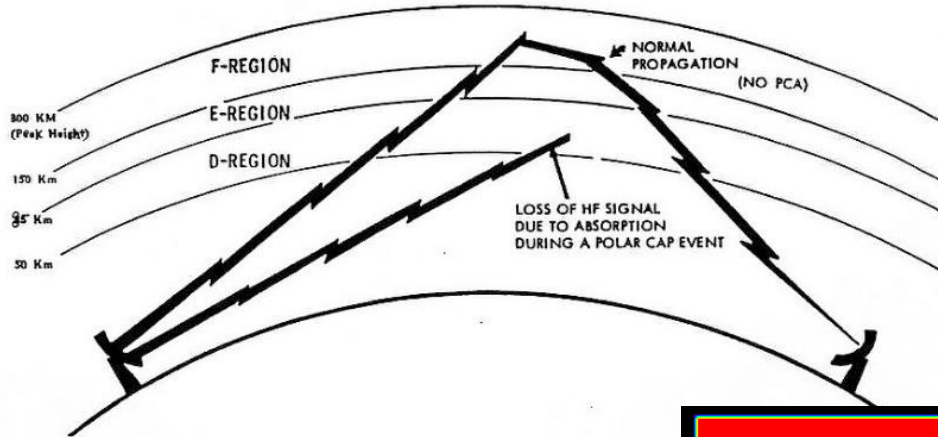
Stations in GLE Alert (0) Last GLE Alert 2017-09-10 17:03:00 Raw Data
Stations in Last GLE Alert BIVK KERQ SOPB THUL (4) History



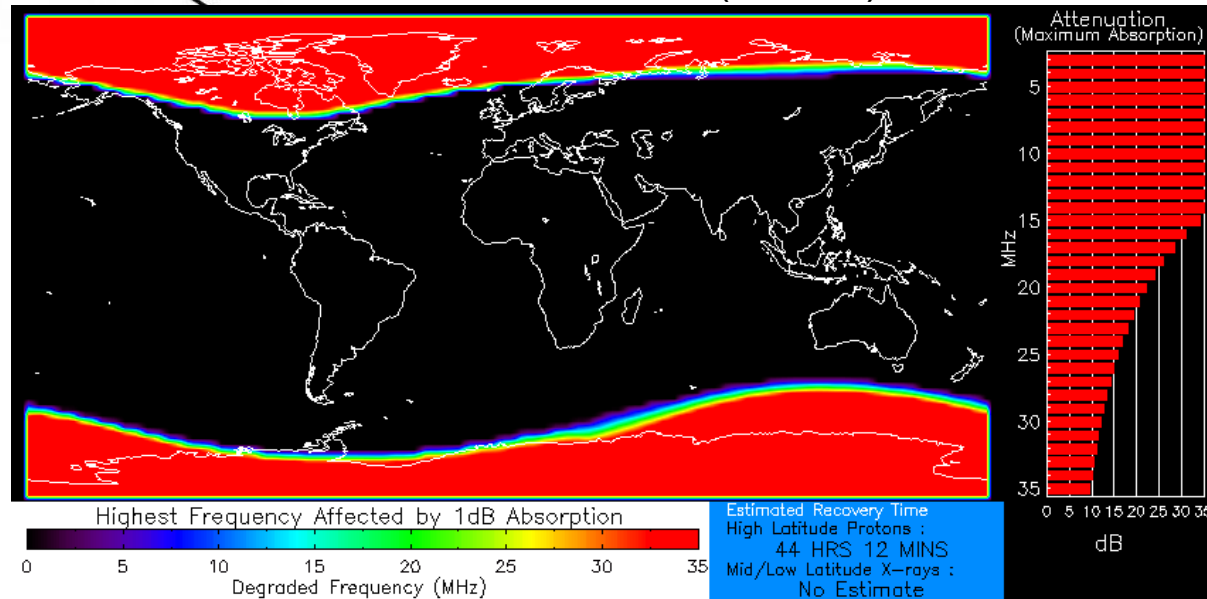
HF (3-30 MHz) degradation due to SEP events: Polar Cap Absorption (PCA)

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Long distance communication



D-RAP model (NOAA)



Normal X-ray Background
Product Valid At : 2017-09-11 17:06 UTC

Strong Proton Flux
NOAA/SWPC Boulder, CO USA

