

ESA/SSA/SWE Space Radiation ESC and the possible role of NMs



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ESA Space Situational Awareness (SSA) Programme



WHY do we need an SSA Programme?

- Support Europe's utilisation of, and access to, space through provision of timely and accurate information, data and services
- Comprehensive knowledge, understanding and maintained awareness of the population of space objects, of the space environment, and of the existing threats/risks.

Three SSA segments:

- Surveillance and Tracking
- **Space Weather**
- Near Earth Objects

SSA Space Weather (SWE) Segment

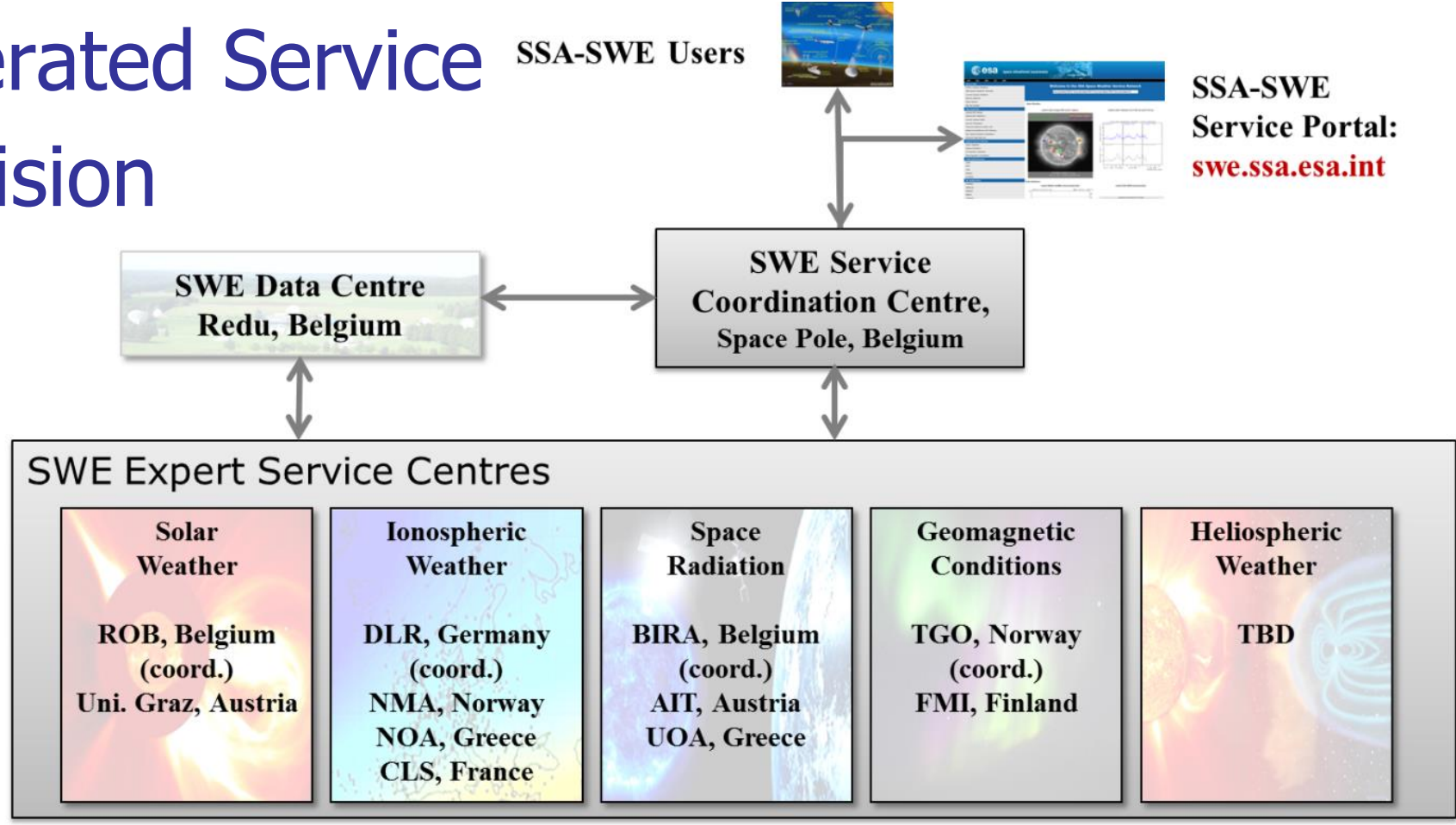
Objective: Strengthen European capability in detection and forecasting of space weather events and their effects on European space assets and ground-based infrastructure.

Focus on User Needs in the SWE Service Domains:

- + Spacecraft design (SCD)
- + Spacecraft operation (SCO)
- + Human space flight (SCH)
- + Launch operation (LAU)
- + Transionospheric radio link (TIO)
- + SSA Space Surveillance and Tracking (SST)
- + Non-space systems operation (NSO)
- + General data service (GEN).



Federated Service Provision



SSA Space Weather Network as of March 2013.

(organisation of the network's principal ground facilities and infrastructure)

The first set of 'initial' Expert Service Centres (ESCs) will be expanded during the Programme's Period 2 (2013-16) and will be complemented by a new Heliospheric Weather ESC.



Expert Service Center (ESC)

Def.: Consortium of expert groups with expertise in a particular service/group of services.

SWE Expert Service Centers:

- Solar Weather
- Ionospheric Weather
- **Space Radiation**
- Geomagnetic Conditions
- Heliospheric Conditions





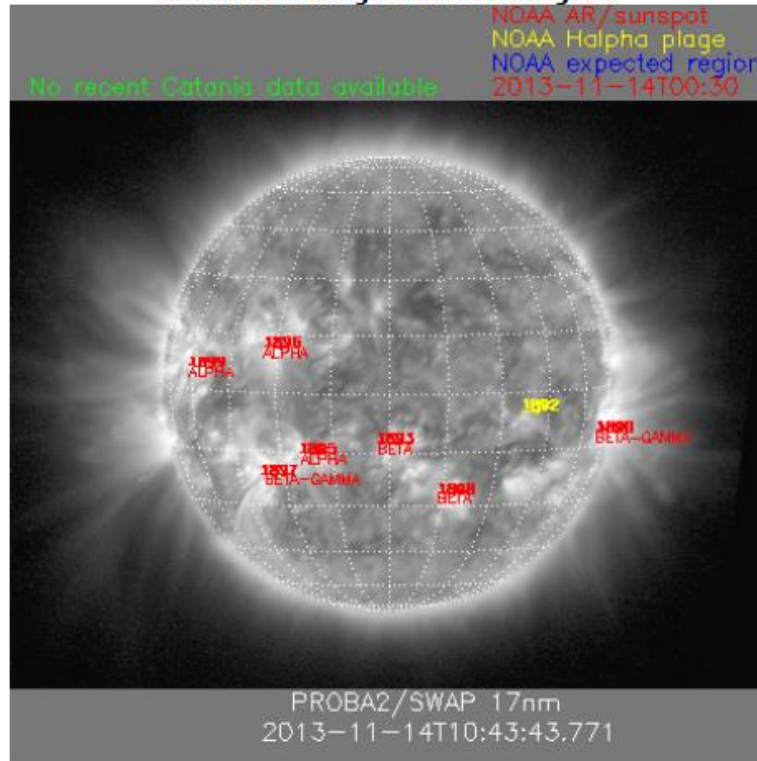
- ESA
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- SST
- About SWE
 - What is Space Weather
 - SSA Space Weather Activities
 - User Domains
 - Current Space Weather
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- Expert Service Centres ?
 - Solar Weather
 - Space Radiation
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 - Geomagnetic Conditions
- SWE Applications ?
 - SWENET
 - SPENVIS
 - SEISOP
 - SEDAT
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 - EDID
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 - DOCUMENTS
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 - SWEN NEWSLETTER
 - UPCOMING EVENTS
- Sign-In
 - You are not signed in.
 - Sign In
 - Register

Welcome to the SSA Space Weather Service Network

Please note that all SSA-SWE Services are under review/construction

ctive, Protons: Warning, Predicted 10CM Flux: 164, Predicted Ap inde

Latest solar image with active regions



Space Radiation

The term “space radiation” is used randomly in the literature, but more specifically it comes in two types:

- **ELECTROMAGNETIC RADIATION**

Energy transmitted in the form of photons (electromagnetic waves).

- **PARTICLE RADIATION**

Energy transmitted in the form of fast-moving sub-atomic particles (electrons, protons, alpha particles, etc.).

- ⇒ Galactic Cosmic Rays
- ⇒ Solar Energetic Particles
- ⇒ Radiation Belts



Solar Energetic Particle (SEP) Events



- SEP events consist of electrons, protons, and heavier ions with energies from tens of keVs to a few GeVs.
- SEP events are sporadic and very hard to predict => they are a serious radiation hazard concern for both spacecraft and humans travelling in space.
- Some SEP events are recorded as ground level enhancements (GLEs) and are observed by ground-based detectors (e.g., neutron monitors).
- GLEs occur when the accelerated SEP events have energies sufficiently high (ions with energies of GeV and above) to penetrate along the geomagnetic field and the Earth's atmosphere.
- Their interactions with the Earth's atmosphere can produce strong intensities of secondary particles (e.g., neutrons).

Real-time monitoring of GLEs

18.05.2012

National & Kapodistrian University of Athens

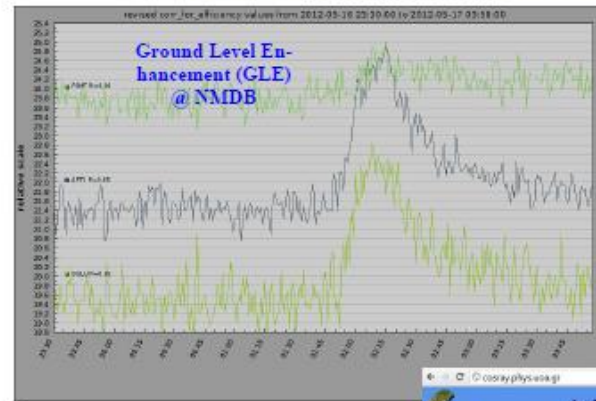
Solar Radiation Storm issued in real-time by the **Athens Neutron Monitor Alert Code** operated via **NMDB**



<http://cosray.phys.uoa.gr>

Prof. H. Mavromichalaki of the Athens Neutron Monitor Station for the NMDB collaboration

The first Ground Level Enhancement (GLE) of solar cycle 24!



A moderate solar cosmic ray event was registered on **17.05.2012** from neutron monitors around the world.

The operational real-time Alert Code of the Athens Neutron Monitor via NMDB issued an **Alert signal** on **17.05.2012** at **02:13 UT**

39 min in advance from GOES!

GLE_General (1) - Notepad

Date	Time	APT	OUL	FSMT
2012-05-17	02:13	APTY	OULU	FSMT
2012-05-17	02:14	APTY	OULU	FSMT
2012-05-17	02:14	APTY	OULU	FSMT
2012-05-17	02:14	APTY	OULU	FSMT
2012-05-17	02:15	APTY	OULU	FSMT
2012-05-17	02:15	APTY	OULU	FSMT

The Athens Neutron Monitor Alert Code which operates in real-time issued an Alert on **17.05.2012** at **02:13 UT**

The relevant ALERT from GOES 100 MeV protons that has been issued in real-time by NOAA was on **17.05.2012** at **02:52 UT** (see second page for details)

Athens Neutron Monitor

Alert

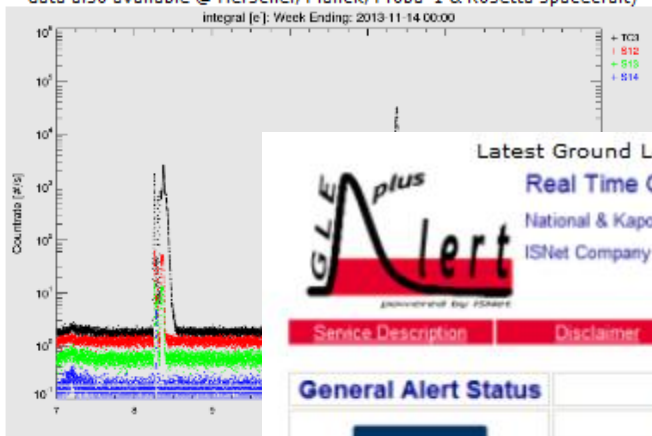
GENERAL ALERT STATUS

Alert ID	Alert Time	Alert Level	Alert Status
201205170213	2012-05-17 02:13	Alert	Active
201205170214	2012-05-17 02:14	Alert	Active
201205170215	2012-05-17 02:15	Alert	Active



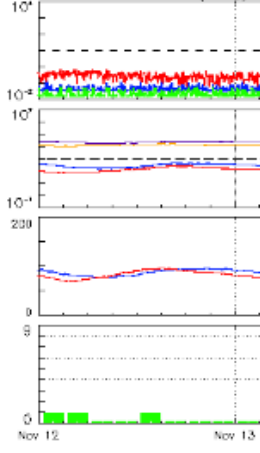
Latest data

Latest ESA SREM particle data. (electron countrate @ Integral spacecraft, data also available @ Herschel, Planck, Proba-1 & Rosetta spacecraft)



Latest NOAA

Satellite Environment (3 day)



Updated 2013 Nov 14 12:41:08 UTC

Latest Ground Level Enhancement Alerts
Real Time GLE ALERT System
 National & Kapodistrian University of Athens / Cosmic Ray Group
 ISNet Company

DATA UPDATED EVERY MINUTE

[Service Description](#) | [Disclaimer](#) | [Archived GLEs\(soon\)](#) | [Get GLE Email](#)

General Alert Status

QUIET

Stations Summary

ALERT [00]	Total [33]
WARNING [00]	● Real Time [18]
WATCH [00]	● Near Real Time [07]
QUIET [33]	● Not in Real Time [08]



Stations in GLE Alert (0)

Last GLE Alert 2012-05-17 02:35:45

Stations in Last GLE Alert APY FSMT SOPO (3)

[Raw Data](#)

[History](#)

NOAA/SWPC Boulder, CO USA

Latest Ground Level Enhancement Alerts
Real Time GLE ALERT System
 National & Kapodistrian University of Athens / Cosmic Ray Group
 ISNet Company

DATA UPDATED EVERY MINUTE

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General Alert Status

ALERT

Stations Summary

ALERT [00]	Total [33]
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ESC tools and products

AVIDOS

- Radiation dosimetry for aviation

ANeMoS

- Ground Level Enhancement (GLE) event alert
- Multistation Neutron Monitor data

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and Space Weather (RAS) tria

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ANeMoS) r of Athens, Greece

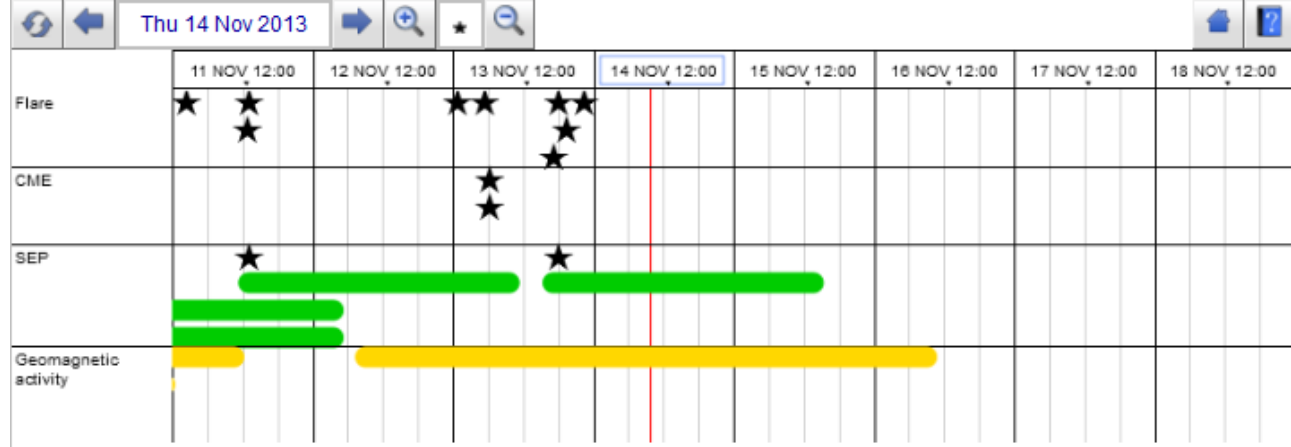
COMESEP Alert System



Alert Viewer Current time: 14-11-2013 09:37

	Latest issued alert	Impact risk
Geomagnetic Storm Alert	08/11/13 13:19	<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 03:24 on 2013-11-08 UTC. The risk level results from the following forecasted parameters: 1) occurrence probability: POSSIBLE 2) storm level: STRONG
SEP Proton Storm Alert > 10 MeV	13/11/13 16:55	<ul style="list-style-type: none"> Forecast for a SEP radiation storm following a M1.4 flare with peak at 2013-11-13 15:20UT (protons > 10 MeV: MINOR, VERY UNLIKELY).
SEP Proton Storm Alert > 60 MeV	No alert since 4 days	Nothing to report

Legend: ★ ... an alert has been issued
 ...risk impact (timing and level, ● low, ● medium, ● high, ● extreme)
 Click on the icons to see alert details Times are in UTC



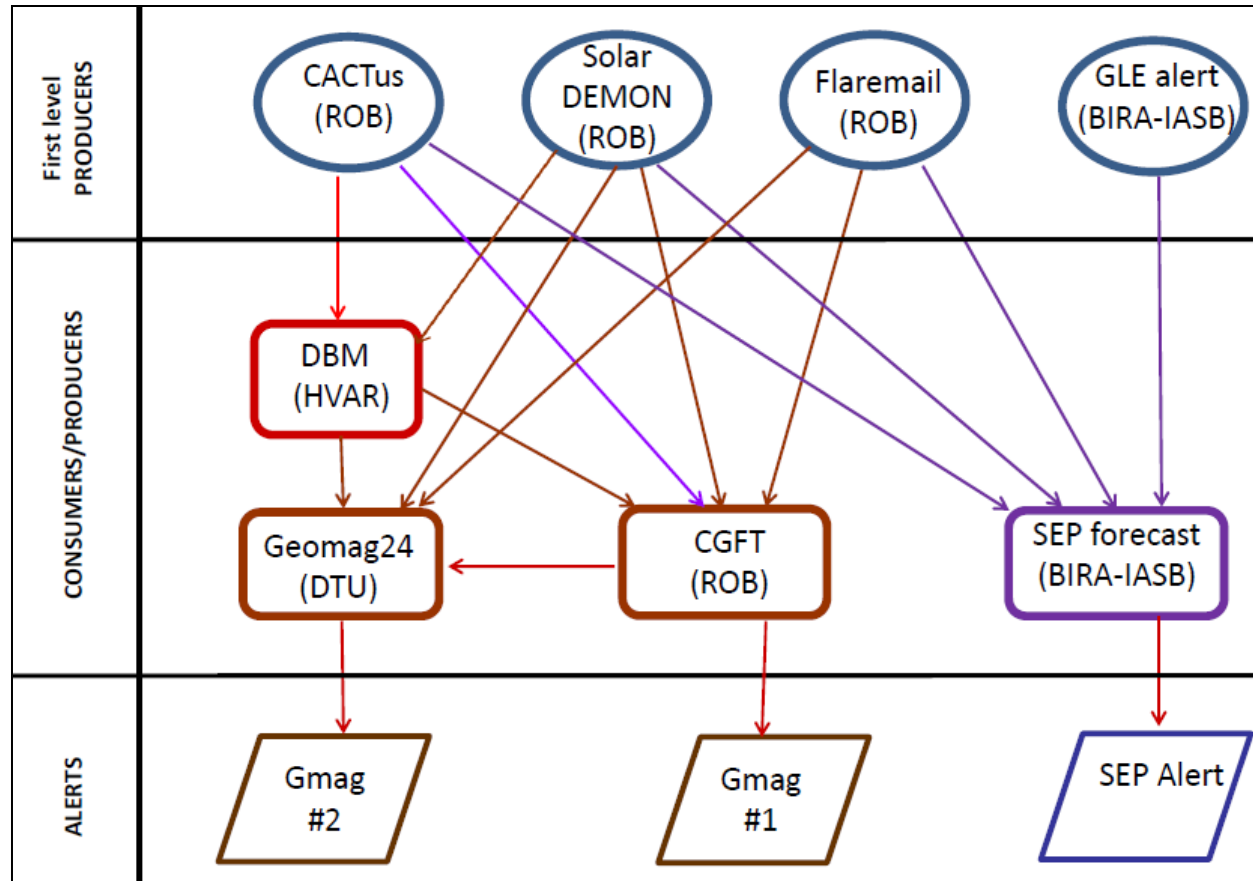
[Register for COMESEP alerts](#) | **DISCLAIMER:** COMESEP makes no warranties or representations as to its accuracy and COMESEP specifically disclaims any liability or responsibility for any errors or omissions in the content on the website, as well as the alerts that are sent out. Neither COMESEP nor any other party involved in creating, producing, or delivering information that is used in the COMESEP alert system is liable for any direct, incidental, consequential, indirect, or punitive damages arising out of your access to, or use of, or inability to use or access, the website and/or the alerts that are sent out.

This work has received funding from the European Commission FP7 Project COMESEP (263252).

<http://www.comesep.eu/alert/>



Flow diagram of the tools used in the COMESEP alert system.



GLE alert: The Ground Level Enhancement (GLE) tool parses the GLE Alert Plus produced by the University of Athens and ISNet (<http://cosray.phys.uoa.gr/index.php/glealertplus>) to the COMESEP alert system. GLE Alert Monitor polls the history page every 2 minutes and checks if there is a new GLE alert. If so, it parses the information and sends an alert to the COMESEP alert system.

Is there a possible role for NMs
in the ESA/SSA/SWE
Space Radiation ESC ?

YES

