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


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"Neutron Monitor Data and the ESA SSA Program" Splinter, ESWW10, 22 Nov. 2013, Antwerp, Belgium

# 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

http://www.esa.int/Our_Activities/Operations/Space_Situational_Awareness

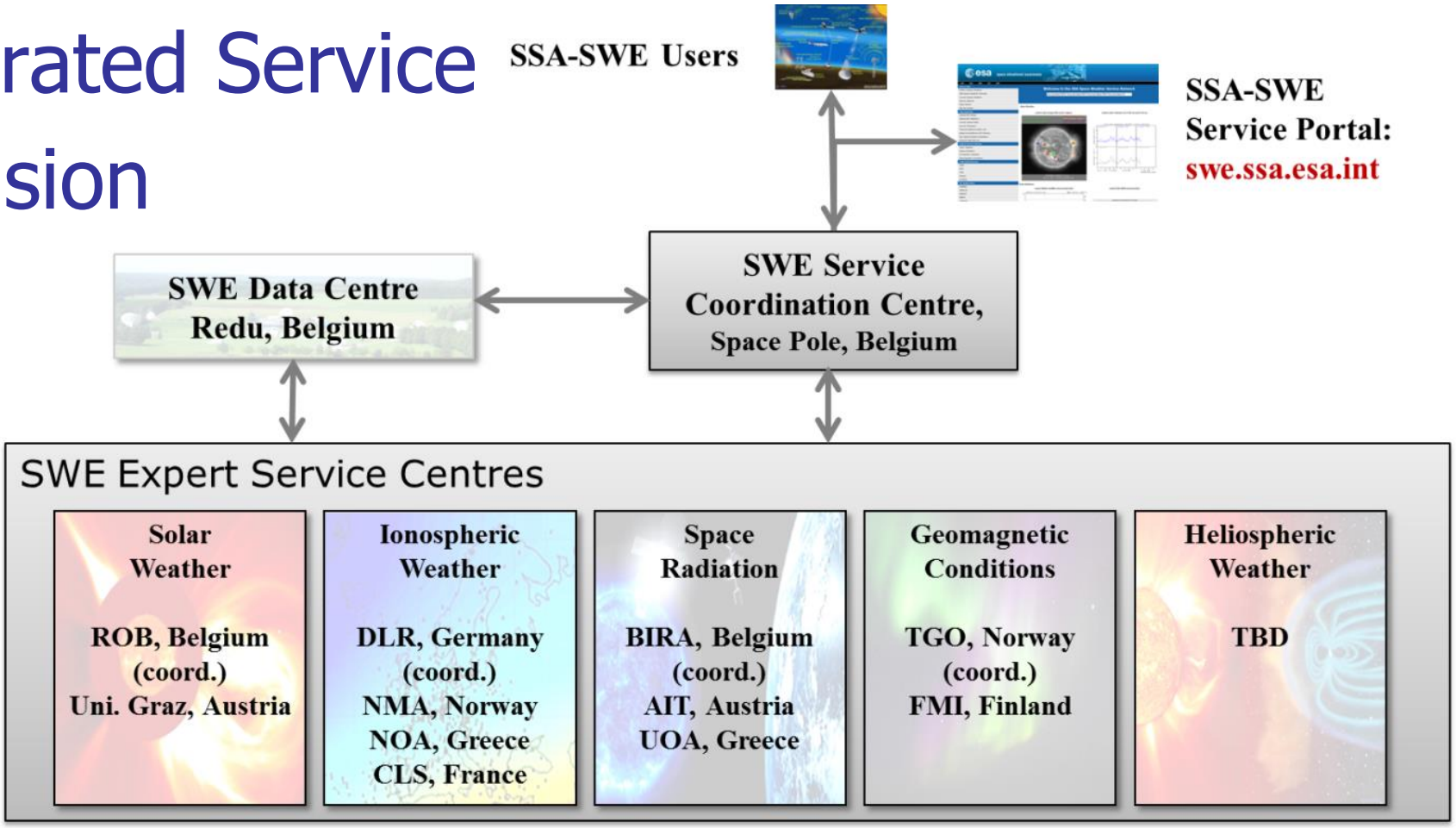
# SSA Space Weather (SWE) Segment

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

# http://swe.ssa.esa.int

esa space situational awareness

European Space Agency

ESA SSA SWE NEO SST

**About SWE**
- What is Space Weather
- SSA Space Weather Activities
- User Domains
- Current Space Weather
- Contact

**Expert Service Centres**
- Solar Weather
- Space Radiation
- Ionospheric Weather
- Geomagnetic Conditions

**SWE Applications**
- SWENET
- SPENVIS
- SEISOP
- SEDAT
- IONMON
- EDID

**Other Resources**
- DOCUMENTS
- SWWT
- SWEN NEWSLETTER
- UPCOMING EVENTS

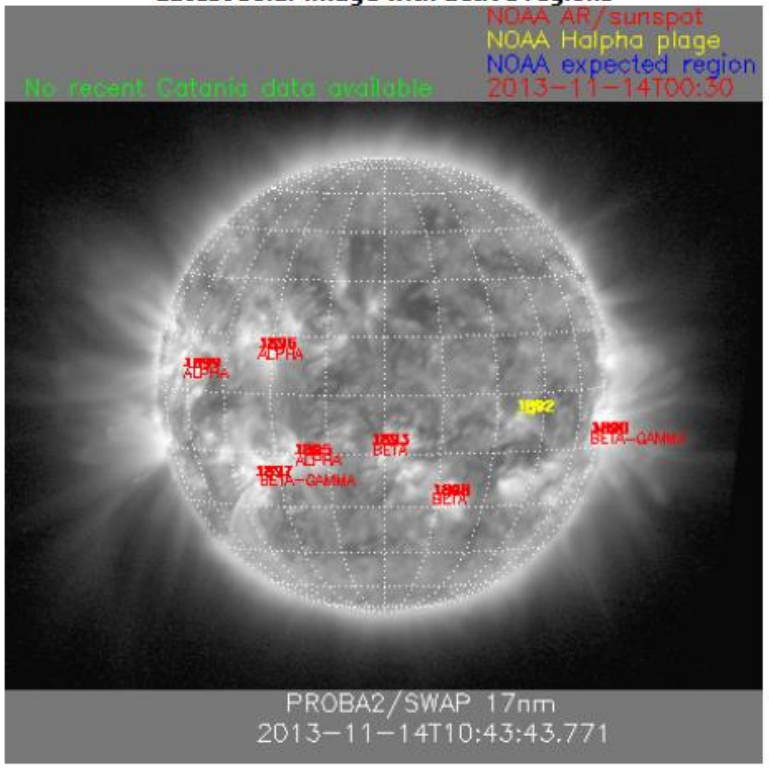
**Sign-In**
- You are not signed in.
- Sign In
- Register

## 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**




Latest data from SWE network. For a full overview of current conditions follow the links to Expert Service Centres.

# 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*

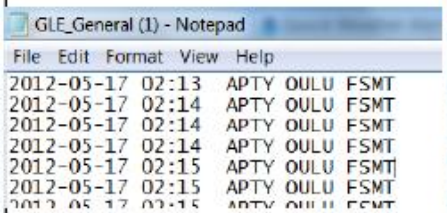
Prof. H. Mavromichalaki of the Athens Neutron Monitor Station for the NMDB collaboration

**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.

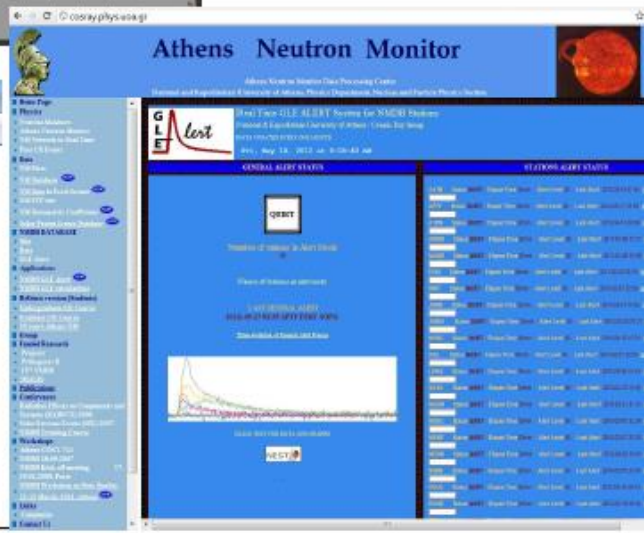
The operational real-time Alert Code of the Athens Neutron Monitor via NMDB issued an Alert signal at 17.05.2012 at 02:13 UT

*39 min in advance from GOES !*




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)

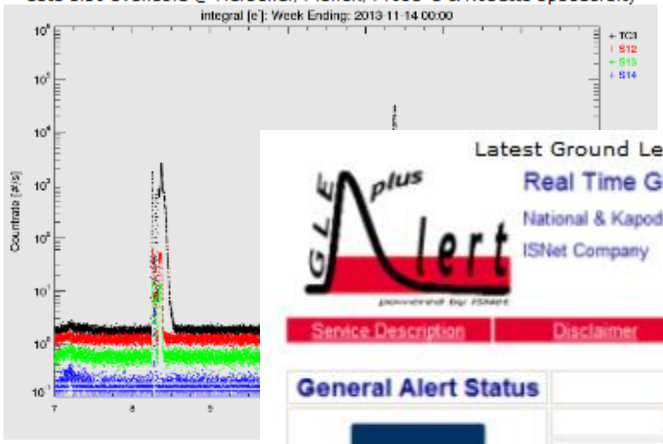


# Space Radiation Expert Service Centre

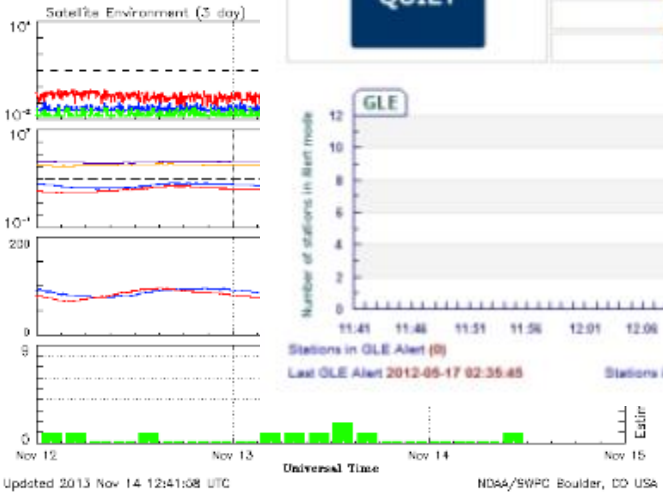
*This page provides access to the latest data, products and analysis tools from the SSA SWE Space Radiation Expert Service Centre.*

## Latest data

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




Latest NOA




Latest Ground Level Enhancement Alerts

Real Time GLE ALERT System

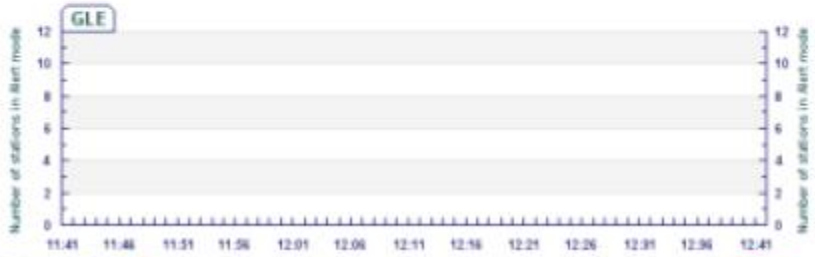
National & Kapodistrian University of Athens / Cosmic Ray Group

ISNet Company

DATA UPDATED EVERY MINUTE

Service Description | Disclaimer | Archived GLEs(soon) | Get GLE Email

| General Alert Status | Stations Summary | |
|---|---|---|
| QUIET | ALERT [ 00 ] | Total [ 33 ] |
| | WARNING [ 00 ] | Real Time [ 18 ] |
| | WATCH [ 00 ] | Near Real Time [ 07 ] |
| | QUIET [ 33 ] | Not in Real Time [ 08 ] |

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## ESC tools and products

| | |
|---|---|
| AVIDOS | ▪ Radiation dosimetry for aviation |
| ANeMoS | ▪ Ground Level Enhancement (GLE) event alert<br>▪ Multi-station Neutron Monitor data |
| | SEDAT |

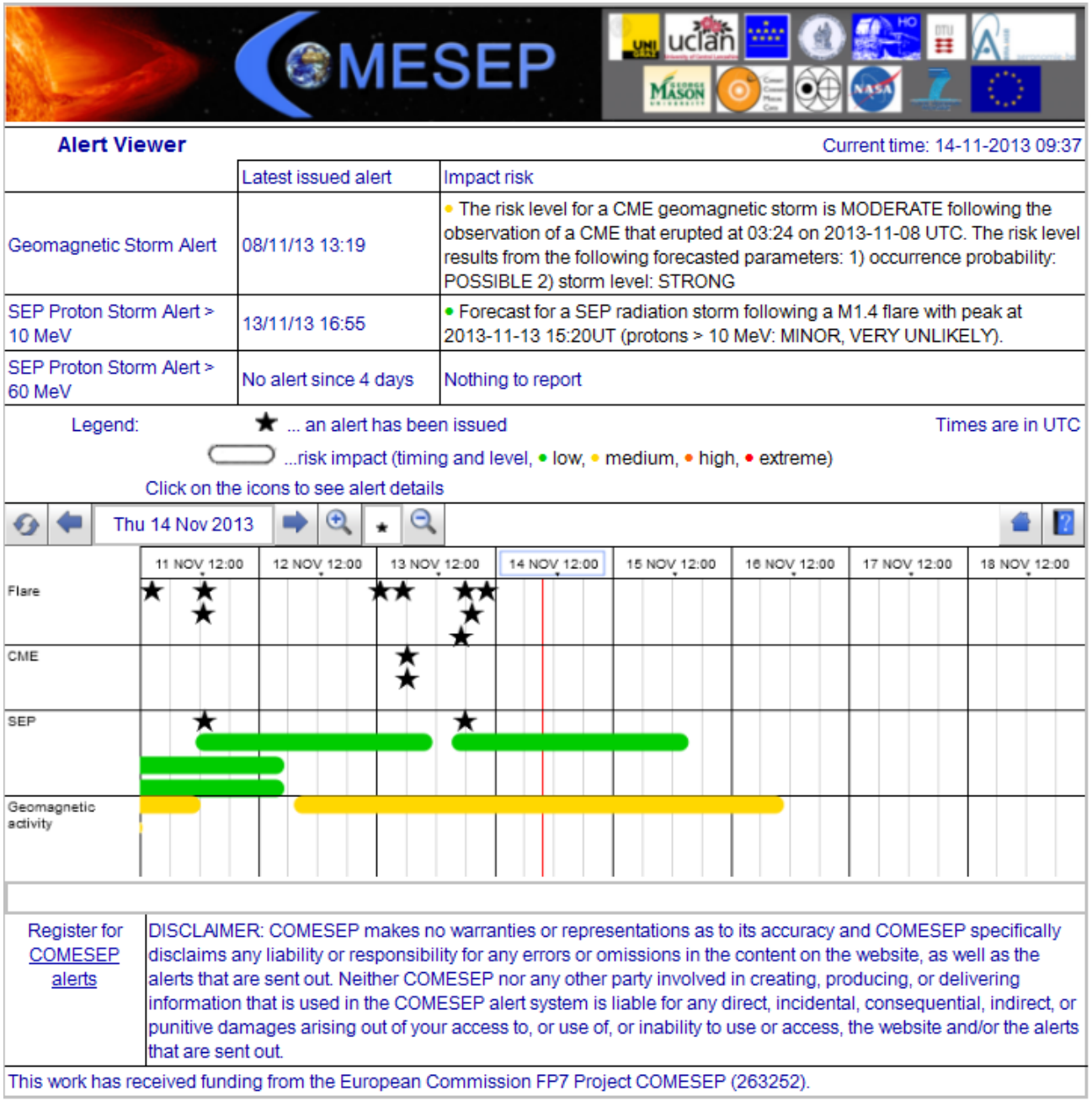
nd Space Weather (RAS)
tria

es (D52)
y, Belgium

ANeMoS)
of Athens, Greece

aeronomie.be

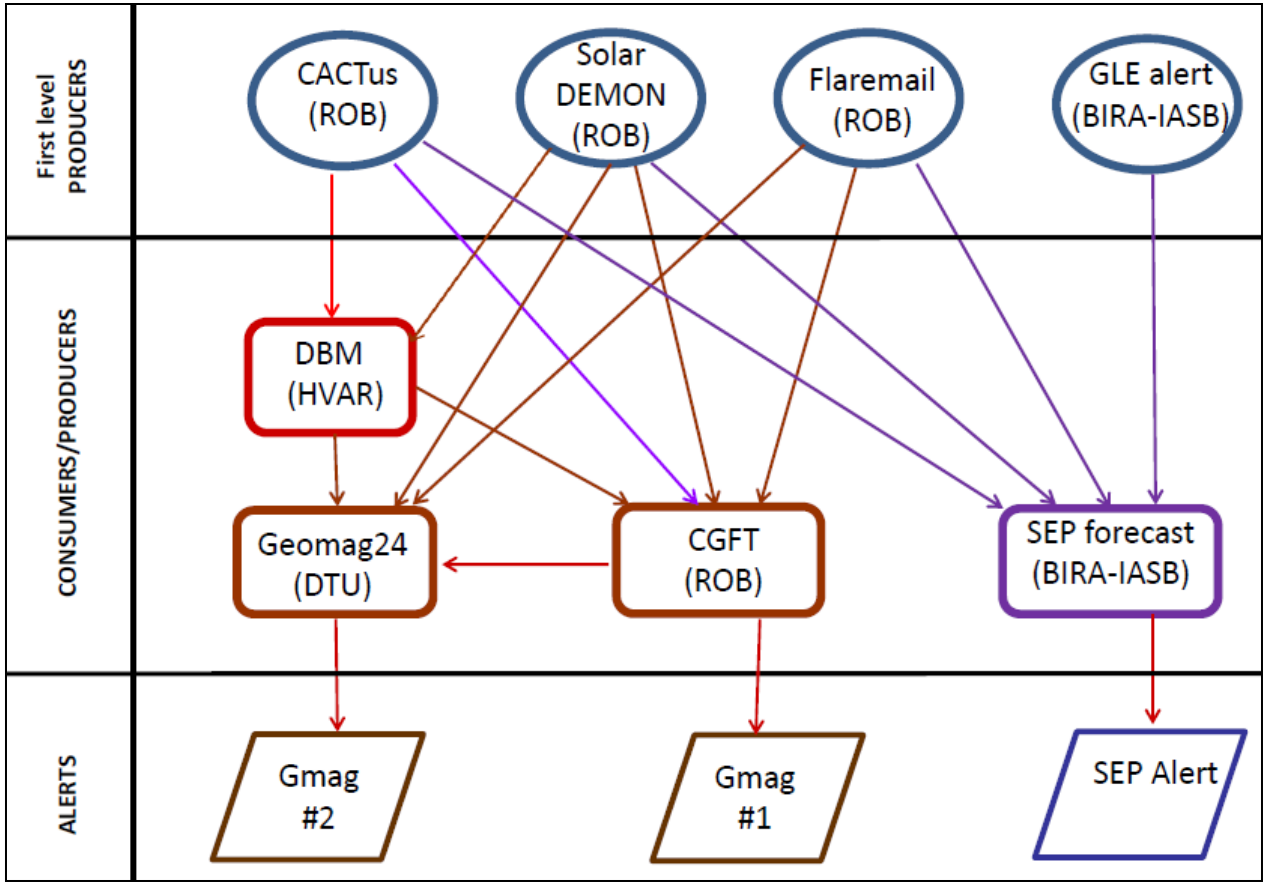
# COMESEP Alert System




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

.be

# 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