

# SEISOP: Space Environment Information System for Operations

ESA/ESOC Darmstadt, Germany  
 Advanced Mission Concepts and  
 Technologies Office  
 Contact: Alessandro Donati  
 E-mail: Alessandro.Donati @ esa.int  
 Tel: +49 6151 90 2574

*Introducing innovative technologies in  
 support of mission operations*

**The Case Study.** Space weather is one of the major sources for spacecraft (S/C) abnormal behaviour and aging. On-board protection mechanisms are often inaccurate or not available. A system is needed that supports S/C operations teams in addressing space weather events and conditions with the goal of increasing the productivity and the health of the S/C, i.e. increased science return.

**The solution.** SEISOP (Space Environment Information System for Operations) collects and provides relevant space environment data to Flight Control Teams (FCT) through two clients: the Monitoring Tool (MT) with an integrated alarming system provides real-time displays of selected data; the Reporting and Analysis Tool (RAT) is used for offline analysis of the data and for the generation of space weather reports.

**Current status.** Operational assessment phase since spring 2005: the system is still considered a prototype, but it is being used under operational conditions.

**Project Team.** Developed by Uninova (P) and Deimos Engenharia (P) in collaboration with the INTEGRAL Flight Control Team and the Mission Control Technologies Unit.

This research was funded by the Portuguese Task Force and the ESA General Studies Programme (GSP).

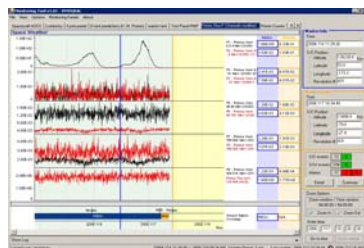


Figure 1: MT screenshot

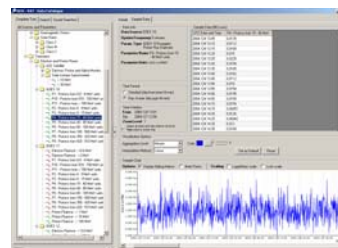


Figure 2: RAT screenshot

Spacecraft (S/C) are subject to hard space environment conditions that influence their performance and reliability as well as their lifetime. The space environment is defined by space weather conditions that result mainly from the solar activity. The effects of space weather on a S/C are many (e.g. single event upsets, degradation of solar arrays, changes in orbit dynamics, loss of instrument functionalities and reduced quality of science data). Therefore space weather information should be a key piece in the decision making processes about when and how long to protect the S/C instruments during hazardous space weather conditions. The "Space Environment Information System for Operations (SEISOP)" was developed to support operations in matters concerning the space environment and its effects on S/C by providing real-time, non-volatile and mission relevant space weather information. SEISOP is a generic system and can support multiple missions. Currently data from INTEGRAL, ENVISAT and XMM missions are collected although the reference mission for the on-going operational validation of SEISOP is INTEGRAL.

Additionally, SEISOP integrates data from other ESA and NASA missions, such as SOHO, ACE and GOES, as well as ground-based measurements. The data is collected and stored in a set of databases in near real-time, and the mission's historical data since their launch, as well as space weather data since 2002, is kept for data analysis and cause-effect correlation.

SEISOP includes two client applications. The MT provides real-time data visualization, assessment and alarms triggering. The RAT allows offline historical data analysis, correlation and automatic report creation.

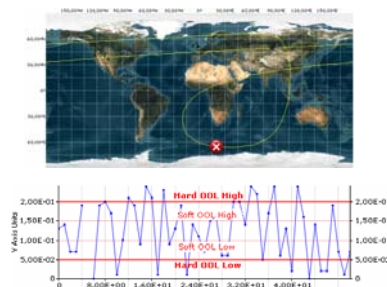


Figure 3: RAT charts examples.

Additionally, SEISOP provides open interfaces to retrieve data from and inject new data into the system. Thus, SEISOP is acting as a platform that facilitates the development and integration of space environment models.

The enabling technologies for these tools and services are data warehousing and OLAP (Online Analytical Processing) databases to store and handle large data volumes.

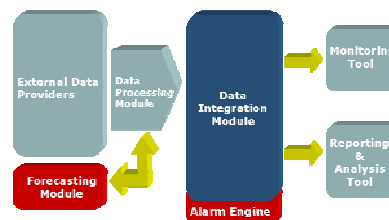


Figure 4: SEISOP architectural overview