SOTERIA space weather project

We live in an era when the concept of environment is enormously extended. It is not bound to the accessible terrestrial sites, oceans and atmosphere, but it also comprises the extraterrestrial environment including the Sun. What we observe in this expanded and dynamic environment is called Space Weather. Influences of the Sun on the Earth come through the solar spectrum of radiation, which provides us with light and heat, and through other changing features of the solar activity.

Some of the most important and impressive phenomena of the solar activity are shown in the figures below depicting sunspots (regions of intense magnetic fields on the solar surface) and coronal mass ejections (CMEs). CMEs carry tremendous amounts of plasma and energy through the solar system, and those which hit the Earth can, in some cases, lead to dramatic consequences. When a CME reaches the Earth, complex series of events in the magnetosphere and ionosphere are triggered, with effects down to the lower atmosphere and on the ground.

Global changes in the solar activity seem to be based on an 11-year cycle. The last cycle has finished recently with its lowest level of activity, and now the new cycle is to begin with an increasingly active phase coming, making the study of space weather even more urgent.

SOTERIA, a new FP7 Space Science project, aims at improving our understanding of the space weather phenomena through collaboration between experts in different fields of solar, space, and geophysics. The main goal is to provide better databases, which will go beyond the present state-of-the-art in regard to details, time-resolution and improved methods of accessing it.

The studies conducted by SOTERIA involve the analysis and processing of the relevant data from 18 satellites, including several ESA and other European satellites. The study will be complemented by a large set of data from European ground-based observatories.

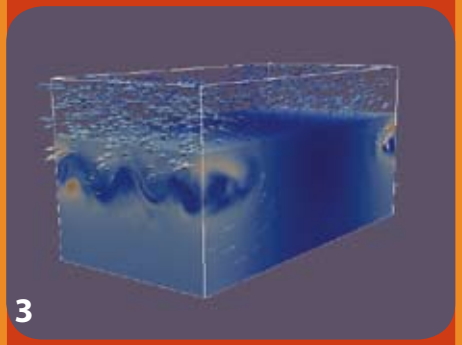
SOTERIA will include also a considerable effort in utilizing the existing and developing improved theoretical and simulation models for interpreting the space weather data.

As an example of the modelling activities, figure 3 shows the results of one simulation of the process called magnetic reconnection, which is at the heart of many space weather phenomena. Magnetic fields are annihilated in localized regions and their energy is released into the space environment.

The team of the SOTERIA project includes scientists from institutions in 8 EU countries (Belgium, Denmark, Germany, Austria, Hungary, France, Poland, Finland) and in 3 non-EU European countries (Switzerland, Croatia and Russia).

Image of the Sun surface showing the presence of sunspots (areas of intensified magnetic fields). From the Uccle solar telescopes at the ROB, Brussels.

Image of the solar corona showing the presence of active regions that can lead to emission of matter and energy (coronal mass ejections, CME). From SOHO/EIT 195 A.



Simulation of magnetic reconnection, the process of magnetic field annihilation and energy release into the space environment. From a Parsek3D computer simulation.

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 218816.