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The SOTERIA EC-FP7 collaborative project.

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Abstract

SOTERIA aims at creating a wide synergy in the fields of solar-space and geo-physics among different centers in a number of European countries to achieve a higher level of quality and accessibility for the observational data and for the models. Our goal is to help creating the basis for a deeper understanding of solar and space processes having terrestrial impact.

1. Introduction

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 a increasingly active phase coming, making the study of space weather even more urgent.

SOTERIA, a 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.

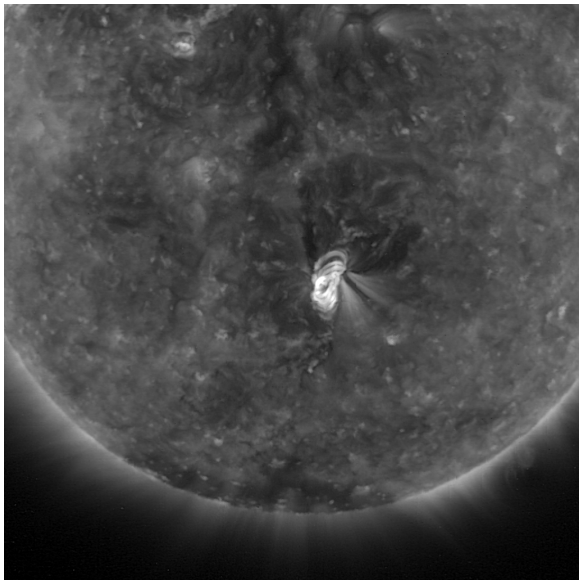

Figure 1: Close-up view of an active region observed by Proba-2's SWAP instrument on 3 April 2010. This eruption caused vast amounts of charged particles that reached the Earth the following Monday, 5 April. Proba2 (*proba2.oma.be*) is a key contributor to the Soteria project.

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

2 Databases

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.

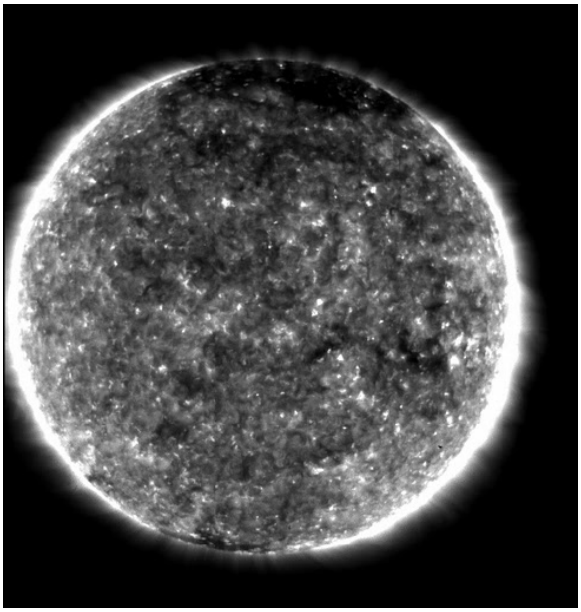

Figure 2: Monochromatic image in FeIX from TESIS instrument on the Russian solar spacecraft CORONAS-PHOTON. Work part of WP3.

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 studyis complemented by a large set of data from European ground-based observatories.

The complete data coverage of Soteria can be found on the Soteria wiki: *www.soteria-space.eu/wiki/index.php/WP6_VO_Action_Plan* and it is organised into different work packages covering all aspects of space weather events:

- WP2: photosphere activities,
- WP3: chromosphere and corona activities,
- WP4: Heliospheric propagation and terrestrial effects
- WP5: Irradiance

An additional WP1 for management and the WP6 for data dissemination and outreach complete the project.

A key aspect of the dissemination activity is related with the Soteria activity on Virtual Observatories (VO). After revieiwing several options, the Soteria VO action plan was centered around adapting and extending the American "Virtual Solar Observatory" (VSO, *sdac.virtualsolar.org/*). With the start of the HELIO FP7 network Soteria will seek further integration with the HELIO's VO, an activity further promoted by the creation of a specific infrastructure funded by the EC-FP7 project CASSIS.

3 Use Databases and Modelling

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

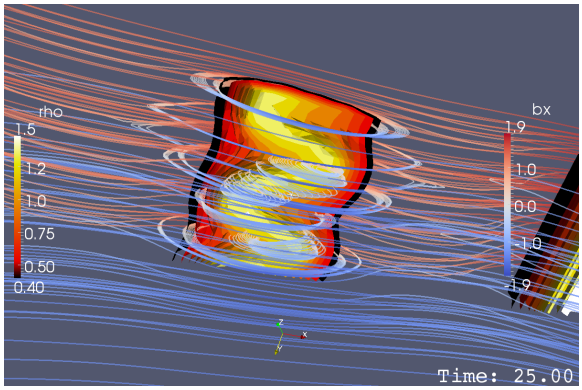

Figure 3: Simulation of magnetic reconnection, the process of magnetic field annihilation and energy release into the space environment.

As an example of the modelling activities, Fig. 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 get annihilated in localized regions and their energy is released into the space environment. In the case considered a flux rope is formed and is subsequently rendered unstable by the kink instability.

A complete list of the modelling tools and efforts can be found on the Soteria wiki: *www.soteria-space.eu/wiki/index.php/Modelling* and on the *Data Assimilation* menu on the main Soteria wen page (*www.soteria-space.eu*)

Acknowledgements

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