SWWT Topical Working Groups 2011 Annual Report

Norma B. Crosby[1], Sean Bruinsma[2], Henrik Lundstedt[3], Juha-Pekka Luntama[4], Susan McKenna-Lawlor[5], Larisa Trichtchenko[6]

[1] Belgian Institute for Space Aeronomy, Ringlaan-3-Avennue Circularie, B-1180 Brussels, Belgium

[2] CNES - DCT/SI/GS, 18, avenue E. Belin, 31401 Toulouse Cedex 9, France

[3] Swedish Institute of Space Physics, Scheelev. 17, SE-223 70 Lund, Sweden

[4] ESA/ESAC, P.O. Box 78, E-28691 Villanueva de la Cañada, Madrid, Spain

[5] Space Technology Ireland, National University of Ireland, Maynooth, Co Kildare, Ireland

[6] Natural Resources Canada, 7 Observatory Crescent, Ottawa, Canada

1. Introduction

Over a decade ago, the Space Weather Working Team (SWWT) was set up to coincide with the two parallel ESA space weather studies that had been awarded, respectively to Alcatel Space (Italy) and RAL (U.K.) in 1999. The SWWT originally consisted of approximately 30 members coming from a variety of backgrounds and ESA member states. These people were to provide independent assessment as well as to maximise the involvement of European expertise and assets that would be taken into account by the two mentioned contractors. Following these two studies the SWWT became open to the wider European space weather community during the ESA Space Weather Pilot Project that began in 2003. With SWWT membership steadily growing it was decided in 2006 to create the SWWT Steering Board (third phase of the SWWT). On 1 Jan. 2009 the SWWT entered its fourth phase with the formal launch of the ESA Space Situational Awareness Preparatory Programme (SSA-PP). Today the SWWT has grown into a community of more than 200 members covering a wide range of disciplines and nationalities.

The main objectives of the SWWT and its community members are listed here:

- To be an forum open to European experts in a variety of both scientific and application oriented fields relating to space weather.
- To advise ESA in space weather strategy and act as a forum for discussion amongst the European space weather community.
- To discuss and initiate non-ESA funded opportunities for space weather.

SWWT membership is open to representatives of any European university, institute or company, or international organisation currently undertaking space weather related activities or affected by space weather. The SWWT consists of members of the space weather community, a Steering Board approved by the community and an elected Chair. SWWT Plenary meetings include the annual mid-year one-day Plenary meeting, as well as the two-hour Plenary meeting at the annual European Space Weather Week meeting. The SWWT Steering Board also meets in conjunction with the SWWT Plenary meetings.

Under the umbrella of the SWWT, several "Topical Working Groups (TWGs)" have been established. TWGs are responsible for initiating projects, discussing new advances and/ or progress in existing research and service development in a specific topic. TWG splinter meetings are organised at the annual European Space Weather Week meeting. The "SWWT Topical Working Groups 2011 Annual Report" highlights on the activities that have been performed by each of the individual TWGs during the last year under the leadership of the listed spokespersons:

1. Fundamental Research, spokesperson: Henrik Lundstedt (IRF)
2. Ground Effects, spokesperson: Larisa Trichtchenko (Natural Resources Canada)
3. Atmospheric Effects, spokesperson: Sean Bruinsma (CNES)
4. Ionospheric Effects, spokesperson: Juha-Pekka Luntama (ESA)
5. Spacecraft, Launcher and Aircraft Environments, spokesperson Susan McKenna-Lawlor (STIL), co-spokespersons Federico di Marco (VEGA) and Guenther Reitz (DLR)
6. Education, Outreach and Emerging Markets, spokesperson: Norma Crosby (BIRA-IASB).

The goal of summarising the work performed under the umbrella of the TWGs is to make the TWGs more visible to the whole community.

It should be noted that in 2012 the "Fundamental Research" TWG was renamed to "1. Drivers of Space Weather (e.g. solar, S-T, including future missions and instrumentation)" and there were some updates to names of spokespersons:

1. Drivers of Space Weather (e.g. solar, S-T, including future missions and instrumentation) [Subgroup 1: Solar Magnetic Energy, spokesperson: Henrik Lundstedt (IRF) ; Subgroup 2: Solar Storms (Solar Flares, CMEs, SEP events), spokepersons: Nicole Vilmer (Paris Observatory) and Olga Malandraki (NOA)]
2. Ground Effects (GIC, prospecting, tourism), spokesperson: Magnus Wik (NeuroSpace)
3. Atmospheric Effects (incl. drag), spokesperson: Sean Bruinsma (CNES)
4. Ionospheric Effects, spokesperson: Matthew Angling (University of Birmingham and QinetiQ)
5. Spacecraft, Launcher and Aircraft Environments, spokesperson Susan McKenna-Lawlor (STIL), co-spokespersons Federico di Marco (VEGA) and Guenther Reitz (DLR)
6. Education, Outreach and Emerging Markets, spokesperson: Norma Crosby (BIRA-IASB).

SWWT TWGs webpages are located at:
http://www.esa-spaceweather.net/spweather/esa_initiatives/swwt/
http://spaceweather.eu/en/swwt

2. Fundamental Research

Topical Working Group Spokesperson: Henrik Lundstedt, Email: henrikl@irf.se

The objective of this topical group is to formulate fundamental research questions in solar physics and Sun-Earth connections, in order to improve our understanding and prediction capability of space weather/climate and effects. Solar physics includes topics such as solar magnetic variability, solar magnetic topology and energy release, as well as solar magnetic flux distribution. Sun-Earth connections covers Sun-climate connections and solar wind magnetosphere-Ionosphere coupling.

The driver of space weather is solar magnetic activity:

- Long-term solar magnetic activity (solar dynamo)
- Short-term solar magnetic activity (solar storms, topological magnetic field connectivity).

It is a great challenge to understand the physics of and forecast strong solar storms (solar flares and coronal mass ejections) based on fundamental math and physics, and not just by applying statistics and numerical solutions of differential equations.

Space weather differs from solar-terrestrial physics in that in space weather one develops a service that the user wants. This TWG suggests that focus should be placed on the severe space weather events and not over-dramatize the situation every time an event on the Sun occurs. Below two European initiatives are described that have contributed to the objective of this TWG.

<u>SOTERIA project</u>:
The FP7 SOlar-TERrestrial Investigations and Archives (SOTERIA) project (http://soteria-space.eu/) covered three years and ended in summer 2011. The main aims of SOTERIA was to create 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. Their goal was to help create the basis for a deeper understanding of solar and space processes having terrestrial impact.

<u>COST Action ES0803</u>:
The four year European COST Action ES0803 "Developing Space Weather Products and Services in Europe" (http://www.costes0803.noa.gr/) addresses the assessment and validation of existing space weather research and operational models as one of its key activities (Action ends in Nov. 2012). The strong interaction with the SWWT community has allowed the identification of key issues that may be summarised as follows:

- Assessment of space weather models in terms of users' needs and requirements (specifically assessment of ionospheric forecasting models).
- Clear definition of metrics for the quantitative assessment of the models' prediction ability (determination of parameters for comparison, cadence, etc.)
- Independent validation of European models by a central system - Model availability and data transfer
- Potential exploitation of the experience that the meteorological community has already gained in this exercise.

3. Ground Effects

Topical Working Group Spokesperson: Larisa Trichtchenko, Email: Larisa.Trichtchenko@NRCan-RNCan.gc.ca

At the Earth's surface, space weather manifests itself as geoelectromagnetic effects. When geomagnetic activity is increased, i.e. the geomagnetic field becomes disturbed, a geomagnetic storm occurs. The geoelectric field drives currents, called geomagnetically induced currents (GICs), in man-made conductors, such as electric power transmission systems, oil and gas pipelines, telecommunication cables and railway equipment. GICs may cause problems to the systems: transformers can be saturated, pipelines may suffer from enhanced corrosion, and telecommunication and railway systems can experience overvoltage.

The main activities covered under the Ground Effects Topical Group (GETG) are:

- Modelling the occurrence of geomagnetic variations and geoelectric fields during space weather events
- Modelling GIC in electric power systems (discrete grounding)
- Modelling GIC in buried pipeline networks (continuous grounding)
- Measurements of geomagnetic variations, geoelectric fields and GICs
- Development of forecast techniques of GICs based on neural networks or on physical models.

The FP7 European Risk for Geomagnetically Induced Currents (EURISGIC) project officially started as of March 1, 2011 and will last for three years (http://www.eurisgic.eu/). EURISGIC will produce the first European-wide real-time prototype forecast service of GICs in power systems, based on in-situ solar wind observations and comprehensive simulations of the Earth's magnetosphere. Papers and other publications:

- Viljanen A., Koistinen A., Pajunpää K., Pirjola R., Posio P., Pulkkinen A. Recordings of Geomagnetically Induced Currents in the Finnish Natural Gas Pipeline - Summary of an 11-year Period, Geophysica, 46, 59-67 2010
- Pirjola R. Eigenvalues and eigenvectors of the transfer matrix involved in the calculation of geomagnetically induced currents in an electric power transmission network Earth, Planets and Space, accepted, 24 pp. (manuscript) 2011

Canada: New Projects

Manitoba Hydro (Risto Pirjola+David Boteler)
Hydro Quebec (David Boteler,+Larisa Trichtchenko +student)
Yukon Power (David Boteler,+Larisa Trichtchenko+ student)
Hydro One continuation (David Boteler+student)

4. Atmospheric Effects

Topical Working Group Spokesperson: Sean Bruinsma , Email: sean.bruinsma@cnes.fr

Orbit predictions for spacecraft in Low-Earth Orbits (ca. 200-1500 km) are subject to large uncertainties due to incomplete knowledge of atmospheric variability, as well as due to errors in solar and geomagnetic activity forecasts. Predictions are strongly dependent on the accuracy with which atmospheric density is predicted by empirical models. Uncertainties in the accuracies of such models severely hamper one's ability to calculate an error budget due to this source. The errors in the current generation of thermosphere models is at the 10-20% 1σ level on average; this error is on average 2-5 times higher during geomagnetic enhanced and storm conditions. The high-level objective of this TWG is advancing our current understanding of the relationship between the neutral upper atmosphere (i.e. the thermosphere) structure and variability, and atmospheric drag forces perturbing satellite motion. The topical areas cover observation and modeling of atmospheric density and winds, as well as factors affecting the drag coefficient. Furthermore, orbit predictions are subject to large uncertainties due to errors in solar and geomagnetic activity forecasts.

The relationship between the neutral atmosphere structure and variability and satellite drag must be established by addressing the key questions, which were formulated in 2008 as the study objectives of the TWG. The relationship between neutral atmosphere structure and variability and satellite drag will be clarified by addressing these key questions:

1. What are the driver-response relationships, the scales (time and space) of the density and wind variability due to EUV/UV radiation and geomagnetic disturbances, and forcing due to disturbances propagating from lower altitudes?
2. Which proxies/indices are most representative of solar EUV/UV and geomagnetic activity and appropriate for density modeling? And additionally, what is the quality of their forecast?
3. What is the accuracy and precision of upper atmosphere density and wind (empirical or first-principle) models, how can they be improved?
4. What is the accuracy of solar and geomagnetic activity forecasts and how can they be improved?
5. How should one compute the drag coefficient?
6. Which density data sets are critically needed to achieve the above-listed 5 key questions, i.e., for analysis and to improve models, and which information is missing (i.e., is there a key question we cannot address presently due to data unavailability)?

The variability of the satellite drag environment of question 1 at all spatial and temporal scales as a function of position (i.e. altitude, latitude, local time and longitude) and solar- and geomagnetic activity needs further study. The spatial scales range from a few km's for small-scale gravity waves, via large-scale waves of several thousands of km, to tens of thousands of km for the diurnal migrating tide for example. The temporal scales range from minutes in case of small-scale gravity waves, hours in case of very large flares, hours to days for geomagnetic sub-storms and storms, 13 and 27 days approximately due to the solar rotation, to semi-annual, annual and finally the solar cycle period of 11 years on average. Thanks to densities inferred from accelerometer measurements we have learned much over the last decade.

The second question concerns determining the best proxy for solar EUV emissions by means of correlative analyses of density and proxies followed by modeling, or by directly modeling using a proxy or combination of proxies and evaluating the fit to the density observations. A similar procedure must be followed in the evaluation of geomagnetic activity indices. However, due to known shortcomings of existing indices, the construction of a more representative new index with a time resolution of 30 minutes or better is an additional requirement. The availability of the observations in the past (for use with the historical density data sets of the '70s and '80s) and at least for the next couple of decades is a further condition.

The average accuracy of semi-empirical thermosphere models is known approximately, but a more detailed error budget (i.e. as a function of altitude, solar activity, local time etc.) is not provided by the modelers. The model precision (the variations are reproduced but scaled or with a bias) is also not well known, although first-principle models tend to be more precise and less accurate than semi-empirical ones. The lack of independent observations is the main reason for the absence of detailed error budgets. A significant model improvement is expected simply by assimilating the high-resolution CHAMP and GRACE accelerometer-inferred densities, covering solar maximum through the prolonged minimum activity (2001-2010). These data are not used in any model yet. Of course, this data assimilation should be done taking advantage also of new EUV and geomagnetic activity proxies, and enhanced model algorithms (convolutive model for example).

The fourth key question concerns operational satellite and debris orbit prediction, which is done for 1 up to 27 days, and, to a lesser degree, satellite lifetime estimation over periods covering an entire solar cycle or more. The question actually concerns heliophysics, but it is an indispensable and integral part of upper atmosphere density prediction since it is often the main error source.
Item 5 addresses the subject of the interaction between the satellite walls or panels and the atmospheric atoms. Drag is caused by the collision energy exchanged in the direction of the satellite velocity, the amount of which is a function of several parameters, for example the atomic species and wall material, ambient temperature, and the speed of the satellite and the incoming atoms. The drag coefficient is thus variable. Its value directly scales the drag force and errors of the order of tens of percent are not uncommon.

The 6th question is in fact the starting point and crux in achieving the objective. A review of existing density and temperature data sets is therefore the first task to be performed in the European Union's 7th framework project 'ATMOP' (Advanced Thermosphere Modelling for Orbit Prediction), which will address all key questions except for #5 over the next 3 years. The research project aims at building a new DTM thermosphere model and prototype versions of DTM and CMAT2 with near-real date assimilation capabilities for density prediction, as well as a solar and geomagnetic activity proxies' database including forecast modules. The models will have the potential to be adopted by national and European space agencies for operational tasks, in particular for ESA's Space Situational Awareness programme. Therefore, ATMOP contributes to ensuring the security of space assets from space weather events and the development of the European capability to reduce dependence of space operations on the US.

The "Advanced Thermosphere Model for Orbit Prediction (ATMOP)" is a European Union FP7 research project that started in January 2011 (http://www.atmop.eu/). Its primary objective is to develop a new thermosphere model that is sufficiently accurate to meet the requirements set by space agencies for orbit computation, and to initiate work on an operational near-real-time version. It will enable precise air drag computation, which is mandatory for improved survey and precise tracking of objects in LEO and the initiation of appropriate measures to minimise risks to satellites (tracking loss, collisions) and ground assets (re-entry zone). Currently there is neither a near-real-time thermosphere prediction model nor operational services to provide regular thermosphere nowcast and forecast in the European Union (United States assets have to be used). The ATMOP project will tackle this lack by:

- Defining and assessing new proxies to describe the external forcing of the thermosphere;

- Developing an advanced semi-empirical Drag Temperature Model (DTM) that meets the requirements for operational orbit computations;
- Improving physical modelling of the thermosphere to assist the development of the advanced DTM and of a global physical model with data assimilation capabilities, which may ultimately become the successor to semi-empirical models;
- Developing schemes for near-real-time assimilation of thermospheric and ionospheric data into an advanced predictive DTM and into the physical Coupled Middle Atmosphere-Thermosphere (CMAT2) model.

The updated semi-empirical DTM model that will be constructed in the framework of the ATMOP project will be based upon the most comprehensive database available to researchers. It will in particular include densities inferred from accelerometers onboard CHAMP, GRACE and GOCE, which provide(d) high quality thermosphere density data over almost one solar cycle already, including years of high geomagnetic activity (2003) and exceptionally low solar activity (2008 -2010).
ATMOP will address the listed items 2-5 of the TWG's objectives. All six questions are already being studied by members of the NADIR (Neutral Atmosphere Density Interdisciplinary Research: http://ccar.colorado.edu/muri/index.html) project in the United States. Both projects are presently considering collaboration on several topics, and this possibility was discussed during a one-day meeting with the PI of NADIR, Jeff Forbes of the University of Colorado, in June in Toulouse. Anticipating a positive reception by members of both projects, the TWG's key questions will all be considered, at least partly, over the next 2-3 years.

5. Ionospheric Effects

Topical Working Group Spokesperson: Juha-Pekka Luntama, Email: Juha-Pekka.Luntama@ESA.INT

The ionosphere is a critical part of the propagation medium for most types of radio transmissions. Reflections of the HF and VHF transmissions allow communications over long distances without using relay stations or satellite links. Higher frequency radio signals propagate through the ionosphere allowing satellite telecommunication links and satellite navigation. However, varying characteristics of the ionosphere can cause significant disturbances in the radio signals and cause errors or breaks in the respective services.

The Ionospheric Effect TWG was established as a forum for discussion and exchange of information, ideas and thoughts regarding ionospheric modelling, observations and mitigation techniques for ionospheric impacts on radio signals. The group has also addressed topics related to the services for the end user community including new approaches for warning the users for conditions when ionospheric disturbances can compromise the integrity of services based on transionospheric radio signals.

The main effects of the ionosphere on radio signal propagation include

- Increased absorption, fading and flutter of HF communications,
- Depressed Maximum Usable Frequencies (MUF) and increased Lowest Usable Frequencies (LUF) for HF communications,
- Radar energy scatter, range, elevation and azimuth angle errors for radar systems
- Faraday rotation, scintillation, loss of phase lock and Radio Frequency Interference (RFI) for satellite telecommunications,
- Range error, scintillation and loss of phase lock for satellite navigation systems.

The European ionospheric research community has been active in multiple research and education projects. Ongoing projects in 2011 include:

- TRANSMIT (Training Research and Applications Network to Support the Mitigation of Ionospheric Threats)
- CIGALA (Concept for Ionospheric-Scintillation Mitigation for Professional GNSS in Latin America)
- ICARUS (Ionospheric threats and suitable Countermeasures Applicable to satellite Radio systems Under next Solar maximum)
- GNSS Scintillation: Detection, Forecasting and Mitigation
- MONITOR (**MON**itoring of the **I**onosphere by innovative **T**echniques, coordinated **O**bservations and **R**esources)
- AFFECTS **(A**dvanced **F**orecast **F**or **E**nsuring **C**ommunications **T**hrough **S**pace)
- MuSIK (Multi Scale Ionospheric Model by Combination of modern satellite techniques)

One important activity especially related to the SWWT is the establishment of the Ionospheric Weather Expert Service Centre (ESC) in the framework of the ESA Space Situational Awareness (SSA) Preparatory Programme (http://www.esa.int/esaMI/SSA/). The Ionospheric Weather ESC is part of the Space Weather Segment of the ESA SSA system. This ESC is coordinated by the German Aerospace Center (DLR) and at the initial stage includes services from the DRL's SWACI (Space Weather Application Center Ionosphere) system. This ESC is expected to expand in early 2012 with new members and services.

6. Spacecraft, Launcher and Aircraft Environments

Topical Working Group Chair and Spokesperson Susan McKenna-Lawlor, E mail: stil@nuim.ie
Topical Group Co-Chairs: Federico di Marco (VEGA), E. Mail: Federico.Di.Marco@esa.int ; Guenther Reitz (DLR), E. Mail: Guenther.Reitz@dlr.de

The Spacecraft, Launcher and Aircraft Environments TWG was formed to act as a conduit between the space weather community and ESA providing, in particular, inputs on matters concerning space weather effects on spacecraft, aircraft and launchers and accounts of related services. Space environments considered include plasma, particle radiation, electromagnetic, and micro-particles. Consequent effects taken into account include electrostatic discharges (ESD), electromagnetic compatibility (EMC) issues and single event upsets (SEUs) in electronic components and subsystems, as well as dose effects on living cells.

An ongoing connection between the TWG, ESA and the community is maintained through a website that was mounted during this year on the European Space Weather Portal.

ESA's new MEREM models were used for the first time within the community to calculate the particle radiation environment on the Martian surface by a team lead by Susan McKenna-Lawlor. It was demonstrated that the results obtained are in reasonable agreement with those obtained using NASA's HZETRN model. A paper "Characterization of the particle radiation environment at three potential landing sites on Mars using ESA's MEREM models" by S. McKenna-Lawlor, P. Gonçalves, A. Keating, B.Morgado, D. Heynderickx, P. Nieminen, G. Santin, P. P. Truscott, F. Lei, B. Foing and J. Balaz, based on this analysis has been published in Icarus (S. McKenna-Lawlor et al., doi:10.1016/j.icarus, 2011.04.004).

Also, the particle radiation environment en route to and at Mars was calculated using the MEREM, Creme 2009 and HZETRN models. The resulting paper "Overview of energetic particle hazards during prospective manned missions to Mars" by S. McKenna-Lawlor, P. Gonçalves, A. Keating, G. Reitz and D. Matthiä, has been published in a special issue of Planetary and Space Science (doi:10.1016/j.pss 2011.06.017).

A technical paper is under preparation by S. McKLawlor, G.Reitz and FDi Marco for the ESA Bulletin which will provide a state of the art overview of space weather user requirements for Launch Service, Trans-Polar Flight and Human Space Flight Providers and for Spacecraft Operators.

A presentation on behalf of the TWG on the "Effects of Space Weather on Space Systems" was made during ESWW8 on 28 November 2011 by S. McKenna-Lawlor. The topical group Chairperson has requested the organisers of ESWW to allot a special session (3 hours) during ESWW2012 to TG-SALE during which tutorials will be provided by experts on topics of interest to the members (e.g. SSA, Radiation Hazards aboard Aircraft and in Space; Acceptable Launch Conditions; Planetary protection etc.). These tutorials will be aimed at providing state of the art information to scientists/ engineers/space program managers etc. at a professional level.

7. Education, Outreach and Emerging Markets

Topical Working Group Spokesperson: Norma B. Crosby (BIRA-IASB), Email: norma.crosby@oma.be

Main objectives of the Education, Outreach and Emerging Markets (EOEM) TWG are to cover:

- Education (primary to university), both formally (e.g. schooling, textbooks, etc.) and informally (e.g. museums, webcasts, etc.) services.
- Public outreach activities (e.g. TV/radio programs, popular books, etc.).
- Emerging space weather markets by acting as umbrella for markets until they are “mature enough” to have a topical group of their own in the context of a European space weather programme.

The EOEM TWG has been considering potential future space weather markets. The possible effects of space weather on human health on Earth is one such topic. This is being done in connection with space weather induced health effects on humans in space. At ESWW8 the splinter meeting “Space Weather Effects on Humans in Space and on Earth” was chaired by N. Crosby (BIRA-IASB) and T. Breus (Space Research Institute RAS). In June 2012 the Space Research Institute in Moscow, Russia is organising/ hosting the “Space Weather Effects on Humans: in Space and on Earth” International Conference (http://swh2012.cosmos.ru/).

Below, are described some of the main outcomes of the EOEM TWG in regard to education and outreach activities performed by the community.

I Love My Sun:

Under the umbrella of the International Heliophysical Year in 2007 and the COST 724 Action the “I Love My Sun” concept was created and initiated by Dr. Yurdanur Tulunay from METU, Turkey. She is continuing the “I Love My Sun” initiative as a European outreach activity under the umbrella of the COST ES0803 Action (http://www.costes0803.noa.gr/) in subgroup “General Public Outreach to the Non-Specialist” and the SWWT EOEM topical group.

The main objective of the “I Love My Sun” initiative is to make children (age 7 through 11) aware of Space Weather, Sun, Sun-Earth relations and of how they, the children, are part of this global picture. An “I Love My Sun” event is divided into three parts:

1. Children are asked to draw the Sun as they perceive it “Before drawing”.
2. Basic set of lectures on the Sun and space weather are given to the children.
3. Children are asked to draw the Sun again “After drawing”.

In the context of the COST ES0803 Action, the “I love My Sun” project has attracted further European interest (see “I Love My Sun” website http://www.ilovemysun.org/). At present, “I Love My Sun” events have been held in Turkey, Belgium, Ukraine and Serbia.

The paper “The COST Example for International Collaborative Outreach to the General Public: I Love My Sun” by Yurdanur Tulunay, Norma B. Crosby, Ersin Tulunay, Stijn Calders, Aleksei Parnowski, Desanka Sulic,” has been submitted to the Journal of Space Weather and Space Climate (2012).

Some of the typical drawings of the Turkish children from the Başkent University Özel Ayşeabla" private school in Ankara. (I Love My Sun 3 event: 1st visit)

FP7 HAMLET project:
The aim of the FP7 HAMLET project (http://www.fp7-hamlet.eu/) is the effective scientific exploitation of data obtained from the ESA Human Model MATROSHKA project for Radiation Exposure Determination of Astronauts. This is being achieved by bringing together leading European scientists in the field of space dosimetry to increase and enhance the output of the project and present it to the European scientific community as well as the public audience. The intention of the HAMLET "Public Outreach Activity Days" has been to present the "science background", the "current state of research" and the "further planned activities" of the group to a scientific interested public audience.

New books:
Dr. Pål Brekke, Senior Advisor from the Norwegian Space Centre, has written the book "Sola – vår livgivende stjerne". It is a book filled with much information and looks at how our closest star works. A star which provides energy for life, generates the beautiful northern lights and influences our society in many ways. Included is a CD full of movies and animations, as well as student activities. This book is for anybody who wants to understand how our closest star works. The book has been translated to English "Our Explosive Sun - A Visual Feast of Our Source of Light and Life" (http://www.springer.com/about+springer/media/pressreleases?SGWID=0-11002-6-1337121-0). Translations to other languages is being investigated.

The book "Harald Moltke – Painter of the Aurora" was written by Dr. Peter Stauning: http://www.forlagetepsilon.dk/?page=84&product_id=10).

New space weather journal :
The COST ES0803 Action created the Journal of Space Weather and Space Climate (http://www.swsc-journal.org); it was launched at the end of 2010. It is an international multidisciplinary and interdisciplinary open access journal, which publishes papers on all aspects of space weather and space climate. Coverage includes, but is not limited to

- fundamental and applied scientific research including theory, observation, data analysis, modelling, and prediction.
- technical applications and engineering solutions
- impact on humans and technology in space, in the air, at sea and on land
- societal and economic implications
- educational and dissemination concepts and experiences
- development of user-targeted products and services
- scientific, technical, political and commercial initiatives.