STCE Newsletter

6 Jul 2015 - 12 Jul 2015

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The Solar-Terrestrial Centre of Excellence (STCE) is a collaborative network of the Belgian Institute for Space Aeronomy, the Royal Observatory of Belgium and the Royal Meteorological Institute of Belgium.

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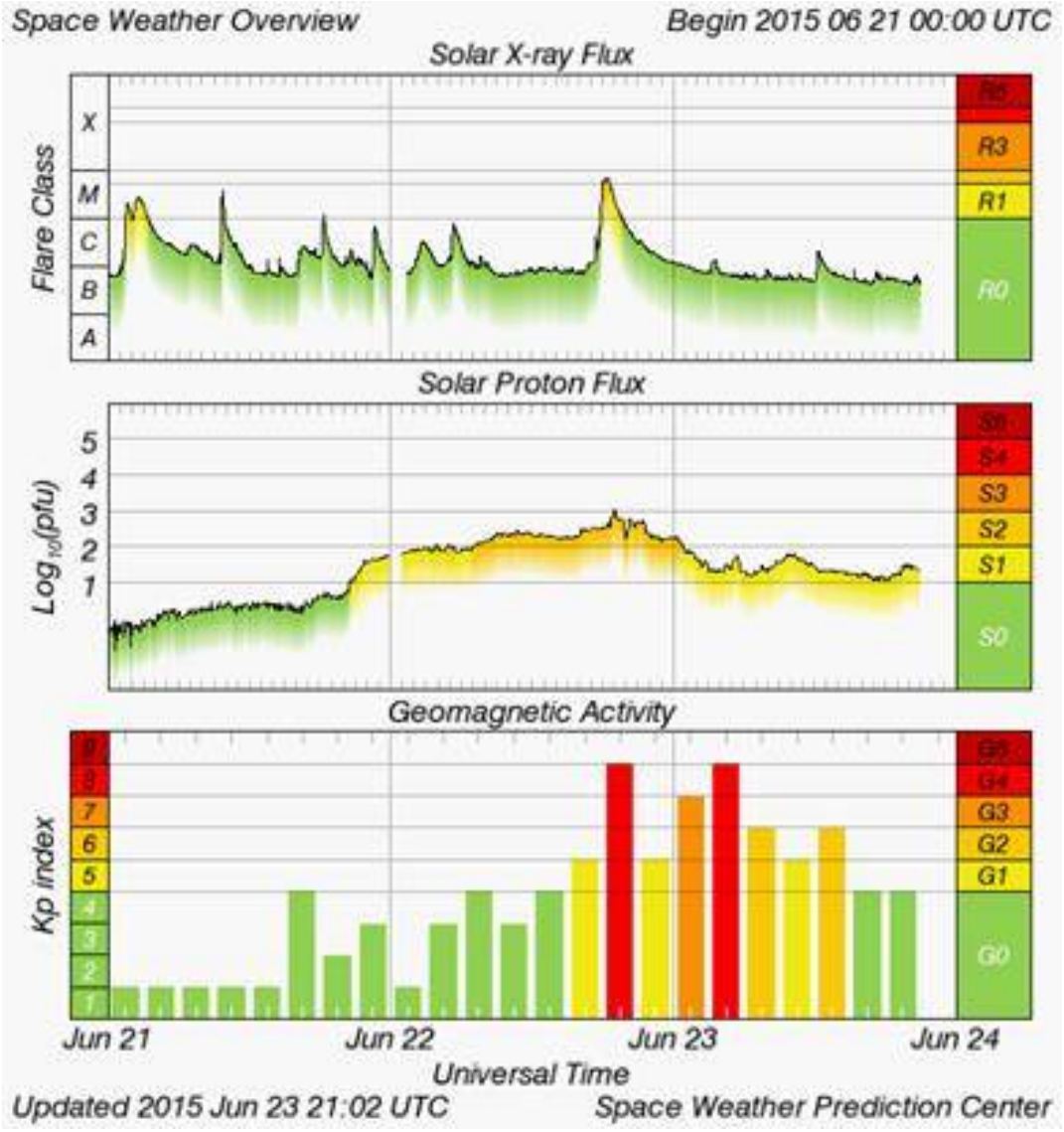
1. Coincidence

On 22 June 2015, the strongest proton event so far this year took place, with the greater than 10 MeV proton flux reaching 1070 pfu (proton flux units; Notes 1 and 2). It was only the 5th such event (more than 1000 pfu) so far this solar cycle (SC), and only the 41st since the start of systematic satellite measurements began in 1976. Interestingly, the maximum (19:00UT) coincided with a period of severe geomagnetic storming (Kp=8) from 18:00-21:00UT, and with a a moderate M6.5 flare peaking at 18:23UT. This was nicely illustrated by the overview chart from SWPC (image underneath).



It goes without saying that there are few of this kind of coincidences, not in the least because of the low number of strong proton events. Also, since 1976, there have only been about 500 X-class flares and 6000 M-class flares. Geomagnetically, there have been only about 500 3-hour periods with strong to (extremely) severe geomagnetic storming. So, it is obvious that the instances of strong geomagnetic storming and strong solar activity falling together with a strong radiation storm are quite rare.

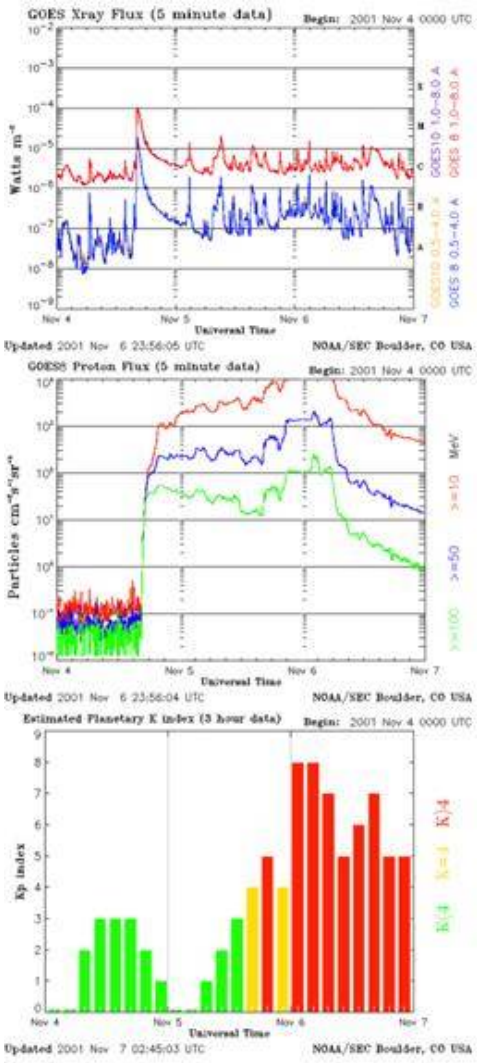
Using the NOAA charts and listings of all these events, a quick review covering SC23 and SC24 revealed that only 11 days satisfy the above conditions. These days are displayed in the table underneath,

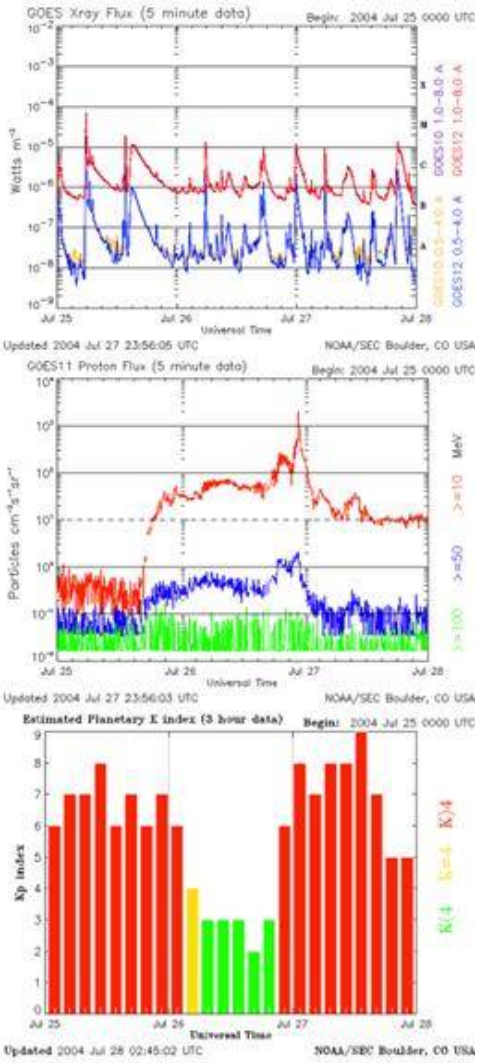
with the intensity of the individual storms as described according to the NOAA-scales (see http://www.swpc.noaa.gov/noaa-scales-explanation for a full description, and the second table underneath for a summary).

Date	Proton flux	X-ray flux		Geomagnetic	
	Smax	at Smax	post Smax	at Smax	post Smax
22-Jun-15	S3	R2		G4	
9-Mar-12	S3		R2		G3
15-Dec-06	S3		R3		G4
11-Sep-05	S3	R3		G3	
17-Jan-05	S3		R3	G3	
26-Jul-04	S3	R1		G4	
29-Oct-03	S4	R1	R4	G5	G5
6-Nov-01	S4	R1		G4	
2-Oct-01	S3	R1		G1	
25-Sep-01	S4	R1		G2	
15-Jul-00	S4	R1	R1	G5	G4

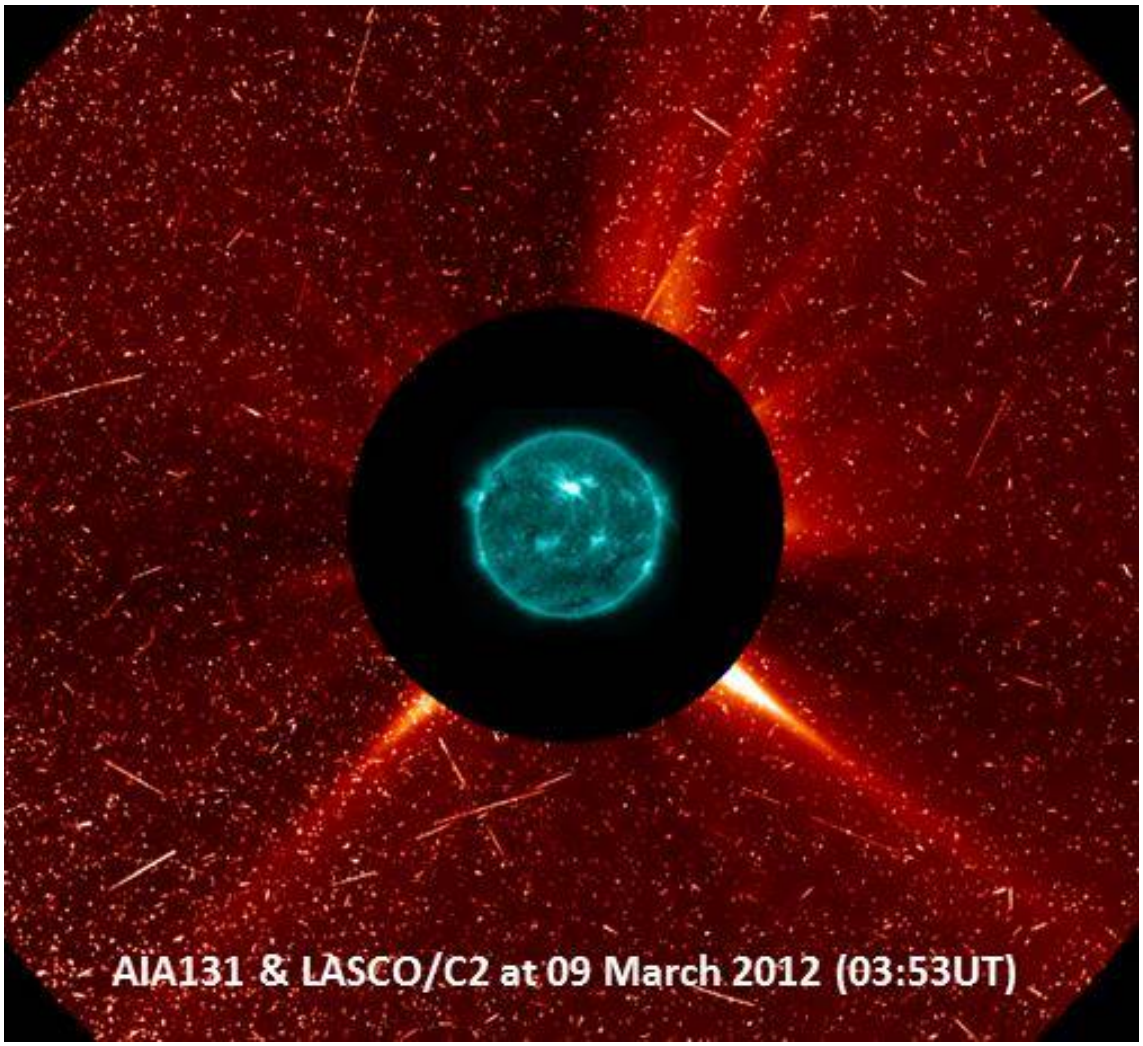
scale	S	R	G
	proton flux ≥	*X-ray class ≥*	*Kp ≥*
1	10	M1	5
2	100	M5	6
3	1,000	X1	7
4	10,000	X10	8
5	100,000	X20	9

The Halloween period (29 October 2003) as well as the Bastille Day event (15 July 2000) are both having coinciding storms during and after the maximum proton flux (Smax). The graphs underneath provide other examples of coinciding storms: on the left the events from 6 November 2001, and on the right those from 26 July 2004. Each display the x-ray flux, proton flux, and evolution of the Kp-index. It is clear that when increased activity of these three fall together, the resulting space weather effects can be felt in all domains. A good thing this does not happen very frequently!





6 November 2001 **26 July 2004**



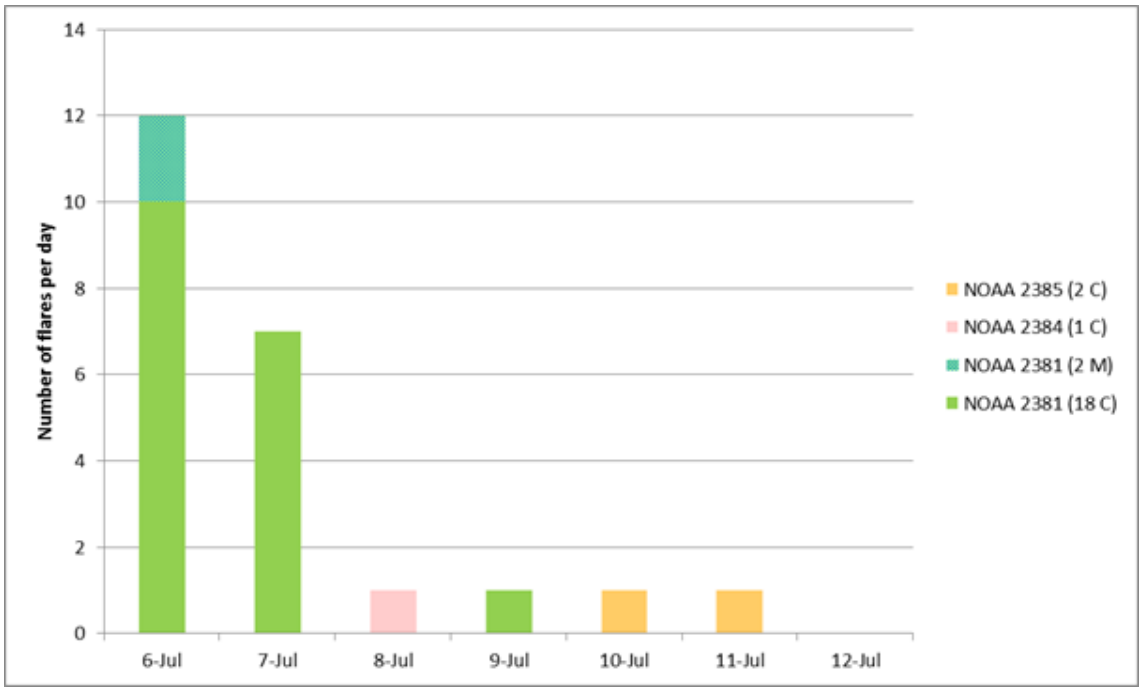
Note 1 - 10 MeV = 10 million eV. The eV (electron volt) is a very tiny amount of energy corresponding to about 0.16 billionth of a billionth of a Joule. For comparison, a flying mosquito has a kinetic energy of about a trillion eV (= 1000 billion eV).

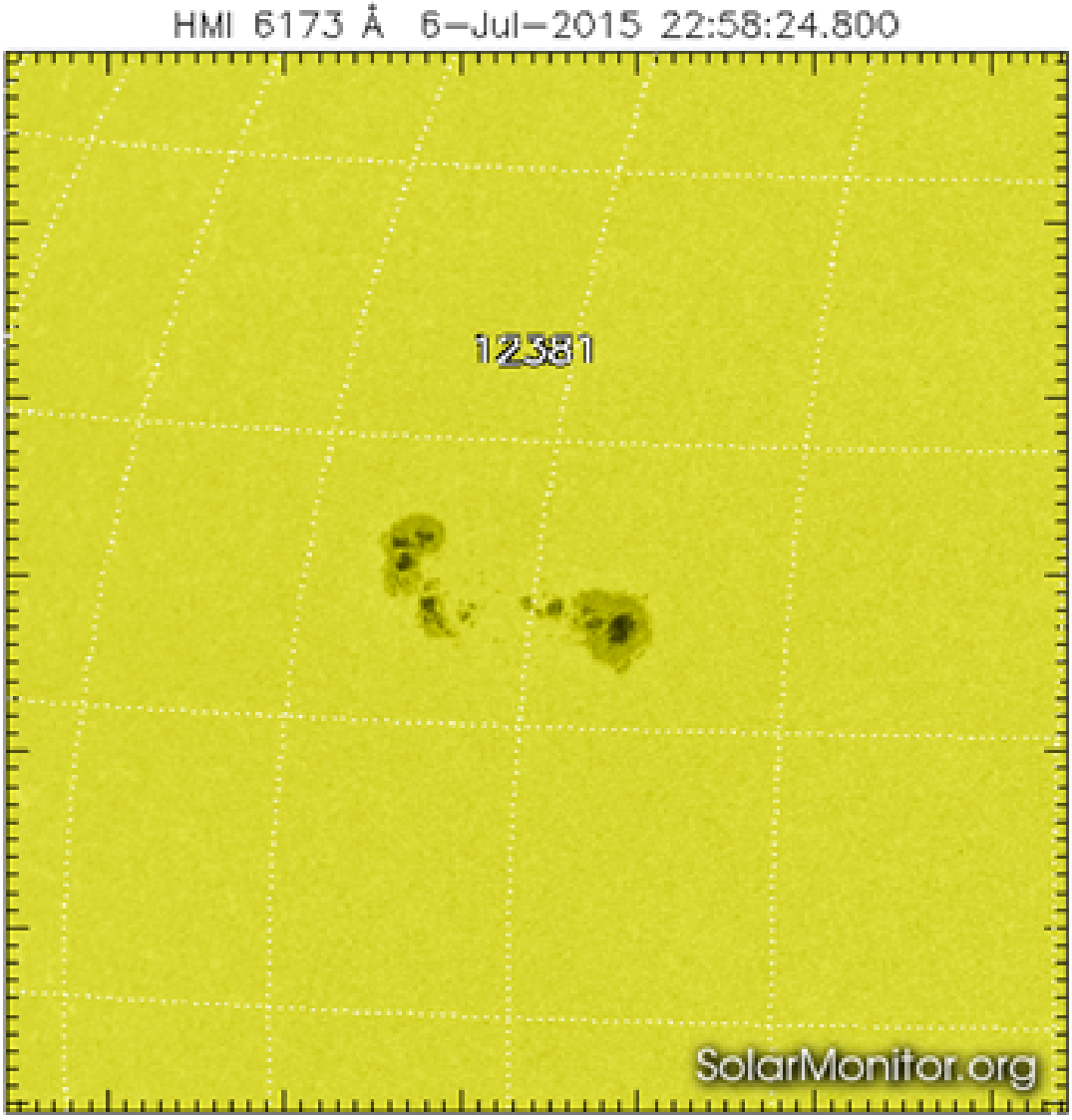
Note 2 - pfu: proton flux unit. This is the number of particles registered per second, per square cm, and per steradian.

Credits - Data and imagery were obtained from NOAA's Warehouse (ftp://ftp.swpc.noaa.gov/pub/warehouse/), SWPC (http://umbra.nascom.nasa.gov/SEP/), NGDC (ftp://ftp.ngdc.noaa.gov/STP/space-weather/solar-data/solar-features/solar-flares/x-rays/goes/), and Helioviewer (http://helioviewer.org/#).

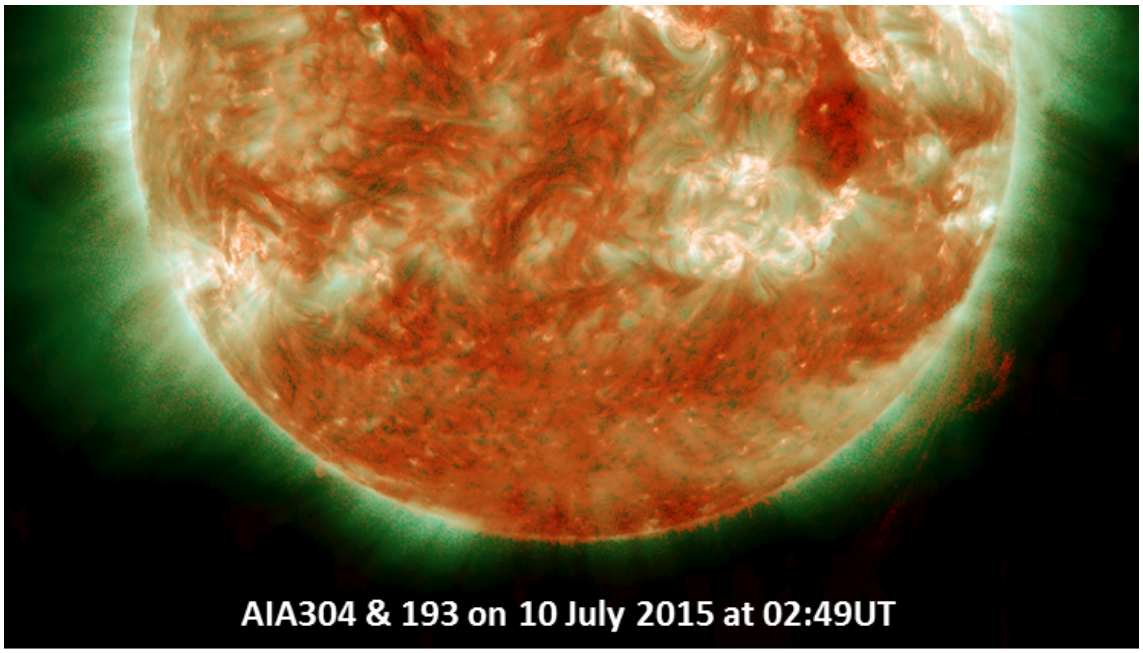
2. Review of solar activity

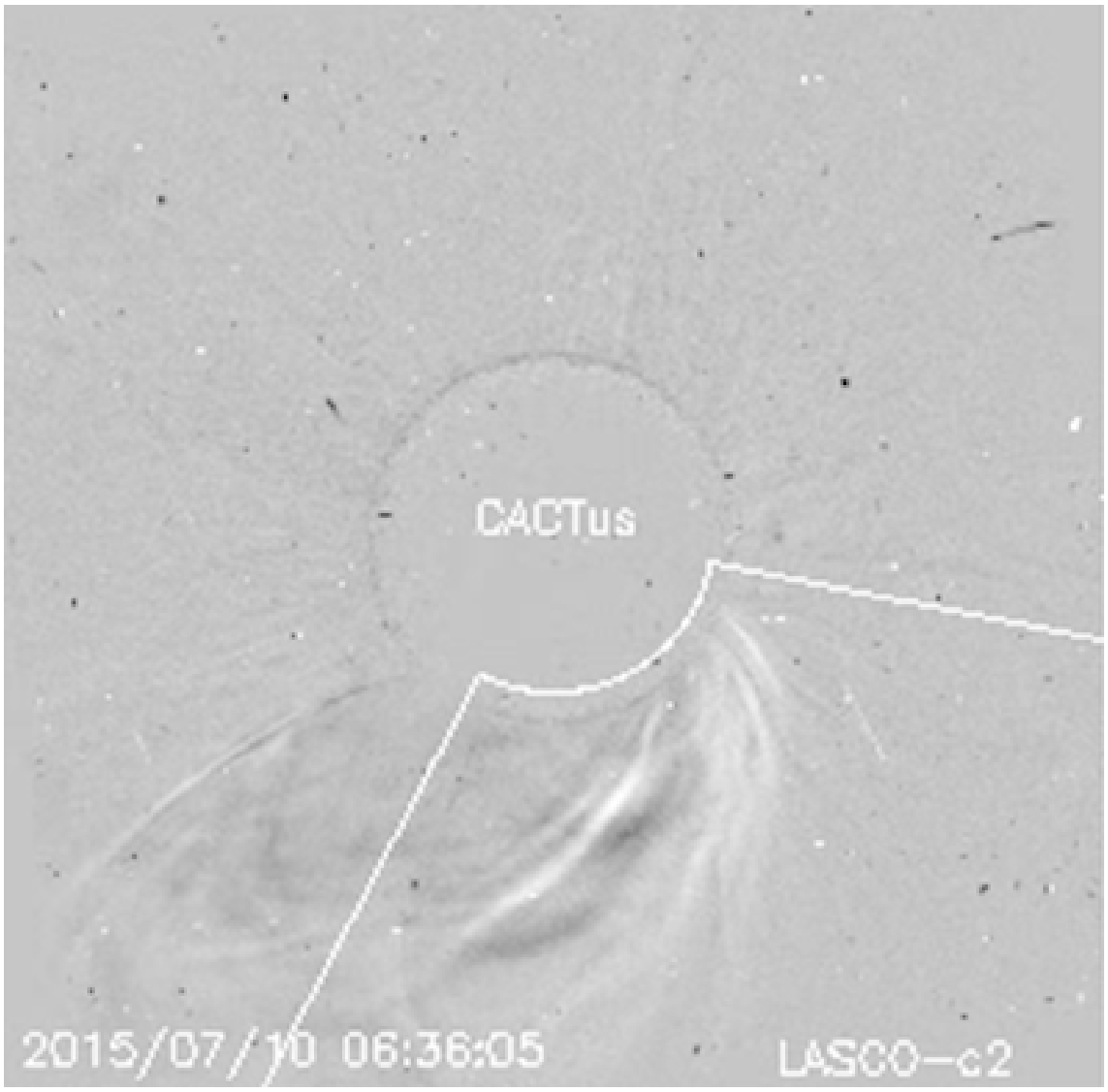
During the first 2 days of the period, flaring activity was dictated by NOAA 2381. This active region produced a total of 17 C-class and 2 M-class flares in 48 hours, the strongest flare being an M1.7 flare peaking on 06 July at 20:40UT. NOAA 2381 then quickly simplified and the flaring activity stalled. The other regions were mostly quiet.


14
12
10
8
6
4
2
0
Number of flares per day
6-Jul
7-Jul
8-Jul
9-Jul
10-Jul
11-Jul
12-Jul
NOAA 2385 (2 C)
NOAA 2384 (1 C)
NOAA 2381 (2 M)
NOAA 2381 (18 C)

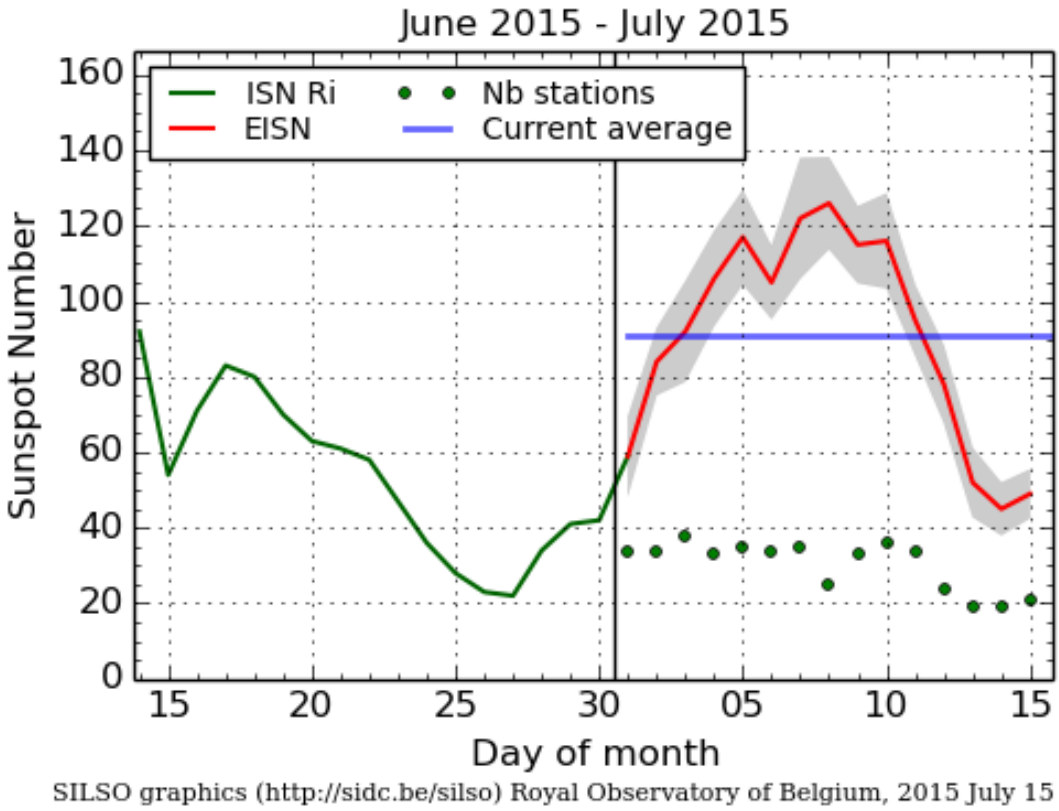


Several filament and prominence eruptions were observed, but none of the associated coronal mass ejections (CMEs) had an obvious earth-directed component. The most prominent CME was about 150 degrees wide and first observed by LASCO/C2 on 09 July at 23:36UT. It seems to have been the result of a series of slow eruptions along a lengthy filament channel near -45 degrees latitude. The bulk of the ejected material was directed well south of the ecliptic.


AIA304 & 193 on 10 July 2015 at 02:49UT


CACTus
2015/07/10 06:36:05
LASCO-c2

3. Estimated International Sunspot Number



Daily Estimated International Sunspot Number (EISN, red curve with shaded error) derived by a simplified method from real-time data from the worldwide SILSO network. It extends the official Sunspot Number from the full processing of the preceding month (green line). The plot shows the last 30 days (~ one solar rotation). The horizontal blue line shows the current monthly average, while the green dots give the number of stations included in the calculation of the EISN for each day.

4. Noticeable Solar Events (6 Jul 2015 - 12 Jul 2015)

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
06	0824	0844	0859	N17E42	M1.0	SN				2381
06	2032	2040	2050	N18E36	M1.7	2N				2381

LOC: approximate heliographic location
XRAY: X-ray flare class
OP: optical flare class
10CM: peak 10 cm radio flux
TYPE: radio burst type
Cat: Catania sunspot group number
NOAA: NOAA active region number

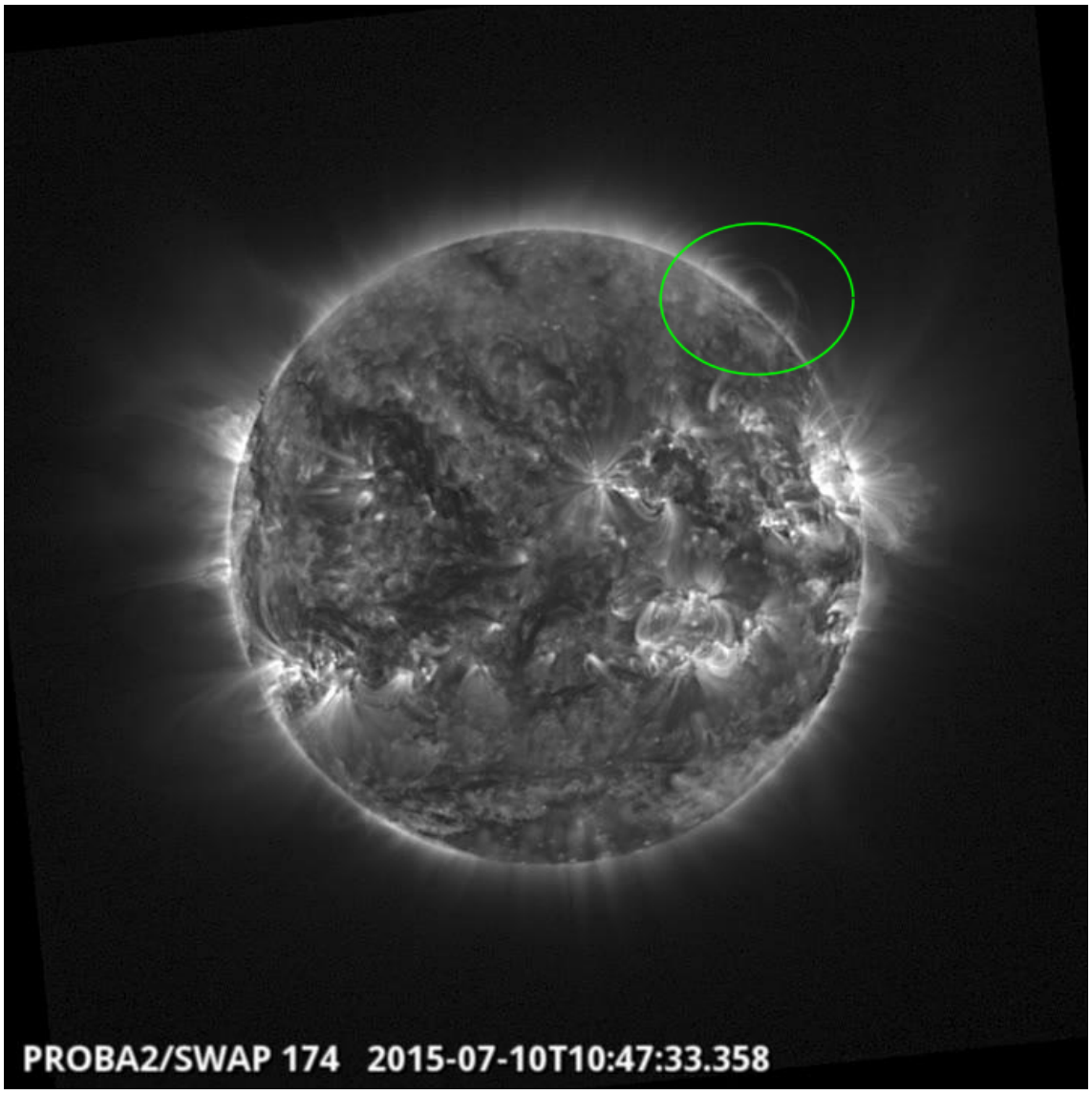
5. PROBA2 Observations (6 Jul 2015 - 12 Jul 2015)

Solar Activity

Solar flare activity fluctuated between very low and moderate during the week.

In order to view the activity of this week in more detail, we suggest to go to the following website from which all the daily (normal and difference) movies can be accessed:
http://proba2.oma.be/ssa
This page also lists the recorded flaring events.
A weekly overview movie can be found here (SWAP week 276).
http://proba2.oma.be/swap/data/mpg/movies/weekly_movies/weekly_movie_2015_07_06.mp4
Details about some of this week's events, can be found further below.

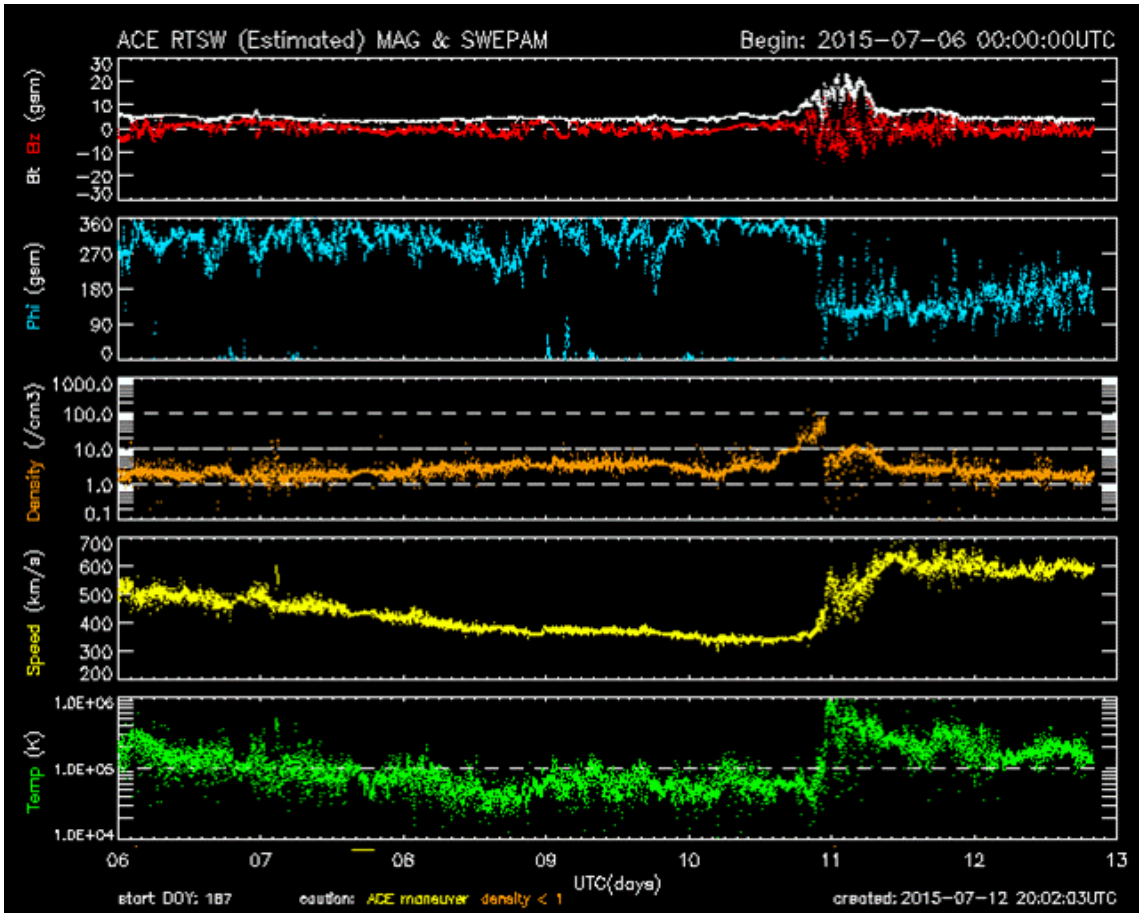
Friday Jul 10



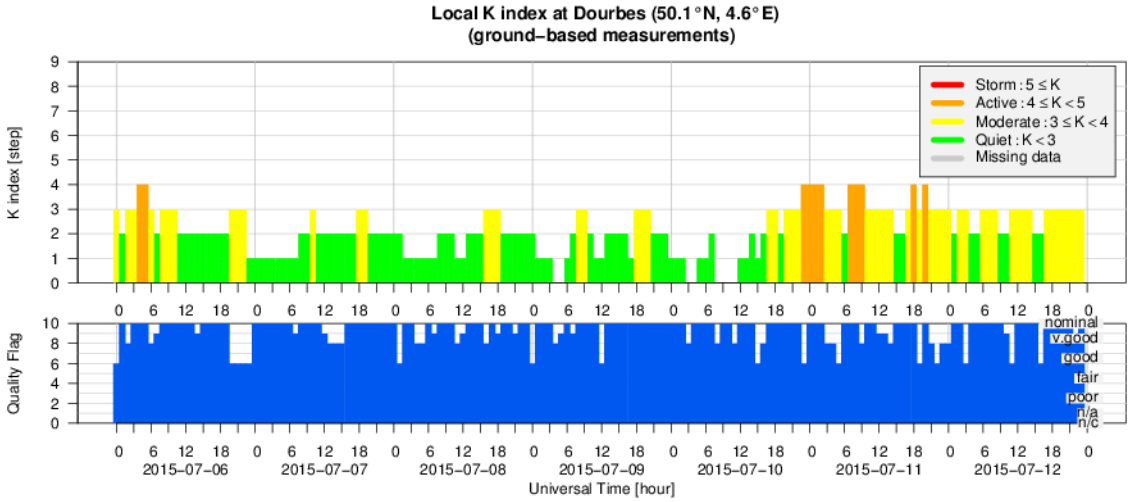
Plasma dynamics on the north west limb @ 10:47 SWAP image
Find a movie of the event here (SWAP movie)
http://proba2.oma.be/swap/data/mpg/movies/20150710_swap_movie.mp4

6. Review of geomagnetic activity

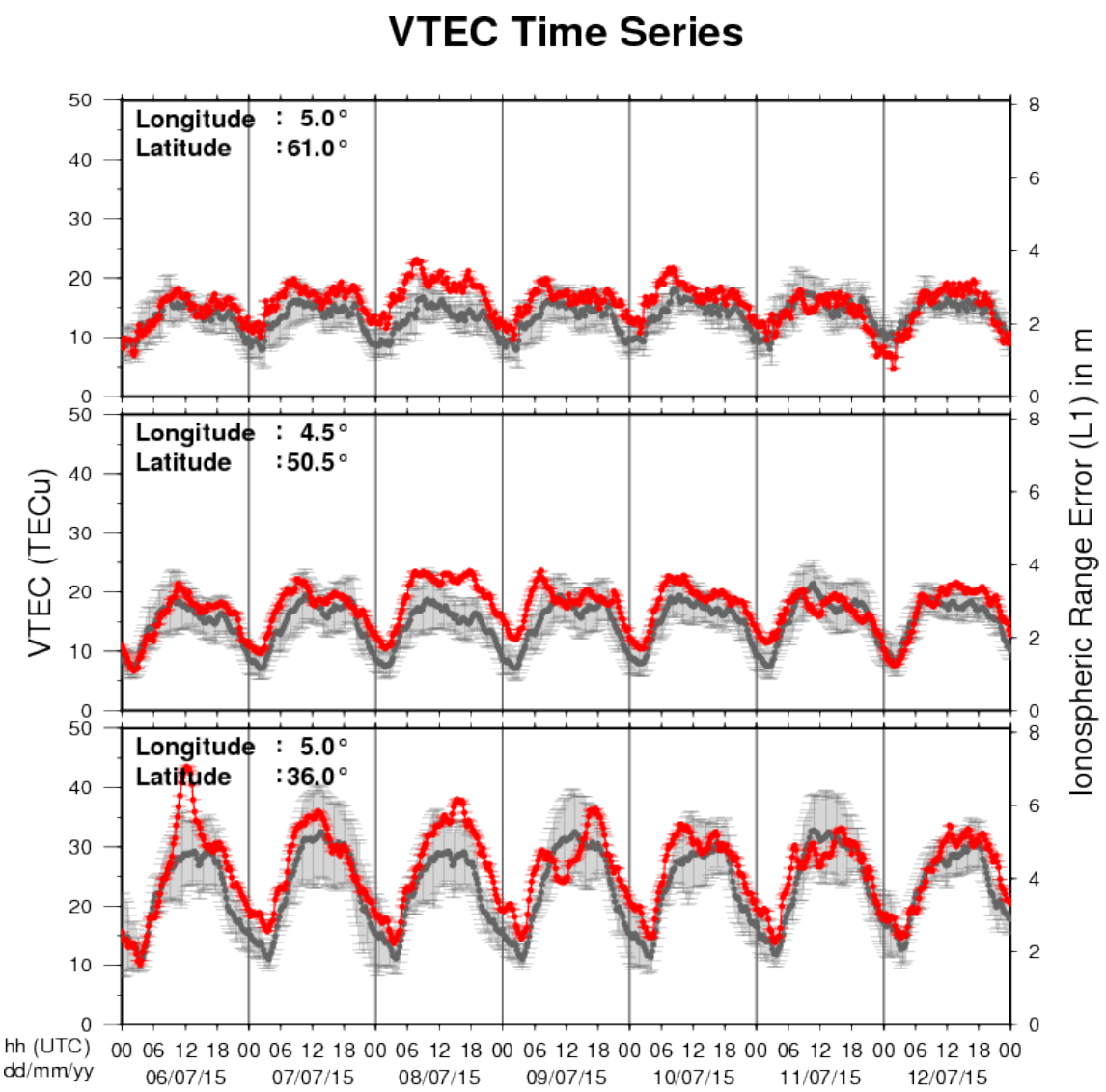
At the beginning of the period, solar wind was under the waning influence of the high speed stream (HSS) of a negative coronal hole (CH). Active geomagnetic conditions were recorded. During the subsequent days, quiet to unsettled conditions were recorded, until the arrival of a co-rotating interaction region (CIR) preceding the HSS of a positive equatorial CH on 10 July. Wind speed increased to values near 650 km/s, and Bz oscillated between -14 and +14 nT. This resulted in active conditions in Dourbes, and some minor storm conditions (Kp = 5) during the 21:00-24:00UT (10 July) and 03:00-06:00UT (11 July) periods. At the end of the week, solar wind speed was still high near 600 km/s.



7. Geomagnetic Observations at Dourbes (6 Jul 2015 - 12 Jul 2015)



8. Review of ionospheric activity (6 Jul 2015 - 12 Jul 2015)



The figure shows the time evolution of the Vertical Total Electron Content (VTEC) (in red) during the last week at three locations:
a) in the northern part of Europe(N61°, 5°E)
b) above Brussels(N50.5°, 4.5°E)
c) in the southern part of Europe(N36°, 5°E)
This figure also shows (in grey) the normal ionospheric behaviour expected based on the median VTEC from the 15 previous days.

The VTEC is expressed in TECu (with TECu=10^16 electrons per square meter) and is directly related to the signal propagation delay due to the ionosphere (in figure: delay on GPS L1 frequency).
The Sun's radiation ionizes the Earth's upper atmosphere, the ionosphere, located from about 60km to 1000km above the Earth's surface.The ionization process in the ionosphere produces ions and free electrons. These electrons perturb the propagation of the GNSS (Global Navigation Satellite System) signals by inducing a so-called ionospheric delay.

See http://stce.be/newsletter/GNSS_final.pdf for some more explanations ; for detailed information, see http://gnss.be/ionosphere_tutorial.php

9. Future Events

For more details, see http://www.spaceweather.eu/en/event/future

Loops7: Heating of the Magnetically Closed Corona in Cambridge, UK

Start : 2015-07-21 - End : 2015-07-23
The conference will review past and recent achievements, as well as future challenges in the field of solar coronal loop physics.
Website:
http://www.damtp.cam.ac.uk/user/astro/cl7/index.html

Heliophysics Summer Schoool 2015: Seasons in Space: Cycles of variability of Sun-Planet systems, in Boulder, CO, USA

Start : 2015-07-28 - End : 2015-08-04
Heliophysics is all of the science common to the field of the Sun-Earth connections. This fast-developing field of research covers many traditional sub-disciplines of space physics, astrophysics, and climate studies. The NASA Living with a Star program, with its focus on the basic science underlying all aspects of space weather, acts as a catalyst to bring the many research disciplines together to deepen our understanding of the system of systems formed by the Sun-Earth connection.
Website:
http://www.heliophysics.ucar.edu/

34th International Cosmic Ray Conference (ICRC) in The Hague, The Netherlands

Start : 2015-07-30 - End : 2015-08-06
The 34th International Cosmic Ray Conference (ICRC) will be held from July 30 to August 6, 2015, in The Hague, The Netherlands. It is an important and large conference in the field of Astroparticle Physics. The ICRC covers: cosmic-ray physics, solar and heliospheric physics, gamma-ray astronomy, neutrino astronomy, and dark matter physics.
Website: http://icrc2015.nl

SOLARNET III / HELAS VII: The Sun, the stars, and solar-stellar relations, in Freiburg (Germany)

Start : 2015-08-31 - End : 2015-09-04
The purpose of this conference is to discuss the latest questions and results in solar and stellar physics. Solar and stellar seismology will be one particular focus but contributions on all aspects of solar-stellar relations will be welcome. We aim to establish links and synergies between the day- and night-time fields of astrophysics.
Website:
http://www.iac.es/congreso/solarnet-3meeting/

1st Joint Solar Probe Plus-Solar Orbiter Workshop, in Florence (Italy)

Start : 2015-09-02 - End : 2015-09-04
The Workshop will address how the joint exploration of the corona and inner heliosphere will lead to advances in our understanding of coronal heating and solar wind acceleration, the magnetic and plasma structure of the heliosphere, and the acceleration of energetic particles at shocks and flares. The workshop will inspire research that will make use of SO and SPP observations within the context of the NASA Heliophysics Observatory System and identify key areas for preparatory research. Synergistic observations from other ground based and space based assets will also be addressed.

Website:
http://www.solarprobeplus.org/2015/

International Workshop and School on Solar System plasma in Mamaia, Romania

Start : 2015-09-06 - End : 2015-09-13
The International Workshop and School on solar system plasma turbulence, intermittency and multifractals (STORM 2015) focus on the quantitative experimental, theoretical and numerical investigation of turbulence, intermittency, fractal/multifractal features, waves and coherent structures interaction, criticality and non-linear cross-scale coupling. As widely documented by in-situ satellite measurements and remote or ground-based observations, turbulence, intermittency and dynamical complexity are quite ubiquitous processes observed in the dynamics of solar, planetary and interplanetary plasmas, as well as in the dynamical evolution of proxies linked to magnetospheric and ionospheric variability.
Unfolding the spatio-temporal structure of magnetic field and plasma fluctuations from experimental observations and numerical simulations provides further insight on the structure of plasma turbulence and intermittency. On the theoretical side, the understanding of such complex dynamical behavior cannot be simply surmised from the basic fluid/kinetic equations, but instead requires novel theoretical, experimental and data analysis approaches. The workshop is a forum to present and discuss latest results in these fields. The purpose of the school is to give to a young audience of Graduate, Ph.D. students, and postdoc scientists, which ideally represents the next generation of scholars in the physics of space plasmas, an overall view of both theoretical and data analysis tools apt to fully exploit unique and unprecedented observations that will be provided by future upcoming mission like Solar Orbiter and Solar Probe Plus.
Website:
http://www.spacescience.ro/conferences/storm2015/

3rd UK-Ukraine-Spain meeting on solar physics and space science in Lviv, Ukraine

Start : 2015-09-07 - End : 2015-09-11
The meeting will cover various aspects of solar physics and space weather related processes. The special emphasis will be paid to progress in data-driven simulations and high-resolution spectro-polarimetry as powerful diagnostic techniques to unravel information about magnetic fields in the photosphere and chromosphere of the Sun.
Website:
http://ssg.group.shef.ac.uk/Conferences/Ukraine_UK_2015/index.html

Summer School on Computational Solar and Astrophysical Modeling in Juelich, Germany

Start : 2015-09-14 - End : 2015-09-18
This summer school will acquaint a generation of young researchers (advanced master students, PhDs, and junior postdoctoral researchers) to modern open-source software efforts adapted to High Performance Computing platforms, with a deliberate focus on hands-on sessions. In these sessions, participants will work with three different open-source software packages, learn about their typical applications and evaluate their performance aspects on massively parallel systems.
Website:
http://www.fz-juelich.de/ias/jsc/EN/Expertise/Workshops/Conferences/CSAM-2015/_node.html

Hinode 9 - International Science Meeting in Belfast, UK

Start : 2015-09-14 - End : 2015-09-18
Hinode is a solar satellite funded jointly by JAXA, NASA, ESA and STFC/UKSA that has entered its ninth year of operations. It has had a major impact across many areas of solar physics and facilitated many fundamental discoveries. These findings are documented in over 850 papers in the refereed literature

and hundreds of papers in conference proceedings. With 96 refereed publications in 2013 and more than 81 papers in 2014, Hinode has remained scientifically highly productive. A non-exhaustive list indicates over 100 students globally who are undertaking or have completed PhDs using Hinode data. With the Solar Orbiter on the horizon, there is a good chance that the two missions will operate at the same time. The meeting will help the solar physics community to maximise the science return from the Orbiter.
Website:
https://star.pst.qub.ac.uk/wiki/doku.php/public/hinode9/start

RADECS-2015 in Moscow, Russia

Start : 2015-09-14 - End : 2015-09-18
The aim of RADECS conferences is to provide an annual European forum for the presentation and discussion of the latest advances in the field of radiation effects on electronic and photonic materials, devices, circuits, sensors, and systems. The scope of the conference encompasses technological processes and design techniques for producing radiation tolerant systems for space, aeronautical or terrestrial applications, as well as relevant methodologies for their characterization and qualification. The conference features a technical program, an Industrial Exhibition, and one day tutorial or "short course" on radiation effects. The technical program includes oral and poster sessions and round tables.
Website:
http://www.radecs2015.org/

Multi-wavelength Studies of the Solar Atmosphere: Celebrating the Career of Costas Alissandrakis in in Ioannina, Greece

Start : 2015-09-21 - End : 2015-09-24
On the occasion of the forthcoming retirement of Prof. Costas Alissandrakis, we organize an international solar physics conference as a tribute to his career. Speakers will address the present state of knowledge of topics that include: The quiet Sun; Coronal/chromospheric heating; Solar magnetic fields; Active regions; Flares; Coronal mass ejections; and Shocks.
Website: http://solar15.uoi.gr/

Heliospheric physical processes for understanding Solar-Terrestrial Relations in L'Aquila, Italie

Start : 2015-09-21 - End : 2015-09-26
A good understanding of solar-terrestrial processes is fundamental to modelling the influence of solar variability on the Earth's environment and climate. To capture all the physical aspects of the solar wind-magnetosphere-ionosphere-atmosphere interaction, and also the impact of solar variability on climate, the Sun-Earth system has to be studied as a whole. The main purpose of this school is to provide graduate, PhD students and also young post-doc researchers with a global view of the main physical processes by which solar variability affects the Earth's environment. In addition, an overview of different data analysis and methods for describing solar-terrestrial relations will be given. The school will provide a mix of lectures and activities requiring students participation.
Website:
http://www.cifs-isss.org/

Ground-based Solar Observations in the Space Instrumentation Era in Coimbra, Portugal

Start : 2015-10-05 - End : 2015-10-09
This CSPM-2015 scientific meeting will cover various aspects of solar dynamic and magnetic phenomena which are observed over the entire electromagnetic spectrum: white-light, Hα, Ca II, and radio from ground and in a variety of other wavelengths (white light, UV and EUV, and X-rays) from space. Emphasis will also be placed on instrumentation, observing techniques, and solar image processing techniques, as well as theory and modelling through detailed radiative transfer in increasingly realistic MHD models. The long-term (cyclic) evolution of solar magnetism and its consequence for the solar atmosphere, eruptive phenomena, solar irradiation variations, and space weather, will be in focus.

Here, special attention will be devoted to the long-term observations made in Coimbra and also to the results of the SPRING / SOLARNET and SCOSTEP VarSITI studies. In particular, the weak solar activity during the current solar maximum will be discussed. Finally, since this meeting is organised around the 90th anniversary of performing the first spectroheliographic observations in Coimbra, a session will be specially dedicated to new solar instruments (both ground-based and space-borne) that will give access to unexplored solar atmospheric features and dynamic phenomena over the coming years.
Website:
http://www.mat.uc.pt/~cspm2015/

AMS-02 Energetic Particle Workshop in Hawaii, USA

Start : 2015-10-18 - End : 2015-10-24
The workshop aims to bring together experts in the field of cosmic rays and solar energetic particles with an additional focus on their propagation inside the heliosphere and their interaction with the magnetosphere. The talks will present the most recent results related to solar energetic particles (SEPs), solar modulation, space radiation and related phenomena.
Website:
http://www.phys.hawaii.edu/ams02/pages/workshop.php

Third Remote Sensing of the Inner Heliosphere and Space Weather Applications Workshop in Morelai, Michoacan (Mexico)

Start : 2015-10-19 - End : 2015-10-23
The workshop aims to gather experts from the various fields of remoteÂ sensing observations of the inner heliosphere, including whiteÂ light, EUV, and radio observation, together with modellers in order to tackle key outstanding science and spaceÂ weather operational issues, establish closer working relations, and devise the best ways to move the field forward as a whole. In addition, the science learned from remote Âsensing observations is critical to improving our capabilities of spaceÂ weather forecasting. The workshop aims to look at ways in which we can more easily and efficiently share and access the various types of data between individual groups and subÂcommunities and to officially launch the IPS Common Data Format v1.0 (IPSCDFv1.0) now in use. It also aims to allow investigations into ways in which we model the inner heliosphere looking at the advantages and disadvantages of the available modelling, updates on present and future remoteÂsensing capabilities, and investigating further the ways in which these data sets all complement each other and are necessary to gain knowledge and understanding of the fundamental physical processes that occur within the inner heliosphere. These are critical processes that are key to both Heliophysics science as well as to spaceÂweather operations and forecasting.
Website:
http://www.sciesmex.unam.mx/workshop2015/

12th Potsdam Thinkshop in Potsdam, Germany

Start : 2015-10-26 - End : 2015-10-29
In the tradition of the series of Â»Potsdam ThinkshopsÂ«, we invite instrument specialists, observers, modellers, and theorists to exchange ideas, to stimulate discussion, to initiate future collaborations among participants, and to attract new users of instruments by showcasing the capabilities. The aim is to make progress towards a comprehensive description of solar eruptive events effectively aggregating their global properties as well as their highly dynamic fine structure.
Website:
https://thinkshop.aip.de/12/cms/

SEST/MiniMax Workshop in Mexico City, Mexico

Start : 2015-10-26 - End : 2015-10-30
The workshop is to improve the scientific understanding of the origin and propagation of solar transients, and develop the prediction capacity of these transients' arrival and potential impact on the Earth. The workshop engages coordinated international activities in observation, theory and modeling, and involves

scientists in both developed and developing countries, and provides an online platform for educational opportunities for students.
Website:
http://cintli.geofisica.unam.mx/congreso/

2015 Sun-Climate Symposium in Savannah, Georgia, USA

Start : 2015-11-10 - End : 2015-11-13
Observations of the Sun and Earth from space have revolutionized our view and understanding about impacts of solar variability and anthropogenic forcing on Earth climate. For more than three solar cycles since 1978, the total and spectral solar irradiance (TSI and SSI) and global terrestrial atmosphere/surface have been observed continuously, enabling unprecedented quality data for Sun-climate studies. The primary objective of this symposium is to convene climate scientists, solar physicists, and experimentalists together for a better understanding how Earth climate system changes and responds to solar variability.
Website: http://lasp.colorado.edu/home/sorce/news-events/meetings/2015-sun-climate-symposium/

European Space Weather Week in Ostend, Belgium

Start : 2015-11-23 - End : 2015-11-27
The European Space Weather Week (ESWW) is the European forum for Space Weather users, forecasters, scientists and the involved industries, as proven by the high attendance to the ESWW 11 in November 2014.
The ESWW 12 will be held in Belgium in November, 23-27, 2015 and its organisation has already started and is benefiting from the experience and inputs from the past editions.
Website: http://stce.be/esww12/

AGU Chapman Conference on Currents in Geospace and Beyond in Dubrovnik, Croatia

Start : 2016-05-22 - End : 2016-05-27
Electric currents are fundamental to the structure and dynamics of space plasmas, including our own near-Earth space environment (also called "geospace"). This recognition is one of the great achievements in space research, going back to the beginning of the last century. With the current multi-spacecraft missions, such as Cluster, THEMIS and Swarm, we have unprecedented opportunities to unravel many of the intriguing puzzles about electric currents.
The conference will provide a forum in which various space science communities can come together to discuss recent achievements of observational, theoretical, and modelling studies. The emphasis will be on cross-disciplinary science sessions.
Website:
http://chapman.agu.org/spacecurrents/general-informationabout-conference/

41st COSPAR Scientific Assembly in Istanbul, Turkey

Start : 2016-07-30 - End : 2016-08-07
The 41st COSPAR Scientific Assembly will be held in Istanbul, Turkey from 30 July - 7 August 2016. This Assembly is open to all bona fide scientists.
Website:
https://www.cospar-assembly.org/

IAU Symposium 327: Fine Structure and Dynamics of the Solar Atmosphere in Cartagena de Indias, Colombia

Start : 2016-10-09 - End : 2016-10-13
The scientific goal of this symposium is to discuss recent results on the processes shaping the structure of the solar atmosphere and driving plasma eruptions and explosive events. Activity of the solar atmosphere entails numerous multi-scale processes. State-of-the-art solar instrumentation is revealing the dynamics of the Sun with unprecedented temporal and spatial resolutions. Together with advanced numerical

simulations these investigations are making new steps in our understanding of the complex dynamical structure of the solar atmosphere.
Major unsolved problems of astrophysics such as how the solar corona is heated and how the solar wind and heliosphere are powered have their roots in the origin of small-scale magnetic fields constituting the Sun's 'magnetic carpet' in the photosphere and appearing as 'magnetic canopy' in the chromosphere.
Website:
http://www.iau.org/science/meetings/future/symposia/1160/

10. New documents in the European Space Weather Portal Repository

See http://www.spaceweather.eu/en/repository