

STCE Newsletter

8 Sep 2014 - 14 Sep 2014



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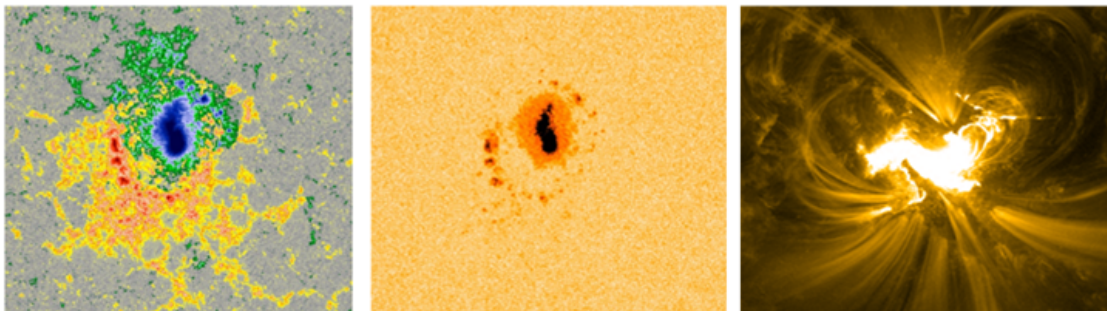
The Solar-Terrestrial Centre of Excellence (STCE) is a collaborative network of the Belgian Institute for Space Aeronomy, the Royal Observatory of Belgium and the Royal Meteorological Institute of Belgium.

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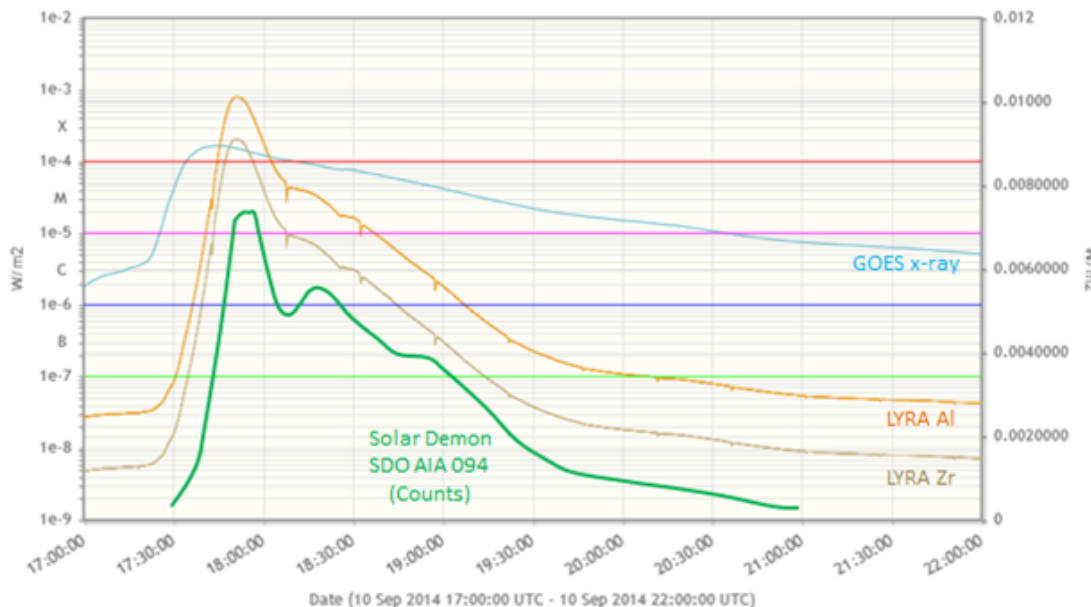
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1. Number 35

On 10 September at 17:45UT, NOAA 2158 produced the 35th X-class flare of the ongoing solar cycle. The X1.6 event was extensively covered in this news item at <http://stce.be/news/267/welcome2.html>. The images underneath show the sunspot region in white light and the corresponding magnetogram about 30 minutes prior to the flare's peak, and the flare at its maximum flux as observed in SDO/AIA 171. The flare took place along the borderline between negative (blue) and positive (red) magnetic polarity.



Graph underneath shows the evolution of the flare in x-ray (GOES) and EUV (PROBA2/LYRA in W/m²; Solar Demon AIA 094 in counts). One can see that the EUV emissions peak 6-12 minutes later than those from x-ray. This is due to the cooling of the post-flare coronal loops, whose emissions become then better visible in the less energetic EUV passbands. The AIA 094 emissions also show a second peak about 30 minutes after its maximum. This second peak is not visible in x-ray. This "extra" EUV emission does not originate from the original flare site, but most probably from a volume of higher coronal loops. This may indicate there's additional post-flare loop reconnection, but at a lower temperature than during the flare's main peak. This is called the "EUV late phase". No doubt this flare will generate quite a few scientific papers!



The geomagnetic storm from the CME related to this X1 flare did not live up to the expectations, as the CME's magnetic field was directed mostly northward. This prevented a good connection with the Earth's magnetic field, and thus severe geomagnetic storming was not possible. Nice polar lights were observed, but they were confined to the usual places (Scandinavia, Canada, Alaska,...). Nonetheless, some aurora were photographed from Franeker, Friesland (northern part of the Netherlands), as picture underneath demonstrates. It was taken by Vincent van Leijen on 12 September at 23:05LT, when the storm was most intense. See also this webpage at <https://www.flickr.com/photos/fotovins/15035943737> Can you see the Big Dipper constellation?

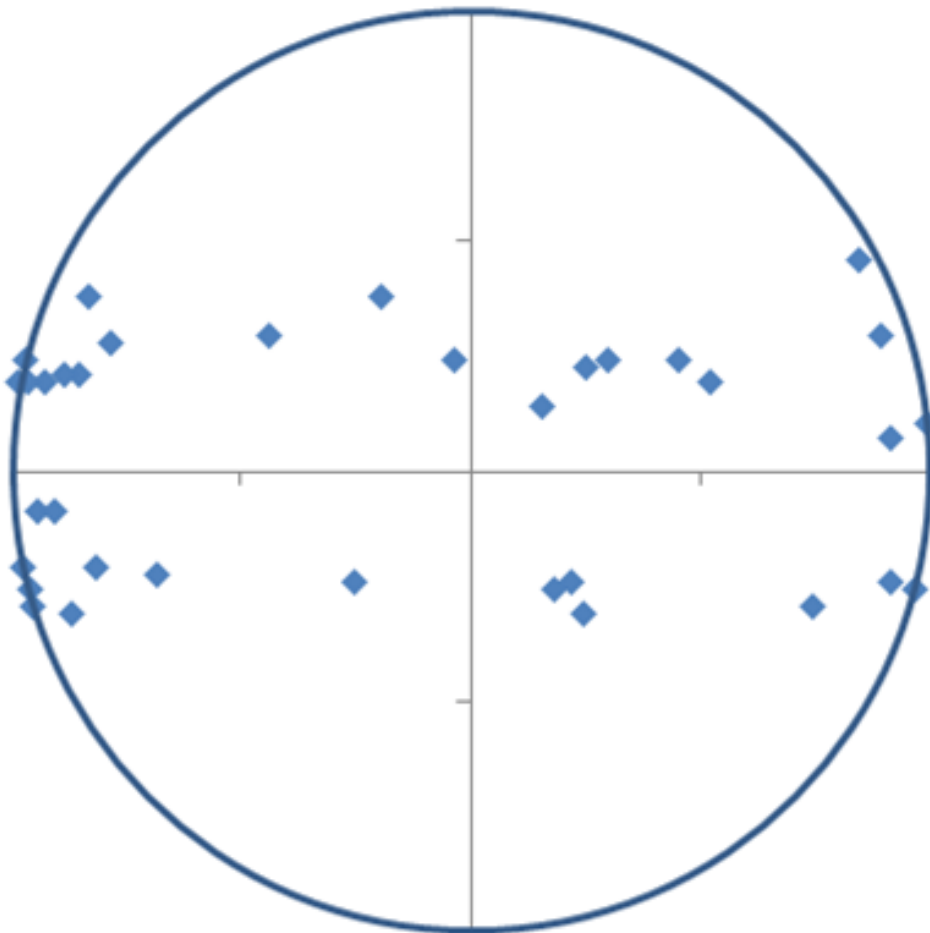


Vincent van Leijen

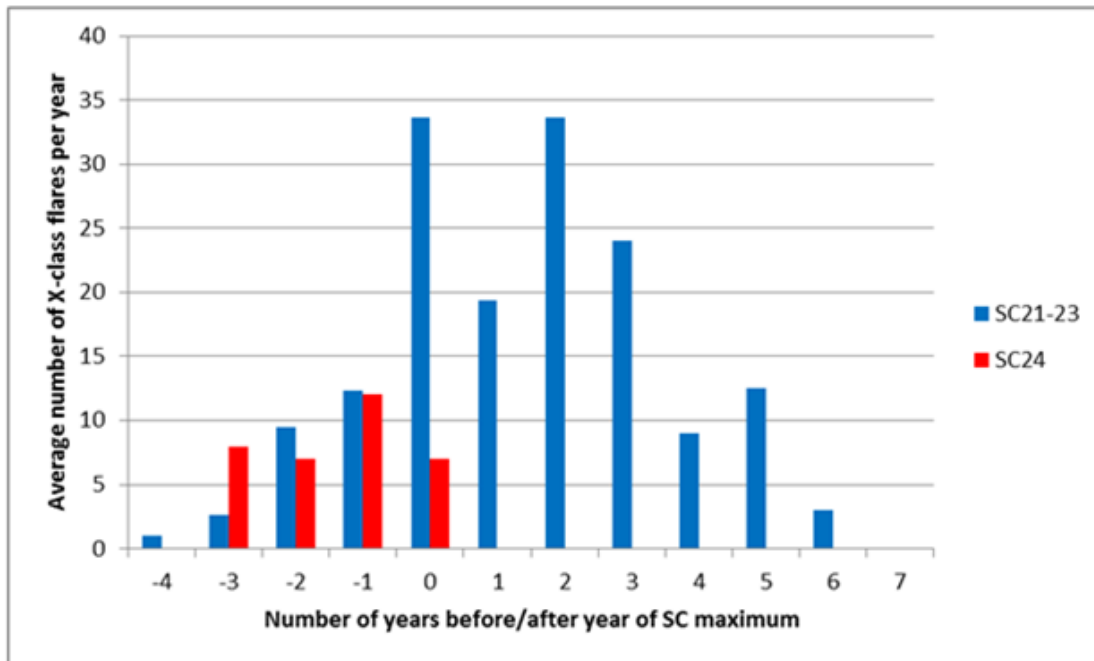
This X1.6 flare was certainly not the strongest one of solar cycle 24 (SC24), ranking somewhere half of the pack. A table with the Top 11 most powerful flares during SC24 can be found underneath. Aside the date, also the hemisphere and source region are mentioned. A little more than half of the X-class flares (20) took place on the northern solar hemisphere. The X6.9 flare, currently the strongest of SC24, is the only one that ranks within the Top 50 of strongest flares since systematic measurements began in 1976 (36th place).

YY	MM	DD	Hem	Peak	NOAA
2011	8	9	N	X6.9	11263
2012	3	7	N	X5.4	11429
2014	2	25	S	X4.9	11990
2013	11	5	S	X3.3	11890
2013	5	14	N	X3.2	11748
2013	5	13	N	X2.8	11748
2013	10	29	N	X2.3	11875
2011	2	15	S	X2.2	11158
2014	6	10	S	X2.2	12087
2011	9	6	N	X2.1	11283
2013	10	25	S	X2.1	11882

It's also interesting to take a look at the position of these 35 X-class flares on the solar disk. Only one third of these flares took place in the center half of the solar disk, with most of the other events taking place near the solar limb. In fact, nearly half took place near the east limb, which makes it of course very difficult for any associated CME to have a geo-effective impact.



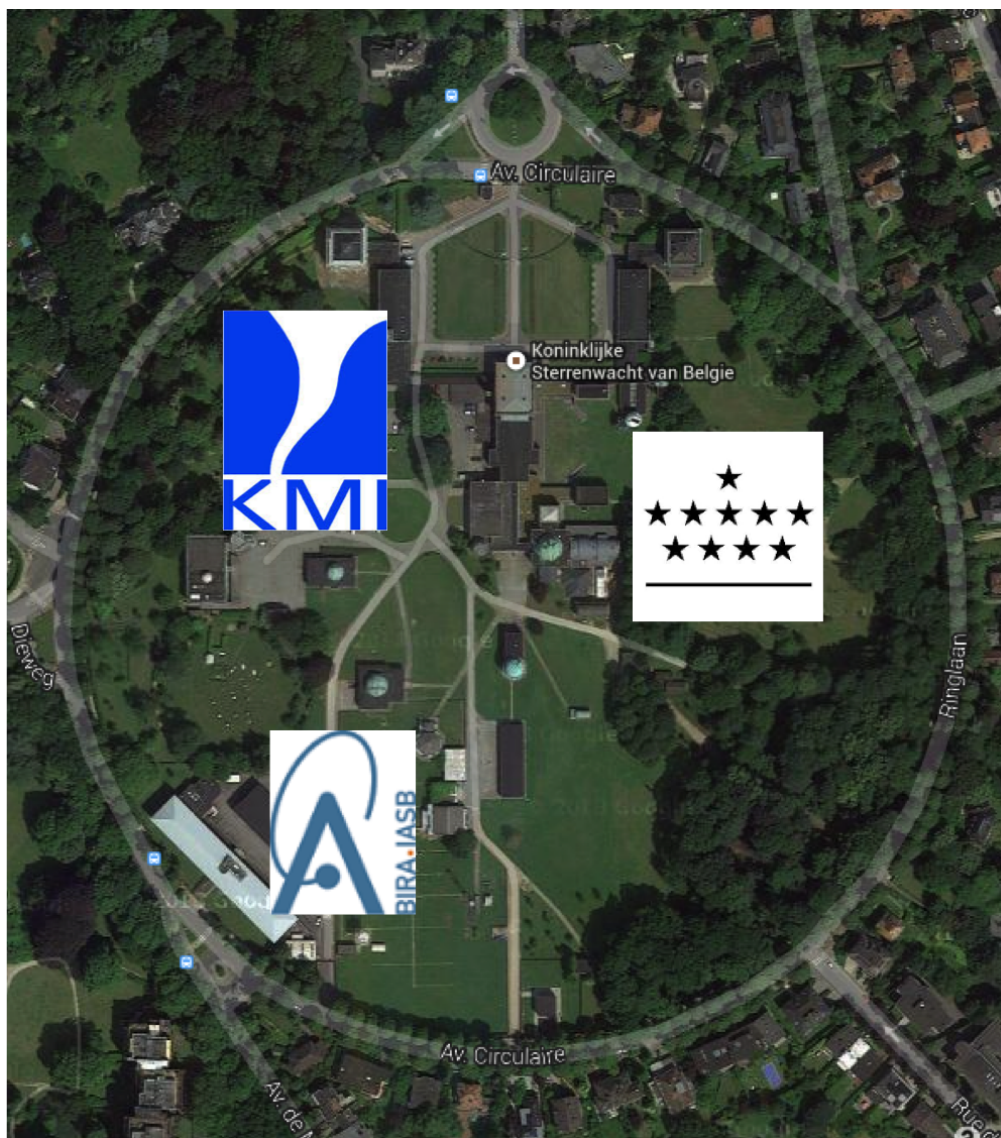
Finally, this solar cycle will certainly produce quite a few more X-class flares as it further unfolds. Indeed, averaging per year the total number of X-flares over the last 3 cycles, the bar-diagram underneath shows that there is a second peak of "eXtreme" flares about 2-3 years after the year when the solar cycle maximum actually occurred. For example, the Halloween flares (October 2003) occurred about 3 years after SC23 maximum. So, though we have not observed that many X-class flares so far this solar cycle, statistically we are still in for quite a bit of X-class activity in years to come.



Credits - Data and imagery were taken from SDO (<http://sdo.gsfc.nasa.gov/data/aiahmi/>), Solar Demon (<http://solardemon.oma.be/>), PROBA2/Lyra (<http://proba2.oma.be/ssa/>), GOES (http://www.swpc.noaa.gov/rt_plots/), NGDC (<http://www.ngdc.noaa.gov/>), Staff (<http://sun-ts-dev.oma.be/>), and Vincent van Leijen (<https://www.flickr.com/photos/fotovins/15035943737>).

2. Remarkable piece of STCE collaboration

August 2014, an article about water vapour research appeared in the journal Atmospheric Measurement Techniques. So what? I hear you thinking. The thing is that the three institutes BIRA-IASB, RMI and ROB worked together, each with its own speciality: positioning by ROB, meteorology by RMI and satellite data retrieval by BIRA-IASB. This collaboration resulted in a remarkable piece of research with a societal relevance: 'A multi-site inter comparison of integrated water vapour observations for climate change analysis'.

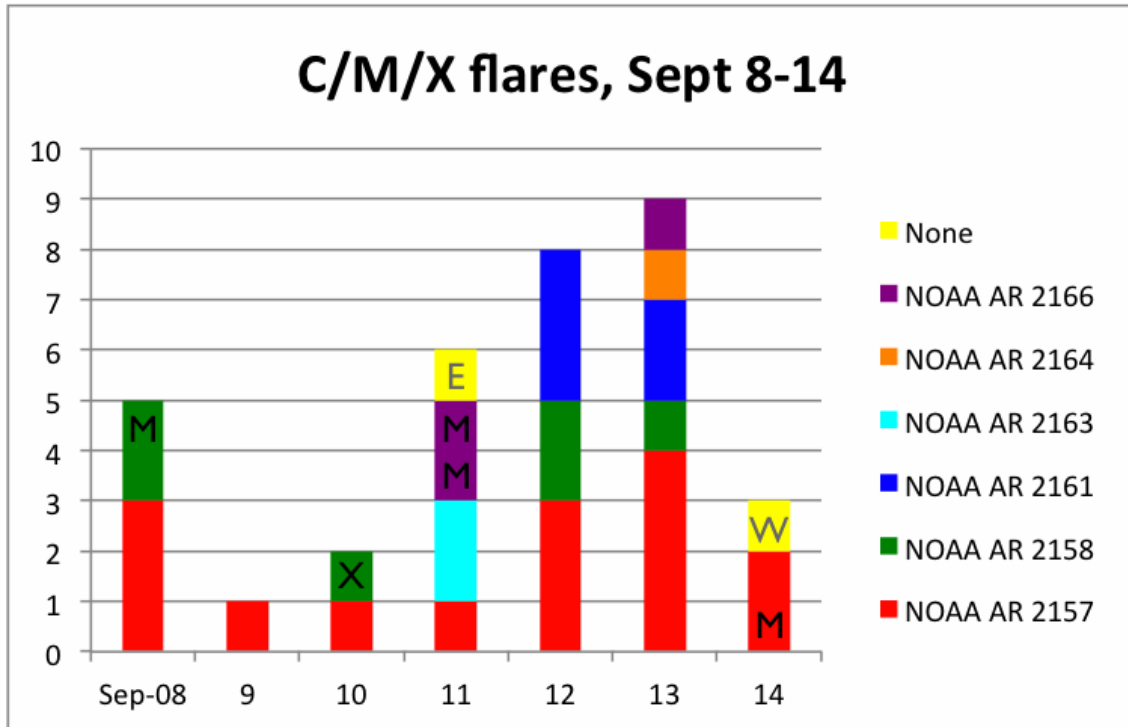


check <http://www.atmos-meas-tech.net/7/2487/2014/amt-7-2487-2014.html>

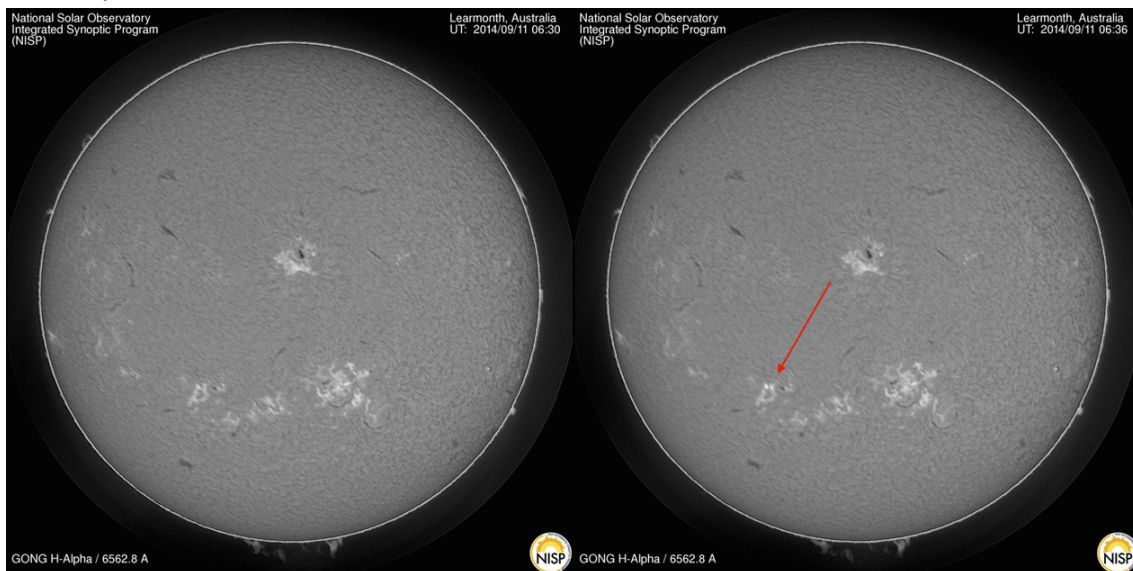
3. Review of solar activity (8 Sep 2014 - 14 Sep 2014)

On top of the 29 C-class flares that were observed this week, also 4 M-class flares as well as 1 X-class flare were recorded.

An overview is given in the chart below where M/X stands for an M/X-flare, flares without a letter are C-flares. The yellow are flares which are not associated with an on disk NOAA active region but come from a region behind the east (E) or west (W) limb.

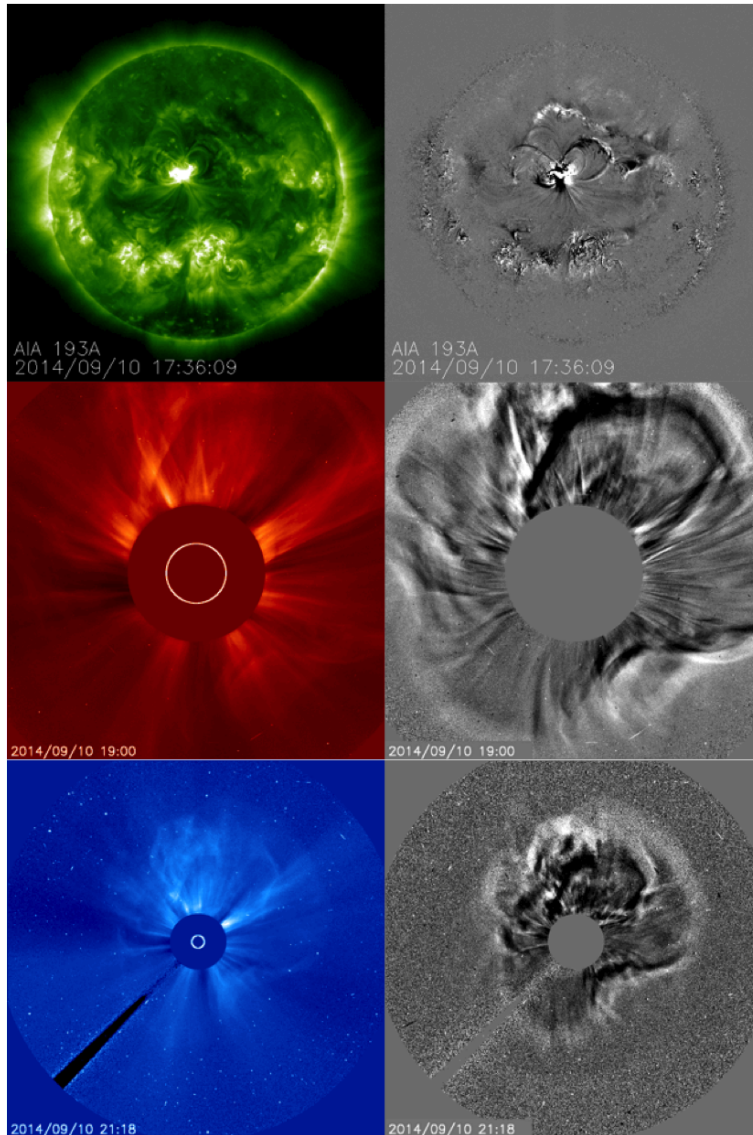


There is one peculiar case with no space weather relevance but just nice to know: GOES and LYRA detected a flare peaking at 06:36UT on 11 September. At that time, the moon blocked the view on the Sun of SDO/AIA which of course could not be used to determine the source region. But, H-alpha pictures taken by a ground-based telescope in Learmonth, Australia (part of the GONG network) gave a clear hint: it was NOAA AR 2163 that 'flickered' in H-alpha. NOAA AR 2163 had only one glory day during which it produced 2 C-flares.

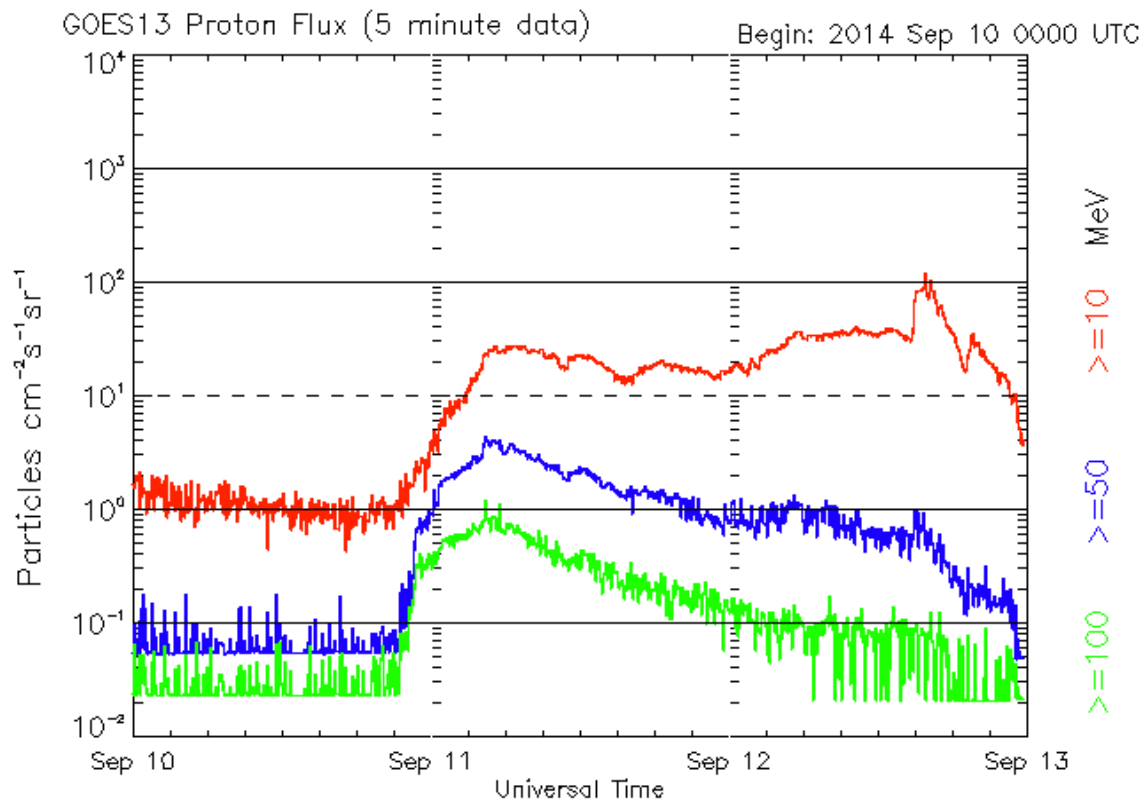


NOAA 2158 (located in the middle of the solar disk at that time - top left) produced an M4.5 flare that peaked on 9 September at 00:29UT. Though the bulk of the associated halo CME was directed to the northeast, it was determined that it had an Earth-directed component. Its plane-of-the-sky speed was about 710 km/s. On 10 September, the same active region produced an X1.6 flare that peaked at

17:45UT. There was an EUV wave which is seen as the circular feature around NOAA 2158 in the grey difference image, top right. An EUV wave is an on disk signature of a plasma ejection. It was a full halo CME clearly visible on the coronagraph LASCO C2 (middle) and C3 (bottom), with a plane-of-the-sky speed around 1200 km/s.



The greater than 10 MeV proton flux levels, still enhanced from a backside event on 1 September, gradually rose to reach a maximum of 28 pfu on 11 September. It was still above event threshold when the arrival of the aforementioned CMEs (in particular the CME related to the X1 flare) drove flux levels back up. The proton flux eventually reached 126 pfu on 12 September at 15:55UT. The proton event ended later that day around 23:10UT.



Updated 2014 Sep 12 23:56:03 UTC

NOAA/SWPC Boulder, CO USA

The other complex active region of this week, NOAA 2157, did produce only 1 M-class flare (M1.5 on 14 September peaking at 02:16UT). The associated CME was not Earth directed. The two other M-class flares originated from NOAA 2166 while the region was at or just behind the northeast limb. The M2.1 and M1.4 flare were produced on 11 September, peaking resp. at 15:26UT and 21:26UT.

Various filament eruptions were observed, e.g. on 12 September around 18:30UT and 23:50UT, and on 13 September around 03:40UT, 16:30UT and 20:00UT. None of the associated CMEs were deemed to be geo-effective.

4. Noticeable Solar Events (8 Sep 2014 - 14 Sep 2014)

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	TYPE	Cat	NOAA
08	2312	0029	0131	N12E29	M4.5	1N		CTM/1	48	2158
10	1721	1745	1820	N14E2	X1.6	2B	1300	II/2IV/2	48	2158
11	1520	1526	1531		M2.1		210			2166
11	2101	2126	2130		M1.4					2166
14	0203	0216	0236	S13W49	M1.5	2N		CTM/1	45	2157

LOC: approximate heliographic location

XRAY: X-ray flare class

OP: optical flare class

10CM: peak 10 cm radio flux

TYPE: radio burst type

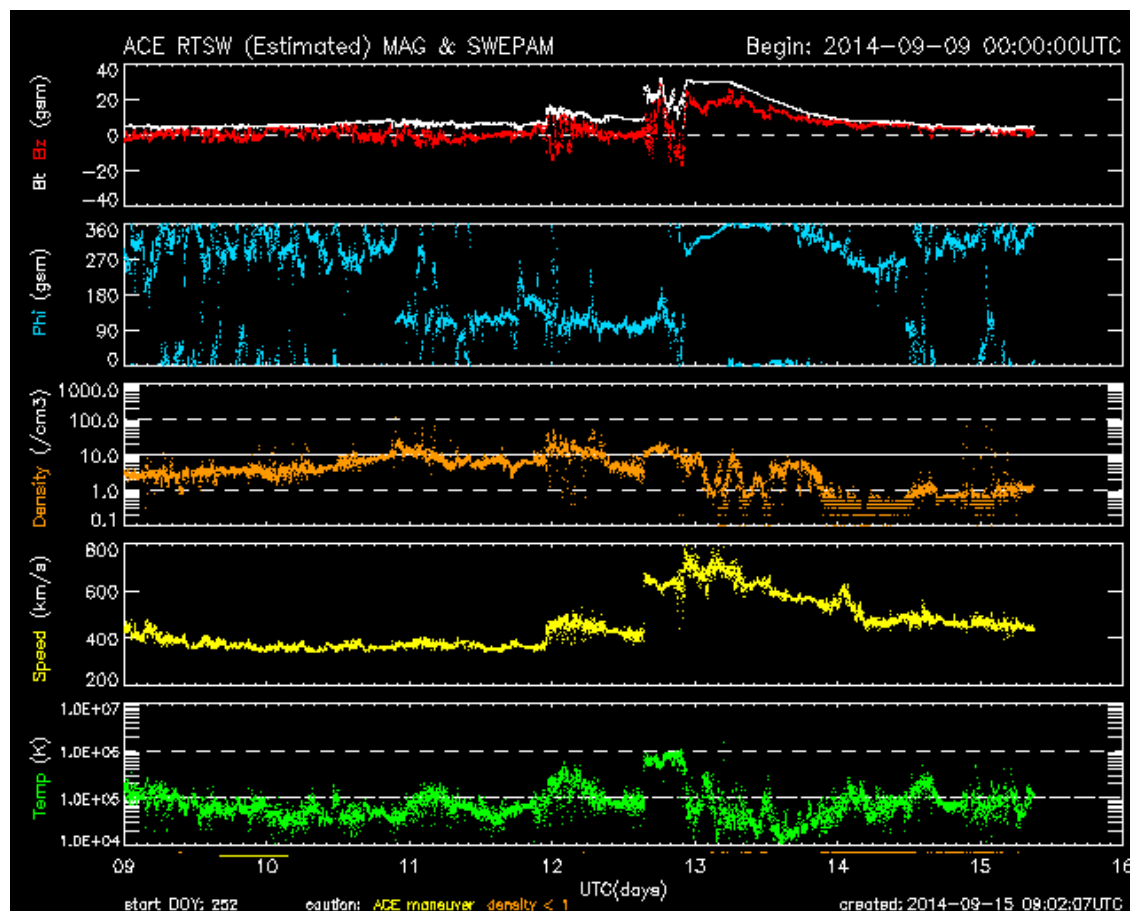
Cat: Catania sunspot group number

NOAA: NOAA active region number

5. Review of geomagnetic activity (8 Sep 2014 - 14 Sep 2014)

From 8 till late on 11 September, geomagnetic conditions were mostly quiet to unsettled. A sector boundary crossing was observed on 10 September around 21:30UT, with IMF turning away from the Sun, resulting locally in brief periods of active geomagnetic conditions.

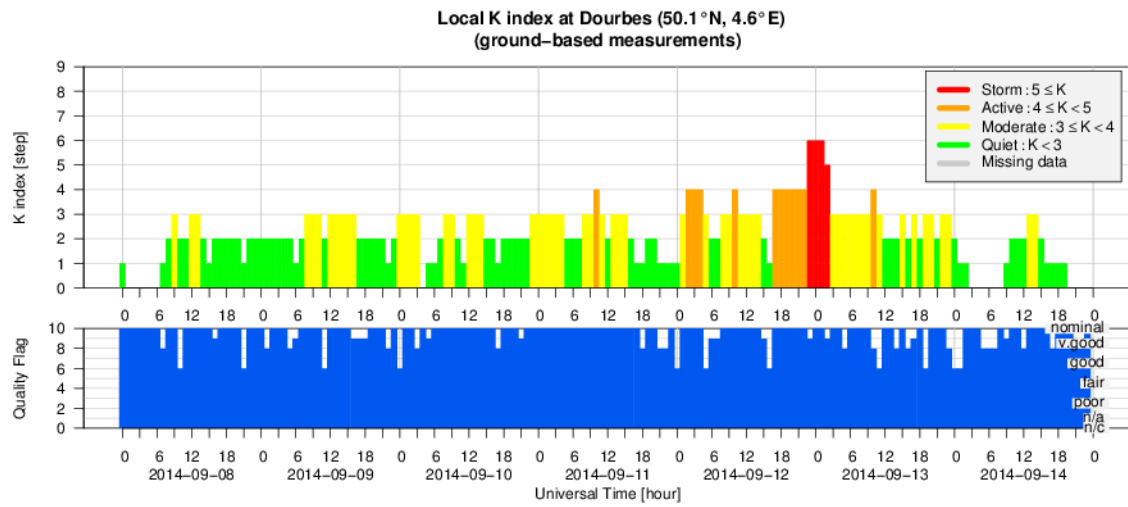
On 11 September at 23:02UT, ACE observed a shock in the solar wind indicating the arrival of the CME related to the M4 flare. Solar wind speed increased from about 350 to 480 km/s, with Bz oscillating between -14 and +11nT. The impact resulted in active geomagnetic conditions (Dourbes), while Kp reached minor geomagnetic storm levels.



On 12 September at 15:27UT, ACE observed another shock in the solar wind, this time related to the arrival of the CME associated to the X1 flare. Wind speed increased abruptly from 430 to 670 km/s, and further increased to a maximum of nearly 800 km/s around 22:00UT. Bz was oriented southward between 20:30 and 22:00UT with maximum values near -17nT, then abruptly turned northward to steady values around +20 nT. The period between 21:00UT and 24:00UT was geomagnetically the most intense, with Kp reaching 7 (strong geomagnetic storm), and local K-indices at Dourbes and Potsdam reaching 6 (moderate storming). Geomagnetic conditions then quieted down, with unsettled to active conditions observed during the first half of 13 September.

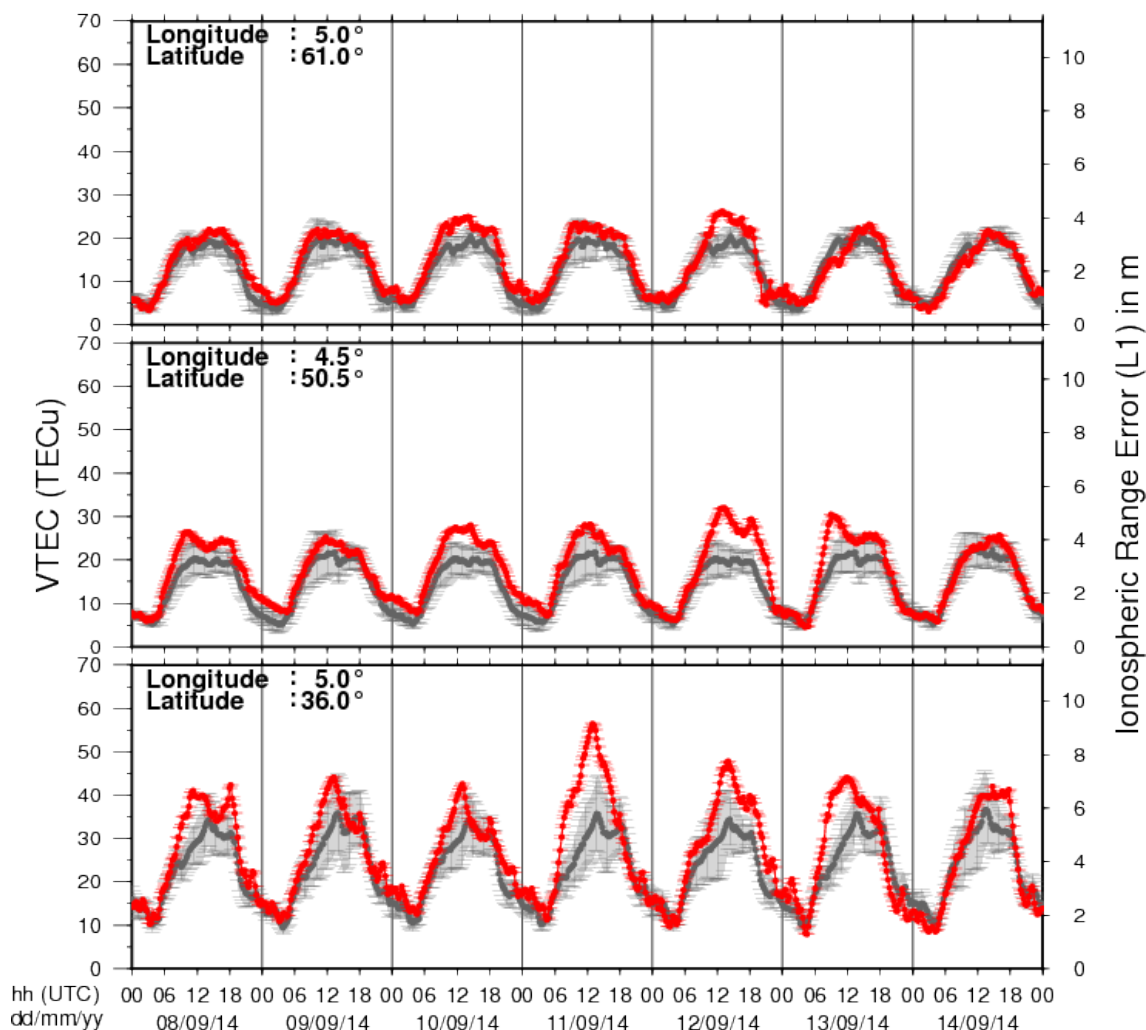
By the end of the period, solar wind speed had decreased to values near 450 km/s, and Bz was at +5 nT. Geomagnetic conditions were quiet to unsettled.

6. Geomagnetic Observations at Dourbes (8 Sep 2014 - 14 Sep 2014)



7. Review of ionospheric activity (8 Sep 2014 - 14 Sep 2014)

VTEC Time Series



The figure shows the time evolution of the Vertical Total Electron Content (VTEC) (in red) during the last week at three locations:

- in the northern part of Europe (N61°, 5°E)
- above Brussels (N50.5°, 4.5°E)
- 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 $\text{TECu} = 10^{16}$ 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

8. New documents in the European Space Weather Portal Repository

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

STCE - Space weather services and products: Solar Cycle

Presentation given during a users' visit about the STCE operational space weather services and products.

<http://www.spaceweather.eu/en/repository/show?id=534>

STCE - Space weather services and products: COMESEP

Presentation given during a users' visit about the STCE operational space weather services and products.

<http://www.spaceweather.eu/en/repository/show?id=535>

STCE - Space weather services and products: SIDC

Presentation given during a users' visit about the STCE operational space weather services and products.

<http://www.spaceweather.eu/en/repository/show?id=536>

STCE - Space weather services and products: Regional Warning Center

Presentation given during a users' visit about the STCE operational space weather services and products.

<http://www.spaceweather.eu/en/repository/show?id=537>

STCE - Space weather services and products: Solar radio observations

Presentation given during a users' visit about the STCE operational space weather services and products.

<http://www.spaceweather.eu/en/repository/show?id=538>

STCE - Space weather services and products: Ruimteweer

Presentation given during a users' visit about the STCE operational space weather services and products.

<http://www.spaceweather.eu/en/repository/show?id=539>

STCE - Space weather services and products: Sola Demon

Presentation given during a users' visit about the STCE operational space weather services and products.

<http://www.spaceweather.eu/en/repository/show?id=540>

STCE - Space weather services and products: SSA Space Weather Coordination Centre

<http://www.spaceweather.eu/en/repository/show?id=541>

9. Future Events

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

2014 Conference on Big Data from Space (BiDS '14) in Frascati, Italie

Start : 2014-11-12

This conference aims to bring together researchers, engineers, users in the area of Big Data in the Space sector.

The focus is on the whole data lifecycle, ranging from data acquisition by spaceborne and ground-based sensors to data management, analysis and exploitation in the domains of Earth Observation, Space Science, Space Engineering, Space Weather, etc.

Special emphasis will be put on highlighting synergies and cross-fertilization opportunities from domains like Climate Change, Solid Earth Science, Planetary Sciences, Life Science, Astrophysics, High Energy Physics, Social Sciences, etc.

We expect this conference to:

- * contribute towards a common "Big Data from Space" scientific and programmatic framework
- * widen competences and expertise of universities, labs and industrial actors
- * foster networking of experts and users towards better access and sharing of data, tools and resources
- * leverage innovation, spin-in, spin off of technologies, and business development arising from research and industry progress

Website:

<http://congrexprojects.com/2014-events/BigDatafromSpace/objectives>

European Space Weather Week in Liège, Belgium

Start : 2014-11-17 - End : 2014-11-21

The 11th Edition of the European Space Weather Week will take place on 17-21nd November 2014 in Liège, Belgium.

The ESWW will again adopt the central aim of bringing together the diverse groups in Europe working on different aspects of Space Weather. This includes but isn't limited to the scientific community, the engineering community, applications developers, service providers and service end users.

The meeting organisation is coordinated by the Belgian Solar-Terrestrial Centre of Excellence (STCE), ESA and the Space Weather Working Team. The local organisation is done by the STCE.

Website:

<http://www.stce.be/esww11/>

2014 AGU Fall Meeting in San Fransisco, USA

Start : 2014-12-15 - End : 2014-12-19

The AGU Fall Meeting is the largest worldwide conference in the geophysical sciences, attracting more than 22,000 Earth and space scientists, educators, students, and other leaders. For 46 years, energized and passionate Earth and space scientists from around the world gather at the AGU Fall Meeting to connect with colleagues, broaden their knowledge base, and embrace the joy of science. The 2014 meeting takes place Monday 15 - Friday 19 December 2014.

Several sessions about space weather are foreseen:

*

When and Why Does Space weather Forecasting Fail?

*

Addressing Operational Space Weather Needs

*

Near Real Time Data for Earth Science and Space Weather Applications

*

Understanding Hemispheric Asymmetry and Space Weather

*

Connection of Solar Events With the Variability of Space Environments

*

Bz from the Sun to the Earth: Observations and Modeling

*

Solar Sources and Heliospheric Consequences of Coronal Mass Ejections in Solar Cycle 24

*

Advances in Ionospheric Forecasting - Modeling, Observations, and Validation

Abstract Submission Deadline: August 6, 2014

Website:

<http://fallmeeting.agu.org/2014/>

Measurement Techniques for Solar and Space Physics, in Boulder, CO, USA

Start : 2015-04-20 - End : 2015-04-24

This gathering was born out of the desire to collect in one place the latest technologies required for advancement of science in the discipline of Solar and Space Physics. In doing so, it was recognized that the two 1998 volumes of 'Measurement Techniques in Space Plasmas' (Particles and Fields) have been a valuable reference and resource for advanced students and scientists who wish to know the fundamentals of measurement techniques and technology.

Website:

<https://mtssp.msfc.nasa.gov/>

26th General Assembly of the International Union of Geodesy and Geophysics (IUGG) in Prague, Czech Republic

Start : 2015-06-22 - End : 2015-07-02

We invite contributions on novel inversion methods with application across the geosciences. Of particular interest are 3D imaging, joint inversion of geodetic, geophysical and geochemical datasets, and multi-disciplinary interpretation approaches such as integration of gravity, EM and seismic data or thermo-mechanical modelling studies constrained by physical parameters.

Modelling of Space Weather Effects: Solar, Magnetospheric and Earth Resistivity Constraints (IAGA, IAMAS)

In this symposium we welcome contributions on all aspects of the modelling of space weather and its effects, from the Sun to Earth. This includes the modelling of the various interactions between travelling solar storms and the solar wind, magnetosphere, ionosphere and solid Earth and the validation of models through measurements. Contributions on models developed to aid end-users, such as satellite and power grid operators, survive the impact of space weather are also encouraged.

Website:

<http://www.iugg2015prague.com/joint-inter-association-symposia.htm#JA>