



# Recent and future actions about Space Weather in Austria



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# Kanzelhöhe (UNI Graz) – ISES Network Regional Warning Center Austria

WELTRAUMWETTER  
ÖSTERREICH
OBSERVATORIUM KANZELHÖHE FÜR  
SONNEN- UND UMWELTFORSCHUNG

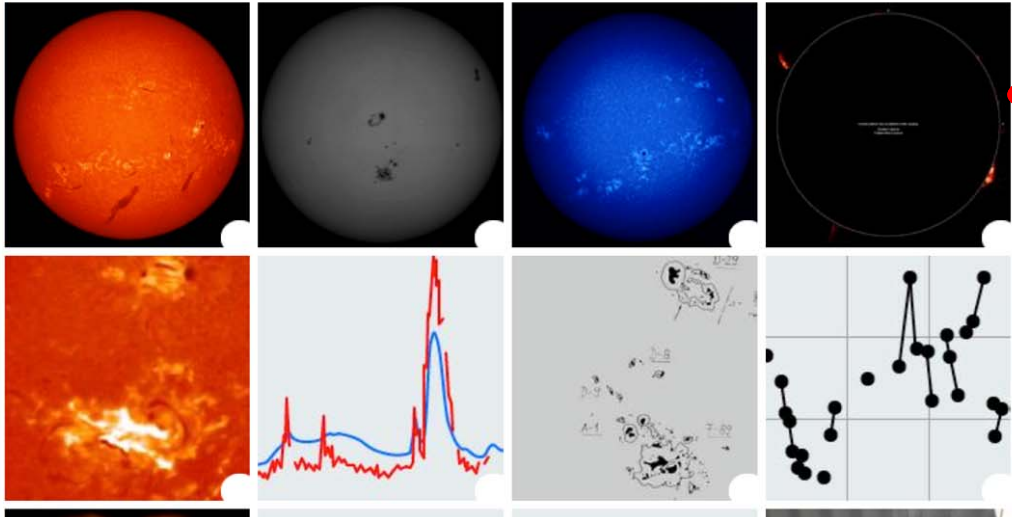



Der Begriff „Weltraumwetter“ beschreibt die veränderlichen Bedingungen im erdnahen Weltraum, die technische Systeme im Weltraum und auf der Erde beeinträchtigen können. Die Hauptursache von Störungen unseres Weltraumwetters sind energetische Ausbrüche von der Sonne. Das [Observatorium Kanzelhöhe für Sonnen- und Umweltforschung der Universität Graz](#) führt regelmäßige, hochqualitative Beobachtungen der Sonne durch.

Mittels automatisierter Bilderkennungsverfahren werden Strahlungsausbrüchen in Echtzeit in den Beobachtungsdaten detektiert und Warnmeldungen ausgesandt. Das Observatorium Kanzelhöhe ist die österreichische Vertretung im [internationalen ISES Weltraumwetter-Netzwerk](#) und die europäische Kernstation zur Sonnenbeobachtung im Rahmen des [SSA Weltraumwetter-Programms der Europäischen Weltraumbehörde ESA](#).


News
3:27UT Flare SF bei S15W18
14.Mar :: 12:16UT Flare SF bei S21W17
14.Mar :: 13:27UT Flare

### Weltraumwetter aktuell



### Information

- Home
- Information zu Datenprodukten
- Was ist Weltraumwetter?
- Forschung in Österreich
- Links
- Blog Posts




### Warnzentren

- Information zu ISES
- ISES Website
- Austria

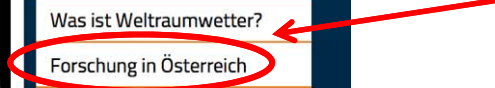
Blog

Die Sonnenfleckenzahl wird eigentlich recht einfach gebildet:  $Rz = k(\dots)$  [mehr](#)



Space Weather  
Forecasts will become  
part of “daily life“  
(NASA/ESA).

**We aim towards better  
synergies and visibility  
of Space Weather  
within Austria.**

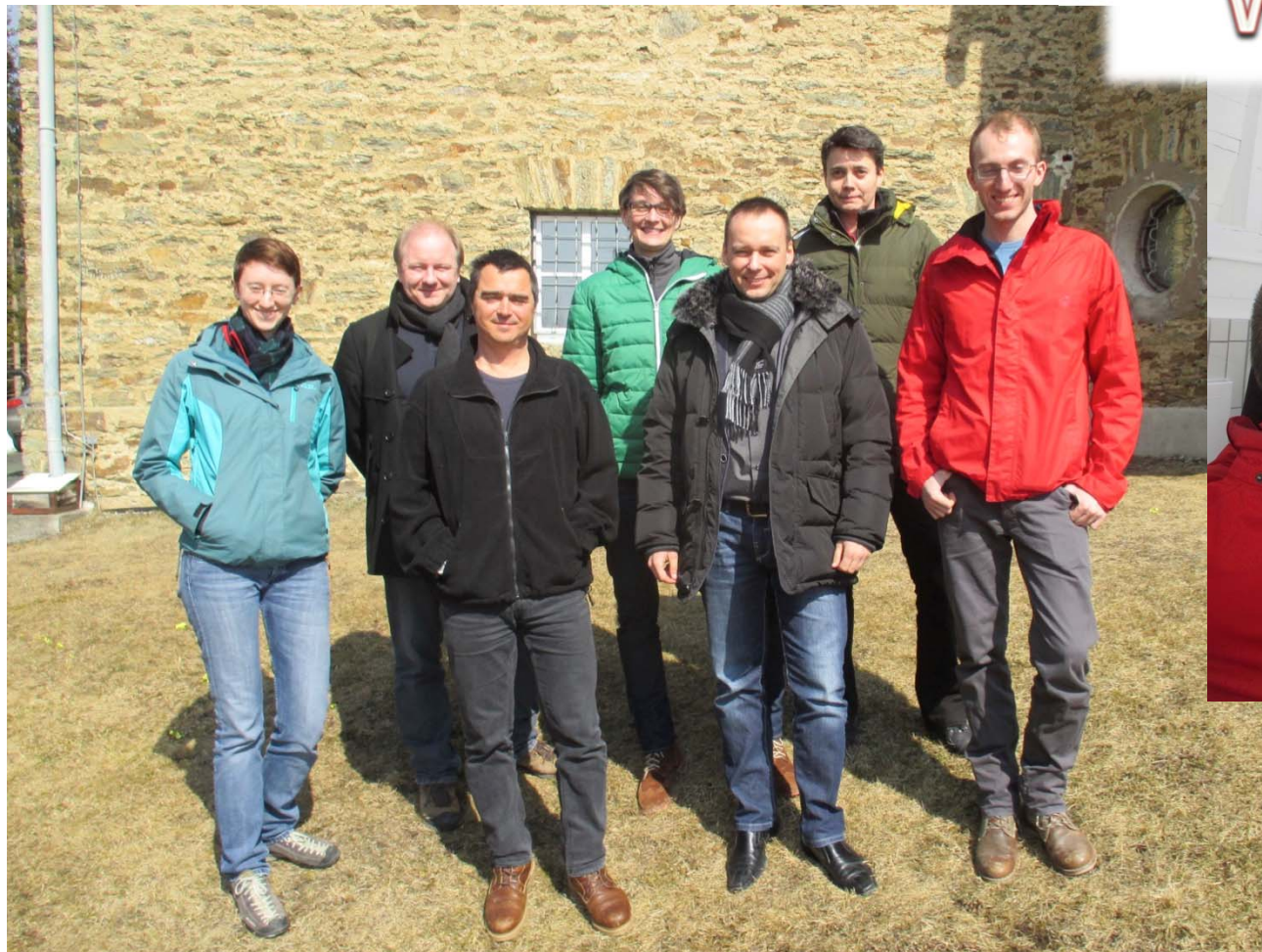


spaceweather.at / weltraumwetter.at

# Organization of the 1<sup>st</sup> Austrian Space Weather workshop 2015

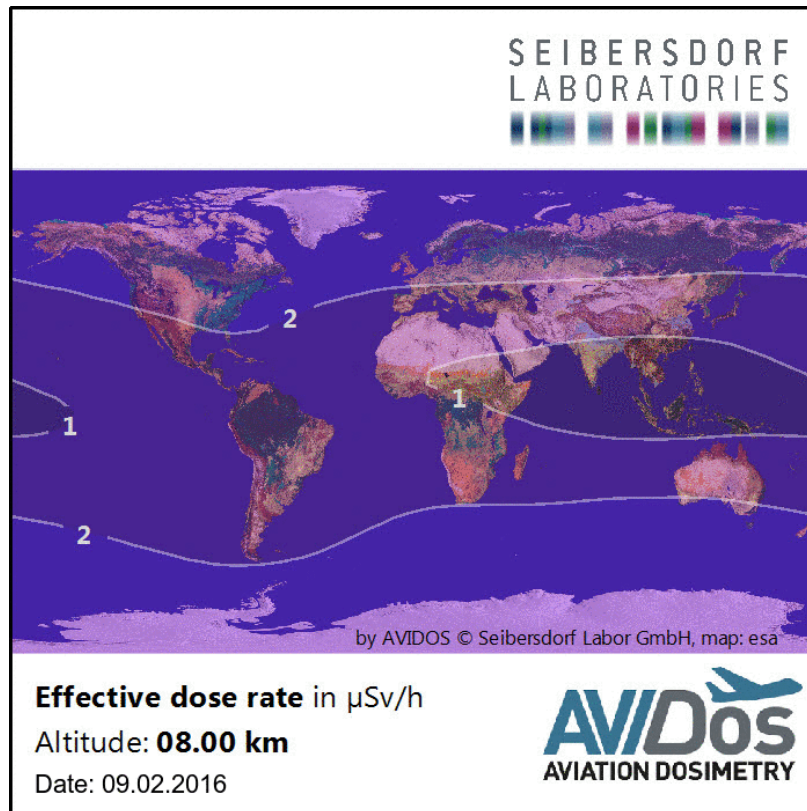
Conrad Observatory (ZAMG) – Seibersdorf  
Laboratories – Space Research Institute  
Graz (IWF) – University of Graz

Österreichischer  
Weltraumwetter  
Workshop



Special event: partial  
solar eclipse (March 20,  
2015)

# „Fruits“ of the workshop...



AVIDOS: effective dose rates for aviation, implemented into spaceweather.at.

We clearly aim to continue the exchange of knowledge among Austrian SWE expert groups (next meeting hosted by Seibersdorf Laboratories).

aktuell

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**ISES**  
International Space Environment Service

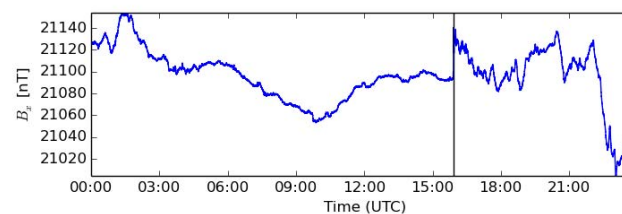
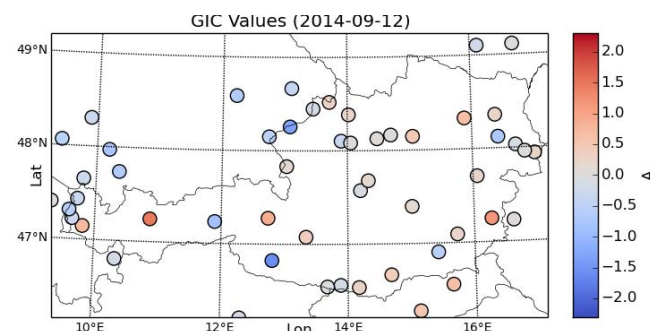
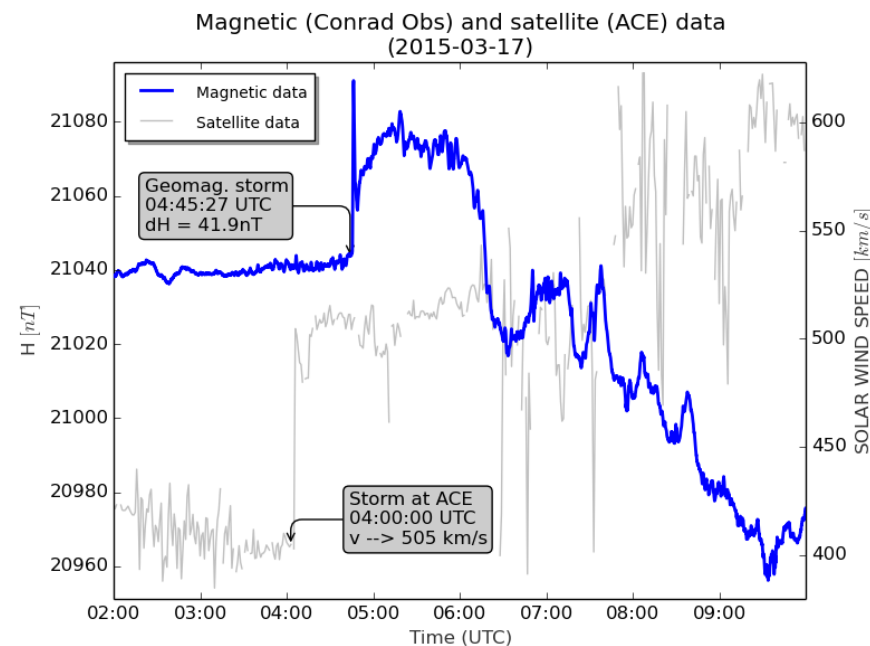
**Warnzentren**

- Information zu ISES
- ISES Website
- Austria
- Beijing
- Boulder
- Brussels
- Hermanus
- Jeju
- Lund
- New Delhi

Beobachtungsbedingungen Kanzelhöhe

# Geomagnetically induced Currents in Austria

- ▶ The Conrad Observatory is (partly) a geomagnetic observatory
- ▶ “GEOMAGICA” is a **Conrad Observatorium (ZAMG)** project (financed by FFG-ASAP)
- ▶ 2015 plan: develop an **automated geomagnetic storm detection system** (upper figure)
- ▶ 2015-2017: development of a **model of GIC in the Austrian power grid** (lower figure)



## Further Information

- ▶ The storm detection system is based on a combination of solar wind and geomagnetic field data. In the case of a storm detection, warnings can be sent out via email or SMS
- ▶ To model GIC, one needs three parameters:
  - measurements of geomagnetic field variations
  - a model of the ground conductivity in Austria
  - a model of the Austrian power grid topology
- ▶ **Contact: Roman Leonhardt and Rachel Bailey**

Project partners: Austrian Power Grid, British Geological Survey, TU Graz, ...

# IWF/OEAW SPACE WEATHER RELEVANT ACTIVITIES

Ongoing ILWS Mission Participation (Data Analysis & Hardware)

- Cluster, THEMIS, STEREO, MMS

Participation in planning/hardware/preparation of SWE relevant future projects

- Solar Orbiter: Magnetometer, Radio and Plasma Waves
- Bepi Colombo PI/CoI: MGF on MMO, PICAM/MERMAG on MPO
- Service Oriented Spacecraft Magnetometer (SOSMAG) onboard GK-2A (Korean SC)
- Solar wind Magnetosphere Ionosphere Link Explore (SMILE):  
Soft-Xray Imager DPU
- Turbulence Heating ObserverR (THOR): Magnetometer, Sci Study Team

Other SWE relevant studies

- Thermosphere-CME relation ([Krauss et al., 2015](#) in collab. with UNI Graz)
- CME Propagation modeling
- Planetary space weather

**Contact: Rumi Nakamura**

# UNI Graz & Kanzelhöhe Observatory – ESA Expert Service Centers for Solar and Heliospheric Weather

- Solar wind **high-speed-streams** forecast w/ 4 days lead time
- **CME propagation model (DBM)** using actual solar wind conditions (collaboration with Univ. Zagreb)
- Solar weather: H-alpha real-time **flare alerts** (filament eruptions)



Services About Us Location Contact Us

Science Website - ESA Expert Service Center for Solar & Heliospheric Weather



Kanzelhöhe Observatory (© KSO)

## The University of Graz

UNIGRAZ with its [Kanzelhöhe Observatory](#) and the research group on Solar and Heliospheric physics at the [Institute of Physics](#), is a world-wide leading institution in the research on space weather. The main research areas cover the physics, interplanetary propagation and geomagnetic consequences of coronal mass ejections (CMEs), the conditions and modelling of the solar wind properties and its effect on ICME propagation, as well as the high-energy physics of solar flares and accelerated particles.

Based on this research, co-operatively performed with the [University of Zagreb](#) in Croatia, we could develop services to forecast solar wind high speed streams as well as arrival times and impact speeds of CMEs at Earth or other planetary targets.

The Kanzelhöhe Observatory and its patrol observations, daily monitor the solar sources of space weather using high-quality, high-cadence and standardized images. Automatic feature recognition algorithms developed co-operatively with the Technical University

## Space Situational Awareness

ESA's Space Situational Awareness 2008 Ministerial Council and formally extended at the 2012 Ministerial Council to 2016.

The objective of the SSA programme is to provide access to, space through the provision of information regarding the space environment, an orbit and on the ground. In general, to identify objects in orbit, harmful space weather events, asteroids, that cross Earth's orbit.

[Read more...](#)

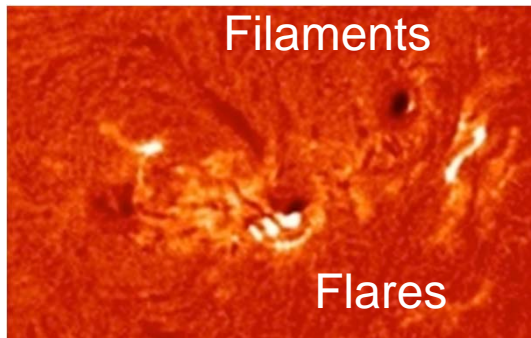




# Kanzelhöhe Obs. – data products

Full disk image data are available in near **real-time**.  
Mean latency < 3 sec (see [Pötzi et al., 2015](#)).

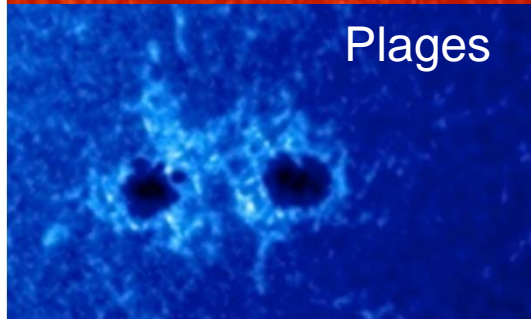
Images of class 1 quality are immediately processed  
providing real-time flare and filament eruption alerts.



Filaments

Flares

4 MegaPixel 12 bit  
10 images / minute



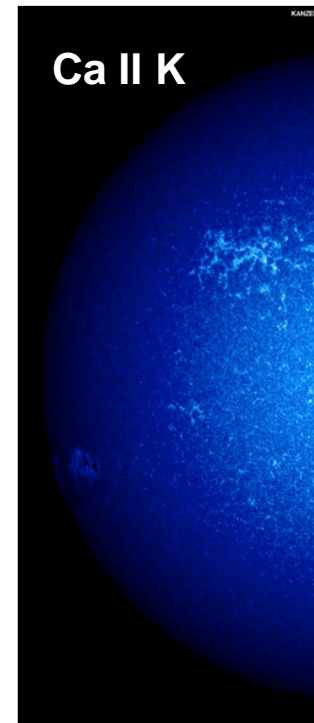
Plages

4 MegaPixel 12 bit  
10 images / minute

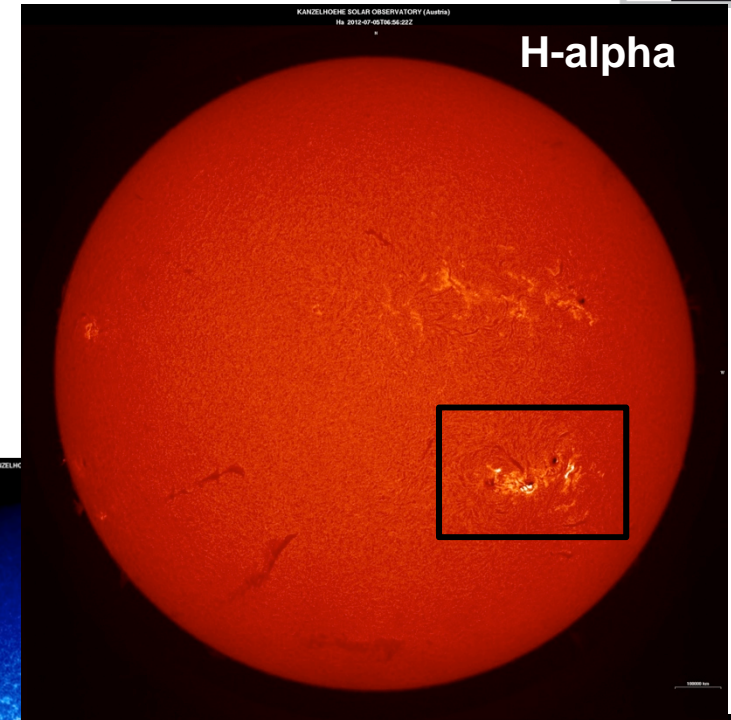


Sunspots

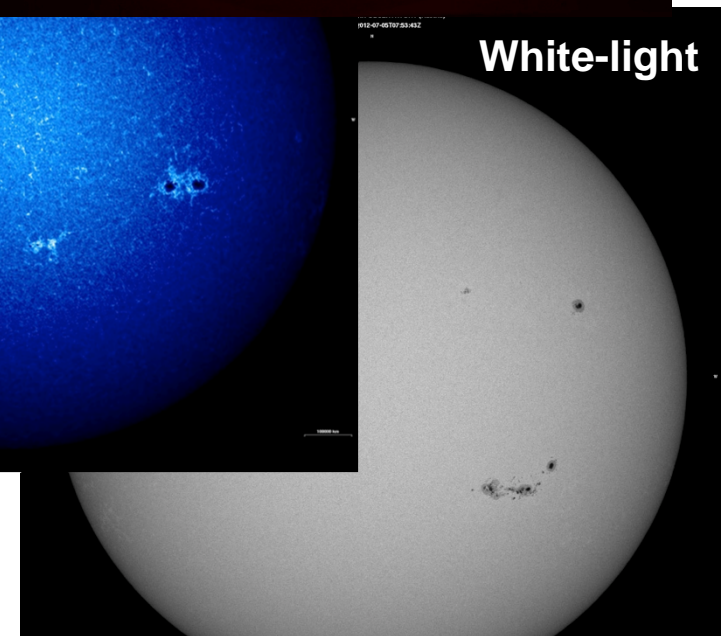
4 MegaPixel 10 bit  
3 images / minute



Ca II K



H-alpha



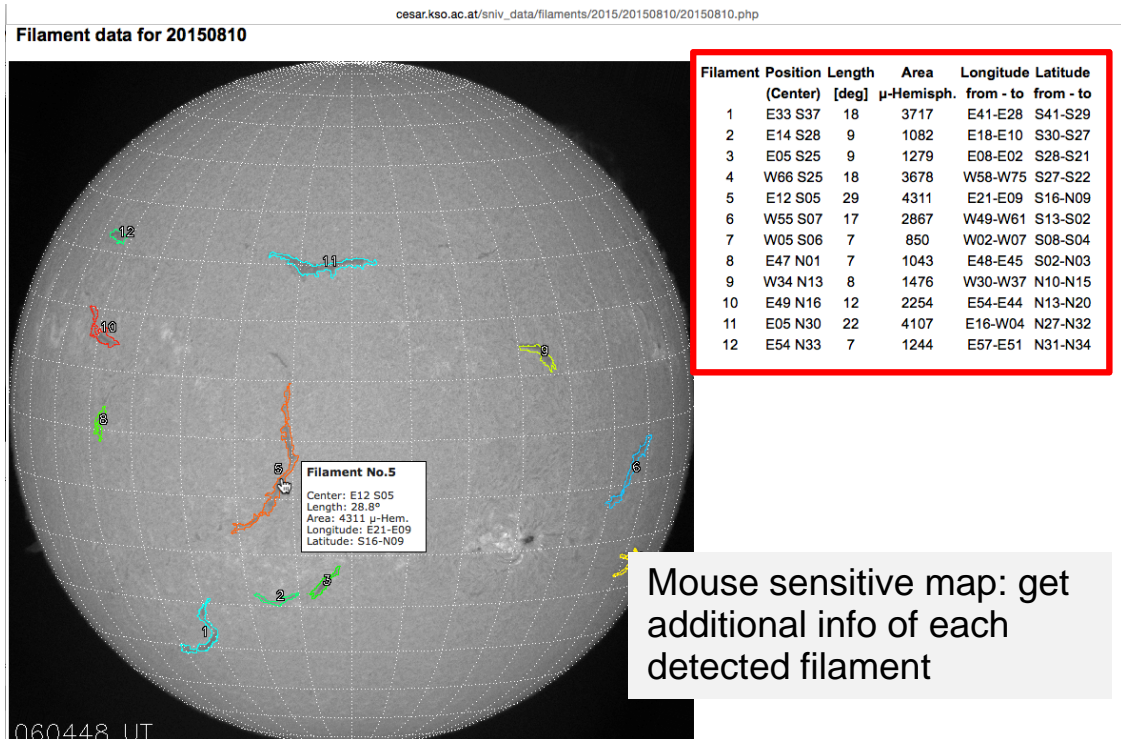
White-light

# VarSITI: scientific program of SCOSTEP (2014-2018)

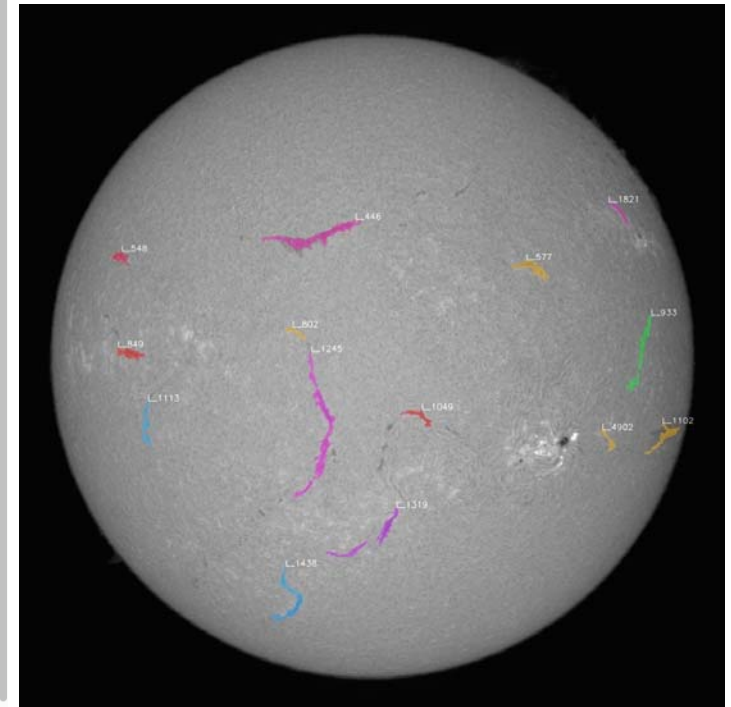


UNI Graz provides daily email service (ISEST/MiniMax24 campaign), giving forecasts of solar wind high speed streams and filament eruptions.

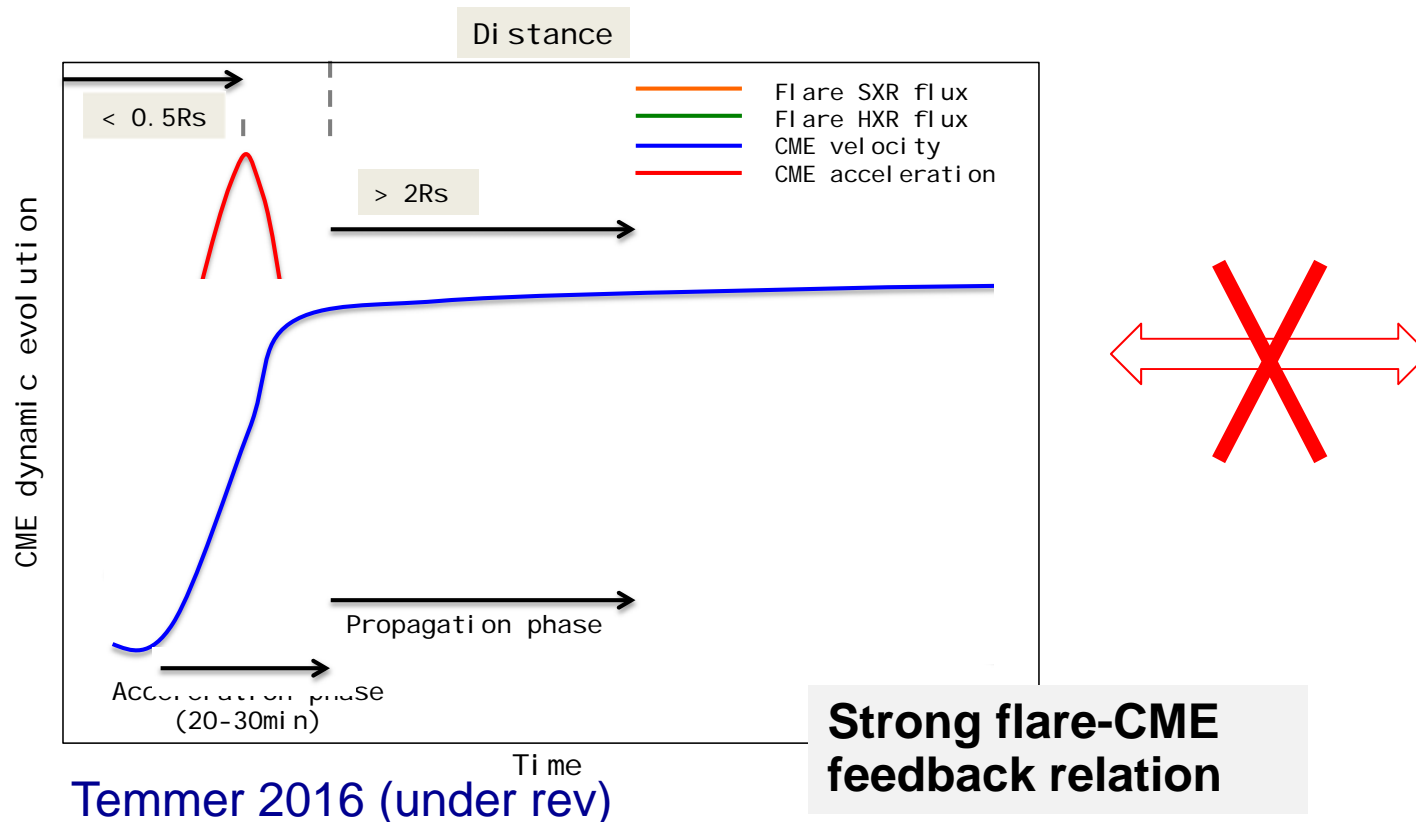
Automated filament detection at Kanzelhöhe (developed during ESA/SSA) is active since summer 2015.



Mouse sensitive map: get additional info of each detected filament

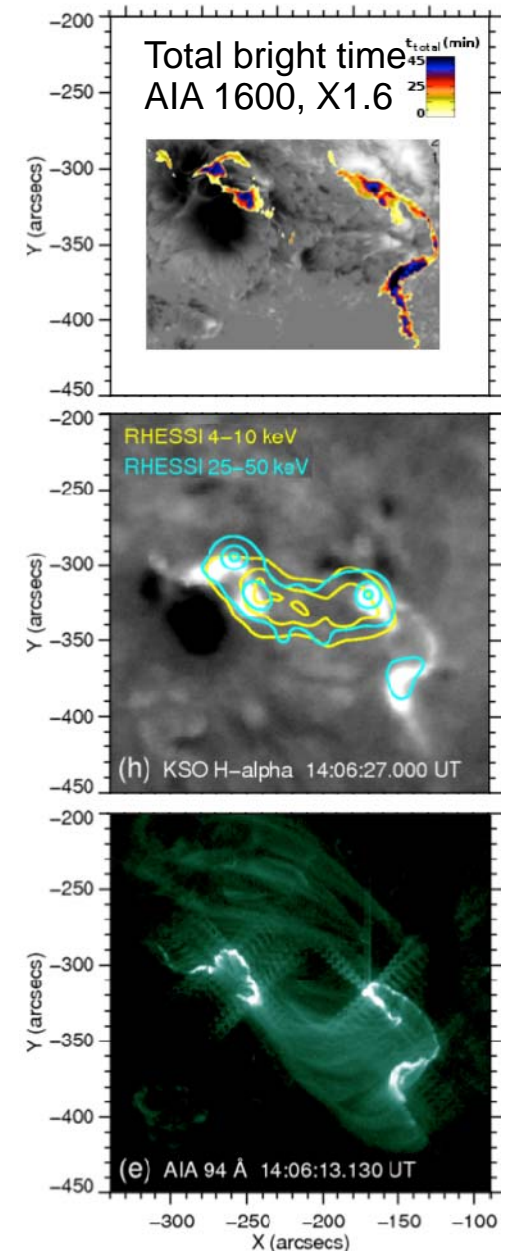


# SWE support: solar surface observations



Temmer 2016 (under rev)

Thalmann et al., 2015



Exceptions from the rule: confined events (e.g., Oct 2014) - strong overlying coronal magnetic fields (NLFF model) slowly decaying with height; flare: **no ribbon separation** (see Thalmann et al., 2015; Veronig and Polanec, 2015).

*Observations of flare ribbon dynamics and magnetic field models needed for more reliable SWE predictions.*

# SWE products „made in Austria“

- *Seibersdorf Laboratories*: AVIDOS – real-time aviation dose rates
- *Conrad Observatory*: GEOMAGICA – development of automated GIC warning system
- *Space Research Institute*: SWE satellite mission participation and research in planetary space weather as well as CME propagation
- *UNI Graz / Kanzelhöhe Observatory*:
  - Automatic near-real-time detection of flares and filaments (Pötzi et al., 2015; Veronig and Pötzi, 2016)
  - Automated forecasting of solar wind speed at distance of 1AU (Rotter et al., 2012, 2015; Reiss et al., 2016 (in prep))
  - In collaboration with University of Zagreb (Croatia), drag-based model (DBM) for forecasting arrival times of CMEs (latest version see: Žic, Vršnak, Temmer, 2015)
  - Research in preconditioning of IP space, CME propagation and relation to solar surface activities (flares, coronal waves, magnetic field models, ...)