Austrian contributions to ESA's SSA Space Weather Programme: Real-time detection of solar eruptions and space weather effects onboard aircraft

A. Veronig¹ and P. Beck²

¹) Kanzelhöhe Observatory & Institute of Physics, University of Graz, Austria
²) Seibersdorf Laboratories, Seibersdorf, Vienna

Relevance of $H_\alpha$ imaging of the Sun for space weather

Imaging of the different layers of the solar atmosphere:

<table>
<thead>
<tr>
<th>Photosphere</th>
<th>Chromosphere</th>
<th>Corona</th>
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White-light $H_\alpha$ EUV 211 A
Relevance of Hα imaging of the Sun for space weather

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Sun 10 years ago (28-Oct-2003): extreme high solar activity
Relevance of Hα imaging of the Sun for space weather

Imaging of the Sun in the Hα spectral line at 656.3 nm to observe the solar sources of space weather disturbances:

1) Flares
2) Filament eruptions, often associated with coronal mass ejections (CMEs)
3) Moreton (shock) waves, often associated with solar energetic particles (SEPs)

1) Flares:
   - Onset times & peak times
   - Importance class (area & brightness enhancement)
   - Location → magnetic connectivity of flare-associated SEPs

Reames (1999)

W40-W60°
2) Filament eruptions:
   Eruption onset times
   Heliographic location

3) Moreton waves:
   Onset times and location
   Presence of coronal shock wave \( \rightarrow \) potentially associated SEPs

\( v \sim 1000 \text{ km/s} \)
Kanzelhöhe Solar Observatory (KSO) of the University of Graz (in Carinthia on mount Gerlitzen): full-disk solar observations in Hα, Ca II K, and continuum.

**KSO Hα observations at ESA SSA SWE portal**

Kanzelhöhe Solar Observatory (KSO) of the University of Graz.

**ESA SSA SWE programme:**
- real-time provision of Hα images on ESA SWE portal
- real-time detection and alerting of flares and erupting filaments
KSO $H\alpha$ observations at ESA SSA SWE portal

Time delay between observation and online provision of the $H\alpha$ images is <5 seconds.
**KSO Hα observations at ESA SSA SWE portal**

![KSO Image]

- **Click on window for full size image display**
- **Local weather information – updated every 10 minutes**
- **H-alpha movie popup window**
- **Flare and filament eruption information**
  - Updates every minute, ongoing events are in red color

**Automatic real-time detection of flares and filaments at KSO**

**Automatic detection of filaments:**

Based on intensity and shape.

If a filament ID disappears → an eruption is detected.

**Real-time output:**
- Filament eruption alert
- Heliographic location
- Time of disappearance
Automatic real-time detection of flares and filaments at KSO

Sample result on filament recognition on KSO Hα image sequence: Right: raw image. Left: the detected filaments are outlined in color. Each filament has an ID assigned, which is annotated in the image.

Automatic real-time detection of flares and filaments at KSO

Sample result on detection of filament eruption on KSO H-alpha image sequence close to the solar limb. Filament ID L_91 disappears, i.e. the filament has erupted.
Automatic real-time detection of flares and filaments at KSO

Automatic detection of flares:
Based on increase of intensity in localized regions.

Real-time output:
- Start & peak time
- Heliographic location
- Importance class (size, brightness)

Real-time output of flare-recognition program

Original Hα images.
Hα images with flare IDs identified.
Automatic real-time detection of flares and filaments at KSO

Real-time output of flare-recognition program

Flare area and brightness as function of time.

AVIDOS Aviation Dosimetry

Seibersdorf Laboratories: P. Beck, M. Latocha

Aircraft crew workers are radiation protected workers in Europe. European countries take legal measures to ensure that aircraft crew worker do not exceed limits of radiation exposure.
Galactic Cosmic Radiation Exposure and Energetic Solar Events in Flight Altitude 15.3 km (50,000 ft)

Radiation exposure due to energetic solar particles can be an order of magnitude larger compared to radiation exposure due to galactic cosmic radiation.
AVIDOS at ESA:
swe.ssa.esa.int/web/guest/avidos-federated

AVIDOS - "aviation dosimetry": software for online calculation of radiation exposure on-board aircraft.

AVIDOS World Wide Web User:
swe.ssa.esa.int/web/guest/avidos-federated
Thank you for your attention!