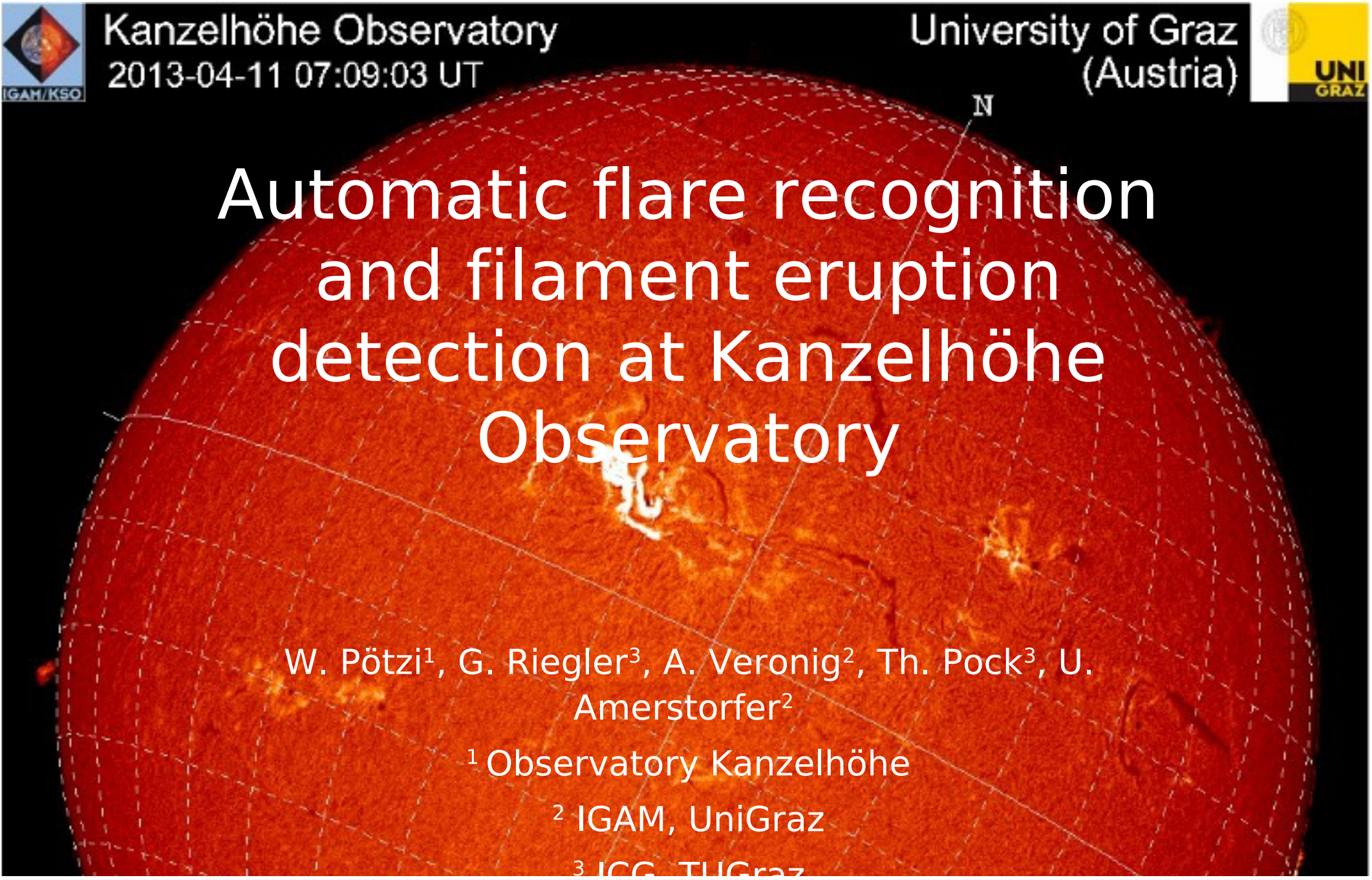

Automatic flare recognition and filament eruption detection at Kanzelhöhe Observatory

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Space Weather Precursor Services Operations (SN-IV 2)

Ground-based H-alpha Solar Monitoring Service (ESA SSA - SWE SN IV-2 activity)

Tasks

1. Provide near real-time H-alpha images and movies on the SWE sub-portal
2. Automatic Flare detection
3. Automatic Filament eruption detection
4. Alerting of Events / Update sub-portal

Processing steps for feature recognition and alerting

Task 1

1. Check image size and quality.
2. Postprocessing of the image.
3. Store processed image as FITS file.
4. Convert processed image to JPEG file.
5. Send JPEG image to the web server.
6. Create/update a log file with H-alpha image observation time and publishing time.
7. Create/update javascript movie and GIF movie.

Tasks 2-4

8. Write input information for the image recognition algorithm to file list.
9. Analyse the incoming images with the image recognition algorithm and save the relevant information on the detected features to flare and filament log files. Save results to summary output log file.
10. Analyse the flare and filament log files to identify flares and filament eruptions.
11. If either a flare and/or a filament is detected, save/update the calculated parameters to a file which contains for each time step (among other supporting information): heliographic position, size, brightness (in case of flares); heliographic position and length (in case of erupting filaments).
12. If a flare identified exceeds the given threshold and/or if filament erupts, issue/update an alert message on the SWE H-alpha subportal. Send email alert message to predefined users.
13. For each flare and filament alert that is provided create/update a log file which includes all the characteristic parameters determined (position, size, importance classification, brightness classification, start and peak time).

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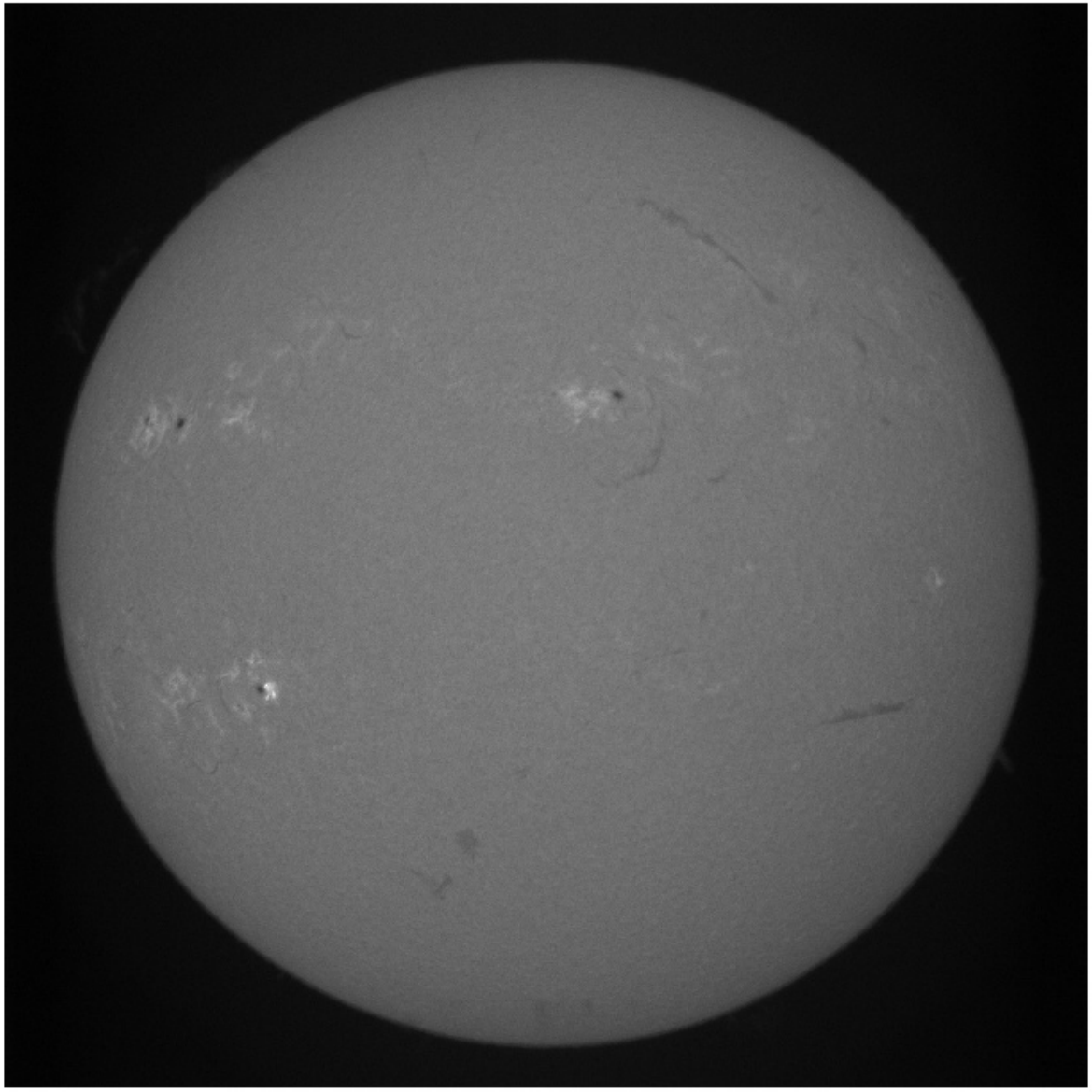
Feature recognition

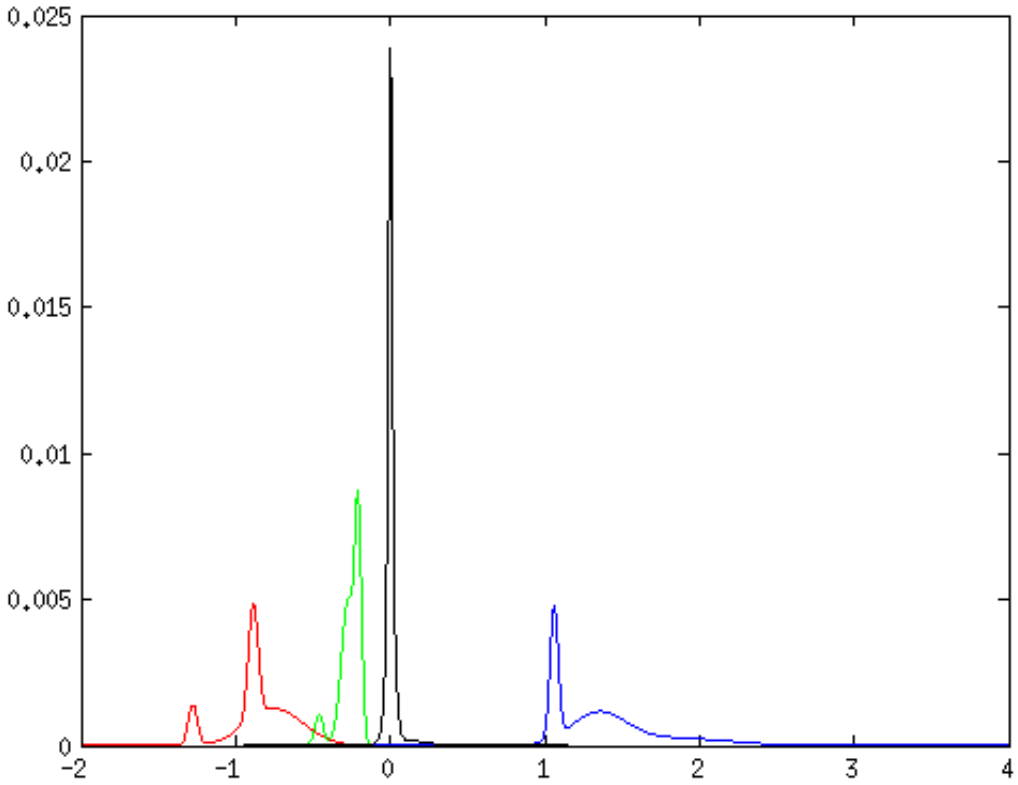
Input
(raw image)



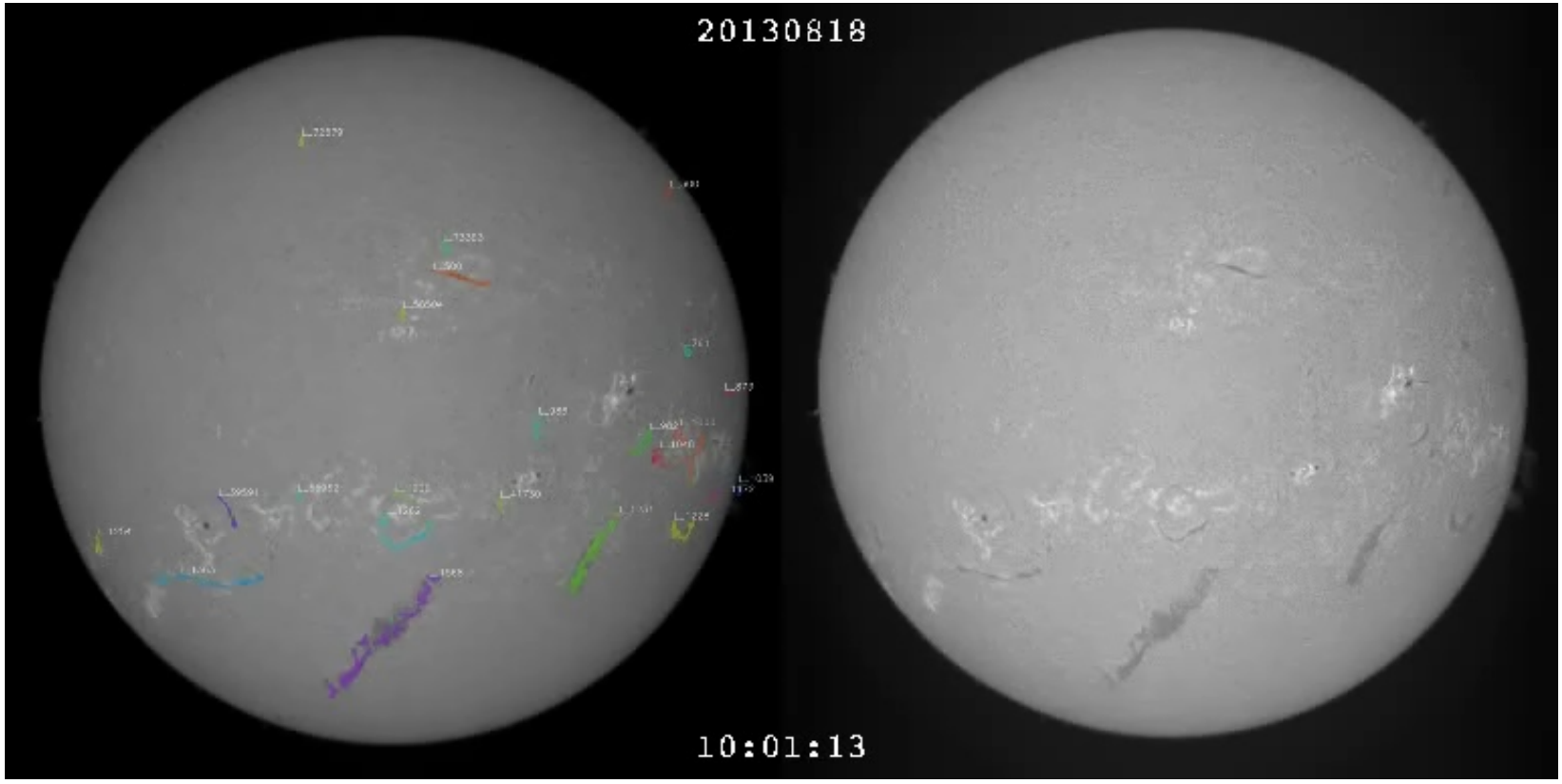
Feature recognition

Assign properties

Filaments
Spots
Background
Flares



Feature recognition



Sample result on filament recognition on KSO H-alpha 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. Too small detections ($L < 150$ arcsec) and regions >60° from Suns center are not yet excluded.

Feature recognition – Output Log Files

Flare log file

Date	Time	Sun_x	Sun_y	Radius	Id	Flare_x	Flare_y	Area	Mean_I	rms	Min_I	Max_I	Max_x	Max_y
20130526	071809	1046.61	1040.98	933.07	3	930.89	735.40	53	2.2507	0.1134	2.0214	2.5127	931.00	736.00
20130526	071809	1046.61	1040.98	933.07	4	1246.71	958.29	48	1.8623	0.0680	1.7507	2.0114	1248.00	956.00
20130526	071945	1046.61	1040.98	932.98	3	931.59	734.37	51	2.2550	0.1385	1.9282	2.5993	931.00	735.00
20130526	071945	1046.61	1040.98	932.98	4	1248.00	959.29	41	1.8796	0.0966	1.6860	2.1466	1250.00	958.00
20130526	072040	1046.61	1040.98	932.51	3	932.21	735.17	29	2.2318	0.1058	1.9452	2.3990	932.00	736.00
20130526	072059	1046.61	1040.98	932.82	3	933.40	734.55	58	2.2384	0.1332	1.9272	2.6114	934.00	734.00
20130526	072059	1046.61	1040.98	932.82	4	1248.76	959.26	50	1.8666	0.0776	1.6910	1.9924	1247.00	960.00
20130526	072111	1046.61	1040.98	932.53	3	933.65	735.78	54	2.2175	0.0986	2.0740	2.4530	933.00	737.00
20130526	072124	1046.61	1040.98	932.53	3	934.23	733.70	70	2.2612	0.1339	2.0473	2.6575	934.00	734.00

Filament log file

Date	Time	Sun_x	Sun_y	Radius	Id	Fil_x	Fil_y	Length
20130526	063701	1046.61	1040.98	932.58	37	850.43	411.27	22
20130526	063701	1046.61	1040.98	932.58	60	931.38	531.87	31
20130526	063701	1046.61	1040.98	932.58	67	613.03	450.21	435
20130526	063701	1046.61	1040.98	932.58	82	980.89	588.05	78
20130526	063701	1046.61	1040.98	932.58	122	1480.43	672.58	91
20130526	063701	1046.61	1040.98	932.58	123	213.92	682.42	55
20130526	063701	1046.61	1040.98	932.58	145	785.22	713.16	133
20130526	063701	1046.61	1040.98	932.58	168	892.14	782.97	102
20130526	063701	1046.61	1040.98	932.58	182	675.34	826.42	102
20130526	063701	1046.61	1040.98	932.58	209	1116.57	901.65	163

Firefox | Observatorium Kanzelhöhe | ESA - Space Situational Awaren...

esa space situational awareness — European Space Agency

ESA SSA SWE NEO SST

- **About SWE**
  - What is Space Weather
  - SSA Space Weather Activities
  - Current Space Weather
  - Service Network
  - Data Centre
  - Service Centre
- **User Domains**
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  - Spacecraft Operation
  - Human Space Flight
  - Launch Operation
  - Transionospheric Radio Link
  - Space Surveillance and Tracking
  - Non Space Systems Operation
  - General Data Service
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  - Ionospheric Weather
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  - SEDAT
  - IONMON
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- **Coming Events**
  - Summer School Alpbach 2013
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  - You are not signed in.
  - Sign In
  - Register

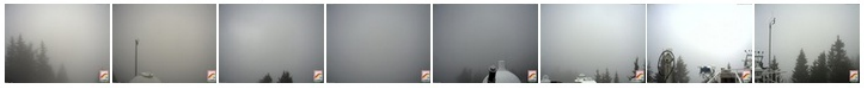
This service is federated via ESA by Kanzelhöhe Observatory

Ground-based H-Alpha Solar Monitoring Service
Kanzelhöhe Observatory

Type	Begin	Max	Position	Size
No events detected today (20130827)				

Not enough data for movie

Click on images for full size



page refresh each 60 seconds

Last update: 20130827 07:21UT

Flare Alerts

Flare alerts are issued when one of the following criteria is fulfilled:
1.The flare detected is of importance class 1 or higher or a subflare with an area exceeding a threshold of 50 micro-hemispheres, or
2.the flare importance class reaches a higher class level (e.g., a flare of importance 1 evolves further to a flare of importance 2).

Von alert@kso.ac.at
Betreff **Kanzelhoehe Observatory flare alert**
An observer@kso.ac.at

```
Kanzelhoehe Observatory solar flare alert
2013-08-12T10:31Z, Flare of importance SF at S21E20
.
```

1st Alert message

Alert update

Von alert@kso.ac.at
Betreff **Kanzelhoehe Observatory flare alert**
An observer@kso.ac.at

```
Kanzelhoehe Observatory solar flare alert
2013-08-12T10:41Z, Flare of importance 1N at S21E18
.
```

Filament Eruption Alerts - Data processing

1. Conversion of the image recognition filament log file
2. Filament eruption extraction from the converted filament log file
3. Update information on SWE H-alpha subportal
4. Filament eruption alerting

Date	Time	Length	Position	Id
20130722	061233	59	W35 N60	4
20130722	061239	65	W35 N60	4
20130722	061244	66	W35 N60	4
20130722	061257	60	W35 N60	4
20130722	061303	55	W35 N59	4
20130722	061309	58	W35 N59	4
20130722	061321	67	W35 N59	4
20130722	061328	58	W35 N60	4
20130722	061333	65	W35 N60	4
20130722	061340	63	W35 N60	4
20130722	061346	66	W35 N60	4
20130722	061358	65	W35 N60	4
20130722	061404	62	W35 N60	4
20130722	061411	61	W35 N59	4
20130722	061422	58	W35 N60	4
20130722	061429	66	W35 N60	4
20130722	061435	68	W35 N59	4
20130722	061441	62	W35 N59	4
20130722	061453	57	W35 N59	4

- All pixel coordinates have to be converted into heliographic coordinates.
- The filament length has to be converted into arcseconds. No correction for foreshortening is applied in the length calculation.
- Very short filaments (<30 arcsec) and filaments outside 60° from disc centre are removed from the list. Very short filaments are not of interest at all as only filaments >150 arcsec are taken into account for alerting.
- Filaments are sorted according to their IDs.