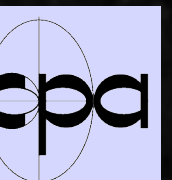


Analysis of dynamic events detected by SoFAST in SWAP EUV images

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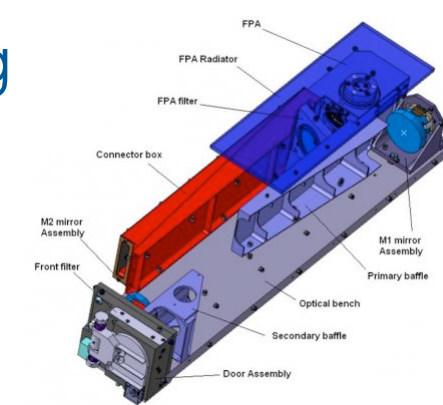


Abstract

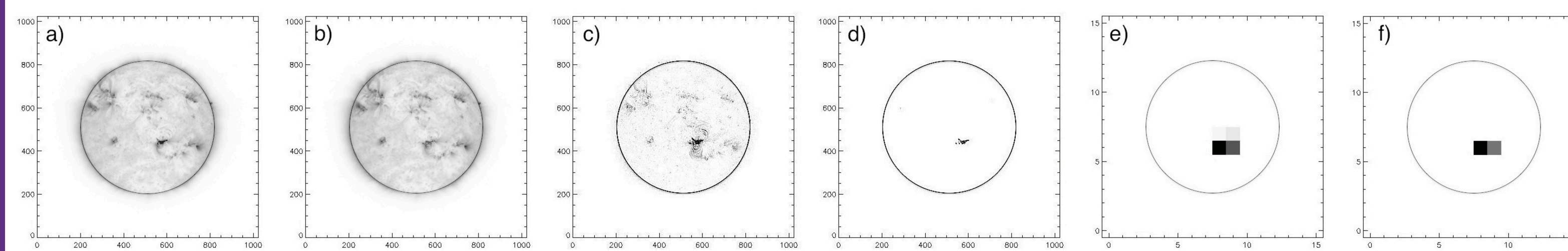
The Solar Feature Automated Search Tool (SoFAST, Bonte et al 2013) detects dynamic events in SWAP EUV images. SWAP is a 17.4 nm EUV imager on the PROBA2 satellite. The SoFAST algorithm is an operational tool that runs on the latest SWAP data, resulting in the real-time list of SoFAST EUV events available online (www.sidc.be/sofast). We have built the first SoFAST EUV event catalogue by running the tool over more than 3 years of SWAP data, taken during the period from April 2010 to June 2013. The catalogue provides timing, heliographic position and a customised classification as well as movies and graphs for more than 2000 EUV events. In this poster, we present results from Katrien Bonte's recently defended PhD thesis. For the validation of the SoFAST tool, we compare its output with associated events, mainly from the NOAA GOES catalogue. We describe the variety of typical dynamic EUV events detected, ranging from AR transient brightenings to large plasma eruptions. We statistically analyse the temporal and the spatial distribution of the SoFAST events during the rise of solar cycle 24. Our analysis shows that SoFAST output is well correlated with other indicators of solar activity. We discuss the persistence of active regions over several Carrington rotations and briefly investigate the appearance of active longitudes in our data. In addition, we investigate whether space weather important CMEs can be correlated with a SoFAST EUV event as potential low coronal signature. Our results indicate both the capability of SoFAST to automatically detect EUV events in real-time data, as the feasibility of using SoFAST to quantify the visibility of the event in SWAP data. These strengths of SoFAST make the package suitable for distinguishing portions of data containing well observed major solar events from other data, in an automated way. Such automated data selection has become a pressing challenge, given the continuous flow of data we receive from contemporary solar-observing spacecraft and the necessity for onboard data selection in future missions (e.g. Solar Orbiter).

SWAP Sun Watcher using Active Pixel System detector and Image Processing

- EUV imager
- 17.4 nm bandpass
- CMOS APS detector 1024 x 1024
- 130s cadence
- FOV of 54 arcminutes



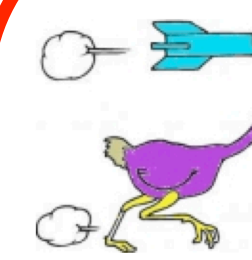
SoFAST Solar Feature Automated Search Tool



- Threshold-based detection of brightness variation in SWAP image sequences
- Clustering detections in space and time
- Simple & robust algorithm: towards onboard intelligence (Solar Orbiter/EUI)

- **Output: REAL-TIME ONLINE** <http://www.sidc.be/sofast>
- **First catalogue created based on SWAP data from April 2010 to June 2013.**

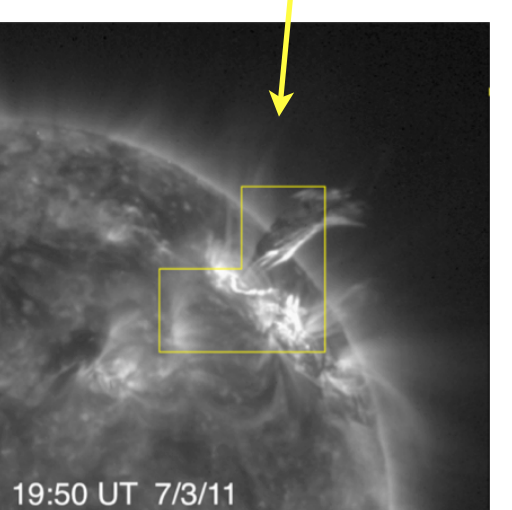
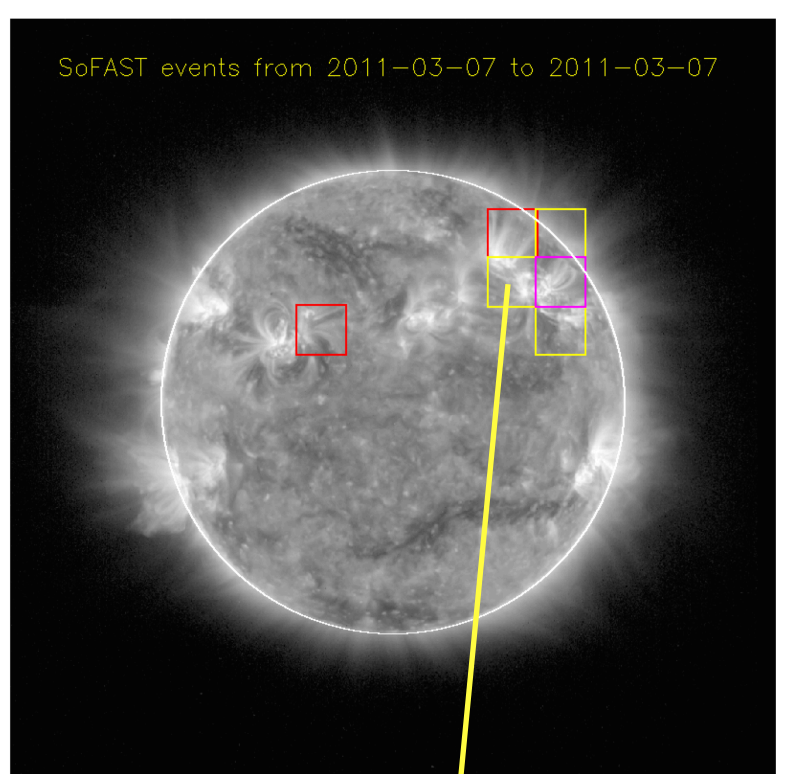
Real-time online



SoFAST 1.2.0
The "Solar Feature Automated Search Tool"

EUV-events detected by SoFAST

```
Issued: Thu Sep 27 20:40:29 2012
Product: SoFAST catalogue
# Instrument: SWAP Detector: CMOS APS 1024 x 1024
# Flare-threshold : 2 | Robinsize : 16 | Modsize : 4 | Offset : 65
# Modus : (1) SW service
#
first SWAP image this run: swap_lv1_20110307_000037.fits
last SWAP image this run: swap_lv1_20110307_235718.fits
#
# Output: Detected EUV-event map with the following characteristics:
#
# EUV EVENT:
# date: Day of observation
# start: Start time, earliest indication of detection (hh:mm UT)
# end: End time, last indication of detection (hh:mm UT)
# pos: Derived position (heliographic coordinates)
# size: Spatial size of event in number of macropixels
# #images: Duration of event in number of images (dt)
# EUV-significance: EUV relative variability.
```



Bonte et al, 2013

CLICK IMAGE to see the complete SWAP movie during this run (with indication of detected events)

www.sidc.be/sofast



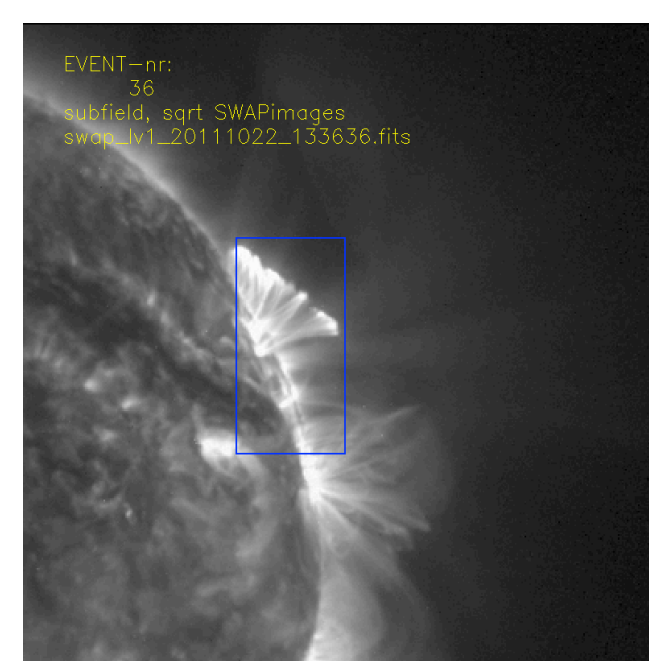
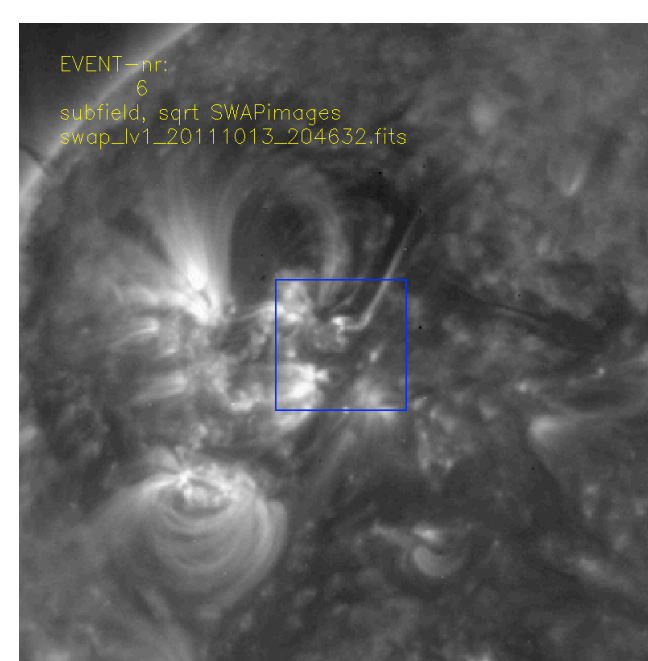
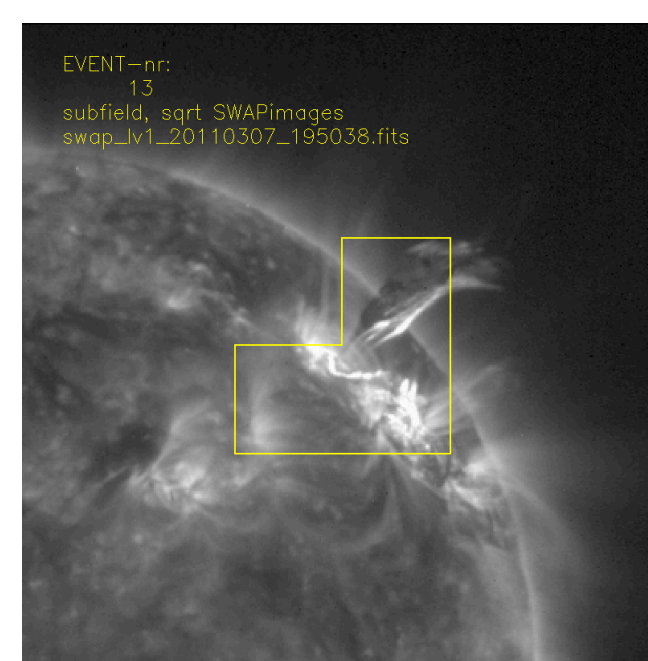
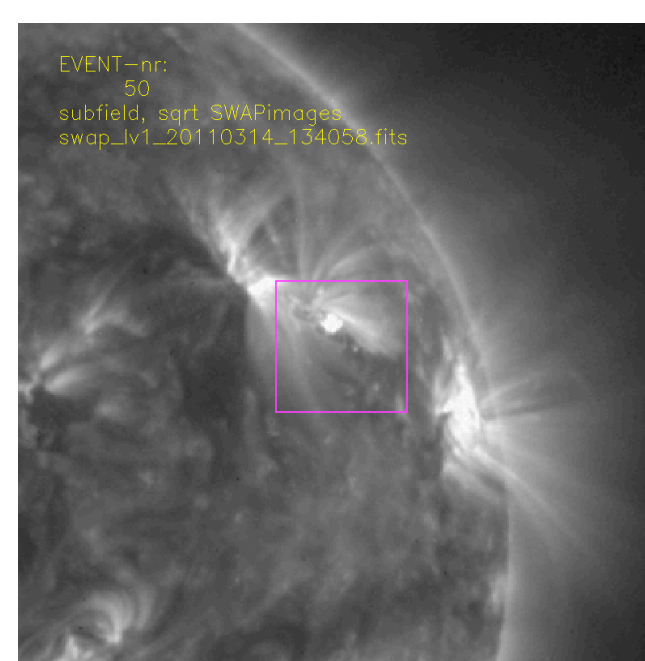
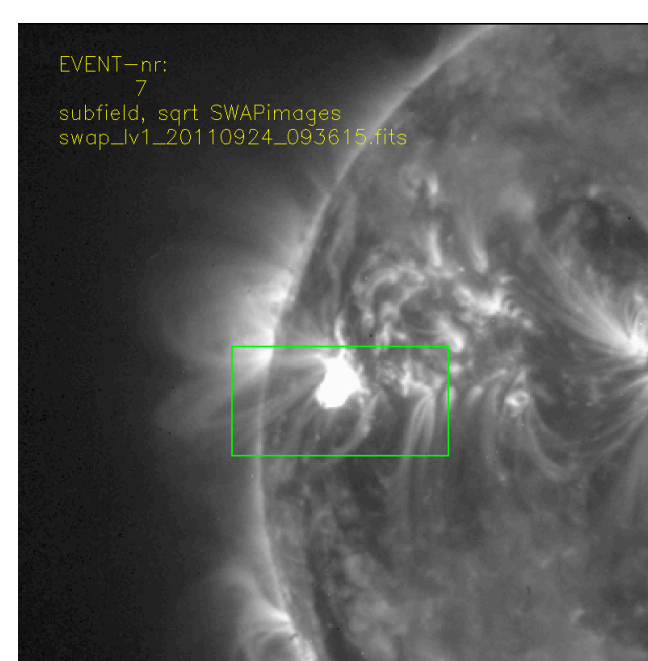
SoFAST catalogue: event analysis

During the 39-month period from April 2010 to June 2013 (covering nicely the rise of solar cycle 24), SoFAST detected 2171 EUV events.

TYPES OF EVENTS (morphologically defined)

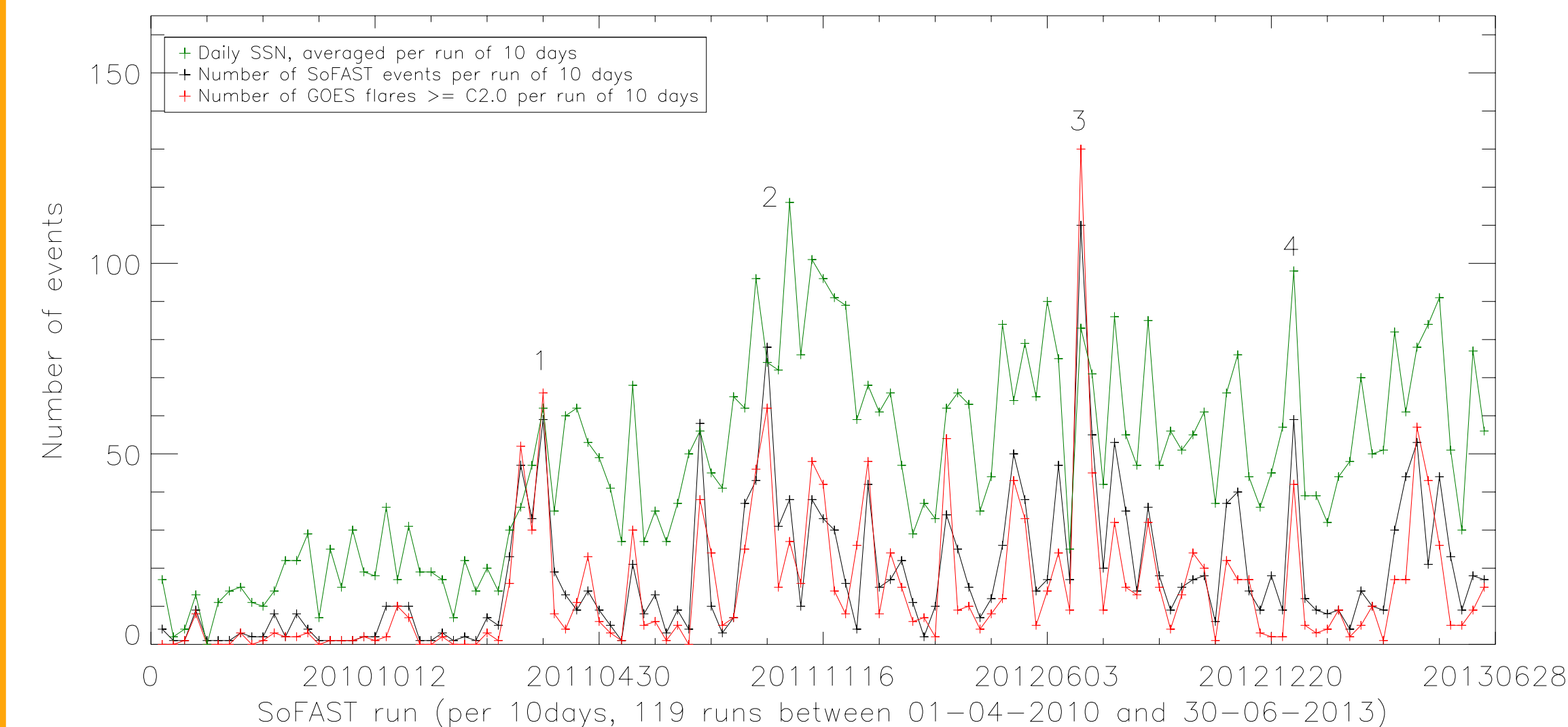
From left to right:

- EUV Flare
- AR transient brightening
- Eruption
- Jet-like
- Post-eruption loops



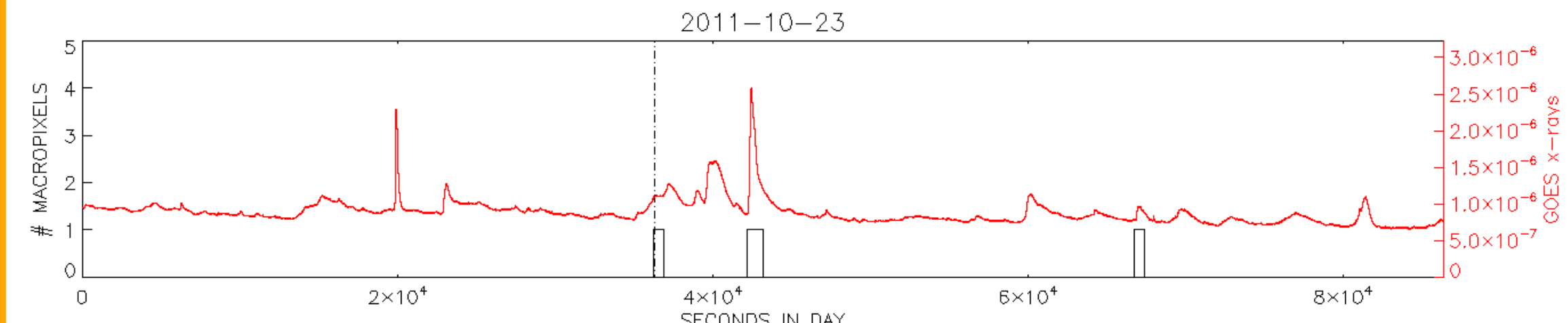
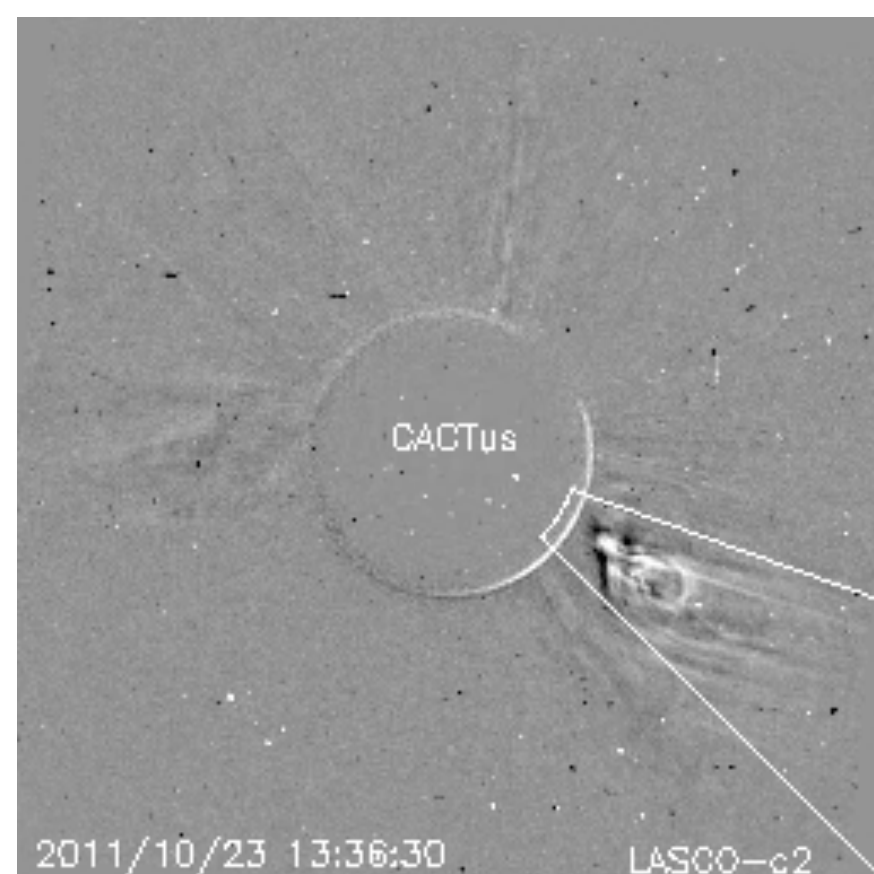
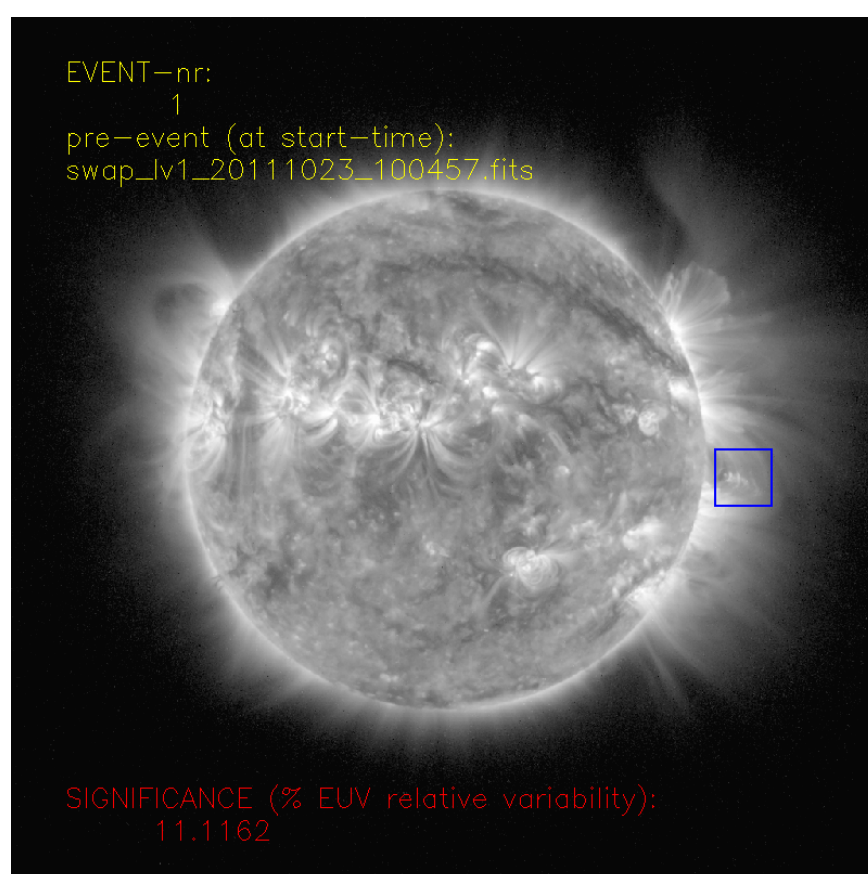
TEMPORAL VALIDATION OF EVENT DISTRIBUTION

- We found best correlation between event numbers, when we compared the EUV events from the SoFAST catalogue with solar flares down to a level of about NOAA GOES class C2.0 as detected in soft X-rays with the GOES 1-8 Å channel:



SoFAST as a space weather monitoring service

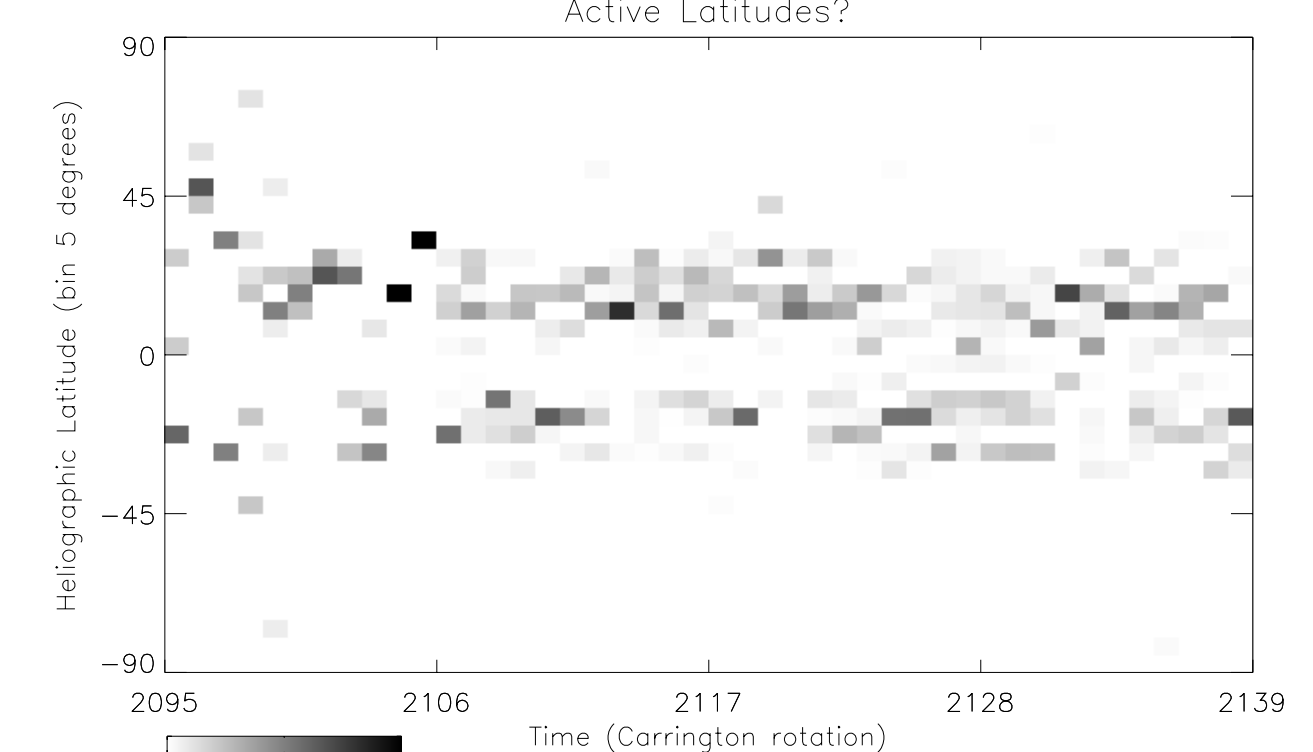
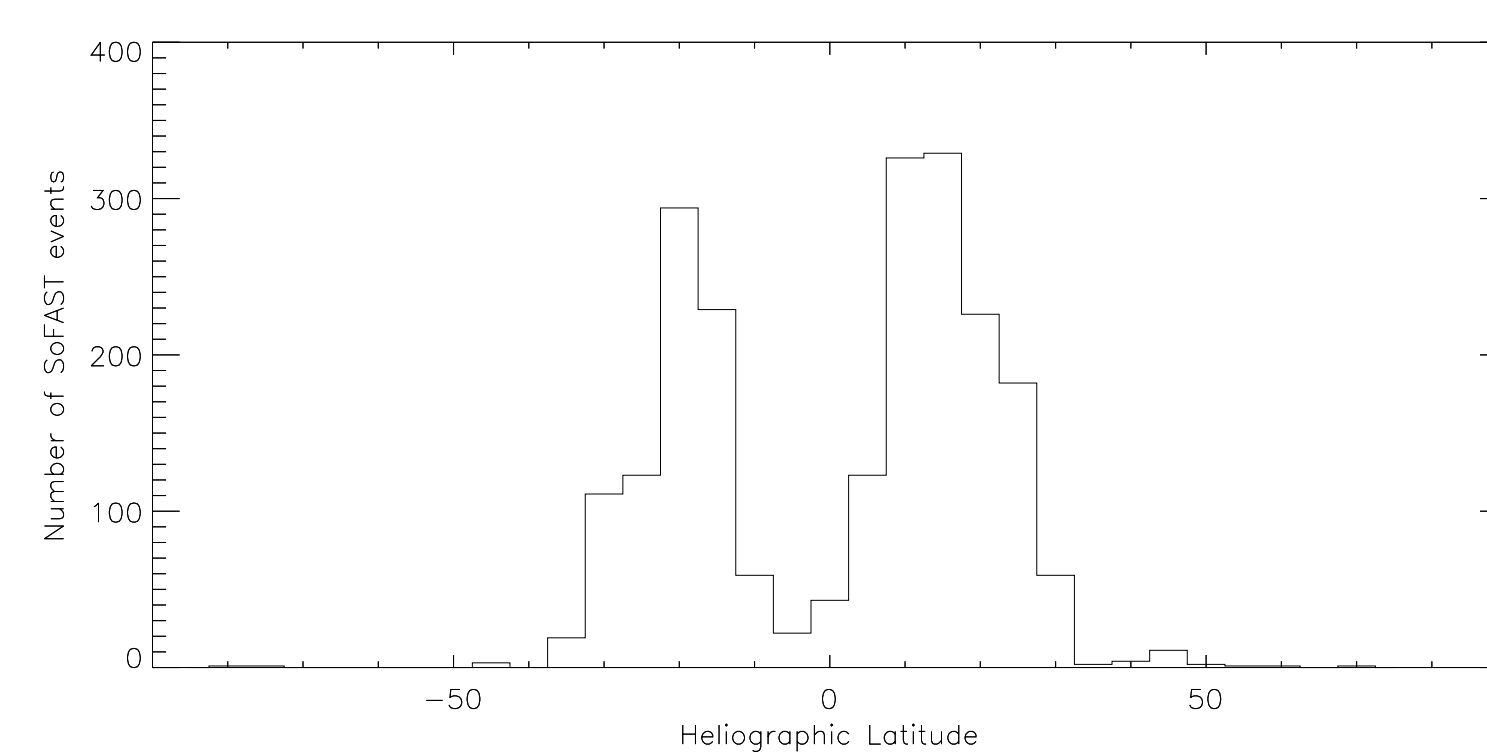
- 20% of SW-important CMEs detected by CACTus could, in an automated way, be correlated with a SoFAST event:



SPATIAL VALIDATION OF EVENT DISTRIBUTION

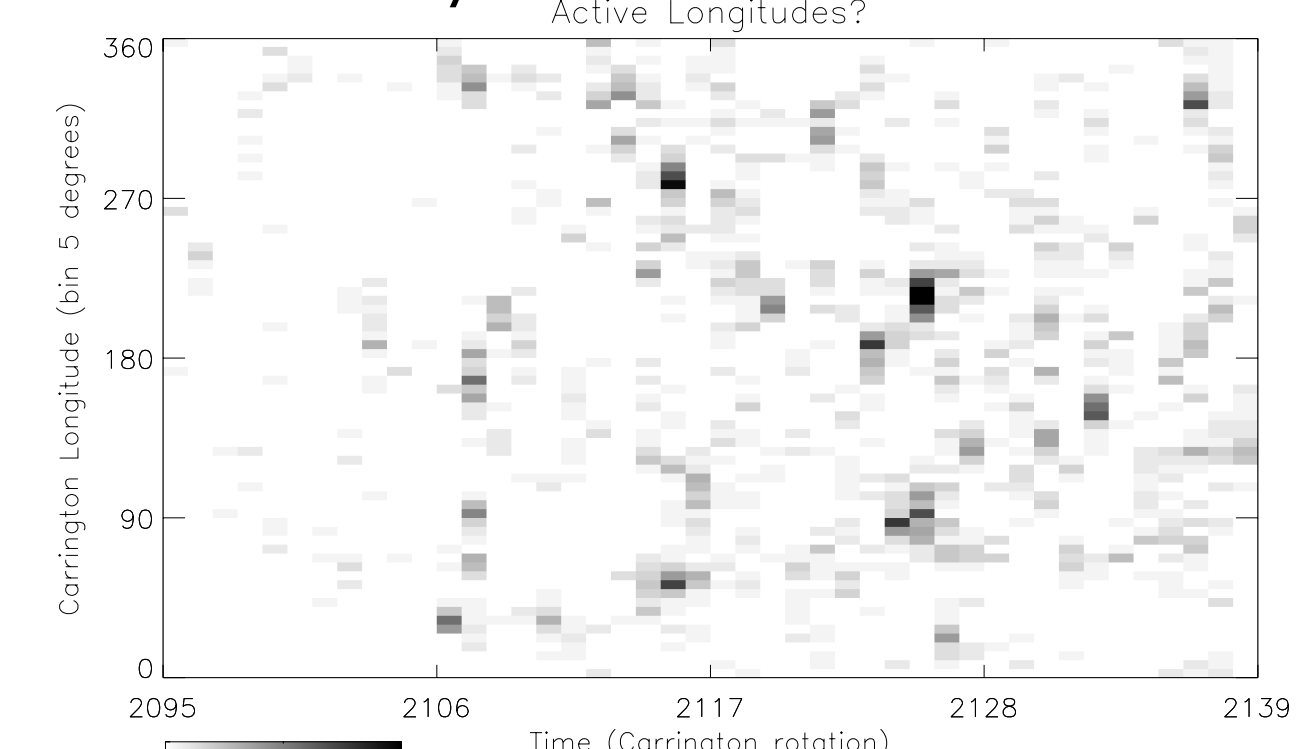
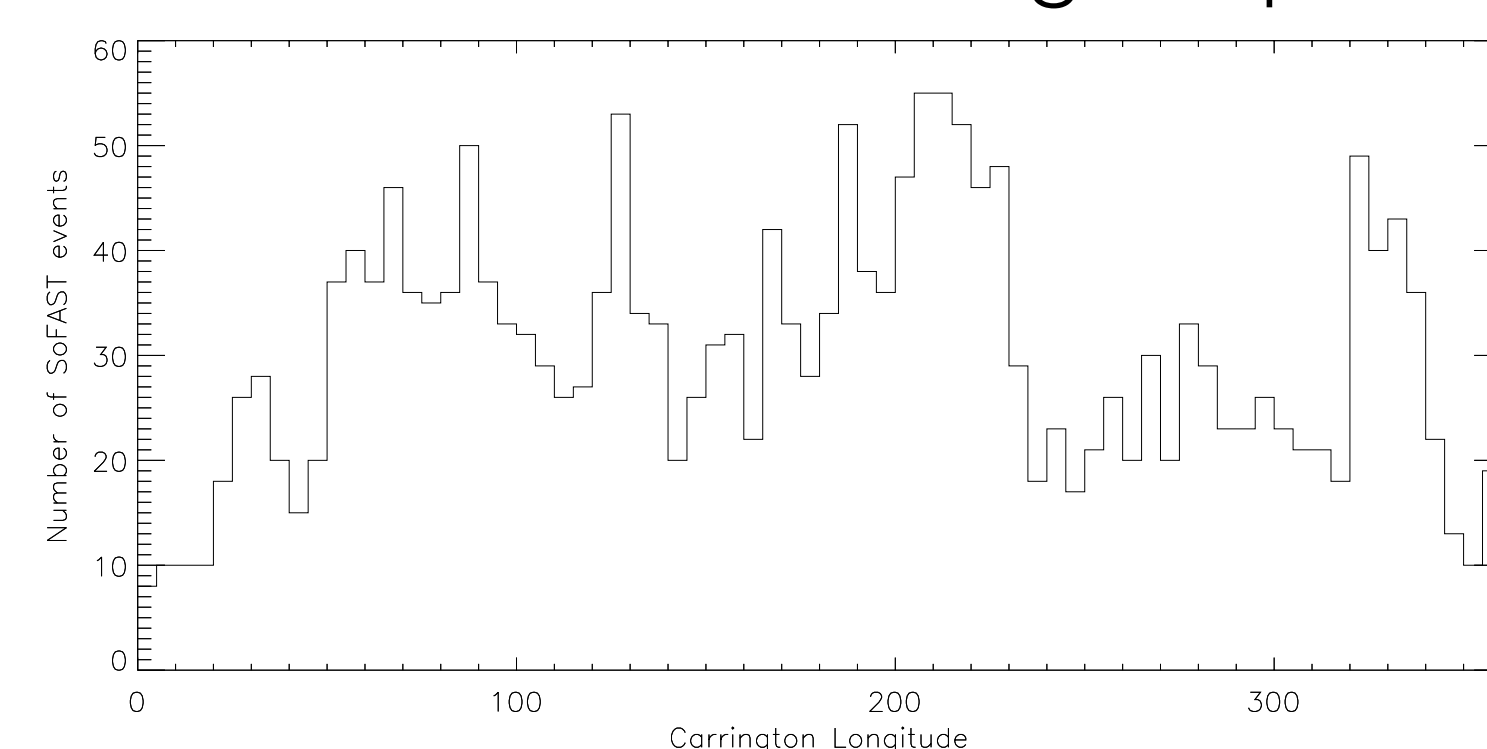
Active latitudes

Below a histogram of heliographic latitudes of all SoFAST events for the period of April 2010 till June 2013. Binsize 5°. In the plot on the right, the number of events is represented by weighted count values plotted for each Carrington rotation (X-axis) and 5° latitudinal bin (Y-axis).



Active longitudes?

Histogram and count values with regard to the Carrington longitudes of all SoFAST events during the period of our study:



Conclusions

- SoFAST output is well correlated with other indicators of solar activity.
- Our analysis of the longitudinal distribution of EUV events illustrates that highly active regions can persist for multiple Carrington rotations (see figure on the right). To support or to disprove the existence of active longitudes, a catalogue of much longer duration is required.
- An important number of SW-important CMEs can be correlated with a SoFAST detection as a potential low coronal signature.

