

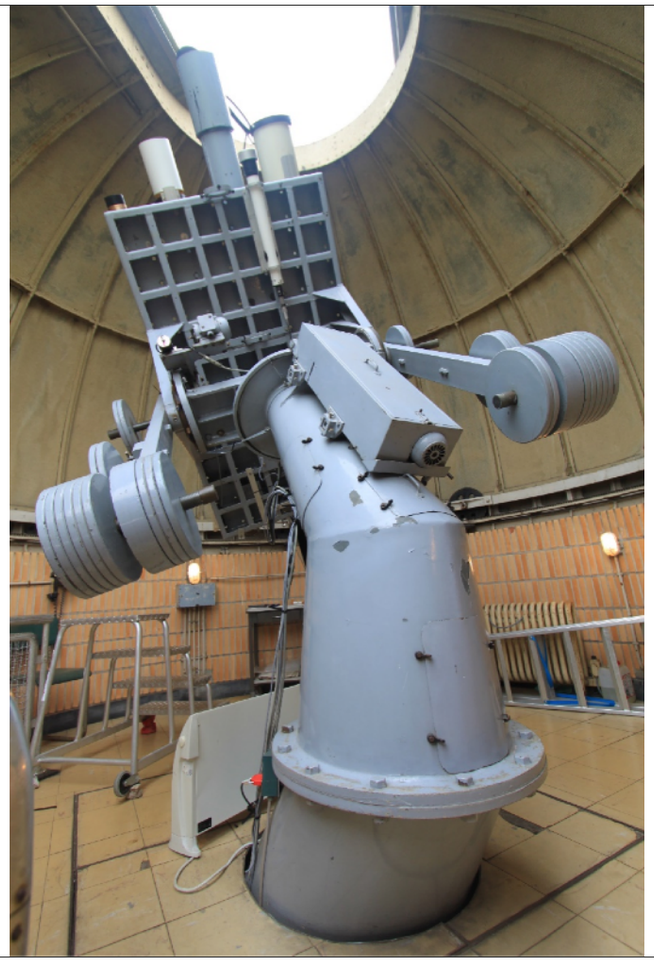
# SOLAR MONITORING
## For Space Weather purposes

# USET



Uccle Solar Equatorial Table

Sabrina Bechet



Location:
Uccle

Observations:
Sunspot group drawings since 1940
Full-disk images in multi-wavelengths :
White-light (415 – 573 nm) since 2002
Hα (656.28 nm) since 2002
CaII K (393.3 nm) since 2012

Observation period and cadence:
Morning to evening, 7/7d when weather permits
Synoptic: 15 min ; High cadence: up to 4 images/s
On average 260 observations/year

Instruments:
Complementary to space-based instruments
Long lifetime
Can be repaired and upgraded



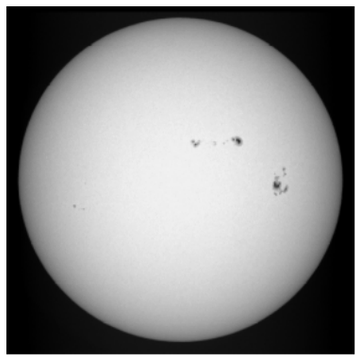
Location:
Uccle

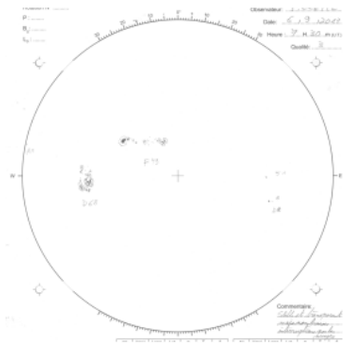
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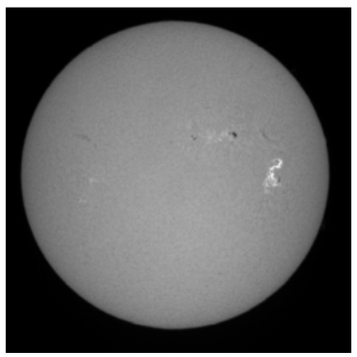
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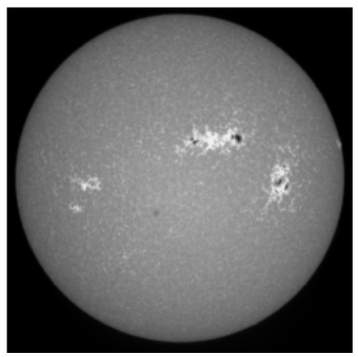
White-light





Drawing

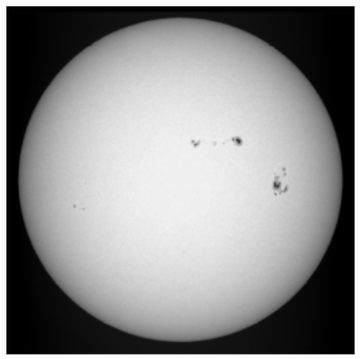


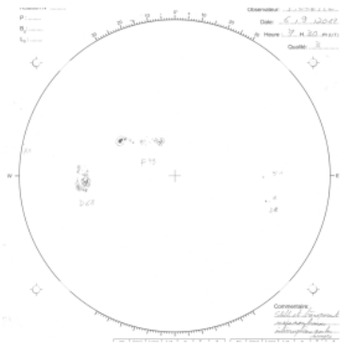


White-light :
Sunspot group parameters (database)
Position
Area
Morphology (Zurich & McIntosh classification)

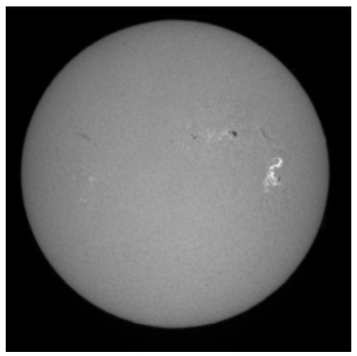
Current usage:
flare forecasting
ESA space weather services

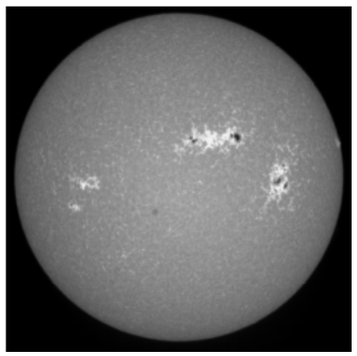
Drawing - to calculate the International Sunspot Number





Hα



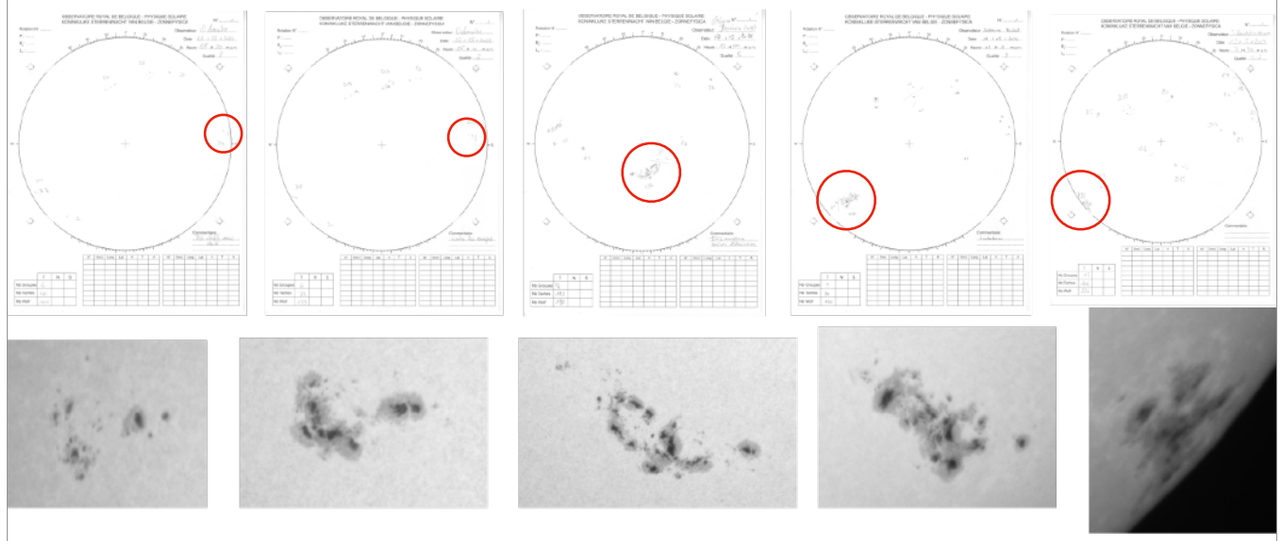


CaIIK

Hα full-disk images
Flares intensity and dynamics
Filaments dynamics
Moreton waves

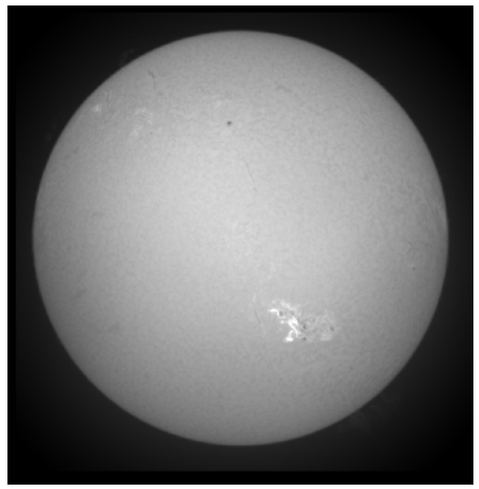
Current usage:
Bass2000 network
GHN (Global High resolution Hα Network )
ESA space weather services

# May 2024 - white light

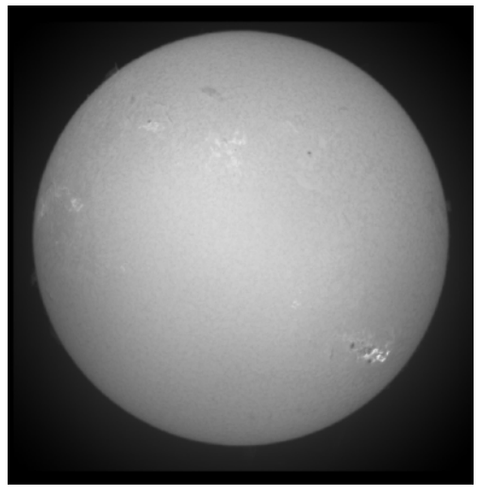


Case study

# May 2024 - H alpha



May 9 08:57:57
X2.2



May 11 11:42:25
X1.5

Flares visible in real-time
Sudden increase of brightness in Hα
Recorded in high-cadence (4 images/sec)

# Prospectives

**Upgrade of instruments**
- **High-cadence image acquisition**
- **Higher sensitivity**

**Automatisation of the dome**

**New products**
- **Automatic sunspot groups segmentation and classification based on machine learning methods**
- **Automatic detection of structures/events: flares, filaments,...**
- **Correction of the atmospheric turbulence based on advanced algorithms (lucky imaging)**

**Development of more products/services depending on needs and funding**

# Solar Observations from Humain

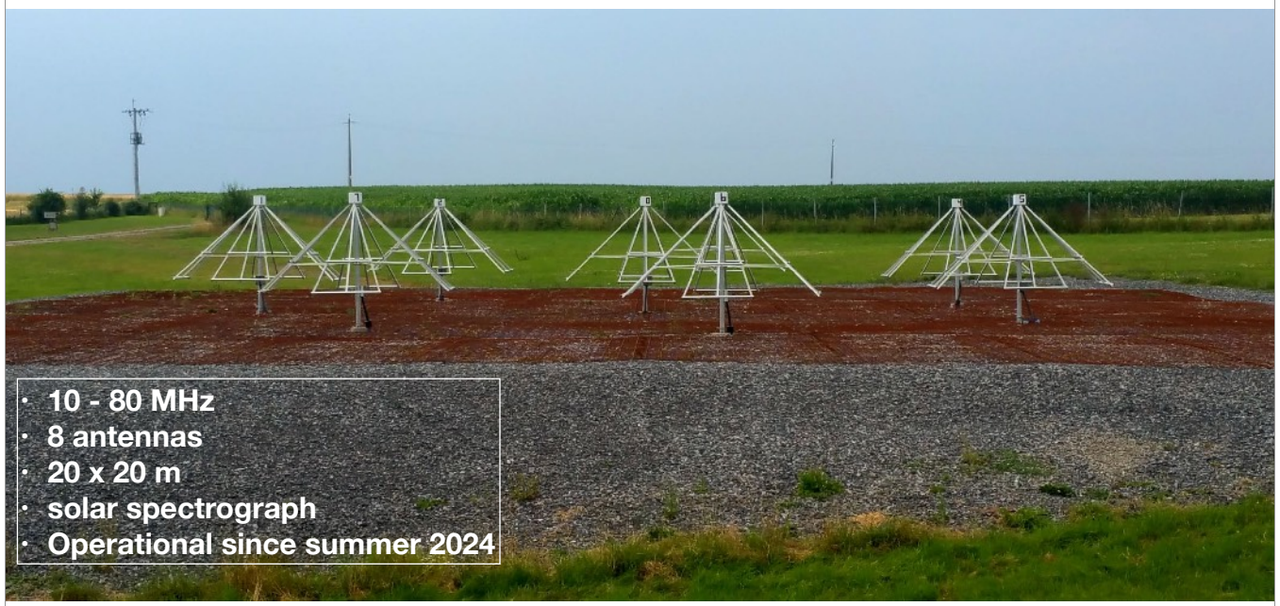



Christophe Marqué

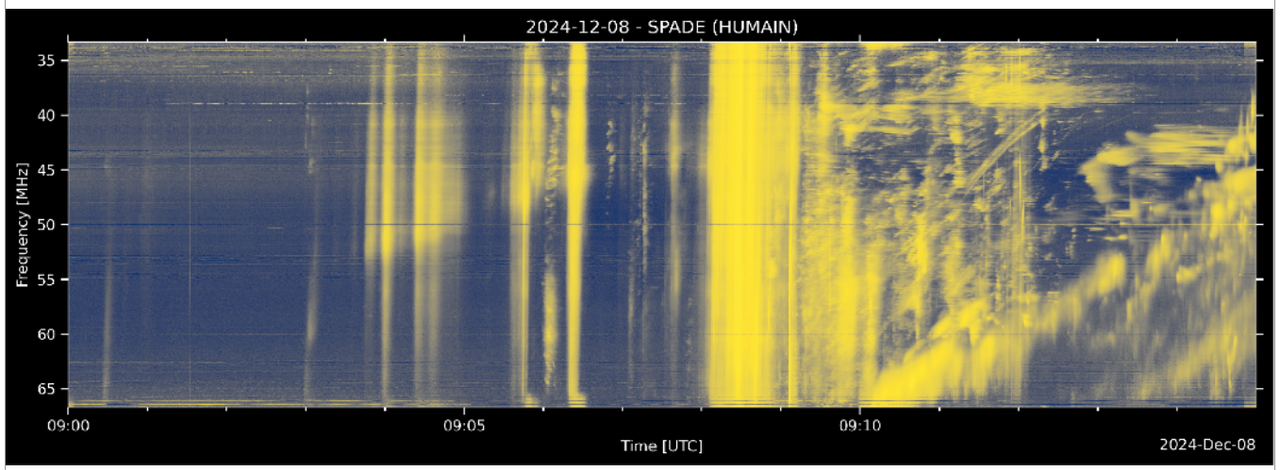
ANT61 - mount for 2 antenna’s: 45 to 1500 MHz
Dynamic spectra of the sun —> SRB: type II, III, IV

ANT34 - SAFIRE - solar flux between 1 to 5 GHz —> radars or GNSS
ATC Air Traffic Control
—> being tested

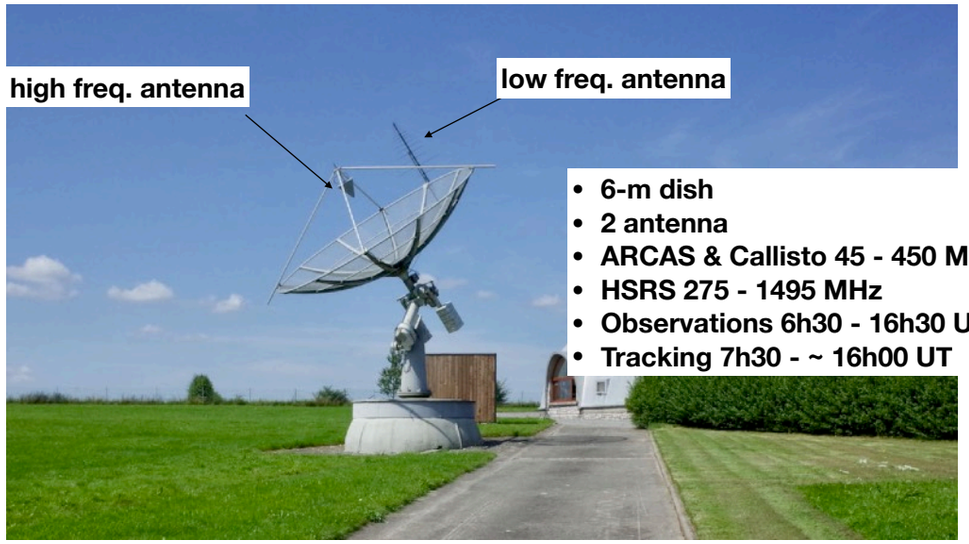
# SPADE


• 10 - 80 MHz
• 8 antennas
• 20 x 20 m
• solar spectrograph
• Operational since summer 2024

# SPADE


2024-12-08 - SPADE (HUMAIN)
Frequency [MHz]
35
40
45
50
55
60
65
09:00
09:05
09:10
Time [UTC]
2024-Dec-08

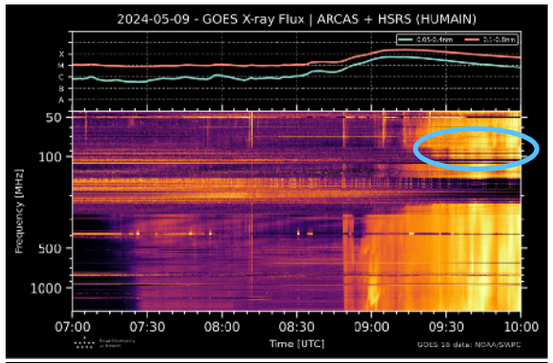
# ANT61

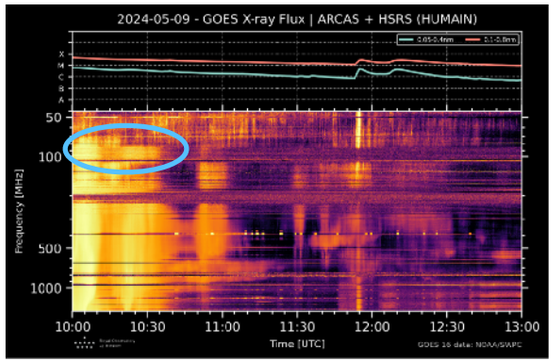


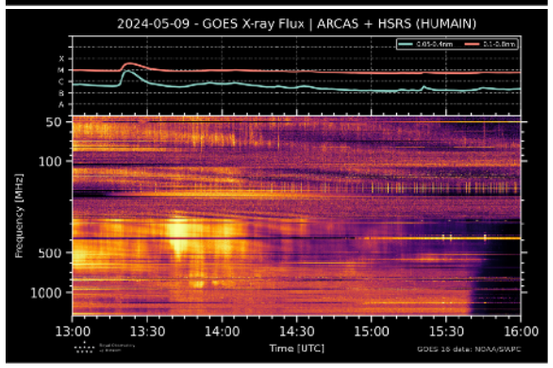

- 6-m dish
- 2 antenna
- ARCAS & Callisto 45 - 450 MHz
- HSRS 275 - 1495 MHz
- Observations 6h30 - 16h30 UT
- Tracking 7h30 - ~ 16h00 UT

- Callisto data and metadata (bursts) sent to ESA
- Quicklook & data available on SIDC website
- Quicklook available on international radio database (France)

# ANT61



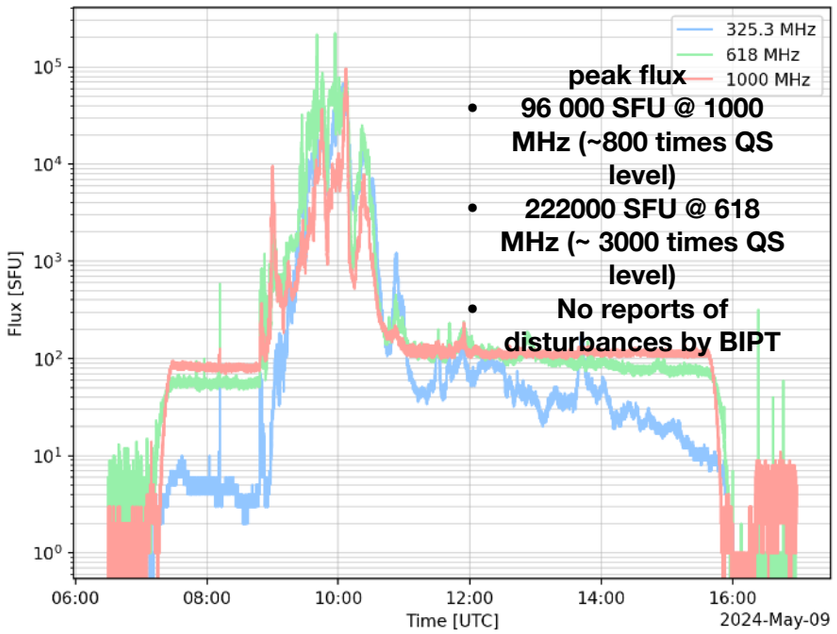




**May 9**

- **Very intense type IV burst linked to X class flare**
- **Solar flux observed even within the FM band rejection filter ! (blue)**

# ANT61


325.3 MHz
618 MHz
1000 MHz
peak flux
• 96 000 SFU @ 1000 MHz (~800 times QS level)
• 222000 SFU @ 618 MHz (~ 3000 times QS level)
• No reports of disturbances by BIPT
Flux [SFU]
$10^5$
$10^4$
$10^3$
$10^2$
$10^1$
$10^0$
06:00
08:00
10:00
12:00
14:00
16:00
Time [UTC]
2024-May-09

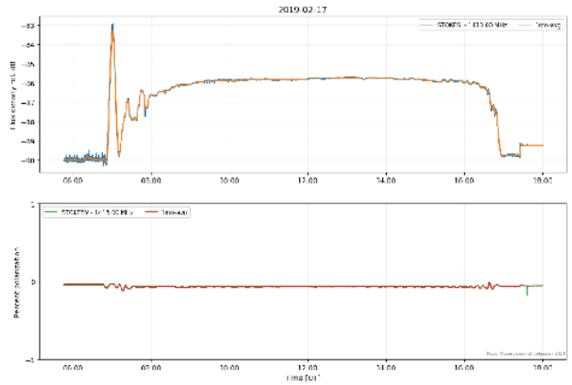
# ANT34

SAFIRE Instrument
Solar flux between 1 & 5 GHz

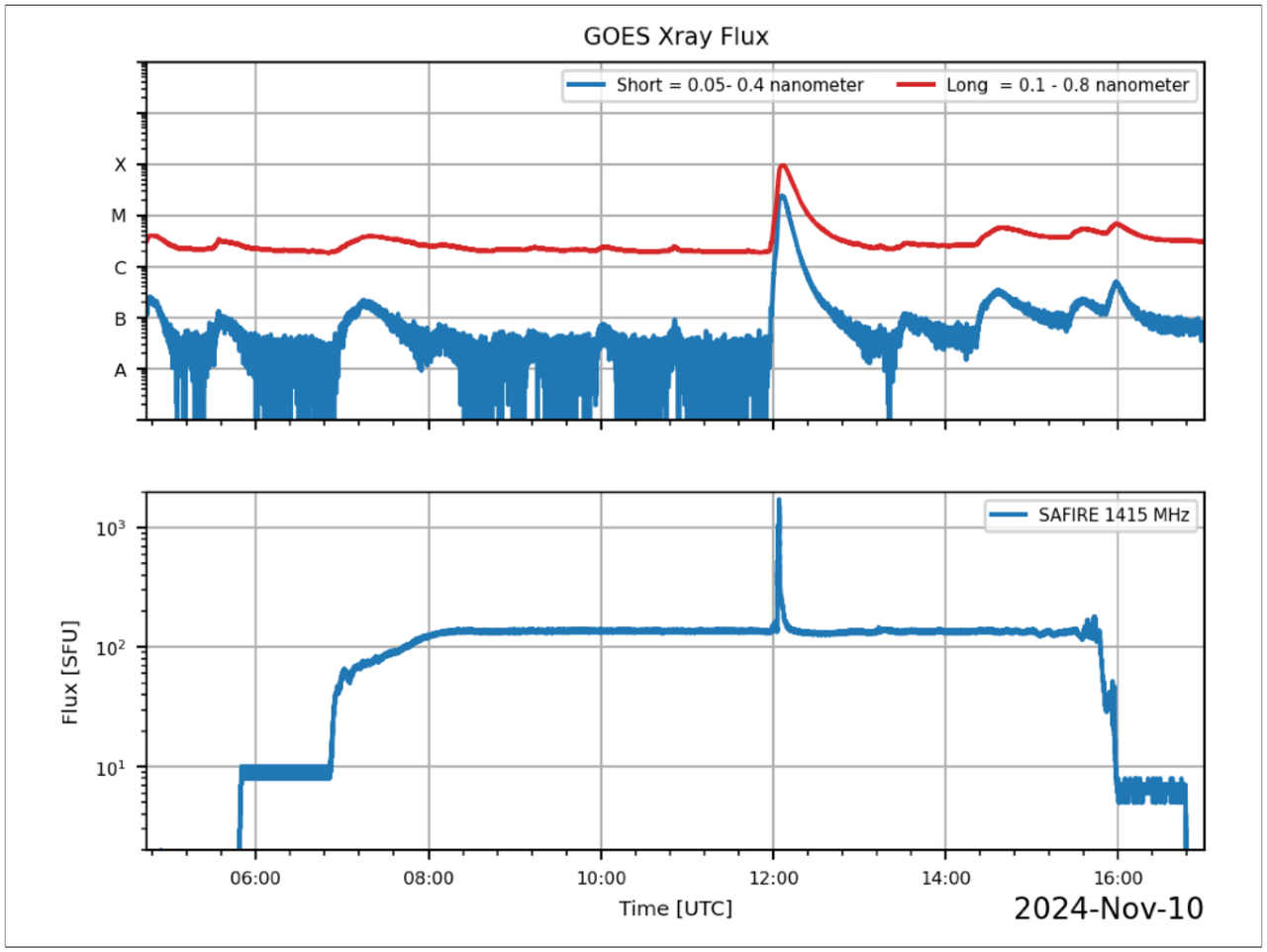


| | | | | | | |
|---|---|---|---|---|---|---|
| 1000 | 1060 | 1176 | 1228 | 1413 | 1575 | 1664 |
| | | | | | 2695 | 2800 |
| | | | 3350 | | | |
| | | | | | | 4995 |

Orbitography, ATC radars, GNSS, R.A




**Currently test observations at 1.4 GHz**


GOES Xray Flux
Short = 0.05- 0.4 nanometer
Long = 0.1 - 0.8 nanometer
X
M
C
B
A
SAFIRE 1415 MHz
Flux [SFU]
$10^3$
$10^2$
$10^1$
06:00
08:00
10:00
12:00
14:00
16:00
Time [UTC]
2024-Nov-10

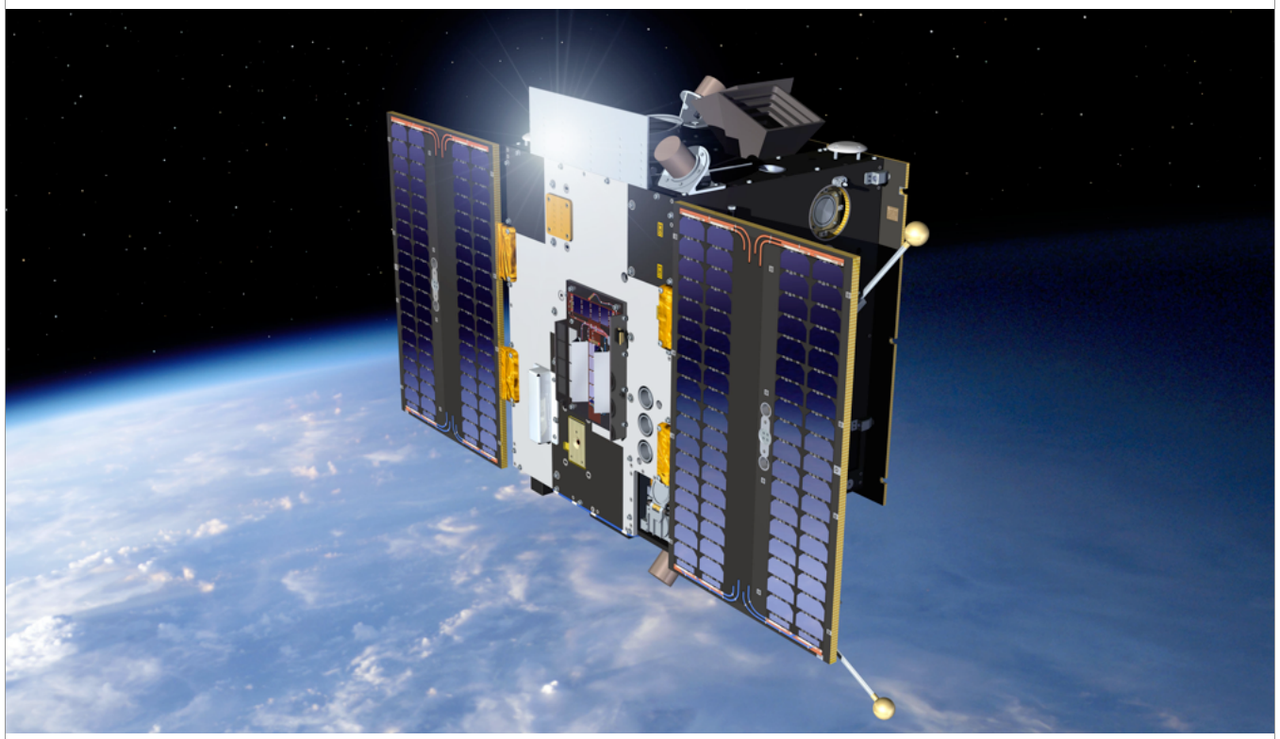
# Summary / Prospectives

**We monitor a wide range of frequencies from HF to L band and soon higher**

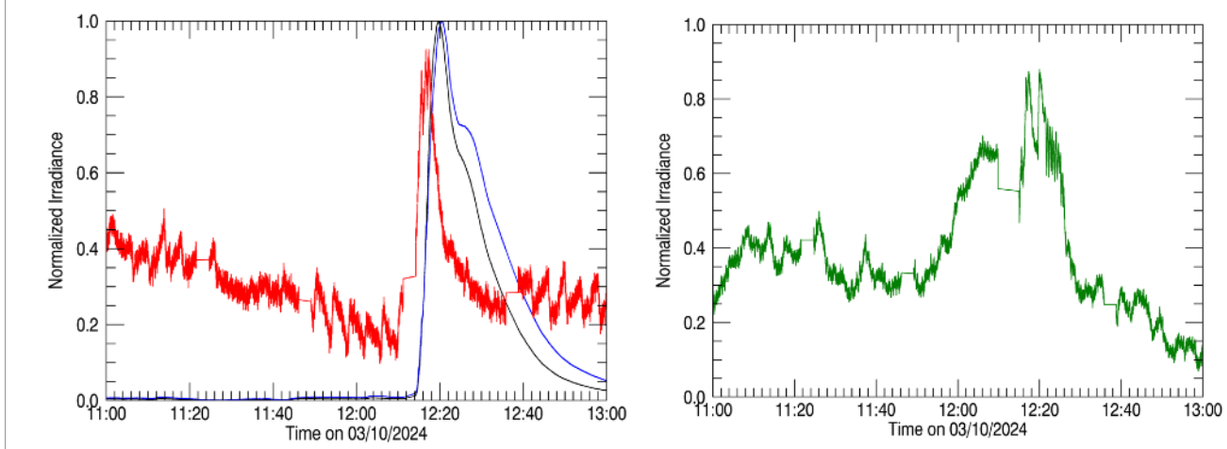
- **We could monitor specific bands for users**
- **We can provide near real-time data**
- **We are working on AI-based burst detection and alert**

**We are not at a 24/7 operational level in terms of performance, repair or maintenance, but it is achievable depending on needs and funding**

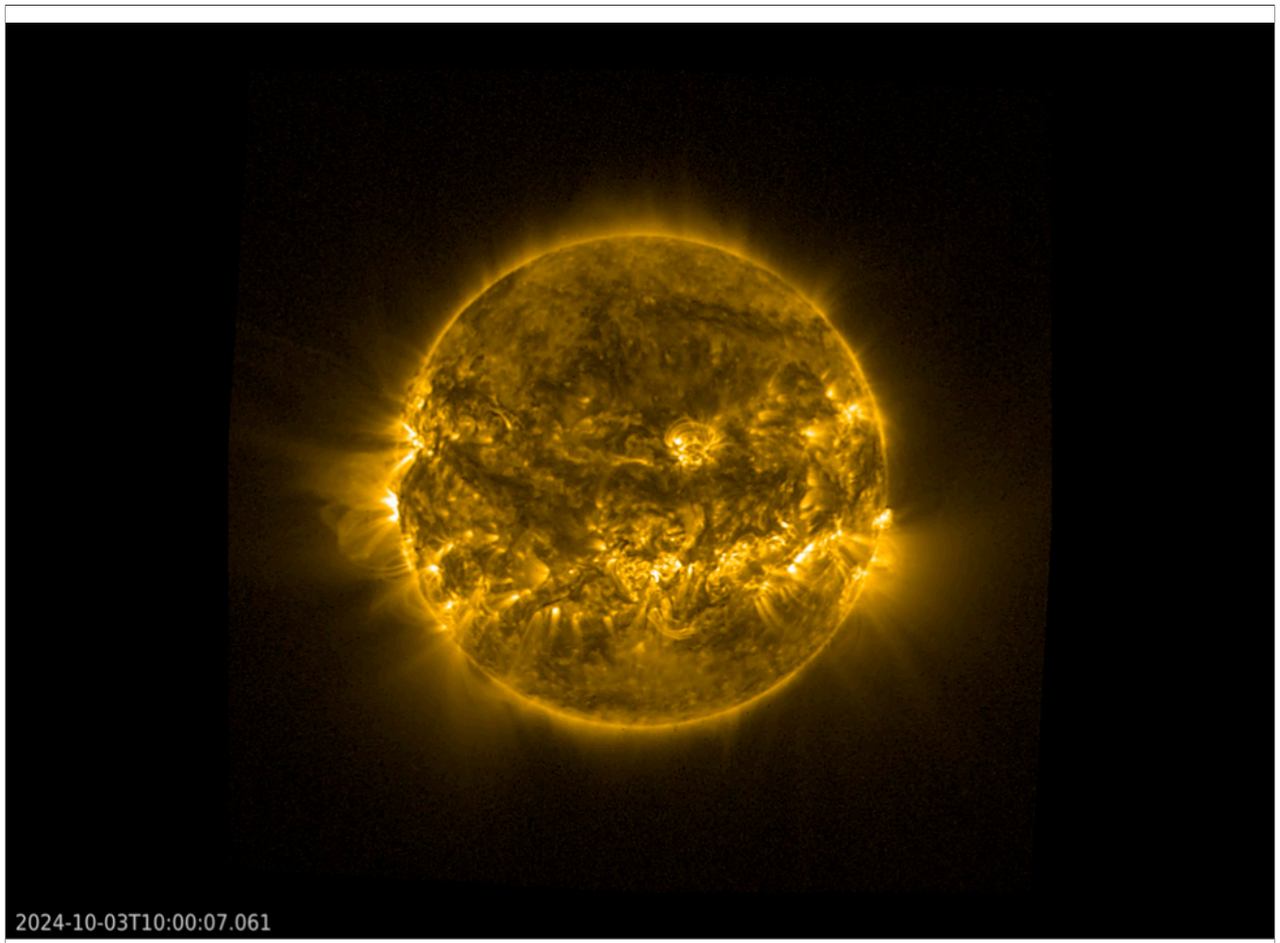
# PROBA2



Orbiting Earth - LEO
Observes the Sun continuously from the same point.



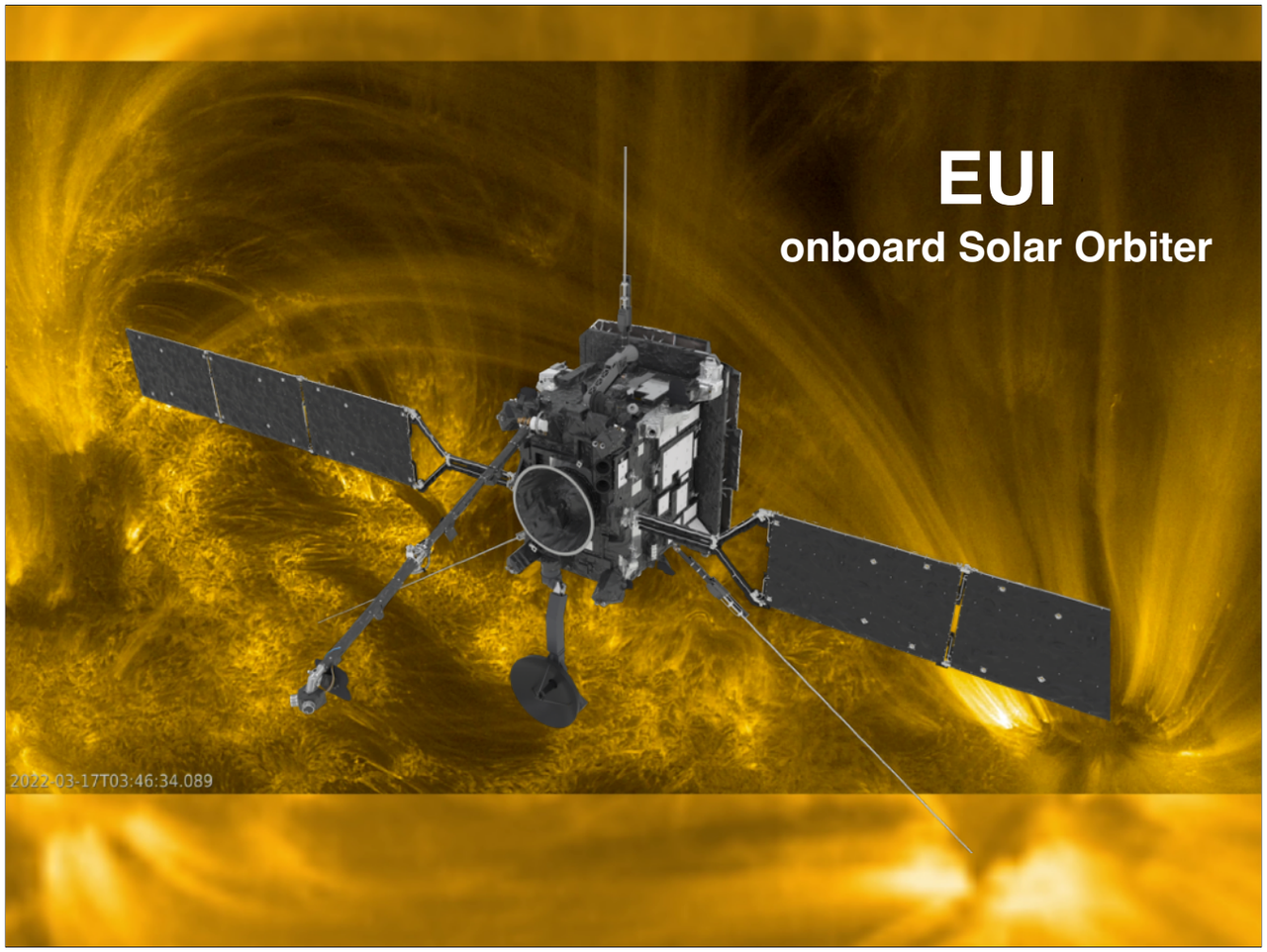

Marie Dominique
X9 flare
The detection of the flare in the Lyman-alpha channel (represented by the red curve) is especially significant, as only a few dozen similar detections have been made over the entire mission. Interestingly, the fourth channel (the Herzberg channel, shown in green) also registered an increase in signal. However, the data from this channel did not follow the typical pattern of a solar flare, prompting further investigation.




Elke D’Huys
Enige space weather satelliet die volledig door ESA beheert wordt, is low-cost, SWAP zo goed als niet gedegradeerd dus kan nog lang mee, maar is niet zomaar gegeven dat ESA en BELSPO blijven betalen.

# In support of
# Space Weather Monitoring

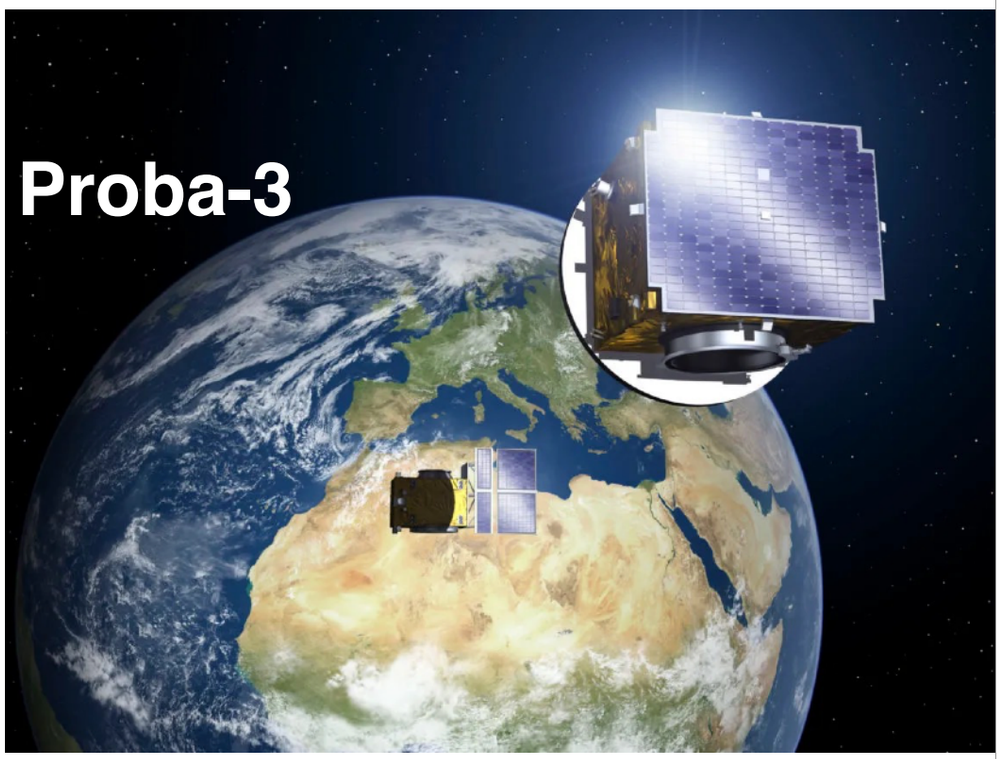
Improving forecast
Occasionally, also monitoring from a
relevant position




David Berghmans

Exotic orbit, monitoring the sun from all possible sides

2024




Andrei Zhukov

Not continuously monitoring - 6 hours in an highly elliptical orbit of little more than 19 hours.