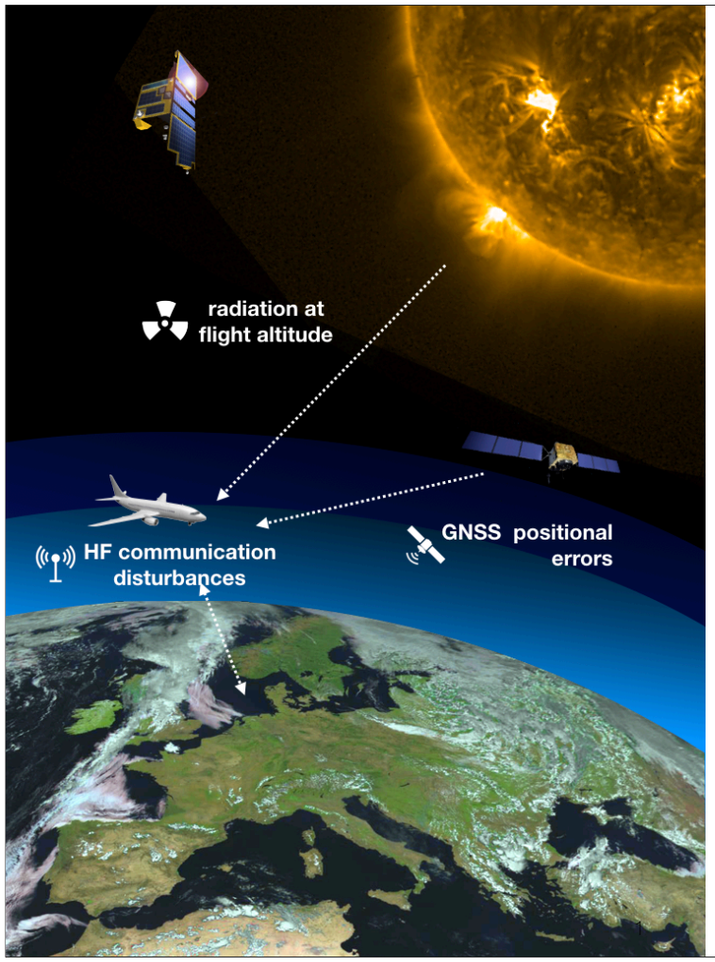
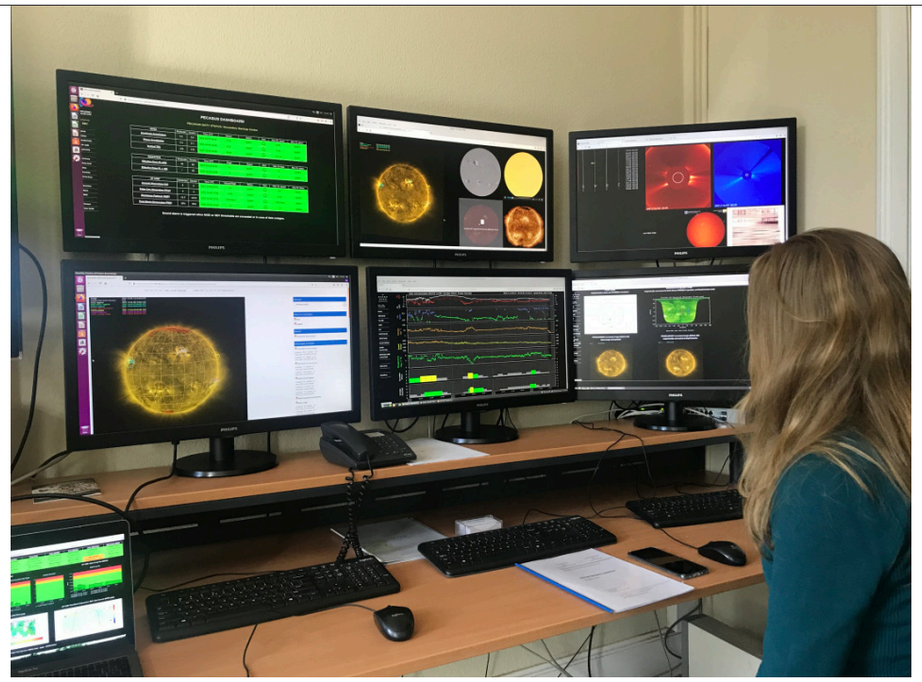


Space Weather impacts on Aviation

PECASUS advisories for ICAO

Course by the
Solar-Terrestrial Centre of Excellence

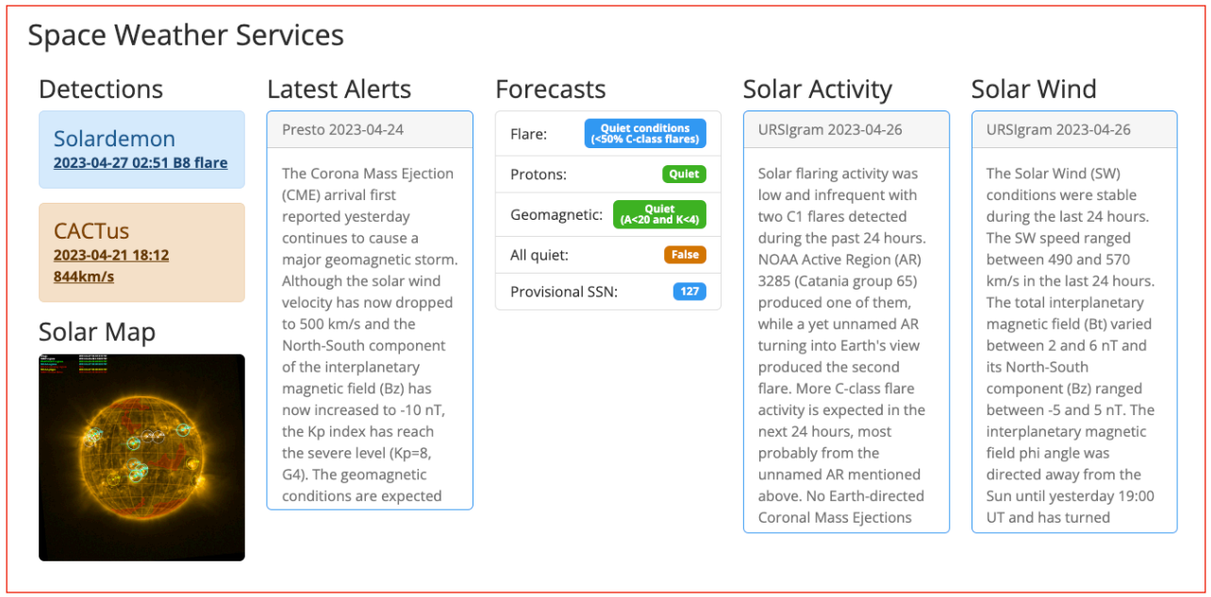
March 2024



Space Weather Forecasting at the STCE
Products and Tools

Elke D'Huys

SIDC Webpage



www.sidc.be

The website gives an overview of most of the products we have: the daily bulletins, but also our automatic detections and alerts

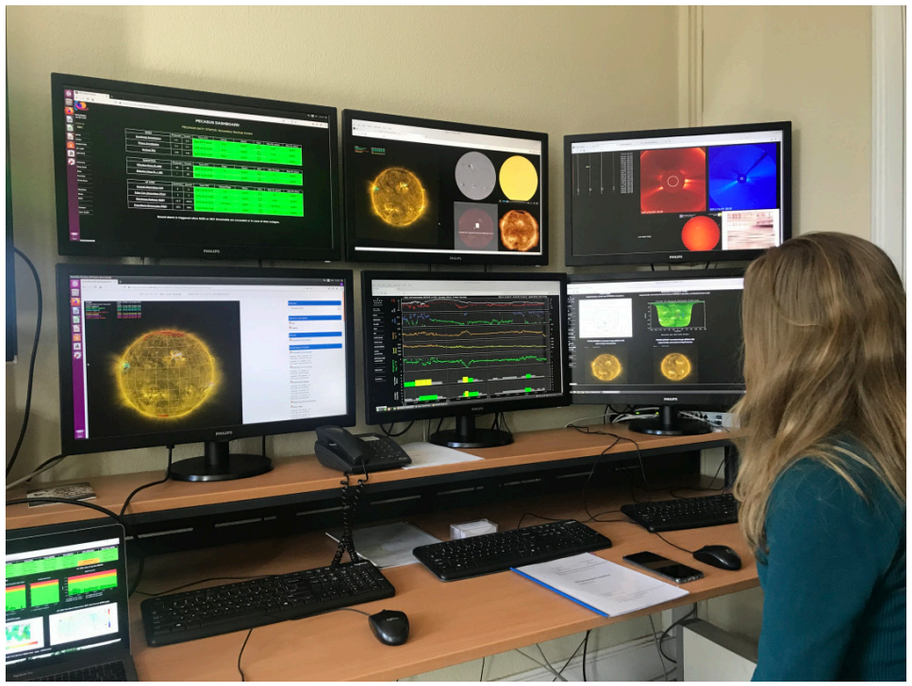
Forecaster and Pecasus operator Tasks

Forecaster
- One week duty cycle
- Daily ursigram
- Alerts when needed
- Briefing/handover on Monday
- 24/7 with automated alerts
- PECASUS operator during day (9-17h)
- Tailored bulletins (BepiColombo, Mars Express)

PECASUS Operator
- 17h-9h (except weekends)
- Night shifts
- On call with support from MeteoWing
- ICAO Advisories when needed + follow-up

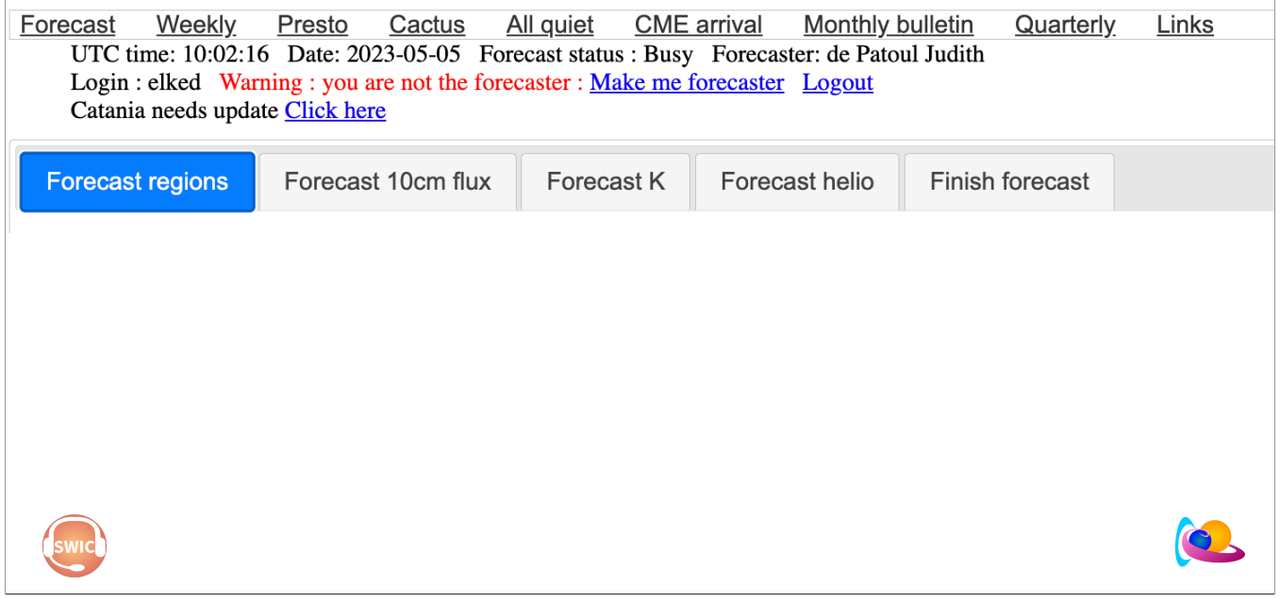
There are two main roles: forecasters and PECASUS operators. Many colleagues combine both roles, but not in consecutive shifts.
All forecasters need to be trained as a PECASUS operator because they combine both roles during the day.

Monitoring



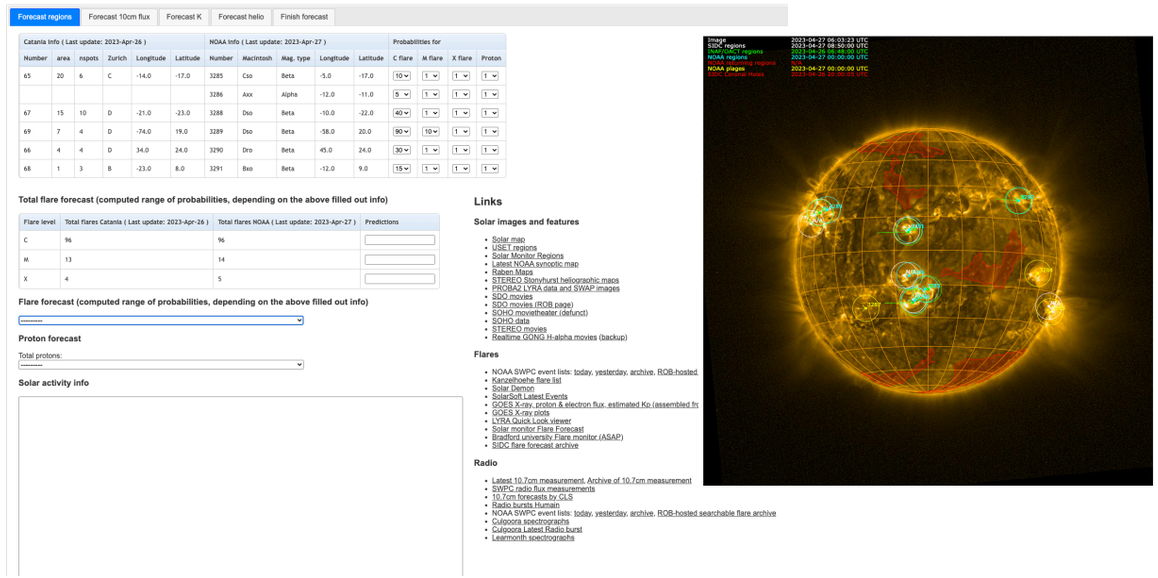
The main task is constant monitoring, based on
- satellite and ground-based data
- data processing & modelling software
- PECASUS dashboard

Previweb - Forecaster page



This is the top of our forecaster prediction page. You can see that besides the preparation of the daily bulletin, the forecaster also makes a weekly overview.
We will focus on two tabs at the bottom: forecasting of flares based on the active regions that are present on the disk and forecasting of the geomagnetic index K since both are directly relevant for PECASUS.

Solar Flares - Regions

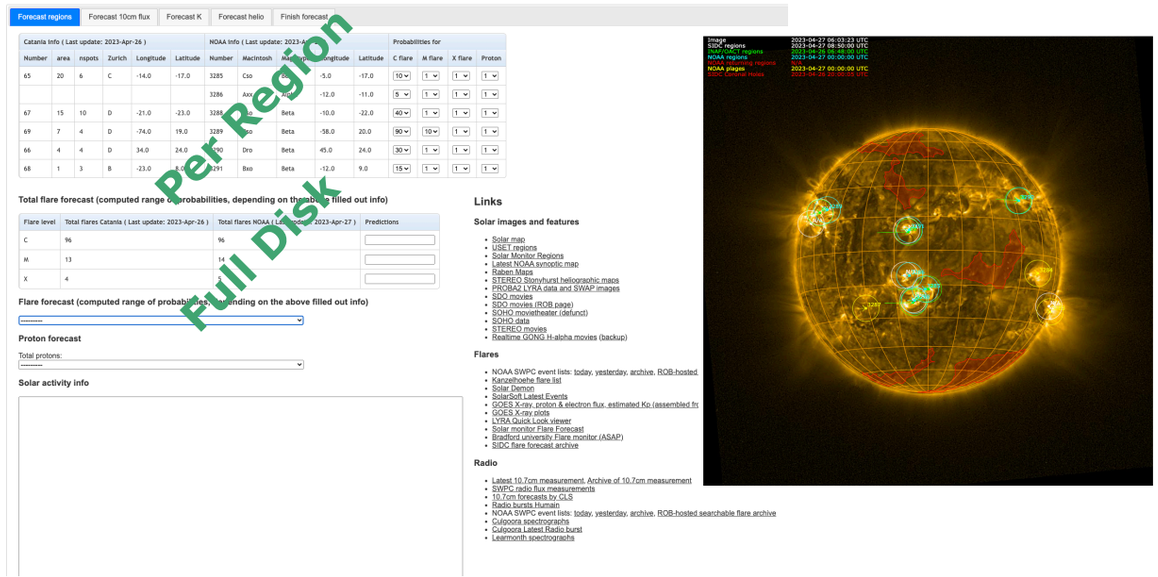


When the forecaster loads this regions page, it is automatically filled with the regions that are on the solar disk that day.
These regions are zone on the solar disk that have a certain classification. We use different types of classifications, which can be linked to the likelihood that this region will produce a (strong) solar flare.
The probabilities can be adapted by the forecaster based on their observations, eg. did the region show increased activity in the past hours, was there flaring observed already, what did this region do during its previous rotation, is the region decaying Etc.
Its position is also important, as for forecasting we are interested in regions that will produce an event that will impact Earth.

A probability here means: “The probability of a flare of a certain magnitude or higher occurring over a certain time period”.
The magnitude bins are interpreted to be unbound at the upper end: e.i. C means C or above, M means M or above, etc.
The time period of prediction covers a period of 24 hours, from 12:30UT of that day until 12:30UT of the next day.

The prediction of the full disc probability corresponds in principle to the sum of all probabilities. However, the forecaster might want to increase or decrease the prediction to take into accounted additional regions expected to rotate from behind the East solar limb or developing on disk.

Solar Flares - Forecast



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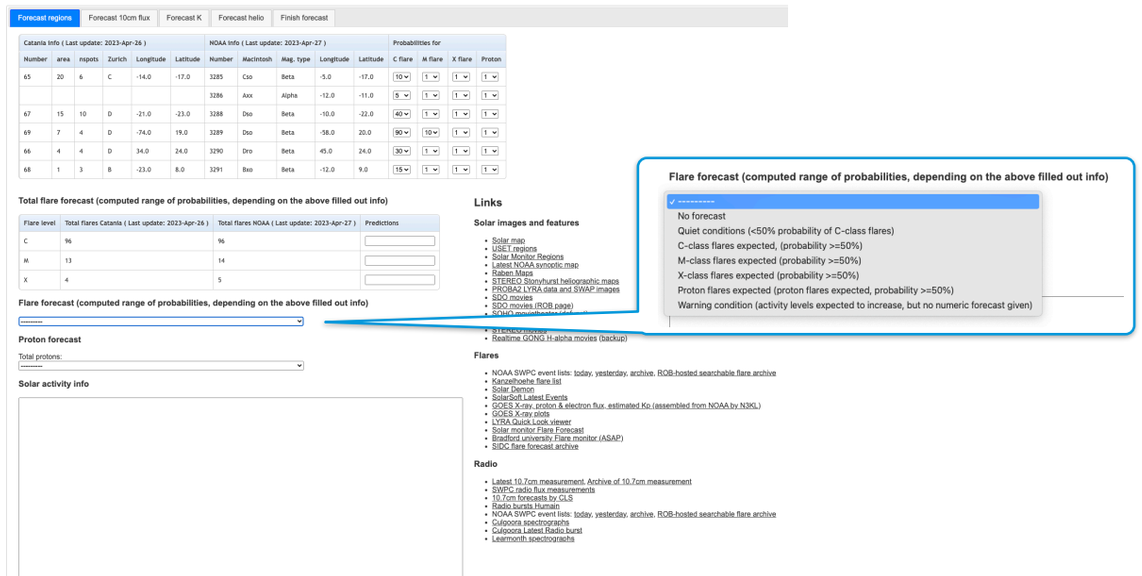
Solar Flares - Forecast Disk



Based on the full disc probabilities the forecaster chooses the applicable ISES (International Space Environment Service) category based on passing the 50 percent threshold for the C/M/X flares.

Flares -> Short Wave fade-out

PECASUS DASHBOARD

PECASUS DUTY STATUS: Secondary Backup Centre

GNSS	Moderate	Severe	Time UTC	Values	Status	Alert	Max-3h values	Max-3h status
Amplitude Scintillation	0.5	0.8	2024-03-04 14:45	0.33	QUIET		0.98	SEVERE
Phase Scintillation	0.4	0.7	2024-03-04 14:45	0.17	QUIET		0.30	QUIET
Vertical TEC	125	175	2024-03-04 14:40	95.92	QUIET		98.57	QUIET

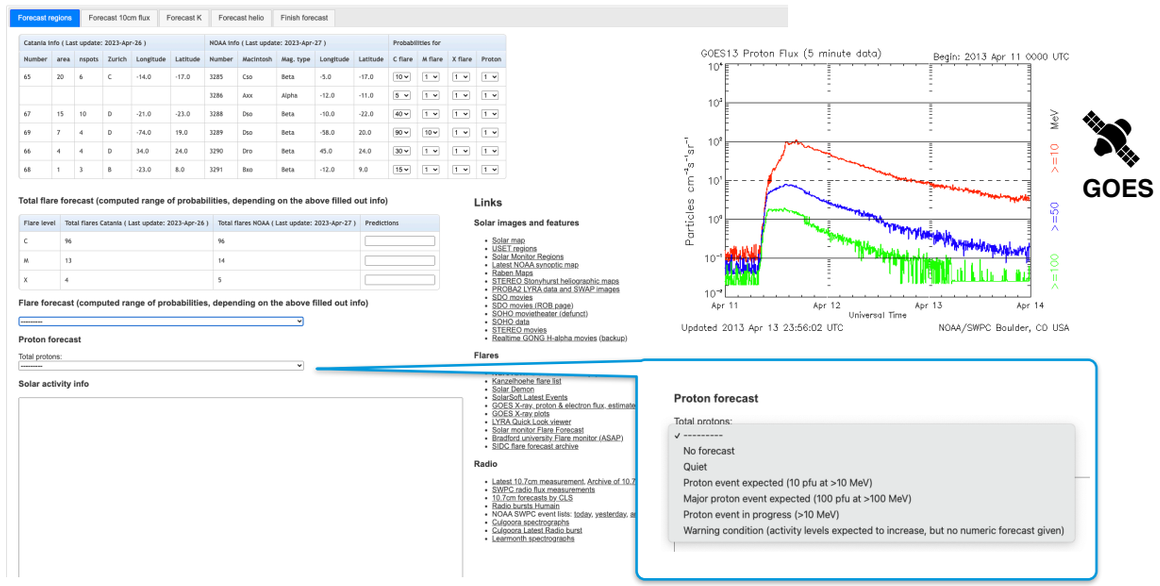
RADIATION	Moderate	Severe	Time UTC	Flags	Status	Alert	Max-3h flags	Max-3h status
Effective Dose FL ≤ 460	30	80	2024-03-04 14:45	0	QUIET		0	QUIET
Effective Dose FL > 460	/	80	2024-03-04 14:45	0	QUIET		0	QUIET

HF COM	Moderate	Severe	Time UTC	Values/Flags	Status	Alert	Max-3h values	Max-3h status
Auroral Absorption (AA)	8	9	2024-03-04 14:48	2.0	QUIET		2.0	QUIET
Polar Cap Absorption (PCA)	2	5	2024-03-04 14:47	0.11	QUIET		0.23	QUIET
Shortwave Fadeout (SWF)	x1.0	x10.0	2024-03-04 14:45	< M5 flare	QUIET		< M5 flare	QUIET
Post-Storm Depression (PSD)	30%	50%	2024-03-04 14:45	2	SEVERE		2	SEVERE

Sound alarm is triggered when MOD or SEV thresholds are exceeded or in case of data outages.

Strong flares (thresholds X1 and X10) may lead to short wave fade-outs, so problem with HF communications on the dayside of the Earth.

Protons - Forecast



The forecaster also predicts proton events. These occur when the greater than 10 MeV proton flux exceeds the threshold of 10 particles.
Proton events can be associated with flares (particles are accelerated) or CMEs (from shock).
There's a higher likelihood for SEP events from the western hemisphere as they travel on magnetic field lines that are connected to the earth's magnetosphere. (Parker spiral)
The stronger gradual events are associated to wider and faster CMEs.

To predict proton events a forecaster will look for active regions & filaments that can:

- Produce strong x-ray flares
- Fast CMEs (~1000 km/s or more)
- Wide CMEs (partial or full halo CMEs)
- Preferably on the western solar hemisphere

Proton event -> PCA

PECASUS DASHBOARD

PECASUS DUTY STATUS: Secondary Backup Centre

GNSS	Moderate	Severe	Time UTC	Values	Status	Alert	Max-3h values	Max-3h status
Amplitude Scintillation	0.5	0.8	2024-03-04 14:45	0.33	QUIET		0.98	SEVERE
Phase Scintillation	0.4	0.7	2024-03-04 14:45	0.17	QUIET		0.30	QUIET
Vertical TEC	125	175	2024-03-04 14:40	95.92	QUIET		98.57	QUIET

RADIATION	Moderate	Severe	Time UTC	Flags	Status	Alert	Max-3h flags	Max-3h status
Effective Dose FL ≤ 460	30	80	2024-03-04 14:45	0	QUIET		0	QUIET
Effective Dose FL > 460	/	80	2024-03-04 14:45	0	QUIET		0	QUIET

HF COM	Moderate	Severe	Time UTC	Values/Flags	Status	Alert	Max-3h values	Max-3h status
Auroral Absorption (AA)	8	9	2024-03-04 14:48	2.0	QUIET		2.0	QUIET
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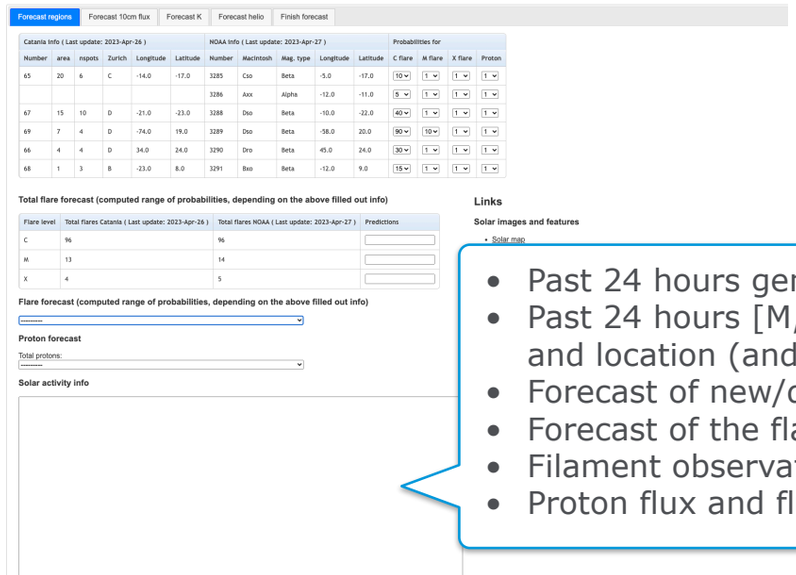
Shortwave Fadeout (SWF)	x1.0	x10.0	2024-03-04 14:45	< M5 flare	QUIET		< M5 flare	QUIET
Post-Storm Depression (PSD)	30%	50%	2024-03-04 14:45	2	SEVERE		2	SEVERE

Sound alarm is triggered when MOD or SEV thresholds are exceeded or in case of data outages.

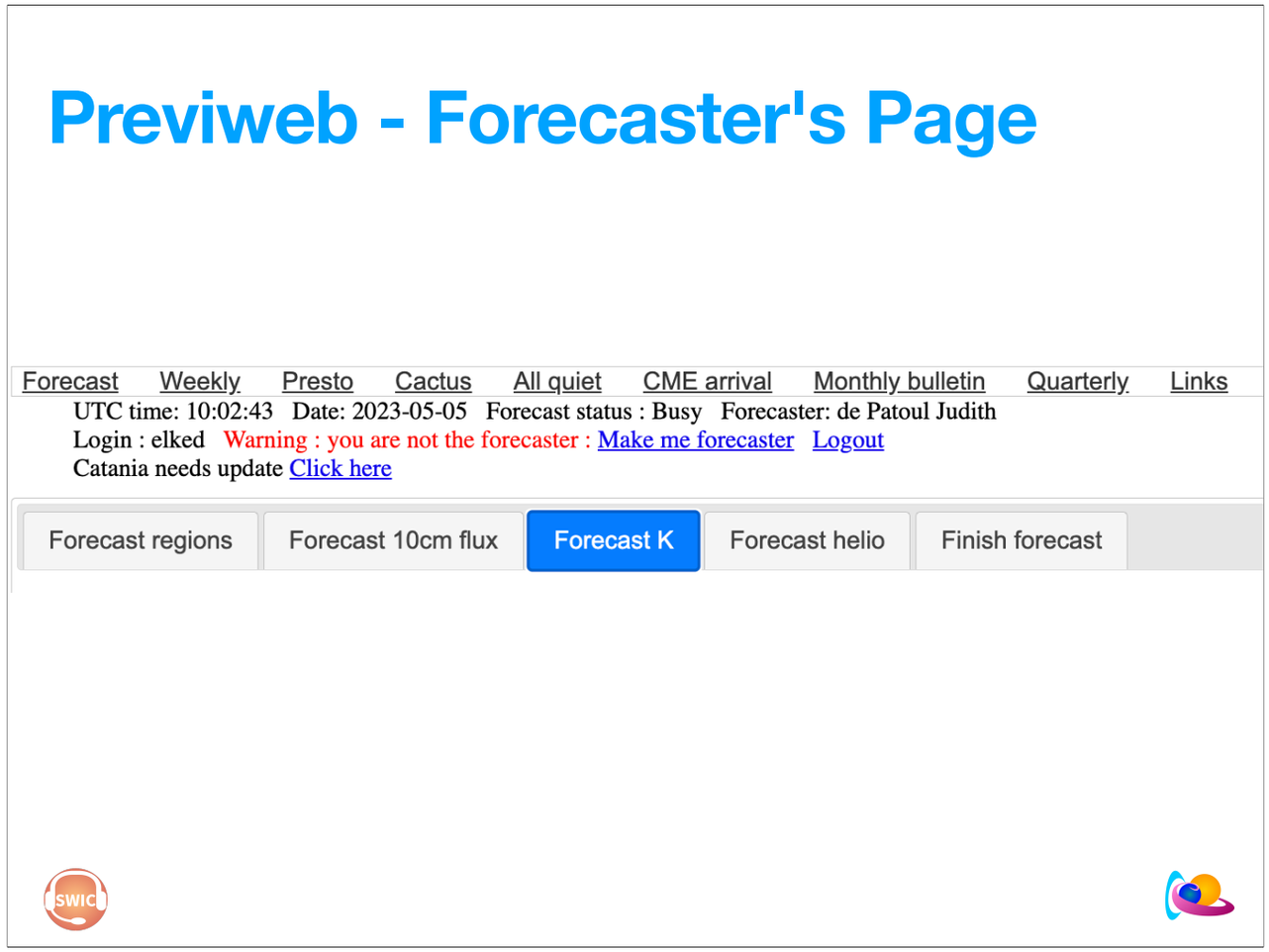
A proton event may lead to a PECASUS HF com advisory for Polar Cap Absorption. Here the thresholds are for the amount of absorption given in terms of db.

Solar Activity - Forecast



- Past 24 hours general solar activity
- Past 24 hours [M,X]-class flares peak time and location (and optionally C-Flare).
- Forecast of new/decaying active regions
- Forecast of the flare activity level
- Filament observations and eruptions
- Proton flux and fluence

In the info box, the forecaster describes the solar activity that was observed in the past 24h (since the last bulletin) and what is expected in the coming hours (next 24h).
This is the first part of the text that appears in our daily bulletins (Ursigram)



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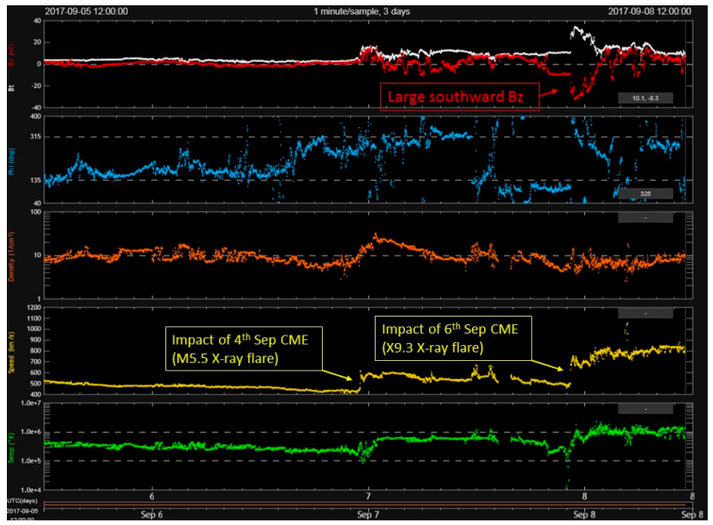
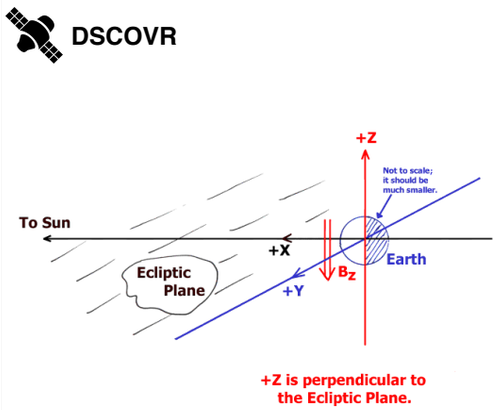
We will focus on two tabs at the bottom: forecasting of flares based on the active regions that are present on the disk and forecasting of the geomagnetic index K since both are directly relevant for PECASUS.

Solar Wind - Observations





Solar wind observations DISCOVR

To forecast the geomagnetic index K, we need to look at disturbances of the solar wind which will provoke disturbances in the Earth's magnetic field.

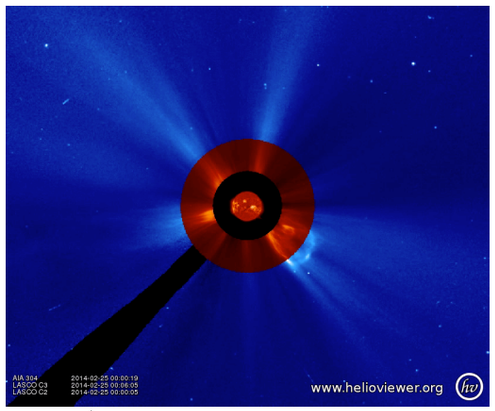
When we monitor the magnetic field, we look at these parameters. These measurements are made by the DSCOVR satellite. They characterise the solar wind. From top to bottom there are measurements of: the magnetic field, the phi angle, the density, the speed, and the temperature.

These measurements show the impact of two coronal mass ejections on the solar wind parameters: we see e.g. a clear rise in the speed of the solar wind, and a strong southward component of the magnetic field for the second coronal mass ejection.

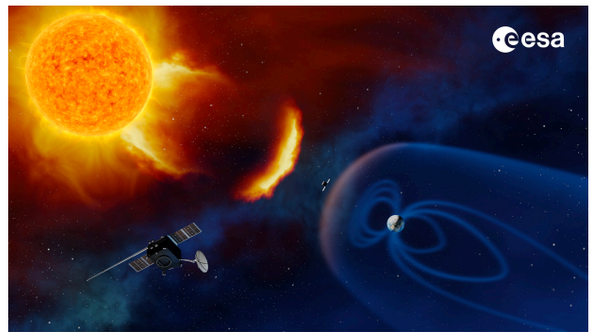
Why is the southward component of the magnetic field so important: because a strongly southward oriented magnetic field allows reconnection with the magnetic field of the earth, creating a geomagnetic storm.

Solar wind disturbances that provoke strong geomagnetic storms are usually linked to either a CME (eruptive) or a coronal hole (non-eruptive)
Eruptive events (CMEs) typically have a stronger impact compared with CH because CME is a magnetic structure with a Bz component.

SW Disturbance - Coronal Mass Ejection



SDO/AIA and SOHO/LASCO



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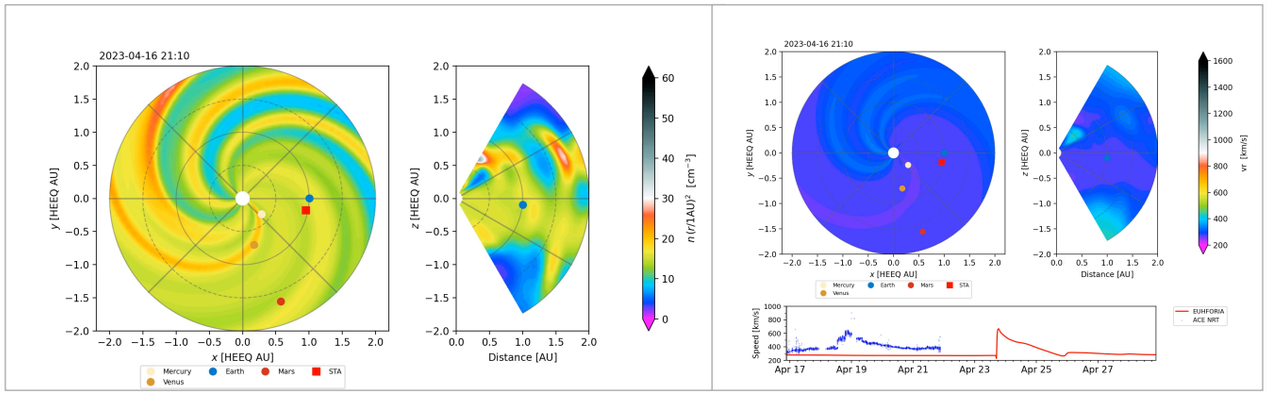
Eruptive events (CMEs) typically have a stronger impact compared with CH because CME is a magnetic structure with a Bz component

In case a CME is observed in the coronagraph data, the forecaster needs to determine its direction and velocity to estimate and arrival time and possible impact.

SW Disturbance - CME Arrival Prediction

Density

Velocity

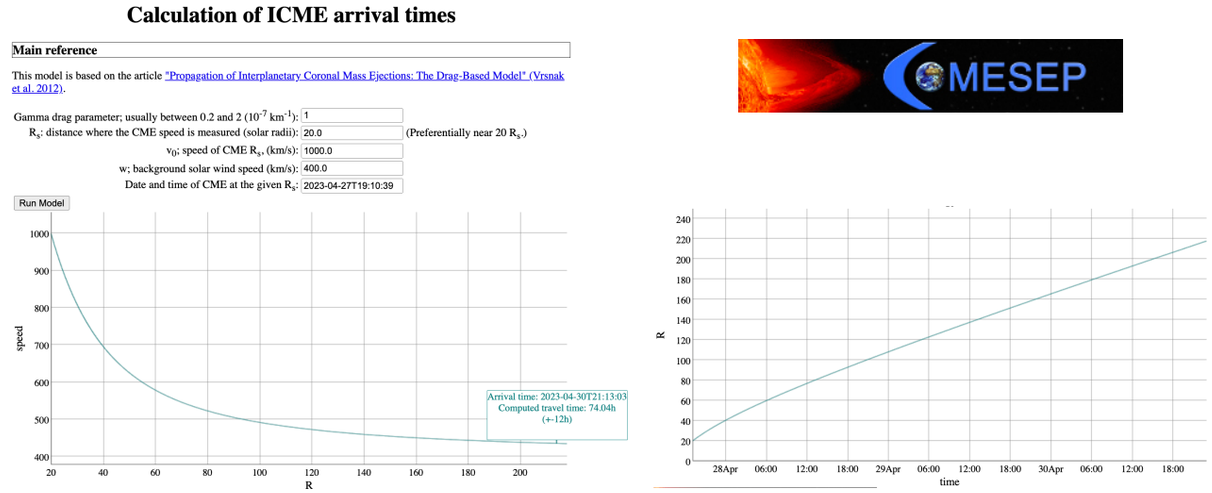


euhforia

This picture is the output of a simulation by EUHFORIA of the cloud propagating in the heliosphere. Left is a 'top' view of the sun (white dot) and the earth (blue dot). The black structure is the front of the magnetic cloud (purple) that reaches the earth. On the right is a side view of space. At the bottom, you see that the curve goes through the roof at the arrival.

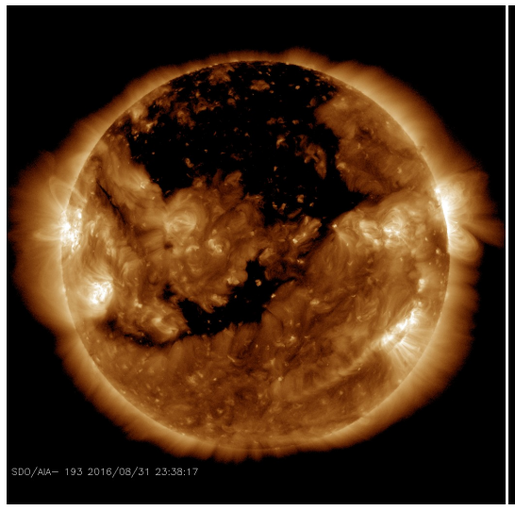
EUHFORIA (EUropean Heliospheric FORecasting Information Asset) aims to **model the propagation of CMEs** in the **inner heliosphere**. The model consists of two main parts: 1. The **semi-empirical WSA model**, which determines the solar wind conditions at the **inner radial boundary (near the Sun)** for the second part 2. The **heliospheric model**, which models the solar wind, with a possibility to insert CMEs.

SW Disturbance - CME Arrival Prediction

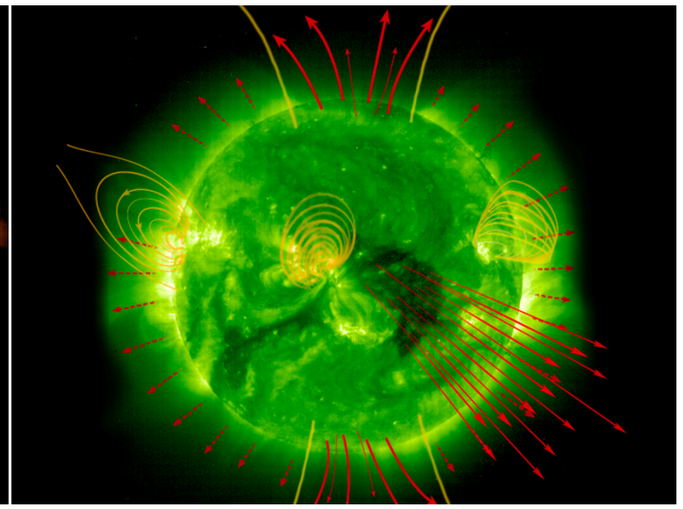


Drag based models
•Simple propagation only influenced by MHD drag
•**Simple and easy to do ensemble runs**

SW Disturbance - Coronal Hole



SDO/AIA



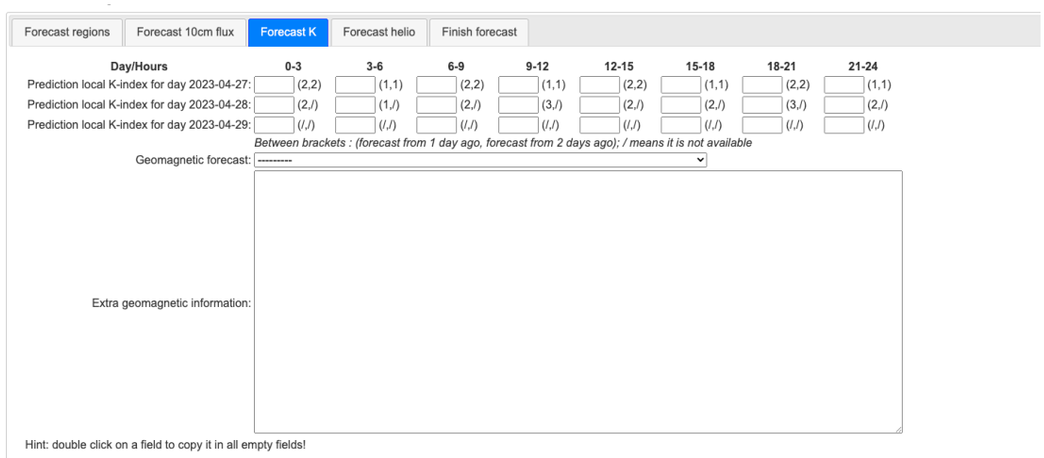
SOHO/EIT

Second type: Non-eruptive disturbance of the solar wind
RECURRENCE is important here, because corona holes can be long-lasting and return at the next rotation.

A coronal hole is a structure in the solar corona that you see as a black area in the EUV. In these regions, the magnetic field is less strong and the magnetic field lines are open, which allows plasma to escape. There is thus less plasma present to radiate and the region appears black in images.
The magnetic field lines of a coronal hole fan out into space, there are no closed magnetic loops above. This gives rise to a solar wind that is faster (~800 km/s) than the regular solar wind (~450 km/s).

In determining how strong the impact of a coronal hole will be, the **latitude of the coronal hole on the solar disk is important**. It is the plasma that leaves at the **central meridian** that will reach Earth. Polar coronal holes only have an impact when they extend to lower latitudes.

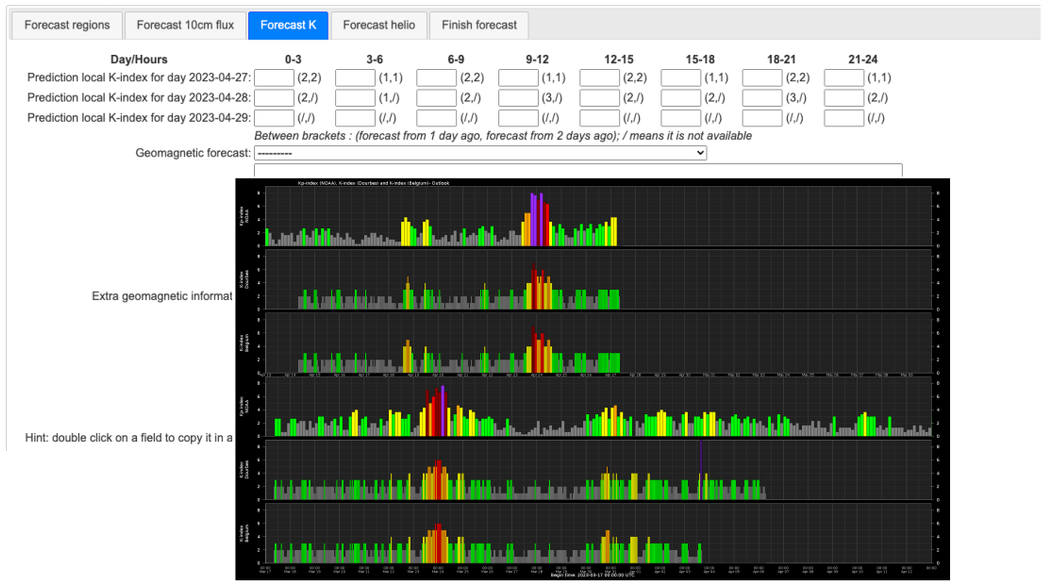
K index - Forecast



To predict K, we take into account:
- Recurrence (27 days rotation)
- CME arrival, high speed stream arrival from CH and orientation of the magnetic field

We predict local K, not Kp!

K index - Forecast



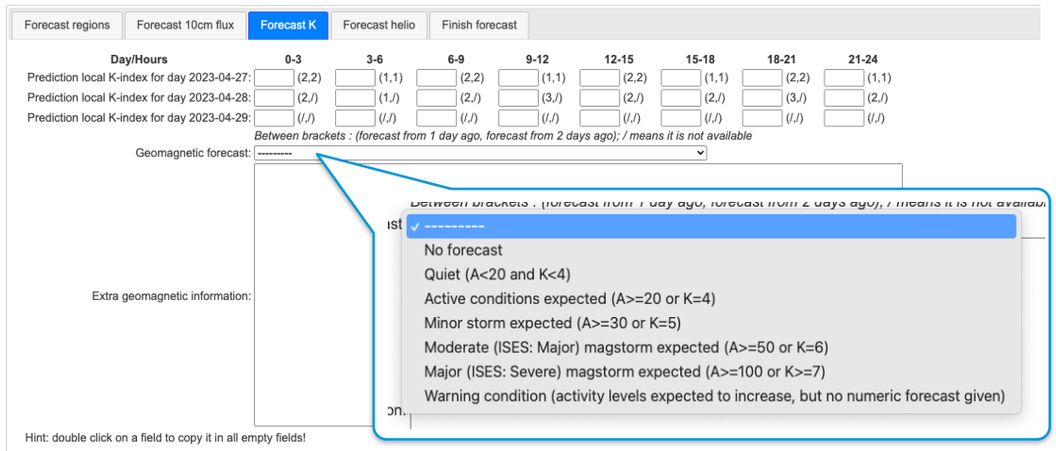
A K-index value is a local measurement over a three hour period.
In Dourbes, K-index values are produced every hour, but traditionally this was done only once every three hours. Therefore, the only Dourbes measurements that have relevance in comparison with most other stations are those at the 3UT,6UT,9UT,12UT,15UT,18UT,21UT,24UT. The indices calculated for the mornings and evenings are usually lower than for the rest of the day.

Look at the latest K-index from Dourbes. Then check the solar wind speed, as well as the Bz and the phi angle. The speed will tell you if you have a fast or slow solar wind, the phi angle if the solar wind crossed a sector boundary and the Bz if the solar magnetic field is pointing towards Earth or Sun.

Look at the phi angle. If there was a Coronal Hole, the phi angle will indicate change in polarity. The effects of a Coronal Hole on the solar wind data show in about 3 days, depending on the solar wind speed. Therefore, look at the solar wind data 3 days after CH first appearance.

Enter the values for the K-index for every three hour period in the coming 3 days. Since our bulletin is produced at UT noon we effectively know the first three local K values. Make sure to use those at the 3UT,6UT,9UT marks and discard the intermediate measurements.
As far as the forecasted values are concerned, the interpretation of the ISES scales is that K is to be interpreted as the **maximum K**. So, even if you expect K to become 4 for only a short period and the A-index is still below 20, you should still predict active conditions.
If in doubt, it is better to over-estimate the K indices than underestimating, as long as it is not happening frequently.

K index - Forecast



A K-index can be translated in an equivalent a-index value (quasi-logarithmic scale). The average of the a-indices over a day is called an A-index value. Since K-index values are interpreted locally, the computed A-index is also local.
Careful!: The ISES scales are based on thresholds both in A-index and K-index values while one is a daily value and the other a 3 hourly value. This is ambiguous.

ak index - The local K index is a quasi-logaritmic index, and as such averages cannot be taken. This poses a problem when one wants to express geomagnetic activity over e.g. a day or a month. To this aim, a 3-hourly "equivalent amplitude" index of local geomagnetic activity was established, with "ak" related to the 3-hourly K index according to the scale underneath

Kp index -> AA and PSD

PECASUS DASHBOARD

PECASUS DUTY STATUS: Secondary Backup Centre

GNSS	Moderate	Severe	Time UTC	Values	Status	Alert	Max-3h values	Max-3h status
Amplitude Scintillation	0.5	0.8	2024-03-04 14:45	0.33	QUIET		0.98	SEVERE
Phase Scintillation	0.4	0.7	2024-03-04 14:45	0.17	QUIET		0.30	QUIET
Vertical TEC	125	175	2024-03-04 14:40	95.92	QUIET		98.57	QUIET

RADIATION	Moderate	Severe	Time UTC	Flags	Status	Alert	Max-3h flags	Max-3h status
Effective Dose FL ≤ 460	30	80	2024-03-04 14:45	0	QUIET		0	QUIET
Effective Dose FL > 460	/	80	2024-03-04 14:45	0	QUIET		0	QUIET

HF COM	Moderate	Severe	Time UTC	Values/Flags	Status	Alert	Max-3h values	Max-3h status
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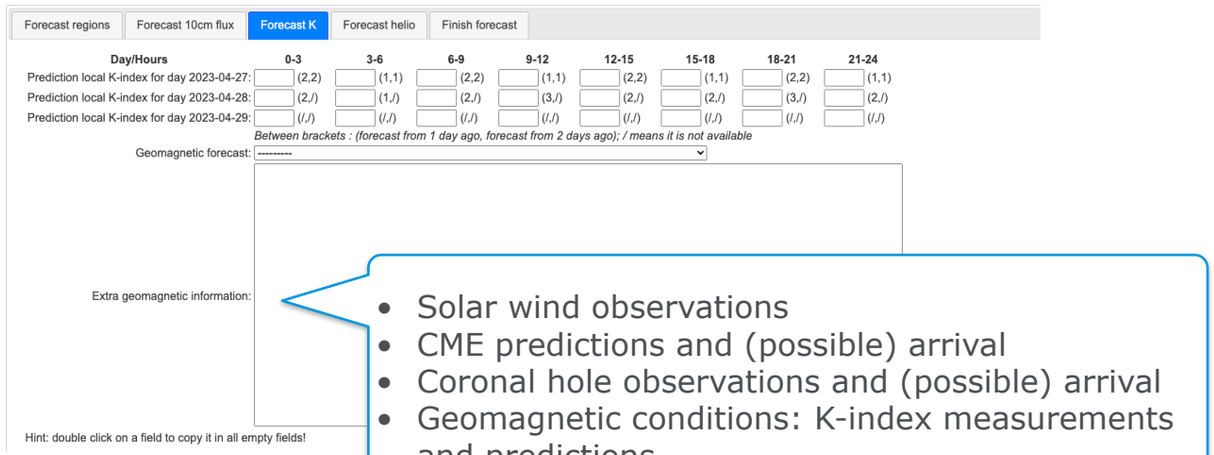
Shortwave Fadeout (SWF)	x1.0	x10.0	2024-03-04 14:45	< M5 flare	QUIET		< M5 flare	QUIET
Post-Storm Depression (PSD)	30%	50%	2024-03-04 14:45	2	SEVERE		2	SEVERE

Sound alarm is triggered when MOD or SEV thresholds are exceeded or in case of data outages.

Planetary K-index NOAA

The thresholds for auroral absorption advisories are defined in function of the planetary K-index, so Kp (we predict local K).
At the end of the main phase of a geomagnetic storm, we may experience a post-storm depression (depression in the MUF).

K index - Forecast



- Solar wind observations
- CME predictions and (possible) arrival
- Coronal hole observations and (possible) arrival
- Geomagnetic conditions: K-index measurements and predictions

In the info box, the forecaster describes the geomagnetic activity that was observed in the past 24h (since the last bulletin) and what is expected in the coming 24h.
This is the second part of the text that appears in our daily bulletins (Ursigram)

Daily Forecast - URSIgram

```
:Issued: 2022 Sep 07 1232 UTC
:Product: documentation at http://www.sidc.be/products/meu
#-----------------------------------------------------------------#
# DAILY BULLETIN ON SOLAR AND GEOMAGNETIC ACTIVITY from the SIDC  #
# (RWC Belgium)                                                   #
#-----------------------------------------------------------------#
SIDC URSIGRAM 20907
SIDC SOLAR BULLETIN 07 Sep 2022, 1230UT
SIDC FORECAST (valid from 1230UT, 07 Sep 2022 until 09 Sep 2022)
SOLAR FLARES  : C-class flares expected, (probability >=50%)
GEOMAGNETISM  : Active conditions expected (A>=20 or K=4)
SOLAR PROTONS : Quiet
PREDICTIONS FOR 07 Sep 2022  10CM FLUX: 123 / AP: 010
PREDICTIONS FOR 08 Sep 2022  10CM FLUX: 122 / AP: 010
PREDICTIONS FOR 09 Sep 2022  10CM FLUX: 120 / AP: 010
```

Forecast

```
COMMENT: Solar flaring activity was low during the last 24 hours, with six C-class flares detected, the brightest being an C3 at 18:42 UTC
yesterday. However, all but one of those flares originated from NOAA Active Region (AR) 3088 that is now invisible from Earth. NOAA AR 3092
produced a C1 flare in the previous 24 hours and it is likely to produce some more C-class activity in the next 24 hours.
```

Flaring Activity

```
No Earth directed CMEs observed in the last 24 hours.
```

CMEs

```
The greater than 10 MeV proton flux was at nominal levels over the past 24 hours and is expected to remain so for the next 24 hours. The greater
than 2 MeV electron flux was above the 1000 pfu alert threshold during the last 24 hours and is expected to remain above this level for the next
24 hours.
The 24h electron fluence was at moderate levels in the past 24 hours and is
expected to remain at these levels during the next 24 hours.
```

Particles

```
The Solar Wind (SW) conditions remained affected by the High Speed Stream (HSS) that arrived on 3 Sep. The SW speed ranged between 530 and 630
km/s over the last 24 hours. The total magnetic field (Bt) varied between 3 and 6 nT, while its Bz component ranged between -6 and 6 nT. The
interplanetary
magnetic field (phi) angle was directed away from the Sun during the last 24 hours. The SW conditions are expected to continue in the same
pattern in the next 24 hours.
```

Solar Wind

```
Geomagnetic conditions reached globally active (Kp 2-4) and locally unsettled (K-Belgium 2-3) levels over the last 24 hours. Unsettled conditions
are expected for the next 24 hours with intervals of active conditions.
```

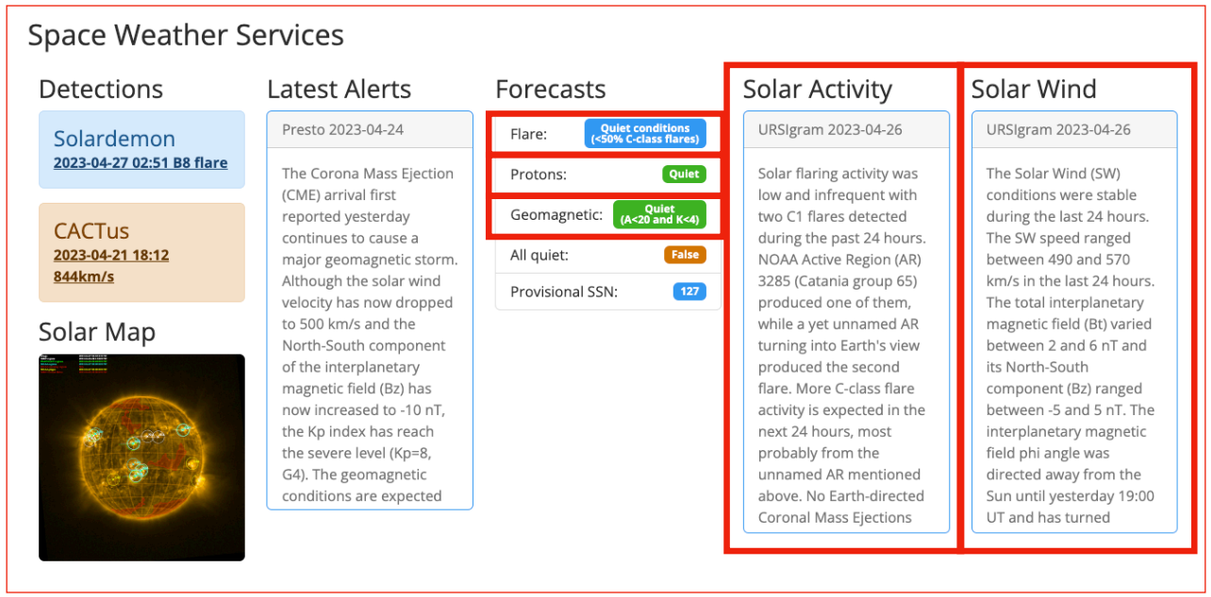
Geomagnetic

```
TODAY'S ESTIMATED ISN  : 095, BASED ON 19 STATIONS.

SOLAR INDICES FOR 06 Sep 2022
WOLF NUMBER CATANIA    : ///
10CM SOLAR FLUX        : ///
AK CHAMBON LA FORET    : ///
AK WINGST              : 022
ESTIMATED AP           : 019
ESTIMATED ISN          : 078, BASED ON 28 STATIONS.
```

The result of all this is a daily forecast bulletin sent to all registered users
This bulletin is made up of different sections that discuss Flares, CMEs, particles, solar wind and geomagnetic effects.
At the top is a general forecast.

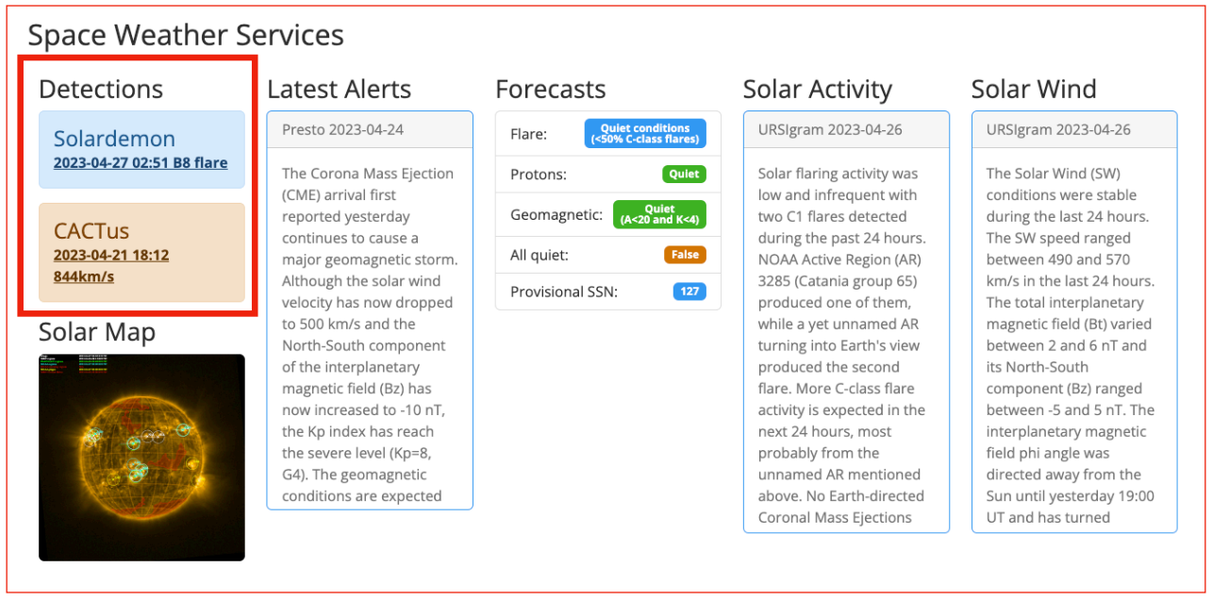
SIDC Webpage - Predictions



www.sidc.be

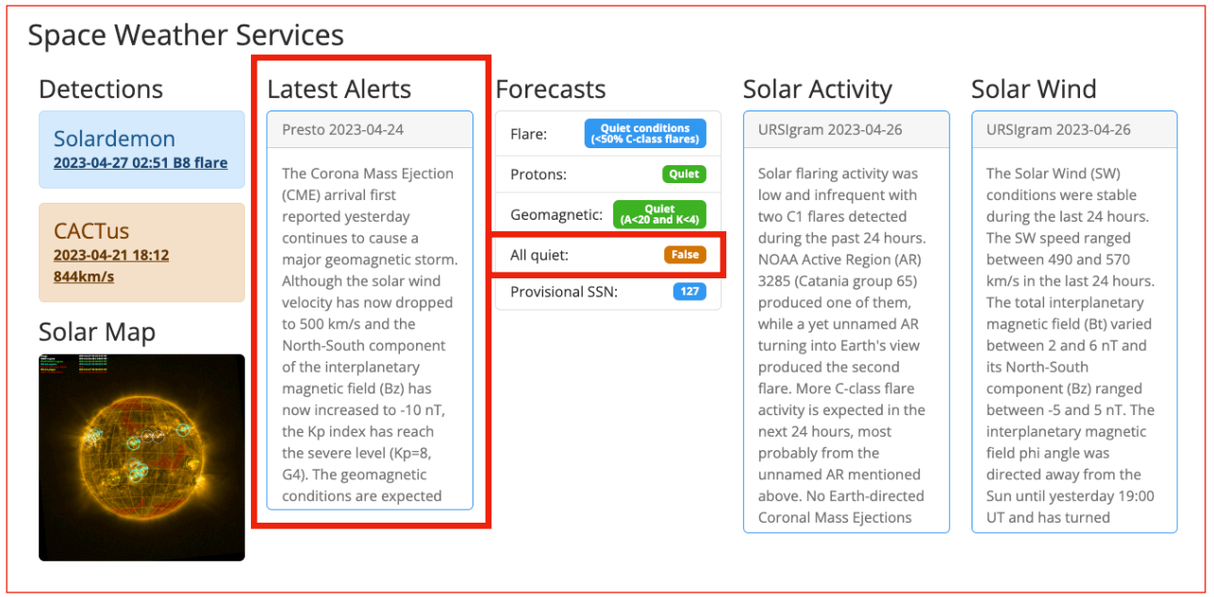
This info is also put on our frontpage.

SIDC Webpage - Detections



Also our automated detections are there. They can alert you of a significant event that took place.

SIDC Webpage - Alerts



www.sidc.be

The PRESTO messages are alert warnings that our sent out to registered users in case of important events.

Types of Alerts

Automated
- Halo CME by CACTus
- Flaremail

Manual
- Presto
- ~~CACTus Correction~~
- ~~CME Arrival~~
- All quiet - End of all quiet

Automated Alerts

Automated: Halo CME

```
:Issued: 2023 Sep 24 2326 UTC
:Product: documentation at http://www.sidc.be/products/cactus
#-----------------------------------------------------------------#
# HALO CME ALERTS from the SIDC (RWC-Belgium), generated by CACTUS  #
#-----------------------------------------------------------------#

  A halo or partial-halo CME was detected with the following
characteristics:

            t0      | dt0| pa | da |  v   |  dv | minv| maxv|
2023-09-24T09:36:07.402 | 4.0 | 296 | 150 | 367 | 133 | 123 | 710


      t0: onset time, earliest indication of liftoff
     dt0: duration of liftoff (hours)
      pa: principal angle, counterclockwise from North (degrees)
      da: angular width of the CME (degrees),
       v: median velocity (km/s)
      dv: variation (1 sigma) of velocity over the width of the CME
   mindv: lowest velocity detected within the CME
   maxdv: highest velocity detected within the CME
#-----------------------------------------------------------------#
# Solar Influences Data analysis Center - RWC Belgium             #
# Royal Observatory of Belgium                                    #
```

Partial or full halo detected, i.e. da >180

This message is of the Fast Alert type.
The CACTUS software package scans through the images produced by the SOHO/LASCO coronagraph. When it detects a partial or full halo CME (a halo CME with an angular width of more than 180°), this warning message is generated.

Automated: flaremail

```
:Issued: 2014 Sep 10 1926 UTC
:Product: documentation at http://www.sidc.be/products/flaremail
#-----------------------------------------------------------------#
# Large flare alerts from the SIDC (RWC-Belgium), detected in GOES  #
# X-ray data                                                      #
#-----------------------------------------------------------------#
A class X1.6 solar X-ray flare occurred on 2014/09/10 with peak time 17:45 UT

#-----------------------------------------------------------------#
# Solar Influences Data analysis Center - RWC Belgium             #
# Royal Observatory of Belgium                                    #
# Fax : 32 (0) 2 373 0 224                                        #
# Tel.: 32 (0) 2 373 0 491                                        #
#                                                                 #
# For more information, see http://www.sidc.be.  Please do not reply #
# directly to this message, but send comments and suggestions to  #
# 'sidctech@oma.be'. If you are unable to use that address, use   #
# 'rvdlinden@spd.aas.org' instead.                                #
# To unsubscribe, visit http://sidc.be/registration/unsub.php     #
#-----------------------------------------------------------------#
```

GOES X-ray > M5

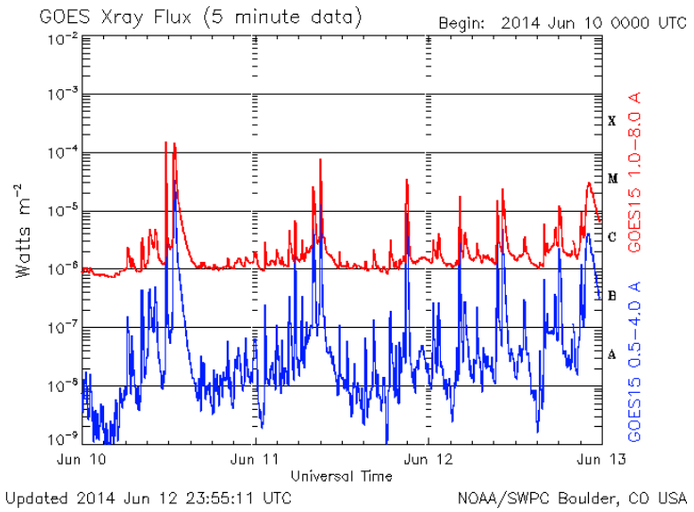
This message is of the fast alert type.
It is sent out when SIDC software detects in the GOES data a flare with an X-ray radiation flux stronger than M5.

Presto Alert

PRESTO

A presto alert needs to be sent ASAP:

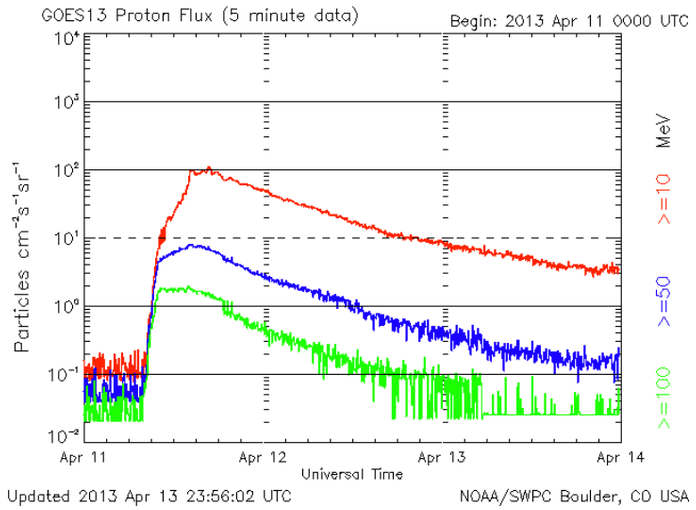
- During or just after an **X-flare**



PRESTO

A presto alert needs to be sent ASAP:

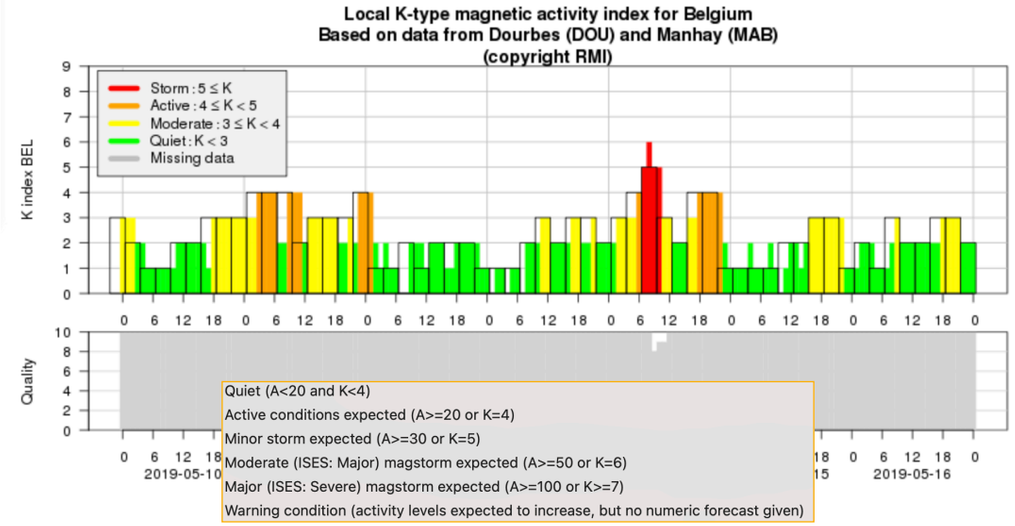
- In case of a **proton event**, i.e., proton flux >= 10 pfu (10 MeV particles)



PRESTO

A presto alert needs to be sent ASAP:

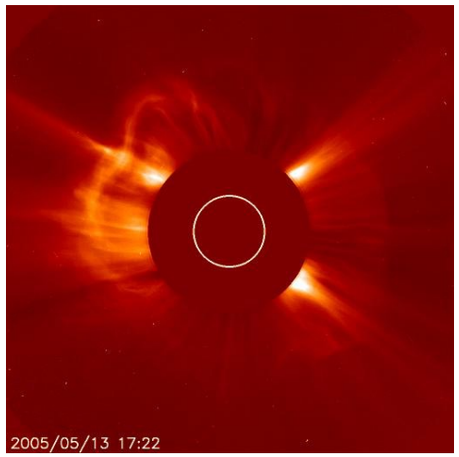
- When **Kp > 5** or K > 5.



PRESTO

A presto alert needs to be sent ASAP:

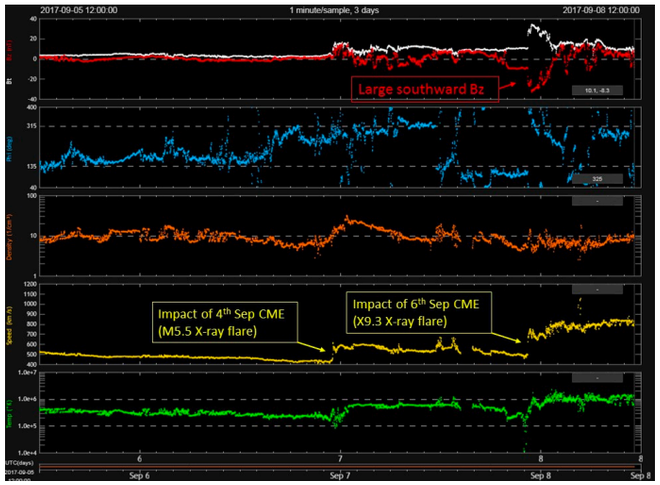
- When a (either front or back-side) (partial) **halo CME** or a strong westward directed CME occurred.
  Try to find out whether the halo CME is front-sided or not, by locating the source.



PRESTO

A presto alert needs to be sent ASAP:

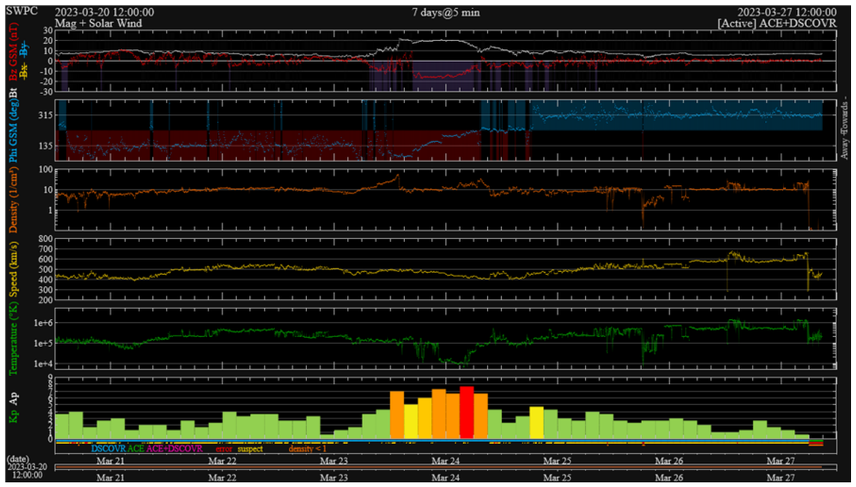
- In case you observe a **fast forward shock** in the solar wind speed. (delta_v>20km/s, ratio_n>1.2 and ratio_B>1.2)



PRESTO

A presto alert needs to be sent ASAP:

- In case you observe **enhanced solar wind conditions** which will likely lead to geomagnetic storm conditions K or Kp > 5.



PRESTO: example

:Issued: 2023 Mar 07 1343 UTC
:Product: documentation at http://www.sidc.be/products/presto
#---#
FAST WARNING 'PRESTO' MESSAGE from the SIDC (RWC-Belgium)
#---#
A halo Coronal Cass Ejection (CME) was observed in SOHO/LASCO-C2 from yesterday 03:12 UT. Although the bulk of the plasma is directed towards the West and South-West, a very faint asymmetric halo can be seen when the data are closely inspected. The speed of the CME is estimated to be 840 km/s and although the bulk of the CME is expected to miss Earth, a glancing blow is likely to arrive on the second half of 8 Mar or early on 9 Mar.

Another partial halo CME was automatically detected by the CACTUS software as launched yesterday 10:36 UT. However, close inspection revealed CACTUS took into account unrelated plasma ejecta and this is a marginally partial halo CME with only a weak component towards Earth's general direction. The speed of the CME is estimated to also be 840 km/s the bulk of the plasma is expected to miss Earth. A glancing blow might arrive on Earth's magnetosphere but if so it is expected to merge with the earlier CME mentioned above.
#---#
Solar Influences Data analysis Center - RWC Belgium
Royal Observatory of Belgium
# #
Website http://www.sidc.be.
E-mail sidc-support@oma.be
To unsubscribe http://www.sidc.be/registration/unsub.php

PRESTo: More examples

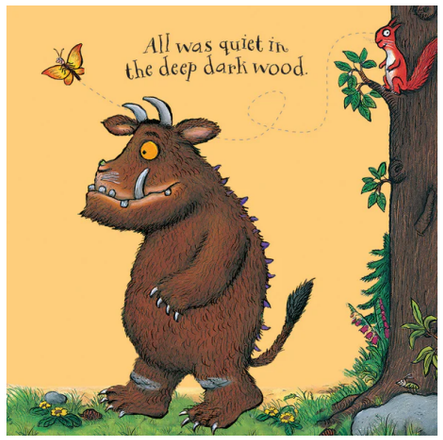
A **shock** in the solar wind at 19:54 UTC on 24 September marks the **arrival** of the ICME from 21 September (and probably that of the 22 September too). The **speed** jumped from 315 km/s to 440 km/s and the interplanetary **magnetic field** from 7 to 19 nT. The speed later reached 470 km/s and the magnetic field 28 nT with Bz down to -27 nT. This created moderate **geomagnetic storms** globally (Kp 6) and minor storms locally (K_Bel 5). The Earth is still inside the ICME (or ICMEs, to be confirmed as more data becomes available) and the corresponding geomagnetic storm is still ongoing.

Geomagnetic conditions have reached **moderate storm** levels globally (Kp 6) and minor storm levels locally (K_Bel 5), due to the ICME that arrived yesterday (**solar wind** speed up to 600 km/s and interplanetary magnetic field up to 22 nT and Bz down to -17 nT) and probably also some effects from a high speed solar wind stream. More disturbed conditions can be expected in the next 24 hours.

A **partial halo CME** with angular width around 150 degrees was first seen by LASCO-C2 at 13:36 UTC on 21 September. The CME was related to the M8.7 **flare** from NOAA **AR** 3435. The CME **speed** was estimated to be around 500 km/s, with the bulk of the material directed to the south. Since the source is located close to disk center, an **impact** at Earth can be expected on 25 September.

An **X1.5 class flare** was observed on August 07 peaking at 20:46 UTC. The flare was produced by the NOAA Active Region (**AR**) 3386 (Catania sunspot group 01), which was located at the west limb. Following this flare, the greater than 10 MeV **proton flux** started to rise at 21:46 UTC and crossed the 10 MeV warning **threshold** at 01:10 UTC on August 08 as measured by GOES. The 10 MeV proton flux remains currently above the threshold.

All Quiet Alert



All quiet

Send all quiet alert if **for the next 48 hours** you are forecasting that:

- the solar **X-ray** flux is expected to remain **below C-class level**
  (probability of C-flares on a daily basis should remain below 20% for the next two days),
- the **K** index is expected to remain **below 5**,
- **AND** the high-energy **proton** fluxes are expected to remain **below the event threshold**
  (10 pfu)

All conditions need to be met!

All quiet: example

:Issued: 2019 May 30 1214 UTC
:Product: documentation at http://www.sidc.be/products/quieta
#---#
From the SIDC (RWC-Belgium): "ALL QUIET" ALERT
#---#
START OF ALL QUIET ALERT
.....
The SIDC - RWC Belgium expects quiet Space Weather conditions for the next 48 hours or until further notice.
This implies that:
* the solar X-ray output is expected to remain below C-class level,
* the K_p index is expected to remain below 5,
* the high-energy proton fluxes are expected to remain below the event threshold.
#---#
Solar Influences Data analysis Center - RWC Belgium
Royal Observatory of Belgium
# #
Website http://www.sidc.be.
E-mail sidc-support@oma.be
To unsubscribe http://www.sidc.be/registration/unsub.php
# #
Legal notices:
- Intellectual Property Rights:
http://www.astro.oma.be/common/internet/en/data-policy-en.pdf
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- Use and processing of your personal information:
http://www.astro.oma.be/common/internet/en/privacy-policy-en.pdf
#---#

All quiet alert email message

End of All quiet

```
:Issued: 2023 Jan 30 1608 UTC
:Product: documentation at http://www.sidc.be/products/quieta
#-----------------------------------------------------------------#
# From the SIDC (RWC-Belgium): "ALL QUIET" ALERT                  #
#-----------------------------------------------------------------#
END OF ALL QUIET ALERT
        ....................
        The SIDC - RWC Belgium expects solar or geomagnetic activity to
        increase. This may end quiet Space Weather conditions.
#-----------------------------------------------------------------#
# Solar Influences Data analysis Center - RWC Belgium             #
# Royal Observatory of Belgium                                    #
#                                                                 #
# Website         http://www.sidc.be.                             #
# E-mail          sidc-support@oma.be                             #
# To unsubscribe  http://www.sidc.be/registration/unsub.php       #
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# - Liability Disclaimer:                                         #
#   http://www.astro.oma.be/common/internet/en/disclaimer-en.pdf  #
# - Use and processing of your personal information:              #
#   http://www.astro.oma.be/common/internet/en/privacy-policy-en.pdf #
#-----------------------------------------------------------------#
```

End of all quiet message

SIDC Webpage - Alerts

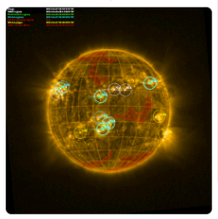
Space Weather Services

Detections

Solardemon
2023-04-27 02:51 B8 flare

CACTus
2023-04-21 18:12
844km/s

Solar Map



Latest Alerts

Presto 2023-04-24

The Corona Mass Ejection (CME) arrival first reported yesterday continues to cause a major geomagnetic storm. Although the solar wind velocity has now dropped to 500 km/s and the North-South component of the interplanetary magnetic field (Bz) has now increased to -10 nT, the Kp index has reach the severe level (Kp=8, G4). The geomagnetic conditions are expected

Forecasts

Flare:	Quiet conditions (<50% C-class flares)
Protons:	Quiet
Geomagnetic:	Quiet (A<20 and K<4)
All quiet:	False
Provisional SSN:	127

Solar Activity

URSIgram 2023-04-26

Solar flaring activity was low and infrequent with two C1 flares detected during the past 24 hours. NOAA Active Region (AR) 3285 (Catania group 65) produced one of them, while a yet unnamed AR turning into Earth's view produced the second flare. More C-class flare activity is expected in the next 24 hours, most probably from the unnamed AR mentioned above. No Earth-directed Coronal Mass Ejections

Solar Wind

URSIgram 2023-04-26

The Solar Wind (SW) conditions were stable during the last 24 hours. The SW speed ranged between 490 and 570 km/s in the last 24 hours. The total interplanetary magnetic field (Bt) varied between 2 and 6 nT and its North-South component (Bz) ranged between -5 and 5 nT. The interplanetary magnetic field phi angle was directed away from the Sun until yesterday 19:00 UT and has turned

STCE Newsletter

NEWSLETTER

STCE Newsletter

SOLAR-TERRESTRIAL CENTRE OF EXCELLENCE

STCE Newsletter

19 Feb 2024 - 25 Feb 2024

Published by the STCE - this issue : 1 Mar 2024.
The Solar-Terrestrial Centre of Excellence (STCE) is a collaborative network of the Belgian Institute for Space Aeronomy, the Royal Observatory of Belgium and the Royal Meteorological Institute of Belgium.

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SWIC

https://www.stce.be/newsletter/newsletter.php

Registration through old webpage for now
Lists differ for each sort of alert!

Registration

E-mail lists - register!

https://www.sidc.be/

Registration through old webpage for now: https://www.sidc.be/registration/registration_step1.php
Lists differ for each sort of alert!