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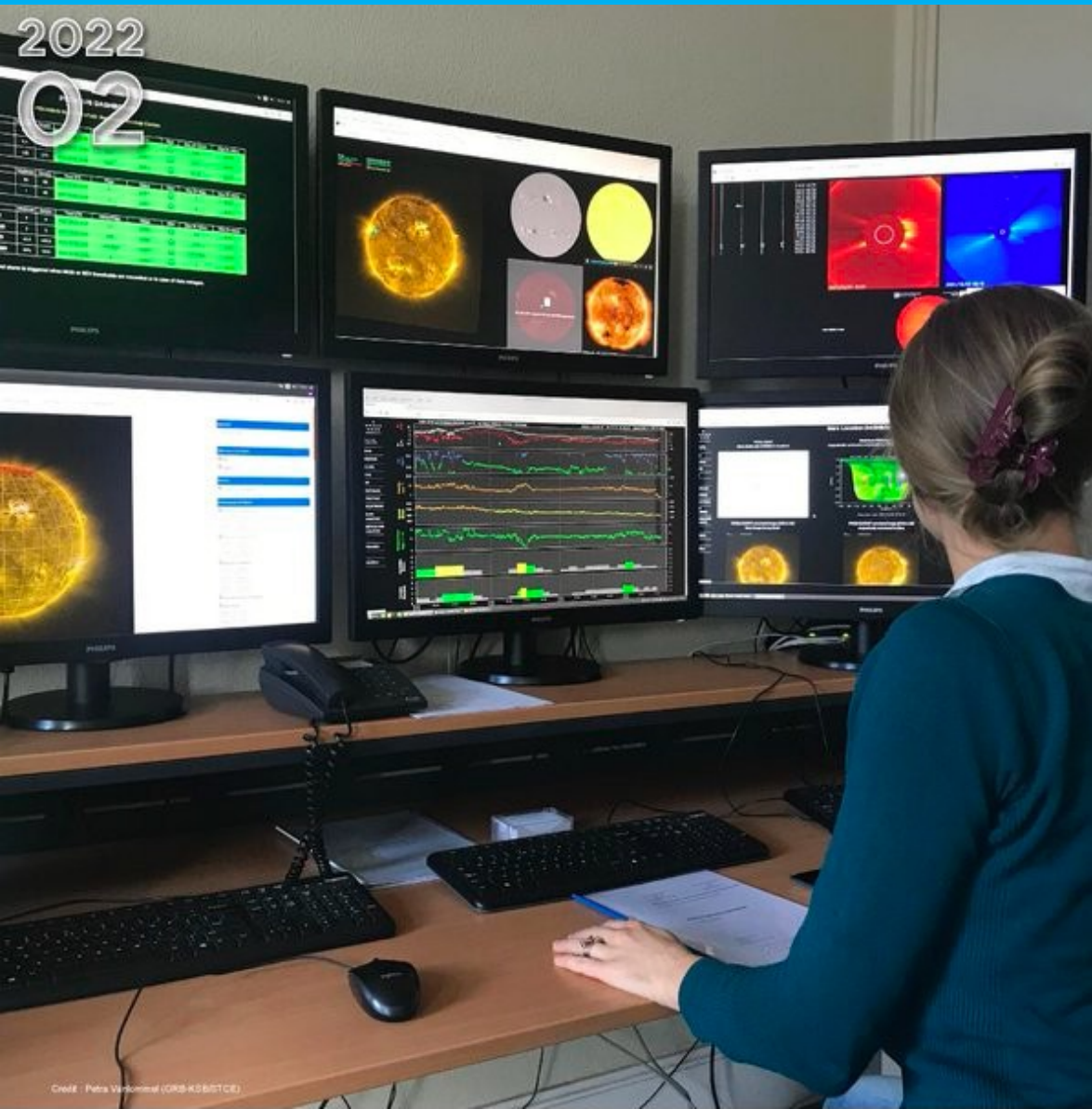
Integration of EUHFORIA within the SWOP environment

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and the SWOP team

10th CCMC Workshop
10th June 2022



SWOP: Space Weather Operational Centre



- Team of 9 scientists covering 7/7, 12/24 + on call during night shifts
- Transitioning to full 24/7 monitoring by partnership with the Belgian Defence weather room
- We collect, manage and process data
- Disseminate SWx information into bulletins, plots, alerts and advisories through ESA, PECASUS, ...



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Space weather services, alerts and bulletin


:Issued: 2022 Mar 07 1248 UTC
:Product: documentation at <http://www.sidc.be/products/m>

DAILY BULLETIN ON SOLAR AND GEOMAGNETIC ACTIVITY from
(RWC Belgium)

SIDC URSIGRAM 20307
SIDC SOLAR BULLETIN 07 Mar 2022, 1246UT
SIDC FORECAST (valid from 1230UT, 07 Mar 2022 until 09 Mar 2022)
SOLAR FLARES : C-class flares expected, (probability >=50%)
GEOMAGNETIC : S1 (M30) (Kp4)

Daily bulletin

PREDICTIONS FOR 09 Mar 2022 10CM FLUX: 112 / AP: 004
COMMENT: Solar activity over the past 24 hours was at very low to low levels with a single C-class flare. There are six numbered active regions on the visible disc, the most prominent being NC currently holds the largest number of sunspots a C1.5-flare with peak time at 12:55 UTC on March region on disc, NOAA 2960 (beta), has remained s The X-ray flare activity is expected to be at ve next 24 hours with 55% chance for C-class flaring.



SIDC Space Weather Briefing

20 February 2022
Cis Verbeeck
& the SIDC forecaster team

Weekly SIDC SWx briefing

Summary Report



Solar activity from 2022-02-20 12:00 to 2022-02-27 23:59

Active regions	NOAA 2948, 2952, 2953, 2954, 2955, 2956, 2957
Flares	# C-class flare: 3 # M-class flare: 0 # X-class flare: 0
Coronal Holes	extension of 1 southern polar coronal hole, equatorial (s) coronal hole
CMEs	No Earth-directed CMEs

Solar wind and geomagnetic conditions

CMEs	None
SW Conditions	B : 0.4 - 13.73 nT // Bz: -13.45 nT to 10.18 nT // Speed: 348.0 - 590.7 km/s
K-indices	max K-index (K _{Bej}): 4 max Kp-index (NOAA): 5


All Quiet Alert: Never on

Solar Influences Data analysis Center (ROB/SIDC)

- ROB/SIDC • S.101 Proba2/SWAP Images
- ROB/SIDC • S.101c SIDC Solarmap
- ROB/SIDC • S.102 Proba2/LYRA Data
- ROB/SIDC • S.103 SIDC/USET Halpha Solar images
- ROB/SIDC • S.104 SIDC/USET White light Solar images
- ROB/SIDC • S.105a SIDC Humain Callisto Solar radio spectrograms
- ROB/SIDC • S.105c SIDC Automated Solar radio burst detections
- ROB/SIDC • S.105d SIDC/Humain Solar radio light curves
- ROB/SIDC • S.106 SDO/AIA Solar EUV images
- ROB/SIDC • S.106b SIDC/SILSO Sunspot number forecast
- ROB/SIDC • S.109a SIDC 10.7cm Solar radio flux (F10.7) forecast
- ROB/SIDC • S.109b SIDC Solar flare forecast
- ROB/SIDC • S.110 SIDC Daily space weather bulletin
- ROB/SIDC • S.111 SIDC/CACTus Automated CME detection
- ROB/SIDC • S.112a SIDC Solar GOES-flare alert
- ROB/SIDC • S.112b SIDC/CACTus Automated halo CME alert
- ROB/SIDC • S.112z SIDC Human operator alert moderation
- ROB/SIDC • S.113 SIDC All quiet alert
- ROB/SIDC • S.123b SIDC/USET Sunspot group characteristics

Services and data





SWX ADVISORY

DTG: 20250815/0555Z
SWXC: PECASUS
ADVISORY NR: 2025/18
NR RPLC: 2025/17
SWX EFFECT: HF COM SEV
OBS SWX: 15/0500Z FOR NOAA 2025-08-15
FCST SWX
FCST SWX

SWx advisory

FCST SWX +18 HR: 16/0000Z NOT AVBL
FCST SWX +24 HR: 16/0600Z NOT AVBL
RMK: SPACE WEATHER EVENT (MAXI FREQUENCY DEPRESSION) IS IN PROGRESS. IMPACT COM FREQUENCY BANDS EXPECTED. LOWER FREQUENCIES LESS IMPACTED.
NXT ADVISORY: WILL BE ISSUED BY 20250815/1155Z=

Observations

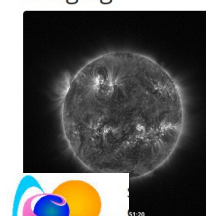
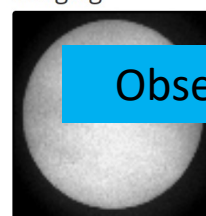
Space Based Imaging


Ground Based Imaging

Observations

SIDC Solarmap

This service allows the user to display solar features (such as sunspots, coronal holes, etc.) and navigate back and forth in time, the closest available observations and up to 15 degrees can also be added to refine the feature location on the surface. Additional features, etc.) of the features are also indicated.



And many more



Data processing, models and tools

CACTUS 2.5.0
A software package for 'Computer Aided CME Tracking'

CMEs detected by Cactus

```

# Executed: Sat Feb  8 20:56:07 2014
# Product: Cactus catalogue (http://aida.be/cactus)
# Instrument: LASCO| Detector: e2 # Instrument: LASCO| Detector: e3
# ...
# Output: Detected eventmap with the following characteristics:
# CME: CME number
# Flow: Flow number. Flows are sequential detections, their color in the detectionmap is dark blue
# LT: onset time, earliest indication of lift-off
# dL: duration of lift-off (hours)
# pa: principal angle, counterclockwise from North (degrees)
# da: angular width (degrees)
# v: median velocity (km/s)
# dv: variation (1 sigma) of velocity over the width of the CME
# hmax: maximum velocity detected within the CME
# hmin: highest velocity detected within the CME
# halo?: II if da>90, III if da>90, IV if da>135, indicating potential halo/partial halo CME
  
```

#	CME	LT	dL	pa	da	v	dv	hMax	hMin	halo?
0001	2014/02/08	18:00	03	104	070	0435	0043	0371	0047	17:48 02/08
0002	2014/02/08	19:36	02	156	036	0305	0029	0186	0259	14:49 02/08
0003	2014/02/08	19:00	09	089	036	0385	0099	0188	0570	11:40 02/08
0004	2014/02/08	05:48	02	252	028	0613	0103	0323	0341	08:48 02/08
0005	2014/02/08	04:36	02	096	010	0205	0147	0129	0496	05:48 02/08
0049	2014/02/07	22:24	03	083	024	0247	0036	0174	0270	02:36 02/08
0048	2014/02/07	22:24	03	107	104	0238	0134	0195	0726	23:24 02/08
0047	2014/02/07	21:04	01	243	012	0651	0073	0532	0703	17:00 02/08
0046	2014/02/07	20:24	01	061	009	0174	0055	0121	0254	16:12 02/08
0045	2014/02/07	19:48	02	102	043	0166	0043	0124	0294	13:20 02/08
0044	2014/02/07	18:00	05	077	052	0212	0069	0134	0405	02:36 02/08
0043	2014/02/07	19:25	09	184	016	0257	0026	0094	0261	06:24 02/08
0042	2014/02/07	09:24	02	304	006	0253	0077	0124	0323	02:48 02/08
0041	2014/02/07	07:36	00	027	012	0249	0062	0237	0400	02:36 02/08
0040	2014/02/07	02:00	04	020	024	0275	0139	0124	0558	02:36 02/08
0039	2014/02/06	18:36	06	343	040	0103	0033	0100	0335	19:36 02/08
0038	2014/02/06	13:25	02	088	006	0496	0115	0322	0694	17:00 02/08
0037	2014/02/06	12:12	02	249	006	0239	0053	0167	0297	11:00 02/08
0036	2014/02/06	10:36	01	019	014	0348	0069	0223	0424	07:36 02/08
0035	2014/02/06	08:12	03	063	048	0248	0060	0120	0305	04:48 02/08
0034	2014/02/06	04:12	01	103	006	0479	0037	0479	0710	01:48 02/08
0033	2014/02/06	02:24	02	324	005	0207	0095	0148	0388	02:12 02/08
0032	2014/02/06	02:24	04	308	038	0158	0177	0120	0664	02:12 02/08
0031	2014/02/06	02:24	04	207	026	0286	0052	0199	0400	19:00 02/08
0030	2014/02/05	22:12	02	102	024	0327	0033	0142	0822	16:12 02/08
0029	2014/02/05	22:12	02	102	024	0327	0033	0142	0822	16:12 02/08

ESA JHelioviewer

File View Movie Plug-ins Options Help

Zoom In Zoom Out Zoom to Fit Actual Size Reset Camera Pan Rotate Annotate Track Off-disk Corona Projection SDO Cut-out

Movie Controls: REC 330/1420

Image Layers:

- ✓ LASCO C3 2015-09-23T23:06:13
- ✓ LASCO C2 2015-09-23T23:24:05
- ✓ AIA 171 2015-09-23T23:17:46
- ✓ Grid
- ✓ Viewpoint 2015-09-23T23:17:46
- Timestamp
- Miniview

No difference images

Opacity: 100%

Sharpen: 0%

Gamma: 1.0

Contrast: 0

Color: SDO-AIA 171 Å

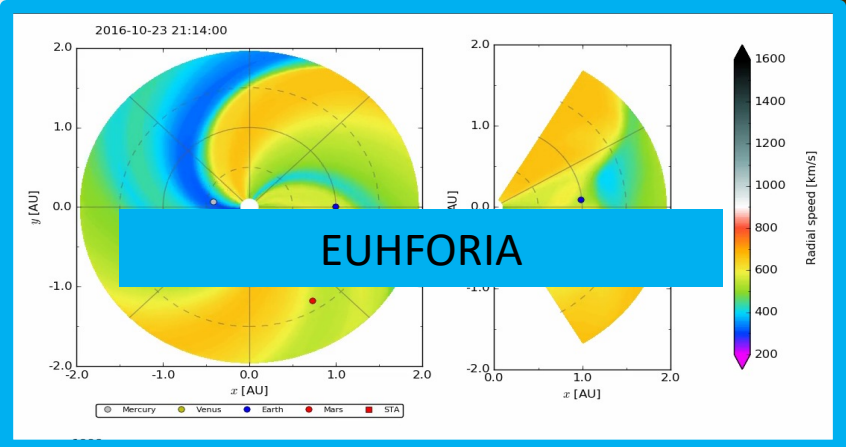
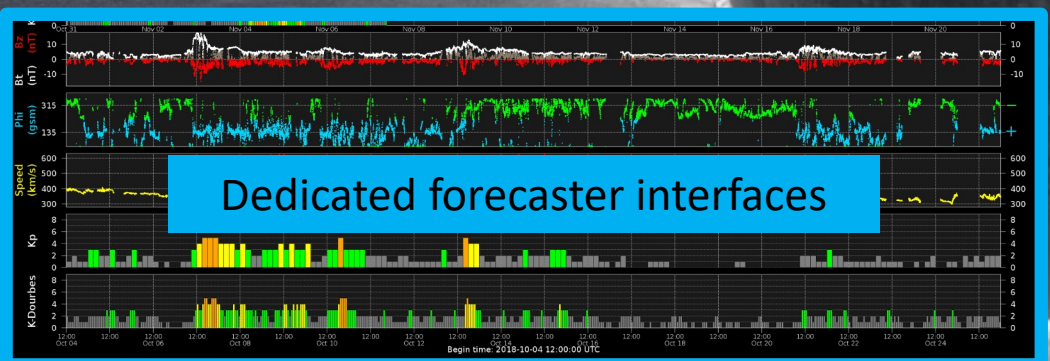
Channels: Red Green Blue

Timeline Layers:

- Callisto Radiogram
- ✓ GWK Events

Space Weather Event Knowledgebase

- Active Region
- NOAA SWDC



And many more



Integration of euh\$oria

The form is valid and can be submitted.

Euhforia

RunType

CME Forecast

Time

2022-06-09T15:01:25Z

HeliosphericModelInfo

Low resolution model

Cone_CMEs

+ item × Last item

item 1

× item

Launch_time

2021-09-01T00:00:00.000Z

Latitude_HEEQ

0

Longitude_HEEQ

0

Half_width

30

Speed

600

Mass_density

1e-18

Temperature

- Automatic daily solar wind run
- Allows forecasters to submit a run (in a similar way to VSWMC)
- Simplified interface containing only key parameters
- Alerts forecasters on progress of run

Today



rwc BOT 3:23 PM

CME run with eventname EUHFORIA_Simulation_2022-06-08T18:00:00Z has started running the empirical model. It is expected that the run is submitted to Spacepole within 15 minutes.



rwc BOT 3:35 PM

CME run with eventname EUHFORIA_Simulation_2022-06-08T18:00:00Z job submitted to SpacePole.
CME run with eventname EUHFORIA_Simulation_2022-06-08T18:00:00Z running at SpacePole.

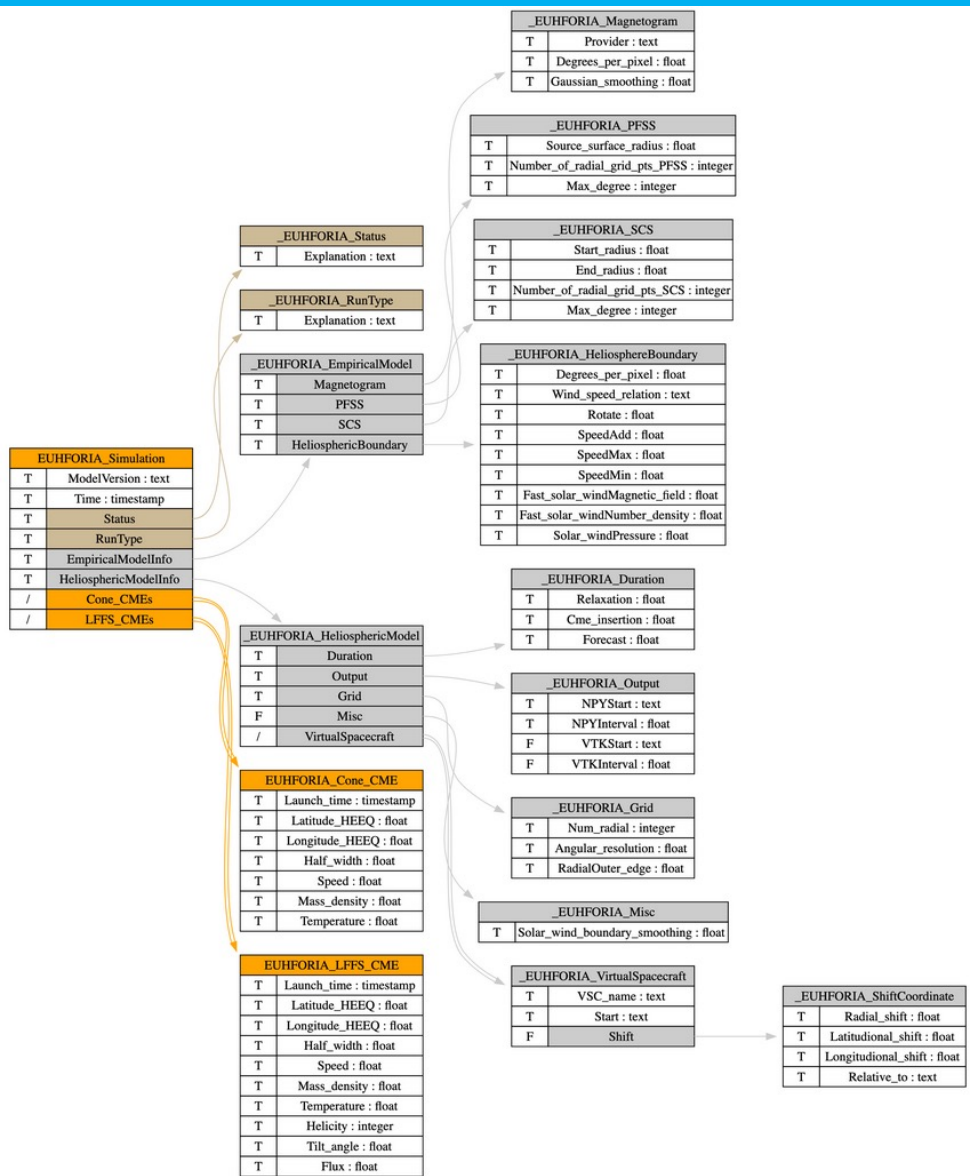


rwc BOT 4:01 PM

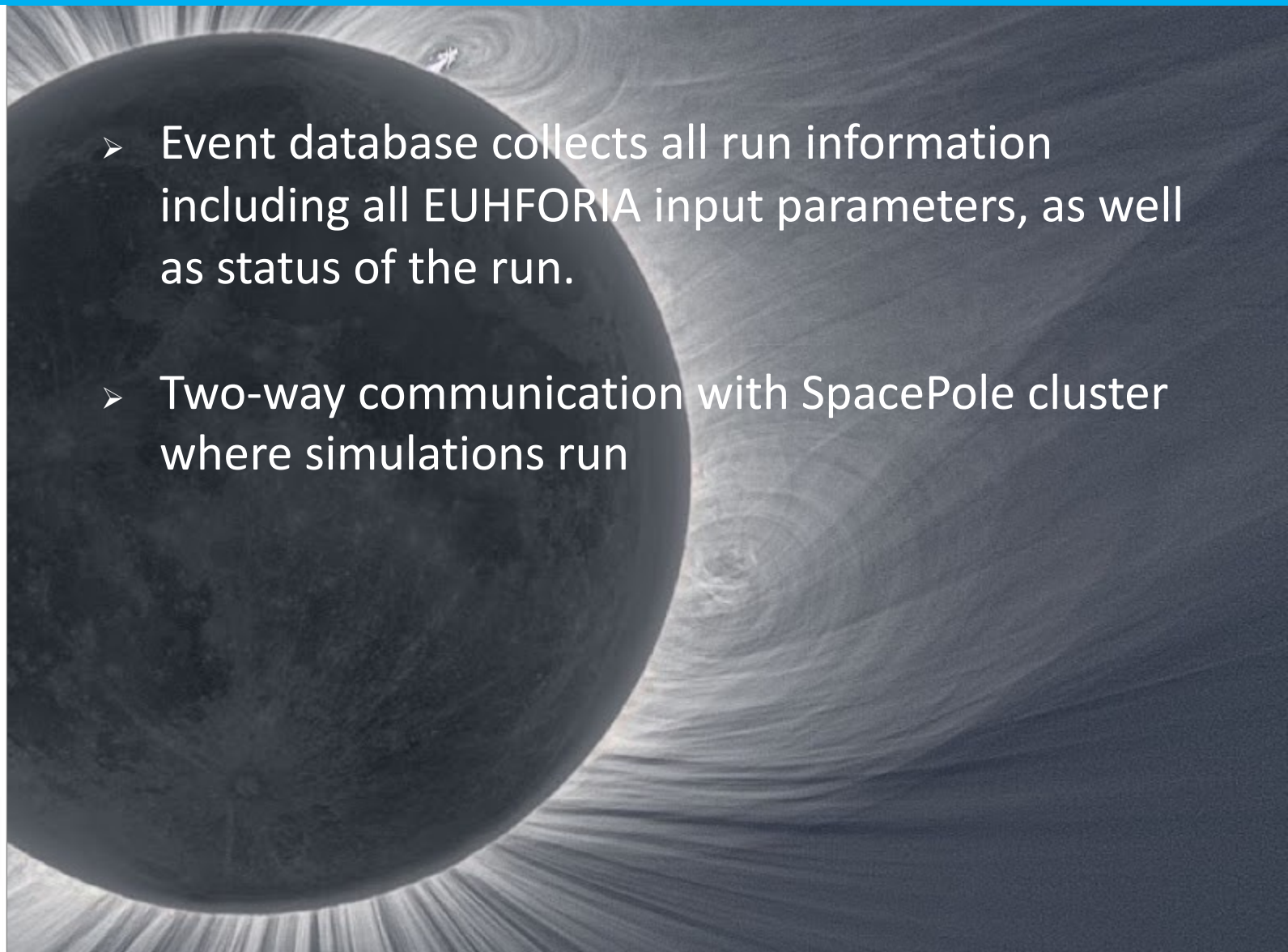
CME run with eventname EUHFORIA_Simulation_2022-06-08T18:00:00Z finished at SpacePole.



Integration of euhforia

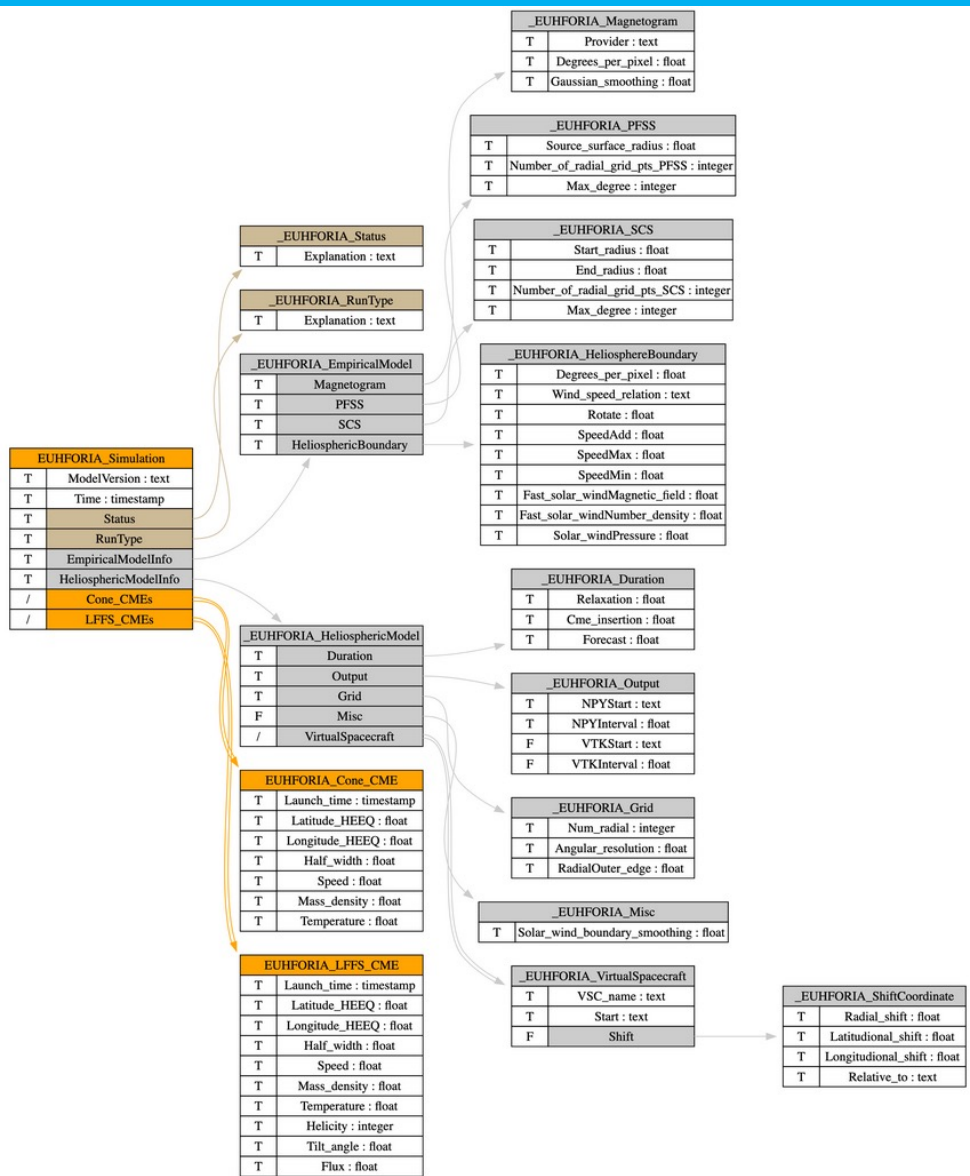


- Event database collects all run information including all Euhforia input parameters, as well as status of the run.
- Two-way communication with SpacePole cluster where simulations run





Integration of euhforia



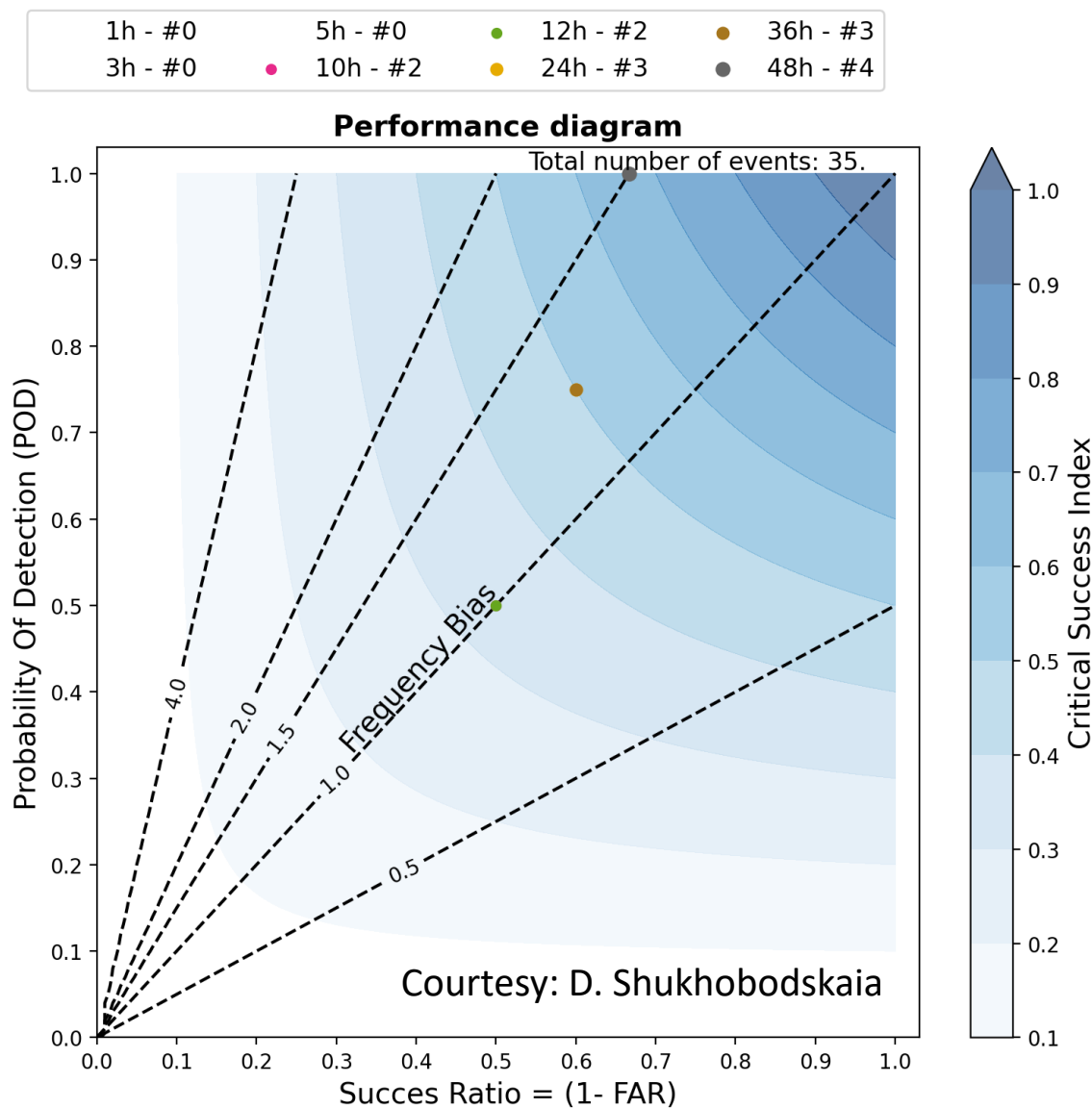
➤ The event database consists of a larger set of data ranging from sunspots, coronal holes to flares and automated CME detection by Cactus

➤ Future work:

- Addition of observed CME database including CME kinematics (similar to CCMC DONKI)
- Coupling of the different events within the event database: flares, coronal holes, high speed streams, observed CMEs, simulated CME arrivals and observed CME arrivals



- Preliminary results of EUHFORIA 2.0 project
- Consider observed CME events in August 2010 and July 2012 with speed above 350 km/s and angular width above 60 degrees (74 events)
- RMSE arrival time: 15h





Collaboration ideas

- Scoreboards:
 - Currently SIDC addition to scoreboards is manual. Ideally, this will be automated.
 - Also send to ambient solar wind scoreboard
- A strong need for an updated, easy and ready-to-use GCS fitting tool that automatically pulls data. We hope to be able to collaborate with all interested parties.
- Event database has similarities to DONKI. We can learn from CCMC/M2M knowledge on this matter.
- We want to gain more insight on how flux-rope CMEs affect our prediction capabilities in a forecasting environment.



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Thank you. Questions?

