

# Investigating Space Weather with CCMC's ISWA & DONKI Dash

Elana Resnick & CCMC Team

*CCMC Training and Project Coordinator*

April 27, 2026

[elana.m.resnick@nasa.gov](mailto:elana.m.resnick@nasa.gov)



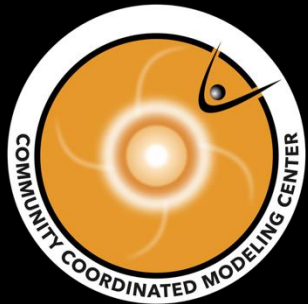
# Outline

1. Introduction
2. ISWA tutorial
3. DONKI-Dash tutorial
4. Trainings at CCMC

# The Community Coordinated Modeling Center

Facilitate  
space science and  
space weather  
**research & model  
development**

Support the transition  
of advances in  
research to **space  
weather operations**



*Multi-agency strategic investment in US space weather program*



**AFRL**  
AIR FORCE RESEARCH LABORATORY



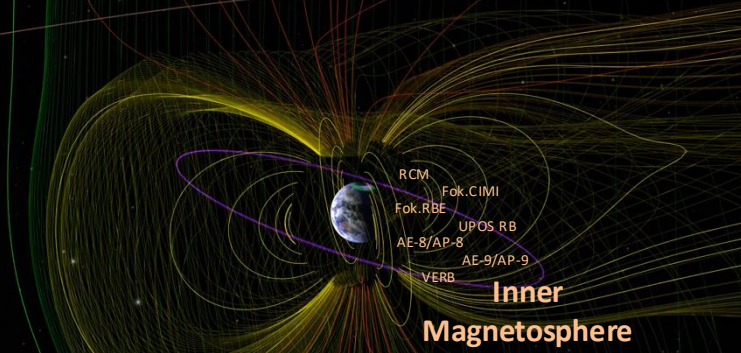
# Corona

- SWMF.SC+EEGGL+CME
- AWSoM
- SRPM EEGGL
- ANMHD PFSS.Petrie
- PFSS.Macneice
- PFSS.Luhmann
- AMOS ASSA
- MAGIC NLFFF
- NOVICE MAG4
- ASAP UMASEP
- SNB3GEO WSA
- GCR BON
- CARI-7
- NAIRAS

# Models at CCMC

## Magnetosphere

- LFM-TING
- GU MICS
- LFM-MIX
- SWMF+RCM +deltaB
- SWMF+RCM +RBE
- SWMF+RCM +RCM
- LFM-MIX-TIEGCM
- WINDMI LAN Lstar
- Tsygane nko GIC
- OpenGGCM+CTIM
- SWMF+RCM
- PS VP
- Weigel-de laB
- AACGM
- AMPS
- Apex
- IGRF



## Heliosphere

- WSA-ENLIL
- WSA-ENLIL+EPREM
- WSA-ENLIL+SEP MOD
- REle ASE
- UMASEP
- iPATH
- EXO Solar Wind
- CORHEL
- SEPSTER
- DBM
- SWMF.SH
- DIPS
- M-FLAMPA
- EPREM Heltomo

## Ionosphere/Thermosphere

- TIE-GCM
- SAMI-3
- JB2008
- IRI
- GITM
- GMAT SAM
- CTIPe IDA4D
- USU-GAIM
- WB2008
- PBMOD
- TRIPL-DA
- Weimer-de laB
- Weimer IE
- SWACI-TEC
- IMPACT
- DTM
- ABBYNormal
- Ovation Prime
- COSGROVE-PF

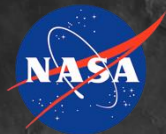
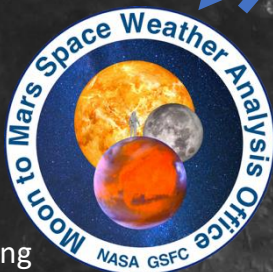
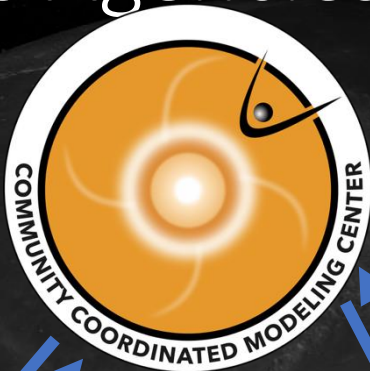
## Local Physics

- VPIC
- PAMHD
- PIC-Hesse

# Space Weather R2O2R Teamwork Across Agencies

Model Developers at  
Research Institutions

- Entry point for R2O2R
- Development of the SEP Scoreboards
- Onboarding and hosting models
- Technical expertise
- Model expertise
- Infrastructure



- Human-in-the-loop products
- CME inputs for SEP Scoreboard models
- Space weather monitoring and analyses

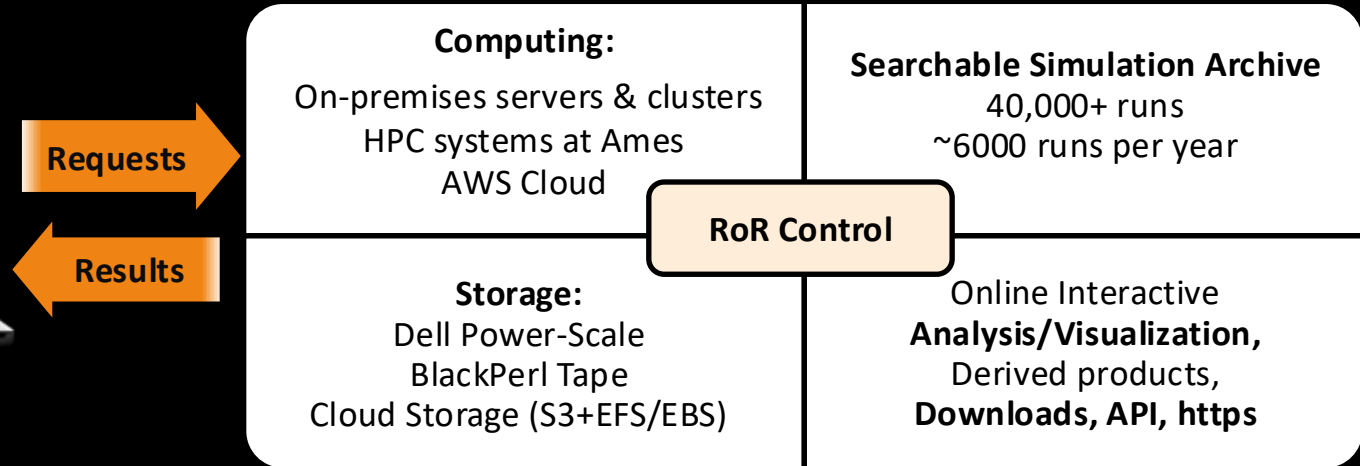
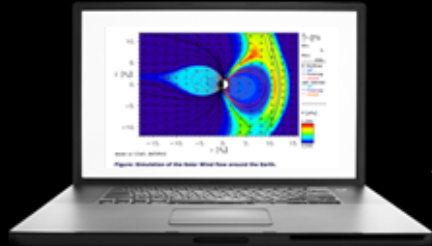
- Space Radiation operations
- Expert end users
- Validation
- Model development

- Primary Support for SRAG
- Operational Support for the Nation
- Testbed & R2O2R

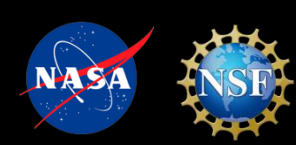
SRAG, CCMC, M2M, SWPC points  
of contact



# Simulation Services: *Runs-on-Request (RoR)*

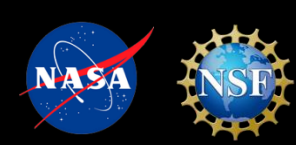


- Enables open use of state-of-the-art models without barriers
- Do-it-yourself: User-configurable simulation settings, interactive tools for inputs generation from observational data
- Expert-guided service: user advising and custom simulations
- Enables model validations by the entire community for historic time periods



# Space Weather Terminology Overview

- Solar cycle: the sun cycles through seasons: solar max and solar min, around every 11 years
- Flares: large eruptions of electromagnetic radiation from the Sun lasting from minutes to hours
- Coronal Mass Ejections (CME): bursts of solar plasma caused by flares or filament eruptions
- Solar energetic particles (SEP): high-speed, charged particles—primarily protons and electrons—emitted by the Sun during intense activity
- Galactic Cosmic Rays (GCR): slowly varying, highly energetic background source of energetic particles that constantly bombard Earth. GCR originate outside the solar system and are likely formed by explosive events such as supernova



# Space Weather Terminology Overview

- Magnetosphere - dynamic, bubble-like region surrounding Earth, formed by the interaction of the solar wind with our planet's magnetic field
- DST - Disturbance Storm Time: metric that measures the intensity of geomagnetic storms by quantifying the strength of the Earth's ring current
- Kp - global, three-hourly measure of geomagnetic activity, ranging from 0 to 9, that quantifies disturbances in the Earth's magnetic field driven by the solar wind

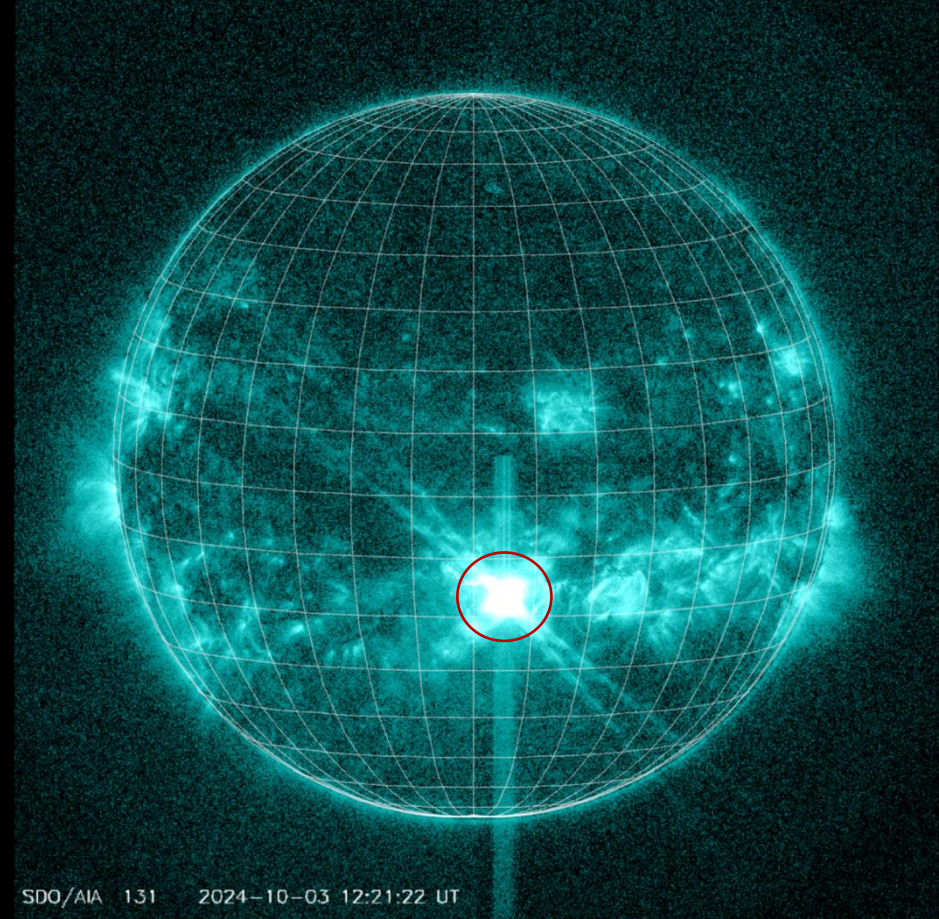


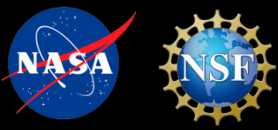
# Solar flare October 3, 2024 X9

SDO  
AIA  
131  
12:25:65 UT

[https://iswa.ccmc.gsfc.nasa.gov/app/?layout=oct032024\\_x9](https://iswa.ccmc.gsfc.nasa.gov/app/?layout=oct032024_x9)

<https://tinyurl.com/oct3x9>





# Coronal Mass Ejection June 21, 2015



The screenshot displays the ISWA (Image Synthesis and Web Analysis) interface for the 2015 Coronal Mass Ejection event. It features four main panels:

- Top Left:** SDO Gallery SDO AIA 131, showing a 3D wireframe model of the Sun with a bright CME structure. Time: 2015-06-21 02:34:22.
- Top Middle:** SOHO LASCO C3, showing a coronagraph view of the Sun with a bright CME structure. Time: 2015-06-21 02:30:00.
- Top Right:** SDO Gallery SDO AIA 131, showing a 3D wireframe model of the Sun with a bright CME structure. Time: 2015-06-21 04:04:22.
- Top Far Right:** SOHO LASCO C3, showing a coronagraph view of the Sun with a bright CME structure. Time: 2015-06-21 04:06:00.

At the bottom, there are two ISWA Sync panels with timelines for SOHO LASCO C3 and SDO Gallery: SDO AIA 131. The left panel shows a time range from 2015-06-20 14:37:00 to 2015-06-23 14:37:00, with a current time of 2015-06-21 02:37:00. The right panel shows a time range from 2015-06-20 14:37:00 to 2015-06-23 14:37:00, with a current time of 2015-06-21 04:07:00. Both panels include 'Preload Images' and 'Select All' options.

<https://iswa.gsfc.nasa.gov/app/?layout=2015flrcme>

<https://tinyurl.com/2015flrcme>



# Solar Energetic Particles

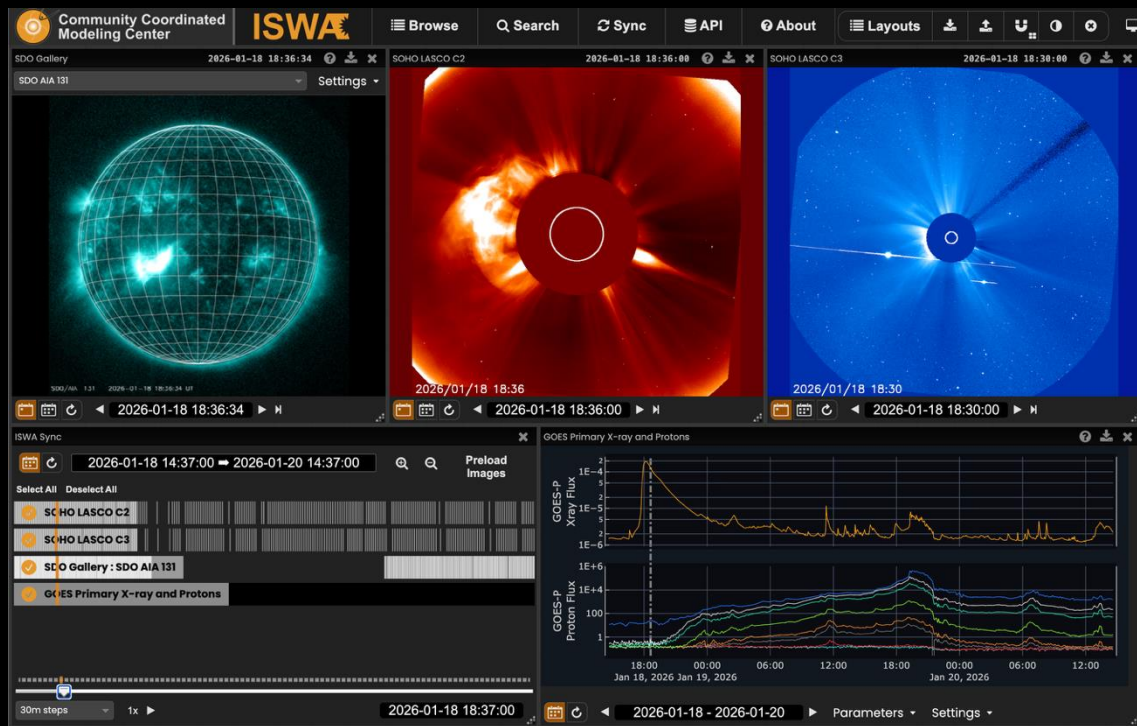


January 18-20, 2026

Flare: X1.9

CME

SEPs

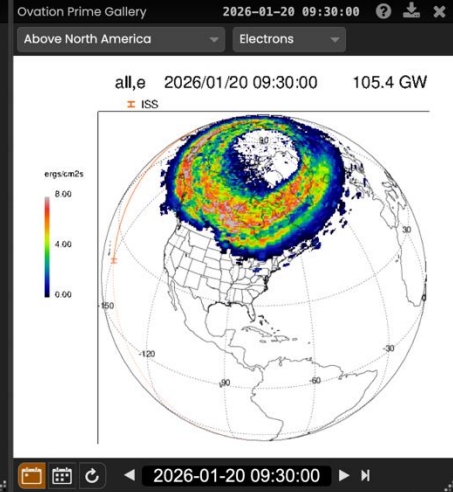
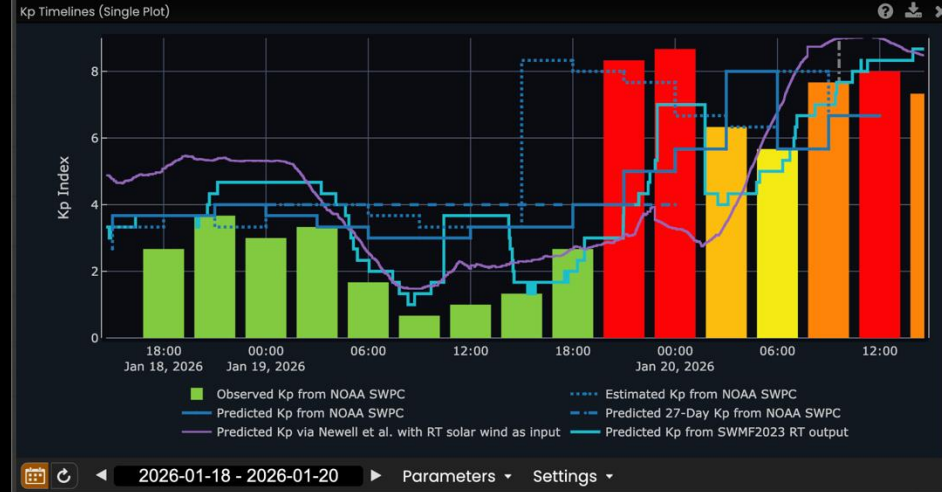


<https://tinyurl.com/flrcmesep>

<https://iswa.ccmc.gsfc.nasa.gov/app/?layout=jan18thru20flrcmesep>



# Kp, DST, Ovation Prime



ISWA Sync

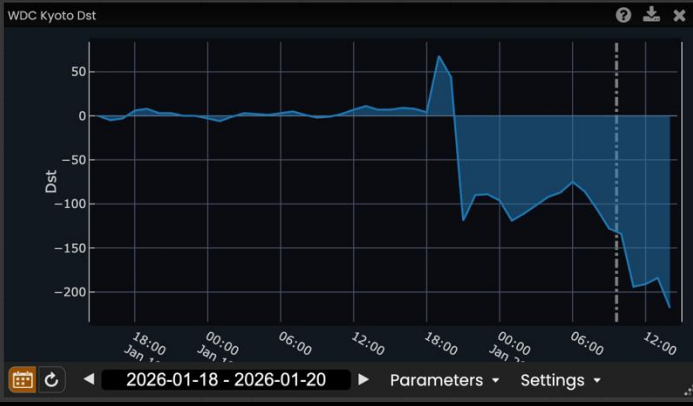
2026-01-18 14:37:00 → 2026-01-20 14:37:00

Select All Deselect All

- Ovation Prime Gallery : Above North America / Electrons
- Kp Timelines (Single Plot)
- WDC Kyoto Dst
- WDC Kyoto Dst

30m steps 1x

2026-01-20 09:37:00



<https://iswa.cmc.gsfc.nasa.gov/app/?layout=jan18thru20kpdstova>

<https://tinyurl.com/jan26geo>



<https://iswa.ccmc.gsfc.nasa.gov/>

- Solar +
- Heliosphere +
- Geospace +
- Magnetosphere +
- Ionosphere +
- Planetary +
- Radiation Effects +
- Moon +
- Mars +
- Events +
- Time Period Runs +
- ISEP +
- All +
- Retired +



Enter at least 1 characters to search



GOES SUVI Gallery



GOES-19 CCOR-1 Gallery



IMPTAM GOES Spectrograms Gallery



GOES X-ray Flux



GOES Integral Proton Intensity



GOES Primary Electron Flux



SWPC GOES Fluxes and RT Solar Wind



GOES Primary X-ray and Protons



ASSA Gallery



Sunspot groups plot on SDO HMI magnetogram



Sunspot groups plot on SDO HMI continuum



Heliospheric Tomography IPS RT Gallery

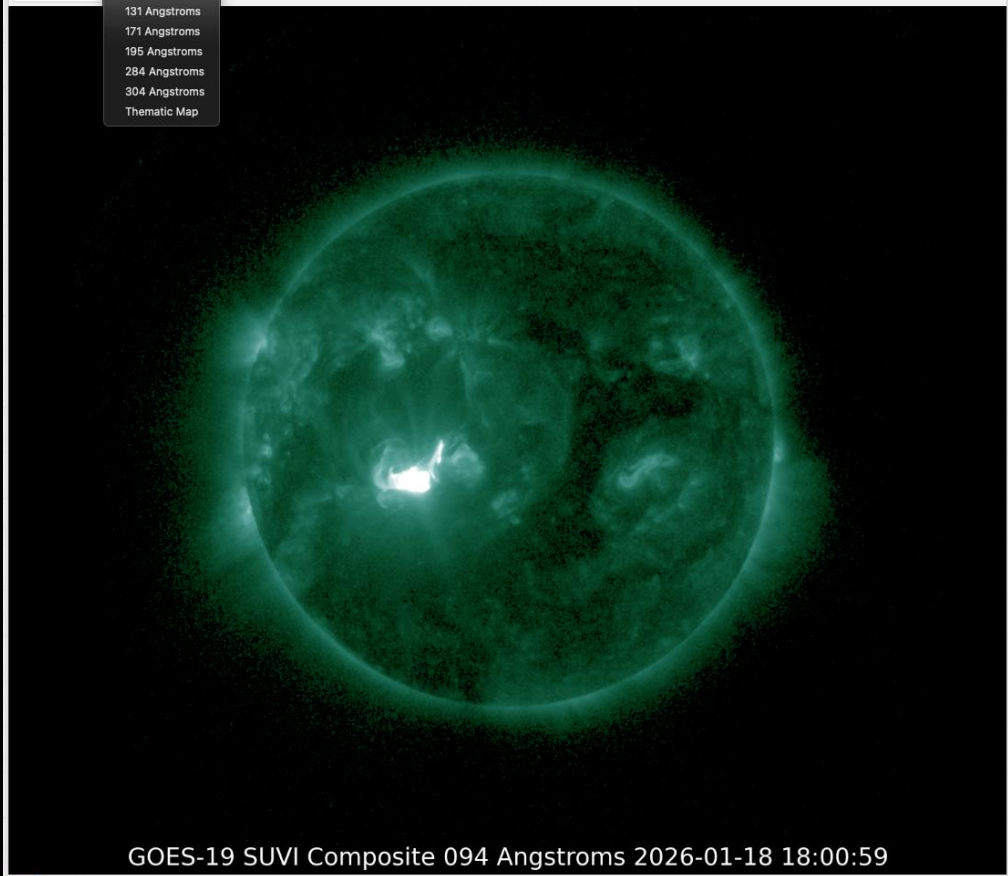


MAVEN - EUVM flare time series plot

GOES SUVI Gallery

- Wavelength
- ✓ 094 Angstroms
  - 131 Angstroms
  - 171 Angstroms
  - 196 Angstroms
  - 284 Angstroms
  - 304 Angstroms
  - Thematic Map

2026-01-18 18:04:00



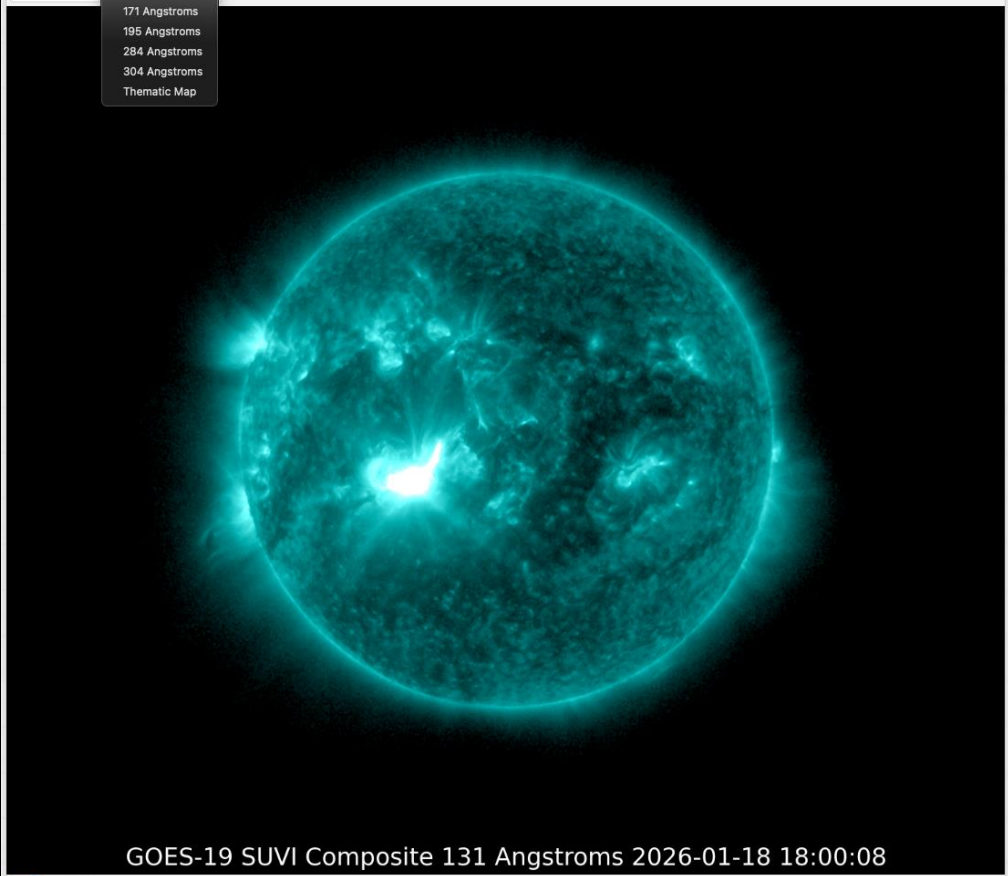
GOES-19 SUVI Composite 094 Angstroms 2026-01-18 18:00:59

2026-01-18 18:04:00

GOES SUVI Gallery

- Wavelength
- 094 Angstroms
  - ✓ 131 Angstroms
  - 171 Angstroms
  - 195 Angstroms
  - 284 Angstroms
  - 304 Angstroms
  - Thematic Map

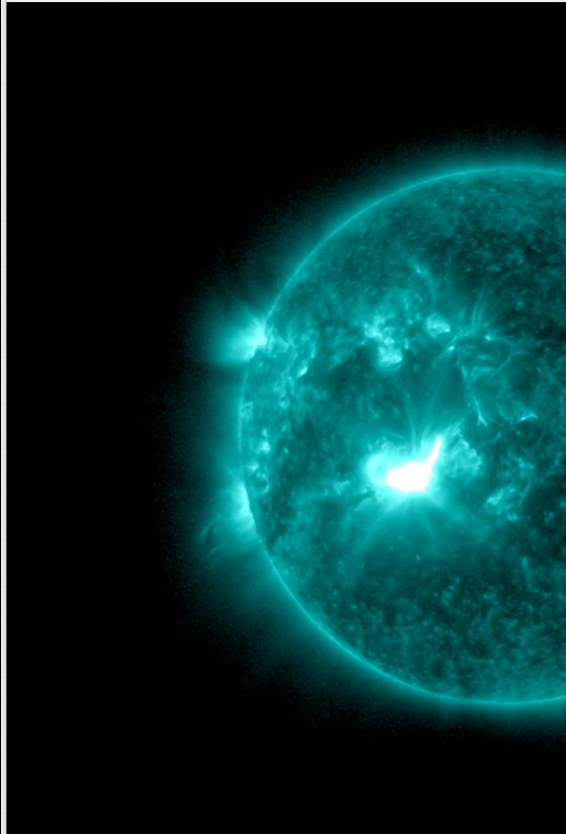
2026-01-18 18:04:00



GOES-19 SUVI Composite 131 Angstroms 2026-01-18 18:00:08

2026-01-18 18:04:00

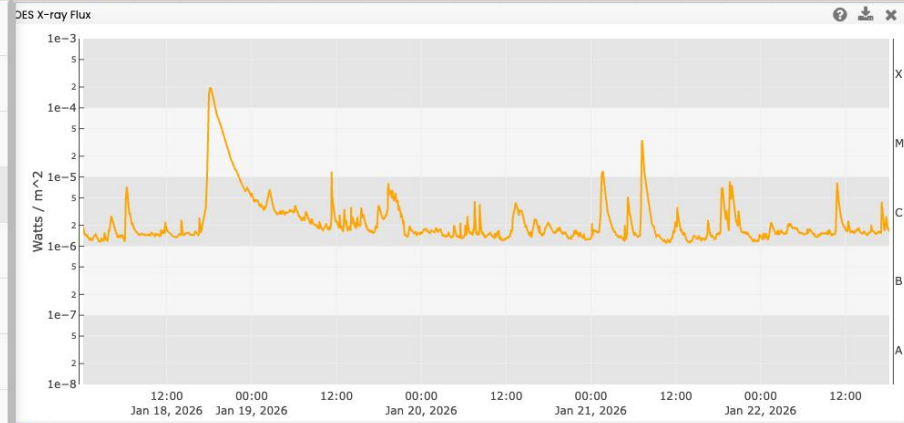
GOES SUVI Gallery  
GOES-P 131 Angstroms



GOES-19 SUVI Composite 131 Angstroms 2026-01-18 18:00:08

2026-01-18 18:04:00

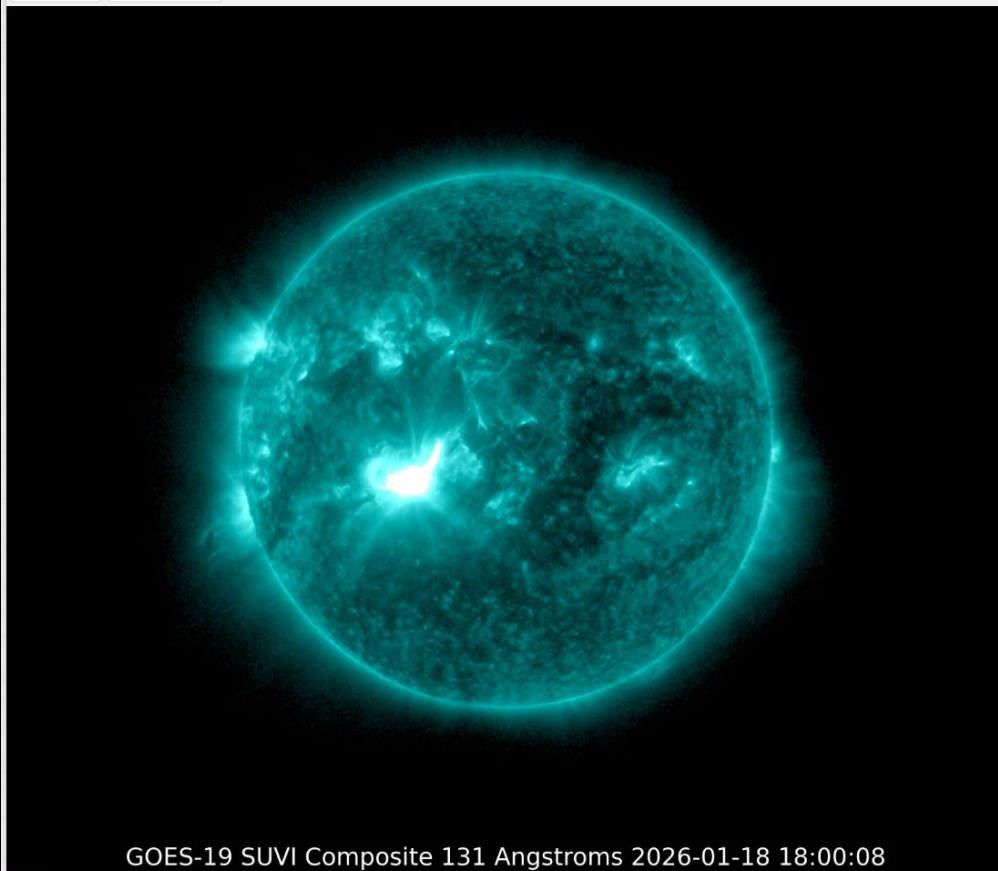
- GOES SUVI Gallery
- GOES-19 CCOR-1 Gallery
- IMPTAM GOES Spectrograms Gallery
- GOES X-ray Flux
- GOES Integral Proton Intensity
- GOES Primary Electron Flux
- SWPC GOES Fluxes and RT Solar Wind
- GOES Primary X-ray and Protons
- ASSA Gallery
- Sunspot groups plot on SDO HMI magnetogram
- Sunspot groups plot on SDO HMI continuum
- Heliospheric Tomography IPS RT Gallery
- MAVEN - EUVM flare time series plot
- MAVEN - EUVM daily time series plot
- NAIRAS SEP Spectral Flux
- NAIRAS-UMASEP SEP Spectral Flux



2026-01-18 - 2026-01-22 Parameters Settings

GOES SUVI Gallery 2026-01-18 18:04:00

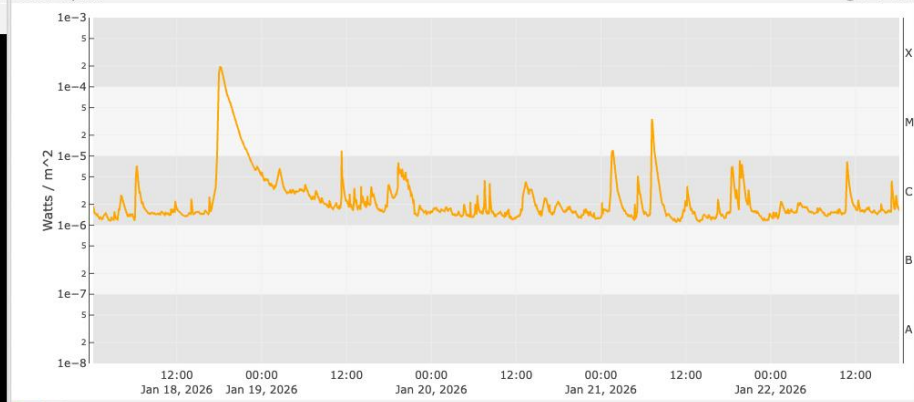
GOES-P 131 Angstroms



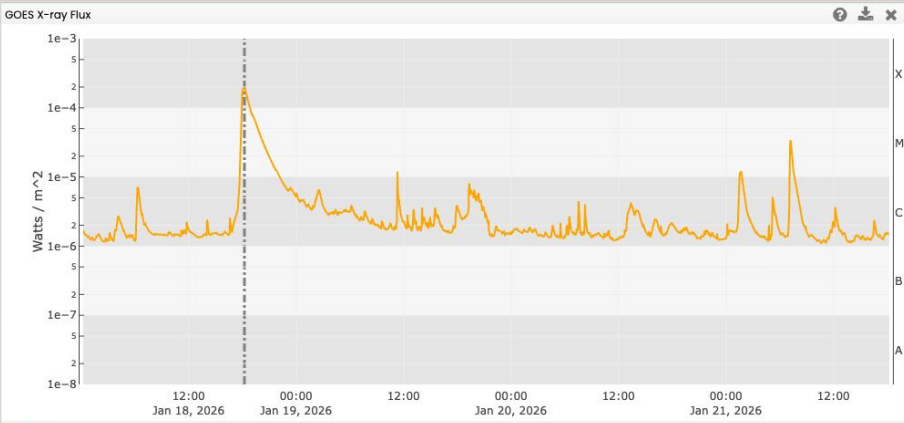
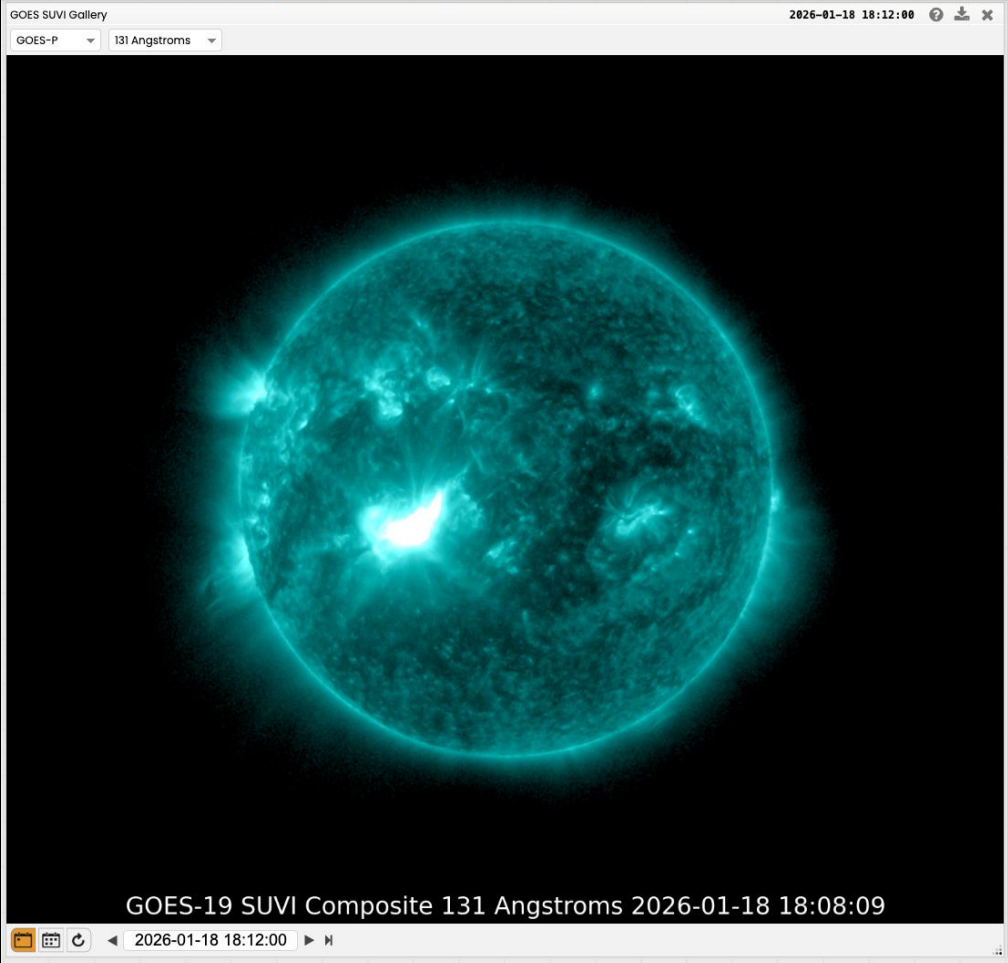
GOES-19 SUVI Composite 131 Angstroms 2026-01-18 18:00:08

2026-01-18 18:04:00

GOES X-ray Flux



2026-01-18 - 2026-01-22 Parameters Settings



2026-01-18 - 2026-01-21 Parameters Settings

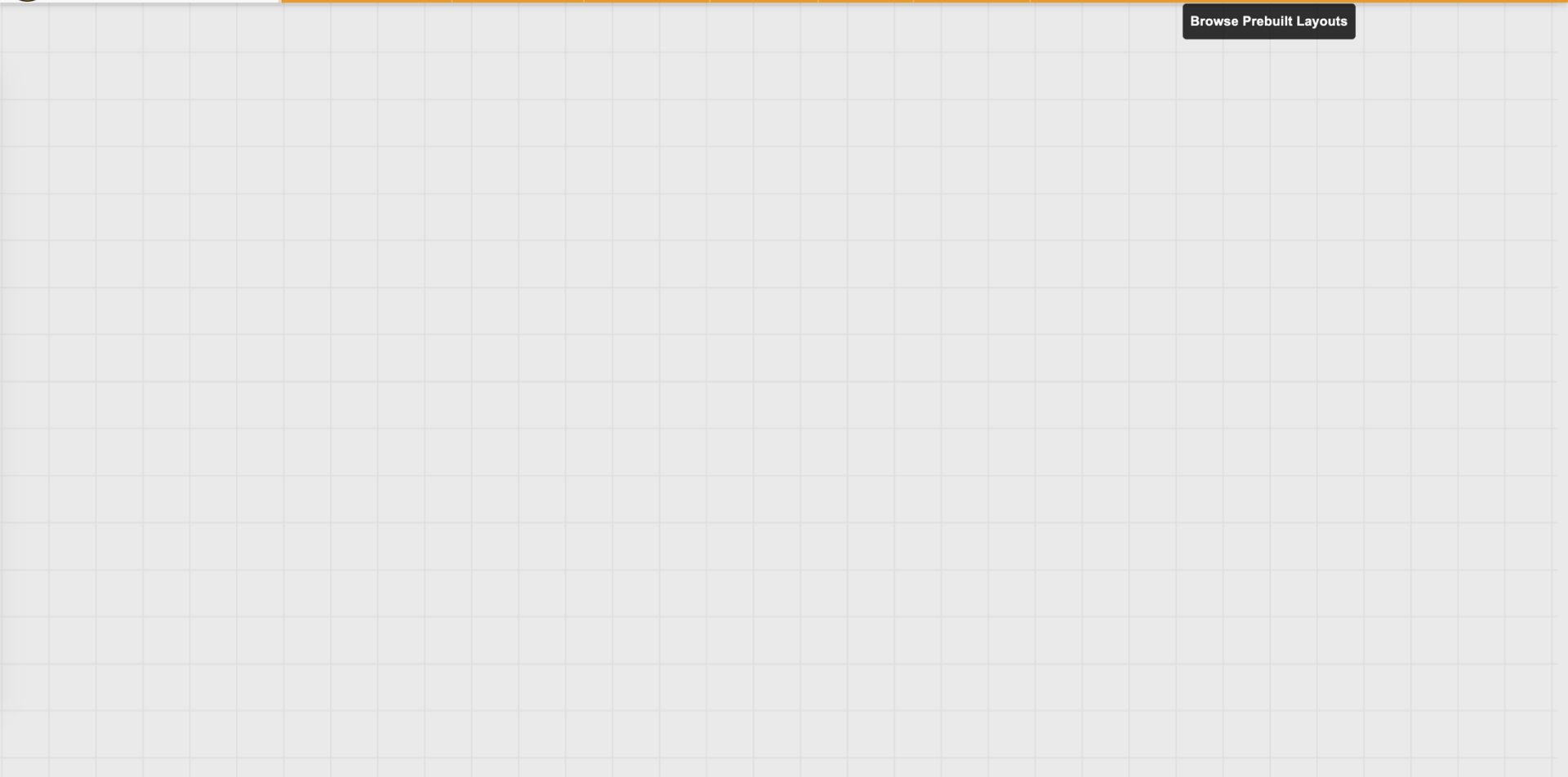
ISWA Sync 2026-01-18 00:14:00 → 2026-01-21 18:14:00 Preload Images

- Select All Deselect All
- GOES SUVI Gallery : GOES-P / 131 Angstroms
  - GOES X-ray Flux

15m steps 1x 2026-01-18 18:14:00





Browse Prebuilt Layouts

















- Models +
- Observations +
- Moon +
- Mars +
- Trajectories +
- Scoreboards +
- Current Real Time Conditions +
- Events +
- Domain Showcase +
- Forecaster Layouts +
- Mission Support +



- Models +
- Observations +
- Moon +
- Mars +
- Trajectories +
- Scoreboards +
- Current Real Time Conditions -
-  Last 3 Days
-  Last Day Featuring NOAA Products
- Events +
- Domain Showcase +
- Forecaster Layouts +
- Mission Support +





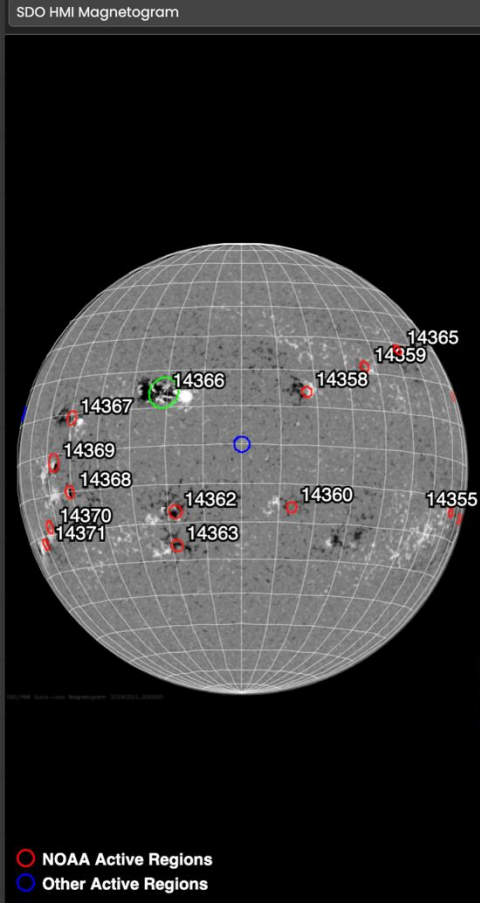
Models -

-  ASAP
-  ASSA
-  Connectivity Models
-  CTIPe
-  ENLIL
-  Heliospheric Tomography IPS RT
-  HESPERIA RELeASE SEP Forecasts
-  HESPERIA RELeASE Plus SEP Forecasts
-  iPATH
-  Li Radiation Belt Prediction Model
-  MagPy
-  NAIRAS Nowcast



- Models +
- Observations +
- Moon +
- Mars +
- Trajectories +
- Scoreboards -
  -  Solar Flare Scoreboard
  -  Geospace Indices Scoreboards
- Current Real Time Conditions +
- Events +
- Domain Showcase +
- Forecaster Layouts +
- Mission Support +

Models	Mode: dark	+
Observations		+
Moon		+
Mars		+
Trajectories		+
Scoreboards		-
 Solar Flare Scoreboard		
 Geospace Indices Scoreboards		
Current Real Time Conditions		+
Events		+
Domain Showcase		+
Forecaster Layouts		+
Mission Support		+



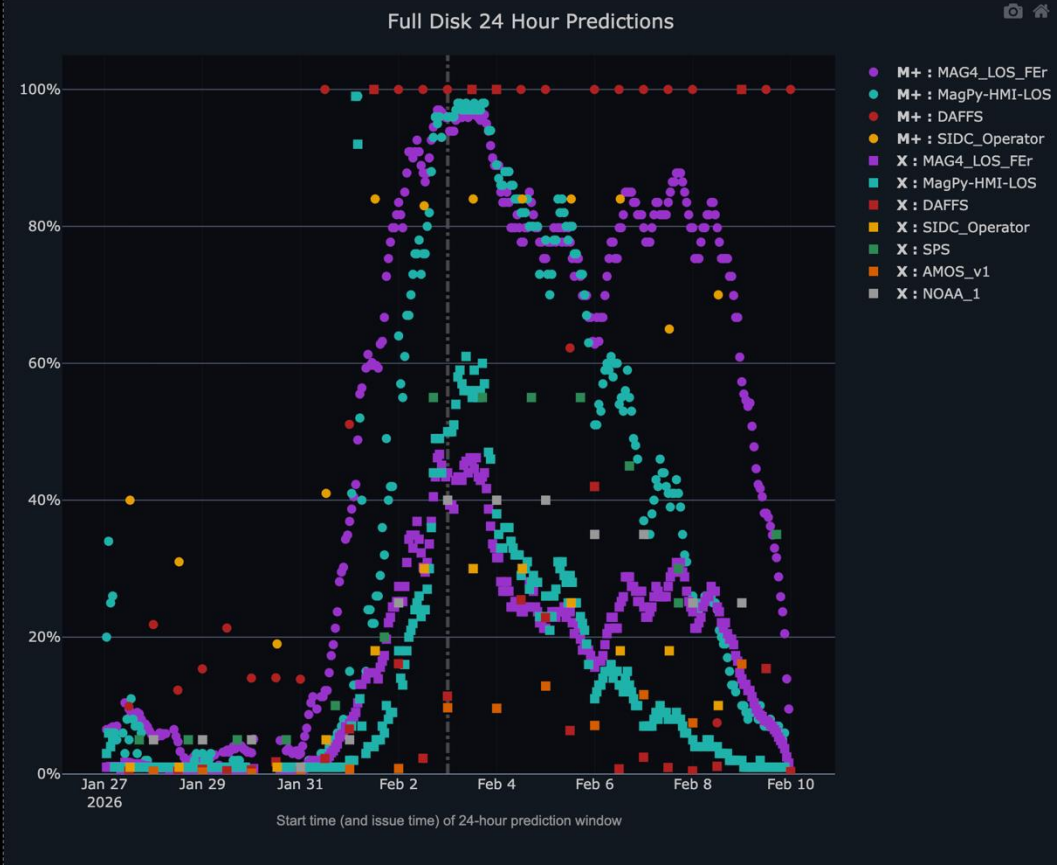
**NOAA AR: 14366 (N14E21)**  
Type: Beta-Gamma-Delta Radius: 3.1

**Region Predictions (24 hour)**

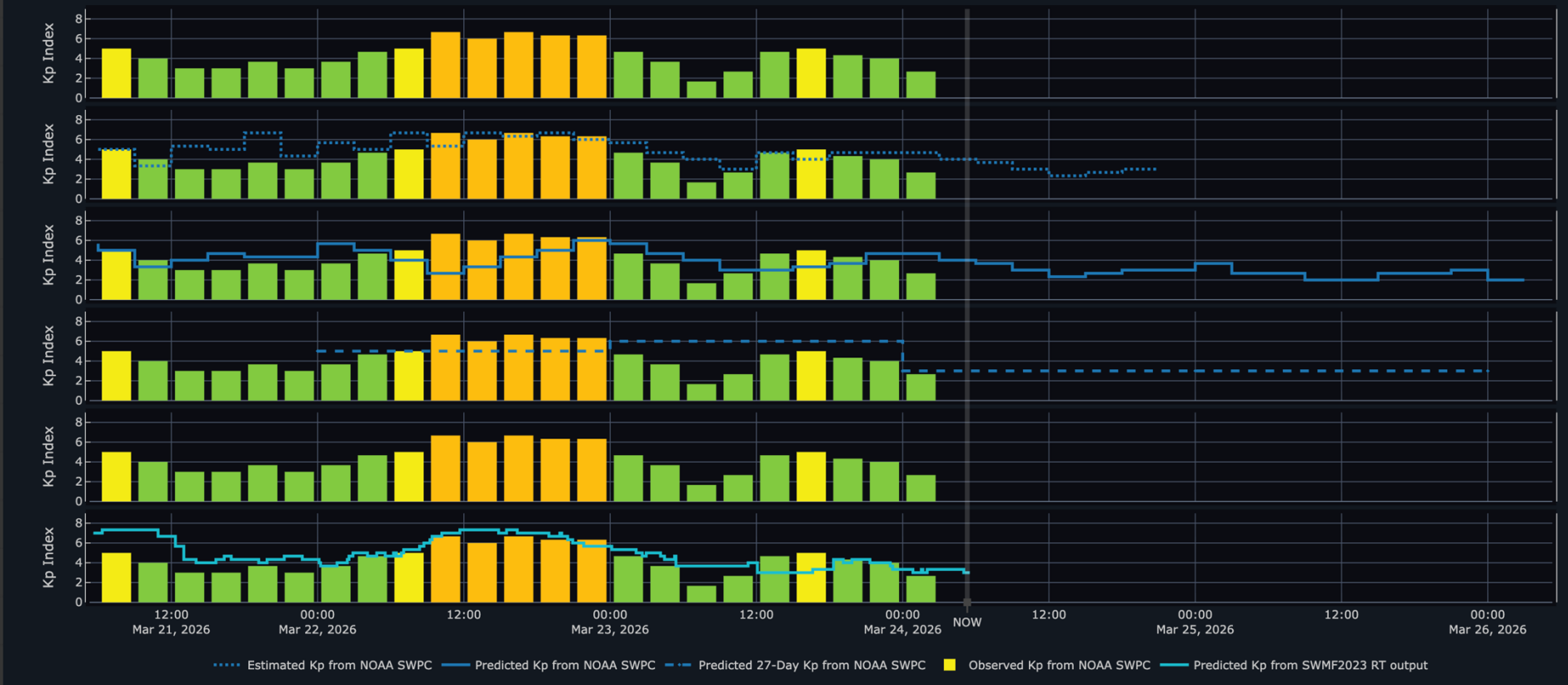
NOAA_1	M+: 0%	X: 40%
MAG4_LOS_FEr	M+: 96%	X: 43%
AMOS_v1	M+: 0%	X: 10%
MAG4_LOS_FEr	M+: 96%	X: 43%
MAG4_LOS_FEr	M+: 96%	X: 43%
DAFFS	M+: 100%	X: 11%
MAG4_LOS_FEr	M+: 96%	X: 43%
MAG4_LOS_FEr	M+: 96%	X: 43%
MAG4_LOS_FEr	M+: 96%	X: 43%
Averages	M+: 75%	X: 36%

**Full Disk Predictions (24 hour)**

MAG4_LOS_FEr	M+: 96%	X: 44%
MagPy-HMI-LOS	M+: 96%	X: 50%
DAFFS	M+: 100%	X: 11%
AMOS_v1		X: 10%
NOAA_1		X: 40%
Averages	M+: 97%	X: 31%

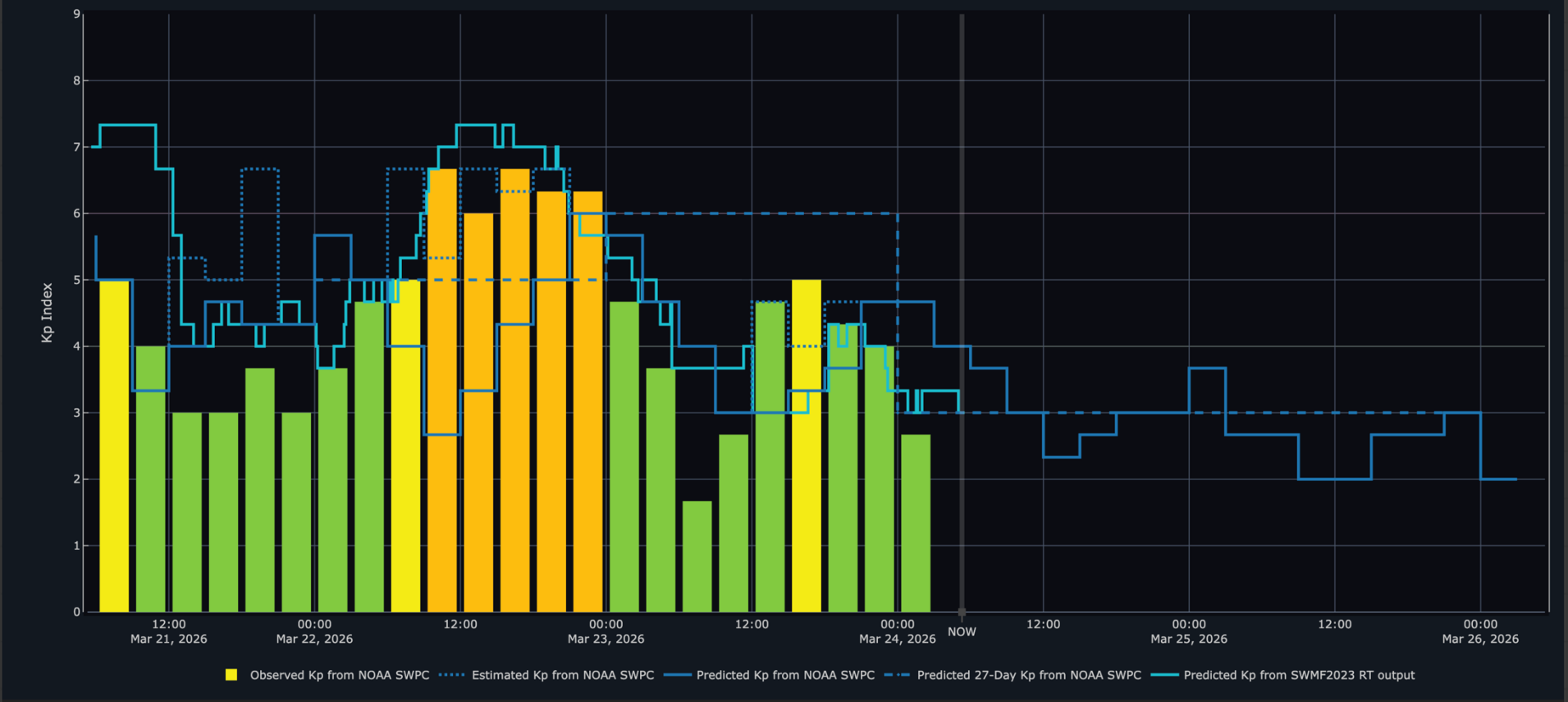


Kp Timelines (Stacked Plot) [Help] [Download] [Close]



[Refresh] [Calendar] latest 3 days | +2 days | Parameters | Settings

Kp Timelines (Single Plot)



■ Observed Kp from NOAA SWPC 
 ⋯ Estimated Kp from NOAA SWPC 
 — Predicted Kp from NOAA SWPC 
 - - - Predicted 27-Day Kp from NOAA SWPC 
 — Predicted Kp from SWMF2023 RT output



**Models** +

**Observations** +

**Moon** -



Lunar Space Weather



Lunar Observations



LRO CRATER



SWMF2023 RT Magnetosphere at Moon



THEMIS - ARTEMIS observations



All THEMIS - ARTEMIS observations

**Mars** +

**Trajectories** +

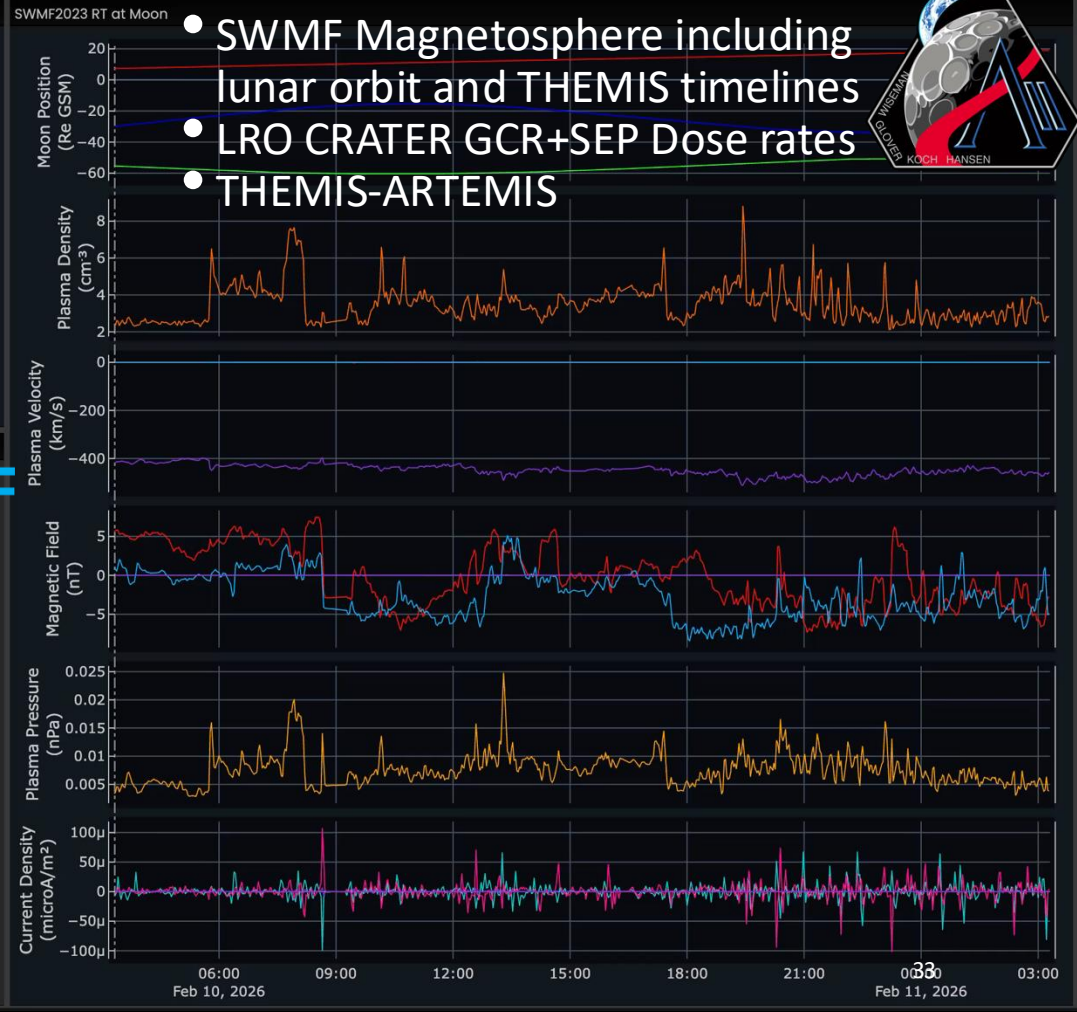
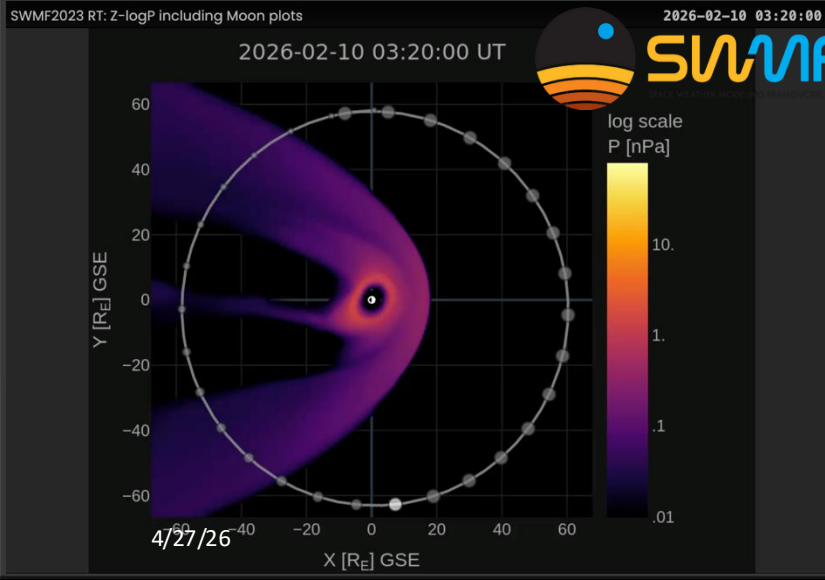
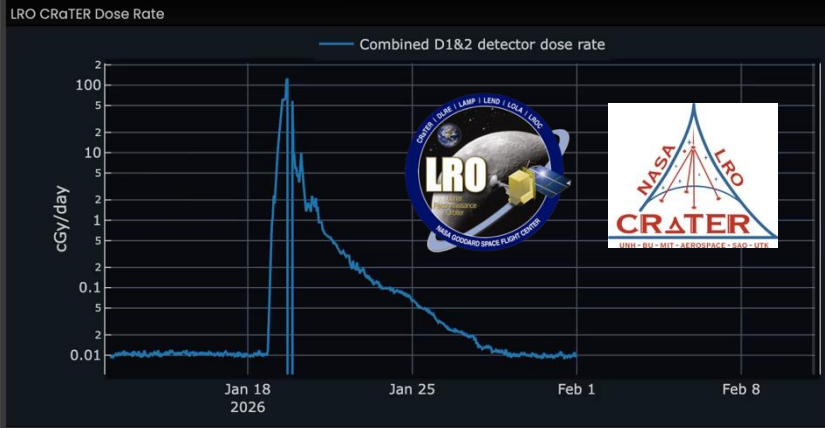
**Scoreboards** +

**Current Real Time Conditions** +

**Events** +

# Lunar Dashboard now live:

- SWMF Magnetosphere including lunar orbit and THEMIS timelines
- LRO CRATER GCR+SEP Dose rates
- THEMIS-ARTEMIS

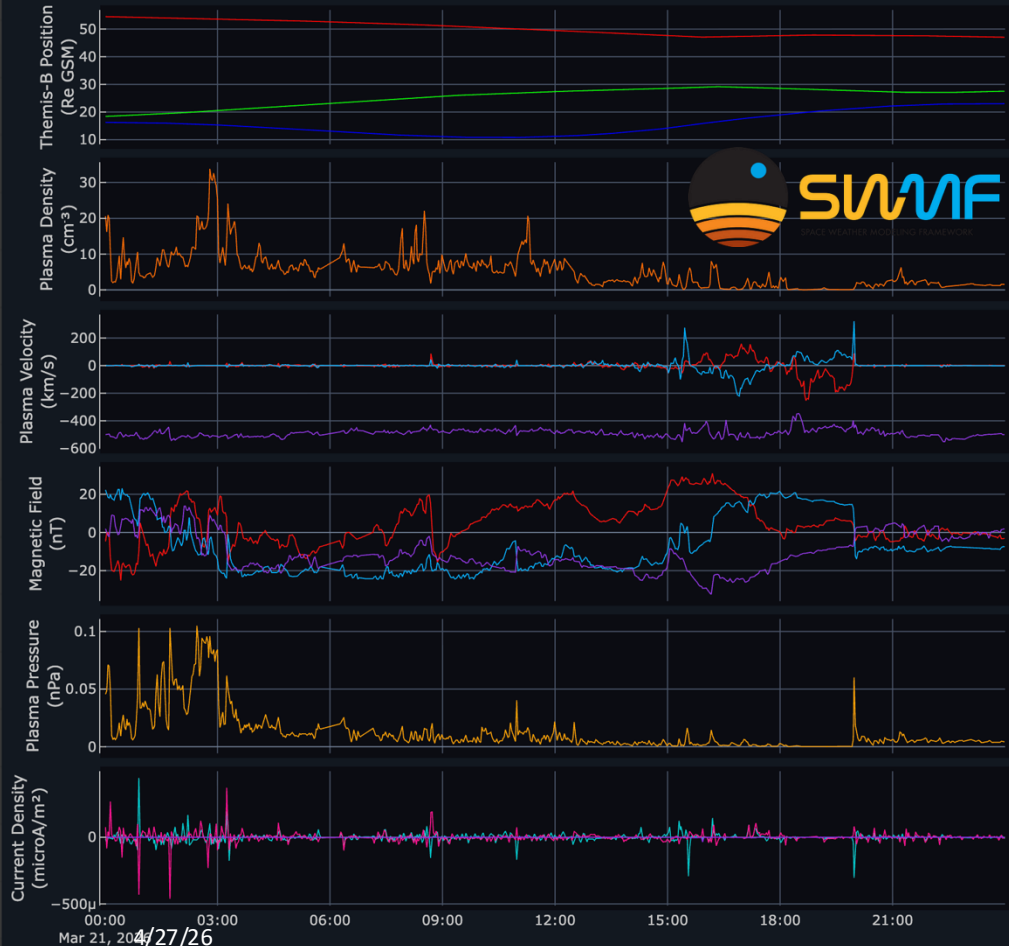


SWMF2023 RT at Themis-B

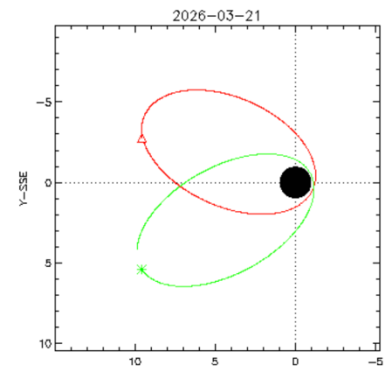


Themis / Artemis Plots

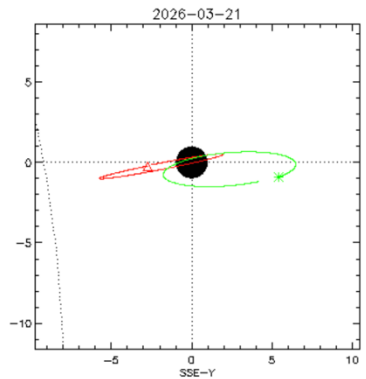
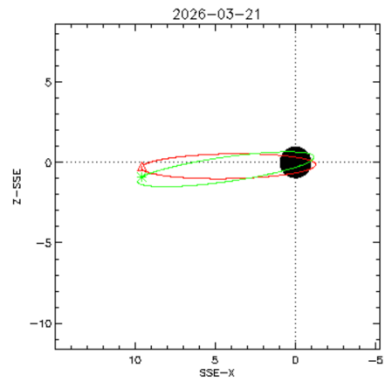
2026-03-21 00:00:00



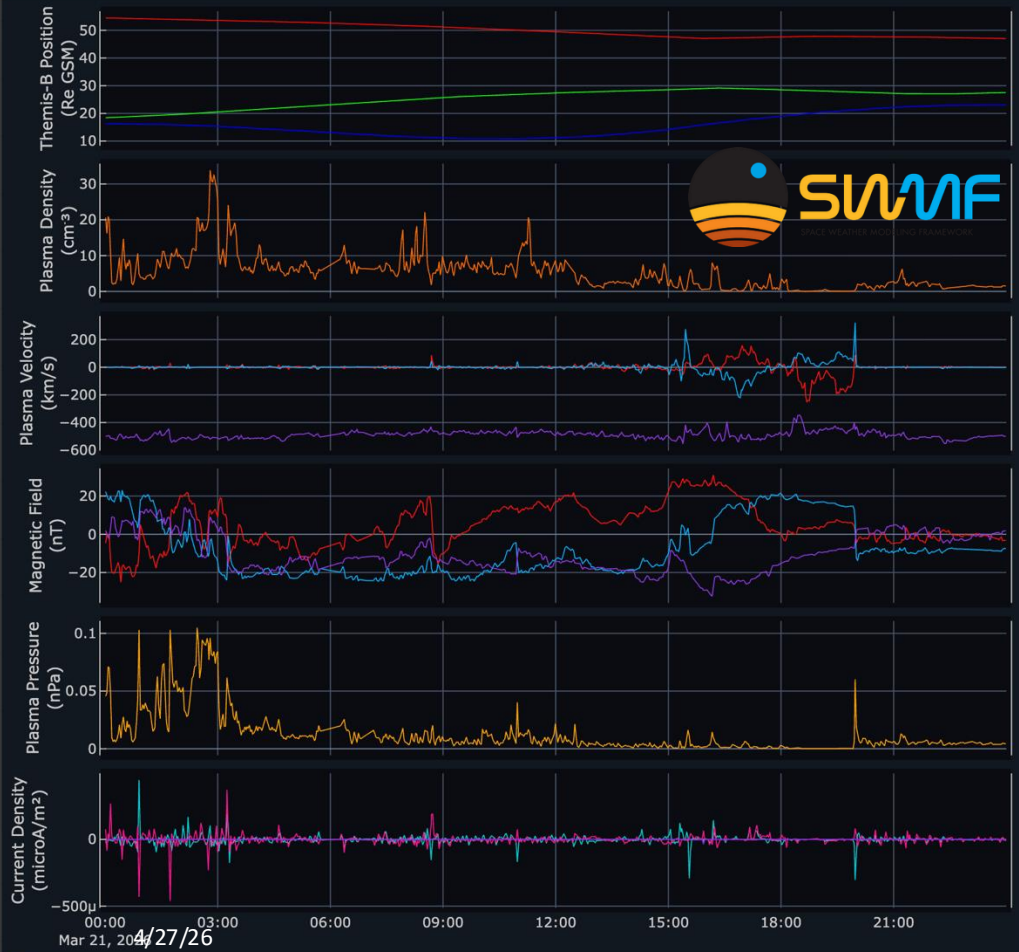
SSE Lunar Orbits (rL)



- Final orbits:
- THEMIS-P1 ( B )
  - THEMIS-P2 ( C )
  - Earth: ( + )
  - Moon: ( O )

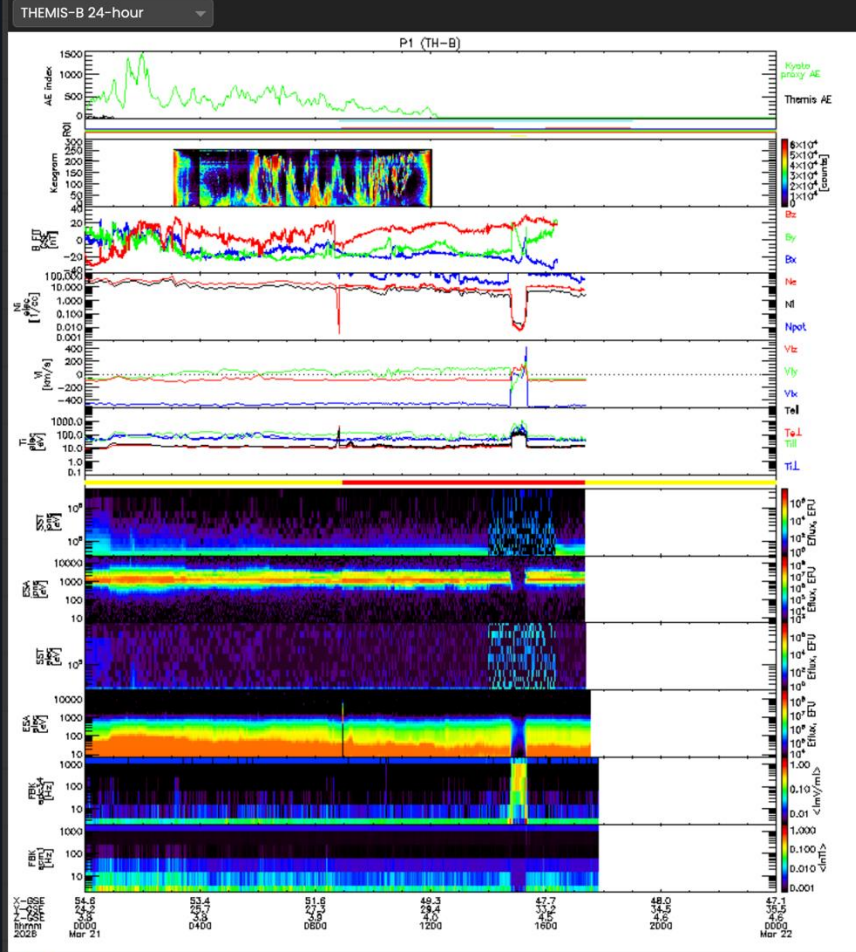


SWMF2023 RT at Themis-B



Themis / Artemis Plots

2026-03-21 00:00:00





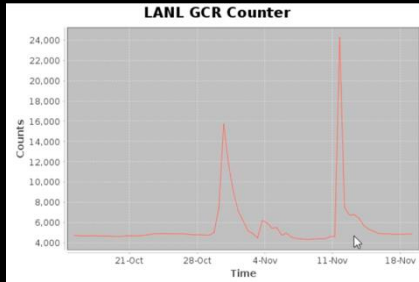
# Mars Dashboard on ISWA



- MAVEN particles, fields, flares
- MSL/RAD dose rate

coming soon:

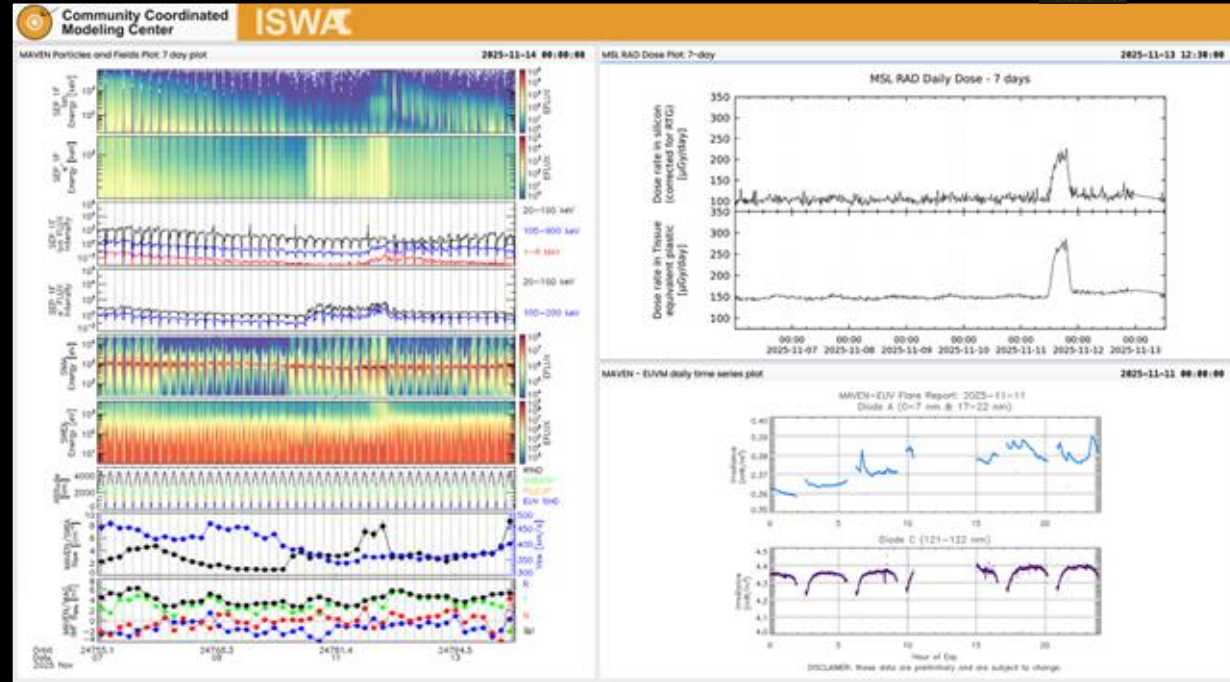
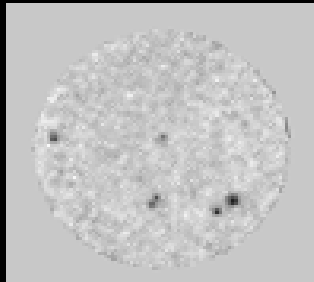
- Mars Odyssey/HEND S4+S6, NS GCR



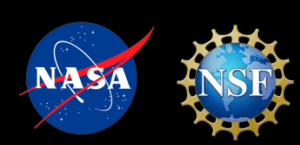
- MSL/Mastcam, Perseverance/Mastcam-Z Sunspot images



4/27/26

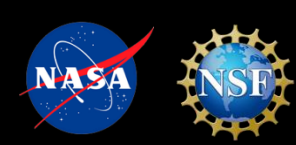


- CCMC is developing **Mars CME and SEP Scoreboards**
- Christina Lee, Mars data experts, and M2M SWAO are creating a **forecaster user guide** for these data products
- Alessandro Bruno developing **Mars SEPSTER2D** SEP forecast model



# Investigate!

Load the 'Current Real Time Conditions' layout for the 'Last 3 Days'.  
What do you notice for the current conditions for space weather?



# Investigate!

Load the 'Current Real Time Conditions' layout for the 'Last 3 Days'.  
What do you notice for the current conditions for space weather?

Go back in time to February 1-6, what do you notice about space weather for this timeline?



# Investigate!

Load the 'Current Real Time Conditions' layout for the 'Last 3 Days'.  
What do you notice for the current conditions for space weather?

Go back in time to February 1-6, what do you notice about space weather for this timeline?

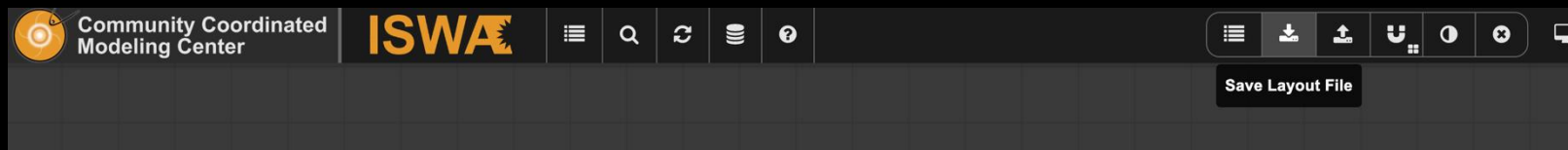




# Create your own ISWA Layout

Take 7 minutes to design your own ISWA layout, or work with a partner to create your layout.

To save your layout, click the 'Save Layout File' option in the menu.





# CCMC DONKI Space Weather Database



- CCMC's DONKI Space Weather Database was established to capture and publicly serve space weather forecasting analysis and chain of events
- Provides general space weather context and event chain, useful for anomaly analysis
- M2M SWAO Analysts populate the DONKI database with CME measurements, and CME simulations, and establish event linkages with observational threshold crossings
- CCMC's DONKI Dash was developed in 2025 as an advanced visual interface for exploring the DONKI database and will soon replace the current DONKI front end.
- DONKI Dash allows comprehensive search and filtering options
- New DONKI event chains view coming soon
- DONKI API available

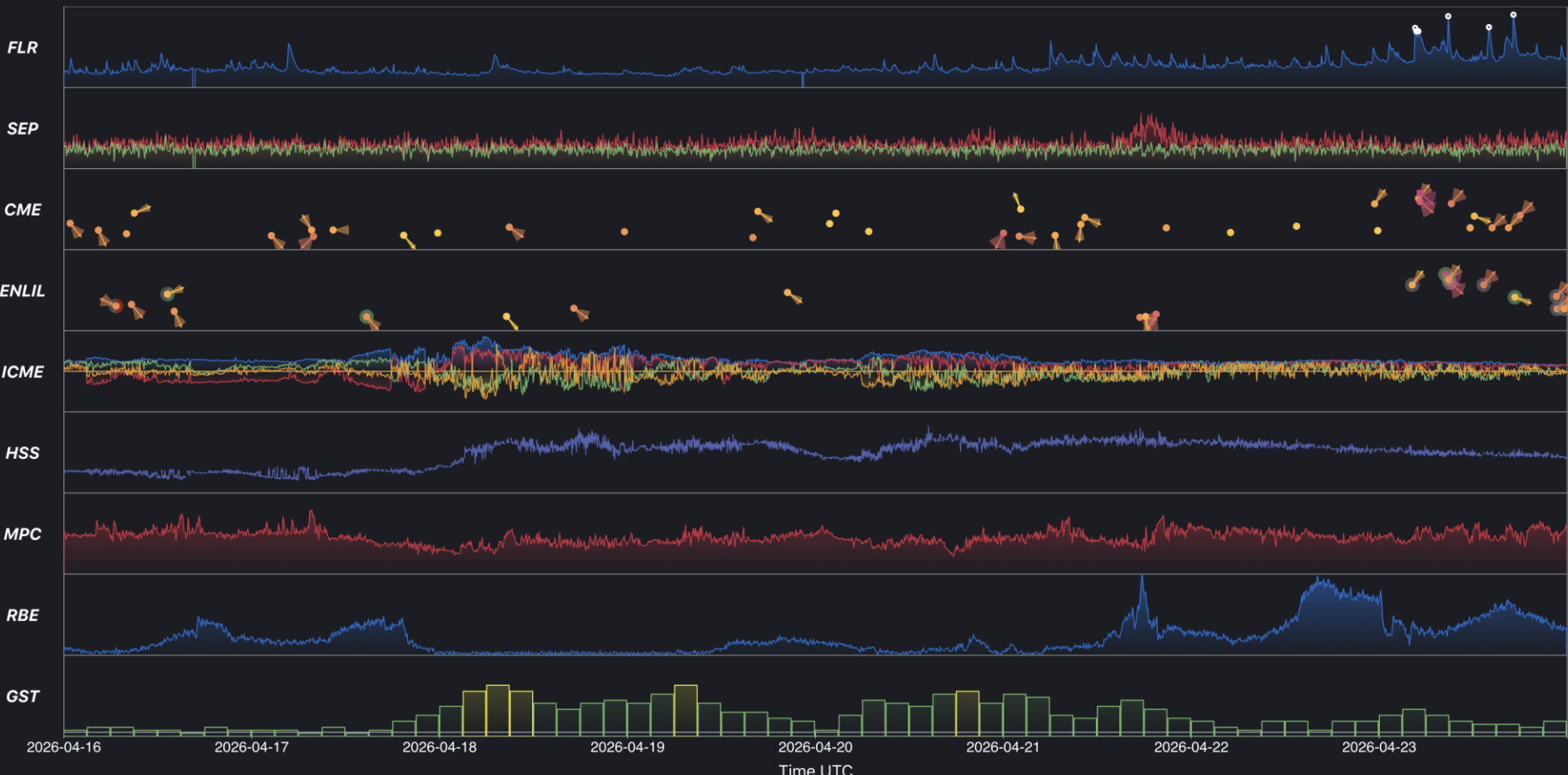
<https://ccmc.gsfc.nasa.gov/tools/DONKI/>



Plots ▾

FLR: 6 SEP: 0 CME: 37 ENLIL: 22 ICME: 1 HSS: 2 MPC: 0 RBE: 1 GST: 1

Catalog M2M\_CATALOG × 2026-04-16 – 2026-04-23 ×





# CCMC-Developed User Focused Training Modules



Two modules developed available online:

- Space Weather Impacts on Satellites
- Human Health Risks From Radiation (co-developed w/NASA JSC SRAG)

In-person instruction by subject matter experts:

- Yihua Zheng – February 2026 - GSFC SWERV Training
- Claudio Corti – November 2025 - Space Weather Training Course for European Space Weather Week

*We are developing more user-focused modules involving CCMC models and tools, get in touch for instruction and/or new module requests*



Moon

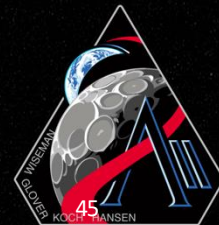


NASA's Scientific Visualization Studio  
Model at CCMC: GAMERA

4/27/26

<https://svs.gsfc.nasa.gov/5622/>

2026 SWW Student Session Presentation - Resnick



Thank you!  
Questions?

[elana.m.resnick@nasa.gov](mailto:elana.m.resnick@nasa.gov)

