



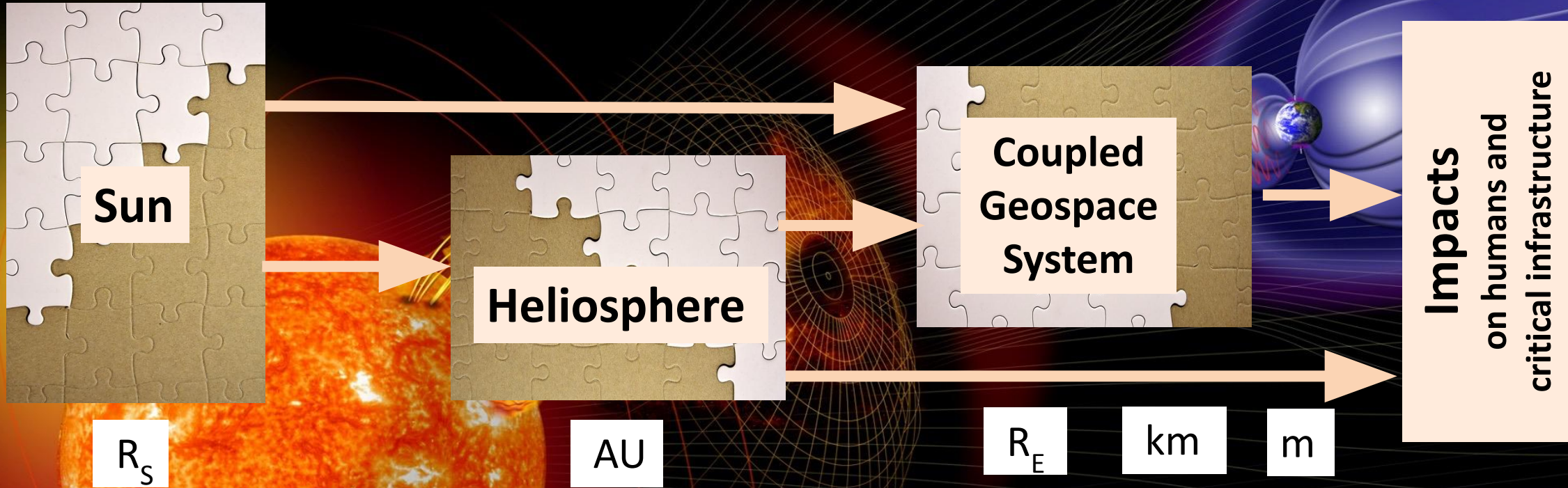
Learn about the Heliophysics Big Year events such as the eclipse through NASA's Community Coordinated Modeling Center's (CCMC) tools

Presented by Elana Resnick with contributions from the CCMC Team
NASA/GSFC/CCMC

CS AAPT Spring 2024

Saturday, March 16, 2024

Grand Challenge: Model Sun-to-Impact Flow of Space Weather Processes

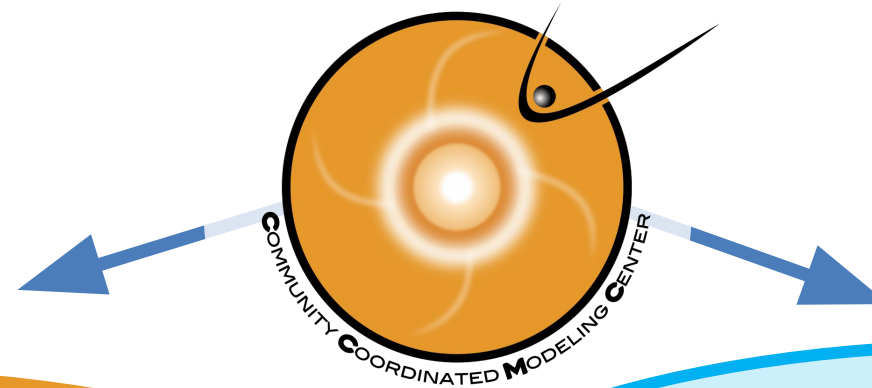


To build space weather predictive capabilities based on science we need to

- assemble parts of the puzzle by solving problems focused on different physical domains with diverse spatial scales and underlying physical phenomena
- identify information passed between domains
- identify space environment quantities linked to impacts
- connect all validated solutions from space weather origins on the sun to impacts

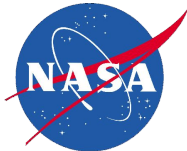


Established in 2000 as multi-agency strategic investment in a national Space Weather program



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

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



Simulation Services



Runs on Request

Runs on Request is a free service open to any user interested in running the simulation models hosted by the CCMC.



Continuous/Real-time Run

Continuous/real-time runs are models that CCMC executes using near real-time observation data as inputs. Post processed results of such runs are sent to iSWA for display.



Instant Run

Simulation models that are available for instant execution and viewing of results online via the Instant-Run web app.

Simulation Services: Runs-On-Request (ROR)

Search by name

Found 53 models [Reset Filters](#)

AMPS
Adaptive Mesh Particle Simulator
Version: 2017
Status: Production
[Runs-on-Request](#)

ANMHD
Anelastic Magnetohydrodynamic
Version: 1.0
Status: Production
[Runs-on-Request](#)

BSPM
Belgian Space Weather Integrated Forecasting Framework (SWIFF)
Plasmasphere Model (BSPM)
Version: 2021

Select a model from the CCMC Model Catalog

- 50+ available models for ROR



BSPM MODEL RUN
Fill in the form below and continue with your run submission.

[I agree to the CCMC DATA Collection Consent Agreement in order to submit a run**](#)

Have your consent?
☒ YES

GENERATE YOUR REQUEST
Results will be published online under your Run Registration Number (FirstName_LastName_MHDDYY_ModelType_RunNumber) e.g. John_Smith_032511_1M_1.

R SCHOOL EMAIL (last you) Enter a valid work or school email address

NAME (GIVEN)

NAME (FAMILY)

NUMBER* no per day

DIS* if and search the results of

SET THE SIMULATION DAY
DO

SET HOUR OR FULL DAY
Run simulation for full 24 hour or single hour of given day.

4 HOUR RUN
ELECTIVE HOUR RUN:

*day

Fill out the model run request form

- Contact info, input selections
- Special request with customized settings is possible



Run Metadata

Metadata Record: [View Full Run Metadata in the CCMC Metadata Registry \(CMR\)](#)

Metadata as JSON: [View Full Run Metadata as JSON](#)

Model Domain: IT

Model Name: WACCMX

Model Version: 2.2

Key Word:

CS output:

Run type:

Boundary:

Year run:

DOY:

Start time:

End time:

E-field model:

“Your run is completed”

- Individual ‘View run’ page online:
- View quick look graphics
- Visualize online
- Browse/download output

Output Data

- [View 3D Ionosphere/Thermosphere](#)
- [Create Timeseries in 3D Ionosphere/Thermosphere](#)

Run Services

Simulation Services: Instant-Run (IR)

IRI

International Reference Ionosphere Model

Version: 2016

→ Runs-on-Request ⚡ Instant Run

IRI

International Reference Ionosphere Model

Version: 2020

⚡ Instant Run → Runs-on-Request

NRLMSIS

Mass Spectrometer and Incoherent Scatter model

Version: 00

⚡ Instant Run → Runs-on-Request

NRLMSIS

Mass Spectrometer and Incoherent Scatter model

Version: 2.0

⚡ Instant Run → Runs-on-Request

SuperDARN Convection Models

SuperDARN
(RST)

Version: 4.3.

⚡ Instant

Teuaganan

Select a model from the
CCMC Model Catalog

- 15+ available models for IR

CCMC Instant Run System

IRI

Version

- ☐ IRI 2020
- ☒ IRI 2016
- ☐ IRI 2012
- ☐ IRI 2007

Time

Time Type

Coordinated Universal Time (UTC)

Date Time

11/30/2023 10:00 AM

Coordinate

Coordinate Type

Geographic

Latitude (-90° to 90°)

10

Longitude (0° to 360°)

110

Height (0 to 1000 km)

300

Profile

Profile Type

Height (0 to 1000 km)

Start

0

Stop

1000

Step Size

10

Upper Height (km) for TEC Integration (0 for no TEC)

2000

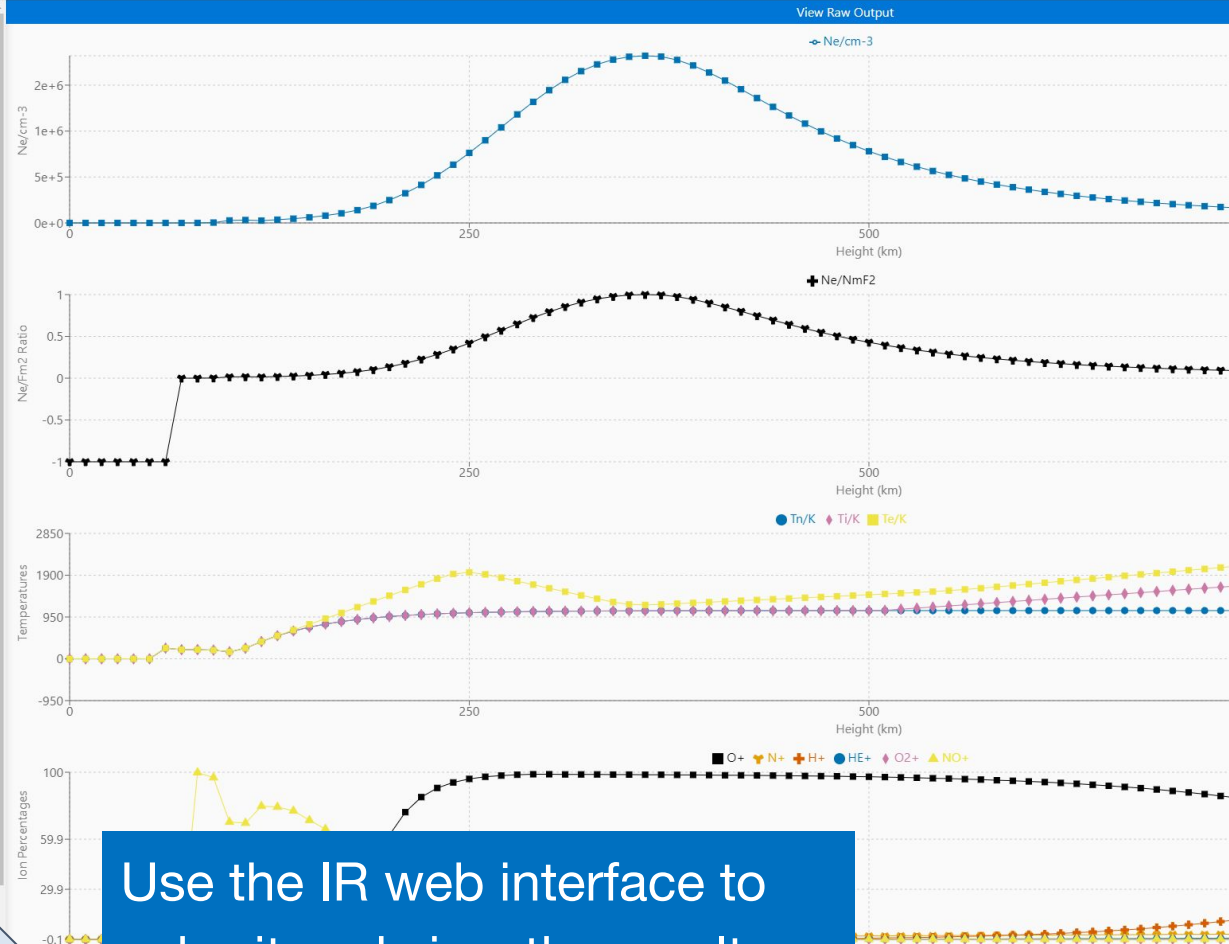
Lower Height (km) for TEC Integration (0 for no TEC)

50

Data Options

Standard table of IRI parameters

Optional Parameters



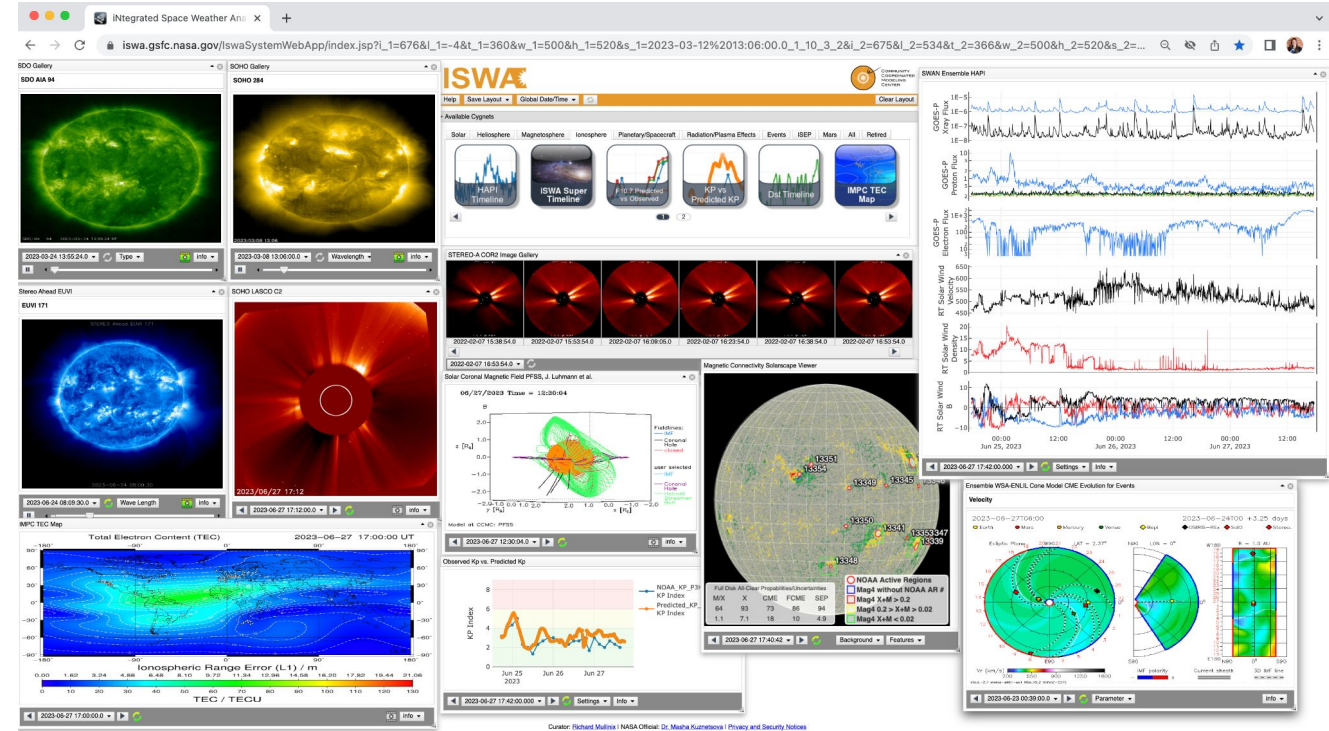
Use the IR web interface to
submit and view the results
immediately online!

Space Weather Analysis



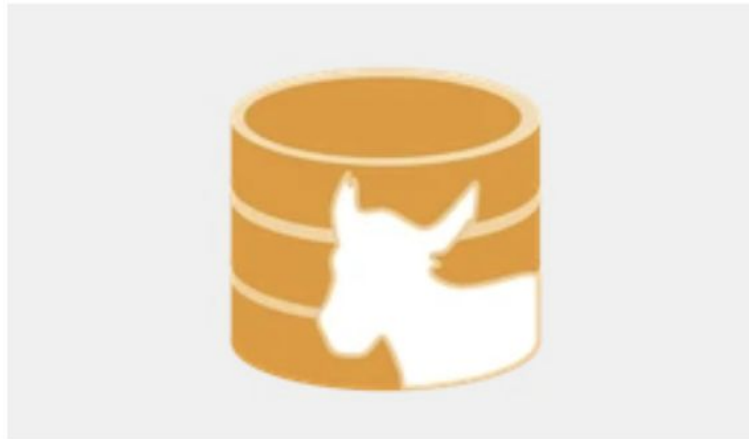
iSWA

iSWA serves CCMC real-time/continuous model outputs and observational data.




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

Space Weather Analysis



DONKI

DONKI is a comprehensive online database of space weather events for the community.



Space Weather Database Of Notifications, Knowledge, Information (DONKI)

Go to:

- [About DONKI](#)
- [DONKI Home](#)
- [Search Space Weather Activity](#)
- [Search Notification Archive](#)
- [Login](#)

Search Space Weather Activity Archive

Space Weather Activity Type :

Select Catalog :

Optional start date in format (e.g. 2013-01-31) :

Optional end date in format (e.g. 2013-06-30) :

Event Type	Start Time (UT)	Associated Instrument	Peak Time	End Time	Class	Source Location	Active Region Number	Directly Linked Event(s)
Solar Flare	2023-12-05 06:39	GOES-P: EXIS 1.0-8.0	2023-12-05T06:44Z	2023-12-05T06:48Z	M1.5	N18E73	13513	
Solar Flare	2023-12-05 06:48	GOES-P: EXIS 1.0-8.0	2023-12-05T06:58Z	2023-12-05T07:06Z	C5.3	S18W90	13500	2023-12-05T07:48:00-CME-001
Solar Flare	2023-12-05 20:59	GOES-P: EXIS 1.0-8.0	2023-12-05T21:10Z	2023-12-05T21:17Z	M1.0	N19E69	13513	
Solar Flare	2023-12-05 21:17	GOES-P: EXIS 1.0-8.0	2023-12-05T21:20Z	2023-12-05T21:25Z	M1.4	N19E69	13513	
Solar Flare	2023-12-06 05:30	GOES-P: EXIS 1.0-8.0	2023-12-06T05:41Z	2023-12-06T05:52Z	M2.1	N19E65	13513	
Solar Flare	2023-12-06 21:26	GOES-P: EXIS 1.0-8.0	2023-12-06T21:44Z	2023-12-06T21:55Z	M2.3	N19E55	13513	

Generate report for all CME parameters ([PDF](#) or [TEXT](#))

Generate report for the most accurate and complete CME parameters only ([PDF](#) or [TEXT](#))

Event Type	Start Time (UT)	Catalog	All Detecting Instruments	Source Location	CME Analysis											
Event Type	Catalog	Measurement Type	Prime?	Technique	Long	Lat	Speed	Type	Half Width	Time 21.5	WSA-ENLIL-Cone Result(s)					
CME	2023-12-05 00:12	M2M_CATALOG	SOHO: LASCO C2 SOHO: LASCO C3 STEREO A: SECCHI COR2	S17W90 (13500)	CME Analysis	M2M_CATALOG	LE	true	SWPC_CAT	90.0	-27.0	365.0	S	29.0	2023-12-05T10:10Z	Result 1 (2.0 AU) Result 2 (5.5 AU) Lucy = 2023-12-12T00:00Z
CME	2023-12-05 07:48	M2M_CATALOG	SOHO: LASCO C2 SOHO: LASCO C3 STEREO A: SECCHI COR2	S17W90 (13500)	CME Analysis	M2M_CATALOG	LE	true	SWPC_CAT	95.0	-22.0	619.0	C	45.0	2023-12-05T14:08Z	Result 1 (2.0 AU) Result 2 (5.5 AU) Lucy = 2023-12-12T00:00Z
CME	2023-12-05 10:00	M2M_CATALOG	SOHO: LASCO C2 SOHO: LASCO C3 STEREO A: SECCHI COR2		CME Analysis	M2M_CATALOG	LE	true	Plane-of-sky	NONE	-59.0	422.0	S	22.0	2023-12-05T18:17Z	Not modeled

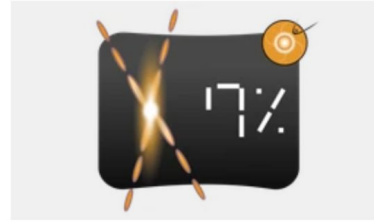
<https://ccmc.gsfc.nasa.gov/tools/DONKI/>

Validation & Scoreboards



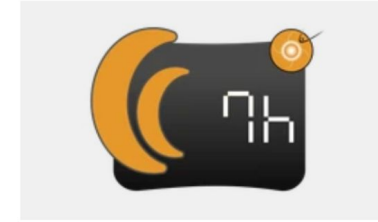
CAMEL

CAMEL is an integrated and flexible framework for comparing space weather and space science model outputs with observational data sets.



Flare Scoreboard

Real-time Forecasting Methods Validation for predicting Solar Flare events.



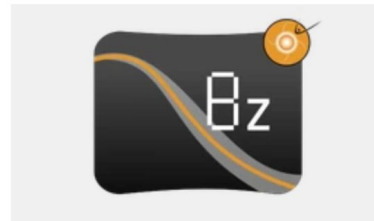
CME Arrival Time Scoreboard

Real-time Forecasting Methods Validation for Coronal Mass Ejections arrival time at Earth.



SEP Scoreboard

Real-time Forecasting Methods Validation for predicting Solar Energetic Particle (SEP) events.

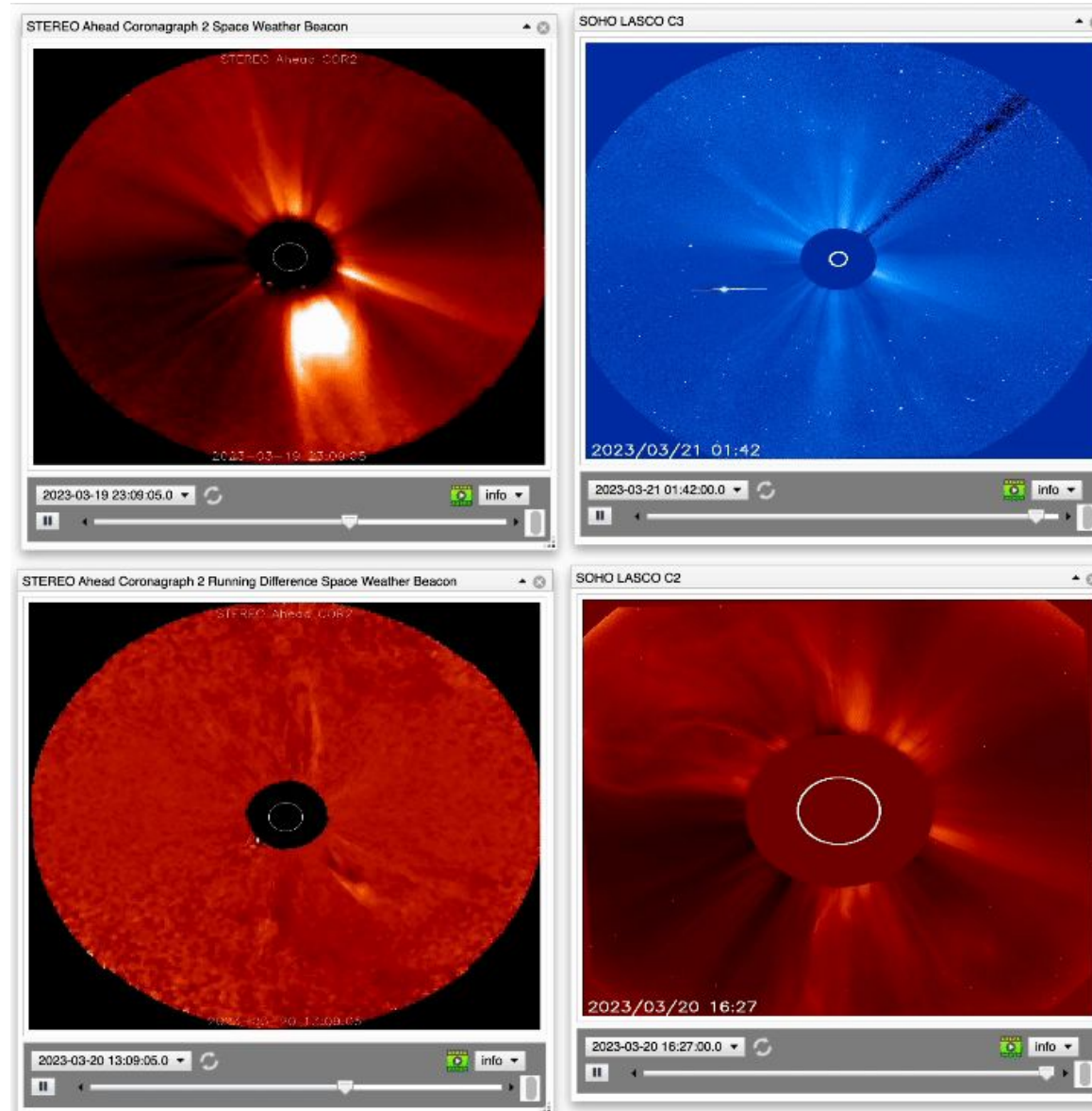


IMF Bz Scoreboard

Real-time Forecasting Methods Validation for interplanetary magnetic field forecasts at L1.

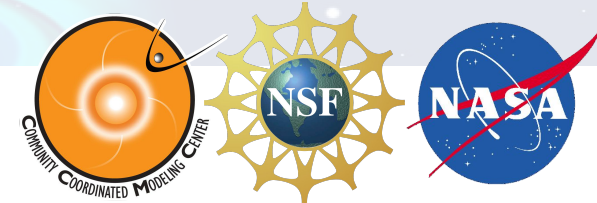
Space Weather Event Example

iSWA



Space Weather Event Example

DONKI



Coronal Mass Ejection

Catalog: M2M_CATALOG

Start Time: 2023-03-20T14:42Z (SOHO: LASCO/C2)

All Detecting Spacecrafts:

SOHO: LASCO/C2

STEREO A: SECCHI/COR2

Activity ID: 2023-03-20T14:42:00-CME-001 (version 1)

Source Location: N27E20

Note Keyword:

FOV: Front Bright front; may be evidence of pileup

GAP: Data gap

PRM: Prominence material (filamentary structures)

SUR: Surge-like eruption

Source Signature Keyword:

PEA: Post eruption arcade

FIL: Filament eruption

OFL: Moving/Opening field lines

BR: Brightening

EUVW: EUV Wave

Morphology Keyword:

F: Flux Rope

FS: Flux Rope and Shock Candidate

L: Loop

LS: Loop and Shock Candidate

Note: Bright, wide CME seen to the NE in SOHO and STEREO A coronagraphs. The eruption is characterized by an erupting sigmoid/S-shaped structure centered around N27E20, though dimming and an EUV wave signature is limited to longitudes closer to 30-50 degrees east.

Submitted on 2023-03-20T16:44Z by Chris Stubenrauch

A Notification with ID [20230320-AL-002](#) was sent on 2023-03-20T17:26Z

A Notification with ID [20230322-AL-001](#) was sent on 2023-03-22T13:05Z

Space Weather Event Example

DONKI



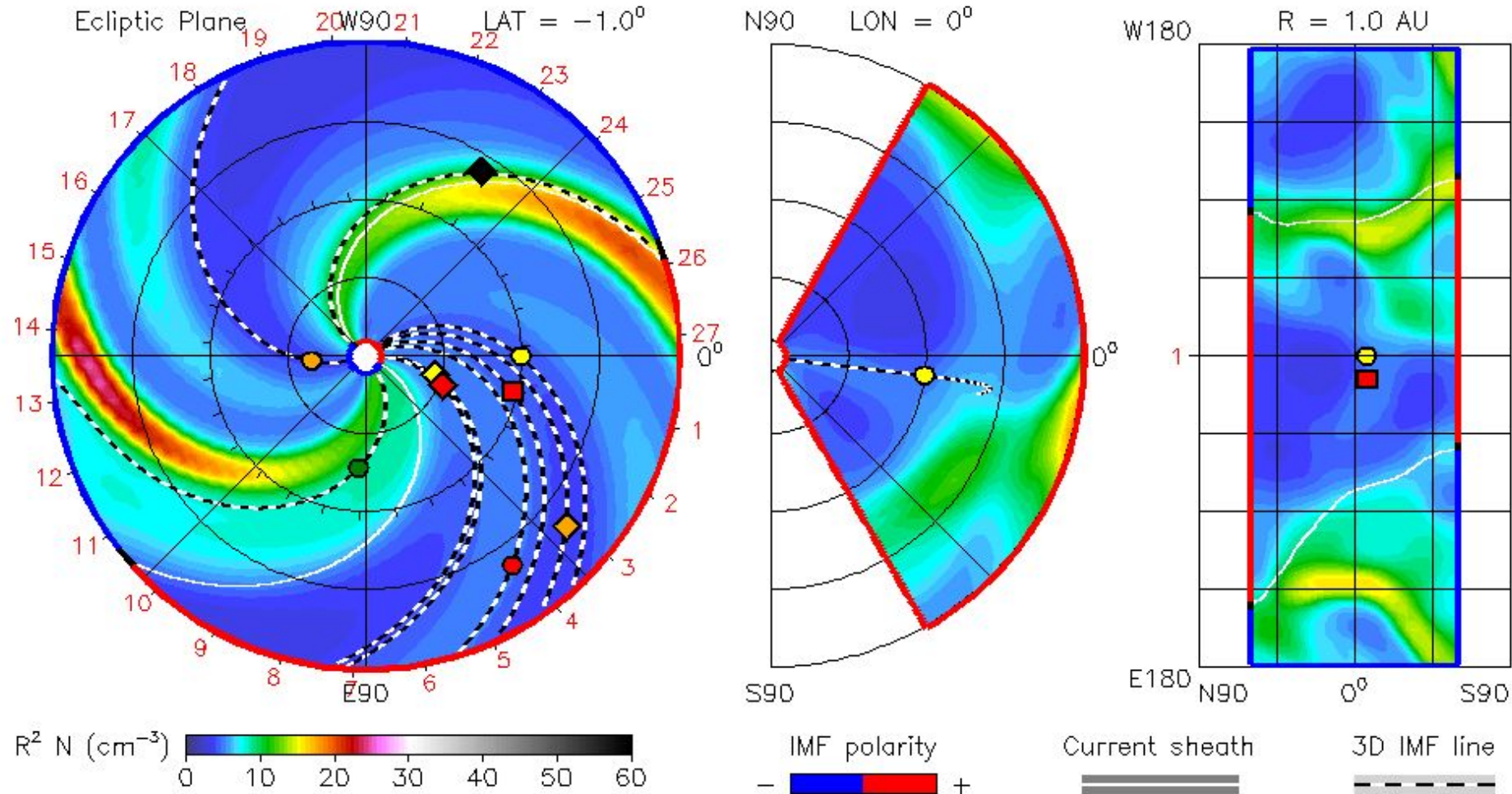
Event Type	Catalog	Data Level	Prime?	Technique	Long	Lat	Speed	Type	Half Width	Time 21.5	Note	WSA-ENLIL+Cone Result(s)	Submitted By
CME Analysis	M2M_CATALOG	0	true	SWPC_CAT	-40.0	27.0	749.0	C	45.0	2023-03-20T19:41Z	Leading edge measurement with limited SOHO and STEREO A coronagraph imagery due to maneuver/campaign, respectively.	1: Result 1 (2.0 AU) Earth = 2023-03-23T17:44Z (PE: 8.6 h) Mars = 2023-03-25T22:16Z Solar Orbiter = 2023-03-21T22:07Z STEREO A = 2023-03-23T11:42Z (PE: 7.7 h) Lucy = 2023-03-25T23:00Z 2: Result 2 (2.0 AU) Earth = 2023-03-23T18:50Z (PE: 9.7 h) Mars = 2023-03-26T00:51Z Solar Orbiter = 2023-03-21T21:49Z STEREO A = 2023-03-23T11:54Z (PE: 7.9 h)	Chris Stubenrauch on 2023-03-20T17:16Z

Space Weather Event Example

2023-03-19T00:00

2023-03-19T00 +0.00 day

● Earth ● Mars ● Mercury ● Venus ◆ Bepi ◆ Lucy ◆ OSIRIS-REx ◆ SoLo
■ Stereo_A



Space Weather Event Example

CME Scoreboard



CME: 2023-03-20T14:42:00-CME-001

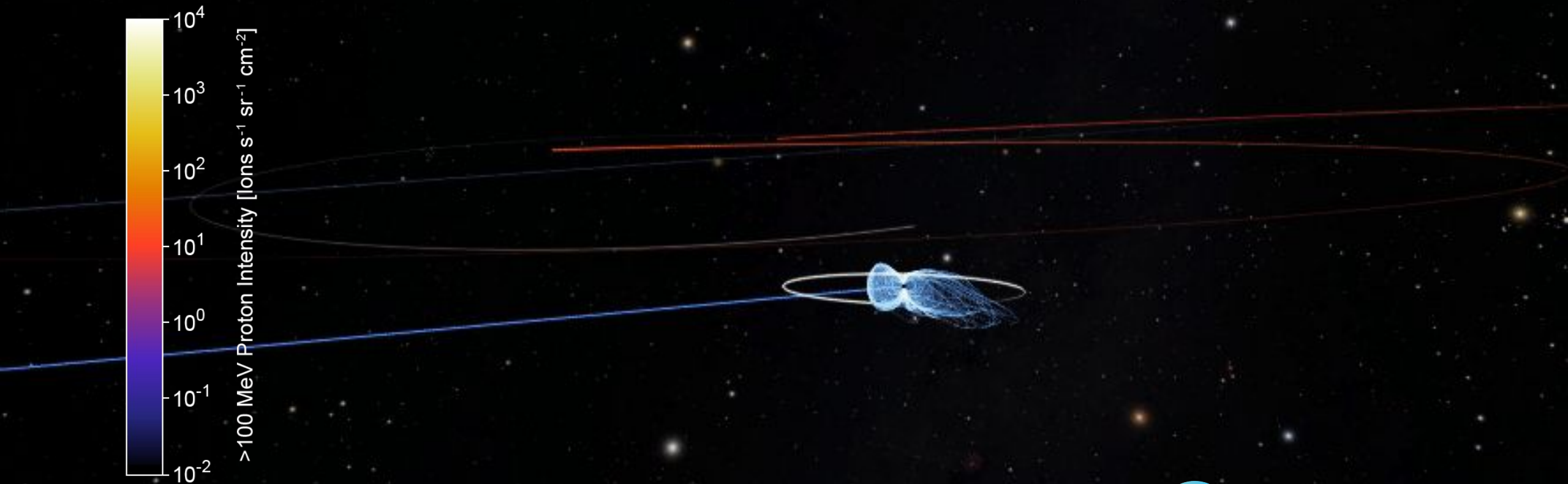
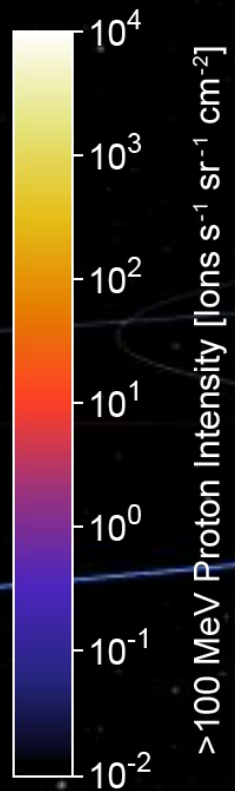
Actual Shock Arrival Time: 2023-03-23T09:10Z

Observed Geomagnetic Storm Parameters:

CME Note: Bright, wide and asymmetrical shape CME seen to the NE in SOHO and STEREO A coronagraphs. The eruption is characterized by an erupting sigmoid/S-shaped structure centered around N27E20, though dimming and an EUV wave signature is limited to longitudes closer to 30-50 degrees east. On arrival signature from Tarik Salman, LASSOS: background solar wind is quite different from normal levels with higher density (normal density around 5/cc) and speed (normal speed around 350-400 km/s)-a possible reason for this ICME not to have an associated shock. The start of the magnetic flux rope likely coincides with the enhancement in the total field and drop in density and the end of it is around 2023-04-24T09Z (based on an increase in temperature beyond this point and the field components becoming less coherent)

<u>Predicted Shock Arrival Time</u>	<u>Difference (hrs)</u>	<u>Confidence (%)</u>	<u>Submitted On</u>	<u>Lead Time (hrs)</u>	<u>Predicted Geomagnetic Storm Parameter(s)</u>	<u>Method</u>	<u>Submitted By</u>	
2023-03-23T17:44Z (-7.0h, +7.0h)	8.57	----	2023-03-20T17:26Z	63.73	Max Kp Range: 3.0 - 5.0	WSA-ENLIL + Cone (NASA M2M)	Chris Stubenrauch (M2M Office)	Detail
2023-03-23T11:20Z (-5.0h, +7.0h)	2.17	87.0	2023-03-20T17:45Z	63.42	Max Kp Range: 3.0 - 5.0	Ensemble WSA-ENLIL + Cone (NASA M2M)	Anna Chulaki (M2M Office)	Detail
2023-03-23T04:47Z	-4.38	----	2023-03-20T19:20Z	61.83	Max Kp Range: 4.0 - 6.0	SARM	Marlon Nunez (UMA)	Detail
2023-03-23T11:00Z (-9.0h, +9.0h)	1.83	70.0	2023-03-21T02:15Z	54.92	Max Kp Range: 4.0 - 6.0	WSA-ENLIL + Cone (Met Office)	Met Office (Met Office)	Detail
2023-03-23T08:00Z (-12.0h, +12.0h)	-1.17	20.0	2023-03-21T15:43Z	41.45	Max Kp Range: 3.0 - 5.0	Other (SIDC)	Anna Chulaki (M2M Office)	Detail
2023-03-23T06:29Z (-7.0h, +7.0h)	-2.68	----	2023-03-22T10:41Z	22.48	----	EAM (Effective Acceleration Model)	Evangelos Paouris (UoA)	Detail
2023-03-23T10:35Z (-7.0h, +7.0h)	1.42	----	2023-03-22T10:42Z	22.47	----	EAM (Effective Acceleration Model)	Evangelos Paouris (UoA)	Detail
2023-03-23T11:20Z (-5.1h, +7.1h)	2.17	87.0	2023-03-22T13:06Z	20.07	Max Kp Range: 3.0 - 6.0	Ensemble WSA-ENLIL + Cone (NASA M2M)	Chris Stubenrauch (M2M Office)	Detail
2023-03-23T10:09Z	0.98	66.0	---	---	Max Kp Range: 3.33333 - 5.5	Average of all Methods	Auto Generated (CCMC)	Detail

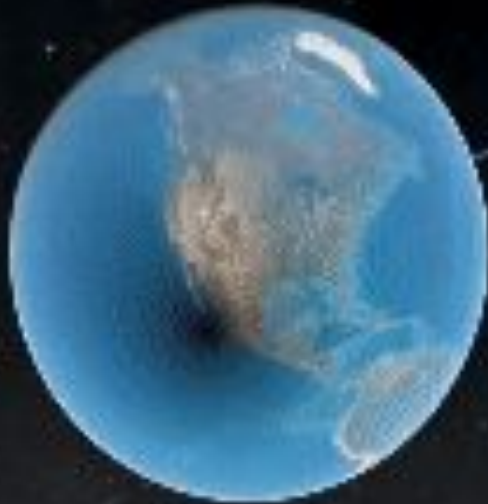
OpenSpace Project Collaboration



OpenSpace Project Collaboration



OpenSpace Project Collaboration



OpenSpace Project Collaboration



The 2024 Total
Solar Eclipse
through the
eyes of **NASA**

Lunar topography data from NASA's Lunar Reconnaissance Orbiter and the Japan Aerospace Exploration Agency's SELENE lunar orbiter were used to precisely calculate the location of the Moon's shadow for the 2024 total solar eclipse. The planetary positions are from NASA's Jet Propulsion Laboratory Development Ephemeris 421. Earth imagery from NASA's Blue Marble Next Generation series were used to create the terrain and Earth at night imagery from NASA's Black Marble were used under the eclipse path.

2024 Total Solar Eclipse
Monday, April 8, 2024

Credit: Michala Garrison and the Scientific Visualization Studio (SVS), in collaboration with the NASA Heliophysics Activation Team (NASA HEAT), part of NASA's Science Activation portfolio
Eclipse calculations by Ernie Wright, NASA Goddard Space Flight Center

0 mi
0 km 200

Niagara Falls, NY
Erie, PA
Cleveland, OH
Indianapolis, IN
Speedway
Carbondale, IL
Russellville, AR
Dallas, TX
Waco, TX
Austin, TX
Stonewall, TX
Kerrville, TX
Houlton, ME
Washington, DC

Niagara Falls State Park
Mercyhurst University
Great Lakes Science Center
Indianapolis Motor
Southern Illinois University
Downtown Fire Station
Cotton Bowl / Arboretum
Baylor Stadium
Austin Central Library
LBJ National Historical Park
Louise Hays Park
Multiple Locations
National Mall

2024 Path of Totality April 8, 2024

Along a path about 115 miles wide, the Moon will completely block the Sun in the sky. Totality lasts up to about 4 minutes and 28 seconds depending on the viewer's location within this path.

Outside of this path, viewers within the 46 contiguous U.S. states and many other areas will see a partial solar eclipse (in the shaded areas below).



Find More: solarsystem.nasa.gov/eclipses/2024

NASA SunSpots

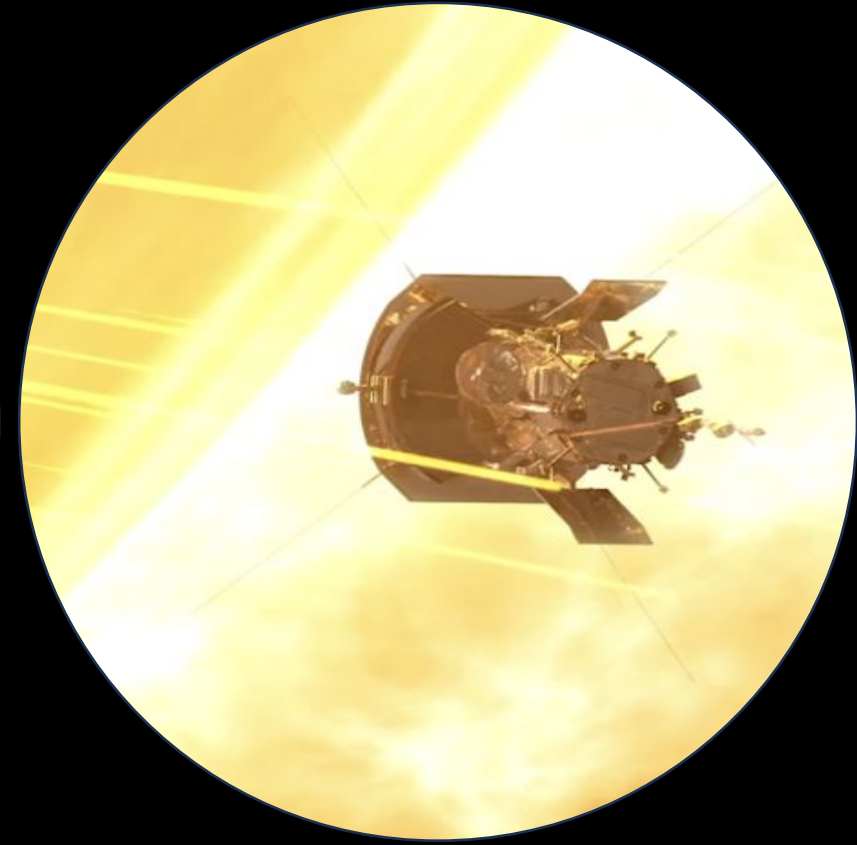
<https://science.nasa.gov/eclipses/>



ANNULAR
SOLAR ECLIPSE
October 14, 2023



TOTAL
SOLAR ECLIPSE
April 8, 2024



PARKER CLOSEST
APPROACH TO SUN
December 24, 2024

<https://science.nasa.gov/eclipses/>

Thank you!



Questions?

CCMC Website



Contact: elana.m.resnick@nasa.gov

**Digital business
card**

