Moon to Mars Space Weather Analysis Office Weekly Highlights

July 16-22, 2025

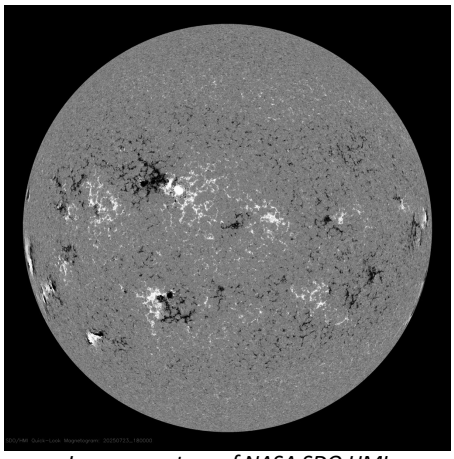


Image courtesy of NASA SDO HMI

Solar Event Summary

- 0 X-class flares
- 0 M-class flares
- 2 O-type CMEs
- 7 C-type CMEs

SCORE CME typification system:

S-type: < 500 km/s
C-type: Common 500-999 km/s
O-type: Occasional 1000-1999 km/s
R-type: Rare 2000-2999 km/s
ER-type: Extremely Rare >3000 km/s

Number of CMEs predicted to impact missions (> 500 km/s)

Missions Near Earth	1
Psyche	6
Mars	4
BepiColombo	4
Juice	2
OSIRIS-APEX	1
Parker Solar Probe	1
Lucy	1
Europa Clipper	1

Details from CCMC's DONKI Catalog

Geomagnetic Activity:

Minor levels with Kp index (a measure of geomagnetic activity, ranging 0-9) <= 5.00 for the reporting period. The highest value of Kp = 5.00 occurred during the synoptic period starting at 21:00 UTC on July 22nd through 00:00 UTC on July 23rd (more details on next page).

Radiation Belt Enhancements:

The > 2.0 MeV energetic electron flux in the Earth's outer radiation belt remained elevated above the threshold level of 1000 pfu throughout the reporting period due to a threshold crossing from the previous reporting period starting at 15:25 UTC on July 14th (more details on next page).

Solar Energetic Particles:

The energetic proton flux of >10 MeV protons detected at GOES and the 13-100 MeV protons at STEREO A were all at background levels for the entire reporting period.

Space Weather Impacts:

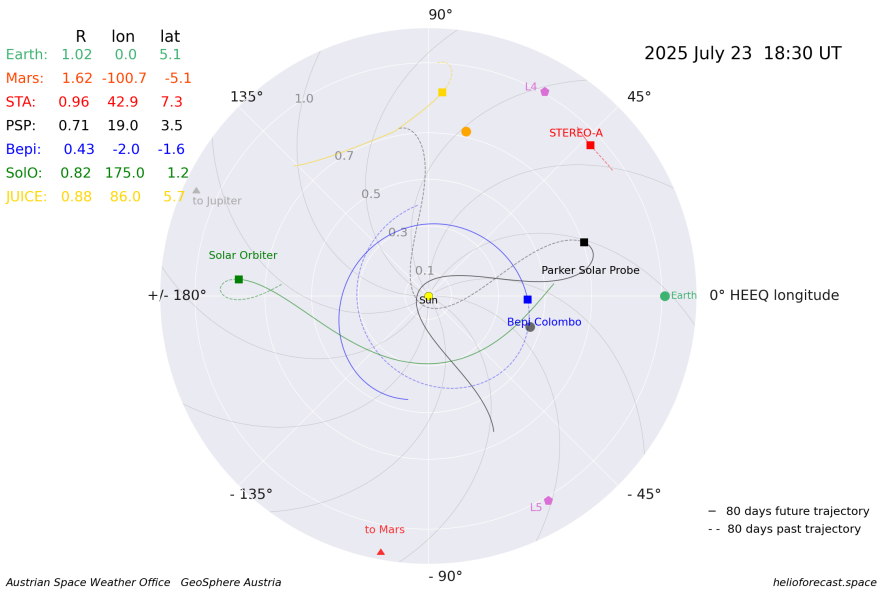
Space weather impacts on NASA spacecraft are expected to have been moderate this reporting period due to the elevated energetic electron flux in the Earth's outer radiation belt.

Space Weather Outlook: July 16th – July 22nd, 2025

Solar activity is expected to vary between low and moderate levels during the outlook period (more details on next page).

Geomagnetic activity is expected to vary between low and moderate levels during the outlook period (more details on next page).

Planets & Mission Locations



Plot courtesy of Alex Young and Solar-MACH.

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Geomagnetic Activity:

Geomagnetic activity was at minor levels with Kp index (a measure of geomagnetic activity, ranging 0-9) <=5.00 for the reporting period. The highest value of Kp = 5.00 occurred during the synoptic period starting at 21:00 UTC on July 22nd through 00:00 UTC on July 3rd. This enhancement in geomagnetic activity was associated with the interplanetary shock detected at L1 by ACE on July 22nd at 10:59 UTC which was likely associated with a coronal hole high speed stream starting on July 22nd and possibly the arrival of the C-type CME first seen in STEREO A COR2 on July 20th at 07:53 UTC.

Radiation Belt Enhancements:

The > 2.0 MeV energetic electron flux detected at GOES remained elevated above the threshold level of 1000 pfu throughout the reporting period due to a threshold crossing from the previous reporting period. This elevation of energetic electron flux levels observed since 15:25 UTC on July 14th was associated with the arrival of a coronal hole high speed stream detected by DSCOVR and ACE at L1 on July 11th. The energetic electron flux levels returned to background levels late on July 22nd.

Space Weather Outlook: July 23rd – July 29th, 2025

Solar activity is expected to vary between low and moderate levels during the outlook period. There are currently six Active Regions on the Earth-facing disk. Active Region 14150 (S14E18) produced numerous C-class flares during the reporting period and may continue to produce similar flaring activity during the outlook period.

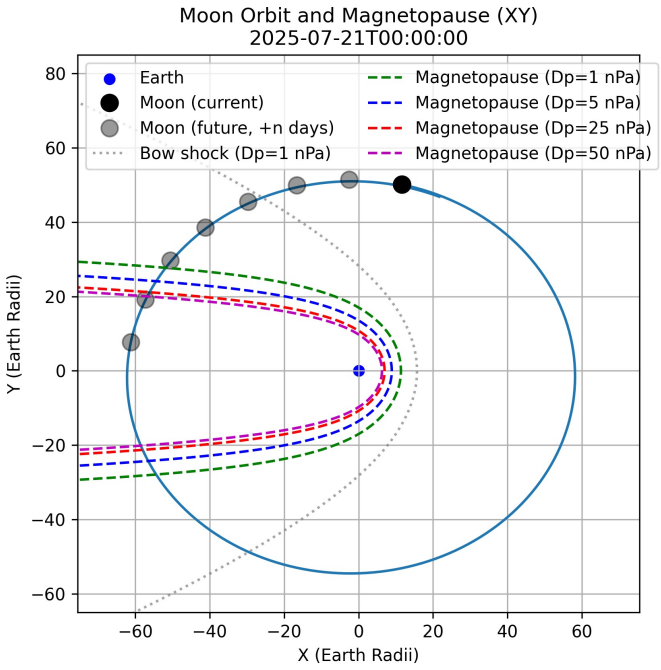
Geomagnetic activity is expected to vary between low and moderate levels during the outlook period. The energetic electron flux levels at GOES may become elevated above background levels during the outlook period due to the effects of the coronal hole high speed stream detected at L1 by ACE on July 22.

For more information,
check out the M2M SWAO's **Weekly Report.**

Earth's Moon Outlook:

The moon is expected to be outside of the Earth's magnetosphere on July 21st 00:00 UTC, crossing into the Earth's bow shock by July 24th at 00:00 UTC, and continuing into Earth's magnetosphere around July 26th.

This plot is courtesy of Daniel da Silva.
It displays the Moon's orbit in relation to Earth and Earth's Magnetopause.



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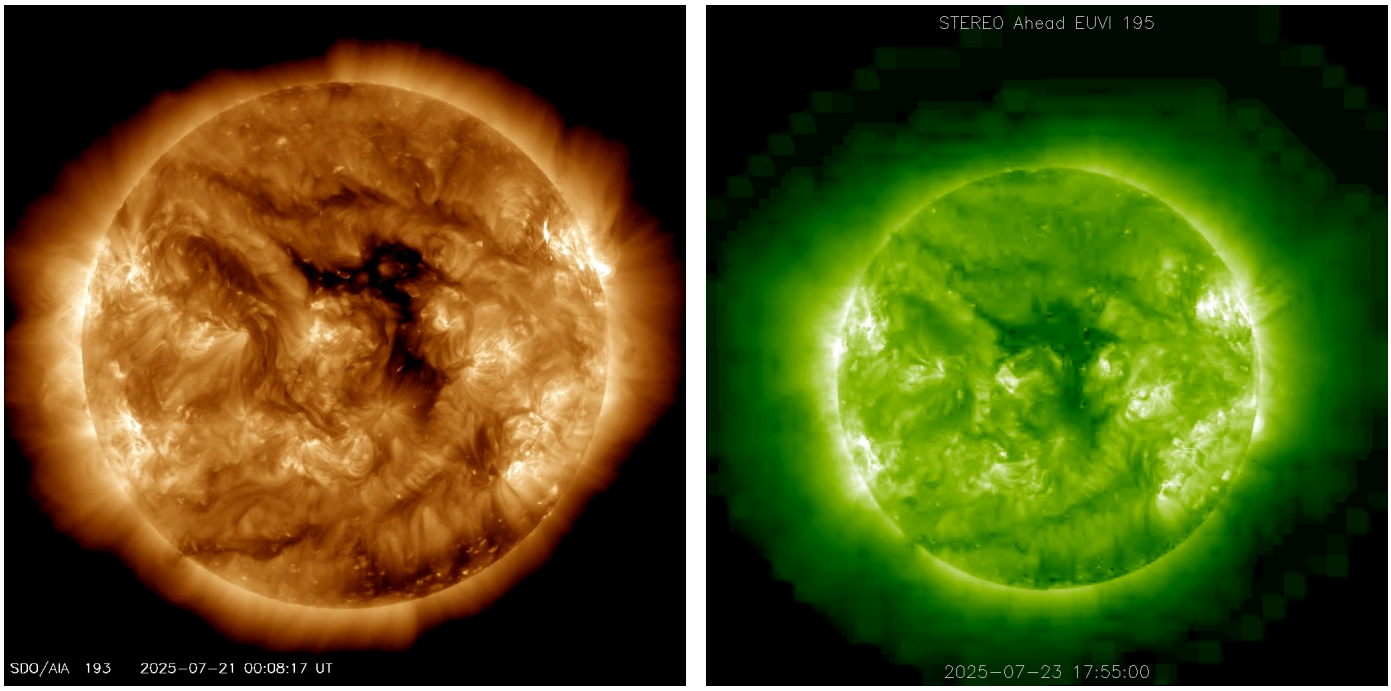
Event Highlight: *A "T"-shaped coronal hole brings high speed solar wind streams to L1.*

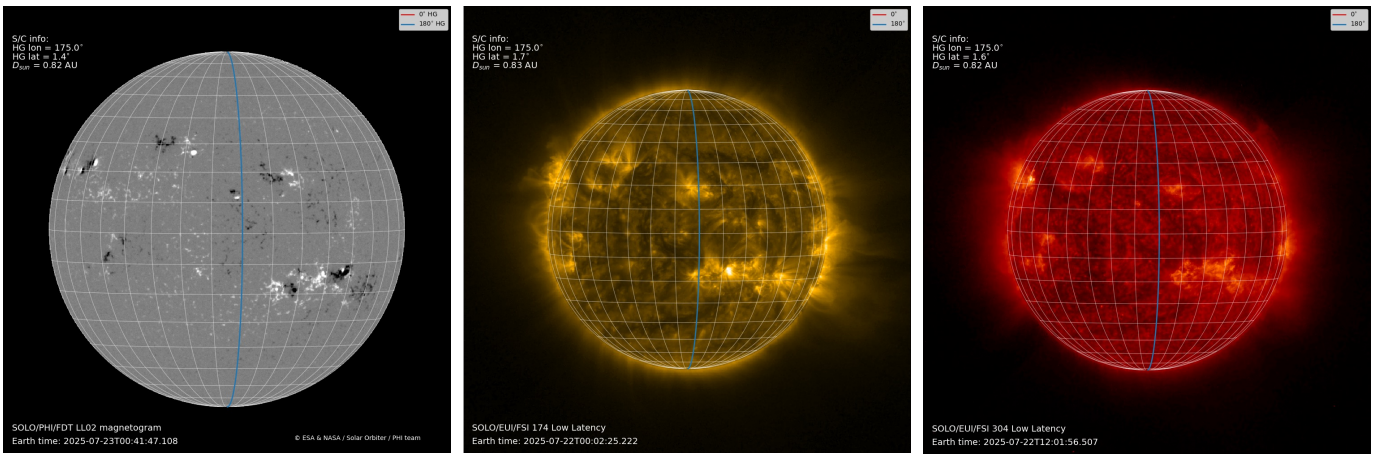
A "T"-shaped coronal hole is visible on the Earth-facing disk on July 21st at 00:00 UTC in the SDO/AIA 195 (gold) image. This coronal hole has brought high solar wind speeds to the near-Earth environment and with it induced a minor geomagnetic storm (Kp = 5.00). This same coronal hole can be seen in STEREO A EUVI 195 (green) image on the right and is expect to emit high solar wind speeds that may be detected by STEREO A IMPACT/PLASTIC instruments in the next few days.



Imagery available in CCMC's ISWA Webtool: https://ccmc.gsfc.nasa.gov/tools/ISWA/

Solar Orbiter Highlight:

A look at the latest imagery available from Solar Orbiter's PHI/FDT LL02 magnetogram (gray, bottom left) and Solar Orbiter's EUI/FS1 174 Low Latency imagery (yellow, bottom center) and Solar Orbiter's EUI/FS1 304 Low Latency imagery (red, bottom right).



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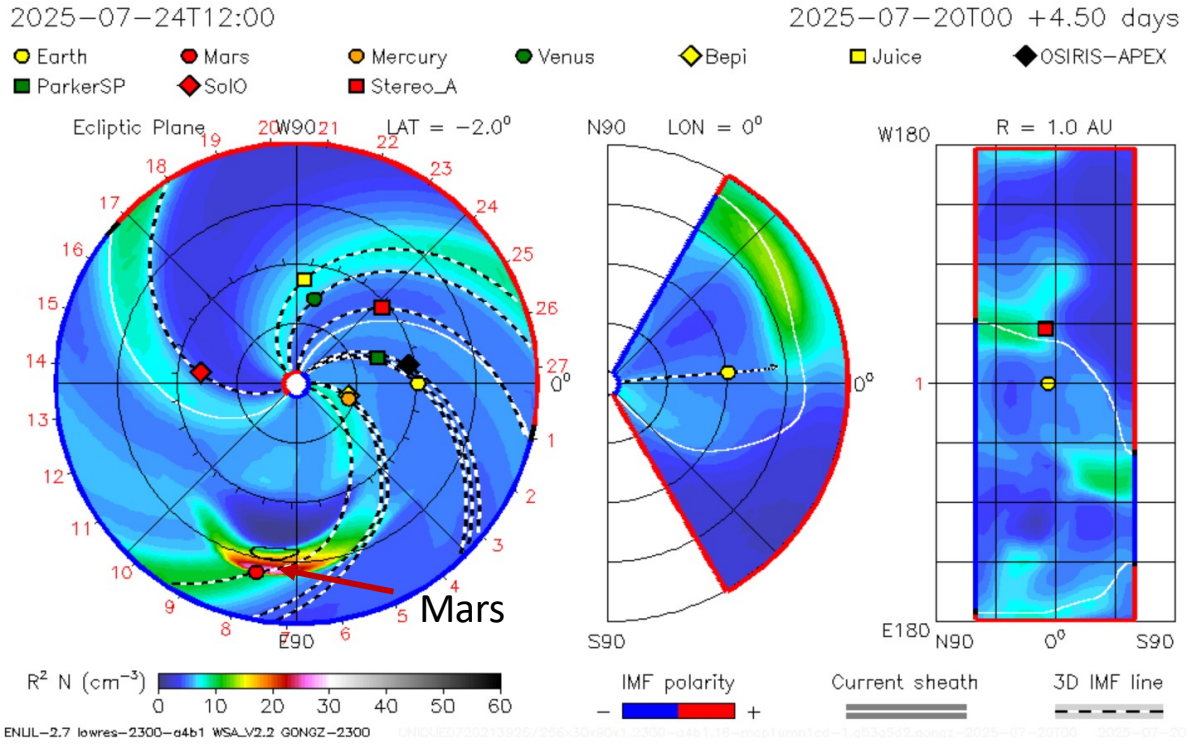
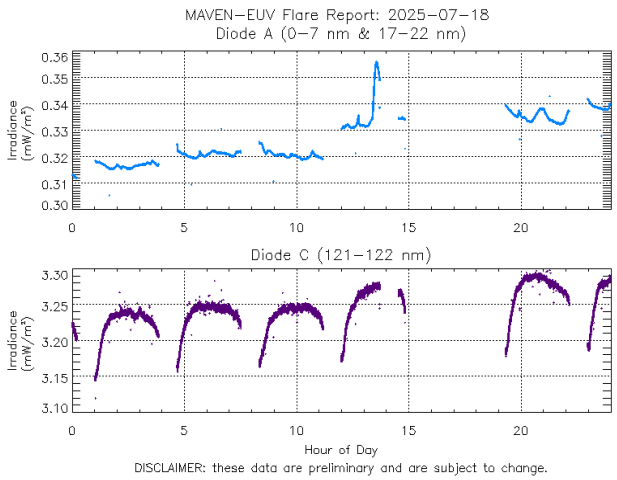
Mars Highlight: Solar activity was likely at low to moderate levels near Mars. Five CMEs were directed towards Mars during the reporting period.

CME Start Time	Estimated Arrival Time (plus/minus 7 hours)
2025-07-18T12:24Z	Mars at *2025-07-24T00:00Z (glancing blow)*
2025-07-20T17:00Z	Mars at *2025-07-24T10:57Z*
2025-07-21T14:09Z	Mars at *2025-07-26T20:00Z (glancing blow)*
2025-07-22T16:00Z	Mars at *2025-07-27T16:00Z (glancing blow)*



WSA-ENLIL+Cone model of CME: 2025-07-20T17:00Z

The simulation results can be found in DONKI:
https://kauai.ccmc.gsfc.nasa.gov/DONKI/view/WSA-ENLIL/40169/1



Flares:

Flaring was likely at mostly C-class levels during the reporting period. So far, no M-class flares were detected at MAVEN during the reporting period.

Left: A snapshot of flaring as seen on July 18, 2025 in MAVEN quicklook plots.

Preliminary quicklook MAVEN plots available in CCMC's ISWA Webtool: https://ccmc.gsfc.nasa.gov/tools/ISWA/