

MDEM Risk Analysis Brief: Space Weather, May 2024

Situation: On Thursday, May 9, the NOAA Space Weather Prediction Center Issued a Severe (G4) Geomagnetic Storm Watch for the evening of Friday, May 10, 2024. At Least seven earth-directed coronal mass ejections (CMEs) were observed and expected to arrive as early as midday Friday, May 10, 2024 or early on May 11, and persist through Sunday, May 12, 2024.

Link: <https://www.swpc.noaa.gov/news/g4-watch-effect-may-11>

Impacts: Low probability of damage to systems. The use of HF Radios, electrical systems, or space based equipment may be disrupted during this incident. The aurora might be visible as south as Alabama and to northern California.

Contact: MJOC: 410-517-3600

Director on Call: Anna Sierra

Duty Officer: Emily Wesselhoff

NOTE: This analysis is for planning purposes only. MDEM does not guarantee the accuracy of any forecast or predictive elements.

Potential Impacts – Community Lifelines:

Note: **Blue** icons indicate potential future impacts



Safety & Security	Impacts: NSTR
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Food, Hydration, Shelter	Impacts: NSTR
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Health & Medical	Impacts: NSTR
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Energy (Power & Fuel)	Impacts: Disruption of energy systems is possible but unlikely
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Communications	Impacts: HF Radio systems may be degraded or inoperable during periods of high solar activity
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Transportation	Impacts: Communications, sensors, and electrical systems utilized in transportation system may be affected resulting in closures or delays
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Hazardous Materials	Impacts: NSTR
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Water Systems	Impacts: NSTR
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KEY

Green = Impacts are absent, minimal, or stabilized
Red = Significant impacts & limitations, no identified solution/plan

Yellow = Moderate impacts with an identified solution/plan
Gray = Impacts are unknown

Current Situation:

- On May 9, NOAA Space Weather Prediction Center issued a G4 Geomagnetic Storm Watch - the first since January 2005.
- The CMEs are expected to arrive late Friday, May 10, and persist through Sunday, May 12.
- The aurora may become visible over much of the northern half of the country.



Severe Geomagnetic Storm LIKELY

Updated 2024-May-10 11:30 EDT


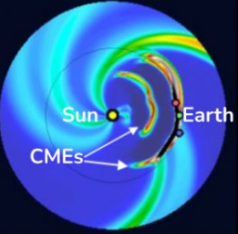
WHAT: SWPC's First G4 Watch Since Jan. 2005

KEY MESSAGES: A Severe (G4) Geomagnetic Storm is **LIKELY** – possibly as early as later today and continuing through the weekend; exact timing remains somewhat uncertain. At least seven earth-directed Coronal Mass Ejections (CMEs) are in transit.

IMPACTS: HF communication, GPS, power grids (voltage control), spacecraft, satellite navigation, and other technologies may be affected. *Critical infrastructure operators have been notified.*

CONTEXT: Only three Severe (G4) geomagnetic storms have occurred so far this solar cycle (since 2019); the last was a brief occurrence on March 23. This is SWPC's first G4 Watch since 2005. The last Extreme (G5) event occurred with the Halloween Storms in 2003.

CAUSE: The source has been a large, complex sunspot cluster (NOAA Region 3664) that is **16 times the diameter of Earth**. Additional activity from this Region is still expected.



National Oceanic and Atmospheric Administration
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Space Weather Prediction Center
Boulder, CO



Geomagnetic Storm WATCH for May 11, 2024

Updated 2024-05-09 1:30pm EDT

G4

WHAT: Several CMEs will quite likely reach Earth and lead to highly elevated geomagnetic activity



EVENT:
A coronal mass ejection (CME) is an eruption of solar material. When they arrive at Earth, a geomagnetic storm can result. Watches at this level are very rare.


TIMING:
The CMEs are anticipated to merge and arrive at Earth by late on May 10th or early on May 11th.

EFFECTS:
The general public should visit our webpage to keep properly informed. The aurora may become visible over much of the northern half of the country, and maybe as far south as Alabama to northern California.

National Oceanic and Atmospheric Administration
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Safeguarding Society with Actionable Space Weather Information

Space Weather Prediction Center
Boulder, CO



Active Space Weather Conditions Through Weekend

WHAT: Large Sunspot Groups and Flares Lead to First G4 Watch Since 2005



- On Thursday, May 9, the NOAA Space Weather Prediction Center issued a Severe (G4) Geomagnetic Storm Watch – the first since January 2005.
- At least five earth-directed coronal mass ejections (CMEs) were observed and expected to arrive as early as midday Friday, May 10, 2024, and persist through Sunday, May 12, 2024. This is an unusual event.
- Several strong flares have been observed over the past few days and were associated with a large and magnetically complex sunspot cluster (NOAA region 3664), which is **16 times the diameter of Earth**. Additional solar activity is expected from the region.
- Only three Severe geomagnetic storms have been observed during this solar cycle which began in December 2019. The last G4 (Severe) was on March 23, 2024, and the last G5 (Extreme) was the Halloween Storms in October 2003. That G5 resulted in power outages in Sweden and damaged power transformers in South Africa.

2024-05-09 19:28:00 UTC

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Boulder, CO

Potential Impacts & Risk Analysis:

Geomagnetic Storms

G4 (Severe)
Geomagnetic
Storms
General Impacts

Scale	Description	Effect	Physical measure	Average Frequency (1 cycle = 11 years)
G 5	Extreme	<p>Power systems: Widespread voltage control problems and protective system problems can occur, some grid systems may experience complete collapse or blackouts. Transformers may experience damage.</p> <p>Spacecraft operations: May experience extensive surface charging, problems with orientation, uplink/downlink and tracking satellites.</p> <p>Other systems: Pipeline currents can reach hundreds of amps, HF (high frequency) radio propagation may be impossible in many areas for one to two days, satellite navigation may be degraded for days, low-frequency radio navigation can be out for hours, and aurora has been seen as low as Florida and southern Texas (typically 40° geomagnetic lat.).</p>	Kp = 9	4 per cycle (4 days per cycle)
G 4	Severe	<p>Power systems: Possible widespread voltage control problems and some protective systems will mistakenly trip out key assets from the grid.</p> <p>Spacecraft operations: May experience surface charging and tracking problems, corrections may be needed for orientation problems.</p> <p>Other systems: Induced pipeline currents affect preventive measures, HF radio propagation sporadic, satellite navigation degraded for hours, low-frequency radio navigation disrupted, and aurora has been seen as low as Alabama and northern California (typically 45° geomagnetic lat.).</p>	Kp = 8, including a 9-	100 per cycle (60 days per cycle)
G 3	Strong	<p>Power systems: Voltage corrections may be required, false alarms triggered on some protection devices.</p> <p>Spacecraft operations: Surface charging may occur on satellite components, drag may increase on low-Earth-orbit satellites, and corrections may be needed for orientation problems.</p> <p>Other systems: Intermittent satellite navigation and low-frequency radio navigation problems may occur, HF radio may be intermittent, and aurora has been seen as low as Illinois and Oregon (typically 50° geomagnetic lat.).</p>	Kp = 7	200 per cycle (130 days per cycle)
G 2	Moderate	<p>Power systems: High-latitude power systems may experience voltage alarms, long-duration storms may cause transformer damage.</p> <p>Spacecraft operations: Corrective actions to orientation may be required by ground control, possible changes in drag affect orbit predictions.</p> <p>Other systems: HF radio propagation can fade at higher latitudes, and aurora has been seen as low as New York and Idaho (typically 55° geomagnetic lat.).</p>	Kp = 6	600 per cycle (360 days per cycle)
G 1	Minor	<p>Power systems: Weak power grid fluctuations can occur.</p> <p>Spacecraft operations: Minor impact on satellite operations possible.</p> <p>Other systems: Migratory animals are affected at this and higher levels; aurora is commonly visible at high latitudes (northern Michigan and Maine).</p>	Kp = 5	1700 per cycle (900 days per cycle)

<https://www.swpc.noaa.gov/noaa-scales-explanation>

Potential Impacts & Risk Analysis:

Event Specific Impacts:

Area of impact will be primarily north of 45° geomagnetic latitude.

Potential impacts could include disrupt communications, the electric power grid, navigation, radio and satellite operations:

- Satellite navigation (GPS) degraded or inoperable for several hours.
- HF (high frequency) radio transmission degraded or black out (for real-time information <https://www.swpc.noaa.gov/products/d-region-absorption-predictions-d-rap>).
- Voltage control problems may be possible to local power grids.
- Aurora may be visible as far south as California to Alabama.

Overall, (1) infrastructure agencies should be prepared for pulses, and Critical infrastructure operators have been **notified** by SWPC (Space Weather Prediction Center) so they can take protective action.

(2) general public would likely see only minor affects such as possible temporary loss of GPS or very limited power outages.

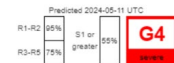
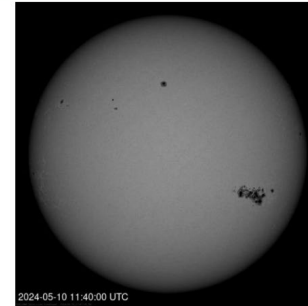
Maryland Specific (from MEA): The **PJM** Emergency Operations Manual has a specific section to address Geomagnetic Disturbances which Maryland would abide by in the event of a disruption. PJM is currently **monitoring the situation** and MEA's Emergency Management team has been notified.



Geomagnetic Storm Watch Issued

G4

Prepared by the National Weather Service Eastern Region Operations Center

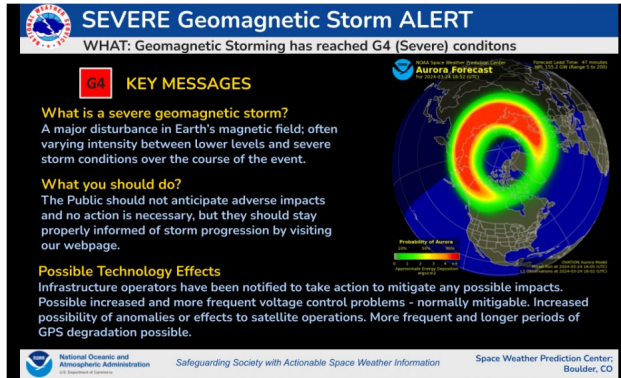


- * No changes to the forecast since May 9 *
- A Geomagnetic Storm Watch has been issued for May 11, 2024 from the Space Weather Prediction Center
- A Coronal Mass Ejection (CME), or an eruption of solar material is expected to arrive at Earth late May 10 or early May 11, 2024.
- Area of impact will be primarily north of 45° latitude.
- Impacts:
 - Satellite navigation (GPS) degraded or inoperable for several hours.
 - HF (high frequency) radio transmission degraded or black out.
 - Voltage control problems may be possible to local power grids.
 - Aurora may be visible as far south as California to Alabama.
- More details will be provided in the following days.

From: FEMA, Space Weather Prediction Center

Historical information:

- Only **three** severe geomagnetic storms have been observed during this 11-year solar cycle which began in December 2019. (The average frequency for G4 storms is 100 per solar cycle)
- The **last G4** (Severe) was on March 23, 2024. As a result of this storm, power grid irregularities were reported in Canada.



SEVERE Geomagnetic Storm ALERT
WHAT: Geomagnetic Storming has reached G4 (Severe) conditions

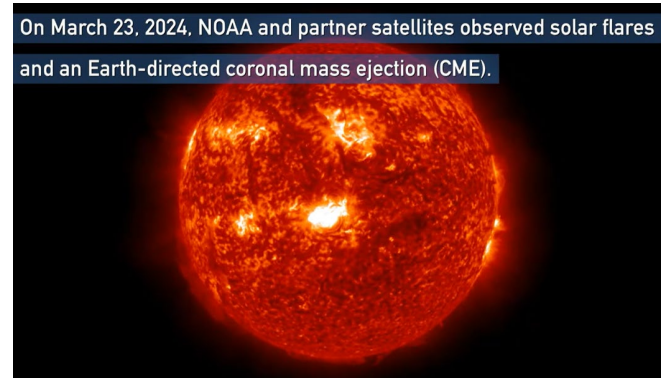
G4 KEY MESSAGES

What is a severe geomagnetic storm?
A major disturbance in Earth's magnetic field; often varying intensity between lower levels and severe storm conditions over the course of the event.

What you should do?
The Public should not anticipate adverse impacts and no action is necessary, but they should stay properly informed of storm progression by visiting our webpage.

Possible Technology Effects
Infrastructure operators have been notified to take action to mitigate any possible impacts. Possible increased and more frequent voltage control problems - normally mitigable. Increased possibility of anomalies or effects to satellite operations. More frequent and longer periods of GPS degradation possible.

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- The **last G5** (Extreme) was the Halloween Storms in October 2003. That G5 resulted in power outages in Sweden and damaged power transformers in South Africa.