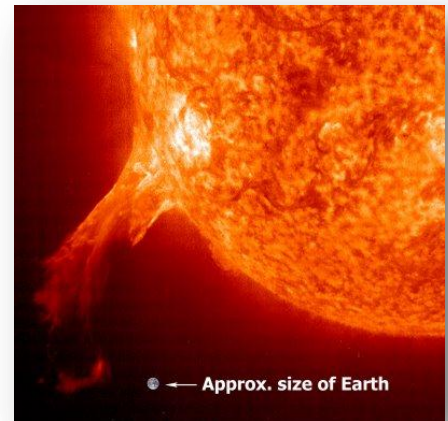


SEVERE SPACE WEATHER — GEOMAGNETIC STORMS

Geomagnetic Storms are caused by solar activity, when the sun ejects material – a “coronal mass ejection,” (CME) which can strike the earth, causing disruptions in the earth’s magnetic field which can lead to large ground-induced currents (GIC). Often associated with solar flares, GIC can damage electrical equipment. If large enough, depending on the CME’s magnetic field, such GICs can damage or burn out extremely high voltage transformers which are critical to keep national electric grids operating.

According to the U.S. Federal Energy Regulatory Commission, consequent widespread blackouts could last months or years.



Geomagnetic storms on earth are caused by coronal mass ejections from the sun, associated with solar flares.

History of major geomagnetic storms, 1859 to the present:

1. **August 28th, 1859: The “Carrington Event,” or “Superstorm.”** The storm was observed world-wide and is considered one of the greatest natural events recorded in the last 150 years. This geomagnetic storm was actually two massive worldwide auroral events which occurred within a few days of each other. The storm caused the telegraph network to fail, worldwide, with fires reported in some stations.
2. **November 18, 1882: The Transit of Venus Storm.** All telegraphic transactions in the Northeastern U.S. and Midwest were halted. The Chicago stock market was also disrupted all day. In the British Isles, telegraphic communication was also greatly disturbed.
3. **November 1, 1903:** Telegraph systems and also transatlantic cables were affected by the most severe storm detected since 1888. A power outage caused by the storm disabled street cars in Switzerland.
4. **May 13, 1921: The New York Railroad Storm.** This geomagnetic storm was comparable in size to the 1859 Carrington Event. The storm began with a sunspot which was 94,000 miles long and 21,000 miles wide. On May 15th the entire signal system of the New York Central Railroad below 125th street was disabled. The storm caused a fire which destroyed the Central New England Railroad station.
5. **January 25, 1938: The Fatima Storm.** The Great Aurora was seen over all of Europe and as far south as Southern Australia, Sicily, Portugal and across the Atlantic to Bermuda and Southern California. Radio systems and railroad services were disrupted.
6. **March 25, 1940: The Easter Sunday Storm.** A major geomagnetic storm disrupted and damaged telephone cables and caused electrical surges. Nearly every long-distance telegraph or telephone office in the U.S. needed repair work.
7. **February 11, 1958-** An important storm caused a radio blackout in the U.S., cutting off the U.S. from communication with the rest of the world.
8. **March 13, 1989- The Quebec Blackout Storm.** Ground-induced currents caused by the geomagnetic storm entered the power grid of the Hydro-Quebec Power Authority, causing the entire Quebec power grid to collapse in about 90 seconds. 6 million people were affected by the power outage. If the power outage had reached the U.S. East Coast it could have caused \$6 billion in damages.
9. **October 29, 2003- The Halloween Storm.** Auroras were seen over most of North America. The \$450 million Midori-2 research satellite was lost and extensive satellite problems were caused. This was one of the fastest solar storms in history. Impact was minimized due to a fortunate, benign magnetic field orientation of the coronal mass ejection. A few days later on November 4th, one of the most powerful x-ray flares ever detected disrupted satellite operations.