

Ground Truth: Storm of a Century

Florence Liu

Infrastructure Categories: Communications, Emergency Services, Healthcare, Transportation, and Water and Wastewater Sectors

Threat Details: Hailed as the “Storm of a Century”, a geomagnetic storm has not only caused spectacular auroras but blackouts, telecommunication failures, aviation disruptions, and GPS navigation errors across the world. In the United States, strong electromagnetic pulses have damaged communication satellites and collapsed power grids in regions in the Midwest, such as North Dakota and Wisconsin. Many citizens, particularly in rural areas, find themselves in the dark – no power, no information. Some cannot access running water as urban water supplies largely rely on electrical pumps.

Previous storms, most notably the 1859 Carrington Event, occurred before the advent of modern technology. Until now, never has a storm of similar magnitude struck during the age of the Internet. Across the world, damage to long-distance cables forming the backbone of Internet infrastructure has significantly reduced Internet capacity. Compared to regions such as Europe, the United States has fared worse due to the greater use of longer land and submarine cables more susceptible to damage during solar storms.

Origin of the Threat: During periods of high solar activity, coronal mass ejections (CMEs) increase in frequency and intensity. These billion-ton clouds of magnetized plasma are highly directional and can travel to Earth in anywhere from 13 hours to five days. In this case, multiple CMEs reached Earth in only 16.4 hours, causing a geomagnetic storm of previously unseen magnitude. The magnitude of this storm is estimated to be greater than that which caused the Carrington Event.

Although solar activity is difficult to predict, sentinel spacecrafts are present across the globe to monitor space weather and provide forewarning of such storms headed to Earth. However, current technology can only provide approximately 13 hours of warning. Here, the warning received a mixed response from government officials. Some thought it necessary to shut down power grids and satellites, but others disagreed, questioning the need for such a drastic response. This was largely due to a lack of understanding of the risks associated with geomagnetic storms. Previous attention to space risks had been largely focused on asteroids. Moreover, some officials voiced concerns that undue panic in the public would cause people to hoard essential goods. Therefore, a combination of the magnitude of the storm and delayed response mobilization to the initial warning resulted in unforeseen damage to multiple infrastructure sectors.

Lastly, high-voltage electrical wires in certain regions of the United States, such as North Dakota and Wisconsin, are more susceptible to geomagnetic disturbances from solar flares. This is due to the abundance of more electrically resistive rock in the ground. As a result, these regions experienced blackouts reminiscent of the Quebec Blackout of 1989.

Other Impacting Factors: The total worldwide economic impact is estimated to exceed \$2.5 trillion. Although humans were protected from direct harm by the Earth's magnetic field and atmosphere, the subsequent disruption to multiple infrastructure sectors is no minor challenge. Healthcare operations have stalled. Medical staff must resort to paper charts, but with the lack of electricity and water, only the bare minimum of care is provided. As the hours become days, the death toll begins. Due to communication outages, many citizens cannot contact 911 and emergency services cannot be coordinated. Communication failures are particularly felt by seniors over the age of 65, more than half of which still rely on landlines, and those living in rural communities. GPS navigation errors further compound the ability of emergency services to respond. However, those who arrive in emergency departments often cannot be adequately treated or cared for.

Unfolding Response: Due to the destruction of communications infrastructure and the Internet, citizens cannot receive timely updates on the status of the unfolding response. In many towns and cities, municipal government officials have resorted to 'town square' style updates. However, citizens living in rural and remote communities are left in the dark.

Crews are working overtime to restore electricity, communications, and the Internet. However, the full extent of the damage is unknown and, given the lack of communication capacity, it is challenging to coordinate efforts.

Works Consulted

“2015 Communications Sector-Specific Plan – CISA.” *US Department of Homeland Security*, www.cisa.gov/sites/default/files/publications/nipp-ssp-communications-2015-508.pdf?mod=article_inline. Accessed 5 Oct. 2023.

Anderson, Margo. “Here Are the U.S. Regions Most Vulnerable to Solar Storms.” *IEEE Spectrum*, IEEE Spectrum, 22 Sept. 2023, spectrum.ieee.org/us-regions-most-vulnerable-solar-storms. Accessed 25 Sep. 2023.

“Geomagnetic Storms | NOAA / NWS Space Weather Prediction Center.” *Noaa.gov*, 2019, www.swpc.noaa.gov/phenomena/geomagnetic-storms. Accessed 25 Sep. 2023.

Jones, Alexandra Mae. “Growing Risk of Once-in-a-Century Solar Superstorm That Could Knock out Internet, Study Says.” *CTVNews*, CTV News, 10 Sept. 2021, www.ctvnews.ca/sci-tech/growing-risk-of-once-in-a-century-solar-superstorm-that-could-knock-out-internet-study-says-1.5579689. Accessed 25 Sep. 2023.

Jyothi, Sangeetha Abdu. “Solar superstorms: Planning for an Internet Apocalypse.” *Proceedings of the 2021 ACM SIGCOMM 2021 Conference*, 2021, <https://doi.org/10.1145/3452296.3472916>.

McGrath, Carol. “Here Comes the Sun: How a Massive Solar Storm Could Put Canada at Risk.” *Global News*, Global News, 30 Oct. 2021, globalnews.ca/news/8333956/here-comes-the-sun-how-a-massive-solar-storm-could-put-canada-at-risk/. Accessed 25 Sep. 2023.

Phillips, Tony. “Near Miss: The Solar Superstorm of July 2012 | Science Mission Directorate.” *Science.nasa.gov*, 23 July 2014, science.nasa.gov/science-news/science-at-nasa/2014/23jul_superstorm. Accessed 25 Sep. 2023.