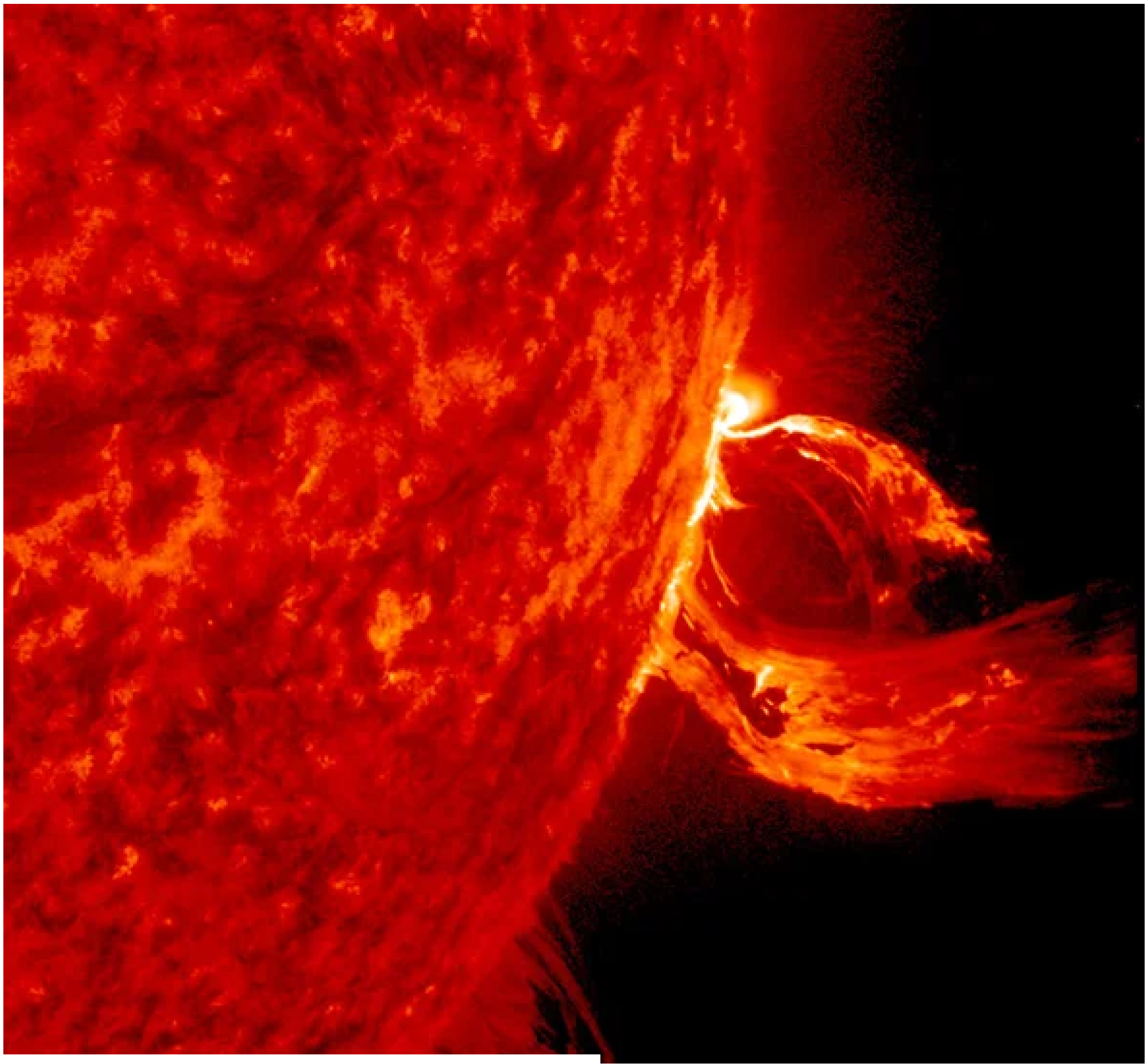
New Studies Warn of Cataclysmic Solar Superstorms

New data suggest the New York Railroad Storm could have surpassed the intensity of the famous Carrington Event of 1859

By Jonathan O'Callaghan on September 24, 2019



A powerful disaster-inducing geomagnetic storm is an inevitability in the near future, likely causing blackouts, satellite failures, and more. Unlike other threats to our planet, such as supervolcanoes or asteroids, the time frame for a cataclysmic geomagnetic storm—caused by eruptions from our sun playing havoc with Earth's magnetic field—is comparatively short. It could happen in the next decade—or in the next century. All we know is, based on previous events, our planet will almost definitely be hit relatively soon, probably within 100 years.

Geomagnetic storms are caused by sunspots, solar flares and coronal mass ejections, resulting in calamities to which our modern technological society is becoming ever more susceptible. Most experts regard the Carrington Event, a so-called superstorm that occurred in September 1859, as the most powerful geomagnetic storm on record. But new data suggest that a later storm in May 1921 may have equaled or even eclipsed the Carrington Event in intensity, causing at least three major fires in the U.S., Canada and Sweden—and highlighting the damaging effects these storms can have on Earth today.

In a paper published in the journal *Space Weather*, Jeffrey Love of the U.S. Geological Survey and his colleagues reexamined the intensity of the 1921 event, known as the New York Railroad Storm, in greater detail than ever before. Although different measures of intensity exist, geomagnetic storms are often rated on an index called disturbance storm time (Dst)—a way of gauging global magnetic activity by averaging out values for the strength of Earth's magnetic field measured at multiple locations. Our planet's baseline Dst level is about –20 nanoteslas (nT), with a "superstorm" condition defined as occurring when levels fall below –250 nT. Studies of the very limited magnetic data from the Carrington Event peg its intensity at anywhere from –850 to –1,050 nT. According to Love's study, the 1921 storm, however, came in at about –907 nT. "The 1921 storm could have been more intense than the 1859 storm," Love says. "Prior to our paper, [the 1921 storm] was understood to be intense, but how intense wasn't really clear."

Chris Balch of the National Oceanic and Atmospheric Administration's Space Weather Prediction Center (SWPC), who was not involved in the paper, notes that there are several ways to measure the intensity of geomagnetic storms. While Dst is a good measure of events in the past, he says it is less useful for modern real-time analyses of storm intensity and energy, which instead rely on something called the KP-index. "Dst is based on these low-latitude observatories around the world," he says. "For [the KP-index], there are 13 observatories located in auroral zones and at midlatitudes." Being closer to Earth's geomagnetic poles, these stations are able to get a better handle on fluctuations in the field's strength.

Historical measurements of geomagnetic storms are not easy. Whereas today we have an array of instruments around the world to monitor such events, our knowledge before 1957—when official Dst records began—relies on disparate data taken by different magnetometers scattered around the globe. Before Love's paper, data from only one observatory in Samoa had been used to estimate the 1921 storm's intensity. But he was able to track down additional handwritten records from other locations in Australia, Spain and Brazil. Averaging out the readings from these four locations, Love and his co-authors reconstructed the 1921 storm's intensity more accurately than ever before—much more accurately, for instance, than intensity estimates of the Carrington Event, which presently rely on just a single magnetometer measurement from India. "I was really excited to finally see a quantitative measure of the 1921 event," says Delores Knipp of the University of Colorado Boulder, who is an editor at *Space Weather*. "I think it's actually something that will come as a surprise to many people."

The Carrington Event is particularly famous for its effects on Earth, sending geomagnetically induced currents coursing through the planet's nascent electric grid and starting fires the storm was weak. But looking at previously overlooked written records, Hapgood noted that three major fires had erupted on the same day. One, sparked by strong currents in telegraph wires at a railroad station in Brewster, N.Y., burned the station to the ground. The second was a fire that destroyed a telephone exchange in Karlstad, Sweden, while the third occurred in Ontario.

The 1921 event unfolded in two phases, unleashing an opening burst of disruption before intensifying into a full-fledged superstorm. In Karlstad, for instance, night-shift operators of the telephone exchange initially reported that their equipment was malfunctioning and had begun emitting smoke. After the smoke cleared, in the hours before dawn, electrical cables in the exchange erupted in flames, eventually setting the entire structure ablaze. By sunrise, the interior had burned to ashes.

Hapgood's research shows just how impactful the storm of 1921 really was—and not just in the U.S. and Sweden. Records from Samoa, which is not far from the equator, show that auroral displays were visible to observers even in this low-latitude locale. "It's an astonishing observation," Hapgood says. Auroras were also recorded near Paris and in Arizona, while telegraph systems and telephone lines were disrupted in the U.K., New Zealand, Denmark, Japan, Brazil and Canada. "[This storm] has got a period of earlier activity that caused some problems," Hapgood says, "and then the next night, all hell broke loose," as what began as a more modest event from the sun grew in strength to become far more disruptive.

Today we have sentinel spacecraft in place, such as NASA's Advanced Composition Explorer, to monitor space weather and provide warnings to Earth if a large storm is heading in our direction. This system should allow power grids or satellites to be shut down as a storm arrives to lessen its effects. But if an exceedingly large storm were to strike again—as one very nearly did in 2012—the results could be severe, regardless of forewarnings. "If the 1921 storm occurred today, there would be widespread interference to multiple technological systems, and it would be quite significant," with effects including blackouts, telecommunications failure, and even the loss of some satellites, Love says. "I'm not going to say it would be the end of the world, but I can say with high confidence that there would be widespread disruption."

While another large event would undoubtedly cause problems, organizations such as the SWPC closely monitor space weather to prepare the planet for the worst. Knipp believes

1921 storm is maybe worthy of just as much discussion," Love says. "Looking at these two storms, they are, far and away, the biggest ever recorded."

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