New geoelectric hazard map shows potential vulnerability to high-voltage power grid for two-thirds of the U.S.

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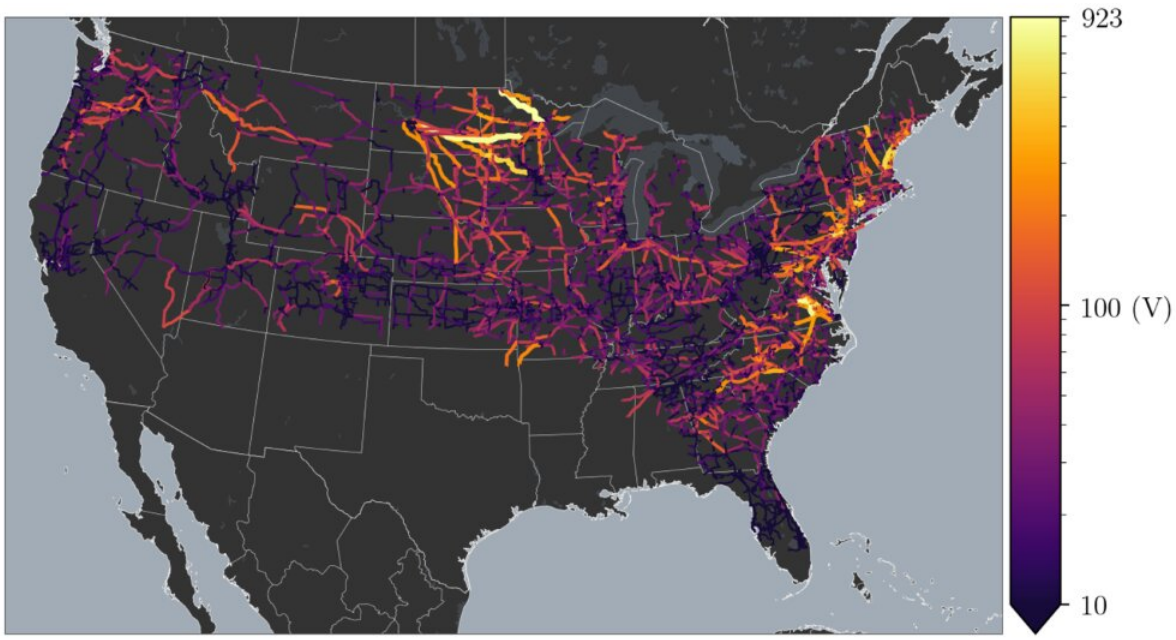

Map from the report showing 100-year storm-induced voltages on the national electric power grid. Credit: United States Geological Survey

The U.S. Geological Survey released a new report on geoelectric hazards for two-thirds of the contiguous U.S., spanning from the northeast to the west coast of the Nation.

The research, featured in *Space Weather*, includes a map of voltages that would be induced on the national electric power grid by a geomagnetic superstorm. This research furthers Executive Order 13865 on Coordinating National Resilience to Electromagnetic Pulses, signed by President Trump in March 2019.

"The new voltage map is a critical step forward in our ability to assess the Nation's risk to geoelectric hazards," said Jim Reilly, USGS director. "This information will allow utility companies to evaluate the vulnerability of their power-grid systems to magnetic storms and take important steps to improve grid resilience."

Geomagnetic storms are caused by the dynamic action of the sun and solar wind on the space environment surrounding the Earth. Magnetic disturbance during such a storm generates electric fields in the Earth's crust and mantle. These electric fields can interfere with the operation of grounded electric power-grid systems.

Geomagnetic storms occur only occasionally, but when sufficiently energetic they can produce blackouts—for example, a storm in March 1989 caused a blackout of Quebec, Canada. Similarly, the great magnetic storm of 1921 caused fires in telegraph stations used by railroad companies in New York City and other parts of the State. Even more concerning are rare magnetic superstorms comparable to the "Carrington" storm of 1859. If one were to occur today, a National Academy of Sciences study suggests that it could bring widespread blackouts, damage infrastructure, and have an economic impact of as much as $2 trillion.

The new USGS research shows that geologic structure is an important factor affecting storm-induced voltages on the power grid. In particular, the map shows that due to electrically resistive rock, there is high hazard in the northern Midwest and, notably, in the Piedmont formation east of

the Appalachian Mountains—an area adjacent to many of the nation's largest cities. Last year, the USGS published foundational work that focused on probabilities of a once-per-century geomagnetic superstorm in the Northeast.

This project is identified as a priority in the National Space Weather Strategy and Action Plan and the Presidential Executive Order for Coordinating National Resilience to Electromagnetic Pulses.

This work relies on data acquired by the USGS, Natural Resources Canada and the EarthScope project of the National Science Foundation. The USGS Geomagnetism Program continuously monitors the Earth's magnetic field through a network of ground-based observatories. Data from the observatories, in addition to supporting analyses of geoelectric hazards, are used by NOAA and the U.S. Air Force for monitoring variable space weather conditions. These data are also used in support of mapping of the crust and directional drilling for oil and gas.

"Already a priority in the National Space Weather plans, this work highlights the need to complete a national-scale magnetotelluric survey and for additional magnetic observatories so that geoelectric hazards can be mapped across all parts of the U.S.," said Reilly. "The recently passed omnibus appropriations legislation for fiscal year 2020 includes funding for the USGS to continue the magnetotelluric survey across the southern tier of the country."

More information: G. M. Lucas et al. A 100-year Geoelectric Hazard Analysis for the U.S. High-Voltage Power Grid, *Space Weather* (2020). DOI: 10.1029/2019SW002329

Jeffrey J. Love et al. Intensity and Impact of the New York Railroad Superstorm of May 1921, *Space Weather* (2019). DOI: 10.1029/2019SW002250