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On the challenge of mapping storm-time geoelectric fields

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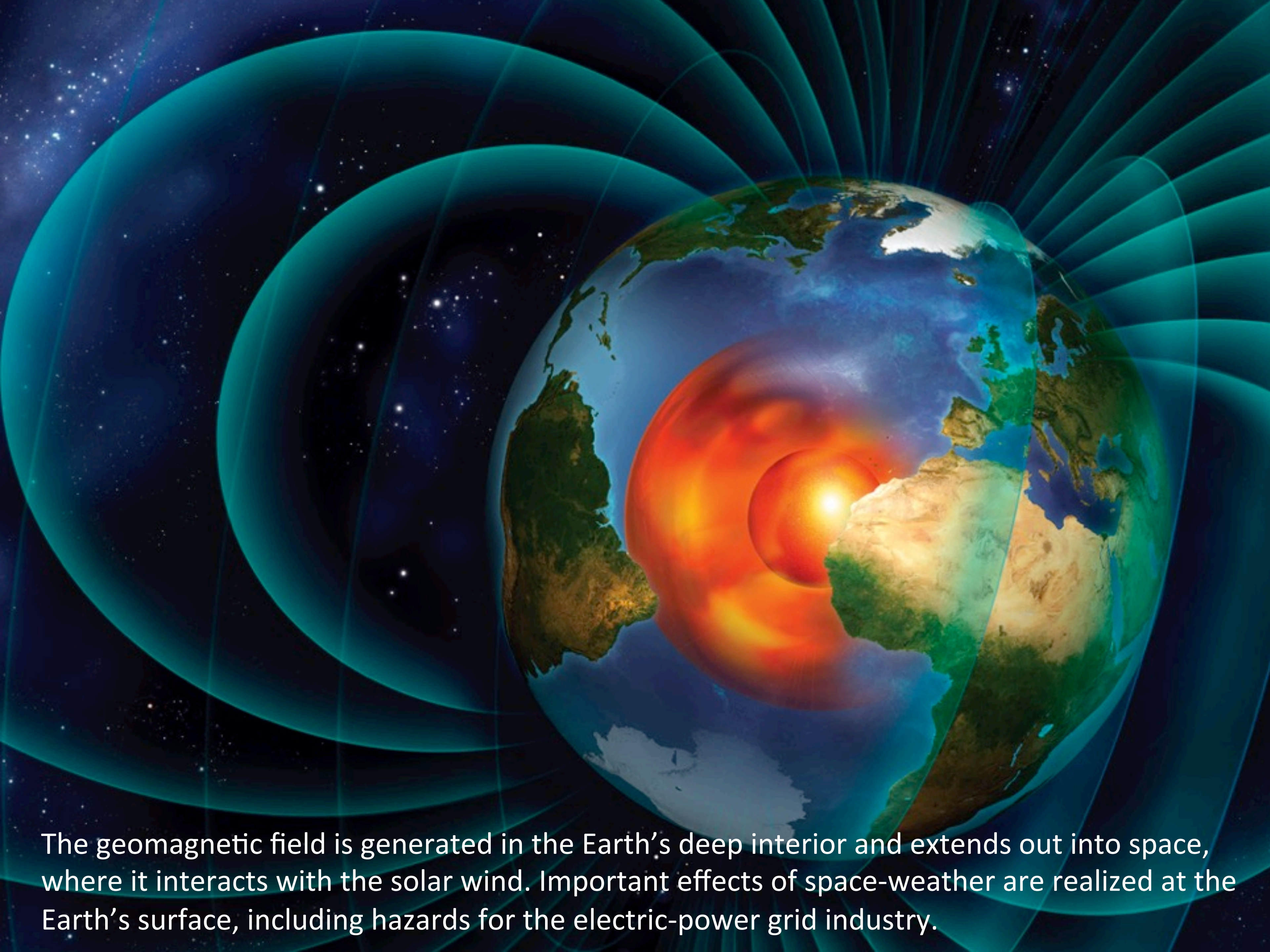
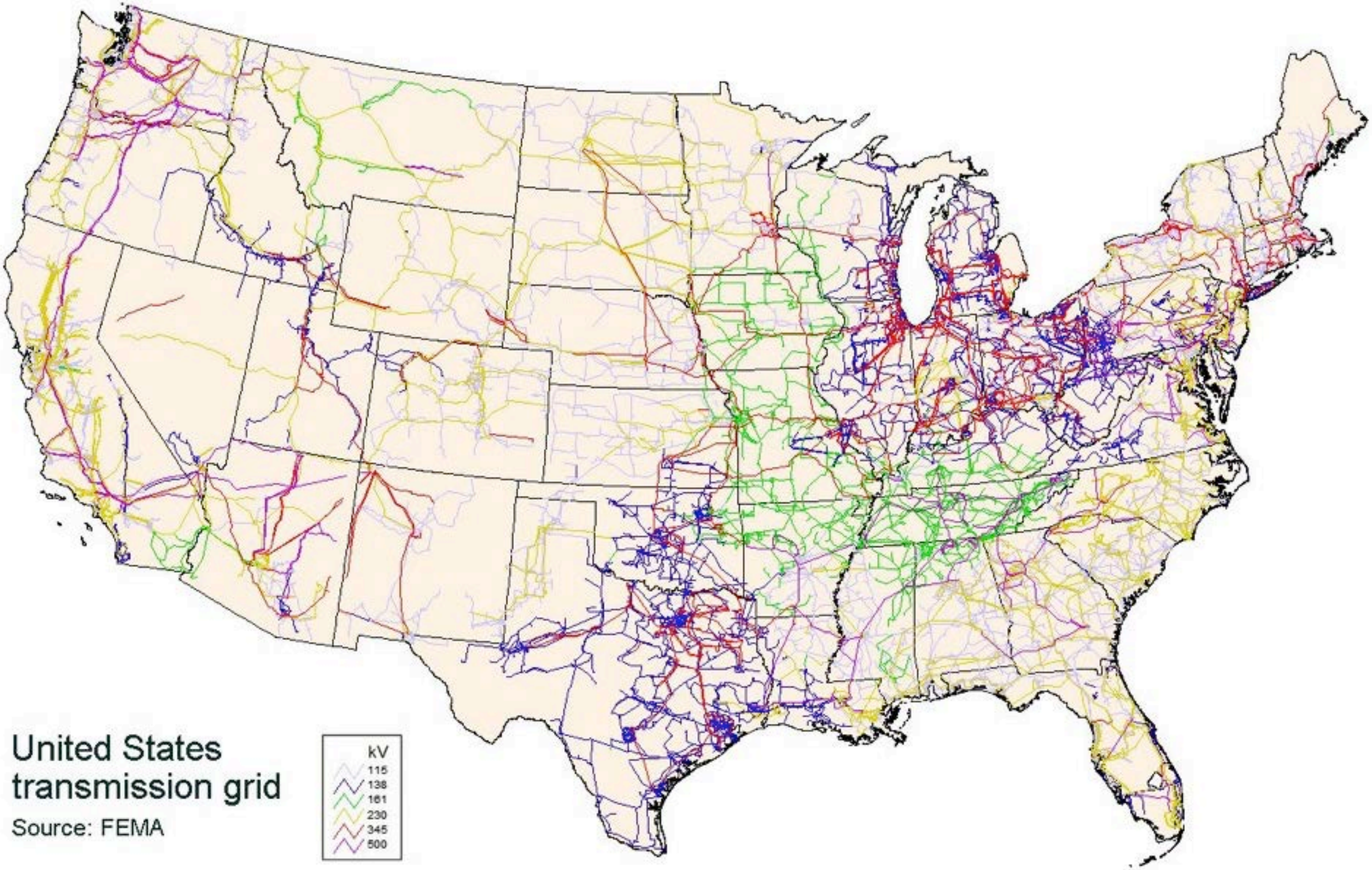


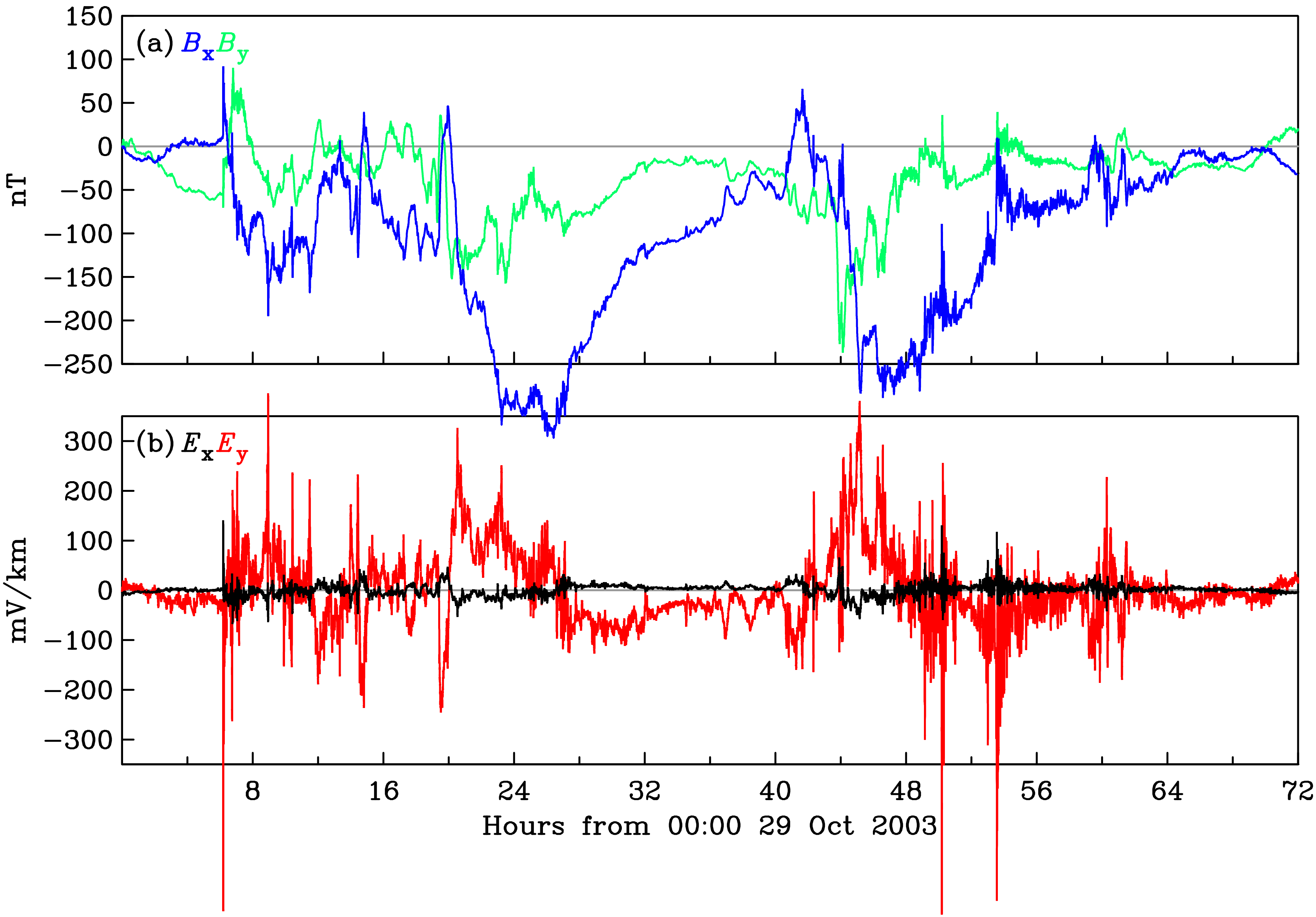
The geomagnetic field is generated in the Earth's deep interior and extends out into space, where it interacts with the solar wind. Important effects of space-weather are realized at the Earth's surface, including hazards for the electric-power grid industry.

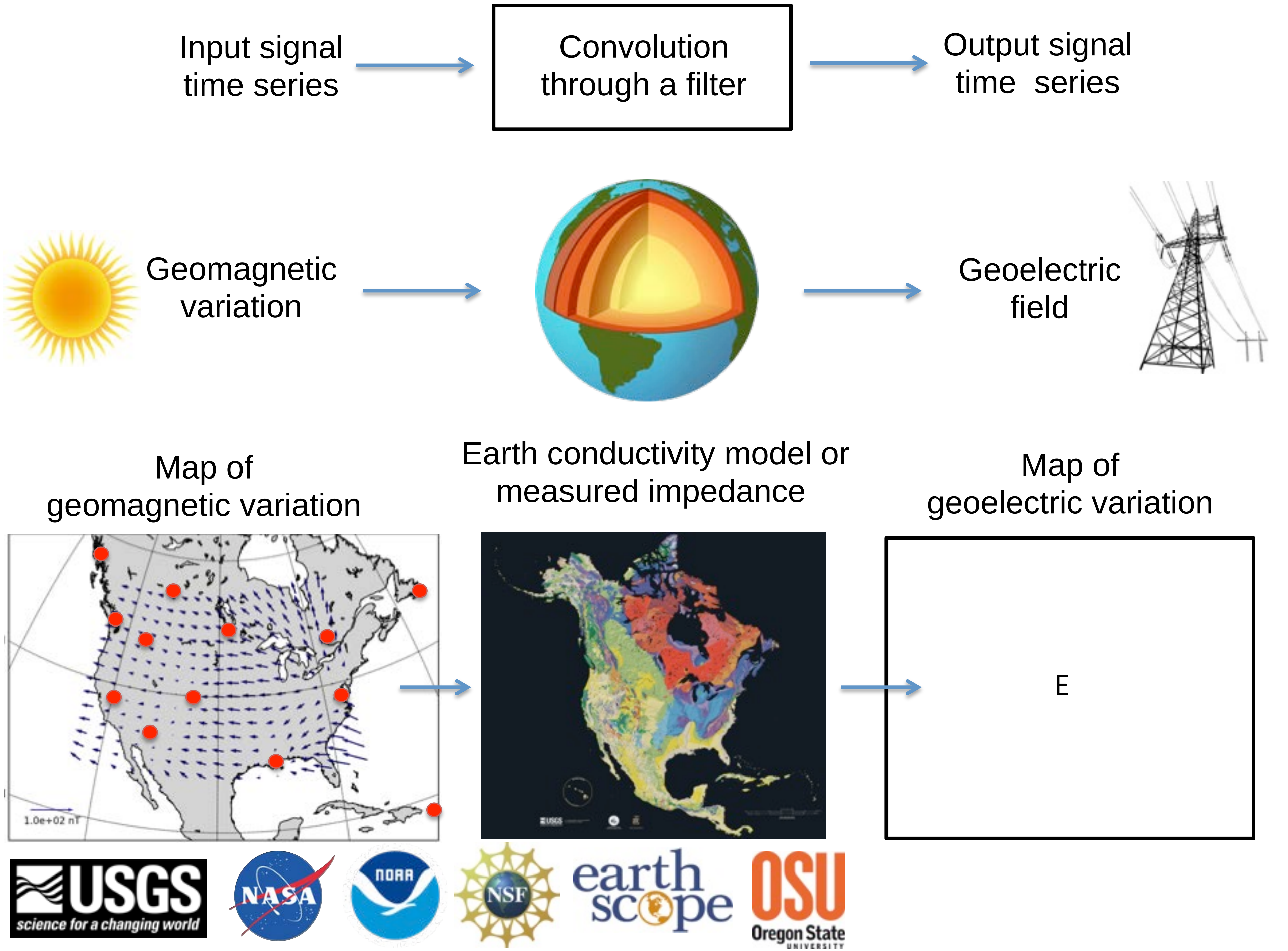
eology and deeper lithospheric structure of the United States (and North America) is extremely



The electric-power grid of the United States stretches across a geography of geological structure, and, therefore, electrical conductivity structure.

Geomagnetic and Geoelectric Data
Japan Meteorological Agency, Kakioka, 29-31 October 2003




Input signal
time series
Convolution
through a filter
Output signal
time series
Geomagnetic
variation
Geoelectric
field
Map of
geomagnetic variation
Earth conductivity model or
measured impedance
Map of
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1.0e+02 nT
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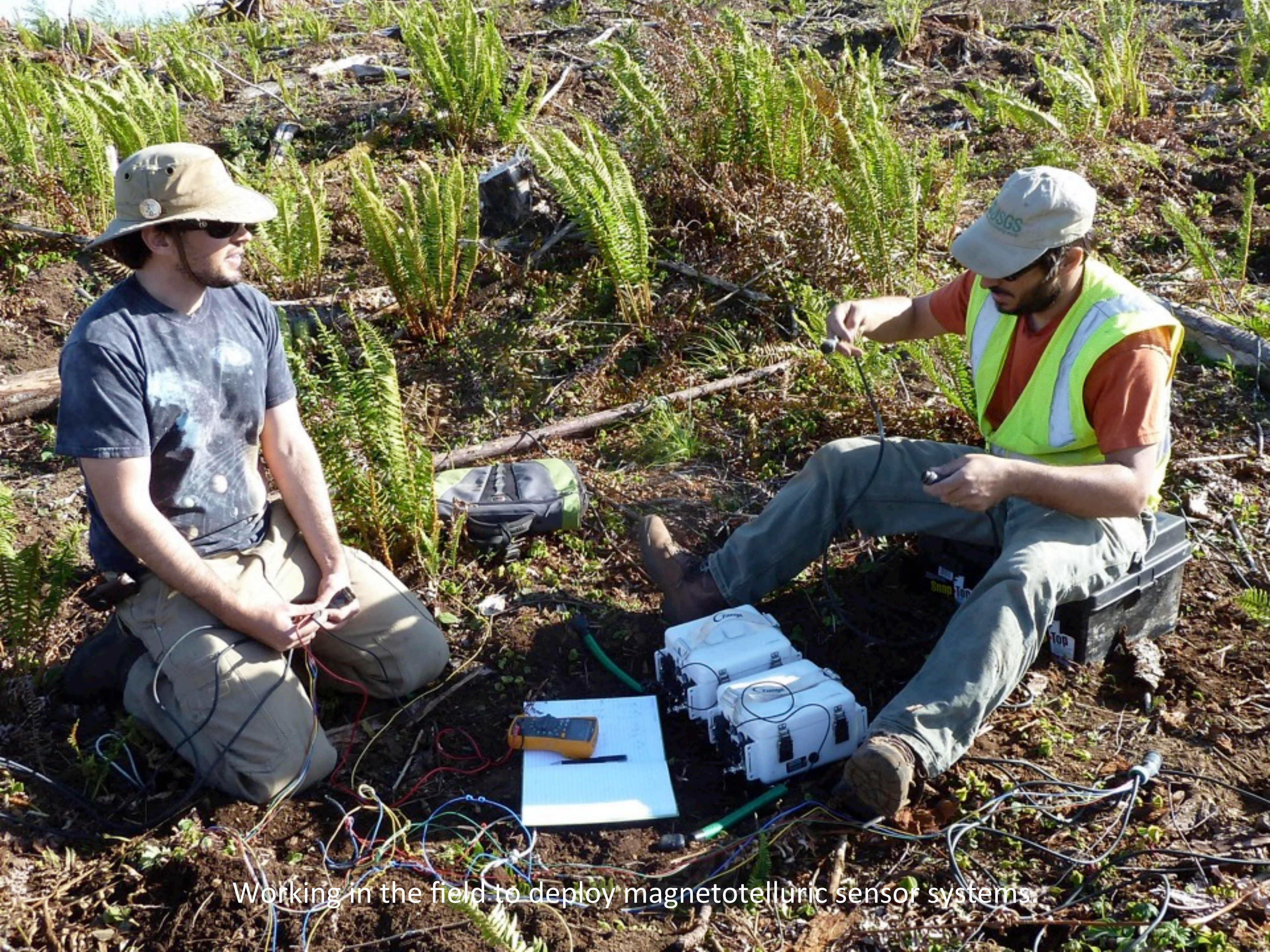
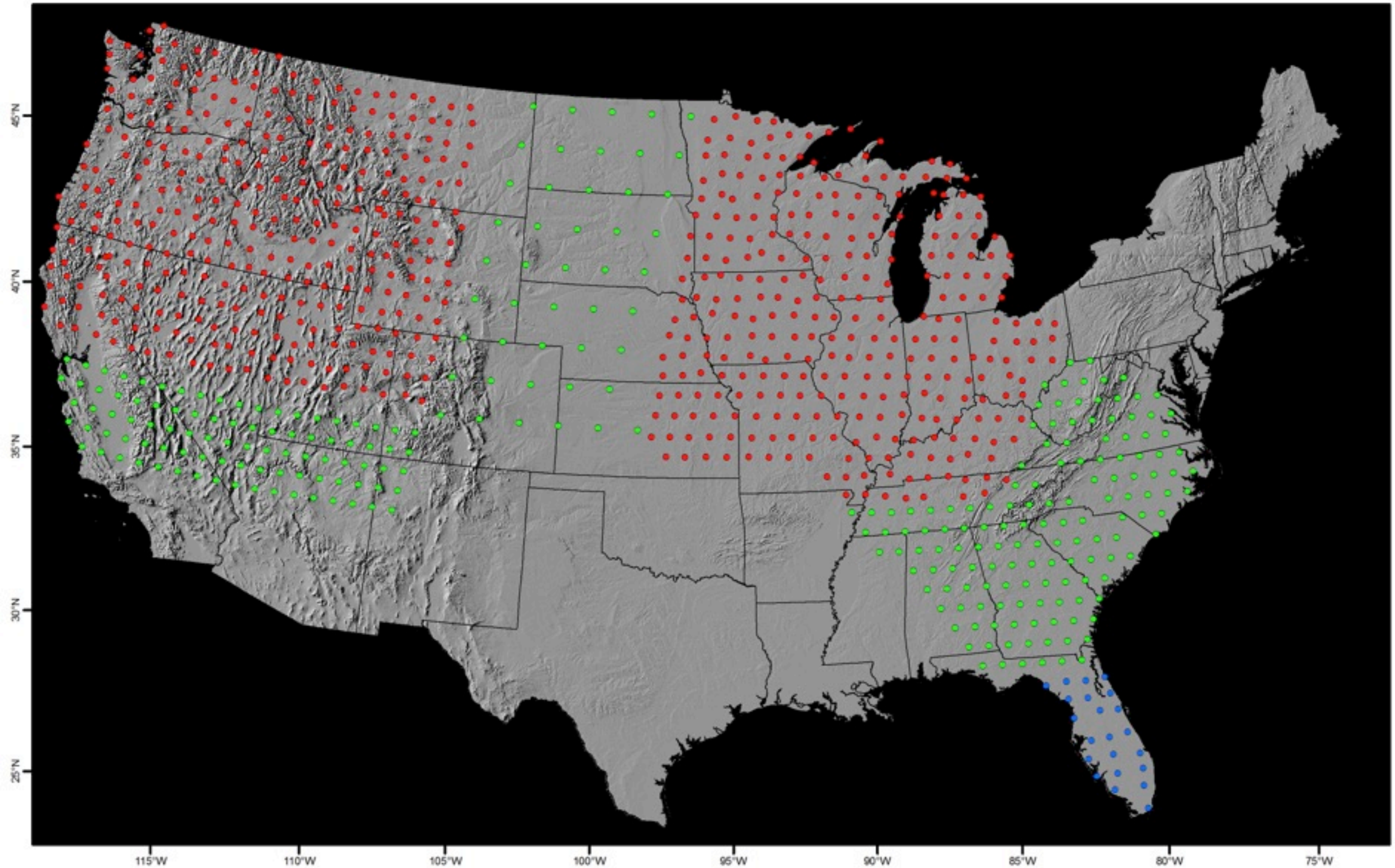
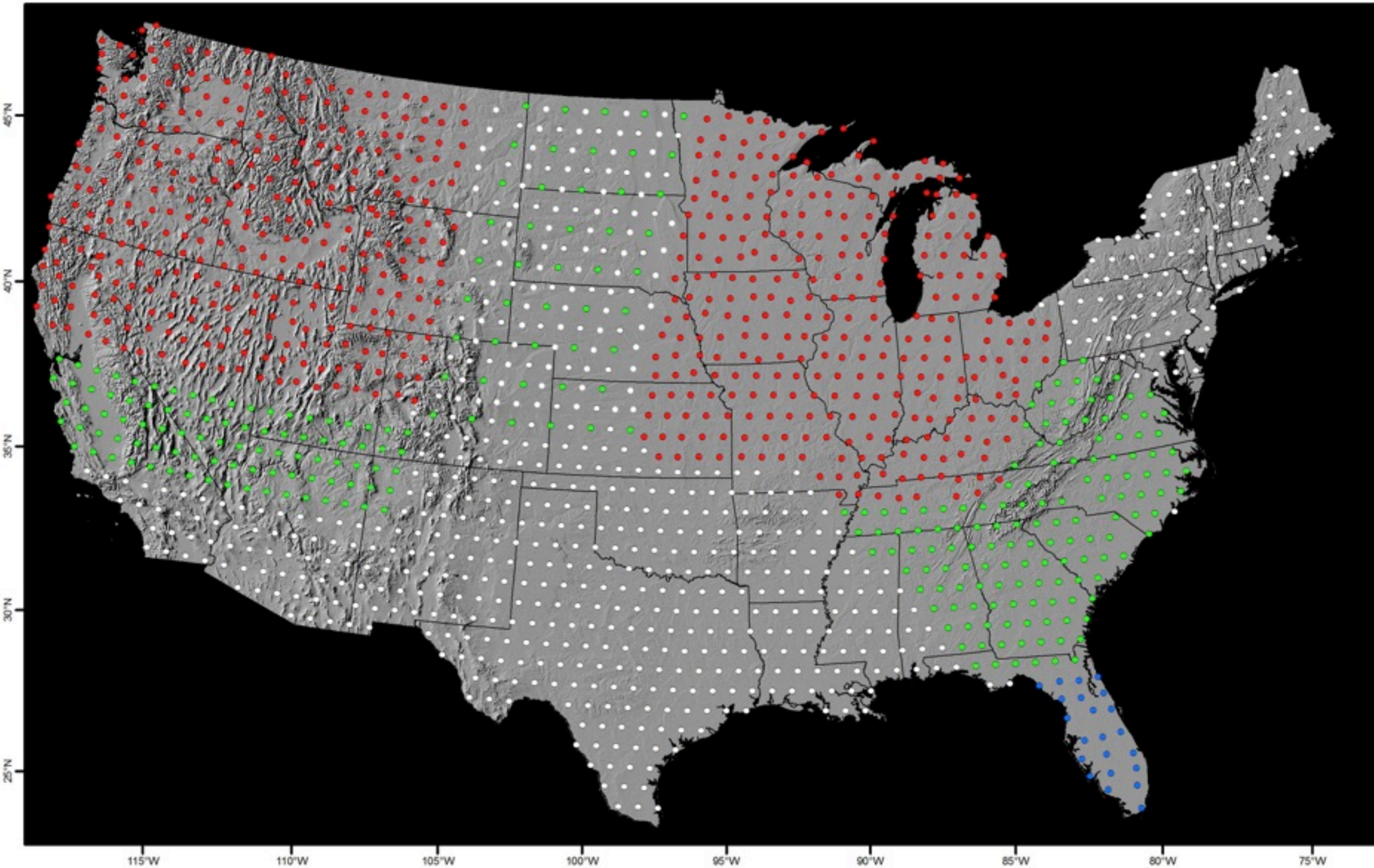


Working in the field to deploy magnetotelluric sensor systems.

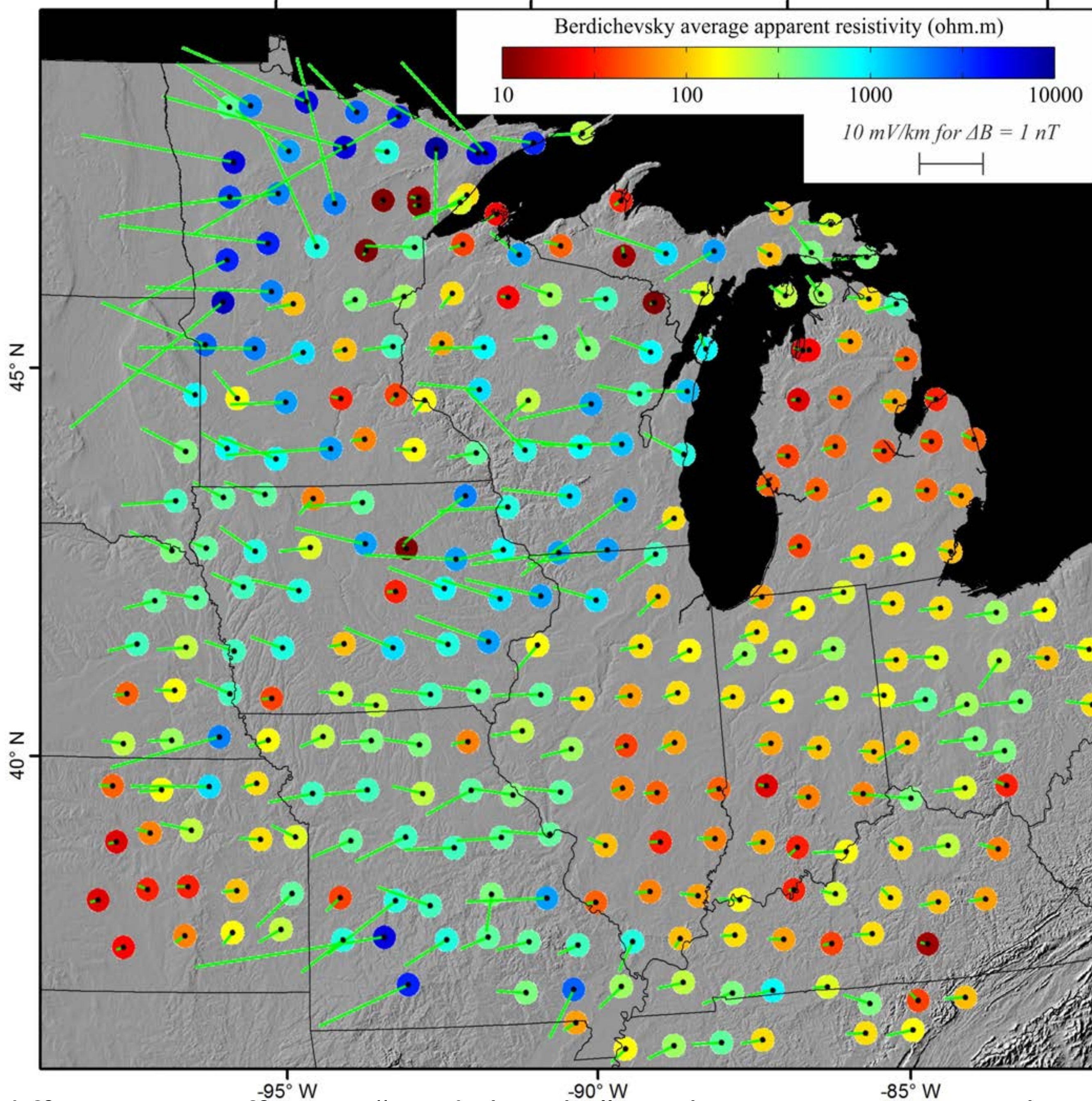
NSF EarthScope MT survey by 2018 with recent USGS work in Florida.



Possible augmentation of MT survey (white)



Will provide data useful for induction-hazard science and
for fundamental geological understanding of the Earth's lithosphere.



Localized differences in effective “Berdichevsky” Earth resistivity are correlated with localized geoelectric response. For reference: seawater resistivity = 0.2 ohm.m.

Conclusions

- Induced geoelectric fields show substantial geographically distributed differences in amplitude, direction, and phase.

- Across the north-midwestern United States, an intense magnetic storm having 500 nT amplitude at 100 seconds would induce geoelectric fields with an average amplitude of about 2.71V/km, but a representative range of 0.15 V/km to 16.77 V/km.

- Significant improvements in the evaluations of induction hazards will require much more detailed knowledge of the Earth's interior 3D conductivity structure.

Related publications

Love, J. J., 2008. Magnetic monitoring of Earth and space, Physics Today, 61(2), 31--37.

Love, J. J. & Finn, C. A., 2011. The USGS Geomagnetism Program and its role in space weather monitoring, Space Weather, 9, S07001, doi: 10.1029/2011SW000684.

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Love, J. J., Rigler, E. J., Pulkkinen, A. & Balch, C. C., 2014. Magnetic storms and induction hazards, Eos Trans. AGU, 95(48), 445-446, doi: 10.1002/2014EO480001.

Bedrosian, P. A. & Love, J. J., 2016. Mapping geoelectric fields during magnetic storms: Synthetic analysis of empirical United States impedances, Under review.