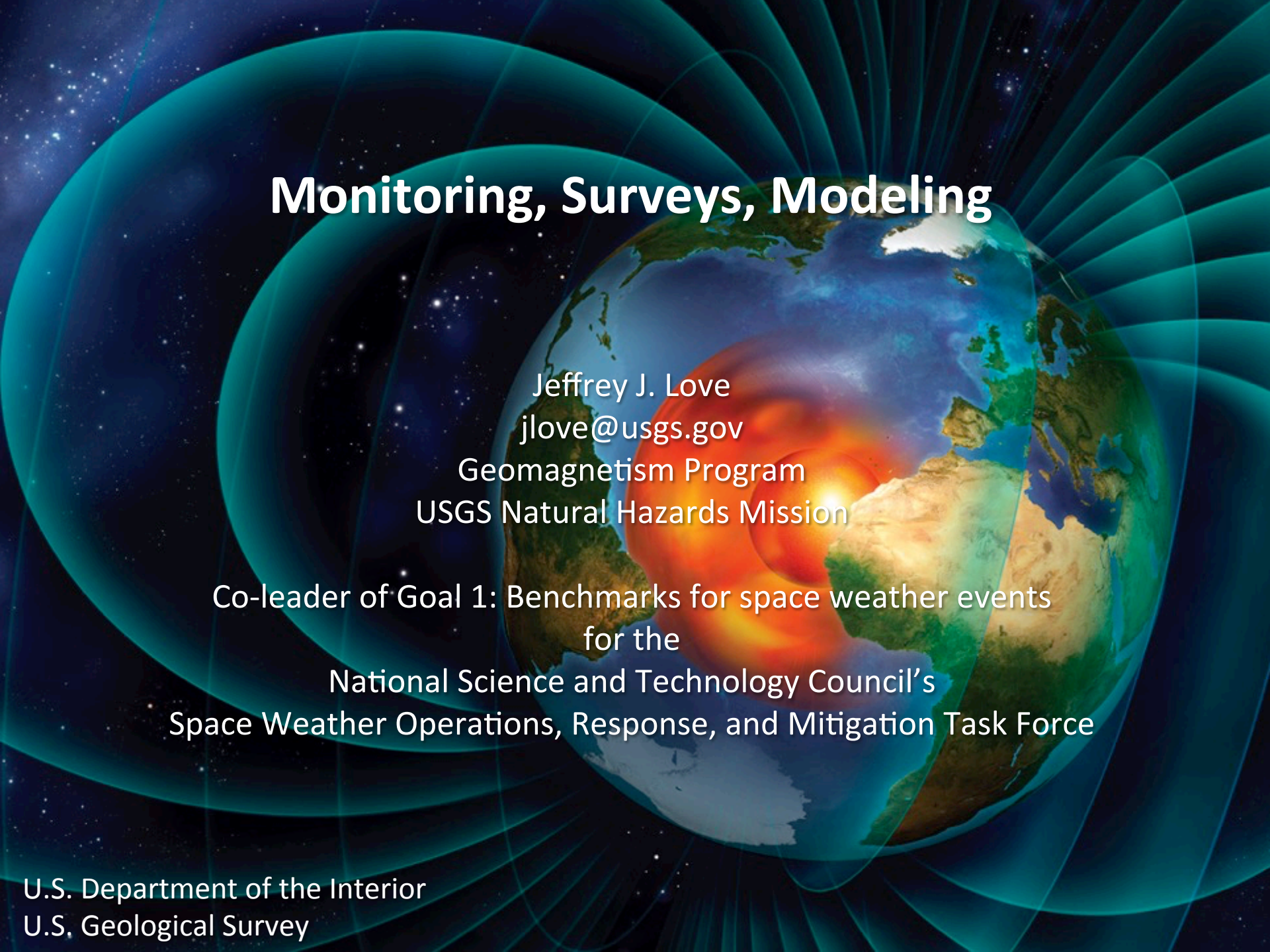

Monitoring, Surveys, Modeling

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Geomagnetism Program
USGS Natural Hazards Mission

Co-leader of Goal 1: Benchmarks for space weather events
for the
National Science and Technology Council's
Space Weather Operations, Response, and Mitigation Task Force

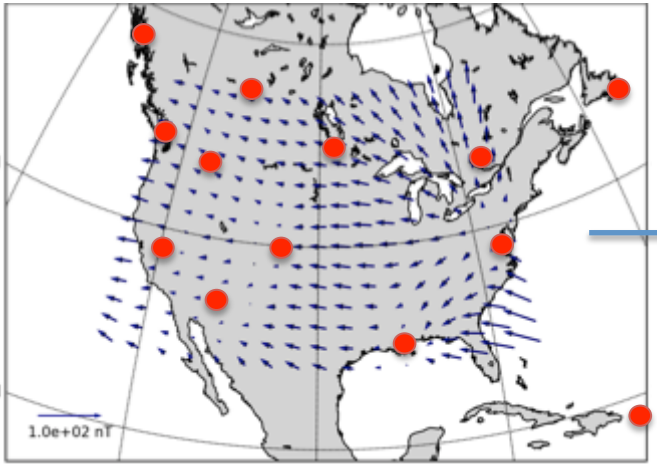
U.S. Department of the Interior
U.S. Geological Survey

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

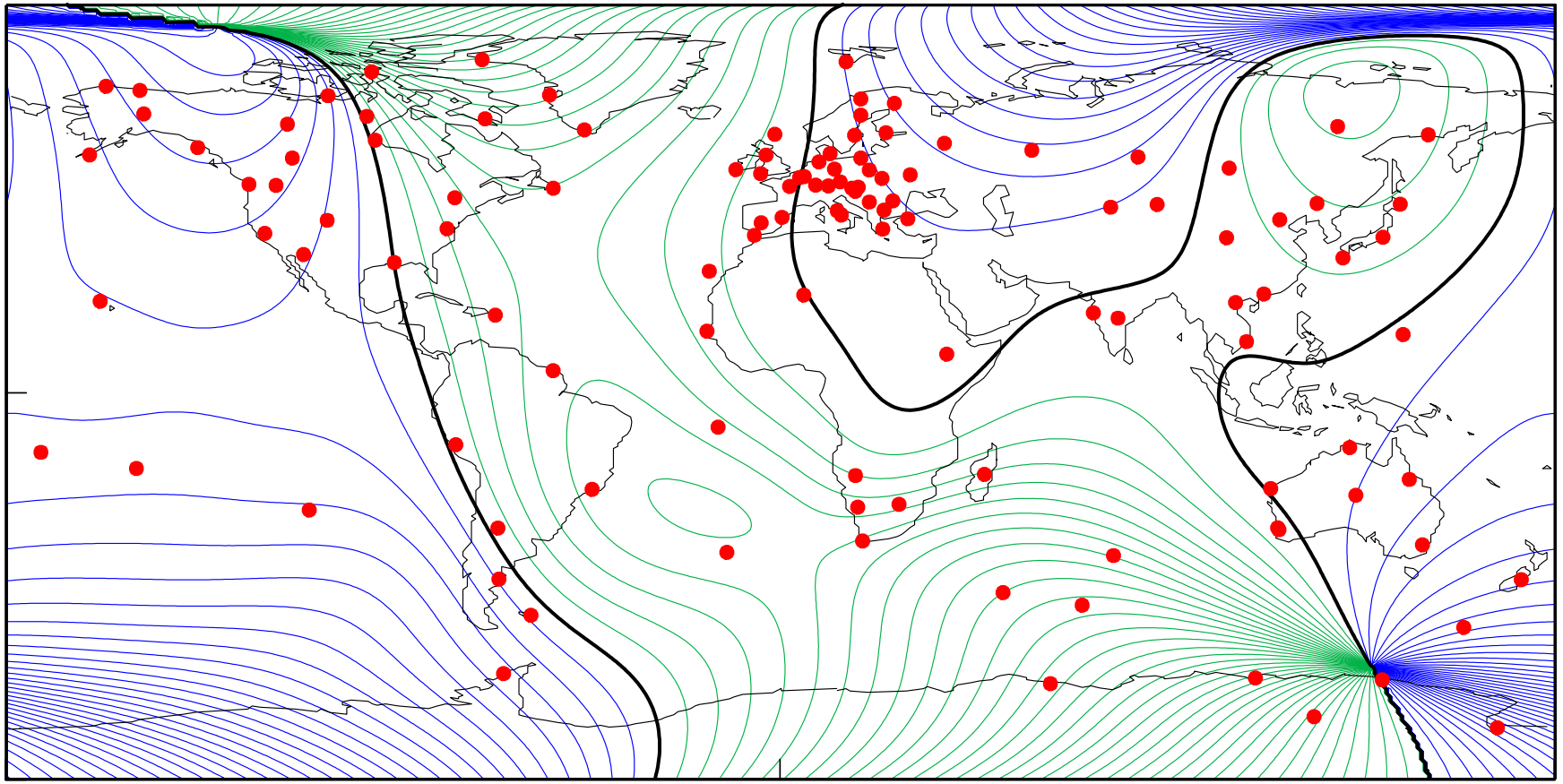
Map of geoelectric variation

E

Love, J. J., Rigler, E. J., Pulkkinen, A., Balch, C. C., 2014.
Magnetic storms and induction hazards, Eos, Trans. AGU, 95(48), 445-446, doi10.1002/2014EO480001.

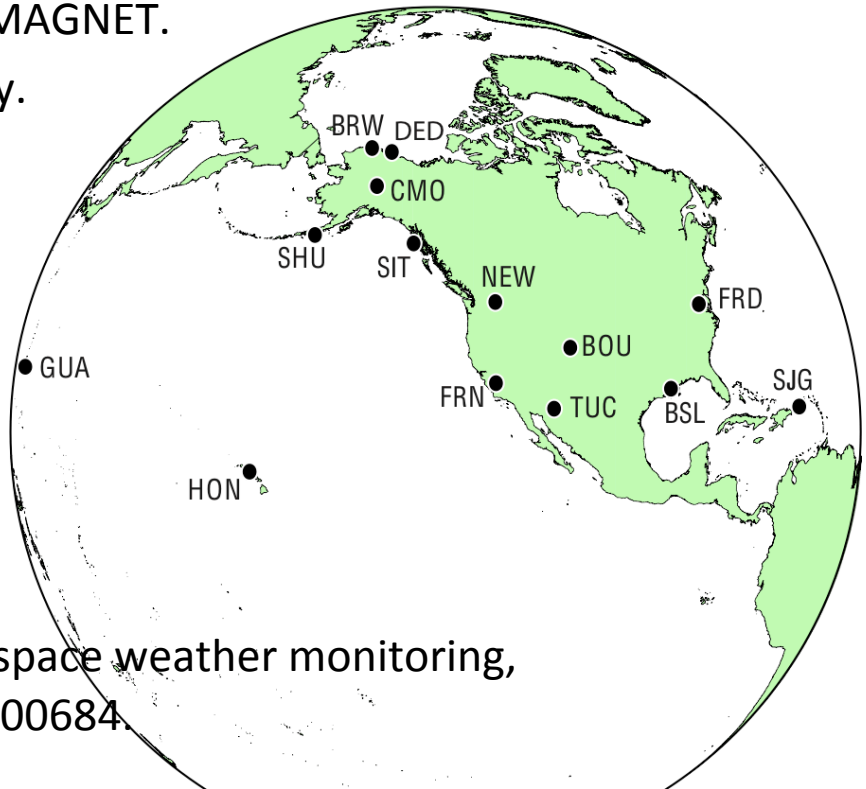
INTERMAGNET www.intermagnet.org

Love, J. J., Chulliat, A., 2013. An international network of magnetic observatories, Eos, 94(42), 373-374, doi:10.1002/2013EO420001.



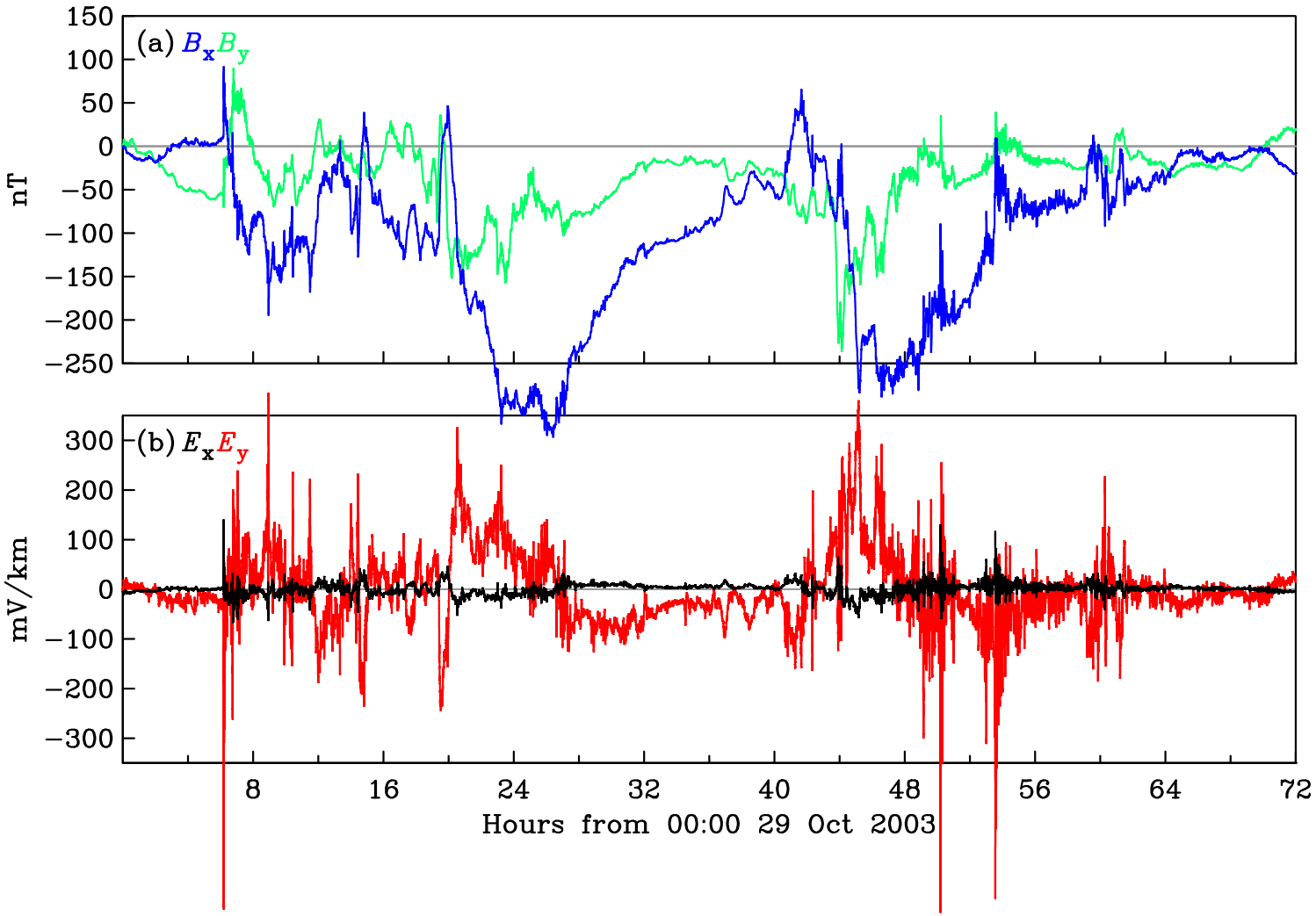
USGS Geomagnetism Program
geomag.usgs.gov

- Part of a USGS Natural Hazards Mission.
- DOI representation in the National Space Weather Program.
- Monitor Earth's magnetic field at ground-based magnetic observatories.
- Report data with high accuracy, resolution, and reliability.
- Customers: Air Force, NOAA, NASA, GFZ, NICT, industry, academia.
- Promote operations around the world: INTERMAGNET.
- Operational partnership with oil & gas industry.
- Conduct research of societal importance.
- Carol A. Finn, Geomagnetism Group Leader.
- 16 staff, 14 observatories.
- Budget: $1.9 million/yr.



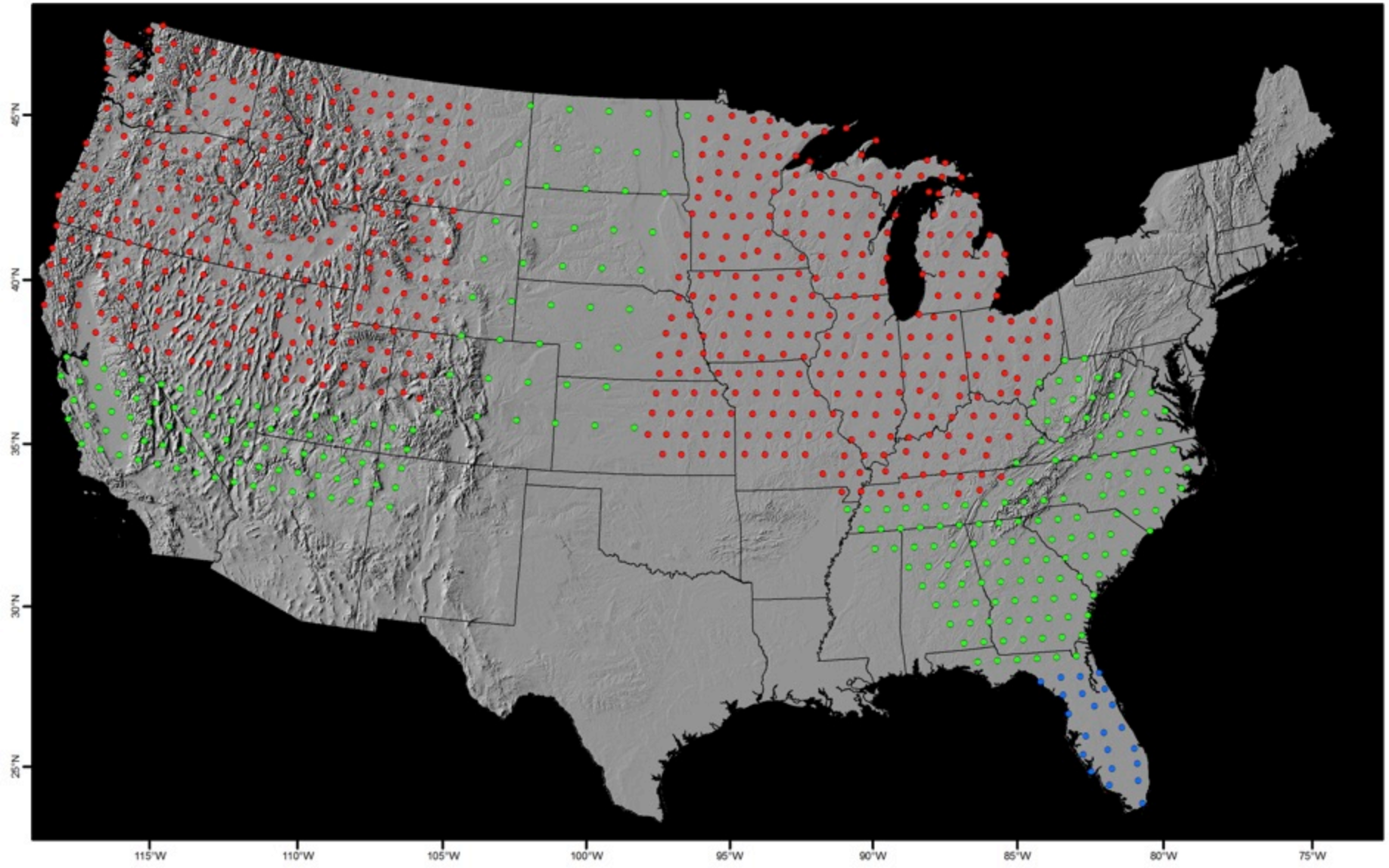
Love, J. J. & Finn, C. A., 2011.
The USGS Geomagnetism Program and its role in space weather monitoring,
Space Weather, 9, S07001, doi 10.1029/2011SW000684.

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

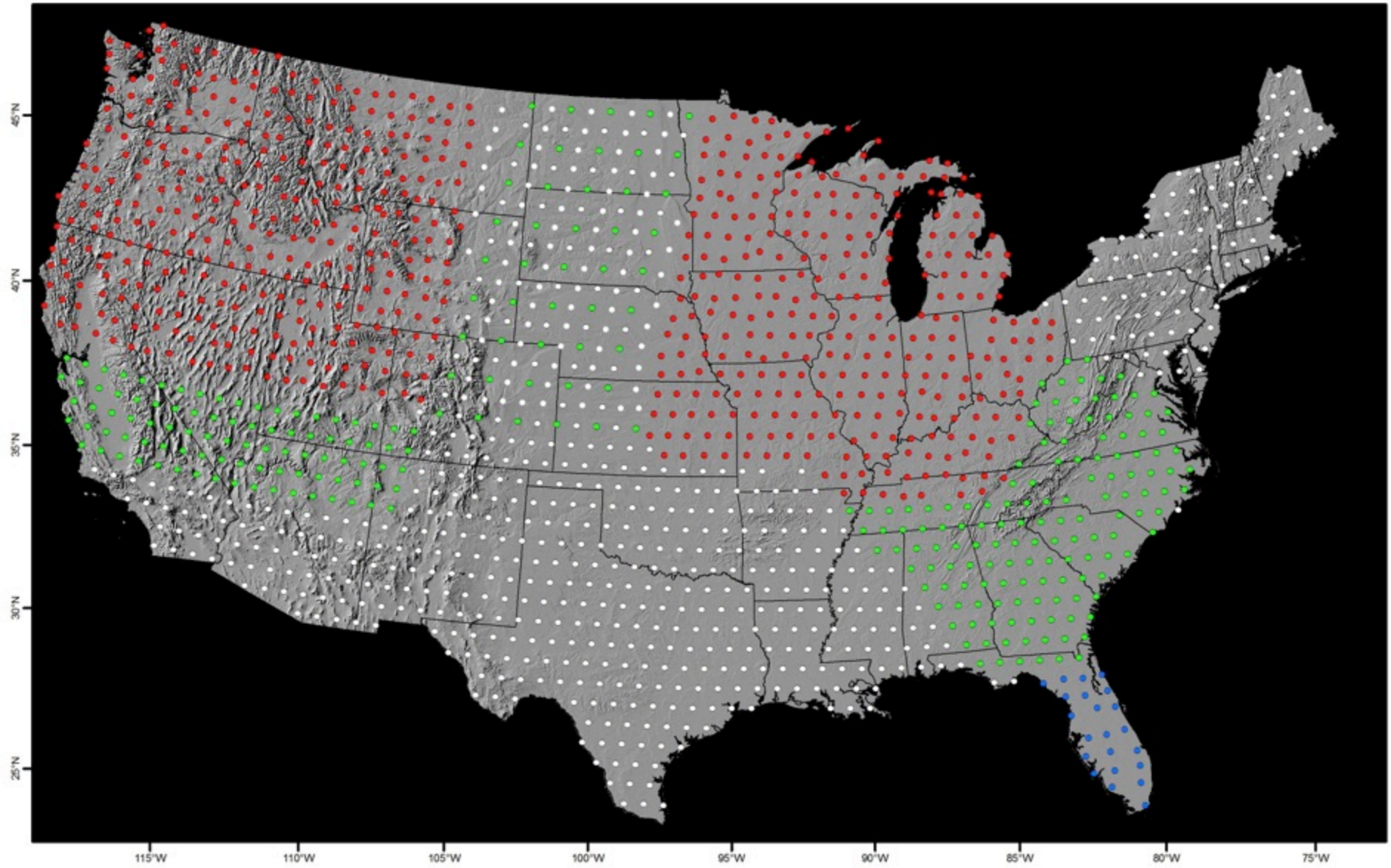


The United States needs both more geomagnetic monitoring and some geoelectric monitoring (none is in place).

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

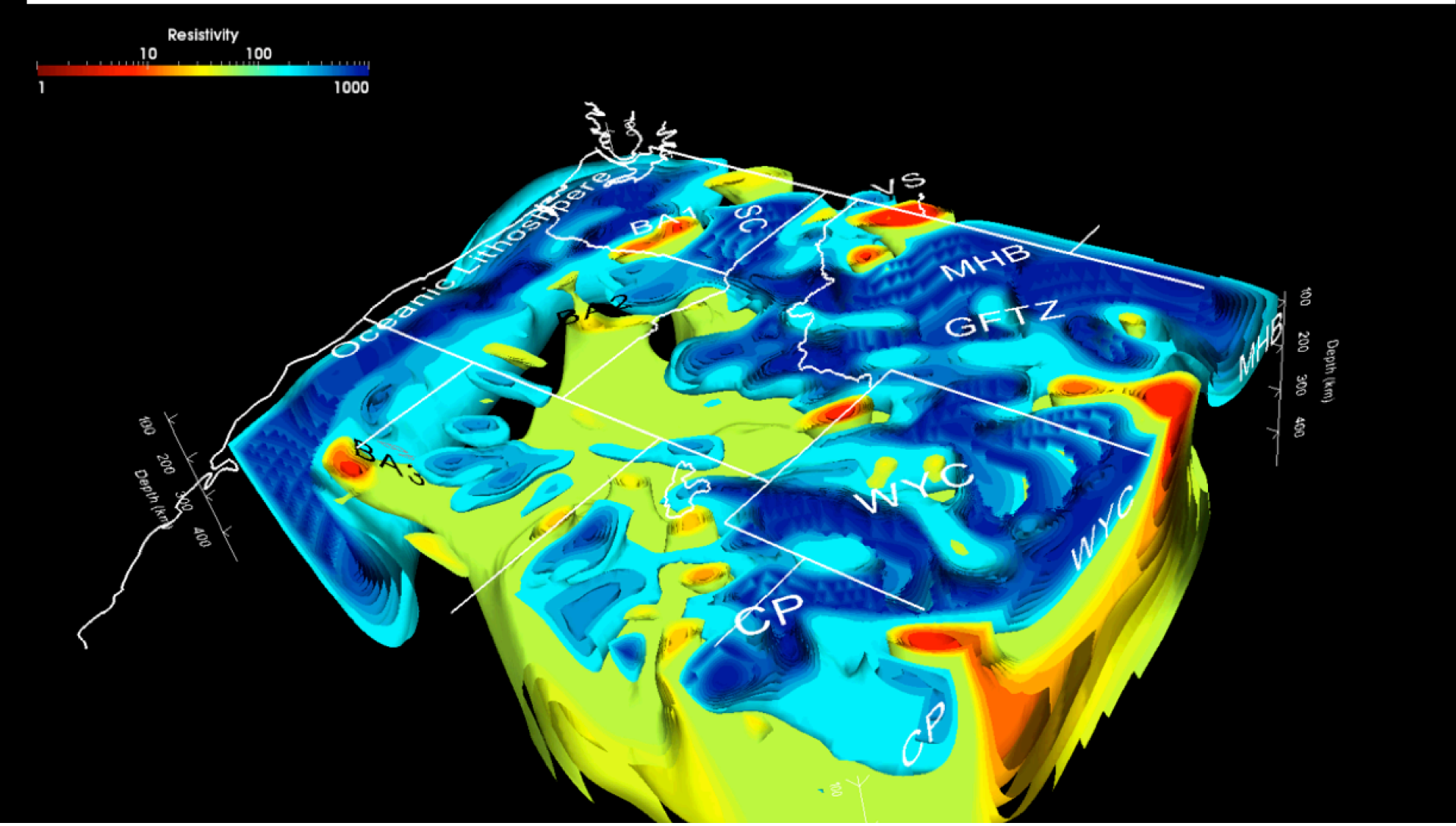


Possible augmentation of MT survey (white)



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

3D models of Earth resistivity derived from EarthScope survey data



Meqbel, N. M., Egbert, G. D., Wannamaker, P. E., Kelbert, A. & Schultz, A., 2014. Deep electrical resistivity structure of the Pacific Northwestern U.S. derived from 3-D inversion of USArray magnetotelluric data, Earth Planet. Sci. Lett., 402, 290-304, doi:10.1016/j.epsl.2013.12.026.

Conclusions

- Significant improvements in the evaluations of induction hazards will require:

  1. Improved geomagnetic and geoelectric monitoring
  2. Completing national magnetotelluric surveys
  3. Constructing models of the Earth's 3D conductivity structure.

- Future products of use to the electric-power grid industry:

  1. Gridded maps of geomagnetic activity
  2. Gridded maps of Earth impedance derived from 3D models
  3. An algorithm for calculating the geoelectric field from 1 & 2.

- A lot of work has been done, and a lot remains to be done.