



Space Weather Action Plan Implementation: Challenges and Opportunities, USGS Perspective

Carol A. Finn

USGS Geomagnetism Group Leader

Space Weather Workshop, April 18, 2018

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

USGS Geomagnetism Program

Space Weather Action Plan Goals

- **Goal 1: Establish Benchmarks for Space-Weather Events**
- Goal 2: Enhance Response and Recovery Capabilities
- Goal 3: Improve Protection and Mitigation Efforts
- Goal 4: Improve Assessment, Modeling, and Prediction of Impacts on Critical Infrastructure
- **Goal 5: Improve Space-Weather Services through Advancing Understanding and Forecasting**
- **Goal 6: Increase International Cooperation**



Space Weather Action Plan

– DOI/USGS actions

Goal 1: Establish Benchmarks

- Co-lead for benchmark development
- 1.1 Develop Benchmarks for Induced Geoelectric Fields

Goal 5: Improve Space-Weather Services

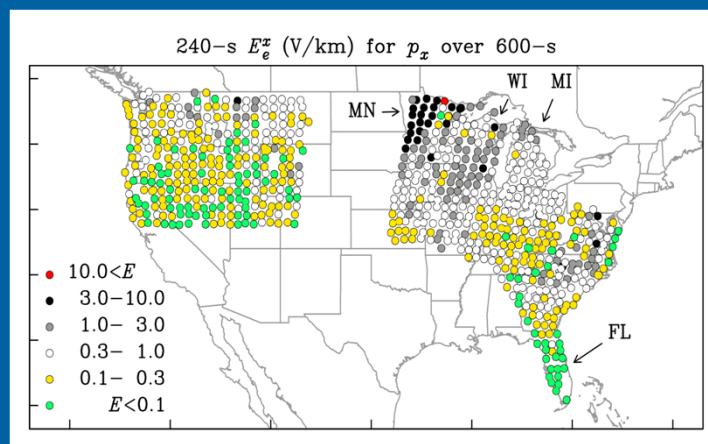
- 5.3.6 Sustain and expand geomagnetic monitoring
- 5.5.4 Initiate geoelectric monitoring
- 5.5.5 Fill gaps in magnetotelluric surveys / Improvements to localized estimates of geoelectric fields and in lithospheric conductivity models
- 5.5.6 Map geomagnetic and geoelectric hazards
- Collaborate with other agencies on space-weather data calibration and accuracy

Goal 6: Increase International Cooperation

- 6.2.1 Complete strategy for expanding global geomagnetic monitoring, improving global data exchange



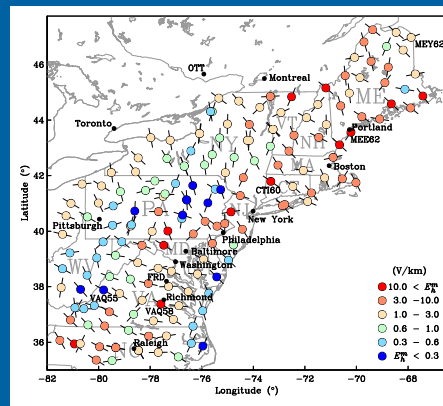
Goal 1.1 Develop Benchmarks for Induced Geo-Electric Fields



Goal 1.1 Develop Benchmarks for Induced Geoelectric Fields

Work is focused on developing estimates of 100-year geoelectric hazards derived from:

- Magnetotelluric impedance tensors collected by NSF's EarthScope Program
- Historical geomagnetic field variation data collected at USGS and NRCAN observatories



Map of 100-year geoelectric amplitudes and polarities across the Northeast United States.

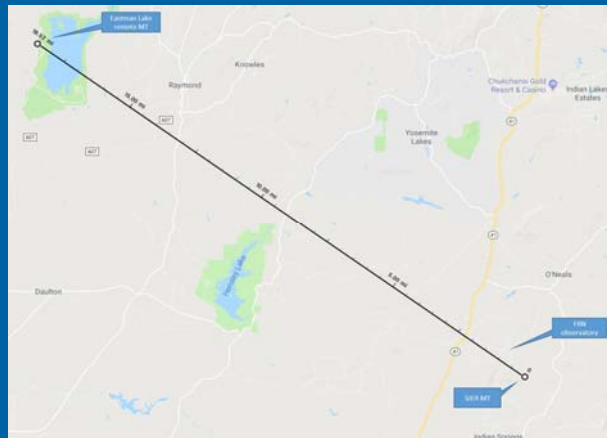


Goal 5.5.4: Initiate Geoelectric Monitoring

- Implementation:
 - A pilot electric-field (e-field) system was installed at the Boulder (BOU) observatory in 2016 and has been operating nearly continuously since then.
- Challenge:
 - Lack of resources have prevented us from expanding to other observatory locations
- Opportunity: co-located MT data



Temporary MT sites near USGS observatories



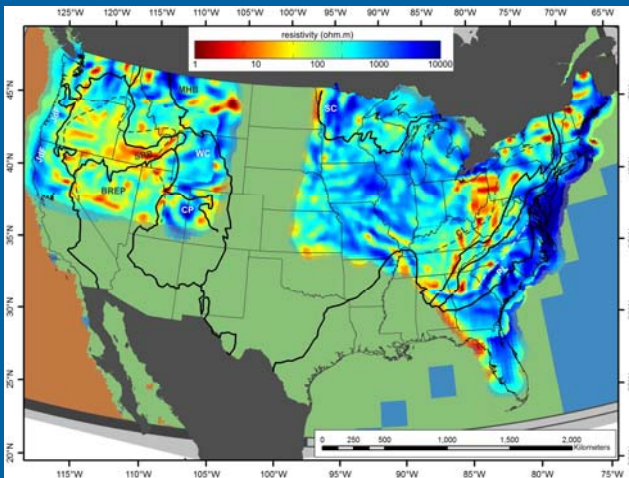
Map of MT sites relative to each other and FRN observatory



Goal 5.5.5 Lithospheric Conductivity Models

CONUS:

A compilation of existing 3D electrical conductivity models in continental US constrained by USArray MT data. Slice at 60 km depth is presented. Note 4 orders of magnitude variation.



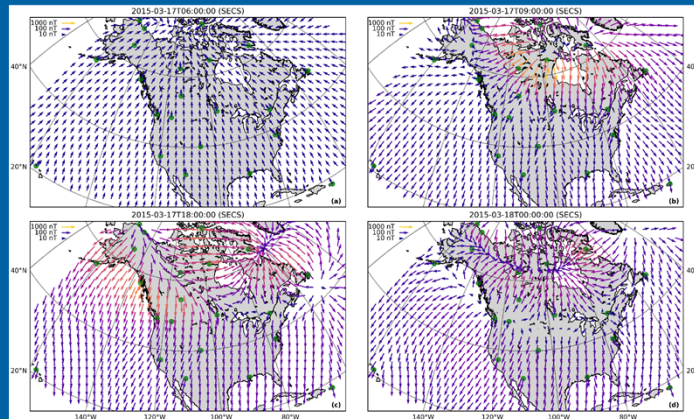
Kelbert, Bedrosian & Murphy, 2018, AGU monograph, in review



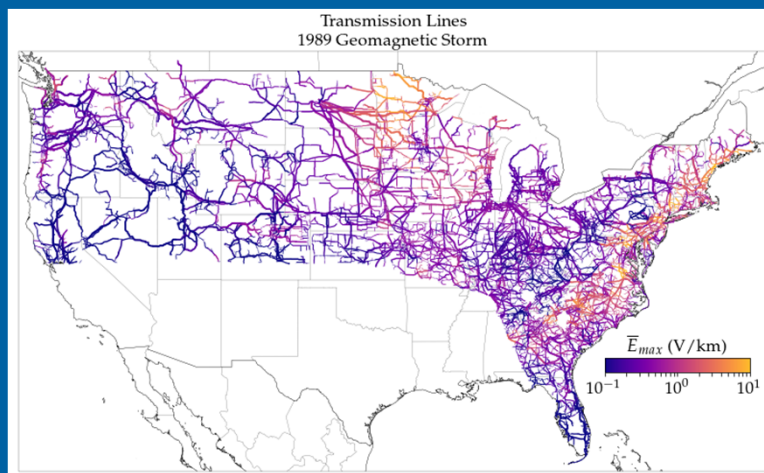
Goal 5.5.6 Map Geomagnetic and Geoelectric Hazards

USGS and NRCAN near-real-time geomagnetic data are used to constrain a physical model that generates spatially continuous maps of geomagnetic disturbance across North America.

The graphic represents how the geomagnetic field can change over the course of a storm.



Goal 5.5.6 Map Geomagnetic and Geoelectric Hazards



Goal 6.2.1 Complete Strategy for Expanding the Magnetometer Network

- Published a 'commentary' in Space Weather, June 2017, on Real-time geomagnetic monitoring for space weather related applications: Opportunities and challenges
- Provides a summary of challenges and opportunities associated with global availability of real-time ground-level geomagnetic monitoring

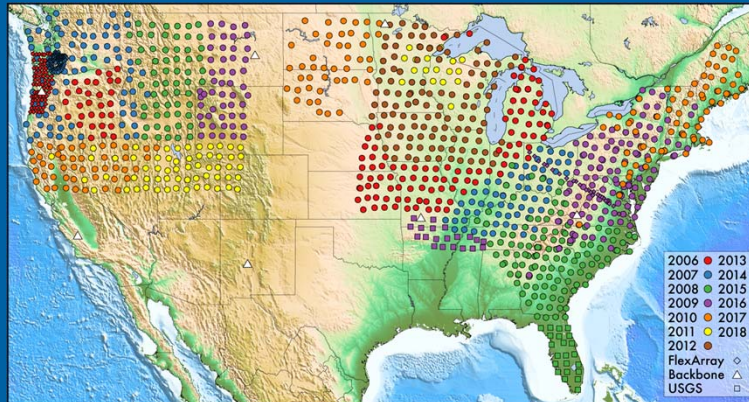


Challenges and Opportunities

- What are the challenges and opportunities for implementing the Space Weather Action Plan, and related work, going forward?



Challenge: NSF EarthScope MT survey incomplete



Surveys are accomplished through temporary "transportable" array deployments of ground-based geomagnetic and geoelectric sensors.



Challenge: Funding

- Flat or reduced funding has prevented any significant progress on Goal 5.3.6, Sustain existing ground-based geomagnetic monitoring network and enhance the network through the installation of new observatories
- Lack of funding/inability to expand data networks impacts most of the other SWAP actions that USGS is involved in.
- Uncertainty in funding has also impacted staffing within the Geomagnetism Program



Opportunities

- Continue to produce the best data possible
- Continue to make system improvements within means
- Make the best use of available data – focused research on high-impact applications
- Partner with outside entities (other Federal, academic, private sector, international)
- Encourage data sharing (EPRI Sunburst, GEM variometers, INTERMAGNET)



Thank you!

