



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

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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

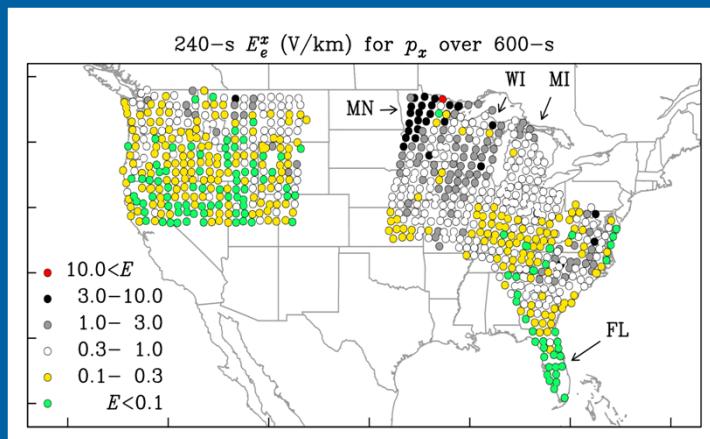
- 5.3.6 Sustain and expand geomagnetic monitoring
- 5.5.4 Initiate geoelectric monitoring
- 5.5.5 Fill gaps in magnetotelluric surveys / Improvements to localized estimates of geoelectric fields and in lithospheric conductivity models
- 5.5.6 Map geomagnetic and geoelectric hazards
- Collaborate with 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



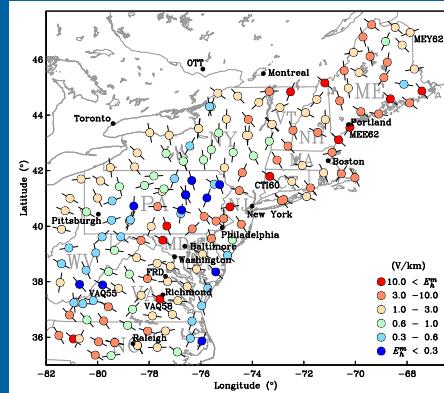
Goal 1.1 Develop Benchmarks for Induced Geo-Electric Fields



Goal 1.1 Develop Benchmarks for Induced Geo-Electric 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.

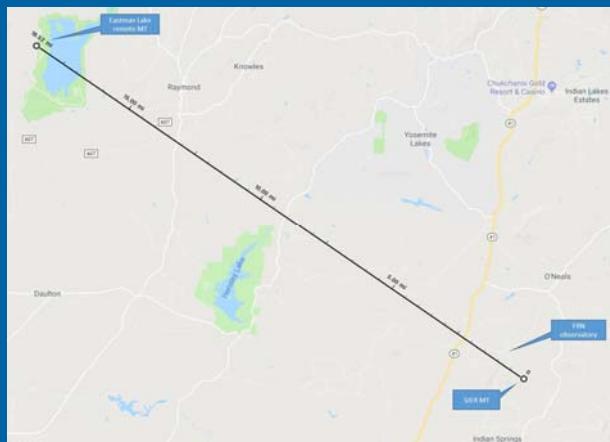
▪ Challenge:

- Lack of resources have prevented us from expanding to other observatory locations

▪ Opportunity: co-located MT data



Temporary MT sites near USGS observatories



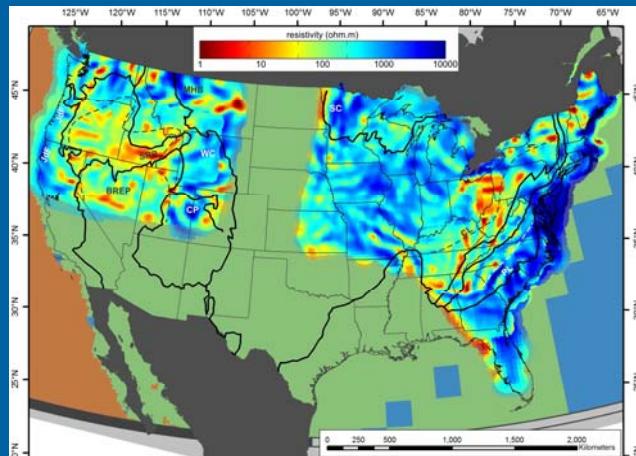
Map of MT sites relative to each other and FRN observatory



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.



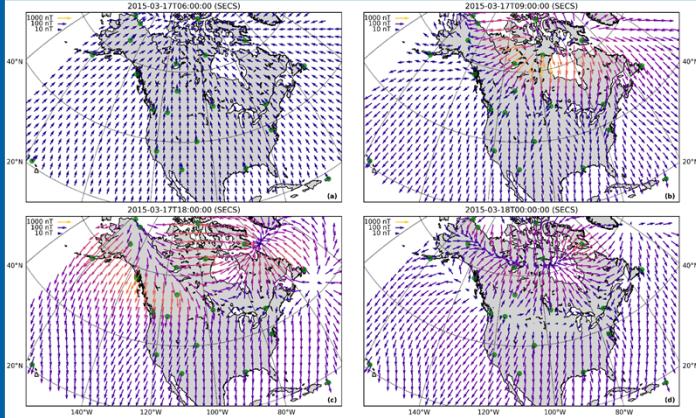
Kelbert, Bedrosian & Murphy, 2018, AGU monograph, in review



Goal 5.5.6 Map Geomagnetic and Geoelectric Hazards

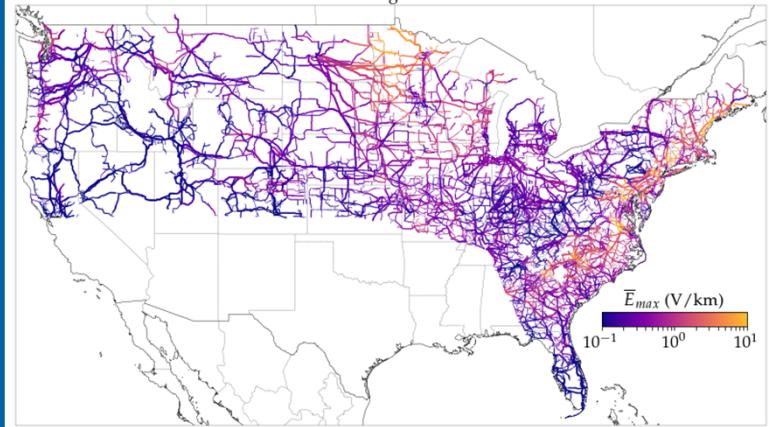
USGS and NRCan near-real-time geomagnetic data are used to constrain a physical model that generates spatially continuous maps of geomagnetic disturbance across North America.

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



Goal 5.5.6 Map Geomagnetic and Geoelectric Hazards

Transmission Lines
1989 Geomagnetic Storm



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

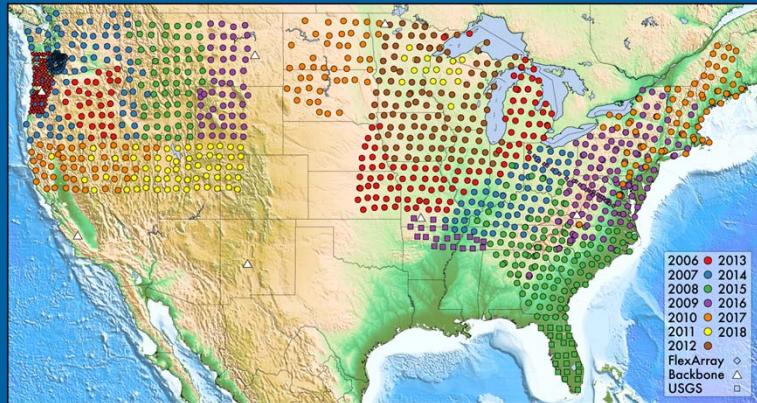


Challenges and Opportunities

- 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!

