The USGS Geomagnetism Program: Down to Earth with magnetic hazards from space

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Six hazard science programs:
• Earthquake Hazards
• Global Seismographic Network
• Volcano Hazards
• Landslide Hazards
• Coastal & Marine Geology
•Geomagnetism

Strategic priorities for hazard science:
• Enhanced observations
• Fundamental understanding
• Assessment products and services
• Effective situational awareness
USGS Geomagnetism Program Summary
geomag.usgs.gov

• Part of a USGS Natural Hazards Mission
• DOI representative for NSTC’s SWORM project; Space Weather Strategy & Action Plans
• Monitor Earth’s magnetic field at ground-based magnetic observatories.
• Report data with high accuracy, resolution, and reliability
• Customers: Air Force, NOAA, NASA, GFZ, 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

INTERMAGNET (www.intermagnet.org)

- Voluntary consortium: 120 observatories, 55 institutes, 42 countries
- Modern operational standards, checks data quality, organizes data, website
- Certified INTERMAGNET data since 1991 --- over two solar cycles!
- All observatories produce 1-minute data. Approx. 60 produce 1-second data.
- Many institutes are real-time
- Supports:
  - Space-weather monitoring
  - Induction-hazard assessment
  - Main-field mapping
  - Aeromagnetic surveys
  - Magnetic indices
  - Solid-Earth geophysics
  - Space physics

Magnetic orientation for directional drilling for oil & gas: A public-private collaboration

Goal 1: Geophysical Benchmarks
• Co-lead for benchmark development.
• Geoelectric benchmarks: 100-year event, theoretical upper-limit event.

Goal 5: Space-Weather Services
• Sustain and expand geomagnetic monitoring.
• Initiate geoelectric monitoring.
• Support magnetotelluric surveys: augment those of NSF EarthScope Program.
• Map geomagnetic and geoelectric hazards.
• Collaborate with other agencies on space-weather data calibration and accuracy.

Goal 6: International Cooperation
• Improve global geomagnetic monitoring, improve global data exchange.
President’s 2017 budget for USGS Geomagnetism Program:
Increase of $1.7 million/year to $3.6 million/year

This additional funding would enable DOI responsibilities within OSTP’s National Space Weather Action Plan:

• New geomagnetic observatories.
• Geoelectric monitoring at some observatories.
• Magnetotelluric surveys, augmenting those of the NSF EarthScope Program.
• 3D modeling of lithospheric electrical conductivity.
• Scenario assessments of induction hazards.
• Real-time geoelectric mapping capability.
• Support international geomagnetic monitoring and data exchange.
• Induction-hazard research of importance for National economy and security.
• Relieve US Air Force of financial support for USGS operations.
Input signal time series $t$

Convolution through a filter

Output signal time series $t$

Geomagnetic variation

Geoelectric field

Map of Geomagnetic variation

Earth conductivity model or measured impedance

Map of geoelectric variation

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

Surveys are accomplished through temporary “transportable” array deployments of ground-based geomagnetic and geoelectric sensors.
Possible augmentation of MT survey (white)

Will provide data useful for induction-hazard science and for fundamental geological understanding of the Earth’s crust and lithosphere.
Installation of Geoelectric Monitoring at the USGS Boulder Observatory
USGS Mendenhall Post-Doctoral Fellowship

Earth electrical conductivity and magnetic-storm hazards

http://geology.usgs.gov/postdoc/

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