CSES: Center for Space and Earth Science

Geophysics Focus Area

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Considerations for Setting Geophysics Theme and Priorities

Areas of geophysics that address research knowledge gaps and serve pressing national needs

- National security needs include: improved capability not only to detect and characterize nuclear explosions, but also newly defined DoD and DTRA focuses on close-in monitoring of battlefield operations, quick and confident assessment of hazards and situational changes.
- These real-time hazardous operation scenarios may include detection of disturbed ground, buried ordinances, tunnel detection, movement of materials, presence of chemical agents or nuclear material.
- Continued efforts in support of the energy sector depend increasingly upon data-intense modeling of porosity and permeability, with complex models of fluid flow and careful analysis of the model uncertainties as well as data uncertainties.

Align with LANL Science Pillars *Science of Signatures* and *Integrating Science, Information and Technology for Prediction*

Geophysics Focus Area Theme

The Geophysics focus area supports basic and applied research concerning the Earth's surface and lithosphere. This includes numerical, experimental and field studies of structure, properties, processes and dynamics of the Earth.
We encourage leveraging of unique laboratory assets such as:

- Sensor technology capabilities in C, EES, ISR and N divisions
- LANL HPC resources or innovative exploitation of LANL interfaces with modern cloud computing
- Geochemical analysis facilities resident in C and EES
- Emerging field surveying advances such as UAV data acquisition and other remote deployment capabilities.

Focused Science Topics

1. Exploiting advances in robotics and automation for geophysical, geochemical or surface feature data sets.. New techniques in remote sensing, data acquisition and digital data analysis that provide information used in modeling surface or subsurface characteristics.

- Demonstrable exploitation of benefits can extend understanding of traditionally inaccessible areas, and improve efficiencies of surveys for dynamic change detection
- The increased data associated with robotic acquisition will require increased computational efficiencies as well as innovative data transmission and improved density and accuracy of survey methods.

2. Exploitation of combined independent signatures to inform static and dynamic geologic models.. Leveraging novel combinations of data types (e.g. LIDAR images and subsurface resistivity derived from EM methods, combined to identify underground geological, anthropogenic or fluid-generated anomalies).

- Joint inversion methods for disparate data sets that includes understanding of model uncertainties
- New insights into the correlated vs. independent behavior of signatures
- Extension of our understanding and modeling capacity to all scales.

Focused Science Topics

3. Detection of low-magnitude signals for real-time monitoring of phenomena. Development of techniques to characterize background and distinguish signals from noise, Leveraging HPC and cloud computing for prompt (real-time) evaluation of signals and importation into dynamic modeling and monitoring applications.

- Data collection from a large area
- Small signals detected within significant noise
- Optimizing existing signatures
- Can be addressed through improved signal analysis methods or through new sensor design and deployment methods.