



# **BER-LANL Strategic Synergies**

John Sarrao, Associate Laboratory Director  
for Theory, Simulation, & Computation

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# Laboratory mission and overview

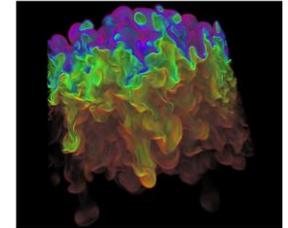
**Los Alamos National Laboratory is the nation's premier national security science laboratory**

***Vision*** Deliver science and technology to protect our nation and promote world stability

***Mission*** Solve national security challenges through scientific excellence.

This requires a multidisciplinary scientific approach for solving some of the nation's toughest challenges, including ensuring the safety, security, and reliability of the U.S. nuclear deterrent; reducing global threats; and energy security.

## Stockpile Stewardship



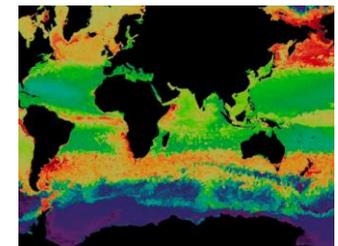
Hydrodynamics

## Global Security



Nuclear detonation verification & treaty monitoring

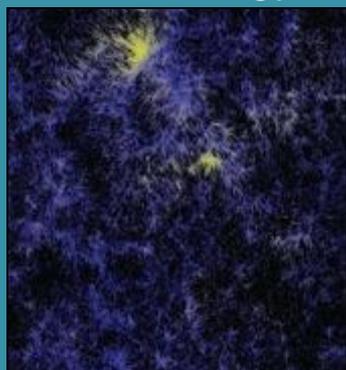
## Energy Security



Climate/Energy Impacts:  
Measurement, simulation,  
prediction

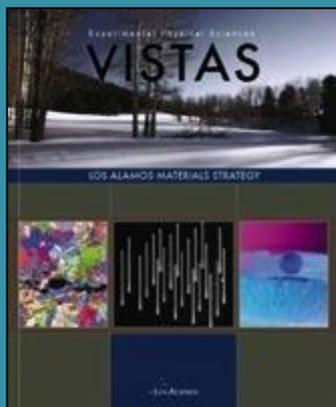
# 5 Focus Areas drive institutional priorities including major LDRD investment

## Information Science and Technology



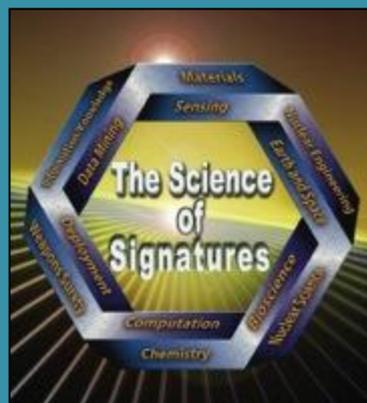
**Data Science at Scale**  
**Computational Co-design**  
Complex Network Science

## Materials for the Future



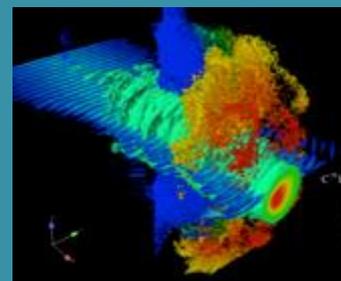
Defects and Interfaces  
Extreme Environments  
Emergent Phenomena

## Science of Signatures



Radiological, **climate, biological, chemical and energy signature detection and measurement**  
Instrumentation Deployment

## Nuclear and Particle Futures



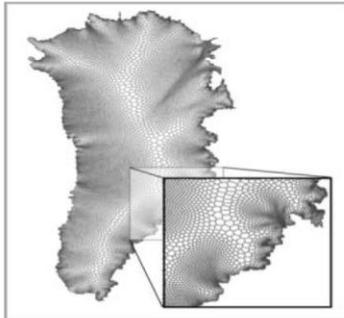
Nuclear & Particle Physics, Astrophysics & Cosmology  
Applied Nuclear Science & Engineering  
Accelerators and Electrodynamics  
High Energy Density Plasmas and Fluids

## Complex Natural and Engineered Systems



Geoscience and **Climate**  
**Health and Systems Biology**  
Chemical Science  
Space science

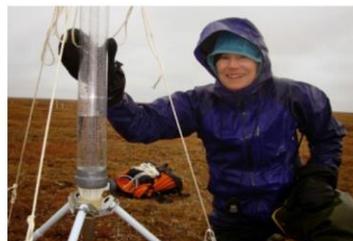
# Core capabilities: research and facilities



Variable-resolution Ice Sheet Models

## Modeling & HPC:

For more than two decades, LANL has played a leadership role in Climate, Ocean and Sea Ice Modeling, developing and applying high-performance, multi-scale models of the Earth's climate for studying the role of ocean and ice systems in high-latitude climate change and the subsequent impacts on regions throughout the globe.



Characterizing soil properties in Alaska for models

## Terrestrial Ecology, Hydrology, Geomorphology, and Geochemistry:

We partner with ORNL on NGEA-Arctic to lead the observations and modeling of permafrost hydrology processes. We also partner with LBNL on NGEA-Tropics to lead the task on understanding and predicting impacts of El Nino on rain forests.



Environmental genomics

## Genomics and Bioinformatics:

These capabilities serve multiple sponsors, e.g., DOE, DoD, DHS, FDA, DOS, USDA, & CDC. We lead the Soil Metagenomics and Carbon Cycling BER SFA team, developing and using community genomics approaches to link the biological processes controlling soil carbon storage and release to the community of microorganisms conducting those processes.



Programmable environmental photo-bioreactor array for laboratory simulation of algae growth in outdoor cultivation ponds.

## Bioenergy:

For DOE-EERE-Bioenergy Technologies Office (BETO) we are creating competitive, sustainable forms of bioenergy. As a leader in algal genomics and 'omics integration, we apply biotechnology and genetic engineering to improve algae strains for biofuel and bio-product production. In terrestrial feedstocks we are leaders in understanding and improving the efficiency of photosynthesis for increasing biomass yield, and in multi-scale modeling of biochemical and thermochemical conversion of cellulose to hydrocarbon fuels.



LANL predictive analysis of power system restoration times for every >Cat3 hurricane since Katrina

## Climate Impacts:

LANL capabilities in modeling, simulation, and uncertainty quantification of infrastructure vulnerabilities support DoD, DOE-OE, and other Government agencies' needs in understanding the interface between climate prediction and infrastructure assessment.



Antarctica AWARE campaign

## Facility Operations & Project Mgmt:

We are responsible for ARM Field Deployments & Operations throughout the world with ultra-high data recovery and exceeding metrics. Recent deployments: GoAmazon campaign managing 142 instruments for 100 collaborators from 24 institutions; data across the Pacific between California and Hawaii; Antarctica; the fixed Eastern North Atlantic site in the Azores.



Nate McDowell 2010 - 2015 EC  
Nathan Urban 2013 - 2018 EC  
Joel Rowland 2014 - 2019 EC

**Outstanding Workforce** consisting of nationally renowned Principal Investigators, three BER Early Career Award winners since 2010, and multiple LANL Director's funded postdocs.

# Future strategic science priorities & partners

## Deliver on and enhance current commitments and SFA partnerships:

- **Execute our 10-year vision for the Soil Metagenomics and Carbon Cycling SFA** to improve terrestrial C flow understanding and microbial metrics, to enable improvements in climate modeling and carbon management.
- **Expand our role as a trusted and effective SFA leader and partner** with cross-lab SFAs such as NGEN Arctic and Tropics, ARM, ACME, and HiLAT.

## New initiatives:

- **Provide leadership to DOE Exascale Computing Initiative/Project**, contributing to BER strategies for exascale solutions to next generation ESM and RGCM projects.
- **Partner with next-generation Bioenergy Research Center(s)** by offering our capabilities in efficient plant photosynthesis, algae production and harvesting, cellulose conversion, algal 'omics, and data resourcing.
- **Develop the next generation of Integrated Assessment and Vulnerability models** in partnership with SC-Labs by offering our capabilities in regional infrastructure models, uncertainty quantification, and probabilistic risk-assessment.
- **Model and implement new “integrated disturbance” processes for BER climate models** that consider impacts of drought induced mortality, wildfire impacts, and insect-pathogen mortality - areas where LANL is a proven leader.
- **Pursue a “Coastal Zone Grand Challenge,”** a decadal vision supported by DOE and other agencies for integrated physical, ecological, and human impacts science in the coastal zone. This challenge, launched by LANL in 2015, tackles a problem of extreme complexity currently unrepresented in Earth System Models and requiring transformational science. Workshop planning and outreach is underway to develop strong partnerships, especially with multiple multi-purpose national labs.