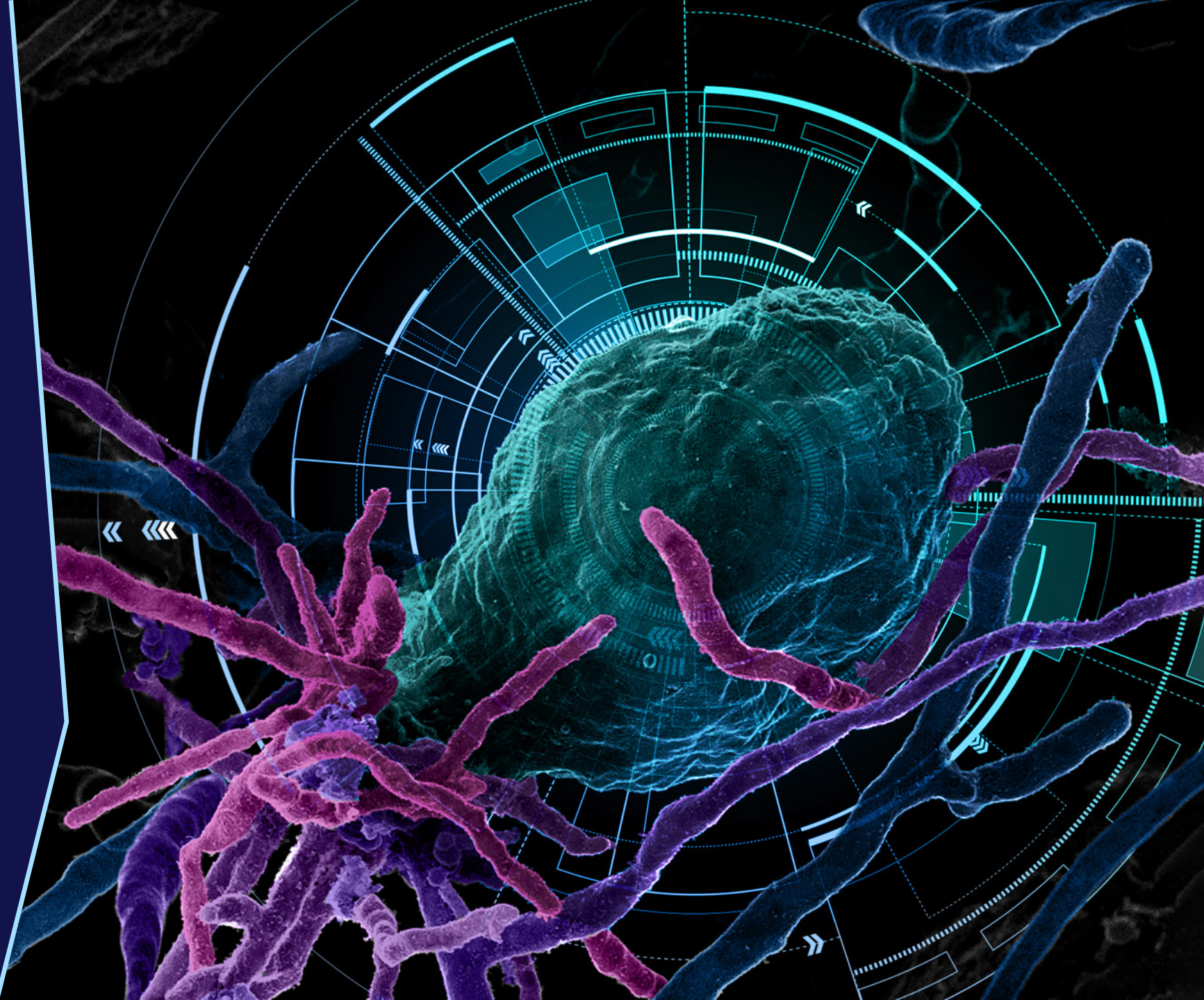
EMSL

Environmental Molecular Sciences Laboratory

Nancy Hess
Environmental Transformations and Interactions Science Lead



EMSL at a glance

Research highlights

Access

EMSL at a glance

EMSL is a national user facility with expertise and capabilities in environmental and biological science

- Funded by Office of Science Biological and Environmental Research (DOE SC BER)
- Integrative experimental, modeling, and computational approaches across molecular to ecosystem scale
- User access through peer-reviewed proposal process
- Free for non-proprietary work

EMSL at a glance

EMSL is a large user facility

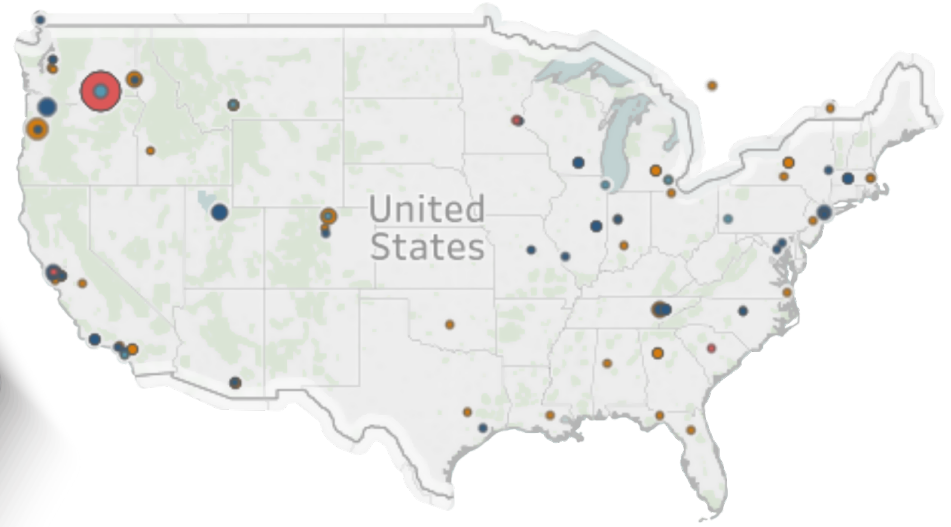
234k ft²

766
users from the US and worldwide

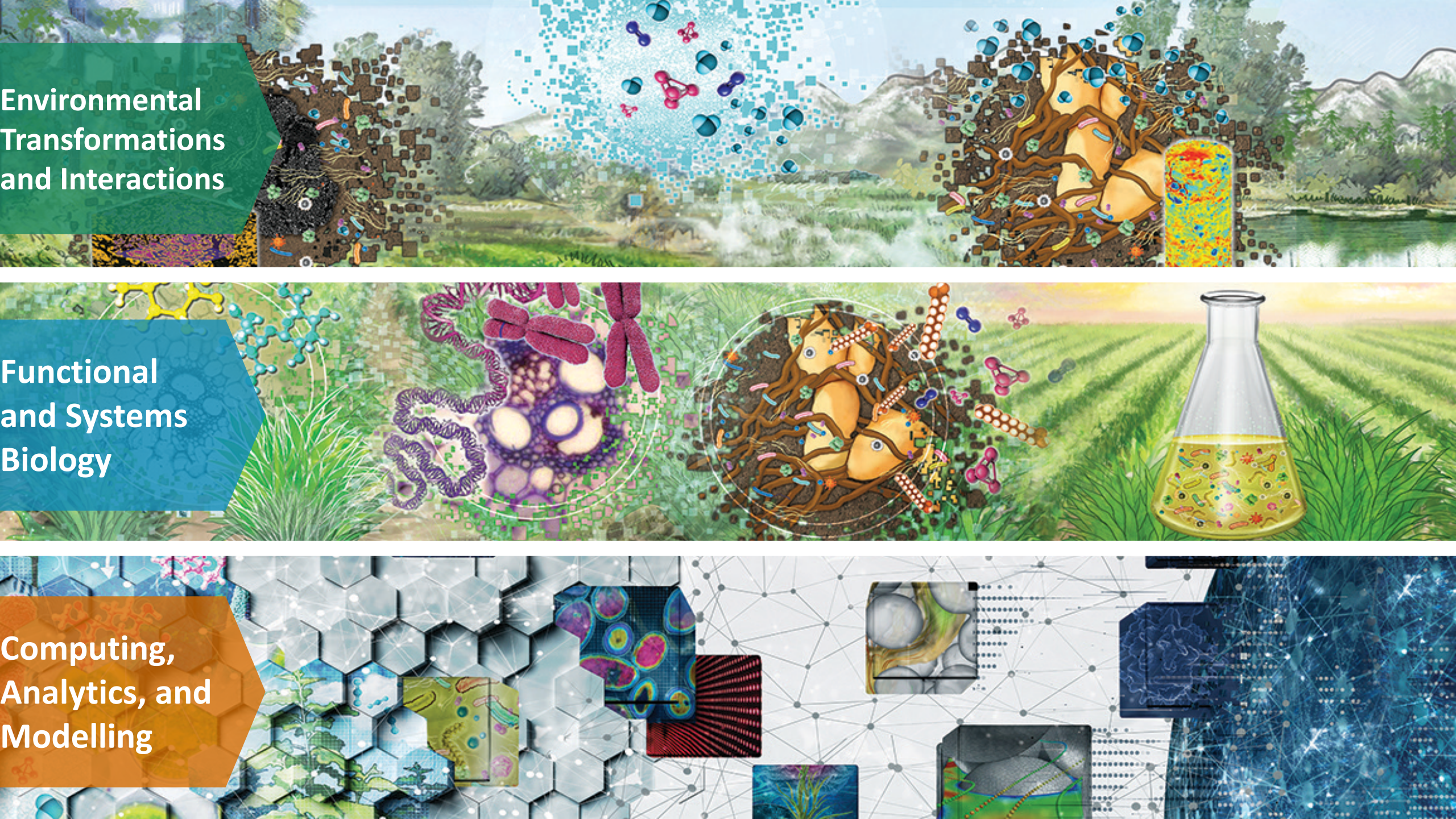
Unique collection of
>150
instruments and supercomputer

216
active user projects

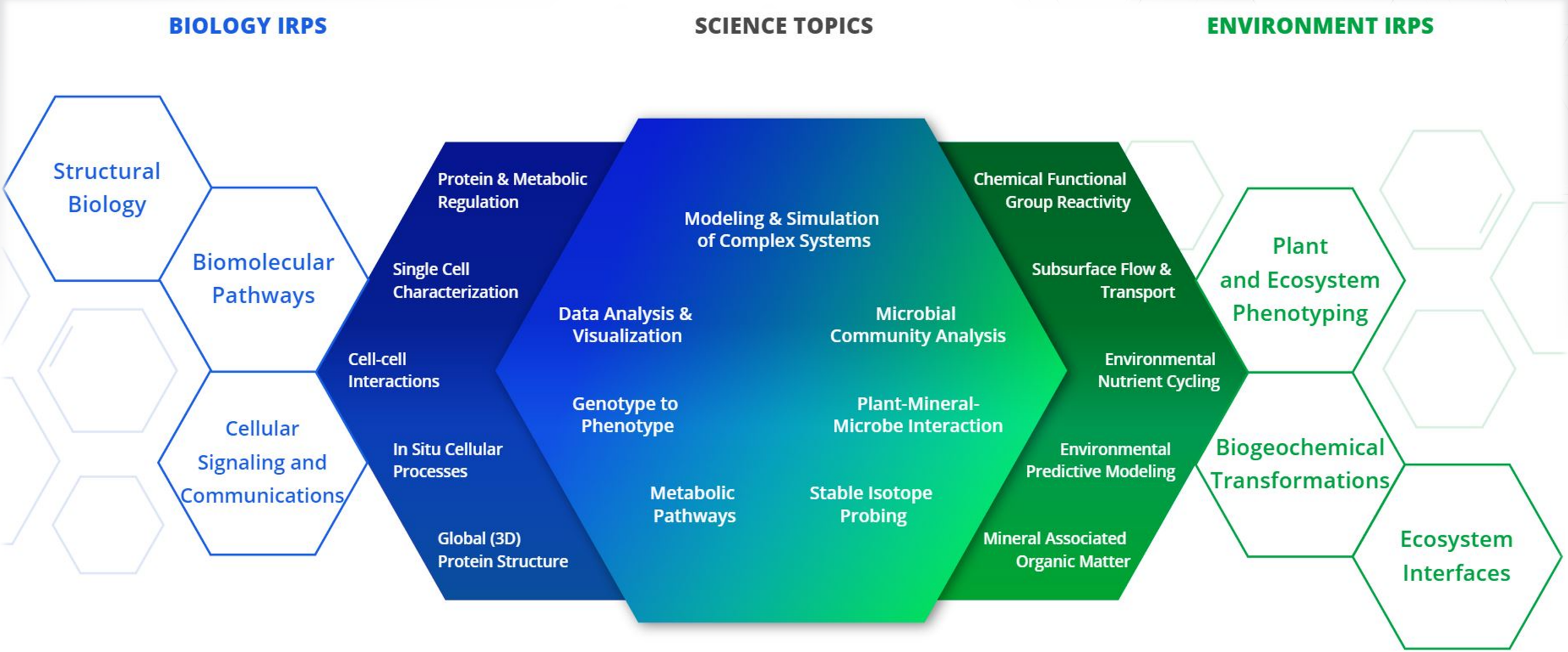
$43.5M
operating budget

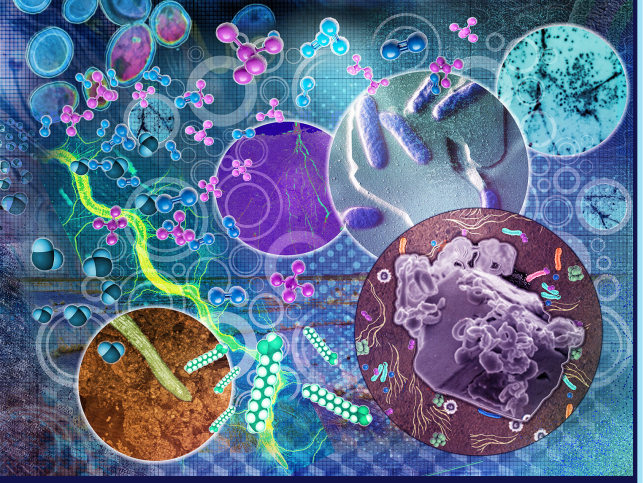


EMSL's global and U.S. user community
https://www.emsl.pnl.gov/emslweb/for-users


Environmental Transformations and Interactions
Functional and Systems Biology
Computing, Analytics, and Modelling

EMSL's Science Areas and Integrated Research Platforms





Biogeochemical Transformations and Ecosystem Interfaces

IRP Leads
Emily Graham (BGT)
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Jim Moran (EI)
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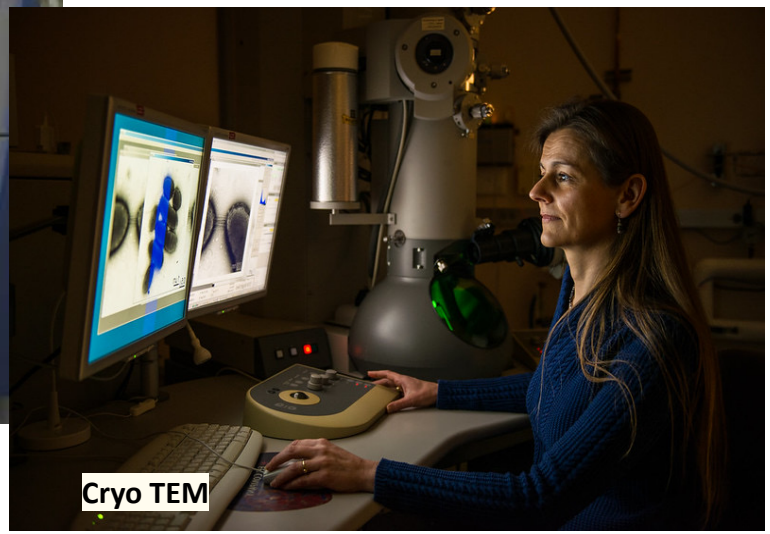
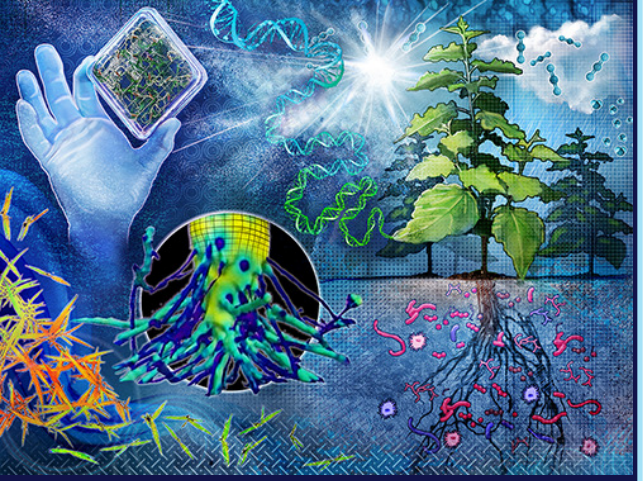
BGT: Examines the detailed molecular biogeochemistry within microdomains in soils and sediments.
EI: Multi-disciplinary expertise focused on studying the transport of nutrients and materials that contribute to enhanced rates of biogeochemical processes at ecosystem interfaces.


SOM/DOM characterization

IRMS


Cryo TEM

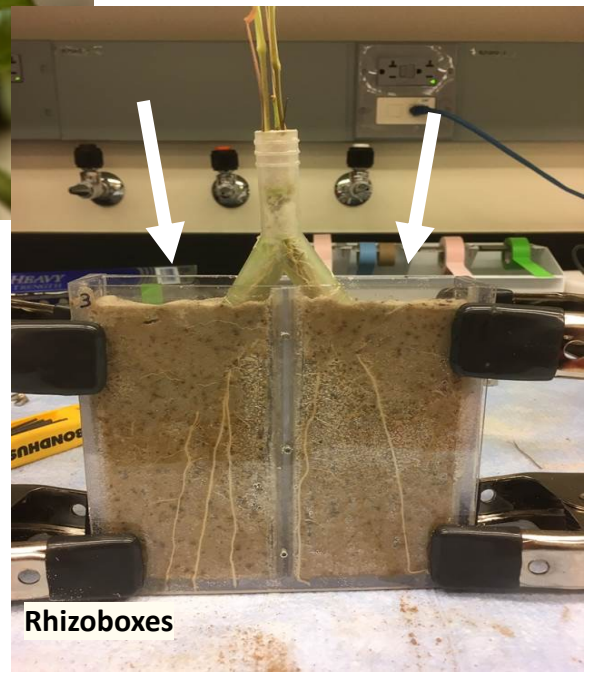
- MS and NMR based organic matter analysis
- Isotope studies for quantification of stable isotope tracers
- Electron microscopes for chemical imaging



Plant and Ecosystem Phenotyping

Aims to dissect plant genotype-environment interactions, including the plant-microbe crosstalk in the rhizosphere region, to establish an advanced understanding of the molecular mechanisms involved in the determination of phenotypic plasticity in a complex multifactorial ecosystem. .

Plant Growth Chambers



Rhizoboxes

- Phytotron for controlled plant growth.
- Rhizoboxes and rhizotrons, track plants and their developing roots
- MS and stable isotope tracers to track metabolite and substrate flux

IRP Lead
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Biomolecular Pathways

IRP Lead
Mary Lipton
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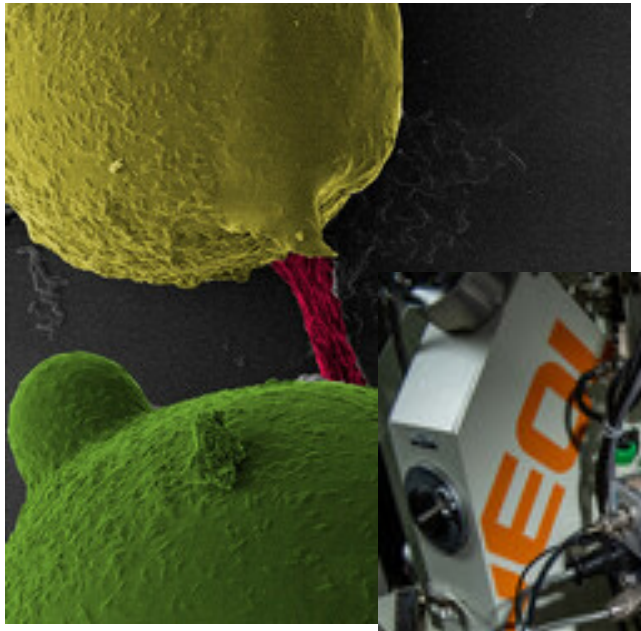
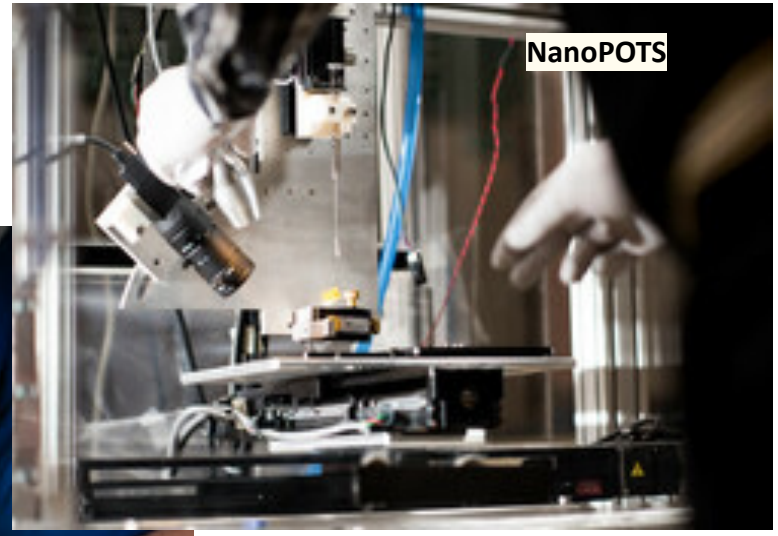
Discovers the principles underlying the translation of genomic information into the metabolic pathways and regulatory networks that determine cellular function.

- Comprehensive and integrated characterization of complex biological and environmental systems
- Multi-omics on the same sample
- In-depth structure and function studies of intact proteins
- MS imaging capabilities for spatial, quantitative molecular information

Cell Signaling and Communication

Pursues an understanding how complex phenotypes arise from individual molecules and their interactions with other molecules within the communication networks that exist between, and across populations and communities of cells.





- Laser capture microdissection microscopes to isolate individual cells or cell types
- Optical microscopy techniques, to understand dynamic processes in live or intact cells.
- Single-molecule fluorescence in situ hybridization (FISH), for quantitative analyses of biomolecules in individual cells within communities or tissues.

IRP Lead
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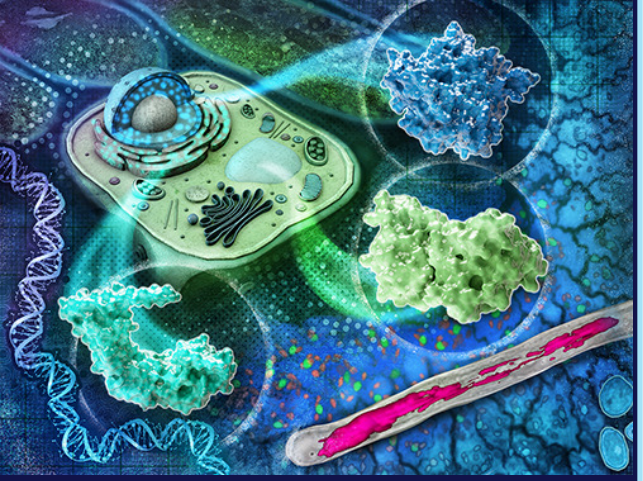
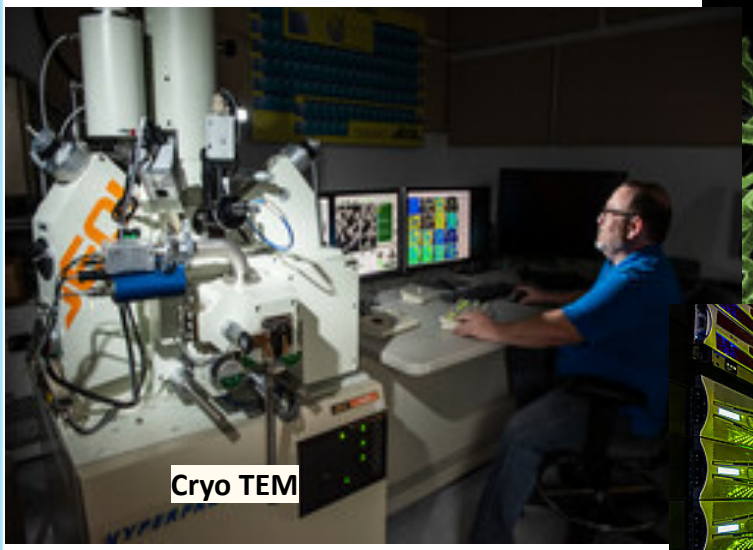


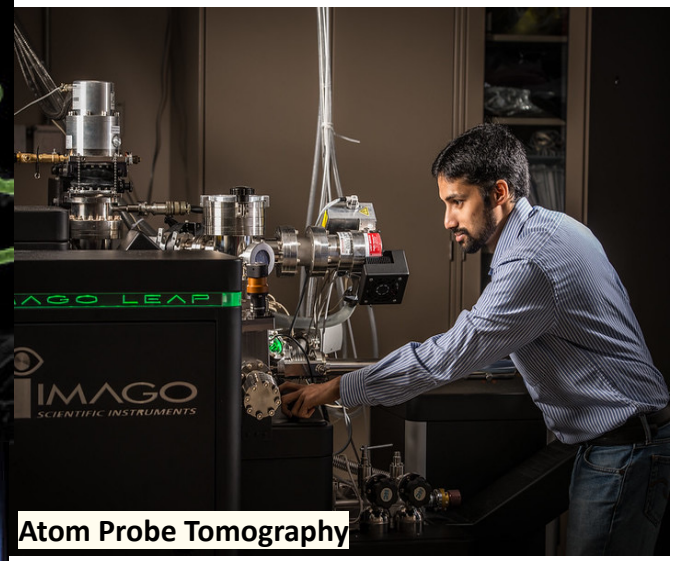
Structural Biology

Generates structural, biochemical, and dynamic information about proteins, protein complexes, and other biomolecules at nanoscale spatial and temporal resolution to determine biological function.



Cryo TEM

Tahoma Super Computer



Atom Probe Tomography

- Produce three-dimensional images of elements and molecular fragments—at the atomic scale—within soft biological materials.
- Determine the atomic-scale structure of proteins and protein complexes greater than ~100kDa.
- EMSL's structural biology is expanding to include correlative multi-modal imaging and analyses.

IRP Lead
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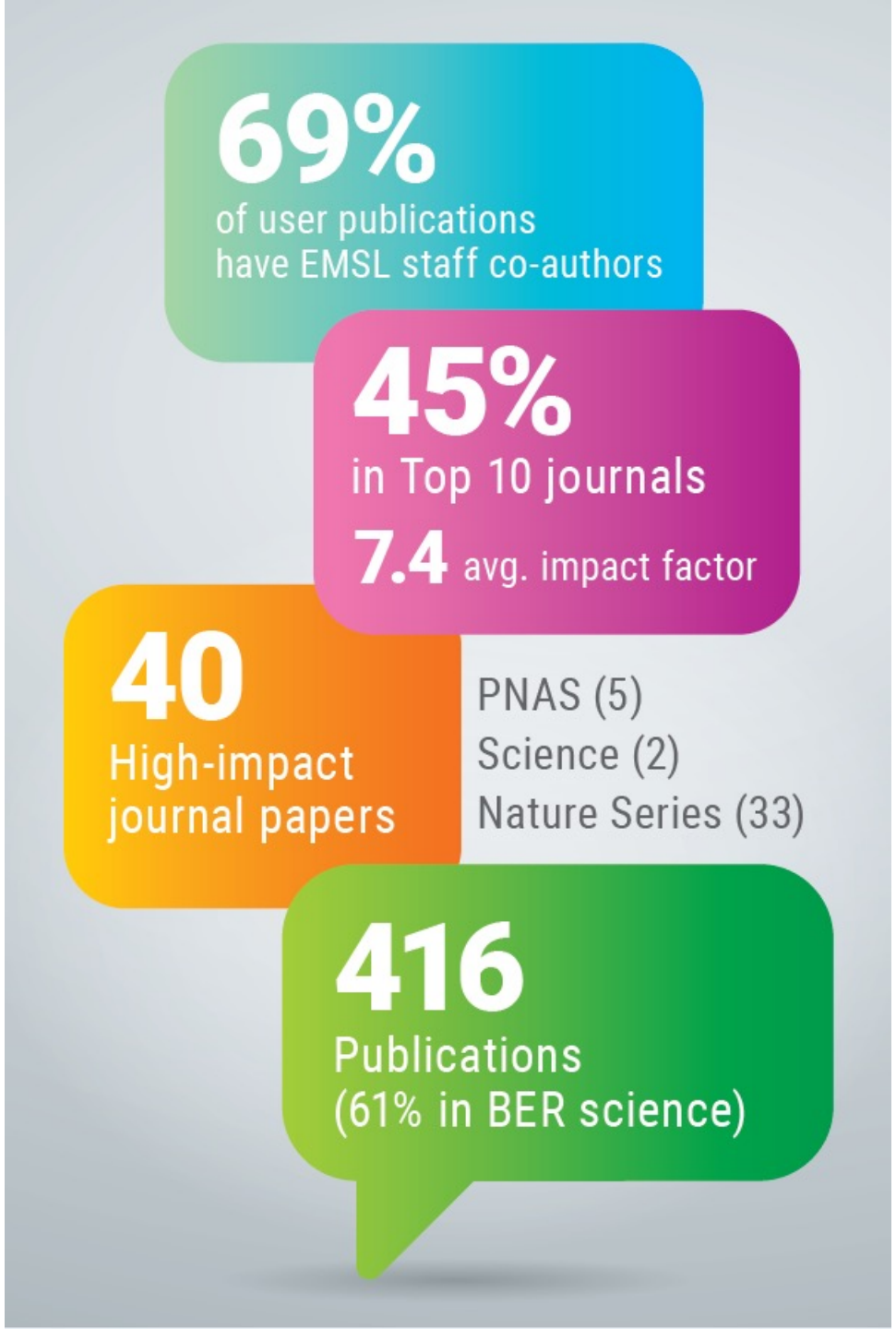
Science highlights



PNAS

Science

nature

nature structural & molecular biology

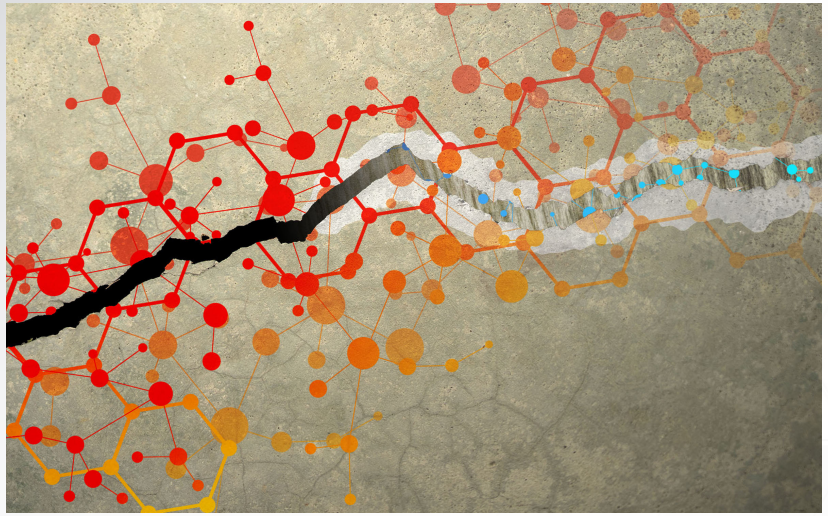
nature COMMUNICATIONS

nature microbiology

nature ecology & evolution

nature materials

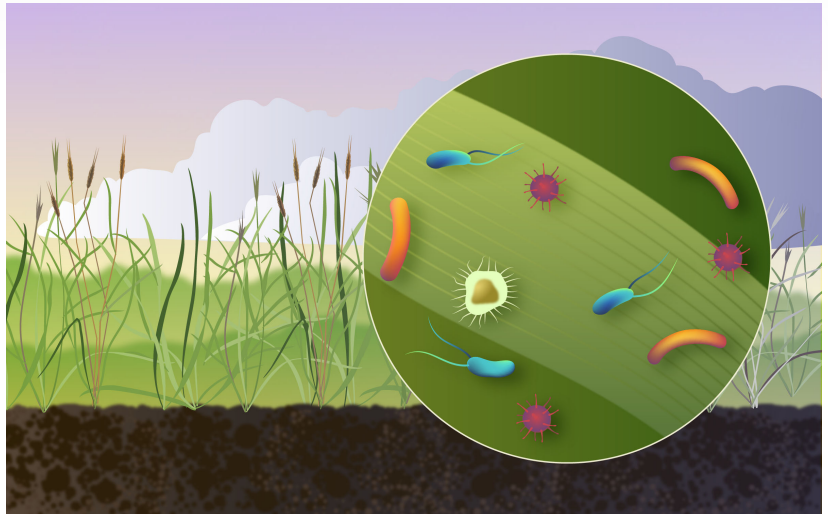
Environmental science highlights



Self-healing cement for deep CO2 sequestration

Microscopic and spectroscopic analysis of self-healing polymer-cement composite reveals reduced structural and chemical changes after carbonate formation.

M.S. Elbakhshwan, *et al. Geothermics* (2021)
DOI:10.1016/j.geothermics.2020.101932

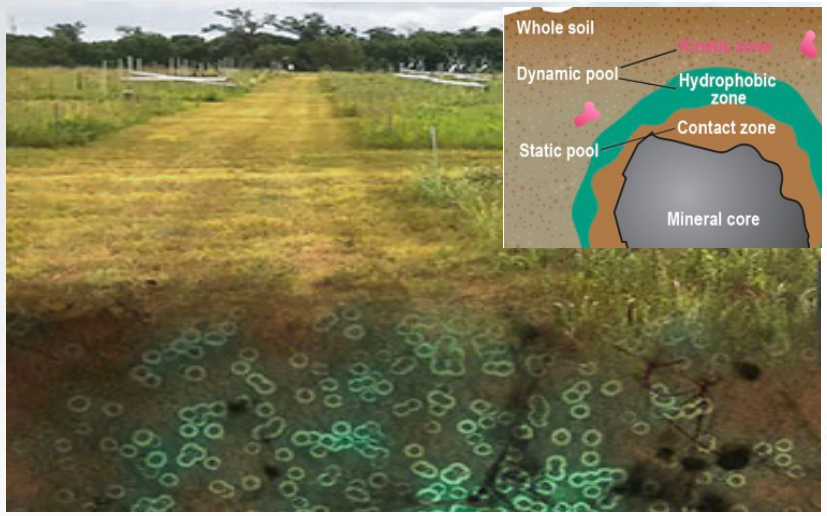


Wild grass releases a variety of particles into the air over its life cycle

Fungal spores are found to be most abundant during initial growth, while bacteria predominate during flowering and fruit development.

S. China, *et al.*, *ACS Earth and Space Chemistry* (2020).
DOI: 10.1021/acsearthspacechem.0c00144

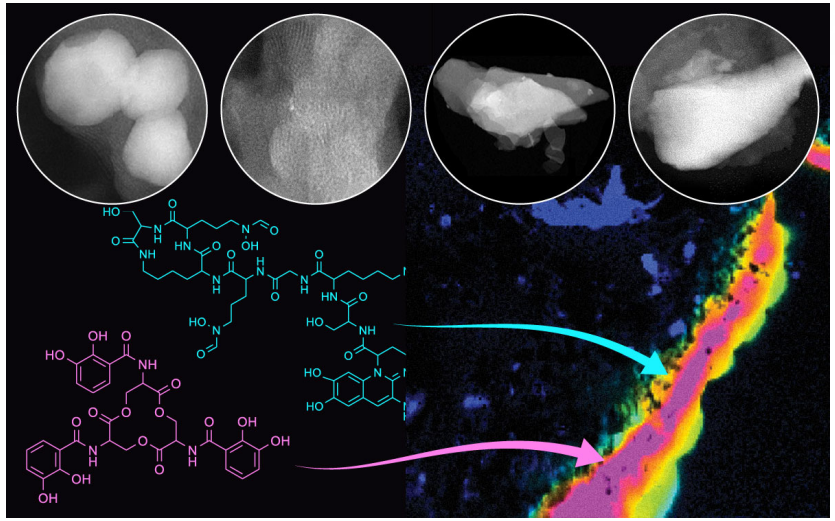
Environmental science highlights



Soil minerals control carbon availability in N fertilized grasslands

Fertilized plots had different assortment of organic molecules associated with soil Fe-minerals than non-fertilized plots.

Q. Zhao, *et al., Science of the Total Environment* (2020)
DOI: 10.1016/j.scitotenv.2020.137839]



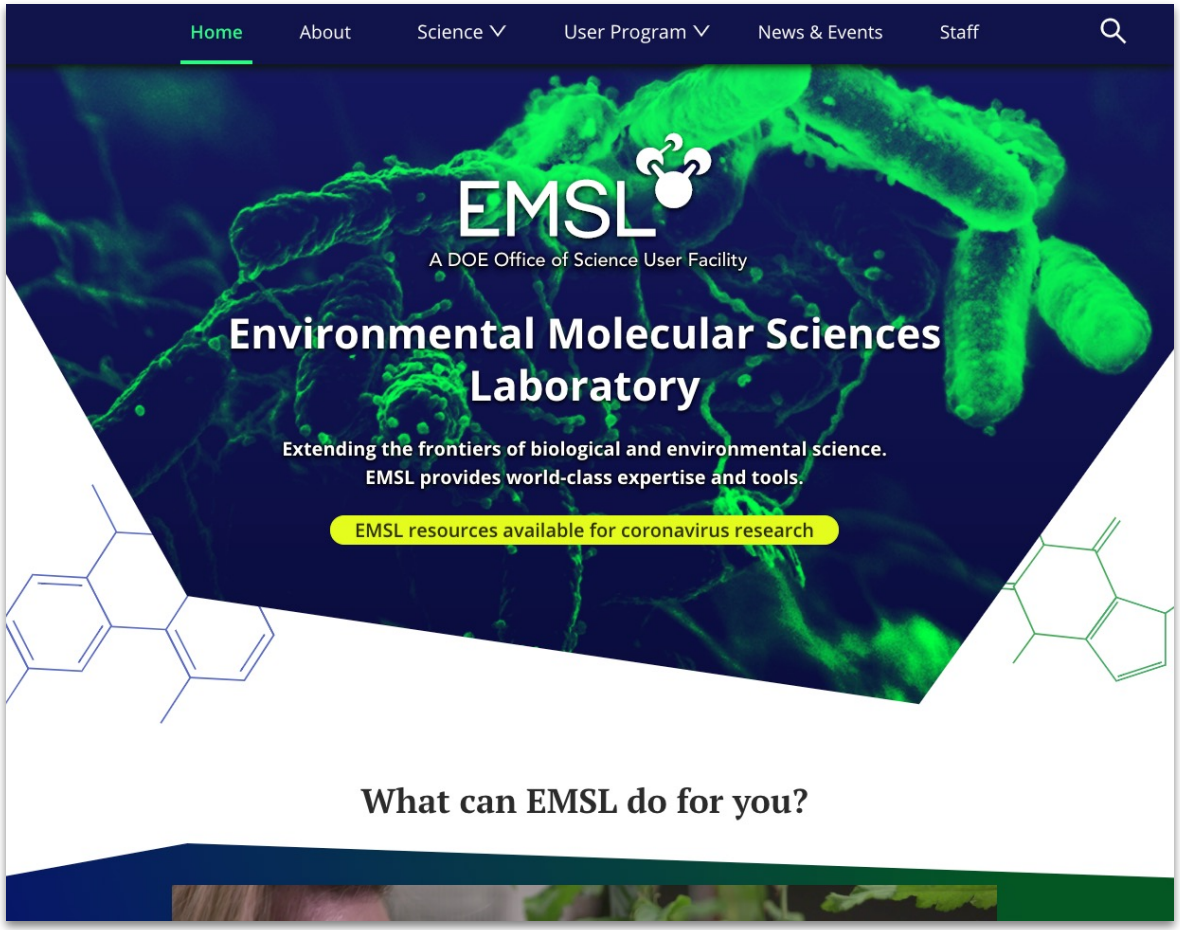
Ca bridging between OM and minerals in alkaline soil

Revealed that organic molecules in which aggregate via cation bridging favoring the stabilization of organic molecule complexes rather than on mineral surfaces.

R.M. Boiteau, *et al. Science of the Total Environment* (2020)
DOI: 10.1016/j.scitotenv.2020.138250

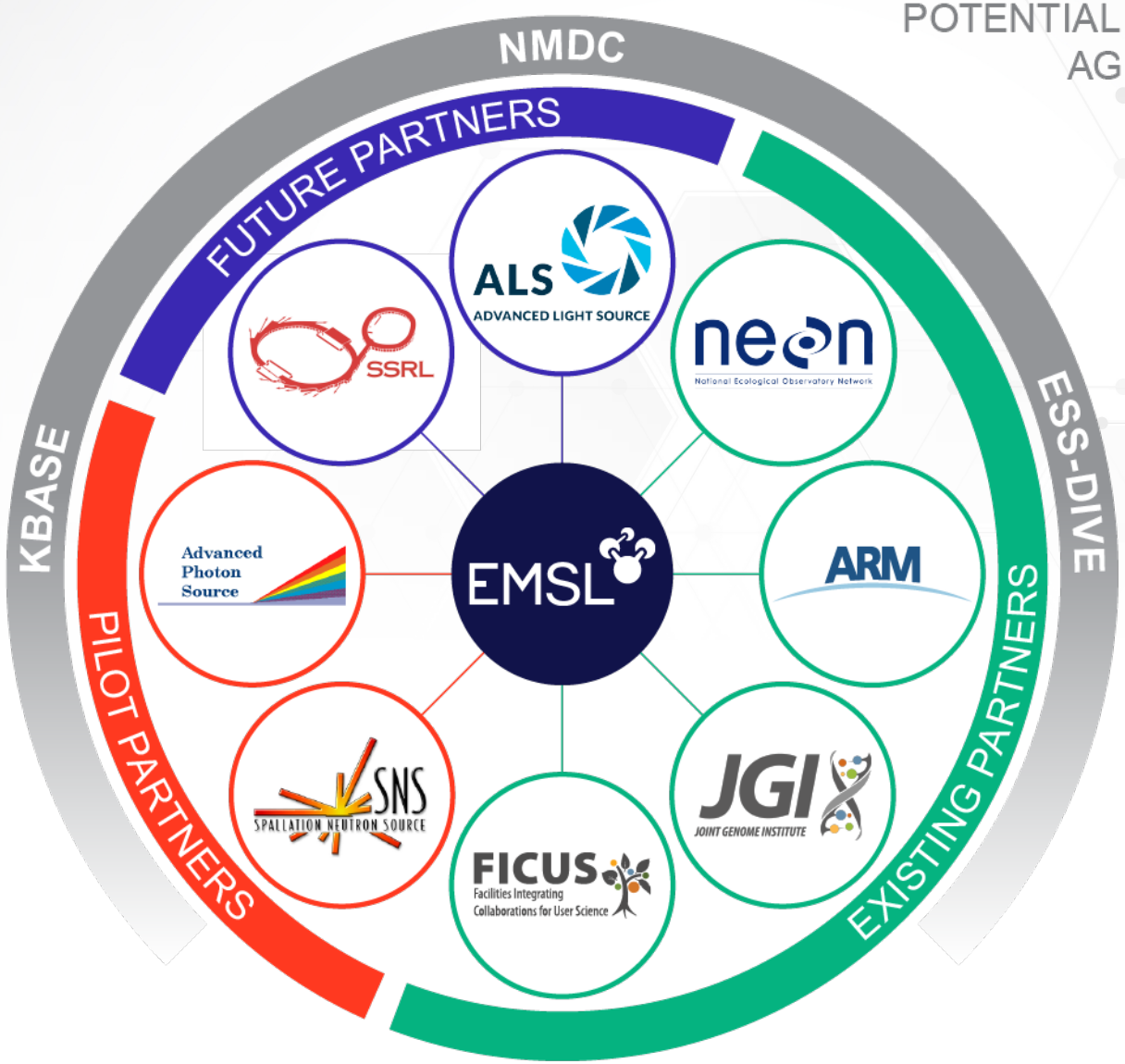
EMSL offers multiple opportunities for user access

- Large-Scale Research Proposals
- Joint-access FICUS Proposals
- Exploratory Proposals



More information at www.emsl.pnnl.gov

FICUS - Facilities Integrating Collaboration for User Science



POTENTIAL CONTRIBUTING AGENCIES

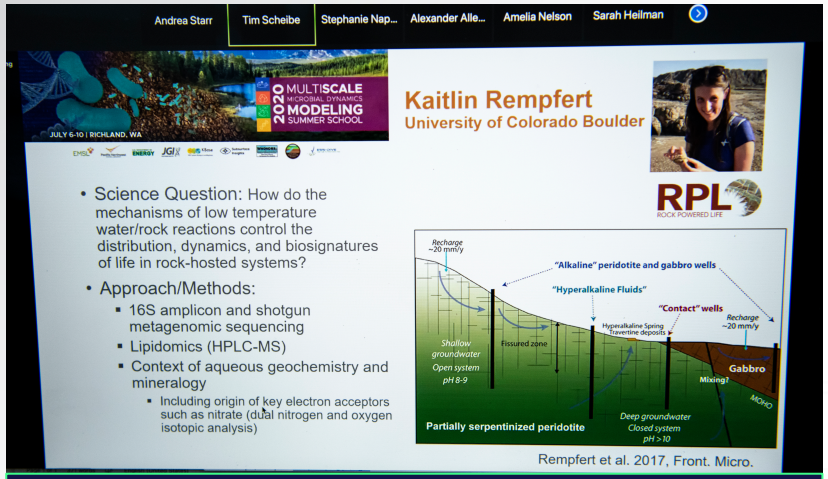
NASA

NSF

USDA

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

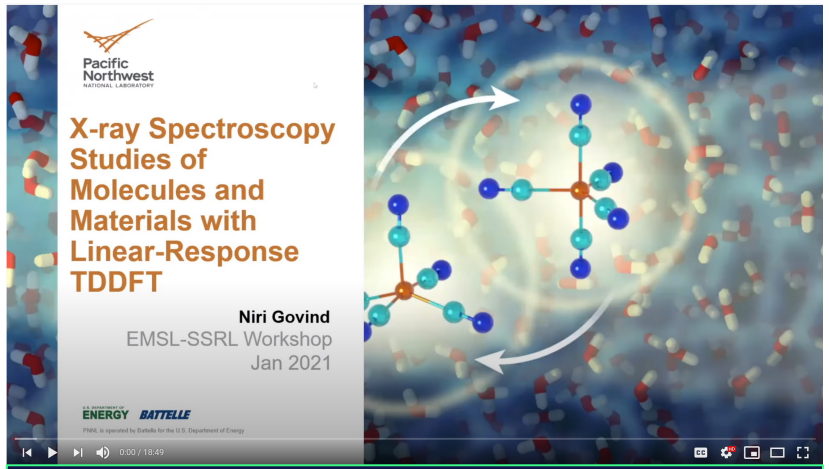
Previous events



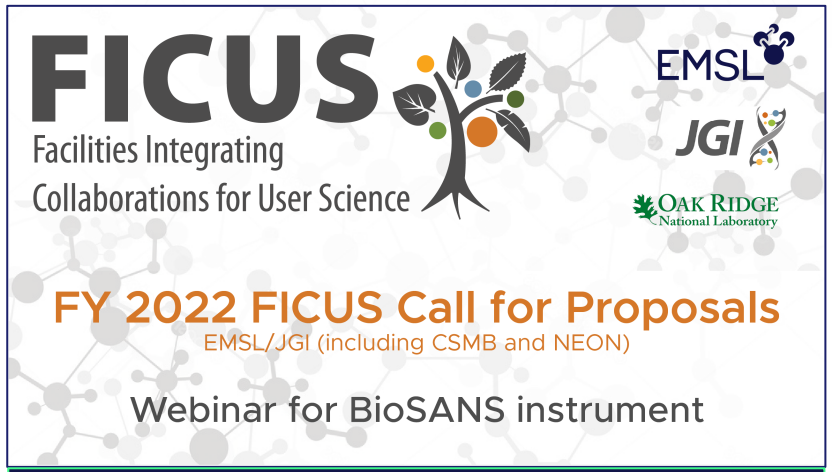
Summer School 2020
July 6-10, 2020

2020 EMSL Integration
October 5-8, 2020

AGU BER User Facility Townhall
December 7, 2020



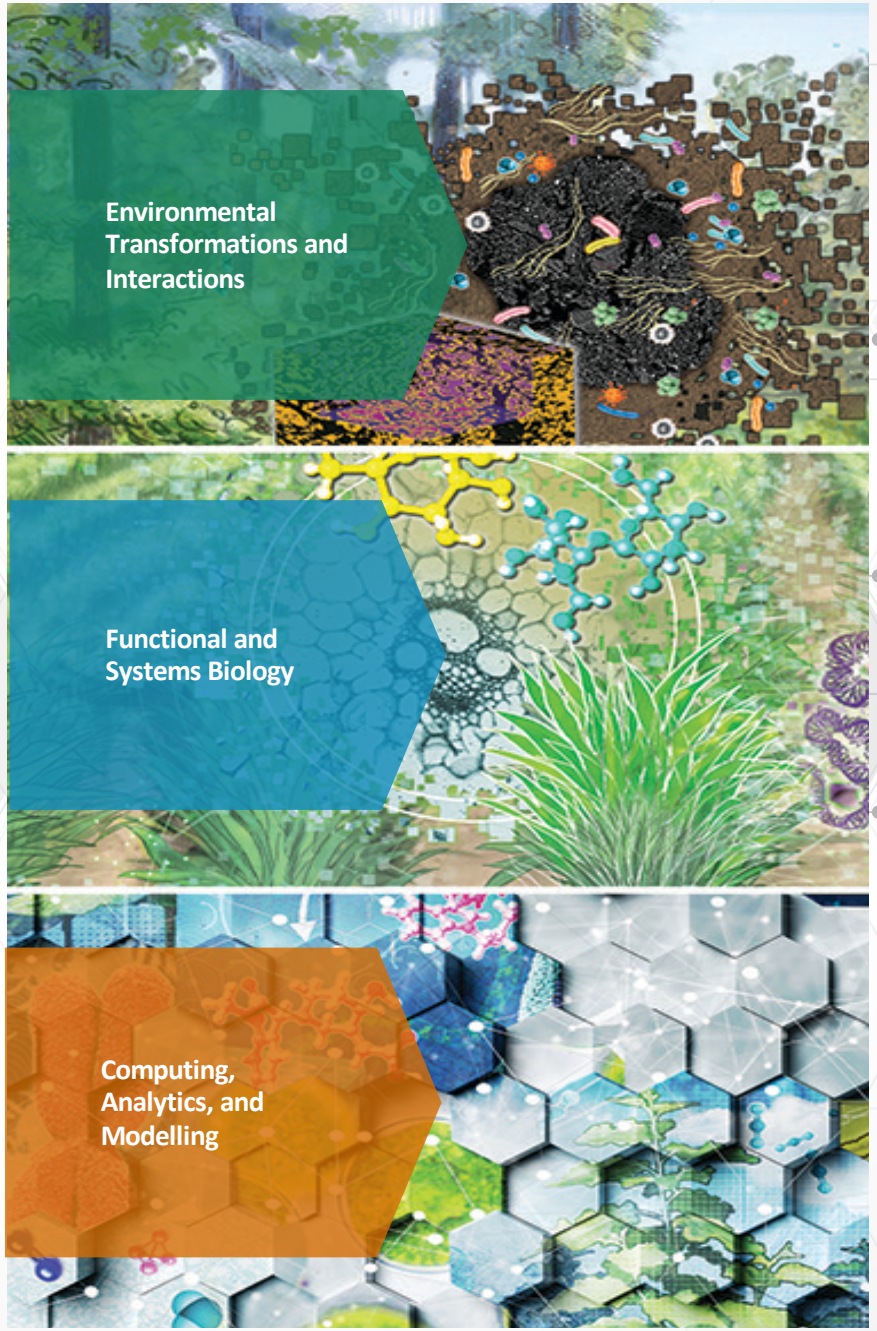
Spectroscopy and Modeling Workshop
January 26, 2021



LSR/FICUS Webinars
February - March 2021

UPCOMING EVENTS

Questions?



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Computation, Analytics, and Modeling