Biological and Environmental Research

Program Website: https://science.osti.gov/ber/.

The mission of the BER program is to support transformative science and scientific user facilities to achieve a predictive understanding of complex biological, Earth and environmental systems for energy and infrastructure security, independence and prosperity. The program seeks to understand the biological, biogeochemical, and physical processes that span from molecular and genomics-controlled scales to the regional and global scales that govern changes in watershed dynamics, climate, and the earth system.

All ALCC applications to BER should address specific research goals in one or more of the following research program areas (or program) and explain how the proposed high performance computing effort supports the broad scientific objectives and mission of the BER program and its priorities.

1. Earth System Model Development (ESMD) Program Area – to develop Earth system models, i.e, the Energy Exascale Earth System Model (E3SM) and its subcomponents for an improved representation, simulation, prediction and projection of the earth system processes to address the grand challenge of actionable predictions of the changing Earth system from subseasonal to centennial time scales. The model development should be driven by the most critical scientific questions facing the nation and DOE.

2. Regional and Global Model Analysis (RGMA) Program Area – to enhance predictive and process level understanding of Variability and Change in the Earth system by advancing capabilities to design, evaluate, diagnose, and analyze global and regional earth system models informed by observations. The primary model focused on is the Energy Exascale Earth System Model (E3SM). Multi-model approaches and a use of a hierarchy of models of varying levels of varying complexity to address the relevant science questions are encouraged.

3. Environmental System Science (ESS) Program – to advance an integrated, robust, and scale-aware predictive understanding of terrestrial systems and their interdependent microbial, geochemical, ecological, hydrological, and physical processes. The program seeks to develop an integrated framework using a systems approach to elucidate the complex processes and controls on the structure, function, feedbacks, and dynamics of terrestrial systems that span from molecular to global scales and extend from the bedrock through rhizosphere to the atmosphere immediately above the vegetative canopy. Incorporation of

scientific findings into process and system models is an important component of the ESS strategy, intended both to further predictive understanding as well as to enable the identification of new research questions and directions.

4. Computational Biosciences (CB) Program - to develop robust computational frameworks for data integration and analysis of large, complex, and heterogeneous systems biology data that determines the molecular mechanisms, regulatory elements, and integrated networks to understand genome-scale functional properties of microbes, plants, and interactive biological communities; including observational and experimental data across scales to integrate structural, genomic, other omics and imaging data with cellular and multicellular processes; improve quantitative understanding of biological systems, incorporating detailed molecular, biochemical, physiological, and structural information into biological models and simulations, creating models that predict biosystem response

5. Data Management (DM) Program - to develop and make available to the community novel scale-aware visualization and analysis methods involving observational and model-generated data. This activity also prioritizes the further development of tools to quantify uncertainty and adapt to different modeling frameworks that enable integrated analysis and comparison of data from multiple sources and across variable experimental conditions.