Workshop summary

Watersheds are a fundamental unit of the Earth system in which physical, biological, and chemical processes interactively mediate the hydro-biogeochemical (HBGC) function of terrestrial systems. There is a need for improved mechanistic models that simulate impacts of perturbations on watershed HBGC functions such as the fluxes of water, carbon, nutrients, and contaminants. With improvements to computational capacity, these models provide increasingly detailed spatial and temporal representation of key processes such as plant-microbe-soil interactions and domains such as groundwater-surface water exchange zones.

To benchmark such models, data must be collected over a wider range of spatial and temporal scales than are currently available. There are practical limitations to this. However, there are also significant opportunities to deploy increasingly sophisticated and cost-effective sensing platforms and sampling schemes in strategically selected watershed subsystems using model simulations to guide the locations and level of spatial and temporal resolution.

This workshop will bring together experts in watershed hydrobiogeochemistry, sensor development, modeling, and data science to develop a strategy to capitalize on these opportunities. By integrating highly scalable platforms that leverage BER investments in analytical, computational, and field capabilities, our goal is to enable coordinated, consistent, scalable, networked, and open research across a broad range of watershed systems. This ‘distributed research’ philosophy will provide transferrable knowledge needed to predict watershed HBGC beyond local systems and towards continental scales.
Workshop outcomes

- Provide tangible details on challenges, solutions, and actionable plans for using open, coordinated, scalable, distributed, network science to address science challenges facing BER (environment and biology) and other agencies (e.g., USGS, EPA, NSF, NASA, NOAA). Example areas of focus include strategies for:
  - Use of mechanistic and data-driven models to guide data generation (field-based and remote sensors, physical samples, and experiments) and iterative model-data integration
  - Integration among computational tools (models, informatics, analytics), data-generating programs and facilities, and data accessibility tools (repositories, aggregators, distributors)
  - Leveraging of existing networks and infrastructure

- Inform future investments that link together capabilities and scientific domains from both environmental and biology sides of DOE-BER, as well as from inter-agency coordination. Example areas of focus are on national-scale programs of coordinated, open science focused on watershed function to:
  - Provide fundamental knowledge, data, and modeling tools to inform operations-based programs used to inform decisions from local to national scales.
  - Address needs of Earth system models, particularly in the context of processes connecting terrestrial and aquatic components of terrestrial ecosystems.

- Foster a scientific community passionate about open, coordinated, scalable, distributed, network science across BER and other agencies. Example topics to be discussed include:
  - Solutions to barriers to a cultural shift towards this science model
  - Sustainability of this science model
  - Integration with traditional approaches
Workshop timeline

November 26: Pre-workshop webinar-based discussion (open to all)
Early December: White paper call (open to all)
December 13: AGU Townhall and mixer in Washington D.C. (open to all)
Early-January: White papers due (open to all)
Mid-January: Webinar-based discussion around working groups (open to all)
January 28-30: Workshop in Washington D.C. (invite only)
Mid-April: Workshop report complete (invited writing team; report made public)
Late-April: Present workshop summary at ESS PI meeting (slides made public)

Workshop leadership

Program Managers
David Lesmes (U.S. DOE); Paul Bayer (U.S. DOE)

Chairs
James Stegen (Pacific Northwest National Lab); Kelly Wrighton (Colorado State University); Eoin Brodie (Lawrence Berkeley National Lab)

Leadership Team
Marty Briggs (USGS); Jesus Gomez-Velez (Vanderbilt University); Charu Varadharajan (Lawrence Berkeley National Lab)

Associated AAAS Science & Technology Policy Fellows
Sujata Emani (U.S. DOE); Jessica Moerman (U.S. DOE)