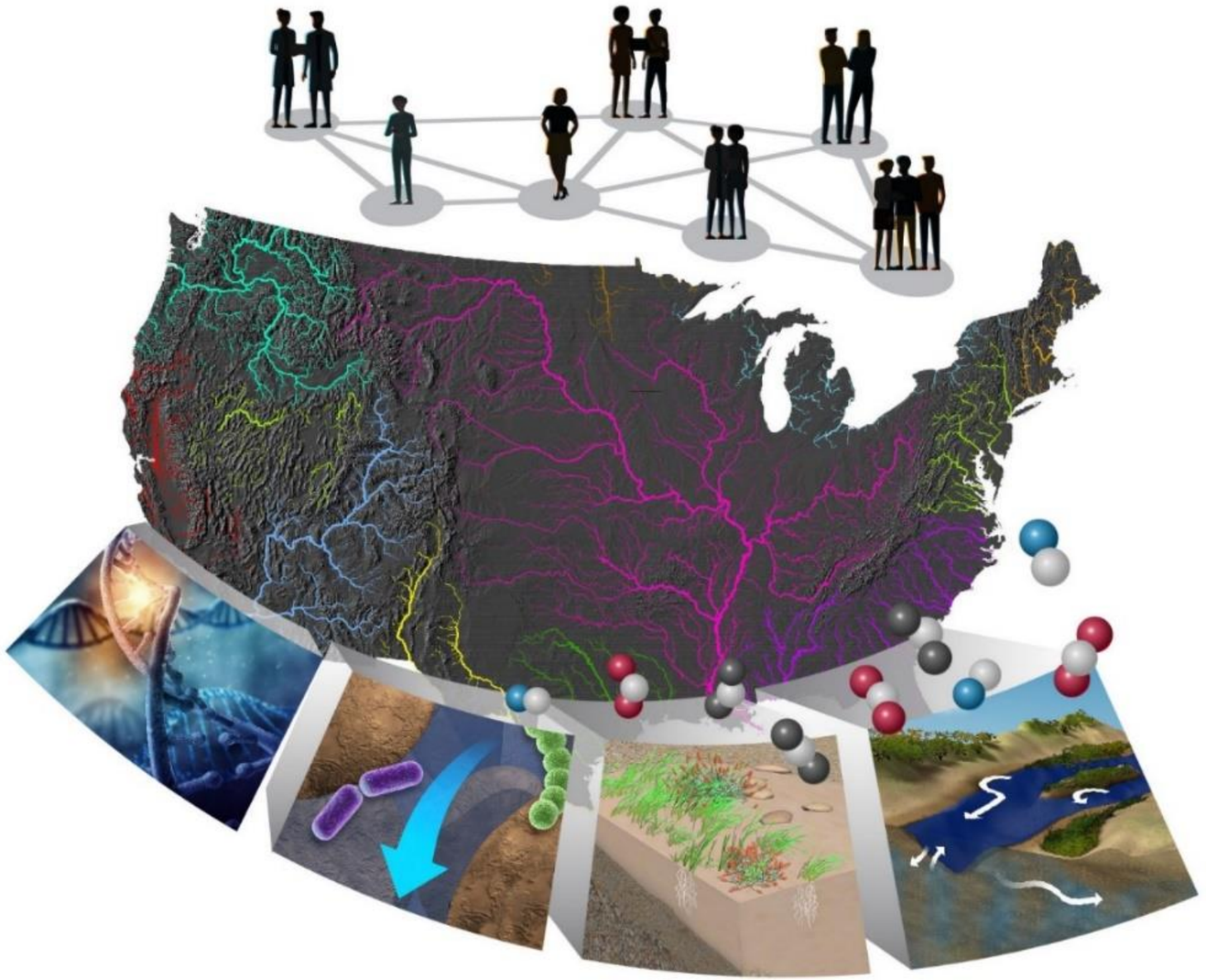
# Multi-Watershed Perturbation Response Traits

@JamesStegen

Subsurface Biogeochemical Research

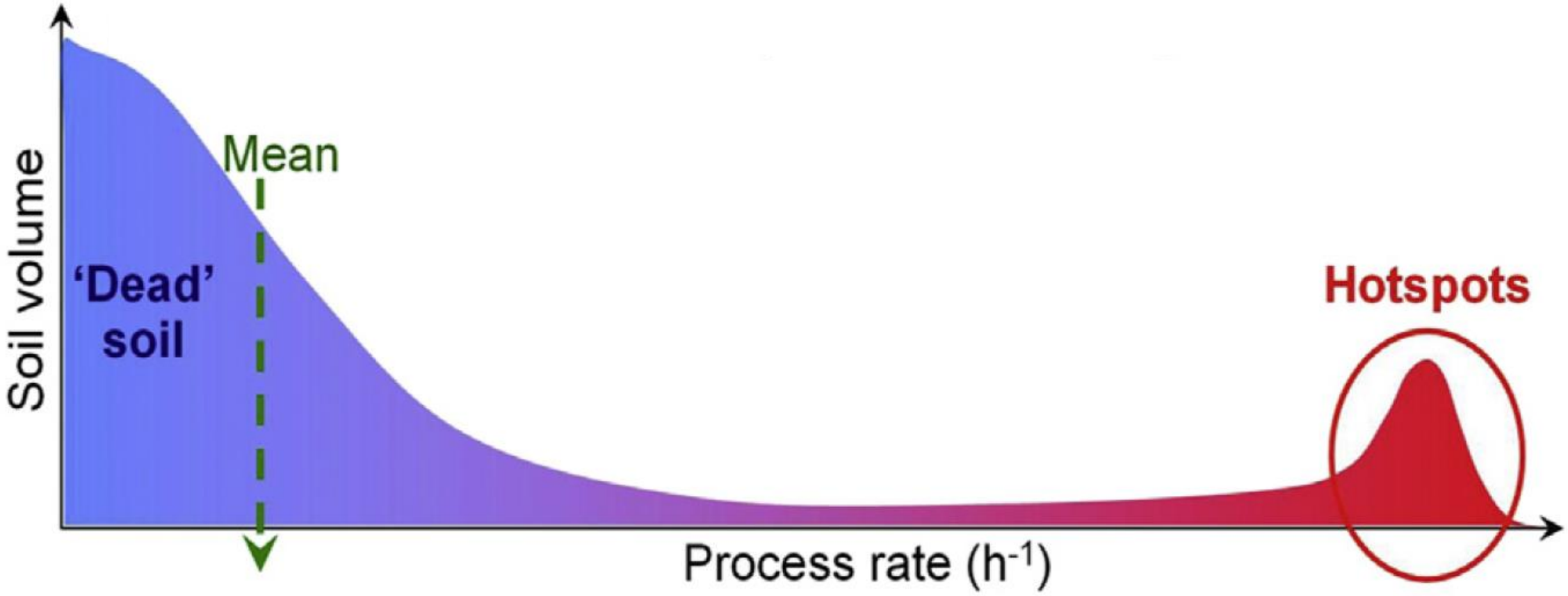
U.S. DEPARTMENT OF ENERGY



# Understanding and accounting for biogeochemical hot spots and moments remains a challenge

## Hotspots: small volumes with much higher rates than the mean

McClain et al. 2003;Kuzyakov and Blagodatskaya 2015

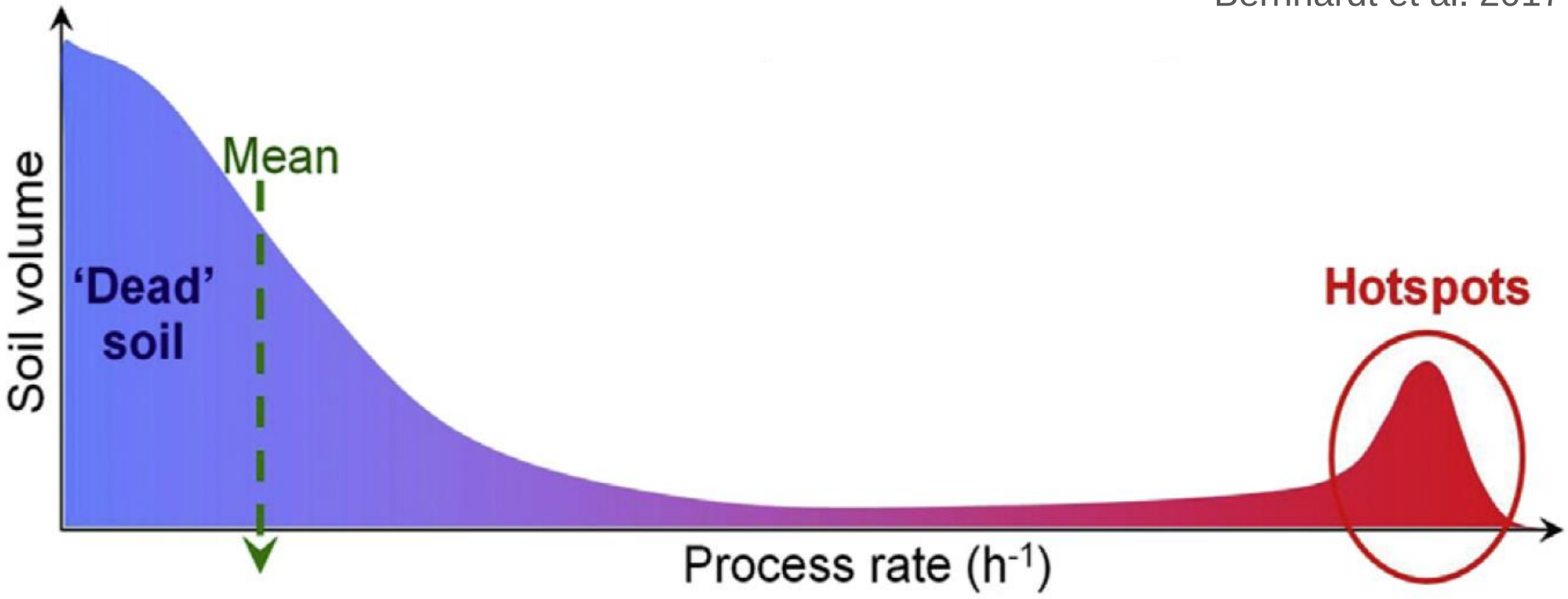


# Understanding and accounting for biogeochemical hot spots and moments remains a challenge

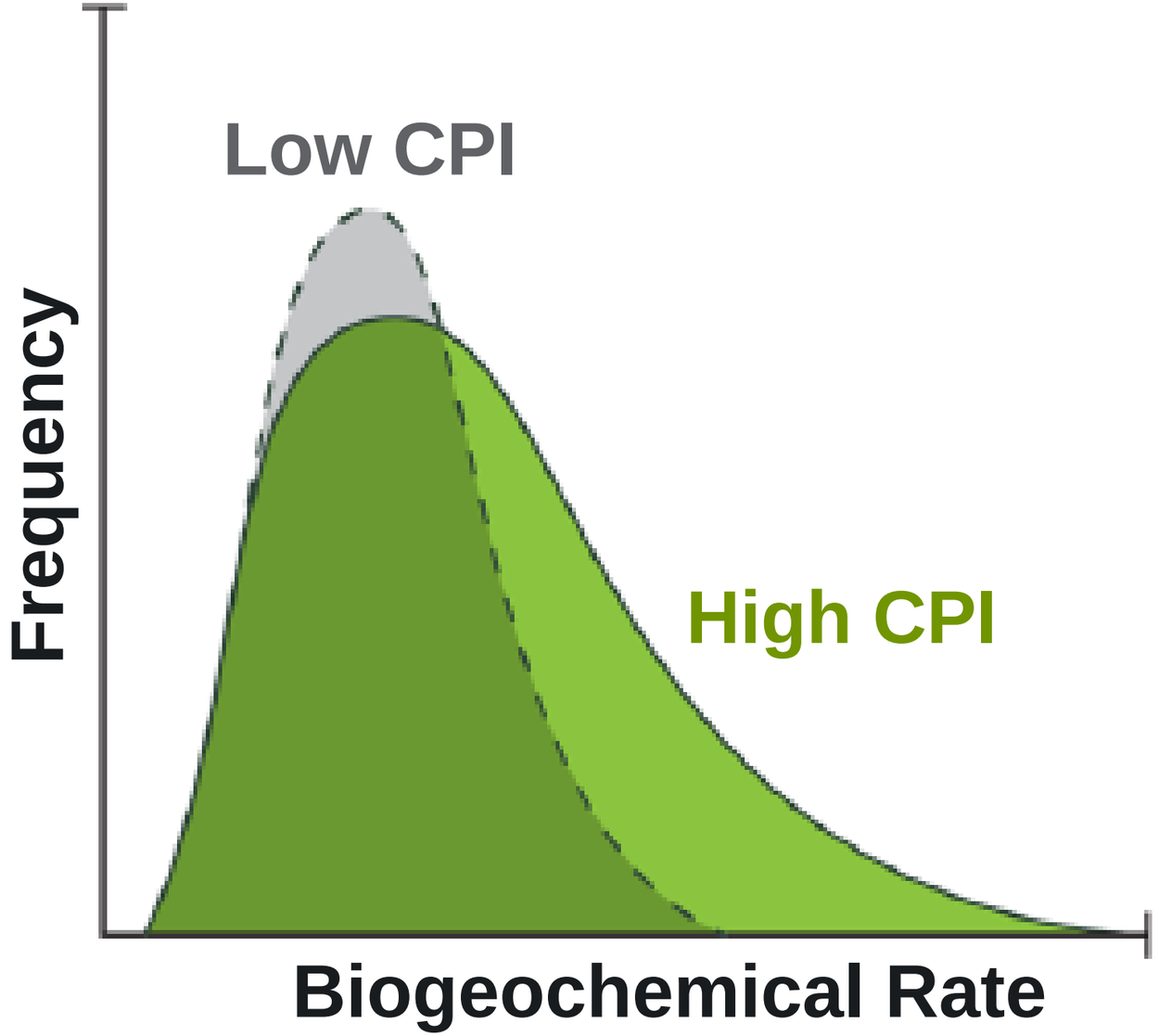
**Hotspots**: small volumes with much higher rates than the mean

**Control Points**: rate of sufficient magnitude to affect ecosystem

Bernhardt et al. 2017

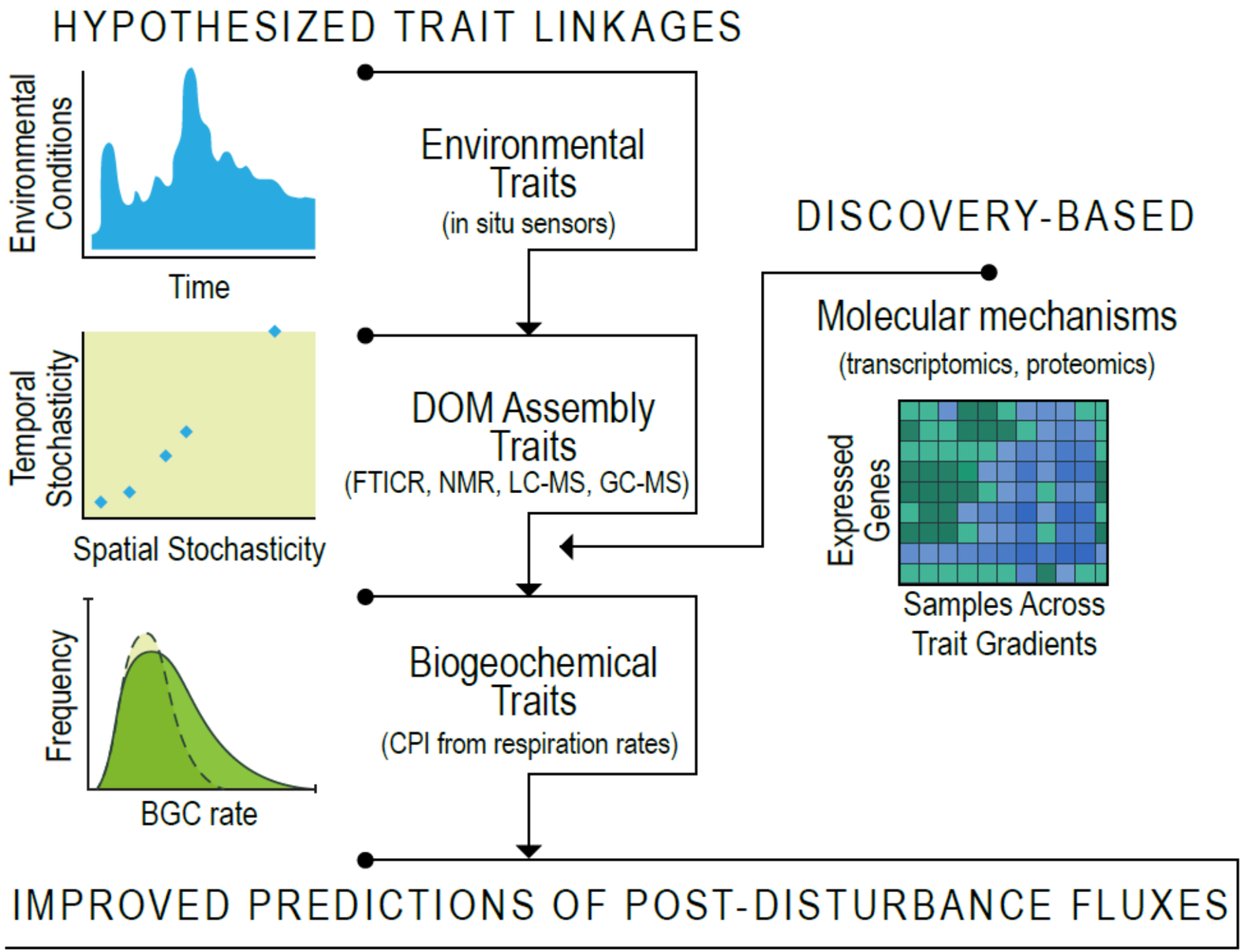


# Moving beyond ‘hot or not’ to understand variation in control point influence (CPI) as a biogeochemical trait

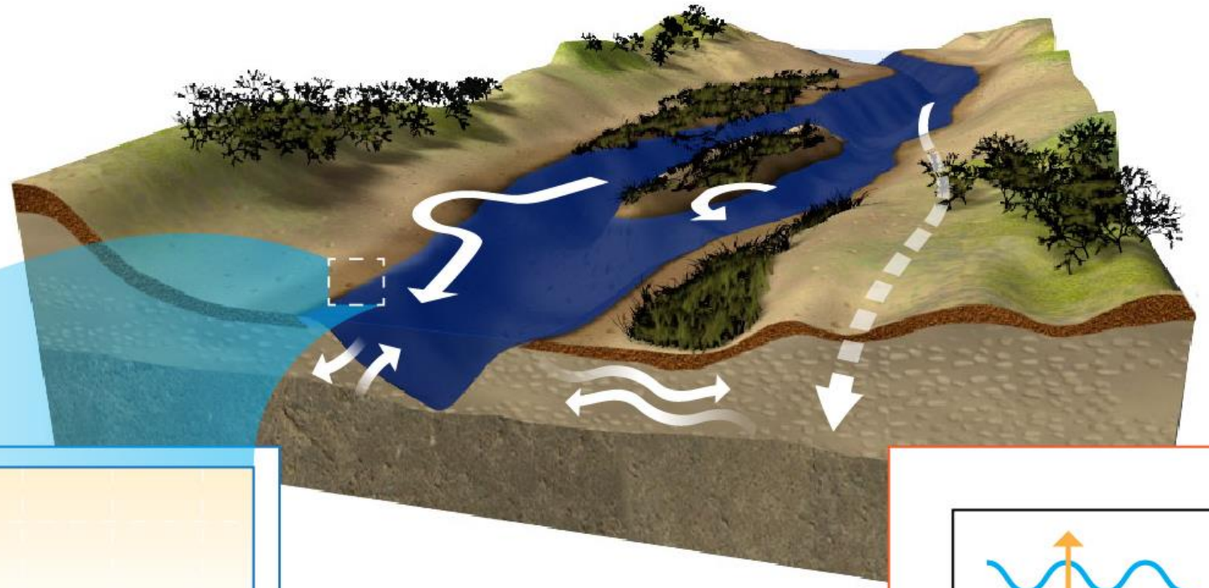



Arora et al. 2020

# Trait-based framework to understand and predict CPI

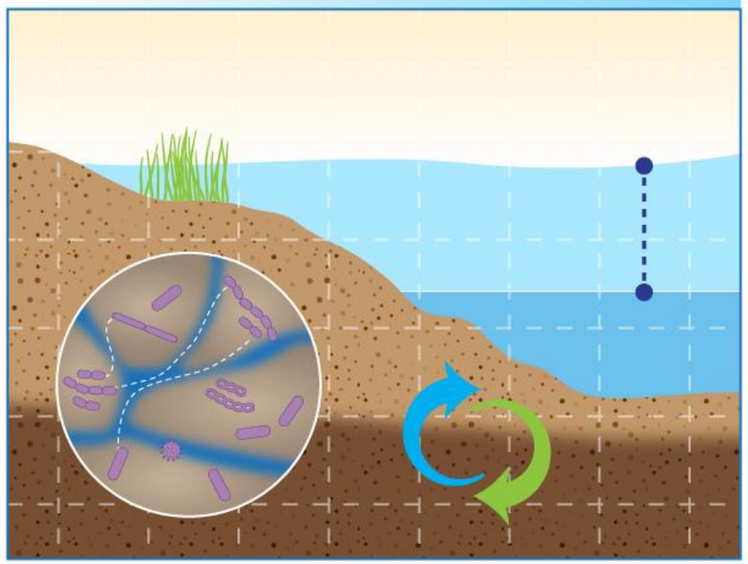


# Trait-based framework to complement site-specific models



CURRENT SITE-SPECIFIC APPROACH

PROPOSED TRANSFERABLE APPROACH



$$\frac{\partial C}{\partial t} = -v\frac{\partial C}{\partial x} + D_L\frac{\partial^2 C}{\partial x^2} - \frac{\partial q}{\partial t}$$

Complex · Numerous Parameters

Mechanistic refinement

OUTCOMES

Improved predictions of post-disturbance fluxes of energy and materials

Statistical predictions of CPIs

Trait framework

Environmental Traits

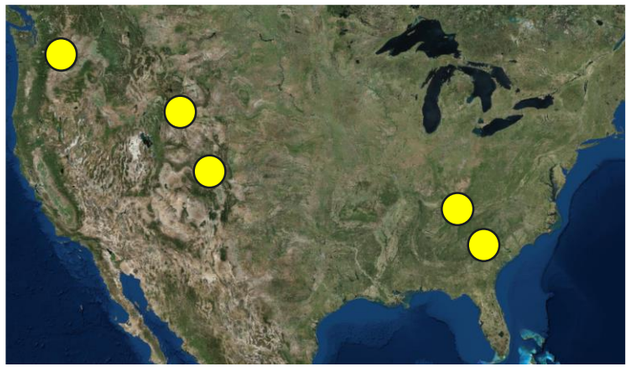
DOM Traits

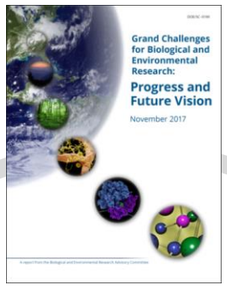
BioGeoChem Traits

Simplified · Transferable

# Open watershed science to amplify Earth System Science

## Doing together what would be impossible alone






IDEAS

EMSL

ESS-DIVE
Deep Insight for Earth Science Data

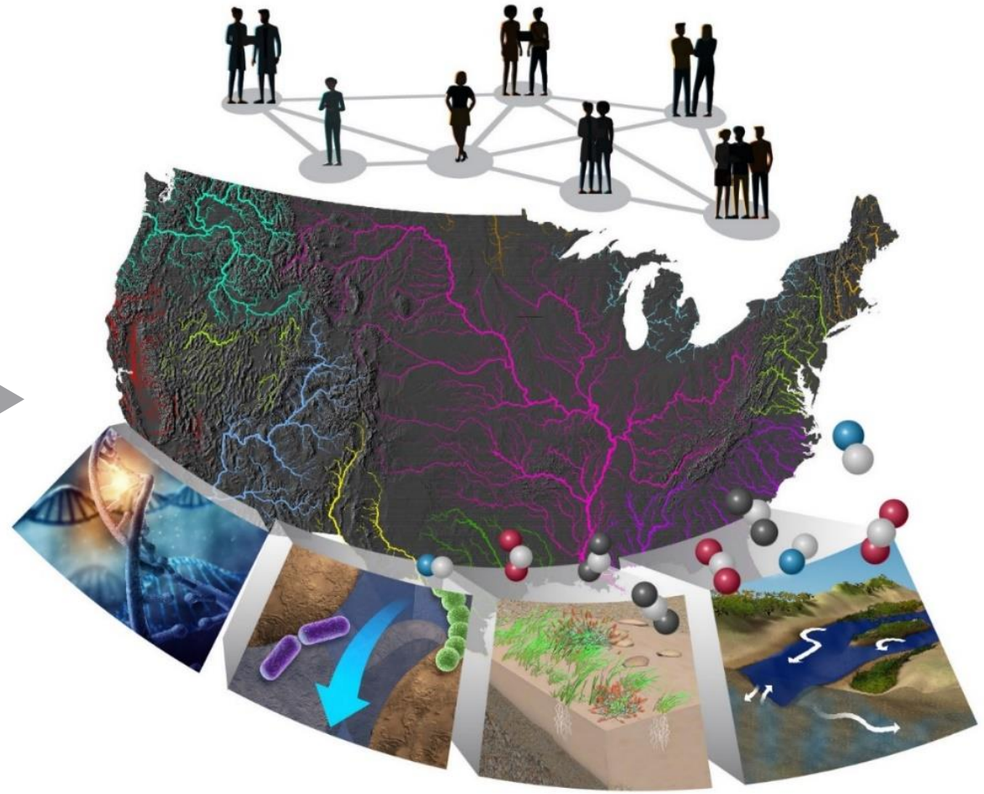
JGI
JOINT GENOME INSTITUTE

NMDC
National Microbiome Data Collaborative

USGS
science for a changing world

KBase

NSF



Subsurface Biogeochemical Research

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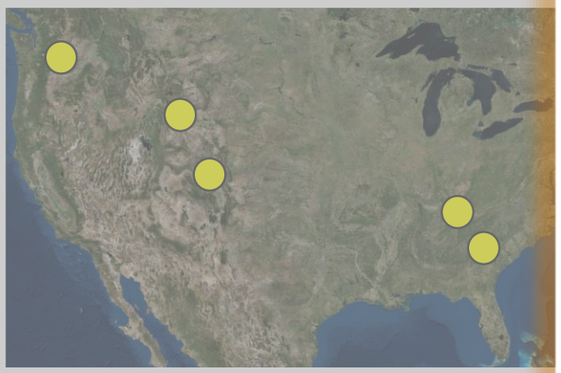
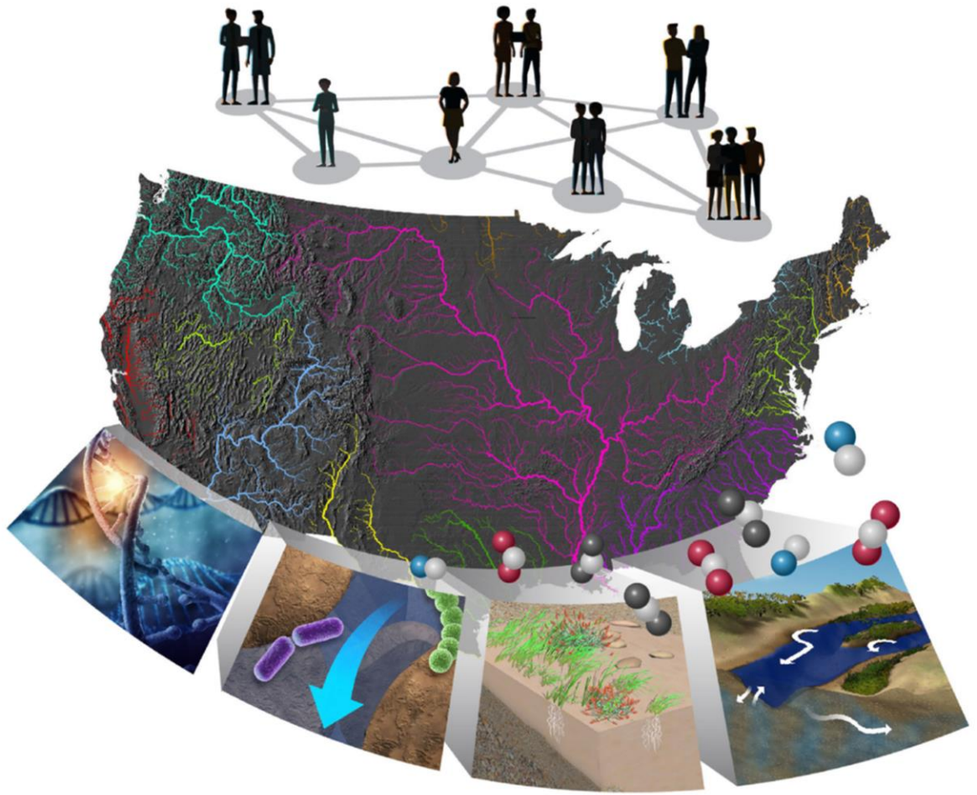


# Open Watershed Science by Design

## Leveraging Distributed Research Networks to Understand Watershed Systems

Workshop Report



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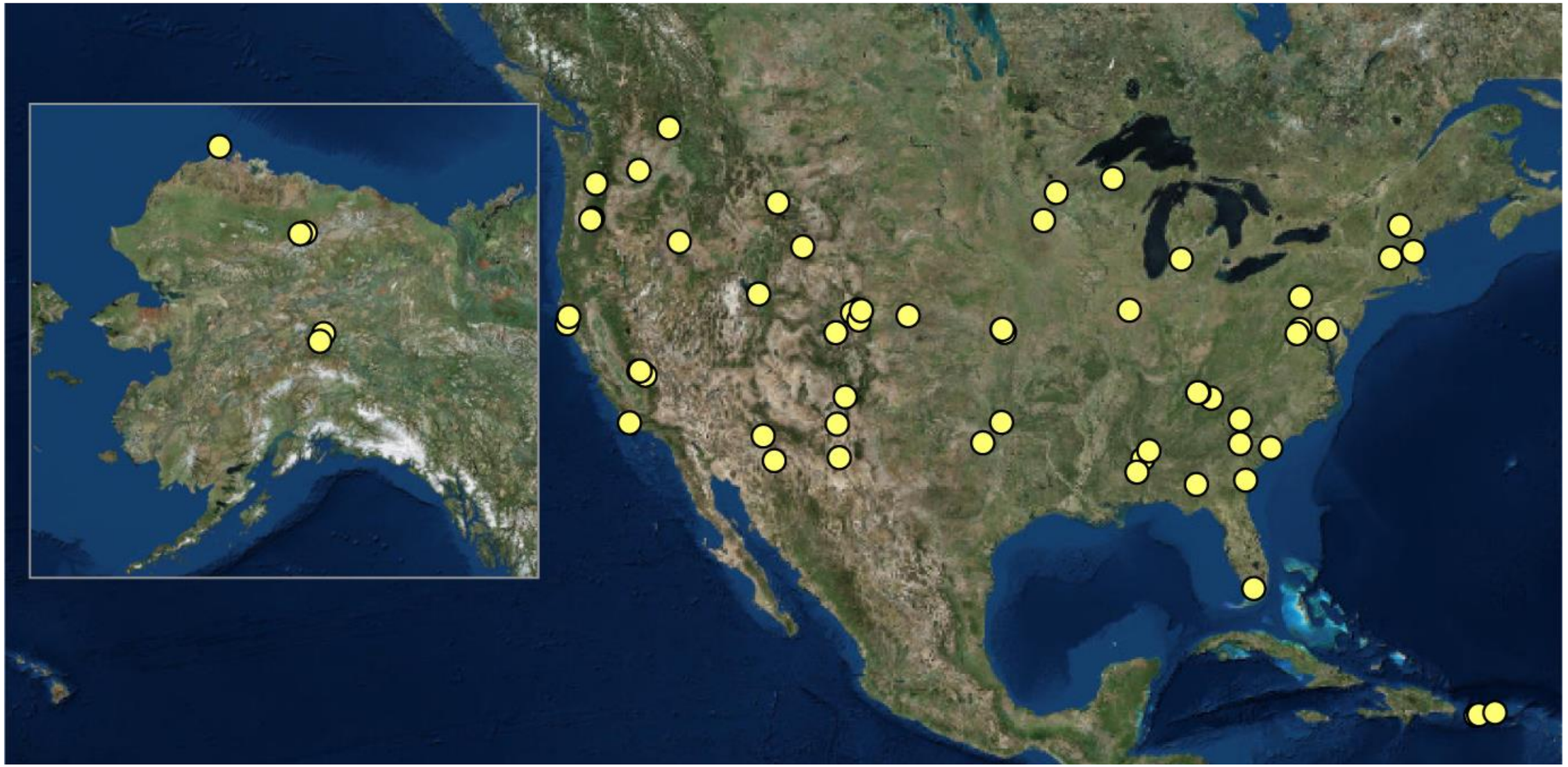
Office of Biological and Environmental Research

# WHONDRS: For and by the community

## Integrative, model-relevant, FAIR river corridor data for transferability

# Transferability through community-enabled open science

## Integrative, model-relevant, FAIR river corridor data for transferability



# Parafluvial hyporheic zones as a model system to build predictive and transferable trait-based framework

**Environmental traits**

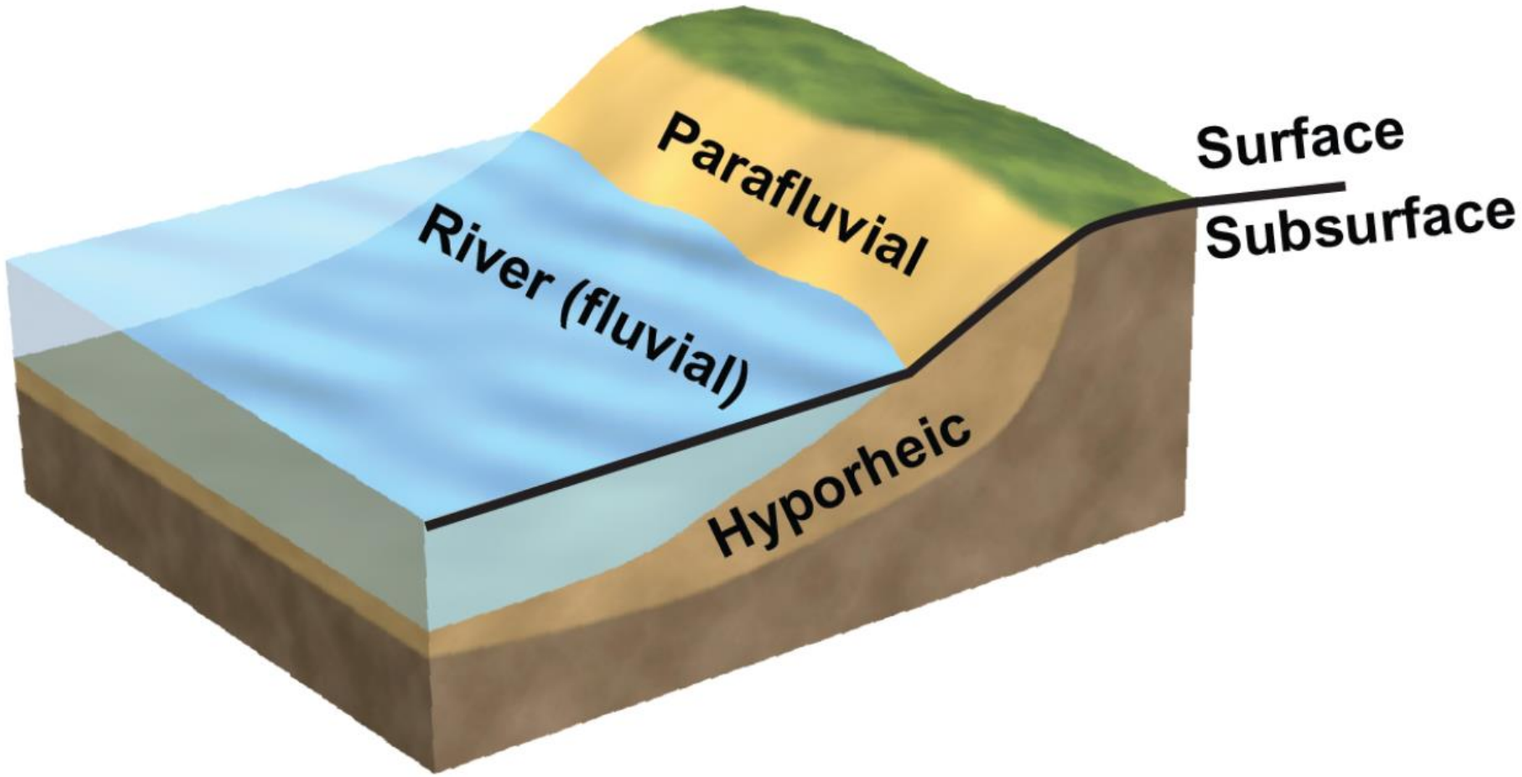
- Sensors
- Public data

**DOM traits**

- Sediments
- EMSL
- Null modeling

**BGC traits (CPI)**

- Lab incubations
- Field manipulations




Goldman et al. 2017