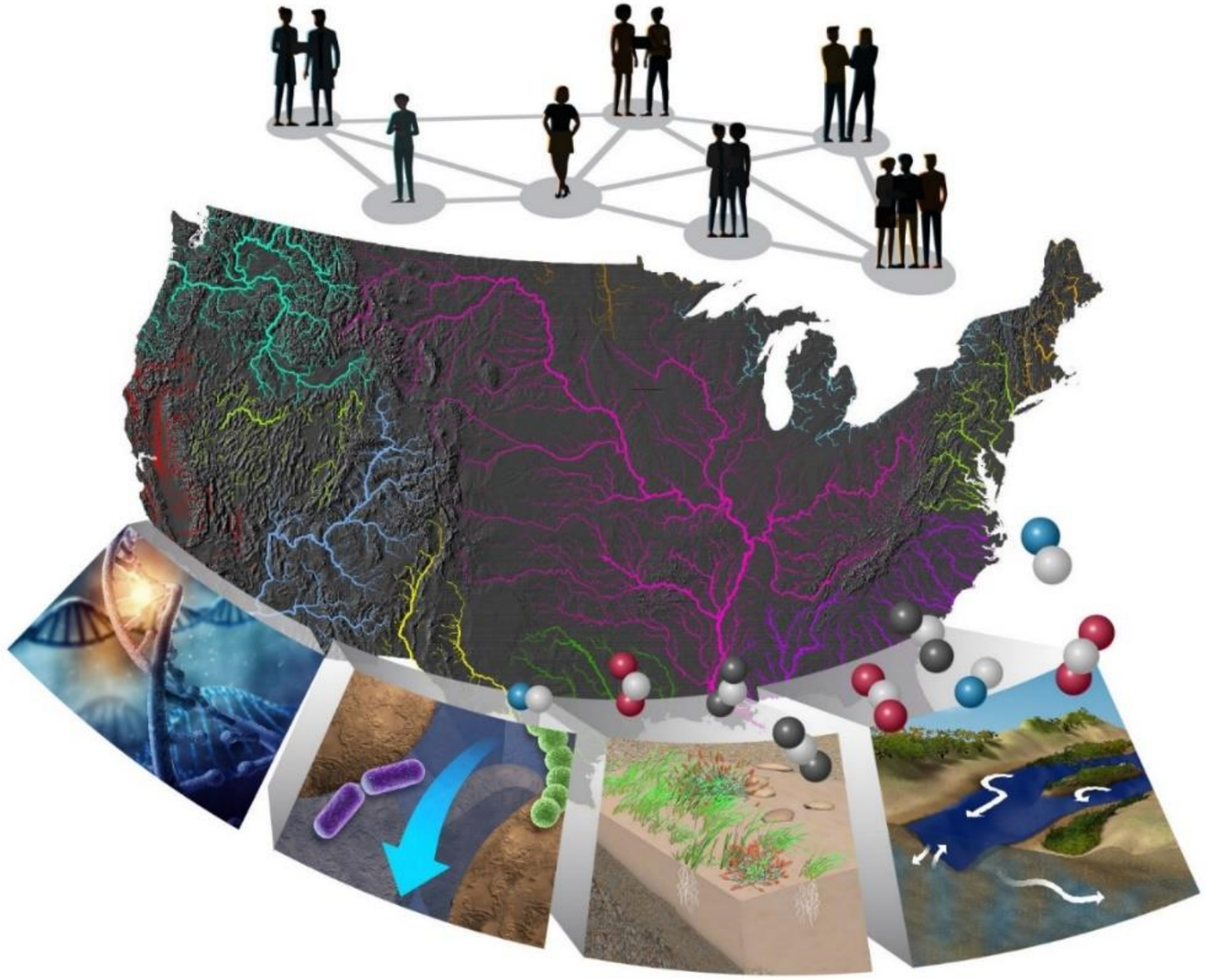
Open Watersheds by Design

Leveraging Distributed Research Networks

Presenter: James Stegen
@JamesStegen
@WHONDRS

Subsurface Biogeochemical Research

U.S. DEPARTMENT OF ENERGY



Workshop Leadership

Program Management

David Lesmes
- Former PM (USGS)
- Geophysics

Sujata Emani
- AAAS Fellow
- Data science

Jessica Moerman
- AAAS Fellow
- Water isotopes

Workshop Chairs

James Stegen
- Ecology
- Hydro-BGC

Kelly Wrighton
- Microbiology
- Bioinformatics

Eoin Brodie
- Microbiology
- Modeling

Key Leadership

Marty Briggs
- GW/SW exchange
- Hydrogeology

Jesus Gomez-Velez
- Hydrology
- Modeling

Charu Varadharajan
- Biogeochemistry
- Data science

STRENGTH and LIMITATION

Integration within but not across sites

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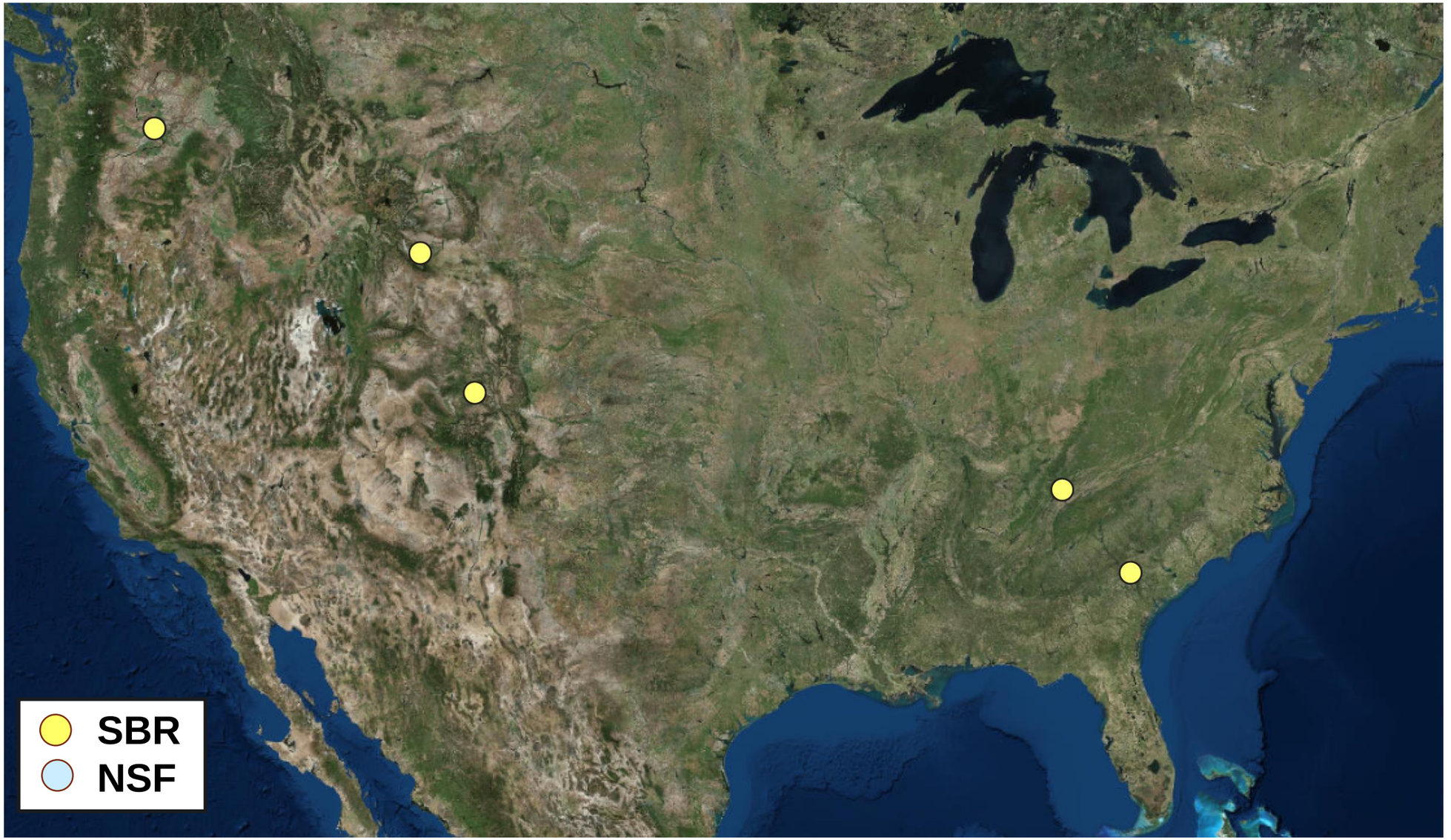
Integration within but not across sites

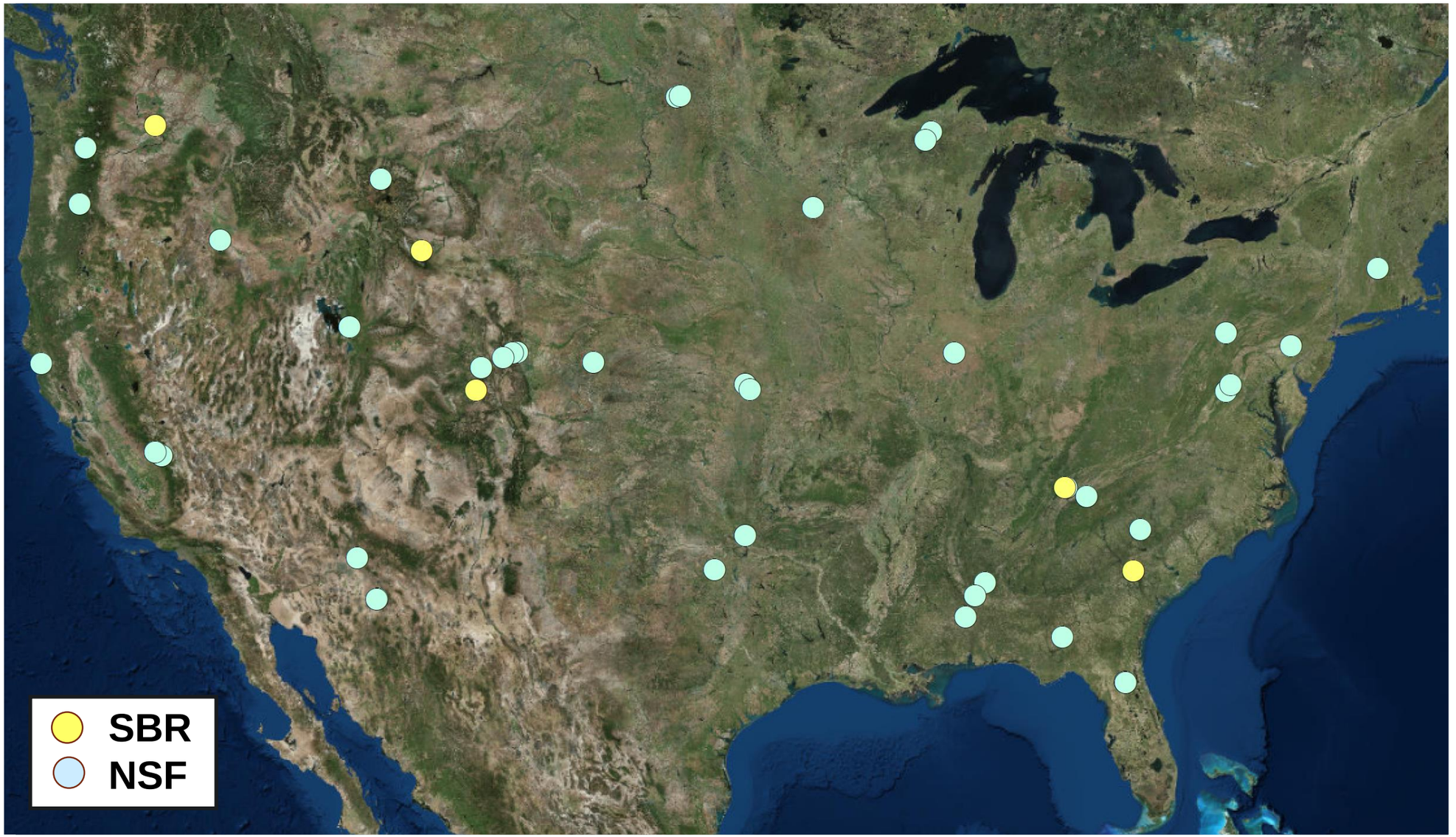
CHALLENGE

Transferable data, knowledge and models



CHALLENGE

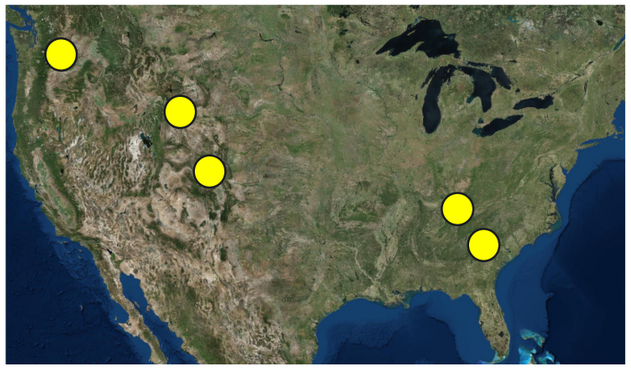
Transferable data, knowledge and models

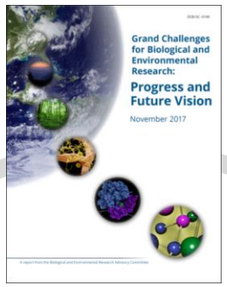


Subsurface Biogeochemical Research

Amplifying Earth System Science through

OPEN WATERSHEDS BY DESIGN





Subsurface Biogeochemical Research

IDEAS

WHONDRS

EMSL

ESS-DIVE
Deep Insight for Earth Science Data

JGI
JOINT GENOME INSTITUTE

NMDC
National Microbiome Data Collaborative

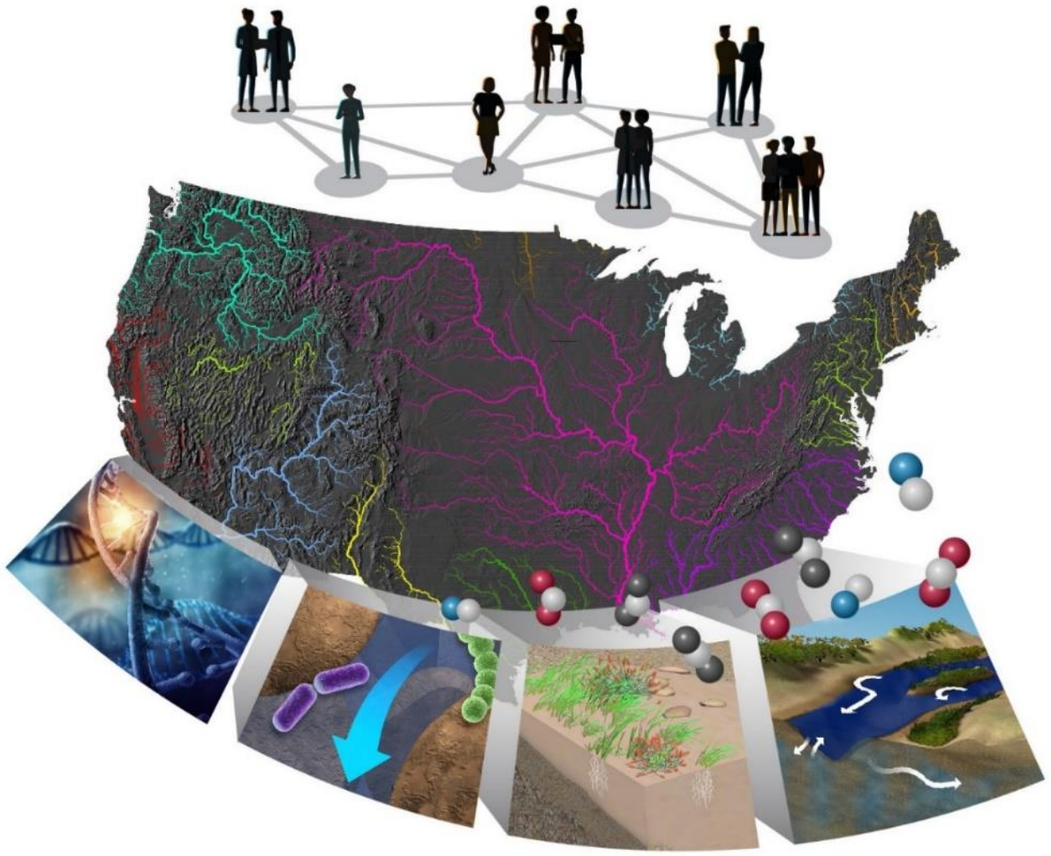
USGS
science for a changing world

KBase

NSF

Doing together what would be impossible alone

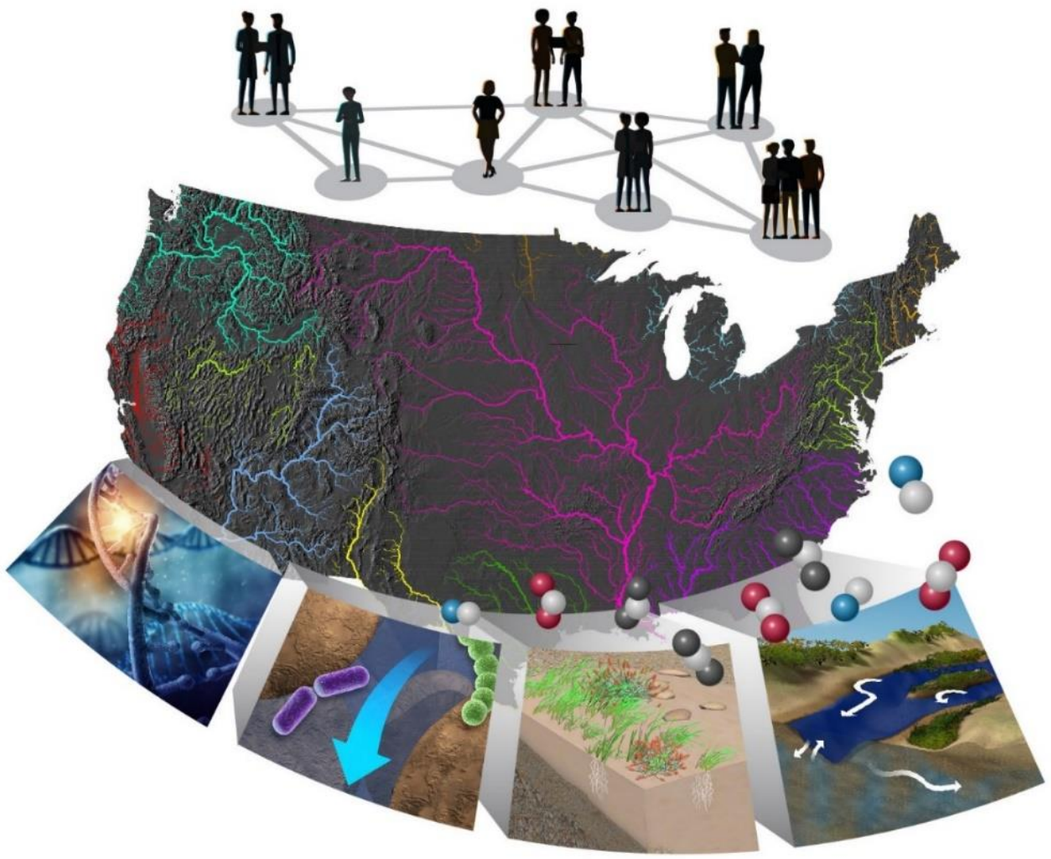
Open Watersheds by Design



Watersheds

Integration of physical, chemical, and biological processes that impact society and the Earth system.

Open Watersheds by Design



Watersheds

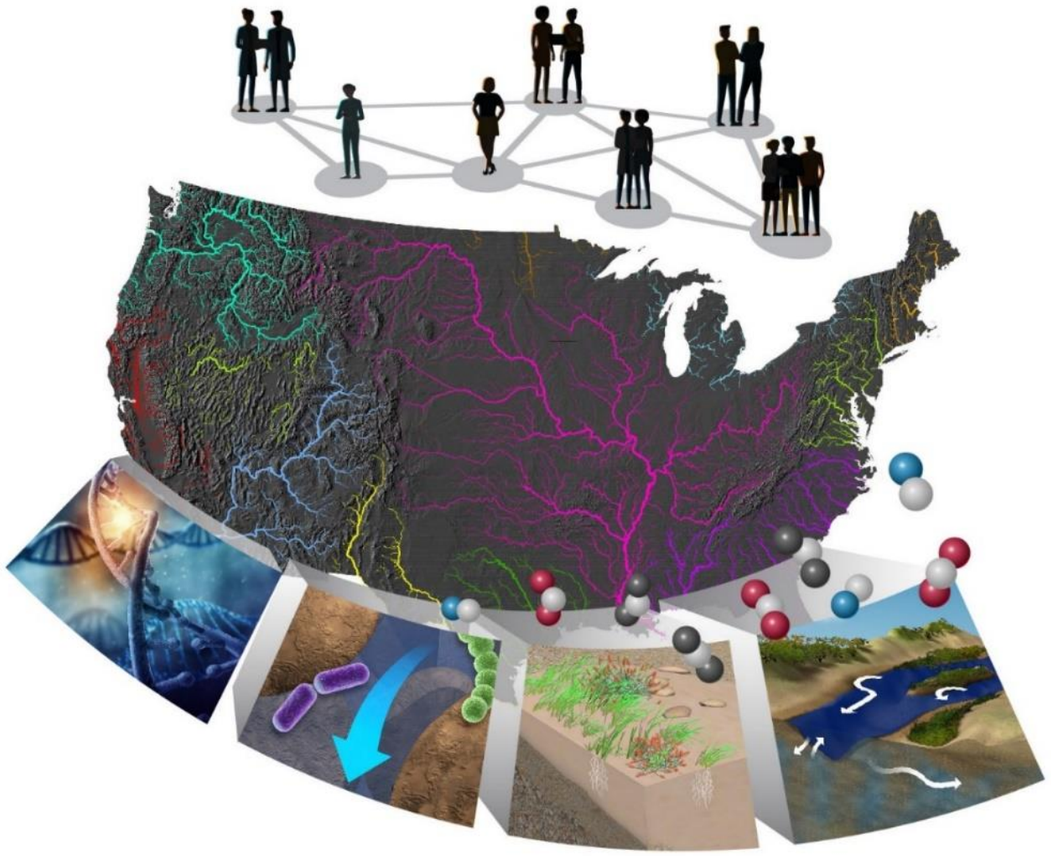
Integration of physical, chemical, and biological processes that impact society and the Earth system.

Open

ICON: Integrated, Coordinated, Open, Networked

FAIR: Findable, Accessible, Interoperable, Reusable

Open Watersheds by Design



Watersheds

Integration of physical, chemical, and biological processes that impact society and the Earth system.

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Design

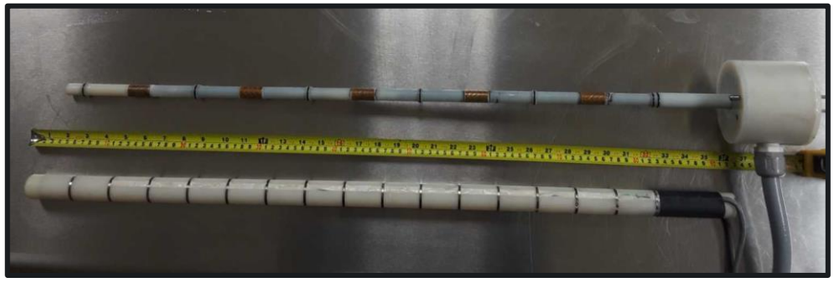
Development based on open principles using iterative design-test-build-learn focused on community needs.

INNOVATION

Coordinated open science by design

WHONDRS

Worldwide Hydrobiogeochemistry Observation Network for Dynamic River Systems

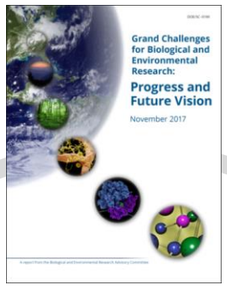


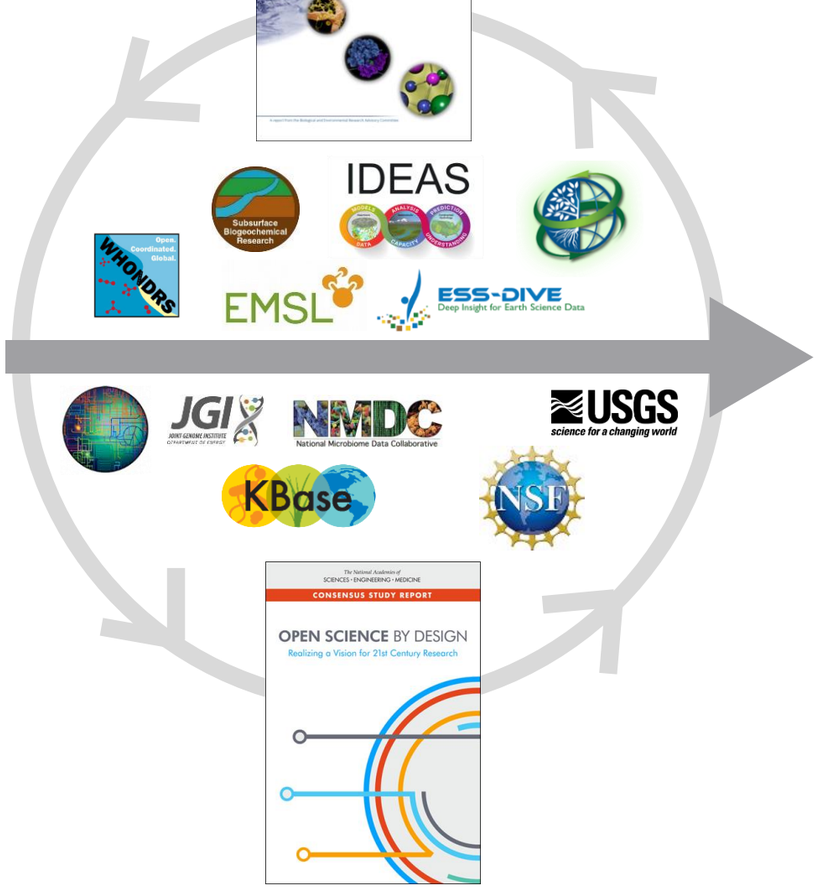
PFLOTRAN

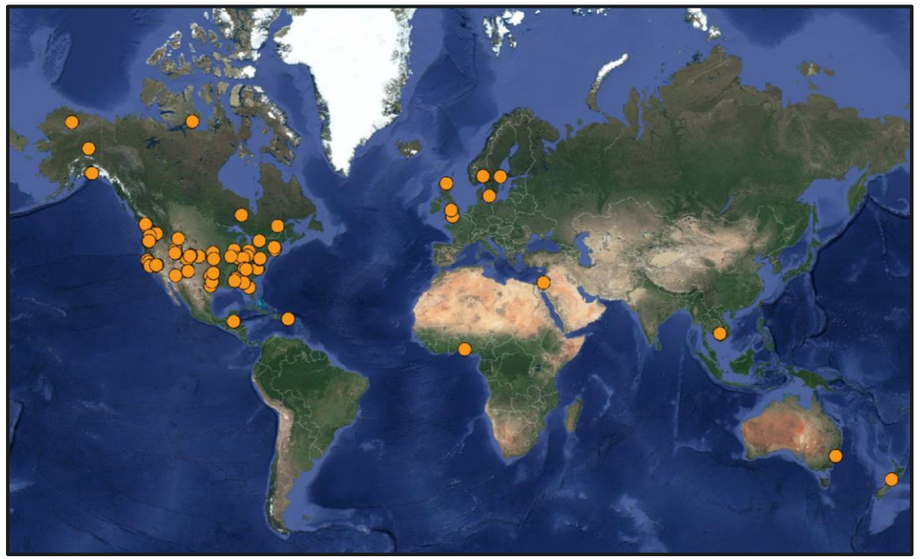
$$r_i = \mu^{\max} \exp\left(\frac{-Y_{Cs,i}}{V_h[Cs_i]}\right)$$

INNOVATION: WHONDRS

Coordinated open science by design



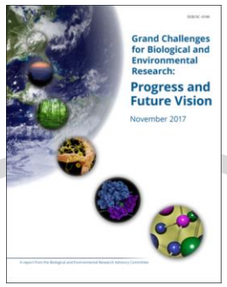




Doing together what would be impossible alone

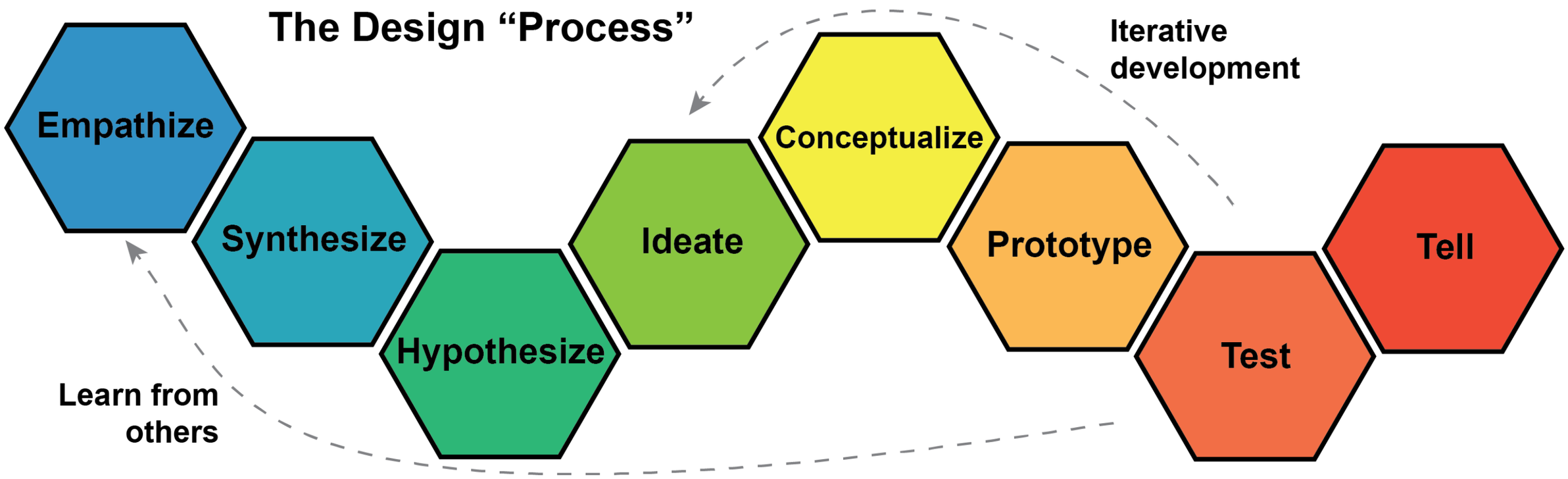
INNOVATION: WHONDRS

Coordinated open science by design



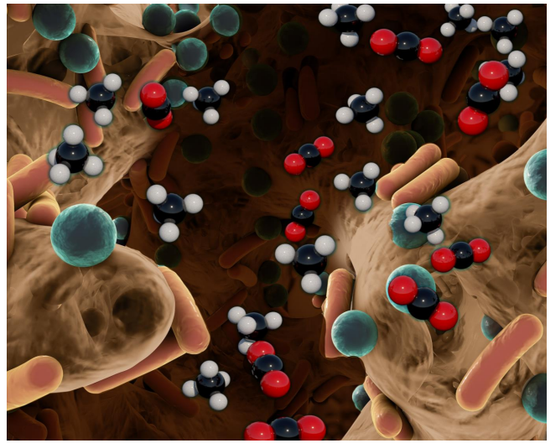
Doing together what would be impossible alone

Creating Open Watersheds by Design

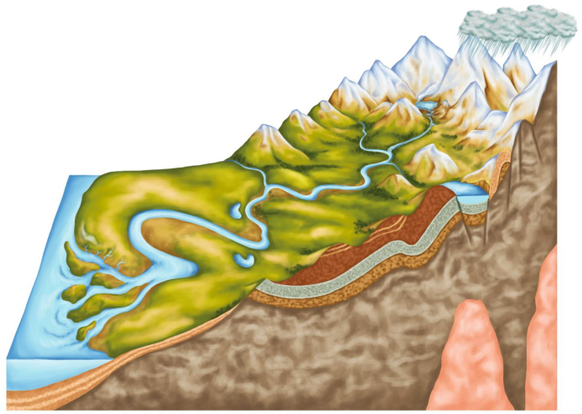


Creating Open Watersheds by Design

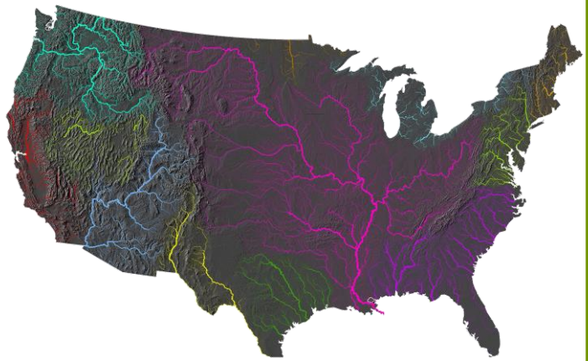
Reaction Scale

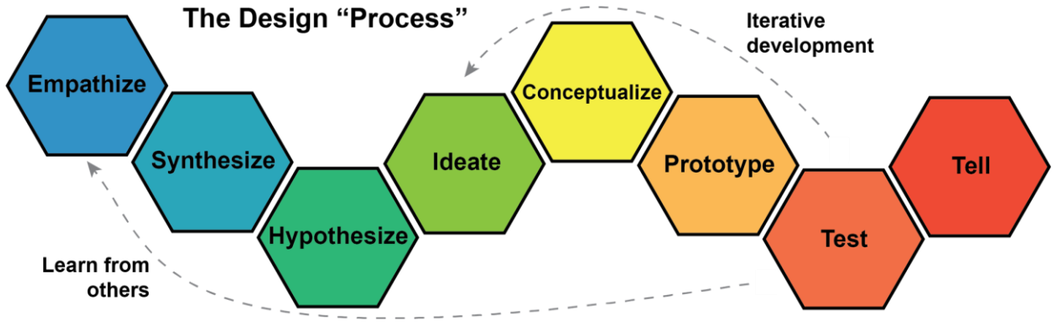


Watershed Scale



Multi-Scale





Reaction-Scale Prototype

Challenge

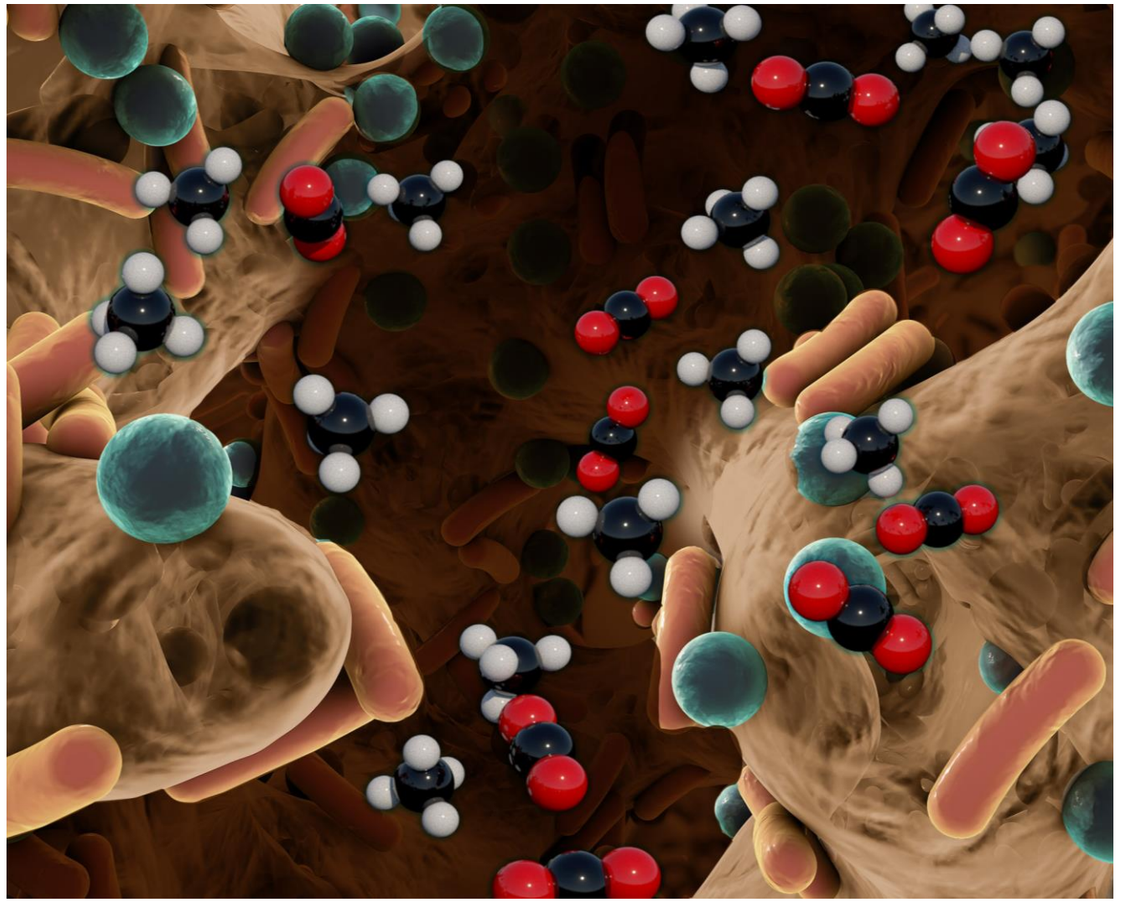
Integrate data from multiple users to generate standardized information to feed interoperable models.

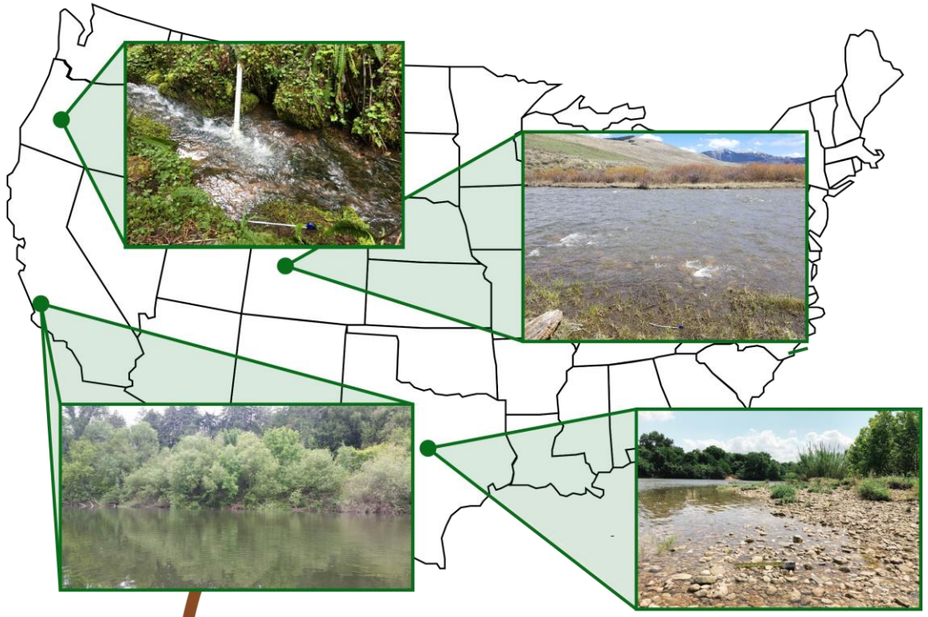
Solution

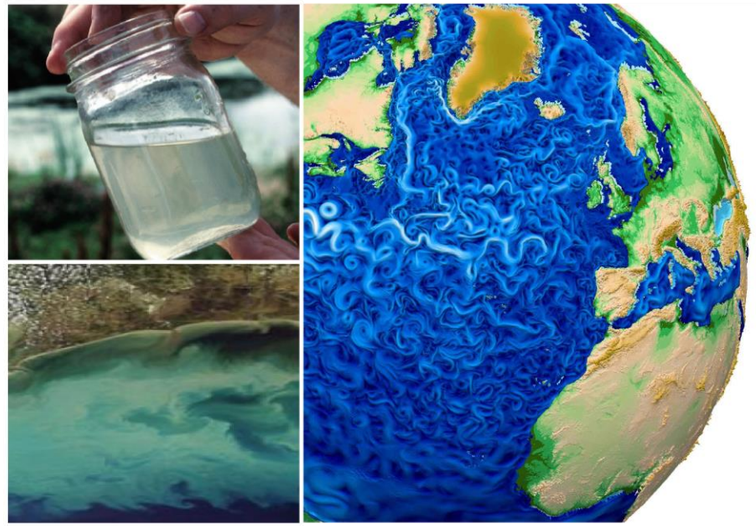
New system for reaction scale integration using data and models from DOE capabilities.

Outcome

Identify biological and biogeochemical principles that transfer across watersheds to enable prediction.







IDEAS

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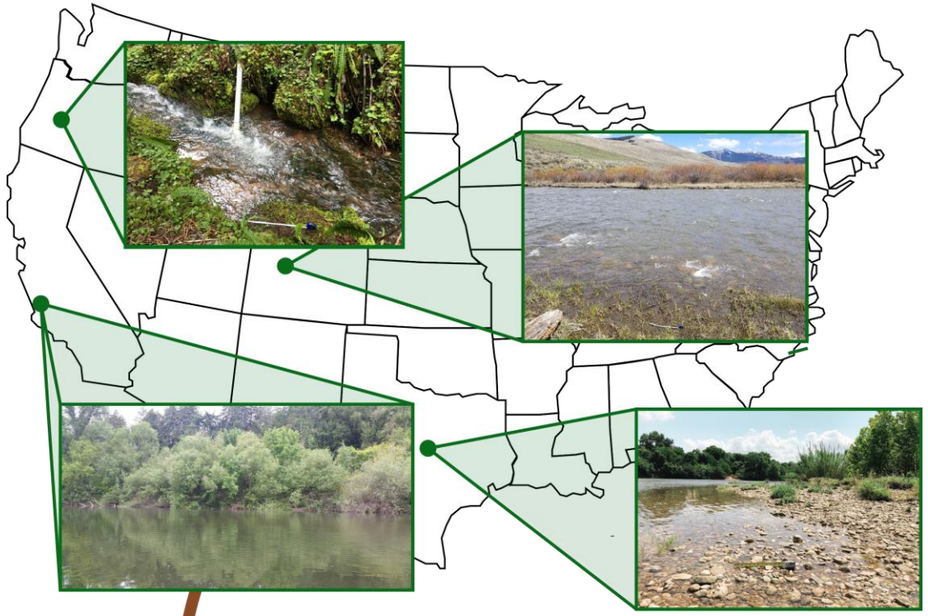
DEPARTMENT OF ENERGY

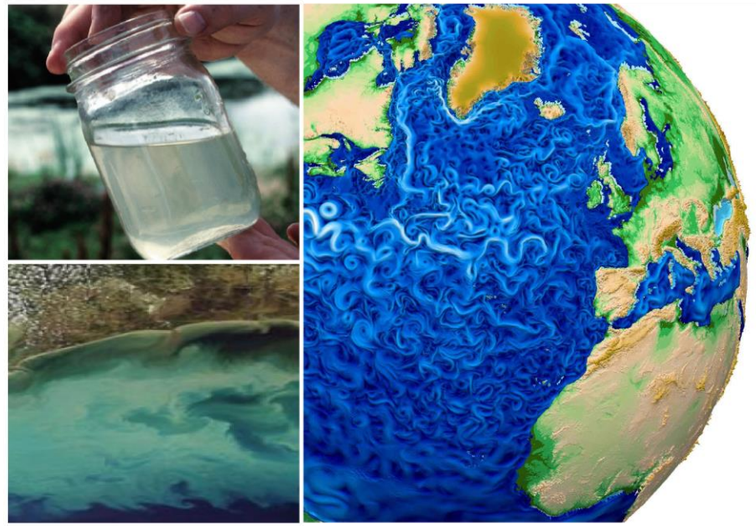
EMSL

NMDC
National Microbiome Data Collaborative

ESS-DIVE
Deep Insight for Earth Science Data

KBase





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Watershed-Scale Prototype

Challenge

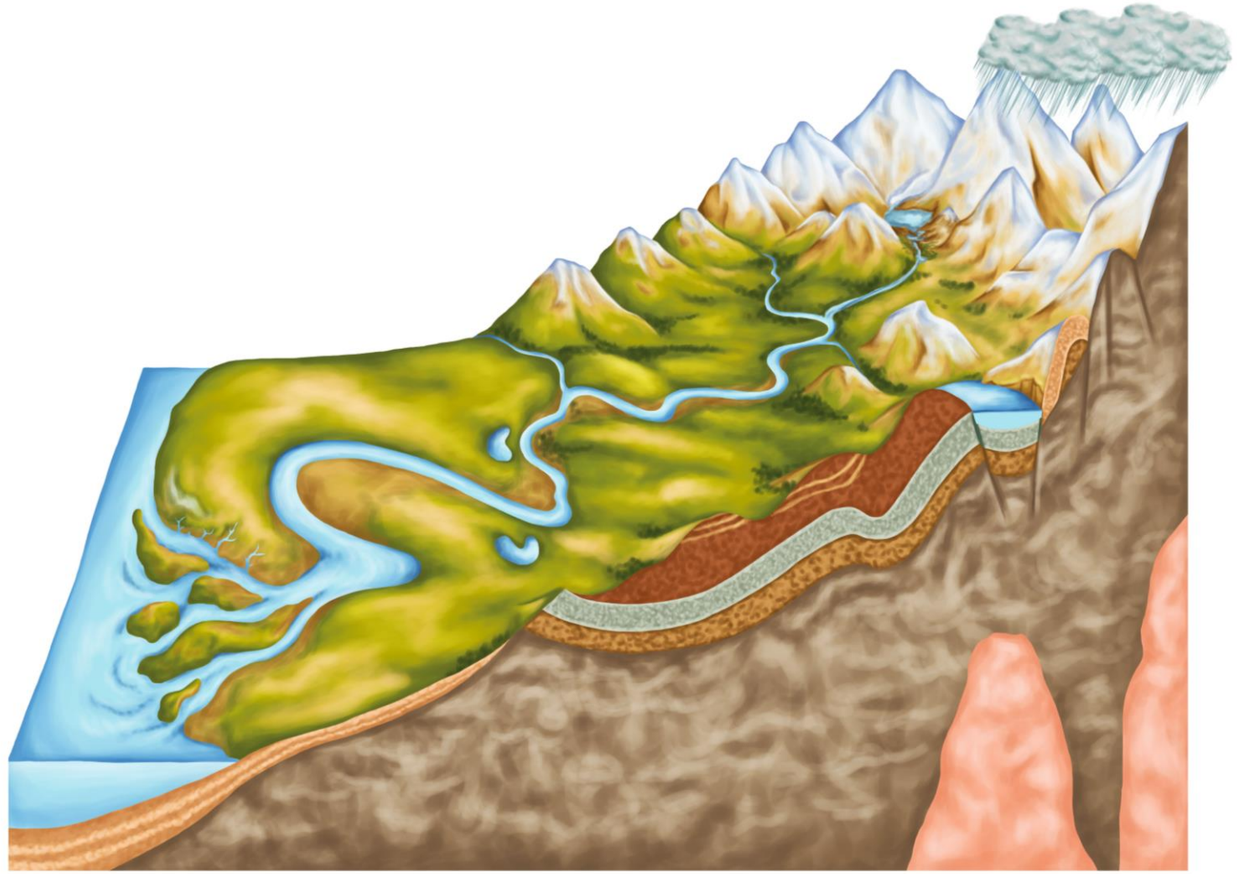
Watershed research is fragmented, leading to understanding that is less than the sum of its parts.

Solution

Combine remotely sensed data with interoperable process research and models.

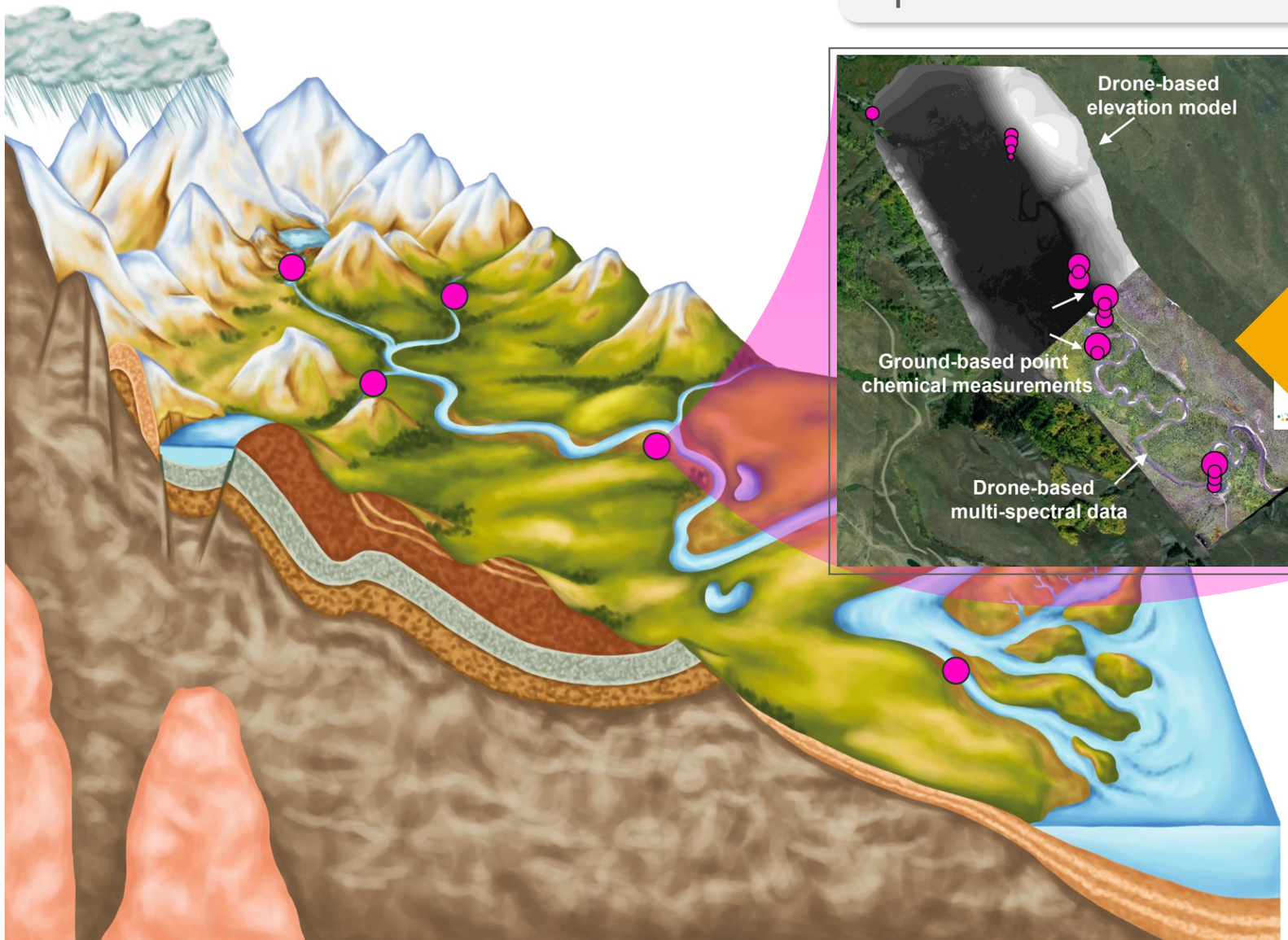
Outcome

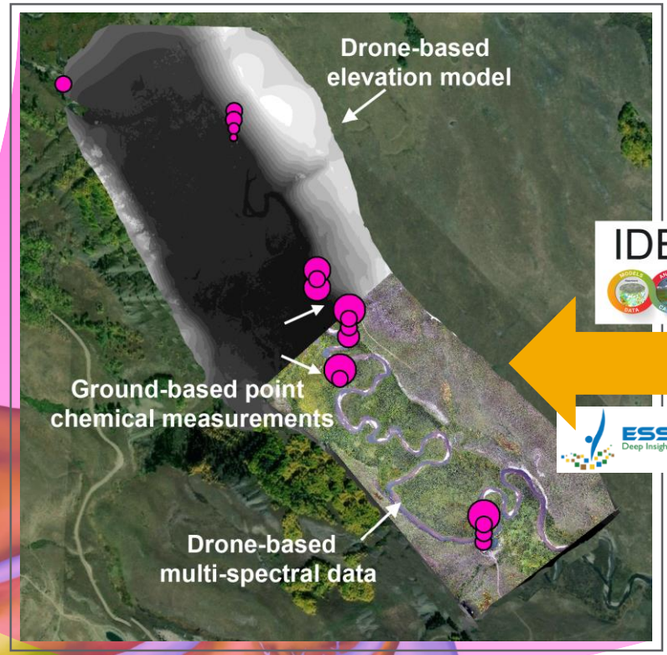
Integrative process knowledge in a watershed context to improve predictions.



ICON-FAIR field campaigns across the watershed

Couple interoperable data and models to improve predictions of water resources and system fluxes





IDEAS

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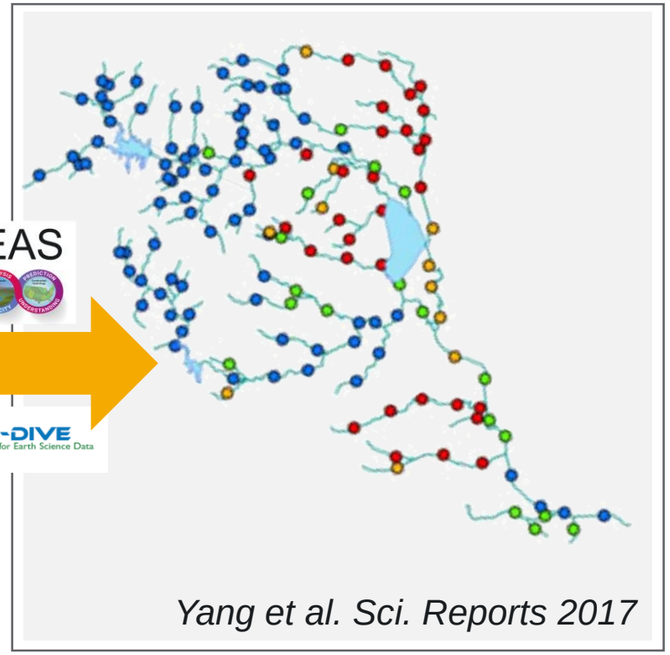


Yang et al. Sci. Reports 2017

Multi-Scale Prototype

Challenge

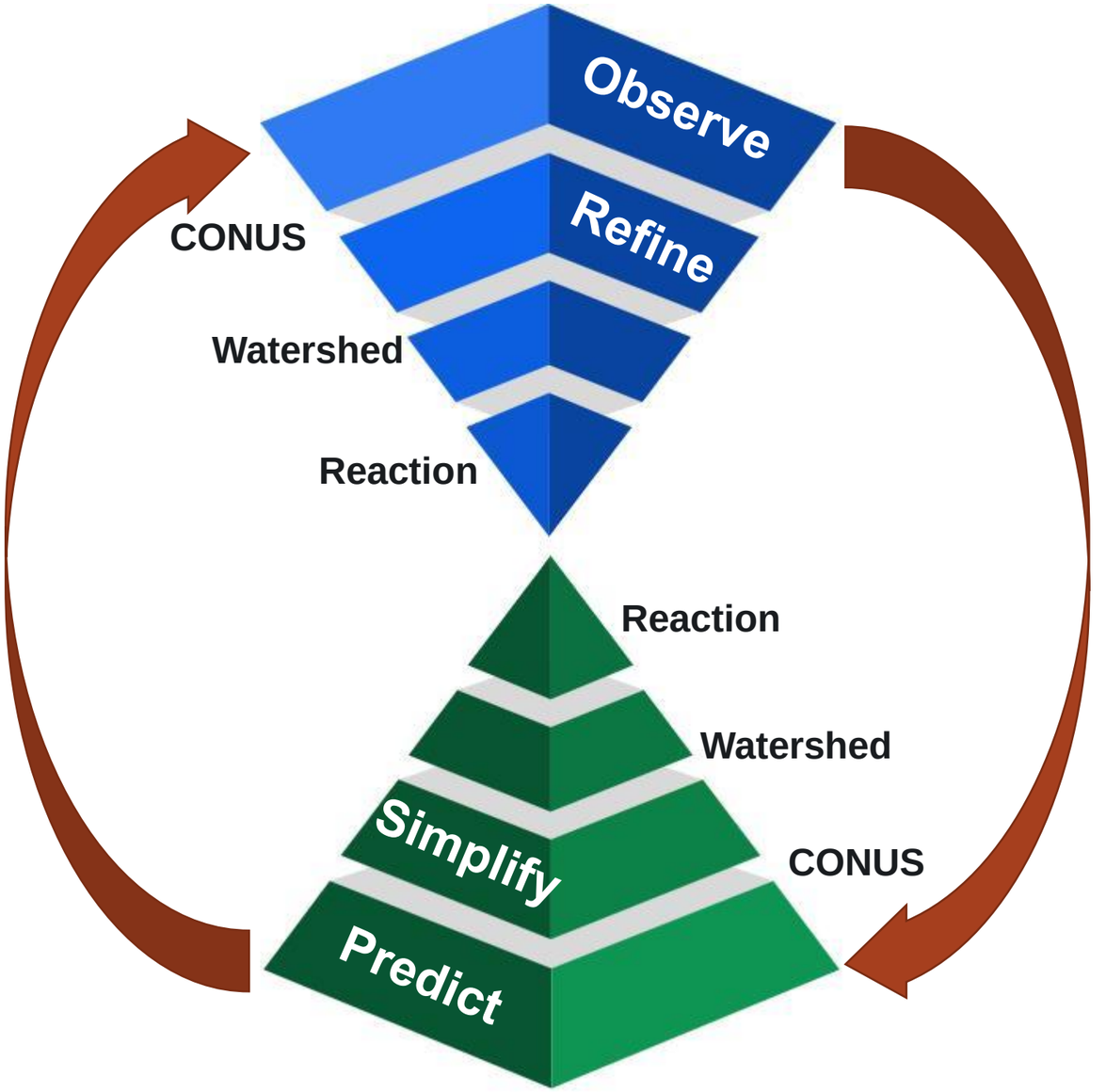
Couple energy, water, and land use across scales to understand and predict system responses to disturbance.

Solution

Use interoperable data and models across scales to understand resilience.

Outcome

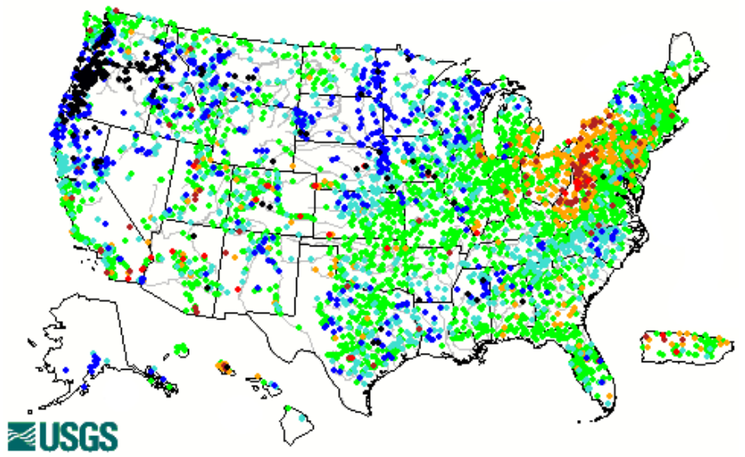
Predict the resilience of different energy sustainability strategies.



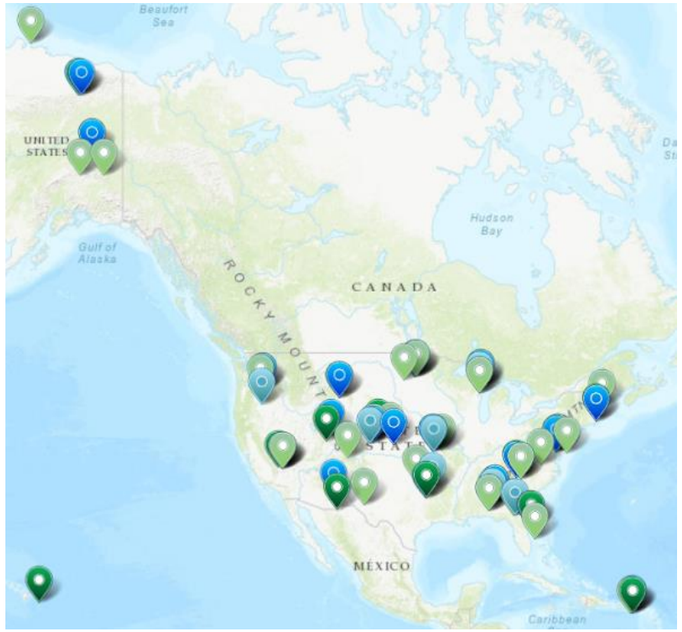
Multi-Scale Integration Through Strategic Partnerships

DOE hydrobiogeochemistry

USGS monitoring



NSF infrastructure



- Improved predictions of watershed response to disturbance.
- Inform decisions to enhance resilience of energy sustainability solutions.

Continuing the Vision

Workshop Report
Targeting early June

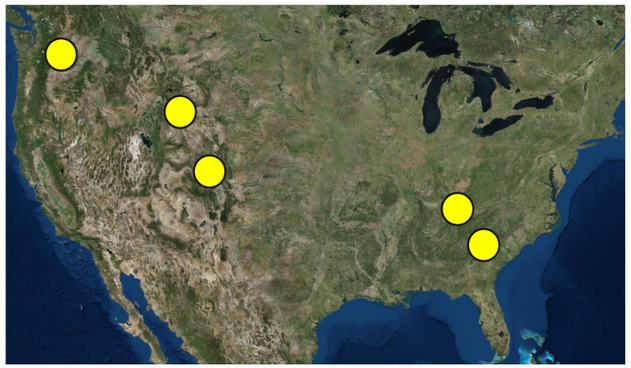
2019 ESS PI Meeting
Plenary presentation, town hall, breakouts

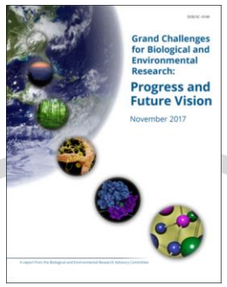
Broader Community
Open webinars (ongoing), AGU session and town hall (2019), AAAS session (2020), capability integration (ongoing)

Subsurface Biogeochemical Research

Amplifying Earth System Science through

OPEN WATERSHEDS BY DESIGN





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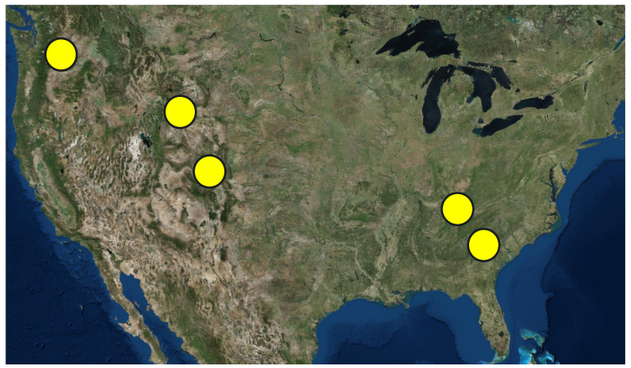
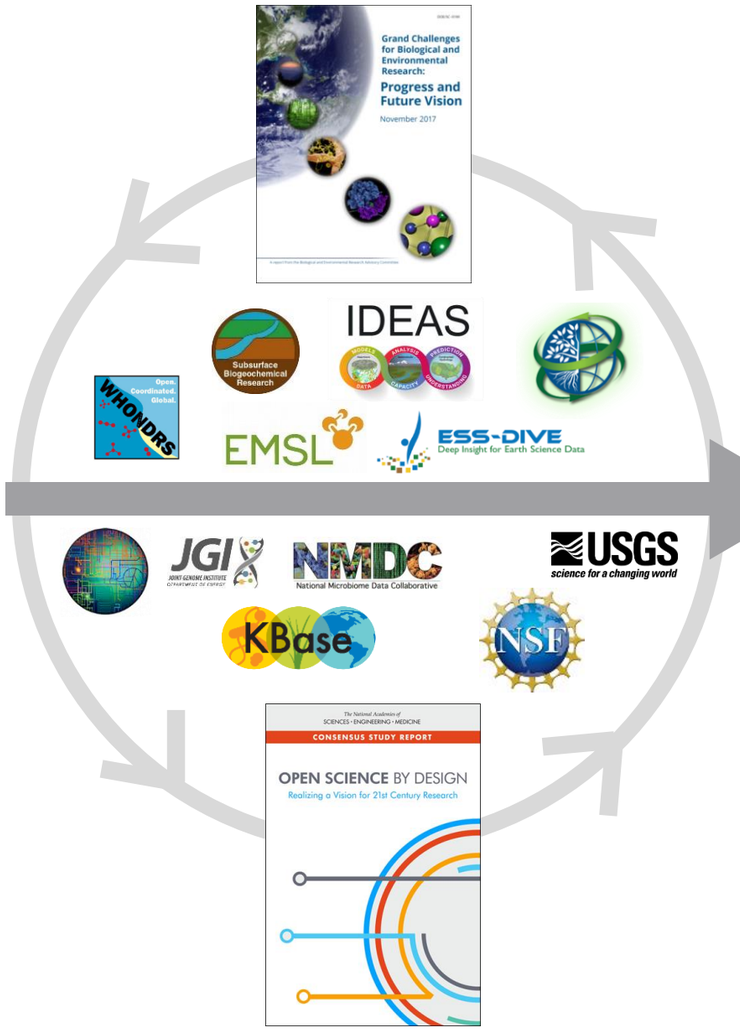
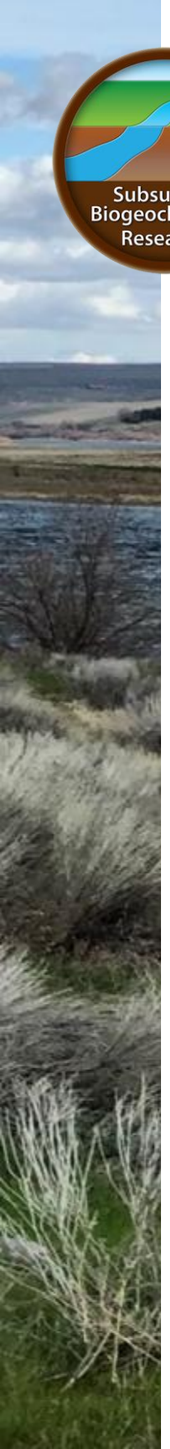




Doing together what would be impossible alone



Leveraging Distributed Research Networks to Understand Watershed Systems

- **Dates:** January 28-30, 2019
- **Location:** Bethesda North Marriott Hotel, Rockville, MD
- **Leadership:** David Lesmes (SBR PM, now at USGS), Paul Bayer (SBR PM), Jessica Moerman (AAAS Fellow), Sujata Emani (AAAS Fellow), James Stegen (co-chair, PNNL), Kelly Wrighton (co-chair, CSU), Eoin Brodie (co-chair, LBNL), Marty Briggs (leadership team, USGS), Charu Varadharajan (LBNL), Jesus Gomez-Velez (Vanderbilt)
- **Attendees:** 48 invitees across national labs (PNNL, LBNL, ORNL, ANL, SLAC,SRNL, LANL, BNL), numerous academic institutions, and federal agencies beyond DOE (USGS, USDA, NSF, EPA, NASA), and private companies funded through DOE-SBIR. Some invitees associated with federal agencies were not able to attend due to the government shutdown.

Leveraging Distributed Research Networks to Understand Watershed Systems

Workshop for the U.S. Dept. of Energy, Biological & Environmental Research Program

January 28-30, 2019
Bethesda North Marriott Hotel, Rockville, MD

Use ***#OpenWatersheds2019*** to post your thoughts and comments to Twitter and please Follow @OpenWatersheds on Twitter

AGENDA

Registration: https://www.regonline.com/sbrjanuarywkshp

Sunday, January 27

TIME	TOPIC
8:00 – 10:00pm	Mixer (*Bethesda North Marriott Hotel Bar*)

Monday, January 28: ***Linden Oak Conference Room***

TIME	TOPIC
7:30 – 8:30am	*Continental Breakfast* (*Hallway outside the Linden Oak Conf. Room*)
8:30 – 8:35am	Welcome (*Jessica Moerman*)
8:35 – 9:05am	Overview of agenda, vision, goals, and outcomes (*James Stegen*)
9:05 – 9:15am	Participants write "I like, I wish, I hope" statements related to workshop vision, and 1 sentence on what open science is. (*Share with partner; post to big board during break*)
9:15 – 9:30am	Open science overview (*Carly Robinson*)
9:30 – 9:55am	Pre-workshop feedback presentations (*5 mins each*) ➢ Key functions to predict, governing processes and scales of understanding (*Eoin Brodie*) ➢ Measurements (*Audrey Sawyer with help from Marty Briggs*) ➢ Computation (*Jesus Gomez-Velez*)

AGENDA

January 28-30, 2019
Bethesda North Marriott Hotel, Rockville, MD

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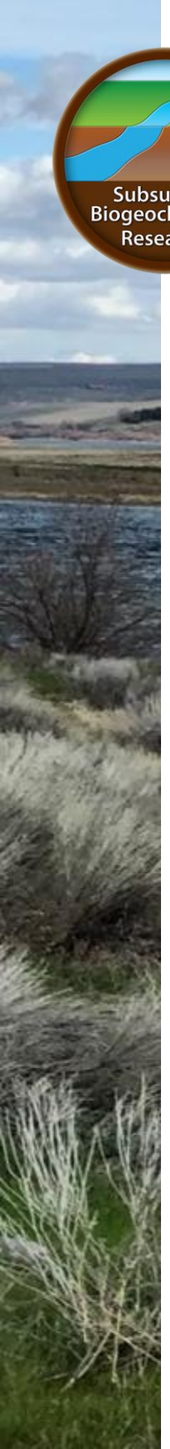
TIME	TOPIC
	➢ Cyberinfrastructure (*Kelly Wrighton*) ➢ Data standards (*Charu Varadharajan*)
9:55 – 10:05am	Group discussion on pre-workshop outcomes (*Panel style; Jessica Moerman scribe to Google doc*)
10:05 – 10:20am	*Break* (*Post "*I like, I wish, I hope*" and open science sentence to big board; mingle, discuss, and/or draw a picture; NO email*)
10:20 – 10:25am	5 mins to plan a birthday party using yes, BUT vs. yes, AND (*Kate Maher and David Moulton*)
10:25 – 10:40am	Provocative ideas for national scale distributed research (*Eve Hinckley, Audrey Sawyer, Ethan Coon; 5 mins each*)
10:40 – 10:50am	Group 'yes and' discussion exploring synergies among the 3 provocative ideas (*Everyone together; Jessica Moerman scribe to Google doc*)
10:50 – 11:15am	Exchange of big, wild ideas around national scale distributed research in a 'yes and' exercise using the Solo, Share, Synergy approach (*3 mins to describe S^3 from Kate Maher; 20 minutes to do S^3*). Capture ideas on paper, and capture the synergy between ideas with a drawing and write a headline. Post to big board. (*Everyone, partnered with neighbor*)
11:15 – 11:30am	Describe how breakout will work, its goals, etc., and organize people into breakouts (*participants align breakout theme to their expertise*) (*James Stegen*)
11:30 – 1:30pm	*Working Lunch and Breakouts*: 3 concurrent, each focused on challenges and opportunities in measurements, cyberinfrastructure/standards, or computation (*Audrey Sawyer/James Stegen - measurement; Eoin Brodie/Jesus Gomez-Velez – computation; Kelly Wrighton/Charu Varadharajan – cyberinfrastructure*)
1:30 – 2:00pm	Report outs from breakouts and associated discussion (*1 lead from each*)
2:00 – 2:15pm	*Break* (*explore the big board, mingle, discuss, and/or draw a picture; NO email*)



Leveraging Distributed Research Networks to Understand Watershed Systems

AGENDA

January 28-30, 2019
Bethesda North Marriott Hotel, Rockville, MD
Use **#OpenWatersheds2019** to post your thoughts and comments to Twitter and please Follow @OpenWatersheds on Twitter

TIME	TOPIC
2:15 – 2:30pm	Describe how breakout will work, its goals, etc., and organize people into breakouts (*mix people from across first breakout*) (*James Stegen*)
2:30 – 4:30pm	Breakouts: 3 concurrent, each focused on challenges and opportunities in linking measurements, cyberinfrastructure/standards, AND computation (*Audrey Sawyer/Eoin Brodie; Kelly Wrighton/James Stegen; Charu Varadharajan/Jesus Gomez-Velez*)
4:30 – 5:00pm	Report outs from breakouts and associated discussion (*1 lead from each*)
5:00 – 6:00 pm	*Break*
6:00pm	*Dinner (On your own within groups of 4-5; list of restaurant options within walking distance will be available)*

Tuesday, January 29: ***Linden Oak Conference Room***

TIME	TOPIC
7:30 – 8:30am	*Continental Breakfast* (*Hallway outside the Linden Oak Conf. Room*)
8:30 – 8:50am	Overview of agenda, day-one outcomes, themes, major ideas, etc. (*James Stegen*)
8:50 – 9:10am	Hot Takes: Open to anyone that wants to speak for 2 mins on any topic they feel strongly about, especially on ideas that came about during informal evening discussions. Could have 1 slide, or no slides (*Self-identify; Jessica Moerman to scribe to Google doc*)
9:10 – 9:25am	Vision for how to use models to guide the design (spatial and temporal layout) of field sensor/sampling programs (*Eoin Brodie, Praveen Kumar, Maoyi Huang; 5 mins each*)
9:25 – 9:35am	Group 'yes and' discussion exploring synergies among the 3 visions (*Everyone together; Jessica Moerman scribe to Google doc*)
9:35 – 9:55am	Exchange of big, wild ideas around model-guided data collection in a 'yes and' exercise using the S^3 approach. Capture ideas on paper, and

AGENDA

January 28-30, 2019
Bethesda North Marriott Hotel, Rockville, MD
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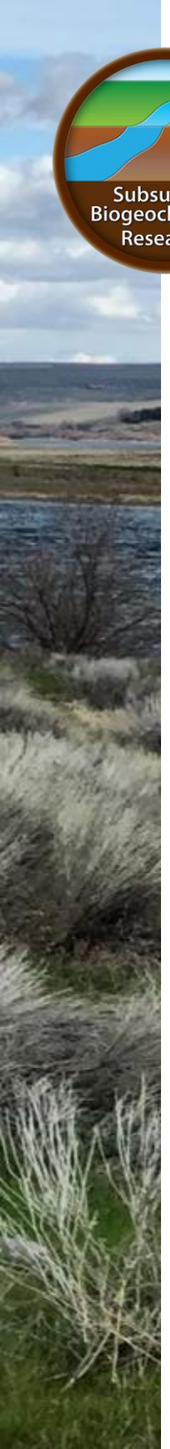
TIME	TOPIC
	capture the synergy between ideas with a drawing and write a headline. Post to big board. (*Everyone, partnered with neighbor*).
9:55 – 10:10am	*Break* (*explore the big board, mingle, discuss, and/or draw a picture; NO email*)
10:10 – 10:55am	Vision and opportunities for connecting (*5 mins each*) ➢ NEON to coordinated open watershed networks (*Bill McDowell*) ➢ LTER and CZO to coordinated open watershed networks (*Bill McDowell*) ➢ USGS to coordinated open watershed networks (*James Stegen via Marty Briggs*) ➢ CUASHI to coordinated open watershed networks (*Jesus Gomez-Velez*) ➢ IDEAS to coordinated open watershed networks (*David Moulton*)
10:55 – 11:05am	Group 'yes and' discussion exploring ways to link existing infrastructure to national scale distributed watershed science programs (*Everyone together; Jessica Moerman scribe to Google doc*)
11:05 – 11:25am	Exchange of big, wild ideas around infrastructure synergy in a 'yes and' exercise using the S^3 approach. Capture ideas on paper, and capture the synergy between ideas with a drawing and write a headline. Post to big board (*Everyone, partnered with neighbor*)
11:25 – 11:40am	Describe how breakout will work, its goals, etc., and organize people into breakouts (mix people again) (*James Stegen*)
11:40 – 1:40pm	*Working Lunch and Breakouts*: 3 concurrent, each focused on challenges and opportunities in model-guided field deployments, leveraging existing infrastructure, or connecting efforts across agencies (*Kelly Wrighton/Eoin Brodie; Charu Varadharajan/James Stegen; Audrey Sawyer/Jesus Gomez-Velez*)
1:40 – 2:00pm	Report outs from breakouts (*1 lead from each*)
2:00 – 2:15pm	*Break* (*explore the big board, mingle, discuss, and/or draw a picture; NO email*)
2:15 – 2:30pm	Vision for changing science culture and incentive schemes towards broader adoption of open science (*David Mellor*)



Leveraging Distributed Research Networks to Understand Watershed Systems

AGENDA

January 28-30, 2019
Bethesda North Marriott Hotel, Rockville, MD
Use ***#OpenWatersheds2019*** to post your thoughts and comments to Twitter and please Follow @OpenWatersheds on Twitter

TIME	TOPIC
2:30 – 2:45pm	Describe how breakout will work, its goals, etc., and organize people into breakouts (mix people again) (*James Stegen*)
2:45 – 4:45pm	Breakouts: 3 concurrent, each focused on challenges and opportunities in changing science culture and incentive schemes towards broader adoption of open science (*Carly Robinson/Kelly Wrighton, David Mellor/Audrey Sawyer & James Stegen/Charu Varadharajan*)
4:45 – 5:15pm	Report outs from breakouts (*1 lead from each*)
5:15 – 5:45pm	Closing remarks and next steps (*James Stegen*)
5:45 – 6:45pm	*Break*
6:45pm	*Meet in the hotel lobby & walk to restaurant*
7:00pm	*Dinner (Private room at Seasons 52, 11414 Rockville Pike, North Bethesda, MD 20852; Phone: 301-984-5252)*

Wednesday, January 30: ***Linden Oak Conference Room***

TIME	TOPIC
7:30 – 8:30am	*Continental Breakfast (Hallway outside the Linden Oak Conf. Room)*
8:30am – 12:00pm	Writing team reviews material generated before and during the workshop, uses it to update the report storyboard, identifies key graphics needs, and assigns writing tasks (*James Stegen to Lead; Workshop Team*)

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)

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

Workshop Participants

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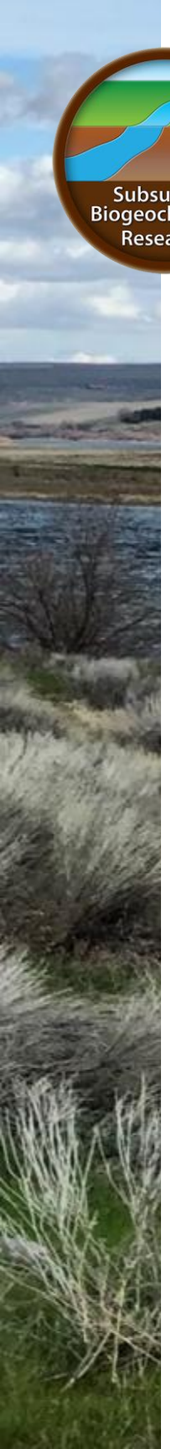
35. Carly Robinson, DOE; carly.robinson@science.doe.gov
36. Audrey Sawyer, OSU; sawyer.143@osu.edu



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37. *Denice Shaw, EPA; shaw.denice@epa.gov
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**Participants may not be able to attend due to the government shutdown*