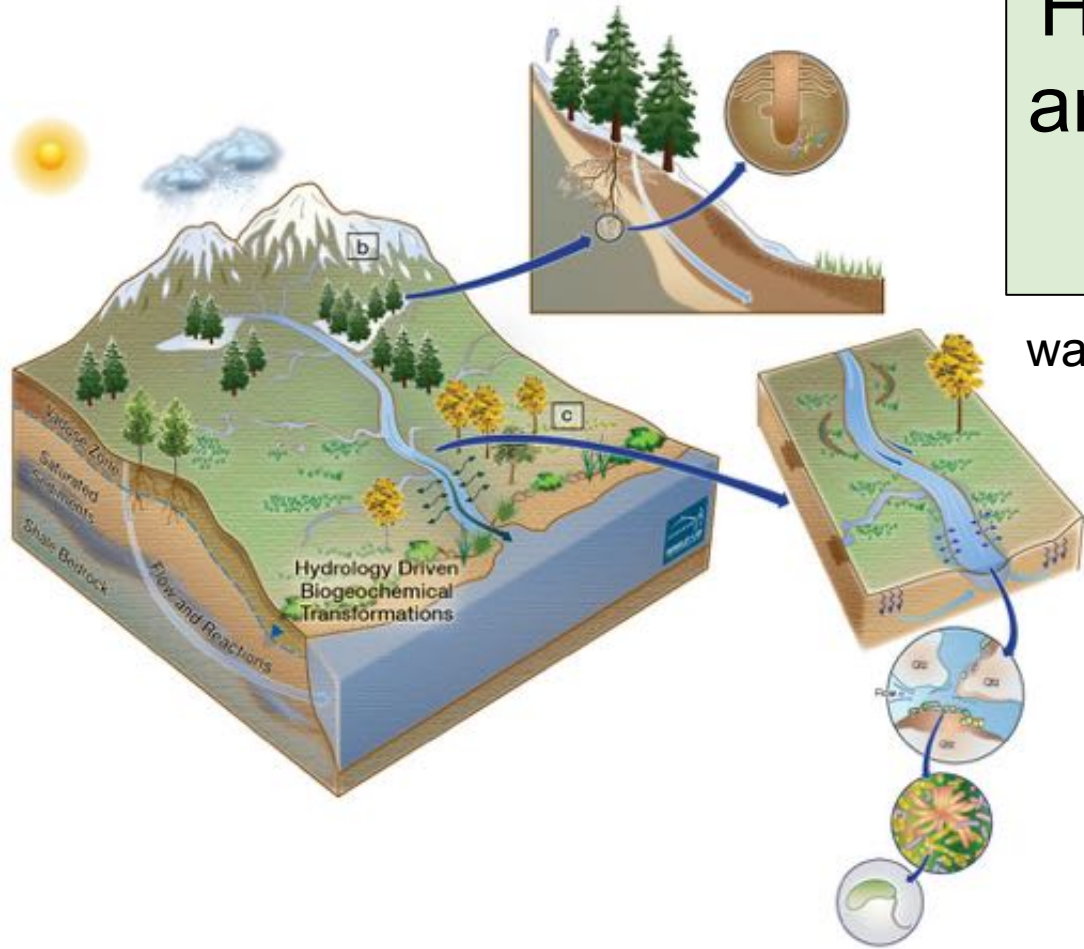# The East River Watershed:
Berkeley Lab's Watershed Function SFA and synergy with SAIL & SPLASH

Kenneth H. Williams and the **Watershed Function SFA Team**

Berkeley Lab's Watershed Function **S**cientific **F**ocus **A**rea (SFA)

Hydrology Driven Biogeochemical Transformations

How do mountainous watersheds retain and release water, nutrients, carbon and metals?

What are the consequences of early snowmelt and drought on water availability and biogeochemical cycling at episodic to decadal timescales?

Outline:

1. SFA Research Components
2. Overview of the "Community Watershed"
3. Research Infrastructure and Community datasets
4. Watershed SFA + SAIL/ SPLASH Research Questions

Objective: Subdivide a watershed system into a collection of representative elements or "sub-systems" that may be characterized, monitored, and ultimately modeled *as an integrated "system"*
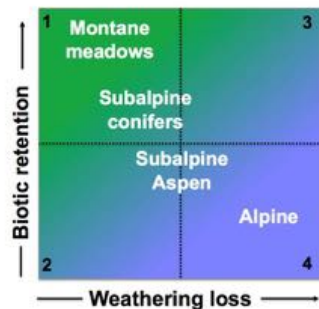
SFA Research Components

EcoHydroGeology

Quantify and predict hillslope contributions to river chemistry
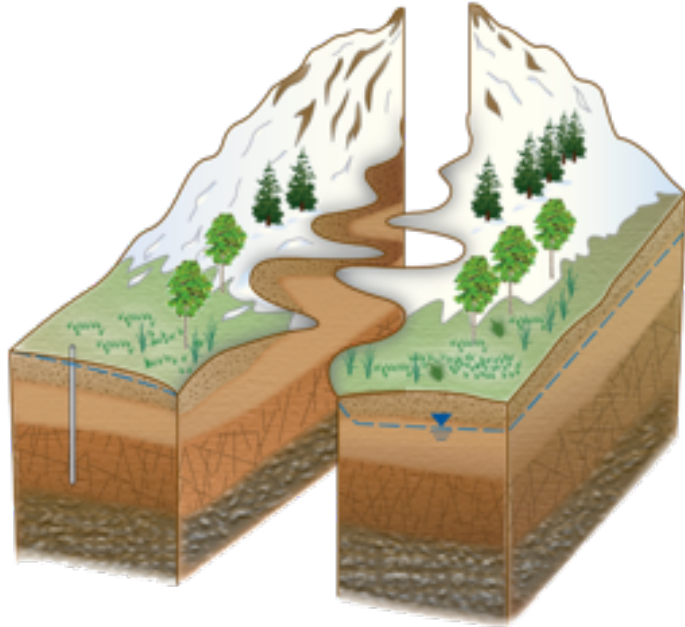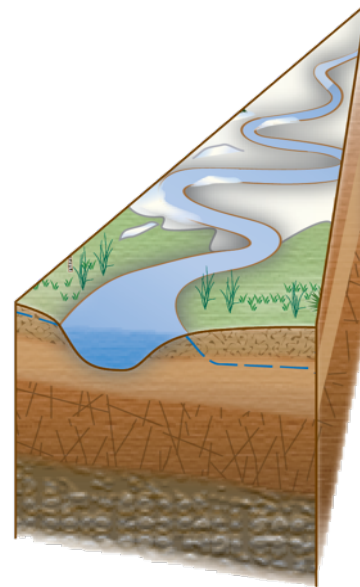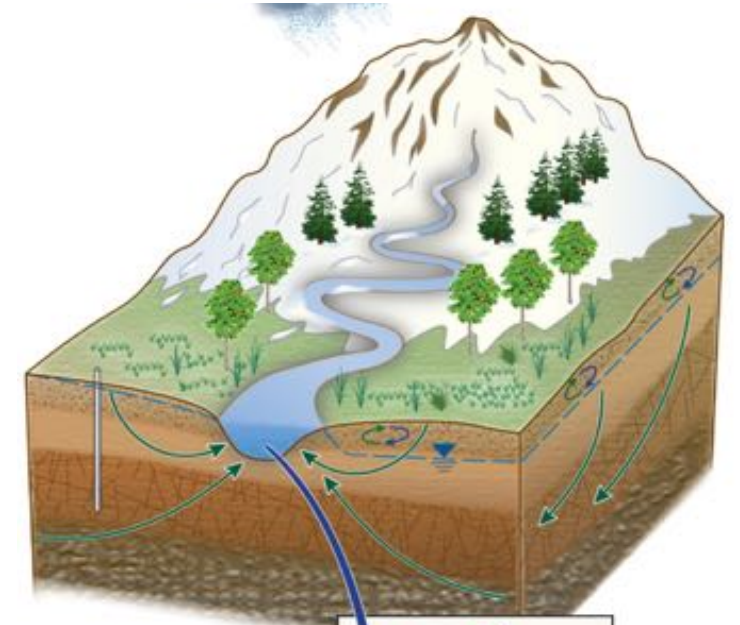

Watershed Index for Retention and Loss (WIRL)

River Corridor Processes

Quantify how hydrobiogeochemical exchanges across river corridor interfaces alter chemistry exports downgradient
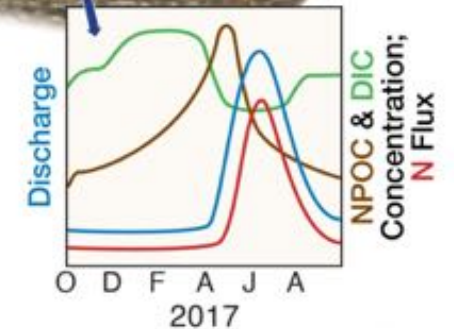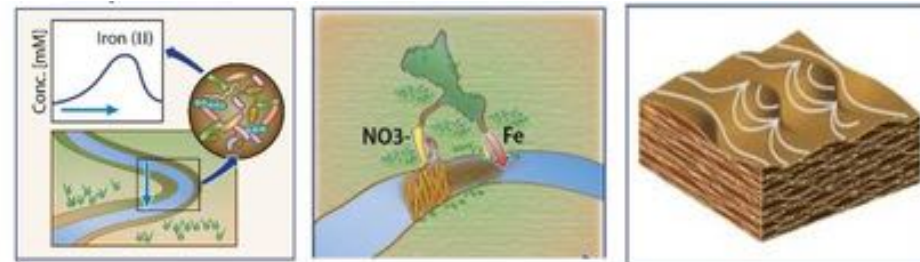

Meanders   Off-channel Wetlands   Hyporheic Zone

Watershed Aggregation

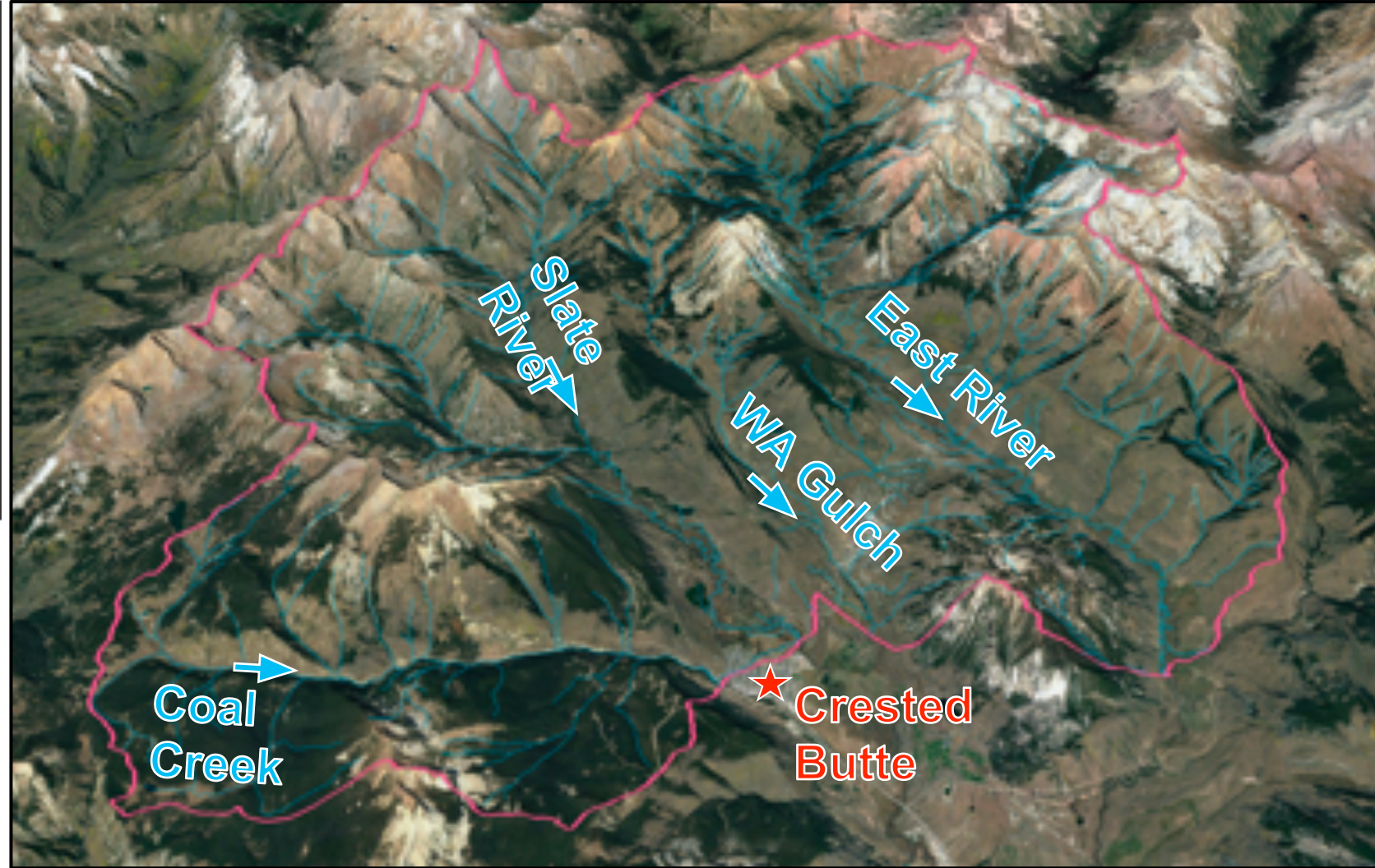Quantify and predict how heterogeneous watershed subsystem exports aggregate in response to perturbations


EESA19-029

The East River Community Watershed:

- Representative headwater in the UCRB
- Headwaters of the Gunnison River
- Snow dominated system

300 km² experimental watershed *encompassing strong gradients* near Crested Butte, CO hosting the research of 150+ investigators

East River system diversity and "eco-gradients"

Geologic gradients

Vegetation

Metal

Fluvial
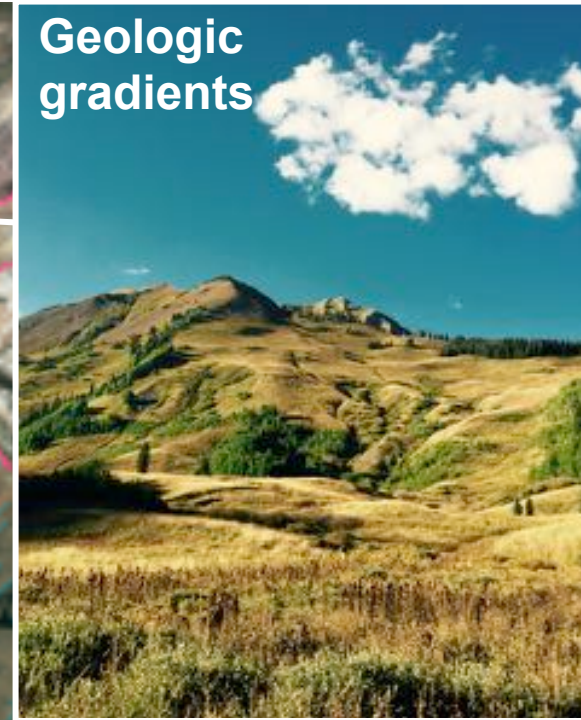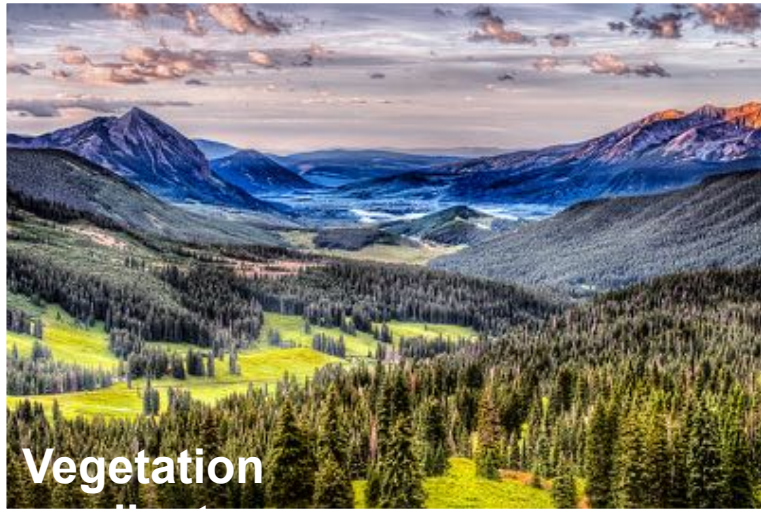
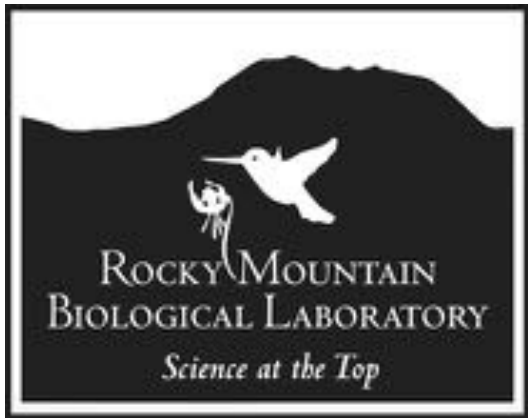# How to tackle so much system diversity?

Community Watershed

"to accomplish collectively what can't be accomplished alone"
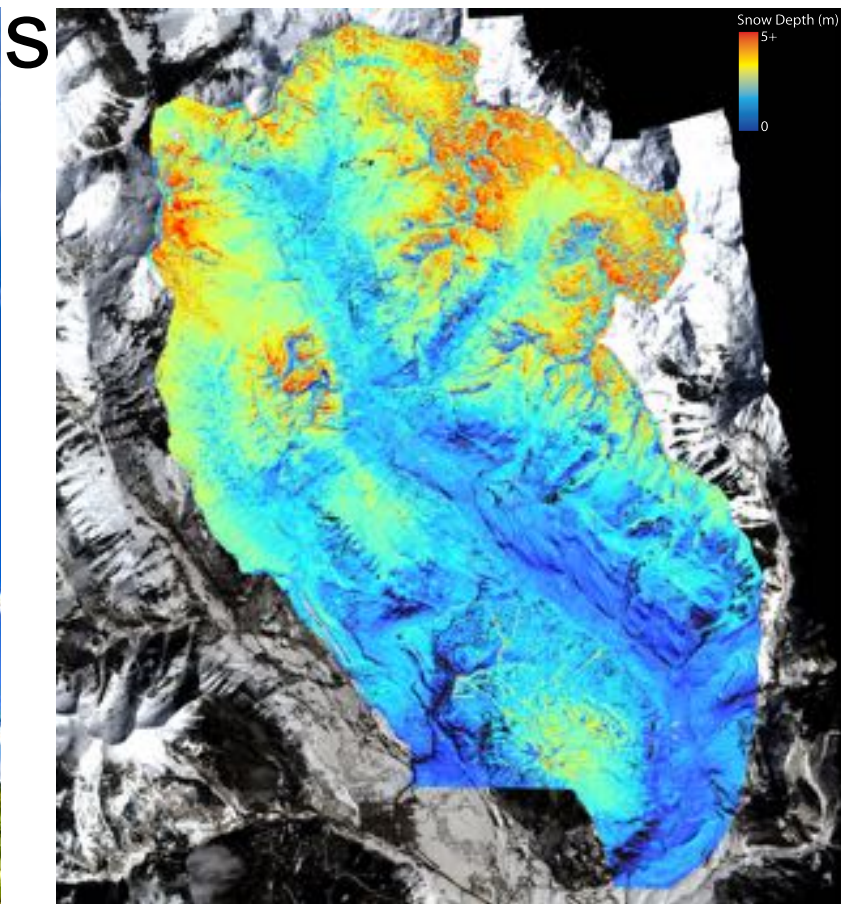
"Community Watershed"

A multi-institutional, multi-disciplinary team led by Berkeley Lab and its key partner and site host RMBL:

- Tight coordination of research to promote collaborative ('open') rather than duplicative ('closed') science

- 7 National Labs; 28 Universities; 6 Federal & State agencies; 3 local stakeholders; 6 small businesses

- Hosts 2 NSF CZCN projects, 1 USGS NGWOS, and 2 new DOE-ASR projects

- 150+ investigators, staff, students, and postdocs

- Hydrology, geology, (bio)geochemistry, geophysics,

"Community Watershed"

Collection, installation, maintenance of community data

Remote sensing (<1m DEM)
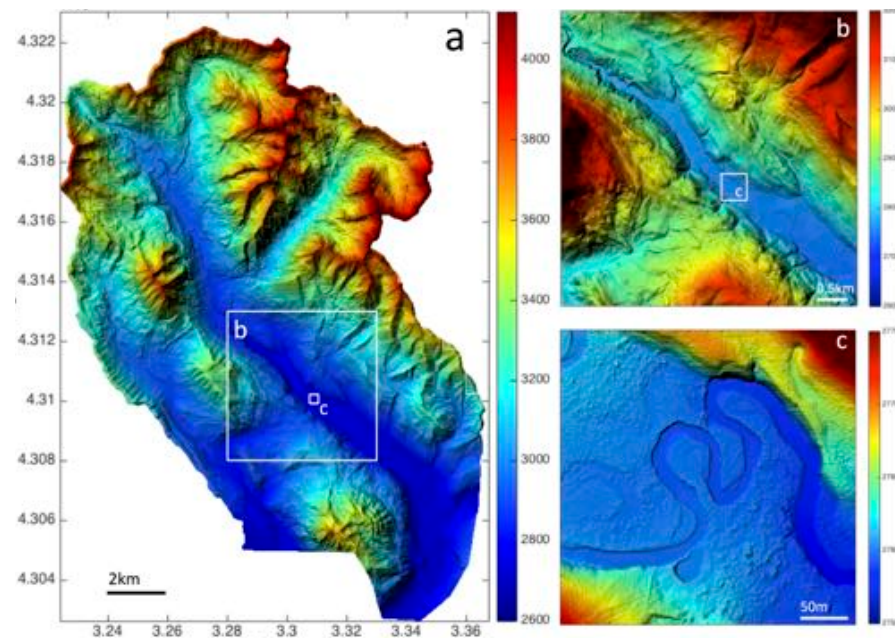
Met stations / flux towers   Remote sensing (NASA ASO)

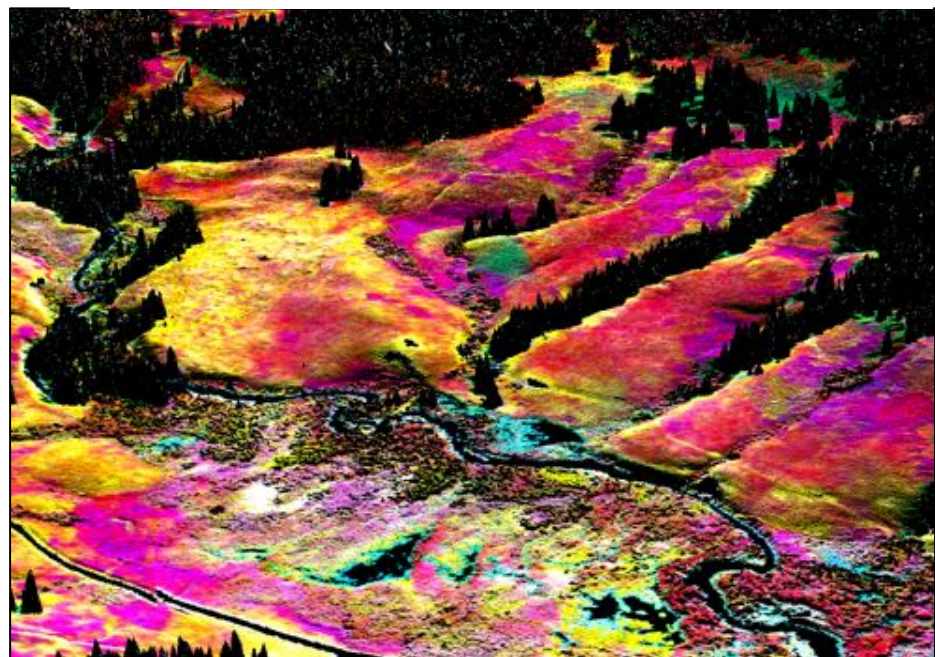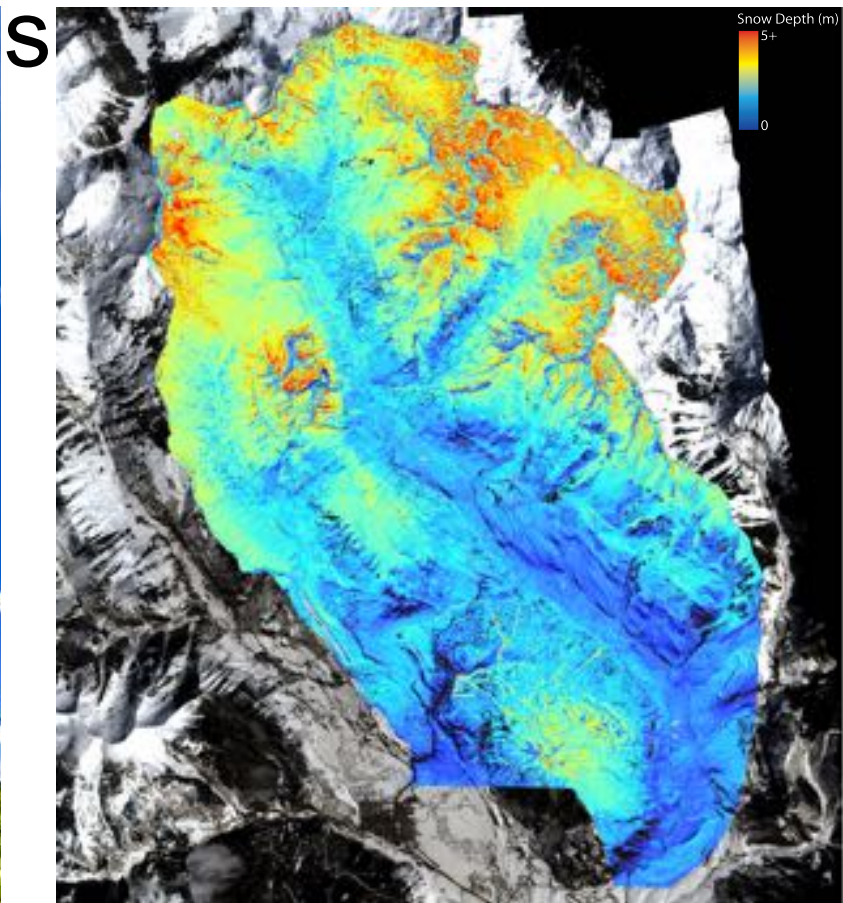Stream gauging network

"Community Watershed"

Collection, installation, maintenance of community data

Remote sensing (Hyperspectral)
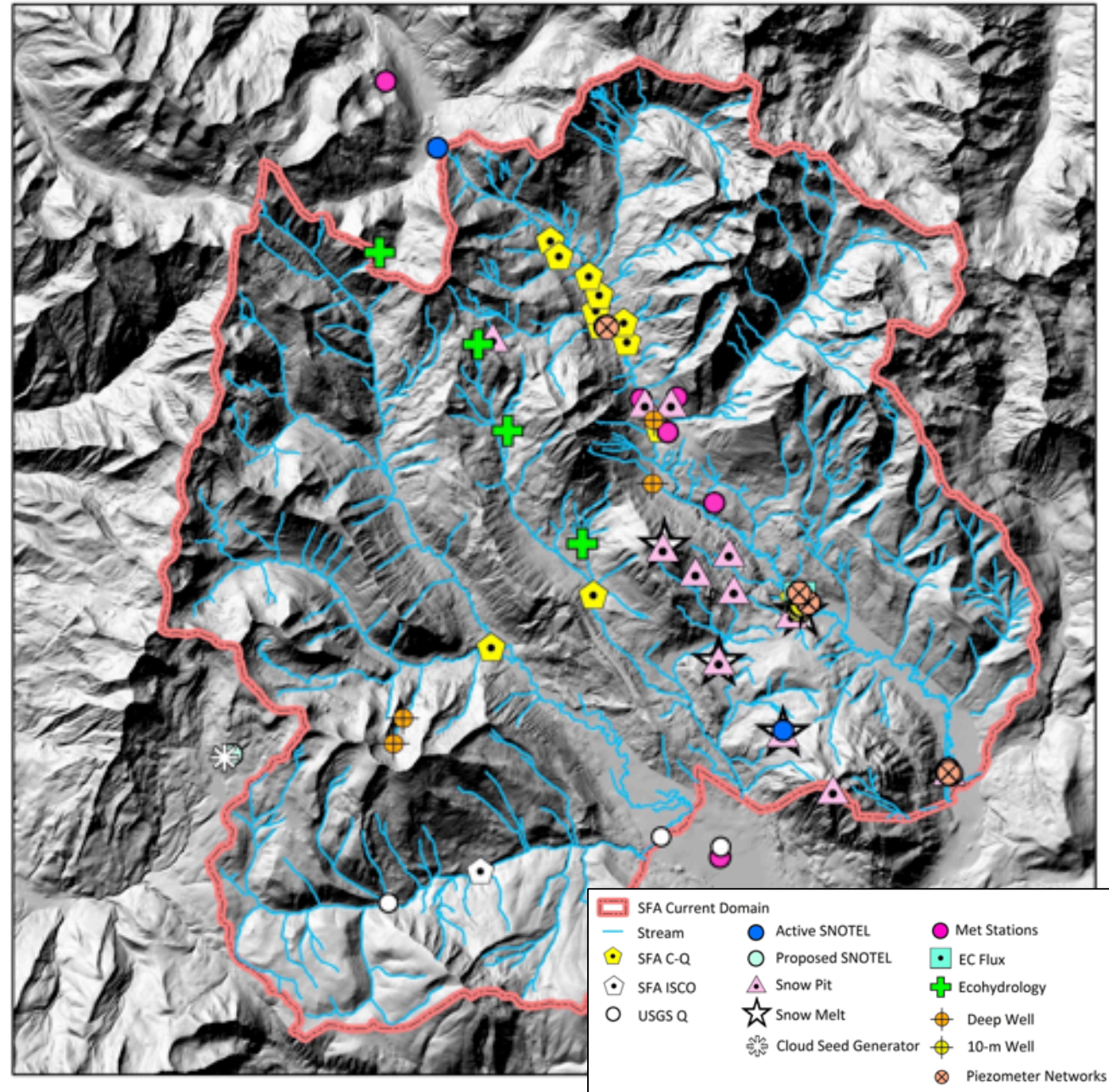

Snow Depth (m)

Met stations / flux towers   Remote sensing (NASA ASO) Drilling, groundwater wells, permitting

Research
in

- **Rocky Mountain Biological Lab:** Base of operations; research facilitator
- Lab space; high speed internet; Off-Highway Vehicle; Snowmobile
- 11 weather stations; 1 EC flux tower; 2 SNOTEL sites; EPA CASTNET station
- Monitoring well network (1-100m)

Legend:
- SFA Current Domain
- Stream
- SFA C-Q
- SFA ISCO
- USGS Q
- Active SNOTEL
- Proposed SNOTEL
- Snow Pit
- Snow Melt
- Cloud Seed Generator
- Met Stations
- EC Flux
- Ecohydrology
- Deep Well
- 10-m Well
- Piezometer Networks

Research Questions Enabled by WFSFA + SAIL/SPLASH

How does complex topography control **snowpack accumulation, sublimation, melt, and groundwater recharge**?

How do summer and fall monsoon inputs impact **antecedent soil moisture conditions** and following season **stream flow?**

How do spatial variations in **precipitation and phase** (snow vs. rain) impact **soil moisture and stream discharge?**
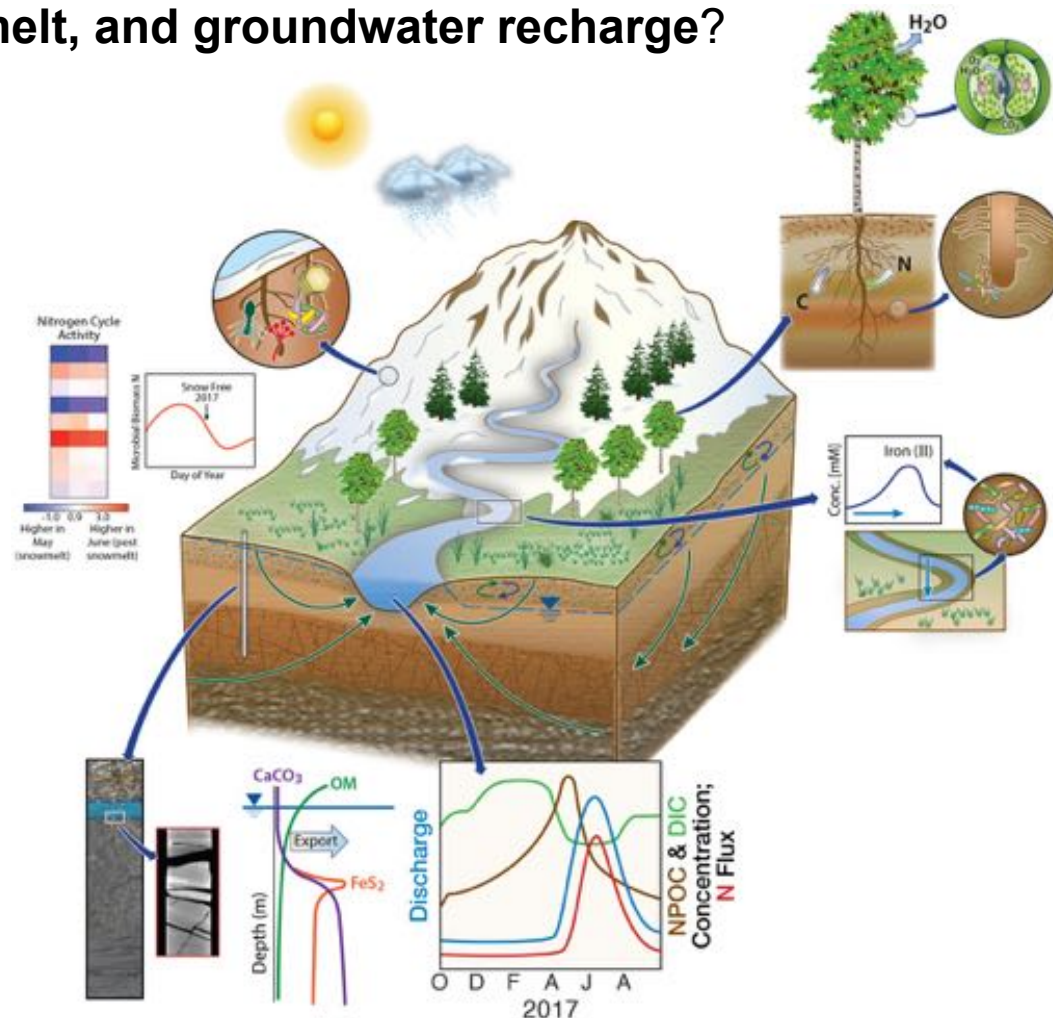
How do spatiotemporal variations in **aerosol deposition** impact snowmelt rates, melt patterns, **nutrient delivery, and "hotspots" of microbial activity**?

Can we quantitatively track the input and impacts of **cloud seeding** at the scale of the single 300 km^2 watershed?

What is the **minimum-but-sufficient** information spanning the **atmosphere-to-bedrock continuum** needed to accurately predict fluxes of water and solutes?