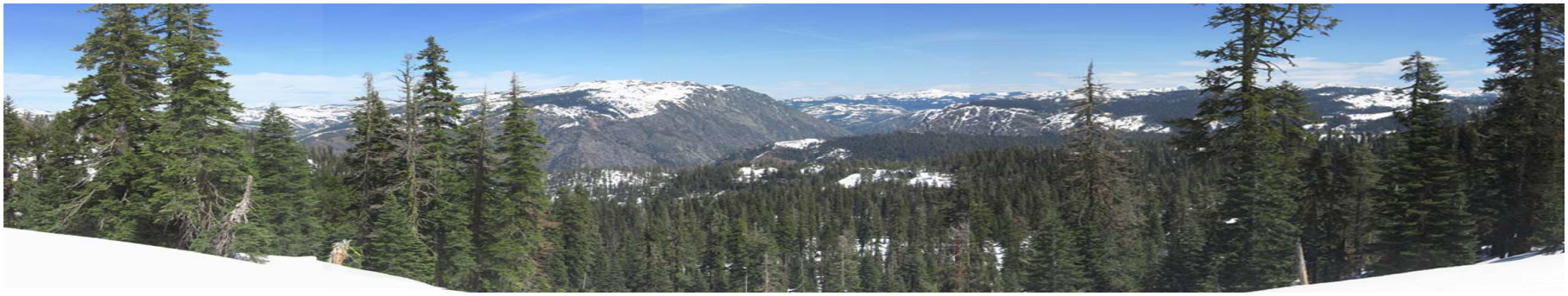


Sierra Nevada Adaptive Management Project:

Design and Current Research

SIERRA NEVADA
ADAPTIVE
MANAGEMENT
PROJECT
SNAMP.CNR.BERKELEY.EDU

Topics Covered

- Background, overview, & objectives
  - What and why of SNAMP
- Research questions, study sites, & instrumentation
  - What do we hope to learn?
  - What approach are we using? how?
- Observations, & data
  - Research highlights
- Scaling up & next steps
  - Modeling approach
  - Future plans

Background

Consensus that forests are at risk from fire & uncertainty on how best to reduce risk

- USFS Sierra Nevada Forest Plan Amendment (2001)
  - Outlines "regional planning efforts aimed at managing species and ecosystems of the Sierra Nevada bioregion" (USFS)
- Record of Decision (2004)
  - Updates SNFPA to "improve protection of old forests, wildlife habitats, watersheds and communities"

Controversy over USFS management

- Lawsuit by State of California
  - Not sufficiently practicing 'Adaptive Management'

An acknowledged need to learn more

- UC involved as neutral third party

Adaptive Management Framework

USFS: Plan projects with existing management direction (ROD)

Analyze & model expected environmental affects

USFS: Implement projects as treatments

Observe & measure

Analyze & recalibrate models

Propose adjustments to management?

USFS: Change management direction as needed

"Adaptive management must be a participatory process that engages scientists, stakeholders, and managers in a long-term relationship grounded in shared learning about the ecosystem and society." UC Science Team

Topics Covered

- Background, overview, & objectives
  - What and why of SNAMP
- Research questions, study sites & instrumentation
  - What do we hope to learn?
  - What approach are we using? how?
- Observations, & data
  - Research highlights
- Scaling up & next steps
  - Modeling approach
  - Future plans

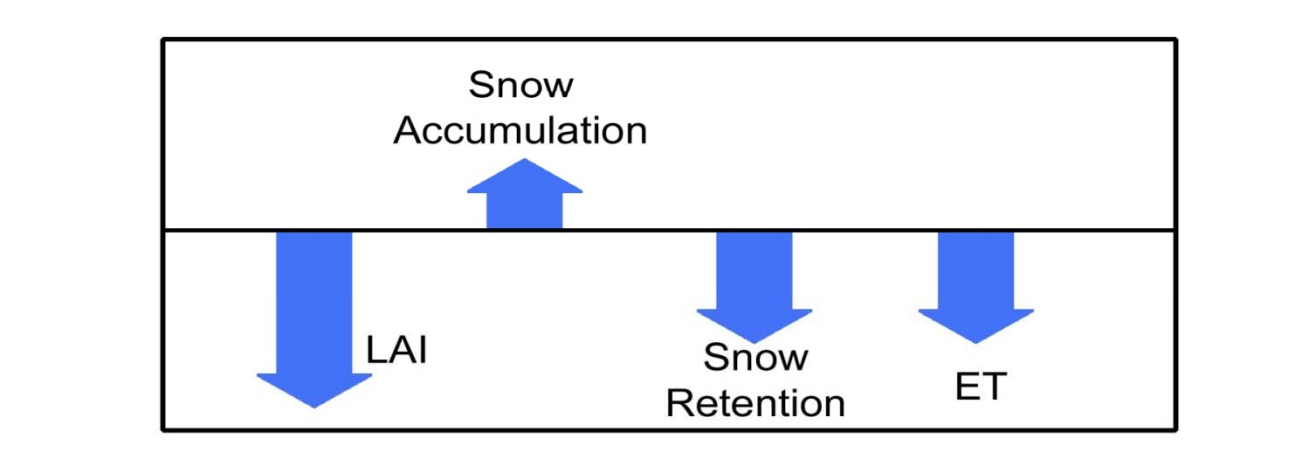
Research Questions

Where and when is water stored and how is it routed through the catchments?

What effects do forest treatments have on water quality, quantity, storage and routing through the catchments?

What is the transferability of 1 km2 watersheds to fireshed response?

What do we expect to see?



Fuels treatments will reduce **Leaf Area Index (LAI)**

As Leaf Area Index (LAI) decreases, snow accumulation on the ground will increase, while evapotranspiration (ET) and snow retention in late spring will decrease.

Leaf Area Index

- "the ratio of total upper leaf surface of vegetation divided by the surface area of the land on which the vegetation grows"
- "the one sided green leaf area per unit ground area"
- "the amount of leaf material in an ecosystem"

LAI ~ canopy cover

Fuels treatments will reduce **Leaf Area Index (LAI)**

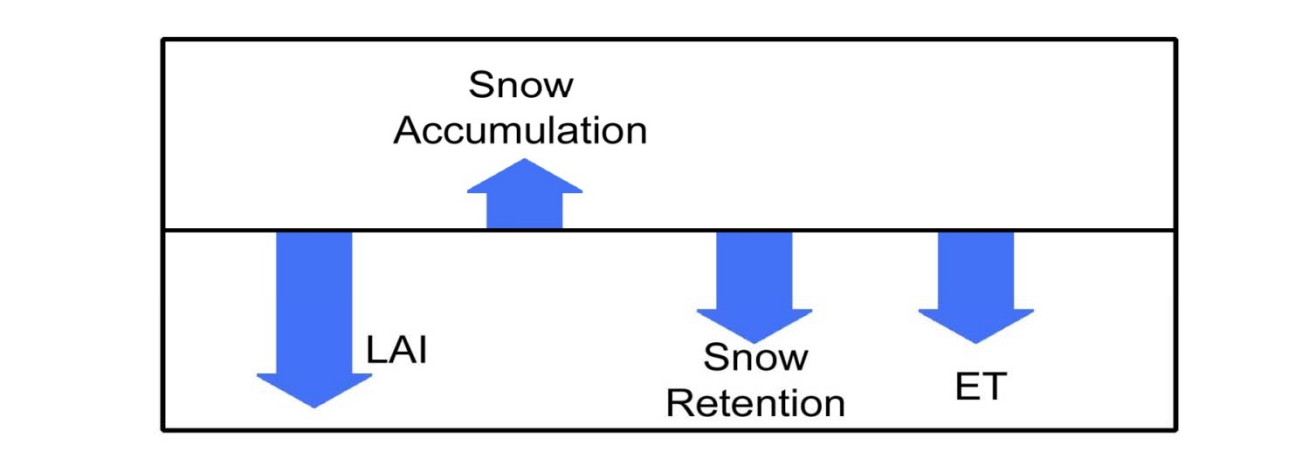
As Leaf Area Index (LAI) decreases, snow accumulation on the ground will increase, while evapotranspiration (ET) and snow retention in late spring will decrease.

http://en.wikipedia.org/wiki/Leaf_Area_Index

http://www.uni-giessen.de/~gh1461/plapada/lai/lai.html

http://gosic.org/ios/MATRICES/ECV/TERRESTRIAL/ECV-GCOS-TERRESTRIAL-LAI.htm

What do we expect to see?



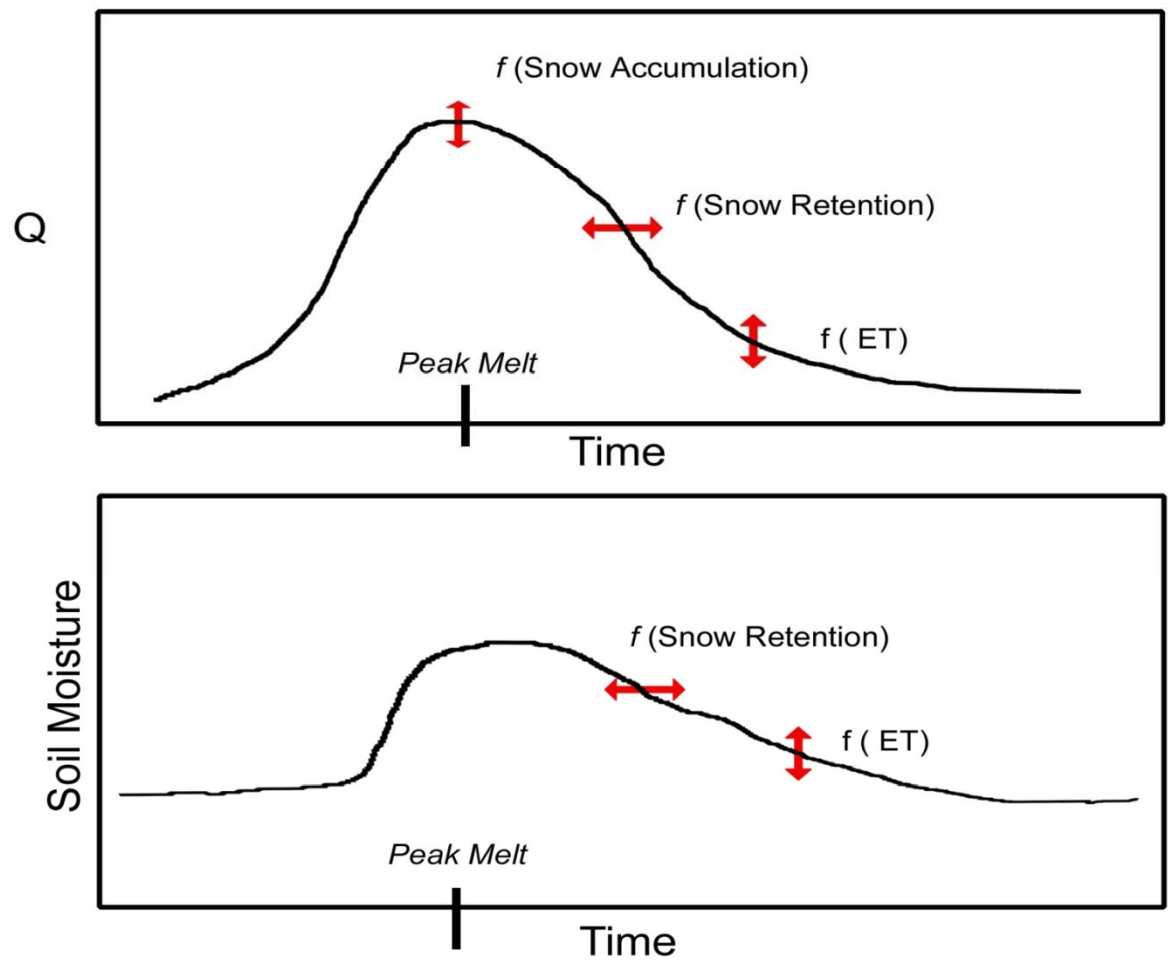
Fuels treatments will reduce **Leaf Area Index (LAI)**

As Leaf Area Index (LAI) decreases, snow accumulation on the ground will increase, while evapotranspiration (ET) and snow retention in late spring will decrease.

What do we expect to see?

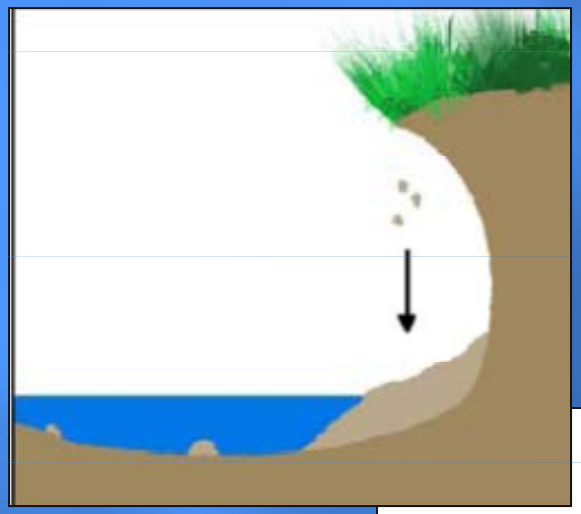
A change in snow accumulation will be seen in the magnitude of peak stream flow.

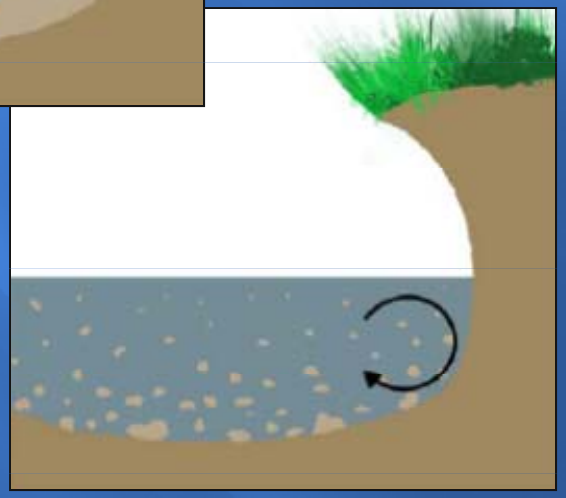
Changes in snow retention, will be observed in the recession limb of the hydrograph and the soil moisture curves.



Changes in ET will affect both the timing and the magnitude of late season base stream flow.

What do we expect to see?





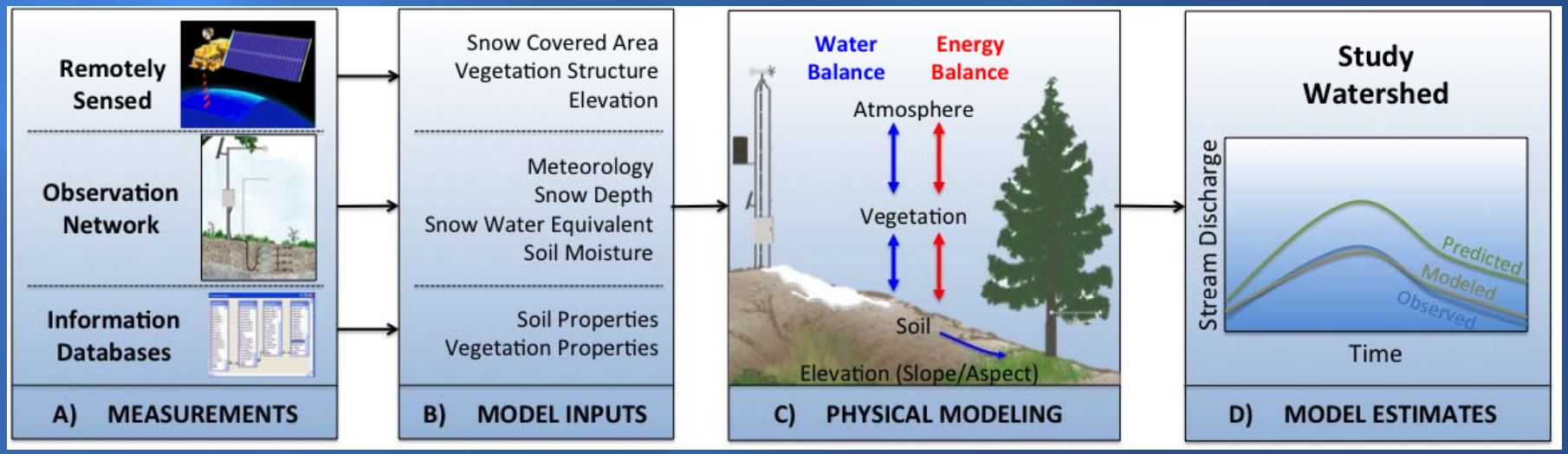
Changes in water chemistry will be a function of changes in discharge.

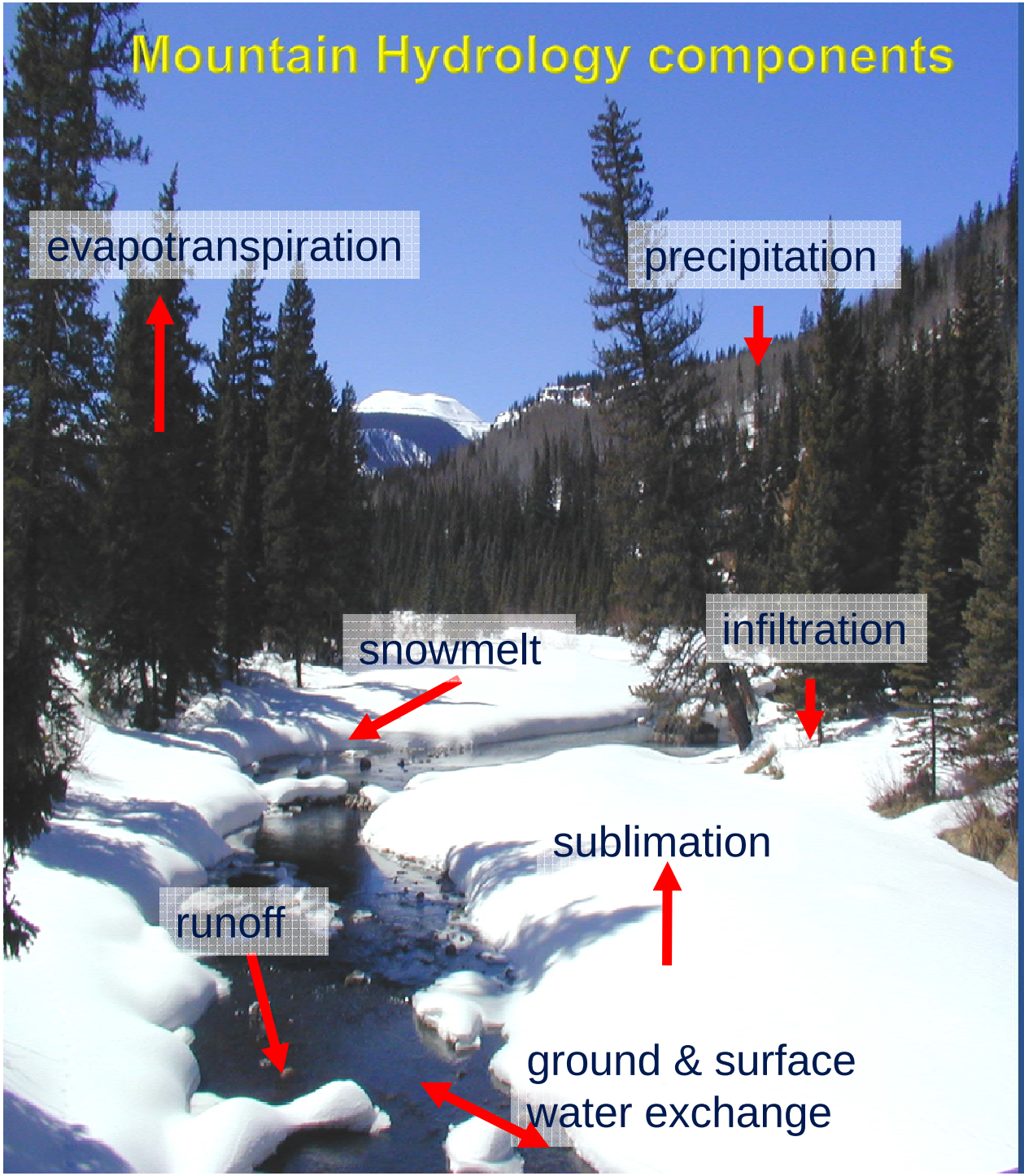
Increased turbidity will be a function of stream discharge as opposed to hillslope erosion.

What do we expect to see?

Using hydrologic models, physiographic and hydroclimatic thresholds can be defined linking area treated with aquatic effects and impacts on forest water cycle.

Hydrologic models will allow us to scale up responses to the larger watershed and fireshed levels.





Reservoirs:
Snowpack storage
Soil-water storage

Two myths:

We can, with current information, estimate or predict the magnitude of these fluxes & reservoirs with a high degree of skill

Better hydrologic modeling using existing data sources will yield significant improvement

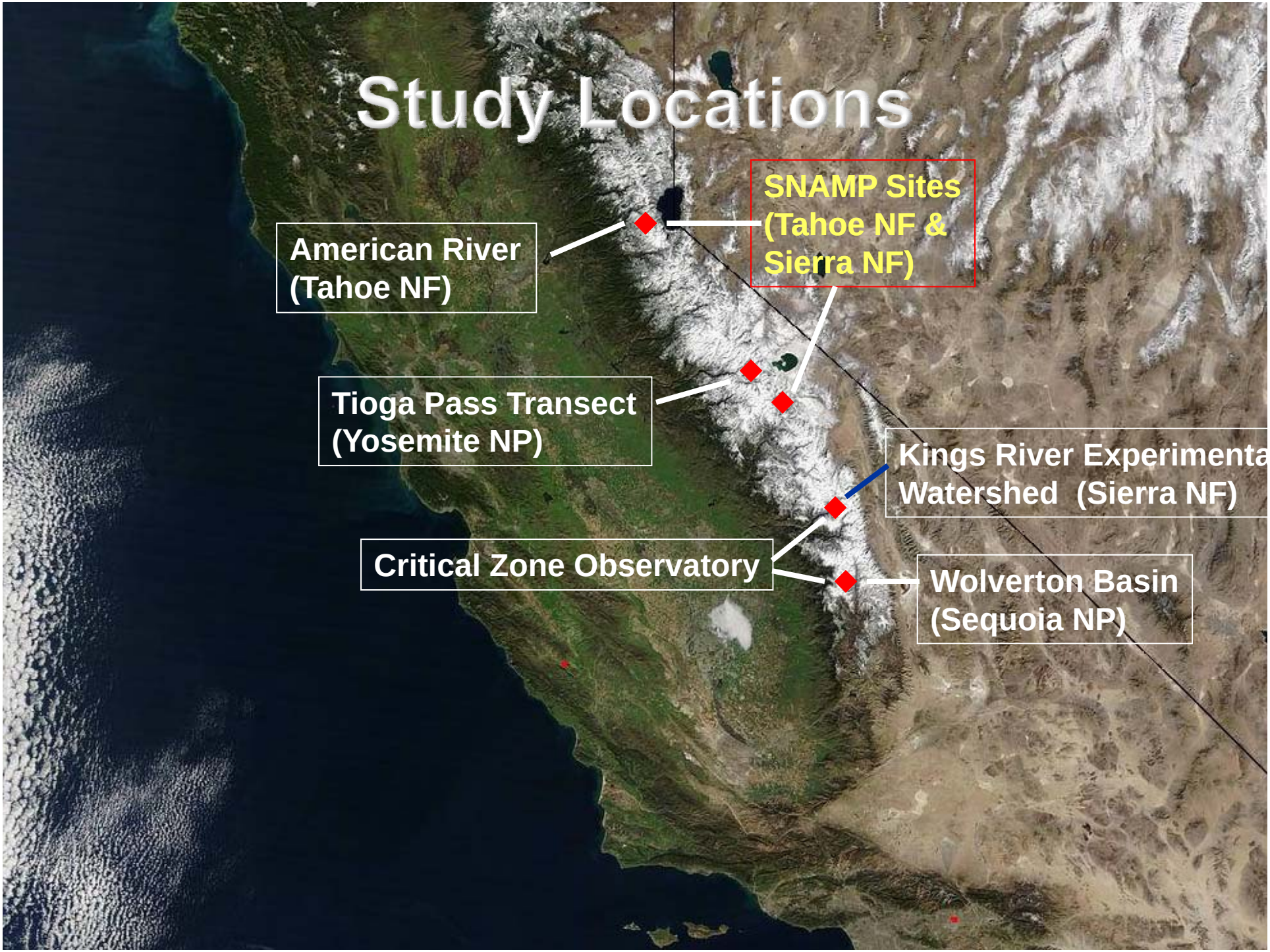
Sampling Design

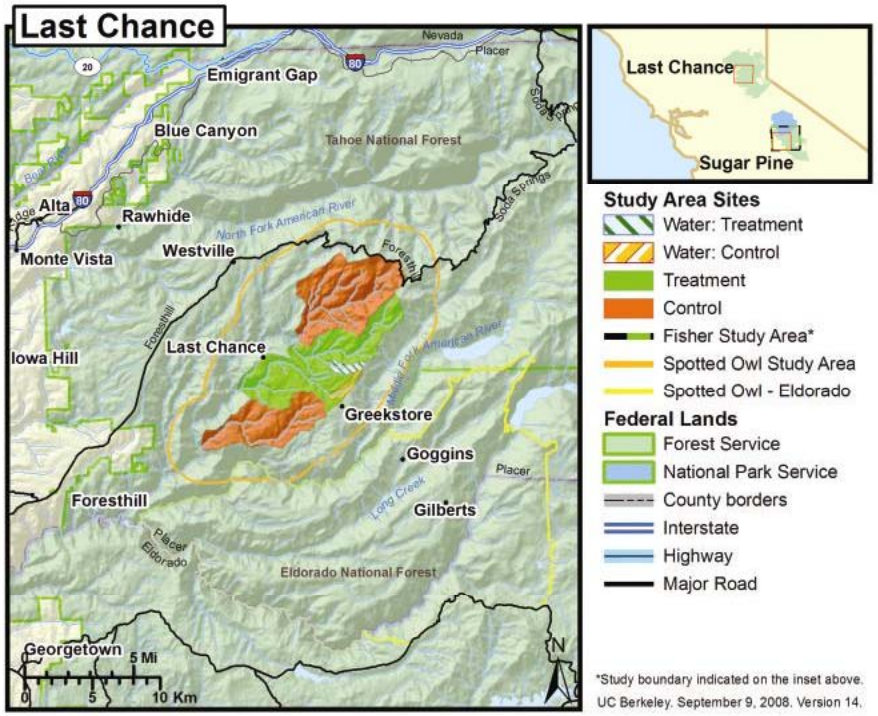
BACI design

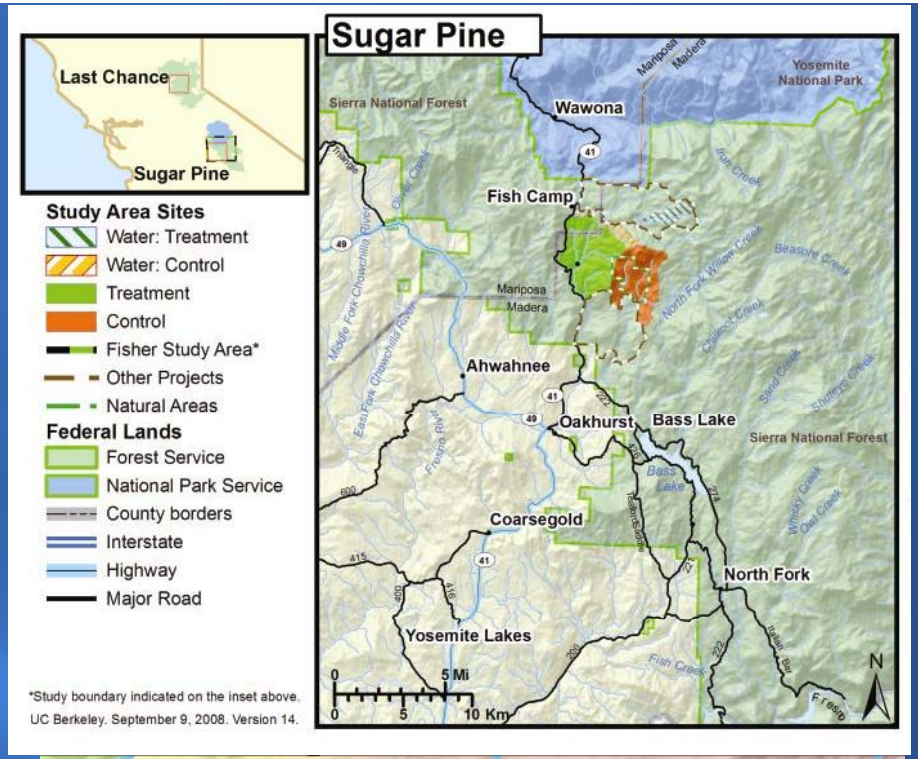
Final Criteria:

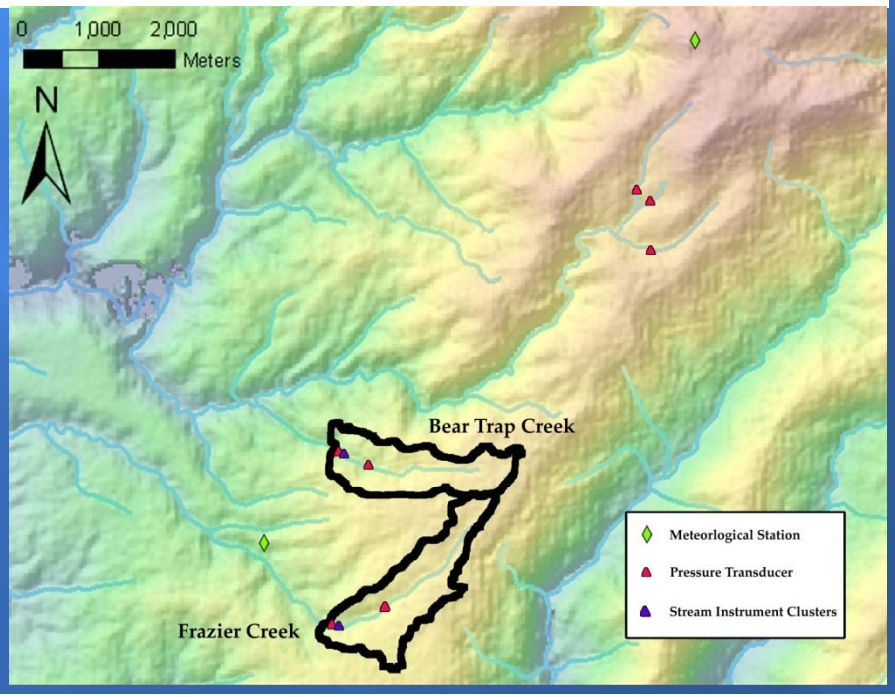
- ~1 km^2 headwater catchments
- perennial stream reach
- nested within fireshed of 40-200 km^2
- Similar vegetation, slope, stream length, aspect
- Near rain-snow transition

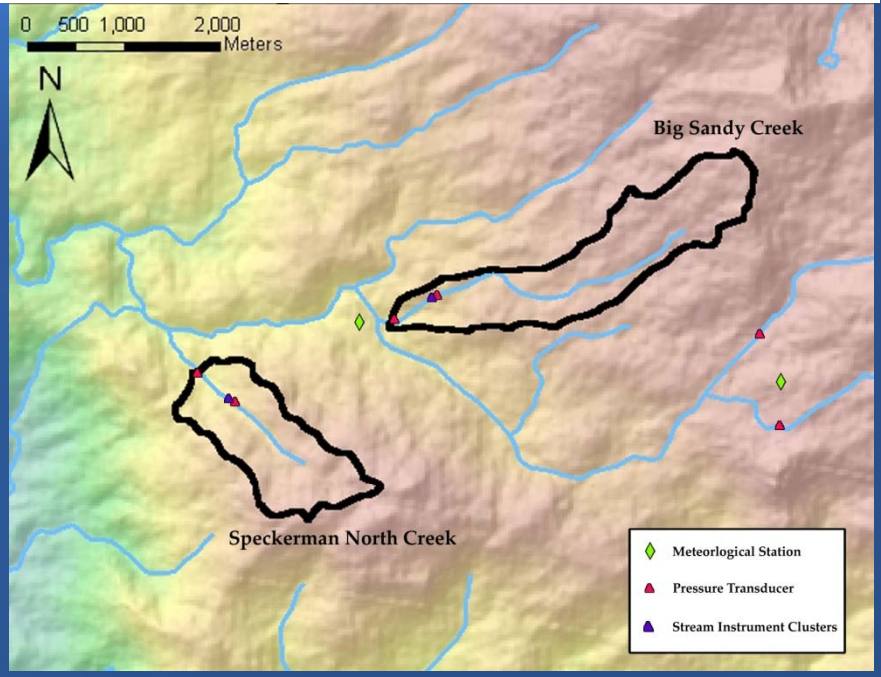
Study Locations




Last Chance
Nevada
Placer
Emigrant Gap
Blue Canyon
Tahoe National Forest
Alta
Rawhide
Monte Vista
Westville
North Fork American River
Iowa Hill
Last Chance
Greekstore
Goggins
Placer
Foresthill
Gilberts
Long Creek
Placer
Eldorado
Eldorado National Forest
Georgetown
5 Mi
0
5
10 Km
N
Last Chance
Sugar Pine
Study Area Sites
Water: Treatment
Water: Control
Treatment
Control
Fisher Study Area*
Spotted Owl Study Area
Spotted Owl - Eldorado
Federal Lands
Forest Service
National Park Service
County borders
Interstate
Highway
Major Road
*Study boundary indicated on the inset above.
UC Berkeley. September 9, 2008. Version 14.

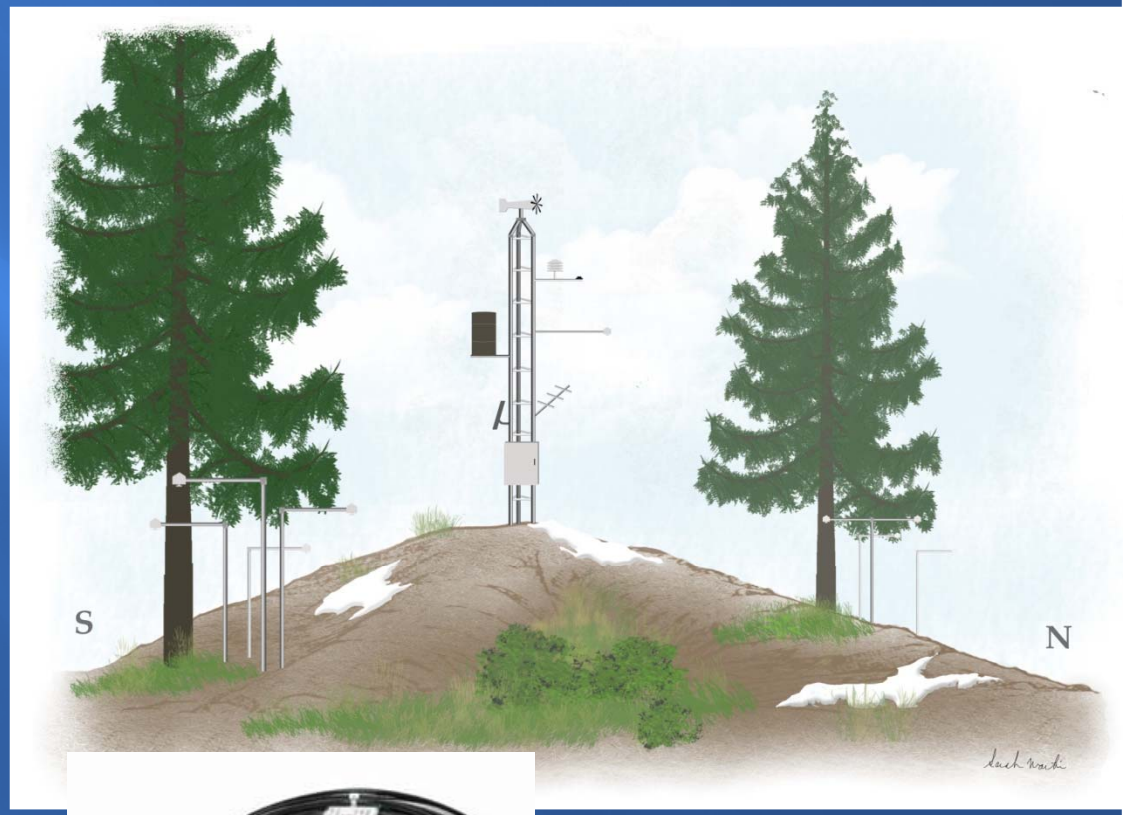

Sugar Pine
Last Chance
Sugar Pine
Study Area Sites
Water: Treatment
Water: Control
Treatment
Control
Fisher Study Area*
Other Projects
Natural Areas
Federal Lands
Forest Service
National Park Service
County borders
Interstate
Highway
Major Road
*Study boundary indicated on the inset above.
UC Berkeley. September 9, 2008. Version 14.
Sierra National Forest
Wawona
Yosemite National Park
Fish Camp
Mariposa
Madera
Ahwahnee
Oakhurst
Bass Lake
Sierra National Forest
Coarsegold
North Fork
Yosemite Lakes
0
5 Mi
0
5
10 Km
N


0
1,000
2,000
Meters
N
Bear Trap Creek
Frazier Creek
Meteorlogical Station
Pressure Transducer
Stream Instrument Clusters

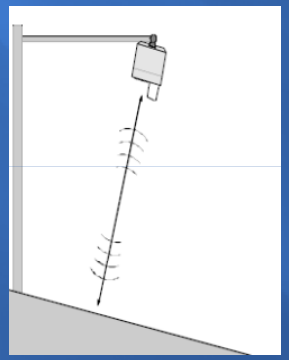

0
500
1,000
2,000
Meters
N
Big Sandy Creek
Speckerman North Creek
Meteorlogical Station
Pressure Transducer
Stream Instrument Clusters

Meteorological Stations

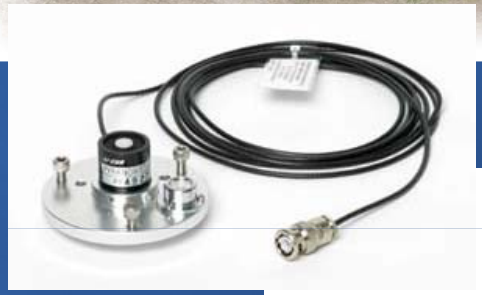
- 4 Stations
  - northern and southern sites
  - lower and higher elevation
- Open areas on ridge tops
- Weather measurements



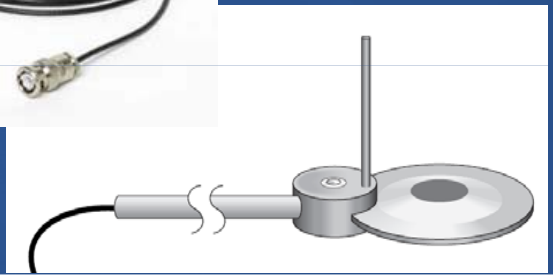
http://www.derm.qld.gov.au/



http://www.juddcom.com/ds2manual.pdf



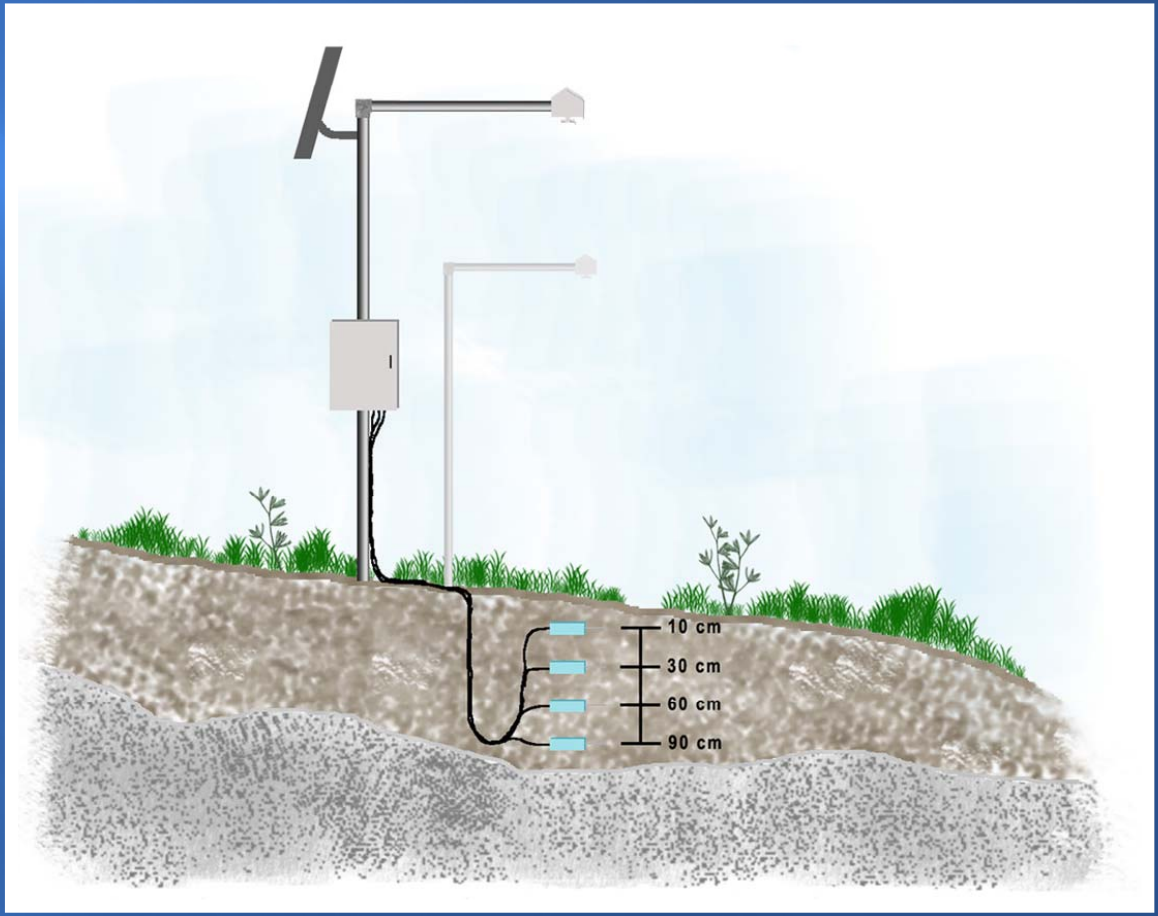
http://www.licor.com/env/Products/Sensors/200/li200_description.jsp



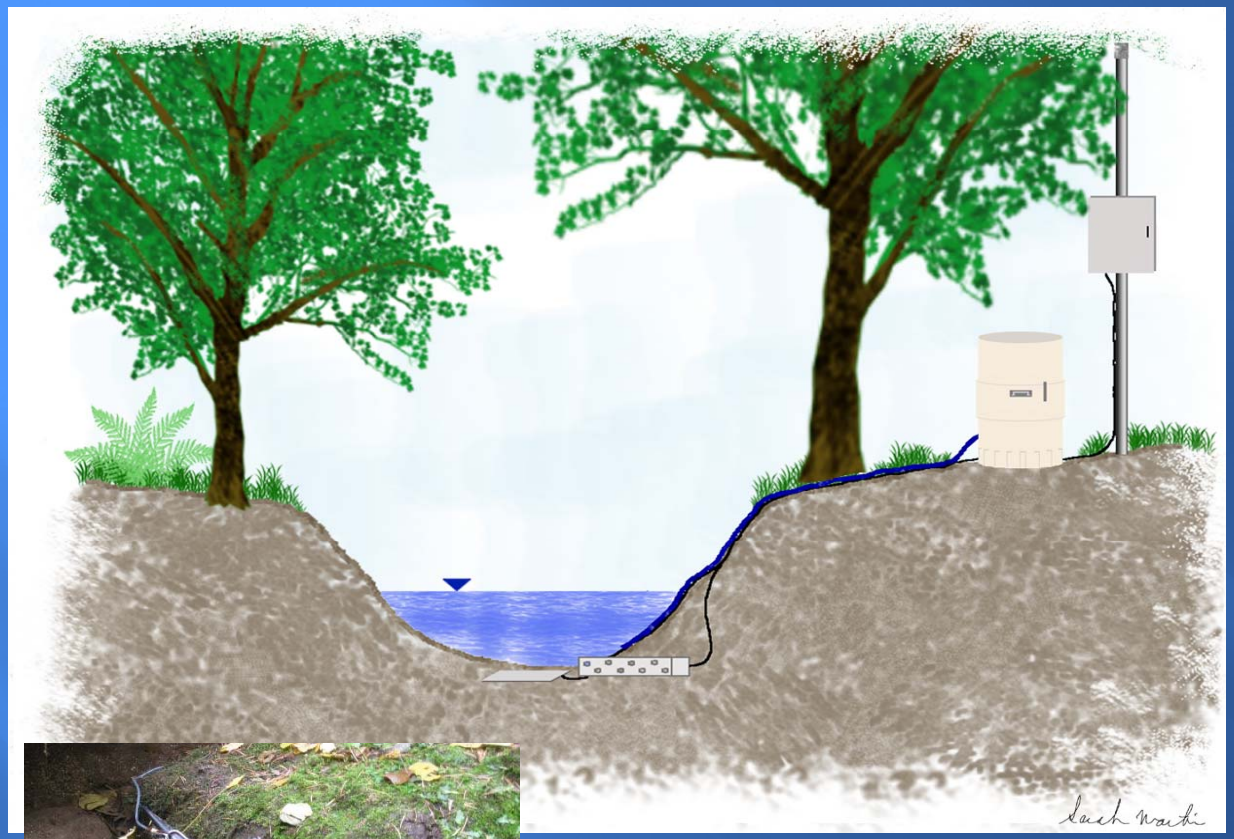
http://www.campbellsci.com/documents/manuals/nr-lite.pdf

Hillslope Instruments

- Snow depth and soil moisture instrument nodes
- On north and south facing slopes adjacent to met stations and stream instruments



Stream Instrumentation

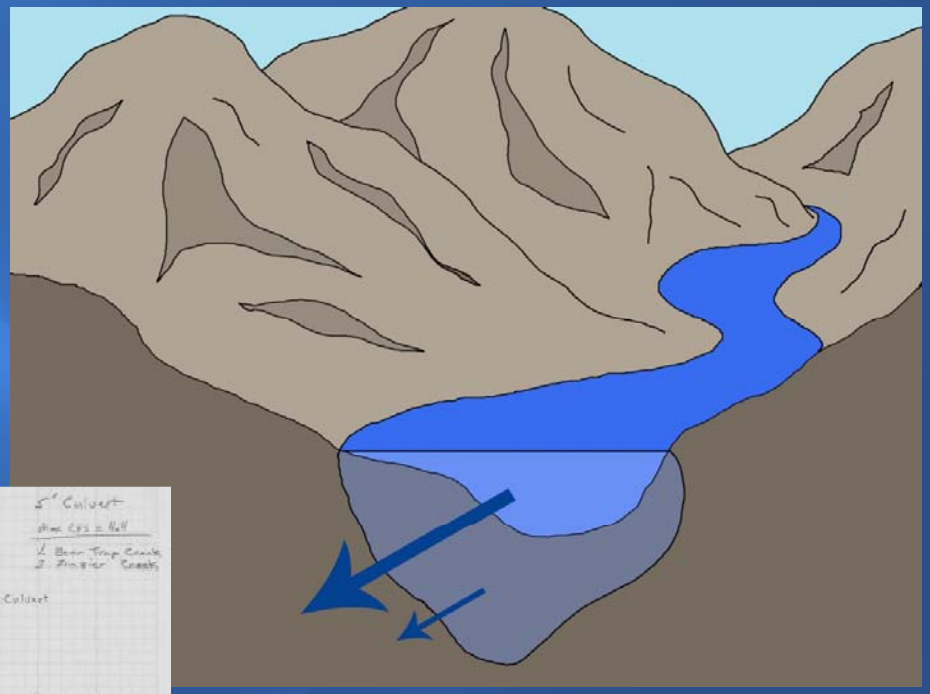


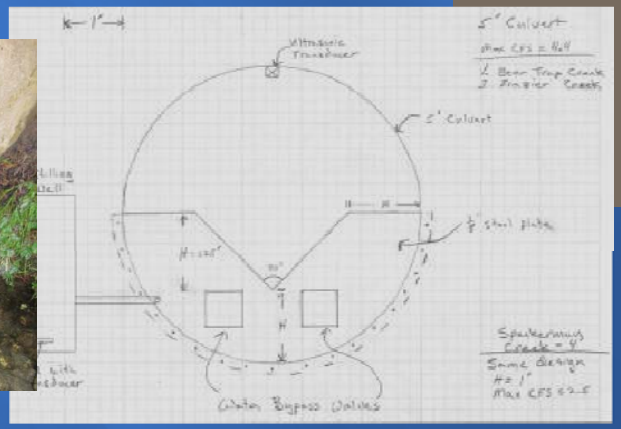
- Water quality, sediment, and flow measurements
- Automated and manual grab samples
- Manual discharge measurements for a rating curve

Discharge

Pressure transducers + rating curves

Weir/Stilling wells





The challenge is to measure both peak and base flows in streams with a wide range of discharges and a significant subsurface component

Topics Covered

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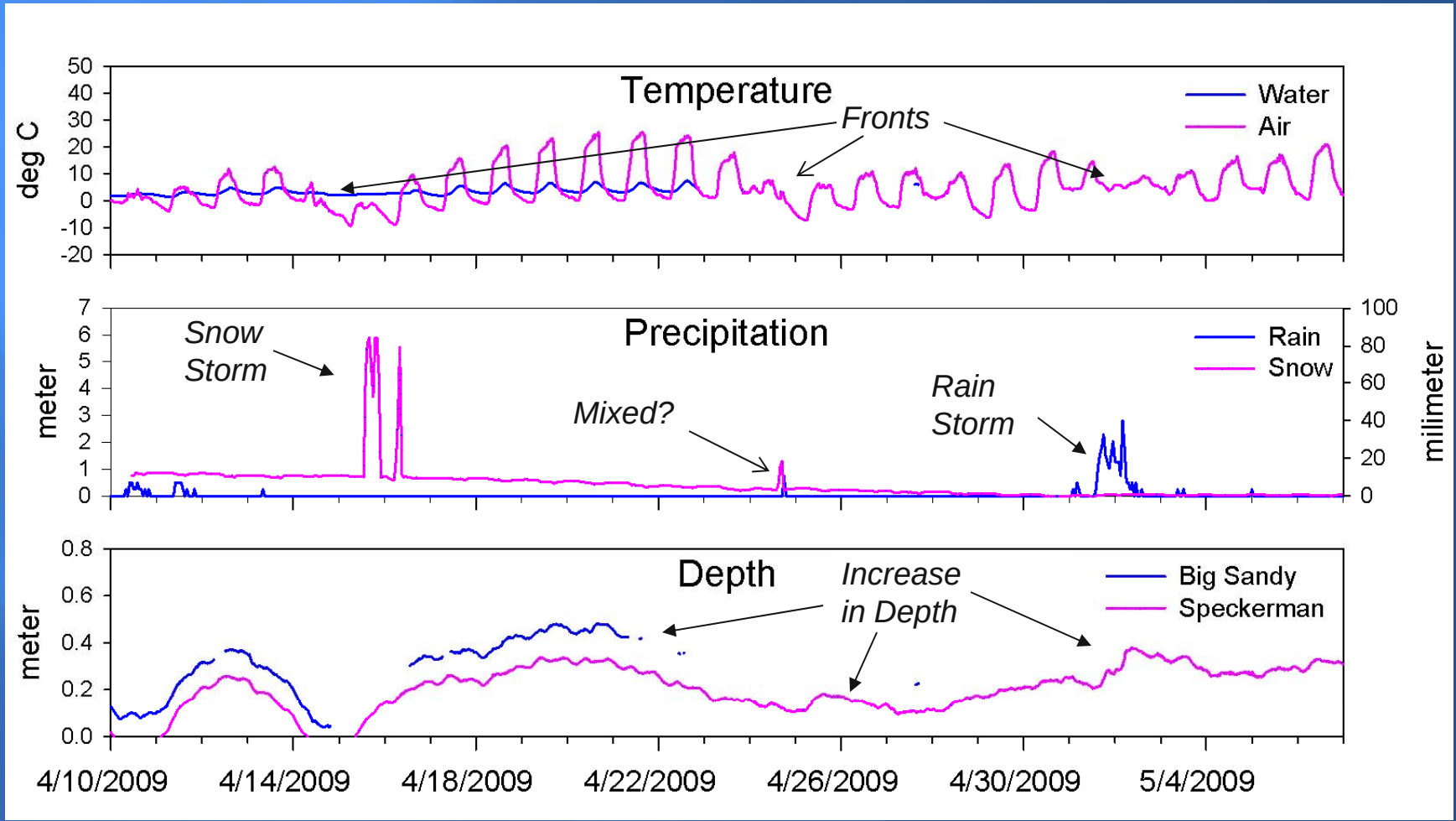
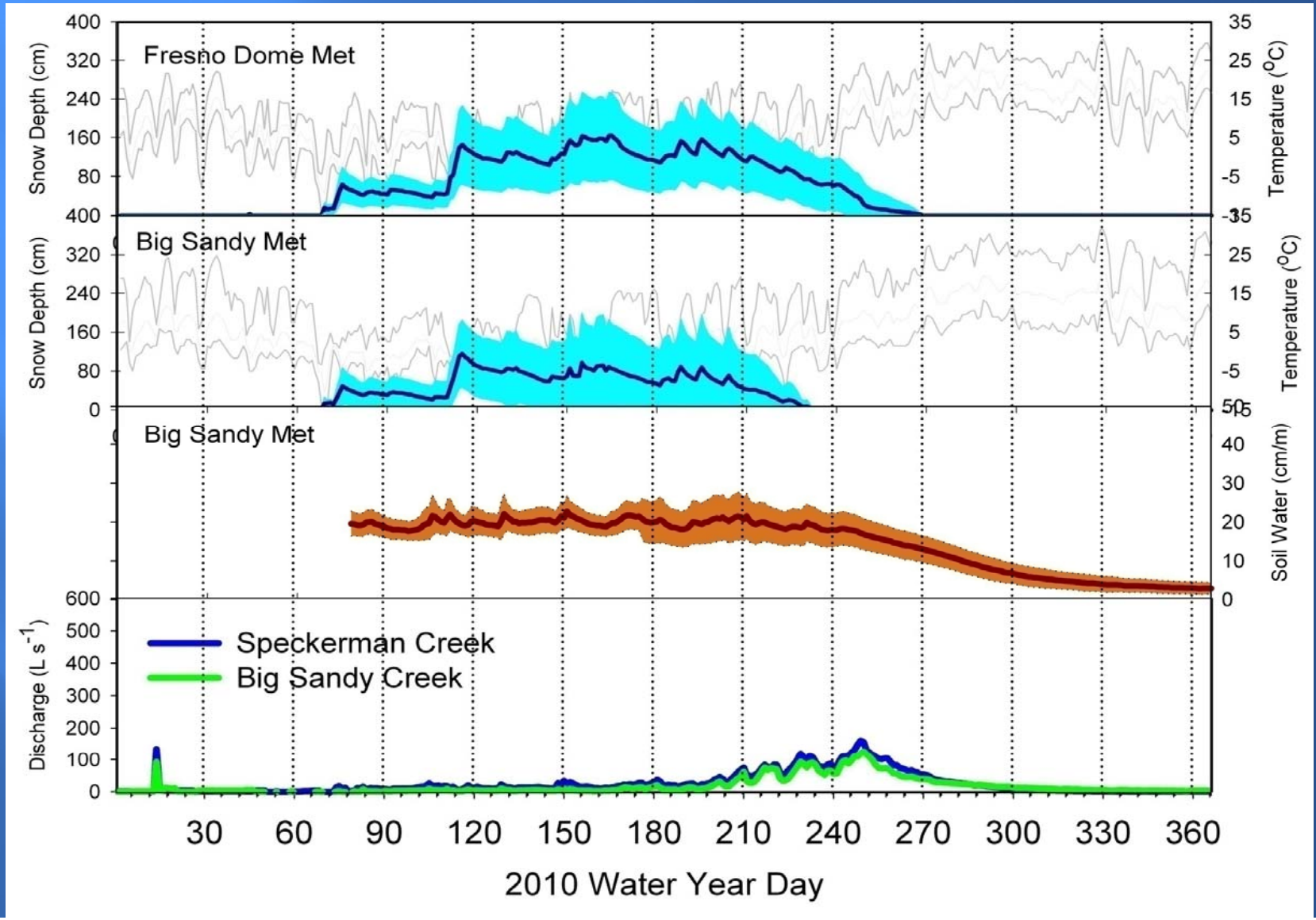
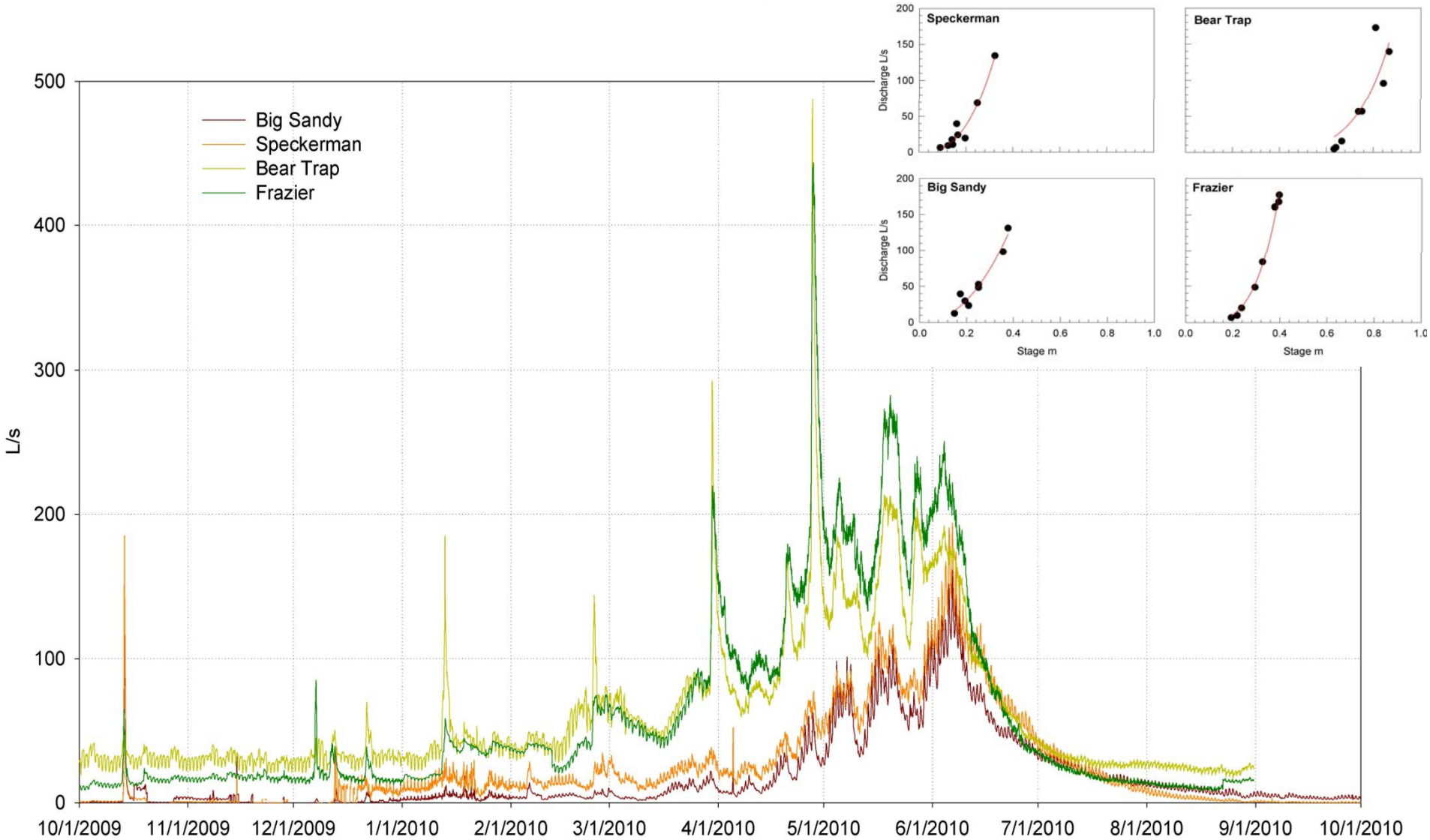
Met data


Temperature
Fronts
Water
Air
deg C
50
40
30
20
10
0
-10
-20
Precipitation
Snow Storm
Mixed?
Rain Storm
Rain
Snow
meter
milimeter
7
6
5
4
3
2
1
0
100
80
60
40
20
0
Depth
Increase in Depth
Big Sandy
Speckerman
meter
0.8
0.6
0.4
0.2
0.0
4/10/2009
4/14/2009
4/18/2009
4/22/2009
4/26/2009
4/30/2009
5/4/2009

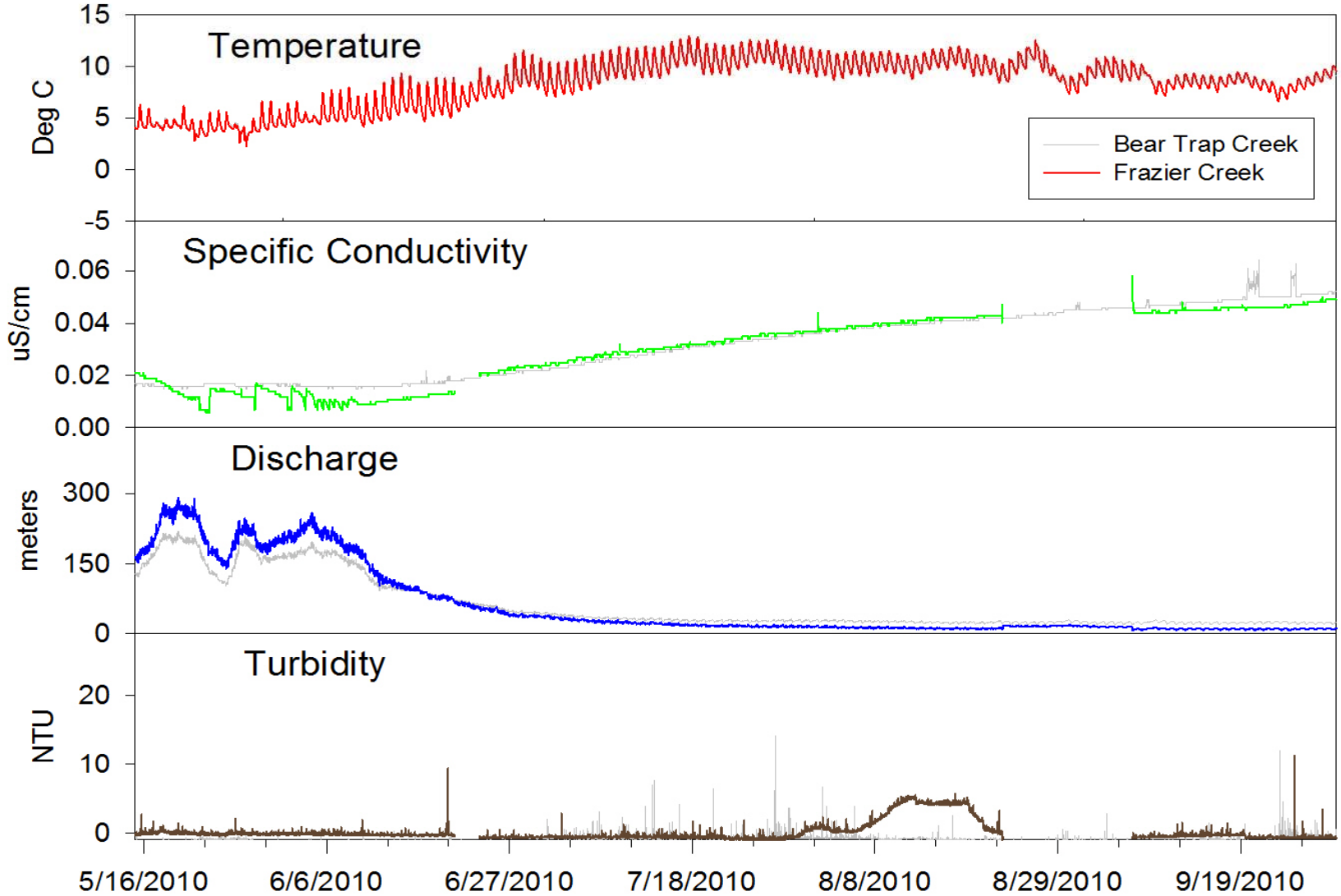
Hilslope Data

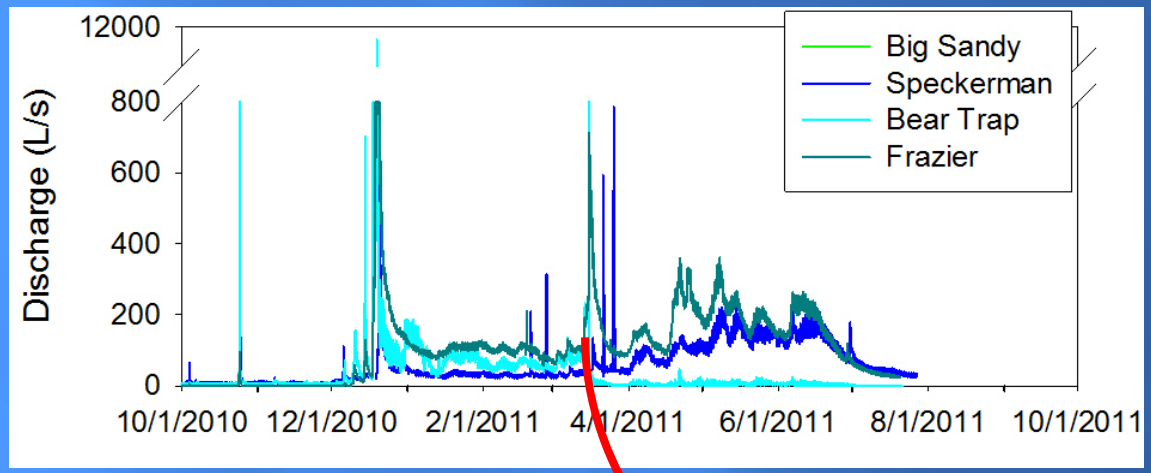


Stream Discharge
WY 2010



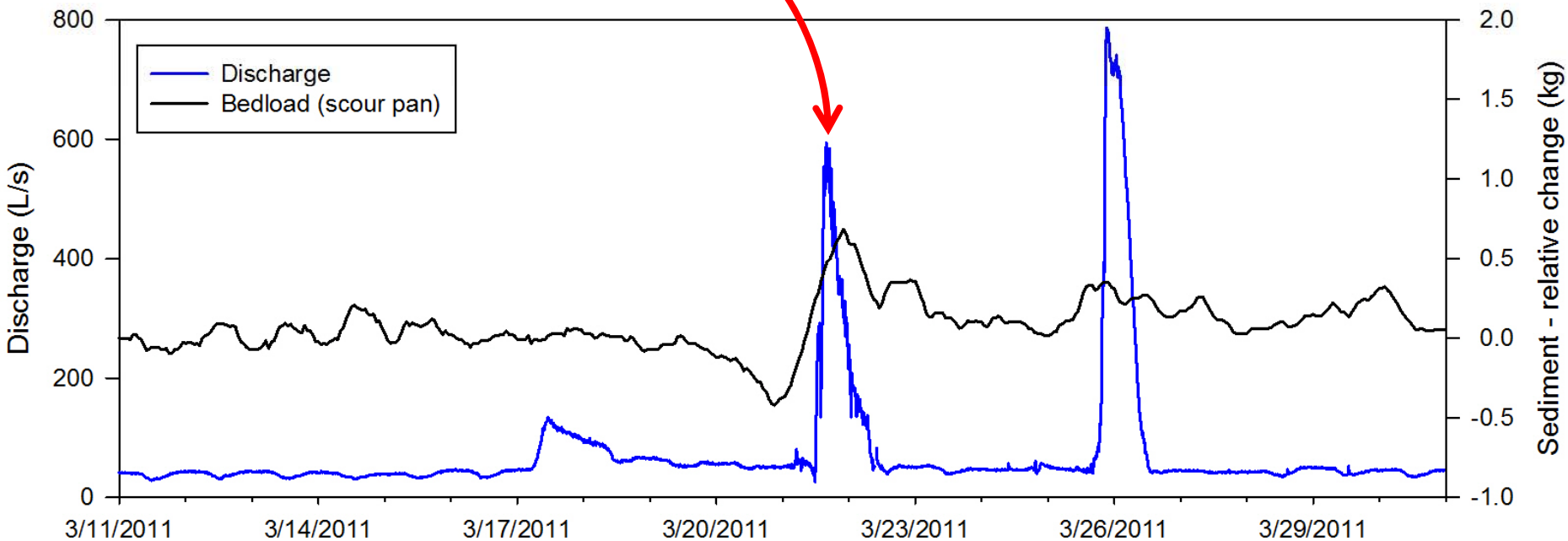
Water Quality Data



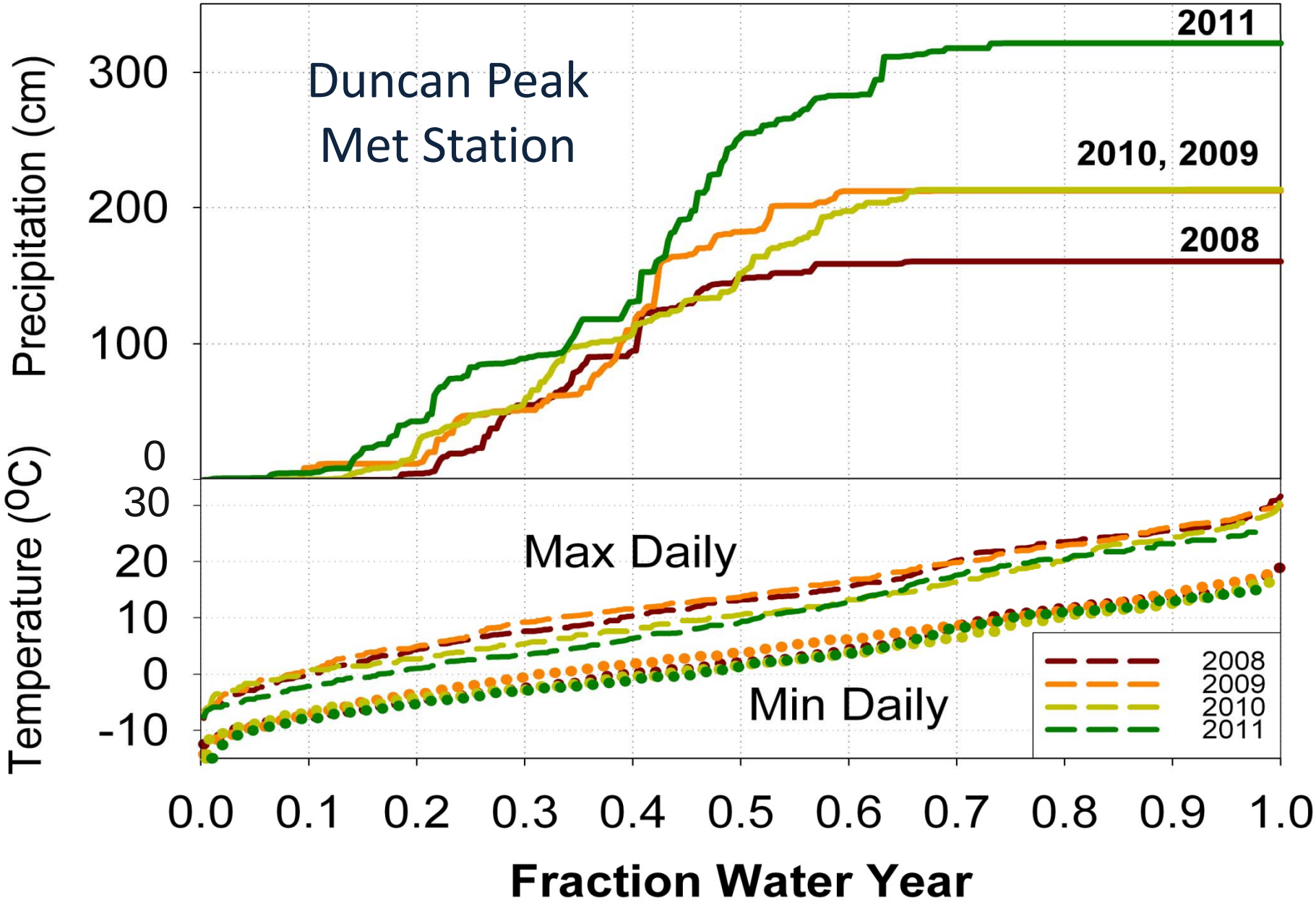


Successive storm events show sediment supply depletion

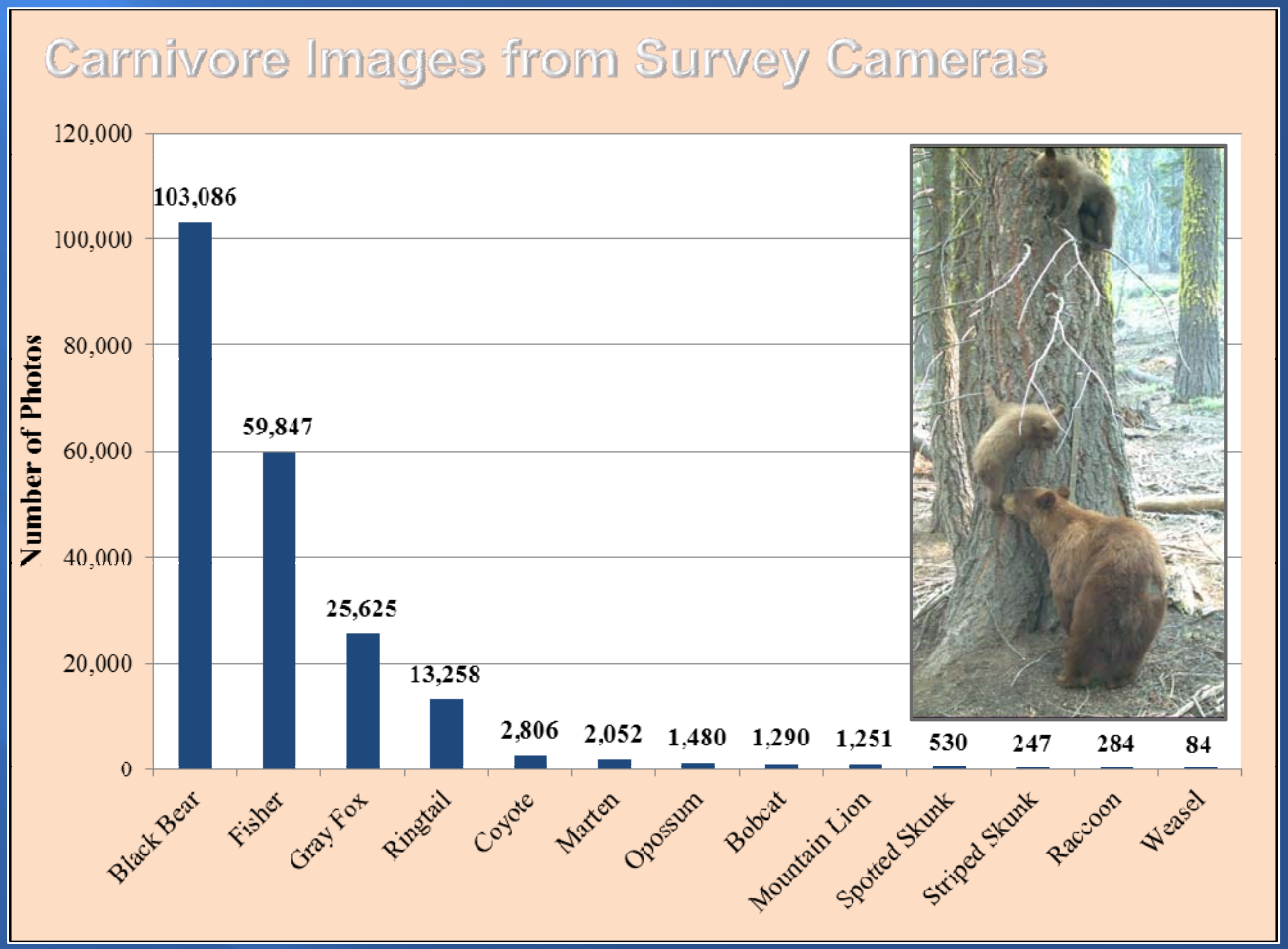
Speckerman



4 Years: Water & Energy Inputs



Wildlife Collaboration….



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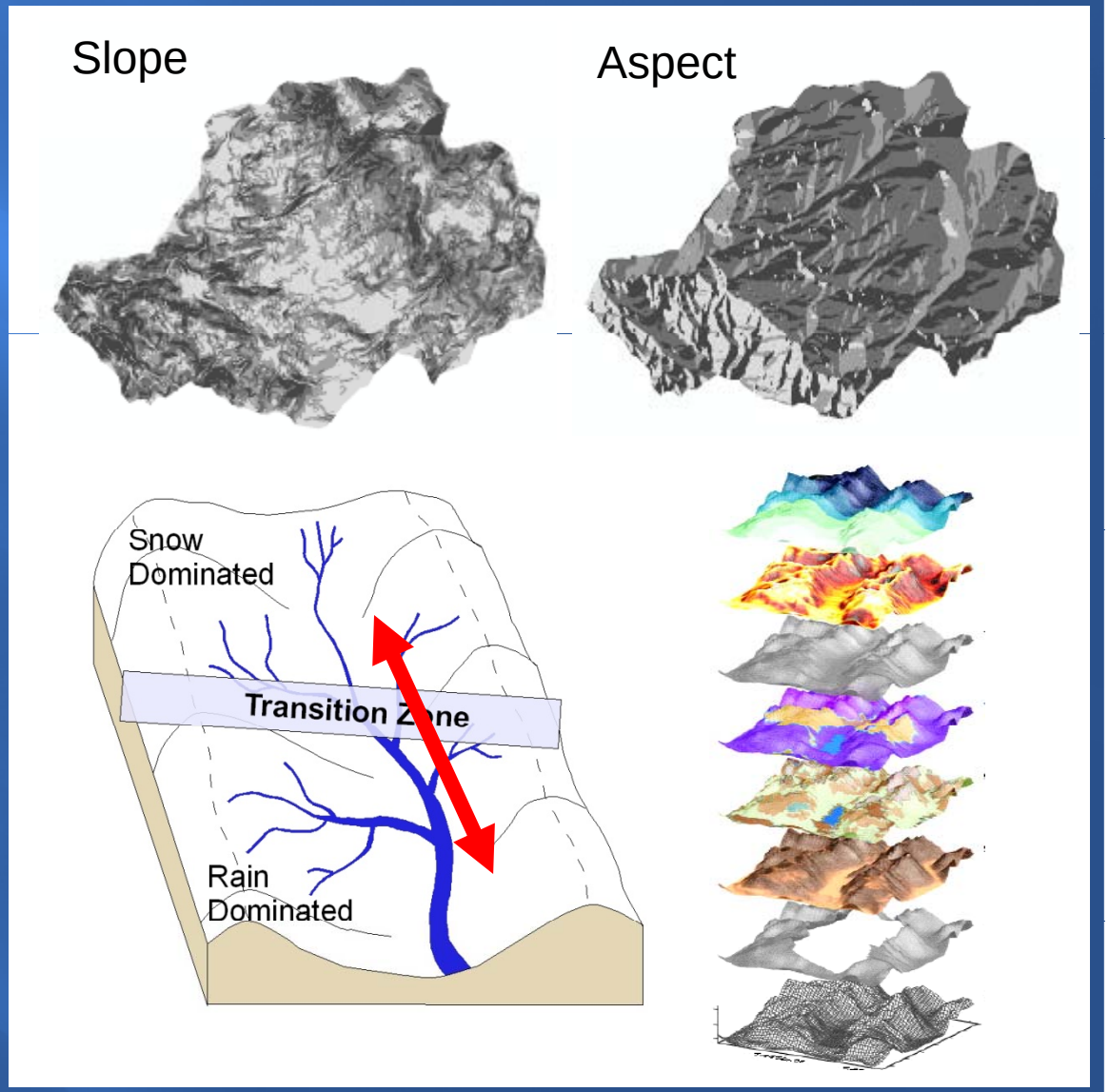
- Research questions, study sites, & instrumentation
  - What do we hope to learn?
  - What approach are we using? how?
- Observations, & data
  - Research highlights
- Scaling up and future work
  - Modeling approach
  - American River

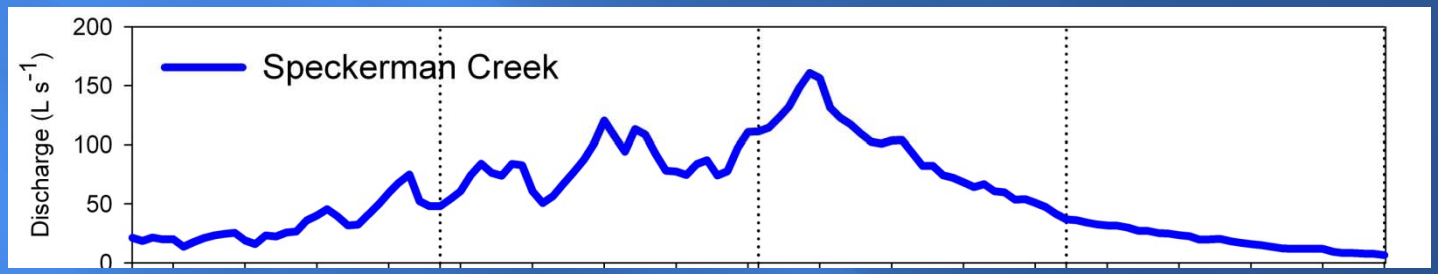
Scaling up & modeling change

- Computer models allow us to better represent heterogeneity across a broad area
- Also to change parameters and see effects
  - drought vs. wet years
  - increase in temperature

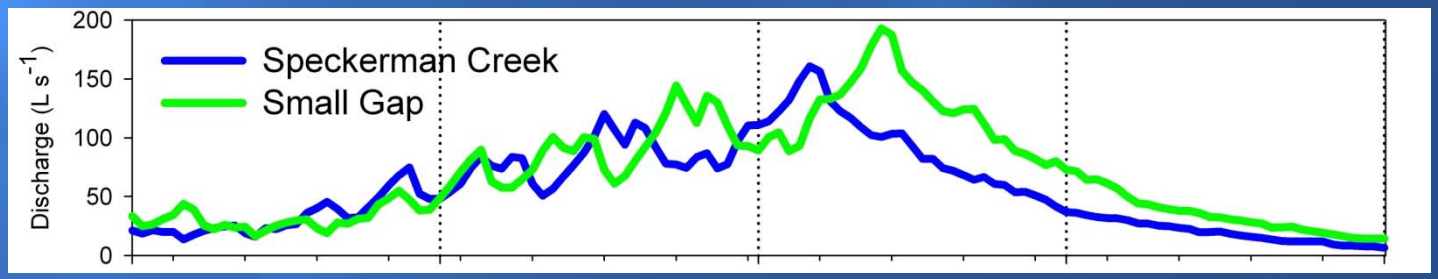


Modeling Steps

1) Match current observations



2) Obtain threshold values to observe changes in streamflow



3) Incorporate projected changes: climate, forest regrowth

American River: Objectives

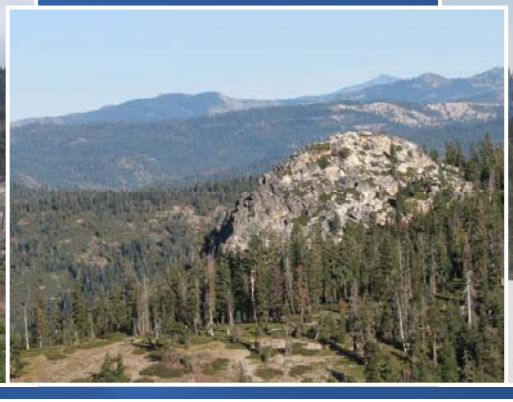
Basin scale data coherence

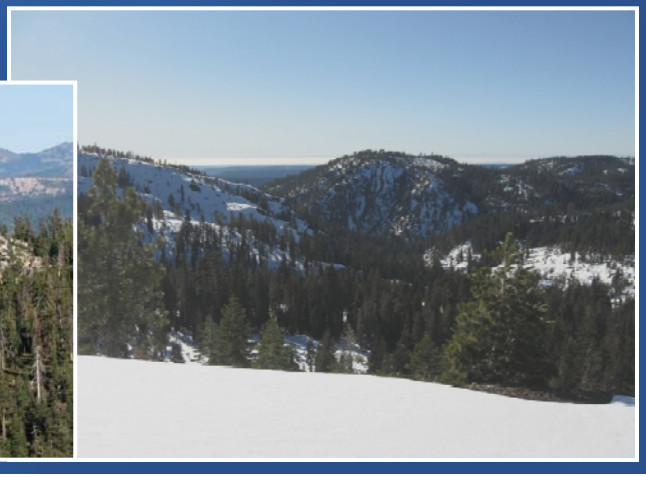
Quantify basin scale gradients

- Elevation - orographics
- Precipitation, snow volume, temp, and humidity
- North-South gradients
- Dynamics of rain/snow transition

Quantify site or catchment-scale gradients (wireless sites = 1 km^2)

- Slope, aspect, canopy density
- Snow depth, temp, humidity, soil moisture





Current NSF-supported project

Title: Development of a Basin-Scale Water-balance Instrument Cluster for Hydrologic, Atmospheric and Ecosystem Science

Purpose: research infrastructure; water information system

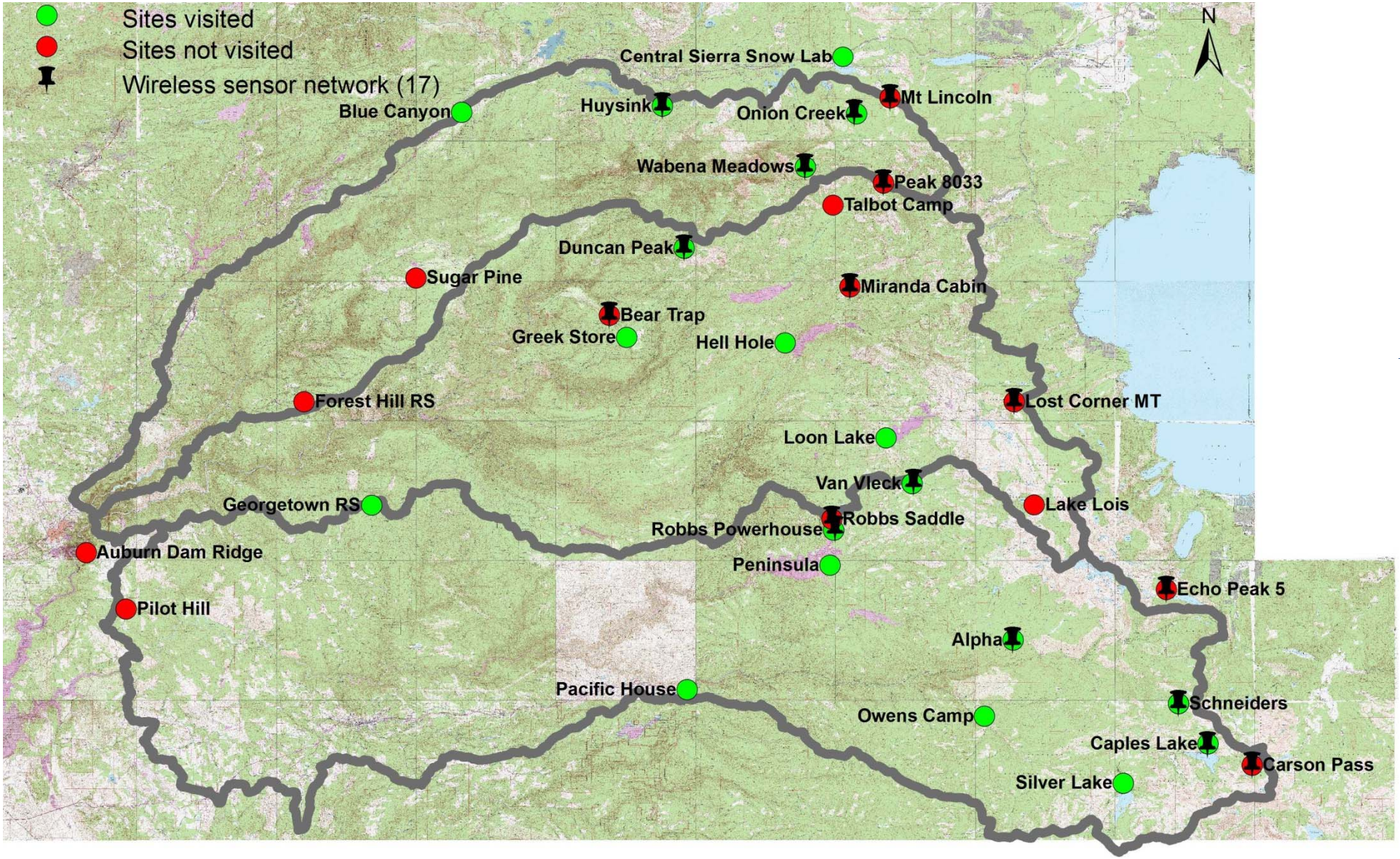
Budget: $2 million

Timeline: fall 2011- fall 2015

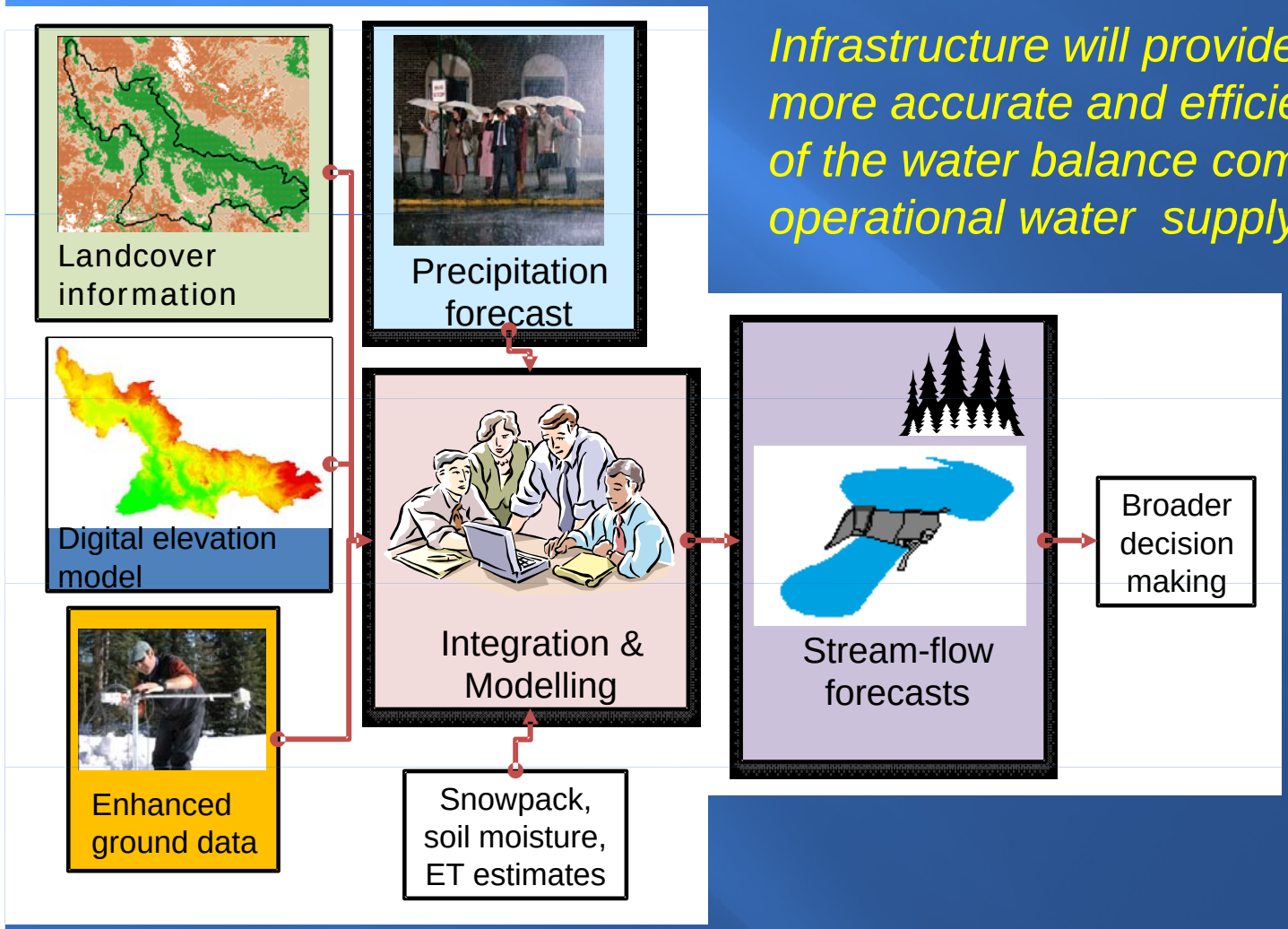
Investigators: Roger Bales, Martha Conklin & Bob Rice (UCM), Steve Glaser (UCB), Danny Marks (ARS)

Scope: deploy 23 local sensor clusters, each w/ 10-20 snow-depth & temperature sensors & met station; some will have soil moisture & temperature, sap flow

Research: need outside grants


Sites visited
Sites not visited
Wireless sensor network (17)
N
Central Sierra Snow Lab
Mt Lincoln
Blue Canyon
Huysink
Onion Creek
Wabena Meadows
Peak 8033
Talbot Camp
Duncan Peak
Sugar Pine
Miranda Cabin
Bear Trap
Greek Store
Hell Hole
Forest Hill RS
Lost Corner MT
Loon Lake
Van Vleck
Georgetown RS
Lake Lois
Robbs Powerhouse
Robbs Saddle
Auburn Dam Ridge
Peninsula
Echo Peak 5
Pilot Hill
Alpha
Pacific House
Schneiders
Owens Camp
Caples Lake
Carson Pass
Silver Lake

Enhancing seasonal water-supply forecasting



Infrastructure will provide the basis for a more accurate and efficient measurements of the water balance components for operational water supply (timing and magnitude) and quality for decision support systems.

Contacts

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(559) 359-6252
Phil Saksa
psaksa@ucmerced.edu
Ram Ray
rray@ucmerced.edu
Bob Rice
rrice@ucmerced.edu