Sierra Nevada Adaptive Management Project Research Highlights

Including a two-part seasonal approach to discharge measurement in small mountain drainages

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Topics Covered

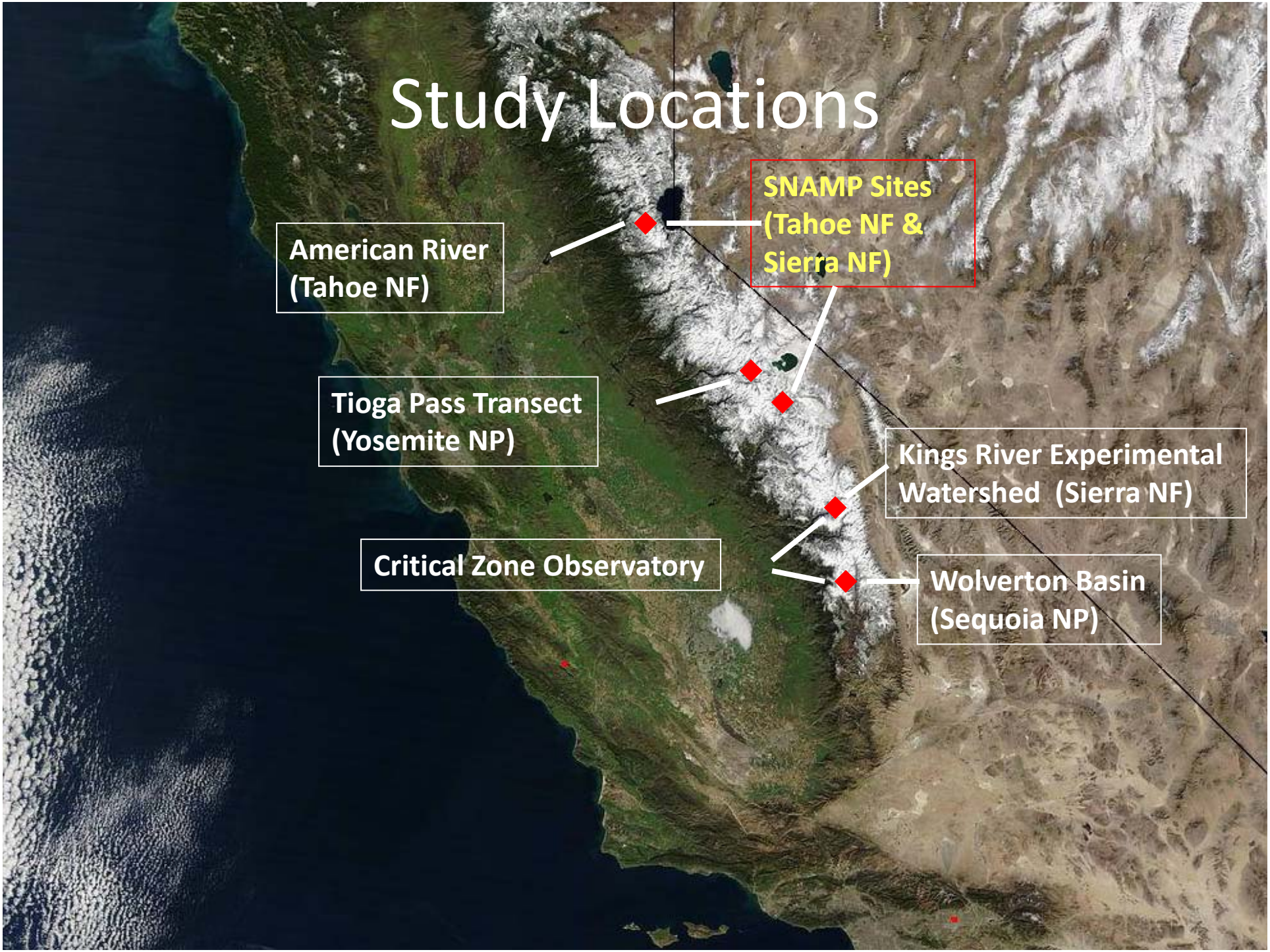
SNAMP work updates

Culvert discharge measurement design

SNAMP research highlights

American River Project

Study Locations



Work-plan Highlights

Released report *Sierra Nevada Adaptive Management Project Water Team Field Activities, Methods, and Results* to DWR (link available at http://snamp.cnr.berkeley.edu/teams/water)

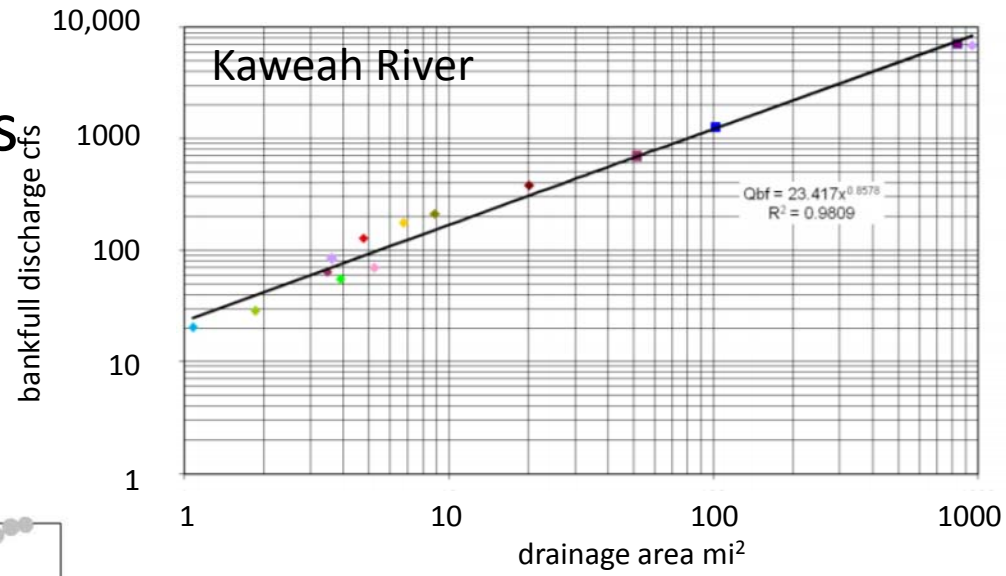
Installed v-notch plate at Speckerman

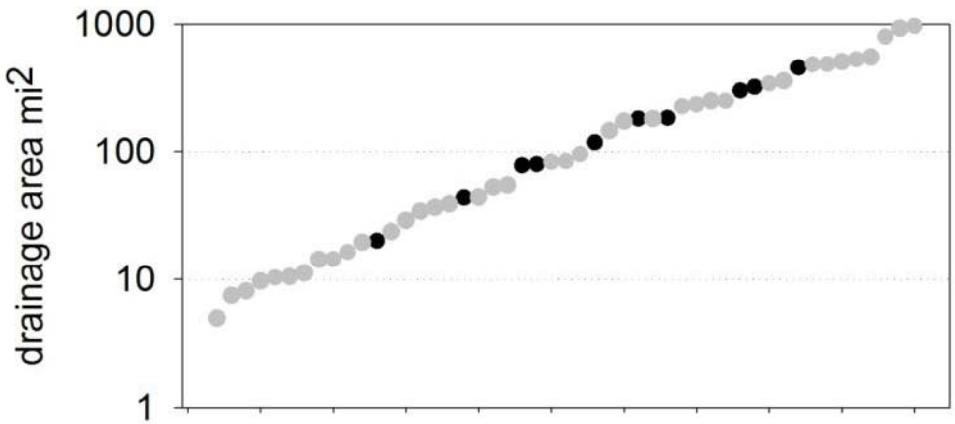
Currently installing wireless sensor networks surrounding Last Chance met stations to better capture snow-depth variability (leveraged)

Synoptic water-chemistry surveys for characterizing sub-surface flow input to streams

Culvert Discharge Design

Small streams in the Sierra's lack gauged data…





- …but they're important for understanding watersheds

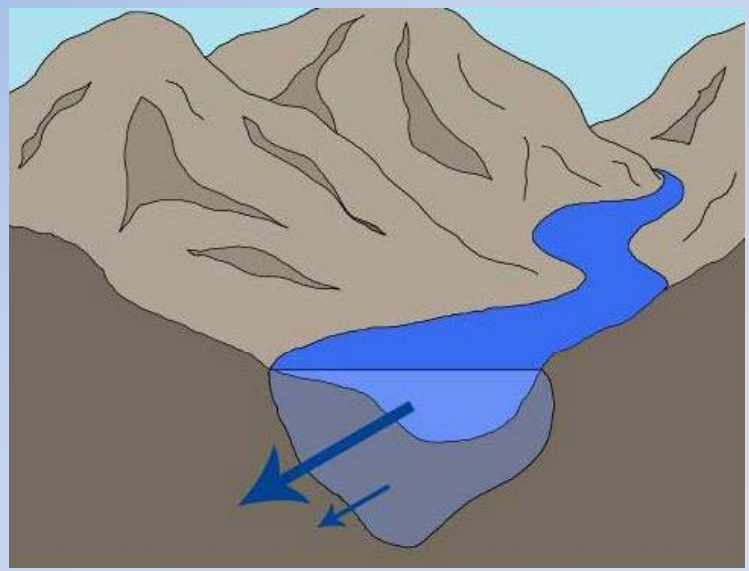
http://www.wunderground.com/data/wximagenew/y/yosemiteclimber/24.jpg

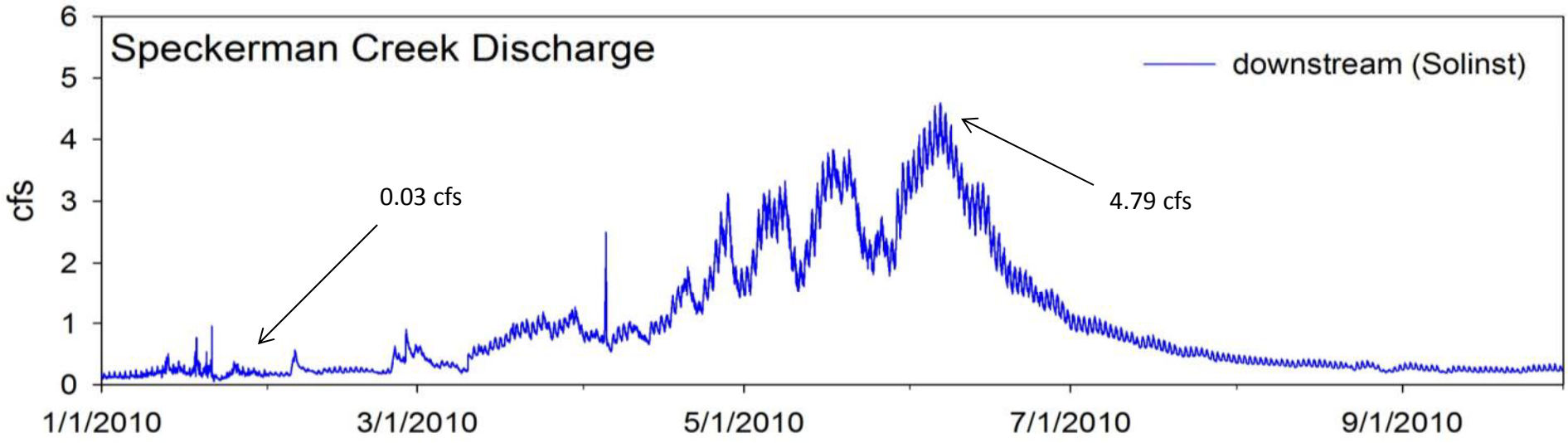
Challenges

Order of magnitude difference between base and peak flows

Subsurface flow

Potential for change in a natural channel cross-sections

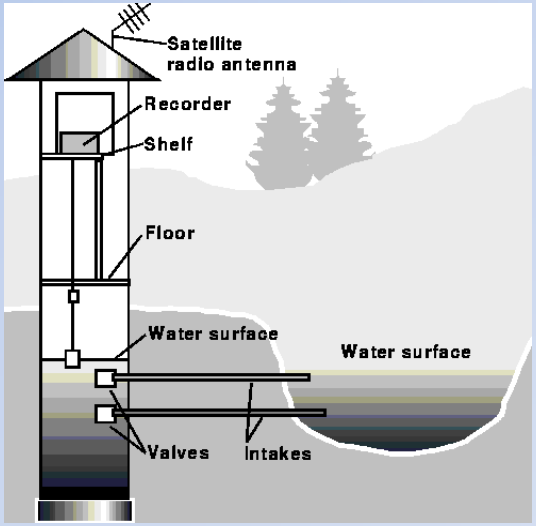




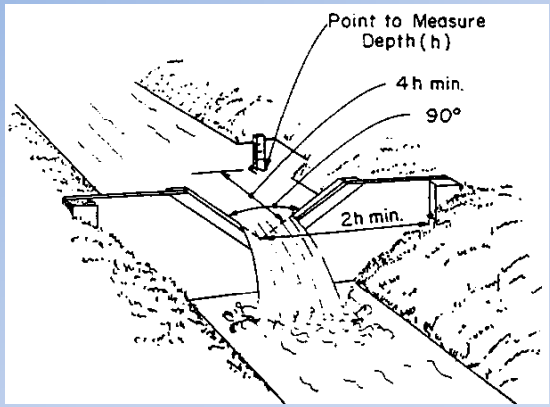
Challenges

Numerous approaches but often..

- expensive install
- maintenance requirements
- personnel hours required for rating curves
- biological concerns



http://virtual.yosemite.cc.ca.us/ghayes/images/Gage_Diagram.gif



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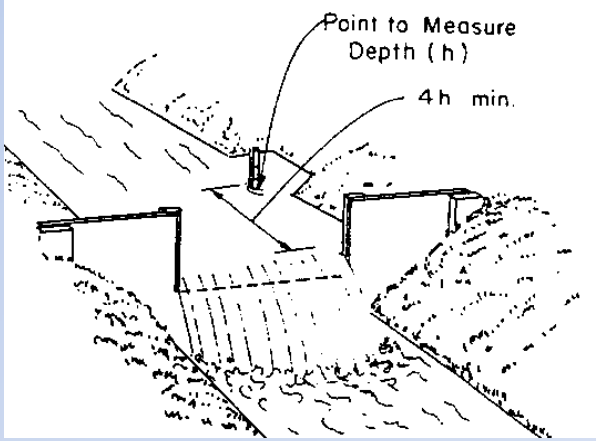

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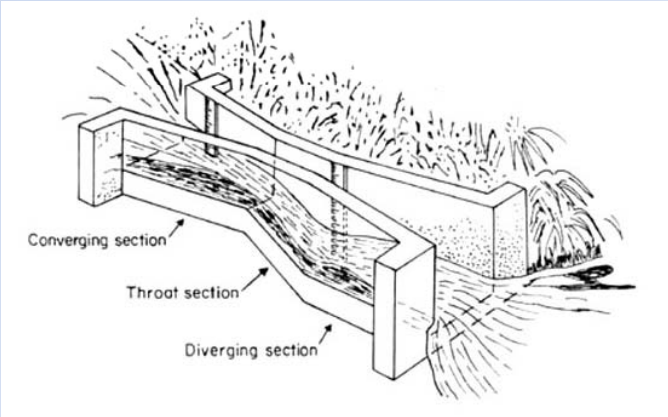


http://www.fao.org/docrep/T0848E/t0848e36.jpg

Methods: a two part approach

Speckerman Creek - 1 km^2 drainage

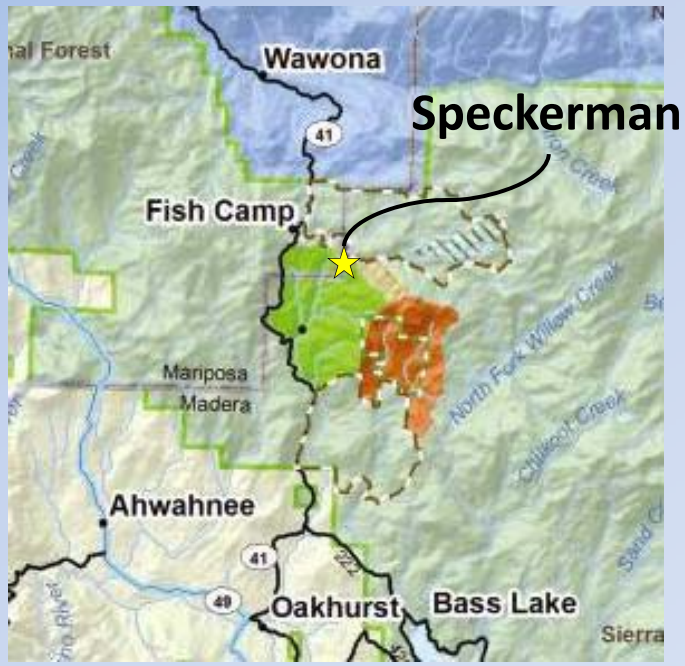
4 ft diameter corrugated culvert at road crossing

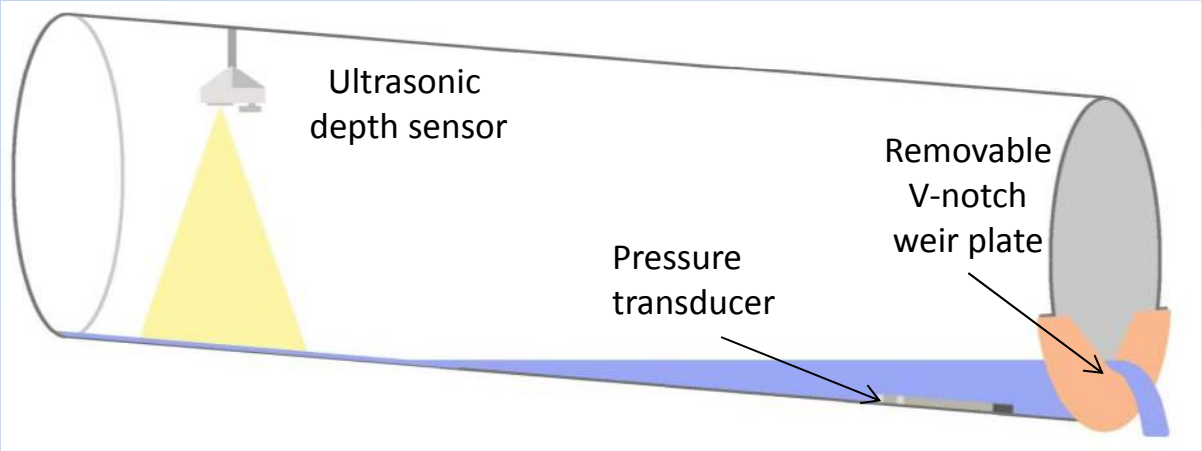
High flows measured by ultrasonic depth sensor

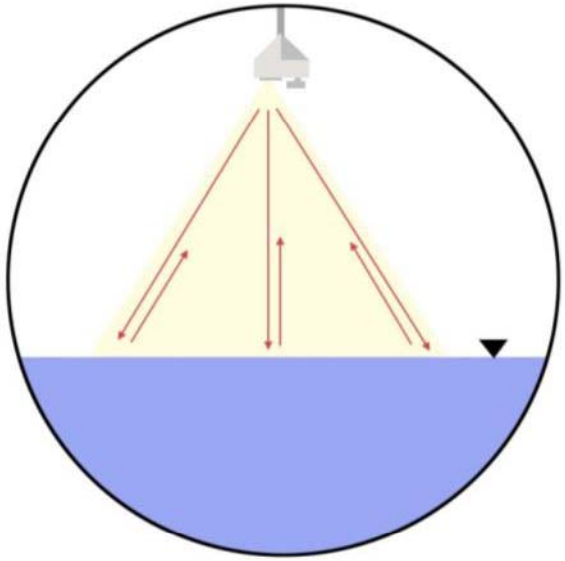
Low flows measured by seasonal V-notch weir

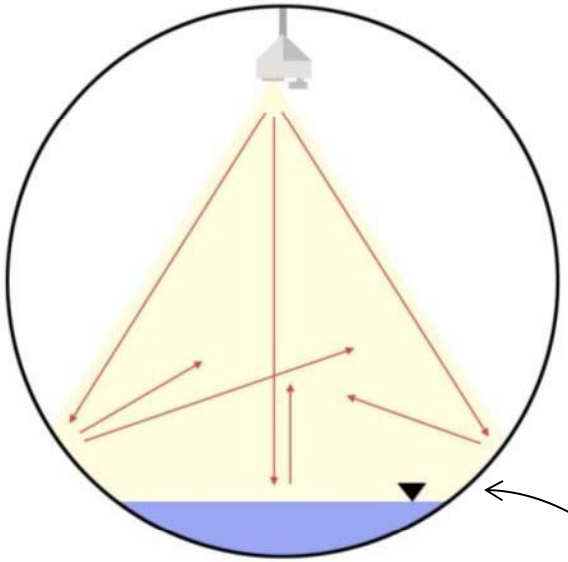
Ultrasonic sensor installed Jan 2011

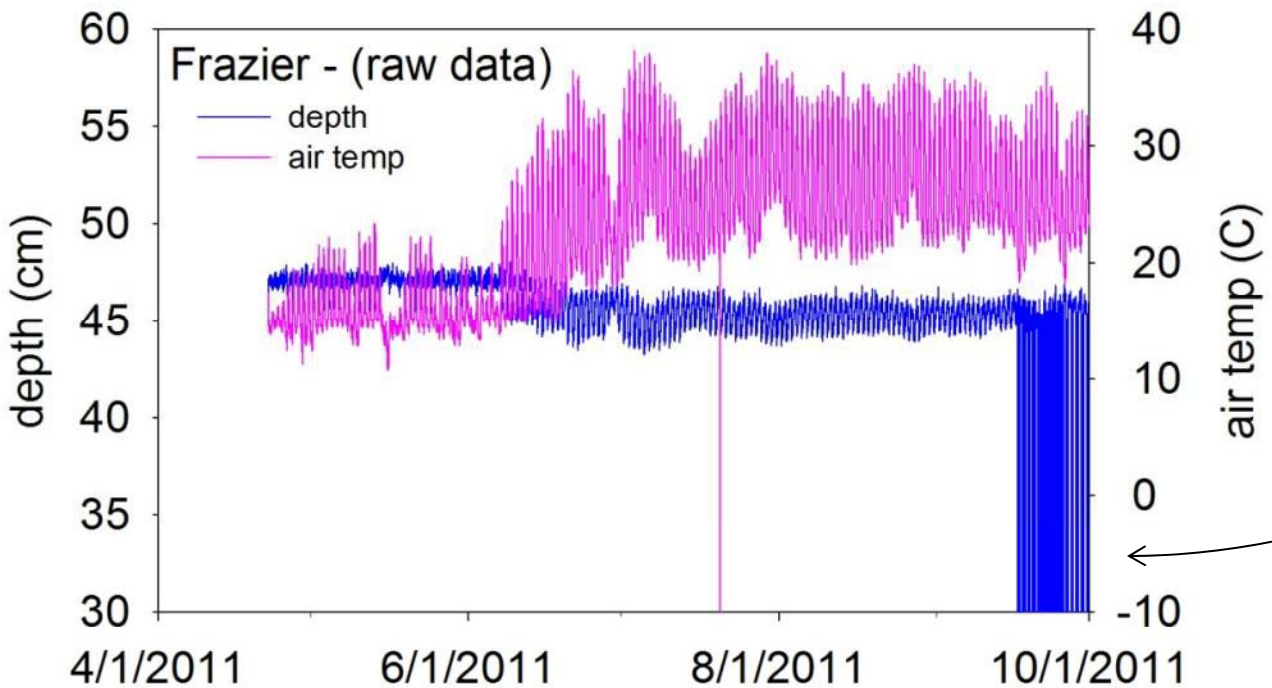
V-notch collar installed Dec 2011, plate placed July 2012











At low flows culvert sides may interfere with signal

Measuring low flows with V-notch solves this issue

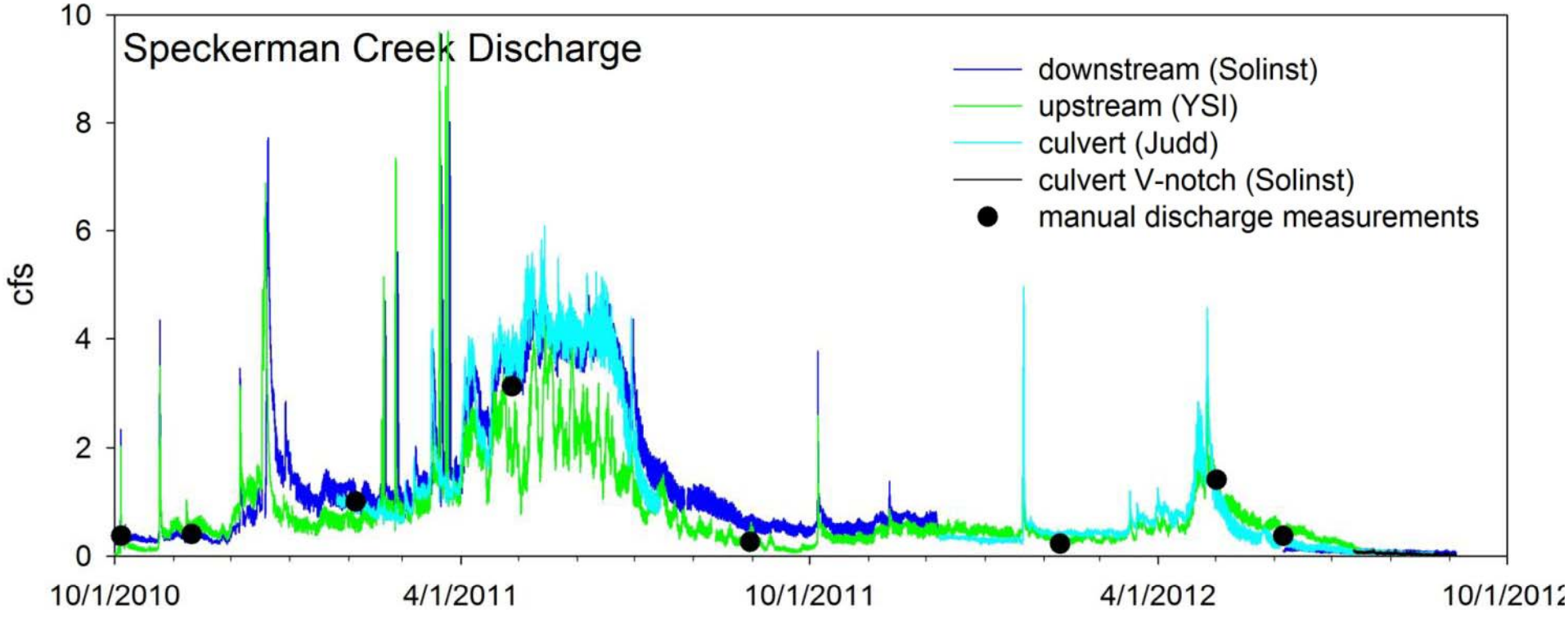
Criteria for culvert:

1. Closed bottom
2. Fill well compacted
3. Power or solar available
4. Suitable drop for weir

Benefits:

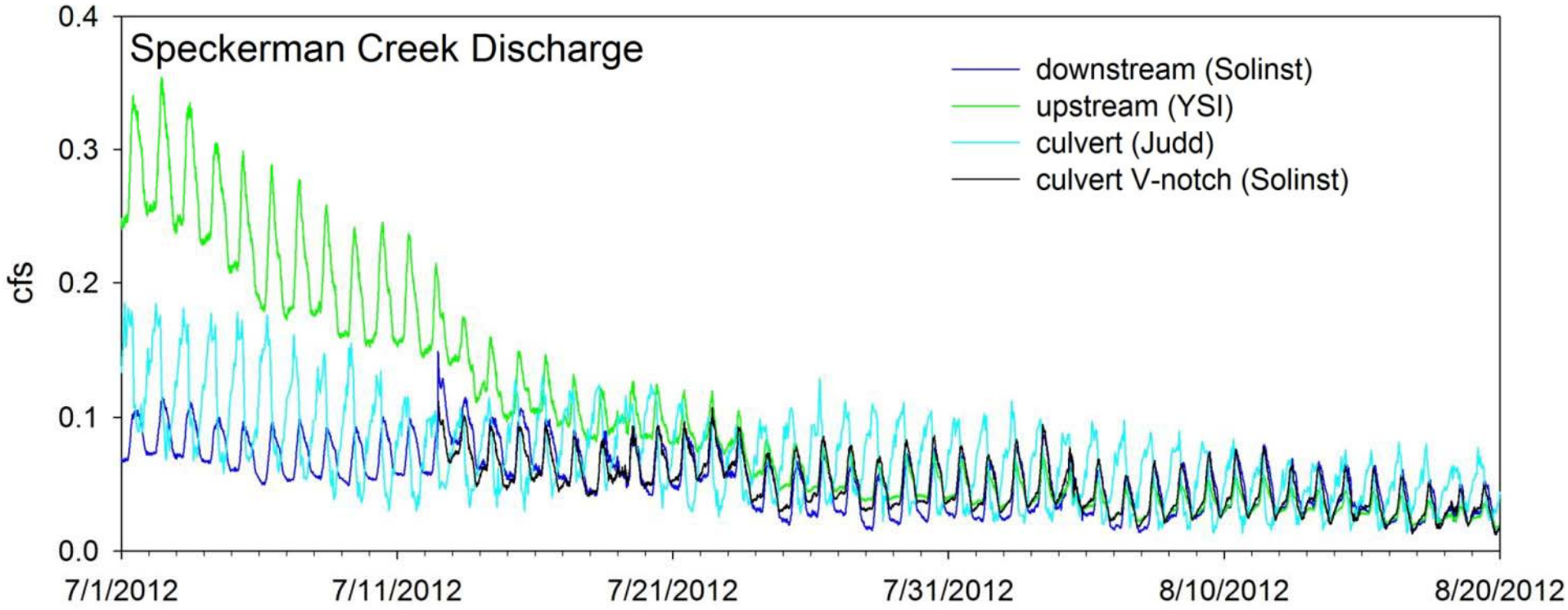
1. Cost
2. Minimal maintenance
   - -Sediment flushed out when plate removed
   - -Minimal debris movement at low flow when plate in place – free flowing during high flow season
3. Uses culvert geometry so rating curves not required
4. Plate can be installed after spawning season minimizing impacts to fish

Both depth sensor and v-notch measurements match well with independent discharge readings



Good agreement between various sensors

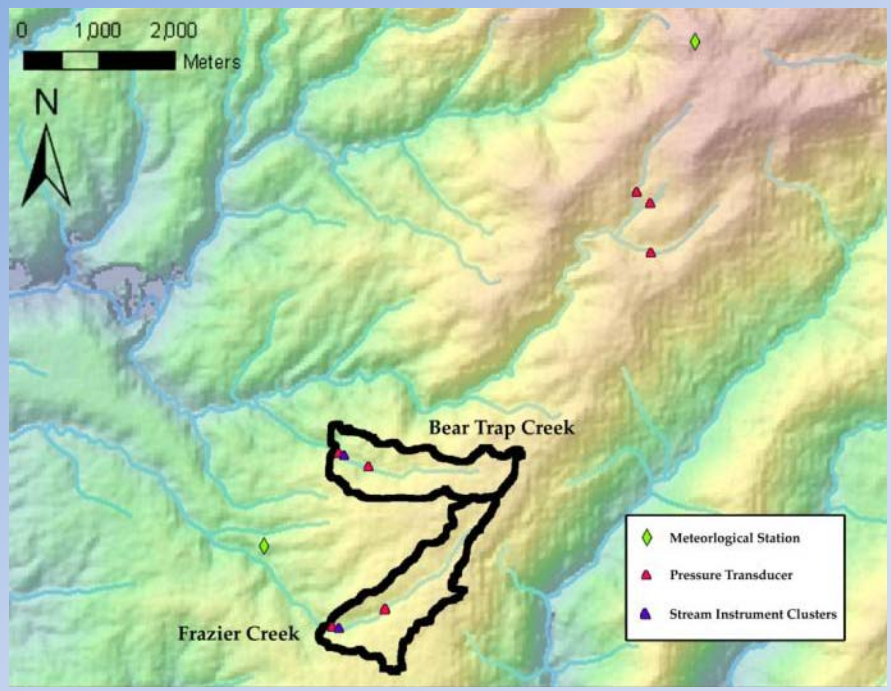
Sonic depth sensor also worked well for low flow in this catchment

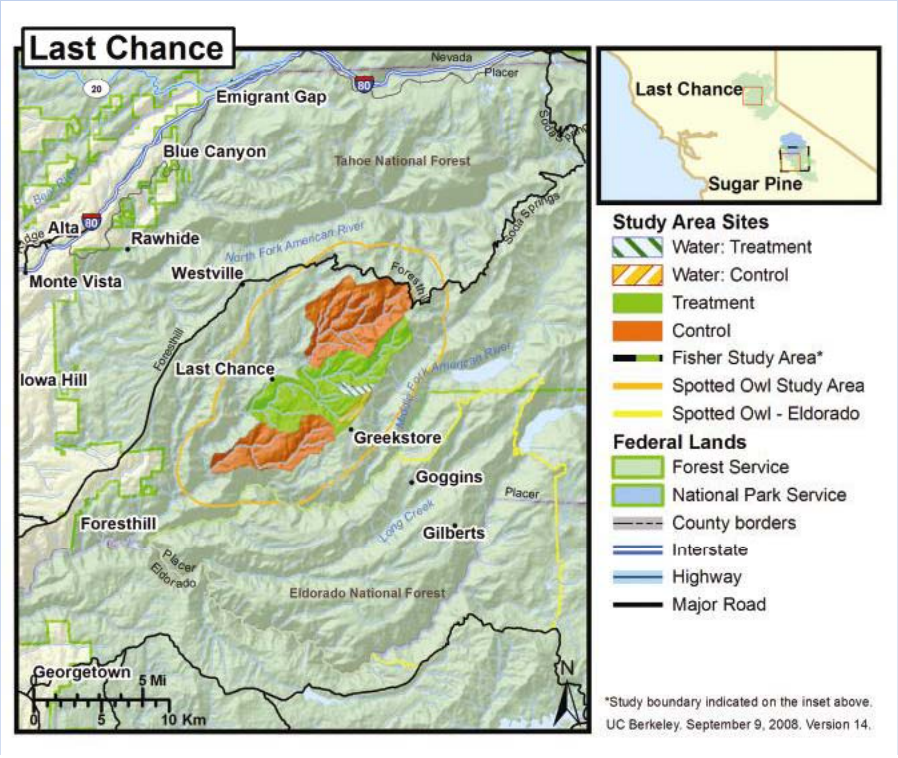


Future Plans

V-notch installations planned at Last Chance SNAMP sites

Looking for partners to help fund and to take over measurements after research completed

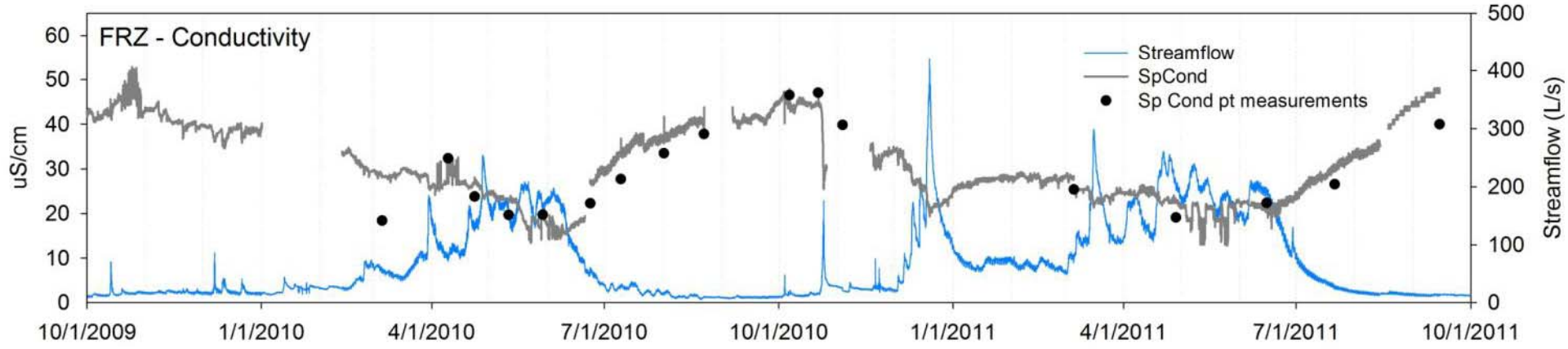


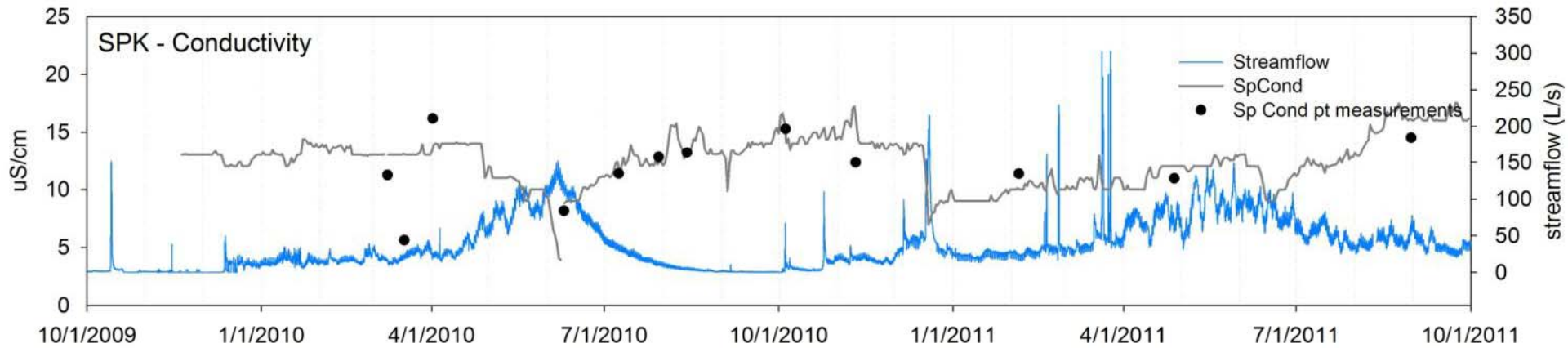


SNAMP Research Highlights

Hypothesis 1:

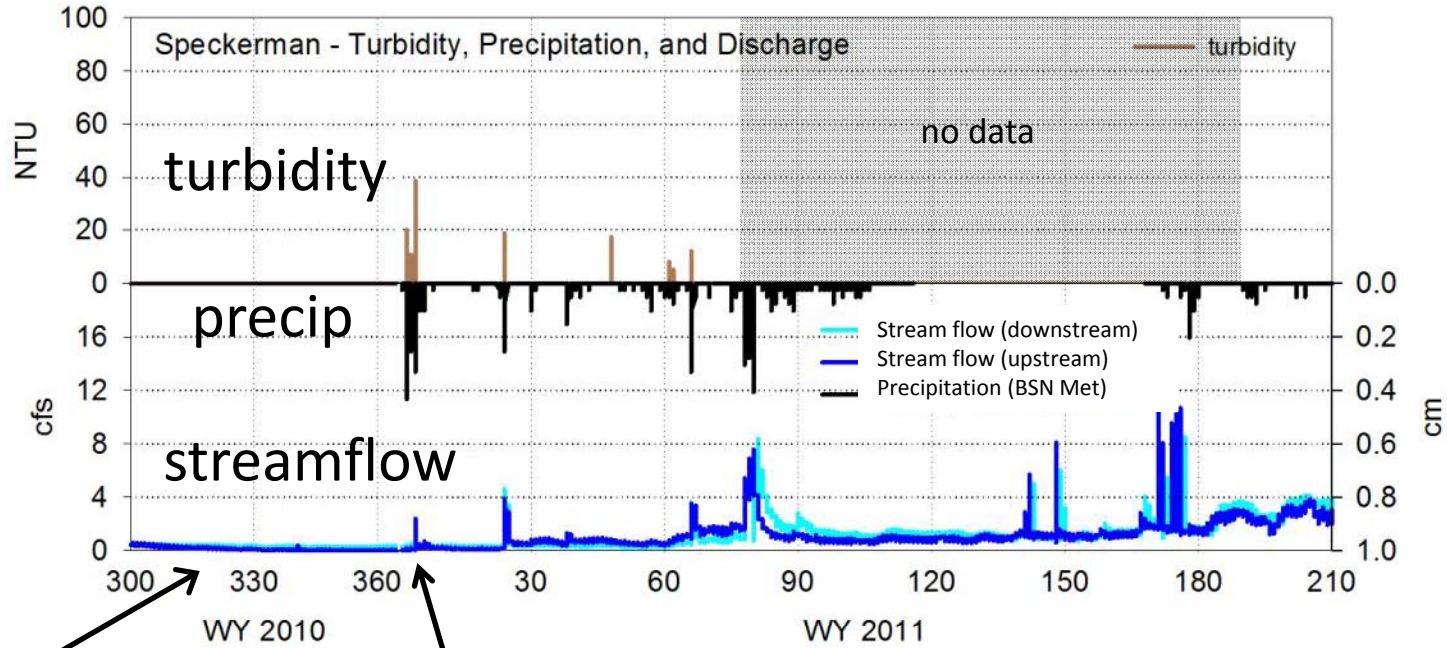
Changes in water chemistry will be a function of changes in streamflow.

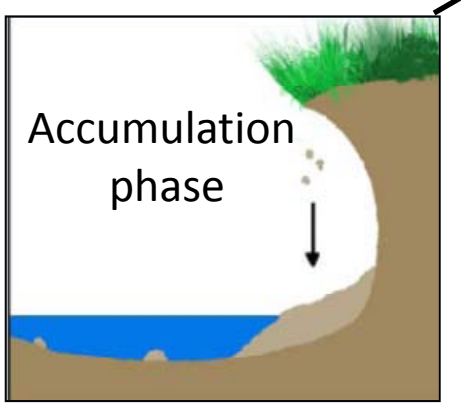


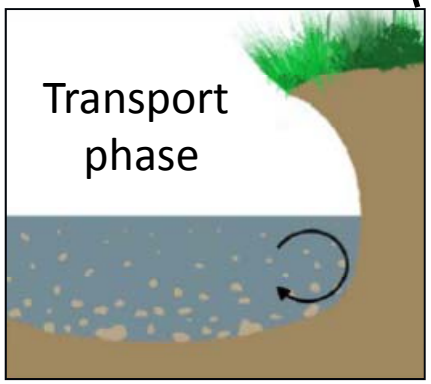


Research Highlights – Water Quality

Observations: often largest seasonal flush at initial rains



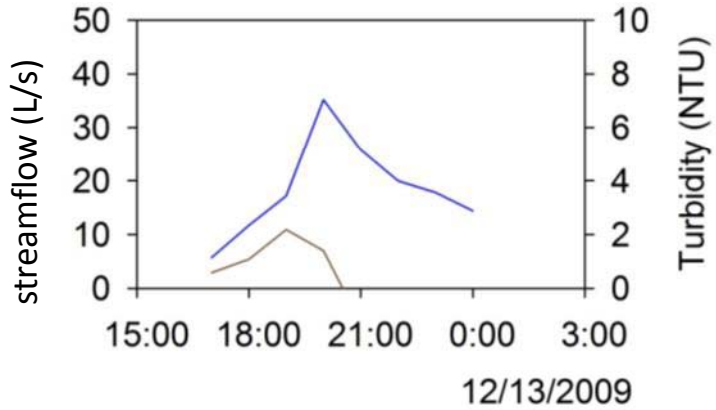


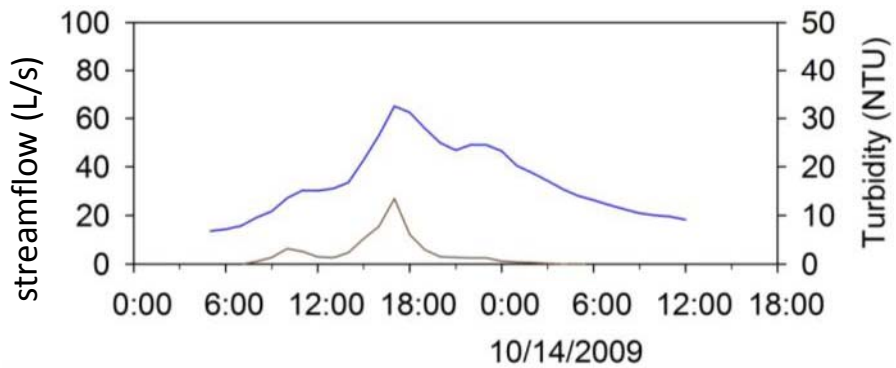


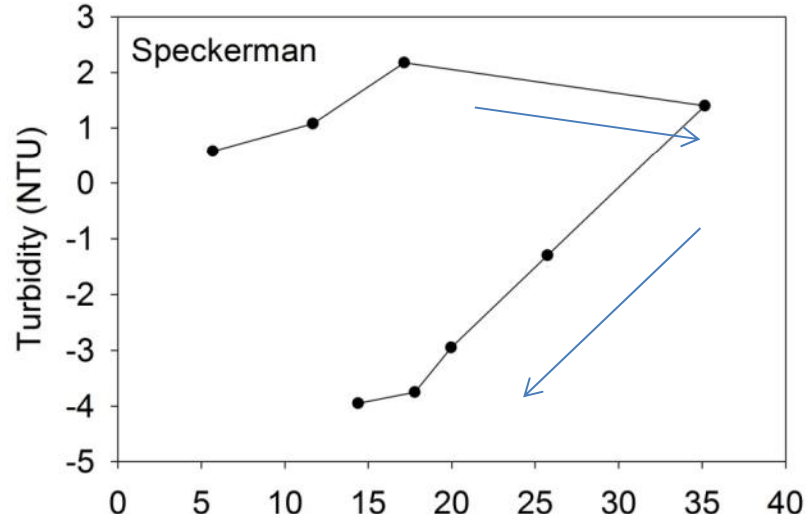
Looks like there is a seasonal depletion of sediment, especially following multiple storm events

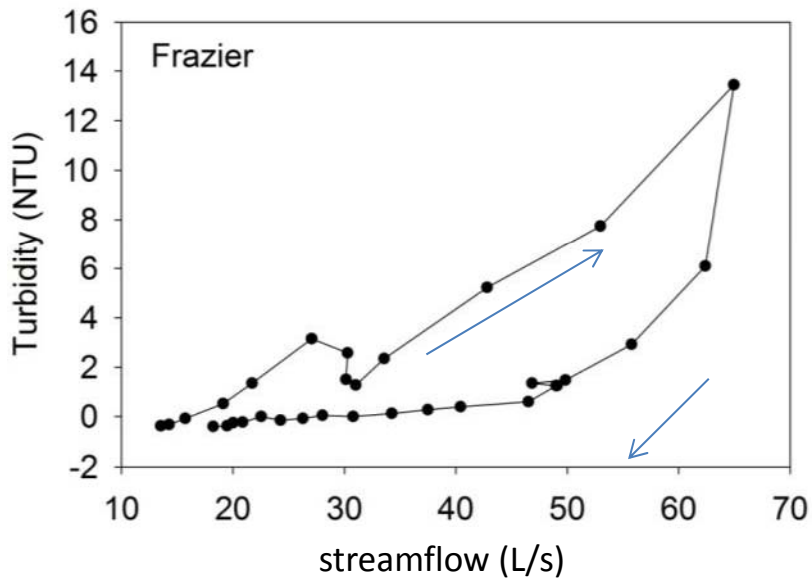
Increased turbidity will be a function of changes in streamflow

Research Highlights – Water Quality









Current analysis: comparing streamflow to turbidity to analyze sediment transport patterns

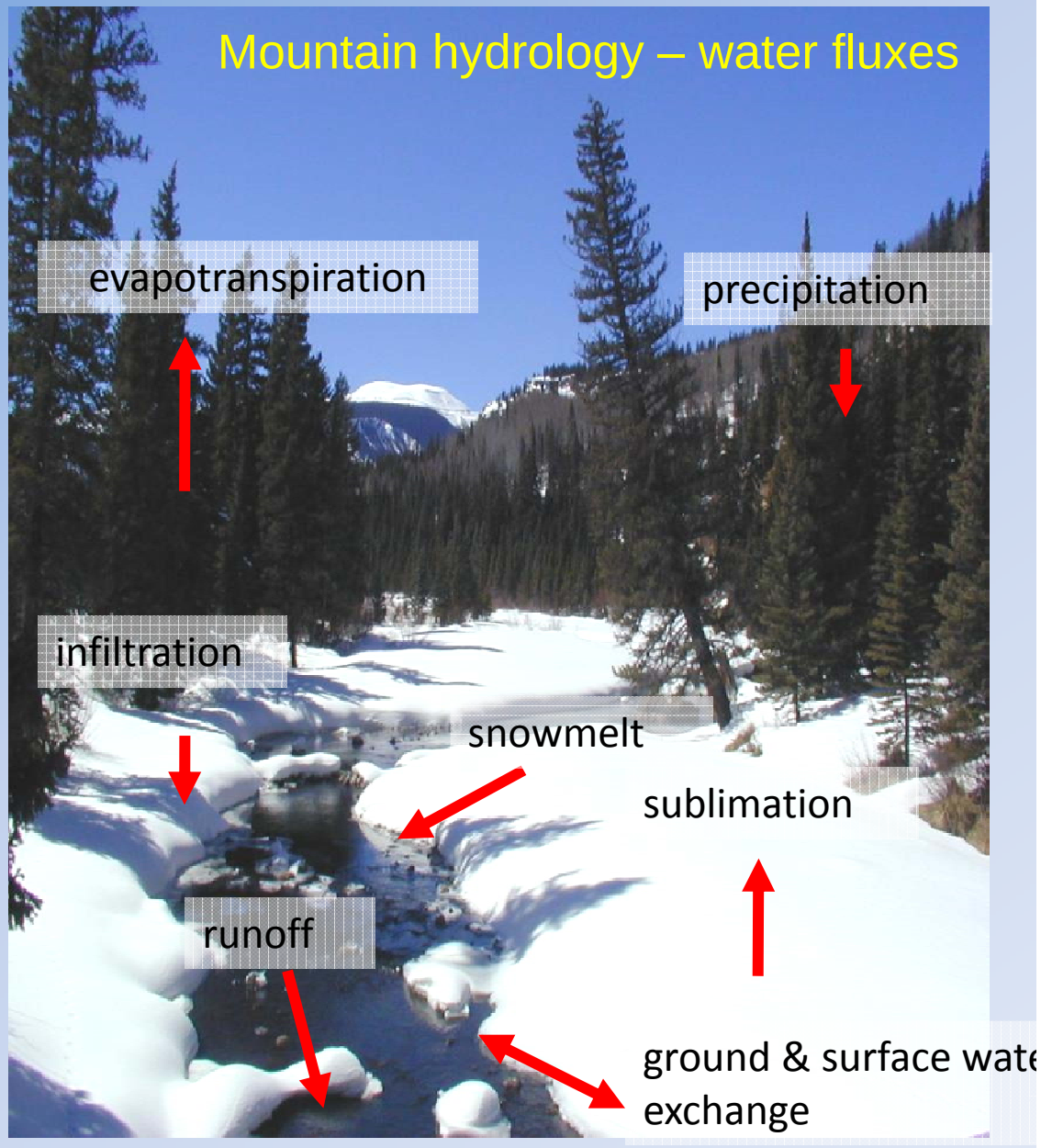
Water Quality - Findings

- In terms of water chemistry, paired watersheds are comparable and water chemistry <u>signals are behaving as expected</u>
- We are trying to understand sources of water going into streams and the controls on isotope and ion chemistry of the stream water.
- Turbidity a function of both streamflow and history of prior high-flow events.

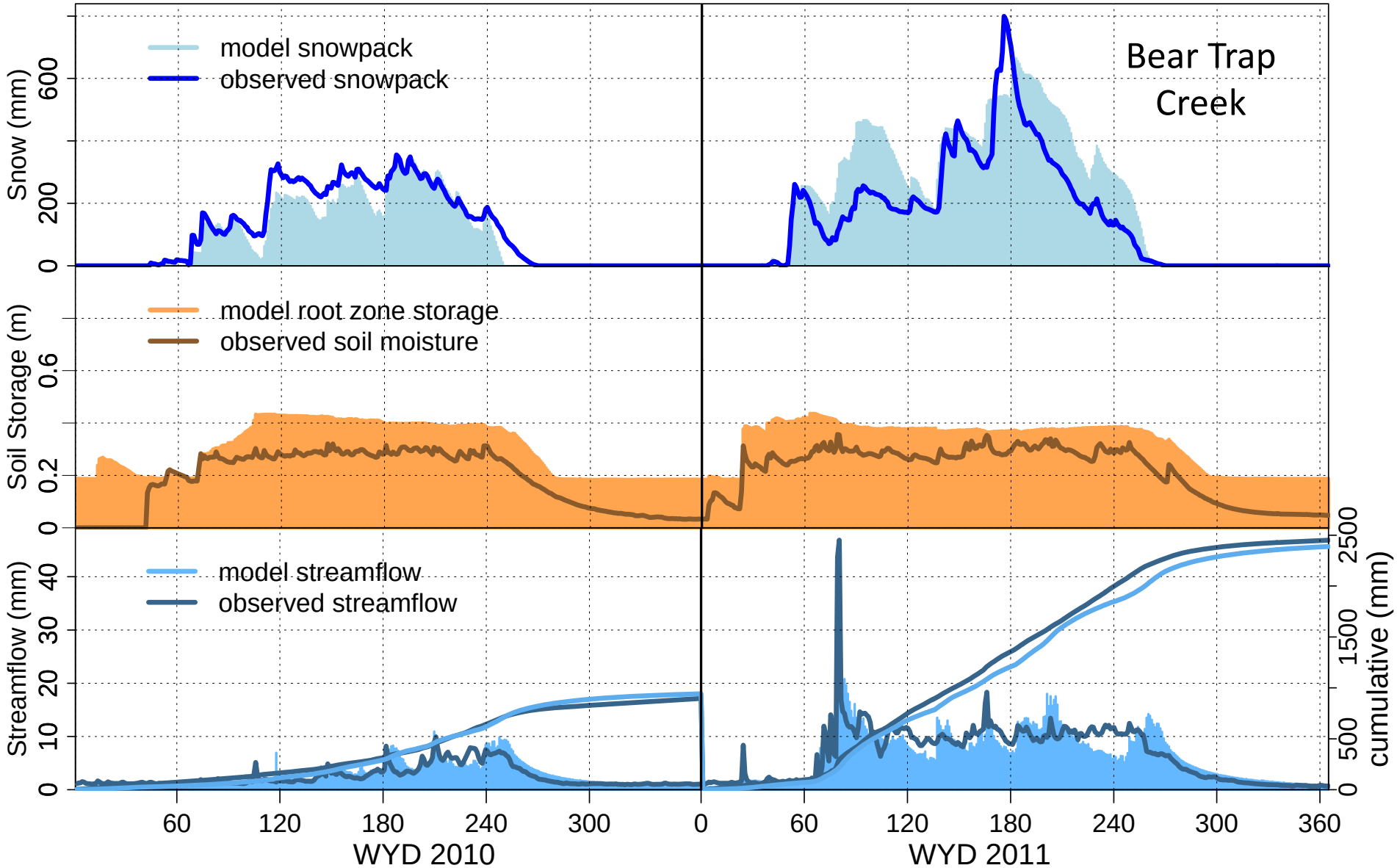
Hydrologic Modeling

Water Balance &
Energy Balance

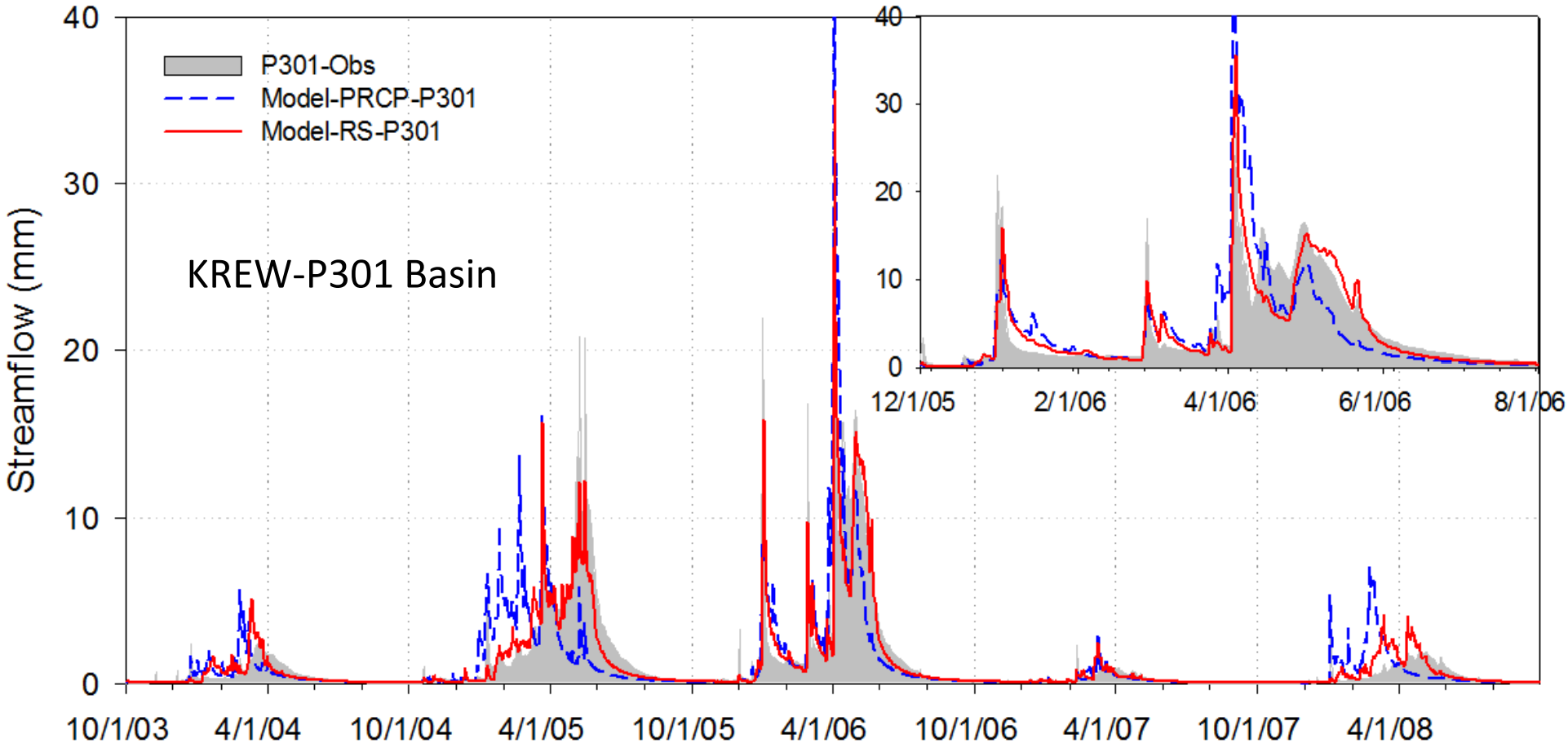
RHESSys – Regional
Hydro-Ecological
Simulation System



Research Highlights – Model Analysis



Research Highlights –Model Calibration



Snow/rain input (red) simulates better than single precipitation (blue)

Nash-Sutcliffe (NS) values:

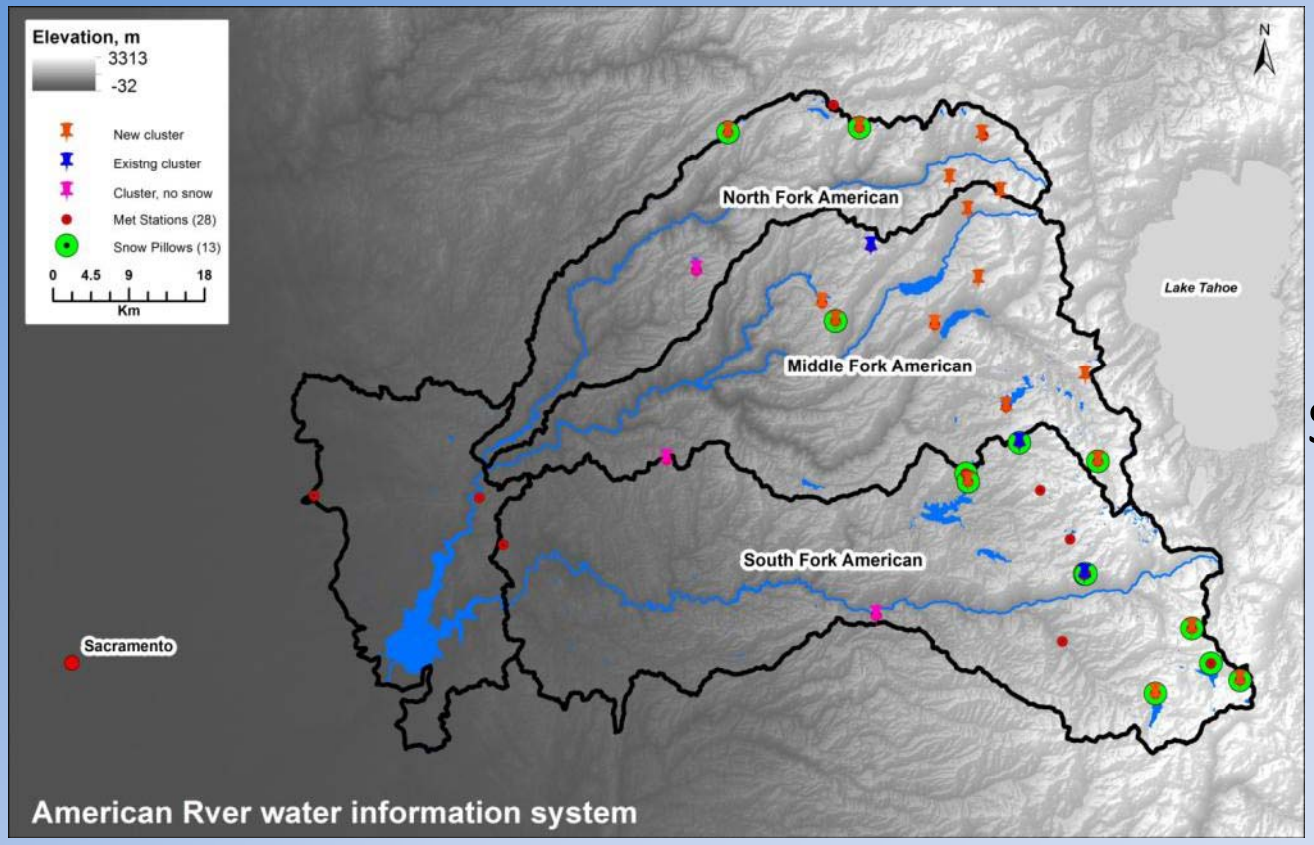
P301	Precip - 0.50	Snow/Rain - 0.82
P303	Precip - 0.50	Snow/Rain - 0.80

Water Quantity - Findings

- Using multiple measurements to constrain model: snow, soil moisture, streamflow, evapotranspiration (KREW-CZO).
- Separation of precipitation inputs to snow and rain proved critical to accurately model melt timing and streamflow.
- Preliminary forest thinning model scenarios shows streamflow increasing in both wet and dry years, due in part to the concentrated winter-time period of precipitation.

American River Project

American River basin
Basin-wide deployment of hydrologic instrument clusters

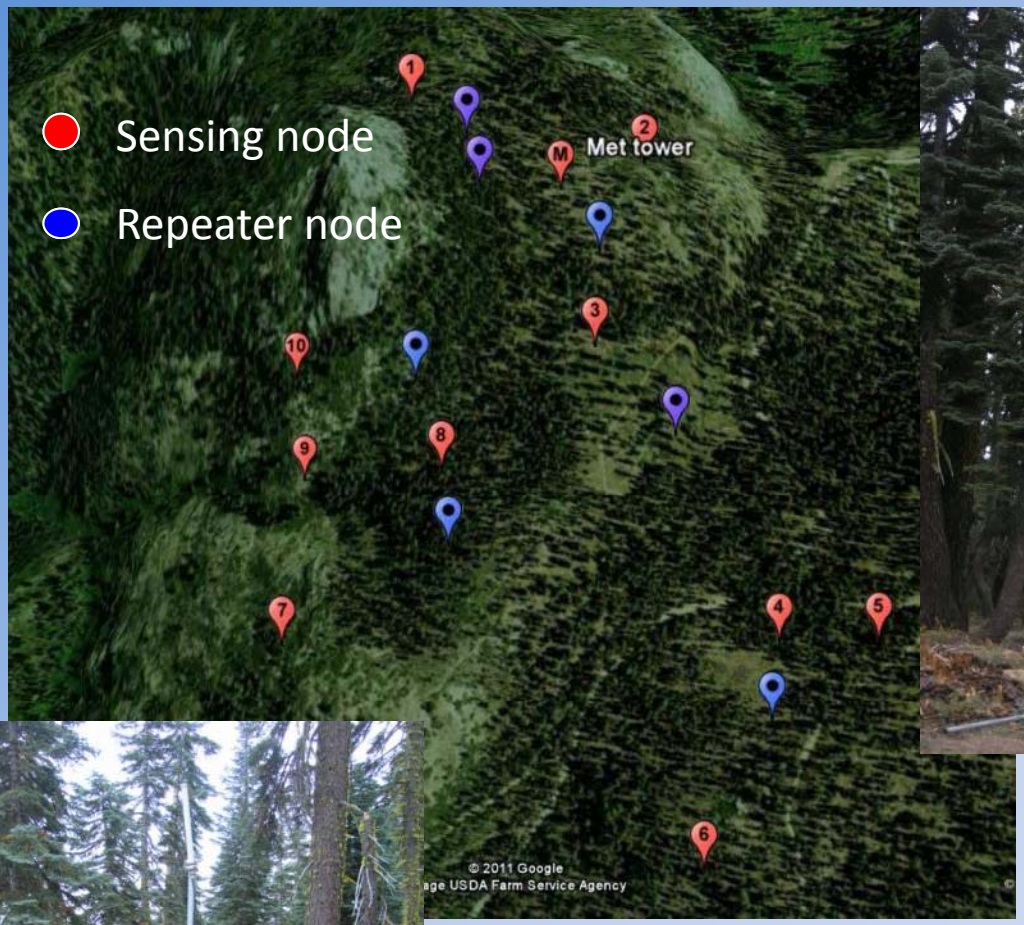


Core element of a larger water information system for the Sierra Nevada.

Strategically place low-cost sensors to get <u>real-time spatial estimates</u> of snowcover, soil moisture & other water-balance components

Network & integrate these sensors into a single spatial instrument for water-balance measurements, and combine with satellite remote sensing of snow cover.

Wireless network layout & equipment



Met tower
(wireless hub)

Repeater node

Sensing node

American River Updates

6 sites installed (4-South Fork, 2-North Fork)

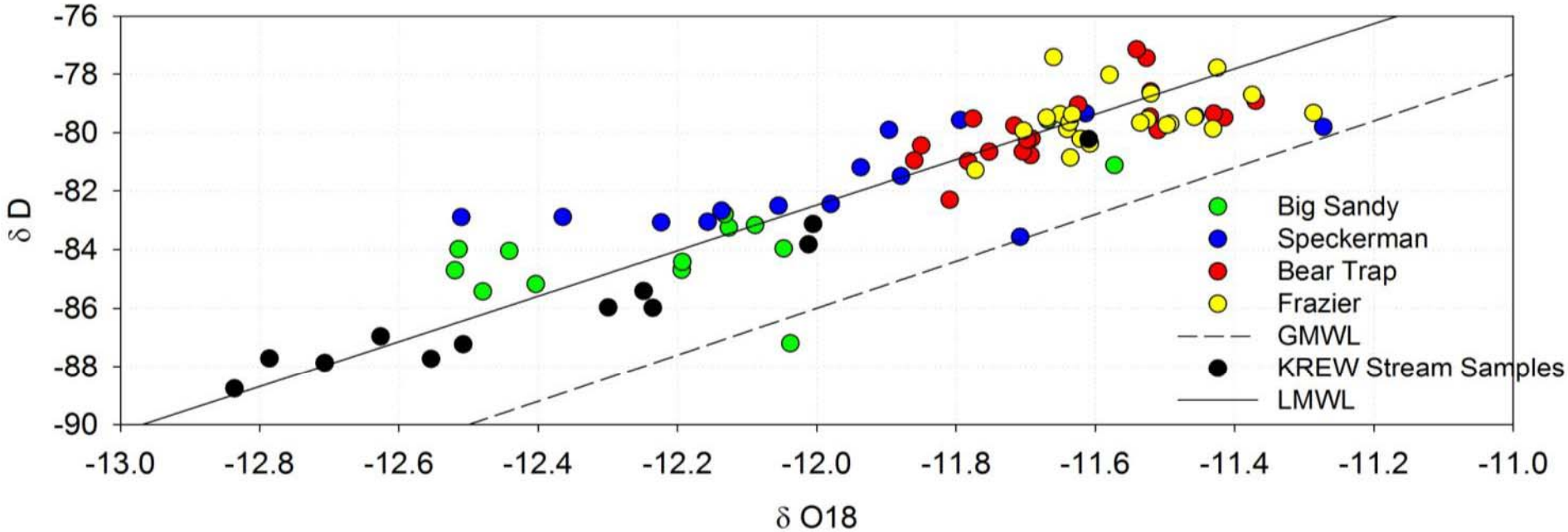
Each node measuring snow depth, temp/rh

Waiting for final completion of data boards, then sites will be operational

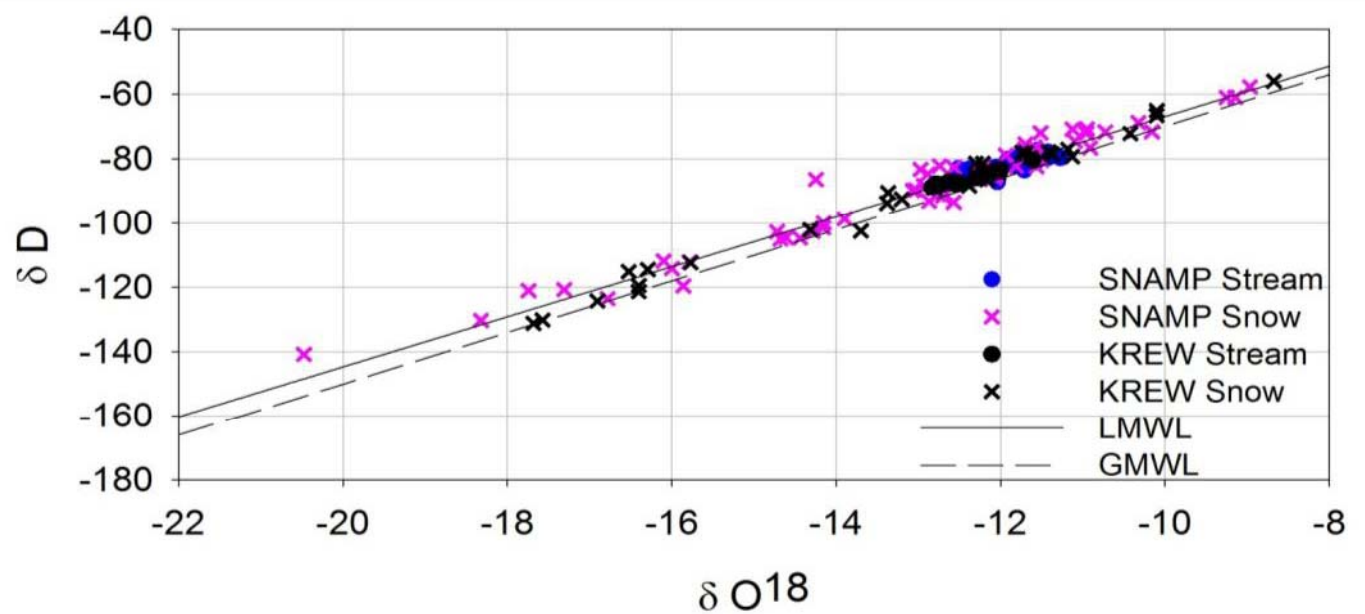
Communication links will be either cell, or satellite

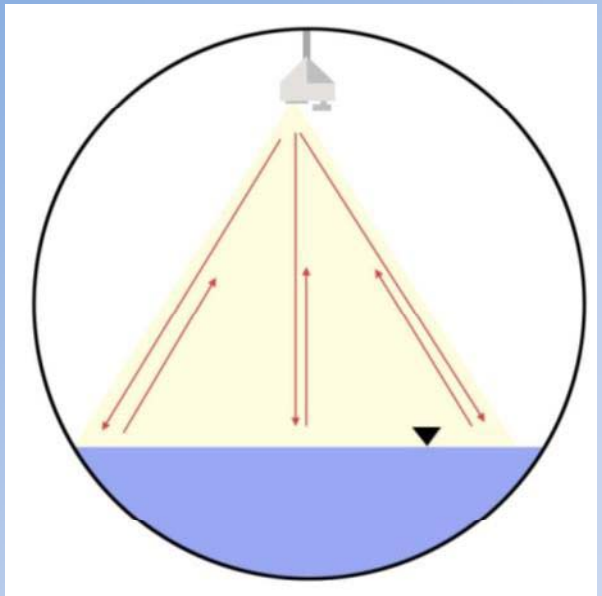
- Satellite uses the Inmarsat Broadband Global Area Network, which provides internet connectivity

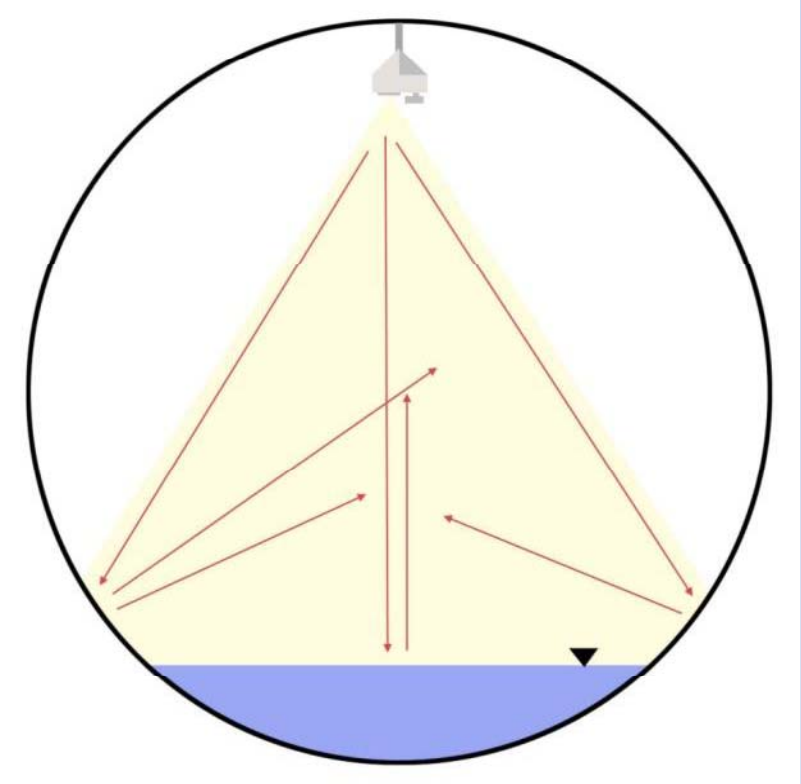
Research Highlights – Water Quality



Elevational trends for wat chemistry







Noise at low flows may be tied to diameter of culvert and subsequent size of signal cone

TQ14