

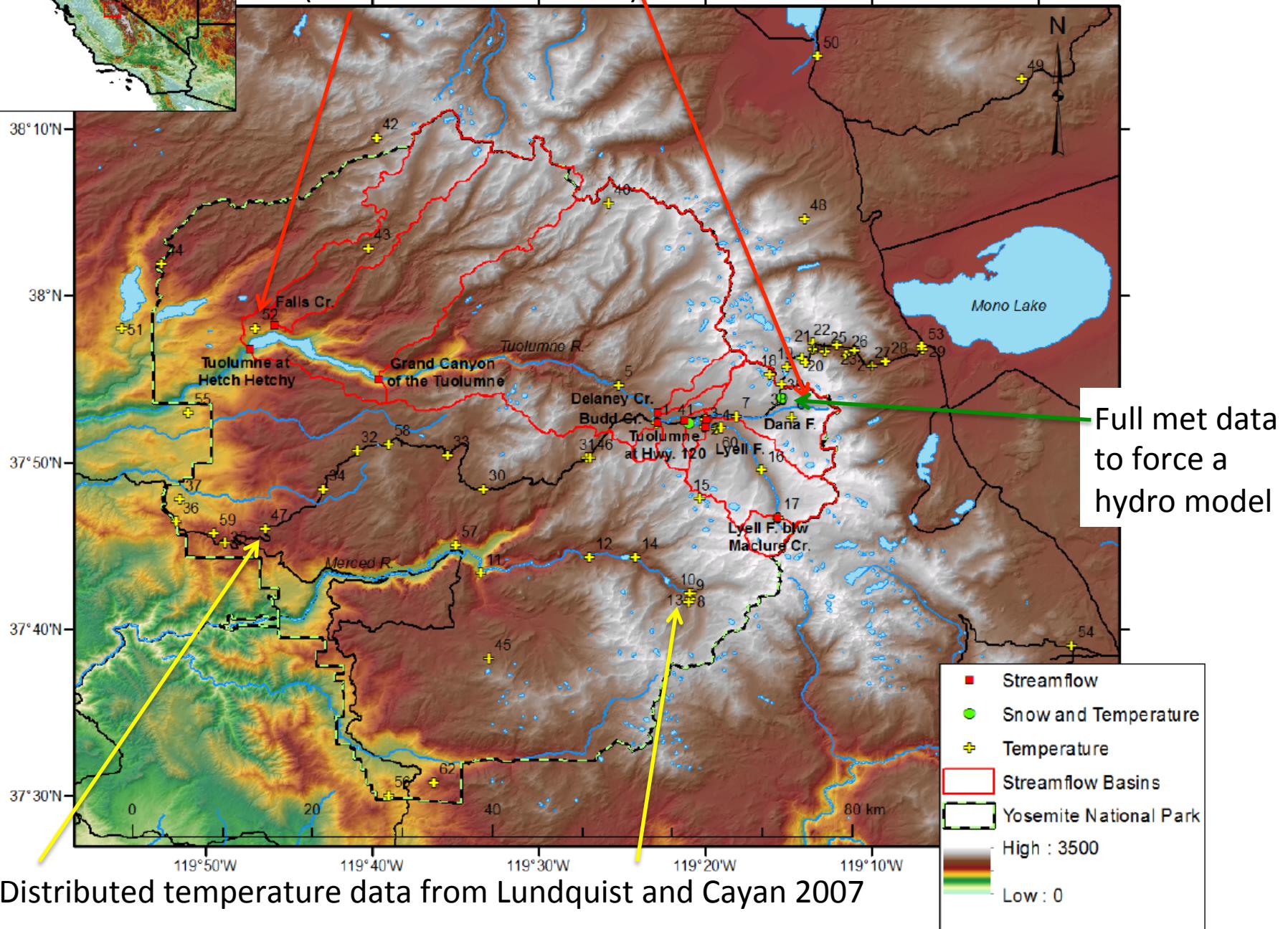
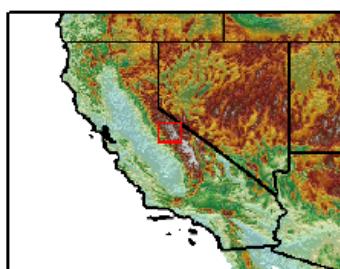
# Tuolumne River Hydroclimate Dataset



Jessica Lundquist, Harrison Forrester, Jim  
Roche, Bruce McGurk, Brian Huggett,  
Courtney Moore, Dan Cayan, Gwyn Perry,  
Eric Keenan, Nicoleta Cristea Brian Henn

With special thanks to Dave Clow and Mike Dettinger, who have supported this effort since its inception but may not claim that the data are standard USGS stream gauge data.

# Nested streamflow data for Tuolumne contributing to Hetch Hetchy (the ASO LiDAR domain)



# Brief History of “Wilderness Stream Gauging”

Also, see Harrison's Poster.



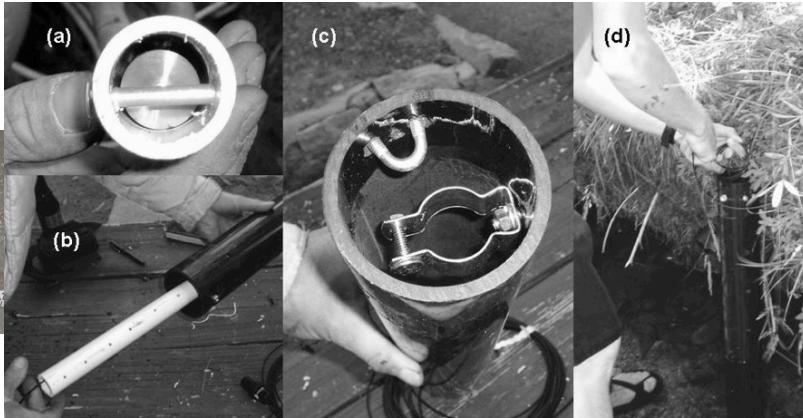
Aug 2005: Switch to  
wilderness stilling tube



Aug 2001: Solinst and  
Seabird in anchors



2015: Most sites  
upgraded to vented  
pressure transducer

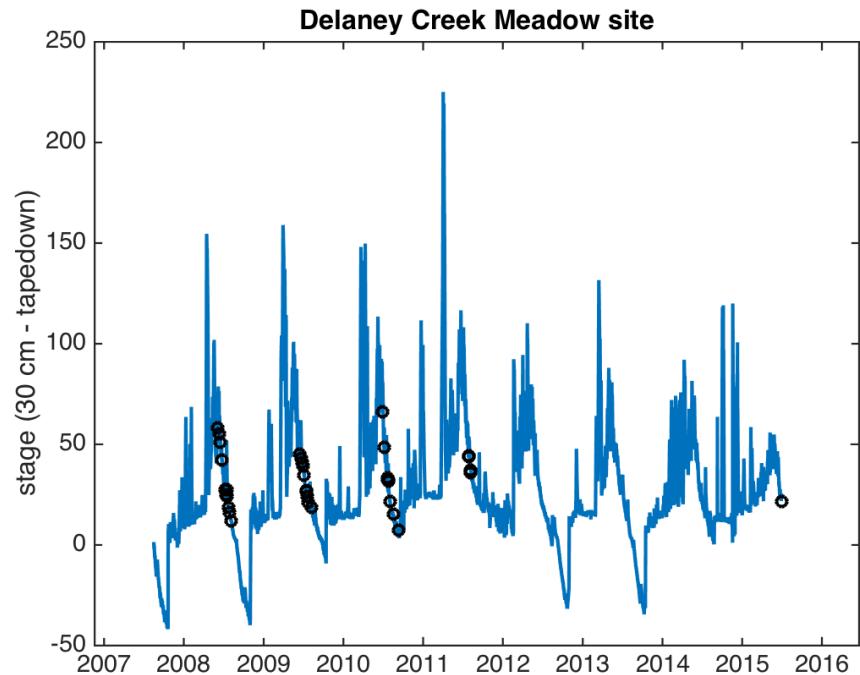
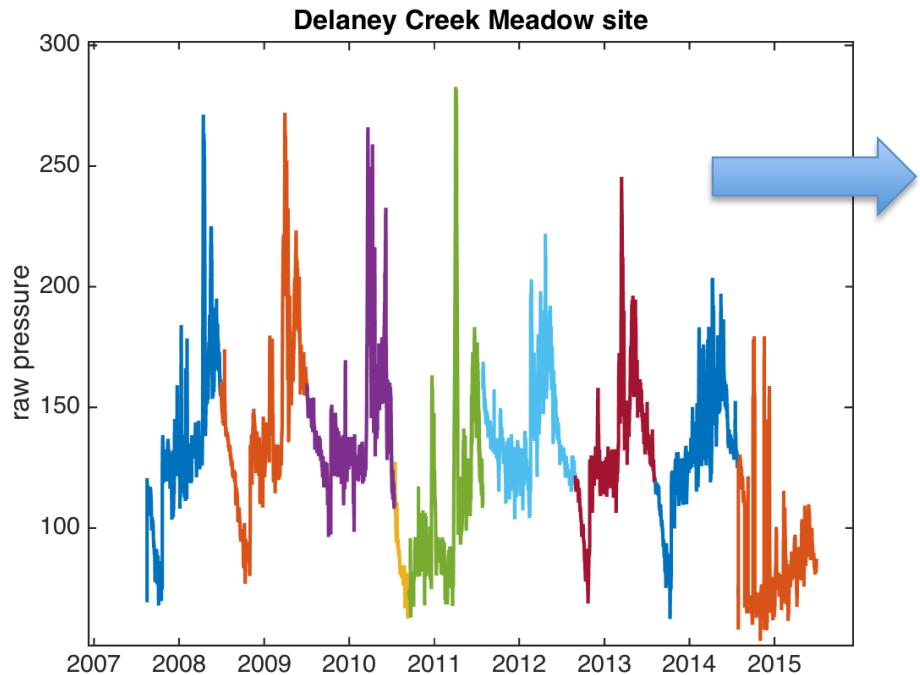


Instrument

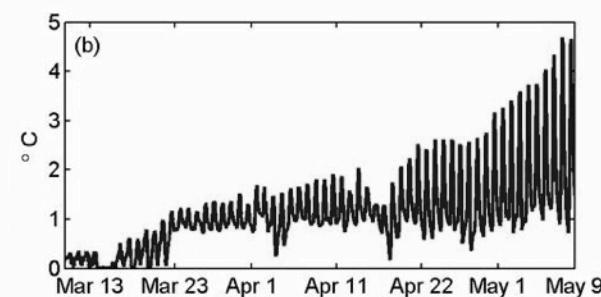
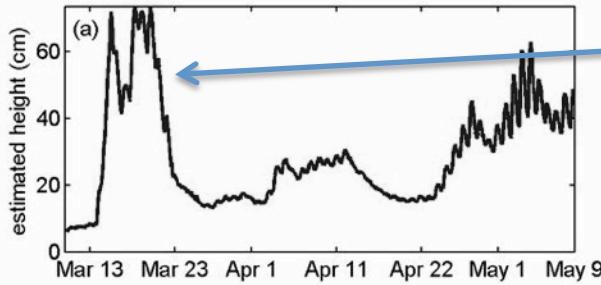
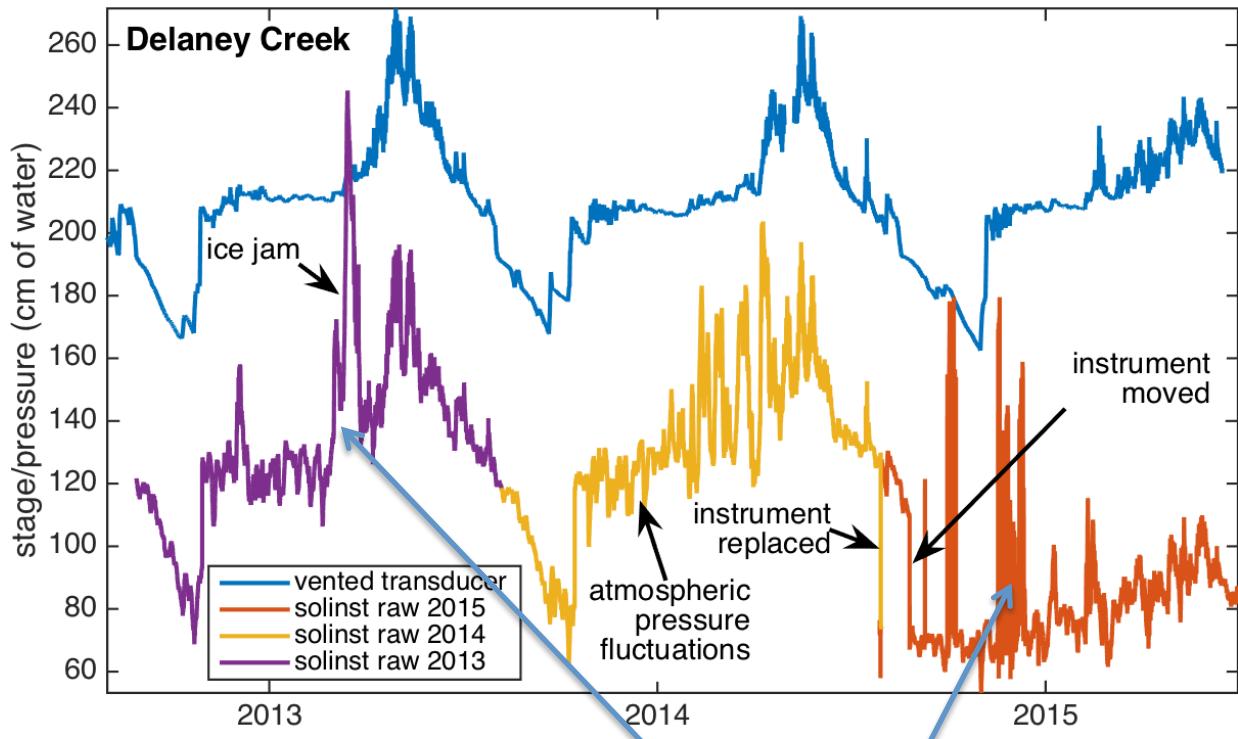


# Overview of Data Processing

- 1) Raw pressure (left, different color each year)
- 2) Remove atmospheric pressure and correct for instrument drift and movement
- 3) Yield continuous record matching available reference stage data (right)

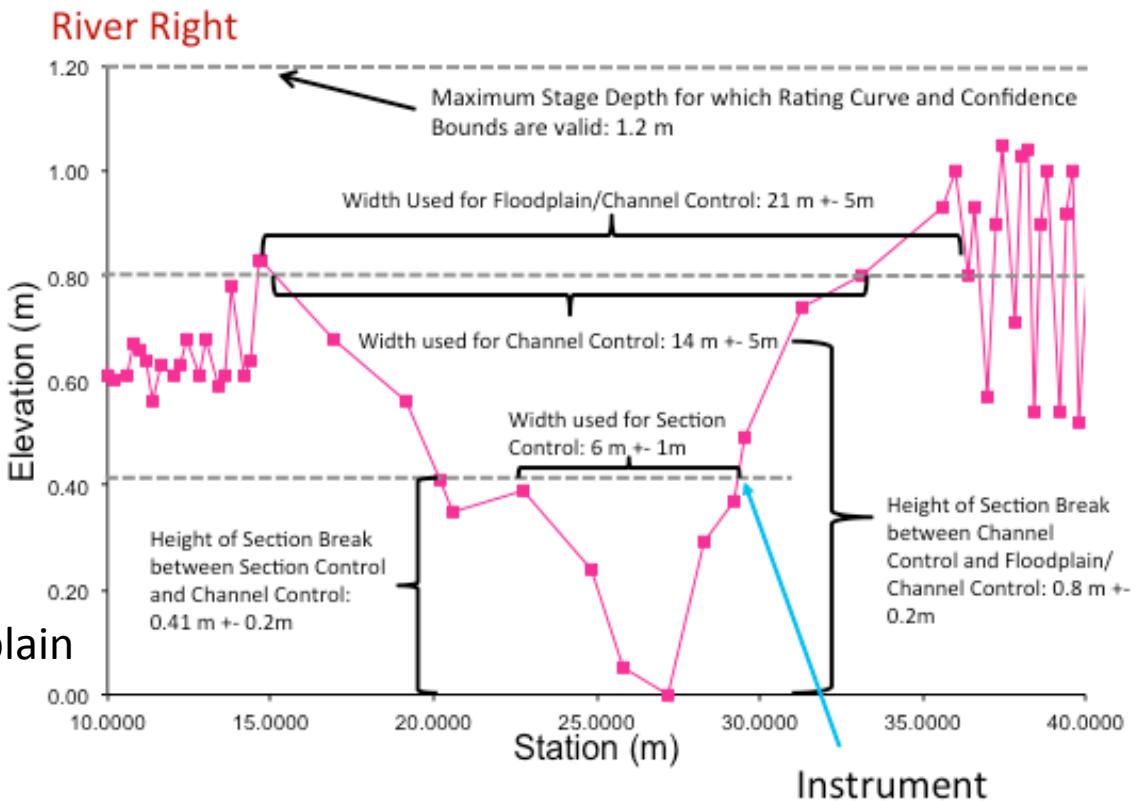
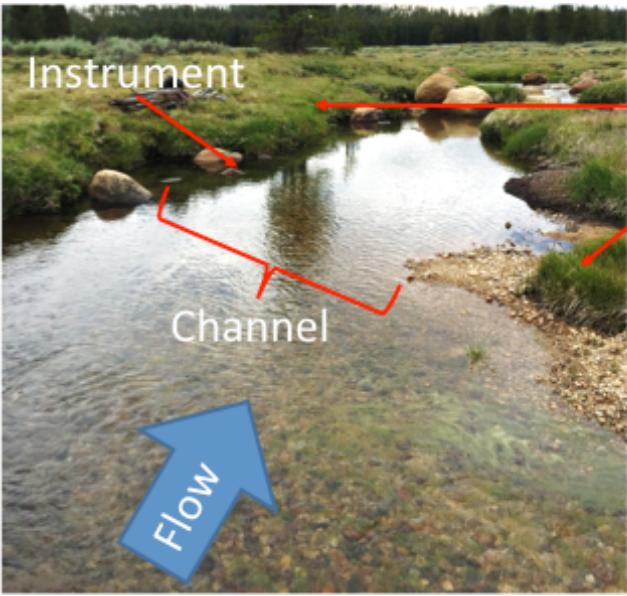


# Compare with upstream vented transducer



Meadow locations are subject to ice jams during which discharge is not related to the recorded pressure/stage

# Rating Curve with Uncertainty: Start with Surveys and Hydraulics



$$Q = a (h - b)^c$$

Slope: 0.00422 m/m

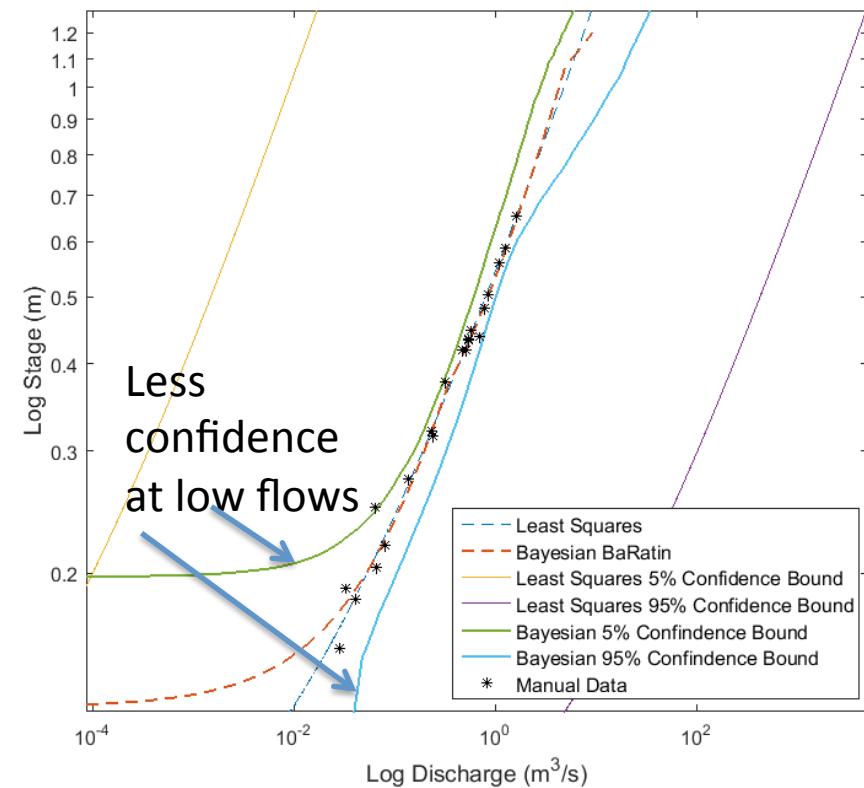
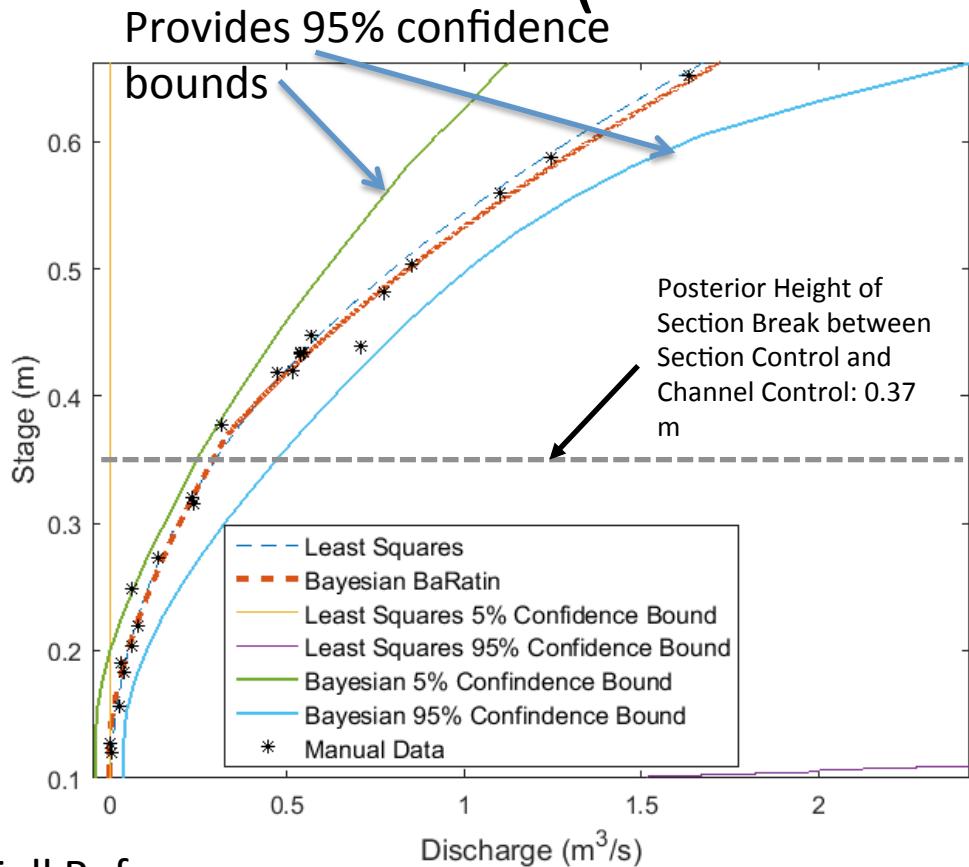
Use cross-section geometry, with manning's equation for most flows and weir equation for low flows, as first guess (prior)

**Table 1**

Mean prior values for parameters,  $a$ ,  $b$  and  $c$ , given by classical hydraulic formulas for most common types of hydraulic controls. The definitions of all the variables are provided in the text. We always set  $g = 9.81 \text{ m/s}^2$  for gravity acceleration. From Le Coz et al. 2014

Control type	Ideal assumptions	$a$	$b$	$c$
Channel	Wide rectangle, steady and uniform flow	$K_s B \sqrt{S_e}$	Average bed level	5/3
Section (rectangle)	Perpendicular to mean flow, no backwater	$C_r B_r \sqrt{2g}$	Crest level	3/2

# Rating Curves: Use stage-discharge observations to update the first guess in a Bayesian framework (LeCoz et al. 2014)

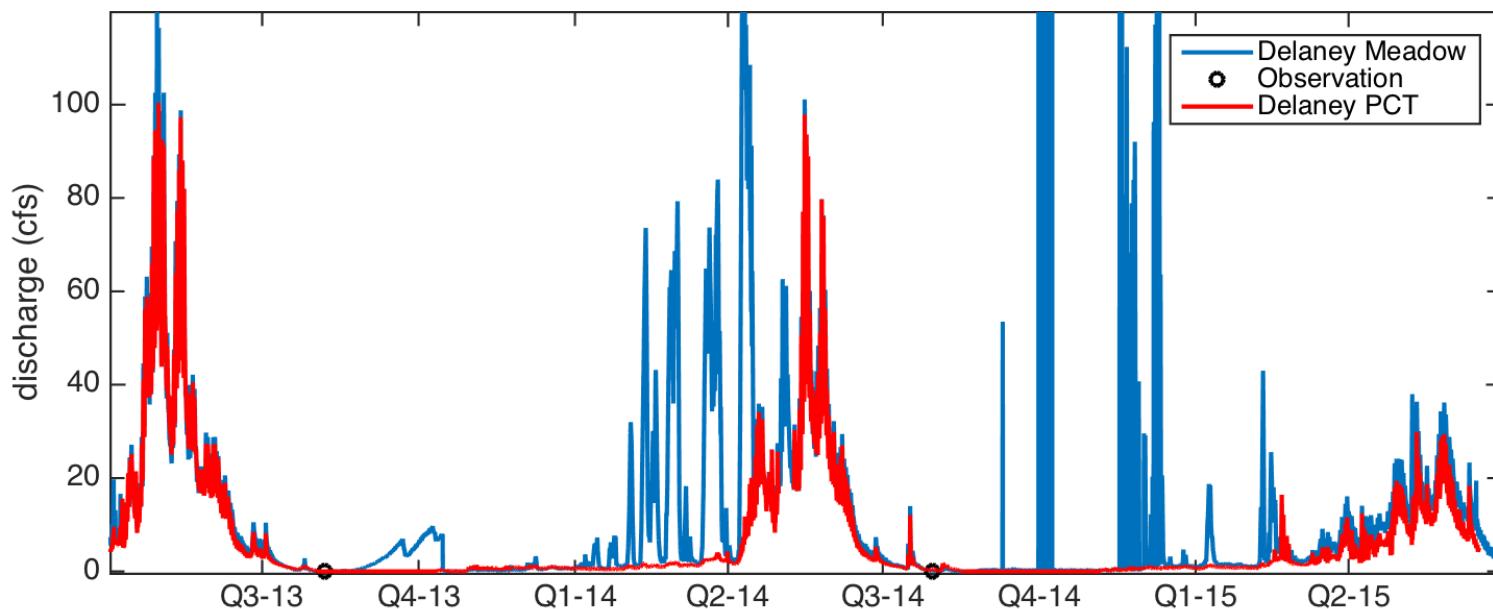


Full Reference:

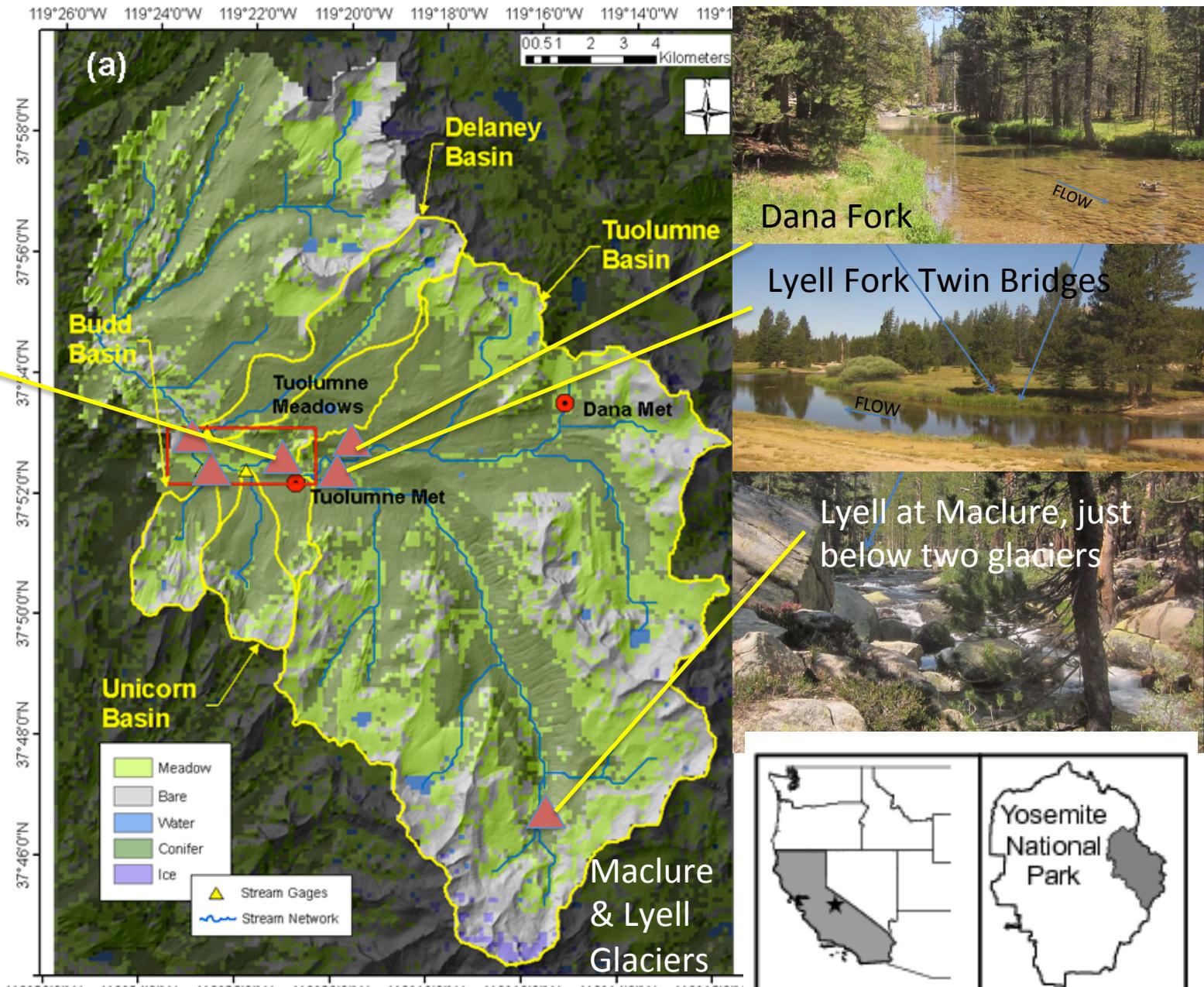
LeCoz, J., B. Renard, L. Bonnifait, F. Branger, and R. Le Boursicaud (2014), Combining hydraulic knowledge and uncertain gaugings in the estimation of hyrometric rating curves: A Bayesian approach, *J. Hydrol.*, 509, 573-587. doi: <http://dx.doi.org/10.1016/j.jhydrol.2013.11.016>

# Compare Delaney upstream (vented) and downstream (solinst)

- Compare independently calculated discharge from two sites on same stream
- Largest difference: Meadow site subject to ice jams (blue lines not evidence in red timeseries)

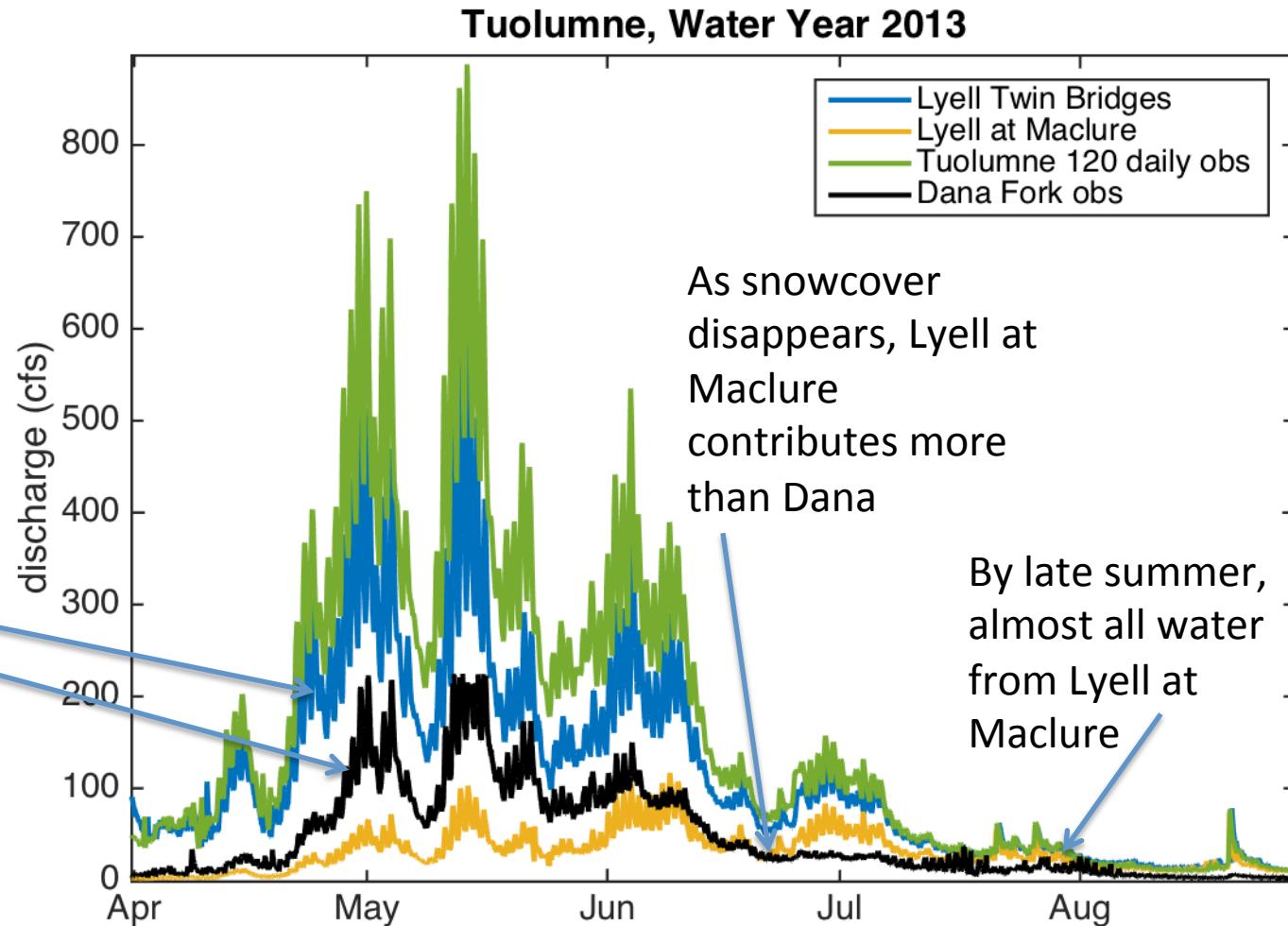


Hwy 120

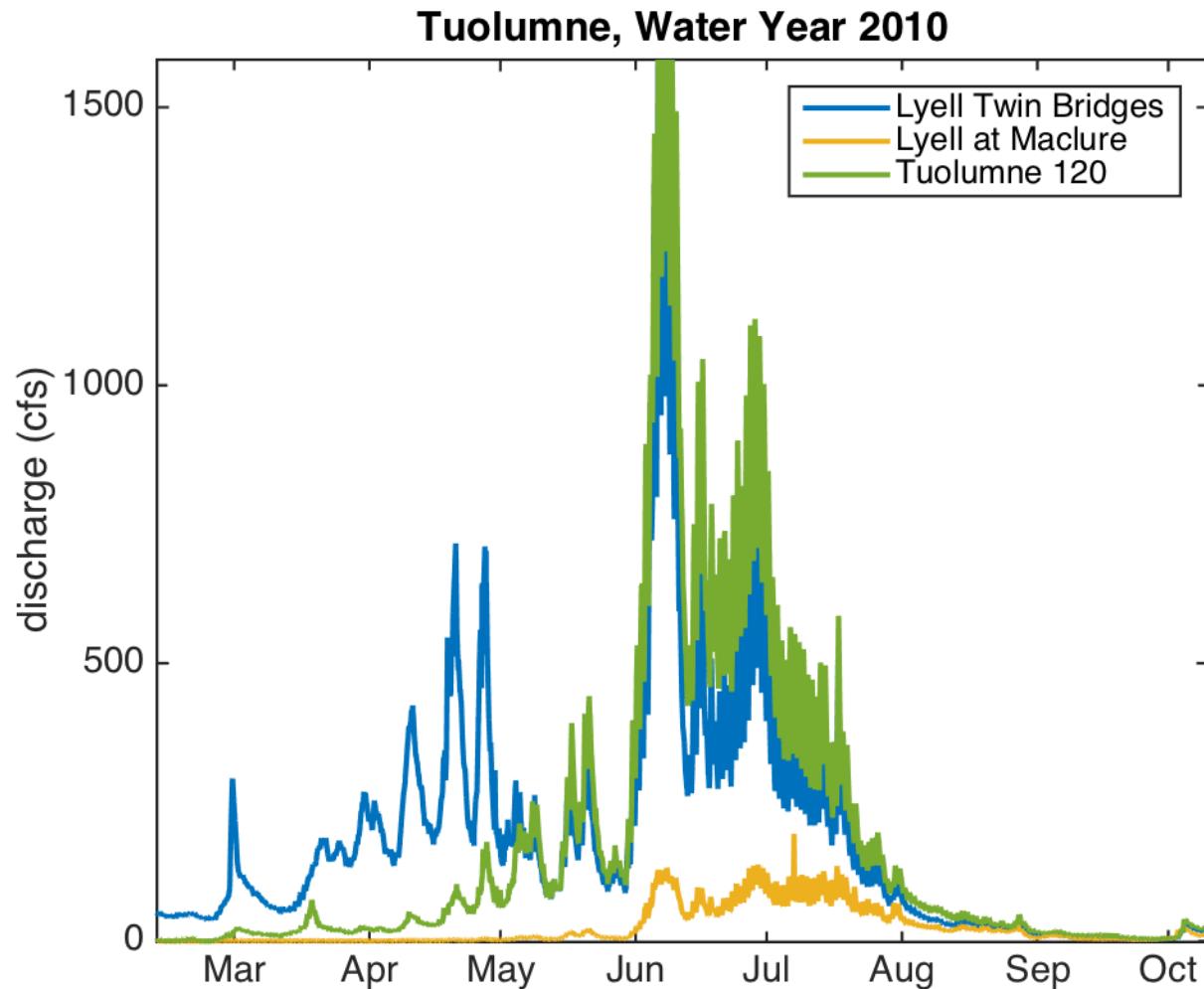


# Network illustrates importance of glacier contribution in a dry year

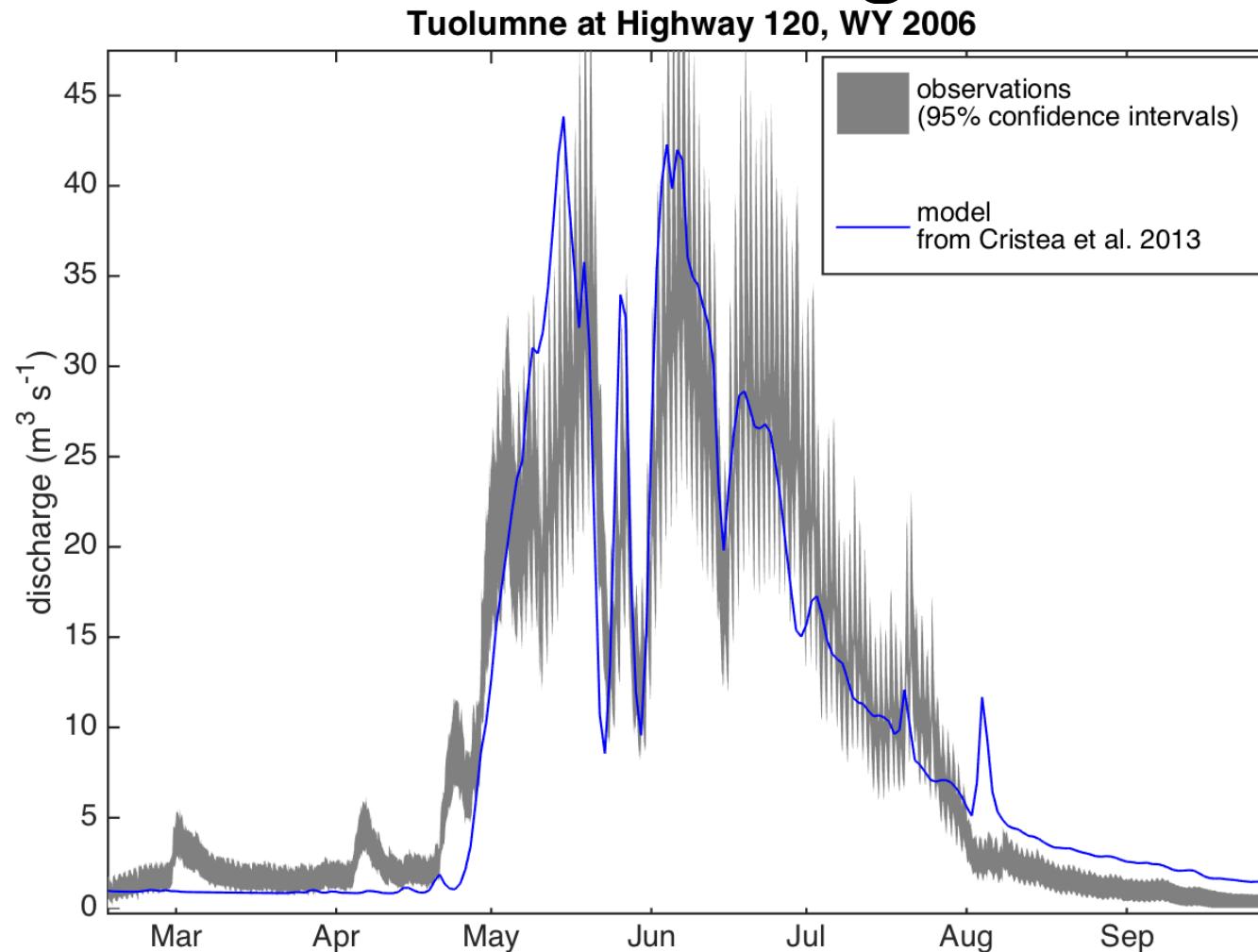
In general, Lyell Fork contributes 2/3<sup>rds</sup> and Dana Fork contributes 1/3<sup>rd</sup> to flow at Highway 120 (similar to their areas)



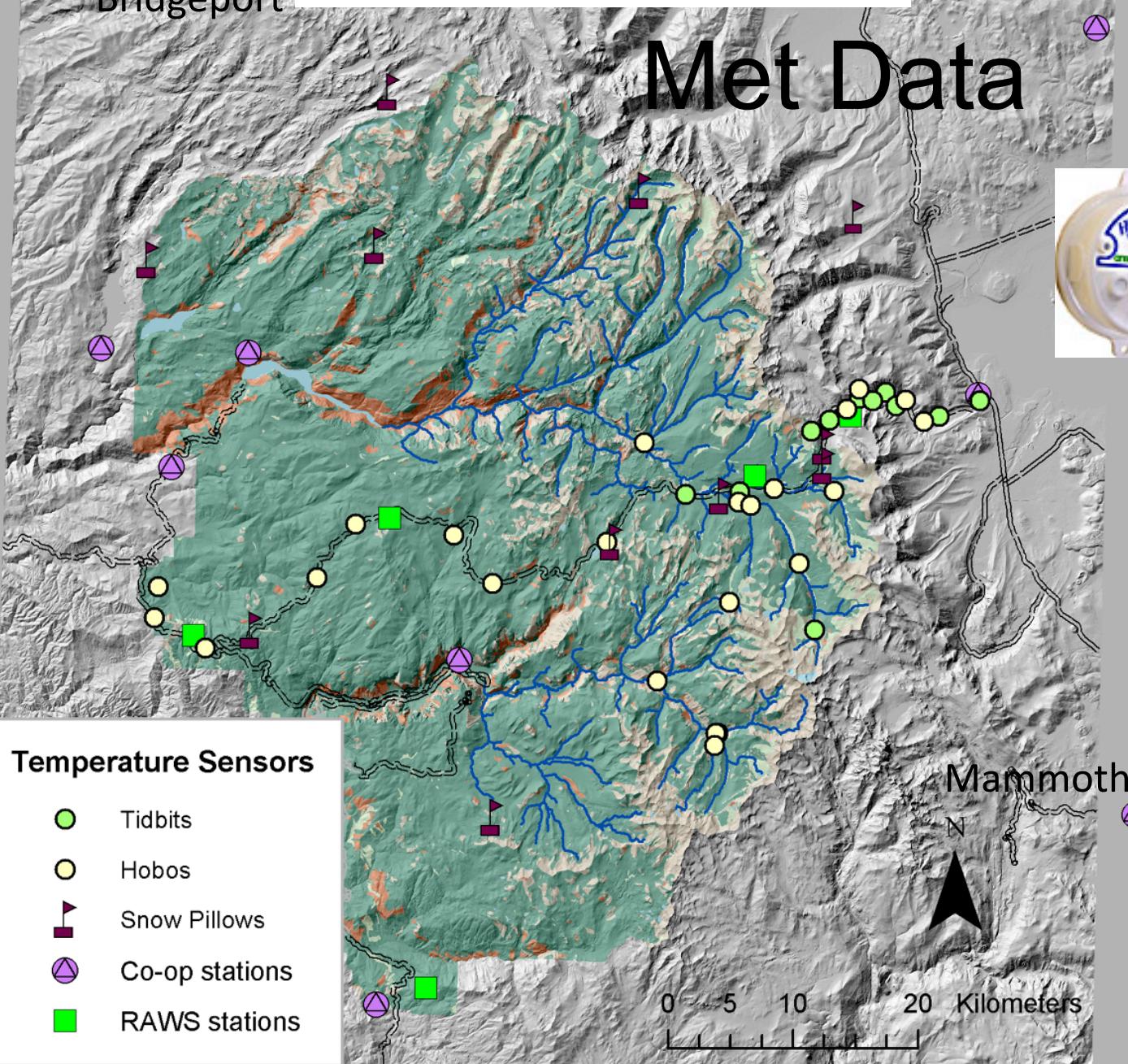
Glaciers also important in a wet year,  
but later in the season.



# Provided as reference for management, I&M, distributed modeling



Details in Lundquist & Cayan 2007,  
JHydromet



Summer 2001 to  
2005 available



# Data Details:

- Looking for beta-users: Please let us (Jessica: [jdlund@uw.edu](mailto:jdlund@uw.edu)) know if you look at it and find anything that looks odd
- Use at your own risk (these are remote locations maintained on a small budget, and we are not the USGS)
- Preliminary site:  
[http://depts.washington.edu/mtnhydr/data/  
yosemite.shtml](http://depts.washington.edu/mtnhydr/data/yosemite.shtml)
- Will be archived by UW Library and in CUAHSI HIS, detailed in WRR data paper (currently in preparation). Site above will be updated when official archiving occurs

What data you can get now (most at half-hour time-steps up to summer 2015):

- Raw pressure and temperature
- Barometric records and corrected stage
- Water temperature
- Discharge (best guess and 95% confidence intervals)
- Manual measurements of stage and discharge
- Manual cross-sections
- Daily T<sub>min</sub>,T<sub>max</sub>,T<sub>mean</sub> temperatures for summer 2001 to winter 2005

# Thank you!

- Field Data installation and Collection: Dan Cayan, Mike Dettinger, Dave Clow, Julia Dettinger, Courtney Moore, Brian Huggett, Nathan Ernster, Josh Baccei, Harrison Forrester, & more
- Data processing and Analysis: Gwyn Perry, Eric Keenan
- Map help: Brian Henn and Nicoleta Cristea

Questions: Jessica Lundquist at [jdlund@uw.edu](mailto:jdlund@uw.edu)