Impacts of variable glacier coverage on downstream fluvial discharge: a case study from the Eklutna Basin

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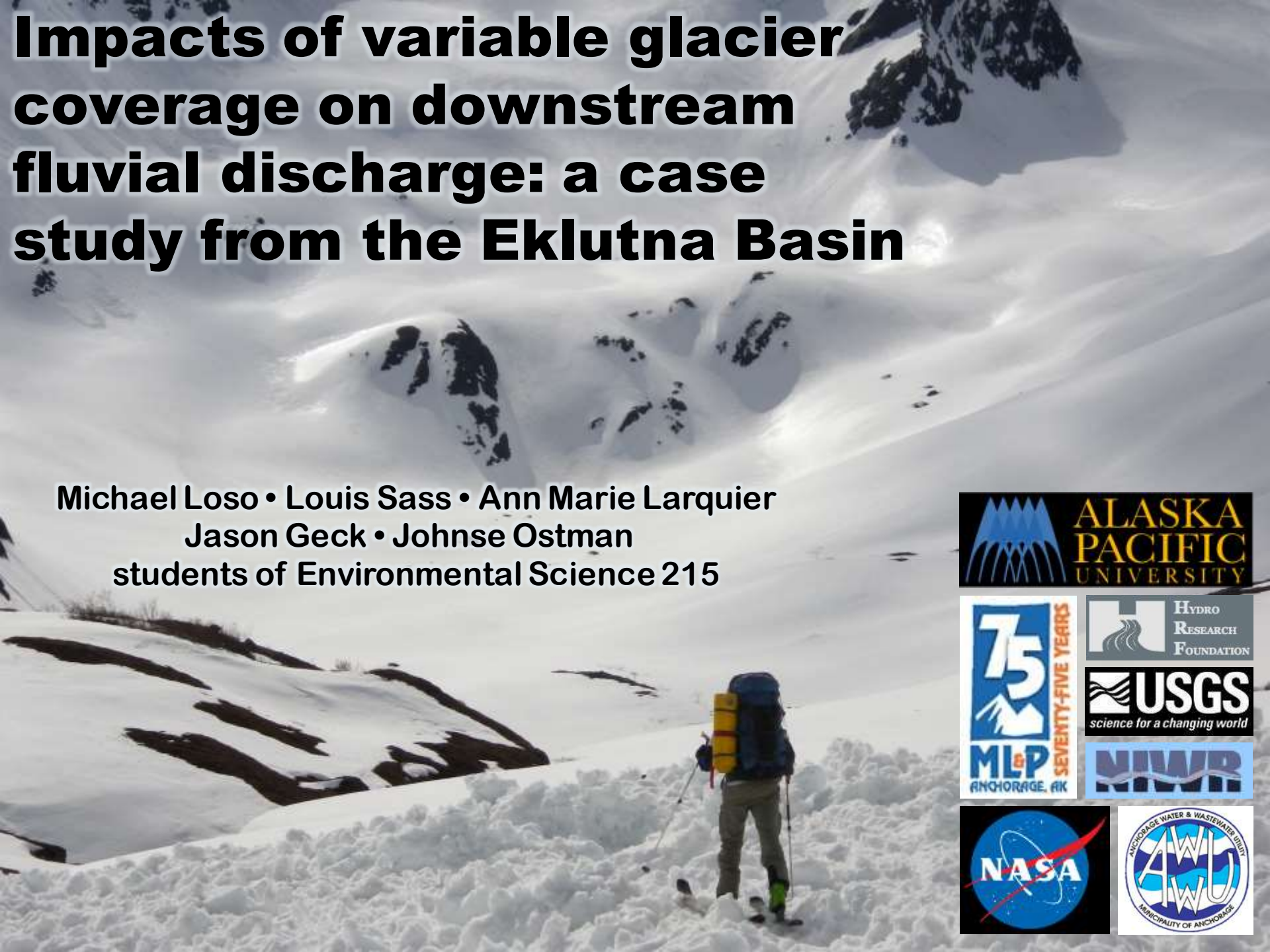
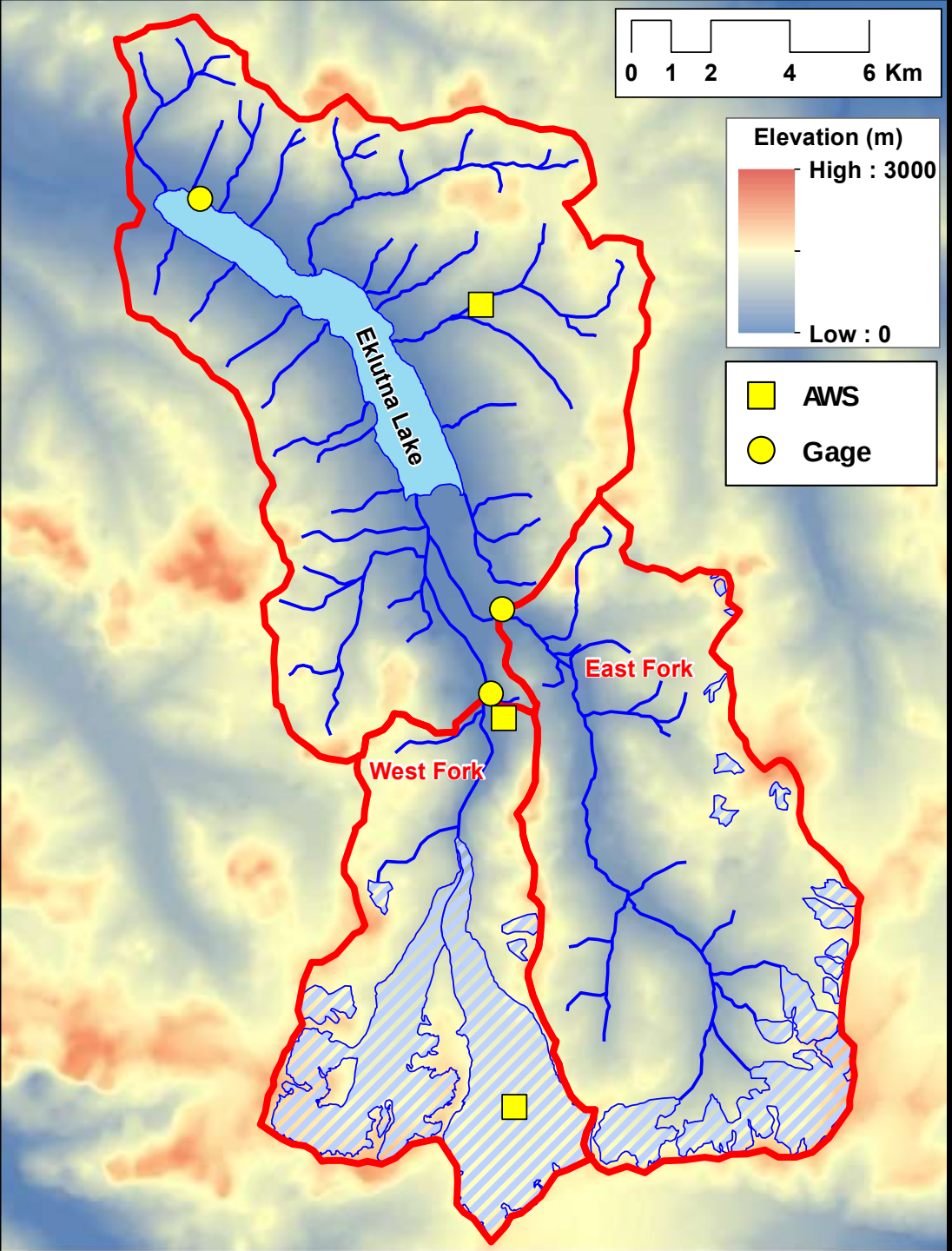
students of Environmental Science 215



12 minutes

Eklutna Study Area
Glacier variation
Fluvial discharge
Implications

L. Sass photo



Eklutna Basin

Inputs

West Fork: 64 km^2, 49% ice
East Fork: 101 km^2, 13% ice
The rest: 142 km^2, no ice

Outputs

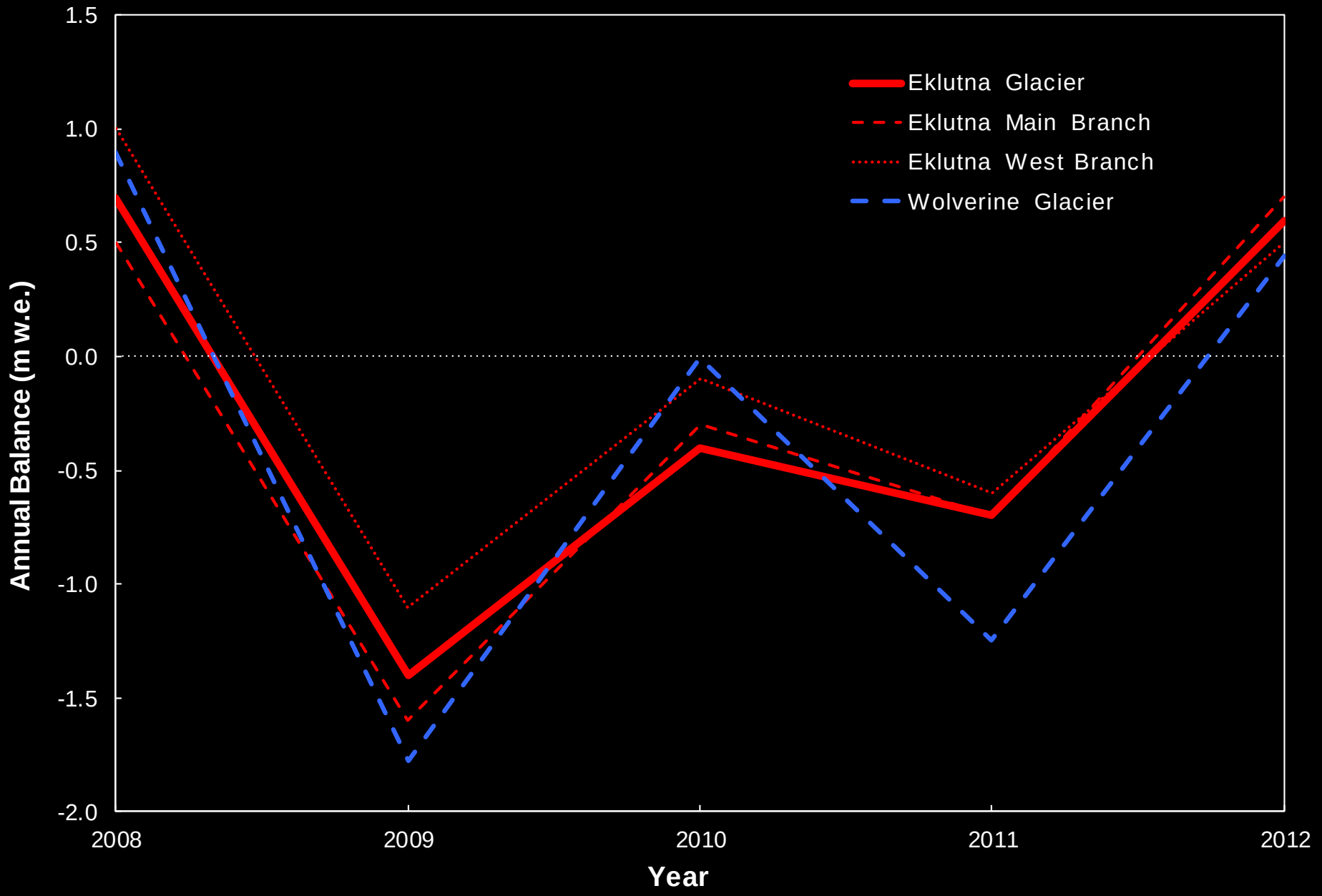
Anchorage water: ~11% (2010)
Hydropower: the rest

Salmon

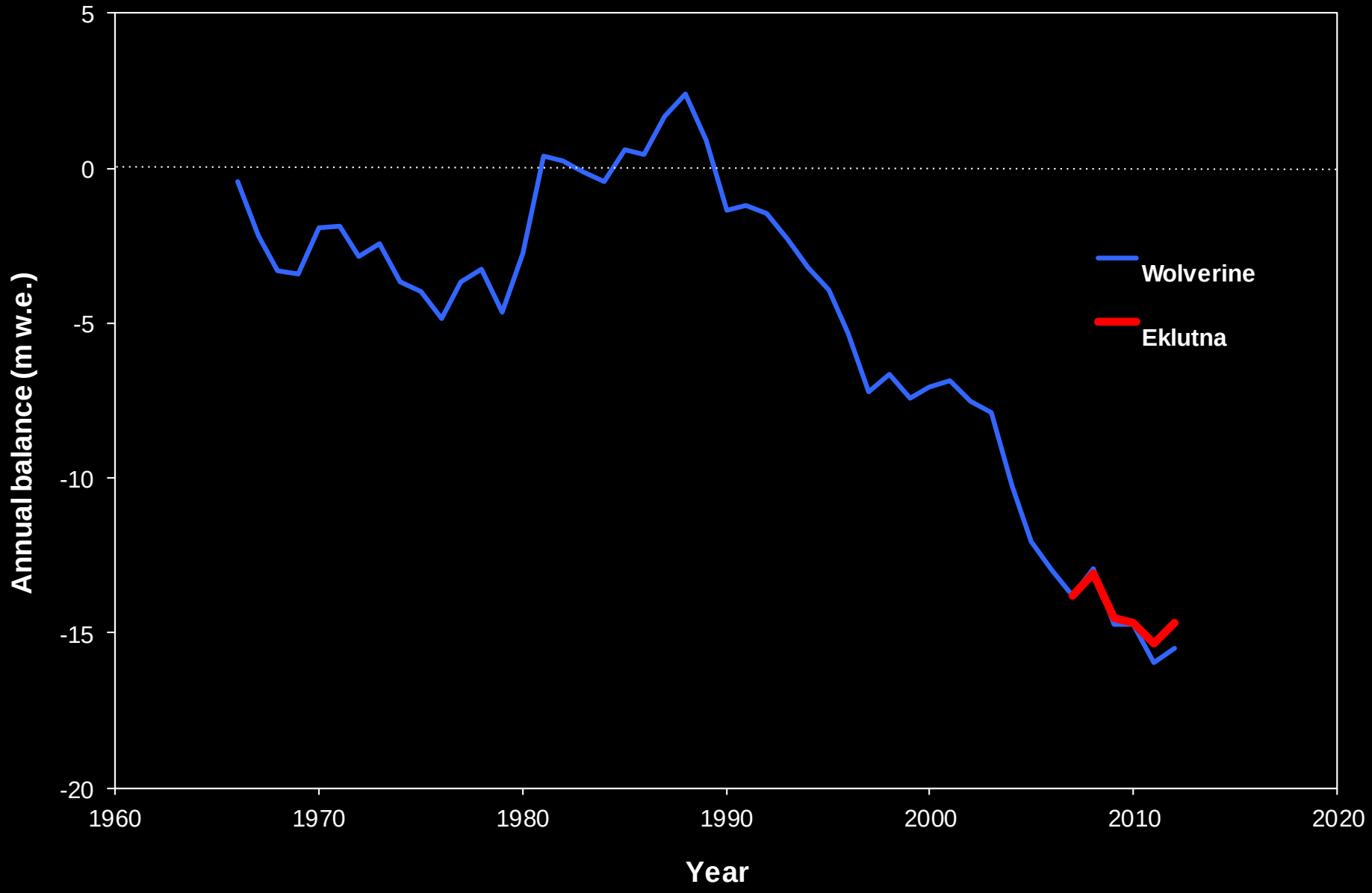
None

The Glacier Sweatshop

Glacier variation: 5 years



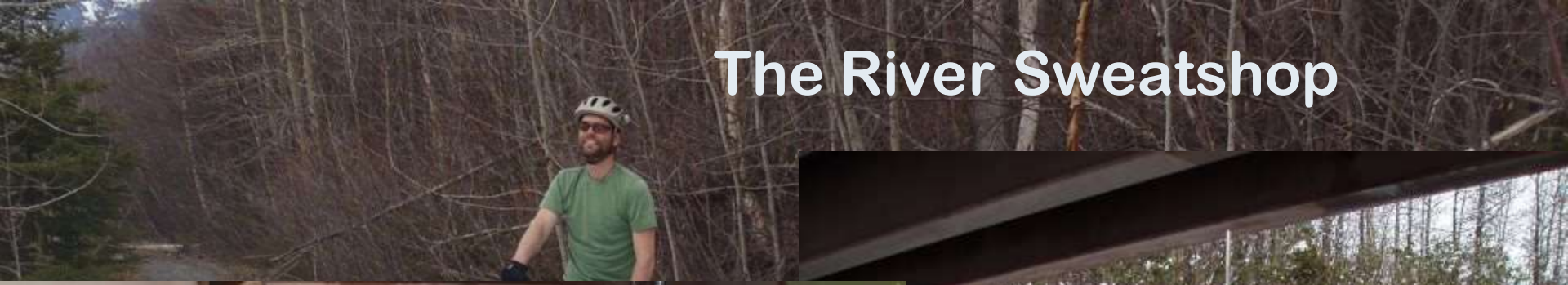
Glacier variations: ~50 years

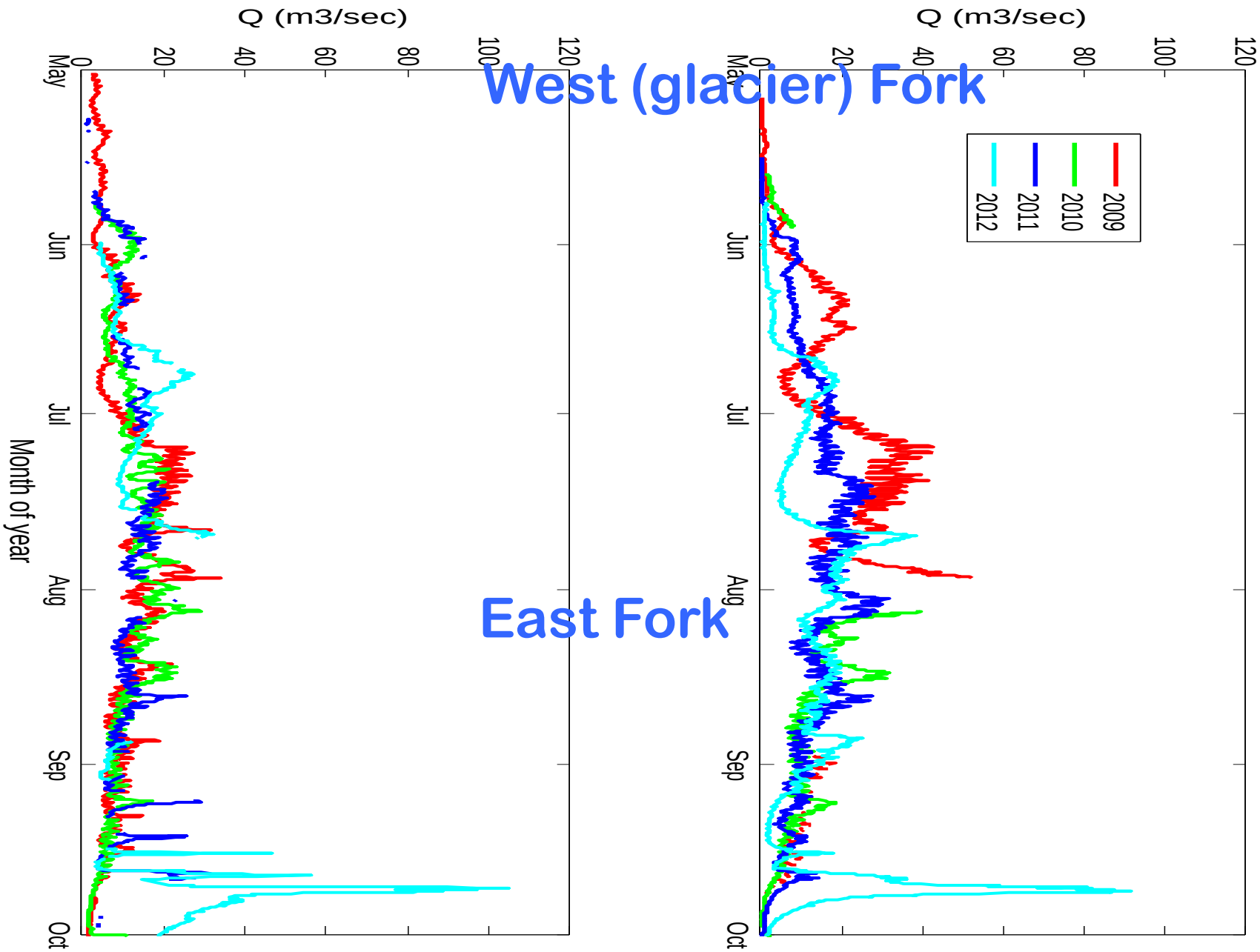


Glacier variation: ~100 years

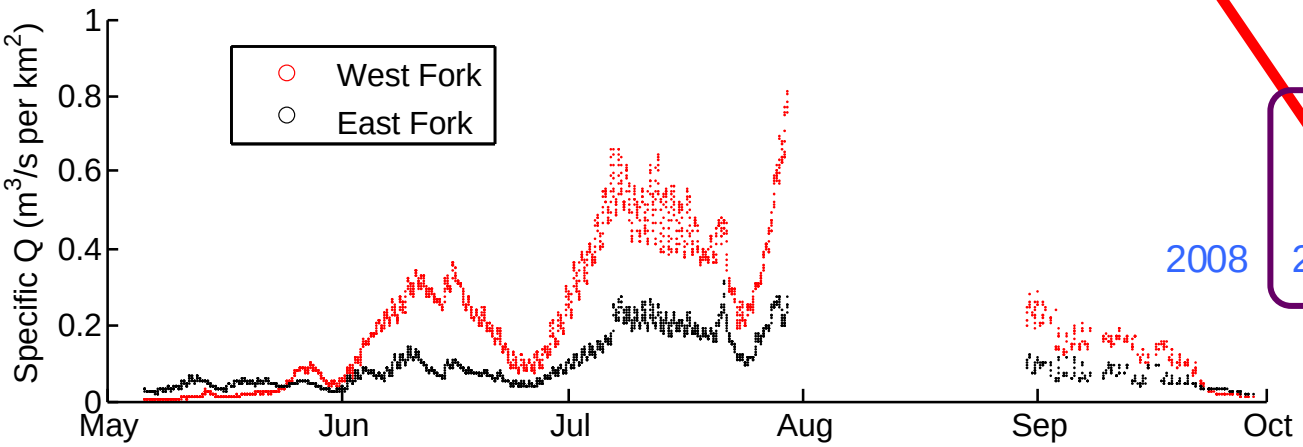
Stephan Capps (1915)

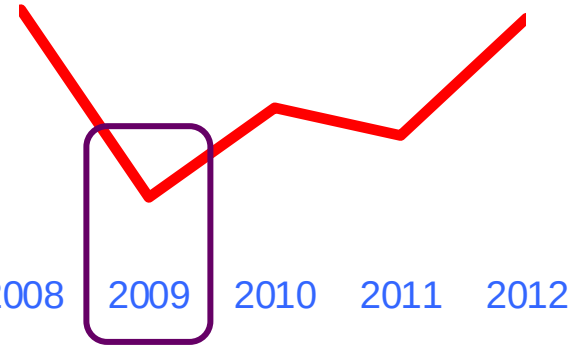
The River Sweatshop

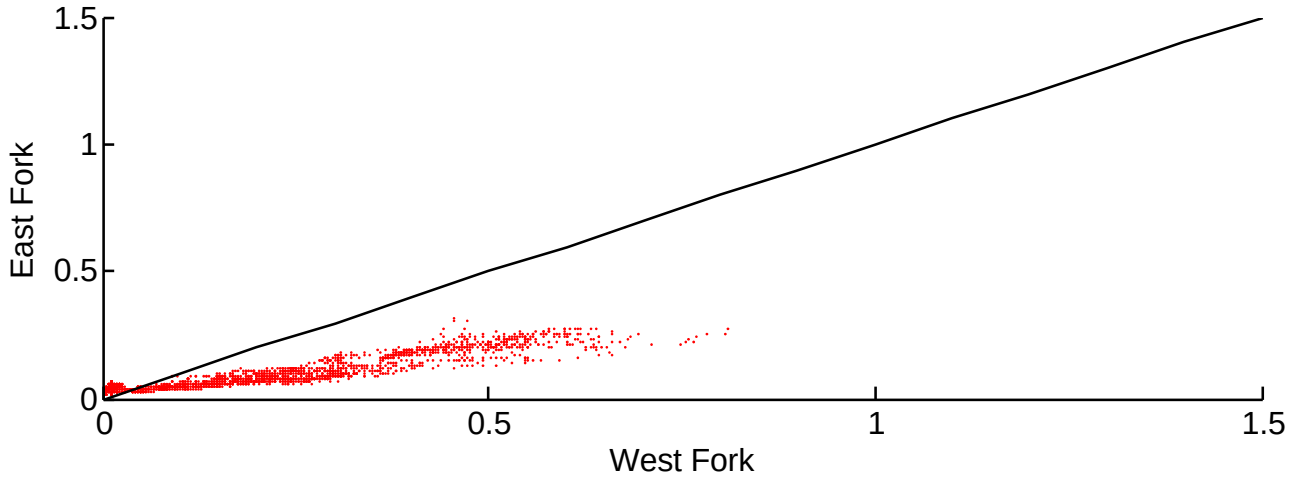



West (glacier) Fork
East Fork
Q (m3/sec)
0
20
40
60
80
100
120
May
Jun
Jul
Aug
Sep
Oct
Month of year
2009
2010
2011
2012

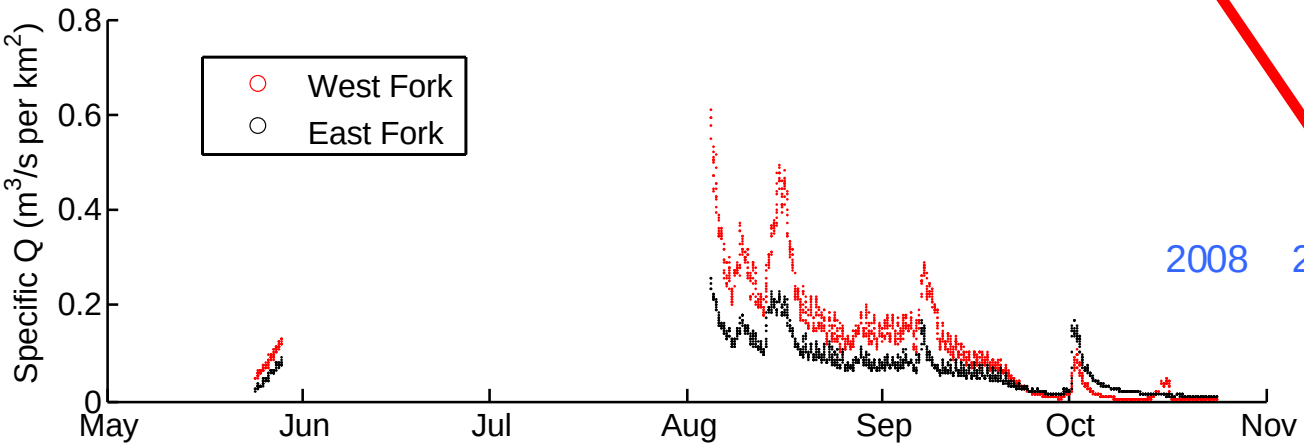
2009

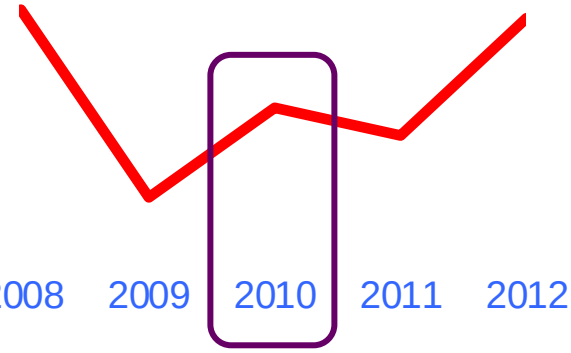

Specific Q (m3/s per km2)
1
0.8
0.6
0.4
0.2
0
West Fork
East Fork
May
Jun
Jul
Aug
Sep
Oct

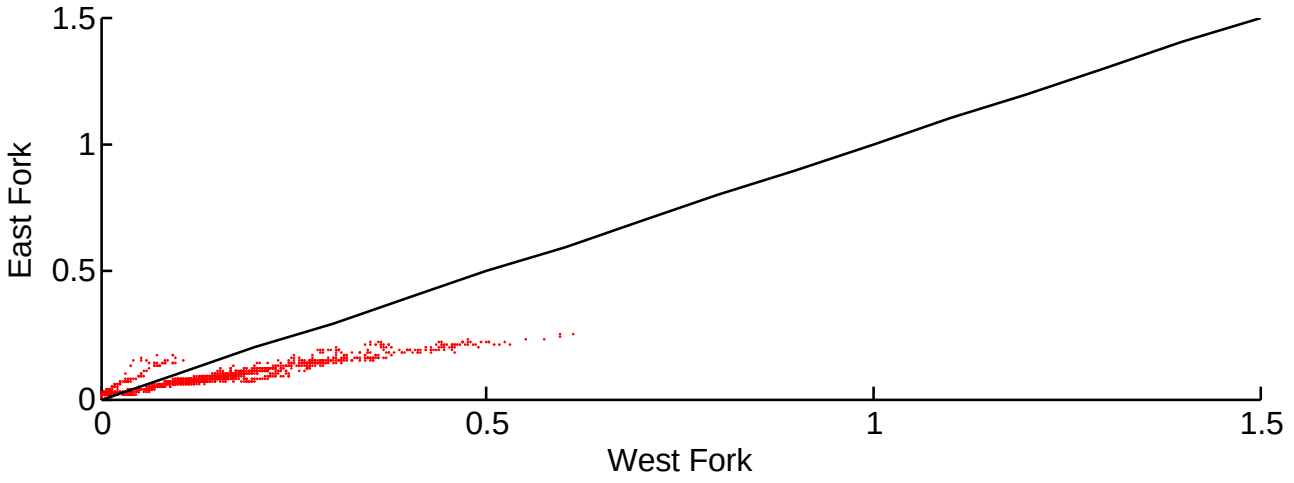

2008
2009
2010
2011
2012


East Fork
1.5
1
0.5
0
0
0.5
1
1.5
West Fork

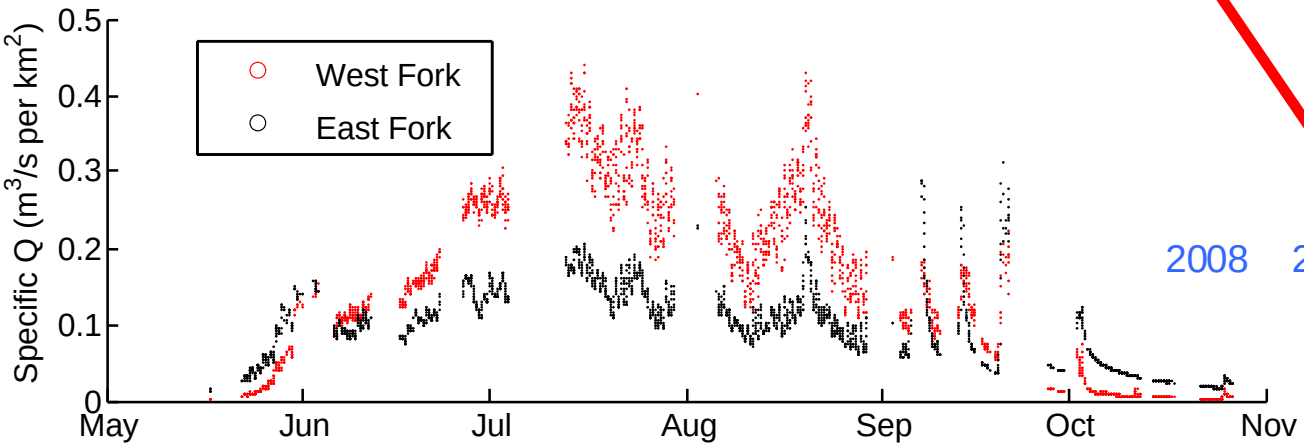
2010

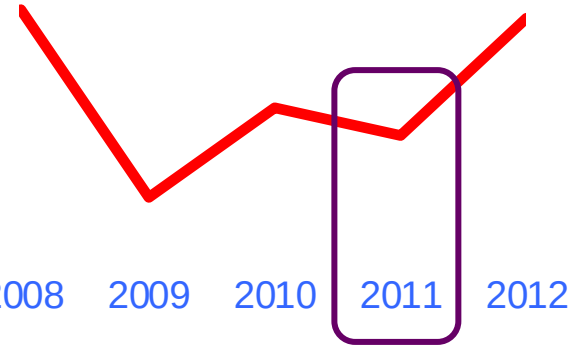

Specific Q (m3/s per km2)
0.8
0.6
0.4
0.2
0
West Fork
East Fork
May
Jun
Jul
Aug
Sep
Oct
Nov

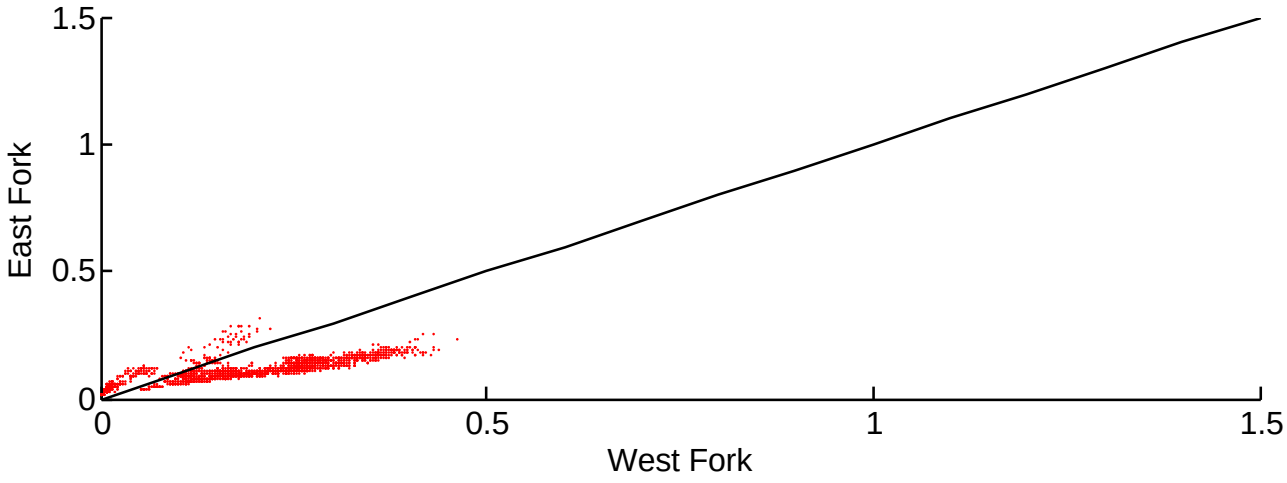

2008
2009
2010
2011
2012


East Fork
1.5
1
0.5
0
0
0.5
1
1.5
West Fork

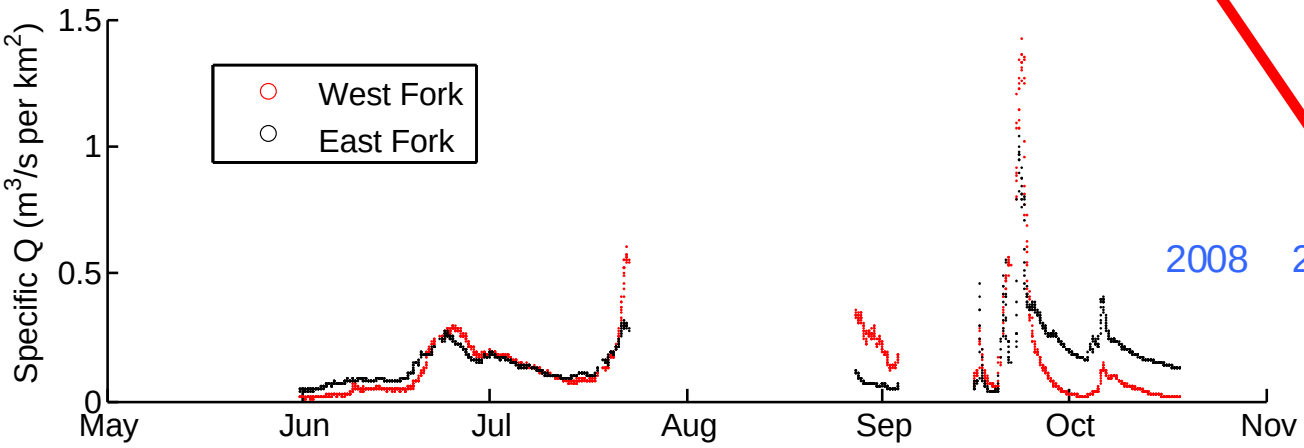
2011

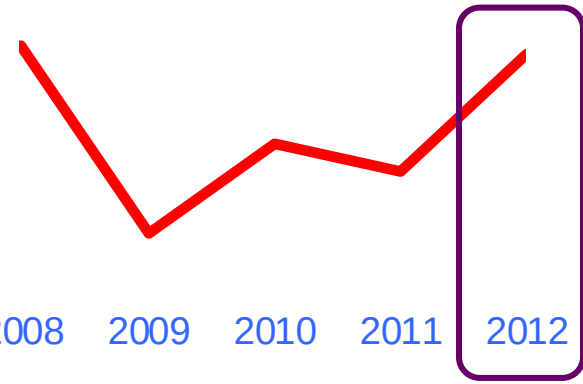

Specific Q (m3/s per km2)
0.5
0.4
0.3
0.2
0.1
0
West Fork
East Fork
May
Jun
Jul
Aug
Sep
Oct
Nov

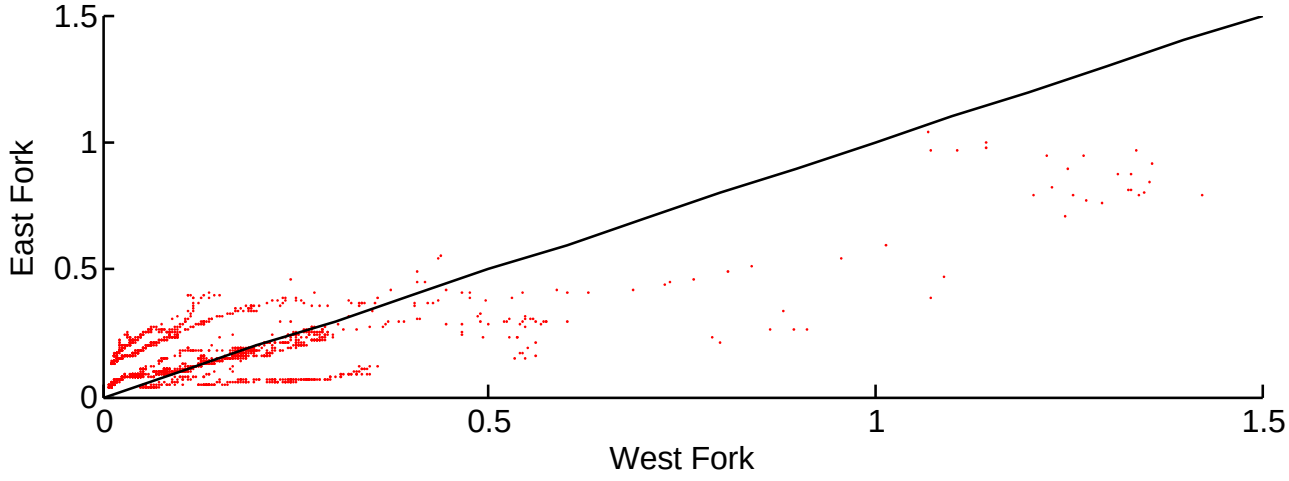

2008
2009
2010
2011
2012


East Fork
1.5
1
0.5
0
0
0.5
1
1.5
West Fork

2012


Specific Q (m3/s per km2)
1.5
1
0.5
0
West Fork
East Fork
May
Jun
Jul
Aug
Sep
Oct
Nov

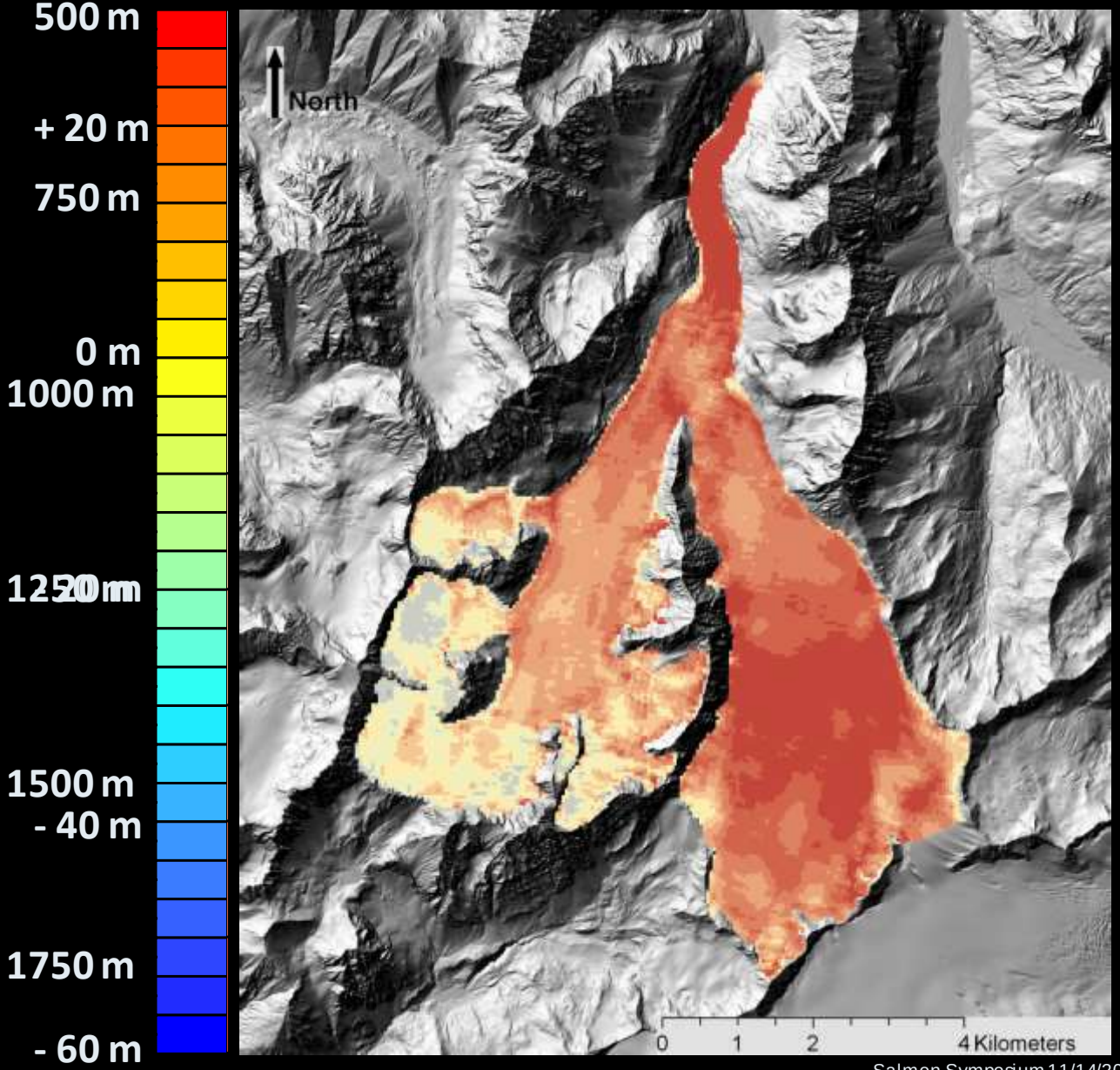

2008
2009
2010
2011
2012


East Fork
1.5
1
0.5
0
0
0.5
1
1.5
West Fork

Deglaciation Discharge Dividend – 50 year

1957–2010
Elevation Change

53-year volume change
-973,000 acre ft
8% of annual usage



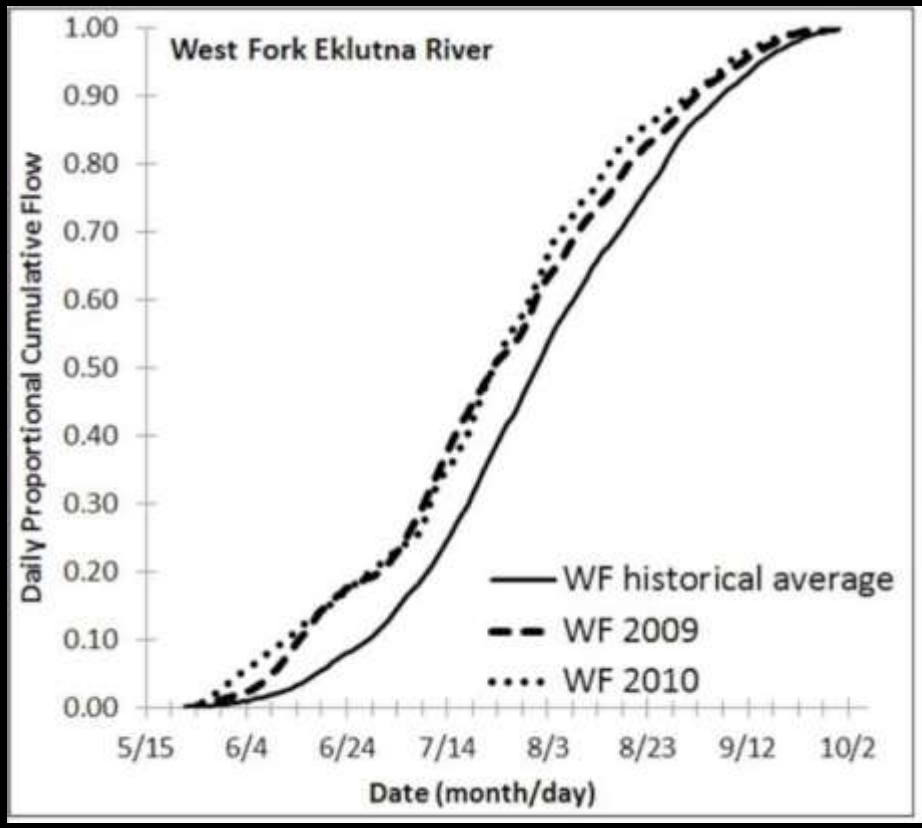
Deglaciation Discharge Dividend – 4 year

Remember…

“Past performance is no guarantee of future results”

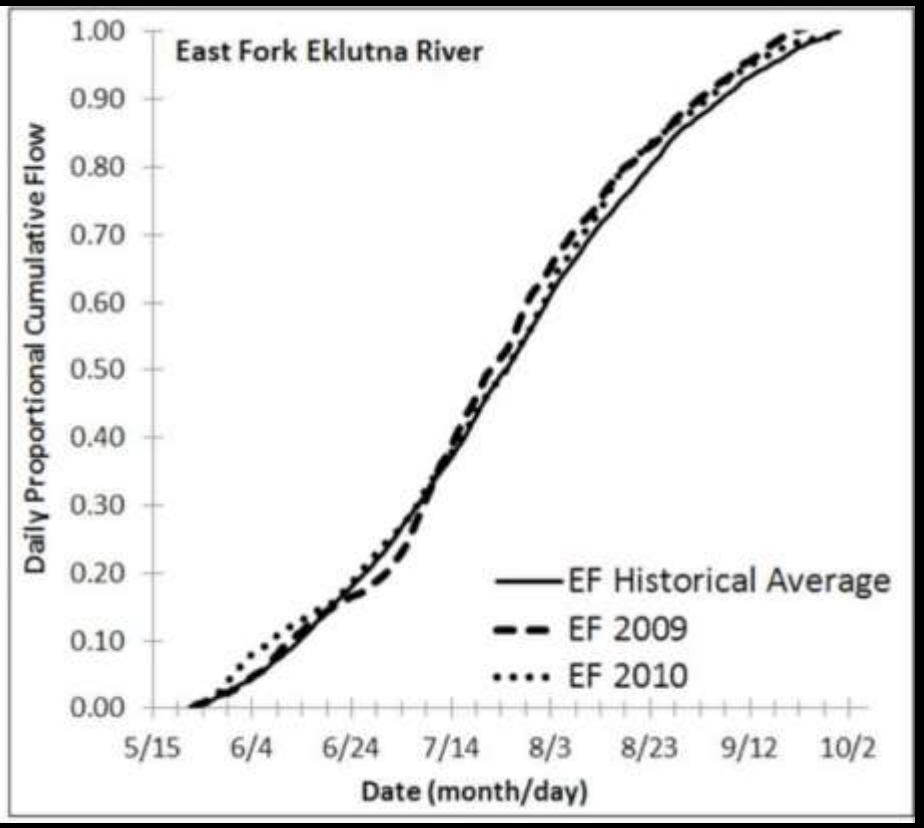
	2009	2010	2011	2012
Net glacier mining (km^3)	0.041	0.005	0.019	-0.019
Net glacier mining (acre-feet)	33,482	4,066	15,545	-15,545
Mining contribution to West Fork runoff	23.7%	3.1%	14.0%	-14.10%

Shrinking glacier, earlier discharge peak

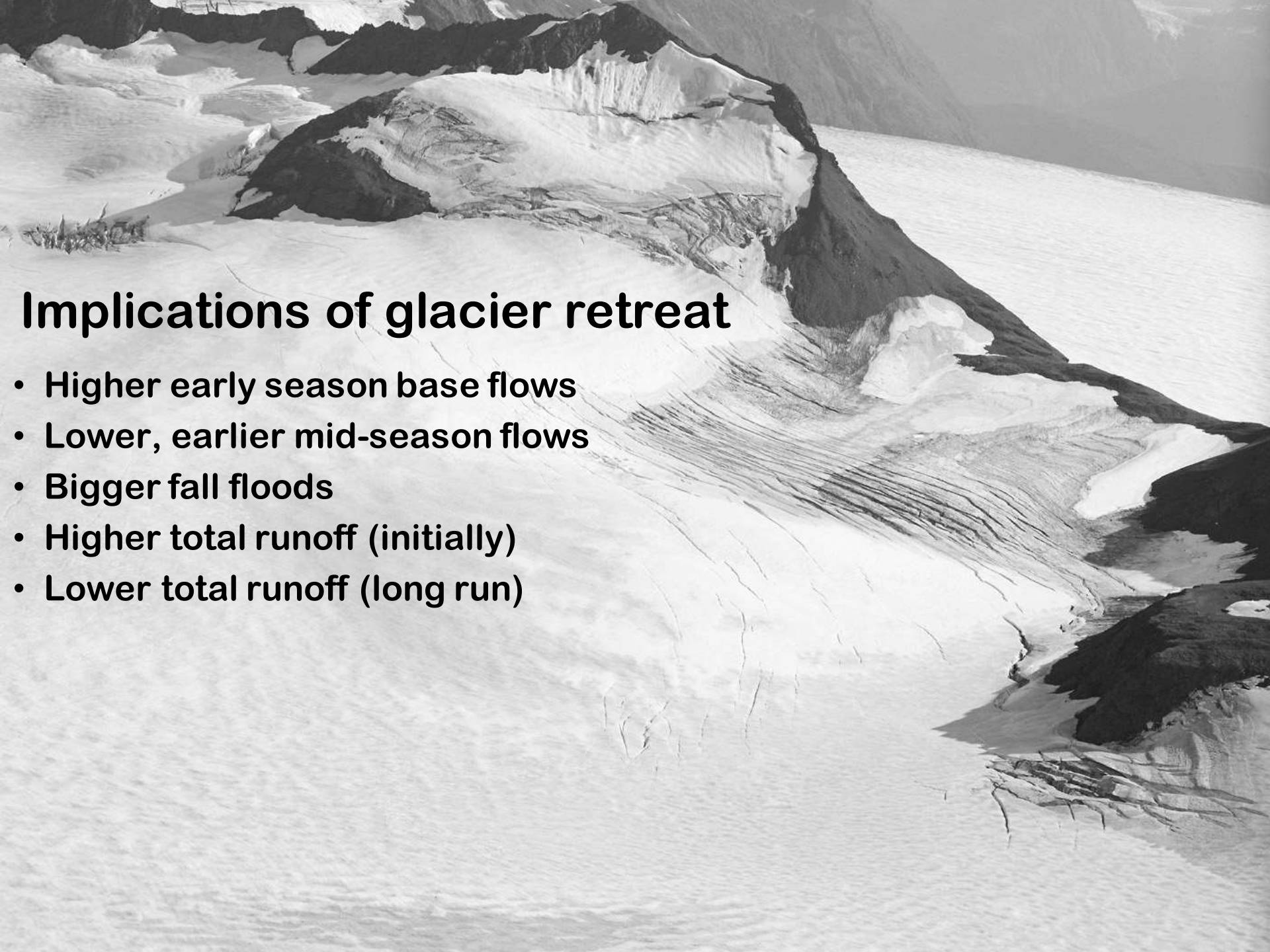


Larquier 2011

West Fork
50% flow is 1 week earlier



East Fork
No change

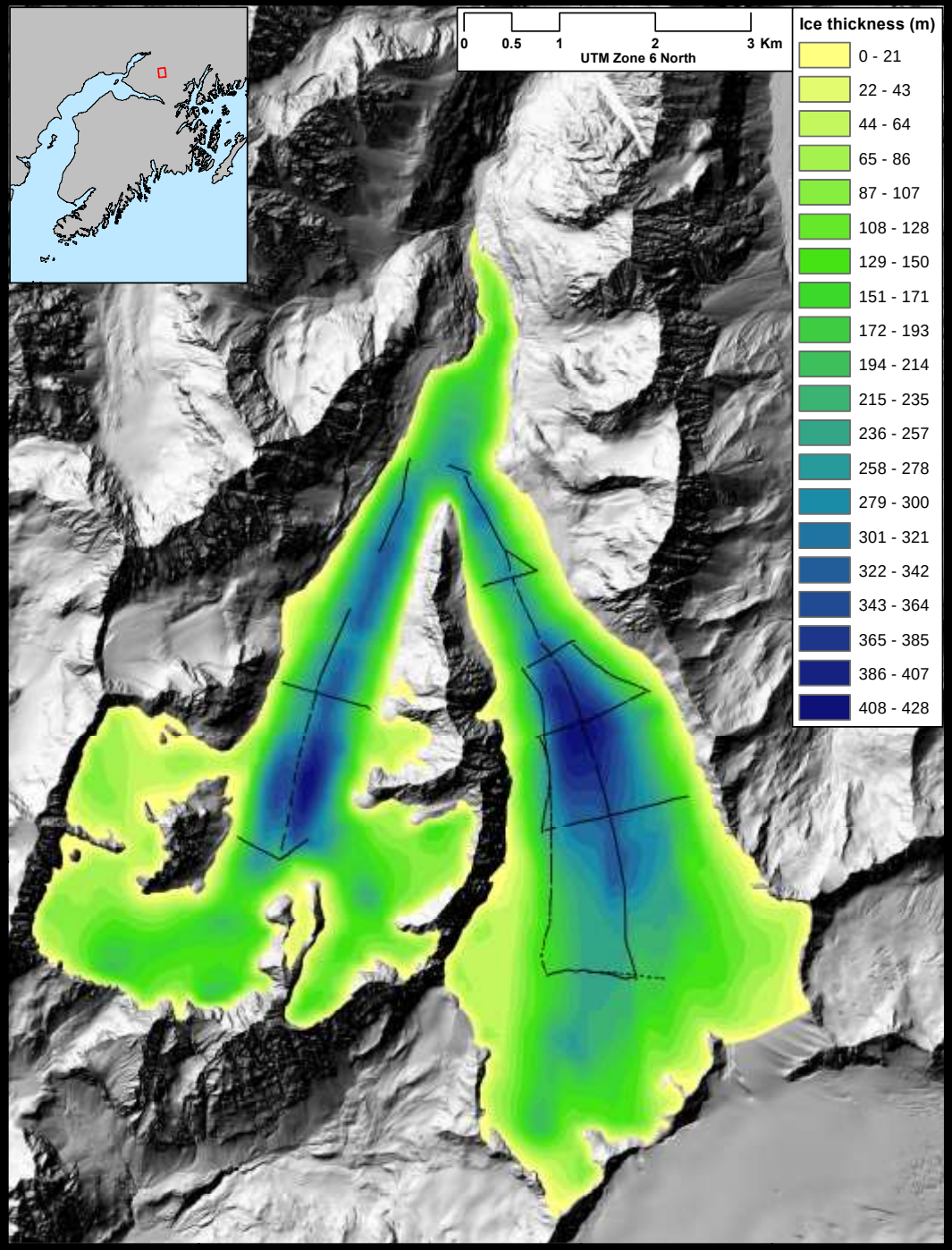


Implications of glacier retreat

- Higher early season base flows
- Lower, earlier mid-season flows
- Bigger fall floods
- Higher total runoff (initially)
- Lower total runoff (long run)

Take home?

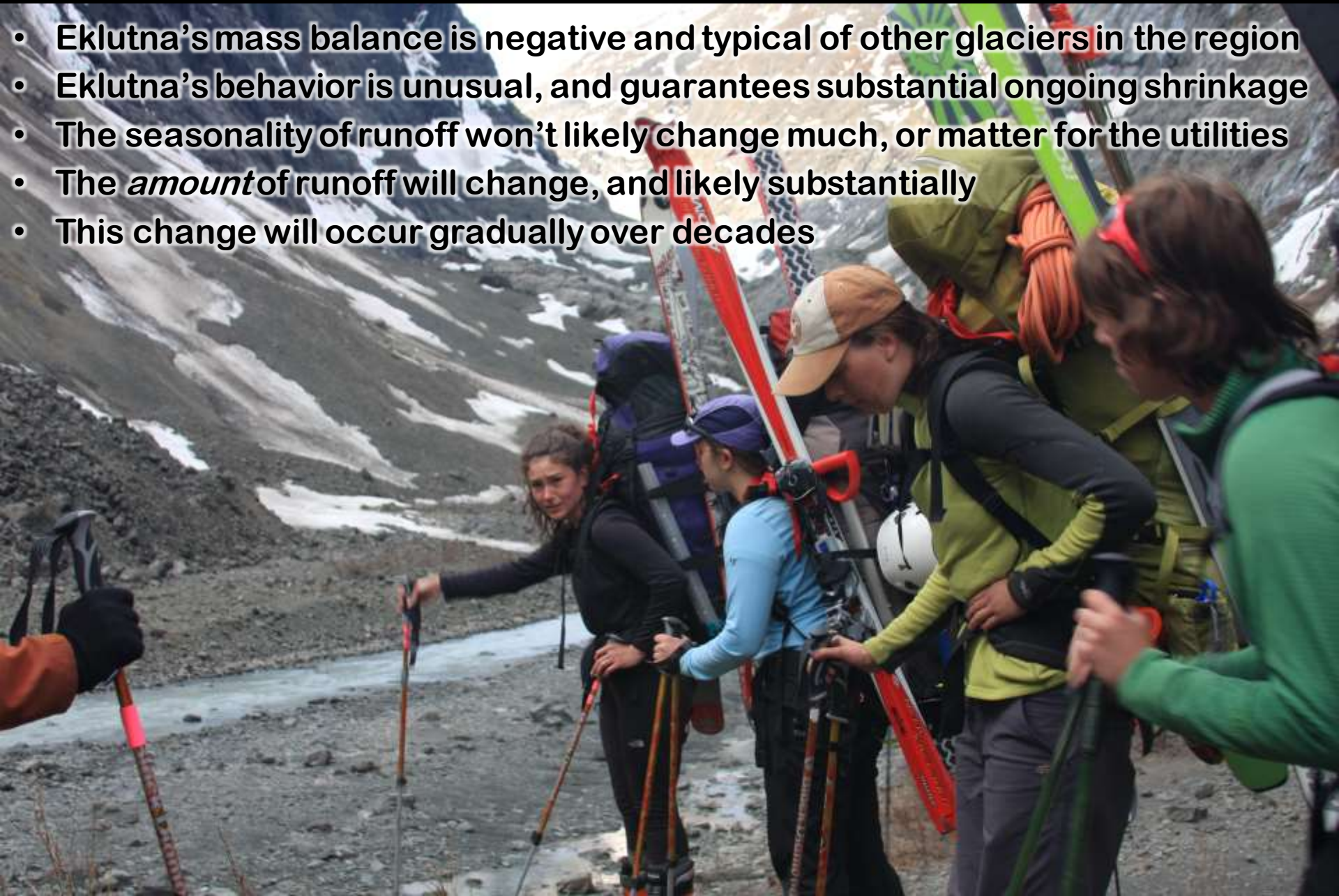
Historic/present runoff
in most Alaskan glacial rivers
is going to decline



Glacier as reservoir

Max Thickness: 430 m
Mean Thickness: 149 m
Area: 29.5 km^2
Ice volume: 4.40 km^3
As water: 3.21x10^6 ac-ft

Five things



- Eklutna's mass balance is negative and typical of other glaciers in the region
- Eklutna's behavior is unusual, and guarantees substantial ongoing shrinkage
- The seasonality of runoff won't likely change much, or matter for the utilities
- The *amount* of runoff will change, and likely substantially
- This change will occur gradually over decades

Ongoing projects

- Mass Balance (Loso, Geck, Boyes, SC215)
- Mass Balance Modeling (Geck)
- River Gaging (Bosch and Boehme)
- Suspended and Bedload Sedimentation (Bosch)
- River Corridor Mapping (Boehme)
- Effects of Volcanic Ash (Gould)