Where Does Sediment Come From?

Sediment Storage Dynamics in the Lower Sauk River Watershed
Background

http://www.skagitclimatescience.org/skagit-impacts/sediment/
Background

- Transient sediment storage in ‘transport’ zones can decouple upland sediment production from lowland transport over ‘short’ (geologic) timescales

- Recent studies have reiterated contemporary importance of sediment storage dynamics in western WA rivers
Motivation

- Need reasonable understanding of present-day sediment and channel dynamics before we can forecast potential climate impacts.

- Need contemporary understanding and potential future changes for effective river and floodplain management.

[Images of natural landscapes and water samples]
Sauk River Watershed

- Major unregulated tributary of the Skagit
- Watershed includes all of Glacier Peak
- Supplies ~30-50% of lower Skagit River sediment load (Curran et al., 2016; Jaeger et al., 2017)
Overview

- Sediment transport monitoring
- Repeat topography
- Gravel lithology
- Knit all together

Lower river sediment budget
Sediment Flux Monitoring

- Suspended sediment monitoring at three locations along Sauk River
  - Using mass-balance to estimate inputs from Suiattle, White Chuck

- Bedload measurements at Middle Sauk gage (USGS 12187500) near Darrington

Jaeger et al., 2017
Supported by Sauk-Suiattle Indian Tribe

Lower Sauk 2004-14 avg SSL: 1.35 million tons/yr
Middle Sauk 2004-14 avg SSL: 0.25 million tons/yr
Upper 2004-14 avg SSL: 0.10 million tons/yr

Bedload is ~14% of total load

SSL - Suspended sediment load
BL - Bedload
Repeat Topography

- Using repeat aerial lidar surveys to quantify sediment storage gains/losses
- Relatively complete surveys in ~2004 and 2014/16
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- Negative storage trend throughout the Sauk

Results preliminary and subject to change
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  - Total: \( \sim 2.0 \text{ million m}^3 \)
  - \( \sim 0.36 \text{ million tons/yr} \)
    - Assume 2 tons/m³

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Integrated Sediment Budget, 2004-2014

- Valley floor erosion within available data limits accounted for ~25% of total sediment flux past the lower Sauk gage

- Seems reasonable that relative contribution of bed material would be higher

Assumptions:
- Uniform bulk density of 2.0 tons/m³
- Bedload is 14% of total load at gage sites
Gravel Lithology

- Following in Allison’s footsteps

- Sieved gravels to 32-64 mm fraction; sorted out and weighed vesicular Glacier Peak Dacite
  - Lahars, pyroclastic debris

- Attempt to characterize relative importance of Glacier Peak gravel input, including secondary reworking of valley deposits
Gravel Lithology

- Spatial trends in vesicular Glacier Peak dacite independently imply gravel exchange/input from distinct valley floor sources

- Gravel samples from 4-m terrace have higher dacite fractions
  - Modern channel: ~15-20%
  - Terrace fluvial gravels: ~25-30%
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Presence of 4-m terrace originally called out by:

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Summary

- Valley floor erosion in the lower watershed has recently been a non-trivial component of the total Sauk River sediment load.
- Predominately erosion of ‘low’ (<5 m) surfaces, lateral regrading of valley floor.
- Eroded material includes a mix of modern fluvial, relict fluvial, lahar, and glacial deposits.
- Persistence and cause of recent erosion remain open questions.
What does it all mean?

- Channel dynamics reflect an interplay between contemporary climate + hydrology + disturbance and landscape history, as encoded in storage.

- Downstream sediment + channel dynamics are not simply lagged/muted responses to contemporary changes in upland sediment delivery.

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This part is complicated.
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