A 184-year record of river meander migration from tree rings, aerial imagery, and cross-sections

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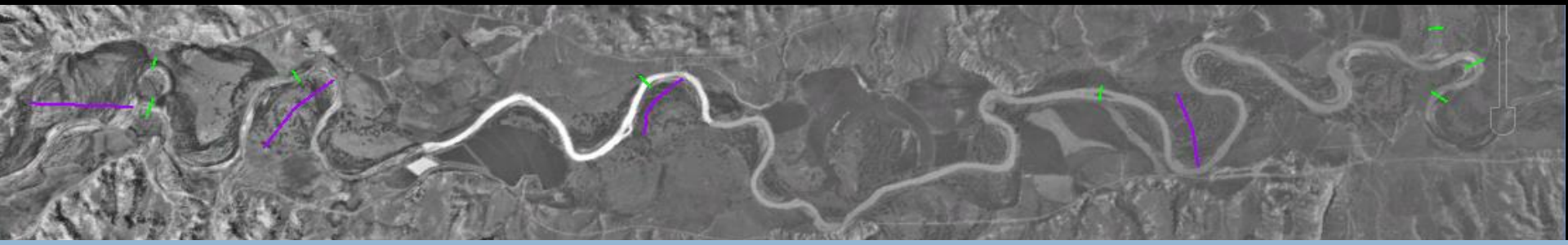
Fluvial Forms vs. Processes



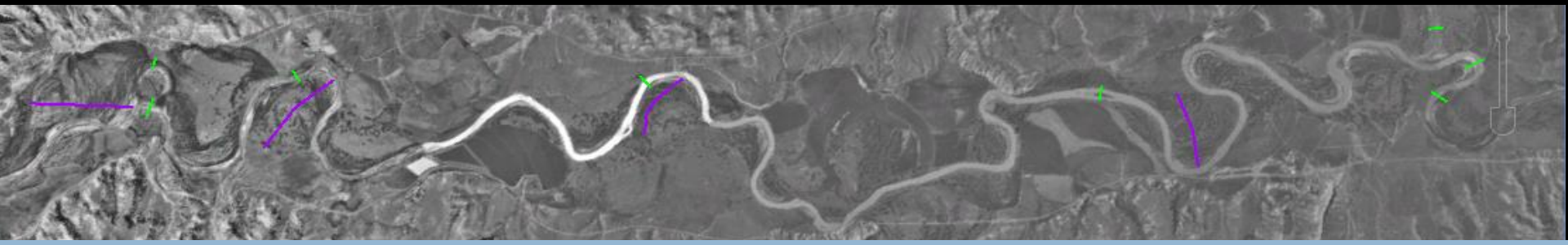
Forms

Riffles, pools, sinuosity, plants, habitat

Processes

Discharge, migration, invasion, regeneration, succession

Process: Channel Migration



Drivers

- Energy
- High flows

Consequences

- Property destruction
- Habitat mosaic
- Self-sustaining landscape

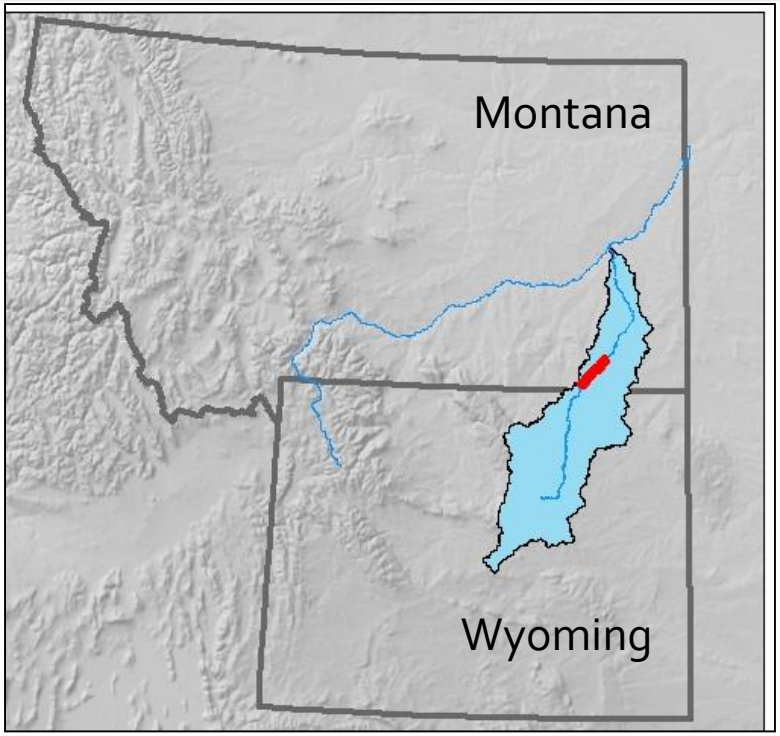
Challenges

- Short-term records
- Spatial variability & complex response


1985 250
Ucayali River, Peru
10 km

Powder River, Montana

- 75 km reach
- Free-flowing, rural
- Rich research history



Study Objectives

1) Quantify rates of channel migration
2) Identify if the recent past represents long-term conditions
3) Combine research methods to evaluate each and build understanding

Approach: 3 nested methods

Cross-sections
1975-2014

Moody and Meade 2014

20 cross-sections

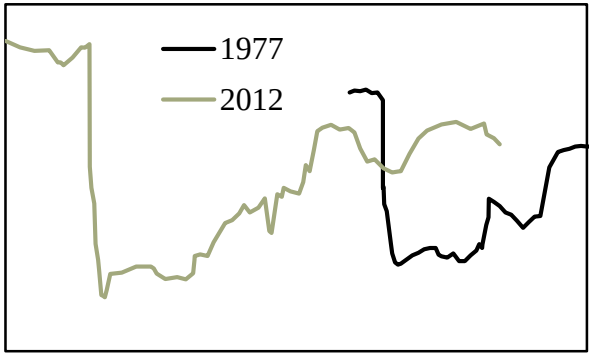
Air photos
1939-2013

Cottonwood transects
1829-2014

Data output from 3 methods

Cross-sections

1975-2014



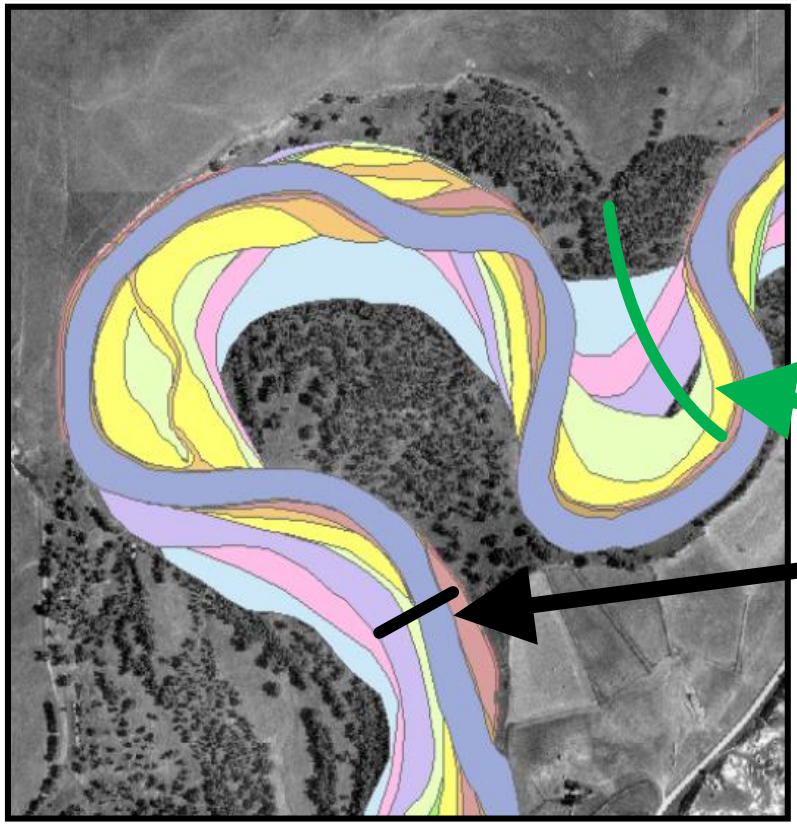
Air photos

1939-2013

Cottonwood transects

1829-2014

All approaches standardized to entire study reach

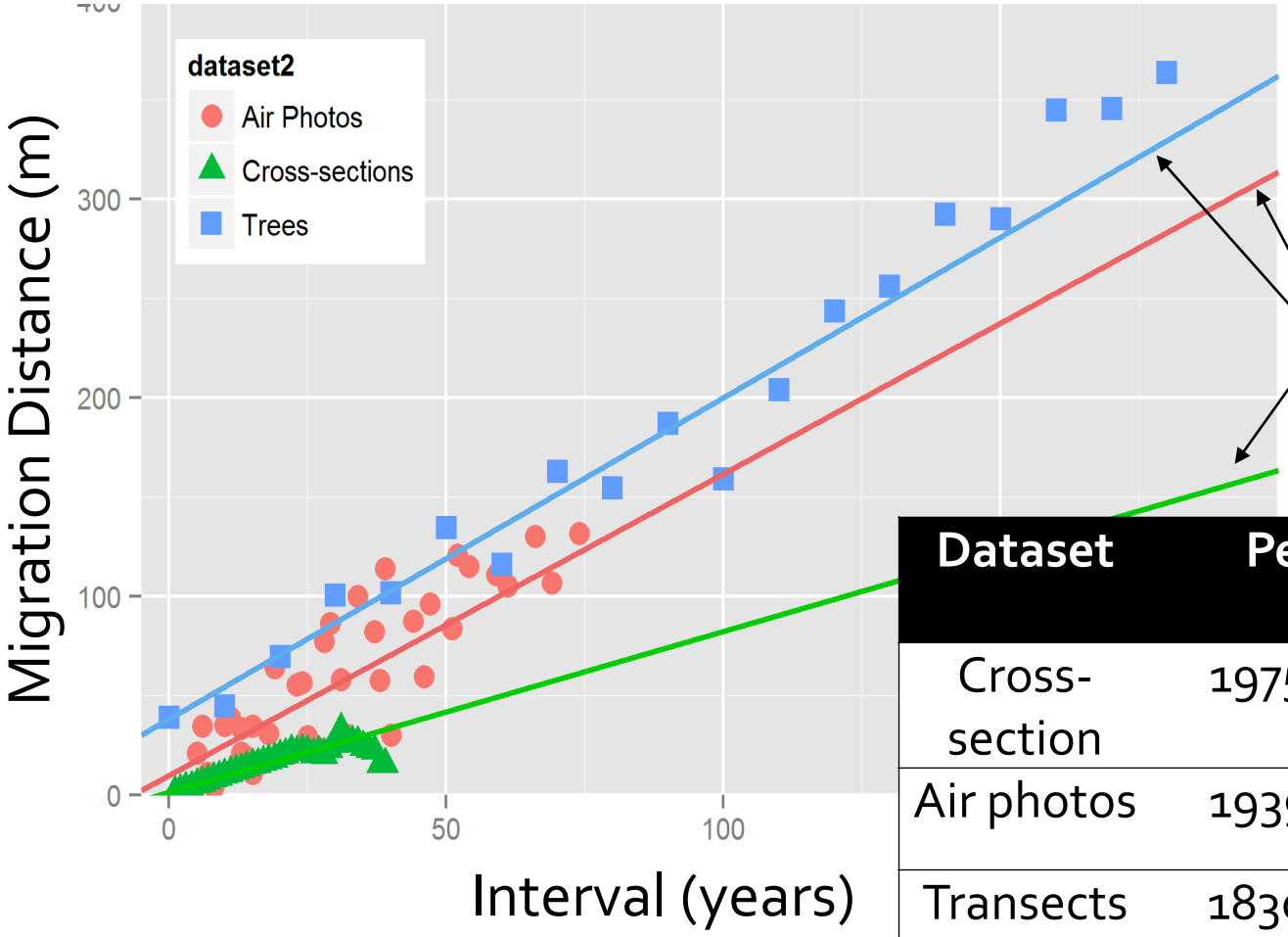


Air Photo average (entire reach)

Transects

Cross-sections

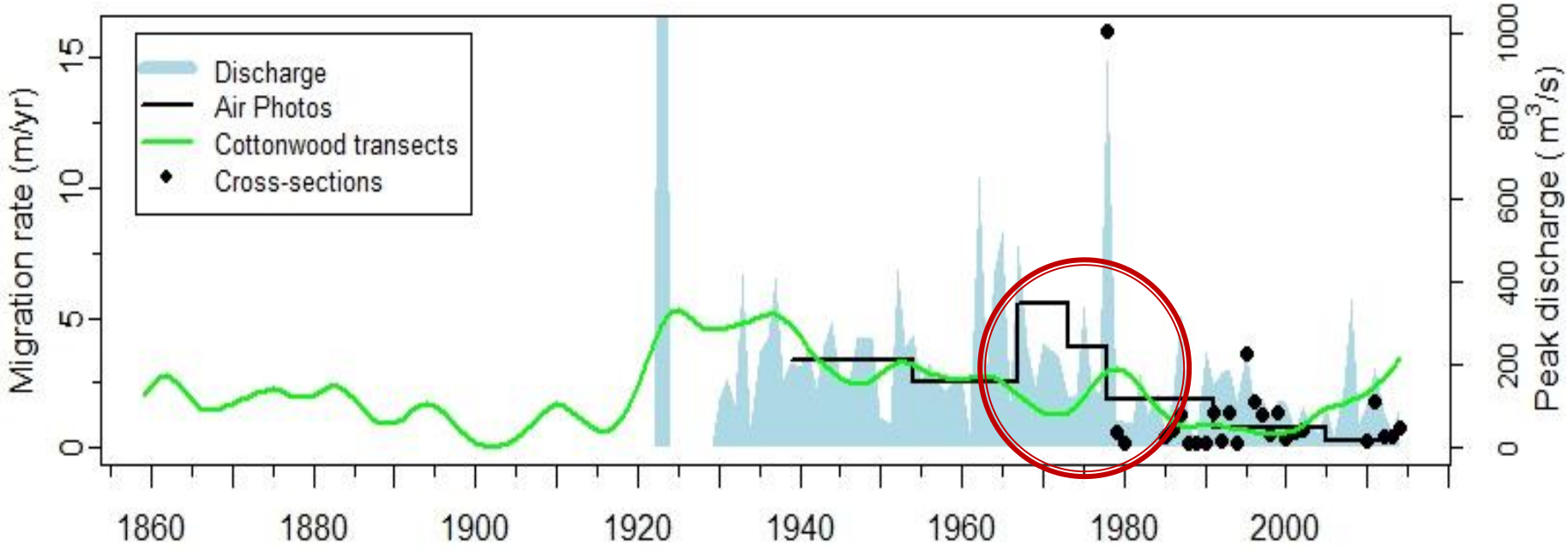
Migration rates from the 3 datasets



slope = migration rate

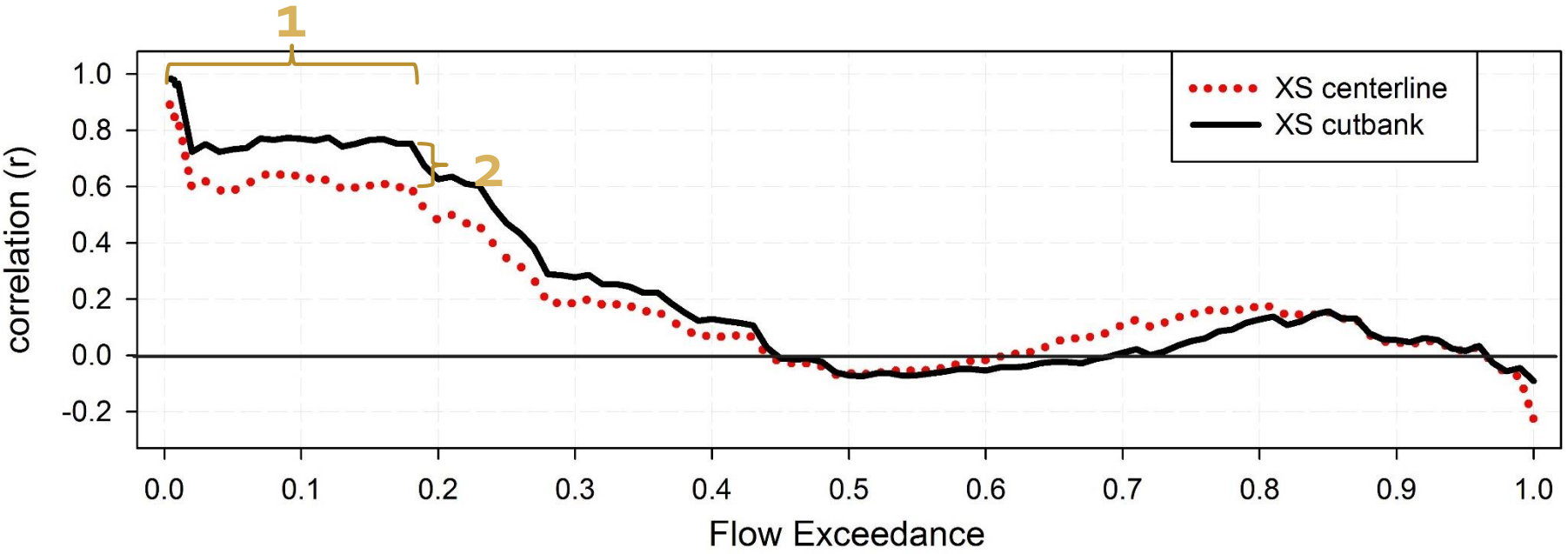
Dataset	Period	Migration (m/yr)
Cross-section	1975-2014	0.8
Air photos	1939-2013	1.5
Transects	1830-2014	1.6

Channel migration through time



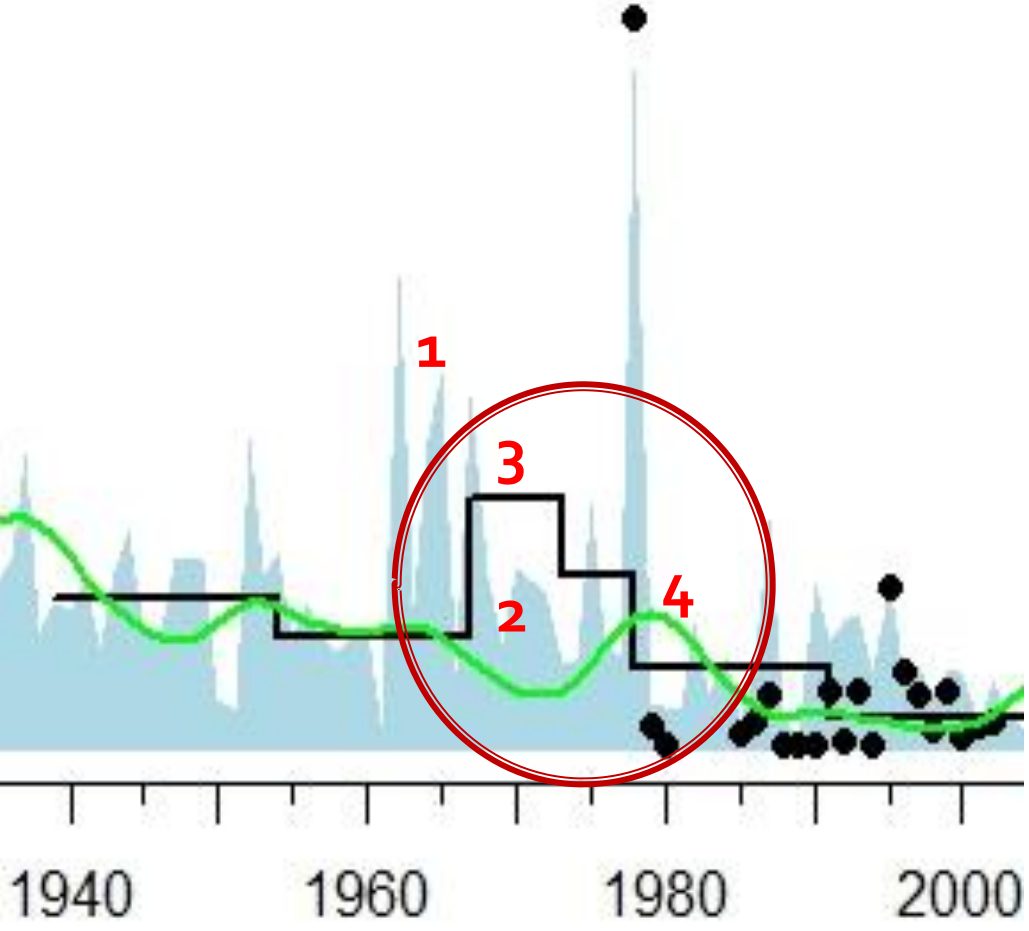
- decreasing flood peaks
- decreasing migration
- cross-method ~compatibility

High flows drive channel migration



1. migration = f(high flow)
2. Cutbank mig. correlates stronger than centerline mig.

Controls on migration through time

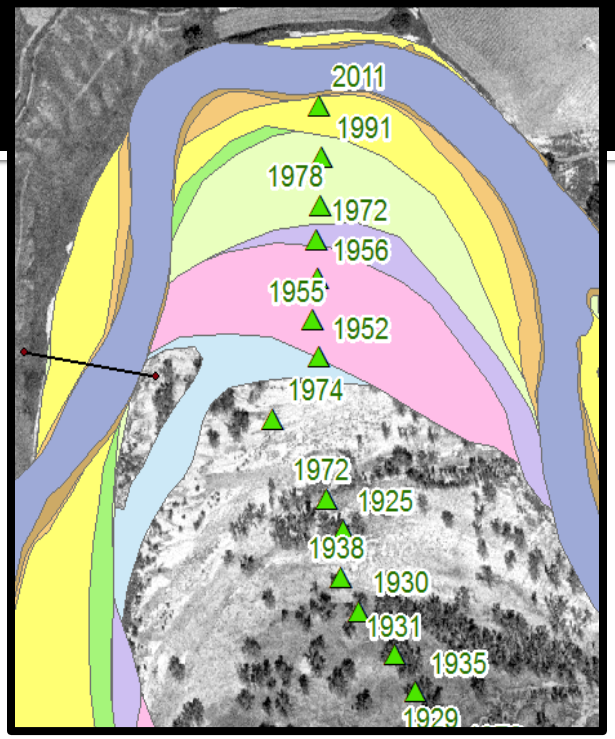


1. high flow
2. low flow
3. channel narrowing
4. 9-year delay, or 1978 flood?

<u>Considerations</u>:
High flows, Low flows, Erosion, Deposition

Key Findings

1. Reduced migration through time
   - 40-year record provided limited view
2. 3 approaches increase understanding
3. Evolving setting



Management Implications

1. Channel migration is required for habitat mosaic
2. Processes dictate fluvial forms
   - Prioritize processes
   - Species play different roles

Management Implications

3. Rivers operate on multi-decadal timescales
   - Scales affect conclusions
4. Integrating methods improves interpretation

Thank You

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Schook, DM, SL Rathburn, JM Friedman, and JM Wolf. 2017. A 184-year record of river meander migration from tree rings, aerial imagery, and cross sections. *Geomorphology* 293: 227-239.

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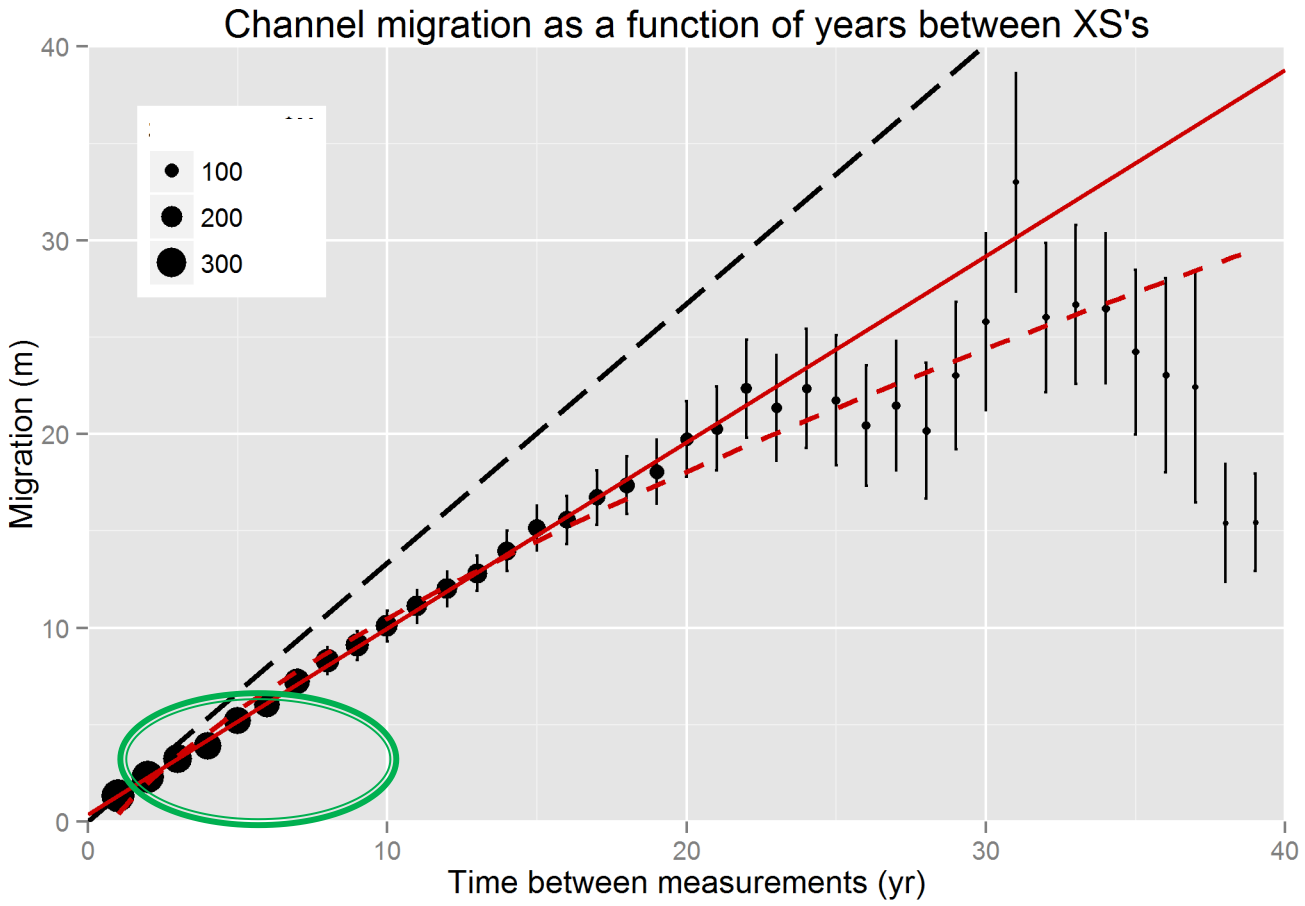
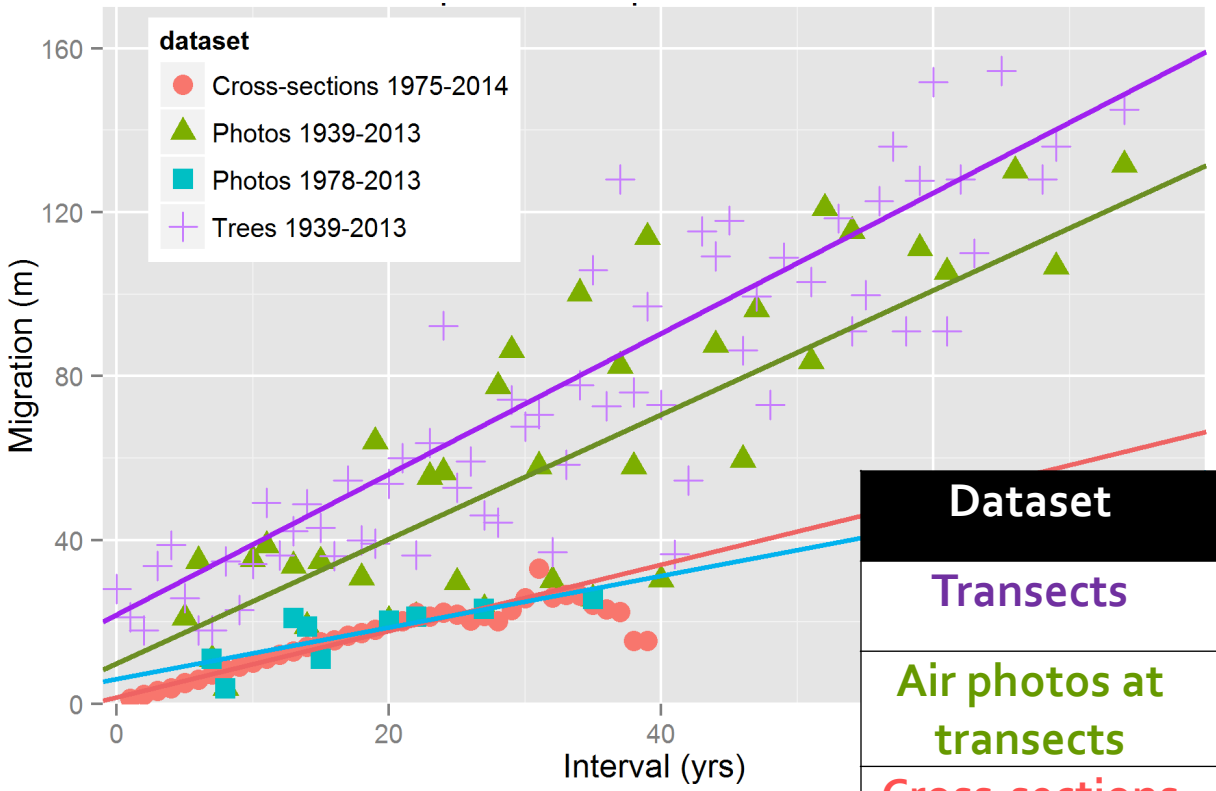
Quantifying interval-induced error



Increasing underestimates as interval increases

Correction factor for inconsistent intervals

Within period, cross-method comparisons



Dataset	Period	Slope (m/yr)
Transects	1939-2013	1.72 +/- 0.16
Air photos at transects	1939-2013	1.52 +/- 0.24
Cross-sections	1975-2014	0.81 +/- 0.05
Air photos at cross-sections	1978-2013	0.63 +/- 0.33

Photo vs. tree ages