Using Landsat as a template for SWOT

Getting the best discharge possible by combining big-data remote sensing, global hydrologic modelling, and river routing.

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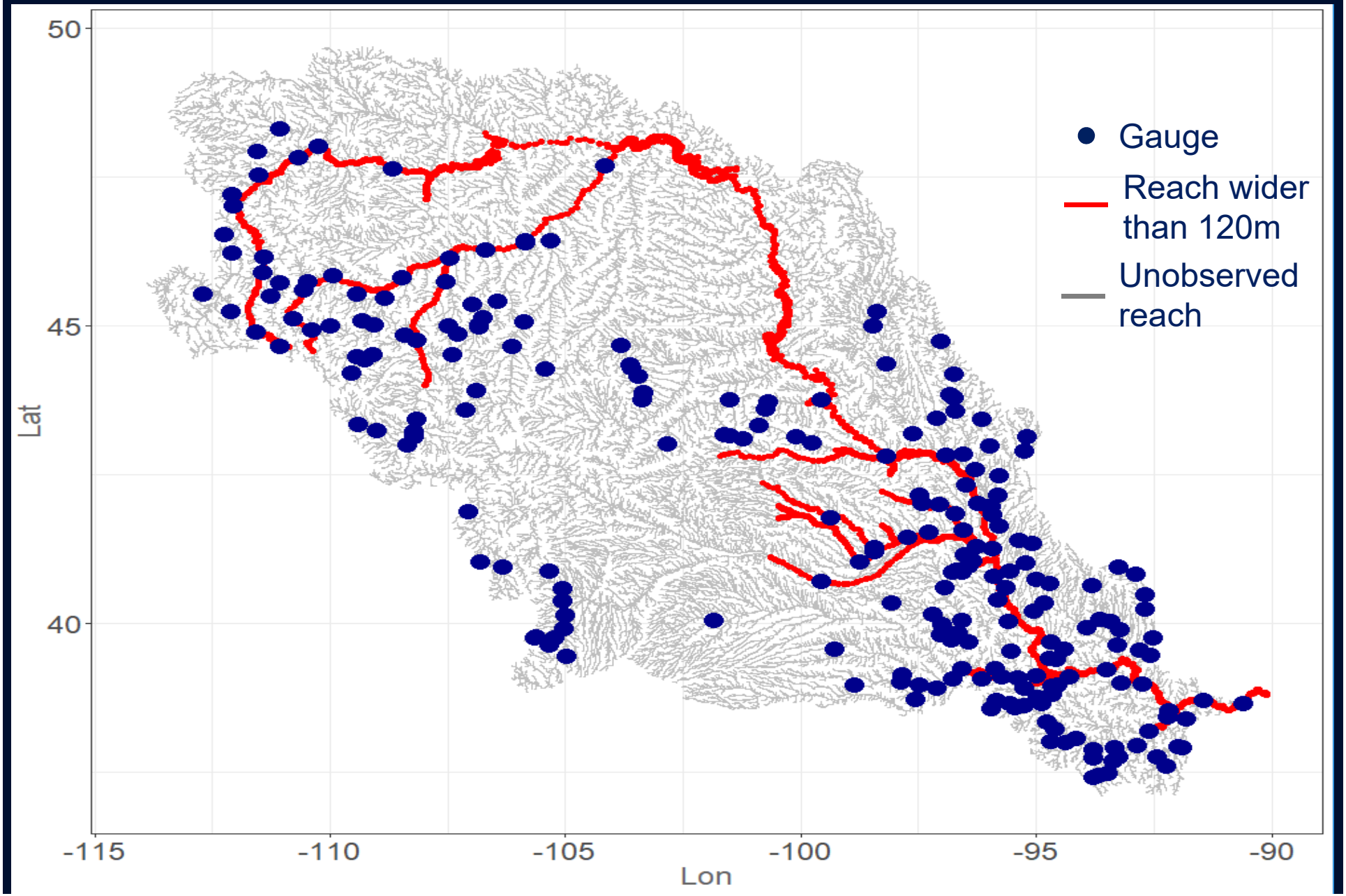
Problem

McFLI (any algo) has a few issues that appear when we think beyond single MC reaches

- Discontinuity
- Spatial Sparseness
- Temporal Sparseness

A post-launch example: 1.4M km^2 of Missouri



What to do?

1. Use Landsat &GEE to estimate ~1M widths at 2,700 cross sections
[SWOT observes large areas with orbit geometry]

2. Run McFLI (BAM) to get Q in each reach
[Estimate discharge from SWOT]

3. Use Lin et al [2019] as a model baseline for 29,000 reaches
[*State of the art hydrologic understanding for SWOT to improve: will users get better data after SWOT?*]

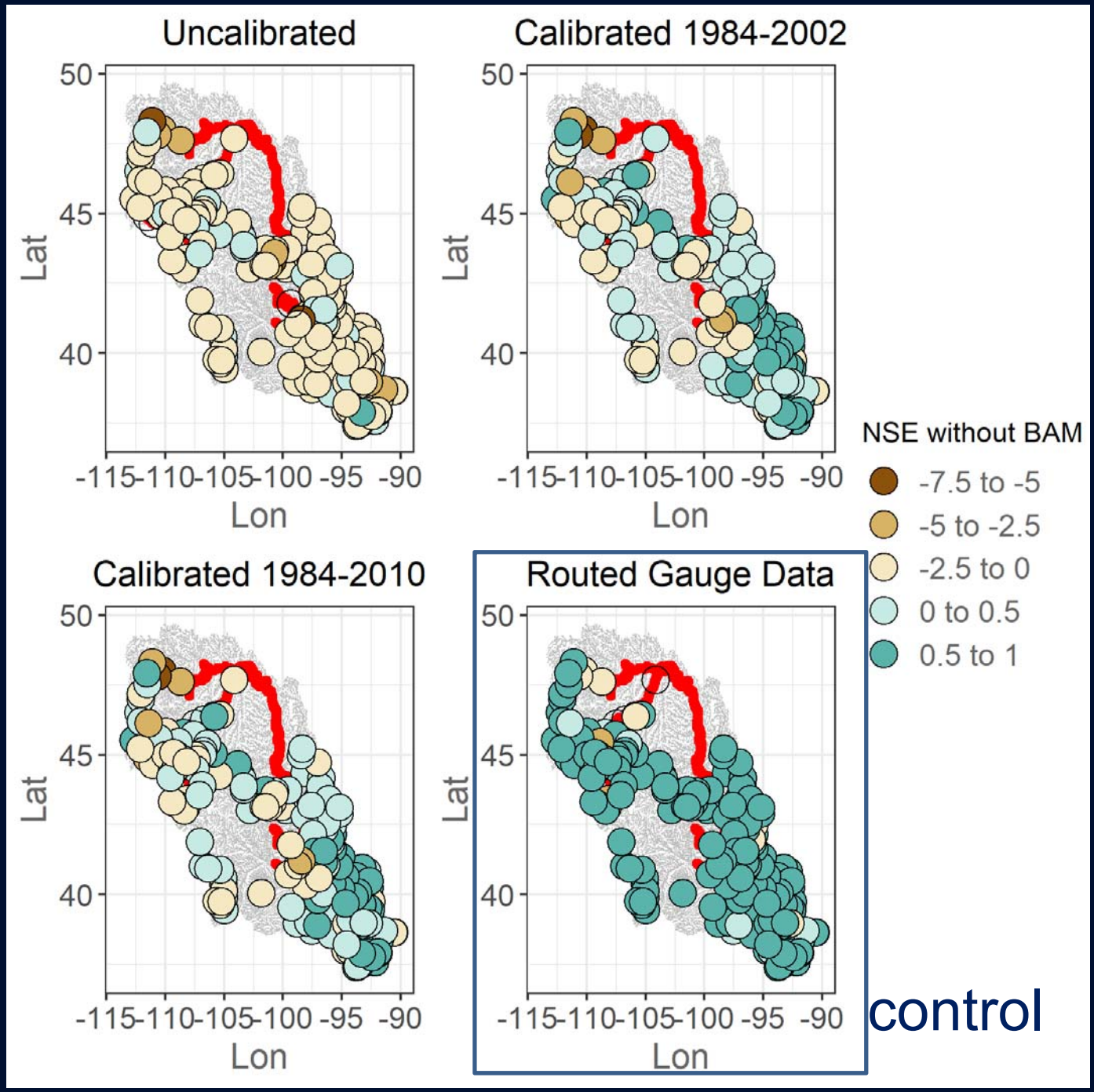
What to do?

4. Combine BAM Q and the model baseline
[*Merge SWOT and models to hopefully improve hydrologic understanding*]

5. See what happens!
[*validate*]

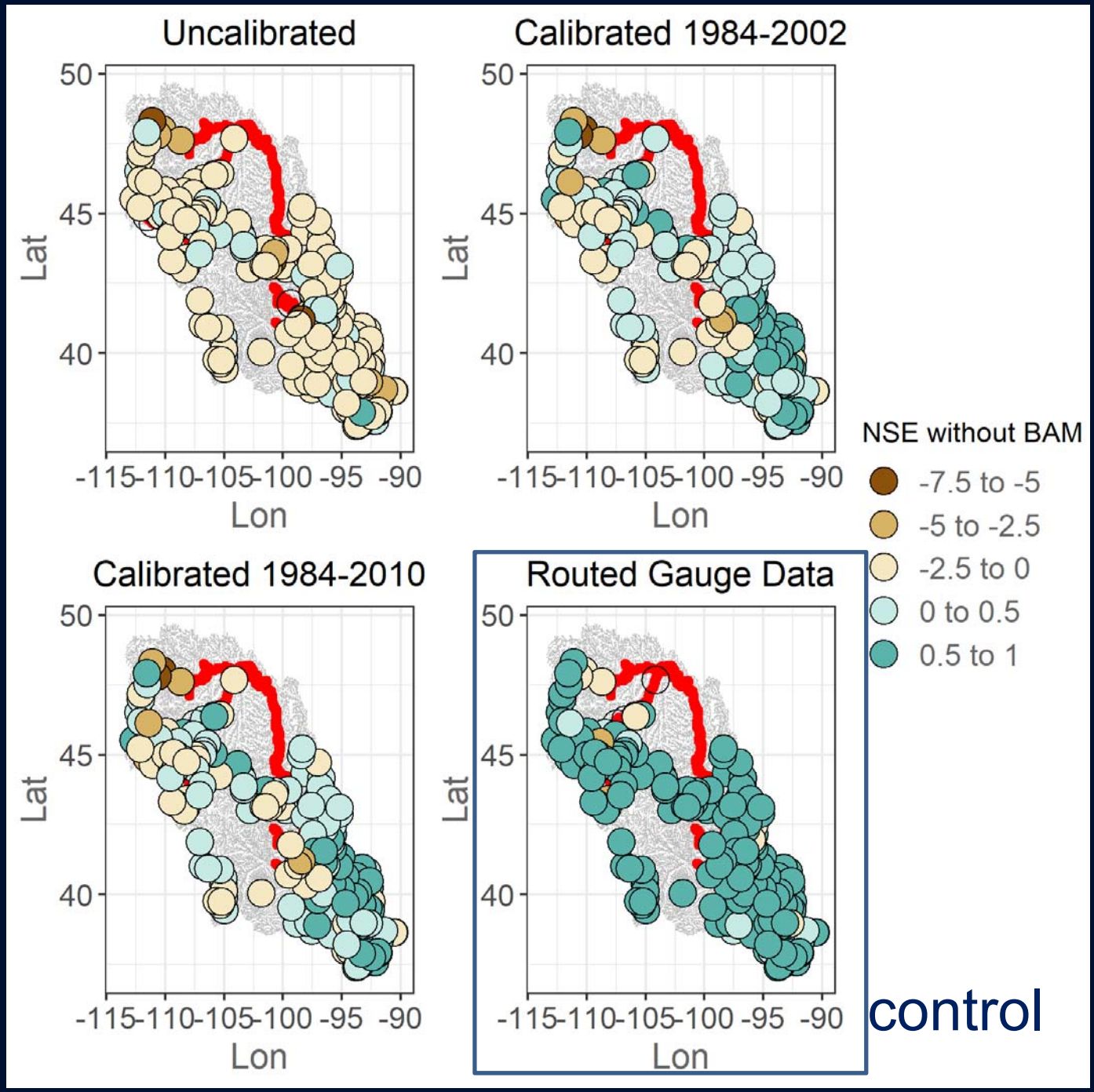
Lin et al: A state-of-the-art in global modeling* [*SWOT will start here too*]

*note that we need to modify the Lin et al product, which makes their results worse in the uncalibrated case



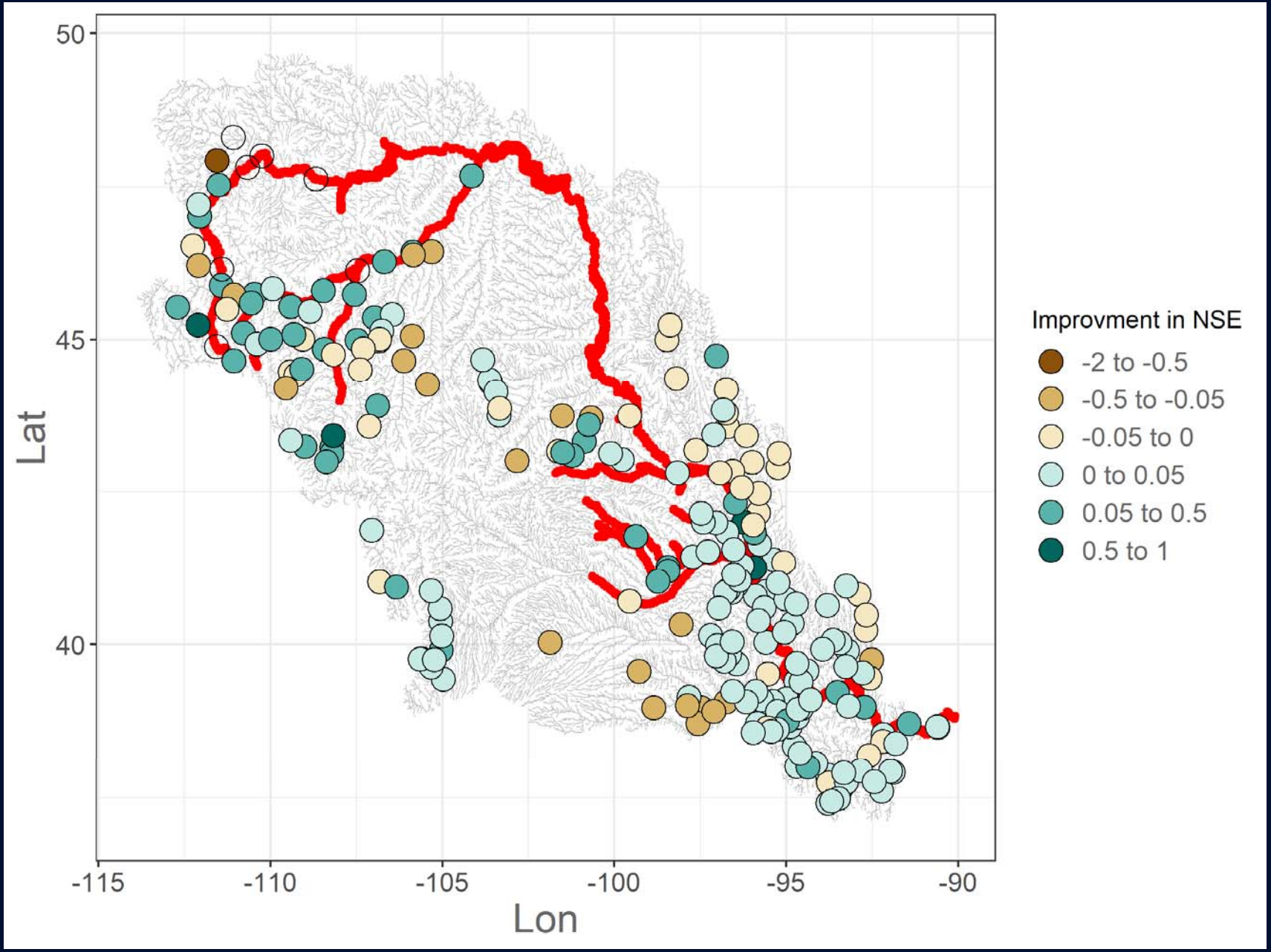
Now, add Landsat [SWOT].

Direct insertion [Data assimilation]

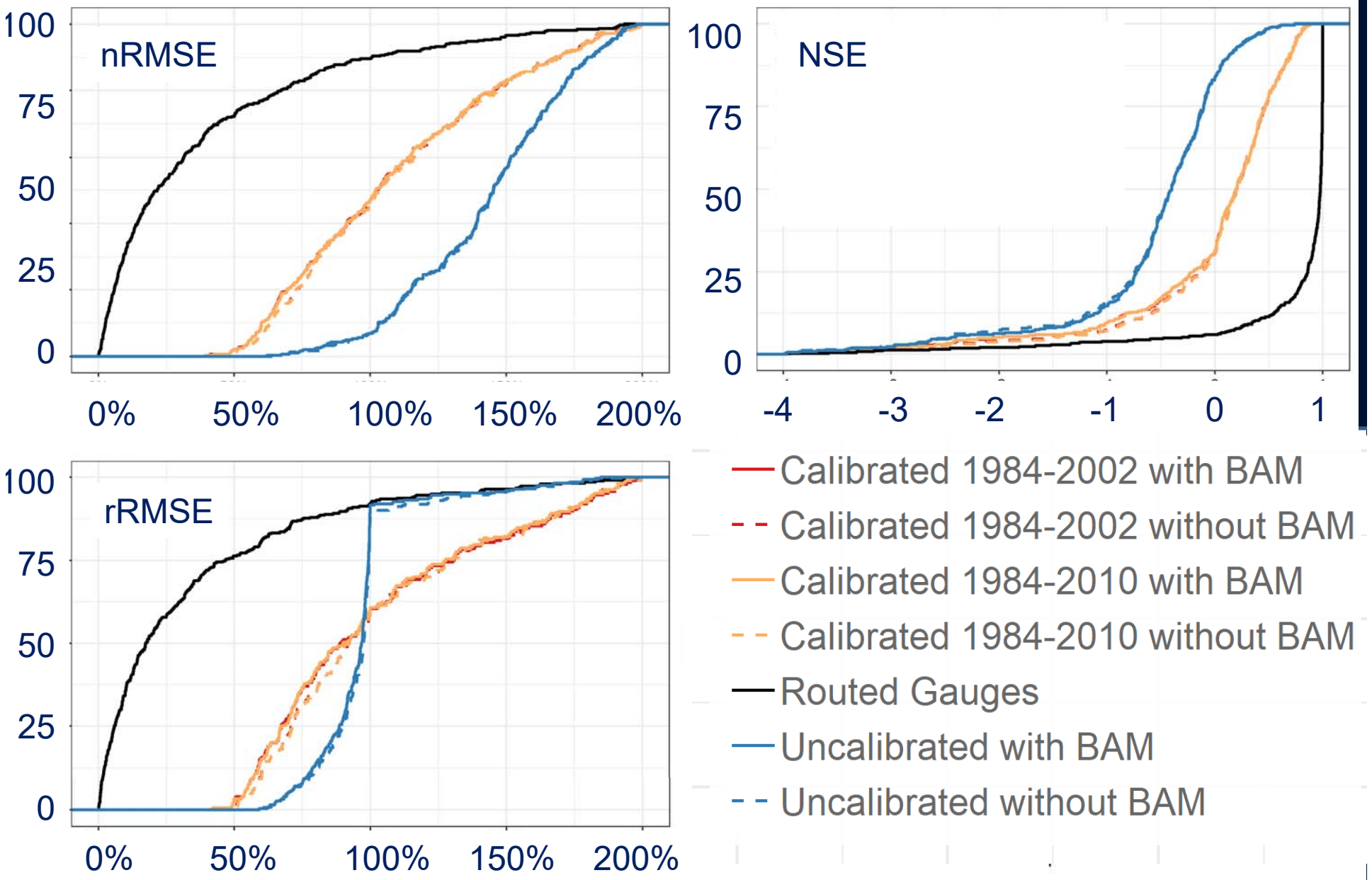


control

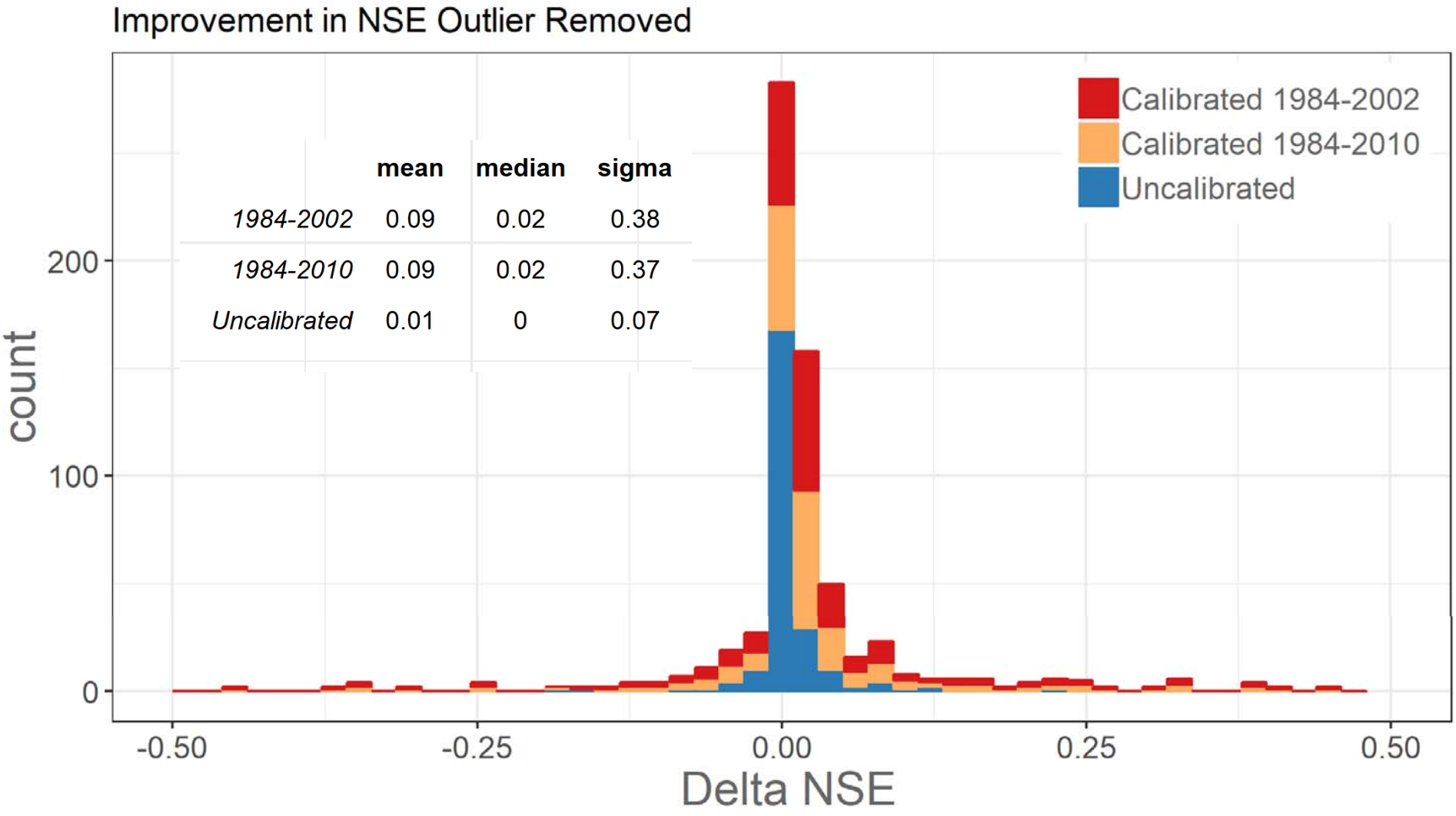
Spatial improvements, daily validation



CDFs across 403 validation gauges (DAILY)



Histogram of change in error after adding BAM



What does this mean?

1. *Large basin* demo of *daily SWOT-like* discharge estimation at *29,000 reaches* using *real satellite data*

2. It took *26 hours of computational time*, one week of manual QA/QC, *four years* of development, *and eight people*.

What does this mean?

3. Adding RS discharge made the model better. [*model + McFLI synergy better than either component*]

4. Much room for improvement (DA, reservoirs). [*lots of work to do before launch*]

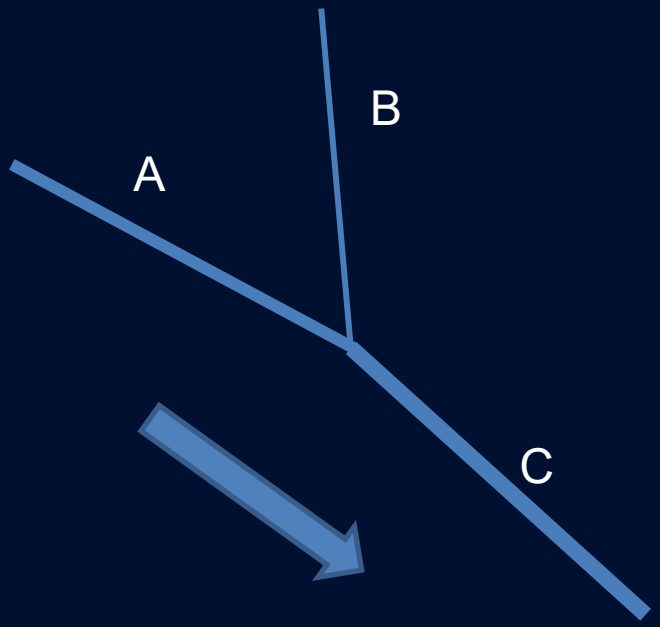
5. *This is a possible template for SWOT*. SWOT data should be a big upgrade.

What does this mean?

This is encouraging!!!!

A simple example

We know at any given time, $Q_c = Q_a + Q_b$



TRUTH	Q_a	Q_b	Q_c
t_1	50	40	90
t_2	155	35	190
…	…	…	…
t_n	40	1	41

McFLI	Q_a	Q_b	Q_c
t_1	58	42	85
t_2	160	36	110
…	…	…	…
t_3	N/A	8	67

Because of our necessary ‘Mc,’ we are in a quandary