

2023 SWOT Cal/Val Activities for the North Saskatchewan River



BROWN



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Motivation and Background

- The recently launched Surface Water and Ocean Topography (SWOT) Ka-band radar interferometry satellite mission is collecting new measurements of water surface elevation (WSE) and inundation extent of rivers and lakes globally.
- To provide accurate information on the spatial-temporal evolution of global WSE, the mission requires calibration and validation (CalVal) using in-situ measurements.
- Here we provide the first results of in-situ measurements from a tier-1 SWOT CalVal site in Canada, the North Saskatchewan River (NSask).
- These field data are used to validate SWOT.

Field Data Collection

- Field measurements of WSE were acquired over the summer months in NSask river from May 17 to June 14, 2023, using 18 pressure transducers (PT), 4 Water Survey of Canada temporal gauging stations, and tow Global Navigation System Satellites (GNSS) receivers drifted by boat along 3 SWORD reaches of the NSask (total 44 km).



Fig. 1. Field Data collection in NSask, Canada (Photo courtesy: Bo Wang, Brown University)

Study Site and Method

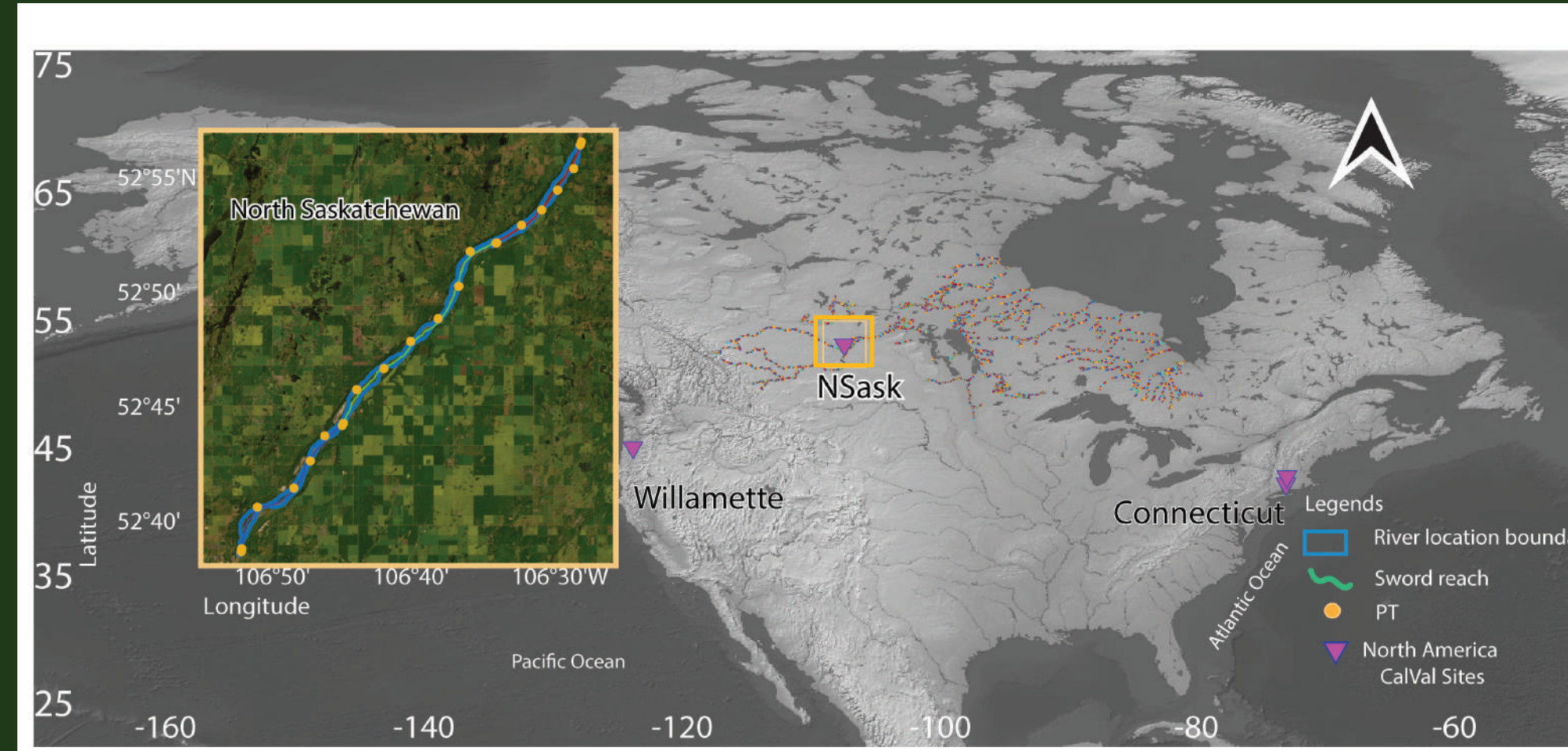


Fig. 2. Study site: North Saskatchewan River. North American Calval sites are also highlighted.

1) Data Pre-Processing

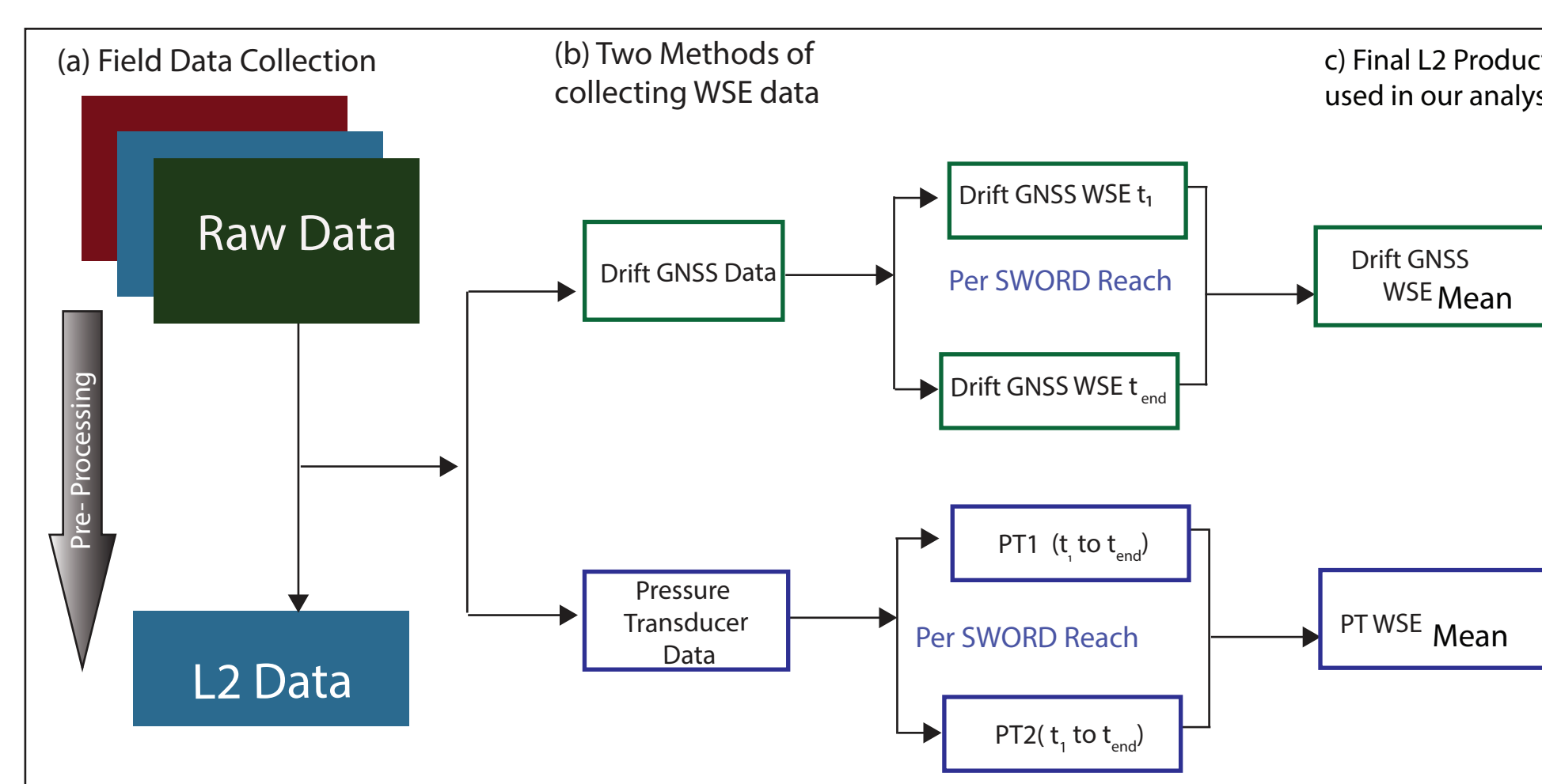


Fig. 3. Field data pre-processing from L1 to L2 (Approach by Gleason C. University of Massachusetts 2023, SWOT Science Meeting Talk)

2) Statistical Analysis for WSE Data Comparison

For comparison of WSE from GNSS and PT we obtain relative difference dD using following formula,

$$\left(WSE_{GNSS_{T1}} - WSE_{GNSS_{T2}} \right) - \left(WSE_{PT_{T1}} - WSE_{PT_{T2}} \right)$$

Where,

- $WSE_{GNSS_{T1}}$ = Mean drift water surface elevation at time 1 per reach
- $WSE_{GNSS_{T2}}$ = Mean drift water surface elevation at time 2 per reach
- $WSE_{PT_{T1}}$ = Mean water surface elevation at time 1 (paired with $GNSS_{T1}$) per reach
- $WSE_{PT_{T2}}$ = Mean water surface elevation at time 2 (paired with $GNSS_{T2}$) per reach

Research Questions

Objective

Provide recommendations on the use of field cal/val datasets to calibrate and validate SWOT observations.

Research Questions

- What information do we see from the field using PT and GNSS WSE datasets?
- How well do in situ PT and GNSS measurements correlate in the NSask CalVal site?

3) PT vs. GNSS

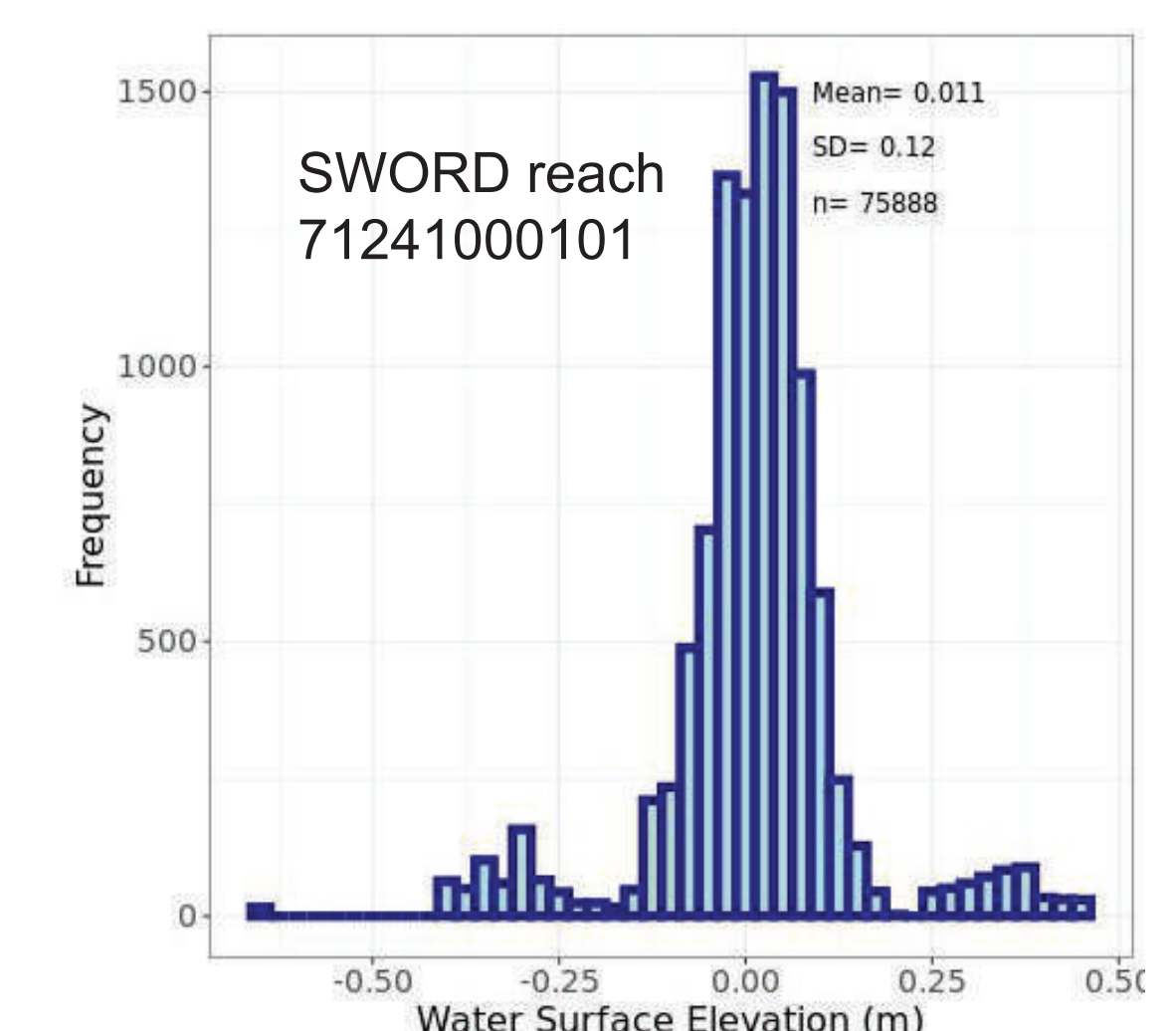
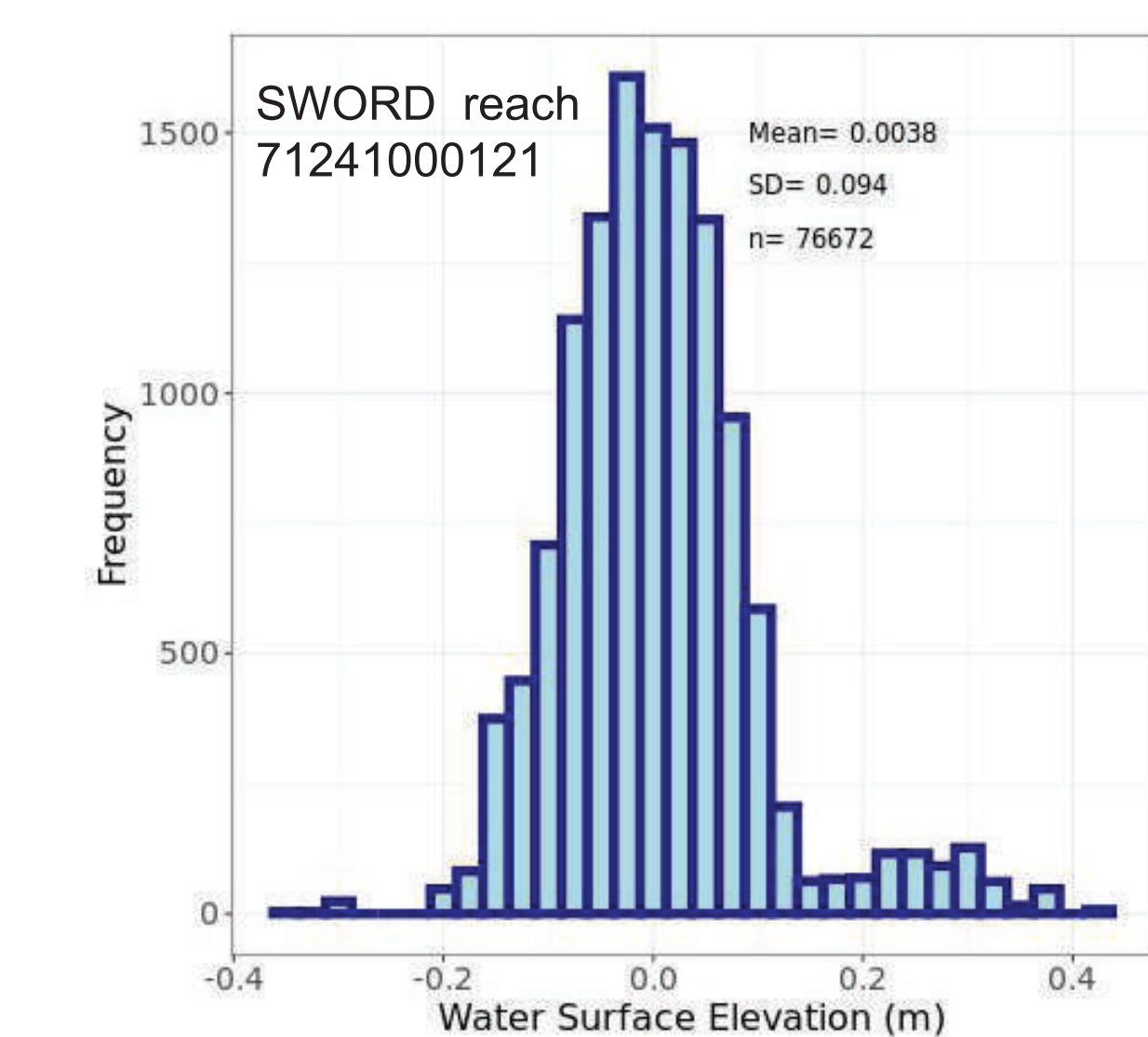
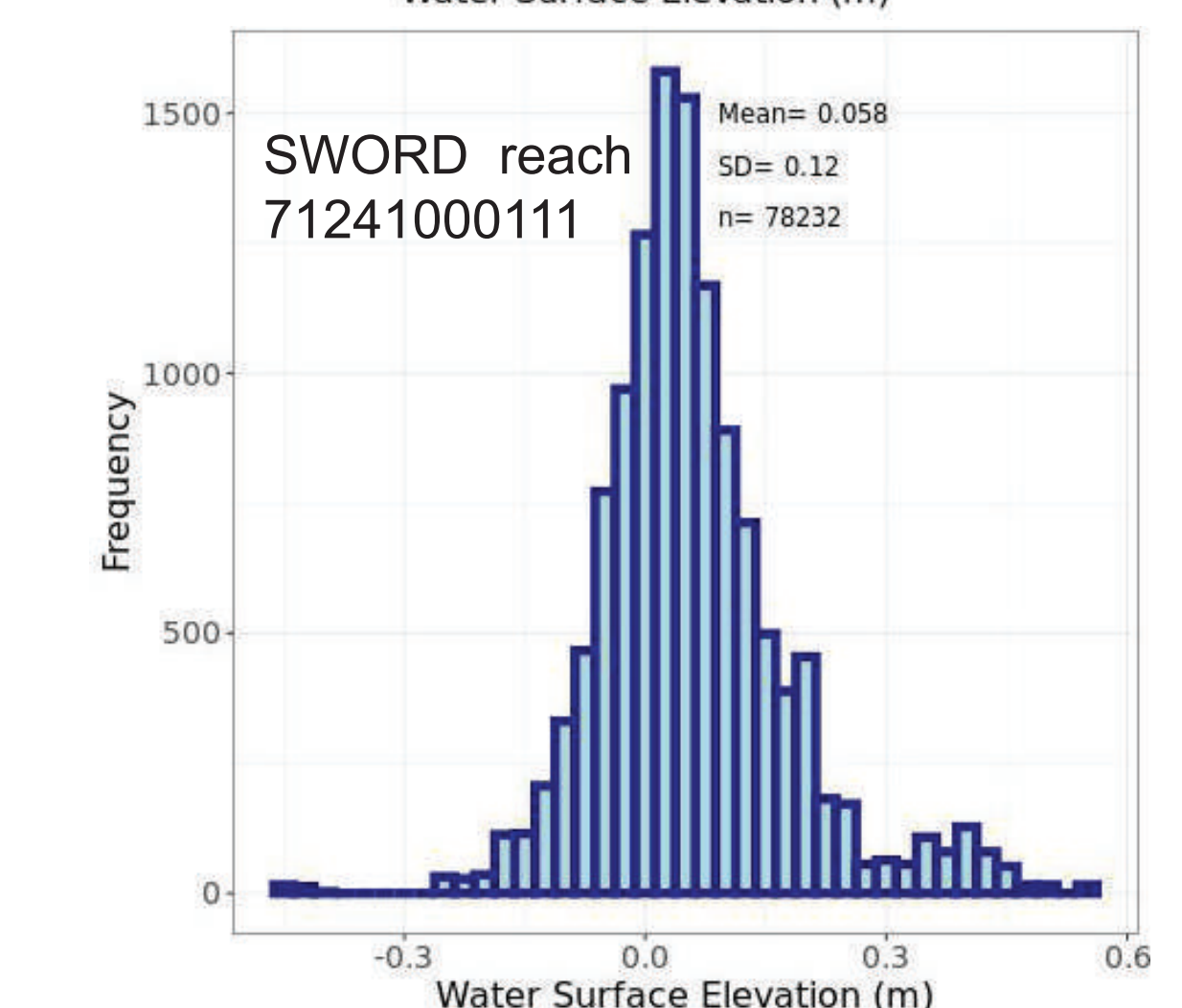


Fig. 4. Distribution of relative differences in WSE from GNSS and PT for each Nsask reach



Results and Discussions

North Saskatchewan River

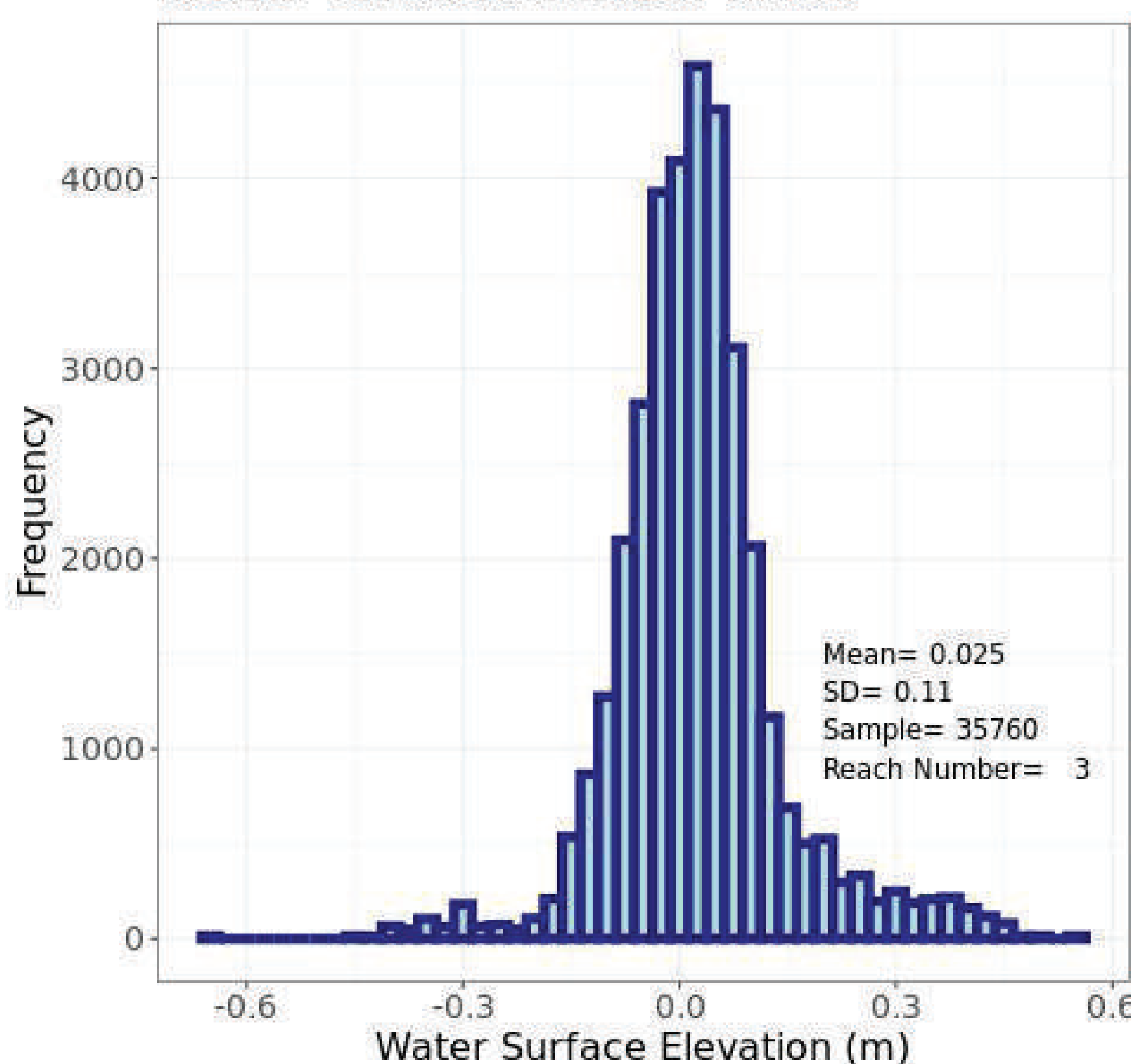


Fig. 5. Distribution of relative differences in WSE from GNSS and PT for all three Nsask reaches.

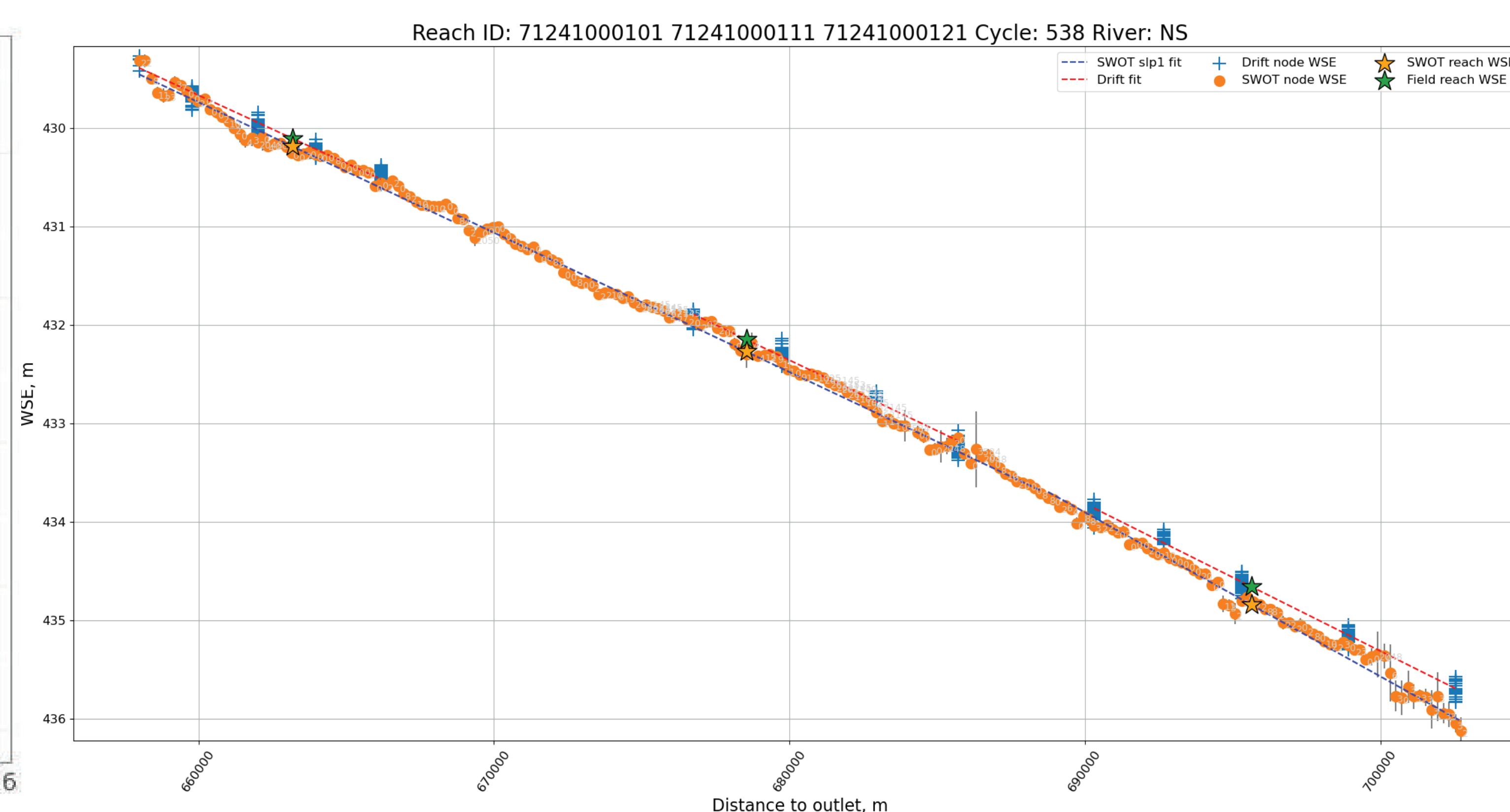


Fig. 6. Comparison of field reach WSE (green stars) and SWOT reach WSE (gold stars). Orange circles are SWOT node WSE. (Courtesy: Cassie Stuurman, JPL)

- We compare WSE measured from in situ Pressure Transducers and GNSS drifts.
- Pre-processed data (Gleason C.) allows pairing of PT and GNSS drift data at the reach scale.
- The mean relative difference in WSE is 2.5 ± 11 cm.
- North Saskatchewan field are within the range of SWOT uncertainty.

Affiliations

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