Novel AirSWOT Measurements of River Height and Slope, Tanana River, AK

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1. Key Points

- AirSWOT provides a new method for measuring river water surface elevations (WSEs) and slopes without the need for *in situ* data.
- Errors from AirSWOT are sufficiently small to allow detection of decimeter-level variations in WSEs over 1 km^2 areas and cm/km level variations in slopes along 10 km reaches.
- Results indicate AirSWOT is capable of producing measurements useful for validating SWOT-quality measurements of river WSEs and slopes.

2. Data Analysis

- Collected a GPS profile of WSEs along the main channel of the Tanana River coincident with AirSWOT measurements on June 9, 2015 (Figure 1).
- Filtered AirSWOT WSEs using a ratio of radar magnitude to estimated error. This filter helps eliminate pixels effected by layover and artifacts due to the processing methodology.
- Calculated orthogonal means of AirSWOT WSEs for every GPS measurement along the profile (Figure 2).
- Estimated AirSWOT WSE errors when averaged over 1 km^2 areas (Figure 3).
- Used a moving window every 100 m along the GPS profile to calculate AirSWOT and GPS profile slopes along 10 km reaches, and assessed AirSWOT's ability to capture slope variability by calculating Nash-Sutcliffe Efficiency (NSE) values between GPS Profile and AirSWOT slopes (Figure 4).
- Calculated AirSWOT slope errors for the 499 overlapping 10 km reaches (Figure 5).
- AirSWOT WSE and slope errors are compared to the SWOT mission's science requirements for executing robust science of surface water dynamics. These requirements are ±10 cm or better for WSEs when averaged over 1 km^2 areas and ±1.7 cm/km for slopes after processing along a maximum of 10 km of flow distance [Biancamaria et al., 2016; Rodriguez, 2016].

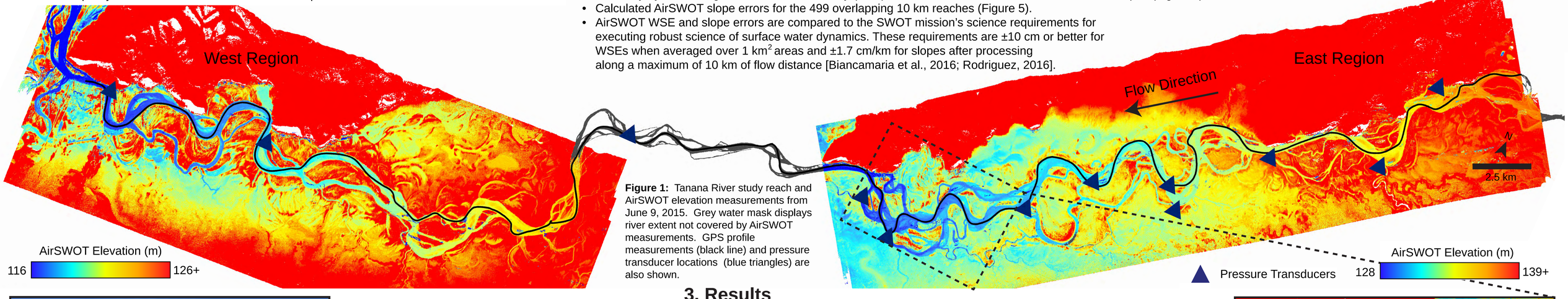
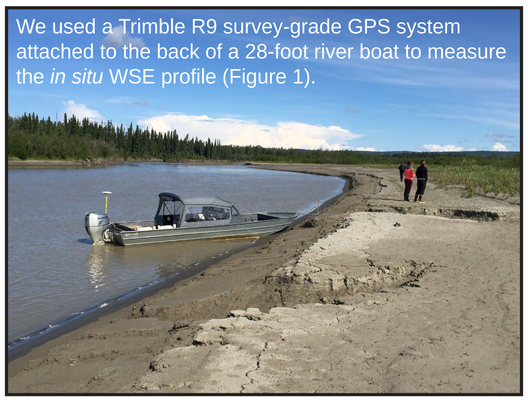


Figure 1: Tanana River study reach and AirSWOT elevation measurements from June 9, 2015. Grey water mask displays river extent not covered by AirSWOT measurements. GPS profile measurements (black line) and pressure transducer locations (blue triangles) are also shown.

3. Results



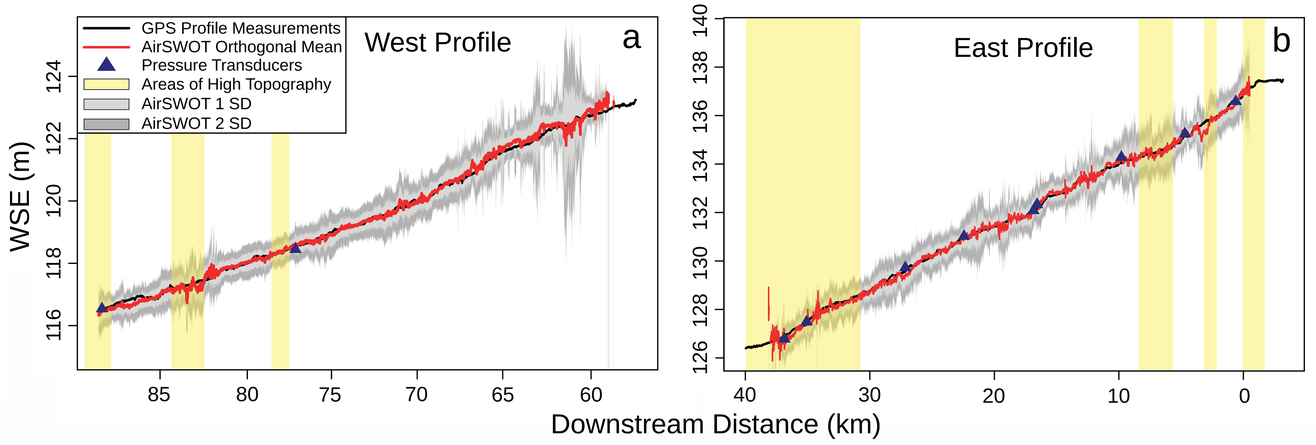
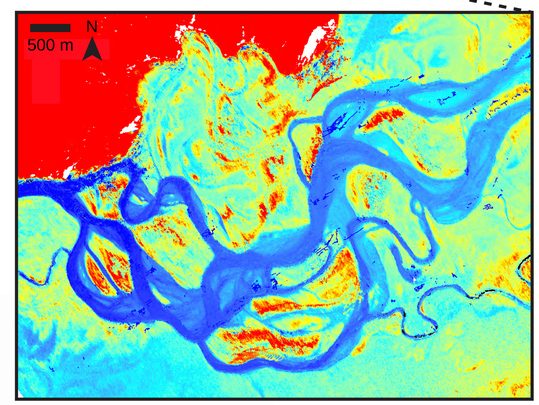


Figure 2: WSE profiles derived from GPS profile (black) and AirSWOT (red) for the (a) west and (b) east regions. Standard deviations (SD) are shown for the AirSWOT WSEs in the grey shaded areas.



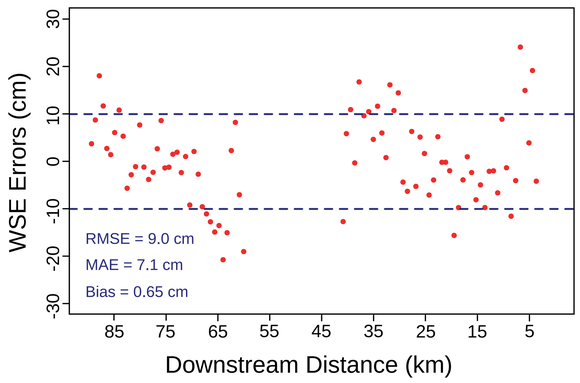


Figure 3: Differences between GPS profile and AirSWOT WSEs averaged over 1 km^2 areas. Blue dashed lines mark the SWOT science requirement for WSE accuracies (±10 cm).

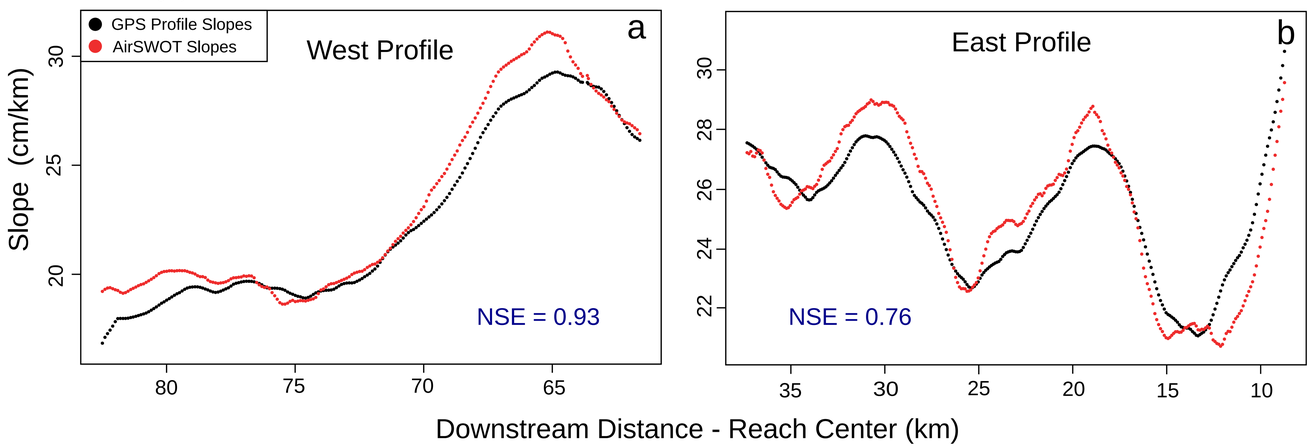


Figure 4: Slopes from GPS profile and AirSWOT for the 499 overlapping 10 km reaches within the (a) west and (b) east regions versus the center of each reach in order of downstream distance. Successive reach segments are shifted downstream by 100 m.

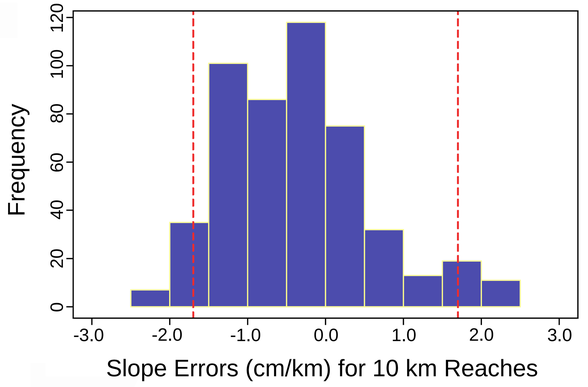


Figure 5: Histogram of slope errors for AirSWOT slopes relative to GPS profile slopes. Red dashed lines mark the SWOT science requirement for slope accuracies (±1.7 cm/km).

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References:

- Biancamaria, S., D. P. Lettenmaier, and T. M. Pavelsky (2016), The SWOT Mission and Its Capabilities for Land Hydrology, Surv. Geophys., 37(2), 307–337, doi:10.1007/s10712-015-9346-y.
- Rodriguez, E. (2016), Surface Water and Ocean Topography Mission (SWOT) Project - Science requirements Documents.