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AirSWOT observations versus hydrodynamic model outputs of water surface elevation and slope in a multichannel river

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Anabranching rivers make up a large proportion of the world's major rivers, but quantifying their flow dynamics is challenging due to their complex morphologies. Traditional in situ measurements of water levels collected at gauge stations cannot capture out of bank flows and are limited to defined cross sections, which presents an incomplete picture of water fluctuations in multichannel systems. Similarly, current remotely sensed measurements of water surface elevations (WSEs) and slopes are constrained by resolutions and accuracies that limit the visibility of surface waters at global scales. Here, we present new measurements of river WSE and slope along the Tanana River, AK, acquired from AirSWOT, an airborne analogue to the Surface Water and Ocean Topography (SWOT) mission. Additionally, we compare the AirSWOT observations to hydrodynamic model outputs of WSE and slope simulated across the same study area. Results indicate AirSWOT errors are significantly lower than model outputs. When compared to field measurements, RMSE for AirSWOT measurements of WSEs is 9.0 cm when averaged over 1 km squared areas and 1.0 cm/km for slopes along 10 km reaches. Also, AirSWOT can accurately reproduce the spatial variations in slope critical for characterizing reach-scale hydraulics, while model outputs of spatial variations in slope are very poor. Combining AirSWOT and future SWOT measurements with hydrodynamic models can result in major improvements in model simulations at local to global scales. Scientists can use AirSWOT measurements to constrain model parameters over long reach distances, improve understanding of the physical processes controlling the spatial distribution of model parameters, and validate models' abilities to reproduce spatial variations in slope. Additionally, AirSWOT and SWOT measurements can be assimilated into lower-complexity models to try and approach the accuracies achieved by higher-complexity models.