Characterizing AirSWOT elevation accuracy on the Willamette River, Oregon

H21F-1482

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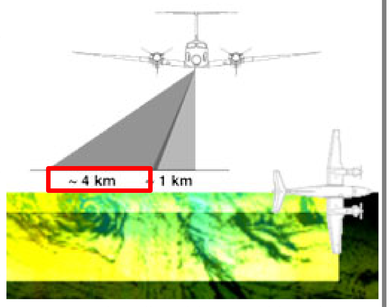
Background

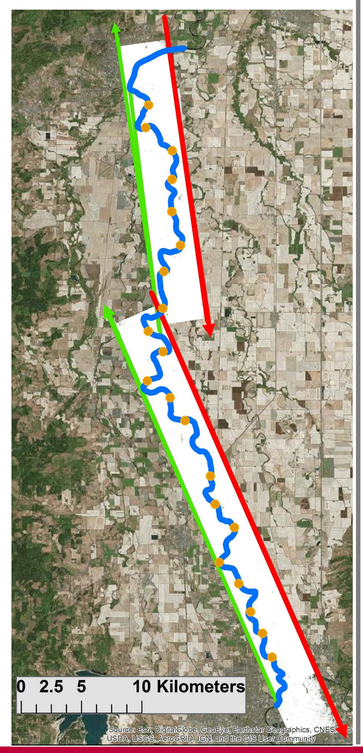
- SWOT (swot.jpl.nasa.gov) will launch in 2021 and will produce novel datasets of inland water extent and storage change
- SWOT's Ka-band Radar Interferometer (KaRIN) will use single-pass interferometric radar to map water surface elevations
- An airborne variant of SWOT called AirSWOT was developed for characterizing Ka-band phenomenology, testing discharge algorithms, and performing Cal-Val for SWOT
- AirSWOT instruments: Ka-band SWOT phenomenology airborne radar (KaSPAR) and NASA Digital Camera System (DCS)
- KaSPAR has two imaging modes; data in this poster is from the far-swath mode which ranges from ~4° - 30° off nadir
- NIR imagery allows for land/water masks where land/water contrast of Ka-band radar is insufficient (high incidence angles)
- Field campaign on the Willamette River in March 2015 featured six days of flights to capture dynamic flow conditions
- In-situ measurements collected by team from USGS Oregon Water Science Center, University of Wyoming, and University of Oregon
- AirSWOT images processed by JPL's Radar Science & Engineering Section
- DCS images processed by Cirrus Digital Systems



Source: https://swot.jpl.nasa.gov/airswot/

Study area

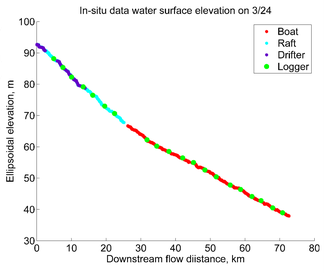
- 80km stretch of the Willamette River in western Oregon
- Watershed: 5,300 km^2 upstream (south) to 11,400 km^2 downstream (north)
- Historically anastomosing river through alluvial floodplain; mostly single channel hemmed in by agricultural land
- Average annual discharge at downstream reach 370 m^3/s
- At right, flight coverage from 3/24/15 with four northbound flights (ground track = green line) and four southbound flights (red line). Yellow dots along the river centerline show the location of 20 pressure transducers installed in the riverbed, and the area in white represents the combined swath coverage of 8 combined flight lines



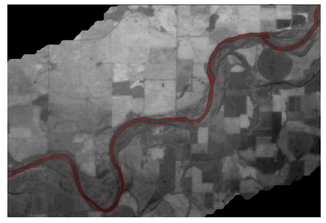
In-situ data

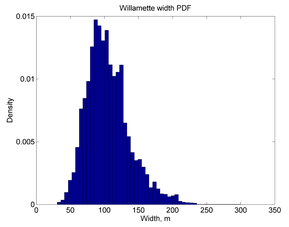
Water surface elevation, bathymetry, and flow velocity data were collected as part of a field campaign coordinated by UO and USGS. In-situ data shown in this poster were collected using

1. Raft-mounted RTN GPS
2. GPS Drifter
3. Pressure transducers installed on the river bottom
4. Motorboat-mounted RTN GPS

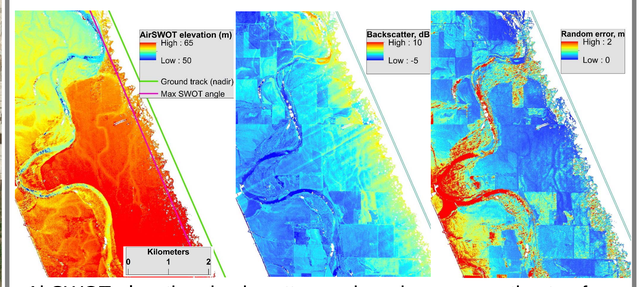


AirSWOT data

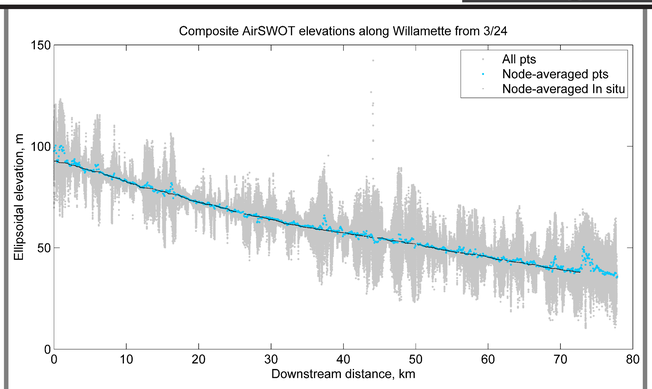


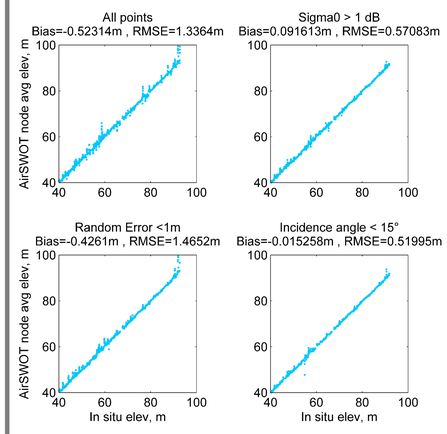


NIR orthoimagery from the DCS was used for the water mask. A manual mask from the 3/16 flight was used for this poster; this was the only cloud-free flight day. River width from the mask gives a mean of ~100m and range of ~50-200m.

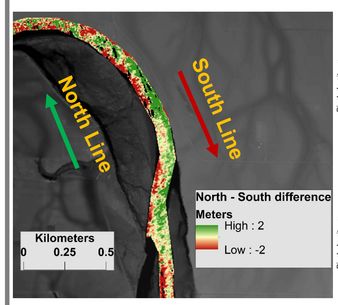


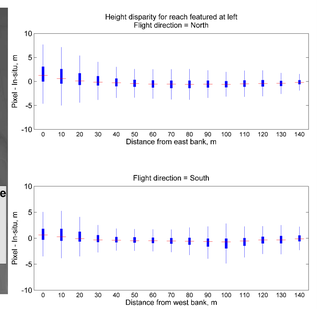
AirSWOT elevation, backscatter, and random error estimates from a southbound flight. Backscatter over water is higher than land in the near range and lower in the far range; the random error value (a function of the complex correlation of the SAR images) shows a similar, albeit inverted, relationship.



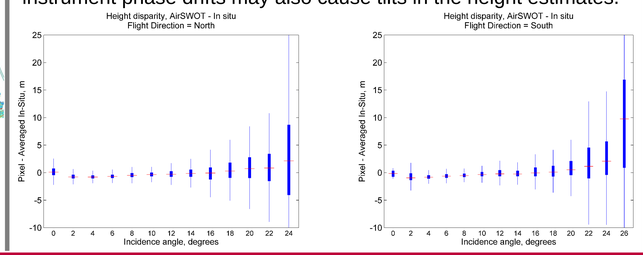


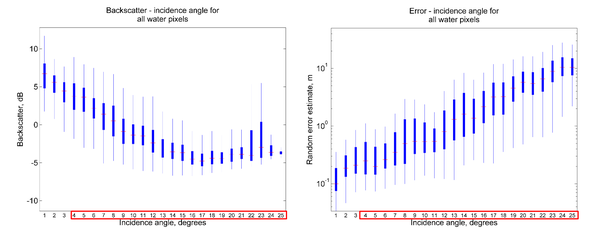
Above, AirSWOT elevations from all flights extracted from river mask and averaged at 1050 'nodes' along the river centerline. At right, in-situ data averaged to the same nodes compared to unfiltered and filtered AirSWOT.





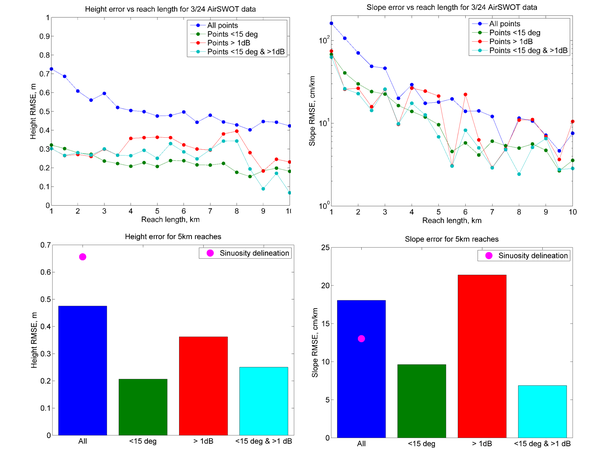
Elevation difference between northbound and southbound AirSWOT elevation returns (above left). Potential layover error would be expected on the east bank for the 'north line', and on the west bank for the 'south line' (above right). Below, node- and directionally-averaged AirSWOT – in-situ WSE disparities show a positive relationship at high incidence angles. Residual, uncompensated instrument phase drifts may also cause tilts in the height estimates.



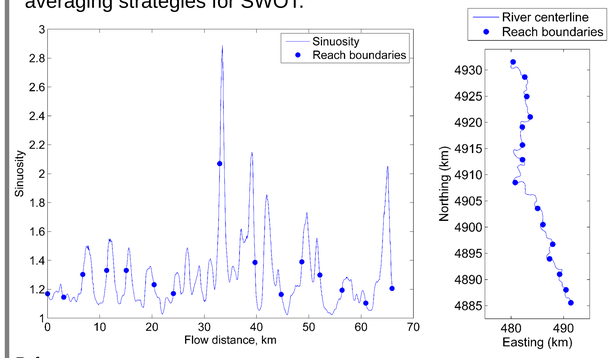


Backscatter – and random error estimate – incidence angle relationships for all AirSWOT water pixels. Backscatter drops off quickly with incidence angle, while random error estimates average 1m or higher for pixels above ~13°.

Slope accuracy & reach definitions



Data from 4 to 70km were used to exclude outliers at the start and end of the study reach. Longer reach lengths reduce slope errors and filtering AirSWOT data improves height and slope estimates. A sinuosity-based reach delineation with mean reach length of 5km improved slope estimates compared to constant 5km reaches (pink circle). See poster **H21F-1485** for reach-averaging strategies for SWOT.



References:

Moller, D., and J. Carswell (2009), The Ka-band SWOT Phenomenology Airborne Radar (KaSPAR): A Novel Multi-baseline Interferometer for SWOT Characterization, Calibration and Validation, *Remote Sens. Solut. Doc.*

Wallick, J. R., Grant, G. E., Lancaster, S. T., Bolte, J. P., & Denlinger, R. P. (2007). Patterns and controls on historical channel change in the Willamette River, Oregon, USA.

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