

AirSWOT Hydrology

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- AirSWOT is an airborne SWOT analogue and a primary SWOT calibration and validation tool.
- Primary payload is the Ka-band SWOT Phenomenology Airborne Radar (KaSPAR)
- Secondary payload is a NASA Color/IR Digital Cirrus Camera
- Integrated on a NASA King Air B200 out of NASA Dryden
- Two swaths of data: 80 MHz swath collected from ~ 4 - 25 deg. Incidence angles, 400 MHz swath from ~ 0 - 4 degrees.

AirSWOT Hydrology Campaigns

- November 2014: Mono Lake & Lake Tahoe
 - Focus: understanding SWOT/AirSWOT phenomenology
- Piute Points 2014-2015:
 - Focus: Phenomenology, lake height variations
- March 2015: Sacramento and Willamette Rivers
 - Focus: Testing river algorithms, including height, slope, and discharge.
- May 2015: Wax Lake Delta & Atchafalaya Wetlands
 - Focus: Understanding flow patterns in delta systems. Coincident with UAVSAR and AVIRIS-NG
- June 2015: Tanana River and Yukon Flats, AK
 - Focus: Boreal hydrologic science, testing algorithms, phenomenology in northern wetlands and braided rivers.
- Winter 2016: Tuolumne Meadows
 - Focus: Understand SWOT returns over different snow conditions, relevant to detecting ice cover in rivers & lakes.

Where We Are Now

AirSWOT is a complex, novel instrument. There is no off-the-shelf software available to process the data.

The AirSWOT team at JPL is not large, and they have many competing responsibilities (chiefly addressing questions about ocean phenomenology)

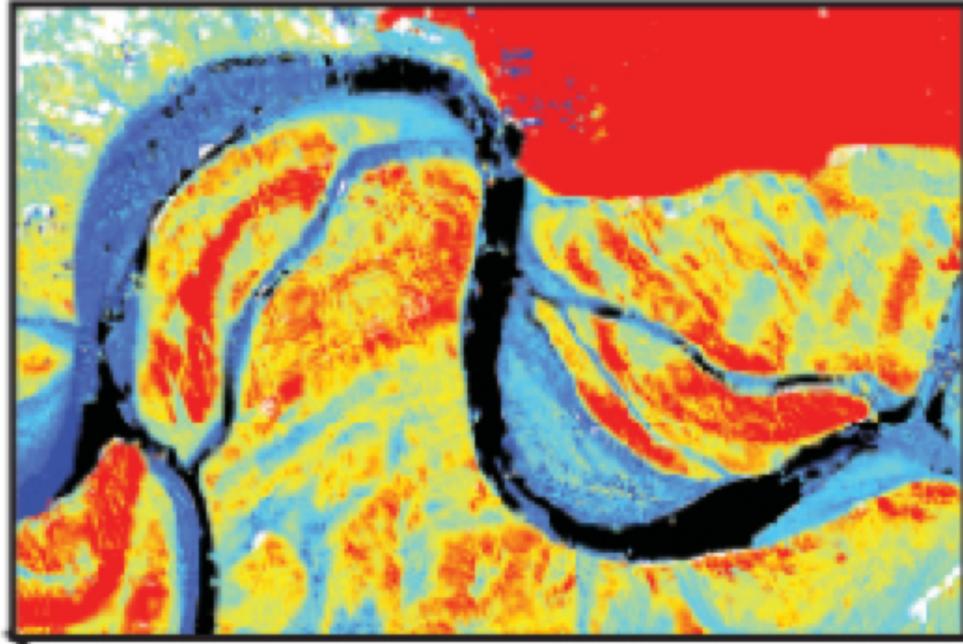
Correct processing of AirSWOT data is an iterative process requiring feedback from hydrologists and reprocessing multiple times.

This presentation represents a snapshot in time. I will show errors in the AirSWOT data. The AirSWOT team is currently working to address these errors and reprocess the data.

Key Questions

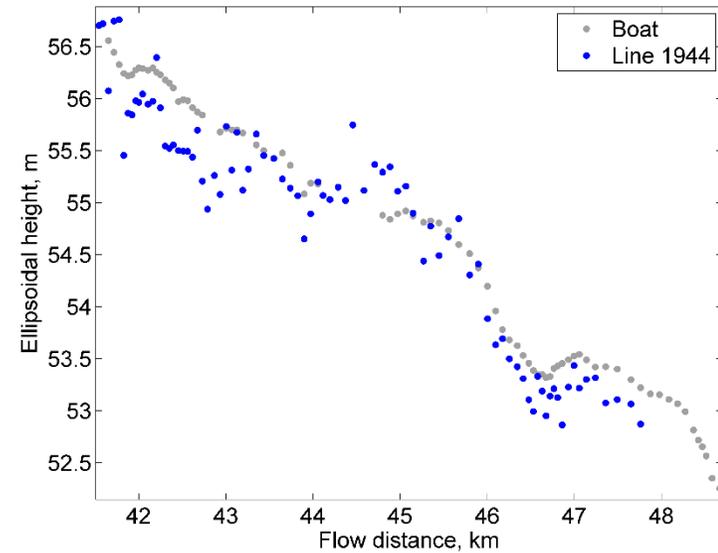
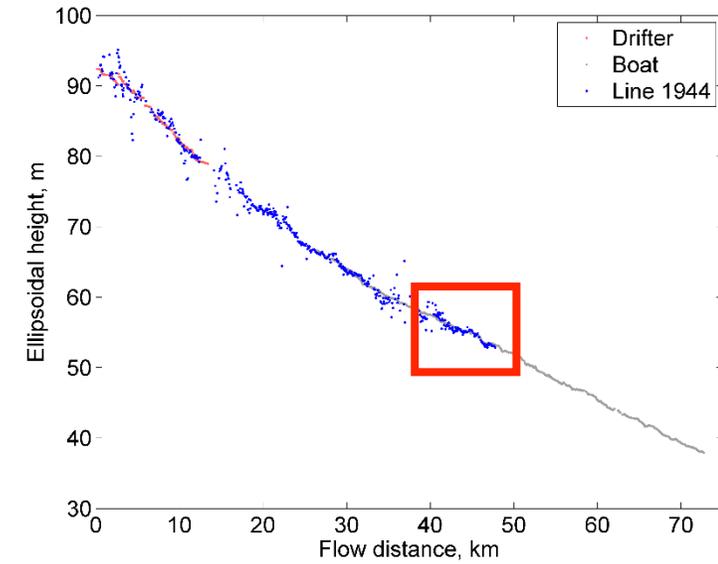
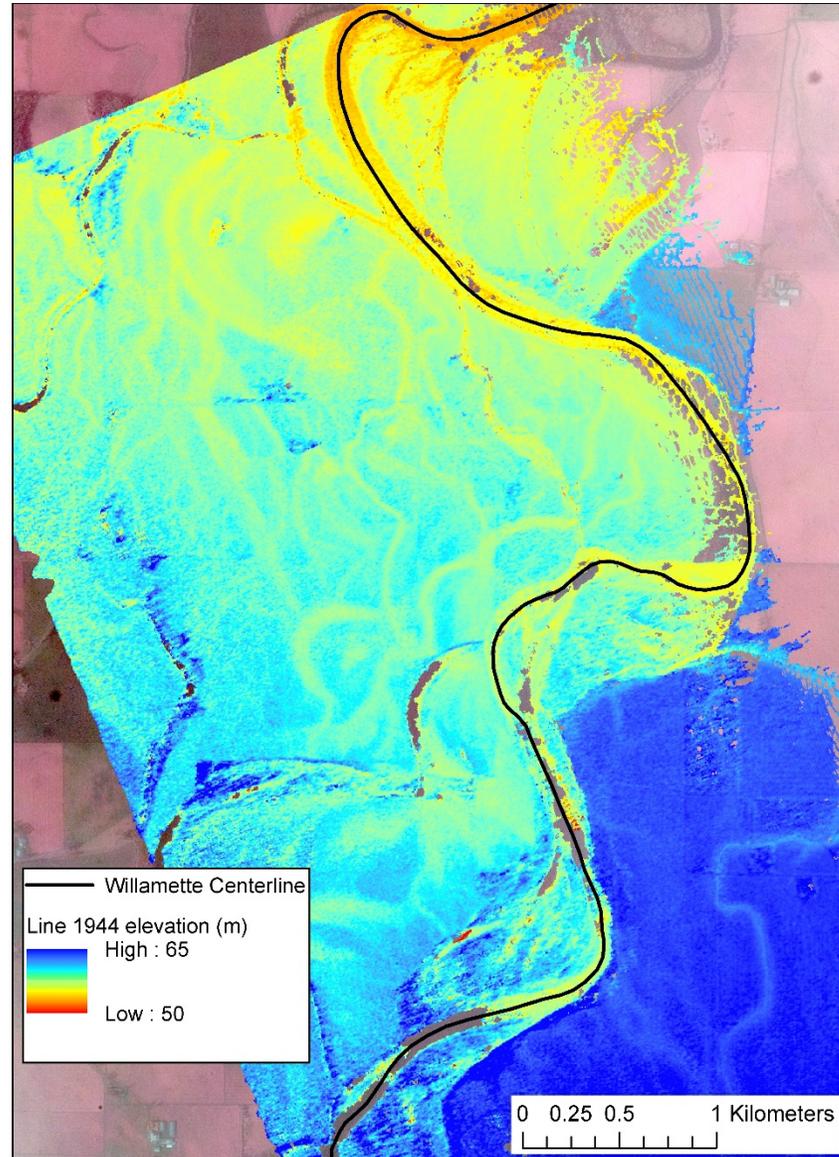
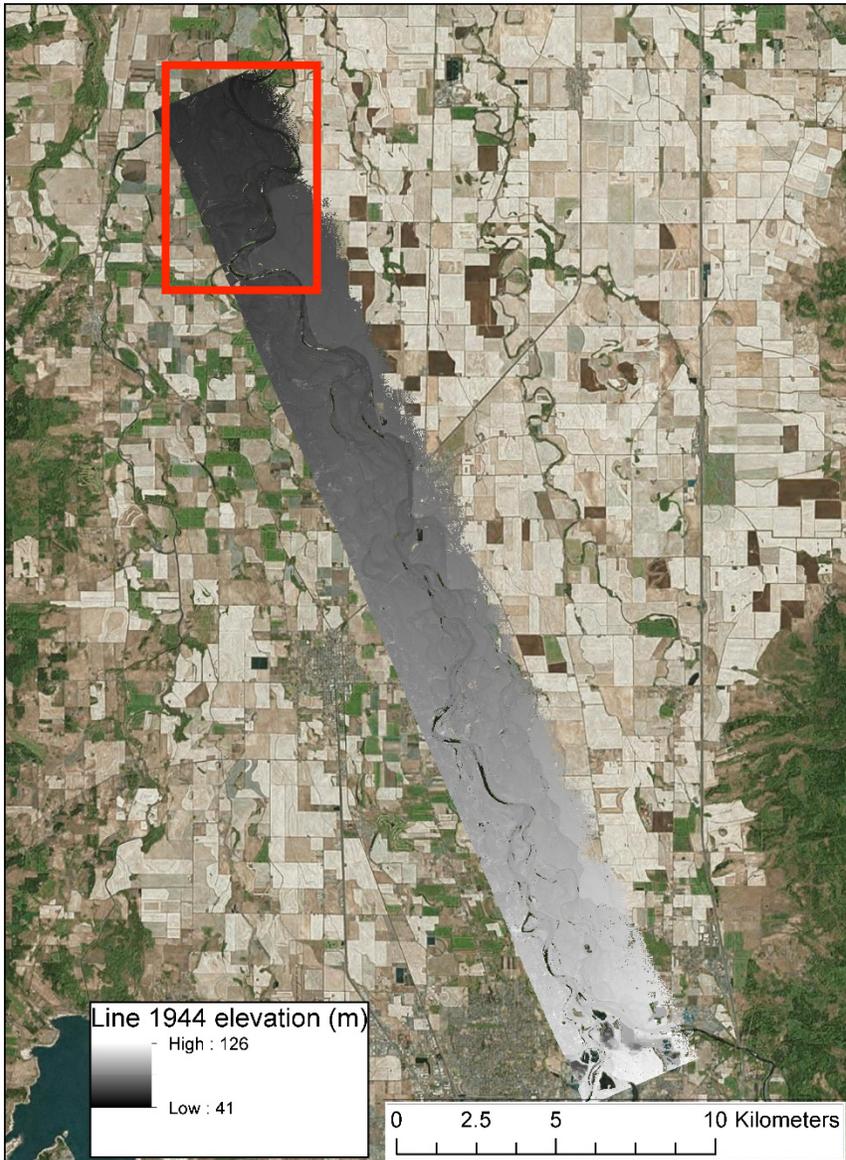
1. Can AirSWOT accurately represent river height, slope, and width?
2. How consistent are AirSWOT data from pass to pass over the same site?
3. How does layover appear to influence AirSWOT data?
4. Can we reliably distinguish between water and wet sand bars in rivers?
5. How prevalent is “dark” water, for which reflectance is specular?

Key Questions



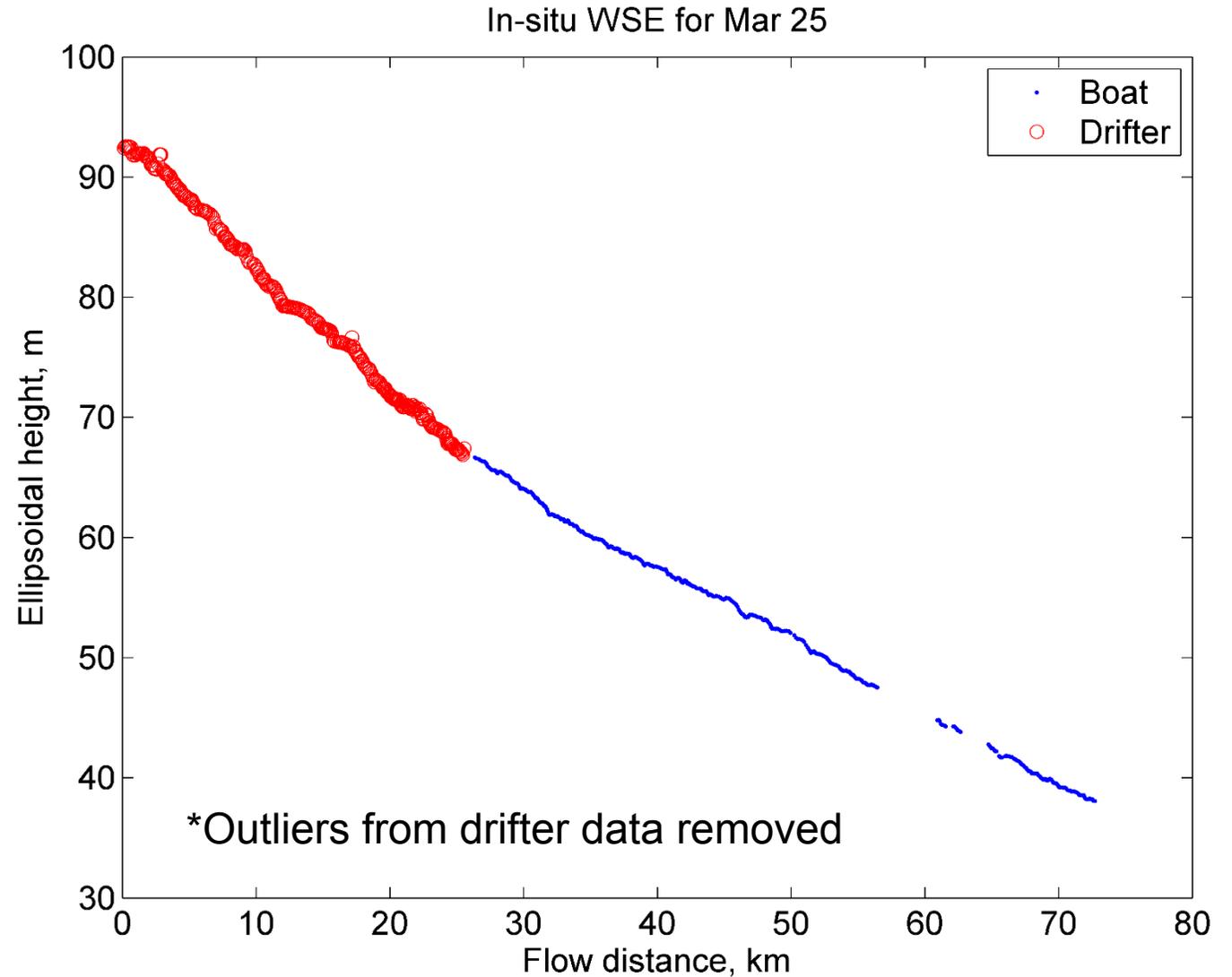
AirSWOT on Willamette

* line 1944, Mar 16 2015, not yet reprocessed for elevation correction

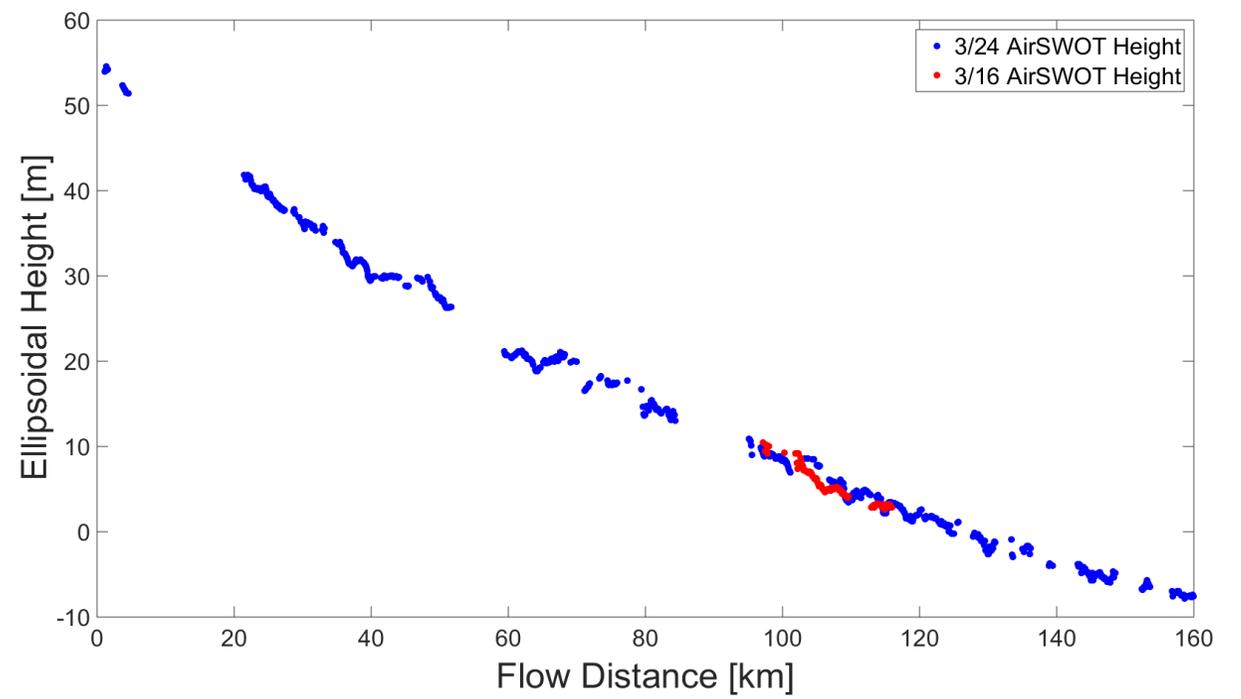
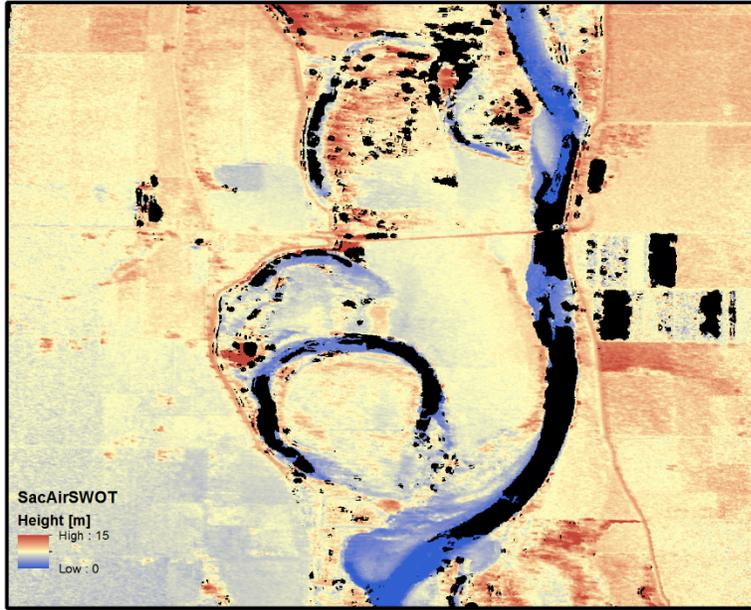


In-situ WSE data for Willamette

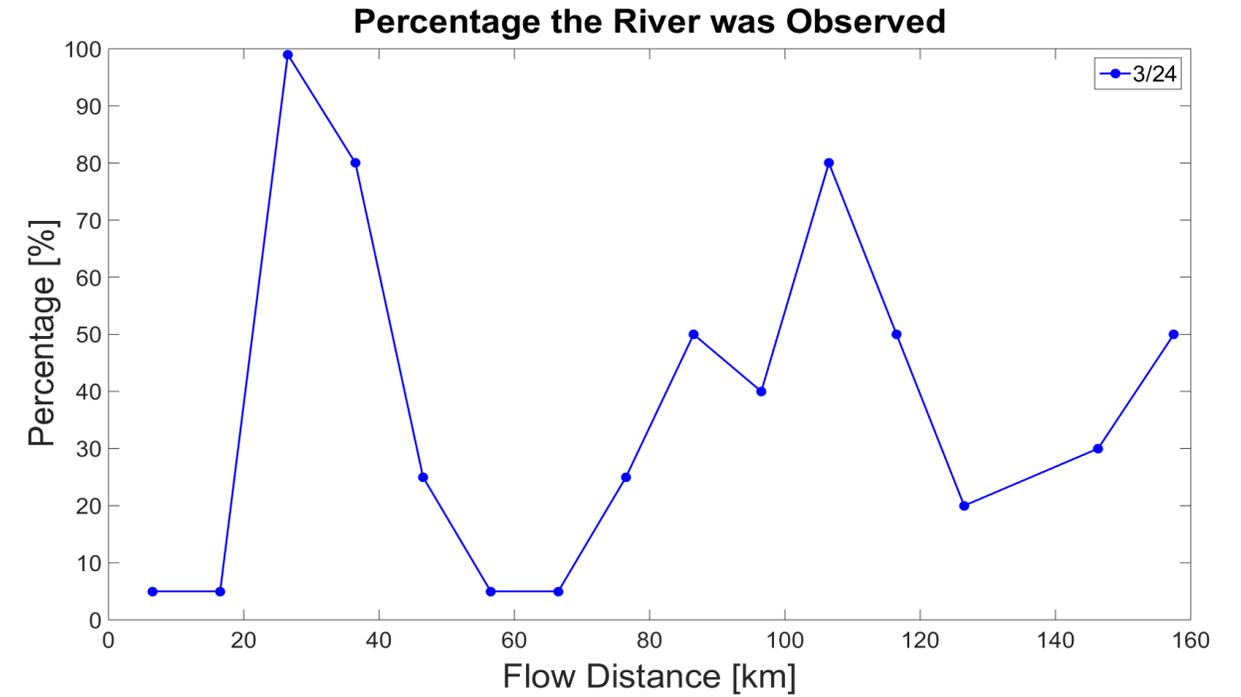
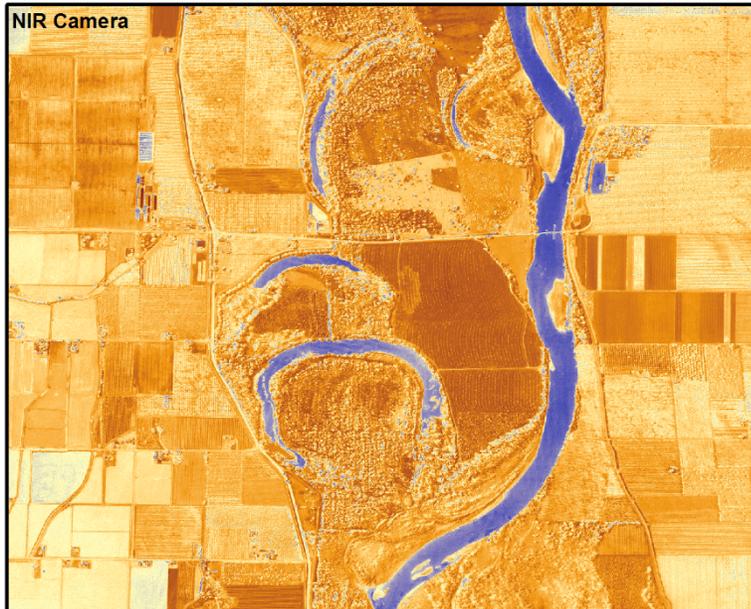
- Three methods of measuring water elevations in situ compared
- Boat-based WSE surveys for March 16, 17, 24, 25, 30
- Drifter WSE surveys on 14, 15, 16, 17, 24, 25, 30, 31
- Level loggers being processed



Sacramento River AirSWOT data
with dark water

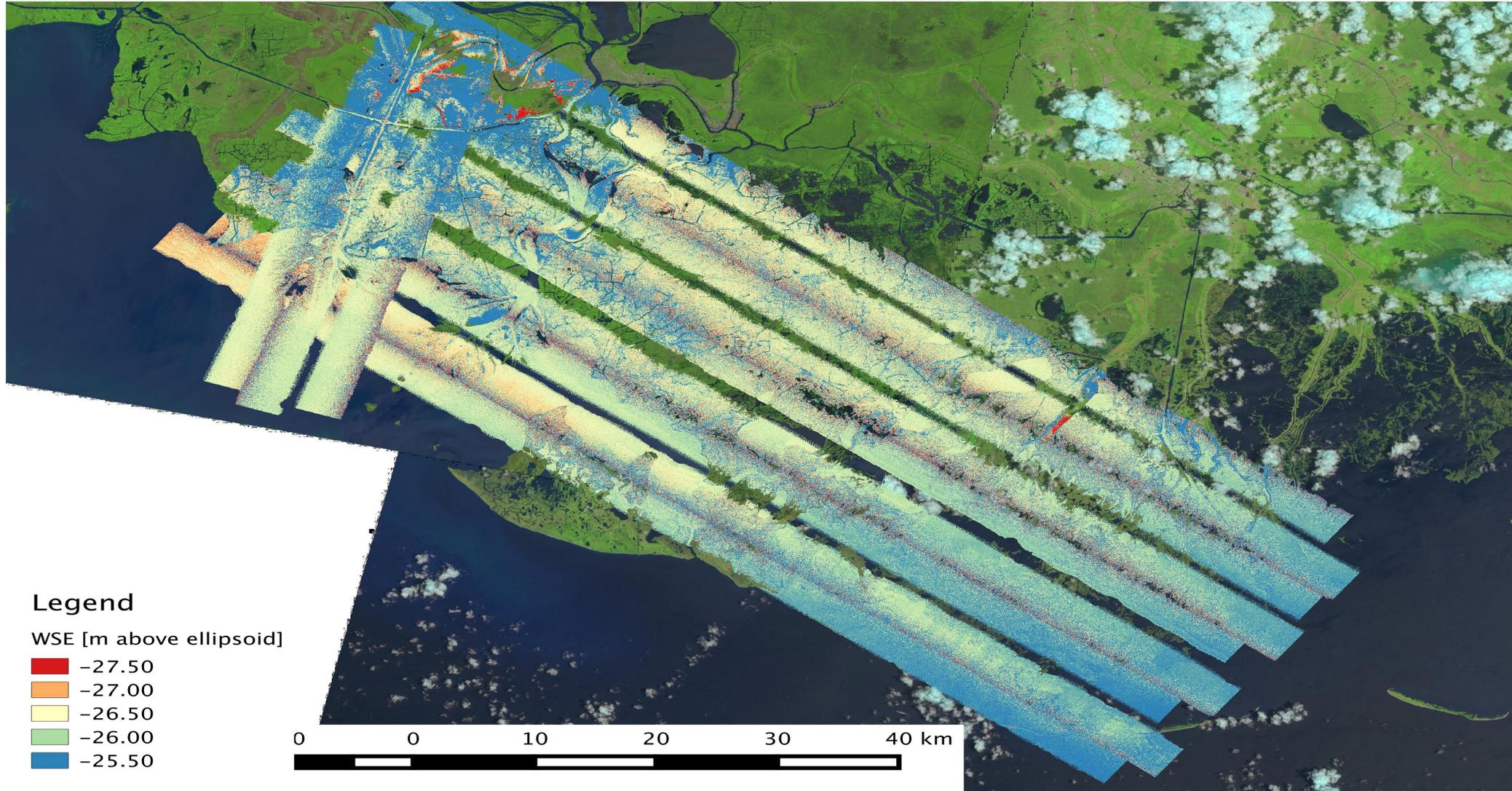


NIR Camera Data
will be used for better dark water characterization



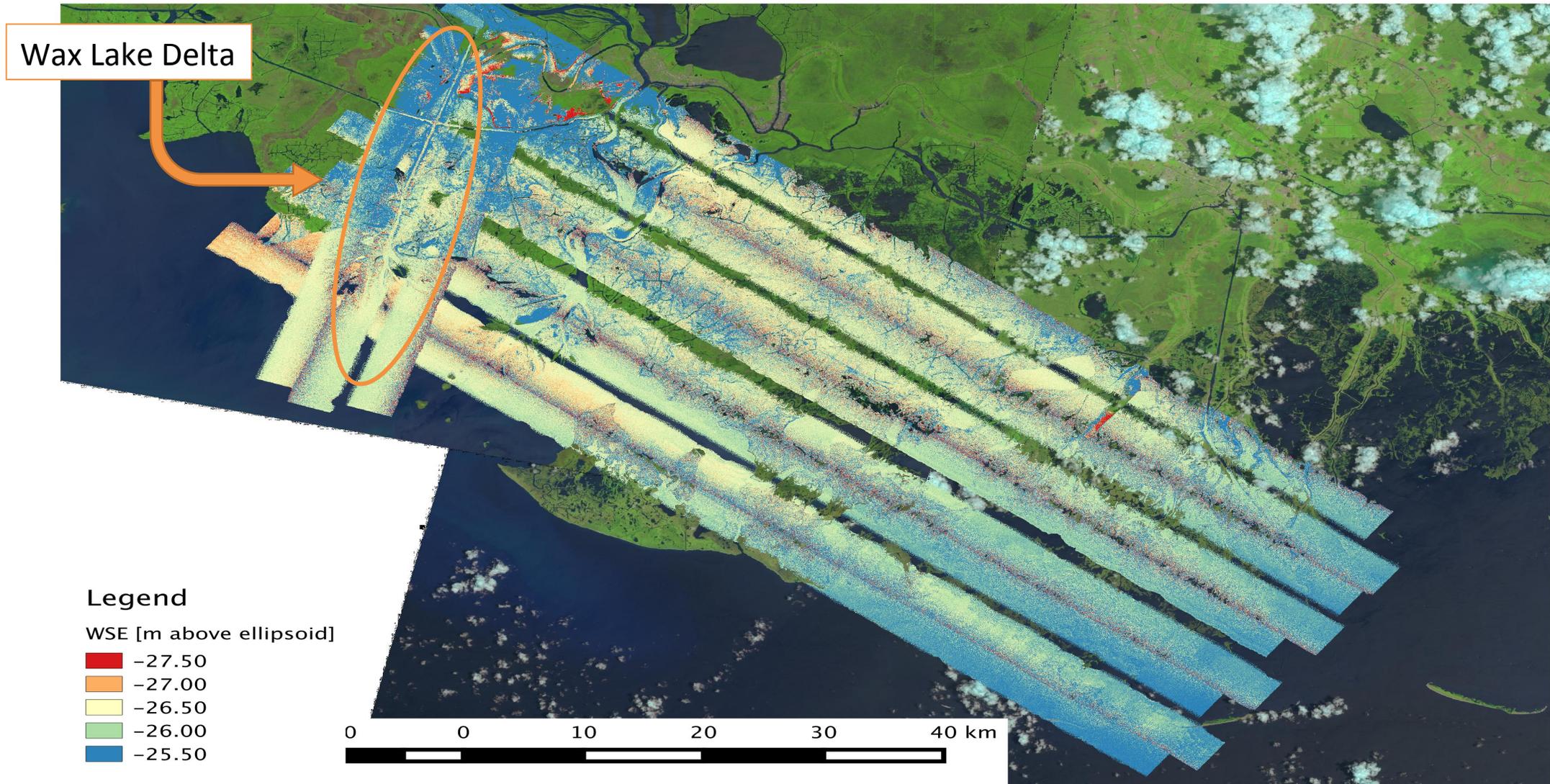
AirSWOT Louisiana flights

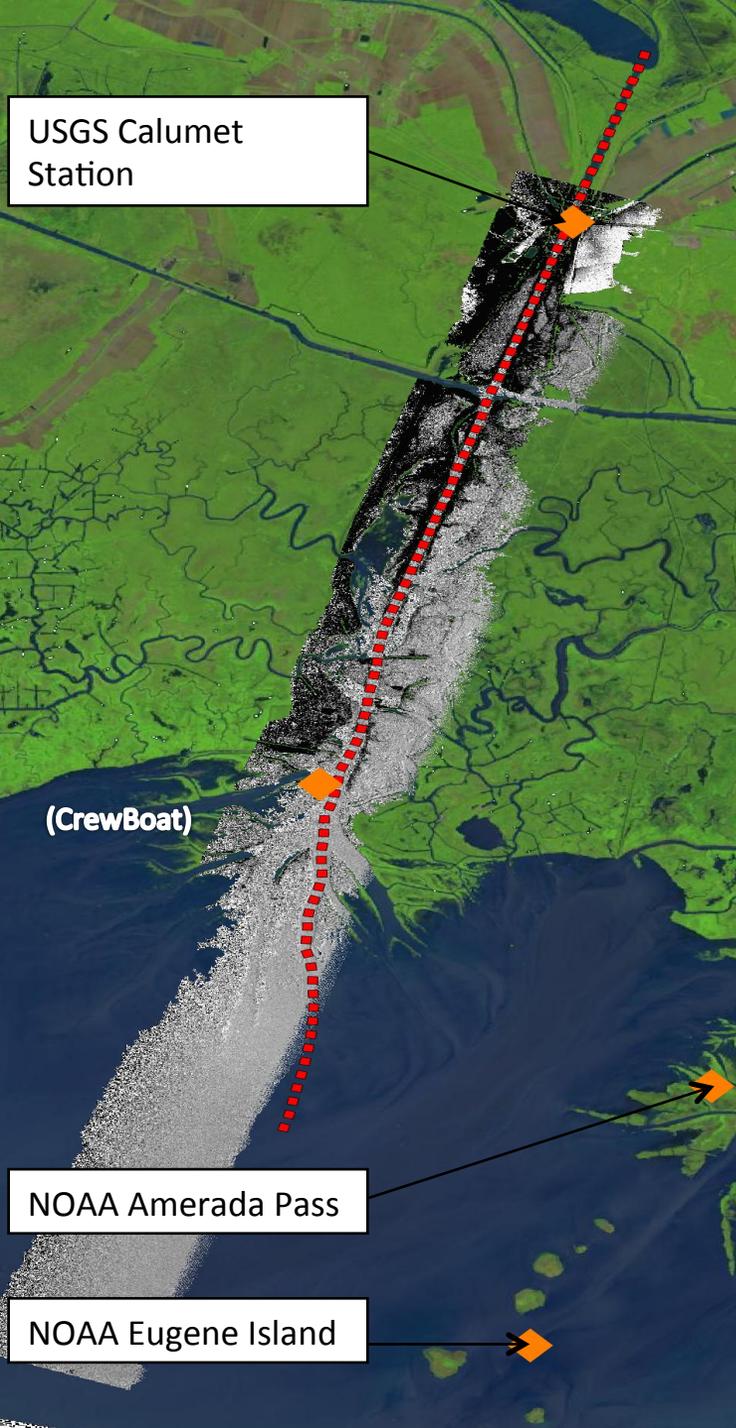
2015/05/09



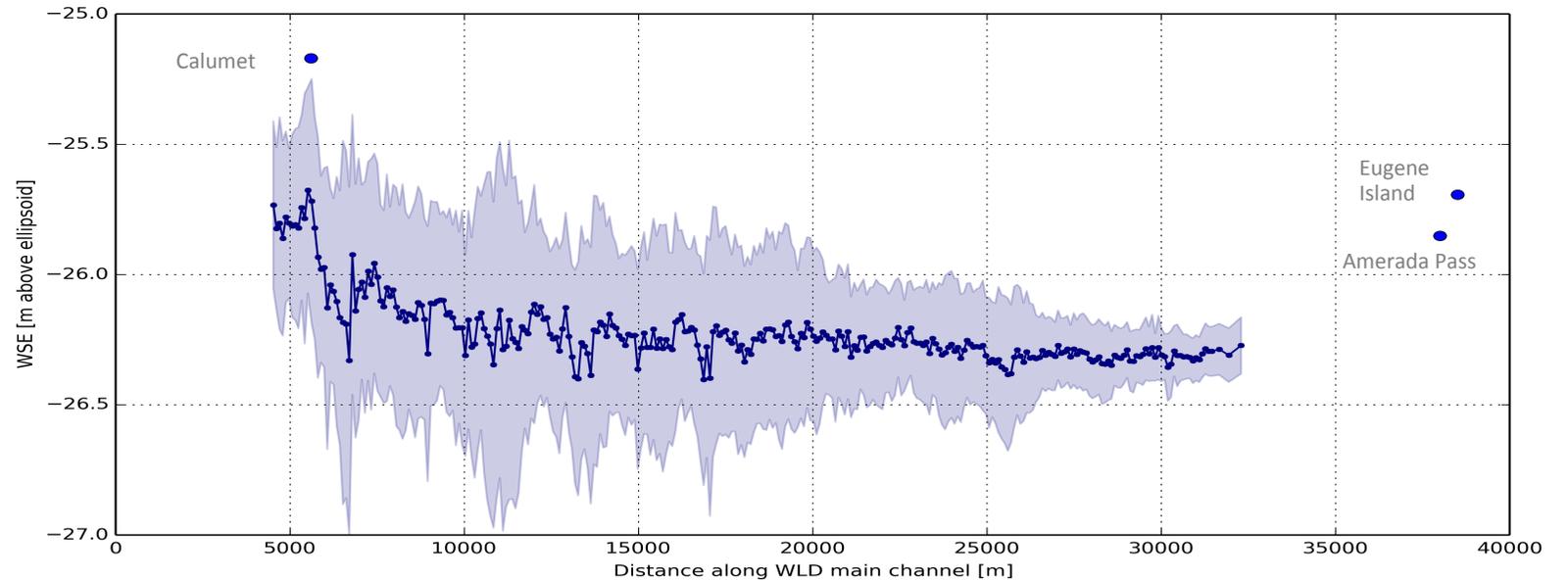
AirSWOT Louisiana flights

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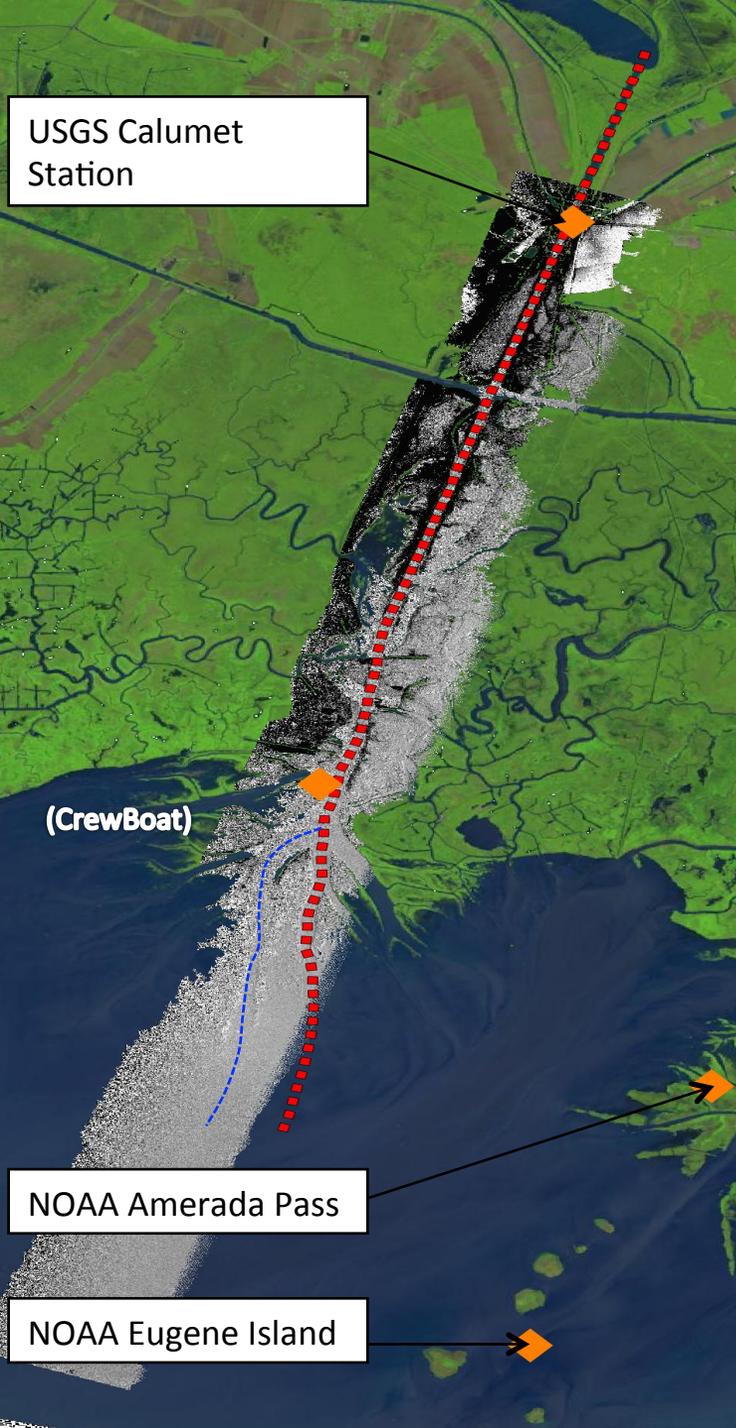




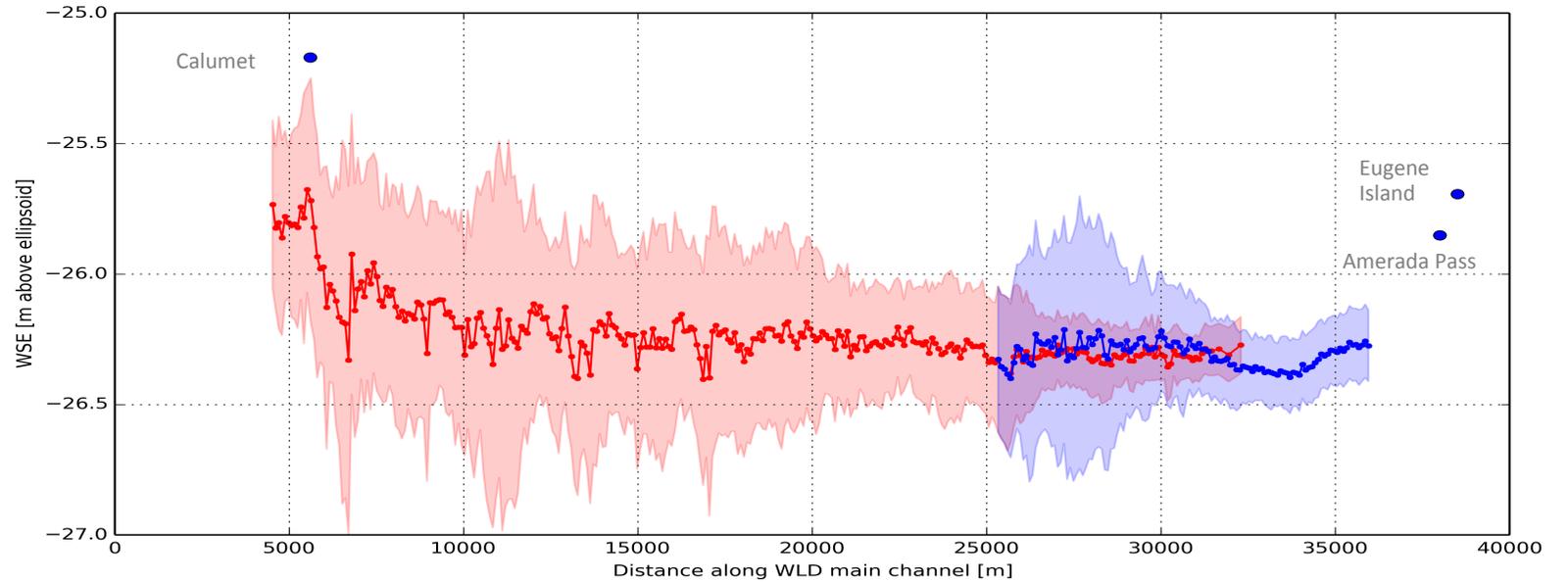
WSE along the Wax Lake Delta – 1 Flight Line

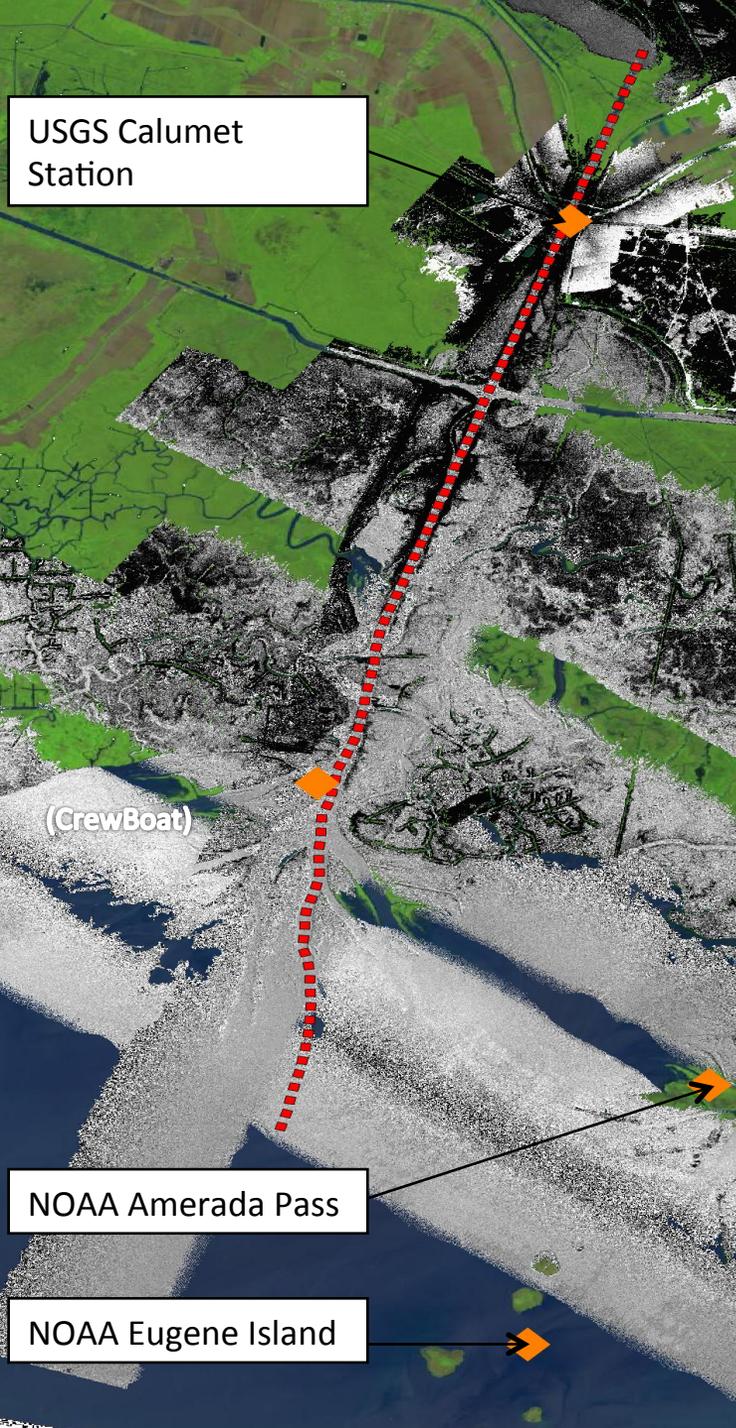


- AirSWOT data averaged across river width and along 30 measurements along-river
- Filled area +/- 1 std for averaging box
- Bias observed relative to in situ stations
- Note: NOAA stations not at real location on plot above

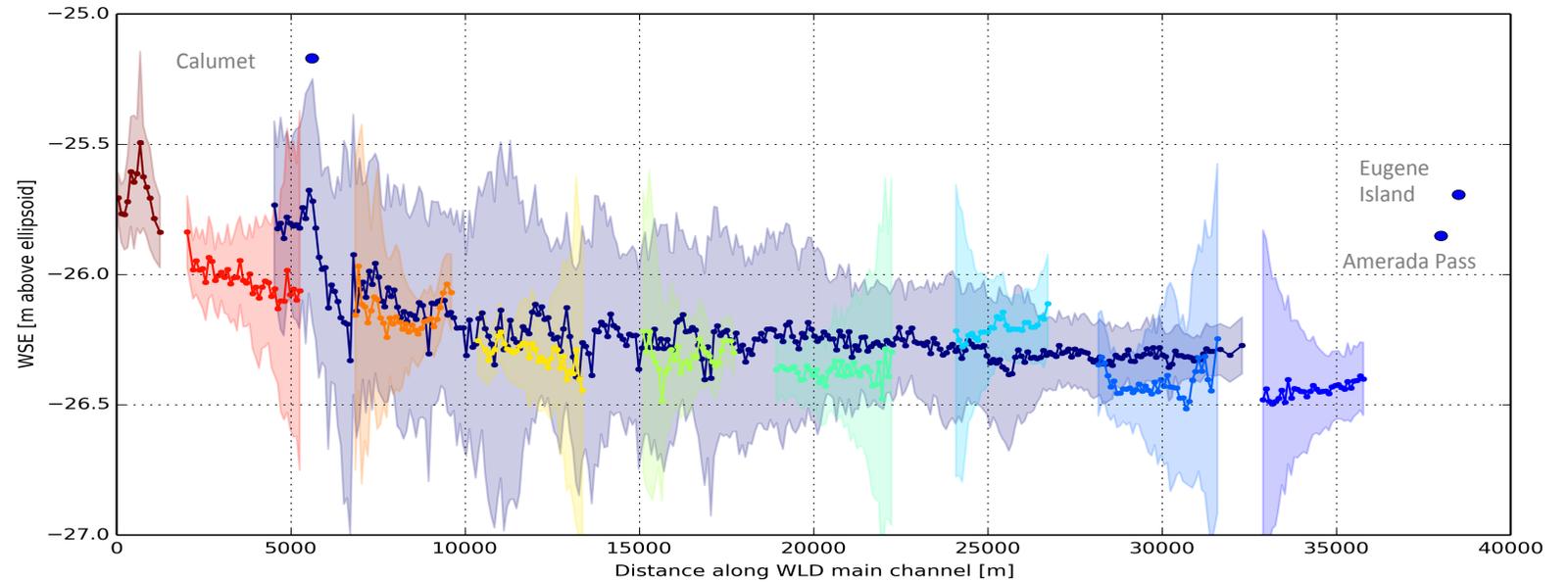


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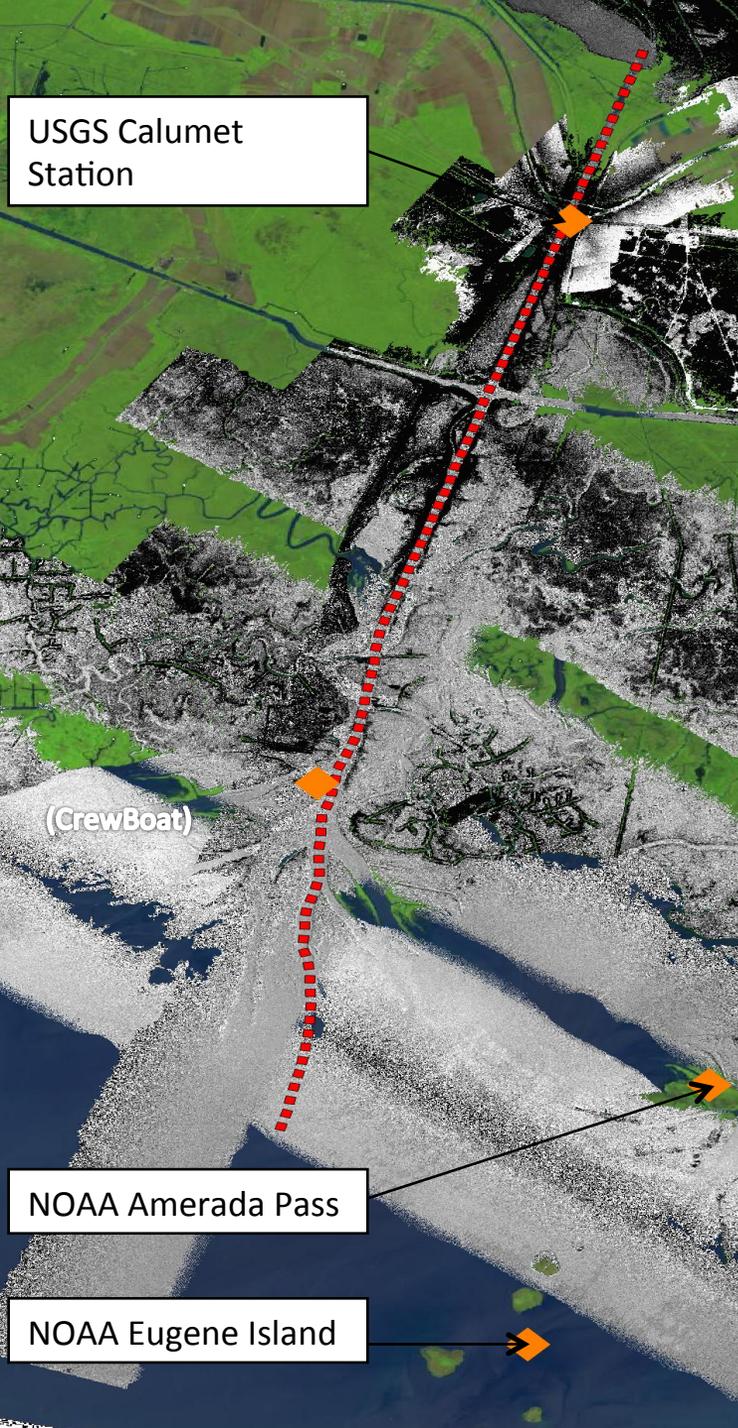




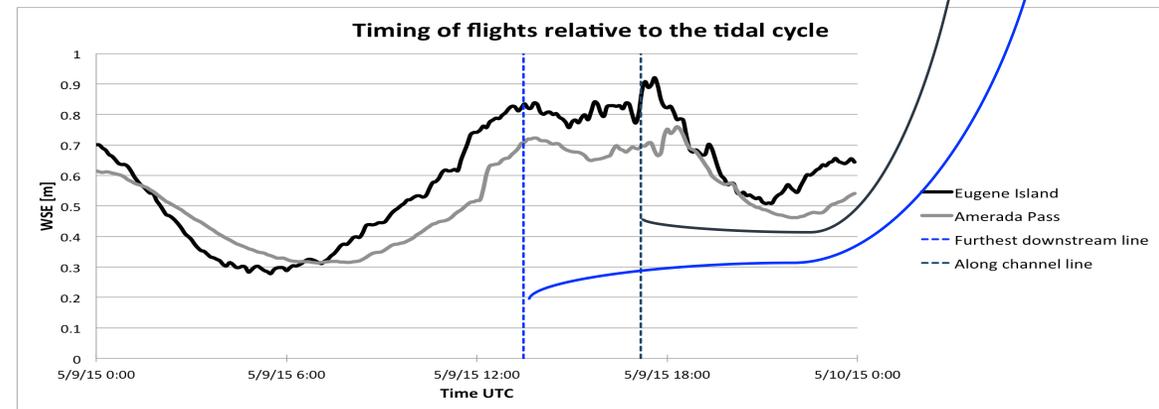
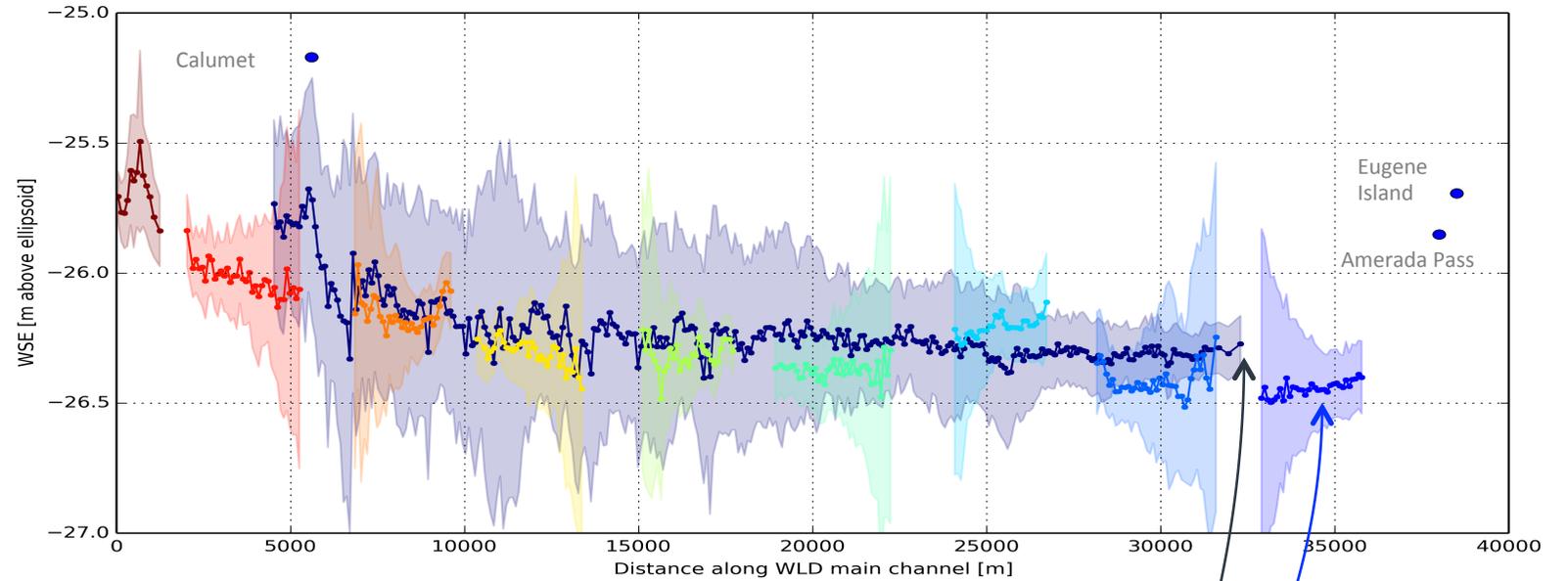
WSE along the Wax Lake Delta – Crossover lines



- Uncertainty increase towards higher incidence angle
- Challenge separating issues due to instrument/processing errors and actual physical signal due to time difference between flights (see next slide)



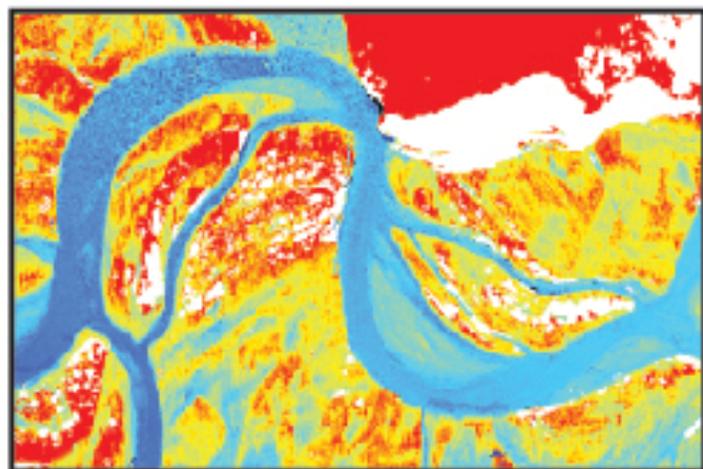
WSE along the Wax Lake Delta – Crossover lines



Summer 2015 Field Data Collection, Alaska

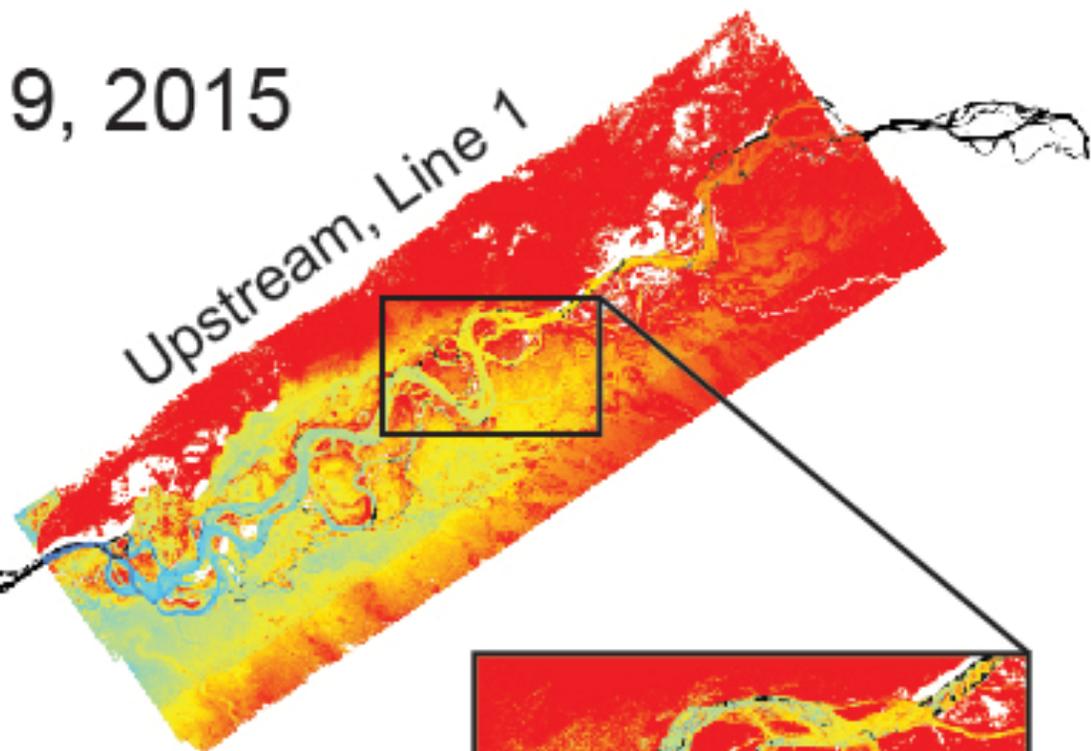


June 9, 2015

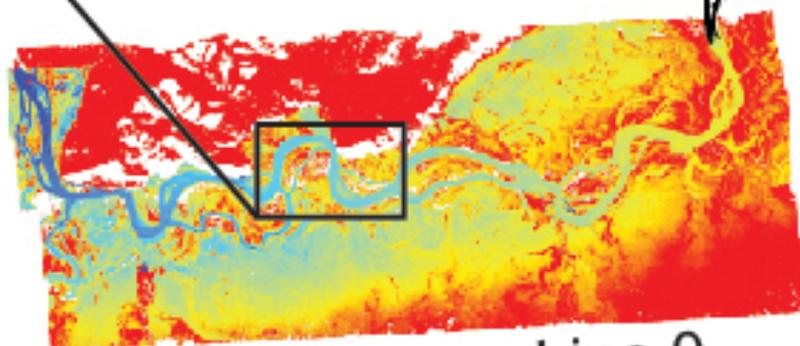


1 km

Upstream, Line 1



1 km



Downstream, Line 0

5 km



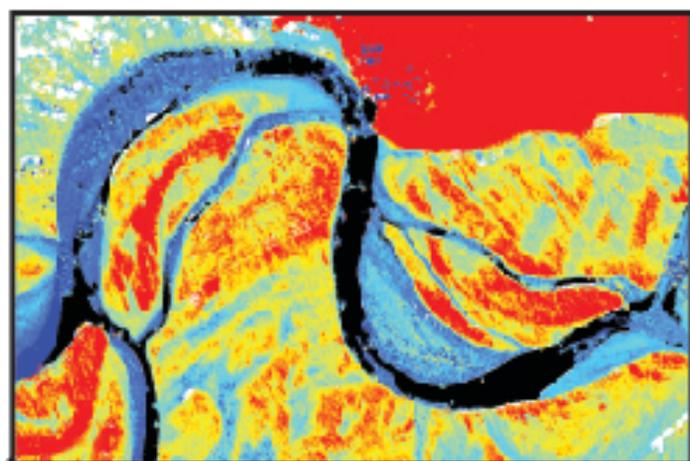
Elevation (m)



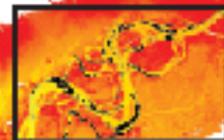
Water Mask



June 17, 2015



1 km



1 km

5 km



Elevation (m)

114

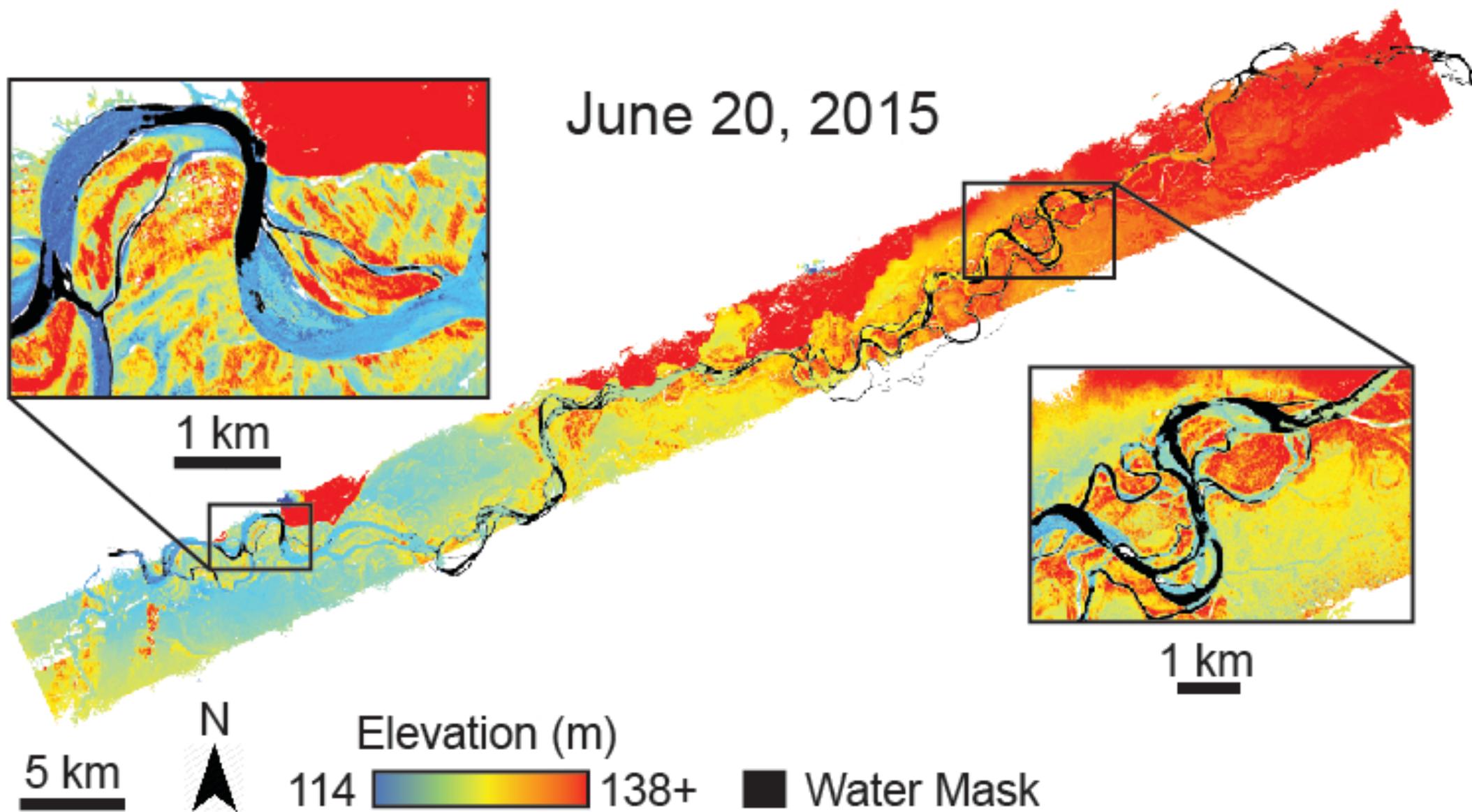


138+

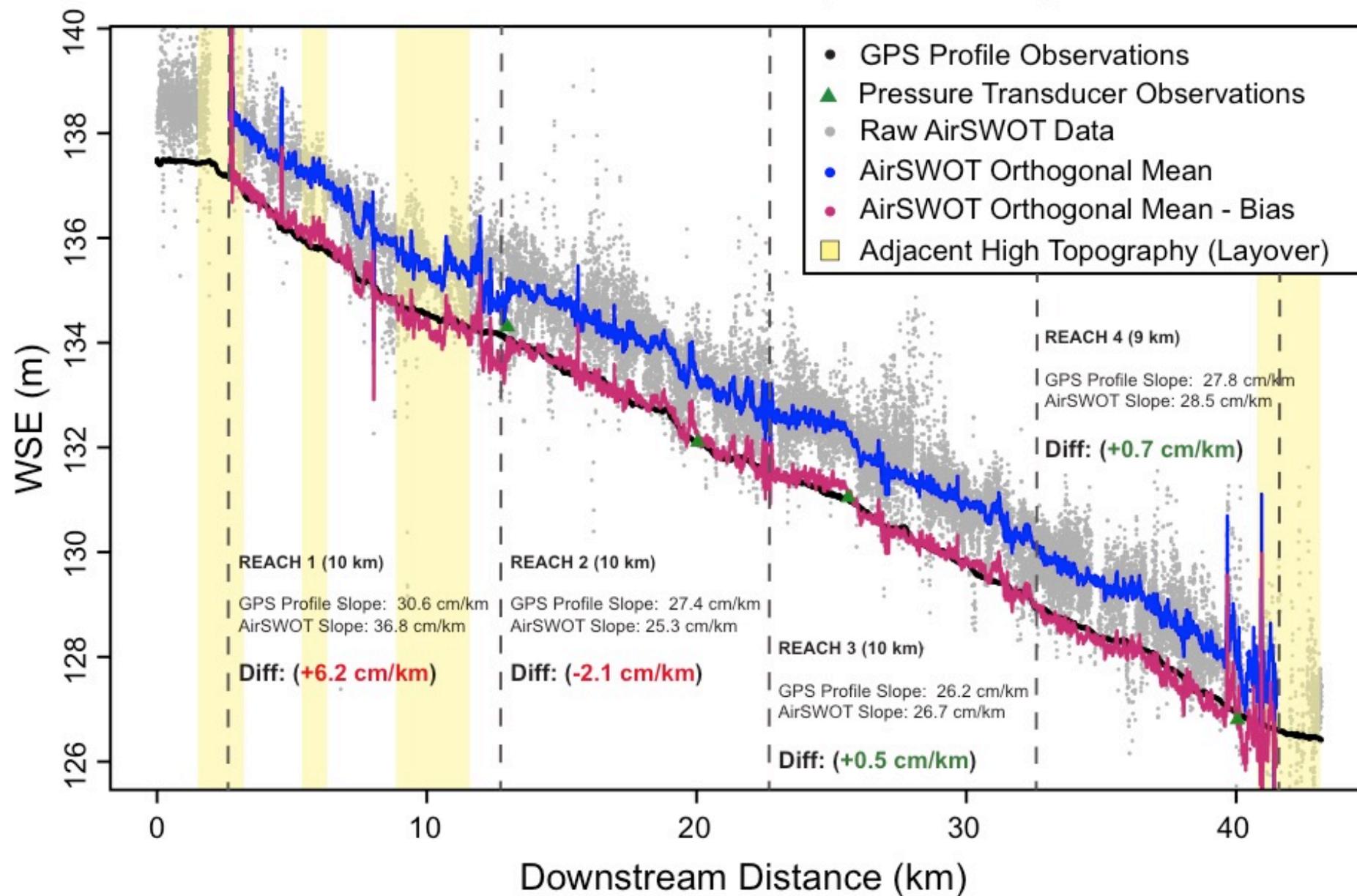


Water Mask

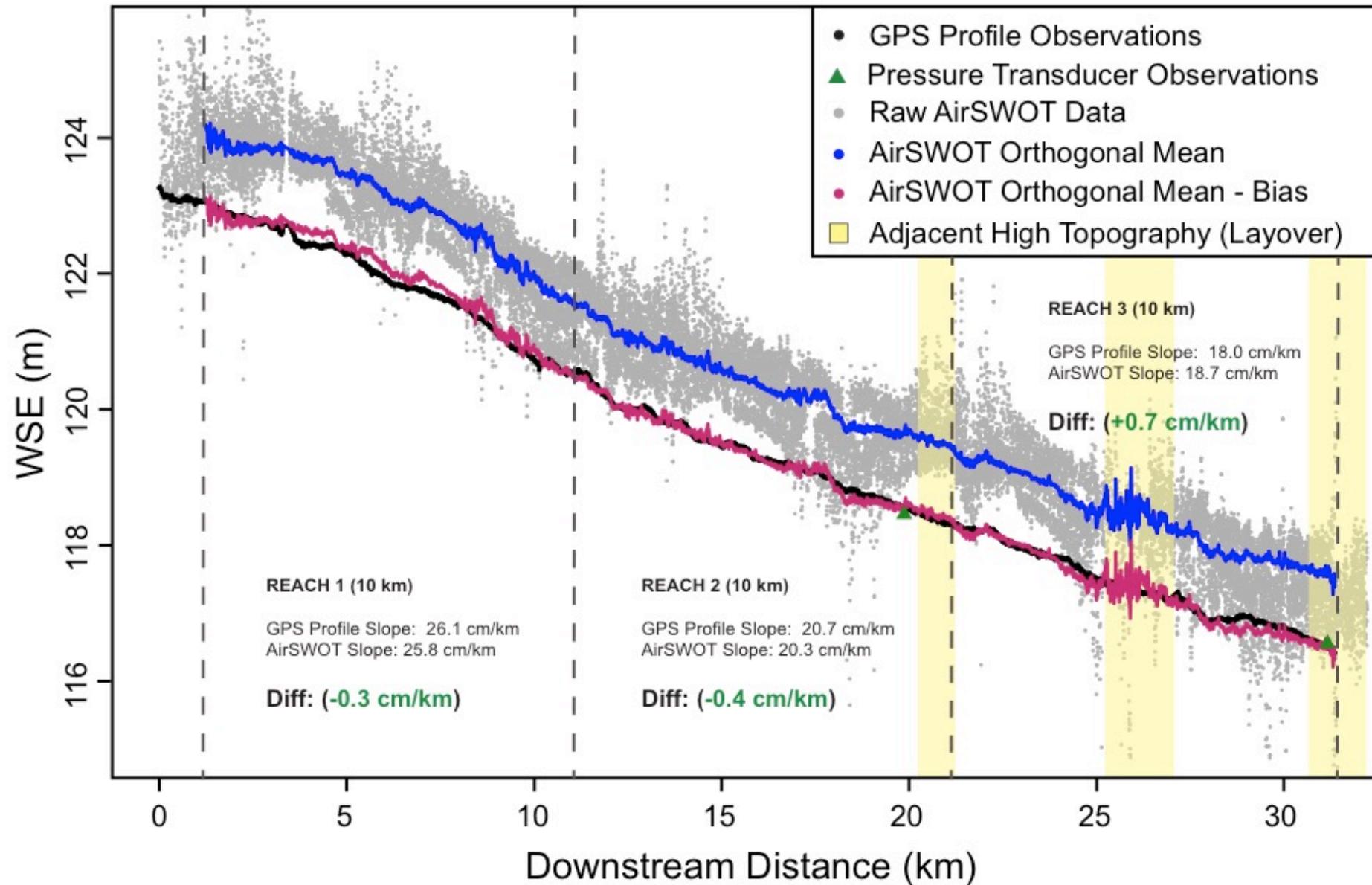
June 20, 2015



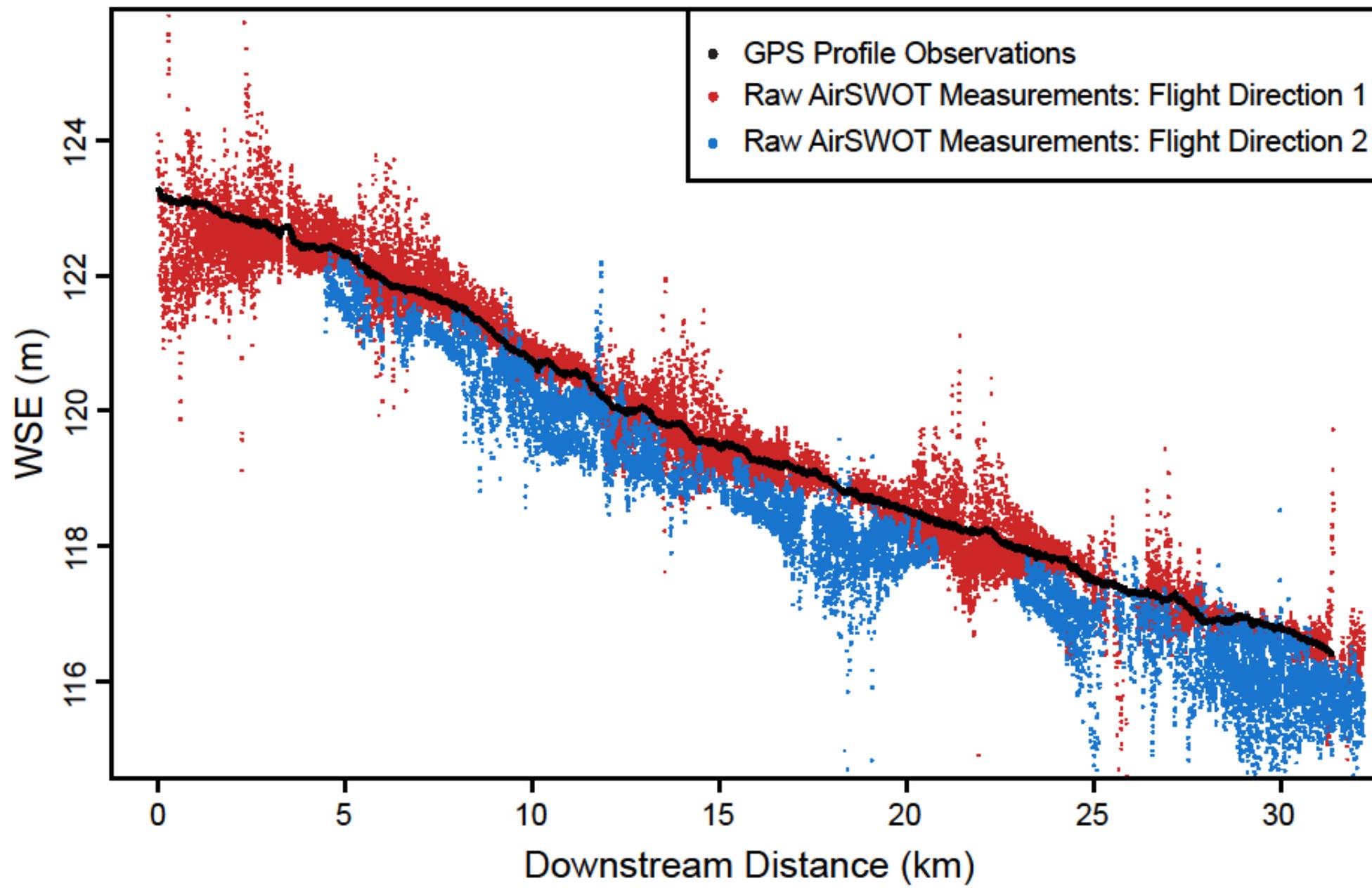
Observations vs. AirSWOT Measurements (June 9, 2015): Upstream Profile



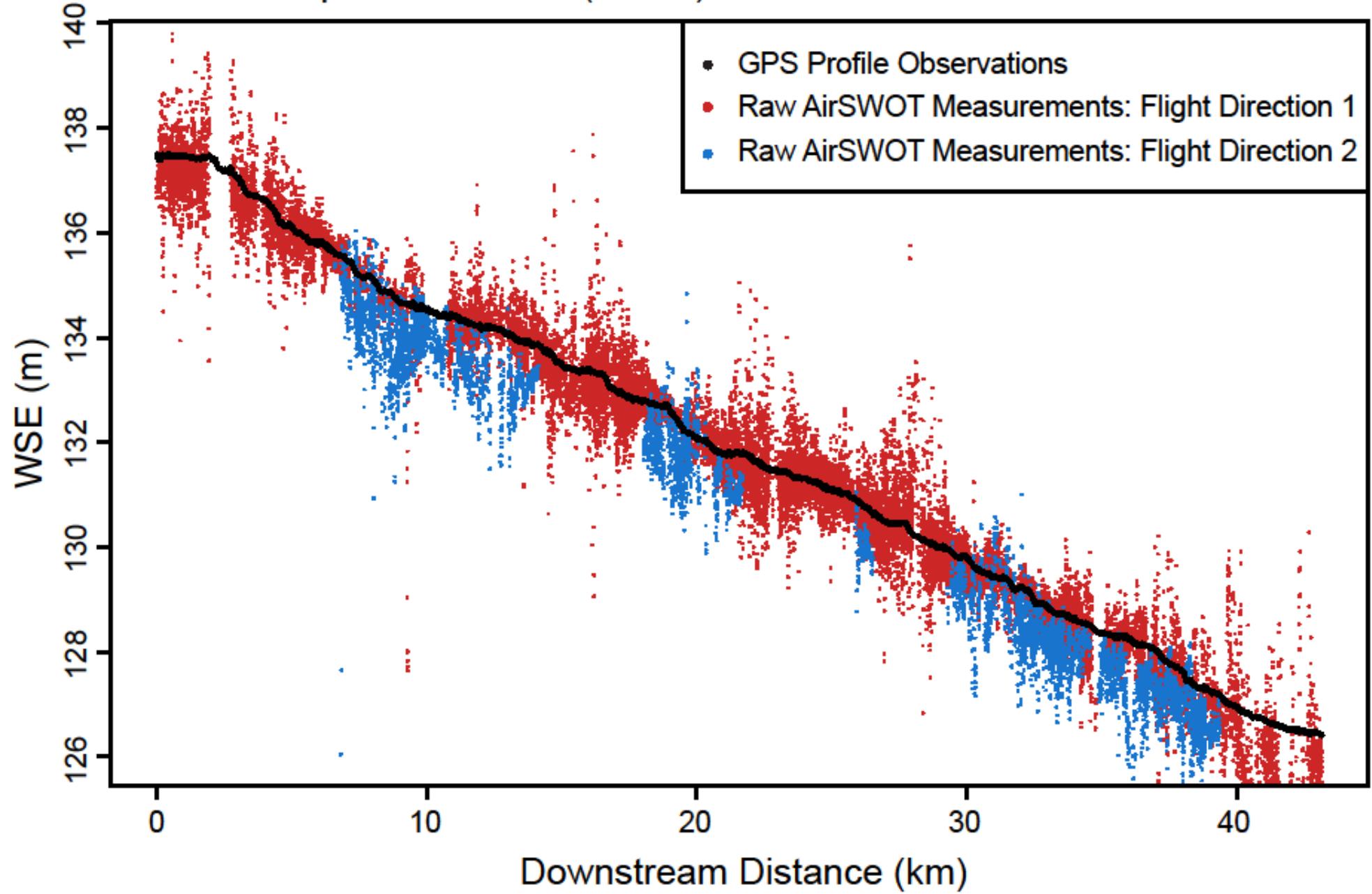
Observations vs. AirSWOT Measurements (June 9, 2015): Downstream Profile



Observations vs. AirSWOT Measurements (June 9, 2015)
Downstream Profile (Line 0) Subtracted Bias of 1.33 m



Observations vs. AirSWOT Measurements (June 9, 2015)
Upstream Profile (Line 1) Subtracted Bias of 1.33 m



Summary of Preliminary Results

1. Can AirSWOT accurately represent river height, slope, and width?
Yes (for height and slope, under some circumstances, and it may get better with reprocessing.
2. How consistent are AirSWOT data from pass to pass over the same site?
Not entirely inconsistent, but this is one area where we would like to see significant improvement.
3. How does layover appear to influence AirSWOT data?
Qualitative examination of the Tanana suggests an impact, but not a crippling one. This may change at SWOT-like incidence angles.
4. Can we reliably distinguish between water and wet sand bars in rivers?
TBD. Waiting for 400 MHz data.
5. How prevalent is “dark” water, for which reflectance is specular?
Dark water can affect a substantial portion of an image when water is very smooth. However, we need to look at effects of incidence angle. Waiting for 400 MHz data.

Next Steps

1. Reprocess 80 MHz data for scenes shown here in order to address offsets and inconsistencies from line to line.
2. Process additional 80 MHz data from field campaigns already conducted.
3. Process 400 MHz data and compare against field measurements of vegetation characteristics, sediment grain size & soil moisture.
4. Assess impacts of layover and dark water in 400 MHz data.
5. Collect additional data to:
 - a. Understand impacts of vegetation on water detection, height retrieval (Wax Lake Delta 2016).
 - b. Distinguish between water and river/lake ice
 - c. Prepare scientists to work with SWOT-like data