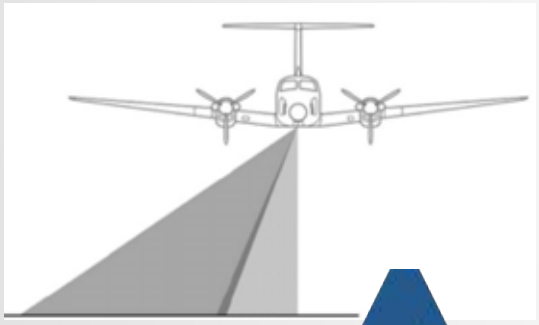
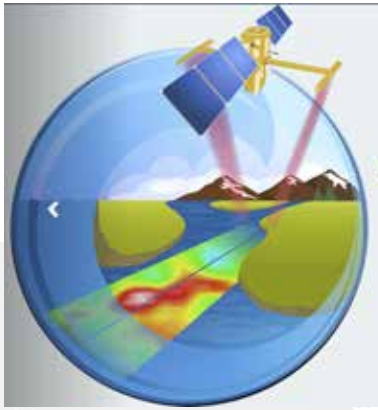


ABoVE
ARCTIC – BOREAL VULNERABILITY EXPERIMENT



SURFACE WATER & OCEAN TOPOGRAPHY
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Preliminary Ka-band returns from 2017 NASA ABoVE AirSWOT flight campaigns (L. Smith, UCLA)

Ph.D. work of Jessica Fayne (UCLA) and Ethan Kyzivat (Brown University)

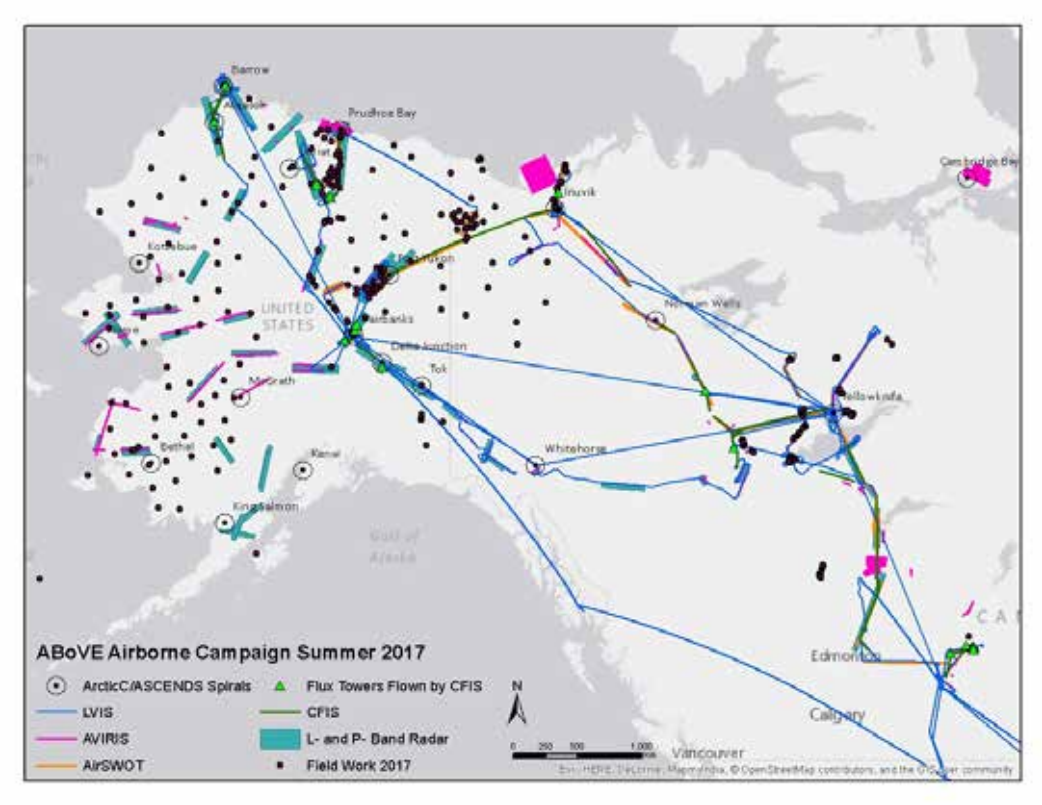
JPL AirSWOT Processing Team: Curtis Chen, Albert Chen, Michael Denbina, Xiaoqing Wu

Field work: Tamlin Pavelsky, Colin Gleason, Al Pietroniro, Lincoln Pitcher, Sarah Cooley, Simon Topp, Ted Langhorst, Merrit Harlan, Matt Cooper, Toby Minear, Brandon Overstreet, Dan Peters, Daqing Yang, Cuyler Onclin, Tom Carter, Chris Spence, J-F Cretaux, Daniel Moreira...and others

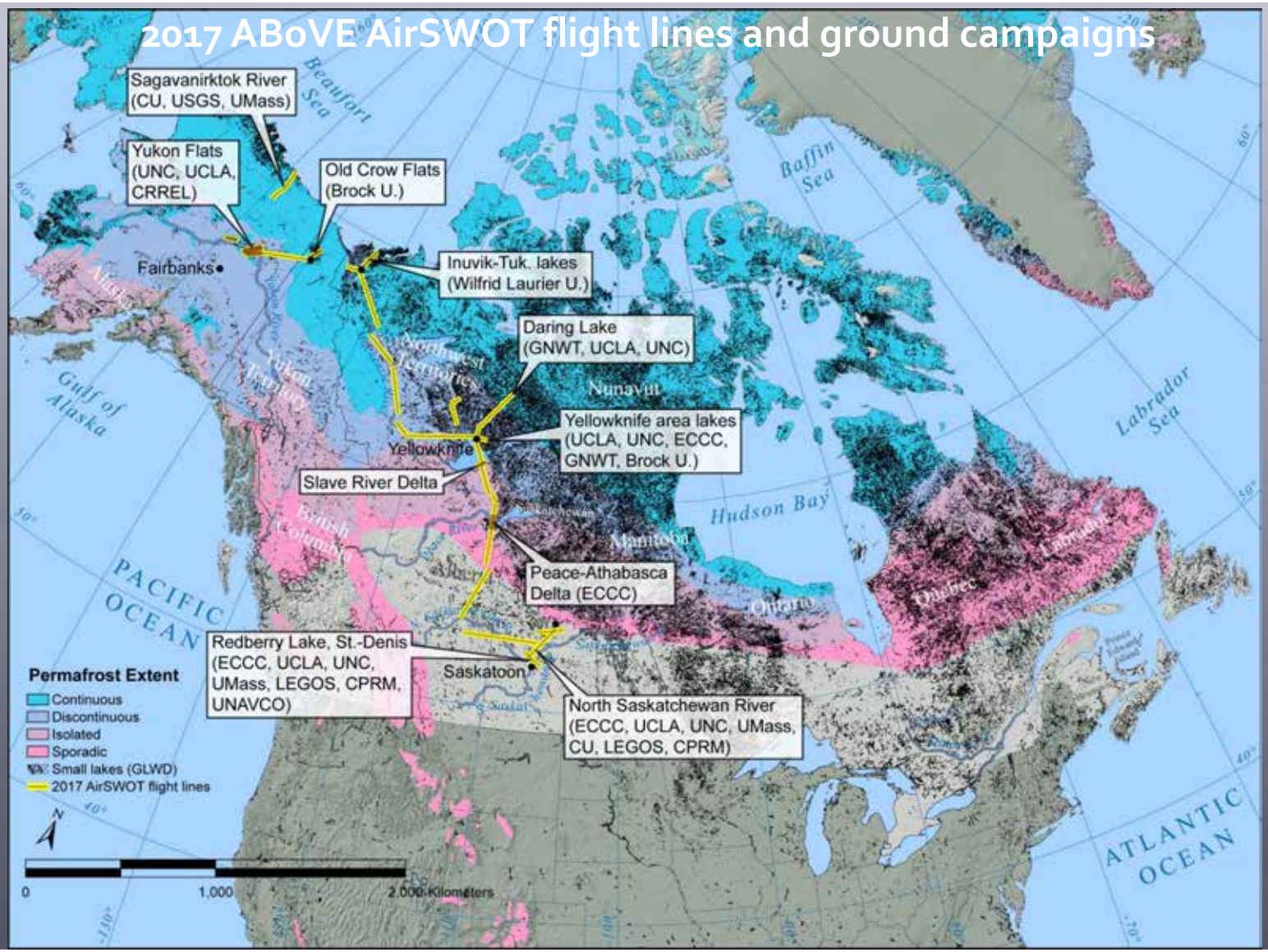
2017 ABoVE (Arctic-Boreal Vulnerability Experiment) Flight Campaigns

ARCTIC – BOREAL VULNERABILITY EXPERIMENT

- Radar:
  - UAVSAR (L-band), AirMOSS (P-band), AirSWOT (Ka-band)
- Waveform LIDAR:
  - LVIS
- Optical Imagery:
  - AVIRIS, HyTES,CFIS, PRISM, AirSWOT CIR
- 171 Publications so far
- https://above.nasa.gov

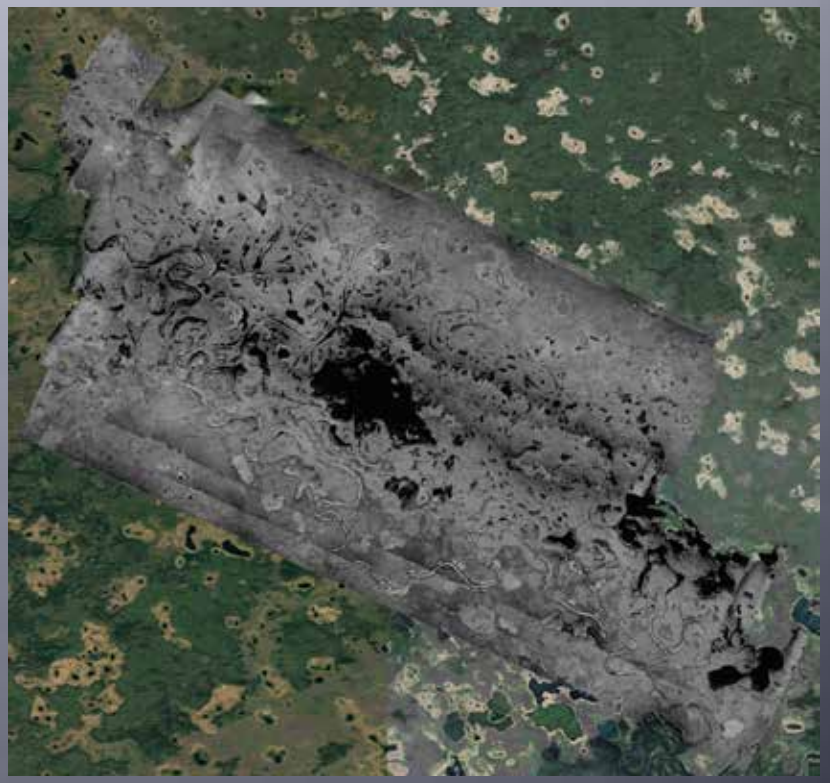


2017 ABoVE AirSWOT flight lines and ground campaigns

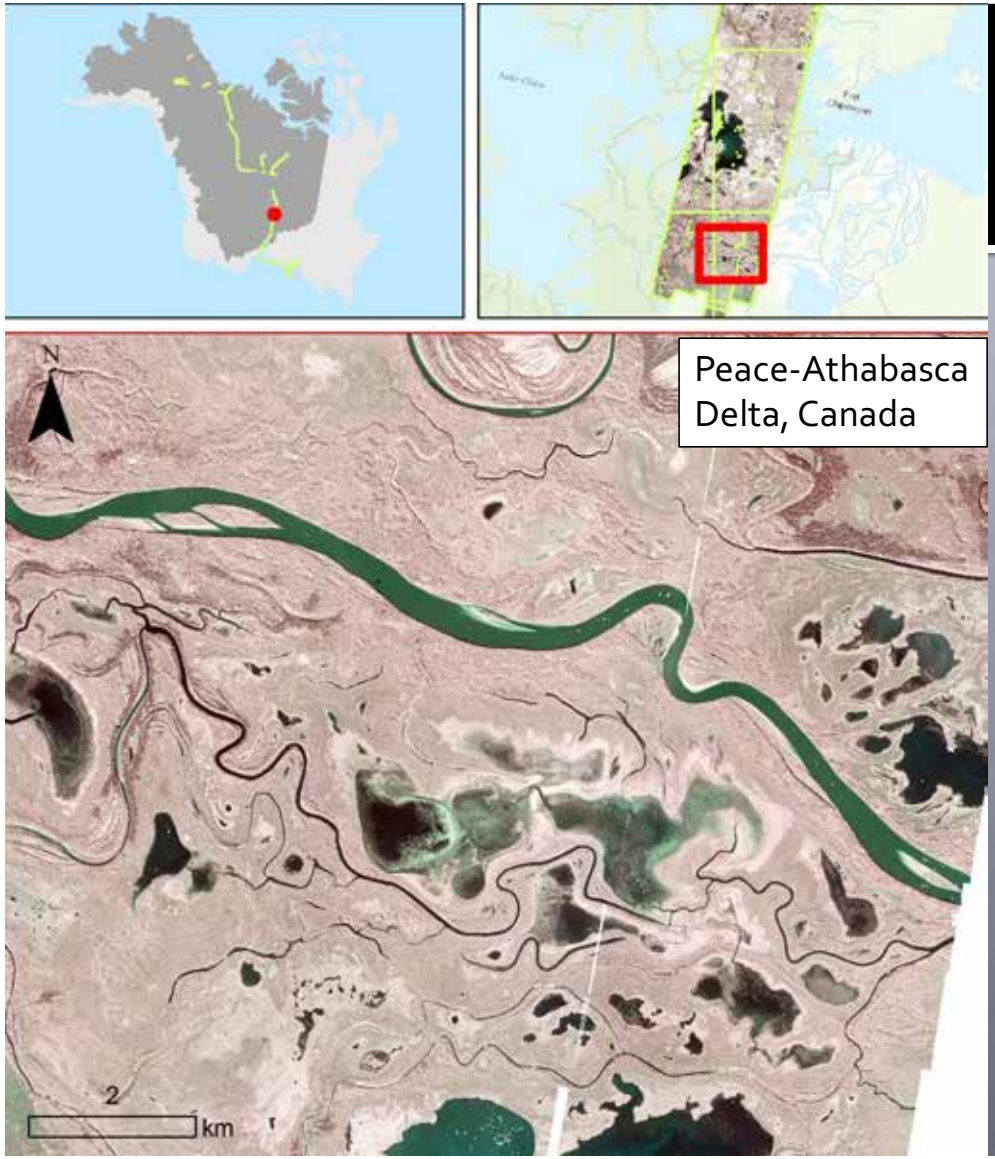


Yukon A
~50 lines
2015, 2017

Yukon B
~17 lines
2015, 2017

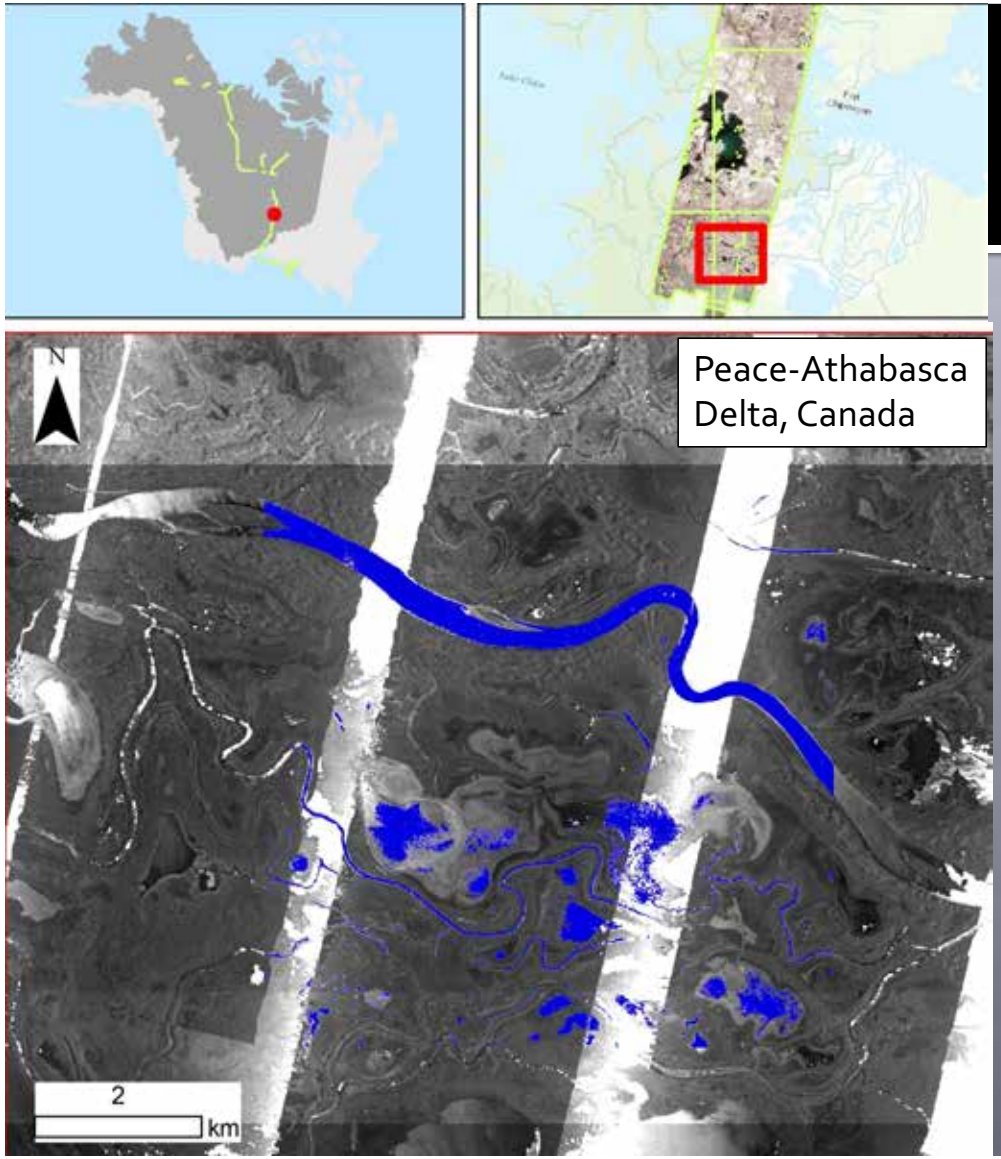


AirSWOT Ka-band backscatter



AirSWOT color infrared camera

AirSWOT CIR camera imagery and water classifications in preparation for submission to ORNL
(Ethan Kyzivat)



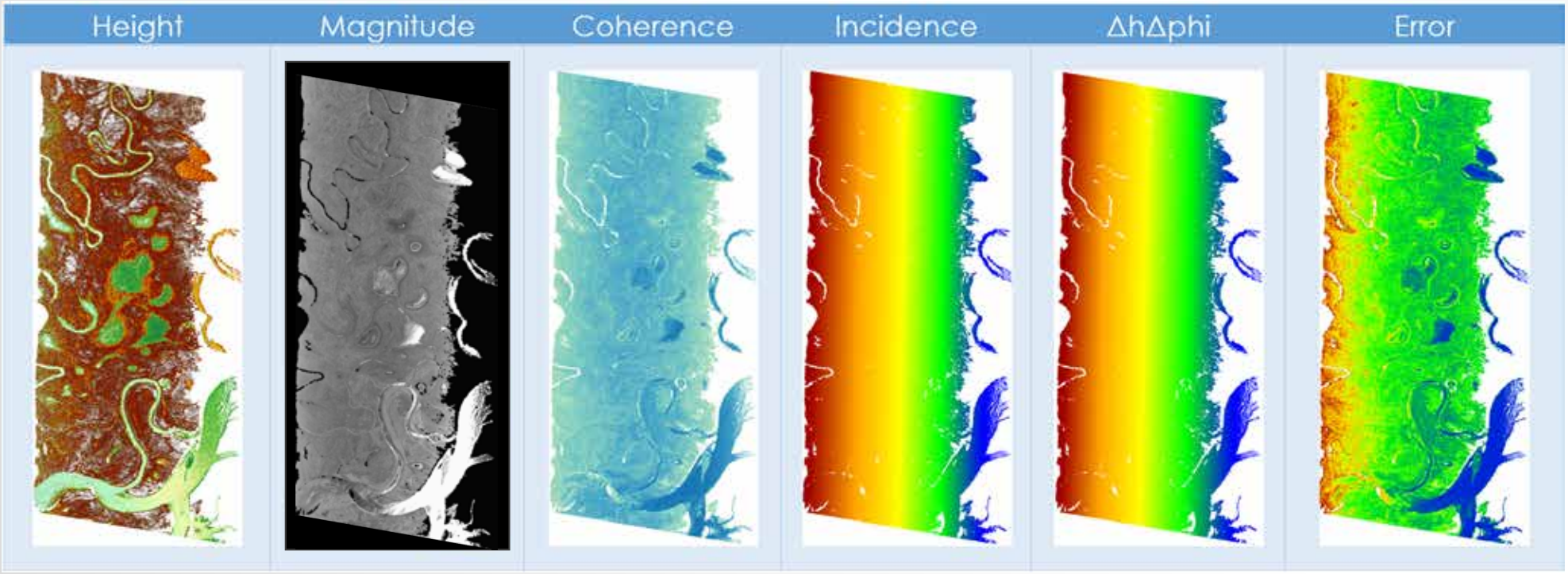
AirSWOT color infrared camera

AirSWOT CIR camera imagery and water classifications in preparation for submission to ORNL
(Ethan Kyzivat)

→ *CIR data valuable for testing and/or training AirSWOT Ka-band water detection algorithms*

AirSWOT radar products (JPL)

- The AirSWOT Radar processing team at JPL have been working to produce 6 distinct datasets from the interferometer.

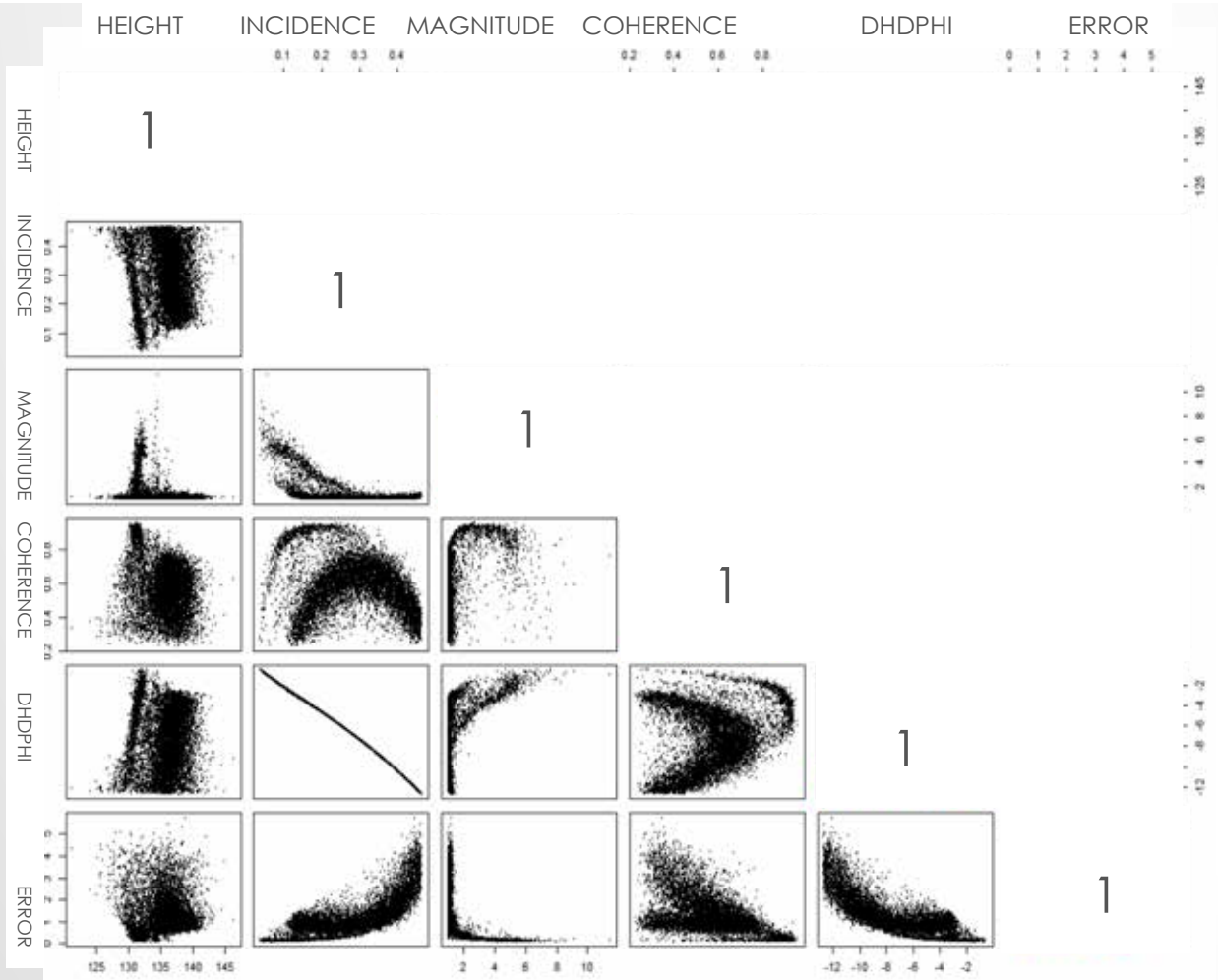


How well can AirSWOT Ka-band detect surface water?
(Jessica Fayne, UCLA)

Tested Methods:

Incidence Angle Median-Regression
Multivariate Regression
K-Means Clustering
Open Water Likelihood (OWL)
Random Forest

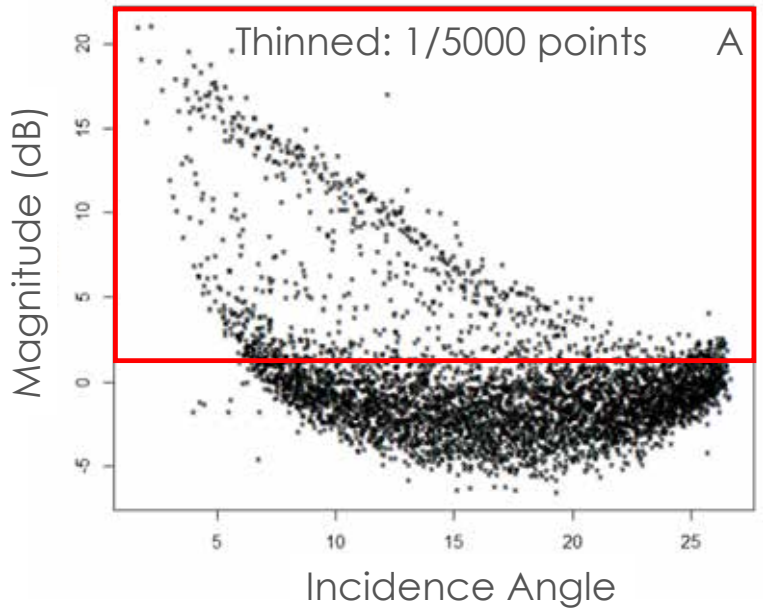
Correlations among AirSWOT data products

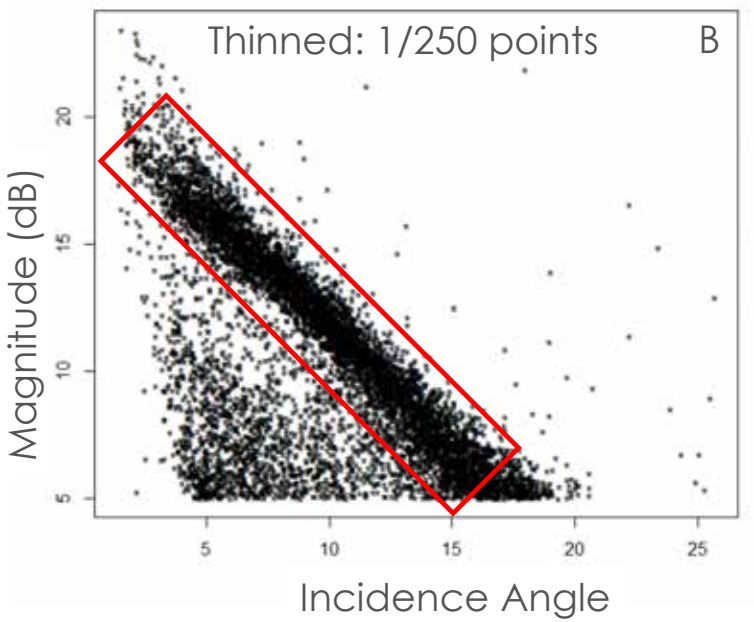


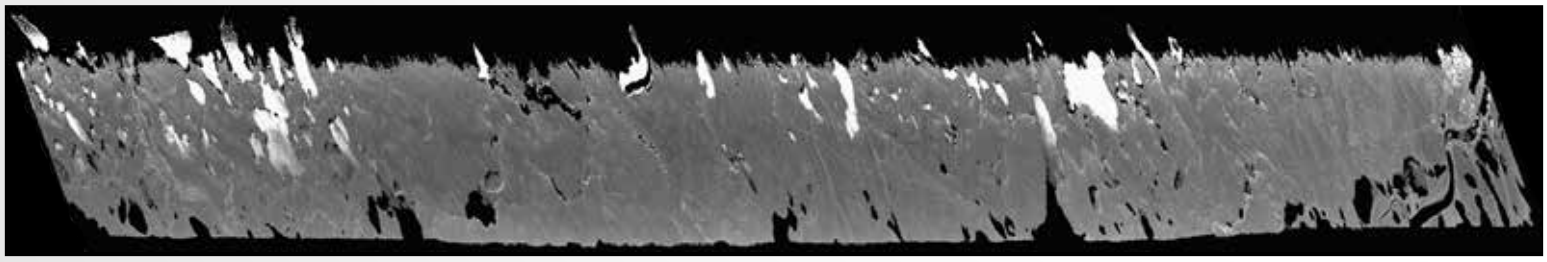
Correlations among AirSWOT data products

Incidence Angle Median-Regression

Clear open water returns can be distinguished at magnitudes >5dB and incidence angles < 15 degrees





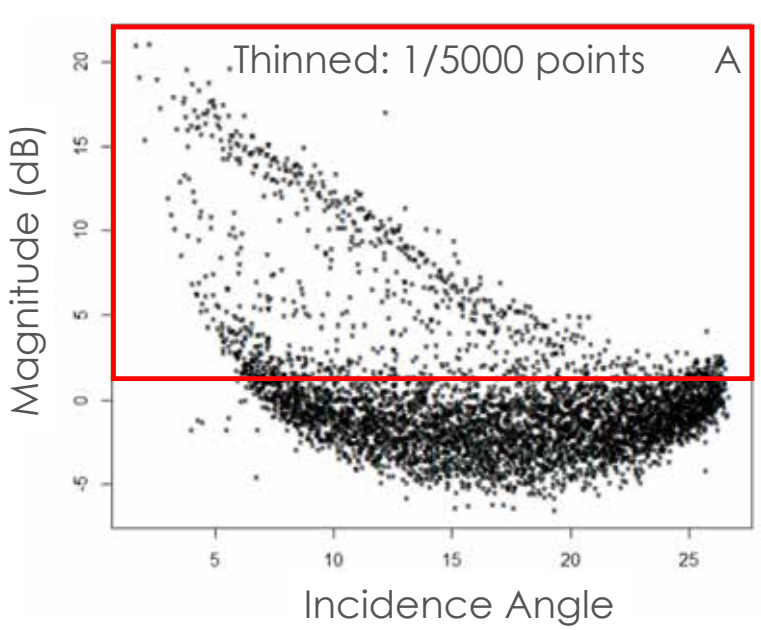


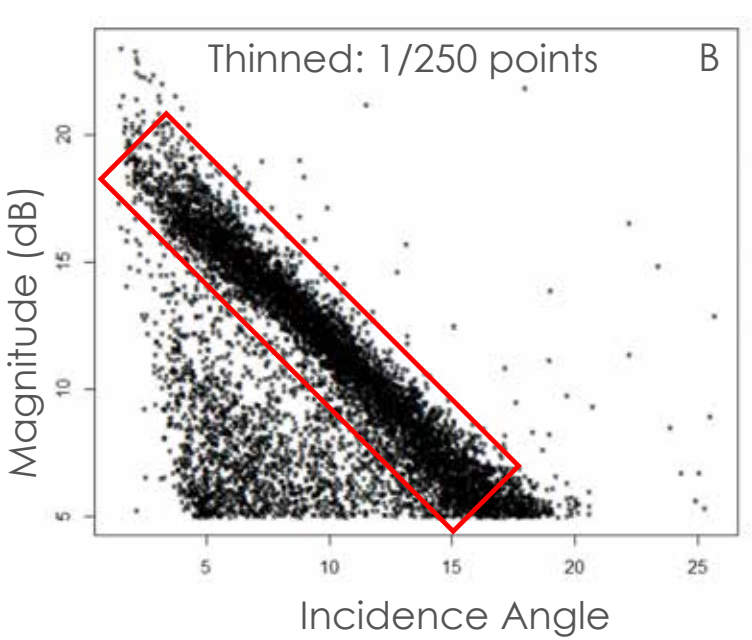
Incidence Angle Median-Regression

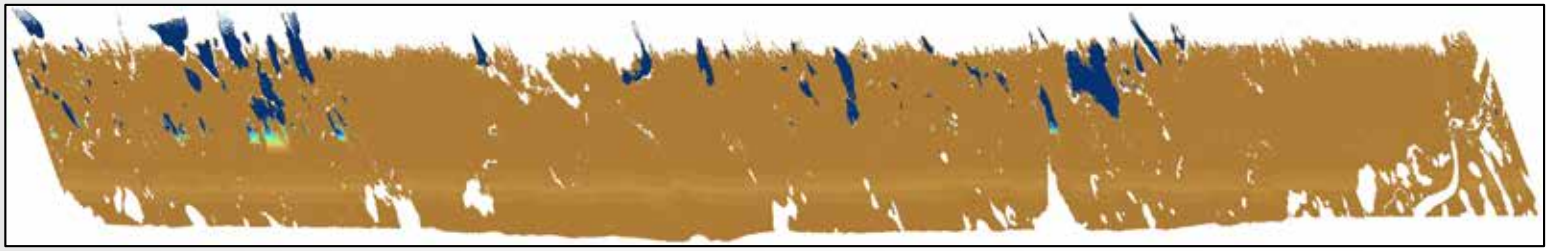
Theil-Sen Regression line used to estimate the median of the slope and ignore outliers.

Pixels within the upper and lower bound of the regression line classified as water.

Multivariate regression adding coherence, incidence angle doesn't help much

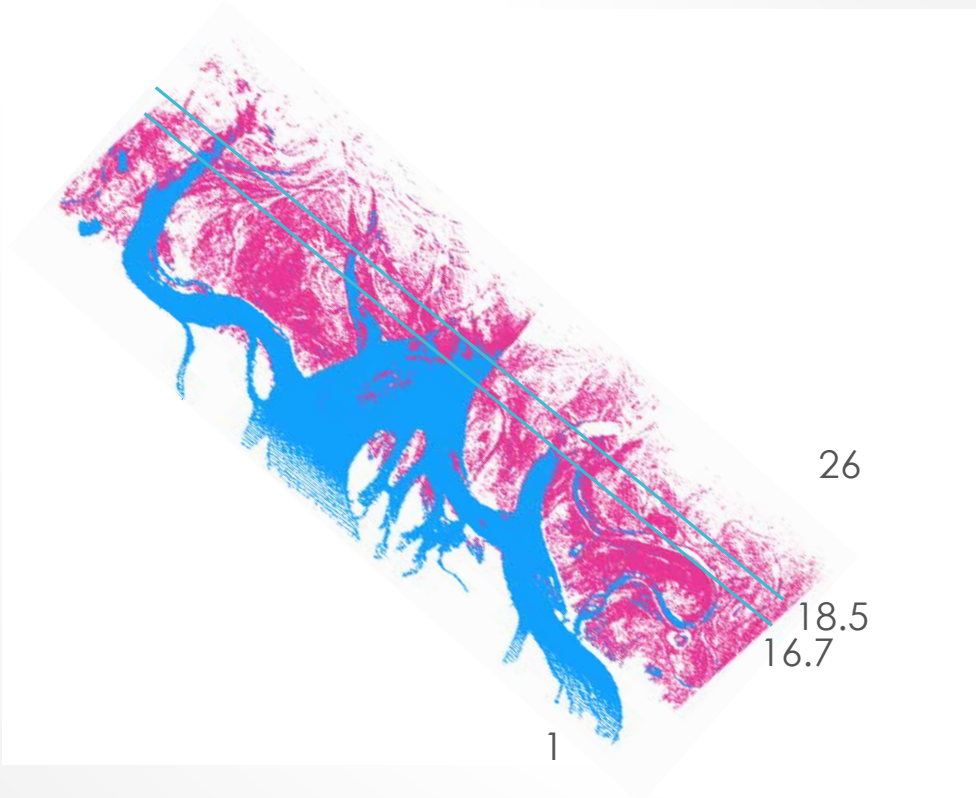






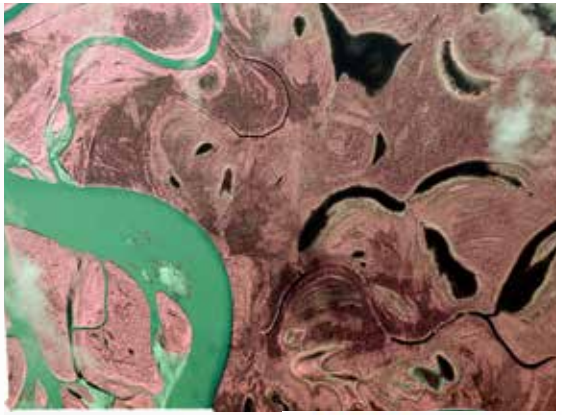
How to get beyond 15 degrees? K-means Clustering

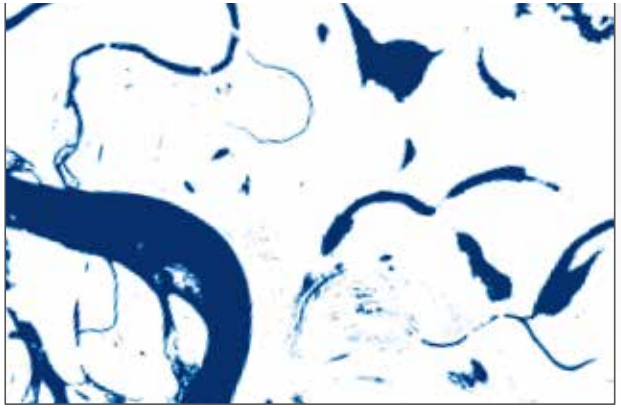
- Requires a simultaneous optical dataset (AirSWOT CIR camera)
- **Labor intensive** – manual control points
- Land clusters are removed and the clusters that are commonly water can be combined.
- **Didn't work well** in mid-swath (land/water confusion, red tones)

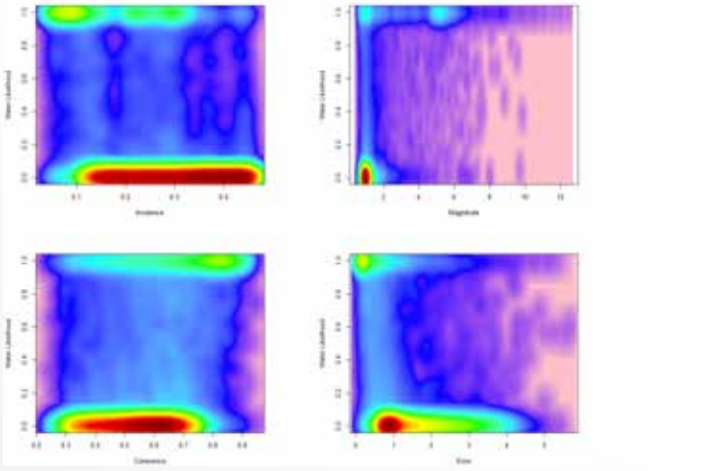


How to get beyond 15 degrees? Open Water Likelihood (OWL)

- Requires a simultaneous optical dataset (AirSWOT CIR camera)
- Correlate Water Fraction with magnitude, incidence angle, coherence, and error
- **No useful correlations found**

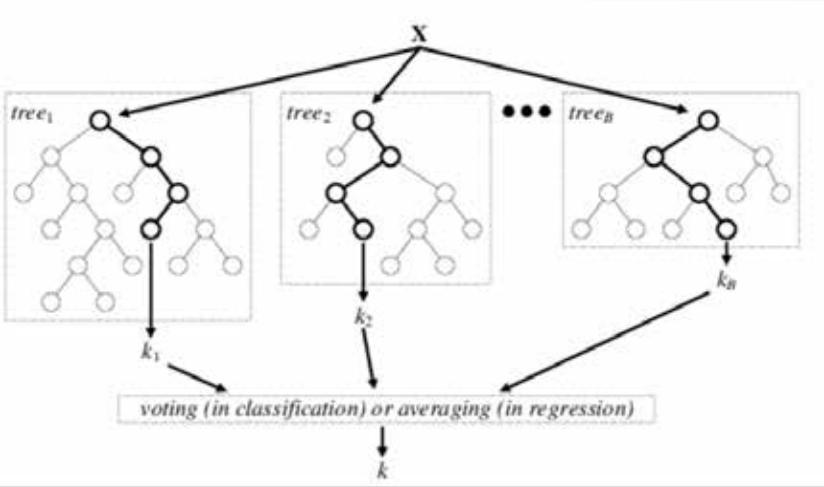






How to get beyond 15 degrees? Random Forest Ensemble

- Requires a simultaneous optical dataset to train likely values (AirSWOT CIR camera)
- Random Forest models create a user defined number (hundreds to thousands of) decision trees based on the input data.
- Classes are generated based on the average of the decision trees' classification
- RESULTS ENCOURAGING



(Verikas et al 2016)

How to get beyond 15 degrees? Random Forest Ensemble

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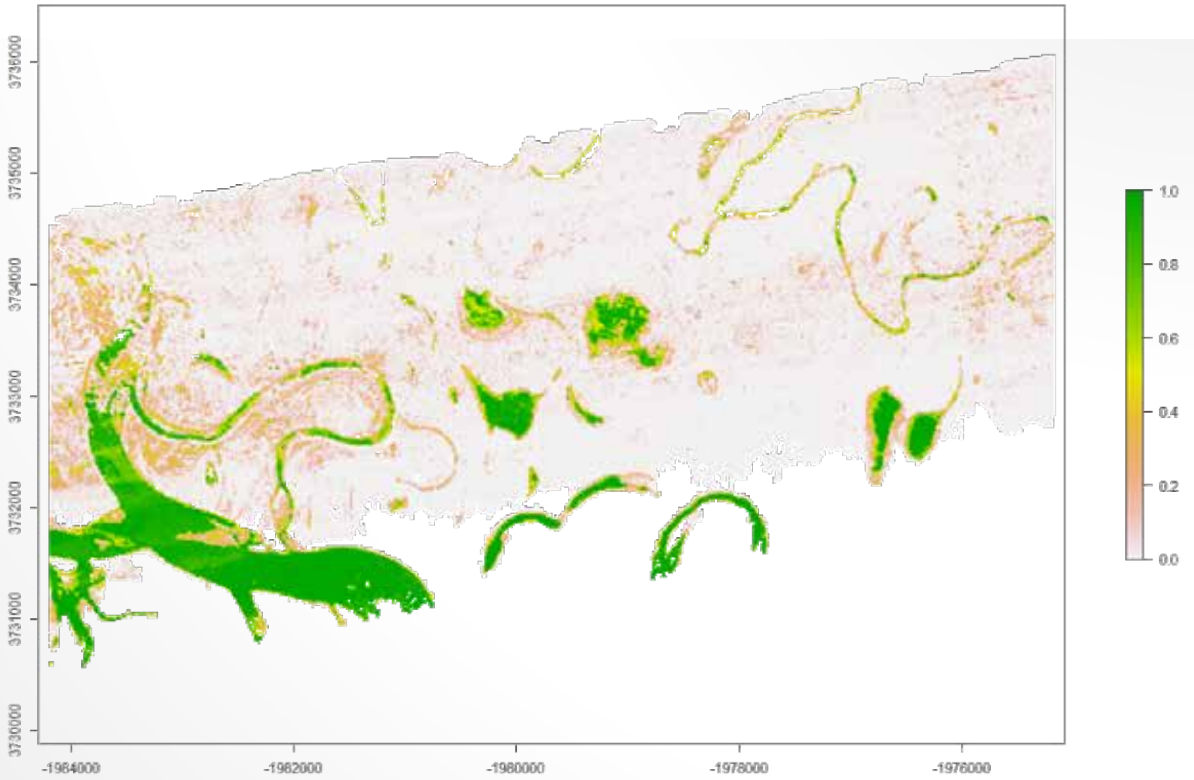
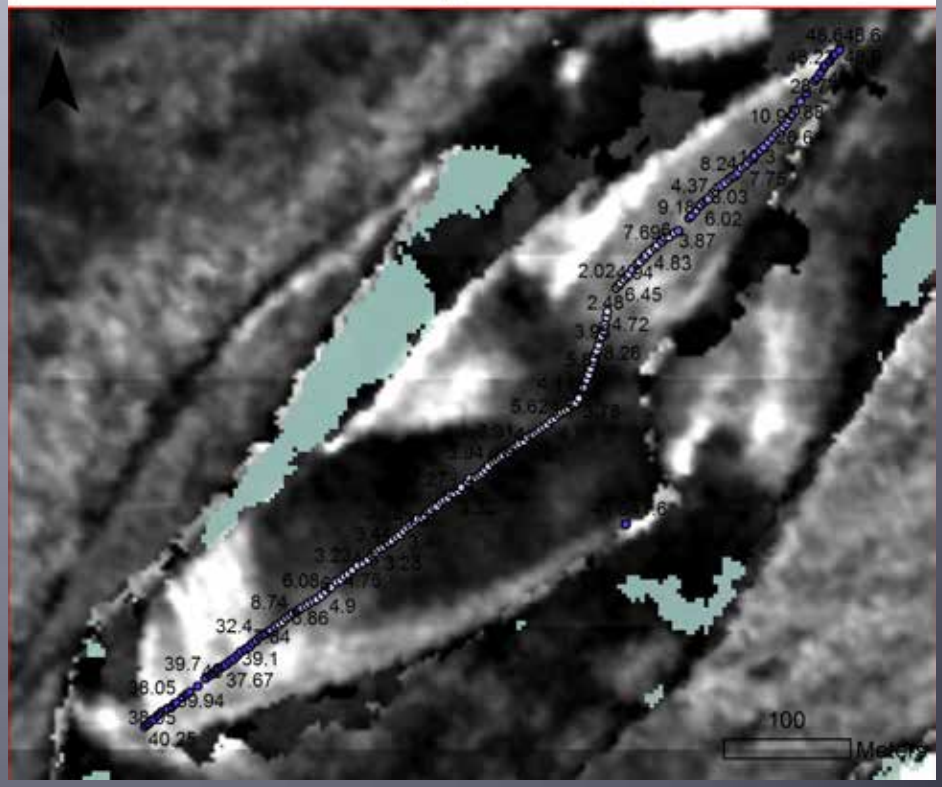
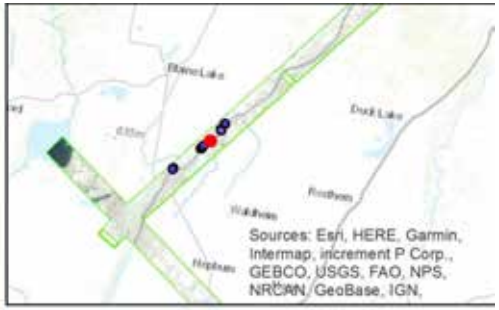


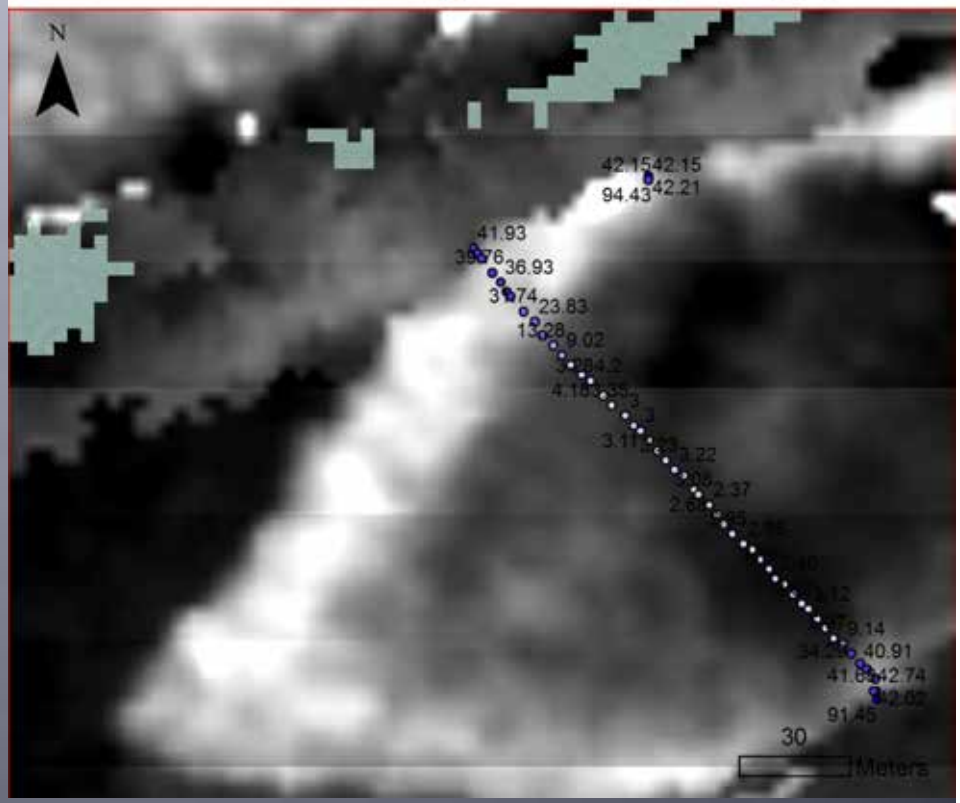
"Bright mud" a problem for SWOT?

- 2017 field experiments on N. Saskatchewan River
- GPS bar shorelines, soil moisture transects
- Bright returns from wet sediments



"Bright mud" a problem for SWOT?





Conclusions

- 2017 ABoVE flight campaigns collected large datasets of AirSWOT radar and CIR optical camera imagery
- AirSWOT radar and CIR datasets under preparation for ORNL (J. Fayne, E. Kyzivat)
- AirSWOT backscatter sufficient for water detection in near-swath (<15 degrees)
- Simultaneously collected CIR imagery are critical for training algorithms for mid-swath water detection. Random Forest Ensemble exhibits promise.
- "Bright mud" returns a potential phenomenology error for AirSWOT/SWOT. We are pursuing this with 2017 field AirSWOT datasets. Processing of inner-swath (SWOT-like) will help assess this error for SWOT mission.
- New students growing the SWOT research community and user base