Recent AirSWOT results for lakes and wetlands

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SWOT
SURFACE WATER & OCEAN TOPOGRAPHY

Science Team Meeting
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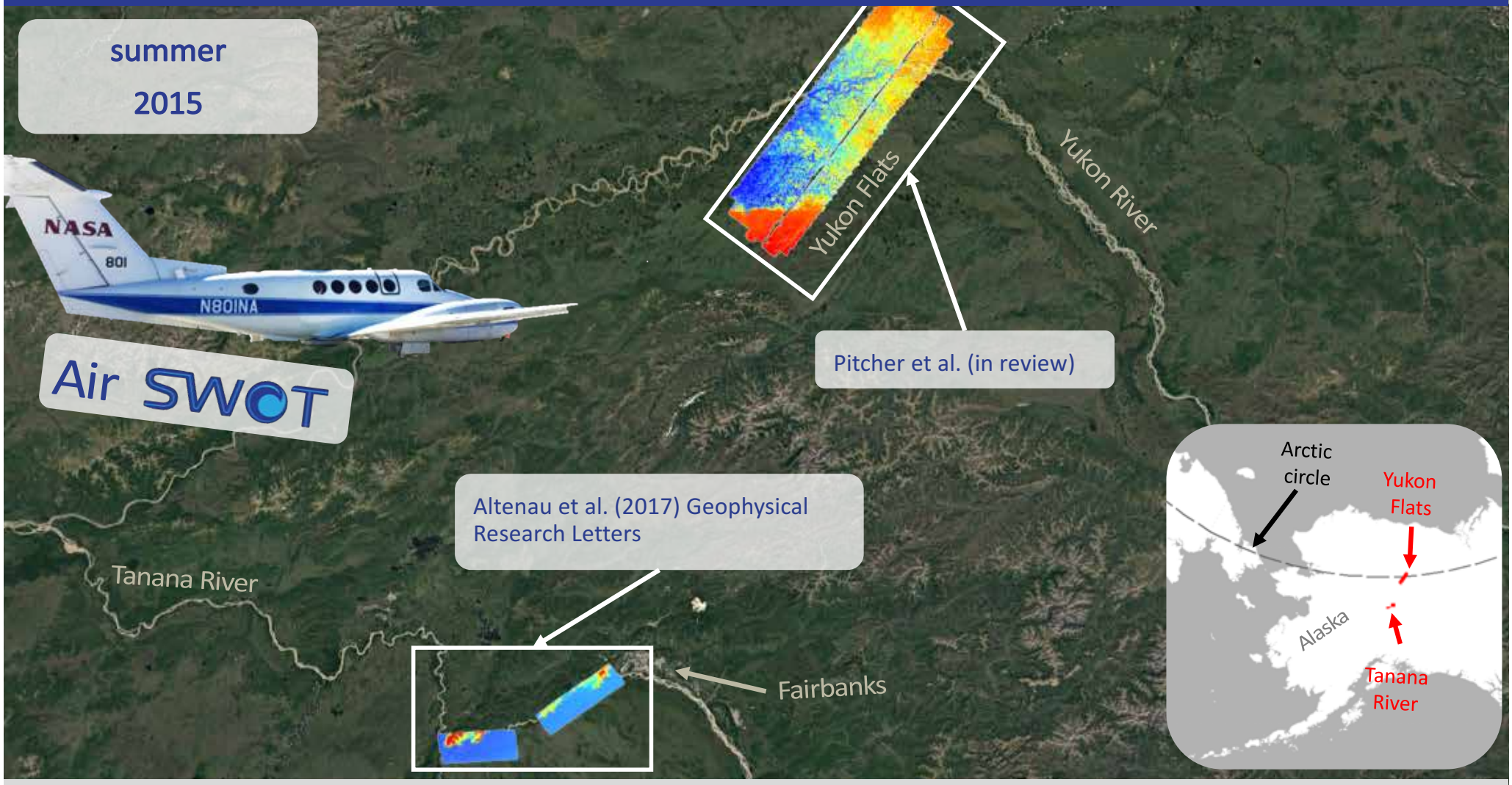
Montreal, Canada

Introduction:



Introduction:

open water extent:

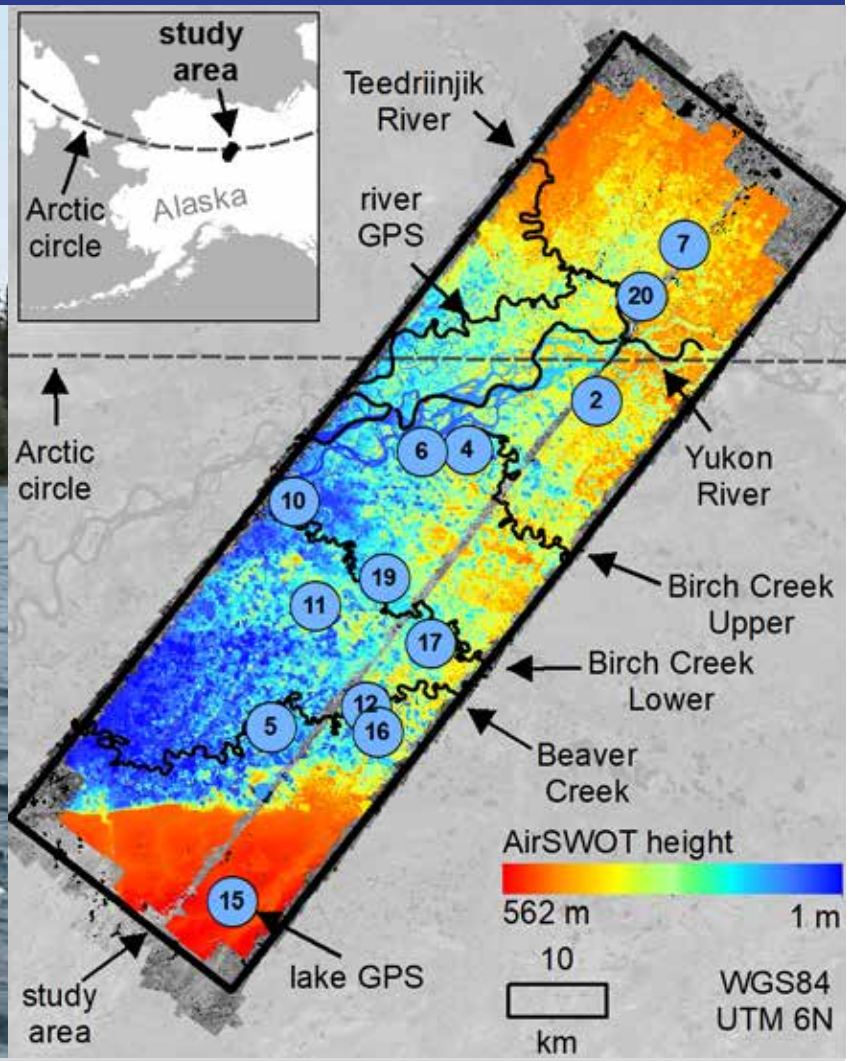
AirSWOT color-infrared digital camera imagery

water surface elevation (WSE):

AirSWOT ka-band SWOT phenomenology airborne radar

lake/wetland WSE validation:

GPS and pressure transducers



Outline:

(1) can AirSWOT resolve WSE in lakes and wetlands with accuracies sufficient to validate SWOT?

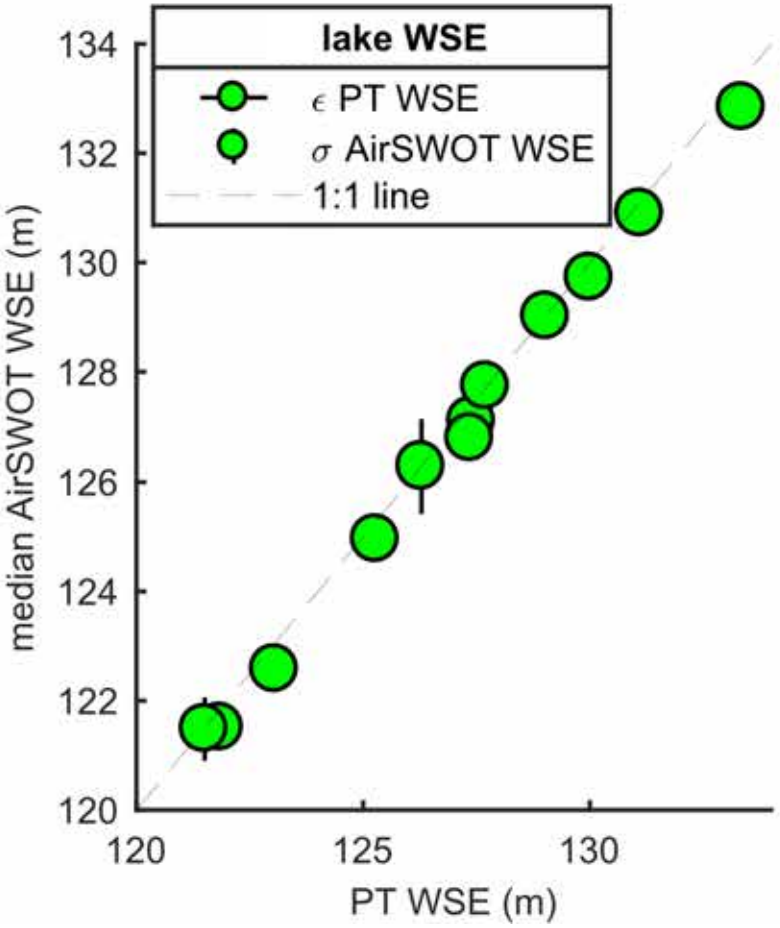
SWOT mission accuracy standards: WSE in open water to **±10 cm per 1 km^2** and **±25 cm per 0.0625 km^2**

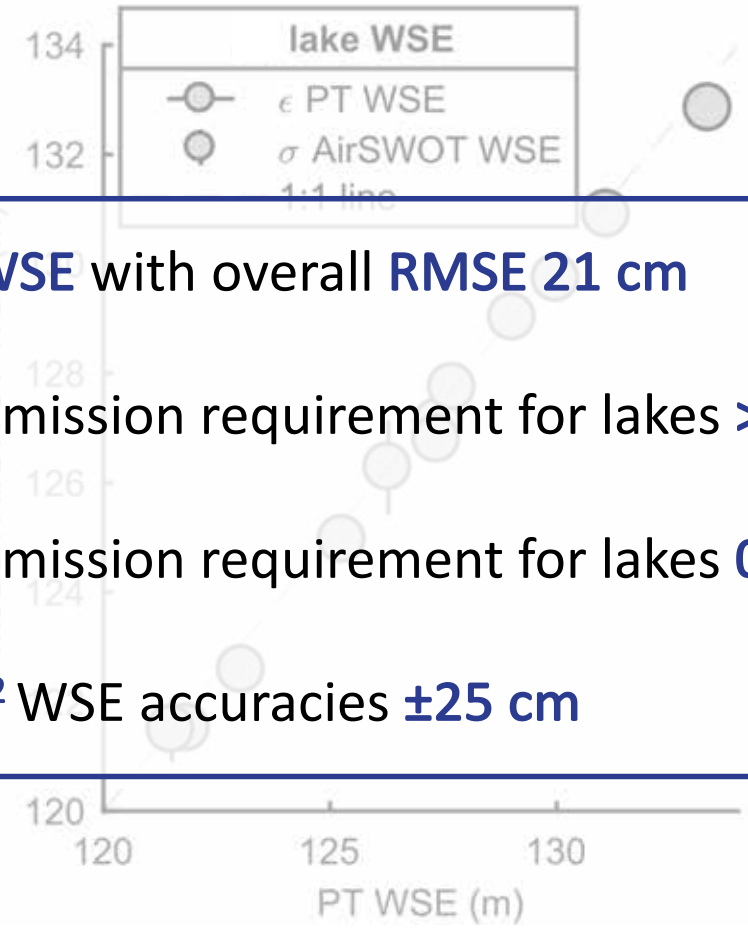
(2) how might AirSWOT be used to enhance hydrologic understanding of Arctic and Boreal lake-river-wetland systems like the Yukon Flats?

(3) AirSWOT updates

motivations: intended use of AirSWOT to validate SWOT, and AirSWOT as stand-alone instrument for surface water hydrology investigations

(1) can AirSWOT resolve WSEs in lakes and wetlands with accuracies sufficient to validate SWOT?





AirSWOT resolves **lake WSE** with overall **RMSE 21 cm**

2 of 5 lakes meet SWOT mission requirement for lakes **>1km^2**

0 of 3 lakes meet SWOT mission requirement for lakes **0.0625 to 1 km^2**

2 of 5 lakes **<0.0625 km^2** WSE accuracies **±25 cm**

AirSWOT remains **experimental,** research into **sensor calibrations** and improvements to **processor** are ongoing

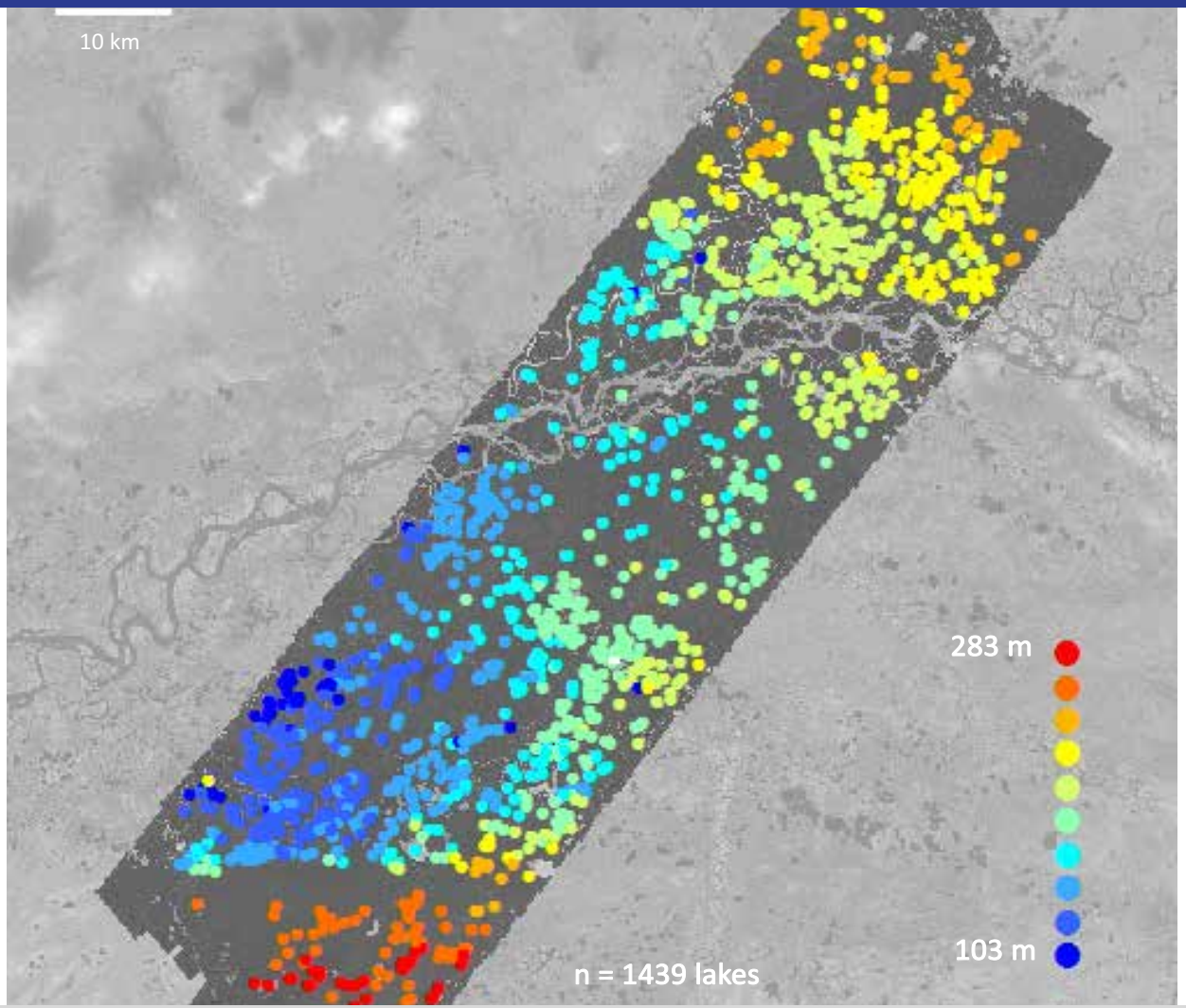
from an airborne remote sensing perspective, these accuracies remain high, especially considering no additional **ground calibrations**

water surface **roughness** during data collection remains unknown

advances in data processing may **increase accuracies** in future

2015 data being **reprocessed** to mirror 2017 **NASA ABoVE** data

(2) how might AirSWOT help enhance hydrologic understanding of lake-river-floodplain hydrology?



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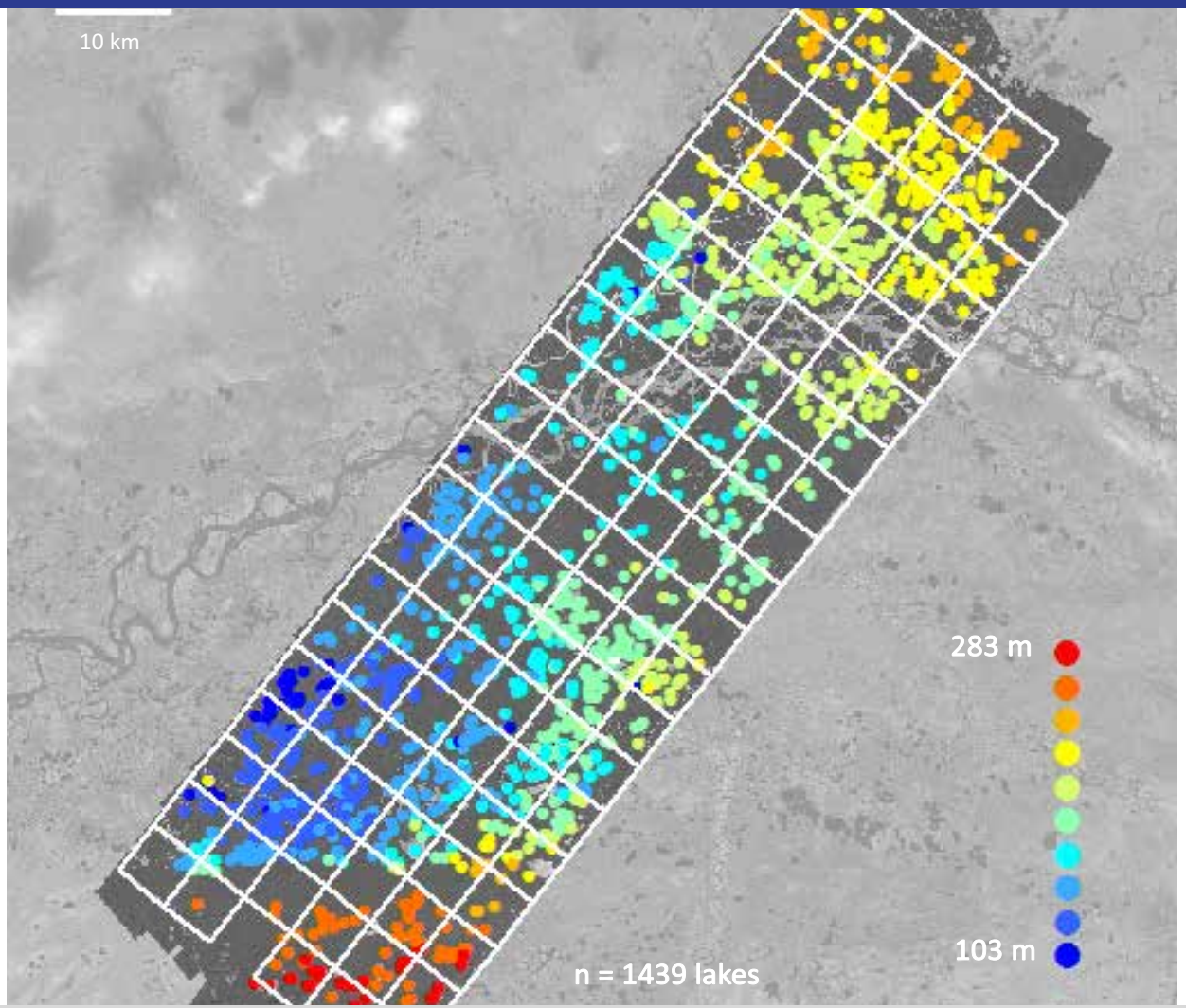

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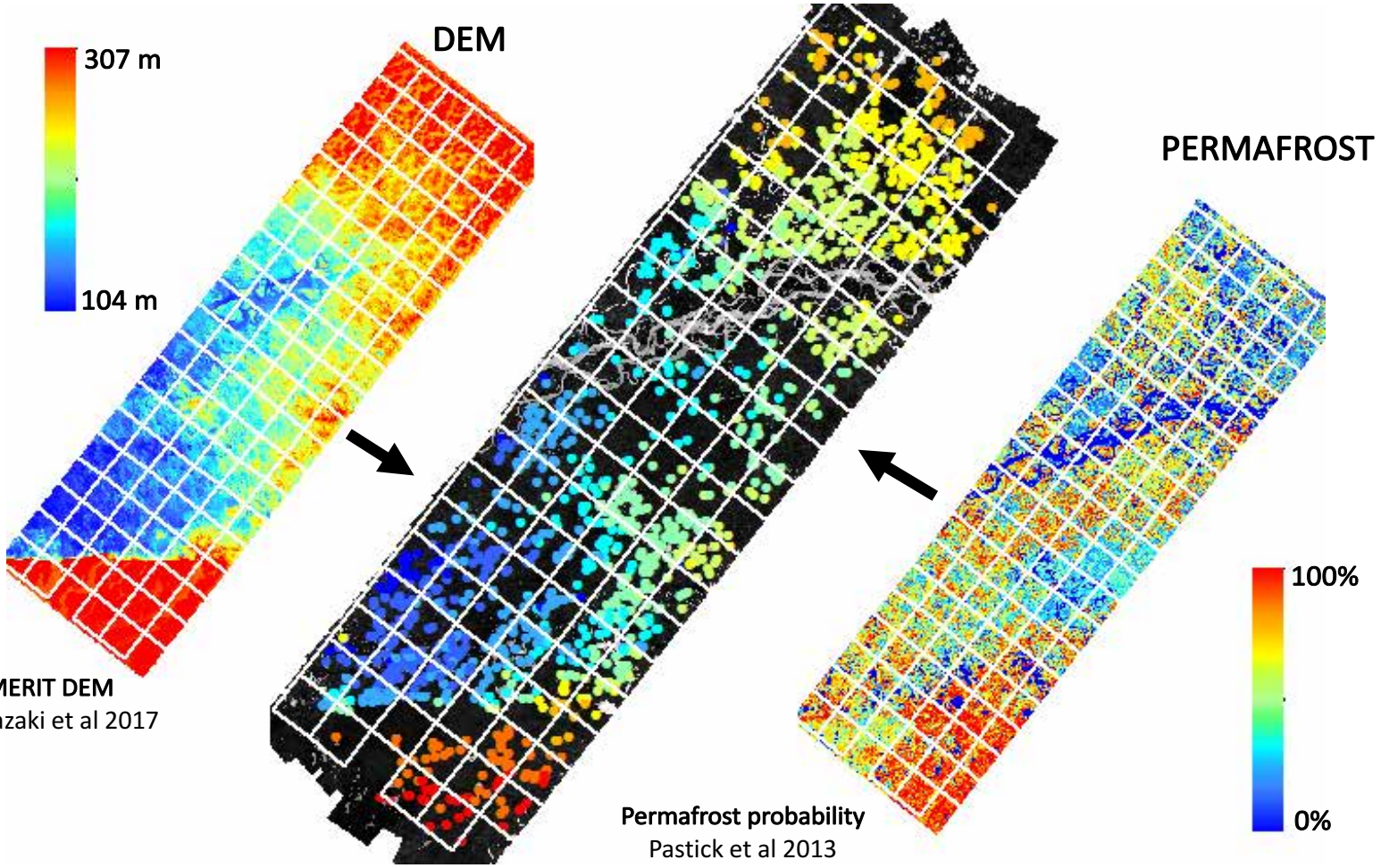

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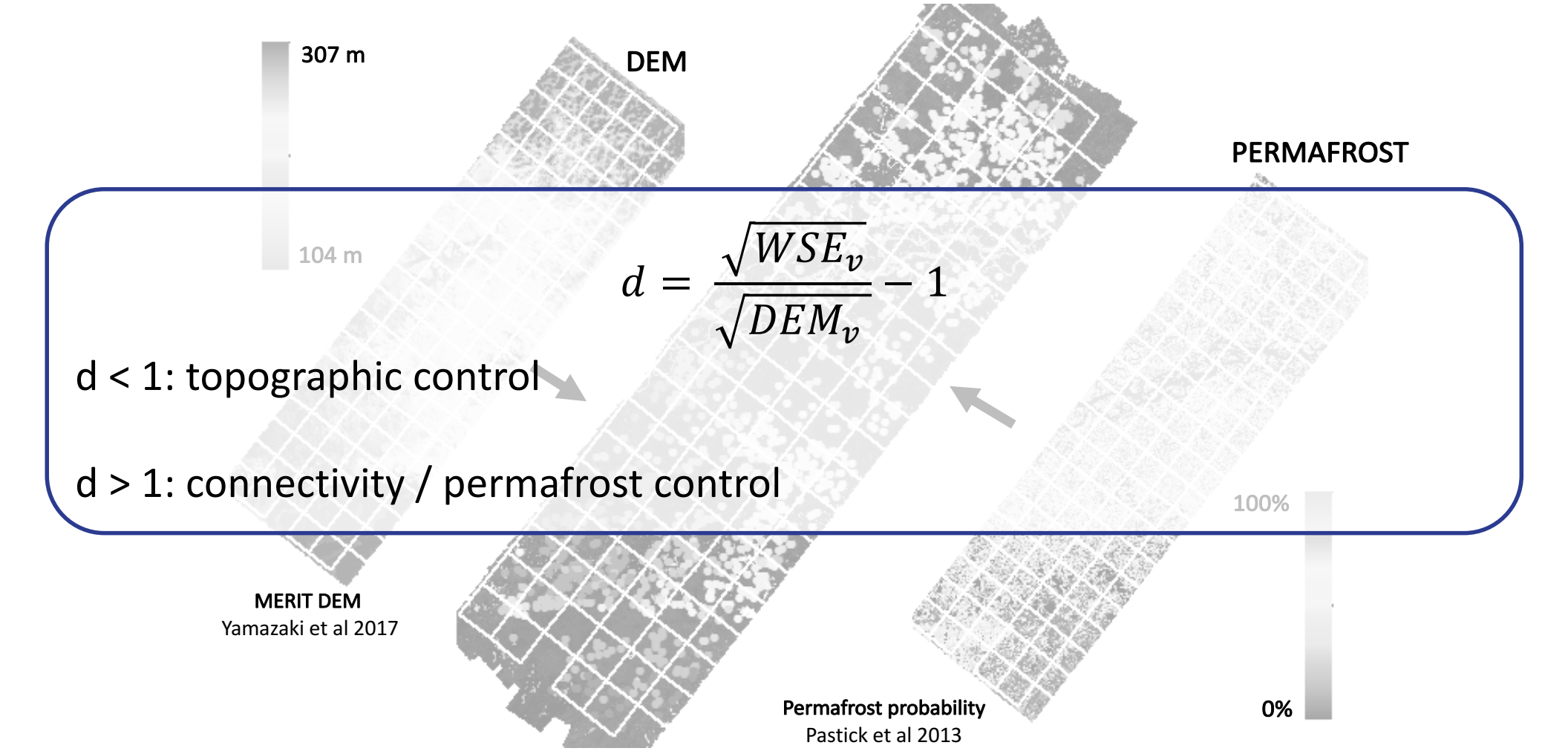

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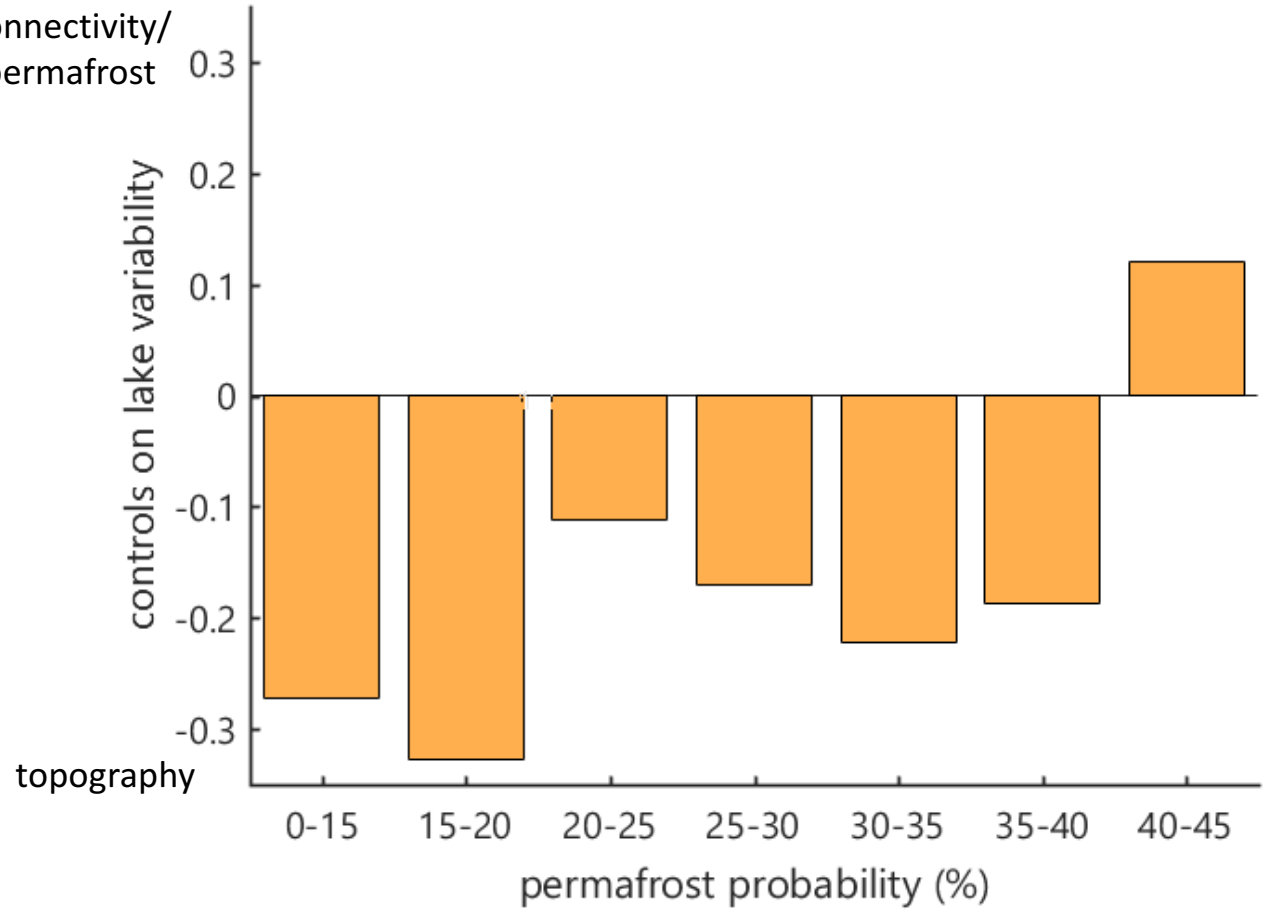
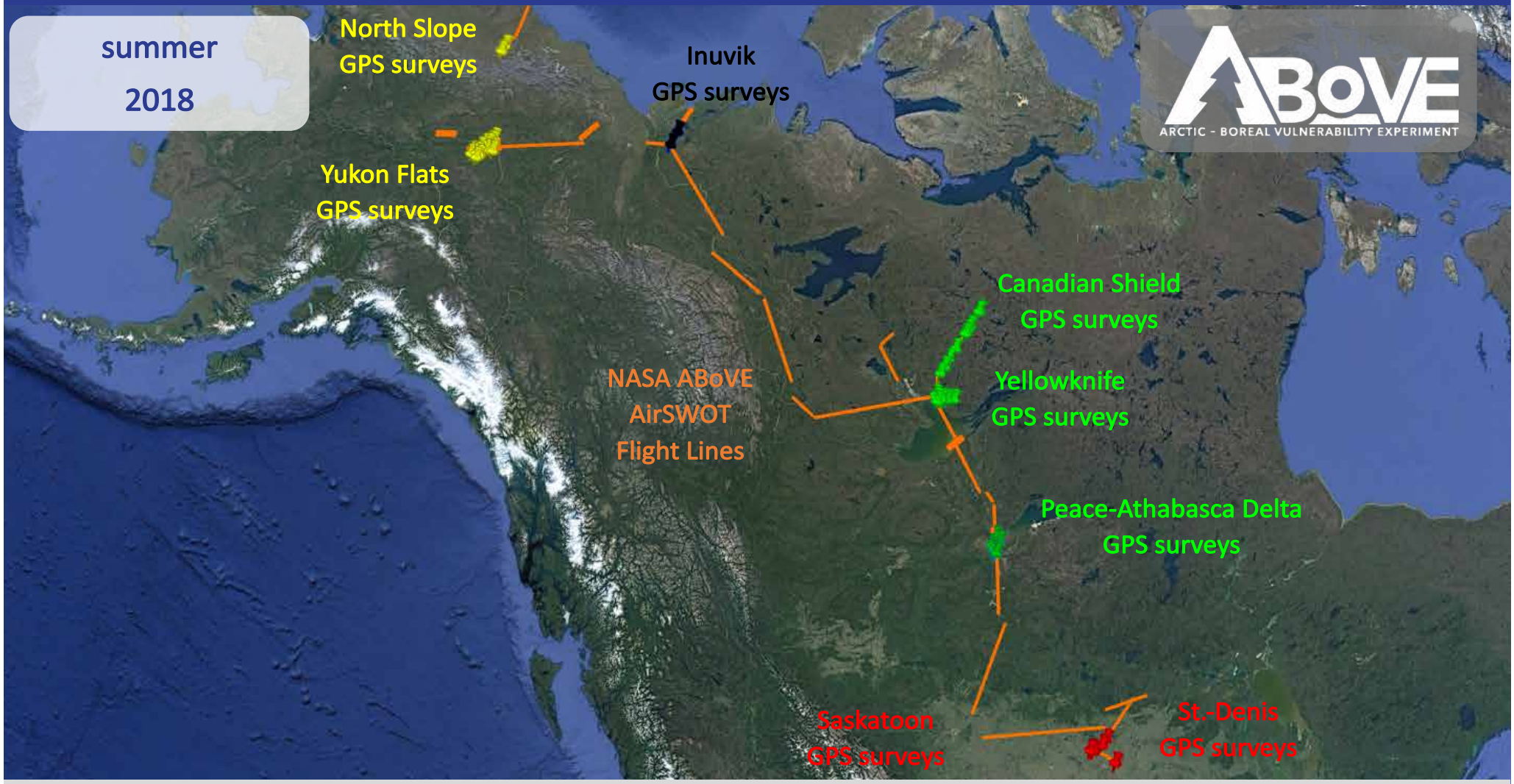


(3) AirSWOT updates



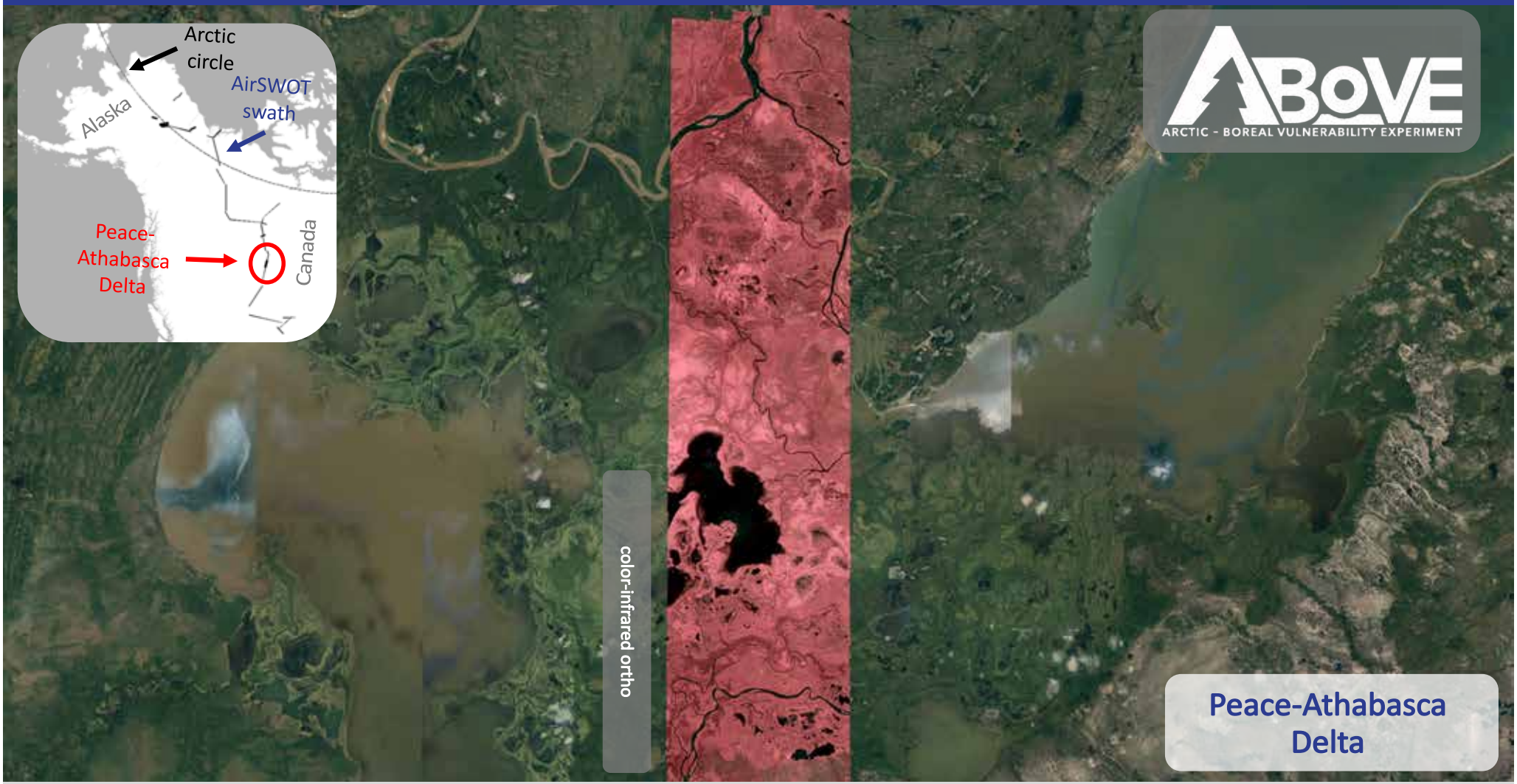
(3) AirSWOT updates

- **>28,000 km** flown
- **>40,000** Landsat observable water bodies (from Pekel et al 2016)
- **>3,000 km^2** surface water area mapped (from Pekel et al 2016)
- **>100** field validation GPS surveys in lakes across Canada and Alaska
- international collaborative field effort with participants from **15 institution** across **4 countries**

ABoVE
ARCTIC - BOREAL VULNERABILITY EXPERIMENT

Lincoln Pitcher (lincolnpitcher@ucla.edu)

(3) AirSWOT updates



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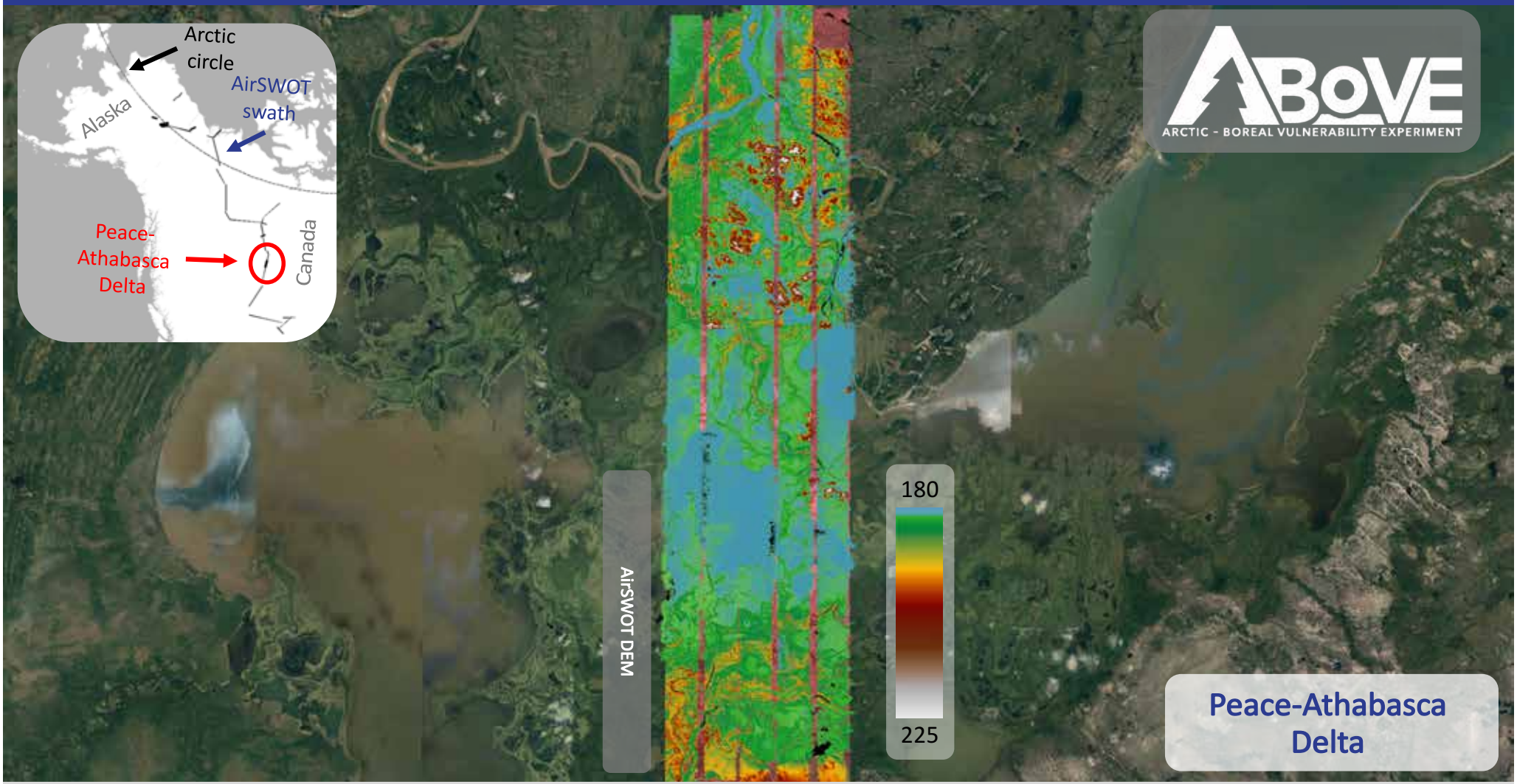

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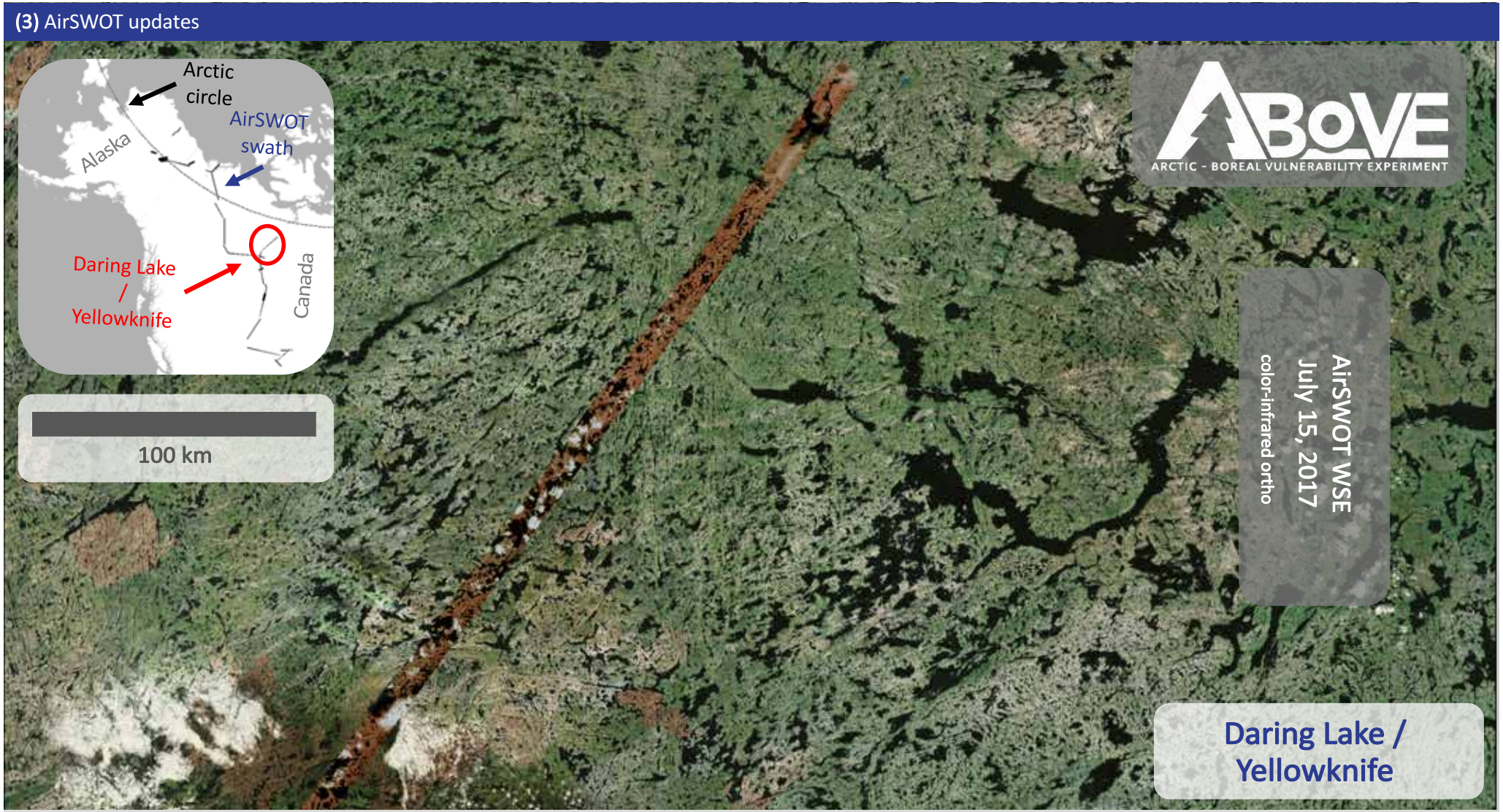

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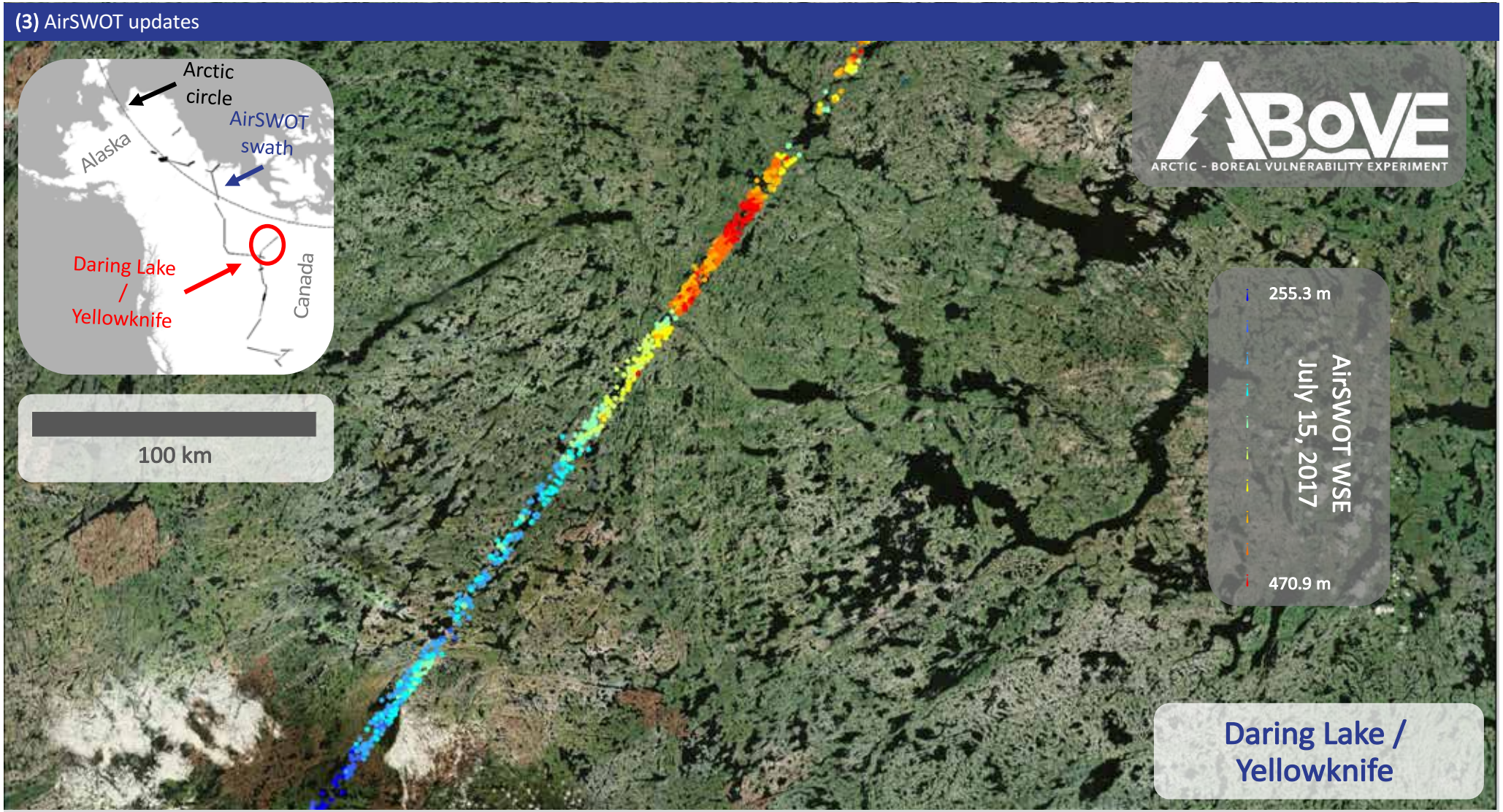

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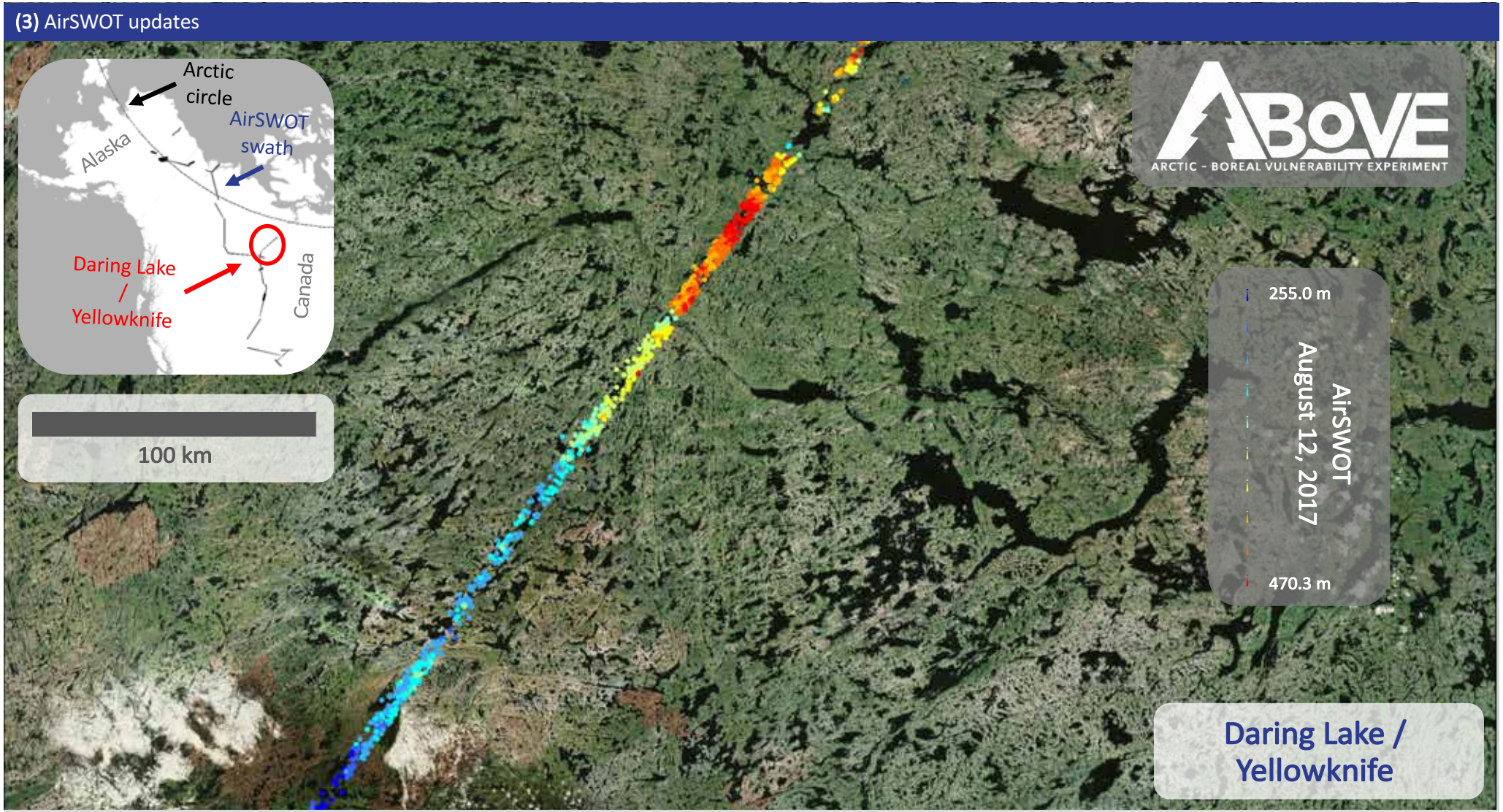

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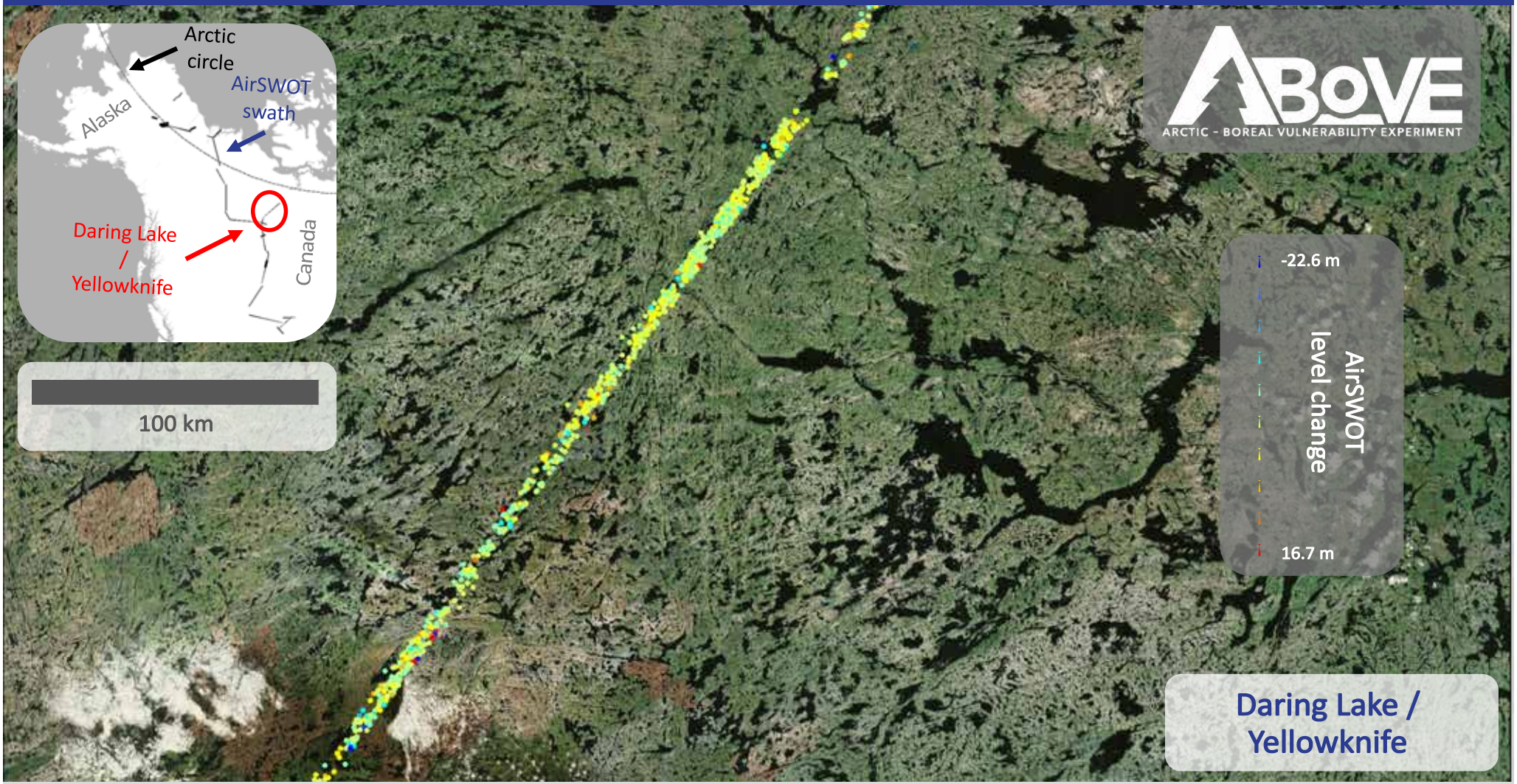

Summary:

(1) can AirSWOT resolve WSEs in lakes and rivers with accuracies sufficient to validate SWOT?

AirSWOT **lake and wetland WSEs** from **2015 Yukon Flats** data remains subpar for SWOT validation. However, wider range in environmental conditions (e.g. wind), refined calibrations and improvements to AirSWOT processor may improve accuracies in the future.

(2) how might AirSWOT be used to enhance hydrologic understanding of complex lake-river-wetland systems

we demonstrate AirSWOT's utility for mapping **hydraulic gradients** and assessing **controls on lake levels** across complex Arctic and Boreal wetland systems

(3) AirSWOT updates

AirSWOT was deployed as part of the **2017 NASA ABoVE** campaign. JPL is processing the data and it is also being prepared for submission to ORNL DAAC. Preliminary results suggest surface **water fluxes** can be estimated from repeat mappings. Future work includes: generating open water mask for AirSWOT radar extractions and refinement of AirSWOT lake/wetland WSE accuracy characteristics with field WSE surveys.

NASA Terrestrial Hydrology Program grant: NNX13AD05G, managed by Dr. Jared Entin
NASA Terrestrial Ecology Program grant: NNX17AC60A, managed by Dr. Hank Margolis
NASA Earth and Space Sciences Fellowship Program grant: NNX14AP57H

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AirSWOT radar data was processed by Albert Chen, Curtis Chen, and Craig Stringham at JPL
custom engineered GPS equipment used for field surveys was designed and engineered by Dr. Alberto Behar at JPL

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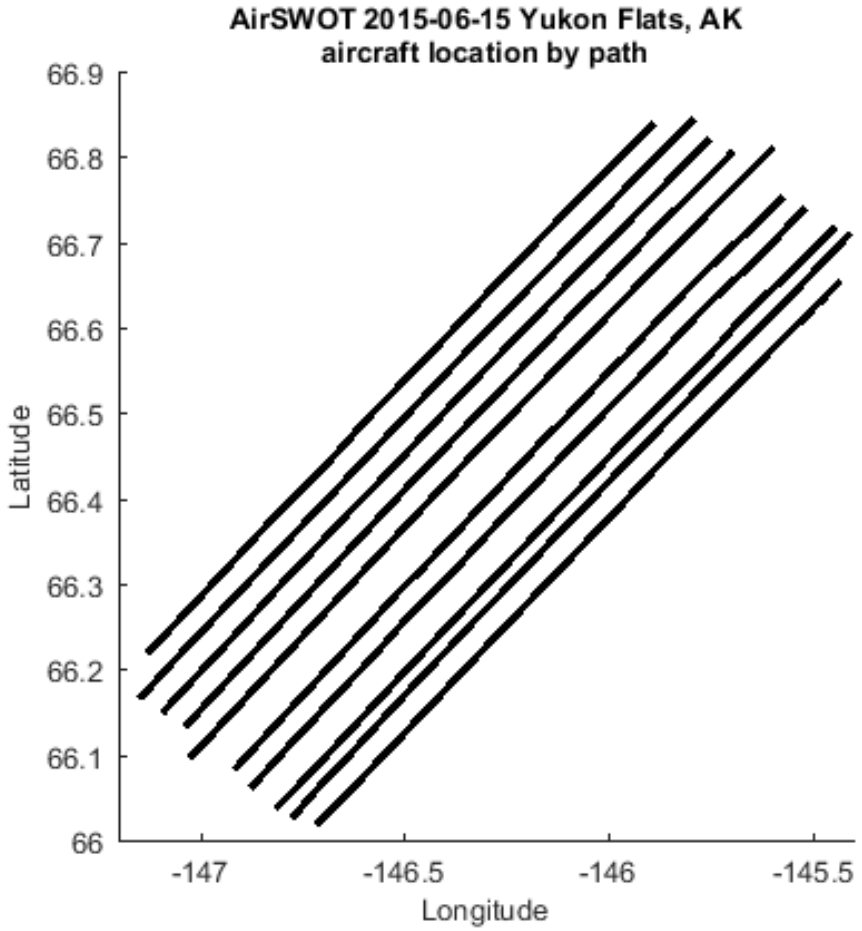
Jerry Carrol in Fort Yukon for transportation on the Yukon River.
The Arctic DEM was created by the Polar Geospatial Center from DigitalGlobe, Inc., imagery and funded under National Science Foundation awards 1043681, 1559691, and 1542736.

Extra Slides:



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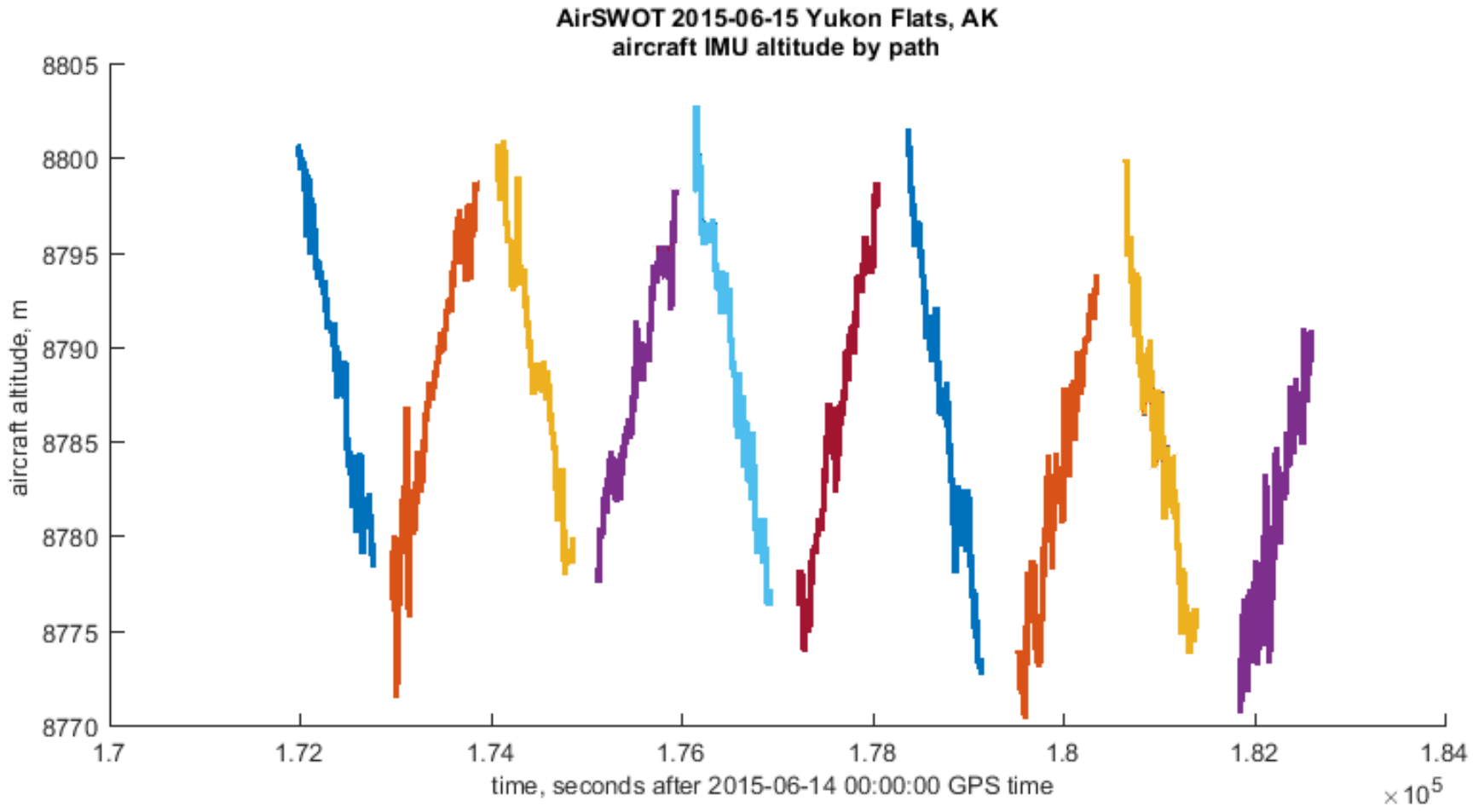

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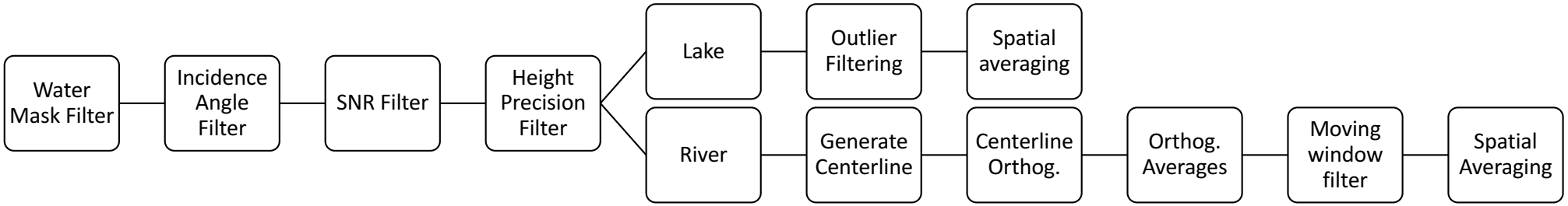
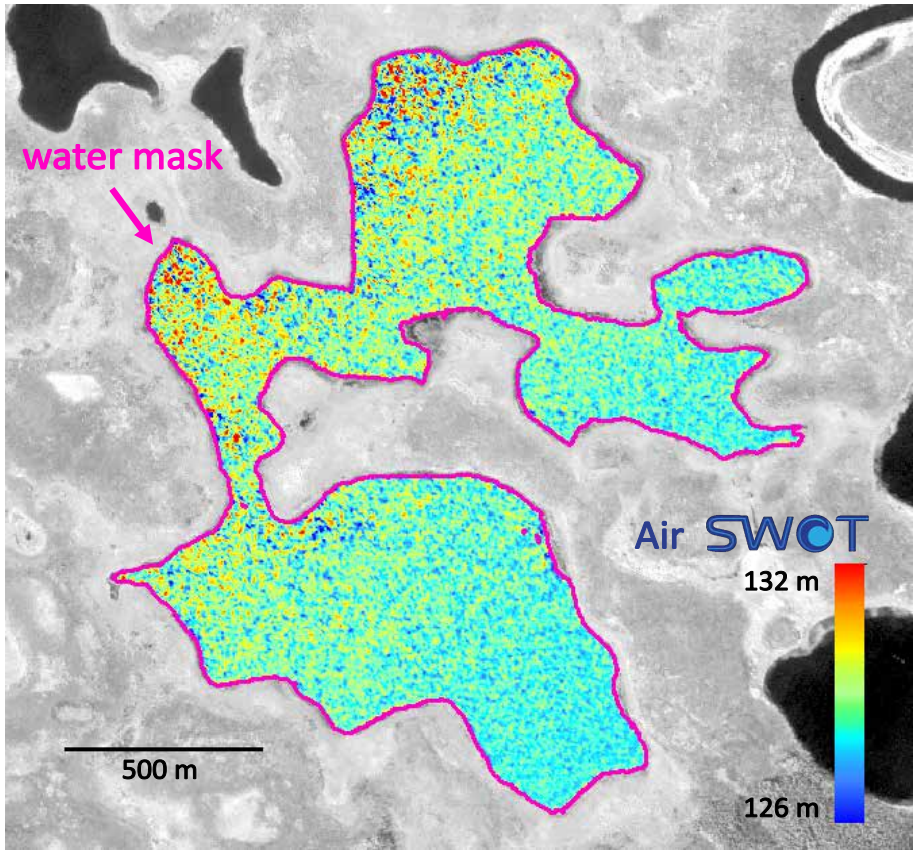
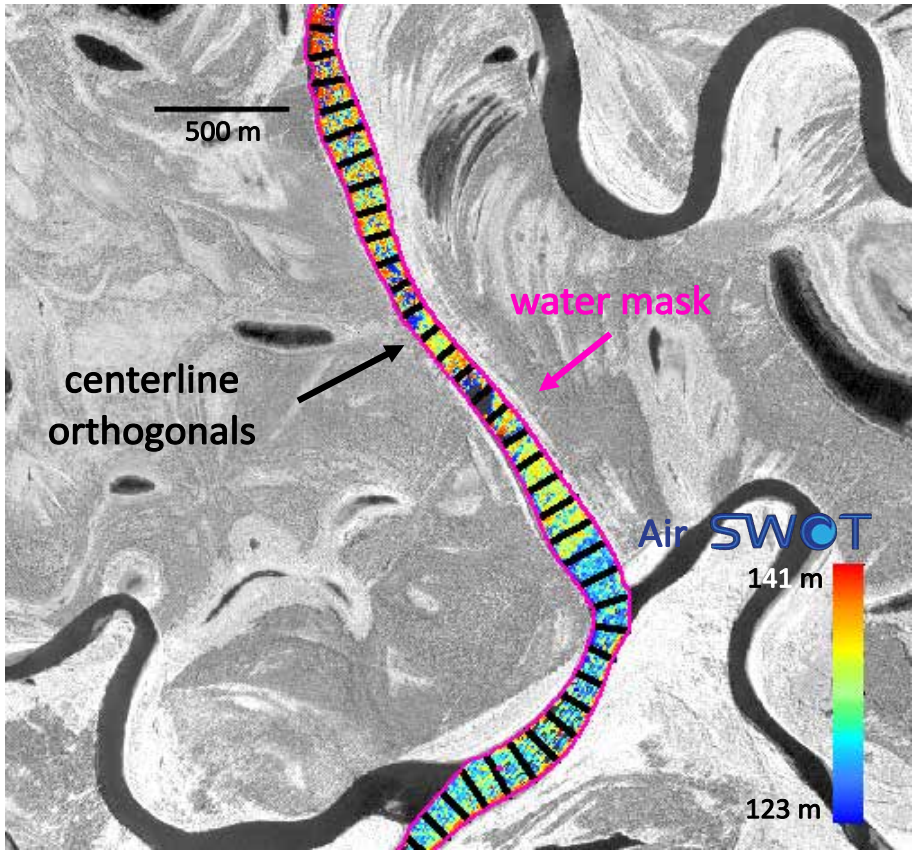


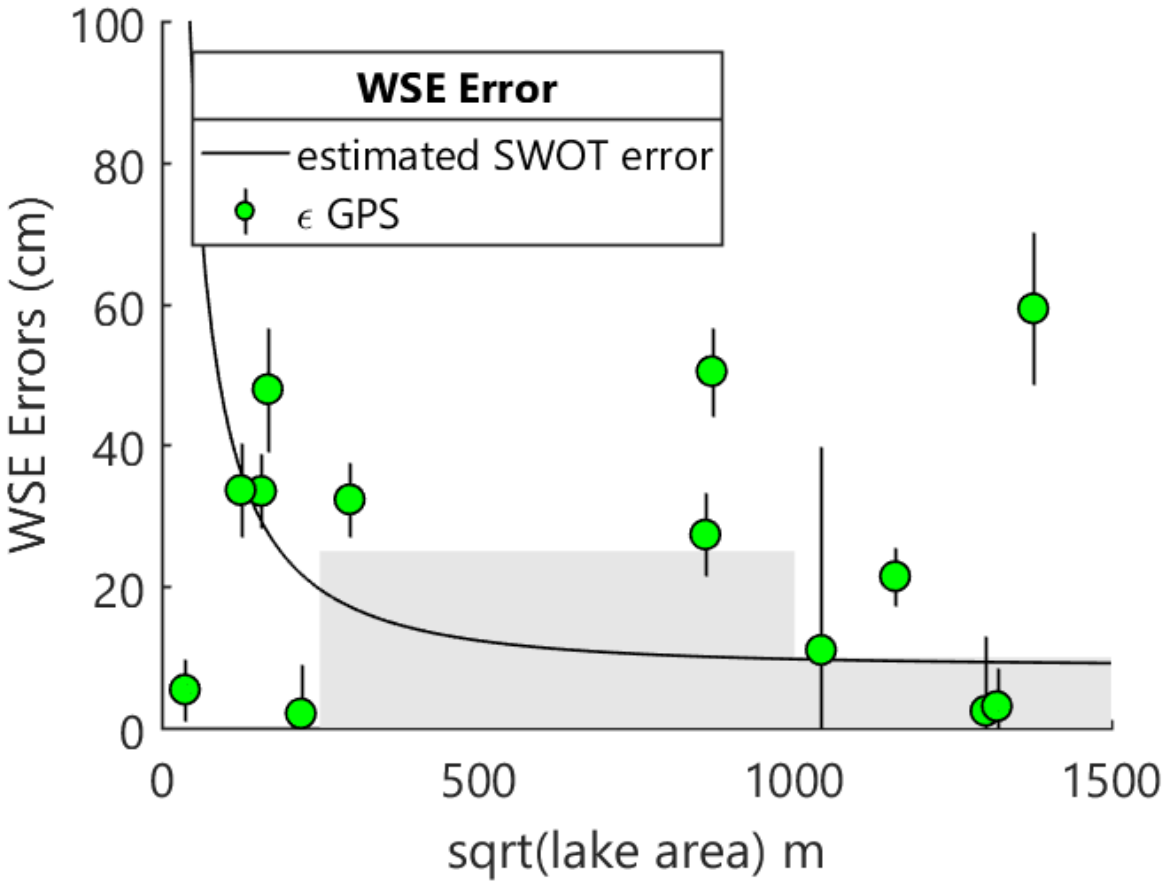
Extra Slides:

lakes processed within **water mask** polygons



rivers processed **orthogonal** to flow direction





YUKON FLATS LAKES:

SWOT requirement 2.8.3:

> 1km2
2 of 5 lakes ± 10 cm

0.0625 to 1km2
0 of 3 lakes ± 25 cm

no SWOT requirement:

< 0.0625 km2
2 of 5 lakes ± 25 cm

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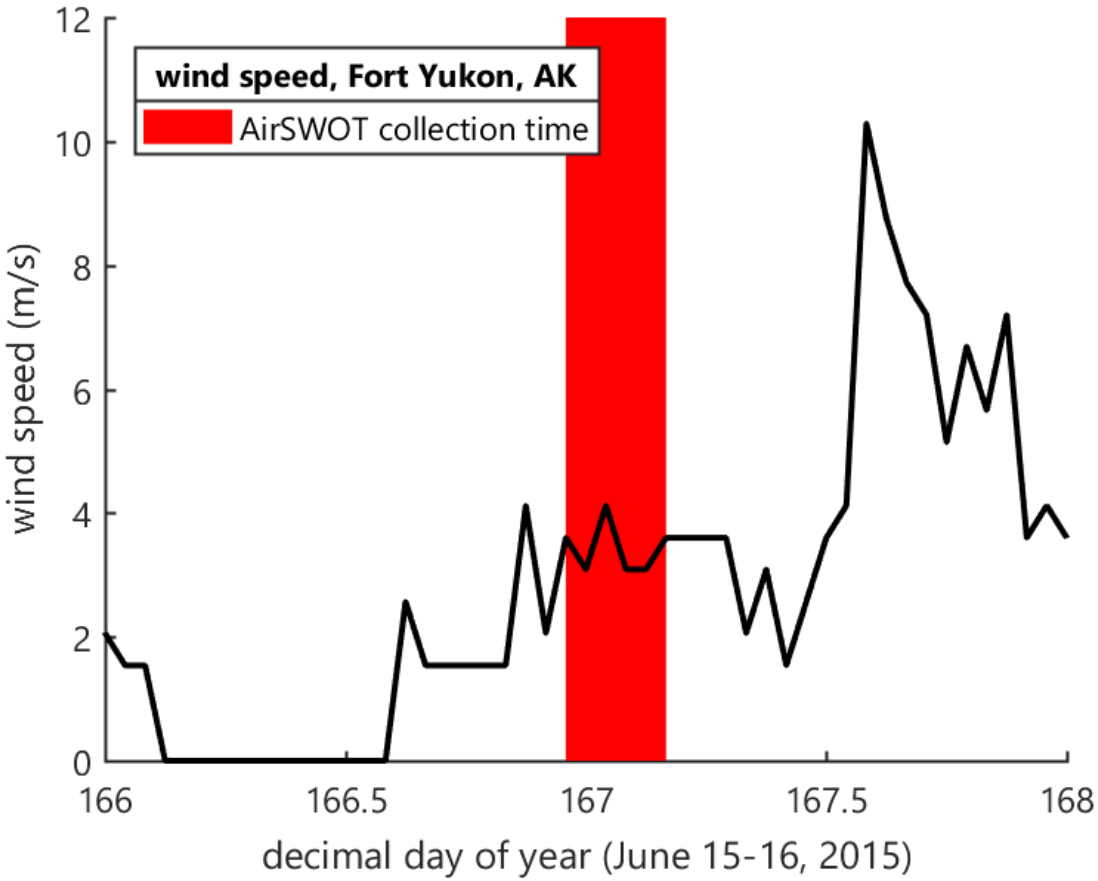

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