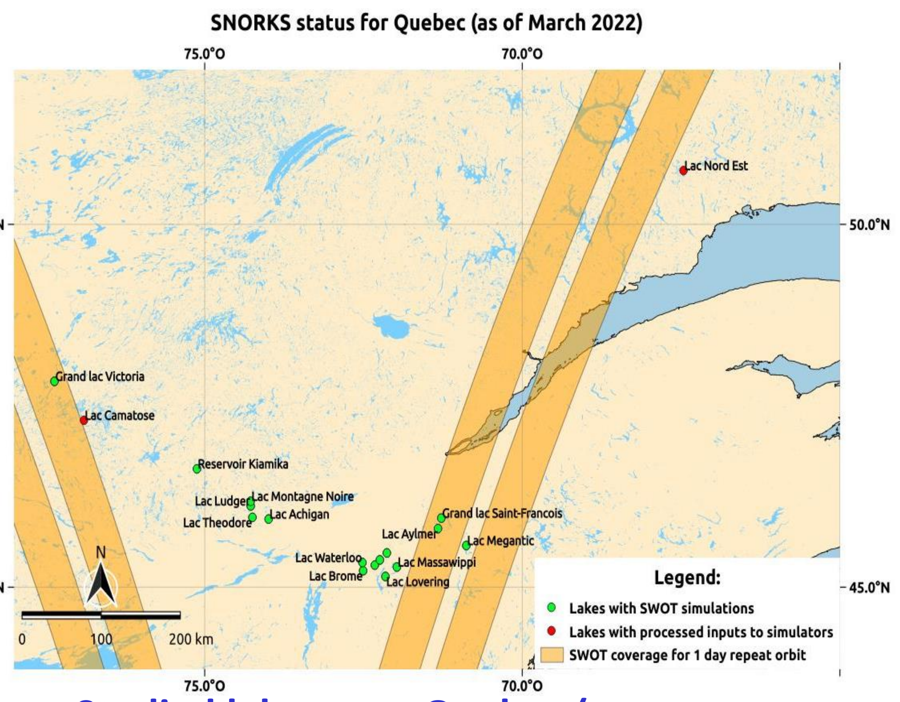
SWOT and NORthern laKeS (SNORKS) project

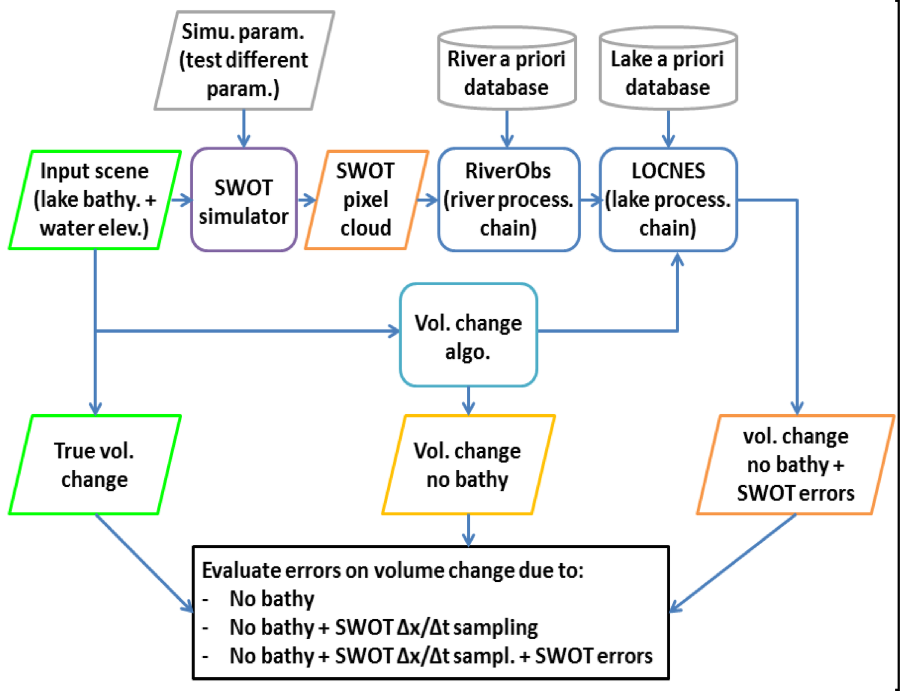
S. Biancamaria, M. Trudel, G. Siles, M. Delhoume, C. Pottier , N. Desrochers, A. Texier, E. Cauvier-Charest, D. Peters, J.-F. Crétaux

Main objectives and study domain

- The SNORKS project is a contribution to the SWOT ST and aims to investigate errors that could be expected from the official SWOT level 2 lake products. The studied lakes and reservoirs are located in Canada, more specifically in the Peace-Athabasca Delta (PAD) and in Quebec regions. The proposed work is performed pre-launch using the SWOT simulators available from JPL and CNES. Post-launch, the real SWOT errors will be studied and compared to selected in-situ data.



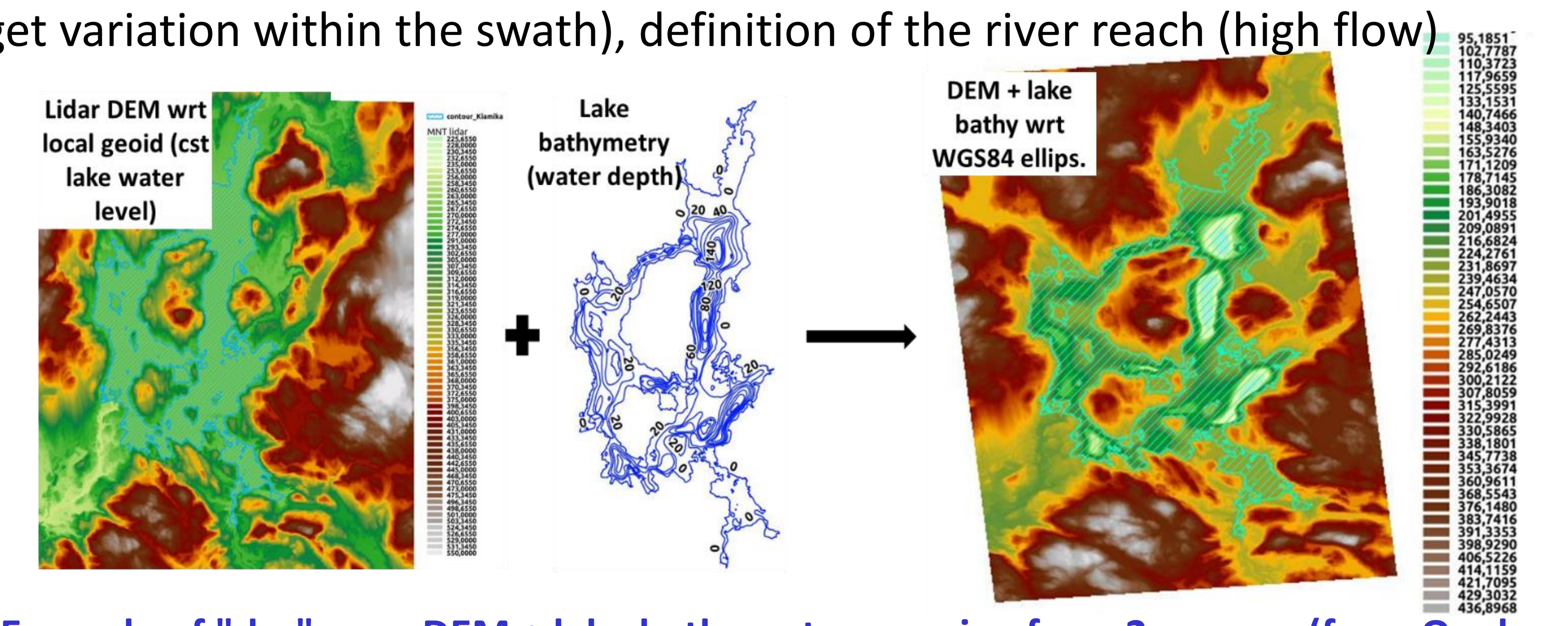
Studied lakes over Quebec (mean area from 60 ha to 11,000 ha



Prelaunch error assessment methodology)

Prelaunch volume variation assesment

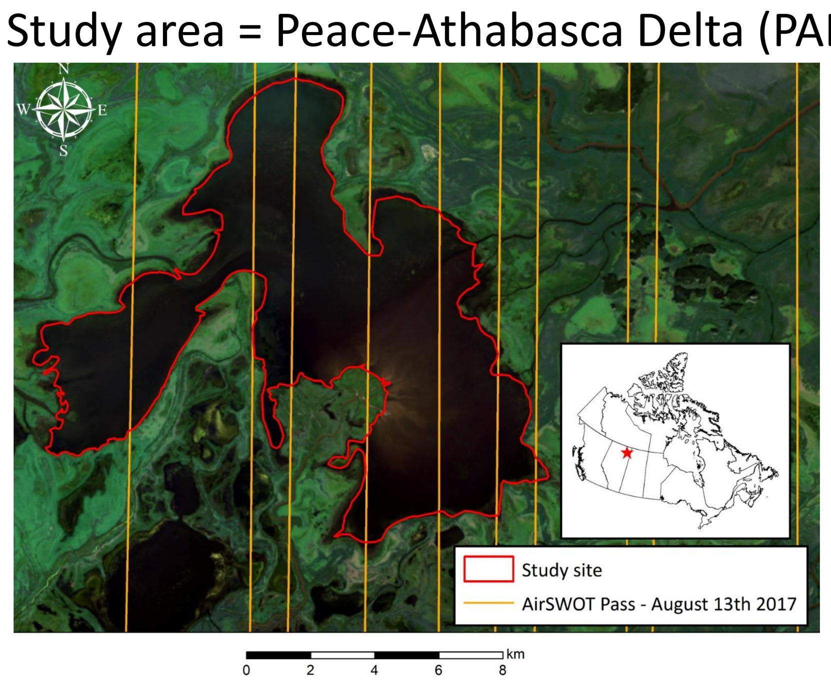
- Input scenes generated from “dry” zone DEM and lake bathymetry water level (not elev.) from Quebec Government open source data for all lakes.
- CNES SWOT large scale simulator has been used and Lake volume changes have been computed by Manon Delhoume (CS group) for a full year with SWOT science orbit
- Results showed an important source of error on lake storage change is the lake extent underestimation from SWOT observations. Error on lake extent could be due to partial swath coverage of the lake, size of the lake, complexity of the lake shape, and/or position of the lake within the swath (i.e pixel size and error budget variation within the swath), definition of the river reach (high flow)



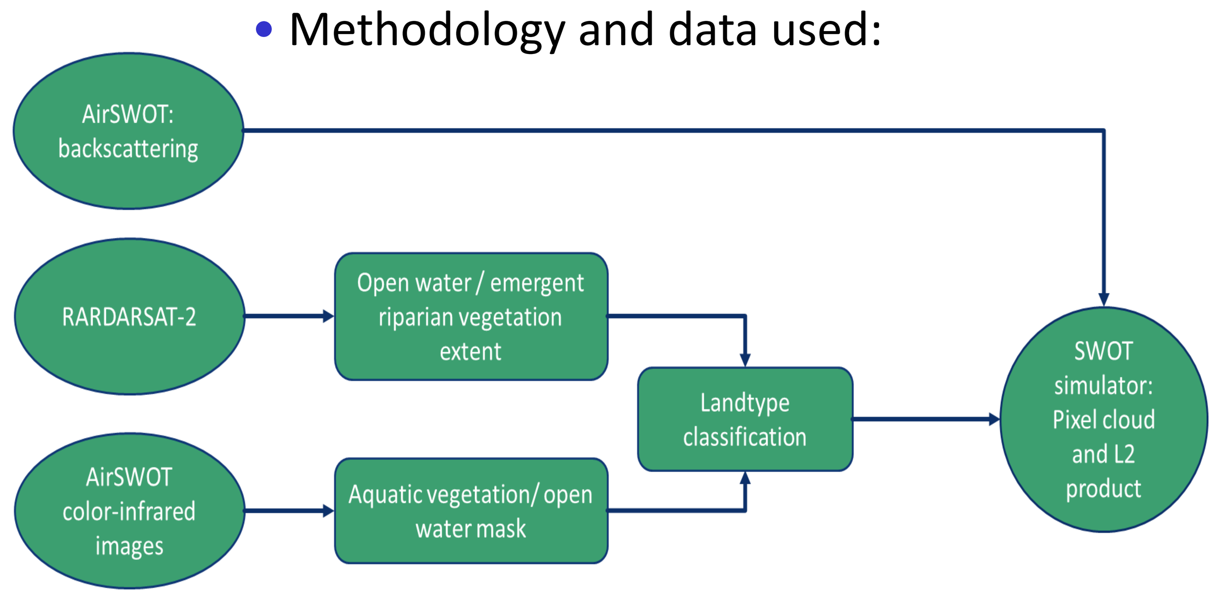
Example of "dry" zone DEM + lake bathymetry merging from 2 sources (from Quebec government) to compute SWOT simulator input data with gage water elevation

Effects of aquatic and emergent vegetation on SWOT data (Desrochers et al., 2021)

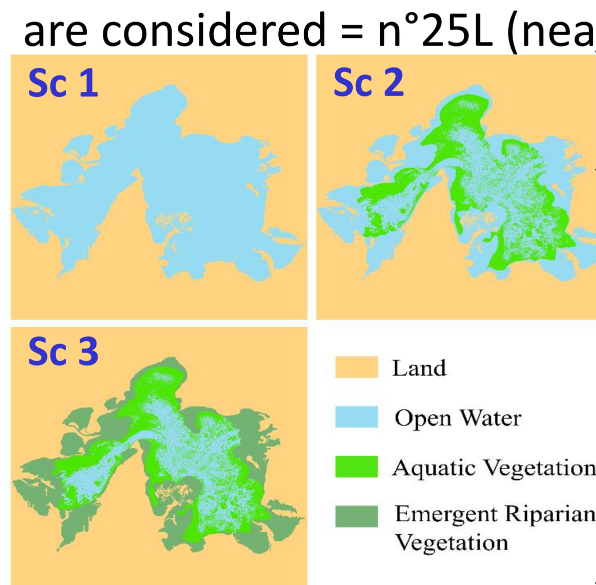
- Objective: test the impact of aquatic and emergent riparian vegetation on SWOT backscattering using the JPL SWOT simulator with AirSWOT backscattering values
- Study area = Peace-Athabasca Delta (PAD) :



- Methodology and data used:

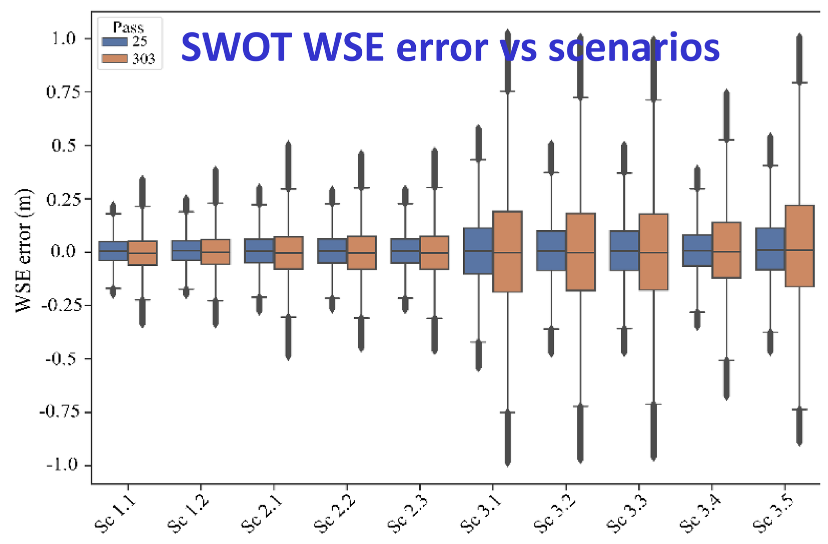


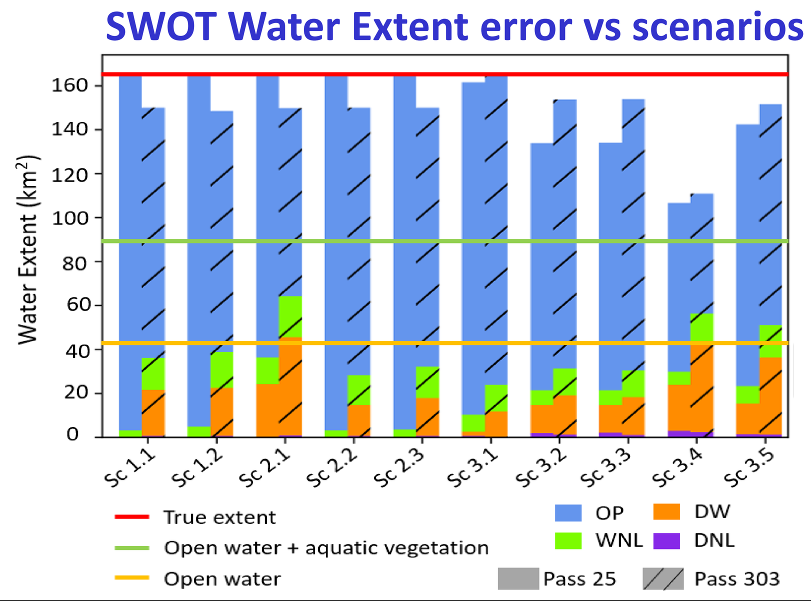
- Studied scenarios based on AirSWOT data - 2 SWOT passes are considered = n°25L (near range) and 303 (far range):



	Open Water (dB)	Aquatic Vegetation (dB)	Emergent Riparian Vegetation (dB)	Land (dB)
Sc 1.1	10	10	10	-5
Sc 1.2	9.11	9.11	9.11	3.03
Sc 2.1	10	5	10	-5
Sc 2.2	9.11	8.52	9.11	-5
Sc 2.3	9.11	6.32	9.11	-5
Sc 3.1	9.11	8.52	5.21	-5
Sc 3.2	9.11	8.52	4.33	-5
Sc 3.3	9.11	9.11	4.33	-5
Sc 3.4	9.11	8.52	4.33	3.03
Sc 3.5	9.11	8.52	5.21	3.03

- Results:

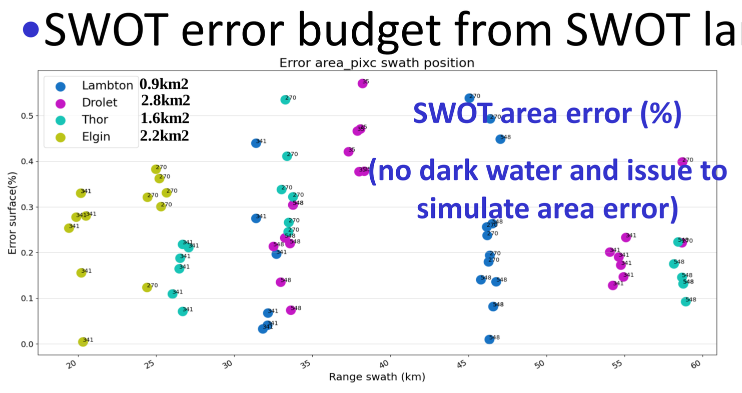


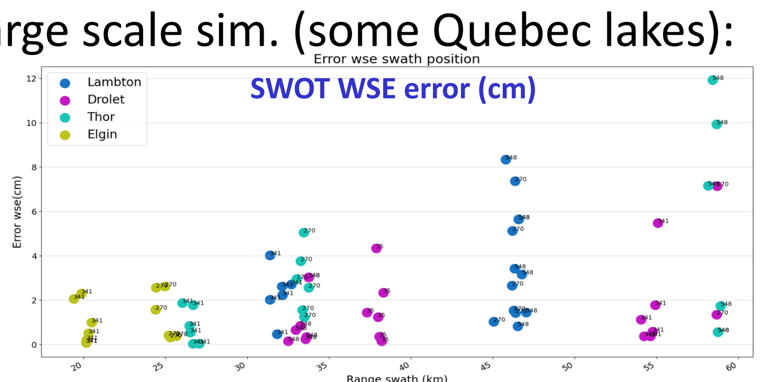


- Conclusions:
  - Little to no effect of aquatic vegetation on SWOT’s WSE and water classification
  - Emergent riparian vegetation may influence SWOT pixel classification when the intensity of the return signal from the land is high (high soil moisture content), with values similar in return signal intensity to emergent riparian vegetation
  - Water storage dynamics of lakes in wet environments might be affected by important errors.
  - Higher level products specific to wetland with ancillary data might be needed

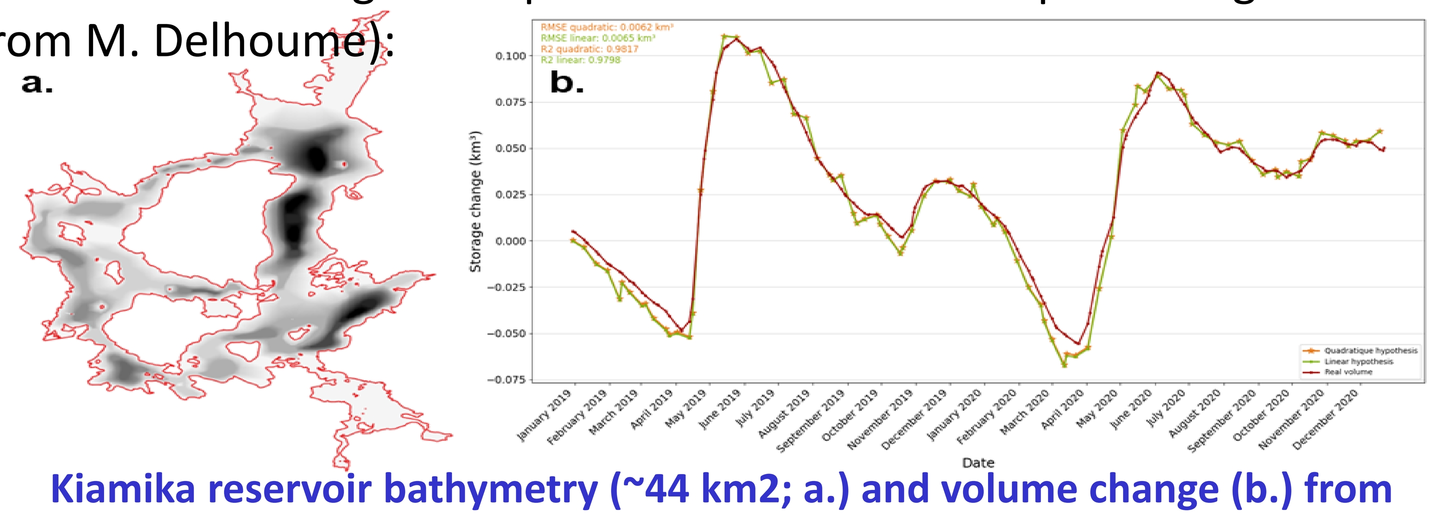
SWOT simulated data and in situ measurements over Quebec lakes during the SWOT cal/val phase

- SWOT error budget from SWOT large scale sim. (some Quebec lakes):



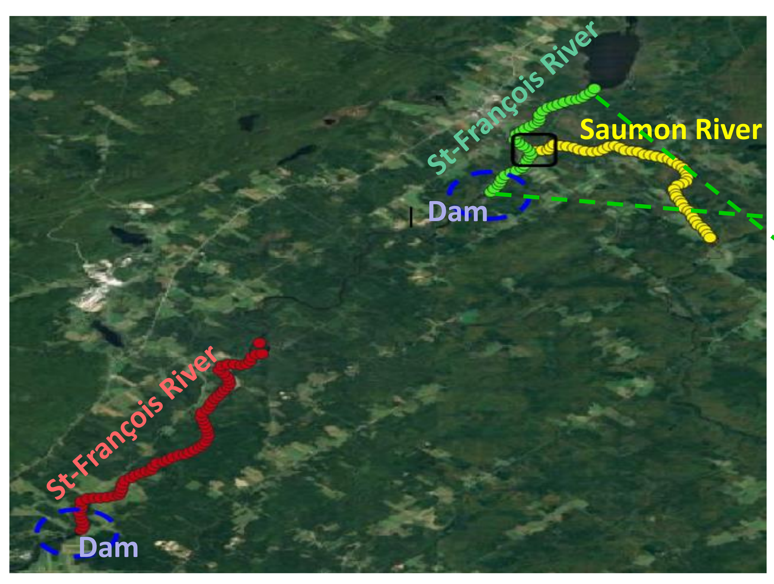


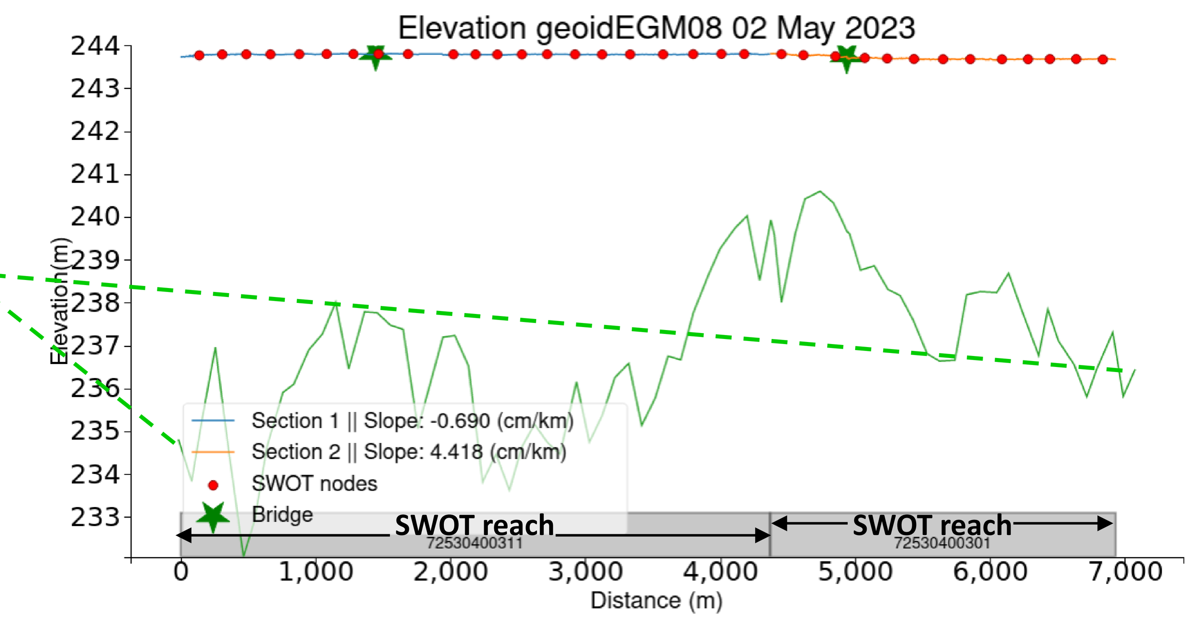
- Lake volume change example from “official” SWOT processing chain (from M. Delhoume):



Kiamika reservoir bathymetry (~44 km2; a.) and volume change (b.) from virtual SWOT data (green and orange lines) & "true" storage change (red line)

- Water level profile, water level probe, drone, camera, ADCP measurements under the cal/val orbit in spring 2023 (see Siles et al. Young Researcher Poster and Trudel et al. oral during cal/val session, Wednesday 20 September):





- Developed tools to process SWOT data PixC, PixCVec and Lake L2 product -> PixC is needed to investigate some unexplained errors on Lake L2 products
- Developed tools to process in situ data to compare them to SWOT products (at nodes or reach)

Conclusions

- Errors on water extent are the main cause of error on volume change. As expected, error budget and water classification depend on the location of the lake in the swath.
- Vector products suitable to study lakes in Quebec, but analyzing pixel cloud product needed when an error or unexpected result is detected in the vector product
- SNORKS done in collaboration with CNES and CS Group teams -> helped lake processing chain validation

Acknowledgements

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References

- Desrochers N. et al. (2013). Effects of aquatic and emergent riparian vegetation on SWOT mission capability in detecting surface water extent. IEEE JSTARS, 14, 12467-12478, doi:10.1109/JSTARS.2021.3128133