Satellite Altimetry for Inland Water in Malaysia

Project Members:

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Background

Importance of Project

- Water-levels in lakes are traditionally measured from gauge data. While gauging stations can provide accurate water-level observations, only limited gauged water-level measurements are available in remote areas (e.g. Temenggor Lake, Kenyir Lake etc).
- For a sustainable dam management, information such as lake water-levels are essential for water resource management and understanding the impact of climate change and extreme weather.

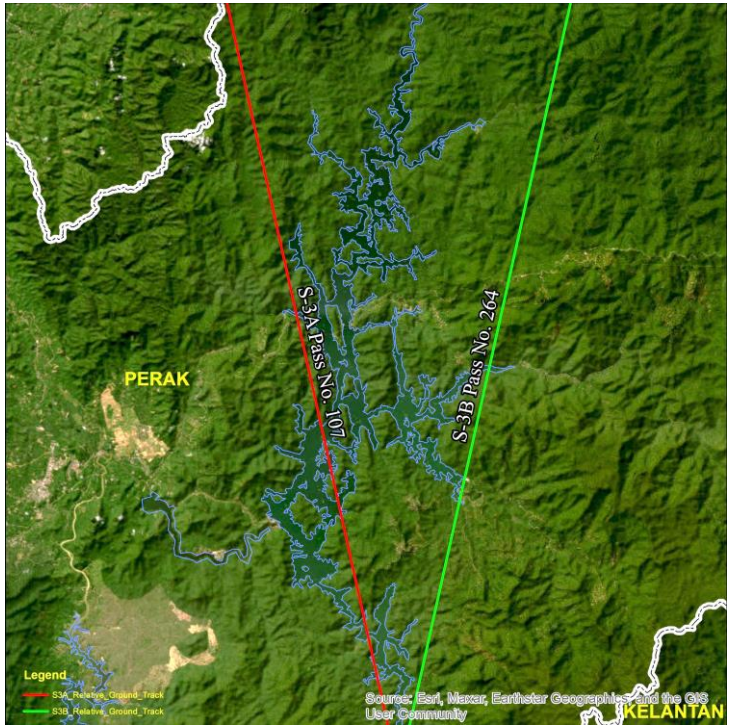
Satellite Altimetry Technology

- The technology of satellite altimetry has been recognised as an essential technique for monitoring inland waters. It is proven to be an important tool when in-situ data are sparse or non-existent.

Remaining Problem to Solve

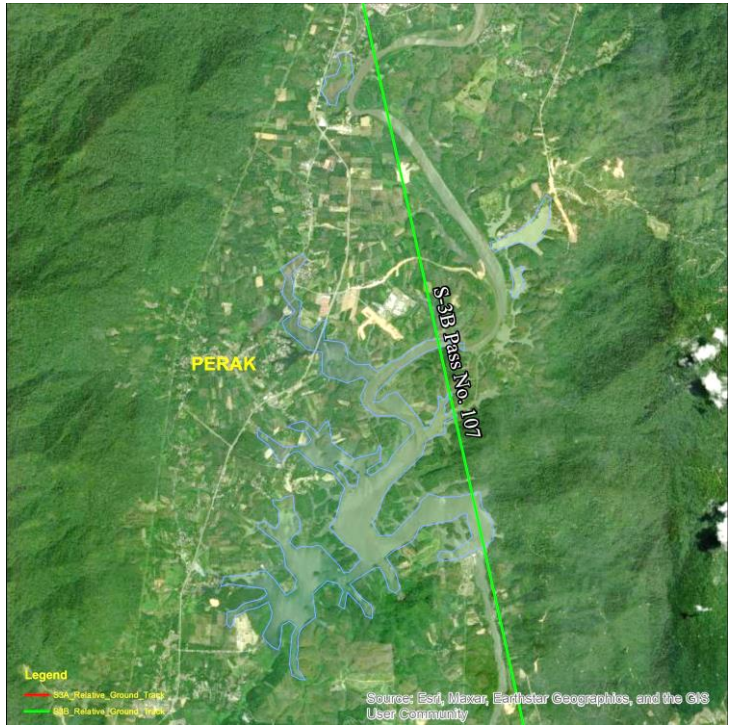
- The altimeter adds value to the existing technique of gauged water-level by improving the spatio-temporal coverage, and reaching to the area where gauged station becomes unavailable.
- However, the technology has yet to be adapted in Malaysia due to its' relatively small size of lakes and rivers.
- Coastal altimetry has been established in Malaysia for various applications over coastal ocean (e.g. sea level rise (NAHRIM), coastal vulnerability assessment etc.). However, application to the inland water is yet to be explored.

Sentinel 3A and 3B Data Availability over Malaysian Lakes



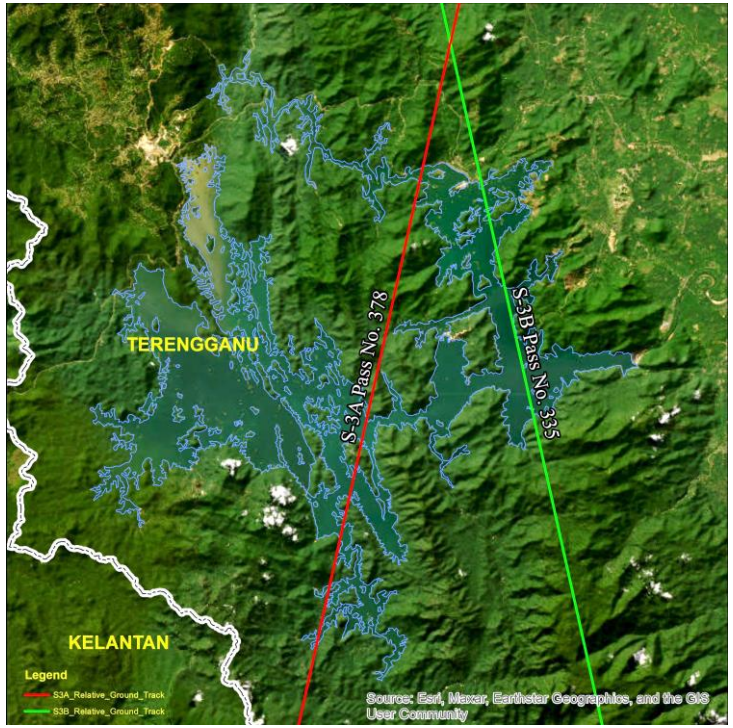
Temenggor Reservoir, Perak

Water Surface Area = 137.25 sq. km [1]



Chenderoh Reservoir, Perak

Water Surface Area = 8.55 sq. km [1]



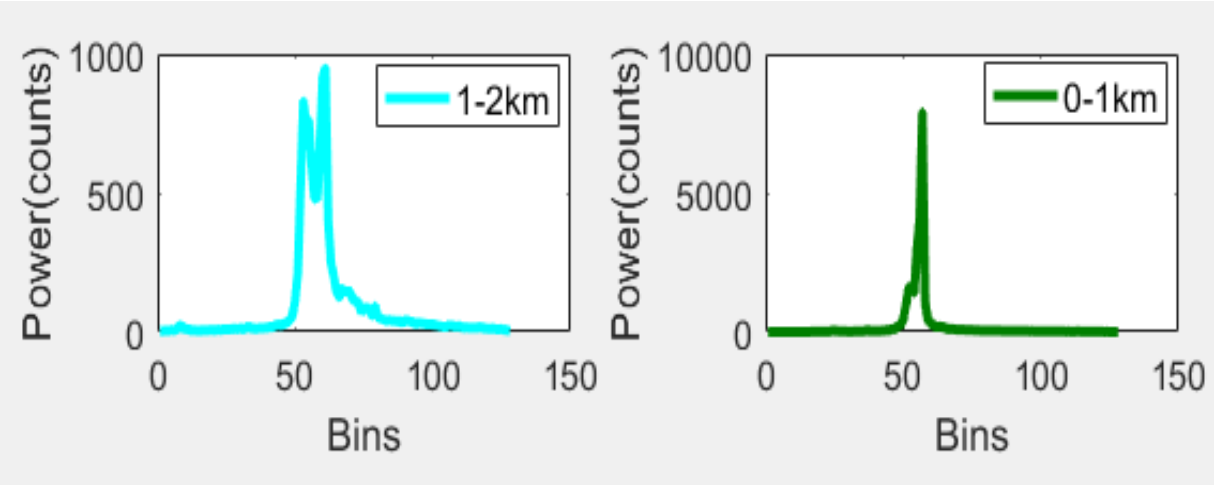
Kenyir Reservoir, Terengganu

Water Surface Area = 326.38 sq. km [1]

Satellite altimeter tracks are available in several lakes in Malaysia, thus the potential for inland water application (water-level monitoring and forecasting) could be further explored.

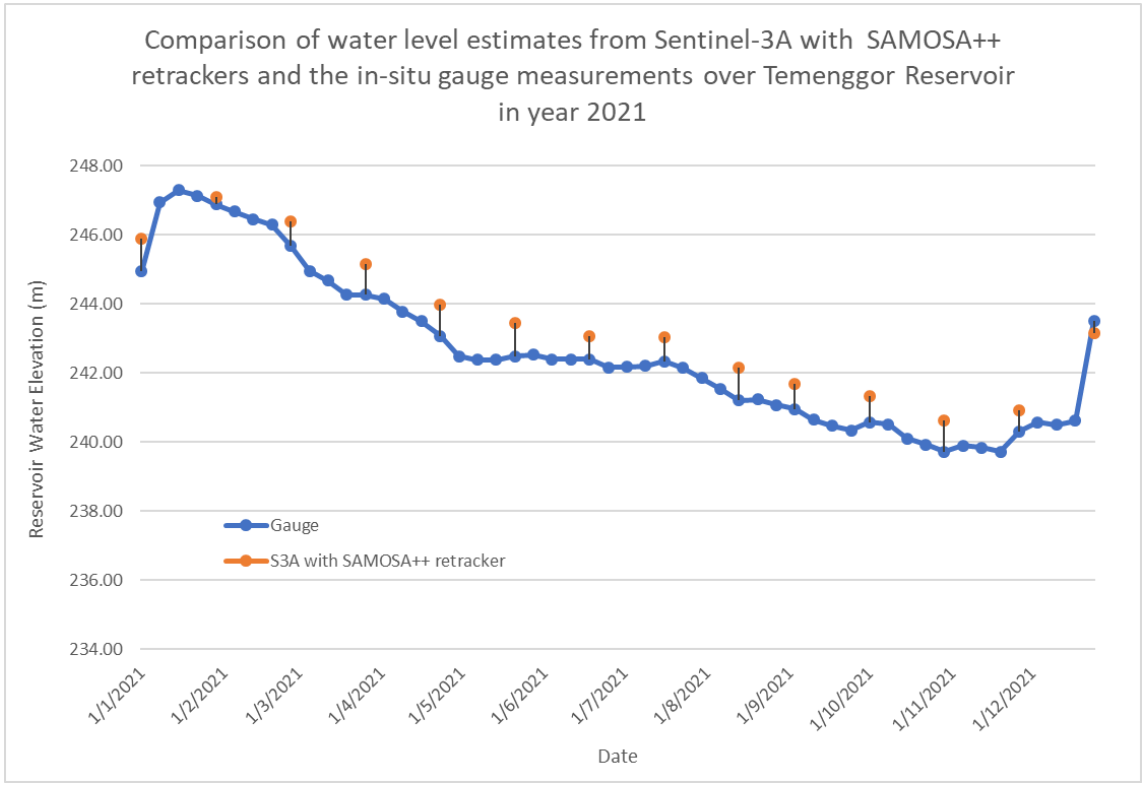
[1] *Messager, M.L., Lehner, B., Grill, G., Nedeva, I., Schmitt, O. (2016): Estimating the volume and age of water stored in global lakes using a geo-statistical approach. Nature Communications: 13603. doi: 10.1038/ncomms13603. Data is available at www.hydrosheds.org.*

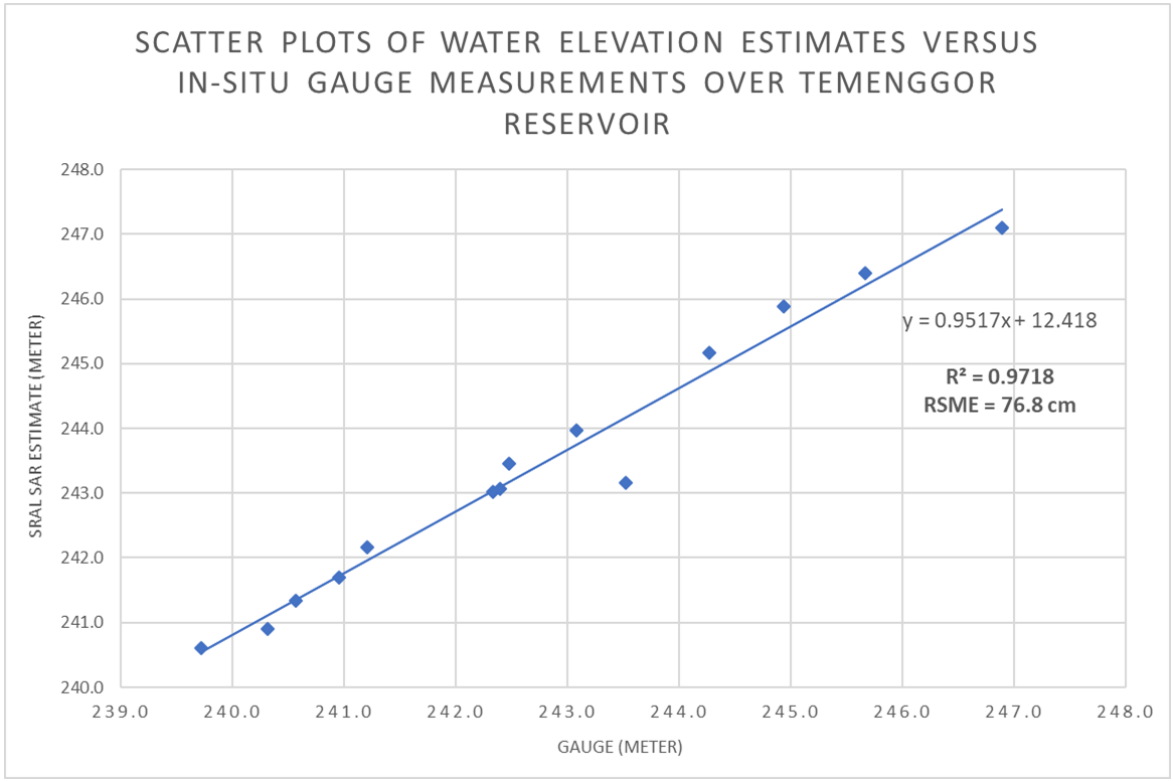
How convincing is SAR altimetry data in Malaysia?



Waveform shapes along Sentinel 3A pass 107 passing Chenderoh lake

Water Elevation Profile Against Gauged Level

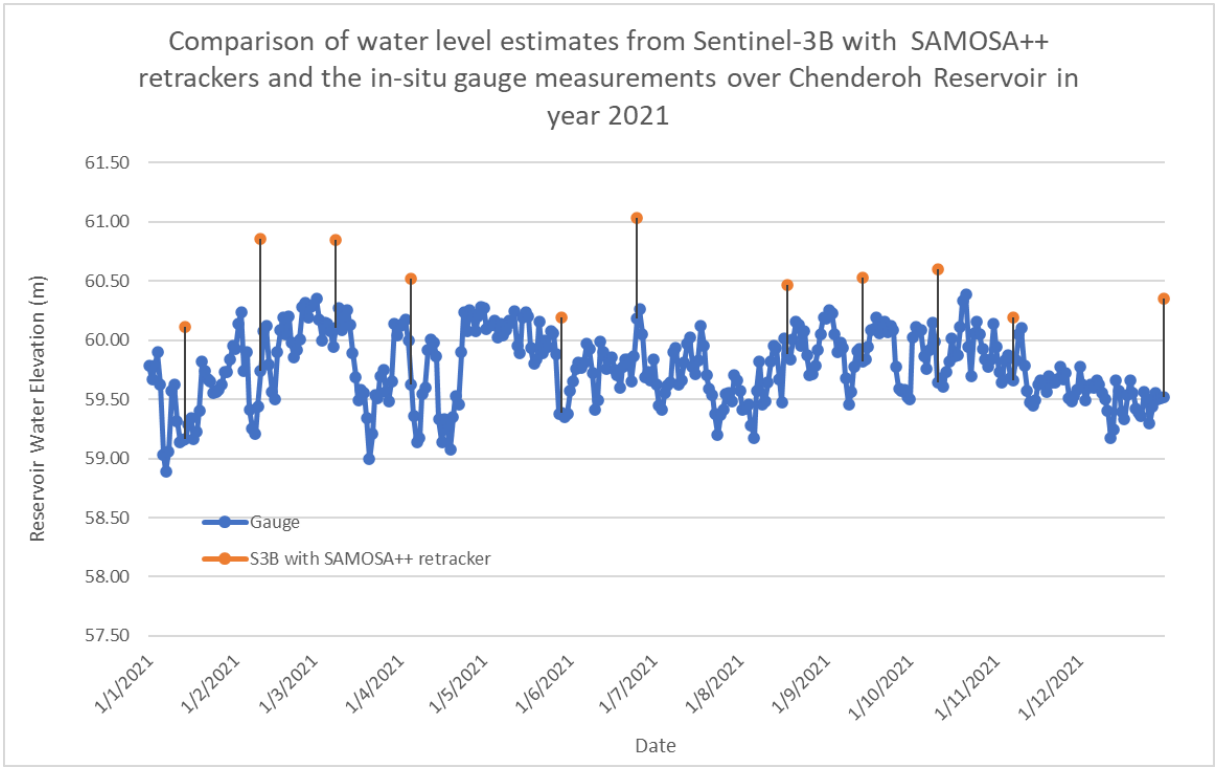


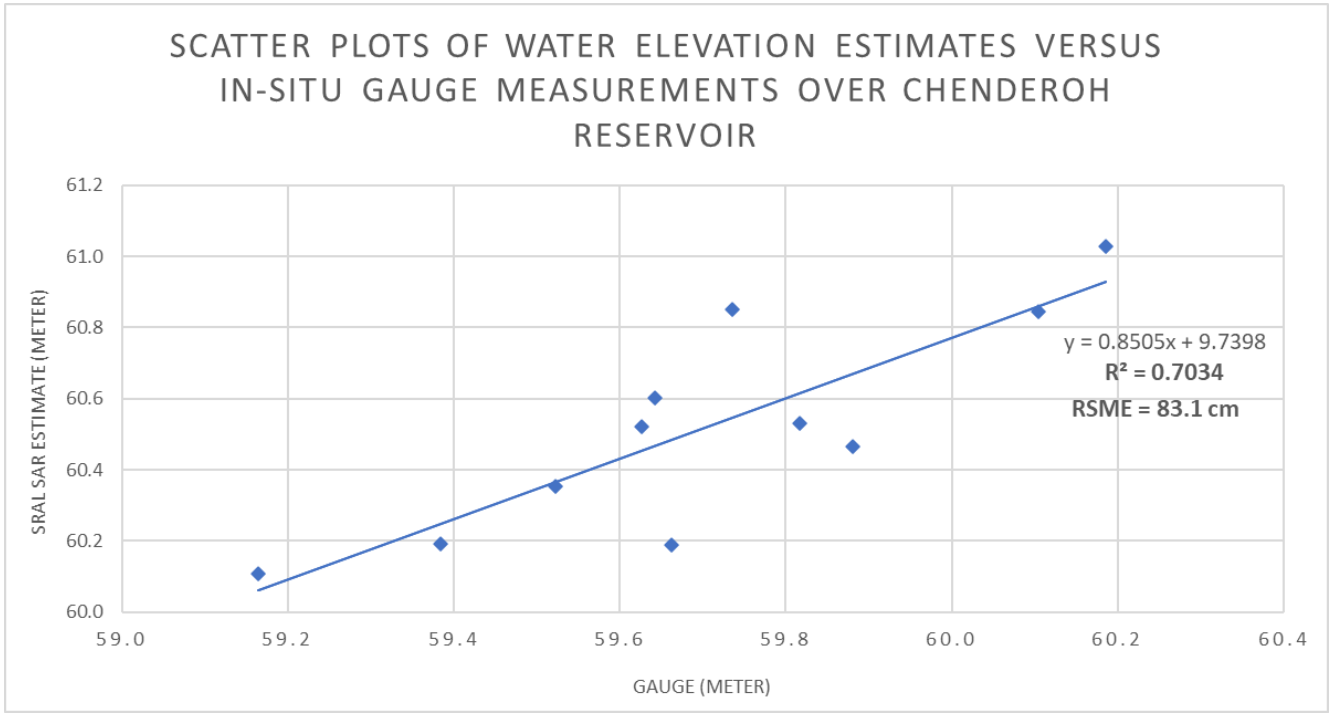


SAR altimeter water elevation shows a good agreement with the gauged level. Promising results for a relatively small reservoir < 150 sq. km

R^2=0.9718, RMSE=76.8 cm

Water Elevation Profile Against Gauged Level





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R^2=0.7034, RMSE=83.1 cm

Discussion

- This is the pioneer to investigate the data reliability and accuracy for the relatively small lakes in Malaysia.
- In Malaysia, the application of radar altimeters for inland water has never been explored. This is due to the relatively small lakes/rivers, thus corrupting the radar signals.
- The typical size of lakes and rivers in Malaysia is ~ 100 sq. km.
- The findings from this study:

-the SAR altimetry signals show a clear leading edge, and thus could be possible for extracting the water returned from the waveforms.

-The RMSE and correlation of radar altimeter data against gauged levels show some degree of relationship (up to 80 cm of RMSE, and $\geq$0.7 correlation).

Acknowledgement

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