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Quality Flag and Uncertainties over Inland Waters

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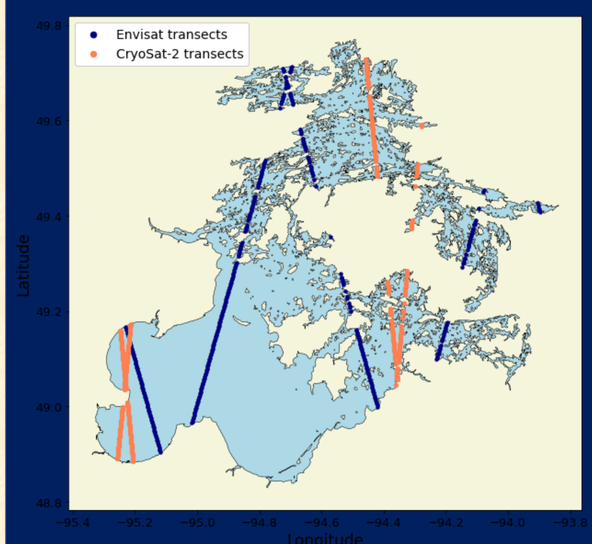
Introduction

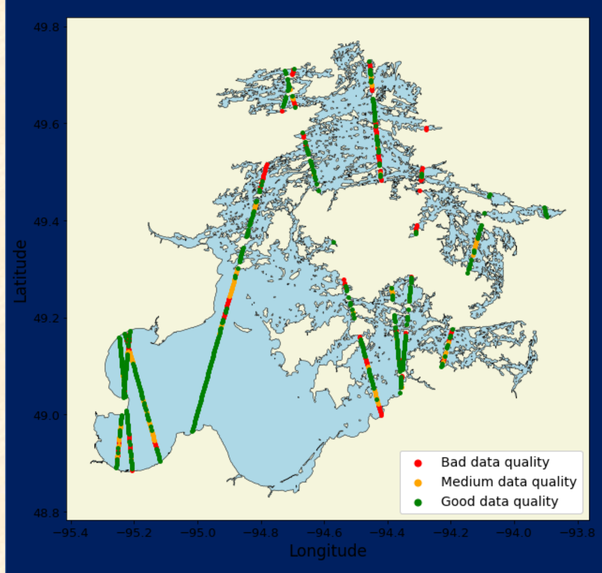
Inland waters are essential for environmental, societal and economic services such as transport, drinking water, agriculture or power generation. But inland waters are also one of the most affected resources by climate change and human populations growth.

Altimetry, which has been used since 1992 for oceanography, has also proven to be a useful tool to estimate inland water surfaces such as rivers and lakes, which are considered Essential Climate Variables (ECVs). However, the heterogeneity of the target sizes, surfaces roughness and the surrounding environment near the water targets make the interpretation of the altimetry retrieved water surface height (WSH) more complex, especially in terms of quality and uncertainties of the measurements.

This poster describes the results of a waveform classification method based on neural network algorithms, which aims at identifying reliable and unreliable measurements on water body targets. Waveforms resulting in WSH estimation are systematically classified in three groups of distinct quality in order to define a quality flag, which is in turn used to quantify uncertainty over time of WSH . The definition of this quality flag is being implemented into two ESA projects using data from the reprocessing of several missions : FDR4ALT with data from ENVISAT, ERS-1 and ERS-2 missions, and CryoTempo with data from Cryosat2 (hereafter CS2).

Waveform classification approach

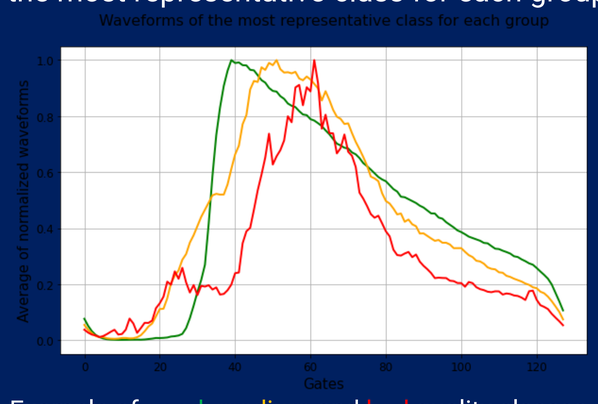




The waveform classification method is applied on the Lake Woods, where both CS2 and ENVISAT missions have transects for each cycle.

Each WSH measurement is associated to a group of good, medium or bad quality according to its waveform class. The spatial distribution of these groups is most of the time related to the lake shape : bad data quality are often around the shoreline as echoes are complex due to the proximity of land area.

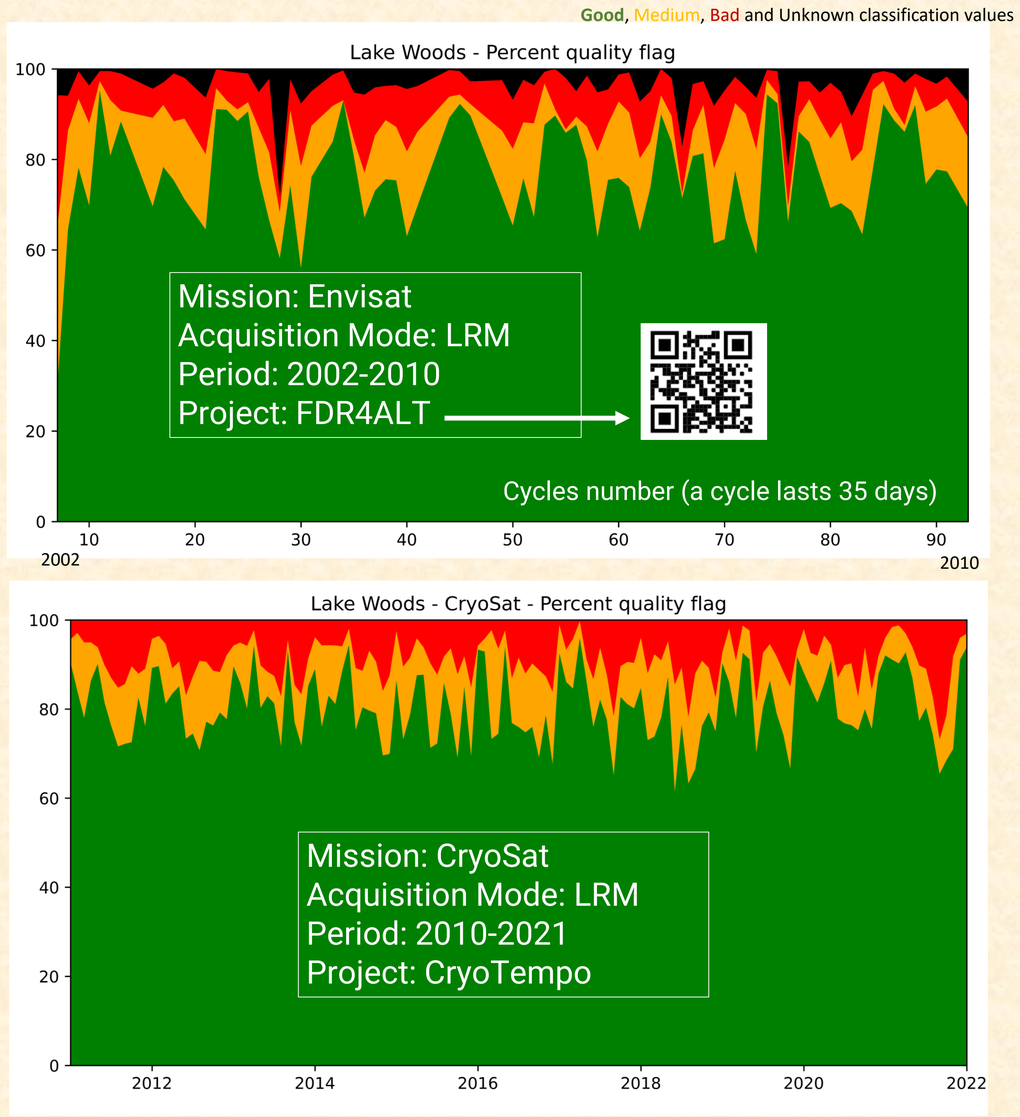
The case of Lake Woods is representative of this general behavior with good data quality gathered in the middle of the lake. The reliability of the waveform classification is clearly confirmed by the average waveform of the most representative class for each group.



Example of good, medium and bad quality classes of waveforms for WSH estimation (CryoSat2)

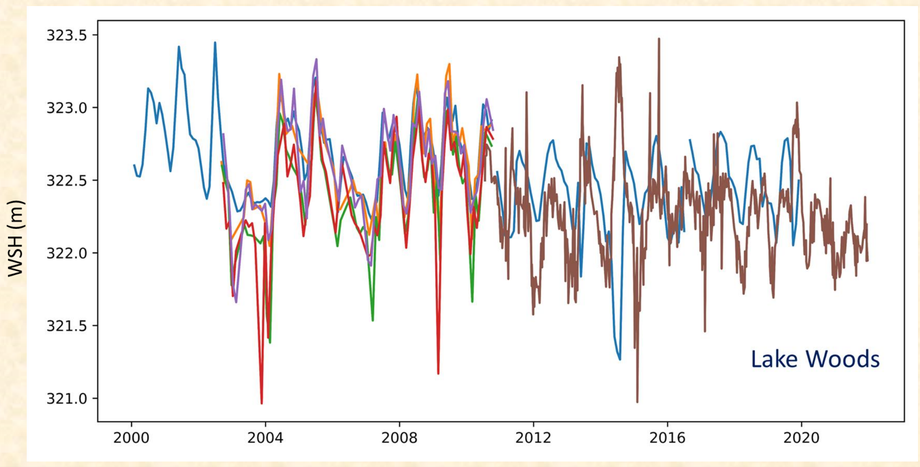
Quality flag evolution over Lake Woods

Good, Medium, Bad and Unknown classification values



Percentage of data in the different quality classes as a function of time over Lake Woods. Both mission data exhibit an annual cycle in the quality percentages, linked to water icing coverage.

Comparison of altimetry based timeseries using good quality data, based on our flag, to in situ data showing a very good correlation.



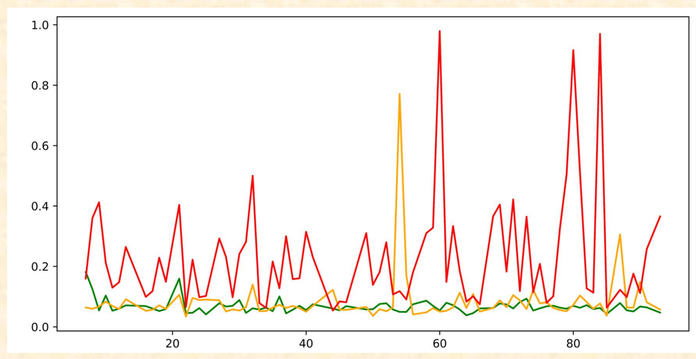
Blue: Water Office of Canada (in situ)

Mulitcolor : Envisat data (multitrack, 2002-2010)

Brown : Cryosat data (2010-2020)

The range uncertainty, which drives the error budget, is based on a statistical method that estimates the retracking noise, defined as the difference between consecutive measurements, of a similar quality class, on a given surface.

Plot shows that for lake Woods, data qualified as good quality present a 10 cm uncertainty on range for ENVISAT mission data.



Uncertainty (in m) per cycle and per quality flag:
Green: Good quality
Orange: Medium quality
Red: Bad quality (higher uncertainty)

Conclusion

The waveform classification, based on a neural network algorithm, allows to identify reliable measurements on water body targets, and can be used as a metric for WSH data quality. This information is being implemented in two ESA projects generating products dedicated to the Inland Water community: FDR4ALT (ERS1, ERS-2 and ENVISAT data) and CryoTempo (Cryosat-2 data). We present a method to provide data uncertainties in Level 2 products. Results showed that over lakes, good quality data have 10 cm uncertainty for ENVISAT. This methodology is being applied to rivers, wetlands, floodplains …