

## Validation of CryoSat-2 SAR mode based lake levels - DTU Orbit (08/11/2017)

### Validation of CryoSat-2 SAR mode based lake levels

Lake level serve as an important indicator of the climate and continuous measurements are therefore essential. Satellite radar altimetry has now been used successfully for more than two decades to measure lake level as an addition to gauge measurements. The technique has, due to the large footprint of conventional altimetry, primarily been used for large lakes. CryoSat-2, which was launched in 2010, carries the first altimeter that is able to operate in SAR mode. The along-track resolution is approximately 300. m in SAR mode thus enabling us to accurately monitor substantially smaller lakes. Here we evaluate the precision of the along-track mean lake levels derived from CryoSat-2 data for five lakes; Skanderborg sø, Mossø, and Arresø (Denmark), Okeechobee (US), and Vänern (Sweden) with a surface area ranging from 9 to 5600km<sup>2</sup>. Three of the lakes are compared with gauge data. As a reference we compare our results with water levels obtained from Envisat. We find that the along-track precision of the mean based on CryoSat-2 is a few centimeter, even for the small lakes, which is a significant improvement compared to previous missions such as Envisat. When validating against gauge data we find RMS values of differences between the estimated lake levels and in-situ gauge measurements of only 8cm or less, after bias correcting the estimated lake levels. To estimate the along-track mean values we apply a novel approach. Instead of attempting to identify and remove the polluted observations we use a mixture distribution to describe the observation noise, which prevents the polluted observations from biasing our final reconstructed time series. These results demonstrate the promising possibilities of the upcoming mission Sentinel-3, which potentially will be able to provide accurate time series even for small lakes.

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