Assessment of Green LiDAR to map the bathymetry of lakes

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ABSTRACT: LiDAR stands for Ligth Detection And Radar technology and is a technique for detailed mapping of the Earth's surface. The LiDAR can be divided into two main types, the Red LiDAR which is based on the use of electromagnetic waves in the infrared wavelength specter (1064 nm) and can be used to map terrestrial areas. In contrast to Red LiDAR, the Green LiDAR penetrates water surfaces by using another wavelength spectrum, i.e. the green spectrum of electromagnetic waves (532 nm). This is a more complex and costly technology and has so far been less applied in Norway. Due to the field of application of Green LiDAR, it is sometimes denoted as bathymetric LiDAR, in contrast to the topographic LiDAR (Red Lidar).

The overall objective of this study reported has been to assess the suitability of Green LiDAR to map the bathymetry of lakes. The has been carried out by use of Green LiDAR data from three different lakes, i.e. Selbusjøen and Benna in Trøndelag and Krøderen in Viken, being the only lakes in Norway with Green LiDAR bathymetry data available. The assessment has been made by systematically compare the performance of different lidar sensors, as well as multibeam echosounder (MBES), against each other in those lakes where two or more datasets are available and spatially overlap.

The residuals while comparing multibeam (MBES) measurements with Green LiDAR measurements and Green LiDAR measurements against each other are generally very small, i.e., in most cases, much less than 10 cm, based on the mean and median residuals. When comparing different Green LiDAR sensors, the residuals are close and normally distributed around 0 cm, indicating no systematic error. The outliers in the datasets (large residuals, filtered out in some of the figures) have the highest representation in the outer range of the coverage, i.e., in very shallow water and close to the maximum penetration depth of the sensors.

Under perfect flying conditions and clear water, Green LiDAR seems capable of measuring down to more than 20 meters below the lake surface as in Lake Benna, while in most lakes probably less than 20 meters. Green LiDAR might be more suitable for mapping shallow parts of lakes, while MBES is more suitable for the deeper parts. In moderately deep areas, the two technologies seem both suitable and useful.