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A new processing strategy for CryoSat-2 SAR data over lakes based on waveform classification, sub-waveform retracking and outlier rejection

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The estimation of lake water level variations with satellite altimetry is a challenging task because the majority of altimeter waveforms of smaller lakes are contaminated by land. In this study we used CryoSat-2 SAR data to estimate reliable water level time series for the four lakes: Tonle Sap (Cambodia), Vättern (Sweden), Okeechobee (Florida, USA) and Lough Neagh (North Ireland) with different size, surrounding landscape and water oscillation. Therefor a novel processing strategy was developed based on waveform classification, sub-waveform retracking and outlier rejection. The classification of waveforms is essential to find out which observations are performed over water and at the land-water transition. For this purpose, in a training area CryoSat-2 SAR waveforms were grouped into clusters with respect to the similarity of the amplitude, width and center of gravity of the waveforms by using the k-means algorithm. Especially for waveforms at the land-water transition the identification of the "best" sub-waveform becomes very important. The results are validated with modeled water heights derived from CryoSat-2 SAR data, multi-mission water level time series from classical altimetry and in-situ gauging data. The CryoSat-2 time series show similar quality although in our approach no model assumptions are applied. Especially for smaller lakes water heights can be derived from CryoSat-2 SAR data with higher precision than from classical altimeter data.