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Method for Improving ICESAT-2 ATL13 Altimetry Data Utility on Rivers

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Abstract : The application of ICESAT-2 altimetry data in river hydrology critically depends on the accuracy of the mean water surface elevation (WSE) at a virtual station (VS) where satellite observations intersect with water. The ICESAT-2 track generates multiple VSs as it crosses the different water bodies. The difficulties are particularly pronounced in large river basins where there are many tributaries and meanders often adjacent to each other. One challenge is to split photon segments along a beam to accurately partition them to extract only the true representative water height for individual elements. As far as we can establish, there is no automated procedure to make this distinction. Earlier studies have relied on human intervention or river masks. Both approaches are unsatisfactory solutions where the number of intersections is large, and river width/extent changes over time. We describe here an automated approach called “auto-segmentation”. The accuracy of our method was assessed by comparison with river water level observations at 10 different stations on 37 different dates along the Lower Murray River, Australia. The congruence is very high and without detectable bias. In addition, we compared different outlier removal methods on the mean WSE calculation at VSs post the auto-segmentation process. All four outlier removal methods perform almost equally well with the same R2 value (0.998) and only subtle variations in RMSE (0.181–0.189m) and MAE (0.130–0.142m). Overall, the auto-segmentation method developed here is an effective and efficient approach to deriving accurate mean WSE at river VSs. It provides a much better way of facilitating the application of ICESAT-2 ATL13 altimetry to rivers compared to previously reported studies. Therefore, the findings of our study will make a significant contribution towards the retrieval of hydraulic parameters, such as water surface slope along the river, water depth at cross sections, and river channel bathymetry for calculating flow velocity and discharge from remotely sensed imagery at large spatial scales.

Keywords : lidar sensor, virtual station, cross section, mean water surface elevation, beam/track segmentation
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