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A waterline method to derive intertidal bathymetry from multispectral satellite images and its application to hydrodynamic modelling

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Bathymetric data are a key parameter to assess shallow-water hydrodynamic processes. In-situ surveys provide high data quality; however, surveys are expensive and cover a limited spatial extent. To fill this gap, over recent years, the Satellite Derived Bathymetry (SDB) techniques have been developed. The present work aims to elaborate a technique to estimate bathymetric data from satellite images for intertidal zones. The method applied in this work is composed of 6 steps: (1) image querying and pre-processing is done through Google Earth Engine application (API) using Copernicus Sentinel 2A and B, product type 2A. (2) Identification of the intertidal zone for the study area by temporal variability of the Normalized Difference Water Index (NDWI). (3) Recognition of the waterline in each image by the use of an adaptive threshold technique; and assignment of the elevation for each detected waterline based on local observed tide heights. (4) Validation of the estimated bathymetry by comparison with LiDAR measurements. (5) Implementation of a SDB correction: numerical and/or statistical and, (6) assessment of the validity of SDB for hydrodynamic modelling. The SDB technique was applied to 4 different estuaries in New Zealand: Maketu, Ohiwa, Whitianga and Tauranga Harbour showing similar or better estimations in comparison to previous works using optical or synthetic aperture radar (SAR). For Tauranga Harbour, results from the statistical and dynamical corrections showed that the major error source is due to the image optical properties and environmental conditions when the image was acquired (35%). However, the tidal propagation can significantly decrease the SDB accuracy (13%). Finally, the use of the SDB in numerical simulations does not present huge differences in the predicted waterlevels in comparison to the use of survey bathymetry, showing that SDB could be potentially used for coastal flooding simulations.