Fully Automated Bathymetry

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Satellite imagery can be used to map bathymetry cheaply over large and inaccessible areas. Physics-based approaches to satellite-derived bathymetry do not require existing data for calibration, but they are sensitive to small errors in radiometry that arise from imperfect sensor calibration or atmospheric correction. We developed a fully automated workflow for physics-based satellite-derived bathymetry, and applied it to over 850 Sentinel-2 and Landsat 8 scenes across five sites spanning 84 degrees of latitude. Comparison to validation data demonstrated that use of Landsat 8 imagery leads to overestimation of water depth for intermediate depths (from ~5 to ~15 m) across all sites, a pattern also seen to a lesser degree with Sentinel-2 imagery, most notably for two Arctic sites. Applying greater-than-unity vicarious gains to the 443 nm band of either sensor was able to correct this overestimation. The vicarious gains needed are of comparable magnitude to the mission requirements for these sensors' radiometric accuracy, and to their estimated radiometric calibration uncertainties. However, the optimal vicarious gain differs between the five sites, and additional investigation is needed to better understand its physical basis. The resulting bathymetry estimates are comparable in accuracy to those produced with empirical methods, yielding RMSE values of ~1 m in clear low-latitude waters and <2 m in inland and Arctic waters.