Detecting coral reef presence using ICESat-2 data and machine learning methods

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As ocean temperatures and sea levels continue to increase and weather storms become more severe and frequent, benthic habitats such as coral reefs become more vulnerable to deadly conditions such as mass bleaching events and infectious diseases. With these ever-changing conditions, it becomes imperative that monitoring efforts are made to ensure longevity of the world's coral reefs. Current coral reef monitoring techniques require significant manpower to collect in-situ data, such as fixed site surveys using photography and visual counts. The Ice, Cloud, and land Elevation Satellite-2 (ICESat-2), while initially intended for collecting data regarding changes in the cryosphere, utilizes a green laser thus opening the door for an abundance of oceanic and bathymetric applications. ICESat-2 is currently an underutilized data source for ocean-related purposes, despite its high resolution and frequency, as well as the economical alternatives it potentially offers the remote sensing community. Using ICESat-2 as the primary data source, in this study machine learning methods are used in the detection of coral reefs located around Heron Island, Australia. Classic ICESat-2 variables such as date, depth and geographical location are used in conjunction with algorithmically extracted features of the seafloor such as a window-based pseudo-rugosity measurement. Binary logistic regression results are promising, motivating a comparison with convolutional neural network results. Both machine learning models show that the addition of Sentinel-2 satellite derived bathymetry values increase accuracies of coral detection. This research suggests ICESat-2 to be a useful data source in future coral reef monitoring methodologies. Ongoing work examines the value of automated reef identification in developing monitoring methodologies, as well as the value of other information that can be extracted from ICESat-2 data alone. Future steps will explore the applicability of these results to other types of reefs or benthic habitats.