

EVALUATING SPACE BASED REMOTE SENSING ALGORITHMS FOR ARCTIC SHORELINE DETECTION

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INTRODUCTION

In the face of climate change, Arctic coastal regions are increasingly an area of interest. Arctic sea ice loss is accelerating, which creates longer periods of open-water nearshore, potentially leaving coastal areas more vulnerable to erosion, with coastal retreat rates increasing by a factor of 2 or more (Nielsen [2022]). Understanding this change is important to protect vulnerable coastal communities and for tracking a rapidly changing region. However, this region is hard to study due to its remote location, harsh weather, often impassable seas, and lack of resources for research. This work investigates the use of space-borne sensors to quantify shoreline change and coastal morphology evolution in Arctic regions.

METHODS

We evaluate multiple methods to investigate the applicability of different sensors and algorithms to measure shoreline change, nearshore ice coverage, and bluff erosion in Arctic regions, including a range of shoreline types and coastal processes impacting shoreline evolution. Specifically, we investigate Point Hope (a location with important cultural sites and in-situ data [Cohn 2022]), Drew Point (which has experienced dramatic coastal erosion in the last decade [Jones 2018]), and Utqiagvik (the largest city on the North Slope).

To investigate the ability to track shoreline change in Arctic regions, we apply CoastSat, an open source, frequently used algorithm which exploits publicly available Sentinel and Landsat satellite imagery to automatically extract shorelines (Vos [2019]). CoastSat was developed for sandy shorelines and automatically maps the sand water interface as well as white water location in the surf zone. CoastSat is limited to images that are taken during daylight hours so we investigate other sensors and remote sensing techniques that can collect data during night time to fill gaps in collection during winter months.

In its default configuration, CoastSat has a classification algorithm that separates the image pixels into 'sand', 'white-water', 'water', and 'land'. In the Arctic due to the presence of seaward and landward ice those categories may need adjustment (Figure 1). However, initial investigation shows that the 'white-water' classification can be utilized in images of Arctic regions to indicate the presence of ice, and at times still provide a reasonable approximation of the shoreline (Figure 1). We evaluate the accuracy of this pixel classification and subsequent shoreline extraction over time, explore the addition of new classifications, and compare results to in-situ data of shoreline locations.

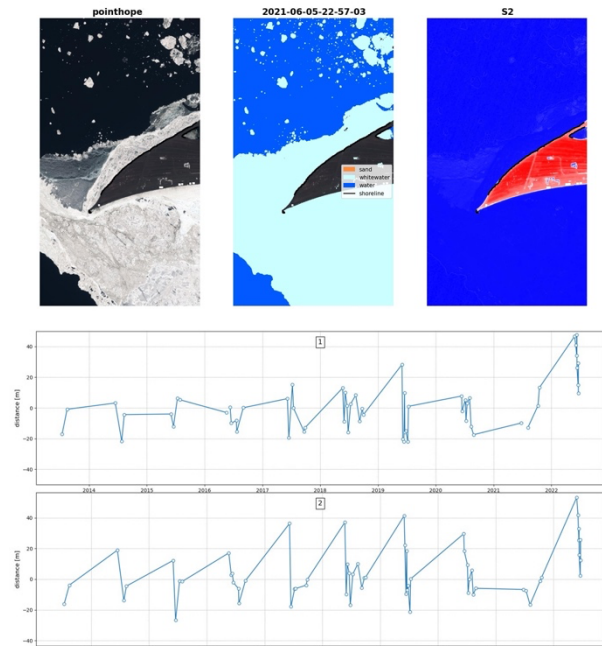


Figure 1. (a) Results of example default CoastSat classification at Point Hope, Alaska (b) Two transects of shoreline change over 2014-2022 showing the relative change in shoreline position over time at Point Hope, Alaska

RESULTS:

Example initial results for Point Hope are shown in Figure 2. Initial results suggest the first shorelines extracted at the beginning of each summer may have strong on-shore biases potentially due to the presence of ice on the beach. Ongoing work is focused on assessing and improving these results, through investigation of effects of ice, darkness, image registration and spatio-temporal resolution, sensor type, and water levels on tracking shoreline change.

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