Title
A New Method for Iceberg Tracking Using Contour Matching

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Abstract

Icebergs drifting through the Southern Ocean release fresh water and nutrients. This has local impacts on surrounding ecosystems and sea ice formation. On a global scale, salinity patterns and ocean circulation are affected. In addition,
tudying icebergs as a proxy for ice shelves in a warming climate can help predict future climate impacts and sea level rise. Furthermore, drifting icebergs can pose a threat to ship navigation and offshore projects. In the past, icebergs have been tracked mostly manually, a time-consuming and labour-intensive task. The most widely used data source for this is Synthetic Aperture Radar (SAR), as icebergs often have a much higher backscatter than their surroundings. A few attempts have been made to automatically track icebergs, but these methods do not allow tracking of icebergs that are only partially visible in a satellite image. In this study, a new method is proposed based on partial contour recognition using the contours' curvature, a technique derived from the matching of ancient pottery fragments. Since the automatic tracking of multiple icebergs requires a large amount of data and computational resources, the web-based environment of Google Earth Engine is used. The new method, called the Contour Curvature (CC) method, is based on three main steps. (1) Detection of icebergs using Simple Non-Iterative Clustering (SNIC) in combination with a threshold function. (2) The icebergs targets are filtered using an area and solidity filter. (3) Among the remaining targets, the best match is selected by comparing the curvature function of the contour with the reference iceberg. The performance of the algorithm is tested by automatically tracking 15 icebergs and comparing the results to the existing Centroid Distance Histogram (CDH) method. The overall performance of the CC method can be attributed in large part to the inclusion of the area and the solidity filter, with the latter serving as an overall shape filter. For small icebergs (< 10 km2), both the CC and CDH method perform poorly, due to the abundance of icebergs in this range. For medium to large icebergs (10 to 1000 km2), the methods show similar performance with one method occasionally outperforming the other method. For large icebergs (> 1000 km2), the CC method performs better. Since these icebergs are often only partially visible, this leads to strong deviations in the histogram used in the CDH method, making this method less suitable for these situations. Since the CC method allows for partial contour recognition, these icebergs can still be identified. Furthermore, due to the wide variety of backscatter conditions, the detection method occasionally fails to distinguish icebergs from their surroundings.