



Robust Satellite Techniques for detecting and monitoring icebergs

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One of the main consequences of climate change is undoubtedly rising temperatures, which cause the polar ice caps in the Arctic and Antarctic regions to melt and, as a result, icebergs to break off. Due to their high variability in shape and size, their movements and trajectories are not easy to predict, posing a threat to maritime safety and offshore activities. Particularly, along the western coast of Greenland (e. g. in the Davis Strait), in addition to the growing number of icebergs, there has also been an increase in maritime traffic, which has tripled due to the opening of new trade and tourist routes.

Historically, icebergs were detected exclusively by naval sightings or aerial patrols, which were inherently limited in terms of accuracy and unable to reach remote or inaccessible regions. In this contemporary era, advancements in satellite technology have significantly transformed the way in which icebergs are observed, ensuring high temporal and spatial resolution, global and large-scale acquisition, as well as accessible free near-real-time data. The majority of past and present studies focusing on the detection and tracking of icebergs using satellite imagery have employed fixed threshold methodologies. These tend to be prone to false alarms, offer limited sensitivity, and are not easily exportable or automatable due to their heavy dependence on observation time and location. The integration of multispectral information with diagnostic elements from a spectral perspective is a fundamental aspect of the aforementioned techniques.

In order to overcome the limitations described above, this study proposes a multi-temporal differential approach for detecting and mapping icebergs along with other objects that could potentially compromise navigation. This methodology is referred to as Robust Satellite Techniques (RST), and it has been developed to identify statistically significant variations in the signal under investigation, at the pixel level. The RST model, already widely utilised in the domain of natural hazards, is being employed for the first time in the detection of icebergs. The test was specifically conducted within a segment of the ocean in the surrounding area of Nuuk (Greenland), located in the Davis Strait. A preliminary application of the RST approach, just to the visible band of Sentinel-2/MSI, demonstrated, compared with other multi-spectral, fixed threshold approaches, higher sensitivity and reliability, together with an easy and immediate exportability in different geographic areas and observation periods. The methodology was implemented in the Google

Earth Engine (GEE) environment, which allows the process to be fully automated, easily exportable and rapidly executable.