remote sensing

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Technical Note

On the Detection and Long-Term Path Visualisation of A-68 Iceberg

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Abstract: The article presents a methodology for examining a temporal sequence of synthetic aperture radar (SAR) images, as applied to the detection of the A-68 iceberg and its drifting trajectory. Using an improved image processing scheme, the analysis covers a period of eighteen months and makes use of a set of Sentinel-1 images. A-68 iceberg calved from the Larsen C ice shelf in July 2017 and is one of the largest icebergs observed by remote sensing on record. After the calving, there was only a modest decrease in the area (about 1%) in the first six months. It has been drifting along the east coast of the Antarctic Peninsula, and is expected to continue its path for more than a decade. It is important to track the huge A-68 iceberg to retrieve information on the physics of iceberg dynamics and for maritime security reasons. Two relevant problems are addressed by the image processing scheme presented here: (a) How to achieve quasi-automatic analysis using a fuzzy logic approach to image contrast enhancement, and (b) The use of ferromagnetic concepts to define a stochastic segmentation. The Ising equation is used to model the energy function of the process, and the segmentation is the result of a stochastic minimization.

Keywords: SAR image processing; A-68 iceberg; stochastic processes

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1. Introduction

Weather conditions and seasonal variations impose restrictions on the monitoring of Antarctica by satellite remote sensing. Continuous sunlight from December to February makes it a good period for optical image remote sensing. However, clouds, snow and ice elements all display a similar spectral signature in both optical and thermal wavelengths. Antarctica has seven months of winter darkness, from March to September. During the Antarctic night, both synthetic aperture radar (SAR) and infra-red images can monitor ice coverage, however, cloudy weather makes infra-red observation impossible. The scatterometer is an alternative instrument, but because of its low spatial resolution, it can only give rough estimations of large icebergs. Consequently, continuous monitoring of Antarctica can only be carried out by SAR imaging systems. This paper gives an example of Antarctic monitoring by analysing some elements of the drifting trajectory of the A-68A iceberg using Sentinel-1 SAR data.

The fracture of the Antarctic Larsen C ice shelf occurred in 2017 between July 10th and 12th, with a loss of some 5800 km^2 corresponding to about 12% of the entire shelf area. The giant calved iceberg was named "A-68" by the US National Ice Center (USNIC). Later, it broke apart and the largest chunk was named A-68A. It is the sixth largest recorded iceberg, and at present, it is the largest iceberg in the world. Because of its size, an iceberg like A-68A can have a life of several years. Iceberg drifting patterns constitute a risk for navigation and shipping routes. Satellite remote sensing imagery can provide the tool for mapping iceberg trajectory progression.