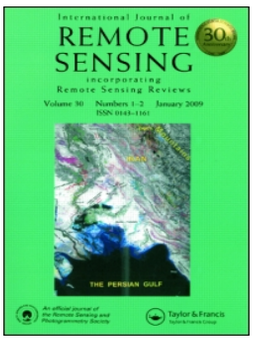

International Journal of Remote Sensing

ISSN: 0143-1161 (Print) 1366-5901 (Online) Journal homepage: http://www.tandfonline.com/loi/tres20

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To cite this article: M. Moctezuma-Flores & F. Parmiggiani (2017) Tracking of the iceberg created by the Nansen Ice Shelf collapse, International Journal of Remote Sensing, 38:5, 1224-1234, DOI: 10.1080/01431161.2016.1275054

To link to this article: http://dx.doi.org/10.1080/01431161.2016.1275054

INTERNATIONAL JOURNAL OF REMOTE SENSING, 2017
VOL. 38, NO. 5, 1224–1234
http://dx.doi.org/10.1080/01431161.2016.1275054

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Tracking of the iceberg created by the Nansen Ice Shelf collapse

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ABSTRACT

This article presents an analysis of the drifting path of one of the two giant icebergs created from the Nansen Ice Shelf (NIS) collapse of 7 April 2016. The study was carried out using synthetic aperture radar (SAR) images of Sentinel-1 satellite. Six SAR images, captured after the collapse from 9 April to 12 May, were retrieved from the European Space Agency Scientific Data Hub and remapped onto an equidistant cylindrical projection. A processing scheme was implemented which consists of the following steps: (1) speckle filtering, (2) binary segmentation, and (3) iceberg centroid detection. The final result is the tracking of the iceberg, with its relative velocity, at the different time intervals.

ARTICLE HISTORY
Received 15 June 2016
Accepted 14 December 2016

1. Introduction

The collapse of the Nansen Ice Shelf on 7 April 2016 was a major event affecting the area of Terra Nova Bay (TNB) (see Figure 1 taken from an Italian Antarctic Manual). The rupture, which caused the detachment of two large icebergs, was captured by two successive Sentinel-1 (S-1) images: the first, on 6 April, only hours before the event, the second, on 9 April, which shows two large icebergs leaving the shelf and drifting to the northeast, presumably propelled by wind, tides, and currents (see Figure 2). Of the two bergs shed by Nansen, only one is large enough to meet the size criteria for naming and tracking by the US National Ice Center; this larger piece is named C33. The area of TNB has been of great interest to Italian scientists as the Italian Antarctic Base 'Mario Zucchelli Station' is located in its vicinity. There have been several studies about TNB area in the last 15 years, in particular studying its winter polynya (Parmiggiani 2006, 2011a, 2011b; Morelli and Parmiggiani 2013; Moctezuma, Parmiggiani, and Lopez 2014) which is one of the most important in Antarctica.

Satellite remote sensing is a useful tool for studying the motion of sea-ice and icebergs (Johannessen et al. 2007), providing complementary basis for establishing kinematic models in time-sequential observations (Kwok 2010). Thorough physical interpretation of synthetic aperture radar (SAR) iceberg signatures, a threshold detection method was implemented using image statistics (Power et al. 2001). The iceberg detection may also include the influence of meteorological and oceanographic conditions on

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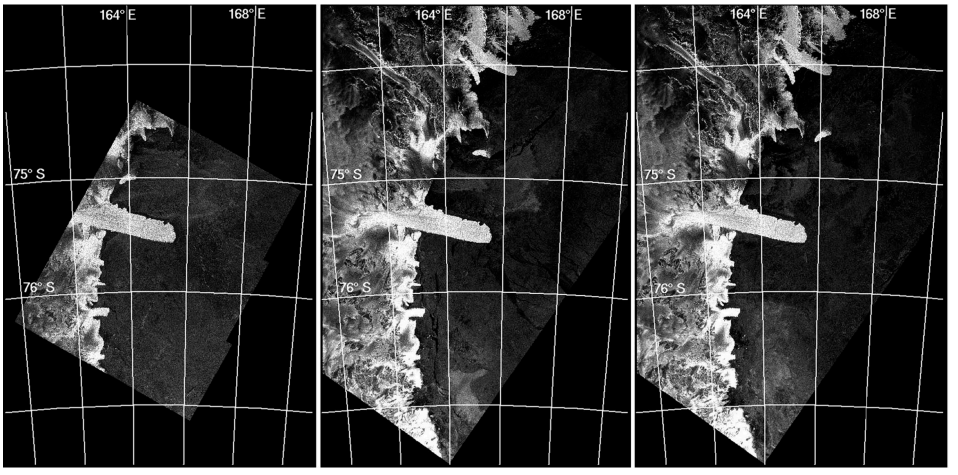

Figure 4. Examples of the SAR image coverage. The drifting path of the C33 iceberg is upward and to the right (northeast direction): left: S-1 IW image of 9 April; centre and right: S-1 EW images of 18 April and 12 May.

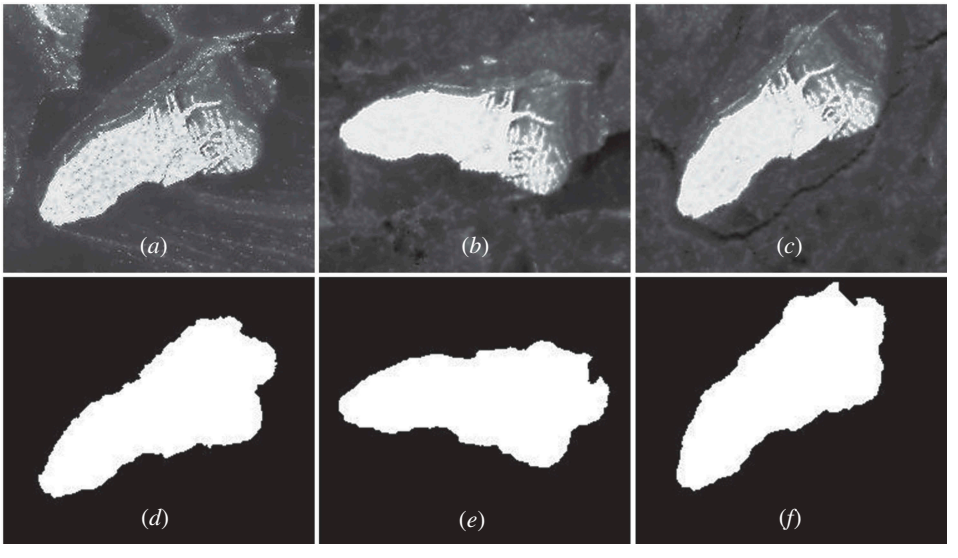

Figure 5. Performance of the filtering and segmentation algorithms. Showing sub windows of the C33 object, first row corresponds to SAR filtering and second row to binary segmentation results on three dates: (a) and (d) 9 April; (b) and (e) 18 April, and (c) and (f) 12 May.

Table 2. Relative displacements and velocities of C33 iceberg derived using the image pairs shown.

image pair (see Table 1)	1–2	2–3	3–4	4–5	5–6
Displacement (km)	46.35	4.18	13.21	3.46	10.23
Velocity (km day^{-1})	5.15	1.40	1.47	1.15	1.14

Figure 6 describes the iceberg drifting in the period studied: on a geo-referenced grid, the mask, with initial (lower-left) and final positions (upper-right) of the iceberg on a black background, is shown. The extracted centroids and the Euclidian path are shown in green.