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Mapping the Antarctic grounding line with CryoSat-2 radar altimetry

Geoffrey Dawson and Jonathan Bamber
University of Bristol, The Bristol Glaciology Centre, School of Geographical Sciences, United Kingdom

The grounding line, where grounded ice begins to float, is the boundary at which the ocean has the most significant influence on the inland ice-sheet. Its position and dynamics are critical in assessing the stability of the ice-sheet, for mass budget calculations and as a parameterisation in numerical models. The most reliable approach to map the grounding line remotely is to measure the limit of tidal flexure of the ice shelf using differential synthetic aperture radar interferometry (DInSAR) or ICESat repeat-track measurements. However, these methods are yet to provide satisfactory spatial and temporal coverage for the whole of the Antarctic grounding zone.

Here, we present a method to map the limit of tidal motion using CryoSat-2 radar altimetry. Our method is based on detecting the tidal signal in pseudo crossovers using a combination of CryoSat-2 standard and swath elevation data. This method has the potential to provide improved spatial and temporal coverage of the grounding zone over the lifetime of the satellite. We first test this new method on the Siple Coast region of the Ross Ice Shelf and show the mapped grounding line is in good agreement with previous observations from DinSAR and ICESat measurements. There is, however, a seaward bias between these methods and ours, which we believe is due to the poorer precision of CryoSat-2. We also show that this new method can provide improved coverage of the grounding zone. For example, the Echelmeyer Ice Stream is approximately 25 km inland from the previous grounding line estimates. Finally we discuss the results of applying this method to the rest of Antarctica.