

INVESTIGATING ANTARCTIC ICE SHELF GROUNDING ZONES WITH ICESAT

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The transition region between the fully grounded ice and freely-floating ice shelves is called the grounding zone (GZ), and is typically a few kilometres wide. Recent studies suggest that changes in the GZ may be sensitive indicators of broader climate change, indicating that regular monitoring, preferably satellite-based, should be carried out over the entire perimeter of Antarctic ice shelves. At the same time, the complex physics which couple the ice, bedrock, till and ocean in the GZ must be adequately understood and modelled in order to represent GZ dynamics in ice sheet models.

Here, we use laser altimetry from the Ice, Cloud and land Elevation Satellite (ICESat) to investigate the GZ for the major Antarctic ice shelves. ICESat's ~65 m footprint and ~172 m along-track sampling interval easily resolves the GZ, while it's maximum latitude of 86°S covers all ice shelves. The floating ice is in constant vertical motion with the ocean tide, so that the GZ experiences variable flexure at tidal periods. Comparisons of elevation along repeat tracks sampled at different phases of the ocean tide allow accurate identification of the landward and seaward limits of tide-forced ice flexure, thus providing grounding zone location and width under the tracks. Analyses of tracks across the grounding zone of the southern Ross and Ronne Ice Shelf illustrate the value of ICESat in studying GZ structure and processes, and highlights the potential for errors in grounding line locations deduced from satellite imagery or digital elevation models. We discuss the potential for using ICESat to detect GZ change over its mission lifetime, as well as in comparisons with previously acquired SAR interferometry from ERS and RADARSAT.