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Locating the grounding line using GLAS ICESat laser altimetry data — Ross Ice Shelf, Siple Coast, West Antarctica

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Grounding lines, or grounding zones, are defined as the transition at which grounded ice goes afloat. Their position is dependent on the interplay between ice volume, sub-ice topography, sea level, and ice dynamics. As such, locating and monitoring changes at the grounding line enables estimates of the variability of an ice sheet–ice shelf system. An accurately determined grounding line is of additional importance for ice sheet–ice shelf and oceanographic modelling due to the markedly different physical processes on either side of the transition.

The grounding line of the Ross Ice Shelf along the Siple Coast, West Antarctica, is determined here by applying a new processing technique to GLAS (Geoscience Laser Altimetry System) ICESat (Ice, Climate and land Elevation satellite) laser altimetry data. We use a simple and robust means for mapping any transition between a grounded ice sheet and floating ice shelf. The zone itself is approximately $8.0\ km$ wide with positional accuracy determined to be less than $\pm 500\ m$.

This new technique exploits the anomalous surface slope that results from the change in basal conditions from the limited-slip basal system of grounded ice to the free-slip basal system of the ice shelf. This change at the bed should manifest itself at the surface as a zone of increased slope. Our observations show that this model is valid for the Siple Coast, where a marked change in slope magnitude clearly delineates the grounding zone, ice stream boundaries, and additional features. We have validated the technique along the Siple Coast by using ground based observations on Whillans Ice Stream, where GPS and radar data have been acquired across the grounding zone.