

The safety band of Antarctic ice shelves

Johannes Fürst

Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany

The floating ice shelves along the seaboard of the Antarctic ice sheet restrain the outflow of upstream grounded ice. Removal of these ice shelves, as shown by past ice-shelf recession and break-up, accelerates the outflow, which adds to sea-level rise. A key question in predicting future outflow is to quantify the extent of calving that might precondition other dynamic consequences and lead to loss of ice-shelf restraint. Here we delineate frontal areas that we label as ‘passive shelf ice’ and that can be removed without major dynamic implications, with contrasting results across the continent. The ice shelves in the Amundsen and Bellingshausen seas have limited or almost no ‘passive’ portion, which implies that further retreat of current ice-shelf fronts will yield important dynamic consequences. This region is particularly vulnerable as ice shelves have been thinning at high rates for two decades and as upstream grounded ice rests on a backward sloping bed, a precondition to marine ice-sheet instability. In contrast to these ice shelves, Larsen C Ice Shelf, in the Weddell Sea, exhibits a large ‘passive’ frontal area. In 2017, this ice-shelf portion did calve off as a vast tabular iceberg and no important and abrupt dynamic response was yet observed.