# Sensitivity of Thwaites Glacier to Ice Shelf Melting

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Strong thinning as ice streams have sped up along the Amundsen Coast produces ice loss well in excess of that from other regions of Antarctica. Much of the increases in speed appear to be caused by the loss of buttressing as ice shelves have thinned in response to warmer ocean water and subsequent loss of basal traction as the grounding line has retreated. We have developed a finite-element implementation of a prognostic shallow-shelf ice stream/shelf model, which we have applied to Thwaites Glacier, Antarctica. We have conducted a number of numerical tests to examine the glacier's sensitivity to increased melting and surface accumulation. For melt rates comparable to present, the glacier continues to lose mass at roughly its present rate. Extreme (fourfold increase) sub-shelf melt rates produce a stepped retreat of the grounding line by more than 40-km over 250 years. Examination of the annual thinning rates shows rapid evolution of the spatial distribution of loss over periods of several years (comparable to the length of a typical satellite altimetry mission). In particular, with each episode of grounding line retreat, a pattern of strong thinning initially develops near the grounding line that then diffuses inland over periods of several years. Only with increased surface accumulation and reduced melting does the glacier stabilize. Thus, it is likely that Thwaites glacier will continue to lose mass over the next several centuries at a rate largely determined by the amount of warm circumpolar deep water that makes its way to the grounding line.