Model-Based Analysis of Ice Sheet Thinning in the Amundsen Sea Embayment

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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 examine this response for Pine Island and Thwaites glaciers using models constrained by satellite data. Our earlier work reproduced the transient response on Pine

Island Glacier and predicted that strong near thinning near the grounding line should abate, but that overall losses should remain high as thinning diffuses inland. Here we find that this conclusion is supported by new IceBridge data, which show recent reduction of near grounding-line thinning as speeds have leveled off. On Thwaites Glacier, we conducted a series of numerical experiments to investigate sensitivity of ice flow to ice-shelf loss and grounding-line retreat. The model suggests that recent changes in speed are the result of enhanced rifting that weakened the ice shelf followed by retreat of the grounding line. In response, surface slopes have thinned causing the speedup to migrate inland. We also use a prognostic model to investigate whether such thinning will continue over the next century.