Numerical modeling of subglacial-sediment dynamics

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Basal properties effect the rate and spatial pattern of ice flow. Historically, whole ice-sheet models simulated regions of ice-stream flow based on basal temperatures and an a priori knowledge of subglacial sediment distribution. The new generation of models will include both a temporal and a spatial evolution of basal properties. In this preliminary study, we couple a shallow-ice model to a non-linear bed to simulate the dynamic interaction between ice-sheet flow and subglacial sediment deformation. In future work, we plan to couple the sediment model to a ``full-stress'' ice-sheet model. Through ice-sheet simulations with a dynamic bed, we hope to gain a better understanding of the behavior of past ice sheets based on present landform distributions as well as the stability of the modern ice sheets under various global-warming scenarios. The greatest uncertainty in our present ability to predict sea-level rise results from our inability to simulate the recently observed rapid and ongoing changes in the Greenland and Antarctic ice sheets. Subglacial dynamics likely play a critical roll in grounding-line stability as well as in coupling shelf, outlet-glacier, and inland-ice flow regimes. Gaining insight into the physics underlying the fast response times of ice sheets is important as eustatic sea level and global climate can both be altered by changes in the cryosphere.