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Modelling landscape evolution under ice sheets

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We use an Ice Sheet Model (Glimmer) with an erosion/ deposition component to examine the evolution of landscape under ice sheets over long time scales in hypothetical situations. The model is a fully coupled thermo-mechanical 3-dimensional ice sheet with a sliding component. The model thus has the ability to predict ice thickness, the distribution of areas at pressure melting point and basal velocities. The erosion rate is assumed to be a simple linear function of the product of ice thickness and basal velocity. Thus erosion only occurs where the bed is not frozen and basal sliding is possible. We examine particularly the feedback between the ice sheet's thermo-mechanical regime and subglacial landforms. Patterns and timescales associated with the development of this feedback are evaluated. The eroding glacial landscape system is modelled for long-term persistent glaciation and for multiple glacial cycles assuming a variety of initial landscapes and tectonic settings. We hypothesise that erosion is maximised in the transition from fluvial to glacial regimes which subsequently adapt so that erosion is minimised.