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Predicting the future of ice sheets: the limitations of linearisation and implications for initialisation.

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The equations of ice sheet flow can be linearised. The resulting expression relates small changes in ice flow to changes in thickness and surface slope. The availability of such a linearised model simplifies the data assimilation procedure used to forecast the future behaviour of the ice sheets enormously. However, given the abundance of non-linear processes in glaciology, it also raises the question of how far into the future these predictions can be relied upon. Here we give examples of ice sheet forecasting using an assimilation scheme built around a linearised model, but also outline some of the glaciological non-linearities that could become important, and discuss some of the implications for initialising large-scale, non-linear ice sheet models.