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“Ice Streams: Patterning and Oscillatory Dynamics in Ice Seets”

ABSTRACT: Many aspects of ice sheet behaviour are simple: their basic dynamics can be described a model that predicts relaxation to a steady state in a constant climate. In this picture, "interesting" phenomena are limited to the existence of multiple stable steady states, where initial conditions dictate which steady state is attained. This can lead to hysteresis, or irreversible changes in ice sheet configuration driven by small changes in climate forcing. I will review two basic mechanisms for hysteresis, one driven by temperature changes and the other by changes at marine ice sheet margins. "More interesting" ice sheet dynamics (that is, dynamics internal to the ice sheet system and not driven by variations in external drivers) is most often caused by thermomechanical feedbacks in ice flow. In particular, this includes the possibility of oscillatory behavior in ice streams (narrow bands of fast flowing ice in a more slowly flowing ice sheet. I will describe one mechanism for generating oscillations (or "surges") in ice streams, how this interacts with some of the mechanisms that underlie hysteresis in marine-terminating ice sheets, and a number of challenges in fully accounting for ice stream dynamics in ice sheet modeling. In particular, I will describe some of the challenges we still face in explaining the spatial patterning of ice streams.