



A rheological-climatological threshold for the existence of steady marine ice-sheet grounding line positions

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A fundamental issue in understanding marine ice-sheet dynamics is determining whether steady profiles exist, and if they do whether they are stable or unstable. It is shown a boundary layer where longitudinal stresses are large stretches tens of kilometres upstream of the grounding line. The existence of a steady profile in this boundary layer is conditional, with an explicit existence criterion depending on ice thickness, forces exerted by the ice-shelf, rheology and climate. When steady solutions exist, adjacent equilibria of ice-sheet profiles is possible. If steady solutions do not exist, the ice-sheet geometry must change. A numerical model capable of representing neutral equilibrium and the dynamical threshold is used to demonstrate retreat of the Antarctic Peninsula ice-sheet being driven by warming and weakening of the upper part of the ice-column. This is an attractive although partial explanation for the variable phasing of the post-LGM retreat of the Antarctic ice-sheet.