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A Theoretical and Experimental Investigation of Ice-Shelf Flow Dynamics MARTIN WEARING, GRAE WORSTER, Univ of Cambridge, RICHARD HINDMARSH, British Antarctic Survey — Ice-shelf buttressing is a major control on the rate of ice discharged from fast-flowing ice streams that drain the Antarctic Ice Sheet. The magnitude of the buttressing force depends on the shelf geometry and confinement. This geometry is determined by the ice-shelf extent, resulting from retreat due to iceberg calving and shelf advance due to flow. In contrast to large-scale ice-sheet models, which require high resolution datasets, we aim to gain insight using simple idealized models, focusing on the transition from lateral confinement to non-confinement. By considering a confined shelf with lateral shear stresses controlling the flow, steady-state analytical solutions can be calculated. These solutions are then compared to a numerical model for a confined flow, which incorporates both shear and extensional stresses. A boundary layer close to the calving front is identified, where both extensional and shear stresses control the dynamics. We test these idealized models against fluid-mechanical laboratory experiments, designed to simulate the flow of an ice shelf in a narrow channel. From these experiments velocity fields and altimetry for the ice-shelf are collected, allowing for comparison with the theoretical models and geophysical data.

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