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Flow speed of Siple Coast, Antarctica, ice streams show strong non-linear hysteresis

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Recent and continuing experiments have demonstrated that the flow speeds of ice streams are strongly modulated by the ocean tide at the grounding line of the ice stream. Current models using the hydrostatic back pressure from the tide height predict a linear response in flow speed at the grounding line, though they do predict non-linear affects inland due to power-law constitutive relationships in subglacial materials. We present results showing a non-linear hysteresis in flow speed vs. tide height with different flow speeds at a given tide according as the tide is rising or falling. We discuss the possible sources of non-linearities leading to the hysteresis, including the flow-law of ice, the strength of the margins of the ice stream, and the frictional properties of the bed.