Ice-shelf flexure and tidal forcing of Bindschadler Ice Stream

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Viscoelastic models of ice-shelf flexure and ice-stream velocity perturbations are combined into a single efficient flowline model to study tidal forcing of grounded ice. The magnitude and timing of ice-stream response to tidally driven changes in hydrostatic pressure and/or basal drag are found to depend significantly on bed rheology, with only a perfectly plastic bed allowing instantaneous velocity response at the grounding line. The model can reasonably reproduce GPS observations near the grounding line of Bindschadler Ice Stream (formerly Ice Stream D) on semidiurnal time scales; however, other forcings such as tidally driven ice-shelf slope transverse to the flowline and flexurally driven till deformation must also be considered if diurnal motion is to be matched.