Geophysical Research Abstracts
Vol. 16, EGU2014-1214, 2014
EGU General Assembly 2014

Insights into ice stream dynamics through modeling their response to tidal forcing

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The tidal forcing of ice streams at their ocean boundary can serve as a natural experiment to gain an insight into their dynamics and constrain the basal sliding law. A 3-D visco-elastic full Stokes model of coupled ice-stream ice-shelf flow is used to investigate the response of ice streams to ocean tides. In agreement with previous results based on flow-line modeling and with a fixed grounding line position, we find that a non-linear basal sliding law can reproduce long period modulation of tidal forcing found in field observations, and the inclusions of lateral effects and grounding line migration do not alter this result. Further analysis of modeled ice stream flow shows a varying stress-coupling length scale of boundary effects upstream of the grounding line. We derive a visco-elastic stress coupling length scale from ice stream equations that depends on the forcing period and closely agrees with model output.