ON THE EFFECTS OF ICE DIVIDE MOTION ON RAYMOND BUMPS

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Motivation: hints about the past
Motivation: hints about ice properties

Fletcher Promontory

Kealey ice rise
Model description

Ice flow: full Stokes (Hvidverg, 96)

Temperature: Solved in bedrock, consider temperature evolution

Sliding is considered using a viscous till layer (Pettit, 03)

Divide migration is forced by ice flux at the flanks

\[ q_x(x_{flank}, t) = \int_{x_d(t)}^{x_{flank}} (a - \frac{\partial h}{\partial t})(x', t) \, dx' \]

Numerics: Finite element and semi Lagrangian methods.
Fast migration: Instantaneous forcing
Migration: Roosevelt an example of fast migration?

Data from Conway et al. (1999)
Slow migration: linear forcing
Transient temperature response to ice divide migration

\[ \tau = \frac{H_d}{a} \]

\[ \tau_v \ll \tau \]

\[ \tau_h \approx \left( \tau / 16 \right)^* \]

\[ \tau_h < \tau_T < \tau \]

* (Hindmarsh, 96)
What’s wrong? Spot the differences
Double-rooted bumps: *ad hoc* explanation

Beneath the ice divide ice should be stiffer

Double-rooted bumps can be explained with:

- $n > 10$
- $n > 5$ small deviatoric stresses ($\sim 10$ kPa)
- Considering ice as a Bingham fluid.
- High anisotropy
Double-rooted bumps: anisotropy?

Anisotropy as in Pettit 2003, Thorsteinsson 2001
Ice divide migration

-There are traces of past ice divide migration in the radar layers geometry

*Fast migration* leaves Raymond bumps in a flank position which are advected with the flow while new ones develop in the new stationary position (e.g., Roosevelt Island).

*Slow migration* produce a tilt in the axis of the crests of the arches (e.g. Siple Dome, Kealey ice rise).

-Transient temperature effects are important when the time scale is comparable to the surface relaxation time \( (\tau / \tau_{16}) \)

Ice divide properties

-Considering a standard rheology \((n \approx 3)\) and isotropy there are features that can not be explained: bump amplitude and width, surface shoulders, radar layer dips... Double-rooted bumps.

-Anisotropy?