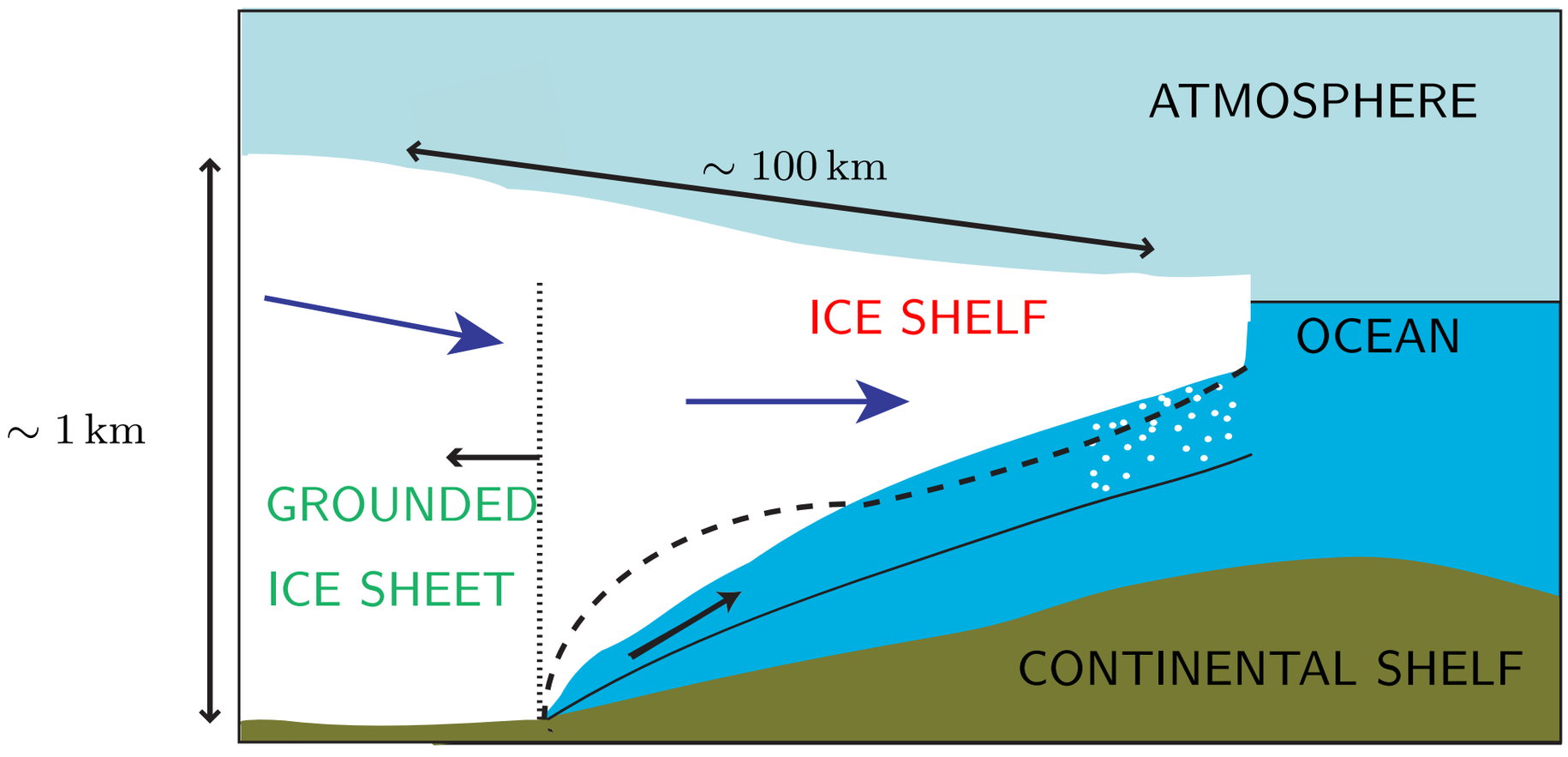
Melting-driven Evolution of an Ice Shelf Coupled to a Melttwater Plume

Andrew Wells

Oxford Physics

Atmospheric, Oceanic, & Planetary Physics, University of Oxford

UNIVERSITY OF OXFORD



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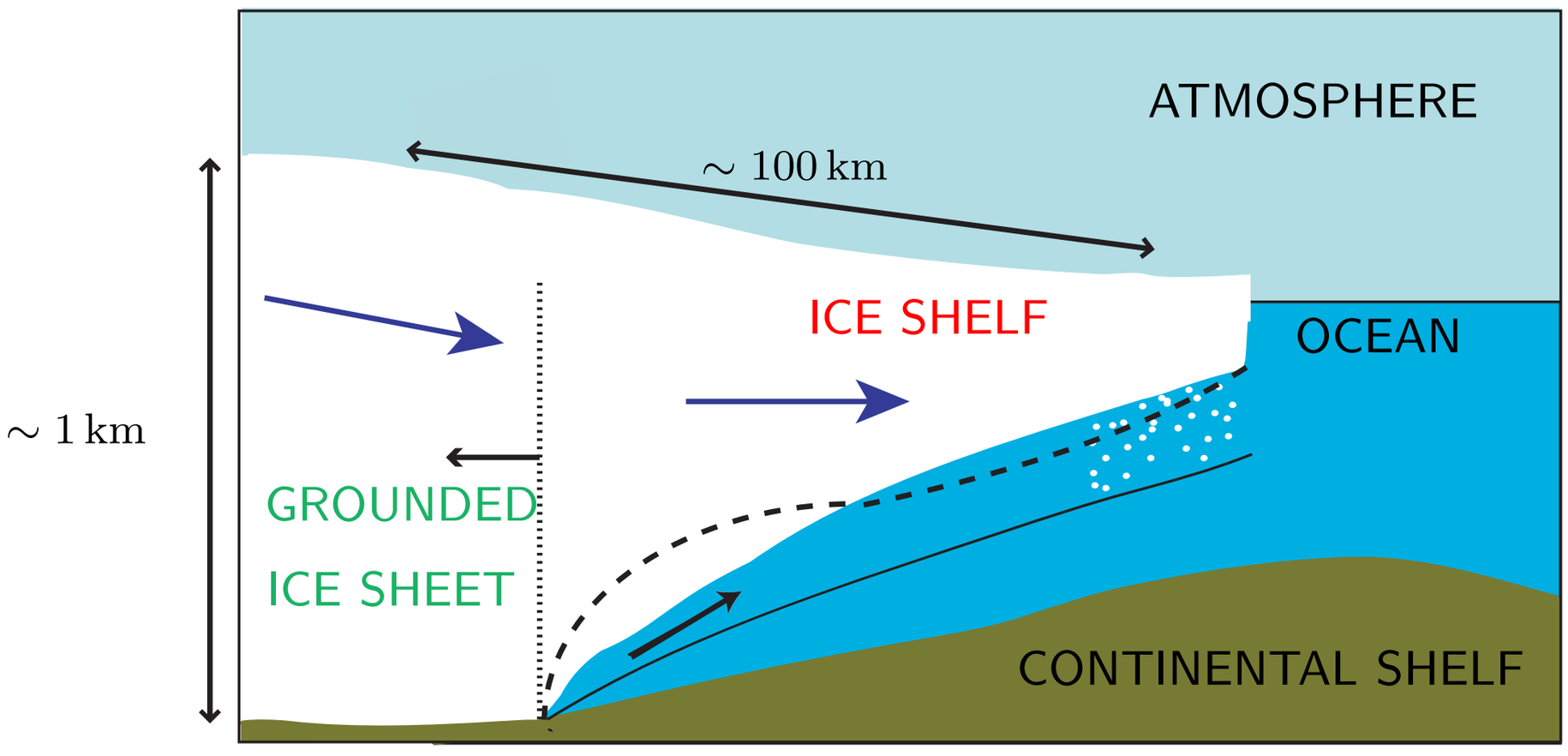

Faster flow and melting under steeper slopes

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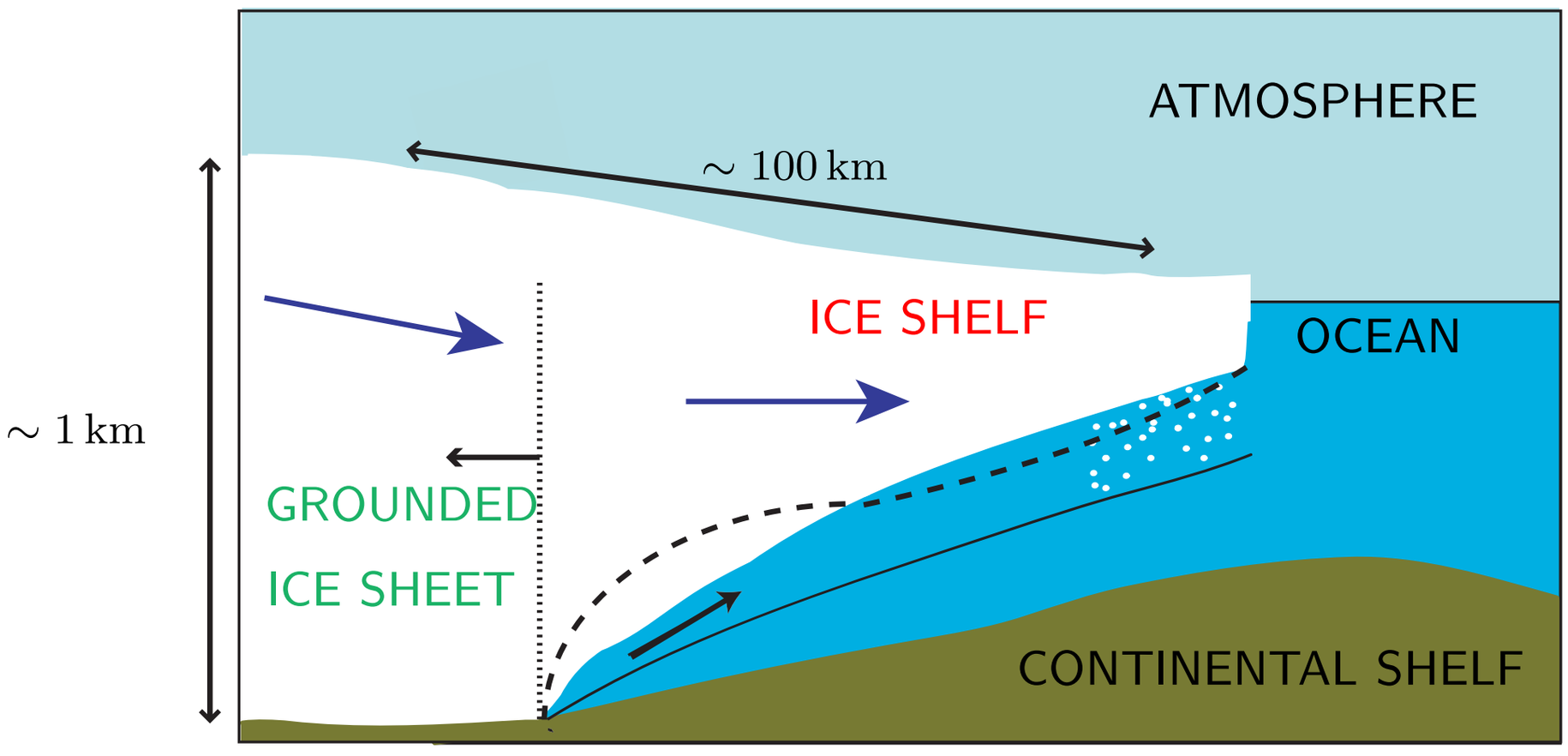

Faster flow and melting under steeper slopes

Is there a feedback between meltwater plumes and the evolving ice-shelf shape?

To flow, or not to flow?

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Using a plume model, find two types of behaviour.

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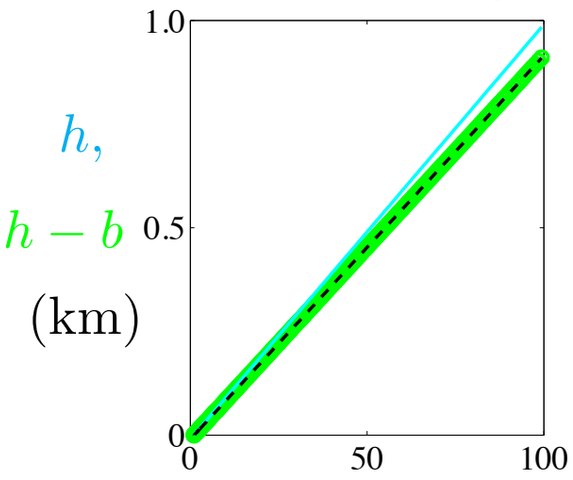
Strong flow:

$U_0 = 0.01\,\mathrm{m\,s^{-1}}$

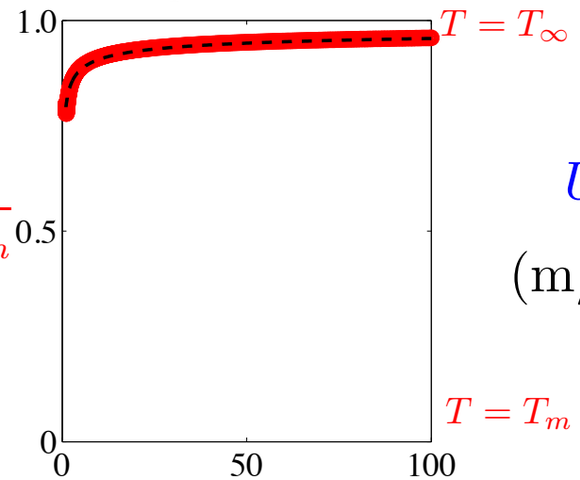
melting rate $\approx 2\,\mathrm{m/year}$.

Ice and plume edges:



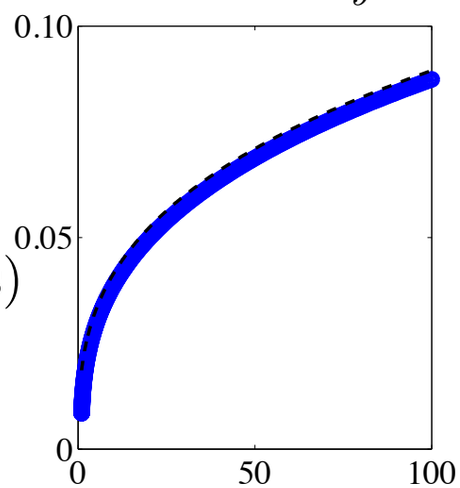
Temperature:

$\frac{T_o - T_m}{T_\infty - T_m}$



Plume velocity:

U (m/s)



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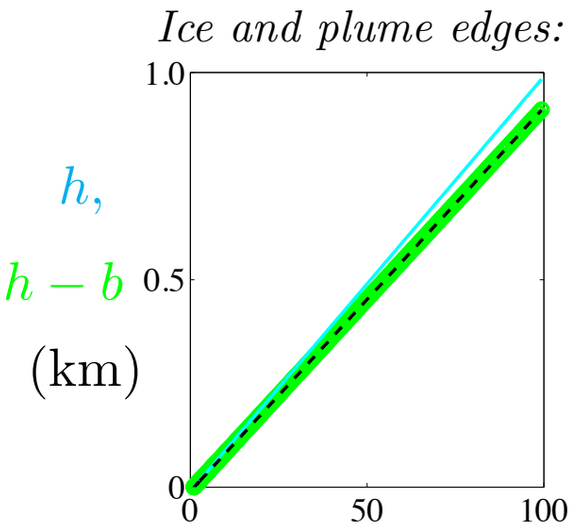
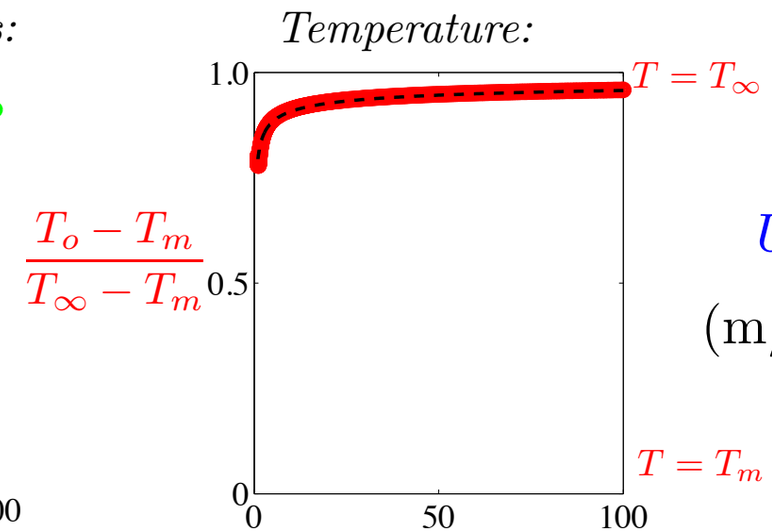
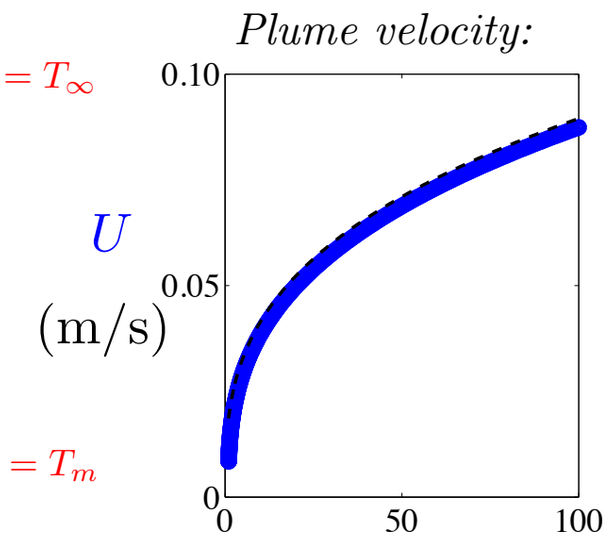


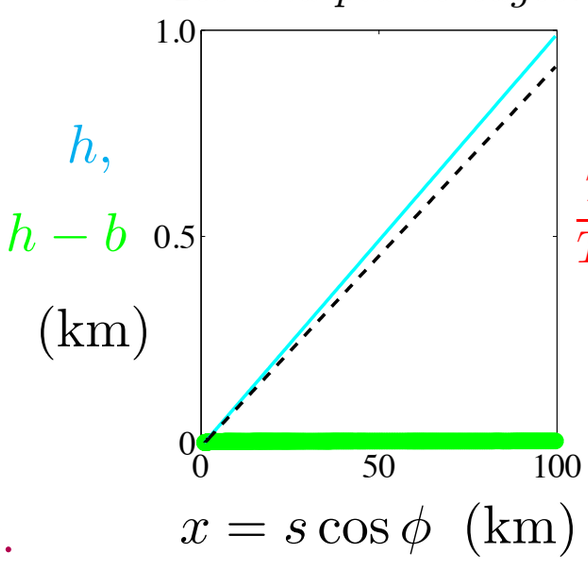


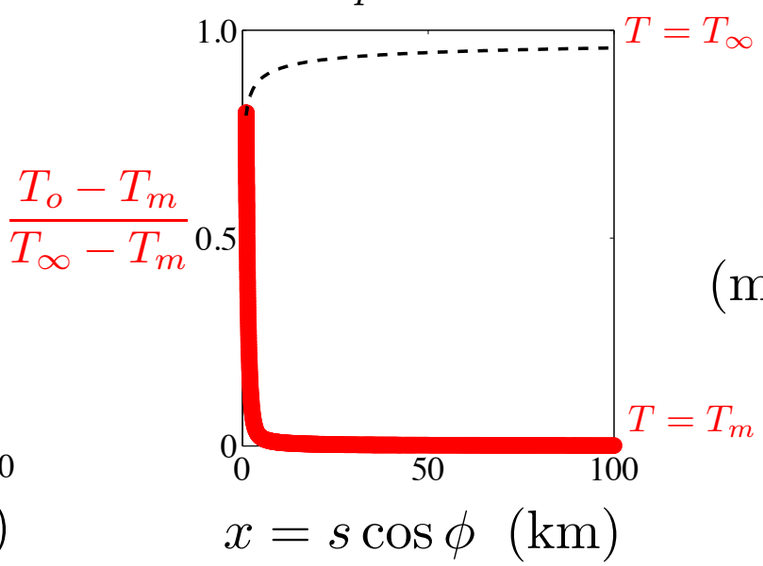


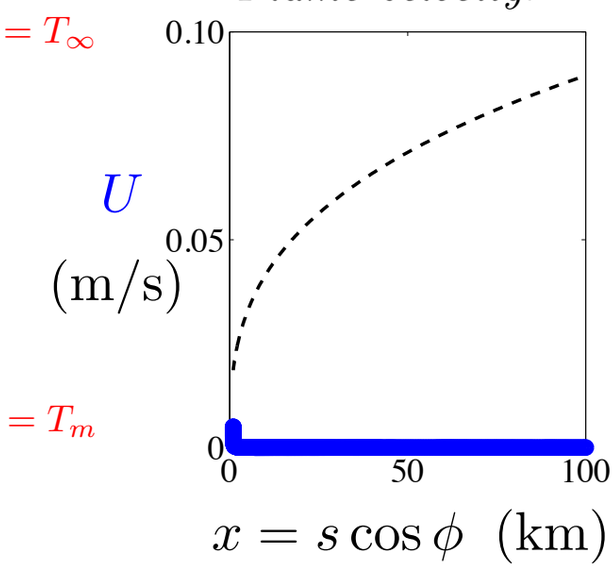
Flow collapses:

$U_0 = 0.005\,\mathrm{m\,s^{-1}}$

melting rate $\approx 0.02\,\mathrm{m/year}$.

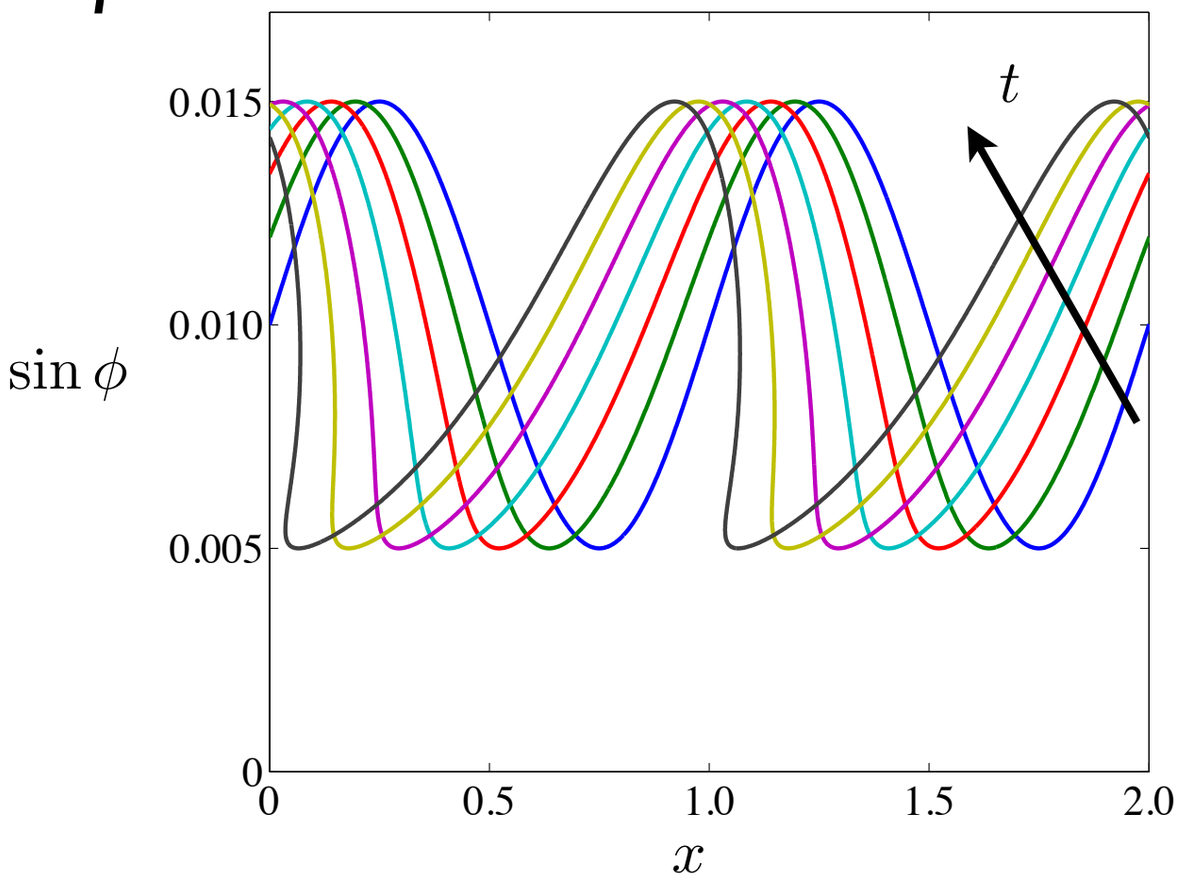




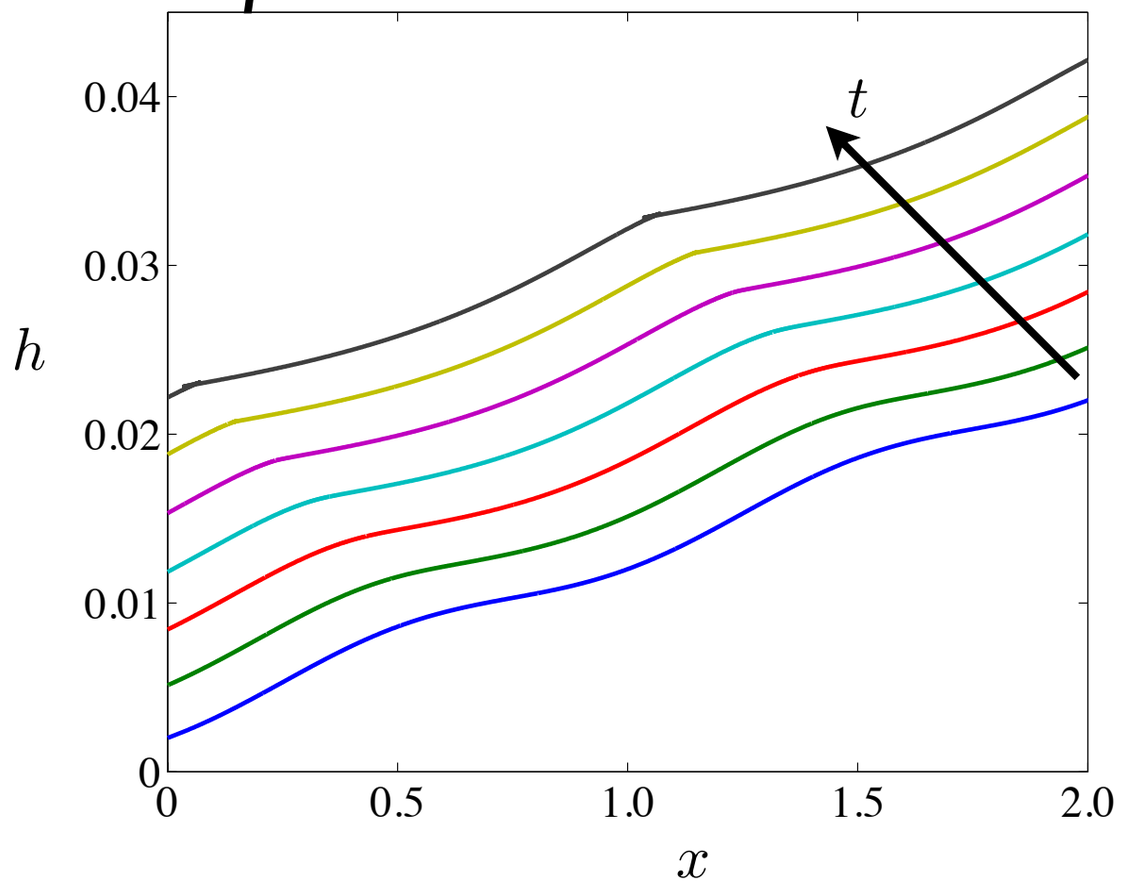


A shocking model of ice evolution

Slope:



Basal shape:



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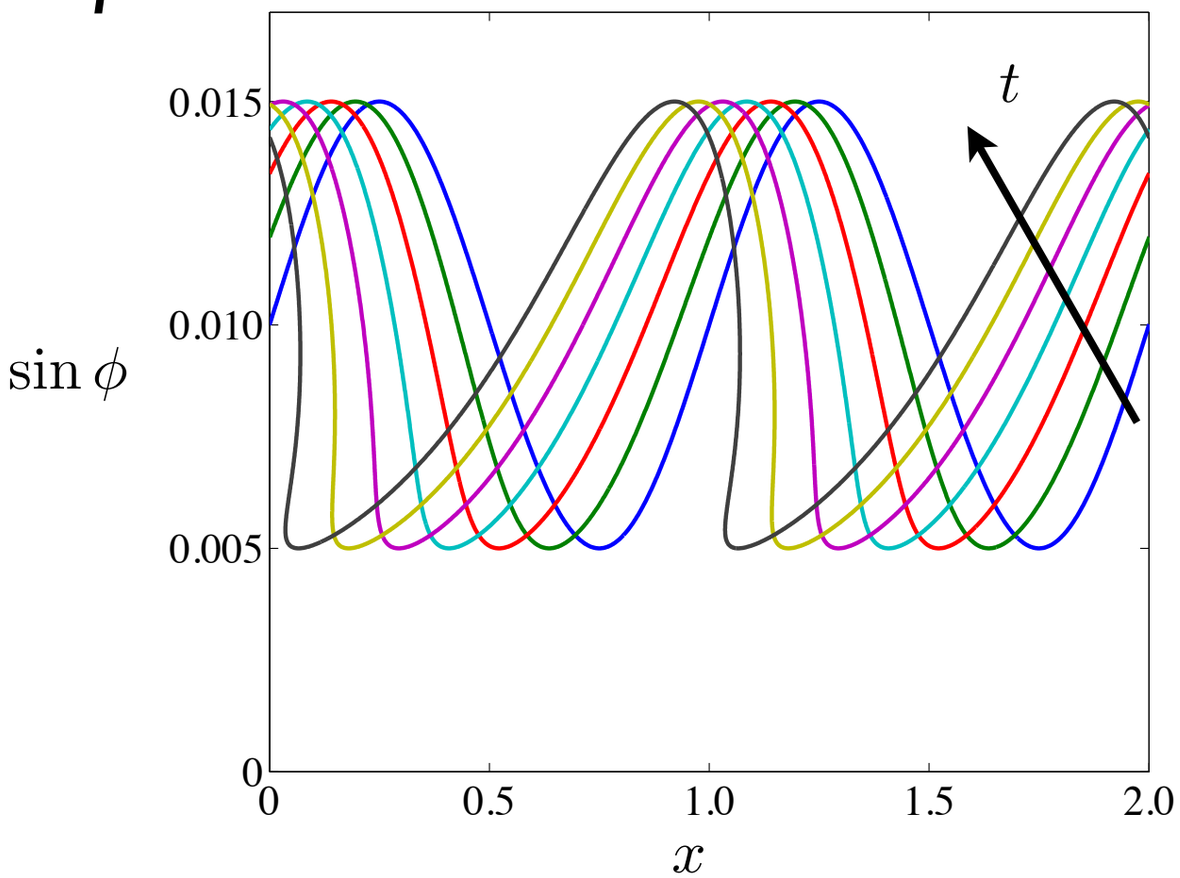
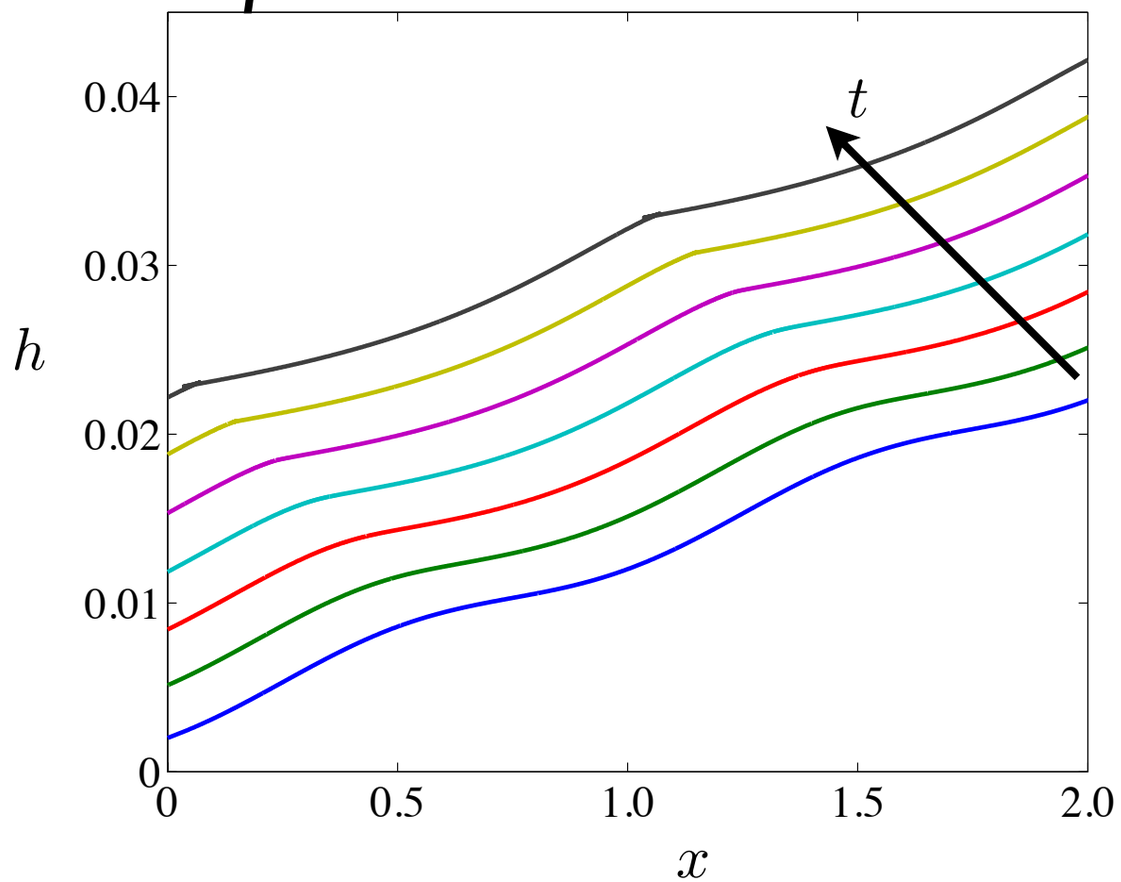


Basal shape:



Key conclusions:

A shocking model of ice evolution

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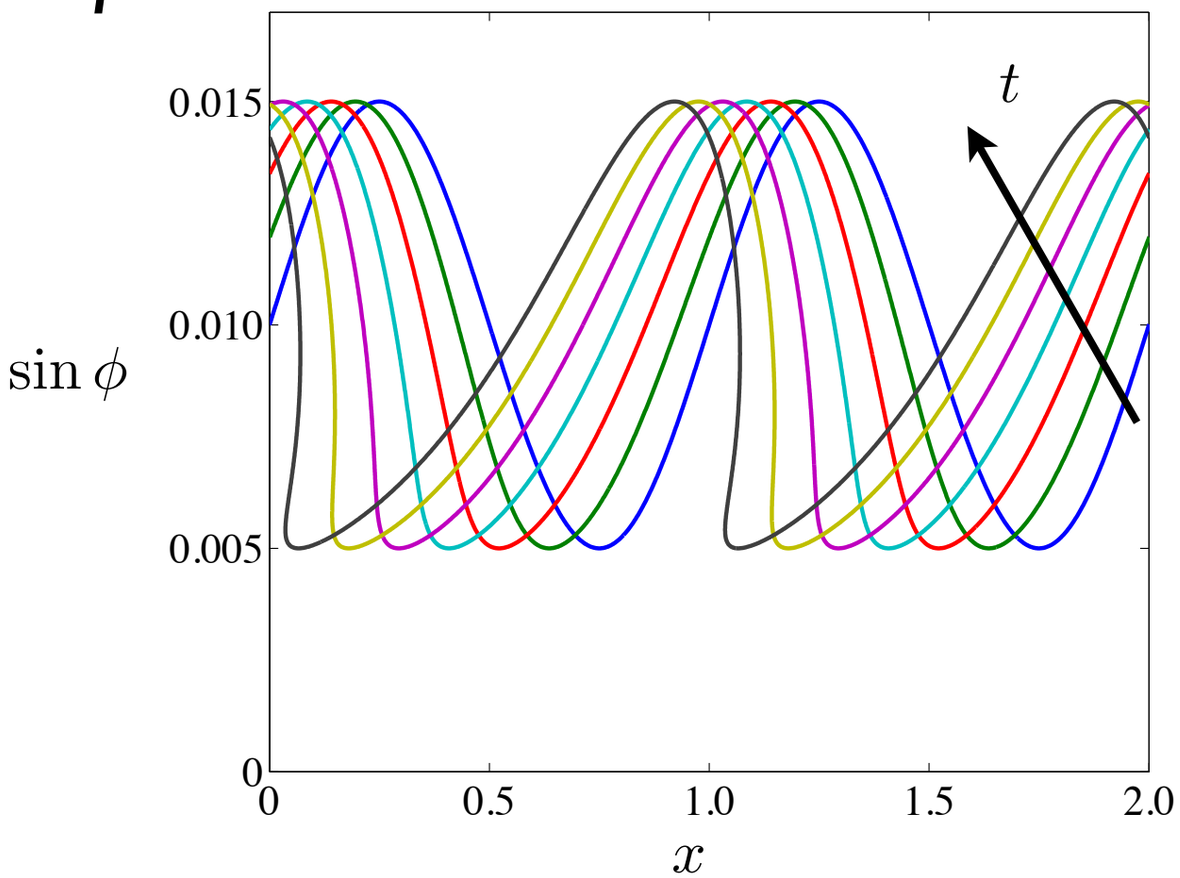

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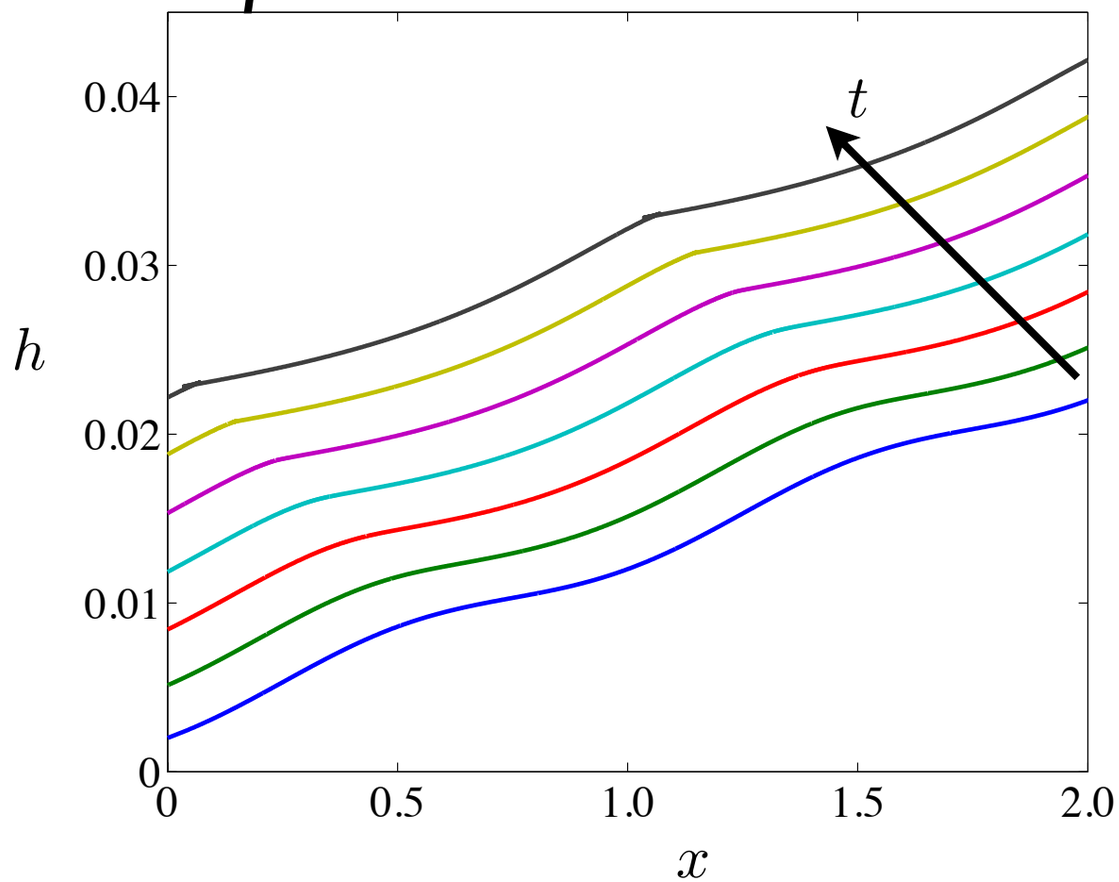

Key conclusions:

- Melting of ice shelves and meltwater flow are sensitive to subglacial fluxes.

A shocking model of ice evolution

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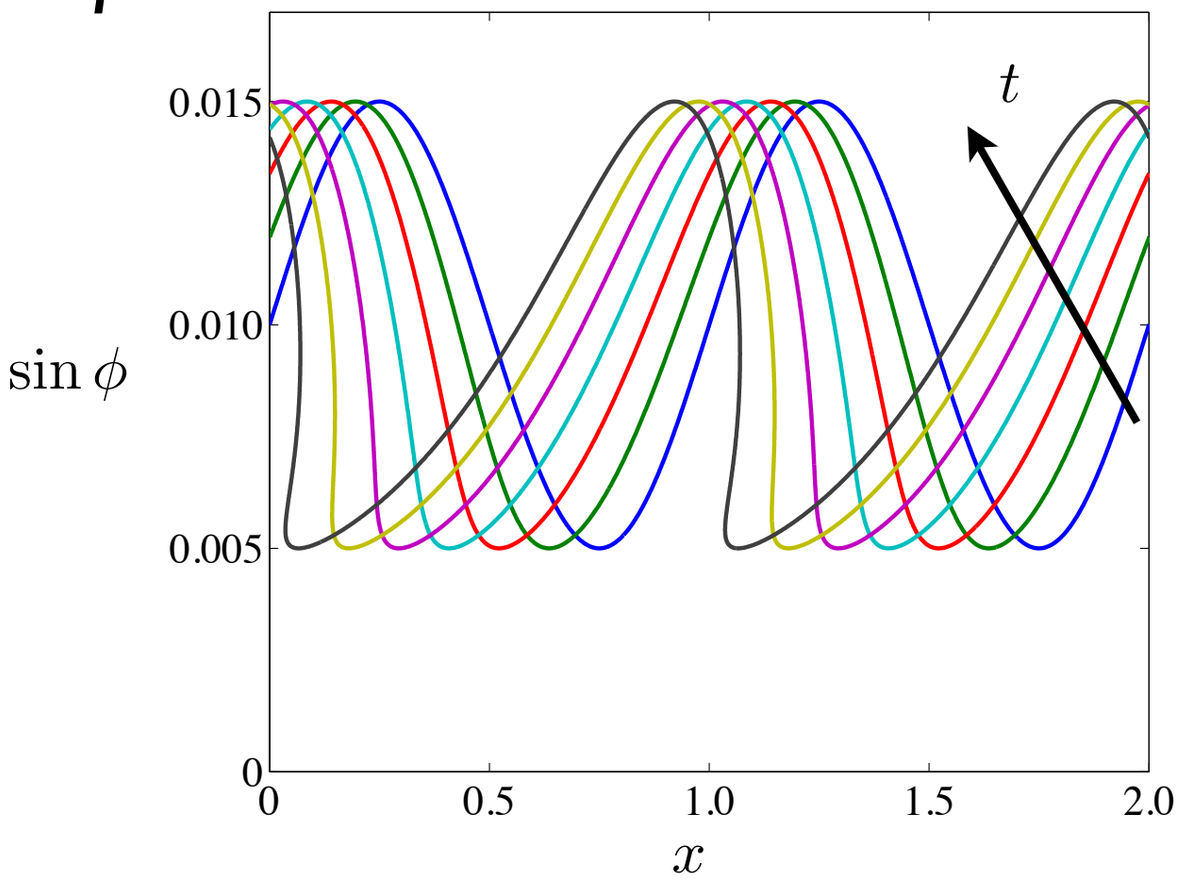

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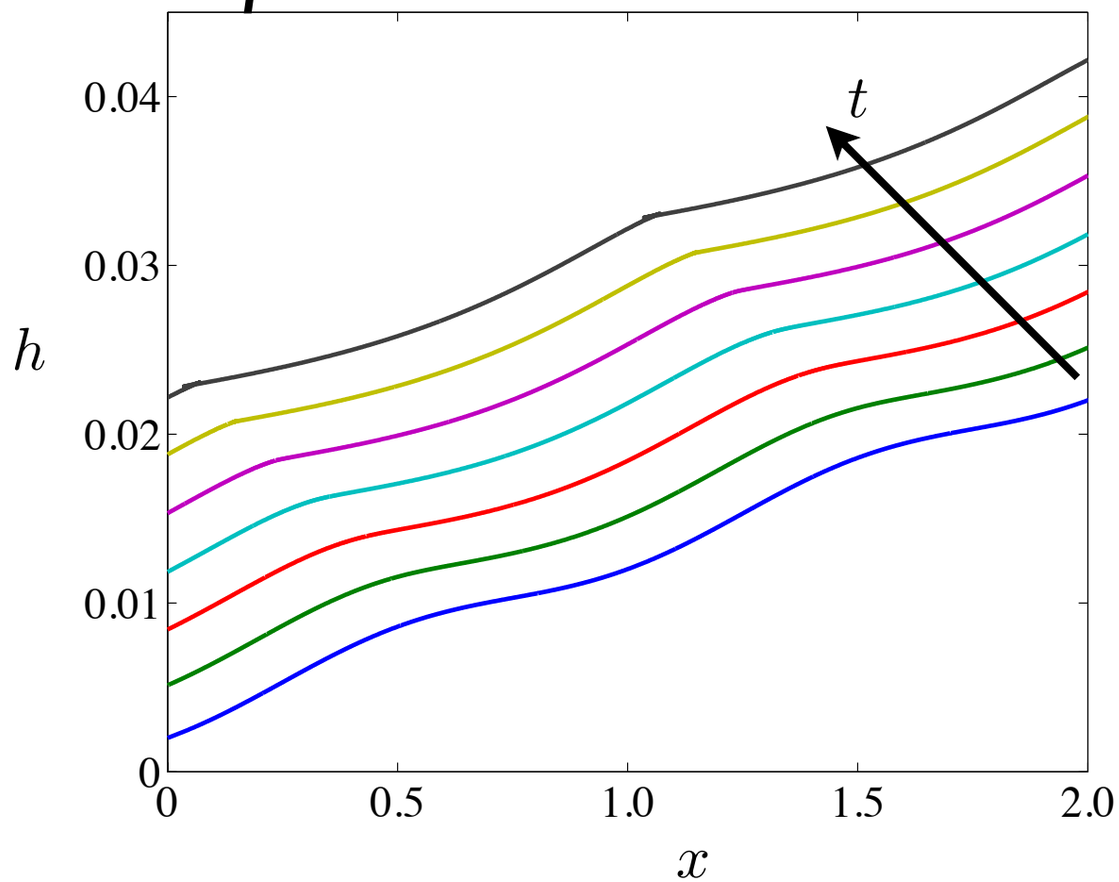

Key conclusions:

- Melting of ice shelves and meltwater flow are sensitive to subglacial fluxes.
- *Near to the grounding line*, basal undulations propagate relative to the ice, but the amplitude doesn't grow.