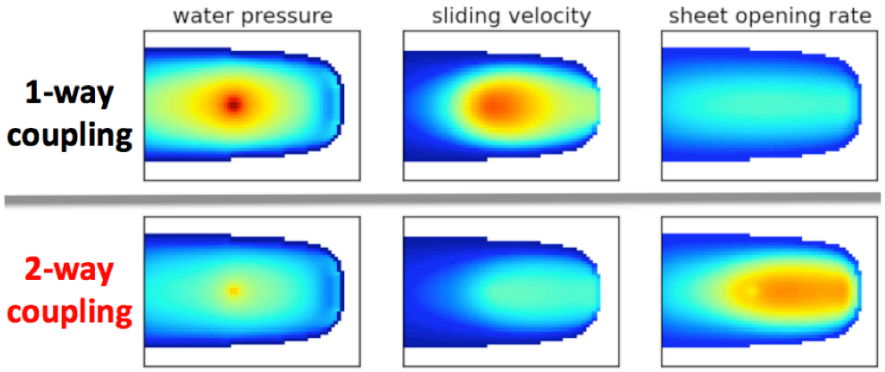
Feedbacks between subglacial drainage and glacier dynamics

Objective

Sliding of ice sheets is controlled by basal water and increases their velocity by orders of magnitude. However, few studies of coupled subglacial hydrology and ice dynamics exist. Using a coupled model, we explore feedbacks between the two systems.

Research

- Created one of the first coupled models of subglacial hydrology and ice dynamics.
- Found a dominant negative feedback due to the sliding-opening of subglacial cavities, which lowers basal water pressure and sliding.
- This feedback can 'look like' channelization of the subglacial drainage system, which has traditionally been used to explain observed changes in drainage efficiency on glaciers.



Model results demonstrating lower water pressure and sliding in the coupled hydrology/dynamics model due to increase of the basal water sheet capacity.

Impact

Coupled modeling of subglacial drainage and ice dynamics appears to be necessary to accurately predict meltwater-induced speedup when drainage remains distributed, a condition expected for most of the Greenland Ice Sheet.

Reference: M.J. Hoffman and S. Price. 2014. Feedbacks between subglacial hydrology and glacier dynamics. *Journal of Geophysical Research – Earth Surface,* **119**, doi:10.1002/2013JF002943.