



Hysteresis in a model for subglacial sheet drainage

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Glaciological orthodoxy holds that meltwater drainage along the base of an ice sheet cannot happen through a water sheet, as such a body of water must be unstable to channelization: a thickening of the sheet leads to additional dissipation of heat, which causes further melting of the overlying ice and thickening of the sheet. We show that this mechanism is indeed expected, but can be suppressed if basal inhomogeneities occur on sufficiently small spatial scales. Instead, the evolution of the film is then controlled by a balance between melting and roof subsidence. Roof subsidence occurs due to viscous creep of ice between ice-bed contacts (clasts, boulders) and regelation around them. Stable and unstable equilibria for the sheet can then be identified, and multiple equilibria are possible for certain size distributions of basal inhomogeneities. Hysteresis can occur due to transitions between these multiple equilibria, corresponding to the switching on and off of an efficient subglacial drainage system.