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Plausibility of a subglacial lake under Amundsenisen Icefield (Svalbard): spatially variable water content and sensitivity to thermal effect of snow and firn layers.

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Within our study of the plausibility of a subglacial lake under the Amundsenisen Icefield in Southern Spitzbergen (Svalbard achipelago) (Glowacki et al., 2007), here we focus on the sensitivity of the system to the thermal effect of the firn and snow layers. Rough heat balance analysis shows that the firn layer plays an important role by driving the heat release to the atmosphere, so that its influence on the ice-water phase transition cannot be neglected (Bucchignani et al., 2012).
We support our investigation with simulation via an in-house numerical code based on a thermomechanical transient model with dynamics given by a full Stokes system for the icefield and Large Eddy Simulation formulation for the water basin. Ice rheology is represented by Glen's law (n=3) with flow rate factor depending both on water content and temperature according to Breuer et al. (2006), for similar environments, and water content obtained from water mass balance (Greve & Blatter, 2009). Firn and snow thermal profiles are assumed to be steady. Their numerical values are partly (firn) available from Zagorodnov et al. (1985) and completed by matching the annual average air temperature at the surface. The ice-water phase interface is defined via the Stephan equation and the momentum and heat exchange between ice and water are regulated by corresponding interface jump conditions.
We compare simulations performed with and without firn and snow layers.

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