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Numerical modelling of Amundsenisen Icefield for compatibility check of a subglacial lake. Preliminary tests

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Recent GPR data from the Amundsenisen Icefield in Southern Spitsbergen, Svalbard archipelago, exhibit high intensity returns from a nearly flat basal reflector (maximum diameter $\sim$500 m) which might correspond to a subglacial lake. Its existence would be an absolute novelty as the other known subglacial lakes are located in Antarctica. The general aim of our research is the identification and verification of necessary conditions for the existence of such a lake. We support our investigation with simulations via an in-house numerical code implementing a mathematical model describing the dynamics and thermodynamics of the icefield and the conjectured lake, the ice-water and the ice-bedrock interfaces. The classical Glen's law is adopted as constitutive relationship for ice, and Large Eddy Simulation modelling is used for subglacial lake hydrodynamics. The ice-water phase change interface is defined via the Stefan equation, and the momentum and heat exchange between ice and water are regulated by corresponding interface jump conditions closing the moving boundary partial differential model. Several environmental variables and their impact on the system are taken into account at the free surface and bottom boundaries (geothermal heat flux, melting at the ice-bedrock interface, air temperature, atmospheric pressure, etc.).
We present numerical results of the simulation of a vertical section of the icefield departing from an ice divide and following a flowline obtained as output of an earlier three-dimensional model of the dynamics of Amundsenisen Icefield (Otero et al., 2011).

References:
J. Otero, F.J. Navarro, J.J. Lapazaran, E. Vasilenko and P. Glowacki, 2011, A three-dimensional dynamical model of Amundsenisen icefield, Svalbard, EGU Annual Assembly 2011, Wien, Geophysical Research Abstracts, Vol. 13, EGU2011-6257.