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Modelling the Younger Dryas outburst flood of the Baltic Ice Lake

E. DeGiuli (1), G.K.C. Clarke (1), M. Jakobsson (2)

(1) Dept. of Earth and Ocean Sciences, University of British Columbia, (2) Dept. of Geology Geochemistry, Stockholm University

Following the last ice age, recession of the Scandinavian ice sheet produced, in what is now the southern Baltic Sea, the ≈350 000 km^2 Baltic Ice Lake. Forced by isostatic uplift, the lake experienced episodic flooding and lowering via open-air, ice-marginal outlets. We consider the largest of these events, which just before the Younger Dryas-Preboreal Transition, ≈11 700 yr BP, lowered the lake 25m and released 7 800 km^3 of fresh water into the North Sea. Developed with newly available paleo-shoreline data, a high resolution digital model of the paleo-bathymetry constrains the geometry and hypsometry of the flow path. We couple these data with a one-dimensional ice-marginal outburst flood model to estimate the flood hydrograph. Based on Spring-Hutter theory, the model is able to accommodate flow path variations in geometry, and in particular does not posit a unique breach point. Uncertainty in flow assumptions, lake temperature, and frictional parameters is explored, and the possible climatic influence of rapid fresh-water discharge is discussed. To validate the applicability of the model, it is applied to the well-observed 2002 outburst flood from glacier-dammed Russell Fiord in Alaska. We estimate the flood hydrograph and compare with USGS data.