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The first comparison of measured and modelled water-flow speeds during the onset of a glacial lake outburst flood

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Observational data allowing the validation of glacier lake outburst flood (GLOF) models are sparse. Due to fortunate circumstances, we were able to directly inject dye tracer into the drainage channel of a glacial lake during the onset of its outburst. This made it possible to test an established GLOF model not only against discharge measurements, but for the first time also against measured water-flow speeds. The GLOF model we use simulates the time evolution of a R-channel using the Spring-Hutter equations. We drive the GLOF model with measured subglacial water pressure, lake water temperature and lake level. The model is fitted to the measured lake discharge and tracer-flow speeds using the initial channel size, the channel roughness and sinuosity. Our calculations show that an ingenuous application of the model, only fitting it to the lake discharge, overestimates water-flow speeds. On the second day of the outburst, this can be remedied by fitting the model to the tracer-flow speeds as well, requiring to either increase the heat transfer or the sinuosity of the channel. However, the low flow speeds on the first day of the outburst cannot be fitted with any parameter combination showing that, initially, the water does not flow through a R-channel. Hence, the early stages of this GLOF cannot be simulated with a R-channel model.