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Calibrating a regional glacier model using post-LIA glacier length changes in the Alps

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We present an approach to calibrate a regional glacier model based on the well observed period since the mid-19th century LIA maximum.
We chose 30 glaciers distributed across the entire European Alps with frequent length change observations in that period. These glaciers account for 25% of today's total glacier area in the Alps. We run simulations with the Open Global Glacier Model (OGGM, https://oggm.org) driven by HISTALP (http://www.zamg.ac.at/histalp) gridded climate data. To calibrate the glaciers individually, we vary three model parameters within a reasonable range: (i) a precipitation scaling factor governing average mass-turnover and mass-balance profiles, (ii) the ice creep parameter governing basal sheer stress and the dynamics of ice flow, and (iii) a constant mass balance perturbation applied to the yearly mass-balance. This results in 1365 unique parameter combinations which were tested for all glaciers. We chose individual parameter subsets for every glacier based on objective criteria minimizing the difference between modeled and observed length changes.

We find that there is no unique parameter combination satisfying our criteria for all glaciers. It is also challenging to identify an ideal parameter combination for each individual glacier, since there is a trade-off between reproducing variability (useful for paleo-climate interpretations) and reproducing observed length change (useful for projections and planing).
Furthermore, model and input data uncertainties are variable in time, leading to non-unique optimal parameter sets. Therefore, we rely on an ensemble of simulations consisting of the best runs with respect to multiple statistical measures. Together with a cross-validation procedure, the ensemble produces a probabilistic uncertainty range which can be applied to Holocene glacier reconstructions and future evolution scenarios.