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Combining state-of-the-art ice flow and regional climate modelling to reconstruct the Alpine Ice Sheet of the Last Glacial Maximum

Michael Imhof (1), Patricio Velasquez (2,3), Julien Seguinot (1), Christoph C. Raible (2,3), Denis Cohen (4), and Guillaume Jouvet (1)

(1) ETH Zürich, VAW, DBAUG, Zürich, Switzerland (imhof@vaw.baug.ethz.ch), (2) Climate and Environmental Physics (CEP), Universität Bern, (3) Oeschger Centre for Climate Change Research, Universität Bern, (4) Department of Earth and Environmental Science, New Mexico Tech

Ice flow modelling studies targeting the last glaciation of the European Alps have so far relied on present-day precipitation and temperature pattern and seasonality. These studies yield interesting insight to the dynamics of this former ice cap. However, the modelled maximum ice extent is inconsistent with geomorphological reconstructions based on terminal moraines. More precisely, the ice flow models systematically overestimate the ice extent in the north-east of the Alps and at the same time underestimate it in the south-west. Furthermore, the modelled flow directions are inconsistent with the depositional locations of erratic boulders with known origin, in particular those carried by the Valais Glacier. Recently, output of a global climate model run for Last Glacial Maximum (LGM, 20,000 years before present) conditions has been downscaled to a resolution of 2x2 km over the European Alps with a regional climate model. This offers, for the first, time the opportunity to drive an ice flow model with a high-resolution climate forcing that is truly representative for this period.

Here we present some simulations of the Alpine Ice Sheet around the LGM utilizing this novel climate forcing. To model the ice flow and mass balance of the ice sheet, we use the Parallel Ice Sheet Model (PISM), which is a state-of-the-art ice sheet model. As only the climate at the LGM is available, we emulate a transient climate by applying a time-dependent temperature offset deduced from the EPICA ice core. We compare the modelled ice sheets with geological evidence such as terminal moraines and trajectories of erratic boulders. Preliminary results show that the new LGM climate forcing yields notable improvements between modelled and reconstructed ice extents. In particular, the ice distribution between south-west and north-east is significantly improved when compared to former simulations employing a climate forcing derived from present-day climate.