



Inconsistent Last Glacial Maximum ice thickness of the Rhine glacier between geomorphological reconstructions and two numerical models

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Using two different state-of-the-art ice flow models (PISM and ELMER/ICE), we simulate the extent of the Rhine glacier (Switzerland, Germany) at the Last Glacial Maximum (LGM). On the one hand, PISM is a computationally efficient and mechanically simplified model, which is used to perform many simulation runs to assess the influence of each model parameters. On the other hand, ELMER is a computationally expensive and mechanically exhaustive model, which is used to assess and refine PISM results. Regardless of the model used, the most uncertain input remains the LGM climate forcing required to compute the surface mass balance. To mimic climate conditions prevailing during the LGM, we apply different temperature and precipitation corrections to present-day climate data, and select the parametrizations which yield the best match between the modelled glacier extent and the mapped end moraines. Using the end moraines to constrain the extent of ice at the LGM, neither PISM nor ELMER could reproduce geomorphological reconstructions of the Rhine Glacier ice thickness accurately in the accumulation area despite a wide range of parameterizations tested. Instead, our model results indicate that the Rhine glacier was substantially thicker in the accumulation area than what has been reconstructed from its landscape imprint.