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Multi-proxy calibration and validation based on natural climate archives: a Swiss case study

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We present a regional multi-proxy/temperature calibration and validation based on (i) ring width and maximum late-wood density of *Picea abies* and *Pinus cembra*; (ii) stable isotope ratios from *Picea abies*, *Sphagnum fuscum*/bulk peat and an alpine ice core; (iii) sediment characteristics, diatoms, and chironomids from varved lake sediments; and (iv) nearby temperature measurements (AD 1864 – 2003). Study sites were located in the Swiss Central Alps, between 1790 and 4000 m a.s.l.

Tree-rings were cross-dated using the COFECHA software. Ice-core dates were based on seasonal δD variations. Lake sediments were dated using ^{210}Pb, ^{137}Cs, varve counts and event horizons. The peat profile was dated using ^{210}Pb and ^{14}C. Diatom, chironomid, and peat samples had a temporal resolution of at least three, five, and eight years, respectively. All other archives had annual resolution.

Non-climatic long-term trends, related to e.g., age effects or human impact, were removed by 300-year smoothing splines (ring width, late-wood density), correction for anthropogenic emissions (δ^{13}C) and trend decomposition (sediments). Principal Coordinates Analysis summarised climate-related variation within chironomids and diatoms. Low count sums of chironomid remains added random variation; hence, all chironomid-related data were smoothed. Isotope measurements in the peat profile and diatom counts were discontinuous; missing values were interpolated.

We show that a multi-proxy approach can improve climate reconstruction on the regional scale, and discuss potentials and problems of this approach.