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Resolving contradictory reconstructions of Alpine climate in 1540 - Using Nonlinearities in Tree Growth Response to Climate

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Reconstructions of Swiss climate based on documentary data suggest that the year 1540 was anomalously hot and dry (Wetter and Pfister 2013, Wetter et al in prep). They stand in stark contrast to reconstructions from tree ring data (Casty et al. 2005) in which 1540 climate is within the range of average conditions.

To resolve this apparent contradiction, we combine documentary and dendrochronological information. This data are used in a hierarchy of models, describing the climate system and both recording processes: the documentary data and the nonlinear growth response of trees. The mechanisms-based model for tree-ring data was derived by Tolwinski-Ward et al. (2010), the documentary data is best described using a multinomial model for the documentary data.

The extreme heat conditions documented in crop records of 1540 indicate that a biological threshold was crossed, above which the growht response of threes is influenced by moisture availability rather than temperature. We demonstrate that the tree ring and documentary data for 1540 are in fact consistent within the ranges of uncertainty used to interpret each source of information, and together indicate anomalously hot and dry conditions in that year, although to a lesser extend as reconstructed by Wetter and Pfister (2013).

Casty et al. "Temperature and precipitation variability in the European Alps since 1500", Int. J. Climatol. 25, 1855-1880 (2005)
Tolwinski-Ward et al. "An efficient forward model of the climate controls on interannual variation in tree-ring width", Clim. Dyn. 36, 2419–2439 (2010)
Werner and Tolwinski-Ward, in prep.
Wetter and Pfister "An underestimated record breaking event: why summer 1540 was very likely warmer than 2003", Clim. Past 9, 41-56 (2013)
Wetter et al. "The European Mega-drought of 1540 - an evidence-based Worst Case Scenario" (in prep.)