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A multi-proxy warm season temperature reconstruction (3400 cal yr BP - 1500 cal yr BP) from the varved sediments of Lake Silvaplana

Monique Stewart, Isabelle Larocque, and Martin Grosjean
University of Bern Institute of Geography, Oeschger Centre, NCCR Climate, Bern, Switzerland (stewart@giub.unibe.ch)

A multi-proxy analysis of a nine-meter sediment core from Lake Silvaplana (1791 m a.s.l., 46º24'N, 9º42'E - 46º30'N, 9º52'E), including an innovative application of Spectrolino (380 – 730 nm) data, provides a decadal warm season temperature reconstruction (3400 cal yr BP - 1500 cal yr BP). The climate of this region has been shown to be representative of continental Europe (Trachsel et al., 2009). Consequently, we offer one of the first high-resolution multi-proxy records of European climate for this time period.

The sediment of Silvaplana contains annual ('varved') layers. Therefore, a chronology has been based on varve counts, 210Pb, 137Cs, documented flood layers and radiocarbon dates (Blass et al., 2007a;b). These varves enable high-resolution (sub-decadal) sampling and measurement of geochemical (Spectrolino, Biogenic Silica [BSi], varve thickness) and biological (chironomids) parameters.

Spectrolino and BSi Flux measurements of the upper three meters of the core have been used to develop two independent calibrations-in-time and warm season (JJAS) temperature reconstructions back to AD 1177 (Spectrolino calibration period = 1864 - 1949; r = 0.92; pcorr = 0.001; BSi calibration period = 1864 - 1949; r = 0.67; pcorr = 0.03) (Trachsel et al., in review a;b; Blass et al., 2007b). A third warm season (July) temperature reconstruction to AD 1177 has been developed from chironomids (Larocque et al., 2009; Larocque-Tobler et al., 2009; accepted). Finally, Leemann and Niessen (1994), Ohlendorf et al. (1997), Nussbaumer et al. (in prep.) and Blass et al. (2007a) have shown a close relationship between local glacial activity and mean summer temperature.

Here, the laboratory methods and calibrations-in-time previously used to reconstruct temperatures to AD 1177 are applied to the lower six meters of sediments (Spectrolino and varve thickness: 3400 cal yr BP - 1500 cal yr BP; BSi and chironomids: 2550 cal yr BP - 1810 cal yr BP).

Both the BSi and chironomid based reconstructions show synchronous episodes (2450 cal yr BP and 1950 cal yr BP) of anomalously warm temperatures, possibly related to solar activity.

Combining these high-resolution and independent summer temperature reconstructions, based on novel and established methods, provides detailed information about the climate of continental Europe during the past several millennia including the Iron-Roman Age.

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