



A new 600-years-long oxygen isotope record from Lac d'Annecy (France) exhibiting sub- to multidecadal temperature variability in Europe

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The detection of the green-house gas related climate change over last decade strongly depends on the quality of climate reconstruction for a past period extending significantly that of instrumental climate observation. Such reconstructions are mainly based on tree ring parameters, in addition to historical archives like harvest records, which are more sensitive to summer climate and subjected to statistical treatments which introduce the risk of reducing the expression of eventual multidecadal temperature trends.

Here, we present new oxygen isotope data of ostracod calcite from a short core taken at 65 m in Lac d'Annecy, representing the last 600 years. According to the chronology (based on varve-counting, radio-isotopes and the recognition of historical events) each sample represents between two and five years, on the order of the lake's mean water residence time of 3.8 years. Sensitivity studies using a one-dimensional mass and heat balance model confirm that hypolimnic water temperatures and changes in the lakes water balance have but little influence on the ostracod calcite oxygen isotopes. The

record can be used to reconstruct the oxygen isotope composition of the lake's input, which is a reliable measure of the oxygen isotope composition of the atmospheric precipitation ($\delta^{18}\text{O}_P$).

Over the last 200 years, the new record is surprisingly well correlated to the $\delta^{18}\text{O}_P$ record from Ammersee (Southern Germany), located about 600 km to the NE of Annecy. In fact, this correlation is much better than that with the local temperature record from Annecy. However, the record is in near perfect agreement with the temperature reconstruction for the nearest grid from the observation-based homogenized ALP-CLIM dataset.

The new record thus provides independent support for a strong spatial coherence of the annual air temperatures in the circum-alpine region and points to a strong temperature dependence of $\delta^{18}\text{O}_P$, at least along the northern Alpine Range. It also confirms relatively high air temperatures around 1800 AD, only slightly lower than those of the last decade, which show up in the ALPCLIM data set but not definitively in any of the tree ring based reconstructions. High $\delta^{18}\text{O}_P$ -values are also found during the first half of the 16th century, which would indicate periods as warm as the last decade for the Annecy region. The record, together with the Ammersee record, is a first step towards a set of highly reliable $\delta^{18}\text{O}_P$ records from lakes in Europe, which will be established within DecLakes, an ESF-Euroclimate project.