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A 500 year early summer temperature reconstruction for the western Mediterranean basin based on stable carbon isotopes from Pinus nigra ssp. laricio

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The Mediterranean is considered as an area which will be severely affected by modern climate change. Strong temperature increase and precipitation decrease is expected for large regions, resulting in a northward extension of arid conditions. Information of past temperature changes which could contribute to a better understanding of future climate changes are still sparse. Carbon isotope chronologies from tree-rings often carry strong temperature information but they are critically in their application as climate proxies because of the influence by the change of atmopsheric CO_2-concentration due to the fossil fuel burning effect. These changes are recorded in the chronologies by a remarkable downward trend over the last approximately 150 years and are routinely corrected. However, these correction values do not account for a plant physiological response to higher pCO_2, a factor which is especially important in high mountain environments.

We tested the influence of different correction models on four annually resolved long-term carbon isotope records (between 400 and 800 years) derived from Corsican pine trees (Pinus nigra ssp. laricio) growing at ecologically varying mountain sites on the island of Corsica in the Western Mediterranean. A negative trend in the carbon isotope ratios during the last 150 years is still visible after correcting for changes of atmospheric CO_2-concentration indicating that plant physiological responses to increased CO_2 levels significantly influence the δ13C tree-ring values. Carbon isotope series corrected for both, increase in atmospheric CO_2 and plant physiological response, show stronger correlations with climate parameters, especially summer temperature, and better mirror increasing temperatures in the climate data. Carbon isotope records from trees at cooler and wetter sites show generally lower δ13C-values and are more sensitive to temperature at the beginning of the vegetation period. δ13C records from drier and warmer sites are sensitive to drought stress during late summer. The strong and stable correlation of the carbon isotope ratios with May-June temperature at one study site allows a 500-year temperature reconstruction for the Western Mediterranean which will contribute to a better understanding of past climate variability in the Mediterranean basin.