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A 217-year record of summer air temperature reconstructed from freshwater pearl mussels (*M. margarifitera*, Sweden)

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Abstract

Variations in annual shell growth of the freshwater pearl mussel *Margritifera margritifera* (L.) were utilized to reconstruct summer (June–August) air temperatures for each year over the period AD 1777–1993. Our study is based on 60 live-collected specimens with overlapping life-spans from six different Swedish rivers. Individual age-detrended and standardized chronologies ranging from 10 to 127 years in length were strung together to form one master chronology (AD 1777–1993) and three regional mean chronologies (Stensele, Uppsala, and Karlshamn). Standardized annual growth rates and air temperature (river water covaries with water temperature) exhibit a significant positive correlation and high running similarity confirming previous experimental findings. Up to 55% in the variability of annual shell growth is explained by temperature changes. From north to south this correlation slightly decreases. We establish a growth-temperature model capable of reconstructing summer air temperature from annual shell growth increments with a precision error of ± 0.6–0.9°C (2SD). The validity of the model was tested against instrumentally determined air temperatures and proxy temperatures derived from tree rings.

Our study demonstrates that freshwater pearl mussels provide an independent measure for past (i.e., prior to the 20th century greenhouse forcing) changes in air temperature. It can be used to test and verify other air temperature proxies and thus improve climate models.

1. Introduction

Climate models require long-term and high-resolution records of environmental conditions. Such information can decipher natural climate variability, help understand rapid shifts of climate, estimate the relative importance on anthropogenic forcing of the climate and can thus enable reliable climate forecasts. Unfortunately, observational data is spatiotemporally incomplete and inhomogeneous as it covers only the last 100–200 years and only parts of the world. For times and places without direct measurements, climate modelers thus rely on proxy data (Jones et al., 2001), i.e. natural recorders of environmental variability, in order to calibrate and validate models.

Summer air temperatures play an important role in modeling the climate of boreal, terrestrial ecosystems (Briffa, 2000; Slonosky et al., 2000; Cook et al., 2002; D'Arrigo et al., 2003). Beyond instrumental measurements such data is almost exclusively inferred from variations of tree ring width and density (dendrochronology) (Briffa et al., 1990; Schweingruber et al., 1991; Grudd et al., 2002; Linderholm et al., 2003). The annual ring widths of trees growing near the timber-line, for example Scots pines (*Pinus sylvestris* L.) in northern Fennoscandia (Briffa, 2000; Gunnarson and Linderholm, 2002; Grudd et al., 2002), exhibit a significant positive correlation with summer (April–August; Briffa et al., 1990) warmth. This enabled the construction of a linear growth-temperature model capable of reconstructing summer air temperature proxies from tree ring data (Briffa et al., 1990; Briffa, 2000). In a recent paper such a model was applied to a 7400-year master chronology constructed from 880 contemporaneous trees with overlapping life-spans and provided

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Corrigendum

Corrigendum to "A 217-year record of summer air temperature reconstructed from freshwater pearl mussels (*M. margarifitera*, Sweden)" [Quaternary Science Reviews 23 (2004) 1803–1816] ☆

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In the title and abstract, the scientific name of the Freshwater pearl mussel was misspelled. The correct version is as follows: "*Margaritifera margaritifera* (Linnaeus 1758)". The authors apologize for any inconvenience caused.

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