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Frequency dependence of tree-ring climate reconstructions

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Improving our estimates of past climate variability is essential to our understanding of the contribution of greenhouse gas forcing to global warming. The purpose of the present study is to test the ability of tree-ring climate reconstruction methods to reproduce a prescribed climate oscillation, and to investigate the sensitivity of the reconstruction to its frequency.

The spatially explicit forest gap model ForLand is used to simulate forest succession over 1ha areas at 12 sites in Switzerland with distinct climatological and topographical characteristics. After the forest reaches equilibrium in present-day climate, sinusoidal temperature perturbations of various frequencies (1/500y, 1/250y, 1/100y, 1/50y, and 1/10y) are introduced. The temperature of a 1000-year period is reconstructed with the ring-width time series of the simulated trees.

First results show that the quality of the temperature reconstruction is sensitive to the frequency of the climate signal. For frequencies below 1/250y, the climate signal is hardly captured by the ring-width chronology. At higher frequencies, such as 1/100y to 1/10y, the oscillations in the ring-width chronology clearly reflect the temperature perturbation imposed upon the system. At very high frequencies (1/10y), however, the reconstruction creates spurious low-frequency oscillations. Possible causes for this sensitivity are investigated.