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Dendrochronology and lakes: using tree-rings of alder to reconstruct lake levels

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Climate change is considered a major threat for ecosystems around the world. Assessing its effects is challenging, amongst others, as we are unsure how ecosystems may respond to climate conditions they were not exposed to before. However, increased insight may be obtained by analyzing responses of ecosystems to past climate variability. In this respect, lake ecosystems appear as valuable sentinels, because they provide direct and indirect indicators of change through effects of climate. Lake-level fluctuations of closed catchments, for example, reflect a dynamic water balance, provide detailed insight in past moisture variations, and thereby allow for assessments of effects of anticipated climate change.

Up to now, lake-level data are mostly obtained from gauging records and reconstructions from sediments and landforms. However, these records are in many cases only available over relatively short time periods, and, since geoscientific work is highly demanding, lake-level reconstructions are lacking for many regions. Here, we present and discuss an alternative method to reconstruct lake levels, which is based on tree-ring data of black alder (*Alnus glutinosa* L.). This tree species tolerates permanently waterlogged and temporally flooded conditions (i.e. riparian vegetation), and is often found along lakeshores. As the yearly growth of trees varies depending upon the experienced environmental conditions, annual rings of black alder from lakeshore vegetation likely capture information on variations in water table, and may therefore be used to reconstruct lake levels. Although alder is a relatively short-lived tree species, the frequent use of its' decay-resistant wood in foundations of historical buildings offers the possibility of extending living tree-chronologies back in time for several centuries.

In this study, the potential to reconstruct lake-level fluctuations from tree-ring chronologies of black alder is explored for three lake ecosystems in the Mecklenburg Lake District, northeastern Germany. Tree-ring data were collected from black alder forests surrounding the lakes 'Tiefer See', 'Drewitzer See' and 'Großer Fürstenseer See'. At all research sites, increment cores were extracted from at least 15 trees (2 cores per tree) using an increment borer. In the tree-ring lab DendroGreif, these cores were prepared and annual tree-ring widths were measured. Thereafter, site-specific tree-ring chronologies were built using established detrending and standardization procedures. Preliminary results show that the growth of alder reacts upon water level fluctuations. We visually and statistically compare the developed tree-ring chronologies with historical lake-level records, and retrospectively model lake levels. Findings will be presented while critically reflecting upon the quality of these reconstructions.