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Climate or vegetation change – what drove Holocene lake level fluctuations in NE-Germany?

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Lake Tiefer See (N 53.59, E 12.53) is one of the rare lakes with a long sequence of annually laminated Holocene sediments in northern Germany. The lake is a valuable link between laminated lakes in more oceanic climates of the Eifel region and NW Germany and laminated lakes in the more continental climate of Poland. The lake provides great potential to study past climate, vegetation and human land use along that climate transition; it is thus a core study site of the ICLEA virtual institute.
One prominent feature of Lake Tiefer See are pronounced lake level fluctuations during the Holocene. Such changes are often interpreted in terms of climatic fluctuations. However, climate fluctuations are supposed to be small during the Holocene. Groundwater formation and thus lake levels may on the other hand be strongly influenced by the plant cover. We therefore hypothesize that the lake level fluctuations have largely been driven by vegetation change in the catchment area. To validate this hypothesis, we test whether the magnitude and timing of the lake level changes corresponds to vegetation change in the catchment area.
Analysis is based on quantitative vegetation analysis that includes both the REVEALS model and the extended downscaling approach (EDA). REVEALS translates pollen deposition from large lakes such as Tiefer See into regional vegetation cover. This method produces a continuous record of vegetation change, yet it is unable to reconstruct vegetation patterns in the catchment area. We therefore for specific time slices additionally apply the EDA to explore these patterns. Both methods are now available in the R package DISQOVER. Vegetation cover and estimates of climate variables are then used to estimate cumulative transpiration and ultimately groundwater recharge. Differences in groundwater recharge are likely to cause fluctuations in groundwater levels and thus also lake levels, as this lake is largely groundwater fed. While only rough estimates, these calculations will nevertheless provide a first test of our hypothesis on the importance of vegetation dynamics as a control on ground- and lake water level fluctuations.
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