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Chrysophyte cyst-inferred variability of warm season lake water chemistry and climate in northern Poland: training set and downcore reconstruction

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Transfer Functions based on modern training sets are well established and powerful tools in quantitative paleolimnology and environmental/climate reconstructions. Lake sediments are excellent natural archive to reconstruct long-term climate and environmental fluctuations. In this sense, the project 'Climate of northern Poland during the last 1000 years: Constraining the future with the past' (CLIMPOL) aims to develop quantitative climate reconstruction in northern Poland during the last millennium using lake sediments. The Polish training set consists of Chrysophyte cyst (golden brown algae, class Chrysophyceae) sediment trap and surface sediment samples, and data for 19 environmental variables collected from 50 lakes in northern Poland. Canonical correspondence analyses (CCA) revealed that water electric conductivity, total nitrogen, total phosphorous, turbidity, cation and anion compositions (Ca2+, HCO_3-) contributed significantly to explaining chrysophytes distribution in the lakes of the training set. A quantitative transfer function was then developed to estimate Ca2+ (log10 transformed) from modern chrysophyte cysts assemblages using weighted-averaging regression (WA) with classical deshrinking. The bootstrapped regression coefficient (R2boot) was 0.68, with a root-mean square error of prediction (RMSEP) of 0.143 (log10 units). The calibration model was applied to a varved sedimentary sequence (AD 1898-2010) from Lake Żabińskie, Masurian Lakeland (NE Poland). Cyst-inferred lake water Ca2+ concentrations were significantly correlated with zonal wind speed (m•s-1) (R=0.50; padj<0.001; AD 1898-2010; 3-yr filtered). We suggest that these changes in calcite precipitation in Lake Żabińskie depend on the lake mixing regime, driven by westerly winds. Observational data from this lake show that the Ca2+ variability in the epilimnion depends on the efficiency of Ca2+ scavenging by $CaCO_3$ precipitation in early summer which, in turn, is a function of water column stratification, temperature and the wind regime from late spring to early fall. This study demonstrates that chrysophyte cysts assemblages in Polish lakes respond to hydrochemical factors driven by climate variability.