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Cyanobacteria during low-wind summers indicate increased lake sensitivity to warming at high nutrient availability (Tiefer See, NE Germany)

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Deposition of varved sediments in Lake Tiefer See (max. 63 m deep, mesotrophic, hardwater lake), today as well as millennia ago (Kienel et al. 2013; Dräger et al. 2016) provides the unique opportunity to monitor ongoing formation of diatom, calcite, and organic matter (OM) varve sublayers and link their characteristics to climate and lake conditions. During the years 2012 to 2015, the particulate matter deposition was trapped at bi-weekly to monthly resolution in 12m and 50m depths. Lake conditions (temperature, ph, oxygen content) and meteorological variables (temperature, wind speed, precipitation) were logged by an in-situ sensor station.

The 13-C concentration in authigenic OM during the summer seasons (2012 to 2015) is related to the duration of low-wind periods (LWP). Enrichment of 13-C above the average of -33 to -30‰ δ13C OM was strongest during summer 2014. Wind speeds below average (3.5 m s-1) and water mixing depth less than 3.5 m for 50 days after 28 June promoted a huge cyanobacteria bloom (Limnothrix redekekei). At that time, δ13C OM increased to -26‰˙

During the shortest summer LWP in 2013 (12 days from 2nd July), neither cyanobacteria nor 13-C enrichment in OM were observed. During intermediate summer LWPs in 2012 and 2015, 13-C of OM was enriched by no more than 2‰˙

The observed relation of 13-C enrichment of OM during extended summer LWPs was tested using δ13C OM measured from individual varves (i.e. annual resolution) from the Tiefer See sediments for the period AD1924 to 2008 and the mixing depth as derived from FLake-model calculations (for 1951 to 2008 based on DWD data from Schwerin). Accordingly, the duration of summer LWPs with shallow mixing explains 25% of the variability of 13-C enrichment in OM for the full period. The explained variability more than doubles when the period with increased nutrient load from 1970 onwards is considered.

In terms of explained variability of lake production, this relation complements the inverse relation of diatom silica determined by the duration of lake mixing in spring, which becomes weak during the period of strongest nutrient load (1987 – 2005) (Kienel et al. 2017).

We show first results of pigment analyses from trap material and sediment record to scrutinize the cyanobacteria – δ13-C relation.

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