Environmental and climate dynamics in northeastern Siberia according to diatom oxygen isotopes

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INTRODUCTION
In the last decade, the high potential of oxygen isotope composition in diatoms derived from lacustrine sediments for reconstructing past climate, environment and hydrology changes (e.g. Meyer et al., 2015; Chaplin et al., 2016; Kostrova et al., 2019) has been demonstrated.

As part of the German-Russian ‘Paleolimnological Transect’ (PLOT) project aiming at investigation the Late Quaternary climate and environmental history along a transect crossing Northern Eurasia, Lake Emanda, one large freshwater lake located in the semi-arid plateau of the eastern slope of the Verkhoyansk Mountain Range.

Lake Emanda characteristics:
Area: ~33.1 km²
Length: ~8.3 km
Width (average): ~3.5 km
Water depth max = ~16.8 m
Catchment area = ~179 km²
Main inflow: River Synaptic
Outflow: Seen (Syr) River

Mean meteorological data:
Average air temperature: January: ~-44.7°C
July: ~+13.0°C
Precipitation: ~250 mm

Lake Emanda is well-mixed spatially uniform water reservoir
δ18Owater changes are mainly driven by:
1) evaporative effect;
2) 818O precipitation (T<sub>air</sub> + moisture source);
3) riverine/meltwater supply.

33 Lake Emanda water samples
6 river water samples
46 precipitation samples

δ18Owater samples:
δ18Owater = δ18OPrecip + δ18Oriver + δ18Olake.

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Cyclotella iris is the dominant taxon (up to 84%). The diatom succession is enriched by frigialandins assemblages in the interval from ca. 11.0 to 13.0 cal. ka BP, while Lindavia bodonica is more frequent at ~11–8.5 cal. ka BP and Aulacoseira ambigua is second dominant between 8.5 and 6.5 cal. ka BP. The most recent δ18Owater = +24.2‰ correlates well with present-day lake water isotopes (mean δ18Owater = -16.5‰), indicating a reasonable water–silica isotope fractionation (f = 1.0144) yielding T<sub>air</sub> of 12°C. The diatom isotope variability reflects changes in water isotope composition rather than changes in lake temperature, strongly dominated by evaporation. The δ18Owater trend follows a decrease in summer insolation and in line with temperature history in the region and the Northern Hemisphere. Maximum values (+26.7 to +27.3‰) at ~10.0–9.0 cal. ka BP reflect very dry conditions in Early Holocene. The Holocene Thermal Maximum at ~8.9–4.5 cal. ka BP (Biskaborn et al., 2016) is characterized by lower mean δ18Owater = +24.7‰. The absolute minimum of +22.5‰ at 0.4 cal. ka BP is visible likely connected to the Little Ice Age.

CONCLUSION
Changes in the Lake Emanda δ18Owater record reflect Late Quaternary variations in δ18Oprecip. 818Owater is linked with both δ18Oprecip, as well as evaporation effects and to a lesser degree, riverine/meltwater pulses from the mountainous hinterland.