

# Dissolved anions and cations at Lake Stechlin 2000-2020

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## Sampling site

Lake Stechlin is a deep, dimictic, formerly oligotrophic clear-water lake that has been undergoing eutrophication since the early 2000s and especially since 2010. The lake is located in a nature reserve approximately 80 km north of Berlin, Germany (53°9'5.6"N, 13°1'34.2"E) at 59 m altitude. Lake Stechlin has a maximum depth of 69.5 m, a mean depth of 23.3 m, a surface area of 4.3 km<sup>2</sup> and a volume of 96.9 x 10<sup>6</sup> m<sup>3</sup> (Casper 1985). The lake basin was formed during the last continental glaciation ca. 12,000 years ago and is today situated at the transition between temperate maritime and temperate continental climate (Fraedrich et al. 2001). The catchment has a size of 12.6 km<sup>2</sup> and is almost completely covered by managed forest (95%). The main species is Scots pine (*Pinus sylvestris*), although beech (*Fagus sylvatica*) is the dominant tree species along the shoreline. Non-forested areas are the site of a former nuclear power plant (KKW Rheinsberg) and the small village of Neuglobsow with about 300 residents (up to 1000 during the tourist season in summer), whose wastewater is diverted to a different catchment. The shoreline is largely undeveloped with no notable infrastructure except on the small beach and the boat rental, the properties of a fisherman, the Federal German Environment Agency and the Leibniz Institute of

Freshwater Ecology and Inland Fisheries. The seepage lake is mainly fed by precipitation and groundwater, resulting in a theoretical water retention time of more than 40 years (Koschel 1995, Holzbecher et al. 1999). There are no river inflows except for occasional discharge from a small stream channel that is dry in most years. The water level of Lake Stechlin is regulated. From 1966 to 1990, the lake received a total of about  $300,000 \text{ m}^3 \text{ d}^{-1}$  of cooling water from the nearby nuclear power plant. The cooling water was withdrawn from neighbouring Lake Nehmitz (North basin) and discharged into Lake Stechlin at an average temperature of approximately  $10^\circ\text{C}$  above the ambient surface water temperature. This resulted in an average increase in water temperature by  $1\text{--}2^\circ\text{C}$  during the power plant operation (1966-1990) and decreased the retention time of Lake Stechlin. For more information, see Casper (1985), Koschel and Casper (1986), Casper and Koschel (1995), Koschel and Adams (2003) and Kirillin et al. (2013).

**Time span** 2000-2020

### **Sampling method**

Water samples were taken monthly at the deepest point of Lake Stechlin (69.5 m) situated in the main basin ( $53^\circ 9' 19.5''\text{N}$ ,  $13^\circ 1' 52.9''\text{E}$ ), and in 2019 and 2020 additionally in the West basin ( $53^\circ 9' 15.1''\text{N}$ ,  $13^\circ 0' 30.5''\text{E}$ ) and in the South basin ( $53^\circ 8' 37.0''\text{N}$ ,  $13^\circ 1' 14.9''\text{E}$ ). The temporal resolution at the other sites is irregular. During ice-free periods monthly samples have been taken, from May to September occasionally fortnightly samples have been taken. All water samples were taken from the surface mixed layer using a 2.6 L or 3.5 L Limnos water sampler (Limnos Oy, Turku, Finland), or occasionally a 5 L Hydrobios water sampler. Epilimnion (surface mixed layer) samples were taken at 5 m increments and then pooled, containing the samples from 0 and 5 m depth, and additionally a sample from 10 m when the epilimnion was deep enough, occasionally, for periods with a very shallow epilimnion depth a pooled sample from 0 and 2.5 m depth was used. Hypolimnetic water was collected at 40, 60 and 65 m depth until 2008. These discrete deep-water samples were separately analyzed. Since 2009, additional discrete samples have been taken during summer stratification at 5 m intervals between 15 and 55 m depth. For mixed samples the respective integrated depth interval is indicated (e.g. "0-5", "0-10") in the data file, while for discrete samples the exact depth is indicated. On some occasions, measurements have been taken 0.5-1m above the sediment. In that case depth is indicated as "uS" (meaning "über Sediment"/ "above sediment").

Dissolved anions (chloride ( $\text{Cl}^-$ ), sulfate ( $\text{SO}_4^{2-}$ )) and cations (sodium ( $\text{Na}^+$ ), potassium ( $\text{K}^+$ ), magnesium ( $\text{Mg}^{2+}$ ) and calcium ( $\text{Ca}^{2+}$ )) concentrations were determined by ion chromatography with conductivity detection following standardized protocols described in the user manual. The ion chromatographs used were a DX-100 (2000-2006), Dionex 1000 (2007-2018), and Dionex Aquion (2019-2020) (all from Dionex Corp., Sunnyvale, CA, USA). All dissolved components were estimated after filtration of the water samples through NC60 membrane filters (0.6  $\mu\text{m}$  pore size, Whatman, Little Chalfont, United Kingdom) before July 2010, cellulose nitrate membrane filters (0.45  $\mu\text{m}$  pore size, Whatman, Little Chalfont, United Kingdom) between July 2010 and April 2012, and cellulose acetate membrane filters (0.45  $\mu\text{m}$  pore size, Sartorius AG, Göttingen, Germany)

since May 2012. If not analyzed immediately after filtration, samples were stored at -20°C. Quality assurance of analytical procedures involved regular calibration and measurements of both, positive and negative control samples in each sample series.

## Parameters

- lake – sampled lake
- site – measurement site
- date – date of measurement [YYYY-MM-DD]
- depth – depth of measurement [m]
- Na – concentration of dissolved sodium ( $\text{Na}^+$ ) [ $\text{mg L}^{-1}$ ]
- K – concentration of dissolved potassium ( $\text{K}^+$ ) [ $\text{mg L}^{-1}$ ]
- Mg – concentration of dissolved magnesium ( $\text{Mg}^{2+}$ ) [ $\text{mg L}^{-1}$ ]
- Ca – concentration of dissolved calcium ( $\text{Ca}^{2+}$ ) [ $\text{mg L}^{-1}$ ]
- Cl – concentration of dissolved chloride ( $\text{Cl}^-$ ) [ $\text{mg L}^{-1}$ ]
- SO<sub>4</sub> – concentration of dissolved sulfate ( $\text{SO}_4^{2-}$ ) [ $\text{mg L}^{-1}$ ]
- device – measurement device
- comment – comments
- comment\_eng – English translation of original German comments given in column “comment”

## References

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### **Change log**

- 2020/2021 Silke R. Schmidt: In the years when the “DX-100” ion chromatograph was used, the measured K concentrations were not covered by the calibration curve and for several records less than zero. These were excluded from the dataset.
- 2022 Sabine Wollrab: Metadata description has been updated. Especially more details have been added to the description of the sampling procedure and the representation of sampling depth in the dataset
- 2025/01 Christine Kiel/ Sabine Wollrab: Metadata description has been updated, adding details on changes in instruments and sampling procedures. Rights of usage has been updated.
- 2025/05 Sabine Wollrab: changed format of csv file from semi-colon to comma separated, added column with English translation of original (German) comments