Table S1. Data of ice phenomena in Lake Wigry (Poland) from 2008-2022.

year	Ice phenomena duration [days]	End ice phenomena [date]
2008	21	24 January
2009	96	3 April
2010	104	31 March
2011	124	4 April
2012	67	31 March
2013	120	19 April
2014	62	21 March
2015	83	20 March
2016	45	14 February
2017	104	21 March
2018	86	6 April
2019	99	10 March
2020	0	0
2021	73	31 March
2022	87	24 March

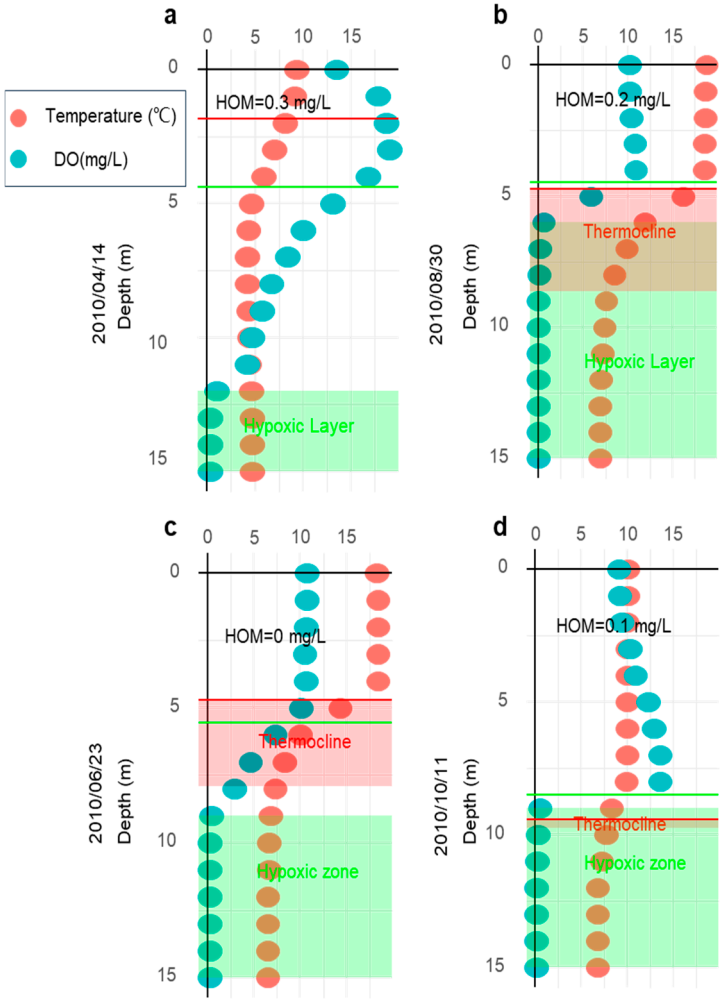


Figure S1. Vertical distribution of temperature and oxygen in April (**a**), June (**b**), August (**c**), and October (**d**) 2010. DO: dissolved oxygen; HOM: hypolimnetic oxygen minimum. Note: The red line denotes thermocline depth, and the green line indicates oxycline depth. The red zone represents thermocline thickness, while the green zone indicates hypoxic thickness. Values for HOM are also provided for each month.

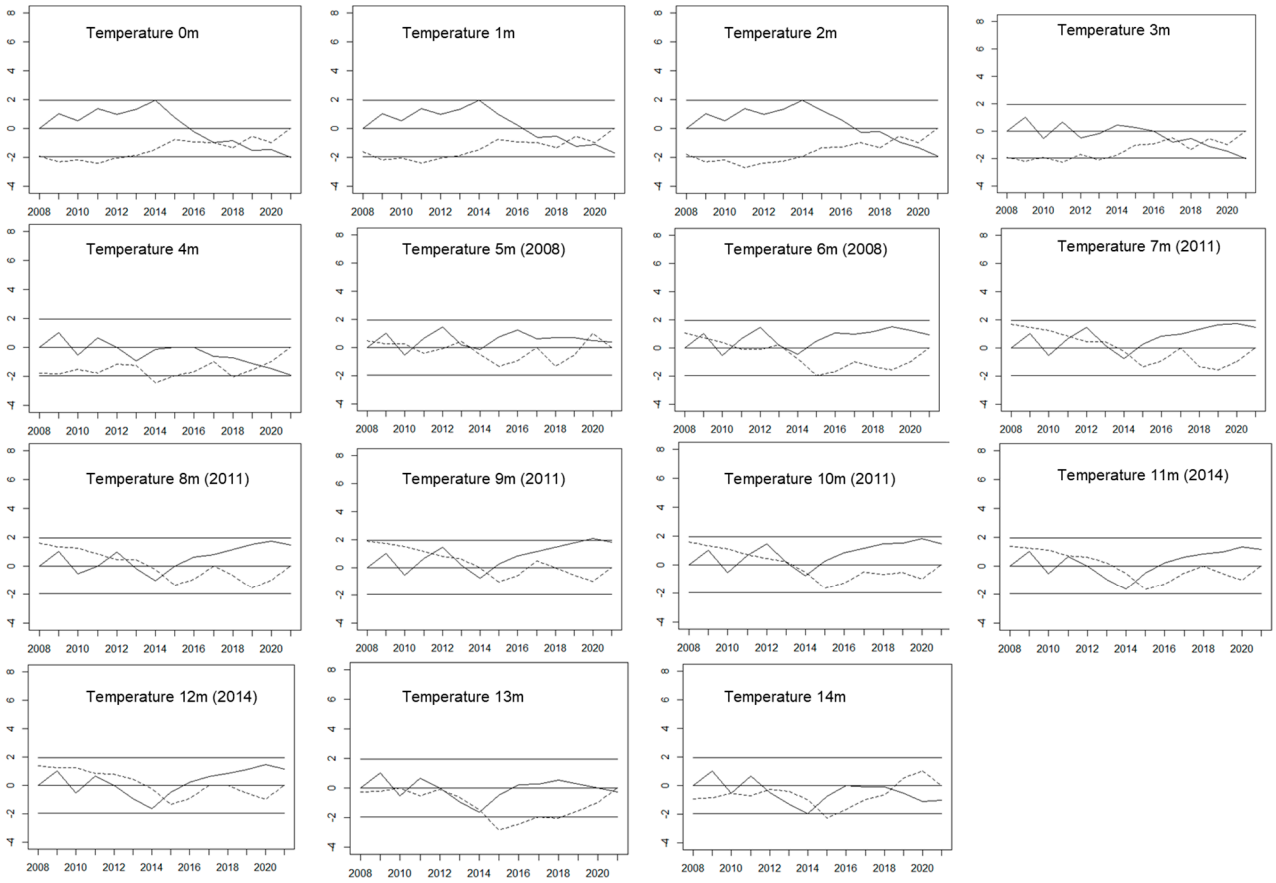


Figure S2. Results of the non-parametric Mann–Kendall (M-K) test for annual water temperature at various depths from 2008 to 2022. Note: as the data from 2018 is absent, here we used the data from 2019–2021 instead of 2018–2022, that means year 2008 in figure represents actual year 2009. Numbers in parentheses indicate the year of significant abrupt changes; blanks indicate no significant changes were detected.

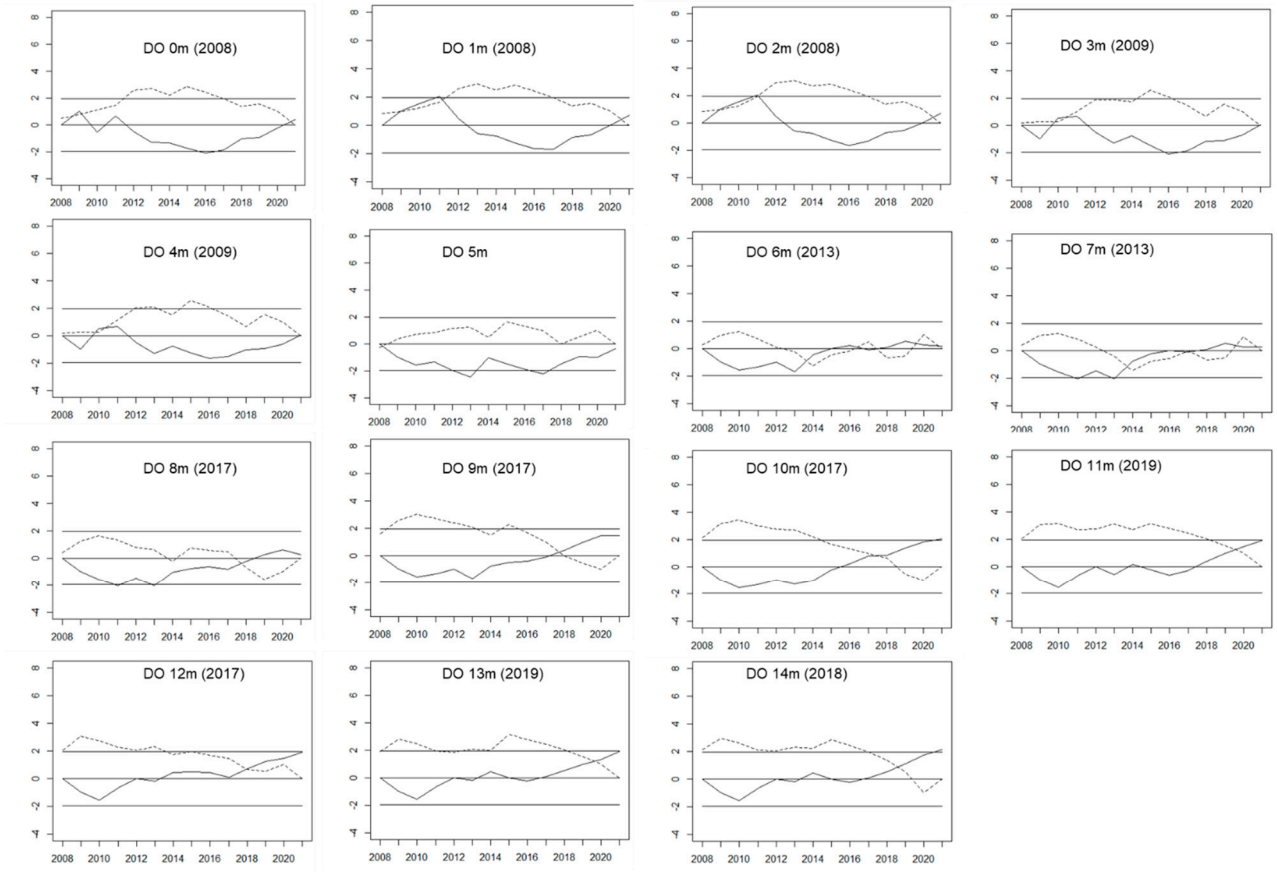


Figure S3. Results of the non-parametric Mann–Kendall (M-K) test for annual dissolved oxygen (DO) at various depths from 2008 to 2022. Note: as the data from 2018 is absent, here we used the data from 2019–2021 instead of 2018–2022, that means year 2008 in figure represents actual year 2009. The numbers in parentheses indicate the year of significant abrupt changes; blanks indicate no significant changes were detected.

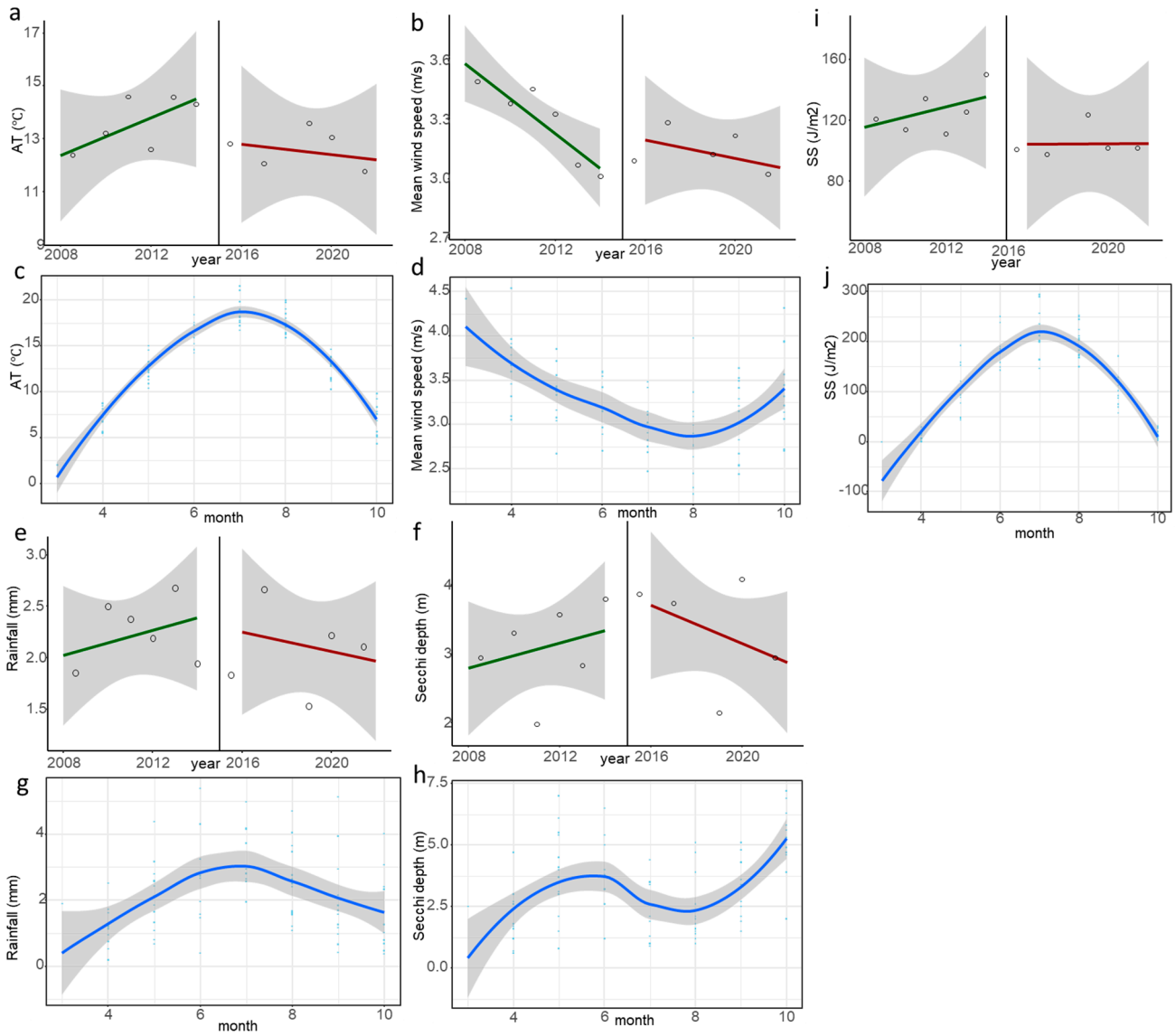


Figure S4. Interannual (piecewise linear fitting) and intraannual (curve fitting) changes in air temperature (**a**,**c**), mean wind speed (**b**,**d**), rainfall (**e**,**g**), and Secchi depth (**f**,**g**).

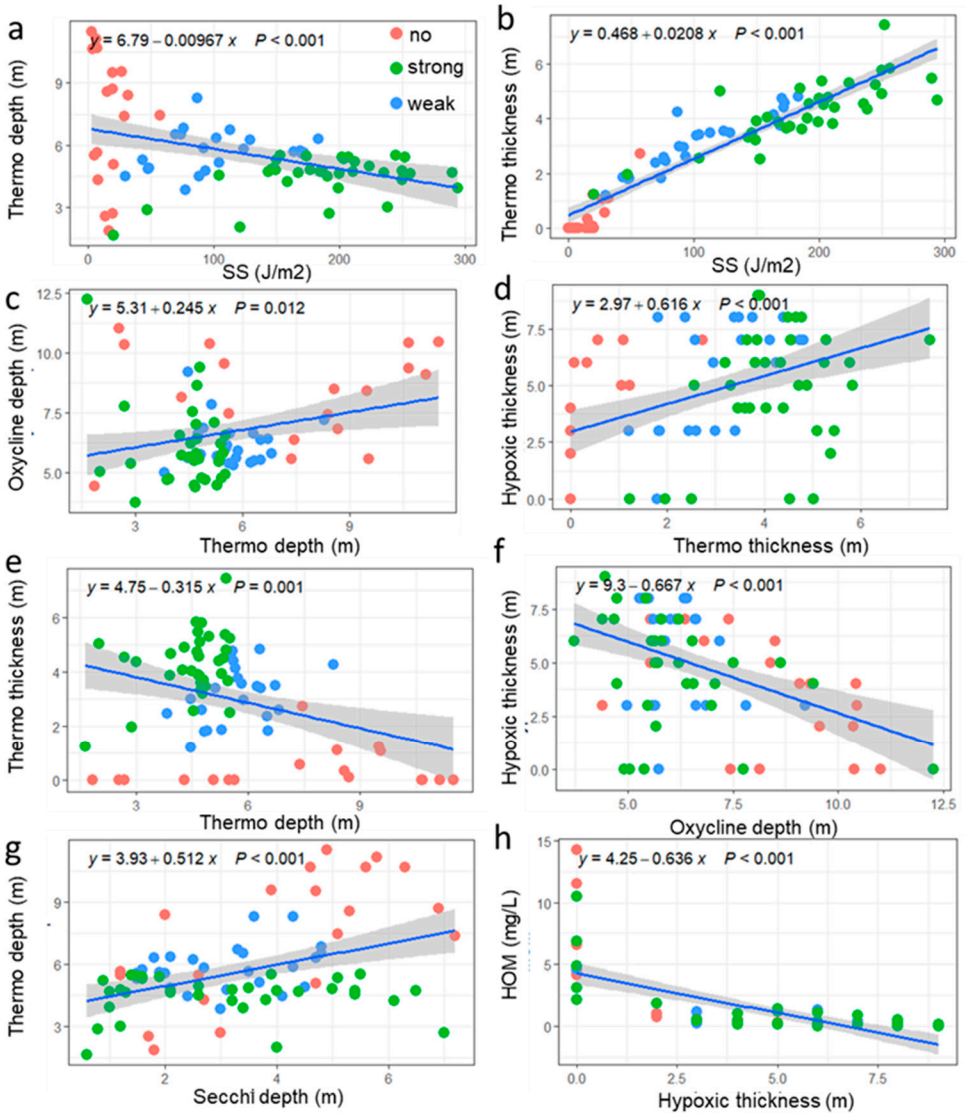


Figure S5. Linear regressions between SS and thermocline depth (**a**), thermocline thickness (**b**), thermocline depth and oxycline depth (**c**), thermocline thickness and hypoxic thickness (**d**), Secchi depth and thermocline depth (**g**), and hypoxic thickness and HOM (**h**). SS: Schmidt stability, HOM: hypolimnetic oxygen minimum. Note, significant when * $p < 0.05$, ** $p < 0.01$, * $p < 0.001$.