Table 3. Model Parameters, grouped into three categories: constants, which are values that were not tuned; manually calibrated, which are parameters manually tuned, typically guided by ranges from the literature; and parameters calibrated through constrained parameter search, which are calibrated through an automated search of parameter space.

Parameter	Abbreviation	Value	Units	Source
Constants				
Conversion of Carbon to Oxygen	$O2_{convert}$	2.67	Unitless	Mass Ratio of C:O
Respiration rate of DOCR	r_{DOCR}	0.001	day^{-1}	(Hanson et al., 2011)
Respiration rate of POCR	r_{POCR}	0.005	day^{-1}	Taken from ranges provided in (Hanson et al. 2004)
Respiration rate of POCR	r_{POCR}	0.005	day^{-1}	Taken from ranges provided in (Hanson et al. 2004)
Respiration rate of POCL	r_{POCL}	0.2	day^{-1}	Taken from ranges provided in (Hipsey et al. 2022)
Michaelis-Menten DO half saturation coefficient	$DO_{1/2}$	0.5	$g\ m^{-3}$	Taken from ranges provided in (Hipsey et al. 2022)
Light extinction coefficient of water	LEC_{water}	0.125	m^{-1}	Taken from ranges in Hart et al. (2017)
Ratio of DOC to POC production from NPP	C_{NPP}	0.8	Unitless	Biddanda & Benner (1997)
Albedo	α	0.3	Unitless	Global average (Marshall & Plumb, 2008)
Atmospheric gas exchange adjustment during ice covered conditions	C_{winter}	0.1	Unitless	Taken from ranges in (Loose & Schlosser, 2011)
Coefficient of light transmitted through ice	C_{ice}	0.05	Unitless	Taken from ranges provided in (Lei et al. 2011)
Settling velocity rate of POC_R	K_{POCR}	1.2	$m\ day^{-1}$	Taken from ranges found in (Reynolds et al.1987)
Settling velocity rate of POC_L	K_{POCL}	1	$m\ day^{-1}$	Taken from ranges ranges found in (Reynolds et al.1987)

Parameter	Abbreviation	Value	Units	Source
Temperature scaling coefficient for NPP	θ_{NPP}	1.12	Unitless	Taken from values provided in (Hipsey et al. 2022) and (Ladwig et al. 2022)
Temperature scaling coefficient for Respiration	θ_{Resp}	1.04	Unitless	Taken from values provided in (Hipsey et al. 2022) and (Ladwig et al. 2022)
Manually calibrated				
Light extinction of DOC	LEC_{DOC}	0.02 - 0.06	$m^2 g^{-1}$	Manually calibrated based on observed Secchi Depth ranges for the study lakes
Light extinction of POC	LEC_{POC}	0.7	$m^2 g^{-1}$	Manually calibrated based on observed Secchi Depth ranges for the study lakes
Maximum Daily Productivity	*Pmax*	0.5-5	$g\ m^{-3} day^{-1}$	Manually calibrated from mean productivity values from Wetzel (2001)
Recalcitrant DOC inflow concentration	$DOCR_{inflow}$	5-10	$g\ m^{-3}$	Based on ranges found in (Hanson et al. 2014, McCullough et al. 2018, Hart et al. 2017)
Recalcitrant POC inflow concentration	$POCR_{inflow}$	2-5	$g\ m^{-3}$	Based on ranges found in (Hanson et al. 2014, McCullough et al. 2018, Hart et al. 2017)
Calibrated through constrained parameter search				
Slope of the irradiance/productivity curve	*IP*	0.055, 0.020	$gCd^{-1}(Wm^{-2})^{-1}$	Based on ranges found in (Platt et al. 1980) and tuned separately for each lake region (South, North)
Sediment respiration flux	r_{sed}	0.1 – 0.4	$g\ m^{-2} day^{-1}$	Based on ranges found in (Ladwig et al. 2021) and (Mi et al. 2020) and fit independently for each lake
Respiration rate of DOCL	r_{DOCL}	0.015, 0.020	day^{-1}	Based on ranges found in (McCullough et al. 2018) and fit for each lake region

Parameter	Abbreviation	Value	Units	Source
				independently (South, North)

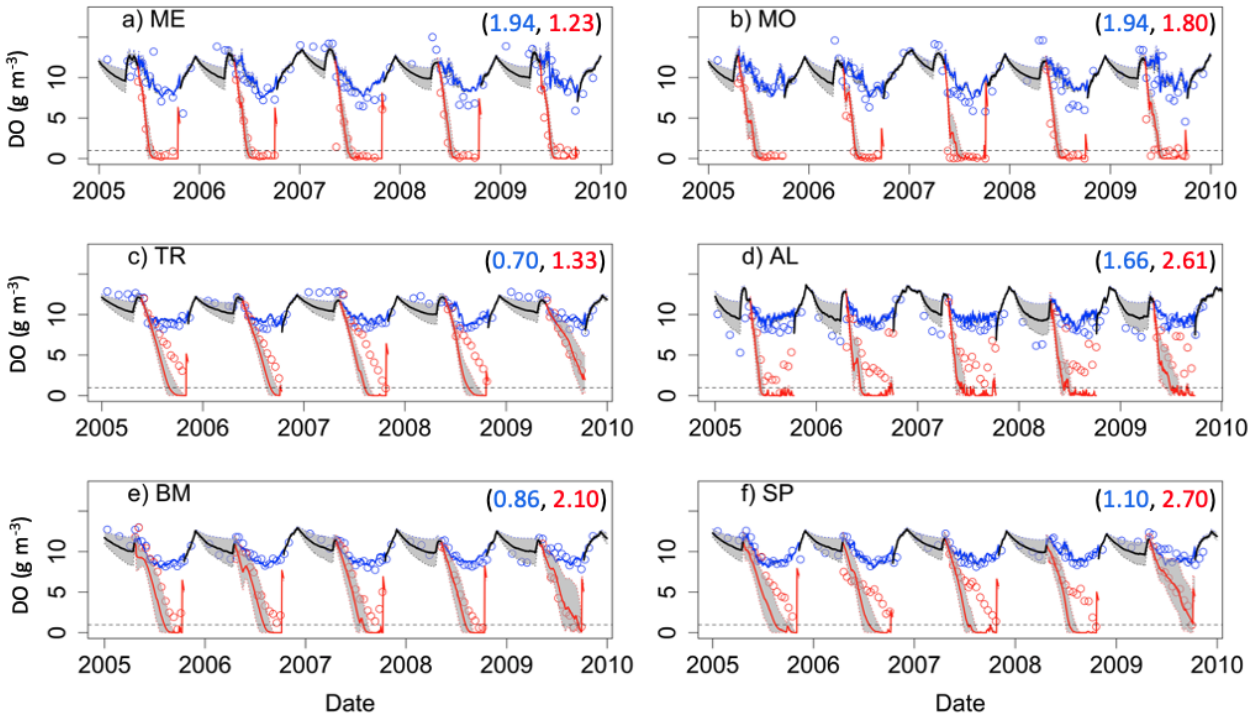


Figure 2. Dissolved oxygen (DO) time series for the years, 2005-2010, for the six study lakes (a-f). Model predictions are represented by lines, and circles represent the observational data. Epilimnetic DO values are blue and Hypolimnetic DO values are red. Fully mixed periods for the lake are indicated by a single black line. RMSE values (epilimnion, hypolimnion; g m^{-3}) are included in the upper right of each panel. Uncertainty is represented by gray shading.

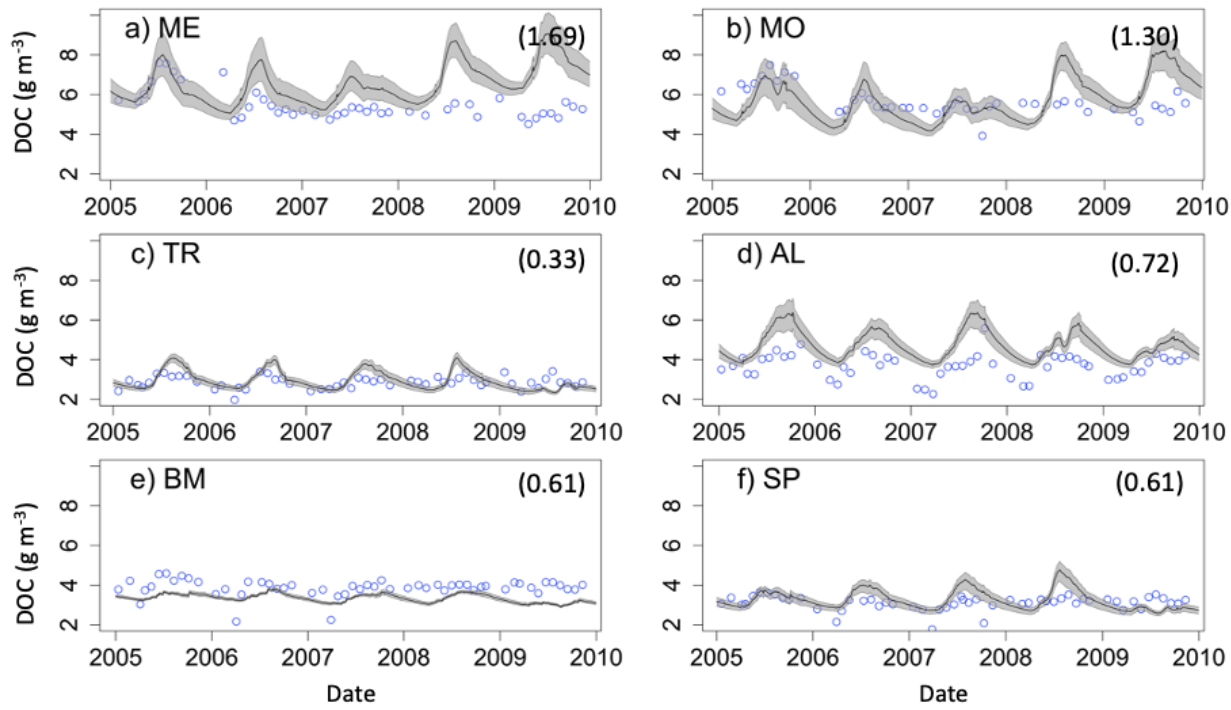


Figure 3. Epilimnetic dissolved organic carbon (DOC) time series for the years, 2005-2010, for the six study lakes (a-f). Model predictions are represented by lines, and circles represent the observational data. RMSE values are included for each lake (g C m^{-3}). Uncertainty is represented by gray shading.

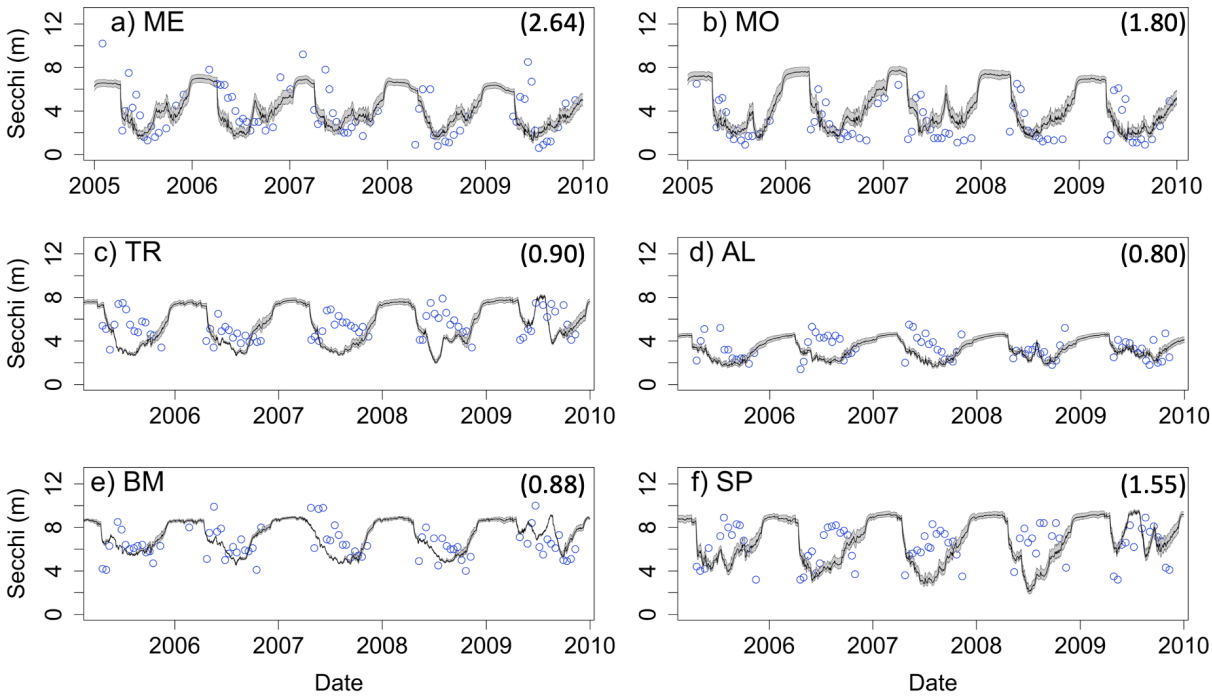
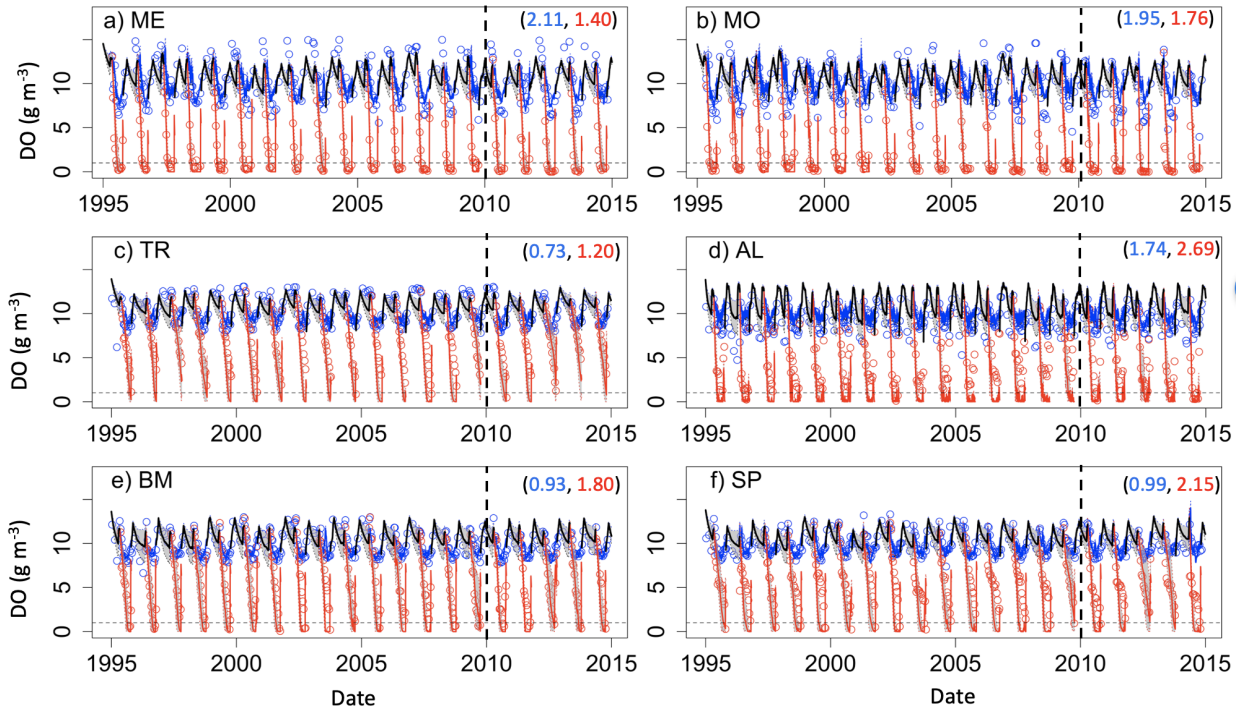
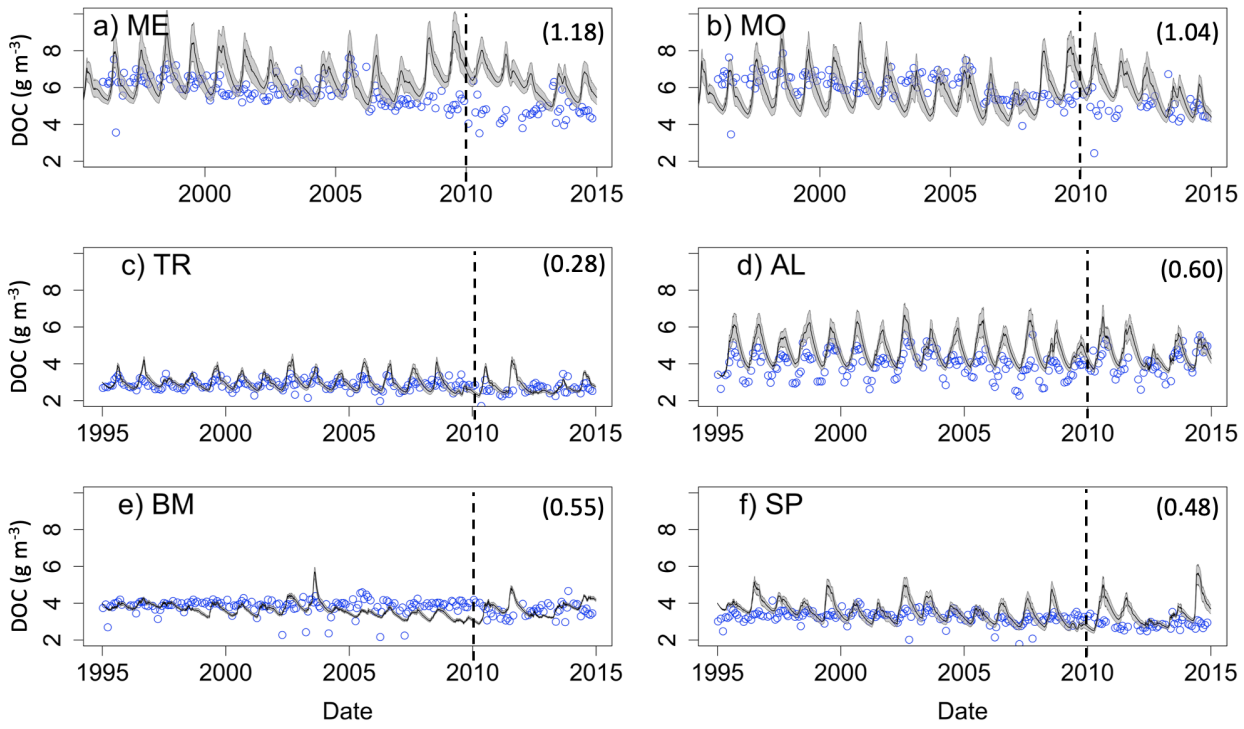


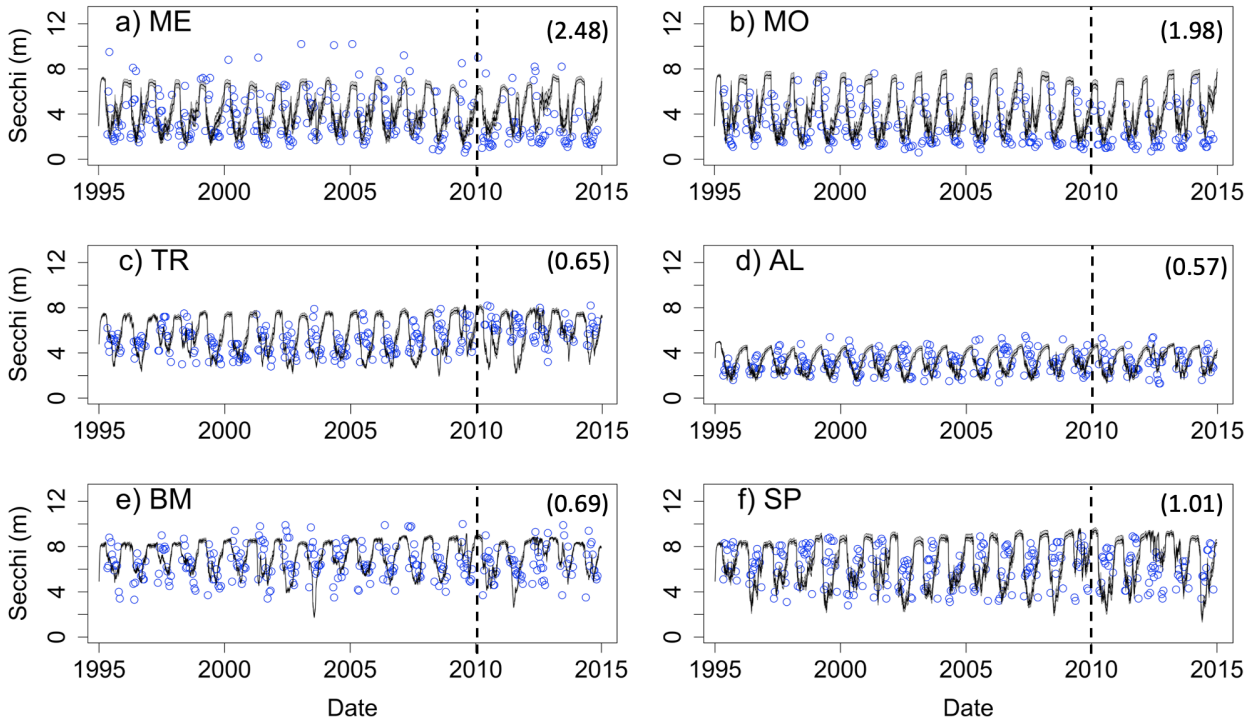
Figure 4. Secchi depth time series for the years, 2005-2010, for the six study lakes (a-f). Model predictions are represented by lines, and circles represent the observational data. RMSE values are included for each lake (m). Uncertainty is represented by gray shading.



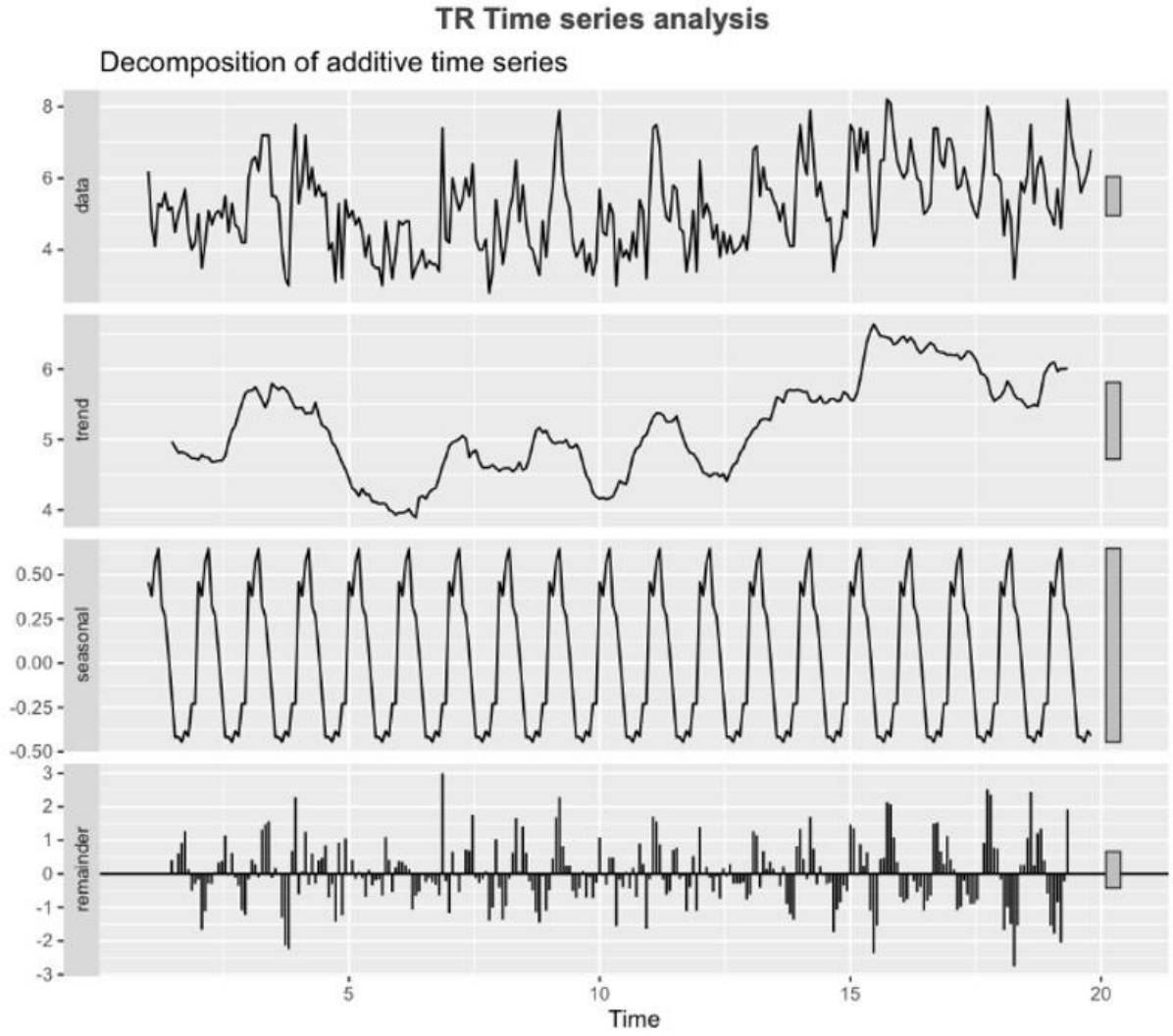
Supplemental Figure 1. Dissolved oxygen (DO) time series for the years for all years. Model predictions are represented by lines, and points represent the observational data. Epilimnetic DO values are indicated in blue and Hypolimnetic DO values are indicated in red. RMSE values (Epi,Hypo) are included in the upper right of each panel. The calibration period (1995-2010) and validation period (2010-2015) are separated by a vertical dashed black line. Uncertainty is represented by gray shading.



Supplemental Figure 2. Dissolved organic carbon (DOC) time series for all years. Model predictions are represented by lines, and points represent the observational data. RMSE values are included for each lake. The calibration period (1995-2009) and validation period (2010-2014) are separated by a vertical dashed black line. Uncertainty is represented by gray shading.



Supplemental Figure 3. Secchi Depth time series for the all years. Model predictions are represented by lines, and points represent the observational data. RMSE values are included for each lake. The calibration period (1995-2009) and validation period (2010-2014) are separated by a vertical dashed black line. Uncertainty is represented by gray shading.



Supplemental Figure 7. Time series decomposition for observed Secchi data for Trout Lake.

Supplemental Table 6. Results for the Wilcoxon significance test performed on the average annual OC sources and fates for our study lakes. Note, any p-value less than 0.05 was considered significant. All non-significant differences between lakes are indicated by “NS”.

Autochthonous OC						
	ME	MO	TR	AL	BM	SP
ME						
MO	*					
TR	*	*				
AL	*	*	*			
BM	*	*	*	*		
SP	*	*	*	*	NS	
Allochthonous OC						
	ME	MO	TR	AL	BM	SP
ME						
MO	*					
TR	*	*				
AL	*	*	*			
BM	*	*	*	*		
SP	*	*	*	*	NS	
Water Column Respiration						
	ME	MO	TR	AL	BM	SP
ME						
MO	NS					
TR	*	*				
AL	*	*	*			
BM	*	*	*	NS		
SP	*	*	*	*	*	
Sediment Respiration						

	ME	MO	TR	AL	BM	SP
ME						
MO	NS					
TR	*	*				
AL	*	*	*			
BM	*	*	*	*		
SP	*	*	*	*	NS	
OC Export						
	ME	MO	TR	AL	BM	SP
ME						
MO	*					
TR	*	*				
AL	NS	*	*			
BM	*	*	*	*		
SP	*	*	*	*	*	
OC Burial						
	ME	MO	TR	AL	BM	SP
ME						
MO	NS					
TR	*	*				
AL	*	*	*			
BM	*	*	*	*		
SP	*	*	*	*	NS	