Figures

Table 1: Mean and interquartile range of selected lake characteristics.

	Mean	IQR
Total Phosphorus (ug/L)	40	20 - 110
Chlorophyll (ug/L)	11.85	6.05 - 21.3
Secchi Depth (m)	1.5	0.9 - 2.4
P Retention (%)	0.46	0.24 - 0.59
Residence Time (yr)	0.63	0.2 - 1.8
Maximum Depth (m)	12.95	9.2 - 21.34
Agricultural Landuse (%)	53.27	17.68 - 74.05
Lake Watershed Area (ha)	8839	2117 - 41006
Network Watershed Area (ha)	14326	5425 - 55026

Table 2: Classification and ranking of connectivity metrics, lake depth, and their partition split values according to median effect size.

Metric	Scale	Connectivity Type	Split Value	Delta k
Average Link Length	nws	Longitudinal	2380	0.23
Closest lake distance	nws	Longitudinal	3274	0.22
Stream density	nws	Lateral	13.84	0.20
Lake Connection	focal	Longitudinal	-	0.17
Upstream lake area	nws	Longitudinal	154	0.16
Max Depth	focal	-	19.81	0.15
Average Link Length	lws	Longitudinal	2177	0.14
Baseflow	lws	Lateral	63.76	0.12
Stream order ratio	lws	Longitudinal	0.67	0.10
Baseflow	nws	Lateral	53.43	0.08
Closest lake distance	lws	Longitudinal	3774	0.05
Stream order ratio	nws	Longitudinal	0.4	0.04
Stream density	lws	Lateral	4.43	0.03

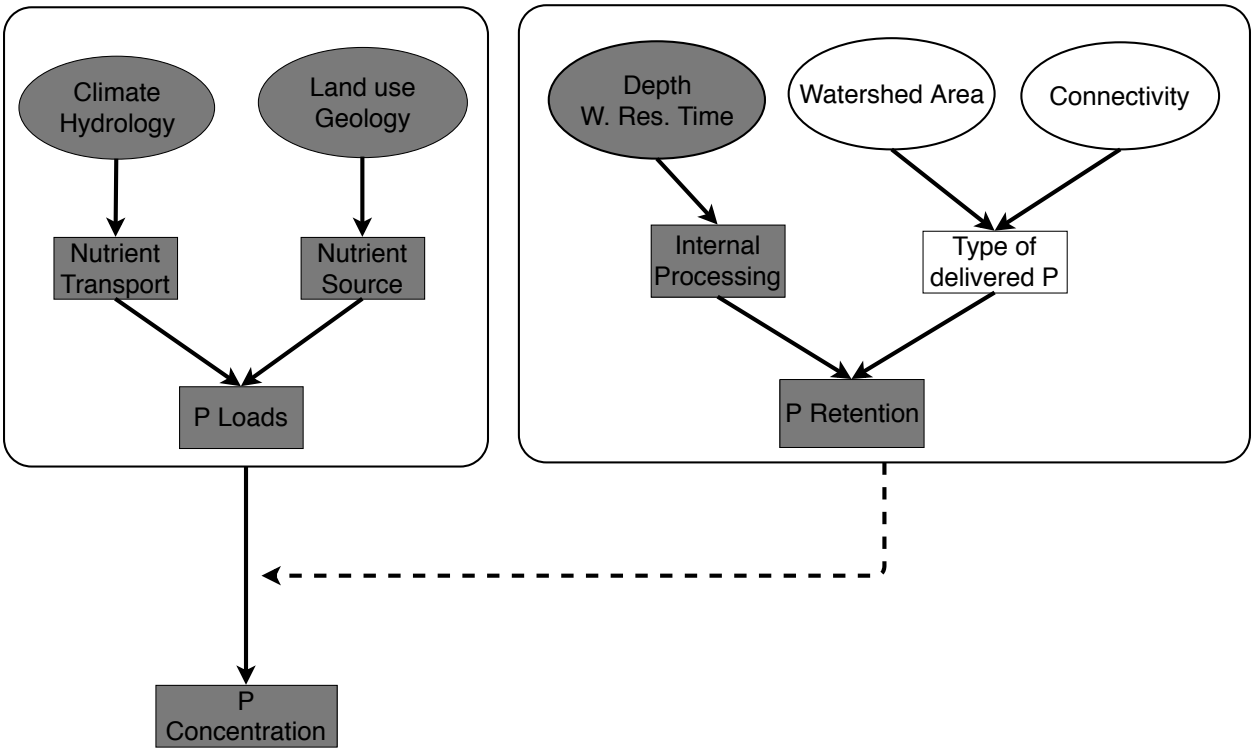

Figure 1: Major lake and watershed characteristics, factors, and processes affecting lake P retention. Shaded symbols indicate items typically considered in P retention models while open symbols indicate additional items considered in the present study.

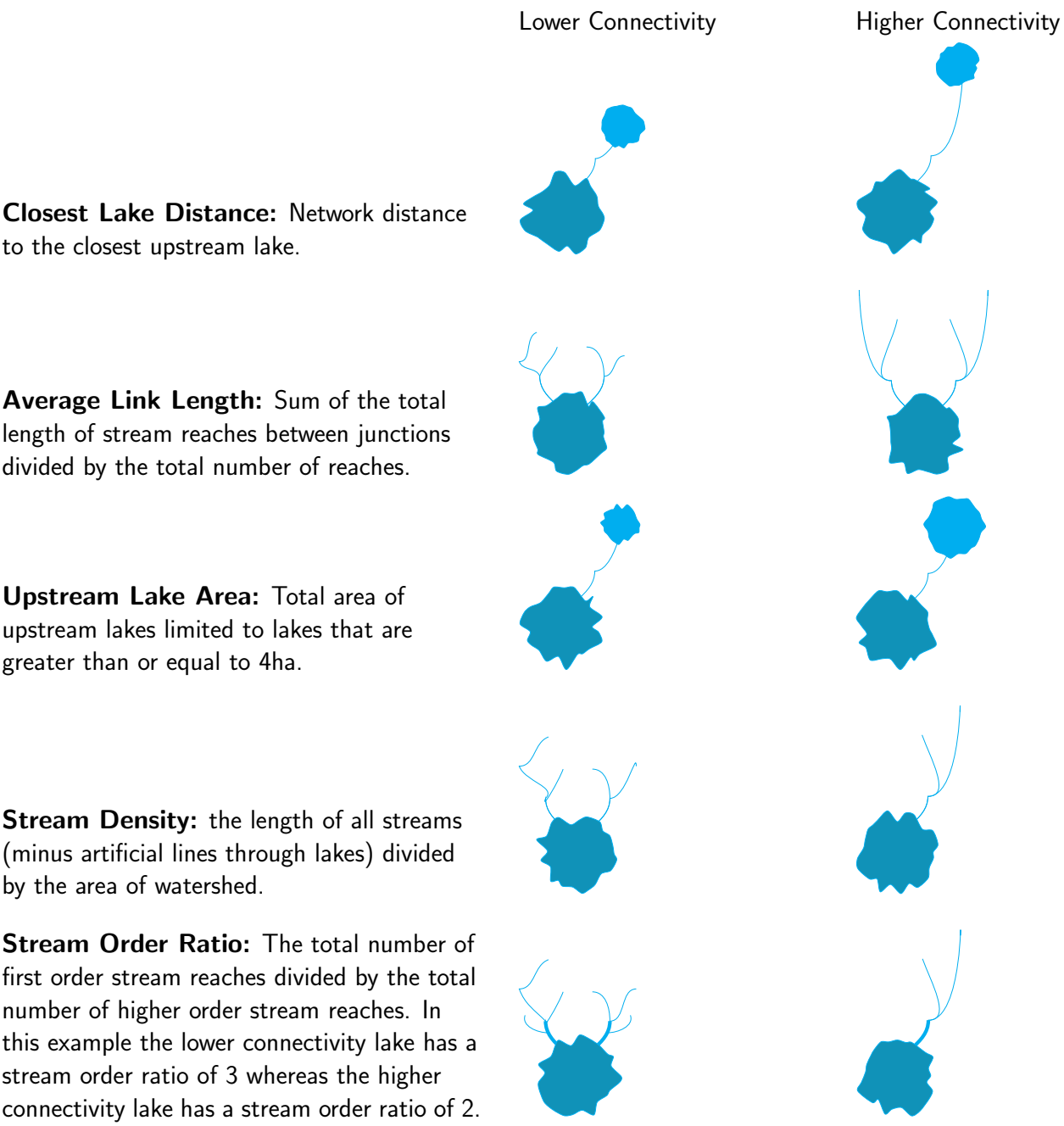

Figure 2: Connectivity metric definitions along with examples of high and low connectivity lakes.

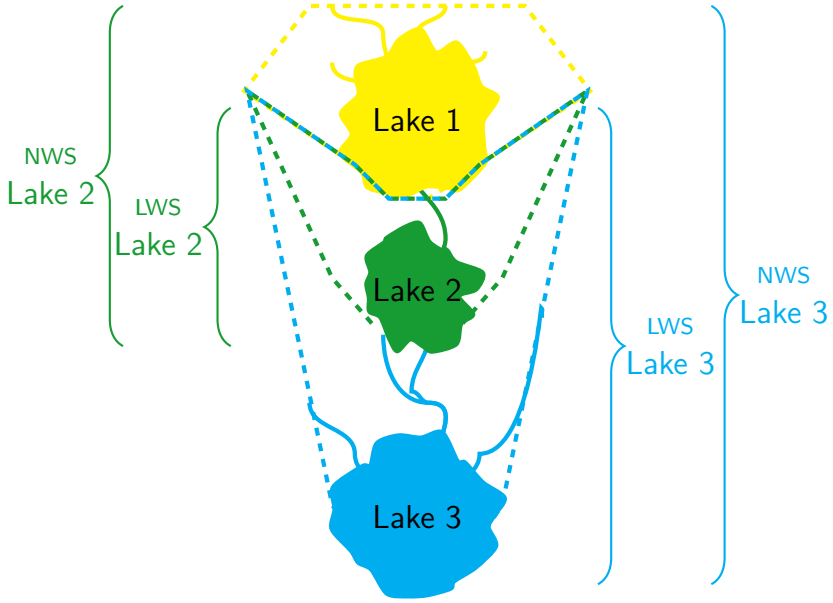

Figure 3: Diagram showing the lake watershed (LWS) and network watershed (NWS) of three lakes. Here the IWS of lake 3 encompasses the LWS of lake 2 because of it is smaller than 10 ha small size but it does not encompass the LWS of lake 1 because it has an area of at least 10 ha. In contrast to the LWS boundaries, the NWS boundaries extend to the headwaters of the lake chain.

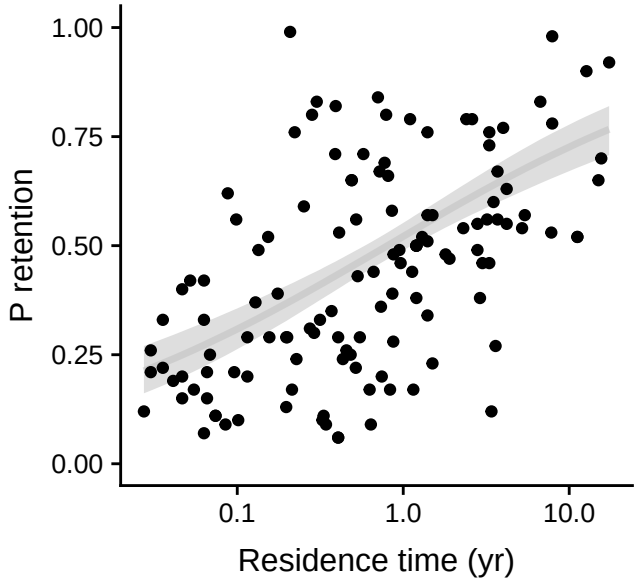

Figure 4: Residence time (yr) versus P retention for the NES dataset and the global model fit to the data where the solid line and shaded interval represents the median and central 95% interval estimates respectively.

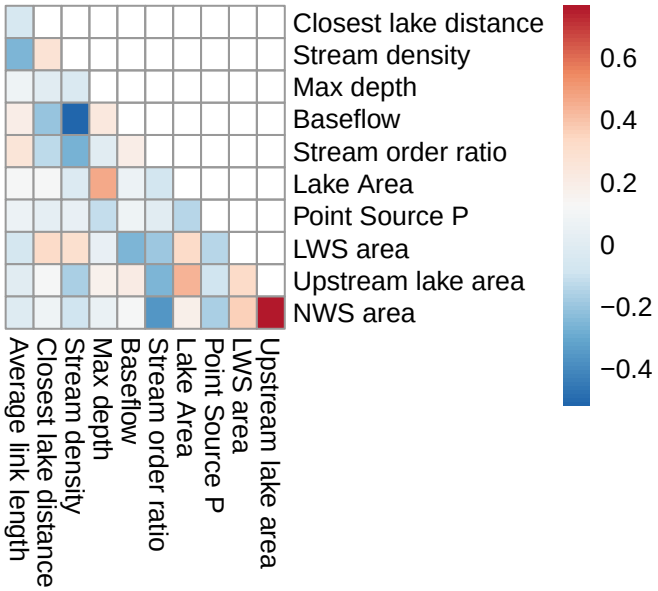

Figure 5: Correlation between connectivity metrics and selected lake characteristics.

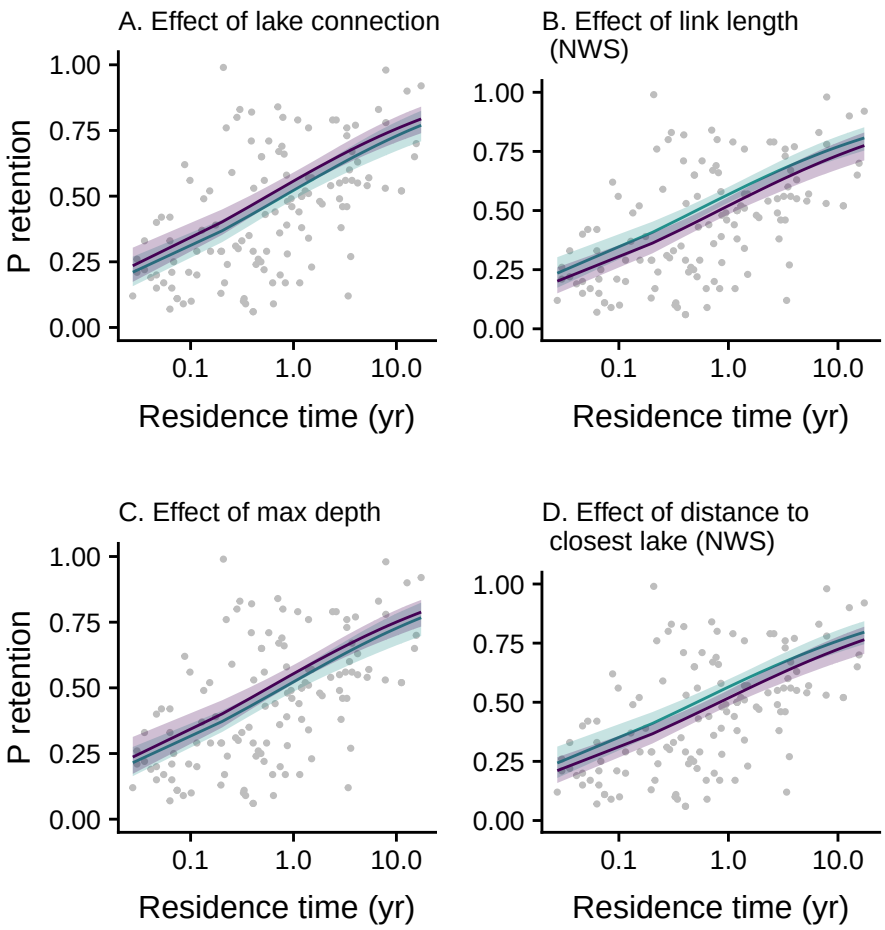

Figure 6: Residence time (yr) versus P retention for the NES dataset and hierarchical model fits to the data where the solid lines and shaded intervals represent the median and central 95% model estimates respectively. The green lines and symbols are the estimates from the lower of the two partition groups while the purple lines are estimates for the upper of the two partition groups (see Table 2).

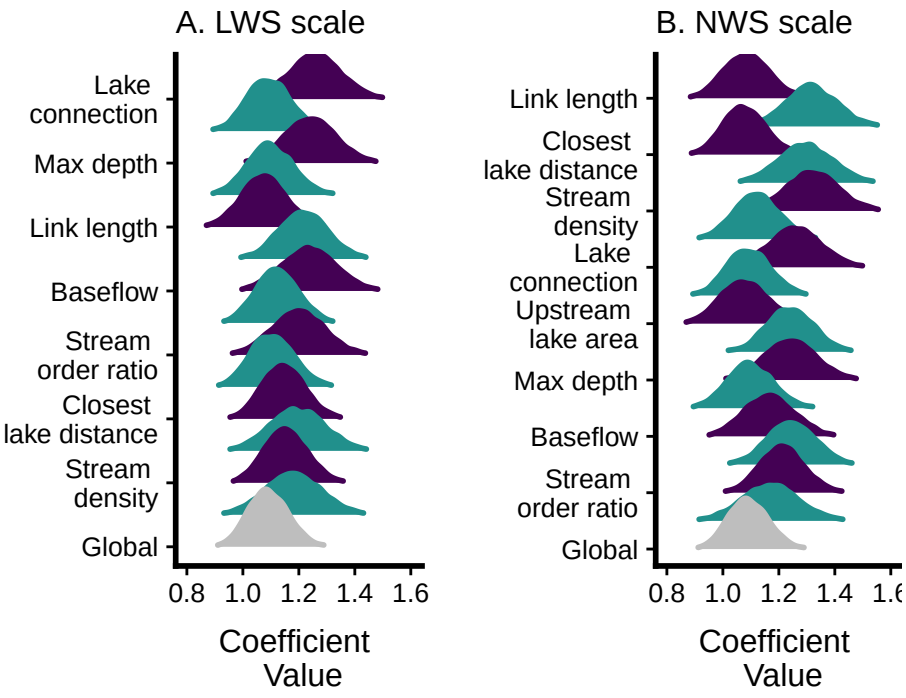

Figure 7: Distribution of the k parameter from the Vollenweider's equation in low and high connectivity partitions at the (A) LWS and (B) NWS scales. Green symbols indicate the lower of the two partition groups while purple symbols represent the higher of the two partition groups (see Table 2).

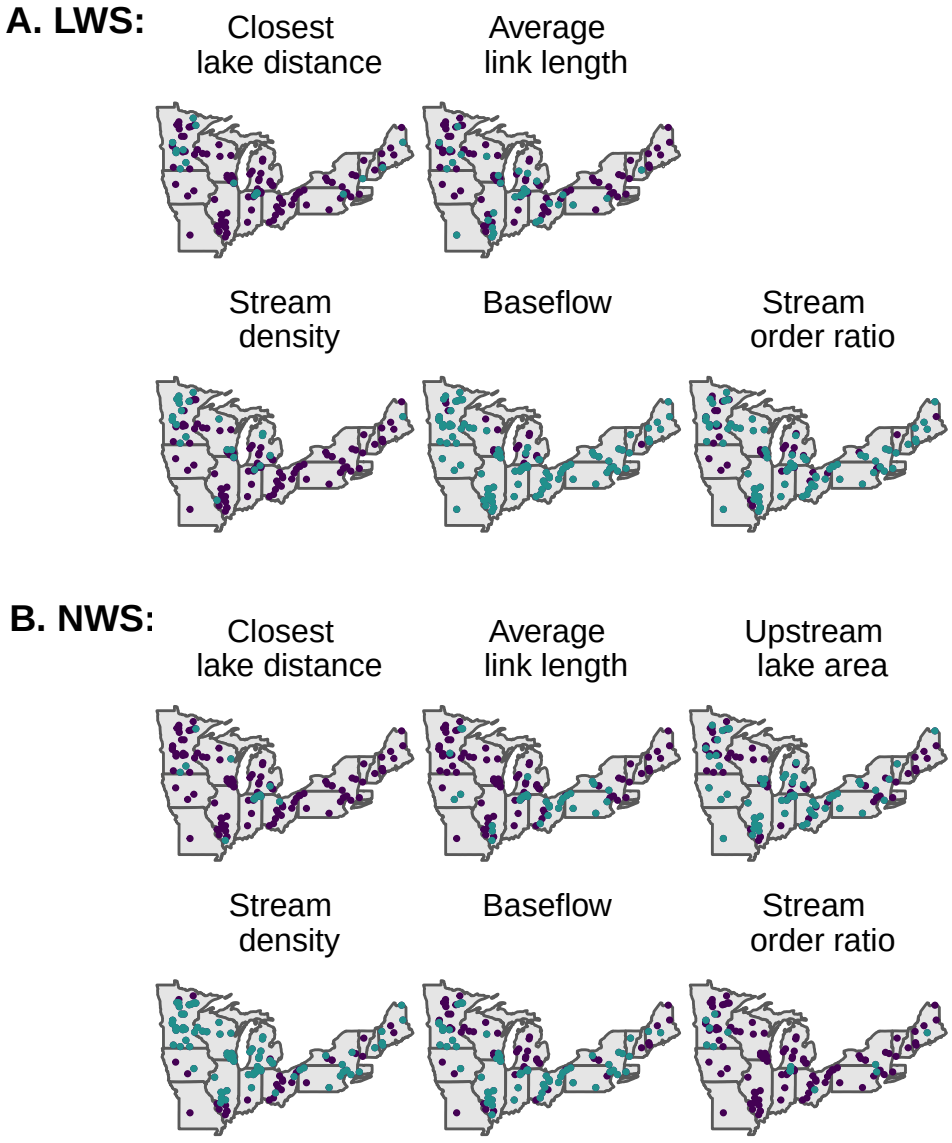

Figure 8: Maps showing the locations of lake connectivity partitions. Green symbols indicate the lower of the two partition groups while purple symbols represent the higher of the two partition groups (see Table 2).