Figure 1: Figure 1: Major lake and watershed P factors affecting lake P retention. Shaded symbols indicate tangible factors that are typically considered in P retention models while open symbols indicate additional factors specific to the present study. Dashed lines indicate inferred linkages, which cannot be tested with available data, but are otherwise discussed herein. The abbreviation 'W. Res. Time' is water residence time.

Lower Connectivity   Higher Connectivity

Lake-based Metrics

A. Closest Lake Distance: Network distance to the closest upstream lake.

B. Upstream Lake Area: Total area of upstream lakes limited to lakes that are greater than or equal to 4ha.

Stream-based Metrics

C . Average Link Length: Sum of the total length of stream reaches between junctions divided by the total number of reaches.

D. Stream Density: the length of all streams (minus artificial lines through lakes) divided by the area of watershed.

E. Stream Order Ratio: The total number of first order stream reaches divided by the total number of higher order stream reaches. In this example the lower connectivity lake has a stream order ratio of 3 whereas the higher connectivity lake has a stream order ratio of 2.
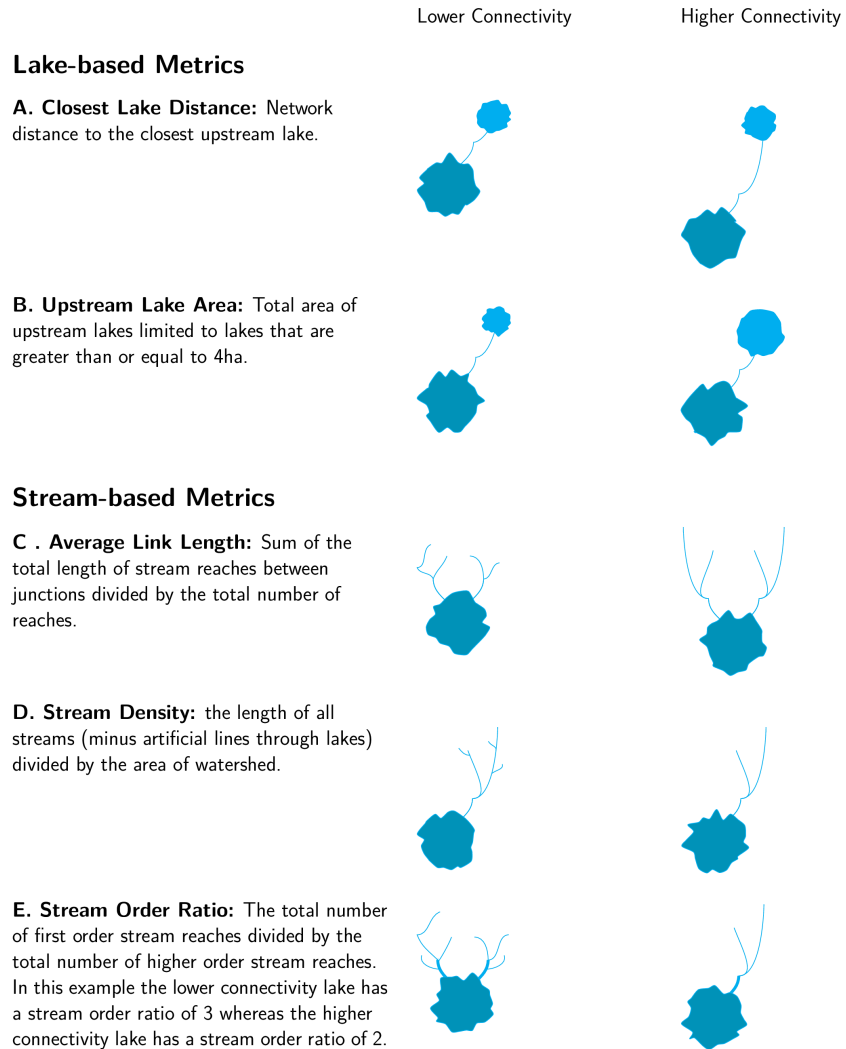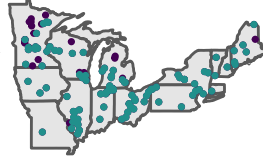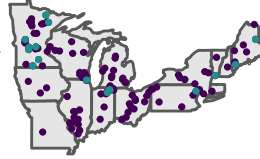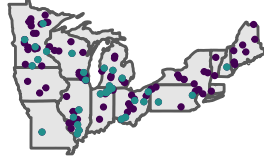
Figure 2: Connectivity metric definitions along with examples of high and low connectivity lakes.

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.

	Average link length	Closest lake distance	Stream density	Max depth	Baseflow	Stream order ratio	Lake Area	Point Source P	LWS area	Upstream lake area	P Loading	NWS area
Closest lake distance	0.05											
Stream density	0.26	0.27										
Max depth	0.08	0.00	0.04									
Baseflow	0.20	0.20	0.52	0.23								
Stream order ratio	0.26	0.12	0.26	0.01	0.19							
Lake Area	0.12	0.12	0.02	0.46	0.07	0.08						
Point Source P	0.07	0.02	0.04	0.11	0.08	0.01	0.13					
LWS area	0.06	0.33	0.30	0.05	0.25	0.19	0.33	0.15				
Upstream lake area	0.01	0.12	0.16	0.17	0.21	0.25	0.43	0.09	0.32			
P Loading	0.08	0.04	0.10	0.09	0.10	0.24	0.14	0.07		0.52		
NWS area	0.01	0.08	0.09	0.05	0.11	0.36	0.18	0.16	0.36		0.62	
W. Res. Time	0.25	0.26	0.29	0.47	0.22	0.26	0.30	0.13	0.02	0.10	0.13	0.08

Figure 4: Correlation between connectivity metrics and selected lake characteristics.

A. LWS

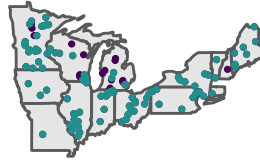Average link length   Closest lake distance   Stream density

Baseflow   Stream order ratio
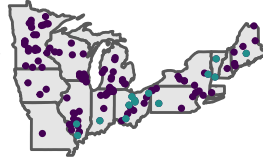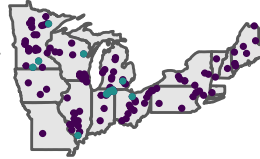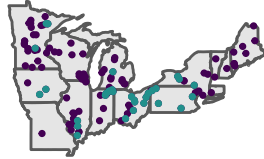
B. NWS

Average link length   Closest lake distance   Stream density

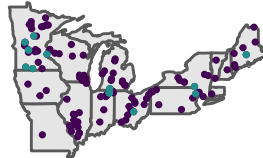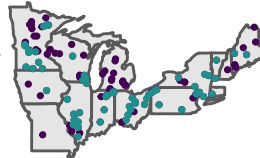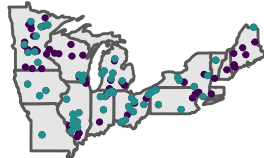Upstream lake area   Baseflow   Stream order ratio

Figure 5: 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).
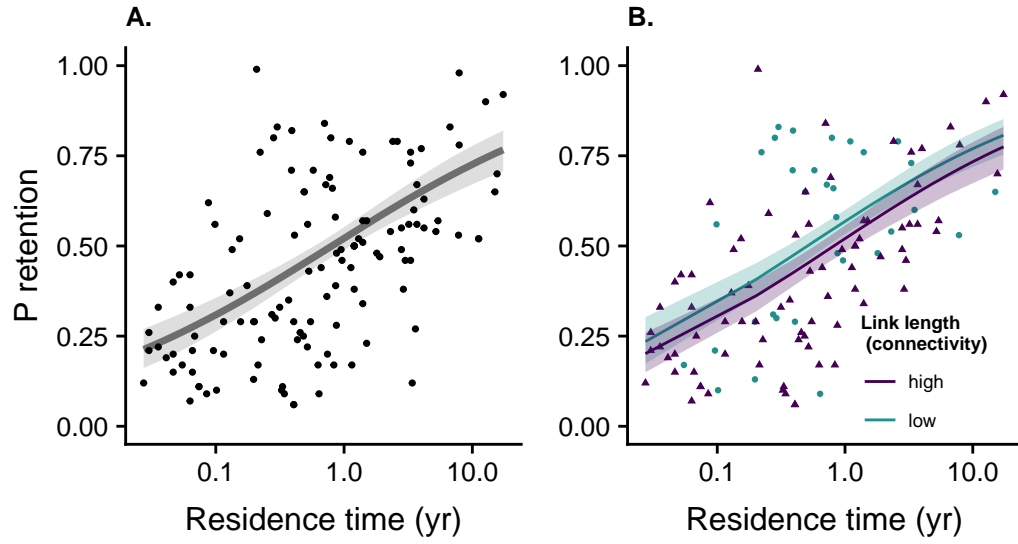
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Figure 6: Residence time (yr) versus P retention for the NES dataset and the global model fit to the data where the solid line and shaded interval represents the median and central 95% interval estimates respectively.
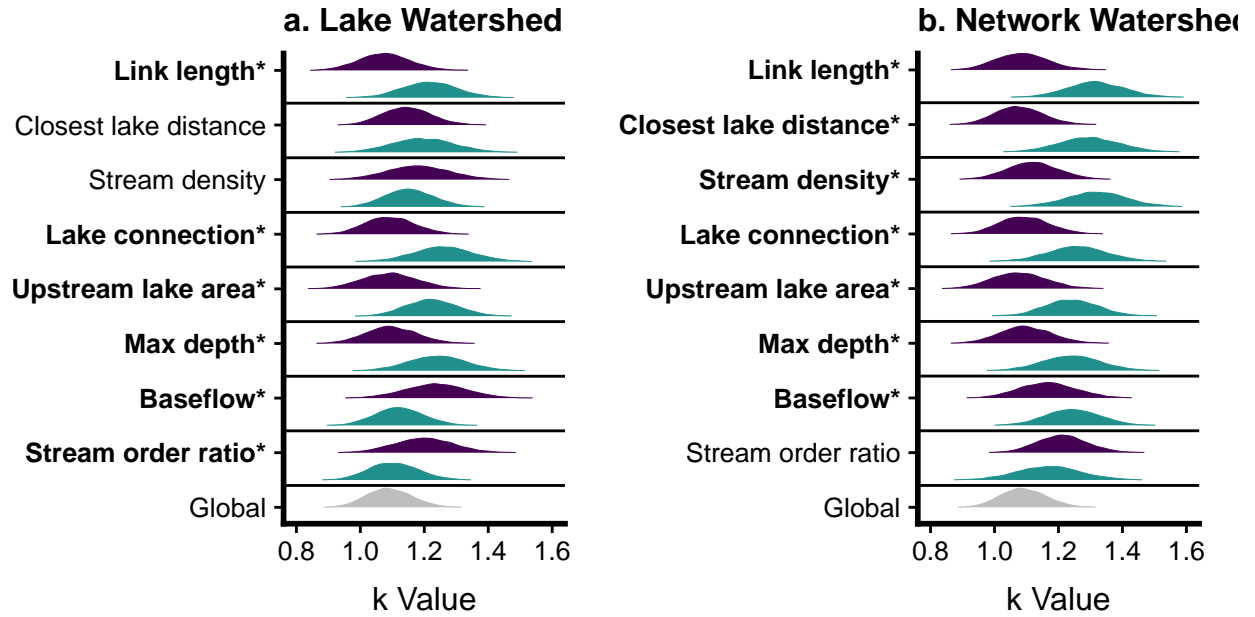

Figure 7: Distribution of the k parameter from the Vollenweider's equation in low and high connectivity partitions at the (A) LWS and (B) NWS scales. Green symbols indicate the lower of the two partition groups while purple symbols represent the higher of the two partition groups (see Table 2).