The Effect of Lake Connectivity on Phosphorus Retention in Lakes

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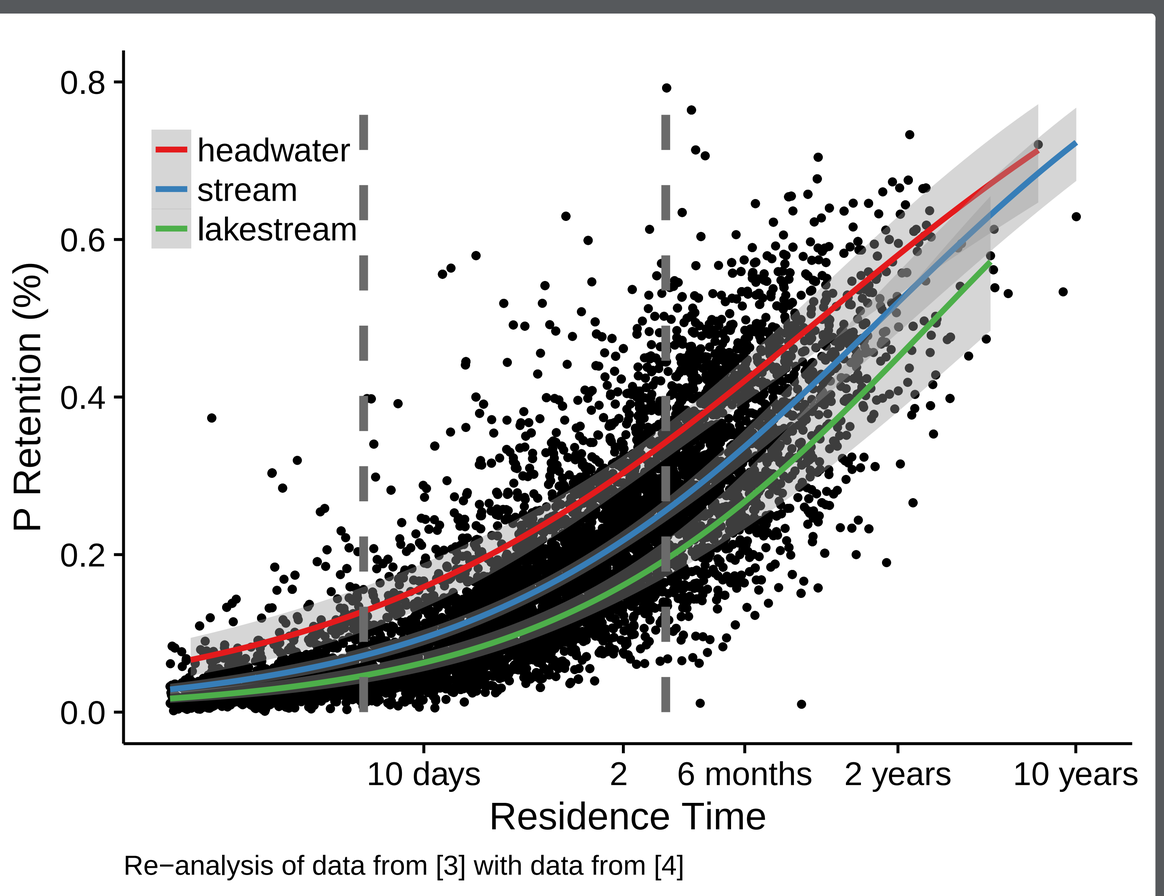
Introduction

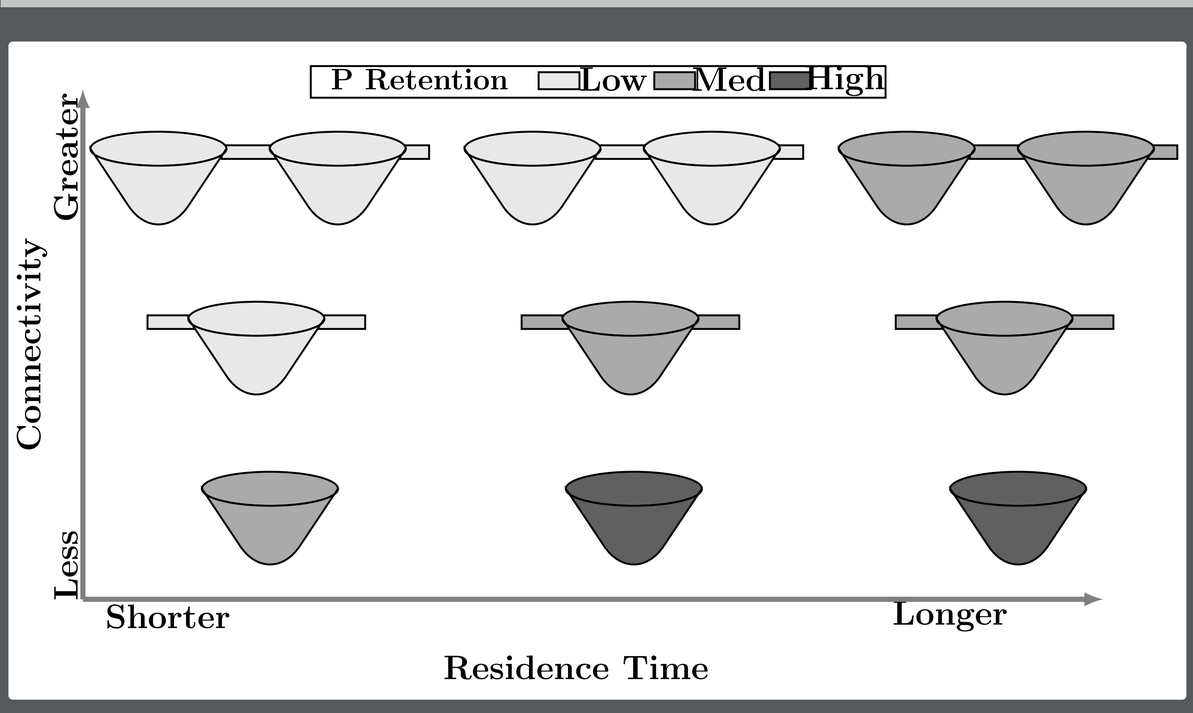
- A comprehensive understanding of phosphorus (P) cycling is neccessary to predict P concentrations among many different lakes types and to better manage the risk of eutrophication from excess nutrient loading.
- P retention is a desirable metric for assessing eutrophication risk because it is a unitless measure that can be easily compared among different lake types irrespective of their baseline P concentrations or total P inputs.
- P retention is typically modelled as a function of a given lake's volume-weighted hydrologic flux (or its inverse, residence time).
- There is some evidence that P retention in lakes and streams is affected by network connectivity.



Re−analysis of data from [3] with data from [4]

Research Questions

1. **Do more well-connected lakes retain less P than lower connectivity lakes (given equal residence times)?**
2. **Are there differences in the relative influence of biological and hydrological control on P retention in lakes of differing connectivity?**

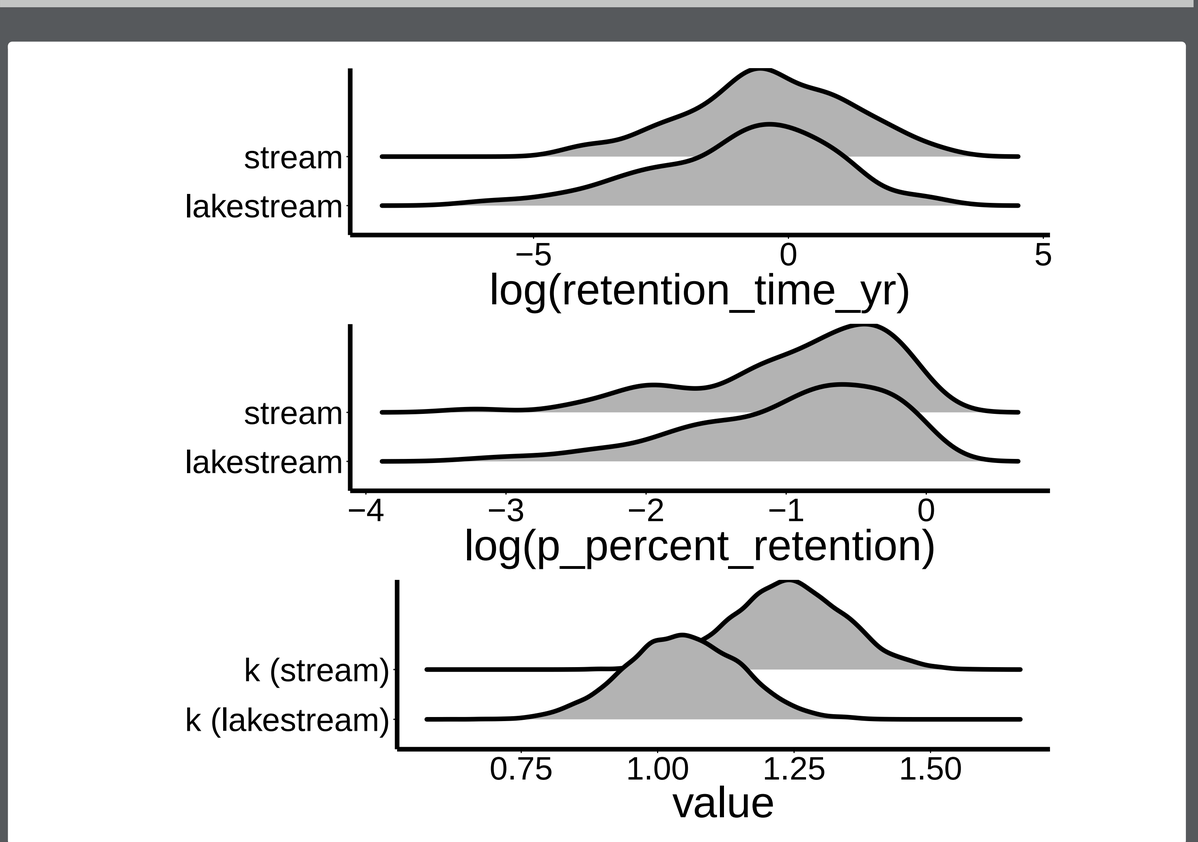


Methods

- Data on P loading, P export, and residence time from approximately 250 lakes included in the National Eutrophication Survey (1972 - 1975)[1].
- Model P retention as a function of residence time using 2 parameter (k, x) Vollenweider models [2].
- k and x can be interpreted as representing biological and hydrological controls on P retention respectively.

Results

- **Estimates of k were higher in lakes without upstream lakes, despite have a similar distributions of residence time and P retention relative to those with upstream lakes.**
- **This suggests that P inputs are controlled by biological processes to a greater extent in lakes without upstream lakes.**



Future Work

- Calculate network properties of each lake catchment such as stream density, upstream lake area, average link length, and stream order ratio.
- Model k and x seperately via 2-component hierarchical models that relate P retention to **lake catchment network properties** as well as other potential explanatory factors such as landuse and climate.

References

[1] J. Stachelek, C. Ford, D. Kincaid, K. King, H. Miller, and R. Nagelkirk. *Earth System Science Data Discussions*, pages 1–11, 2017.

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[3] W. Bryan Milstead, Jeffrey W. Hollister, Richard B. Moore, and Henry A. Walker. *PLoS ONE*, 8(11), 2013.

[4] P.A. Soranno and et al. *GigaScience*, 4(1), 2015.

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