A phosphorus mass-balance model for the Lake St. Clair-Lake Erie system: How important is in-lake phosphorus loading?

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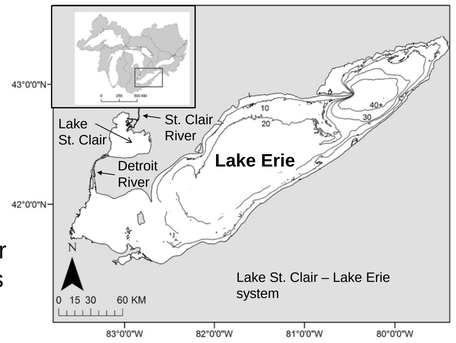
Introduction

q Lake Erie is a critical water resource:

ü provides drinking water for about 13 million people;

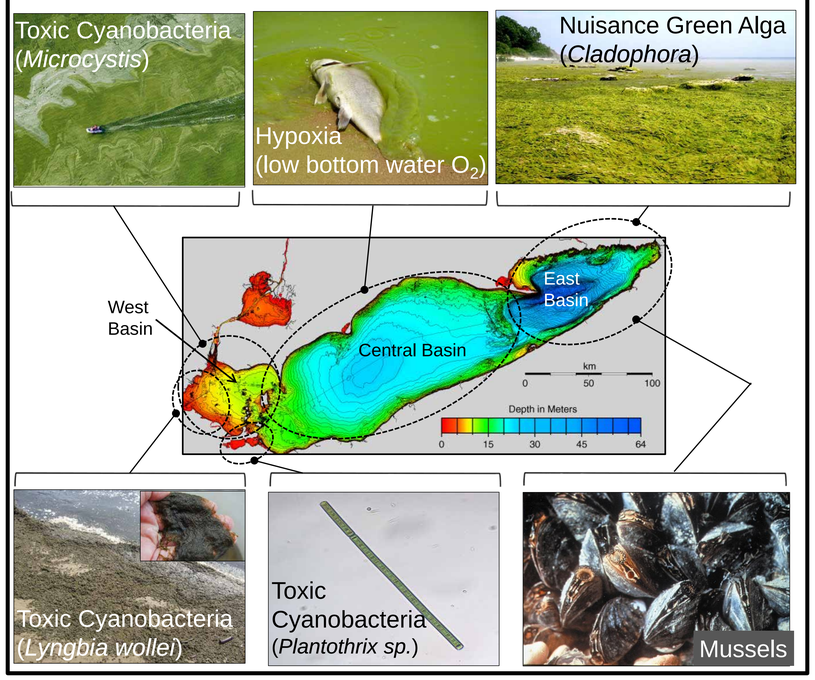
ü supports multi-billion-dollar fishing and tourist industries.

q Despite reductions in point and non-point (riverine) source nutrient loads, water quality has not improved as expected and continues to deteriorate.



q It is well known that eutrophication symptoms can be caused by external phosphorus (P) inputs, internal P inputs, or their combination.

Ecological Issues (current)



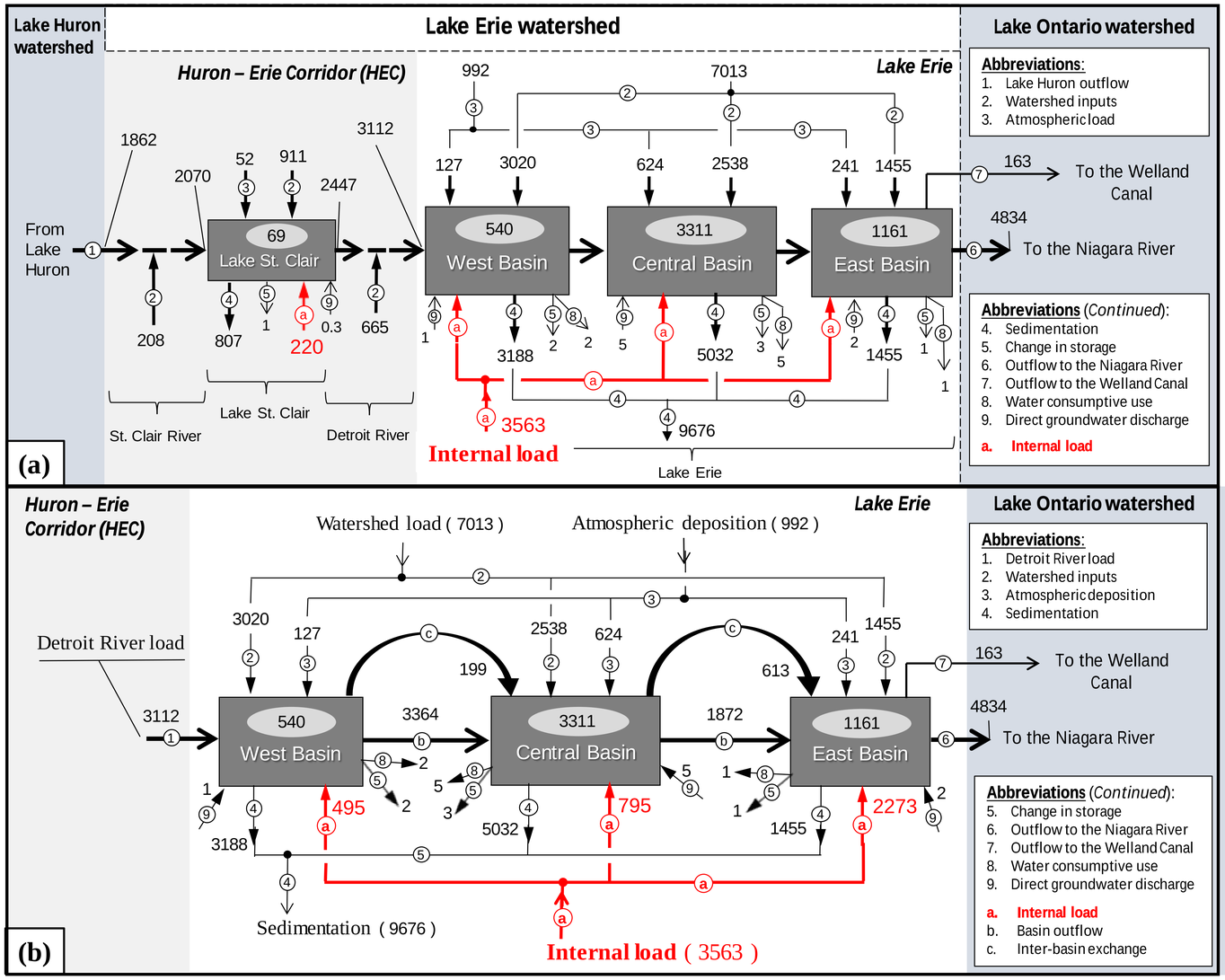
Methods

The estimate of the internal load was approached following these steps:

1. Delineate watershed for each system component;
2. Construct water budget;
3. Close water budget;
4. Construct total phosphorus (TP) budget which includes the whole-lake budget for Lake Erie;
5. In Lake Erie, apply rates of inter-basin water and TP exchange for estimates of inter-basin nutrient exchange;
6. Subtract the total of all outputs from the total of all inputs.

Results

A. Phosphorus Budget: (a) Total Phosphorus (TP) budget (Metric Tonnes per Annum: MTA) for the major system components (2003 – 2013); and, (b) Basin-specific TP budgets (MTA) for Lake Erie. Numbers shown inside the boxes indicate the average annual standing stocks of TP in MTA.



For more details, see Bocaniov et al. (2023)*.

Conclusions

- Mean yearly external TP load to the Lake St. Clair–Lake Erie system is 11,703 MTA.
- Net TP output from Lake Erie substantially exceeds external inputs.
- We estimate that in-lake processes add a net internal TP load of 3783 MTA.

Conclusions (Continued)

- Internal TP inputs represent about a quarter of Lake Erie's total TP input.
- Internal inputs include sediment efflux, shoreline erosion and sediment resuspension.
- Internal P loading may contribute to the re-eutrophication of Lake Erie.

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* Bocaniov, S.A., D. Scavia, P. Van Cappellen (2023): *Ecological Informatics* (https://doi.org/10.1016/j.ecoinf.2023.102131)

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