Using $\delta^{18}O$ to track PO_4 entering the Western Basin of Lake Erie

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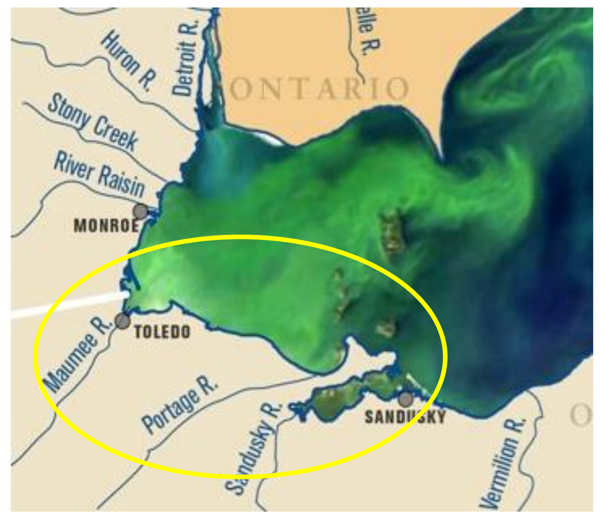
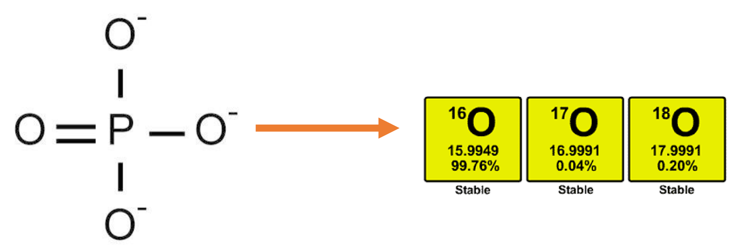
Introduction



Objective: Develop novel methods of tracking DRP throughout watersheds

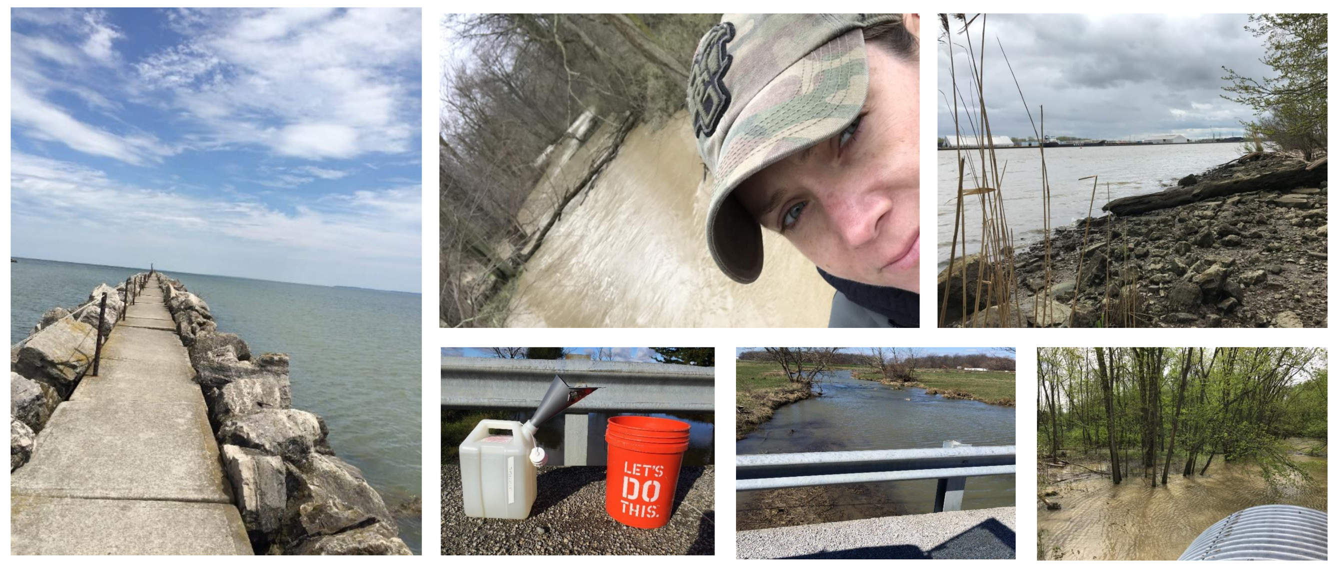
- Collaborative study on methods to identify sources of and reduce PO_4 contributing to algal blooms in Lake Erie
- Lake Erie algal blooms are dependent upon river P but which watersheds, rivers, and tributaries are contributing most?

Stable Isotopes



- Only one stable isotope of phosphorus (^{31}P), but three stable isotopes of oxygen (^{16}O, ^{17}O, ^{18}O)
- Strong P-O bond in phosphate molecules make it possible to analyze oxygen isotope ratios to determine phosphate sources in a watershed
- Ratios only change via biological processing

Field Methods



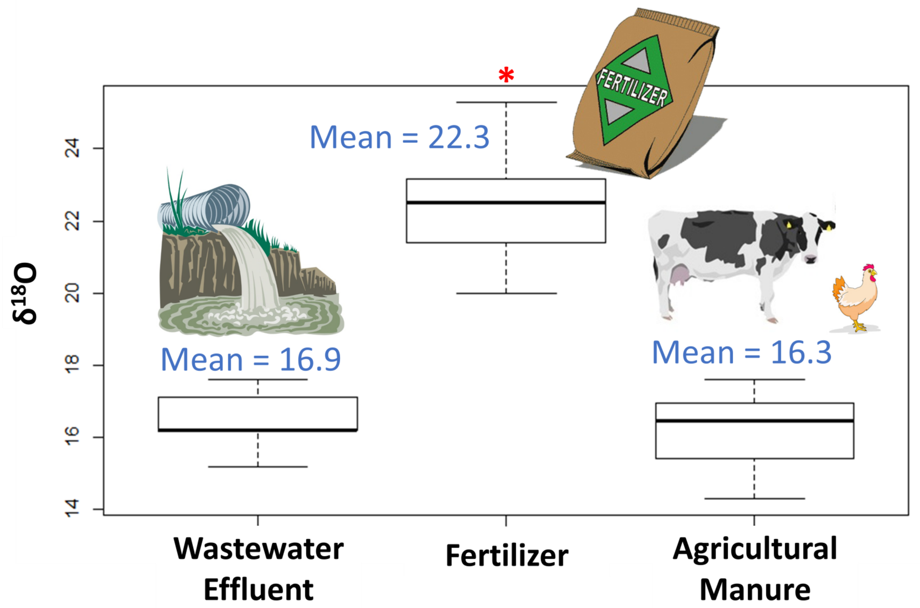
- 3 major watersheds : Maumee, Portage, and Sandusky
- 14 sample sites:
  - 3 in the Portage (convergences of major tributaries), 3 at river mouths, 2 within the Western Basin
- 10 to 20 liters of water per sample
- Lake samples were collected with the help of the George Bullerjahn Lab (BGSU) and the Tom Bridgeman Lab (UT).

Lab Methods

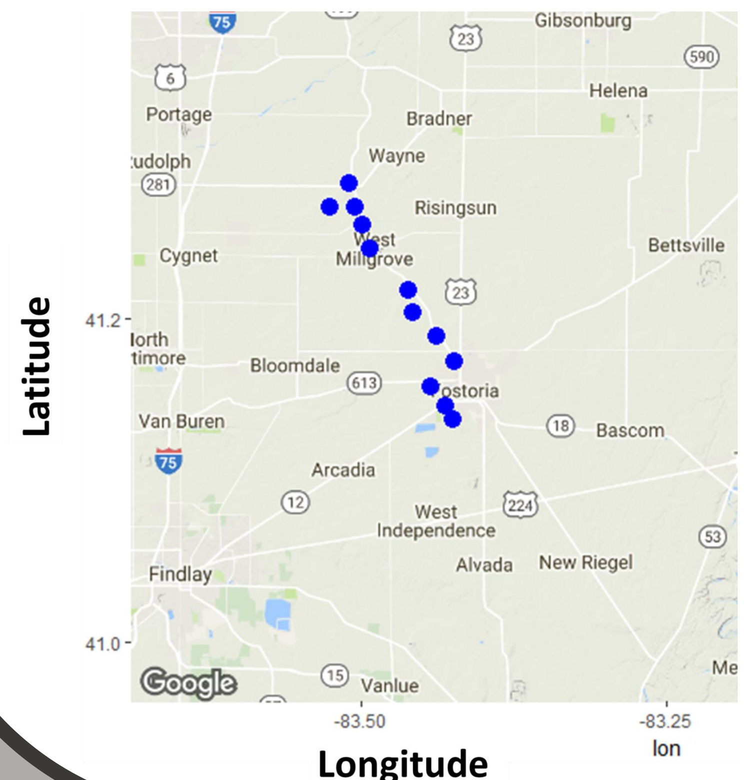
- Samples are filtered and processed using method described in depth in McLaughlin et al. 2004
- Complex procedure consisting of a series of dissolutions and precipitations to produce solid silver phosphate
- 0.6-0.8mg Ag_3PO_4 weighed into silver capsules to be sent to the DEVIL Lab at Duke university for $\delta^{18}O$ analysis

DEVIL
Duke Environmental Stable Isotope Laboratory

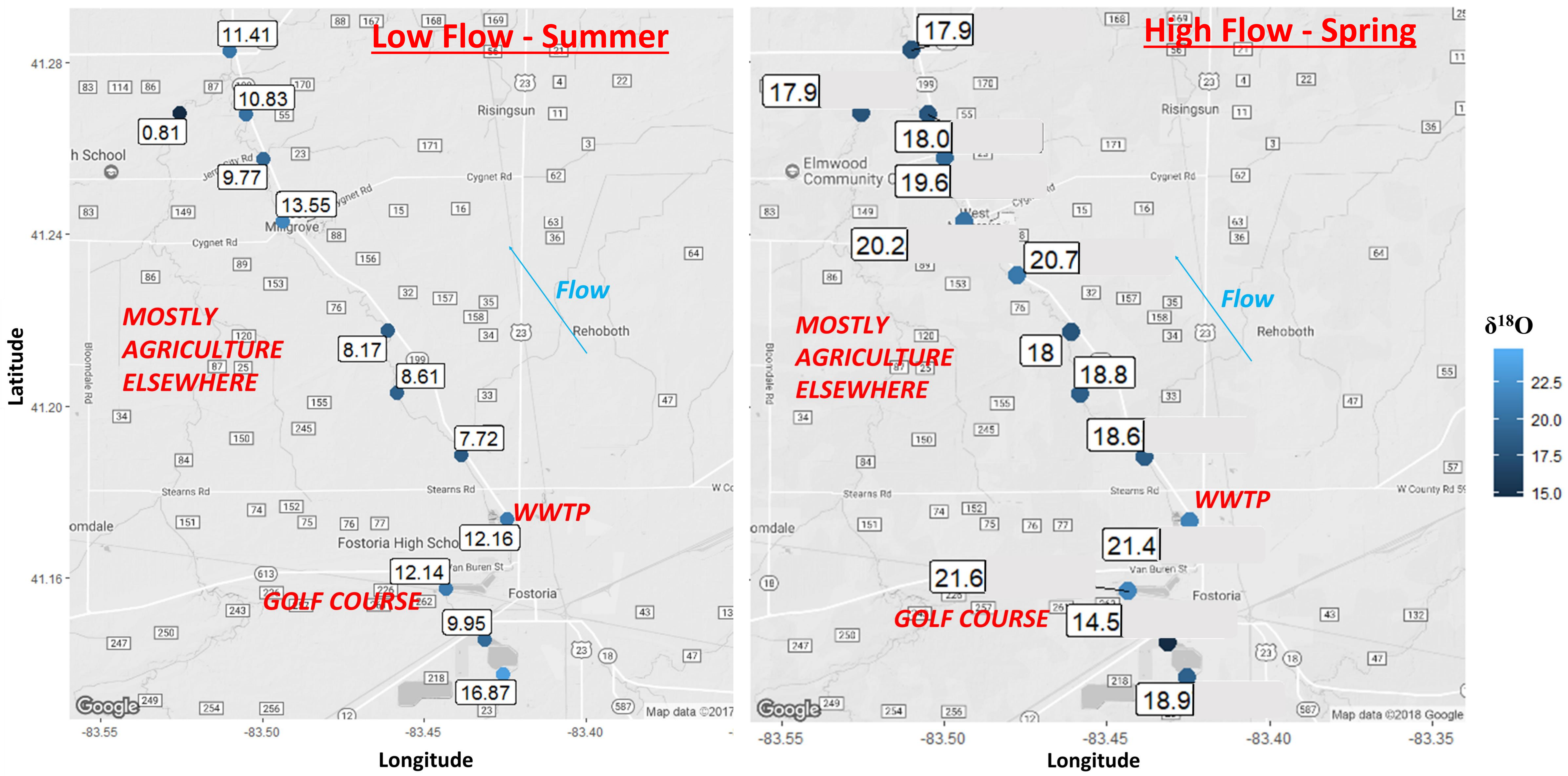
Results and Conclusions



$\delta^{18}O$ of fertilizer samples were significantly higher than those of wastewater effluent and livestock manure.



Data points reported here are from a subset of sample locations approximately 2km apart in the Portage River, just upstream of Fostoria.



We found evidence of similar spatial patterns among these close-proximity sample sites. $\delta^{18}O$ variations are seen near the wastewater treatment facility as well as near a golf course. These variations show an initial spike in $\delta^{18}O$ followed by a gradual decrease, probable evidence of biological processing.

Our predictions were supported as:

1. $\delta^{18}O$ values from samples taken at low/summer flow conditions (July 2016) were more representative of the stream itself.
2. $\delta^{18}O$ values from samples taken at high flow conditions (April 2017) were more representative of various sources of PO_4 in runoff, producing results more relevant for mixing models.

- This is an indication that phosphates entering the stream during low flow have higher residence time and opportunity for biological processing, as well as the opposite for high flow conditions
- To make progress towards developing effective methods of decreasing P contributing to the growth of algal blooms, it is necessary to create a better understanding of the origins of this P as well as a method for following it throughout watersheds.