Nutrient Loading and Lake Erie: Recent Learnings

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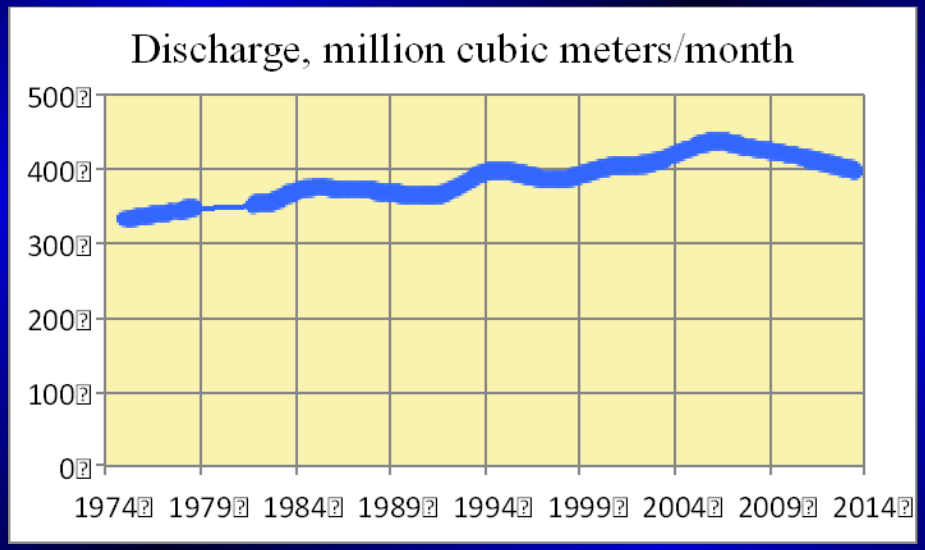
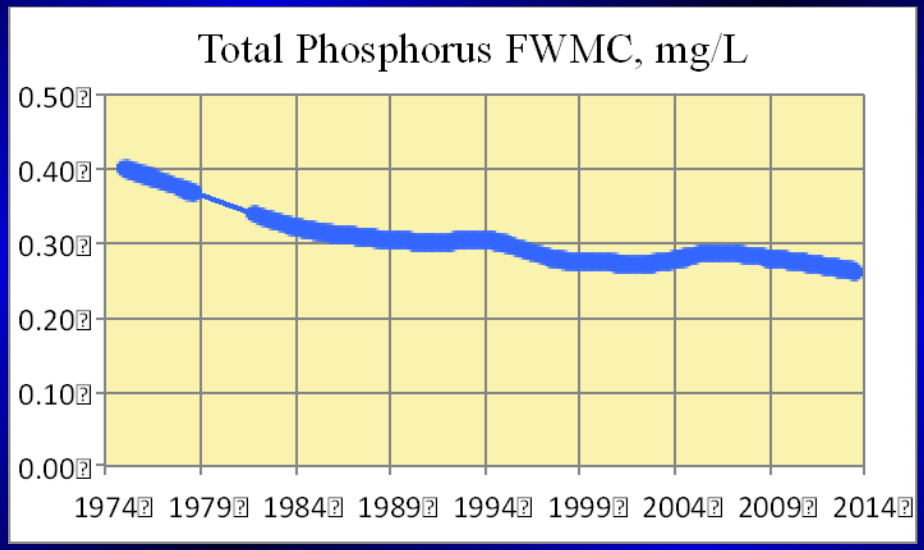
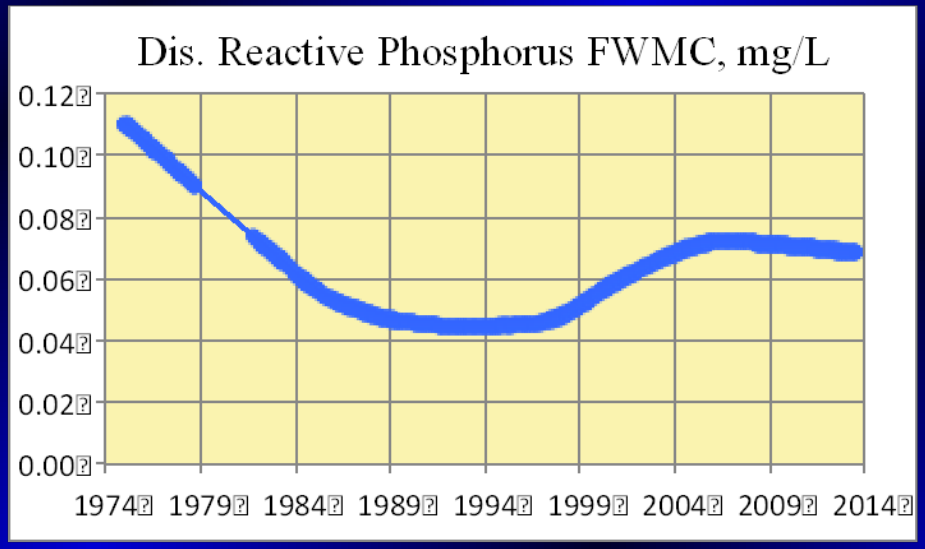
Topics

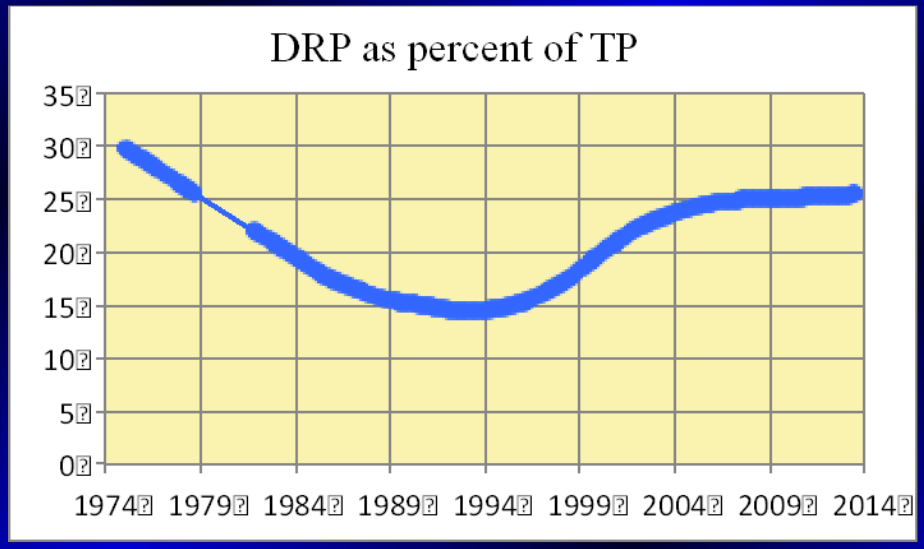
- Phosphorus loading, long-term and 2011-2013
- Predicting HAB intensity

Tributary P trends 1975-2013



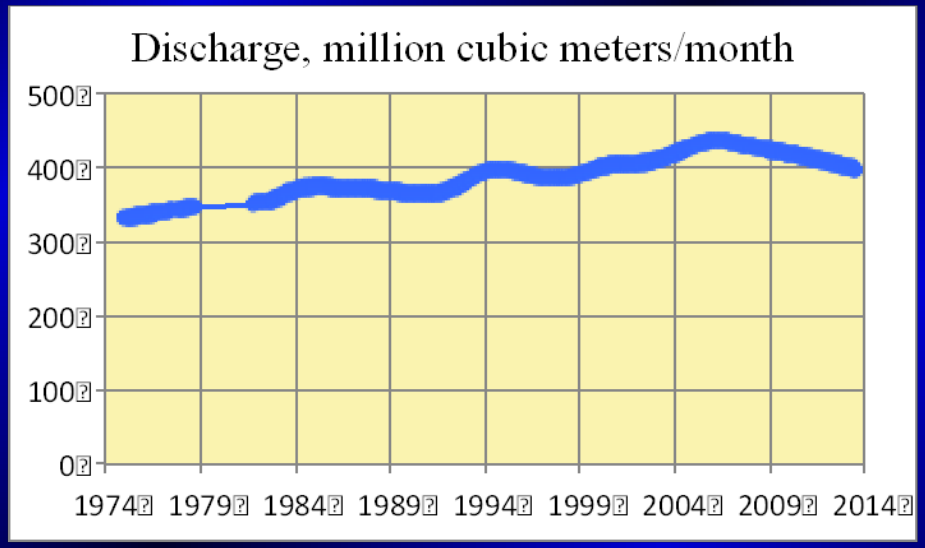


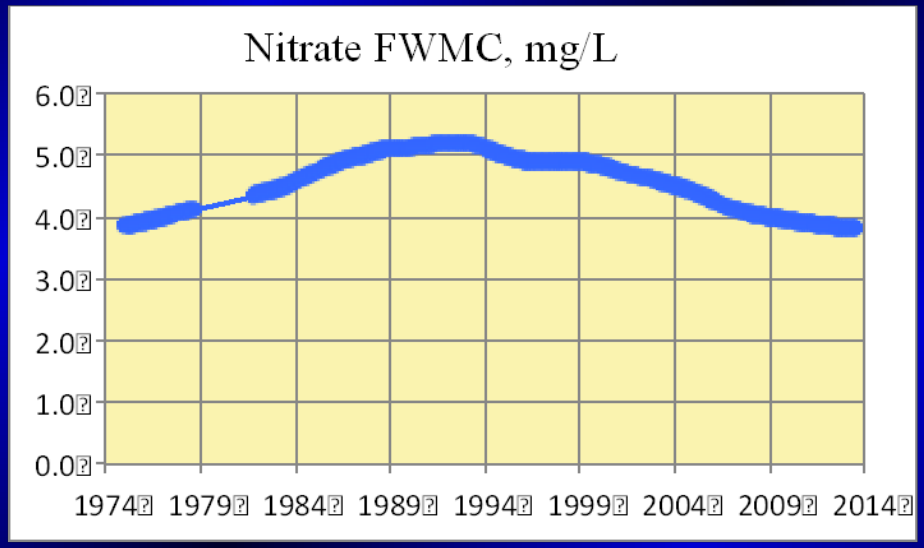


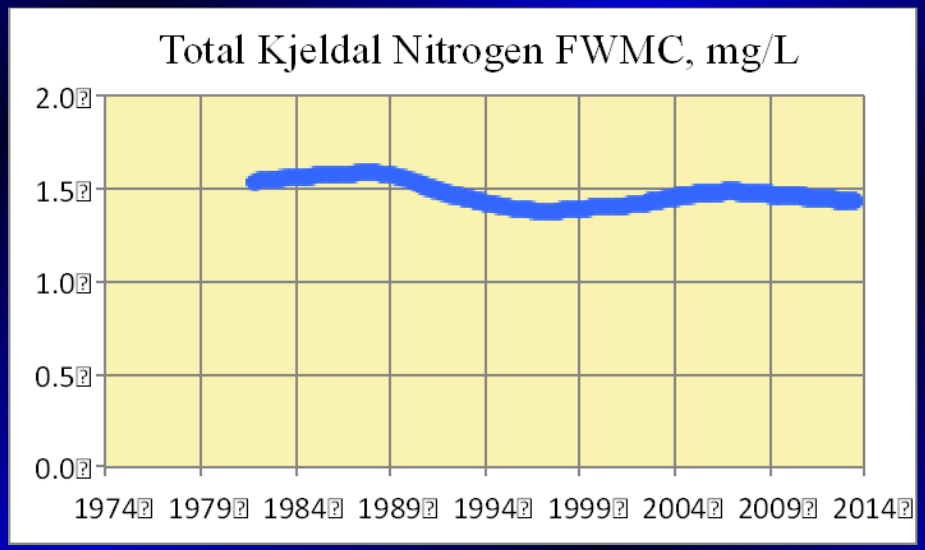


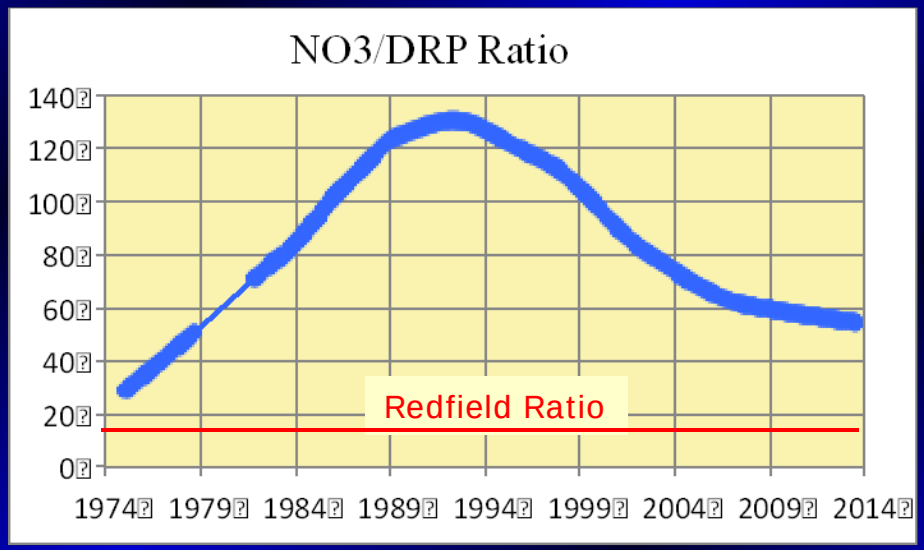
Maumee River monthly averages

Tributary N trends 1975-2013



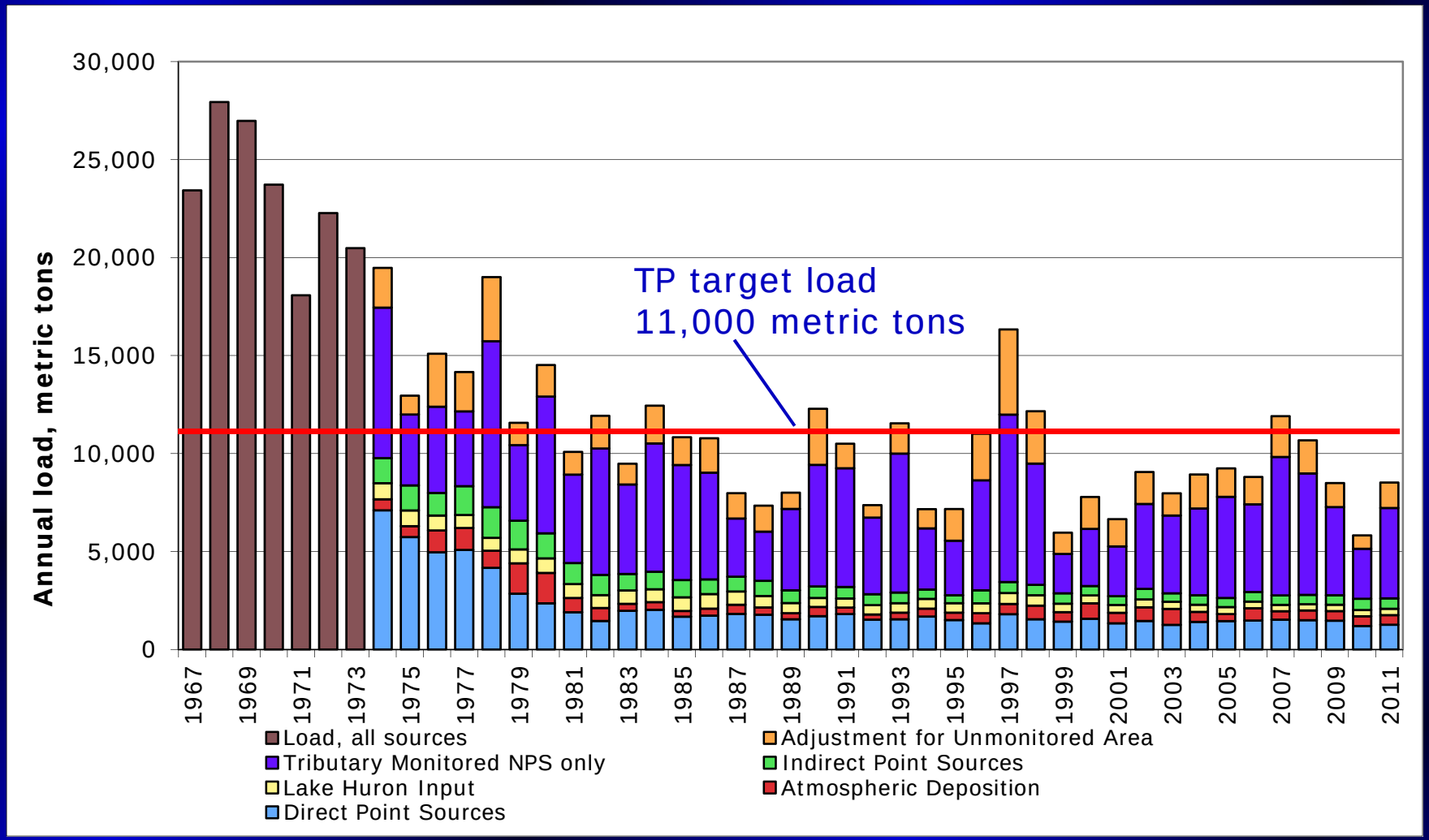






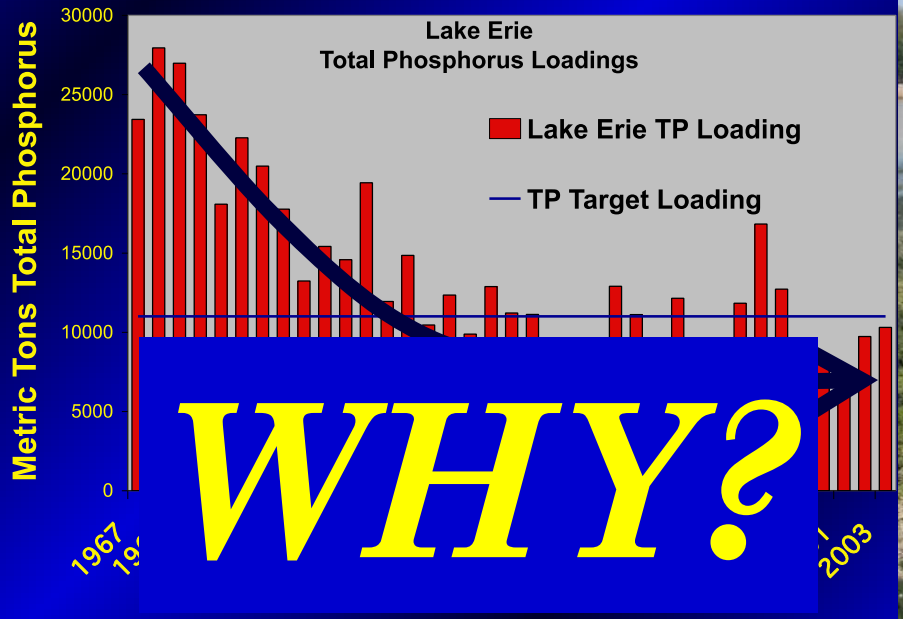
Maumee River monthly averages

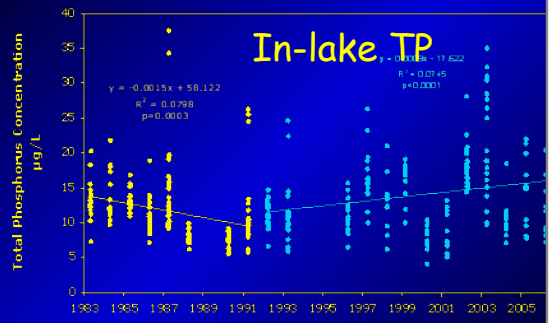
Lake Erie Total Phosphorus Loading, 1967-2008

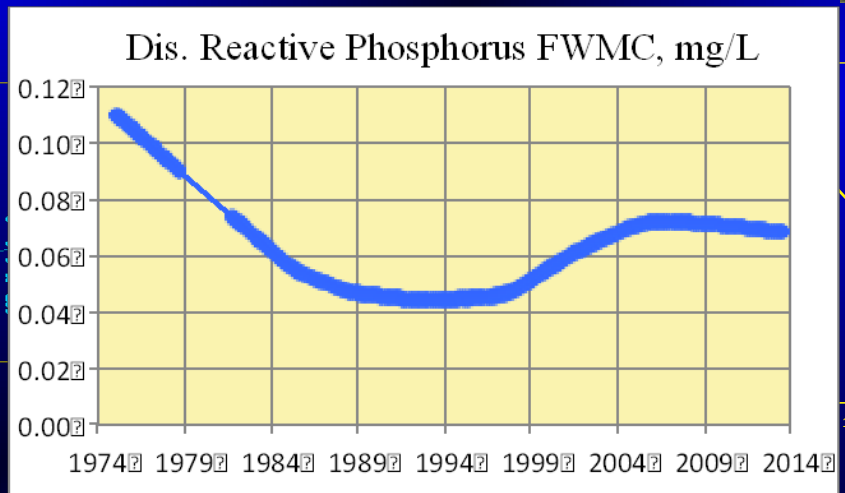


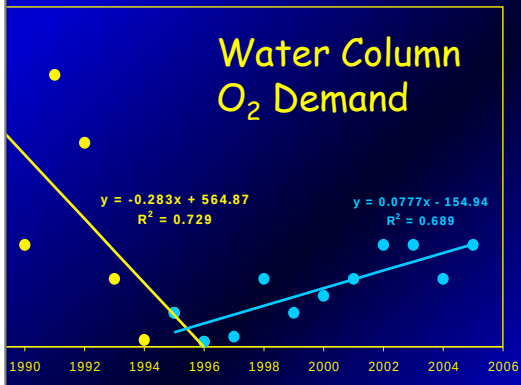
Data from Dave Dolan, UWGB

Shift in lake response?

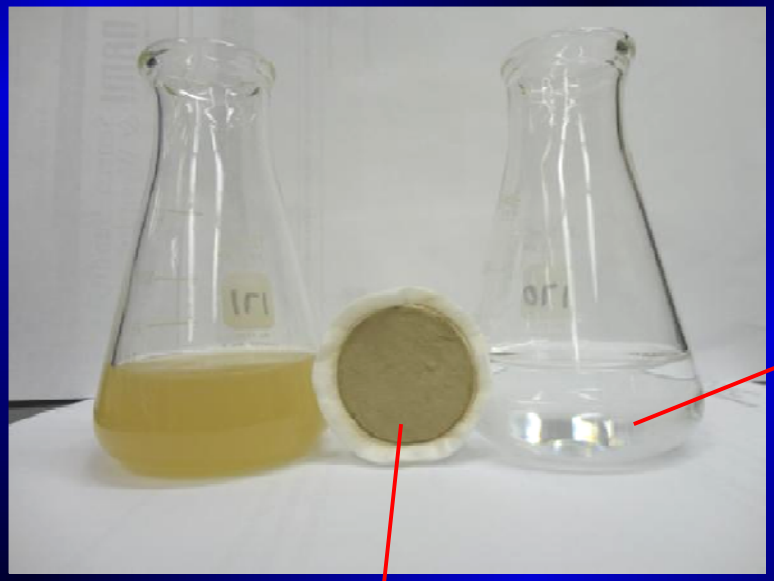








Importance of DRP

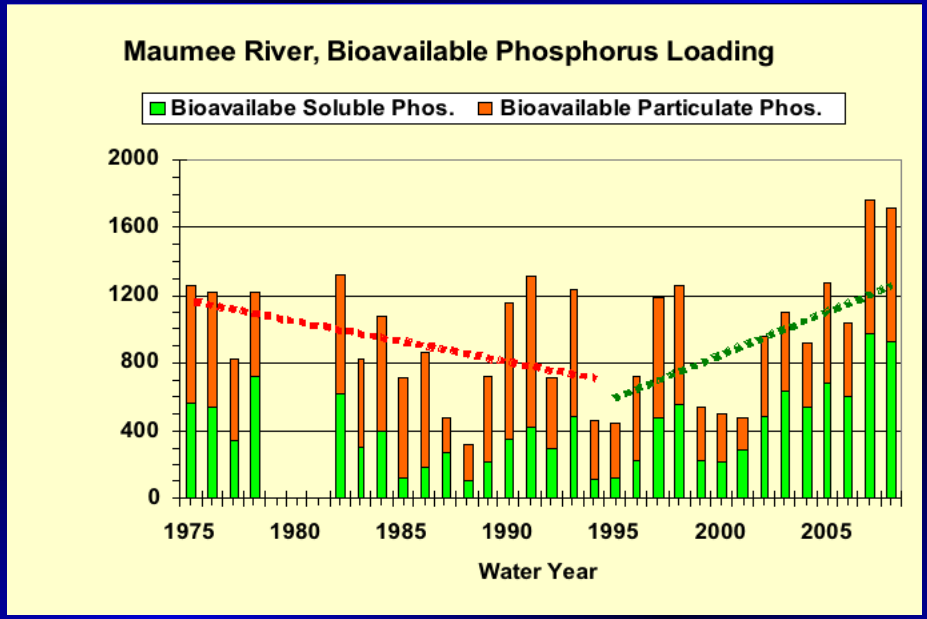


Dissolved P

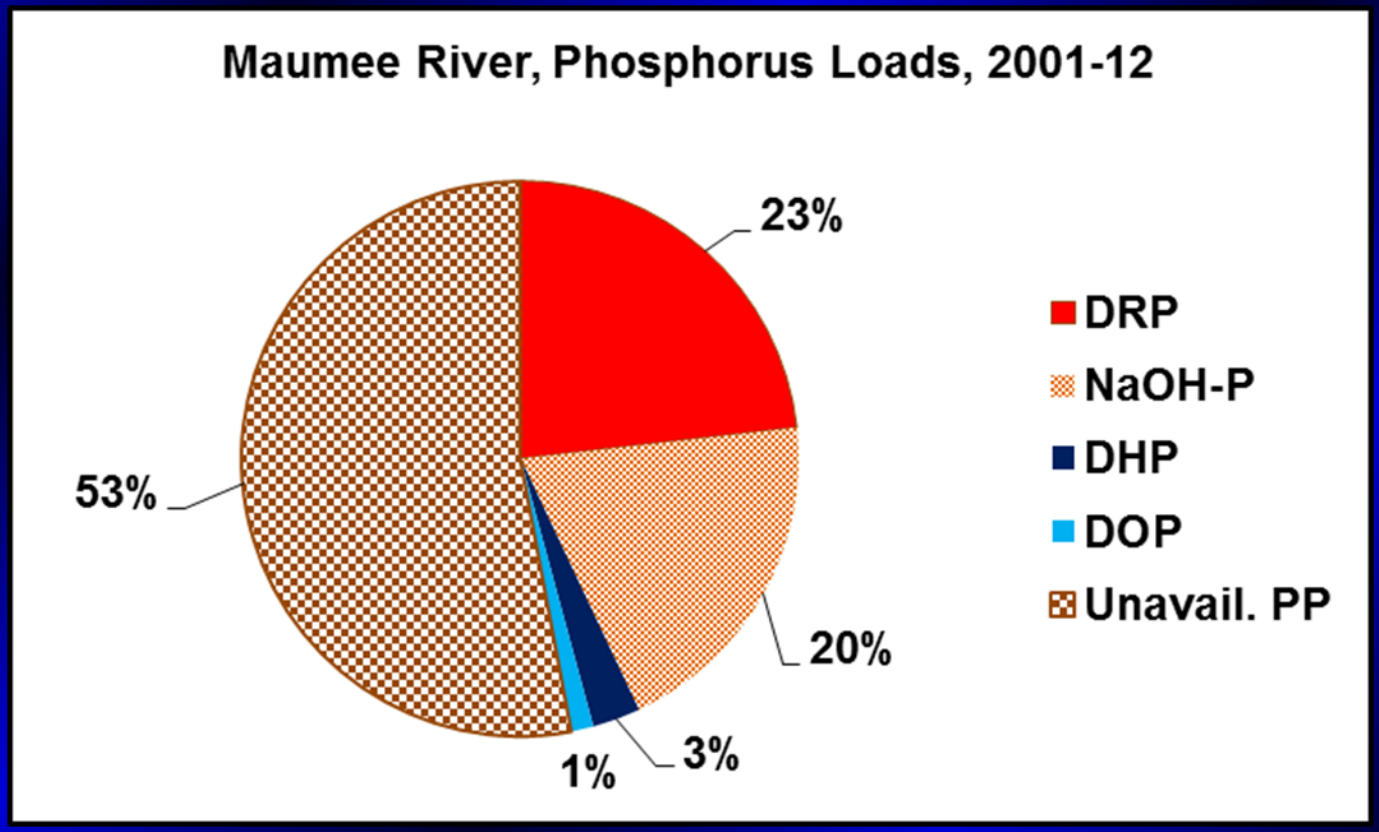
- 90% DRP
- DRP is 100% bioavailable for algal growth

Particulate P

- ~30% bioavailable
- Tends to settle to bottom



Bioavailability of P



Source Ideas

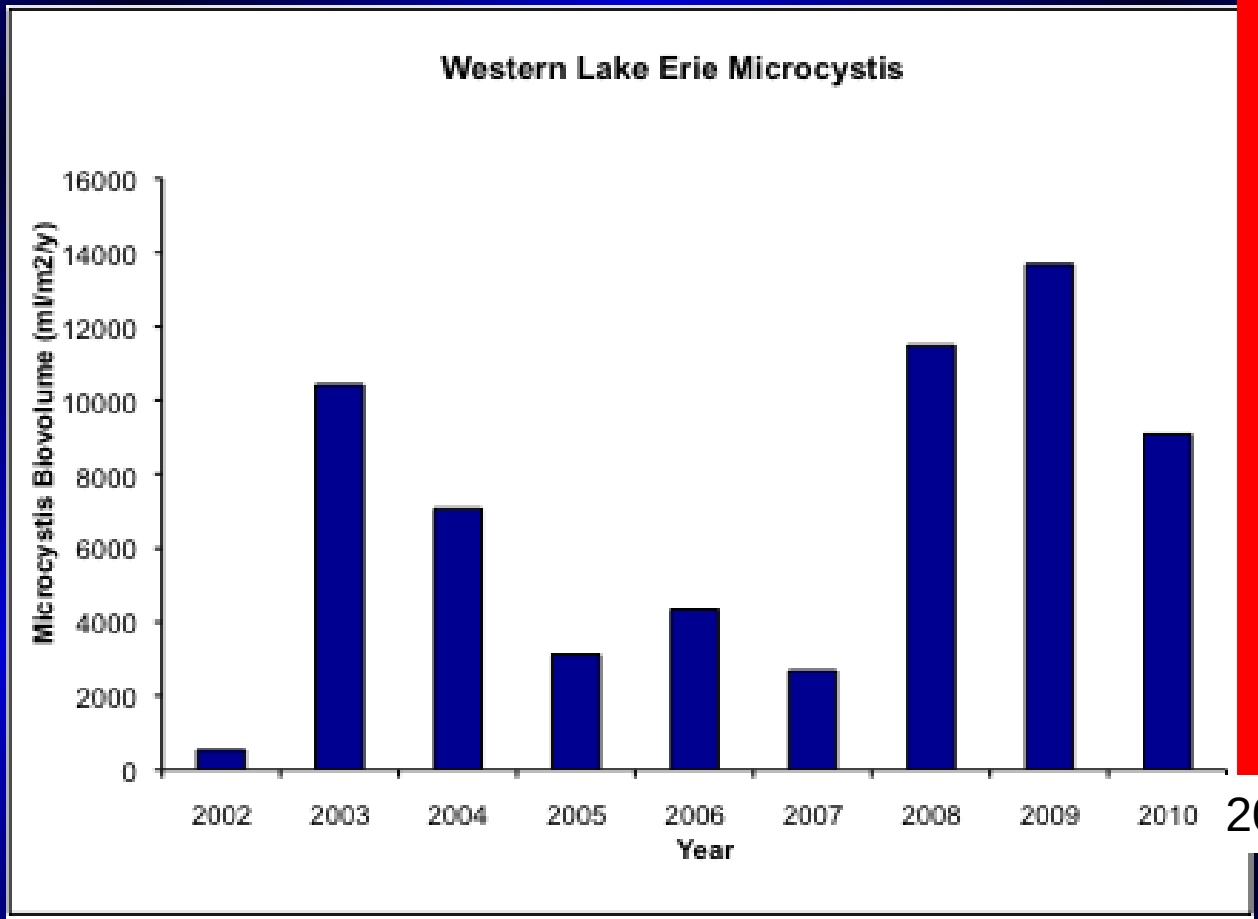
- ~60% of LE TP load enters WB
- Maumee and Detroit River about equal
- Other sources minor
- Algal blooms often appear to grow in Maumee River plume
- Need new target loads that acknowledge bioavailability, basin-specific nature of problems

Seasonal Loading Concept

- P loading drives algal growth
- HABs occur in late summer
- Perhaps P loads in some seasons are more important than loads in others.

Microcystis in Lake E ie

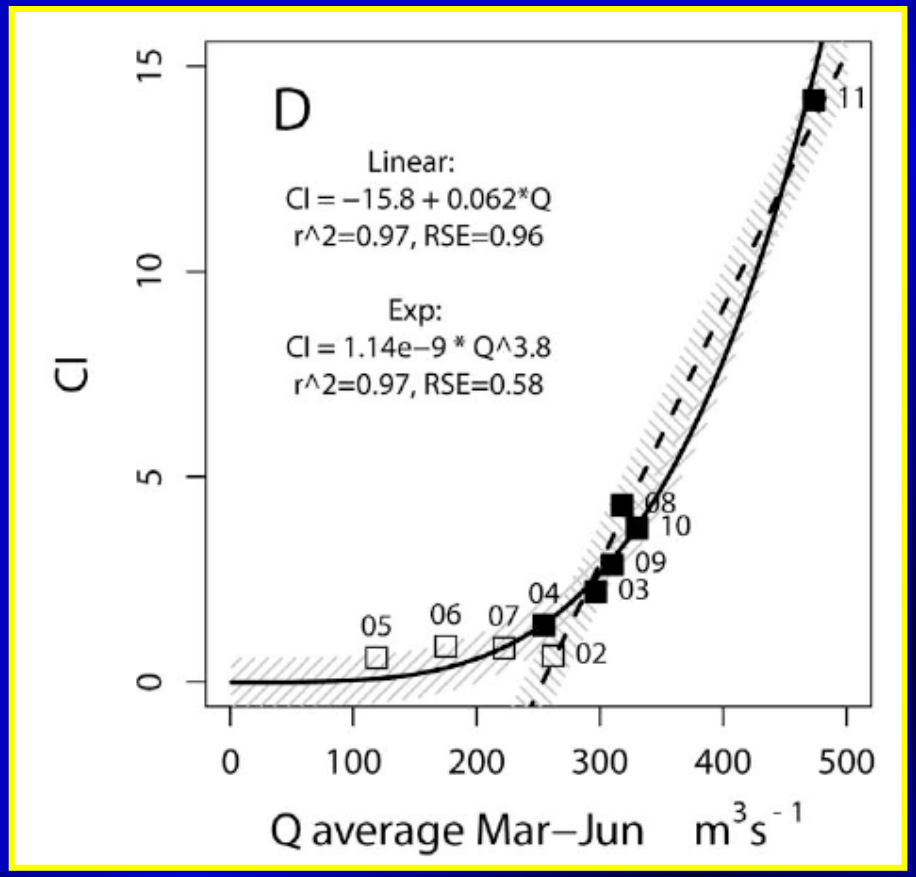
The *Microcystis-Anabaena* bloom of 2009 was ne largest in recent years in our sampling regi n
…until 2011



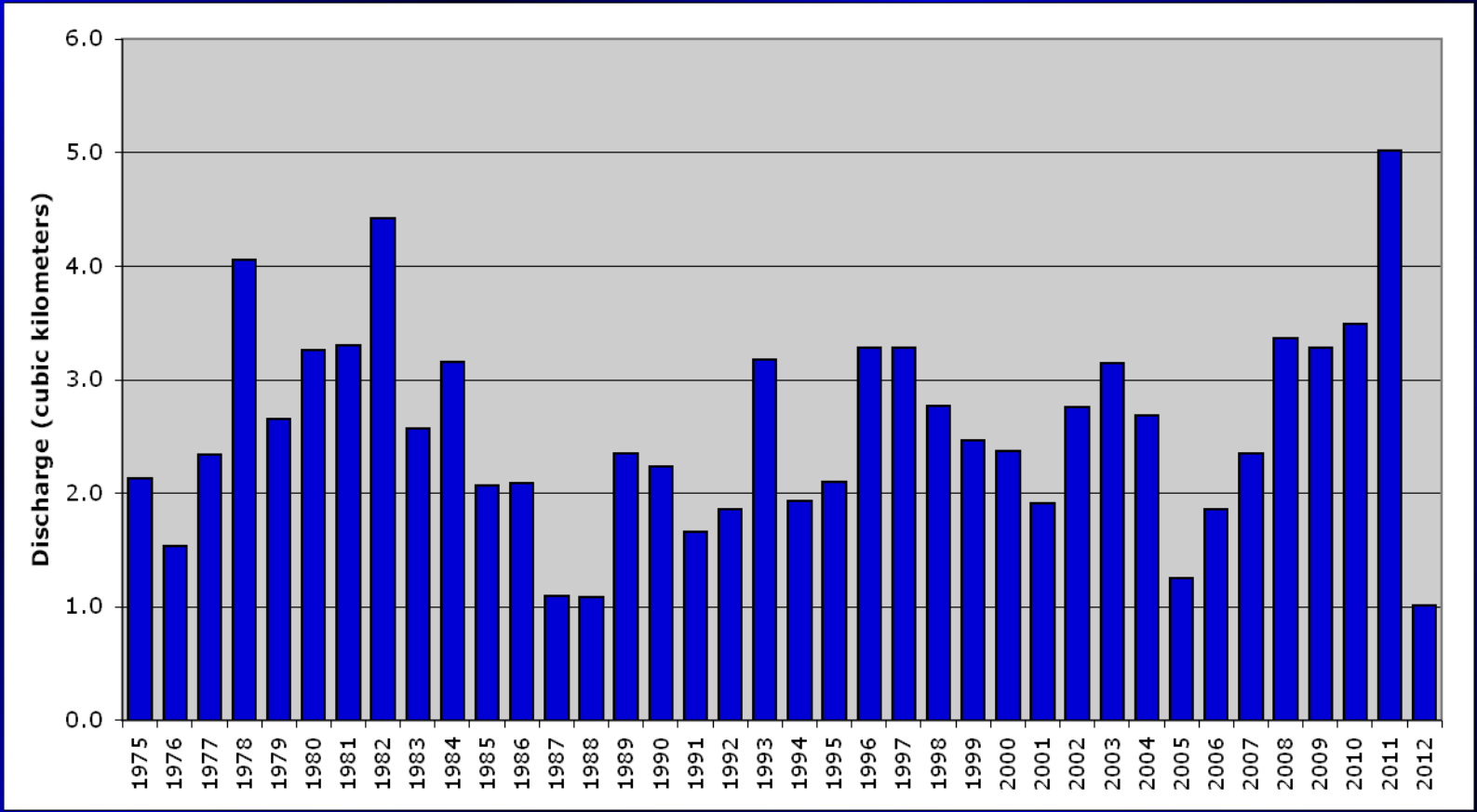
2011

NOAA work

- Relate "cyan
  discharge an
- CI best pred
  discharge
- March-June
  predictive
- Initial work
  predict 2012



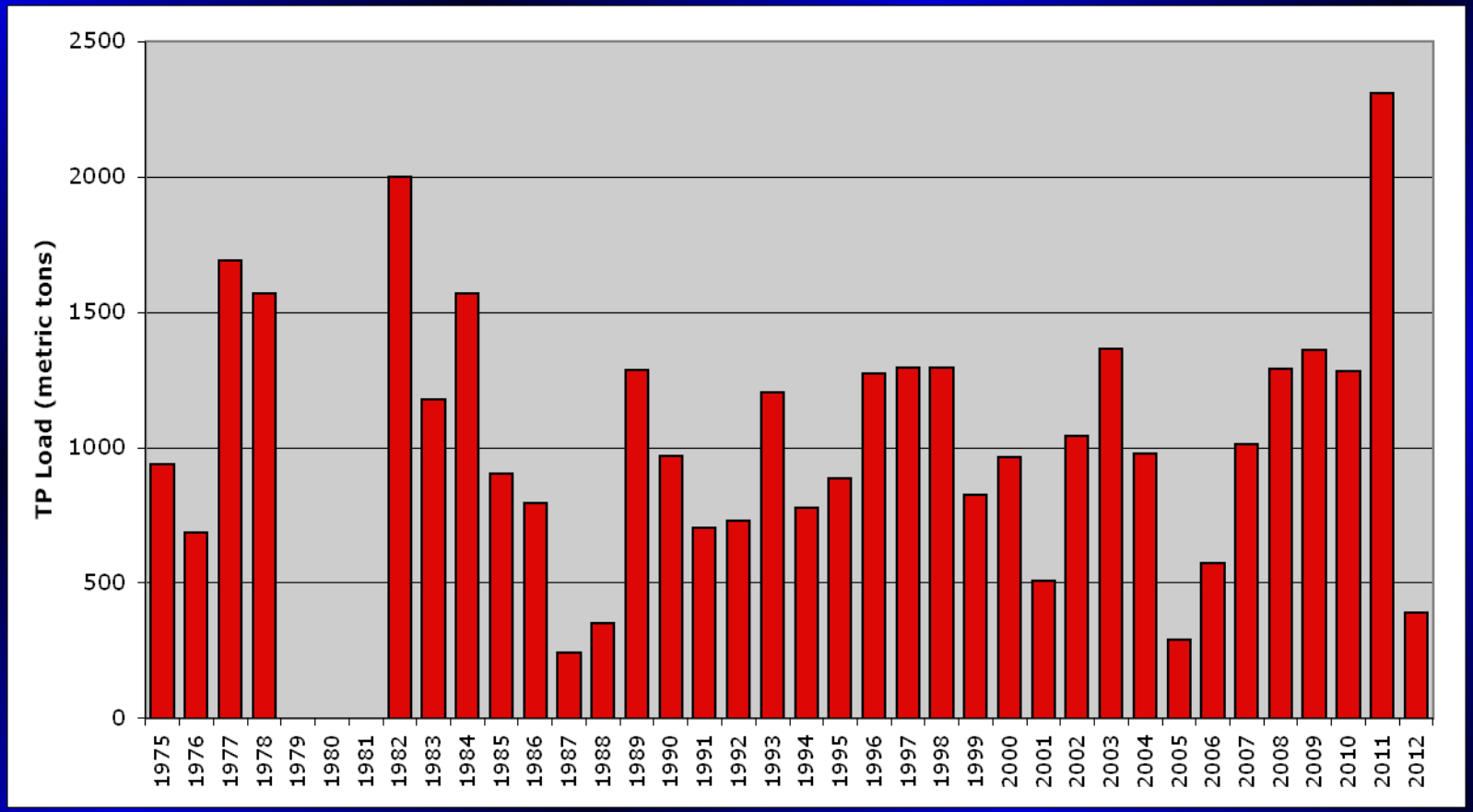
Spring Discharge (March-June)



2011 and 2012 are the extremes - 2012 is 20% of 2011!

NOAA Ecofore/Maumee Loads.xls

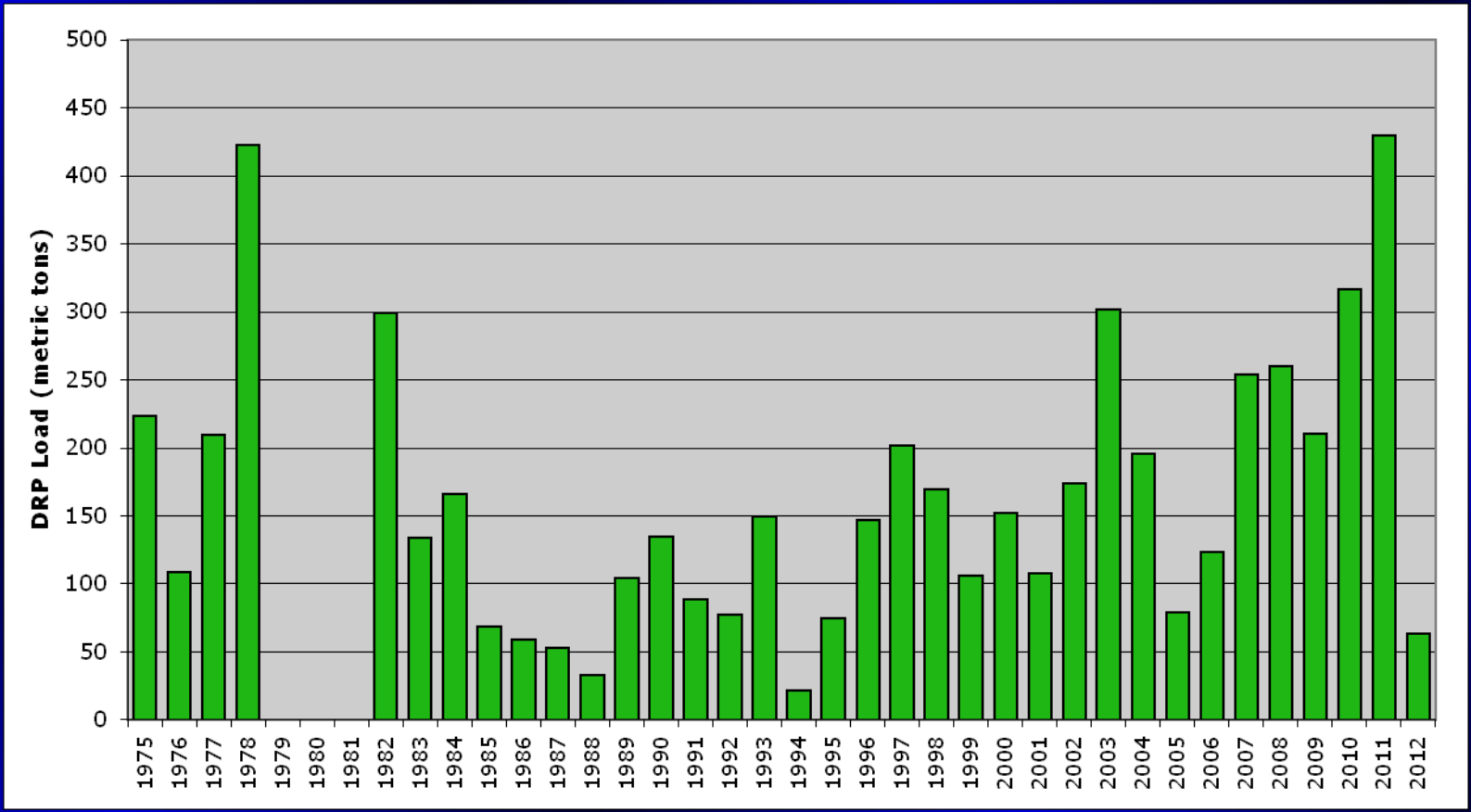
Spring TP Load



2011 and 2012 are extreme - 2012 is 17% of 2011!

NOAA Ecofore/Maumee Loads.xls

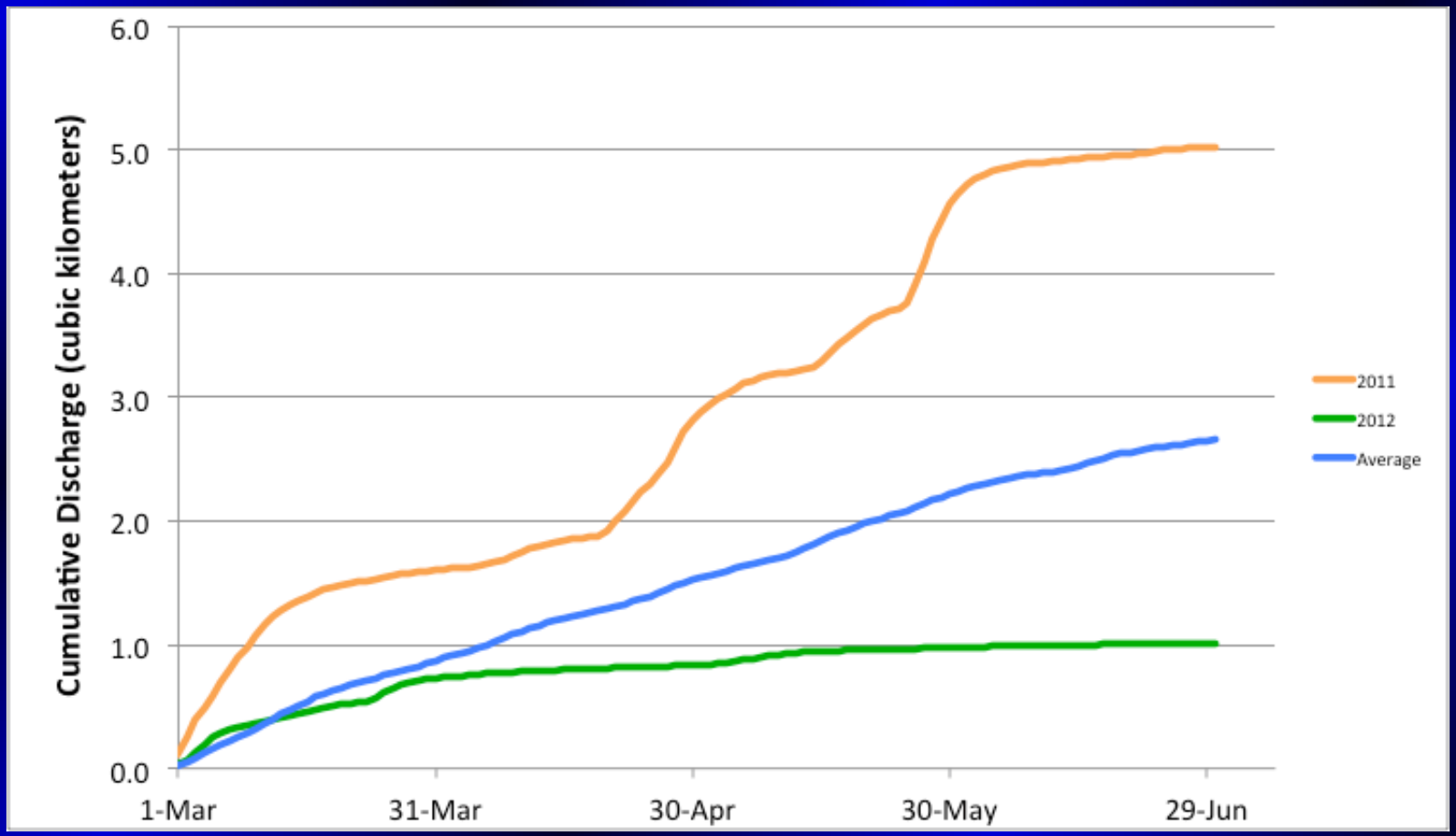
Spring DRP Load



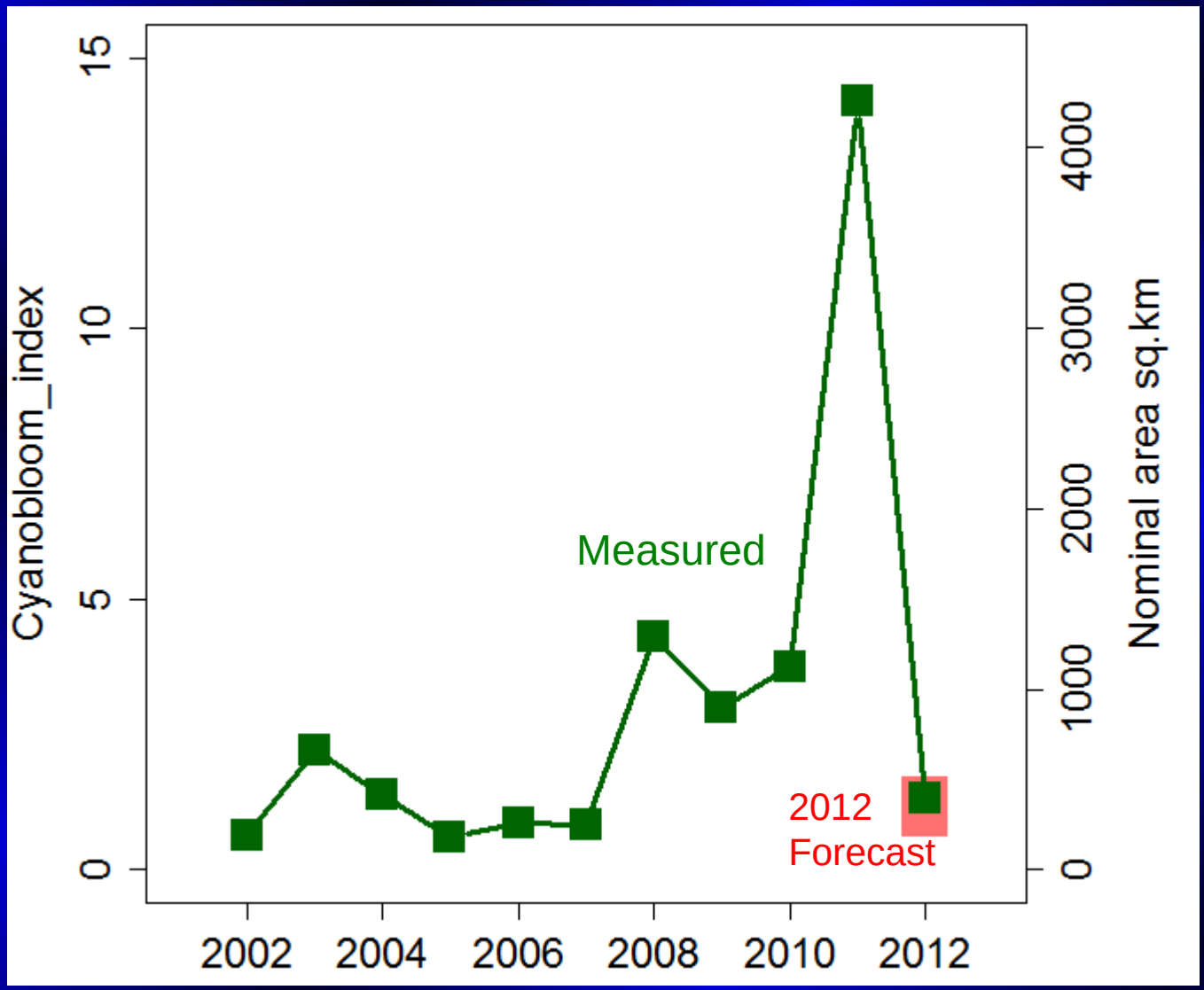
2011 and 2012 are extreme - 2012 is 15% of 2011!

NOAA Ecofore/Maumee Loads.xls

March-June Maumee Discharge



2012 Forecast (mild bloom) and Observed Bloom



09/03/2011 (DOY=246)

Big Contrast!

08/30/2012 (DOY=243)

Learnings

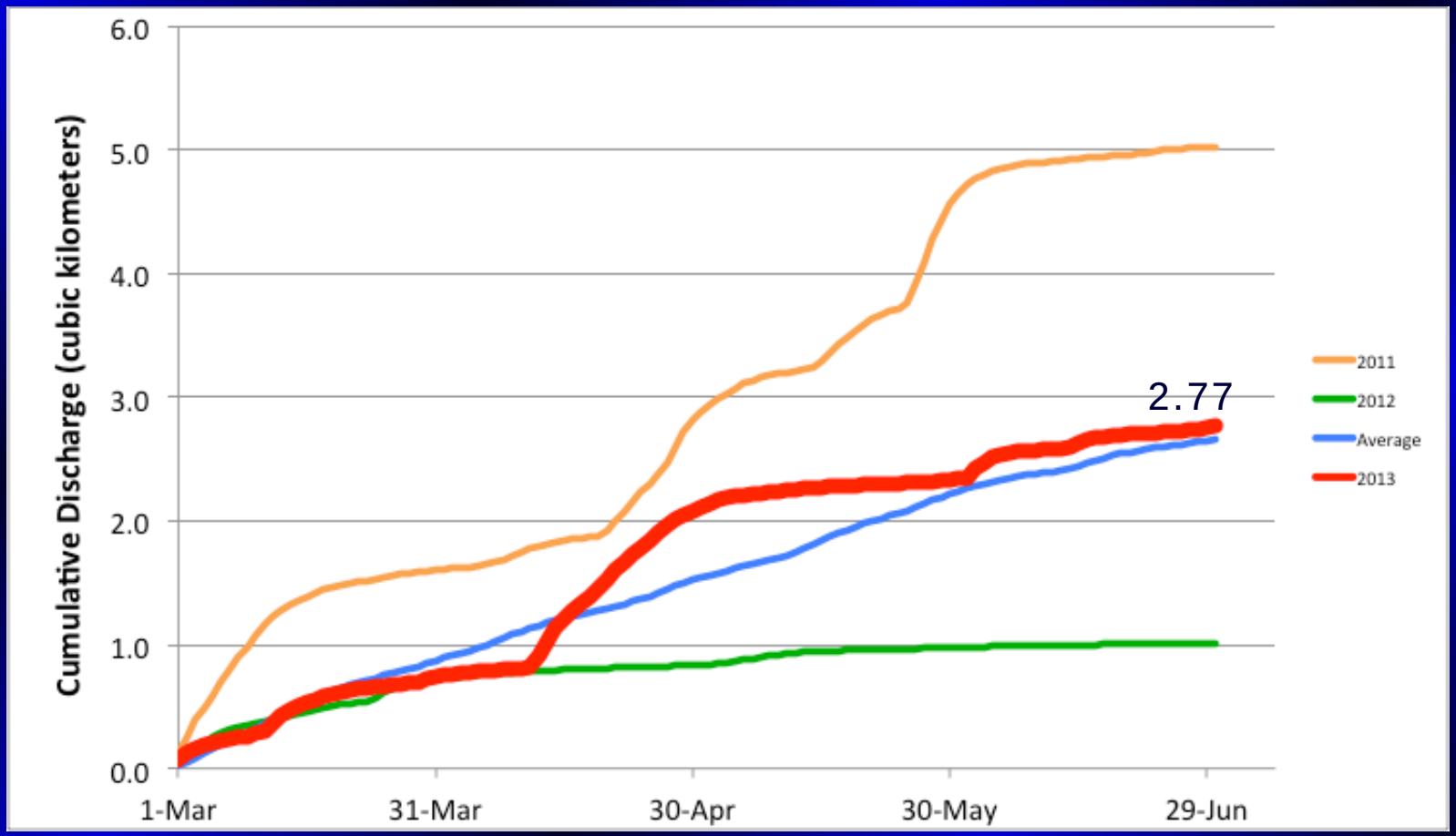
- Lake responds quickly to changed loads
- Internal loading not important
- Detroit River loading not important
  - (maybe along west shore?)

- This is all about HABs; hypoxia is different in all regards

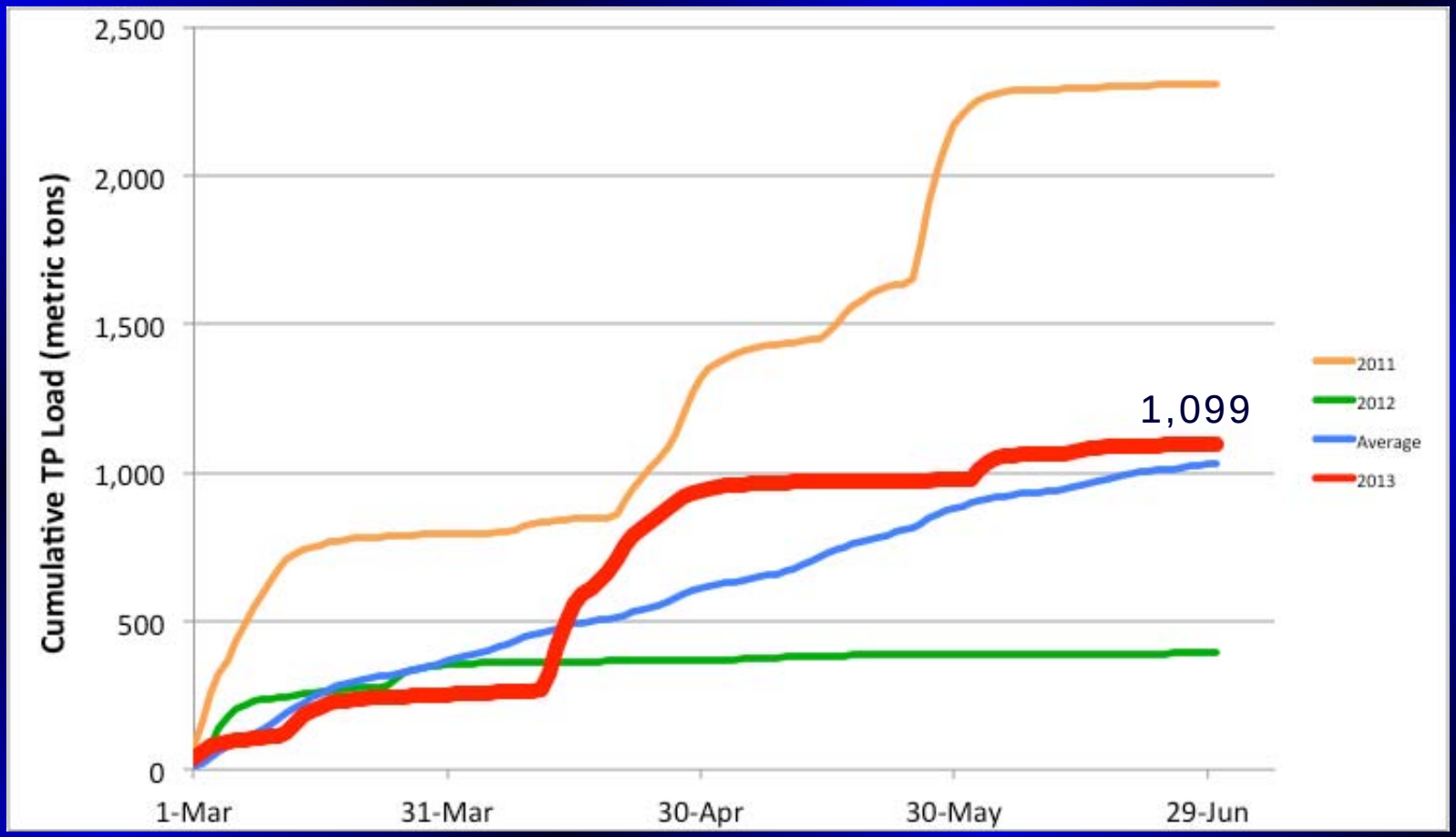
What about 2013?

- Spring totals at end of June
- Predictions given July 2 at a webinar at Stone Lab

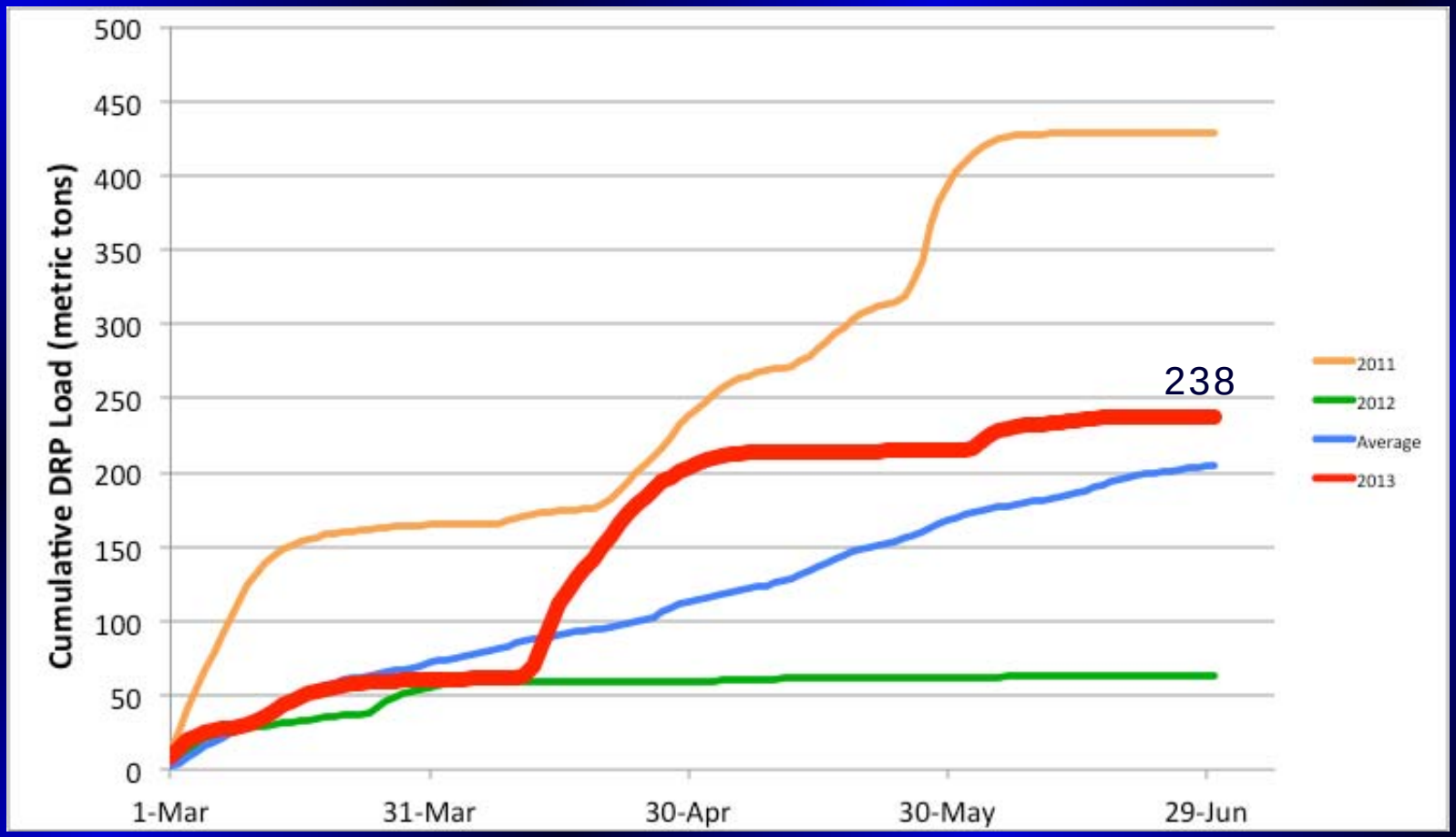
March-June Maumee Discharge



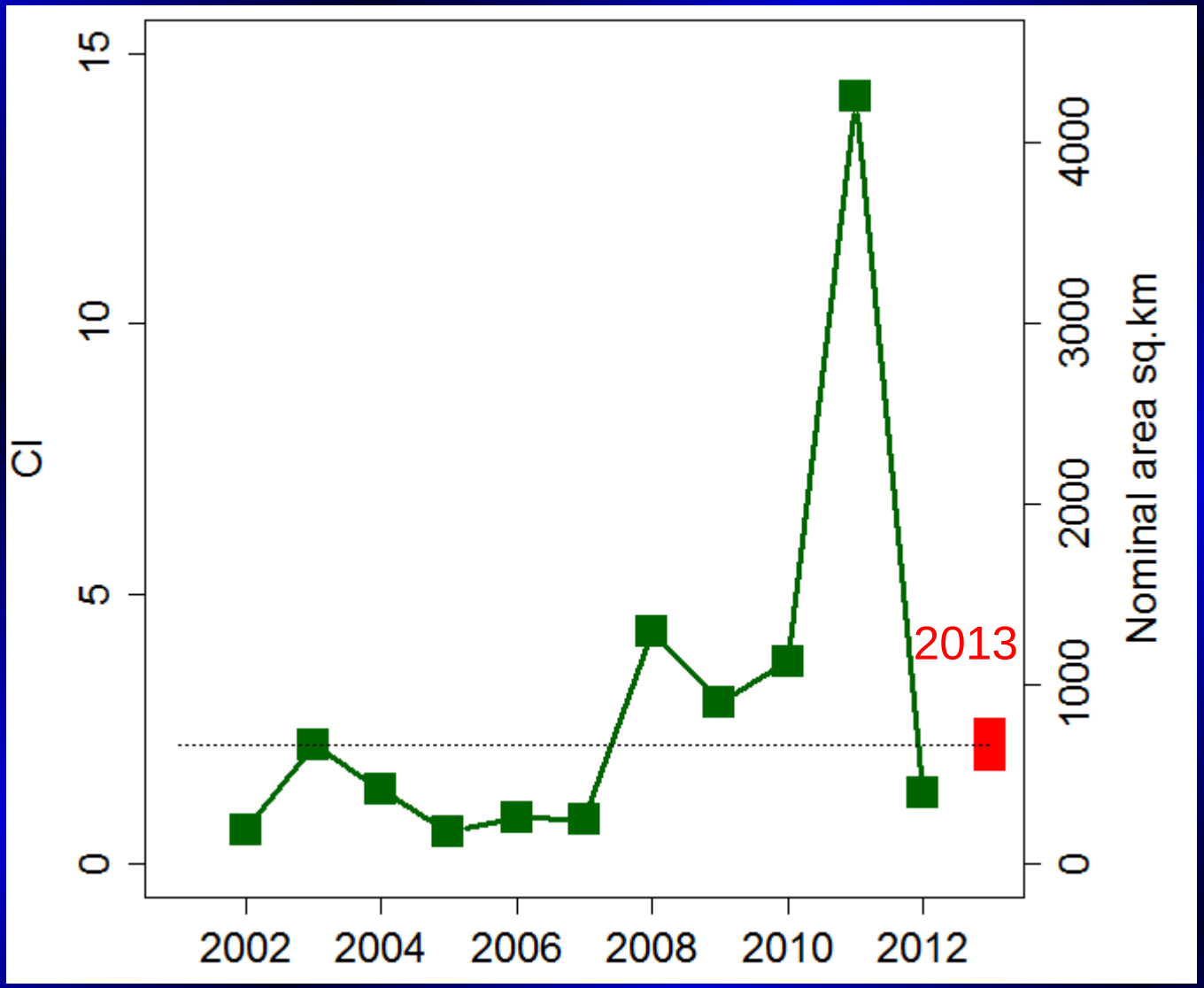
March-June Maumee Total P



March-June Maumee DRP

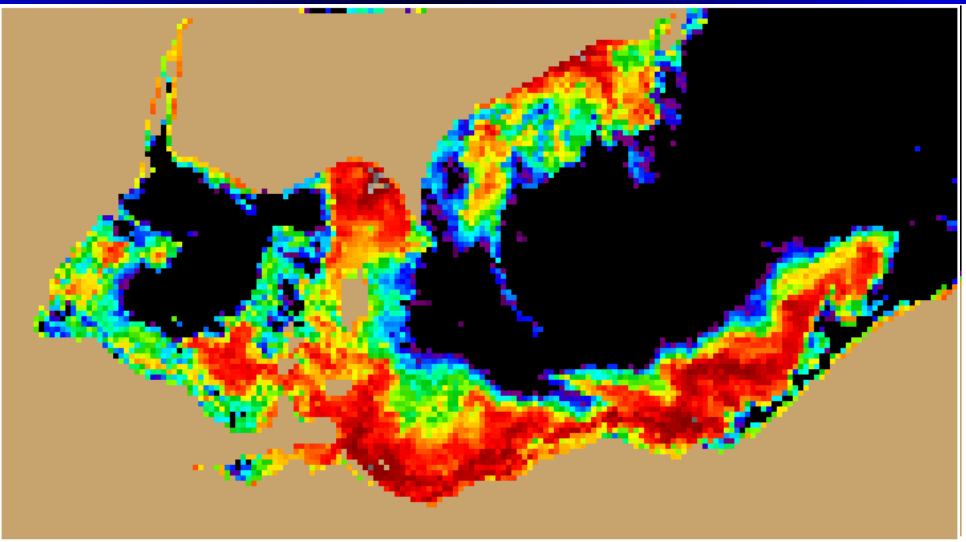


2013 Forecast: Significant bloom, similar to 2003, much milder than 2011



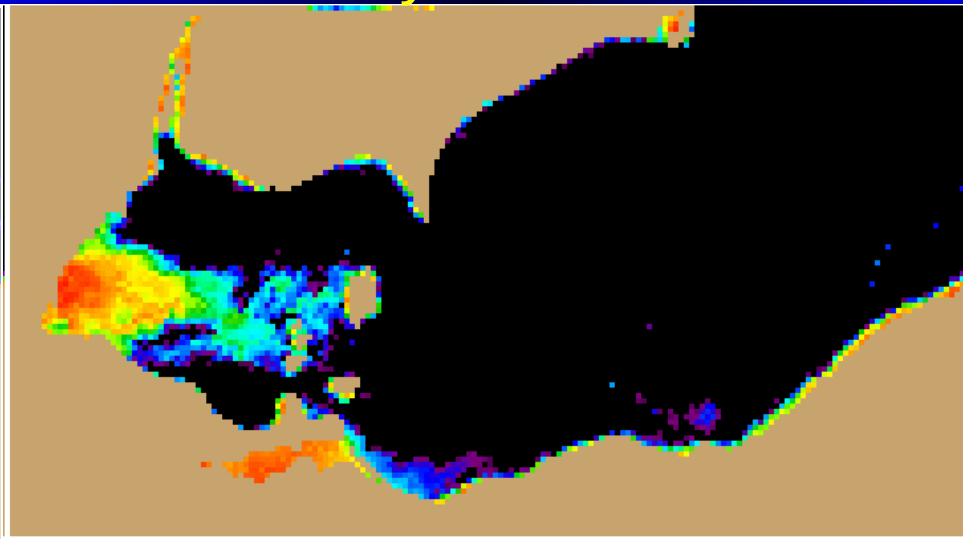
2013 prediction for western Lake Erie similar in intensity to 2003, <1/5 of 2011

2011 for comparison



2011

2013 may resemble 2003

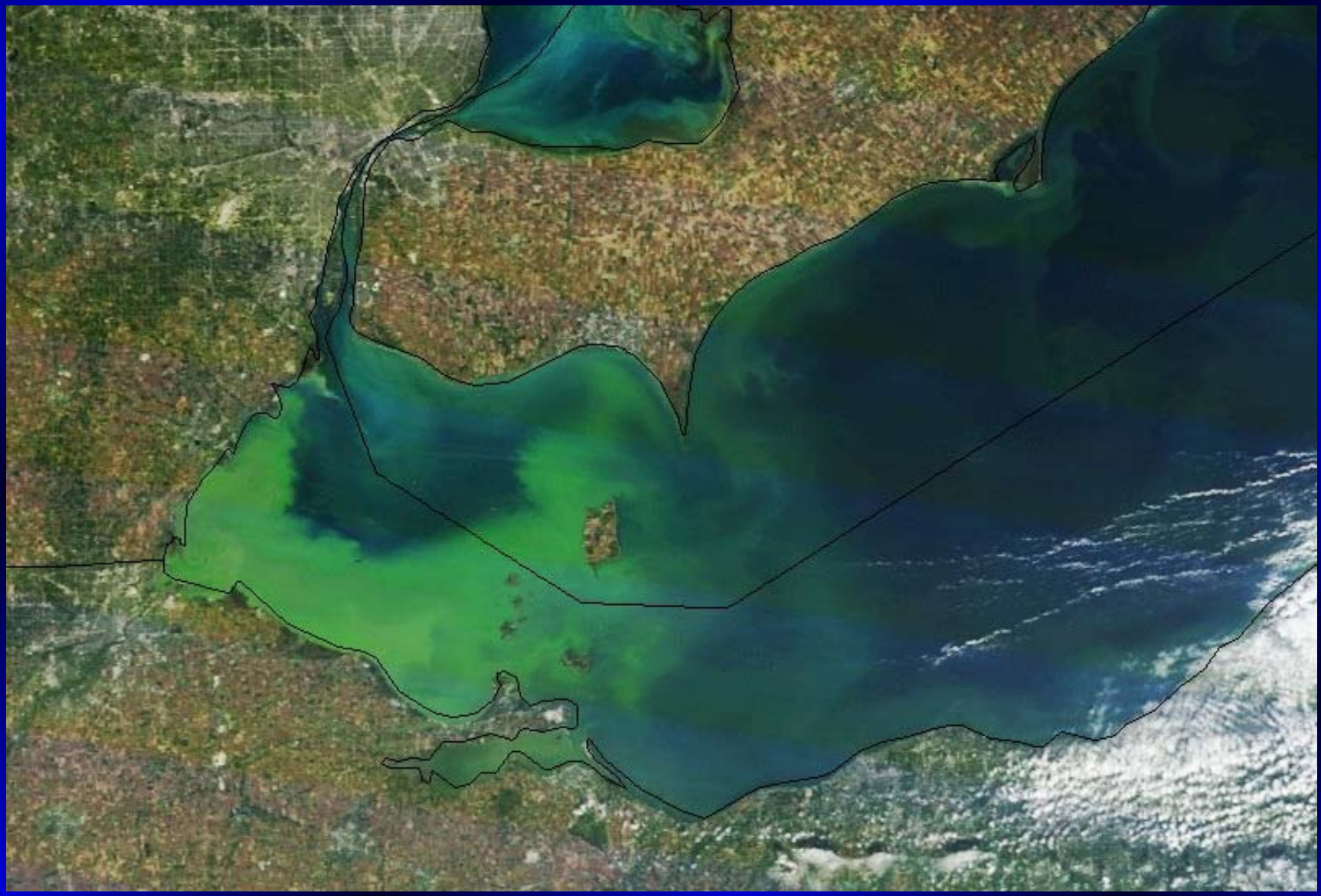


2003

low — medium — high

concentration

October 2, 2013 – looking pretty bad

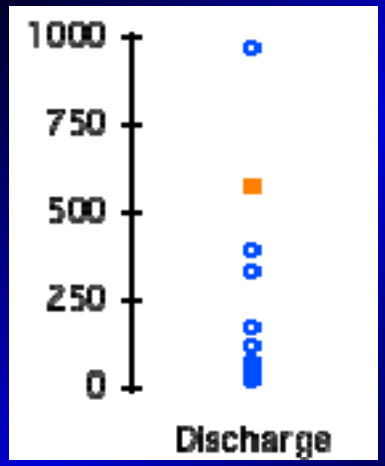


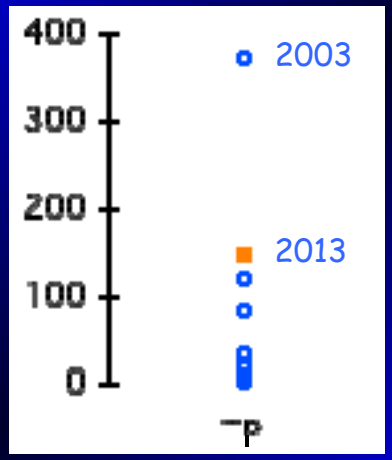
October 2, 2013 – looking pretty bad

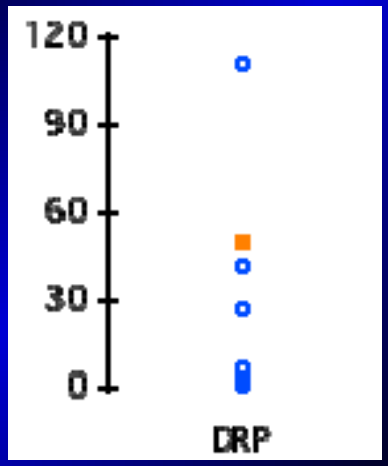
- One day's image does not constitute an annual Cyanobacteria Index value
- But – possible revision to models
- July loads: seems it never stopped raining
- Hypothesis: maybe July loads count, but they don't get into the model because there's not been any important July loading during the period the model is based on.

July Loads

	Discharge	TP	DRP
March-June	2.77	1099	238
July	0.57	149	50
July/Mar-Jun	21%	14%	21%







2013 July loads compared to 2002-2012

March-July Loads

	Year	Discharge	TP	DRP
March-June	2003	3.15	1360	307
	2013	2.77	1099	238
July	2003	0.97	373	111
	2013	0.57	149	50
March-July	2003	4.11	1733	417
	2013	3.34	1248	288

- 2003 loads substantially larger
- Yet 2003 was a small bloom year
- Reject hypothesis!
- Wait for CI to be determined…

Summary

- Inter-annual variability in loading leads to highly variable HABs
- Tributary loading is the main driver
- Seasonality of loading appears important
- Must account for bioavailability of sources
- Need new P targets specific to Western Basin

Useful References

- Ohio Lake Erie Phosphorus Task Force
  - http://www.epa.ohio.gov/dsw/lakeerie/index.aspx
- Paper on climate change, Lake Erie, and water sustainability
  - Anna Michalak and many others including me, Proceedings of the National Academy of Sciences
  - http://www.pnas.org/content/110/16/6448