Simple Descriptive Hypoxia Models

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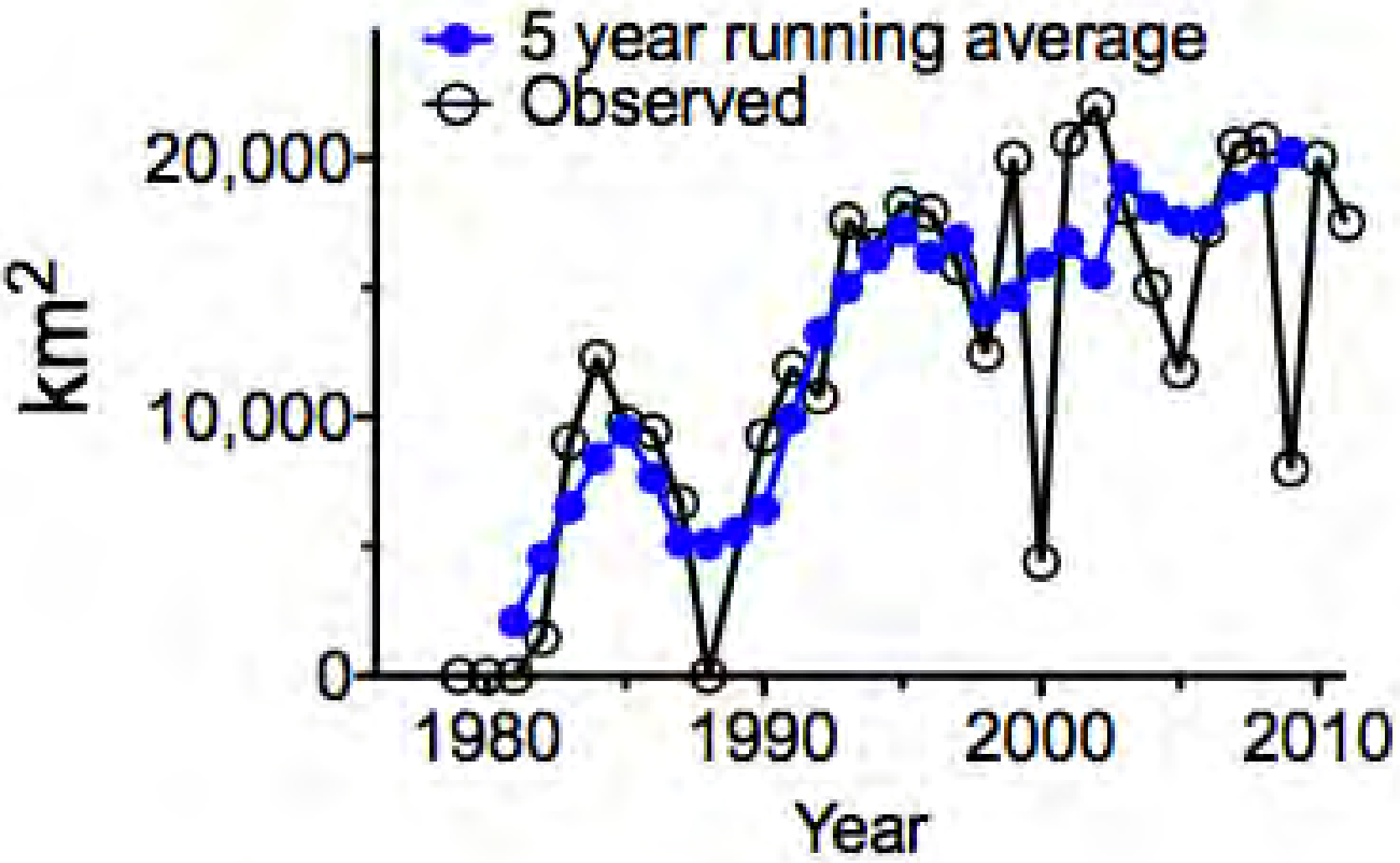
Gulf Action Plan: GOALS

Coastal. By 2015, reduce hypoxia below 5,000 km^2 (over a 5-yr running average)

- Aim to achieve a 30% reduction in N discharge to the Gulf, 5-yr running average

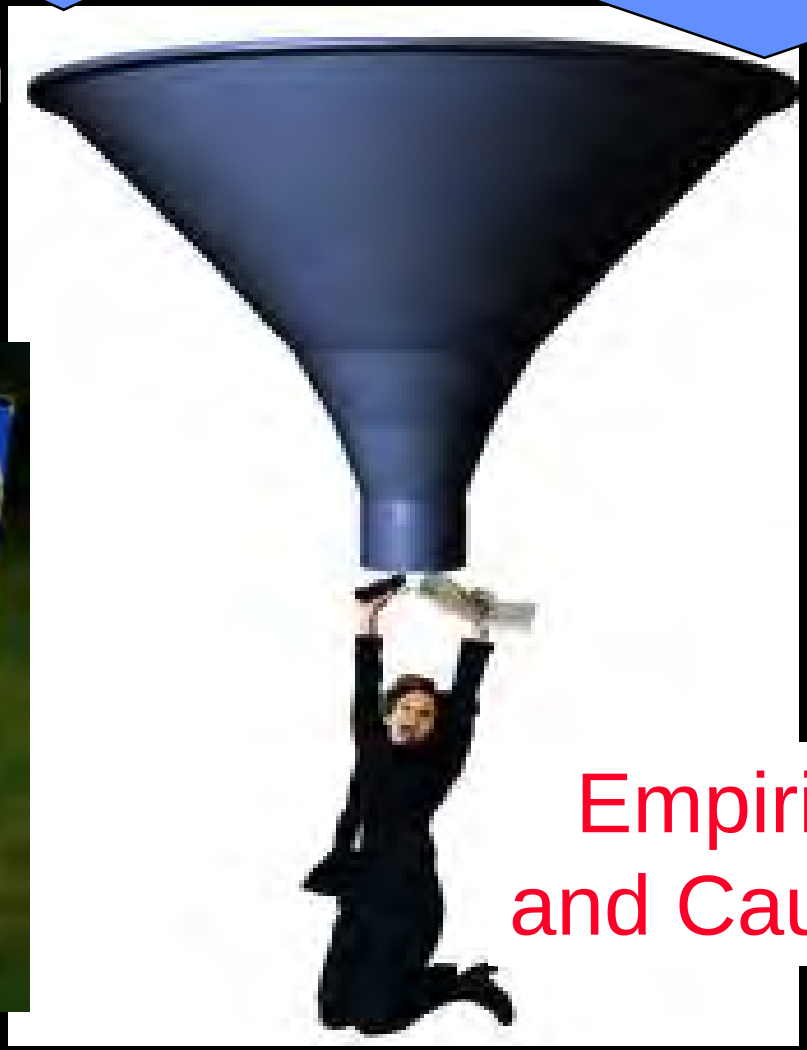
- Voluntary actions, incentives, education


5 year running average
Observed
20,000
10,000
0
km2
1980
1990
2000
2010
Year

INPUTS

Nitrate, silicate, TP, etc.

Hot air; Complex math logic



Discharge; time

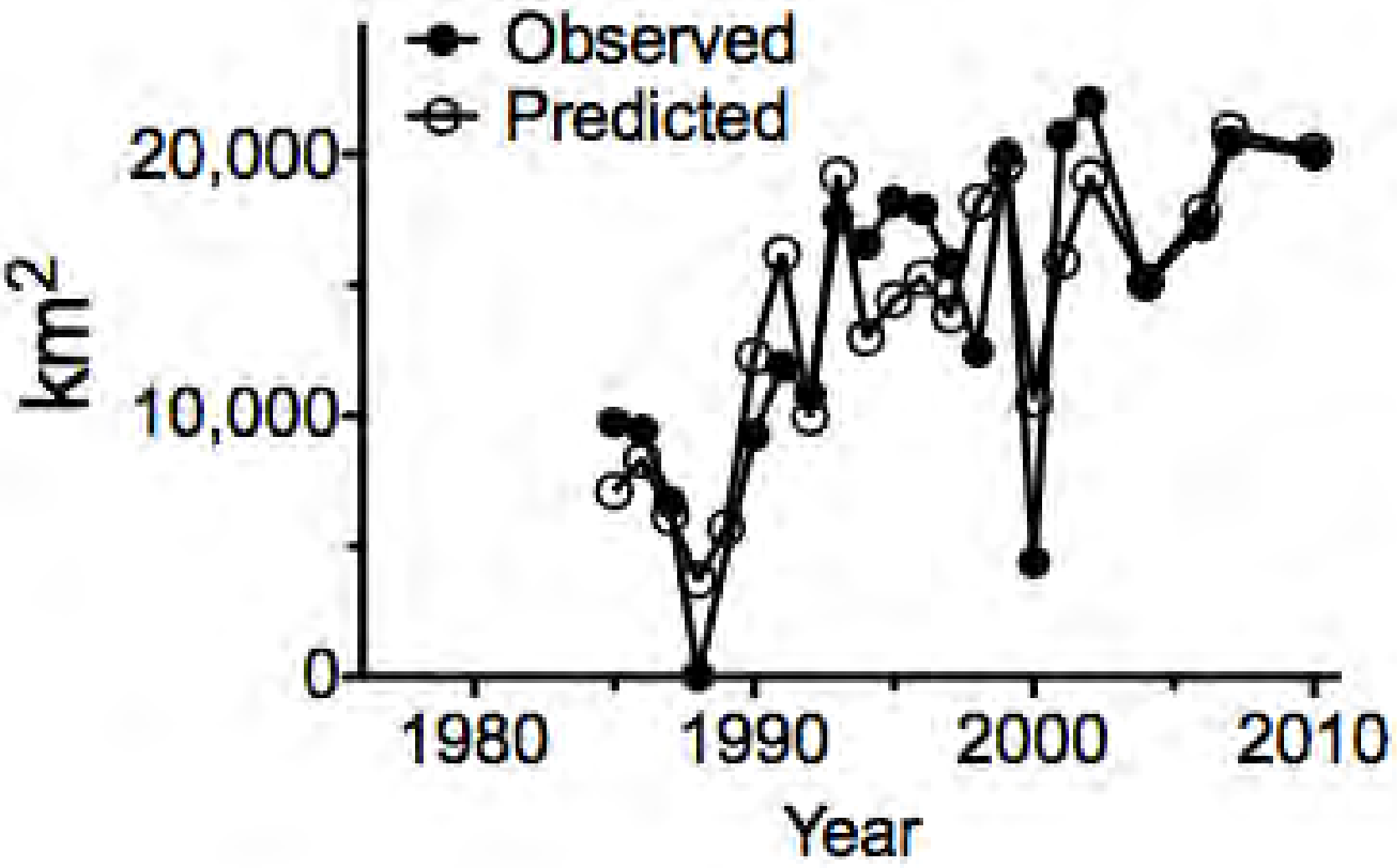
Empiricism and Causation

Descriptive (Dm) and predictive (Pm) models

- optimize R^2
- WQ in Mississippi River preceding 1-6 months

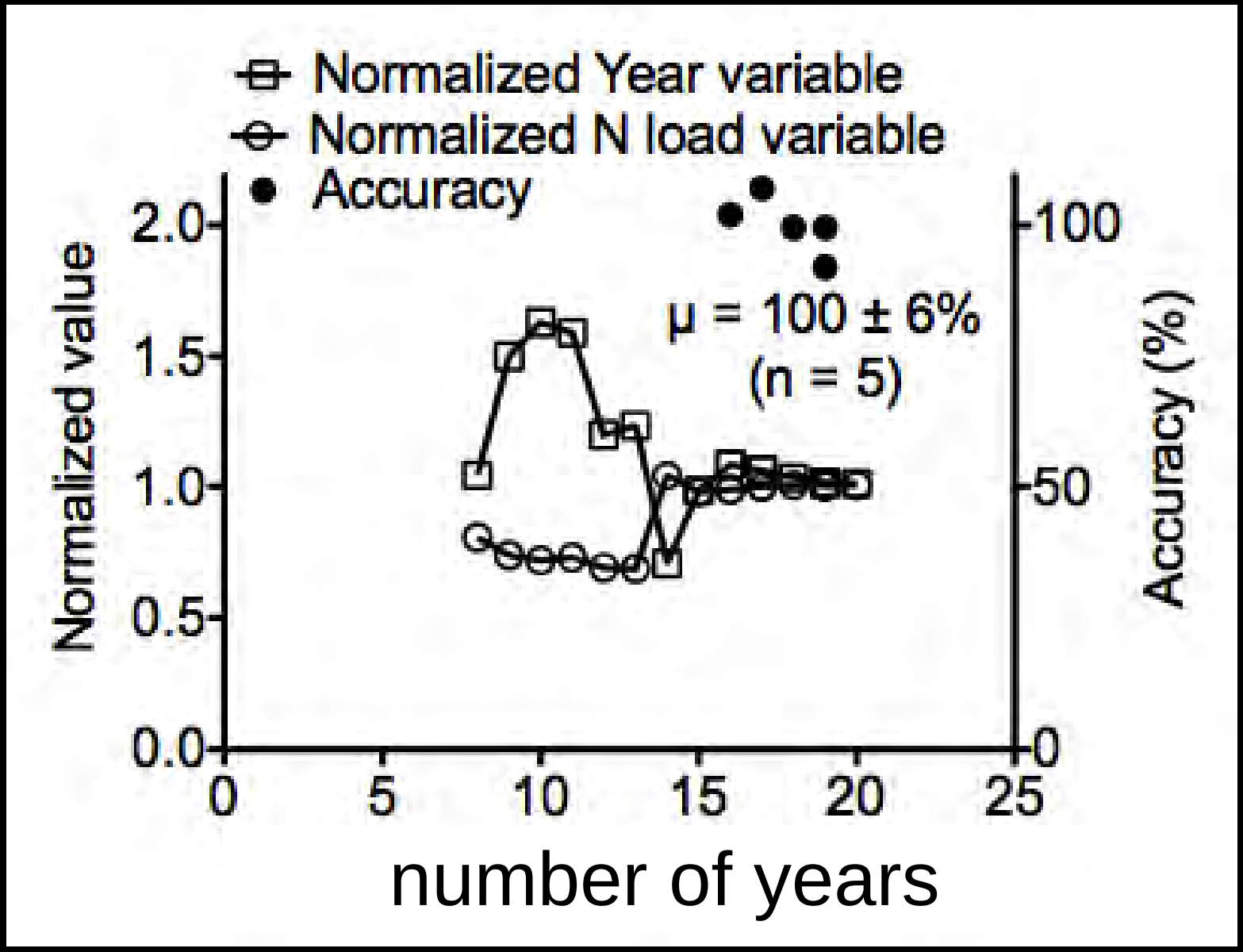
Wiseman et al. 1997; Dm; max R^2 = 0.60
Turner et al. 2005; Dm; max R^2 = 0.69
Turner et al. 2006 ; Dm and Pm; max R^2 = 0.82
Greene et al. 2009 ; Dm; max R^2 = 0.60
Forrest et al. 2011 ; Dm; max R^2 = 0.73
Turner et al. 2012 ; Dm and Pm; max R^2 = 0.94

OUTPUTS: HINDCAST AND FORECAST OF ANNUAL SIZE (one pixel)

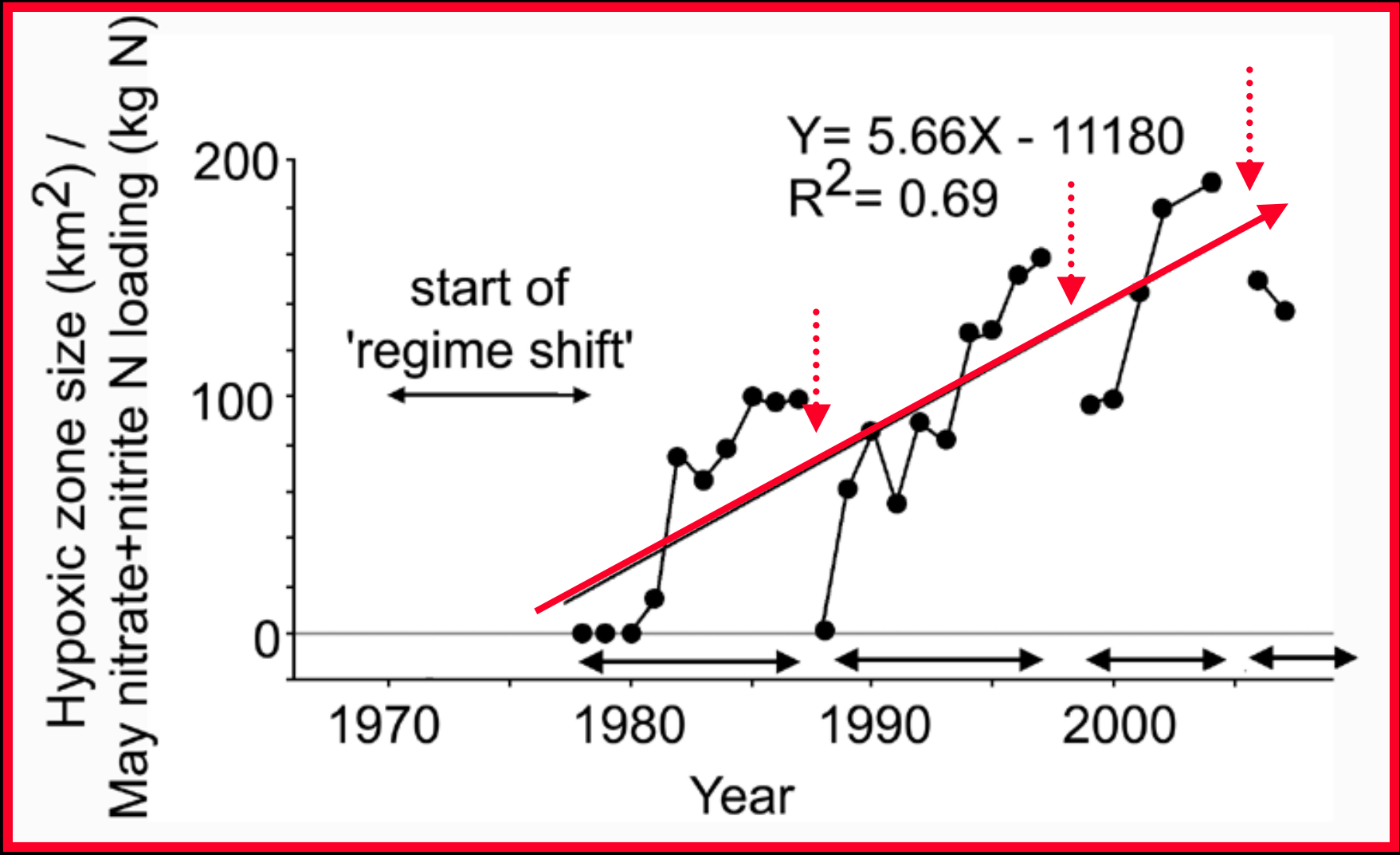


ASSUMPTIONS:Status quo coupling, but flexible evolution; annual updates which, in themselves, are informative, e.g., 2012, 2011

Evolution of model variables (predicted)

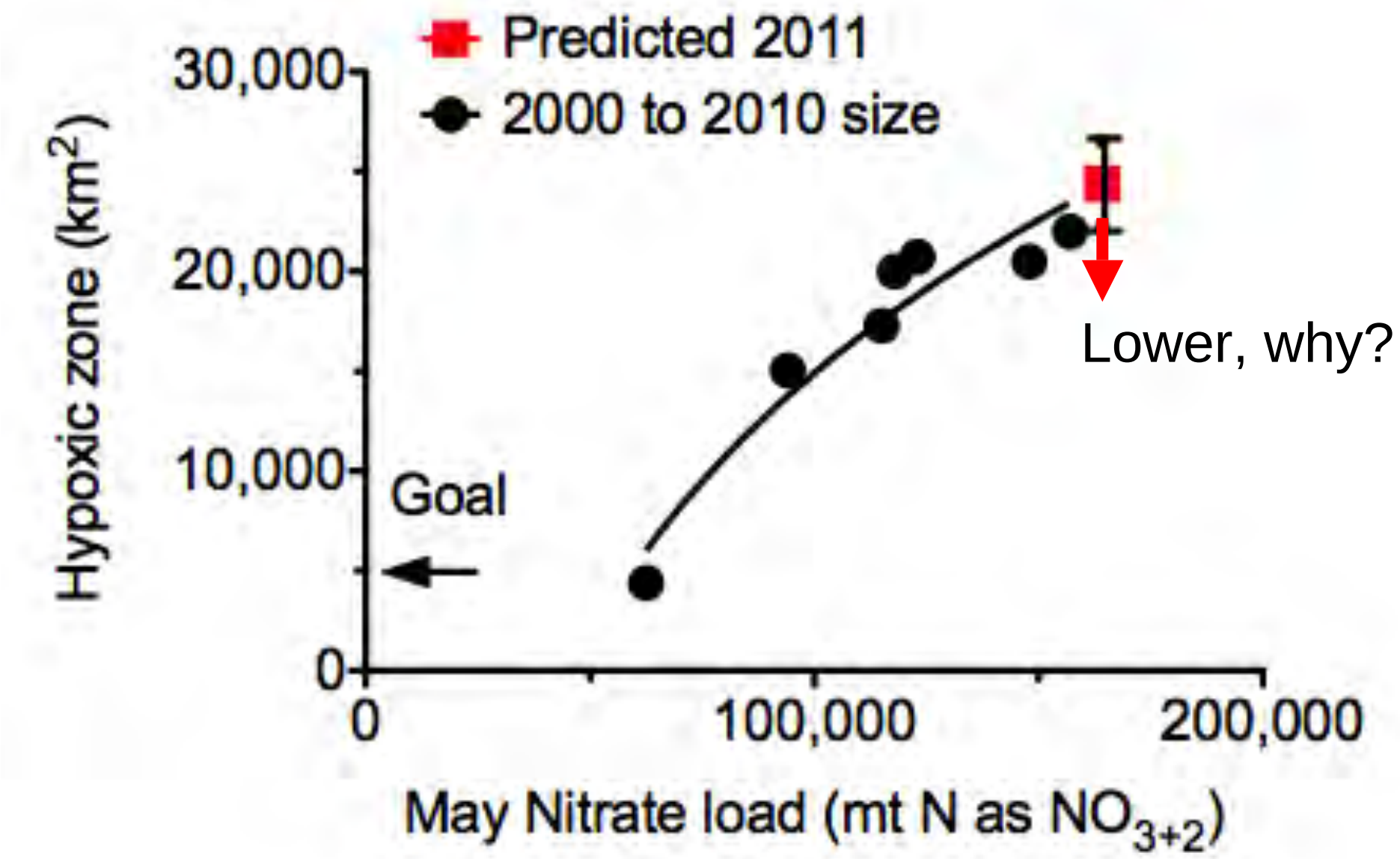


Hypoxia per unit nitrate: rising

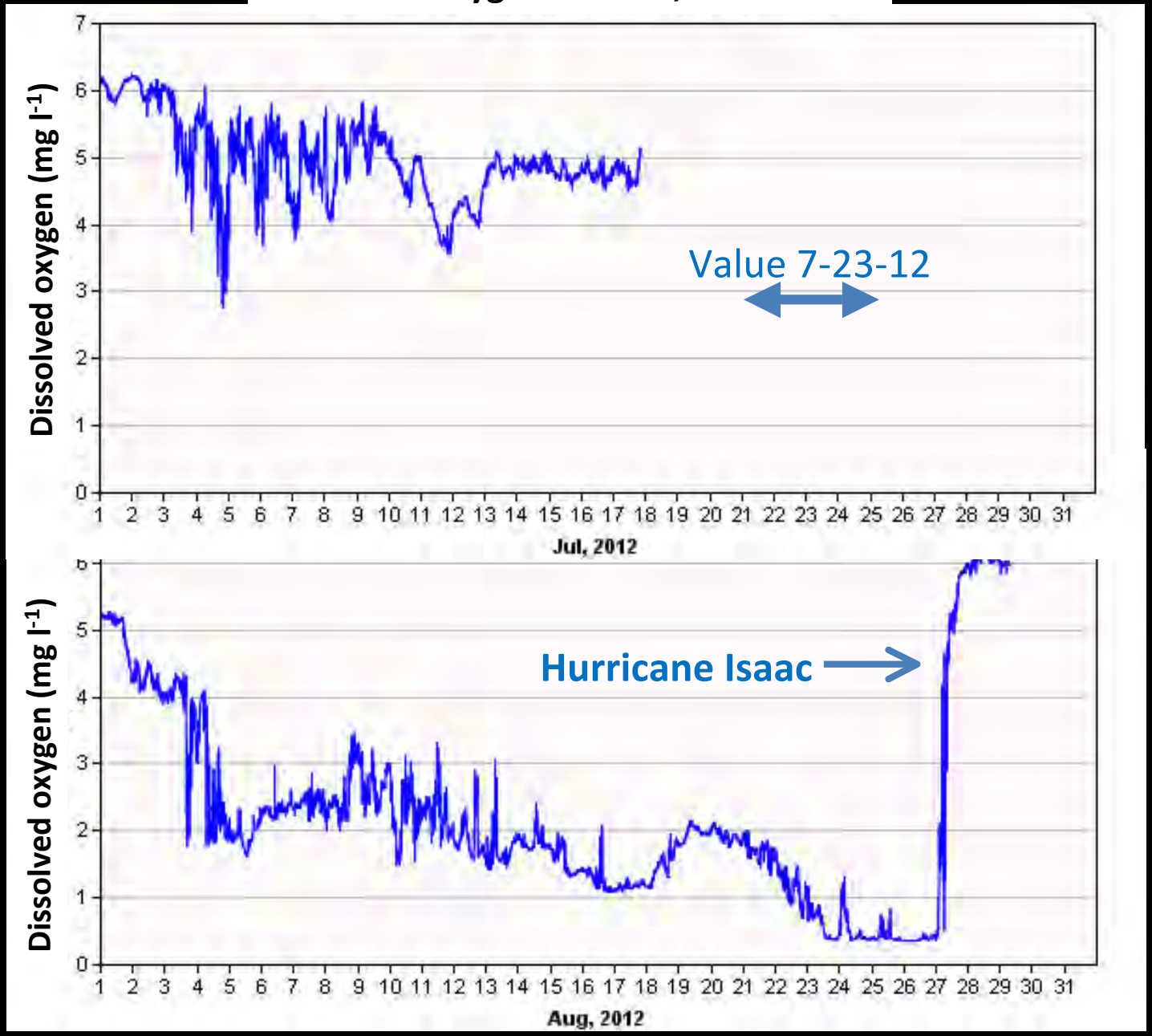


Turner, R. E., N. N. Rabalais and D. Justic 2008. Gulf of Mexico hypoxia: Alternate states and a legacy. Environmental Science and Technology 42: 2323 - 2327

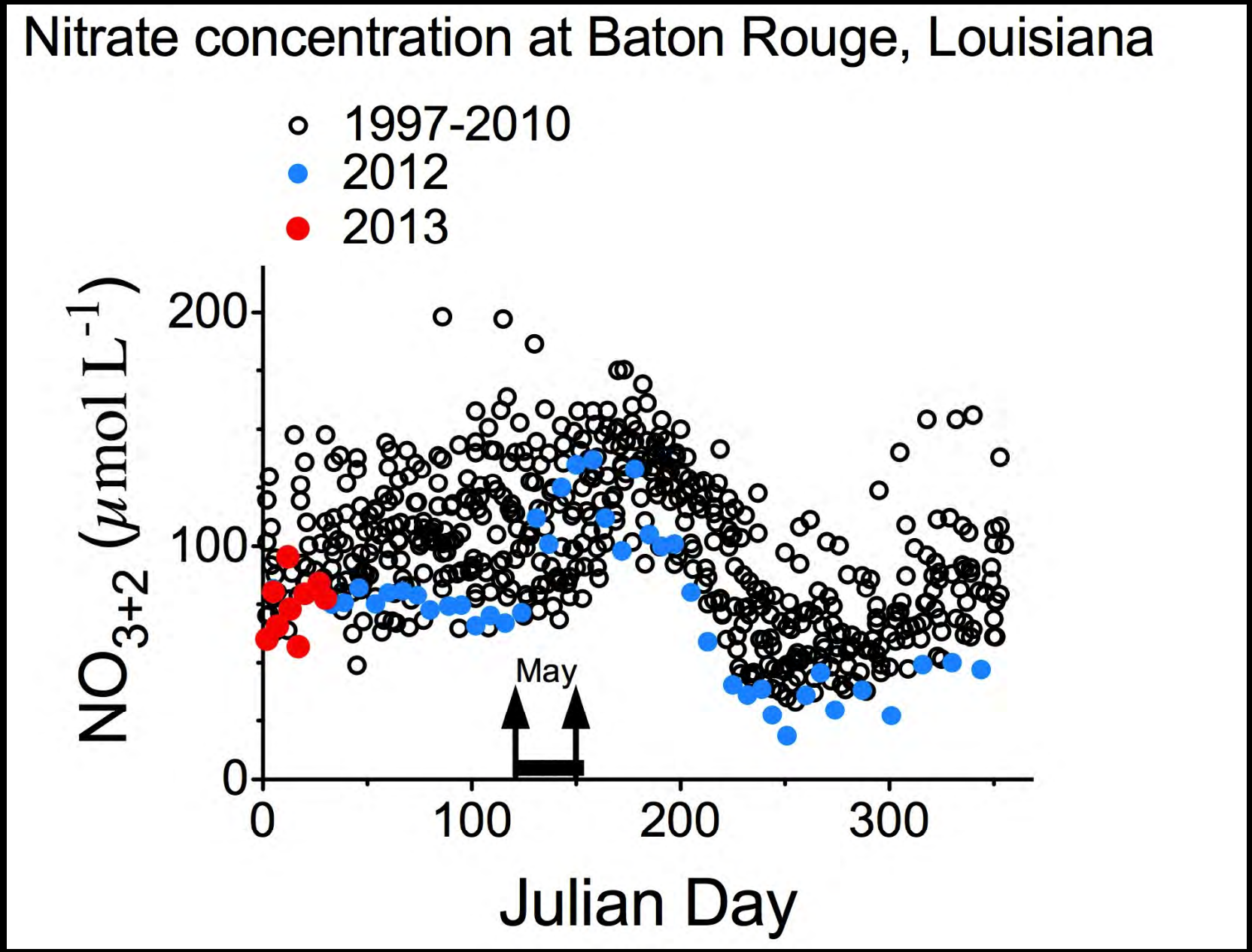
Hypoxic zone size and N load

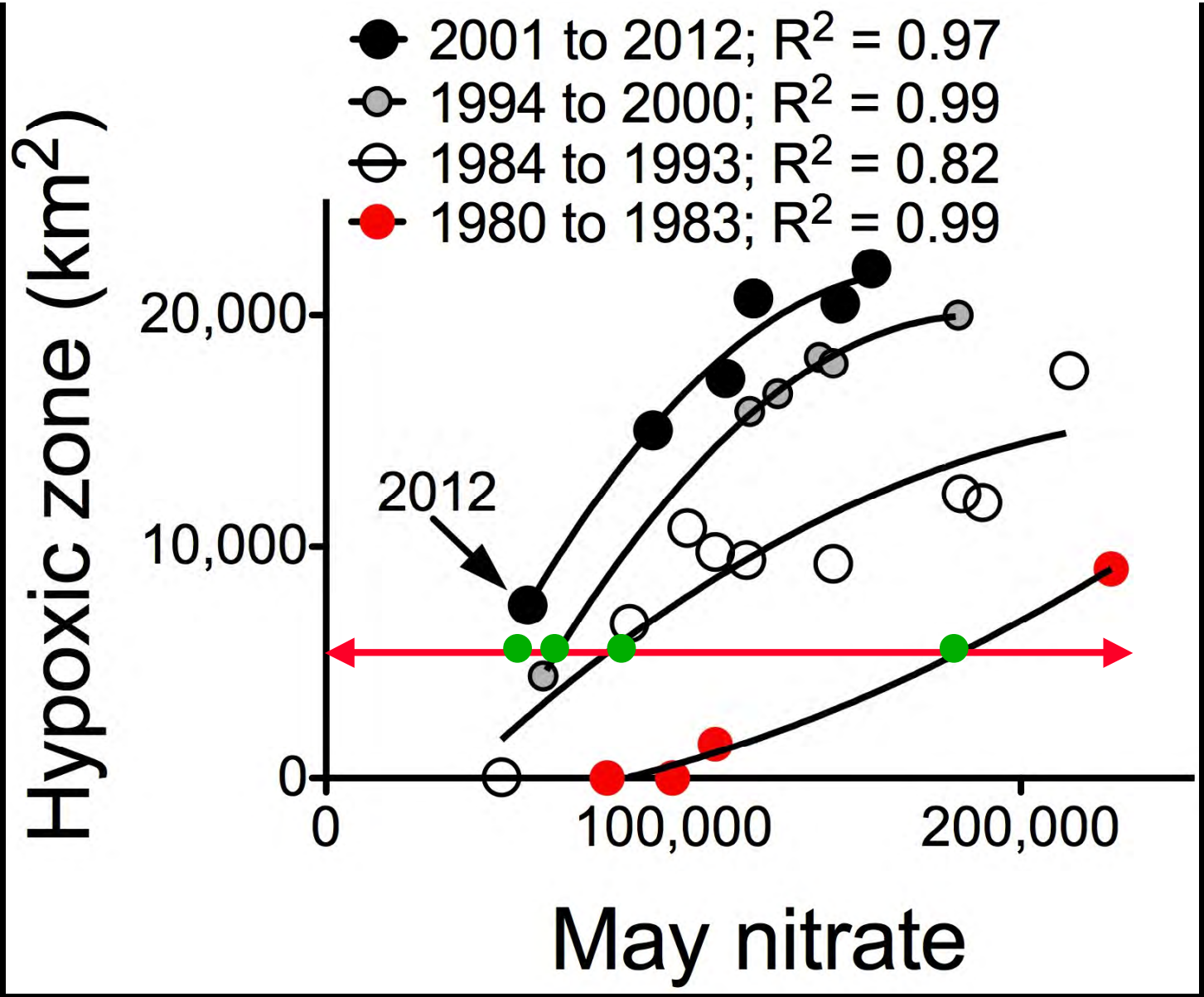


Dissolved Oxygen at 20 m, Station C6C



Baton Rouge nitrate values





HOW APPLIED: formal annual predictions starting in 2002

REMAINING NEEDS:

- Follow trajectory of coefficients; this is not a status quo system
- Maintain a skilled intuitive understanding of system to avoid mistaking empiricism for causation, or missing causal relationships
- Role of storms

TRANSITION TO OPERATION:

- VERY reliable hypoxic zone estimates needed
- NO disruption in estimates (don’t rest in your data)

Thank you -
Questions? Comments?