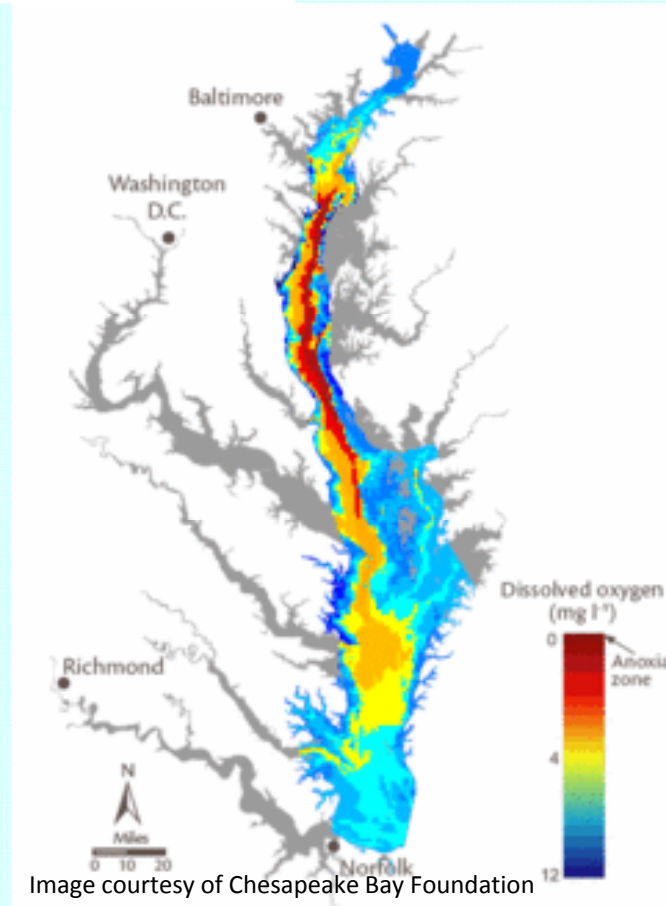
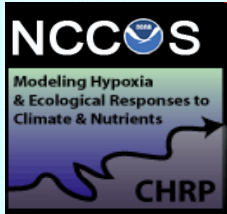


Patterns and Controls on Spring Oxygen Depletion in Chesapeake Bay

Jeremy Testa and W. Michael Kemp

February 16 2011 ASLO Aquatic Sciences Meeting



Outline

- **Motivation**

- Understanding the onset of hypoxia and associated habitat degradation
- Better understanding of spring O_2 aids summer prediction
- Traditional focus on Chesapeake O_2 depletion is on summer period, but spring period is when hypoxia develops

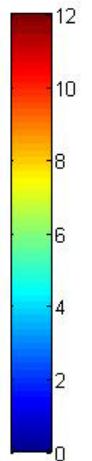
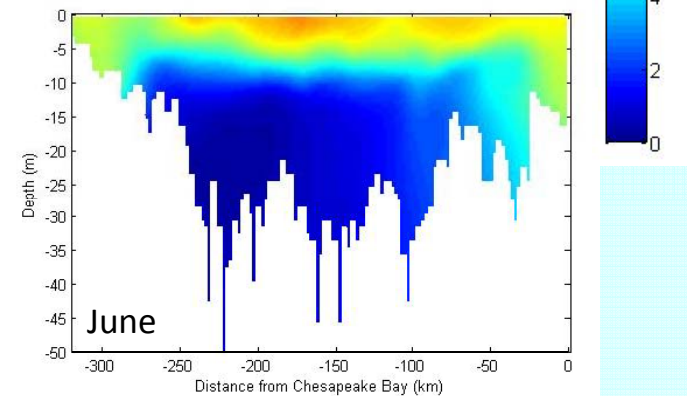
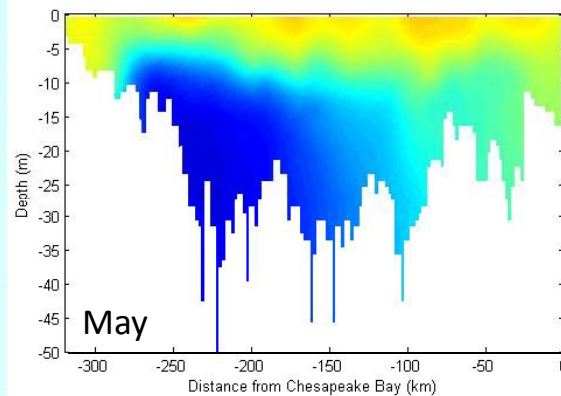
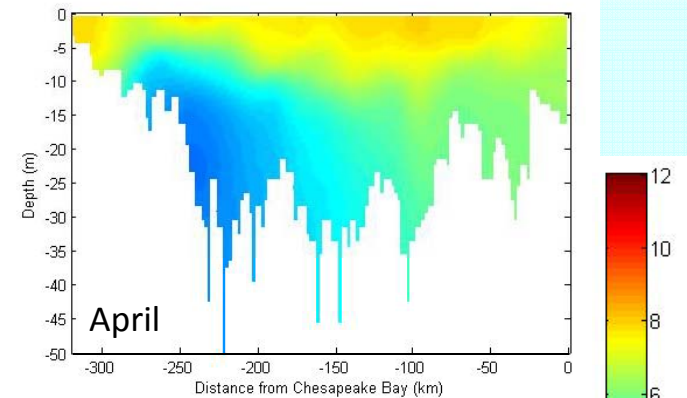
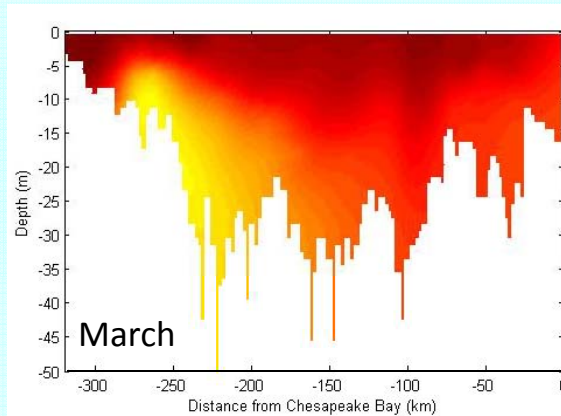
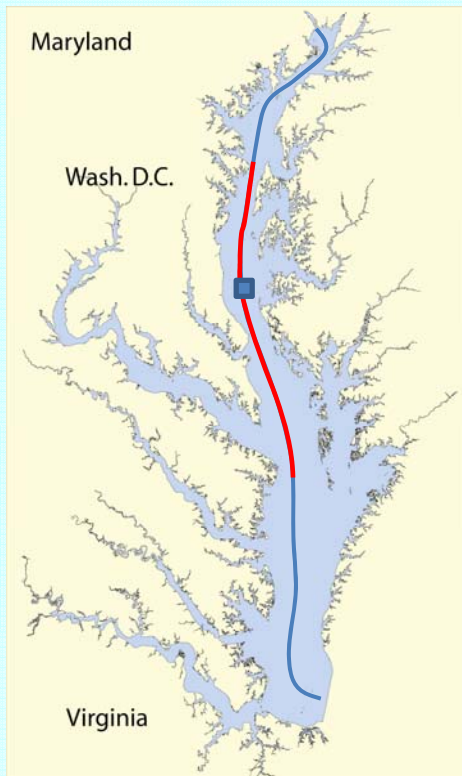
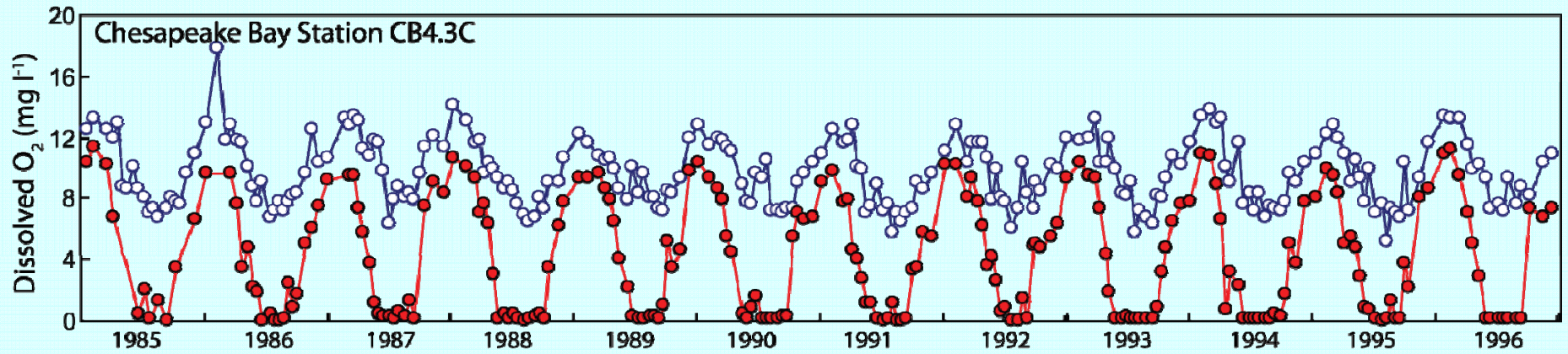
- **Chesapeake Bay Oxygen Controls**

- Algal decay and physical forcing interact to deplete O_2
- Mechanisms non-linear and linked

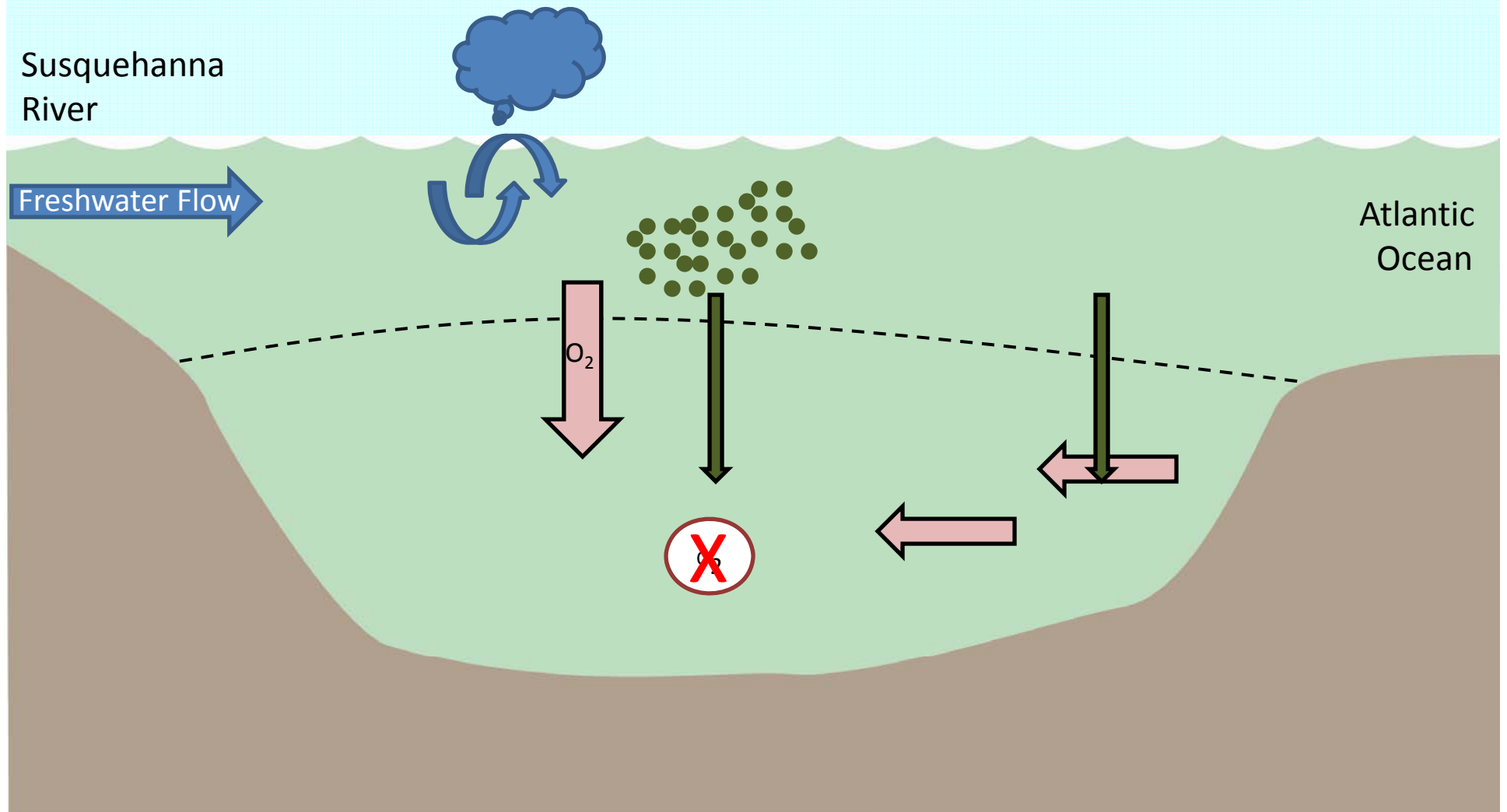
- **Modeling of O_2 -Depletion**

- Statistical models suggests secondary controls on O_2 depletion

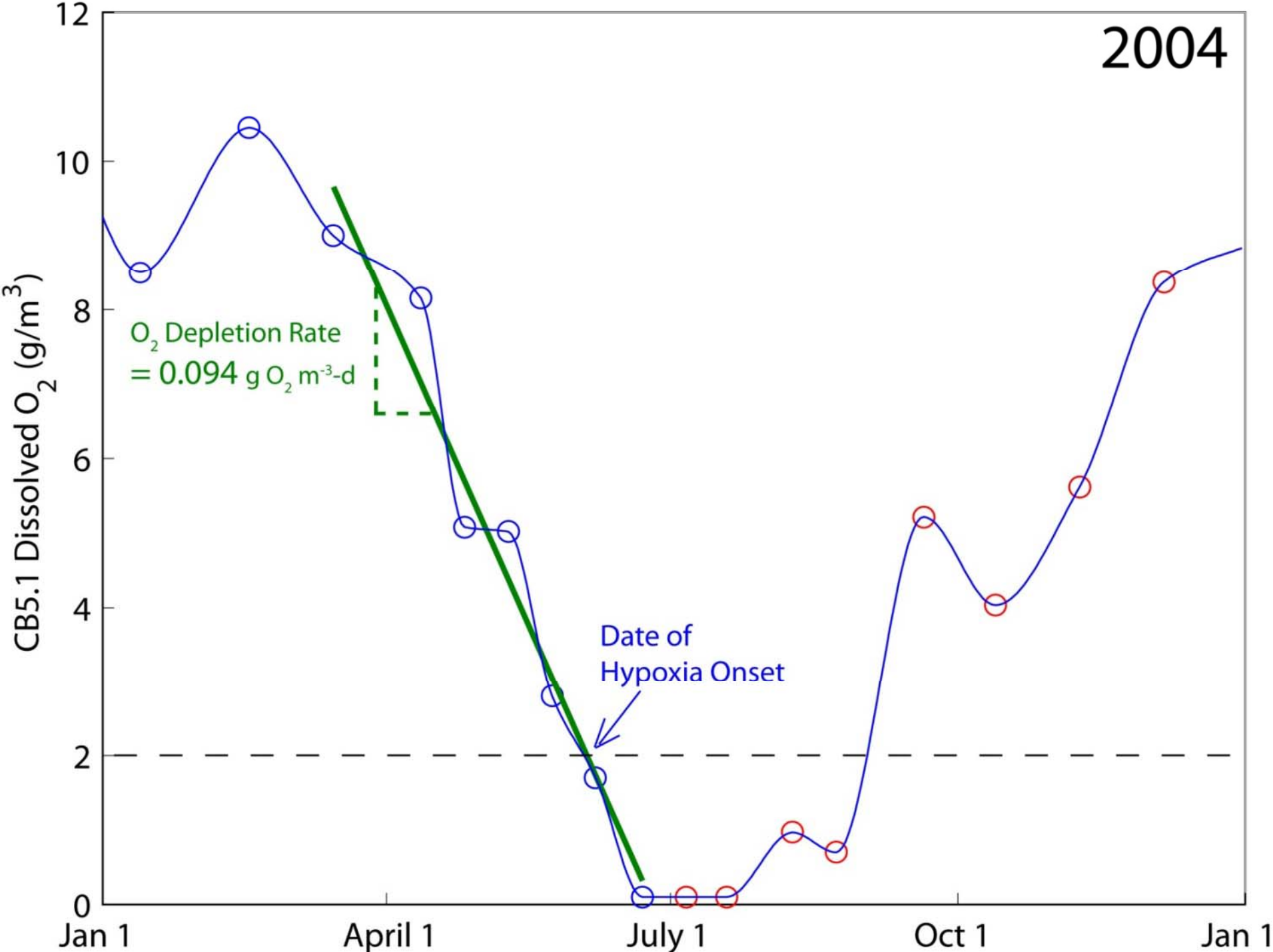
Seasonal Evolution of Low-Oxygen Water in Chesapeake Bay



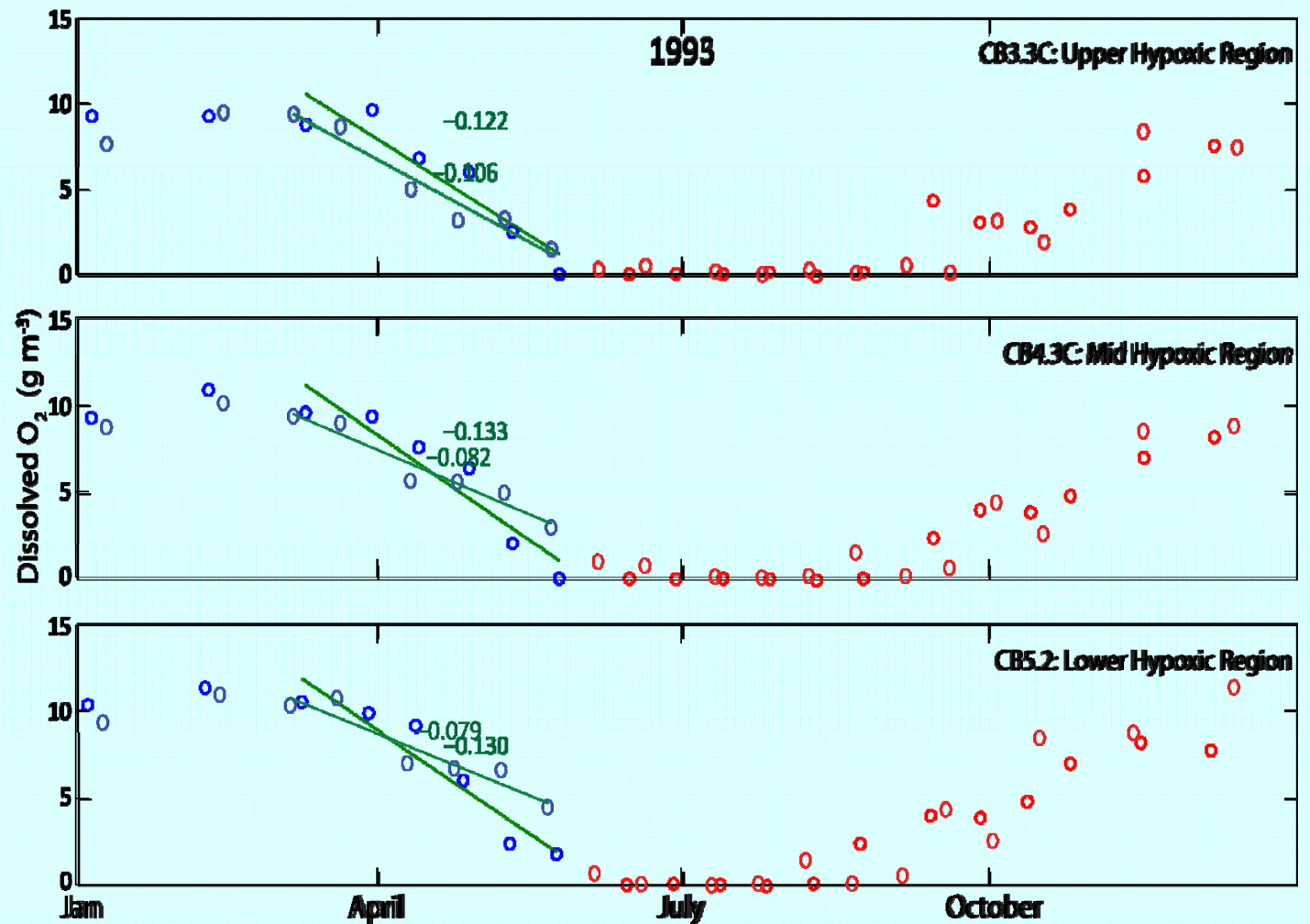
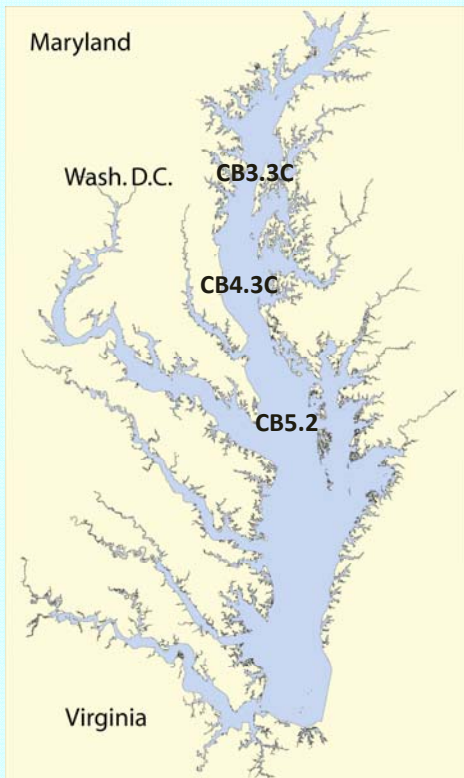
Chesapeake Bay Oxygen Dynamics



2004

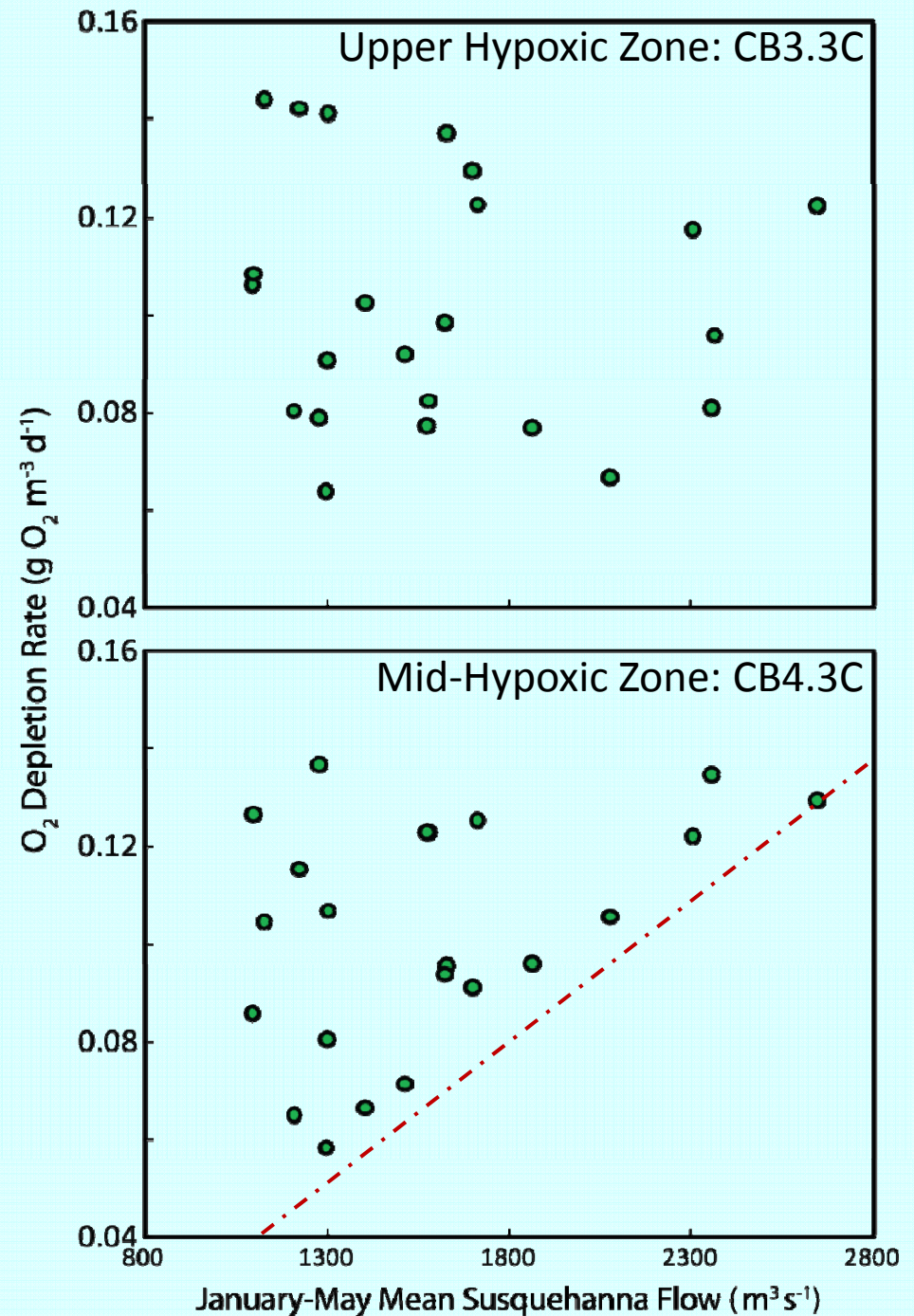


O₂ Depletion Rates Vary Along Axis



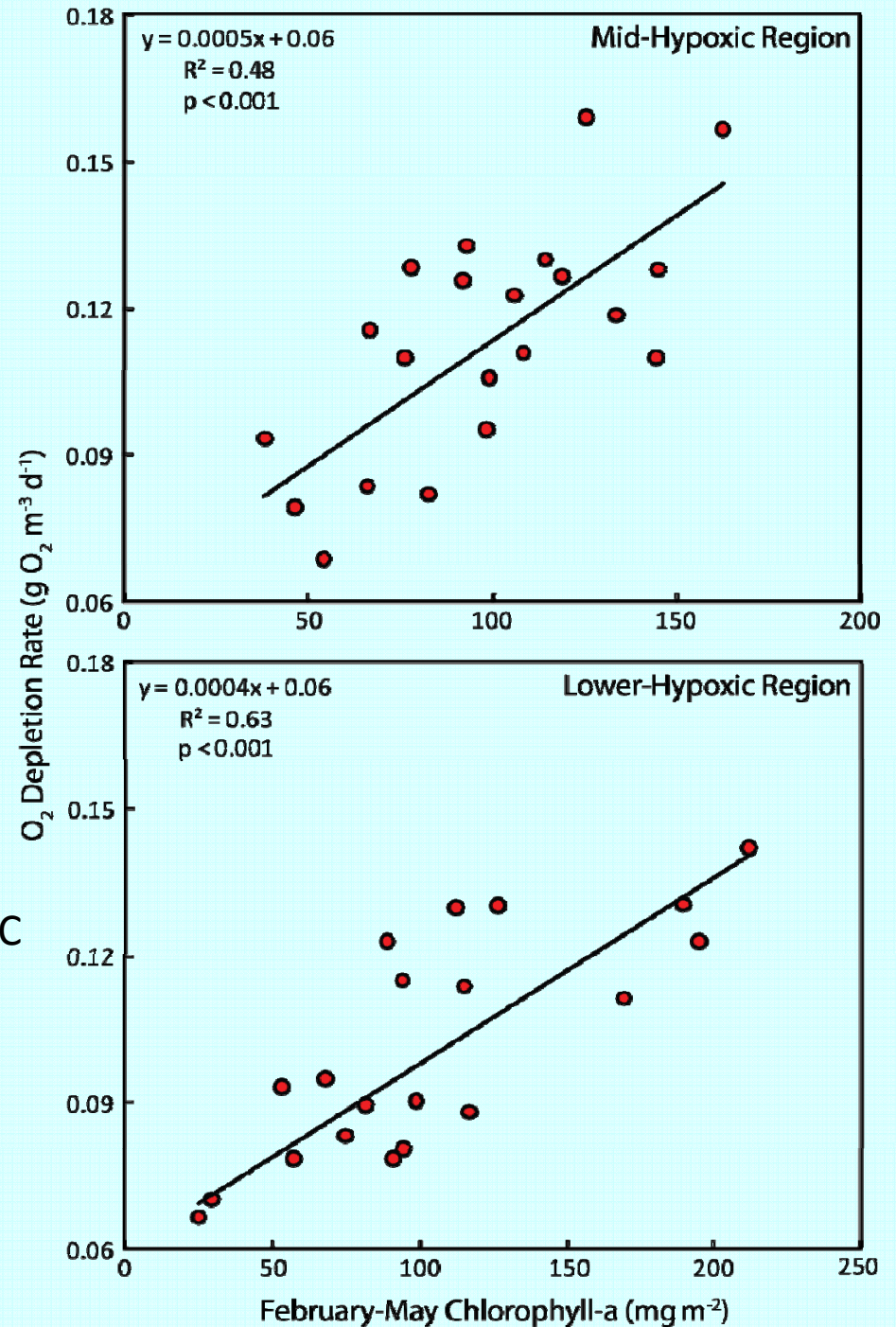
Spatially Dependent Flow-O₂ Depletion Relationship

- Higher freshwater inflow has little impact on O₂ depletion rates in upper hypoxic zone, but elevates rates in lower hypoxic zone
- Correlation with annual measures is poor



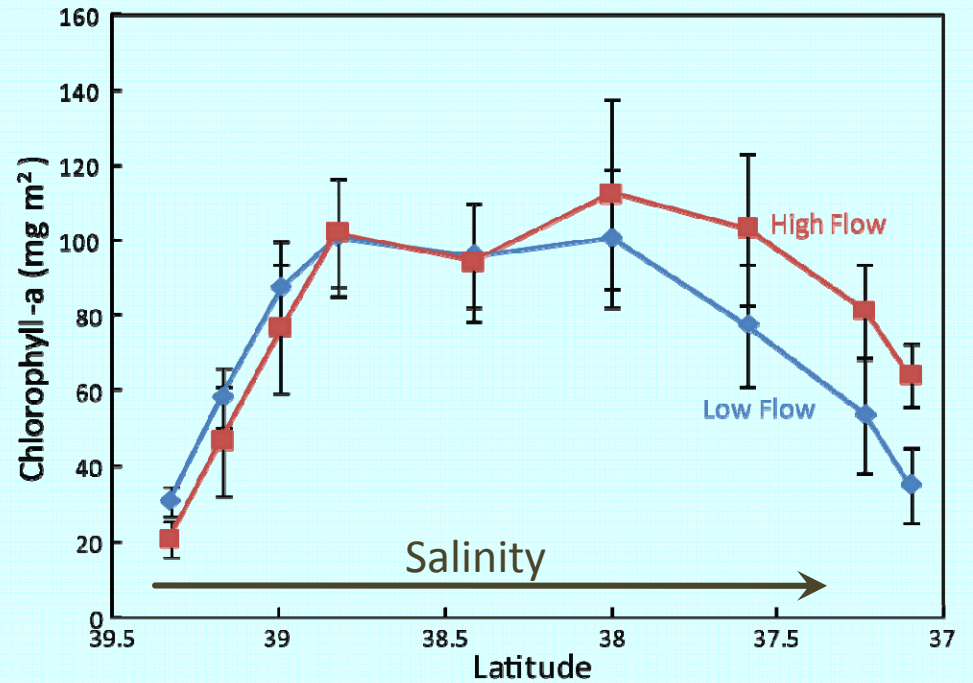
O₂ Depletion Rates Positively Correlated with Spring Chl-a

- Higher spring chl-a in surface layer leads to elevated O₂ depletion rates in middle and lower hypoxic zone
- More labile organic material = more rapid O₂ depletion
- Simple calculations suggest sinking surface POC sufficient to fuel calculated O₂ depletion rates

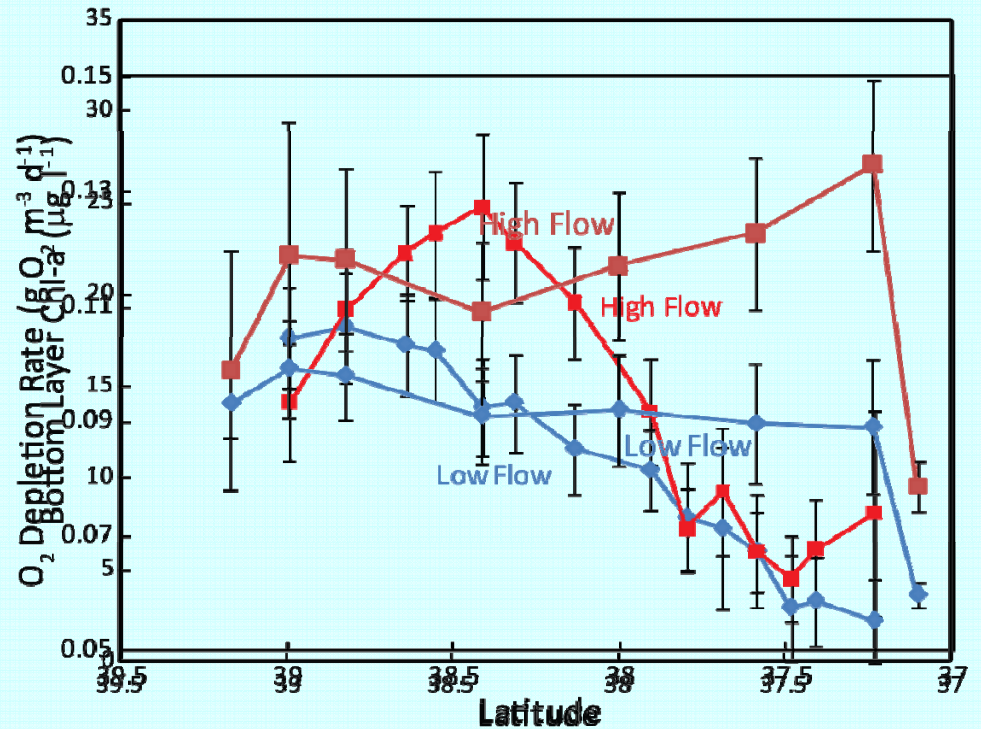


High Flow Pushes Chl-a Seaward

- Higher freshwater inflow pushes surface layer leads chl-a peak seaward, but bottom layer chl-a elevated everywhere along axis



- Seaward shift in peak O₂ depletion rates



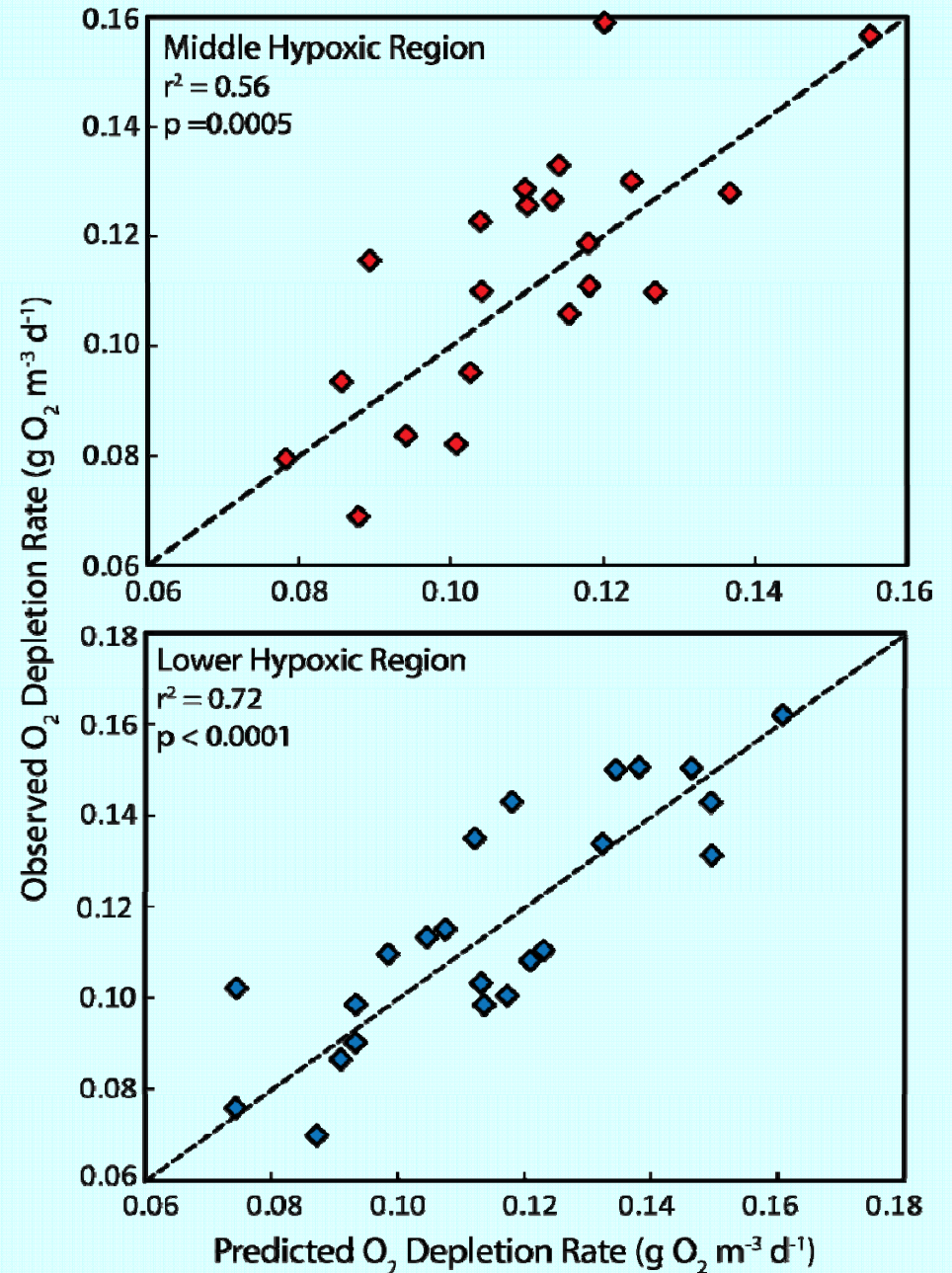
Multiple Linear Regression Models Indicate Secondary Controls

Middle Hypoxic Region

- Jan-May Surface Layer Chl-a
- Fraction of March-May winds from NW
- Susquehanna Jan-April Flow

Lower Hypoxic Region

- Jan-May Surface Layer Chl-a
- Fraction of March-May winds from W
- Susquehanna Jan-April Flow



Conclusions

- Spring O₂ depletion driven by a combination of climatic and biological factors
- Surface chlorophyll explains most of the variation in early season O₂ depletion – but is not related to summer hypoxia, suggesting later season organic production key to summer hypoxia
- Future modeling work will better elucidate mechanisms