Spring-Summer Nutrient Levels and Phytoplankton Growth in Jamaica Bay, New York – Key Factors Controlling Oxygen Levels

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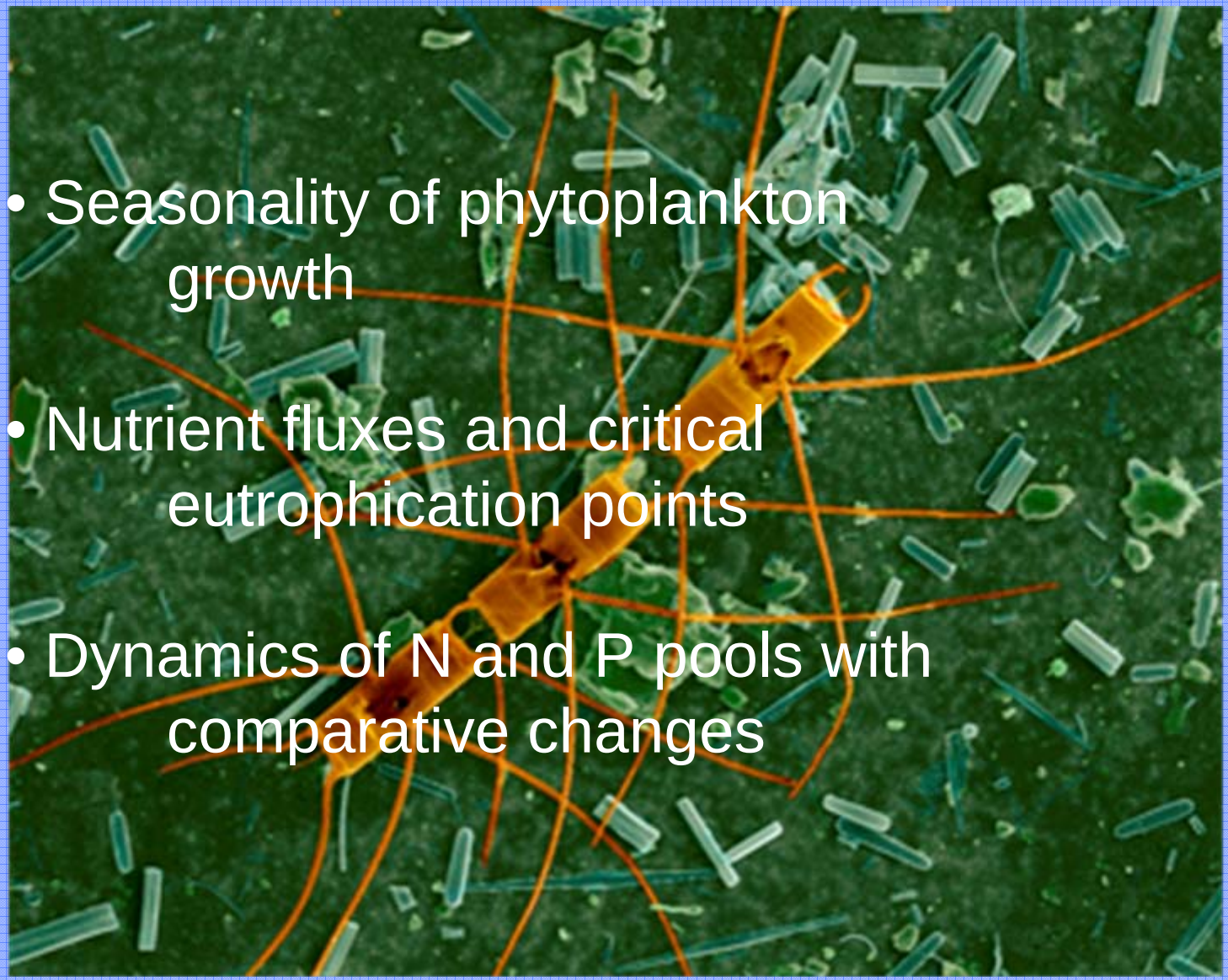
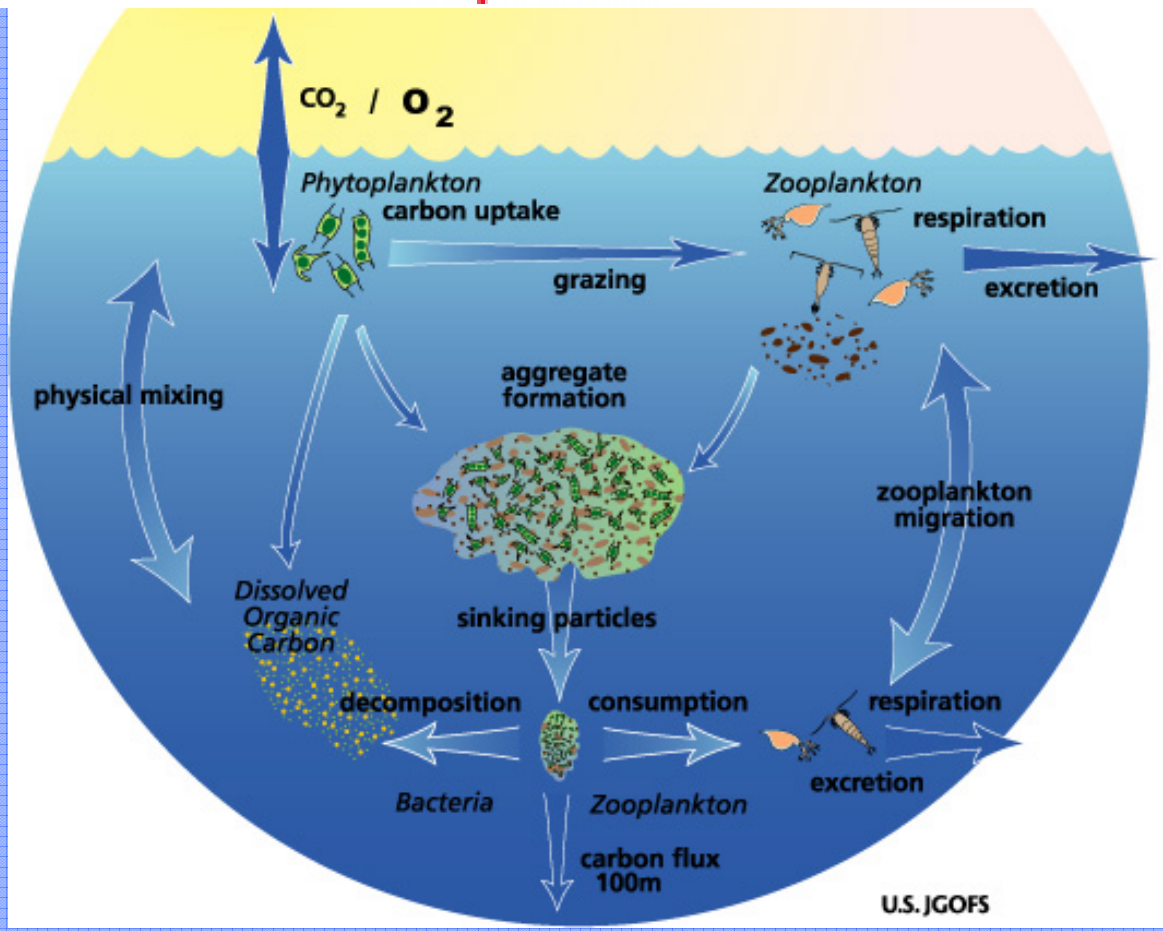
Issues:



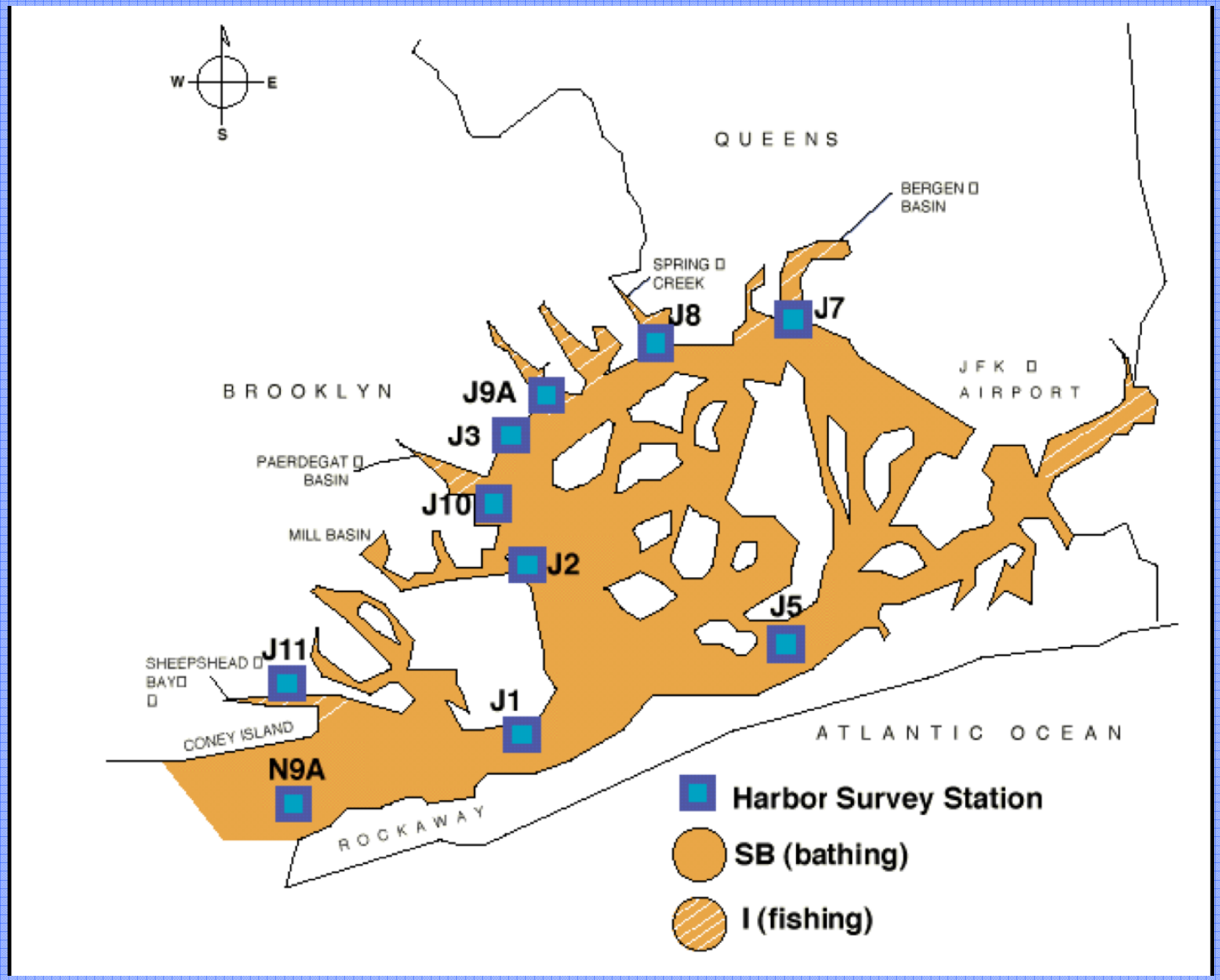
- Seasonality of phytoplankton growth
- Nutrient fluxes and critical eutrophication points
- Dynamics of N and P pools with comparative changes

The carbon pump

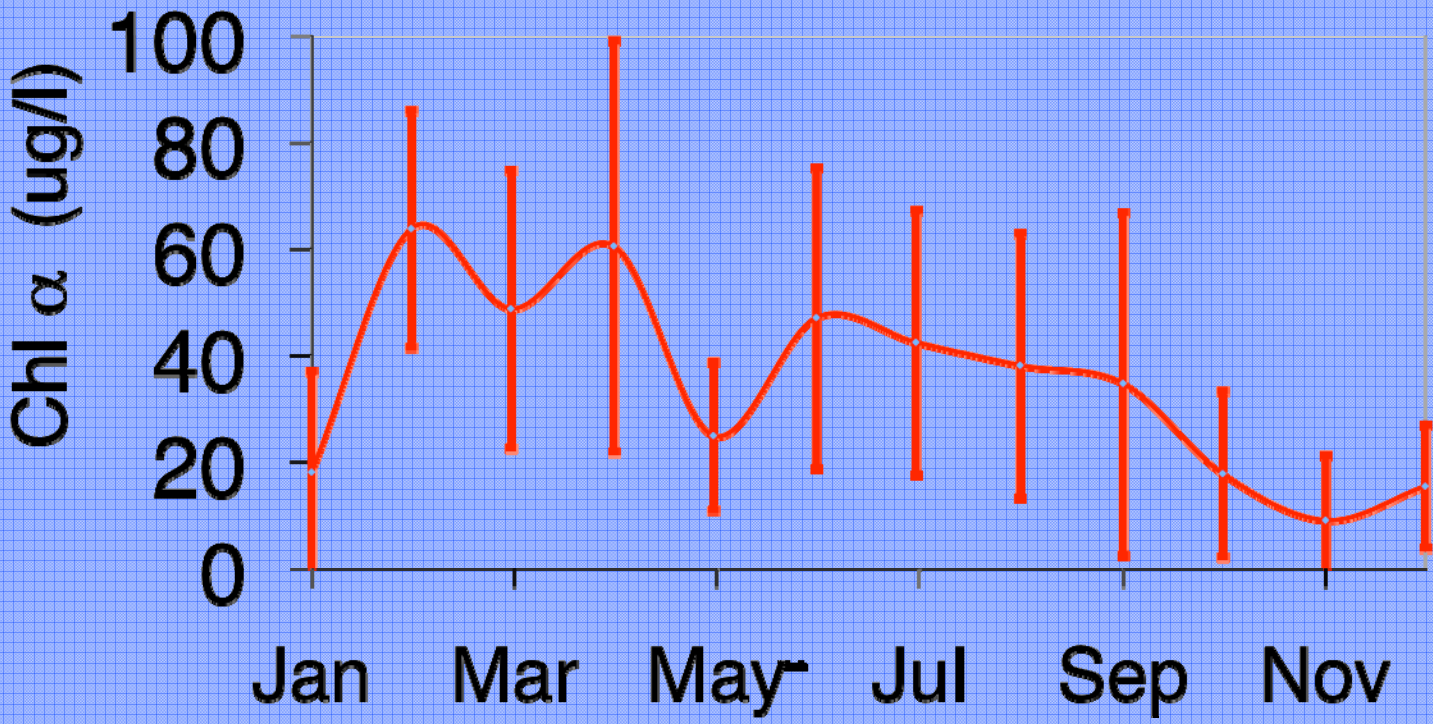
$$106CO_2 + 16NO_3 + 1PO_4 \underset{\text{respiration}}{\overset{\text{photosynthesis}}{\rightleftharpoons}} 106C16N1P + 132O_2$$

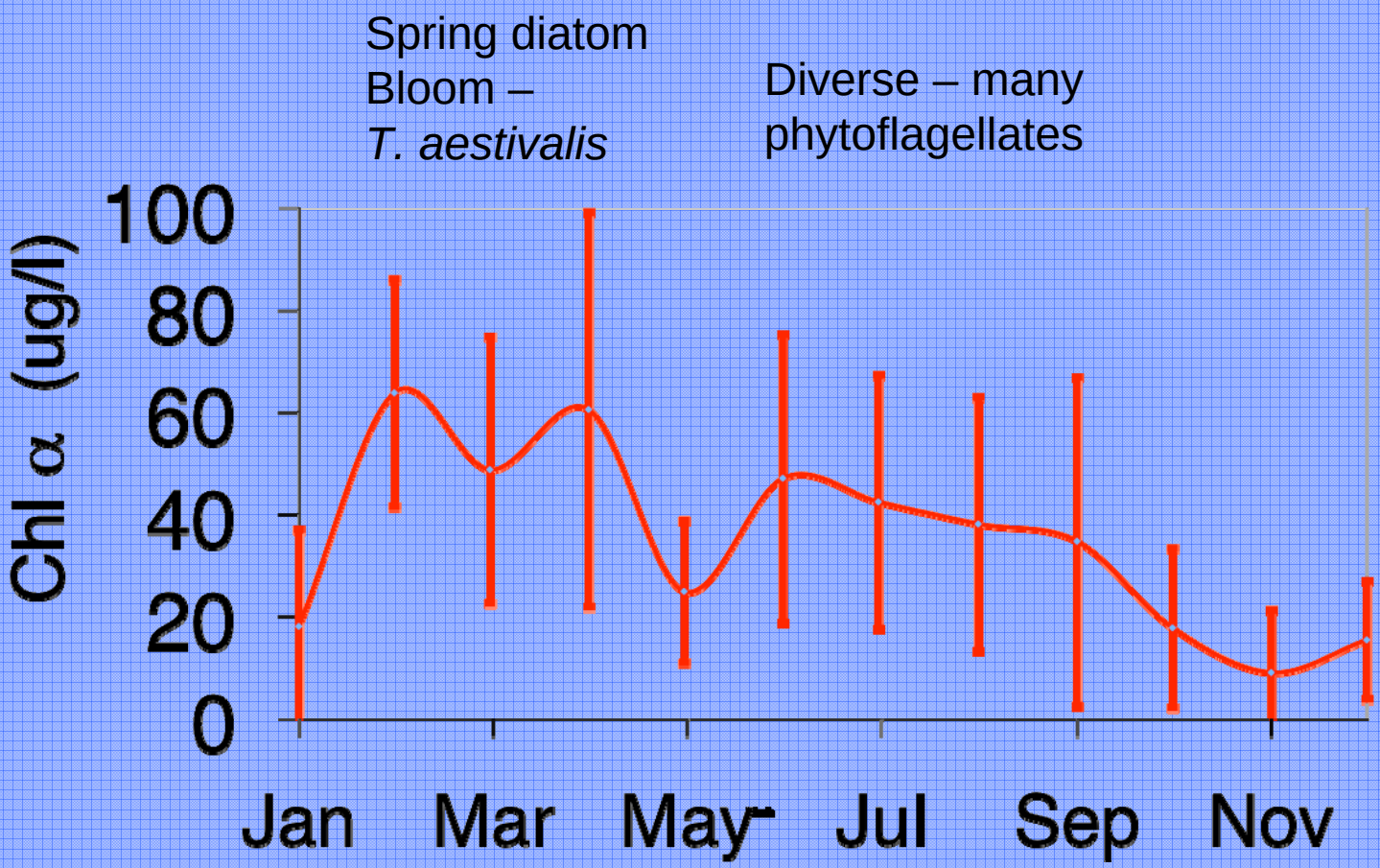


NYCDEP sampling sites used for nutrient analysis; 1990-1999

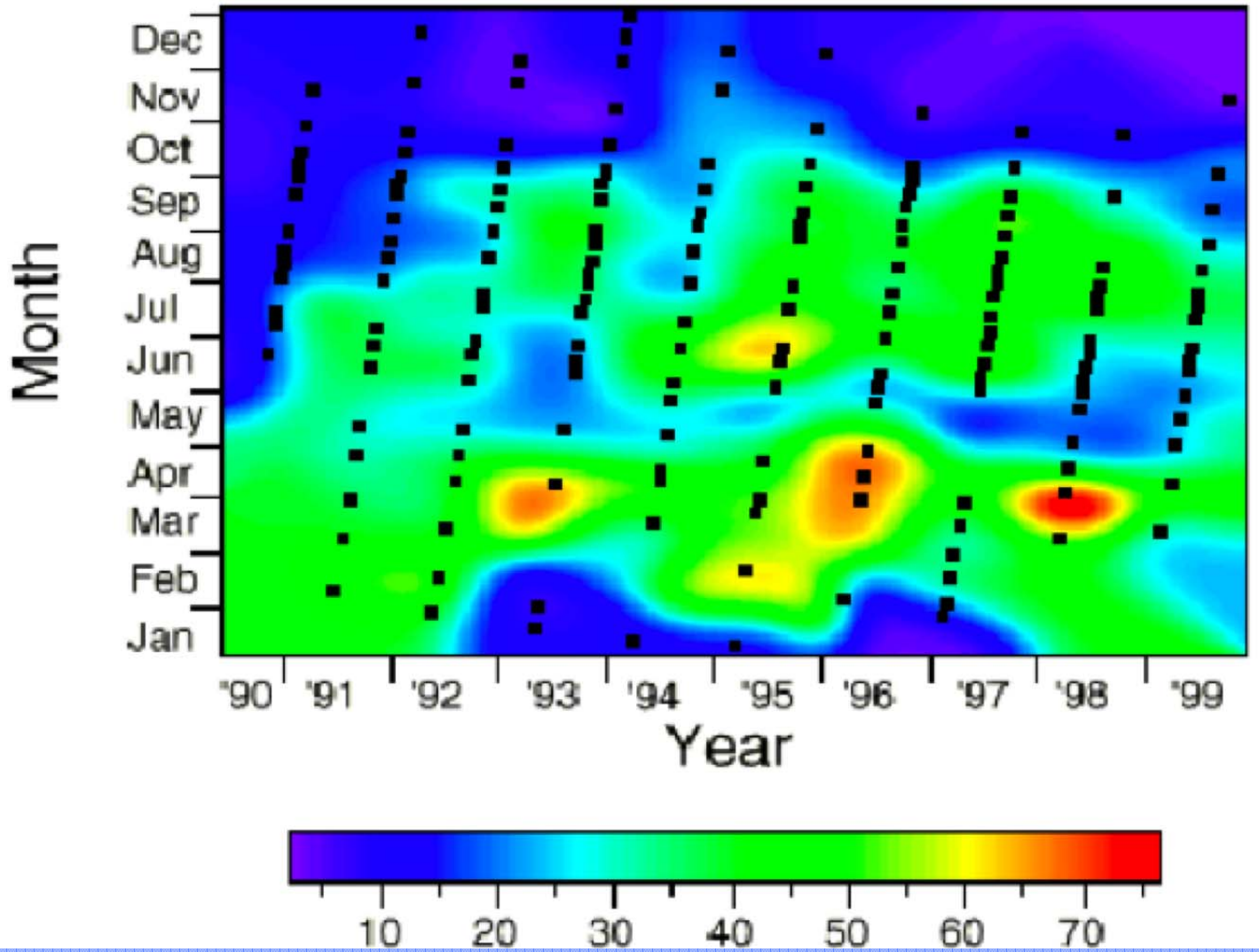


Average monthly Chl a levels, all stations

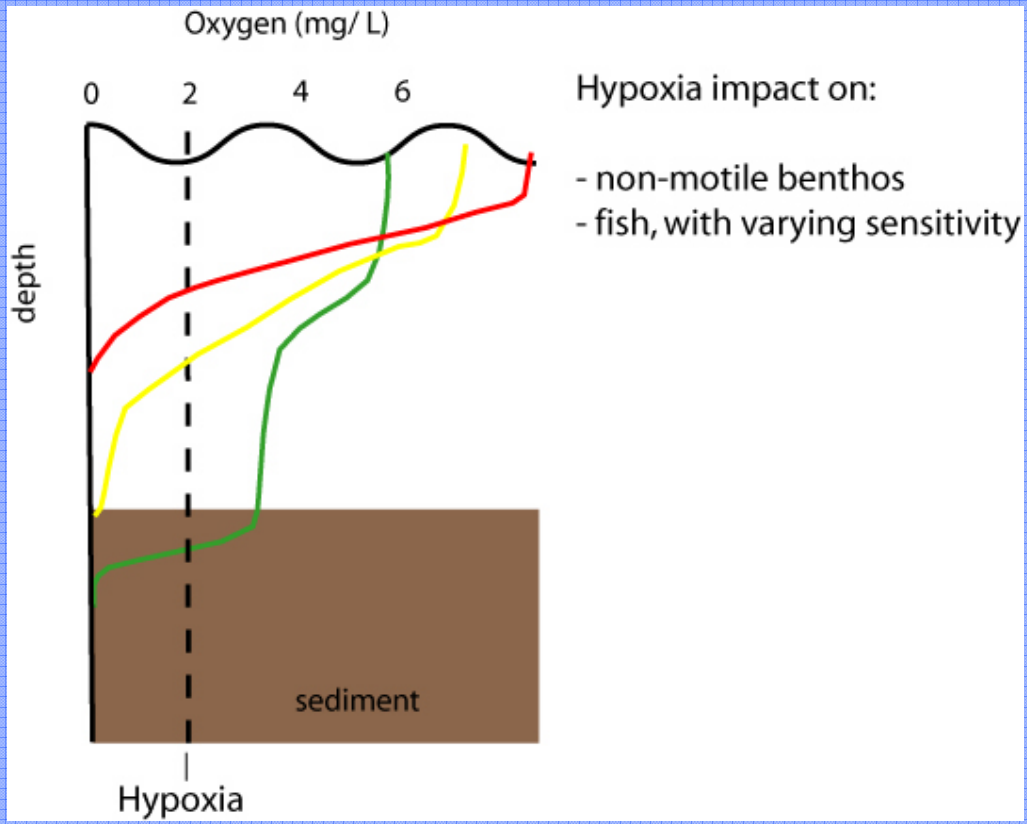



Spring diatom
Bloom –
T. aestivalis
Diverse – many
phytoflagellates
Chl α (ug/l)
100
80
60
40
20
0
Jan
Mar
May
Jul
Sep
Nov

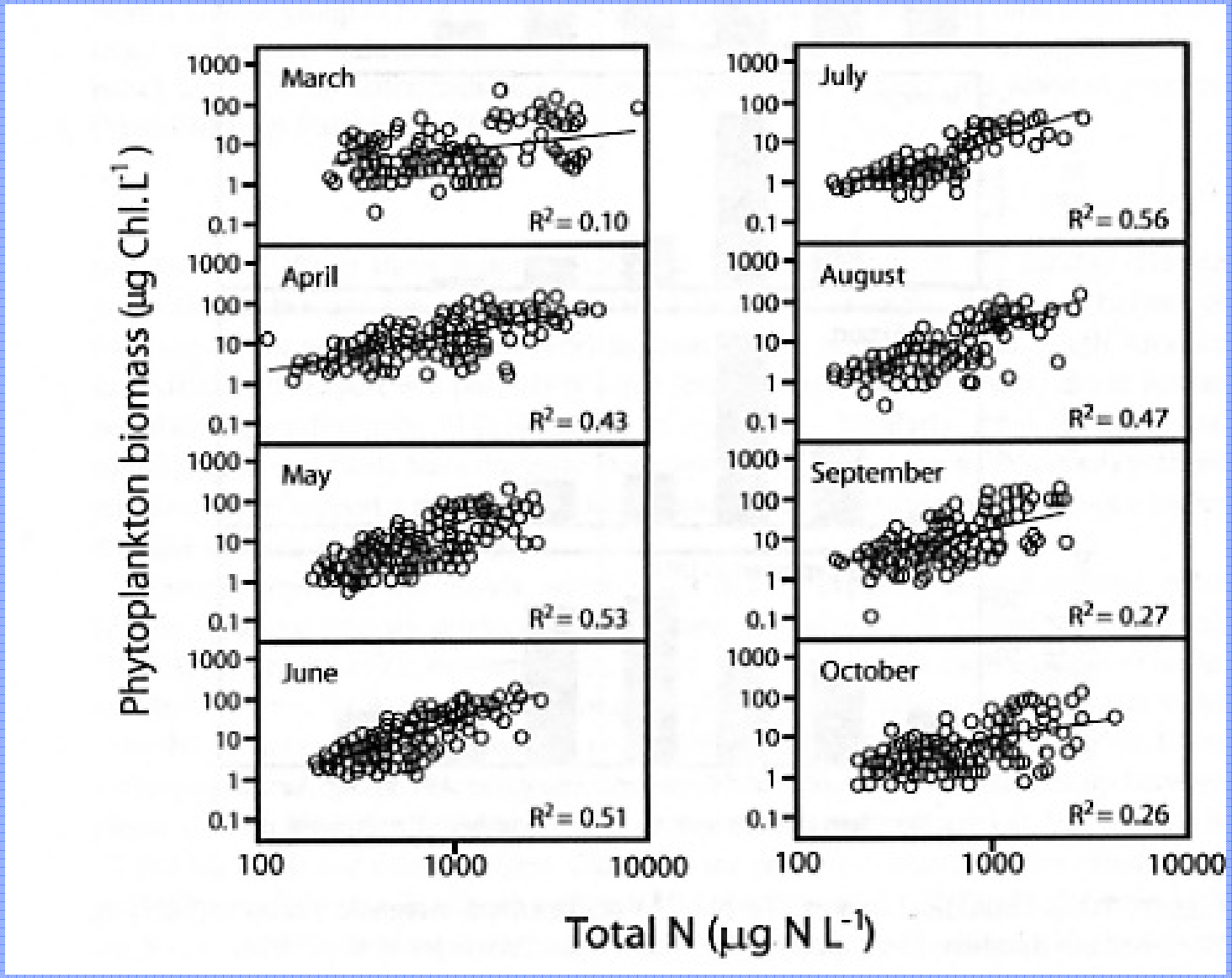
Trend in Jamaica Bay Chl *a* 1990-99 (ug/L)



Continual oxygen demand by sediments

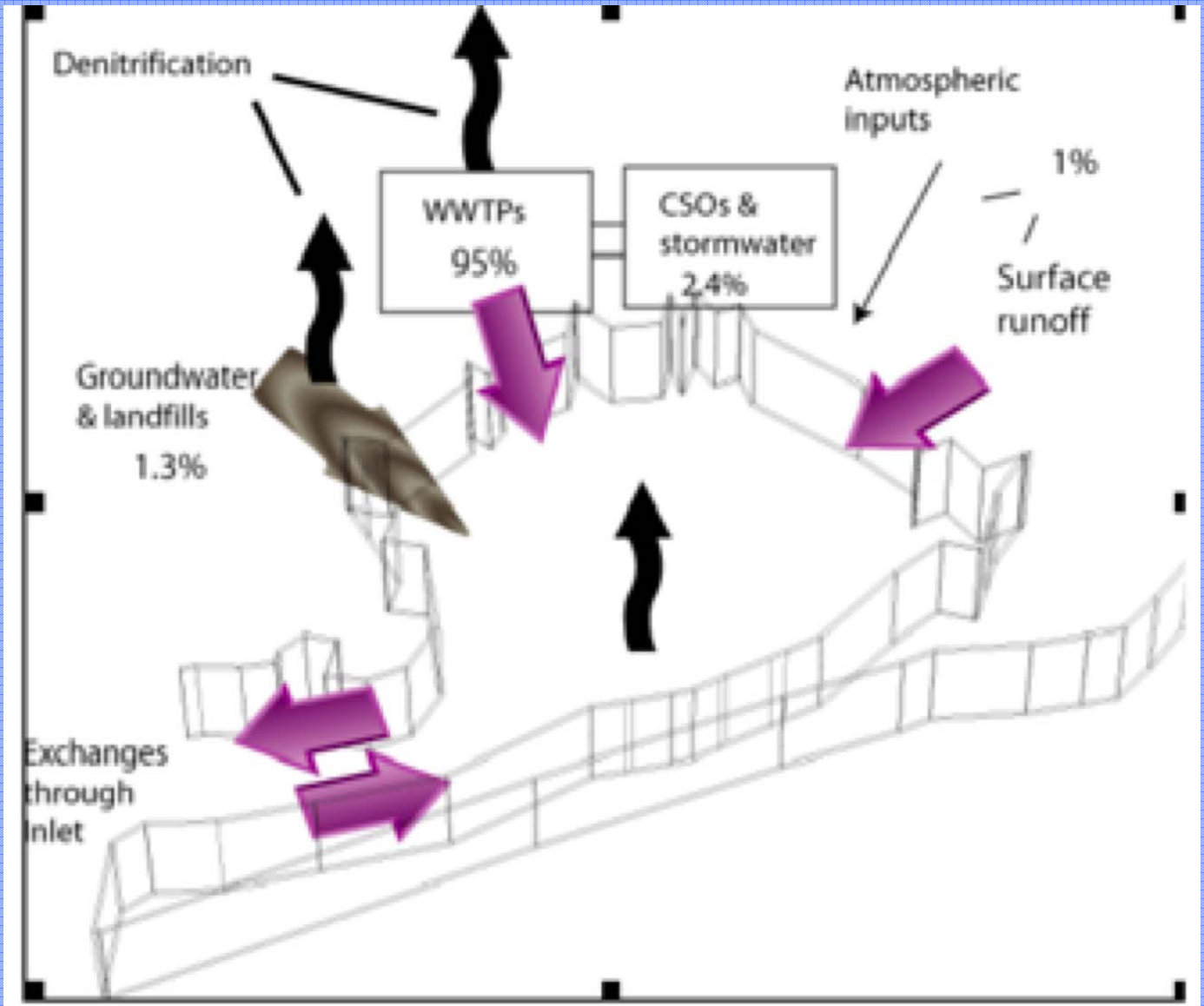


Strong correlation of phytoplankton biomass with nutrient levels

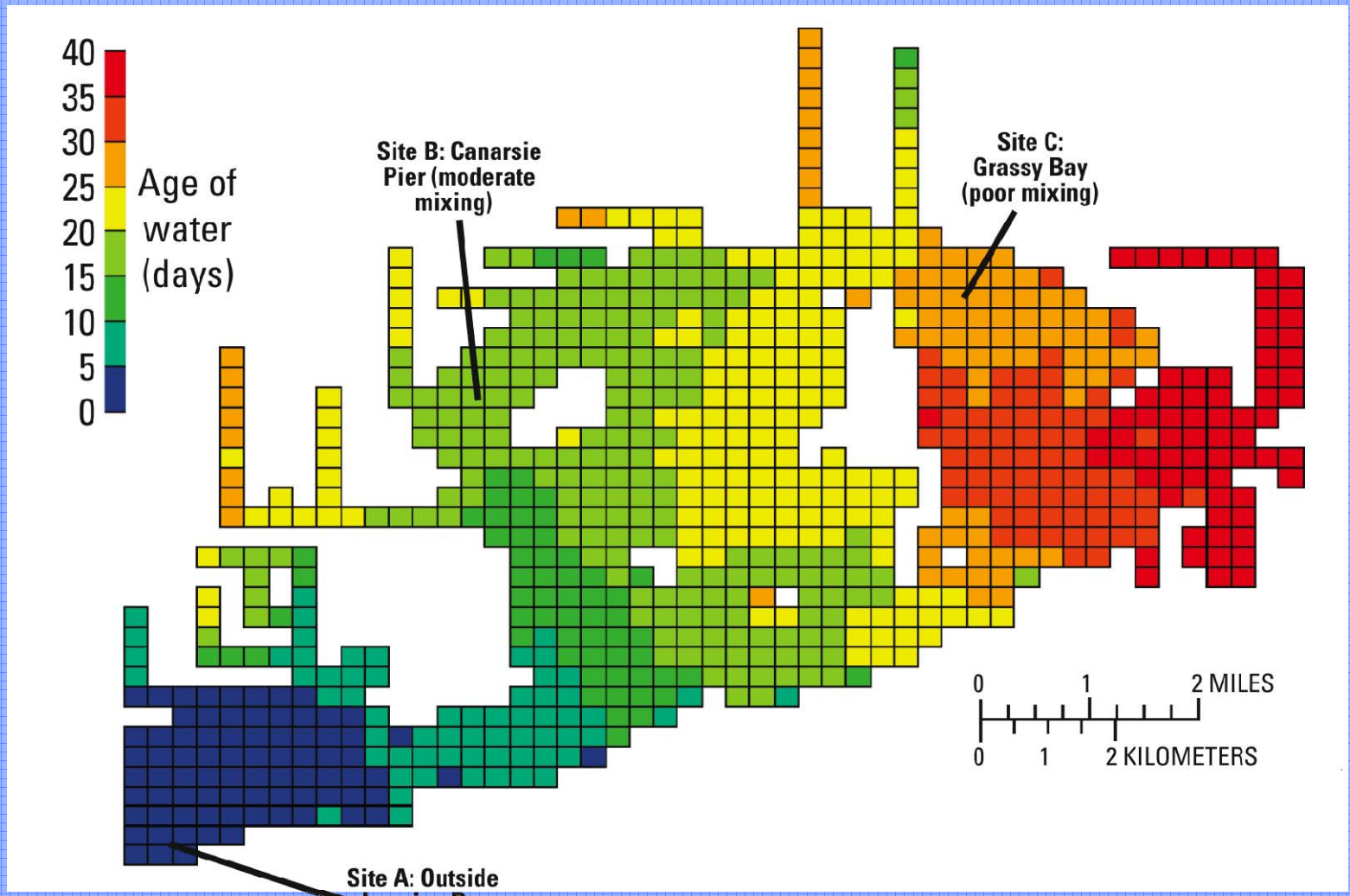


Nixon et al., 2002

N pathways and approximate fluxes
(O'Brien and Gere, 2002)

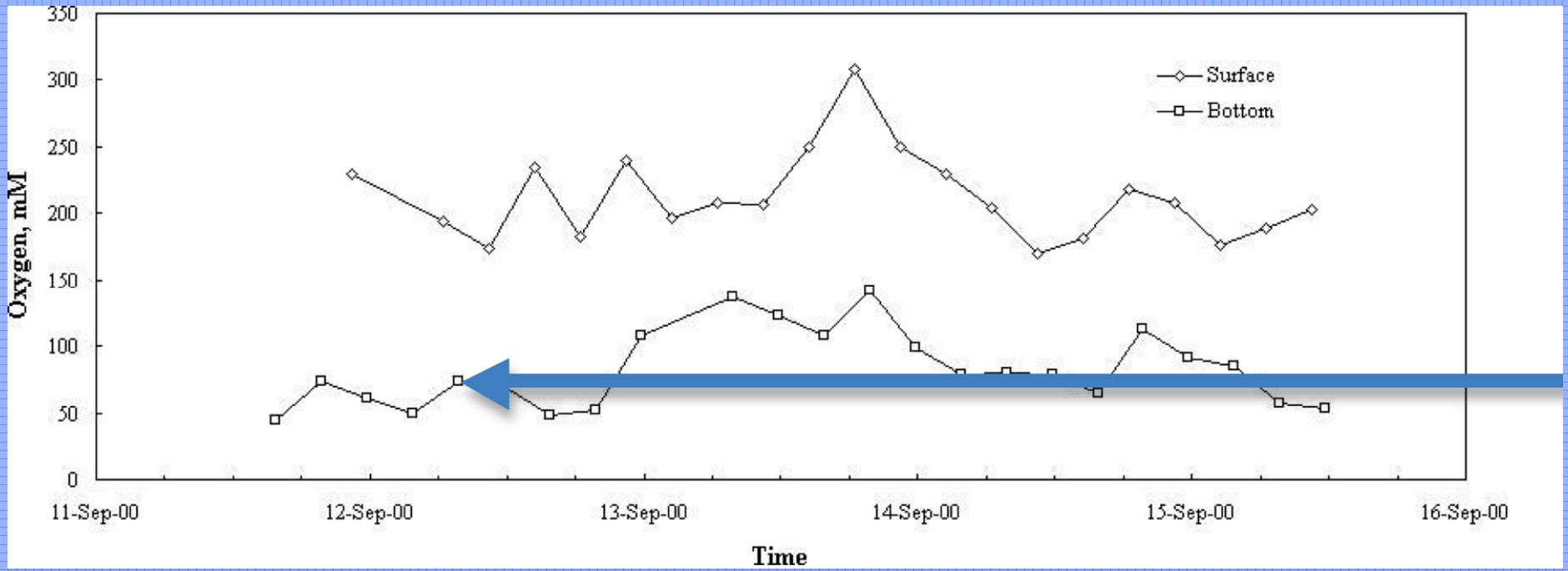


Flushing rates decrease in east

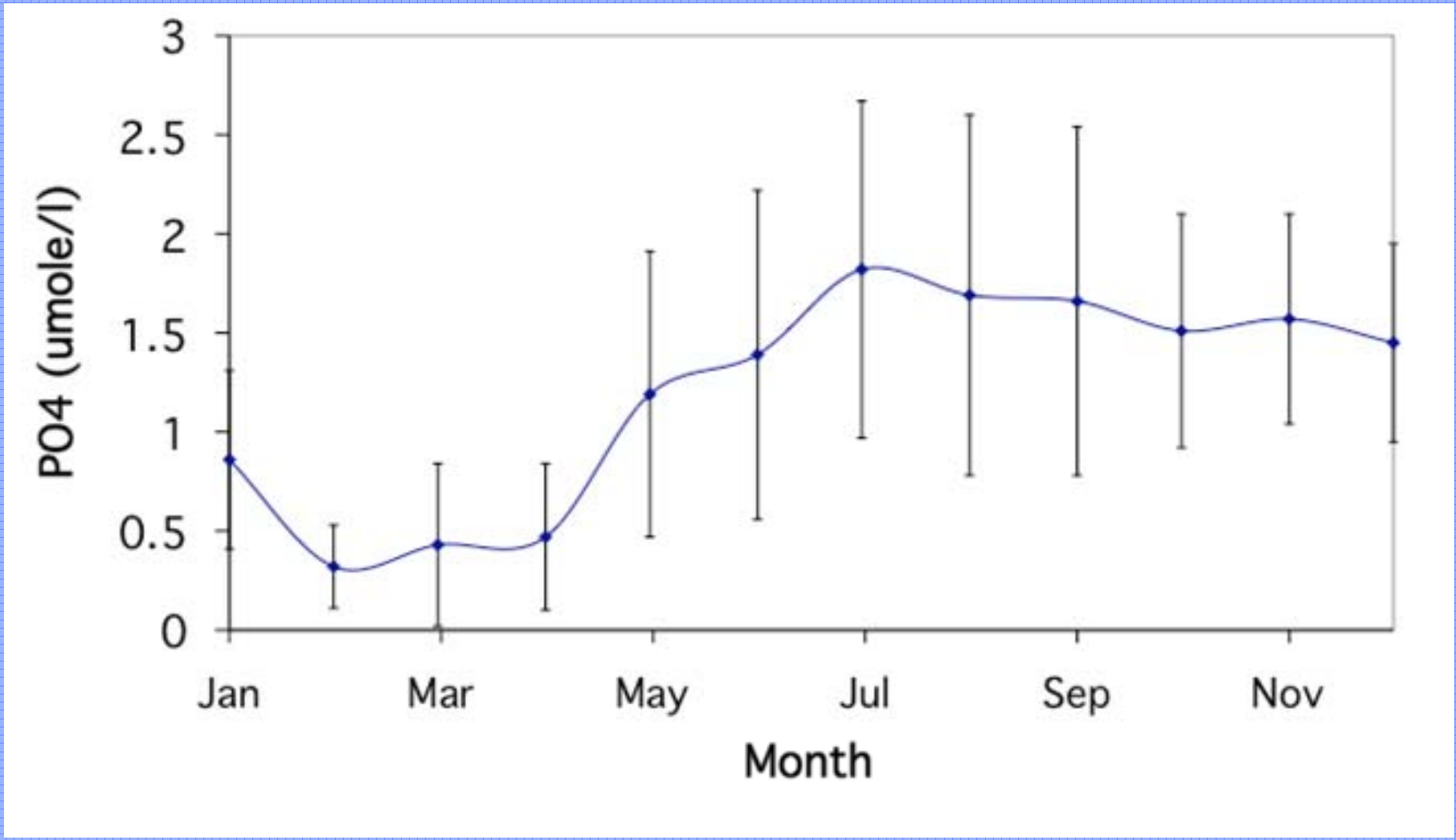


From Benotti, Abbene, and Terracciano, 2007 based on HydroQual model

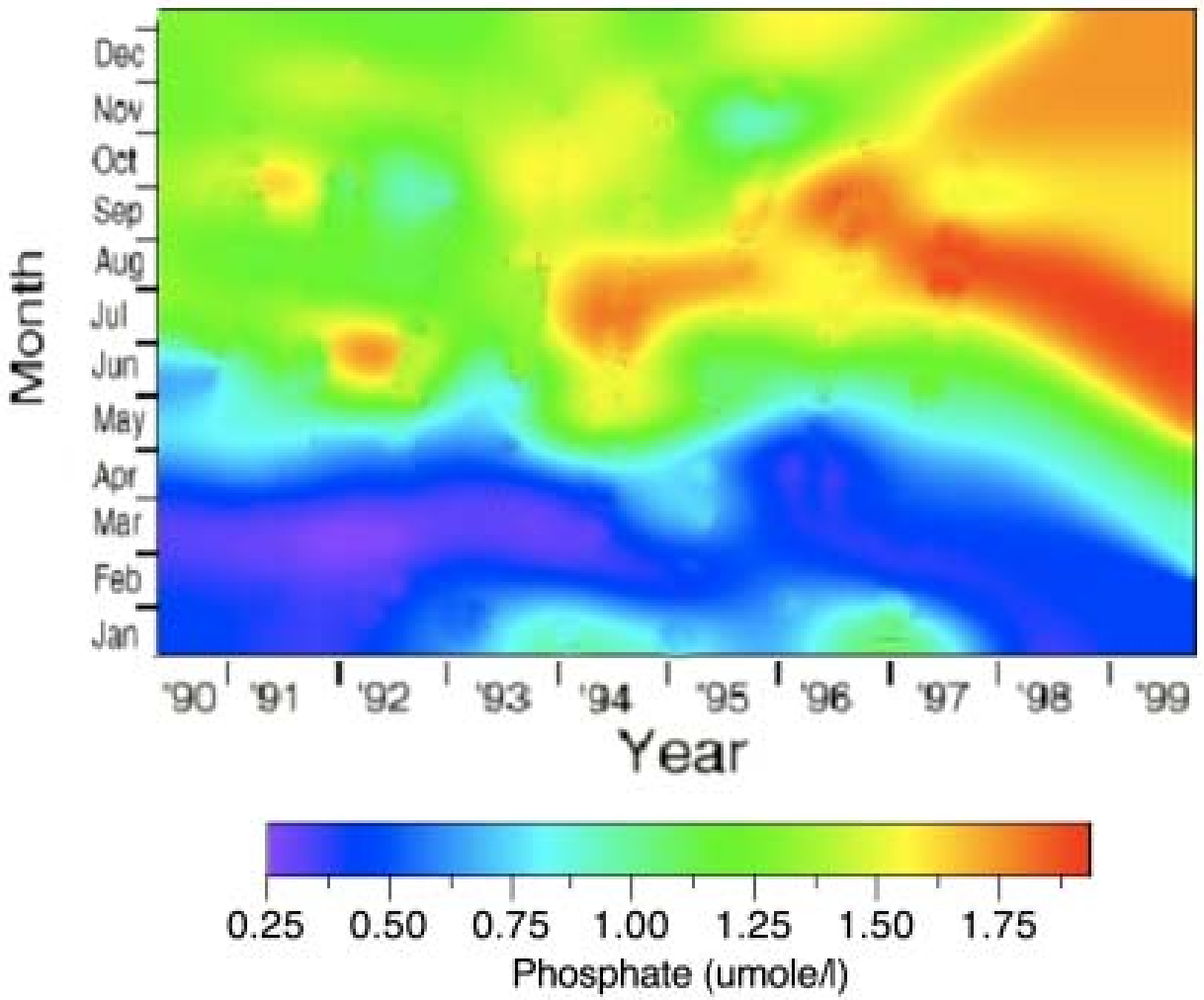
September oxygen levels in Grassy Bay



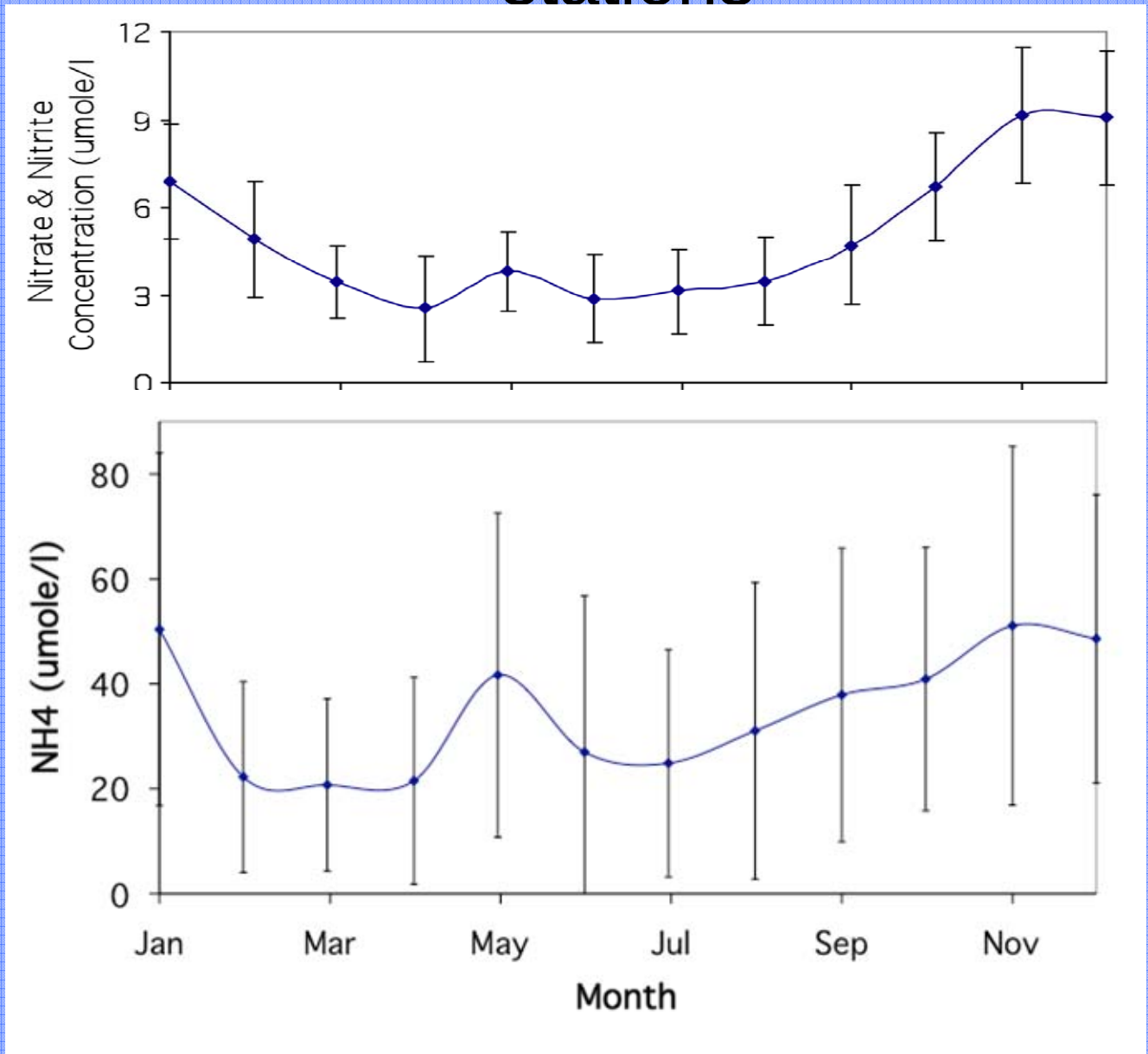
Average phosphate levels, all stations



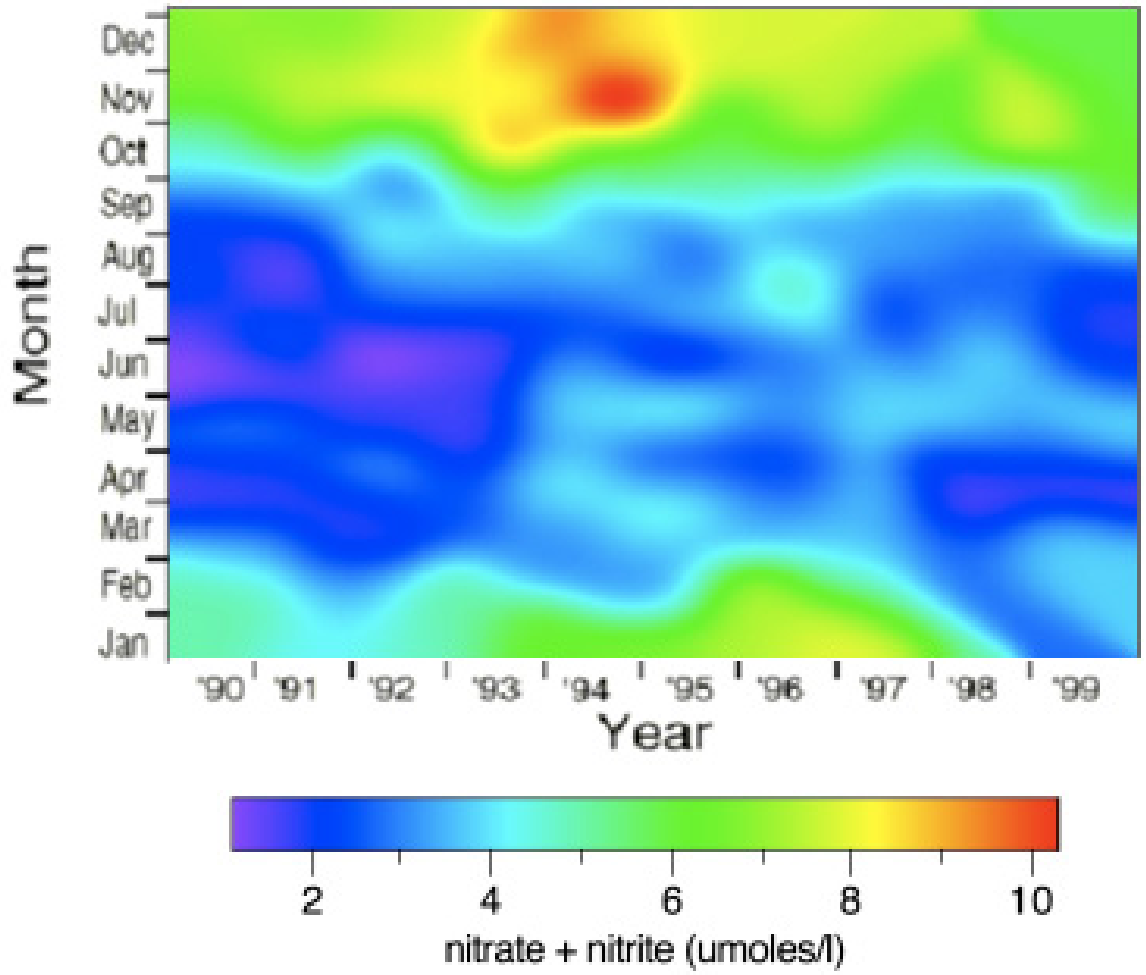
Trend in Jamaica Bay surface phosphate 1990-99 (μM)



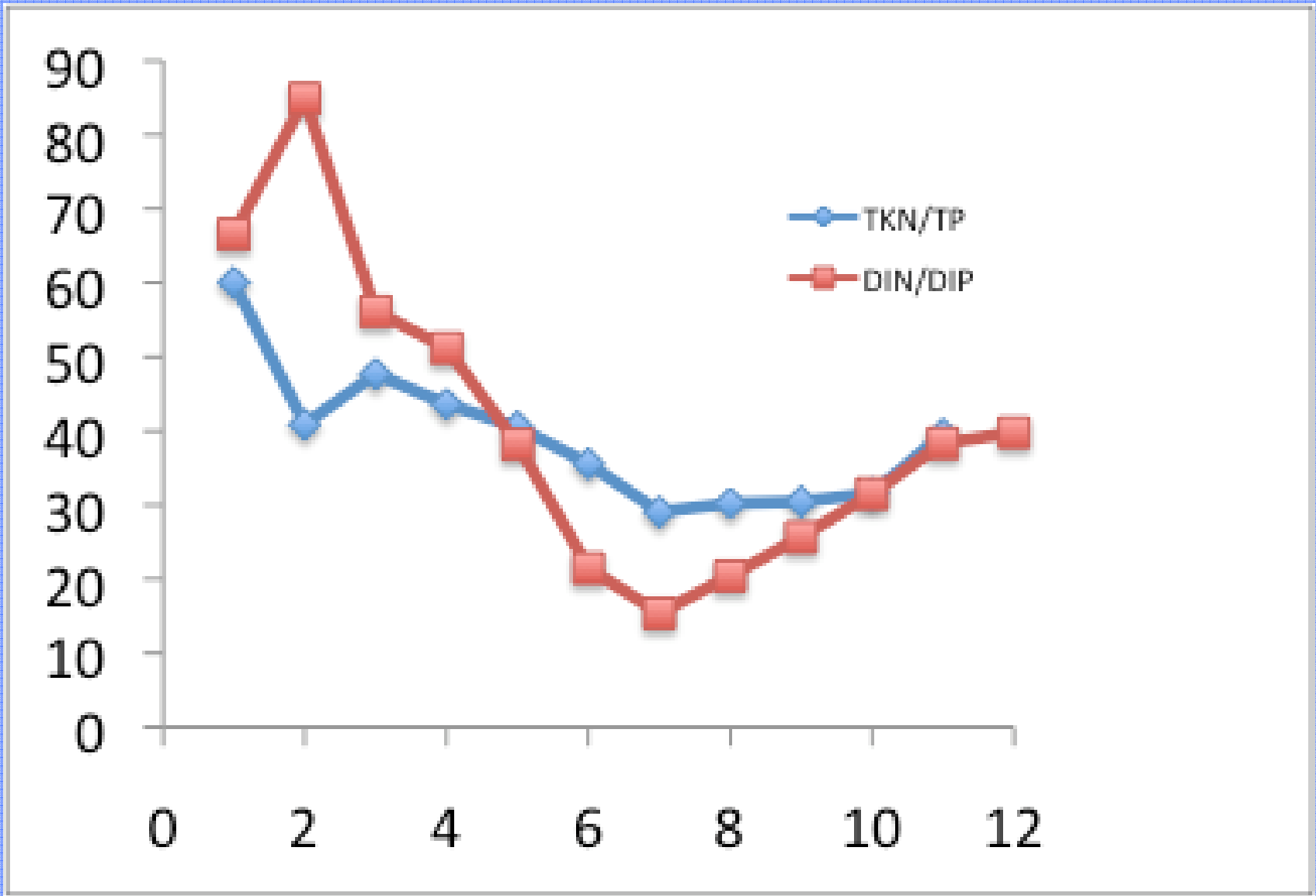
Average N + N and ammonium levels, all stations



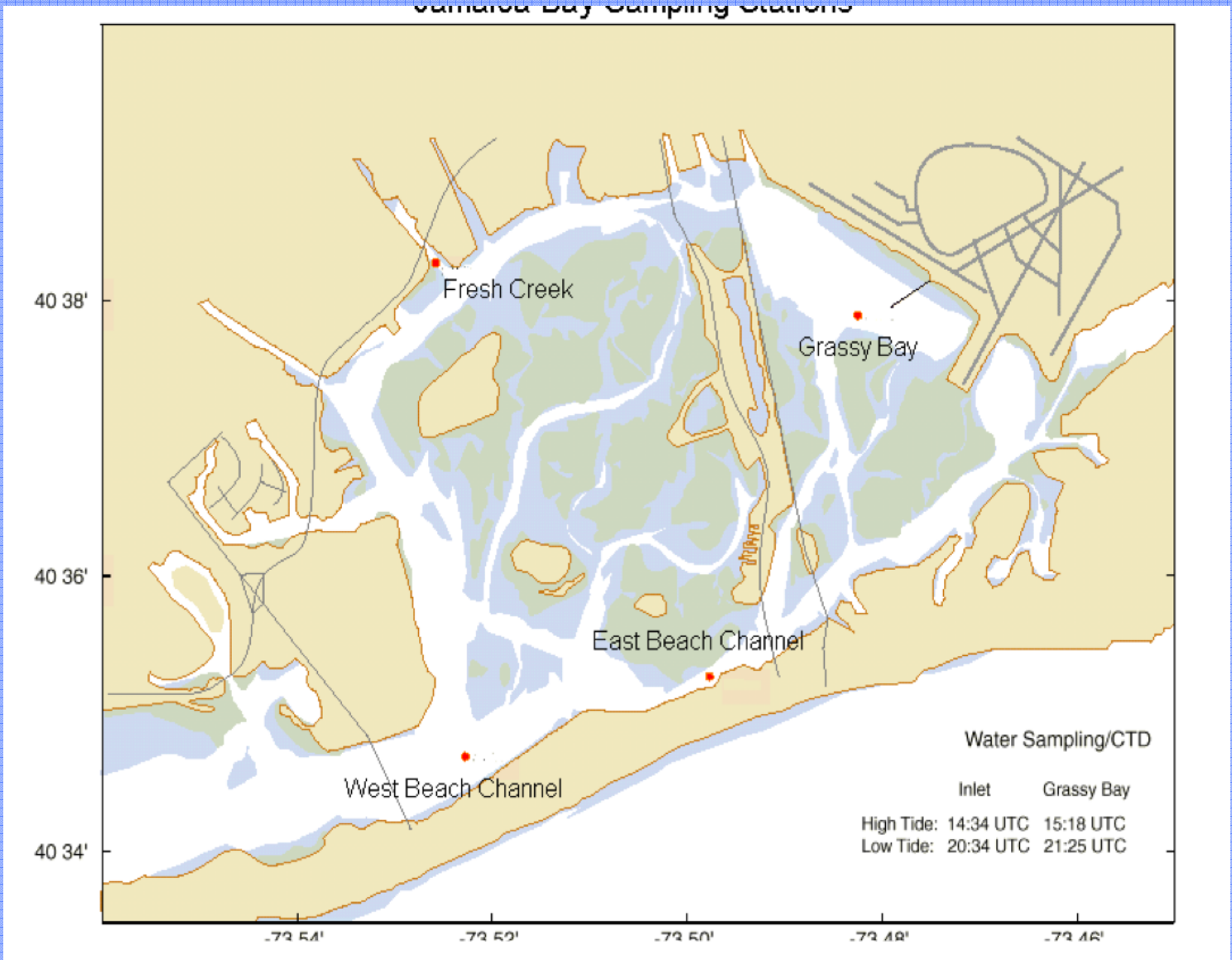
Trend in Jamaica Bay surface nitrate + nitrite 1990-99 (μM)

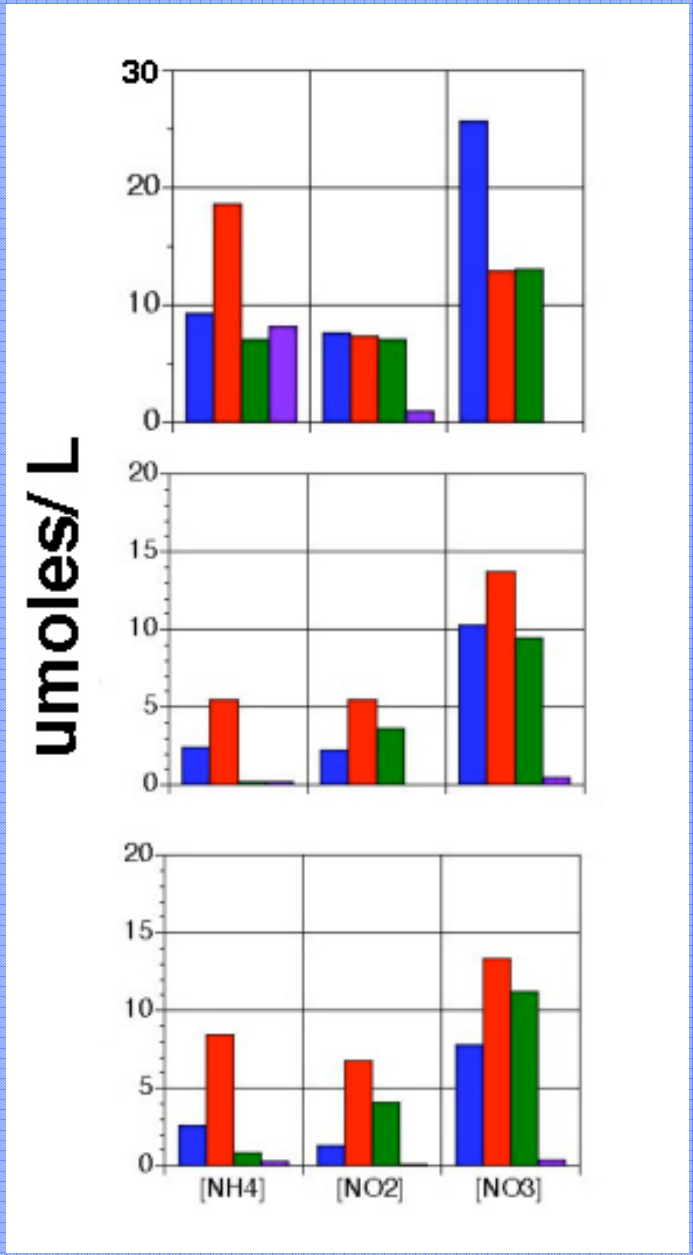


Nutrient ratios suggest Bay is rarely N limited



Sampling sites for N characterization



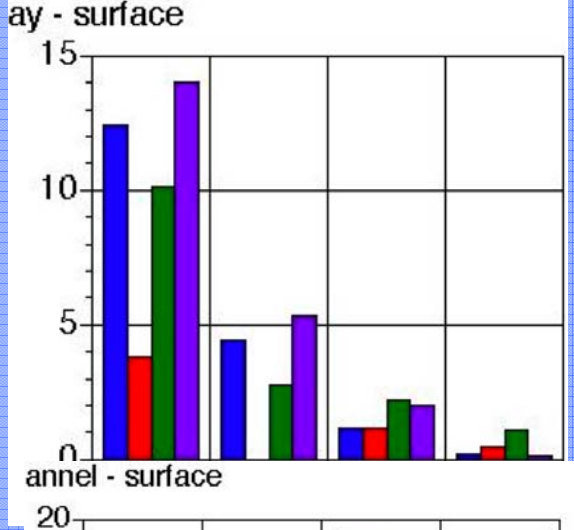


Grassy Bay

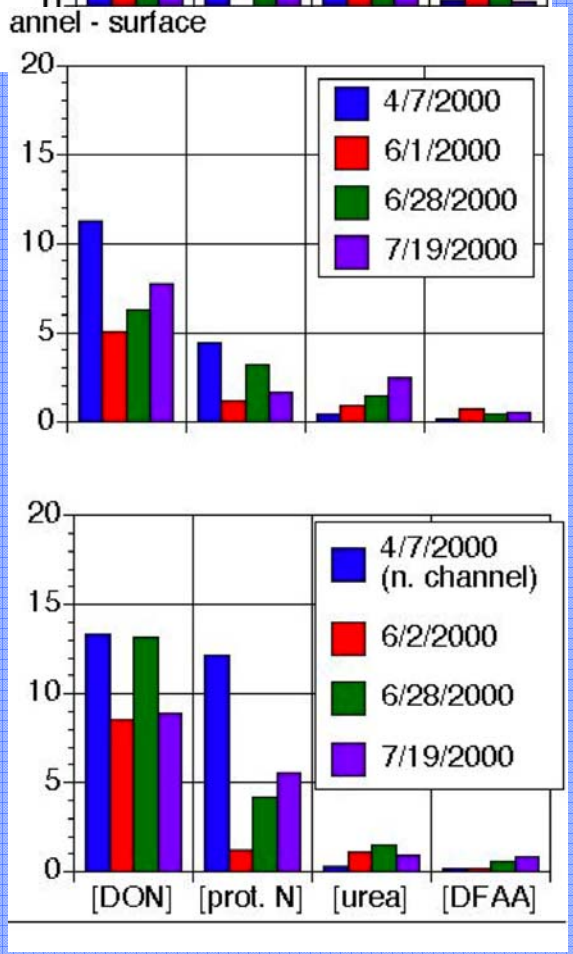
West Beach Channel

Fresh Creek/ North Channel

4/7/2000
6/2/2000
6/28/2000
7/19/2000

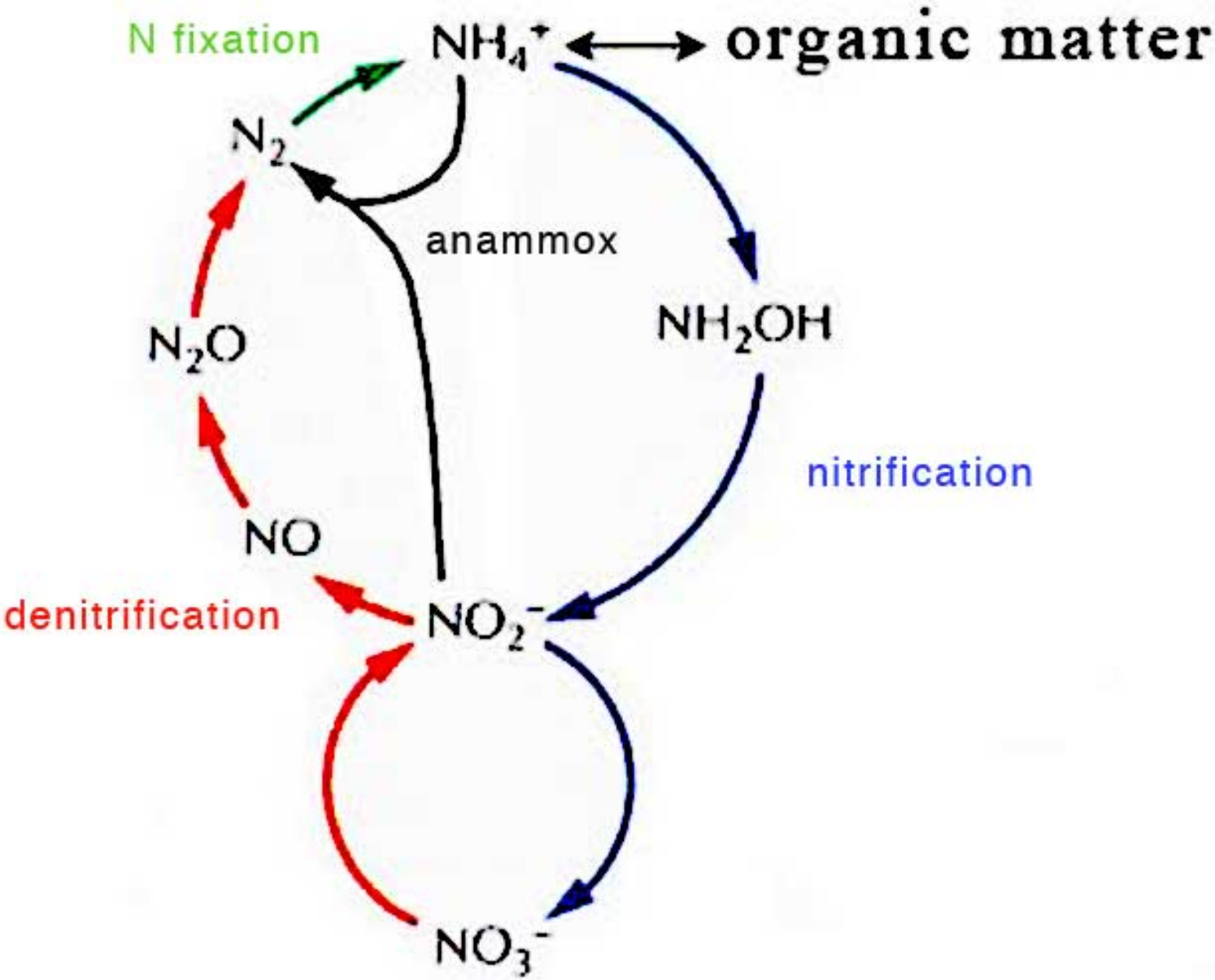


Grassy Bay

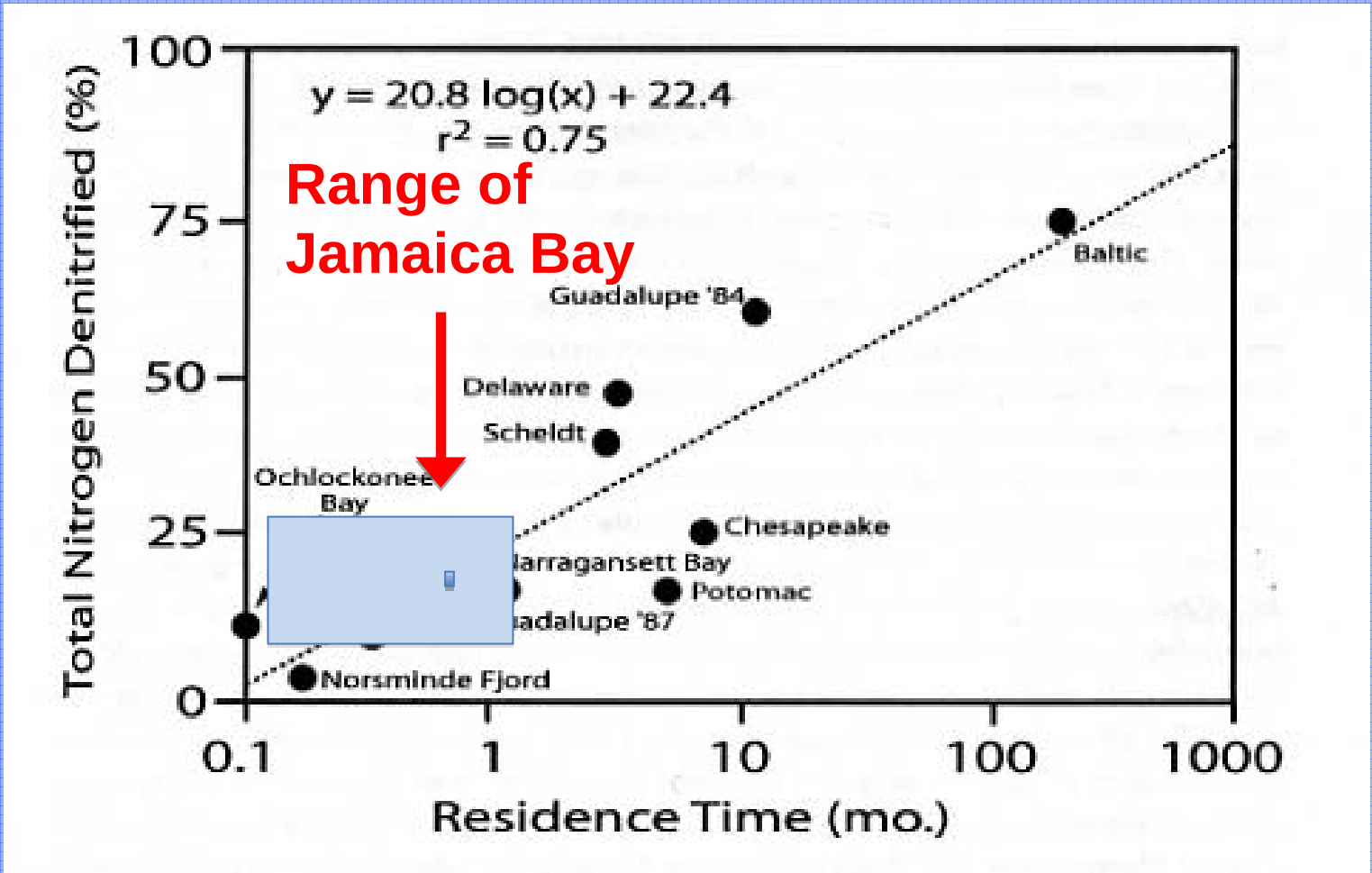


West Beach Channel

Fresh Creek/ North Channel


N fixation
NH_4^+
organic matter
N_2
anammox
N_2O
NH_2OH
nitrification
NO
denitrification
NO_2^-
NO_3^-

Residence time primary factor determining how much N is removed by local denitrification



Modified from Nixon et al., 1996

Summary

- Jamaica Bay is characterized by two major phytoplankton production periods, a hyper-eutrophic spring diatom bloom and an extensive summer bloom of phytoflagellates.

The spring diatom bloom is not as great a threat to Bay oxygen levels as is the summer mixed bloom because the spring bloom takes place in colder, more oxygen rich water.

- Denitrification likely plays a minor role in reducing Bay N.

- N typically is present in excess with respect to P, particularly when the dissolved organic pools are included.

- At least 50% of the dissolved organic N pools is composed of easily degradable compounds.

- There was an overall increase in both DIN and DIP levels in the Bay starting in the mid-1990s, associated with slightly greater chlorophyll levels.