OECOS – East: A study that should still be done!

Processes in HNLC Ecosystems

Remaining Unexplained

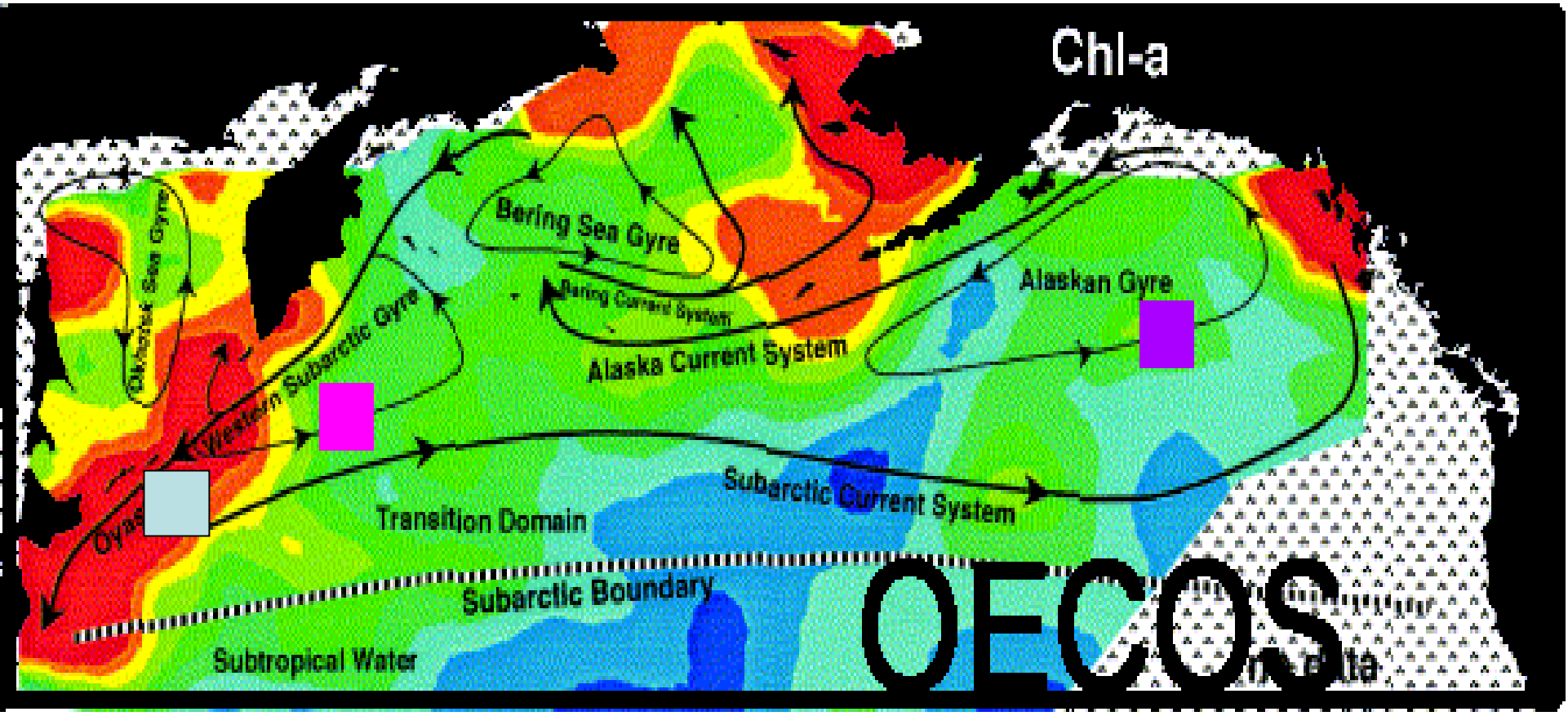
Charles Miller (Oregon State Univ.)

and many others

OECOS-East is (was?)

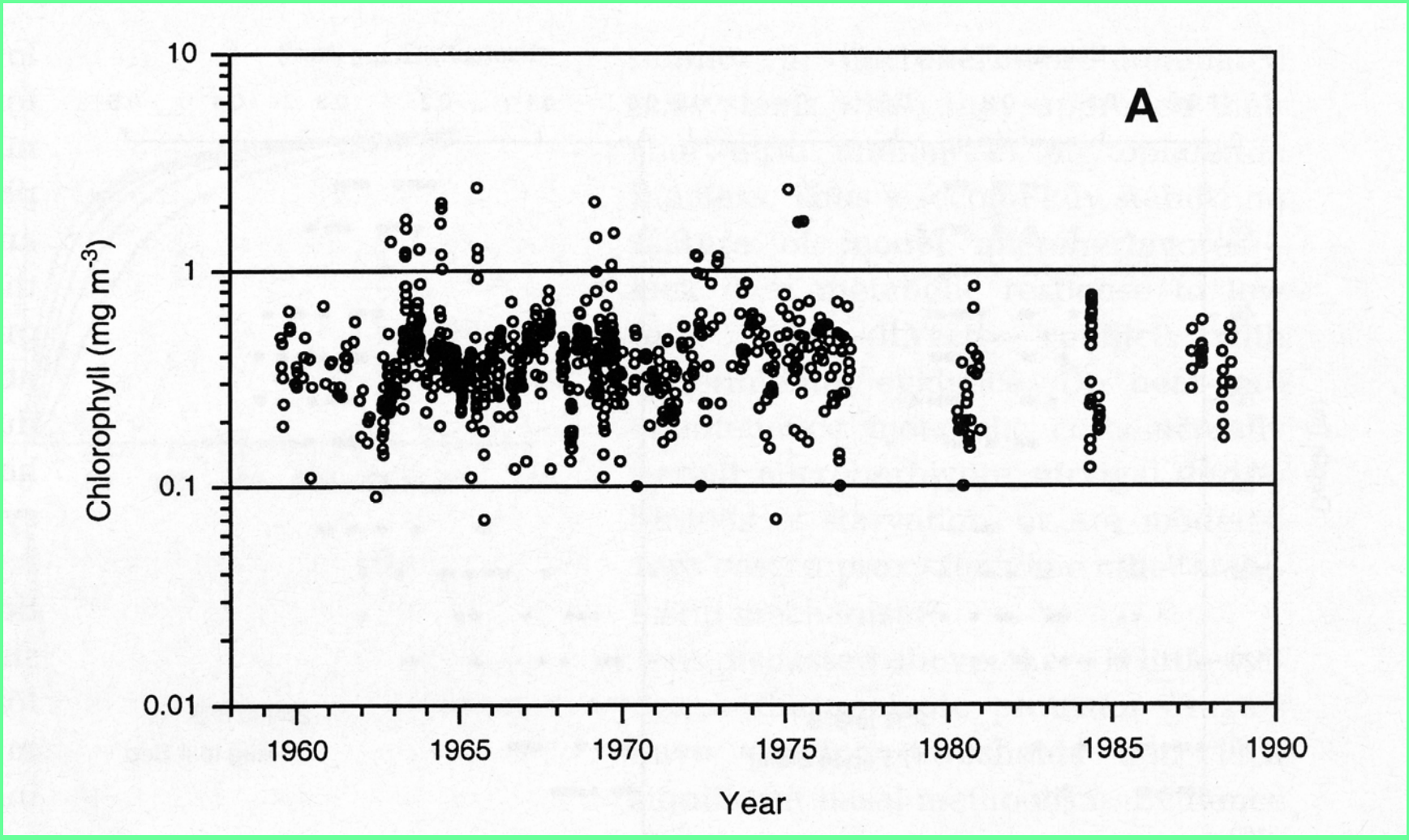
- Harold Batchelder - Models
- Zanna Chase & Jay Cullen – iron chemistry
- Timothy Cowles – water column structure
- Michael Dagg – Mesozooplankton grazing
- Deana Erdner – phytoplankton iron physiology
- Moira Galbraith & David Mackas – mesozooplankton abundance
- Charles Miller – copepod growth rates
- Karen Selph – flow cytometric and microscopic phytoplankton systematics
- Suzanne Strom – microzooplankton grazing
- Peter Strutton – *in situ* instrumentation (drifters)
- Nicholas Welschmeyer – primary production

Program Logo



A* PICES *Program

The issue in 1980's work in the subarctic Pacific:



What holds phytoplankton stocks within narrow limits?

Why are macronutrients never depleted?

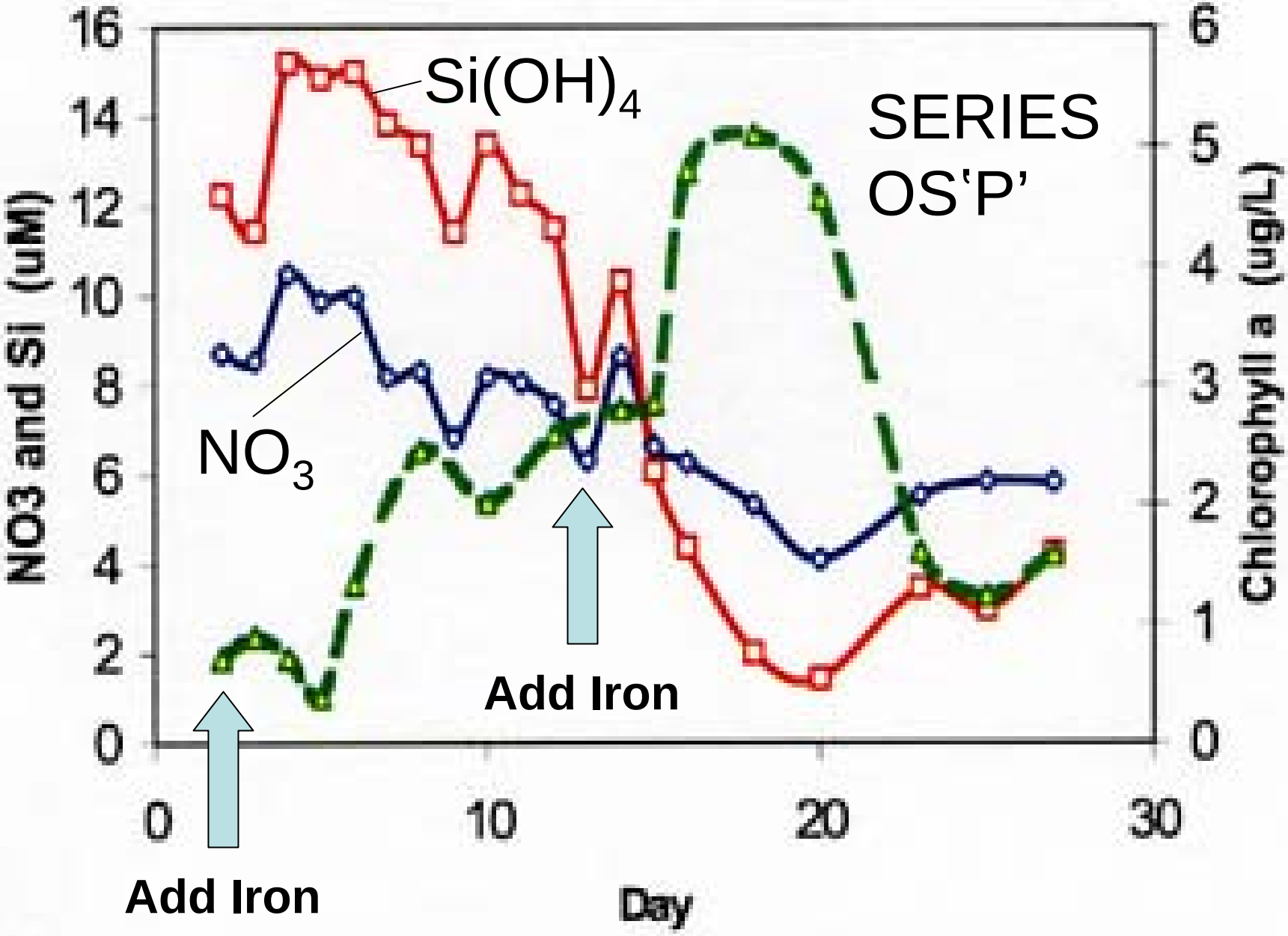
A partial answer: IRON LIMITATION

Martin and Fitzwater:

Iron added to water in jugs increases algal stocks.

The PICES Seeds (Tsuda et al.) and Series (Boyd et al.) Experiments:

Adding dissolved iron directly to the ocean induces blooms, usually diatoms.


Si(OH)4
SERIES
OS'P'
NO3
Add Iron
Add Iron
NO3 and Si (uM)
Chlorophyll a (ug/L)
Day
0
2
4
6
8
10
12
14
16
0
1
2
3
4
5
6
0
10
20
30

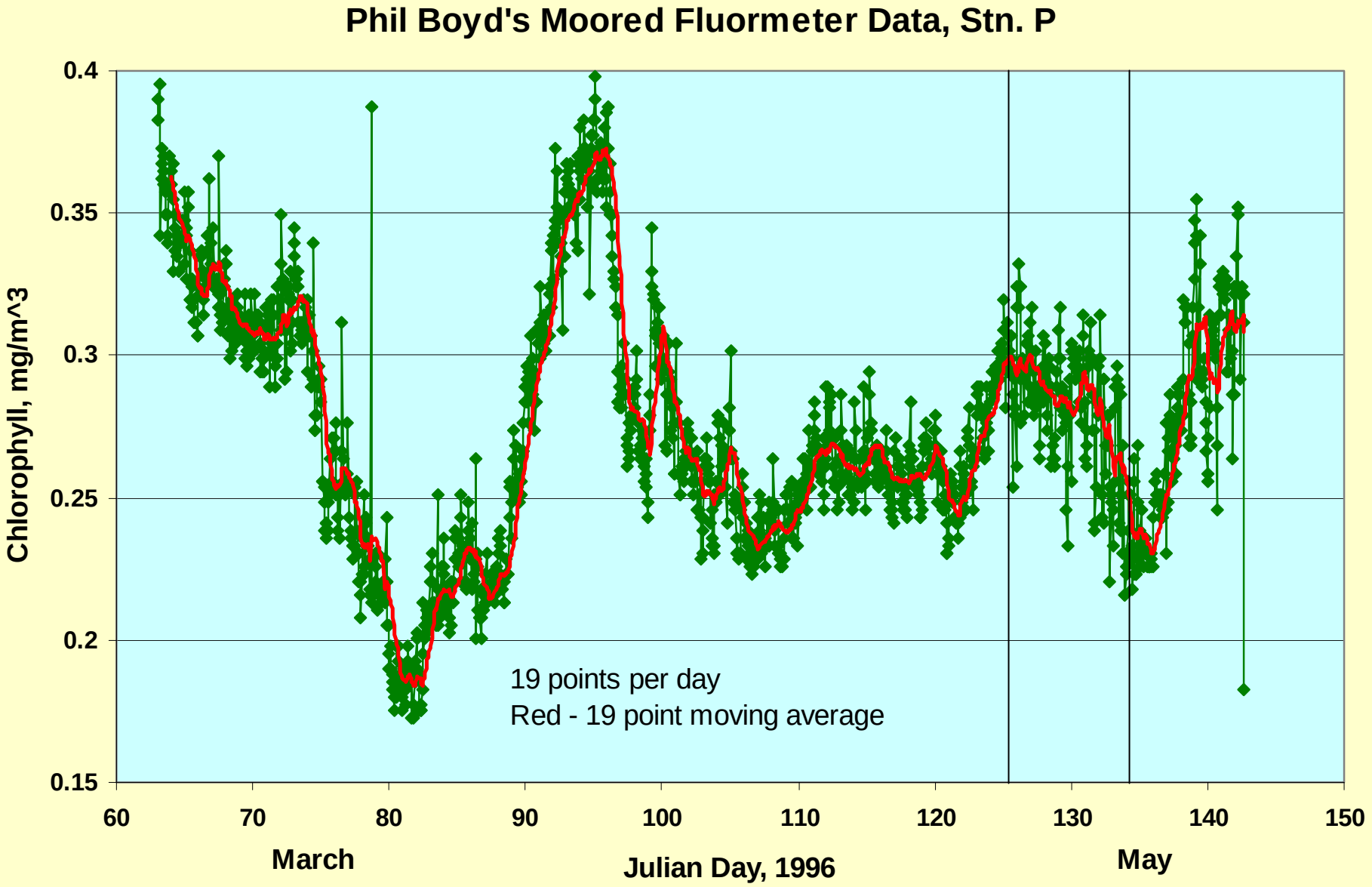
We also know that nano-phytoplankton growth is *not* limited by iron availability, that protozoan grazing almost always keeps them from increasing past

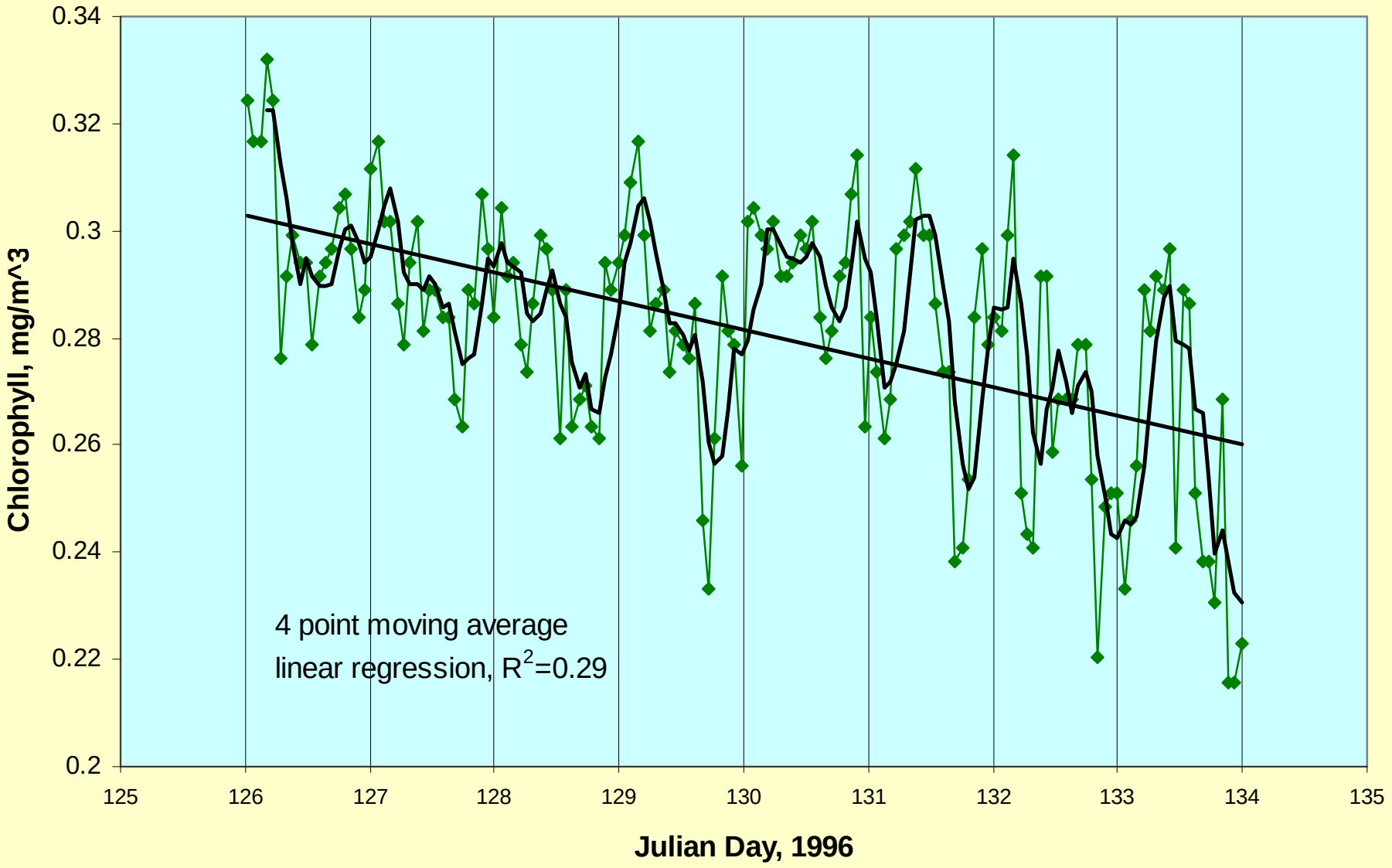
0.6 mg chl/m^3.

We do *not* know the details. How is protozoan grazing regulated? Why does protozoan grazing never remove all the nano-phytoplankton?

The OECOS-East suggestion:

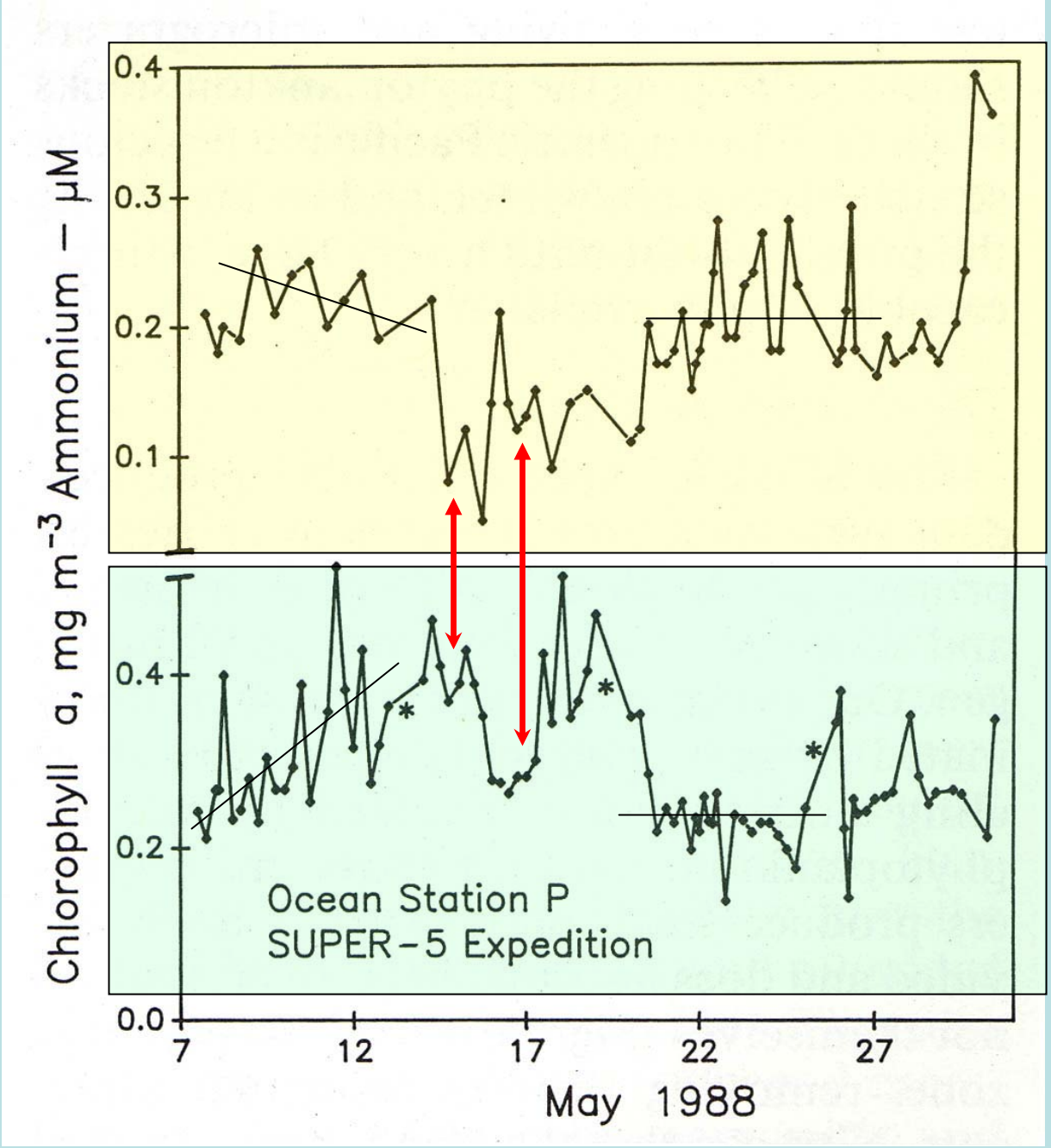
The best clues are likely to come from study of the ‘subseasonal’ variation of phytoplankton stocks:


Phil Boyd's Moored Fluormeter Data, Stn. P
Chlorophyll, mg/m^3
0.4
0.35
0.3
0.25
0.2
0.15
19 points per day
Red - 19 point moving average
60
70
80
90
100
110
120
130
140
150
March
Julian Day, 1996
May


0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
Chlorophyll, mg/m^3
125
126
127
128
129
130
131
132
133
134
135
Julian Day, 1996
4 point moving average
linear regression, R2=0.29

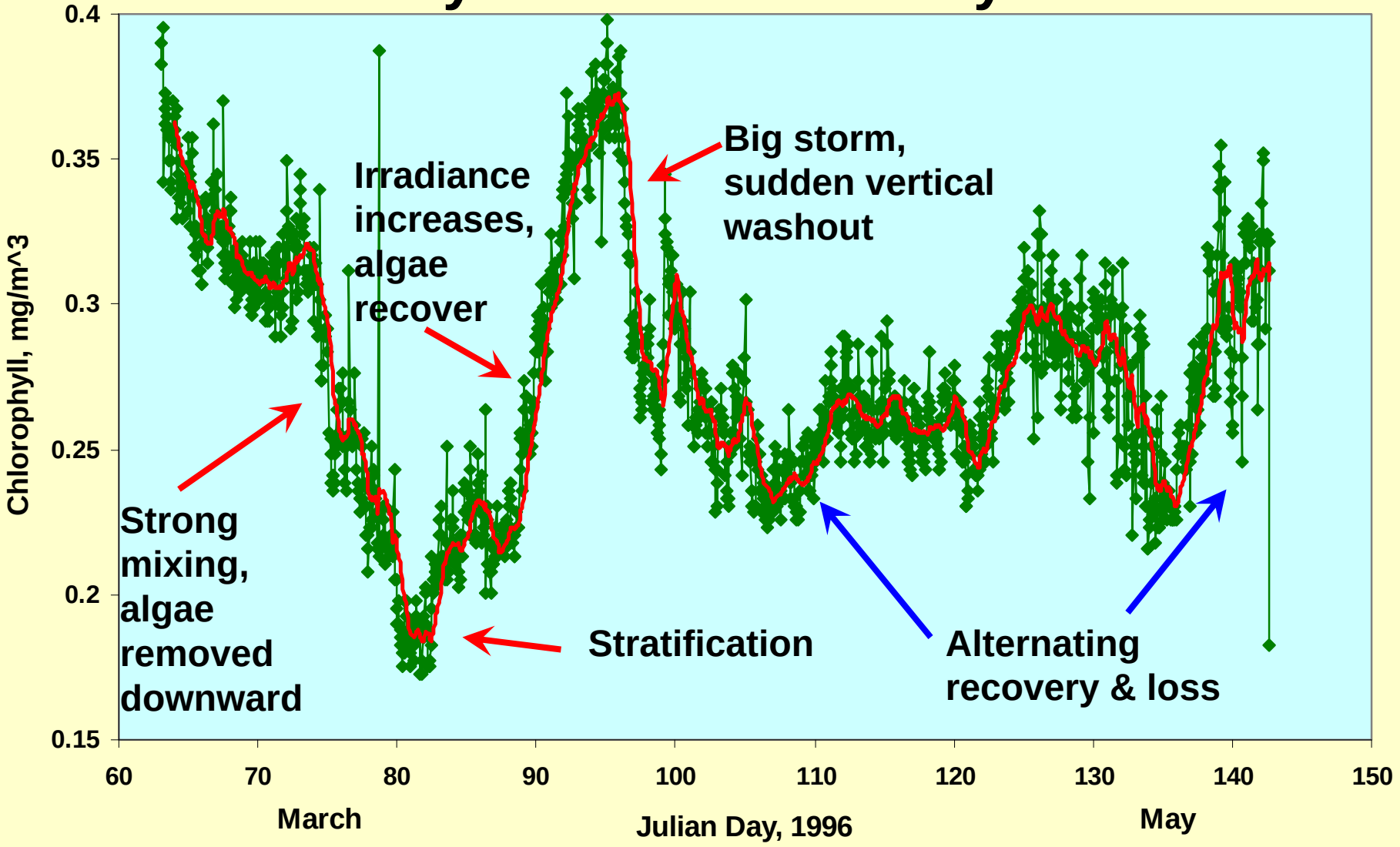
Ammonium Cycling

Phytoplankton cycling



What controls this variation?

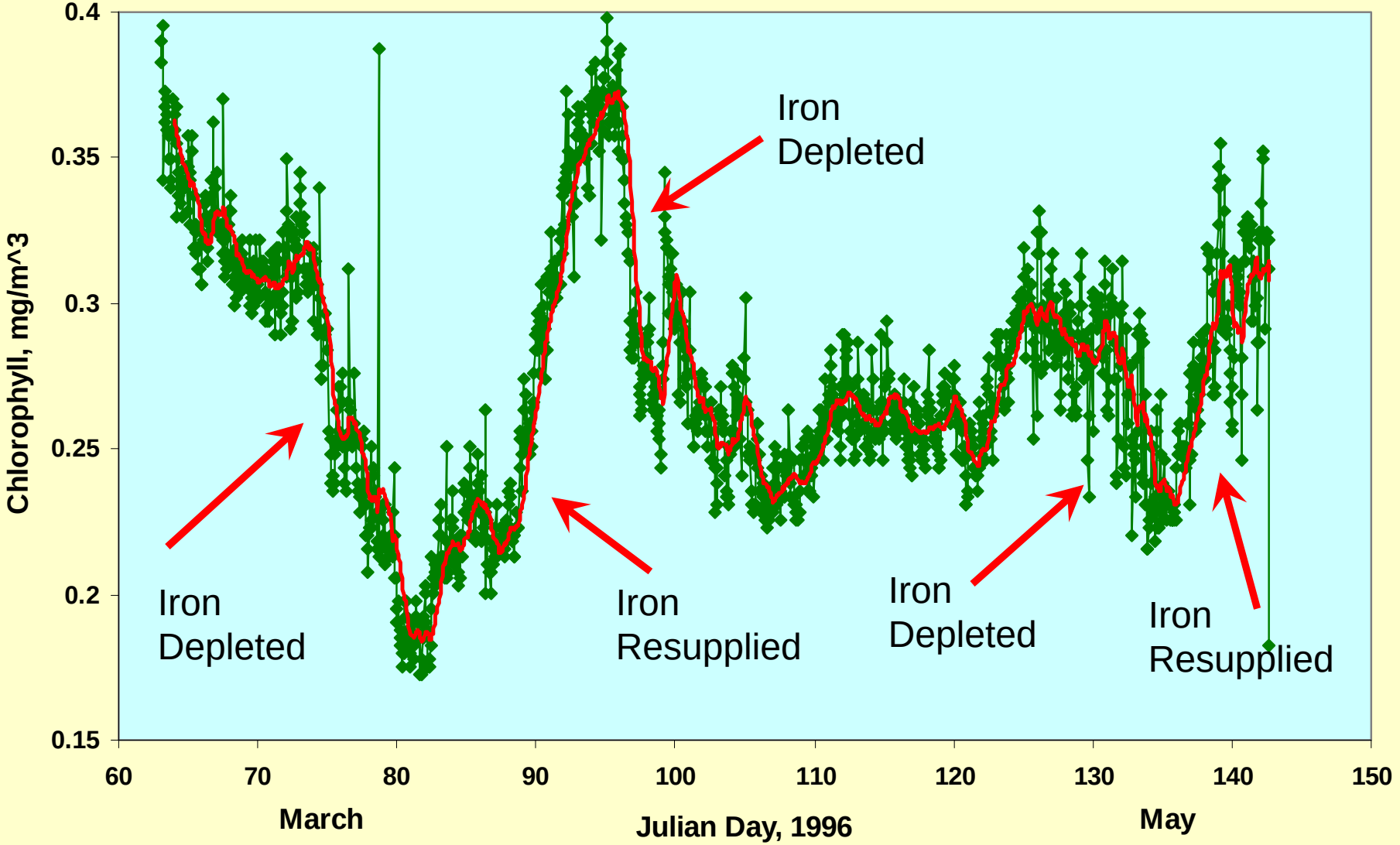
Mostly Water-Column Physics?



Also: mesoscale variation + advection

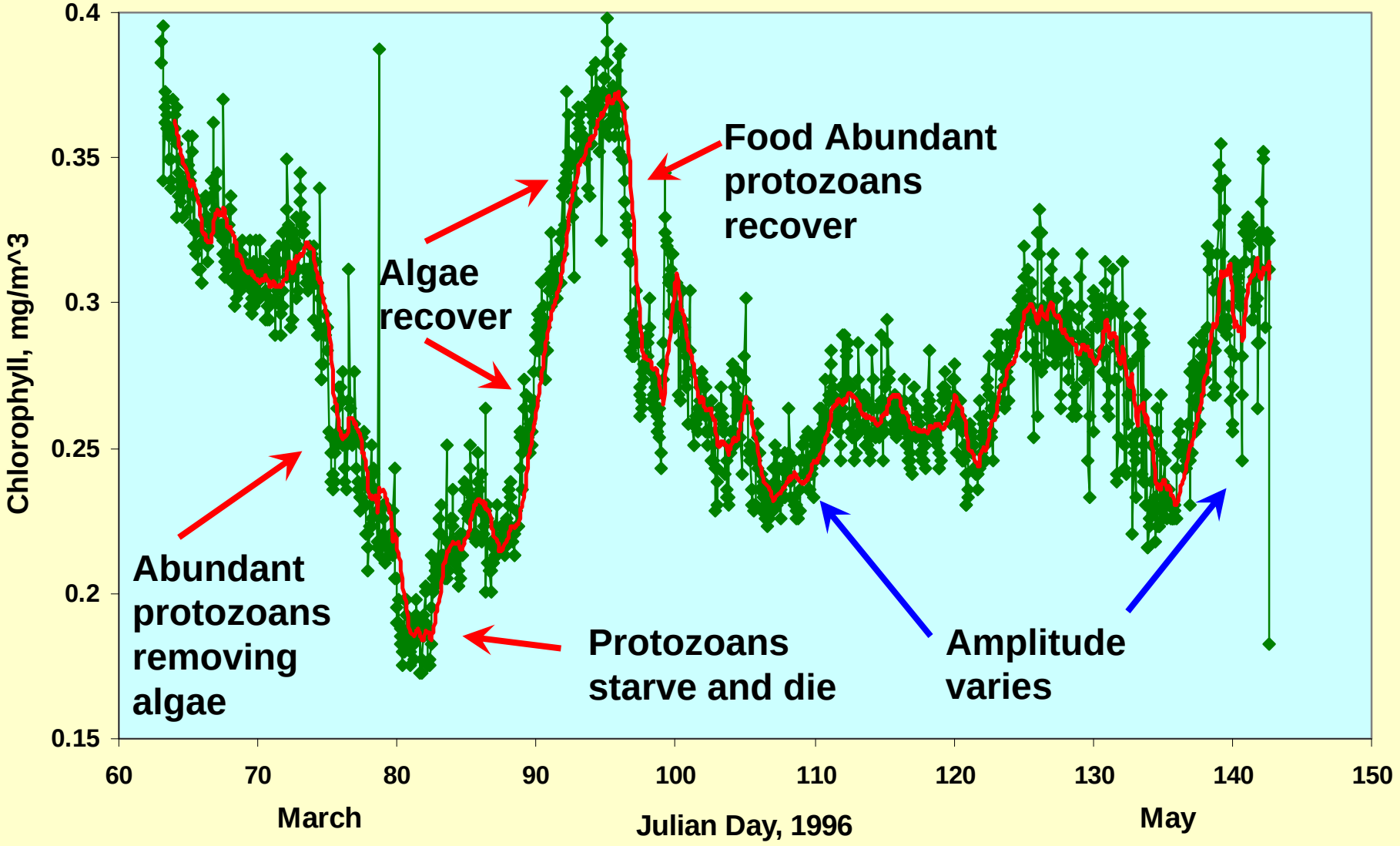
OR

Iron Control At All Points?



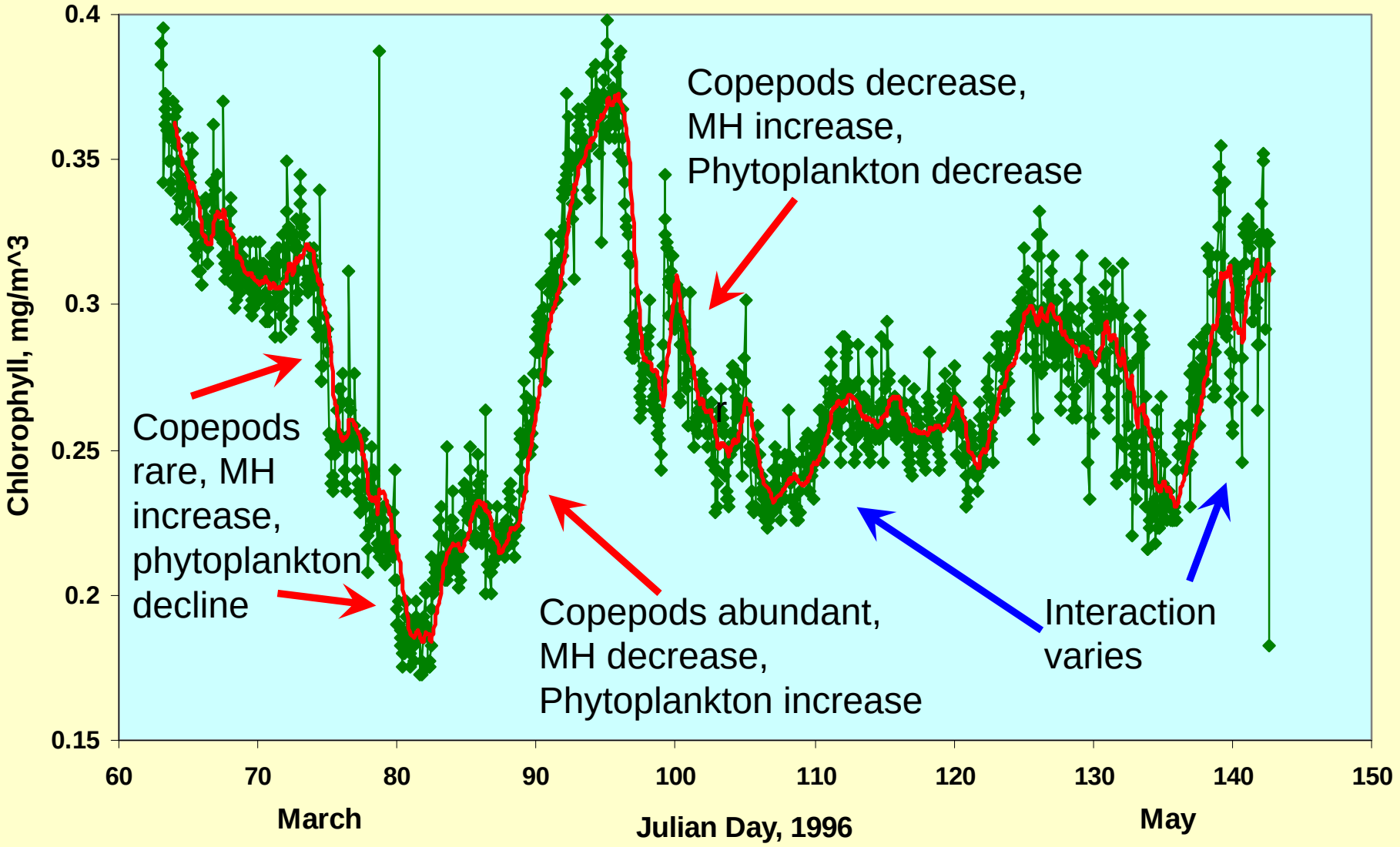
OR

Predator-Prey Cycling?



OR

A Trophic Cascade – Copepods (etc.) control protozoa?



MH = microheterotrophs = protozoa

OR

All of those

How to find out?

1. **Get more chlorophyll time series – learn more about the amplitude and periods of the variation. Learn the relationships to temperature and irradiance. More mooring data. Ammonia data needed.**

How to find out?

2. Measure all the likely relevant variables through all cycle phases – order 60 days:

- ► vertical physics & mesoscale variation
- ► iron availability (amount and forms)
- ► nutrients (NH4, especially)
- ► phytoplankton taxonomy & biomass (not just chlorophyll), vertical patterns, physiology (Flav/Ferr)
- ► primary production rates – light dependence
- ► protozoa - taxonomy, abundance (nanoflagellates to large ciliates & dinoflagellates)
- ► protozoan grazing rates (e.g., dilution experiments)
- ► Mesozooplankton stocks and feeding rates

Such a time-series is the OECOS-East proposal.

It should still be done!

It will tell us more about how nature works than more iron addition experiments.

Xie xie - 谢谢

Komapsumnida - 감사합니다

Domo arigato - どうもありがとう

Spasibo - Спасибо

Thanks - ⏣₪☼☺♫♂∞