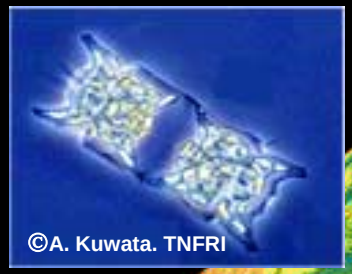
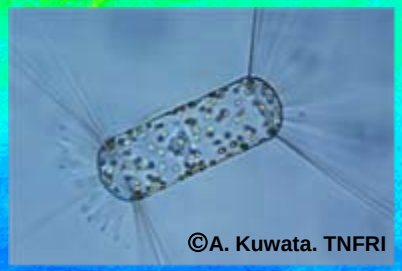
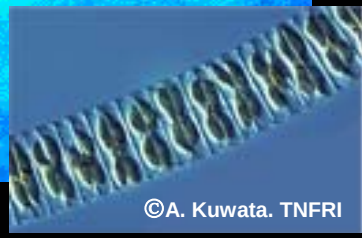
Climatic Forcing and Phytoplankton Phenology over the subarctic North Pacific 1998-2006







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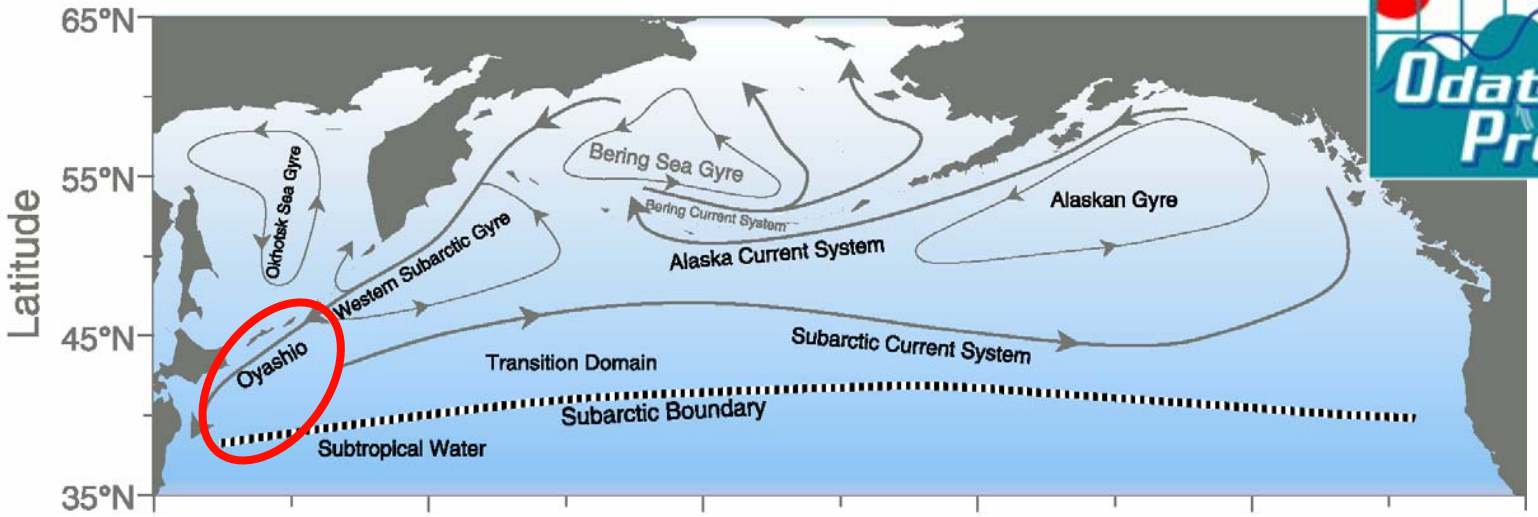
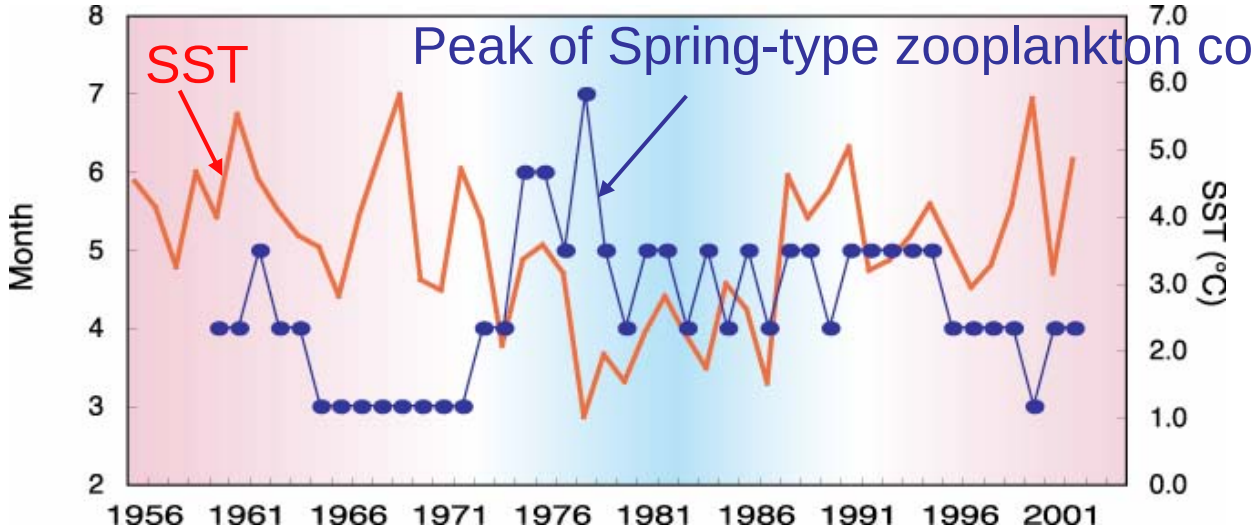
Background

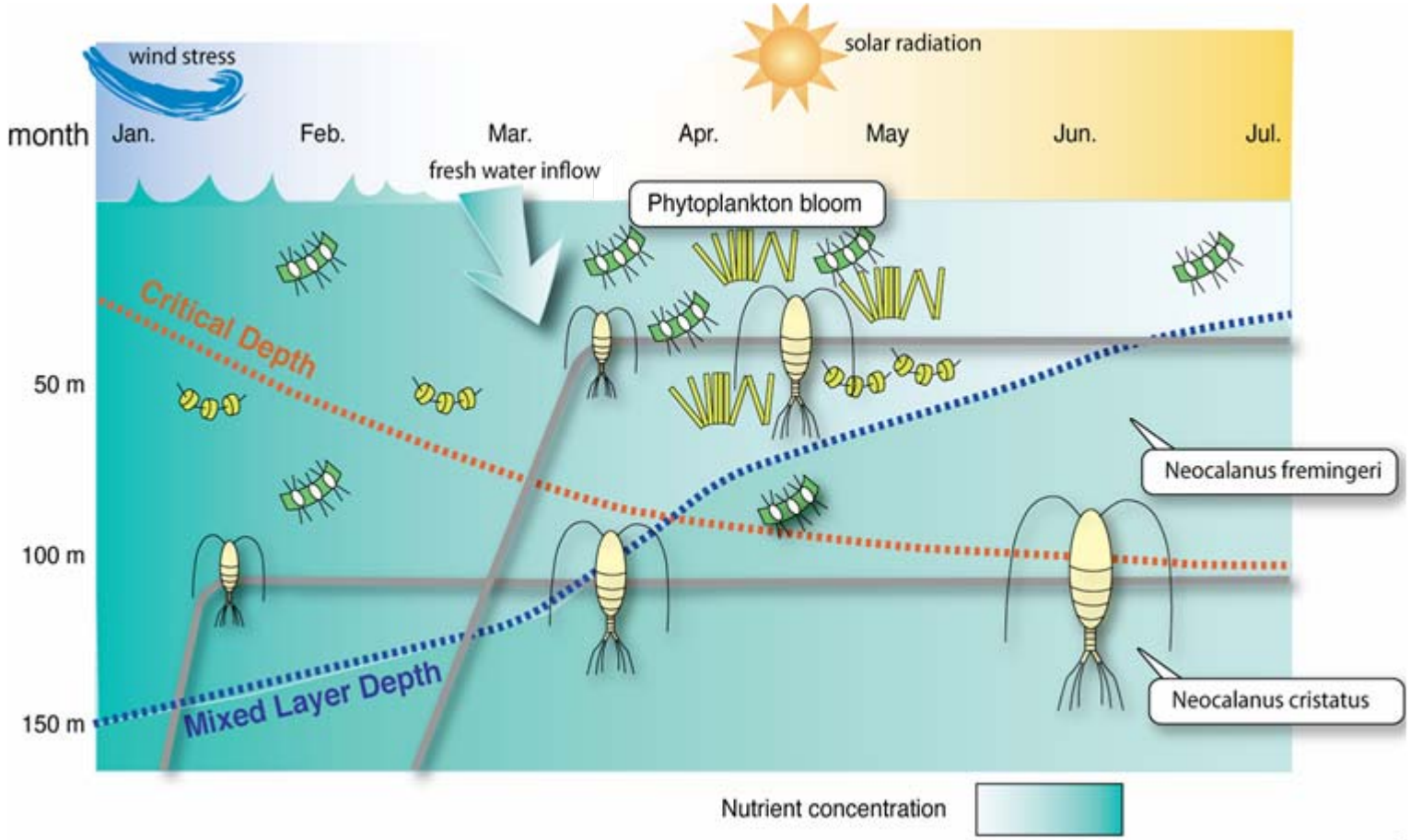




Retrospective study revealed decadal scale zooplankton phenology and warm-cool cycle in the western NP (Chiba et al. 2006).

Background

Dominant Zooplankton *(Neocalanus)* : ontogenetic migrators

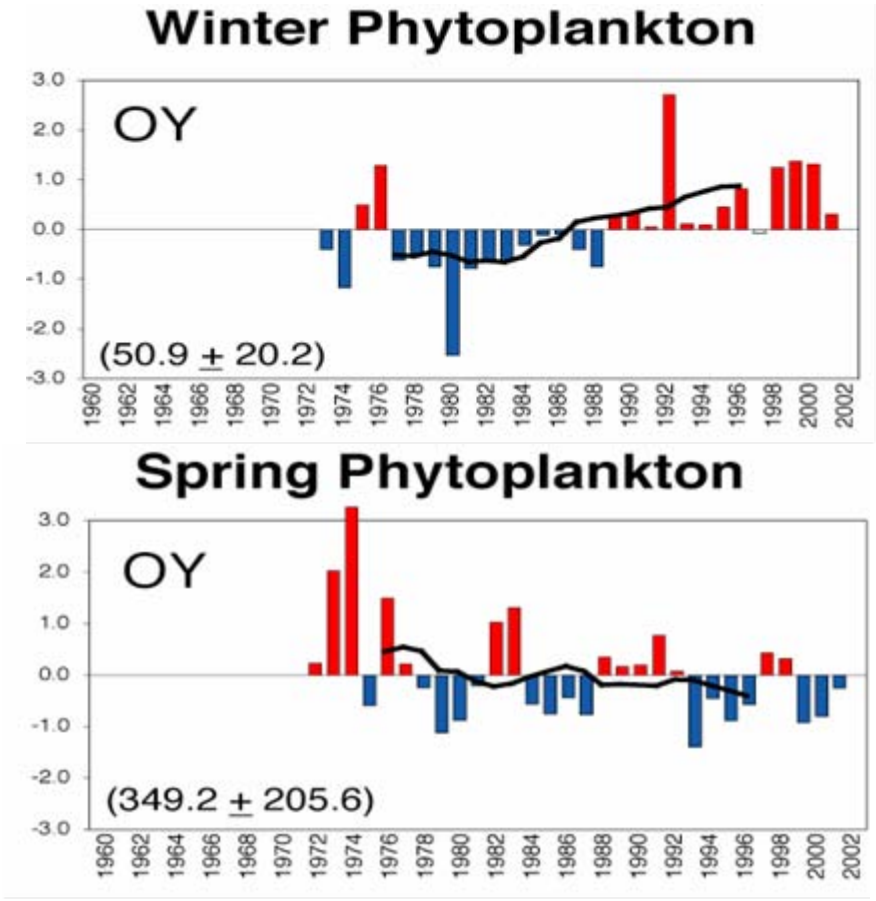


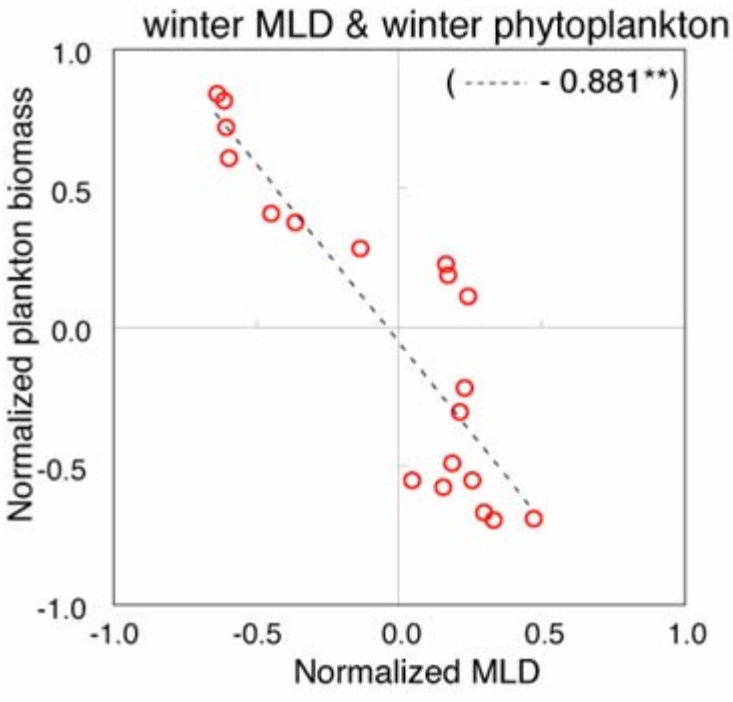
It is unlikely that they can adjust the timing of ascending in response to change in surface environmental condition.

Zooplankton phenology is likely to be a result of survival success, which is determined by food availability when they ascend (match-mismatch).

Background

Link between phytoplankton and phytoplankton phenology: Unclear



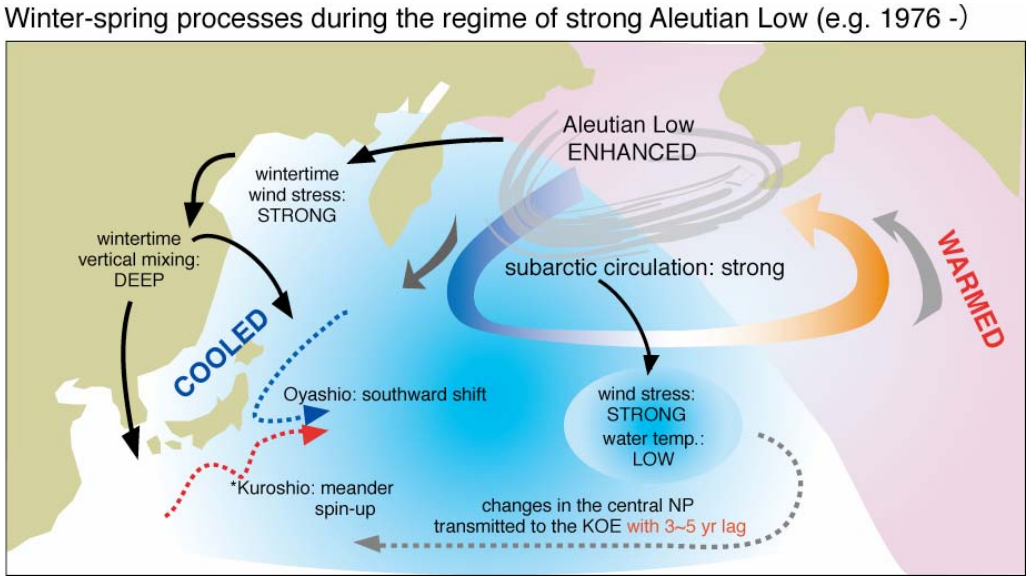


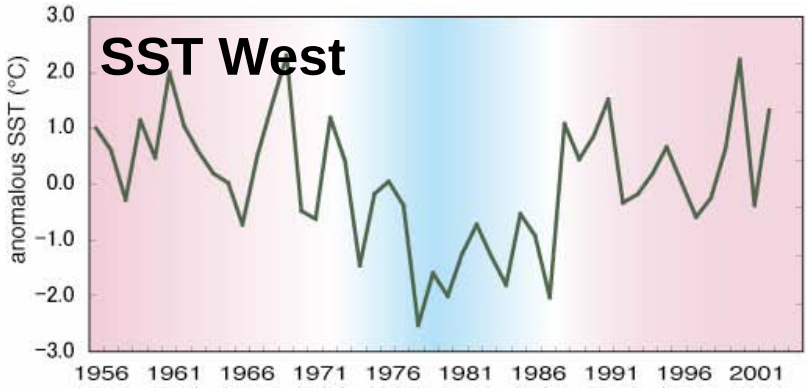
Only seasonal data exist for long-term Phytoplankton variation

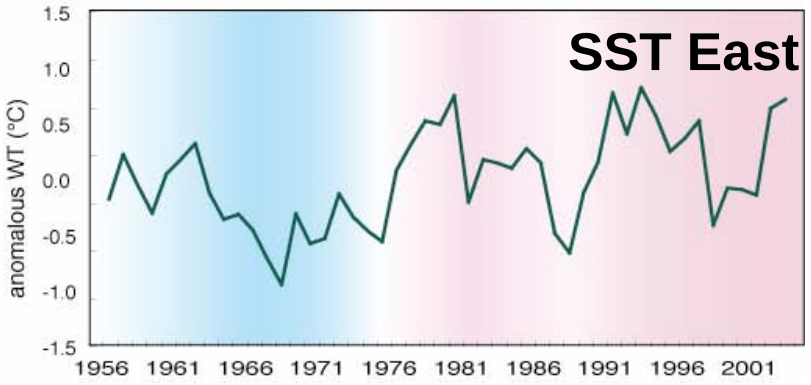
Need analyzing at higher temporal resolution to examine match-mismatch bw PP-ZP

Background

See-saw-like decadal anomaly of SST bw/ East-West subarctic NP







A climatic forcing could differently influence environment in Eastern & Western subarctic North Pacific….and plankton phenology?

GOALS

Investigate interannual-scale phenology of phytoplankton in the subarctic NP, using satellite ocean color data.

Describe regional differences in;

1) *phytoplankton seasonality*
2) *phenological responses to climatic forcing*

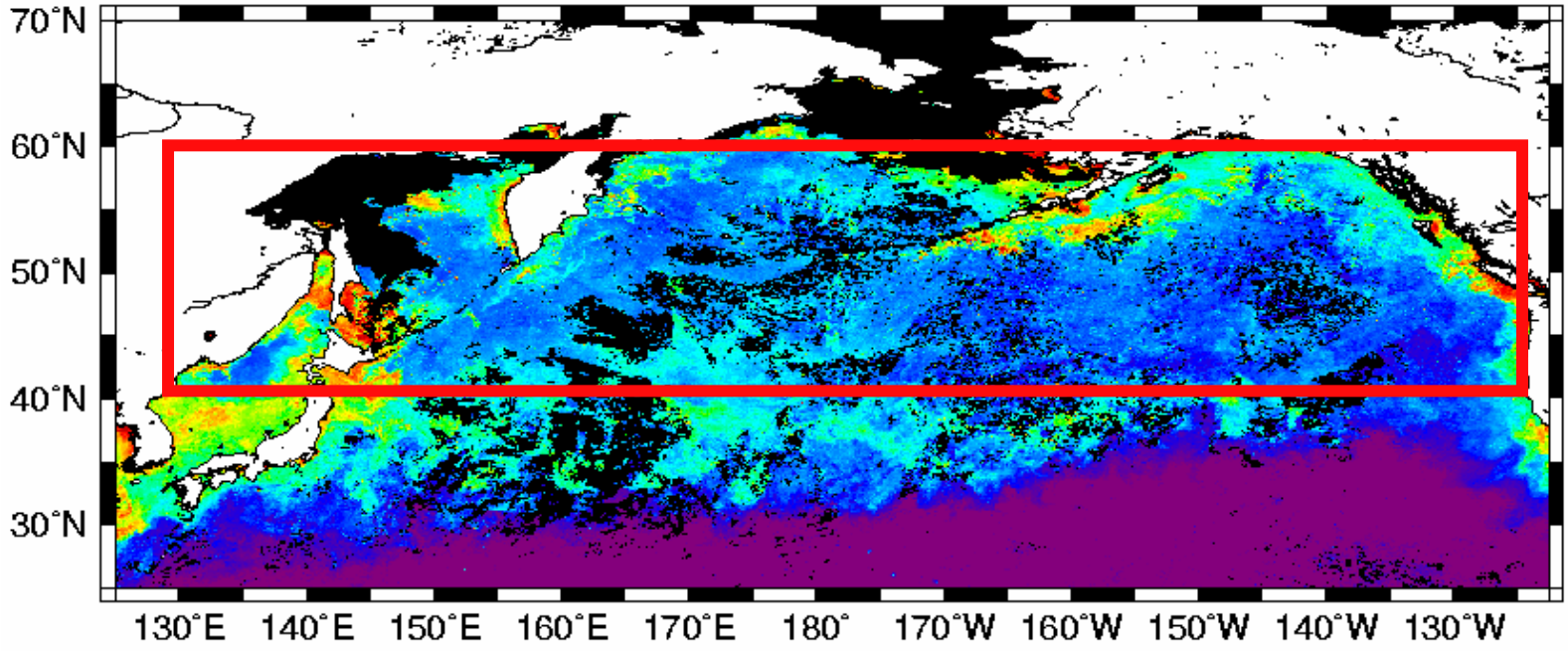
Data

Ocean color satellite Chl *a* data (SeaWiFS)

1998-2006 (Feb - Aug)

40-60°N, 130°E-120°W

10 days composite of each 2° x 2° grid

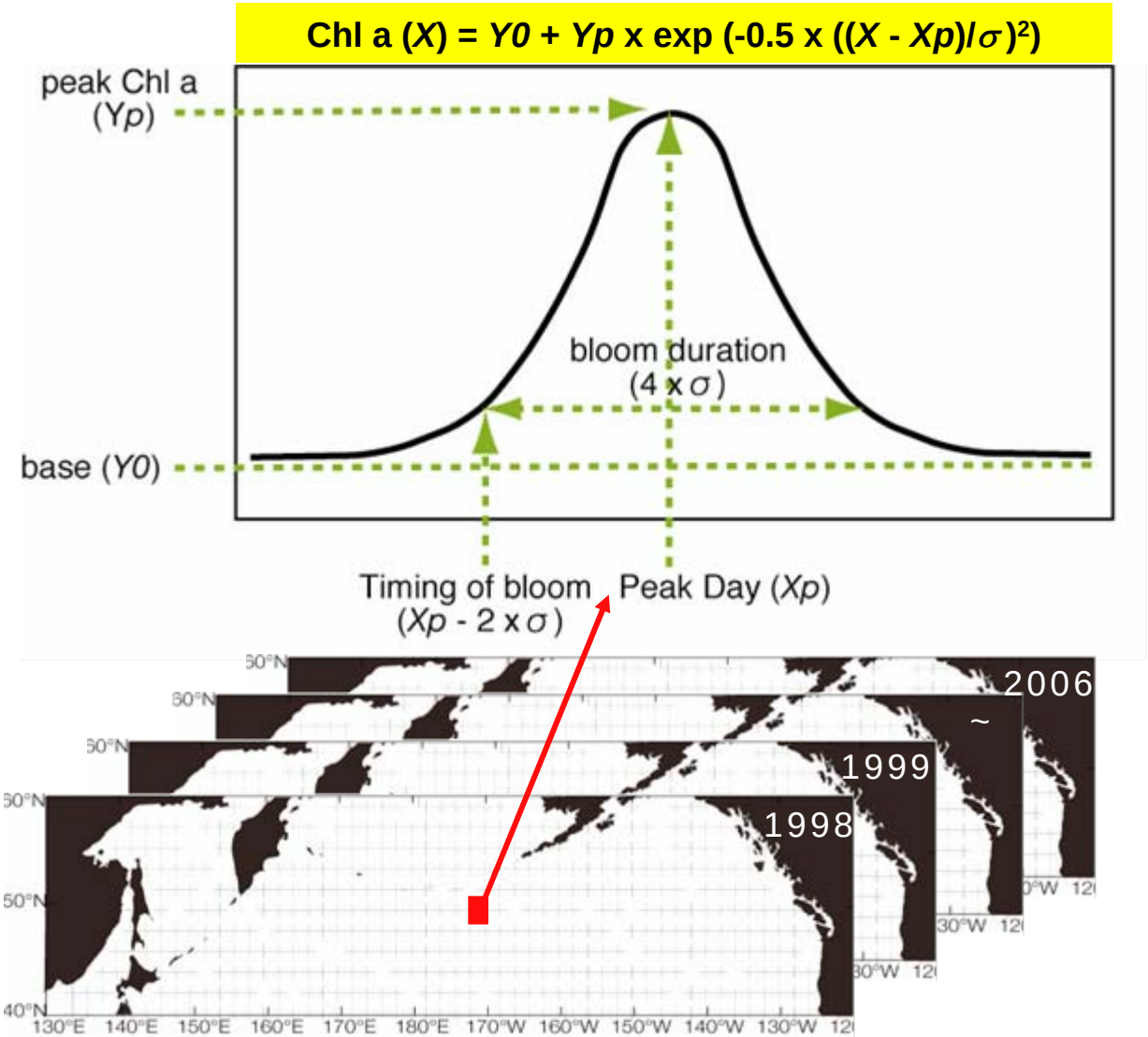


SeaWiFS Image

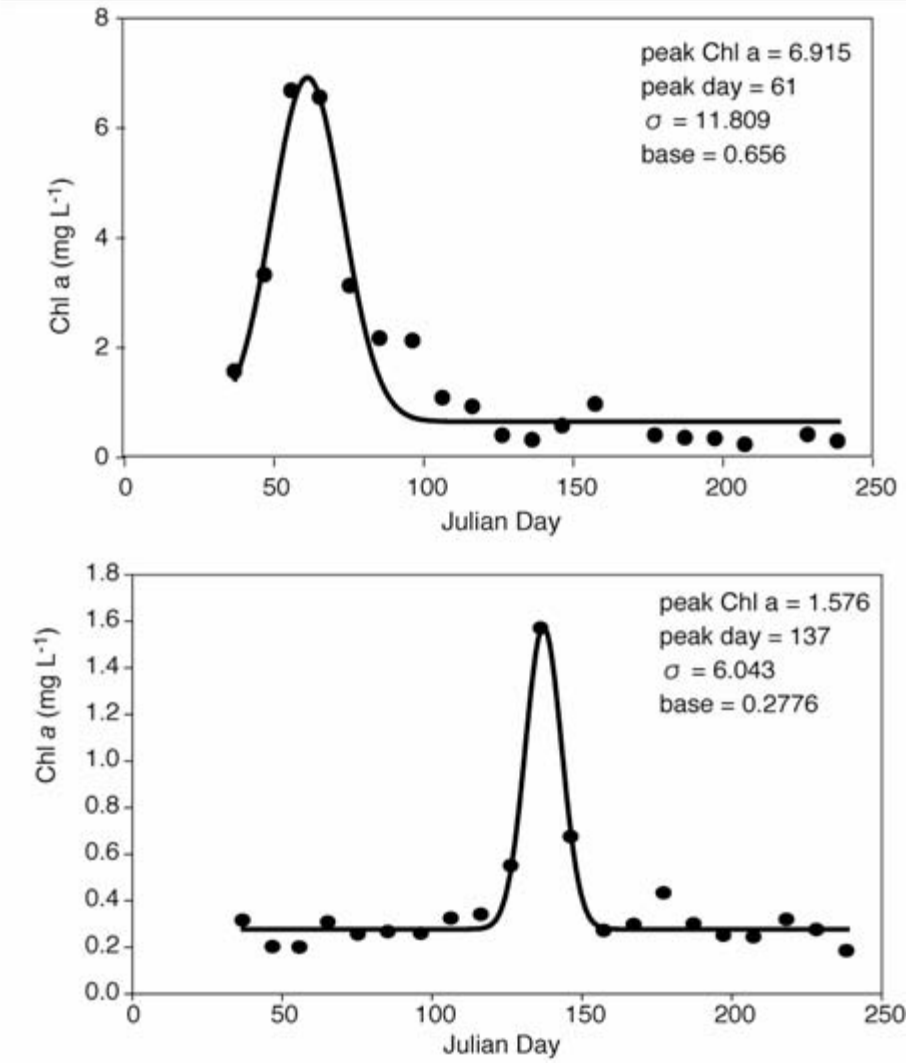
Analysis

Detection of Phenology

Gaussian curve fit (Yamada et al, 2006) of seasonal Chl a variation (Feb-Aug) for the each yr - each grid



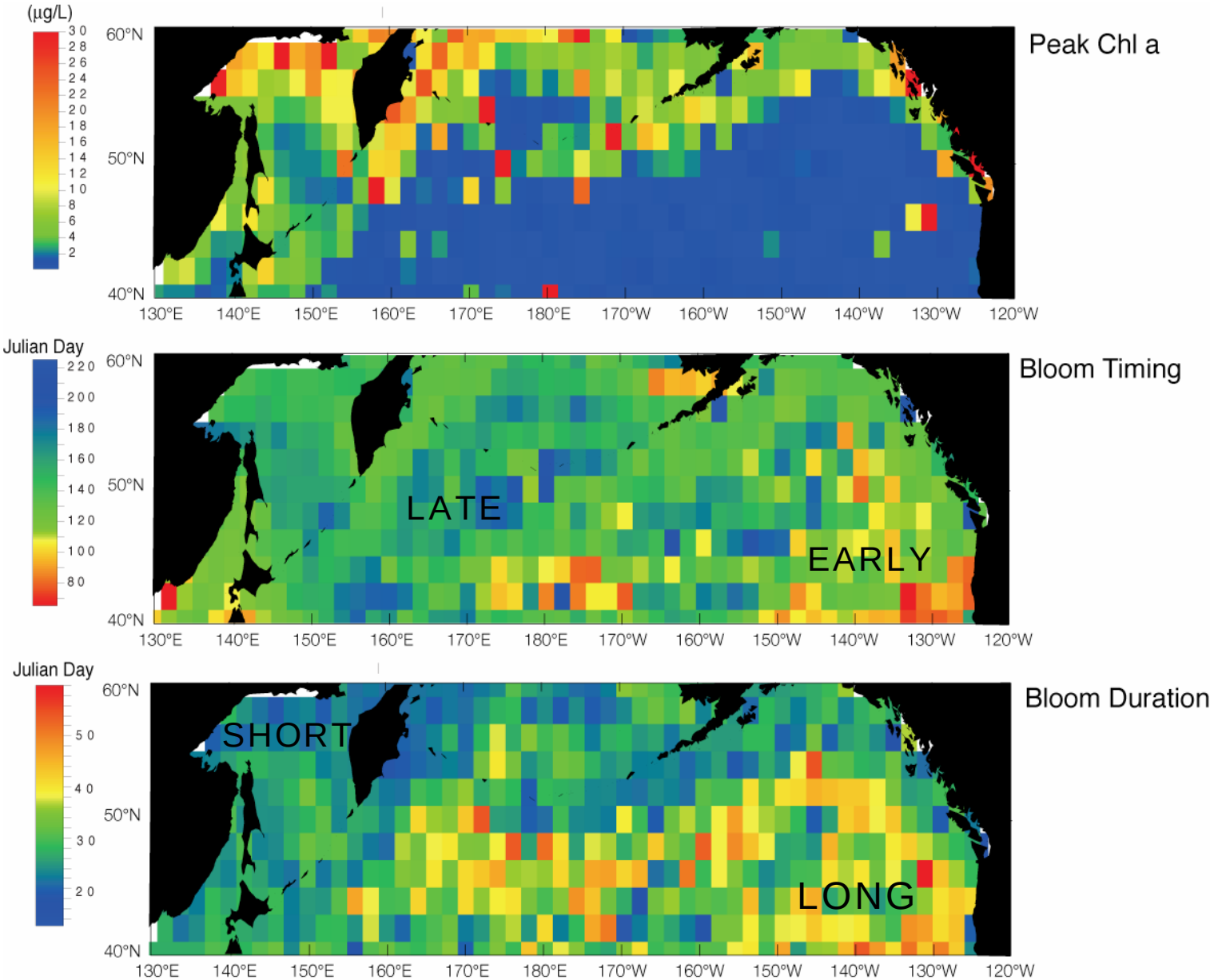
Analysis



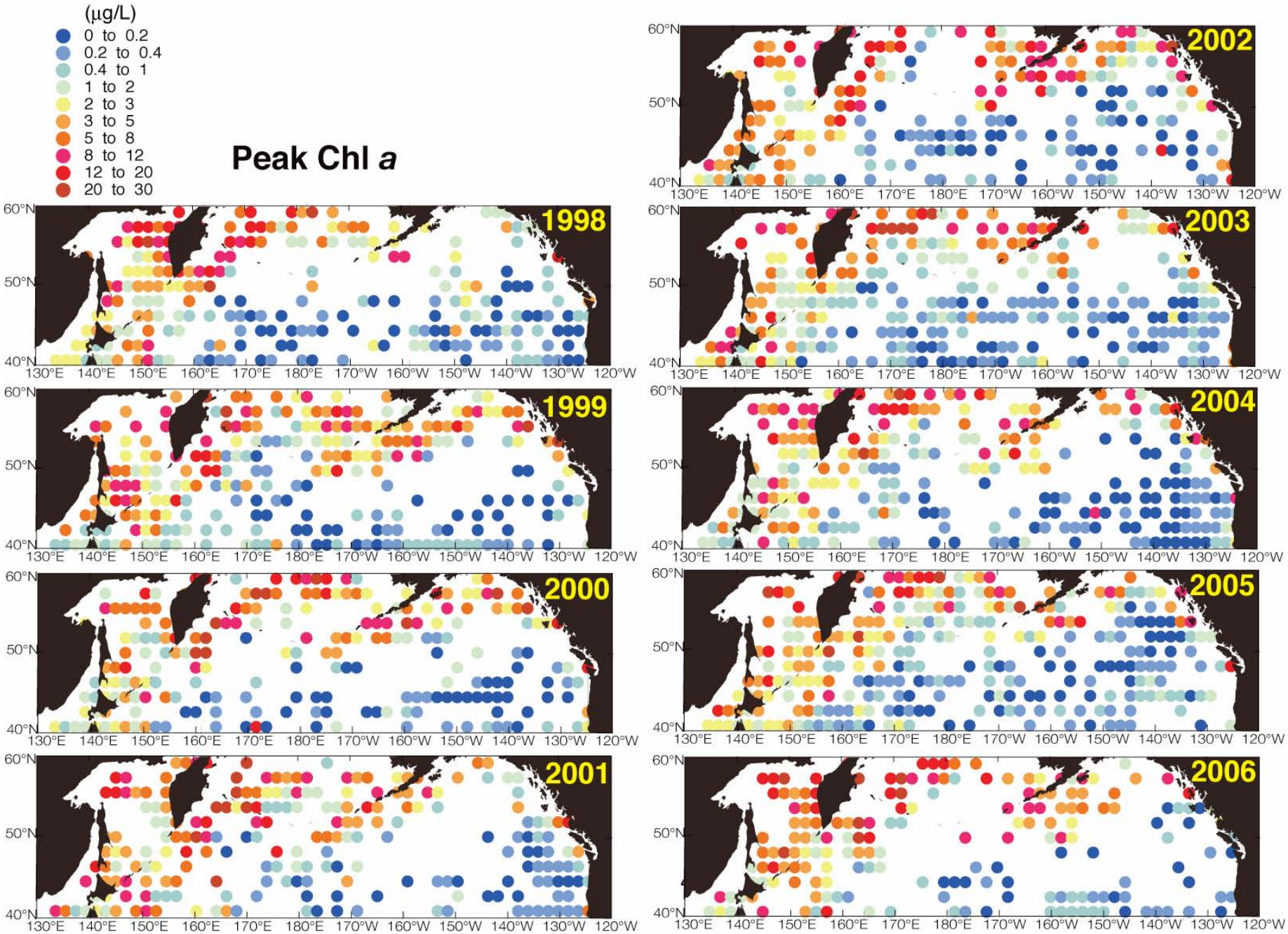
Example of Gaussian curve fit of Chl *a*

Results

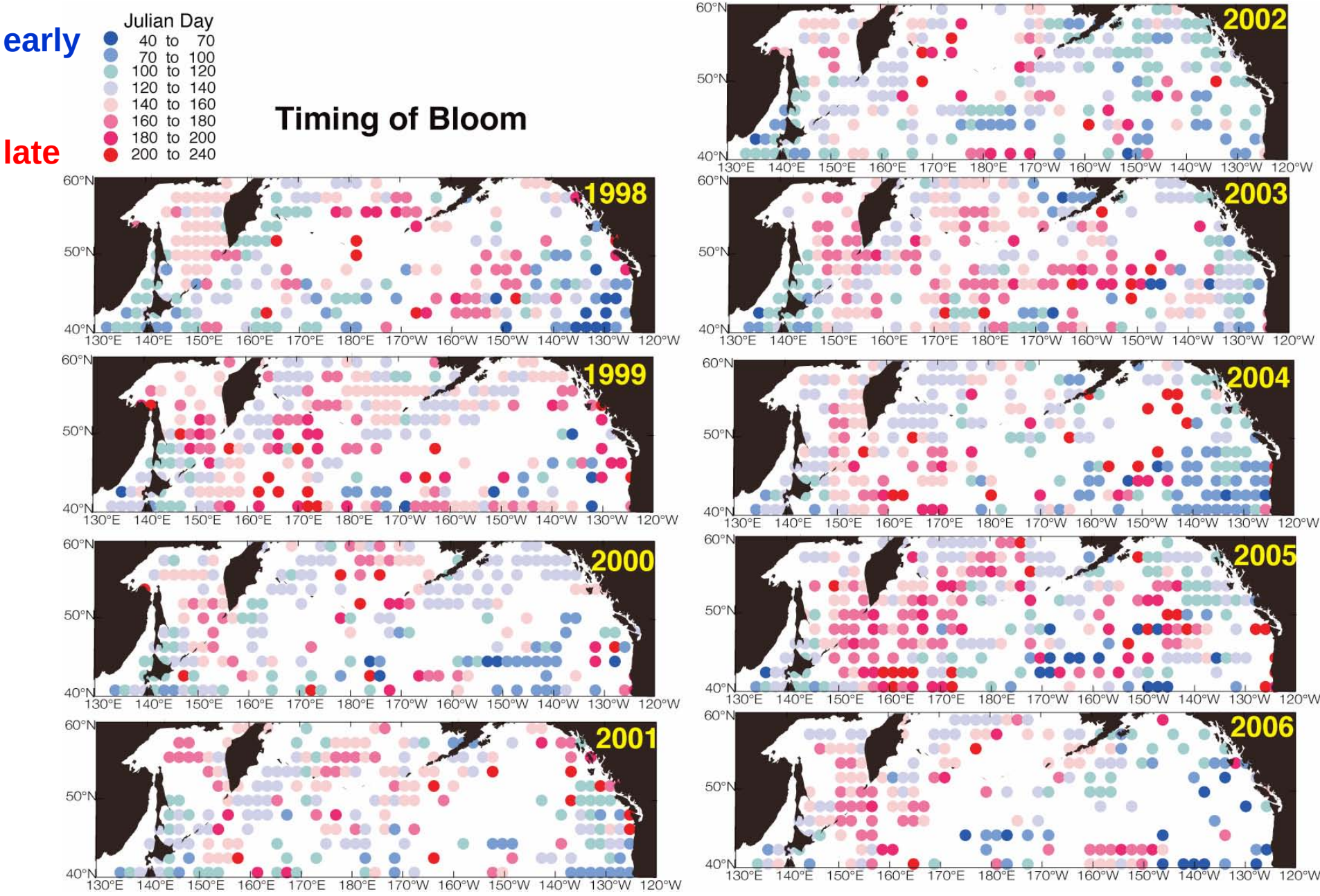
Regional Characteristics (9 yr mean) of Phytoplankton Seasonality



Results

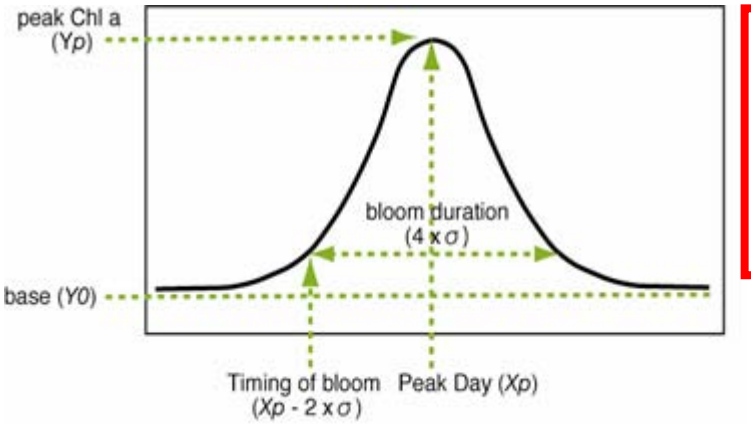

(µg/L)
0 to 0.2
0.2 to 0.4
0.4 to 1
1 to 2
2 to 3
3 to 5
5 to 8
8 to 12
12 to 20
20 to 30
Peak Chl a
1998
1999
2000
2001
2002
2003
2004
2005
2006
60°N
50°N
40°N
130°E 140°E 150°E 160°E 170°E 180°E 170°W 160°W 150°W 140°W 130°W 120°W

Results


early
late
Julian Day
40 to 70
70 to 100
100 to 120
120 to 140
140 to 160
160 to 180
180 to 200
200 to 240
Timing of Bloom
1998
1999
2000
2001
2002
2003
2004
2005
2006
60°N
50°N
40°N
130°E 140°E 150°E 160°E 170°E 180°E 170°W 160°W 150°W 140°W 130°W 120°W

Analysis

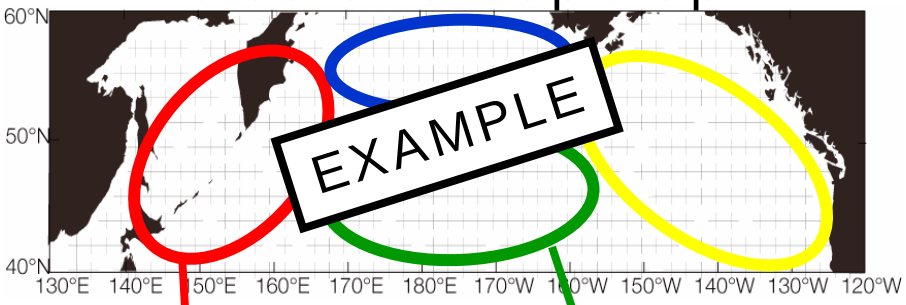
Grouping Grids based on 9 yr Average of 4 parameters of Gaussian Curve for Each Grid (K-means Clustering)



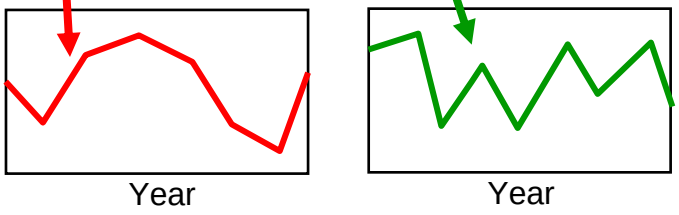
Peak Chl a
Base Chl a
Peak day
SD

*only curves of good fitness used
*data normalized before clustering

Cluster Group Map



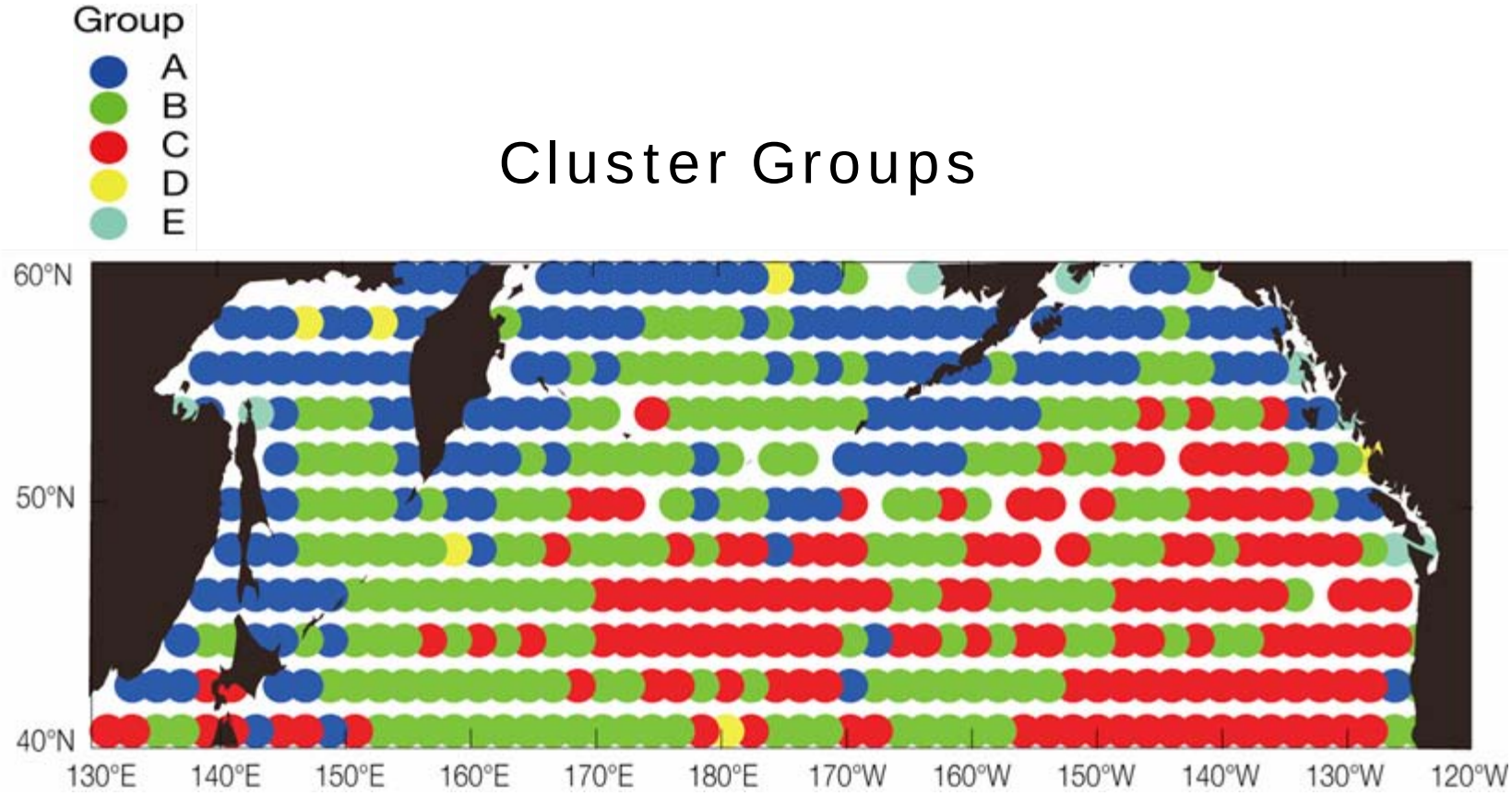
e.g. Bloom Timing



Regional Comparison of Phenology for 1998-2006

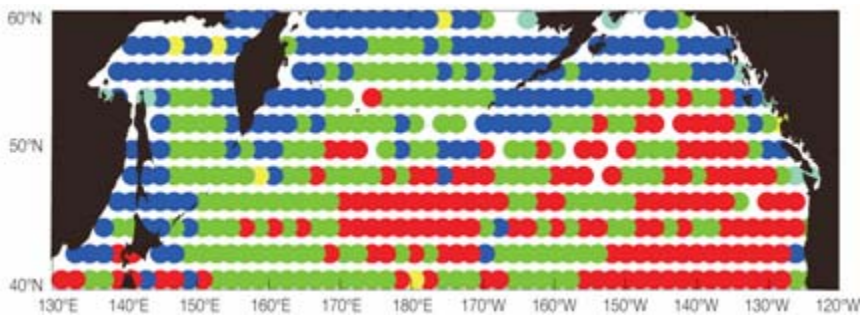
Results

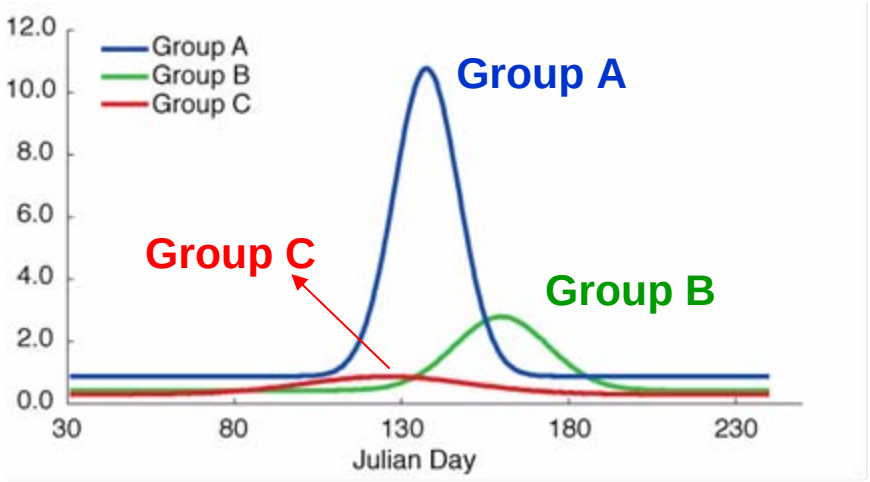
Cluster Groups

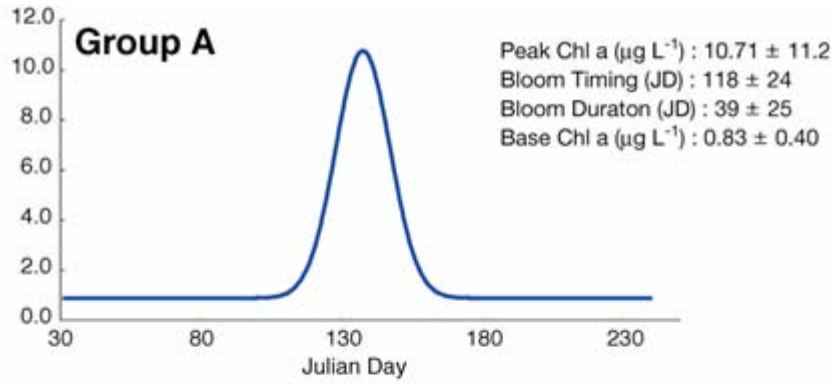


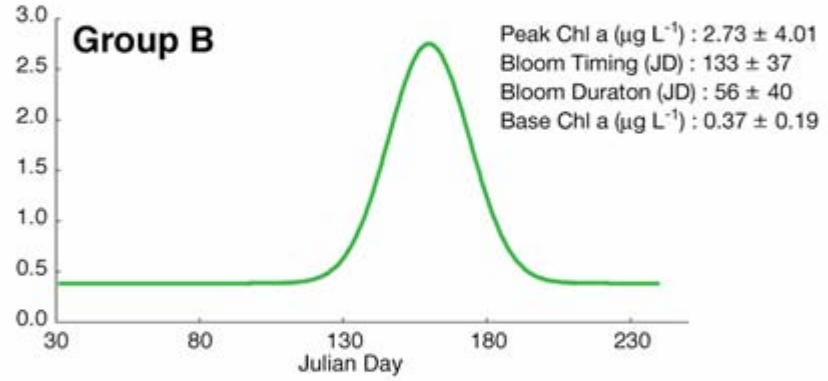
Results

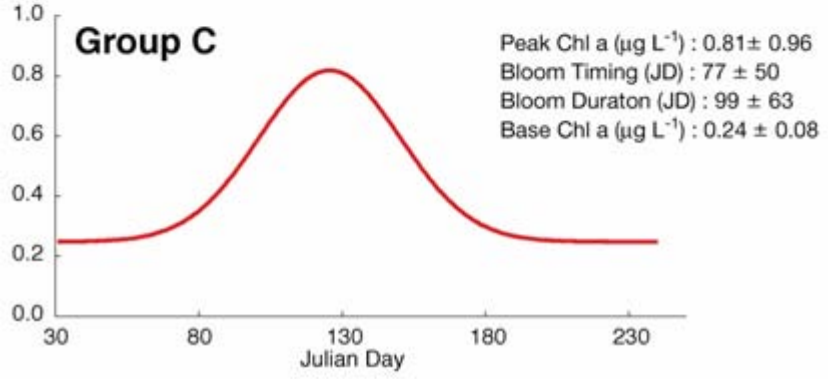
Phytoplankton Seasonality of Each Group





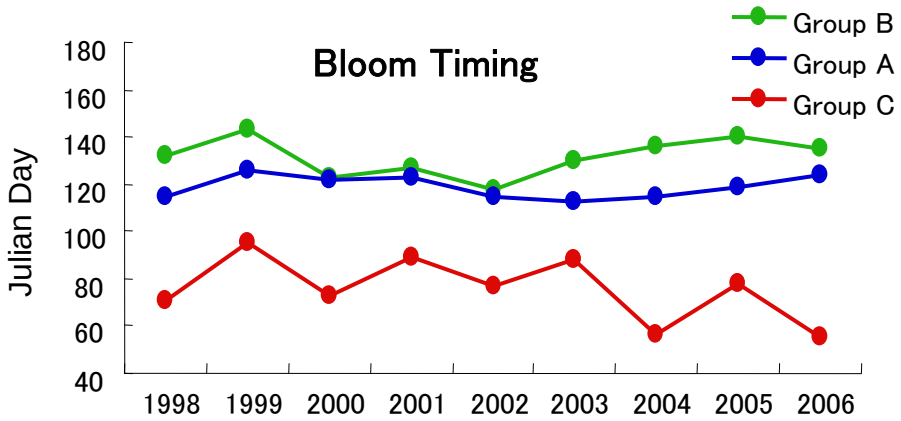


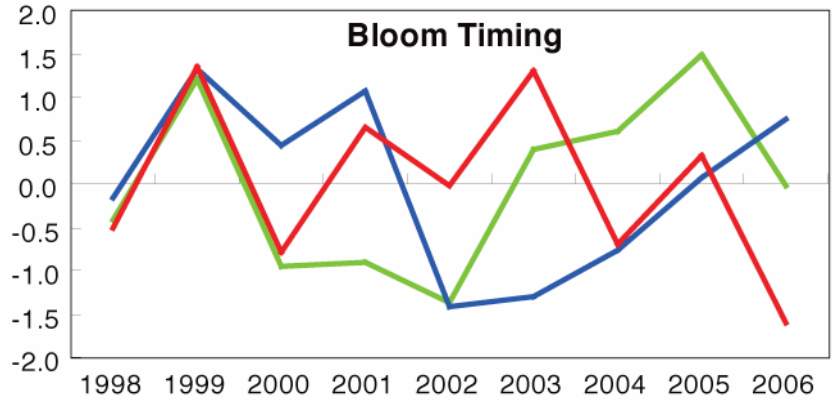


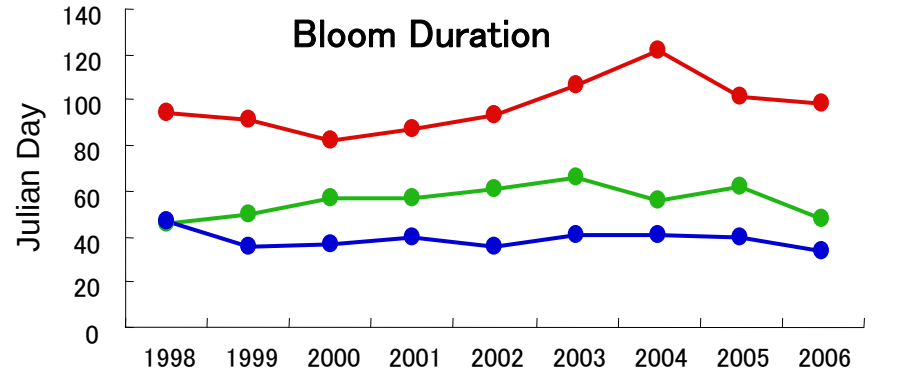


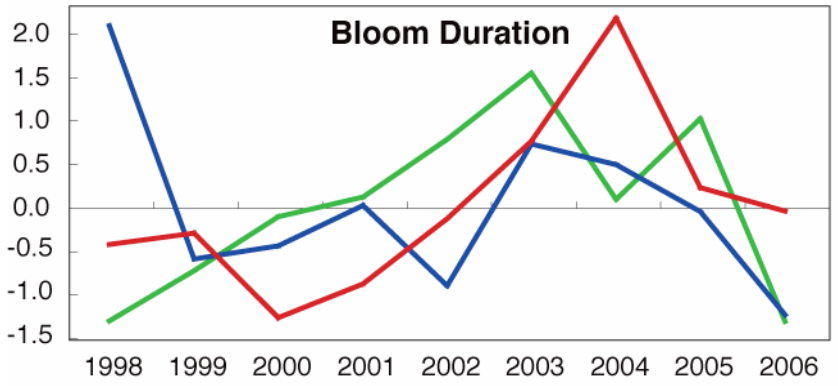
Results

Interannual Variation of Timing and Duration of Phytoplankton Bloom of Each Group







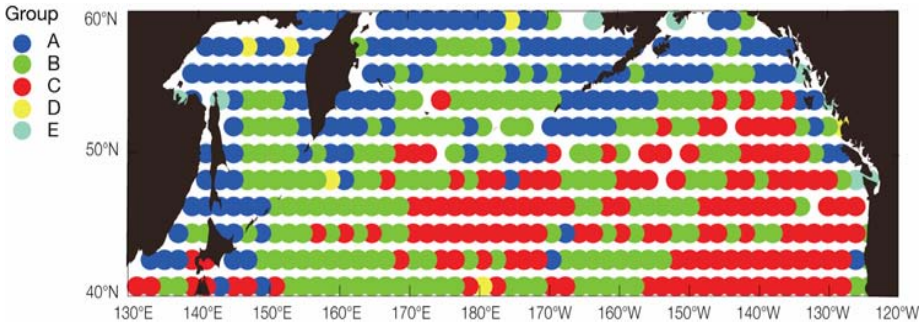


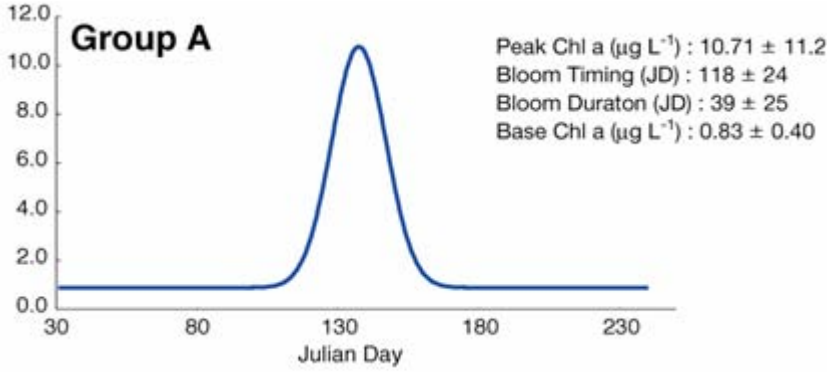
Correlation with Climate Indices?

SOI: ENSO scale variation
ALPI: decadal scale,
wintertime wind stress, circulation

Results

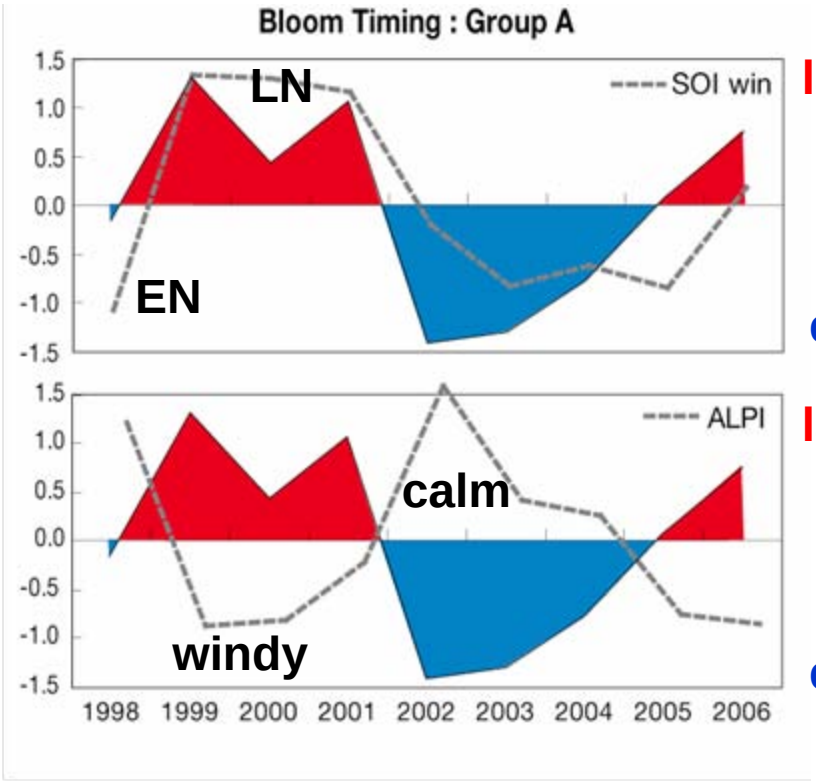
Phytoplankton Phenology & Climatic Forcing: Group A





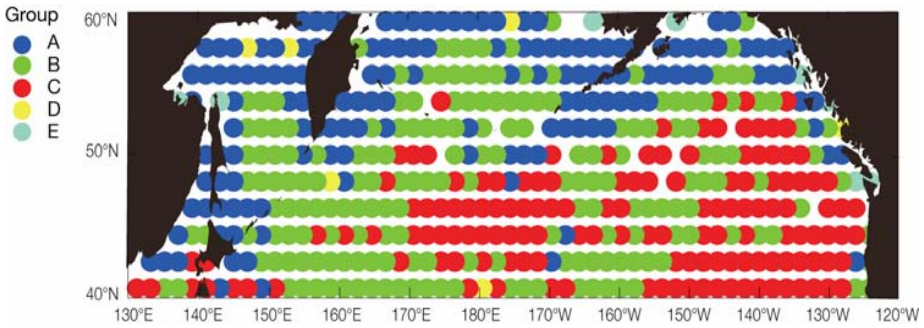
Pearson R = 0.73
P = 0.03

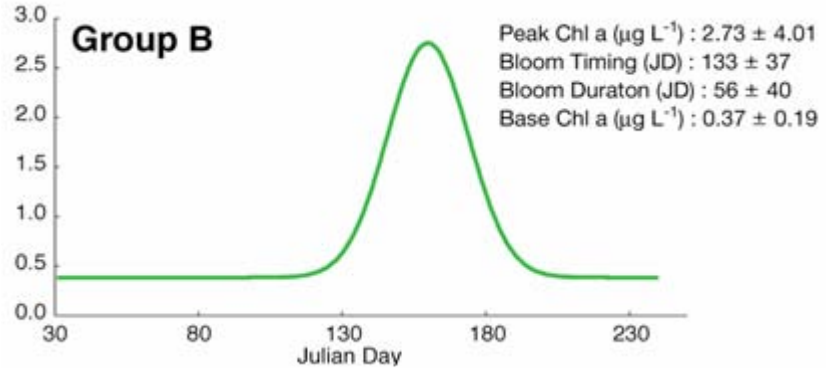
Pearson R = -0.76
P = 0.02

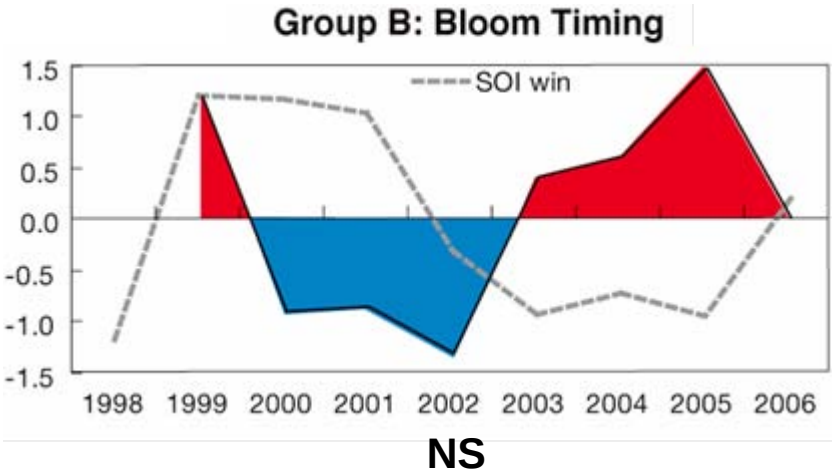


Results

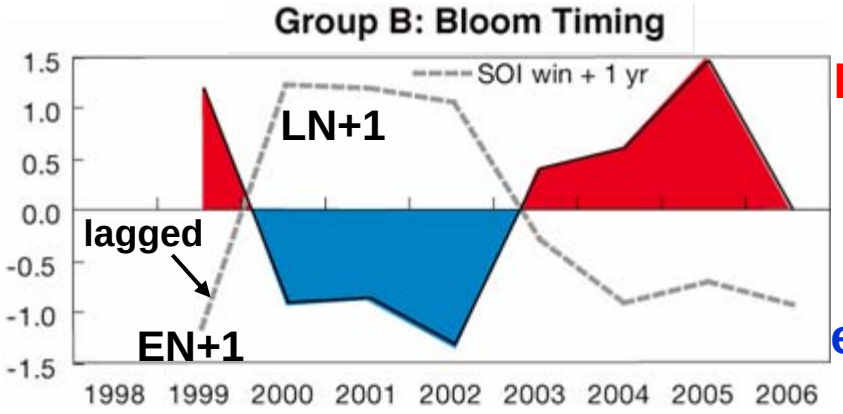
Phytoplankton Phenology & Climatic Forcing: Group B





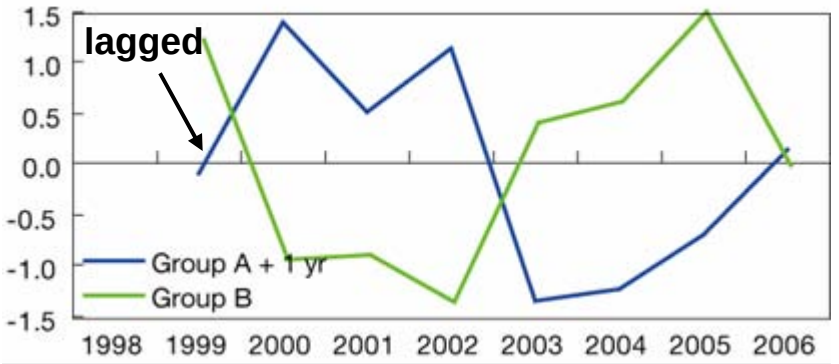


NS



late

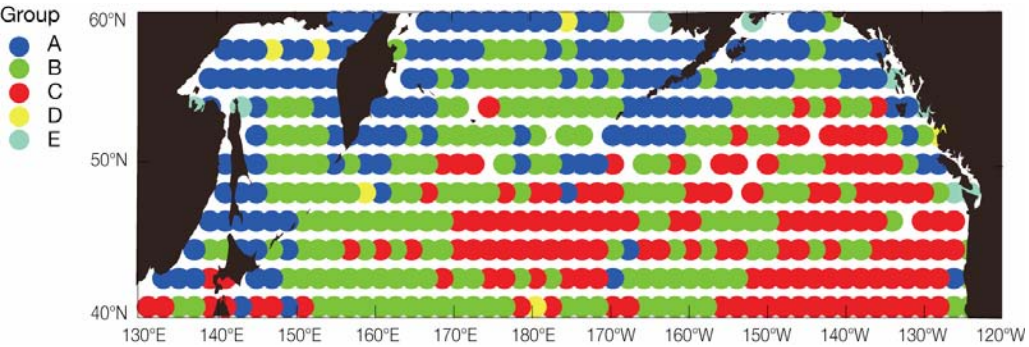
early

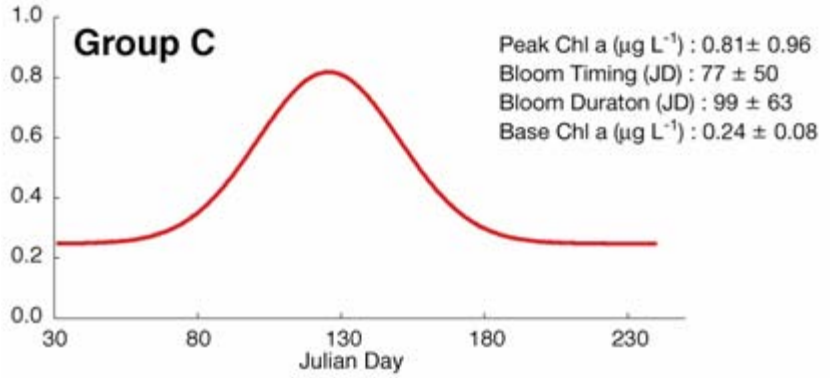


Pearson R = -0.88
P = 0.004

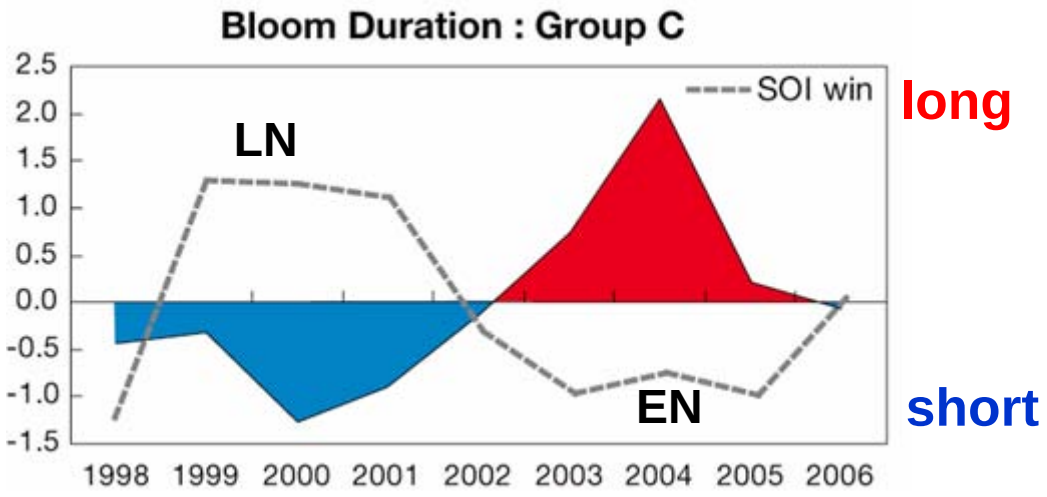
Results

Phytoplankton Phenology & Climatic Forcing: Group C



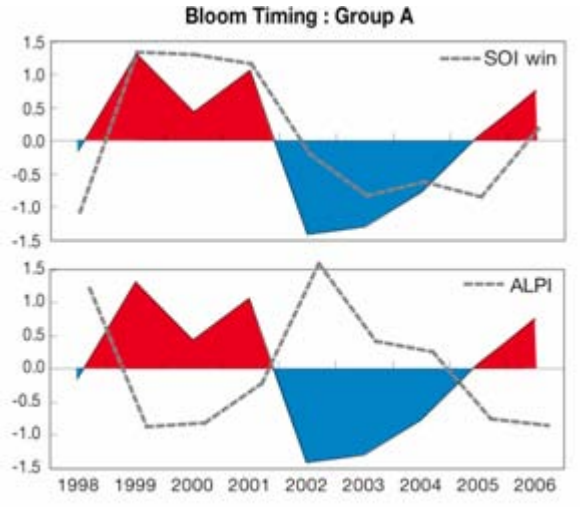


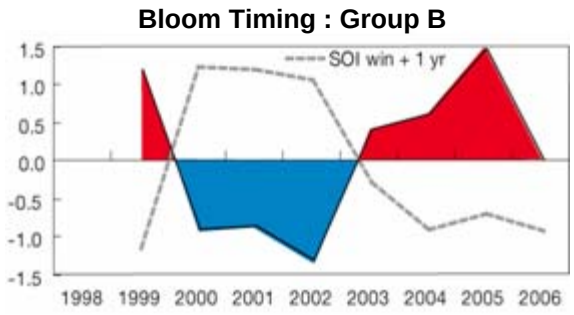
Pearson R = -0.61
P = 0.08

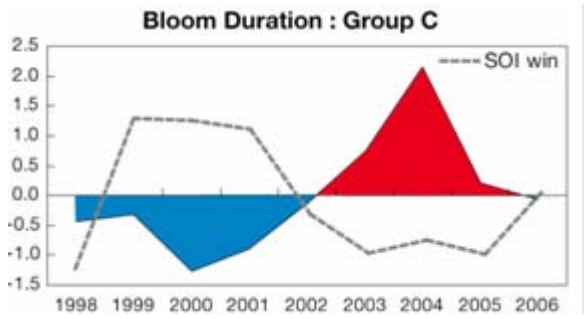


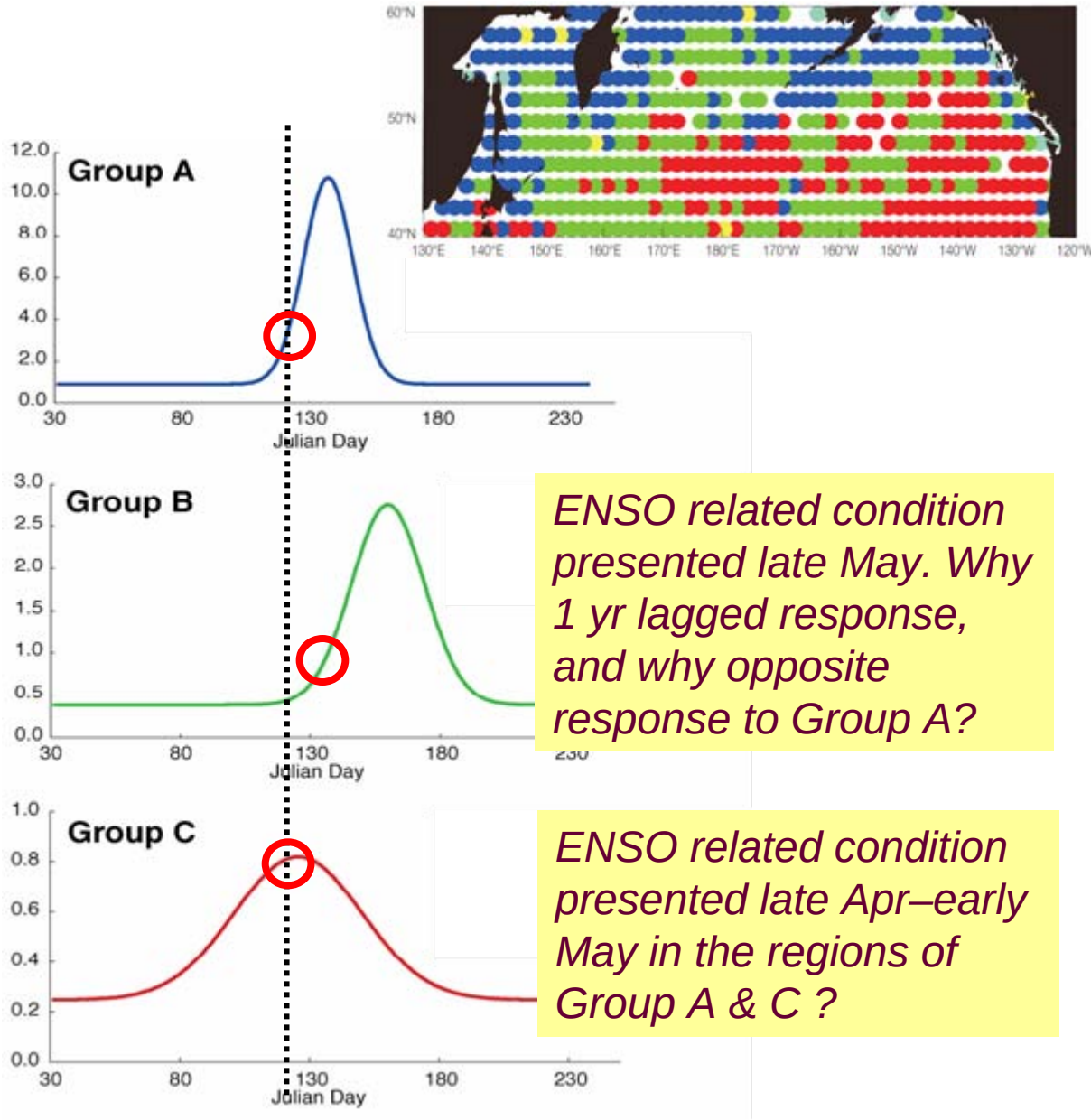
Timing of peak Chl a was delayed during EN phase but moved forward during LN phase

Summary: ENSO scale changes







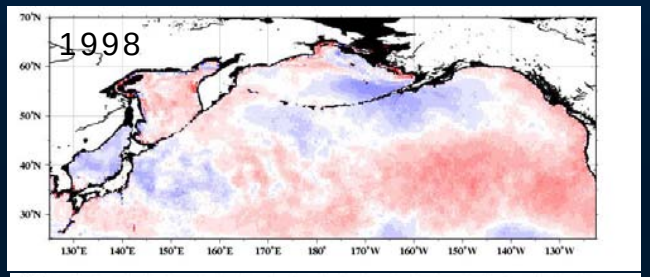


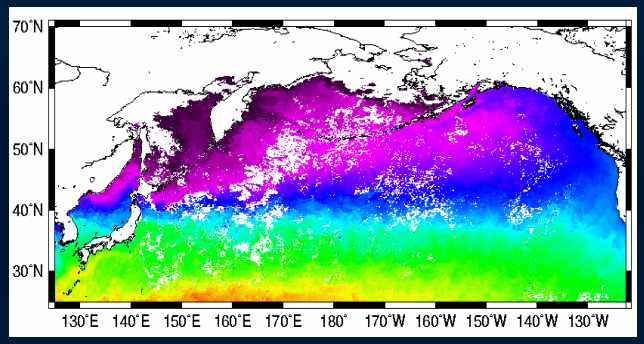
ENSO related condition presented late May. Why 1 yr lagged response, and why opposite response to Group A?

ENSO related condition presented late Apr–early May in the regions of Group A & C ?

Next to Do

Investigate ENSO scale variation of Environmental variables, e.g. wind stress and SST, using multiple satellite based data





SST

Construct a model estimating phenology of the past decades, and compare that to zooplankton phenology, and biomass of higher trophic levels (match-mismatch?)


Thank you
Marine Science:
Do what others just dream....
'96 1 28