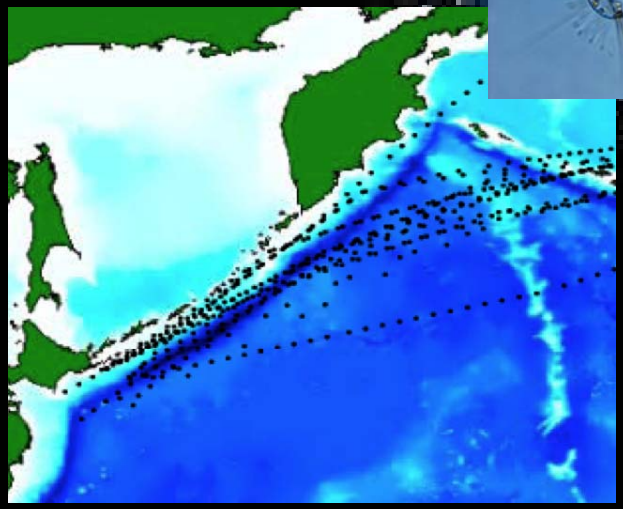
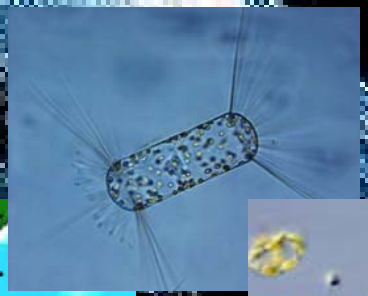
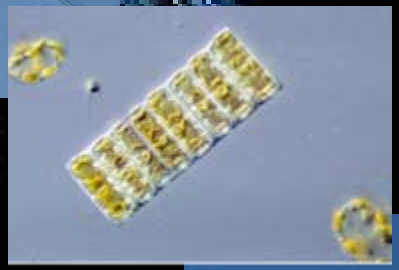
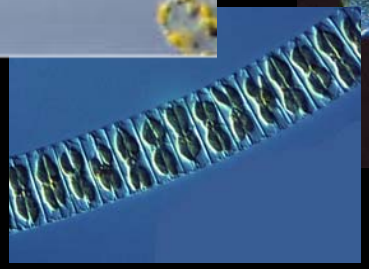
March 15, 2011
IZPS at Pucon, Chile

Changes in community structure, trophic link and phenology in lower trophic level ecosystem in the western subarctic North Pacific during 2001-2009



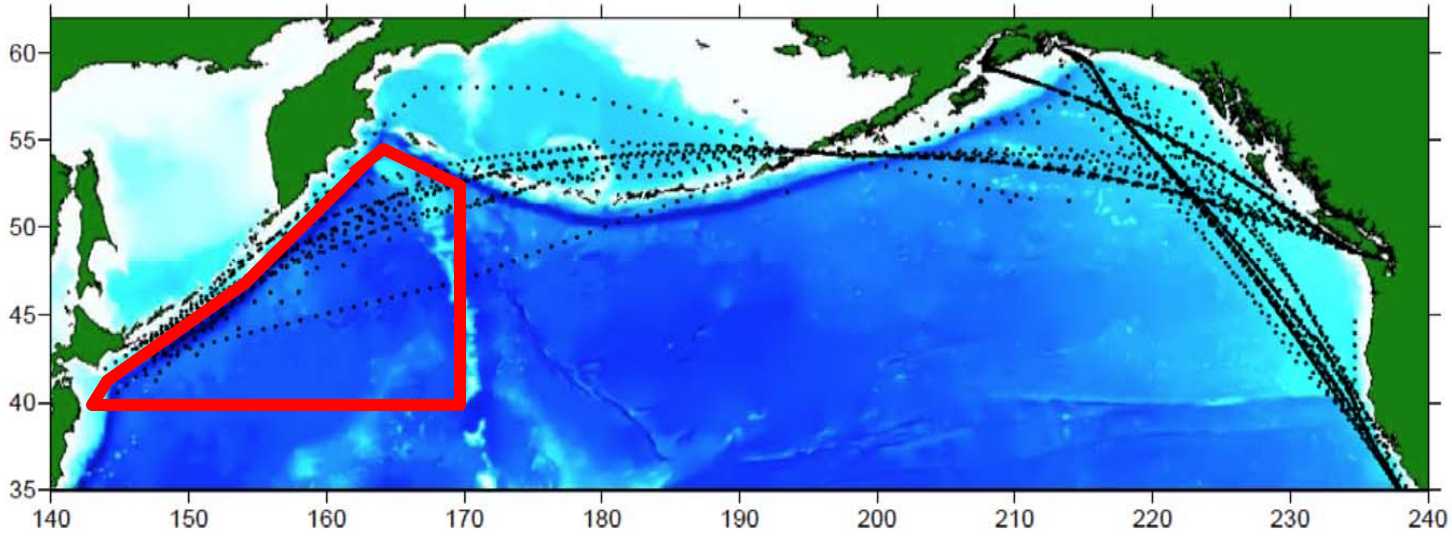




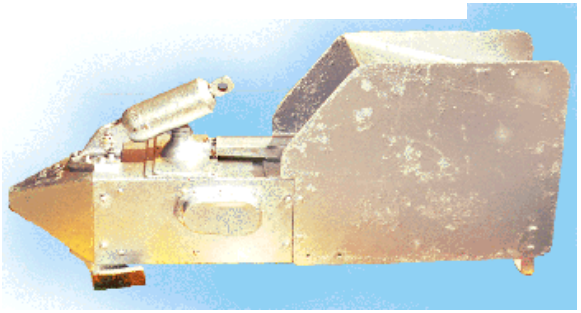


Sanae Chiba, H. Sugisaki, T. Ono, T. Yoshiki and S. Batten
E-mail: chibas@jamstec.go.jp

North Pacific CPR Project (2000~)



Japanese Contribution:
Analysis of data taken < 170° E

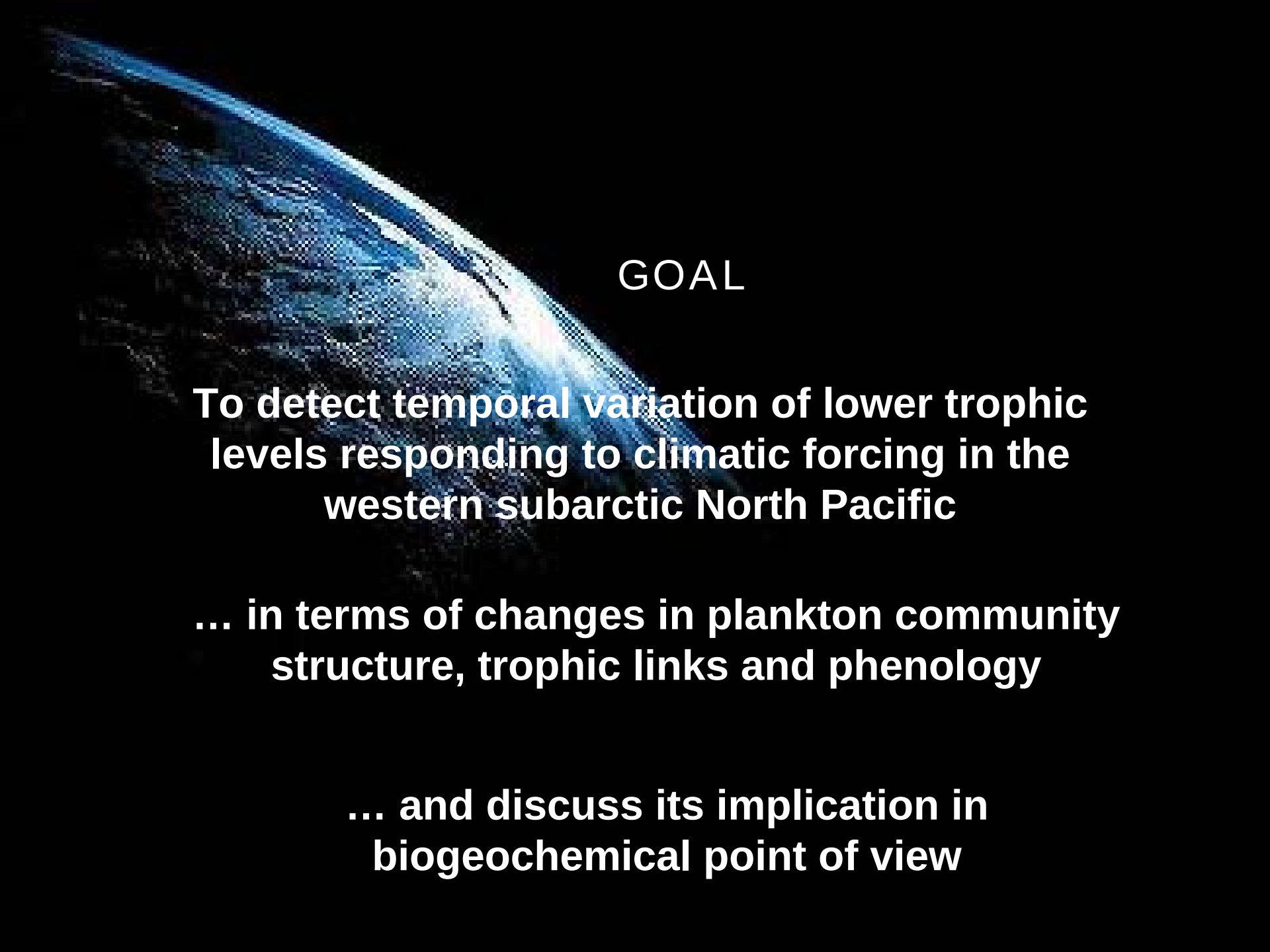


JAMSTEC

Fisheries Resaerch Agency

Fund: JSPS (MEXT)

roll on – roll off cargo ship SKAUBRYN



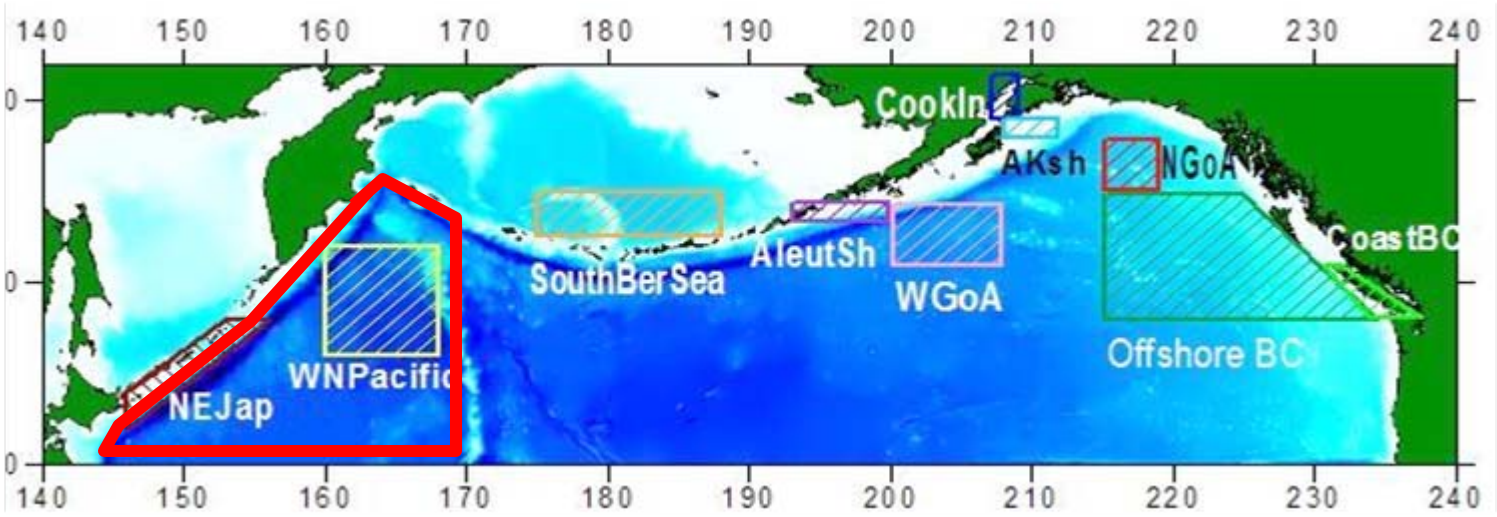
GOAL

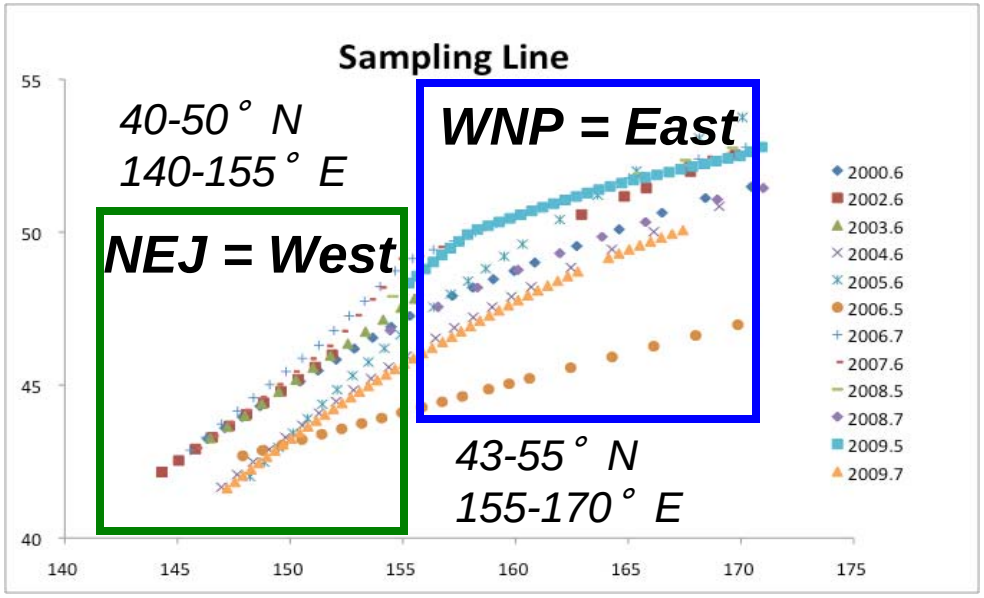
To detect temporal variation of lower trophic levels responding to climatic forcing in the western subarctic North Pacific

… in terms of changes in plankton community structure, trophic links and phenology

… and discuss its implication in biogeochemical point of view

Data for Community Analysis : CPR 2001-2009





3 transects per year (Apr-May, Jun-July, Sept-Oct)

Zooplankton

Neocalanus plumchrus

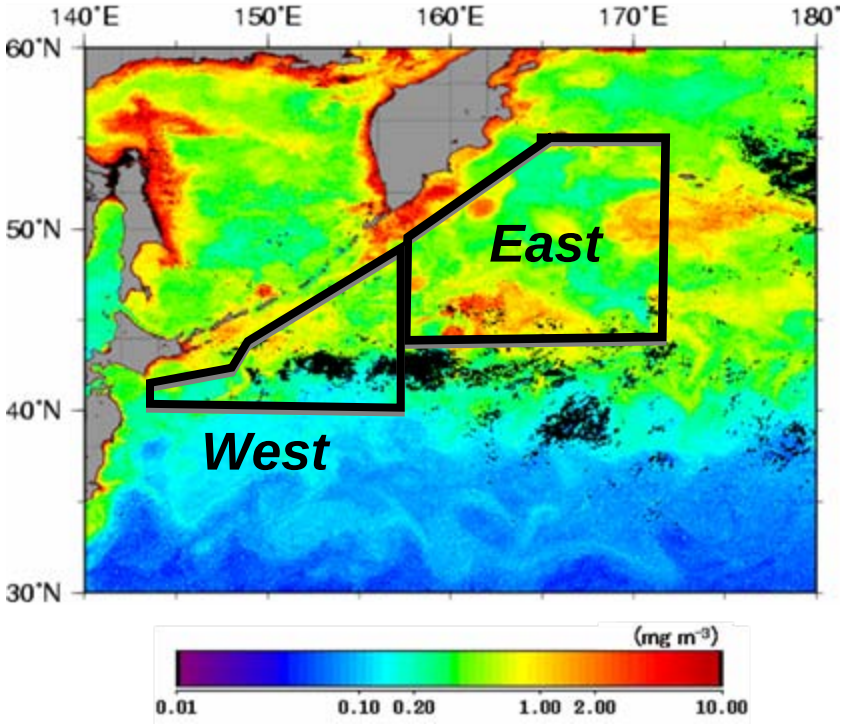
Abundance

Developmental stage composition (Mean copepodite stage)

Phytoplankton

Diatom & Dinoflagellates

Data for Phytoplankton Phenology: Satellite Ocean Color

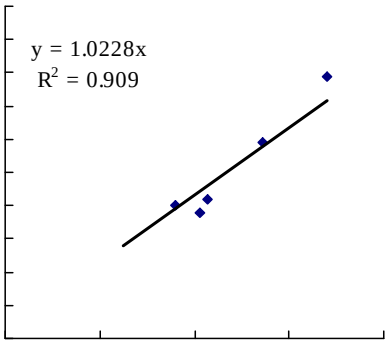


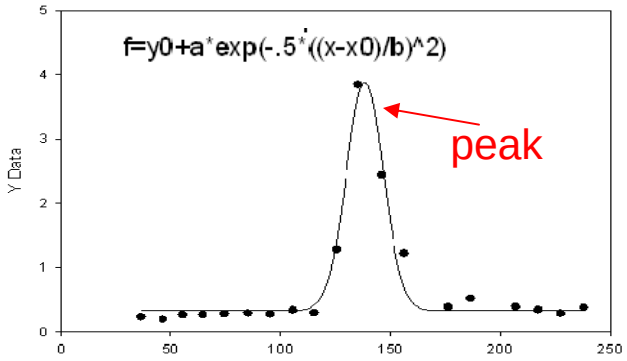
Time-Series Surface Chl a

Area Average Chl a
Feb 1st – August 31st, 2000-2009
Based on 10 days composite of 1° x 1° data

Phenology

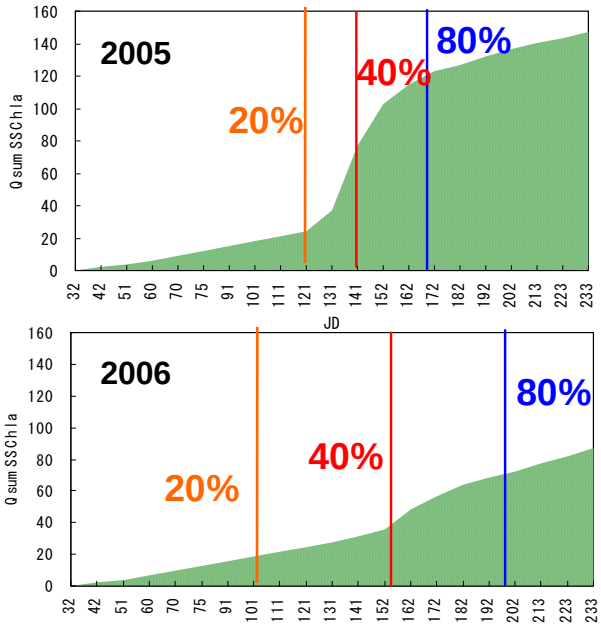
Q-sum Analysis
Julian Day on which Q-sum reaches 40% of overall (Feb-Aug) Q-sum = timing of bloom peak
(based on the Gaussian curve fit analysis)
and that of 20% and 80% = beginning & end of bloom





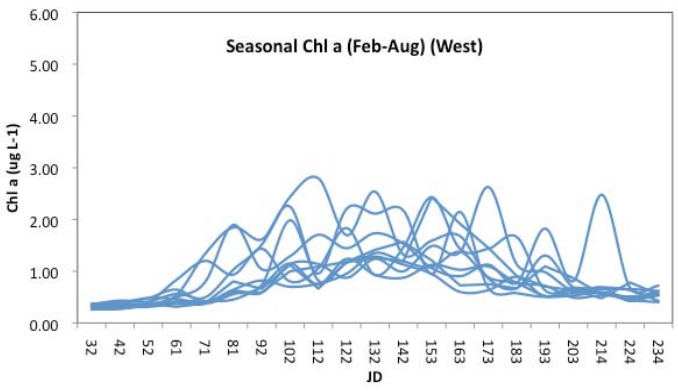
Julian Day

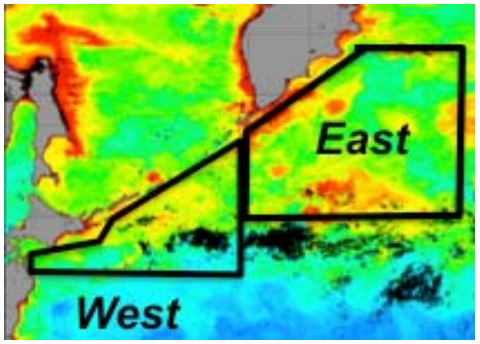
Q-sum Chl a (East)

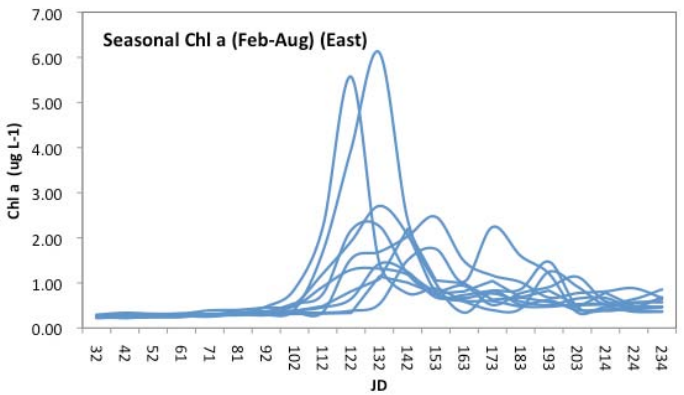


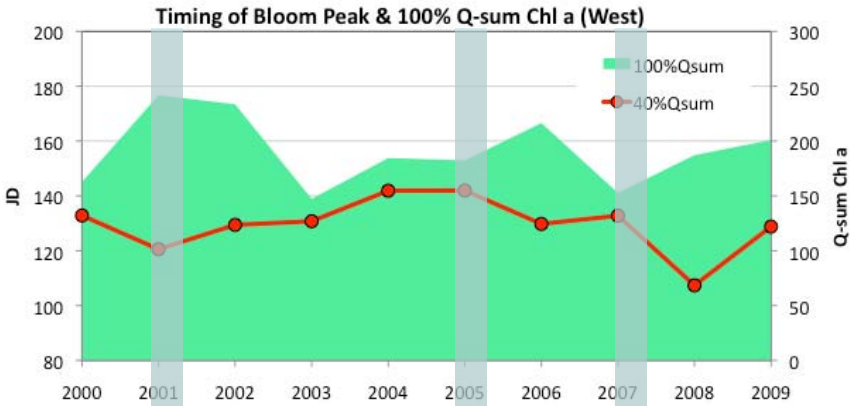
Julian Day

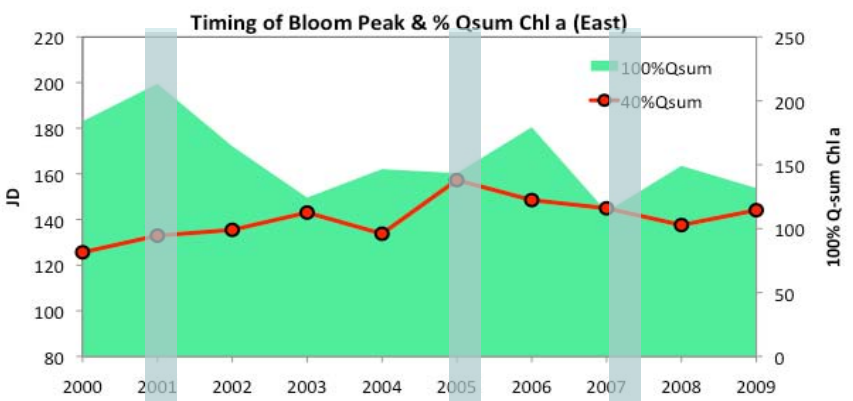
Results :Phytoplankton Phenology

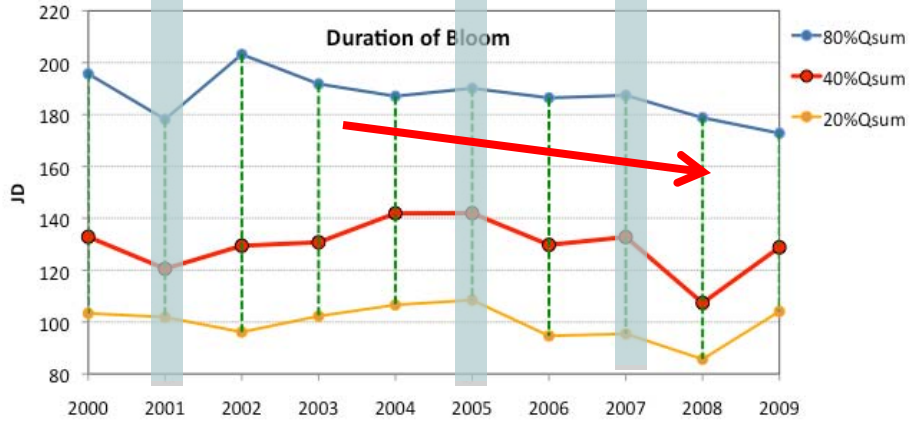


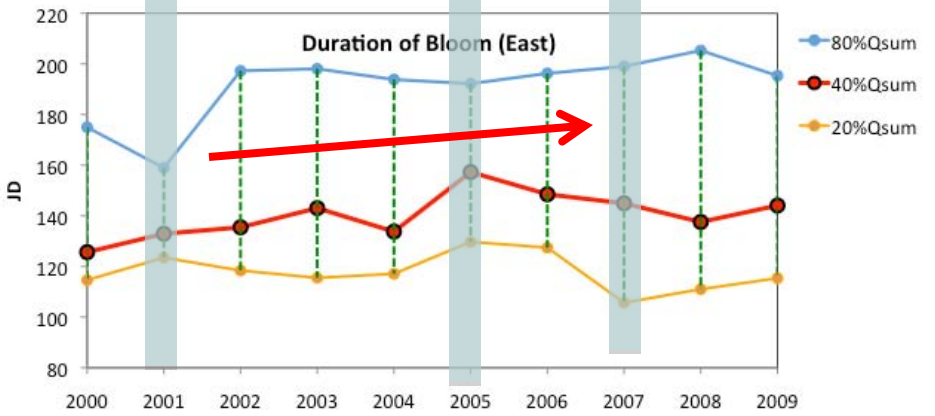




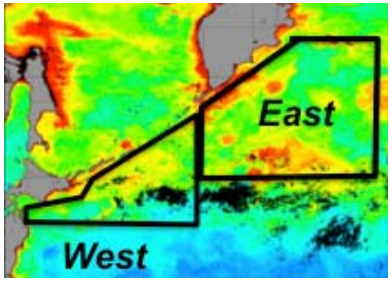


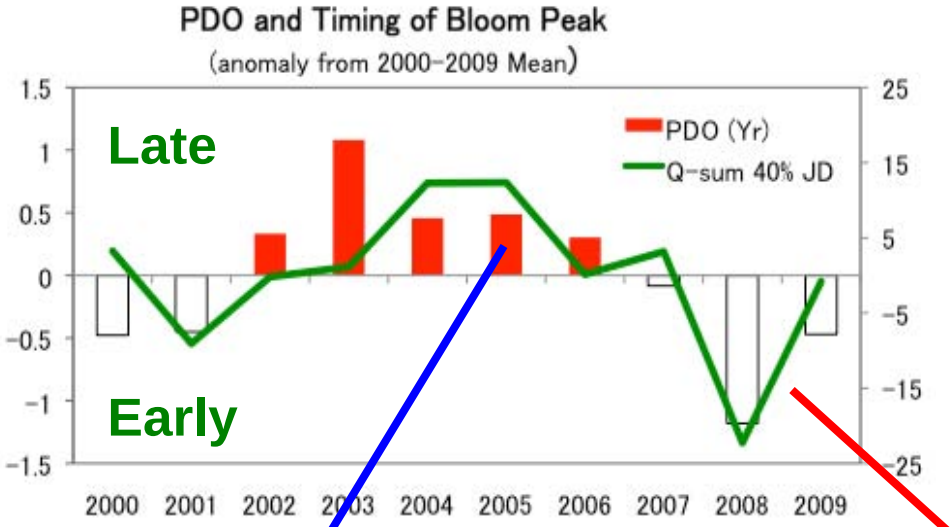


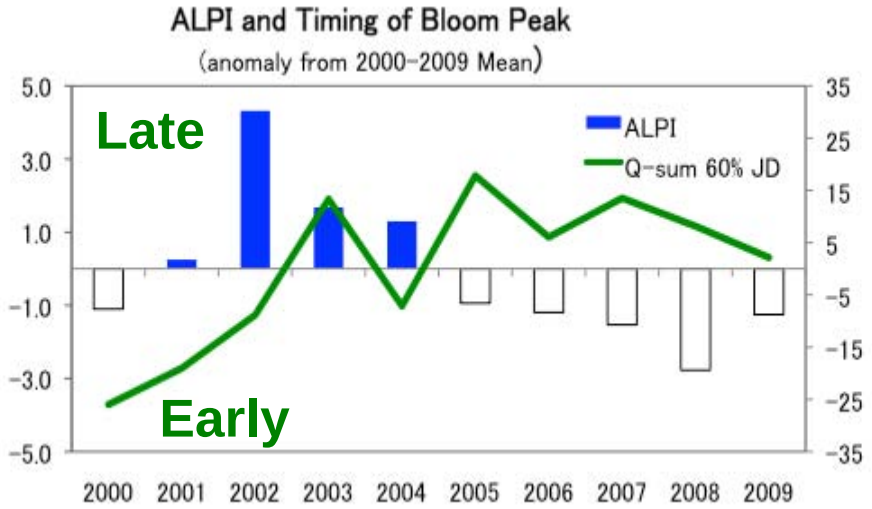


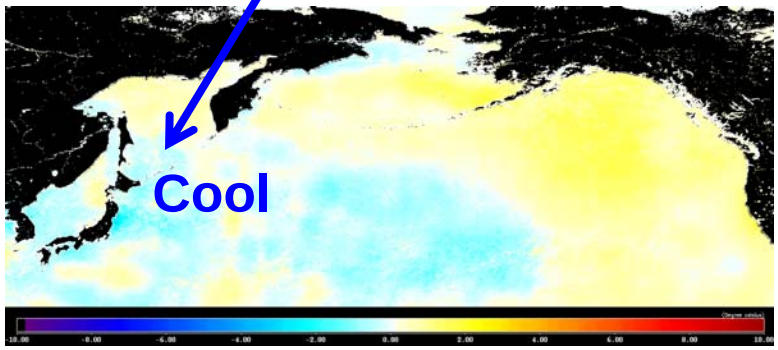


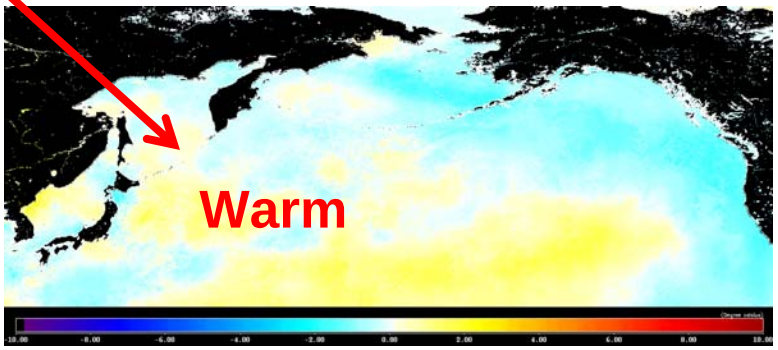
Results :Phytoplankton Phenology & Climate Index









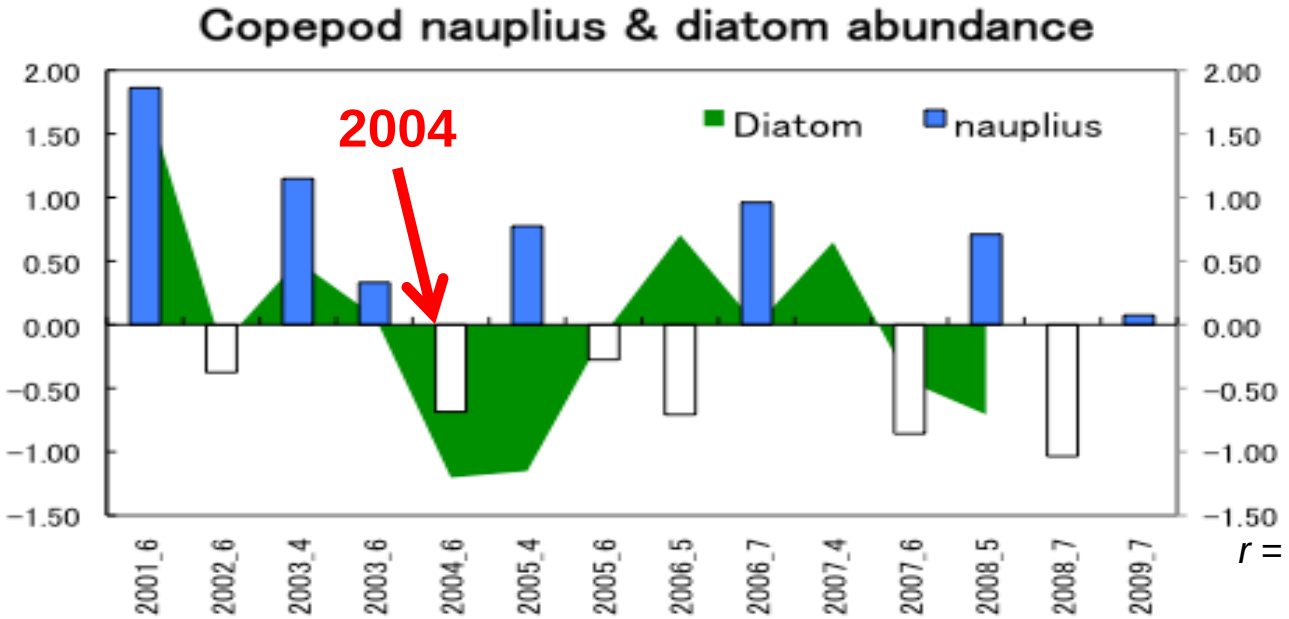


2005 Mar-May SST anomaly

2008 Mar-May SST anomaly

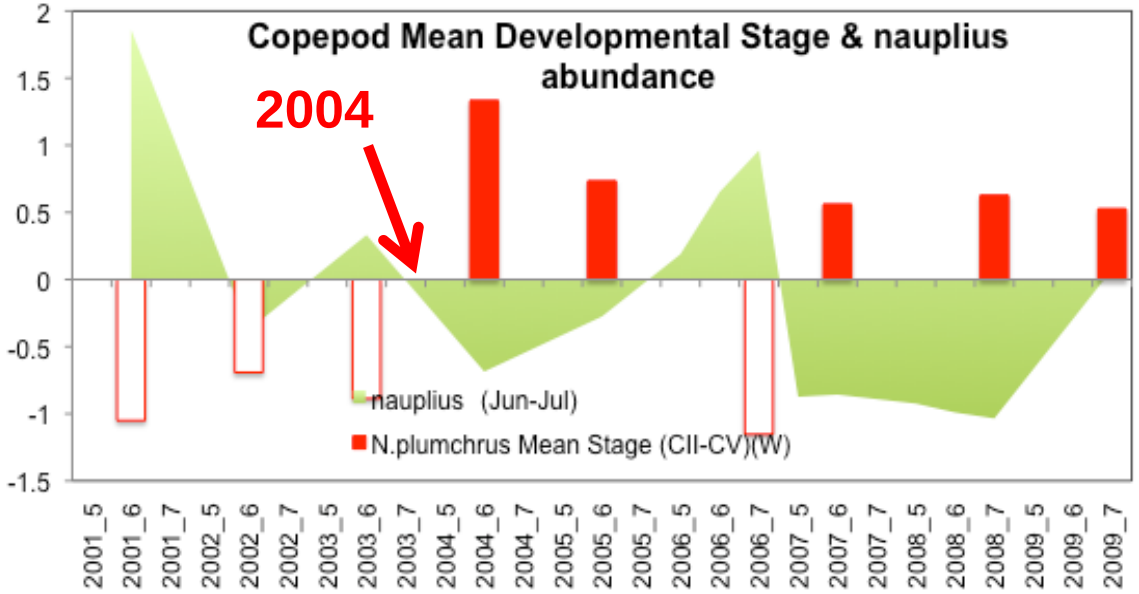
Results : Trophic Link (West)

(Anomaly from Yr-Mon mean)



diatom
X
nauplius

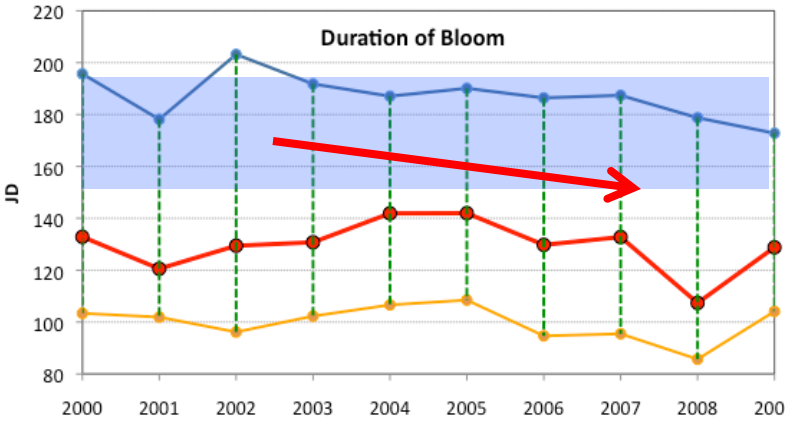
r = 0.944 (for Jun, Jul)

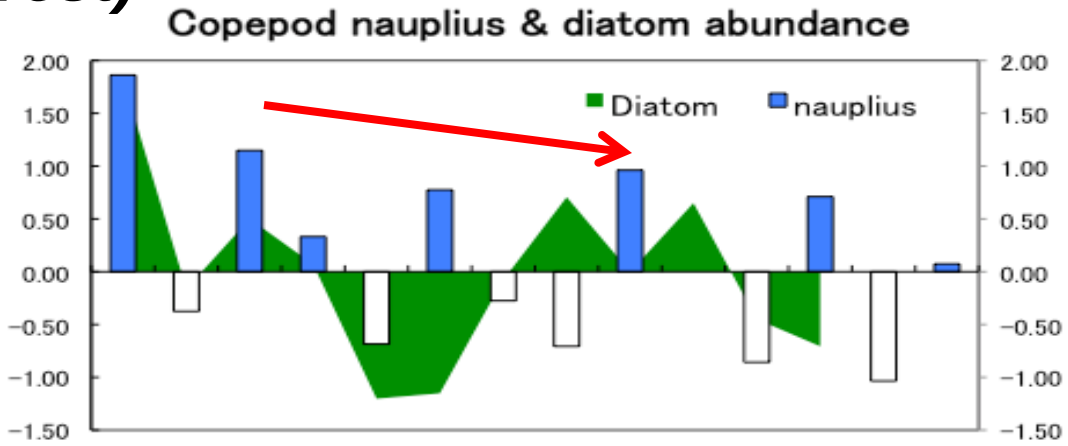


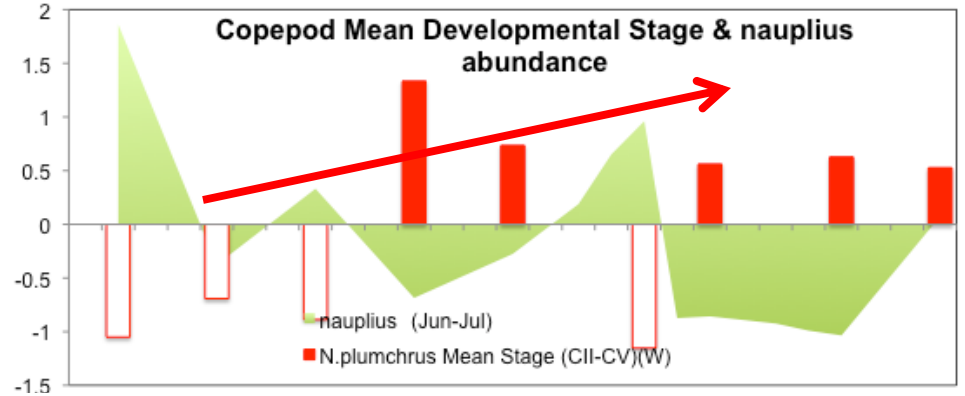
nauplius
X
Neocalanus
development:
Early

r = 0.758 (for Jun, Jul)

Results : Trophic Link (West)

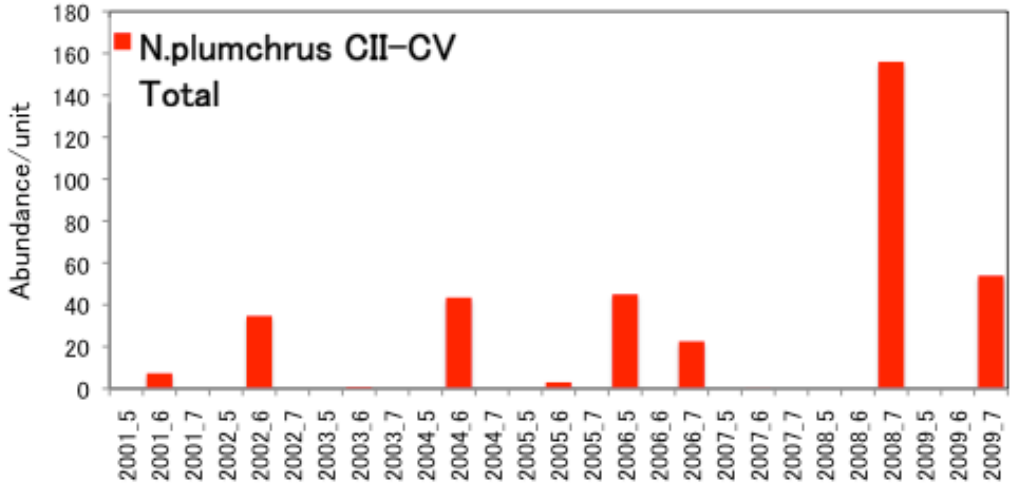




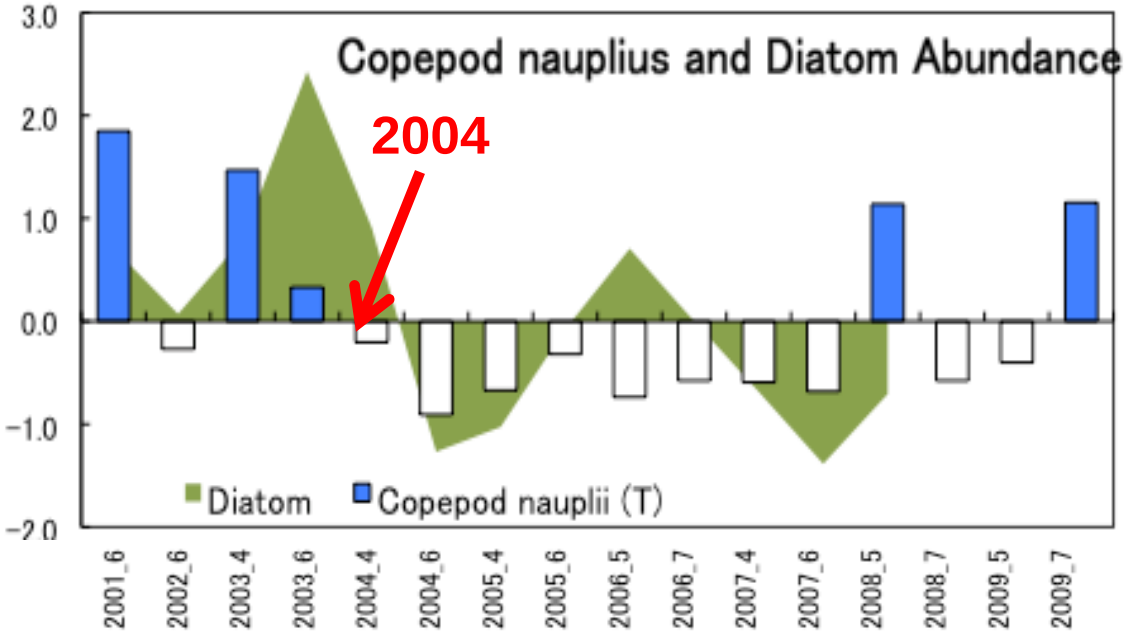


Link?

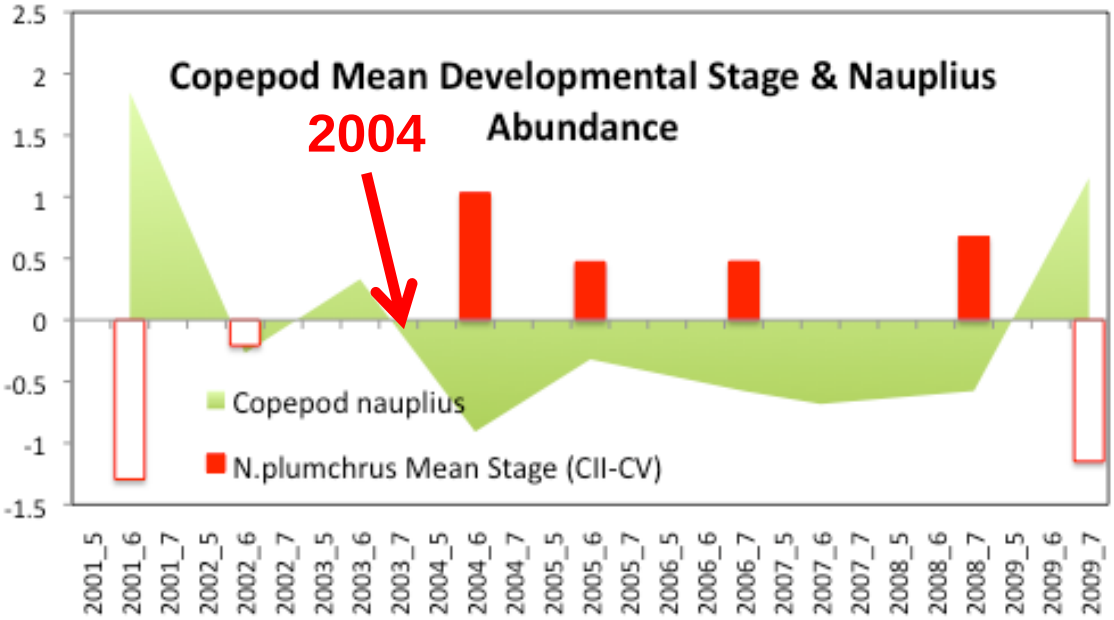
- *Np* phenology
- *Np* abundance



Results : Trophic Link (East)



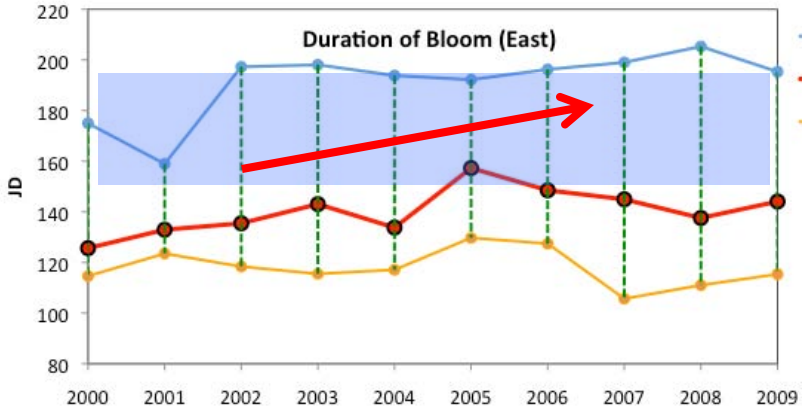
diatom
dinoflagellates
X
nauplius

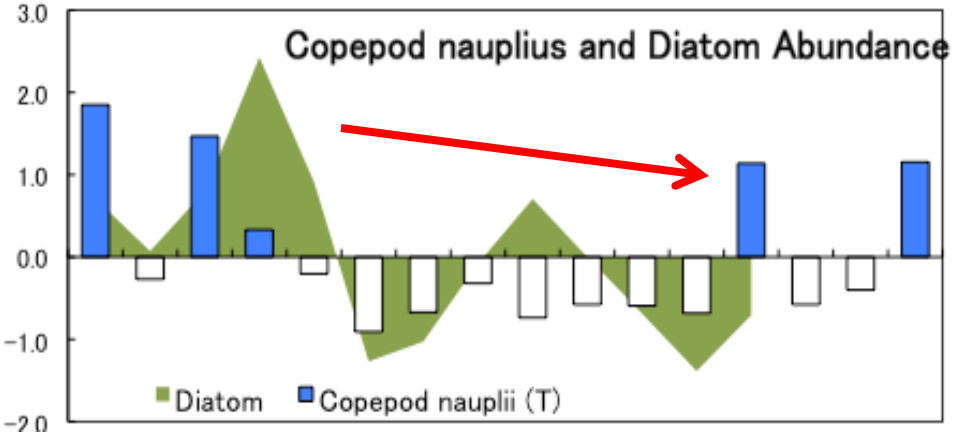


nauplius
X
Neocalanus
development:
Early

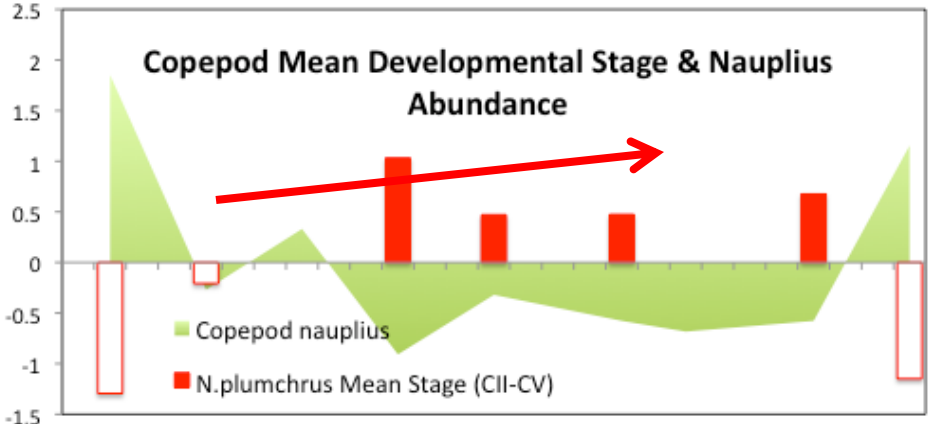
r = -0.957 (for Jun, Jul)

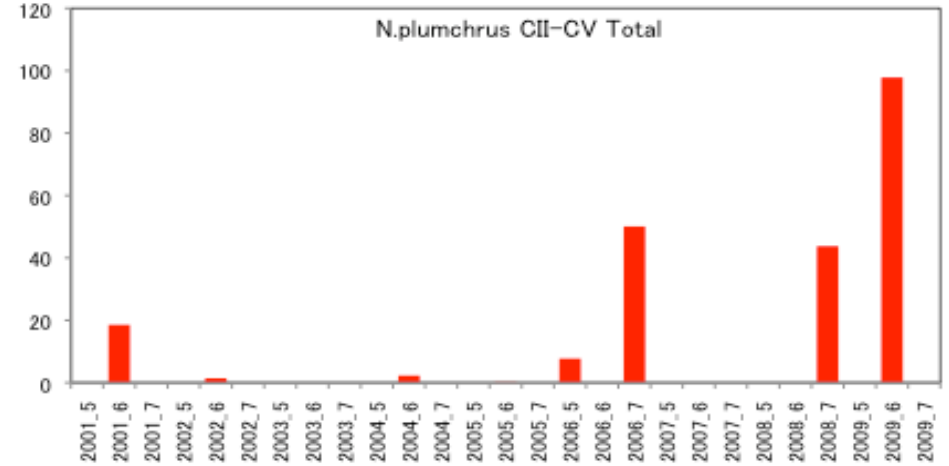
Results : Trophic Link (East)





Np phenology
(nauplius abundane)
vs
Np abundance
r = 0.905 (for Jun, Jul)





Summary: Phenology and Trophic Links

WEST

EAST

PDO – Aleutian Low Dynamics

↓

Cool-**Warm** anomaly

Cool yr => **delayed** bloom peak

Warm yr => **early** bloom peak

Bloom period shifted **Early** for 10 yrs

Bloom peak shifted **Late** for 2000-2005, while bloom period became **longer** after 2006

Diatom & copepod abundance (summer): **decreaed** after **2004**

Diatom, dinoflagellate & copepod abundance (summer): **decreaed** after **2004**

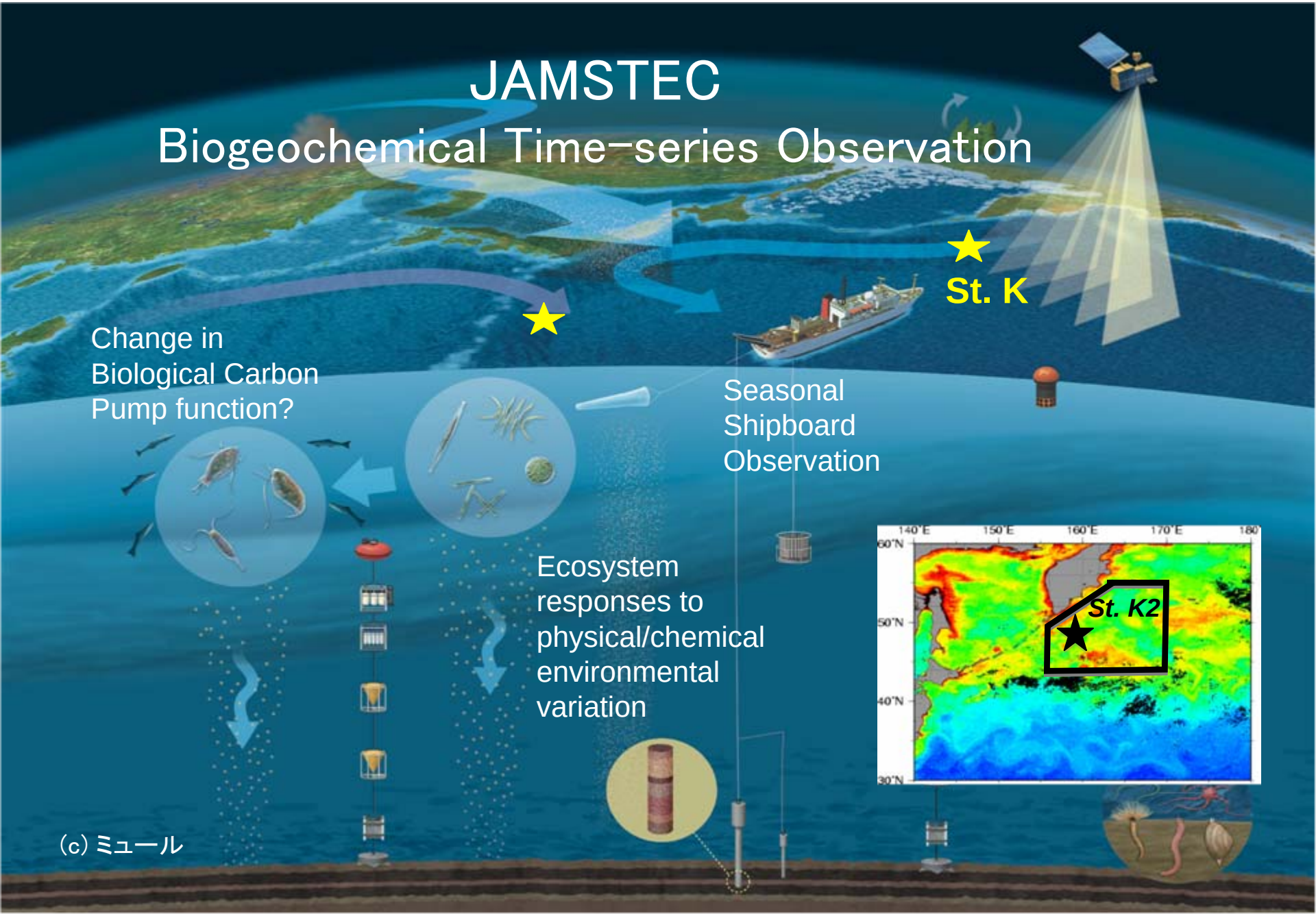
Development timing of *Neocalanus plumchrus* : **Early** after **2004**

Development timing of *Neocalanus plumchrus*: **Early** after **2004**

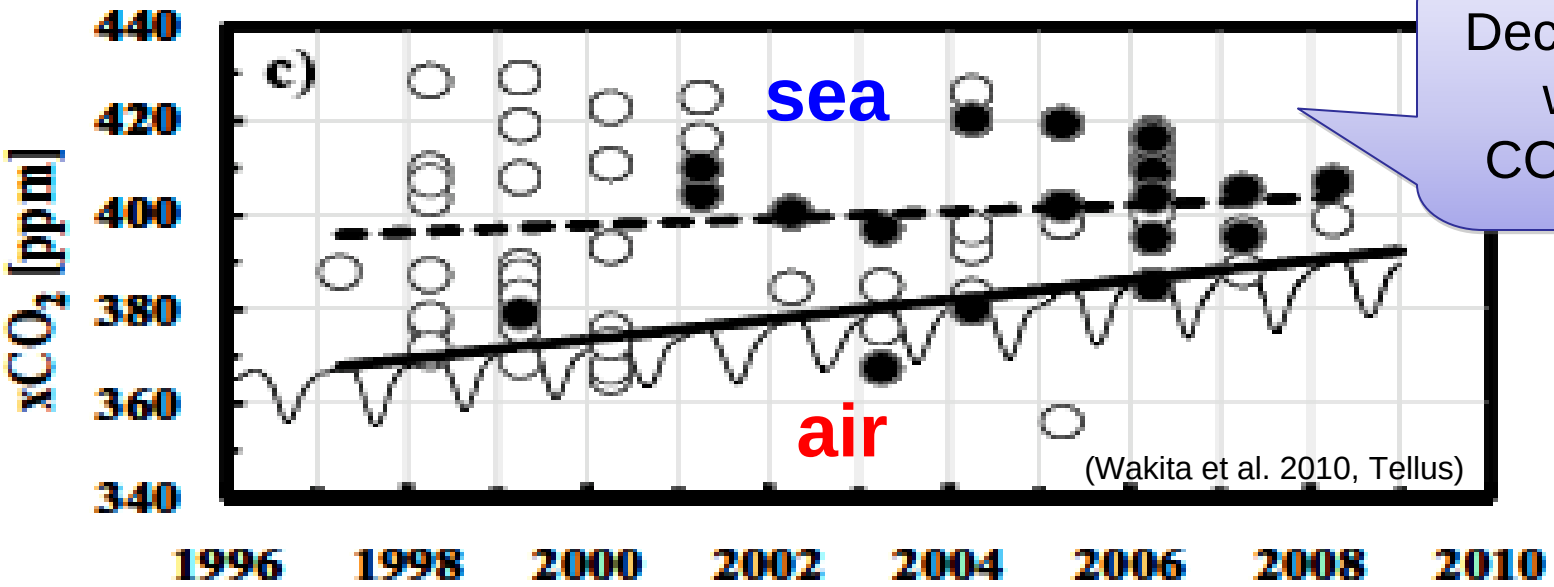
?

copepod abundance

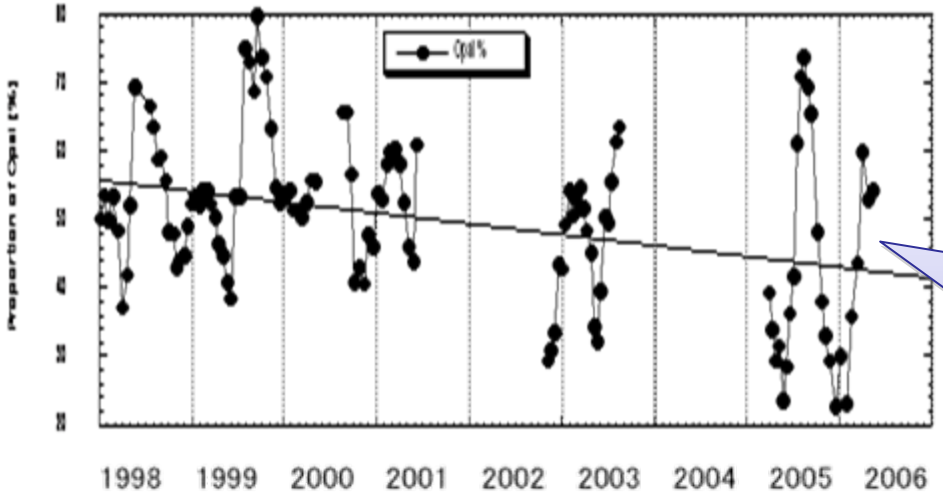
Implication of phytoplankton phenology in biogeochemistry



Implication of phytoplankton phenology in biogeochemistry



Decrease in winter CO_2 uptake

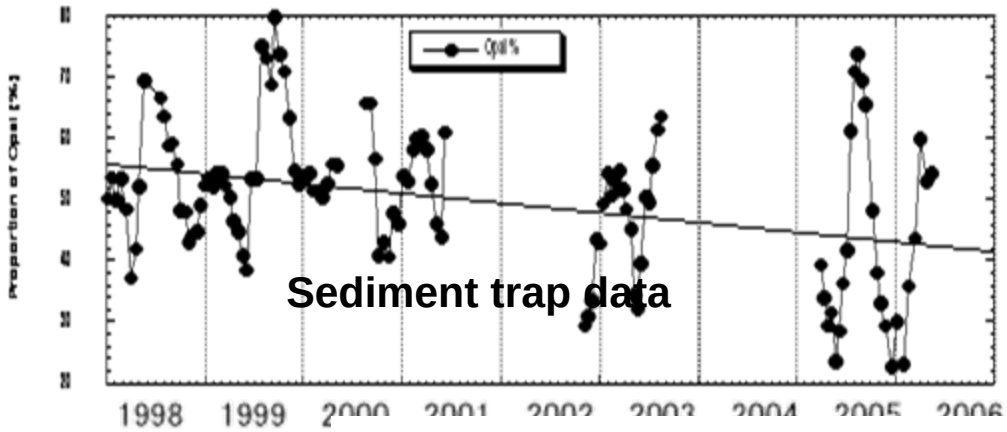


Sediment trap data

Decrease in Opal to $CaCO_3$ ratio flux at 5000 m

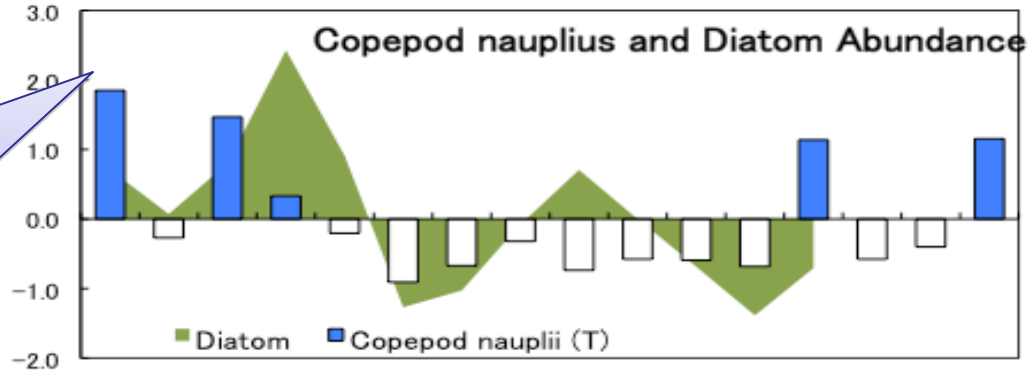
Changes in phytoplankton community & abundance in surface?

Implication of phytoplankton phenology in biogeochemistry

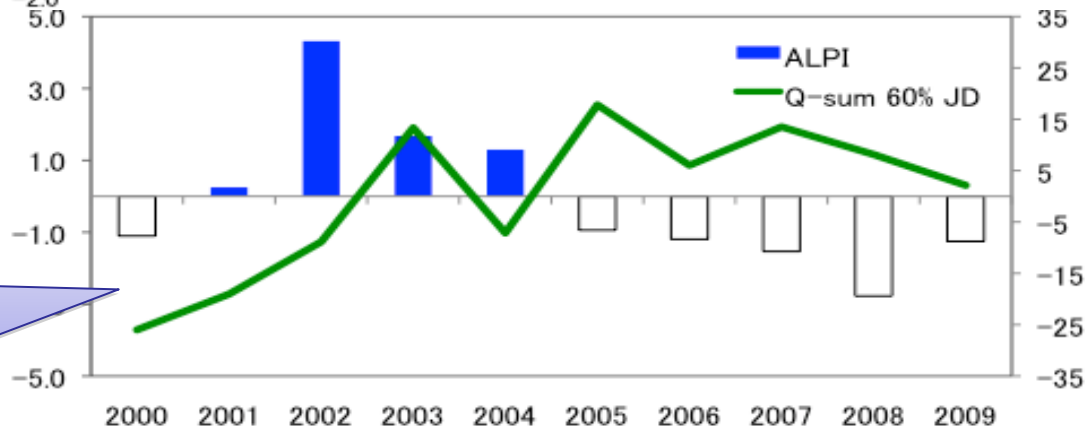


Decrease in Opal to $CaCO_3$ ratio flux at 5000 m

Decrease in Diatom Abundance



Delay in phytoplankton bloom



And… zooplankton roles?

Summary

Interannual Cool-Warm anomaly, which related to Pacific Decadal Oscillation determines Phytoplankton phenology

Marked changes in lower trophic levels around 2004: phytoplankton, copepods nauplius abundance, and *Neoalanus* developmental timing.

Link between *Neocalanus* abundance and phytoplankton abundance & phenology are not clear.

Change in plankton community and phenology might have affect BCP function of these region.