MECHANISMS CAUSING THE INTESE pCO₂ DRAW-DOWN AT THE PACIFIC SUBARCTIC-SUBTROPICAL BOUNDARY

A proposed pilot project to study upper ocean oxygen production

OCB

Float-Glider Workshop  April 2009  Steve Emerson and friends

Mean Annual Air-Sea Flux for 2000

Taro Takahashi data base, www.ldeo.columbia.edu
SEASONALITY IS VERY IMPORTANT

Ocean Color - Summer

Ocean Color - Winter

\[ \Delta pCO_2 \] - Summer

\[ \Delta pCO_2 \] - Winter
HOW IMPORTANT ARE BIOLOGICAL PROCESSES?

Lessons From The Eastern North Pacific

[Graph showing various data trends over latitude (N)]
PROPOSAL: Deploy a Group of Floats at Subtropical-Subarctic Boundary in the Western North Pacific

Dana Swift Holding an ARGO Float

Float End Cap Showing O₂ Sensors

Riser and Johnson, 2008 Figure 4 showing Net Biological Carbon Production determined from Argo O₂ Data
IF WE PUT ARGO FLOATS INTO THE OCEAN IN THE WESTERN PACIFIC AT THE GYRE BOUNDARY WHERE DO THEY GO?
COLLABORATIONS: THE JAPANESE PACIFIC CARBON PROGRAM

Toshiro Saino (Personal communication)

Two Time Series Stations: K2 and S1

Mirai Cruises Between them:

Feb, Nov 2010; Feb, Apr, July 2011
DOES THE SUBSURFACE O$_2$ MAXIMUM RESOLVE BIOLOGICAL PRODUCTIVITY?

Riser and Johnson (Nature 2008) derived subsurface O$_2$ production from ARGO float data.

LESSONS FROM THE E. NORTH PACIFIC:

The subsurface $\Delta$O$_2$-$\Delta$Ar Maximum Is not at the same latitude and is much smaller than the:

Total net biological oxygen flux.
SUMMARY

PROBLEM: - Massive pCO₂ Draw-Down at Subarctic-Subtropical Boundary of the North Pacific Biological and Physical Mechanisms?

FLOATS? - Measure Net Biological O₂ Production
- Strong Seasonality Requires High Temporal Coverage

LOGISTICS: - Collaboration with Japanese Carbon Cycle Prgm
- Crosses Hydrography lines for Calibration

ISSUES: - Requires High Accuracy Calibration at Surface; Calibration at Depth?

PLAN: - Deploy XX Argo Floats in W. Pacific; 35 – 45 N Anderaa O₂ Sensor (Both?); Some NO₃ sensors
O2/Ar, chlorophyll, surface NO3
Leg 2: 145 W
% Biol. O$_2$ sat. and fCO2
Leg 2: 145 W
TN224 \((\Delta O_2 - \Delta Ar)\) (%) along 152 W
Net Biological $O_2$ production in the euphotic zone along 152 W (Evan Howard, calculation)

August/September 2008 net biological oxygen flux ($J$)

- **Leg 2**
- **Leg 3**
- **Leg 4**
- **Nitrate Leg 3 (umol L$^{-1}$)**
- **10xChlorophyll-a Leg 3 (mg m$^{-3}$)**
Proposal for Mirai Cruises

Time series cruises to study seasonal variability of end-to-end food web Dynamics and biogeochemical cycles

Multidisciplinary Cruise
IORGC, MIO, XBR FRCGC + outside JAMSTEC

Comparison of North and South stations
Different response to the same external forcing

Whole year round coverage for the first time

Collaboration with satellites obs. group as well as 4DDA res. group
2 stations: K2 and S1

K2: 47N, 160E
S1: 30N, 145E
KEO: 32-20N, 144-30E
J-KEO: 38-05N, 146-25E
Seasonality is Very Important

$\Delta pCO_2$

February

August
Cruise Track for TN224 Student Cruise August/September 2008