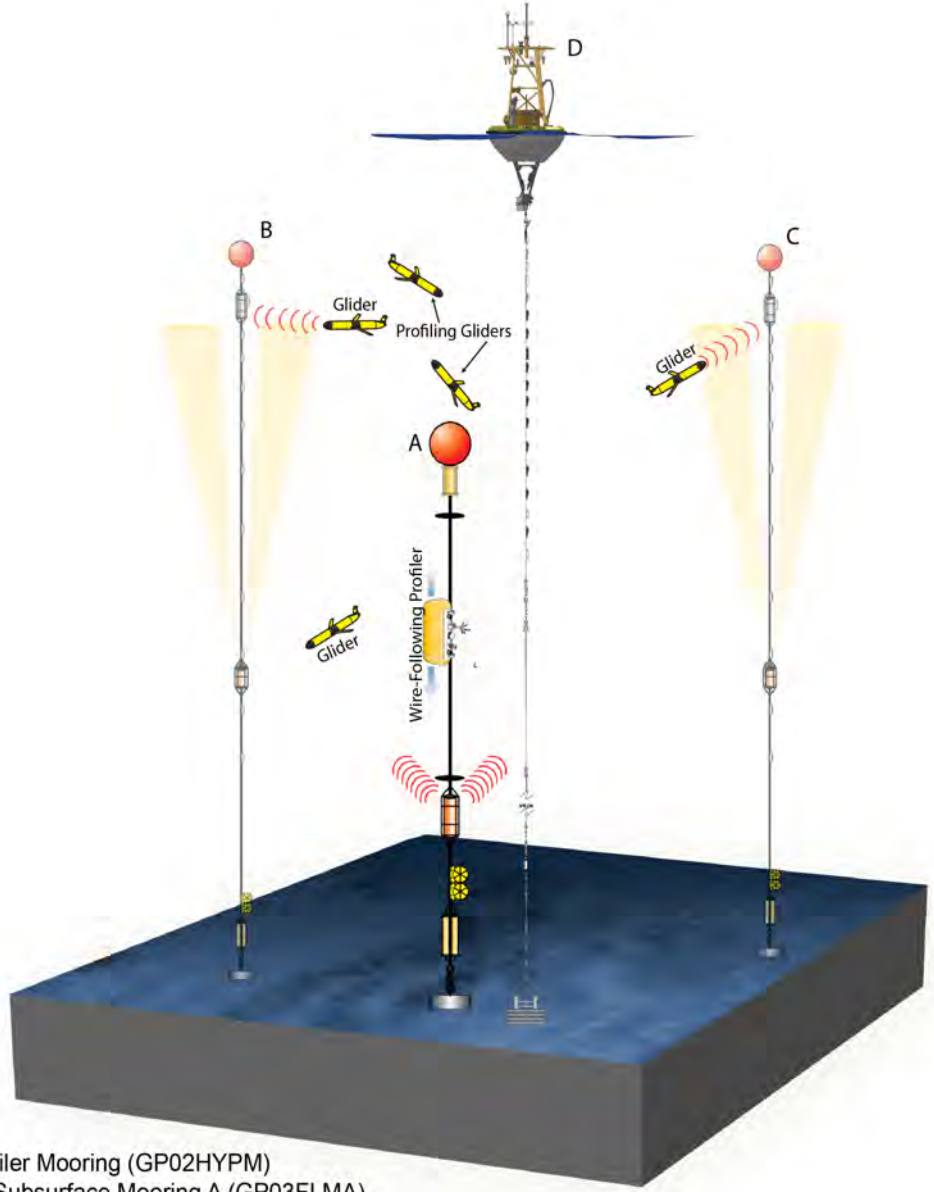
OOI Global Array: PAPA

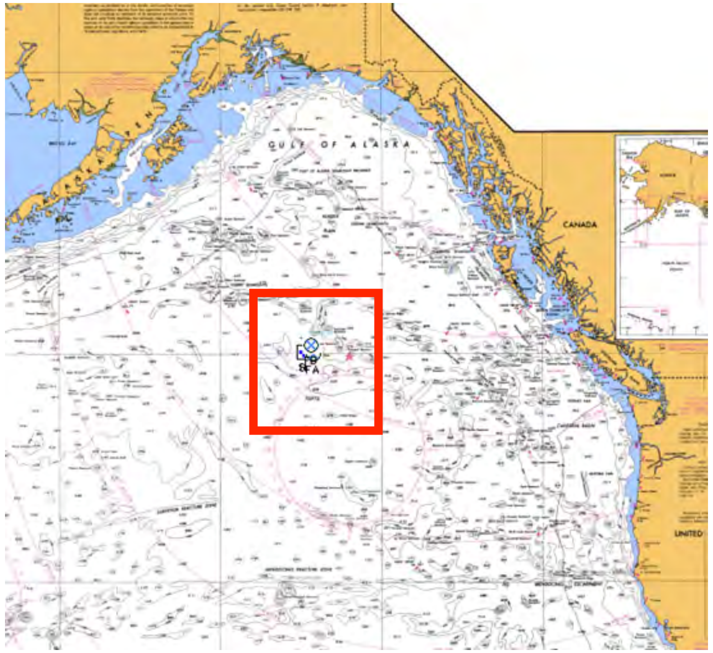
What is there? Why is it there and what it can measure? What can't it do?

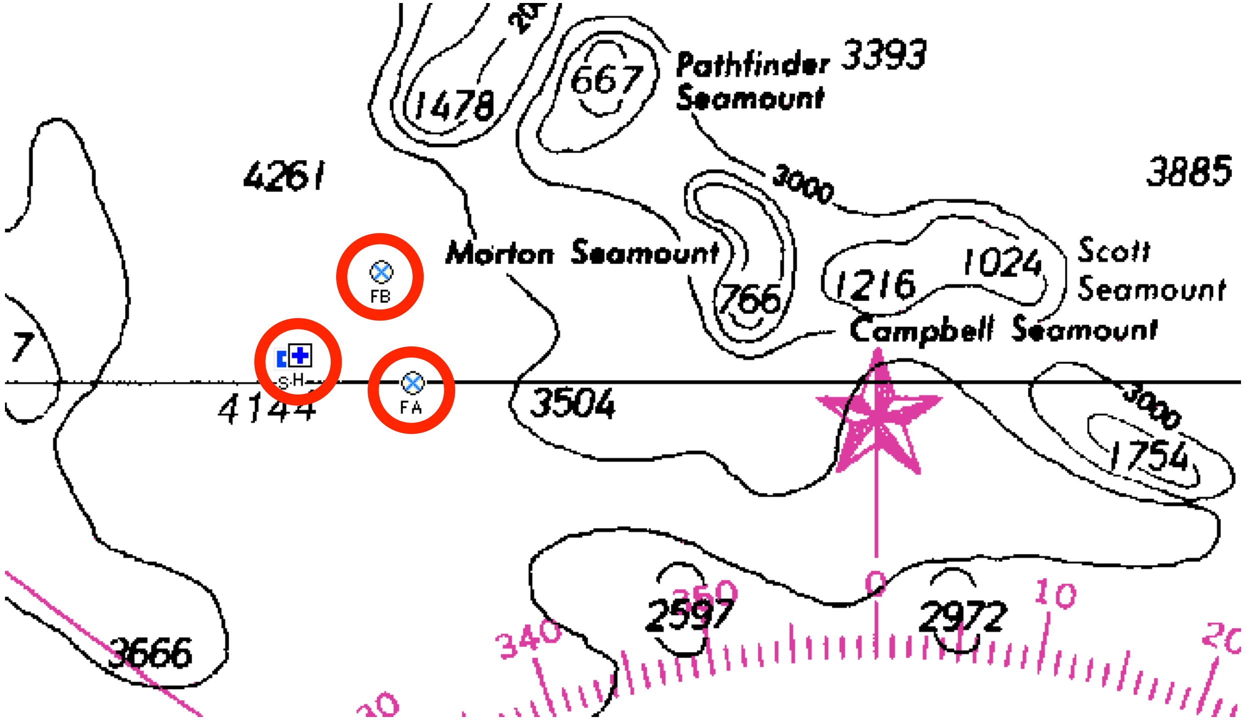
Robert Weller, WHOI
rweller@whoi.edu

Global Station Papa



(A) Apex Profiler Mooring (GP02HYPM)
(B) Flanking Subsurface Mooring A (GP03FLMA)
(C) Flanking Subsurface Mooring B (GP03FLMB)
(D) NOAA PMEL Station Papa Surface Mooring
Mobile - Open Ocean Glider (GP05MOAS-GL)
Mobile - Global Profiling Glider (GP05MOAS-PG)

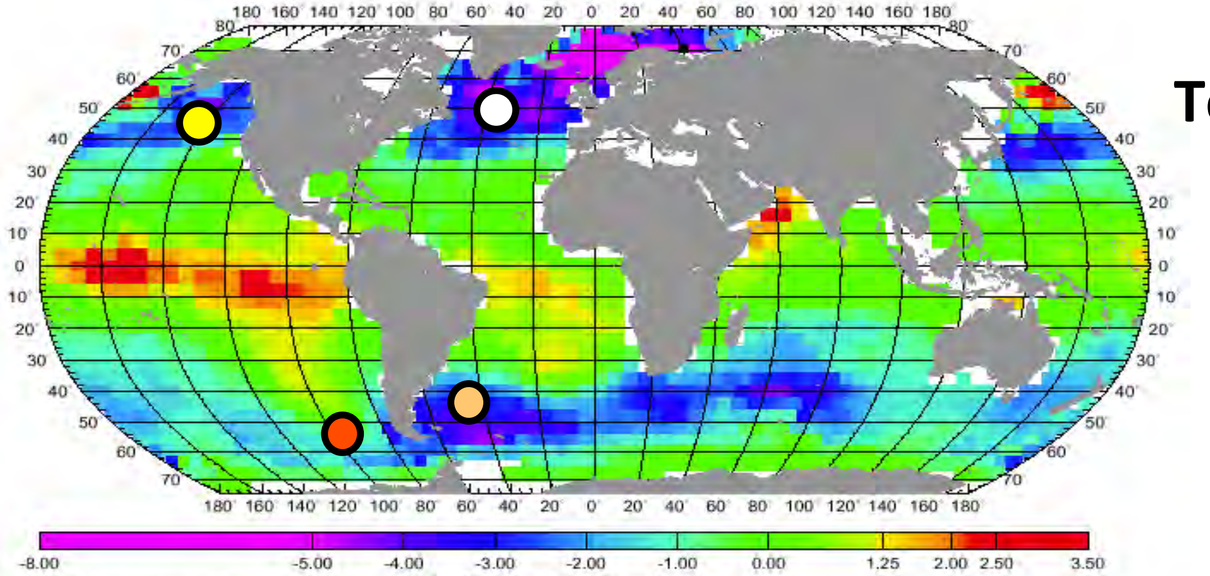




OOI science themes driving global component

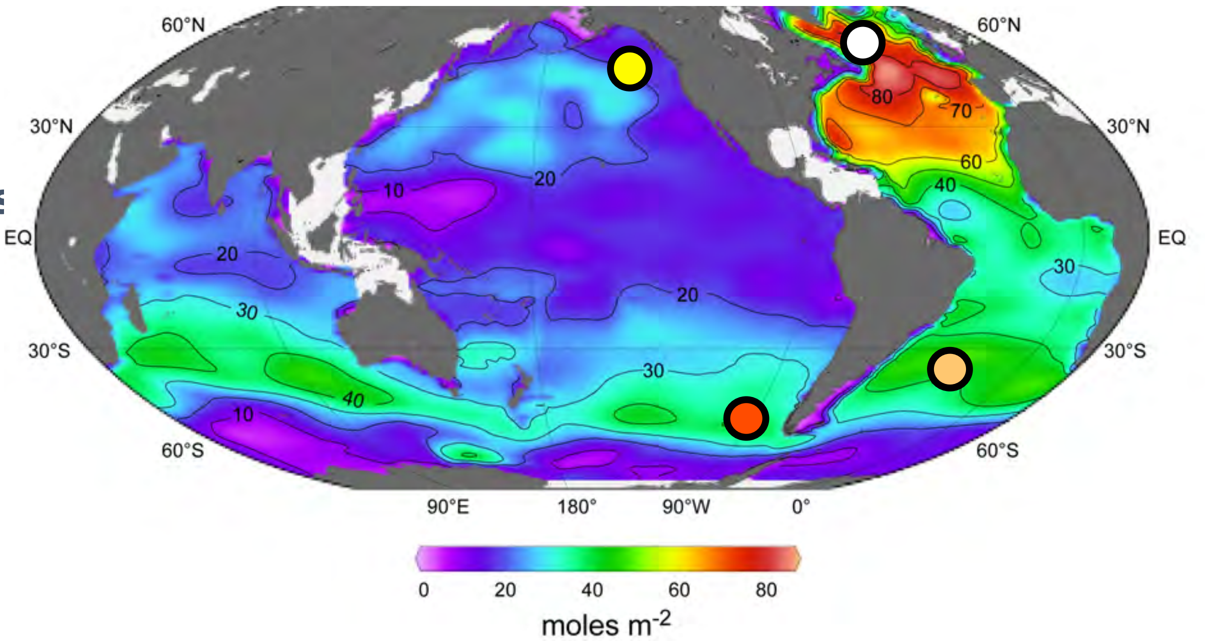
- **Carbon cycle and acidification**
  sequestration is global, depends on open-ocean phys./biol. processes
- **Ocean-Atmosphere exchange**
  heat, momentum, freshwater fluxes/budgets are set in the open ocean
- **Ocean Circulation**
  sets biogeochem.inventories&spreading, propag. of signals, stratification&mixing
- **Climate and ecosystems**
  variability has basin-scale mechanisms/footprints, ecosystem impacts

Global carbon cycle processes and acidification



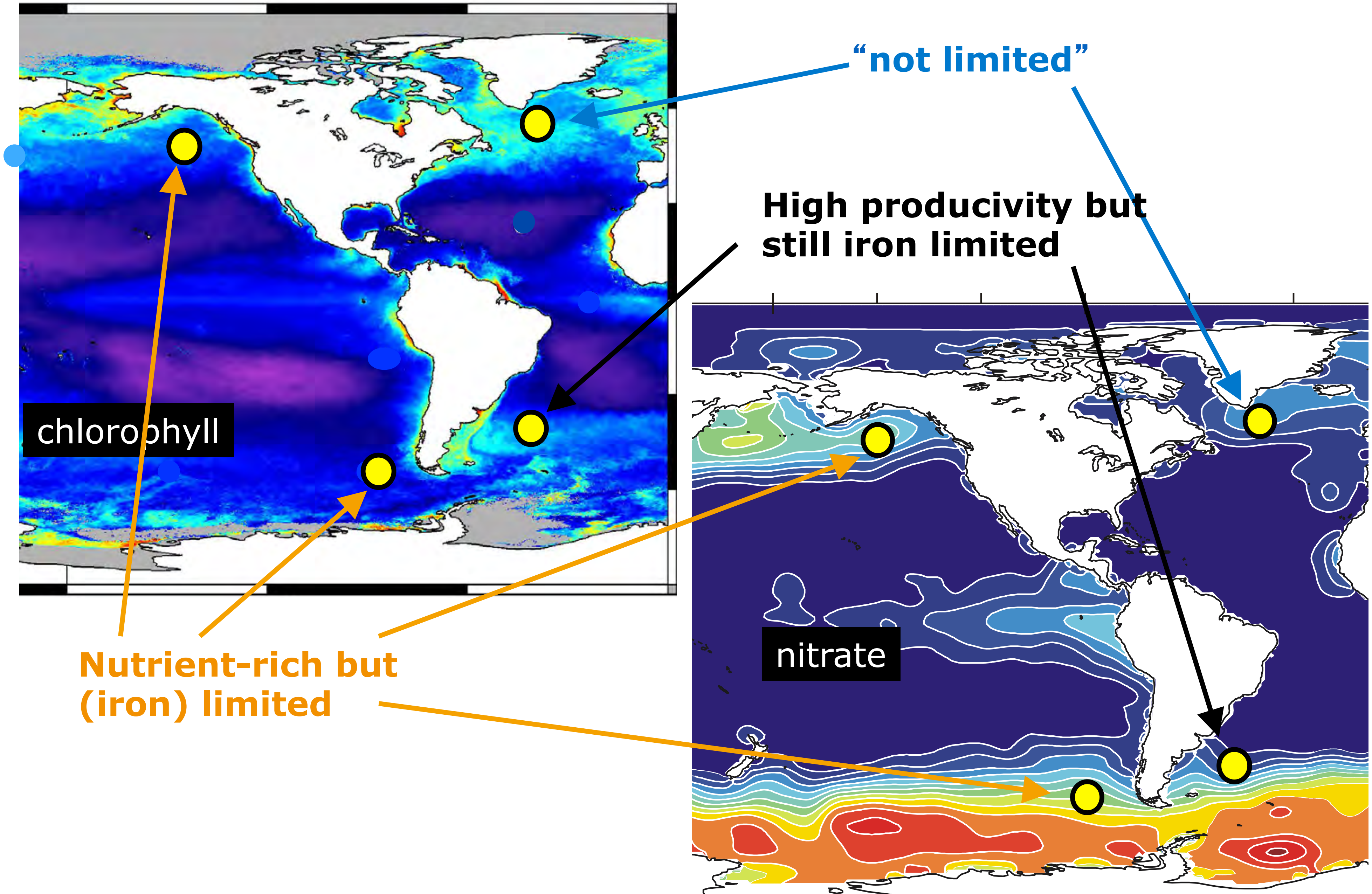
Total CO_2 flux

Anthropogenic CO_2 inventory

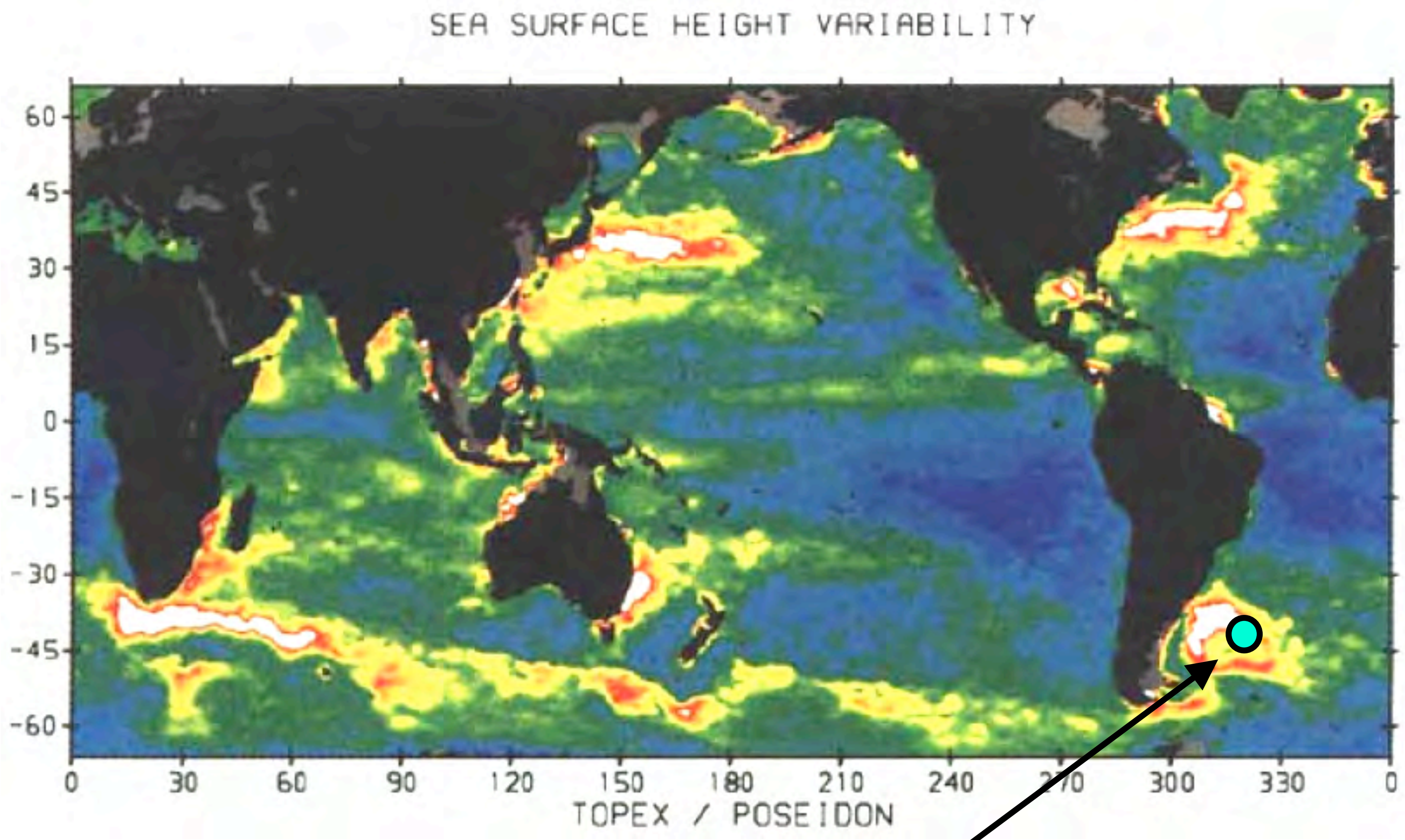


Observe fluxes and inventory changes, AND physical/ biological processes that determine and modulate them

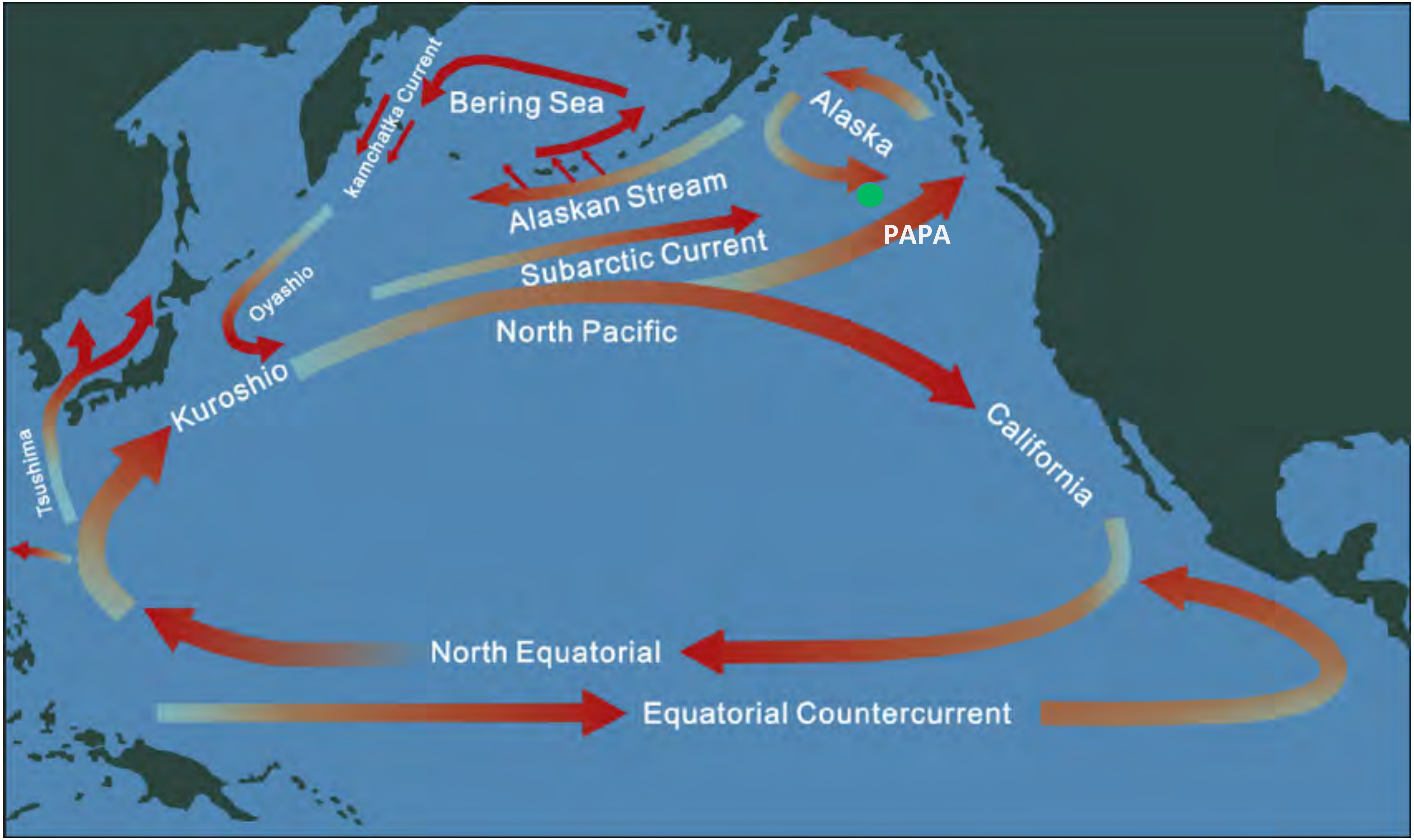
Contrasting ocean productivity regimes



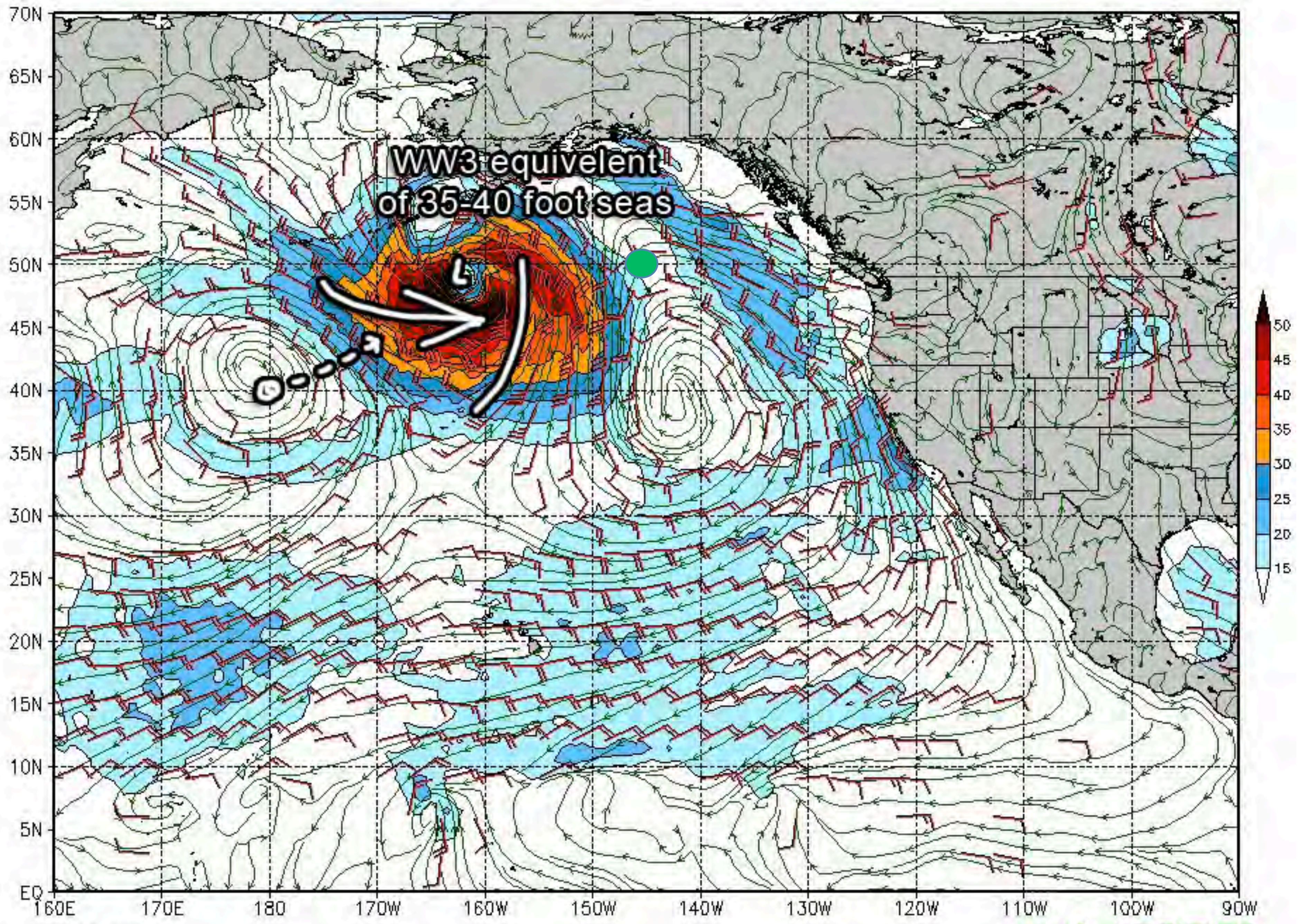
Circulation variability



Energetic circulation variability



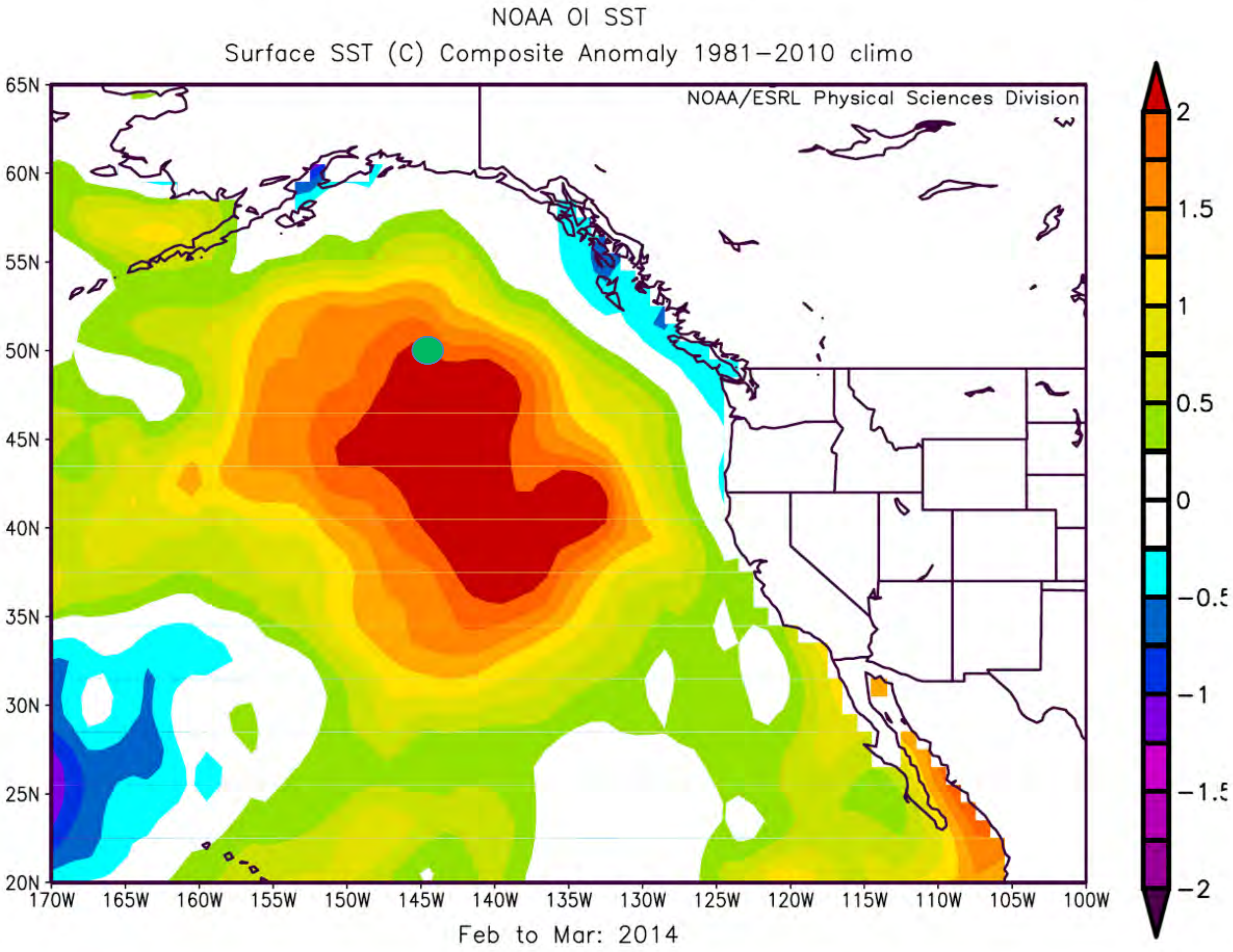
Bering Sea
kamchatka Current
Alaska
Alaskan Stream
PAPA
Subarctic Current
Oyashio
North Pacific
Kuroshio
California
Tsushima
North Equatorial
Equatorial Countercurrent



VT: Tue 12Z 14 APR 15
FNMOC NAVGEM (U): Surface (10m) Isotachs, Barbs, Streamlines [kts]
Run: 2015040906Z Tau: 126

UNCLASSIFIED

Approved for public access. Distribution is unlimite


NOAA OI SST
Surface SST (C) Composite Anomaly 1981–2010 climo
NOAA/ESRL Physical Sciences Division
65N
60N
55N
50N
45N
40N
35N
30N
25N
20N
170W
165W
160W
155W
150W
145W
140W
135W
130W
125W
120W
115W
110W
105W
100W
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2
Feb to Mar: 2014

A Brief History of Ocean Station P/Line P

ATLANTIC

Sta.	Position	Operator
A	62°00' N; 33°00' W	U.S. & Neth.
B	56°30' N; 51°00' W	U.S.
C	52°45' N; 39°30' W	U.S.
D	41°00' N; 41°00' W	U.S.
E	35°00' N; 48°00' W	U.S.
H	36°00' N; 70°00' W	U.S.
I	61°00' N; 15°00' W	U.K.
J	52°30' N; 20°00' W	U.K.
K	45°00' N; 16°00' W	France
M	66°00' N; 02°00' E	Norway

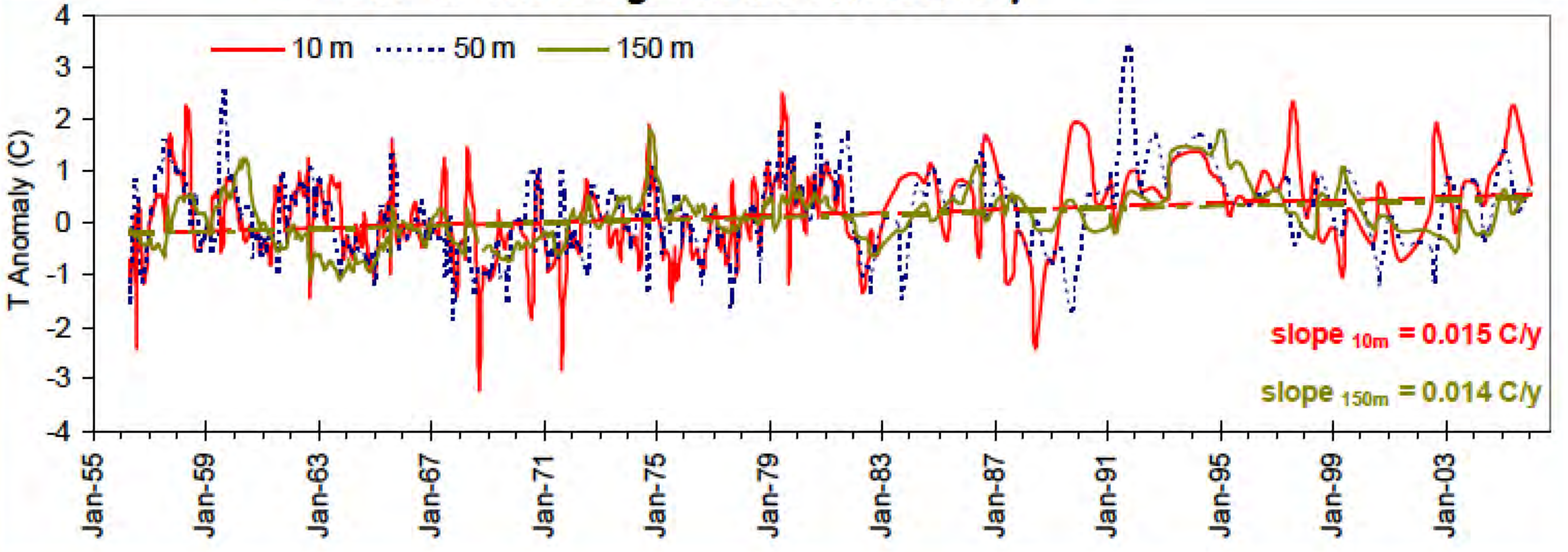
PACIFIC

Sta.	Position	Operator
N	30° N; 140° W	U.S.
P	50° N; 145° W	Canada
V	34° N; 164° E	U.S.

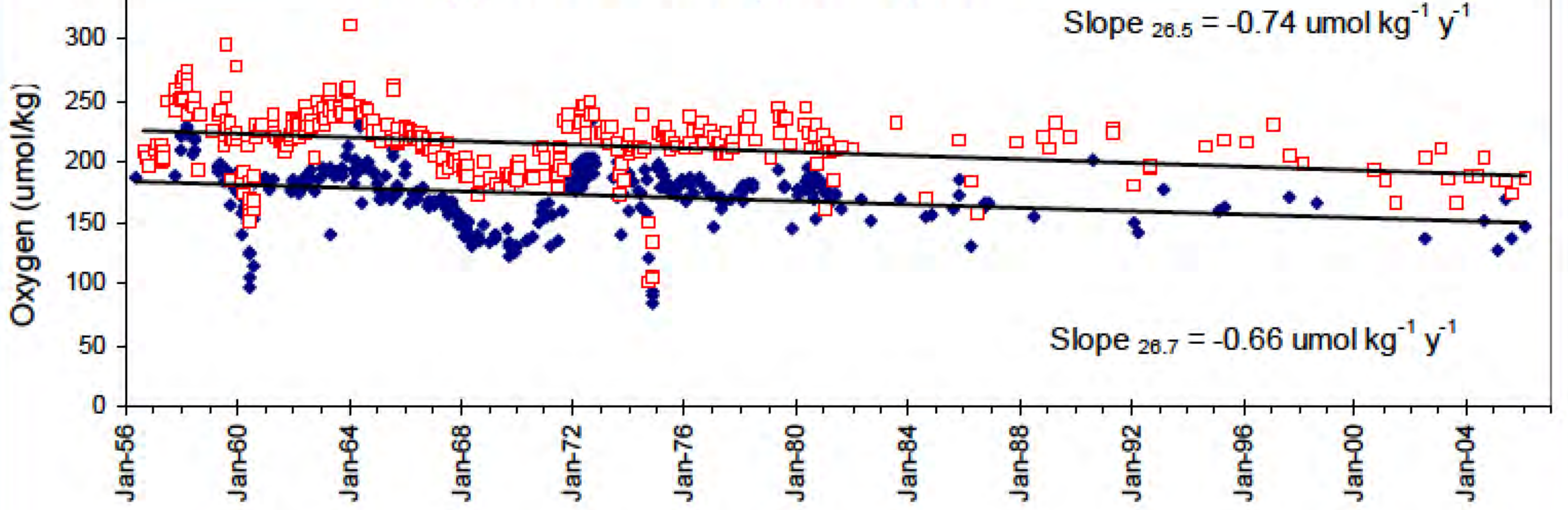
Frank Whitney

With thanks to S Tabata,
H Freeland and M Robert

Heat is entering ocean effectively



Oxygen is declining at depth



An Observational and Numerical Investigation of the Climatological Heat and Salt Balances at OWS Papa

W. G. LARGE

National Center for Atmospheric Research, Boulder, Colorado*

(Manuscript received 11 April 1995, in final form 25 January 1996)

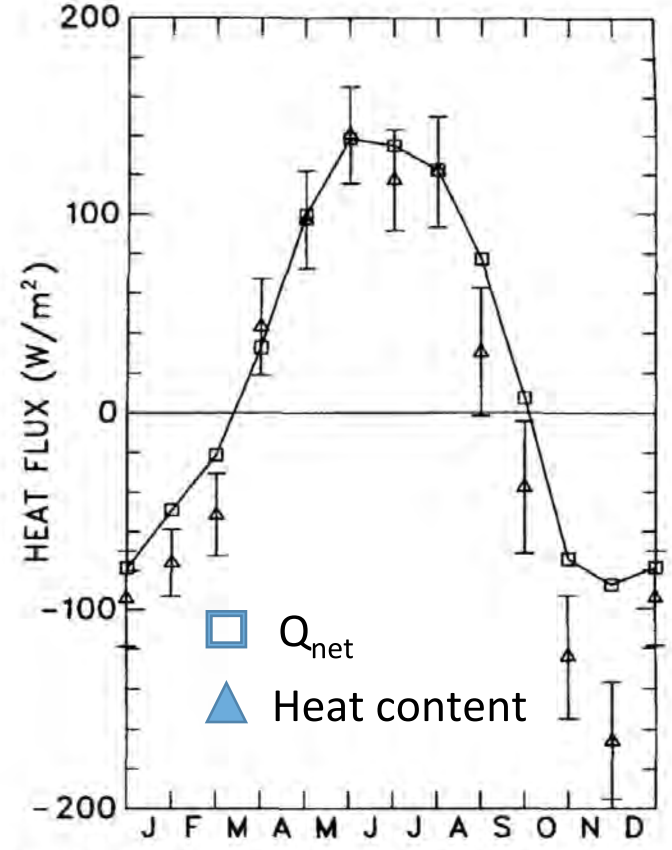


FIG. 3. Mean annual cycle of monthly surface heat flux (squares) and of the heat flux inferred from monthly changes in heat content above 200-m depth (triangles), with vertical bars indicating the uncertainty in the latter. The estimated error in the former is 15 W m^{-2} (appendix).

Variability in the upper ocean during MILE. Part I: The heat and momentum balances

by (in alphabetic order)

R. E. DAVIS*, R. DESZOEKE†, D. HALPERN‡ and P. NIILER†

(*Received 28 April 1980; in revised form 30 March 1981; accepted 20 April 1981*)

Variability in the upper ocean during MILE. Part II: Modeling the mixed layer response

by (in alphabetical order)

R. E. DAVIS*, R. DESZOEKE† and P. NIILER†

(*Received 28 April 1980; in revised form 30 March 1981; accepted 20 April 1981*)

MLD
Obs vs model

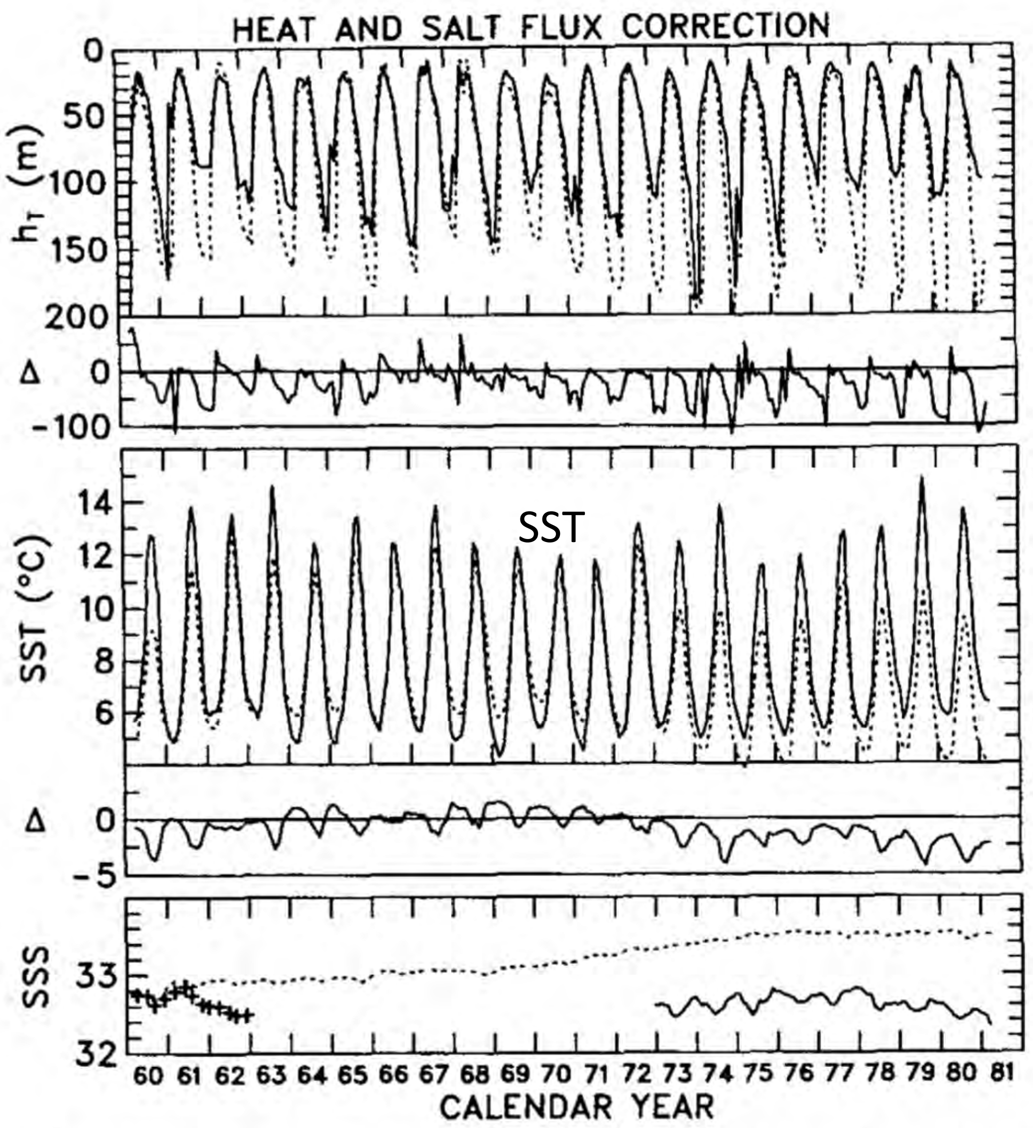


FIG. 5. Twenty-one year time series of observed (solid traces) and modeled (dotted traces) monthly mean mixed isothermal depth h_T, sea surface temperature SST, and sea surface salinity SSS. Also shown are modeled–observed differences, Δ, in h_T and SST. Modeled results are from experiment I with both heat and salt flux correction.

Upper Layer Modification at Ocean Station *Papa*: Observations and Simulation[1]

K. L. Denman[2] and M. Miyake

Institute of Oceanography, University of British Columbia, Vancouver 8, Canada

(Manuscript received 28 August 1972, in revised form 8 January 1973)

ABSTRACT

Time-series observations of the upper mixed layer of the ocean are presented for a six-week period at Ocean Station *Papa* in the northeast Pacific Ocean. These observations indicate the rate and extent of the wind-induced deepening of the mixed layer during the passage of several weather disturbances. The formation of the shallow layer of warm water that occurs under conditions of low winds and intense solar heating is also evident. A numerical model, developed by Denman, accurately predicts the behavior of the upper ocean during a 12-day period for which observed values of wind speed, solar radiation, and back radiation are used as input. To obtain realistic results, a value of 0.0012 for the ratio of the potential energy increase of the water column to the downward transfer rate of turbulent energy by the wind stress is used. This value is in agreement with that obtained from previous laboratory experiments (0.0015) indicating that the results obtained from such experiments are transferable to open ocean conditions.

Ocean Weather Station Papa

NCOF

- Frequently used for validation and tuning of 1D mixed layer models
- Located in N.E. Pacific at 50N, 145W
- Ran Kraus-Turner and KPP models for one year starting in March 1961 (same as Large et al 1994)
- Used vertical resolutions of 0.5m, 2m, 5 and 10m
- Forcing fluxes calculated using bulk formulae (met data courtesy of Paul Martin)

Met Office

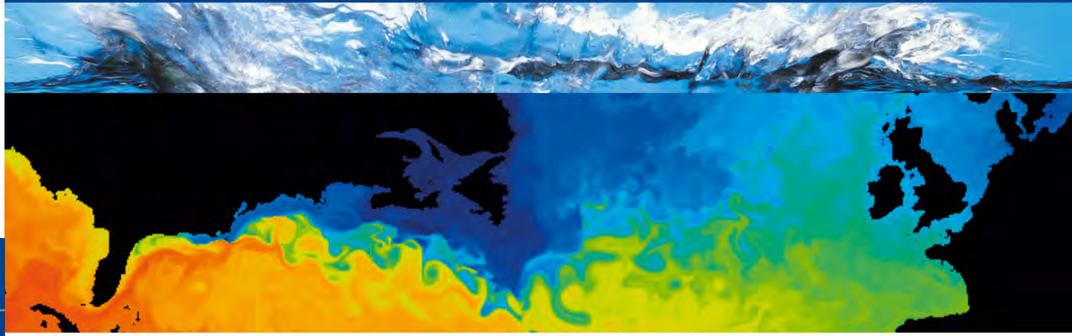
www.ncof.gov.uk

NCOF

The National Centre for Ocean Forecasting

Tuning and Validation of Ocean Mixed Layer Models

David Acreman



Met Office

www.ncof.gov.uk

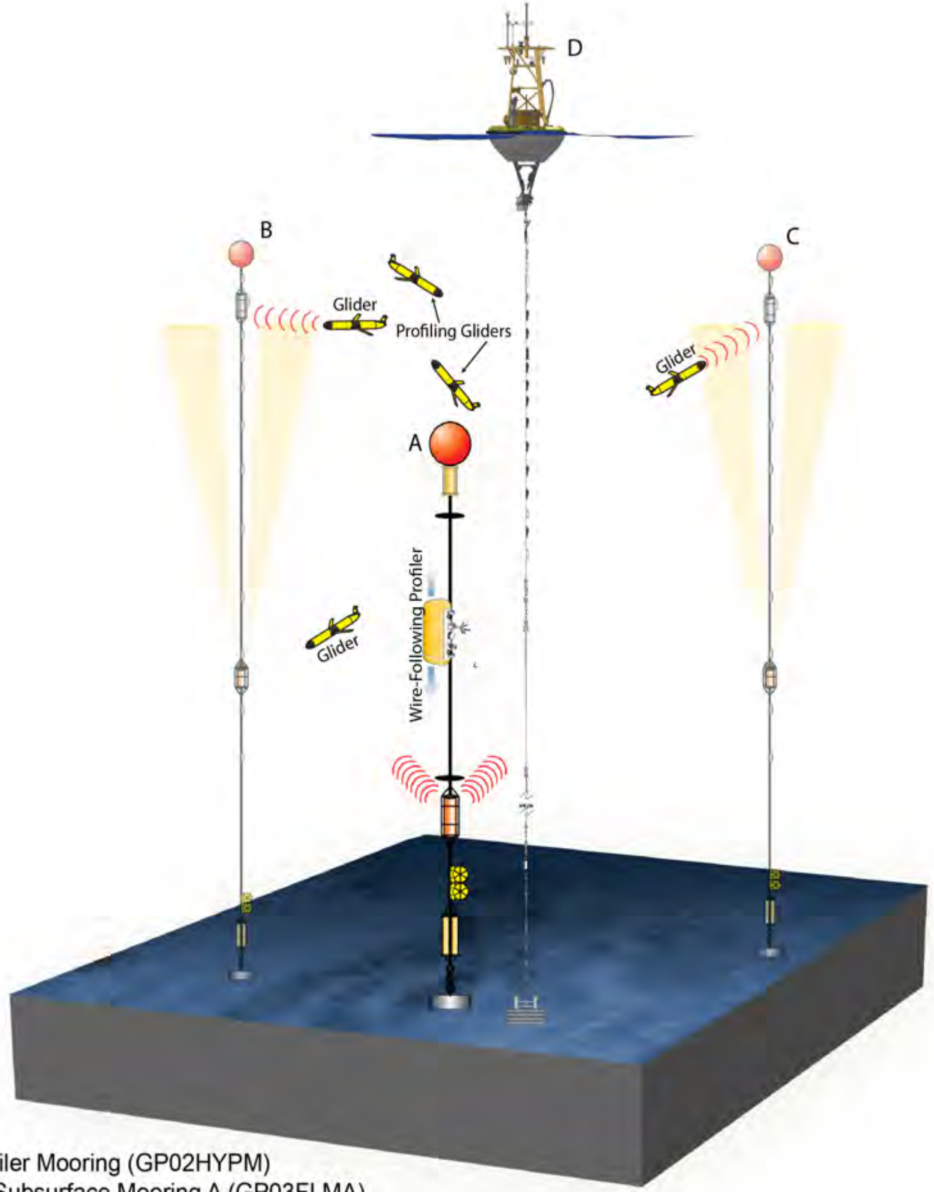
High winds, large waves **Air-sea energy and gas exchange** **PDO variability**

High nutrient, lower chlorophyll, micro-nutrient limitation to productivity in contrast to Irminger Sea

Important fishery **Lower eddy variability**

Collaboration with PMEL; time series since WWII (Canadian); regional partnering

Global Station Papa



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(B) Flanking Subsurface Mooring A (GP03FLMA)
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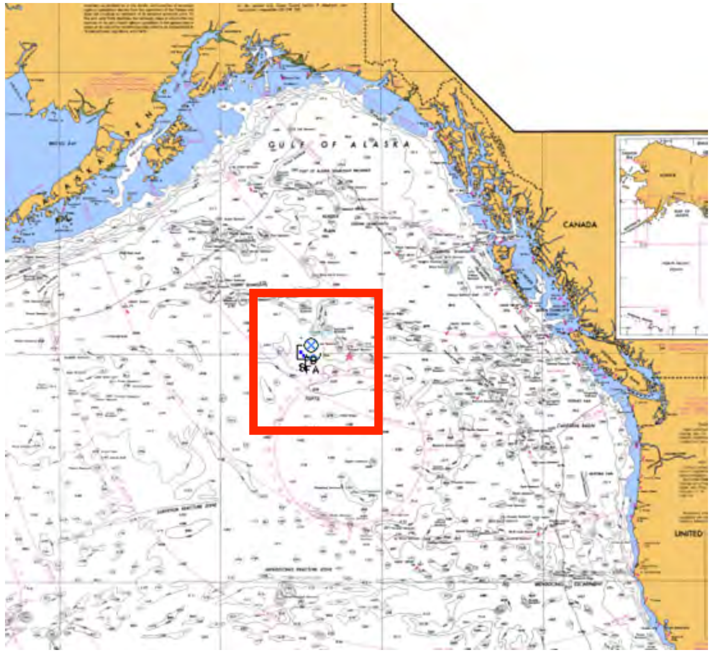
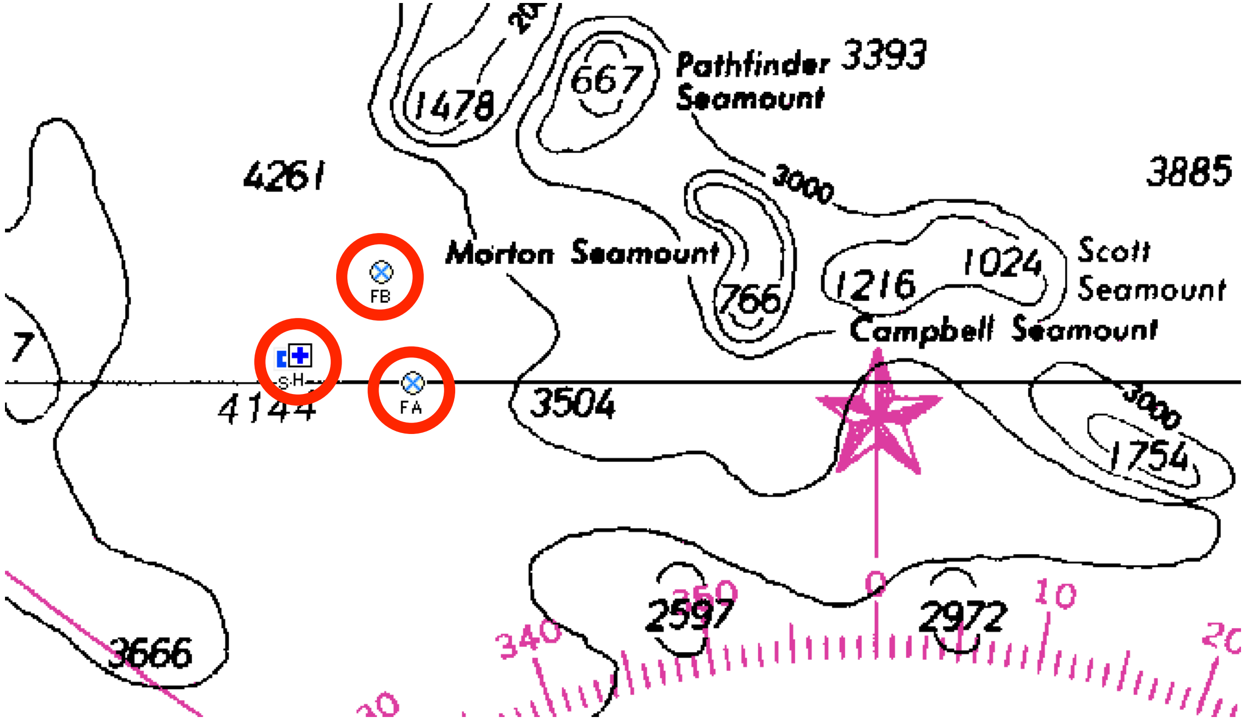
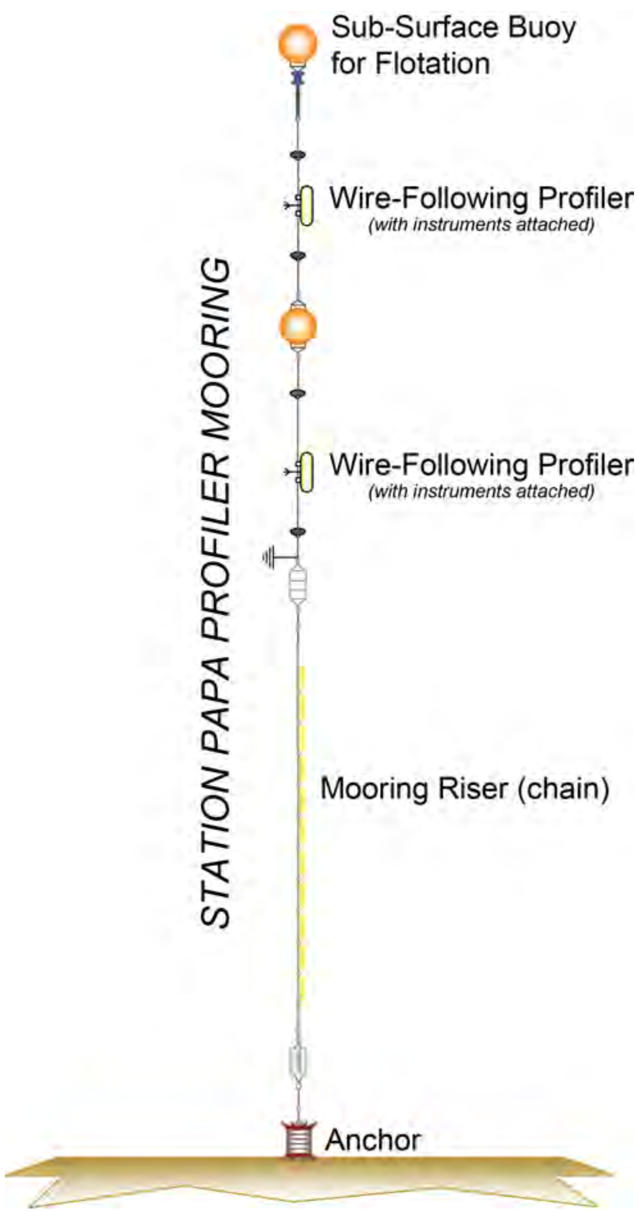




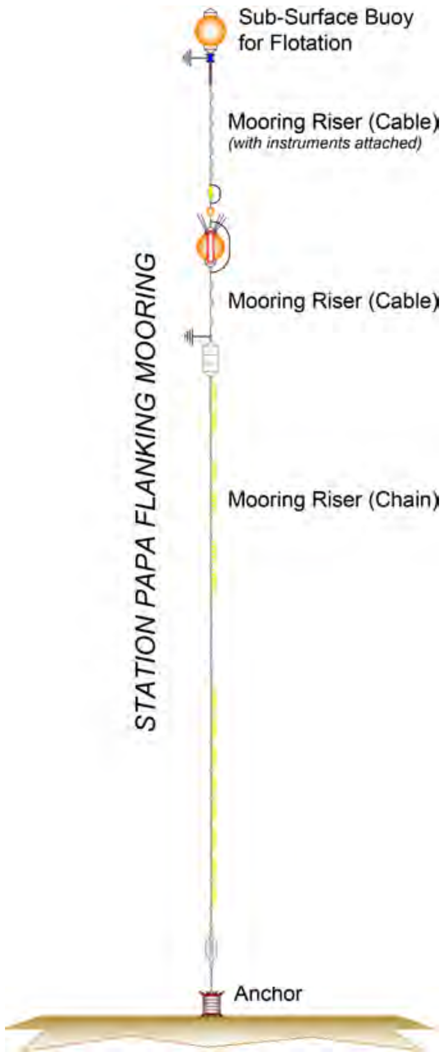
Profiler mooring – 4,219 m of water

- 150 m – bioacoustic sonar (multifrequency acoustic backscatter)
- 164 m - CTD
- 310 to 2,100 m - wire following profiler
    - 2 wavelength fluorometer (chlorophyll-a conc., optical backscatter)
    - Dissolved oxygen
    - CTD
    - 3-D single point velocity
- 2,100 to 4,000 m – wire following profiler
    - 2 wavelength fluorometer
    - Dissolved oxygen
    - CTD
    - 3-D single point velocity



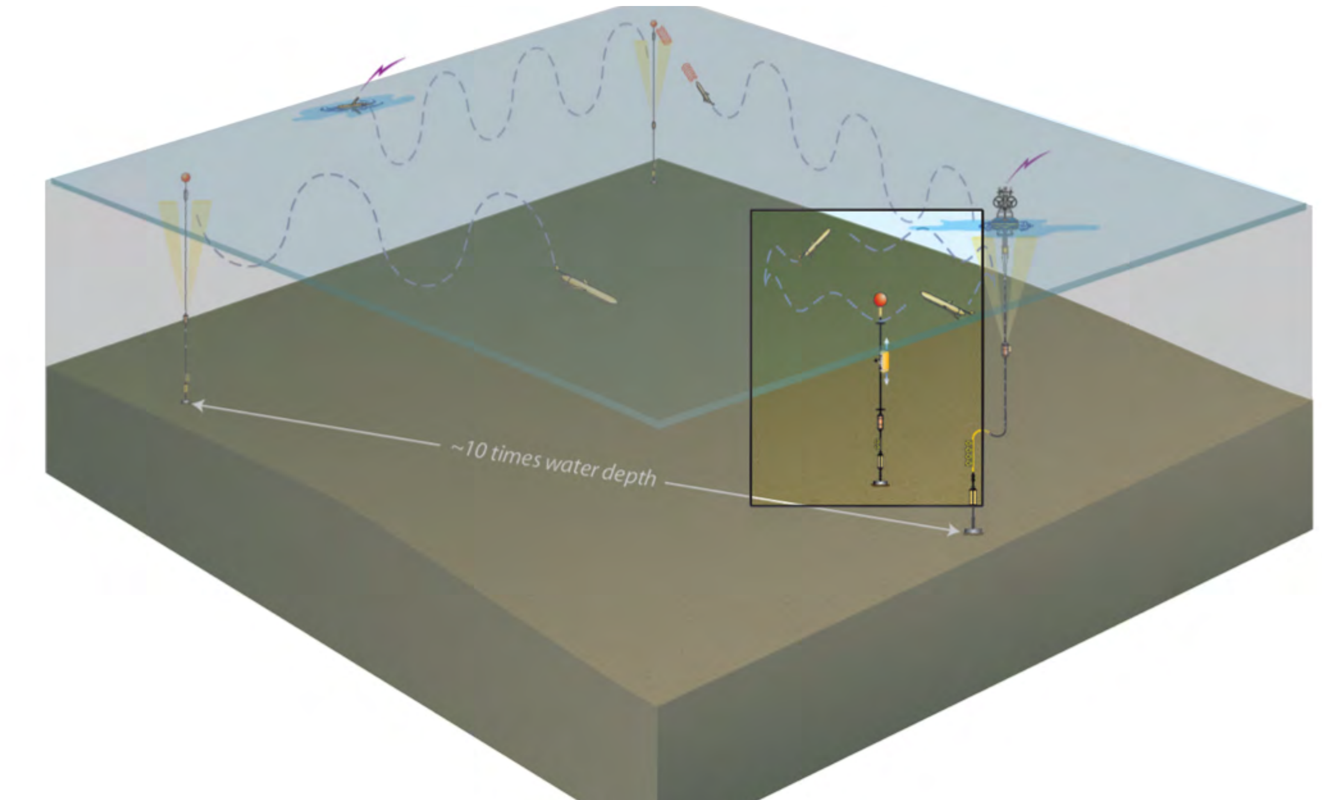
Flanking moorings - 4,126 and 4,145 m depth

- 30, 40, 60, 90, 130, 180, 250 350, 500, 750, 1,000, 1,500m - CTD
- 500 m – upward looking 75 kHz ADCP
- 30 m – dissolved oxygen
- 30 m – pH
- 30 m – 3 wavelength fluorometer
  - Fluorometric CDOM Concentration
  - Fluorometric Chlorophyll-a Concentration
  - Optical Backscatter



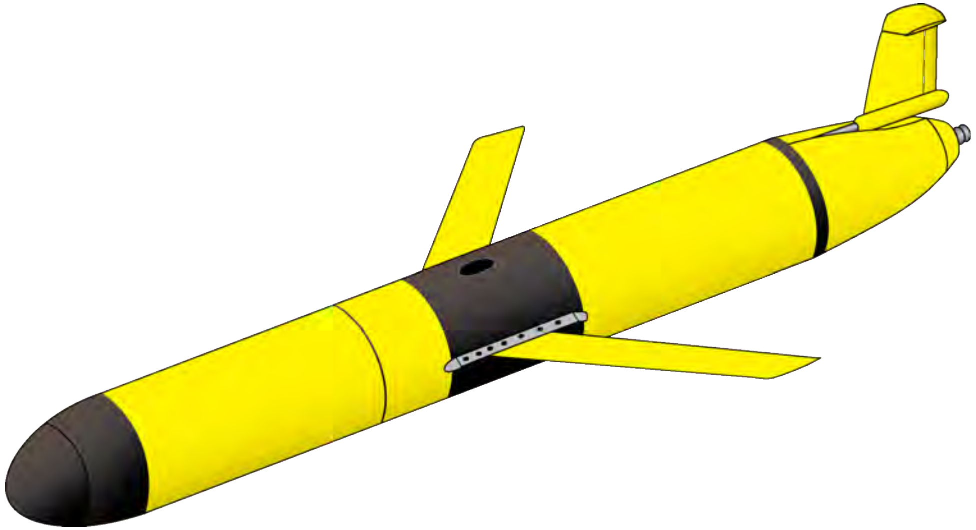
Gliders

- Patrol
  - Spatial sampling
  - Data link to flanking and profiler Moorings
- Profiling
  - Profiles to surface near profiler mooring



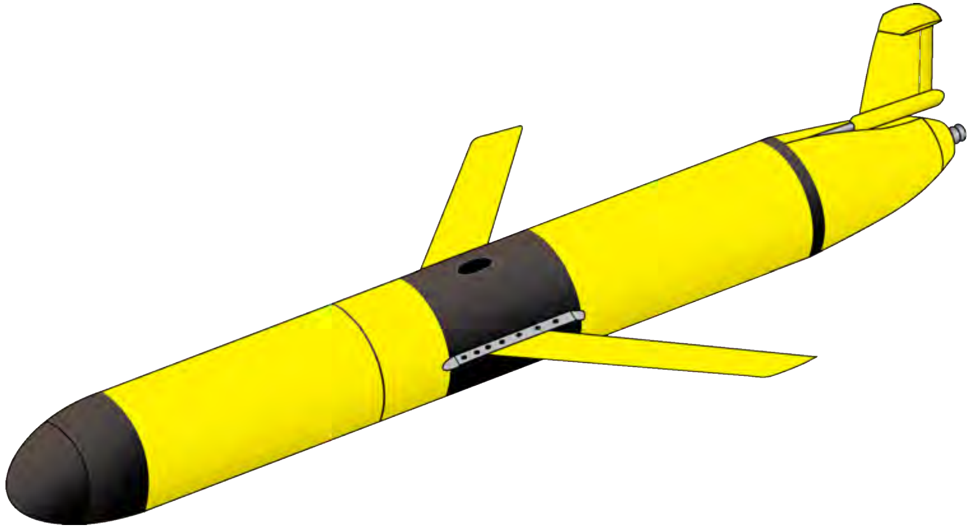
Gliders

- Patrol – 3 gliders
  - Spatial sampling
  - Data link to flanking and profiler Moorings
  - CTD
  - Dissolved oxygen
  - 2-wavelength fluorometer

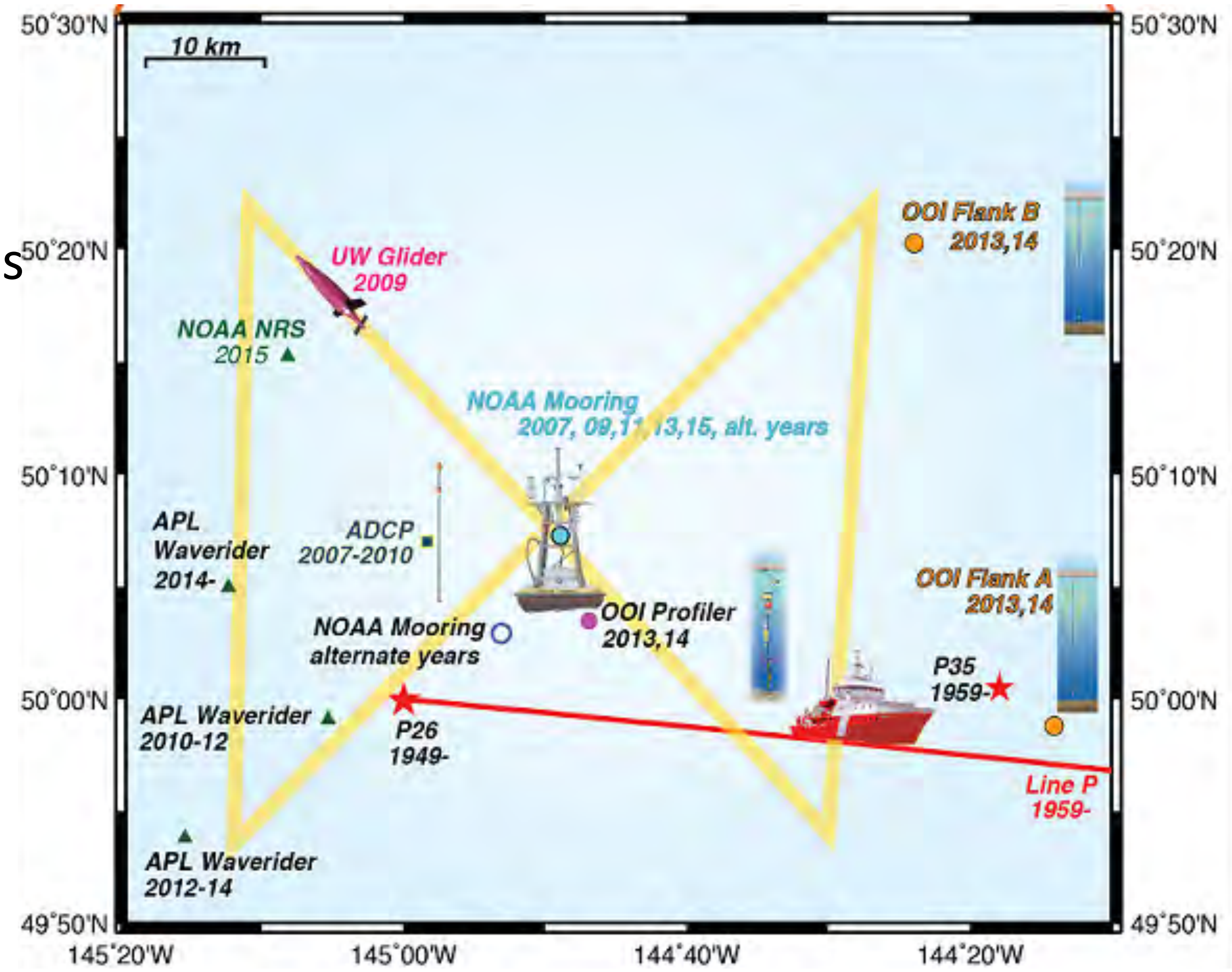


Gliders

- Profiling – 2 gliders
  - Profiling to the surface near profiler mooring
  - CTD
  - Dissolved oxygen
  - 3-wavelength fluorometer
  - Nitrate
  - Photosynthetically available radiation



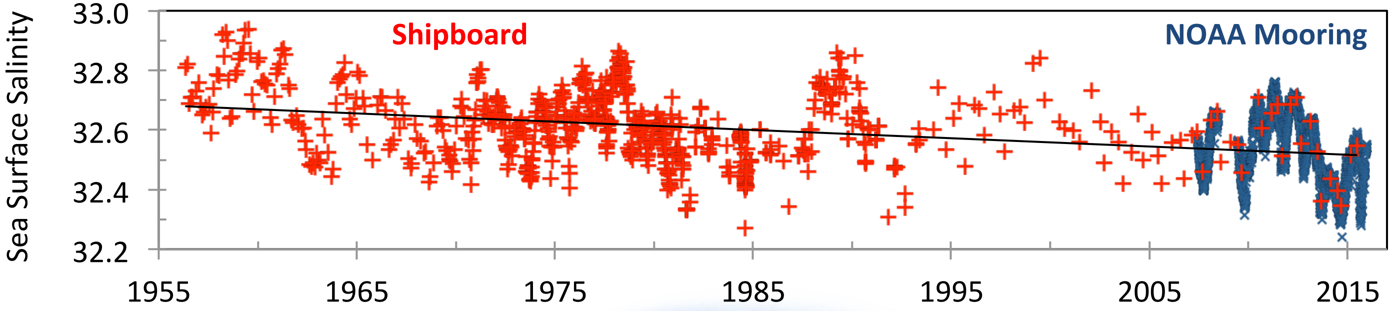
With collaborations, the PAPA array is a very capable observatory ….

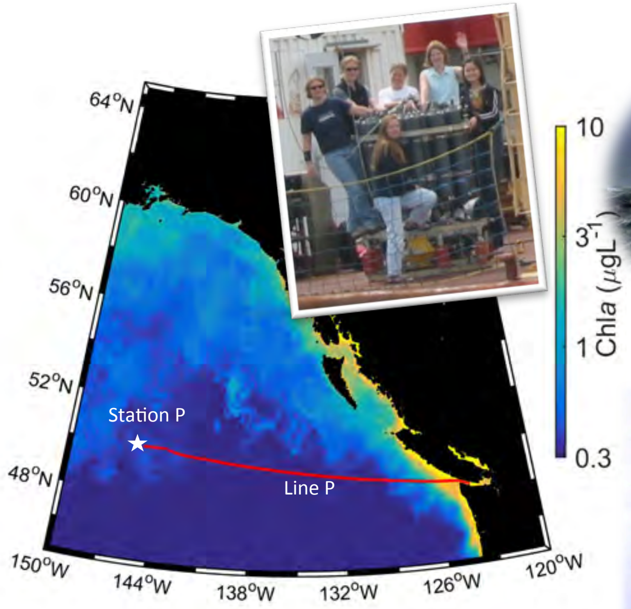


Congratulations DFO Line P Program!

60-year time series in the subarctic NE Pacific

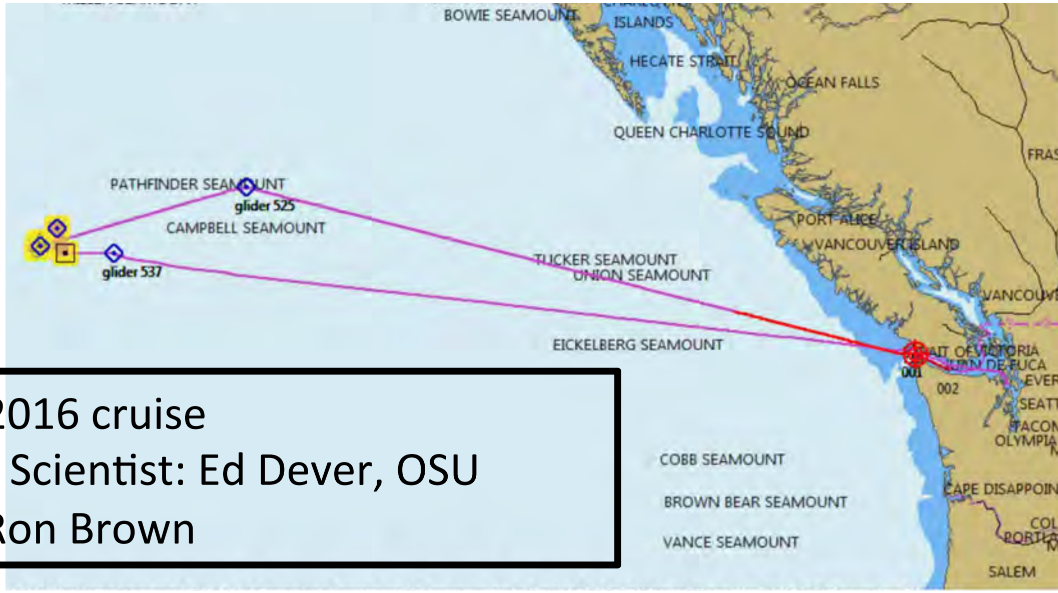
1956 – 2016 *and beyond !*





Fisheries and Oceans Canada Pêches et Océans Canada

OOI PAPA



July 2016 cruise
Chief Scientist: Ed Dever, OSU
R/V Ron Brown

- Annual cruise
  - Possible ancillary sampling
  - In-situ calibration/validation
- Capacity and bandwidth
  - Available capacity on the OOI platforms (mass, power, bandwidth)
  - Proposal writing support
- Programmable sampling
  - Preserve climate record, assure power and bandwidth not compromised
  - Community directed sampling
- A site for process studies
- Data
  - OOI Data Portal and raw data download