Zooplankton populations and circulation vary inter-annually to effect cross-shelf advection of biomass in the northern California Current

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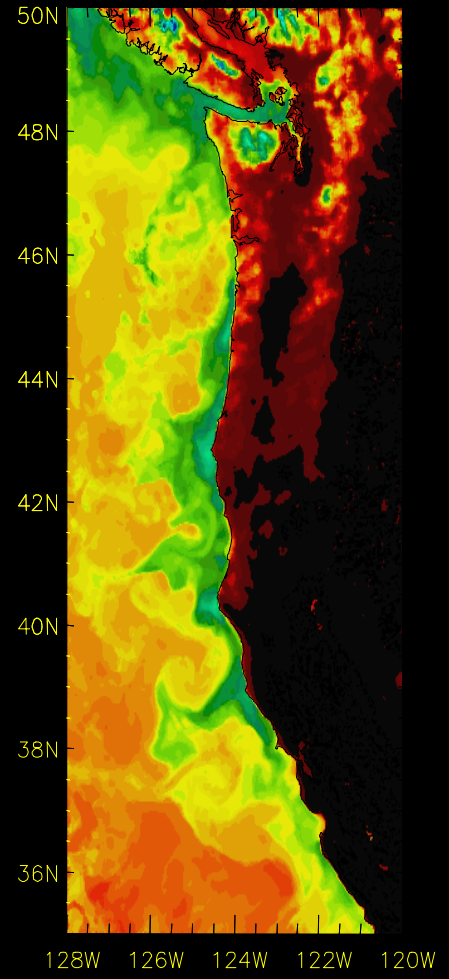


Impact of mesoscale features:

- **Mixing and heat transfer**
- **Elevated nutrients and chlorophyll**
- **Fish aggregation**
- **“Hot Spots” of marine mammal / seabird activity**

★ • **Offshore transport**

Loss from nearshore populations

“Delivery” of prey and biomass to deep sea

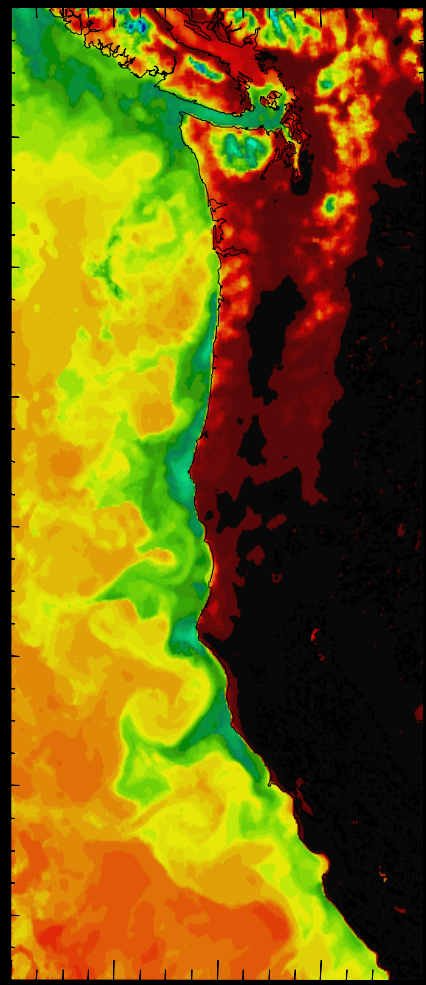
Offshore transport:

- JGOFS:

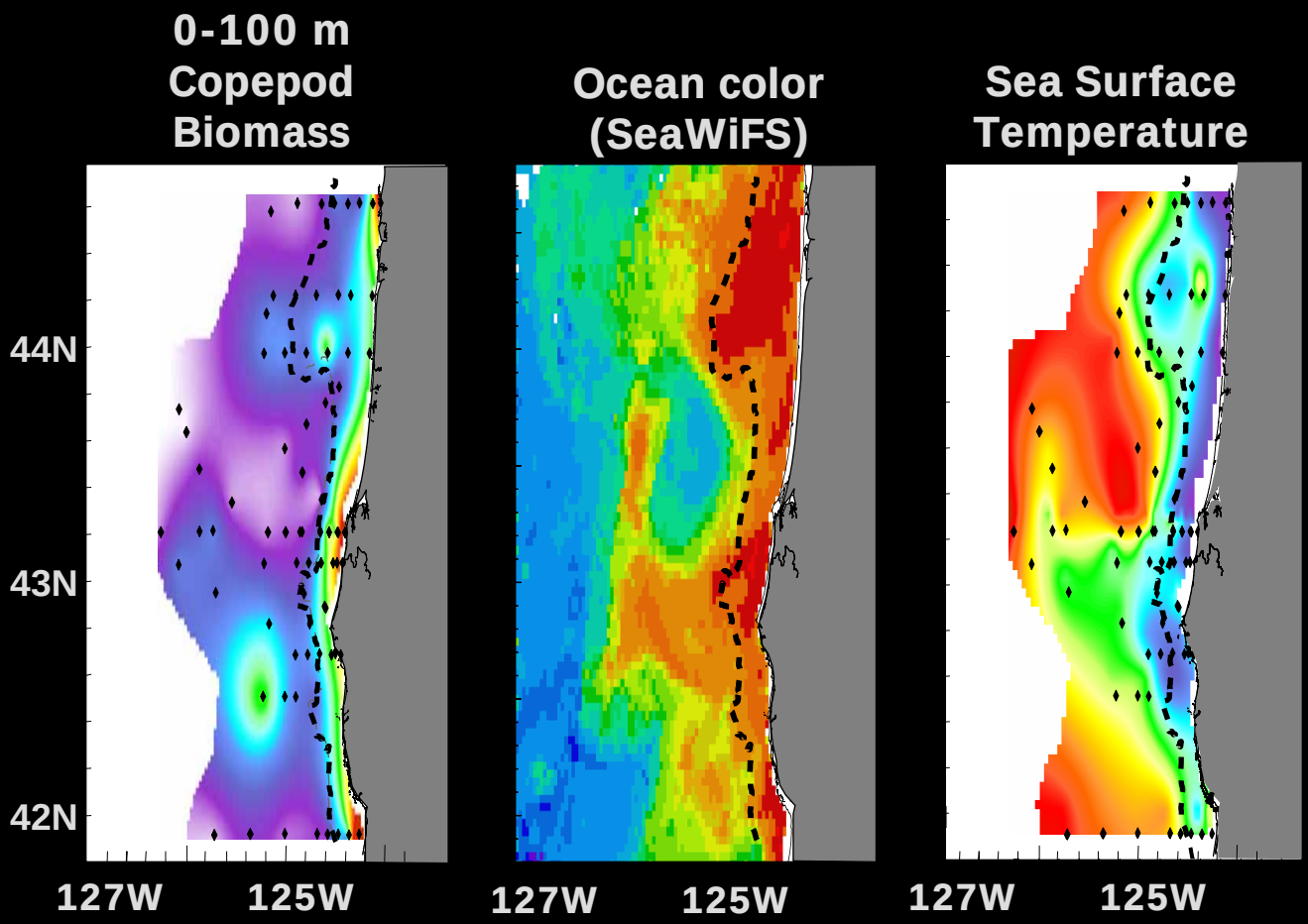
  "Shelf production contributes 7-30% of global export production to >1000 m depth"

- Kosro and Huyer (1991):

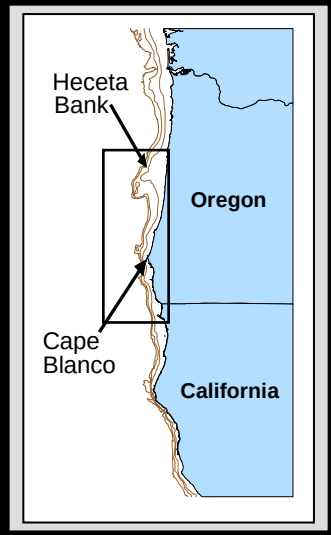
  "One filament of the upwelling jet can transport 1.5 Sv offshore = as much water as all of the Ekman transport along 1000 km of coastline"



August 2000:
Example of strong physical control of biological patterns

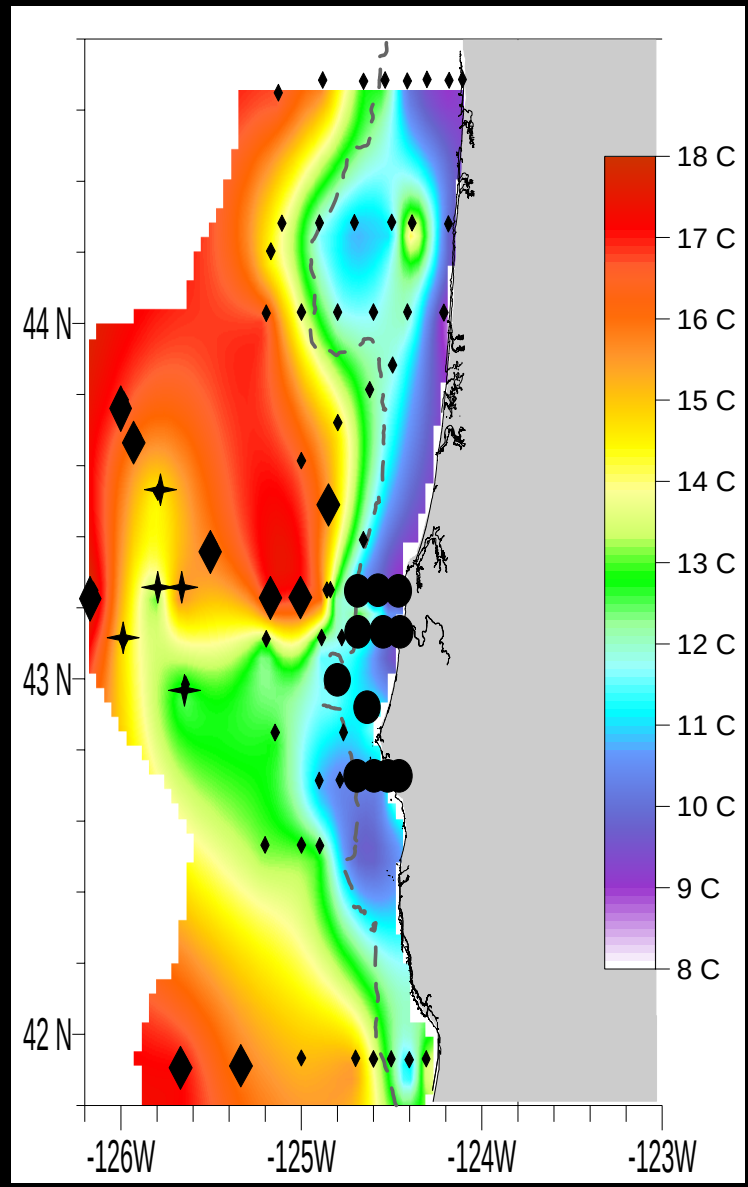


Study area:



Color = 3 m Temperature from CTD casts
Points = locations of net tows:

August 2000



Biomass outside feature:
Average = 4 mg C m^{-3}
(± 4.3)

Biomass inside feature:
Average = 14 mg C m^{-3}
(± 7.1)

On-shelf Biomass:
Average = 44 mg C m^{-3}
(± 22.1)

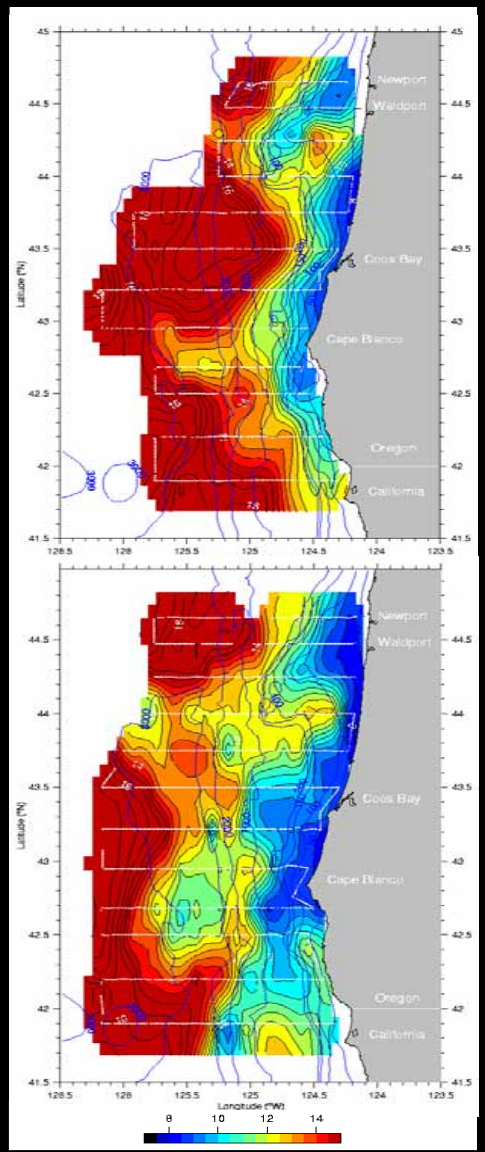
August cruises:

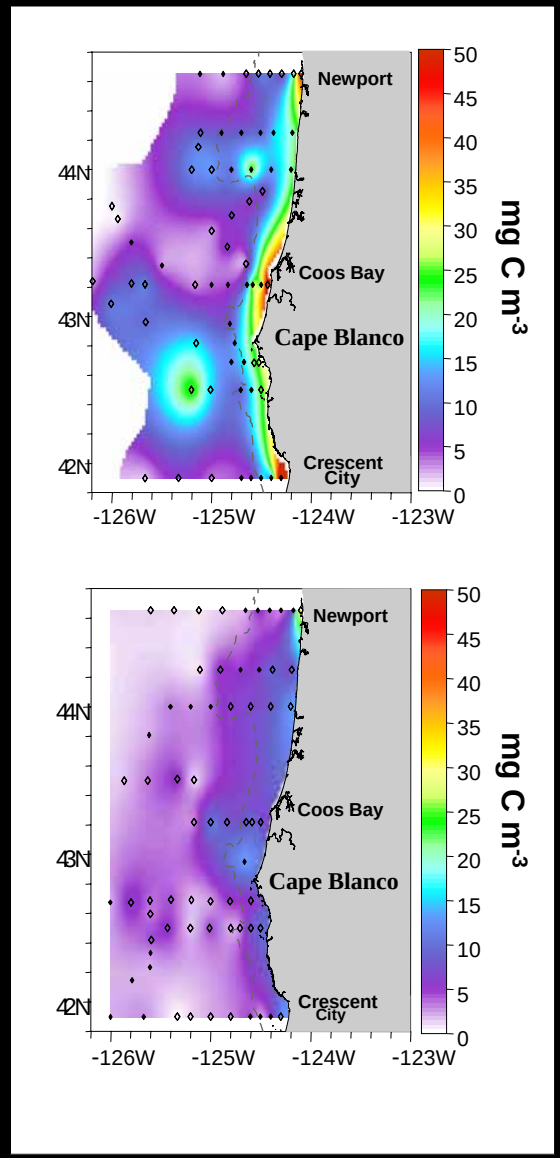
3 m Temperature from SeaSoar

Total Copepod Biomass in the Upper 100 m:

2000

2002





SeaSoar data courtesy of Jack Barth and Steve Pierce

Objective:

Quantify interannual variability in the cross-shelf transport of zooplankton

- **Circulation**
- **Zooplankton biomass**

Approach:

Index interannual variability:

- Satellite altimetry for circulation
- Long-term field sampling of zooplankton

Explore links between the two

Interannual variability in mesoscale circulation:

TOPEX/POSEIDON altimeter

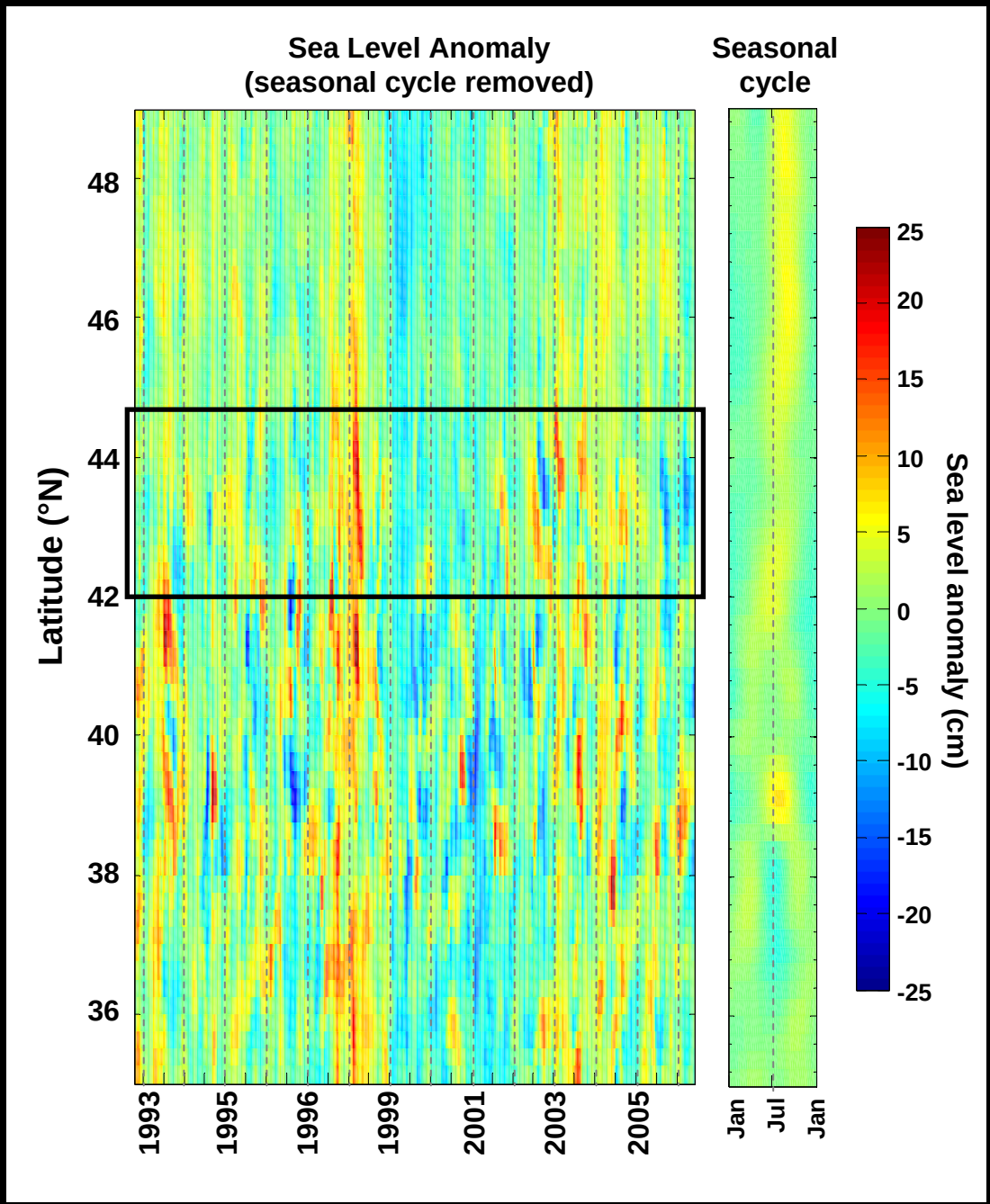
Altimeter data:
Analysis of sea surface height to quantify variance in mesoscale circulation.

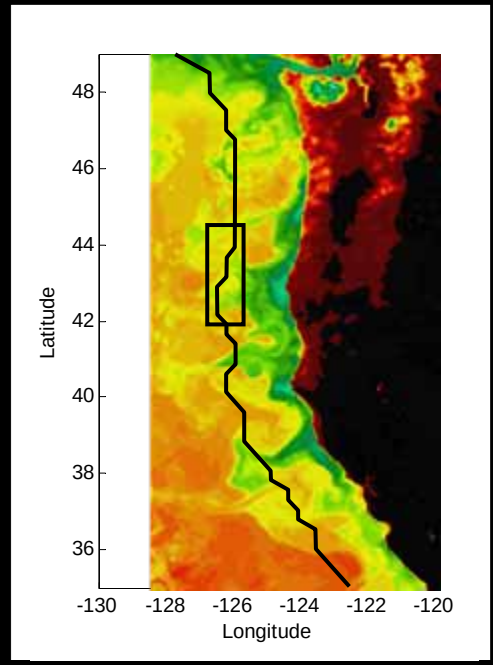
Data:

- **Satellite altimeter (sea surface height) data**
- **Updated, delayed-time, merged, gridded, weekly sea level anomalies provided by AVISO.**
  (http://www.jason.oceanobs.com)

Analysis:

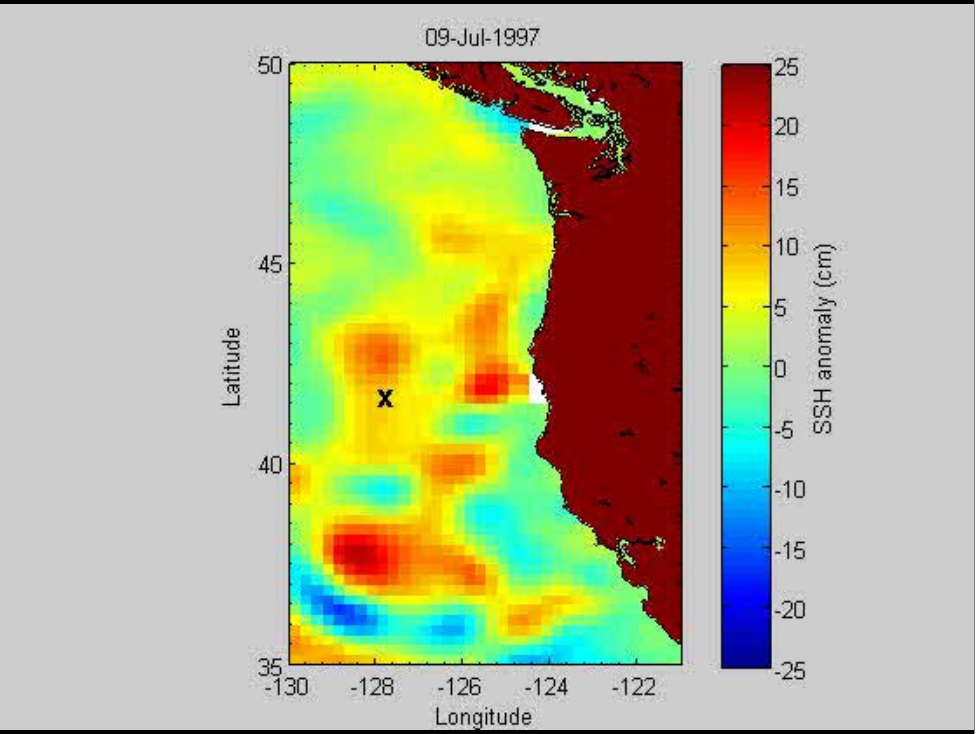
- **Wavelet analysis of SSH anomalies to develop index of interannual variability**

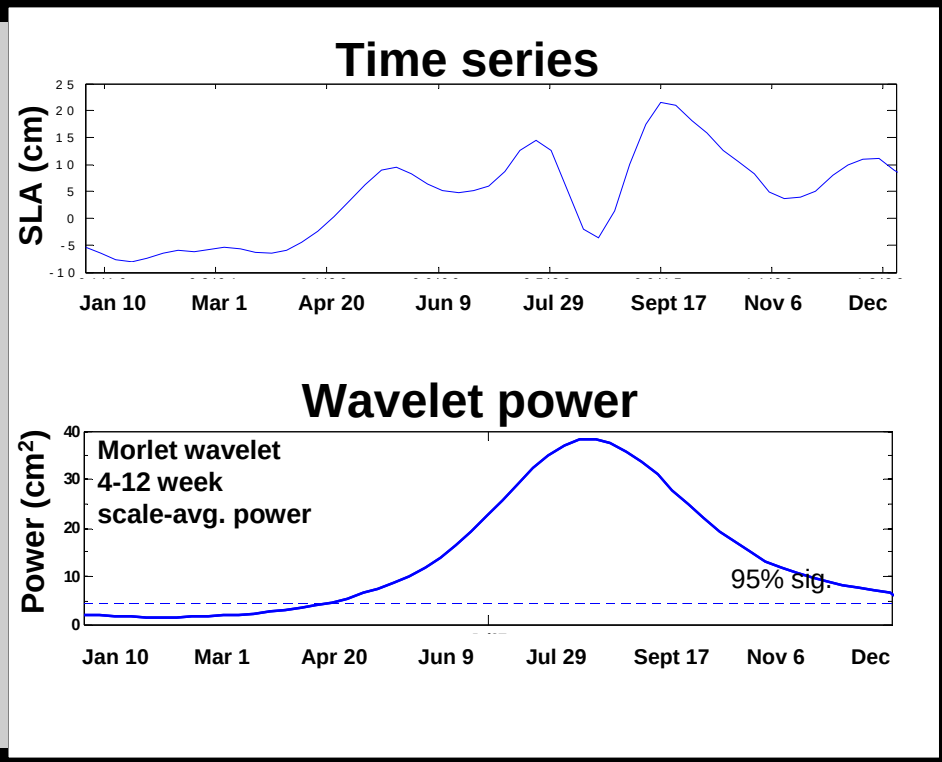

Sea Level Anomaly
(seasonal cycle removed)
Seasonal
cycle
Latitude (°N)
48
46
44
42
40
38
36
1993
1995
1996
1999
2001
2003
2005
Jan
Jul
Jan
25
20
15
10
5
0
-5
-10
-15
-20
-25
Sea level anomaly (cm)


48
46
44
42
40
38
36
Latitude
-130
-128
-126
-124
-122
-120
Longitude

Example:

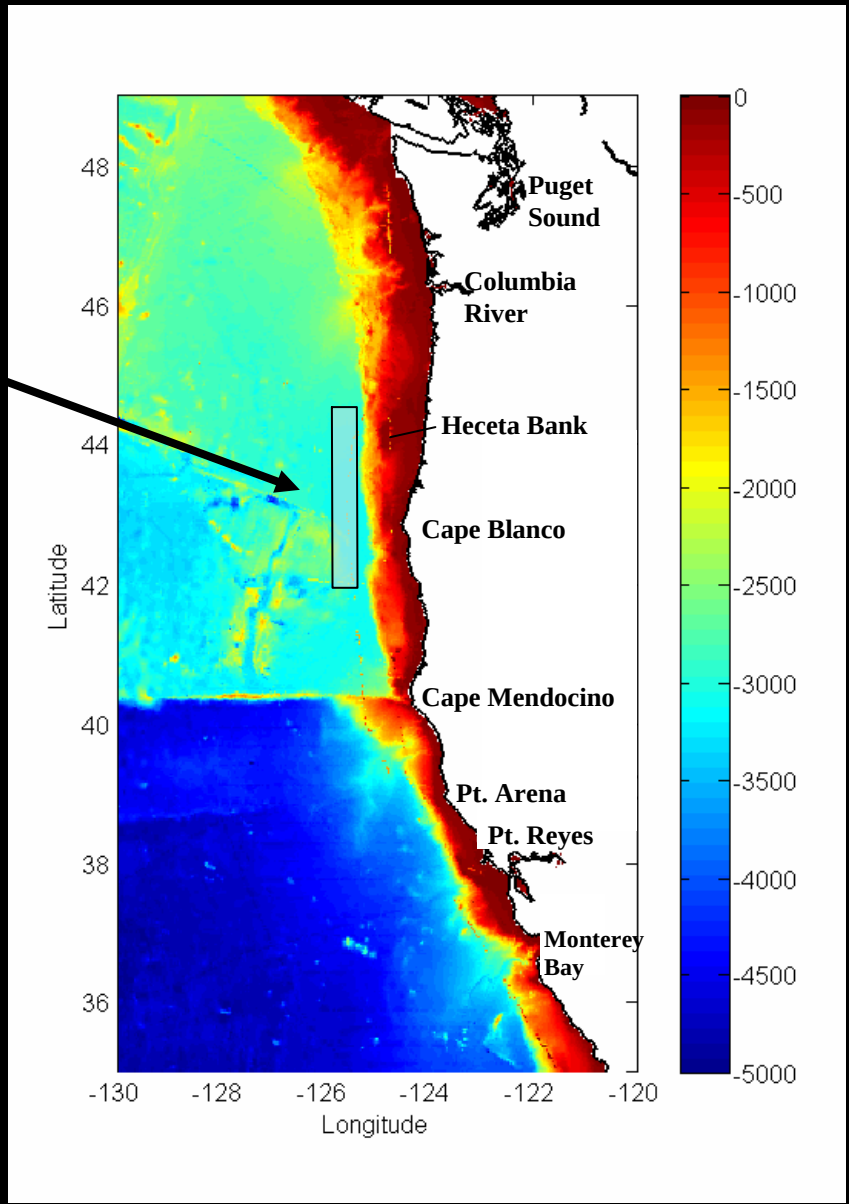
Sea surface height anomaly



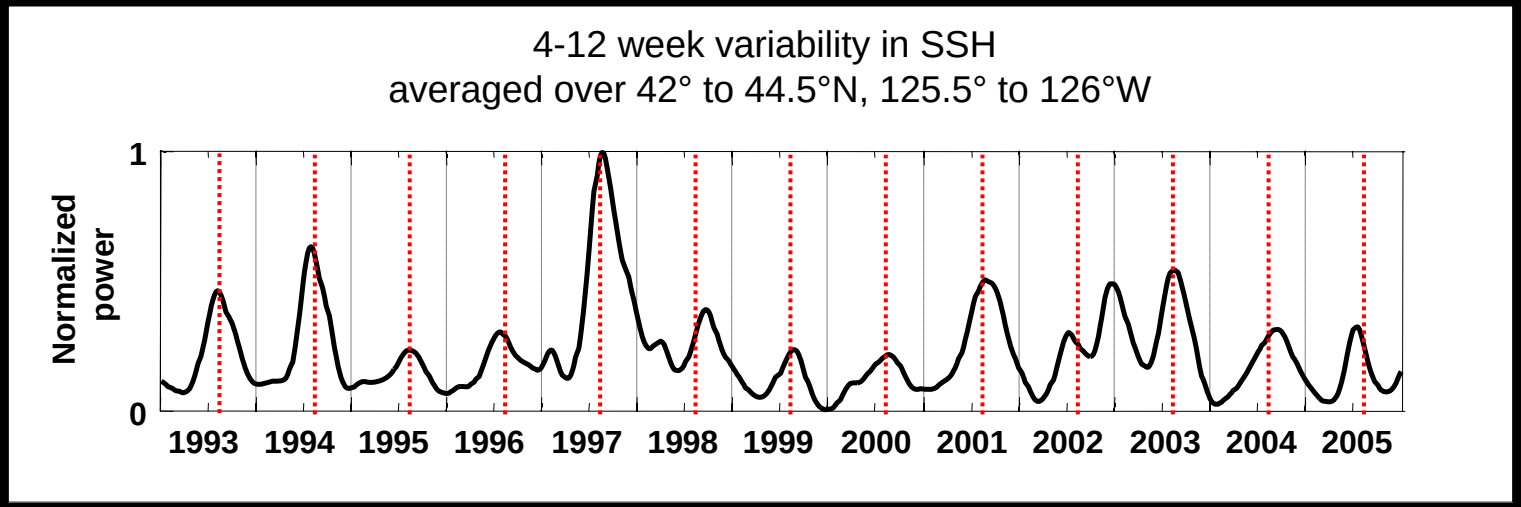


Analysis location on bathymetry:

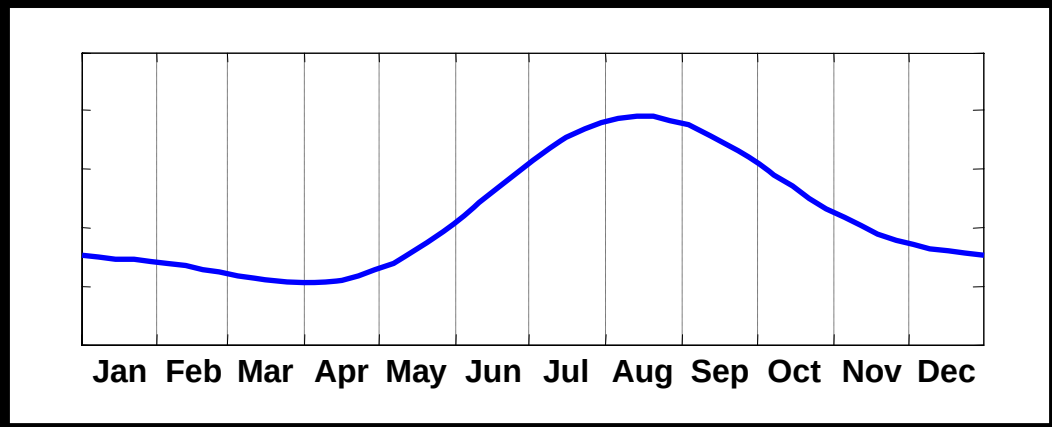
Local study area



Index of Mesoscale Energy

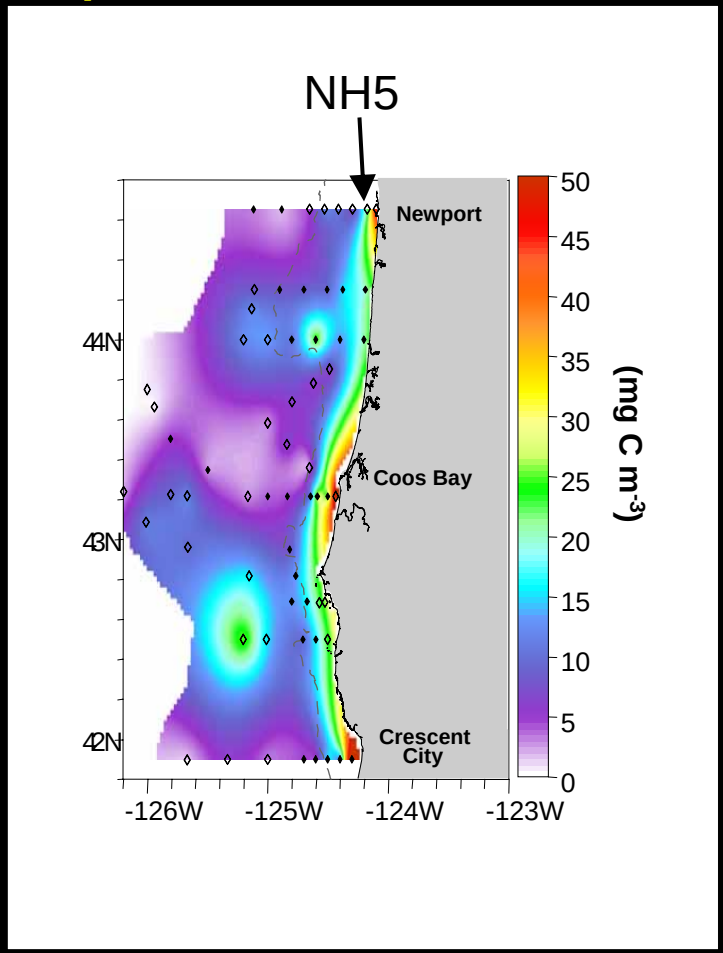


Seasonal cycle of mesoscale energy

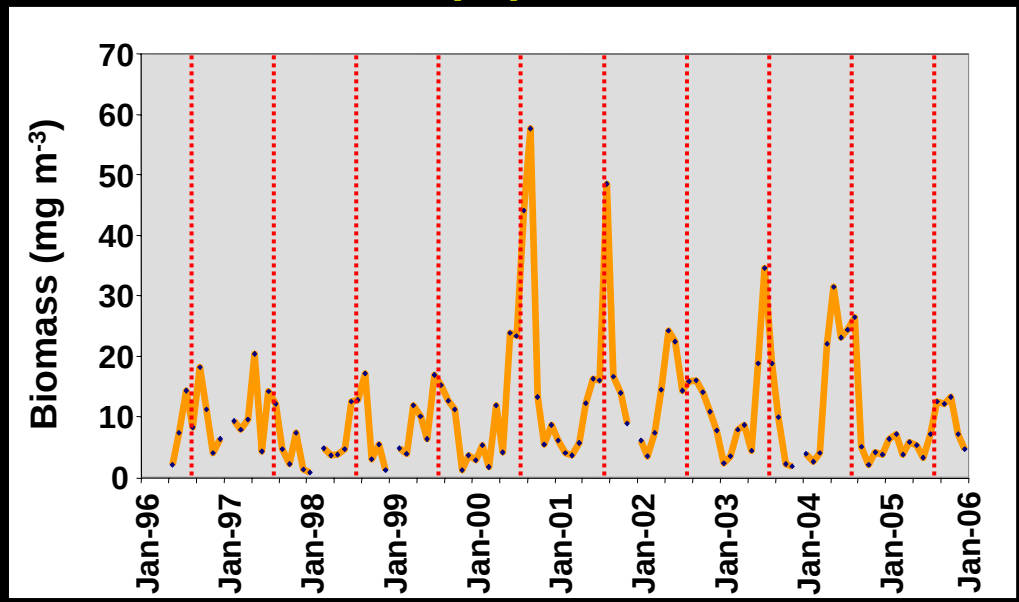


Interannual variability in zooplankton biomass?

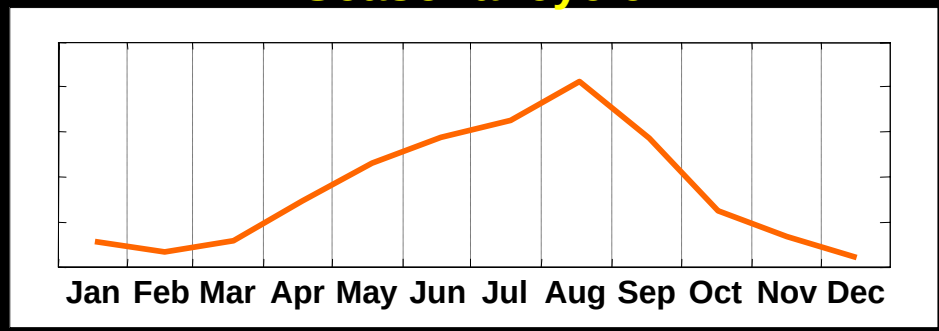
Station NH5 represents coastal biomass:



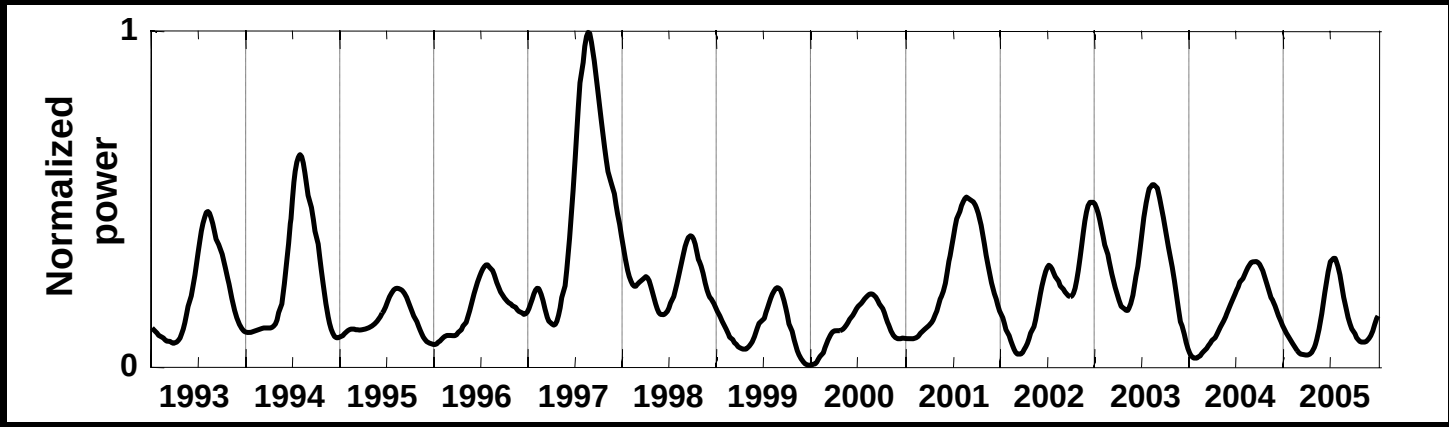
Time series of copepod biomass at NH5



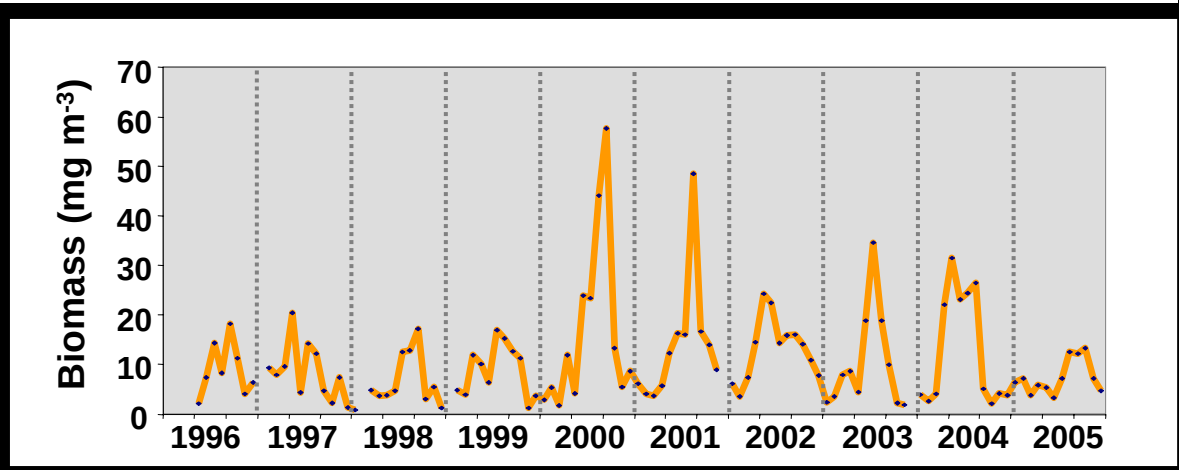
Seasonal cycle



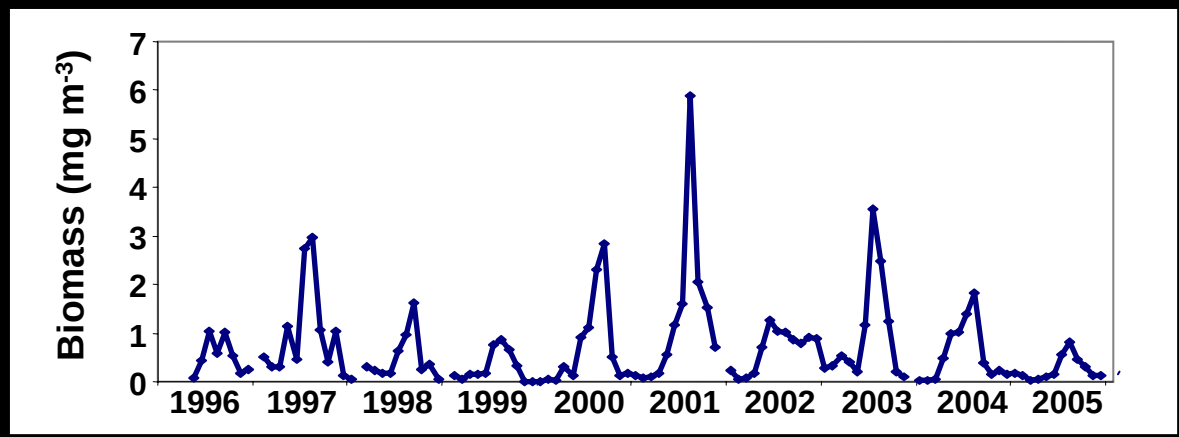
Energy



Biomass

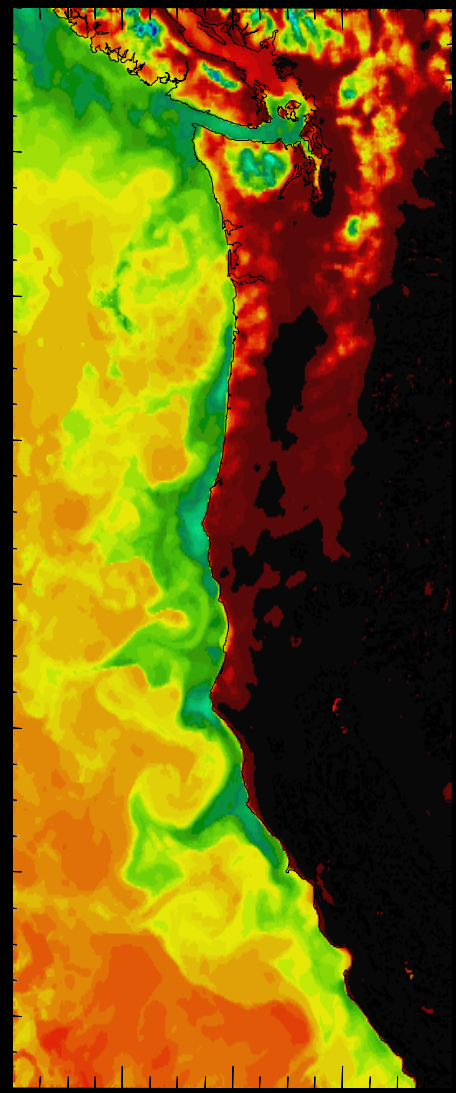


Energy x ¼ biomass = Potential Transport



Conclusions:

- High zooplankton biomass can be advected far offshore in mesoscale circulation features.
- Mesoscale activity and zooplankton biomass vary seasonally and interannually.
- Interaction between variability in biomass and advection lead to large interannual variability in cross-shelf advection of biomass.



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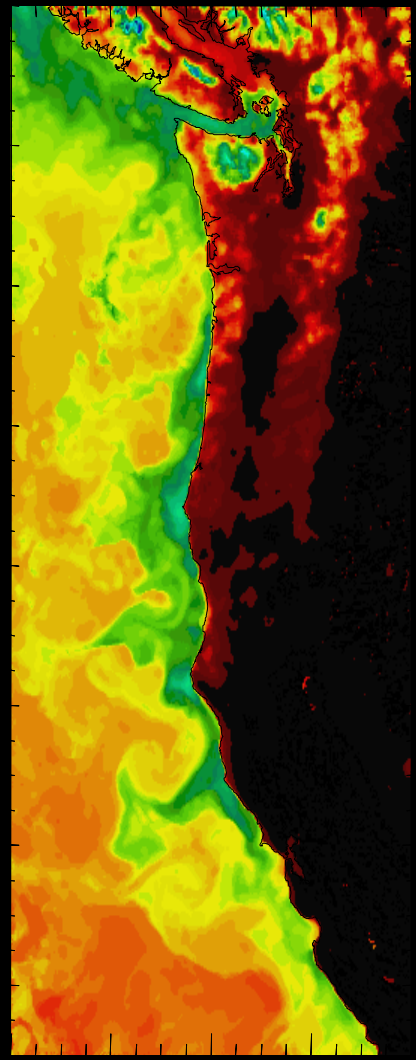
GLOBEC PIs – especially Tim Cowles, Jack Barth, Mike Kosro, Steve Pierce

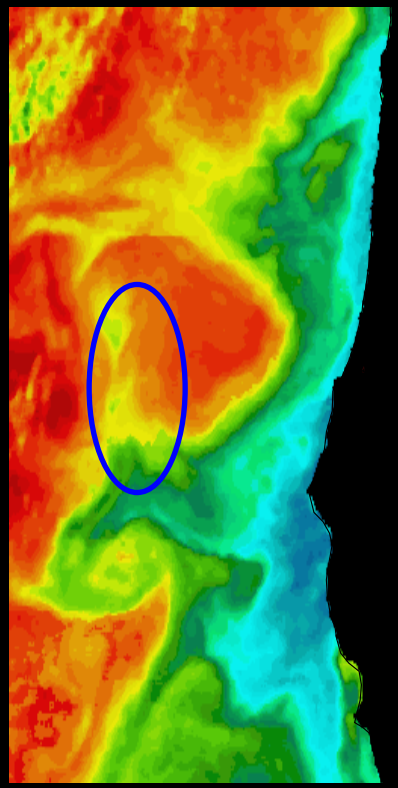
Many cruise participants for help collecting zooplankton

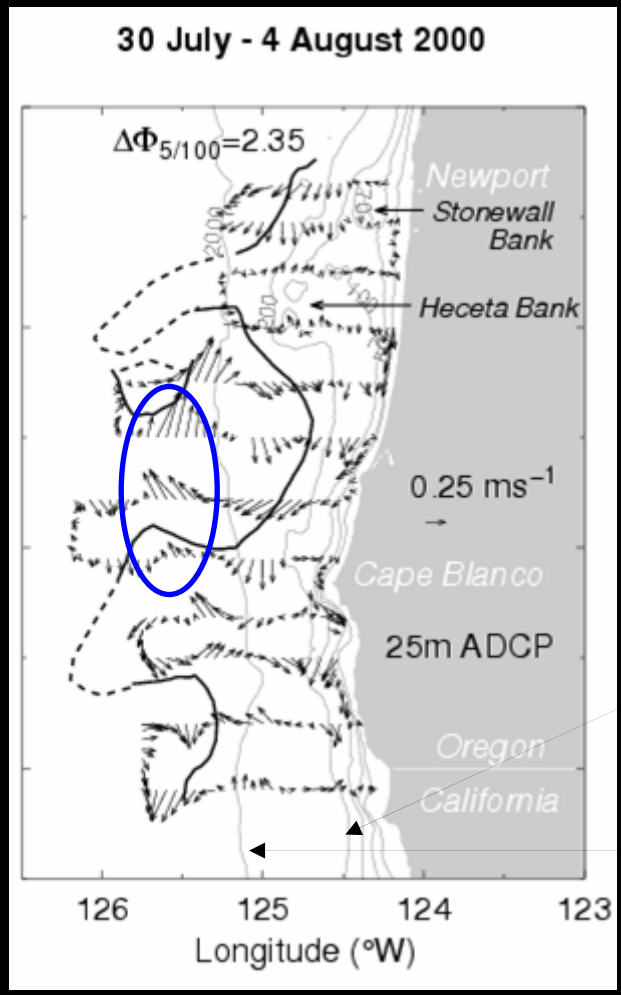
Altimeter products were produced by Ssalto/Duacs and distributed by Aviso, with support from CNES

NOPP, NSF, PEO Scholar Awards, and the NOAA/AFSC for my funding.



ADCP map of currents:



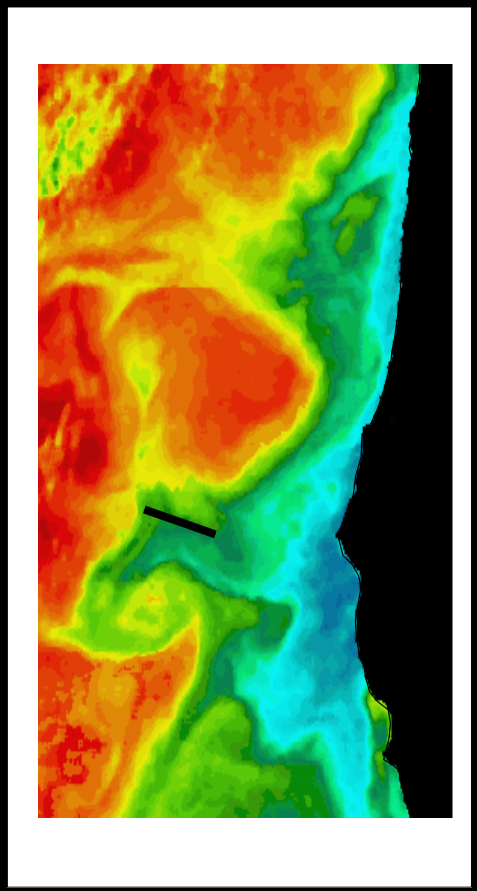


200 m bathy line

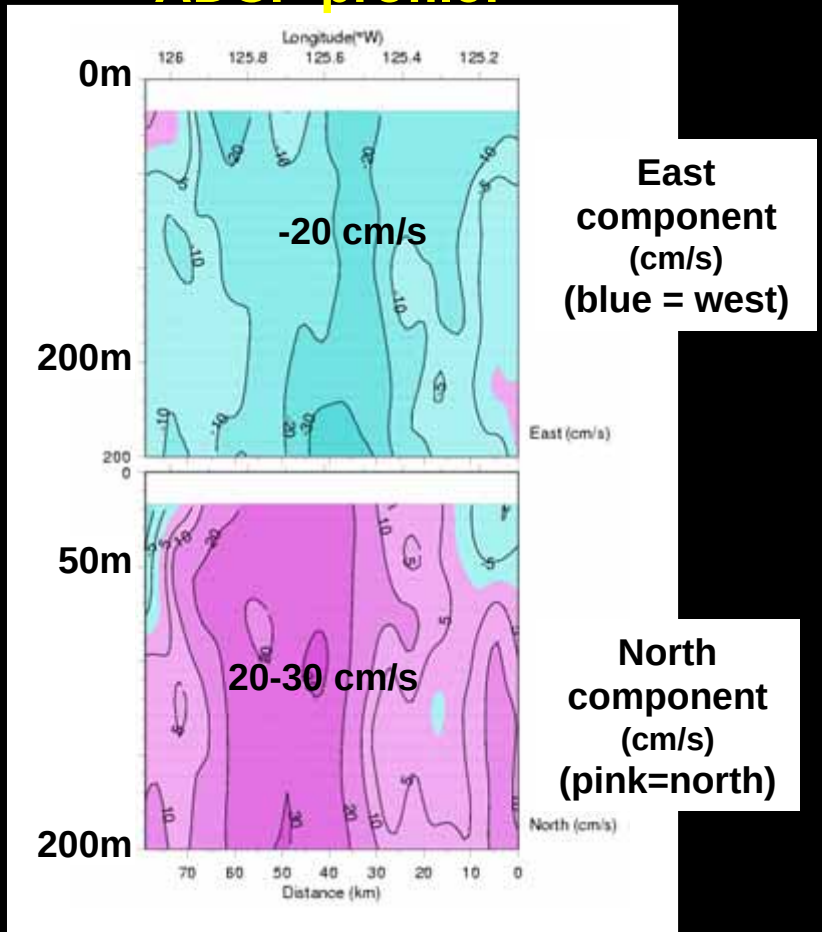
2000 m bathy line

Courtesy of Steve Pierce

SST



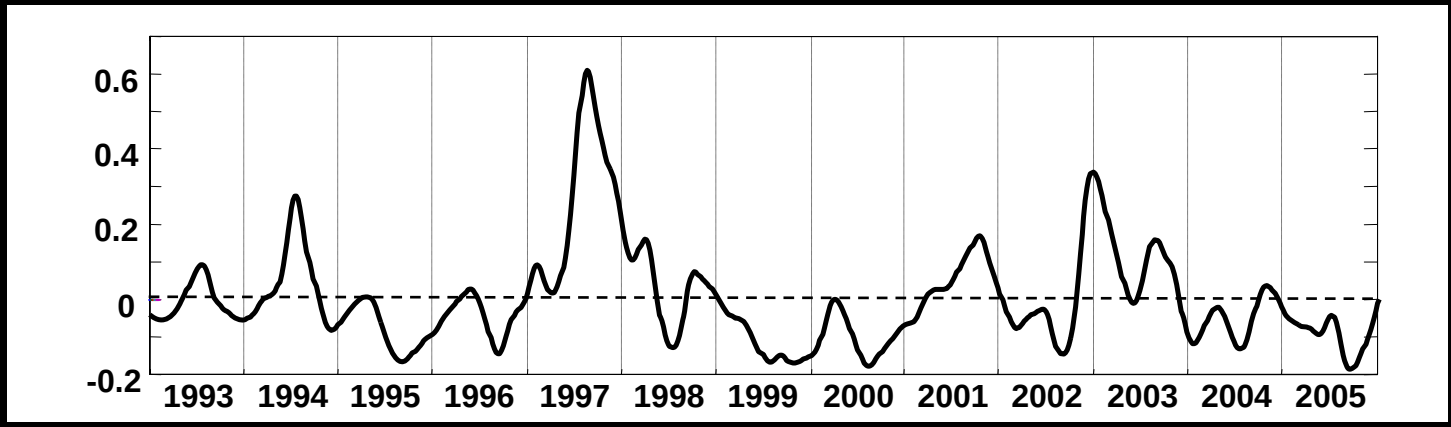
ADCP profile:



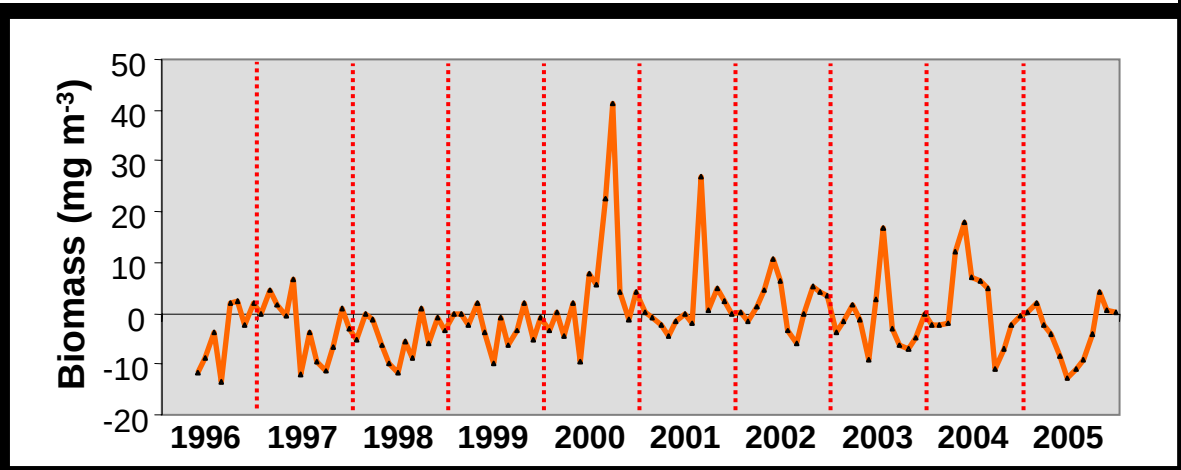
East component (cm/s) (blue = west)

North component (cm/s) (pink=north)

Energy anomalies



Biomass anomalies



Transport estimate