How does mesoscale oceanic structure in the California Current System affect the distribution and ultimately the survival of larval fish?

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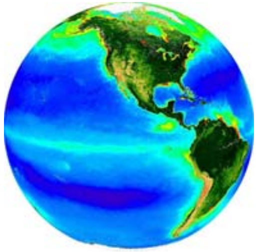

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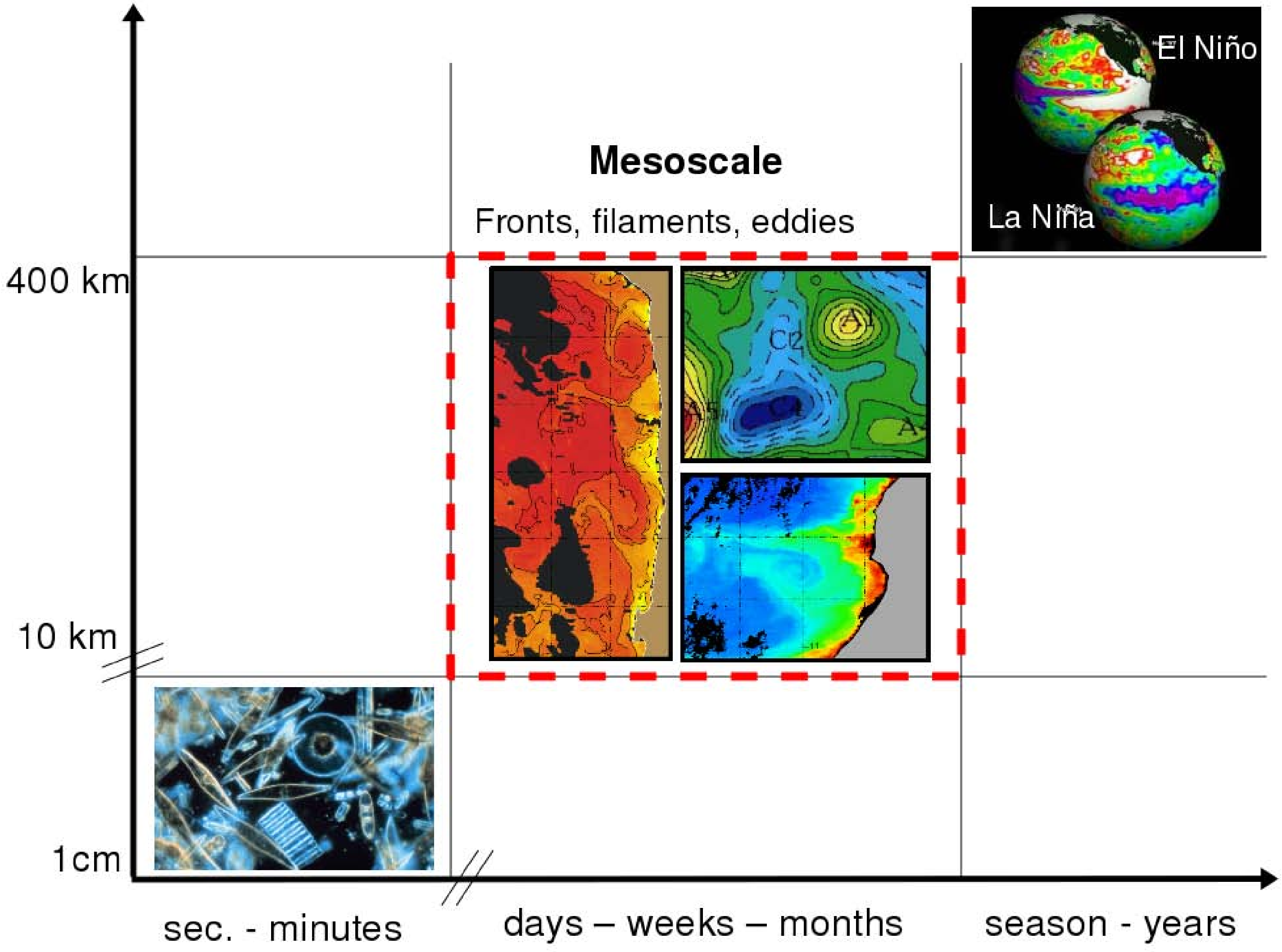
Introduction

The small pelagic fish such as sardine and anchovy are the most abundant pelagic fish species in the California System. The abundance of these species is regulated by the size of the adult population and the environmental conditions.

The influence of environmental conditions on small pelagic fishes is produced in different spatial and temporal scales.

The Mesoscale



Objective

The goal of this work is to explore the relationships between observed mesoscale spatial patterns, from mesoscale structures automatic detected from satellite data, and spatial distribution of Ichthyoplankton in the California System.

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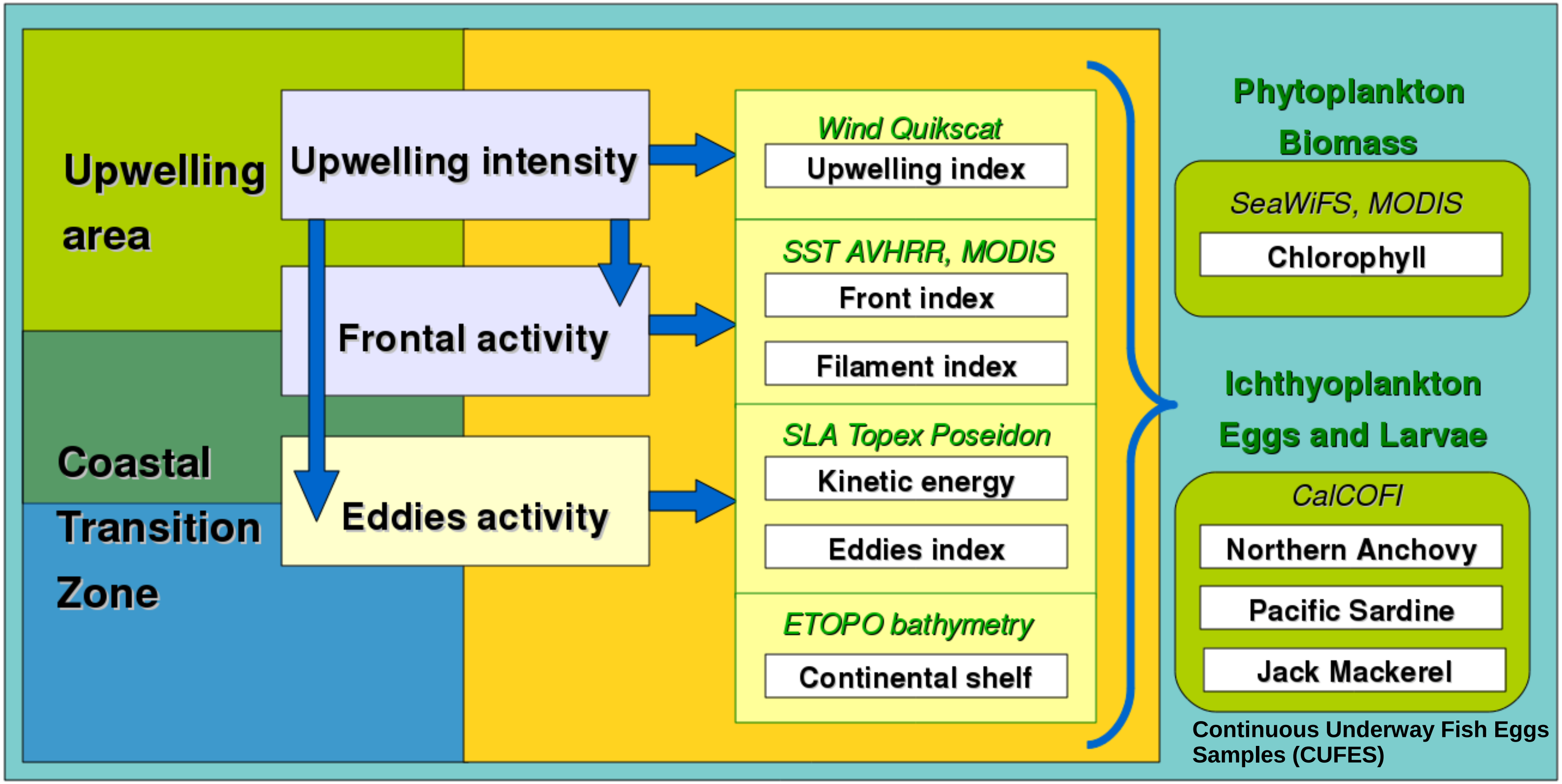
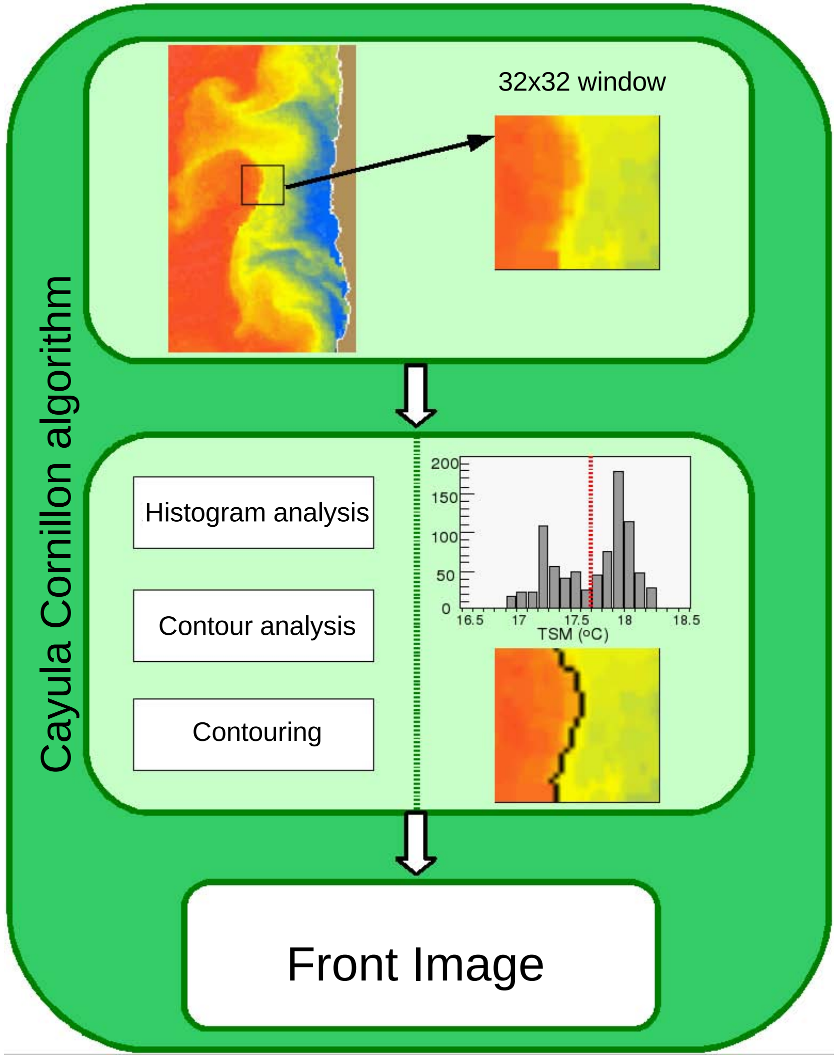
Conceptual frame

California System



1997 – 2009

Front detection algorithm



Cayula Cornillon algorithm

32x32 window

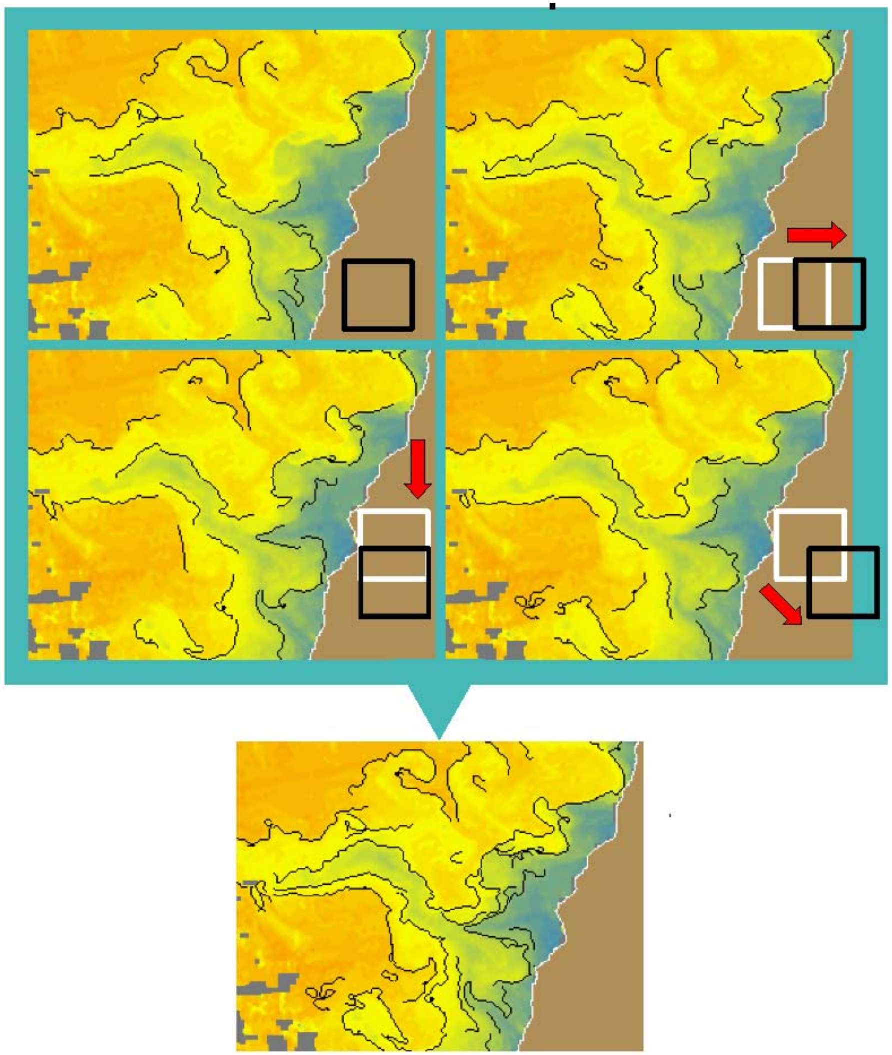
Histogram analysis

Contour analysis

Contouring

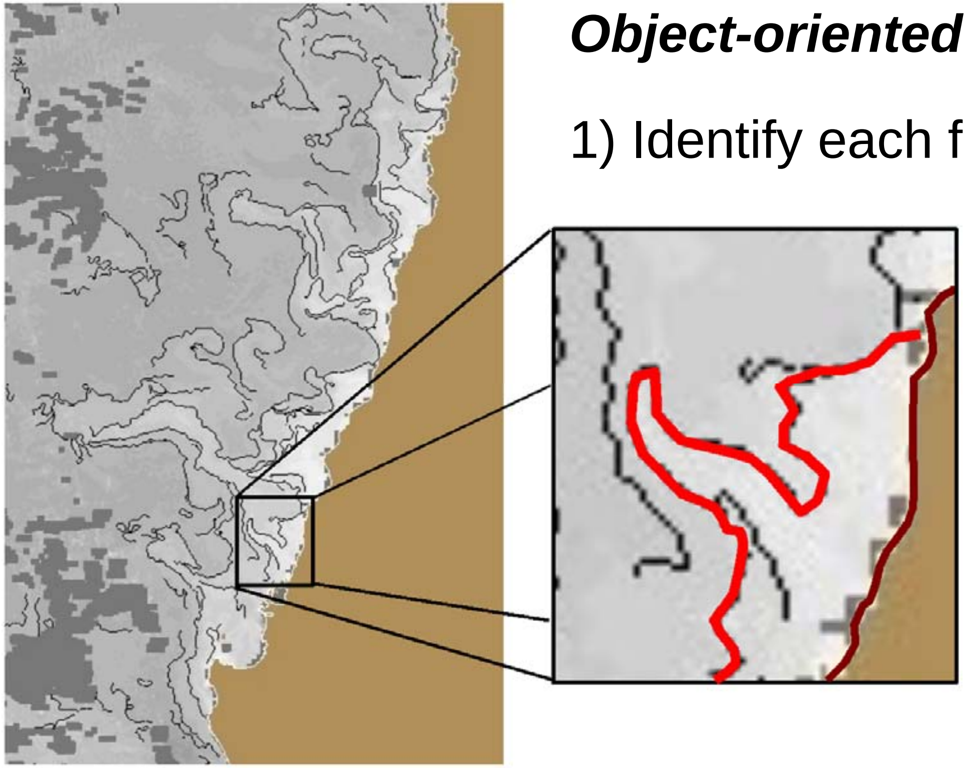
Front Image

Multiple windowing



Filament detection algorithm

We explore here the hypothesis that a front orthogonal to the coast has a higher probability to be a filament.



Object-oriented programming

1) Identify each front (segment)

2) Compute the direction related with the coastline

3) The segment with an angle perpendicular to the coast are considered as a filament

Eddies detection algorithm

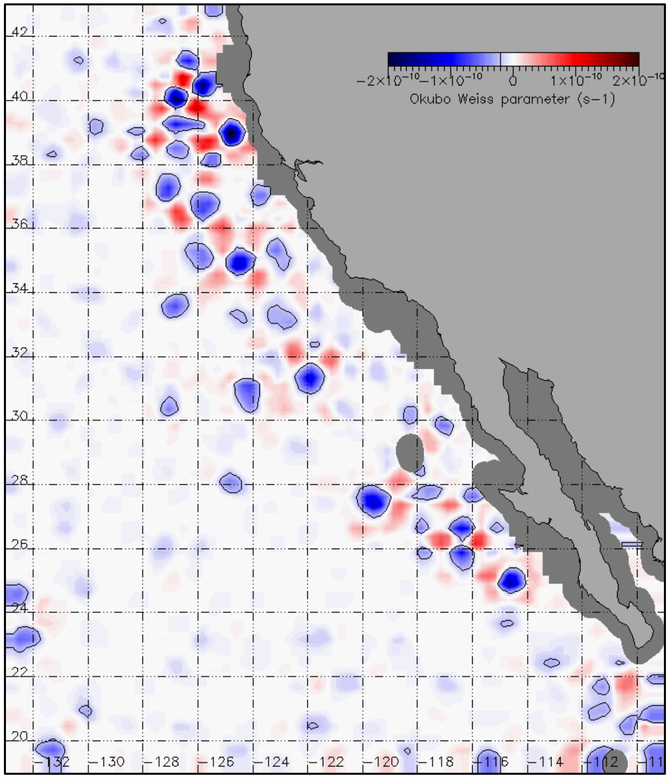
Okubo Weiss Parameter (OWP)

Defined as the normal component of strain (sn^2) plus the shear component of strain (ss^2) minus vorticity (w^2)

$$OWP = sn^2 + ss^2 - w^2$$

$$OWP = \underbrace{\left(\frac{\delta U}{\delta x} - \frac{\delta V}{\delta y}\right)^2 + \left(\frac{\delta V}{\delta x} + \frac{\delta U}{\delta y}\right)^2}_{\text{strain}} - \underbrace{\left(\frac{\delta V}{\delta x} - \frac{\delta U}{\delta y}\right)^2}_{\text{Vertical component of the relative vorticity}}$$

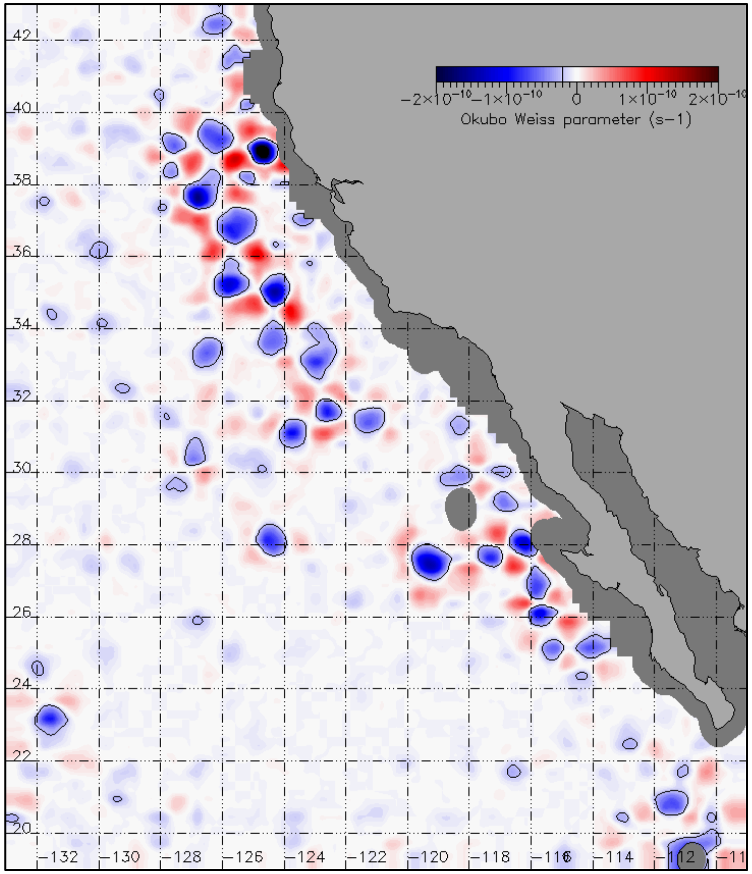
U = meridional geostrophic currents
V = zonal geostrophic currents
x = horizontal spatial orthogonal coordinates
y = vertical spatial orthogonal coordinates



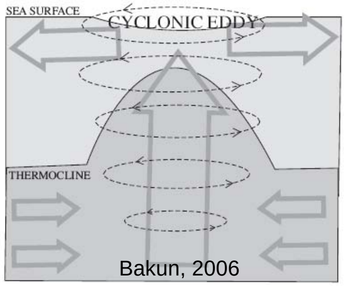
Eddy characterized by:
Strong rotation in the center
Strong deformation in the periphery

➡ Dominated by **vorticity**, ***eddy core*** has large **negative** OWP

Eddies detection algorithm

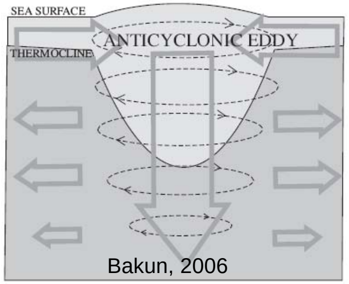


● Cyclonic

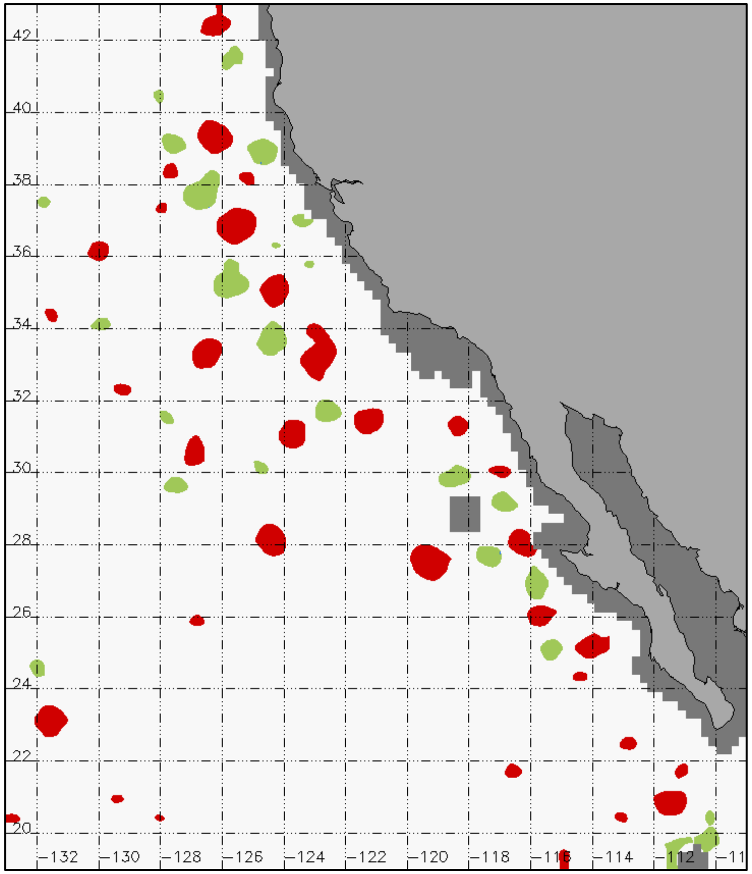


Bakun, 2006

● Anticyclonic



Bakun, 2006



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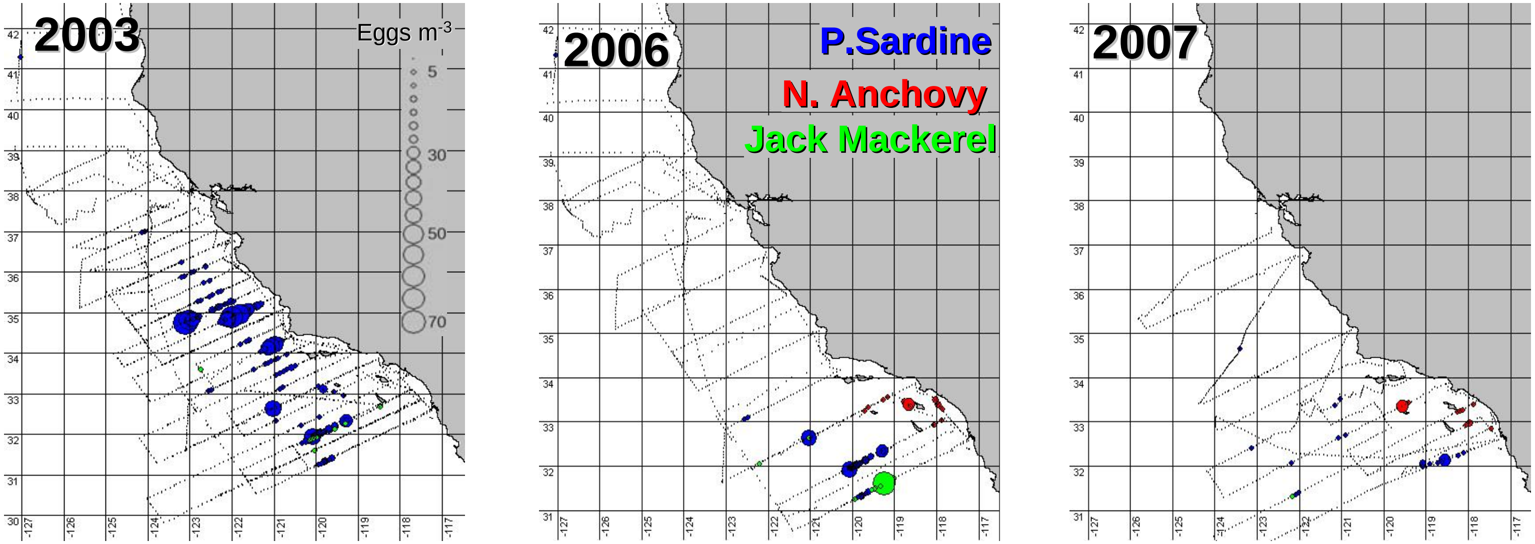
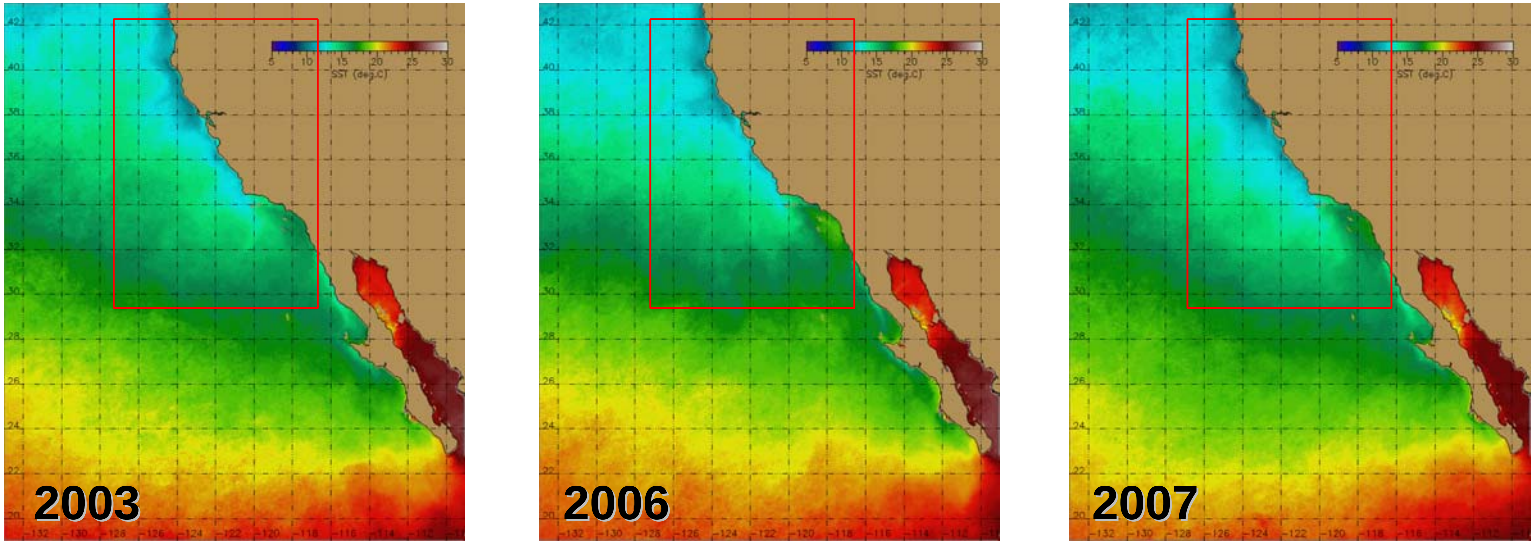
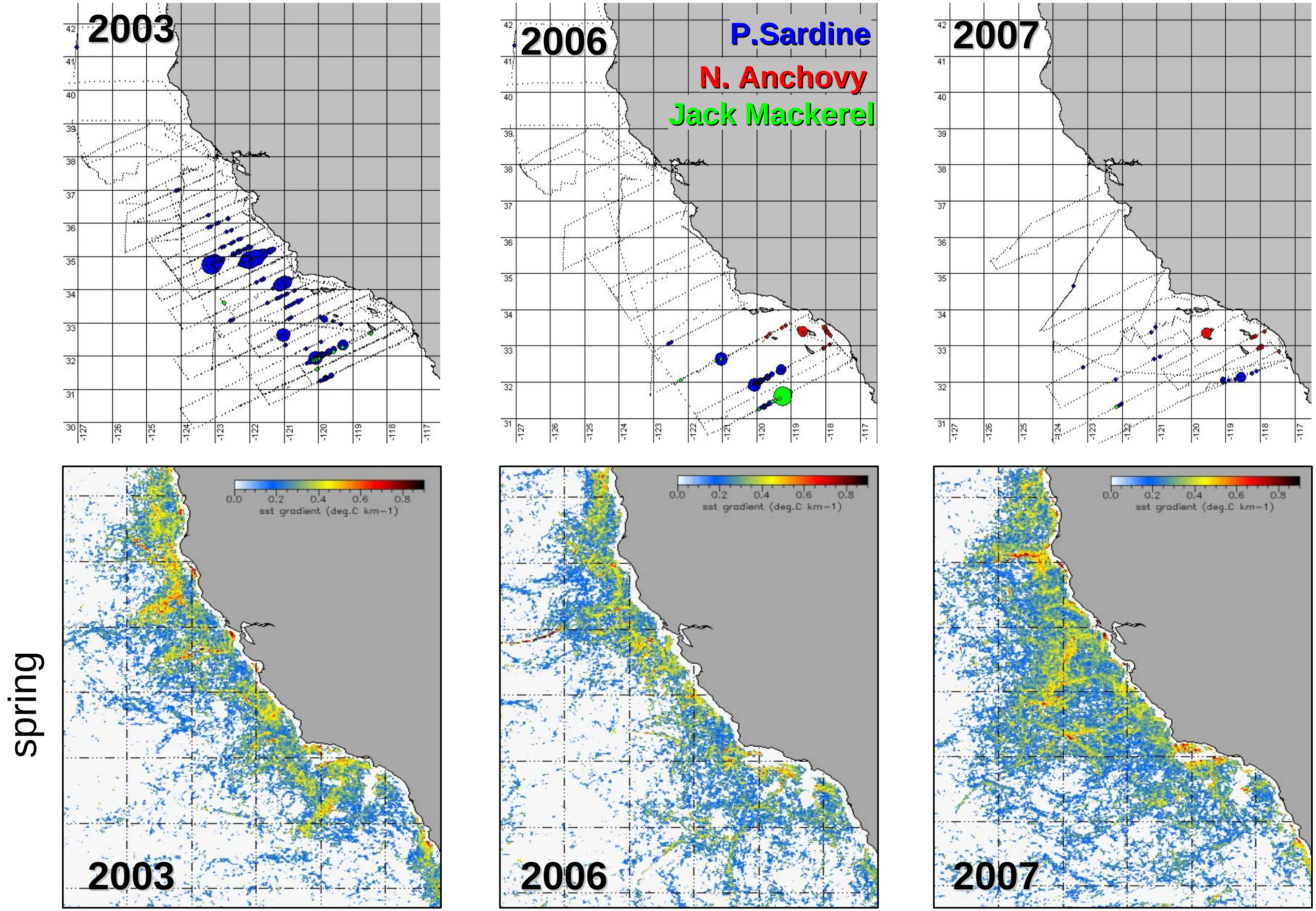
Examples Ichthyoplankton distribution



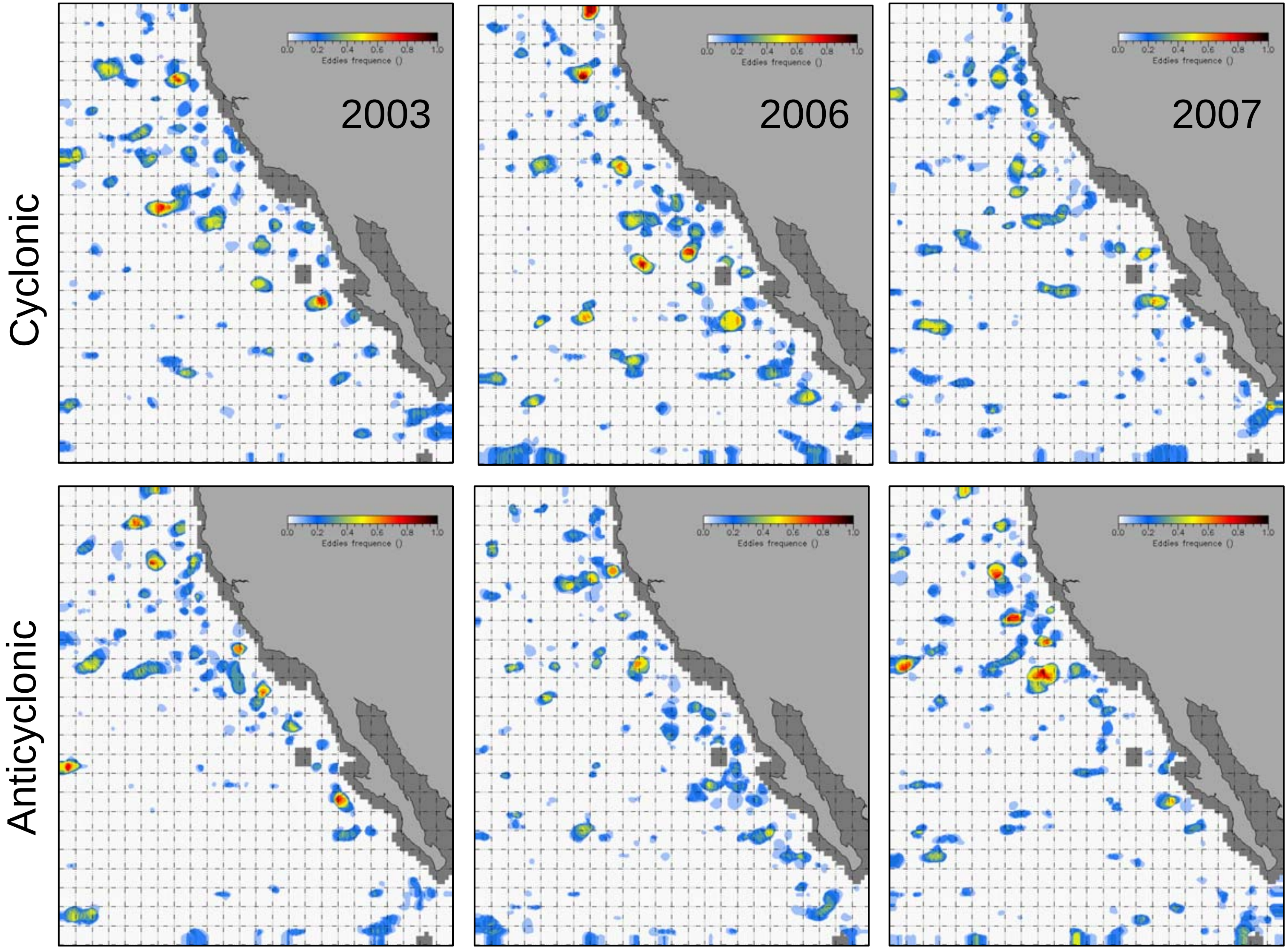
spring



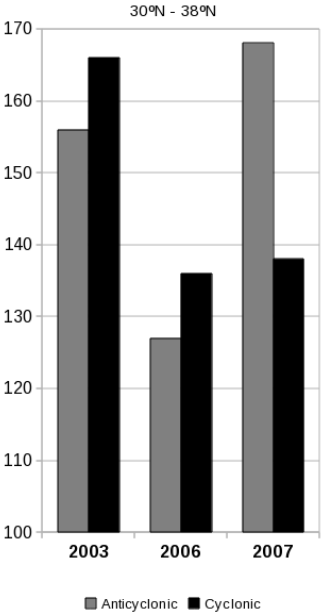
Fronts


2003
2006
2007
P.Sardine
N. Anchovy
Jack Mackerel
42
41
40
39
38
37
36
35
34
33
32
31
30
-127
-126
-125
-124
-123
-122
-121
-120
-119
-118
-117
0.0
0.2
0.4
0.6
0.8
sst gradient (deg.C km−1)
spring
2003
2006
2007

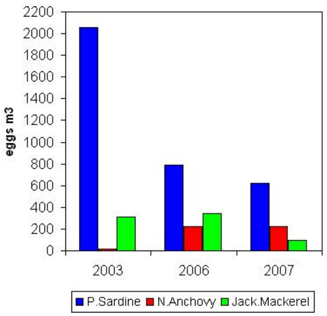
Eddies



Eddies number



Eggs density



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Work ahead

Identify the mesoscale oceanic structures present in the California System, using automatic detection algorithm applied to satellite data from multiple sensors

1997 / 1998 / 1999 / 2000 / 2001 / **2002 / 2003 / 2004 / 2005 / 2006 / 2007 / 2008 / 2009**

Establish the relationships between mesoscale oceanic structures and distribution of eggs and larvae

To predict spawning areas for anchovy and sardine in the California systems, through the analysis of historical data on the distribution of eggs and larvae and environmental conditions associated with these areas

Thank you!