

La circolazione oceanica generale

Andrea M. Doglioli

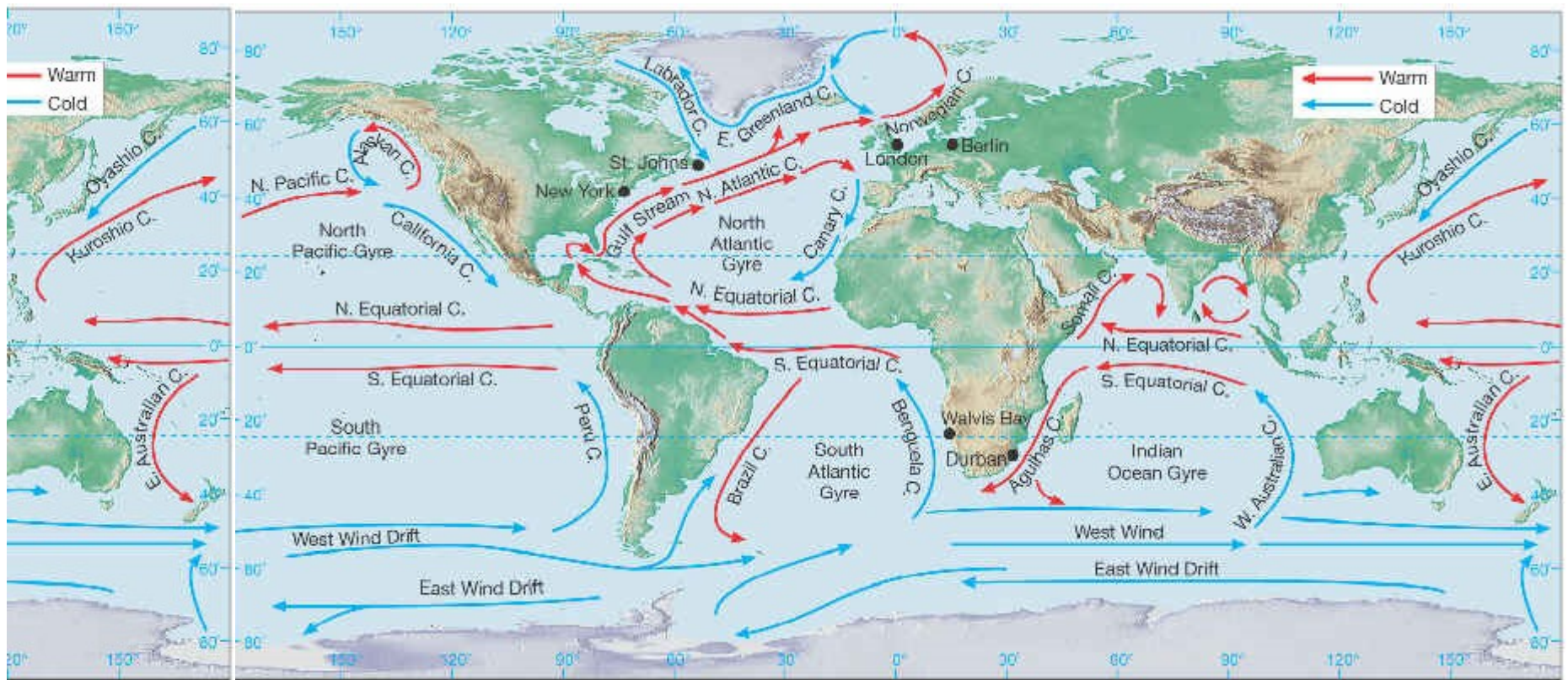


Laboratoire
d'Océanographie
Physique et
Biogéochimique



Mercoledì 29 aprile 2009

Dipartimento di Fisica, Università di Genova



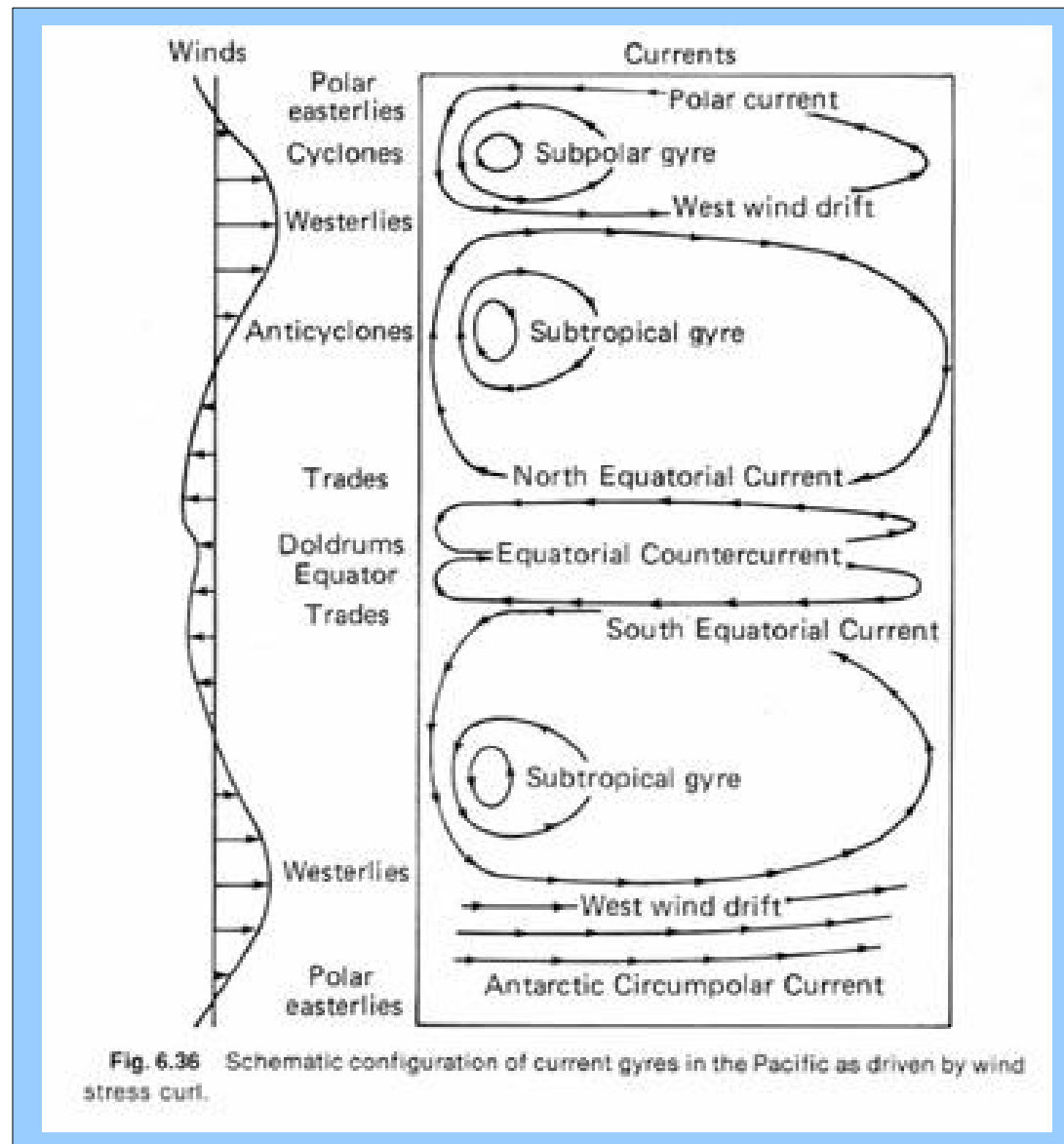
Carta delle principali correnti oceaniche

analogie fra i 5 bacini oceanici:

lato ovest **correnti calde verso i poli**

lato est **correnti fredde verso l'equatore**

Circolazione generata dal vento *Wind-driven circulation*

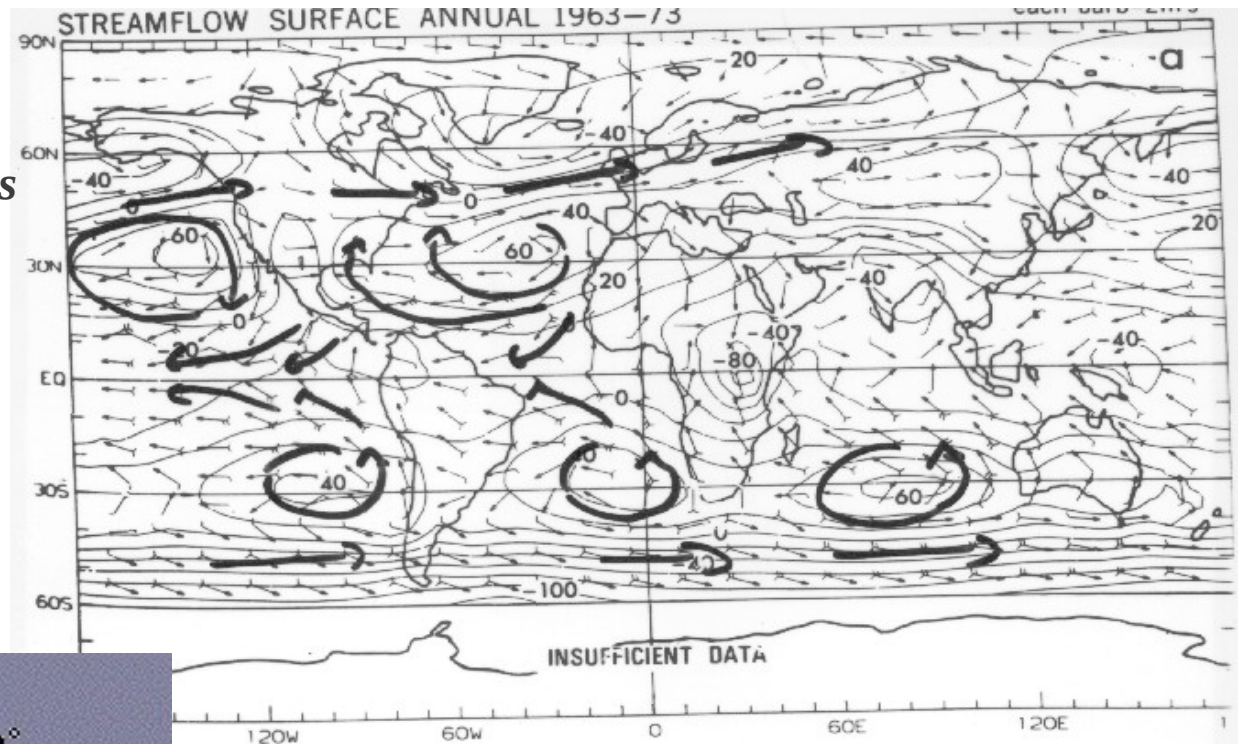


Cinquanta urlanti
 Quaranta ruggenti
 Correnti occidentali

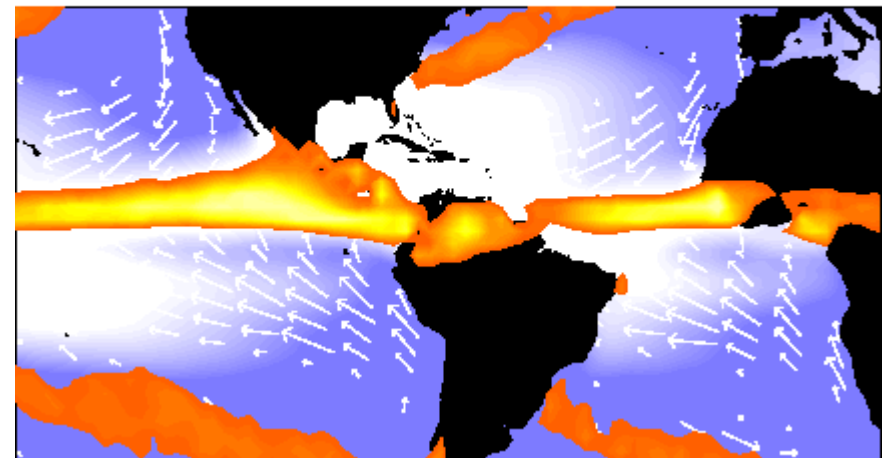
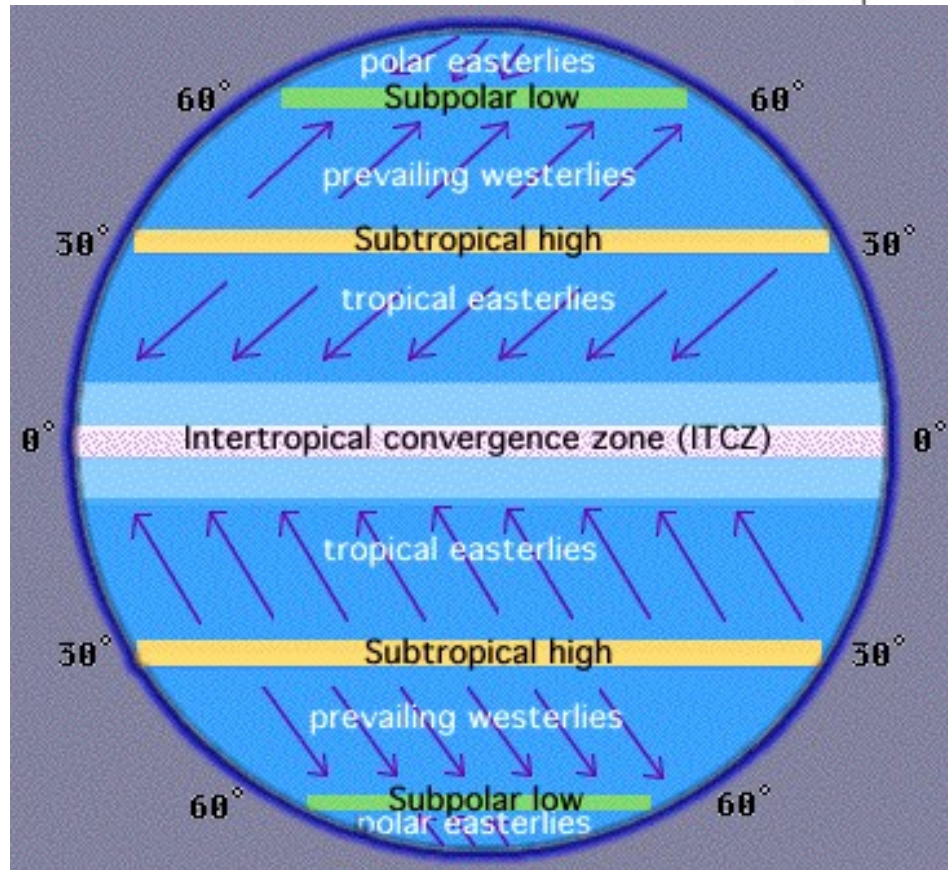
Furious Fifties
Roaring Forties
Westerlies

Alisei

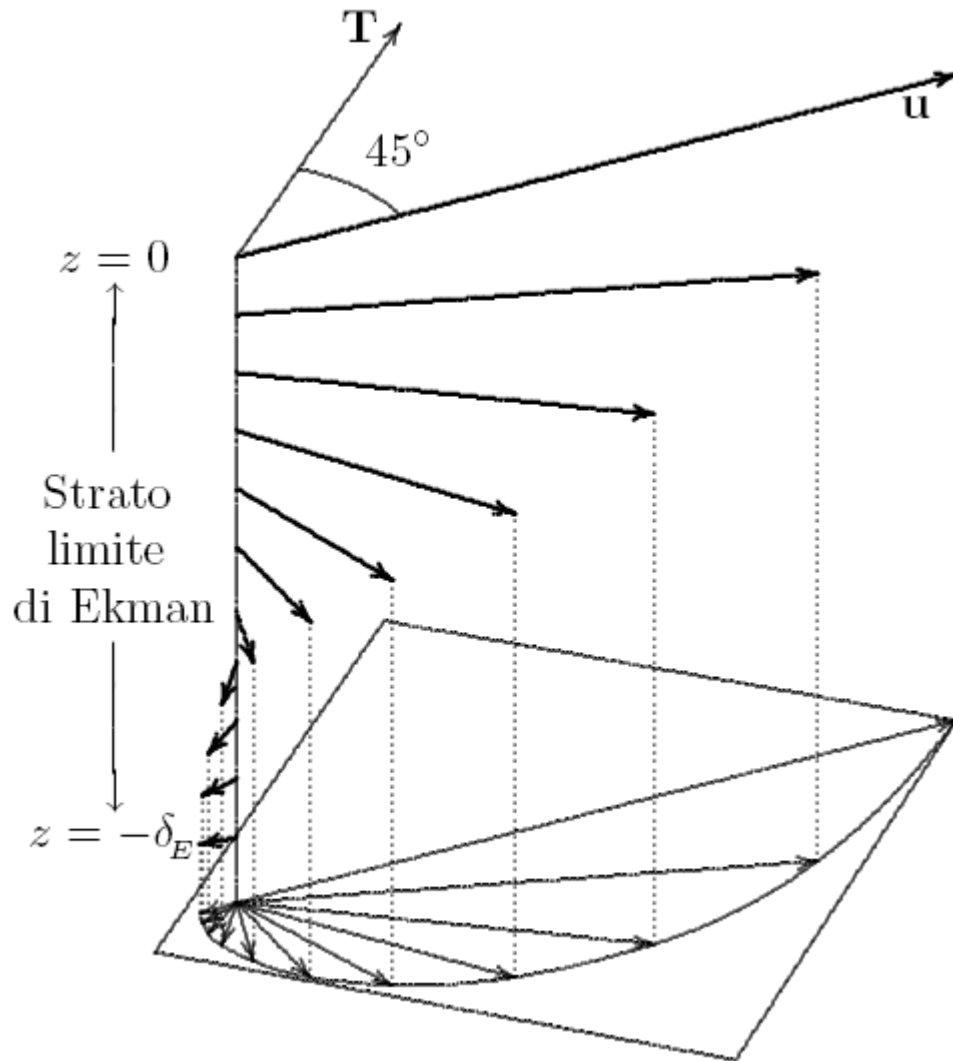
Tradewinds



PanAmerican Climate Studies (PACS)



La spirale di Ekman



depth to $e^{-2\pi} = 1/535$ th part for each time its direction rotates four right angles. The direction and velocity of the

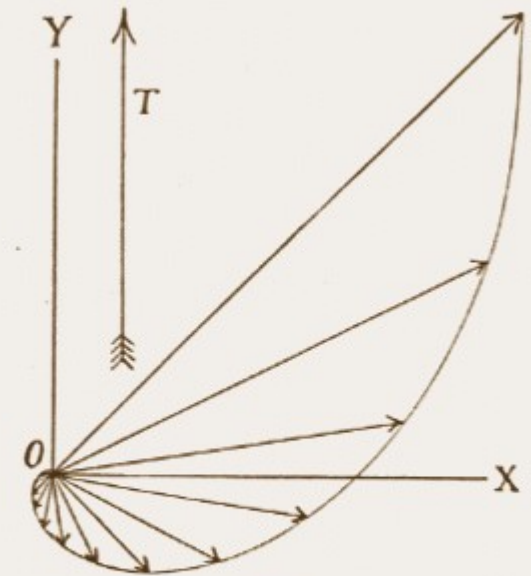
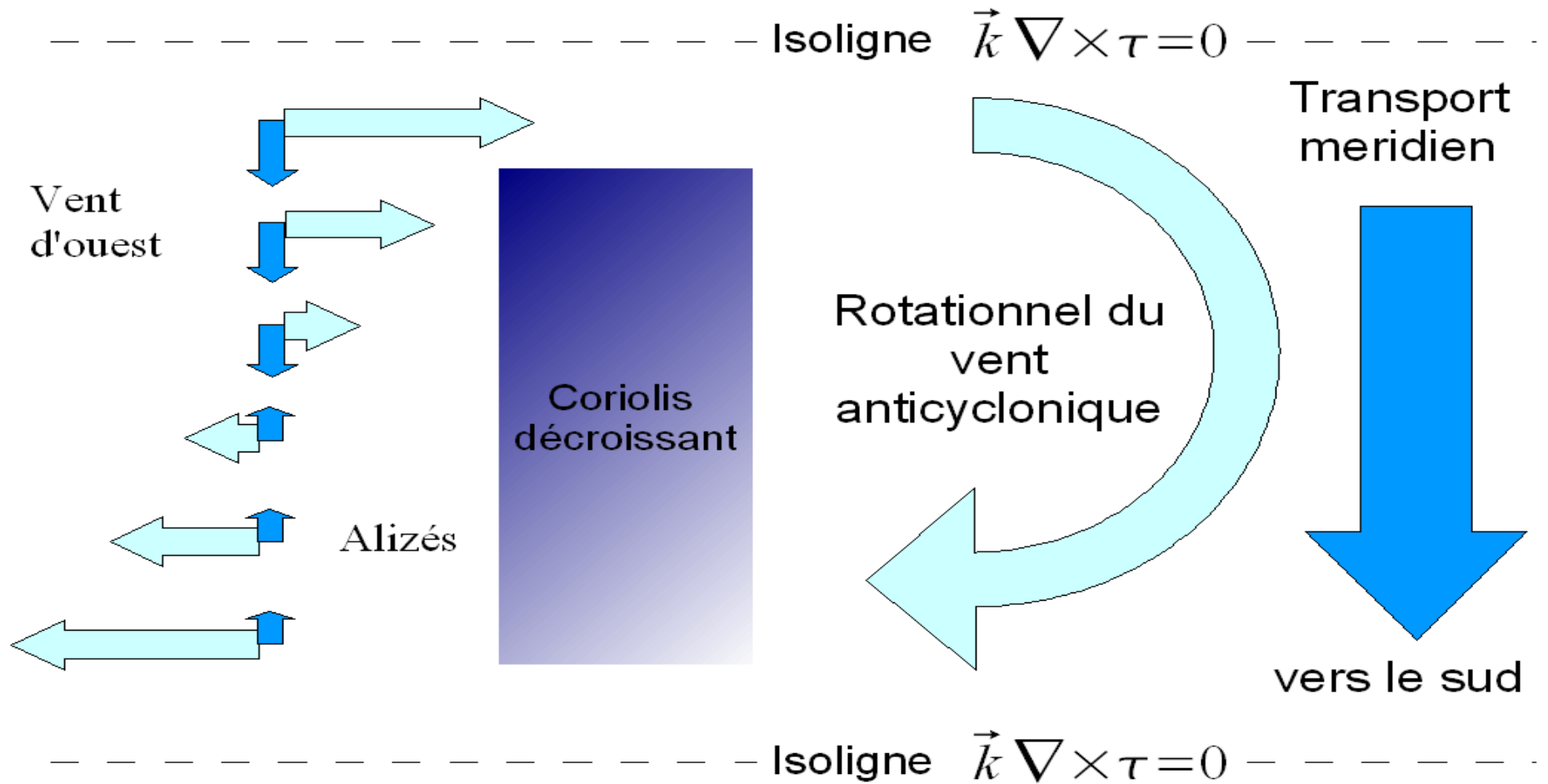


Fig. 1.

current at different depths are represented by the arrows in Fig. 1 above; the longest arrow refers to the surface, the (the water) does not however vary appreciably with the height. within

Effetto Beta e trasporto meridiano

Hémisphère Nord



Circolazione di Sverdrup

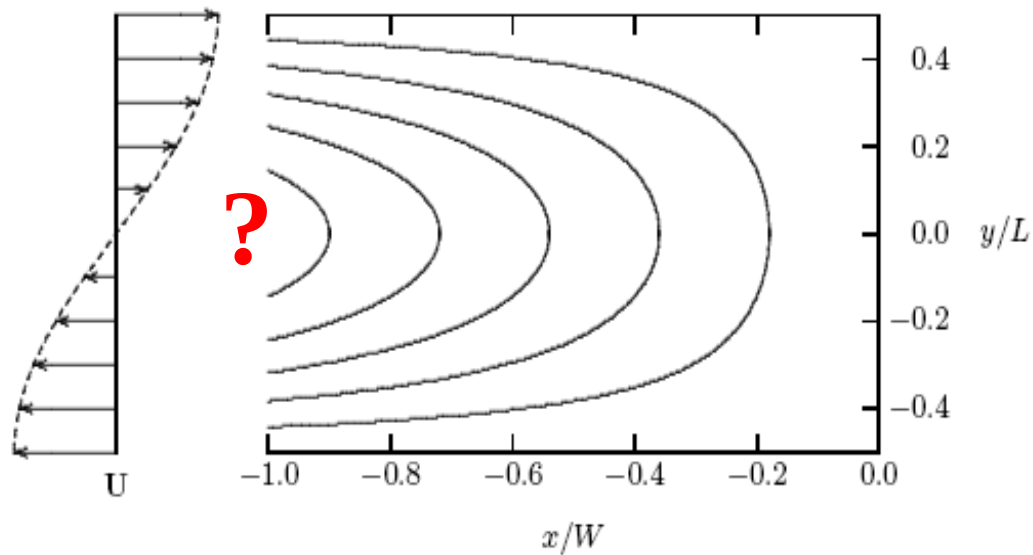
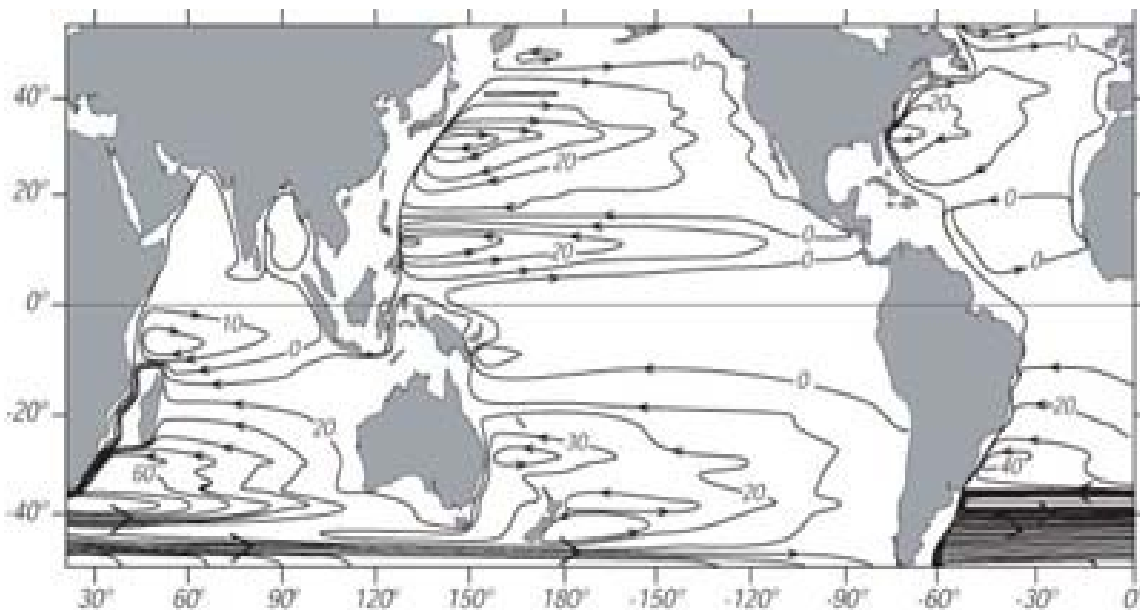
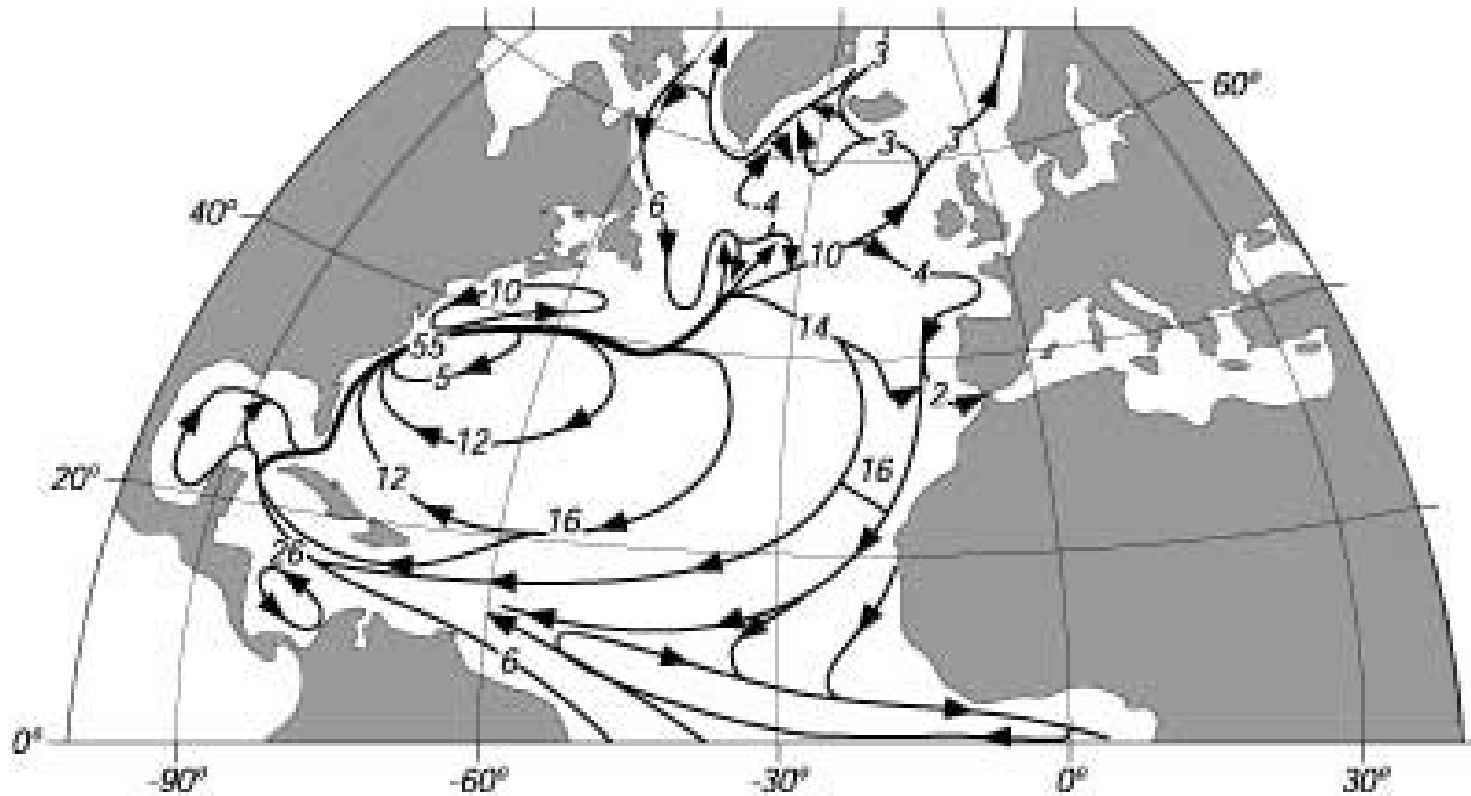


Fig. 52.1 Andamento del vento U e della corrispondente soluzione di Sverdrup in prossimità del contorno orientale di un bacino oceanico.



Depth-integrated Sverdrup transport applied globally using the wind stress from Hellerman and Rosenstein (1983). Contour interval is 10 [Sv].

From Tomczak and Godfrey (1994).
http://oceanworld.tamu.edu/resources/ocng_textbook/chapter11/chapter11_01.htm



Sketch of the major surface currents in the North Atlantic. Values are transport in units of $10^6 \text{m}^3/\text{s}$.

From Sverdrup, Johnson, and Fleming (1942: fig. 187).

The figure shows a broad, basin-wide, mid latitude gyre as we expect from Sverdrup's theory. In the west, a western boundary current, the Gulf Stream, completes the gyre. In the north a subpolar gyre includes the Labrador current. An equatorial current system and countercurrent are found at low latitudes with flow similar to that in the Pacific.

H. Stommel

Intensificazione delle correnti di bordo ovest



Henry Stommel (left) and Lou Howard (right), both principal instructors in the Geophysical Fluid Dynamics program, demonstrate the effect of rotation on seawater. (Photo courtesy of WHOI Archives)

ATTRITO

$$\frac{\partial \psi}{\partial x} + \frac{f d}{2\beta H} \nabla^2 \psi = -\frac{k(\nabla \times \vec{\tau}_0)}{\beta}$$

$$\Psi(x, y) = -\frac{T_0 L}{\pi a} \cos \pi \frac{y}{L} \left[1 - \frac{e^{\frac{\beta}{2a}(W-x)} \sinh \alpha x + e^{-\frac{\beta}{2a}x} \sinh \alpha(W-x)}{\sinh \alpha W} \right],$$

$$\alpha = \sqrt{\frac{\beta^2}{4a^2} + \frac{\pi^2}{L^2}}$$

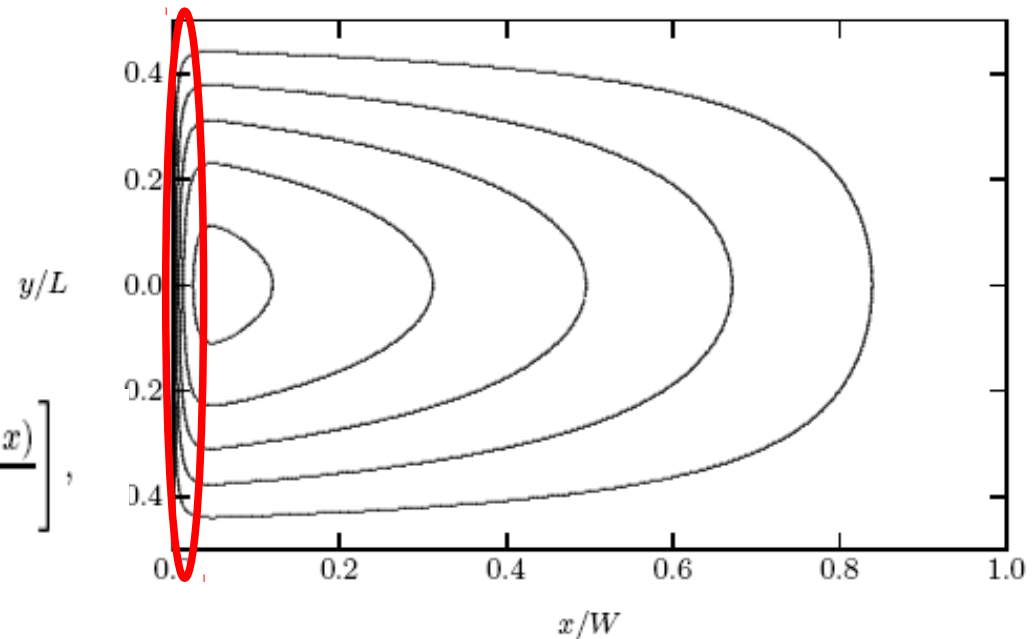
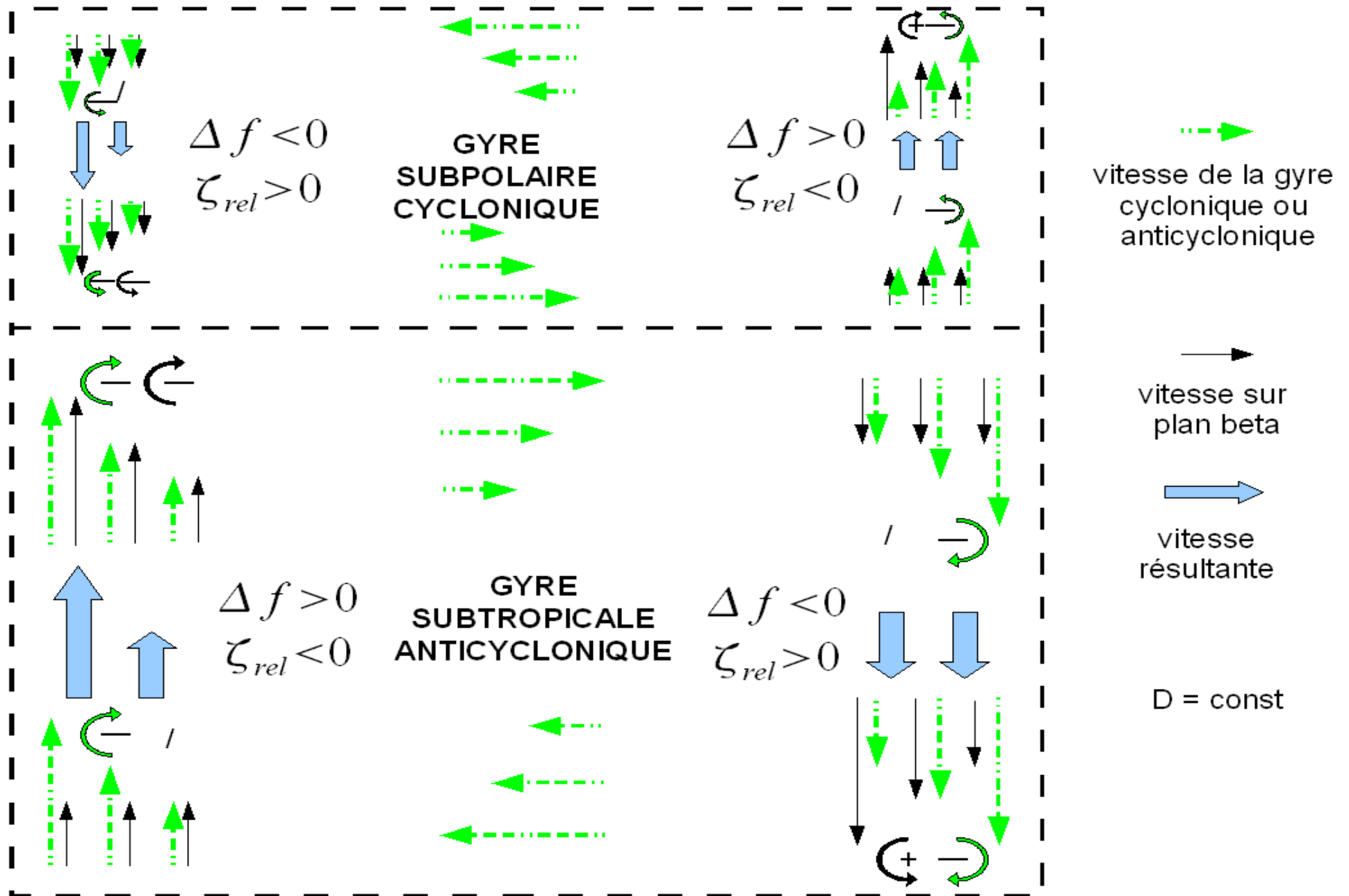
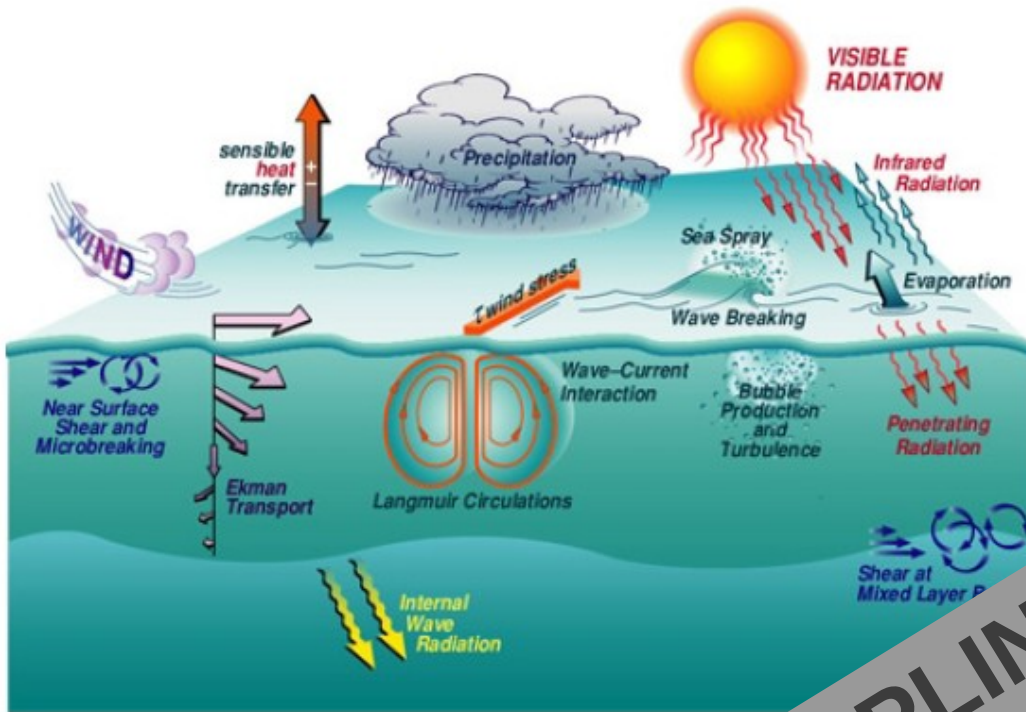


Fig. 52.2 Andamento della soluzione di Stommel per $\beta/\alpha = 10^{-5}$.

Conservazione della vorticità potenziale e correnti di bordo ovest

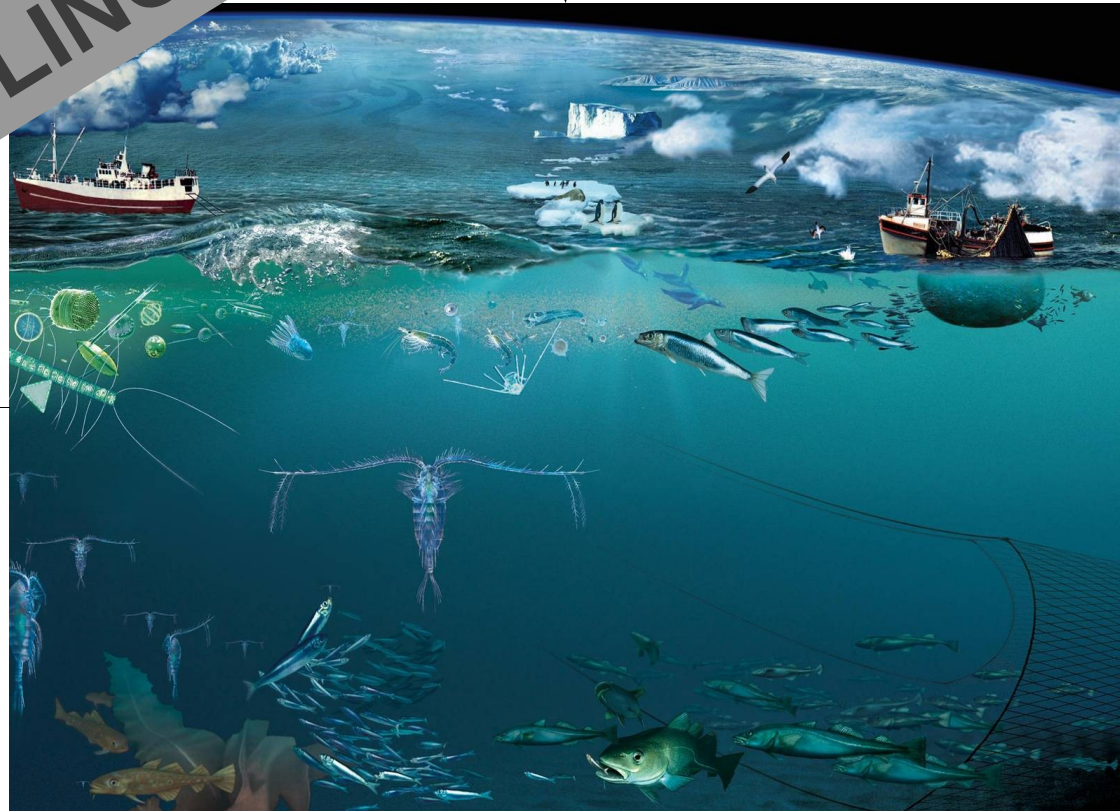




I fenomeni fisici influenzano quelli biologici.

E.G. Le correnti redistribuiscono i sali nutritivi e alcuni organismi viventi

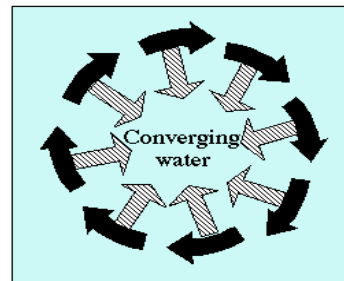
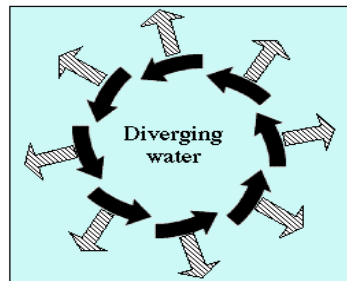
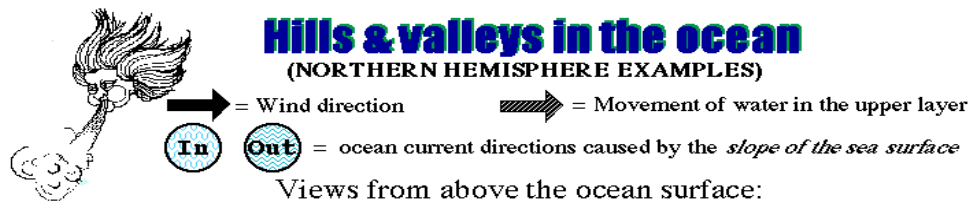
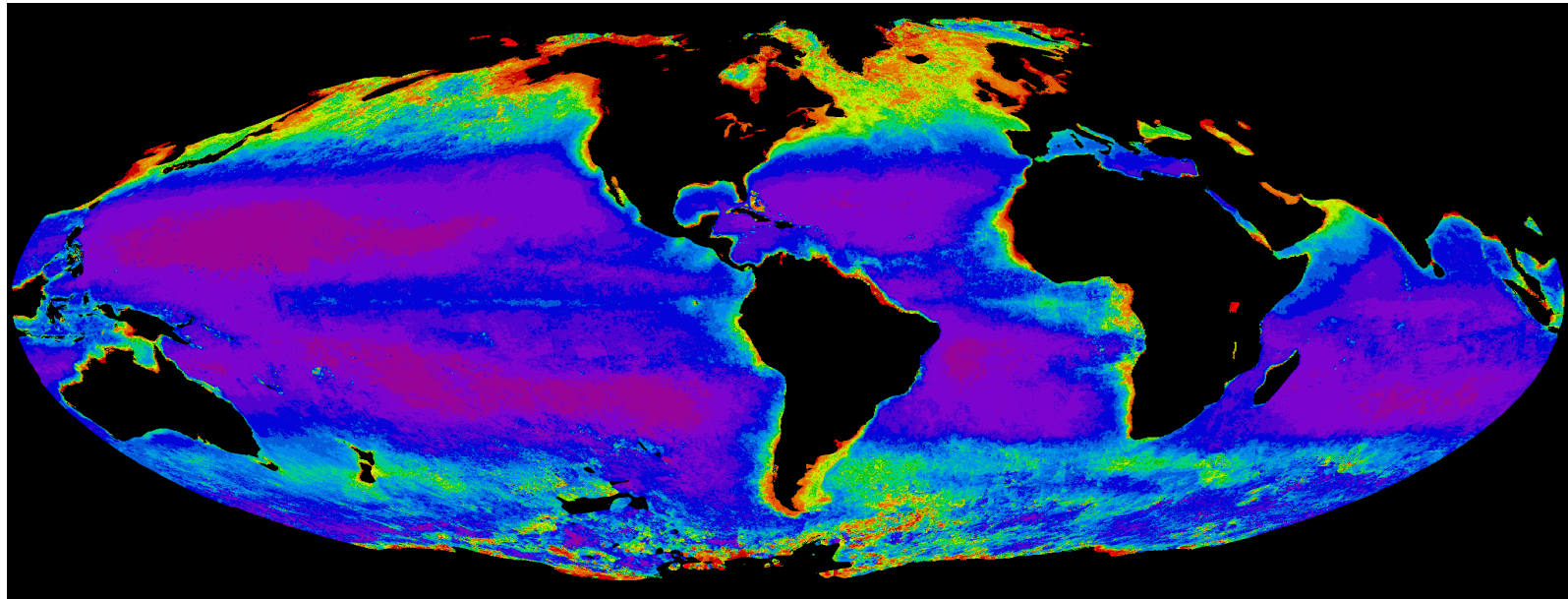
COUPLING



I fenomeni biologici influenzano quelli fisici

E.G. fioritura di plancton riduce la penetrazione della luce

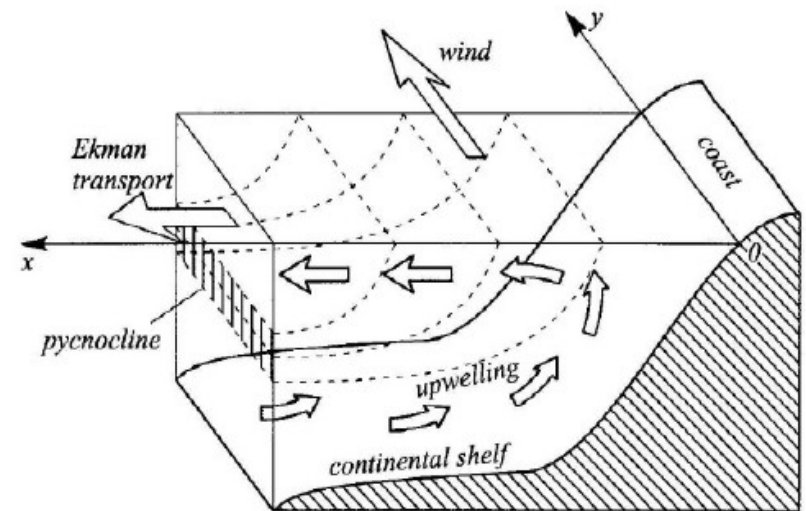
Effetti della circolazione sulla biogeochimica dell'oceano



Side views of sea surface valley and hill:

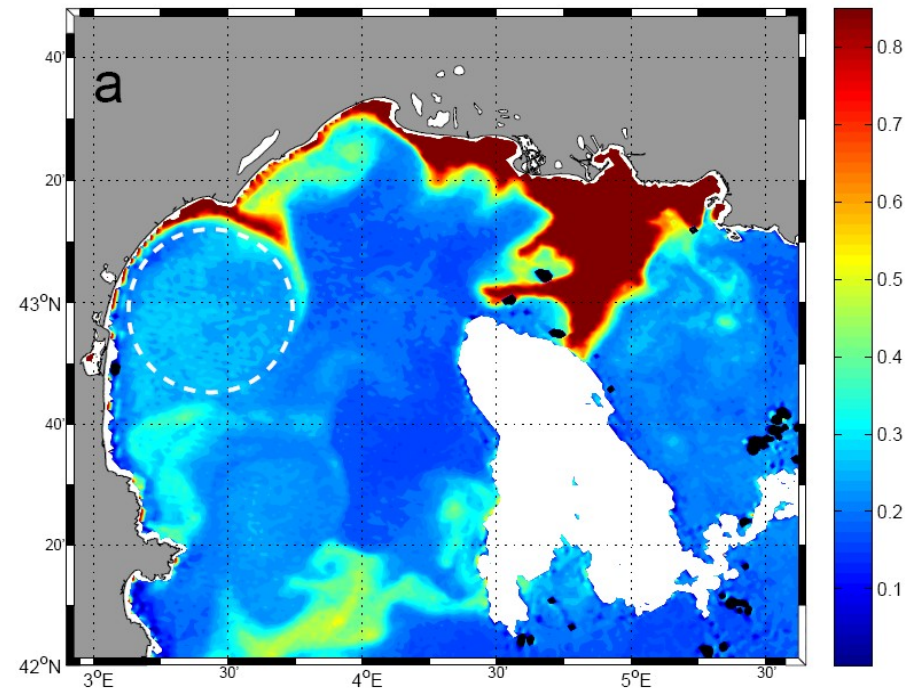
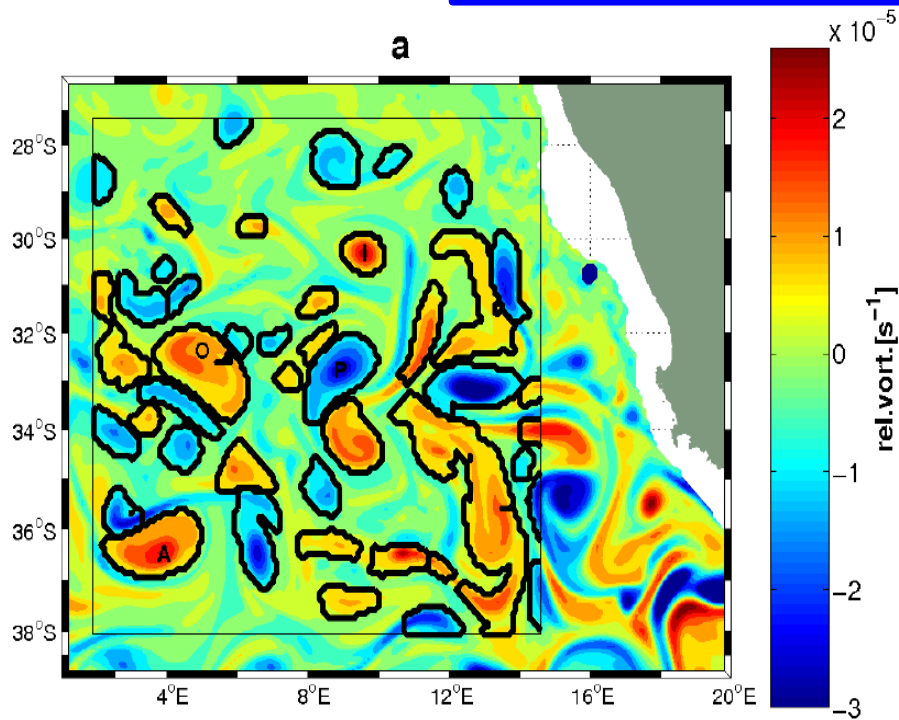
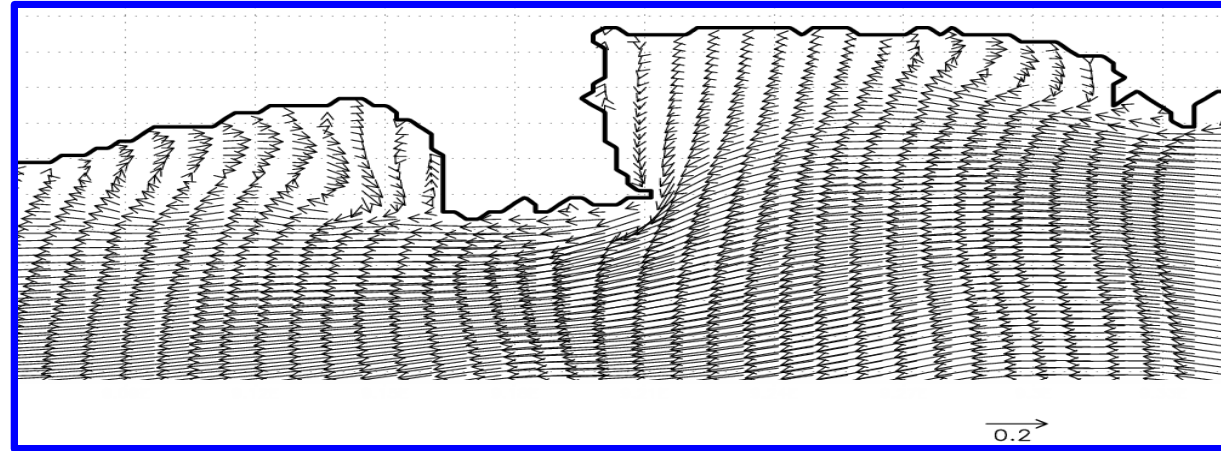


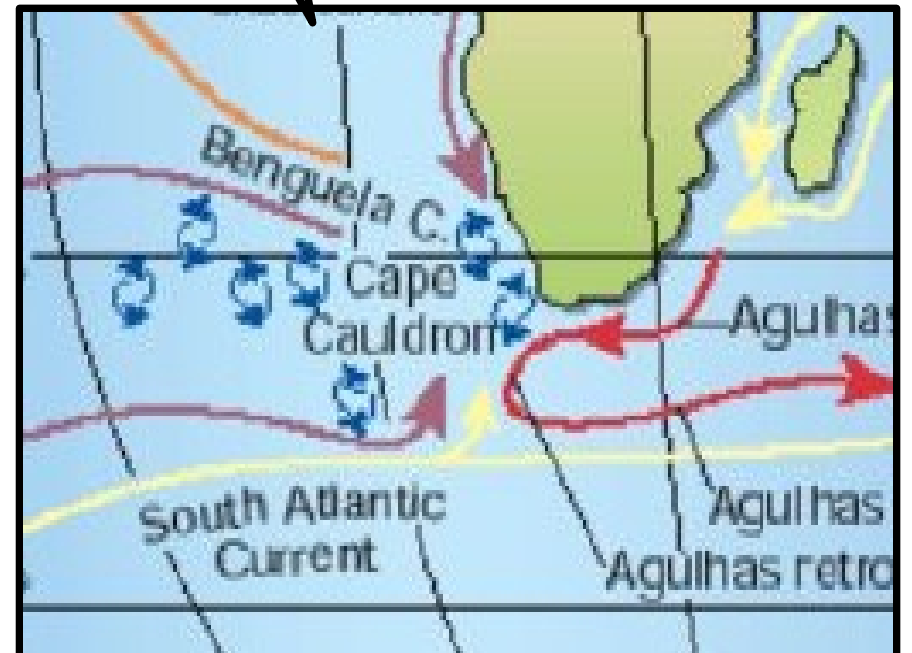
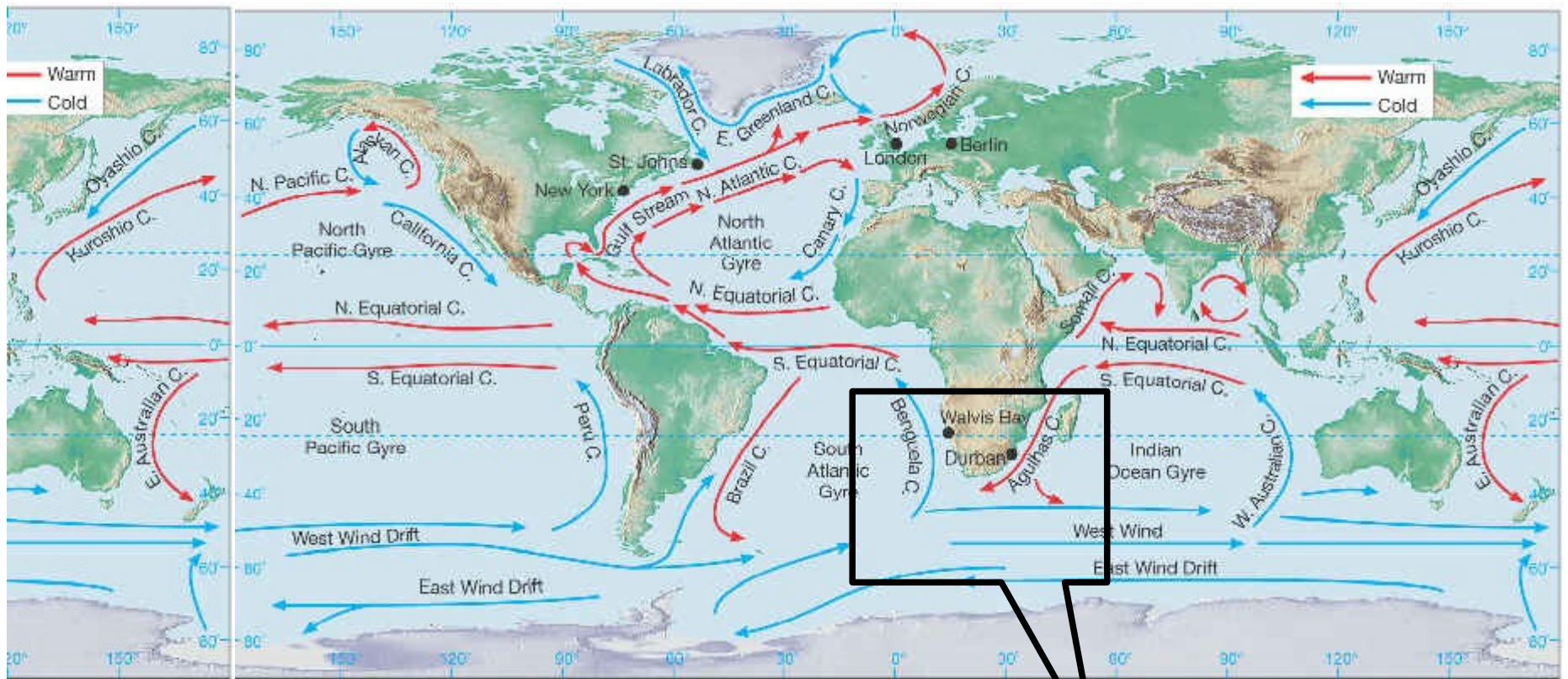
Coastal upwelling
(southern hemisphere example)



Tematiche di ricerca attuali in oceanografia:

i vortici di (sub)mesoscala





**Retroflessione delle Agulhas
e Agulhas Rings del *Cape Caudron***



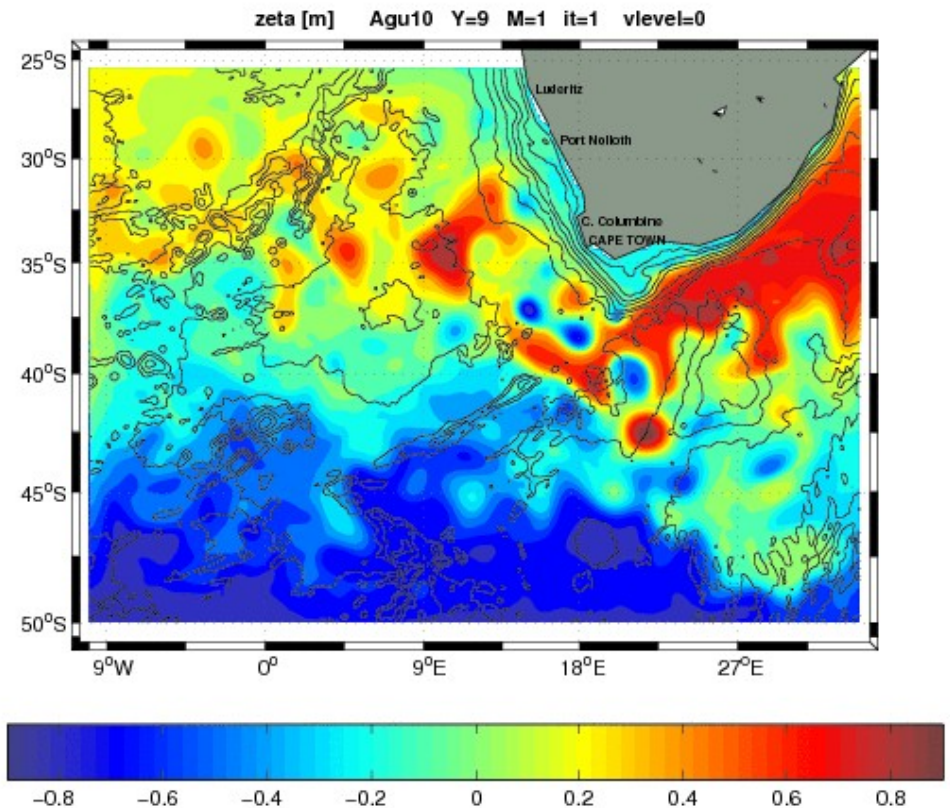
Wavelets Analisisys for Time-tracking Eddies in Regional models



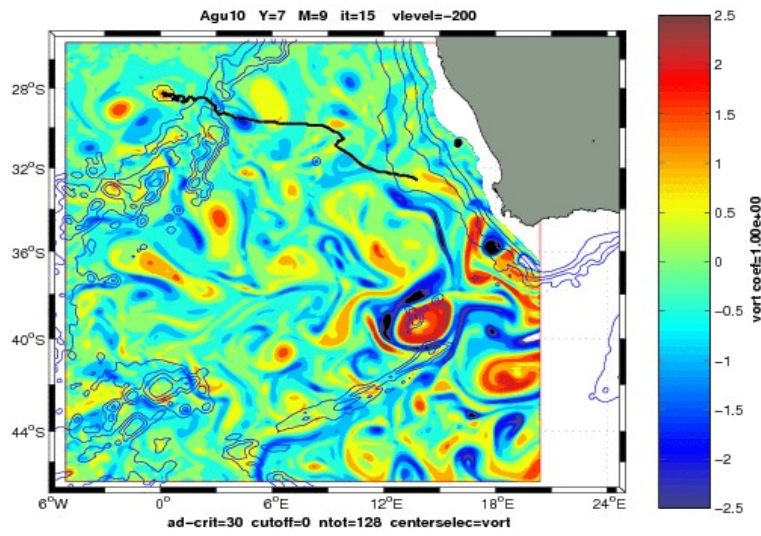
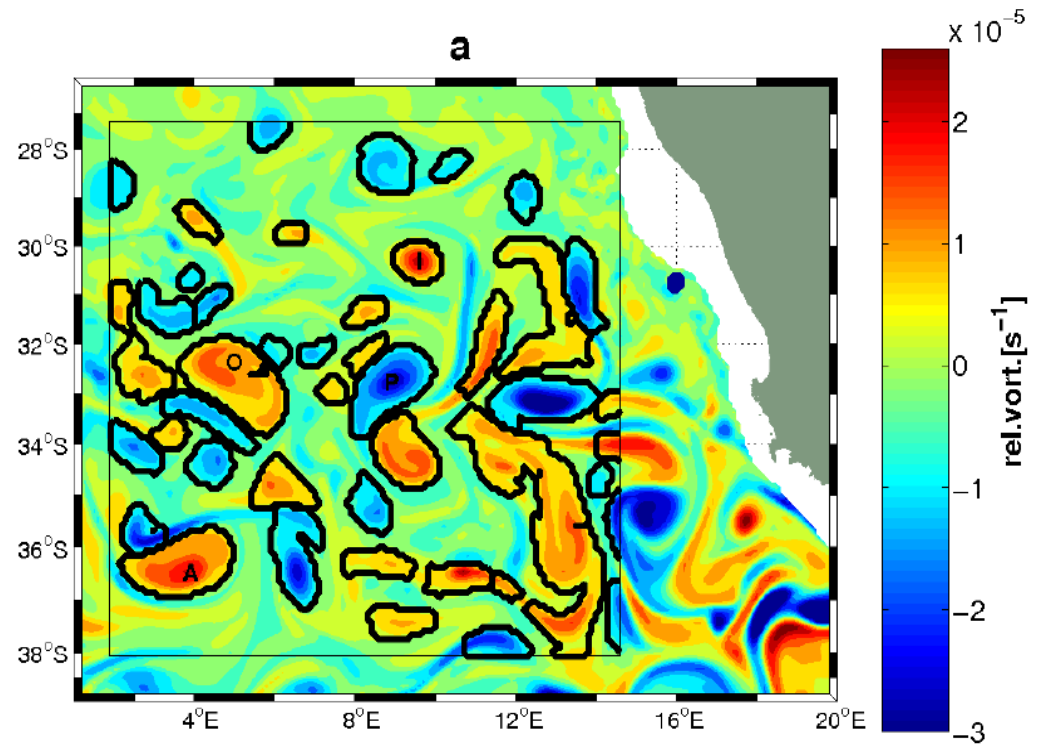
Obiettivi del progetto

identificare nei dati forniti da un modello i vortici con metodo oggettivo

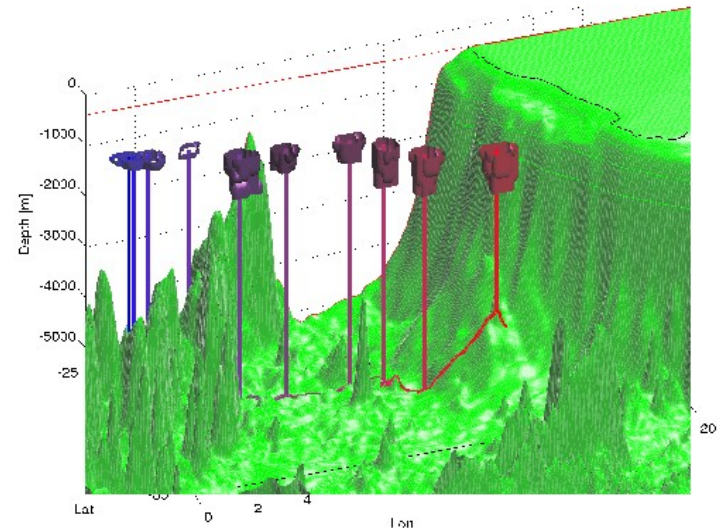
seguirli nel tempo per capire le loro caratteristiche e gli scambi tra i due oceani



ESEMPI DI VORTICI STUDIATI



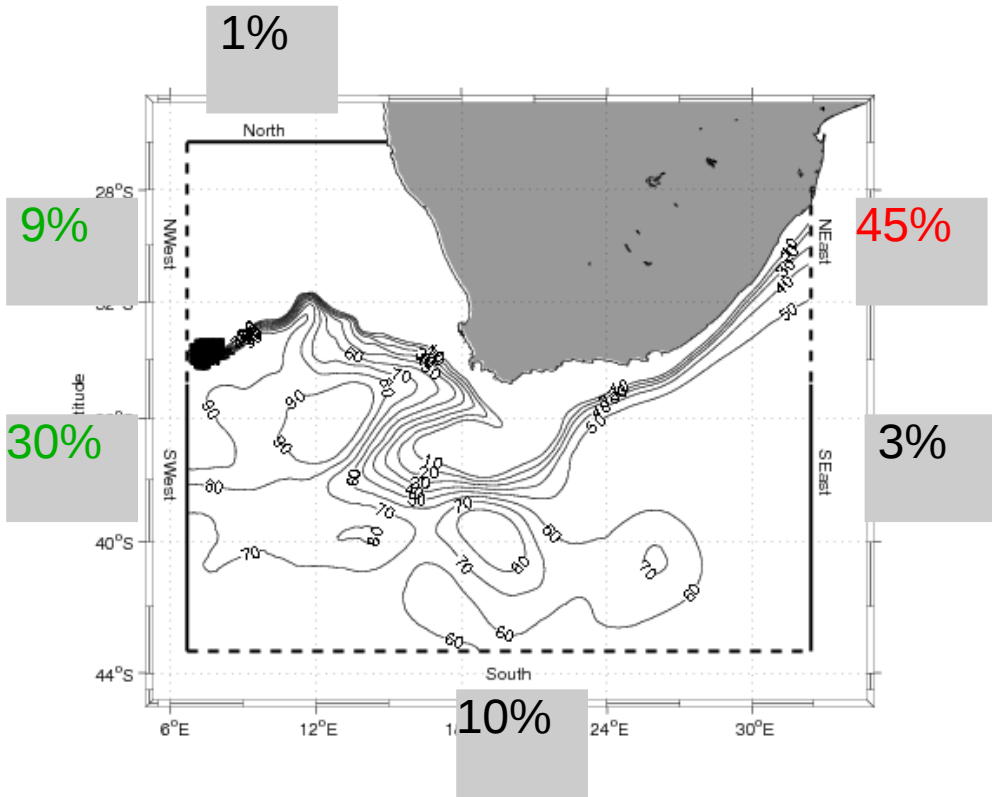
IDEFIX 2D



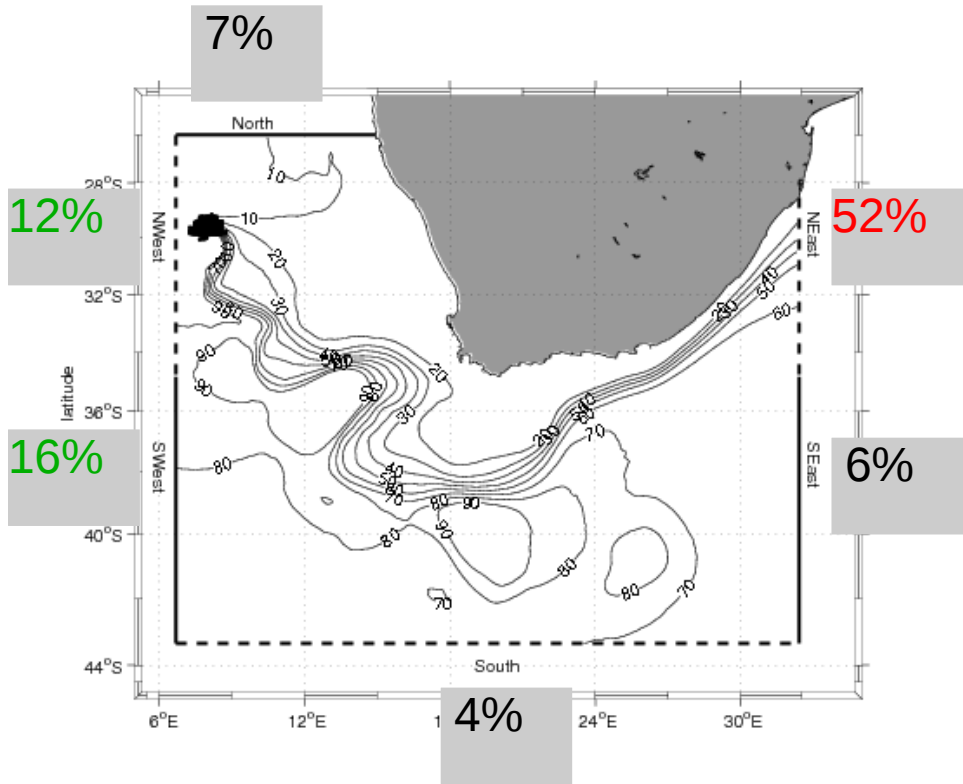
IDEFIX 3D

Stime degli scambi di masse d'acqua tra Oceano Indiano e Atlantico dovuti ai vortici

Cyclone ASTERIX

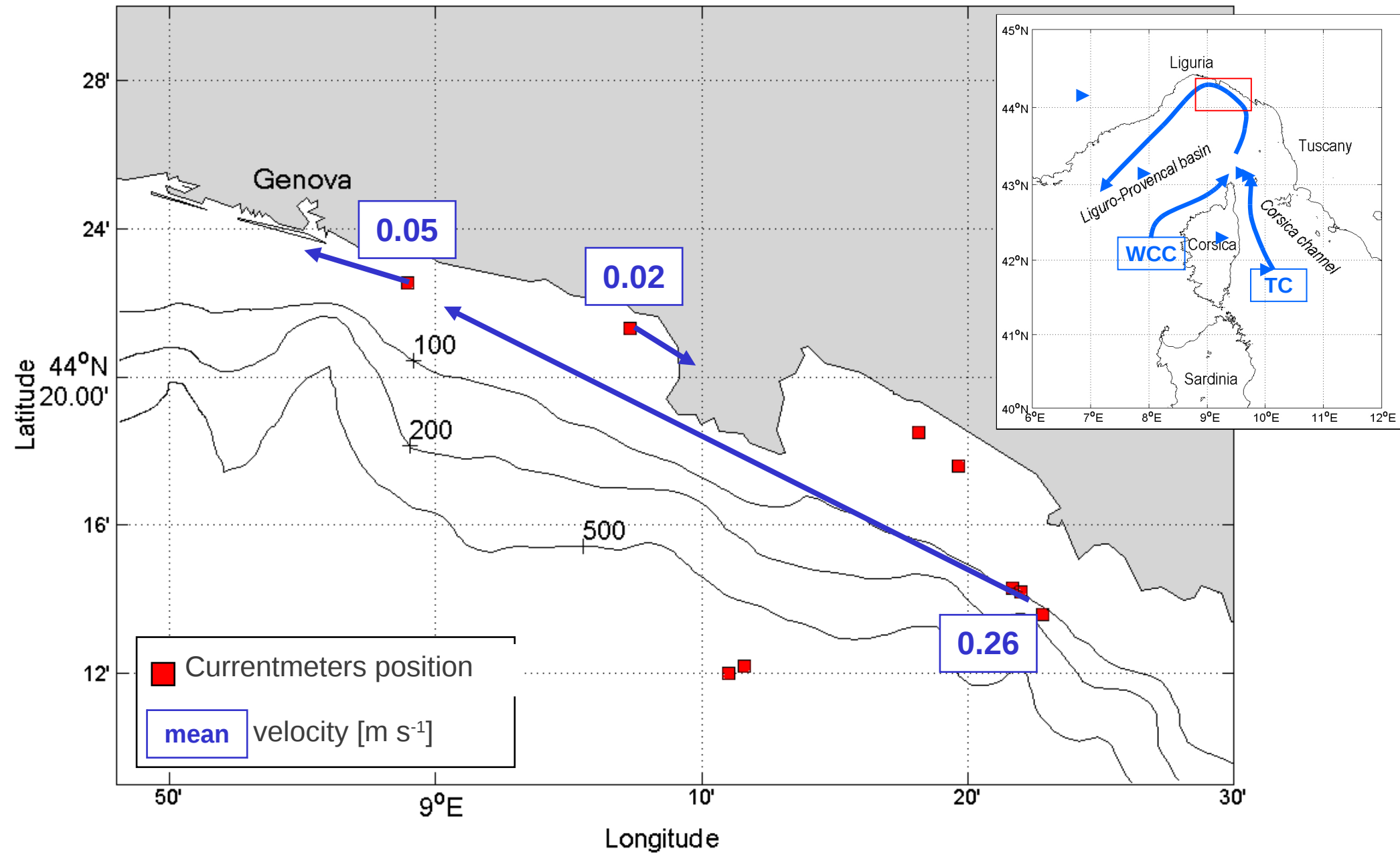


Anticyclone PANORAMIX



Enormi quantità di sale e calore!

Misure storiche di corrente a Portofino



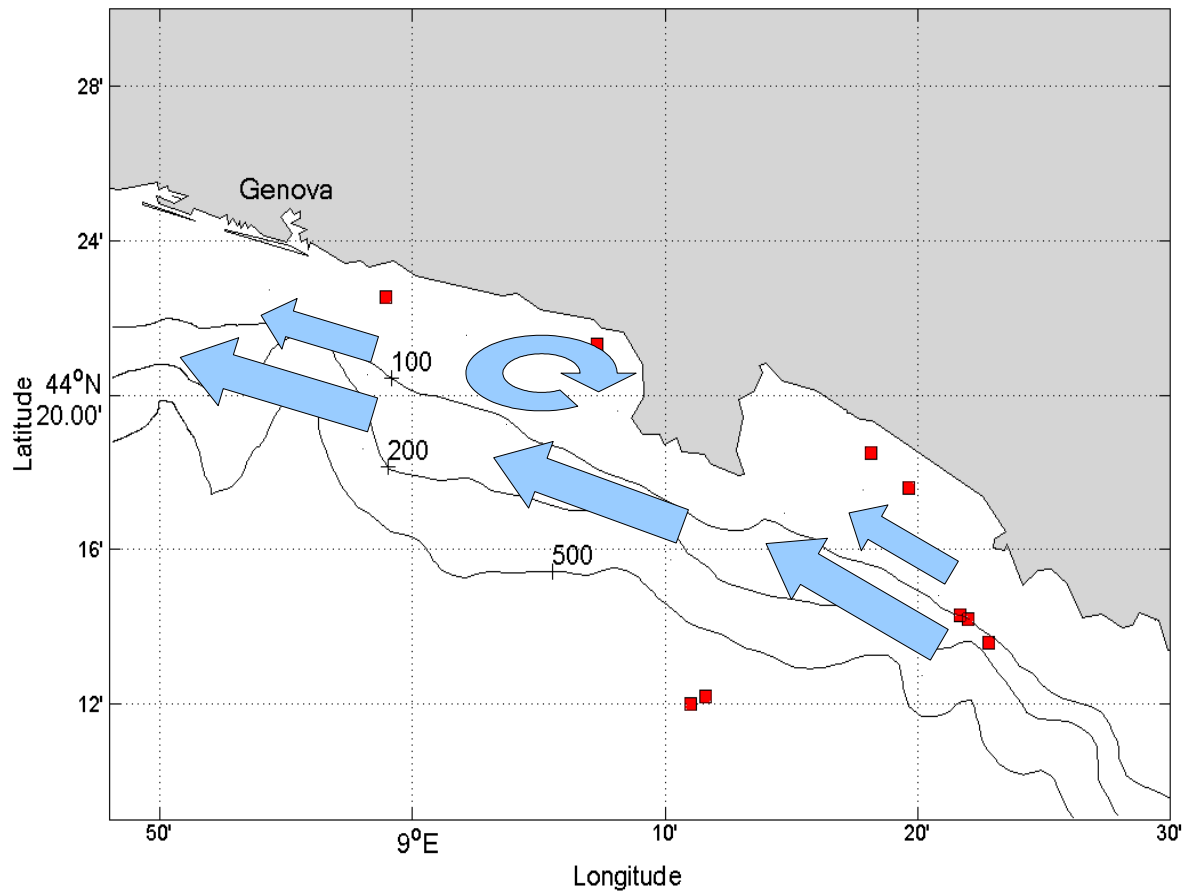
IOF-CNR, 1978-'82

ENEA, 1986-'88, 1992-'94, 1997

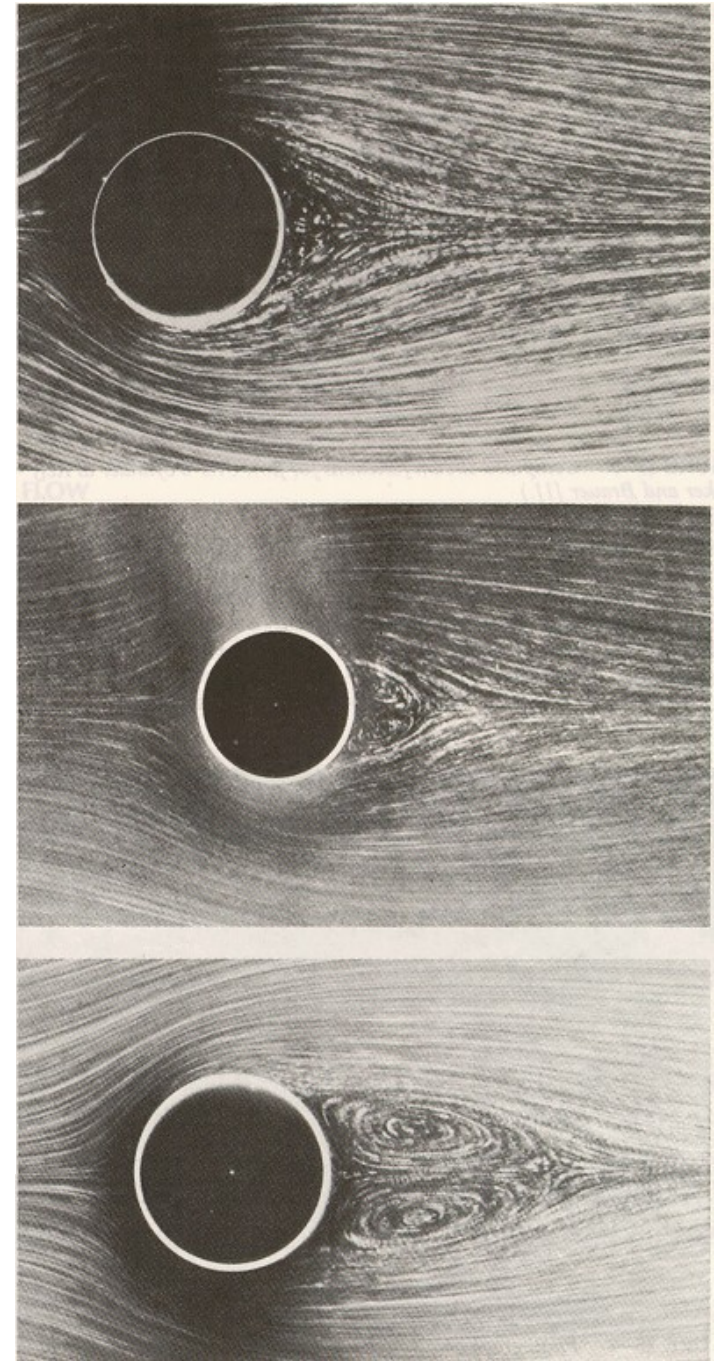
(Astraldi and Manzella, 1982)

Come spiegare questa circolazione?

Un vortice sottoflusso all'ostacolo!



Se é vero, allora come e perché si forma?



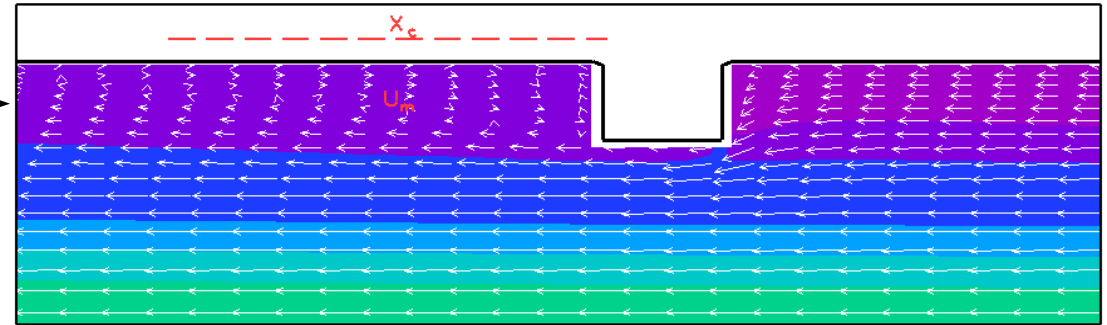


POM (Princeton Ocean Model)

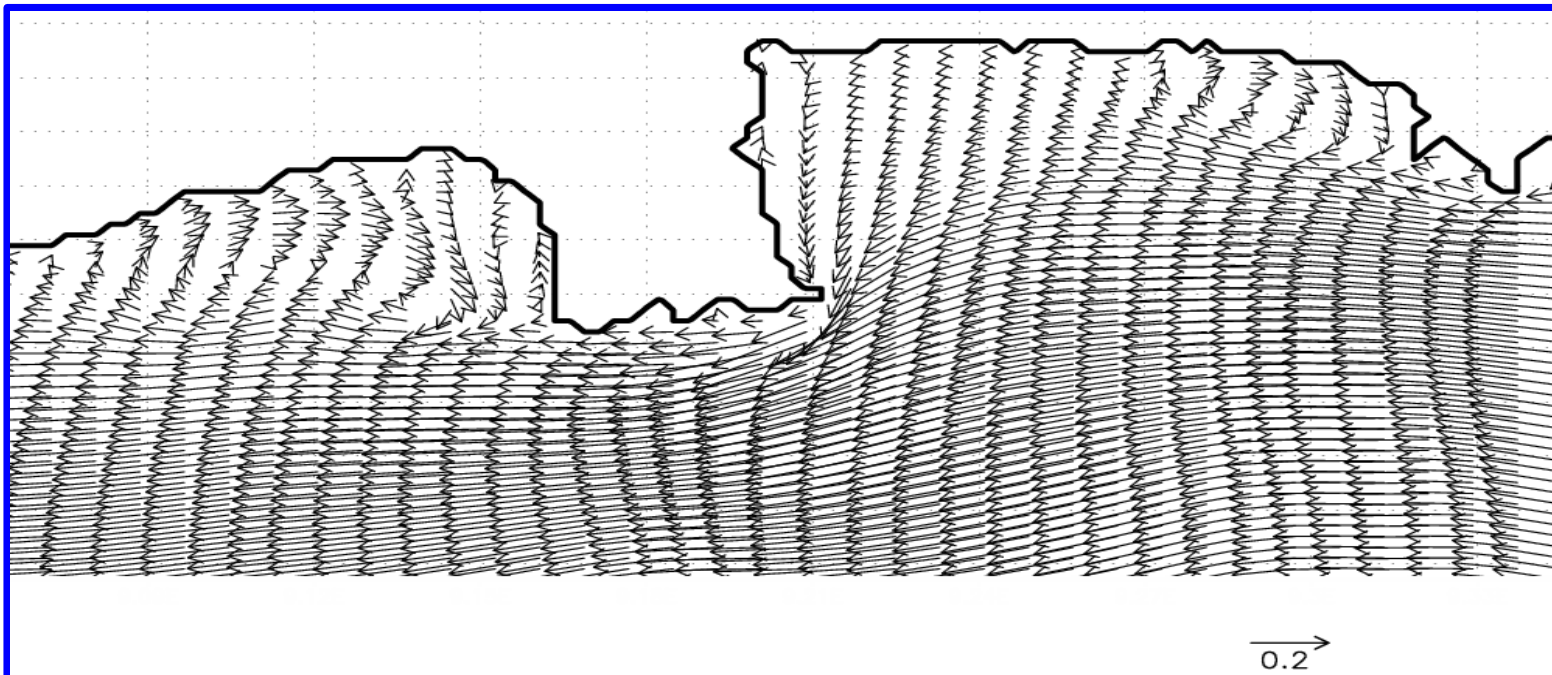
www.aos.princeton.edu/WWWPUBLIC/htdocs.pom

**Software libero
scaricabile da rete**

Studi prima semplificati,
poi sempre più realistici



color interval [m]: 0.064 0.068 0.072 0.076 0.080 0.084 $\vec{0.3}$ m/s



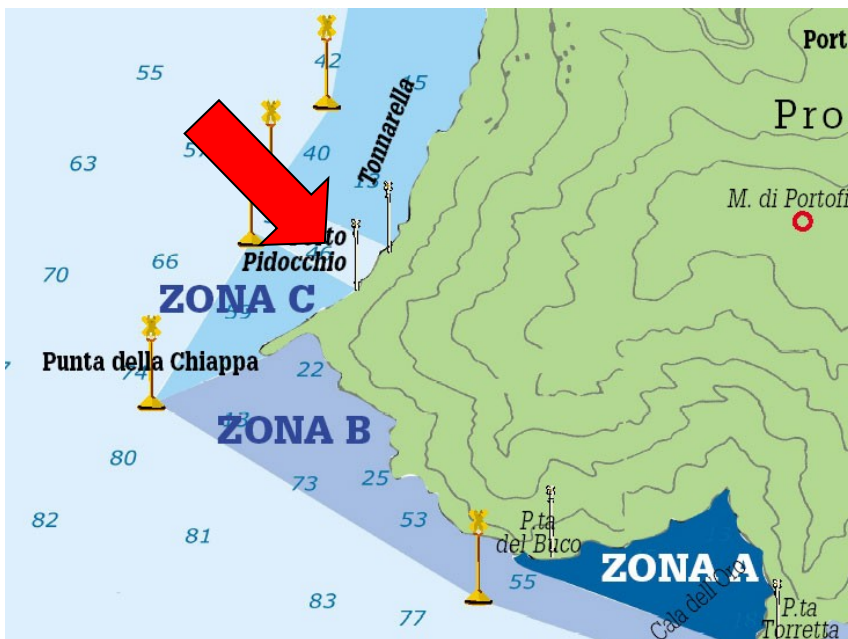
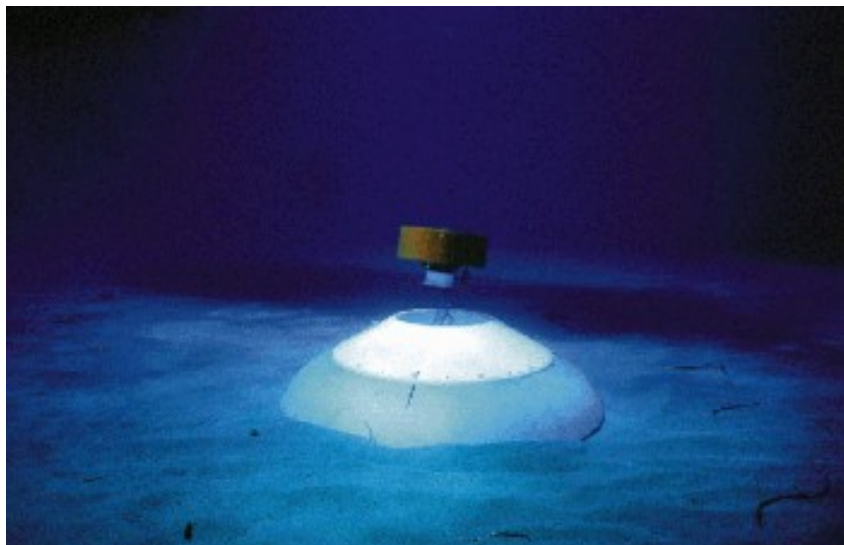
*Approvato
dai pescatori
di Camogli!*

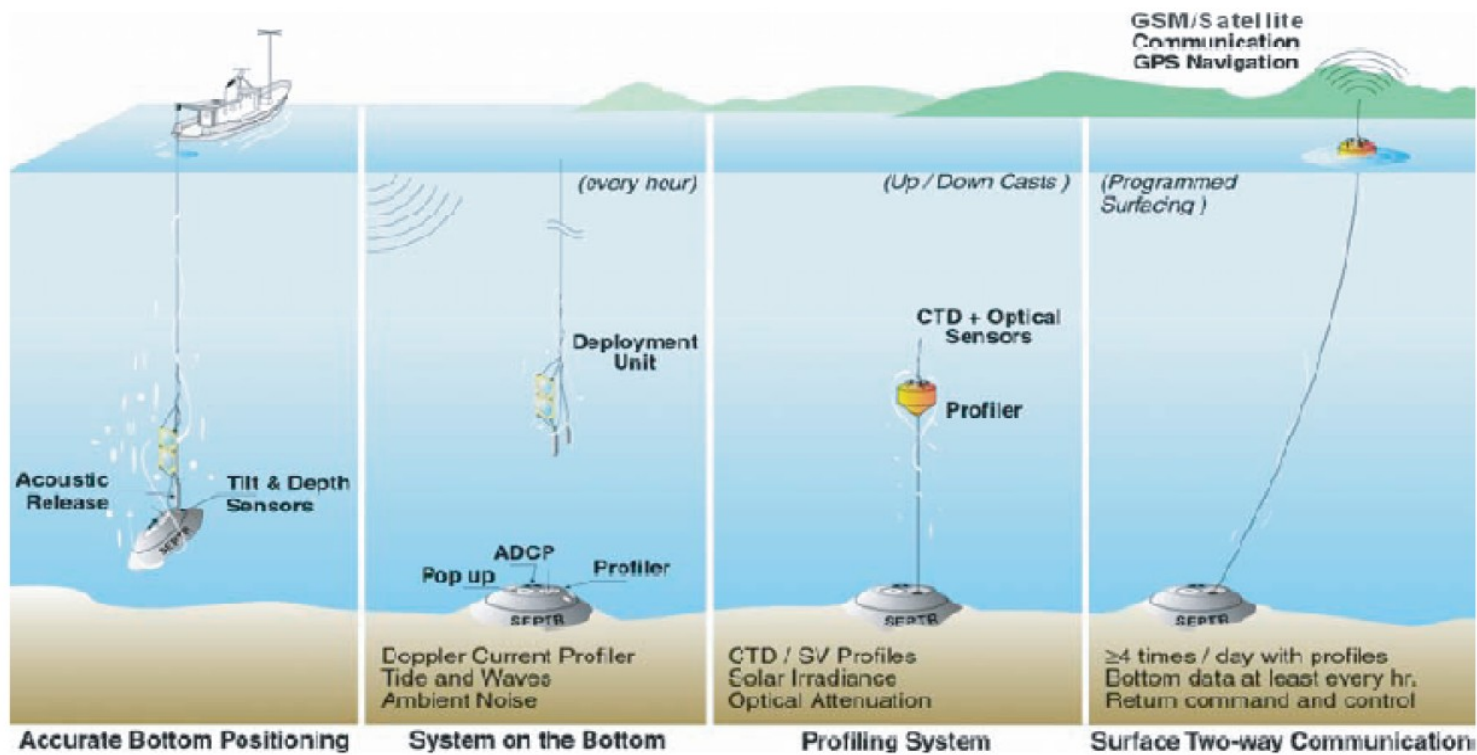
Conferme da misure correntometriche e idrologiche



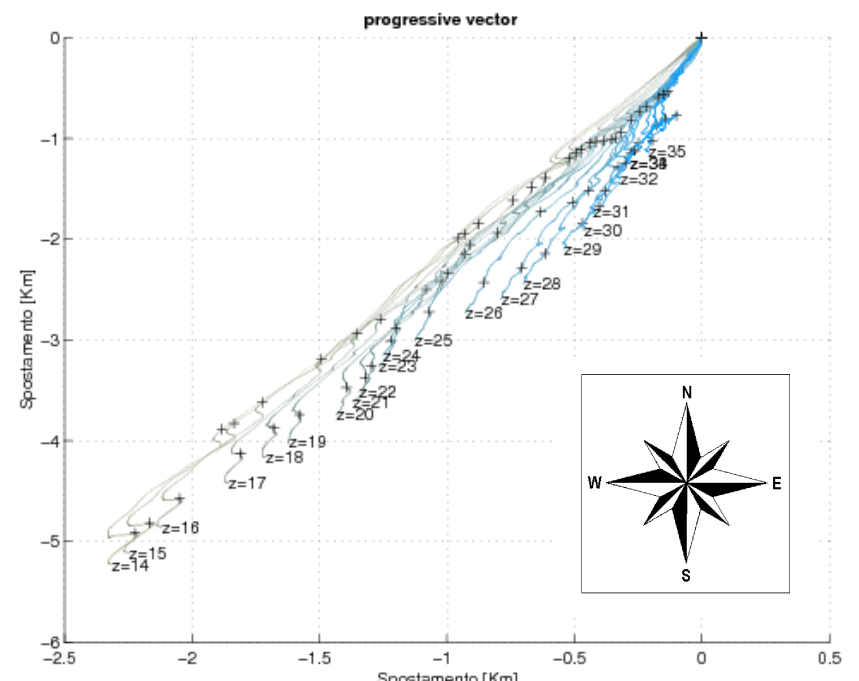
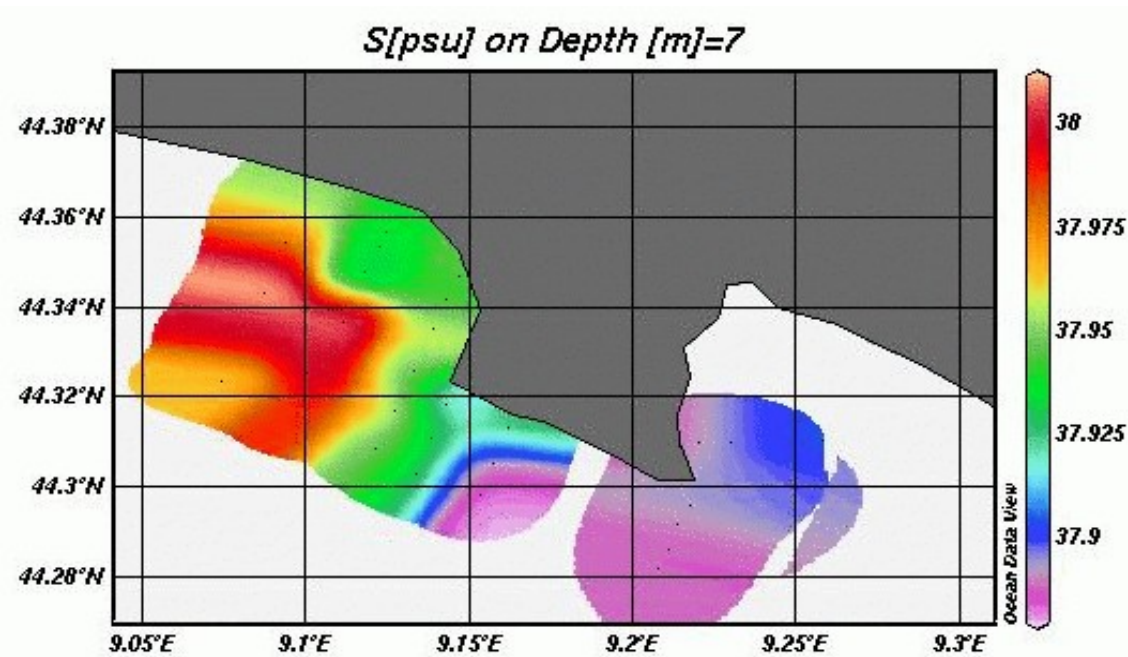
SEPTR

(Shallow water Environmental Profiler
in Trawl-safe Real-Time)





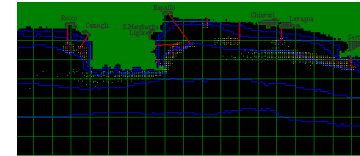
SEPTR operational scenario: deployment and operations



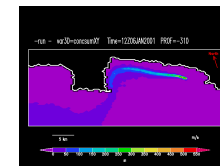
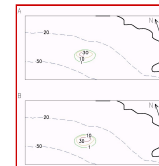
Applicazioni

Studio del trasporto e della dispersione:

* Scarichi di condotte a mare

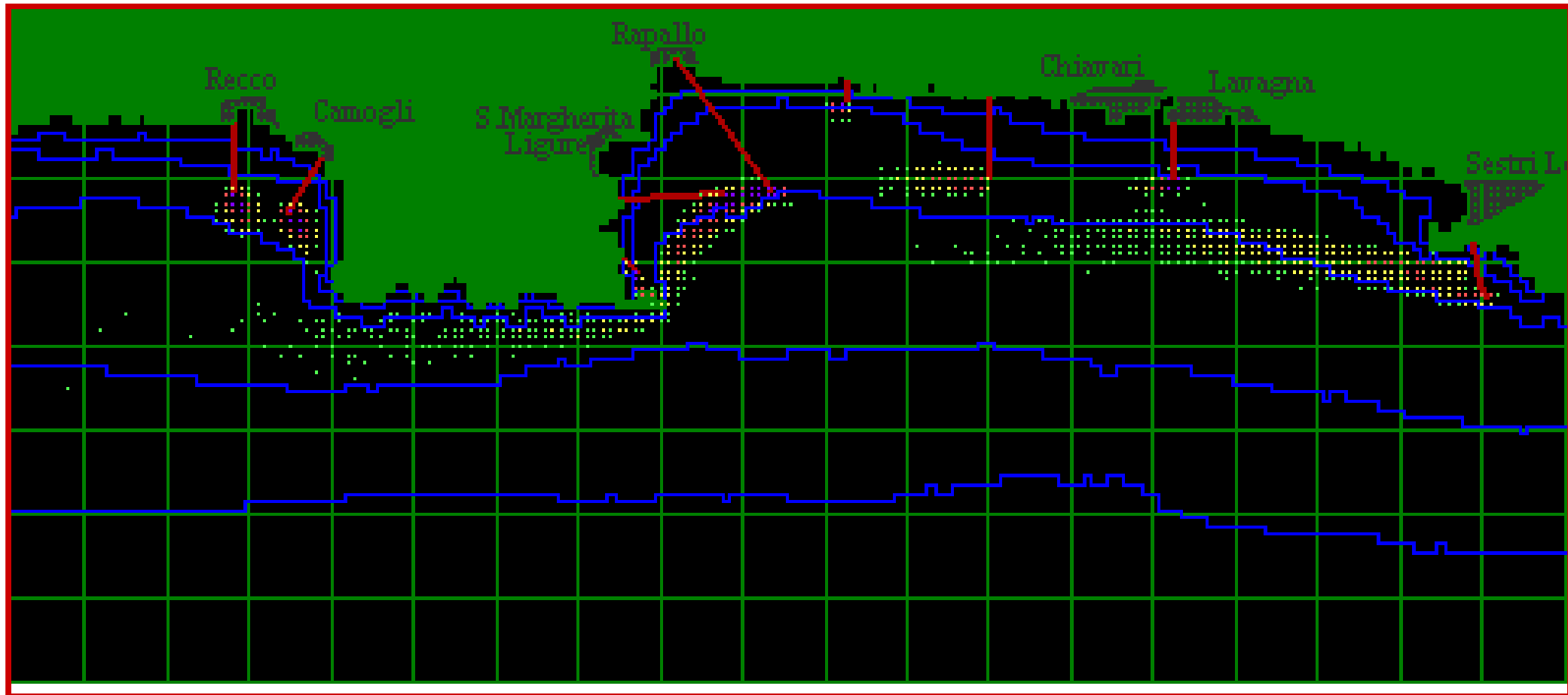


* Rifiuti da acquacoltura



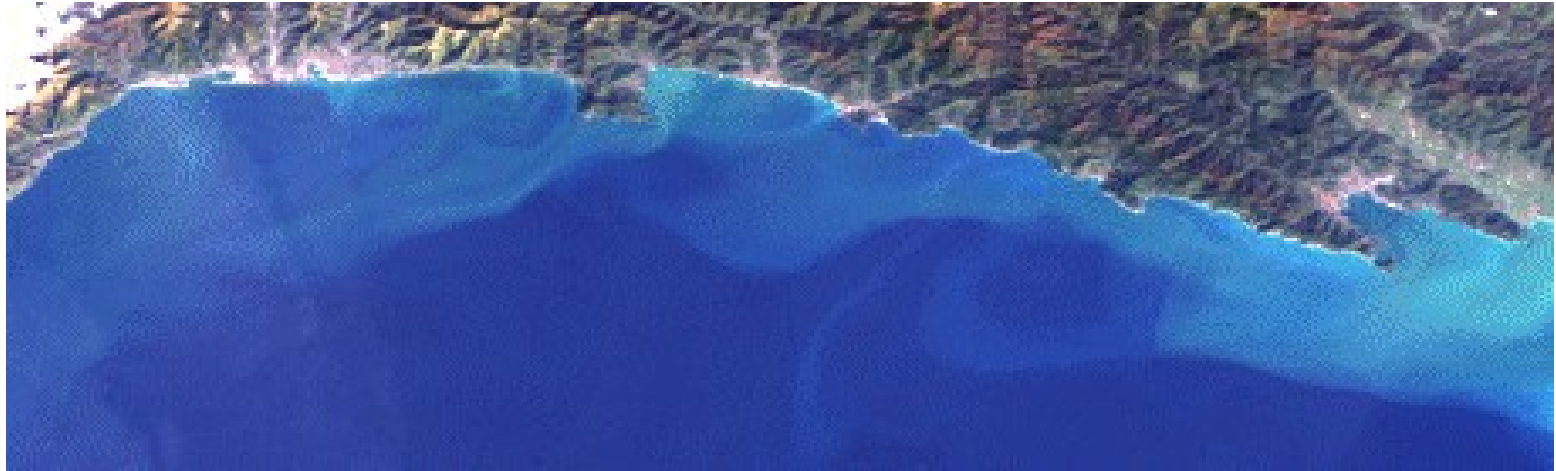
Dispersion degli scarichi delle condotte a mare

LAMP3D (Lagrangian Assessment for Marine Pollution model)

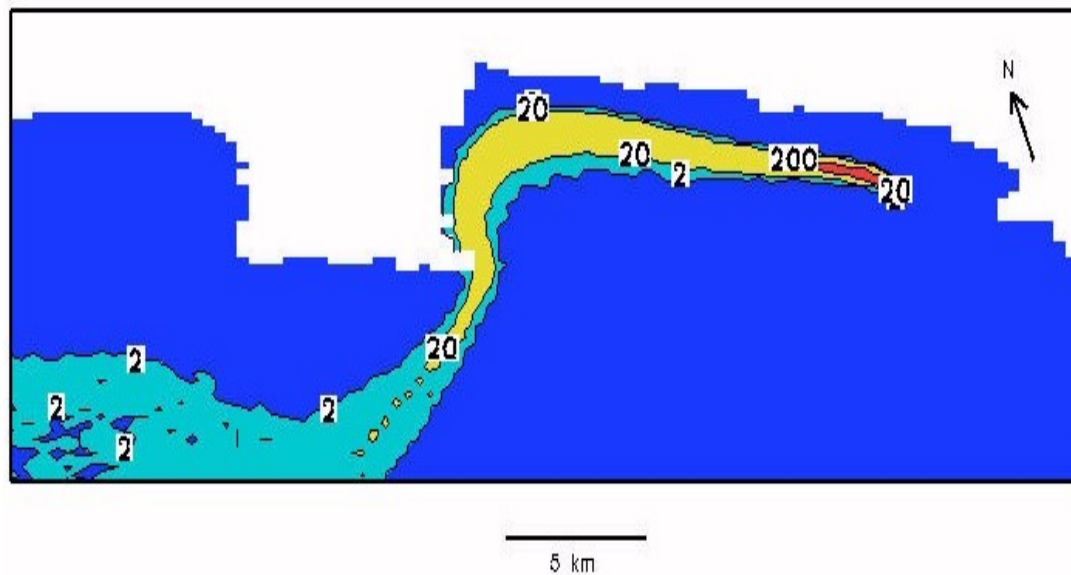


Solidi sospesi

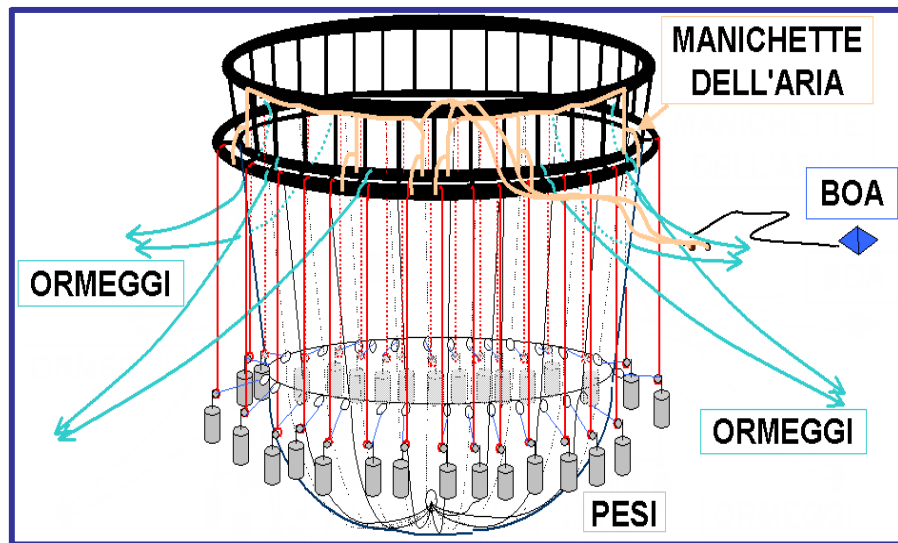
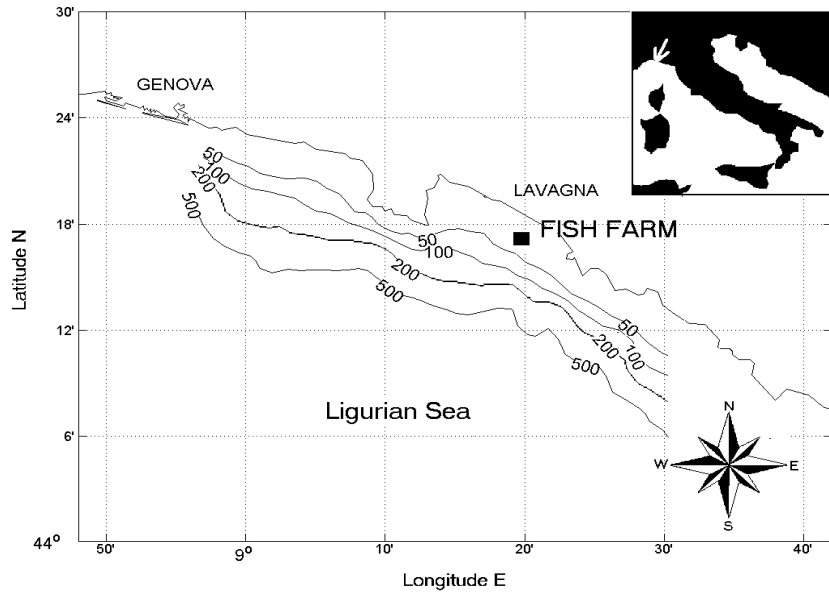
Immagine satellitare MERIS-ENVISAT



Modello POM-LAMP3D concentration [particules/maille]



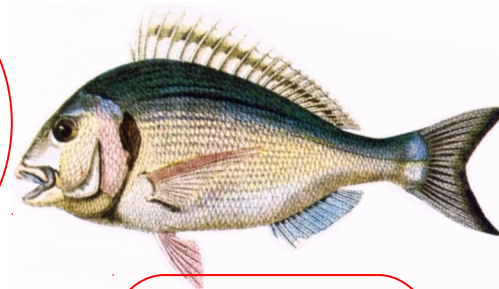
Allevamento "AQUA"



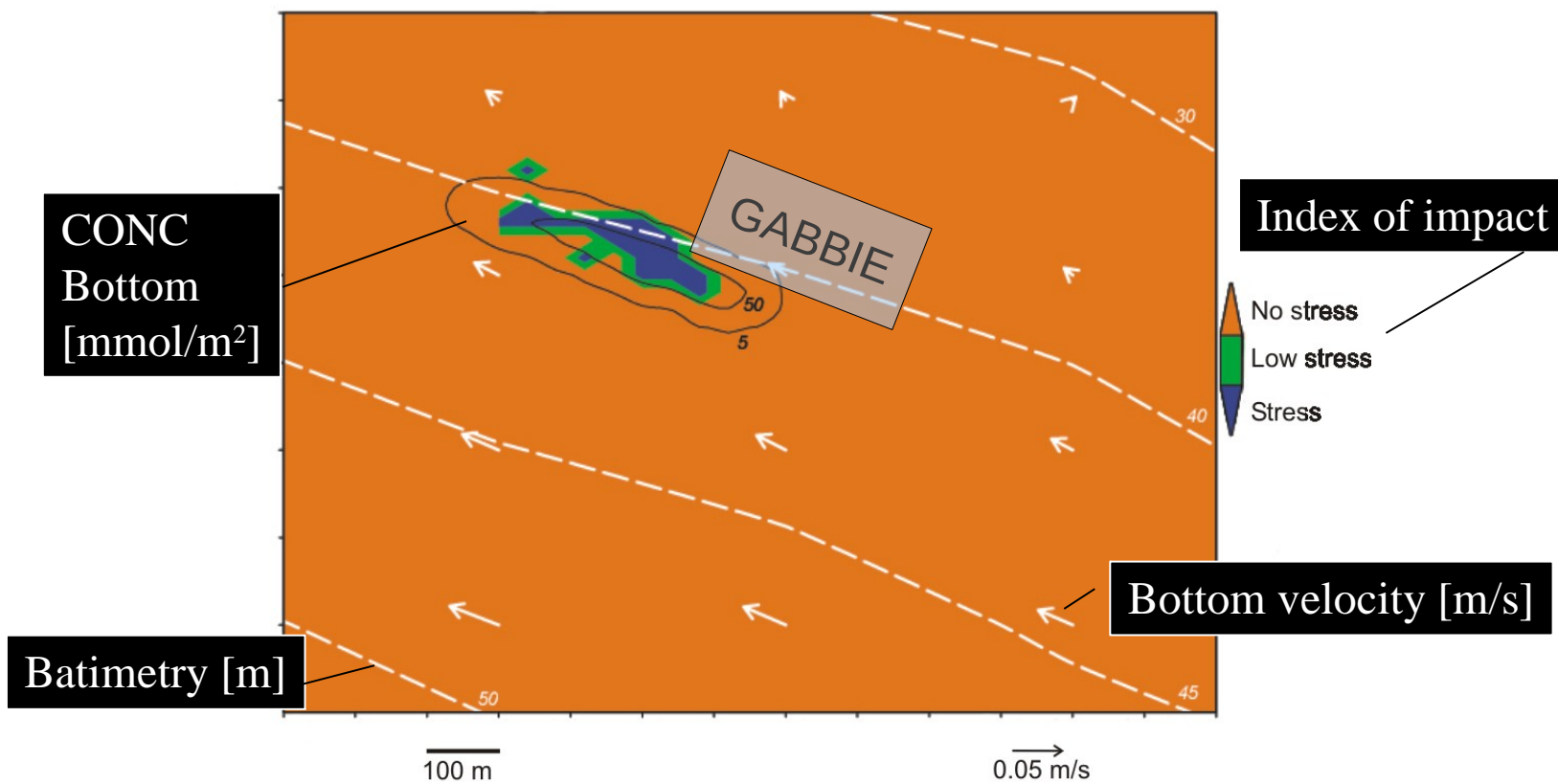
Organic Carbon

in

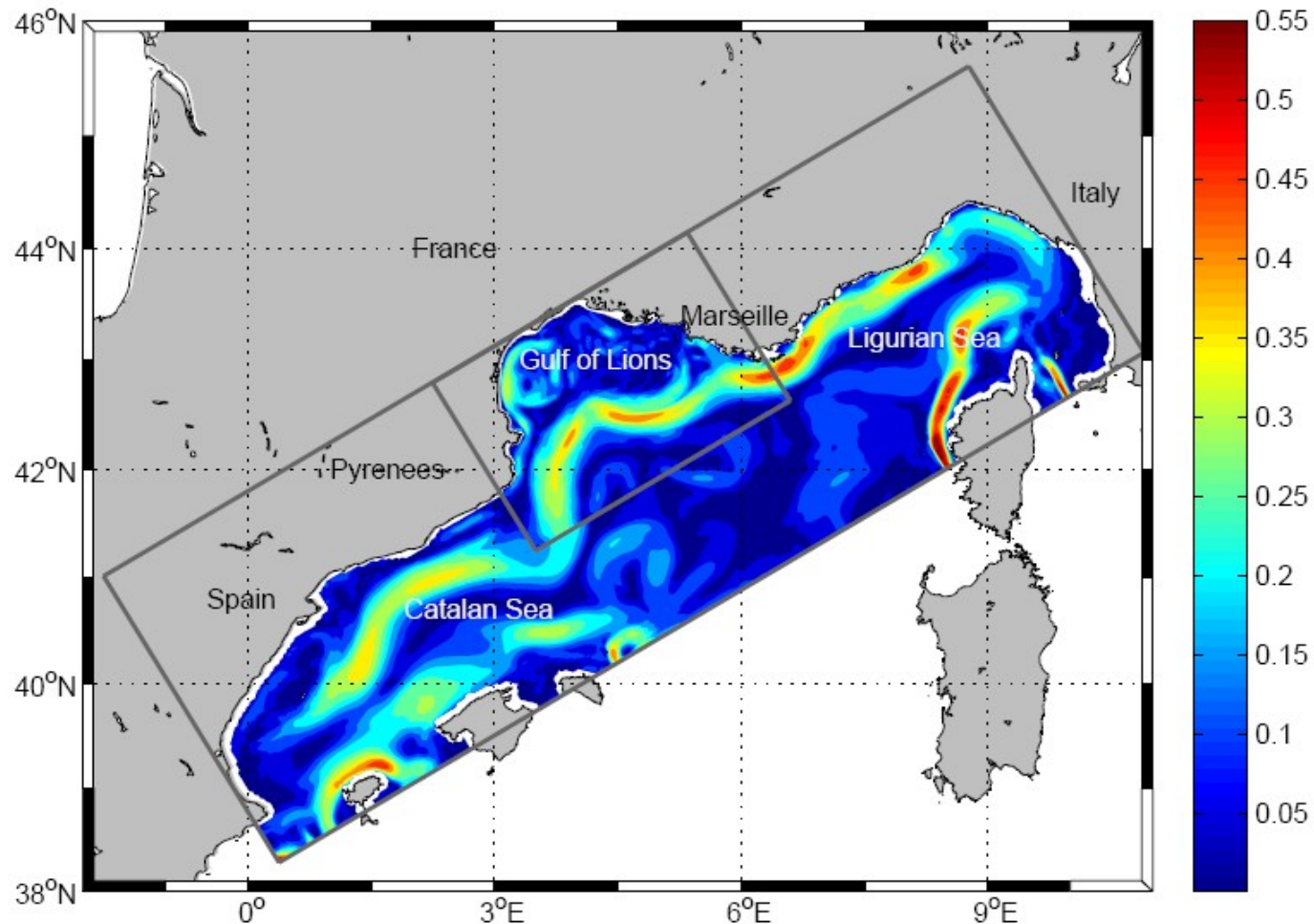
Uneaten feed



Faecal matter

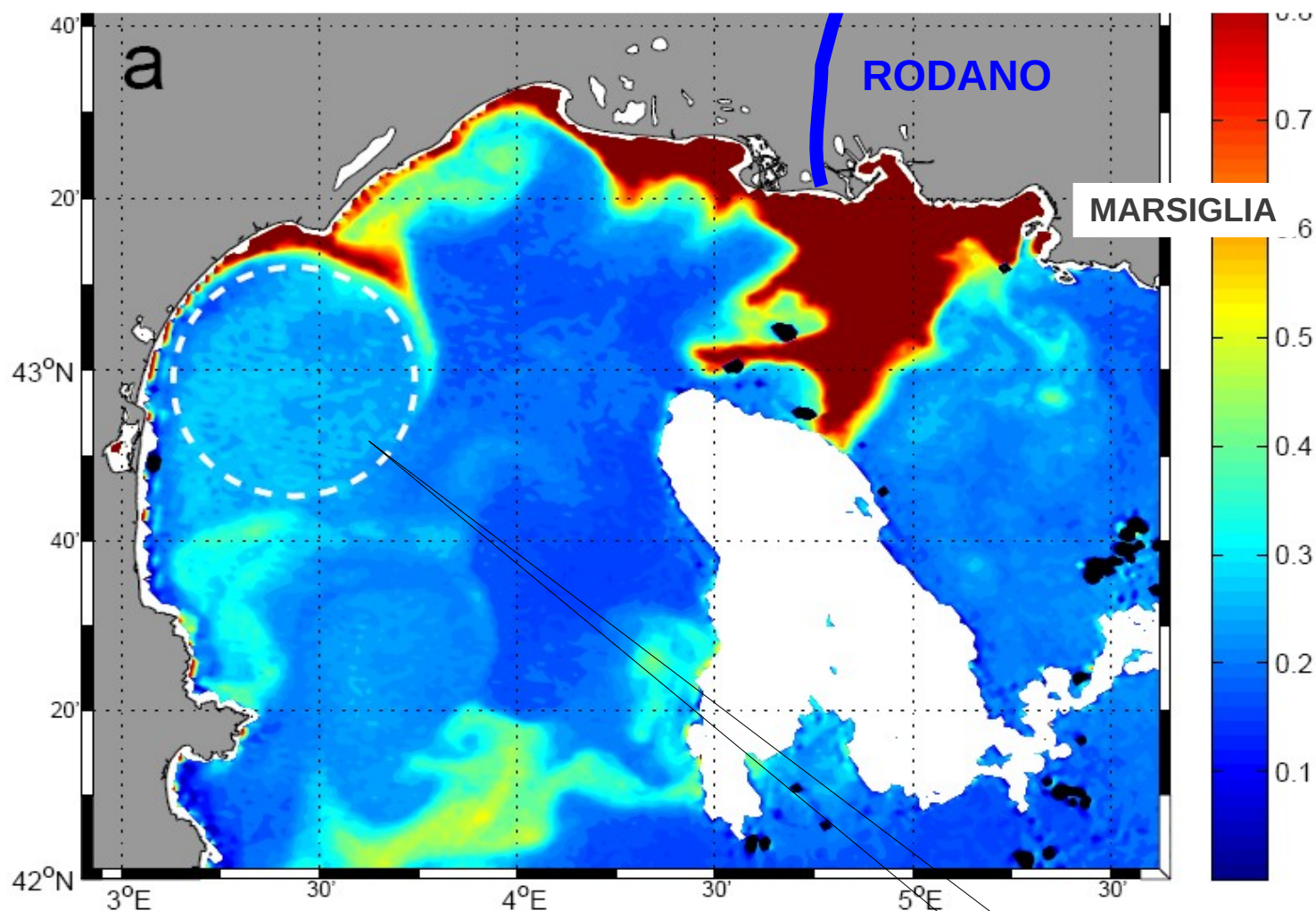


Misura e modellizzazione della Corrente Nord Occidentale Mediterranea e dei vortici costieri del Golfo del Leone

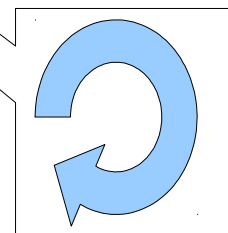


Qual'è il loro ruolo negli scambi tra la zona costiera (**ricca** di sali nutritivi) e il mare aperto (**povero** di sali nutritivi) ?

Distribuzione spaziale della Clorofilla-a in luglio 2001

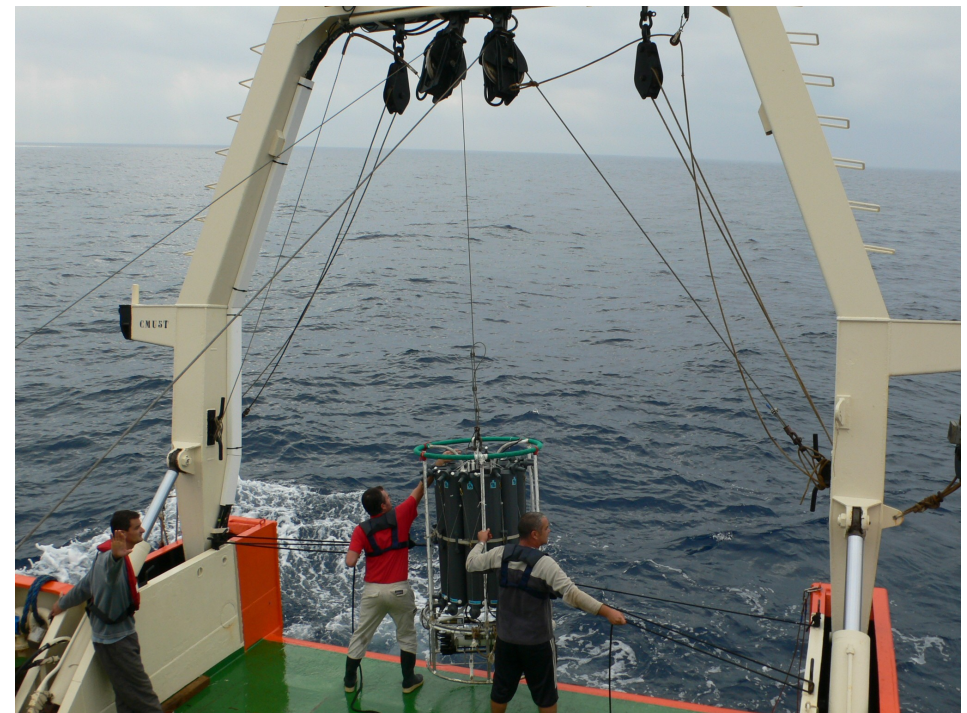


*Modello SYMPHONIE
segnala la presenza di un vortice anticiclonico*



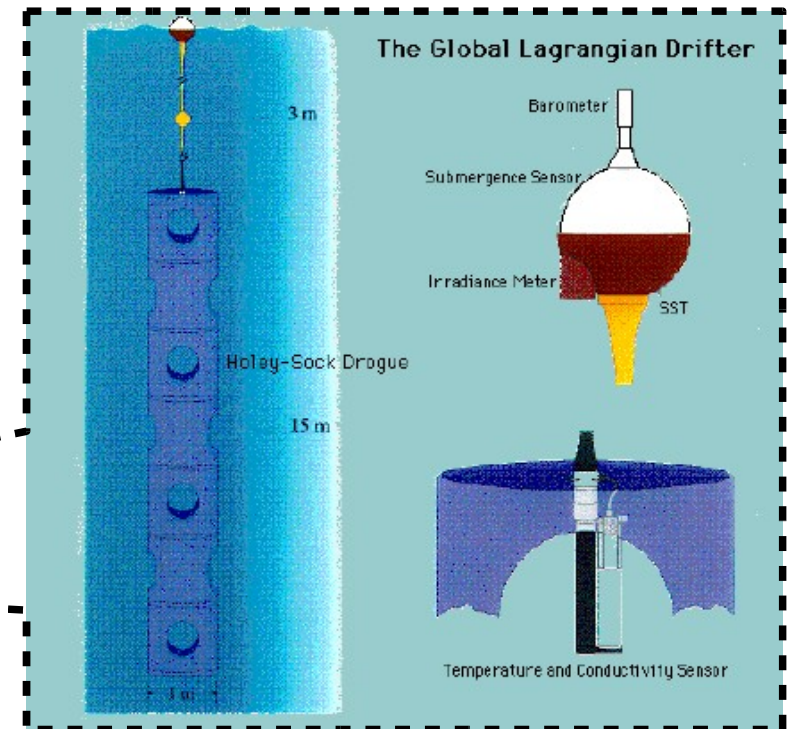
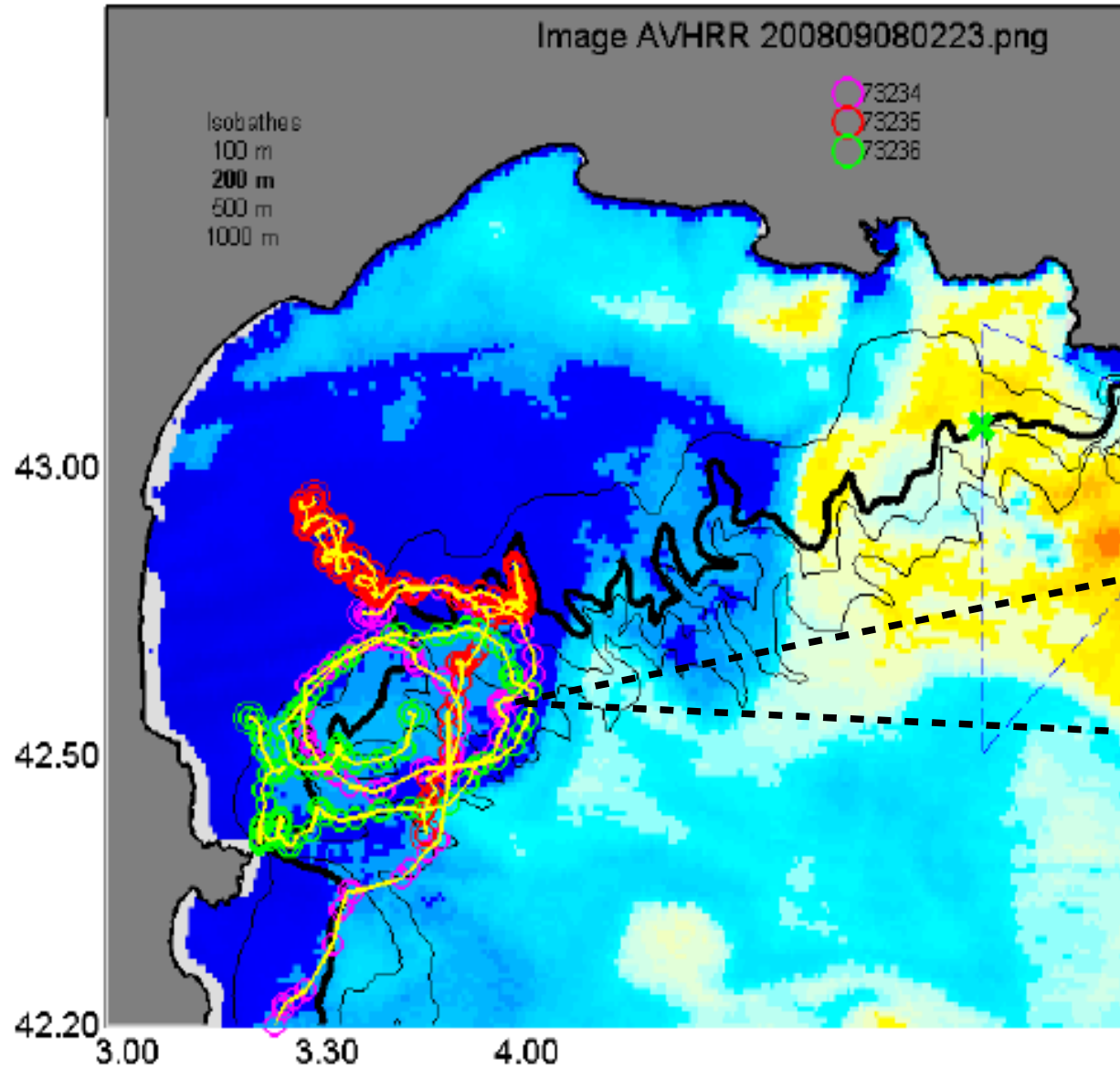
LATEX

Lagrangian Transport Experiment
Campagna Settembre 2008



PH Dopo 4 giorni finalmente ne abbiamo trovato uno!

Latex01 - Positions des bouees le 15-Sep-2008 a 7h 1m



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Assistant Professor



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Physique & Biogéochimique



CENTRE
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DE MARSEILLE
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2017-2018



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<p><i>Research Interests:</i> Coastal Ocean Dynamics and Modelling, Coastal Ocean Pollution Modelling.</p>	<p><i>Address:</i> [directions] LOPB (Laboratoire d'Océanographie Physique et Biogéochimique) - UMR6535, Campus de Luminy - Case 901, 13288 MARSEILLE CEDEX 9, France</p>
<p><i>Web pages:</i> http://www.com.univ-mrs.fr/~doglioli</p>	<p><i>Phone:</i> +33 (0)4 91 82 91 09 <i>Fax:</i> +33 (0)4 91 82 65 48 <i>E-mail:</i> doglioli@univmed.fr</p>

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* February 24, : preprints submitted to *Aquac. Res.* and *C.R. Geosci.*

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Écrit par *af-viao*

Sciences de la Terre et de l'Environnement

Environnement parcours Sciences de la Mer et de l'Environnement

Cette formation est proposée par le Centre d'Océanologie de Marseille (Université d'Aix Marseille 2 - Université de la Méditerranée).

L'objectif de cette licence est d'apporter aux étudiants un socle solide de connaissances et de compétences leur permettant d'appréhender le fonctionnement général de la planète et de ses différents écosystèmes en prenant en compte les perturbations anthropiques, et d'évoluer professionnellement dans le domaine des Sciences de la Terre et de l'Environnement au niveau national et international.

Cette formation est soutenue par une activité de recherche et de surveillance du milieu marin, en relation avec des entreprises travaillant dans ce domaine.

Le Centre d'Océanologie de Marseille (COM) est une école interne composante de l'Université de la Méditerranée et un Observatoire des Sciences de l'Univers (OSU) de l'Institut National des Sciences de l'Univers (INSU) du CNRS.

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Écrit par *quequiner*

OCÉANOLOGIE — Les RUBRIQUES

Océanographie Physique, Chimique, Biologique

Prof. B. Quéquiner (Centre d'Océanologie de Marseille)

Le Master de Sciences de l'Univers et de l'Environnement « OCÉANOLOGIE : Physique, Chimie et Biologie » du Centre d'Océanologie de Marseille a reçu un avis favorable à l'habilitation par l'Agence d'Évaluation de la Recherche et de l'Enseignement Supérieur dans le cadre du nouveau contrat quadriennal d'établissement 2008-2011 de l'Université de la Méditerranée. Il s'agit d'une formation unique en France associant les trois disciplines fondatrices de l'océanographie moderne.

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