

# Frentes

- Definição
- Tipos de frentes
- Dinâmica de uma pluma
- Equilíbrio dinâmico
- Efeito do vento e da maré

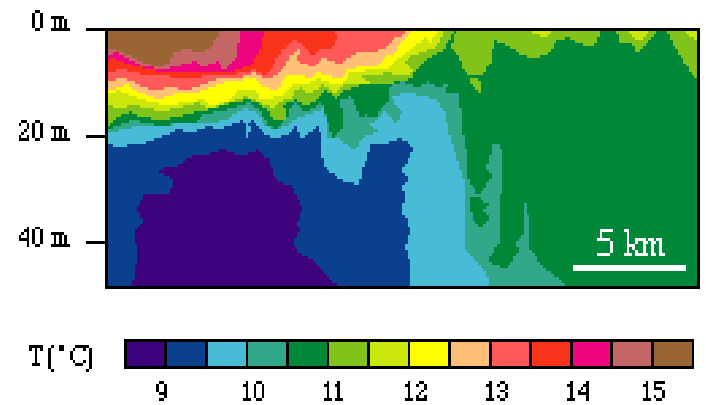
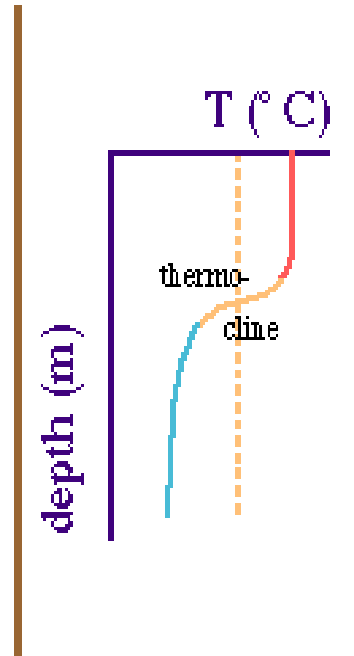
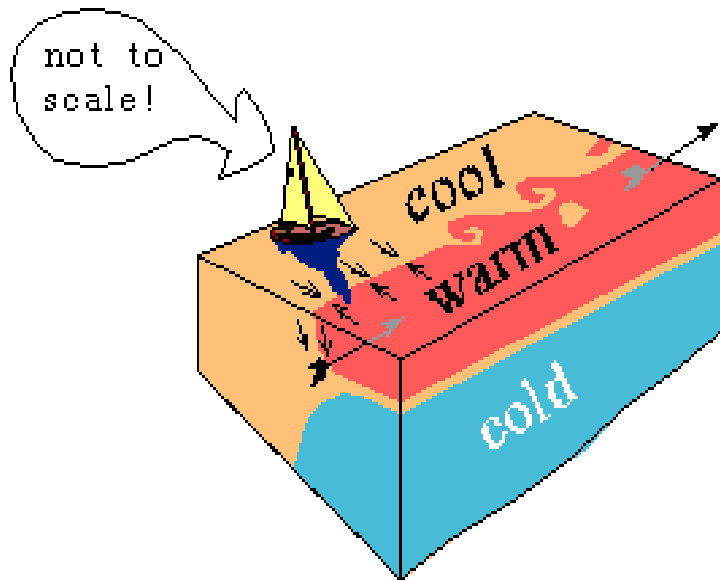
# Frentes

- Regiões oceânicas onde águas de características diversas se encontram:
  - Larga escala – FST, FP
  - Meso-escala – FSTP
  - Micro-escala – frentes estuarinas

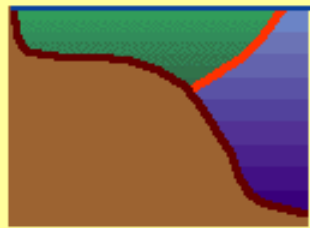
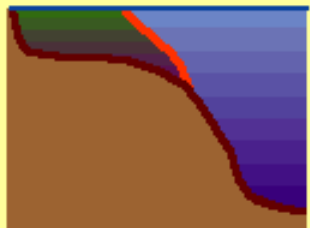
# Tipos de frentes de plataforma

- Frentes de quebra de plataforma – Talude-Argentina, FSTP
- Frentes de ressurgência
- Frentes de marés – Patagônia (Península Valdez)
- Frentes de rios
- Frentes de estuários

# Frentes

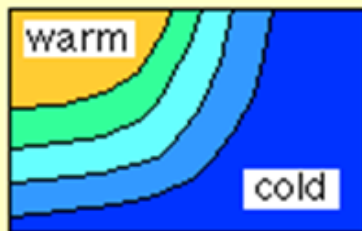


# Tipos de frentes



prograde fronts

retrograde fronts



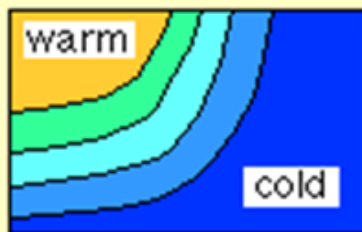
temperature



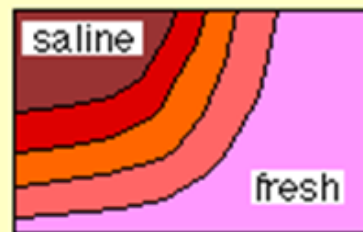
salinity



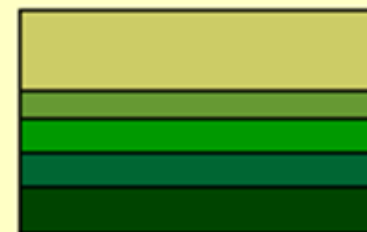
density



temperature



salinity



density



# Movimentos através de uma frente

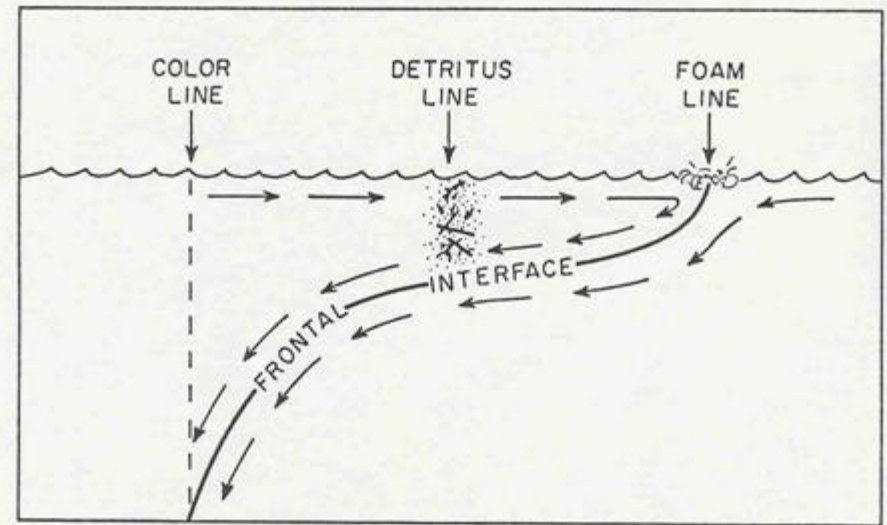
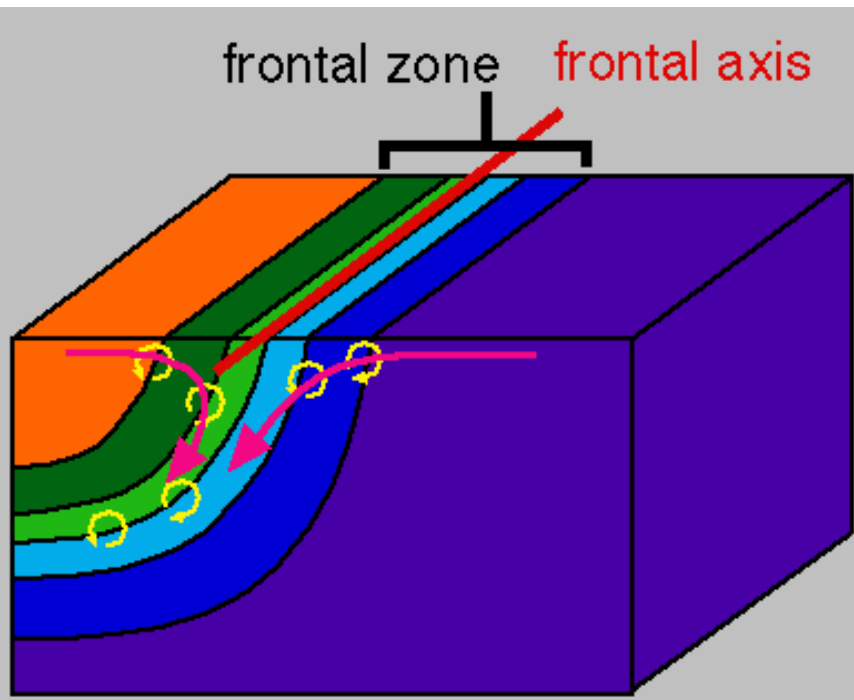


FIGURE 15. Schematic cross section of a shallow front. Three boundaries are often visible:

1. The color front perceived to lie where the depth integrated upwelled light undergoes a distinct spectral shift in the region of rapidly descending isopycnals.
2. The detritus line where large buoyant objects are trapped by oppositely directed currents at the surface and near the frontal interface.
3. The foam line which is located at the surface convergence. Since the frontal slope may be  $\sim 10^{-2}$ , the three demarcations can be separated by several tens of meters.<sup>4,48</sup>

# Frentes de plataforma

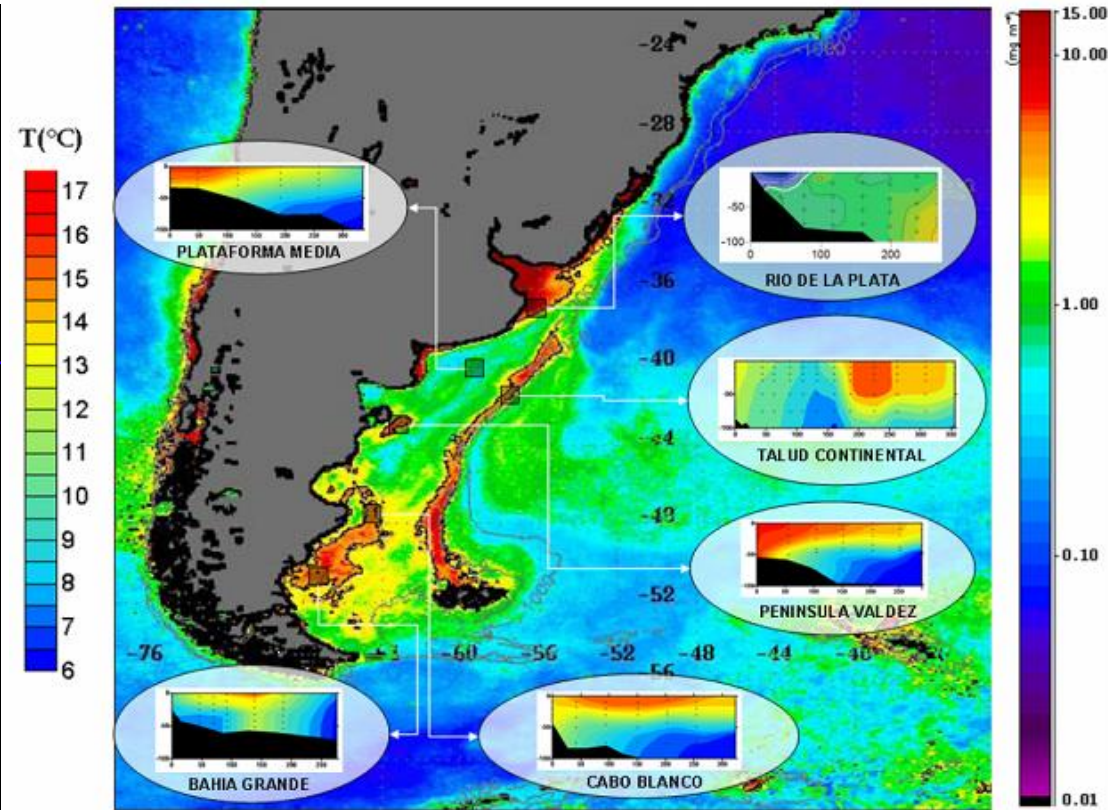
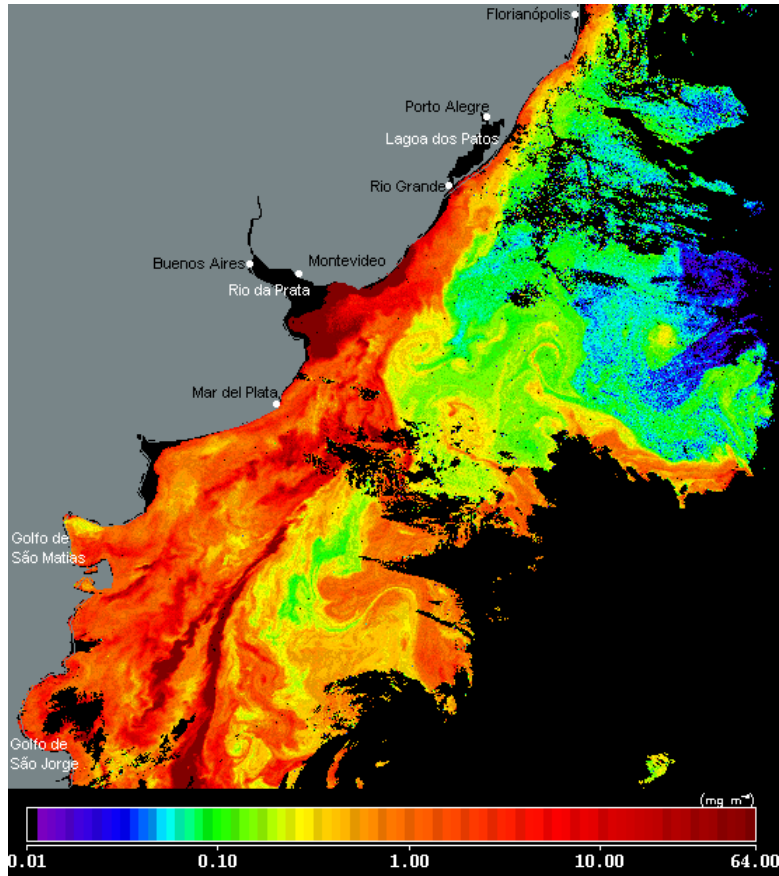
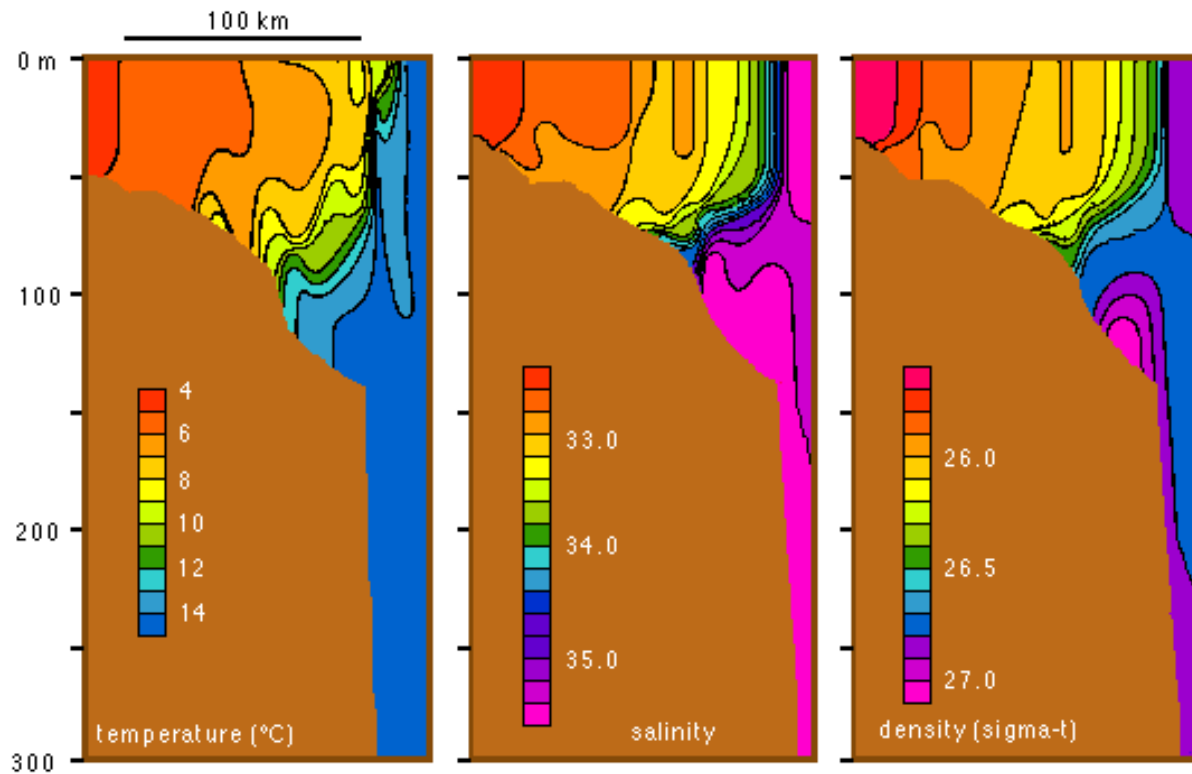


Figura 2-1 CSAT verano. Identificación de frentes



# Frente de quebra de plataforma



## Frente de Talude - Argentina

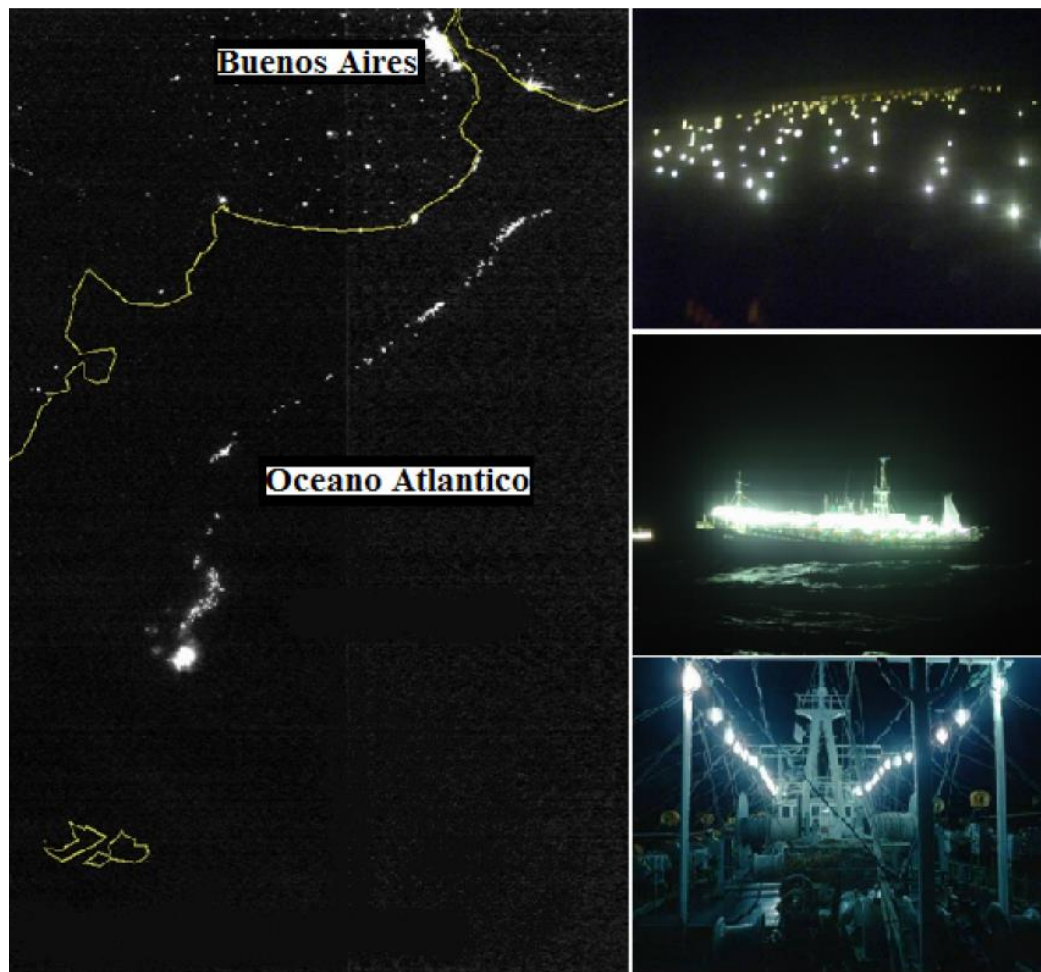


Figura 2-25 Imagen satelital nocturna de poteros en el TC

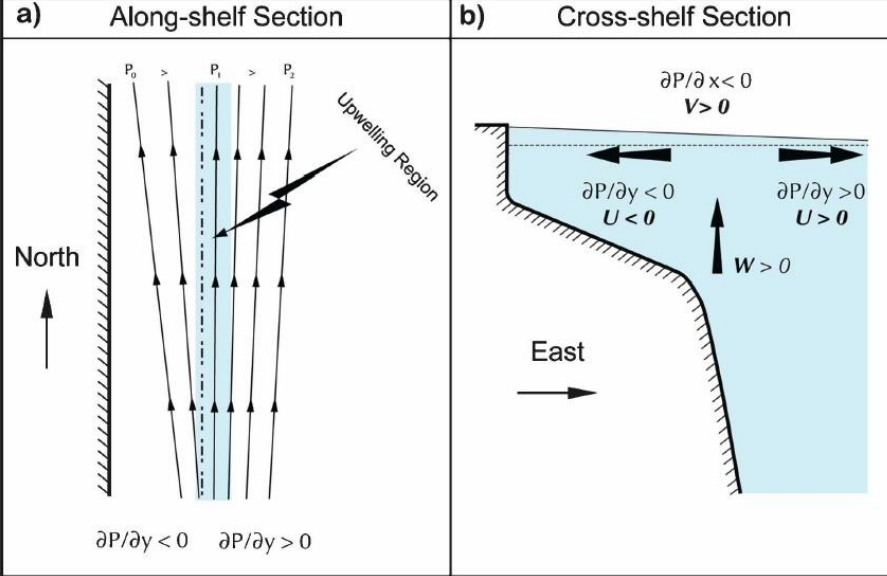
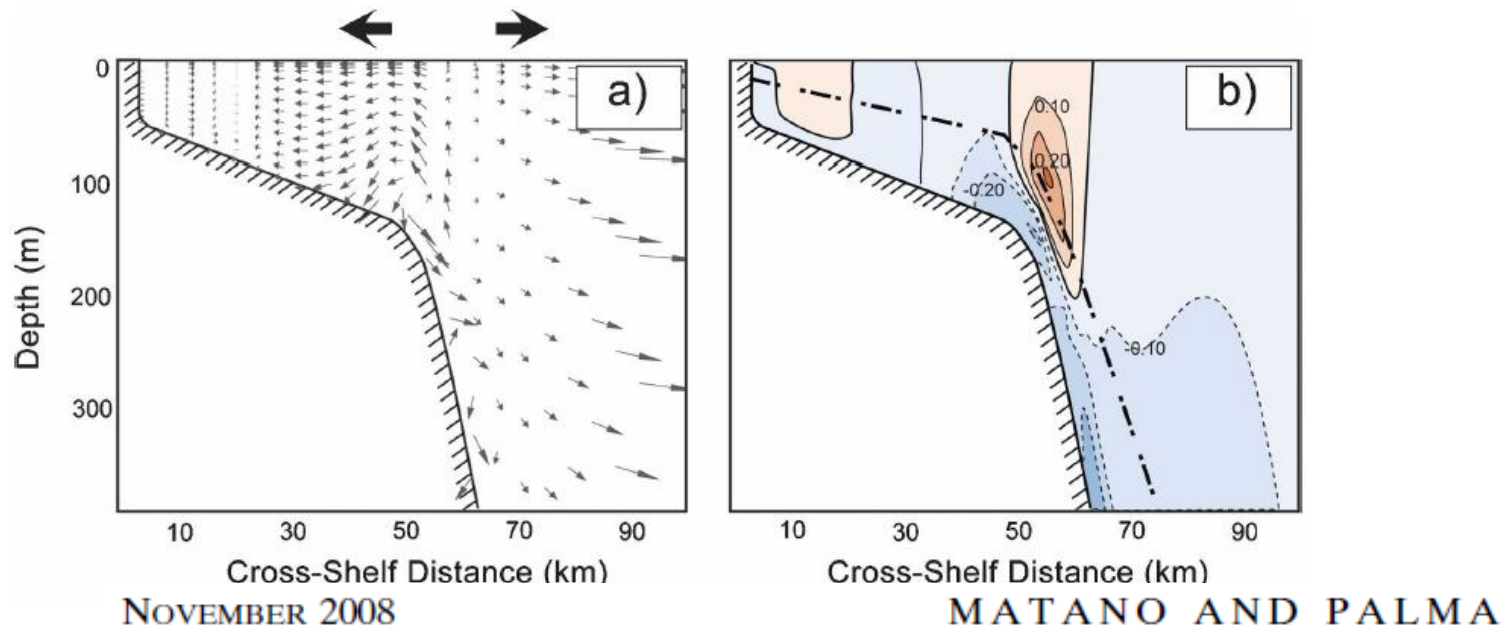
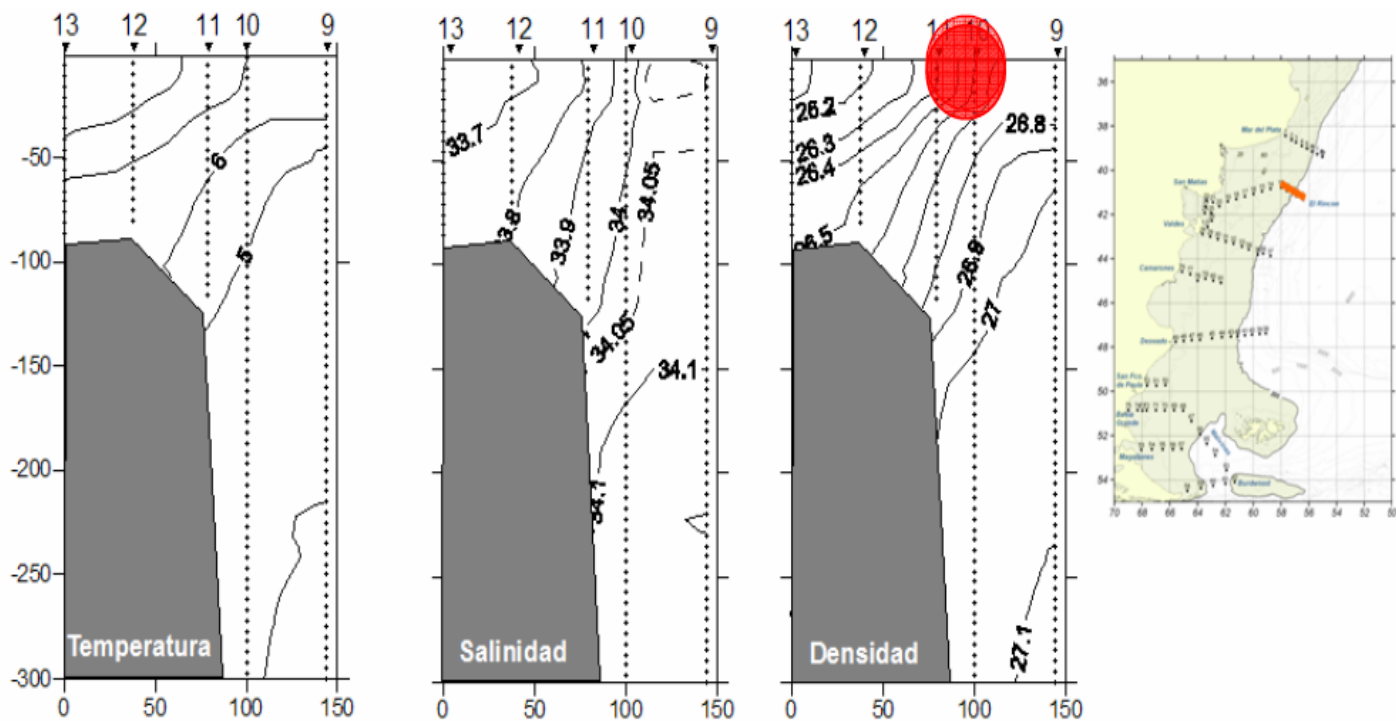


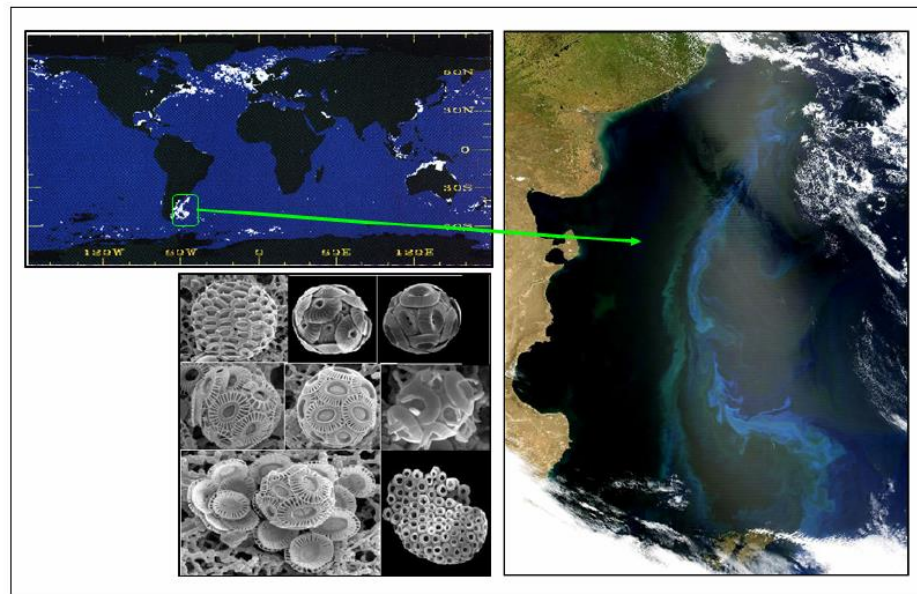
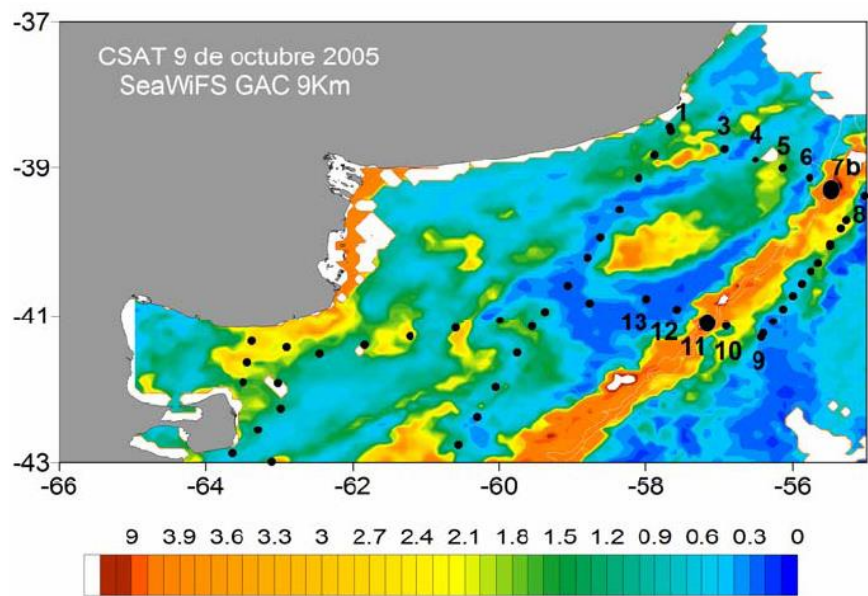
FIG. 2. Schematic representation of the development of shelfbreak upwelling by a cyclonic current. (a) The downstream spreading of the streamfunction associated with the slope current. The dotted line marks the position of the shelf break. A small portion of the downwelling current spreads onto the shelf while its axis shifts toward deep waters. This diverging motion generates downstream pressure gradients of opposite signs at each side of the shelfbreak. (b) The cross-shelf circulation patterns associated with this diverging motion.





**Figura 5-15 Secciones de temperatura, salinidad y densidad transversales al talud entre 40 y 41°S**

Secciones de temperatura, salinidad y densidad transversales al talud entre 40 y 41°S. Corresponden al día 10 de octubre de 2005. Pierna El Rincón. El círculo sombreado en rojo destaca la posición del frente en superficie. La sección de densidad muestra la superficialización de las superficies isopicnicas entre los valores de sigma 26,4 y 26,7 Kg m<sup>-3</sup> en las estaciones 10 y 11 que son indicativas del frente TC



**Figura 2-24 Concentraciones de cocolitofóridos imagen color real**

Figura extraída del trabajo García y otros (2006). En el panel superior izquierdo se muestran las concentraciones globales estimadas de cocolitofóridos (Brown y otros, 2000). Se destacan elevadas concentraciones en el Atlántico Sudoccidental. Panel inferior izquierdo: fotografías detalladas de caparazones microscópicos de calcita de distintas especies de cocolitofóridos. Panel derecho: Imagen SeaWiFS de color real que muestra la banda de alta reflectividad en las proximidades del talud continental argentino.



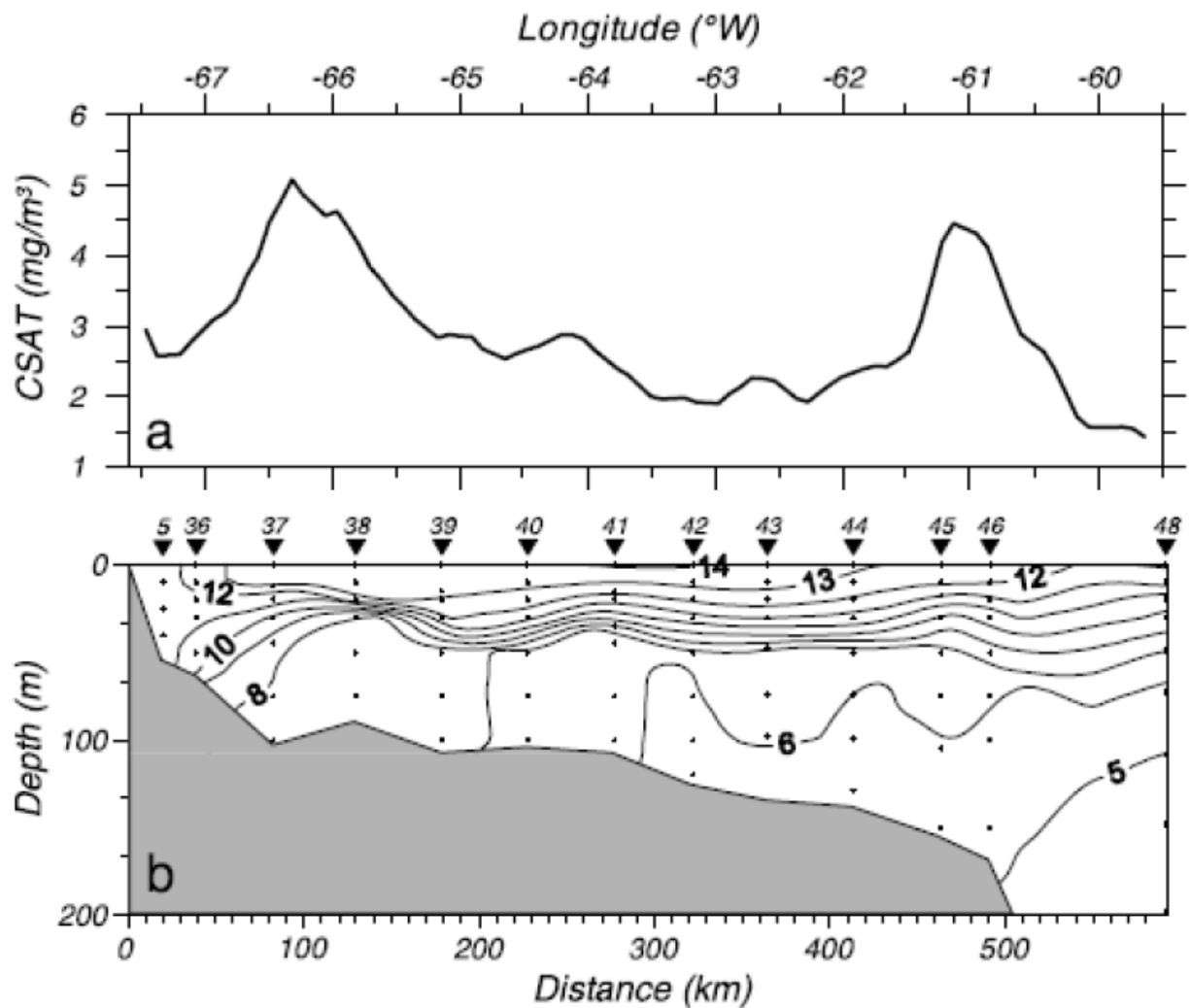
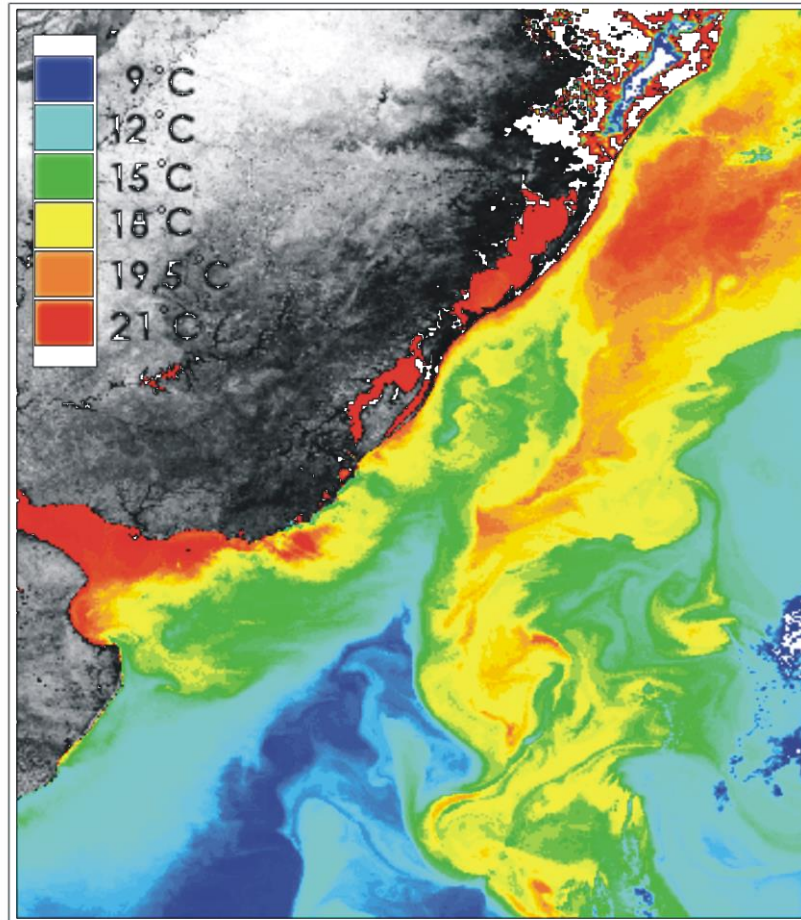
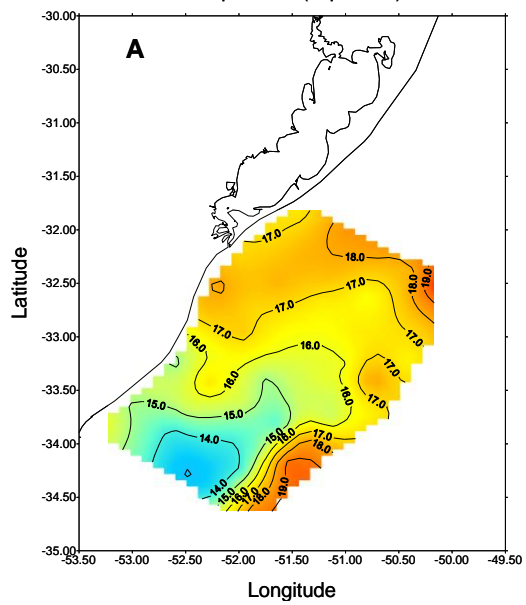


Figura 5-32 Sección temperatura transversal al talud BG

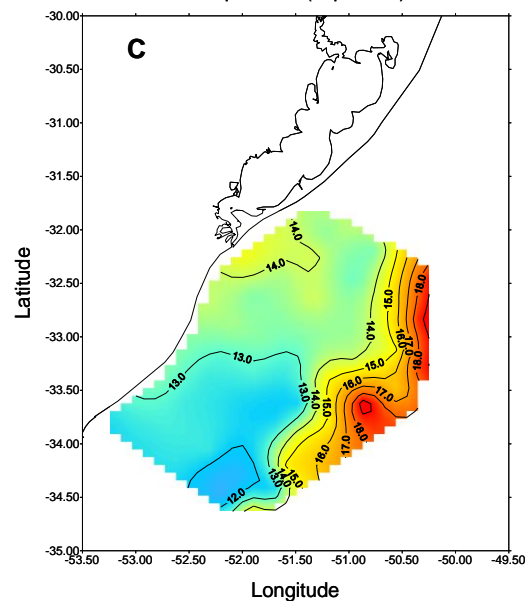
# Frentes de Plataforma



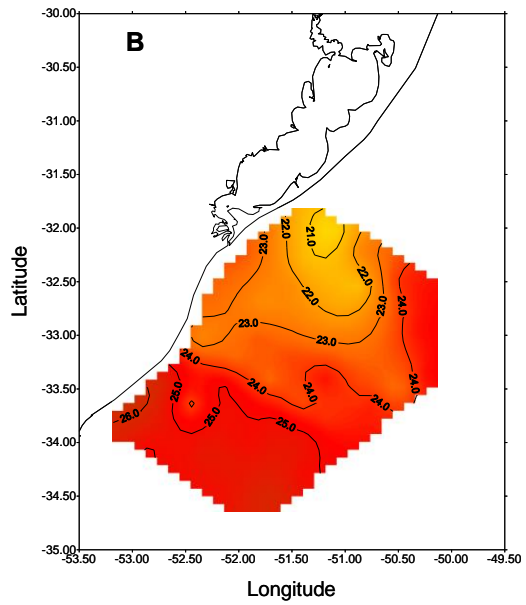
Temperatura (superfície)



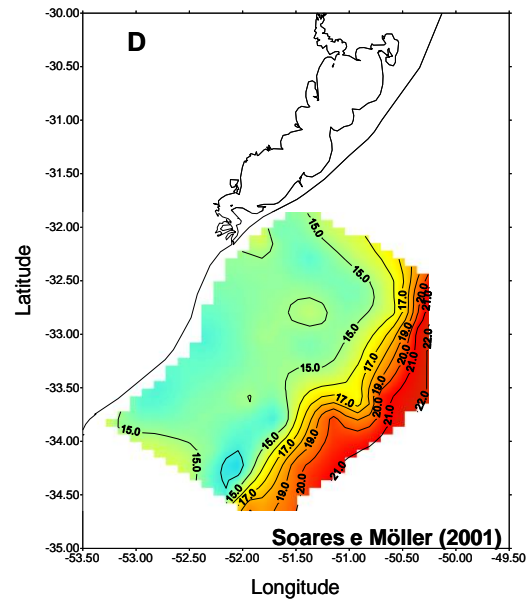
Temperatura (superfície)



Temperatura (superfície)



Temperatura (superfície)

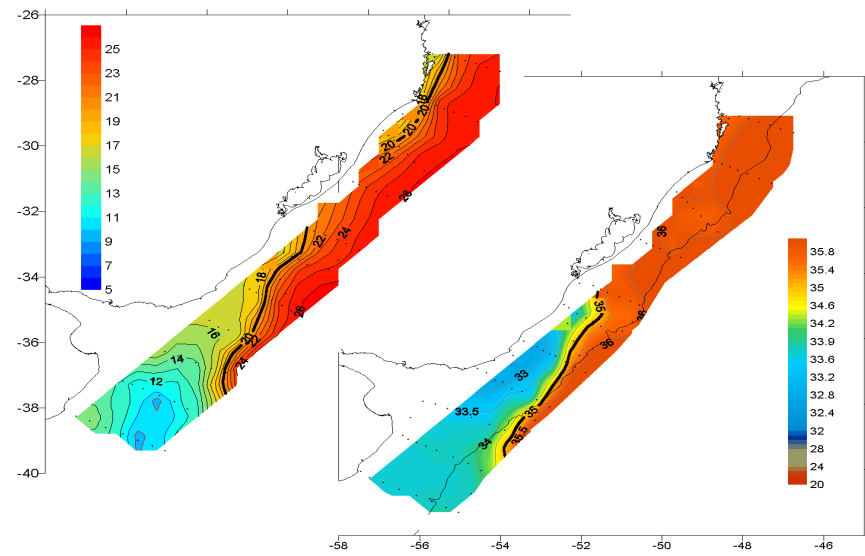
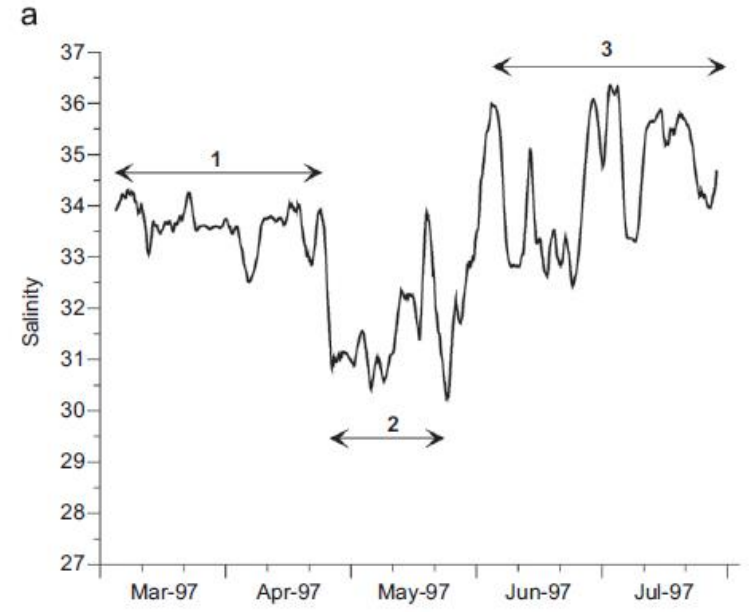
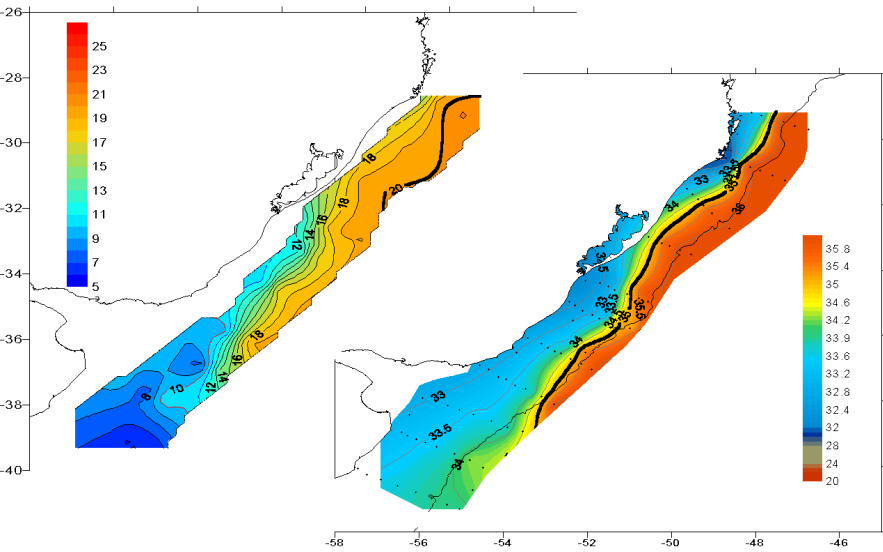


FSTP

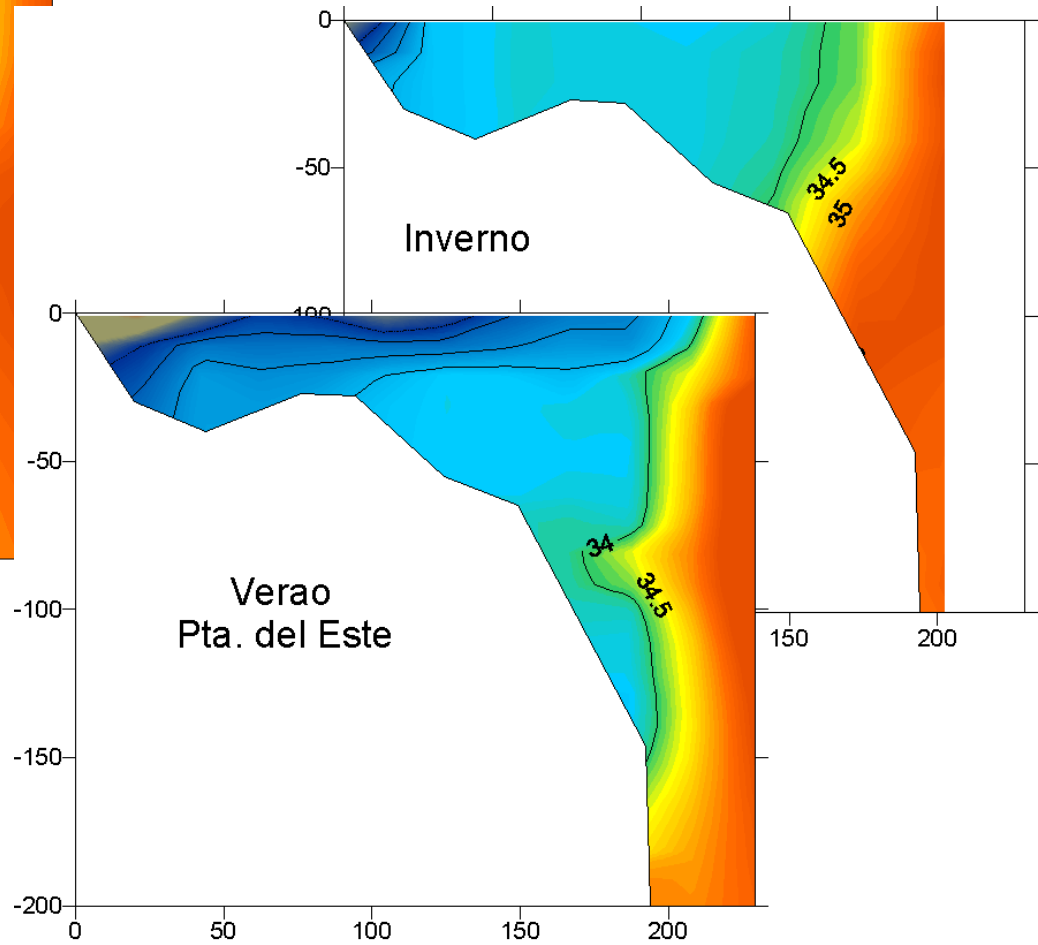
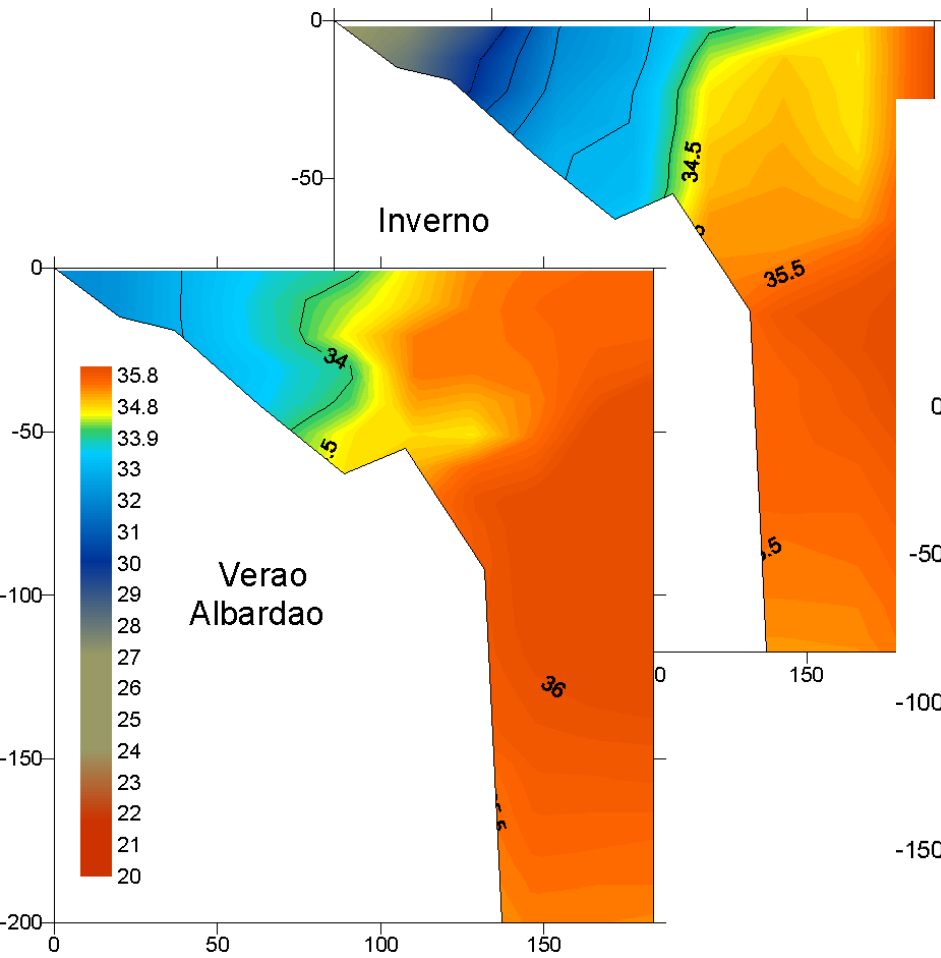
Soares e Möller (2001)



# Subtropical Shelf Front (winter 2003 – top) and the variability of water masses – mooring data.

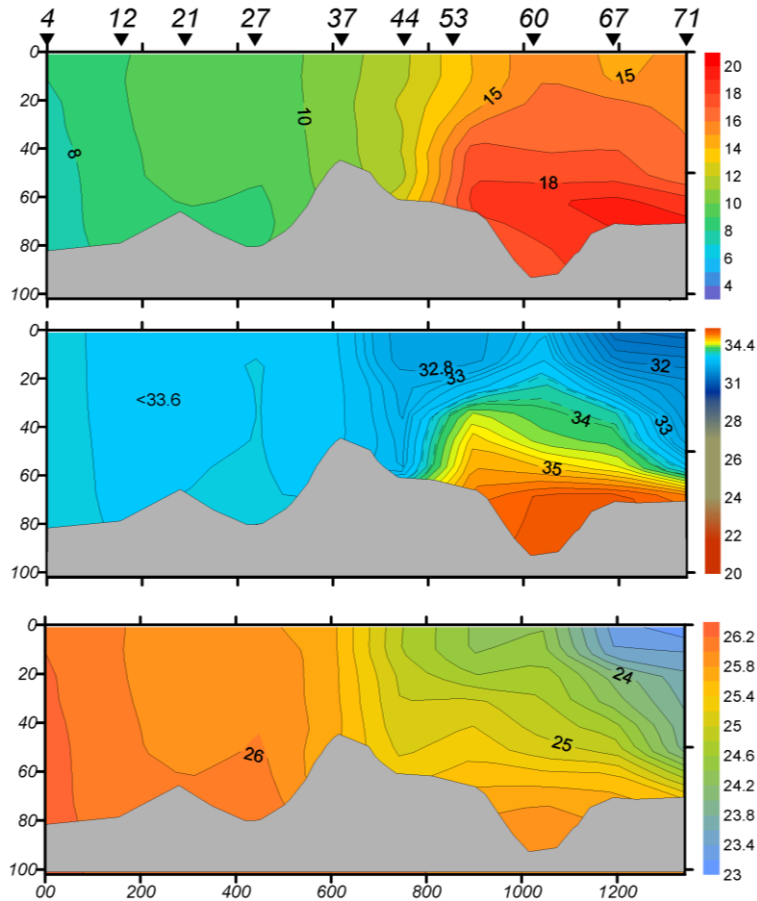


1 – SASW; 2 – PPW; 3 – STSW (Piola et al. 2008)

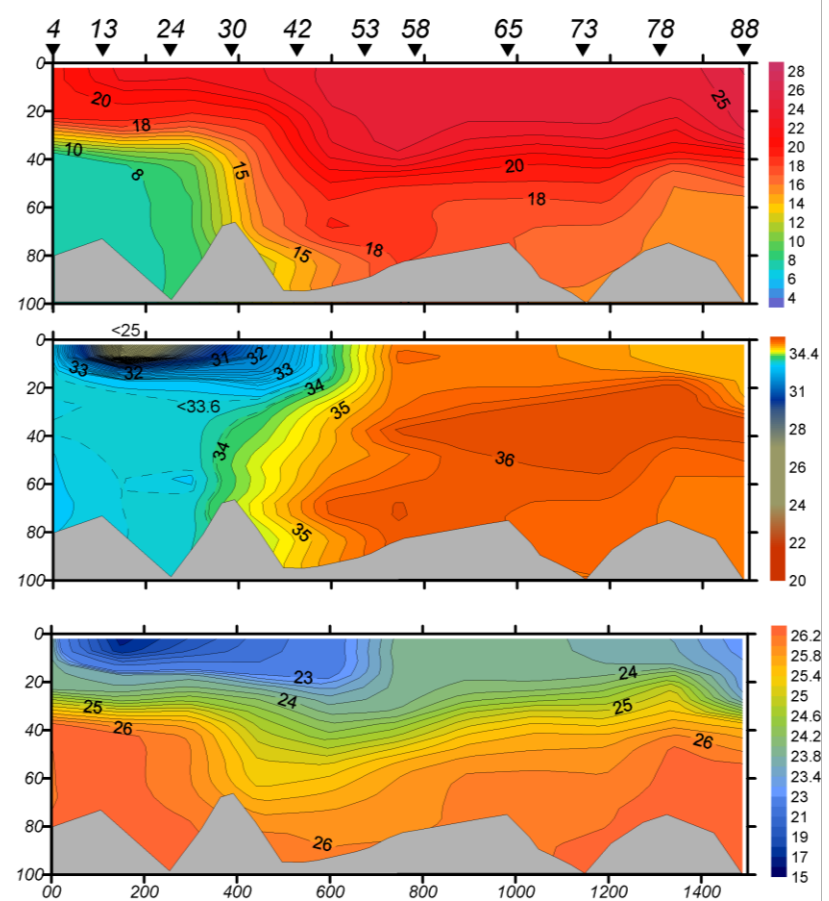


# A Frente Subtropical de Plataforma em inverno (esq.) e verão

## La Plata Agosto 2003

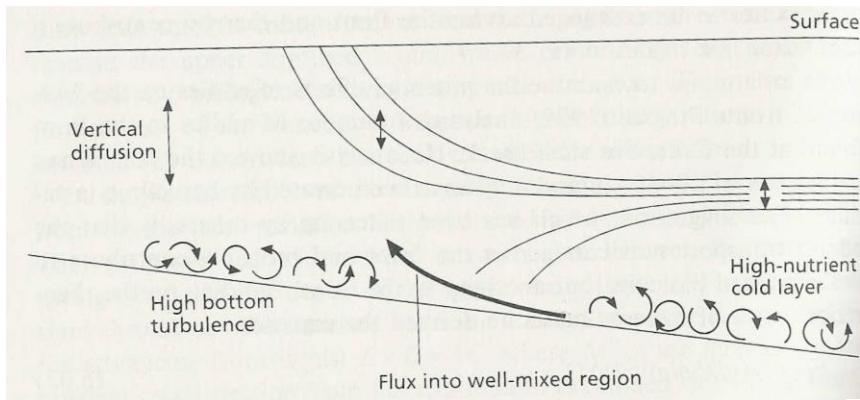


## La Plata – Fevereiro 2004

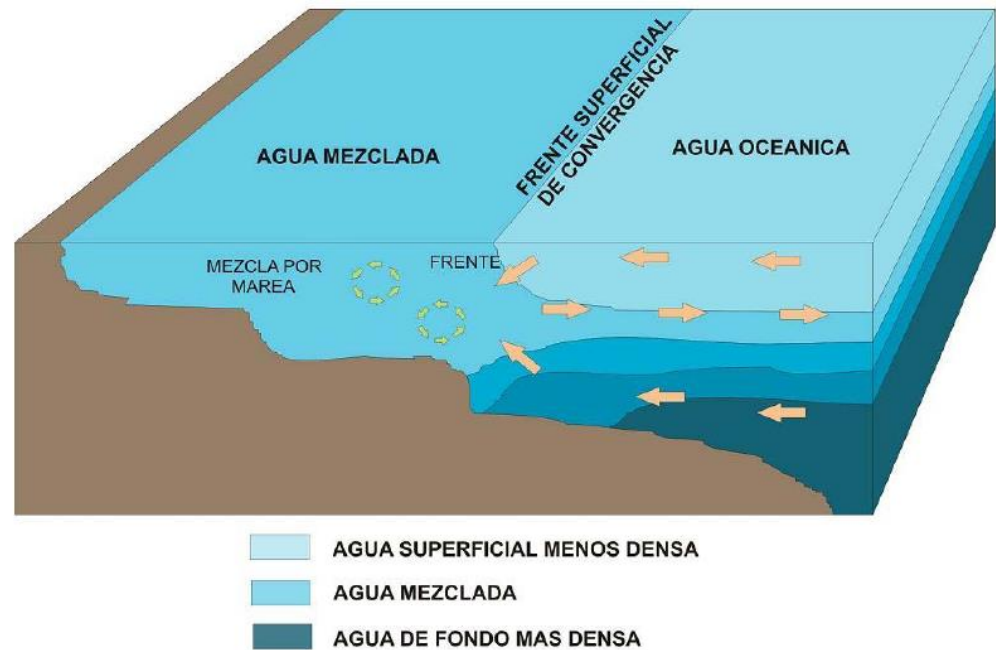


**No inverno a densidade está associada à salinidade enquanto que no verão à temperatura.**

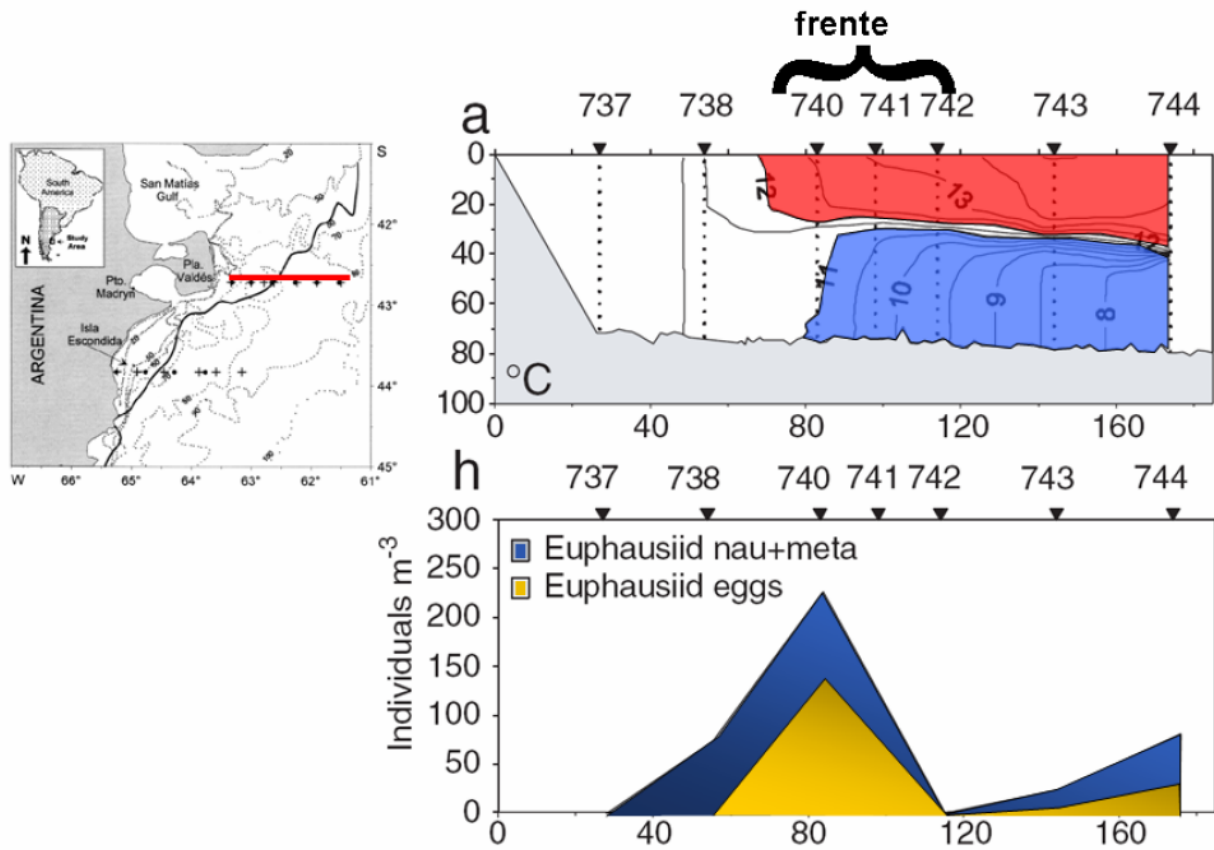
# Frentes de Marés



**Fig. 6.03** Density section through a tidally-mixed front with vertical arrows indicating the increase in the rate of vertical eddy diffusion from the stratified side to the mixed side. At the bottom higher levels of turbulence help to transport nutrients from the cold, high-nutrient layer into the fully-mixed region.

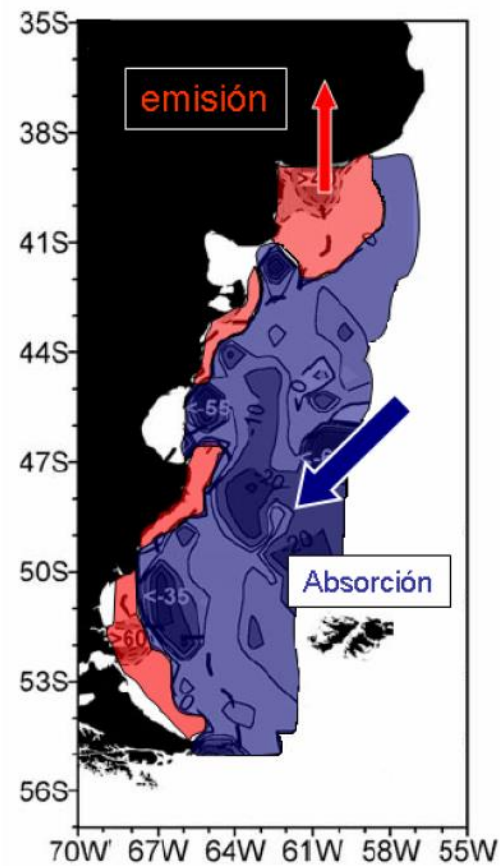


**Figura 2-14** Representación esquemática de un frente de marea



**Figura 2-3 Frente Península Valdés**

Fig. Adaptada de Sabatini y Martos, 2002 donde se aprecian en los paneles de la derecha la posición del frente térmico en concordancia con la abundancia máxima de huevos de organismos zooplanctónicos.



**Figura 1-2 Flujos de CO<sub>2</sub>**

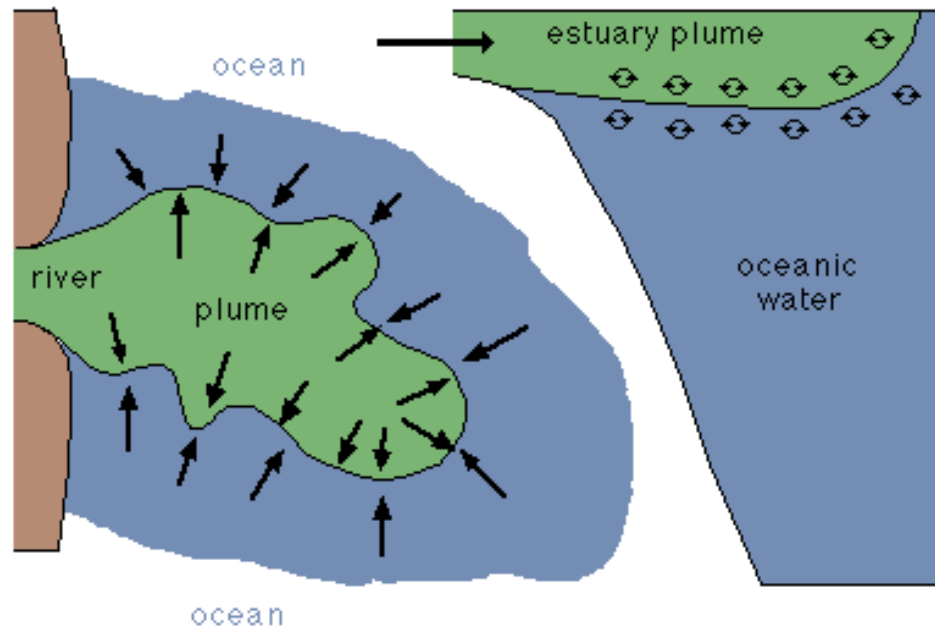
Flujos de CO<sub>2</sub> obtenidos por Bianchi y otros (2005). Estos autores encontraron una clara relación entre los flujos de CO<sub>2</sub> y los frentes de la Plataforma Patagónica, que durante la época cálida separan aguas homogéneas de aguas estratificadas: las zonas costeras mezcladas actúan como fuentes de CO<sub>2</sub> hacia la atmósfera (emisión: zonas sombreadas en rojo), mientras que las aguas estratificadas de la plataforma media y exterior se comportan como sumideros (absorción: zonas sombreadas en azul).



# Frentes de Rios (Plumas)



# Plumas de rios





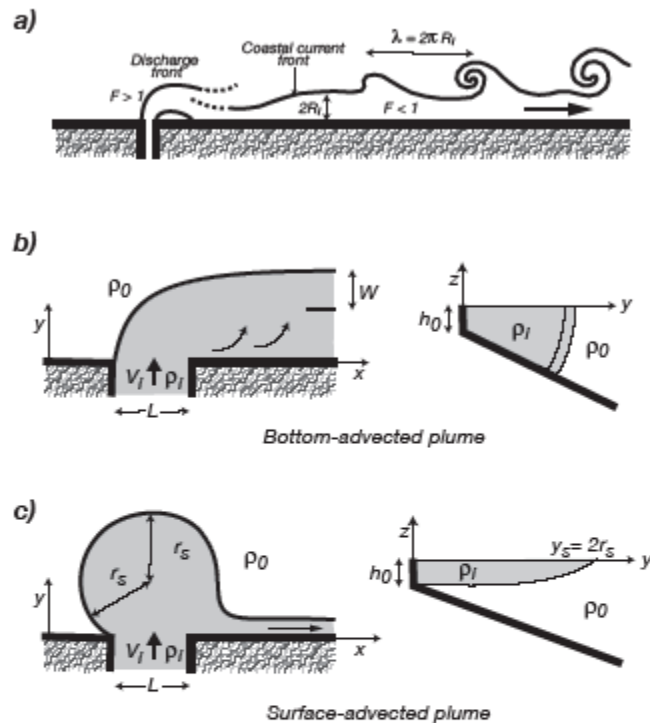
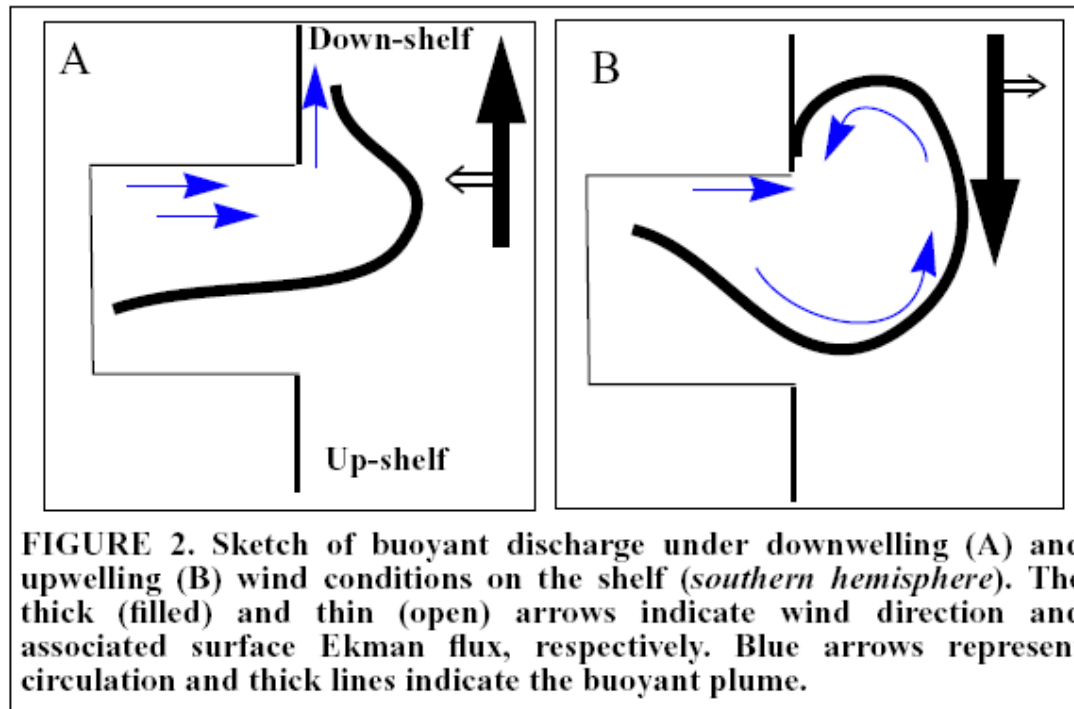


Figure 10.2. Schematics of a buoyant plume in the coastal ocean. a) Large coastal plume turns anticyclonically and reattaches to the coast downstream to form a narrow buoyancy driven current upon which meanders and instabilities develop (adapted from Hill, 1998). Froude number ( $F$ ) indicates that the dynamics is supercritical ( $F > 1$ ) in the bulge, and subcritical ( $F < 1$ ) in the far field; the Internal Rossby number ( $R_I$ ) scales the buoyant current. b,c) Bottom-advected and surface-advected plume (after Yankovsky and Chapman, 1997);  $\rho_I, \rho_0$  density of inflow and ambient flow,  $h_0$  and  $L$  are the depth and width at the estuary,  $w$  is the frontal region width,  $r_s$  the plume's bulge radius and  $y_s$  the plume's location offshore.

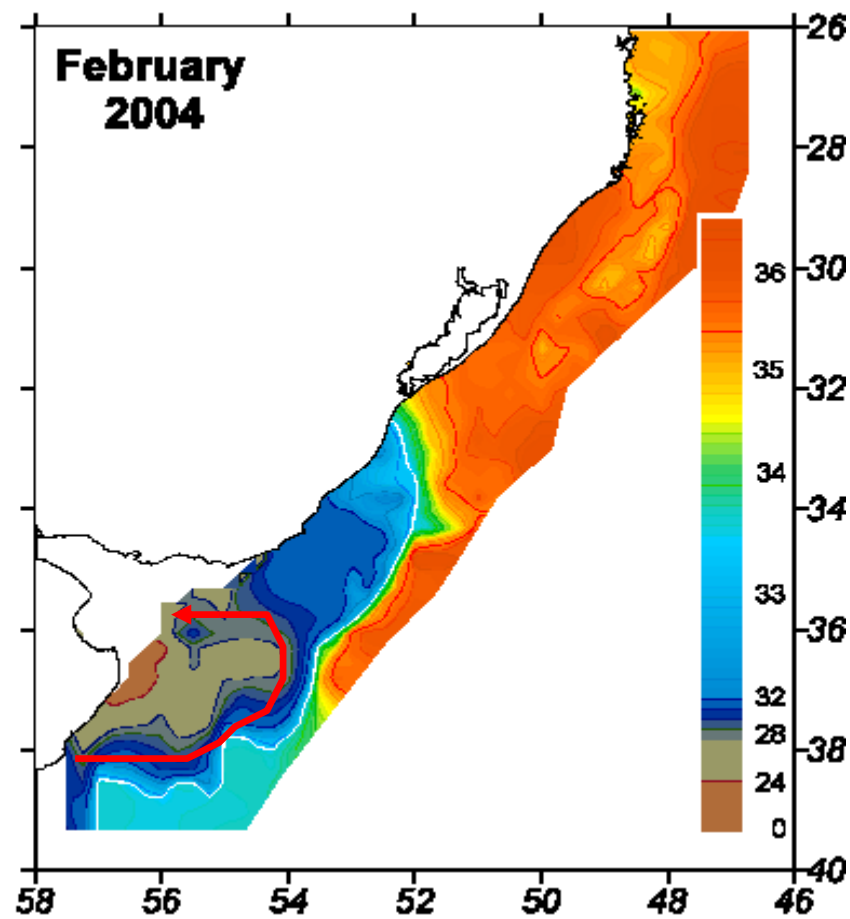
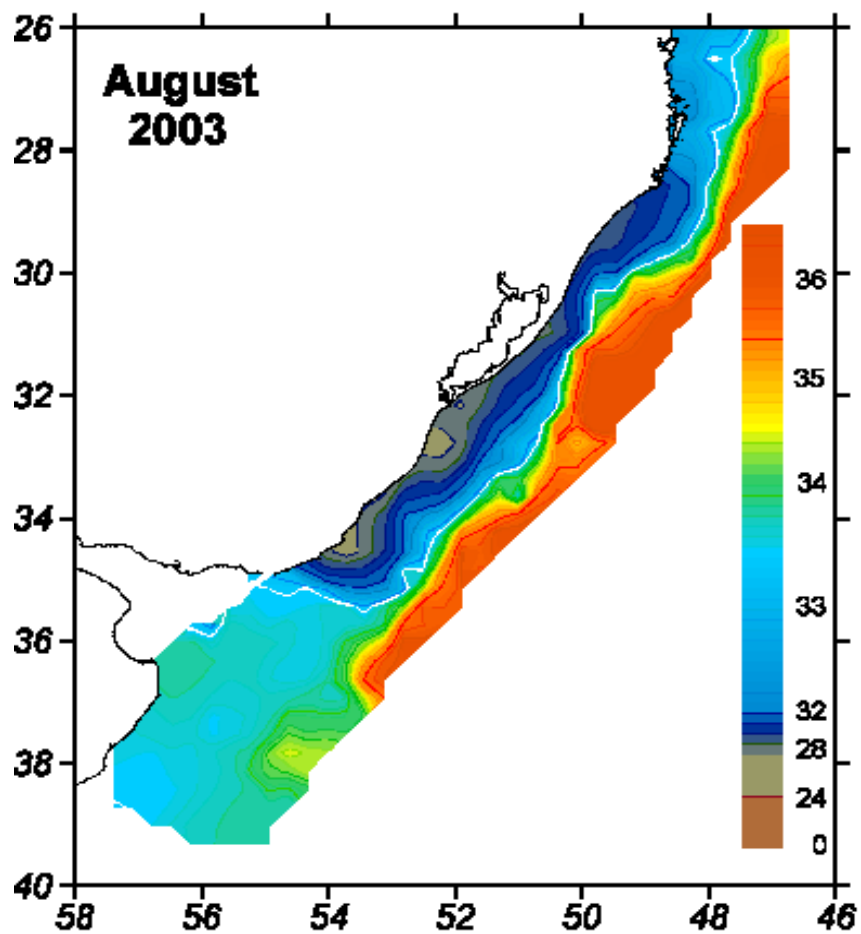
- Ajuste geostrófico
- Efeito do vento
  - A) favorável à ressurgência
  - B) contrário à ressurgência

Efeito da Maré

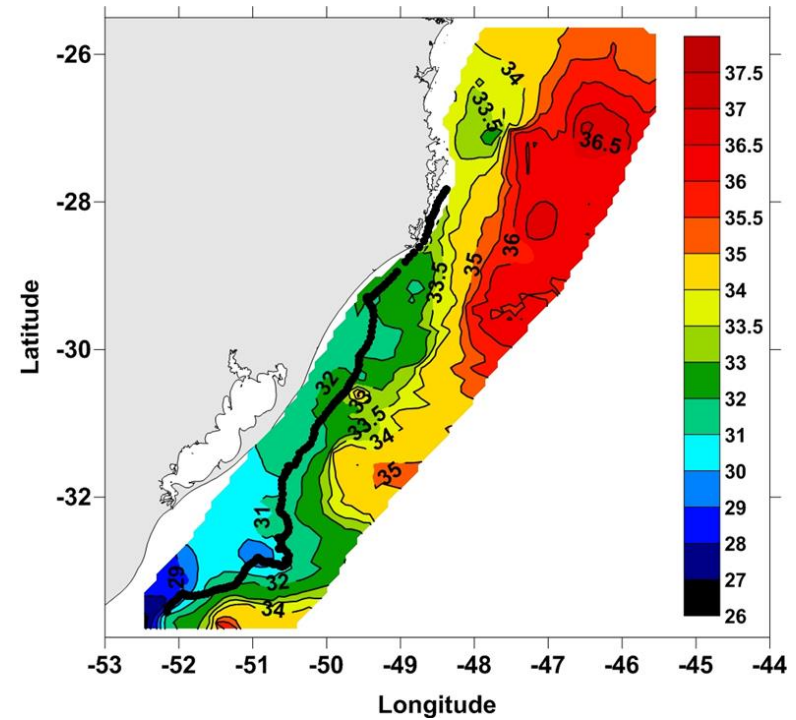
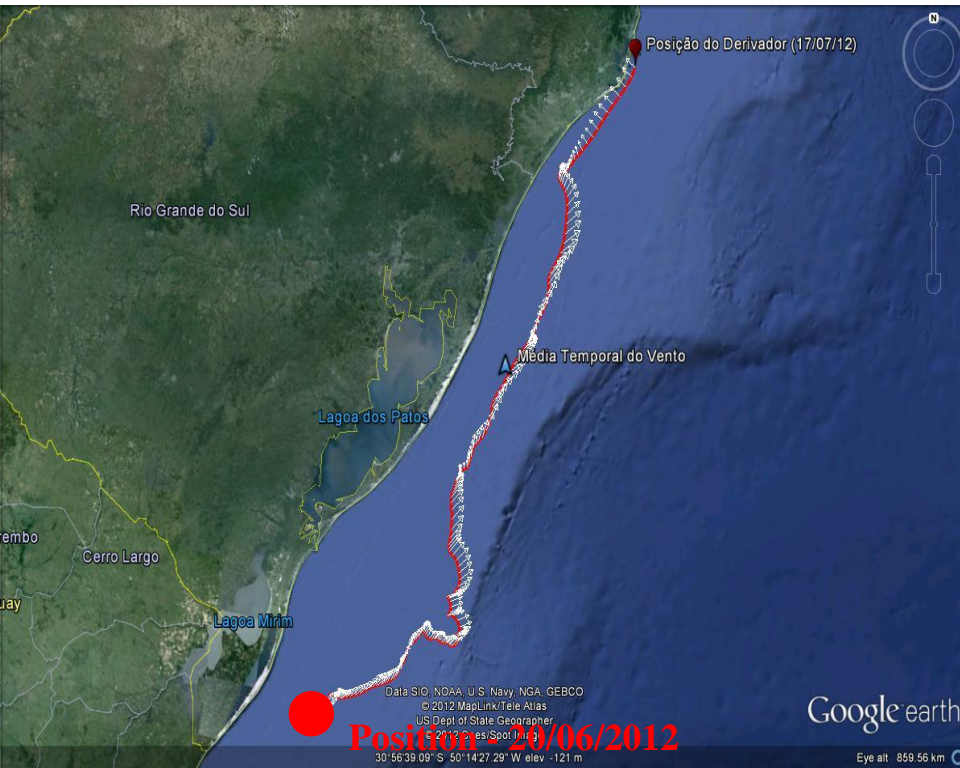
Efeito da morfologia ângulo limite de  $66^{\circ}$  com a costa – acima disto a pluma não “cola” na costa (Garvine, 1982)



**FIGURE 2.** Sketch of buoyant discharge under downwelling (A) and upwelling (B) wind conditions on the shelf (*southern hemisphere*). The thick (filled) and thin (open) arrows indicate wind direction and associated surface Ekman flux, respectively. Blue arrows represent circulation and thick lines indicate the buoyant plume.



# DERIVADOR DE BAIXO CUSTO (LCD) LANÇADO EM 20/06/2012 - ~0.3 M/S



**MESMO VENTOS FORTES DE NE NÃO ERAM CAPAZES DE REVERTER O DESLOCAMENTO PARA O NORTE DO LCD. A CAUSA: FLUXO PARA O NORTE DEVIDO AO GRADIENTE DE PRESSÃO FORMADO PELA PRESENÇA DE ÁGUAS DE BAIXA SALINIDADE E TEMPERATURA DERIVADAS DO RIO DA PRATA**

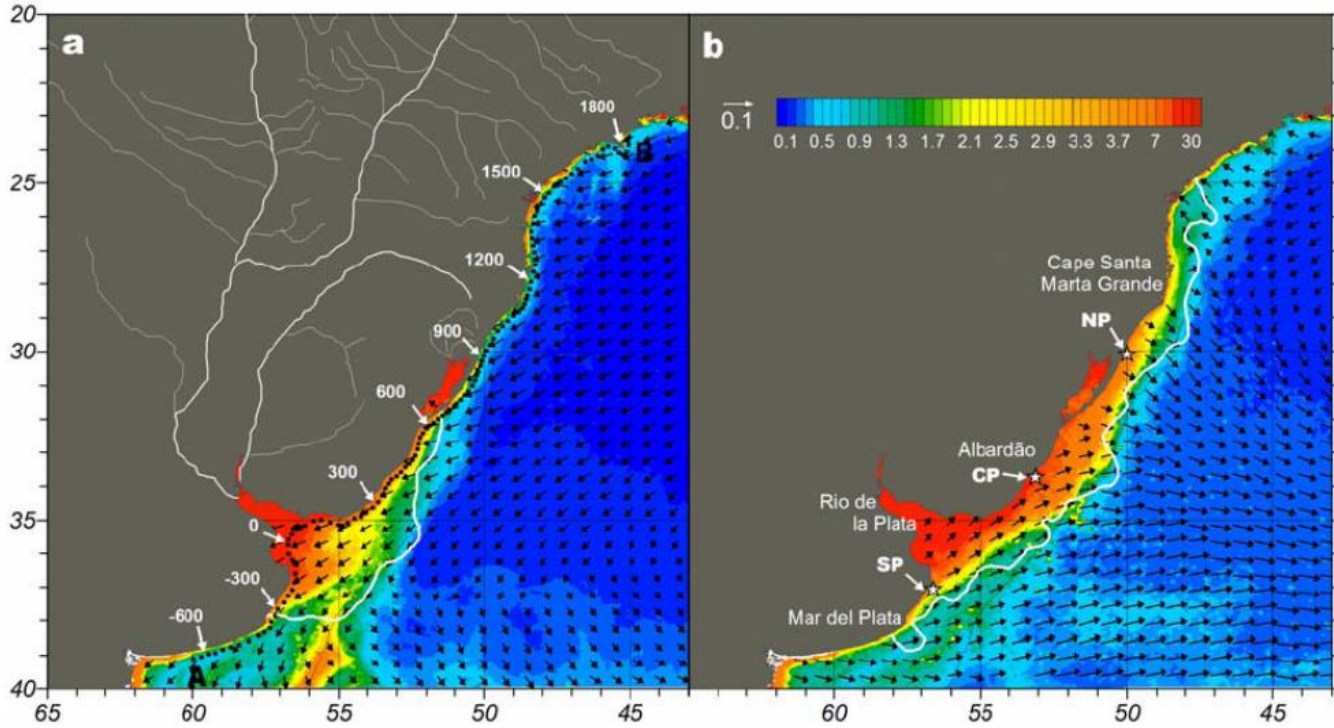
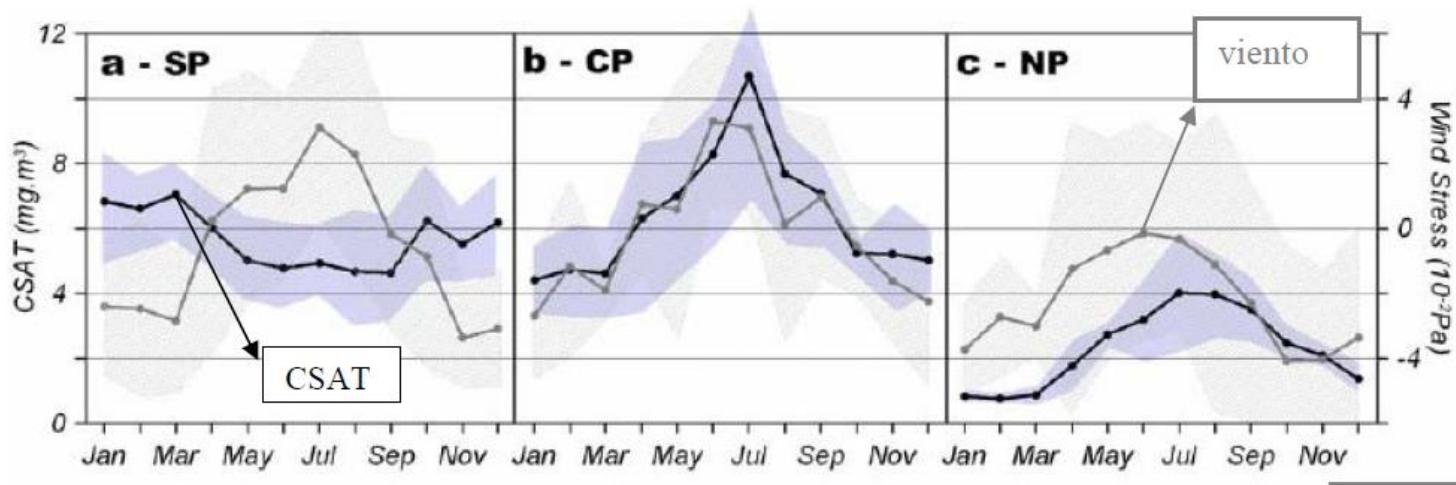
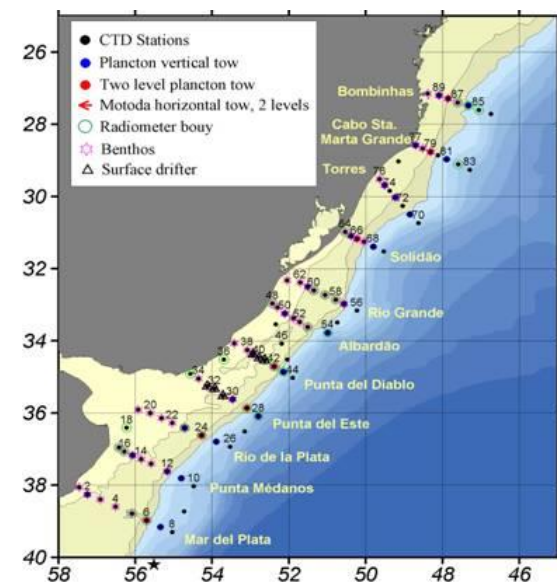
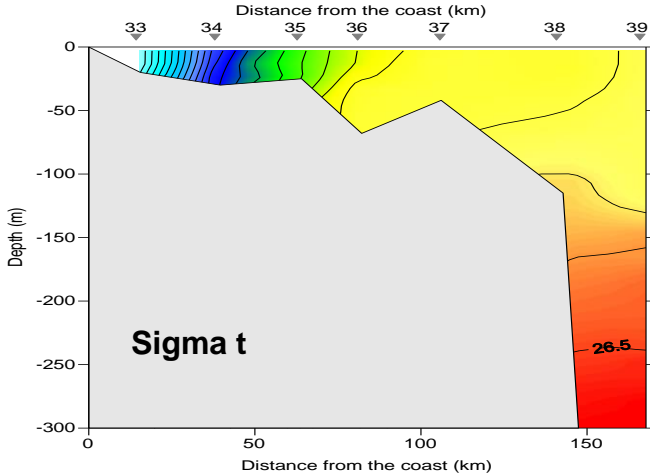
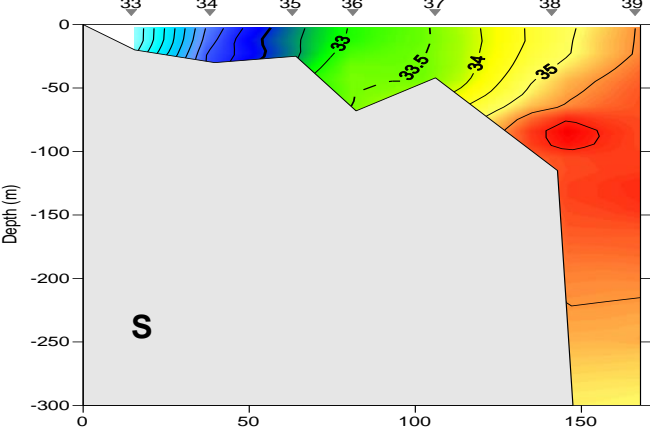
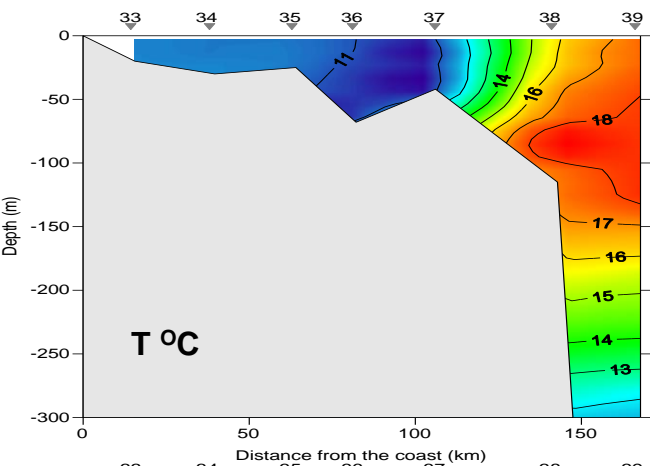


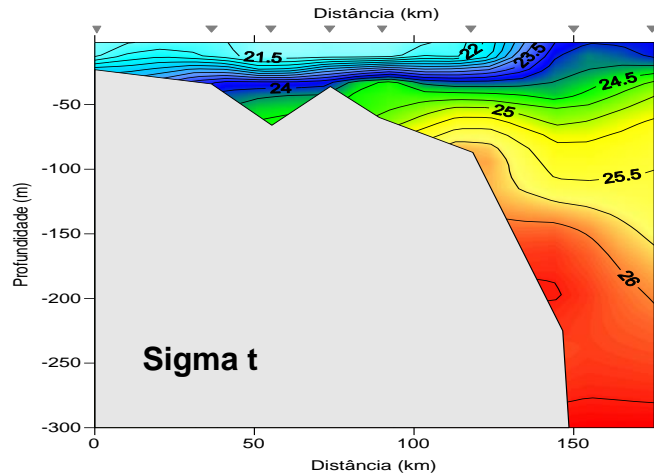
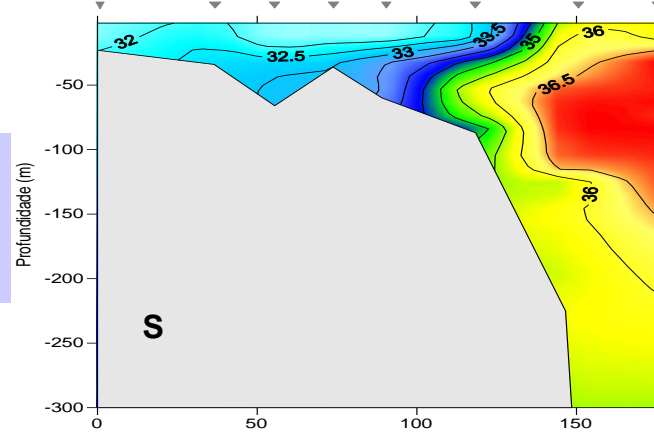
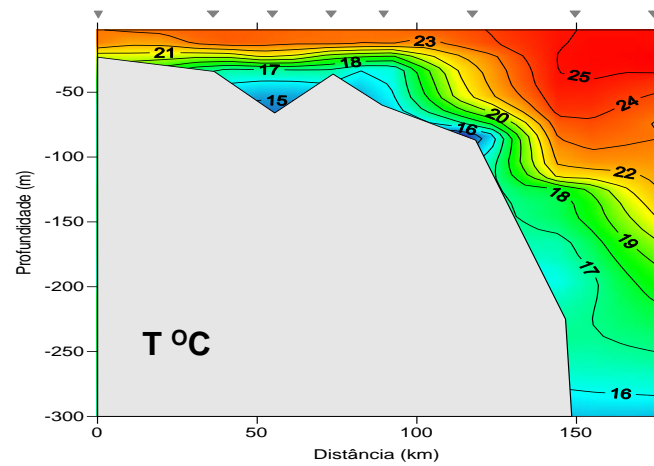
Figura 5-6 Distribuciones climatológicas de CSAT y QuickScat







Punta del Diablo  
 Winter Summer



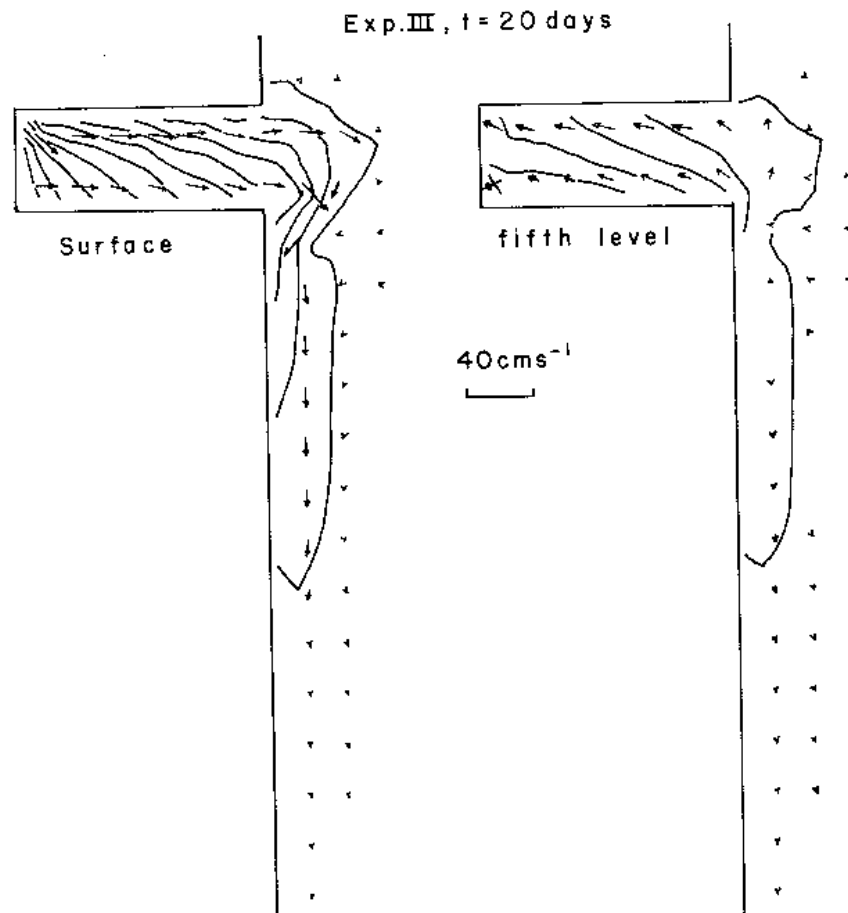
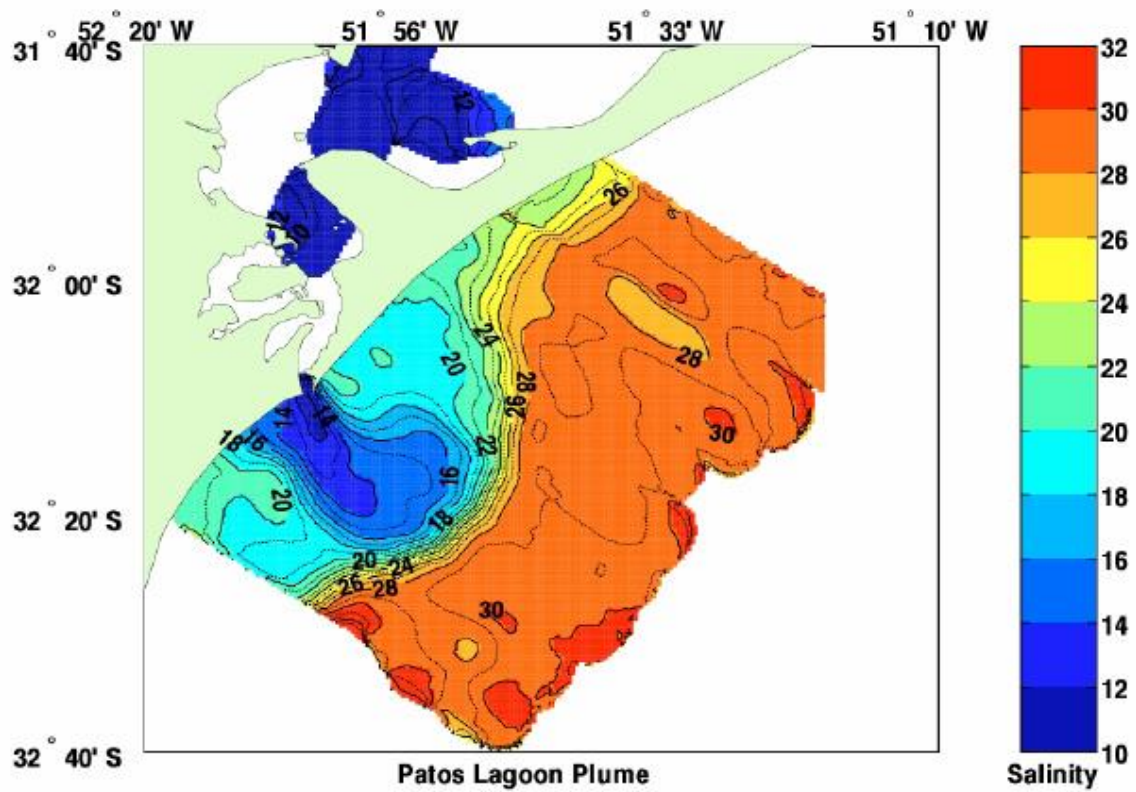


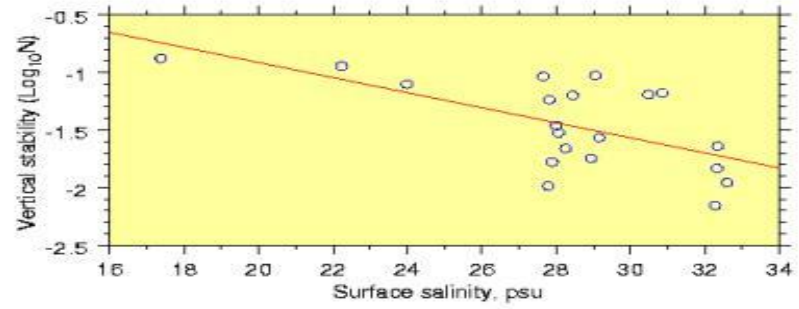
FIG. 16. As in Fig. 4 except for the third experiment at  $t = 20$  days, and the salinity contour is 0.8 ppt. A sloping shelf reduces the seaward excursion of the bulge.



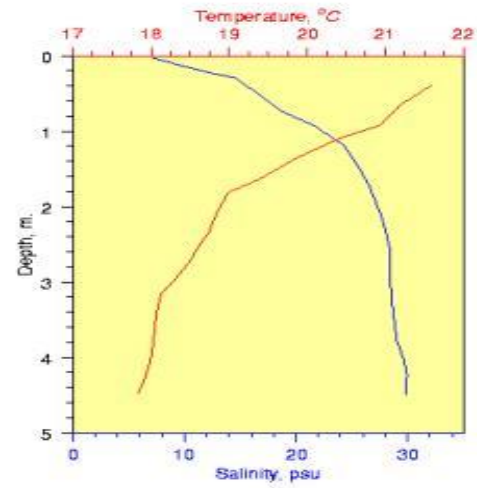


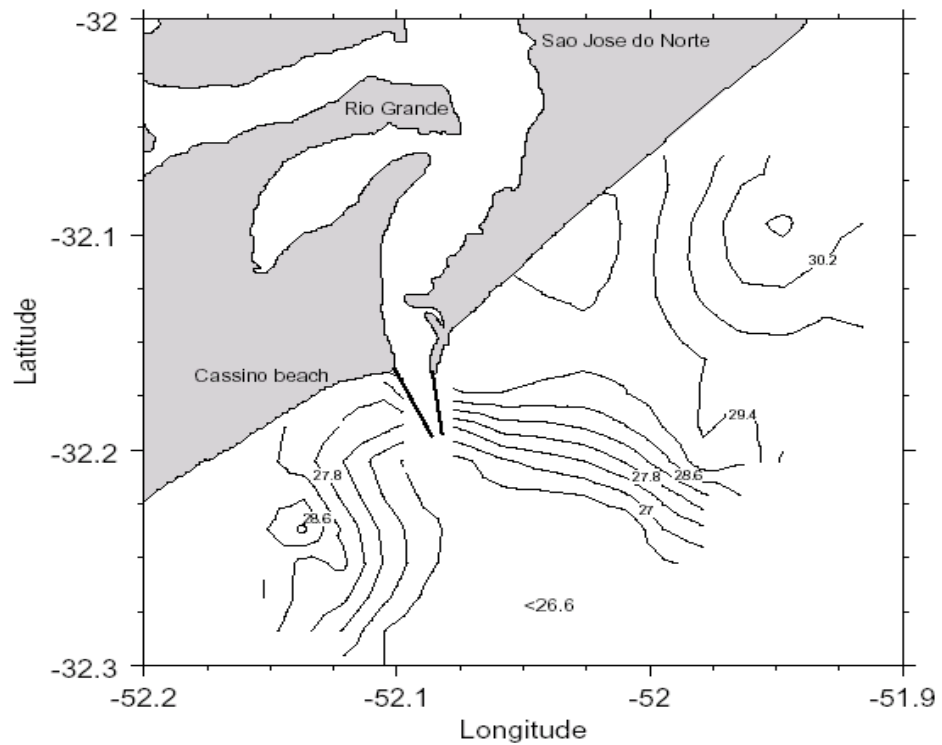
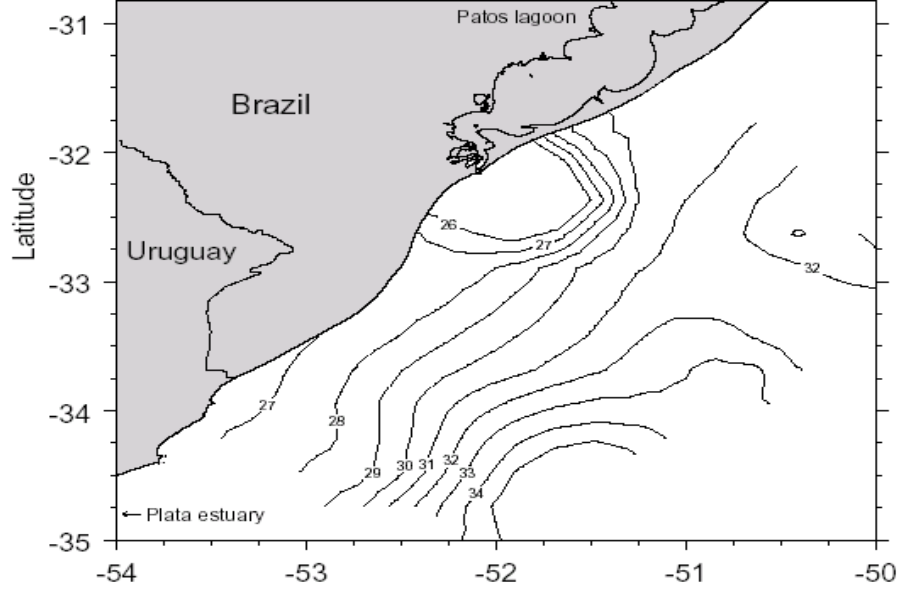


a)



b)



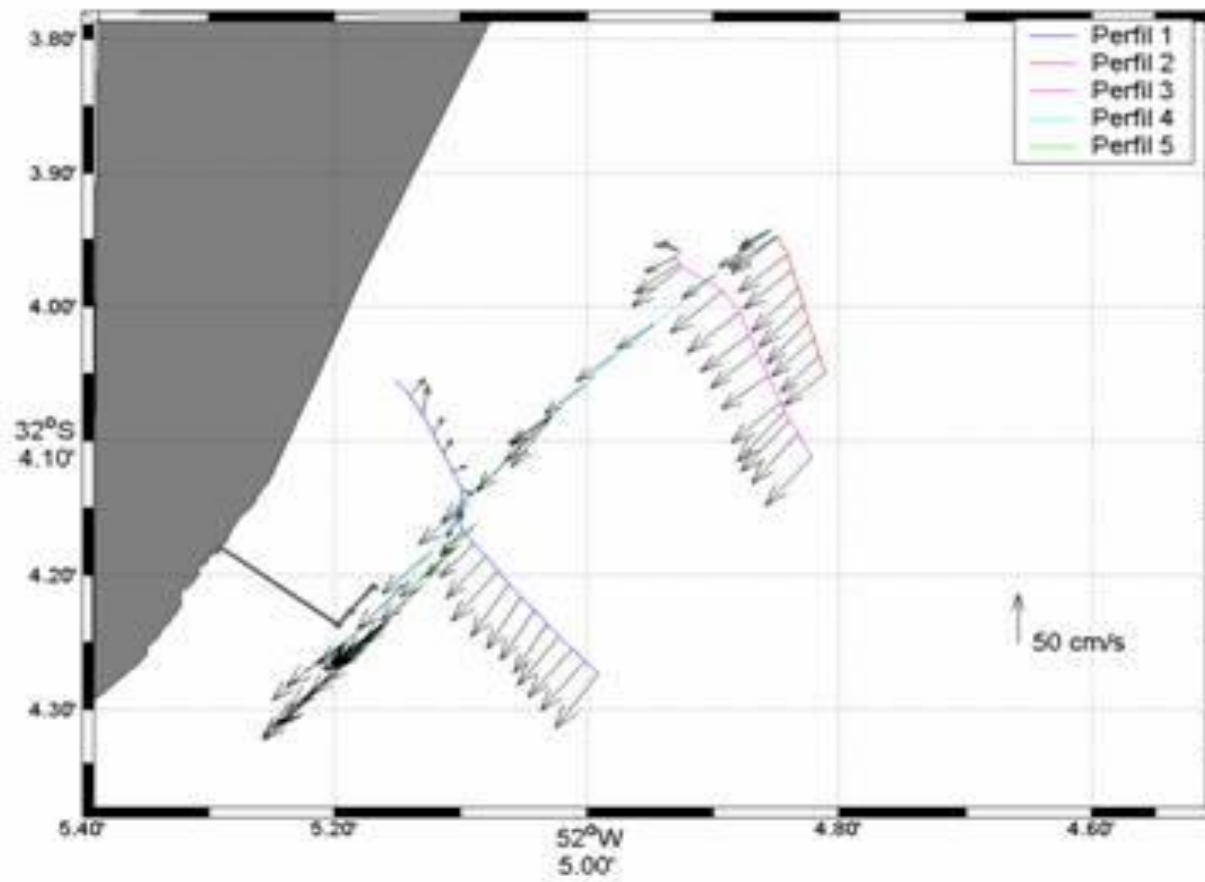








# Frentes de estuário



# Frentes de estuário

Regime de vazante – ventos de NNE: 13/07/2005

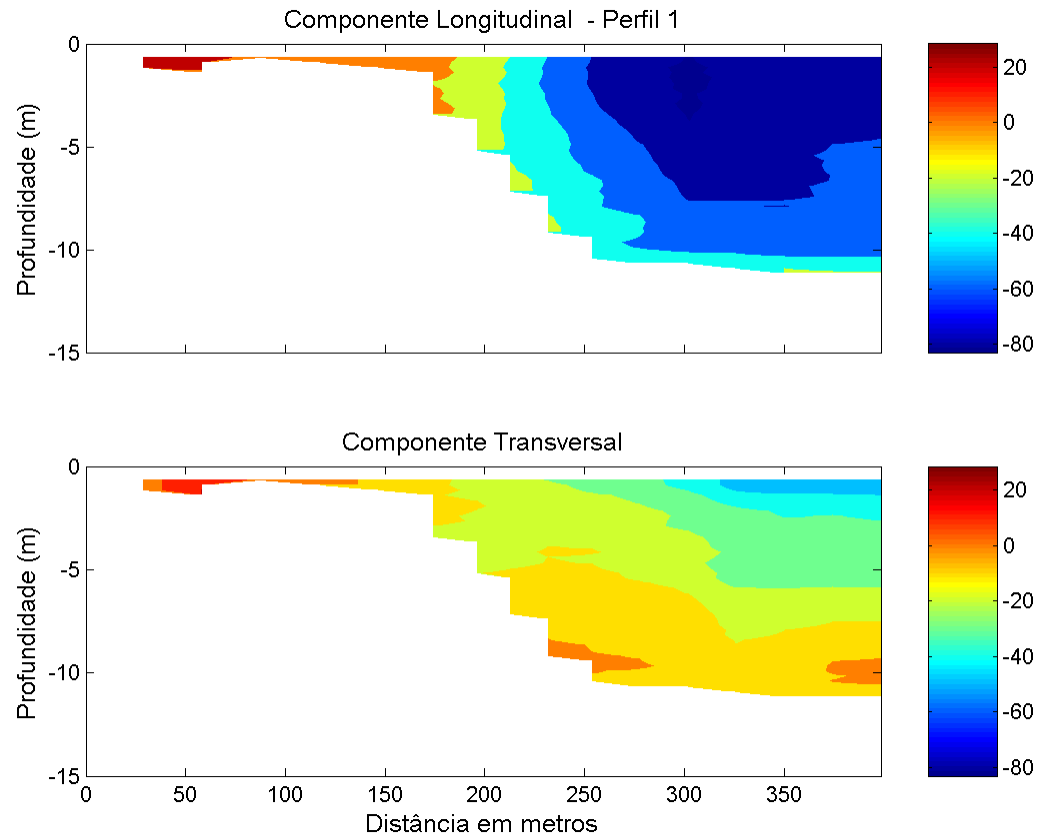






Fig. 17. Linha de espuma formada por diferença de velocidades entre o canal e a parte rasa. A linha acompanha a área onde o empreendimento está previsto

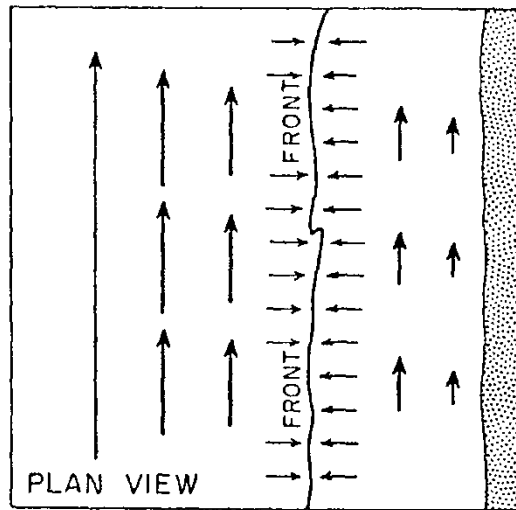


FIGURE 13. Schematic diagram of an estuarine frontal zone. The wiggly lines represent random turbulent motions, and the straight lines tidal currents.<sup>8</sup>

