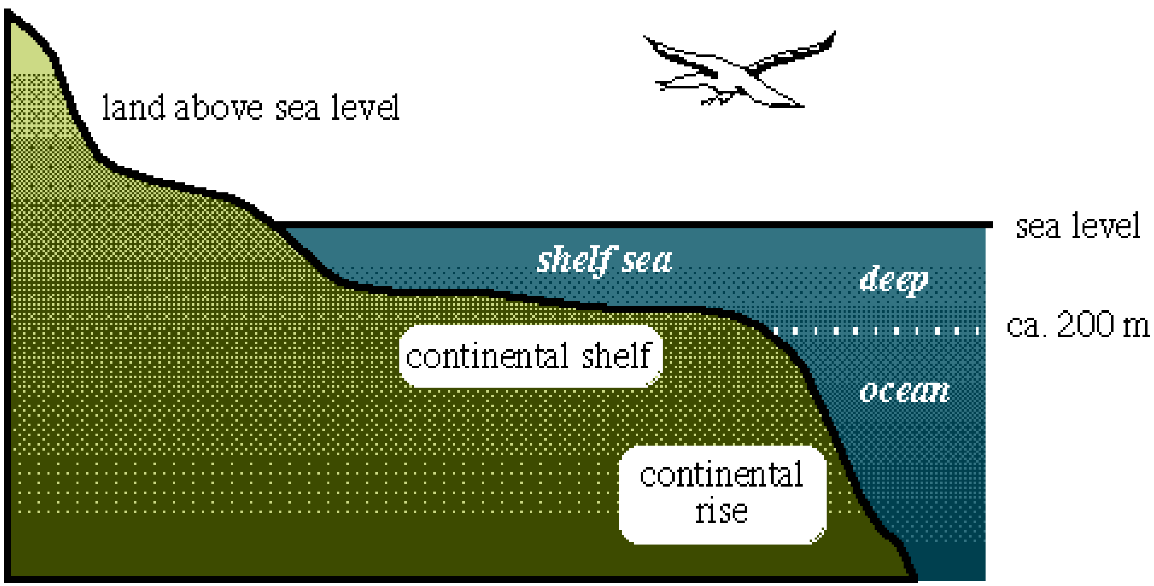
Plataforma Continental

- Área de transição
- Complexa pela interação de processos
- Forçantes:
  - Maré
  - Vento
  - Gradientes
  - Efeito de descarga fluvial


land above sea level
sea level
shelf sea
deep
ca. 200 m
continental shelf
ocean
continental
rise

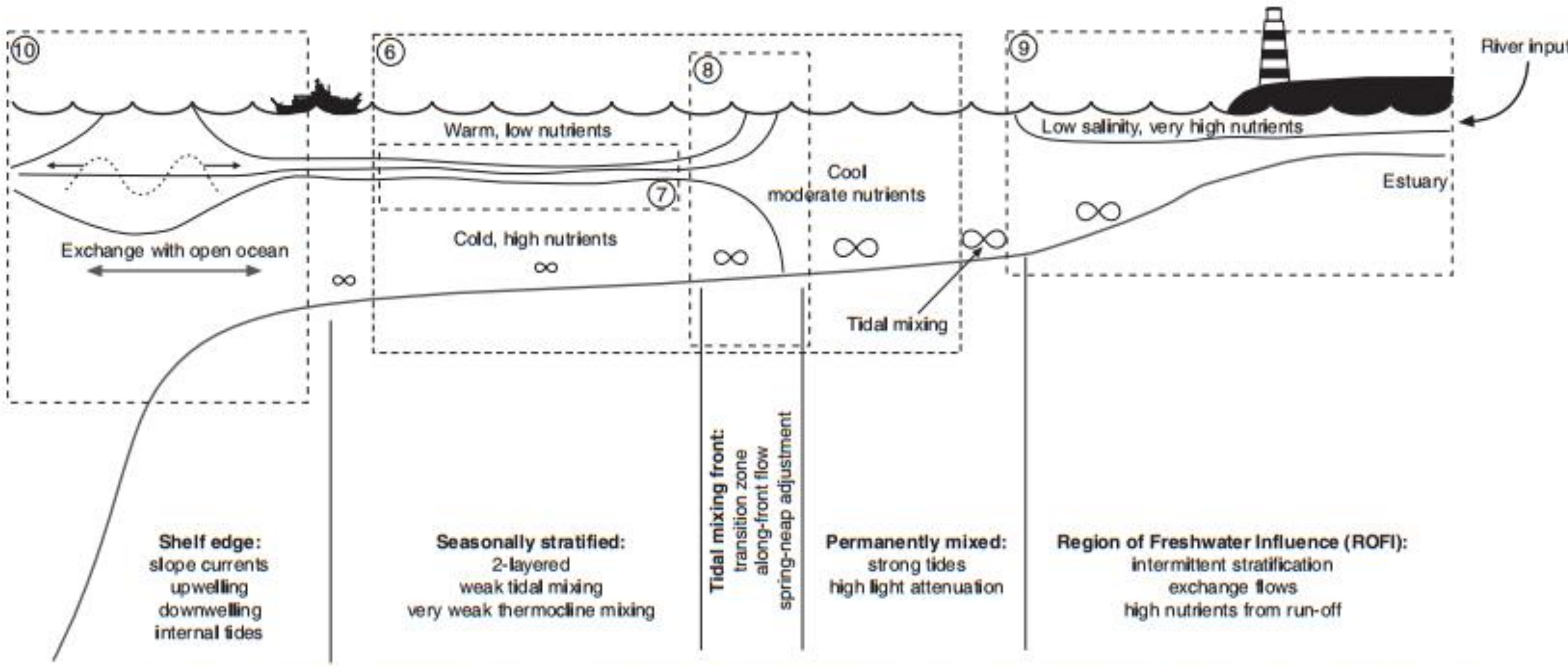
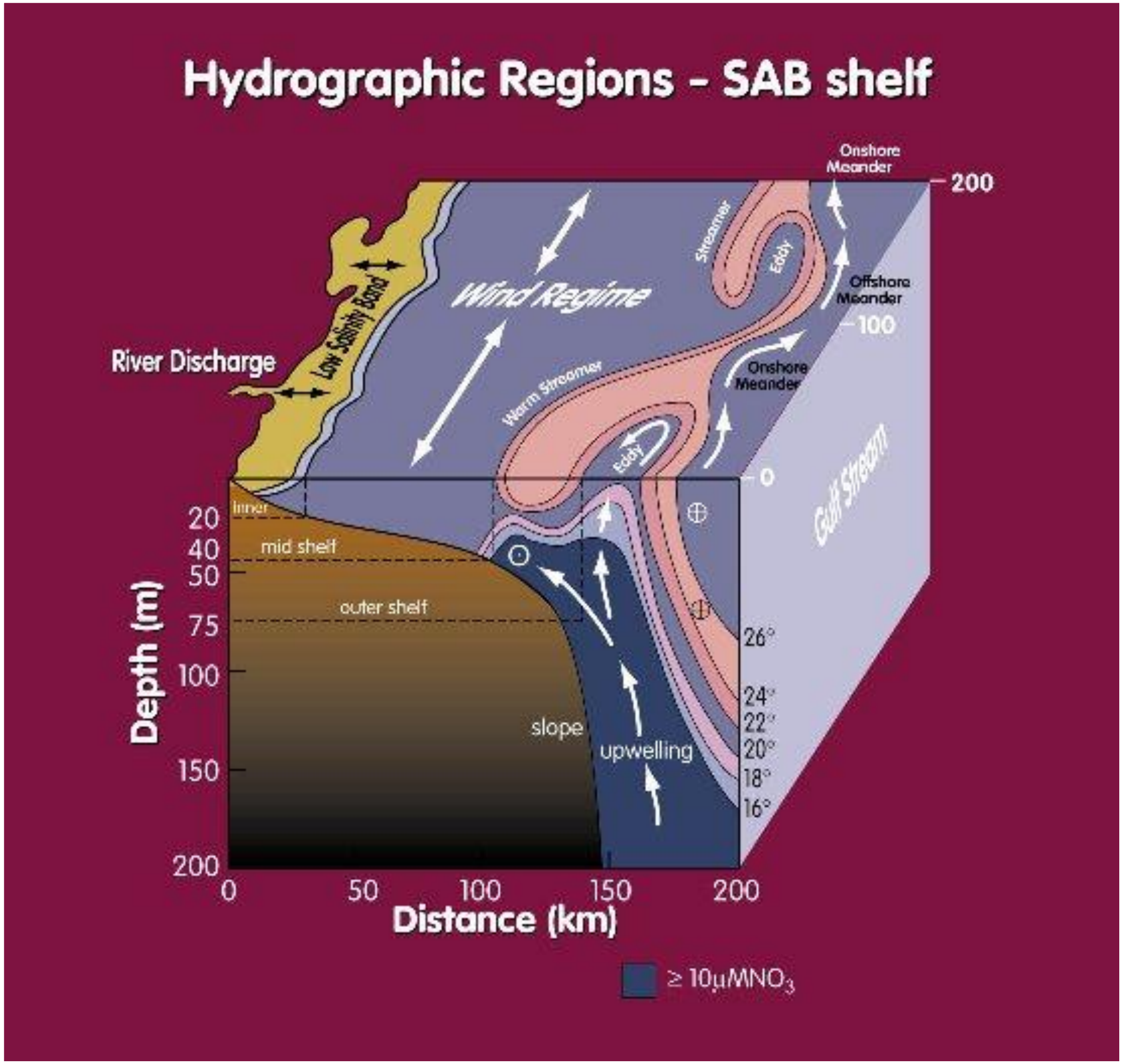


Figure G1 Schematic illustration of the shelf sea regimes. The dashed squares show the regions covered by individual chapters, with the relevant chapter number circled.

Regiões de plataforma continental



Processos em Áreas de Plataforma

- Ondas
- Marés
- Circulação gerada por vento
  - Ressurgência
  - Subsidência
- Correntes devidas a gradientes de densidade
- Frentes

Em comparação com o oceano aberto, áreas de plataforma e costeiras são ambientes extraordinariamente energéticos. Variações de temperatura, salinidade, nível do mar e correntes são mais pronunciados que a maiores distâncias da costa. Isto em parte é resultado do incremento na resposta de uma área mais costeira às forças experimentadas por todas as regiões oceânicas.

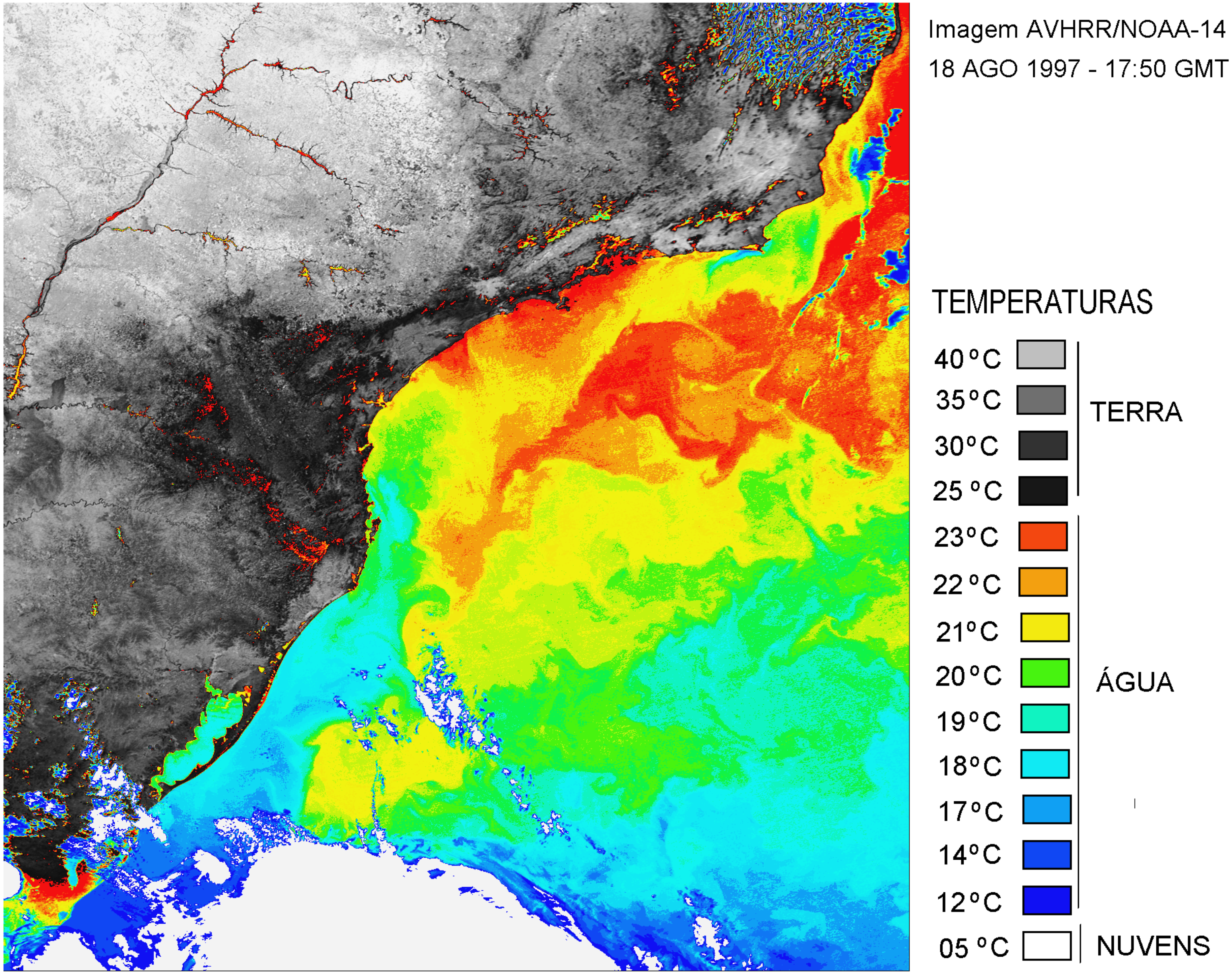


Imagem AVHRR/NOAA-14
18 AGO 1997 - 17:50 GMT
TEMPERATURAS
40 °C
35 °C
30°C
25 °C
TERRA
23°C
22 °C
21°C
20°C
19°C
18°C
17°C
14°C
12°C
ÁGUA
05 °C
NUVENS

Marés

- Co-oscilação com o oceano
- Propagação de ondas Kelvin
- Efeito da batimetria
  - Deformações
  - Ressonância
- Aparecimento de “overtides” – marés de águas rasas – M4

Marés em estuários

Maré – termo genérico para definir subidas e descidas do nível do mar com relação à Terra, produzida pela resultante entre Força Gravitacional (Lua e Sol) e a Força Centrífuga

Marés também ocorrem na atmosfera, em lagos e na crosta terrestre

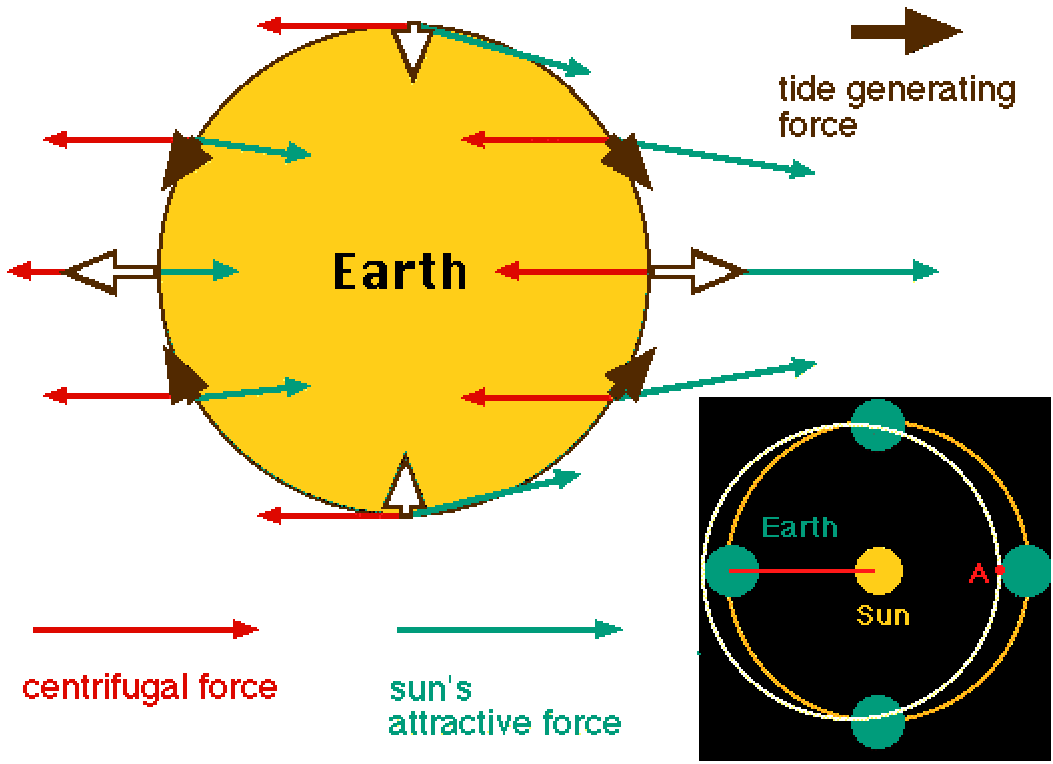
Força Gravitacional:

GmM/R^2

A Força Gravitacional muda de um lado a outro da Terra
Força Centrífuga- constante

Força Geradora de Maré:

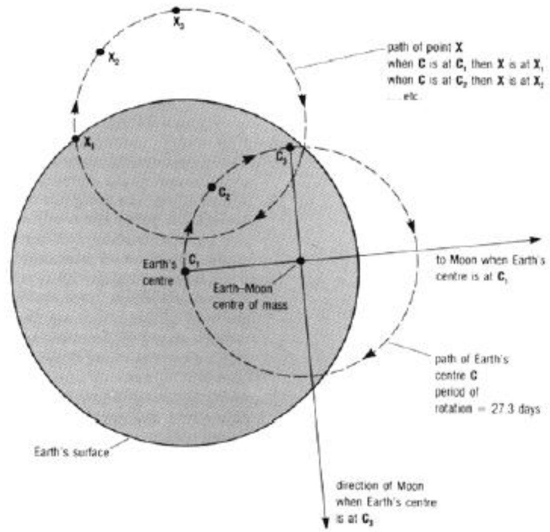
$2GmM/R^3$



A massa do Sol é de $2x10^{27}$ t enquanto que a da Lua é de $7.3x10^{19}$ t. O Sol está 390 vezes mais longe da Terra do que a Lua

A Força Geradora de Maré relativa é = $[(2x10^{27}/7.3x10^{19})]/(390^3)$

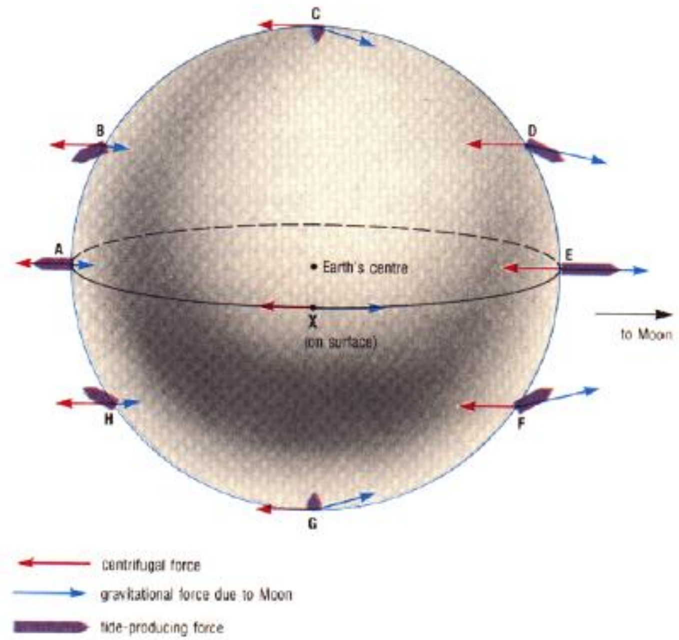
ou = $27x10^6/59x10^6$ = 0.46 or 46%



Força Geradora de Maré:

$2GmM/R^3$

Figura 1 - Revolução excêntrica da Terra em torno do centro de massa Terra-Lua vista de um dos pólos quando a Lua esta diretamente acima do Equador. Cada ponto na Terra segue uma trajetória circular análoga à aquela dos pontos C e X. Figura em Open University, pp 44.



Pontos Anfidrômicos

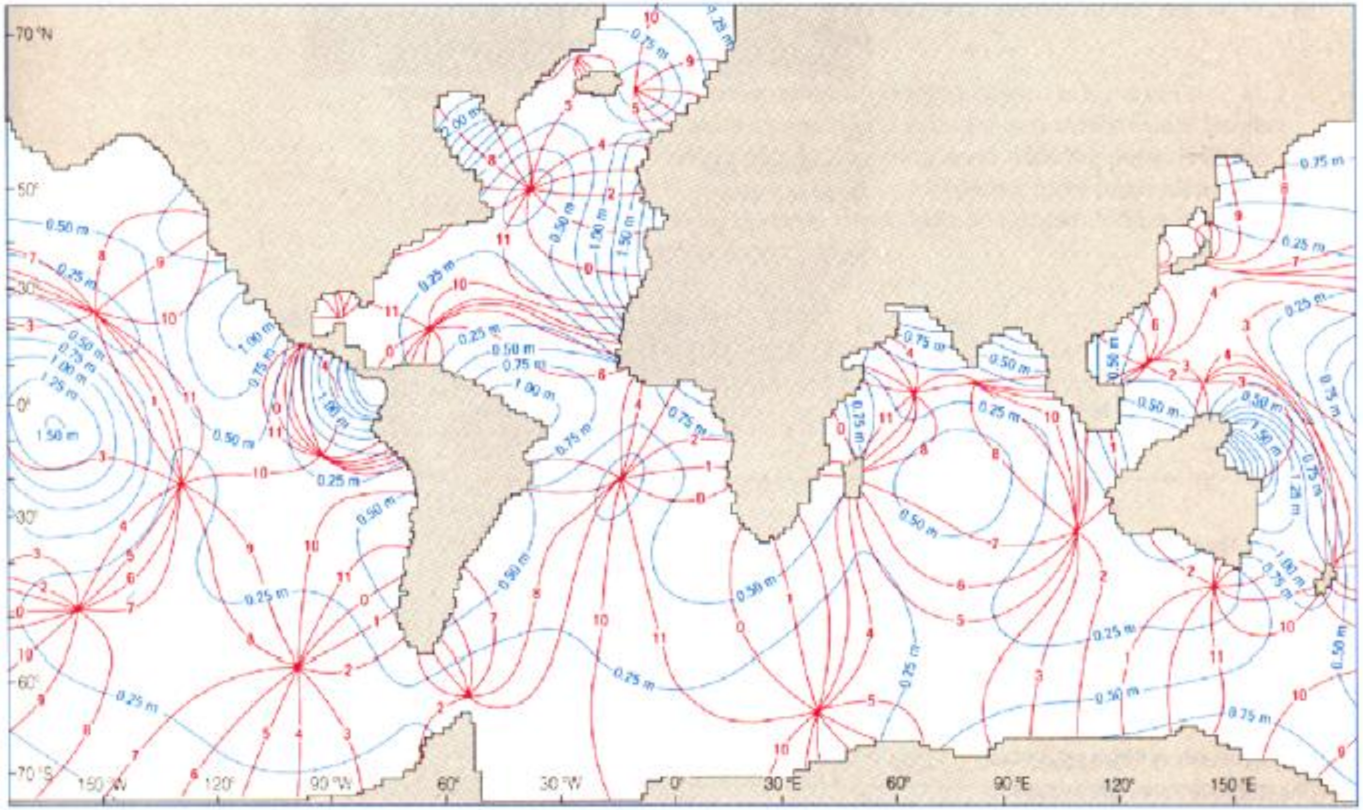
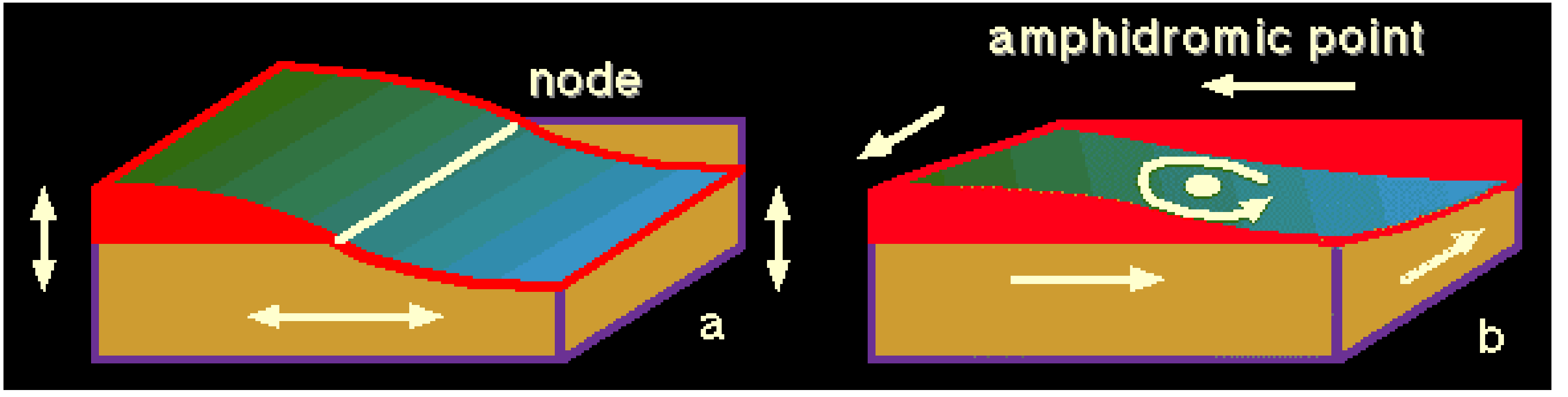
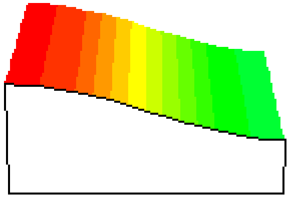
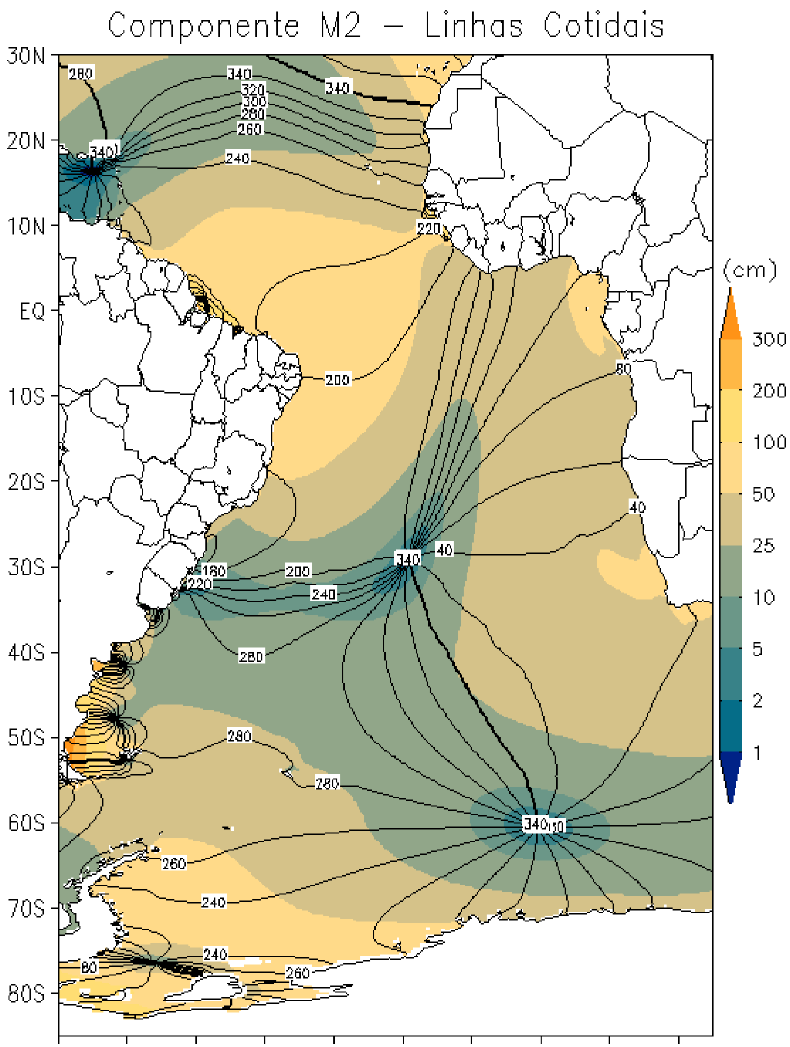


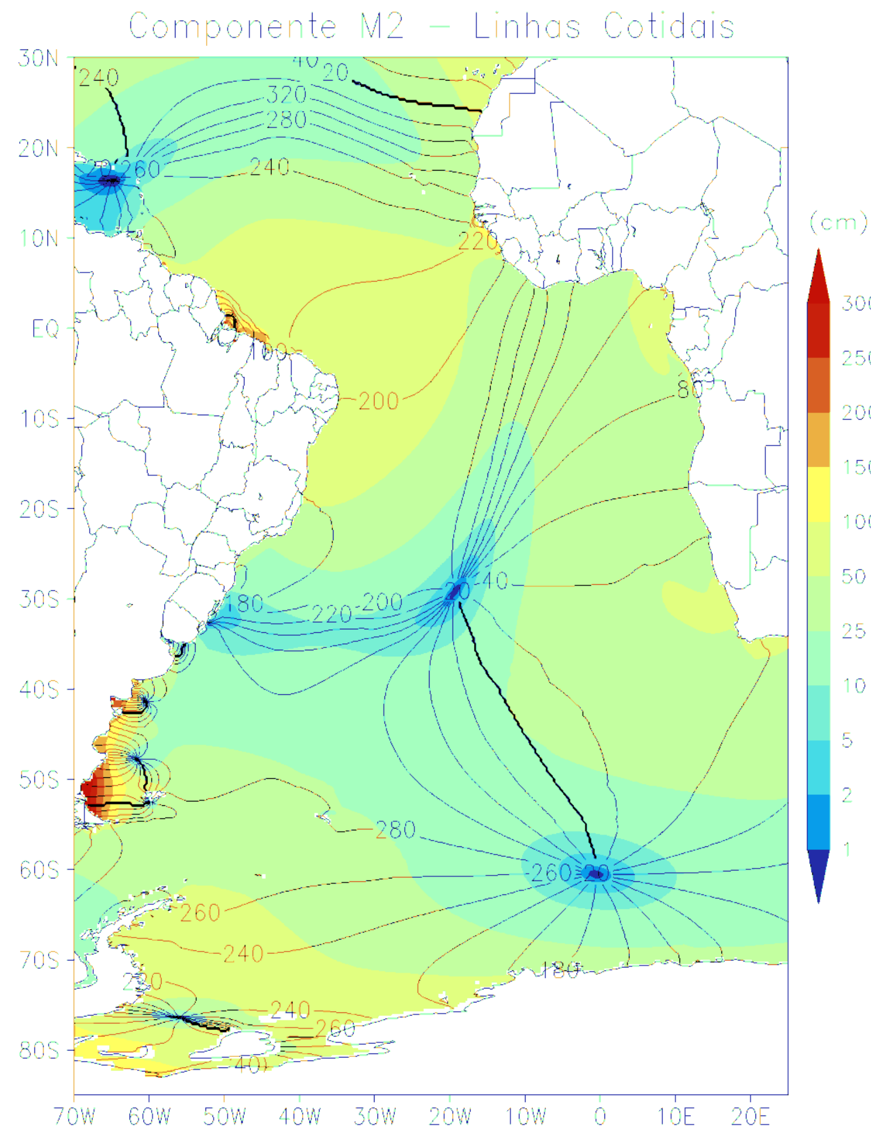
Figura 8 - Diagrama de sistemas anfidrômicos ao redor do mundo para o componente semi-diurno lunar da maré. Linhas de co-maré são vermelhas e linhas de co-variação são azuis. Figura em Open University, pp 55.

Pontos Anfidrômicos









Camargo, R., em preparo

Marés de sizígia e quadratura

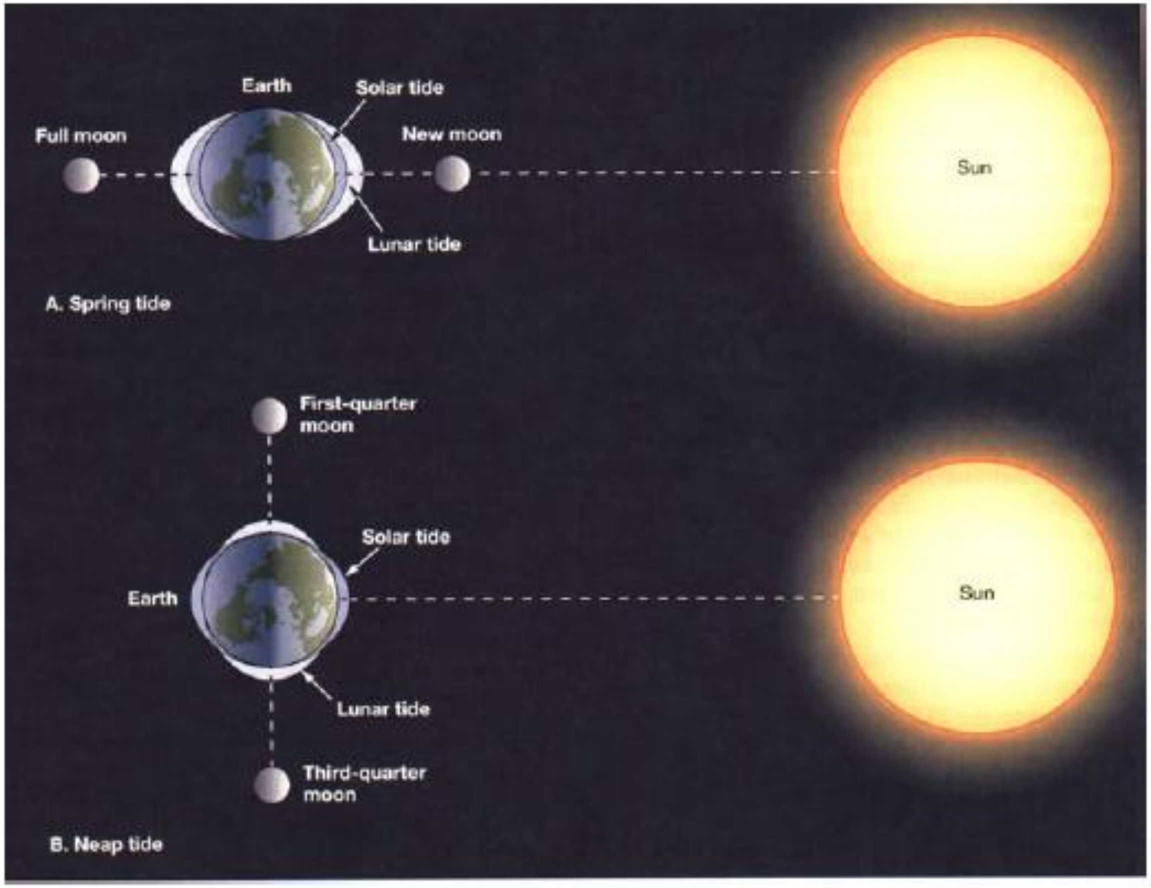
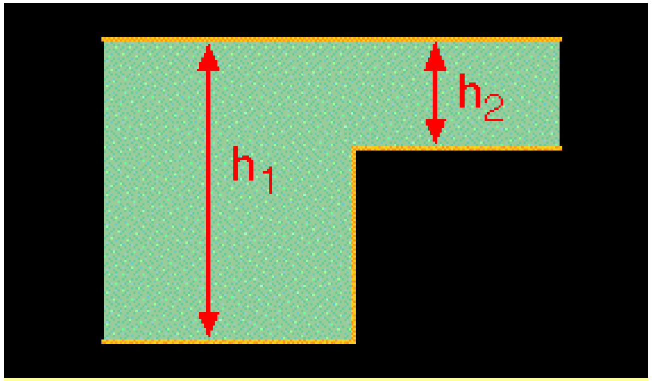
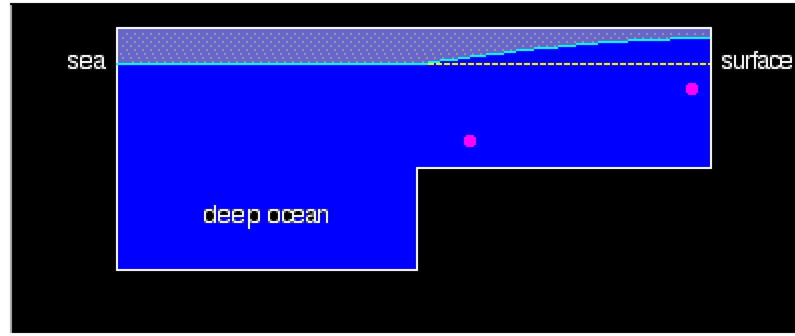
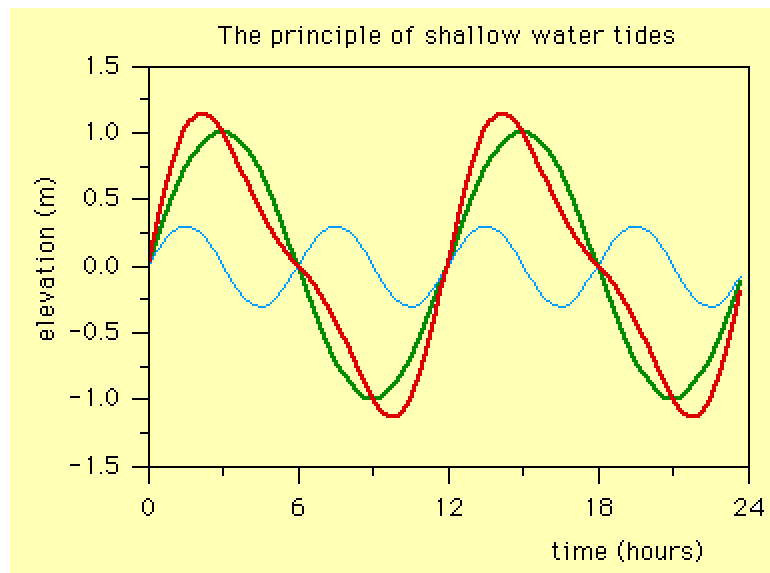


Figura 6 – As posições da Terra, da Lua e do Sol e o comportamento das marés. Figura em Thurman & Trujillo (1999), pp 283.



$$a = \frac{1 - \sqrt{h_2 / h_1}}{1 + \sqrt{h_2 / h_1}} \qquad b = \frac{2}{1 + \sqrt{h_2 / h_1}}$$





O que altera a amplitude e fase da onda da maré produzidas na Teoria do

Fatores não astronômicos:

- **configuração da costa**
- **batimetria**
- **forçante atmosférico (velocidade do vento, pressão atm.)**
- **hidrografia**

Podem alterar velocidade, produzir ressonancia, seiches e variações do nível (storm surges)

Em mar aberto as oscilações de nível são de poucos centímetros.
Quando a onda se propaga na plataforma continental estas variações aumentam

Tendo em conta que ondas de marés se comportam como ondas longas

Típico comprimento = 4500 km (onda semi-diurna sobre 1000 m of water)

Razão profundidade/comprimento de onda = 1 / 4500

A velocidade de fase é dada por: $C = [\, gH \,]^{0.5}$

A maré observada corresponde a sobreposição de várias ondas geradas por diferentes mecanismos

Principais constituintes:

Principal Lunar Semidiurnal	M_2	12.42 h
Principal Solar Semidiurnal	S_2	12.00 h
Larger Lunar Elliptic Semidiurnal	N_2	12.66 h
Lunisolar diurnal	K_1	23.93 h
Lunar Diurnal	O_1	25.82 h

$$\eta = A_{M2}\sin(\sigma_{M2} + \phi_{M2}) + A_{S2}\sin(\sigma_{S2} + \phi_{S2}) + A_{N2}\sin(\sigma_{N2} + \phi_{N2}) + \ldots$$

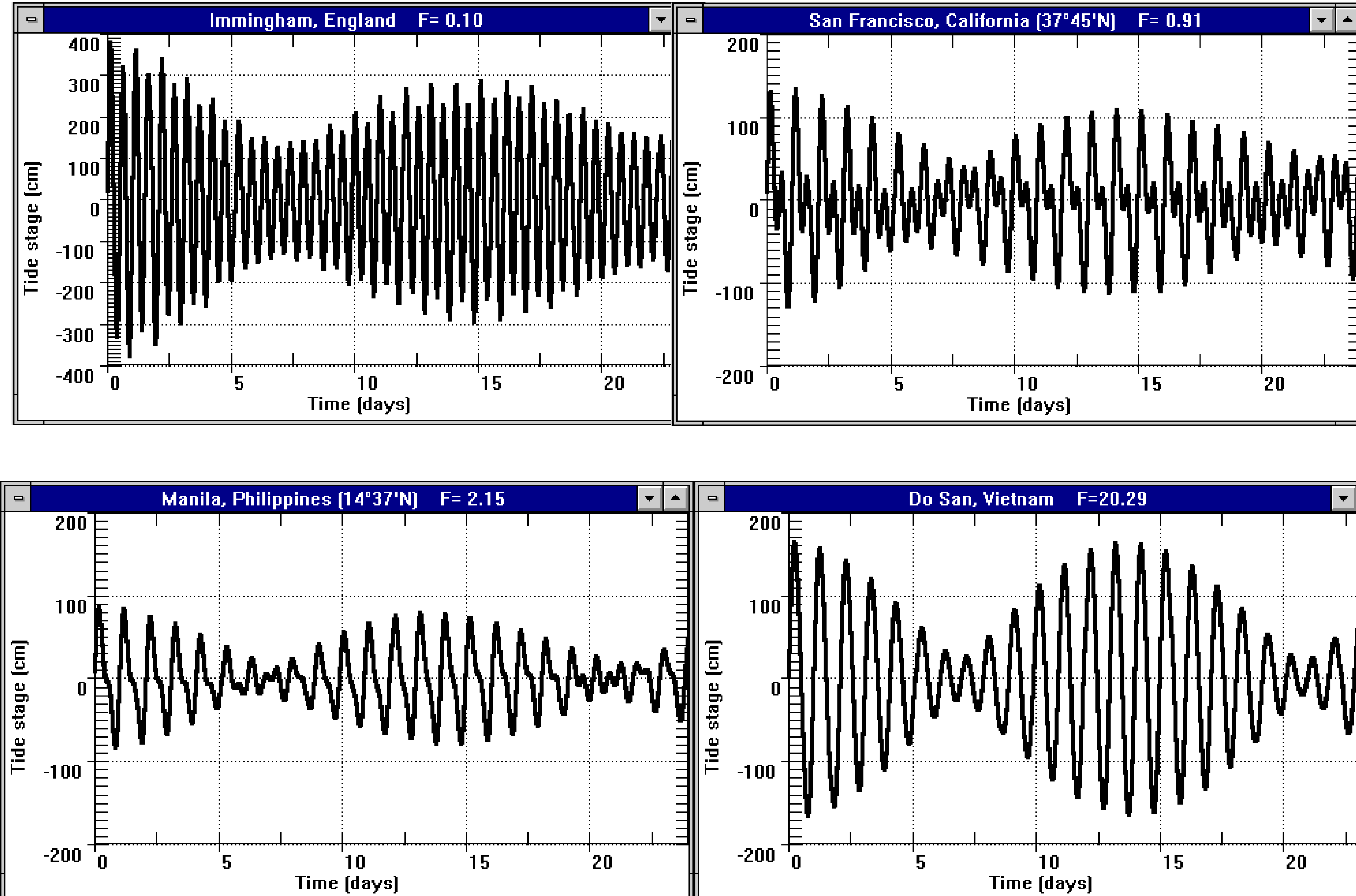
Fator de Forma $F = [K_1 + O_1] / [M_2 + S_2]$

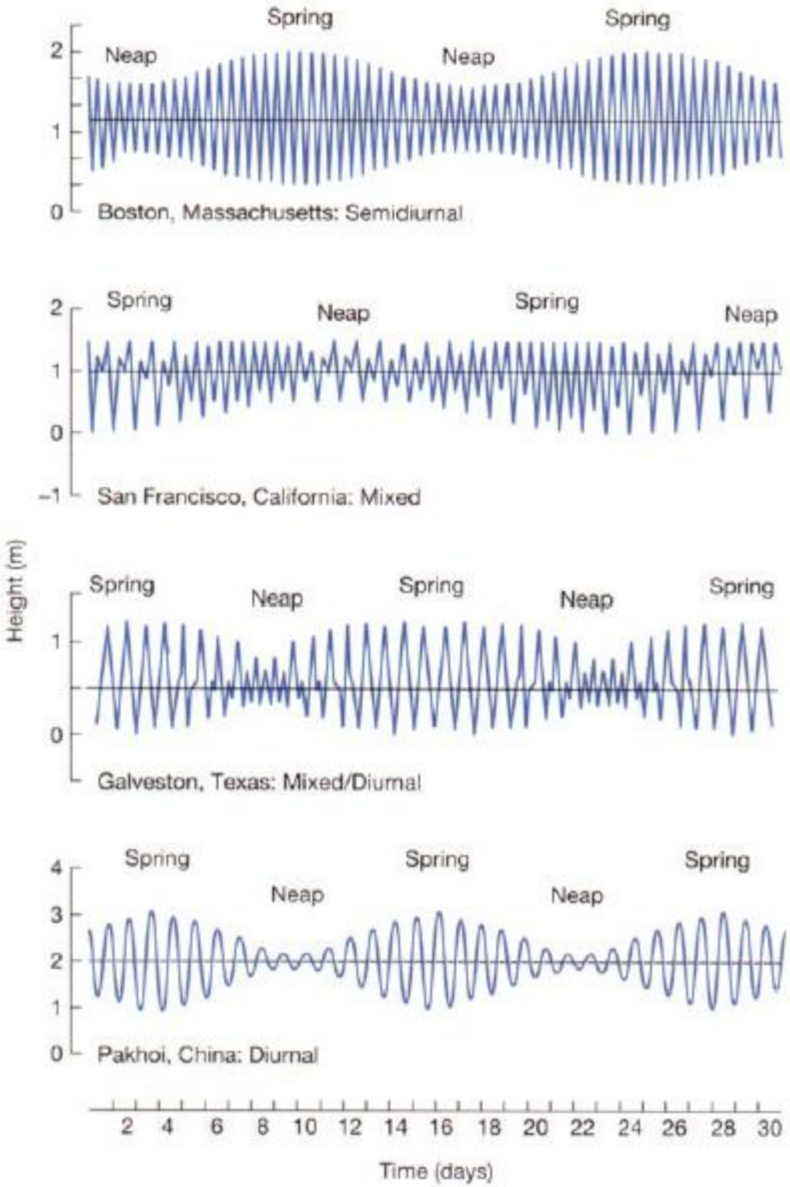
$F < 0.25$ SD

$0.25 < F < 1.25$ Mista com predominância SD

$1.25 < F < 3.00$ Mista com predominância D

$F > 3$ D

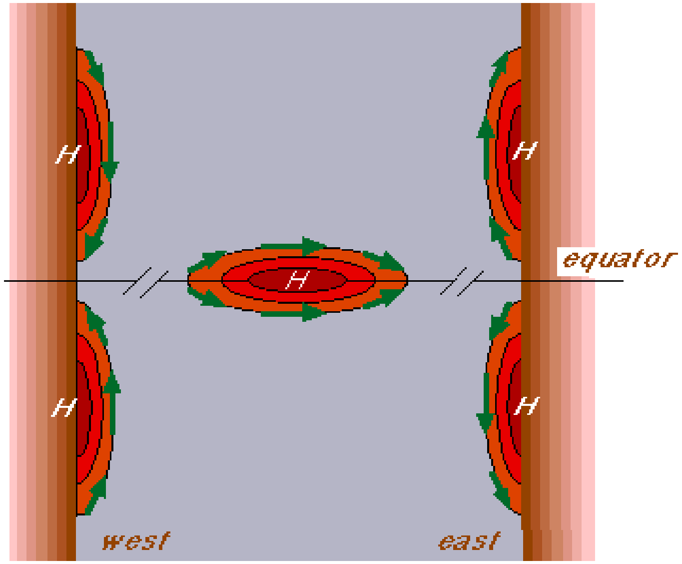

Immingham, England F= 0.10
Tide stage (cm)
400
300
200
100
0
-100
-200
-300
-400
0
5
10
15
20
Time (days)
San Francisco, California (37°45'N) F= 0.91
Tide stage (cm)
200
100
0
-100
-200
0
5
10
15
20
Time (days)
Manila, Philippines (14°37'N) F= 2.15
Tide stage (cm)
200
100
0
-100
-200
0
5
10
15
20
Time (days)
Do San, Vietnam F=20.29
Tide stage (cm)
200
100
0
-100
-200
0
5
10
15
20
Time (days)



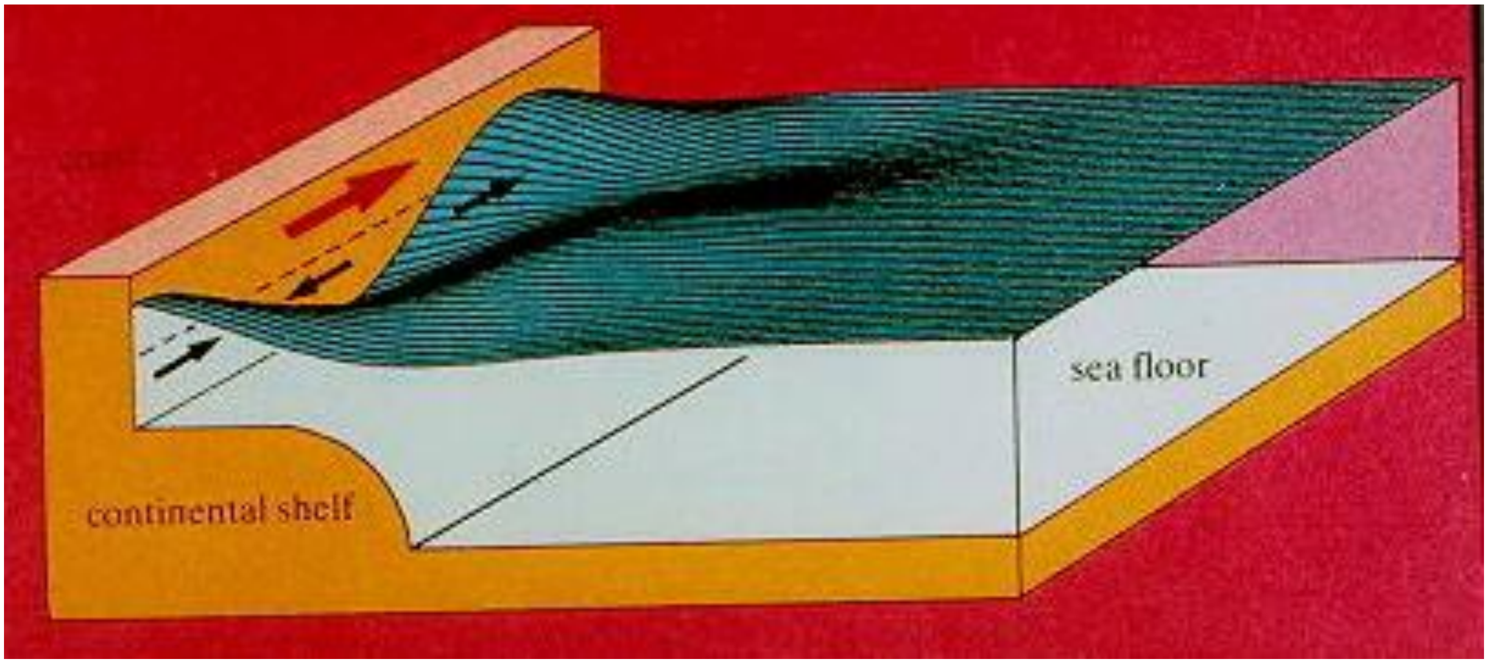
Sobreposição de constituintes gera modulações: bi-semanais, mensais

Tanto para nível como para velocidade

Propagação de onda Kelvin



The movement of high and low pressure centres along the coast is known as a **Kelvin wave**. Kelvin waves have their largest amplitude at the coast. On the western coast of an ocean they can only propagate towards the equator, while on the eastern coast they propagate only away from it. Their amplitude falls off rapidly (exponentially) towards the open ocean, so their presence is only felt within a narrow strip of less than 100 km width along the coast. Their period is in the range of several days to a few weeks, which means that they manifest themselves through slow changes of water level and a reversal of the inshore current at a rate of once a week or so, as successive regions of high and low pressure pass the observation point .



sea floor
continental shelf

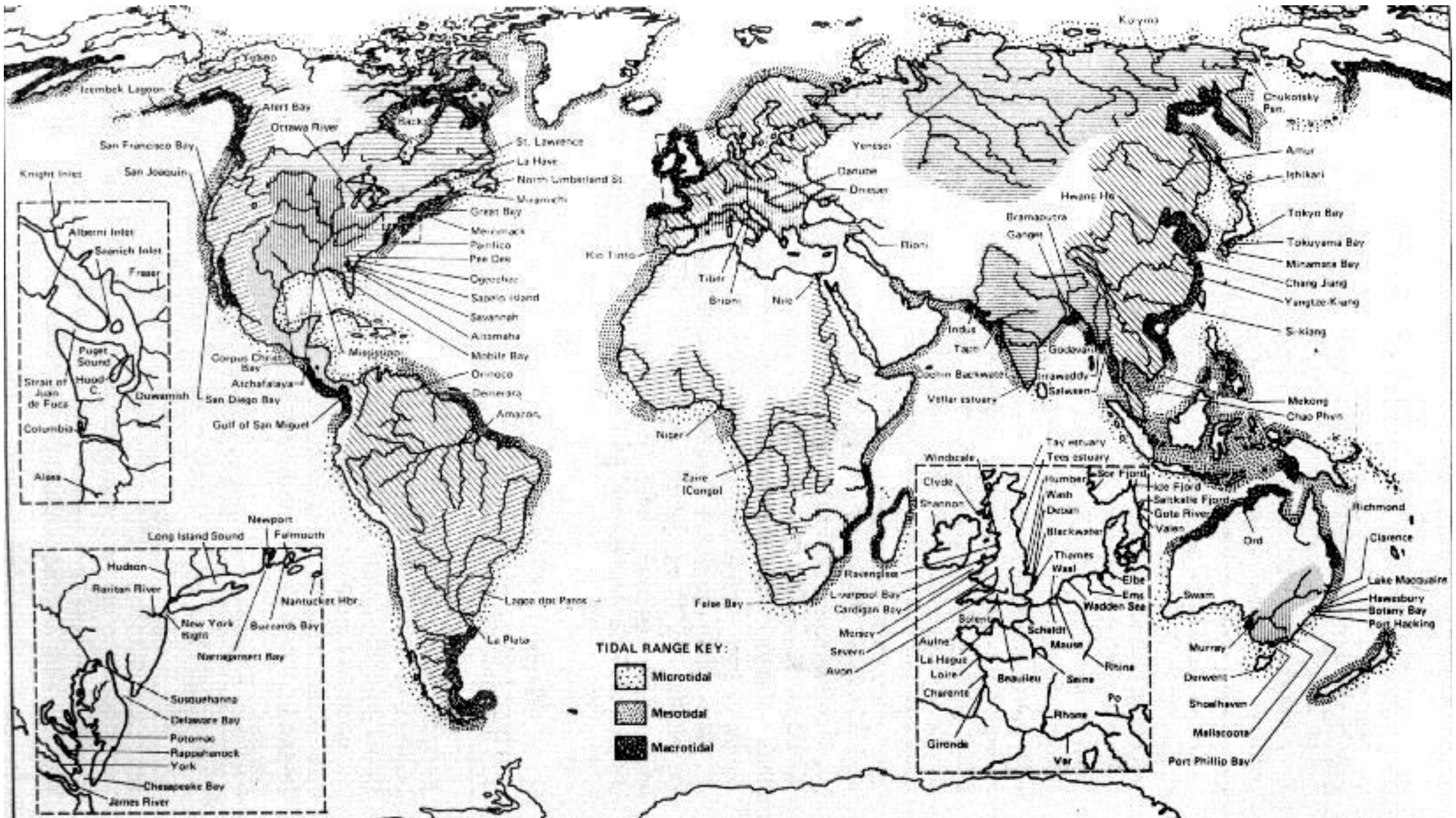
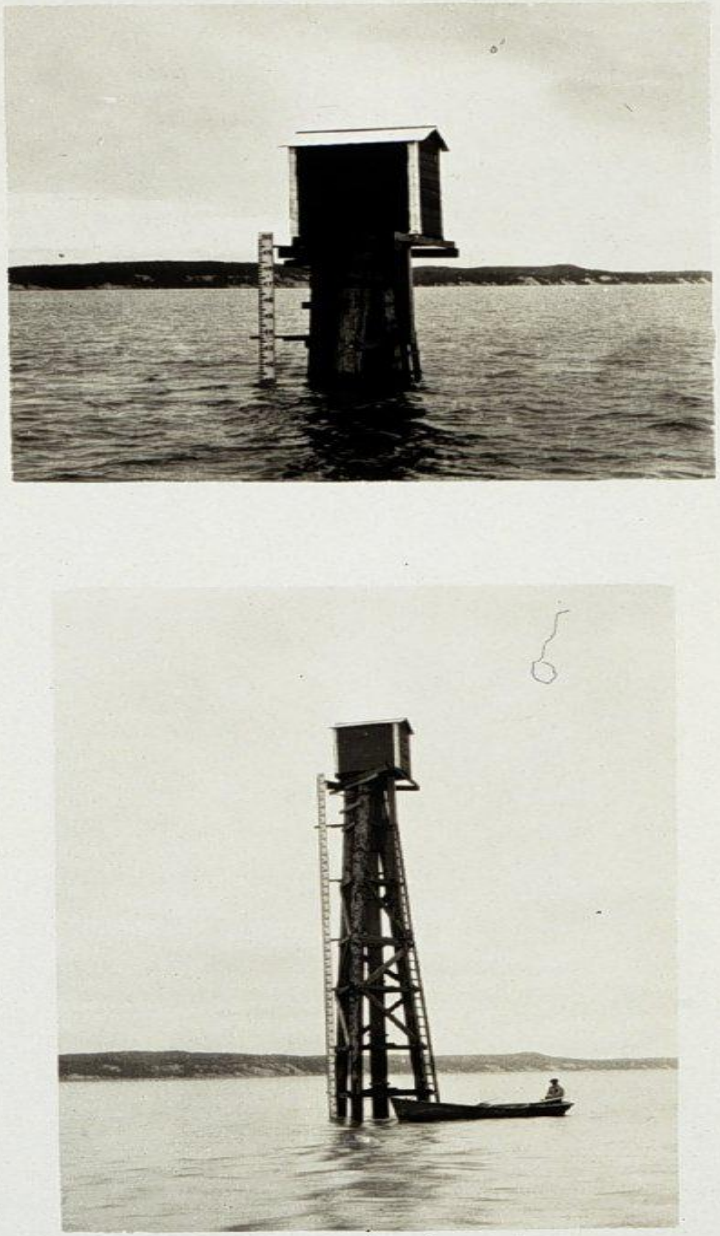


Figure 2-3. Major estuaries of the world and related deltas and bays with estuarine characteristics, (from Olausson and Cato, 1980). Hachured areas on continents represent major drainage basins. Modified and reproduced with permission of John Wiley and Sons.



Gauge near high and low water.

Marés podem ser grandes

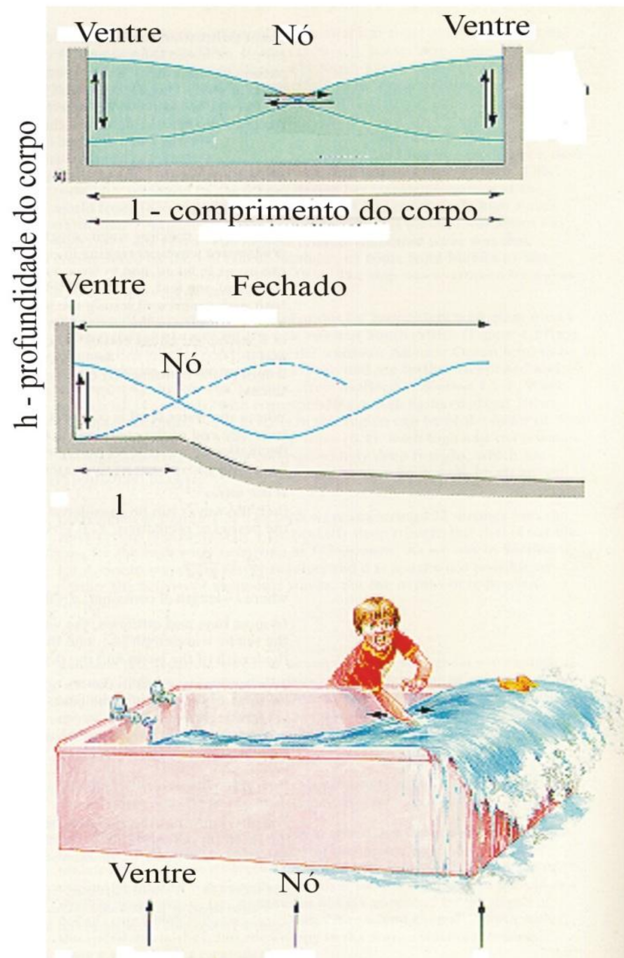
>15 m

Oscilações Naturais - Ressonância (Seiches)

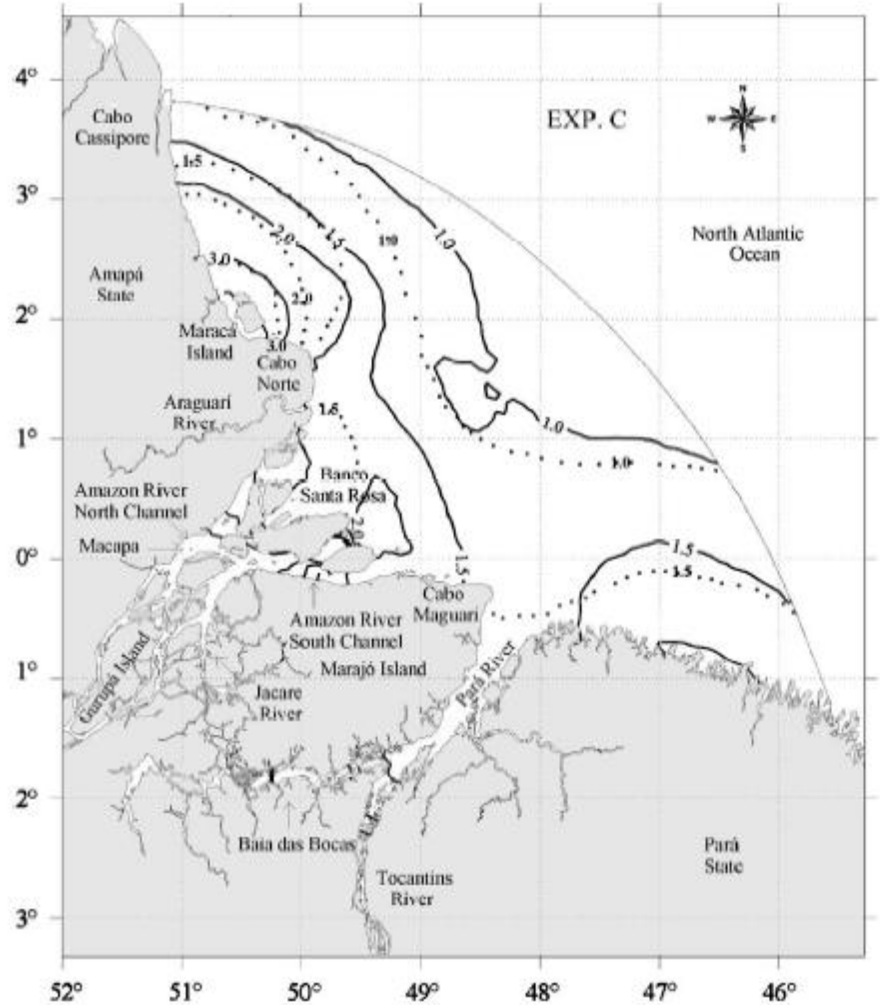
Lei de Merian

$T = 2l / n\ (gh)^{1/2}$ - corpos fechados
$T = 4l / n\ (gh)^{1/2}$ - corpos abertos

Aberto



Veneza
Baía de Fundy - 15 m
Amazonas
Baía de São Luís - 7 m



ig. 3. The M_2 amplitude simulated in the experiment C (solid lines), and given by Beardsley et al. (1995) (dotted lines).

M. Gabioux et al.2005

Frentes de maré

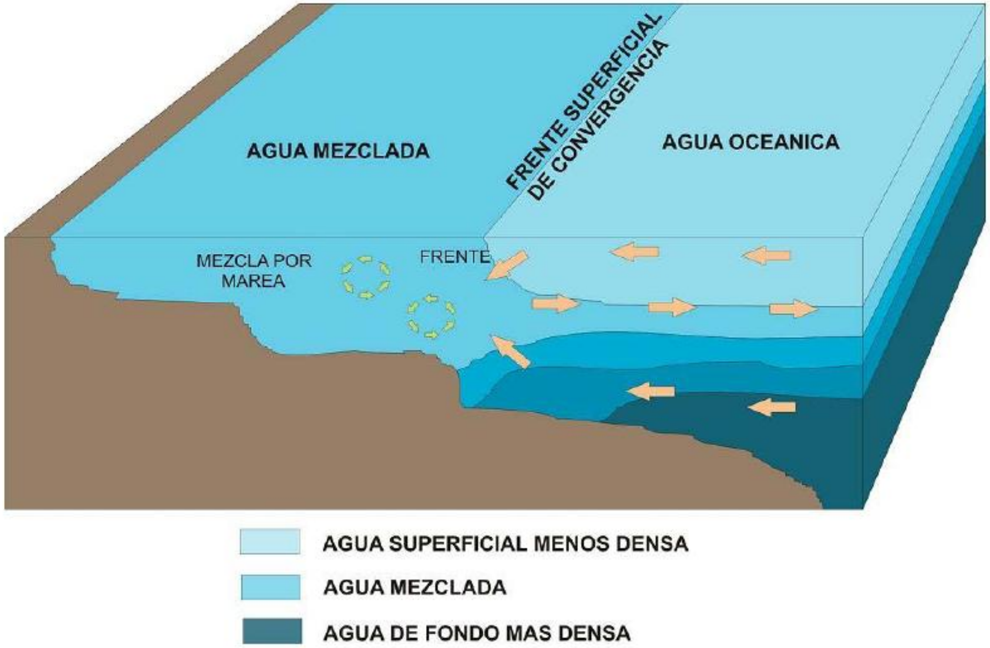


Figura 2-14 Representación esquemática de un frente de marea

Efeito de topografia

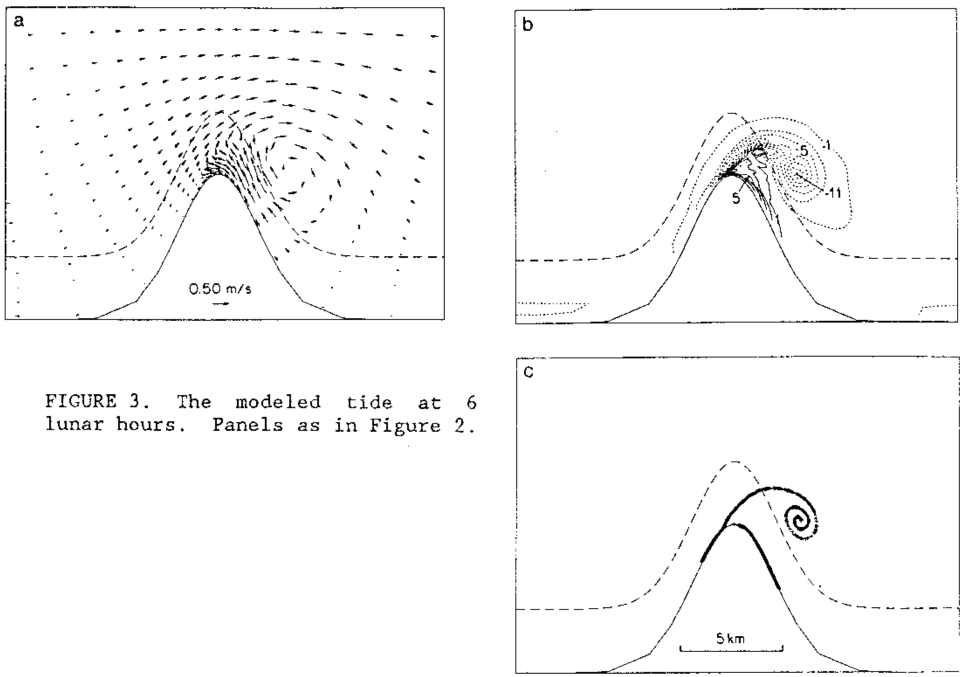


FIGURE 3. The modeled tide at 6 lunar hours. Panels as in Figure 2.

Correntes geradas por vento

- Fricção – tensão de cisalhamento
- Modelo de Ekman
- Camada de Ekman
- Efeito do fundo – camada de Ekman de fundo
- Camada limite

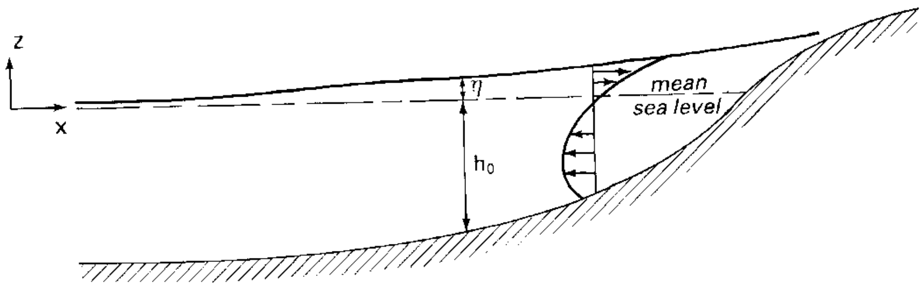


Fig. 8.49, Wind-induced circulation and set-up of water level near coast

$$\frac{\partial \tau_{xz}}{\partial z} - \rho g \frac{\partial \eta}{\partial x} = 0$$

$$\tau_{s,x} - \tau_{b,x} - \rho g (h_0 + \eta) \frac{\partial \eta}{\partial x} = 0$$

$$\tau_{s,x} = \rho_a C_d W_{10,x} \, | W_{10,x} |$$

$$\tau_{b,x} = (1 - \alpha) \tau_{s,x}$$

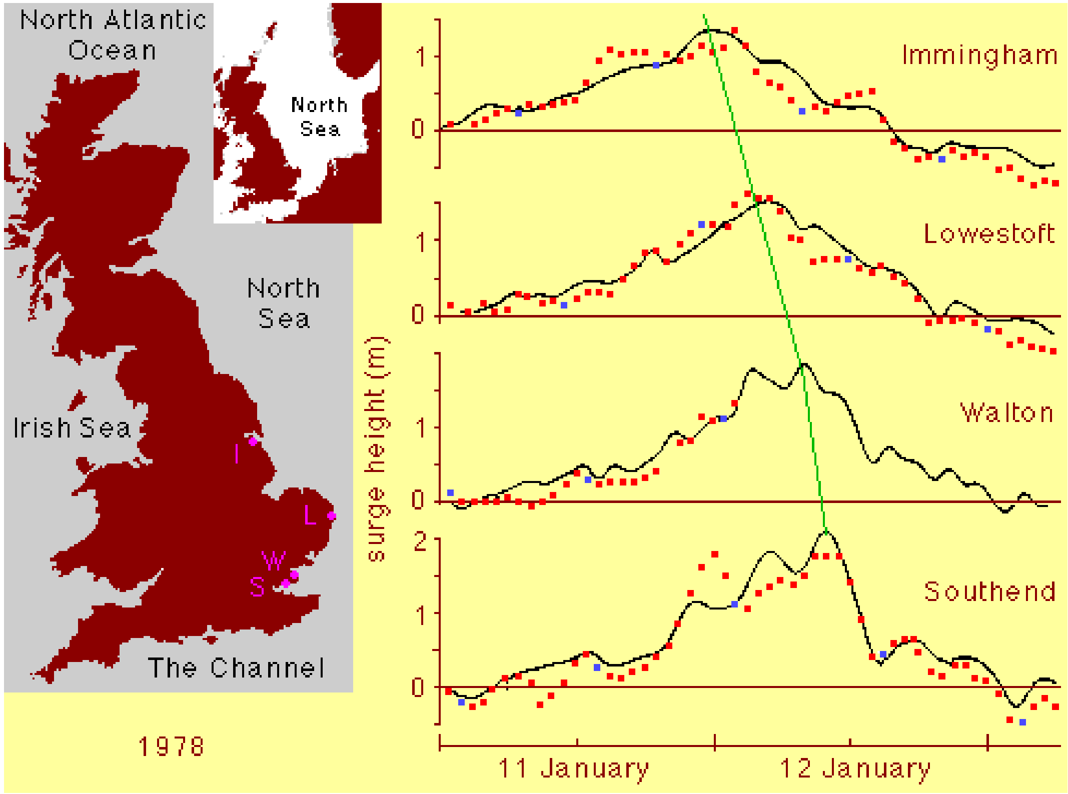
$$\frac{\partial \eta}{\partial x} = \frac{\alpha \tau_{s,x}}{\rho g (h_0 + \eta)}$$

$$\frac{\eta}{h_0} = -1 + (1 + 2ax / L)^{0.5}$$

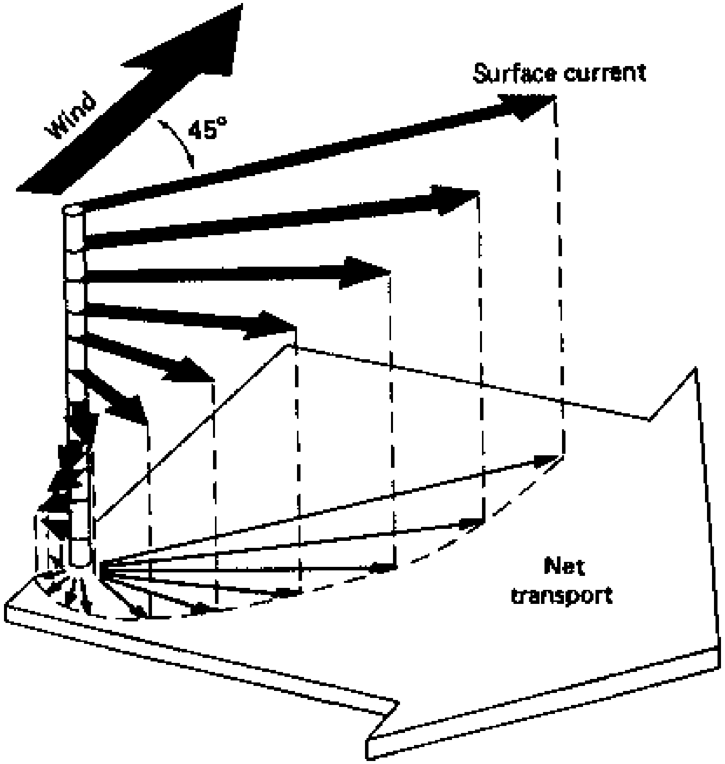
$$a = \alpha \tau_{s,x} L / \rho g h_0^2)$$

$$\alpha = 1.2$$

Storm surge


North Atlantic Ocean
North Sea
North Sea
Irish Sea
I
L
W
S
The Channel
1978
surge height (m)
Immingham
Lowestoft
Walton
Southend
0
1
2
11 January
12 January

Modelo de Ekman



Price et al. 1987. Wind driven ocean currents and Ekman transport. **Science** 238, 1534-1538

Stacey et al. (1986. A wind forced Ekman spiral as a good statistical fit to low-frequency currents in a coastal strait. ***Science*** 233, 470-472

Modelo de Ekman

- Equilíbrio entre FCoriolis e tensão do vento
- Oceano sem bordas e profundidade ilimitada
- Gradiente de pressão nulo
- Vento constante
- Termo de turbulência constante

f – termo de Coriolis

Kz Coef. de difusão turbulenta
 - 1.3 -1.5x10^{-3} m^{2}s^{-1}
Vo – velocidade na superfície
De- espessura da camada de Ekman

W – velocidade do vento
U, v – velocidades em x e y

$$fv = K_z \frac{\partial^2 u}{\partial z^2}$$

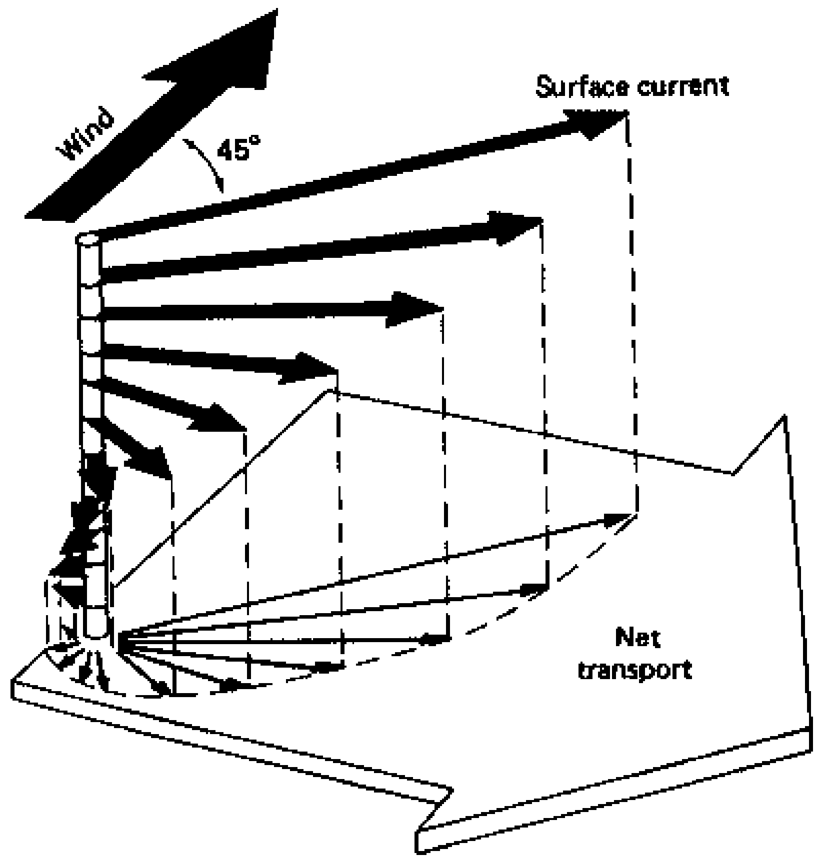
$$fu = -K_z \frac{\partial^2 v}{\partial z^2}$$

$$u = +/- V_0 \cos\left(\frac{\pi}{4} + \frac{\pi z}{D_e}\right)\exp\left(-\frac{\pi z}{D_e}\right)$$

$$v = V_0 sen\left(\frac{\pi}{4} + \frac{\pi z}{D_e}\right)\exp\left(-\frac{\pi z}{D_e}\right)$$

$$D_e = \frac{4.3W}{\sqrt{sen|\phi|}}$$

$$V_0 = \frac{0.013W}{\sqrt{sen|\phi|}}$$


Wind
45°
Surface current
Net
transport

Transporte

$$M_x = \frac{\tau_y}{\rho f}$$

$$M_y = -\frac{\tau_x}{\rho f}$$

$$w_e = \frac{1}{\rho}\left(\frac{\partial \tau_y}{\partial x} - \frac{\partial \tau_x}{\partial y}\right)$$

Rotacional do vento

Ekman pumping

Rot>0 - divergência

Some major historical storm surges			
Date	Shelf region	Estimated maximum surge height	Estimate of lives lost
November 1218	Zuider Zee (Dutch North Sea)	unknown	100,000
October 1737	India and Bangladesh	12 m	300,000
1864	Bangladesh	unknown	100,000
October 1876	Bangladesh	15 m	100,000
1897	Bangladesh	unknown	175,000
September 1900	Galveston, Texas (Gulf of Mexico)	4.5 m	6000
Jan/Febr 1953	Southern North Sea	3.0 m	2000
March 1962	Atlantic coast, USA	2.0 m	32
November 1970	Bangladesh	9.0 m	500,000

Hemisfério Sul - Divergência e Convergência Costeira

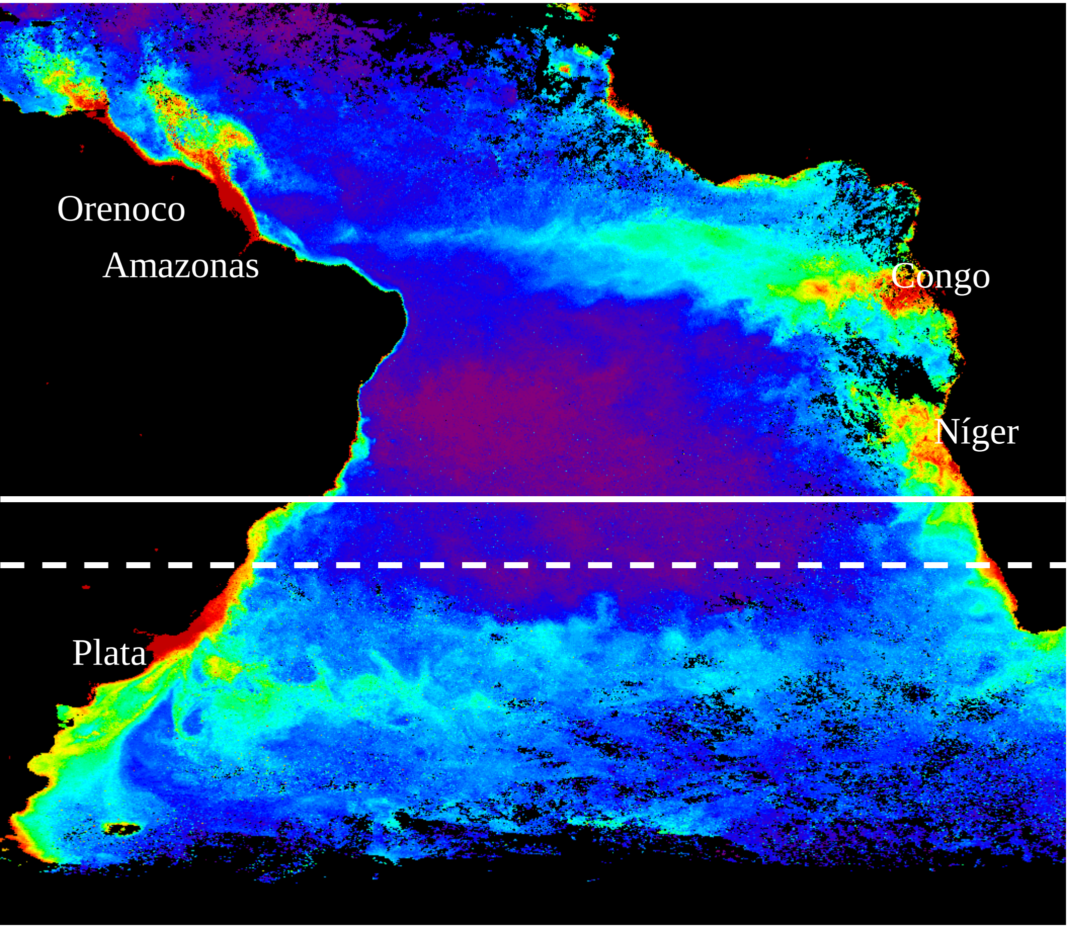
a

Ressurgência Costeira (Upwelling)

b

Subsidência Costeira (Downwelling)

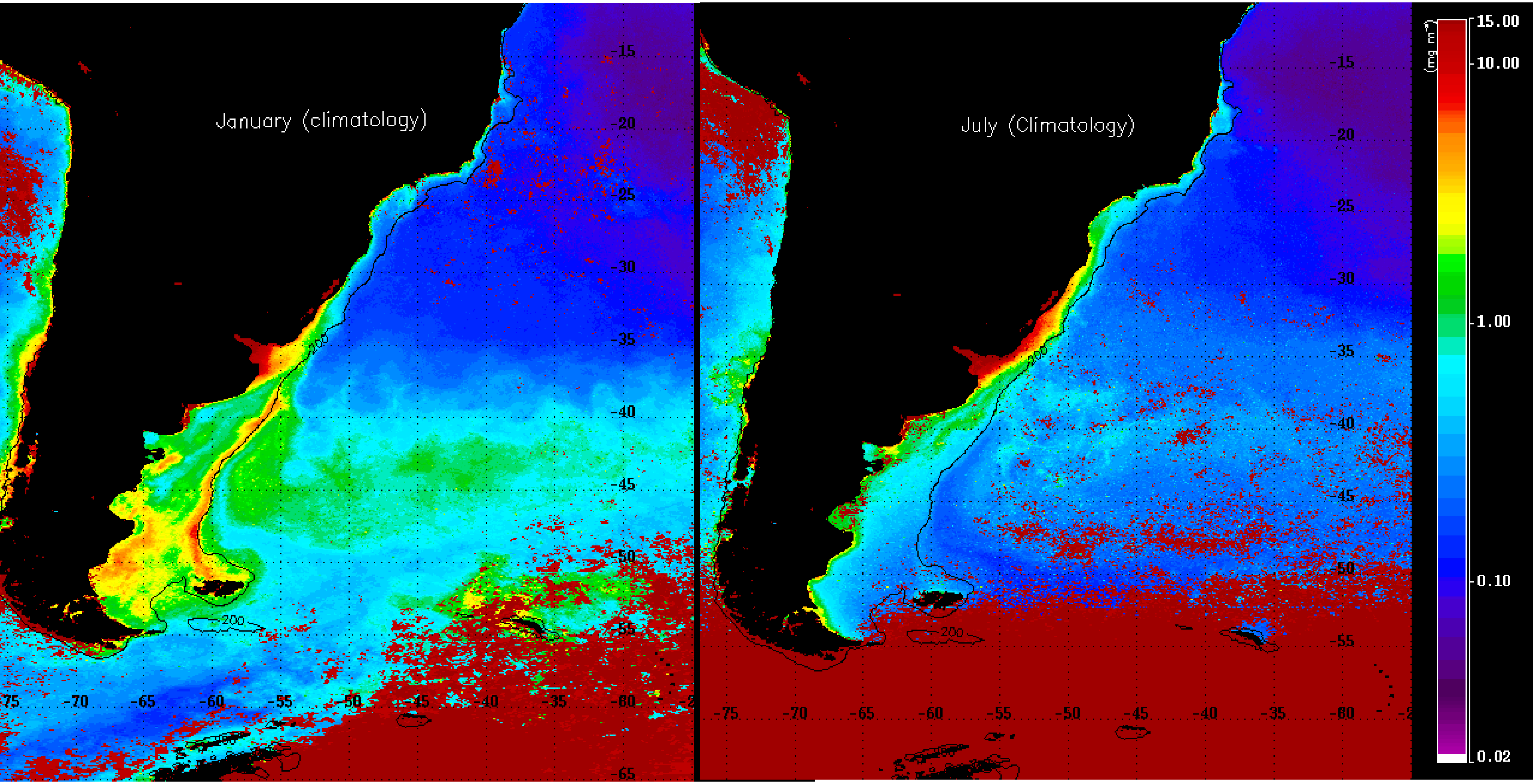
As águas do sul do Brasil, em que são diferentes das do resto do país?



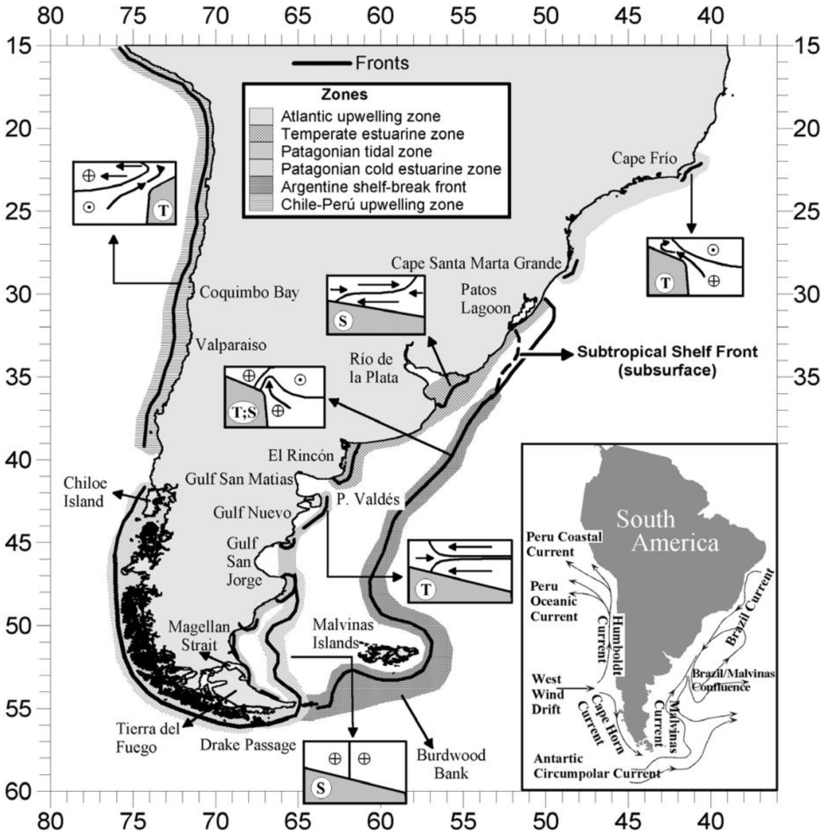
- Clima regional: subtropical
- Pouca influência das marés (a ~0.3 m)
- Regime de ventos: NE/SW
  - NE – primavera/verão
  - SW - mais frequentes no outono/inverno – frentes
  - variabilidade interanual
- Presença de rio de grande caudal – Plata
- Influência de águas subantárticas da plataforma argentina;
- Presença de duas frentes;
- Zona de ressurgência estacional
- Região de alta produção pesqueira;

Clorofila por Satélite

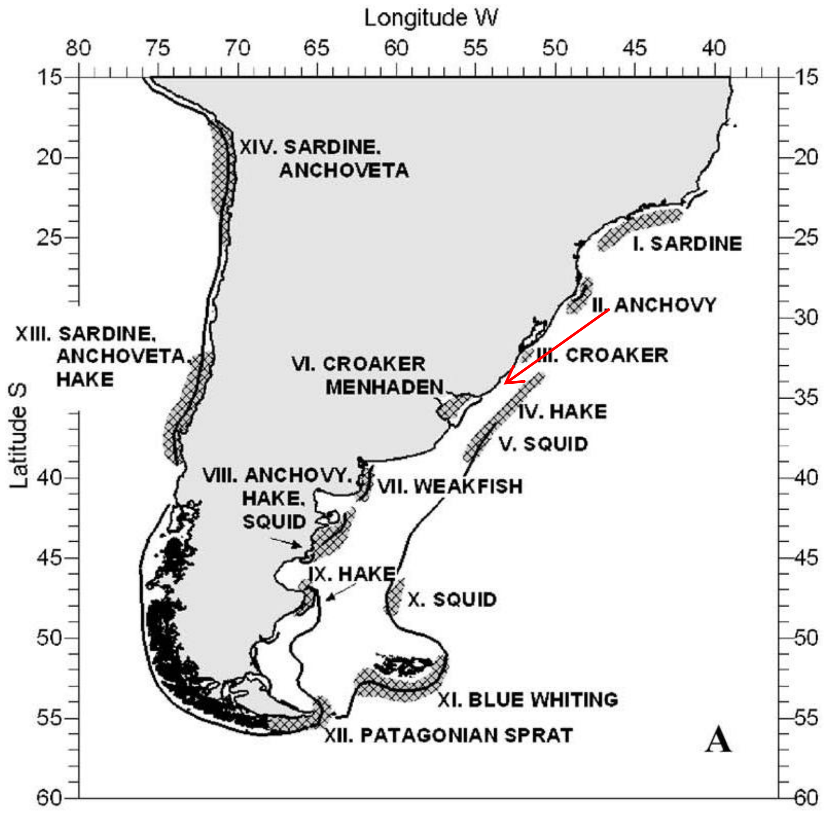
Romero (2008)



As frentes



Acha et al. (2004)



As frentes

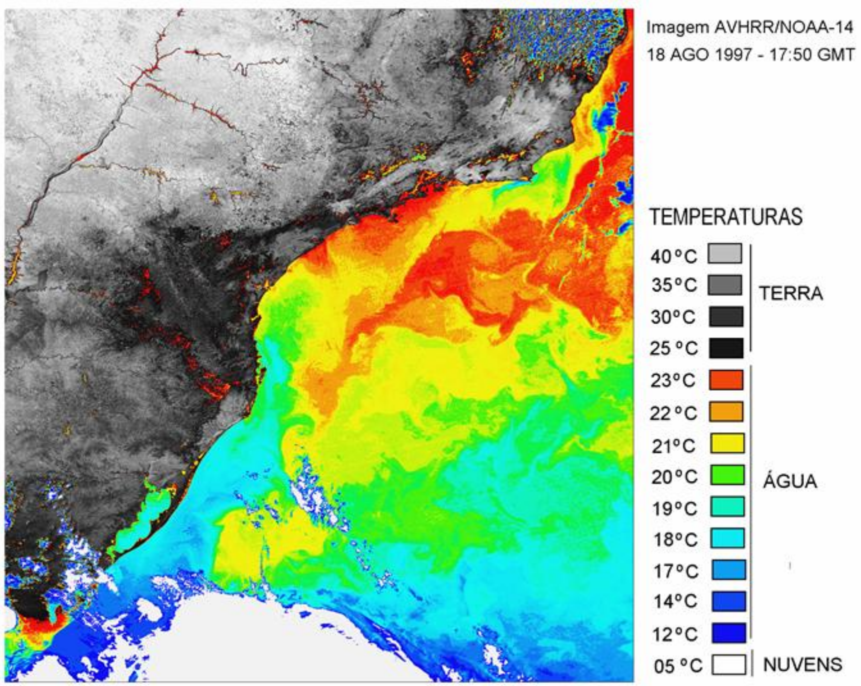


Imagem AVHRR/NOAA-14
18 AGO 1997 - 17:50 GMT
TEMPERATURAS
40°C
35°C
30°C
25°C
TERRA
23°C
22°C
21°C
20°C
ÁGUA
19°C
18°C
17°C
14°C
12°C
05°C
NUVENS

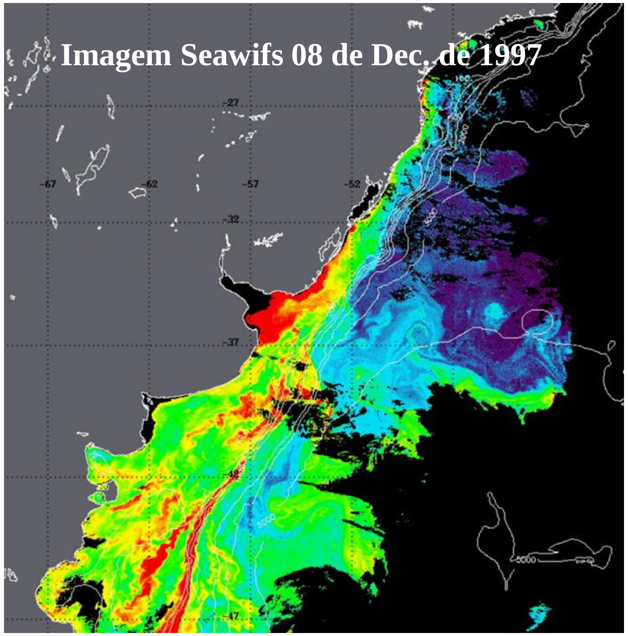
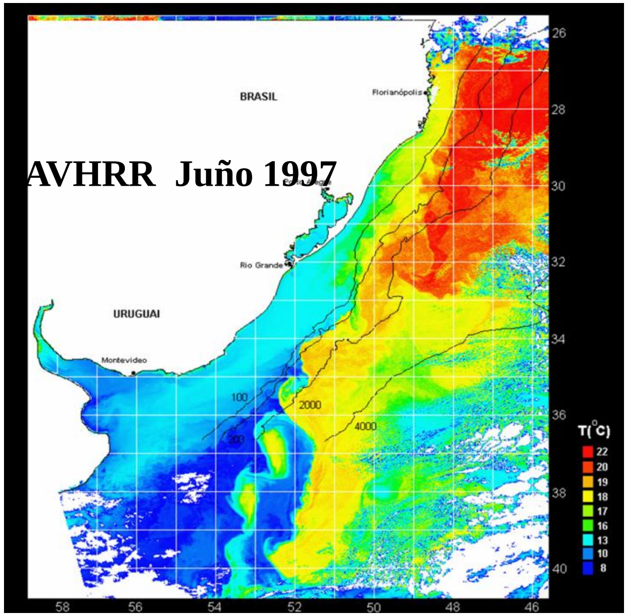


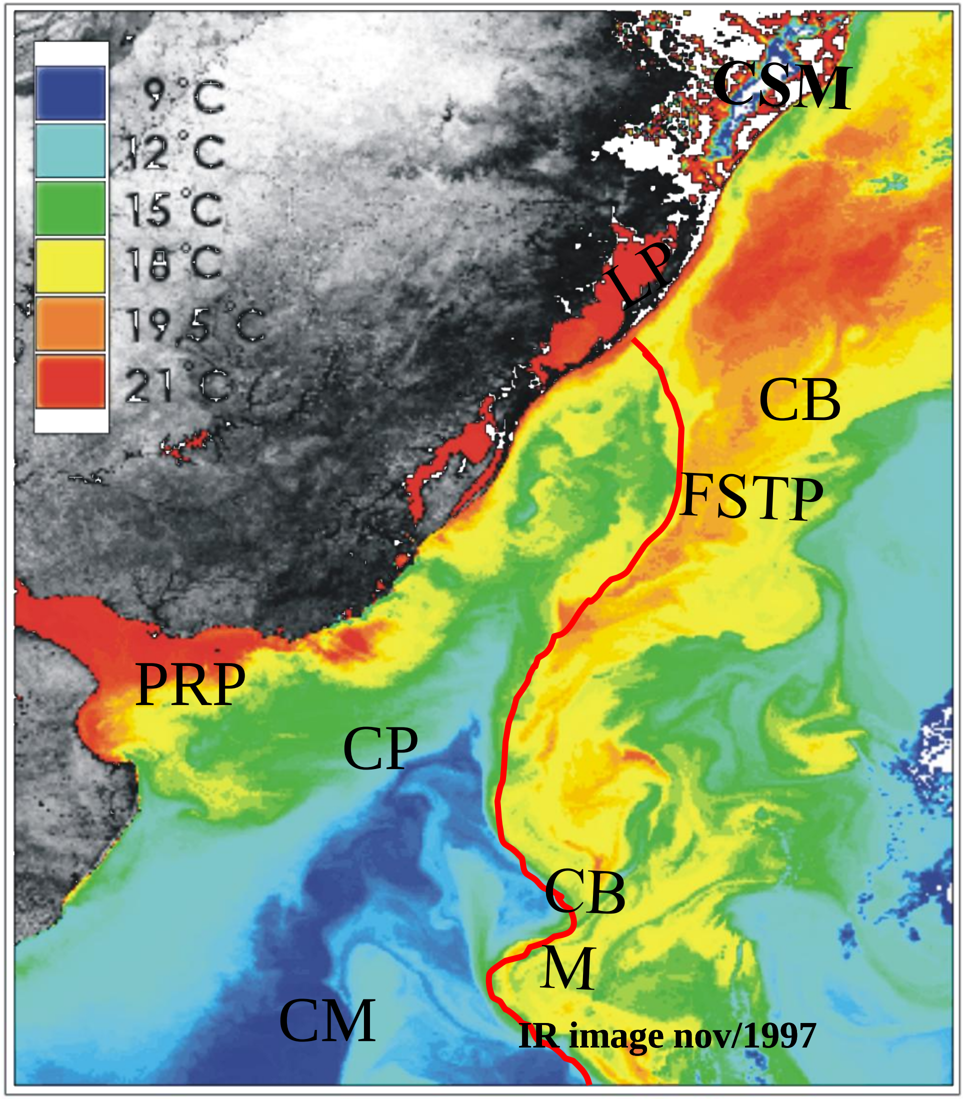
Imagem Seawifs 08 de Dec. de 1997


BRASIL
Florianópolis
AVHRR Juño 1997
Rio Grande
URUGUAI
Montevideo
100
200
2000
4000
T(°C)
22
20
19
18
17
16
13
10
8
26
28
30
32
34
36
38
40
58
56
54
52
50
48
46

Frente de Talude - Argentina

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

Correntes e massas de água



CB – Corr. Brasil – Água Tropical e Central (ACAS) – abaixo da AT e rica em Nitrato e Fosfato

CM – Corr. Malvinas – Águas Subantárticas

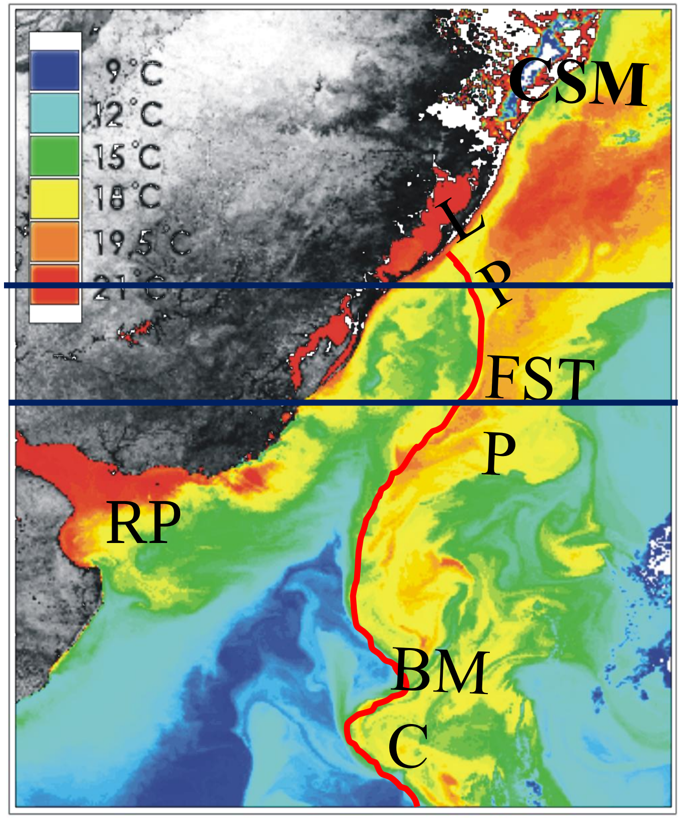
PRP – Pluma do Rio da La Prata – rica em Silicatos

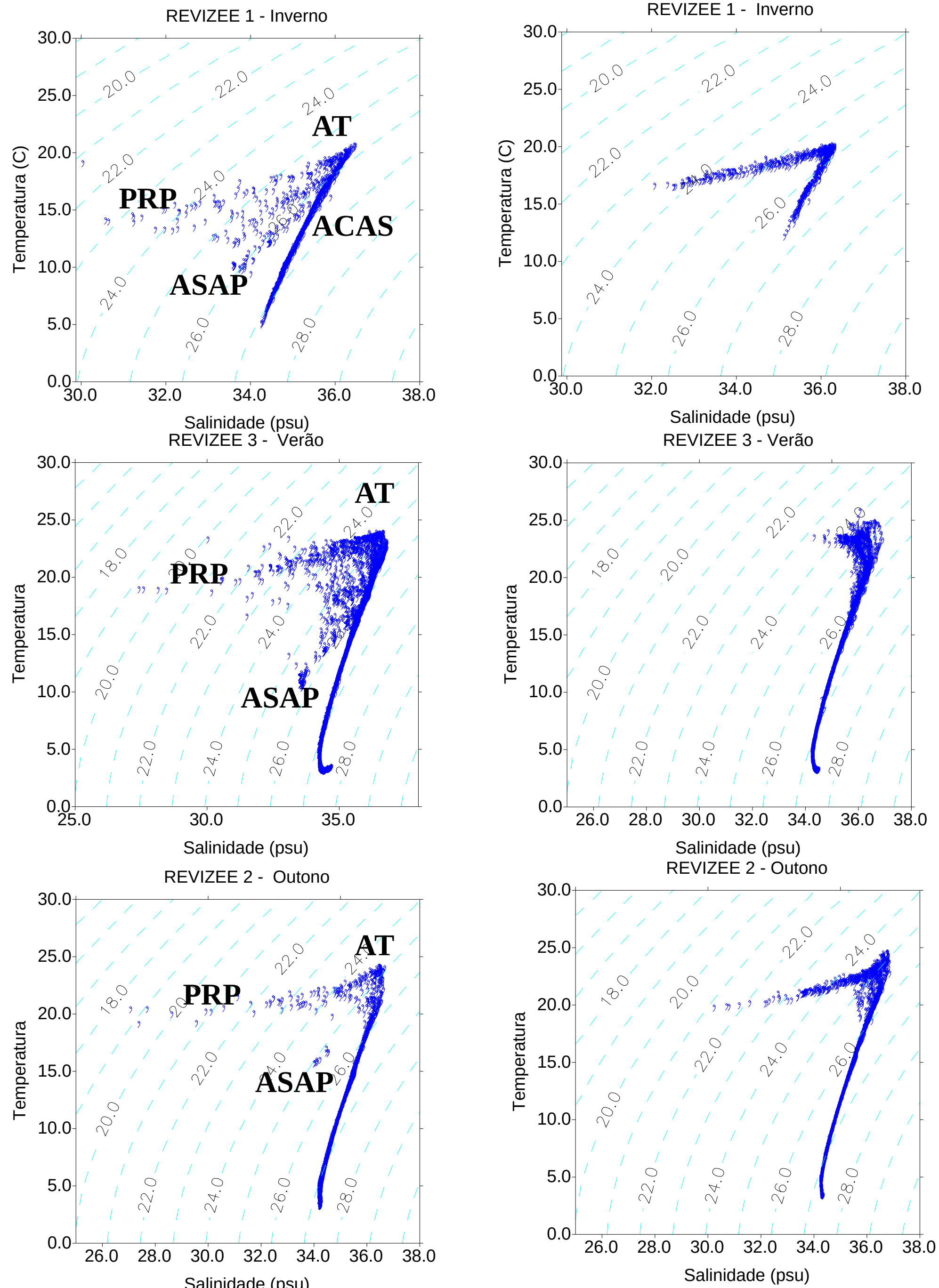
CP – Corr. Patagônia – Águas Subantárticas de Plataforma –ricas em Nitrato e Fosfato

LP – Lagoa dos Patos – Águas Costeiras – pluma sobre pluma

CBM – Confluência Brasil-Malvinas

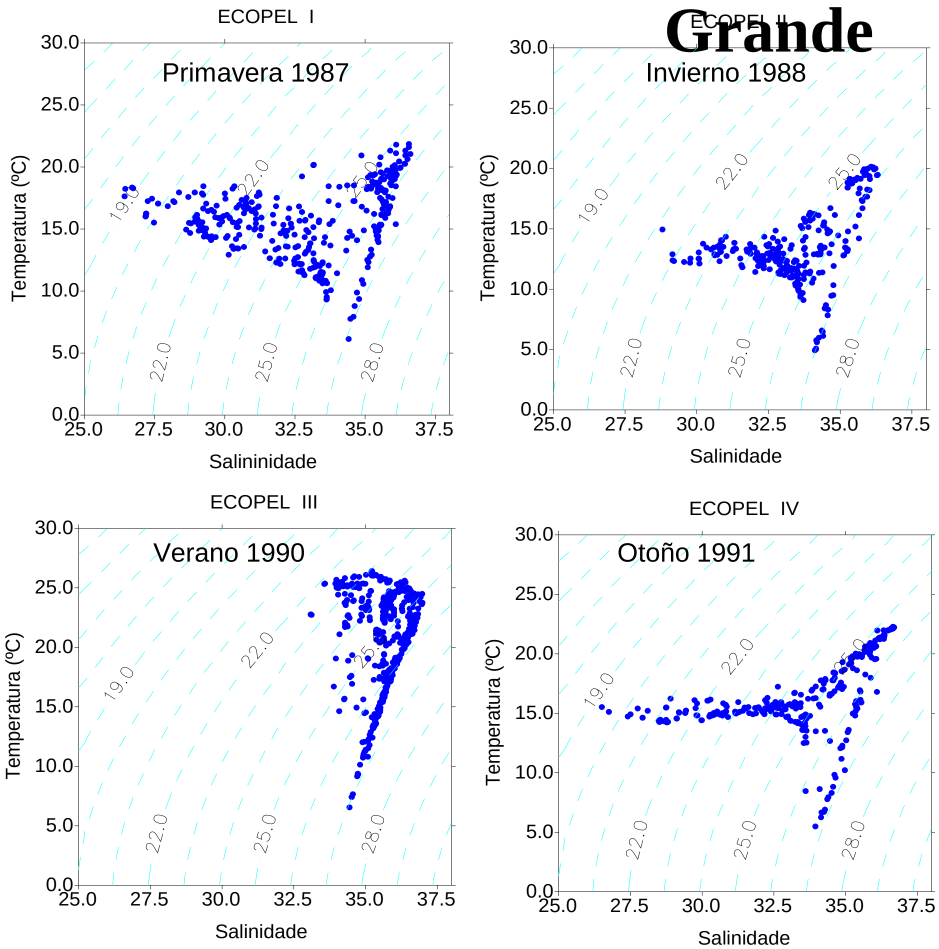
FSTP – Frente Subtropical de Plataforma





Diagramas TS
Projeto REVIZEE
Prof. > 100 m

Diagramas TS – ECOPEL –Entre Chuí e Rio Grande

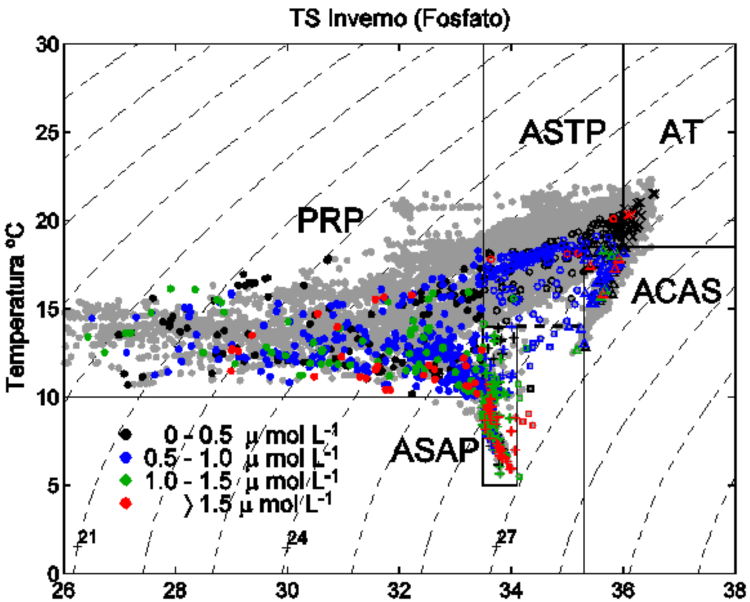


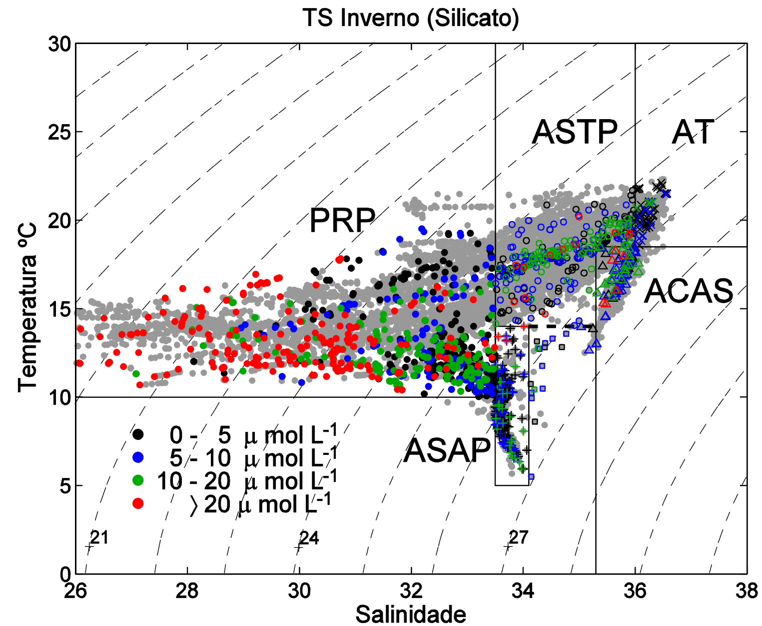
Soares y Möller (2001)

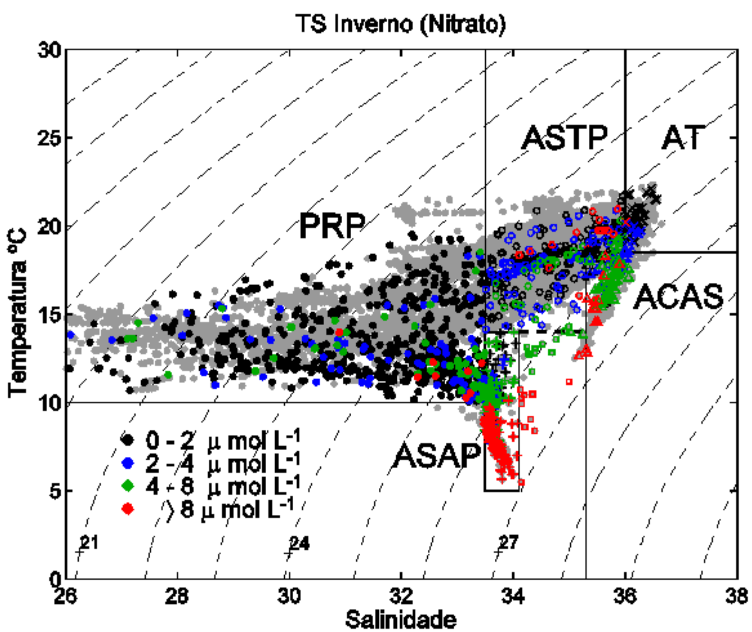
PRP – com exceção do verão está presente em todas as estações do ano.

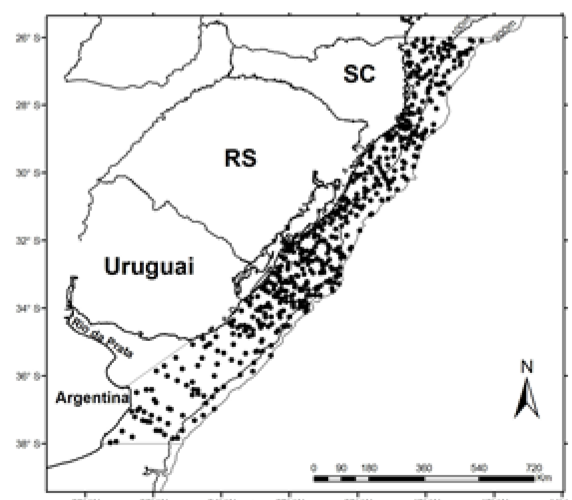
ASAP – presente em todas as estações do ano.

Diagramas TS-nutrientes para inverno



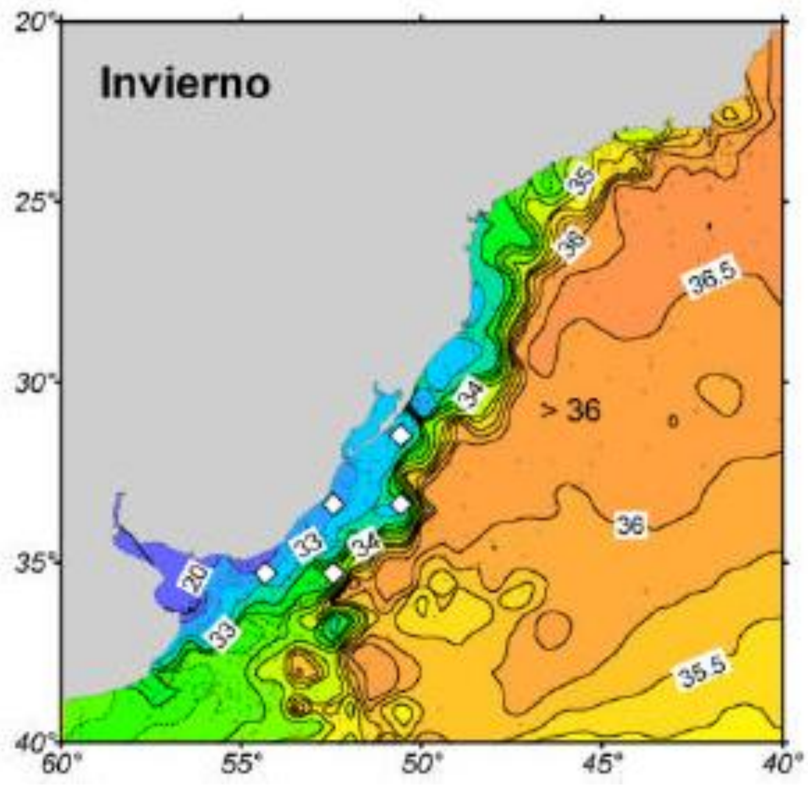


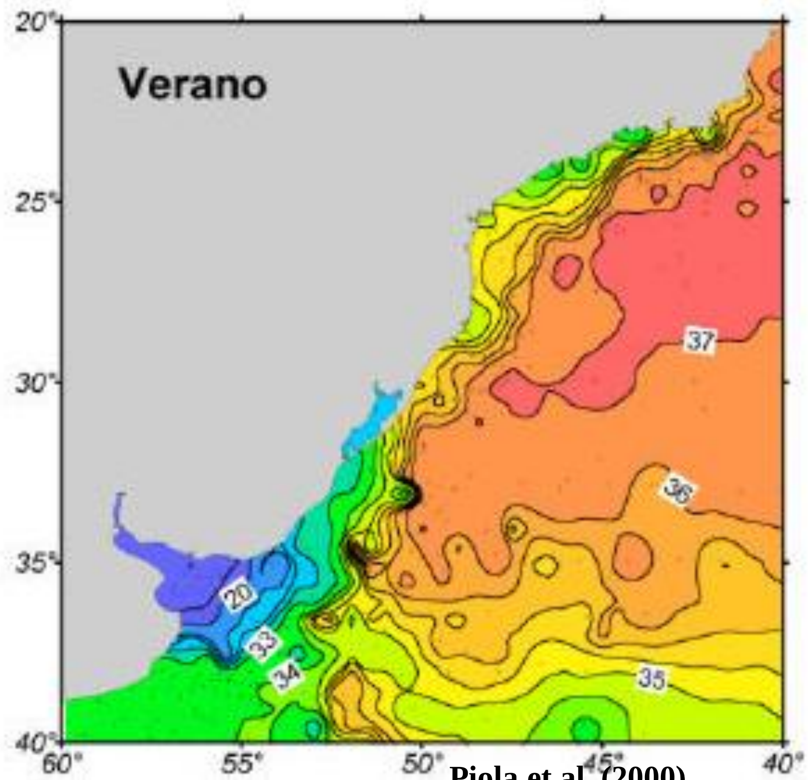




Aseff (2009)

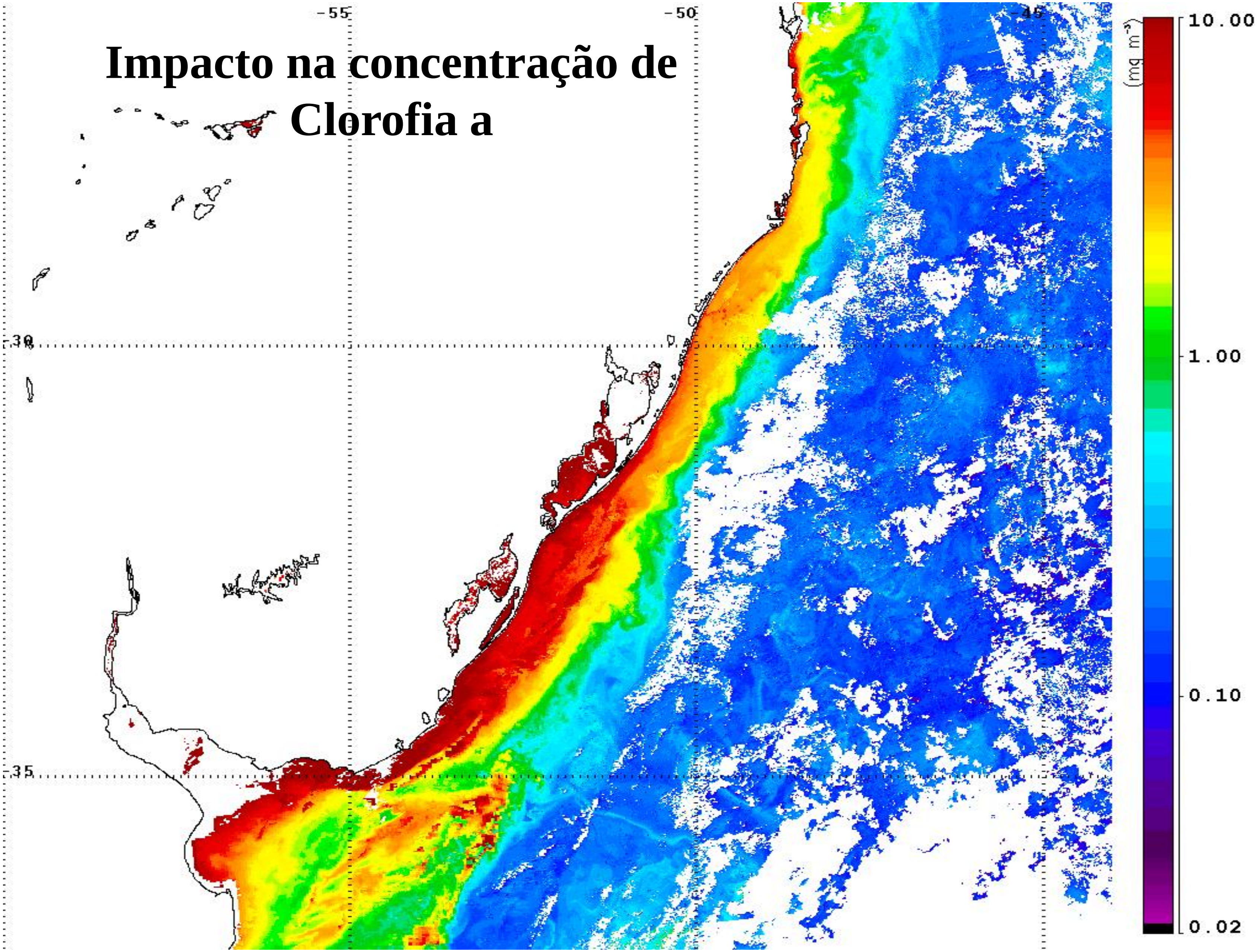
O impacto das águas do Prata: análise de dados históricos



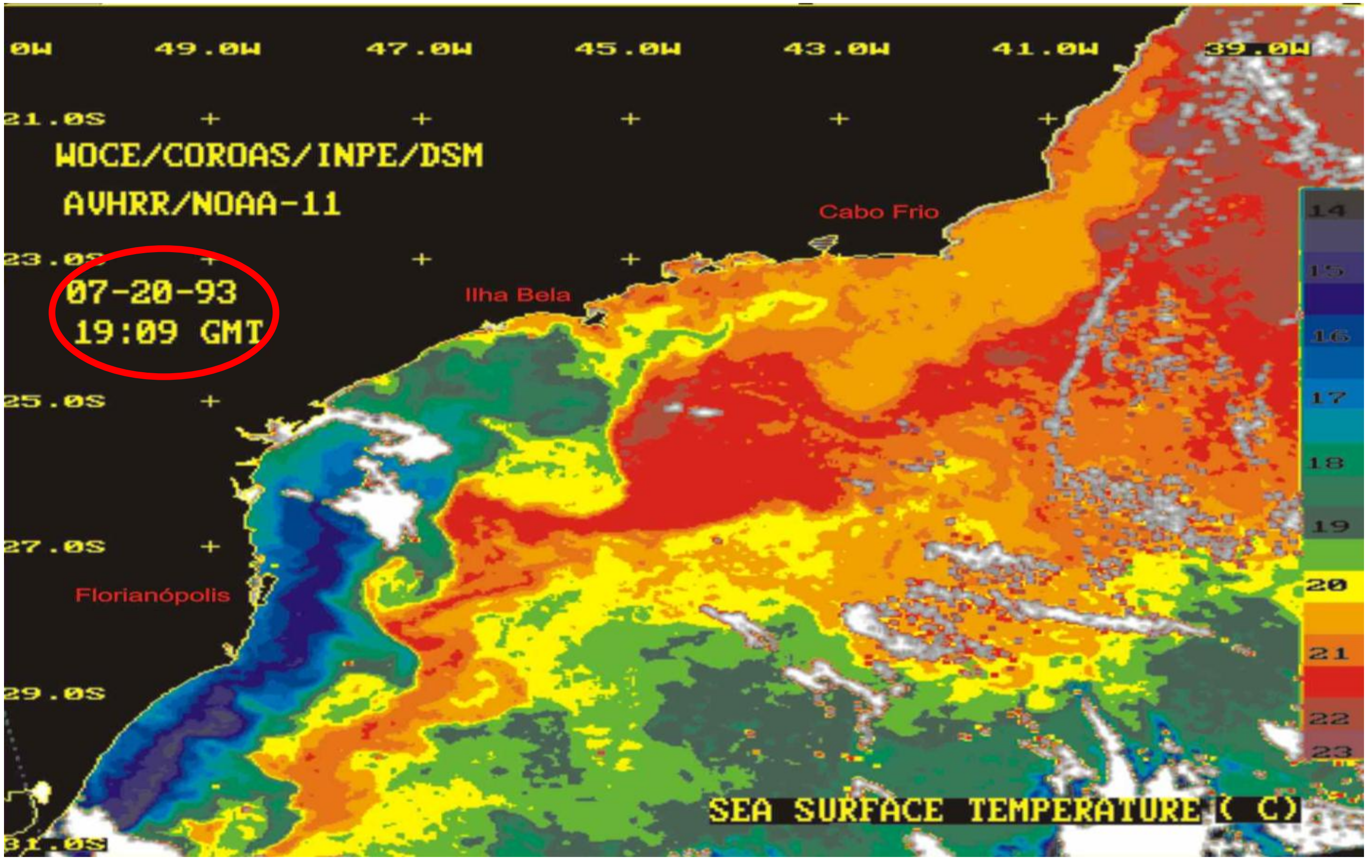


Piola et al. (2000)

Impacto na concentração de Clorofia a



Impacto na TSM



Plata Basin

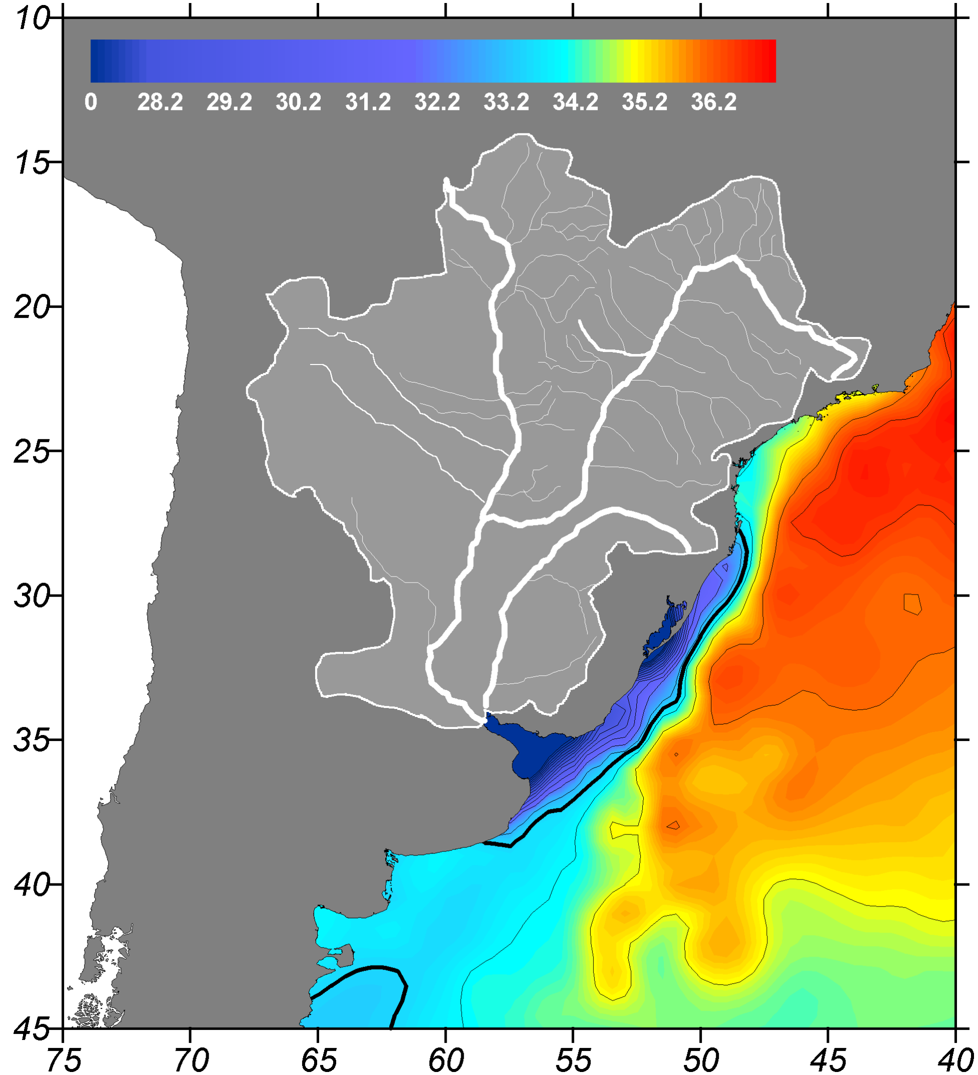
~ 3.1x10^{6} km^{2} (#5, 20% of South America)

~ 23000 m^{3}/s (#6)

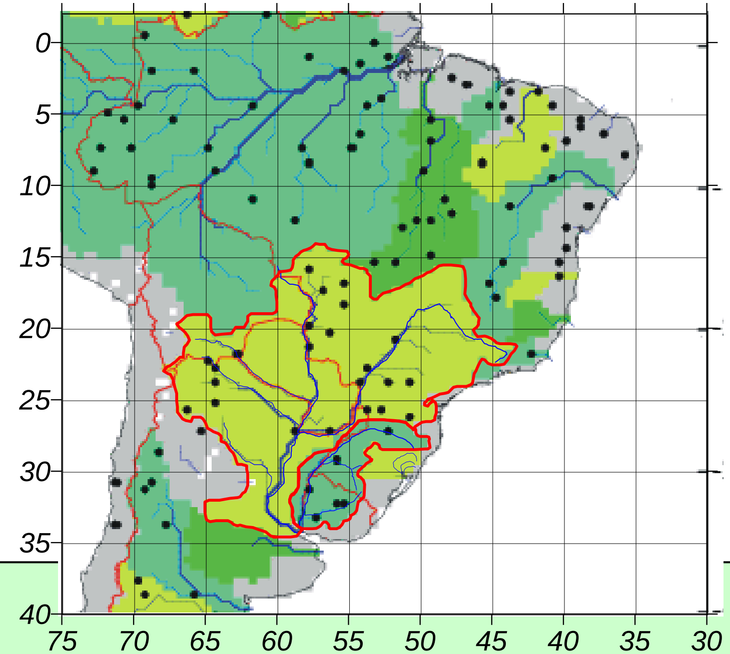
Large input source of

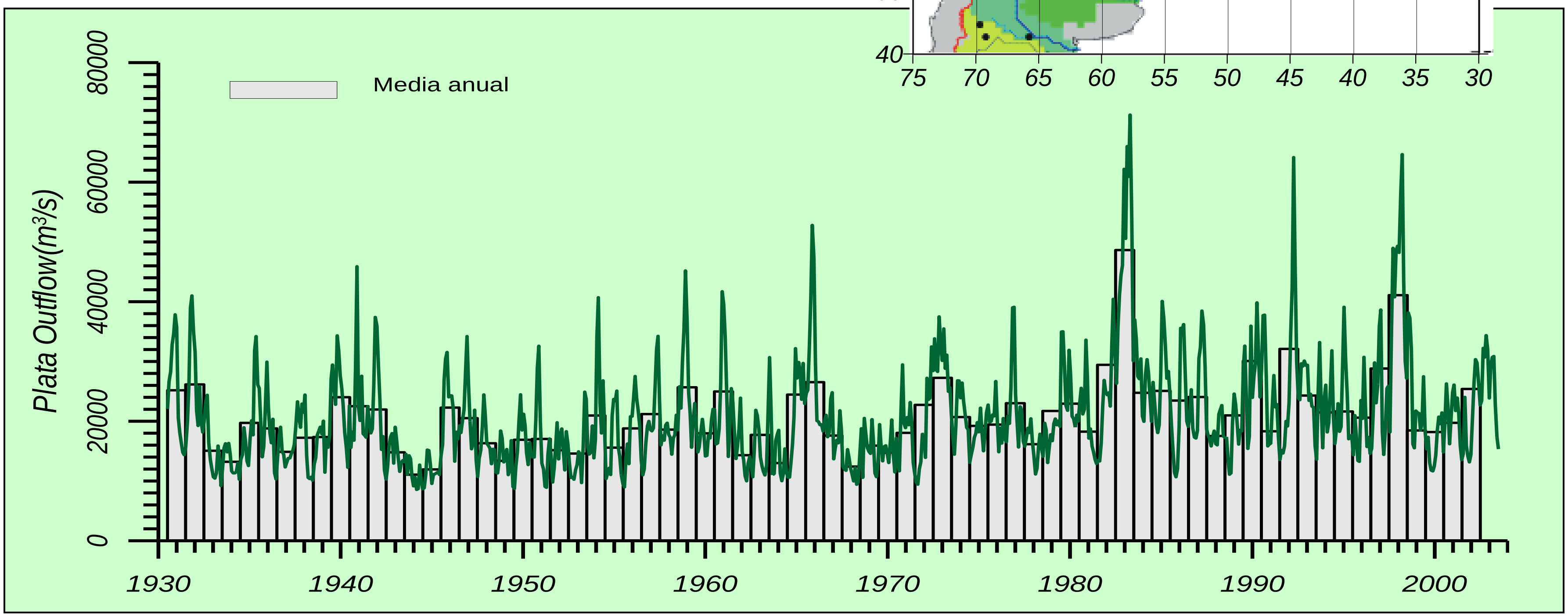
Nutrients

Suspended sediments



Bacia Hidrográfica do Prata



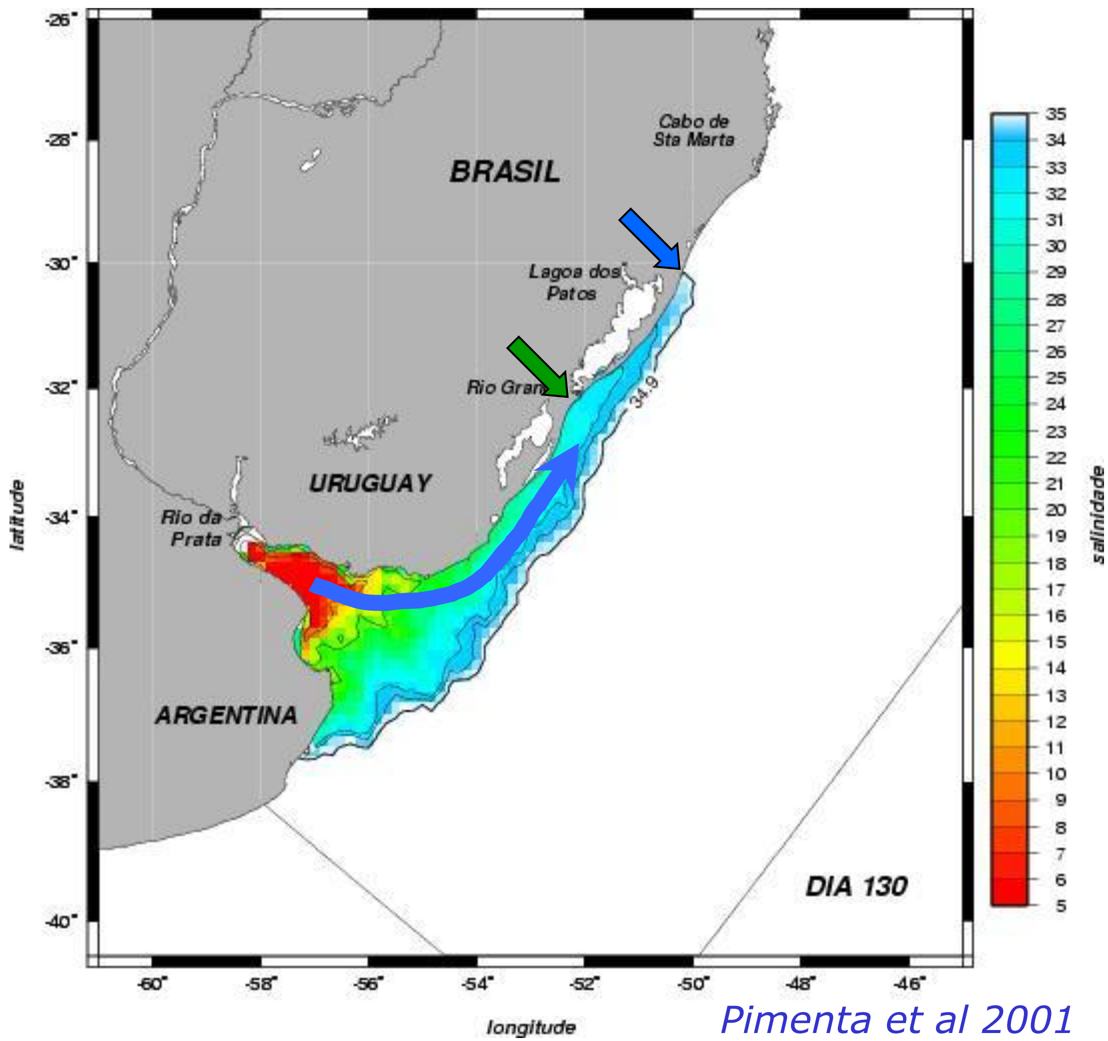


Theory

Low salinity (density) plume introduced in the ocean through river discharge must flow to the left of the river because of the effect of Earth rotation

The extension of the plume is dependent on the amount of river discharge

Numerical experiments

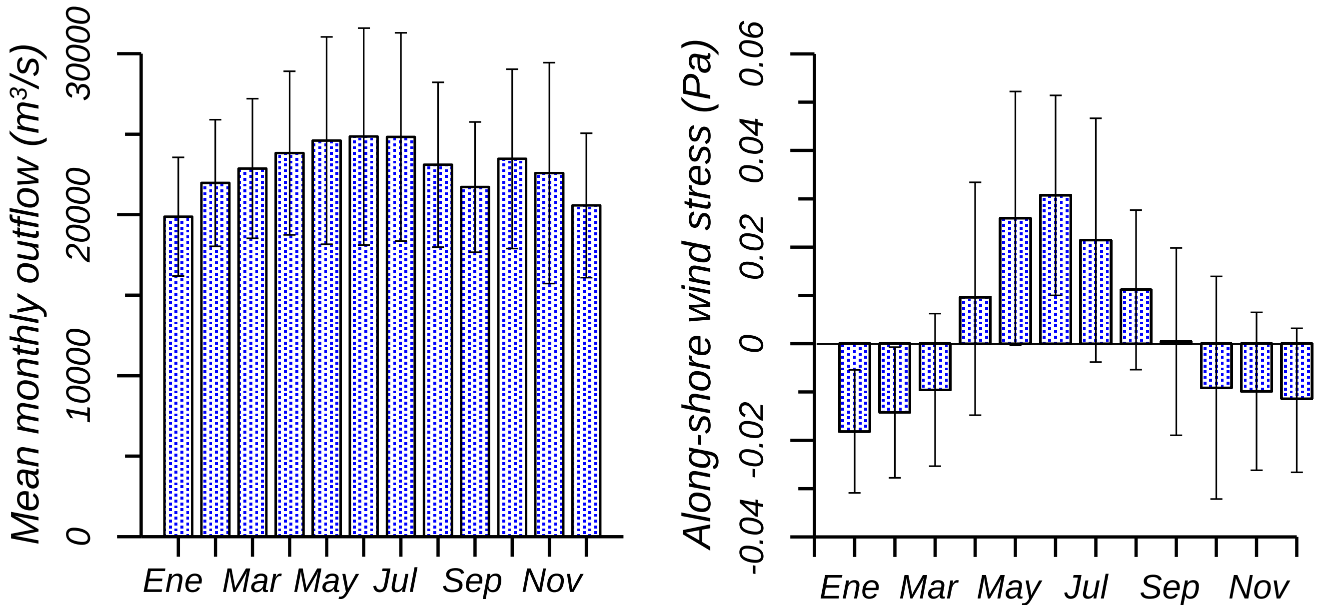


Pimenta et al 2001

R25 **→ 25 x 10^3 $m^3.s^{-1}$ (mean river discharge)**

River discharge and wind monthly means

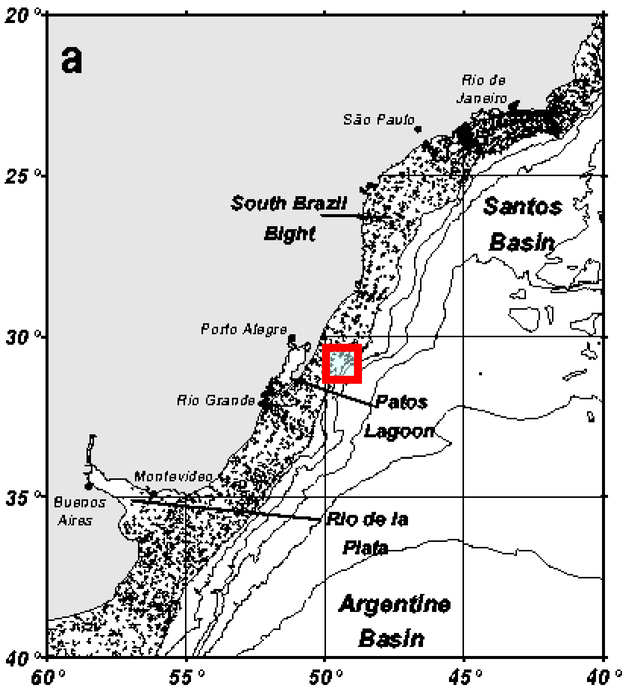
Main forcing 1949-2001 statistics

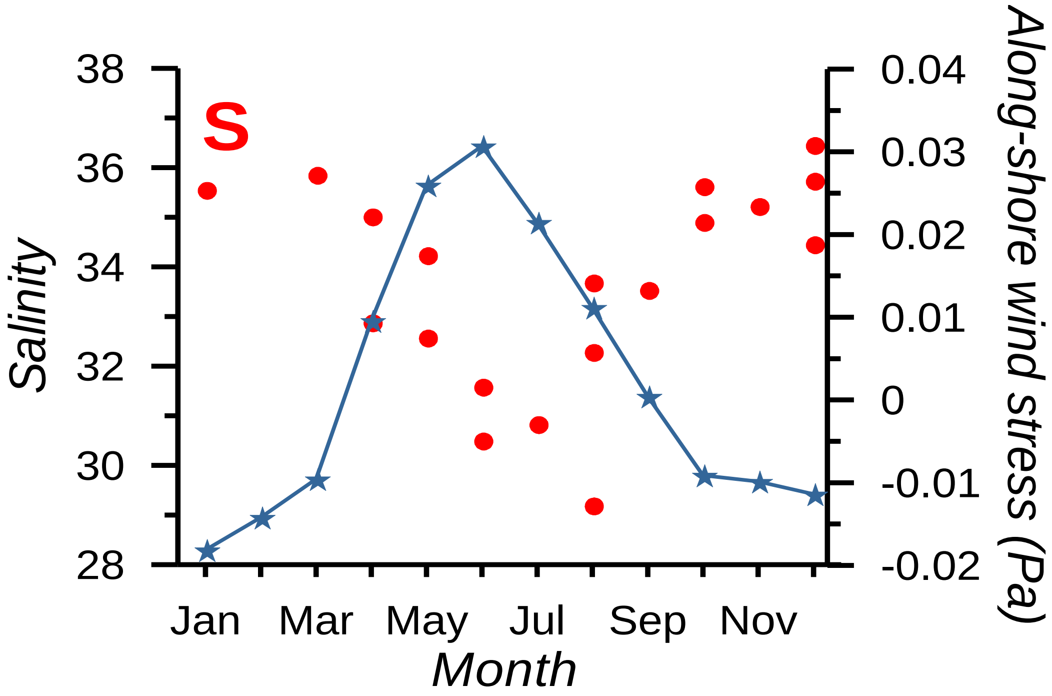


Piola et al. 2005

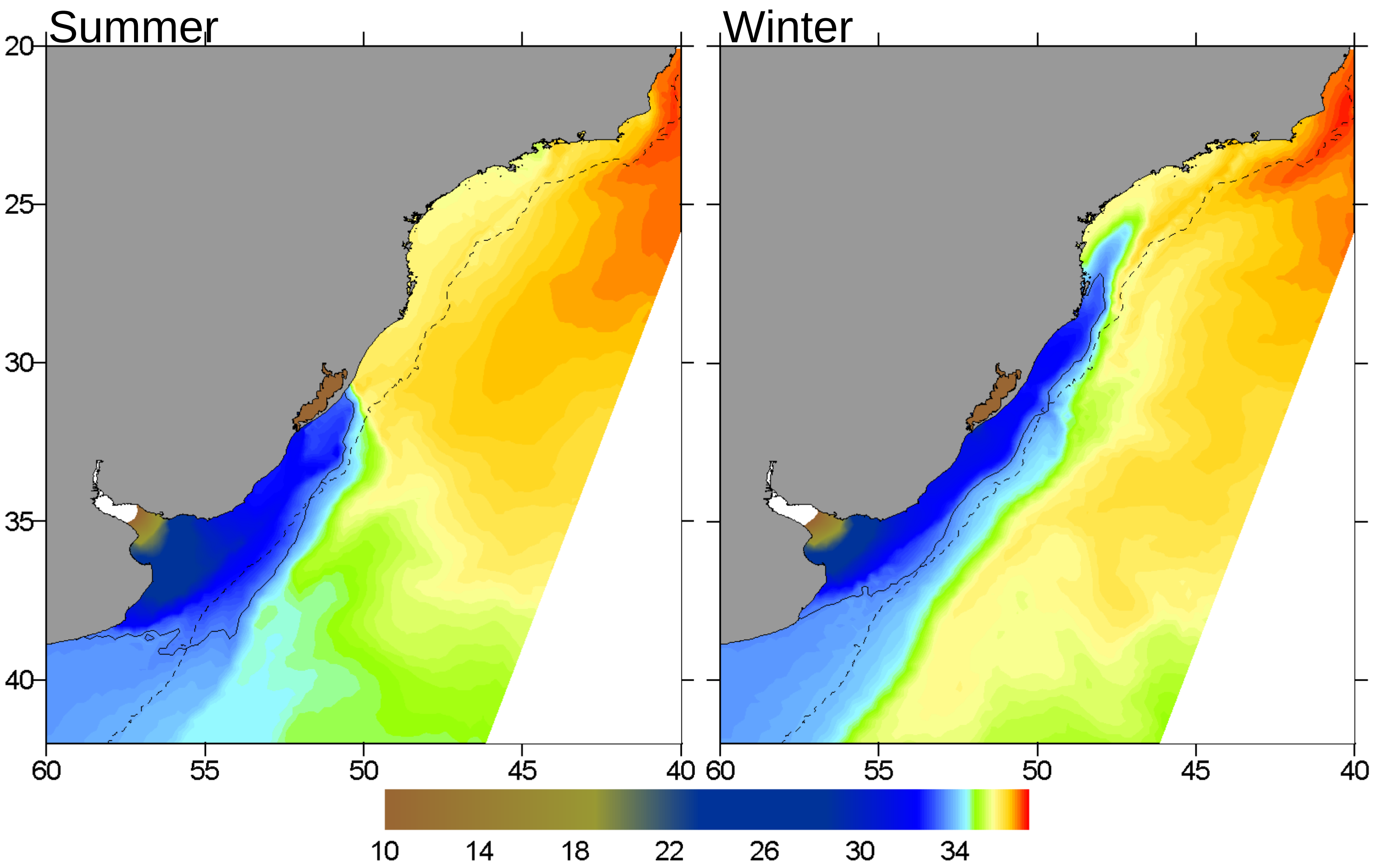
The way salinity reacts to the seasonal wind variation

Piola et al. 2005



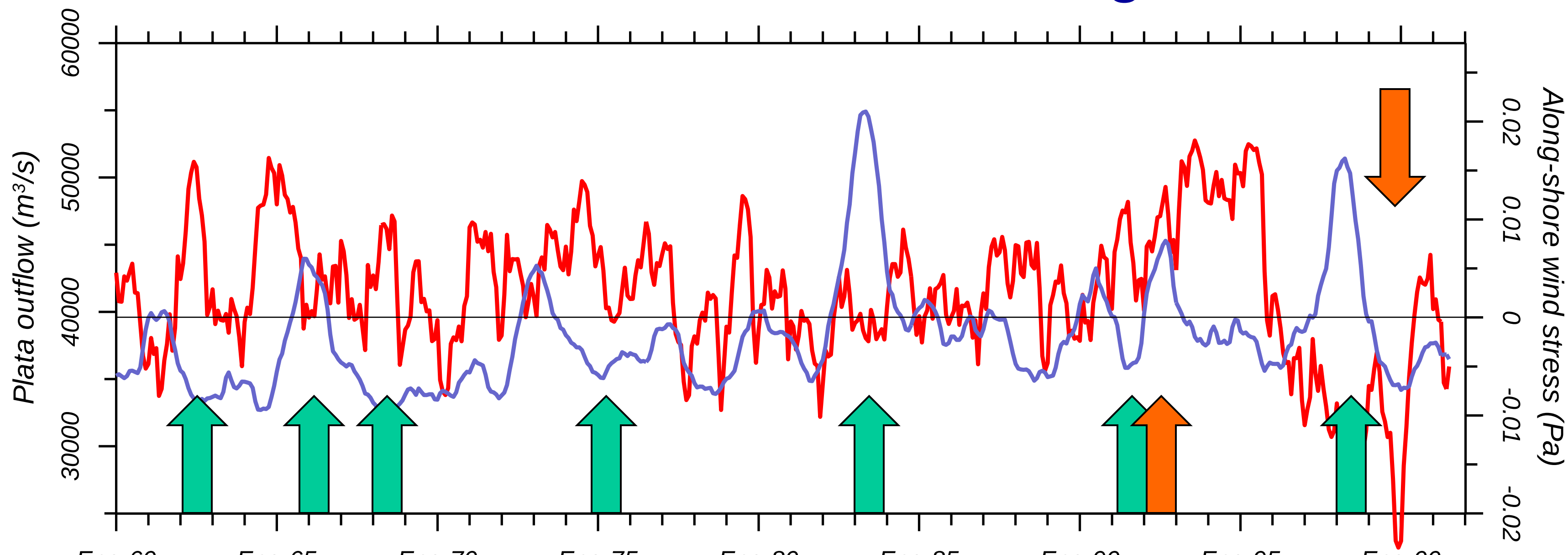


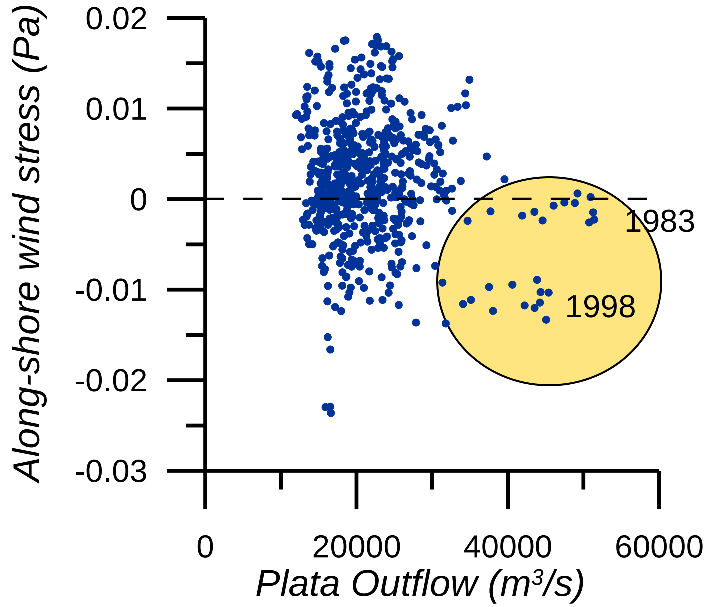
Simulações numéricas



Numerical simulations are being used to study specific events and system response to interannual wind and outflow variability

O dilema vento - descarga



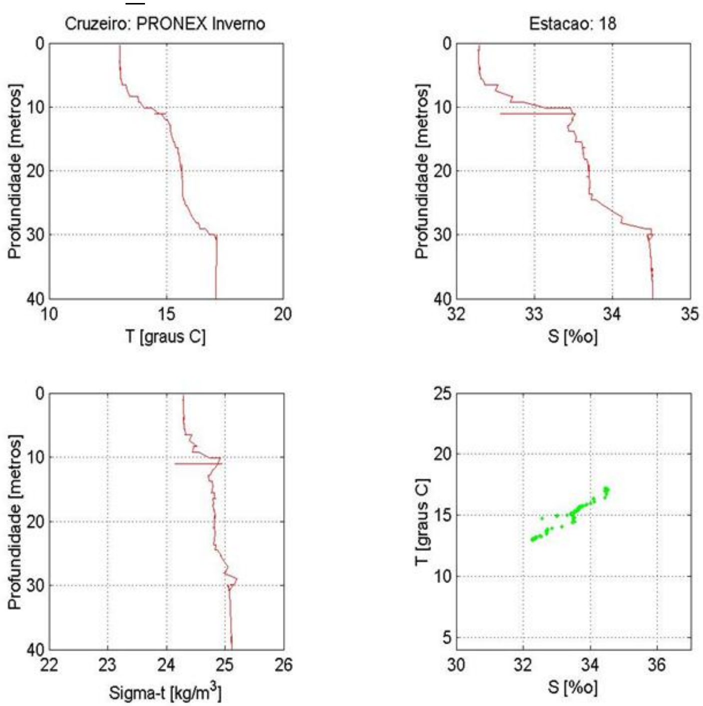


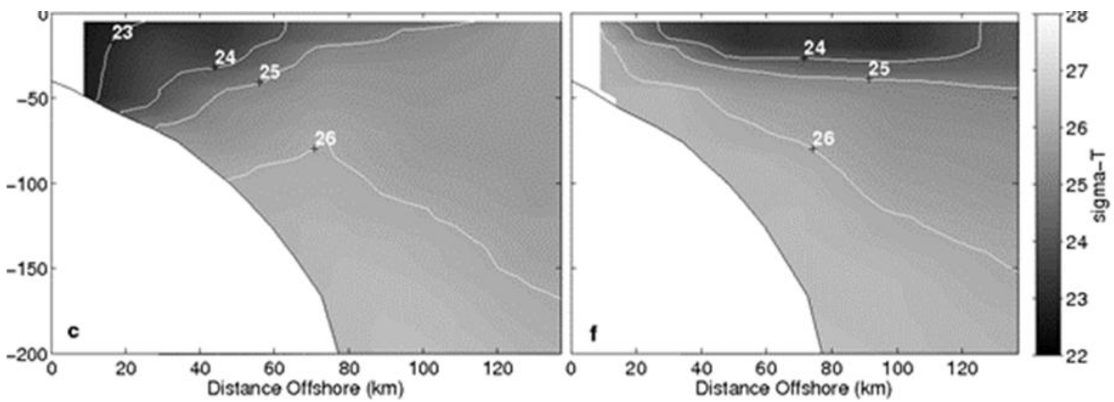
Em "baixa frequência (<1ano) vento e descarga estão 180° for a de fase, isto é, as mais altas descargas (82-83 & 97-98) ocorrem com stress negativo de vento (N-NE).

Apesar da alta descarga, ventos de

As águas do Prata

- Fluxo residual para o Norte (Pereira, 1989; Zavialov et al., 1998; Zavialov et al., 2002).
- Estabilidade (Castello and Möller, 1977; Zavialov et al., 2003)
- A termoclina invertida (Castello and Möller, 1977; Zavialov et al., 2003)
- Nutrientes (Ciotti et al, 1995; Guerrero et al., 1997)
- Impactos en la distribução de espécies (Castello et al., 1990)
- Variabilidade estacional e interanual (Miranda, 1973; Piola et al., 2000; Piola et al., 2005): ventos e descarga;
-



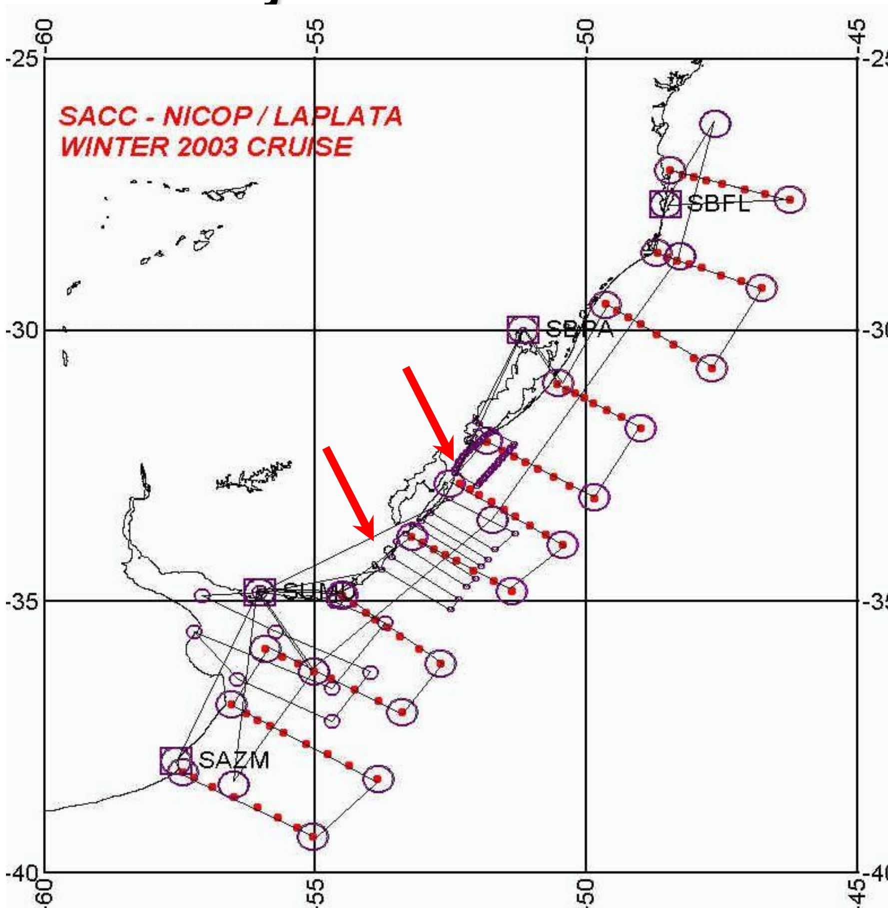


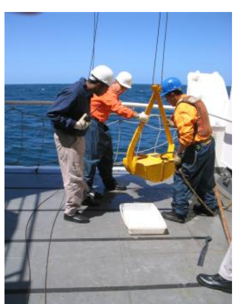
Entretanto:
Os dados existentes foram coletados durante cruzeiros de longa duração (3 meses);
Falta de sinoticidade;
Limitados por fronteiras políticas;
Poucos estudos multidisciplinares

Projeto La Plata - Objetivos

- PLATA Project: caracterizar a variação sazonal das águas da pluma do Rio da Prata e a frente Subtropical de Plataforma e os respectivos impactos na circulação e nos processos químicos e biológicos sobre a plataforma continental.

O Projeto LA PLATA





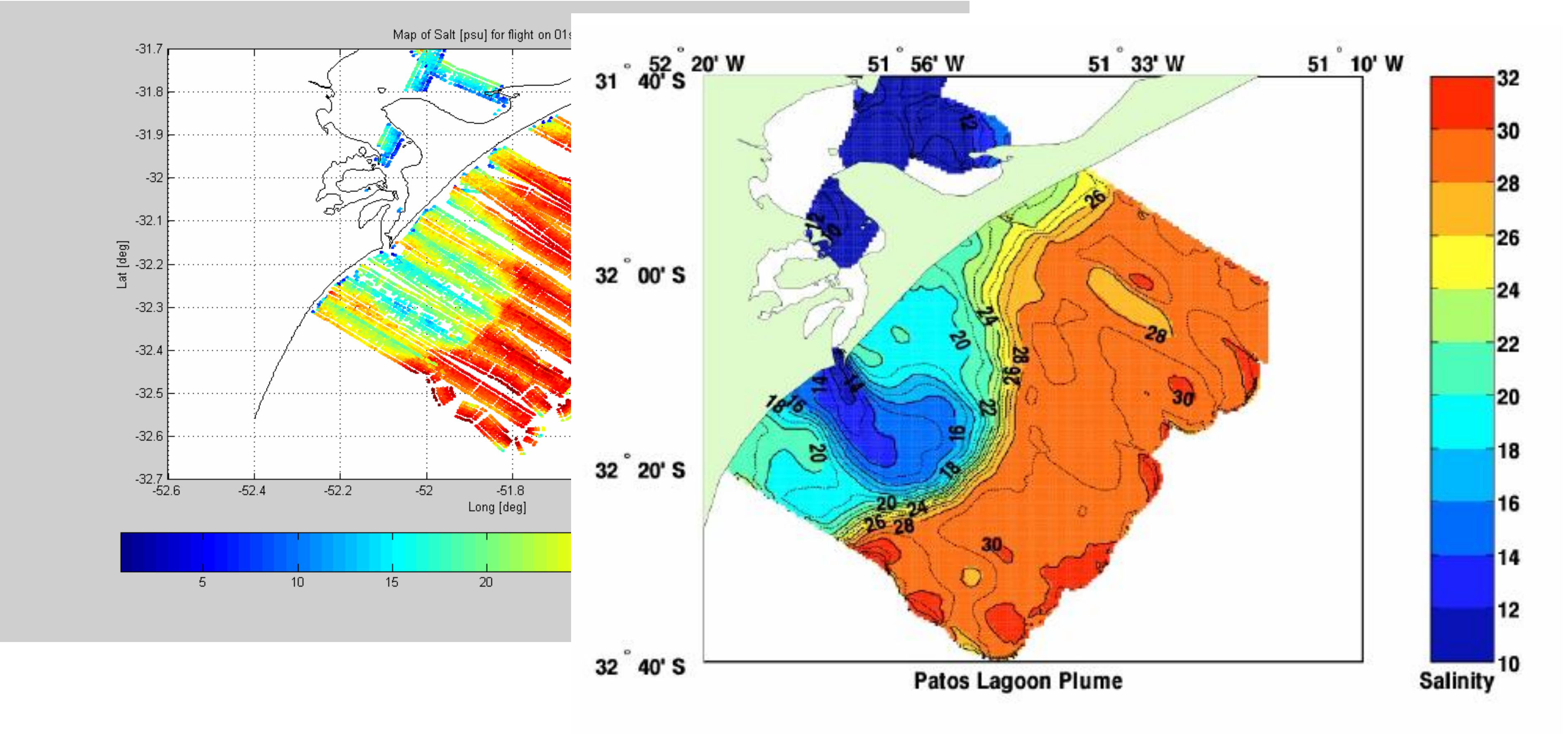
Levantamento aéreo - C-212 Aviocar - Fuerza Aérea Uruguaya

Photo taken by: Alvaro Solari

Levantamento aéreo- Salinity, Temperature, and Roughness Remote Scanner (STARRS)

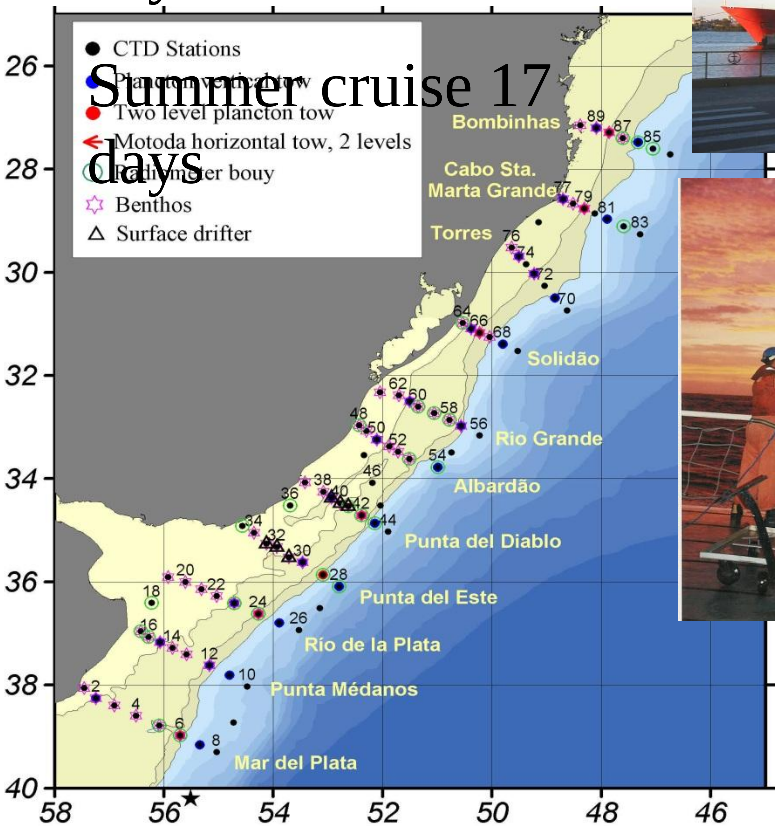
Levantamento aéreo

Levantamento aéreo – Resultados



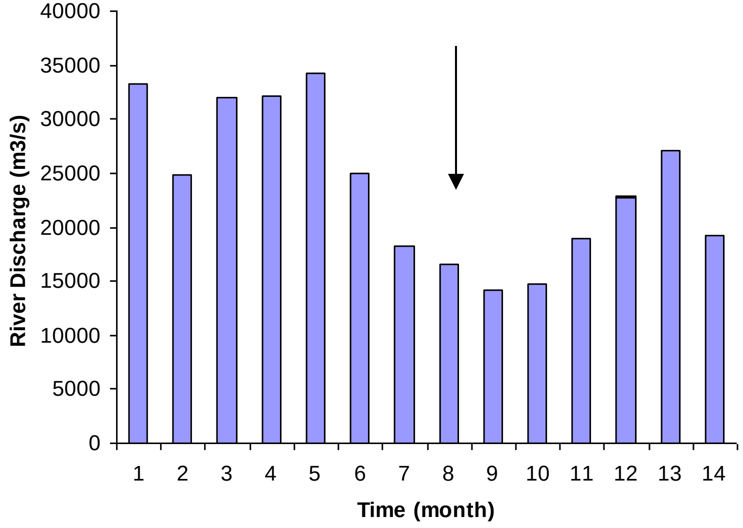
Metodologia
Cruzeiros de Inverno (08/2003) e Verão (02/2004)

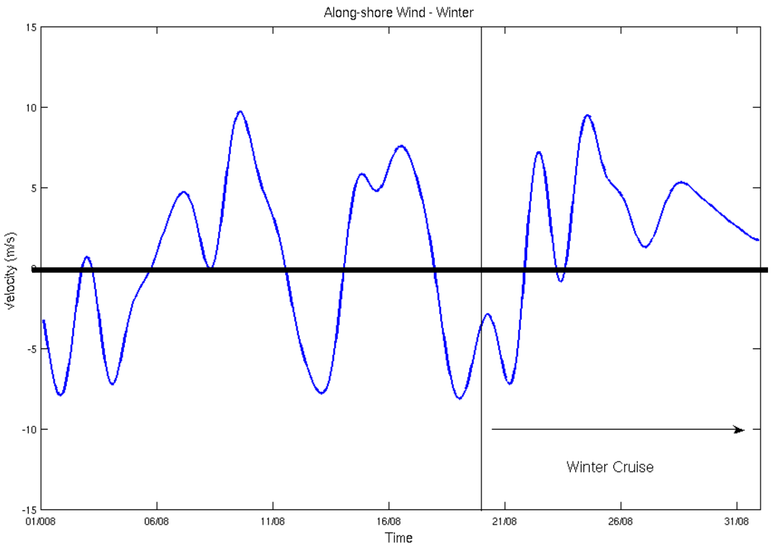
Winter cruise: 12 days



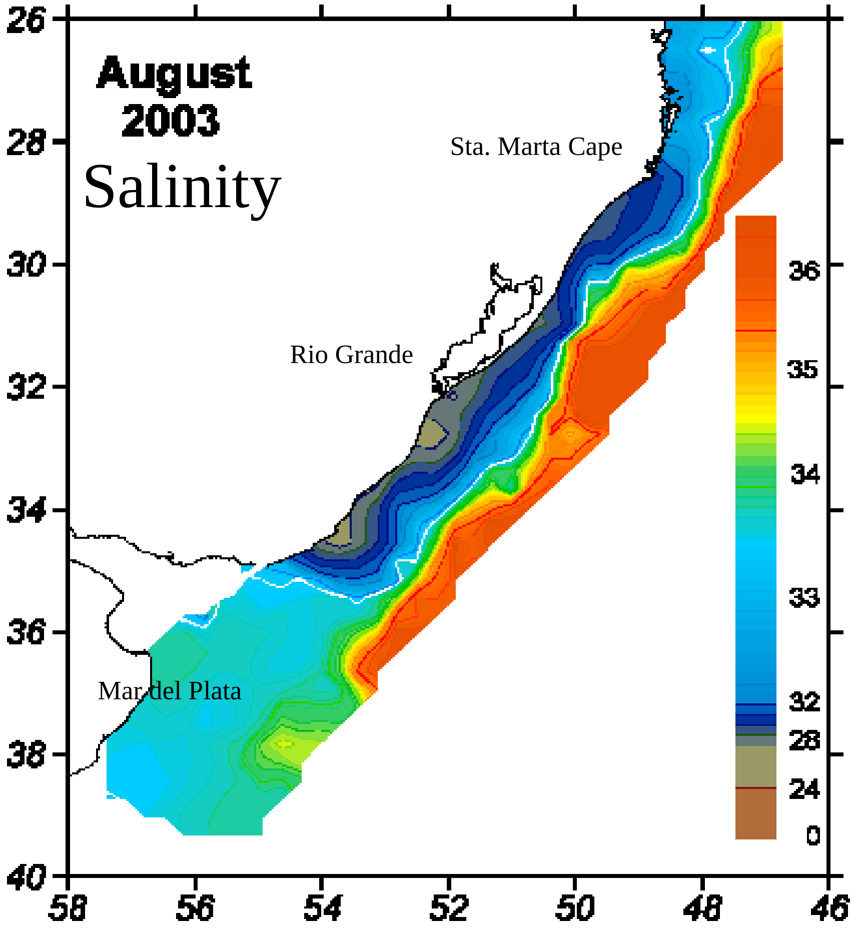
Summer cruise 17 days

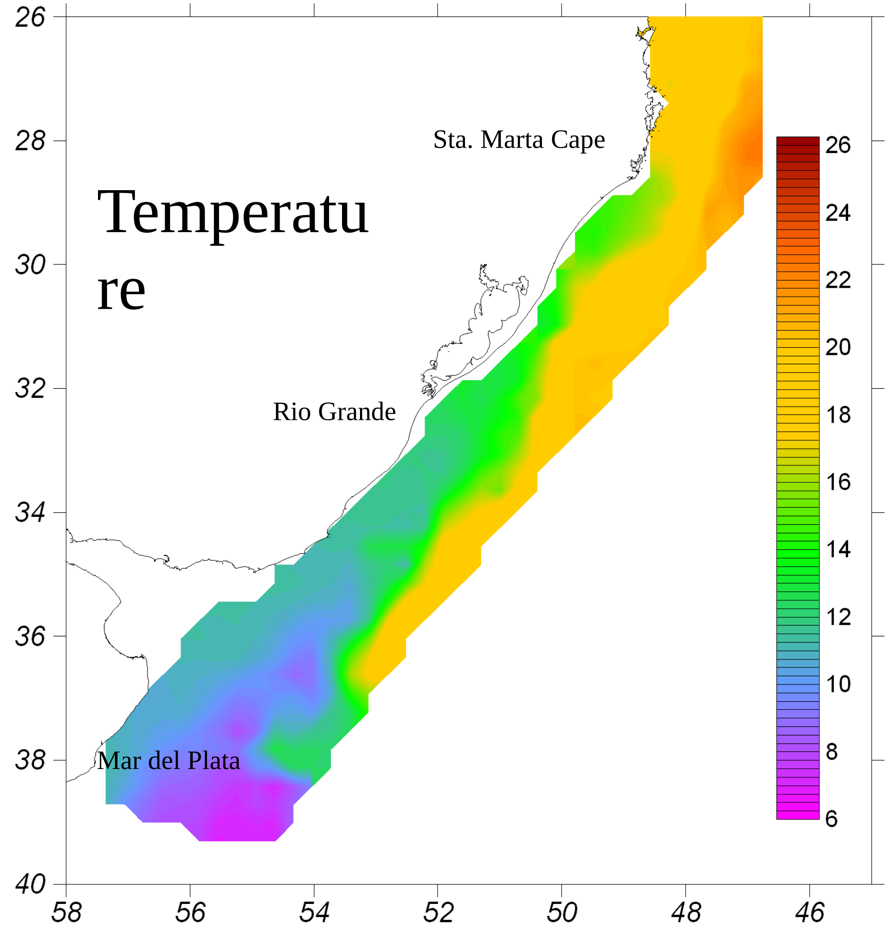
Cruzeiro de Inverno: condições de descarga e de vento

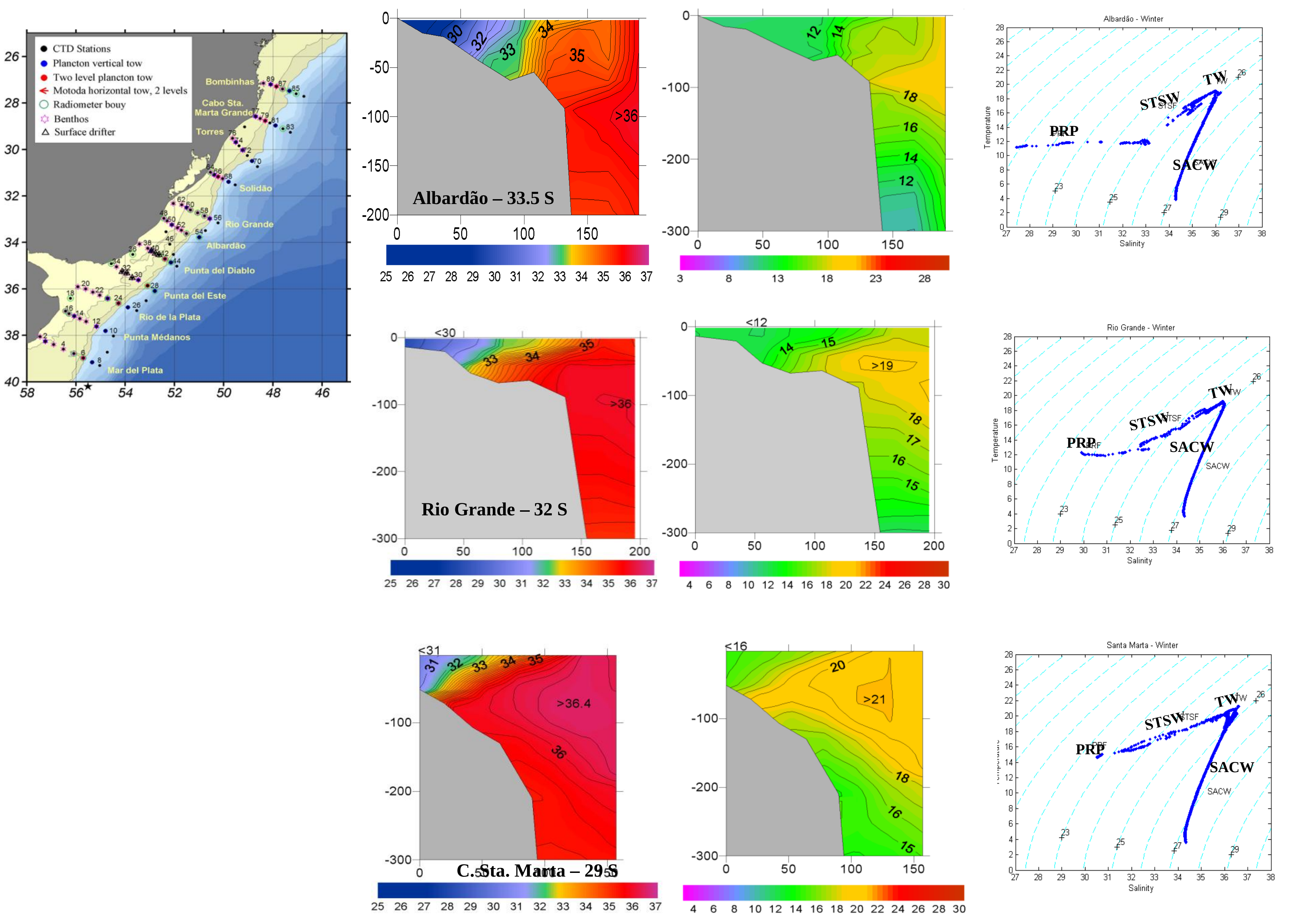




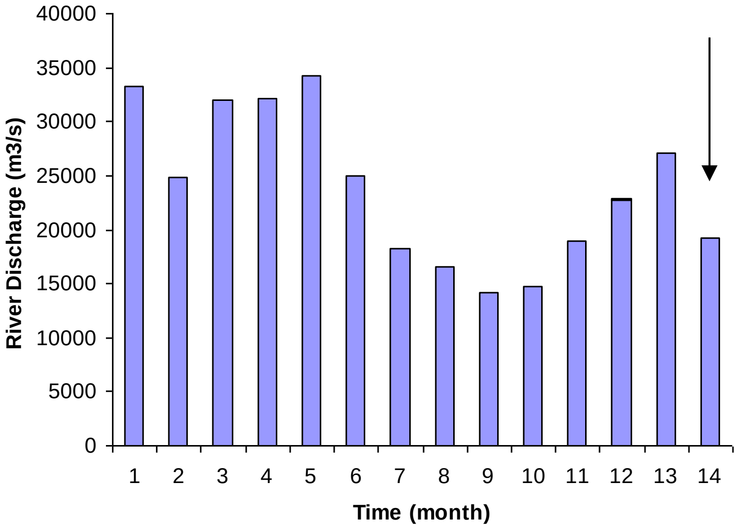
Resultados do Cruzeiro de Inverno

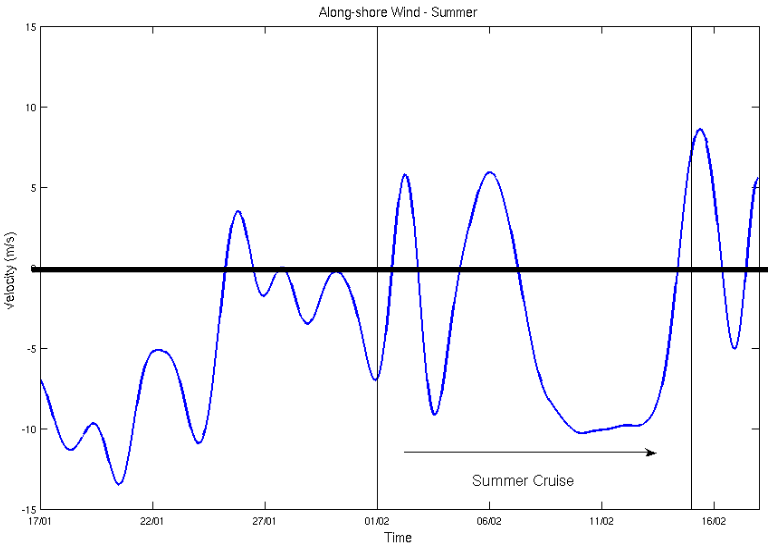




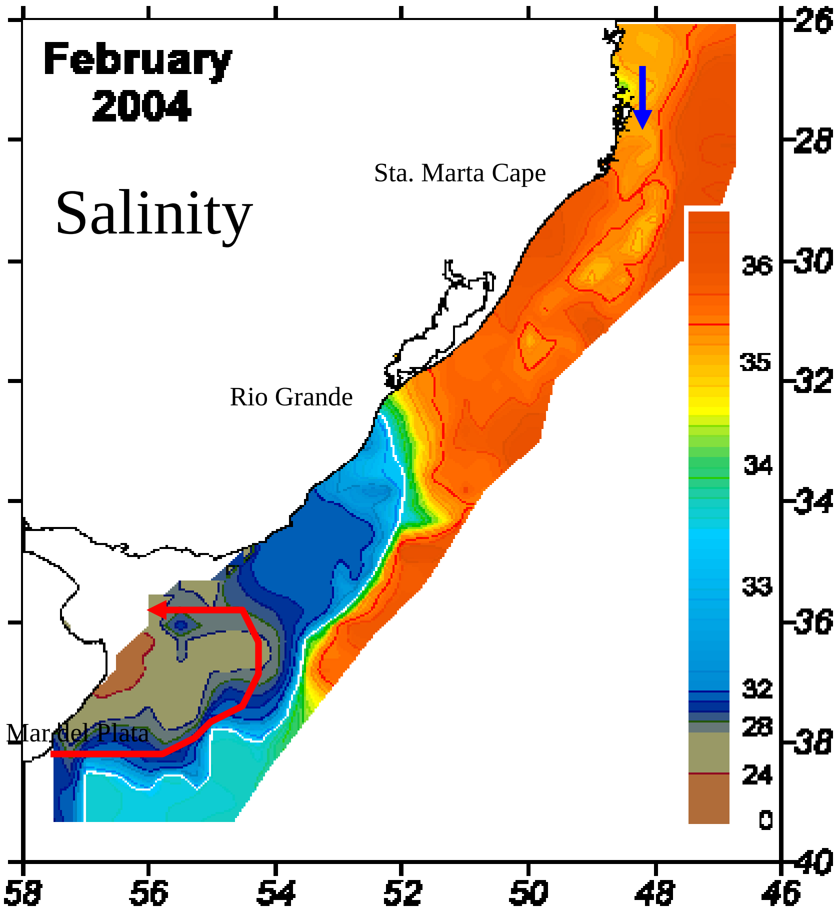

CTD Stations
Plancton vertical tow
Two level plancton tow
Motoda horizontal tow, 2 levels
Radiometer bouy
Benthos
Surface drifter
Bombinhas
Cabo Sta. Marta Grande
Torres
Solidão
Rio Grande
Albardão
Punta del Diablo
Punta del Este
Rio de la Plata
Punta Médanos
Mar del Plata
Albardão – 33.5 S
Rio Grande – 32 S
C. Sta. Marta – 29 S
Albardão - Winter
Rio Grande - Winter
Santa Marta - Winter
Temperature
Salinity
PRP
STSW
TW
SACW

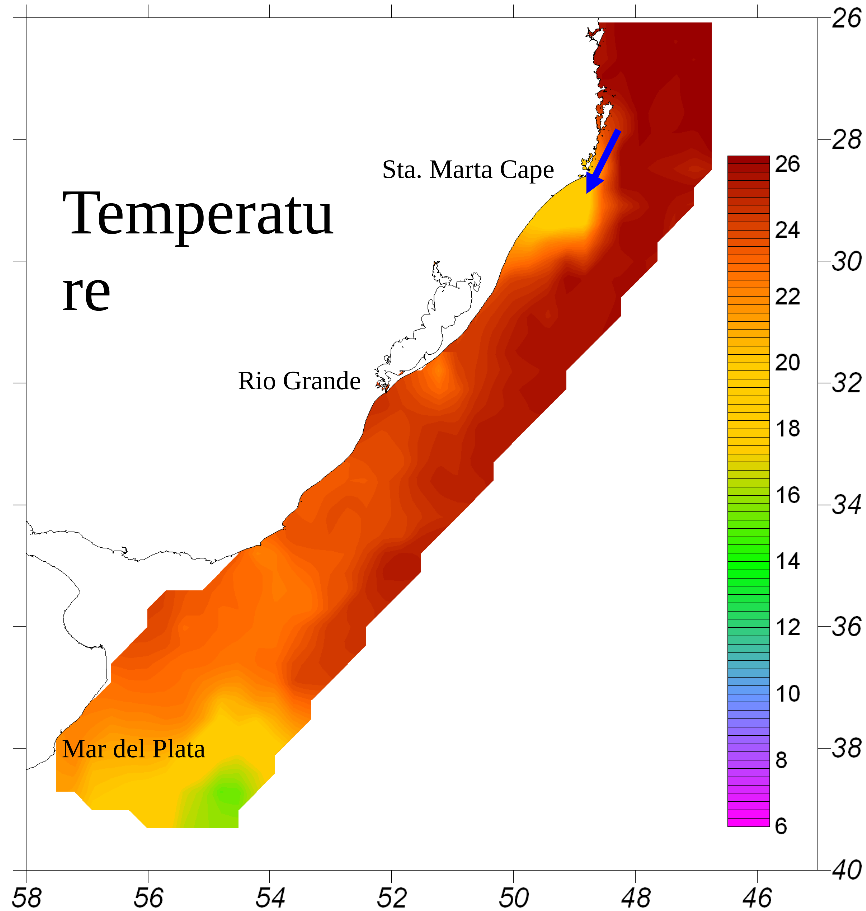
Cruzeiro de Verão: condições de descarga e de vento

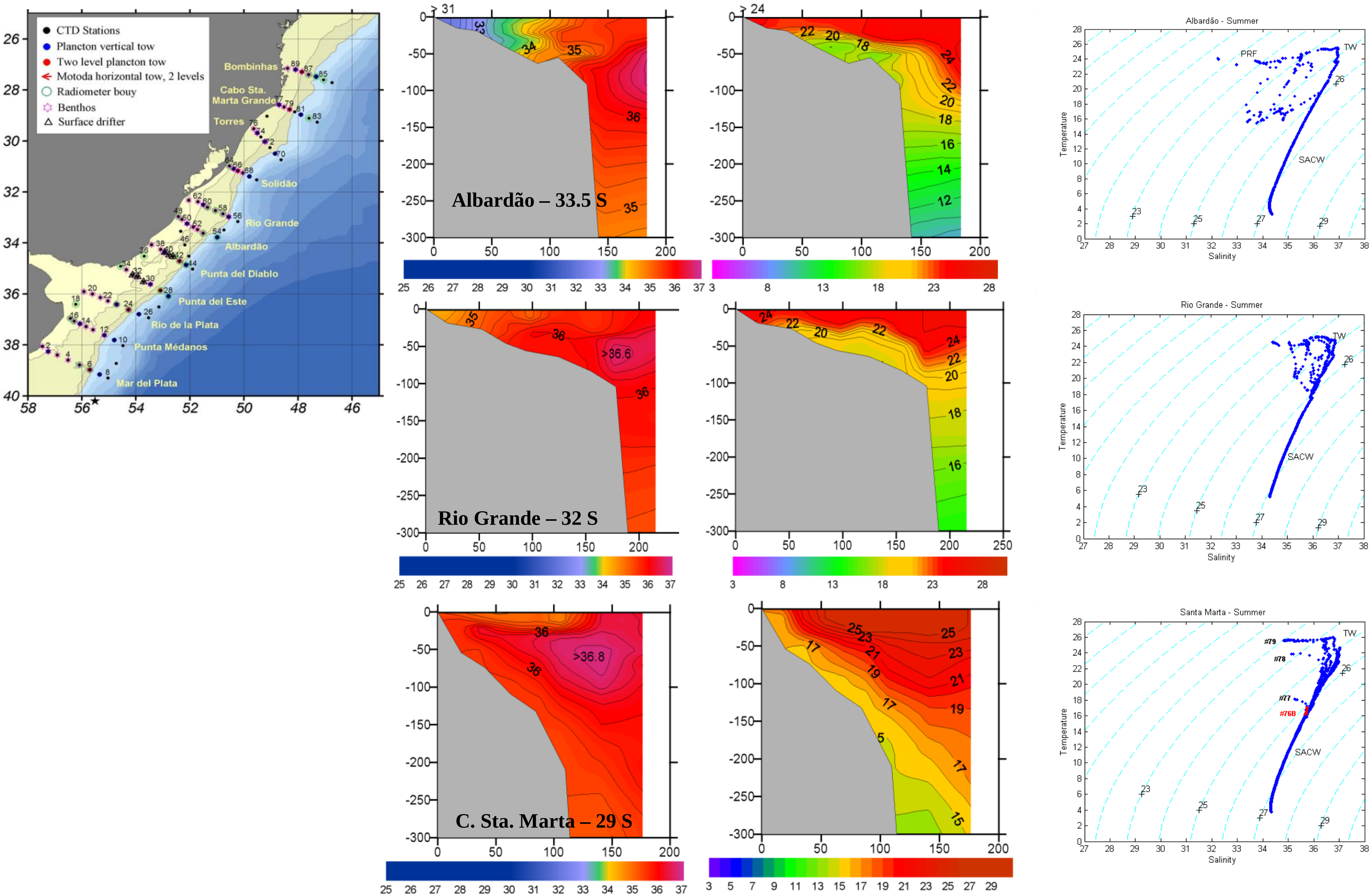




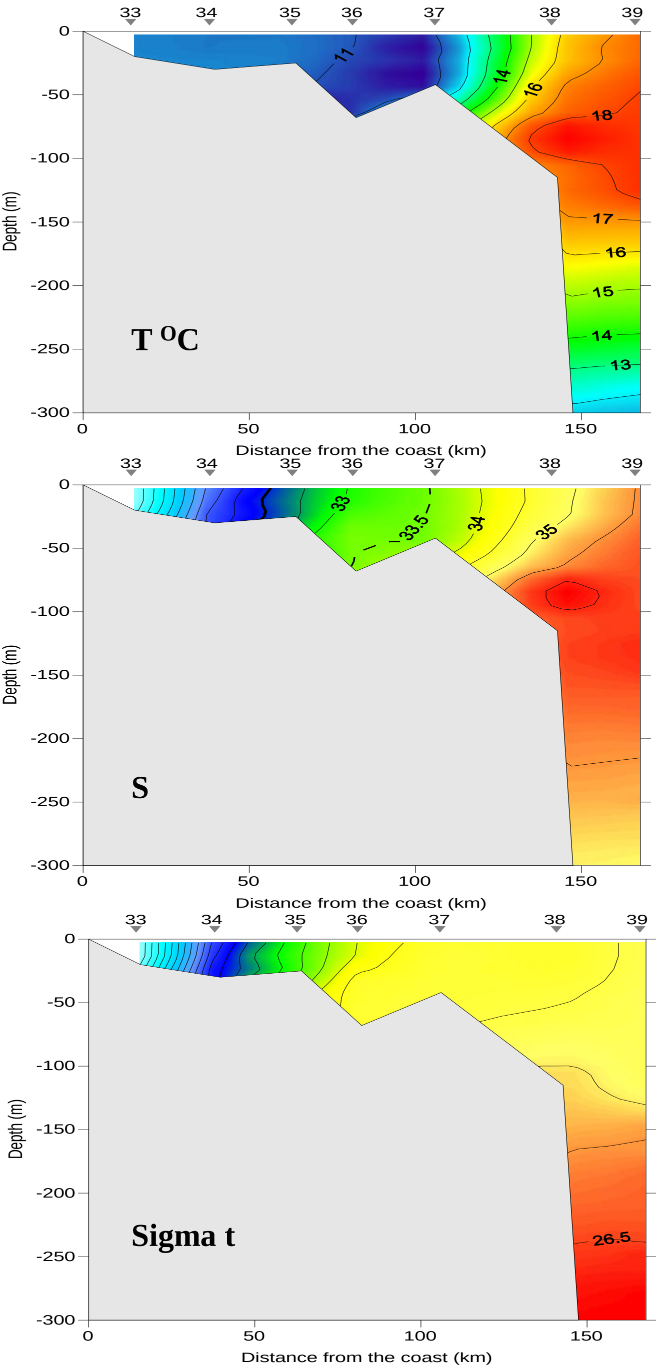
Resultados do Cruzeiro de Verão

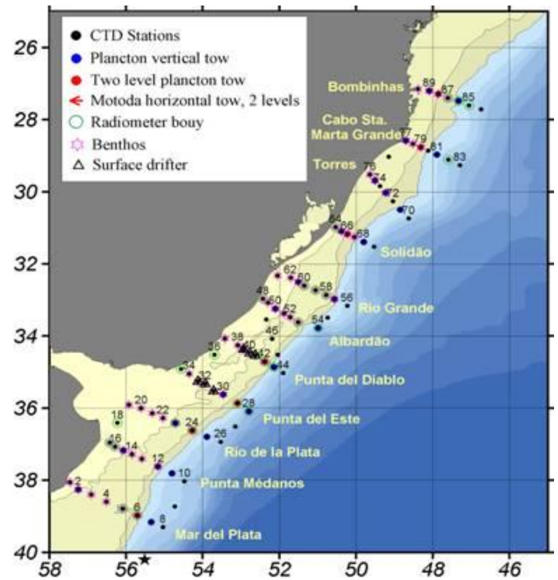






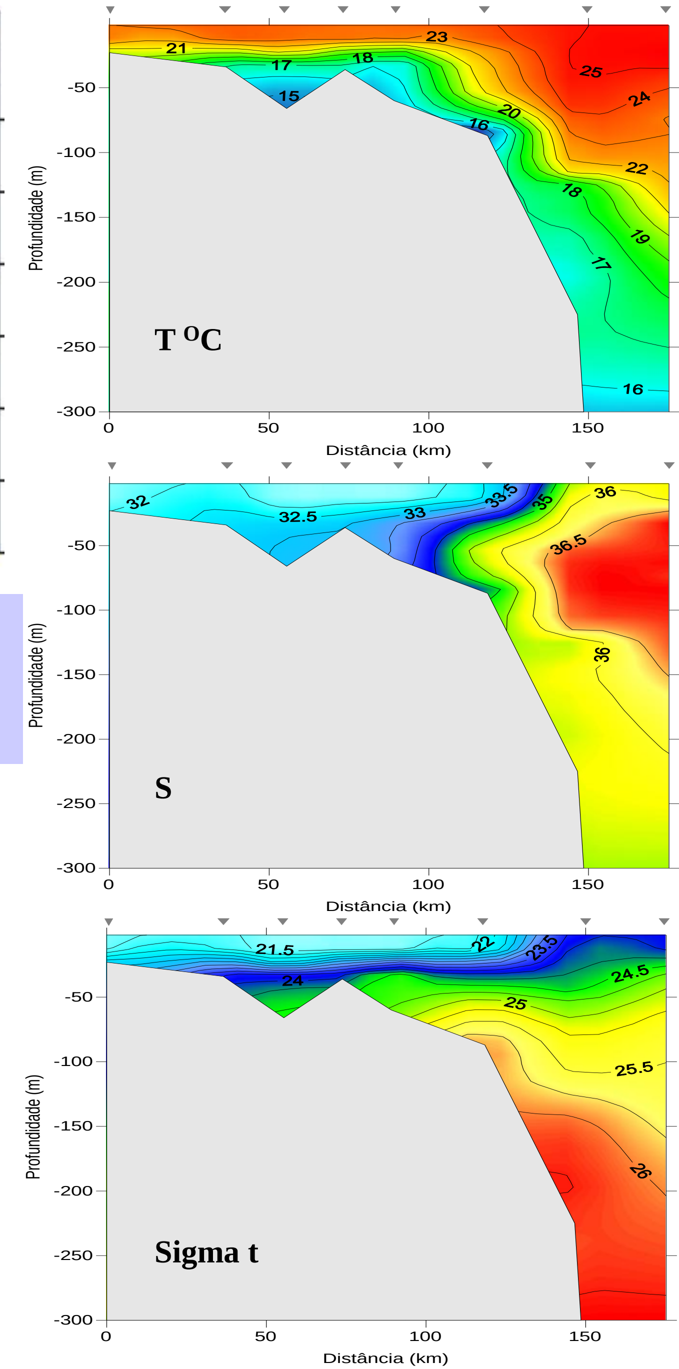
CTD Stations
Plancton vertical tow
Two level plancton tow
Motoda horizontal tow, 2 levels
Radiometer bouy
Benthos
Surface drifter
Bombinhas
Cabo Sta. Marta Grande
Torres
Solidão
Rio Grande
Albardão
Punta del Diablo
Punta del Este
Rio de la Plata
Punta Médanos
Mar del Plata
Albardão – 33.5 S
Rio Grande – 32 S
C. Sta. Marta – 29 S
Albardão - Summer
Rio Grande - Summer
Santa Marta - Summer
Temperature
Salinity
TW
PRF
SACW
#79
#78
#77
#76B



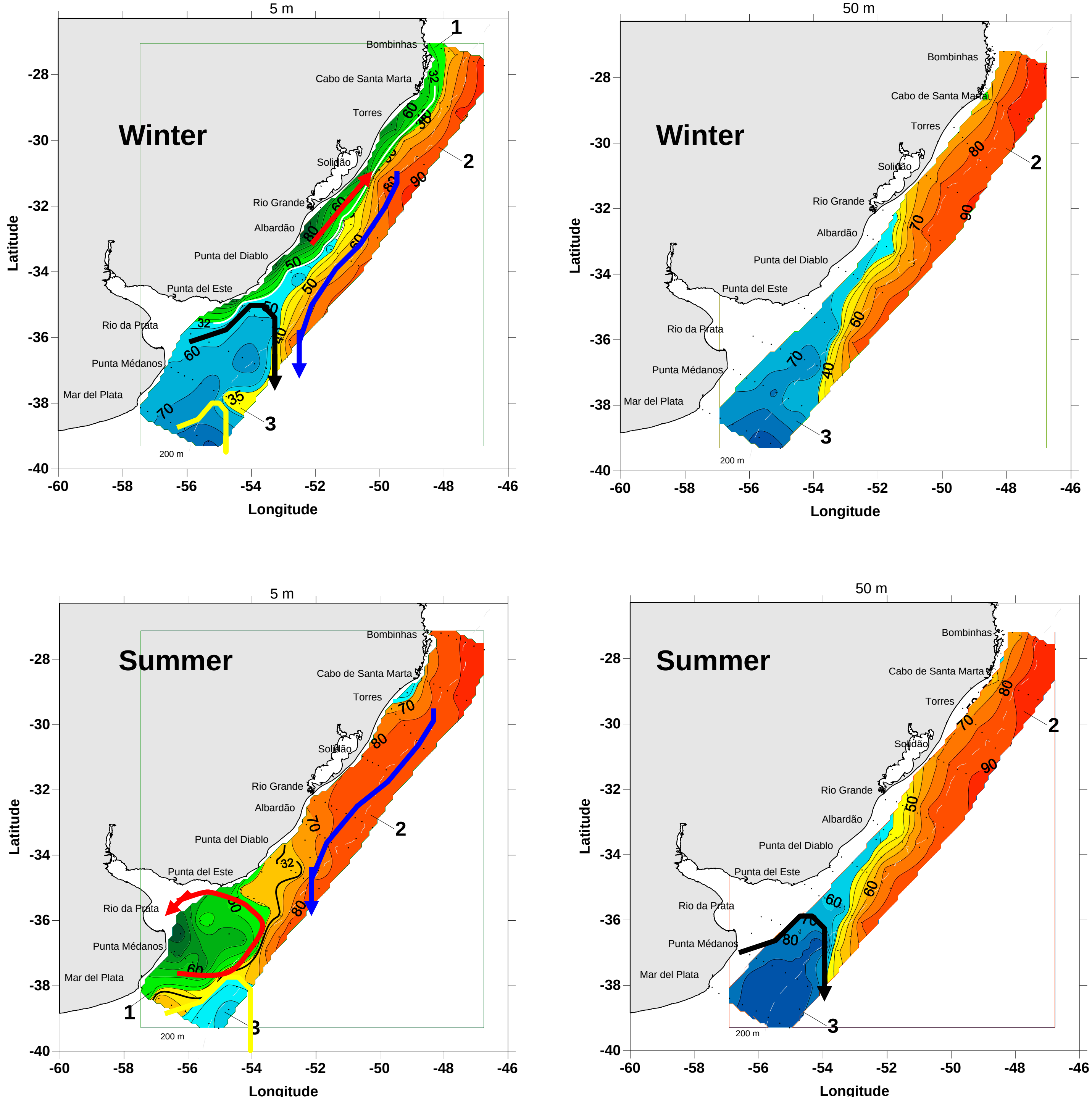


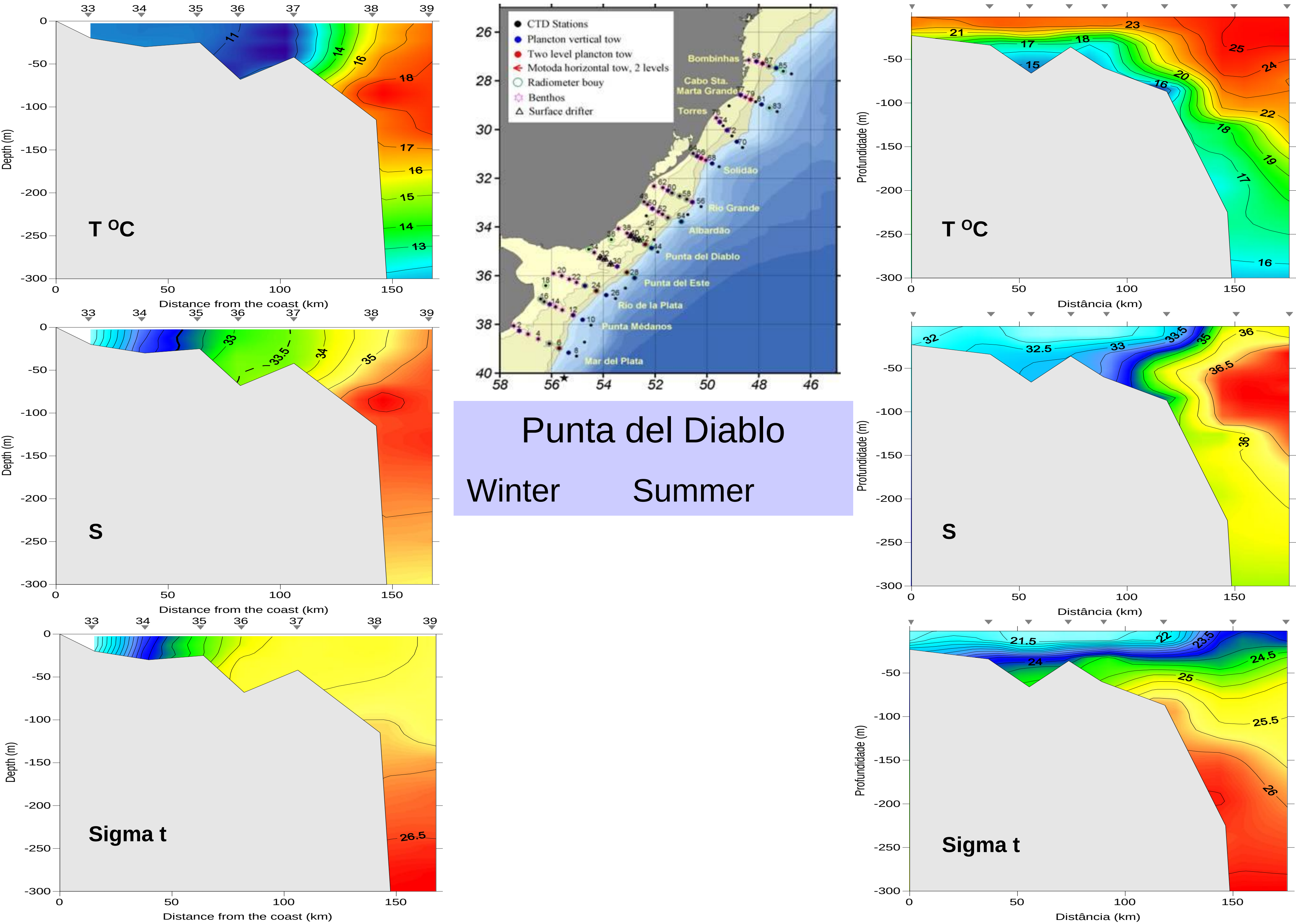
Punta del Diablo

Inverno Verão

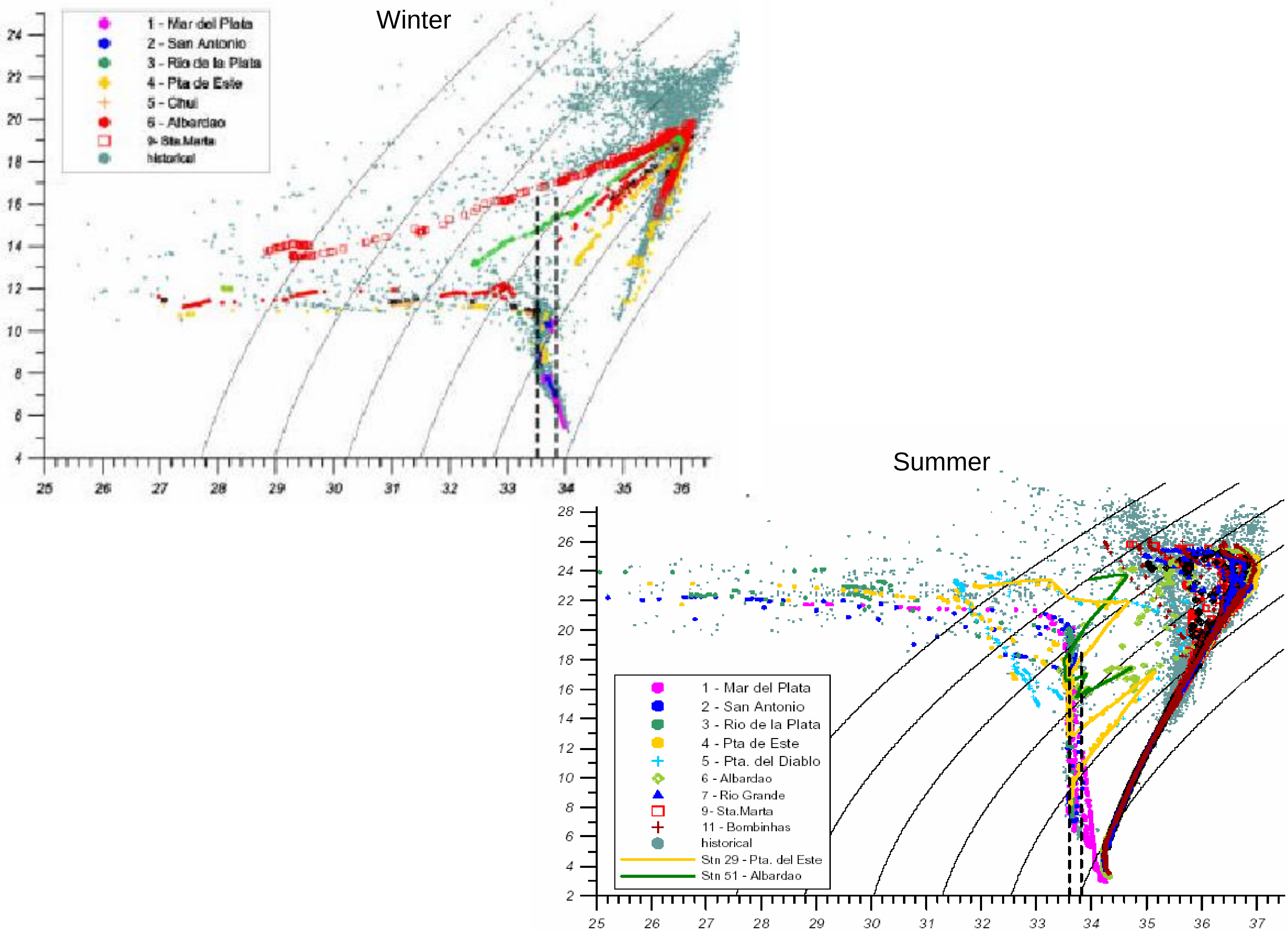


% of Water Masses – following the mixing triangle method of Mamayev 1975

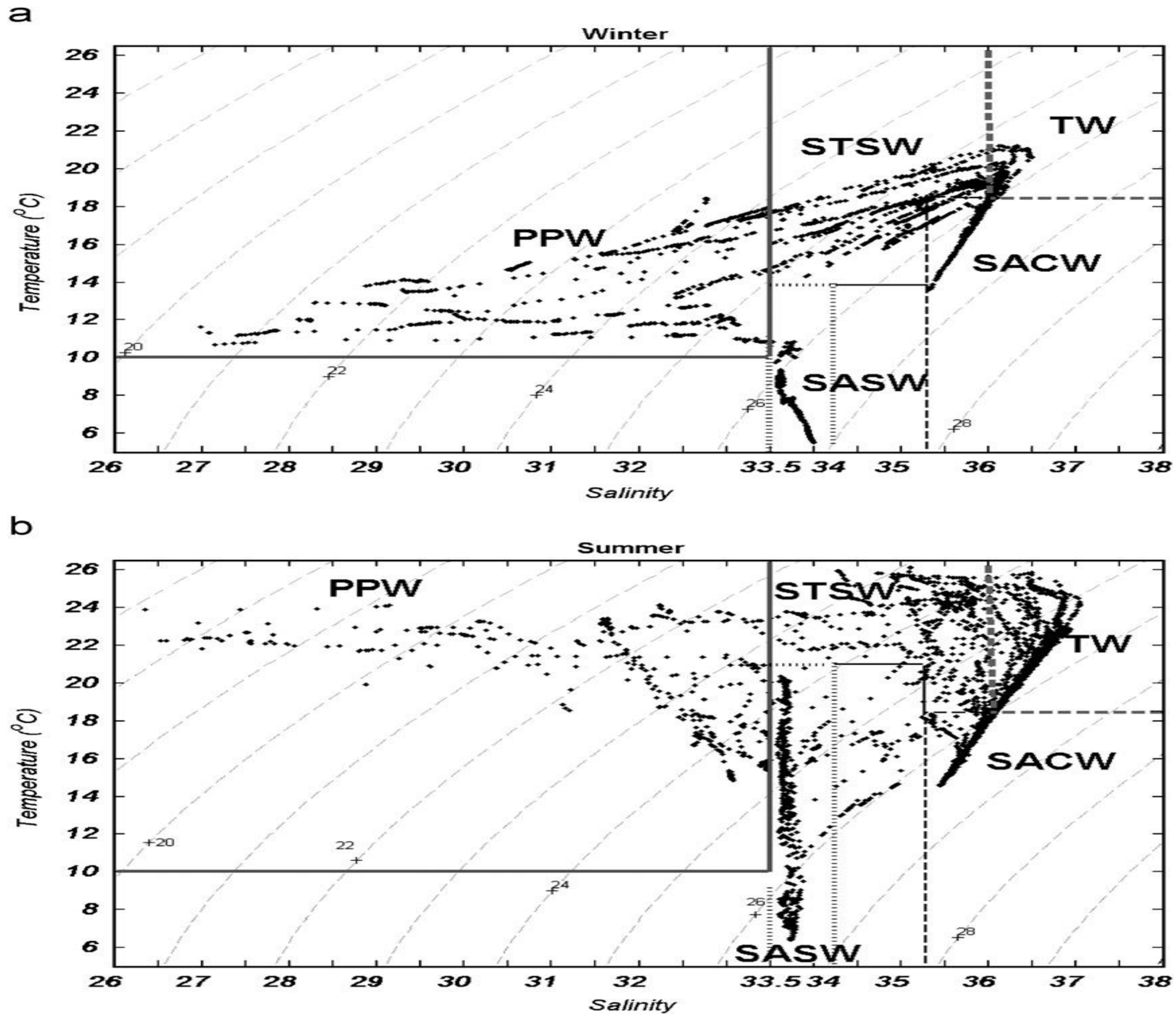




Punta del Diablo
Winter
Summer
T °C
S
Sigma t
Depth (m)
Distance from the coast (km)
Profundidade (m)
Distância (km)
CTD Stations
Plancton vertical tow
Two level plancton tow
Motoda horizontal tow, 2 levels
Radiometer bouy
Benthos
Surface drifter
Bombinhas
Cabo Sta. Marta Grande
Torres
Solidão
Rio Grande
Albardão
Punta del Diablo
Punta del Este
Rio de la Plata
Punta Médanos
Mar del Plata



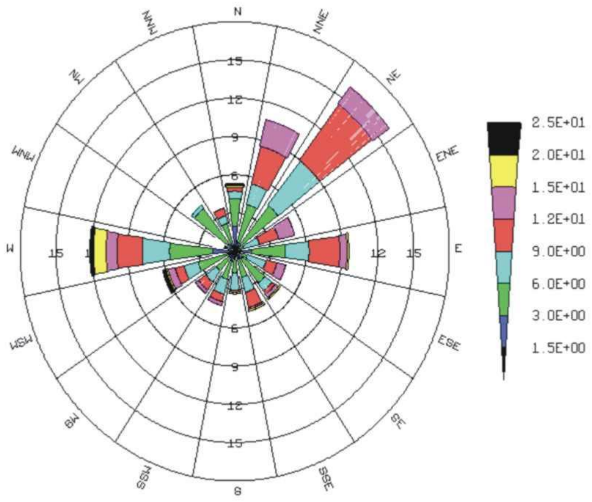
Winter
1 - Mar del Plata
2 - San Antonio
3 - Rio de la Plata
4 - Pta de Este
5 - Chui
6 - Albardao
9- Sta.Marta
historical
Summer
1 - Mar del Plata
2 - San Antonio
3 - Rio de la Plata
4 - Pta de Este
5 - Pta. del Diablo
6 - Albardao
7 - Rio Grande
9- Sta.Marta
11 - Bombinhas
historical
Stn 29 - Pta. del Este
Stn 51 - Albardao



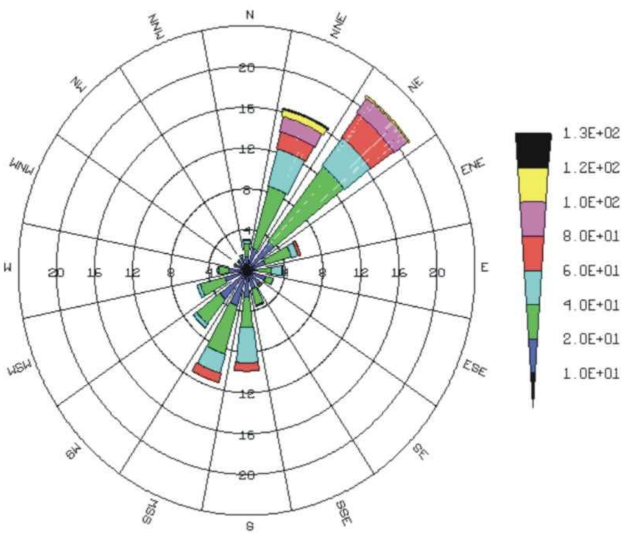
Möller et al., 2008

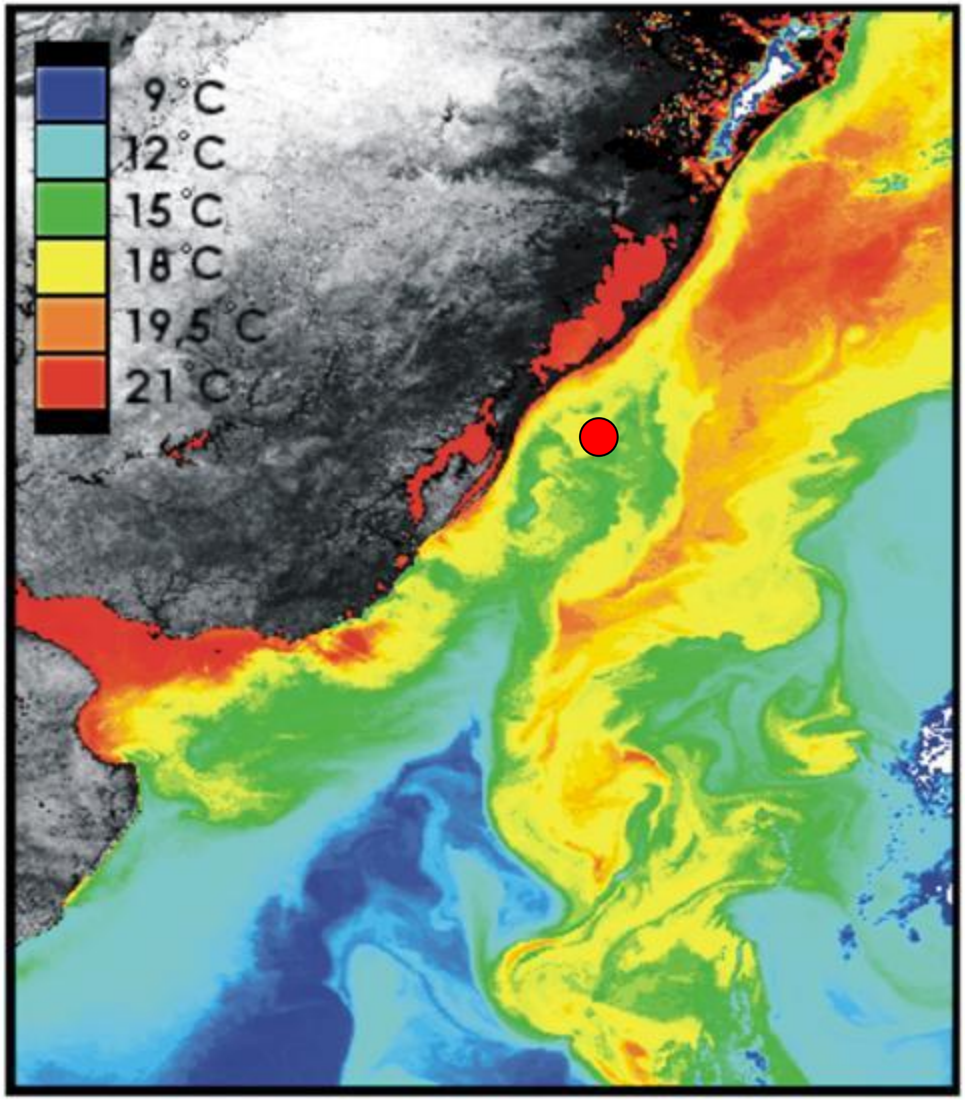
50 m mooring data

Wind



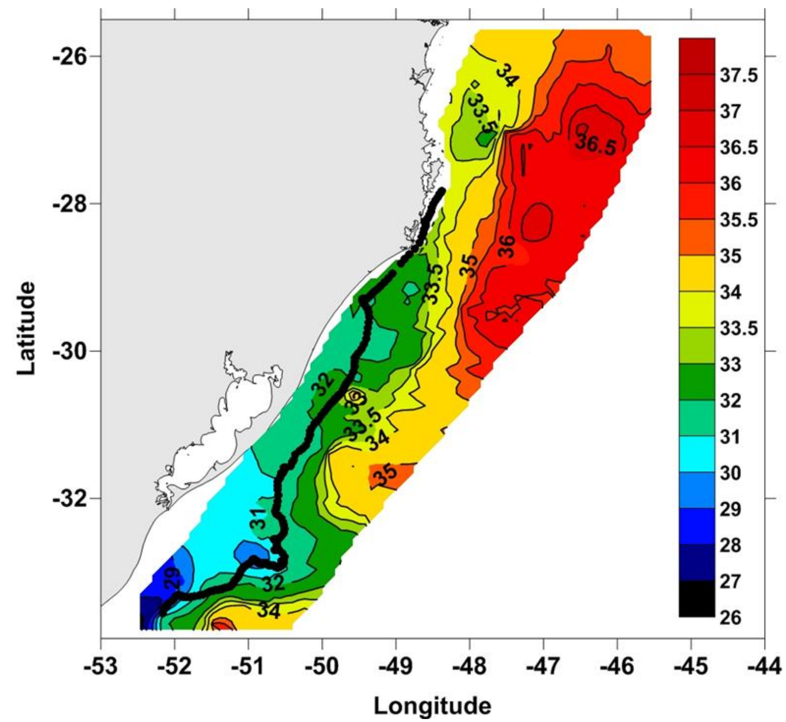
Current 15 m





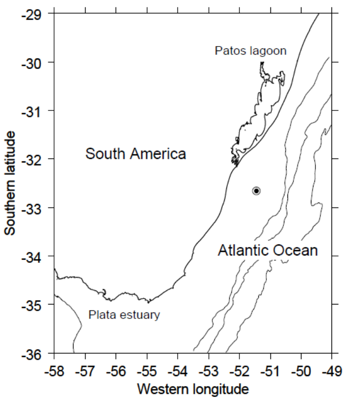
Möller et al. 1998

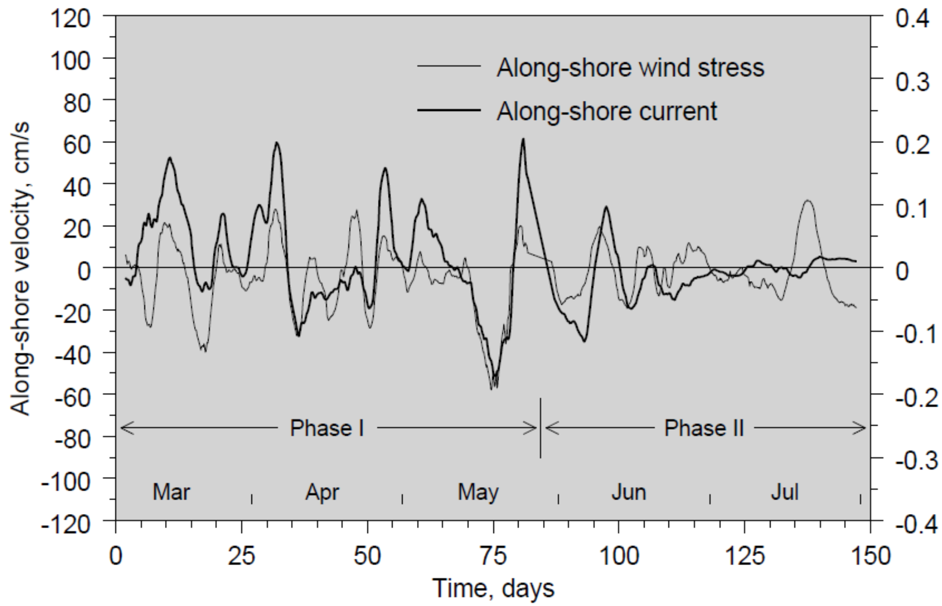
Derivador de baixo custo (LCD) lançado em 20/06/2012 - ~0.3 m/s

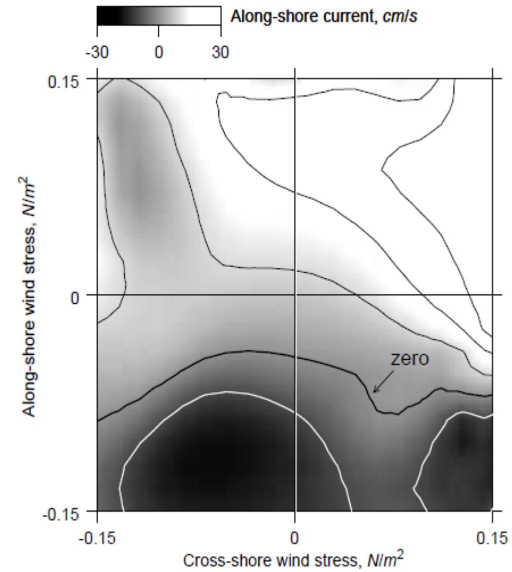


Mesmo ventos fortes de NE não eram capazes de reverter o deslocamento para o norte do LCD. A causa: fluxo para o norte devido ao gradiente de pressão formado pela presença de águas de baixa salinidade e temperatura derivadas do Rio da Prata

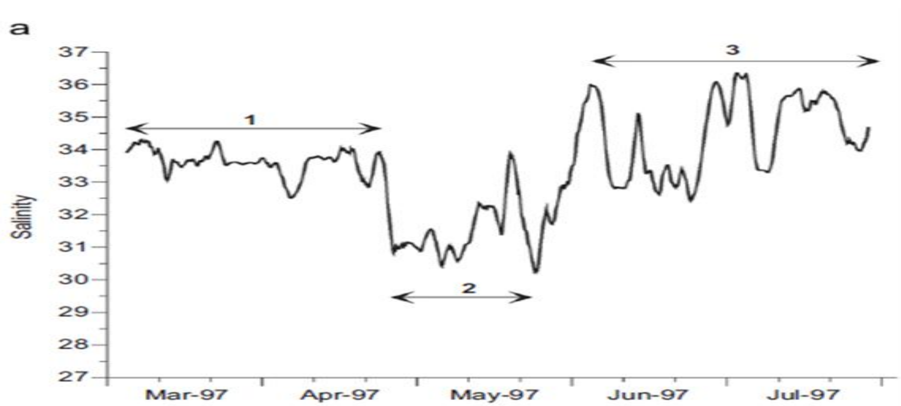
Winds, currents and salinity variability in synoptic time scale – autumn/winter 1997 – mooring at 50 m with 2 Aanderaa RCM 7





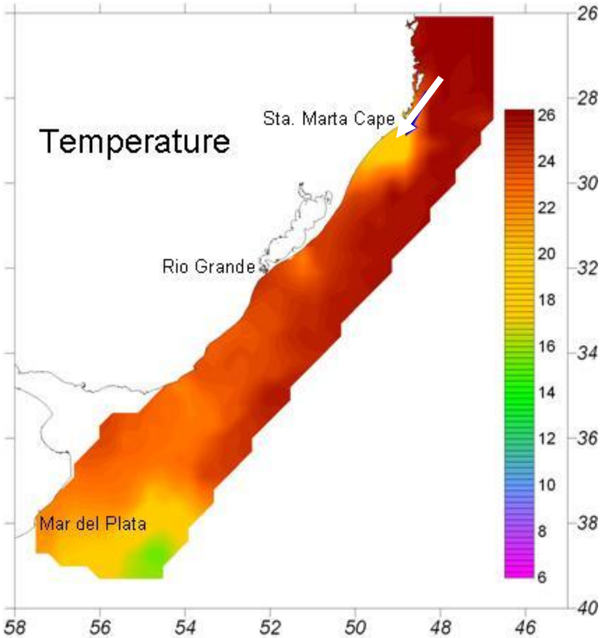


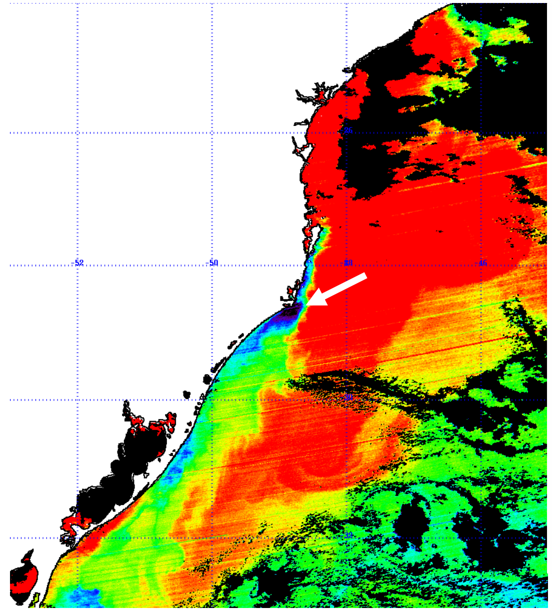
Zavialov et al. (2001)

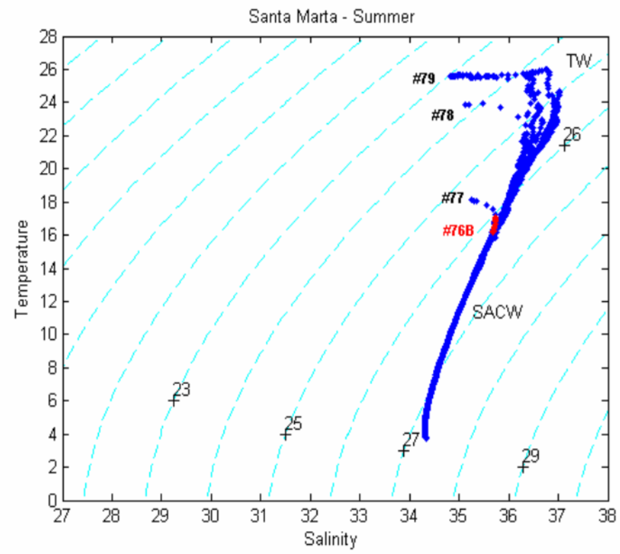


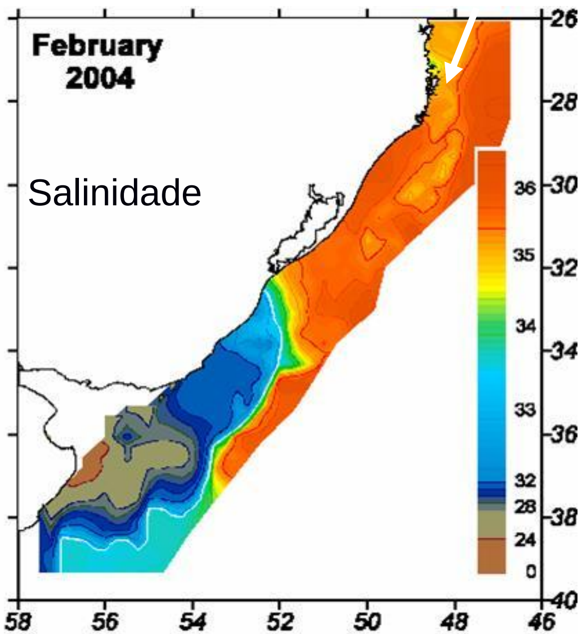
1 – SASW; 2 – PPW; 3 – STSW (Piola et al. 2008)

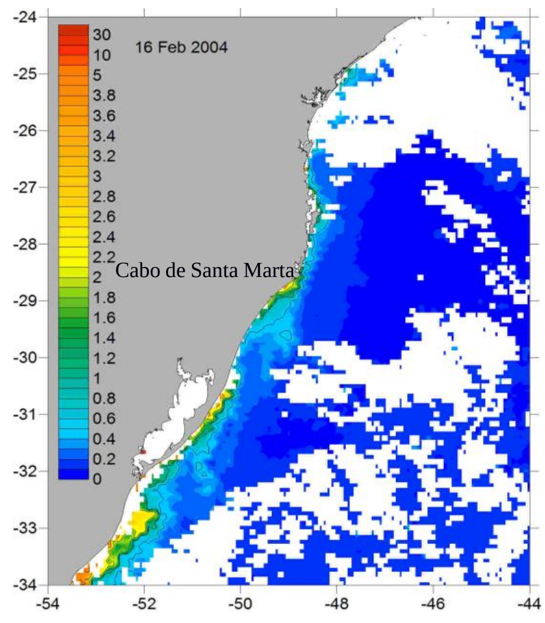
Dados Cruzeiro La Plata: o que ocorre quando as Águas do Prata vão para o Sul?

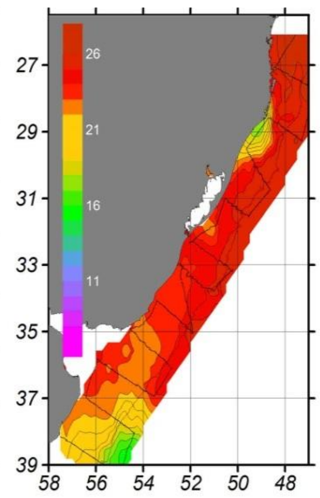


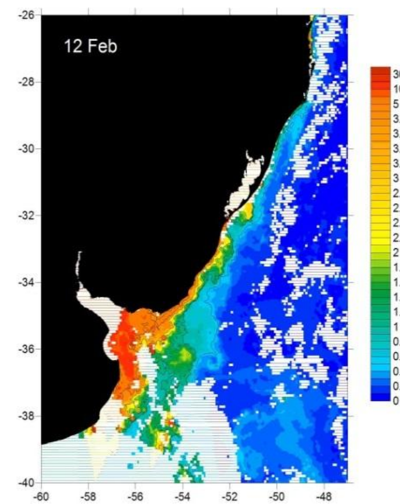


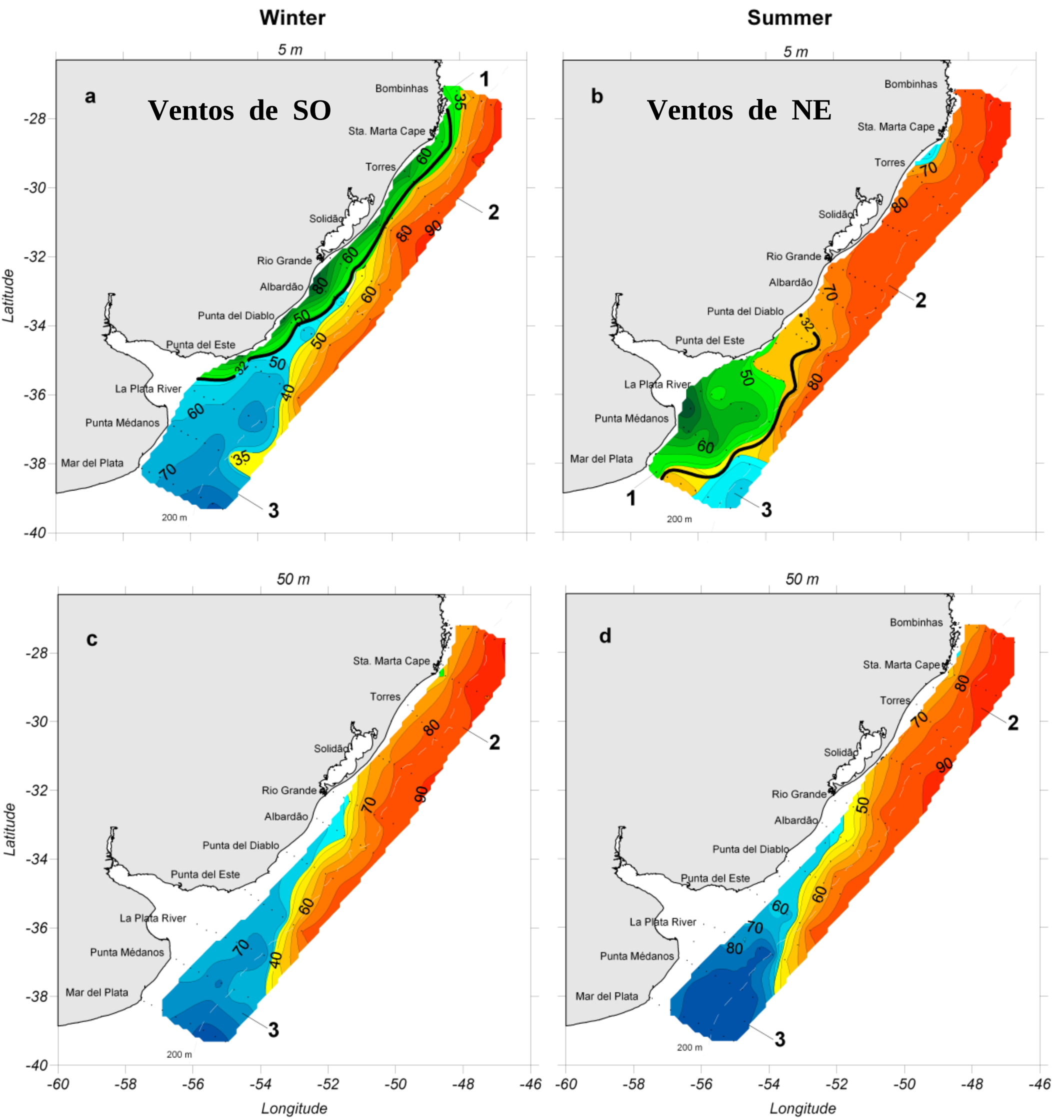












Möller et al. (2008)

Os percentuais de cada massa de água indicam, em superfície, que a circulação é dirigida pelo vento:
a) Deslocamento da APP;
b) ressurgência no CSM quando la APP não está presente.
Se observa a presença de águas subantárticas de plataforma e a FSTP no inverno.

En 50 m se observa a presença de aguas subantárticas de plataforma em inverno e verão. Se supõe que este proceso não tenha relação con o "vento local". Palma et al. (2008) indicam que as entradas a ASAP são devidas aos gradientes de pressão gerados pelo vento na plataforma Argentina e pela intensidade da Corrente de Malvinas

Water Mass	Winter		Summer	
	Termohaline Interval	% of Total Volume (*14.285 km³*)	Termohaline Interval	% of Total Volume (*14.338 km³*)
CW/PPW	T>11^o C & S≤33.5	**23**	T>11^o C & S≤33.5	**12**
TW	T ≥18.5^{o}C & S≥36	**8**	T ≥18.5^{o}C & S≥36	**20**
STSW	T >15^{o}C & 33.5<S<35.5 T >18^{o}C & 35.5<S<36	**20**	T >18^{o}C & 34.5<S<36 T >21^{o}C & 33.5<S<34.5	**18**
SASW	T≤14^{o}C & 33.5<S≤34.5	**32**	T≤21^{o}C & 33.5<S≤34.5	**29**
SACW	T≤18.5^{o}C & S≥35.5	**14**	T≤18.5^{o}C & S≥35.5	**18**

Conclusions and Remarks

-The Plata/Patos outflows induce an extraordinary impact on the continental shelf off Uruguay and southern Brazil.

- The low salinity near-coastal plume presents very large seasonal variations. In winter it can extend beyond 1000 km from the Plata estuary.

- Freshwater dominated continental shelf:

A) In areas where river discharge influences Subtropical Shelf waters are kept away from the coastal region.

B) When the influence of freshwater decreases NE wind action can induce a coastal upwelling system near Cabo de Santa Marta.

-The seasonal variation of the wind is the most important factor for the plume dynamics:

A) SW winds dominating in winter force the northward spreading of the plume to low latitudes even during low river discharge periods.

B) NE winds retain the plume in the southern area and spreads it all over the entire width of the continental shelf east of the estuary. The coastal upwelling observed near Cabo de Santa Marta is another important effect of NE winds.

-**Winds also exert an important effect on the transversal circulation of the continental shelf**

-**Two types of fronts are observed in the region: a haline front – La Plata river waters front and a thermo-haline front, the STSF.**

- There is a large seasonal variation in the volumes of water masses that occur in this area

NEXT STEPS

Time series of salinity and water level, current velocity measured at specific points with Cs and ADCPs to analyse the time and space variability of stratification and the way coastal waters respond to wind action.

Modeling

Cruises

Remote sensing

SACC – South Atlantic Climate Change Consortium – glaucus.fcien.edu.uy/pcmya/sacc