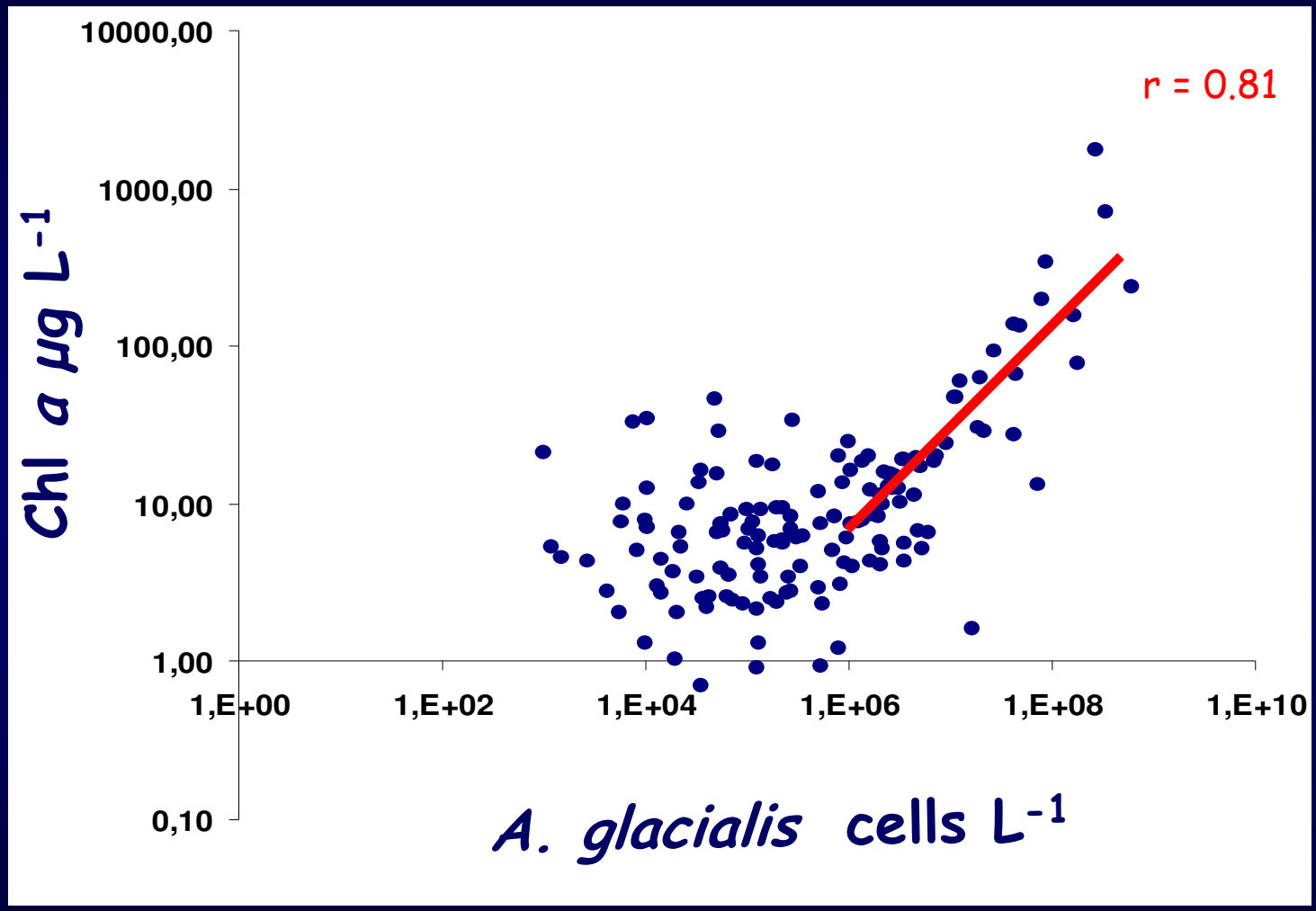
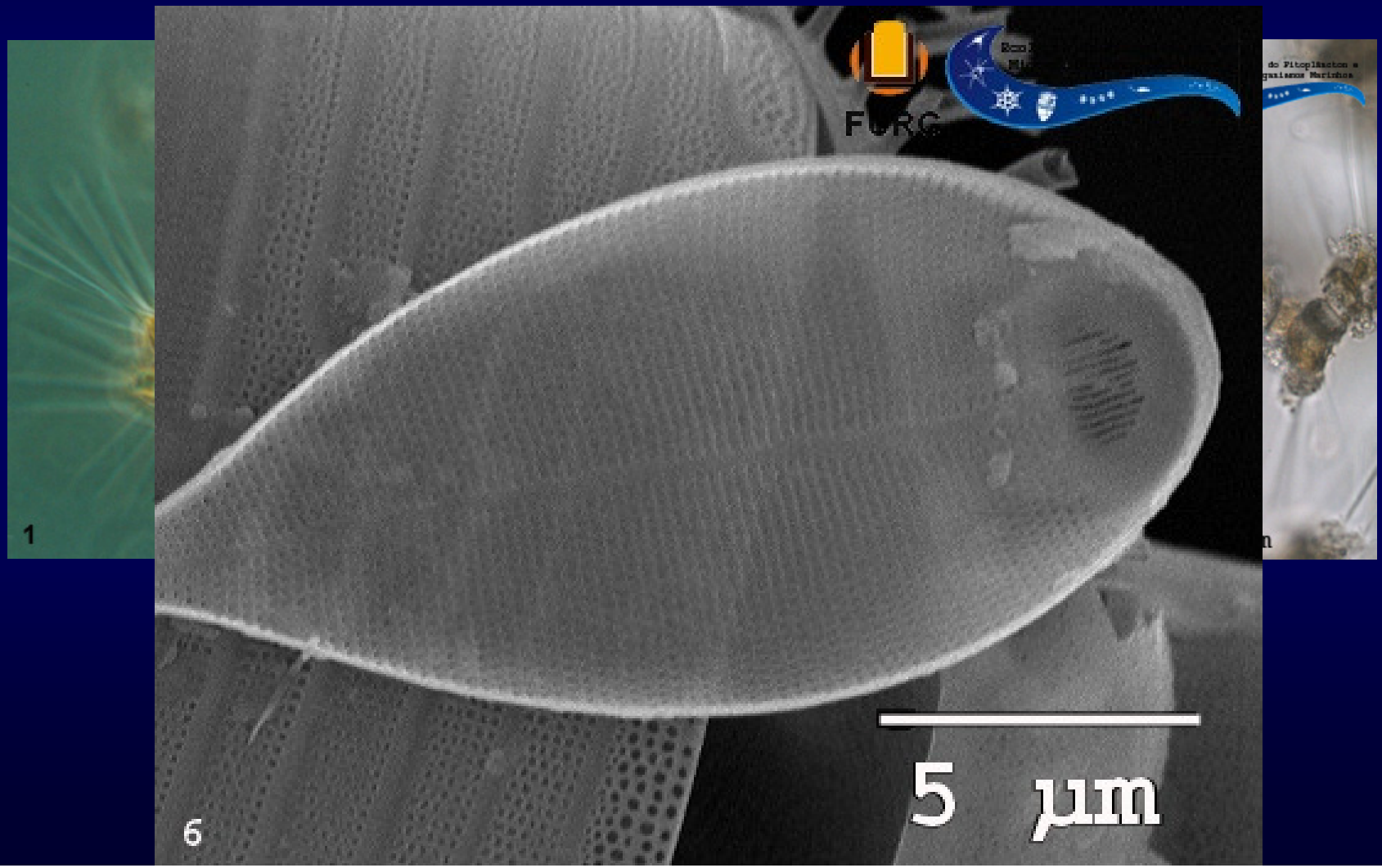
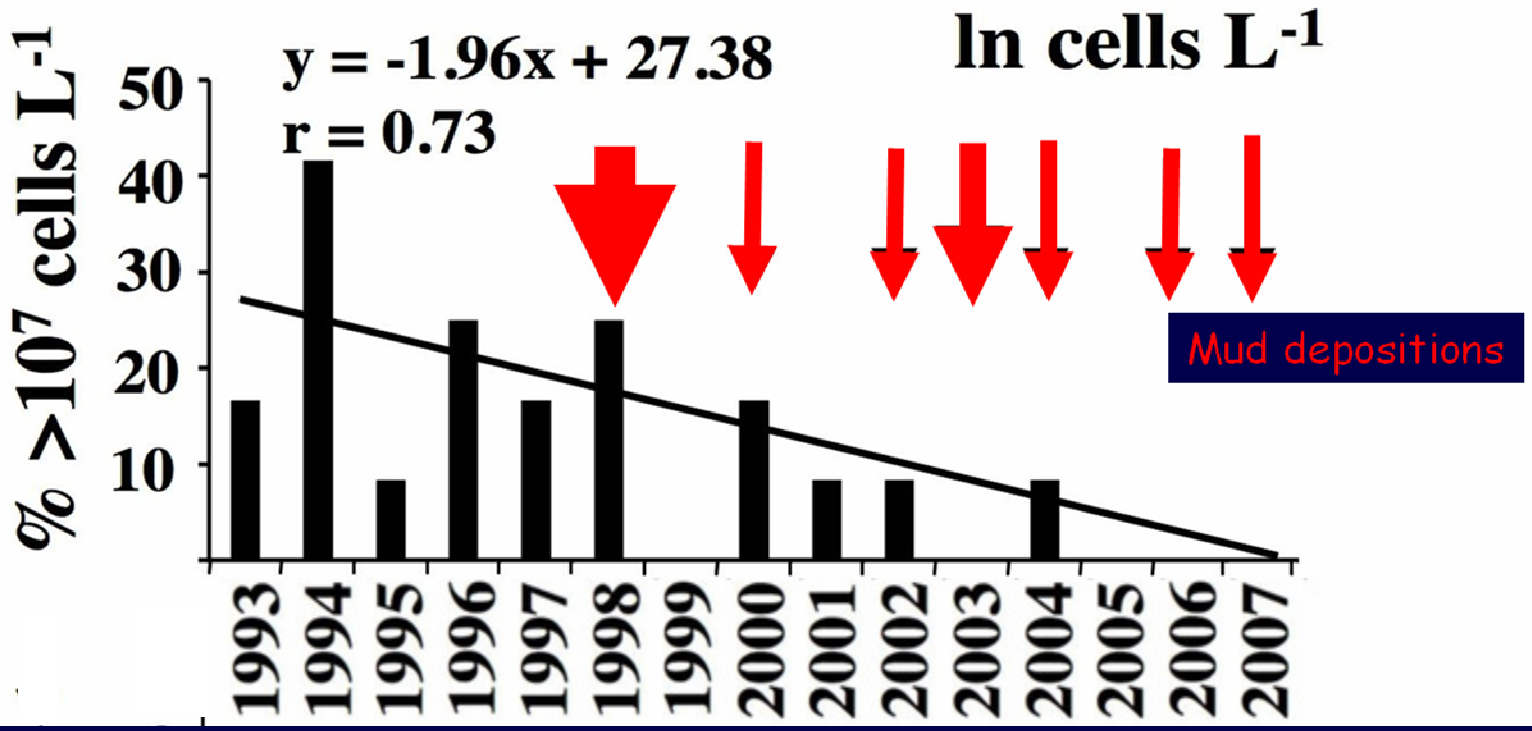
# Diatomáceas da zona de rebentação:

# Variação temporal (1993-2007)

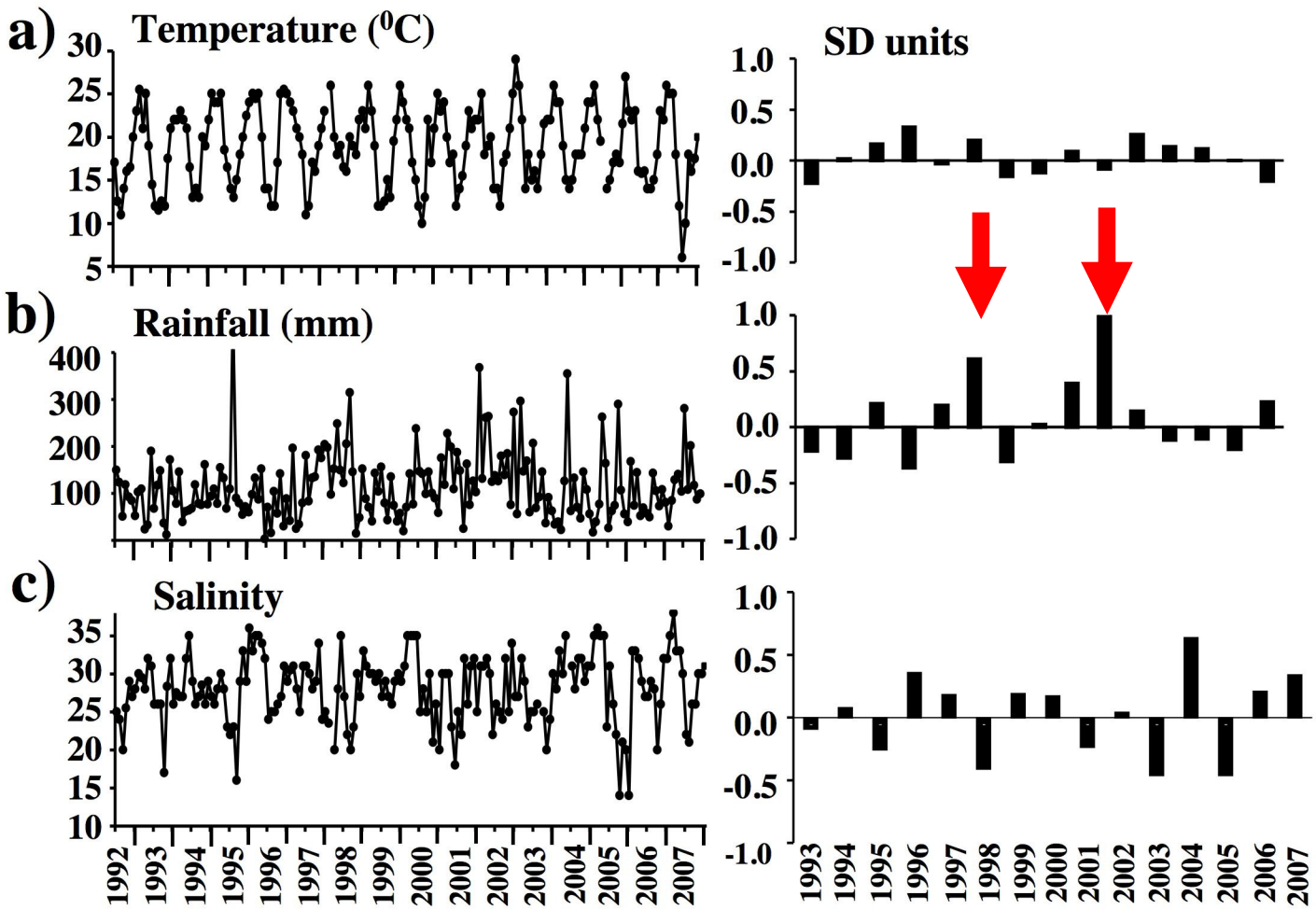

10000,00
1000,00
100,00
10,00
1,00
0,10
Chl a µg L-1
r = 0.81
1,E+00
1,E+02
1,E+04
1,E+06
1,E+08
1,E+10
A. glacialis cells L-1

# Mucus production



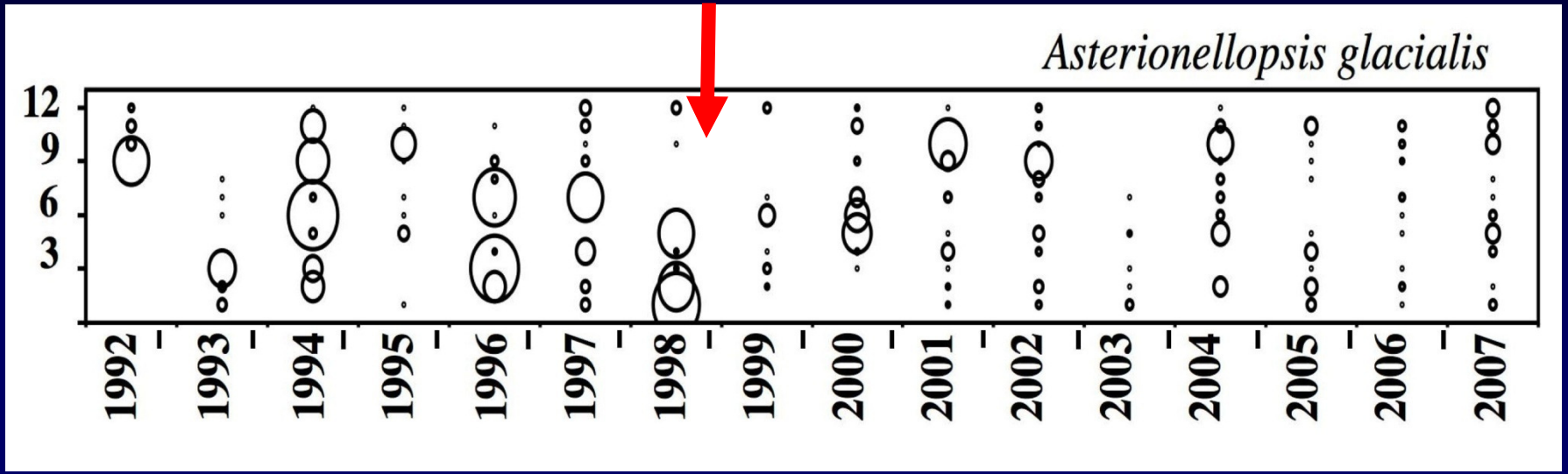



Odebrecht, Bergesch, Rörig, Abreu. Estuaries and Coasts. 2010.


a)
Temperature (⁰C)
30
25
20
15
10
5
SD units
1.0
0.5
0.0
-0.5
-1.0
b)
Rainfall (mm)
400
300
200
100
1.0
0.5
0.0
-0.5
-1.0
c)
Salinity
35
30
25
20
15
10
1.0
0.5
0.0
-0.5
-1.0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007

## Group I

## Change of pattern




## Stepwise regression

(+) Chl *a*

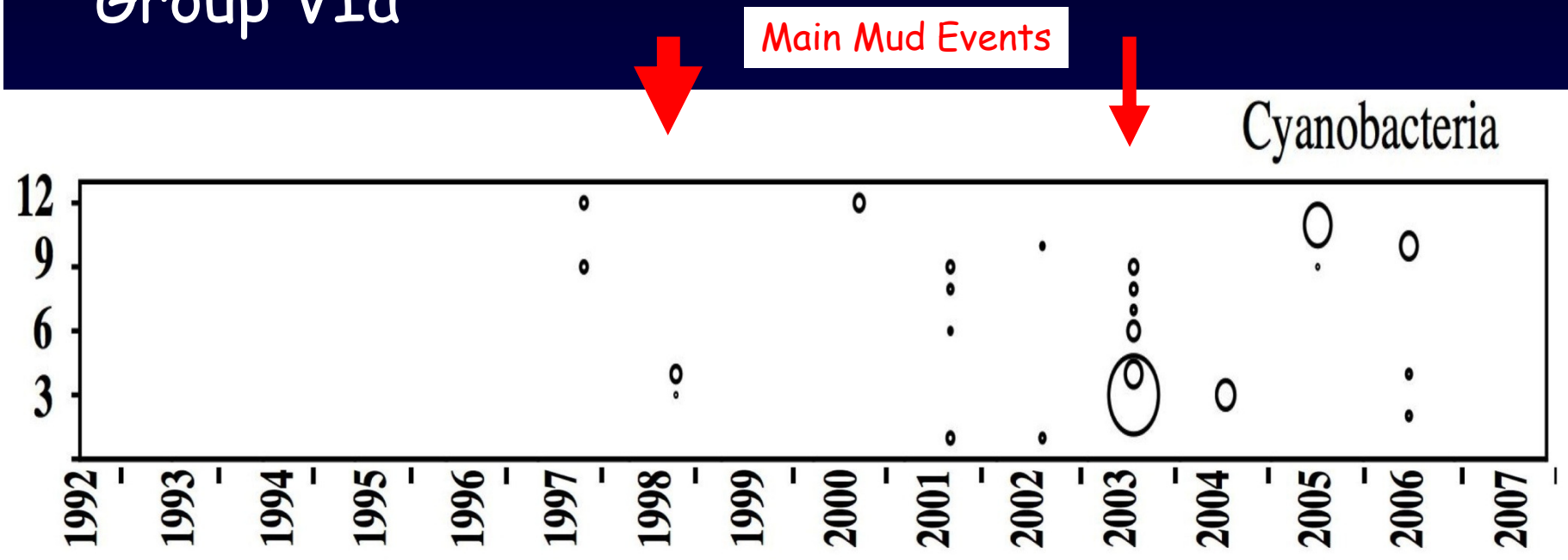
(-) Secchi disk

(-) Silicate

(-) DIN

r 0.41; p <0.05

# Group VIa




## Stepwise regression

(+) Water temperature

(-) Chl *a*

(-) Salinity

r 0.34; p <0.05

## Praia Cassino - EMA

Longo Prazo

Principal Distúrbio para as Microalgas

Meteorologia: tempestades/ressacas

**Eventos de Lama**

Efeitos na trama trófica ??

Variação espacial ??

Ao longo da praia: Tese Fernanda

E ao largo da praia ??

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Ecologia do Fitoplâncton e Microorganismos Marinhos
4

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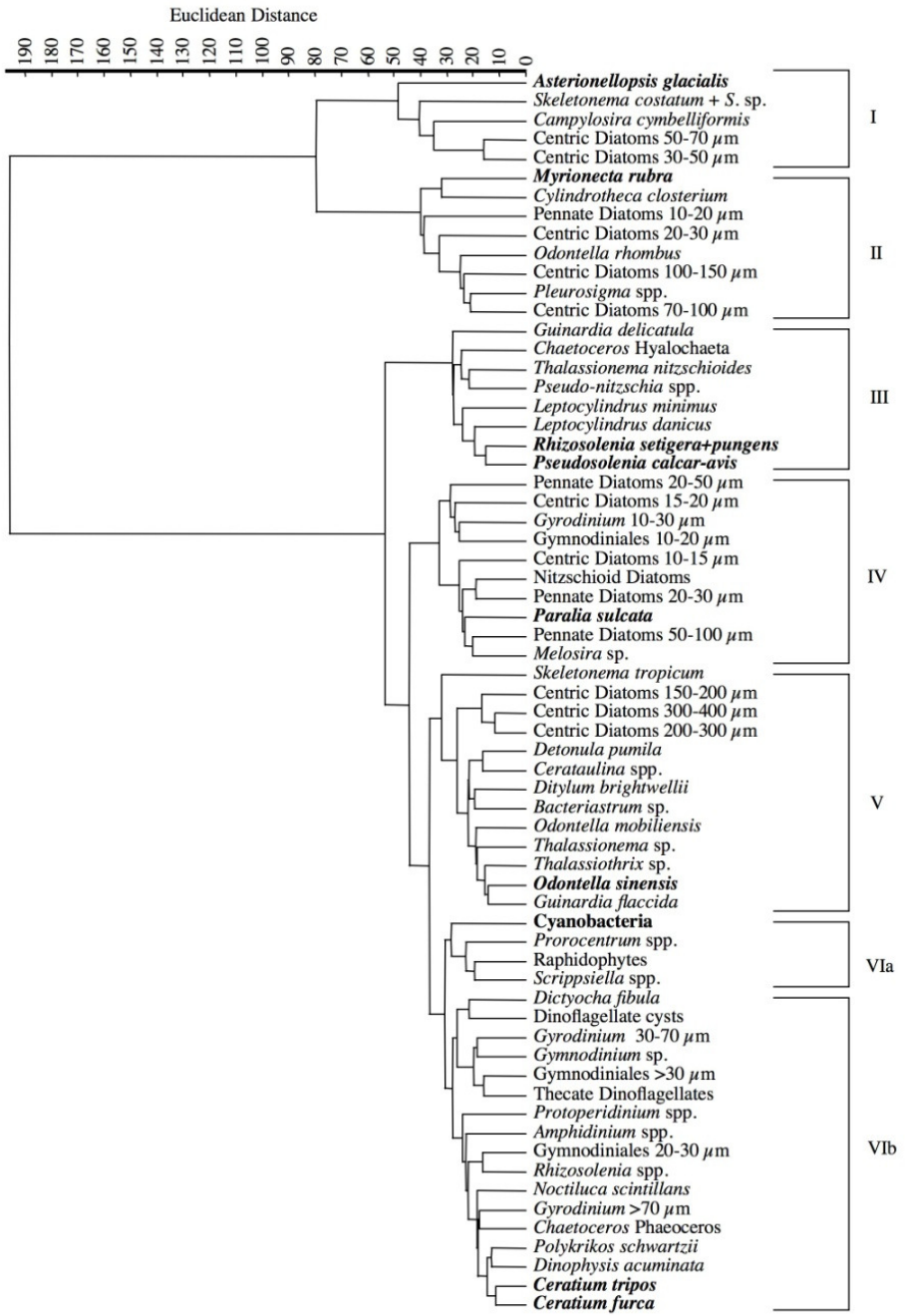
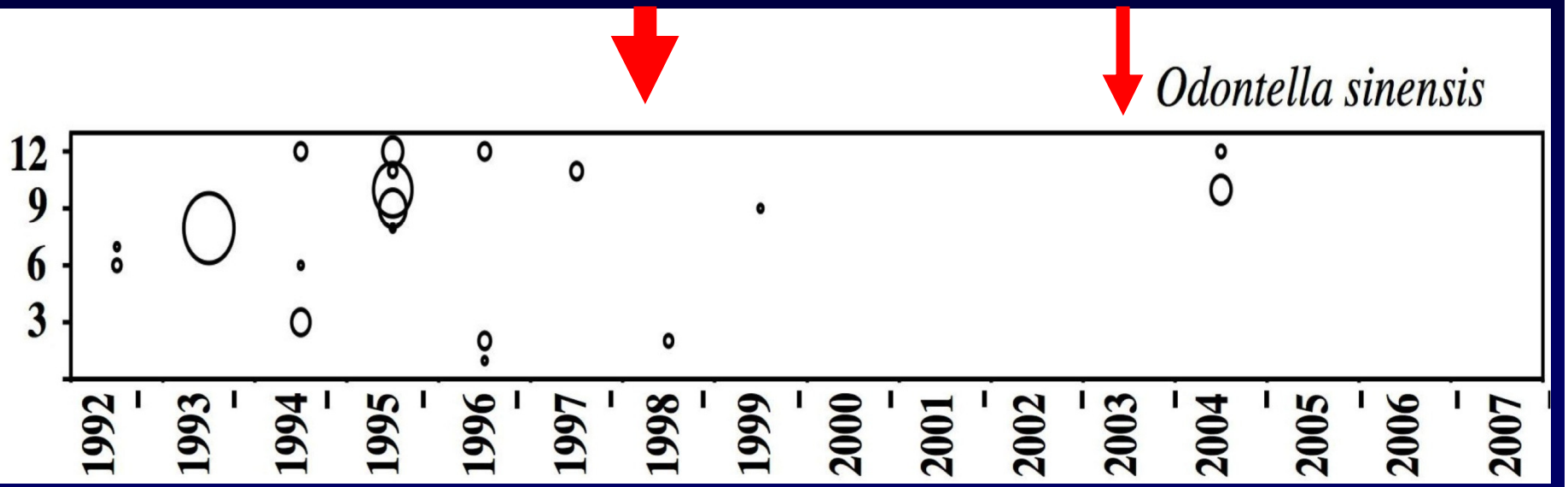
Ecologia do Fitoplâncton e Microorganismos Marinhos
3




Dendogram showing 6 groups differentiated by cluster analysis (significative $p<0.001$, Mantel's test)

# Group V



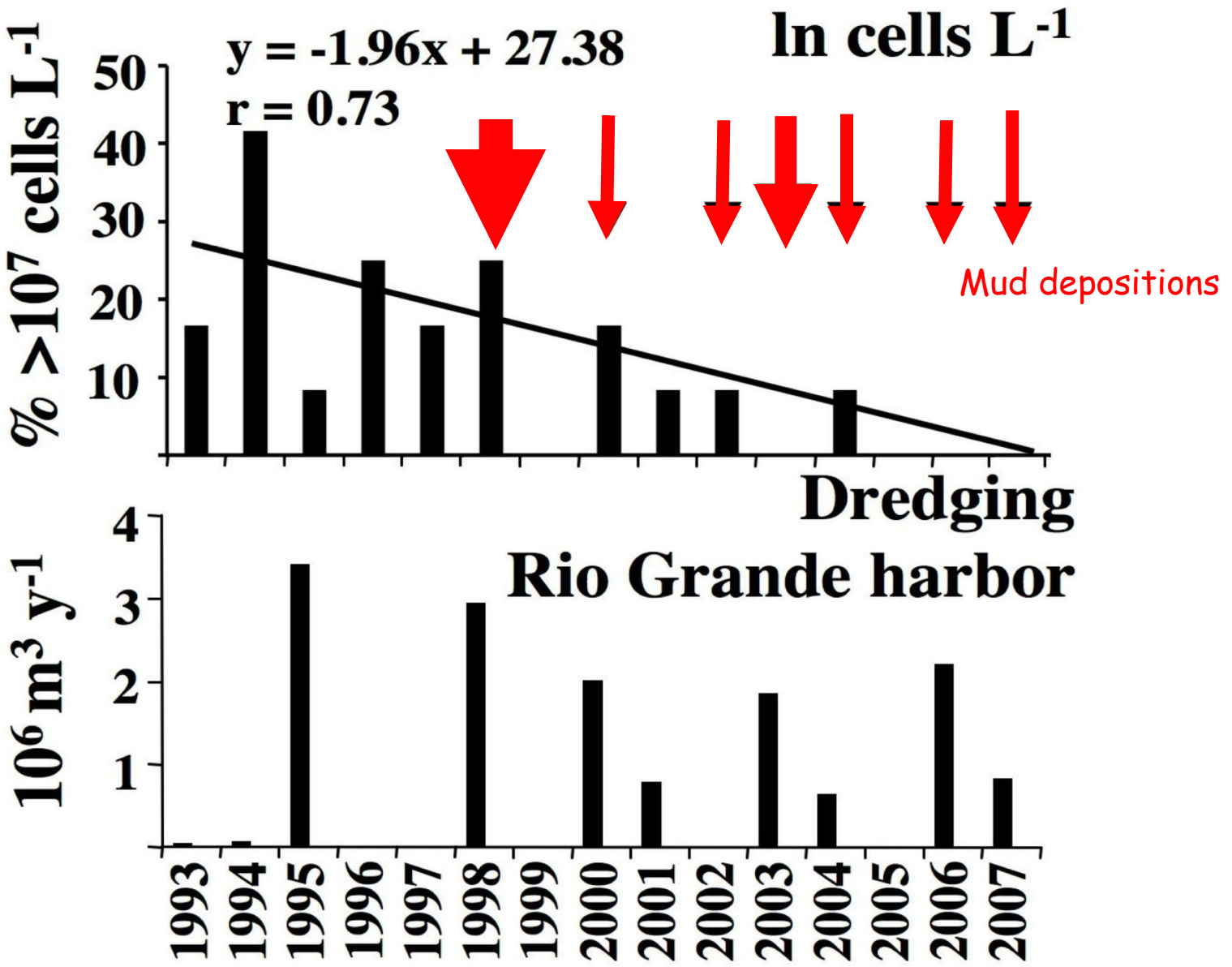

## Stepwise regression

(+) Water temperature

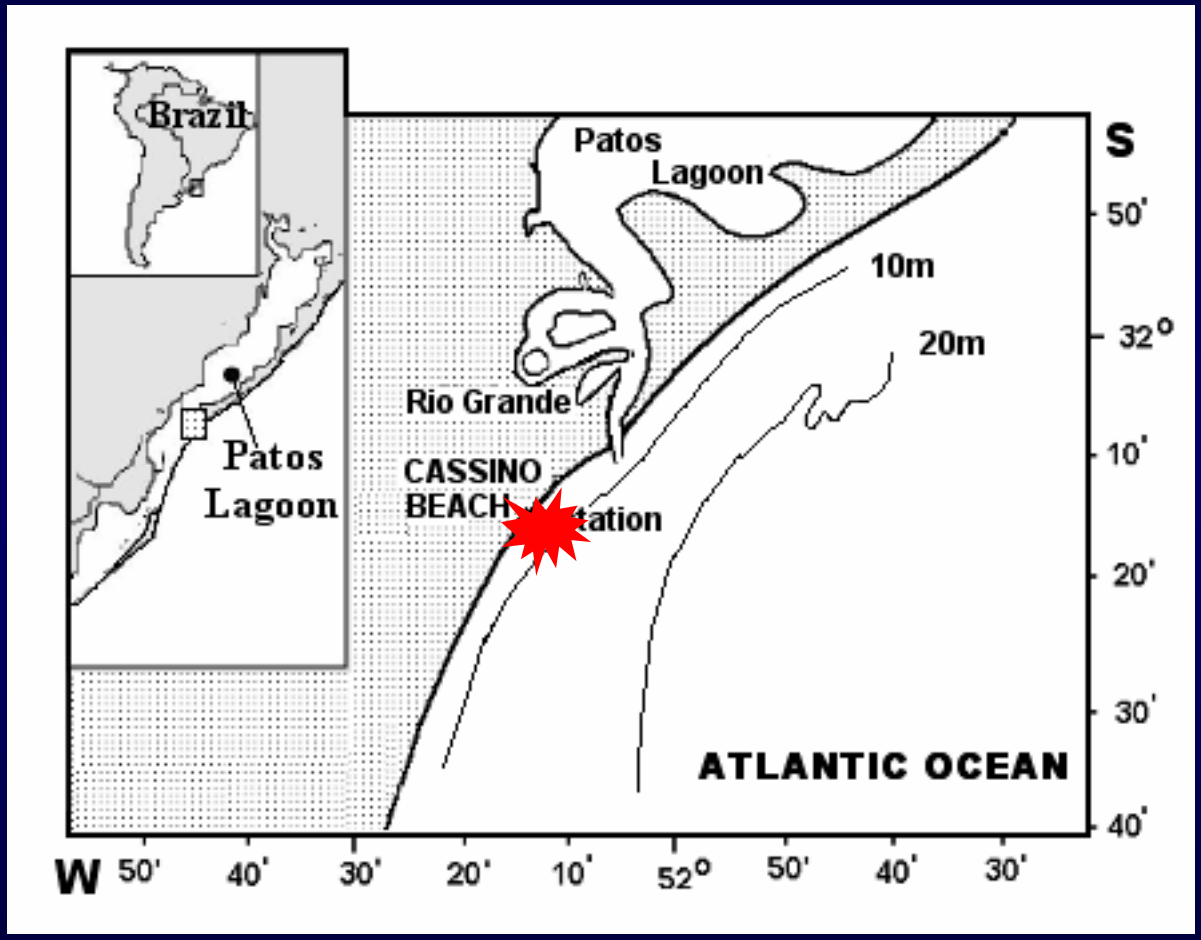
(-) N : Si

(-) Nitrate

*r 0.38; p <0.05*


y = -1.96x + 27.38
r = 0.73
ln cells L-1
% >10^7 cells L-1
50
40
30
20
10
Mud depositions
Dredging
Rio Grande harbor
10^6 m^3 y-1
4
3
2
1
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007

# Cassino Beach - EMA




Sampling station: 12 km south the western jetty

Monthly sampling: 1994…….

# Dinoflagellates

*Noctiluca scintillans*

June 2007, December 2008

# Measured Variables

- ✓ **Environmental data**
  Salinity, Temperature, Secchi;
  DIN (silicate, phosphate, nitrate, nitrite, ammonium);
  Chlorophyll *a*.

- ✓ **Phytoplankton** Abundance, Composition
  Inverted microscope, classical method.

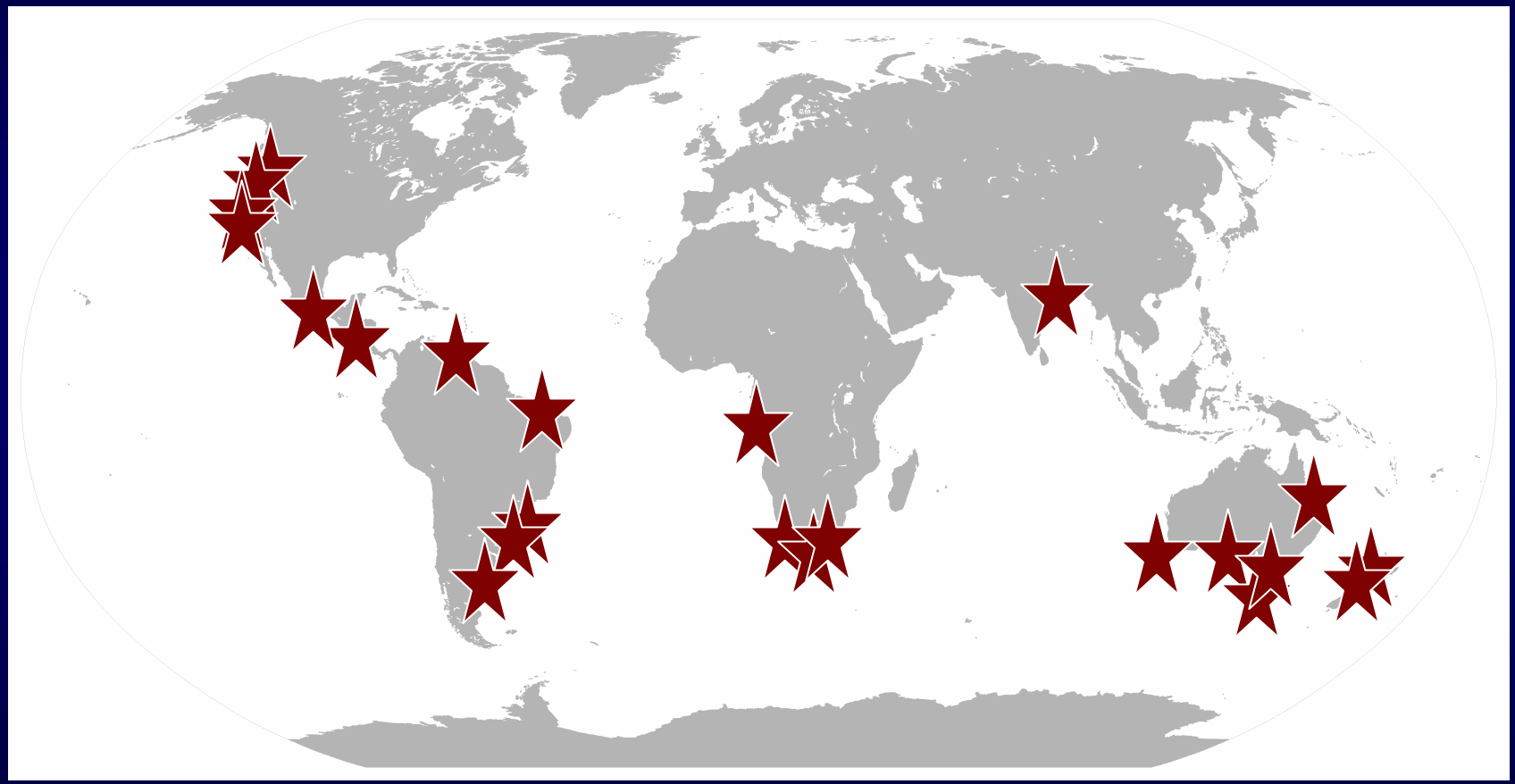
## "Normal" surf-zone

## 1998-1999 Mud Event

*Fonte: Lauro Caliari*

- Damping of wave energy at a distance of 6 km offshore.
- Due to high viscosity of bottom sediments.
- The damping effect lasted 14 months (January 98 - April 1999).

Several sandy beaches: High Biological Production growth and accumulation of Surf Zone Diatoms



## Characteristics of beaches with Surf zone diatoms accumulations

Long sandy beaches

Moderate to high wave energy

Rip current activity

Associated dune system

Nutrient input by ground water

Nutrient input through increased urbanisation

Campbell & Bate 1990, 1991a, 1991b; Campbell 1996

In the Surf Zone Microalgae are subject to disturbances at different scales

In the short-term

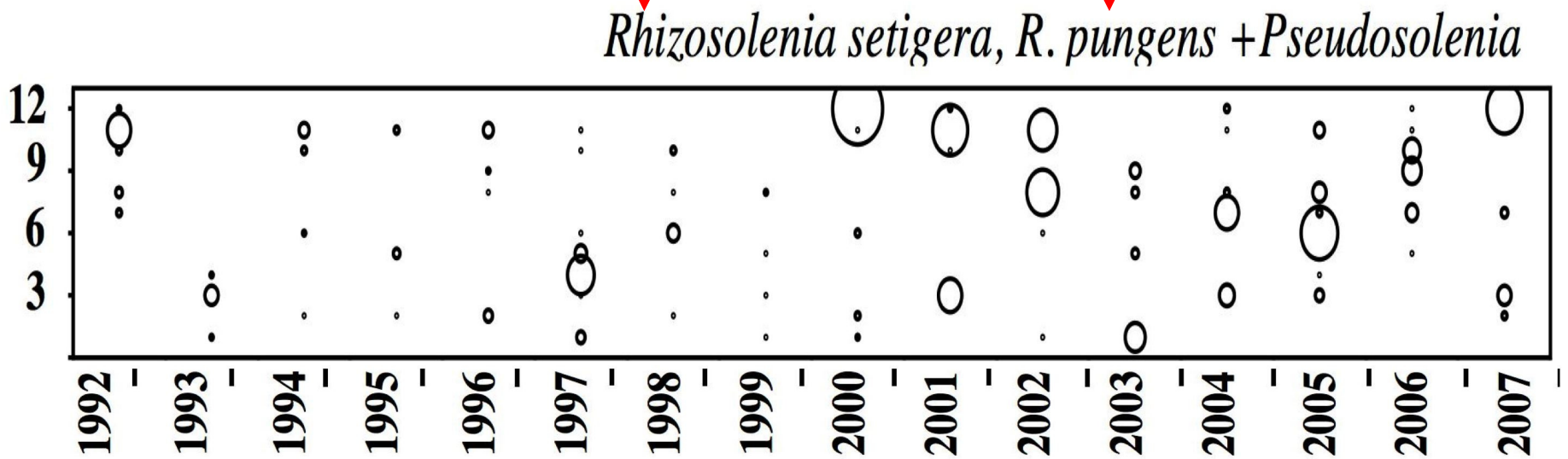
the wind action plays a major role

# Cyanobacteria

***Trichodesmium erythraeum*** March 2004

# Group III

Main Mud Events




## Stepwise regression

(-) Salinity

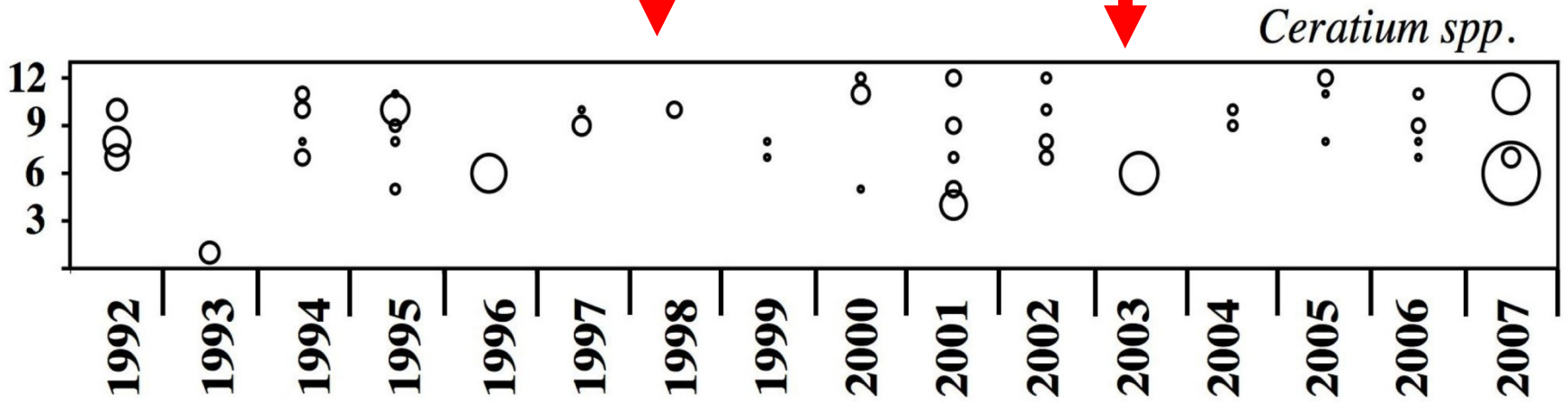
(+) Secchi disk

(+) Phosphate

r 0.32; p <0.05

# Group VIb

Main Mud Events




## Stepwise regression

(-) Salinity

(-) Chl *a*

(-) Silicate

(-) Secchi disk

(-) N : Si

(-) N : P

(+) Ammonium

(+) Si : P

*r 0.63; p <0.05*

# Cassino Beach surf zone

Sampling with a bucket

# CB Short term: 2 d

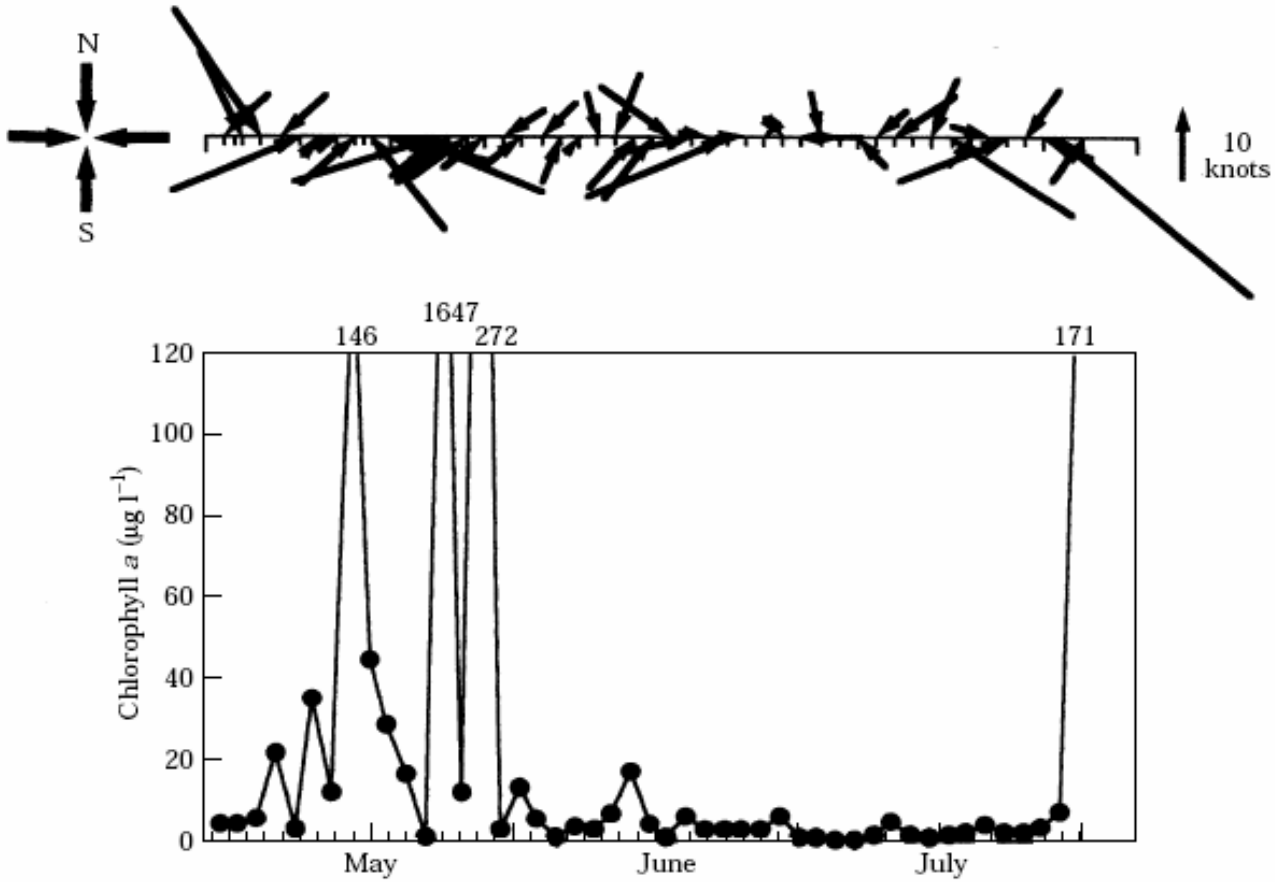
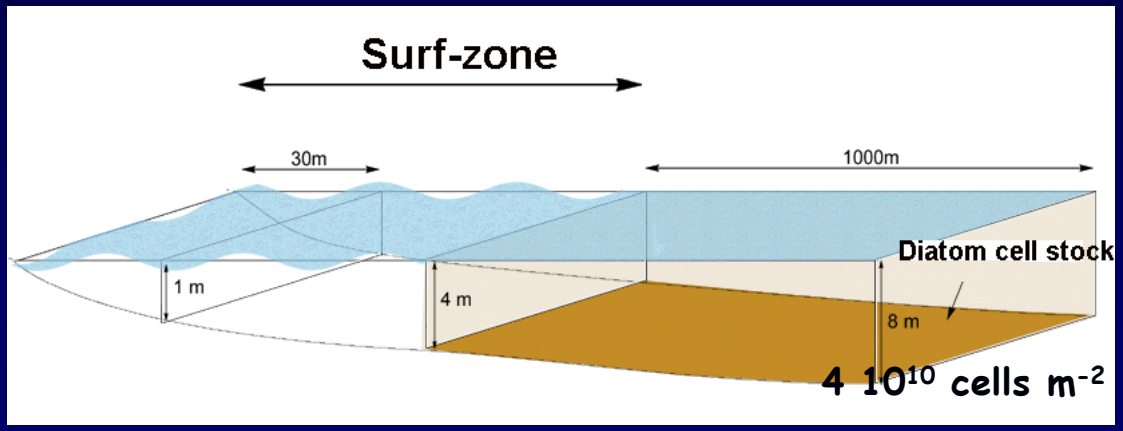



Figure 4. Chlorophyll *a* concentration, wind direction and velocity from 30 April to 31 July 1987 at Cassino Beach, southern Brazil.

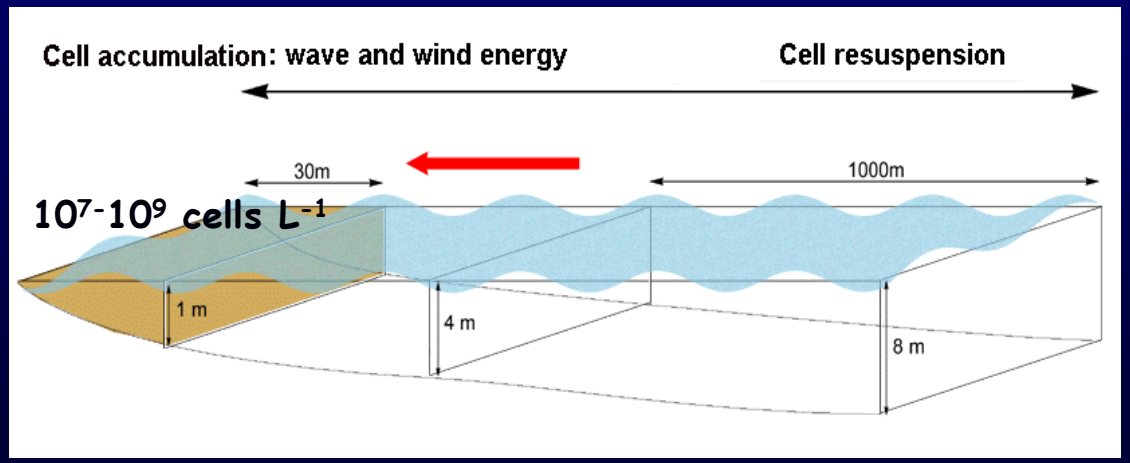
# Importance of southerly winds / storms

# *A. glacialis* accumulation process: CB

## Calm Periods

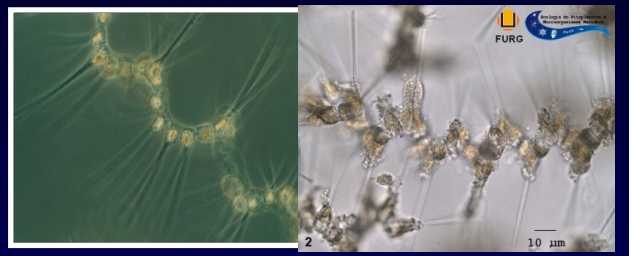


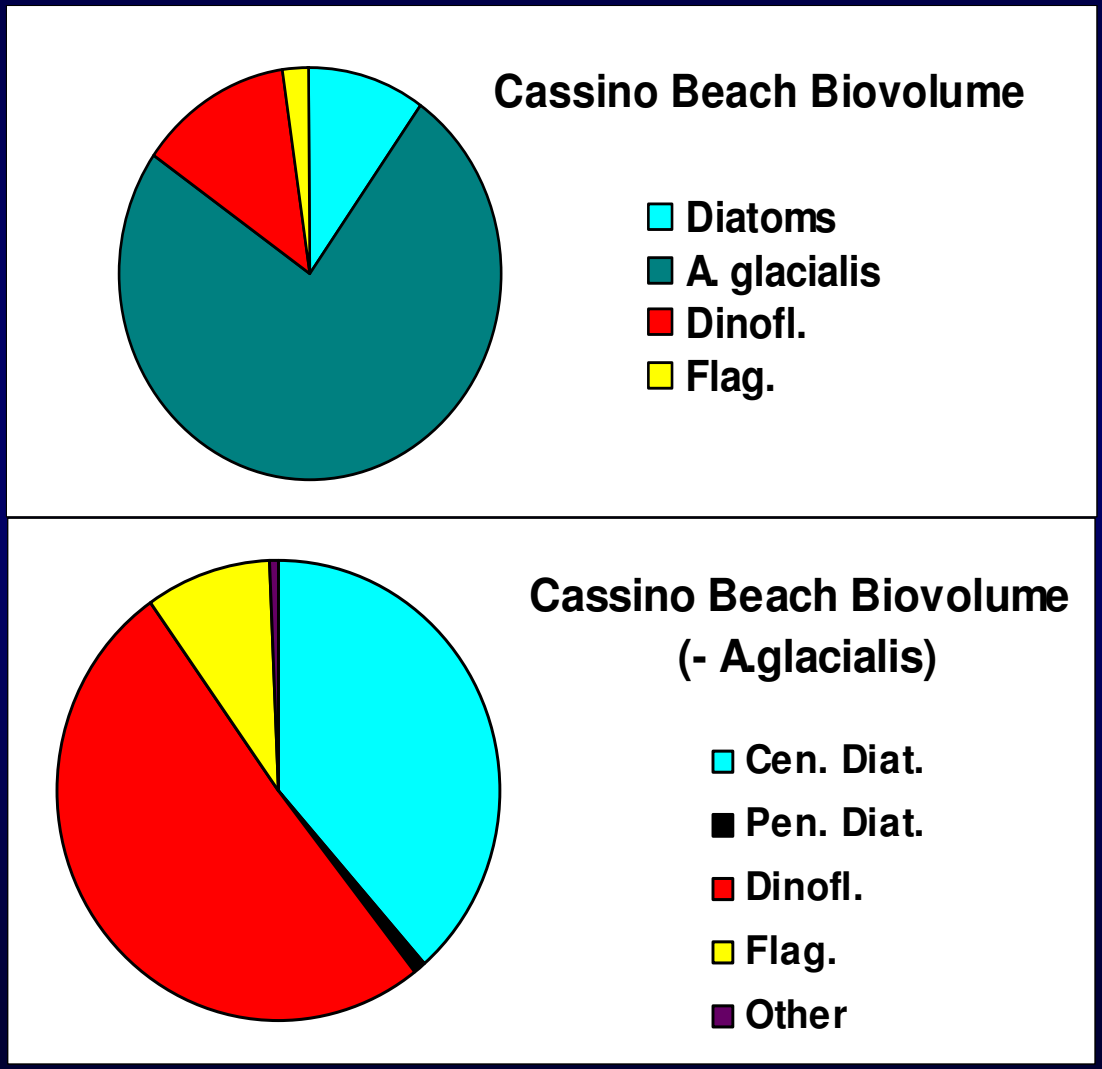

## Periods of high energy (storms SW wind)




(adapted fromTalbot et al. 1990)

# *A. glacialis* = Key Species




Max. Concentr.

$10^9$ cells $L^{-1}$

Chl *a*

4,7 mg $L^{-1}$

Pr. Production

6,4 mg C $L^{-1}$ $h^{-1}$

*Fonte: Lauro Caliari*

Fluid mud **bank**

**Cassino Beach**

**May 09, 2003**

Mud banks on the **foreshore**

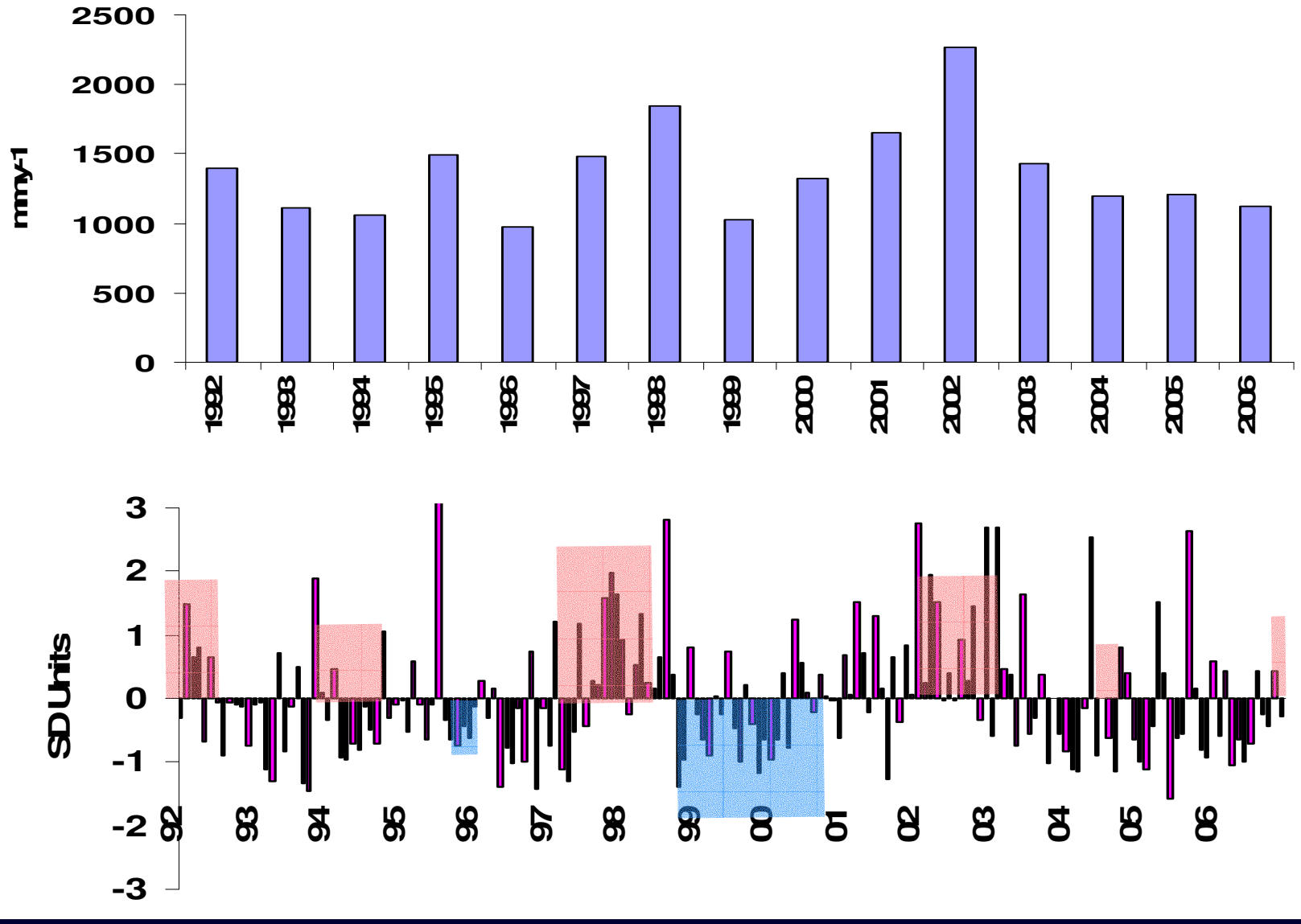
along 10 Km of Cassino Beach

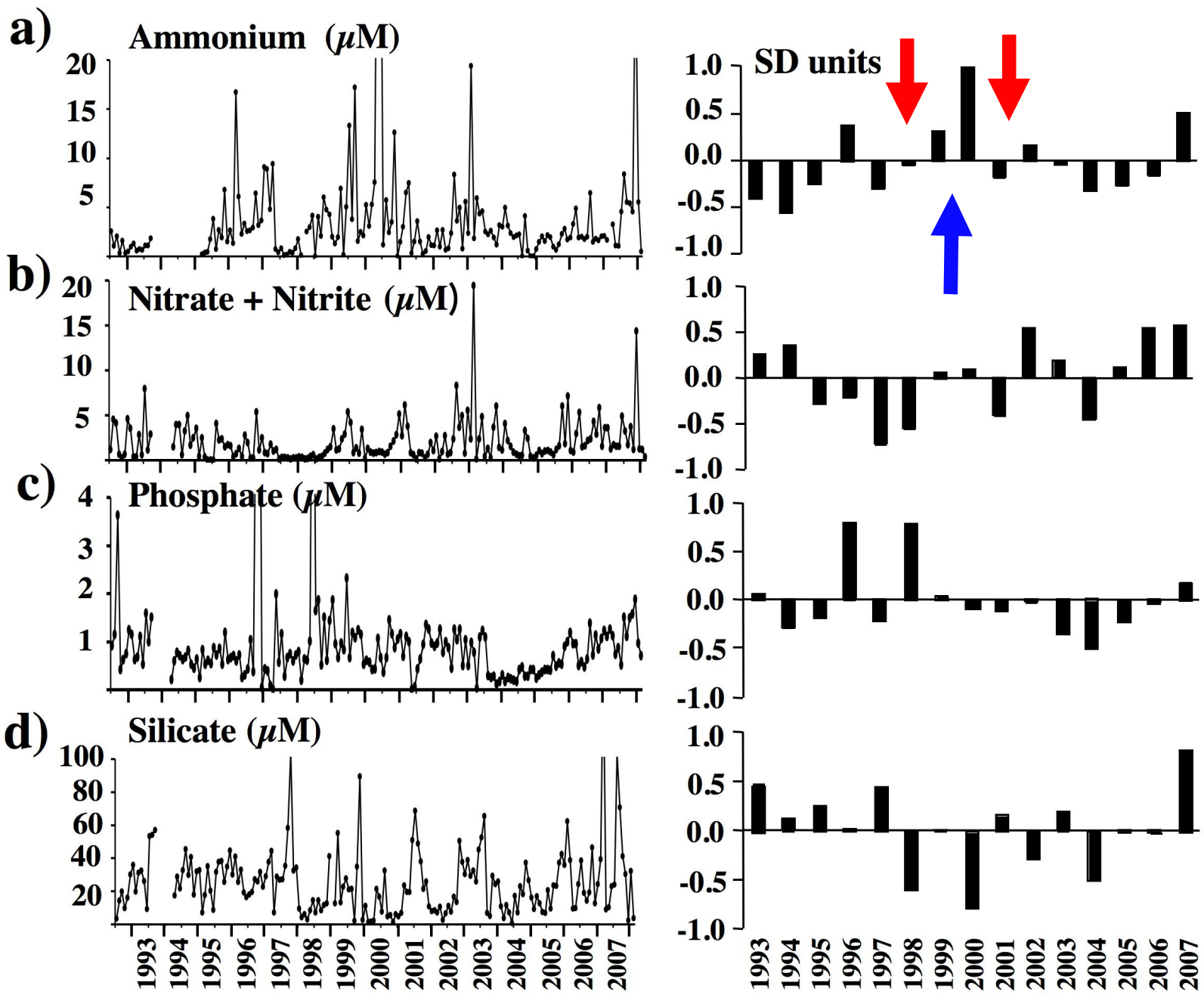
In the **surf zone fluid mud**

(5 m water depth)

# Long term

## *El Niño* Southern Oscillation influences Rainfall




a)
Ammonium (μM)
20
15
10
5
b)
Nitrate + Nitrite (μM)
20
15
10
5
c)
Phosphate (μM)
4
3
2
1
d)
Silicate (μM)
100
80
60
40
20
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
SD units
1.0
0.5
0.0
-0.5
-1.0

# Other Coastal Hazards of mud deposition

## Mortality of mollusks and crustaceans

Clogging the respiratory mechanism
Imobilization/burial of mollusks, crustacea and other filter feeders.
Seabirds stucked in the mud.

| $10^7$ cells $L^{-1}$ | $10^6$ cells $L^{-1}$ | $10^5$ cells $L^{-1}$ | $10^4$ cells $L^{-1}$ | $10^3$ cells $L^{-1}$ |
|---|---|---|---|---|
| ***A. glacialis*** | **Flagellates <10µm** | ***Skeletonema* spp.** | ***Campylosira cymbelliformis*** | *Bacteriastrum* spp. |
| | | *S. tropicum* | *Chaetoceros* Hyalochaeta | *Cerataulina bicornis* |
| | | **Dinoflagellates** | *Cylindrotheca closterium* | *Cerataulina pelagica* |
| | | **Flagellates** 10-20µm | *Guinardia delicatula* | *Chaetoceros socialis* |
| | | | *Leptocylindrus danicus* | *Chaetoceros subtilis* |
| | | | *Leptocylindrus minimus* | *Dactyliosolen fragilissimus* |
| | | | Diatoms-Centric <20µm | *Detonula pumila* |
| | | | **Diatoms-Centric** 20-100µm | Diatoms-Nitzschioid |
| | | | Diatoms-Pennate <20µm | **Diatoms-Pleurosigmoid** |
| | | | Gymnodiniales <20µm | *Hemiaulus* spp. |
| | | | Euglenophytes | ***Odontella* spp.** |
| | | | Raphidophytes | *Paralia sulcata* |
| | | | Cyanobacteria Trichomes | **Diatoms-Pennate** 20-100µm |
| | | | | *Pseudo-nitzschia* spp. |
| | | | | *Rhizosolenia setigera* complex |
| | | | | *Thalassionema nitzschioides* |
| | | | | *Thalassiosira* spp. |
| | | | | *Akashiwo sanguineum* |
| | | | | *Alexandrium* spp. |
| | | | | *Amphidinium* spp. |
| | | | | ***Gyrodinium* spp.** |
| | | | | *Prorocentrum* spp. |
| | | | | *Protoperidinium* spp. |
| | | | | *Scrippsiella trochoidea* |
| | | | | Gymnodiniales 20-50µm |
| | | | | Thecate Dinoflagellates <20µm |
| | | | | Thecate Dinoflagellates >20µm |
| | | | | *Dictyocha fibula* |
| | | | | Cyanobacteria Chroococcales |
| | | | | *Microcystis* Colonies |
| | | | | *Planktolyngbia limnetica* |
| | | | | *Trichodesmium erythraeum* |
| | | | | Chlorophytes |
| | | | | Flagellates >20µm |
| | | | | *Myrionecta rubra* |

Average values of microalgae taxa at Cassino Beach.
In Rose, frequency of occurrence larger than 50%.
*Skeletonema* spp.: mainly *S. costatum* but also *S. pseudocostatum*.
*Rhizosolenia setigera* complex: *R. setigera* and *R. pungens*.

# Coastal Hazards: Beach usage

Mud is quickly covered by a fine sand layer

Tourism, Surfists

Jornal Ca

O jornal do seu balneário o ano

Ano IX - Nº 445 - SEMANÁRIO Rio Grande, sexta-feira, 30 de maio

Lama na praia coloca em risco a vida dos surfistas

FOTO: DIVULGAÇÃO

Surfistas encontram dificuldades para sair da água

Página 3

*Fonte: Lauro Calliari*

## •Mud Events: Natural x Anthropic (?)

**In the *long term*** natural influence is more important. PL is the source of sediments for the last 3,000 thousand years when the inlet was established. Mud event already registered in 1901!

***However, in the last 50-100 years***

man induced erosion increased drastically in drainage basin!

harbor dredging / channel deepening!

inlet fixation !

•***El Niño episodes:*** amplification effect !!

## Examples tell us about
## Vulnerability of beaches
## Importance of long term studies

Thanks

for your attention

Laboratório de
Ecologia do Fitoplâncton & Microorganismos Marinhos