Decadal changes in carbon budget of a SW Atlantic estuary: Coupling between a drop in plankton biomass and the erosion of salt marshes

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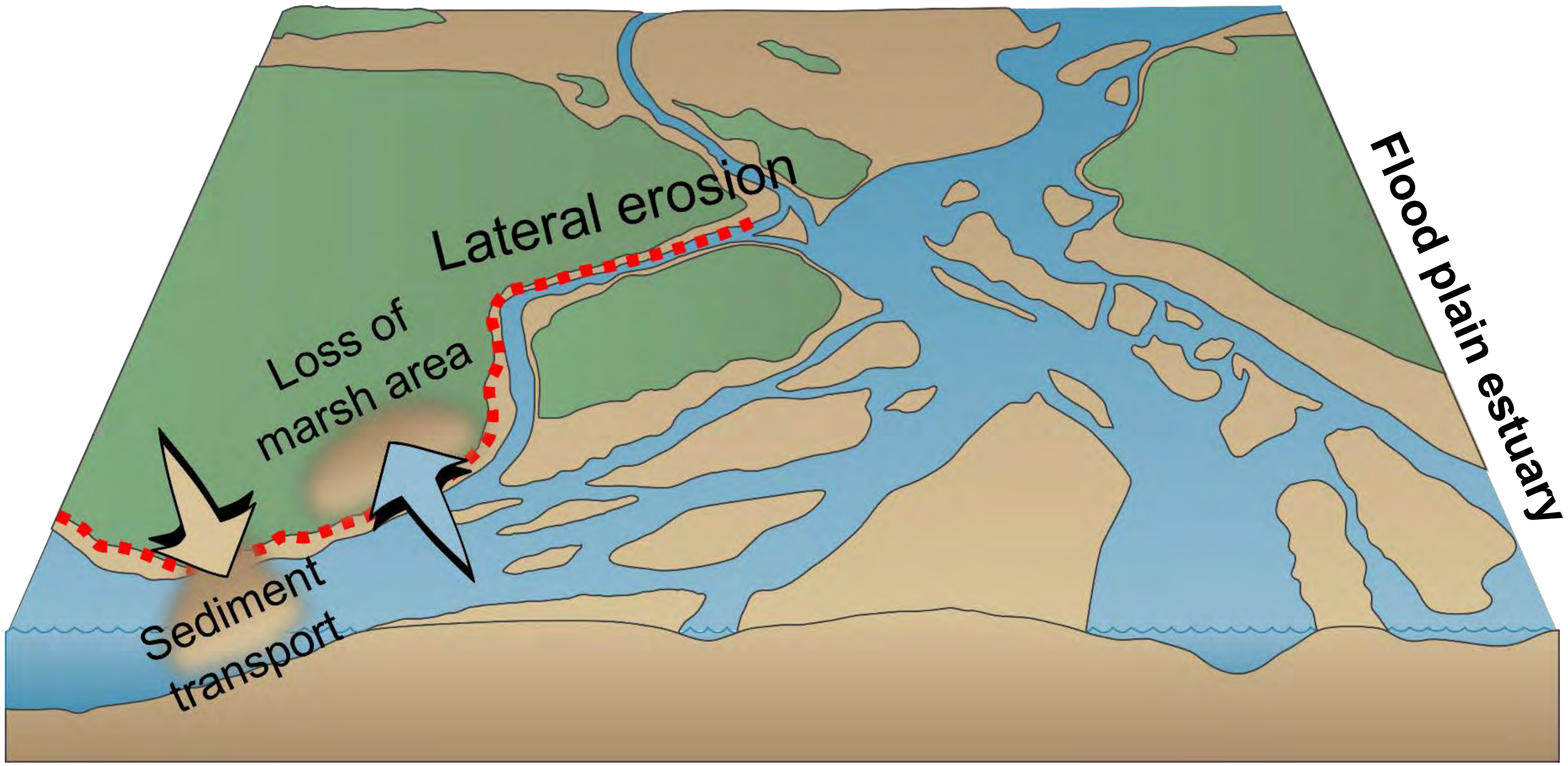
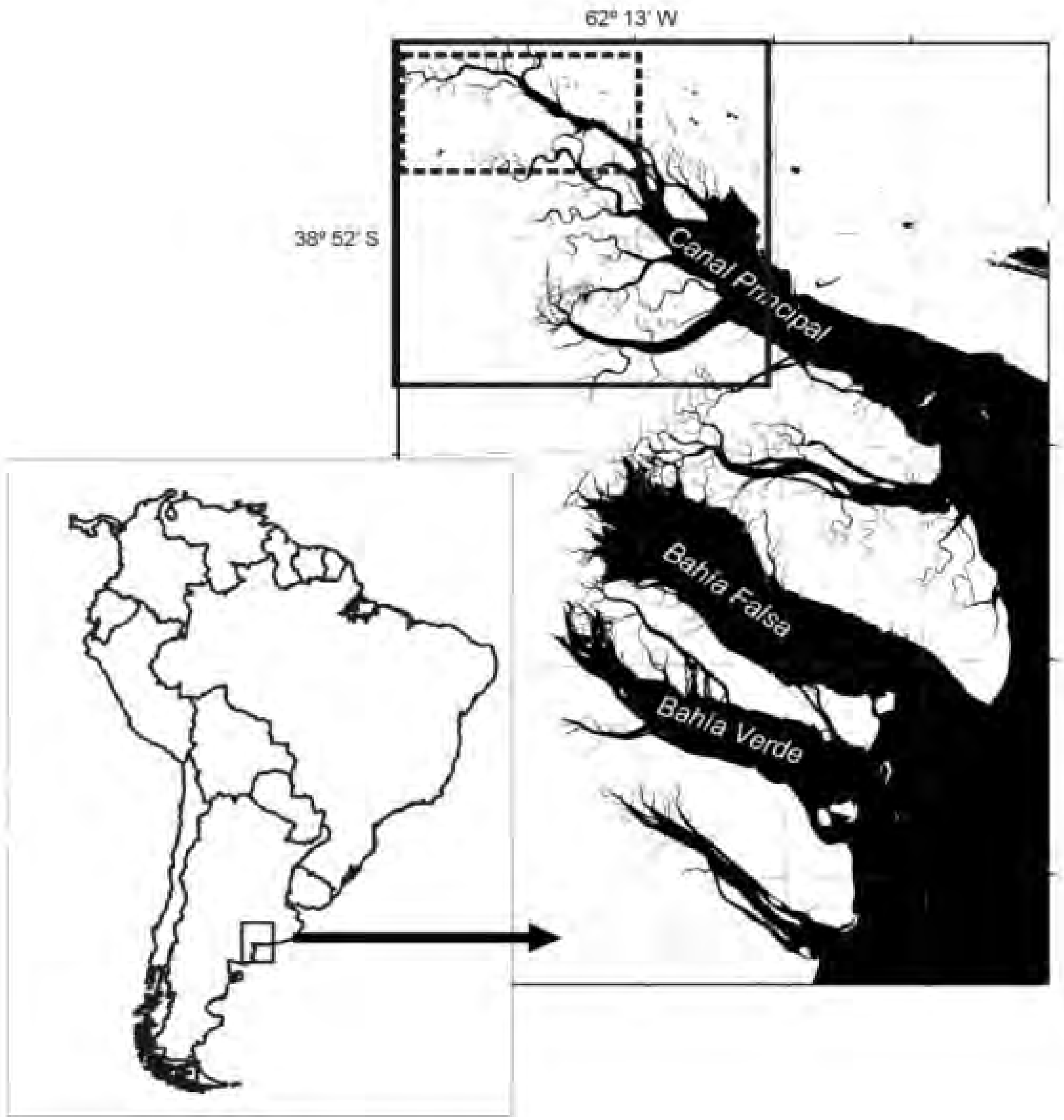
Coastal ocean processes are characterized by the exchange of energy and material across landforms and the water column

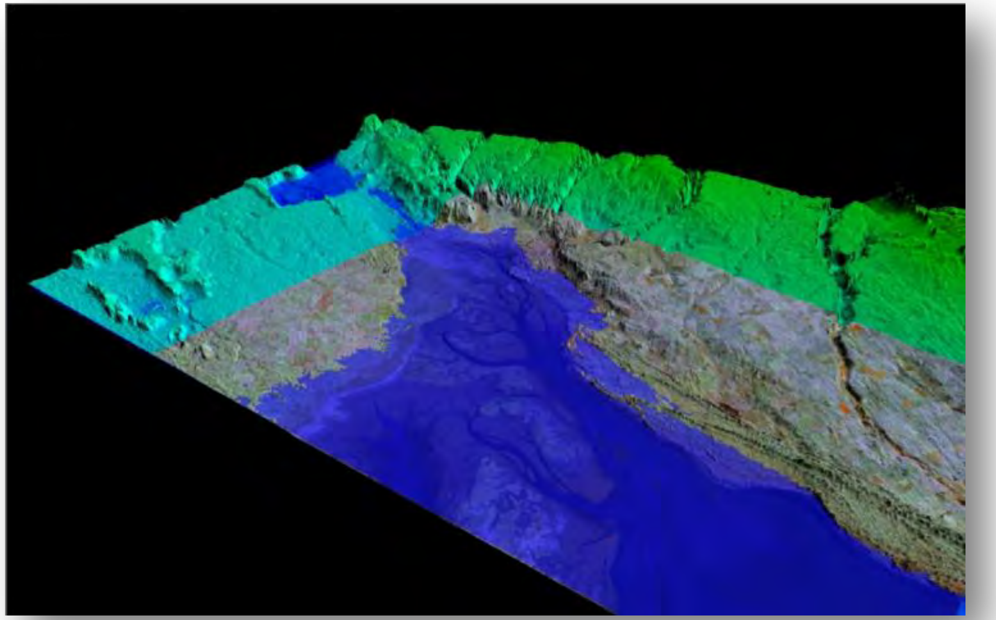


The Bahía Blanca Estuary
Eastern South America



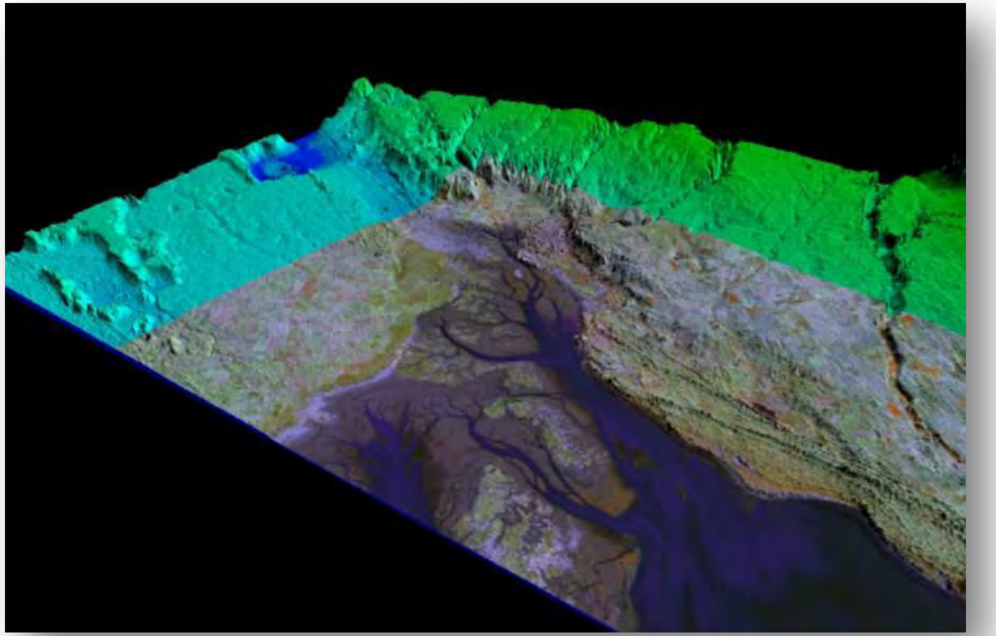
A coastal landscape modeled by the Holocene marine transgression

6k yr BP



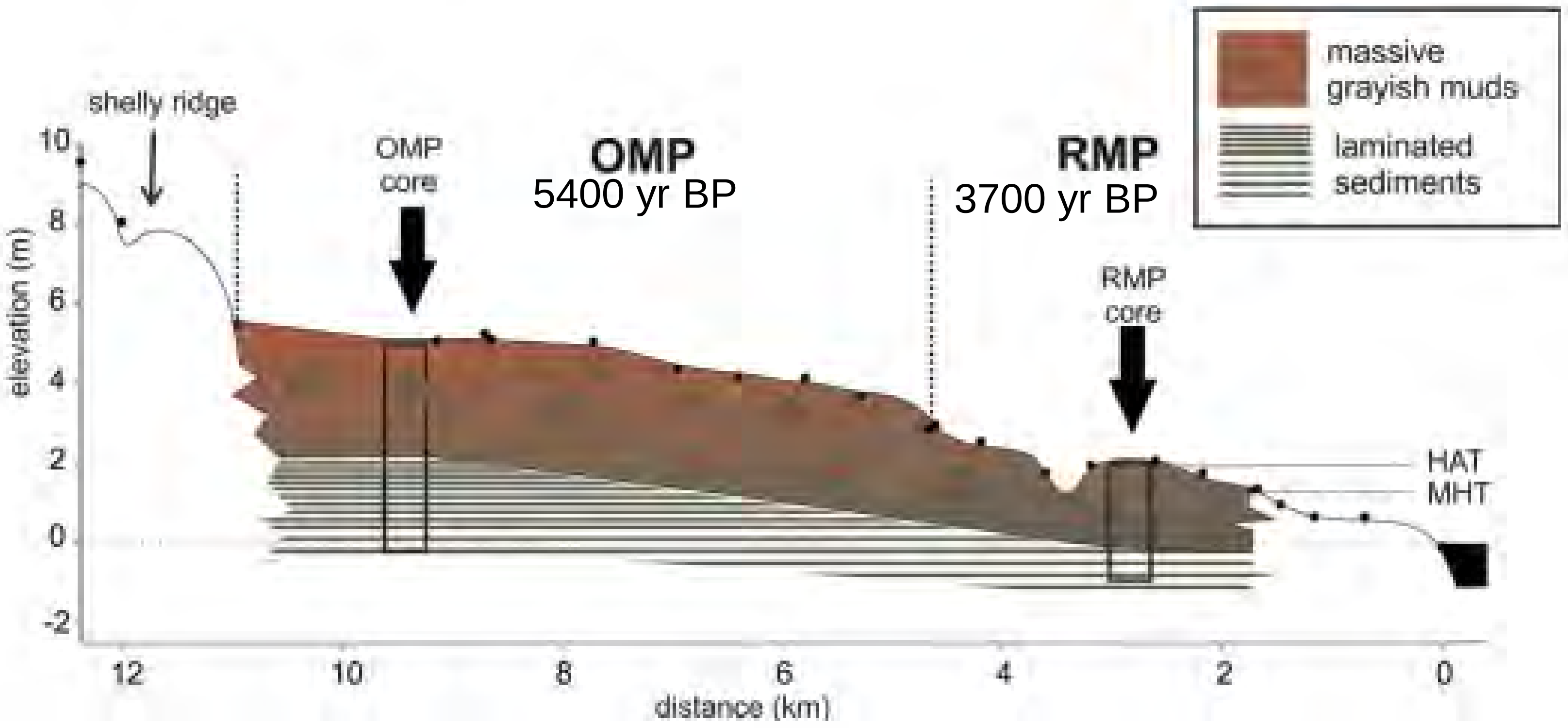
Mid-Holocene highstand

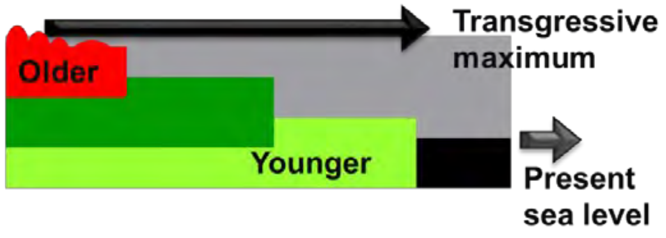
present



Present rate of relative SLR is about 1.6 mm yr^{-1}

A coastal landscape modeled by the Holocene marine transgression

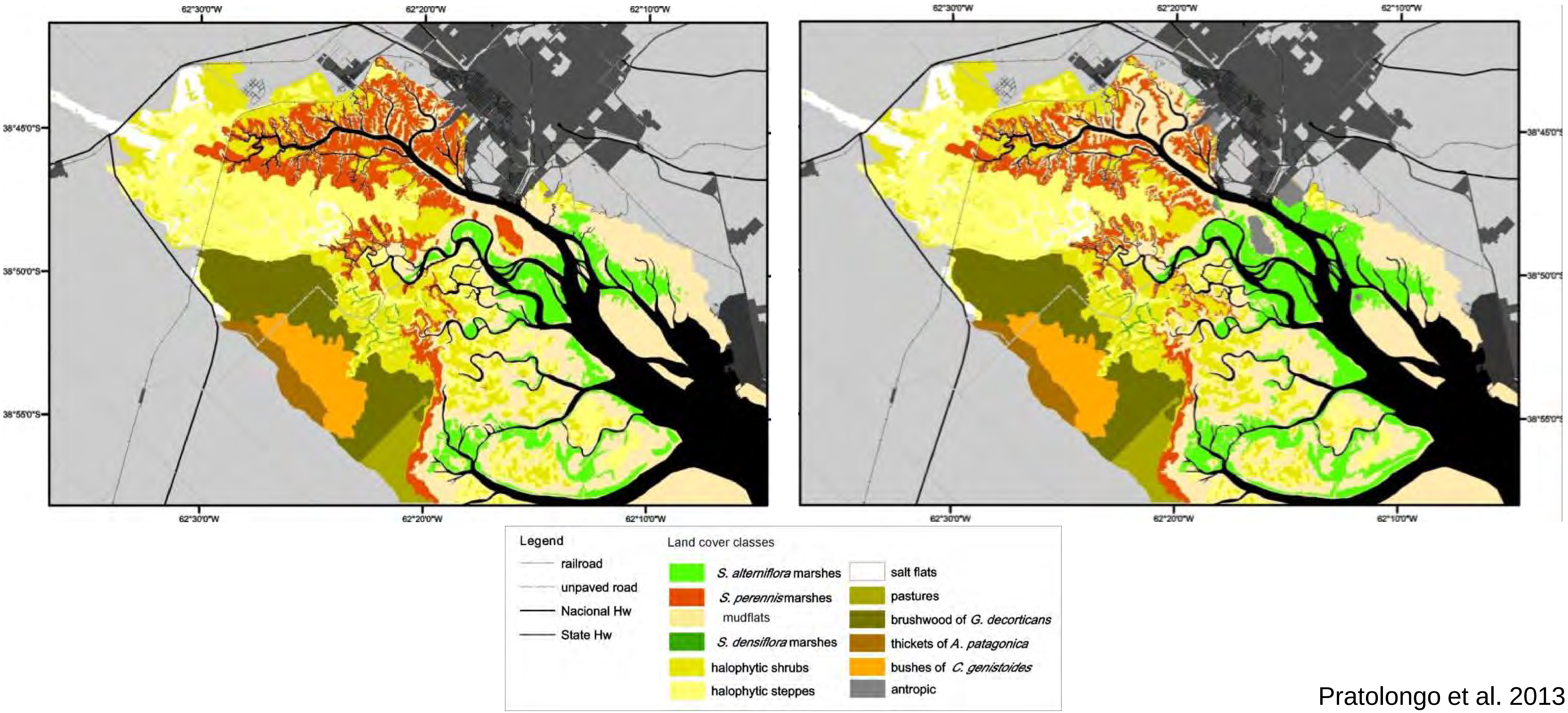




Pratolongo et al. 2017

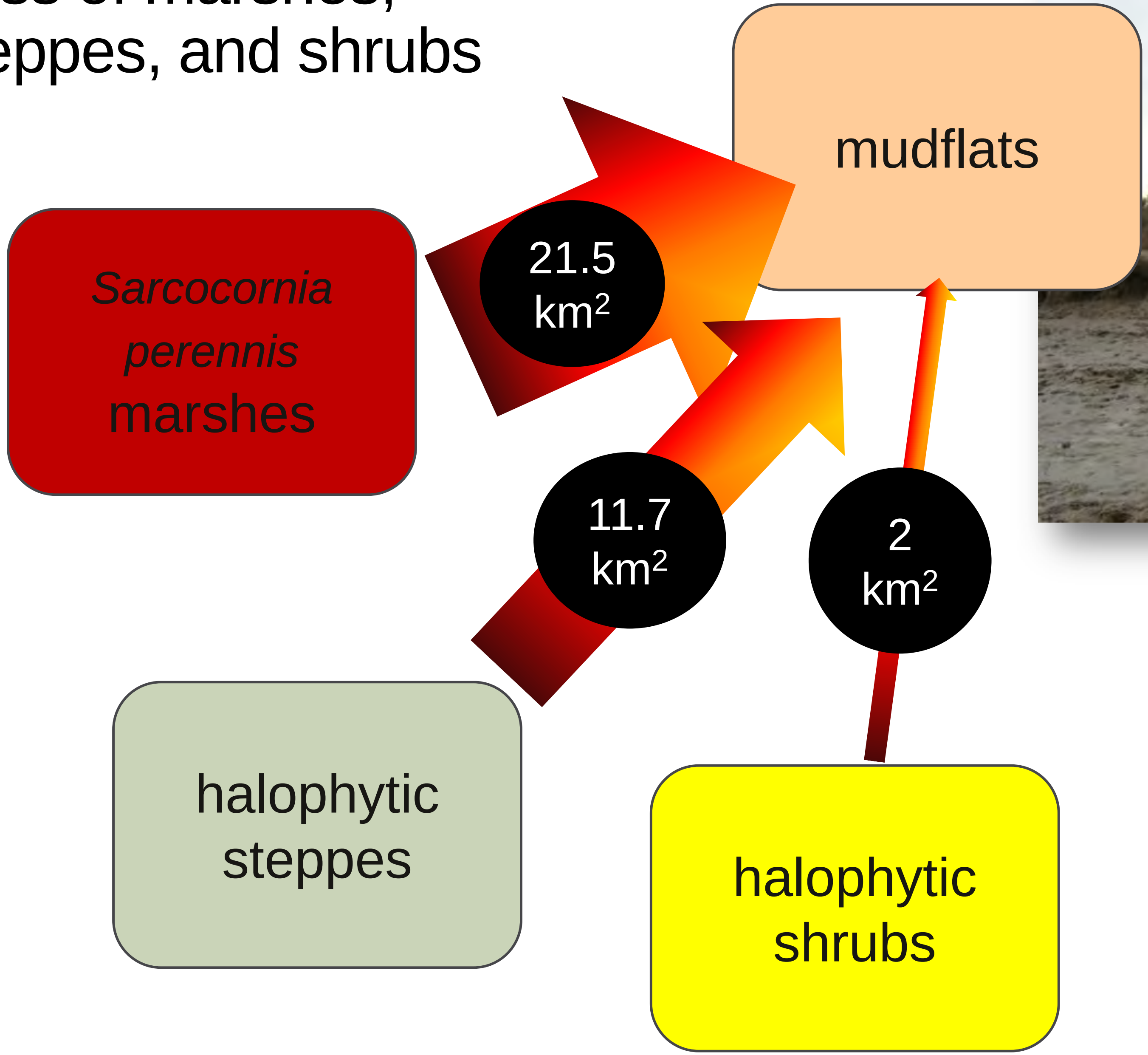
How is landscape responding to SLR?

1967 **2005**



Pratolongo et al. 2013

Loss of marshes, steppes, and shrubs



Pratolongo et al. 2013

How much TSS is delivered to the water column through the erosion of Holocene surfaces

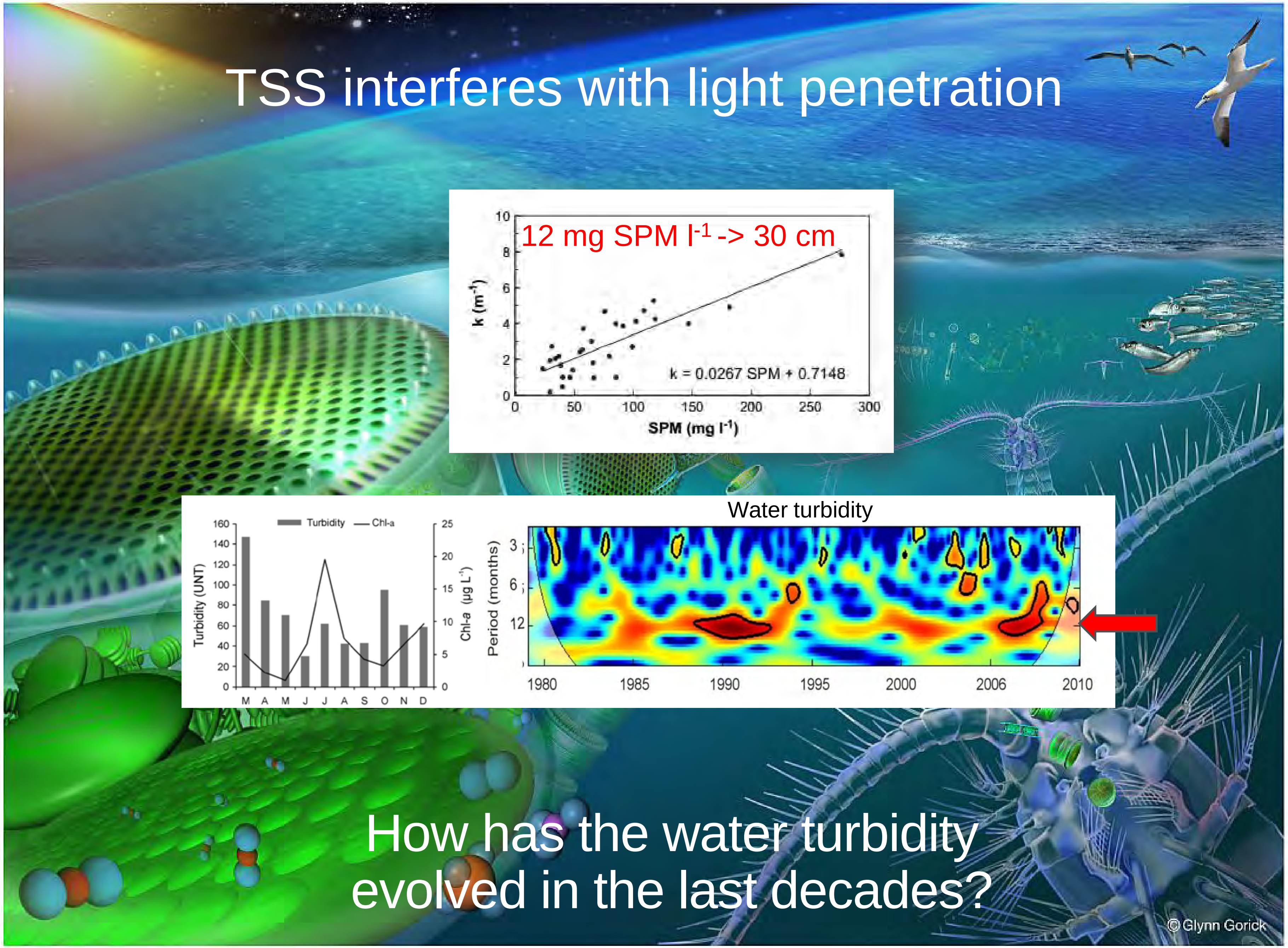
?

12 mg of TSS l^{-1} day^{-1}

✓

What does this value mean?

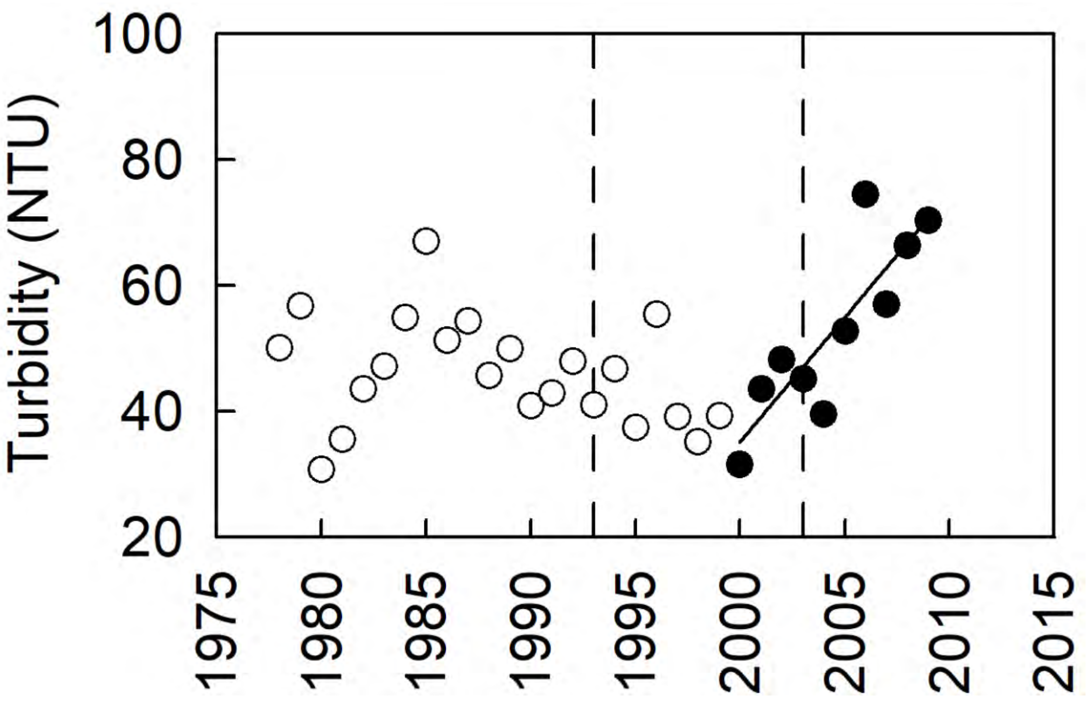
TSS interferes with light penetration



How has the water turbidity evolved in the last decades?

Guinder et al. 2009, Zapperi et al. 2016

Recent positive trend on water turbidity



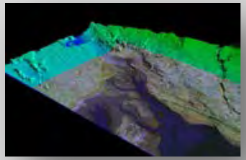
López Abbate et al. 2017

Drifting into the Anthropocene: Multiscale factors interact to drive long-term water turbidity

Global

SLR

Present rate of relative SLR is about 1.6 mm yr^{-1}



Regional

NW winds

Wind

Higher persistence of winds toward of NW quadrant since the 1978

Precipitations

Modulates turbidity at the annual scale

Local

Dredging

The dredged volume increased 11-fold after 1999

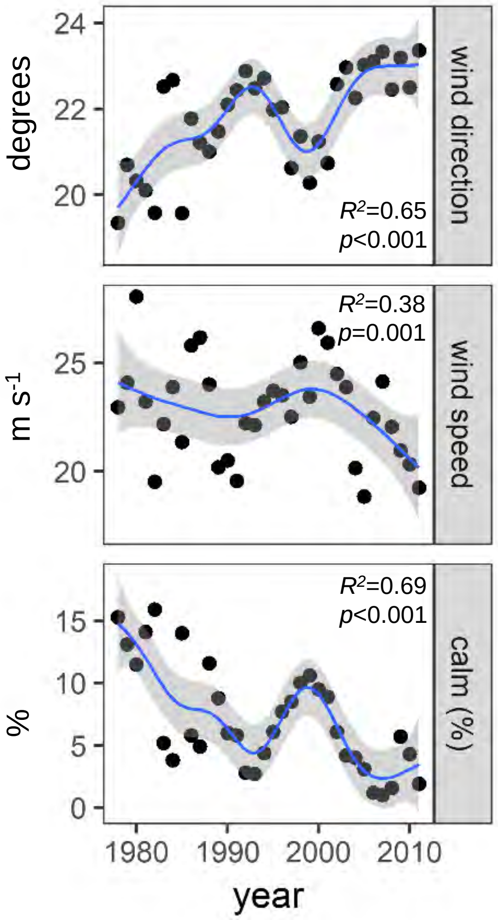
Bioturbation

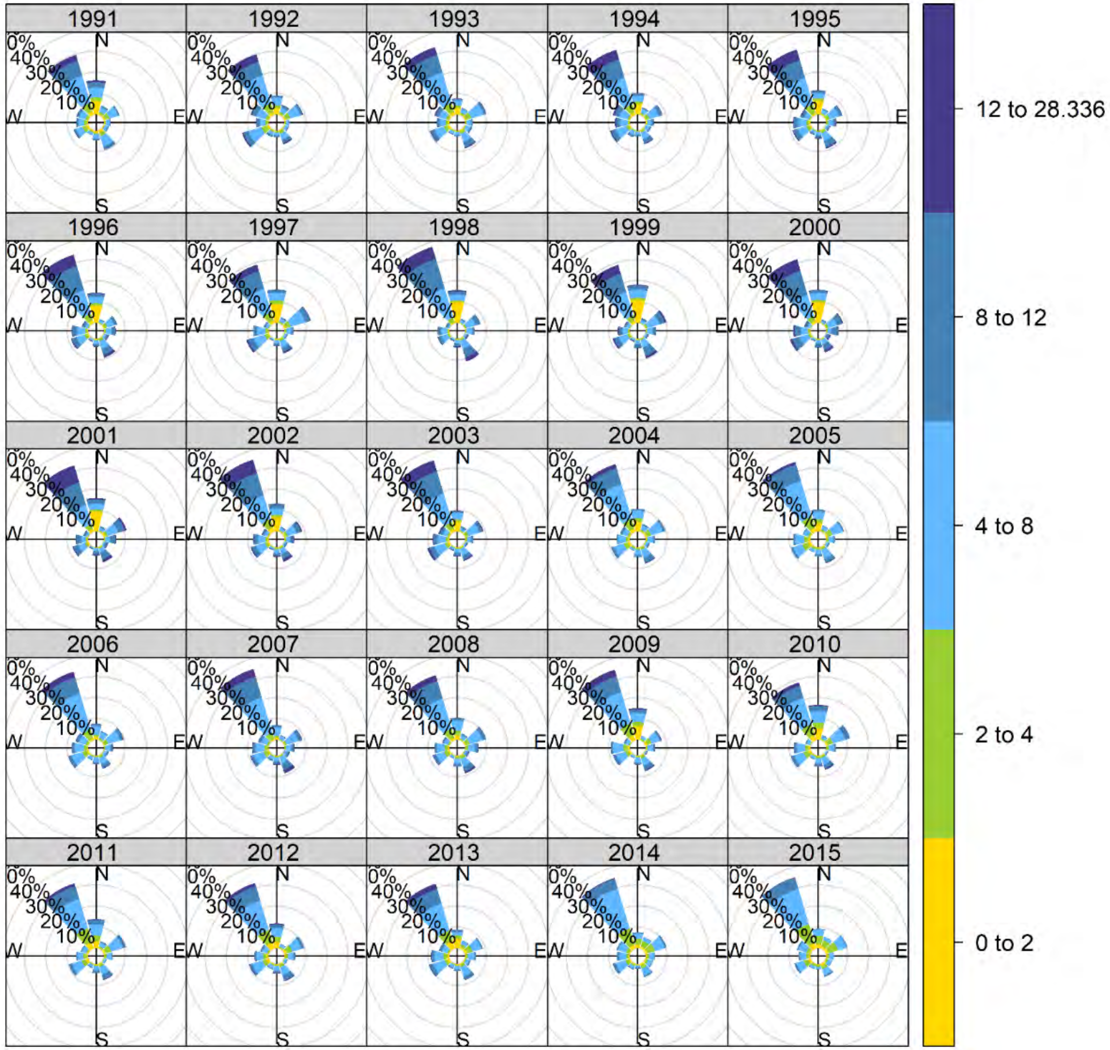
Crabs excavate large burrows and remove up to 5 kg m^2 d^{-1} of sediments

Water turbidity

Long-term wind pattern modifications

shift towards low intensity NW winds

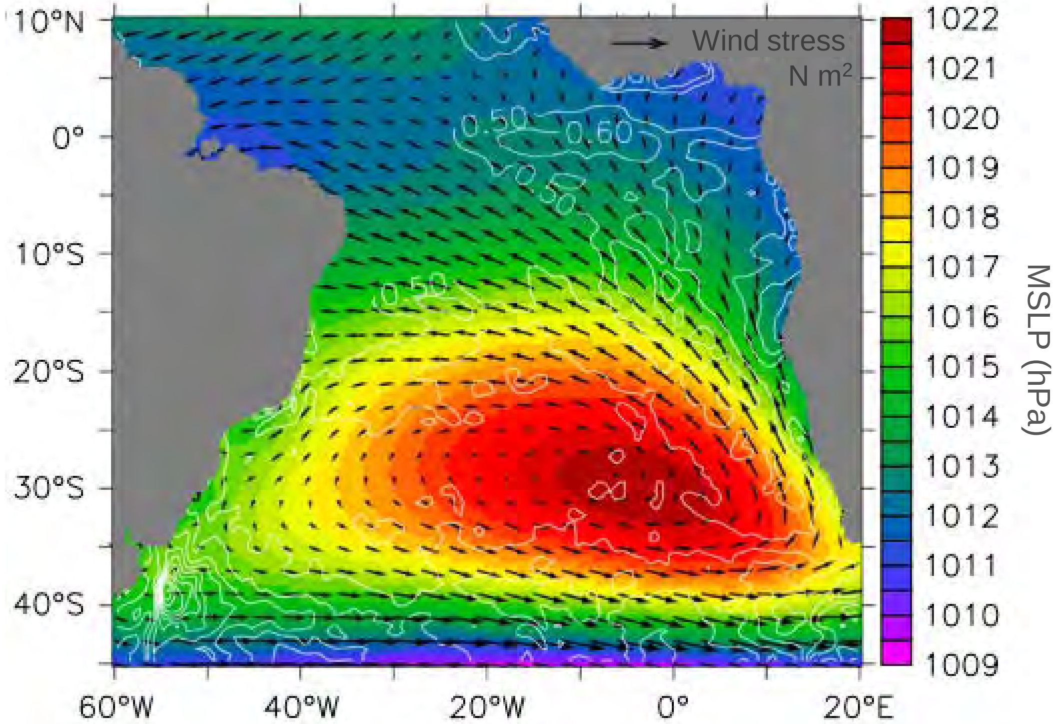




López Abbate et al. in prep.

Long-term wind pattern modifications

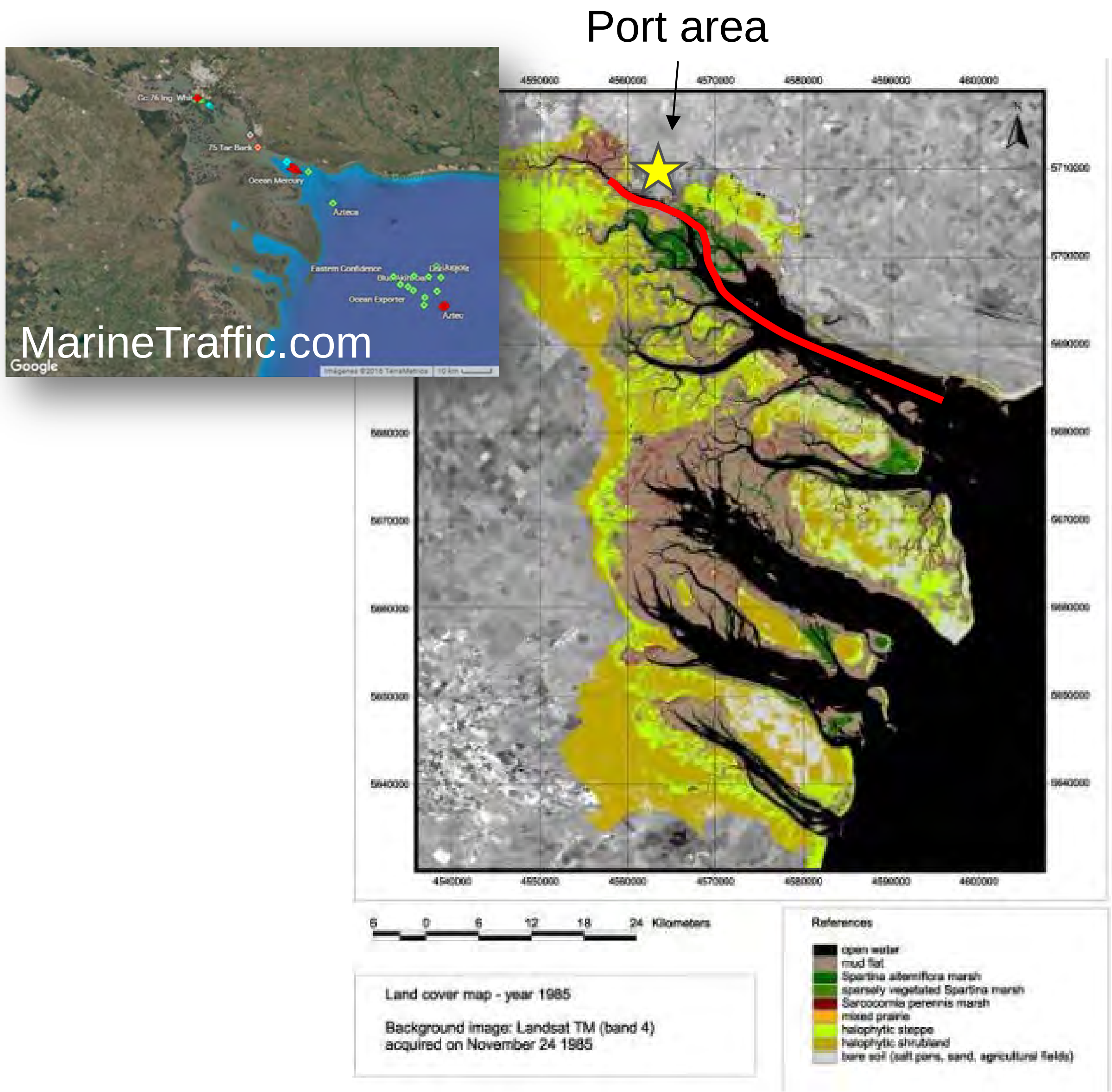
Local wind is modulated by the displacement of the South Atlantic High Pressure System…

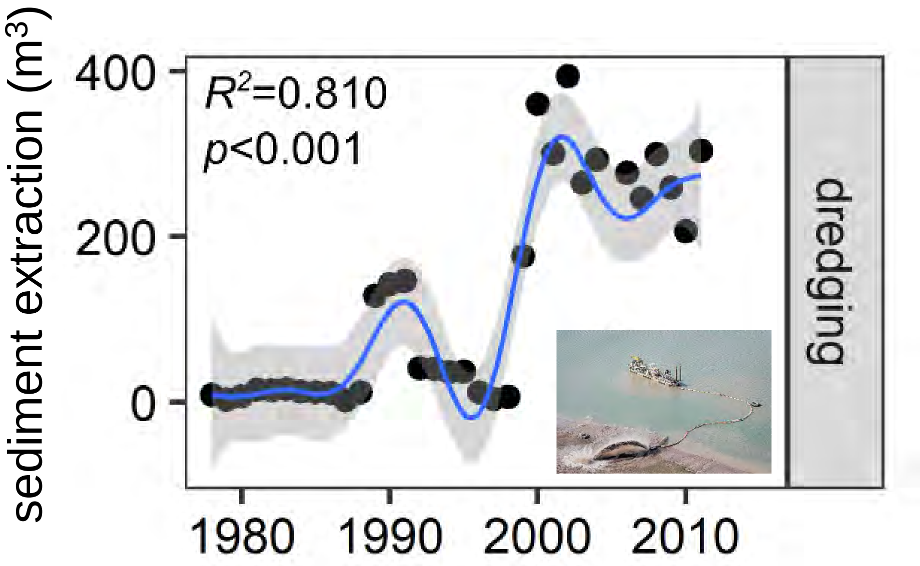


Lübbecke et al. 2014. JCLI.

…which revealed southward movement in the last decades and promoted changes in regional wind patterns

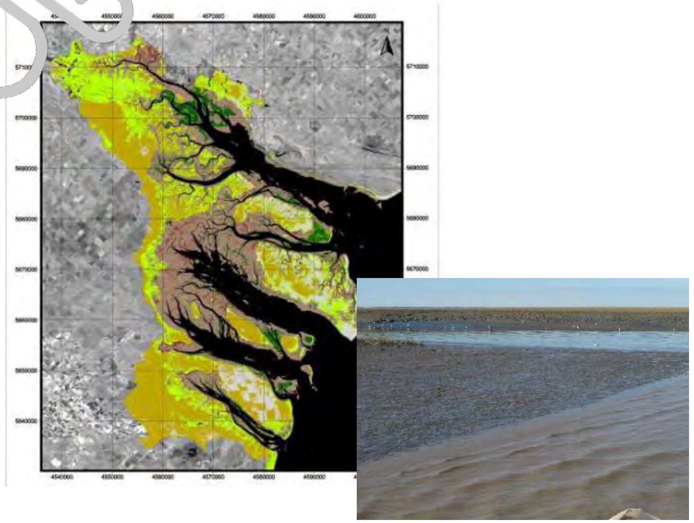
Intense dredging operations to allow maritime trade



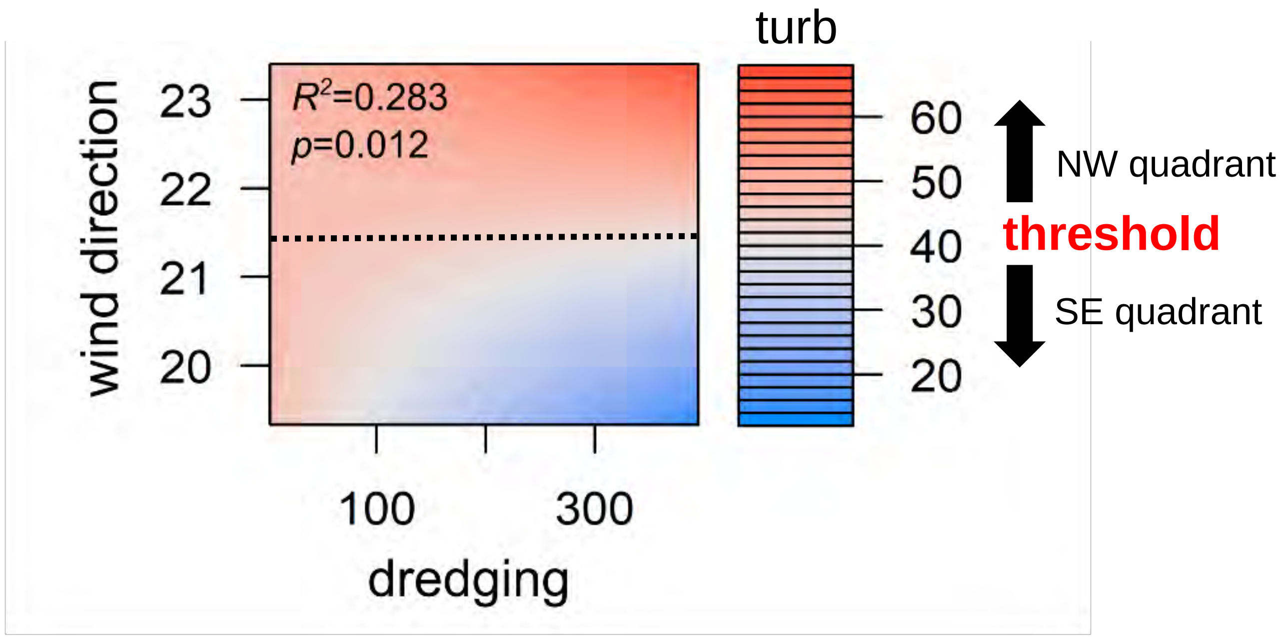


Interactive effect between wind direction and dredging on water turbidity

Long-fetch NW winds

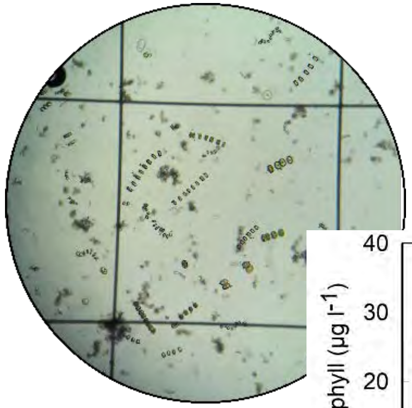


Dredging

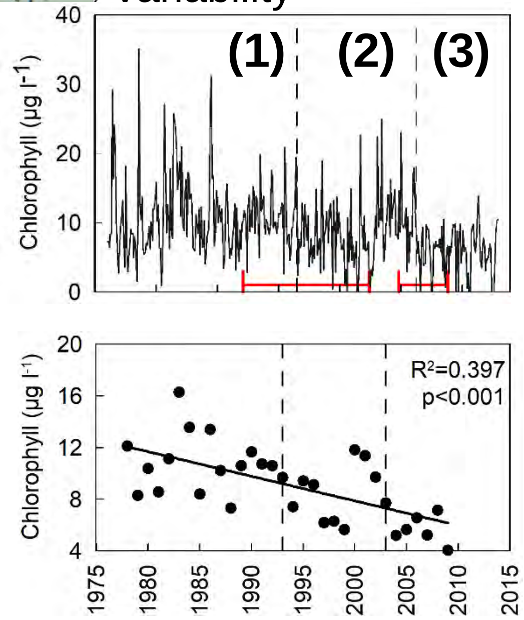


López Abbate et al. in prep.

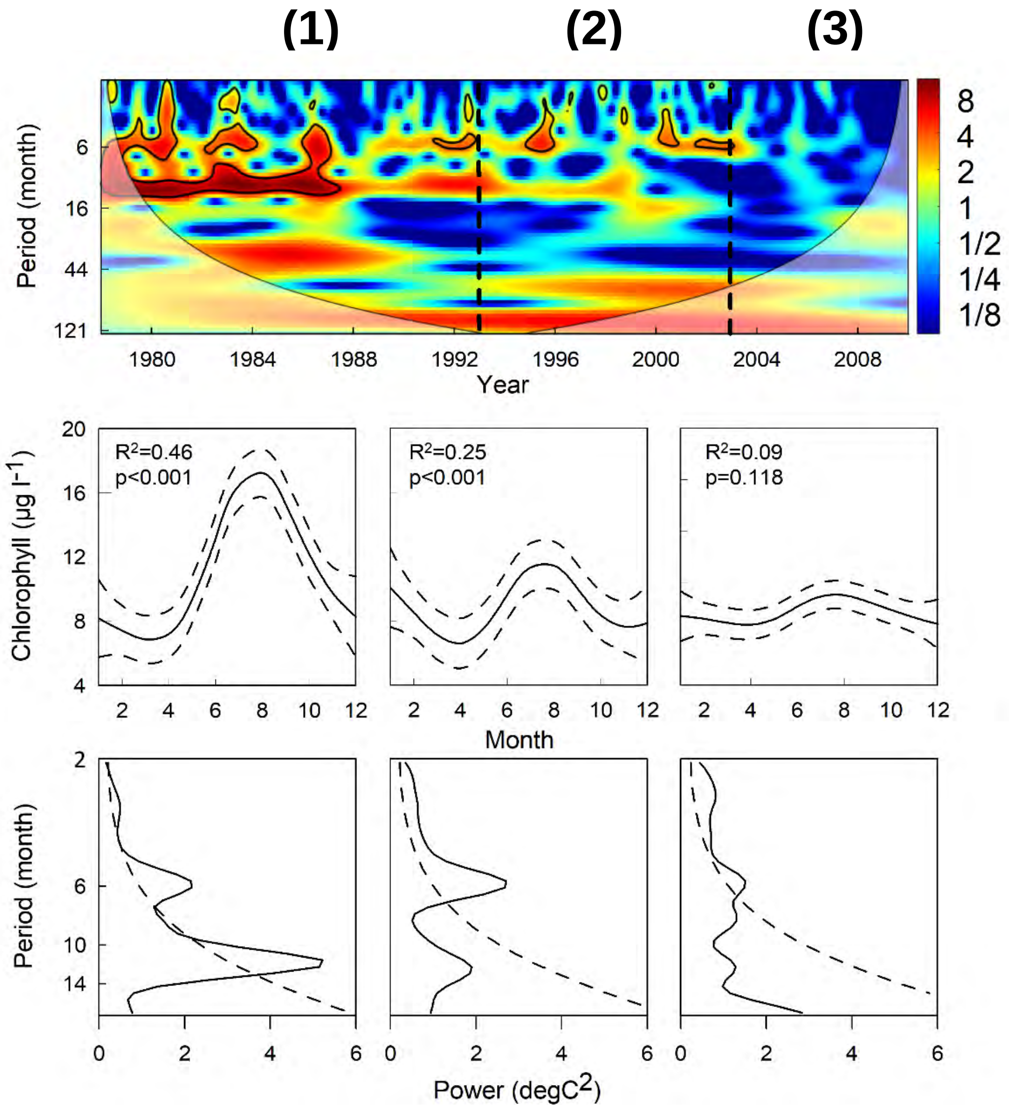
Ecosystem state change: Long-term decline on chlorophyll-a and phenological shift



Three regimes of variability

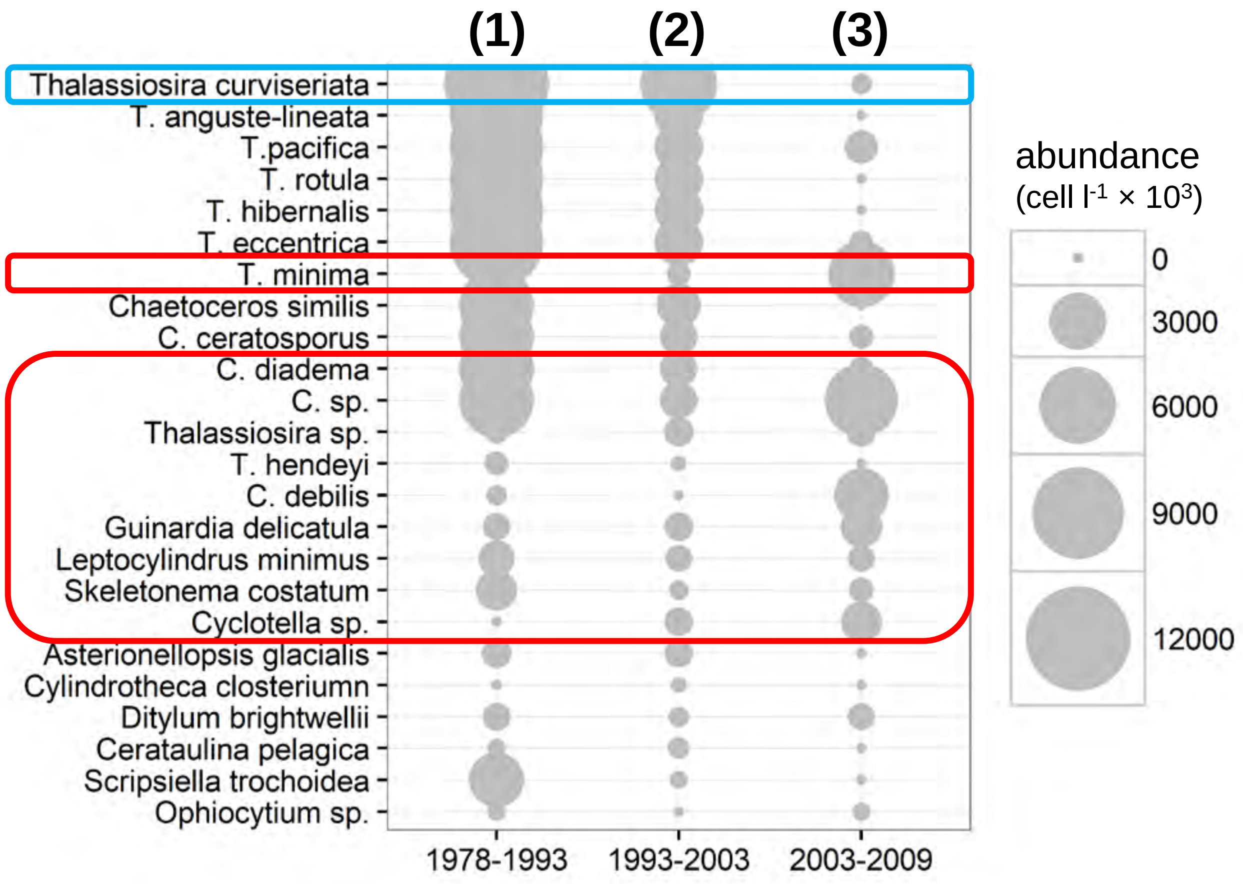


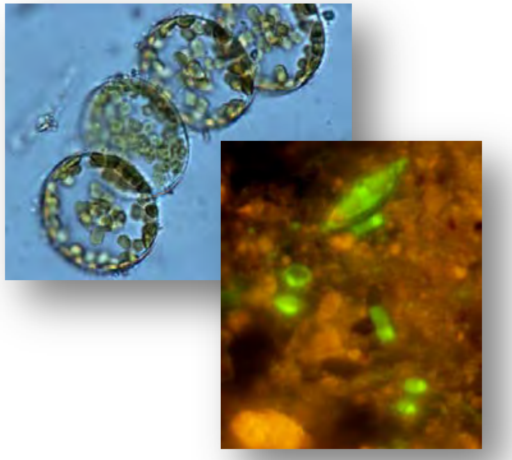
ARD 1%



López Abbate et al. 2017

Ecosystem state change: Phytoplankton structural change





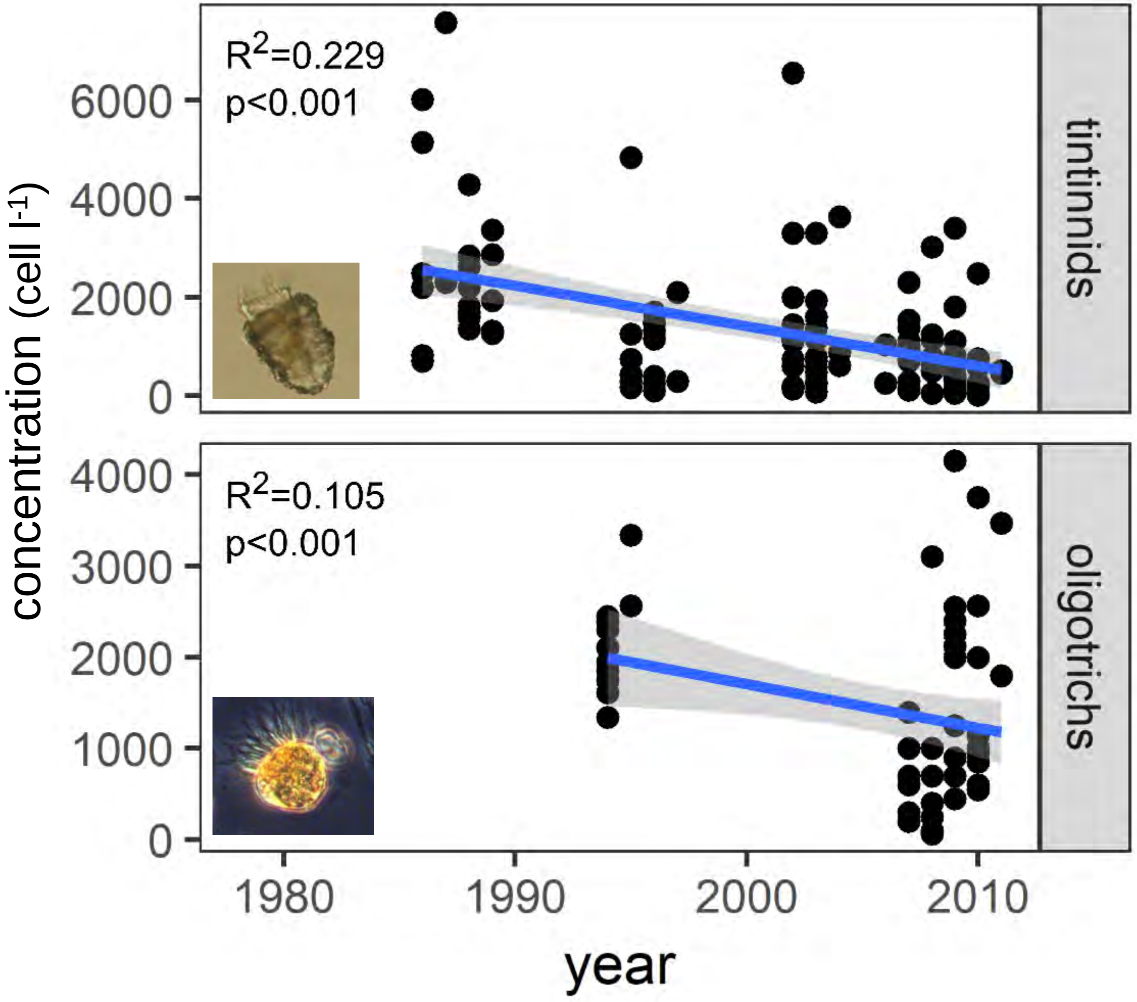
From winter blooming to summer blooming
and non-blooming

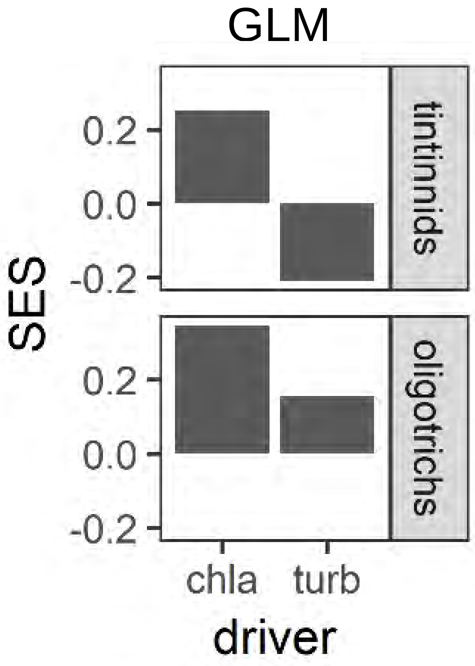
López Abbate et al. 2017

Ecosystem state change: Long-term decline on planktonic ciliates

ARD 2.8%

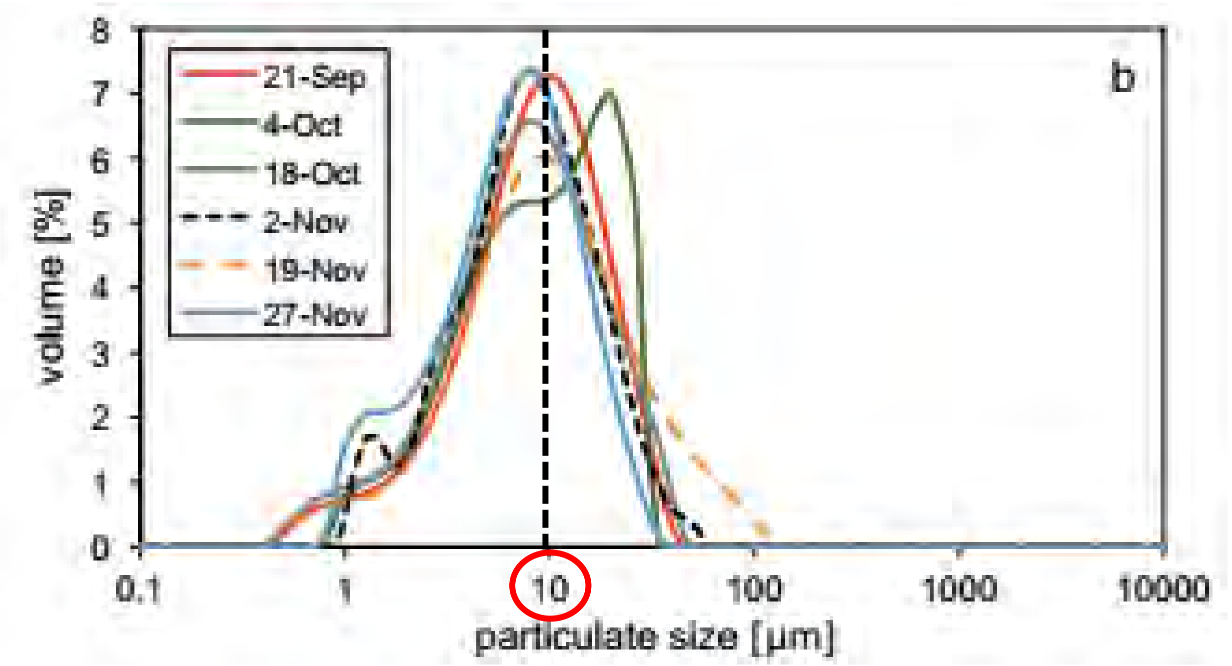
ARD 1.6%



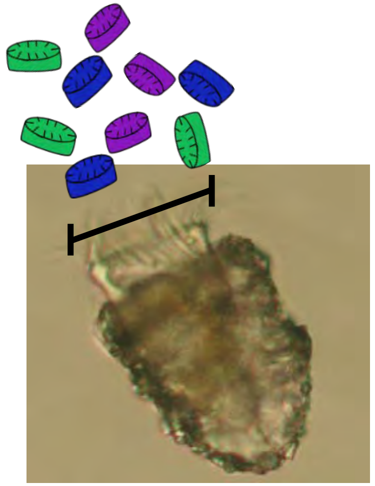


López Abbate et al. in prep.

Ecosystem state change: Long-term decline on planktonic ciliates



Particle size distribution in the surface of the water column during the post-bloom period (September-November)



MOD=40 µm

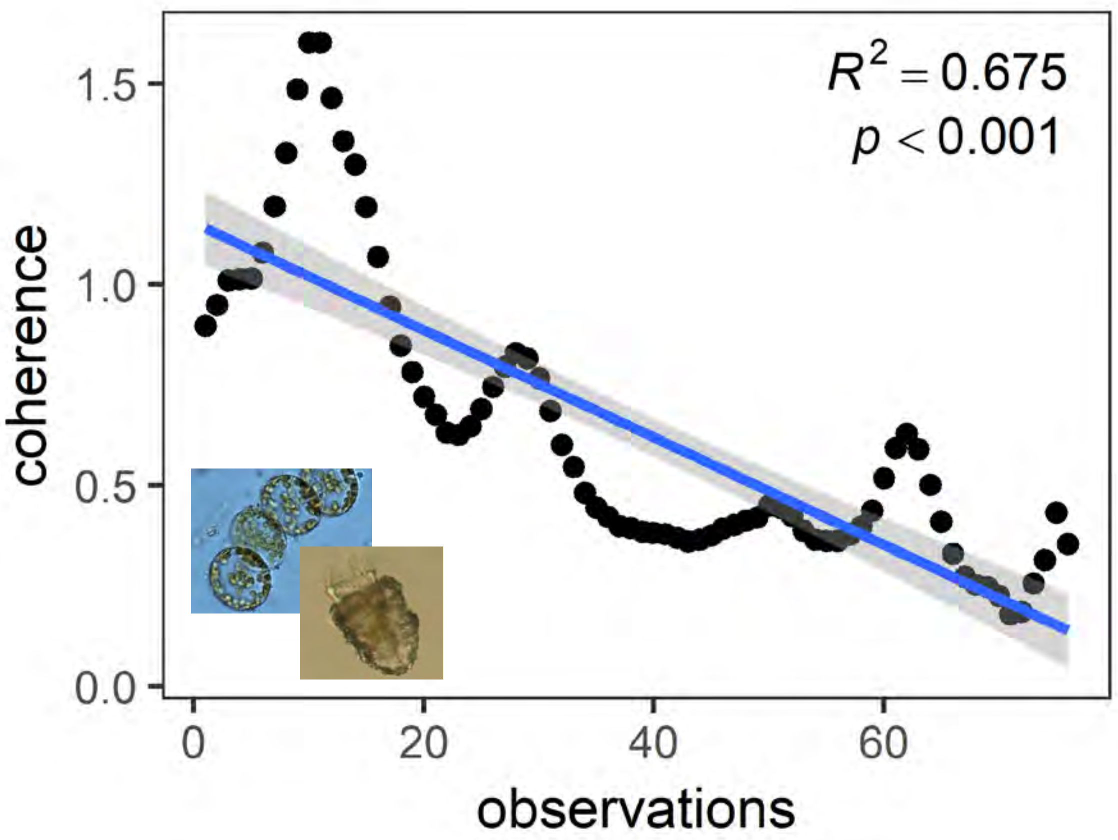
Optimal size spectrum of prey below 10-15 µm

Guinder et al. 2015, López Abbate et al. in prep.

Ecosystem state change: Loss of covariation between chlorophyll-a and tintinnids during 1986-2011

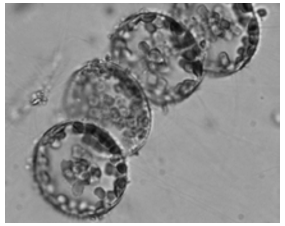
Limitation by encounter and handling

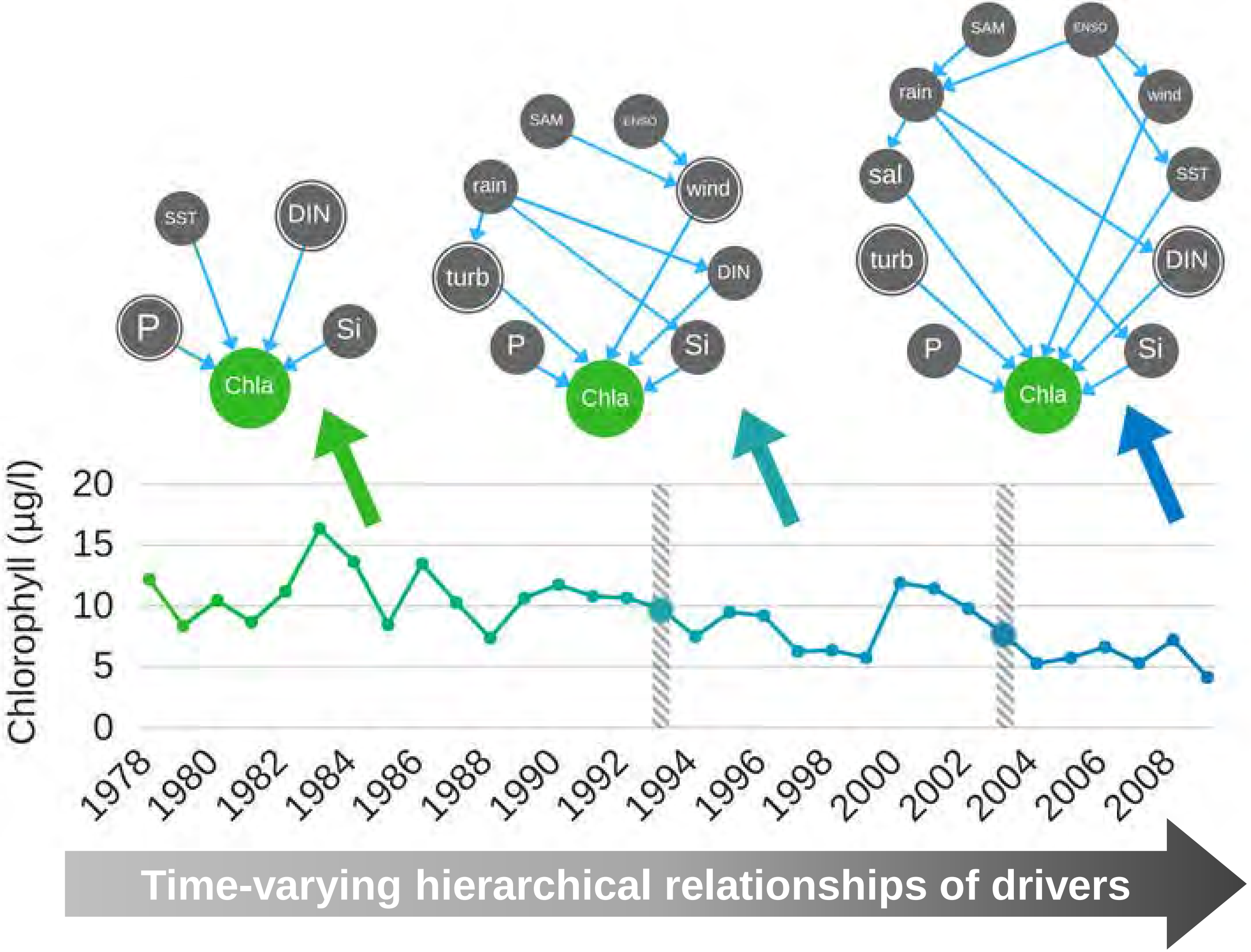
The PSM to phytoplankton biomass ratio in recent years, denotes that ciliates must sort **25%** more inedible suspensoids to meet with their carbon requirement.



López Abbate et al. in prep.

Ecosystem state change: The emergence of turbidity as the dominant driver of chlorophyll-a and a higher interaction among drivers





López Abbate et al. 2017

This is what we learned from the Bahía Blanca Estuary:

•Low lying coastal landforms are undergoing fast erosion in response to the present rate of SLR.

•Soft sediments provided by marsh erosion, and other regional and local factors such as wind shifts and intense dredging, interferes with the pelagic ecosystem by reducing light penetration and limiting the encounter rate between consumers and their prey.

•In coastal areas subject to rapid environmental change, hierarchical relationships may predict biotic responses more precisely than generalizable linear models.

Thank you!

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