COTE
Continental To coastal Ecosystems: evolution, adaptability and governance

LabEx - initiatives d'excellence -

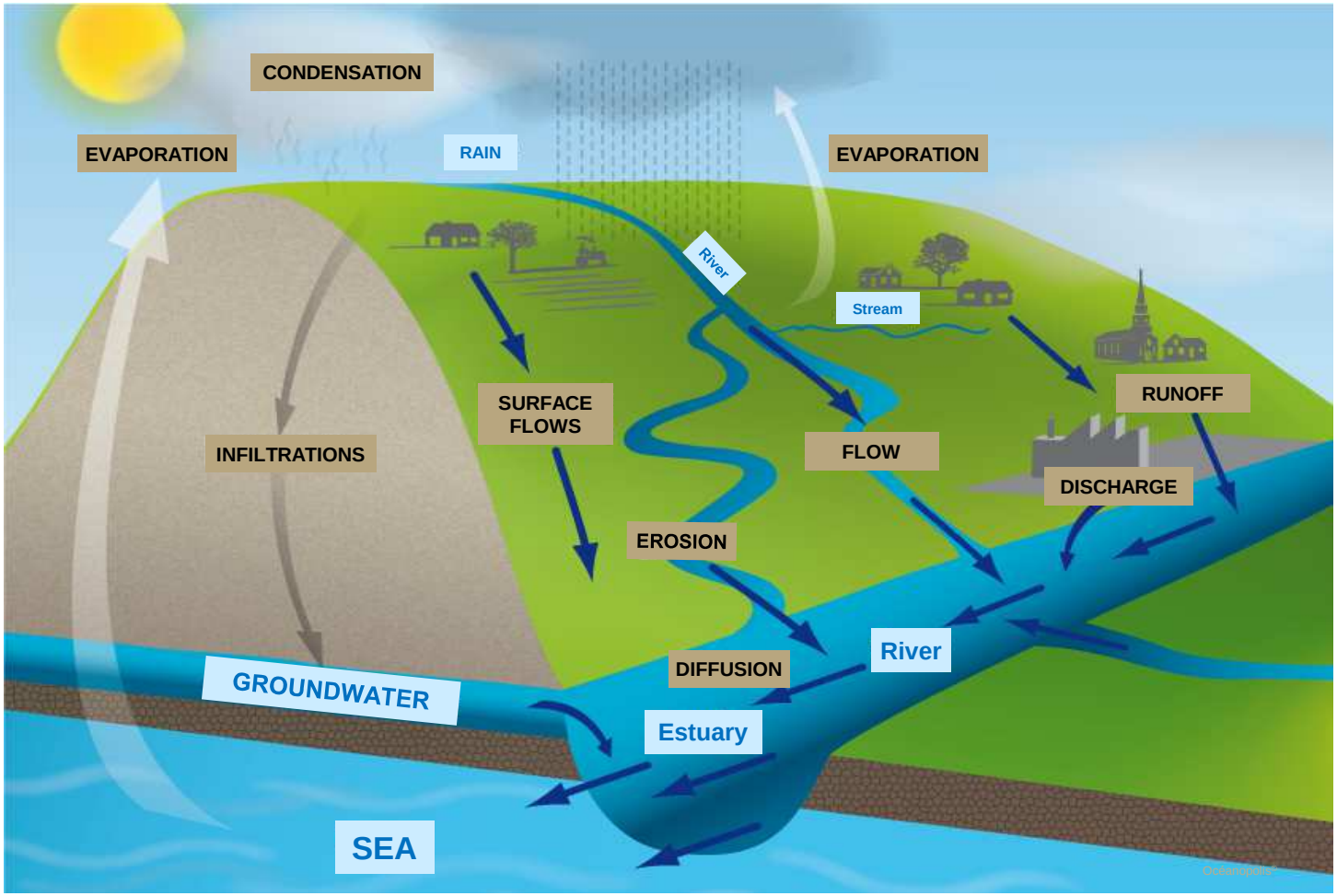
La toxicité des herbicides vis-à-vis de microalgues est-elle influencée par la matière organique dissoute (MOD) naturelle ?

Coquillé N., Stachowski-Haberkorn S., Morin S., Parlanti É., Ménard D., Rouxel J., Haugarreau L., Dupraz V., Eon M., Vedrenne J., Boutry S., Rosebery J., Ezzedine J., Grégoire J., Budzinski H., Tapie N., Pardon P., Chevance-Demars L.

3ème Journées d'Écotoxicologie microbienne (16 - 18 Mars 2016 / Valence)

Context: pesticides and environment

France: the 1st pesticide consumer in Europe (63,700 tons in 2012, UIPP)



Contamination of aquatic environment, from freshwater to coastal waters

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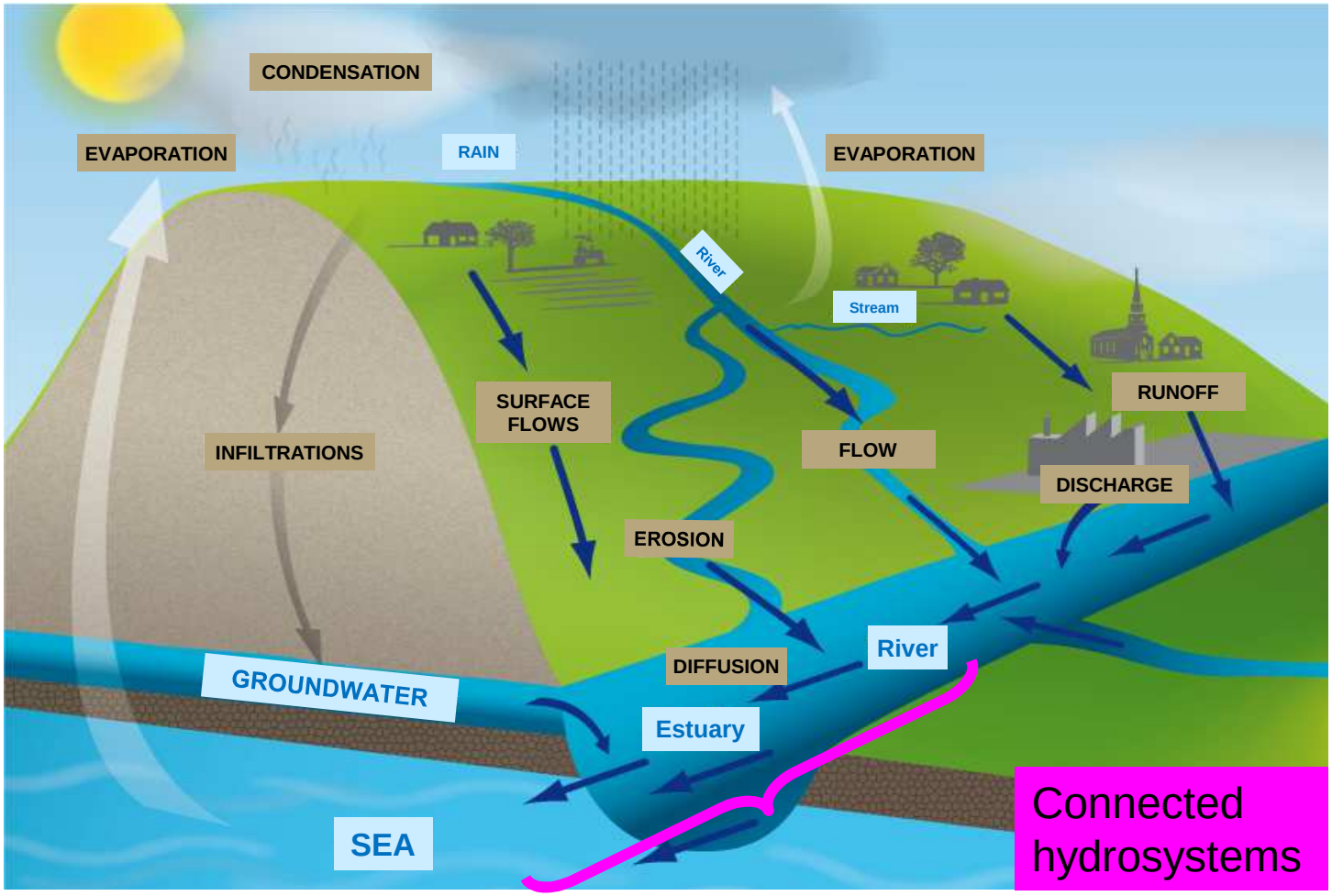

➡ Contamination of aquatic environment, from freshwater to coastal waters

Context: connected hydrosystems – Arcachon bay

From watersheds to coastal waters, transfer of natural and synthetic substances:

- ✓ nutrients
- ✓ dissolved organic matter (endogenous and exogenous)
- ✓ chemical contamination (pesticides among others)

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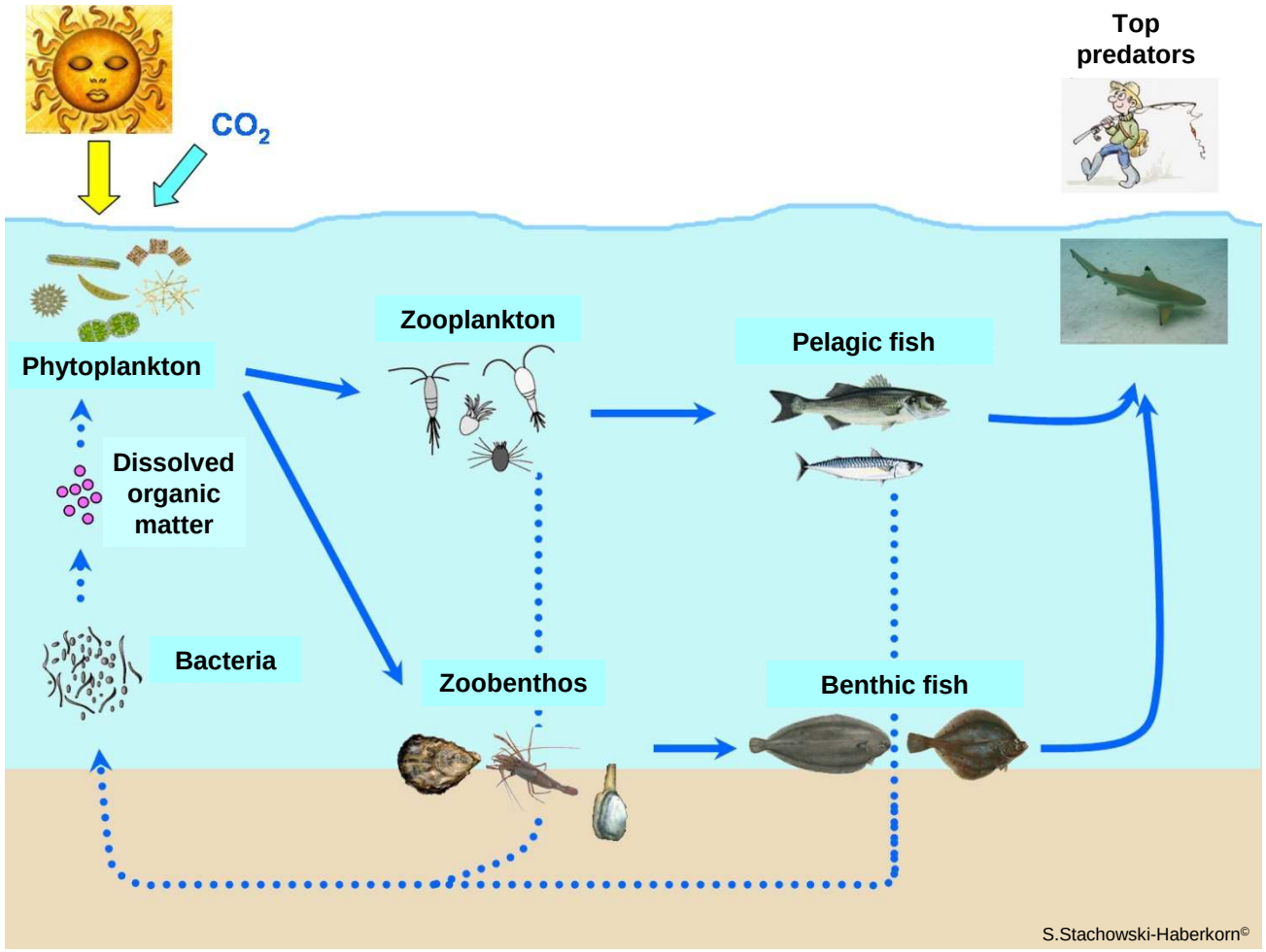
In Arcachon bay, the main freshwater inputs come from the **Leyre river**

Microalgae, key role in aquatic ecosystems

Microalgae: primary producers, at the basis of aquatic food webs



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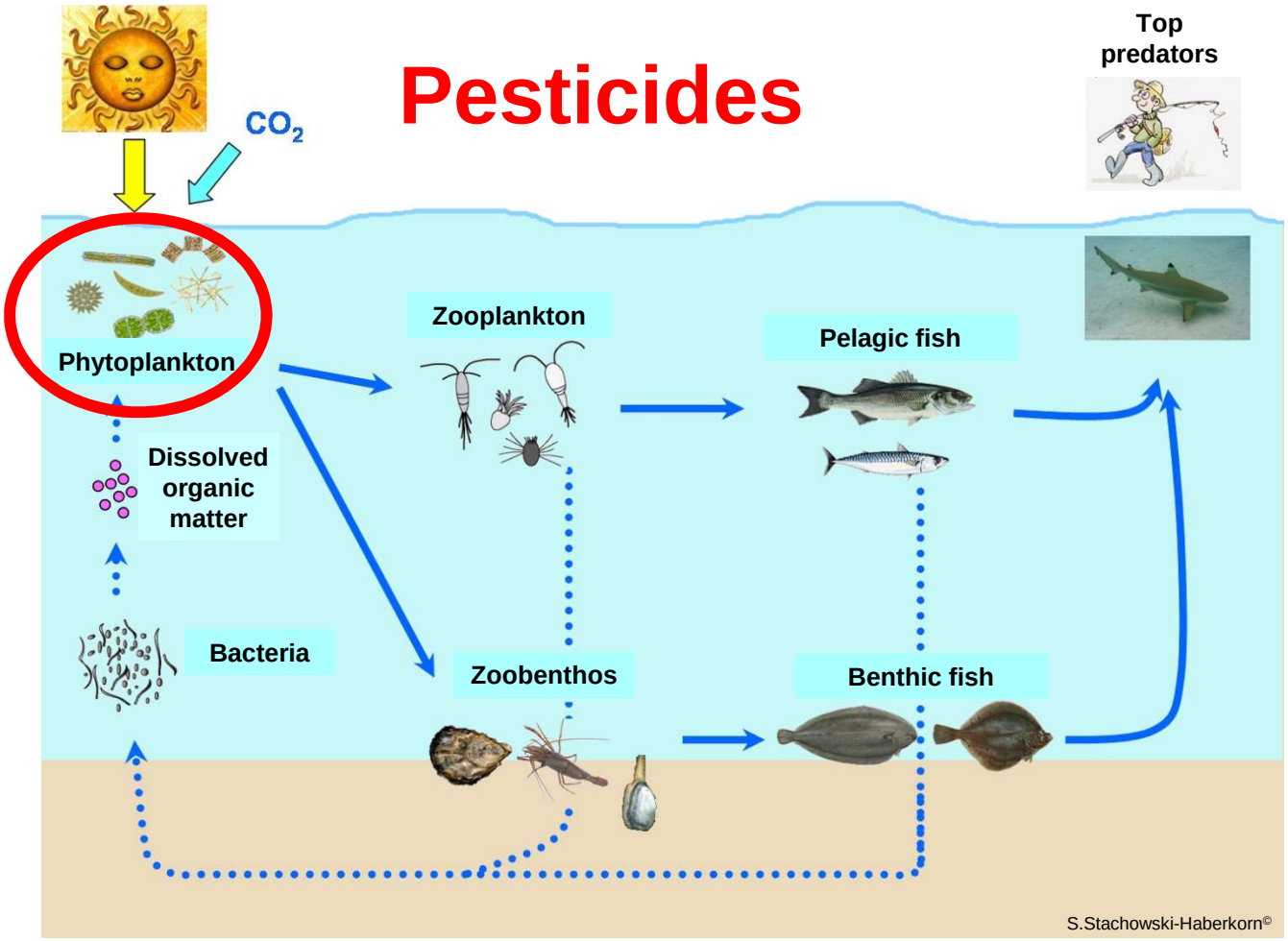


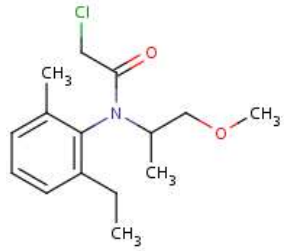
What are the impacts of pesticides on microalgae?

Interactions microalgae/pesticides/environment

Influence of environmental components

Transport

Trapping

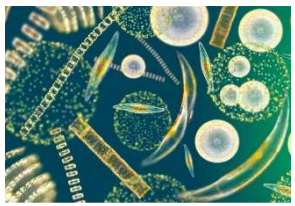


Consumption

Production

Biodegradation

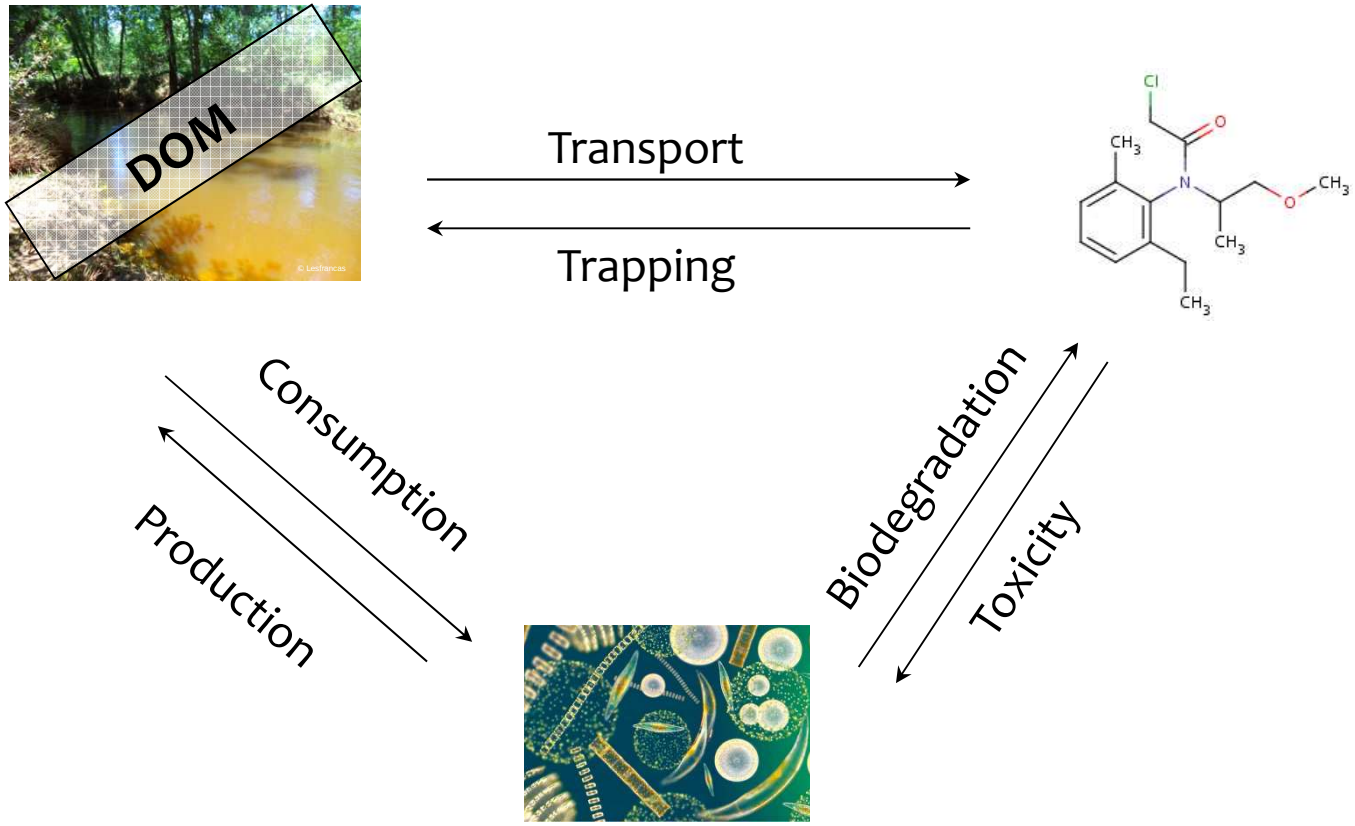
Toxicity



Pesticide effects, singly and mixed, on different microalgae species?

Interactions microalgae/pesticides/environment

Influence of environmental components



Pesticide effects, singly and mixed, on different microalgae species?
What is the influence of DOM on this toxicity?

Study sites

Two sampling sites

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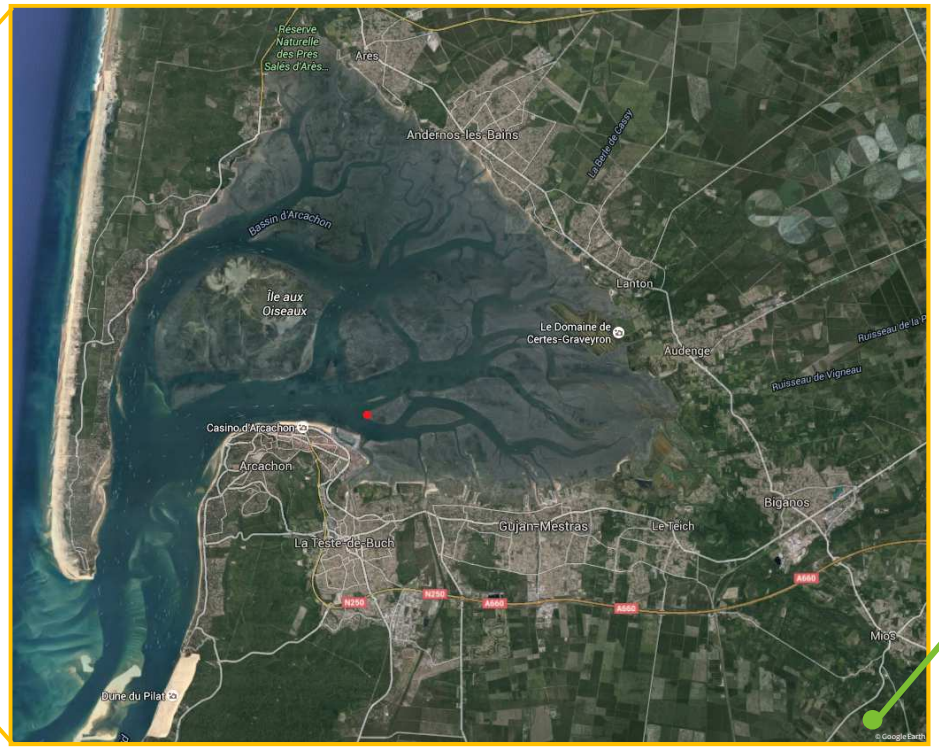
- ✓ upstream, freshwater: Leyre river

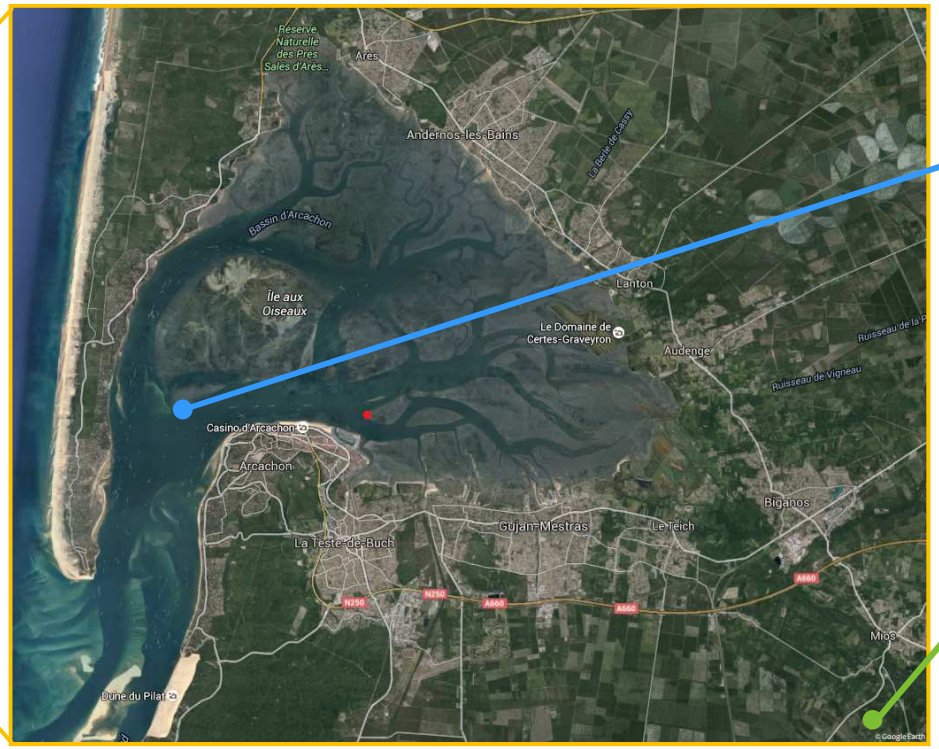


Leyre river

Study sites

Two sampling sites

- ✓ upstream, freshwater: Leyre river
- ✓ downstream, coastal water: Arcachon Bay, Grand Banc



Arcachon Bay

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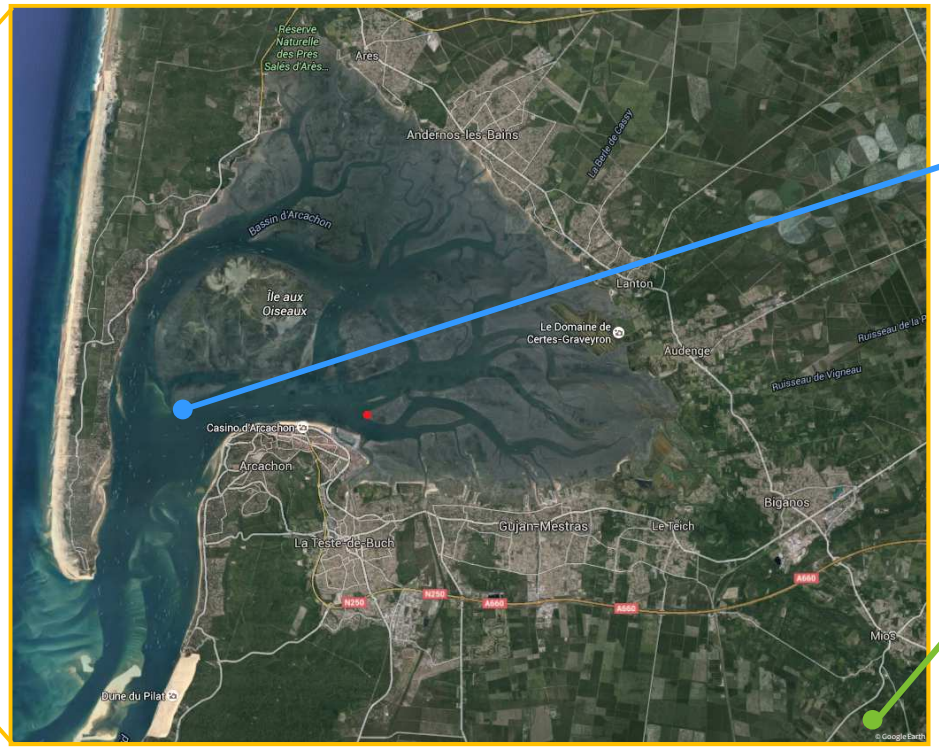


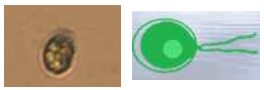
Arcachon Bay

Leyre river

➡ Sampling of DOM for further concentration and use in lab experiments

Experimental design

Marine and freshwater microalgae: 4 species

	Marine water	Freshwater
Diatoms	*Chaetoceros calcitrans* 	*Gomphonema gracile* 
Chlorophyta	*Tetraselmis suecica* 	*Sphaerellopsis sp.* 

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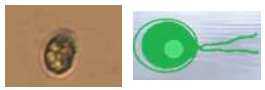
Chlorophyta	*Tetraselmis suecica* 	*Sphaerellopsis sp.* 

Exposure to three herbicides, singly and in mixtures

- ✓ diuron: 0.05 and 0.5 µg/L
- ✓ irgarol: 0.05 and 0.5 µg/L
- ✓ S-metolachlor: 0.5 and 5 µg/L
- ✓ Mixture 1: d0.05 + i0.05 + S0.5
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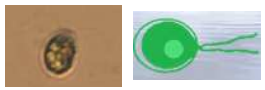
Chlorophyta	*Tetraselmis suecica* 	*Sphaerellopsis sp.* 

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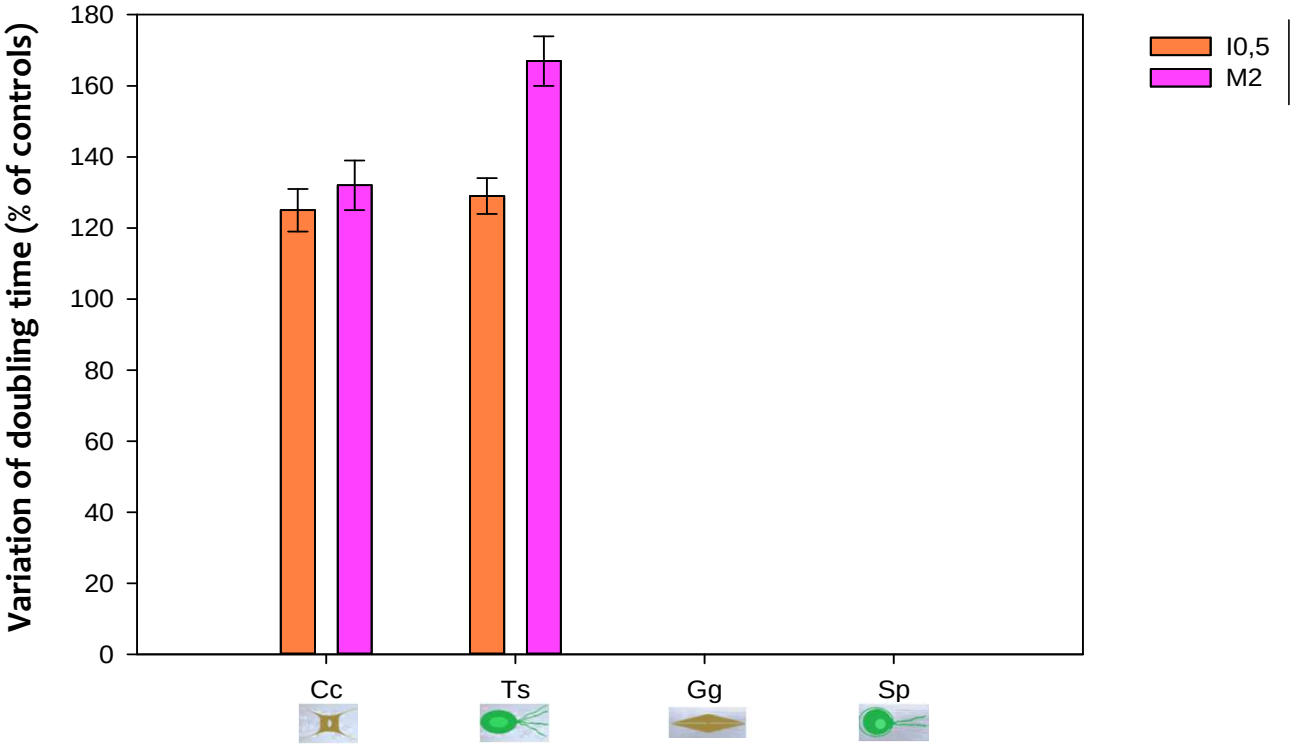
+ DOM (2x)

Herbicide effects on growth

At the highest concentrations of irgarol and mixture



- ✓ Increase of doubling time: growth inhibition
- ✓ Marine species: effects of I0,5 and M2

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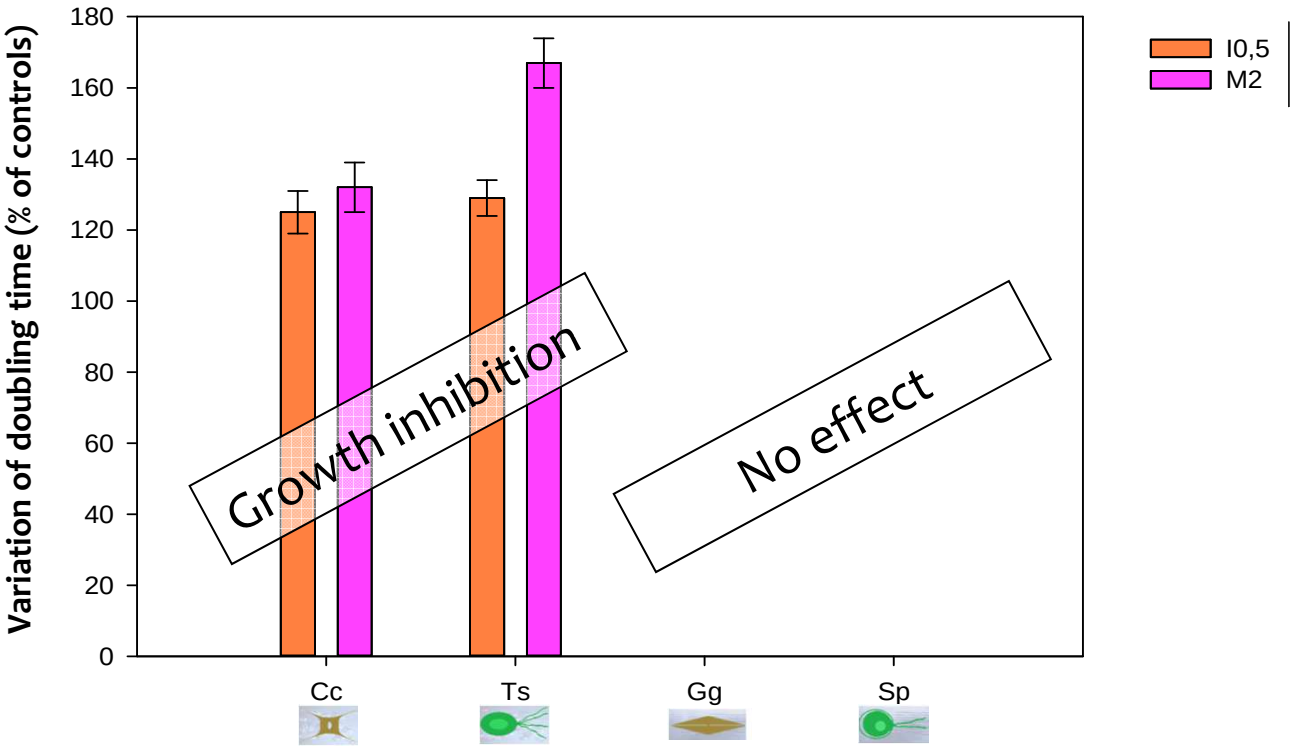

- ✓ Increase of doubling time: growth inhibition
- ✓ Marine species: effects of I0,5 and M2
- ✓ Freshwater species: no effect

Herbicide effects on growth, DOM influence

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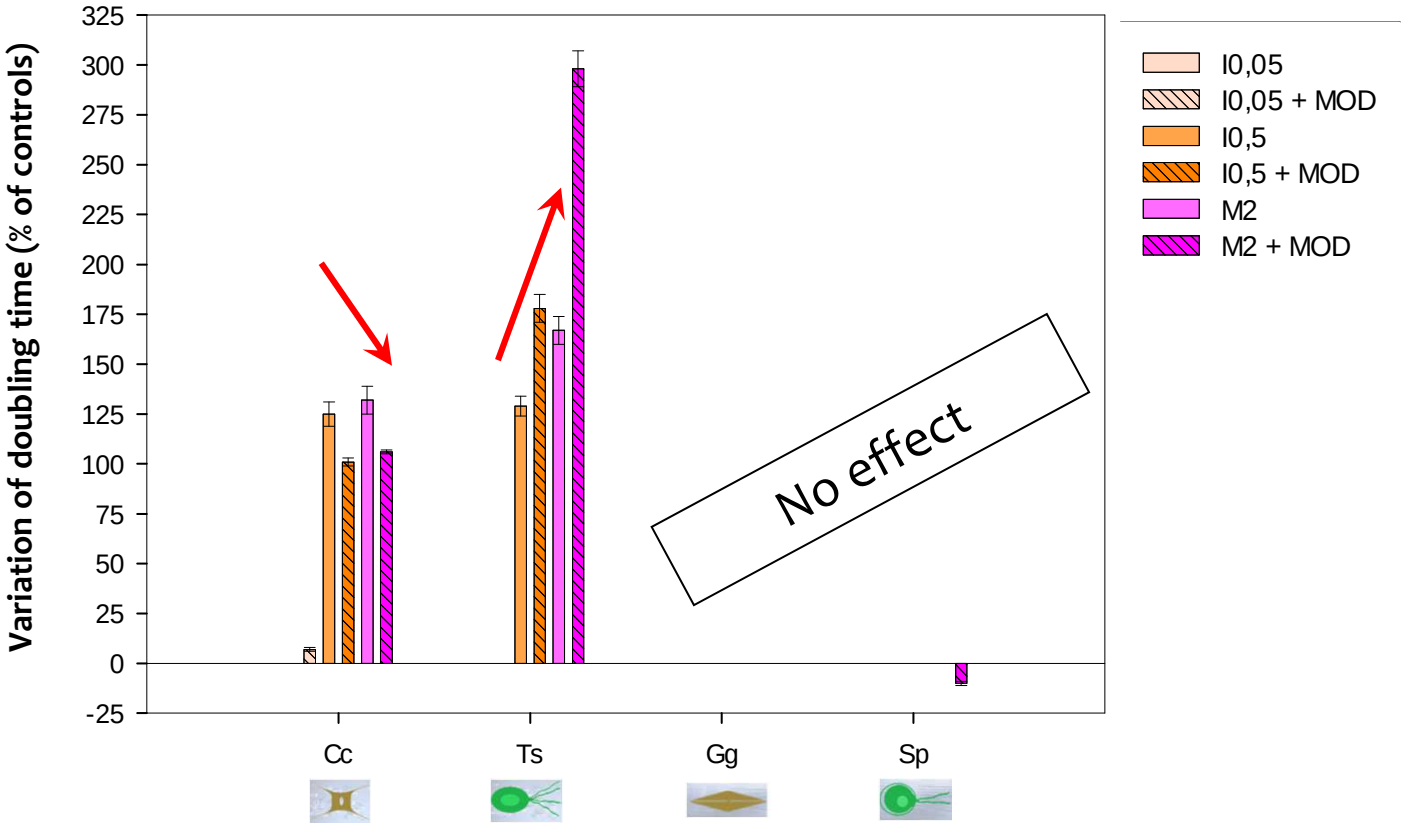
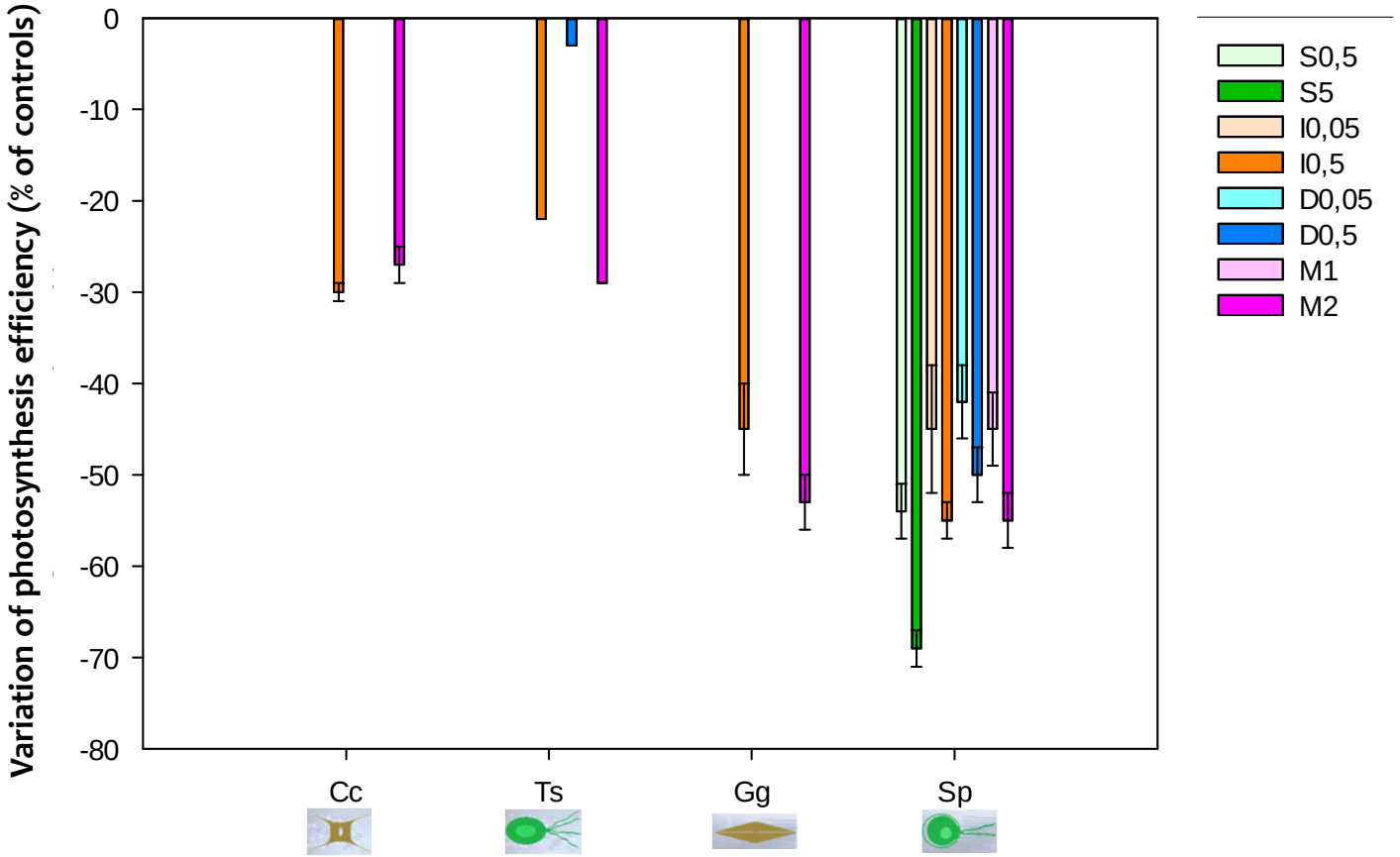


- ✓ Cc: lower growth inhibition with DOM
- ✓ Ts: higher effects with DOM
  effects of M2 dramatically increased
- ✓ Freshwater species: no effect

Herbicide effects on photosynthesis

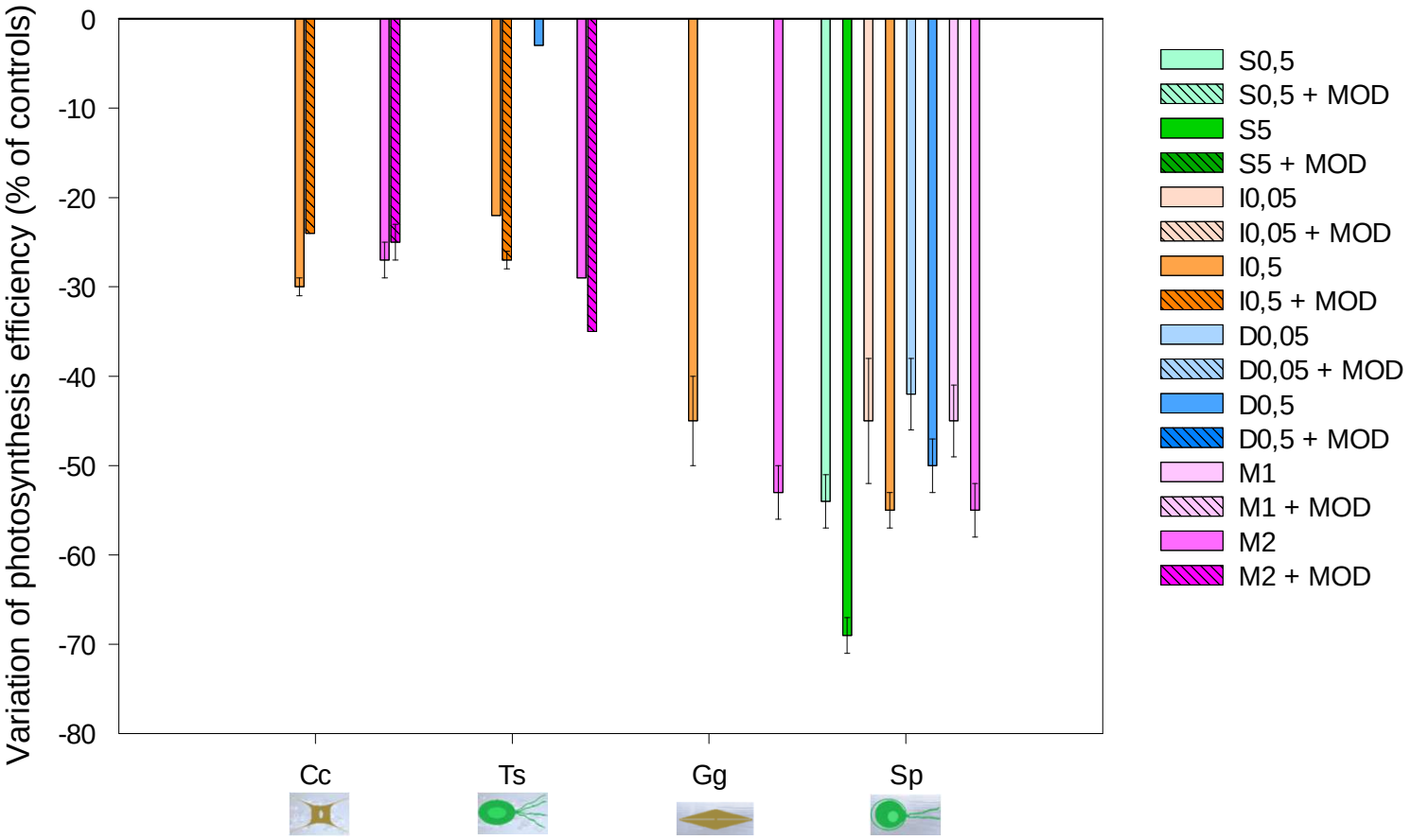


✓ Decrease of photosynthesis efficiency: photosynthesis inhibition

✓ Marine species: effects of I0,5 and M2 + D0,5 for Ts

✓ Freshwater species: effects of I0,5 and M2 for Gg and all conditions for Sp

Herbicide effects on photosynthesis + DOM



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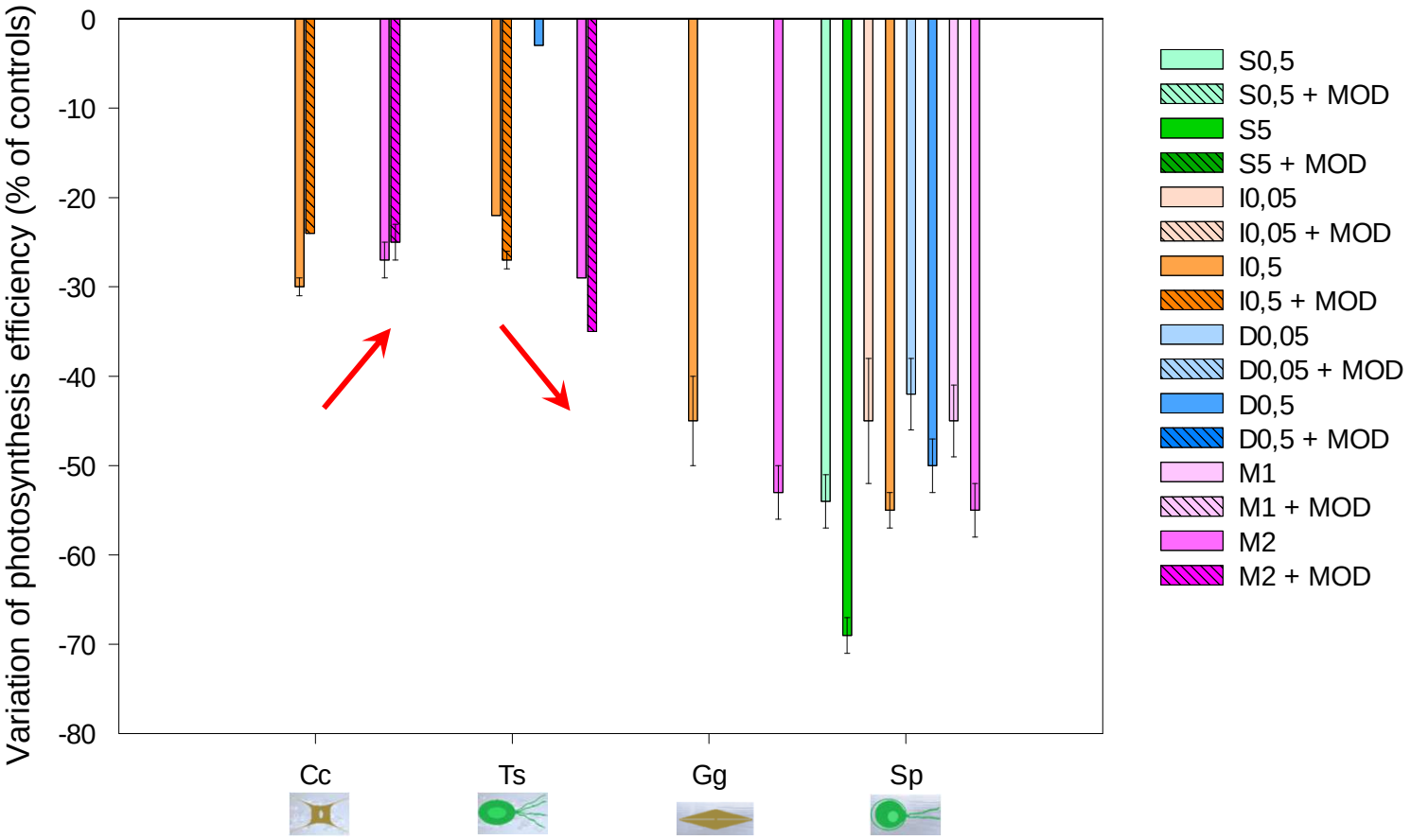
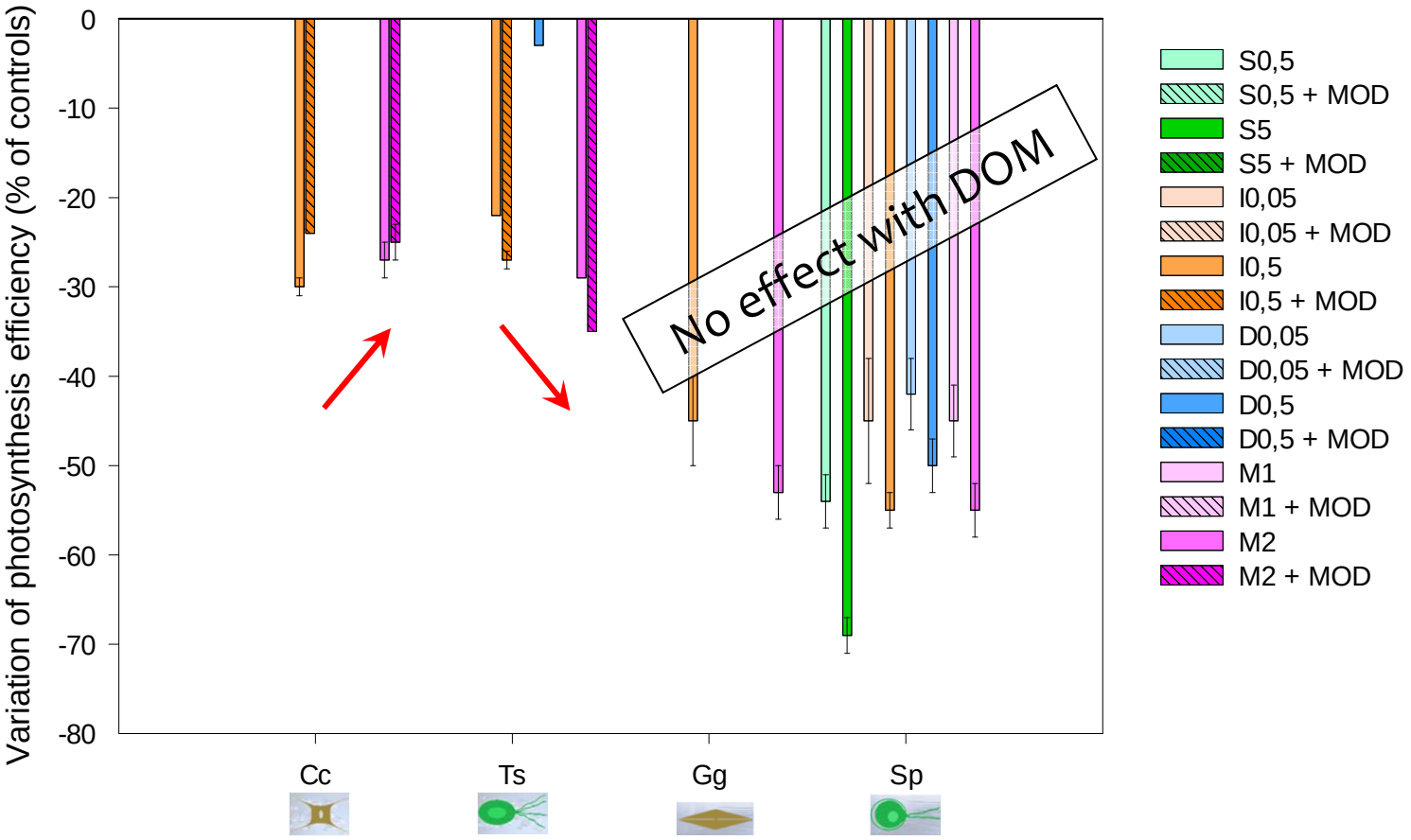


✓ Cc: lower toxicity with DOM

✓ Ts: stronger effects with DOM

Herbicide effects on photosynthesis + DOM



- ✓ Cc: lower toxicity with DOM
- ✓ Ts: stronger effects with DOM
- ✓ Freshwater species: no more inhibition with DOM!!

Influence of DOM on herbicide toxicity

No common pattern in microalgae responses to herbicides and natural DOM

When natural DOM is added to the cultures:

- ⬎ herbicide toxicity towards diatoms and *Sphaerellopsis* sp.
- ⬏ herbicide toxicity towards *Tetraselmis suecica*

➡ Interaction herbicides/DOM: entrapment → bioavailability
Interaction microalgae/DOM: heterotrophy

Chemical analyses (DOM and herbicides) ongoing…

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Marine microalgae seem to be more impacted than freshwater algae

Tetraselmis suecica > *Chaetoceros calcitrans* > *Sphaerellopsis* sp. > *Gomphonema gracile*




Thanks for your attention!

Mélissa Eon, Jacky Vedrenne, Sébastien Boutry, Julie Guéguen, Juliette Rosebery, Jade Ezzedine, Jean-Claude Grégoire,

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