EOF2024

RolE of Mixing on phytoplankton bloom initiation, maintEnance and DIssipatiOn in the galician ríaS (REMEDIOS)

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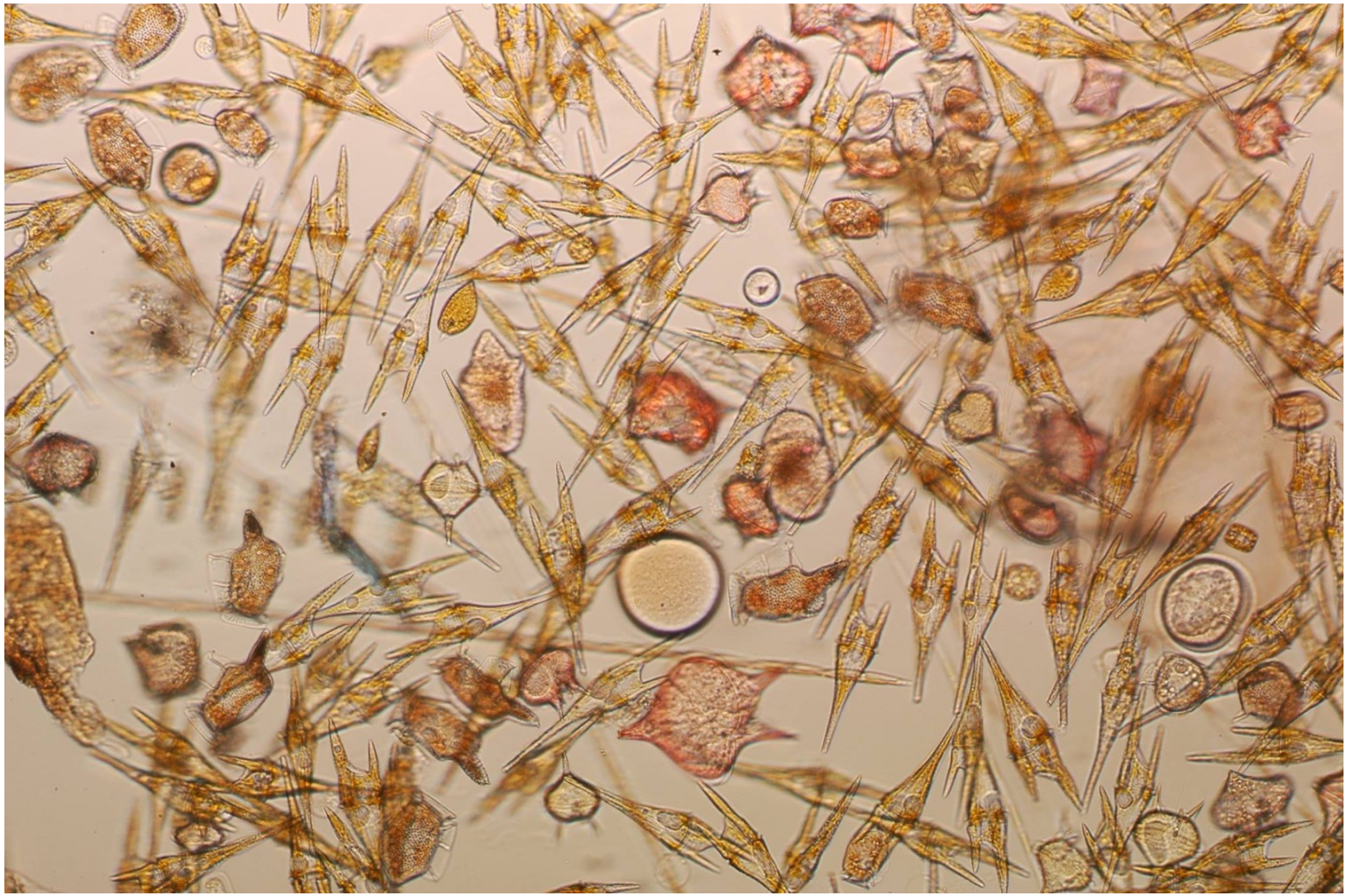
Unsolved mysteries in the Galician Rías Baixas

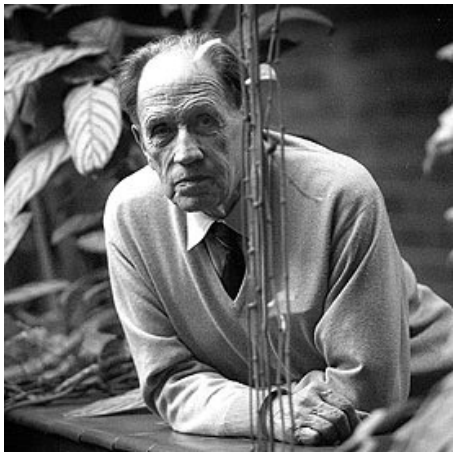
Turbulence and mixing

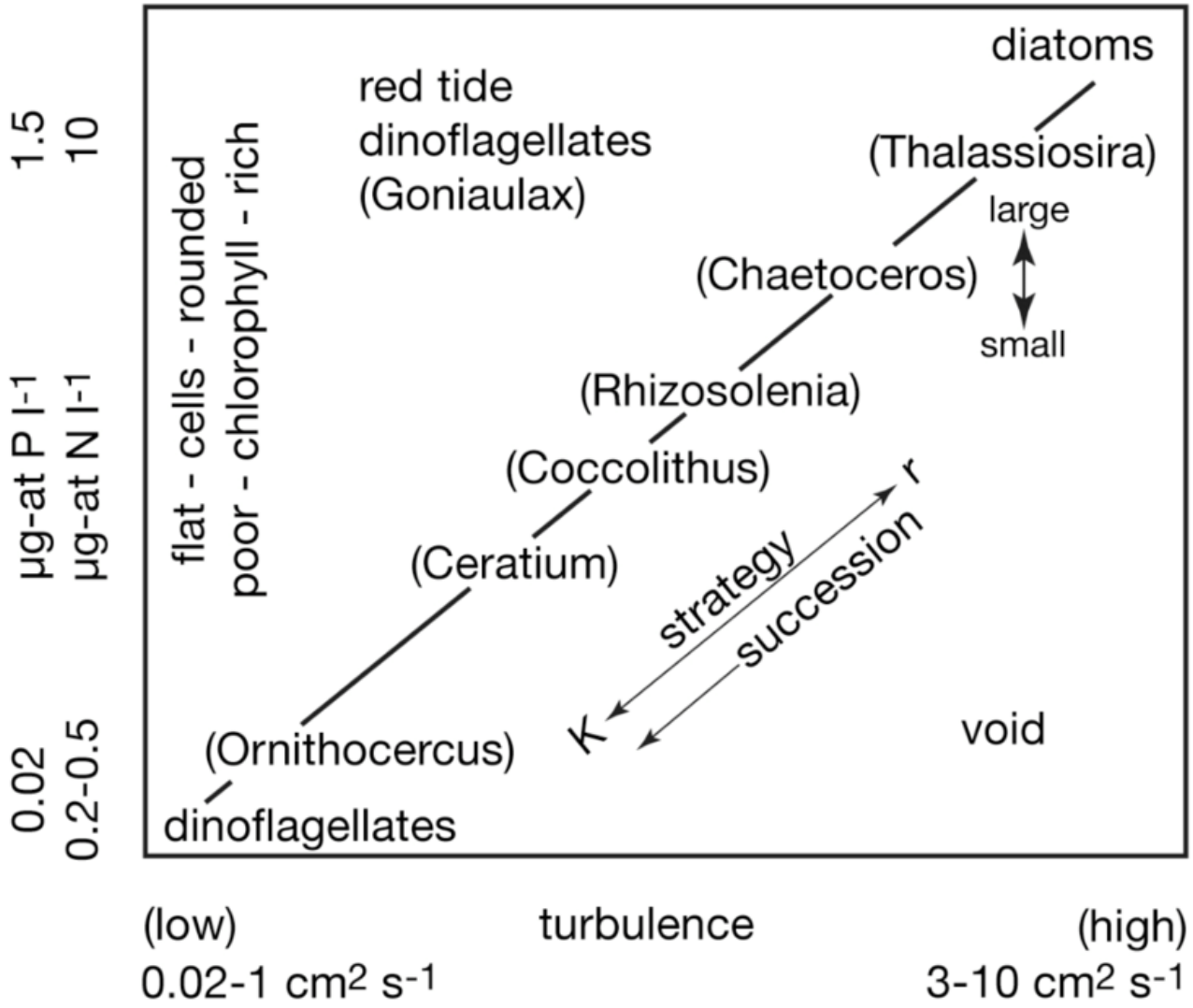
Harmful Algae Blooms



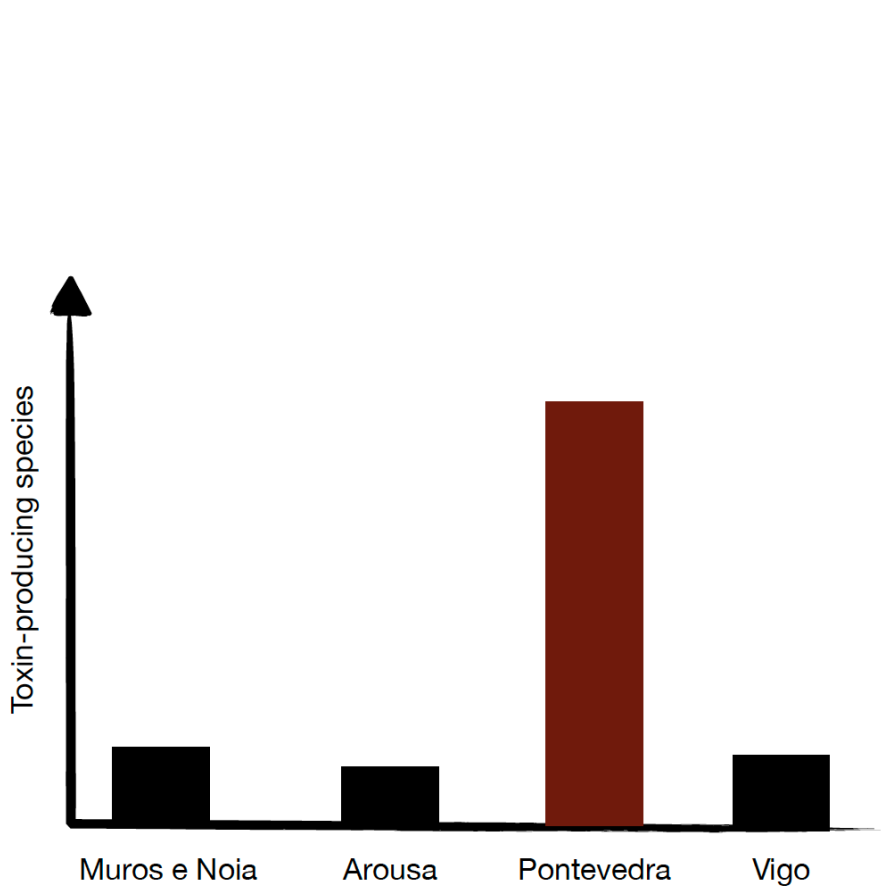
Courtesy of B. Reguera

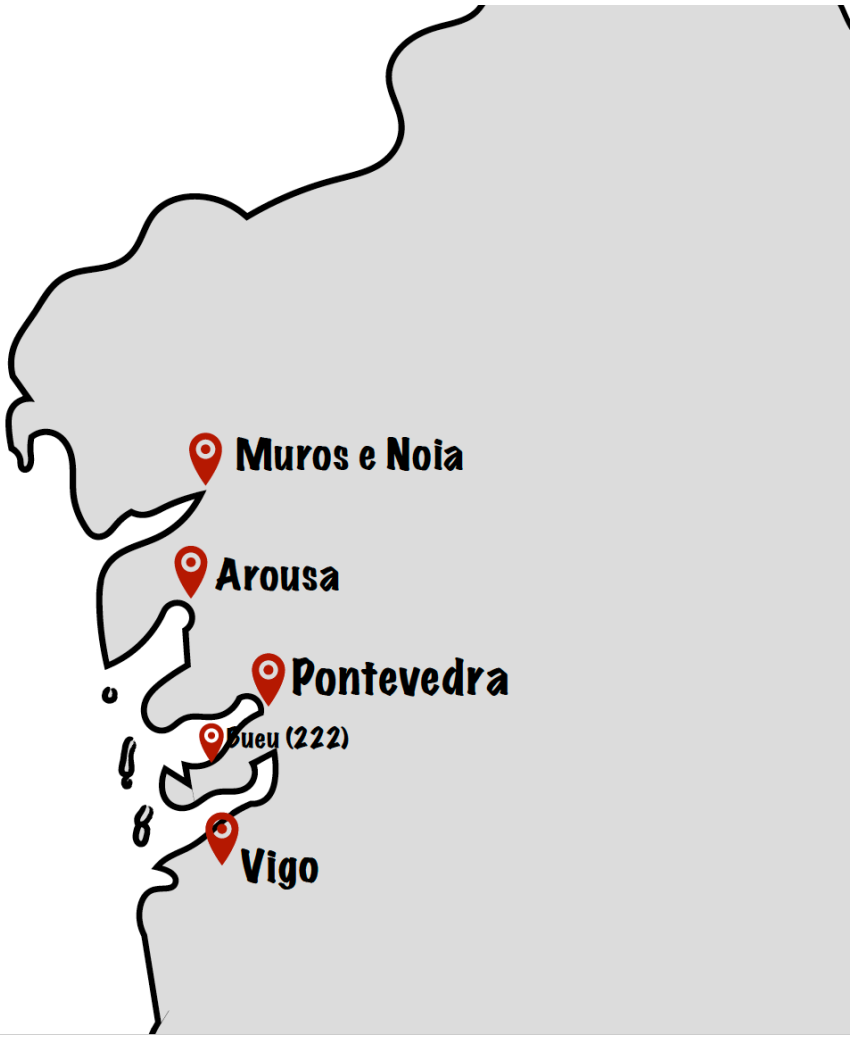
The Margalef´s mandala (1978)





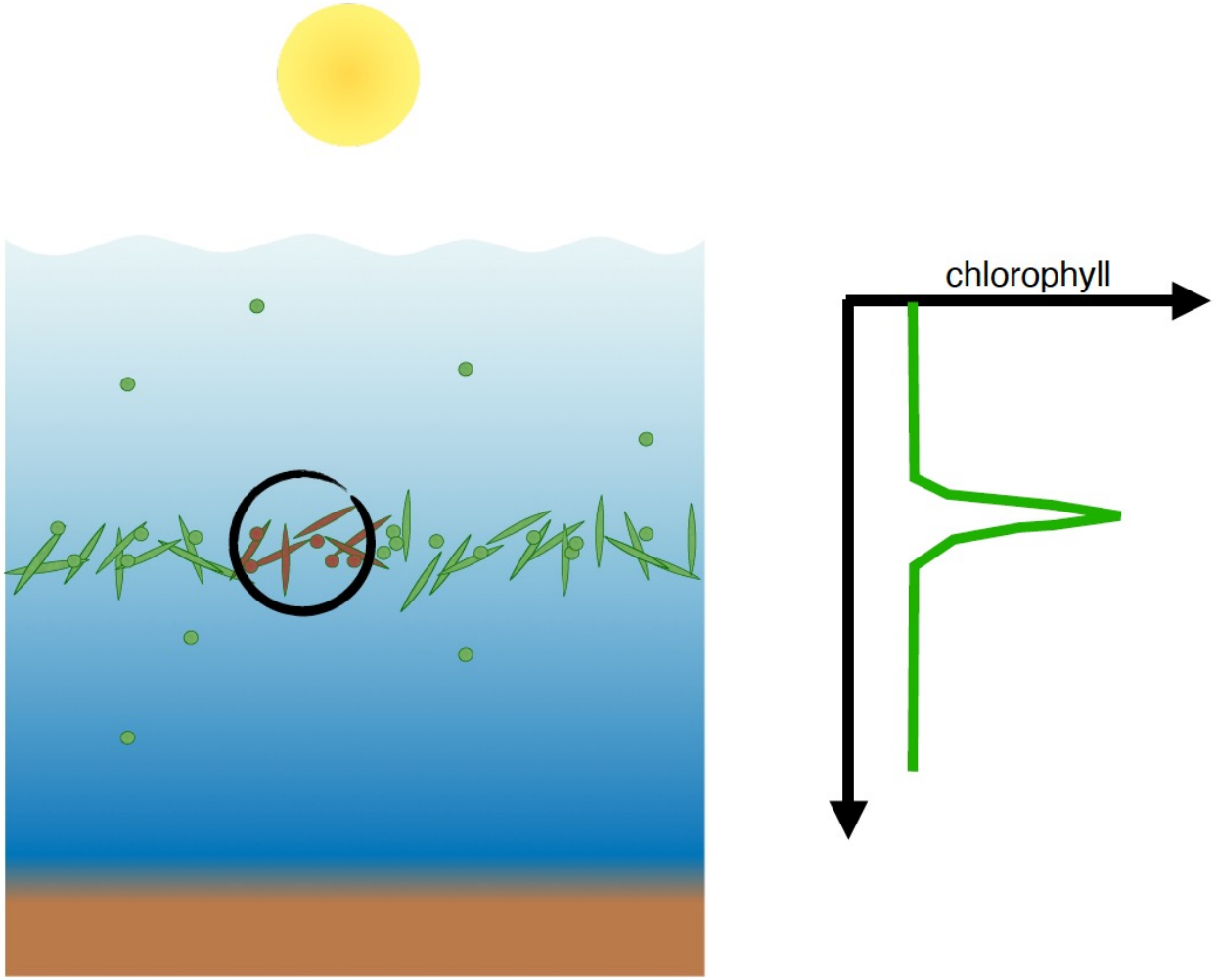
Ría de Pontevedra: a hotspot for toxicity



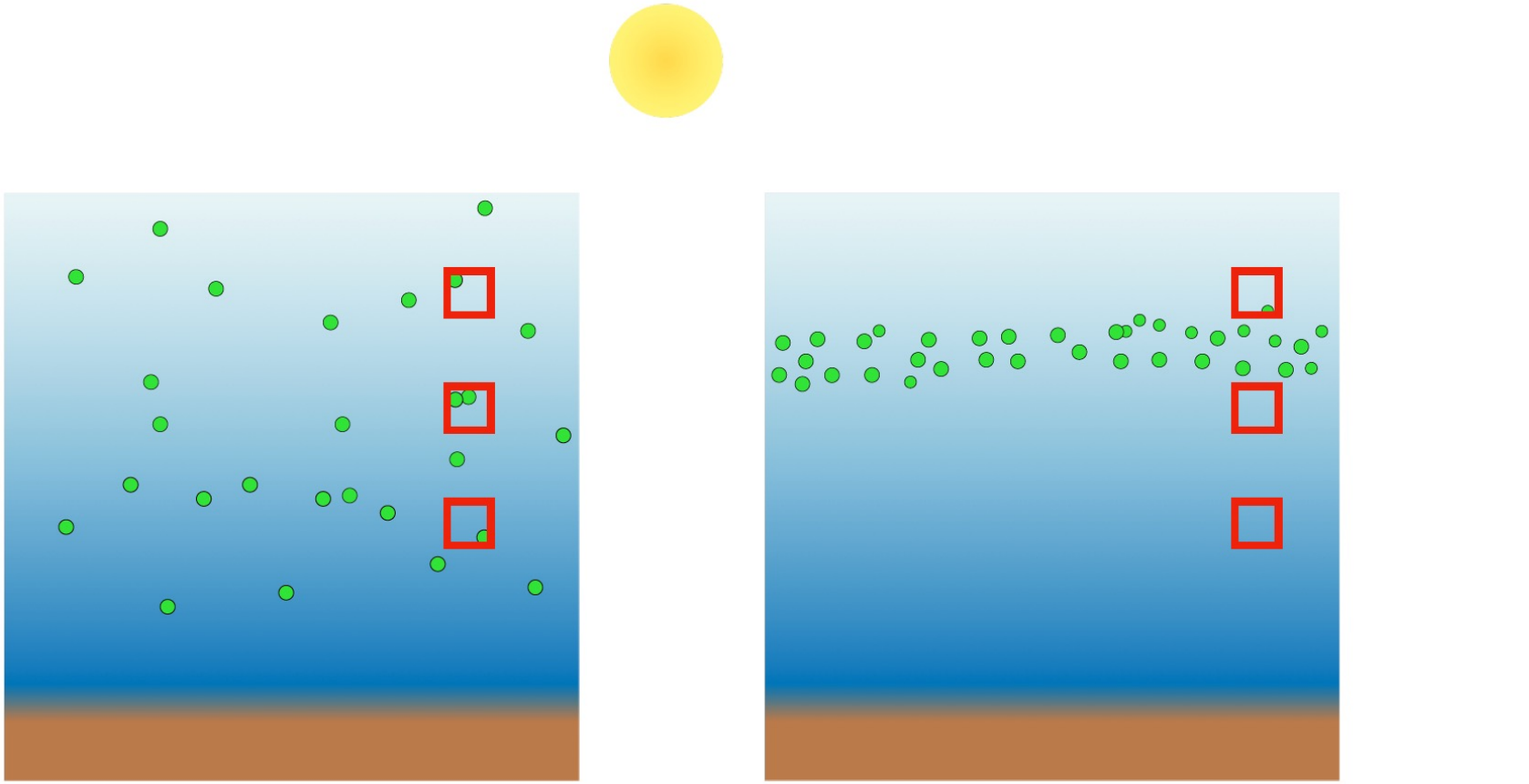


Sacilotto Detoni et al., (2024), Blanco et al., (2019)

Thin Layers of Phytoplankton (TLP) in Ría de Pontevedra

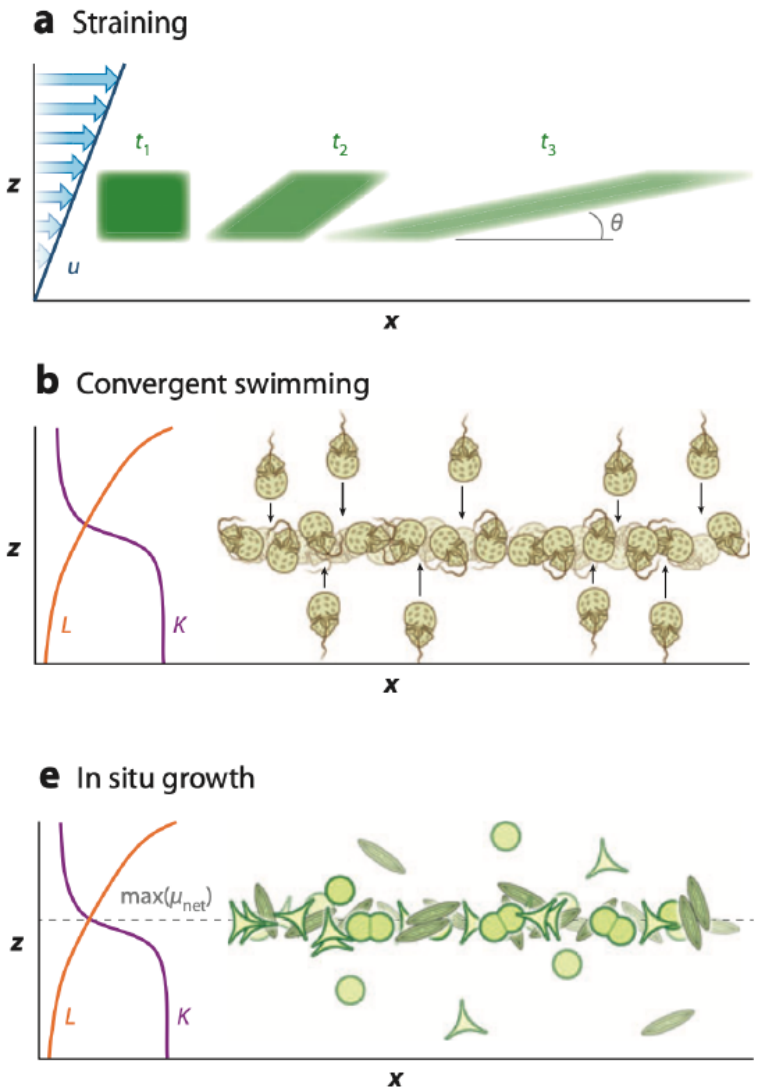


TLP detection

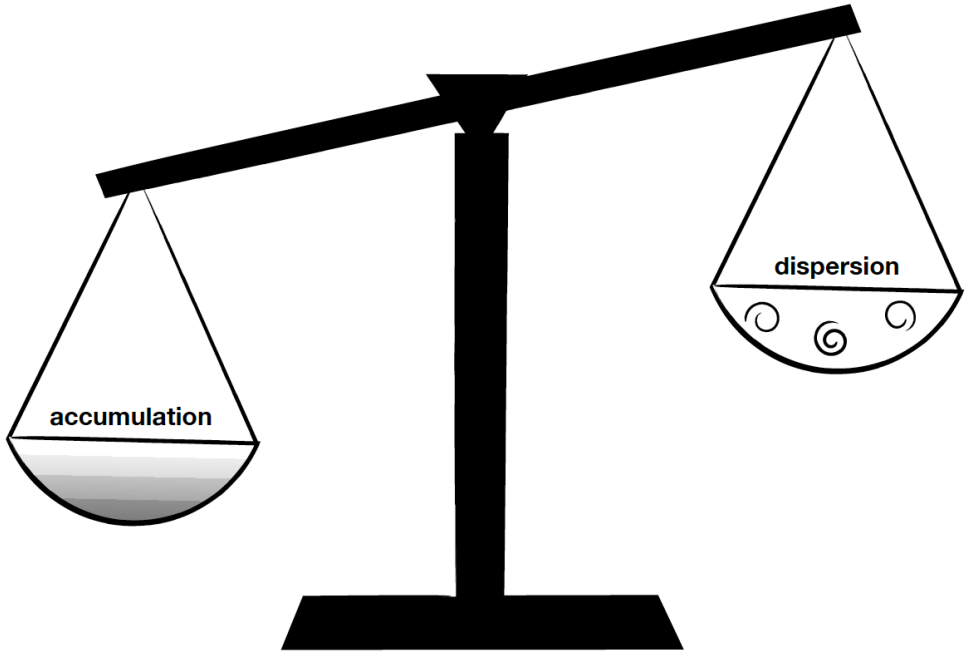


Escalera et al., 2012 (*Marine Pollution Bulletin*)

How do TLP form?



Durham & Stocker (2012)



Main goals:

1) Which is the role of turbulent mixing on phytoplankton growth in the Galician Rías Baixas?

2) Which is the role of TLP in hotspots of toxicity

Esperanza Broullón (Xunta de Galicia PhD fellowship)

Antonio Comesaña (FPI PhD fellowship)

RolE of Mixing on phytoplankton bloom initiation, maintEnance and DIssipatiOn in the galician ríaS (REMEDIOS)

GOBIERNO DE ESPAÑA
MINISTERIO DE ECONOMÍA Y EMPRESA

Main goals:

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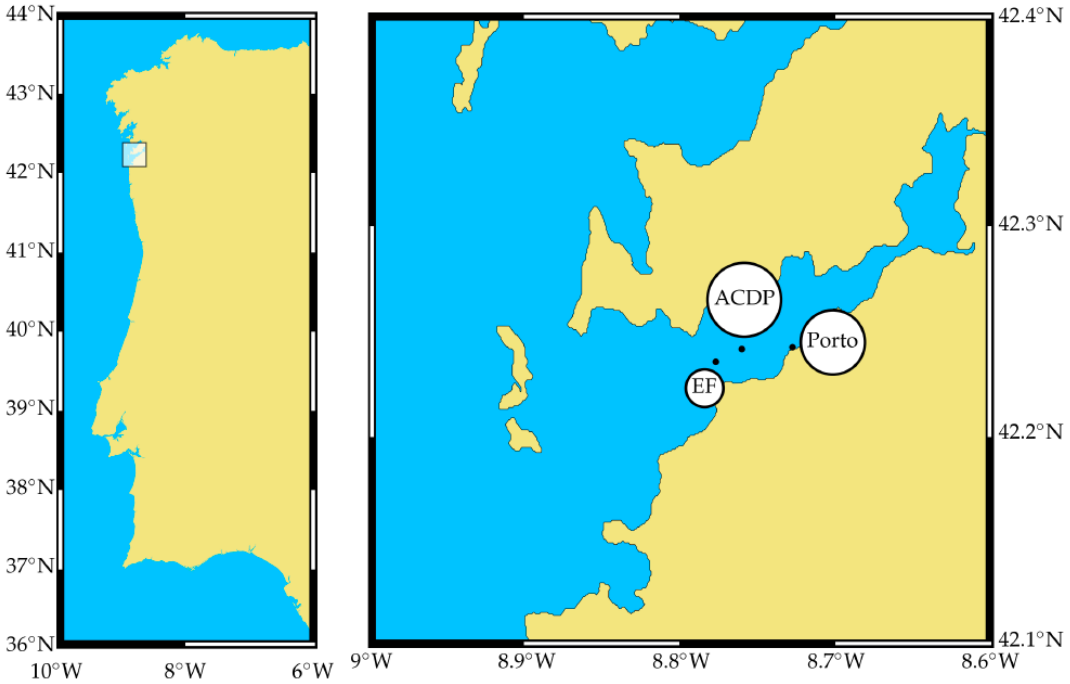
2) Which is the role of TLP in hotspots of toxicity

Observations: seasonal study (March 2017-May 2018)

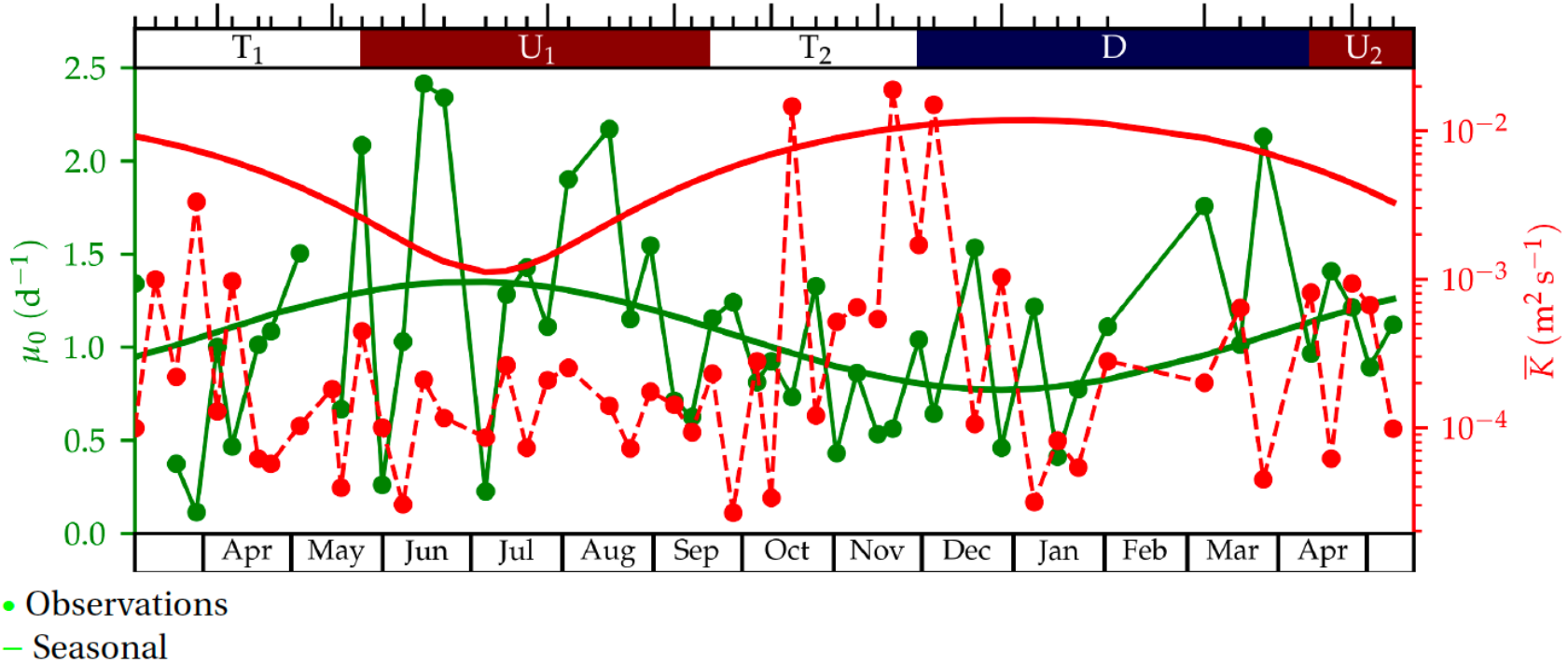


Weekly sampling at EF-Vigo:

- Hydrography, microturbulence & fluorescence profiles
- Inorganic nutrients (8 depths)
- Chlorophyll a (Surface and 10 m)
- ^{14}C-uptake primary production (Surface and 10 m)

Continous ADCP currents

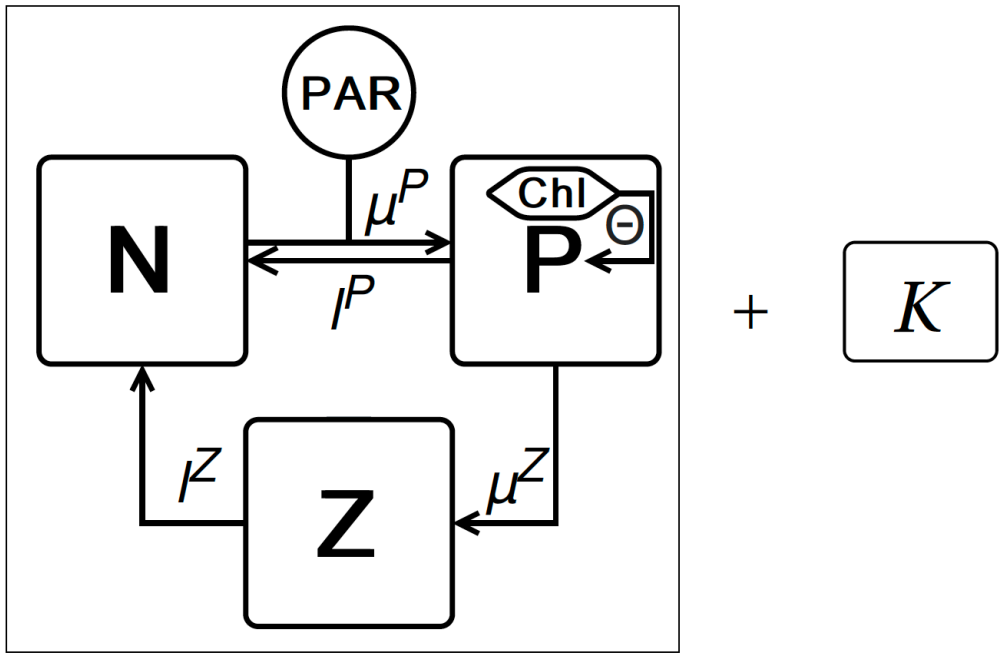
Mixing (K) and phytoplankton growth (μ) during the seasonal study



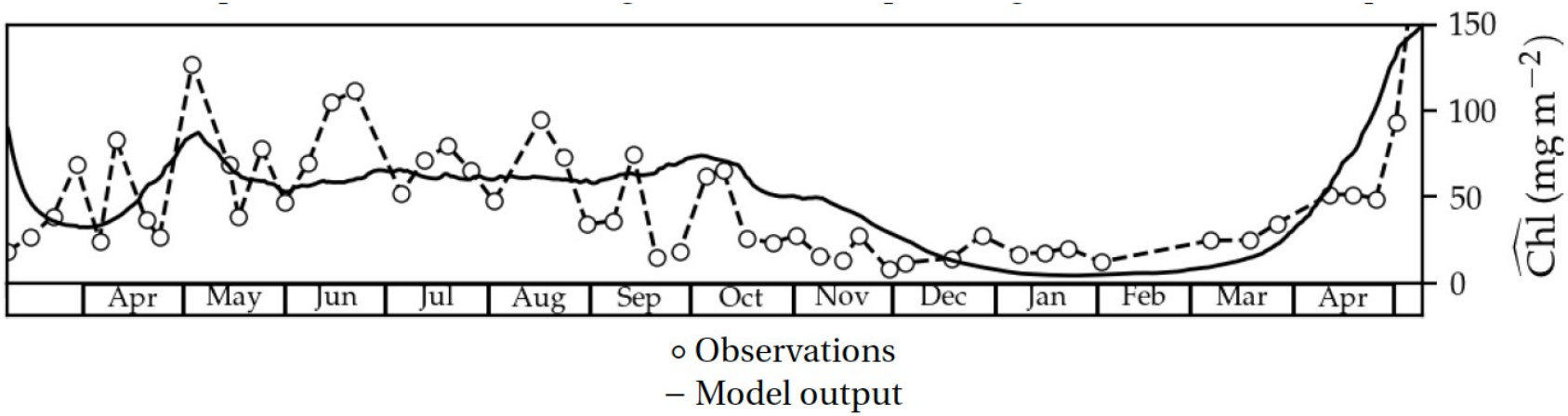
Higher (low) growth rates when mixing was low (high) (Comesaña et al., 2021, FMS)

Does a causal relationship exist between turbulence mixing and phytoplankton growth?

1D plankton-growth model forced with *I* and *K* observations



+ K

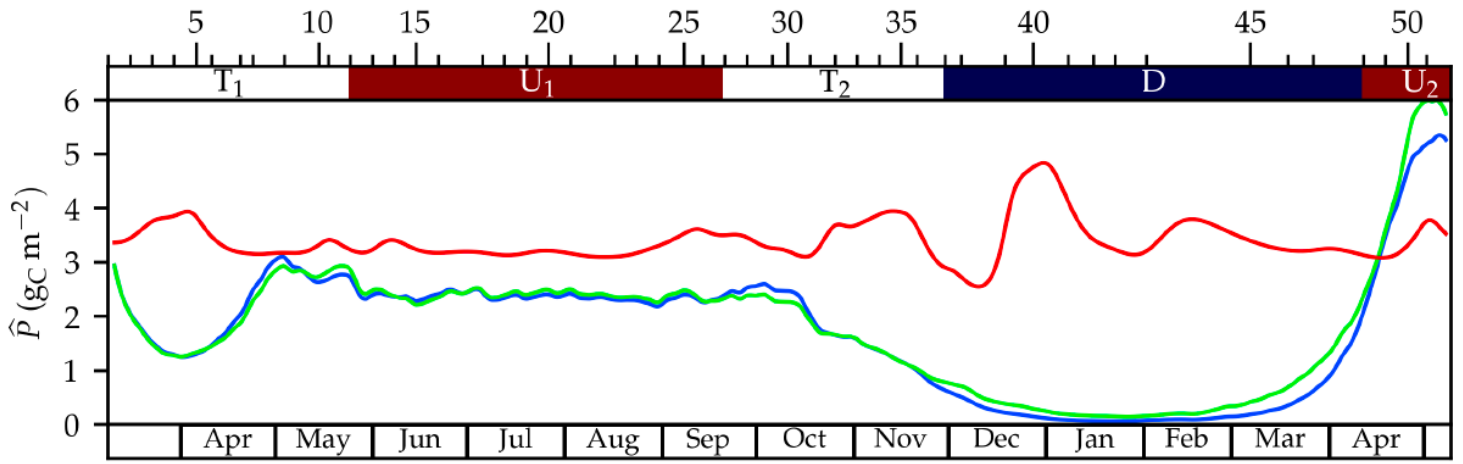


Seasonal variability of modeled phytoplankton

A. Both time-evolving observations of I and K.

B. Only time-evolving observations of I. The first K profile is maintained over time.

C. Only time-evolving observations of K.



Driven by temporal variability of *I,* whereas *K* plays a minor role (Comesaña et al., in prep.)

Seasonal variability of modeled phytoplankton

A. Both time-evolving observations of I and K.

B. Only time-evolving observations of I. The first K profile is maintained over time.

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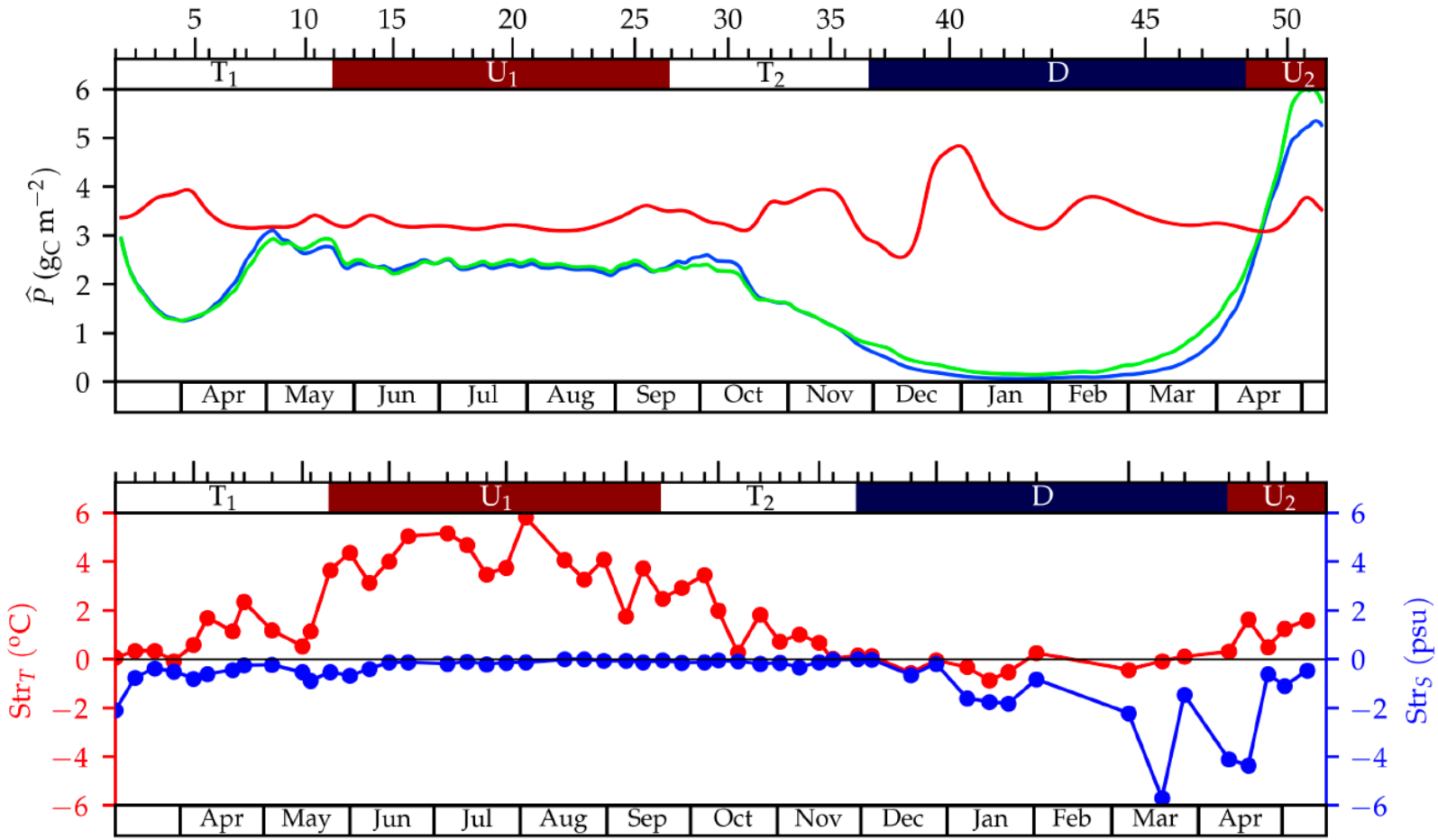
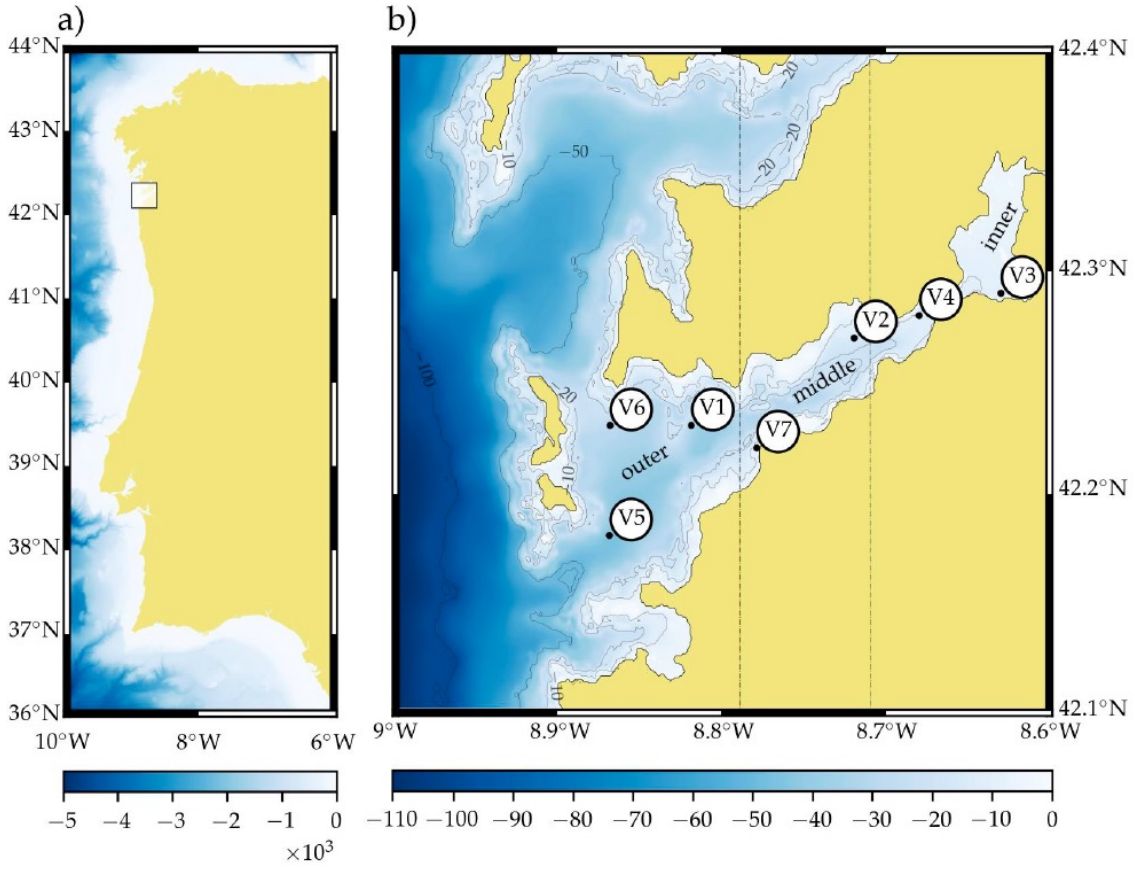


Due to the relevant stratification year round (Comesaña et al., in prep.)

Do these results apply to other years?

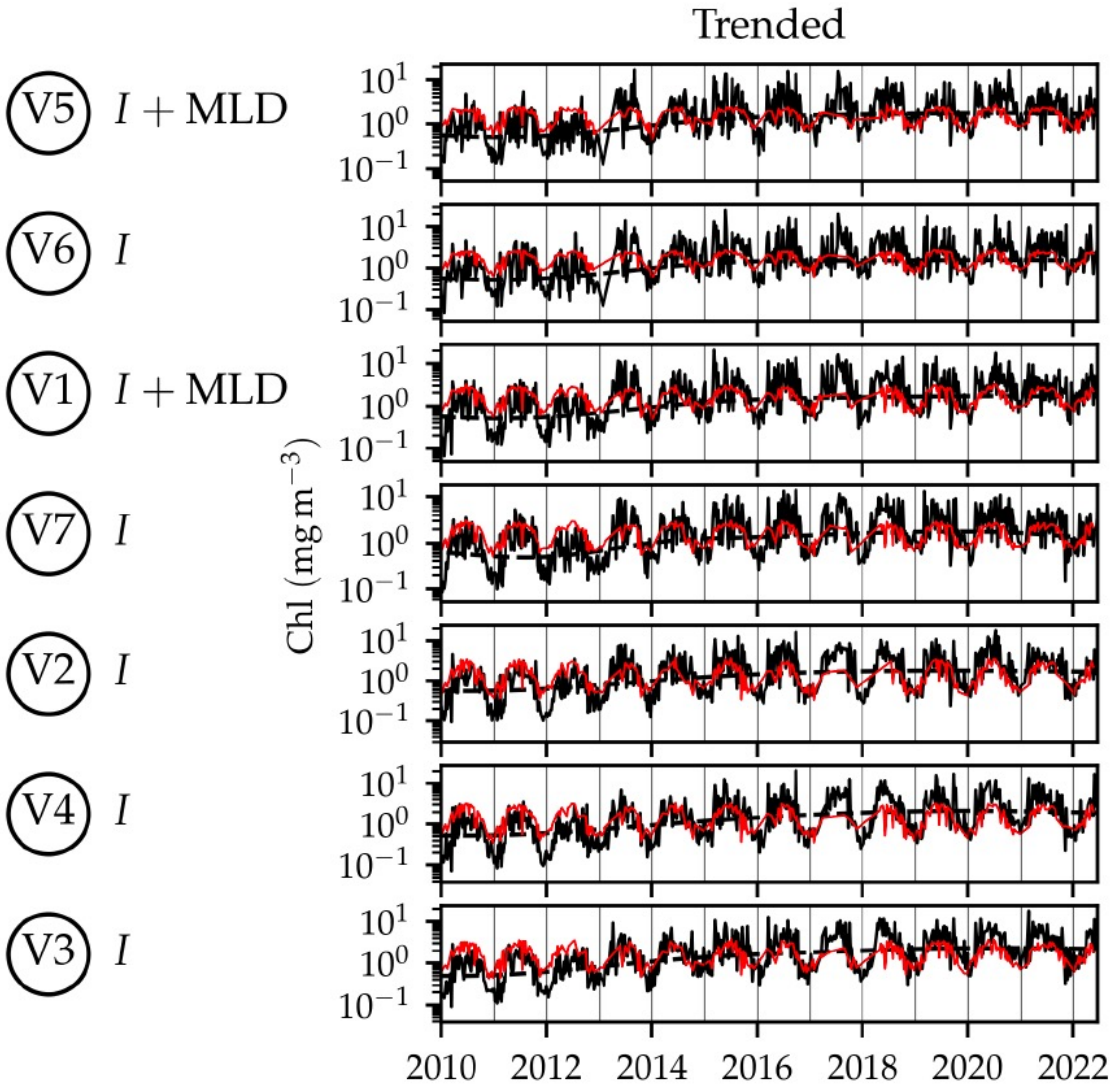
INTECMAR weekly monitoring database analysis



- Ría de Vigo (7 stations)
- Hydrography (2010-2022)
- Inorganic nutrients, Chla (0-15 m; 1998-2022)

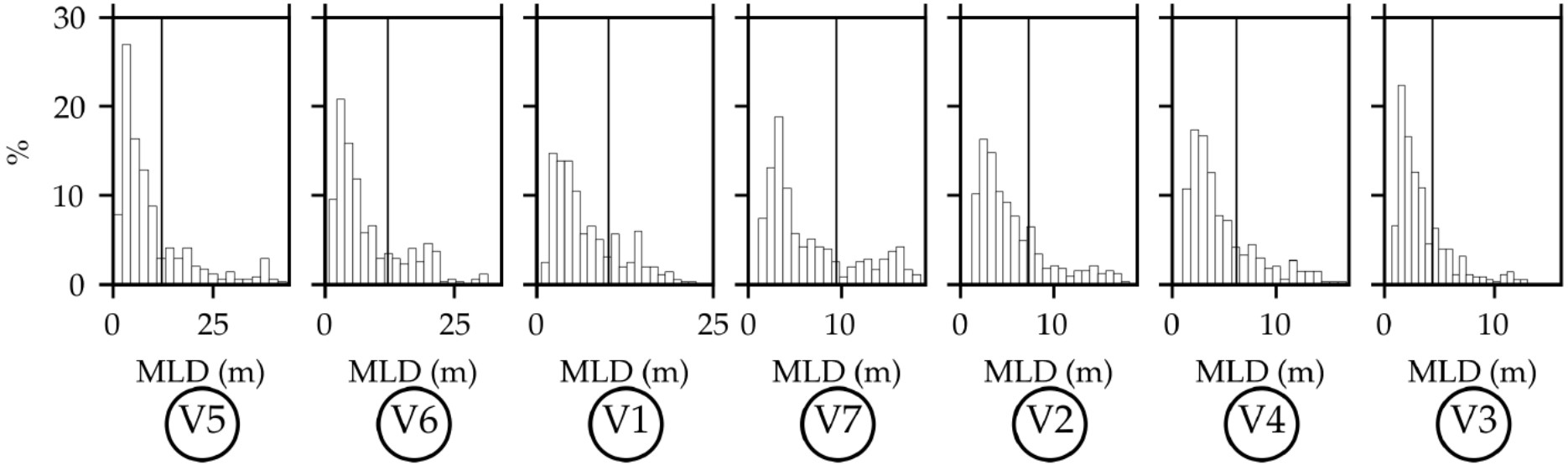
Variance explained by GAM for prediction with *I* and MLD

$$\log \mathrm{Chl}_i = a + f(I_{0_i}) + g(\mathrm{MLD}_i) + \epsilon_i$$



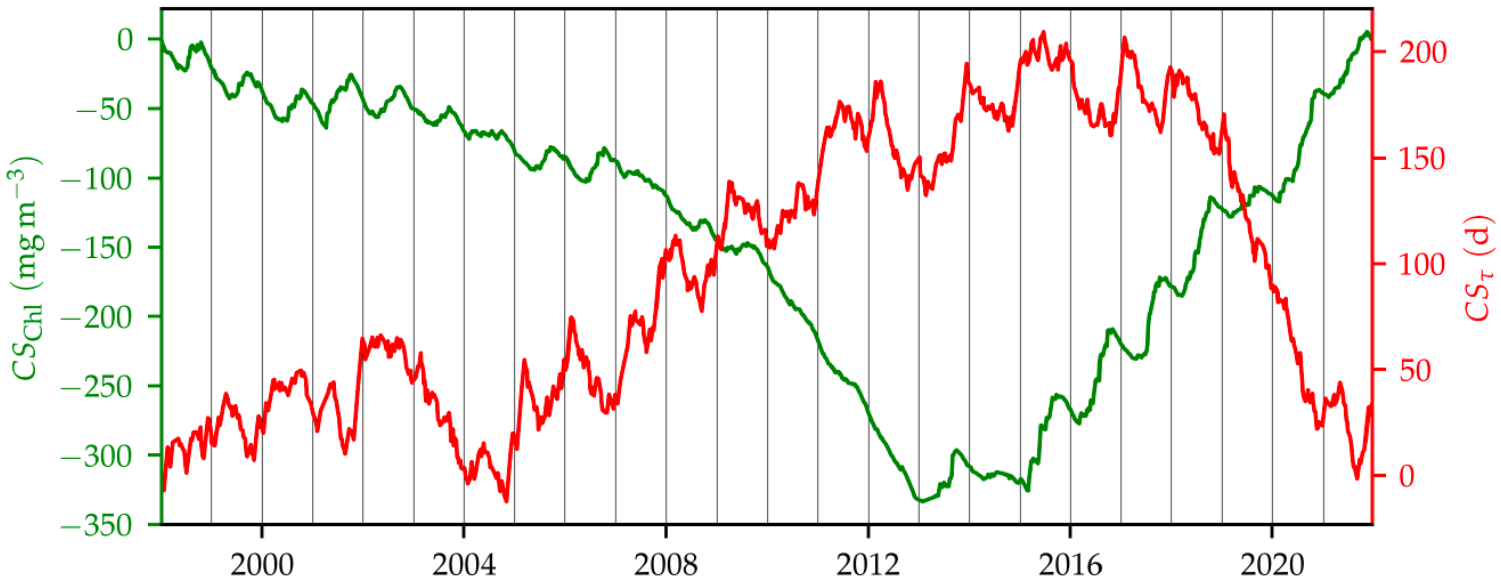
MLD played a minor role whereas *I* was the primary driver (Comesaña et al., in prep.)

Histograms of MLD in Ría de Vigo



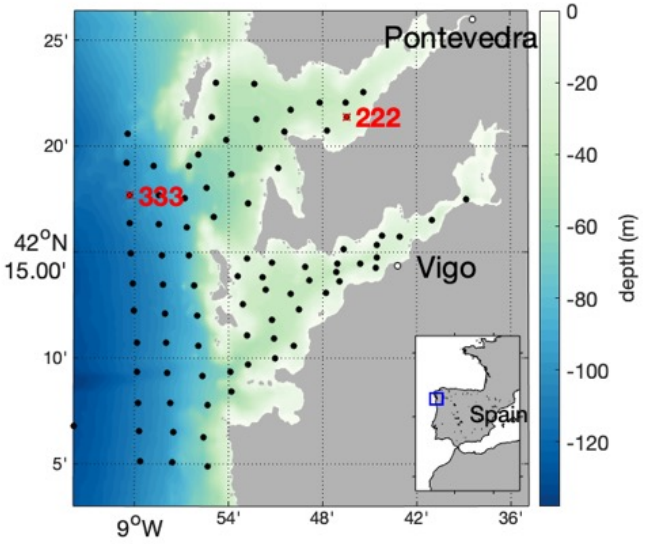
Shallow MLD: 75% of the time MLD did not reach half of maximum value

Temporal evolution of cumsums of Chla and upwelling duration



Chla long-term negatively correlated with duration of upwelling events
(Comesaña et al., in prep.)

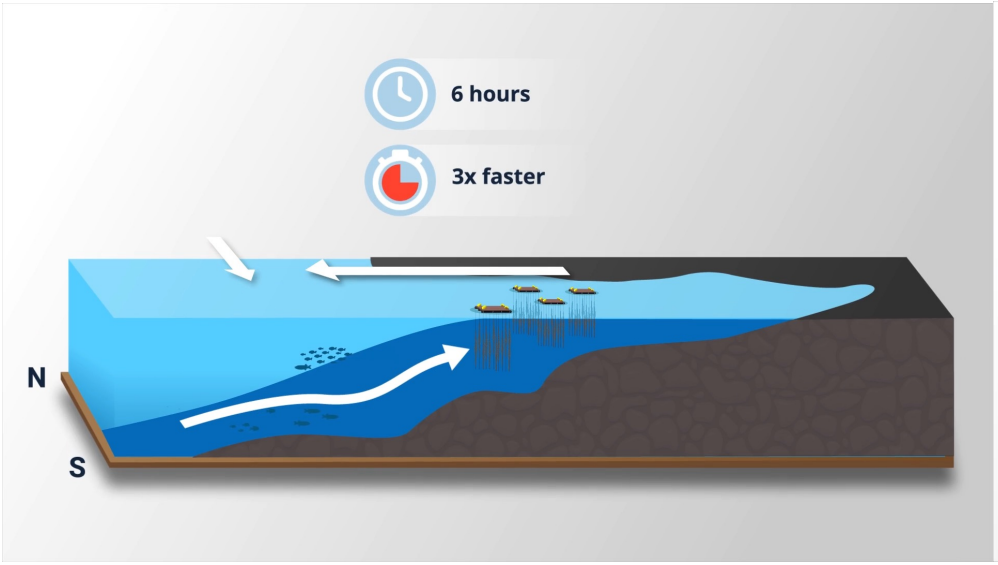
Observations: summer cruise (29 June-16 Jul 2018)

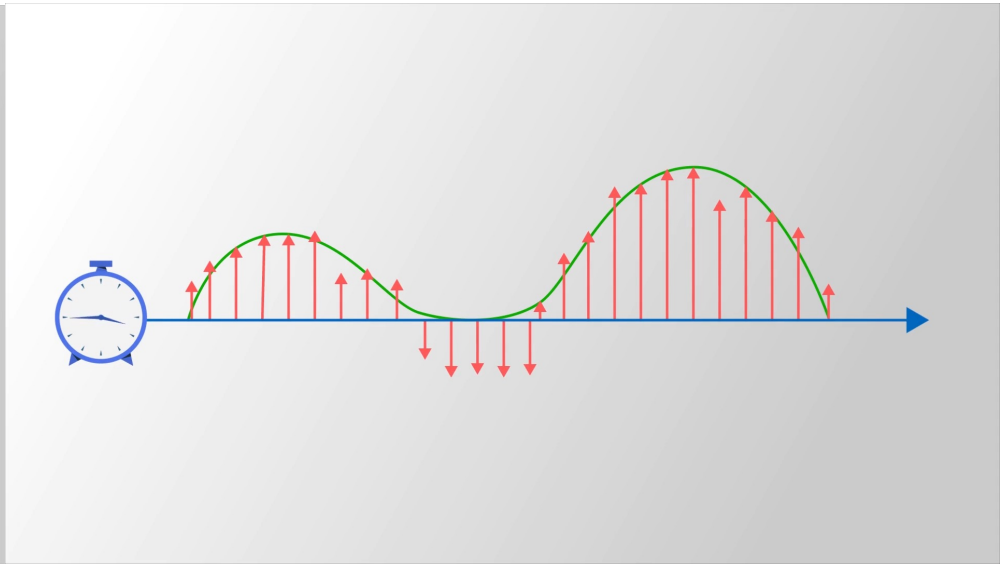


St 333 (Shelf) and st 222 (Ría de Pontevedra):

- Microturbulence profiler (st 222)
- Inorganic nutrients (7-8 depths)
- Chlorophyll a (5 depths)
- ^{14}C-uptake primary production (5 depths)

Rapid phytoplankton response to wind forcing





Resonance time scales of wind-driven upwelling and phytoplankton growth (~ 3 days) could explain higher productivity (Broullón et al., 2023, L&O letters)

Main goals:

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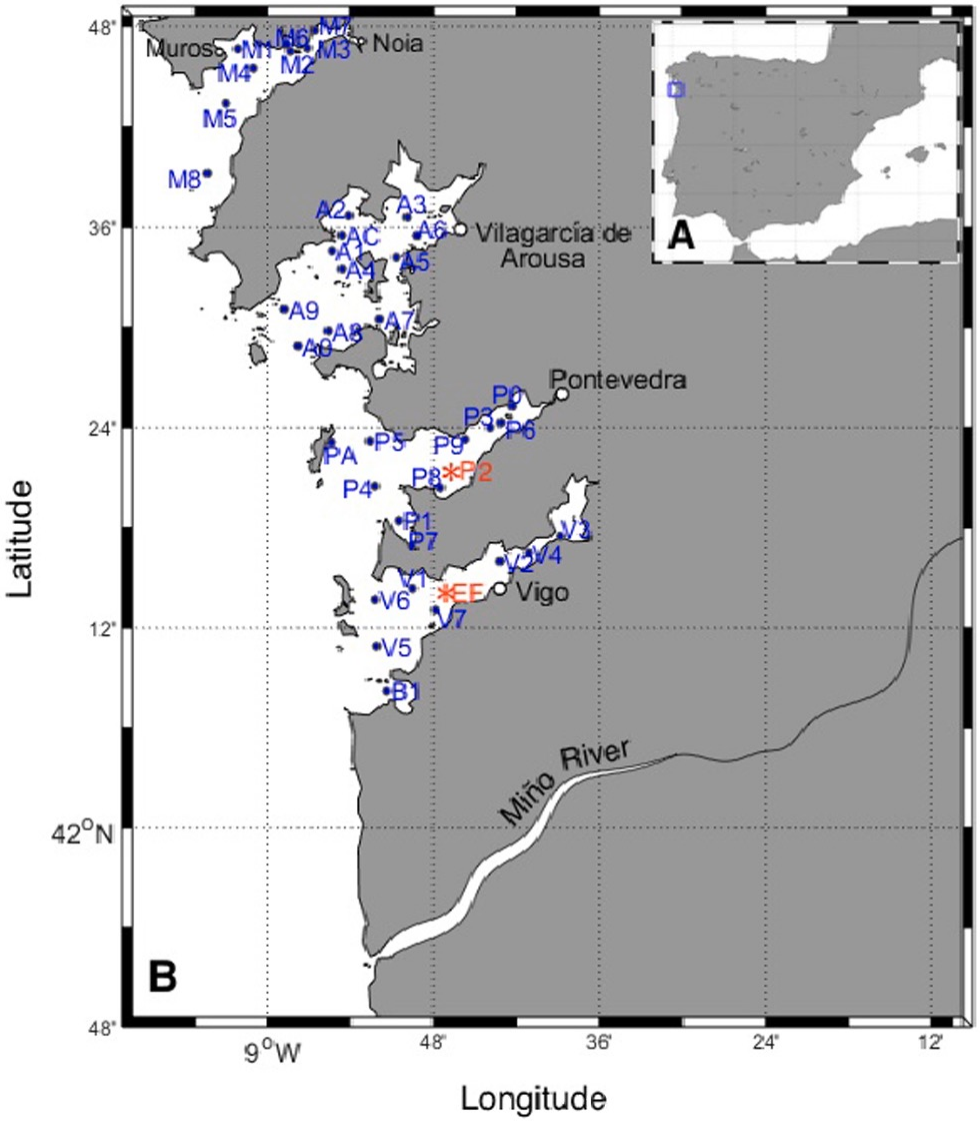
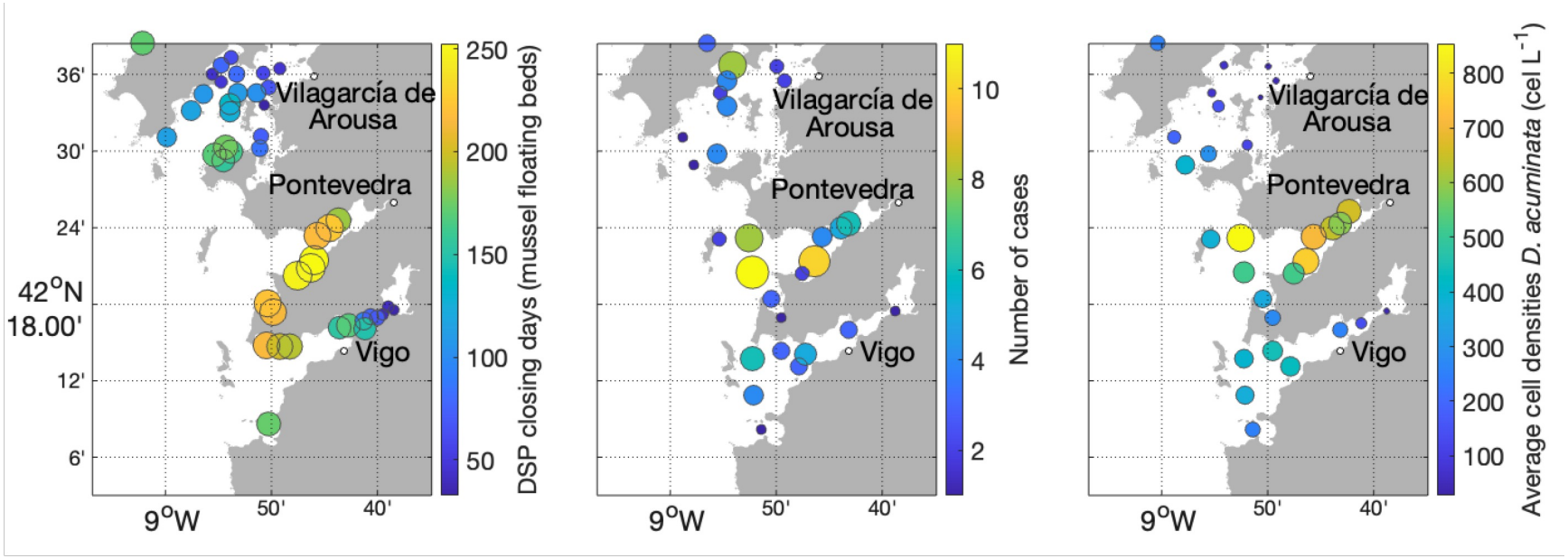
2) Which is the role of TLP in hotspots of toxicity

INTECMAR monitoring database analysis



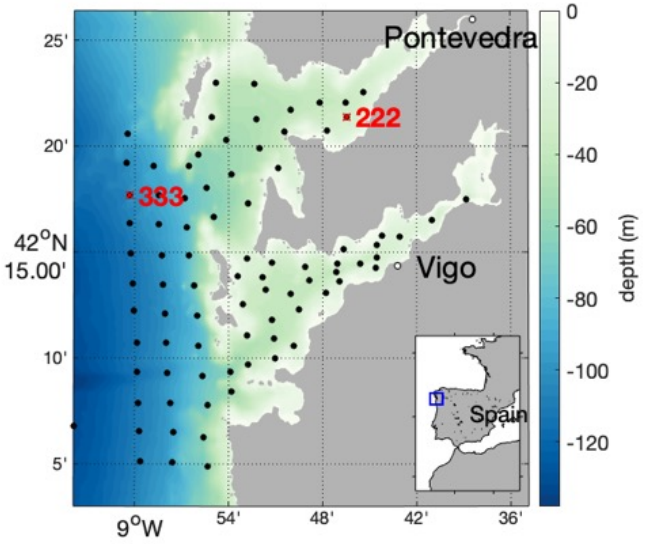
- Rías Baixas (39 stations)
- HAB species (2002-2007)
- Fluorescence profiles (2002-2005)

Harvesting closure days, TLP, and *D. acuminata* densities (2012-2015)



More frequent TLP in Ría de Pontevedra, characterized by longer toxicity events caused by *Dinophysis* species (Broullón et al., 2020, PO)

Observations: summer cruise (29 June-16 Jul 2018)



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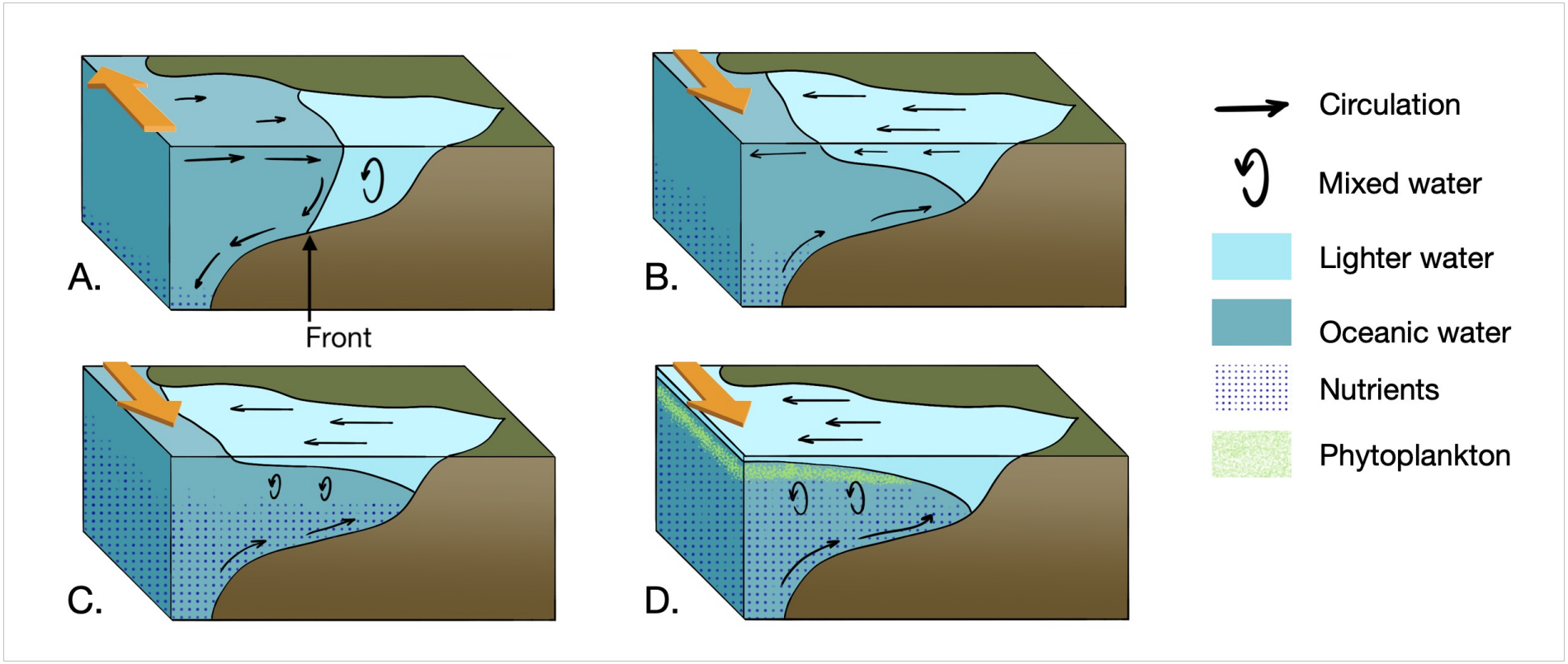
Schematic of the mechanism responsible for the TLP formation



A combination of straining and in situ growth could explain the TLP formation (Broullón et al., in prep.)

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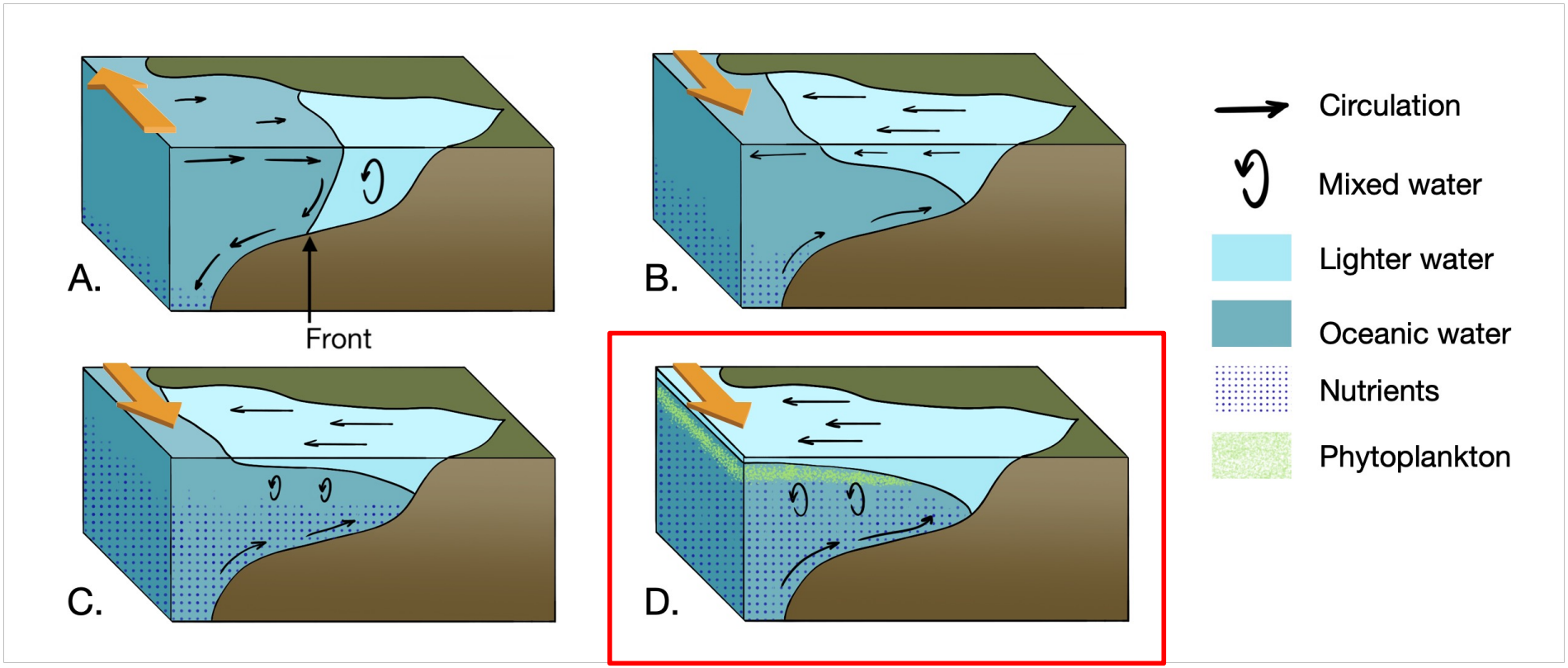

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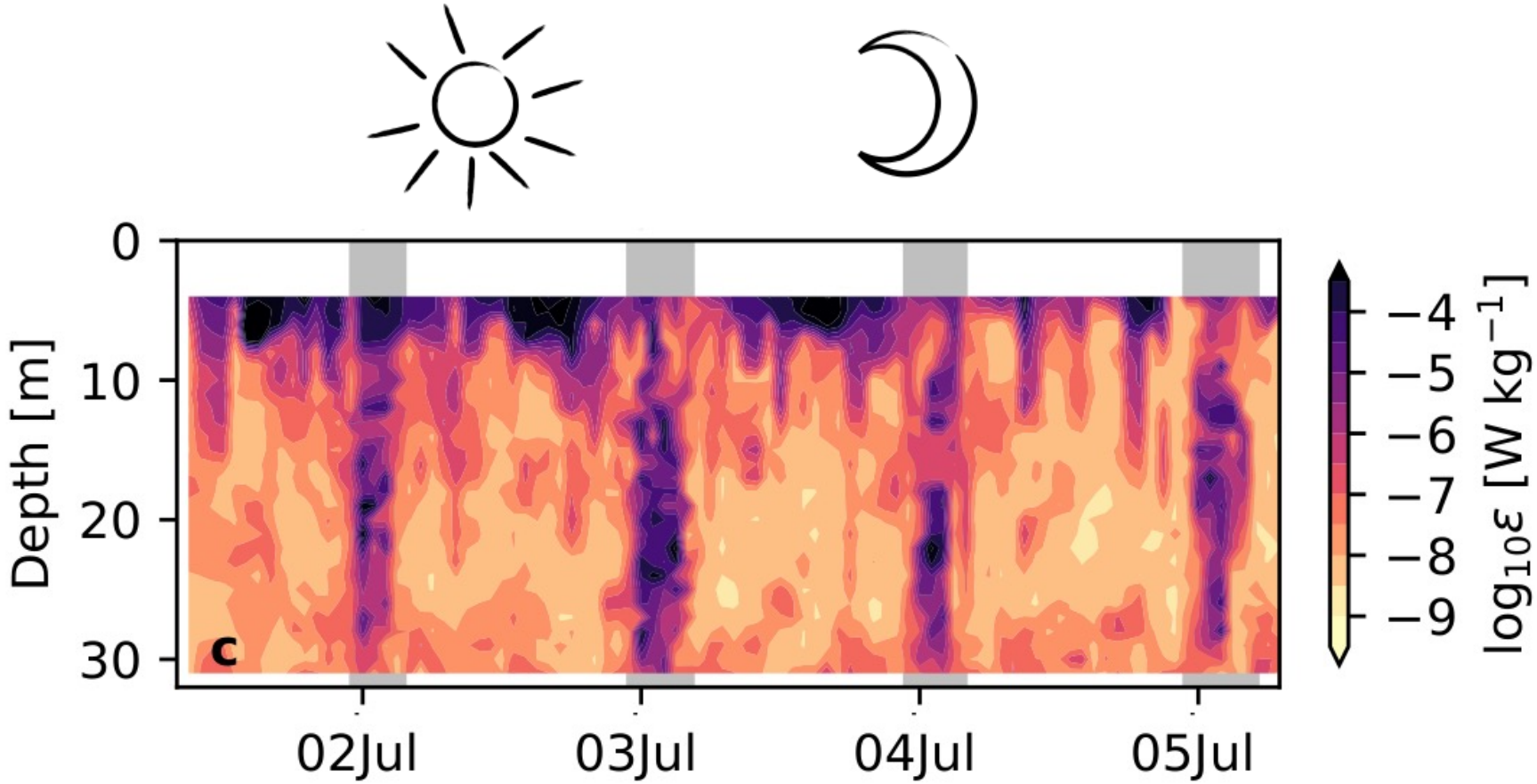
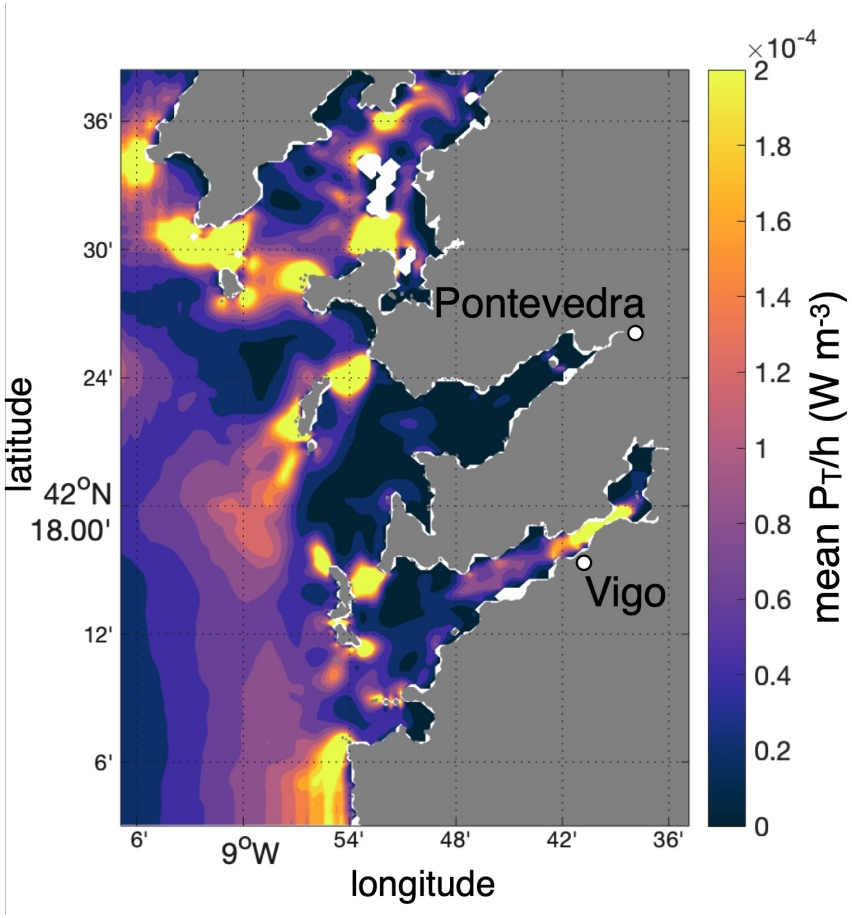
Efficient biomixing due to frenetic fish spawning agregation



TLP may be supported by biological mixing due to spawning fish aggregations
(Fernández-Castro et al., 2022, Nature Geoscience)

Turbulent Energy Production from CROCO model



Weaker TEP could lead to higher TLP and HAB persistence in Ría de Pontevedra (Broullón et al., in prep.)

Main goals:

1) Which is the role of turbulent mixing on phytoplankton growth in the Galician Rías Baixas?

No relationship between K and growth

Relevance of the duration of upwelling pulses

Main goals:

2) Which is the role of TLP in hotspots of toxicity?

More frequent TLP in Ría de Pontevedra (hotspot for toxicity)

Weaker TEP could lead to higher TLP and HAB persistence

Thanks to...

- CTM2016-75451-779 C2-1-R to B. Mouriño-Carballido (Spanish government)