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SIMILARITIES BETWEEN SUMMER NEARSHORE AND OFFSHORE PLANKTON COMMUNITIES IN THE MEDITERRANEAN SEA



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To what degree do nearshore plankton communities constitute an assemblage that is independent and distinct from those offshore in the Mediterranean Sea?
Is the deep chlorophyll maximum an incubator of HAB producing cells?

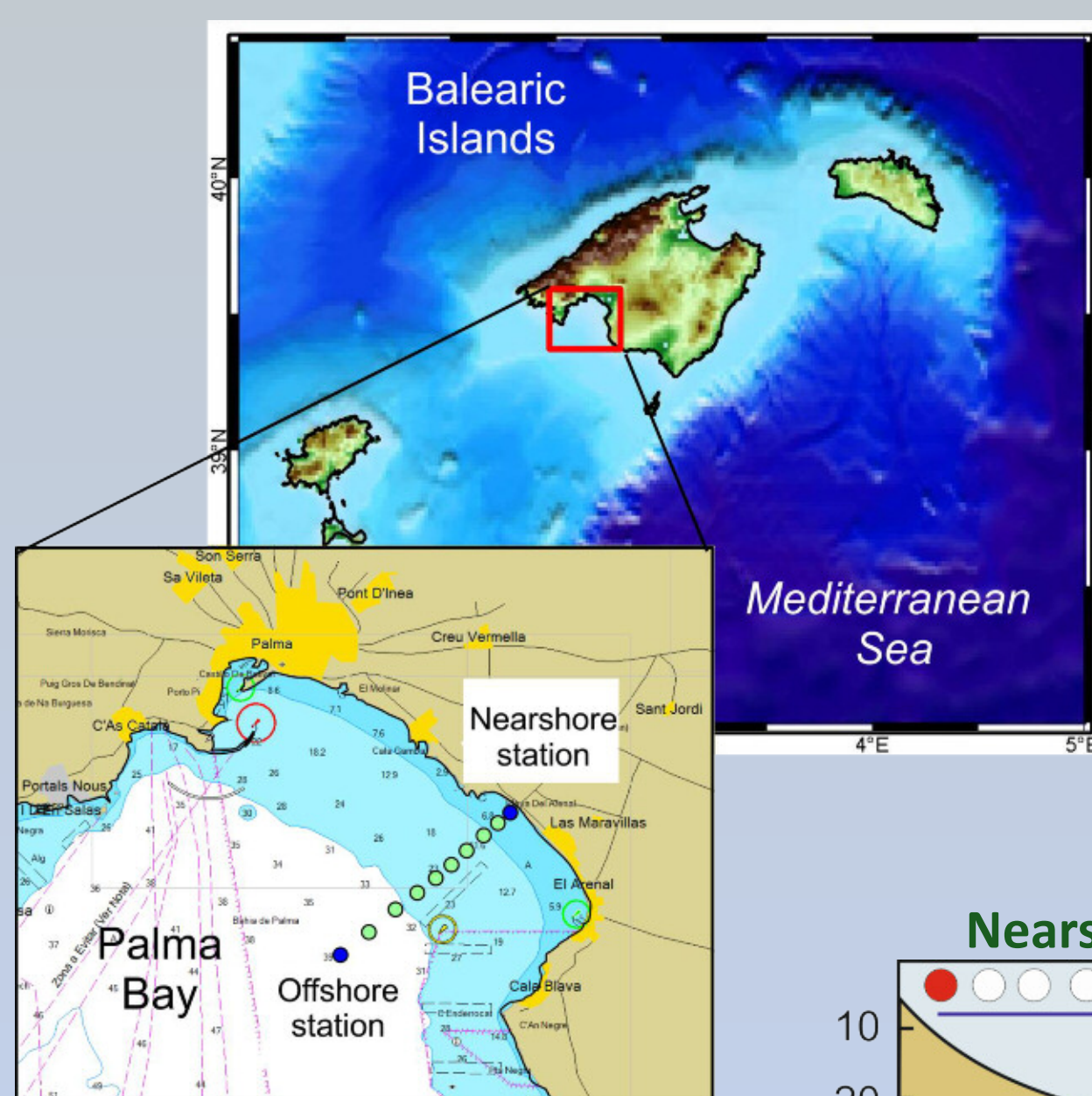
WHAT AND WHY?

The coast is a transitional area characterised by strong physical, chemical and biological gradients that extend from land to sea. There, biological production is closely coupled to processes that deliver nutrients to surface waters, such as riverine inputs, surface runoff and groundwater discharges.

The nutrient-rich nearshore waters of Palma Bay (Mallorca, NW Mediterranean Sea) often host high-biomass blooms.

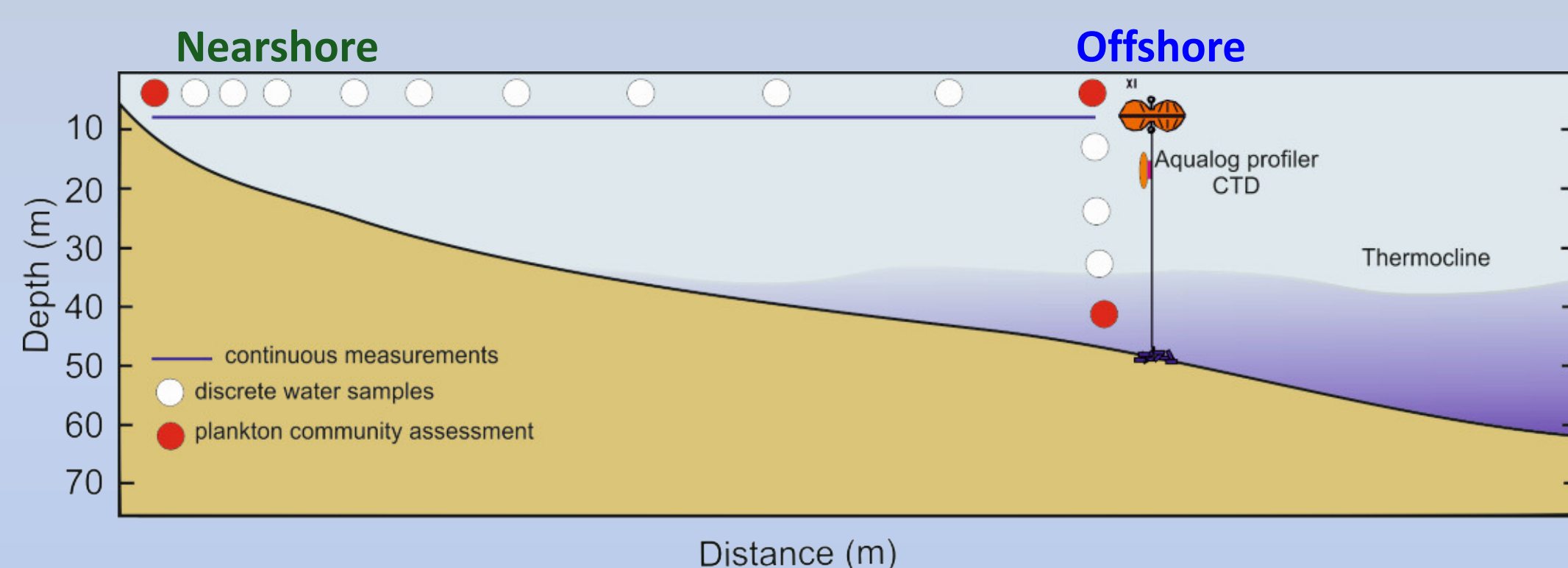
We quantified the temporal and spatial changes in the community that are associated with the presence of fine-scale physical and chemical variations along the coast. Our focus was the changing abundance and composition of phytoplankton populations. We also asked whether **offshore** populations serve as a source for **nearshore** harmful algal blooms (HABs).

WHERE, WHEN AND HOW?

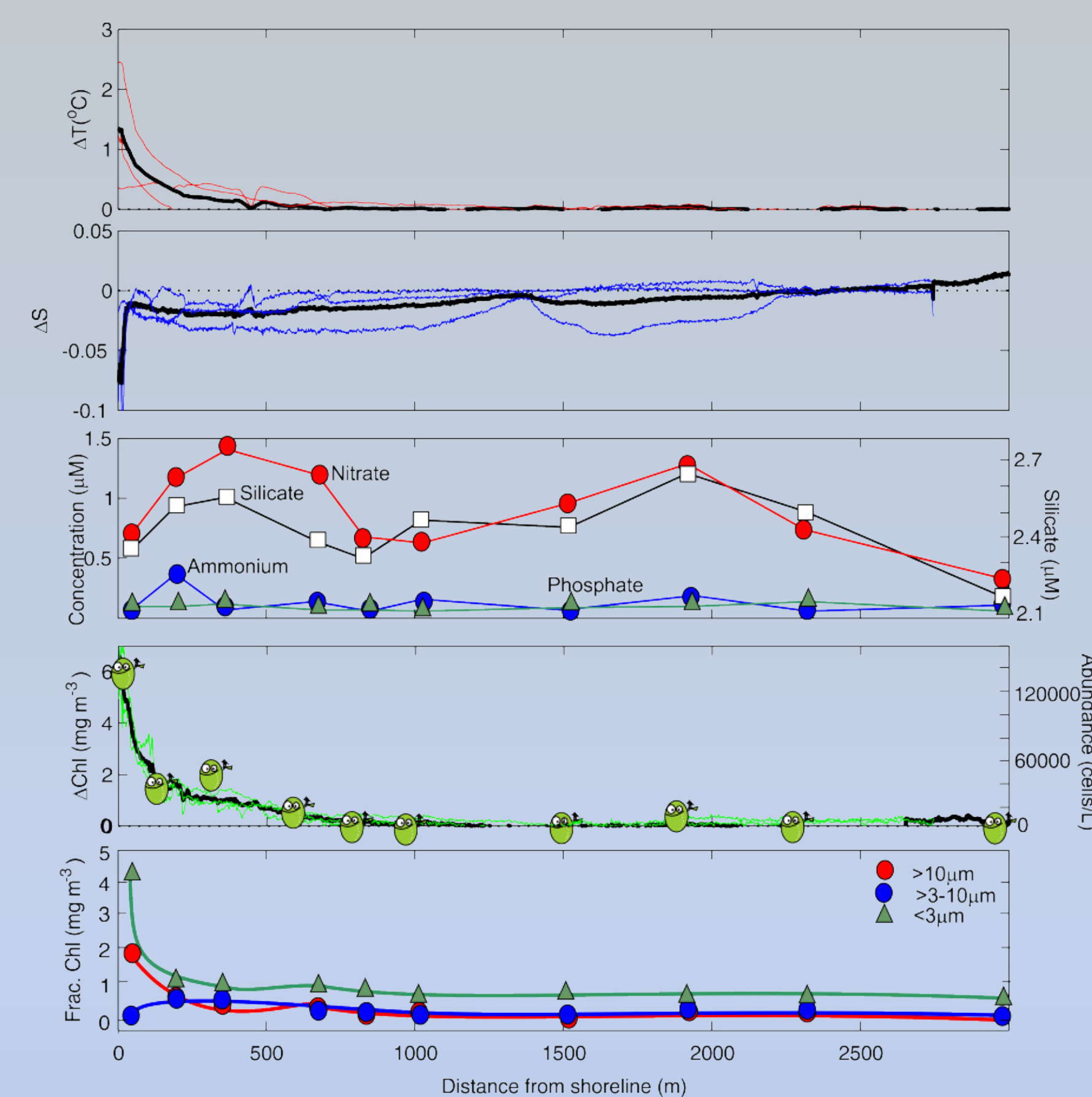


Stations representative of **nearshore** and **offshore** ecosystems were monitored from April 10th to October 8th 2014 in Palma Bay (Mallorca).

Additionally, data from underway continuous measurements and intermediate points were obtained and points located between the two systems were sampled in June, when the water column was stratified. The combined information was used to investigate the transition between the two ecosystems.



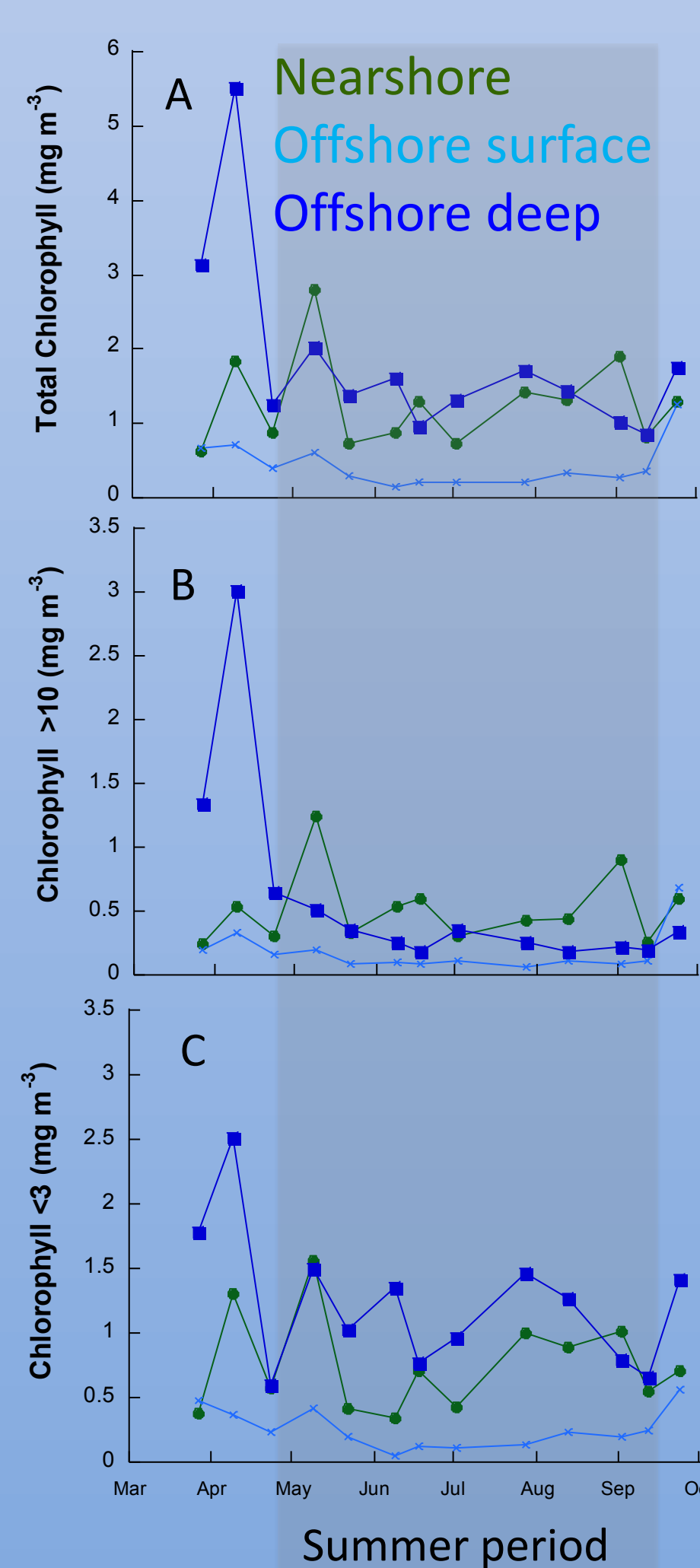
SPATIAL VARIABILITY



High phytoplankton biomass occurs in warm, low-salinity **nearshore** waters but it rapidly declines with distance. Enhanced nitrate and silicate concentrations associated with freshwater inputs extend **offshore** following a decline in salinity. Nitrate and silicate are also available at the **offshore deep** (DCM).

Microphytoplankton and picoplankton dominate **nearshore** phytoplankton biomass. The noxious and toxic species are highly abundant in this environment (*Alexandrium minutum*, *A. tamarense*, *A. margalefi*, *A. insuetum*, *Dinophysis sacculus*, *Lingulodinium polyedrum*, *Karlodinium* spp., *Prorocentrum* spp., *Karenia* spp., *Gymnodinium* spp., *Heterocapsa* spp., *Scrippsiella* spp., *Ceratium* spp., *Gyrodinium* spp. etc...). Picoplankton biomass dominates along the rest of the transect.

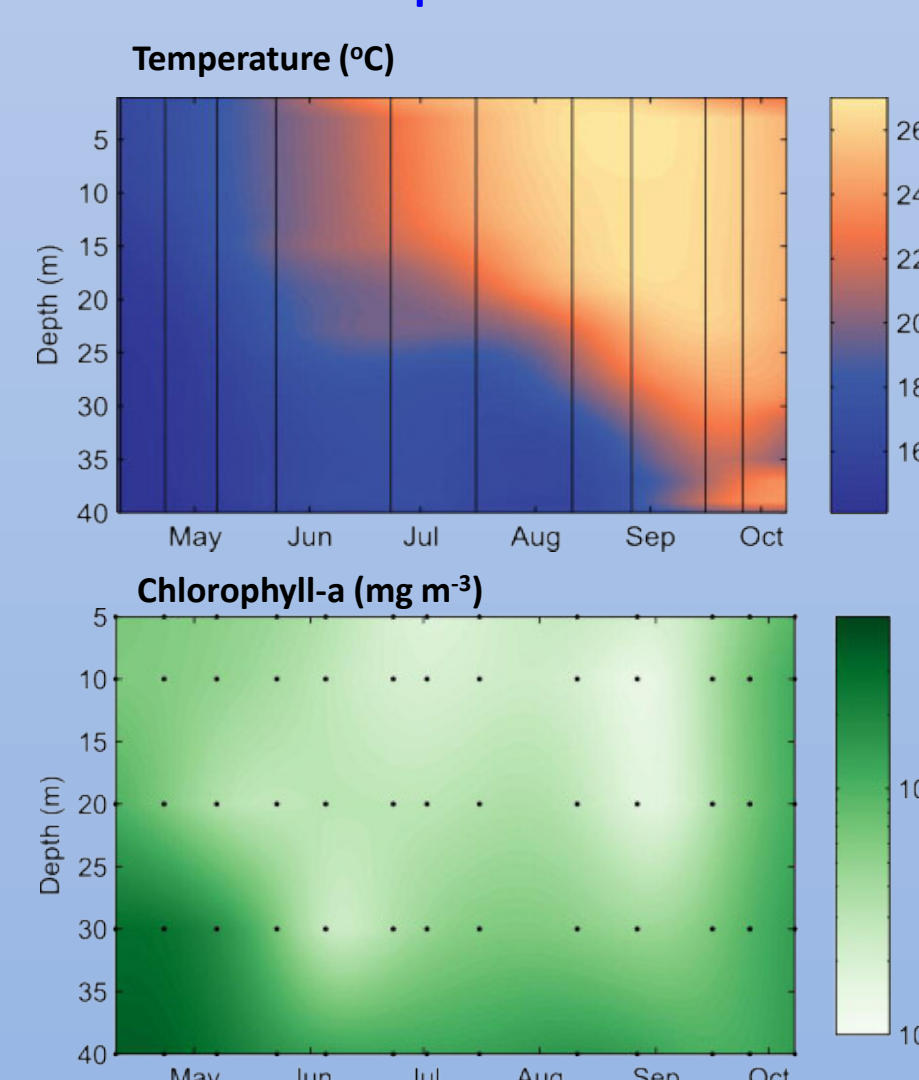
TEMPORAL VARIABILITY



Biomass
(A) In the absence of blooms, **nearshore** and **offshore deep** (DCM) chlorophyll concentrations are similar during the summer (i.e. $>0.8 \text{ mg m}^{-3}$). Lower values prevail in **offshore surface** waters and indicate nutrient limitation.

Size fractions
(B) Microphytoplankton dominates at the **nearshore** during summer whereas picoplankton is most abundant **offshore** (C). *Prochlorococcus* dominates the picoplankton below the thermocline and *Synechococcus* prevails in **nearshore** waters.

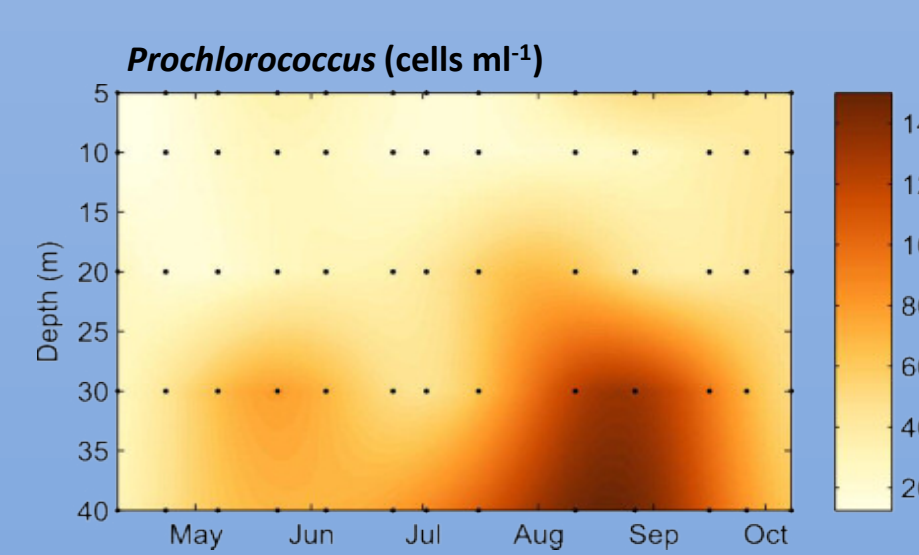
Offshore profiles



A sharp thermocline separates the upper warm waters from the colder and denser bottom layer from June to September.

Offshore surface water contains low phytoplankton biomass throughout the summer.

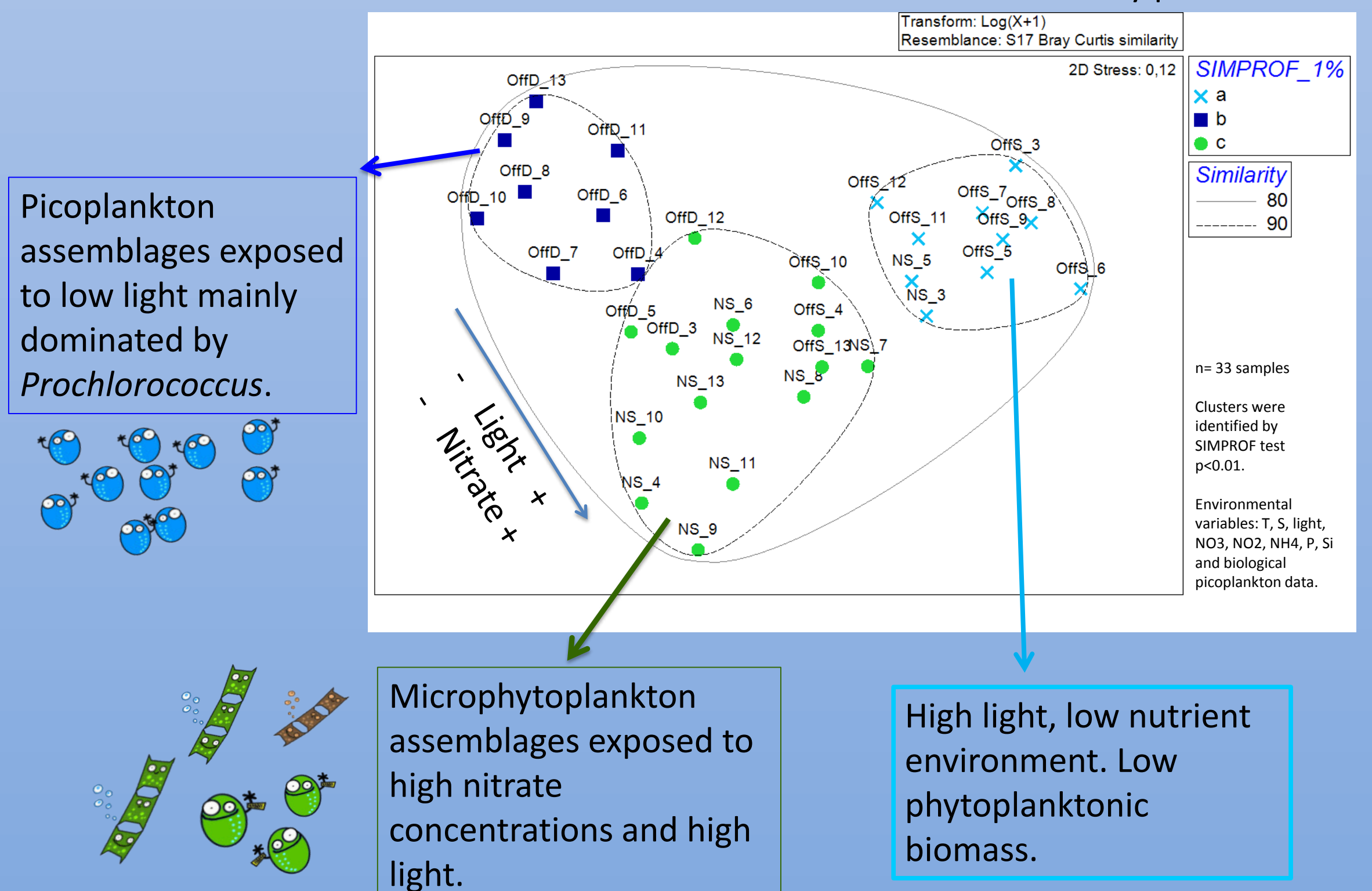
Prochlorococcus has low affinity for high light regimes and concentrates below the thermocline where photosynthetically active radiation (PAR) is under 15% of surface irradiance and mixing is low.



SIMILARITY PATTERNS

Multi-dimensional scaling test based on similarities among the **nearshore**, **offshore surface** and **offshore deep** flow cytometric plankton assemblages

The three assemblages can be clearly distinguished. Major differences are seen between **nearshore** and **offshore deep** and **offshore surface** environments for most of the study period.



Picoplankton assemblages exposed to low light mainly dominated by *Prochlorococcus*.

Microphytoplankton assemblages exposed to high nitrate concentrations and high light.

High light, low nutrient environment. Low phytoplanktonic biomass.

CONCLUSIONS

The phytoplankton assemblage in the coastal waters of the Mediterranean Sea is characterised by strong cross-shore and vertical variations in structure that obey the variations in the physical and chemical processes operating in this zone.

An assessment of the limits and variability of these environments is relevant for monitoring programs carried out in the context of the European Water Framework Directive, for example, to answer the question "where to sample."

Nearshore

- Strong nearshore variations in biomass and composition occur in the first 100 m away from the shoreline.
- The microplankton assemblage in this zone is unique and differs completely from that in offshore waters.
- Intense phytoplankton blooms are frequent and recurrent in these warm and nutrient rich waters during summer.

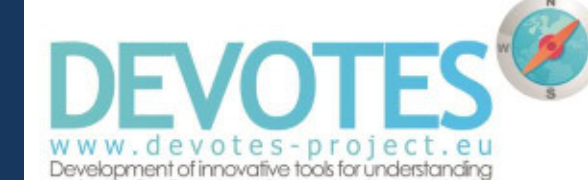
Offshore

- At the ocean boundary, physical conditions, such as stability and available light, govern the phytoplankton assemblage.
- There is a strong vertical variation in phytoplankton assemblage.
- Exchanges between offshore and nearshore assemblages occur sporadically in summer. This favours habitat differentiation. The contribution of offshore DCM communities to those of the nearshore is very small.

* For more information on crossshore midday transects in the Mediterranean areas covering different coastal environments, see G. Basterretxea et al. *Finescale nearshore physicochemical variability and associated plankton communities*, on Wednesday, 9 September 2015 09:45-10:00.

ACKNOWLEDGEMENTS

Cartoons by C. Ruiz.



DEVELOPMENT OF INNOVATIVE TOOLS FOR UNDERSTANDING MARINE BIODIVERSITY AND ASSESSING GOOD ENVIRONMENTAL STATUS. GA: 308392



Fine-scale structure of cross-shore gradients along the Mediterranean coast. Ministerio de Economía y Competitividad. CTM-2012-39476