# Nutrient and phytoplankton responses to external forcing in a Mediterranean coastal area unbiaised by terrestrial inputs and local activities (Calvi, Corsica)


Anne GOFFART [1,*], Jean-Henri HECQ [1], Amandine COLLIGNON [1] and Louis LEGENDRE [2]

[1] University of Liège, Belgium & STARESO, Calvi, Corsica, France * A.Goffart@ulg.ac.be

[2] Laboratoire d'Océanographie de Villefranche (LOV), Villefranche, France


## Context

Despite its relative oligotrophy, the northwestern Mediterranean exhibits rich pelagic biodiversity and traditional fishing that are fuelled by phytoplankton at the basis of the food web. However, long-term observation of phytoplankton blooms shows different amplitudes and durations over the years. The mechanisms controlling this variability are still poorly understood, but have implications for the way we study and manage coastal zones in a changing world.

## Objectives

- To synthesize a long-term high-resolution study of nutrient and phytoplankton bloom dynamics performed between 1979 and 2011 at a permanent oligotrophic station in the Bay of Calvi (Corsica, northwestern Mediterranean),
- To understand mechanisms controlling the interannual variability.

## Time-series (subsurface data)

- Water temperature, wind, phytoplankton and zooplankton from 1979,
- Nutrients from 1988,
- High sampling frequency during phyto- and zooplankton blooms (1 - 7 times per week).



## Phytoplankton bloom characteristics

- Very large interannual variability reaching one order of magnitude from one year to another (Fig 1),
- If occuring, the bloom develops in cold water (< 13,5 °C).

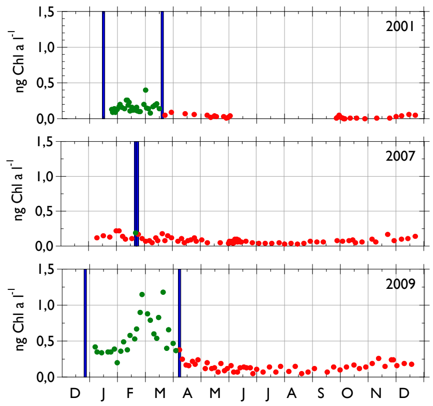



Fig 1 : Temporal changes in Chl a (ng l-1) concentration at 1 m in the Bay c Calvi . Blue bars limit the period of cold water (< 13,5 °C).

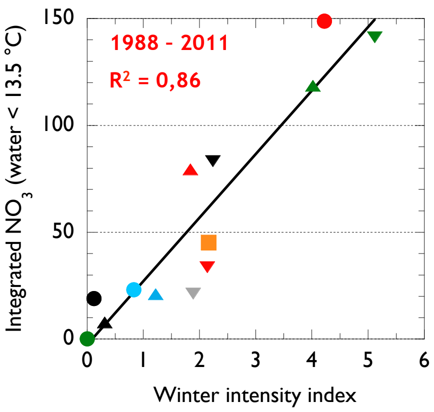
## Definition of a winter index intensity : WII

As we know that surface nutrient enrichment is strongly controlled by wind stress during the period of cold water, we define a winter intensity index (WII). WII takes into account the duration of the period of cold water (< 13.5 °C) and the frequency of windy days (> 5 m s-1) during the period of cold water.

## Control of surface nutrient availability

Winter surface nutrient enrichment is strongly and linearly controlled by WII (Fig 2).

Fig 2 : Relationship between WII and $NO_3$ (μm) integrated over the period of cold water (< 13,5 ° C)




## Control of phytoplankton bloom

Phytoplankton biomass is strongly controlled by WII : increasing phytoplankton concentrations are observed for low and intermediate WII, while high WII are associated with lower phytoplankton biomasses (Fig 3).

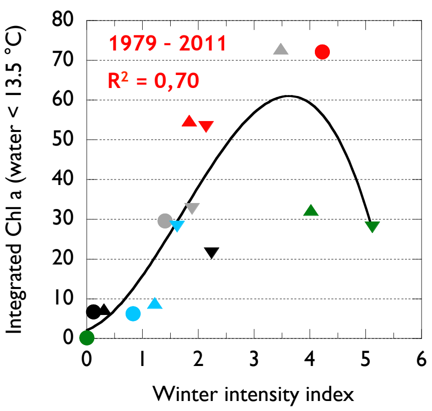



Fig 3 : Relationship between WII and Chl a (ng l-1) integrated over the period of cold water (< 13,5 °C)

Phyto- and zooplankton biomasses increase concomitantly (Fig 4). This implies that lower phytoplankton concentrations observed at high WII are probably not due to enhanced zooplankton grazing, but to disturbance of phytoplankton by excessive turbulence in a nutrient rich water

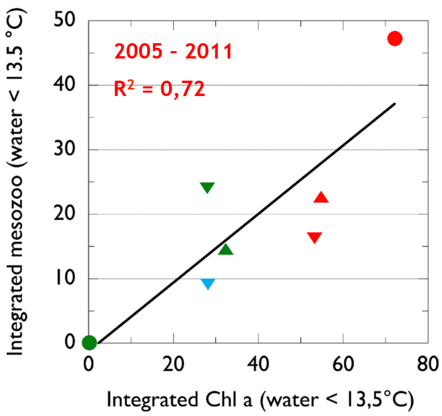
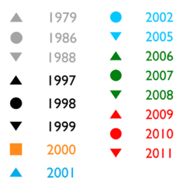



Fig 4 : Relationship between Chl a (ng l-1) and mesozooplankton (ml m-3) integrated over the period of cold water (< 13,5 °C)

## Conclusions

This study, built from three decades of observation acquired in an oligotrophic Mediterranean coastal area,

- shows the combined effects of 2 key natural forcings (wind intensity and water temperature) on nutrient refueling of surface water,
- detects consistent patterns in terms of relationships between environmental drivers and response of winter-spring phytoplankton bloom,
- does not evidence any continuous change in phytoplankton biomass from 1979 but shows a clear year to year response to climate variation.





Université de Liège
STARESO
IMBIZO III The future of marine biogeochemistry, ecosystems and societies 28-31 Jan 2013 Goa, India