



17 06 19

**Response of phytoplankton to climate-driven changes in a Mediterranean coastal area :
results from 4 decades of observations (1979 - 2018)**

Anne GOFFART^{1,*}, Pierre LEJEUNE², Francis GOHIN³, Sylvain COUDRAY³

¹ University of Liège, Belgium ² STARESO , Calvi, France ³IFREMER, France

* A.Goffart@uliege.be



→
The studied area : the Bay of Calvi, Corsica, Western Mediterranean

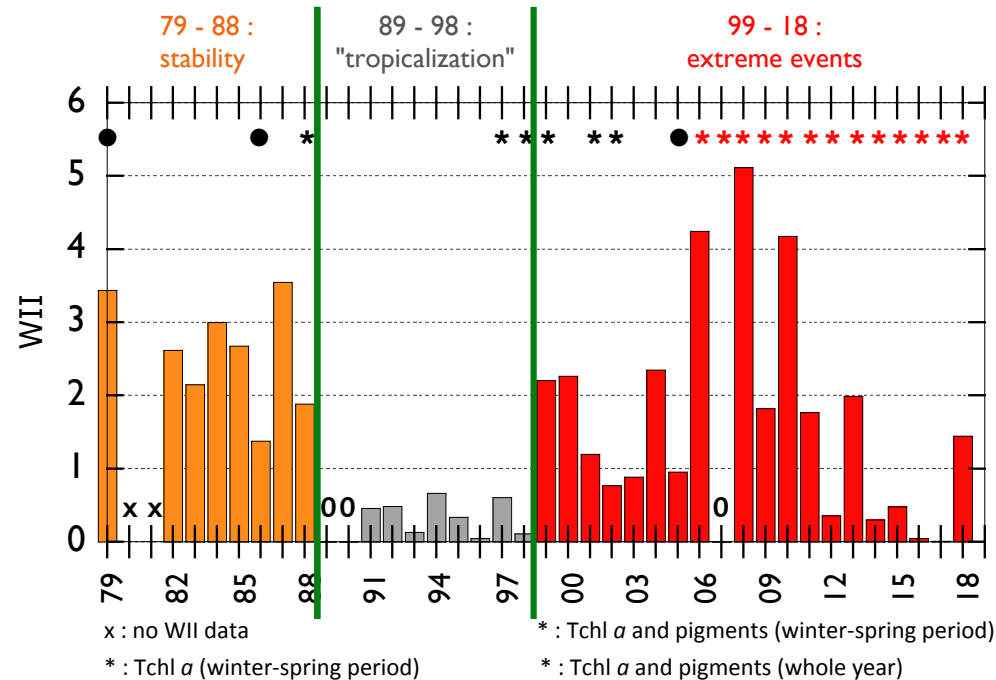


A well-preserved coastal area

**Long-term time series of environmental and phytoplankton data
(1979-2018)**

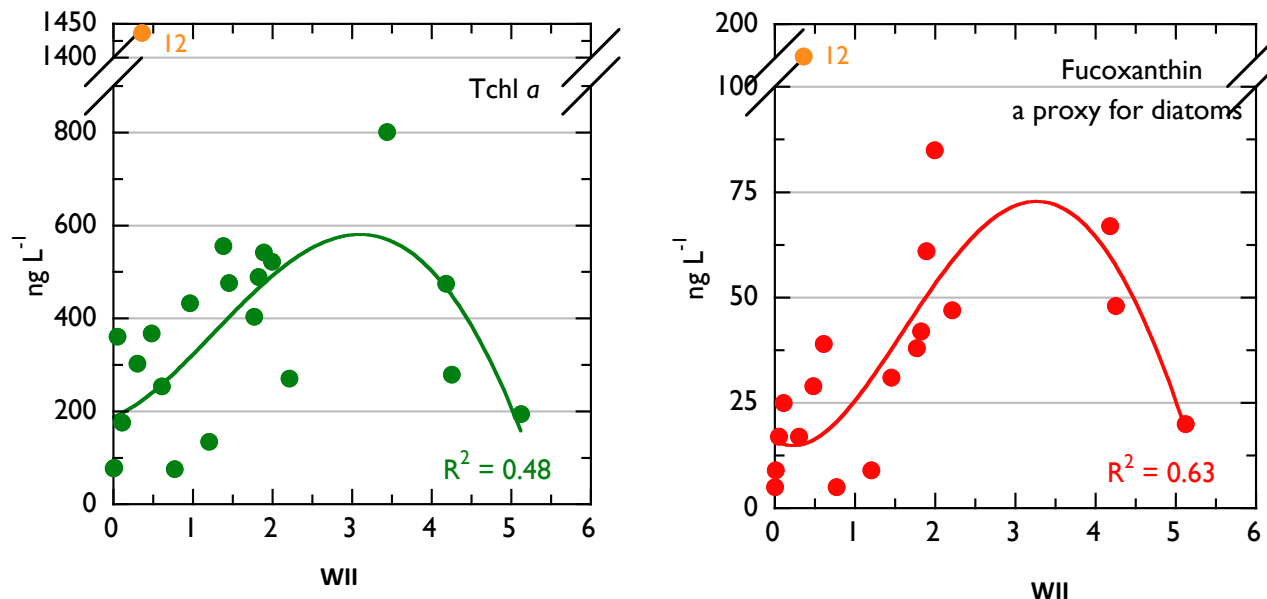
Main results

1. There is a long-term variability in winter intensity, characterized by the WII index, with **three distinct periods**. There are evidences that breaks between the periods resulted in **ecosystem shifts**.



Main results

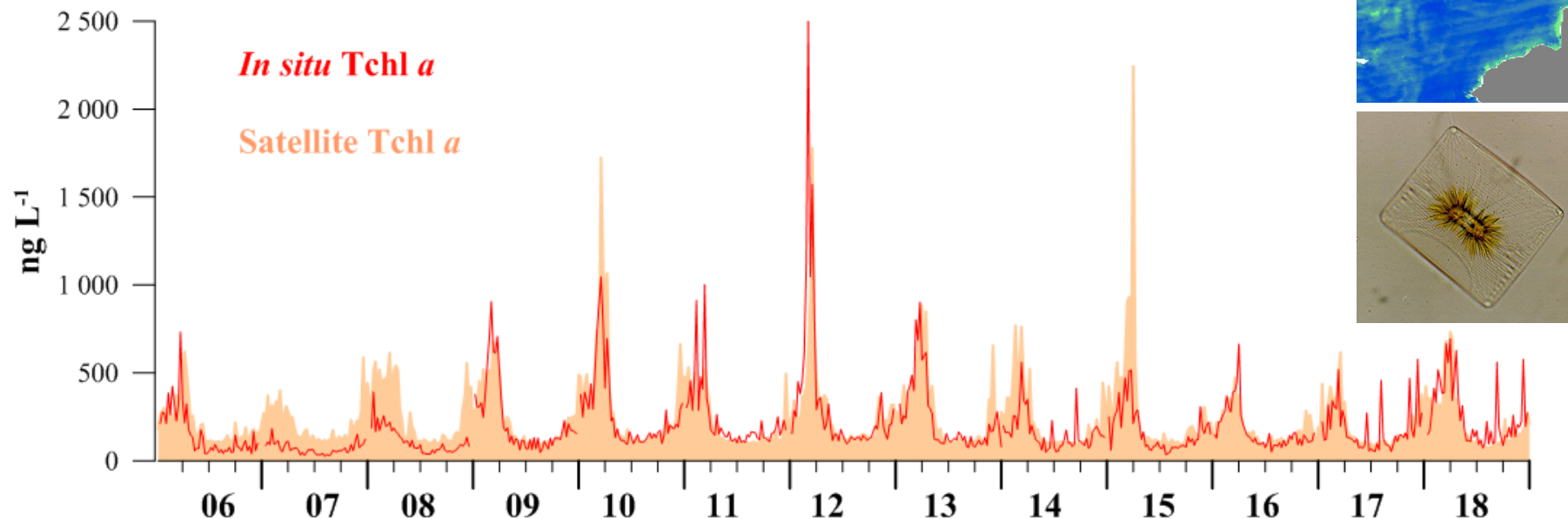
2. Winter intensity is a **key driver** of phytoplankton biomass and composition during the winter-spring period over the 40 years of observations. It influences both winter-spring phytoplankton distribution and community structure. Among the dominant phytoplankton functional groups, **diatoms** are the most sensitive to winter intensity.



Scatter diagrams of mean subsurface Tchl *a* and fucoxanthin as a function of the Winter Intensity Index (WII). Data acquired between 1979 and 2018.

Main results


3. There are **strong similarities** between *in situ* measurements and satellite-derived temperature and Tchl a . This will increase our capacities to monitor phytoplankton dynamics in the Mediterranean coastal areas and to track potential signs of changes as required by the Marine Strategy Framework Directive.





Time series (2006-2018) of *in situ* and satellite derived Tchl a in Calvi area (weekly averages).




See you at poster
100 !









Response of phytoplankton to climate-driven changes in a Mediterranean coastal area : results from 4 decades of observations (1979 - 2018)

Anne GOFFART^{1*}, Marie LEJEUNE², Francis GOHIN¹, Sylvain COUDRAY¹

¹Université de Liège, Belgium; ²Staryo, GMI France; ³France, France; ⁴Université de Liège, Belgium

1. Context

A good understanding of phytoplankton dynamics is crucial for improving our knowledge of the marine environment in a context of multiple and increasing anthropogenic pressures. In the Western Mediterranean Sea, a hotspot for climate change, previous work performed in a coastal area unveiled by local anthropogenic pressure (PetroCCO station, Bay of Calé, Corsica, Fig. 1) has shown that much of the interannual variability of the winter-spring phytoplankton bloom is controlled by interannual differences in winter intensity [1].

2. Objectives

From a long-term in situ time series acquired at the PetroCCO station, which combines environmental parameters and HPLC pigments, we aimed to:

- provide a simplified scheme of changes in winter conditions occurring over four decades of observations;
- demonstrate the importance of winter conditions to determine the state of phytoplankton biomass and composition in our ecosystem;
- compare in situ surface temperature and TSI to data obtained by remote sensing.

Winter Intensity Index
WII = (WV × WI) / 1000

WV : duration [nb of days] of the cold-water period (surface water < 13.5°C)

WI : nb of wind events (mean daily wind speed > 5 m s⁻¹) during the cold-water period.

3. Methods

Mean wind speed, recorded by Météo France at the Calé airport and subsurface water temperature were measured daily from 1979, except in 1980 and 1981. Subsurface sampling was performed the PetroCCO reference site (Fig. 1). Phytoplankton time series include TSI a (02 years) and HPLC pigments (19 years). Sampling frequency ranged from daily to biweekly from 1979 to 2005, sampling focused on the winter-spring period. From 2006, it was performed continuously (Fig. 2). Here we used 3 key photosynthetic pigments (Chlorophyll a, fucoxanthin, peridinin) to identify pyrenoidophytes, cyanobacteria and diatoms, which are the phytoplankton dominant groups in the Bay of Calé. The OCS algorithm developed at Ifremer [2] was used to remote surface temperature and TSI from MODIS-Aqua + SeaWiFS (2003-2012) + SeaWiFS (2012-2018) in front of the Bay of Calé (Fig. 1).

4. Highlights

- There was a **long-term variability** in WII, with **three distinct periods**: the 1980s (and 1988), the 1990s (1989-1996) and the 2000s (1999-2018), which were characterized by moderate, mild and highly variable winters, respectively (Fig. 2). There are evidence that breaks between these periods resulted in **ecosystem shifts**.
- Winter intensity is a key driver of phytoplankton biomass and composition during the winter-spring period over the 40 years of observations. It influences both winter-spring phytoplankton distribution and community structure (Fig. 3). It is likely to have strong consequences on the entire food web. Among the dominant phytoplankton functional groups, **diatoms** are very sensitive to winter intensity, while pyrenoidophytes and cyanobacteria are not correlated with it.
- There is **no continuous long-term trend** (increase, decrease) in phytoplankton biomass and composition over the 4-decades of observations.
- There are **strong similarities** between in situ measurements and satellite-derived temperature (data not shown) and TSI a (Fig. 4). This will increase our capacities to monitor phytoplankton dynamics in the Mediterranean coastal areas at lower costs when compared to traditional survey and to track potential signs of changes as required by the Marine Strategy Framework Directive.



Fig. 1: Schematic diagrams of mean subsurface TSI a, fucoxanthin, peridinin, and fucoxanthin during the cold-water period (2012-2018) and the Winter Intensity Index (WII) data acquired between 1979 and 2018.



Fig. 2: Temporal change in Winter Intensity Index (WII) in the Bay of Calé (1979-2018).



Fig. 3: Time series (2006-2018) of in situ and satellite-derived TSI a in Calé area (weekly averaged).

1 Goffart A. 2020, Prog in Oceanography
2 Goffart A. 2018, Biogeochemical Oceanography