



GlobalHAB symposium on automated in situ observations of plankton  
Kristineberg Marine Research Station, Fiskebäckskil, Sweden  
August 22-27, 2022  
Session 4

# English Channel and Southern North Sea phytoplankton monitoring applying automated approaches

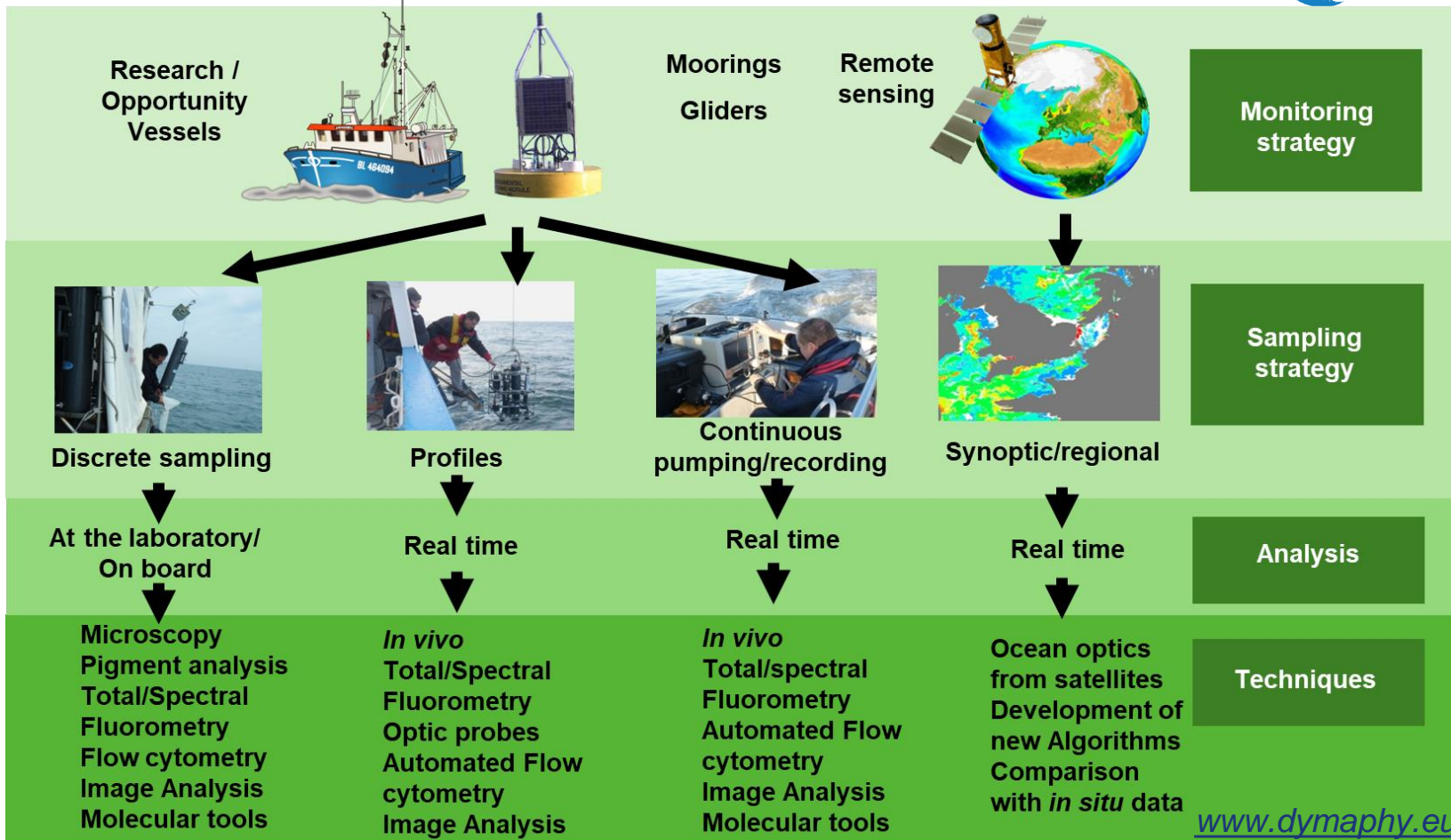
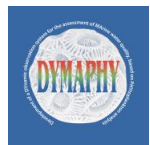
*Zéline Hubert, Clémentine Gallot, Arnaud Louchart, Alexandre Epinoux, Kévin Robache, Florine Verhaeghe, Simon Bonato, Claire Dédécker, Emeline Lebourg, Marie Bruaut, Morgane Didry, Fabrice Lizon, Alain Lefebvre & Luis Felipe Artigas*



Laboratory of Oceanology and Geosciences  
CNRS – UMR 8187 LOG – ULCO  
Wimereux, France



# Approaches for phytoplankton observation



# Phytoplankton automated monitoring by LOG - EC and SNS



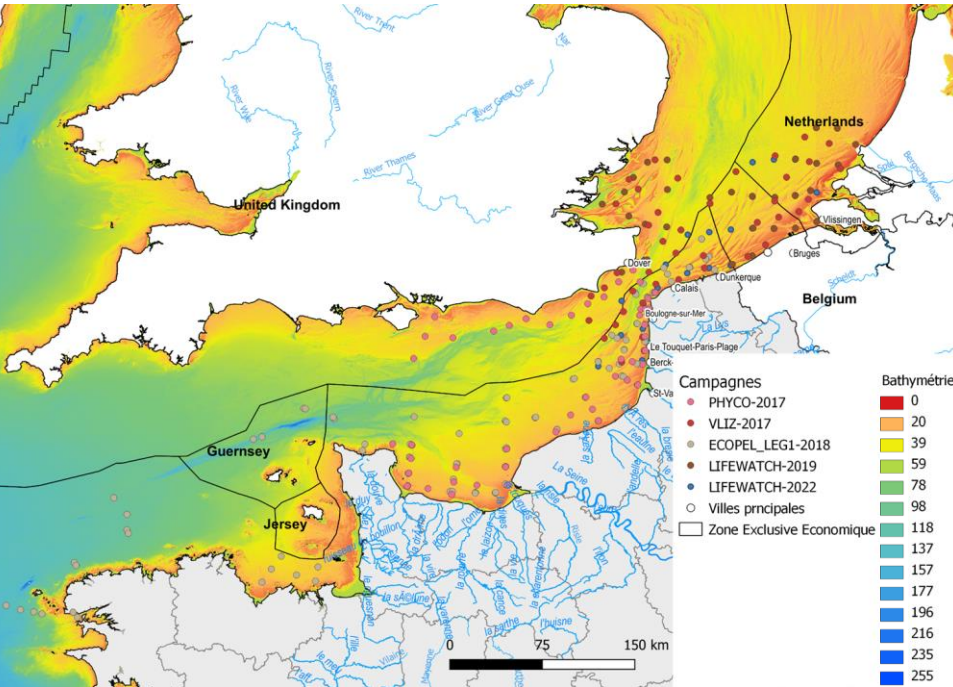
- Additional automated measurements coupled to national regular (monthly to fortnightly long-term monitoring on fixed stations applying reference techniques (microscopy, HPLC)
- Dedicated regular long-term coastal-offshore monitoring at higher spatial and temporal resolution (~1 km, weekly to daily)
- Additional automated measurements coupled to automated High-Frequency stations/moorings during main bloom periods (hourly sampling)
- Dedicated high resolution (every 10-20 minutes) spatial monitoring at targeted seasons and years following punctual projects (oceanography cruises)
- Opportunistic high resolution (every 10-20 minutes) spatial monitoring coupled to TSG or Ferry Boxes on transits or on fisheries cruises at selected seasons on a regular long-term basis



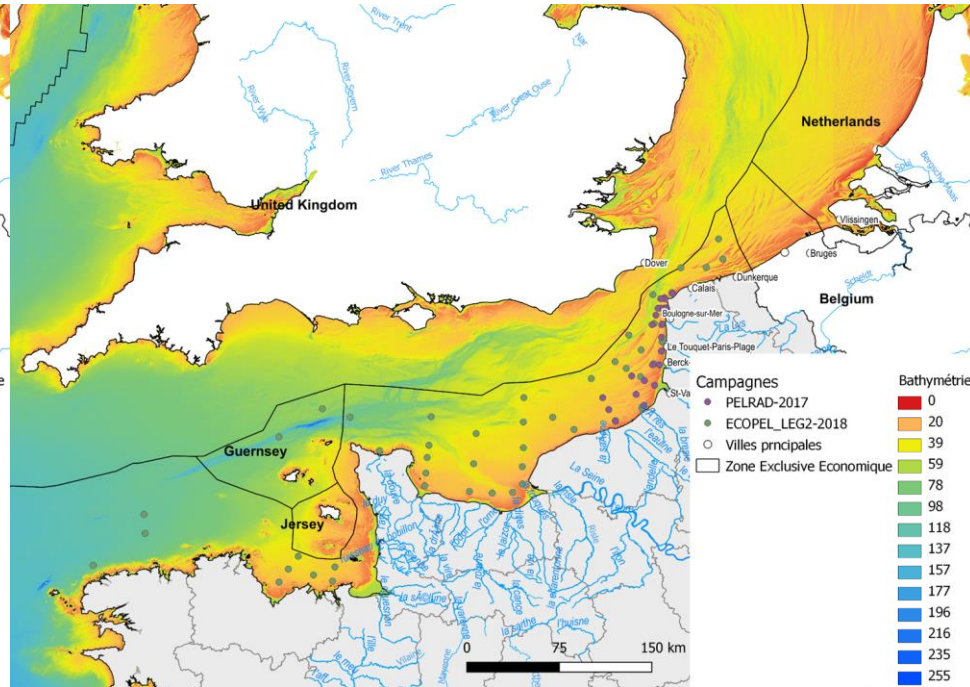


# Automated monitoring on dedicated and Opportunistic Cruises in English Channel and southern North Sea

Spring

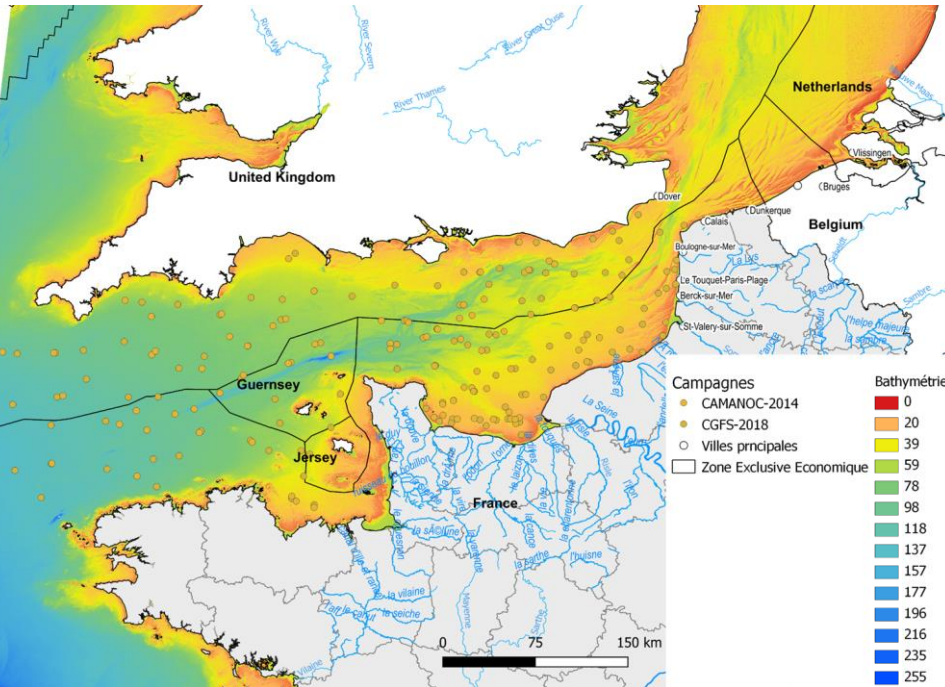


Summer

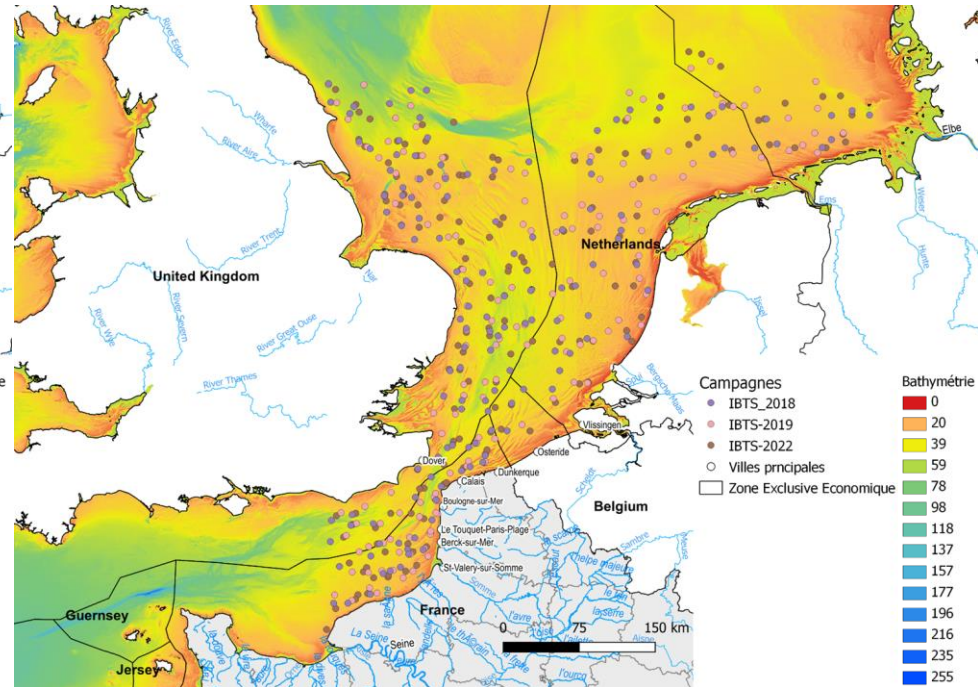


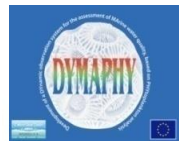
# Automated monitoring on dedicated and Opportunistic Cruises in English Channel and southern North Sea

Fall

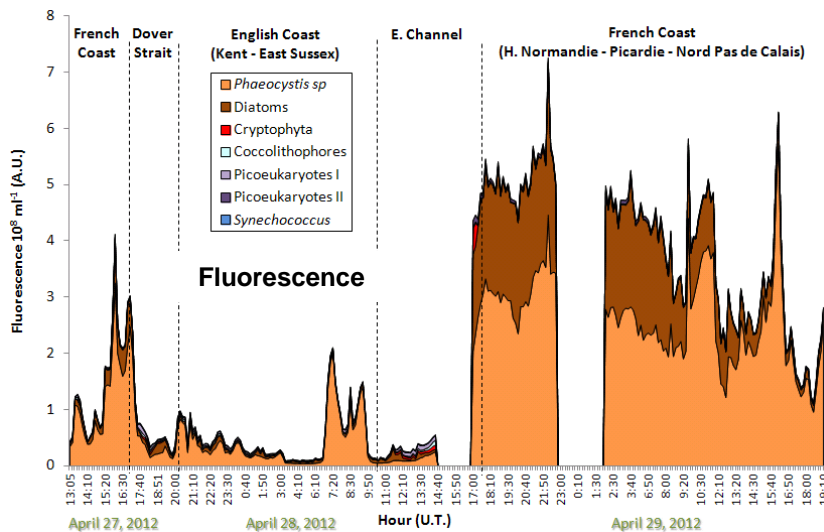
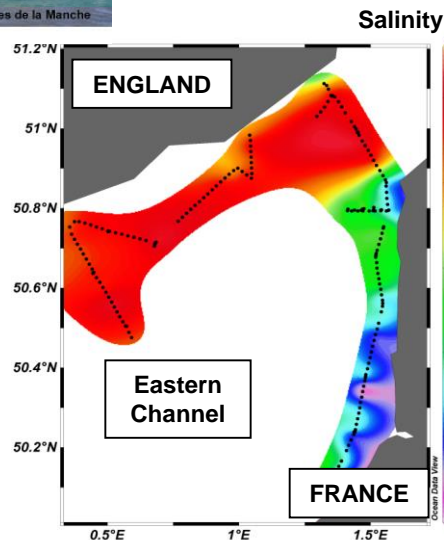
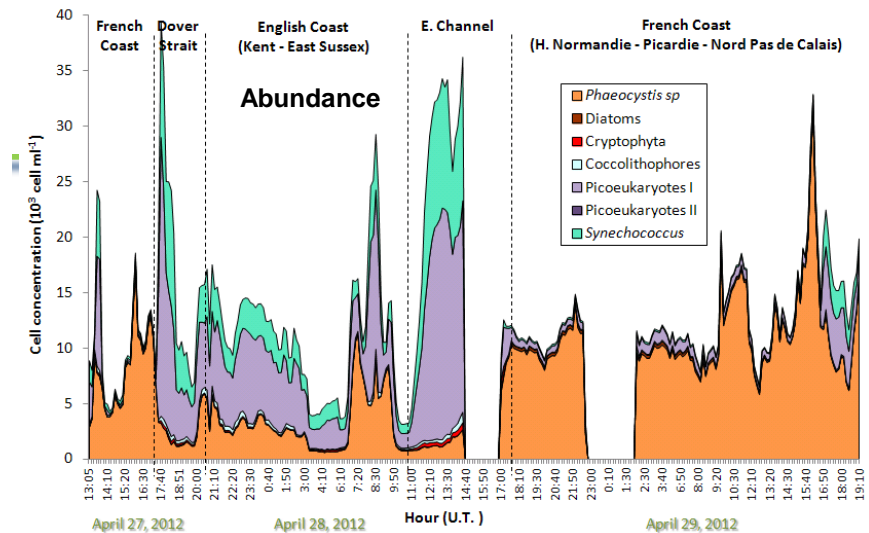
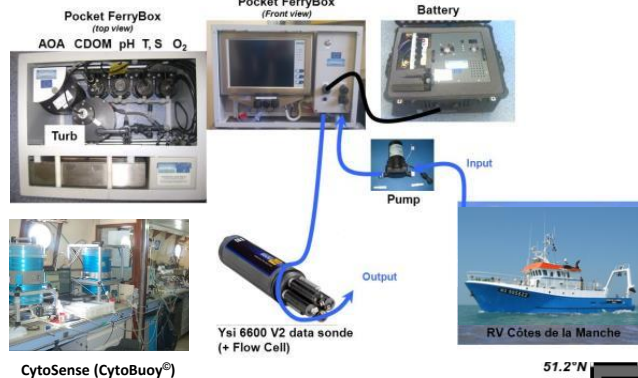


Winter





# Continuous recording of phytoplankton in eastern Channel coastal waters DYPHYMA Cruise (Spring 2012)





# Automated phyto & HAB monitoring in the English Channel & North Sea (CNRS-LOG/VLIZ/CEFAS/ RWS)

Automated  
Flow  
Cytometry  
(CytoSense)

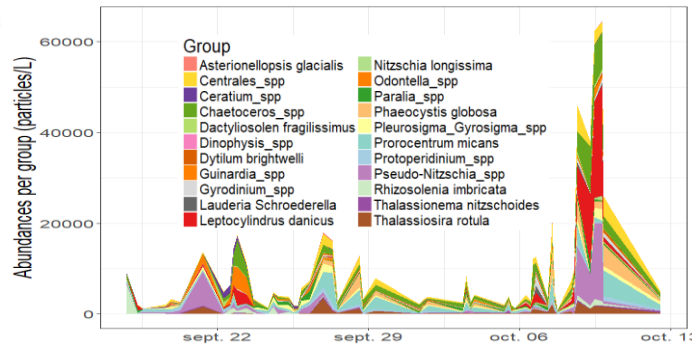
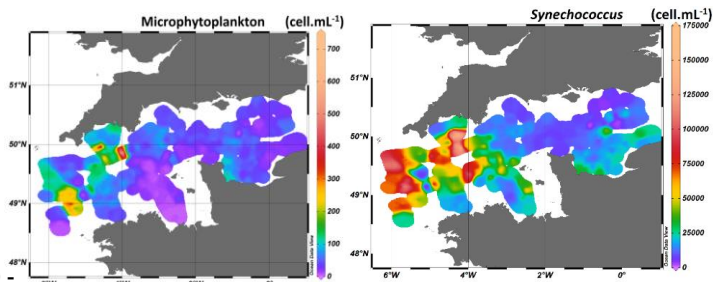
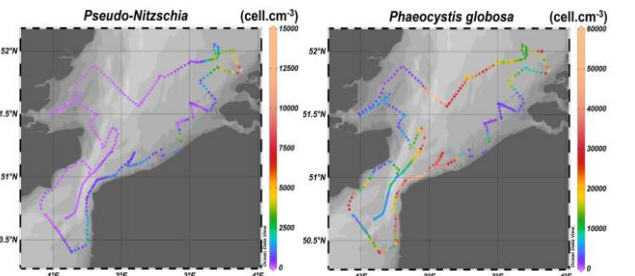
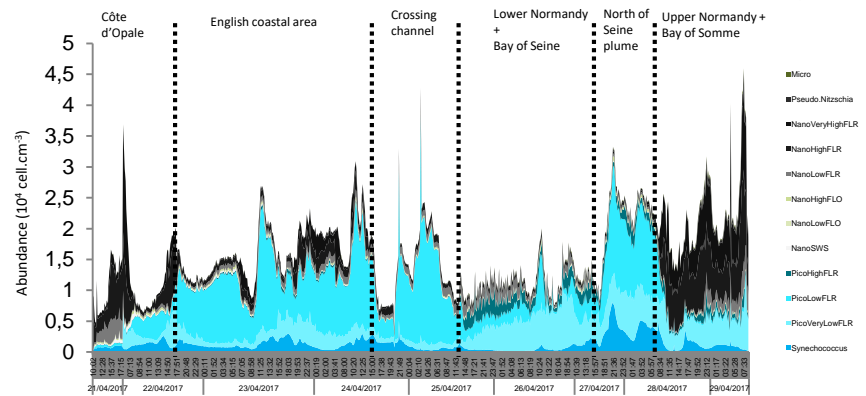


Image Analysis  
(FlowCAM)  
Wacquet *et al.*,  
2020 (ICHA  
2018)

Louchart *et al.*, CSR 2020 -  
<https://doi.org/10.1016/j.csr.2020.104056>

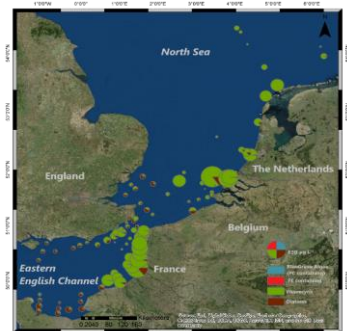


Automated  
Flow  
Cytometry  
(CytoSense)



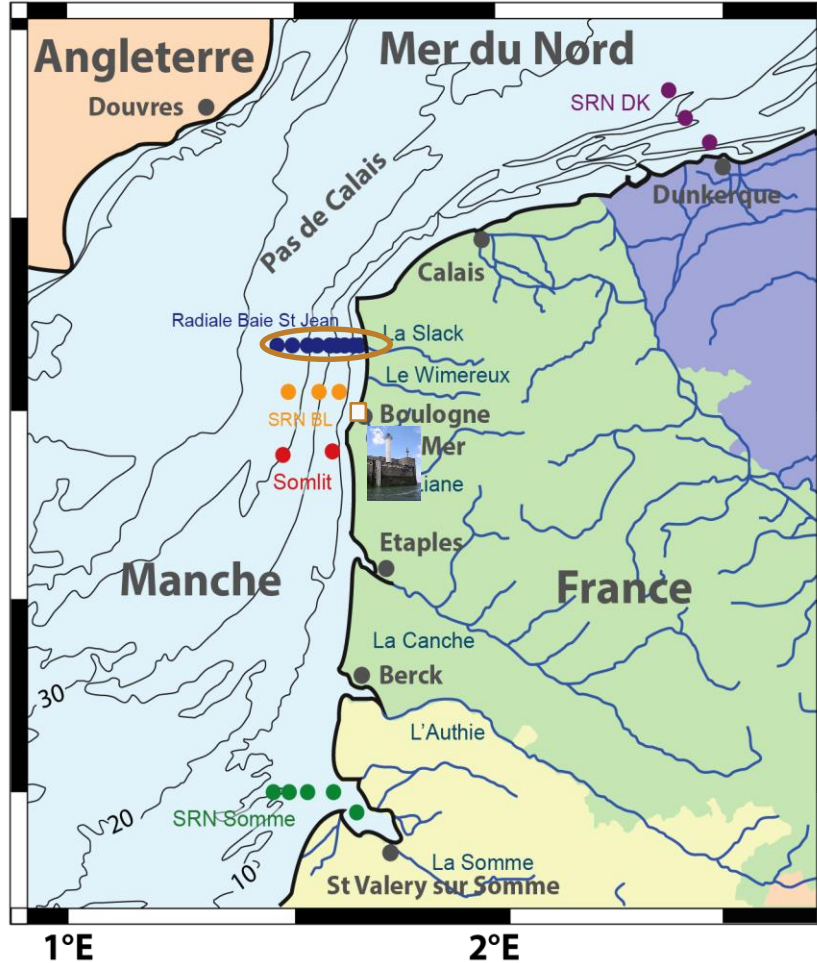
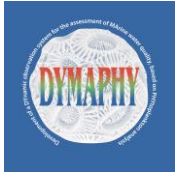
Multispectral  
Fluorometry  
(Fluoroprobe)

Louchart *et al.*, 2020  
(ICHA  
2018)



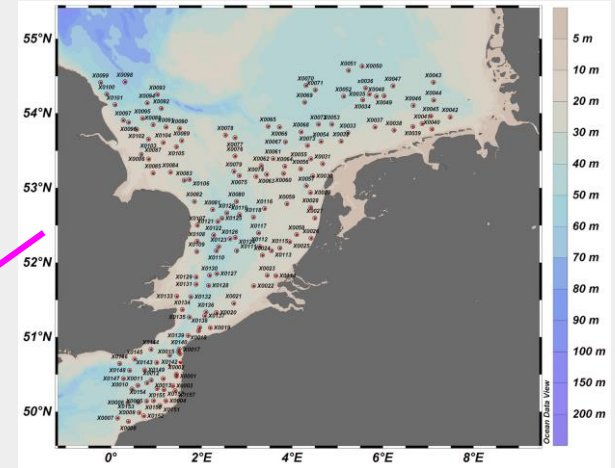


# Phytoplankton automated observation in the French EEC



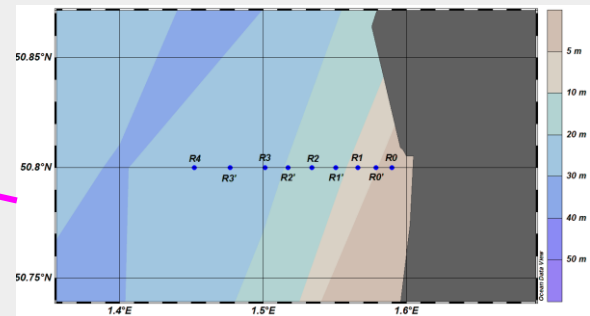
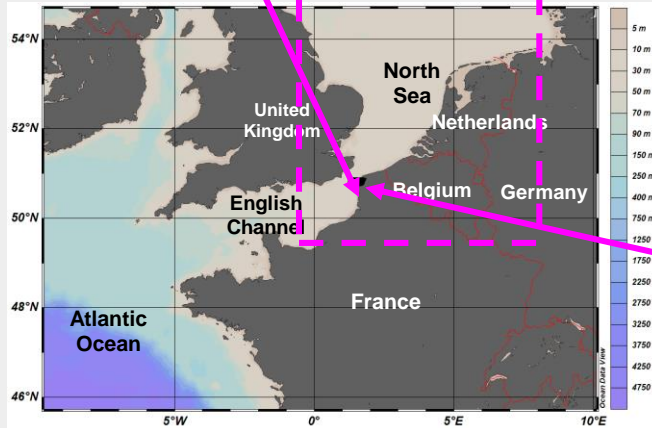
- Eastern English Channel regular monitoring (SOMLIT CNRS INSU, PhytOBS, REPHY SRN IFREMER)
  - High Resolution DYPHYRAD « Baie Saint Jean » transect)
  - High Frequency measurements at MAREL Carnot fixed station
- Supported by :
  - LOG CNRS, ULCO, IFREMER, IR ILICO
  - DYMAPHY Interreg IV-A « 2 Seas » project
  - MARCO & IDEAL (Hauts de France regional project)
  - - JERICO-Next/S3 (E.U. H2020 projects)

# Automated monitoring of phytoplankton abundance, biomass and diversity - Channel and North Sea Pilot Super Site (2019-2022)



IBTS Fisheries cruise January 2020

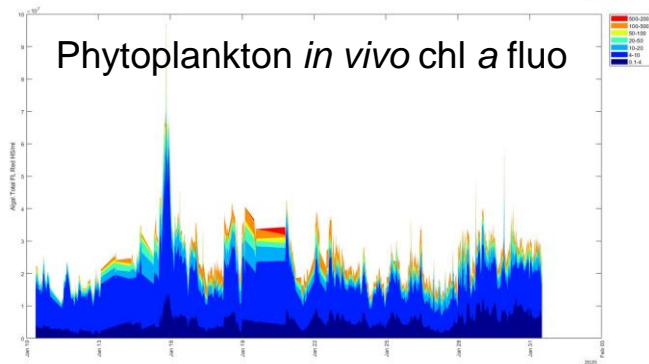
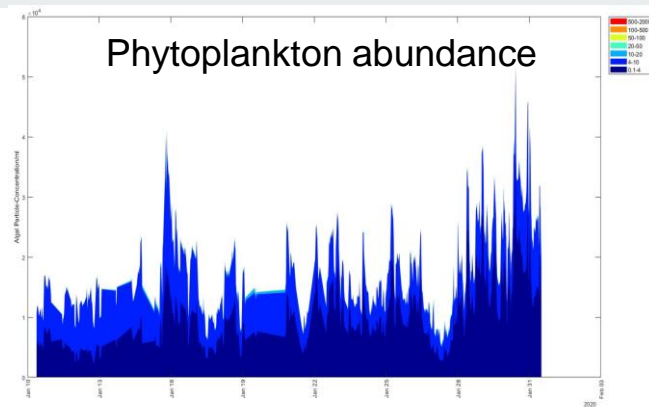
*Zéline Hubert, Clémentine Gallot, Alexandre Epinoux, Kevin Robache, Marie Bruaut, Elise Caillard, Vincent Cornille, Jessica Delarbre, Claire Dédécker, Muriel Crouvoisier, Emeline Lebourg, Eric Lécuyer, Arnaud Louchart, Jean-Valery Facq, Alain Lefebvre, Luis Felipe Artigas*



DYPHYRAD transect by the Strait of Dover

# IBTS Fisheries cruise 2020

- High frequency data (continuous *in vivo* recording every 10 minutes)
- Partnership between CNRS LOG, IFREMER (European Fisheries Policy) and OFB (MSFD), « Thalassa » R.V. (IFREMER) – measurements of opportunity
- CytoSense (Cytobuoy) automated flow cytometer
- Spatio-temporal characterization of the winter season on a wide area (eastern Channel and North Sea)

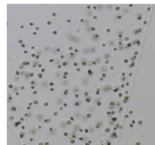


*Real-time visualisation of phytoplankton abundance (top) and chlorophyll *in vivo* fluorescence (bottom) addressed by automated flow cytometry (CytoSense) per size class (LiveClus software) during the IBTS cruise (January 2020)*

# Jerico/Lifewatch cruise 2022

- Intercomparison between Flow Cytometry and FlowCam between LOG & VLIZ
- Monitoring abundance and diversity during the spring bloom (May 2022)
- Continuous measurements every 10 minutes
- Data: FlowCam, FluoroProbe, Flow cytometer, CTD, nutrients, pigments, metabarcodes

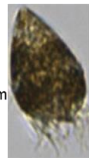
FlowCam  
images



*Phaeocystis globosa*  
2022-05-03 1am  
4X



*Chaetoceros socialis*  
2022-05-02 2pm 4X

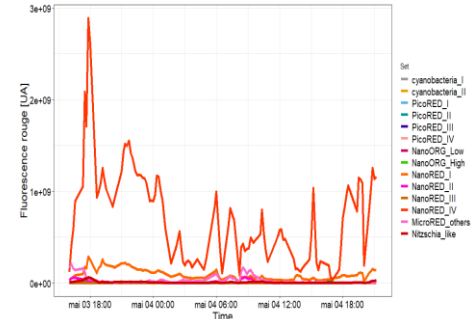
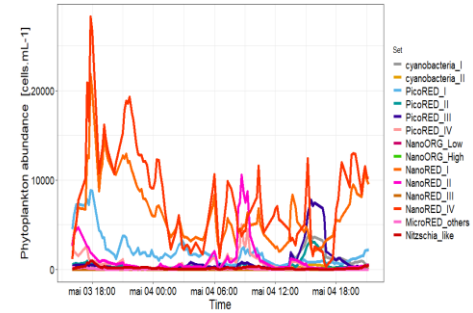


*Prorocentrum sp.*  
2022-05-02  
10pm  
10X

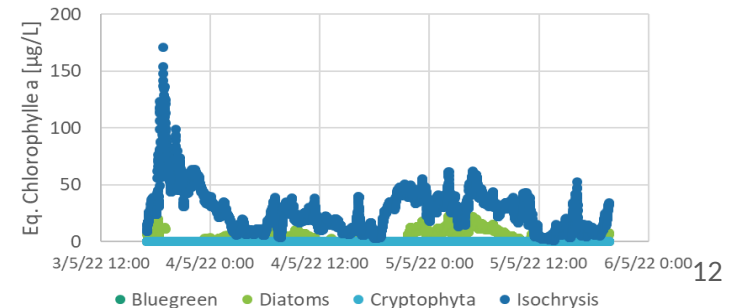


*Prorocentrum sp.*  
JN22\_44 2022-05-05 10X

*Phytoplankton abundance (top) and fluorescence of flow cytometer (middle), eq.chlorophyll a of FluoroProbe (bottom)*



Eq. Chlorophyll a (FluoroProbe) during Lifewatch



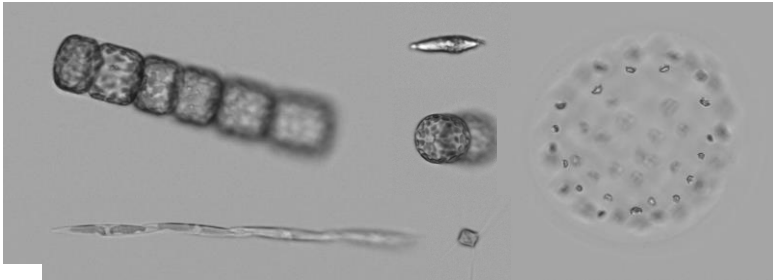


# DYPHYRAD : interannual variability



= DYnamics of PHYtoplankton along the RADiale de la Baie Saint Jean (coastal-offshore transect by the strait of Dover)

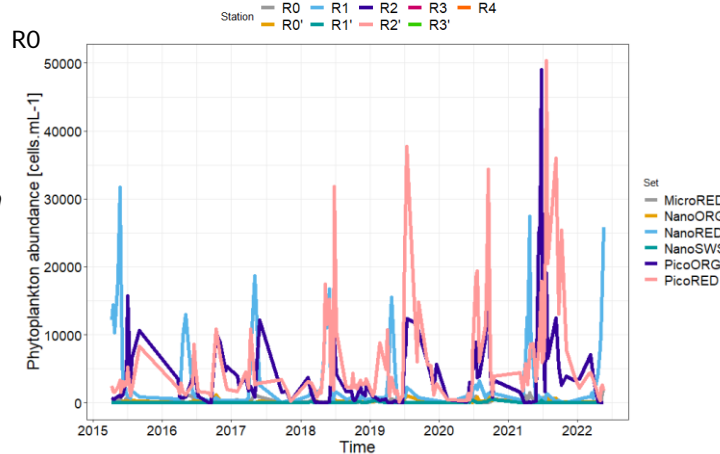
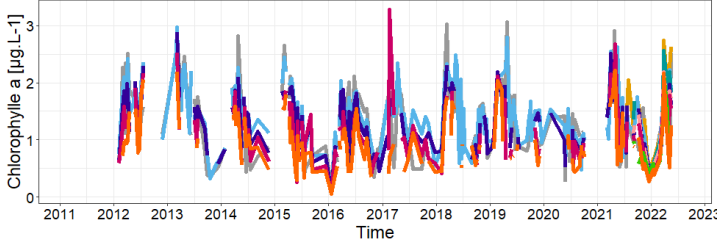
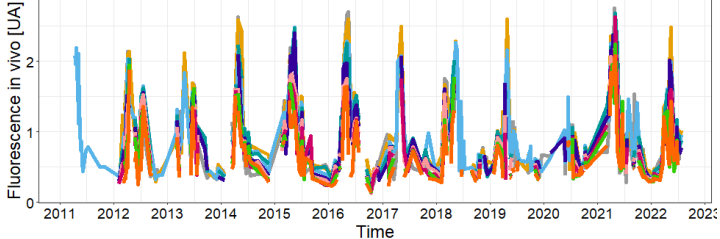
- 9 stations extended over 9.7km (5.25 nautical miles)
- Weekly basis: assessment of seasonal and interannual variability
- *In vivo* total chl a fluorescence and multispectral algal groups (Turner Designs, Fluoroprobe)
- Optically defined phytoplankton groups + image acquisition (CytoSense, FlowCAM)



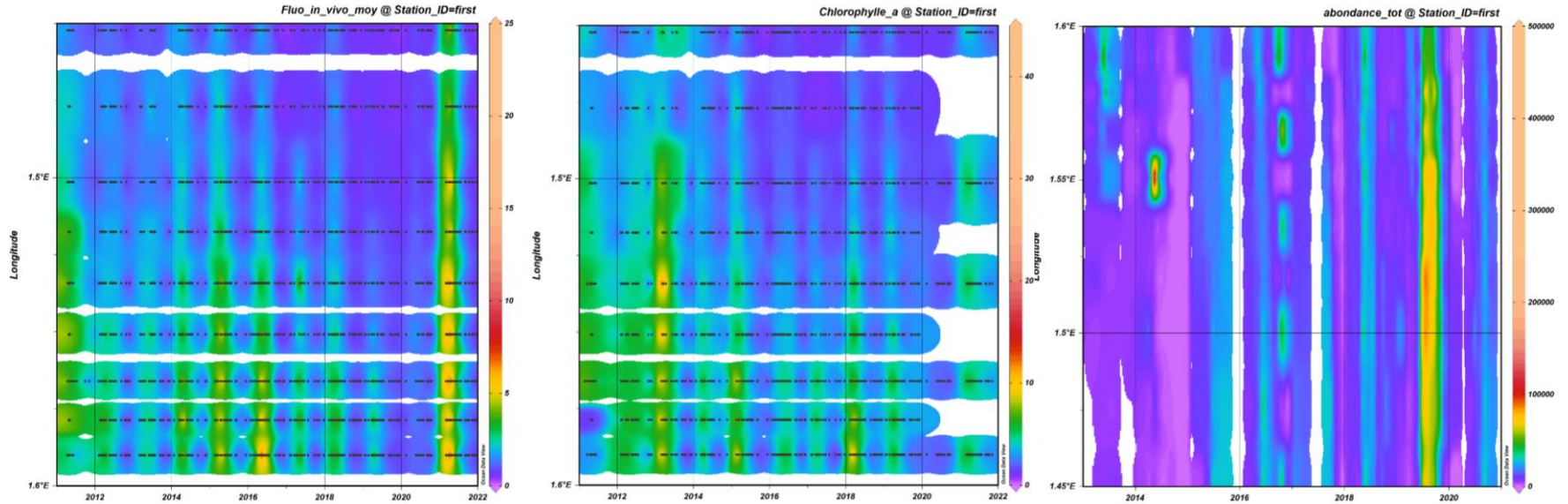
Z. Hubert  
ongoing PhD

CytoSense images (R1, 01/04/21)

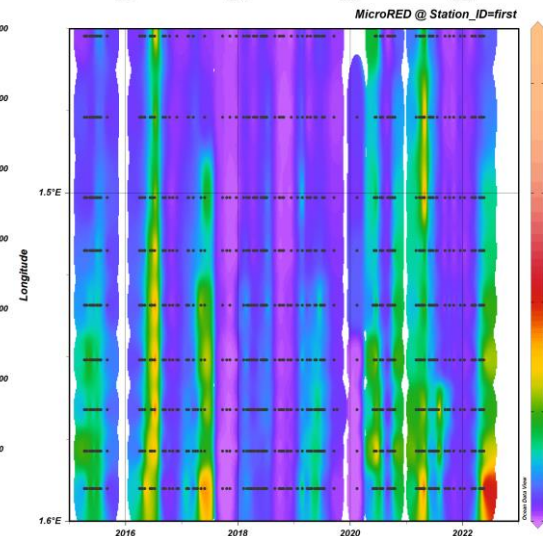
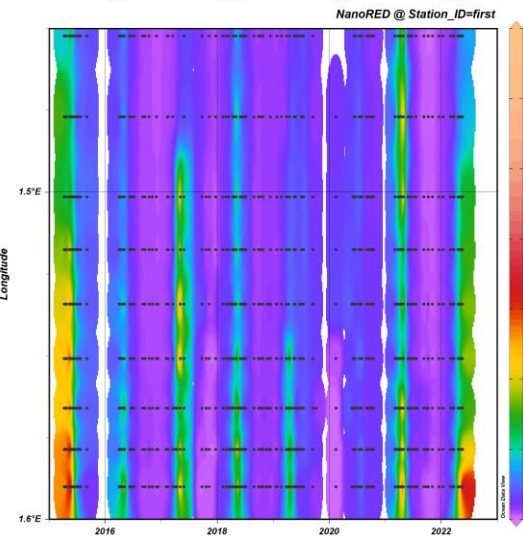
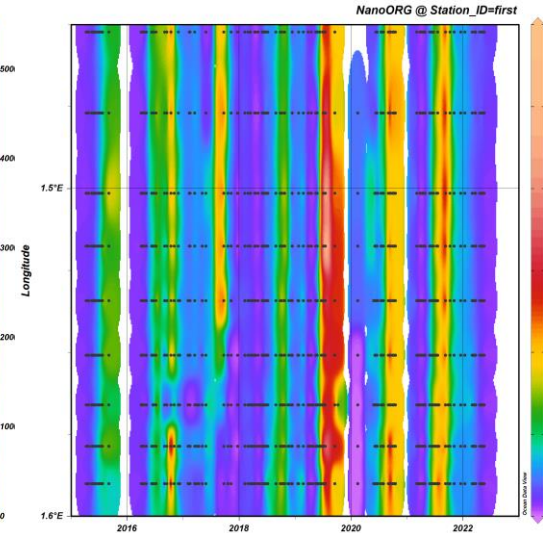
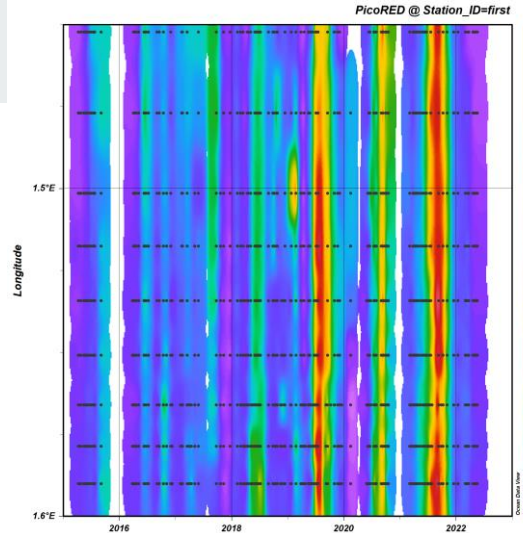
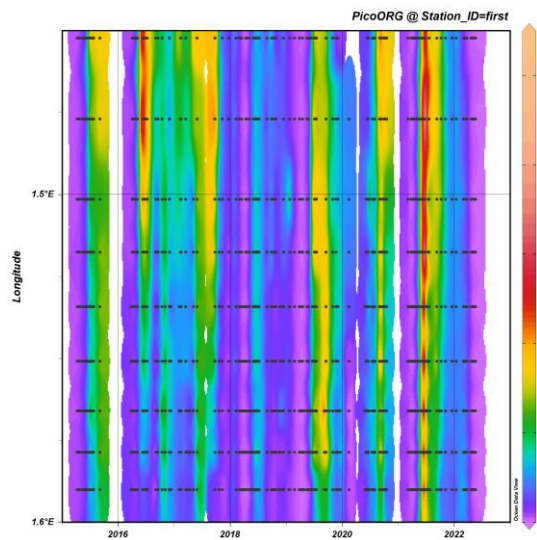
*Fluorescence in vivo (top), chlorophyll a (middle) and phytoplankton abundance using functional groups (bottom)*



# DYPHYRAD transects by the Dover strait: interannual variability



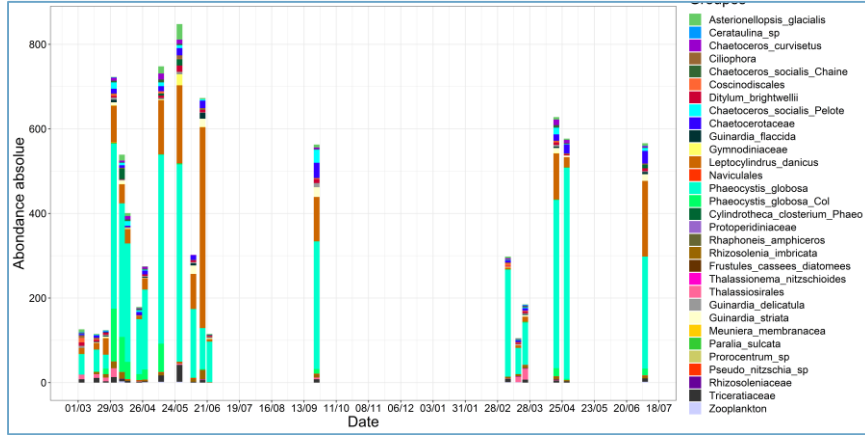
# DYPHYRAD transects



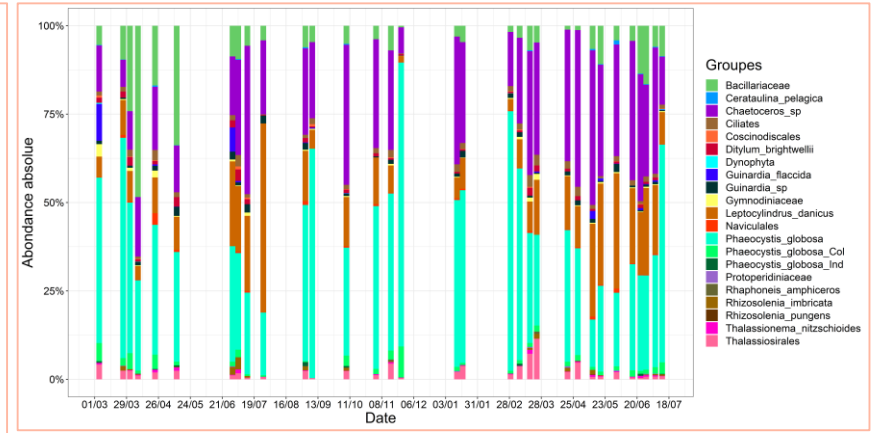
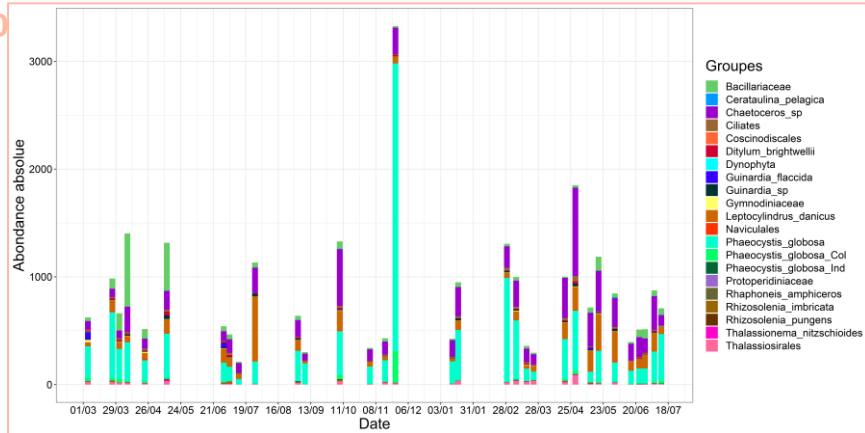
# Seasonal evolution of phytoplankton abundance at R1 station in 2021 and 2022

F. Verhaeghe, Engineer final thesis (2022) – Wacquet & Lefebvre (2022)

X4



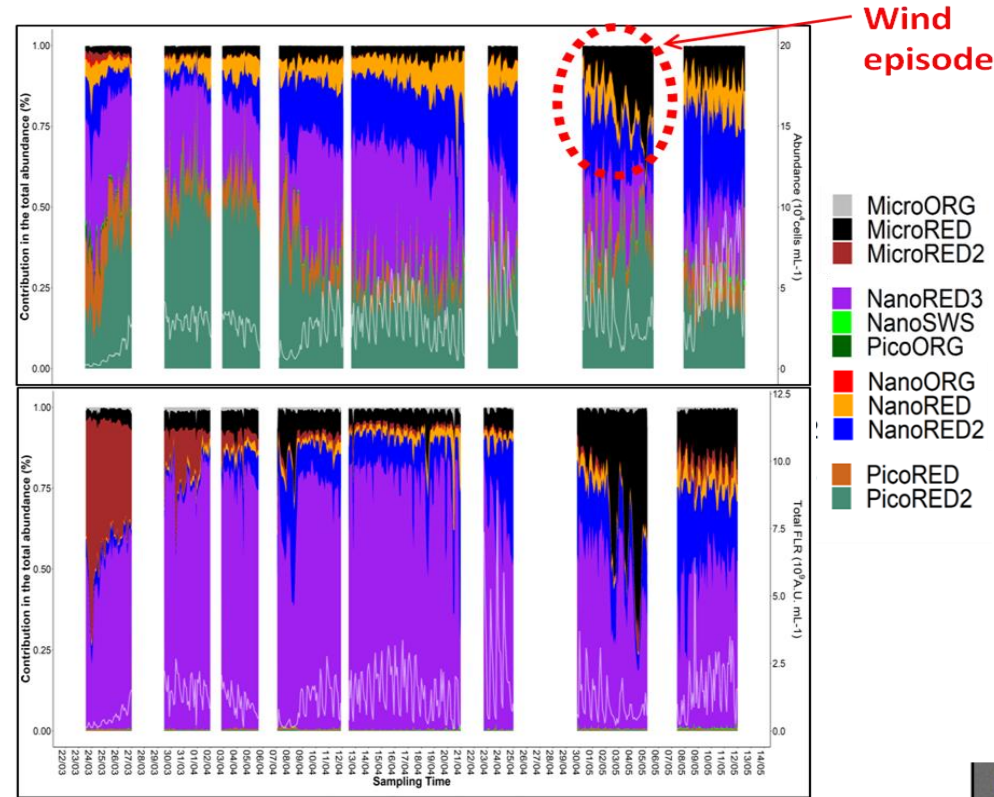
X10





# MAREL CARNOT - 2021

- High frequency data (every two hours)
- Partnership between the French State, the regional council of Nord-Pas-de-Calais, European Regional Funds, IFREMER and INSU
- Deployment of a CytoSub (Cytobuoy) automated flow cytometer phytoplankton monitoring (March 26 – May 10, 2021)
- Visualisation of several phases of the spring bloom



Phytoplankton abundance and FLR (chloro a proxy)

Thanks to :

Funding agencies, P.I. of the different projects, head of institutions,  
organisms involved. . .

P.I.s of oceanographic and fisheries campaigns, scientific teams and  
crews of the different research vessels,

Scientists, post-docs, PhD, M.Sc. and undergraduate students

Administrators and head of laboratories . . .

Thanks for your attention!



Région  
Hauts-de-France

