



# Vlab 3 Carbon-Plankton dynamics



Flanders Marine Institute (VLIZ)



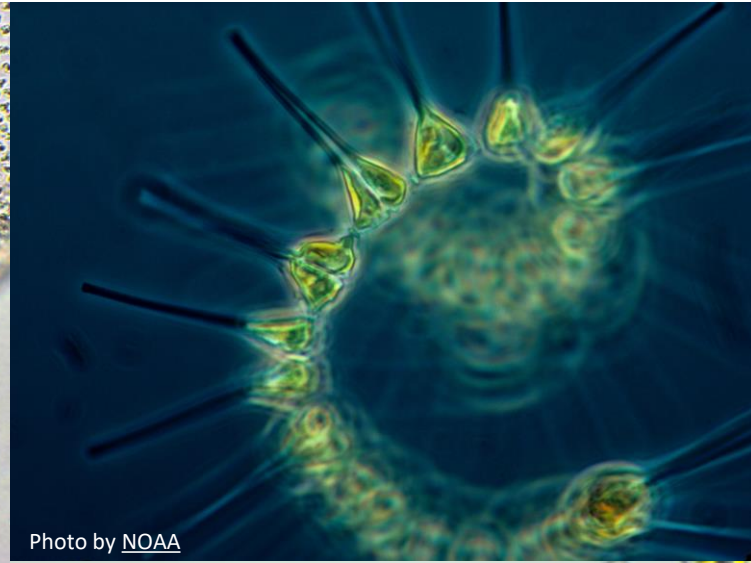
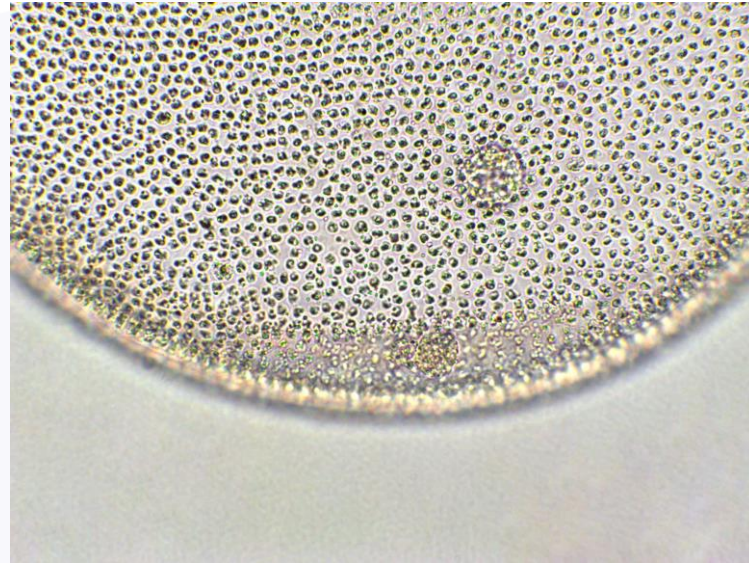
Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS)



Funded by  
the European Union

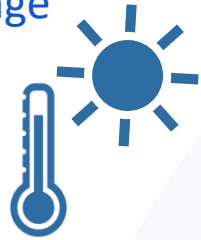
## Phytoplankton

- Produces 50% of the world oxygen
- Base of the marine food chain
- Plays a crucial role in carbon cycling, oxygen production and nutrient cycling



## Phytoplankton under stress

- Climate change



- Blue economy

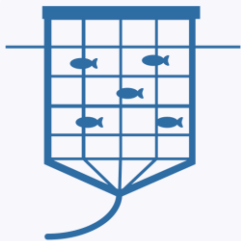


Photo by Hederik Kolk



Photo by Mihály Köles

Understanding the impact on phytoplankton dynamics is crucial for effective management and conservation of marine ecosystems



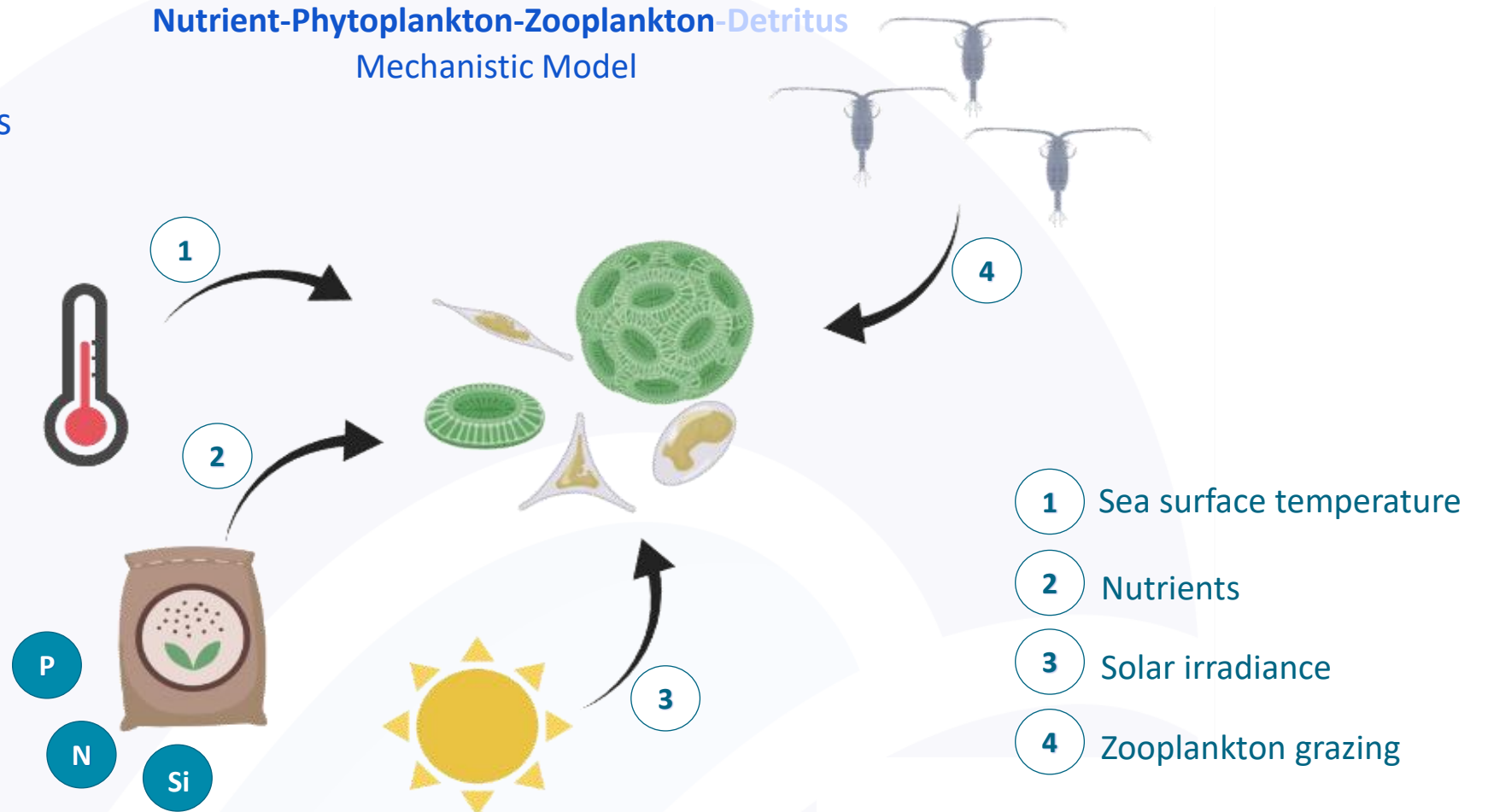
# NPZD model

## Main goals:

Identify drivers of

1. phytoplankton biomass dynamics
2. Carbon fluxes

Nutrient-Phytoplankton-Zooplankton-Detritus  
Mechanistic Model



- 1 Sea surface temperature
- 2 Nutrients
- 3 Solar irradiance
- 4 Zooplankton grazing



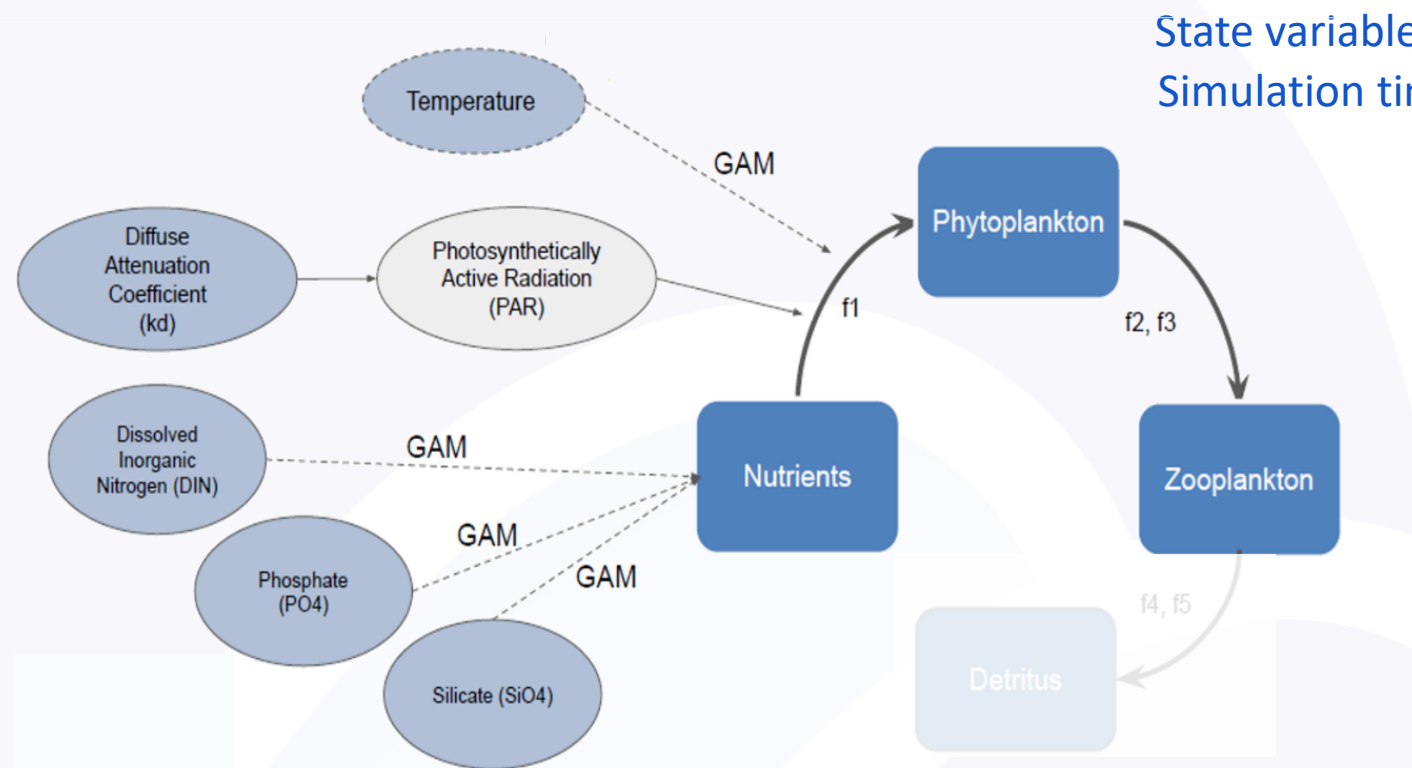
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State variables: mmol N m<sup>-3</sup>  
Simulation time steps: days



Modelling phyto- & zooplankton interactions docs

# Modelling phyto- and zooplankton interactions

This Modelling phyto- and zooplankton interactions service is a workflow to run a mechanistic model using near real-time data to quantify the relative contributions of the bottom-up and top-down drivers in phytoplankton dynamics. **The Nutrient-Phytoplankton-Zooplankton (NPZ) model** used in this demonstrator was adjusted from the Nutrient-Phytoplankton-Zooplankton-Detritus (NPZD) model of Soetaert and Herman (2009). The NPZD model is widely used and describes the four state variables of nutrients, phytoplankton, zooplankton and detritus. Phytoplankton dynamics are simulated based on information from nutrient concentrations and zooplankton density. The Modelling phyto- and zooplankton interactions VLab calculates the relative contribution that limit the growth of phytoplankton of Dissolved Inorganic Nitrogen (DIN), Phosphate (PO<sub>4</sub><sup>-</sup>) and Silicate (SiO<sub>4</sub><sup>-</sup>), Photosynthetically Active Radiation (PAR), Sea-surface Temperature (SST) and zooplankton grazing, over time.

## Data sources

VARIABLES	DATA SOURCES	DATA ACCESS
Phytoplankton abundances (Chla)	<a href="https://rshiny.lifewatch.be/station-data/">https://rshiny.lifewatch.be/station-data/</a>	LifeWatch/Blue-Cloud Vlab*
Zooplankton abundances	<a href="http://rshiny.lifewatch.be/zooscan-data/">http://rshiny.lifewatch.be/zooscan-data/</a>	LifeWatch/Blue-Cloud Vlab*
Nutrients	<a href="http://rshiny.lifewatch.be/station-data/">http://rshiny.lifewatch.be/station-data/</a>	LifeWatch/Blue-Cloud Vlab*
Photosynthetically active radiation (PAR)	<a href="https://rshiny.lifewatch.be/ctd-data/">https://rshiny.lifewatch.be/ctd-data/</a>	LifeWatch/Blue-Cloud Vlab*
Sea-surface Temperature (SST)	<a href="https://rshiny.lifewatch.be/ctd-data/">https://rshiny.lifewatch.be/ctd-data/</a>	LifeWatch/Blue-Cloud Vlab*
	<a href="https://rshiny.lifewatch.be/mvb-data/">https://rshiny.lifewatch.be/mvb-data/</a>	Meetnet Vlaamse Banken

\*Blue-Cloud Vlab= Data also available in the 'VRE Folders' in the Vlab.



Modelling phyto- & zooplankton interactions docs

## Modelling phyto- and zooplankton interactions

This Modelling phyto- and zooplankton interactions service is a workflow to run a mechanistic model from bottom-up and top-down drivers in phytoplankton dynamics. **The Nutrient-Phytoplankton-Zooplankton-Detritus (NPZD) model** of Soetaert and Herman (2009). The NPZD model simulates the dynamics of phytoplankton, zooplankton and detritus. Phytoplankton dynamics are simulated based on light intensity, temperature, and nutrient concentrations. The Modelling phyto- and zooplankton interactions VLab calculates the relative contribution of phytoplankton to total primary production (TPP), Photosynthetically Active Radiation (PAR), Sea-surface Temperature (SST), Phosphate (PO<sub>4</sub>-P) and Silicate (SiO<sub>4</sub>-Si).

### Data sources

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Photosynthetically active radiation (PAR)	<a href="https://rshiny.lifewatch.be/ctd-data/">https://rshiny.lifewatch.be/ctd-data/</a>	LifeWatch/Blue
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	<a href="https://rshiny.lifewatch.be/mvb-data/">https://rshiny.lifewatch.be/mvb-data/</a>	Meetnet Vlaam

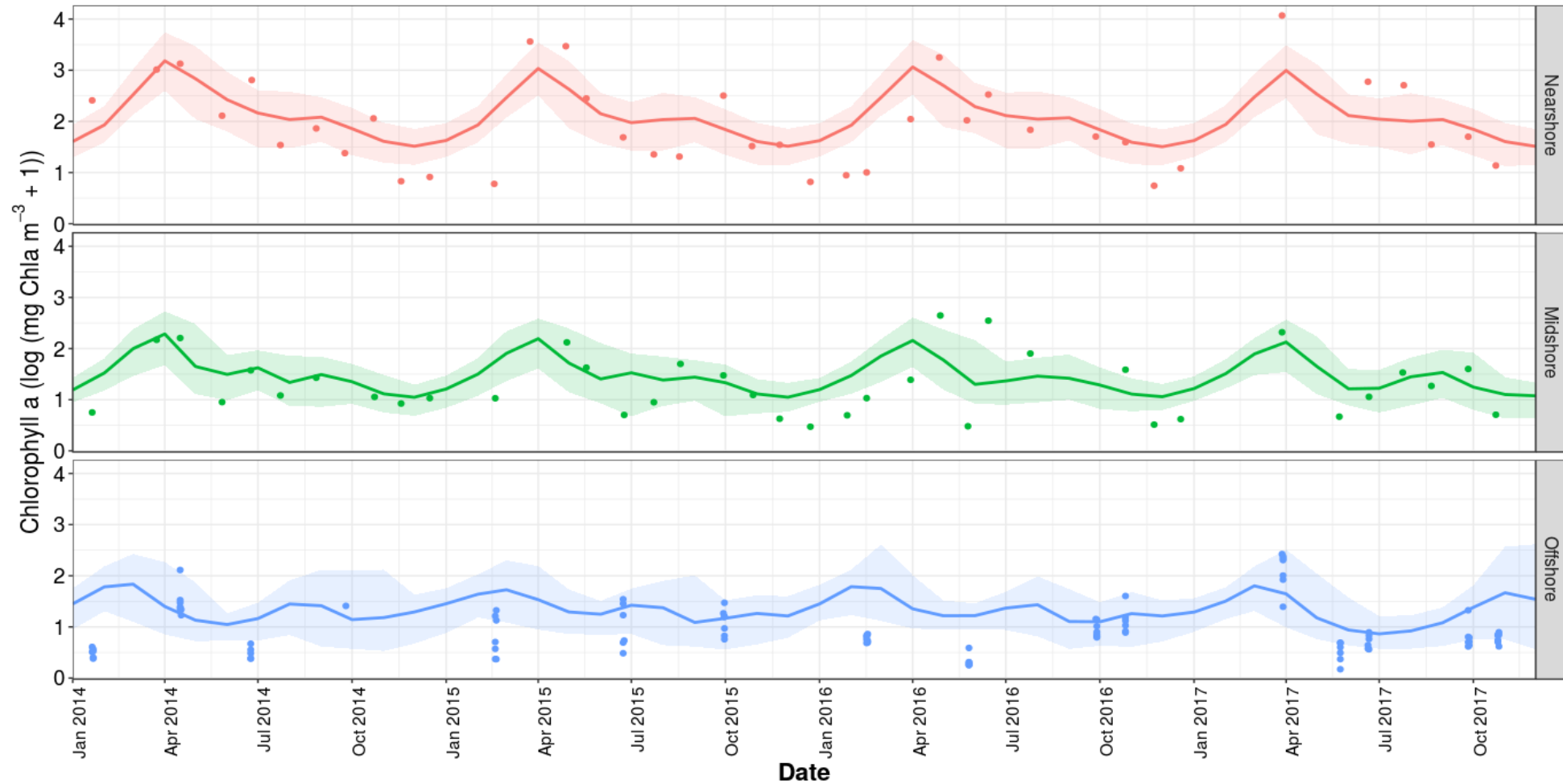
\*Blue-Cloud Vlab= Data also available in the 'VRE Folders' in the Vlab.

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2 title: "Manual_NPZ_model"
3 author: "Steven Pint, Viviana Otero, Patricia Cabrera and Gert Everaert \n Flanders Marine Institute Wandelaarkaai 7 Ostend 8400
4 date: "10/14/2021"
5 output: pdf_document
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7 {r setup, include=FALSE}
8 knitr::opts_chunk$set(fig.align = "left", echo = TRUE)
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10
11 *This pdf file is also available as a Rmarkdown (Folder: Workspace > VRE Folders > Zoo-Phytoplankton_EOV >
12 Modelling_phyto_and_zooplankton_interactions > Manual_NPZ_model > Manual_NPZ_model.Rmd). Store this file in your workspace and
13 open it in Rstudio to have a interactive document.*
14 # Content Table
15 1. Introduction
16 1.1 Modelling Approach
17 1.2 Input Data
18 1.3 Study Area
19 2. Preparation
20 2.1 Join the virtual lab Zoo-Phytoplankton EOv
21 2.2 Working Folder
22 2.3 Rscripts
23 3. NPZ Model
24 3.1 Calibration: Run the NPZ model
25 3.2 Calibration: Calculate the Root Mean Square Error
26 3.3 Simulation: Run the NPZ model a second time
27 3.4 Simulation: Calculate the Root Mean Square Error
28 3.5 Simulation: Calculate the relative contribution of the environmental parameters to phytoplankton dynamics
29 3.6 Visualisation: Creating graphs with the results
30 4. References
31 # 1. Introduction
32 Marine phytoplankton is at the base of the marine food web and regulates functions in coastal ecosystems. Changes observed in the
33 marine plankton community are expected to have a knock-on effect throughout the food web. Therefore, understanding how primary
34 production changes through time and space is of key importance to better quantify the effects of human activities and their
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## Phytoplankton biomass dynamics

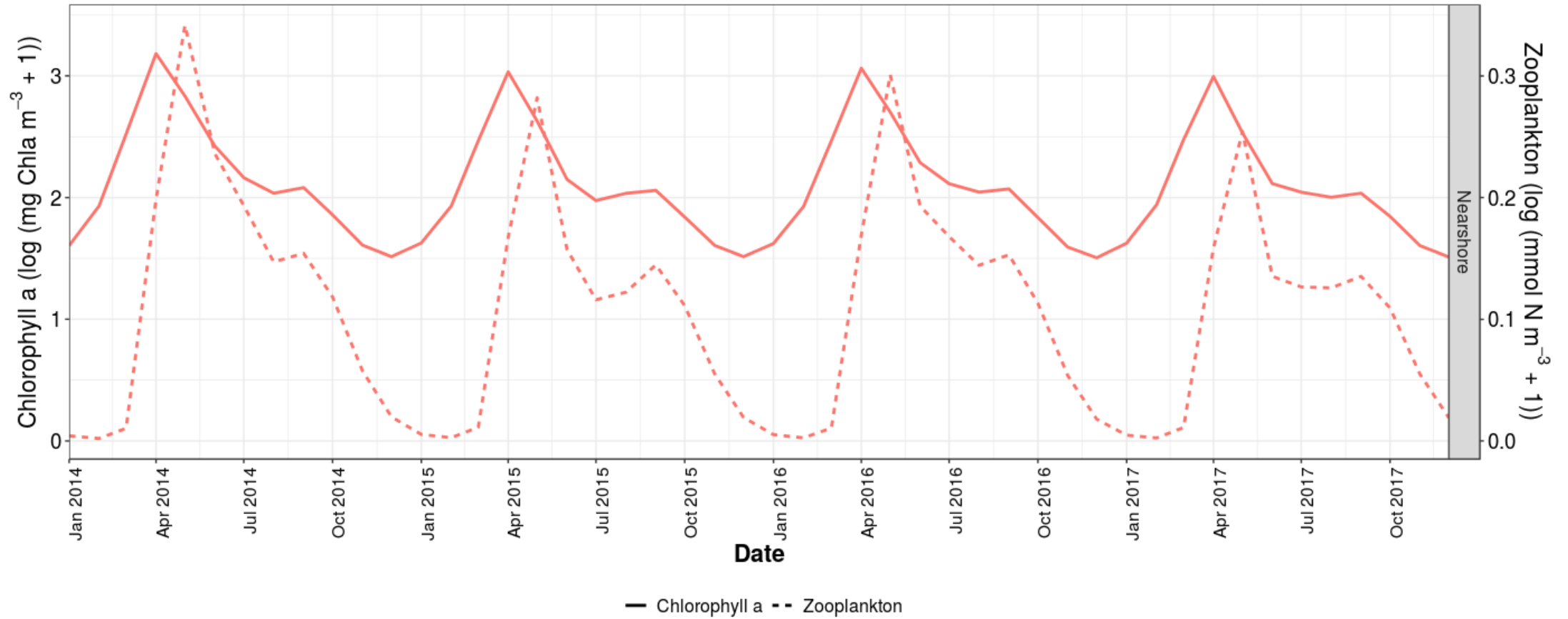


Otero et al. (submitted)

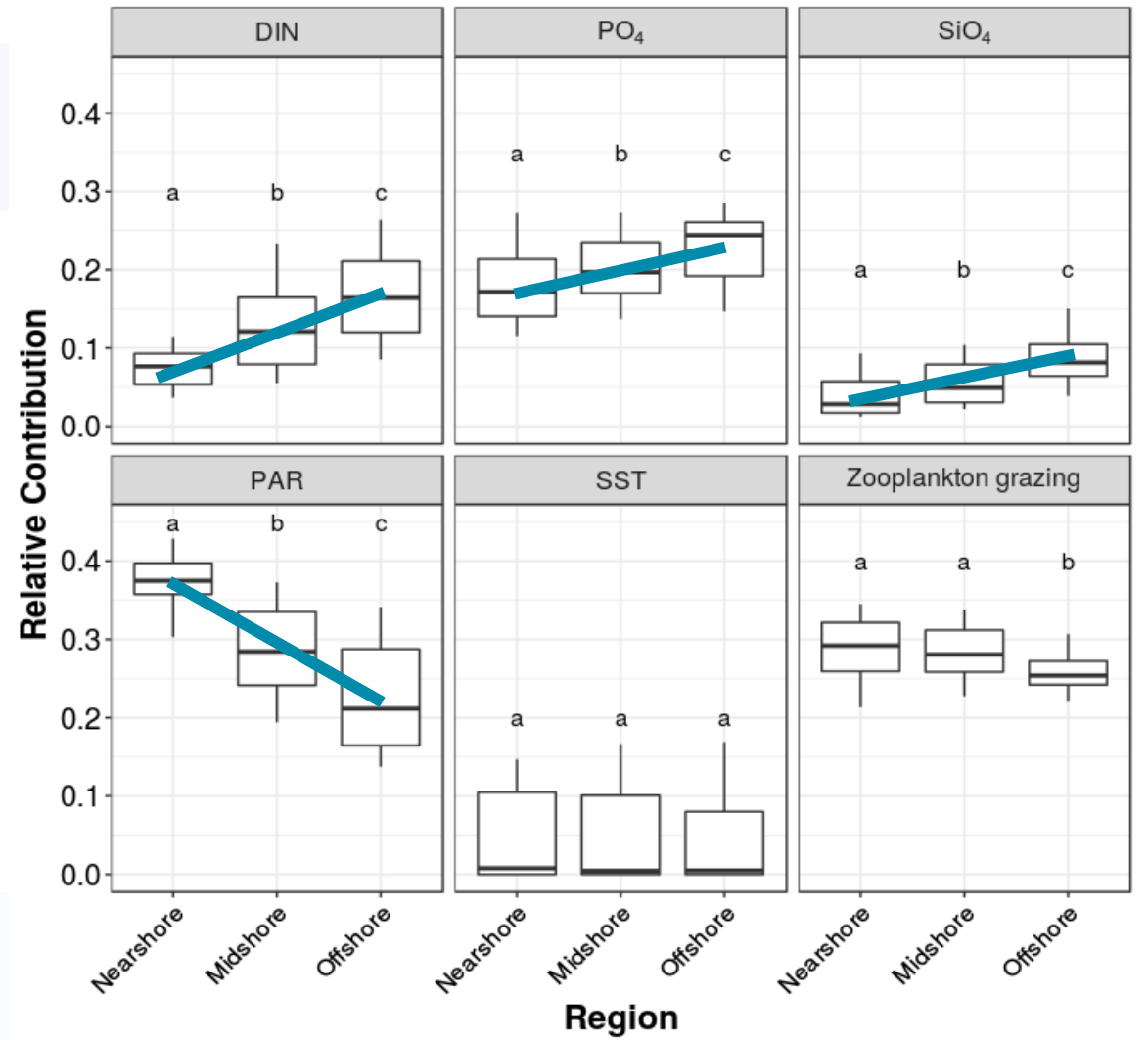
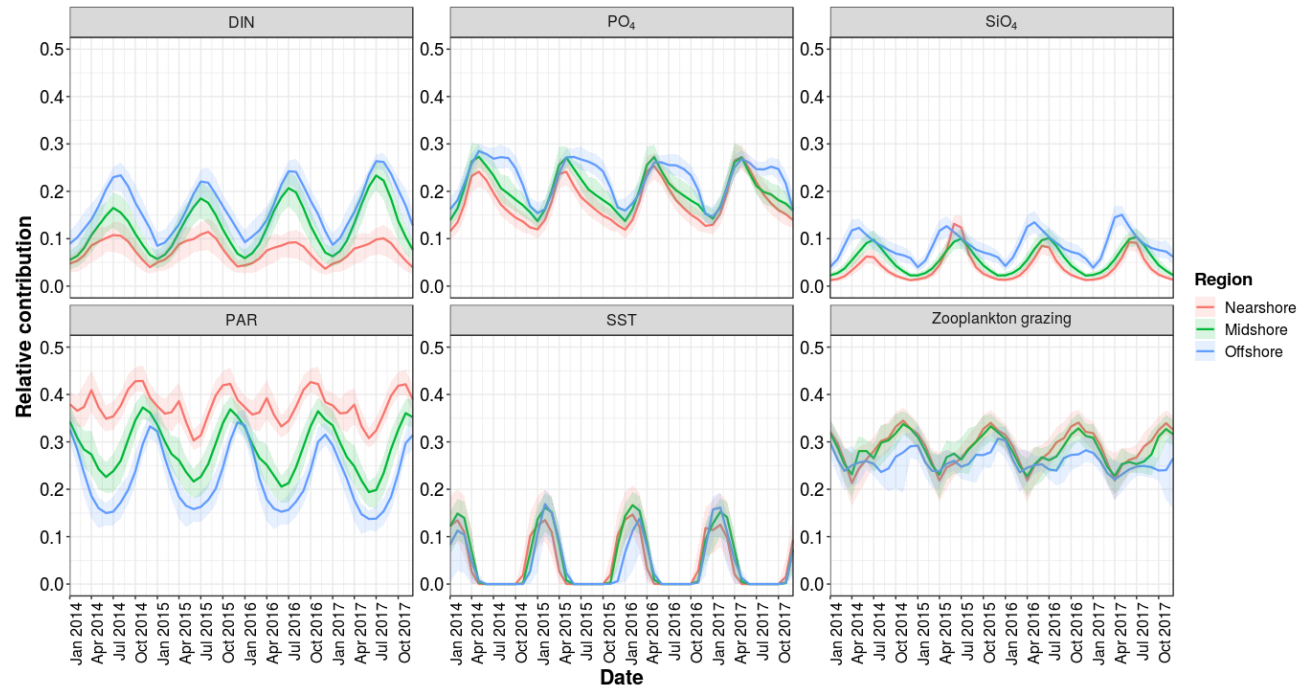




### Classic predator-prey pattern



## Relative contribution of determinants



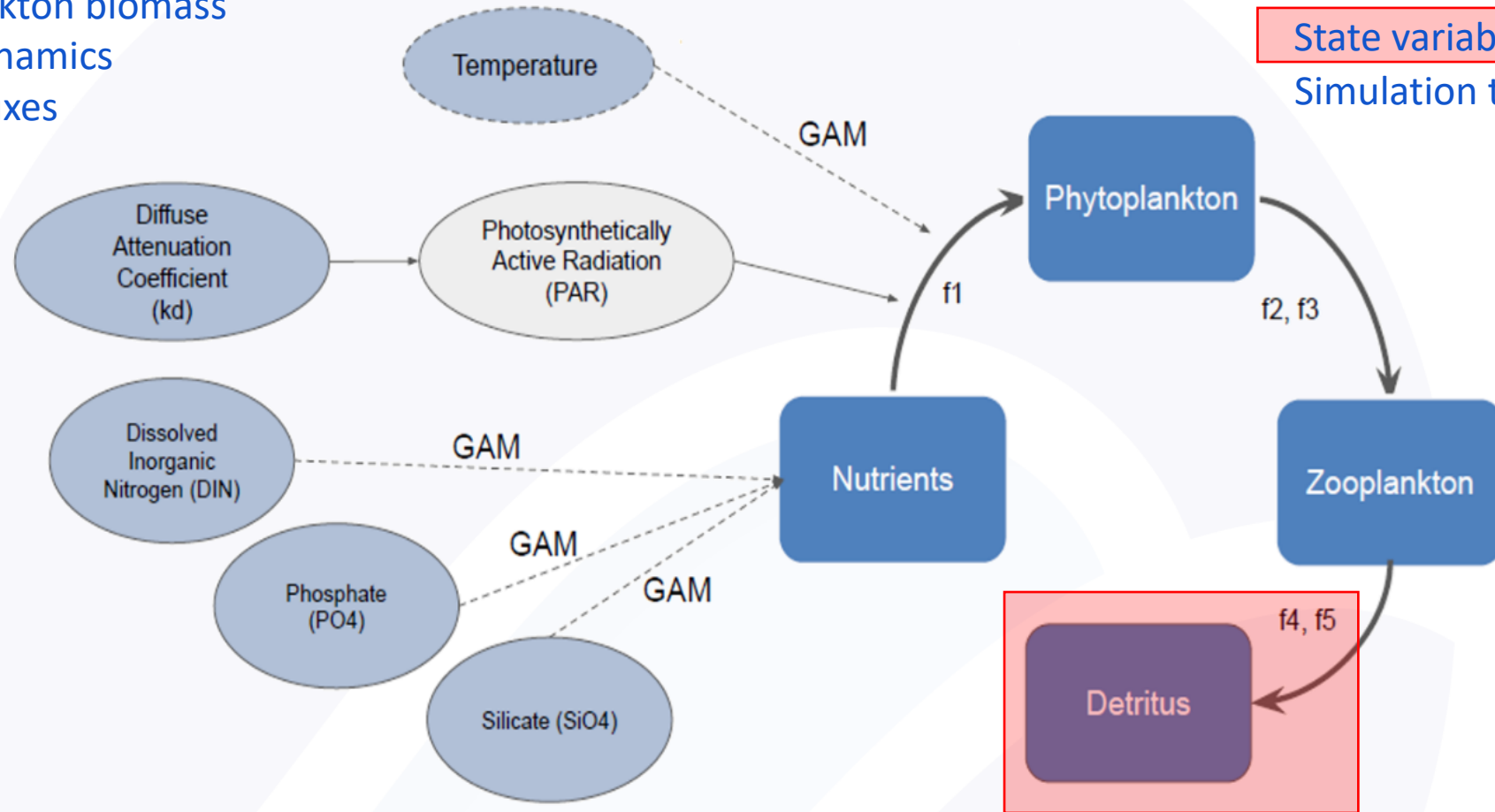
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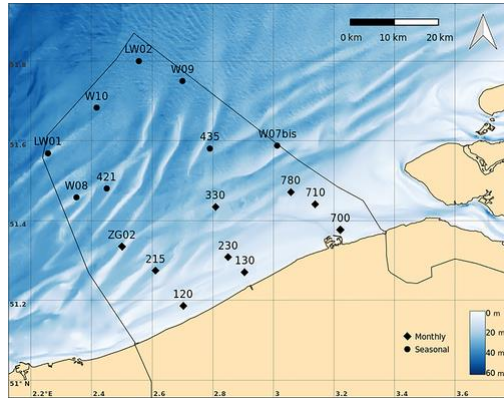
Nutrient-Phytoplankton-Zooplankton-Detritus  
Mechanistic Model



State variables:  $\text{mmol C m}^{-3}$   
Simulation time steps: days



Belgian part of the North Sea



Mortelmans et al. (2019)



Dive into data on Europe's marine life

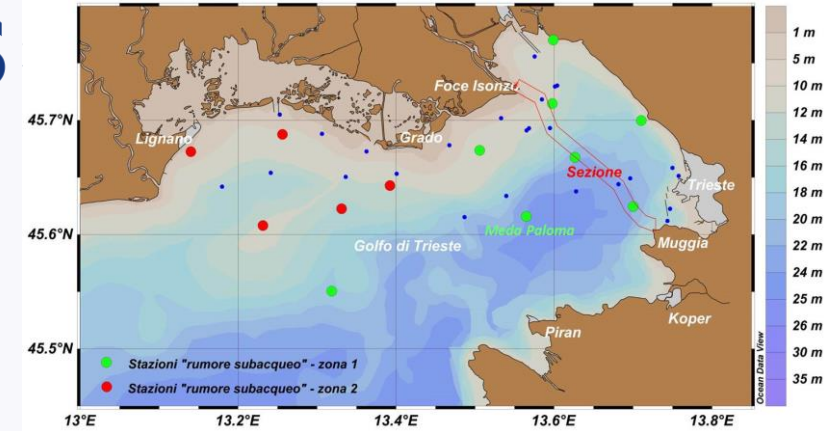


Abiotic

Si P N

Biotic

Northern Adriatic Sea



ogs.it

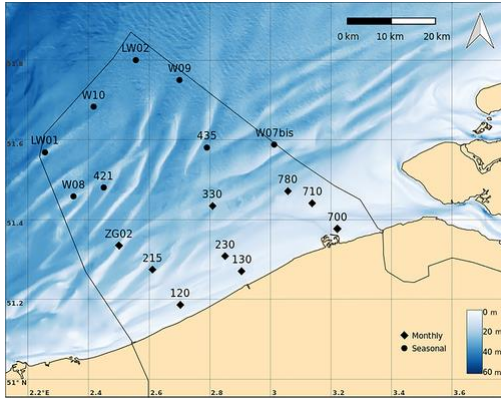


European Ocean Biodiversity Information System

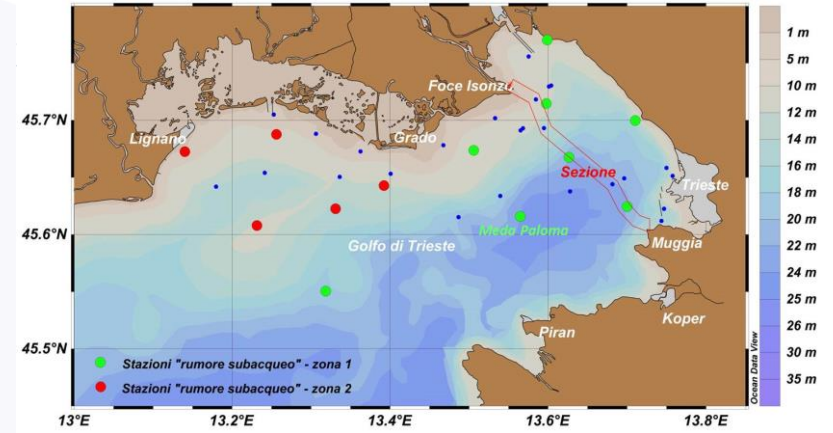


Data & Products on marine water quality



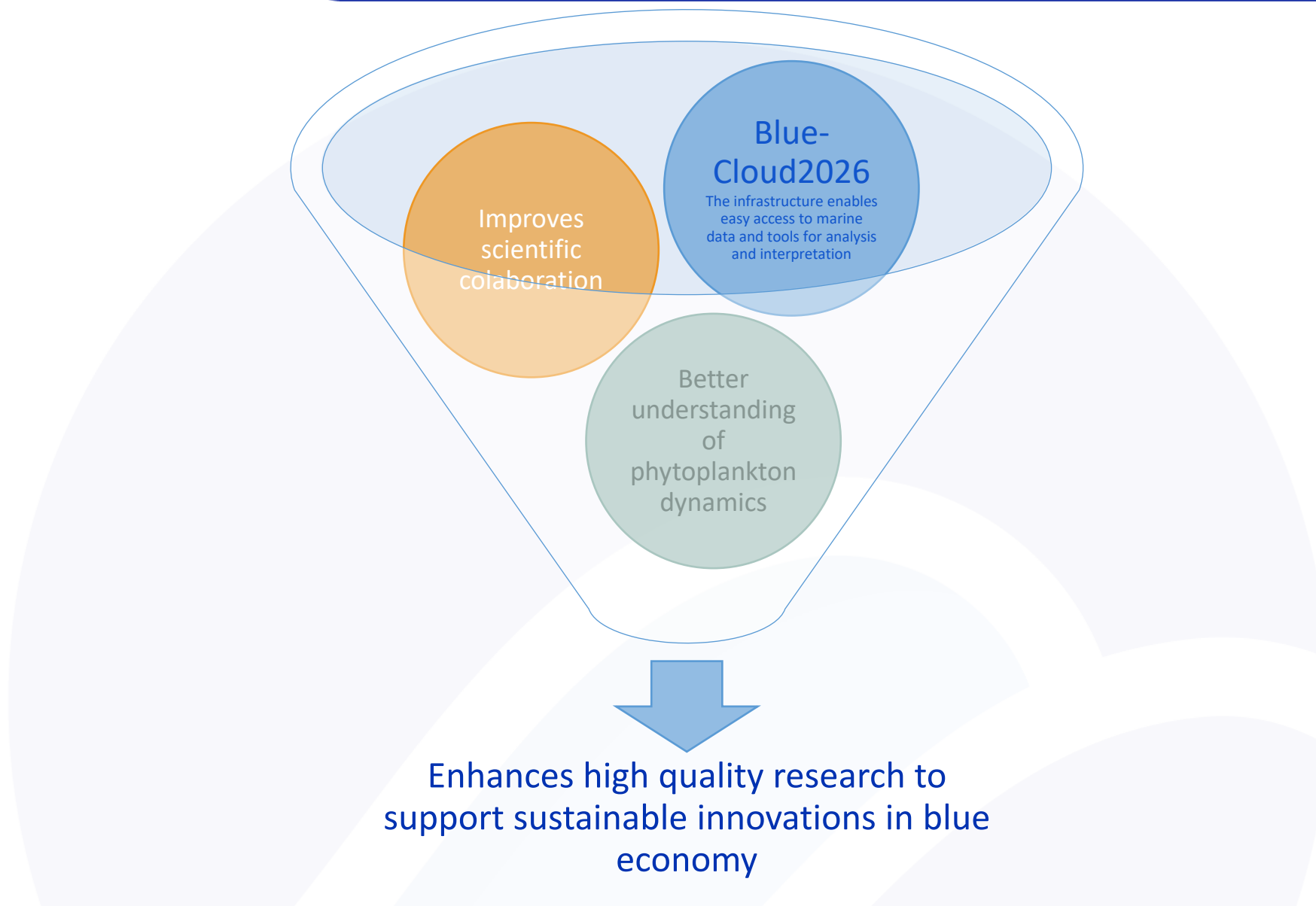


Mortelmans et al. (2019)



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