



# Vlab 3 Carbon-Plankton dynamics



Flanders Marine Institute (VLIZ)



Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS)



Funded by  
the European Union

## Deliverable:

Integrating different data types to understand interactions and identify the drivers of plankton dynamics and carbon fluxes in oceans and seas.

1. NPZD model + carbon sequestration component
2. Machine-learning algorithm to identify hot spots of carbon sequestration and productivity in coastal ocean.
3. Available through notebooks

## Main goals:

Identify drivers of

1. phytoplankton biomass dynamics
2. Carbon fluxes

## Sub goals:

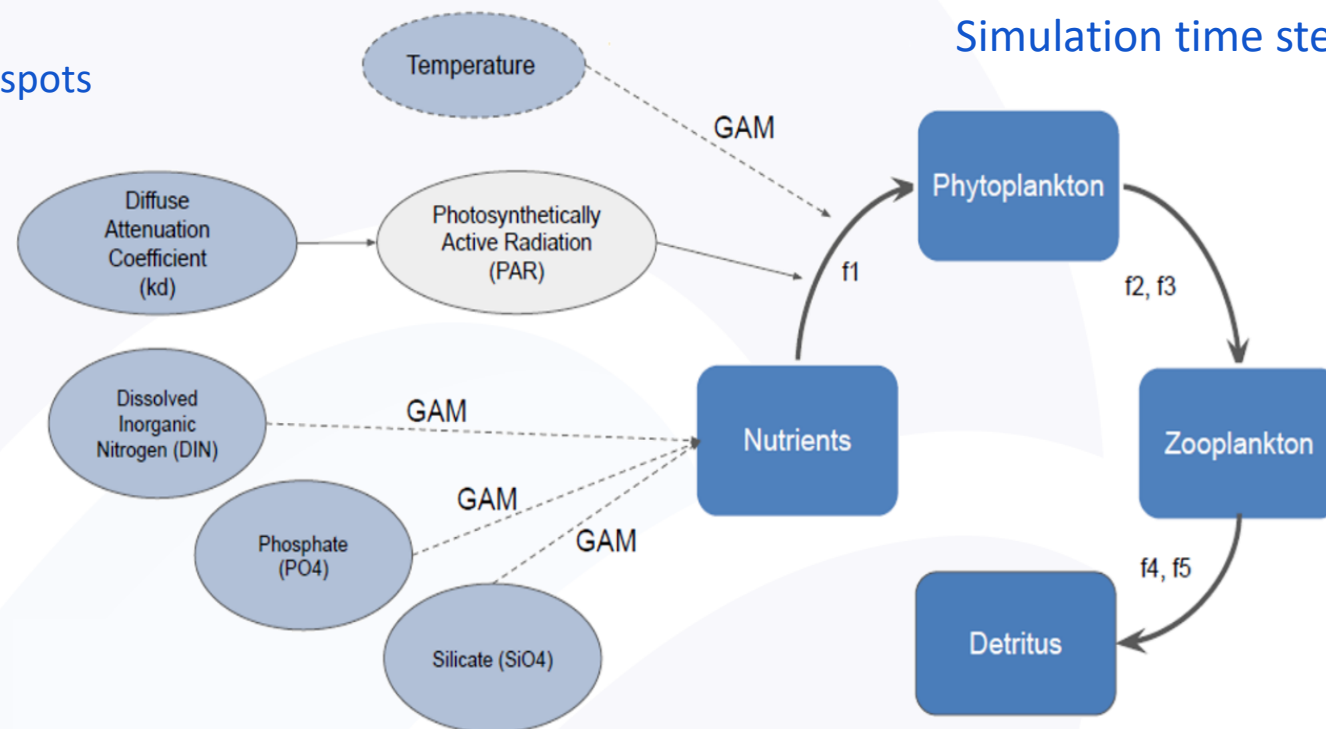
1. Higher level of taxonomic detail
2. Flexible C:N Redfield ratio
3. Convert to carbon units
4. Quantify carbon sequestration

## NPZD model

Nutrient-Phytoplankton-Zooplankton-Detritus

Mechanistic Model

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



Soetaert & Herman (2009)



Modelling phyto- &amp; 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 ( $\text{PO}_4^{3-}$ ) and Silicate ( $\text{SiO}_4^{2-}$ ), 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

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R File Edit Code View Plots Session Build Debug Profile Tools Help
Manual_NPZ_model.Rmd x functions_NPZ_parallel_iter1.R x functions_error_v1.R x functions_NPZ_parallel_iter2.R x functions_error_iter2.R x functions_error_iter3.R x
1 ---
2 title: "Manual_NPZ_model"
3 author: "Steven Pint, Viviana Otero, Patricia Cabrera and Gert Everaert \n Flanders Marine Institute Wandelaarkaai 7 Ostend 8400 Belgium"
4 date: "10/14/2021"
5 output: pdf_document
6 ---
7 {r setup, include=FALSE}
8 knitr::opts_chunk$set(fig.align = "left", echo = TRUE)
9 ---
10
11 *This pdf file is also available as a Rmarkdown (Folder: Workspace > VRE Folders > Zoo-Phytoplankton_EOV > Modelling_phyto_and_zooplankton_interactions > Manual NPZ model > Manual_NPZ_model.Rmd). Store this file in your workspace and open it in Rstudio to have a interactive document.*
12
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14 1. Introduction
15 1.1 Modelling Approach
16 1.2 Input Data
17 1.3 Study Area
18 2. Preparation
19 2.1 Join the virtual lab Zoo-Phytoplankton EOv
20 2.2 Working Folder
21 2.3 Rscripts
22 3. NPZ Model
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24 3.2 Calibration: Calculate the Root Mean Square Error
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26 3.4 Simulation: Calculate the Root Mean Square Error
27 3.5 Simulation: Calculate the relative contribution of the environmental parameters to phytoplankton dynamics
28 3.6 Visualisation: Creating graphs with the results
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527:1 (Untitled) R Markdown

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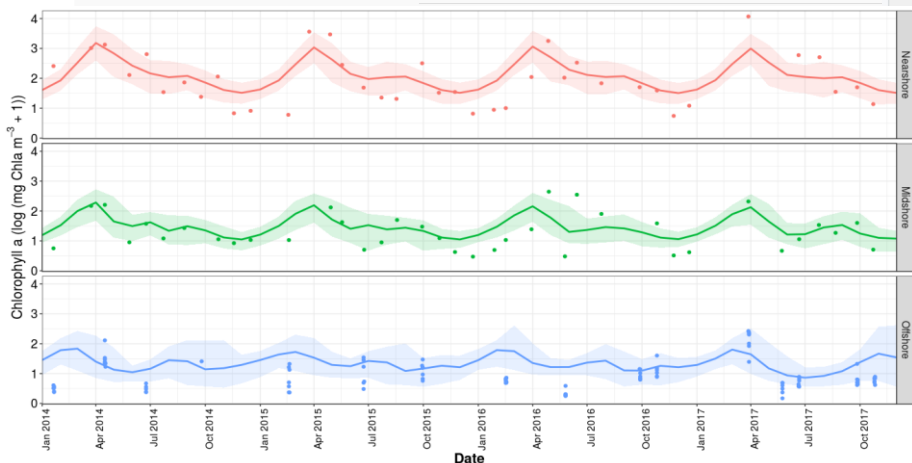
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Otero et al. (submitted)

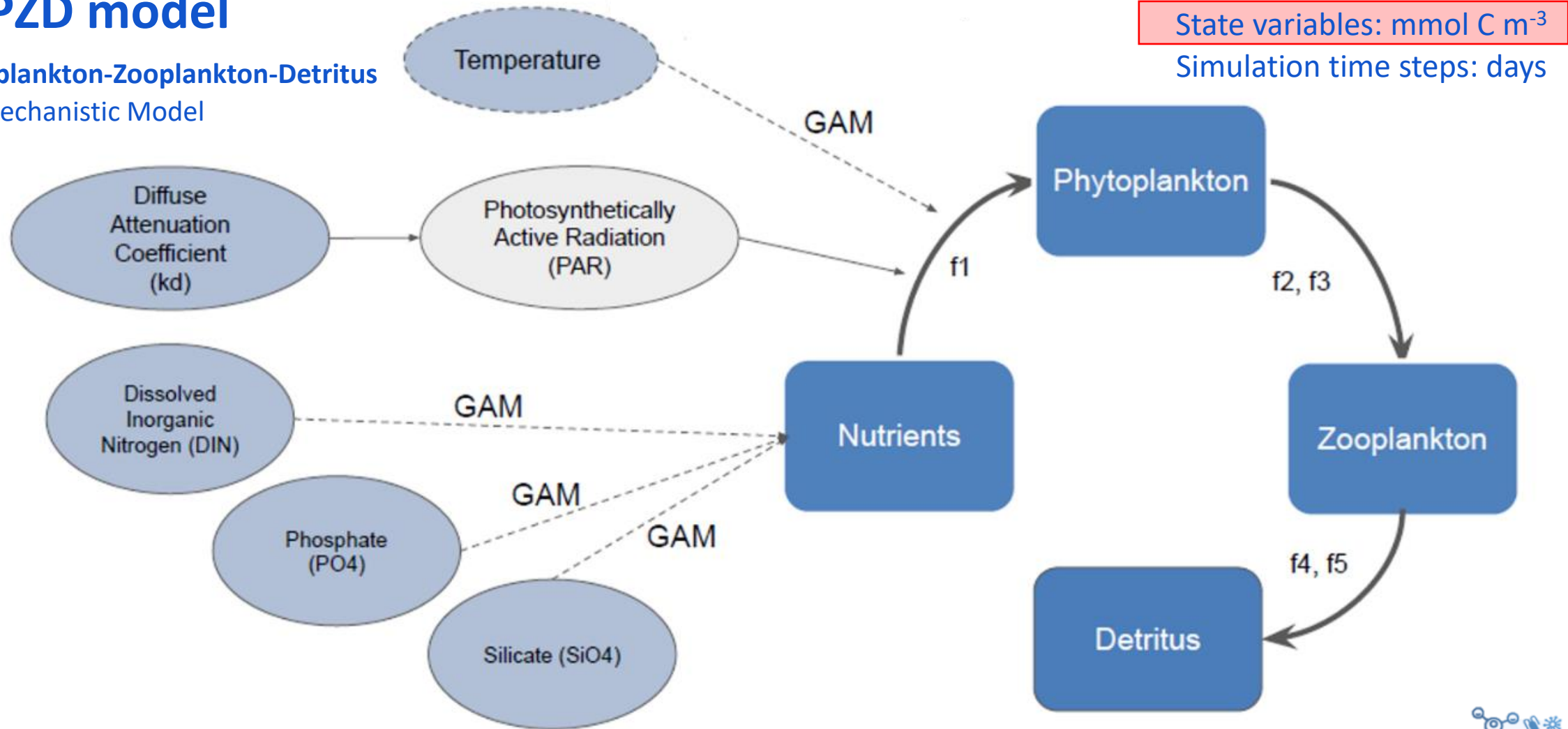
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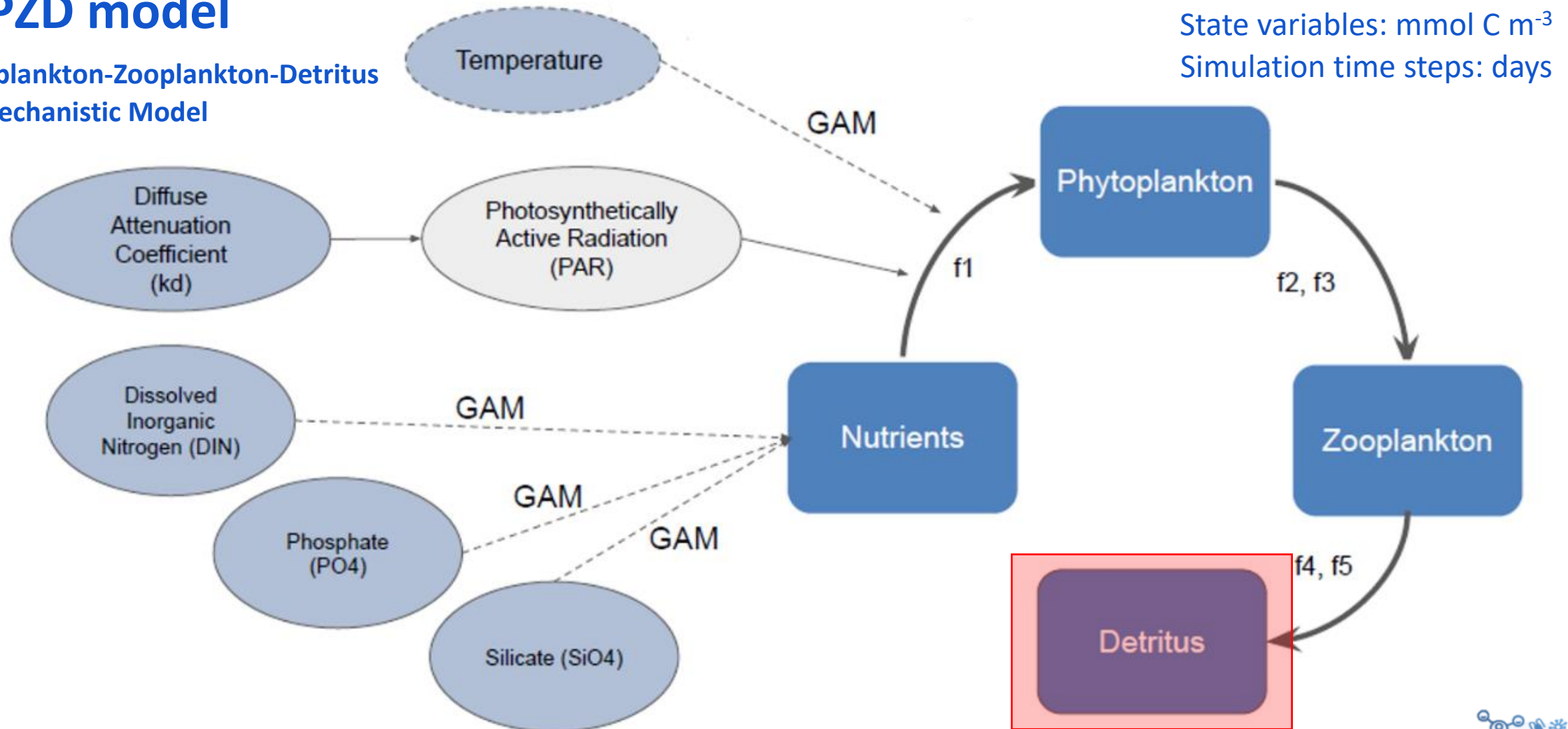
## NPZD model

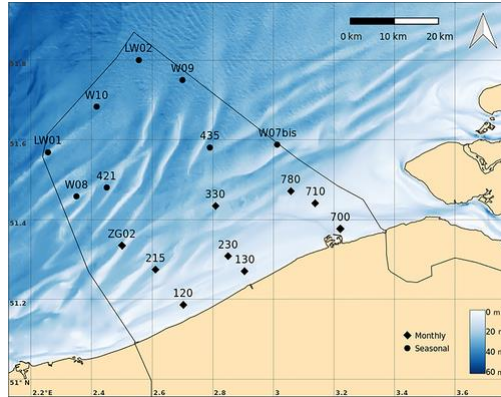
Nutrient-Phytoplankton-Zooplankton-Detritus  
Mechanistic Model



## NPZD model

Nutrient-Phytoplankton-Zooplankton-Detritus  
Mechanistic Model



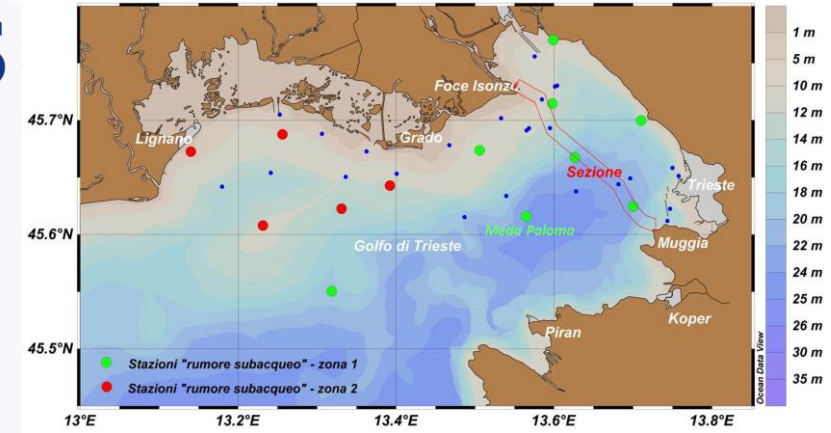
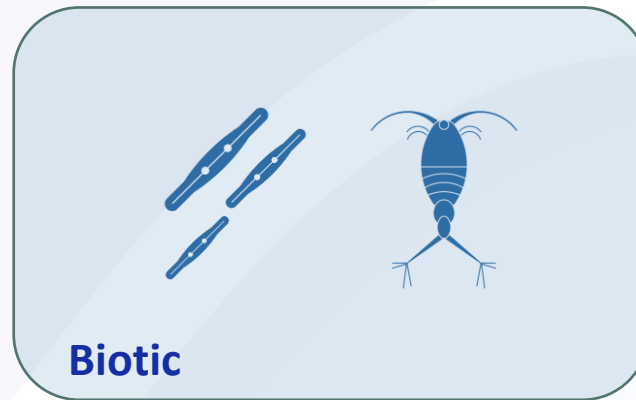
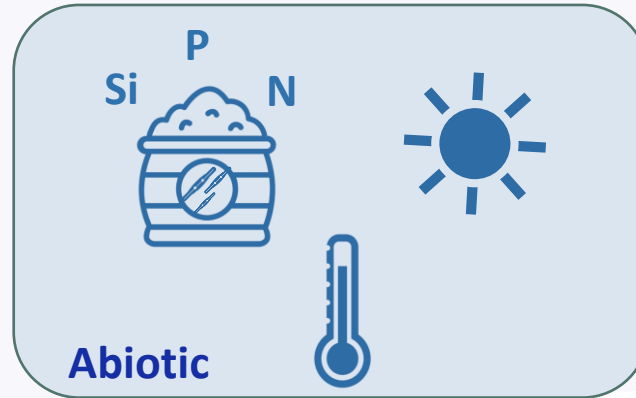


Mortelmans et al. (2019)



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BIOLOGY  
Dive into data on Europe's marine life

Seasonal and monthly records  
from 2011-2022



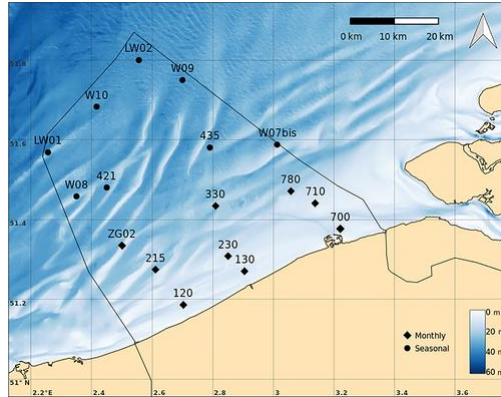
ogs.it

Identify potential source data

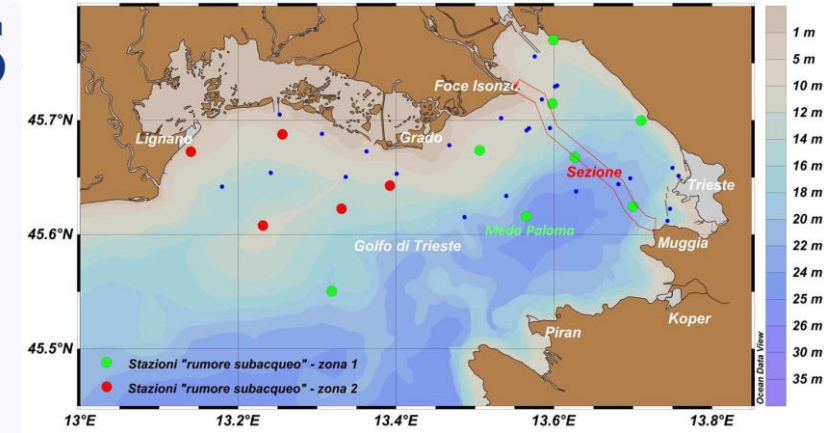
Train and validate the NPZD  
model for the Adriatic







Mortelmans et al. (2019)



ogs.it

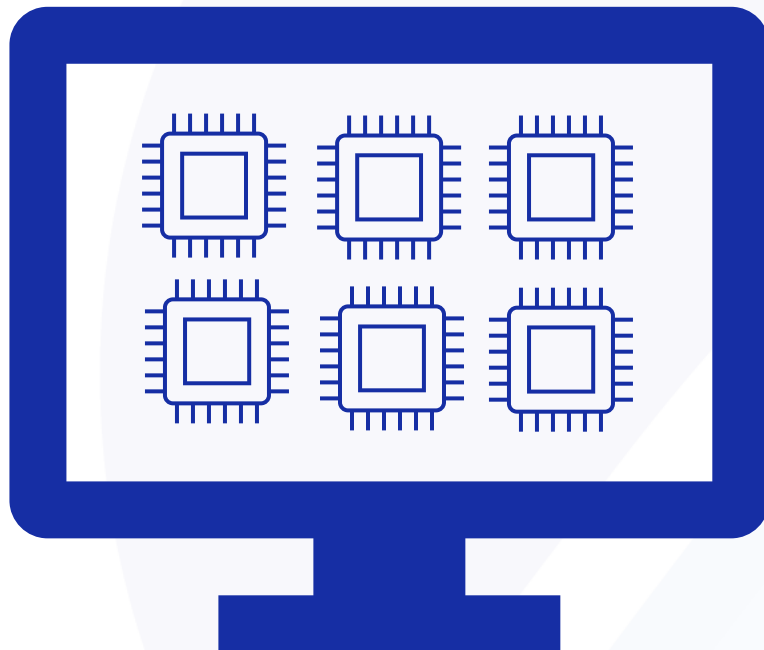


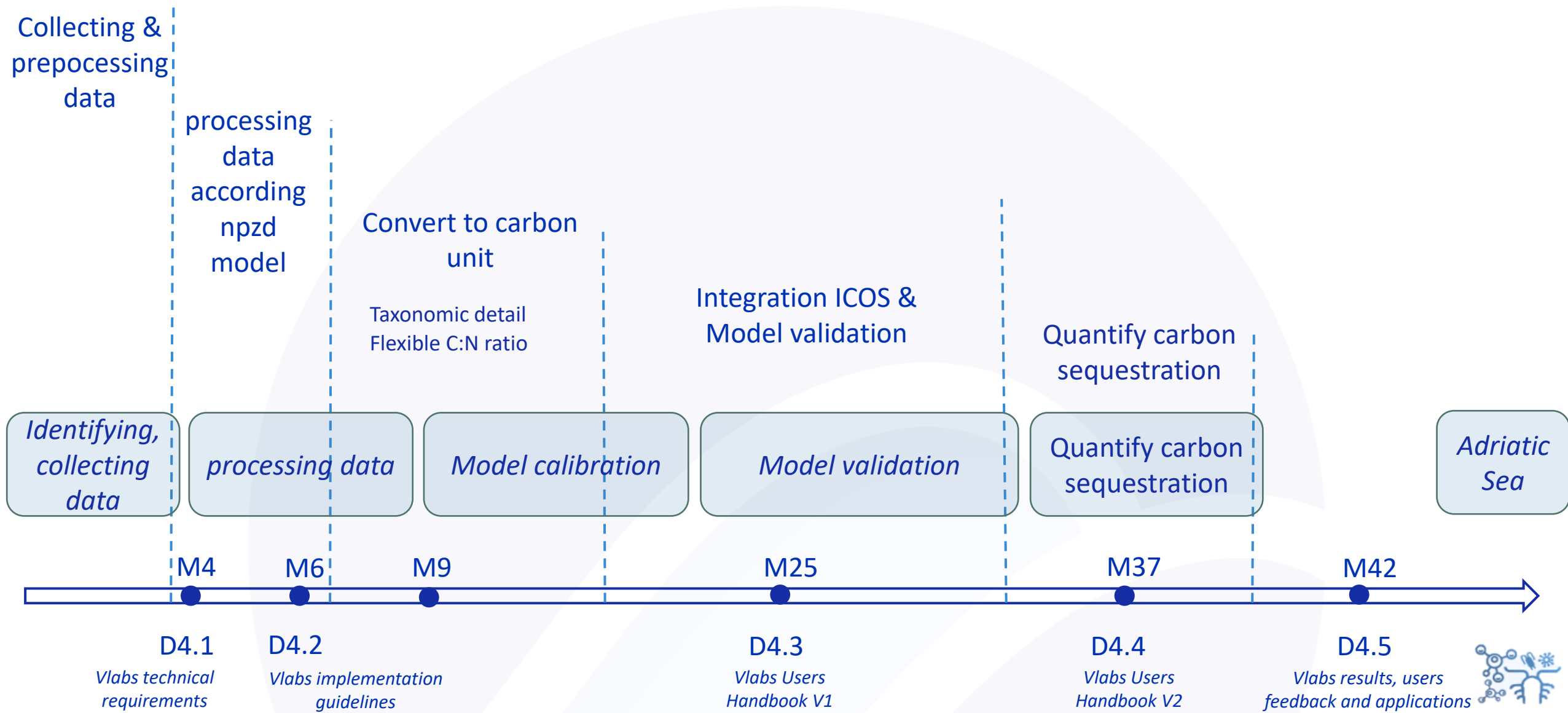
Define right spatial and temporal resolution



## Computing

- Virtual machine with easy access to data sources and 10-20 fast CPUs + ~100 GB of memory
- R + Rstudio





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