eosc | Blue-Cloud2026

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 sequestrationand 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

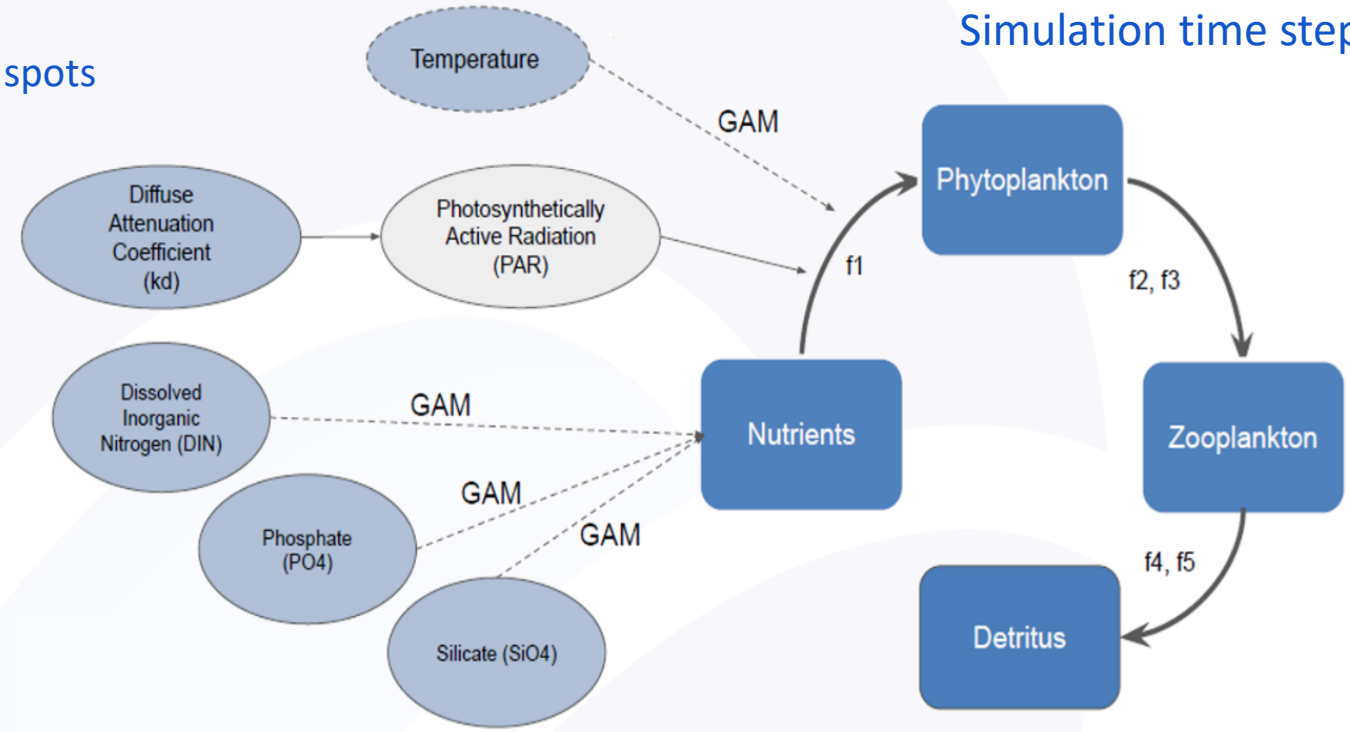
NPZD model

Nutrient-Phytoplankton-Zooplankton-Detritus

Mechanistic Model

State variables: mmol N m^{-3}

Simulation time steps: days



Soetaert & Herman (2009)

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~4~) and Silicate (SiO~4~), Photosynthetically Active Radiation (PAR), Sea-surface Temperature (SST) and zooplankton grazing, over time.

Data sources

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

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

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Photosynthetically active radiation (PAR)	https://rshiny.lifewatch.be/ctd-data/	LifeWatch/Blue
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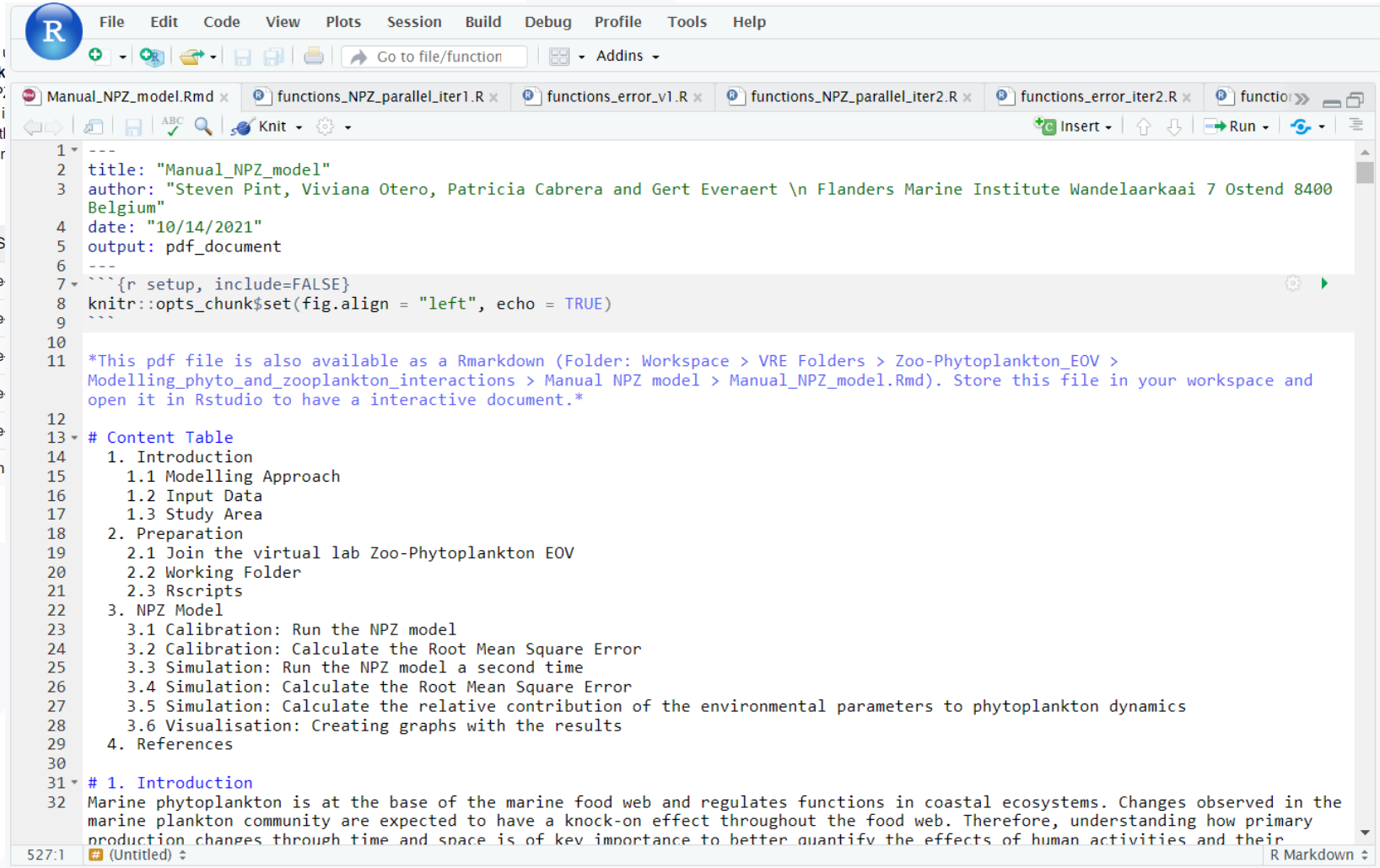

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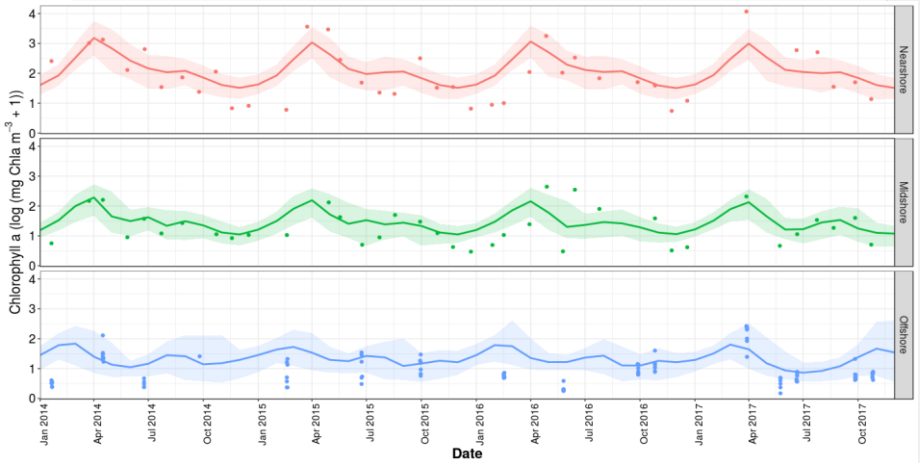
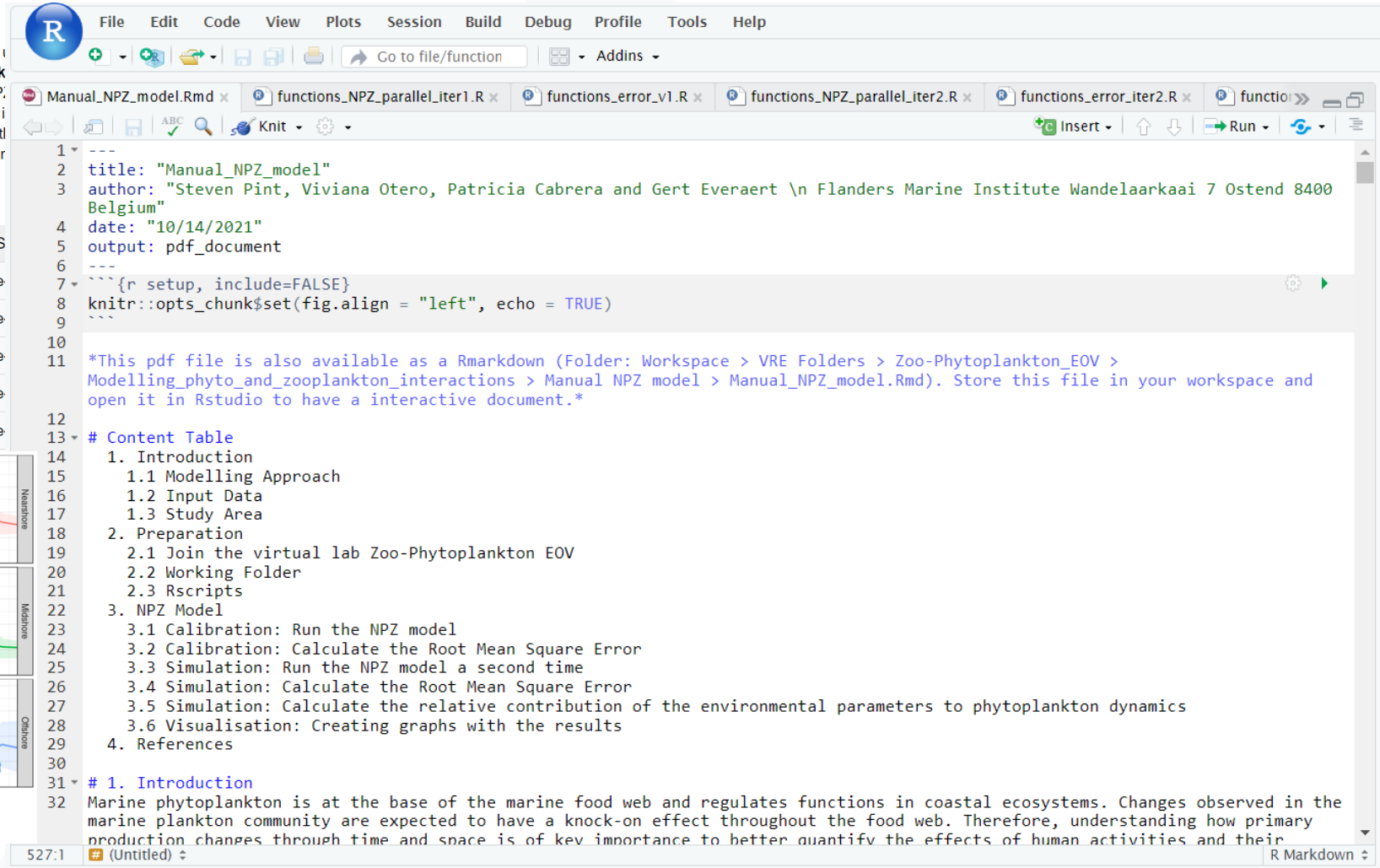


Otero et al. (submitted)



NPZD model

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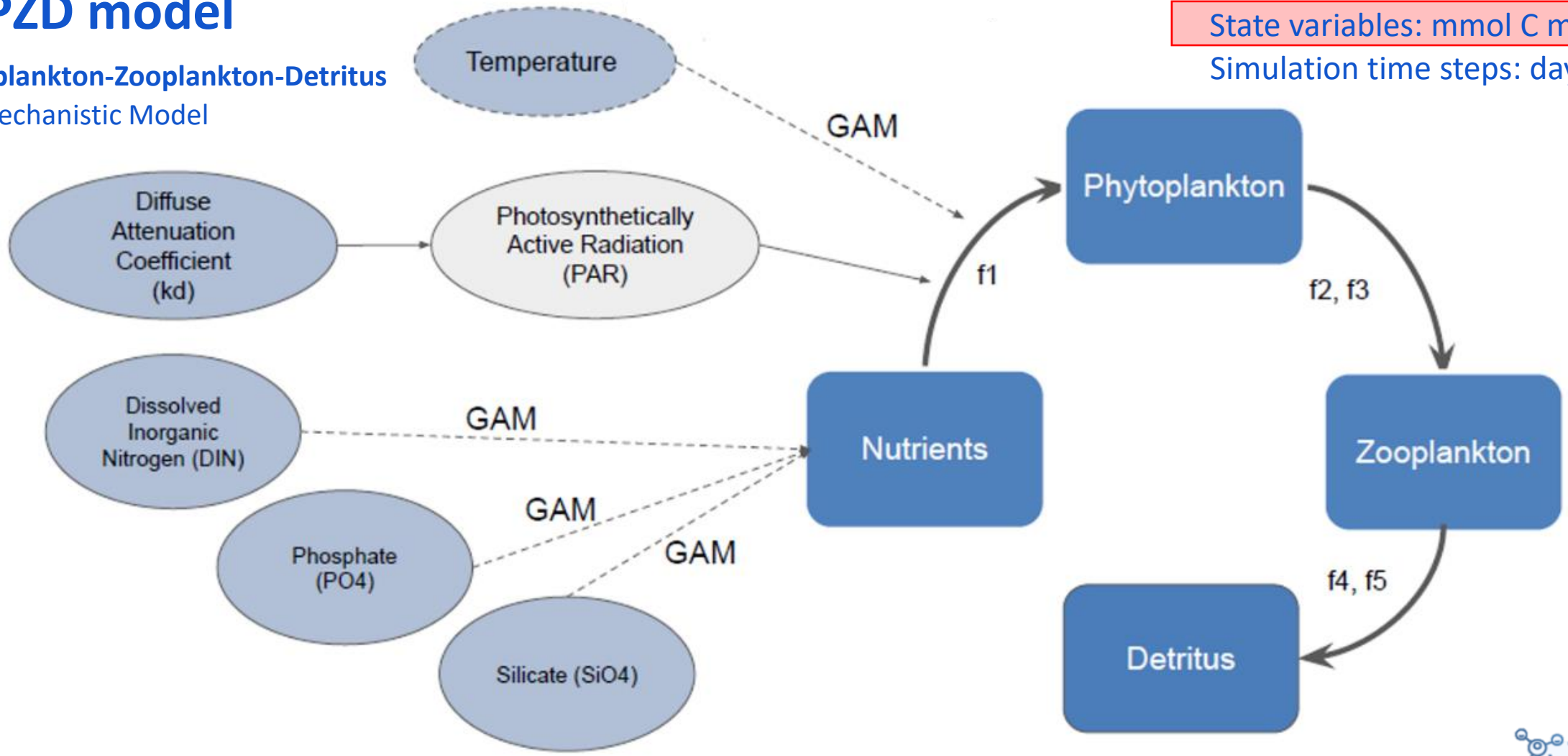
Mechanistic Model

State variables: mmol C m^{-3}

Simulation time steps: days

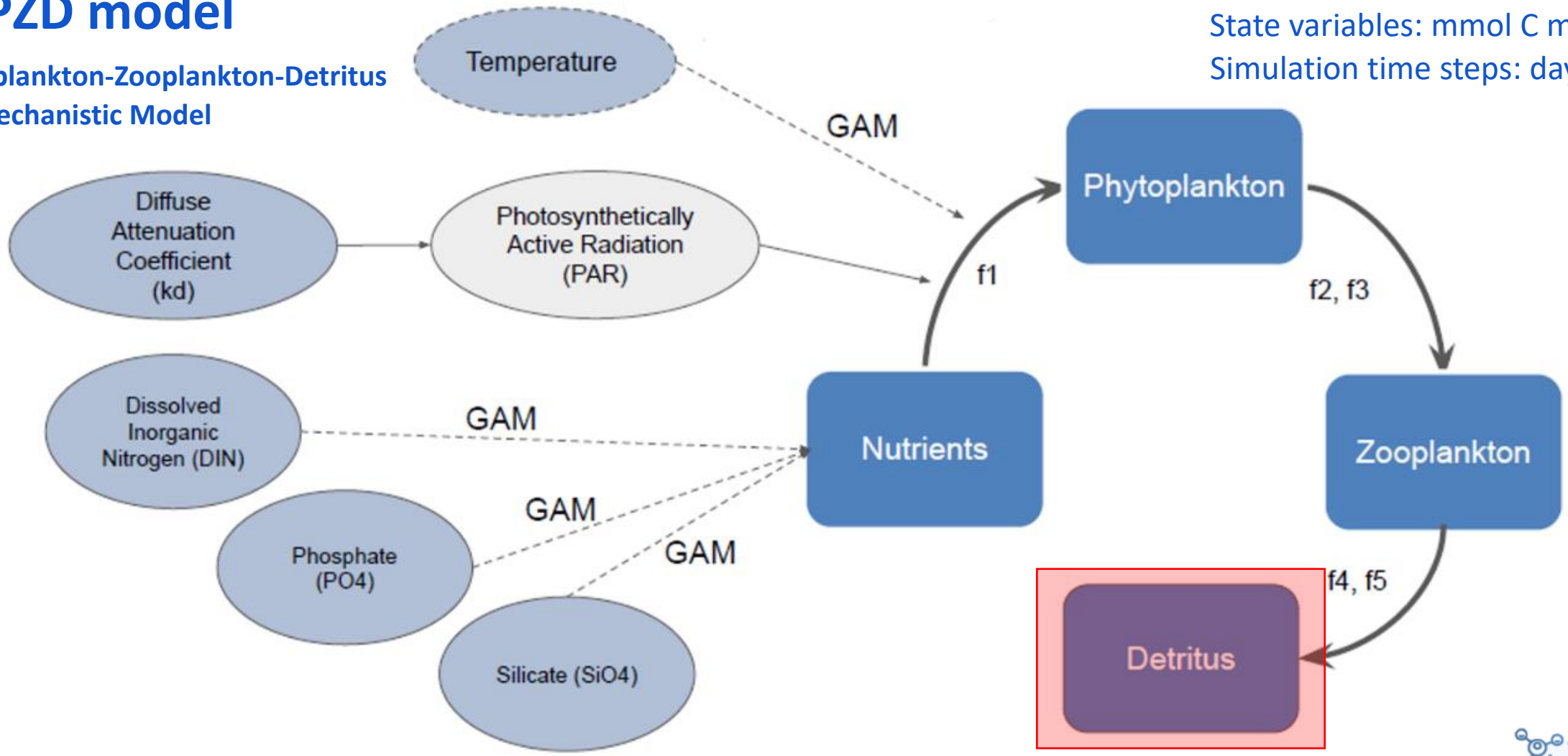


NPZD model

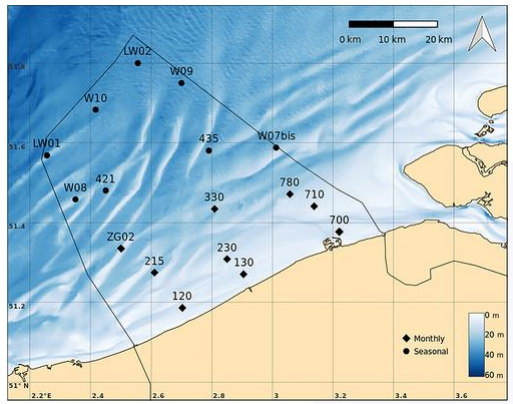
Nutrient-Phytoplankton-Zooplankton-Detritus Mechanistic Model

State variables: mmol C m^{-3}

Simulation time steps: days



Data sources



Mortelmans et al. (2019)

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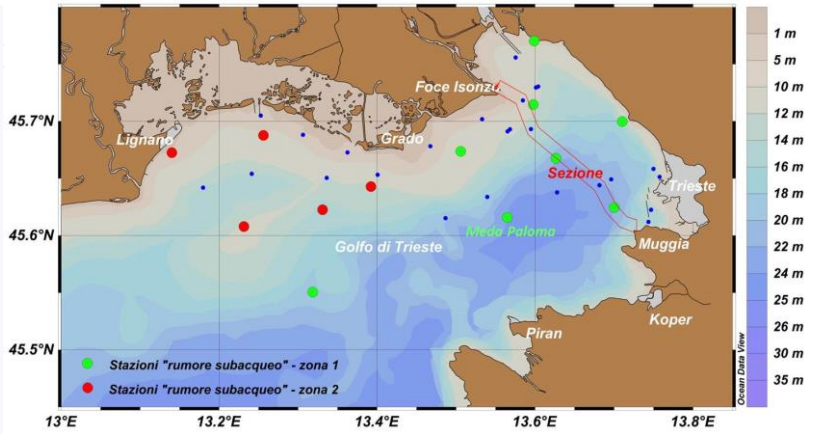

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LifeWatch BELGIUM

EMODnet BIOLOGY
Dive into data on Europe's marine life

Abiotic

P
Si
N

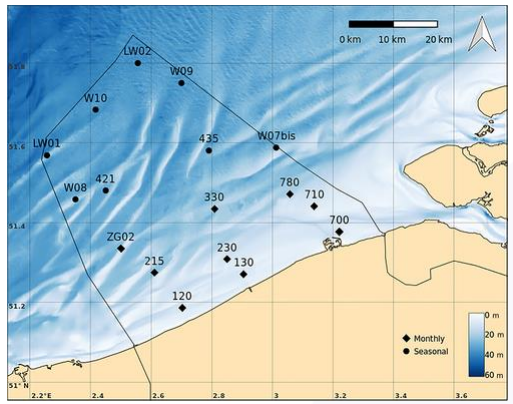
Biotic

Seasonal and monthly records from 2011-2022

Identify potential source data

Train and validate the NPZD model for the Adriatic

Data sources



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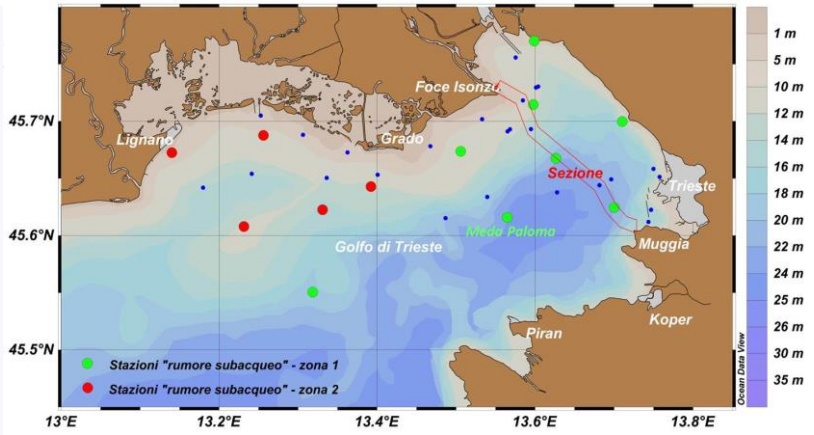

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ICOS Integrated Carbon Observation System

SOCAT · SURFACE OCEAN CO_2 ATLAS ·

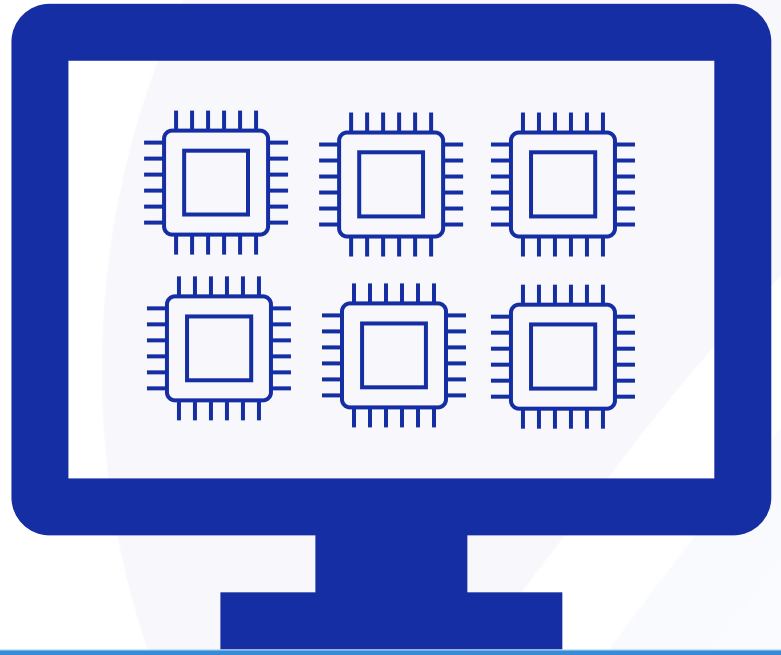
Carbon

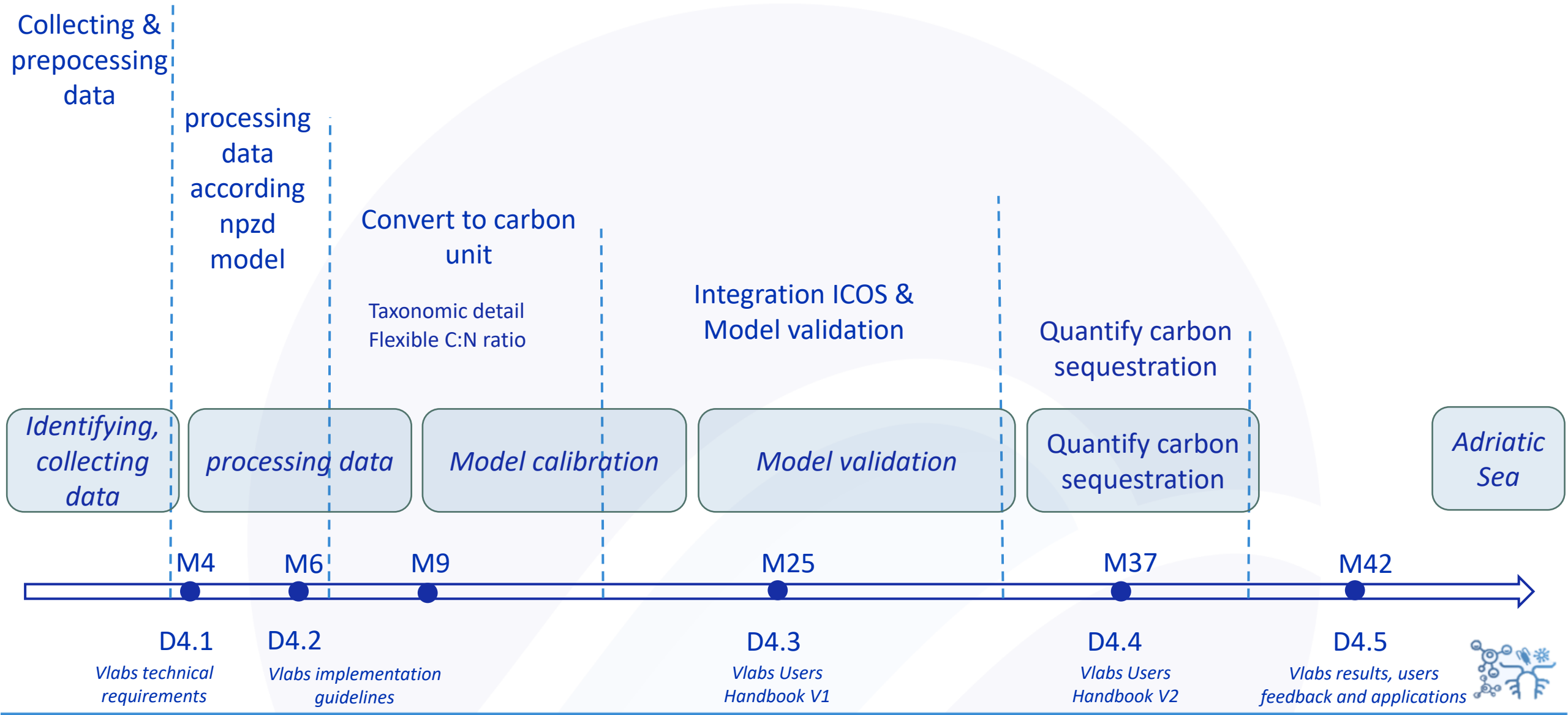
Define right spatial and temporal resolution

Computing

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

- R + Rstudio




Collecting & prepocessing data
processing data according npzd model
Convert to carbon unit
Taxonomic detail
Flexible C:N ratio
Integration ICOS & Model validation
Quantify carbon sequestration
Identifying, collecting data
processing data
Model calibration
Model validation
Quantify carbon sequestration
Adriatic Sea
M4
M6
M9
M25
M37
M42
D4.1
Vlabs technical requirements
D4.2
Vlabs implementation guidelines
D4.3
Vlabs Users Handbook V1
D4.4
Vlabs Users Handbook V2
D4.5
Vlabs results, users feedback and applications

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the European Union