

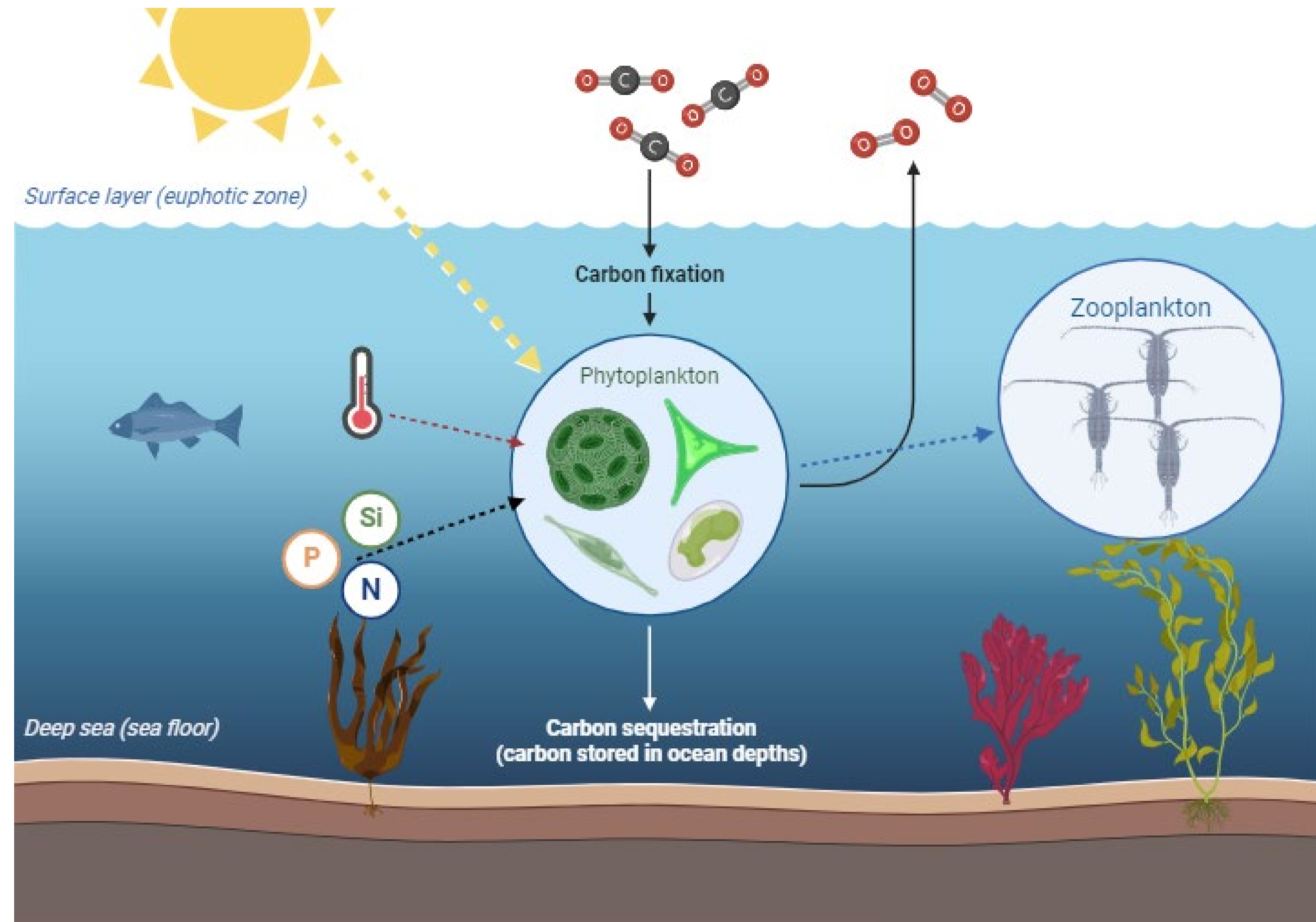


Quantifying Environmental Drivers of Phytoplankton and Carbon Dynamics through Data-Driven Models

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INTRODUCTION

Phytoplankton plays a critical role in oceanic ecosystems and global biogeochemical cycles. Comprehensive characterization of phytoplankton dynamics requires the integration of multidisciplinary data, including biological, biogeochemical, and physical variables. This study demonstrates a novel approach linking diverse data sources from the Blue-Cloud data lake, providing interoperable workflows within a Blue-Cloud Virtual Laboratory (VLab). The VLab provides a service to analyze the relative contribution of the drivers in phytoplankton dynamics. The Nutrient-Phytoplankton-Zooplankton-Detritus (NPZD) model is built using data containing phytoplankton and zooplankton abundances, nutrients (nitrogen, silica and phosphor), and carbon data (dissolved inorganic carbon, air-sea carbon flux). This model helps to understand the spatio-temporal variations of plankton dynamics and to determine whether they act as a carbon sink or source.



GOALS

1. Understand plankton dynamics
2. Quantify relative contribution of determinants
3. Quantify carbon sequestration

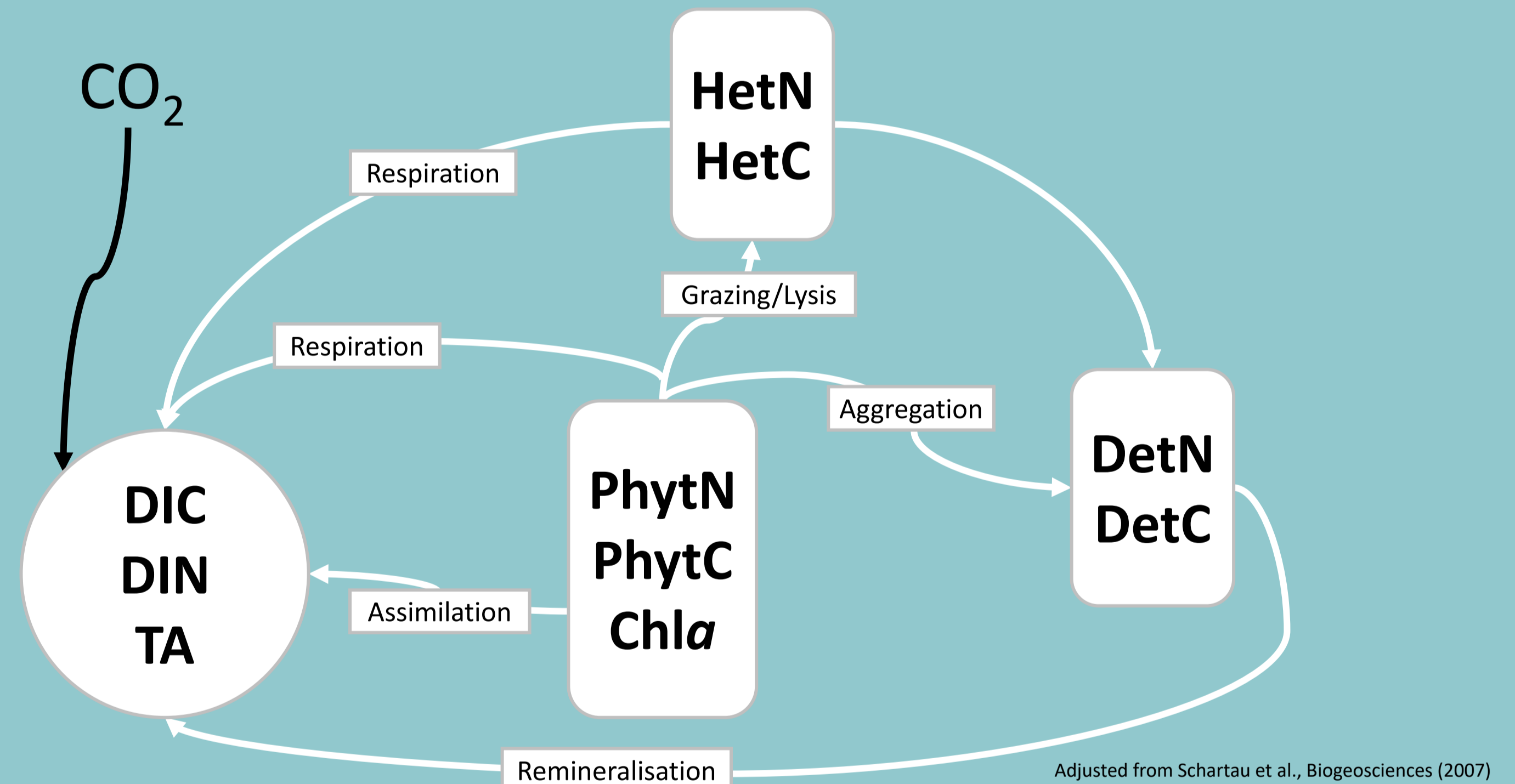
METHODOLOGY

DATA

Nutrients (DIN, PO₄, SO₄)
 Carbon (DIC, pCO₂)
 plankton density
 Temperature



Nutrient-Phytoplankton-Zooplankton-Detritus Model



RESULTS

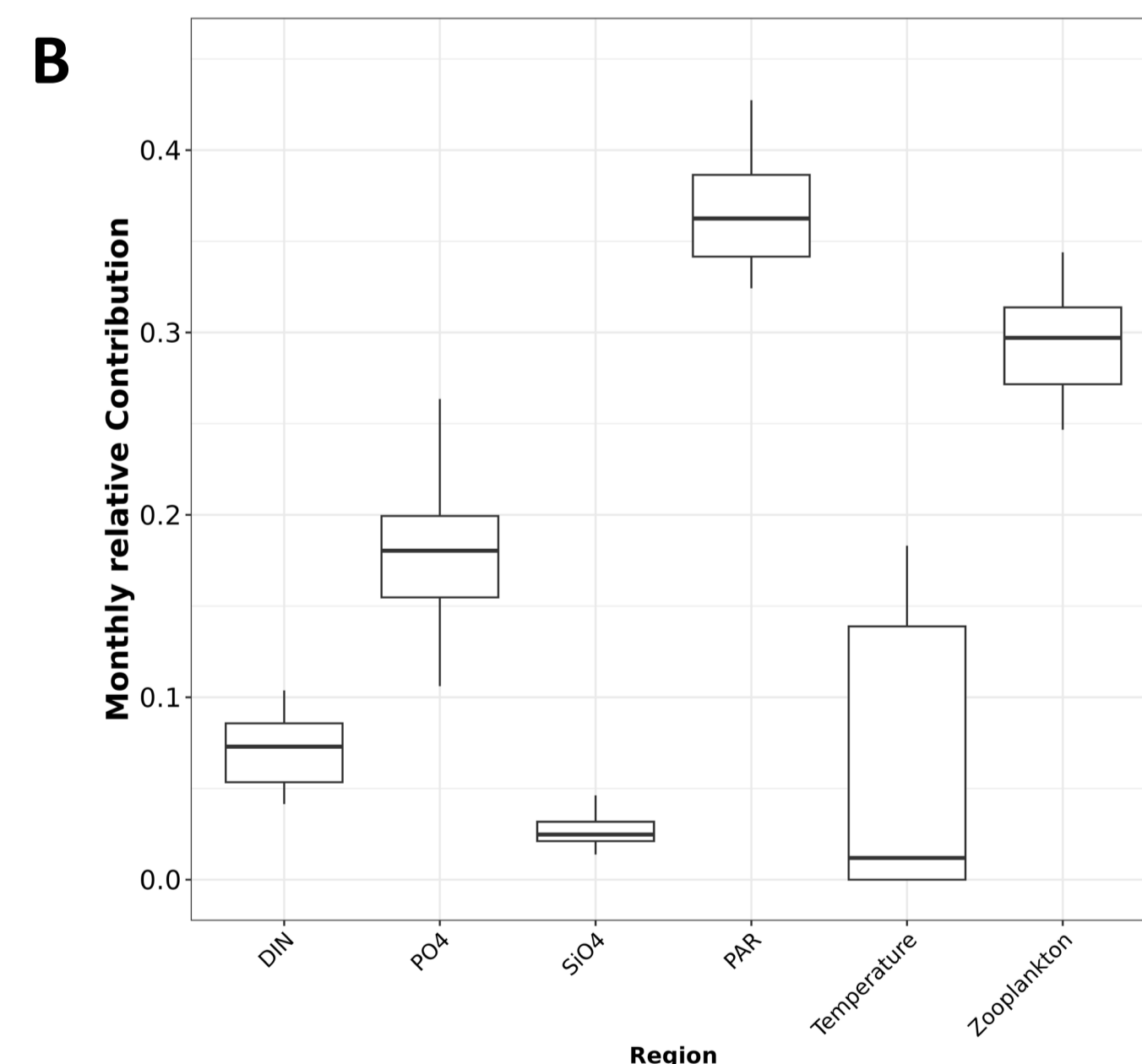
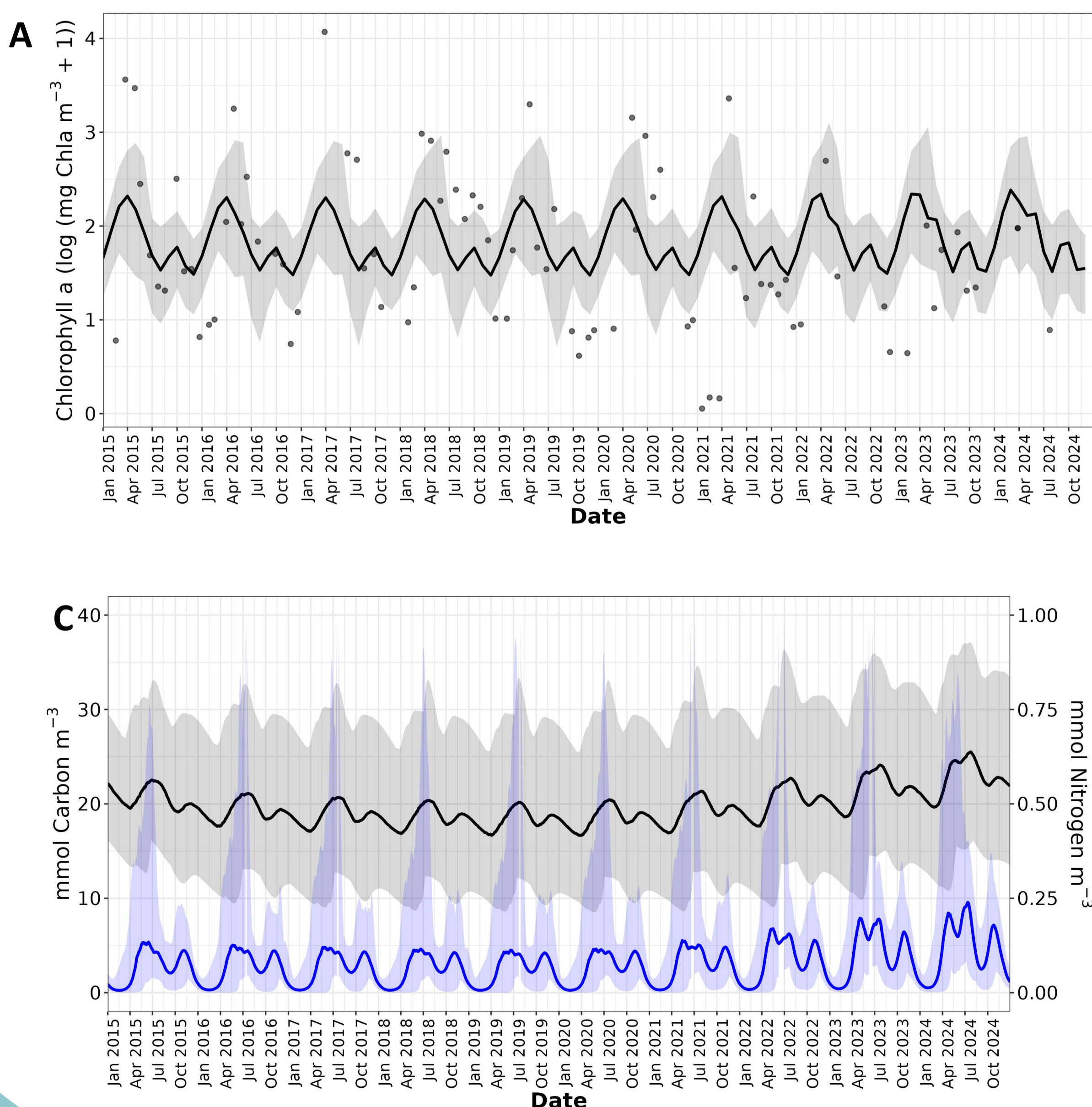


Figure – Nutrient-Phytoplankton-Zooplankton-Detritus modelling of the Belgian part of the North Sea. The bold lines indicate the average phytoplankton biomass predictions, and the shaded areas indicate the 95% confidence interval. **A** – Phytoplankton biomass simulations. The dots are the observed values collected during the LifeWatch campaigns. **B** – Monthly averaged relative contributions for each determinant of the phytoplankton biomass dynamics. The determinants are dissolved inorganic nitrogen (DIN), phosphate (PO₄), silicate (SiO₃), solar irradiance (PAR), sea surface temperature (SST), and zooplankton grazing. **C** – Carbon (black) and nitrogen (blue) concentrations in the detritus.

KEY MESSAGES

- **Seasonality** in plankton dynamics
- **Variability** between determinants
- **Seasonality** within determinants relative contribution
- **Carbon** included in the NPZD
- **Increasing** trend in carbon concentration in the detritus

Publicly available Vlab
 (Scan the QR code)

