



United Nations Decade
of Ocean Science
for Sustainable Development
2021
2030

17-22 March, 2024
Hobart, Tasmania
AUSTRALIA | #ZPS7



GEOMAR
Helmholtz-Zentrum für Ozeanforschung Kiel



**UNIVERSIDADE
FEDERAL
DE PERNAMBUCO**



Deutscher Akademischer Austauschdienst
German Academic Exchange Service

Influence of the Amazon River Plume on plankton distribution in the Western Tropical Atlantic

Claudeilton S. de Santana¹

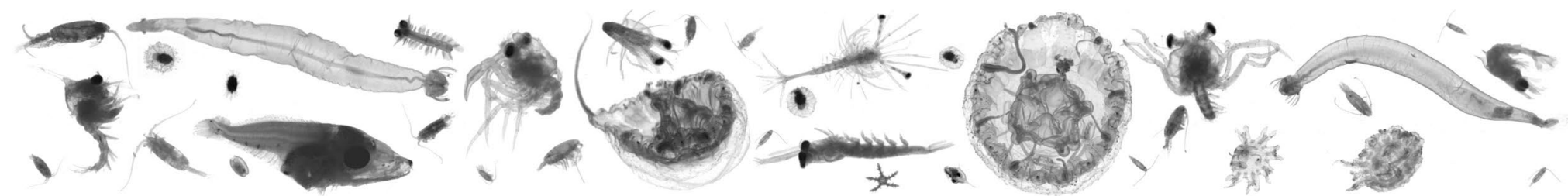
Ralf Schwamborn³, Rainer Kiko¹ and Helena Hauss^{1,2}

¹GEOMAR Helmholtz Centre for Ocean Research Kiel | CAU Kiel

²NORCE Norwegian Research Centre, Mekjarvik

³Federal University of Pernambuco, Recife

B.Sc. Biology | M.Sc. Oceanography
DAAD Ph.D. student
csantana@geomar.de

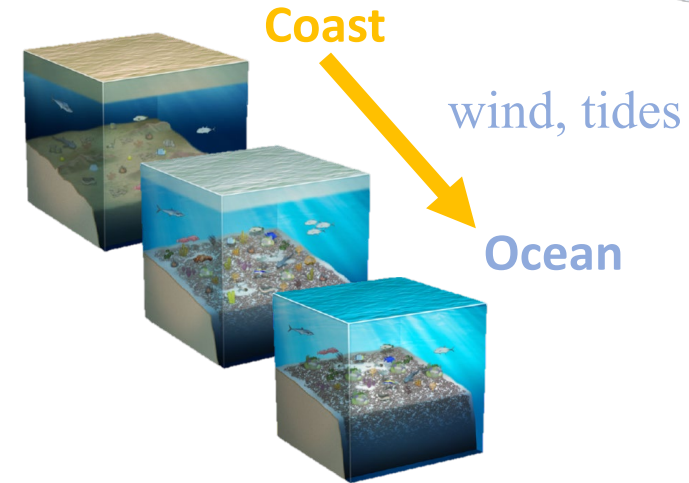




Introduction

Plankton

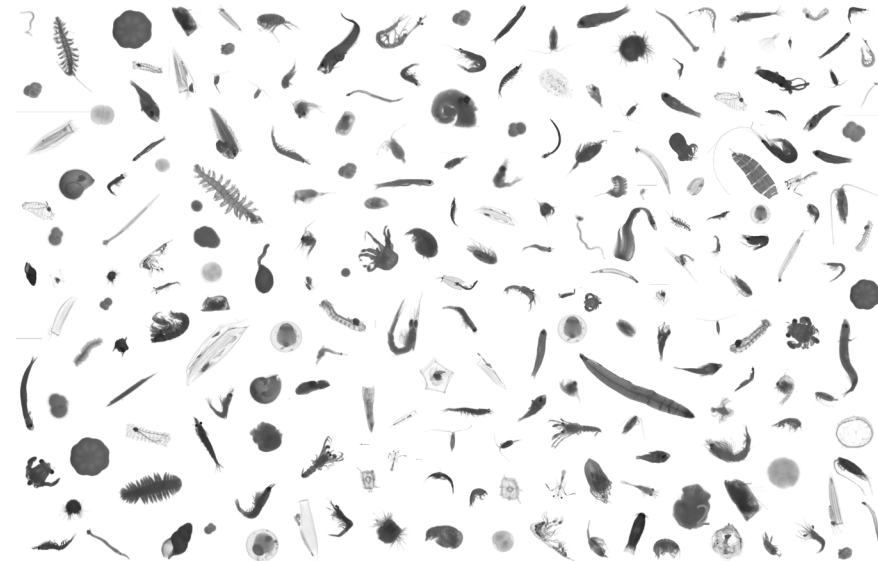
- abundance/biomass/size spectra can inform on energy fluxes and trophic structure of the pelagic ecosystem



Adapted from Moura et al. 2016

Amazon River Plume (ARP)

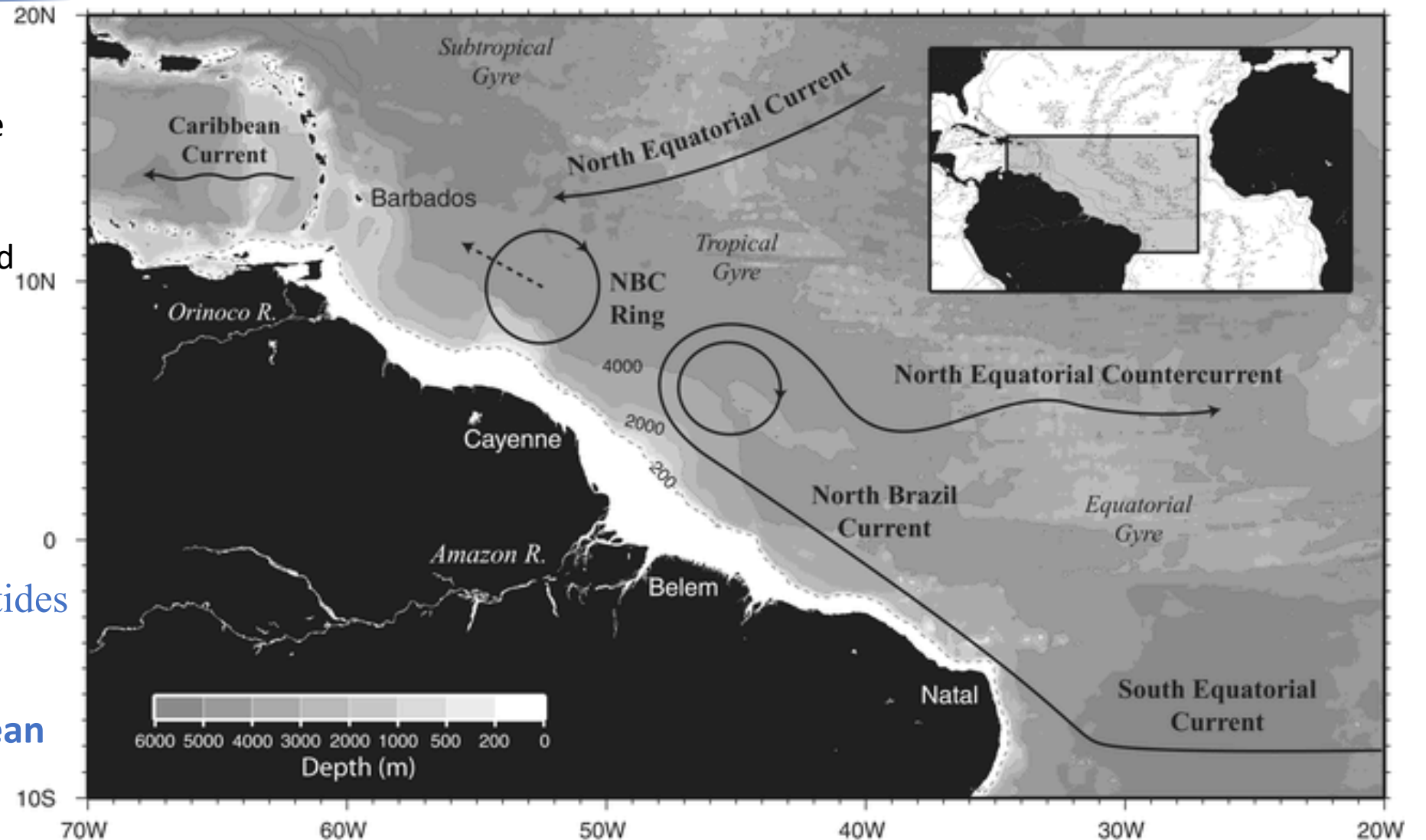
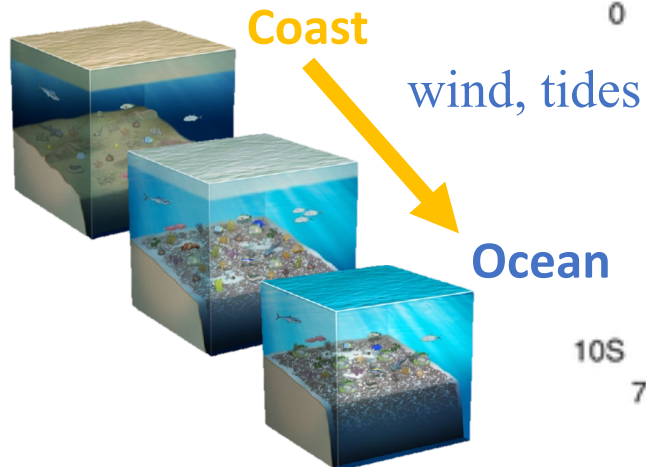
- Huge freshwater discharge $206.000 \text{ m}^3 \text{ s}^{-1}$ → *input* of 17%
- Superficial plume
- Transport of allochthonous materials
- Increase production
- Gradient along the plume continuum



Study area: Western Tropical Atlantic

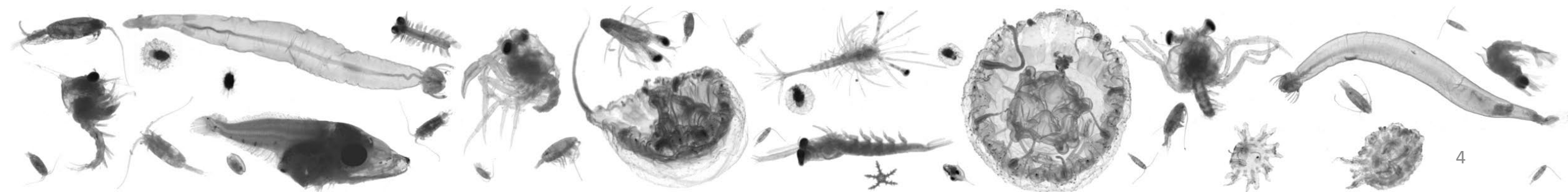
- **ARP** – Amazon River Plume
- North Brazil Current
- Retroflection
- Northwestward -> Eastward

- ARP increases primary productivity and carbon export flux



Fratantoni and Richardson, 2006; Moura et al. 2016

Quantitatively investigate the horizontal zooplankton abundance, biomass, biovolume, and size spectra along the ARP continuum and estimate the amount of carbon horizontally transported to open waters during the ARP retroflection.

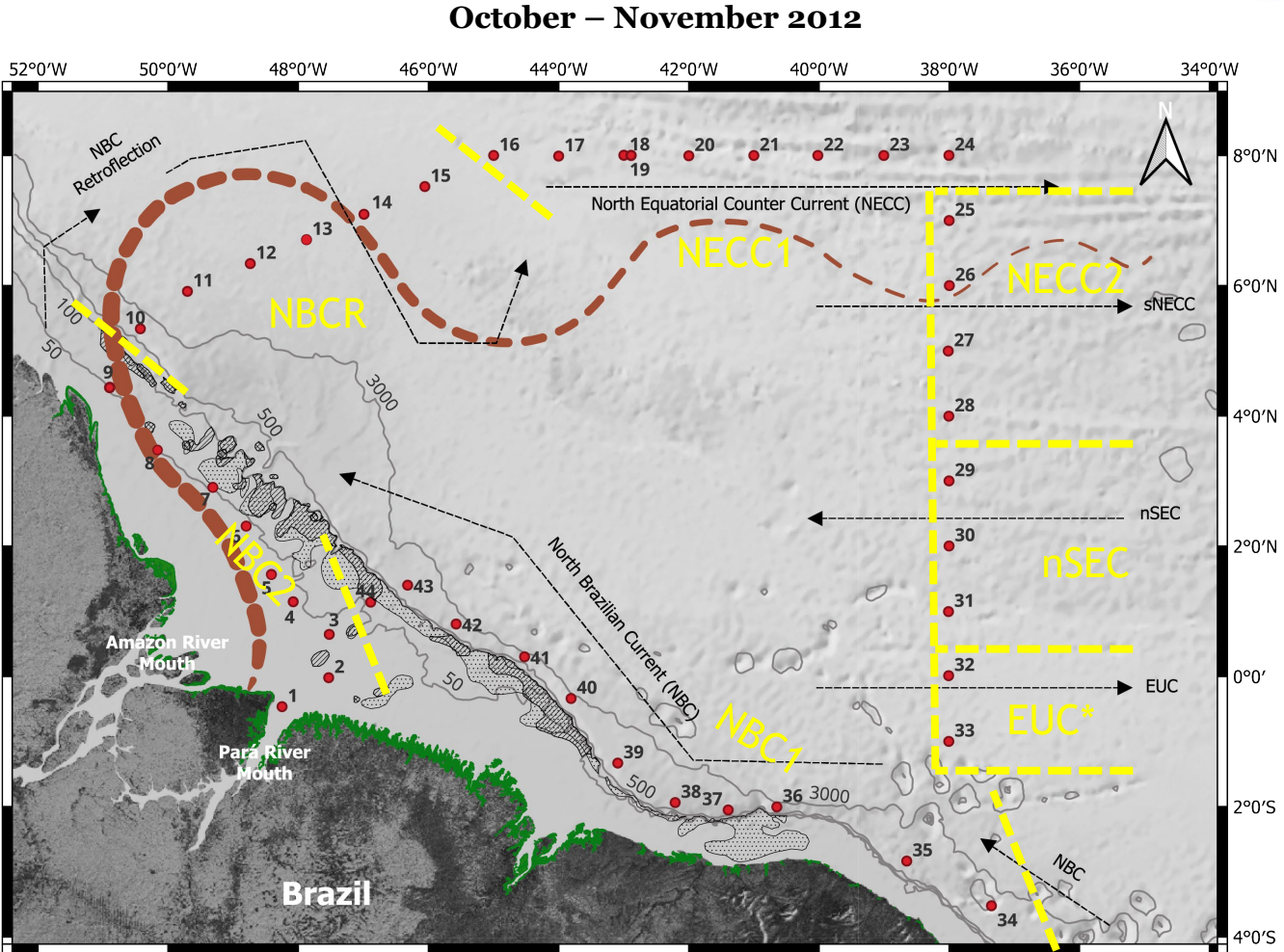
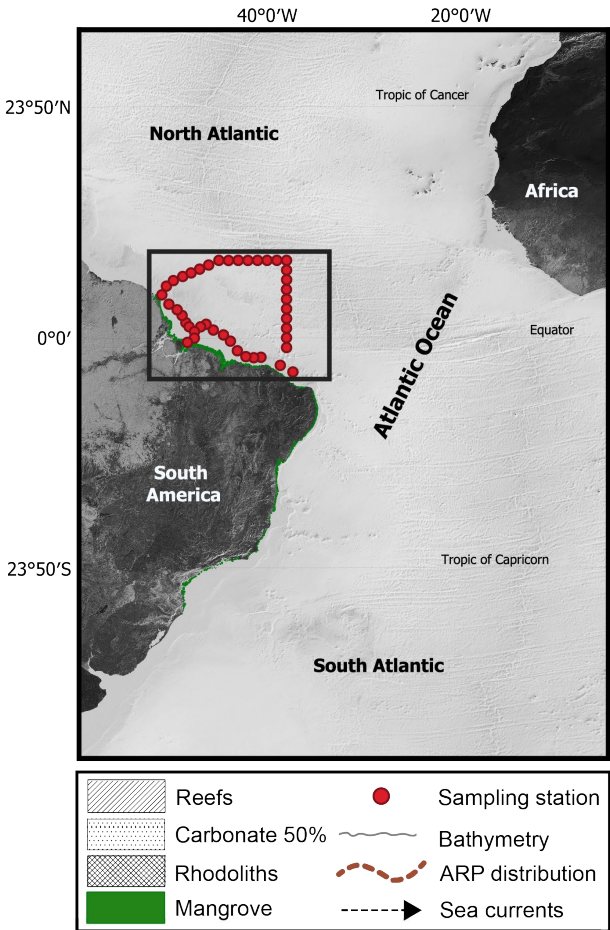
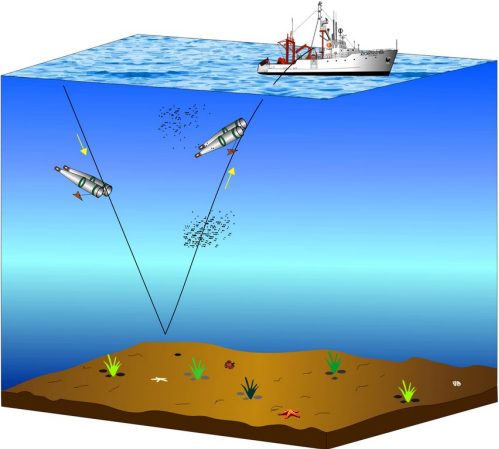


Camadas Finas III (2012)

NHo. Cruzeiro do Sul
(H-38, Brazilian Navy)



Bongo
Oblique tows
300µm mesh size

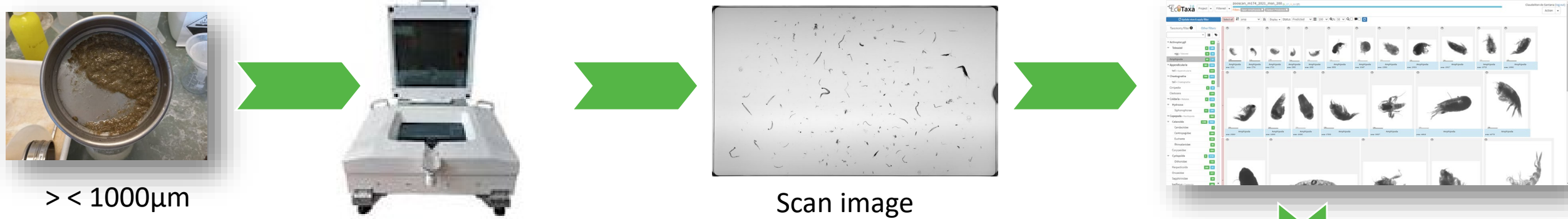


NBC - North Brazil Current
NBCR - NBC Retroflexion
NECC - North Equatorial Countercurrent

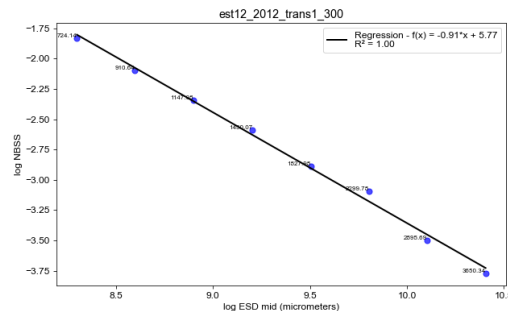
nSEC - northern branch South Equatorial Current
EUC - Equatorial Undercurrent* (core 50–100 m)

Obtaining images

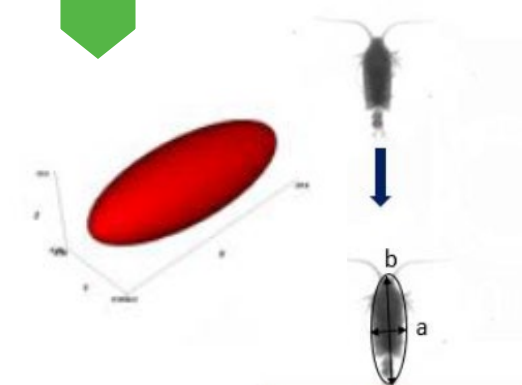
- Waterproof scanner for zooplankton samples
- ZooScan 3: Resolution 2400 dpi in grayscale



Statistics and Data analysis



Particle Size Spectra database
(Dugenne et al., 2023 [Data set]; <https://pssdb.net/>)

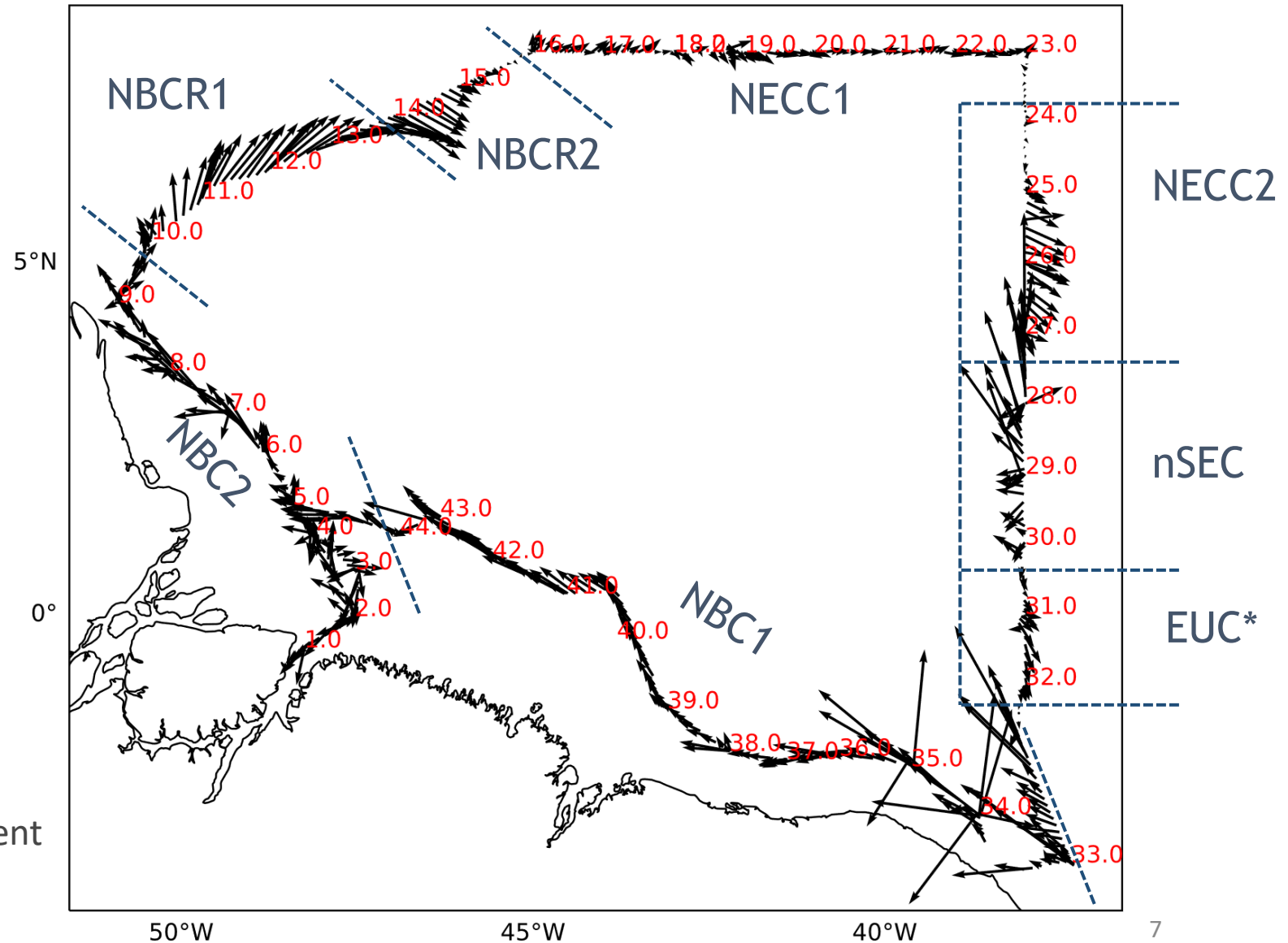


Carbon horizontal fluxes

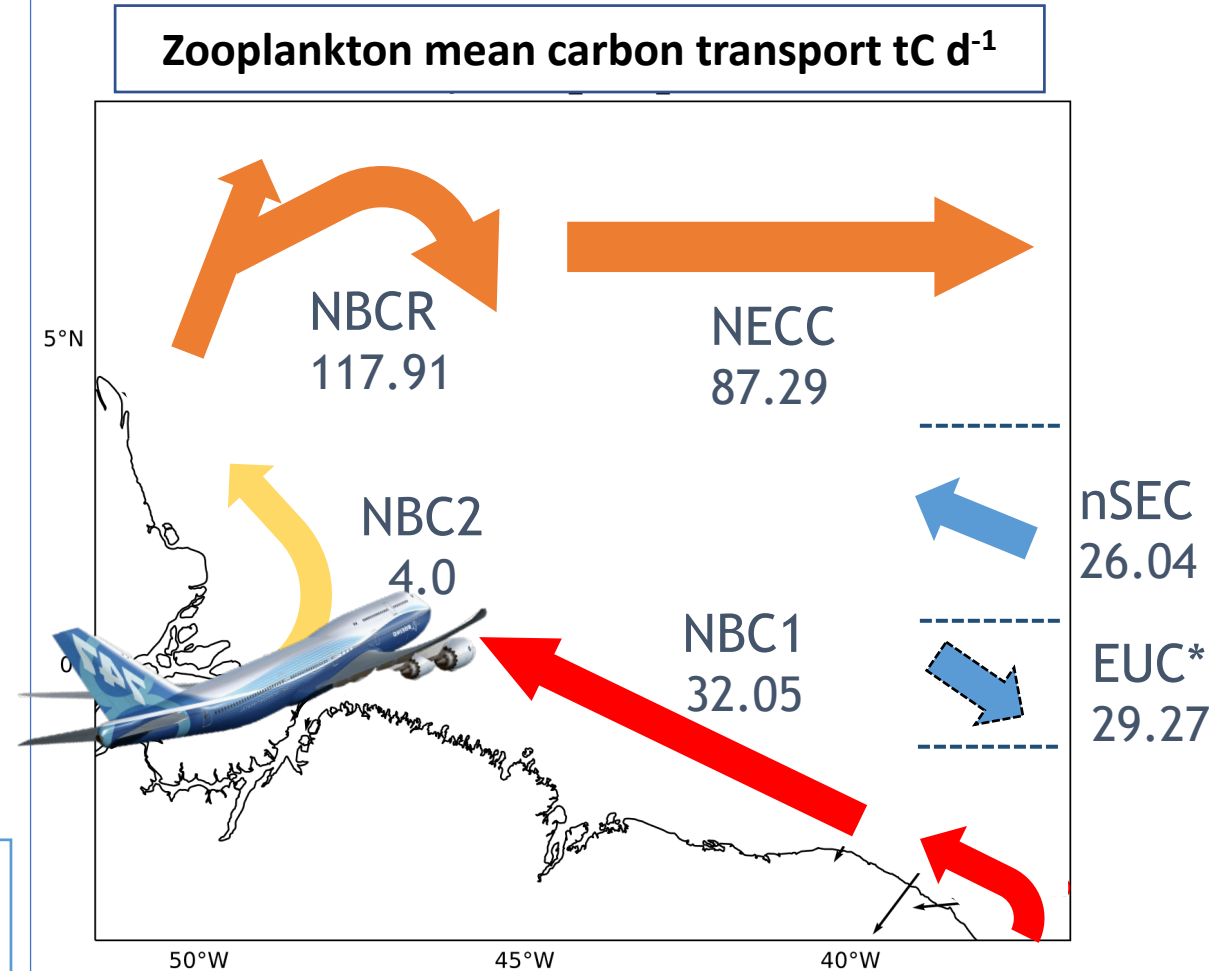
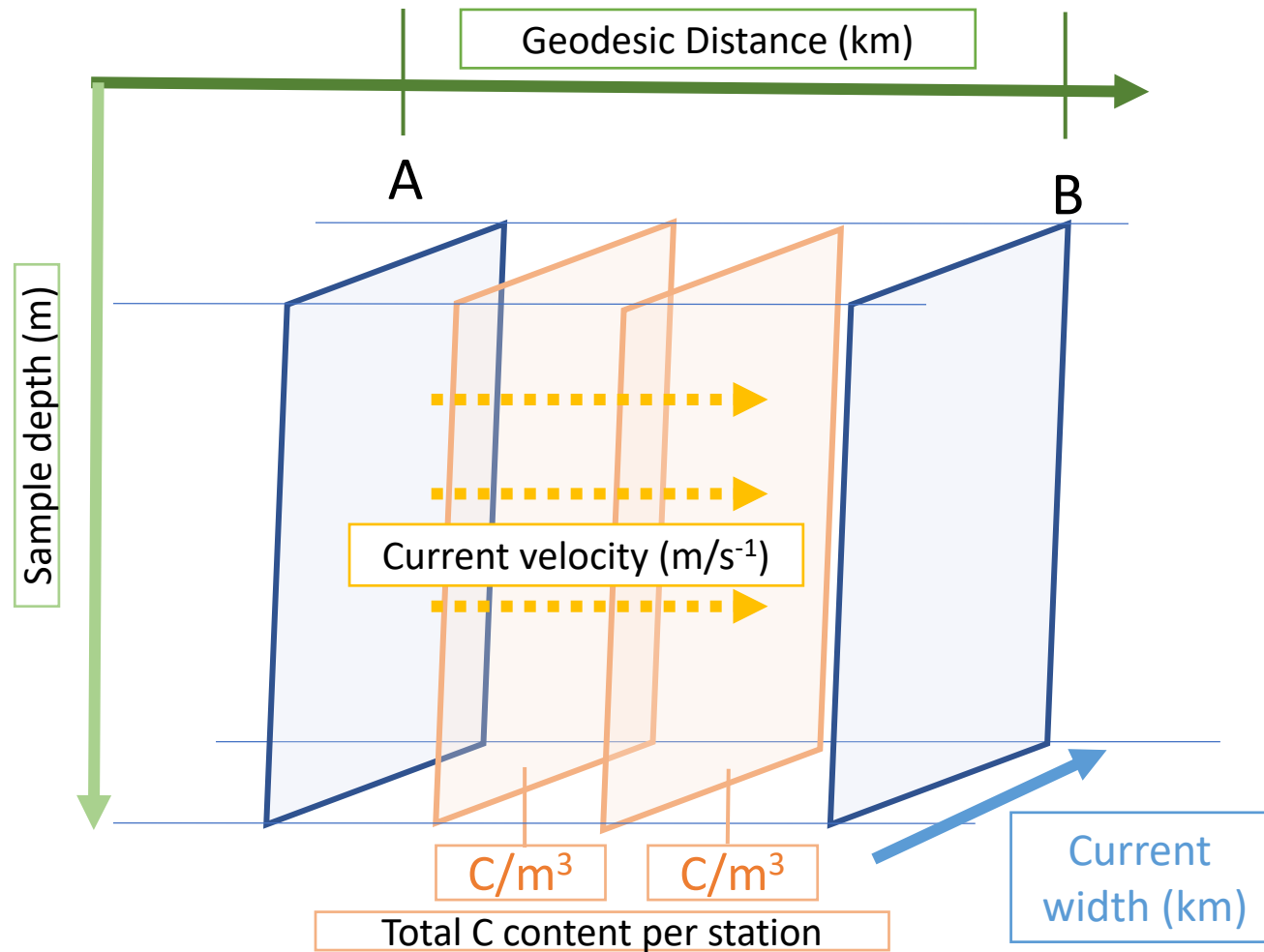
- Dynamic area
- Current sectors:
 - Mean velocity (m/s^{-1})
 - Area of sector (km^2)
- Current width -> Dimoune et al., 2023

NBC - North Brazil Current
NBCR – NBC Retroflexion
NECC – North Equatorial Countercurrent
nSEC - northern branch South Equatorial Current
EUC – Equatorial Undercurrent* (core 50–100 m)

Velocity vectors of currents from 12 to 200m



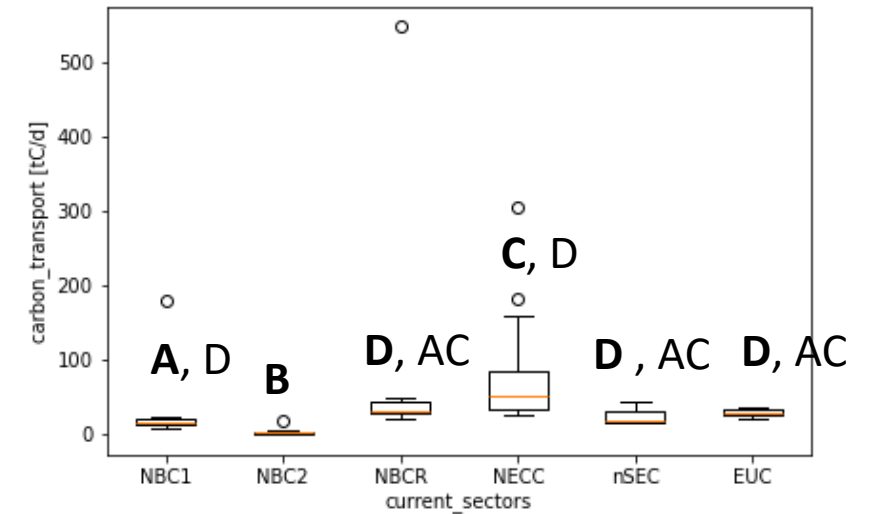
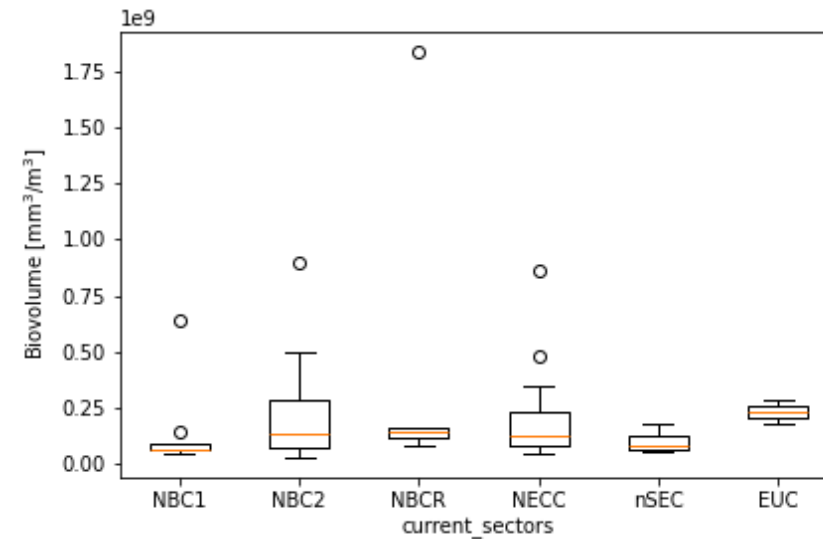
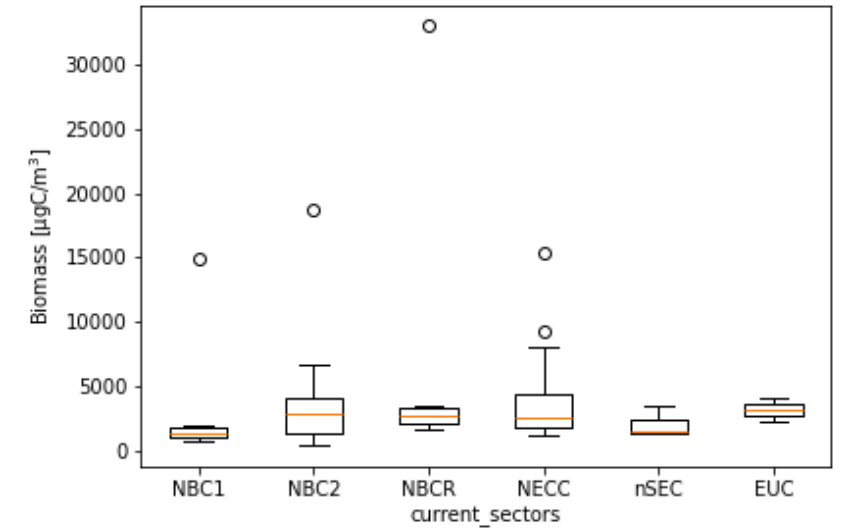
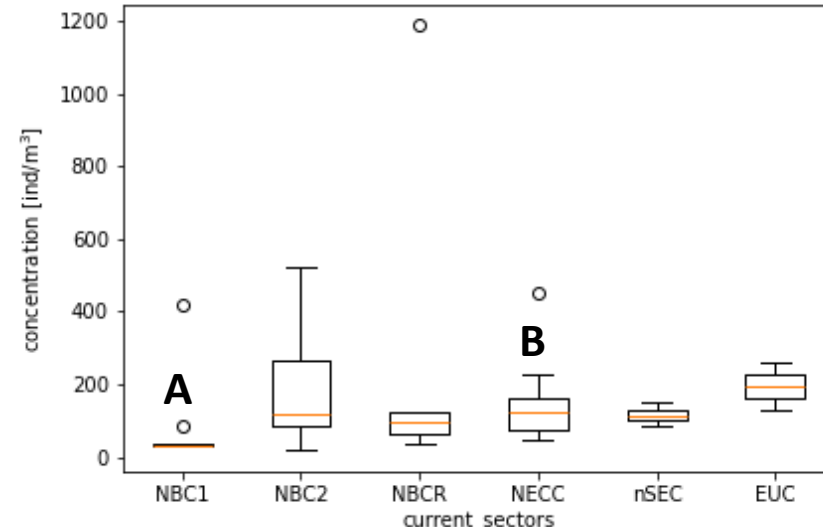
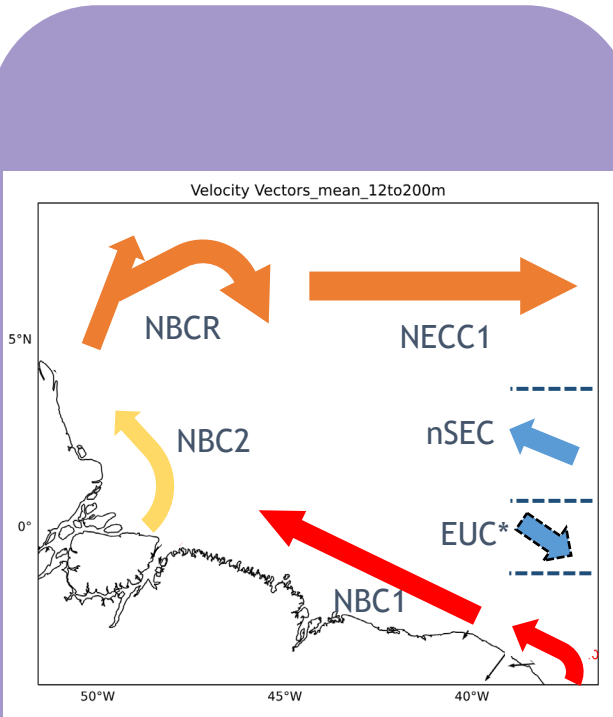
Carbon horizontal fluxes



CURRENT SECTORS

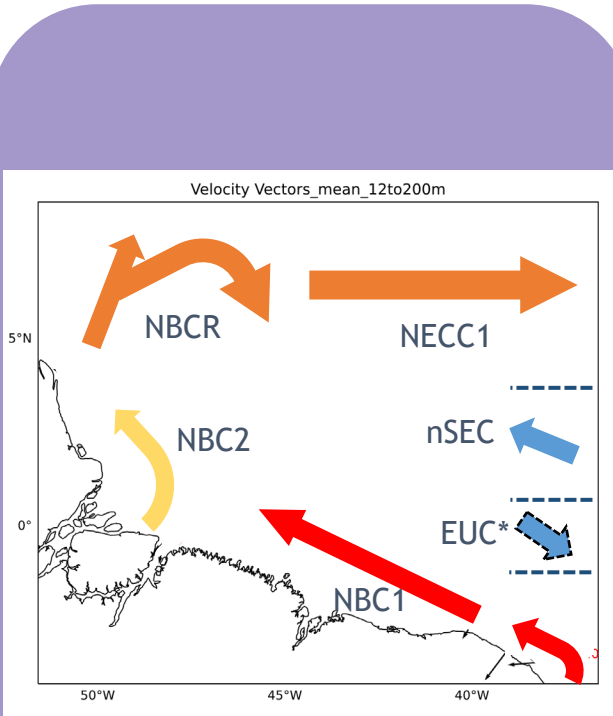
*Methodology based on Rogge et al., 2023

Sectors comparisons

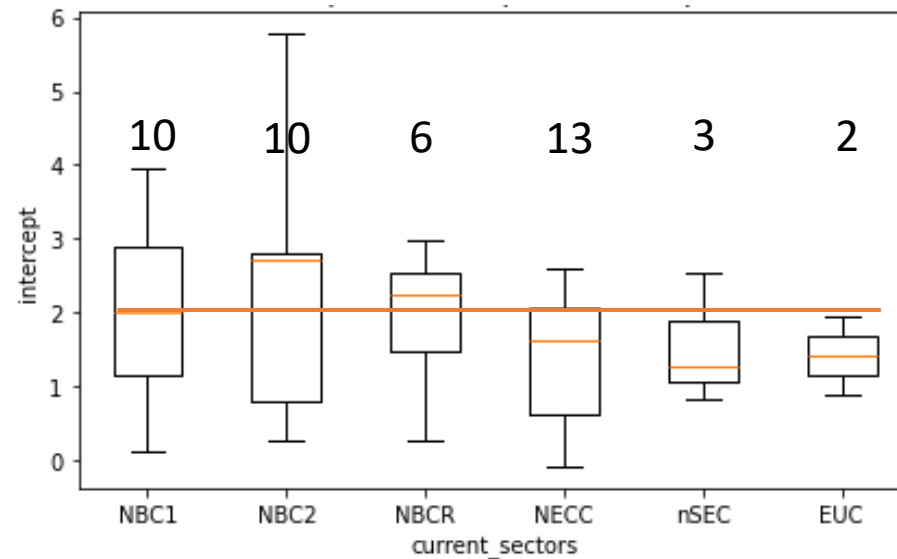


Boxplot (median and quartiles) of mesozooplankton along the ARP continuum; Different capital letters show significant differences ($p \leq 0.05$) based on **Anova Kruskal-Wallis** -> post hoc **Dunn test**

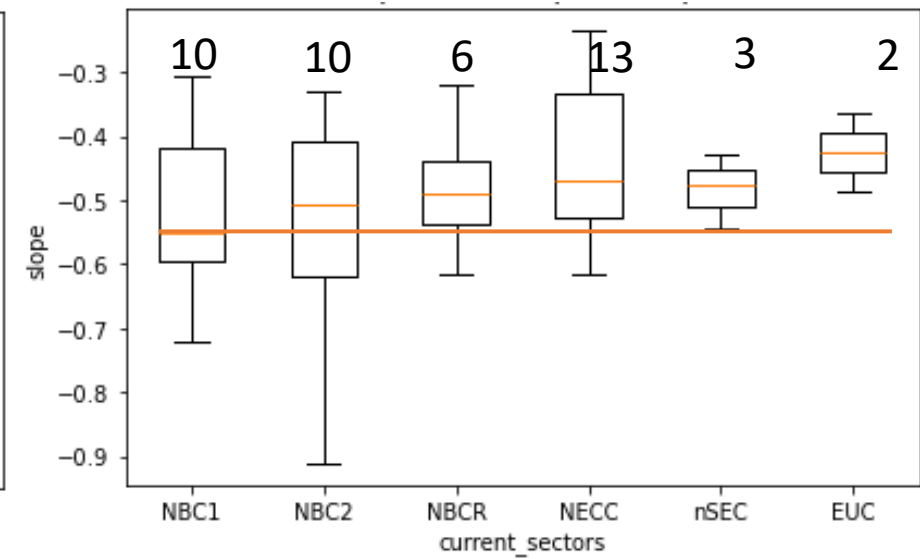
NBSS: slope and Intercept



Boxplot (median and quartiles) of mesozooplankton Normalized Biovolume Size Spectra (NBSS) slope and intercept along the ARP continuum



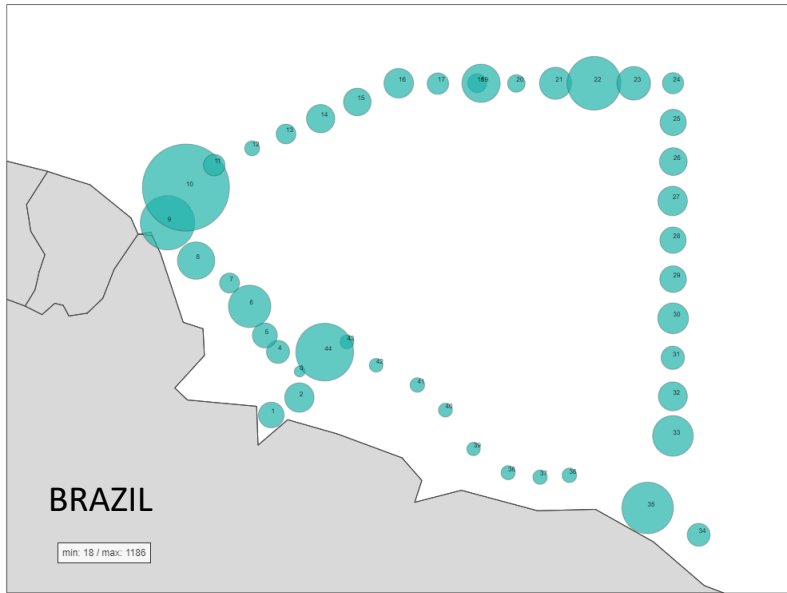
- No statistical differences
- Coast - Ocean decrease gradient
- Plume influenced areas.



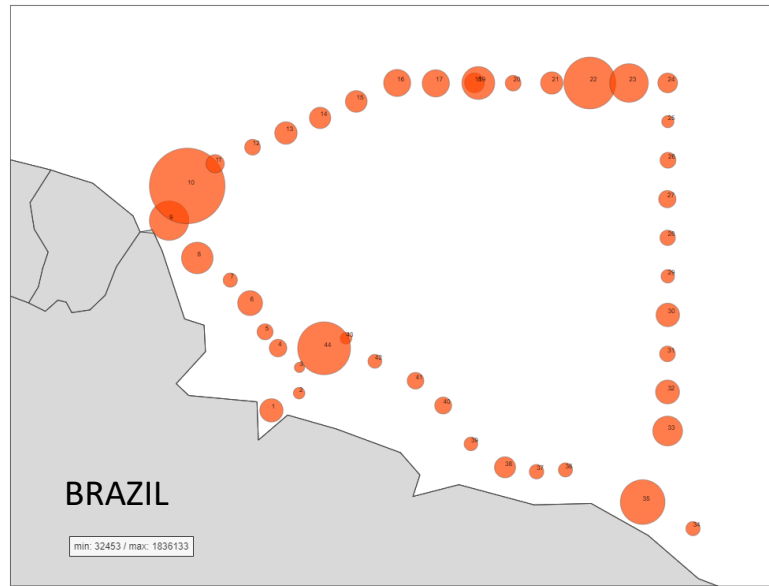
- No statistical differences
- Coast - Ocean increase gradient
- Shallow slopes
- Higher trophic efficiency / contribution of larger organisms

Abundance/Biovolume/Biomass distribution

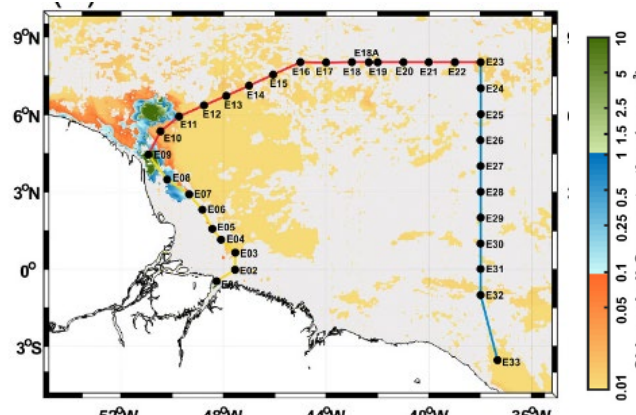
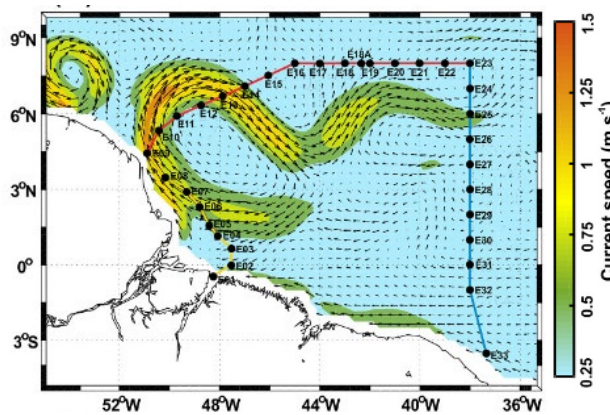
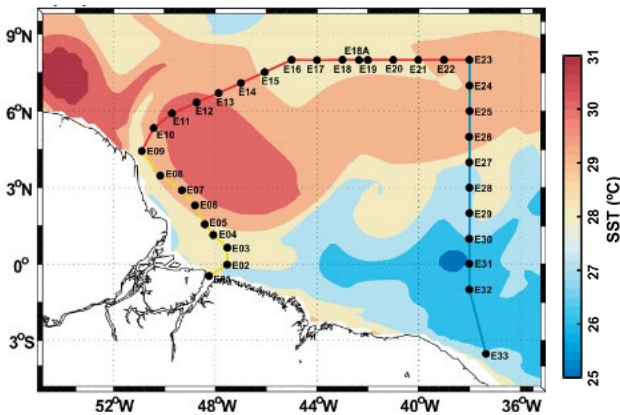
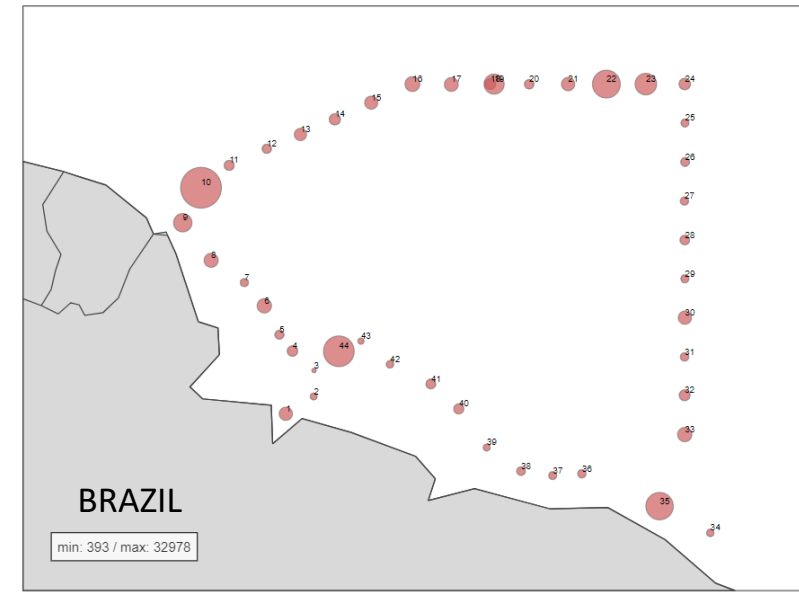
Abundance (ind.m⁻³)



Biovolume (mm⁻³L)



Biomass (µgC.m⁻³)



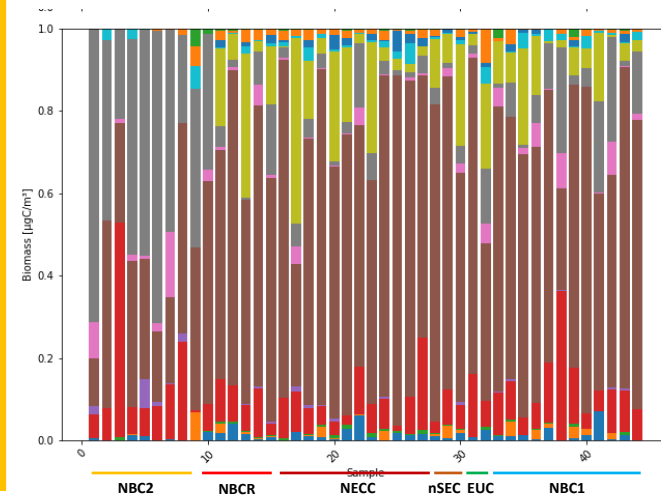
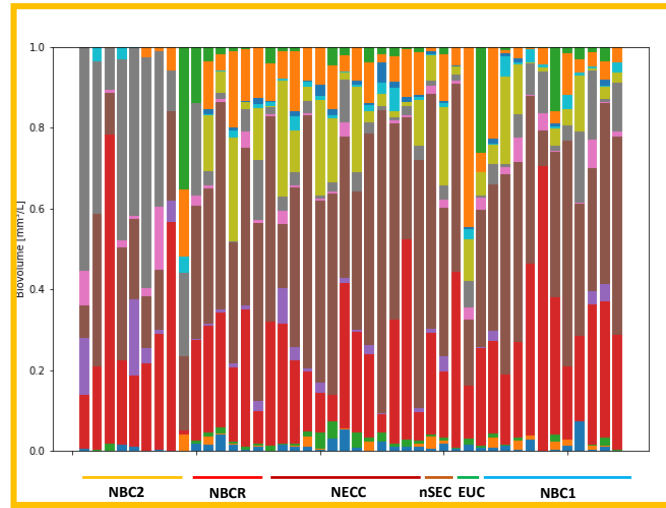
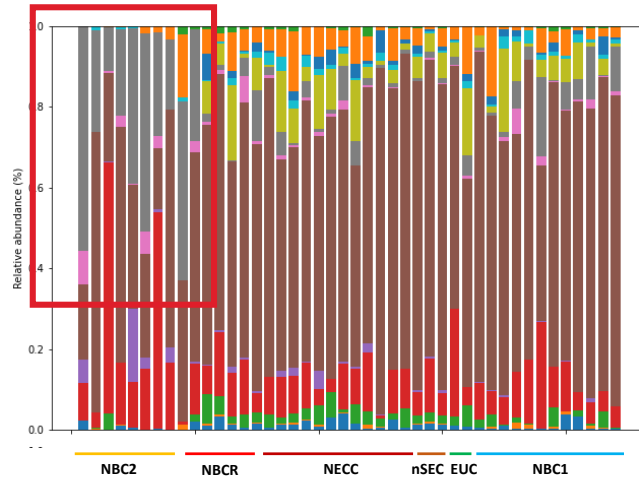
Temperature (°C), Current speed (m s⁻¹), and Chlorophyll concentration (mg m⁻³) weekly variability obtained from MODIS (Moderate-Resolution Imaging Spectroradiometer) in October 2012. Adapted from Varona et al. (2019) and de Santana et al. (2020).

Abundance/Biovolume/Biomass distribution

Abundance (ind.m⁻³)

Biovolume (mm⁻³L)

Biomass (μgC.m⁻³)



- Taxa
- Amphipoda
 - Annelida
 - Appendicularia
 - Chaetognatha
 - Cnidaria
 - Copepoda
 - Crustacea
 - Decapoda
 - Euphausiacea
 - Mollusca
 - Ostracoda
 - Siphonophorae
 - Thaliacea

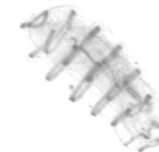
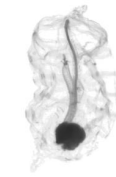


Brachyura (zoea)



Luciferidae

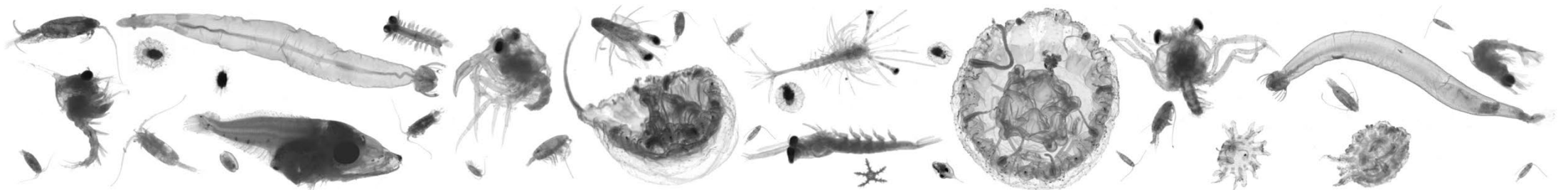
Planktonic decapods



Gelatinous plankton and Euphausiacea

Take home messages

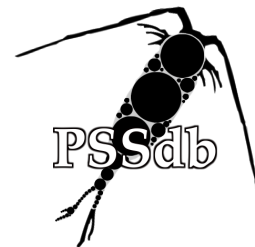
- **Plume retroflection transports high planktonic concentrations from coastal to offshore areas**
- **Plume distribution affecting the oceanic planktonic Community (PERMANOVA $p < 0.05$)**
 - NBC1 vs. NBC2, NECC, EUC, nSEC
 - NBC2 vs. NBC1, NBCR, NECC, nSEC, EUC
- **Coastal zooplankton transport to outer plume zones ~200 km away from the coast**
 - Do these organisms die?
 - Where is this carbon being allocated?



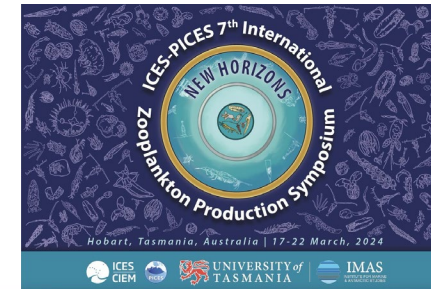
Thank You



Deutscher Akademischer Austauschdienst
German Academic Exchange Service



Pelagic Size Structure Database



csantana@geomar.de