

Mesopelagic carbon fluxes and respiration rates in the Cape Verde Frontal Zone

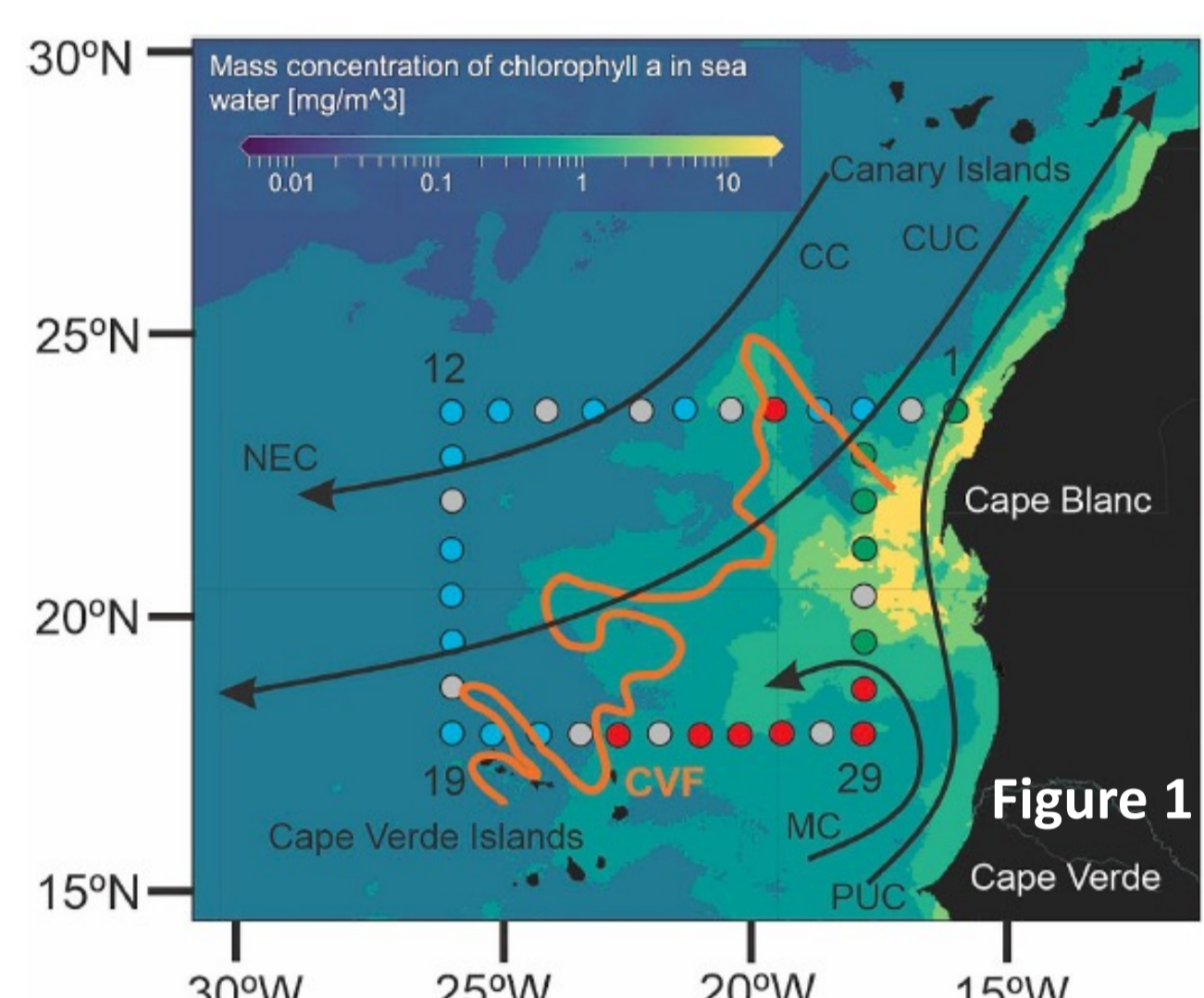
X.A. Álvarez-Salgado¹, B. Fernández-Castro², N. Hernández-Hernández³, I. Klawonn^{4,5}, C.M. Flintrop⁶, M. Gómez-Letona¹, M.F. Montero³, J. Taucher⁷, R. Kiko^{7,8,9}, M. Iversen^{10,11}, J. Arístegui³

- 1 CSIC Instituto de Investigaciones Marinas, Vigo, Spain
- 2 National Oceanography Center, University of Southampton, Southampton, UK
- 3 Instituto de Oceanografía y Cambio Global, Universidad de Las Palmas de Gran Canaria, Telde, Spain
- 4 Leibniz Institute for Baltic Sea Research Warnemünde (IOW), Rostock, Germany
- 5 Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB), Stechlin, Germany
- 6 Hebrew University of Jerusalem, Jerusalem, Israel
- 7 GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany
- 8 LOV Institut de la Mer de Villefranche, Villefranche-sur-Mer, France
- 9 Faculty of Mathematics and Natural Sciences, Kiel University, Kiel, Germany.
- 10 Alfred Wegener Institute Helmholtz-Centre for Polar and Marine Research, Bremerhaven, Germany
- 11 MARUM and University of Bremen, Bremen, Germany



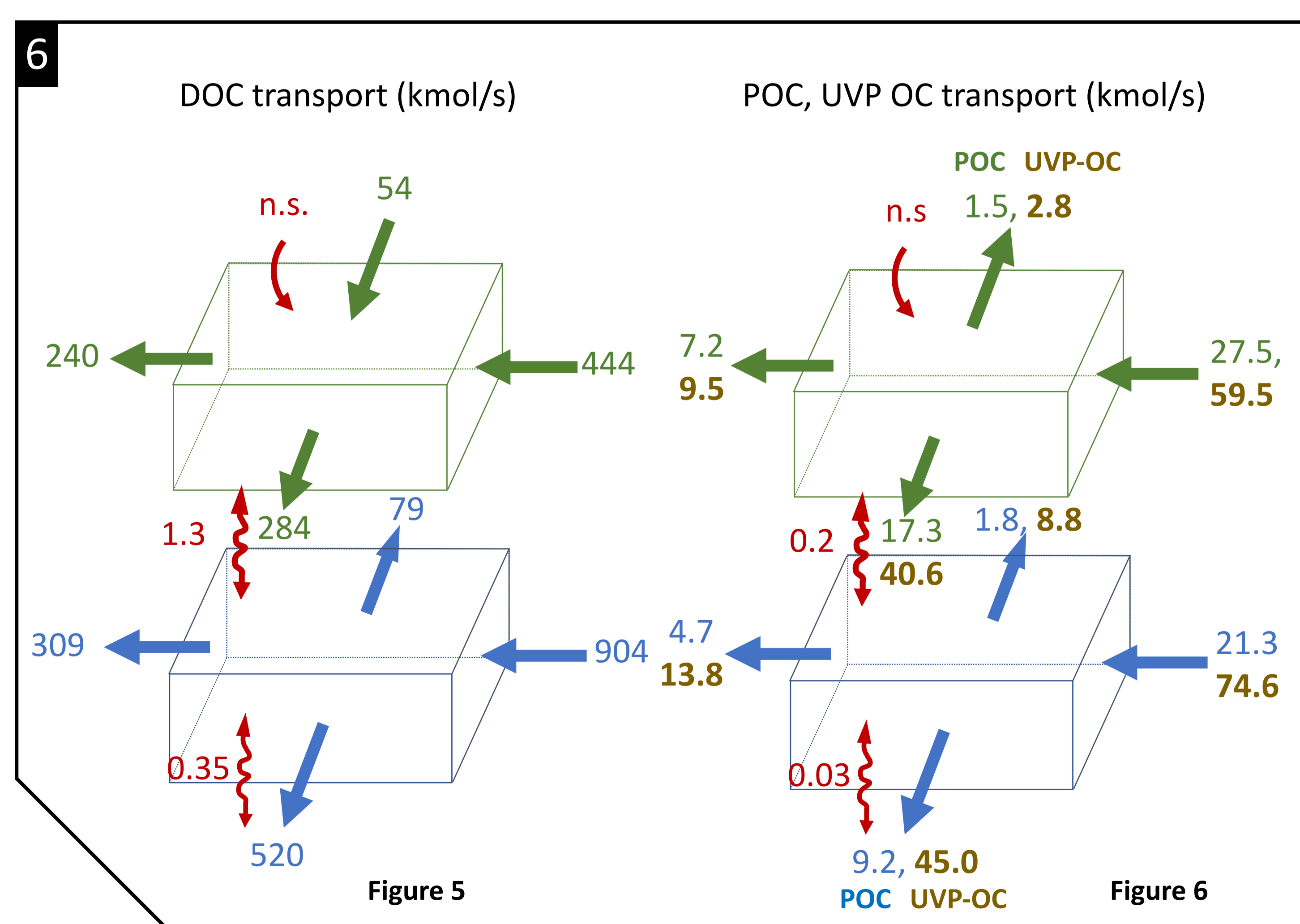
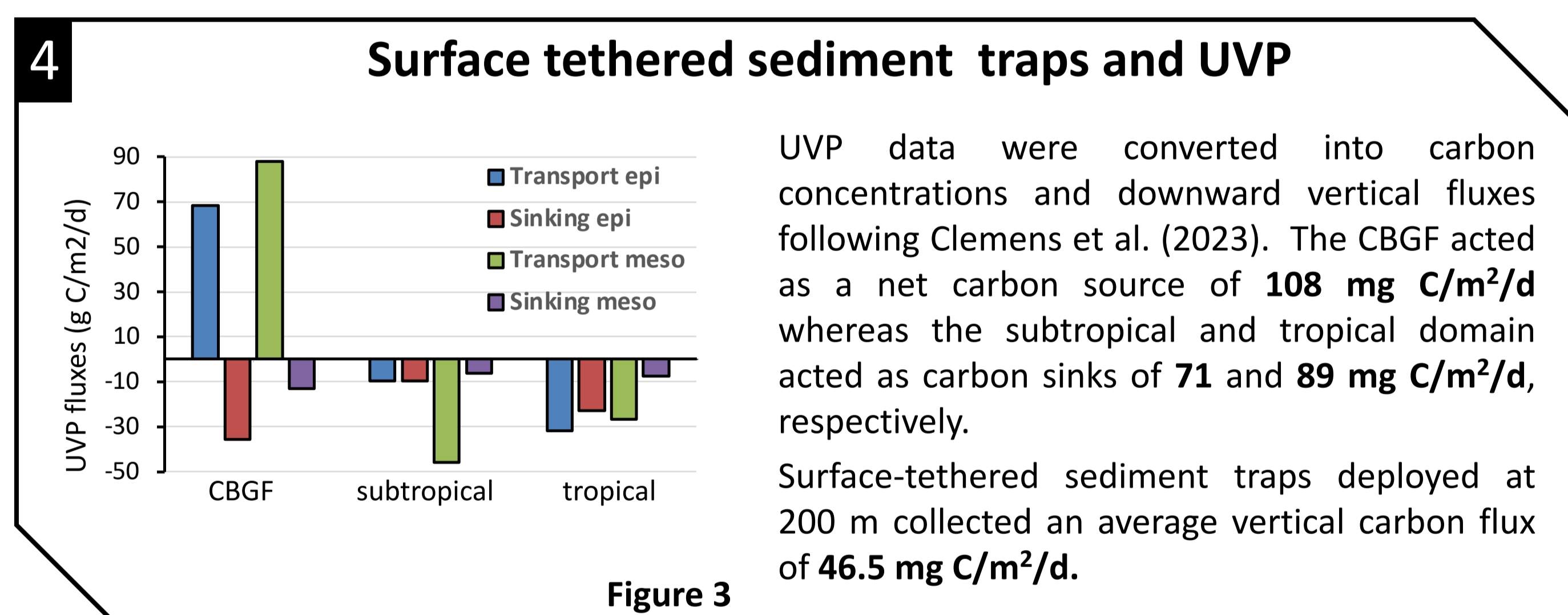
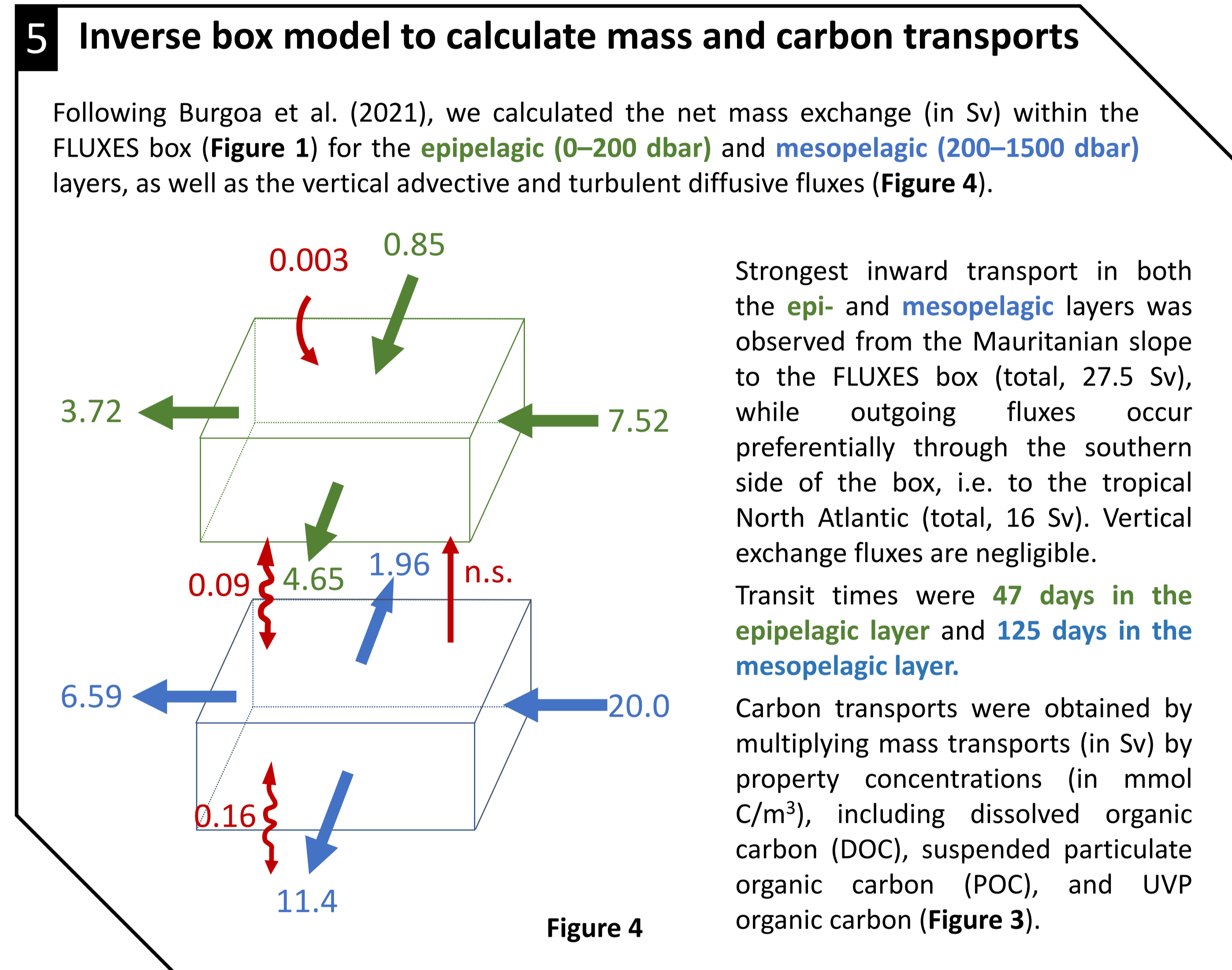
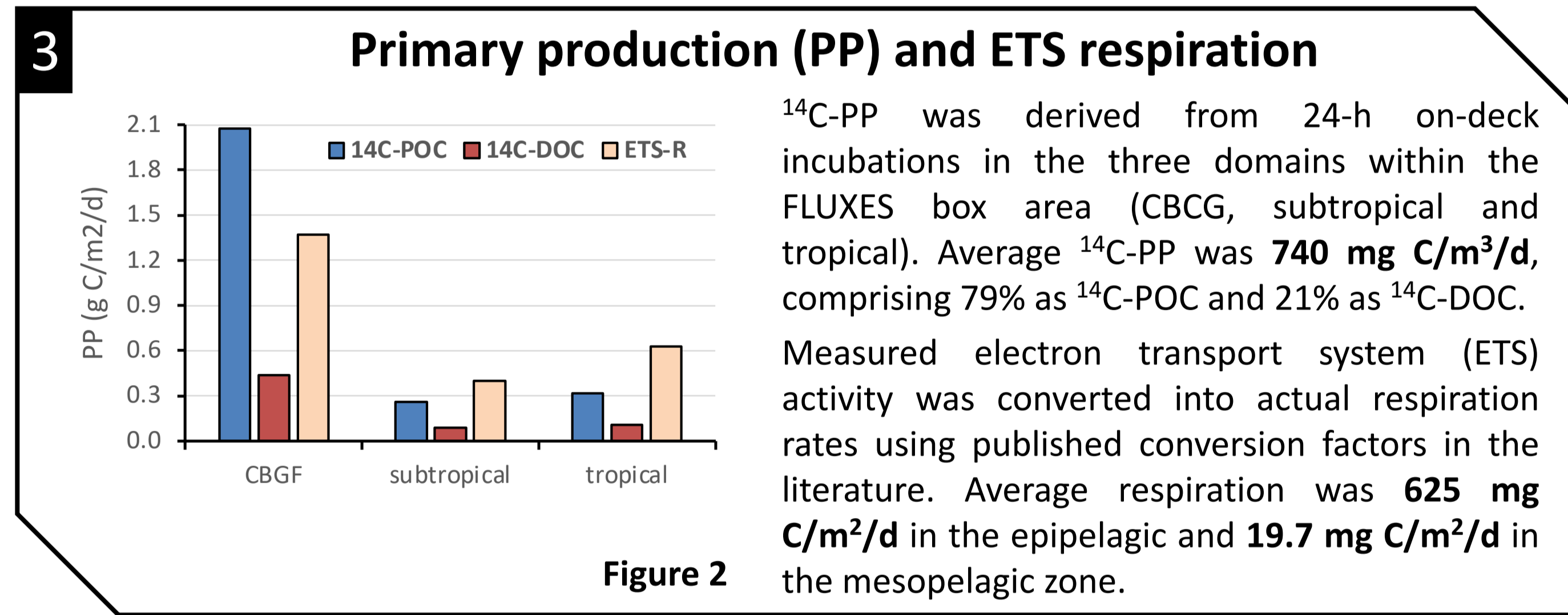
1 The Cape Verde Frontal Zone (CVFZ)

The CVFZ was the primary research area of the FLUXES project. Water transports (Burgoa et al., 2021), drivers of suspended particulate (POC) and dissolved organic carbon (DOC) (Valiente et al., 2022), coloured and fluorescent fractions of DOC (Campanero et al., 2025) and primary production (Hernández-Hernández et al., 2025) have already been published. Building upon these findings, this study incorporates novel data on microbial respiration and POC flux data from surface-tethered sediment traps, a marine snow catcher (MSC) and an underwater vision profiler (UVP) to construct a comprehensive carbon budget for the region.



2 The FLUXES cruise

FLUXES took place from 12/07 to 09/08/2017 on board R/V Sarmiento de Gamba. It consisted of a box with 35 hydrographic stations embracing the CVFZ and the Cape Blanc Giant filament (CBGF). (Figure 1) Water samples were collected using a rosette sampler with 24 Niskin bottles of 12 litres. Sampling depth range covered down to 2,000 dbar in the short stations (grey dots) to 4,000 m in the long stations (coloured dots). Orange line in Figure 1 shows the position of the CVFZ during the cruise, separating subtropical (blue dots) from tropical (red dots) waters. Green dots corresponds to the CBGF waters.



C budget (mg C/m²/d)

NEP DOC : 59
 NEP POC : -6.9
 NEP UVP = -26.9
 trap-200 = 46.5
 UVP-200 = 17.4
¹⁴C-PP = 740
 ETS-resp.: 625

Carbon budget of the CVFZ

By combining mass transports from Figure 4 with DOC and POC profiles from Niskin bottles, we calculated the DOC (Figure 5) and POC (Figure 6) fluxes across the boundaries of the box for both the epi- and mesopelagic layers. Similarly, UVP organic carbon fluxes (Figure 6) were determined by combining mass transports with carbon particle profiles from the UVP (Figure 3). Finally, Net Ecosystem Production (NEP) budgets were computed for each carbon pool from the balance of outputs - inputs, assuming steady state.

In the epipelagic layer, a net DOC production of **58.8 mg C/m²/d** and a combined net POC and UVP organic carbon consumption of **33.8 mg C/m²/d** occurred. The total sinking rate, derived from sediment traps and UVP flux calculations at 200 dbar (Figure 3), amounted to **63.9 mg C/m²/d**. Consequently, the resulting net budget yielded an overall NEP of **88.9 mg C/m²/d**. The difference between ¹⁴C-PP and ETS-respiration (Figure 2) results in a NEP of **114 mg C/m²/d**, which is in close agreement with the estimate derived from the carbon budget.

In the mesopelagic layer, the net consumption of Niskin POC, **12.8 mg C/m²/d**, was in close agreement with the ETS respiration of **23.7 mg C/m²/d**. In addition, there was a combined net POC and UVP organic carbon consumption of **33.9 mg C/m²/d** which is not captured by ETS-measurements based in Niskin bottles.

NEP DOC : 4.6
 NEP POC : -12.8
 NEP UVP : -15.3
 UVP-1500 : 9.7
 ETS-resp.: 23.7

References

Burgoa et al. (2021). Cape Verde Frontal Zone in summer 2017: lateral transports of mass, dissolved oxygen and inorganic nutrients. *Ocean Science*, DOI: 10.5194/os-17-769-2021; Valiente et al. (2022). Dissolved and suspended organic matter dynamics in the Cape Verde Frontal Zone (NW Africa). *Prog. Oceanog.*, DOI: 10.1016/j.pocean.2021.102727; Clemens et al. (2023). New Estimate of Organic Carbon Export From Optical Measurements Reveals the Role of Particle Size Distribution and Export Horizon, *Global Biogeochem. Cy.*, DOI: 10.1029/2022GB007633; Campanero et al. (2025). New insights on dissolved organic matter cycling in the Cape Verde Frontal Zone From its optically active fraction. *J. Geophys. Res.*, DOI: 10.1029/2024JC022068; Hernández-Hernández et al. (2025). Comparing in situ and satellite-derived primary production estimates in the Canary Current upwelling region. *J. Mar. Sys.*, DOI: 10.1016/j.jmarsys.2025.104109.