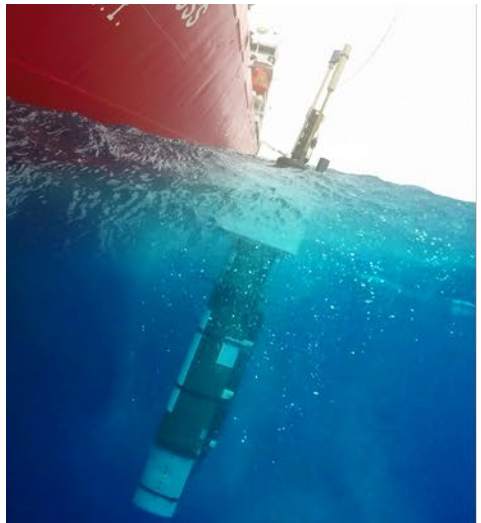
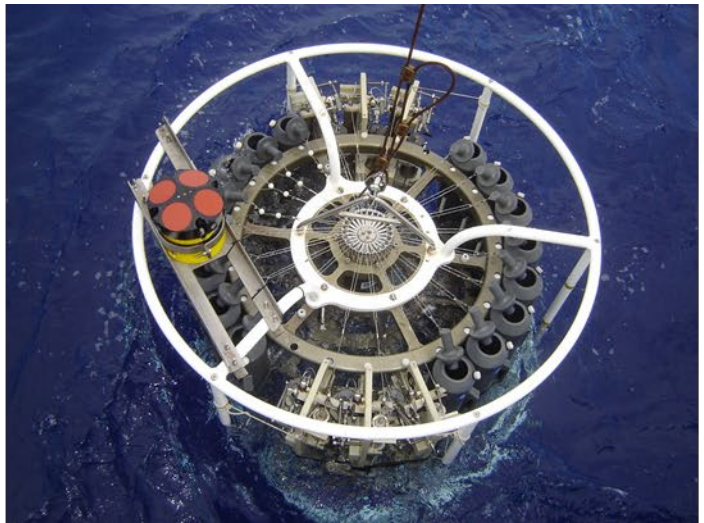
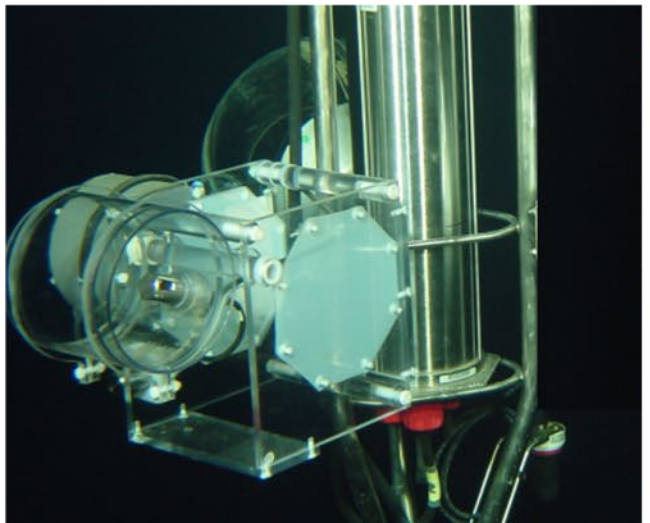
Respiration in the Mesopelagic Ocean (ReMO): Reconciling ecological, biogeochemical and model estimates

SCOR Working Group 161

Co-Chairs : Carol Robinson, Javier Arístegui, Iris Kriest



Terms of reference & deliverables

ReMO
Respiration in the Mesopelagic Ocean

1.

Identify, quantify and prioritise knowledge gaps

#1 action plan
#2 position paper
#3 model paper

2.

Develop a global dataset

#4 dataset
#5 data paper

3.

Produce a new synthesis

#6 case study

4.

Produce a best practice manual

#7 best practice manual
#8 method intercomparisons

5.

Develop capacity

#9 training course
#10 training materials
#11 *Frontiers for Young Minds*

Widen participation, knowledge exchange

seminar series, # mentoring scheme for early career researchers

#1 Identify knowledge gaps ReMO publications

ReMO
Respiration in the Mesopelagic Ocean

LIMNOLOGY AND OCEANOGRAPHY
ASLO
Association for the Sciences of Limnology and Oceanography

Research Article | Open Access

Gross oxygen production and microbial community respiration in the oligotrophic ocean

Sara Ferrón, Karin M. Björkman, Matthew J. Church, David M. Karl

First published: 14 March 2025 | https://doi.org/10.1002/lno.70023

JGR Oceans

Research Article | Open Access

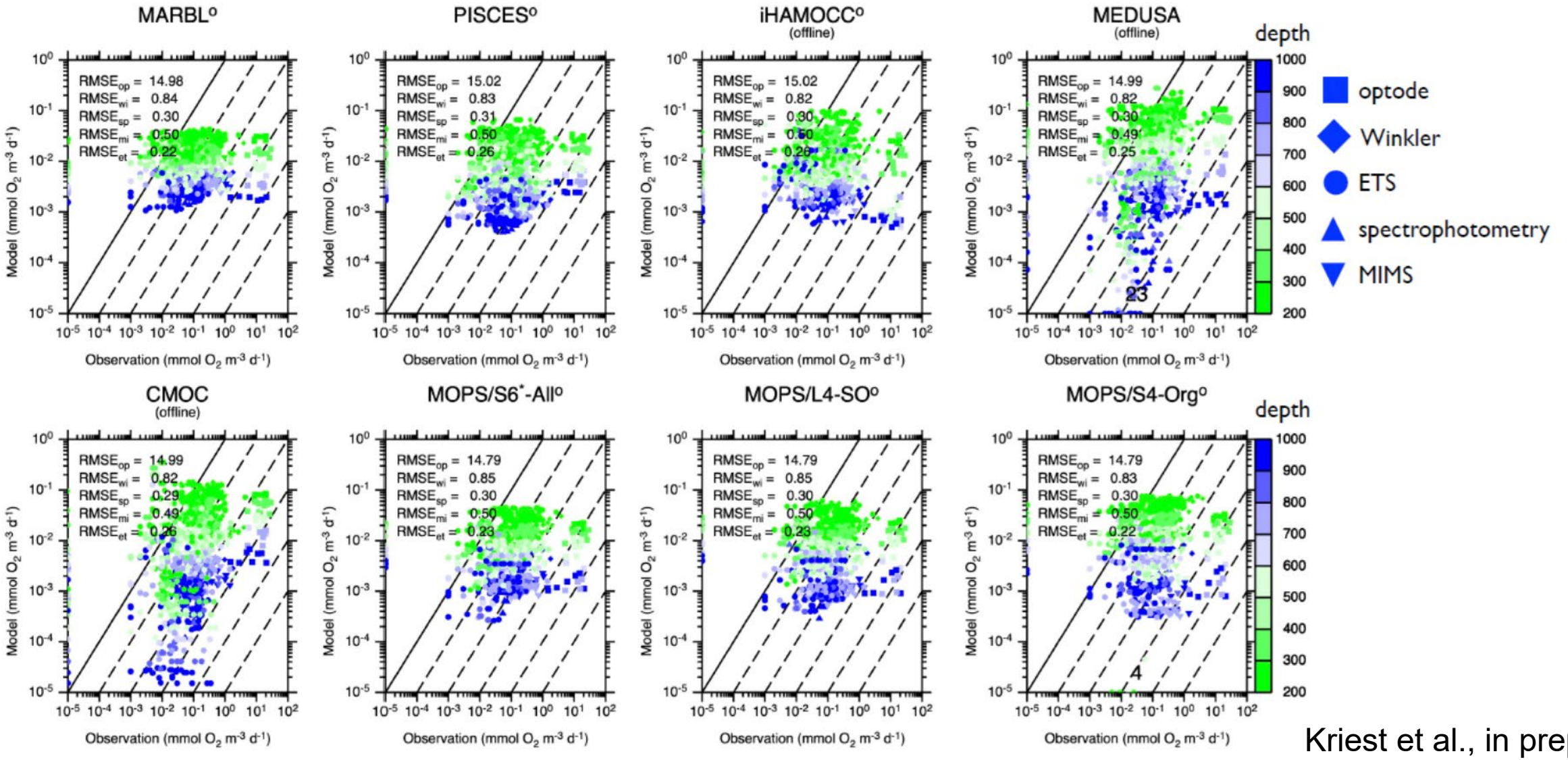
New Insights on Dissolved Organic Matter Cycling in the Cape Verde Frontal Zone From Its Optically Active Fraction

R. Campanero Nieto, J. S. P. Ibanhez, B. Fernández-Castro, A. Martínez-Pérez, M. J. Pazó, V. Vieitez dos Santos, S. Valiente, M. Nieto-Cid, A. Delgado-Huertas, J. Arístegui, X. A. Álvarez-Salgado

First published: 15 July 2025 | https://doi.org/10.1029/2024JC022068

#1 Identify knowledge gaps #3 model comparison

ReMO
Respiration in the Mesopelagic Ocean



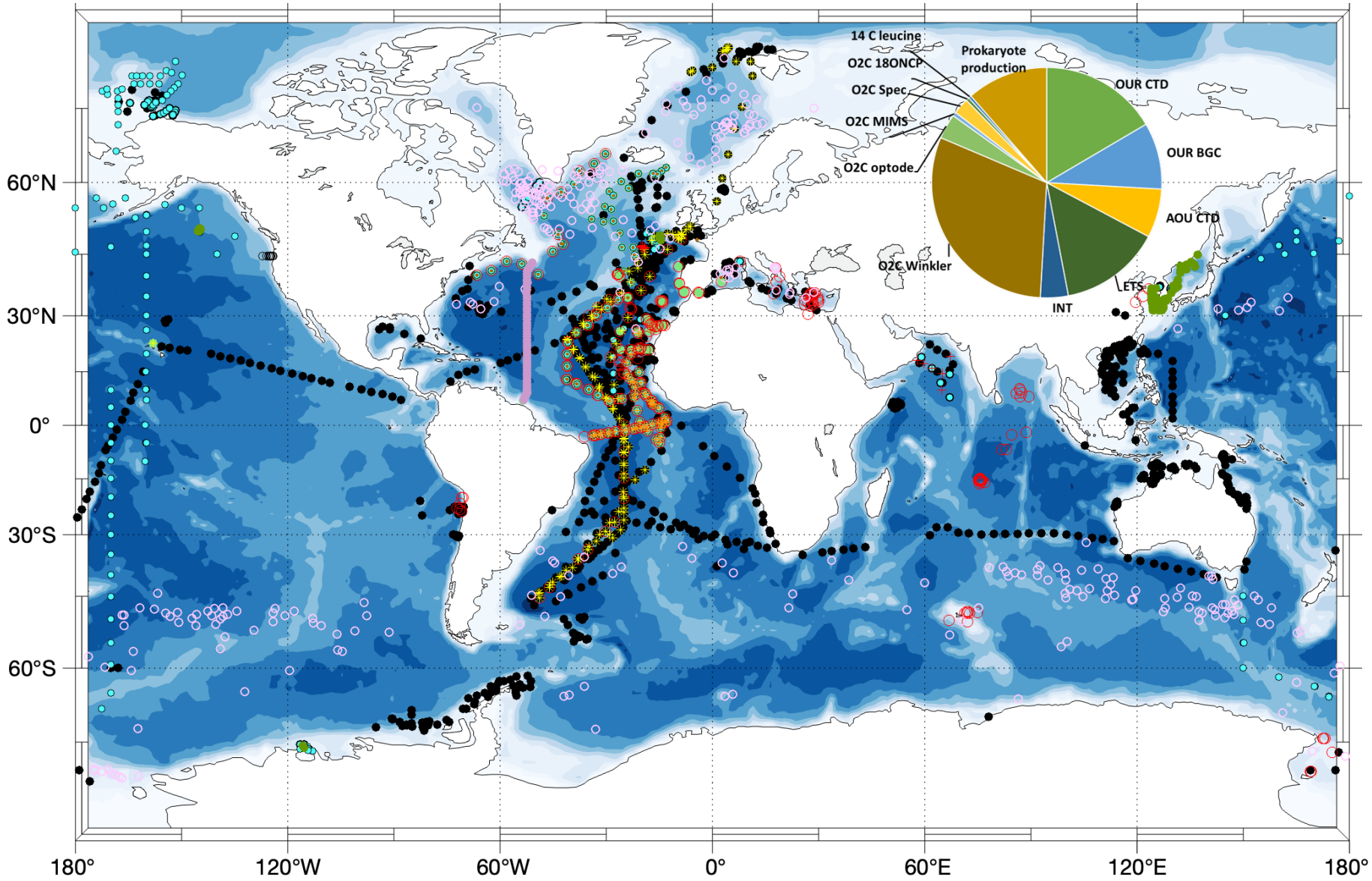
Kriest et al., in prep

#2 Develop a global dataset #4 dataset

Natural Environment Research Council

Micro RESPIRE

ReMO Respiration in the Mesopelagic Ocean



Oxygen consumption during in vitro incubation

- Winkler
- Optode
- MIMS
- Spectrophotometry
- ^{18}O NCP

Apparent oxygen utilisation (AOU)

- AOU from CTD sensor

Oxygen utilisation rate (OUR)

- OUR from CTD sensor
- OUR from BGC Argo

Enzymatic activity

- ETS
- INT
- ^{14}C Leucine

Production rate

- Prokaryote production

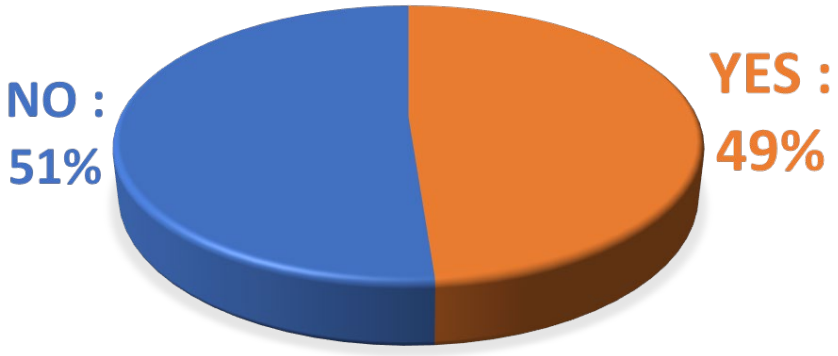
#2 Develop a global dataset #4 dataset

Natural Environment Research Council

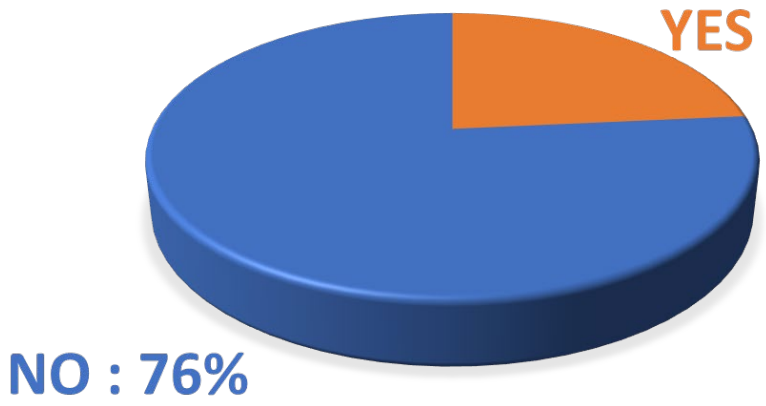
Micro RESPIRE

ReMO Respiration in the Mesopelagic Ocean

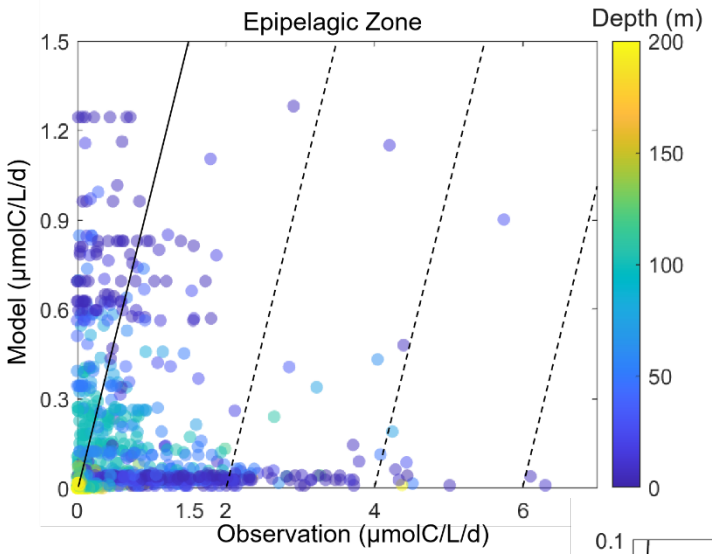
% data published

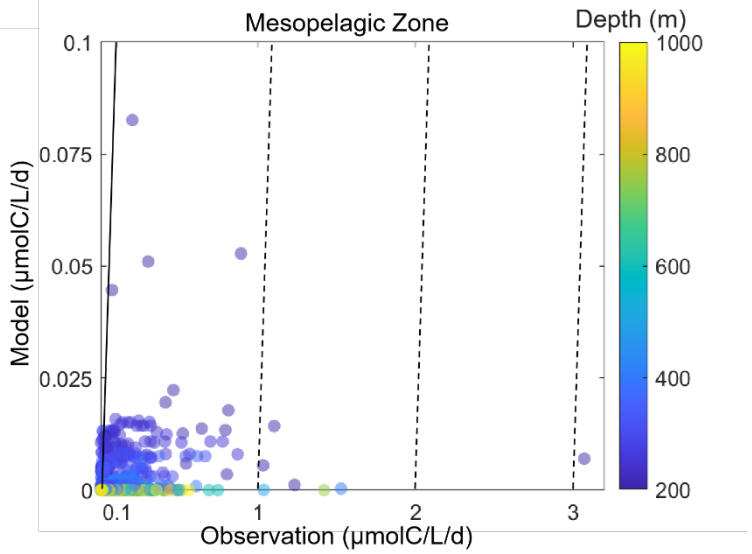


% data archived at a data centre



Planktom12 model data comparisons





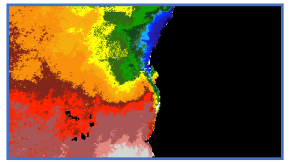
Qin Wang, Marie-Fanny Racault, Corinne le Quéré, Erik Buitenhuis, University of East Anglia

#3 Synthesis #6 Case study

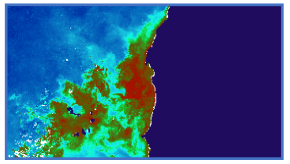
ReMO
Respiration in the Mesopelagic Ocean

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

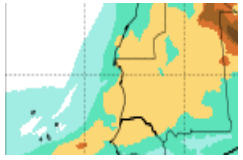
Cape Verde Front

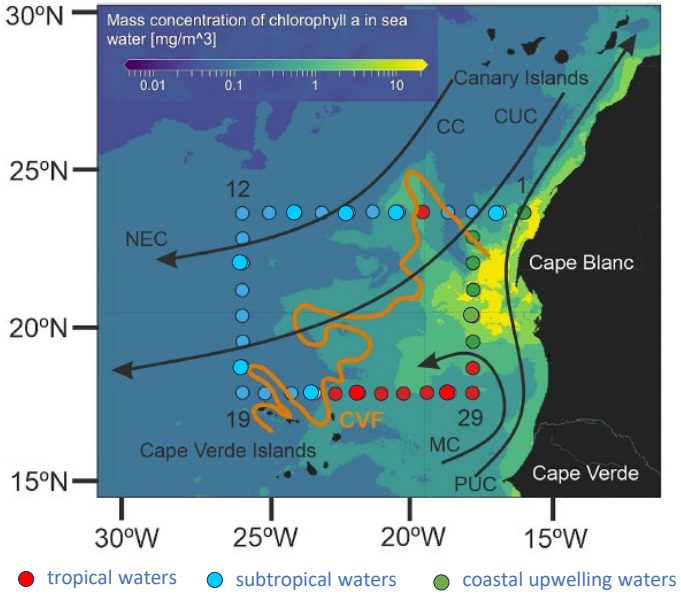


Cape Blanc Giant filament



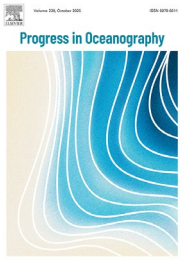
Sahara dust deposition





ReMO members directly involved: X.A. Álvarez-Salgado, M. Iversen, J. Arístegui, with collaboration from I. Kriest and G. Dall'Olmo

Contribution to OSM2026, OB14G: Respiration in the Mesopelagic Ocean: Reconciling Ecological, Biogeochemical, and Model Estimates



Paper to be submitted to *Progress in Oceanography*

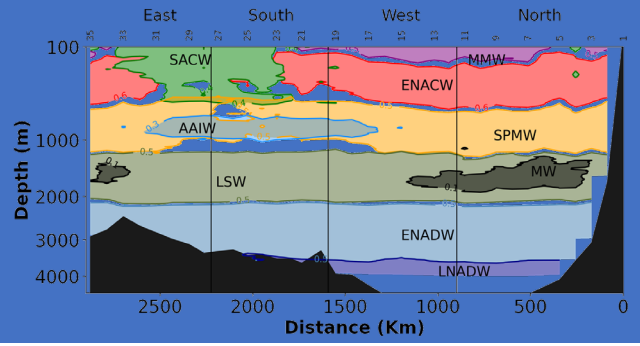
Combining multiple approaches

Carbon stocks

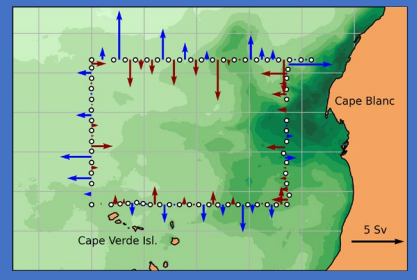
-Dissolved organic carbon (DOC)

-Suspended organic carbon (DOC)

Water mass distributions



Inverse box modelling



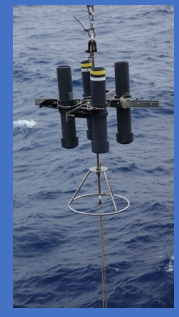
Measured carbon fluxes

-Primary production

-DOC extracellular release

- Microbial respiration (ETS)
- Prokaryotic heterotrophic production
- Particle carbon flux (marine snow catcher, drifting sediment traps and UVP5).

MSC



DST

UVP5

#4 Best practice #7 Best practice manual

How to measure the rate of oceanic mesopelagic respiration

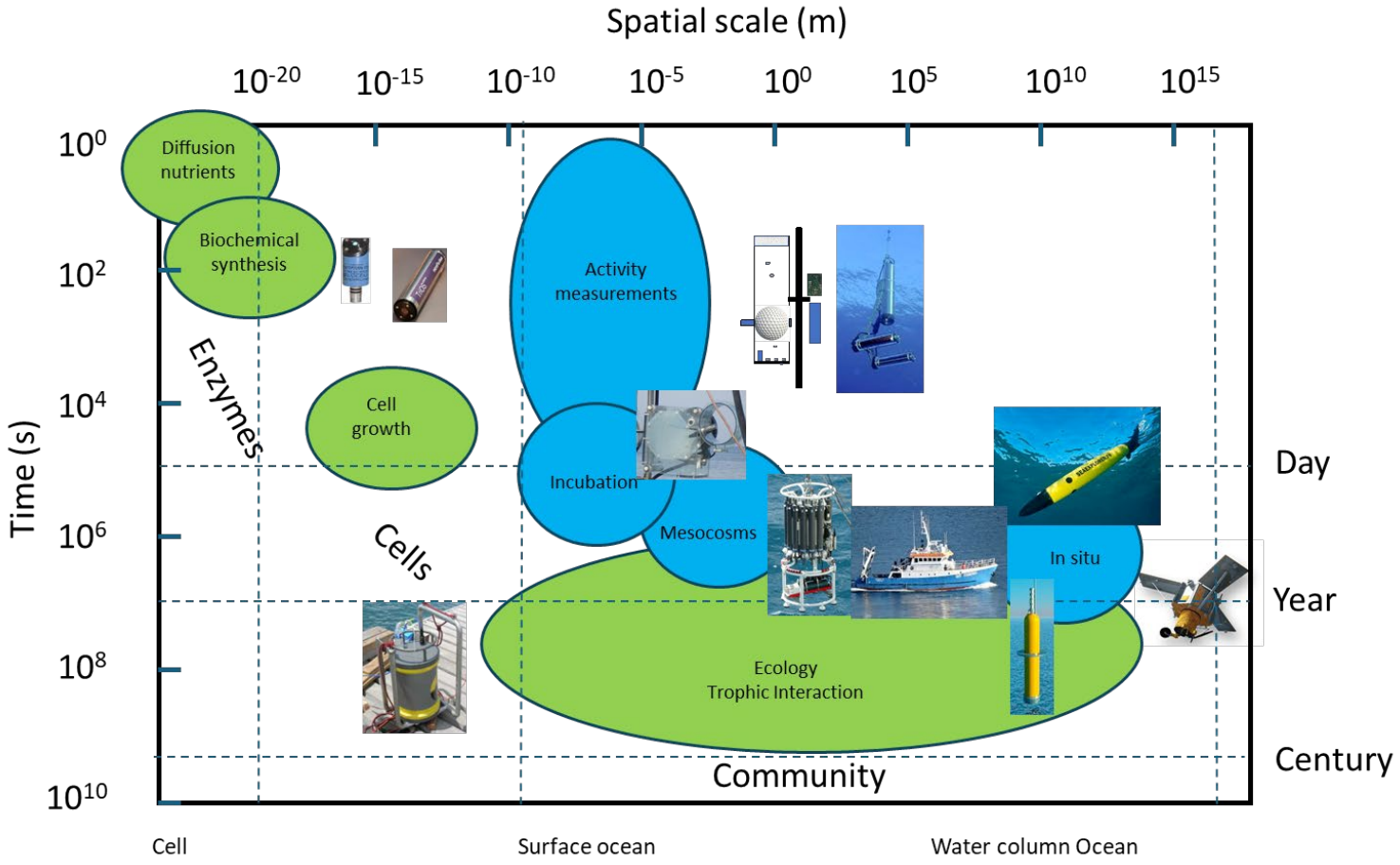
Description of methodology
For example :
Assays, fluorescence, wet chemistry, optodes
Indirect particle flux derivatives
Incubation based

Strengths and weaknesses

Accuracy and sensitivity
Example targets:
Accuracy: 0.05 µmol O_2 dm^{-3} d^{-1}
Precision: ± 0.2 µmol dm^{-3} d^{-1}
Resolution: ~ 0.1 µmol dm^{-3} d^{-1}

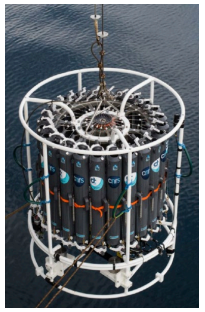
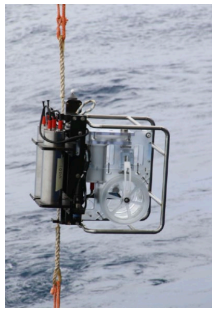
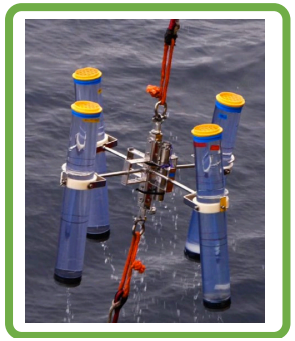
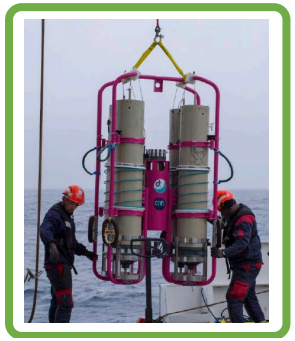
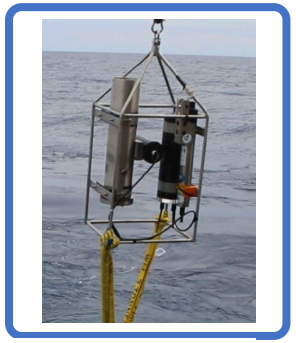
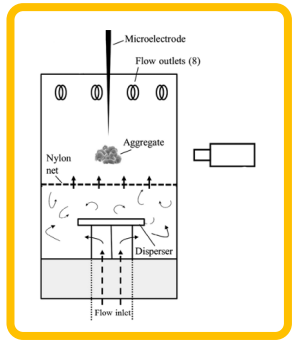
Standards and data management
Metadata – calibration, correction factors
Data standards – SeaDataNet, OceanSites
Recommendations – ancillary data, cross calibration

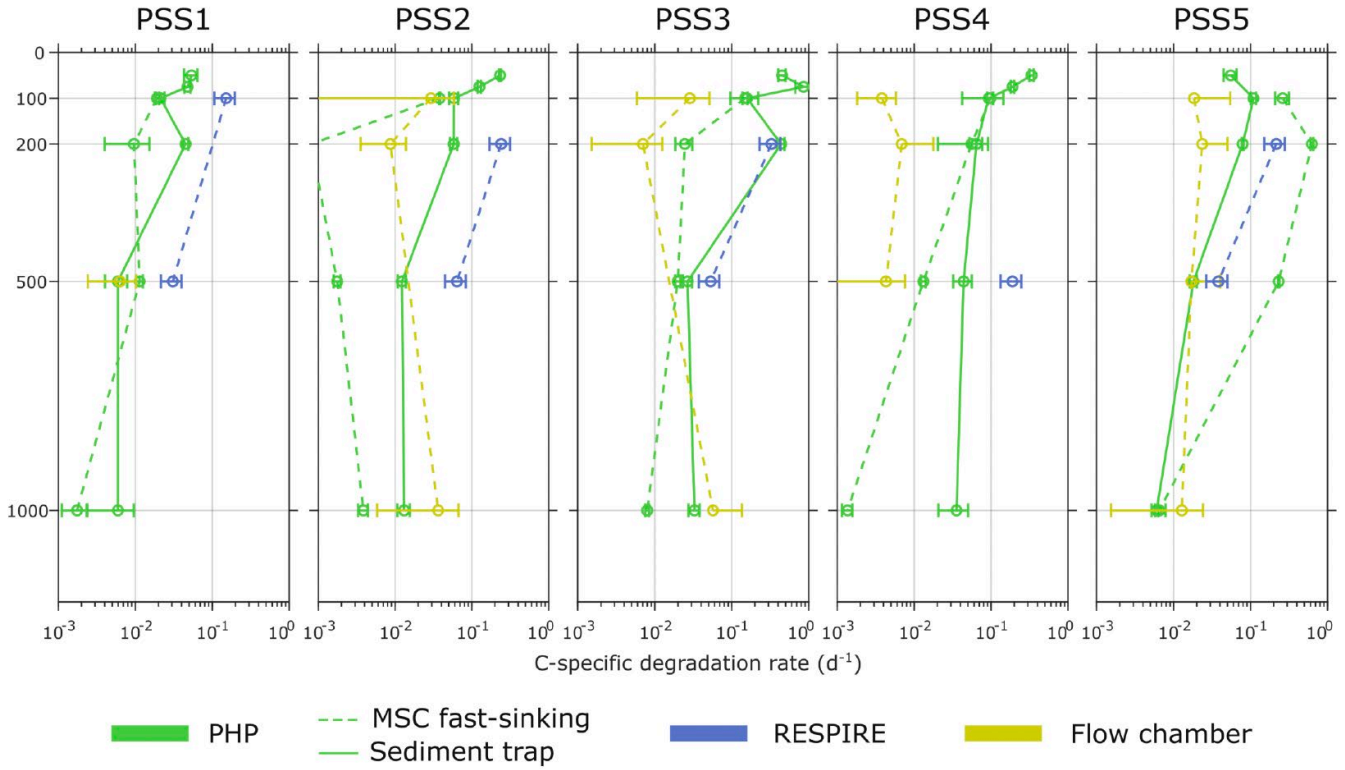
Key references



Biological Processes – Sensors-Platforms

Intercomparison of respiration measurements during the APERO cruise (North Atlantic)



Le Coq et al., accepted
Nature Geoscience

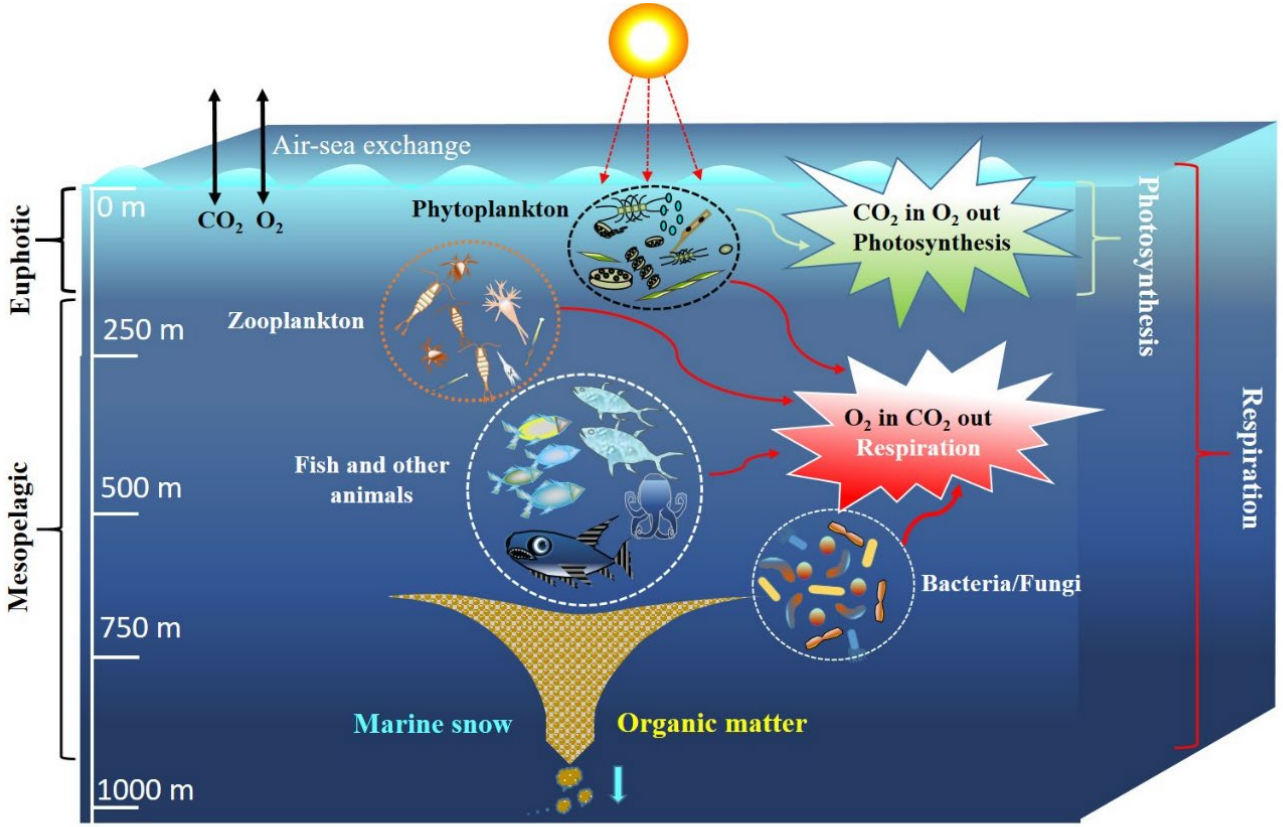
#5 Develop capacity #11 Manuscript(s) for schoolchildren

frontiers | Frontiers for Young Minds

ReMO Respiration in the Mesopelagic Ocean

The mystery of respiration in the dark ocean

Biswas et al. Accepted



Living under pressure **Herndl et al. In preparation**

- Increase of hydrostatic pressure with depth
- Organisms with and without lungs or gas filled organs
- Limitation of life due to pressure
- Adaptations to pressure

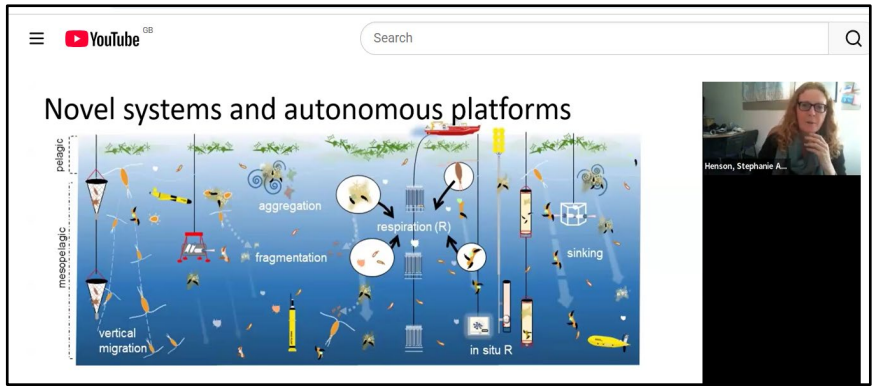
Widen participation, knowledge exchange

Mentoring scheme

- 3 calls, 10 applications from 7 countries
- 6 mentee-mentor pairs, two currently active
- Achievements : research stay to learn analytical techniques, data analysis, progress manuscript and writing research / fellowship proposals

Mentee- Mentor pairs

Seminars & lectures



https://www.youtube.com/@remowg161

Plans for 2025/26

ReMO
Respiration in the Mesopelagic Ocean

During 2025/26 we will:

Progress / submit 6 papers, best practice manual, ReMO session at Ocean Sciences, BioCarbon workshop
Final meeting February/March 2026 in Glasgow, UK – what next, Final report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Thank you SCOR