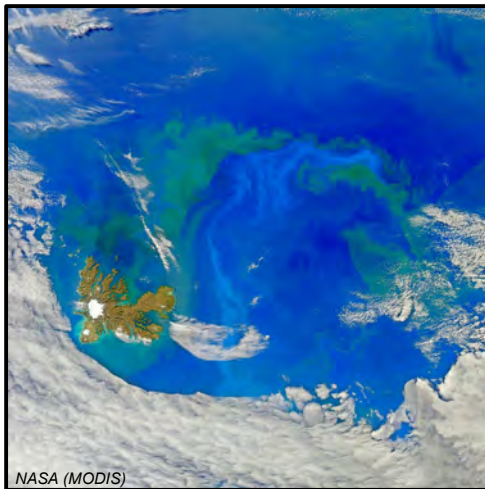


Lumière sur les écosystèmes mésopélagiques de Kerguelen, la « twilight zone »

Cotté Cédric (LOCEAN, MNHN)



d'Ovidio F., Charrassin JB.



Guinet C., Bost CA., Cherel Y.



Lebourges A., Roudaut G., Brehmer P., Behagle N., Josse



B. Queguiner

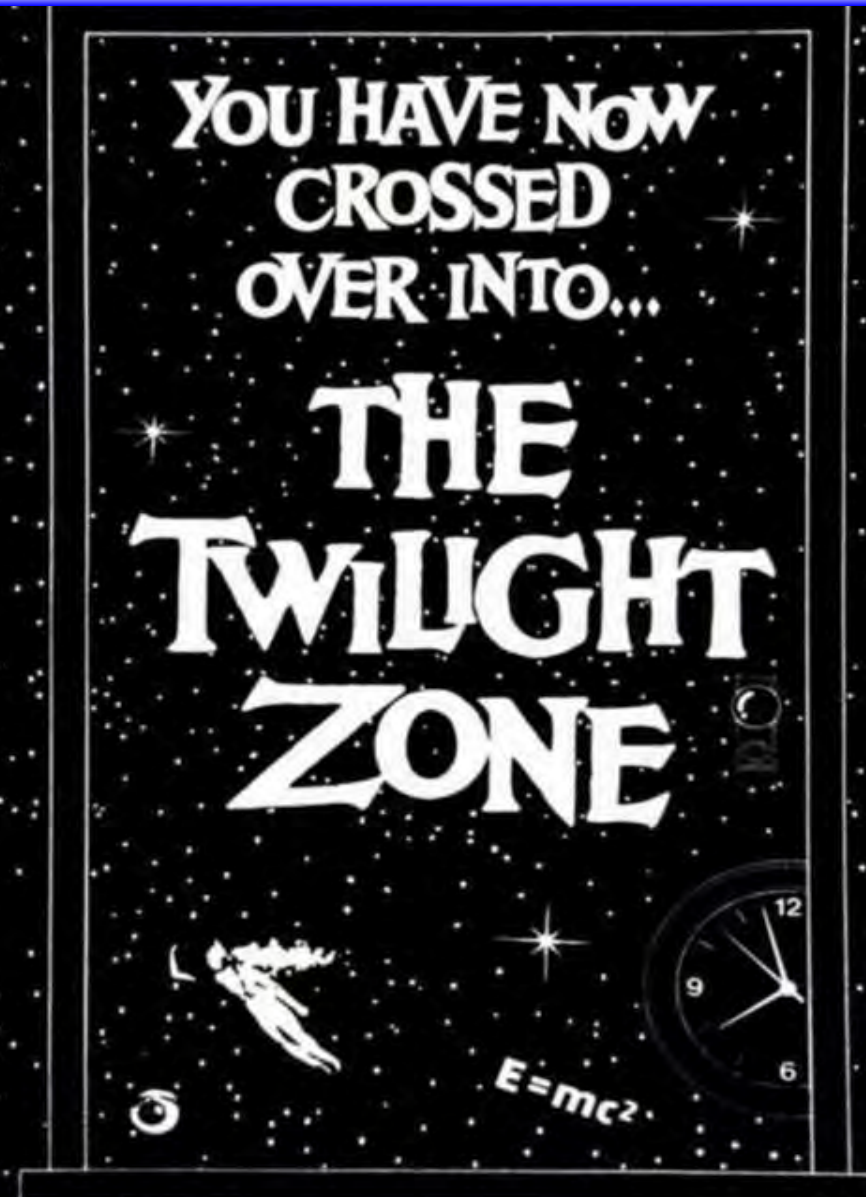
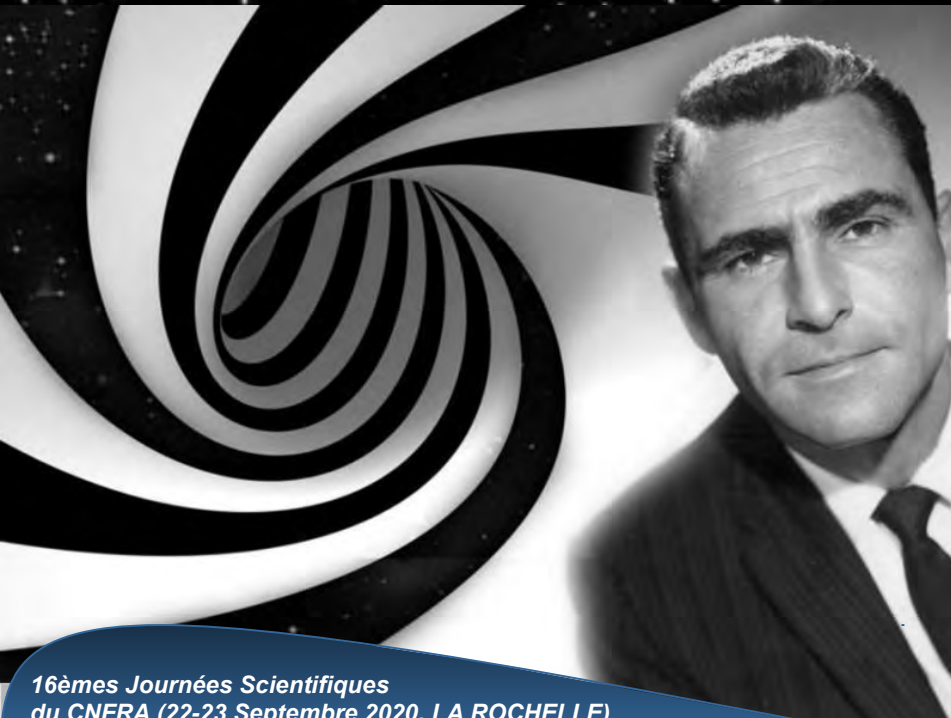


I. Obernosterer, S. Blain,

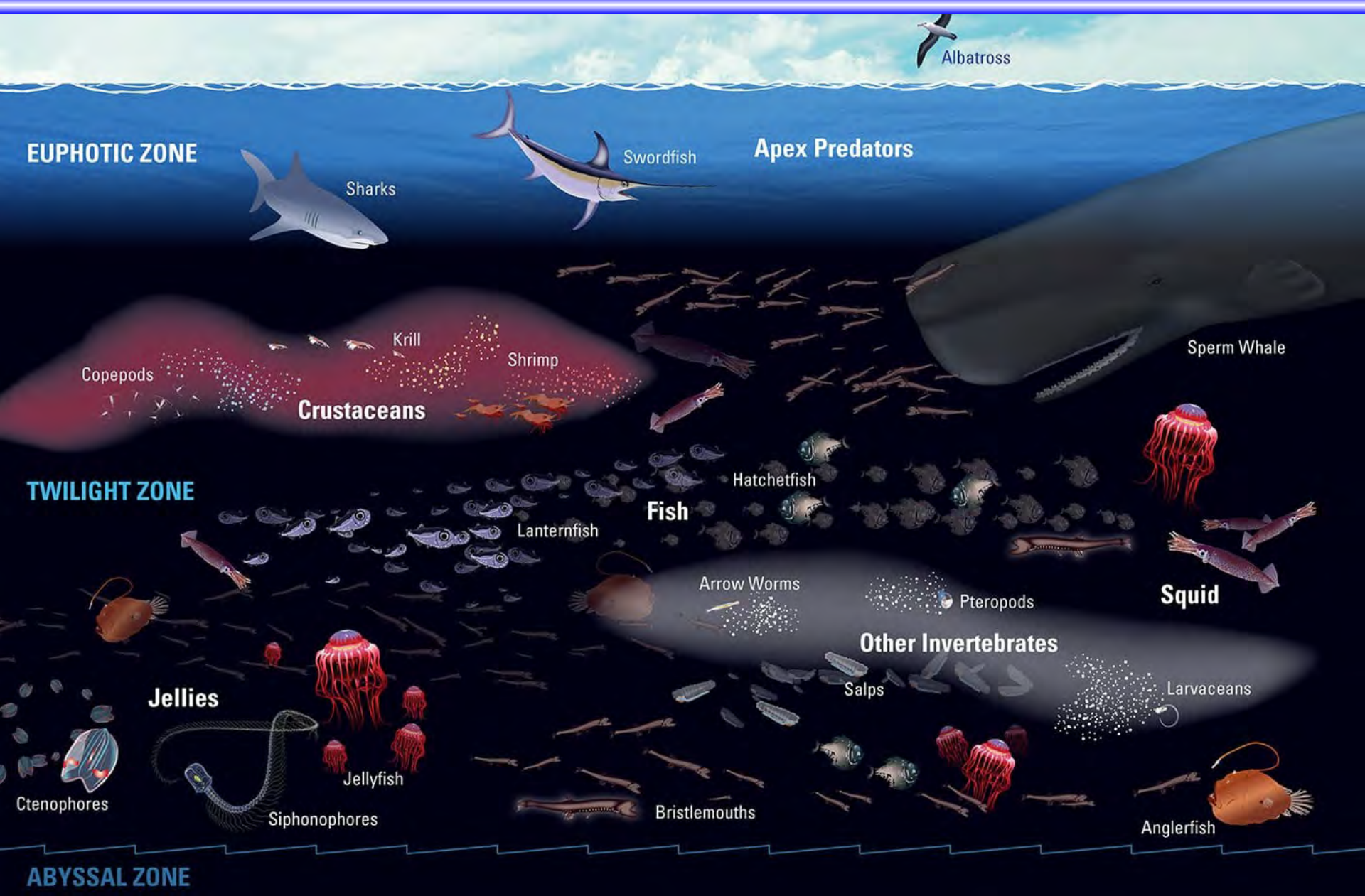


Koubbi P.

What is the ocean twilight zone?



What is the ocean twilight zone?



What is the ocean twilight zone?

NEWS • 27 FEBRUARY 2020

Enter the twilight zone: scientists dive into the oceans' mysterious middle

The vast, wild depths between light and shadow face increasing threats from climate change and overfishing.

Jeff Tollefson



Although thought to be the most abundant vertebrates on Earth, little is known about the species of bristlemouths that inhabit the oceans' twilight zone. Credit: Solvin Zank/NPL

The oceans' twilight zone must be studied now, before it is too late

Exploitation and degradation of the mysterious layer between the sunlit ocean surface and the abyss jeopardize fish stocks and the climate.

Adrian Martin¹, Philip Boyd, Ken Buesseler, Ivona Cetinic, Hervé Claustre, Sari Giering, Stephanie Henson, Xabier Irigoien, Iris Krist, Laurent Memery, Carol Robinson, Grace Saba, Richard Sanders, David Siegel, María Villa-Alfageme & Lionel Guidi²











The elongated bristlemouth (*Sigmops elongatus*) is abundant in the oceans' twilight zone. Credit: Woods Hole Oceanographic Institution/Paul Caiger

PERSPECTIVE ARTICLE

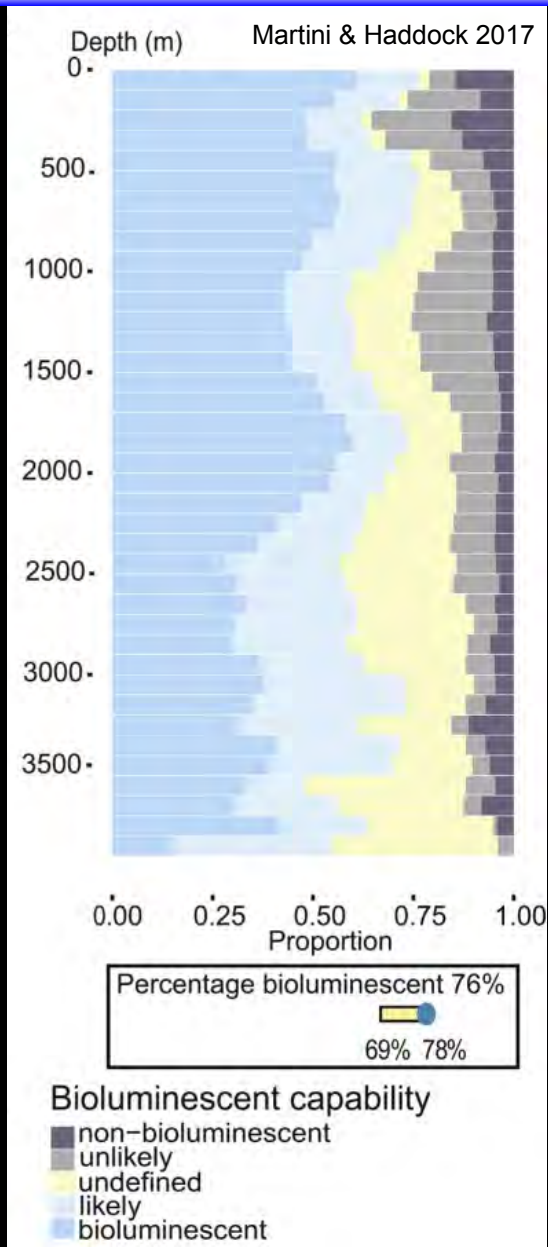
Front. Mar. Sci., 17 March 2016 | <https://doi.org/10.3389/fmars.2016.00031>



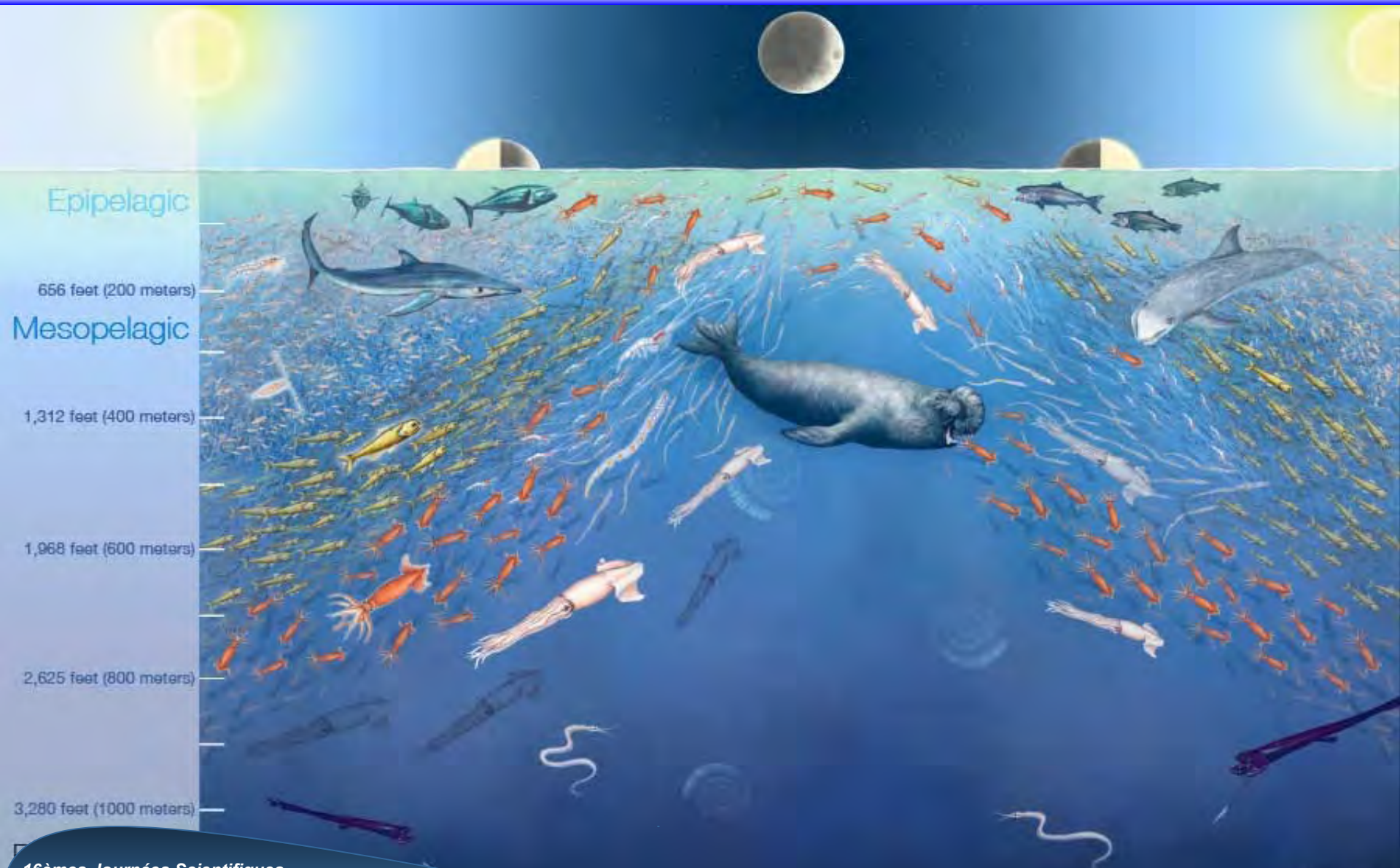
A Dark Hole in Our Understanding of Marine Ecosystems and Their Services: Perspectives from the Mesopelagic Community

 Michael A. St. John^{1*},  Angel Borja²,  Guillem Chust²,  Michael Heath³,  Ivo Grigorov¹,  Patrizio Mariani¹, 
Adrian P. Martin⁴ and  Ricardo S. Santos^{5,6}

What is the ocean twilight zone?



Why studying mesopelagic ecosystems?



Why studying mesopelagic ecosystems?

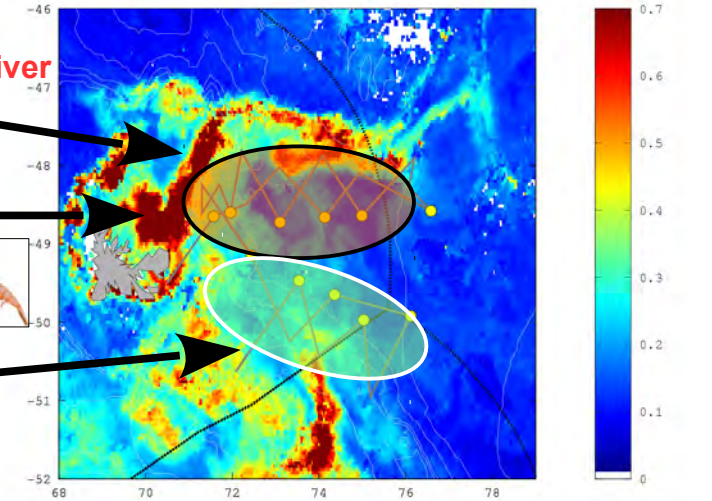
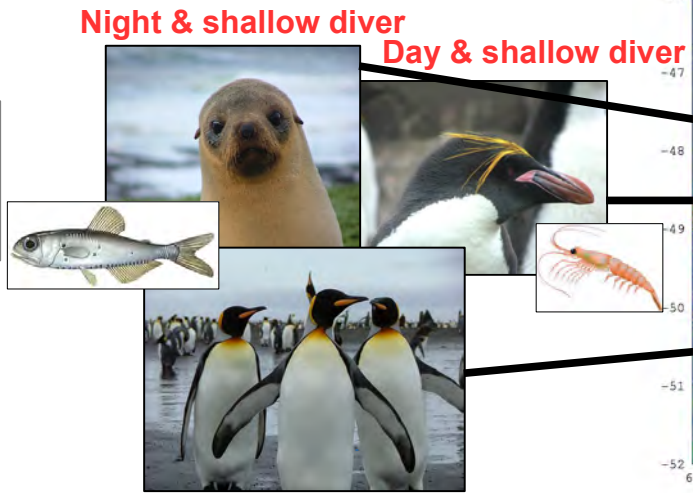
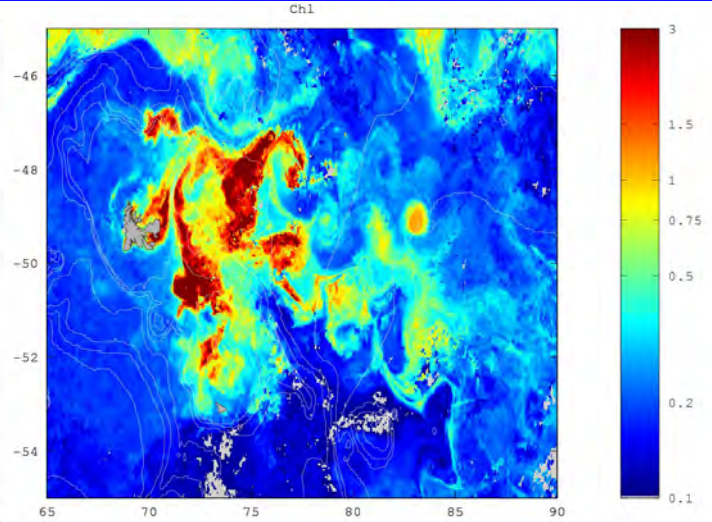
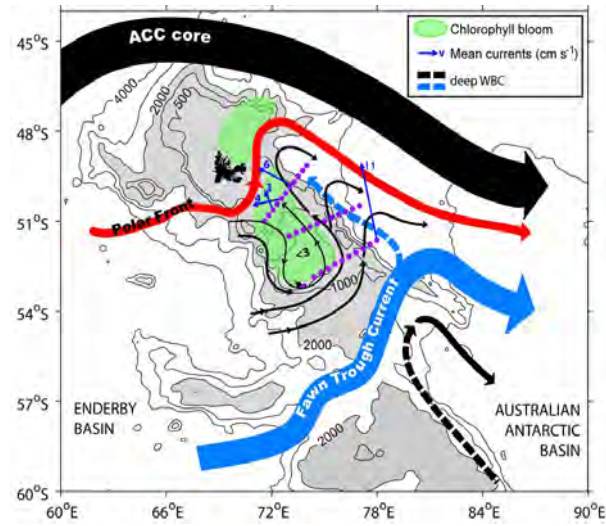
- 1 The distribution of biomass and biodiversity of mesopelagics
- 2 Food web linkages within the twilight zone and with producers and top predators
- 3 Structuring of mesopelagics by the physical forcing
- 4 The role of the mesopelagic in the carbon cycle

Kerguelen ecosystem from carbon to top predators

Physical/biogeochemical variability



Distribution/behavior of top predators

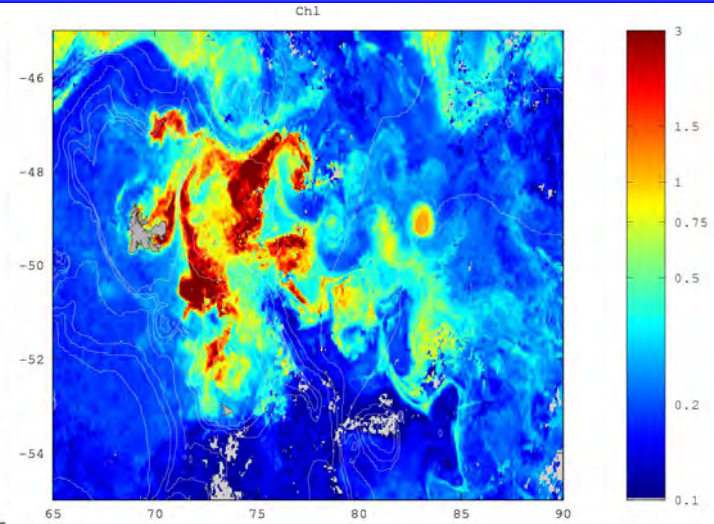
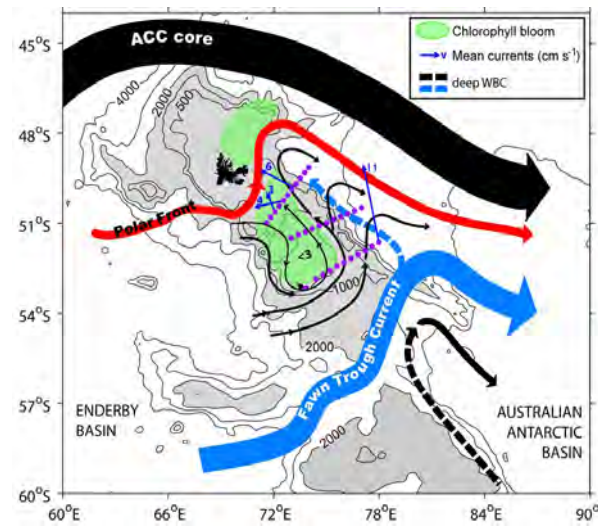


Kerguelen ecosystem from carbon to top predators

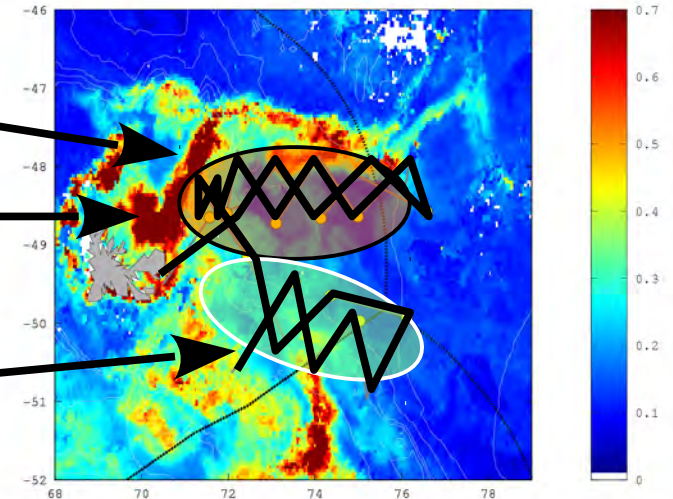
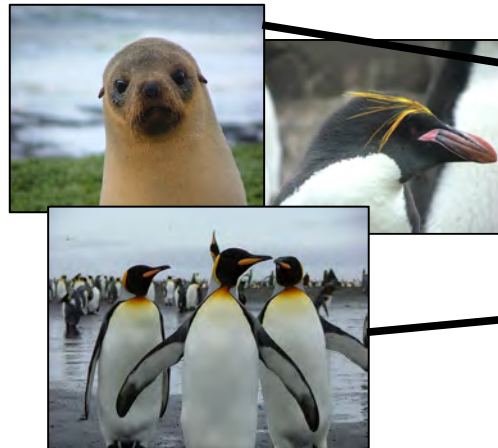
Physical/biogeochemical variability

MyctO-3D-MAP
Intermediate trophic levels

Distribution/behavior of top predators

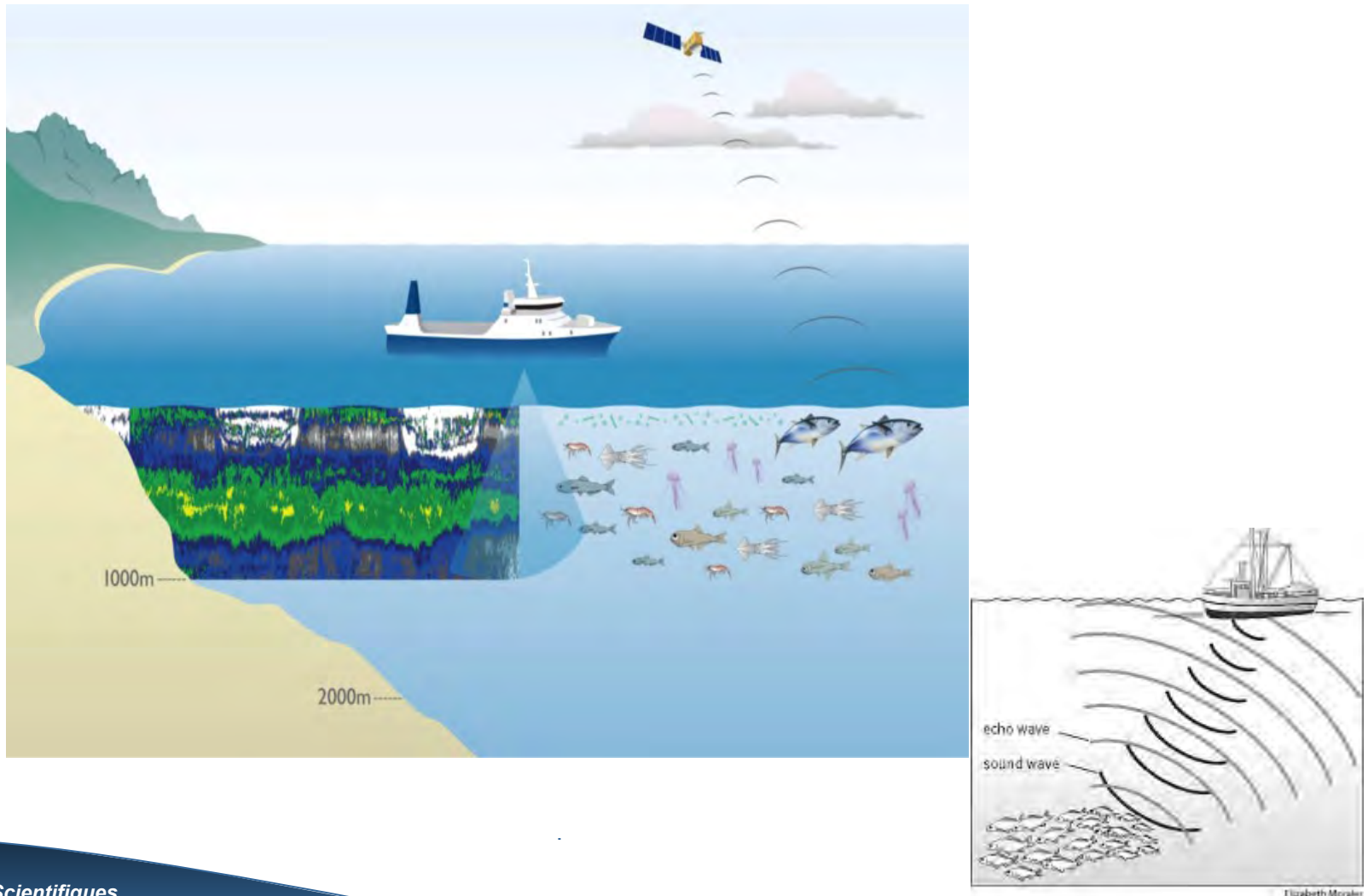


Myctophid assessment in relation to Oceanographic conditions: a **three Dimension Density Distribution** approach combining **Modelling-, Acoustic- and Predators' data**



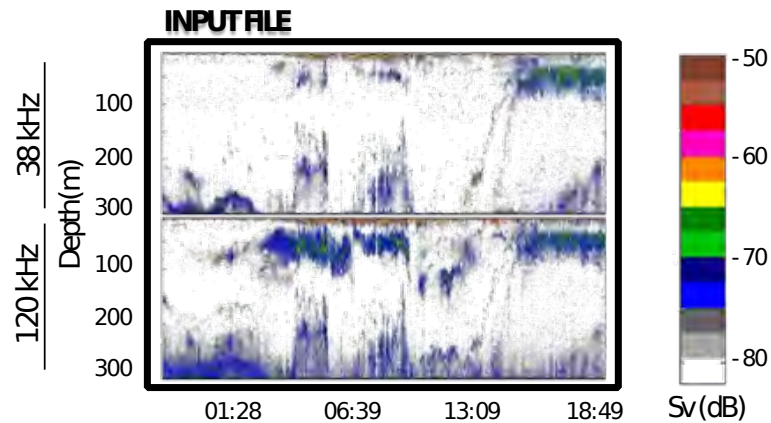
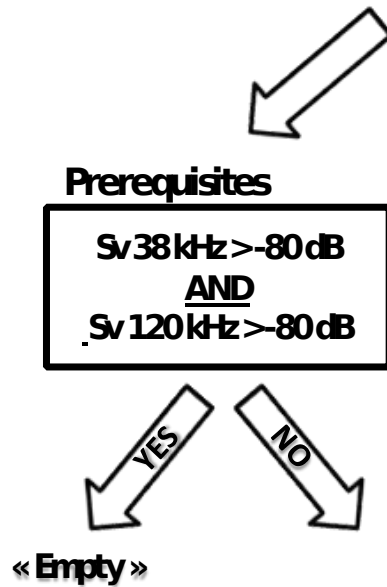
MyctO data and methods

Active acoustic: a powerful approach to estimate distribution and densities of organisms from zooplankton to top predators

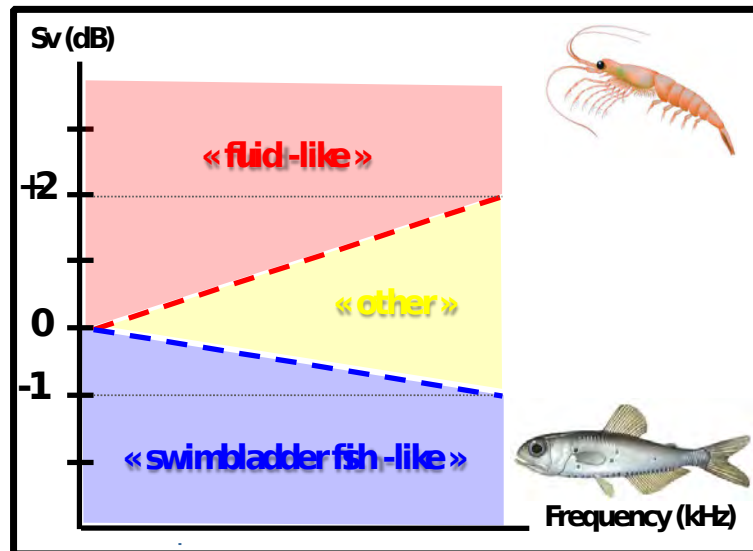


MyctO data and methods

Echosounding (EK60):
Bi-frequency method

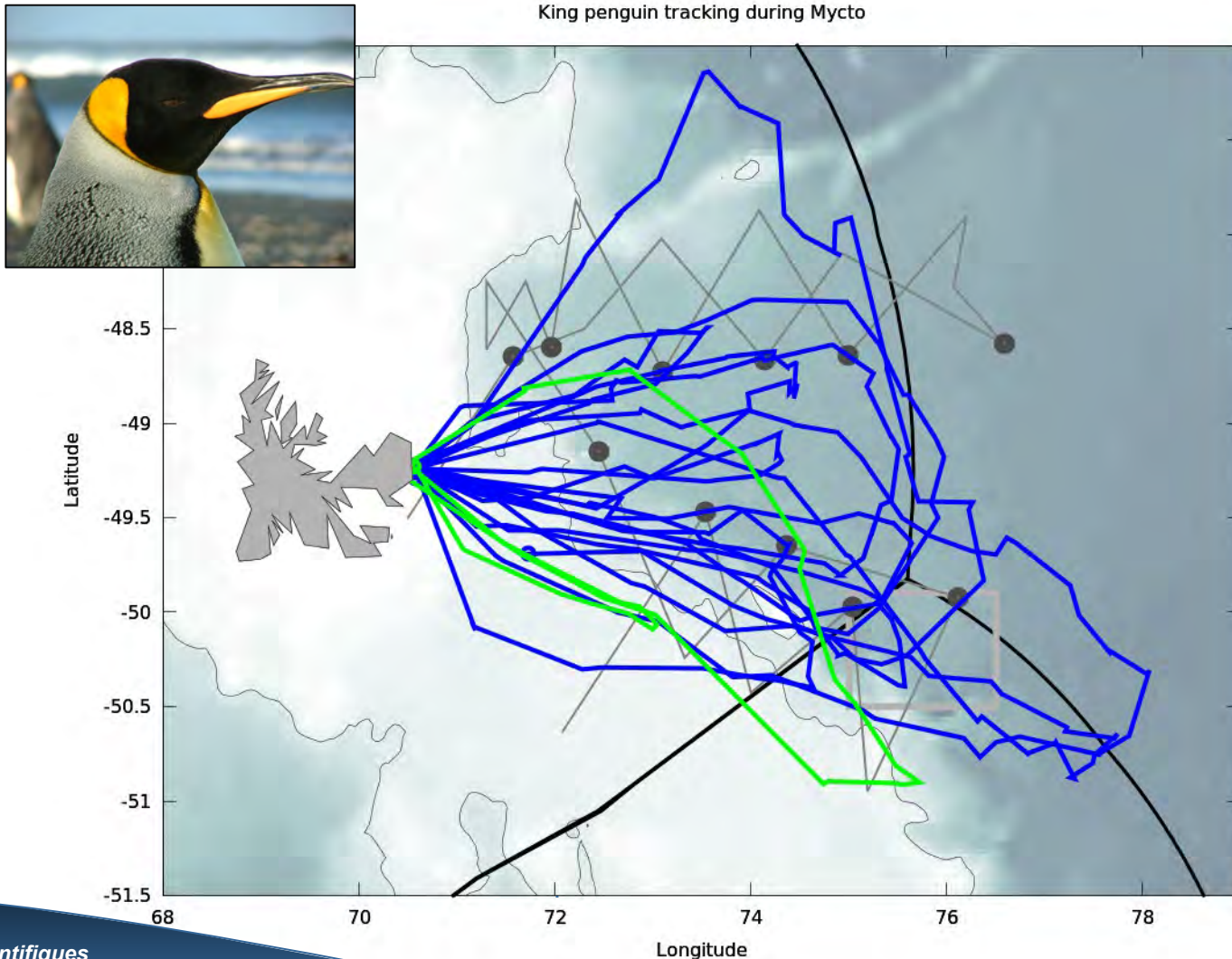


Difference $Sv_{120\text{ kHz}} - Sv_{38\text{ kHz}}$



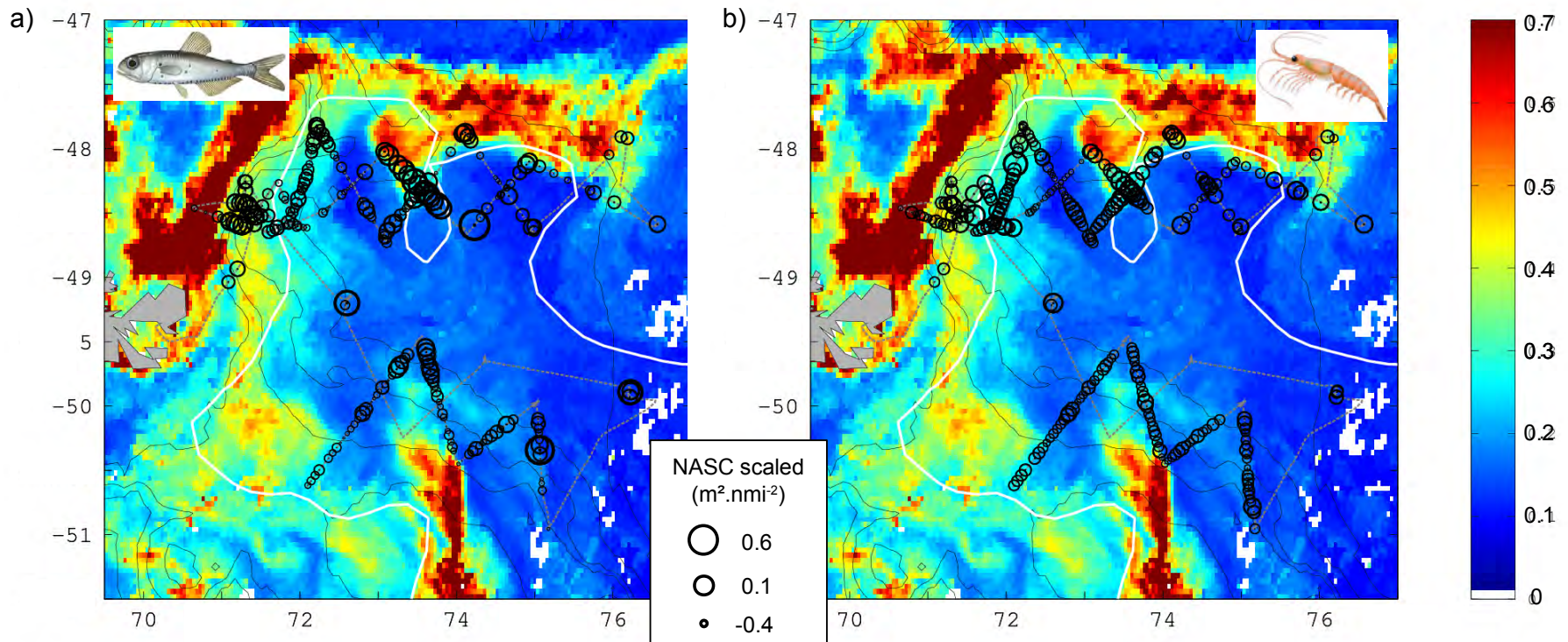
MyctO data and methods

Survey design adjusted in real-time using the simultaneous satellite tracking of king penguins

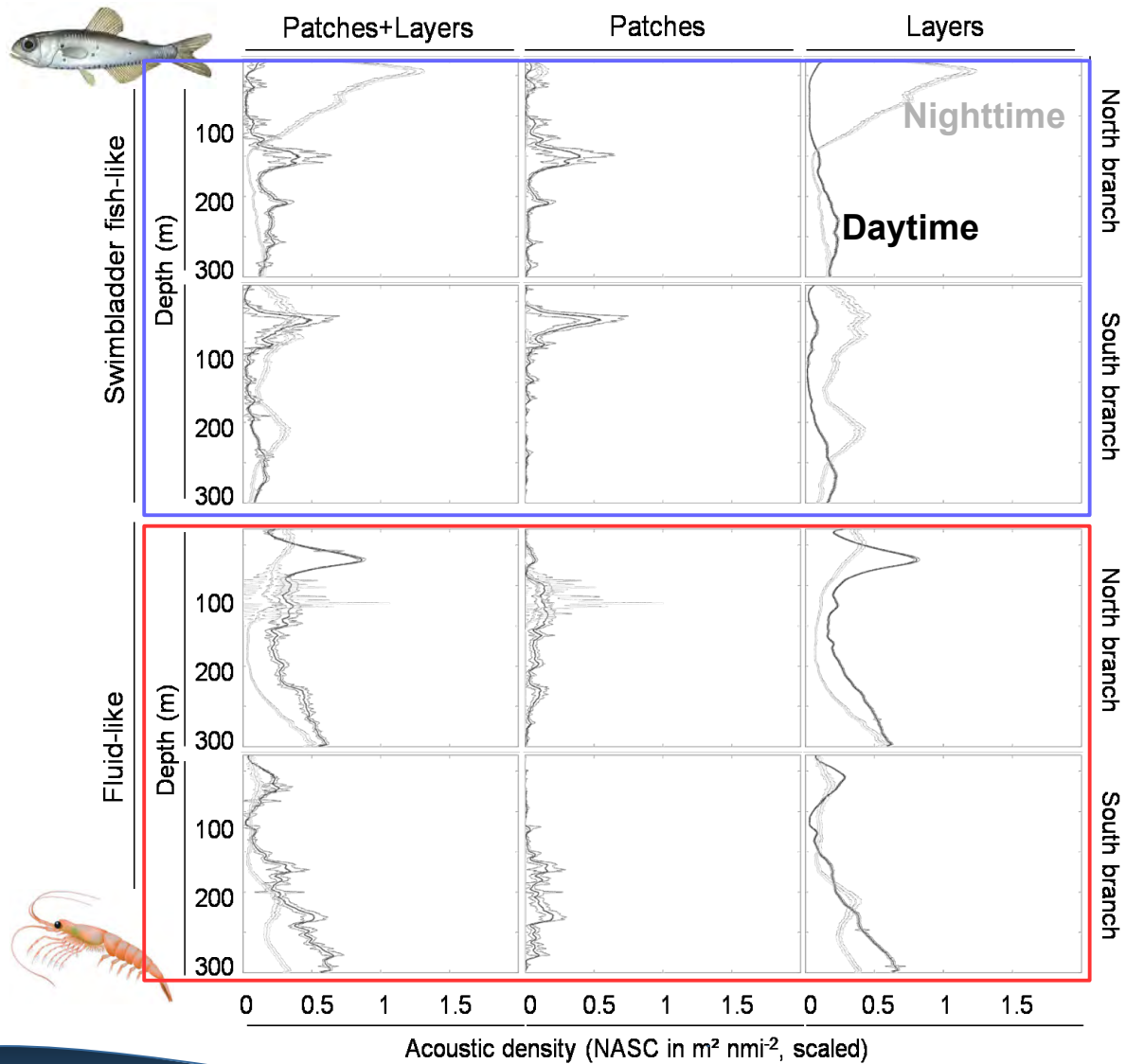


Distribution of micronekton

Heterogeneous total distribution (higher density in the north area), but differences according the structuring



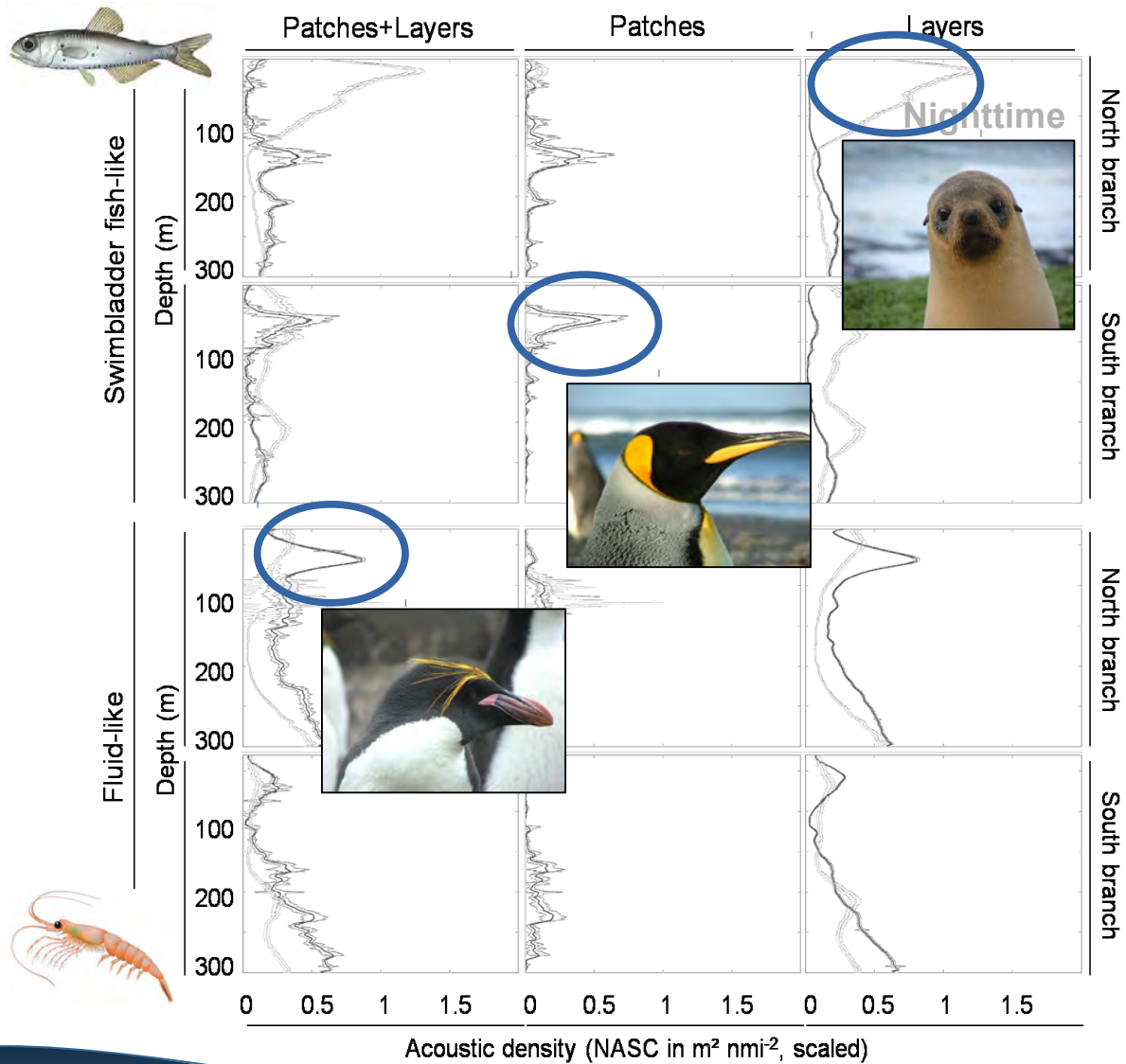
Distribution of micronekton



Contrasted vertical distribution according:

- Area
- Dial cycle

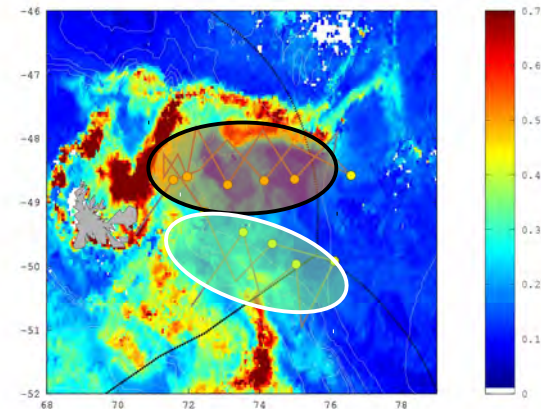
Distribution of micronekton



Contrasted vertical distribution according:

- Area
- Dial cycle

Coherent prey availability with the ecology and diving activity of each predator



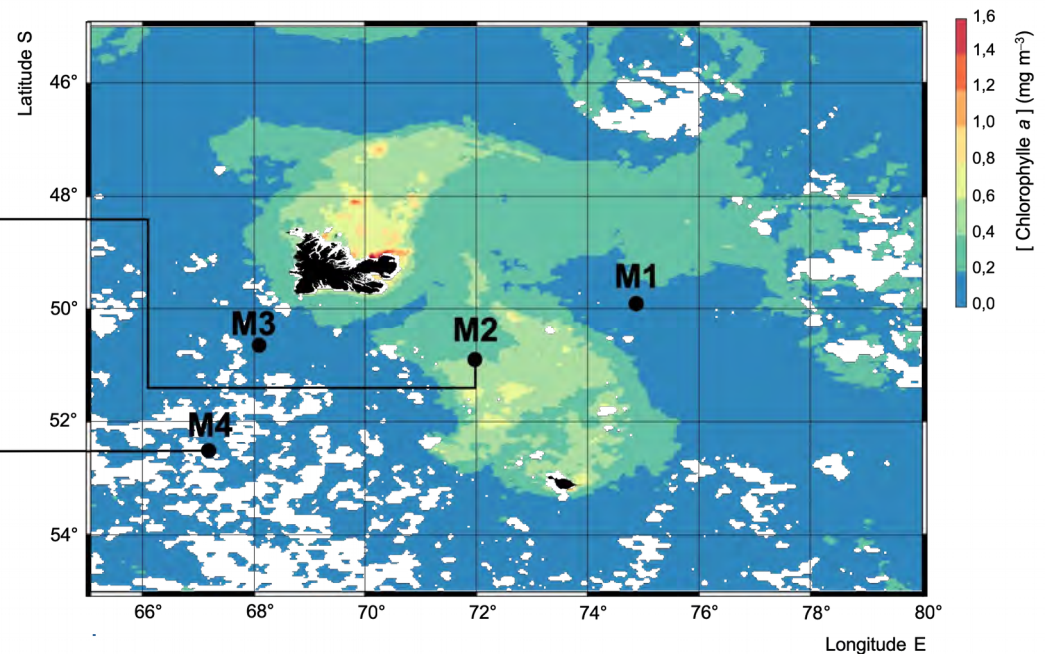
Biodiversity and carbon pump

The MOBYDICK program describes the biological diversity and associated C flows of entire food webs at contrasting sites of the SO in the Kerguelen region. From this information, we will extract synthetic descriptors of biodiversity in relation to the functioning of the biological pump



**'High Biomass Low Export'
(HBLE) ecosystem**

**'Low Biomass Low Export'
(LBLE) ecosystem**



Biodiversity and carbon pump

The MOBYDICK program describe the biological diversity and associated C flows of entire food webs at contrasting sites of the SO in the Kerguelen region. From this information, we will extract synthetic descriptors of biodiversity in relation to the functioning of the biological pump



**'High Biomass Low Export'
(HBLE) ecosystem**

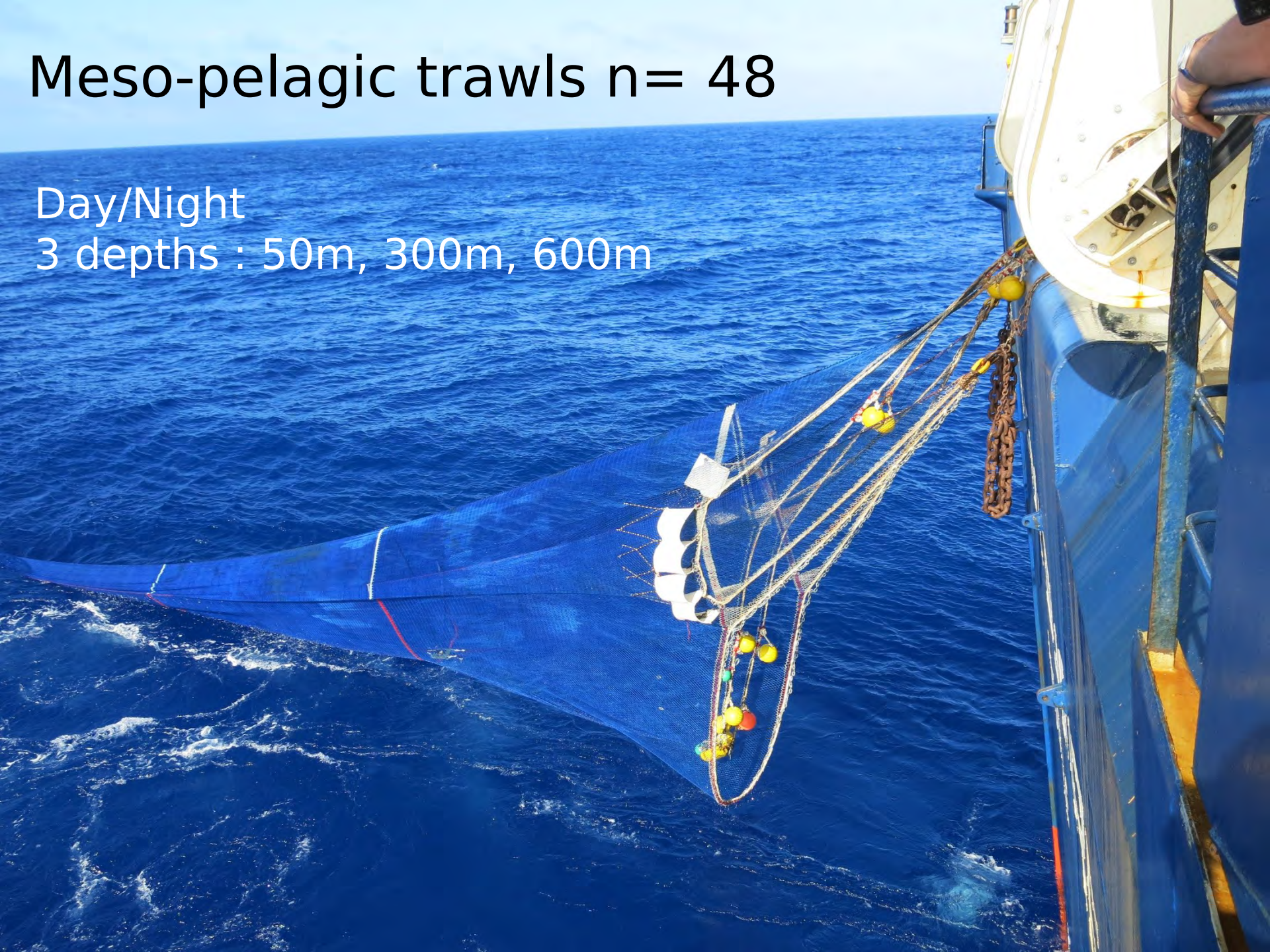
**'Low Biomass Low Export'
(LBLE) ecosystem**



Meso-pelagic trawls n= 48

Day/Night

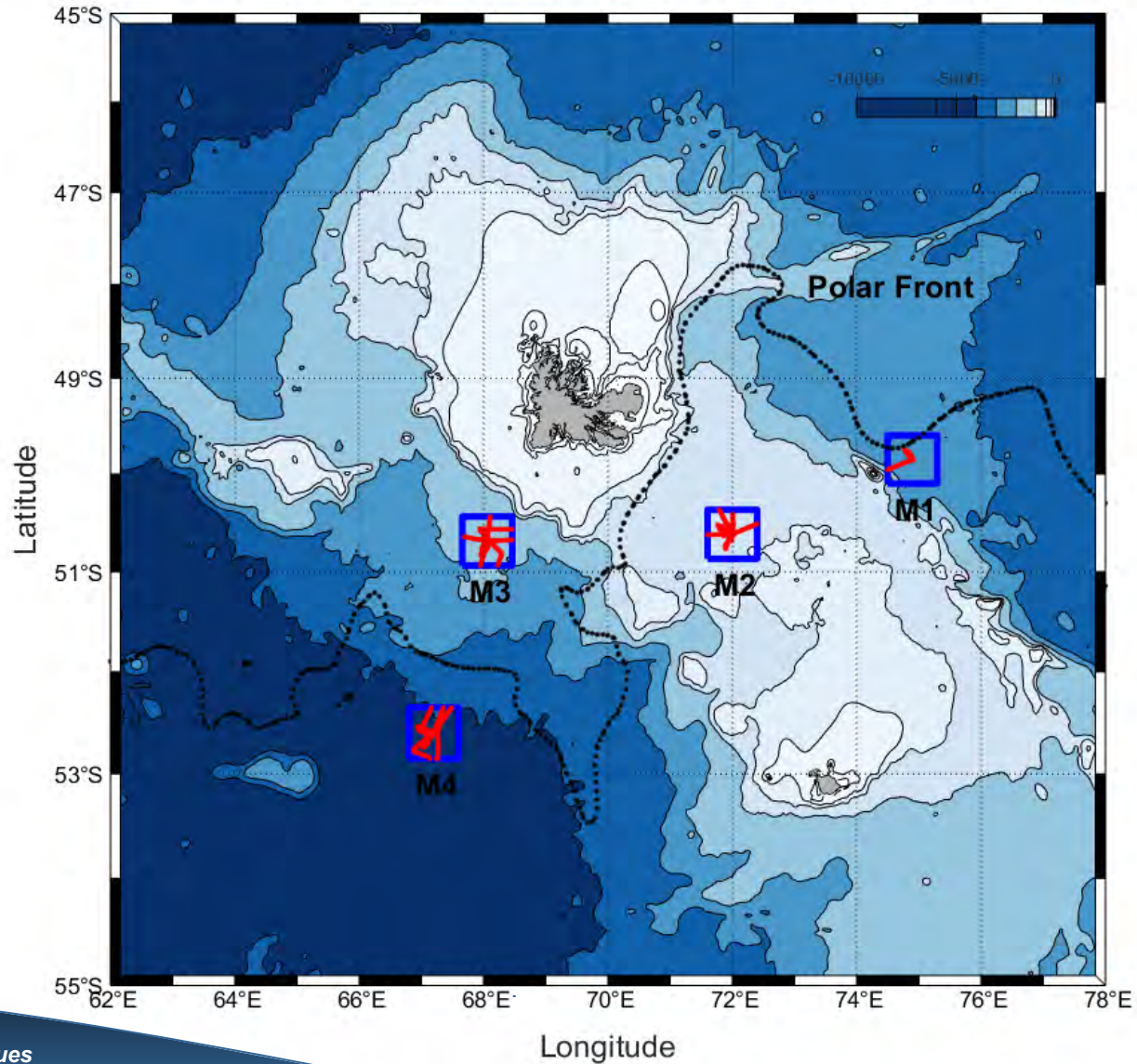
3 depths : 50m, 300m, 600m



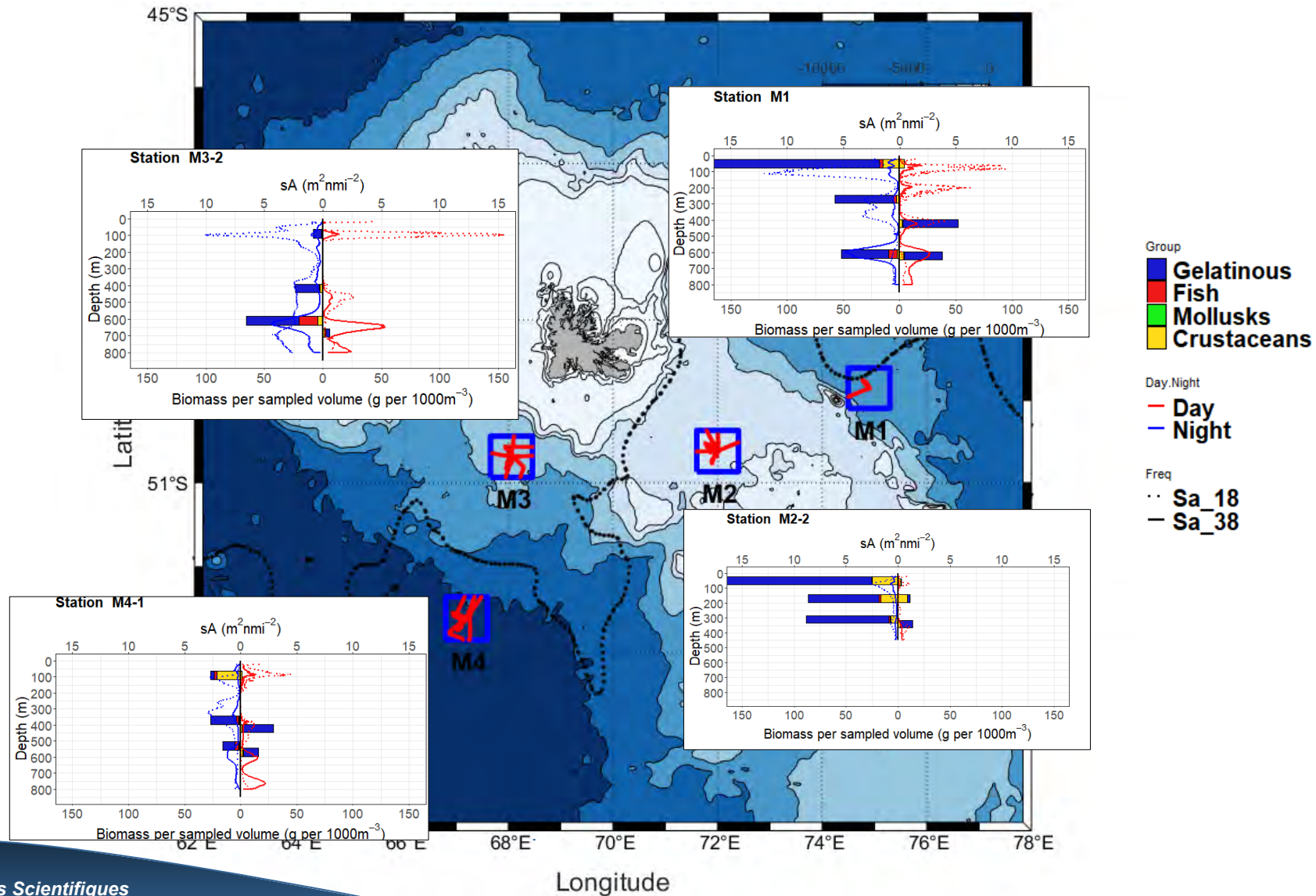
Micronekton : 2-20 cm



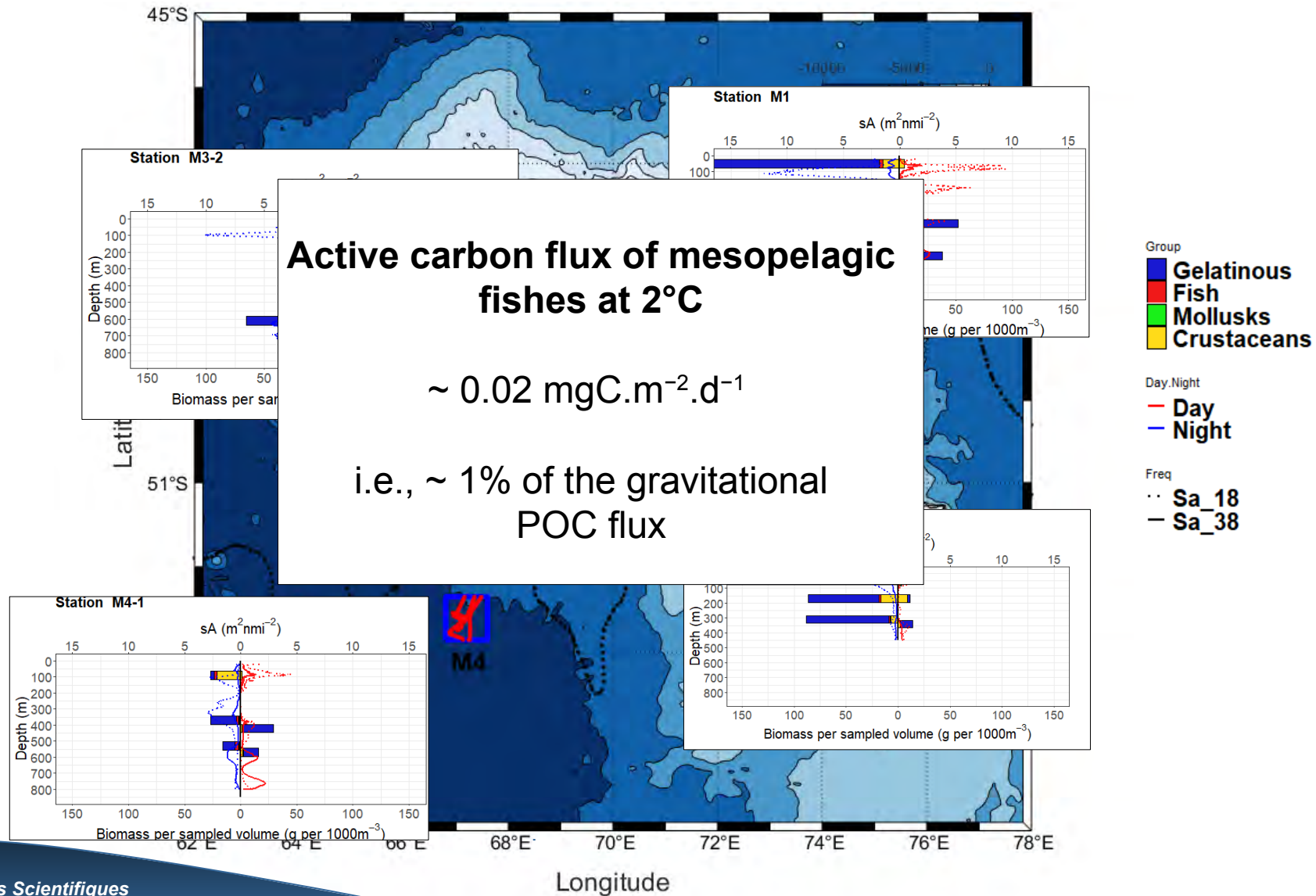
Biodiversity and carbon pump



Biodiversity and carbon pump

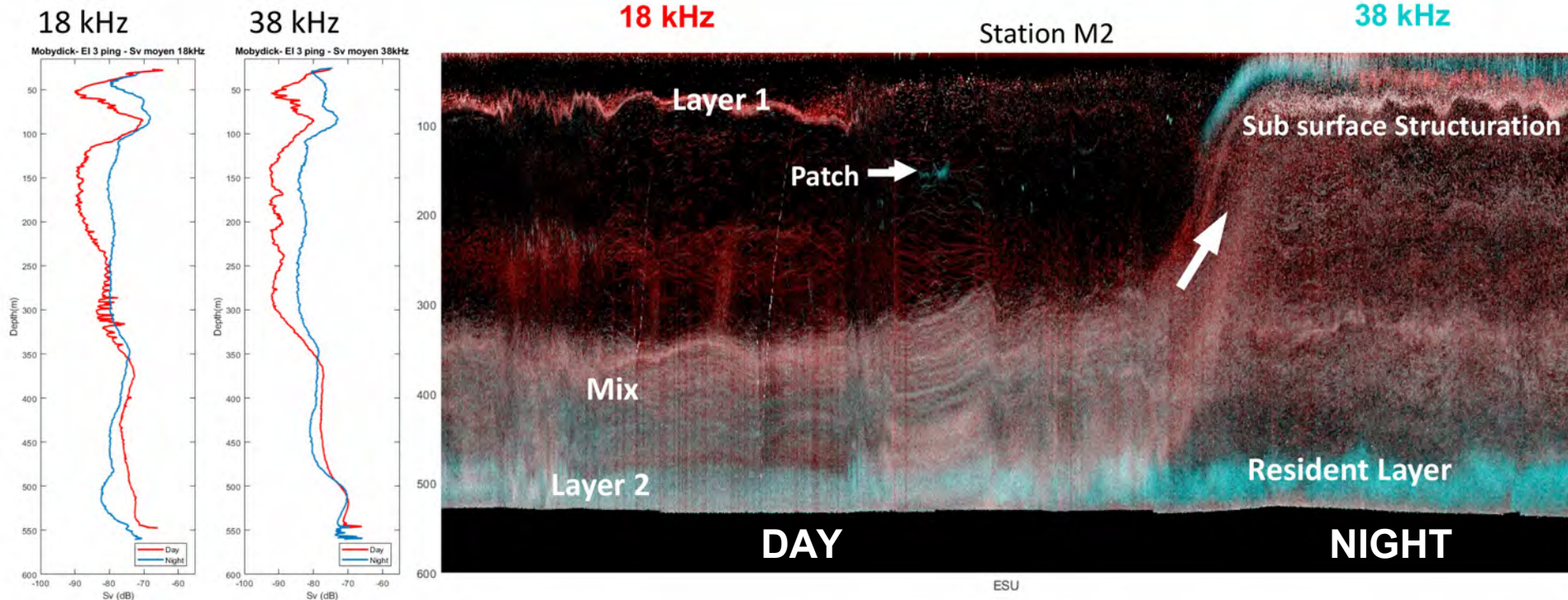


Biodiversity and carbon pump

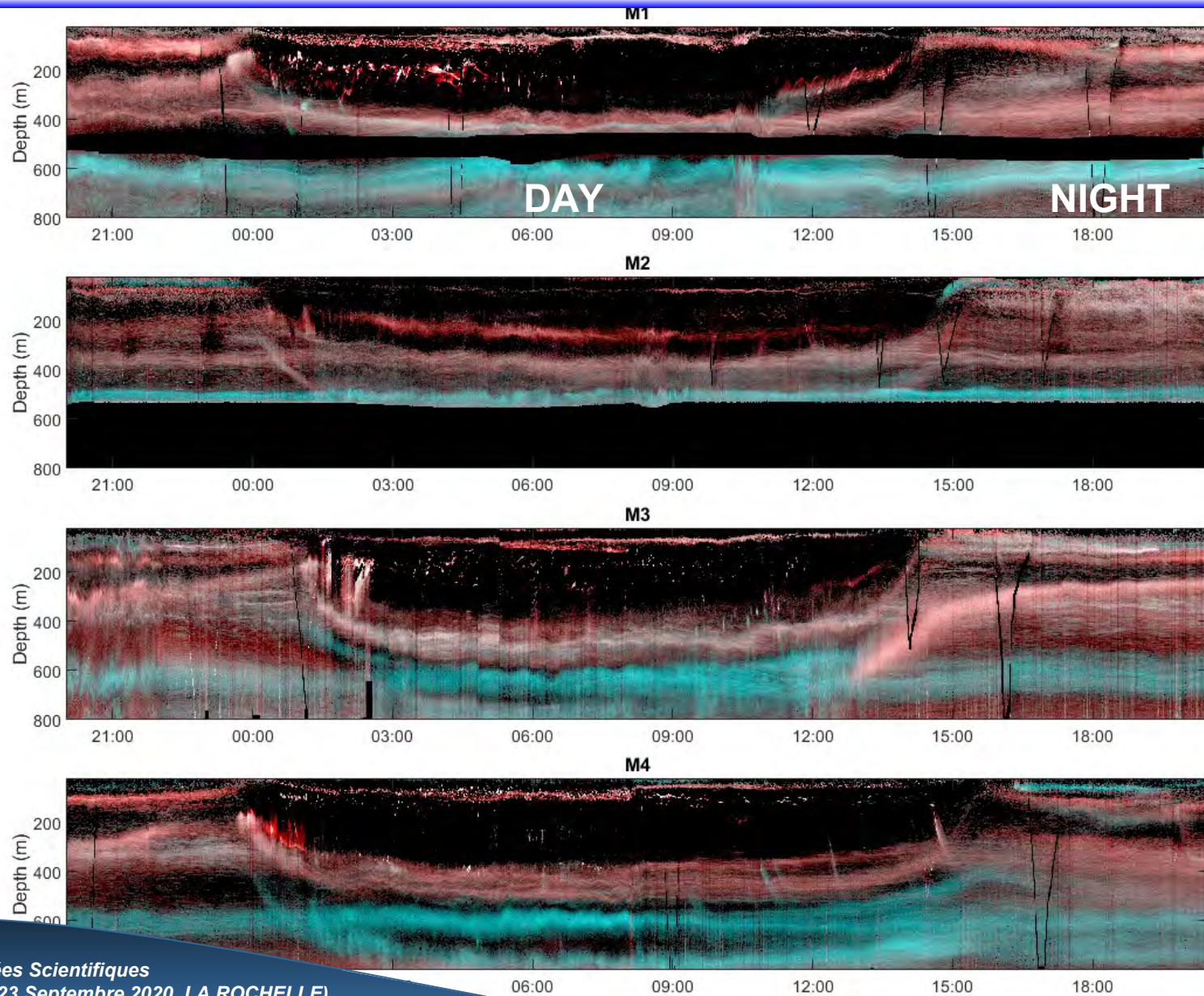


Biodiversity and carbon pump

RGB echogram : Visual representation of frequency response (2 frequencies : 18 and 38 kHz)



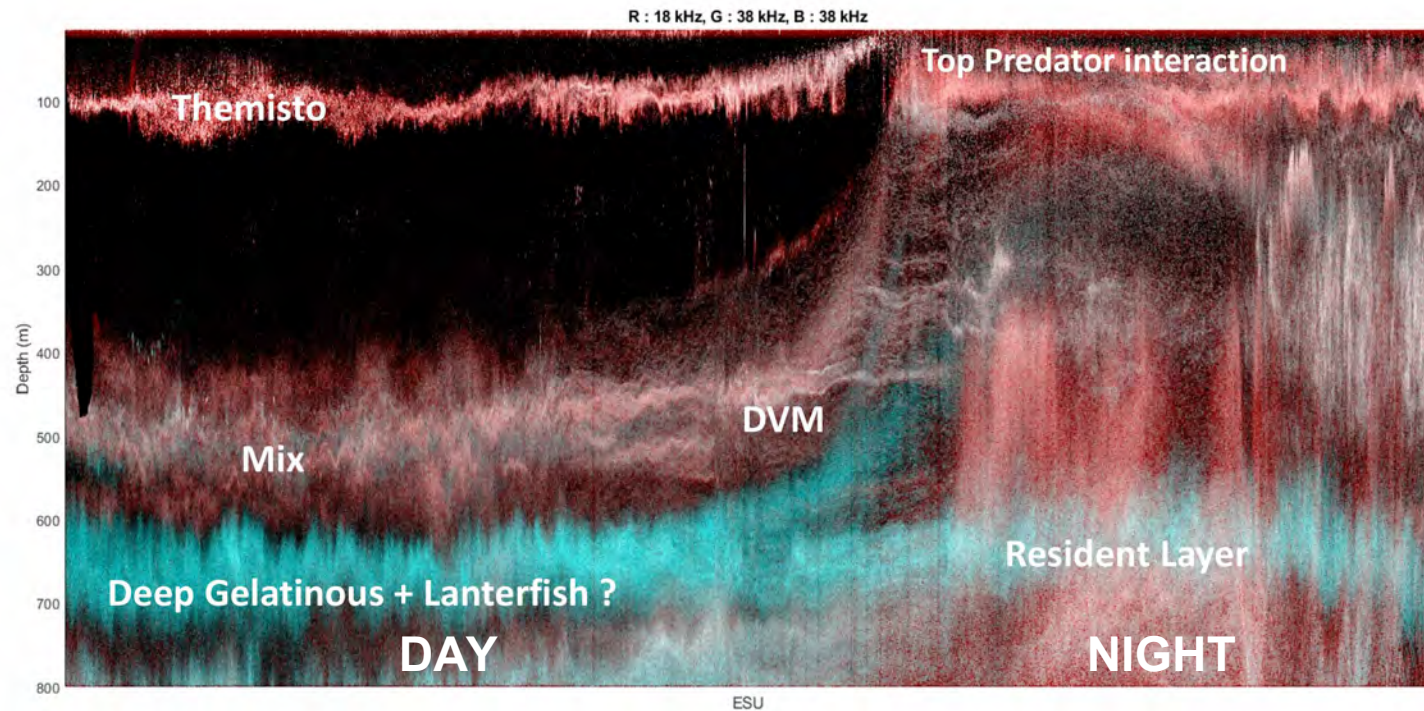
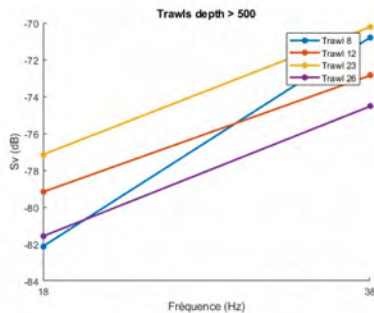
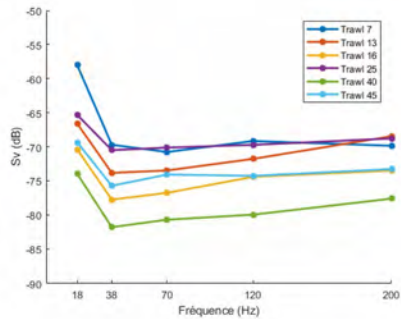
Biodiversity and carbon pump



Biodiversity and carbon pump

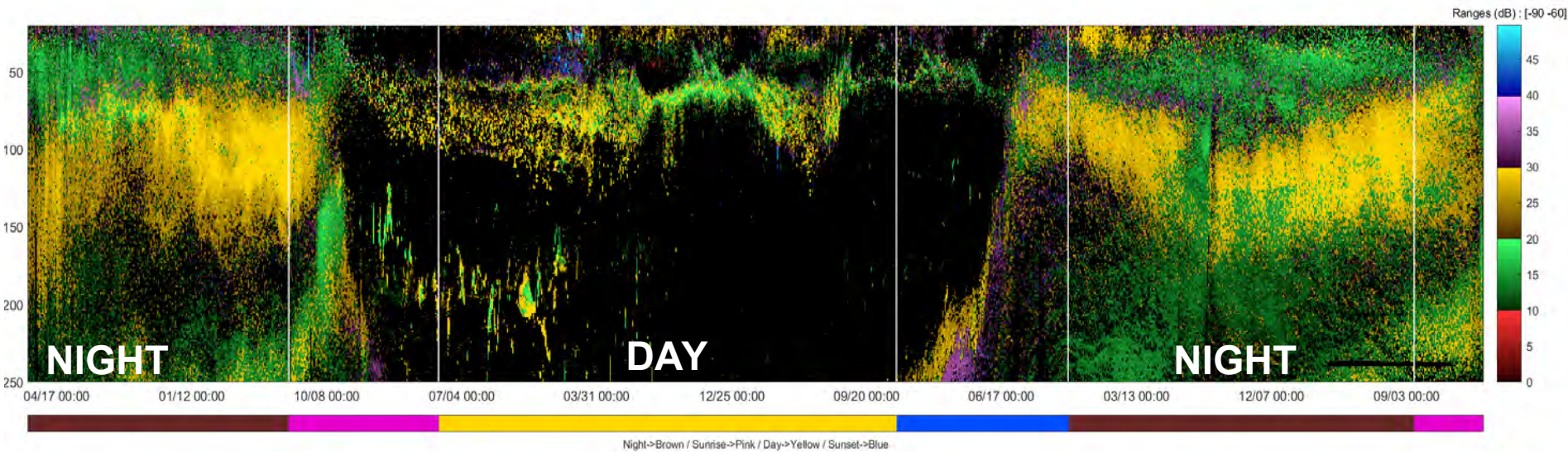
Toward a classification of acoustic layers...

Habitat for *Themisto* → Feeding area for planktivorous seabirds inhabiting the Kerguelen Archipelago ?

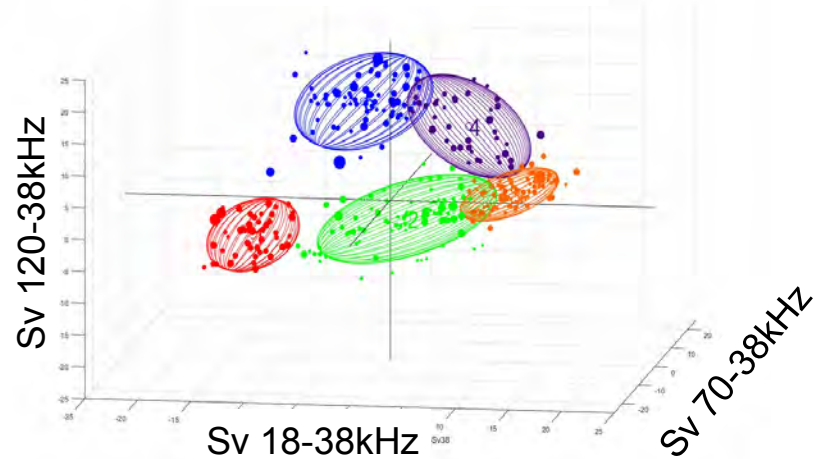


Biodiversity and carbon pump

Acoustic populations



3D- Sv differences



MESOPP



MESOPP (Mesopelagic Southern Ocean Prey and Predators) was proposed to create a first collaborative network between European and Australian research teams/institutes to establish standard methods and datasets to understand, model and estimate the biomass and dynamics of mesopelagic organisms in the Southern Ocean

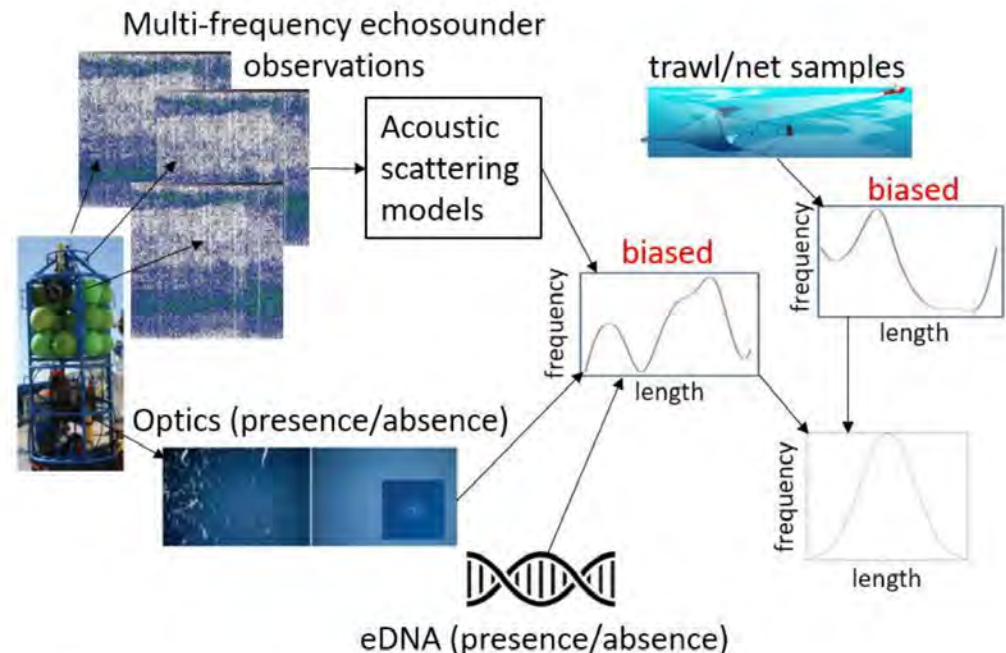
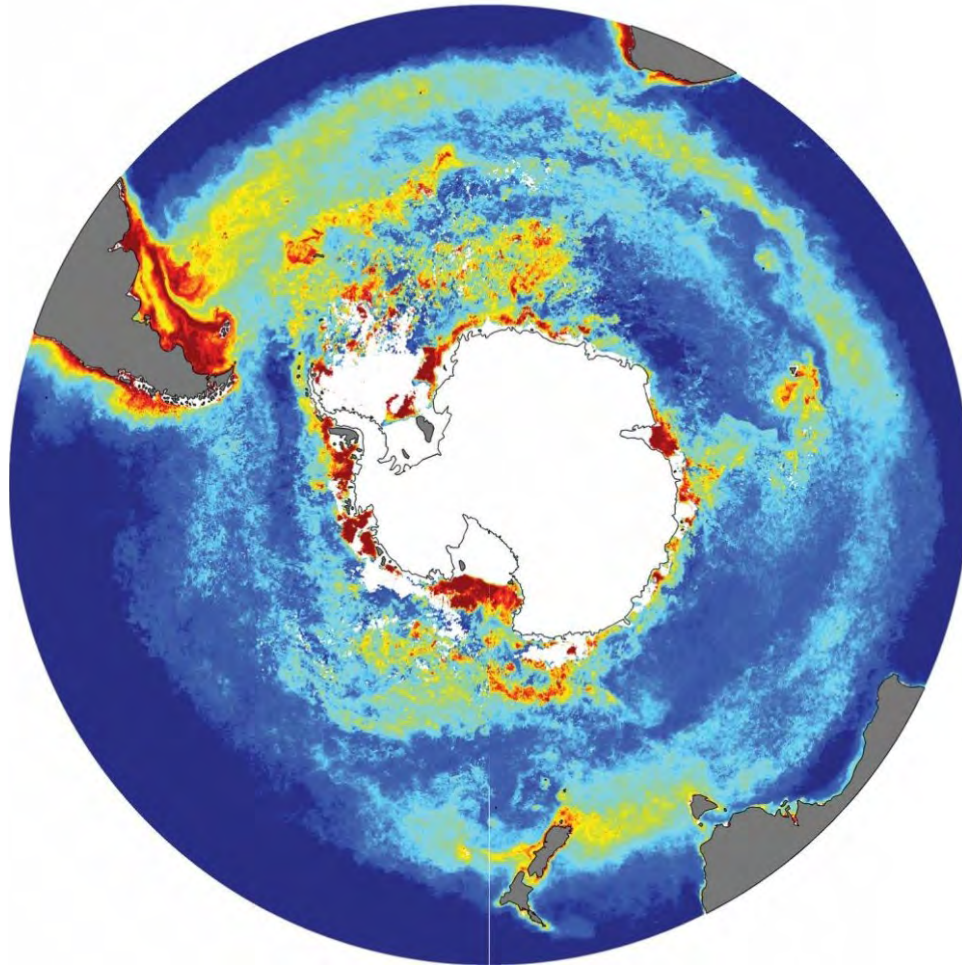


Figure 1: Quantitative biomass estimates of mesopelagic groups require to combine multi-observation systems.



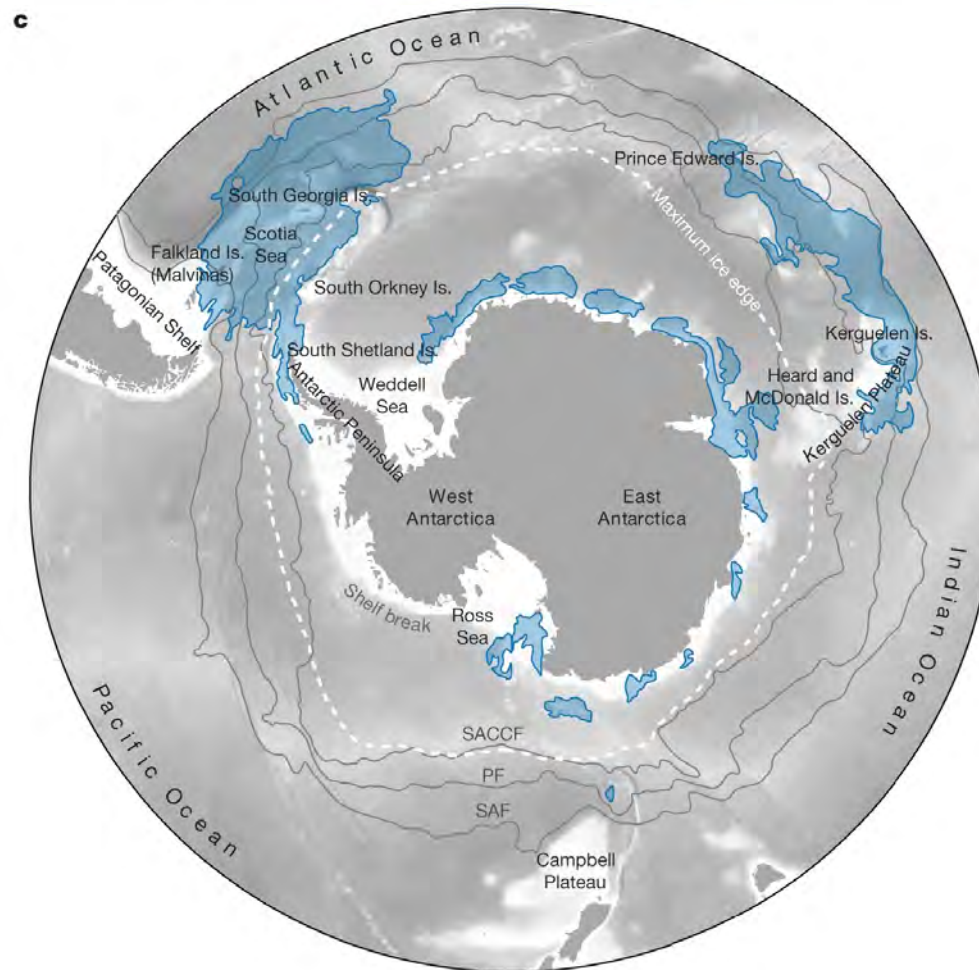
Thank you

Production heterogeneity in the Southern Ocean



© Robert Johnson

Production heterogeneity in the Southern Ocean



Hindell et al. 2020

Production heterogeneity in the Southern Ocean

