BIOGLIDER

Monitoring pelagic communities of the Barents Sea with a novel Bioglider

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BIOGLIDER

Genesis of the Bioglider

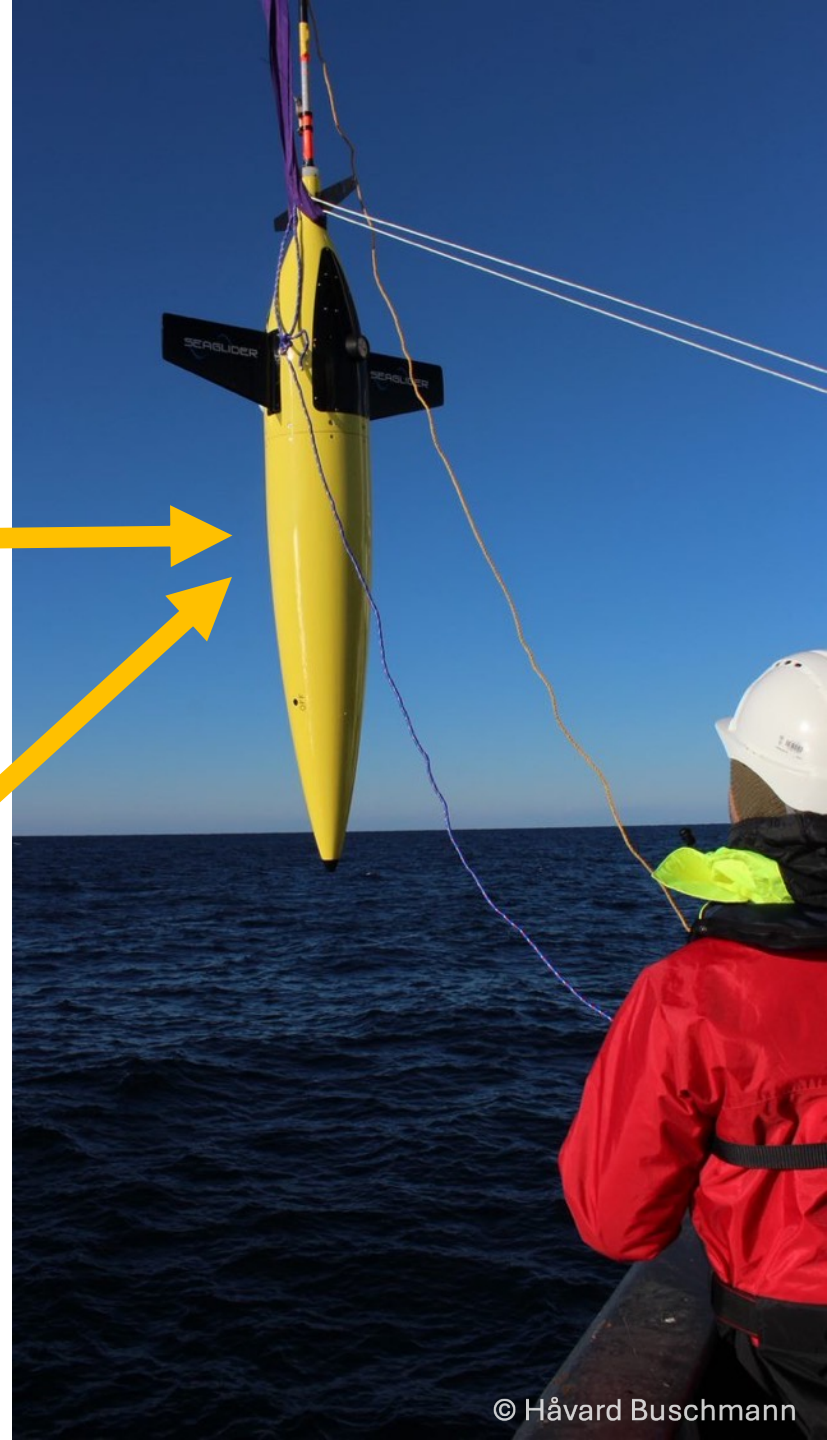
Strengthen the biological observation capacities of gliders

Optical camera
Optical camera for particles and zooplankton counting

Hydroptic UVP6-LP

Echosounder
Broadband scientific single-beam echosounder for fish and zooplankton distribution

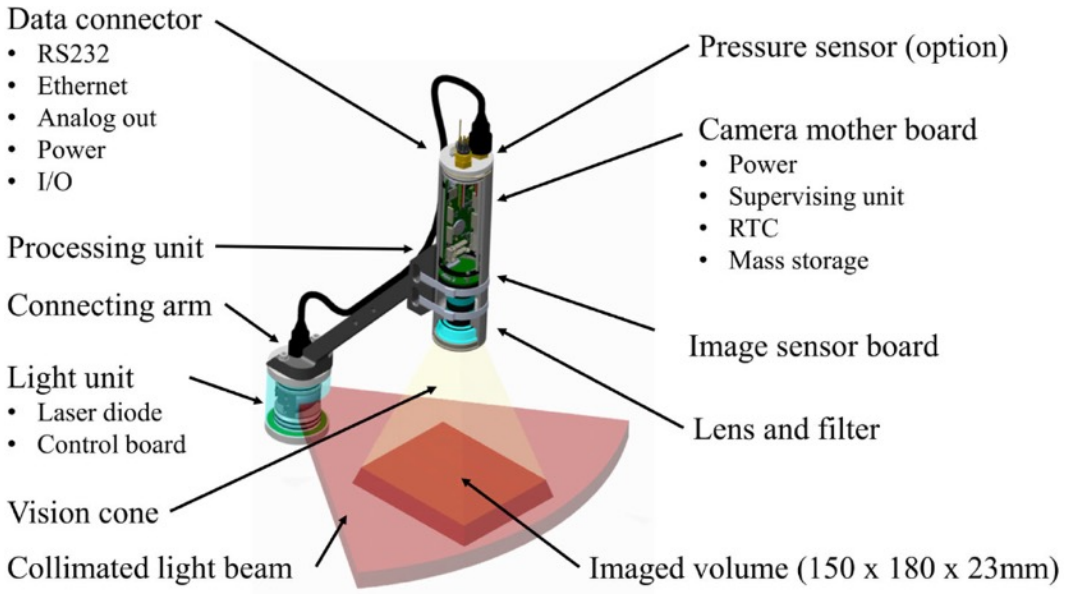
Kongsberg Discovery WBT Mini
333 kHz single beam



Instrumentation

Hydroptic UVP6-LP:

- Continuously recording (downward and upward)
- Sampling volume: 150 x 180 x 23 mm = 0.7 L^{-1}
- Data processing using machine learning:
  - Particle size distribution (> 100 µm) – *Ecopart*
  - Particle "identity" (> 620 µm) – *Ecotaxa*

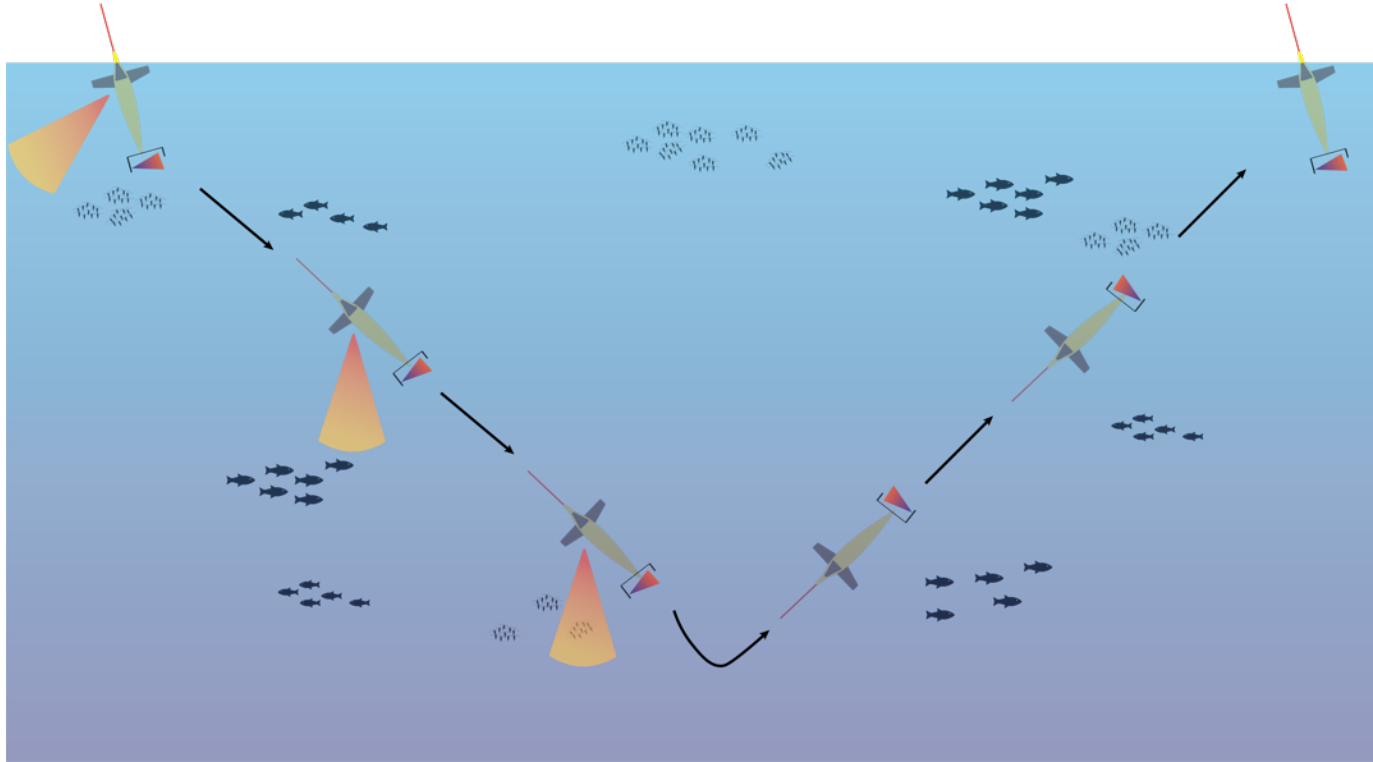


Picheral et al. 2022 L&O Methods

Kongsberg Discovery WBT Mini:

- Recording on downward profiles
- 333 kHz single beam transducer (ES333-7CDK)
- Operated in broadband mode (FM): 280-380 kHz
- 50 m range
- Sampling volume increases with range

  Ex: ca. 30 m^{-2} beam footprint at 50 m range

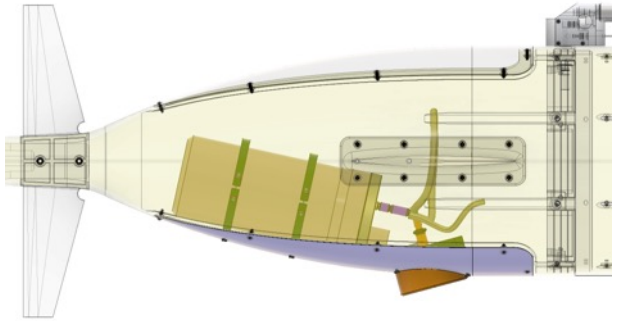


BIOGLIDER

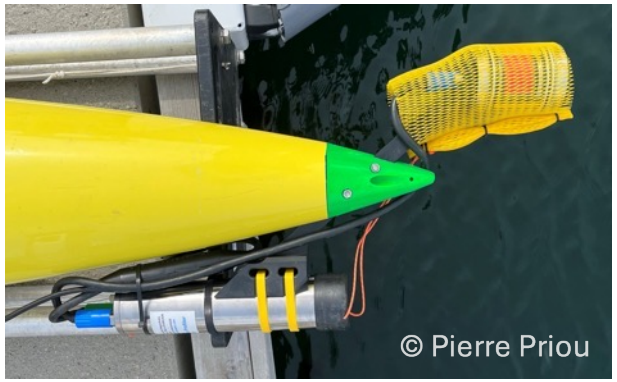
Evolution of the Bioglider

Version 1 - UVP6 *(2021)*
- UVP6 integration

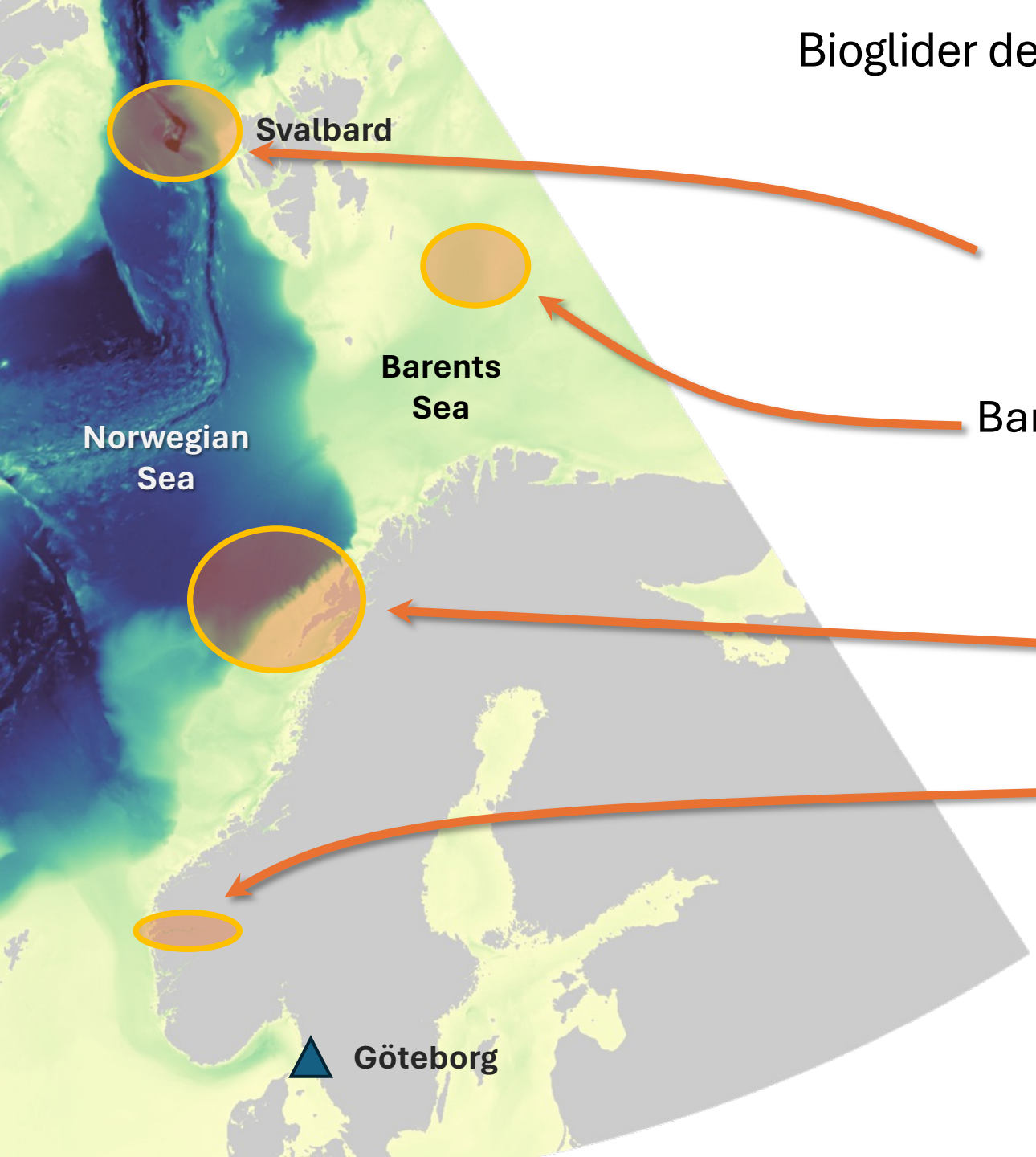
Version 2 - UVP6 and WBT *(2022 - 2023)*
- Echosounder integration
- Challenging flight control (pitching up difficult)



Version 3 - UVP6 and WBT *(2024)*
- Compact version
- Front-brass weight replaced by 3D-printed UVP6 plastic bracket
- Better flight control



Bioglider deployments

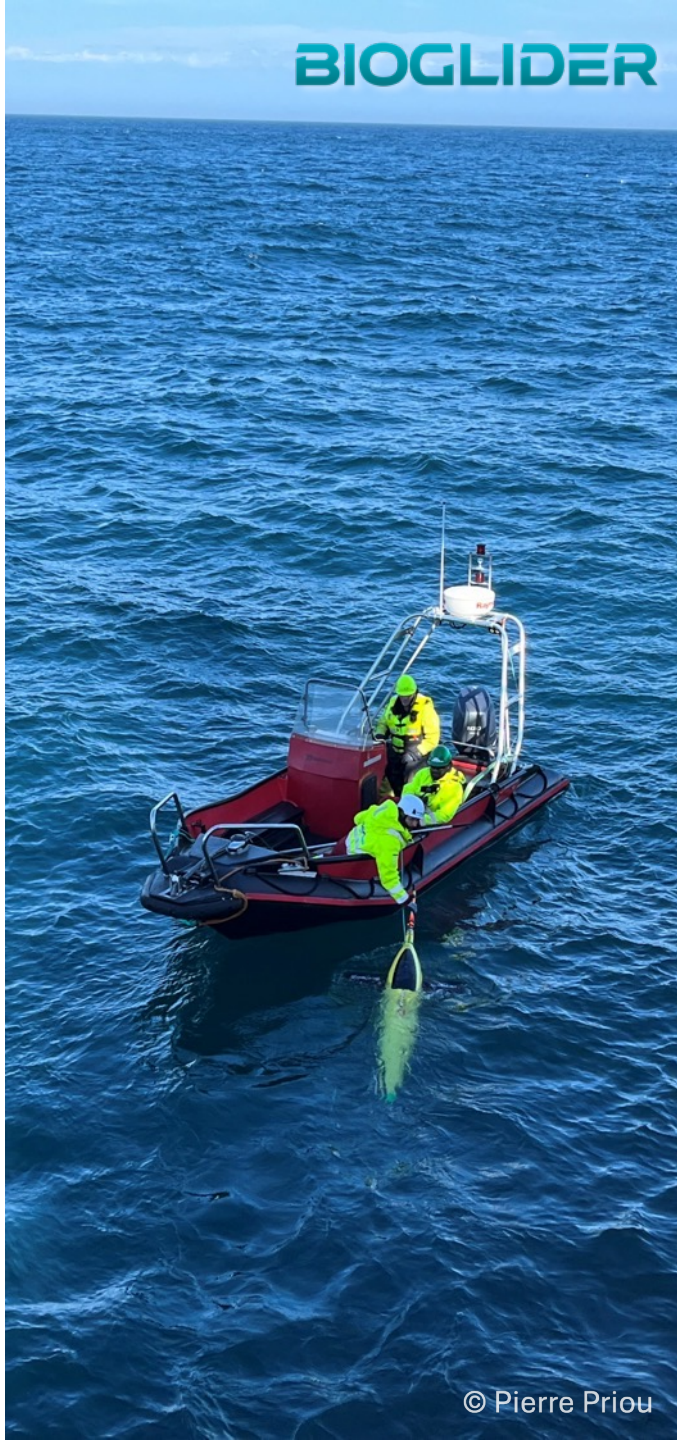


Fram Strait
2023

Barents Sea Polar Front
2021, 2022, 2023

Lofoten-Vesterålen
2021, 2024, *2025*

Sognefjorden
2024

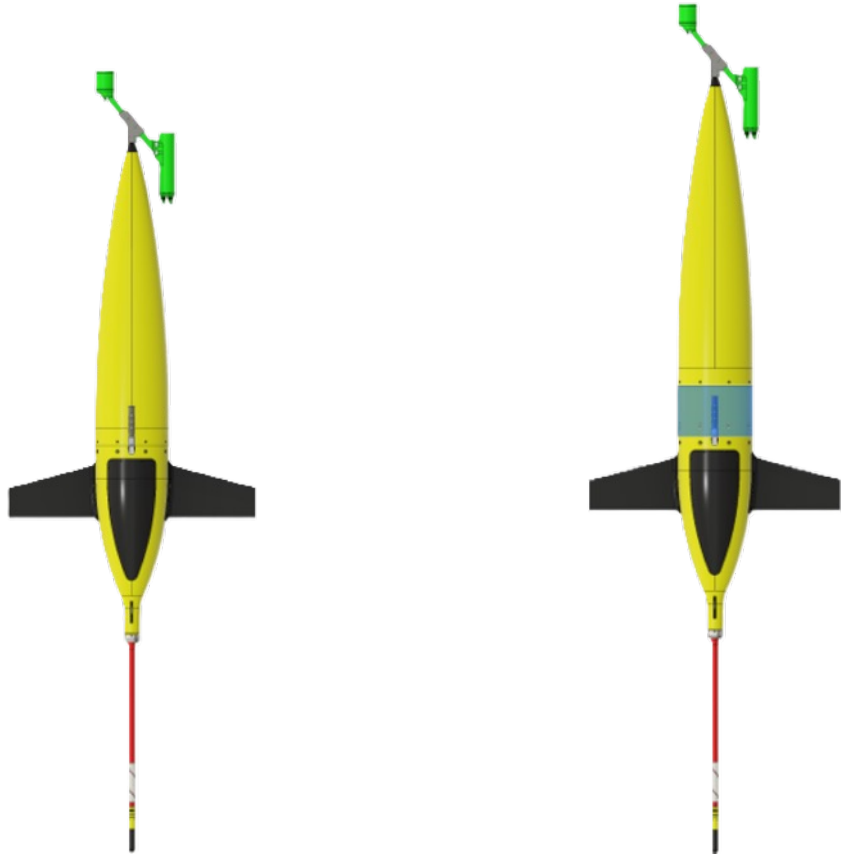


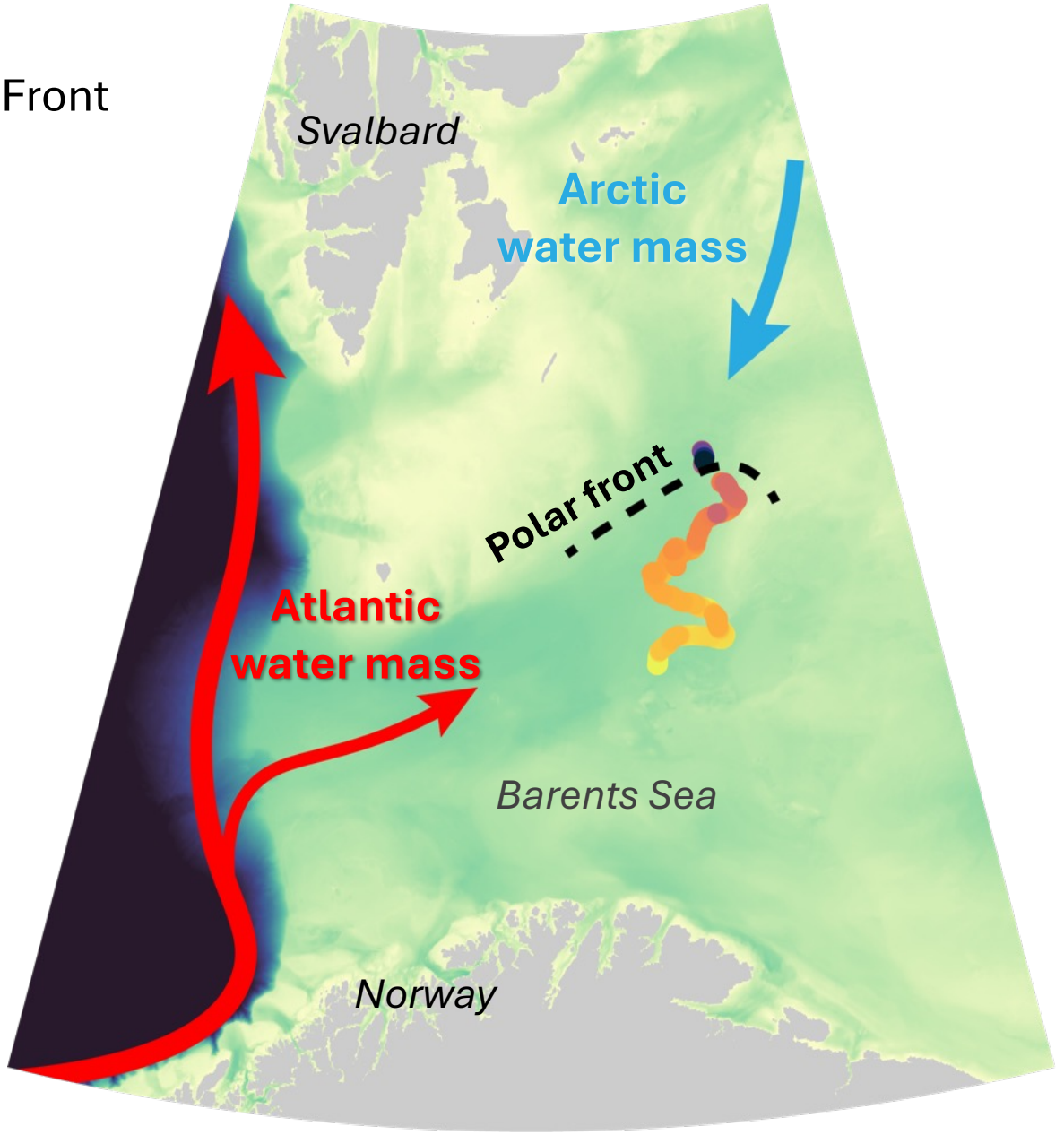
Barents Sea Polar Front

- Test the flying capacities of the Bioglider
- Improve ecological knowledge of the Polar Front
- Two deployments in May

2021 (Version 1) ***2022 (Version 2)***

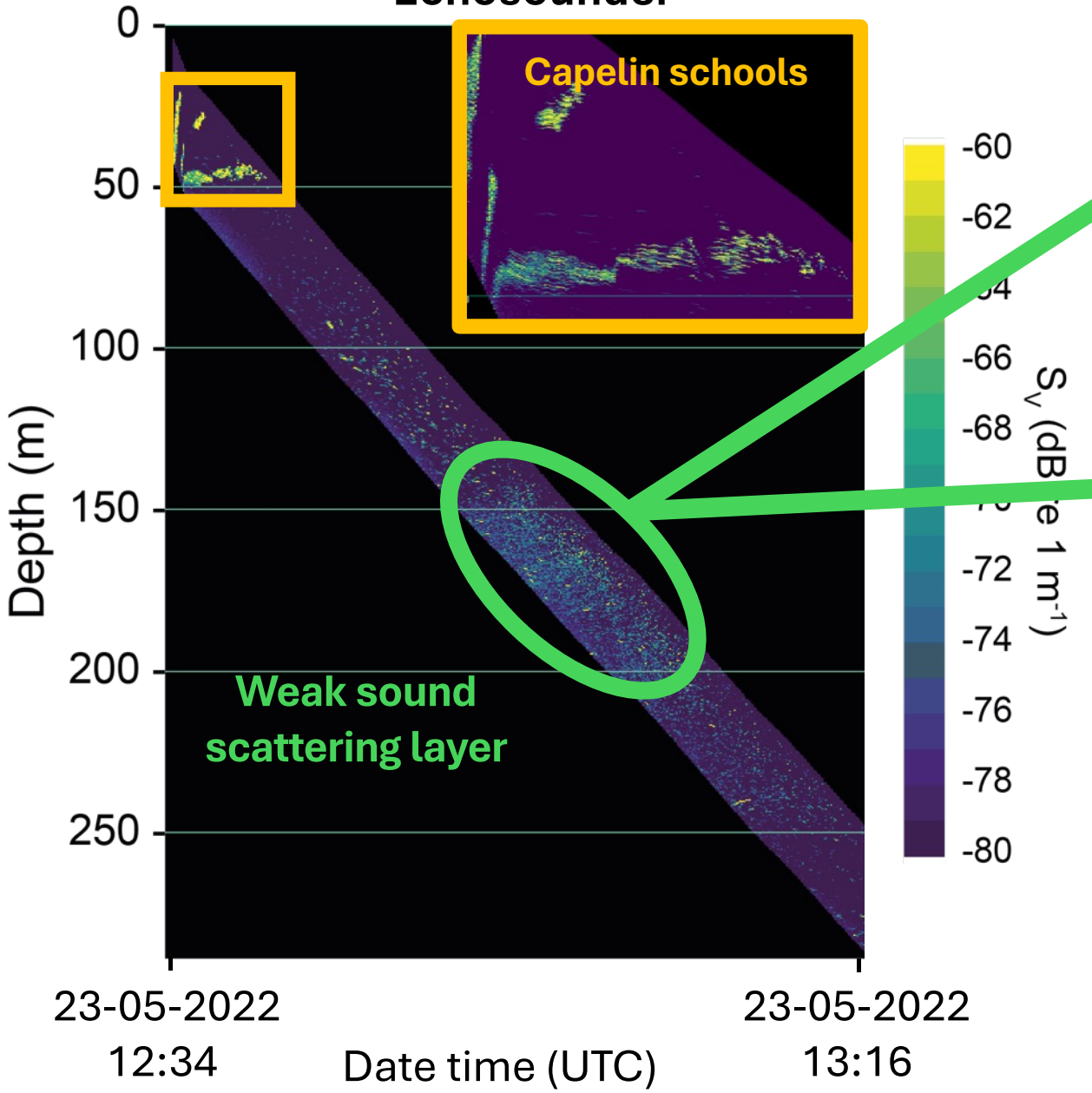
UVP6 *UVP6 + WBT*





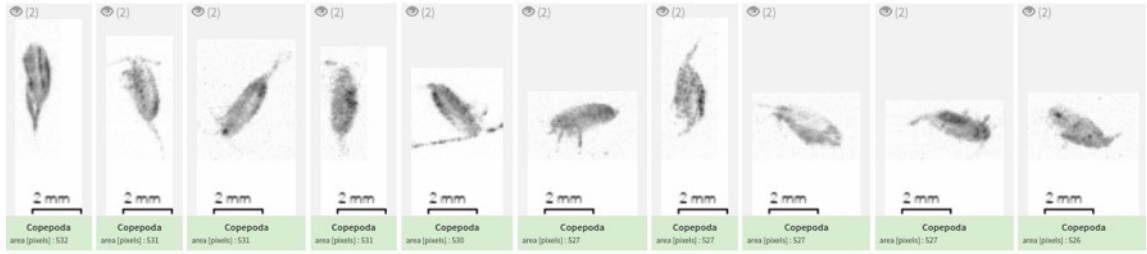
Sensor complementarity

Echosounder

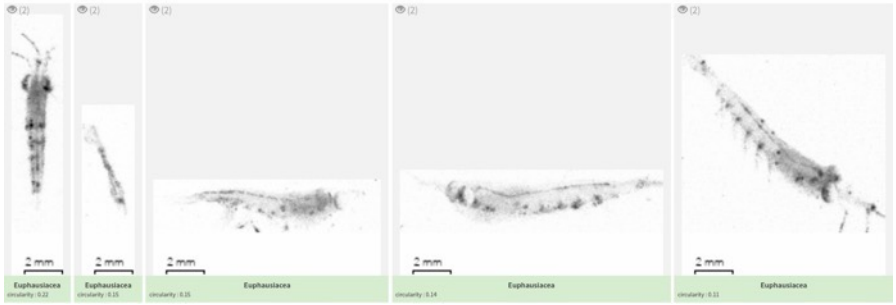


Optics

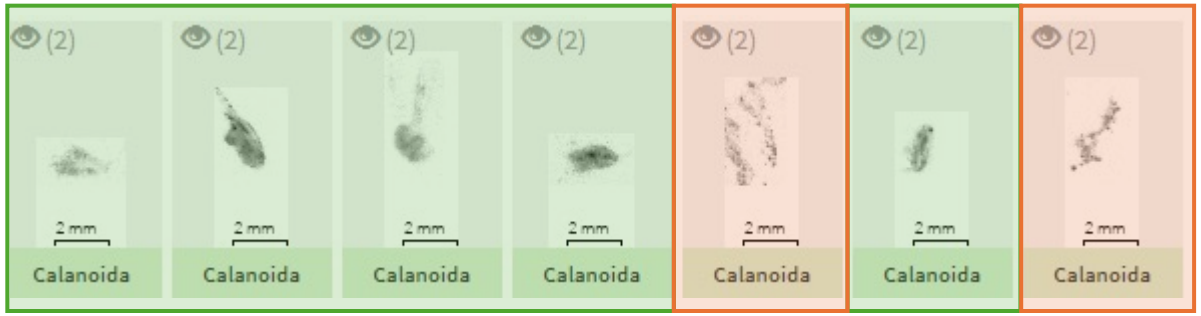
Copepods



Krill



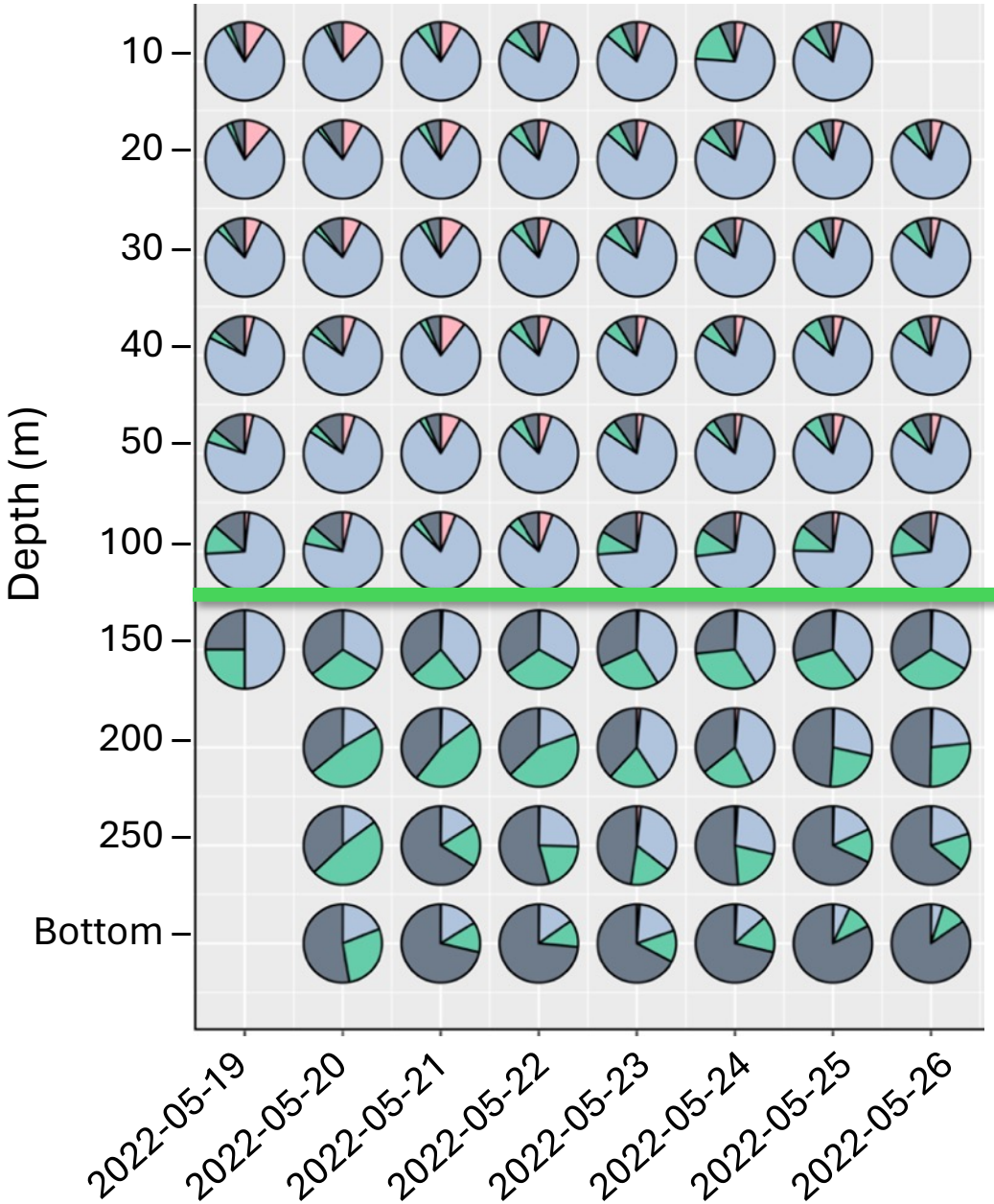
But … classification can be challenging



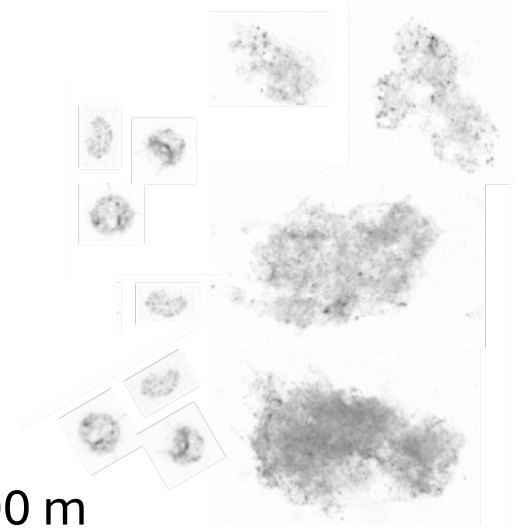
Copepod

Marine snow

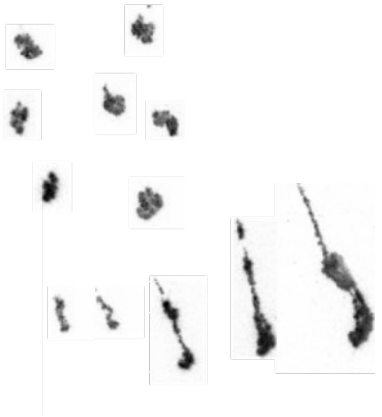
Marine snow morphotypes and distribution



99% marine snow

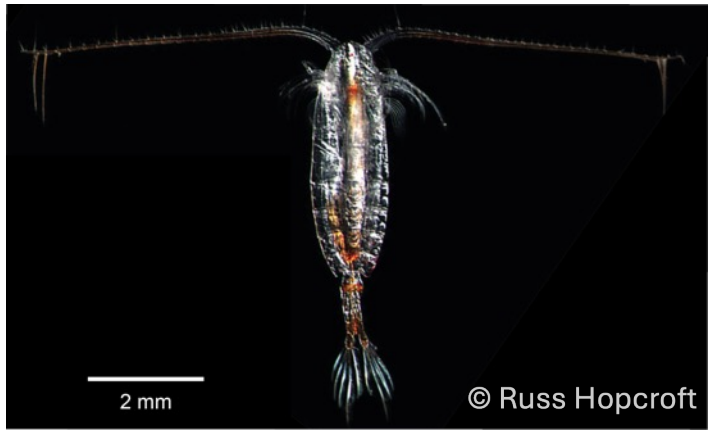


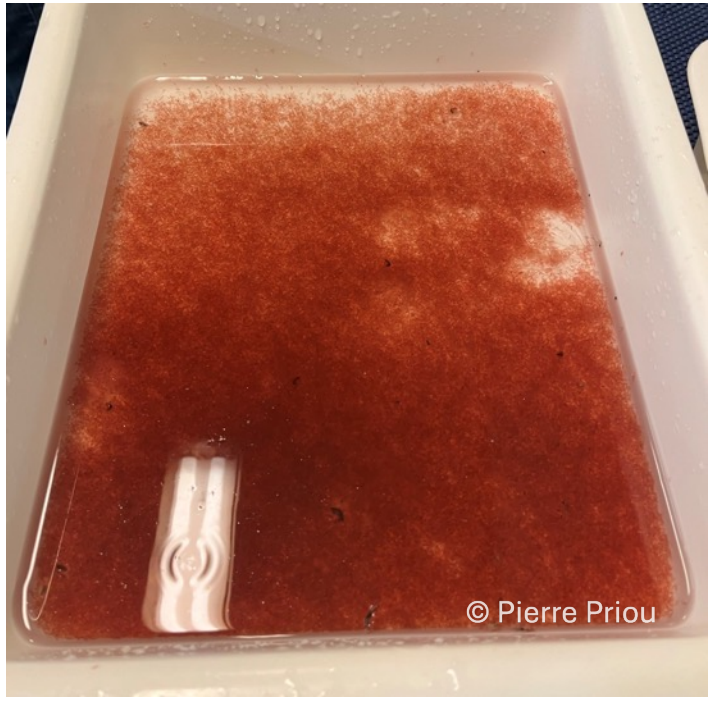
Compositional shift below 100 m



Current projects using the Bioglider (2024-2027)

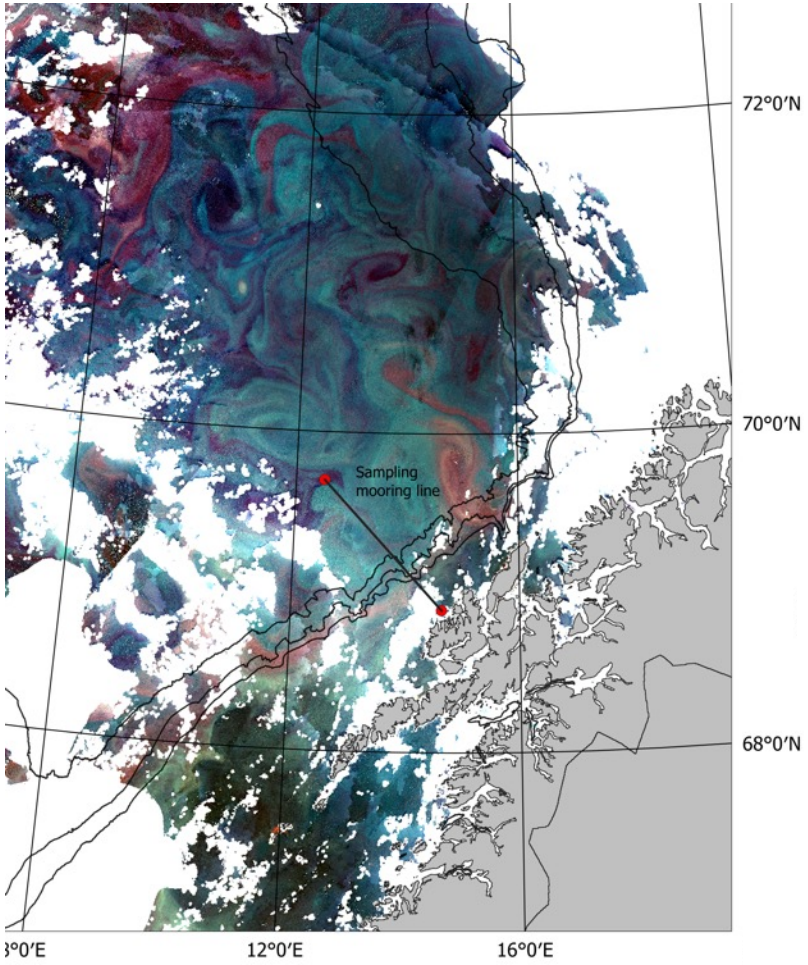
Focus on *Calanus* spp.





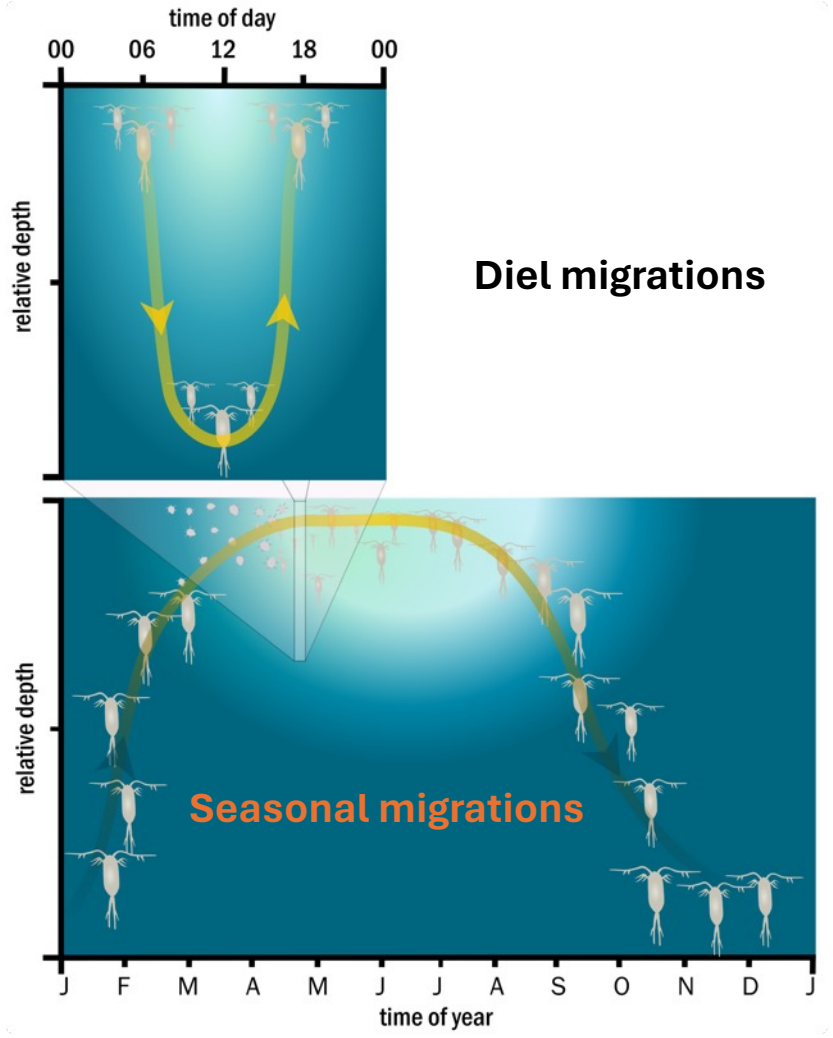
Calanus form surface swarms visible with remote sensing

(OLCI enhanced RGB 300m 95% method)



Basedow et al. 2019 Sci. Rep.

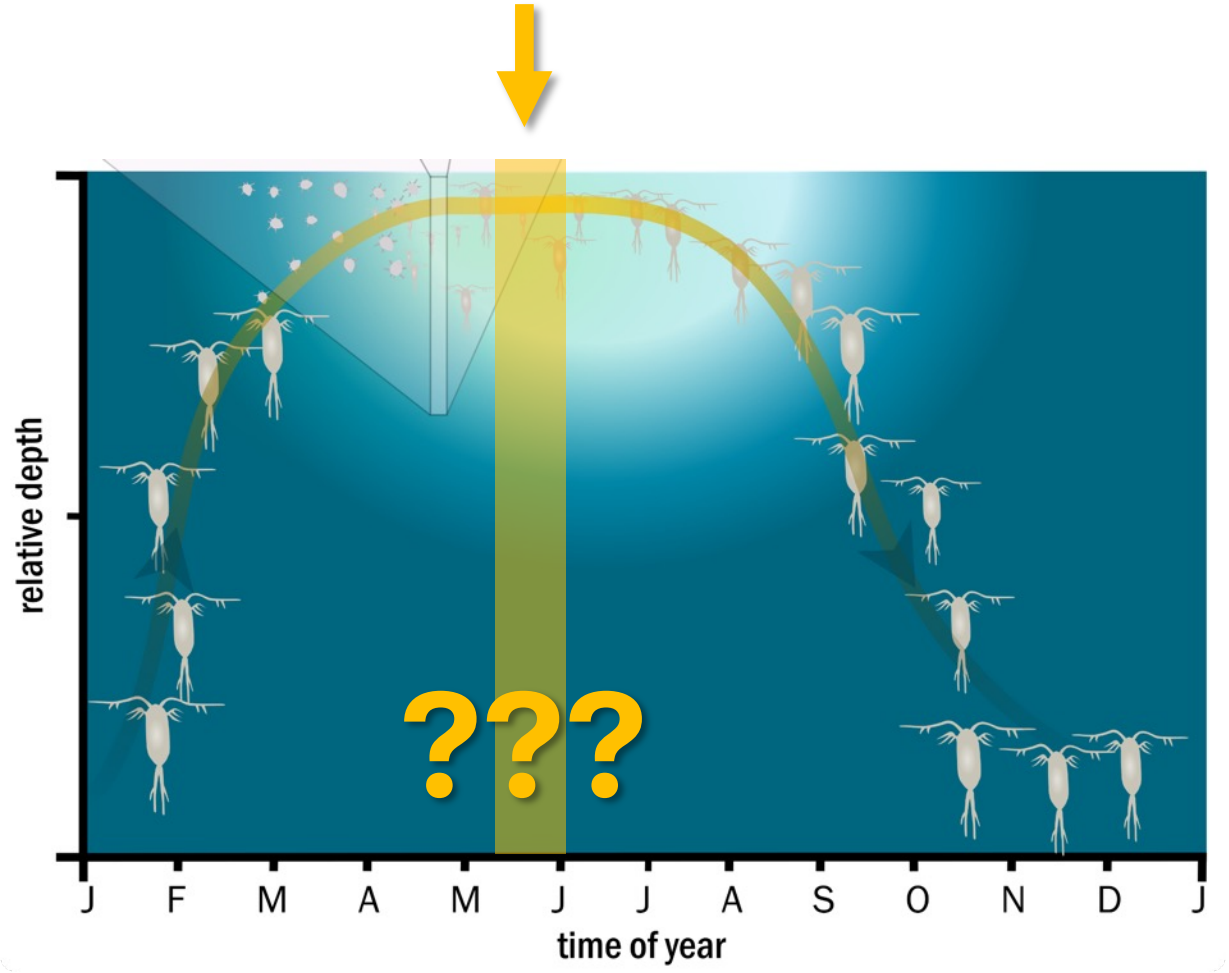
Complex behaviour



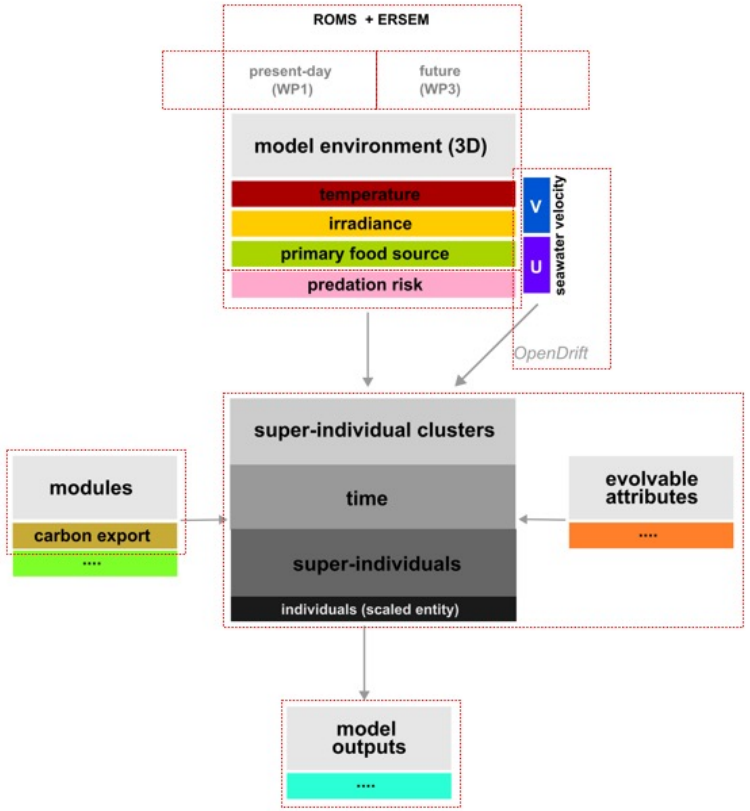
Bandara et al. 2021 Biol. Rev.

Calanus distribution during the spring bloom

- In spring, most *Calanus* are at the ocean surface grazing on phytoplankton
- But, the mechanistic model of *Calanus* (PASCAL) predicts part of the population staying at depth.



PASCAL
Pan-Arctic Behavioral and Life-history Simulator for Calanus
version 4 (2024-2027)



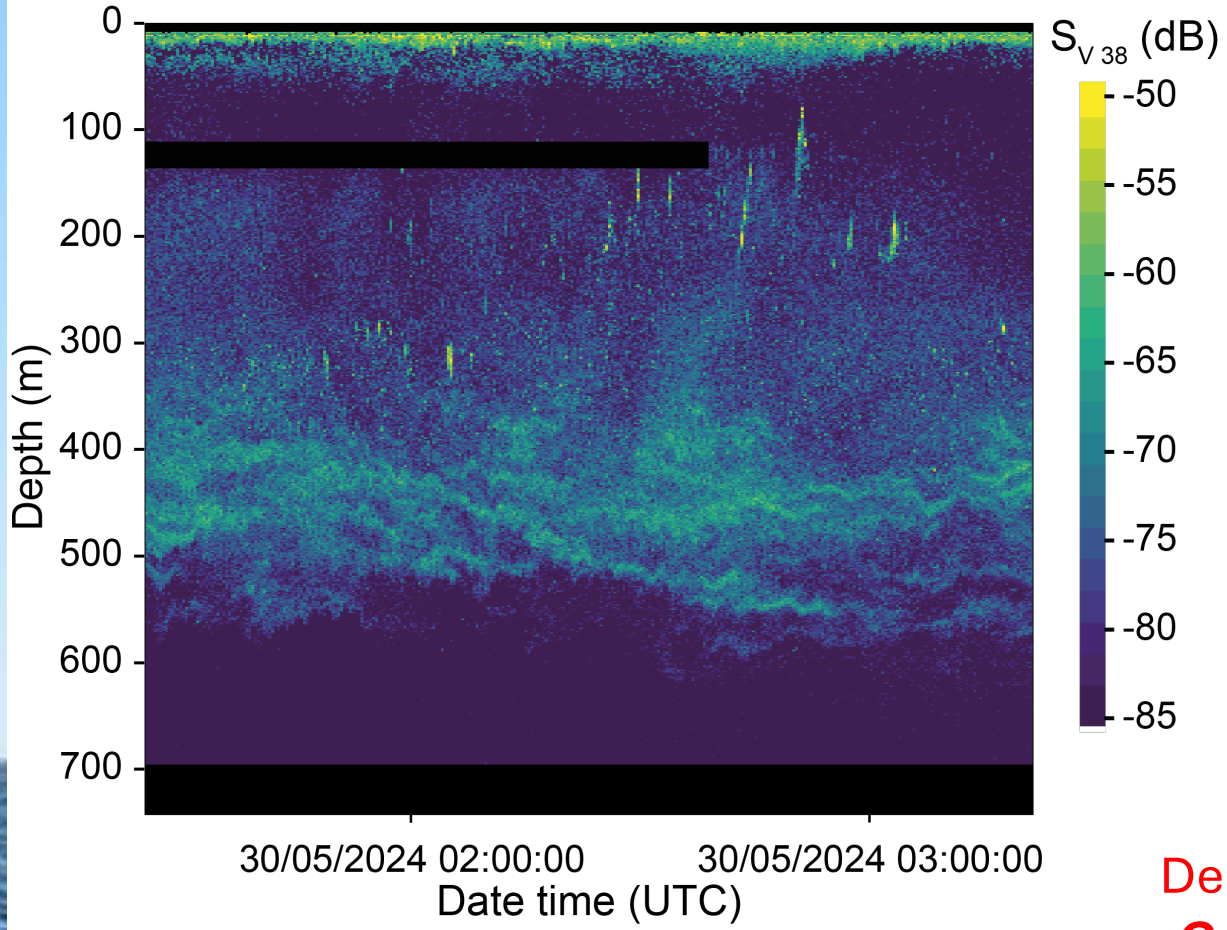
Bandara et al. *in prep*

https://github.com/Kanchana-Bandara/PASCAL-v4.0

Bringing high frequency acoustics to depth

Shipborne echosounder

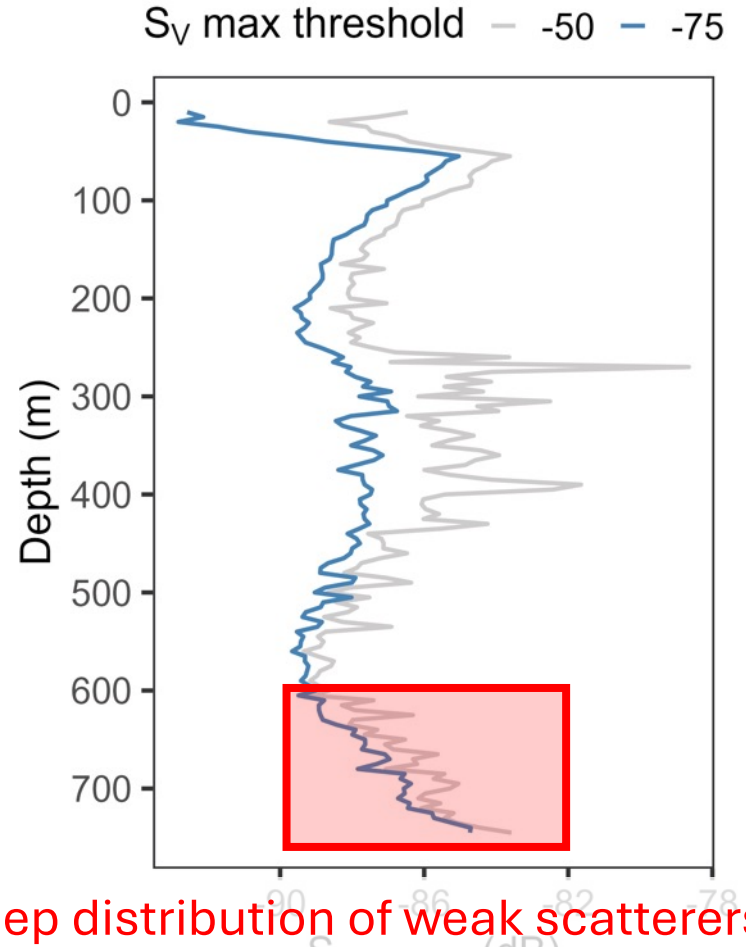
38 kHz



→ ***Calanus*** **are too small to be detected at 38 kHz**

Seaglider 02/06/2024 06:00

280-380 kHz

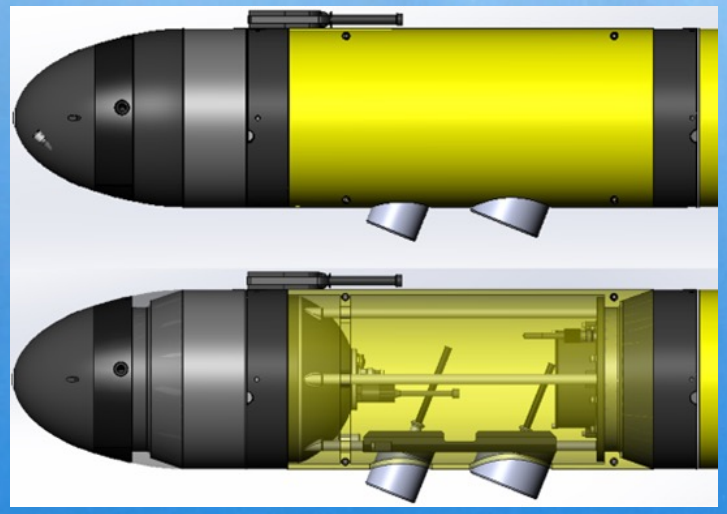


Deep distribution of weak scatterers

Calanus **already overwintering in May?**

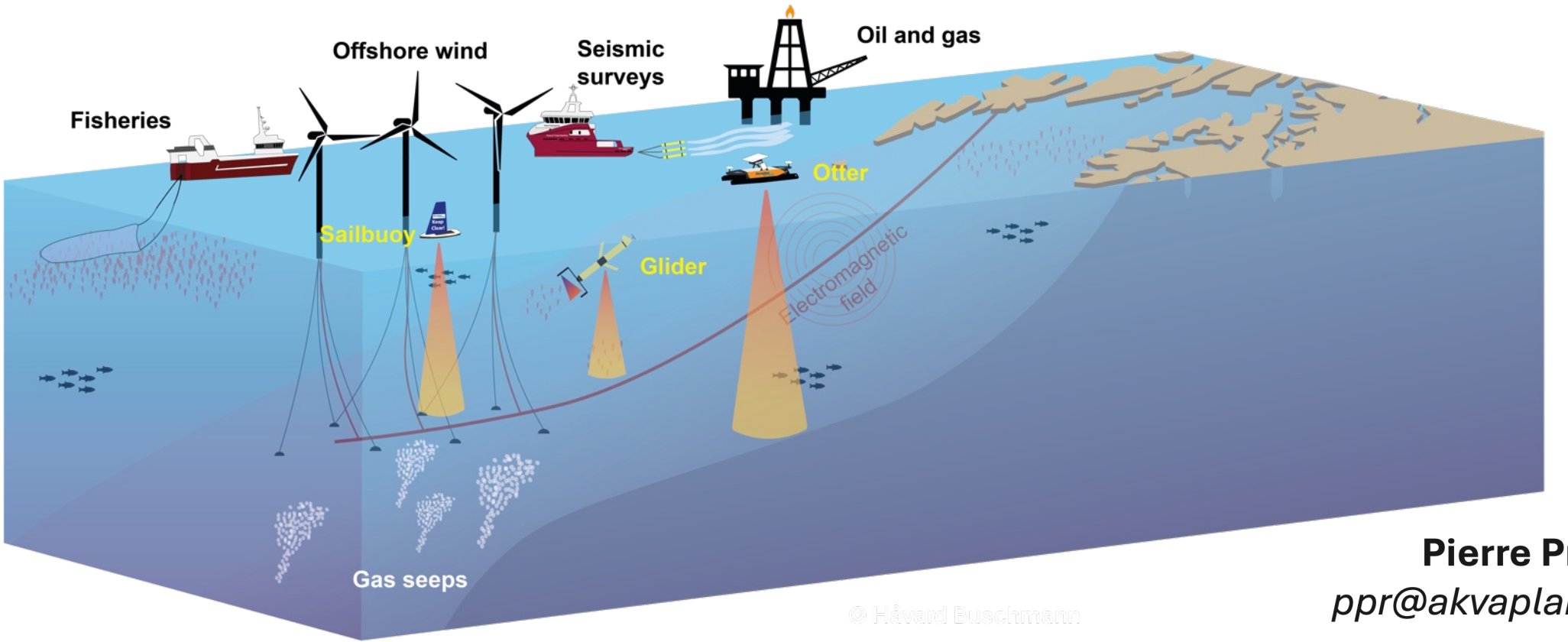
Upcoming integration in the Slocum G3

To be tested in summer and deployed in autumn 2024



Summary

- Biogliders can help understand the ecology of small organisms in areas inaccessible to surface-based instrumentation
- High complementarity between sensors (environmental, optical, and acoustic)
- Currently using the Bioglider to validate mechanistic models of *Calanus*
- Biogliders may be used for ecosystem monitoring stand-alone or as a *"force multiplier"*



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