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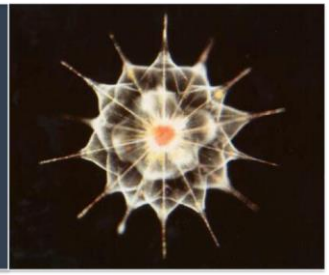
PlanktonID 

Combining deep learning, *in situ* imaging and citizen science to resolve the distribution of zooplankton in major upwelling regions

Rainer Kiko, Svenja Christiansen

Jan Taucher, Reinhard Koch, Martin Schröder, Lars Stemmann

https://planktonid.geomar.de

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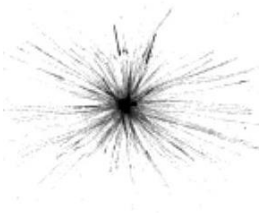
Phaeodaria

Collodaria



Foraminifera

Rhizaria = unicellular with nucleus and pseudopodia, often with photosymbionts, few µm to several mm diameter, often very fragile

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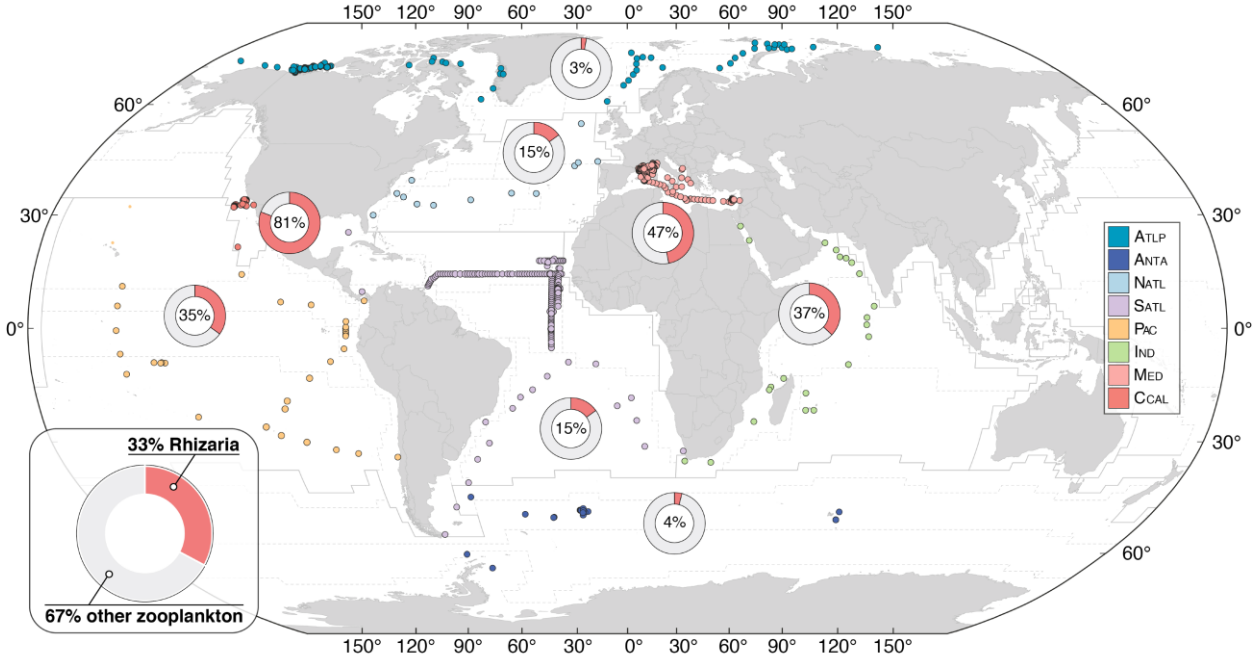
In situ imaging reveals the biomass of giant protists in the global ocean

Biard, […], Kiko et al. Nature, 2016



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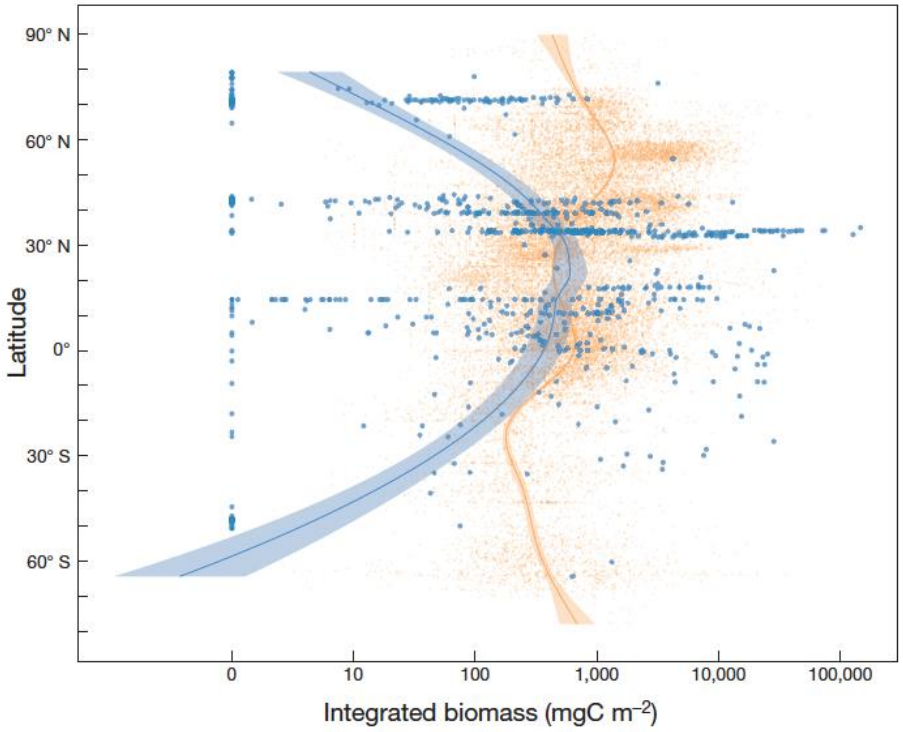

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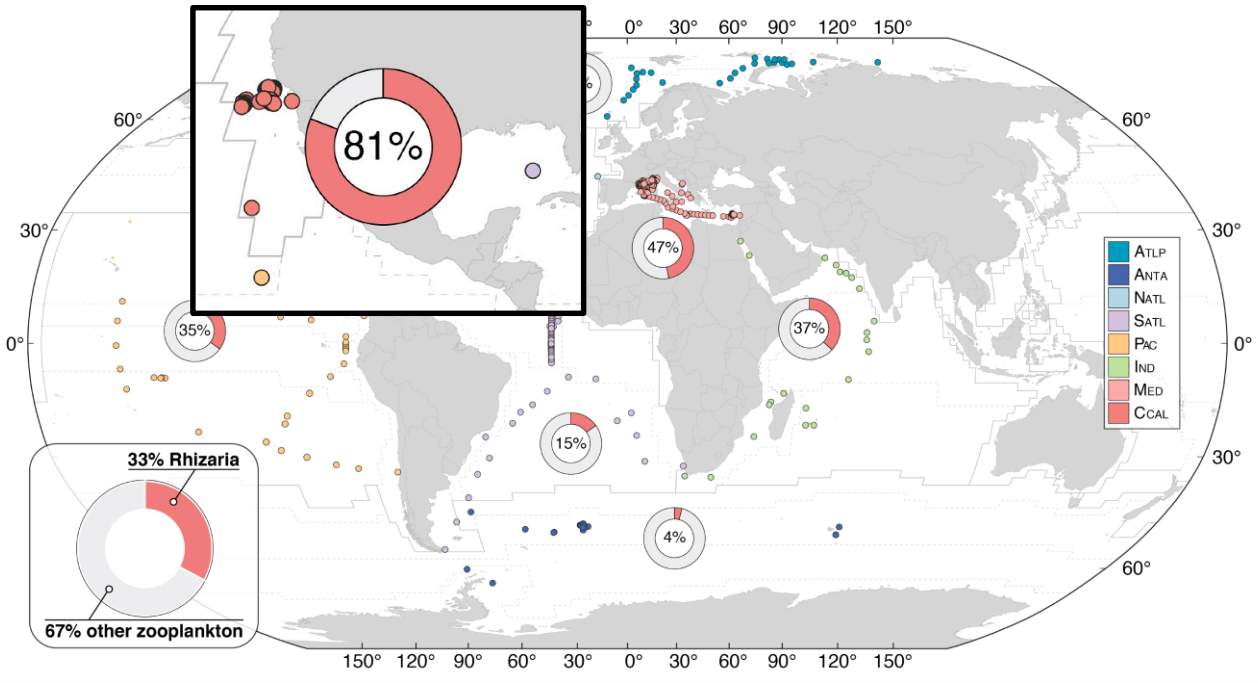

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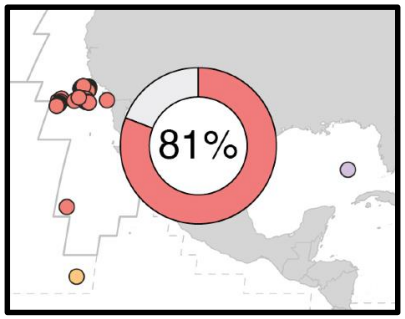

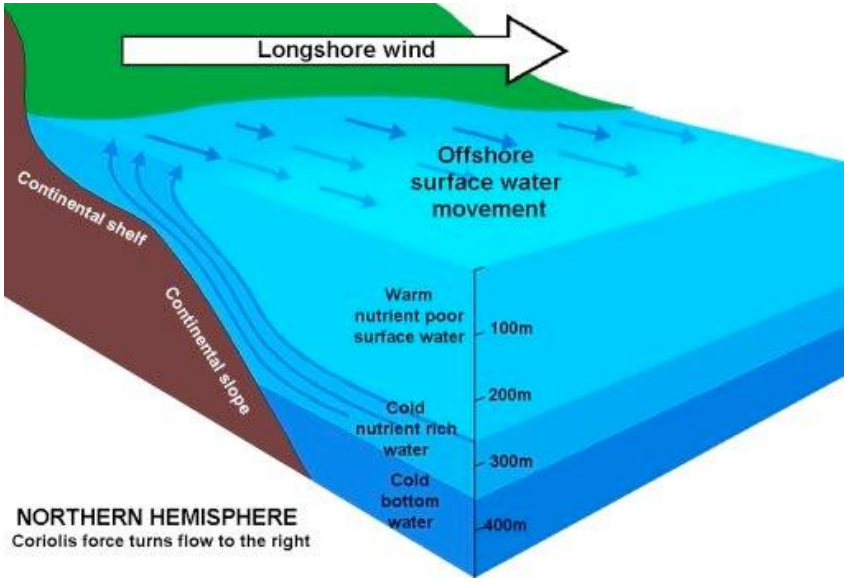

- High productivity
- Important fisheries
- Hypoxic to anoxic midwaters
- Important for the nutrient budget of the ocean
- **Are rhizaria very abundant in all upwelling regions?**

http://www.seos-project.eu/modules/oceancurrents

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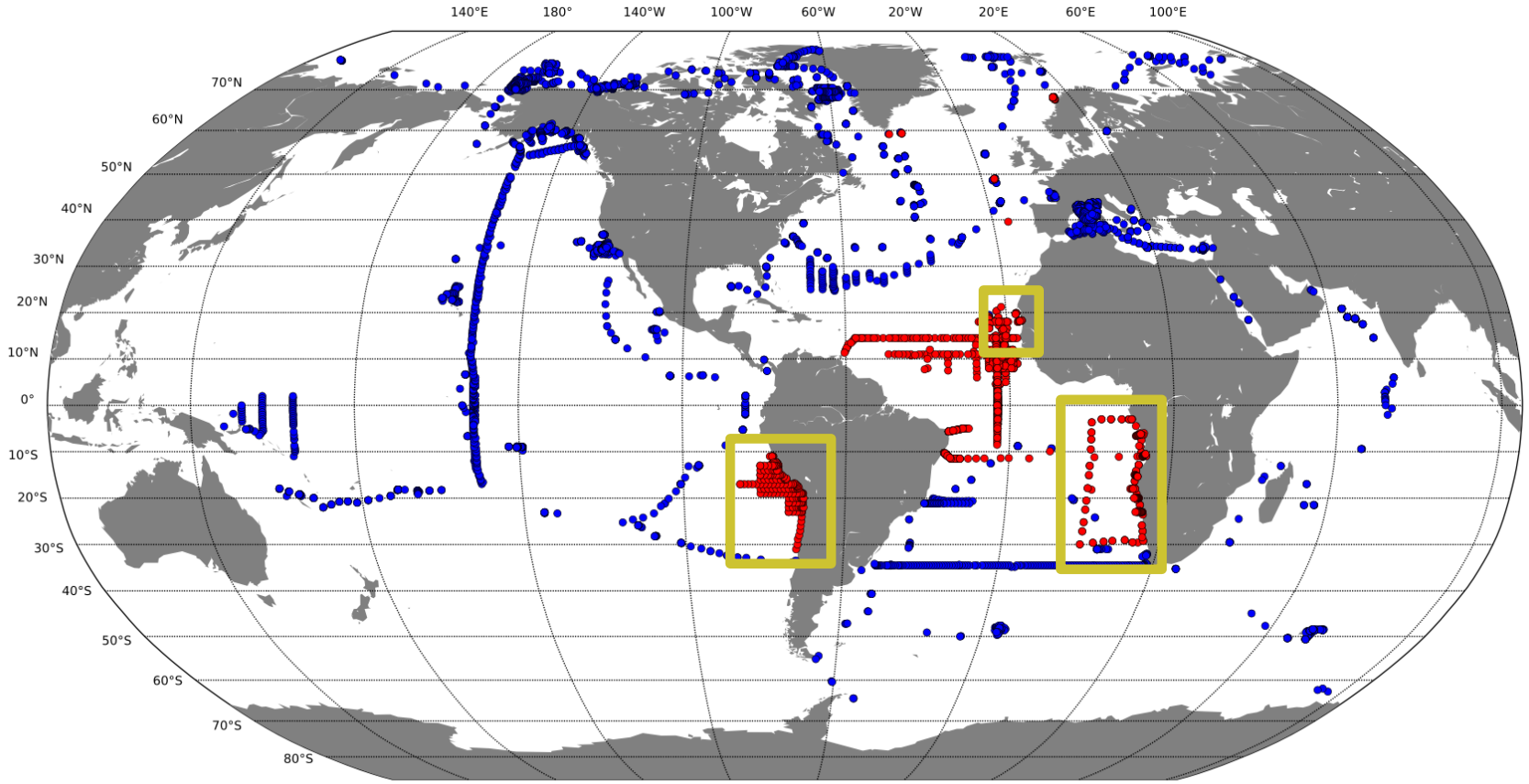

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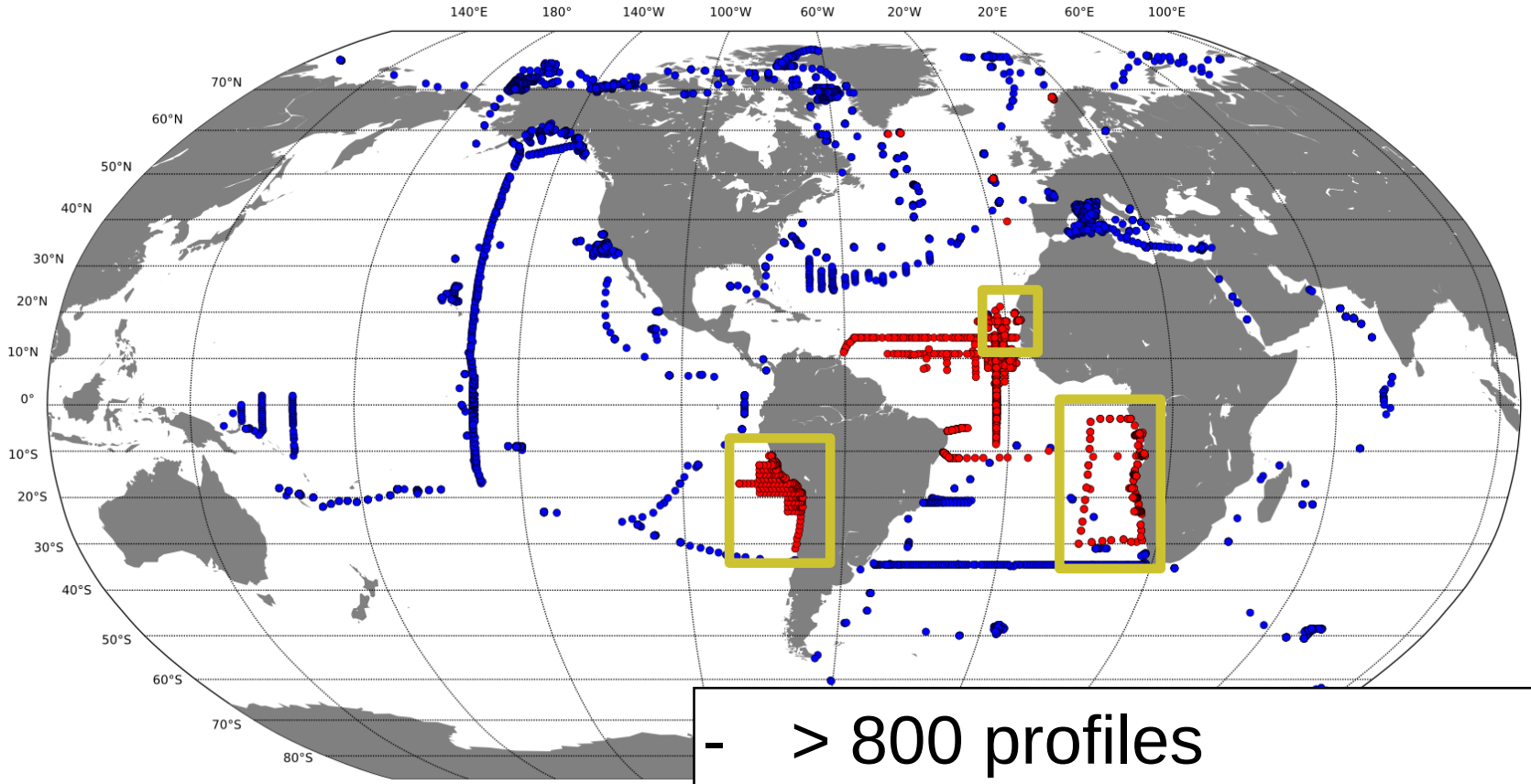

- > 800 profiles
- ~ 2.2 Mio images

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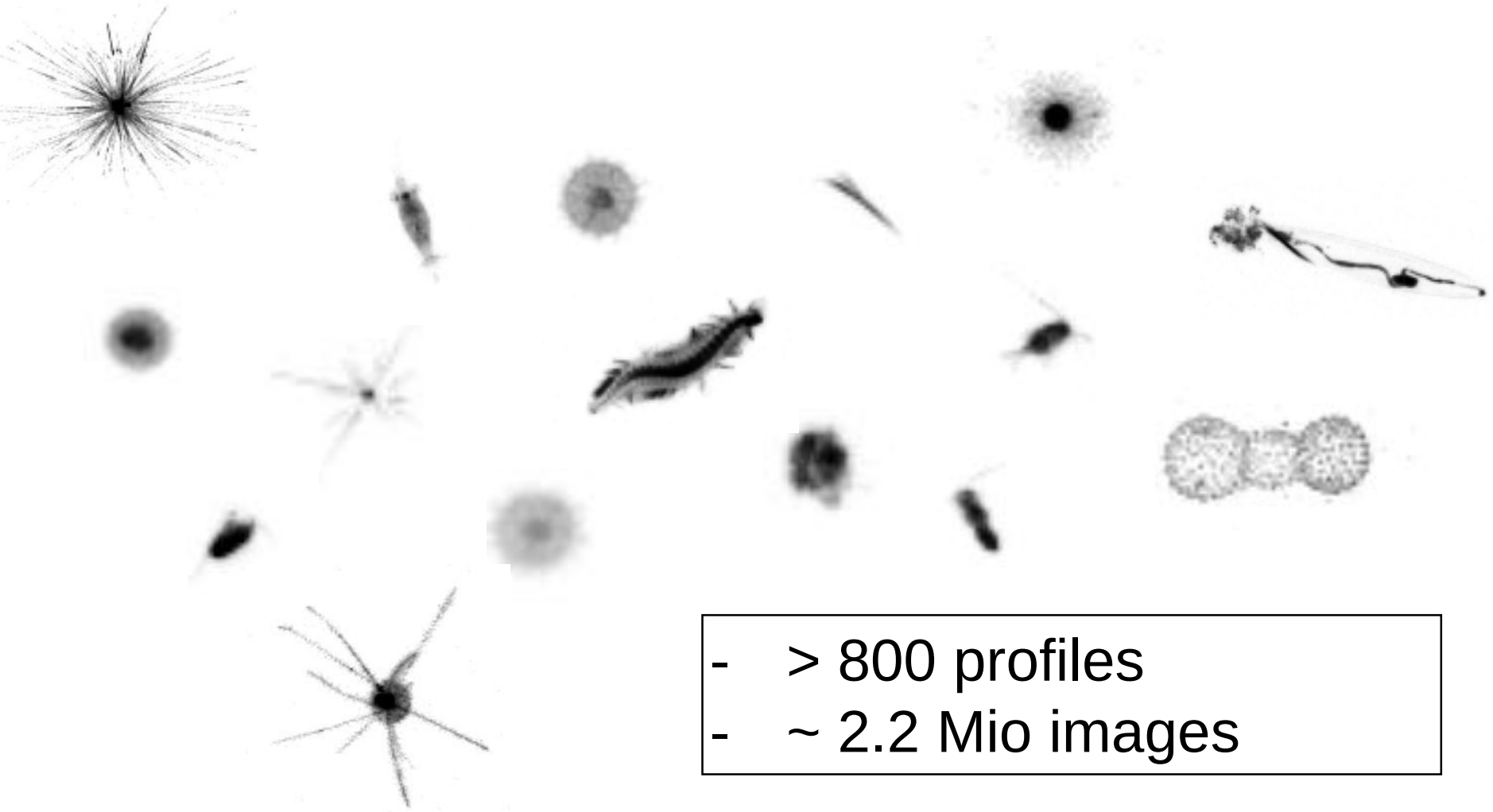

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Deep Learning prediction with Caffe (Python)

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Computer analysis

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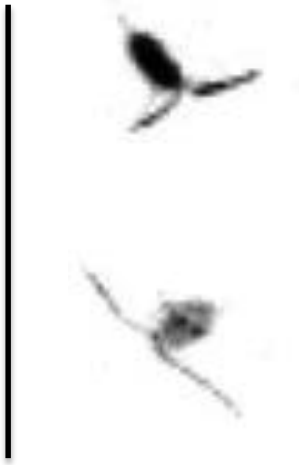
Computer analysis

Examples



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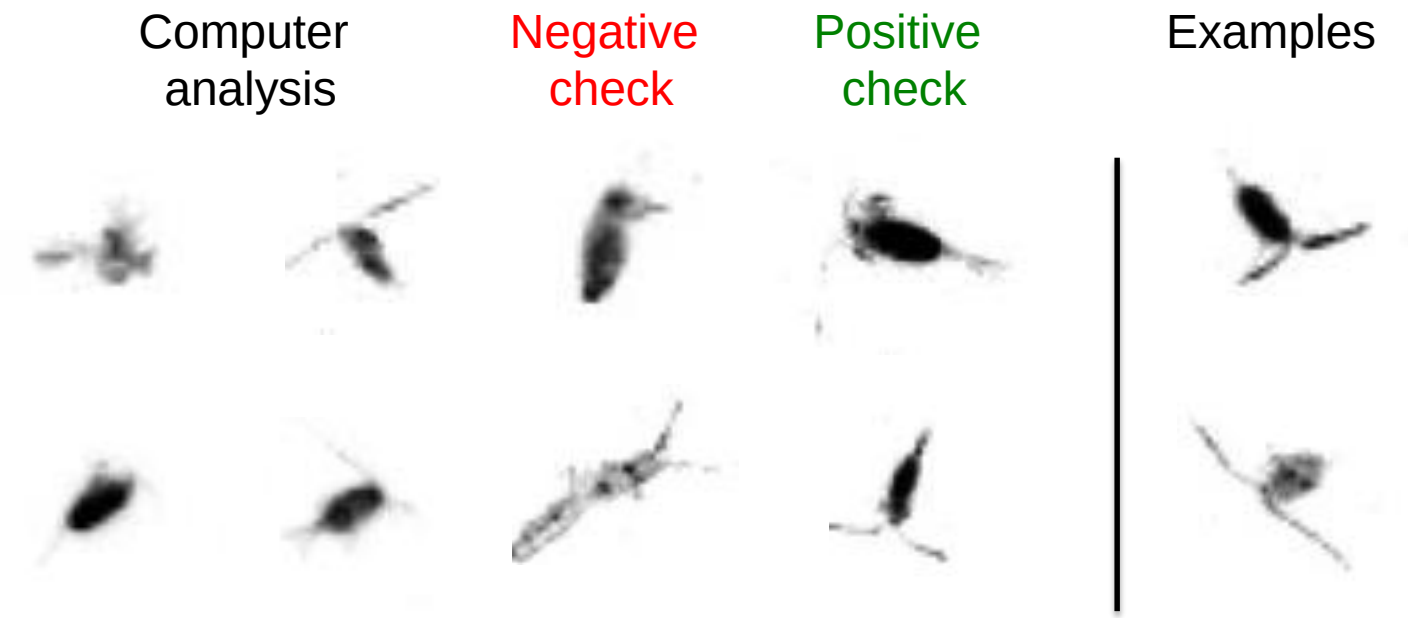

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Examples

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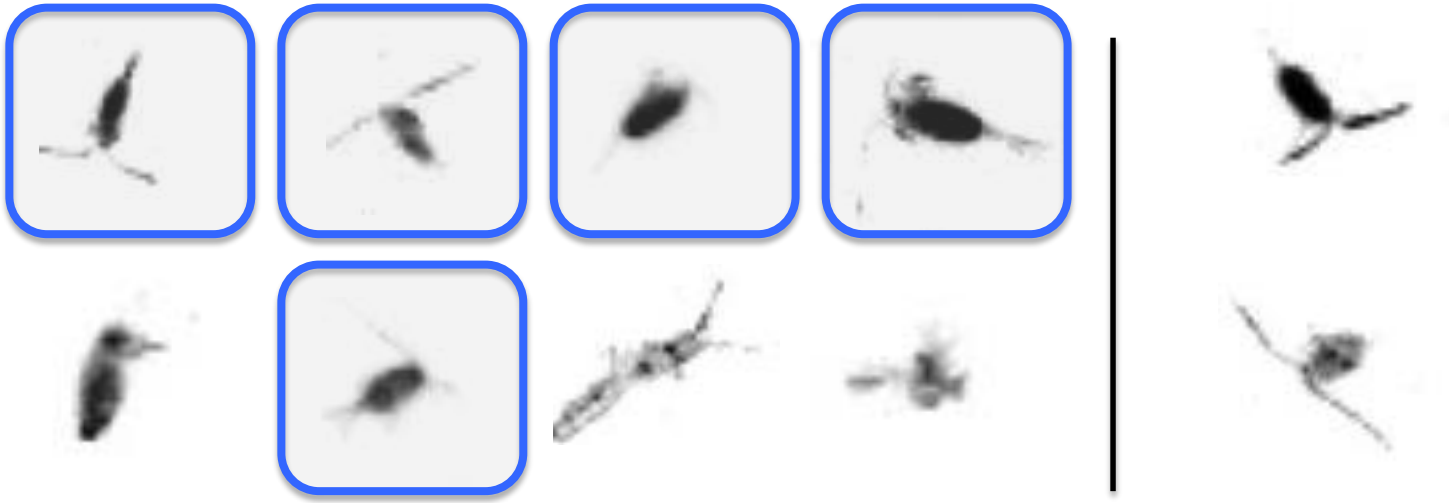
Examples



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Confidence in user: 100%

Examples

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Confidence in user: 100%

Examples

3 predictions confirmed, 1 rejected

10x

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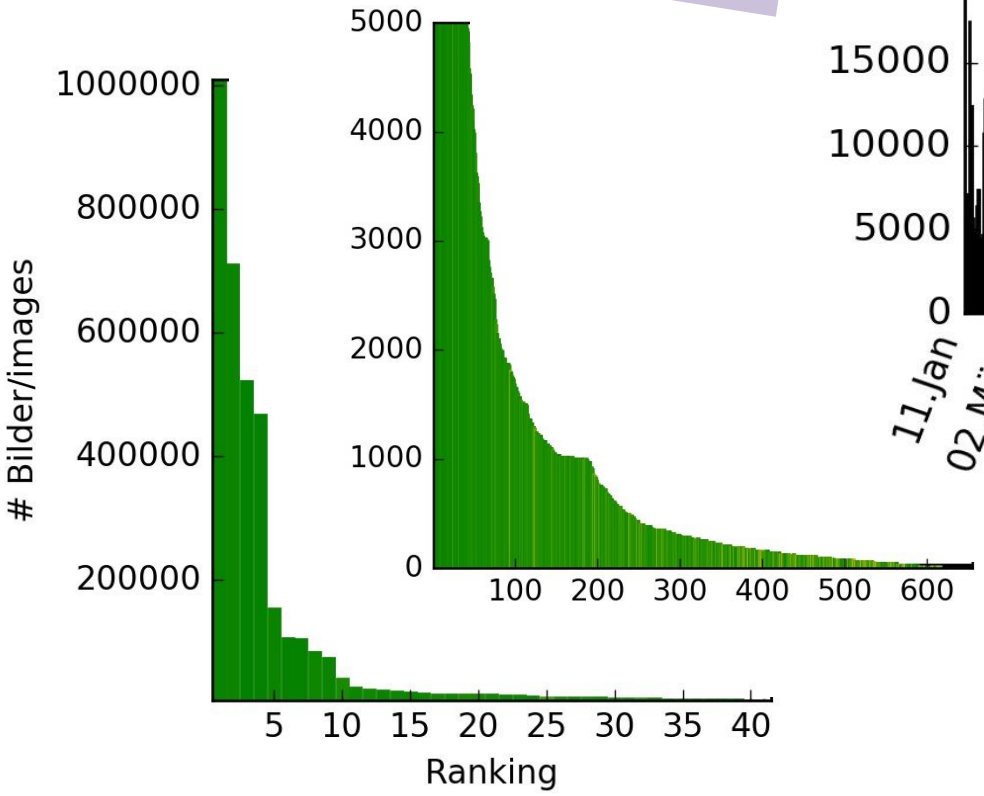
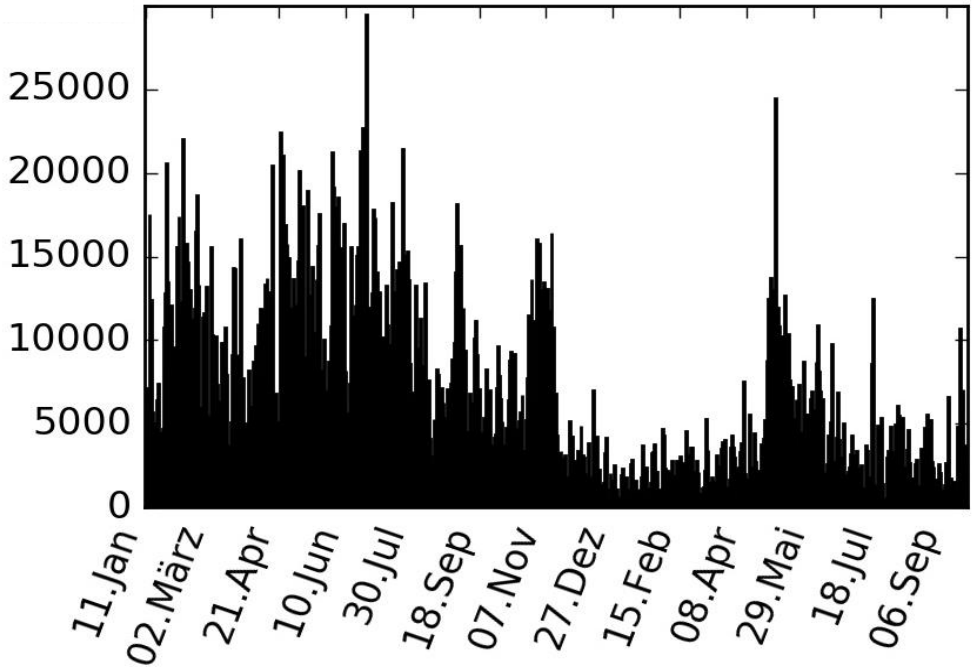
„More useful than Sudoku!"





- 3.9 Million image validations

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Calculation of PlanktonID score

EcoTaxa 1.3

http://ecotaxa.obs-vlfr.fr/

Final validation

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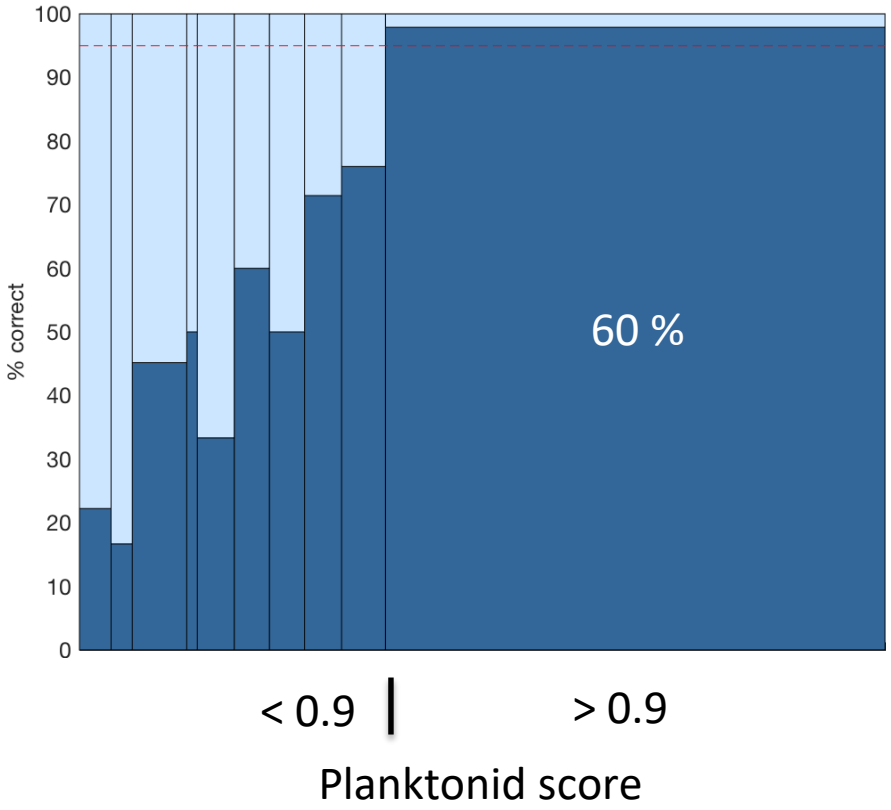
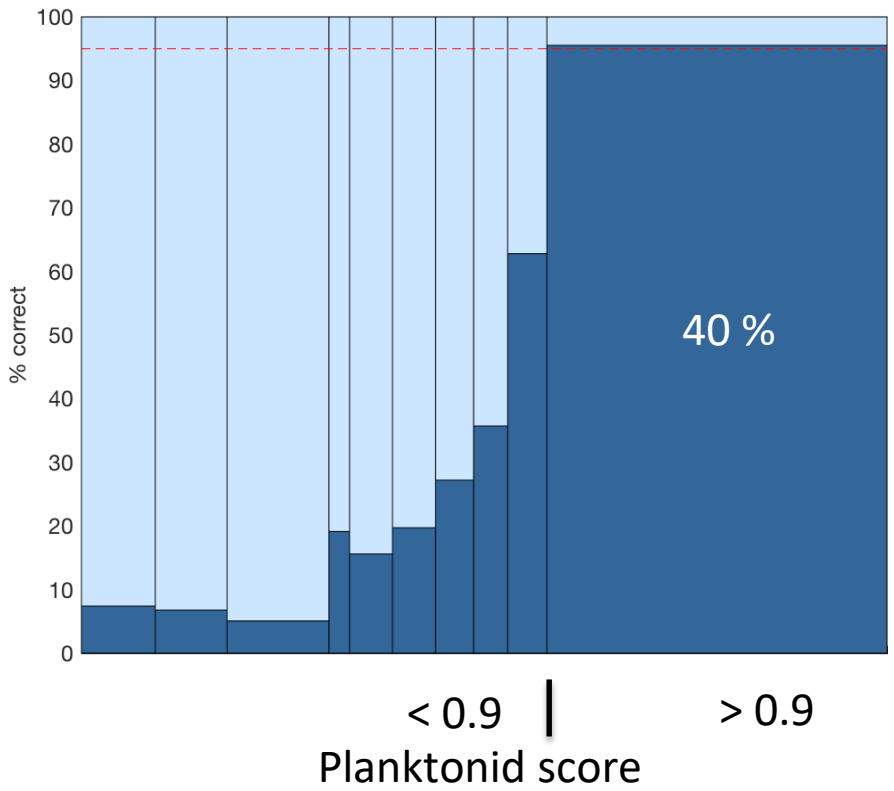
Aulosphaeridae (780 vignettes)



Copepoda (2650 vignettes)



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- A good automatic annotation is crucial for the success
- Positive and negative controls very important for control and feedback
- Yes/No answer system very efficient (but not allowing for identification)

PlanktonID – expert level

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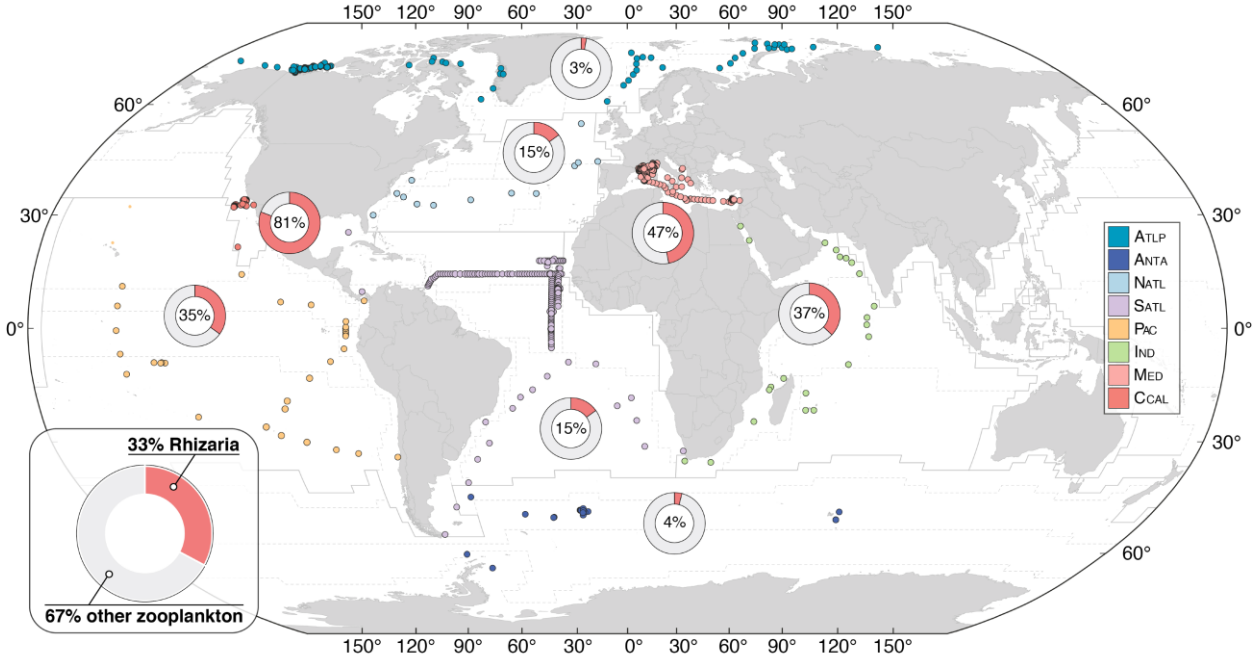

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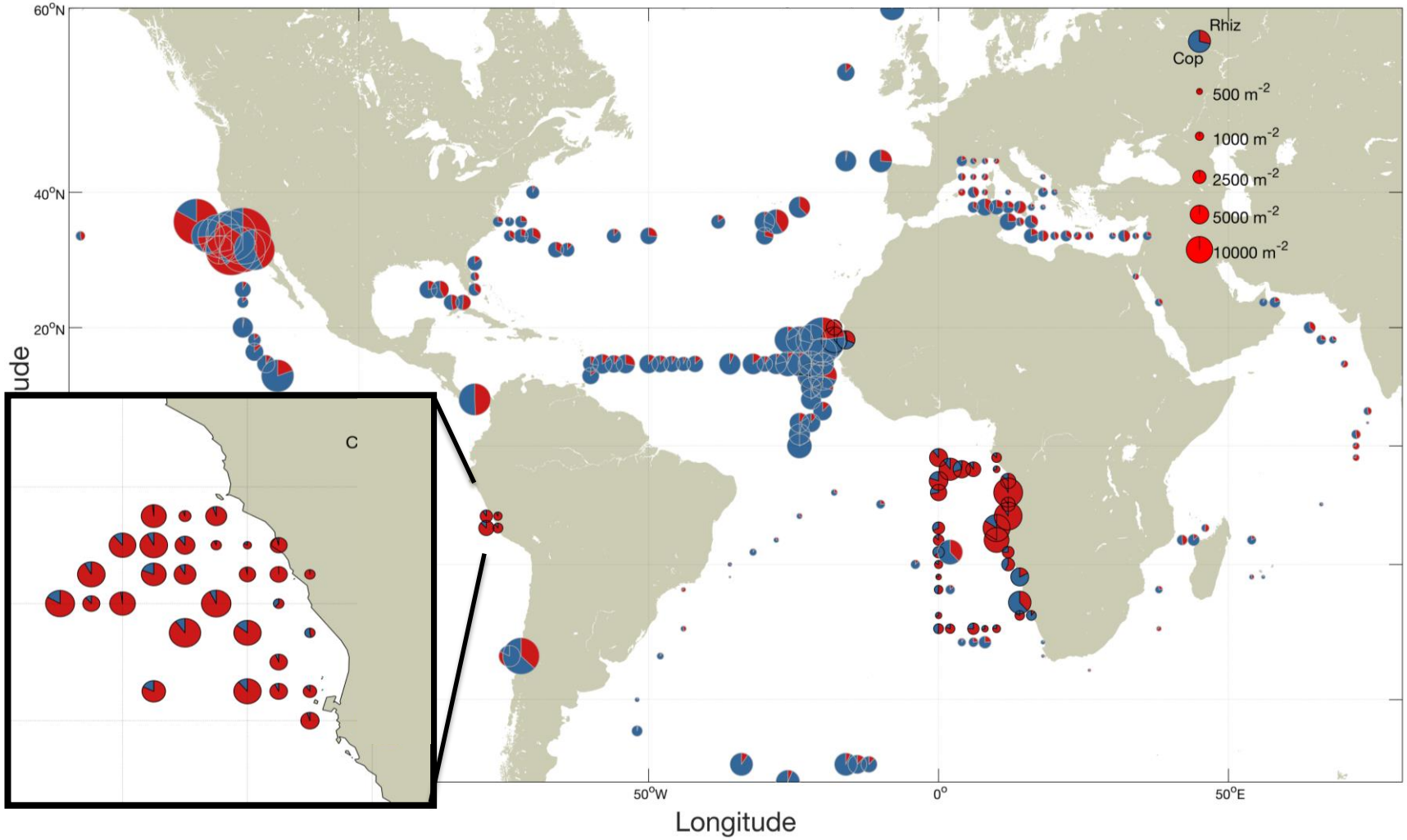

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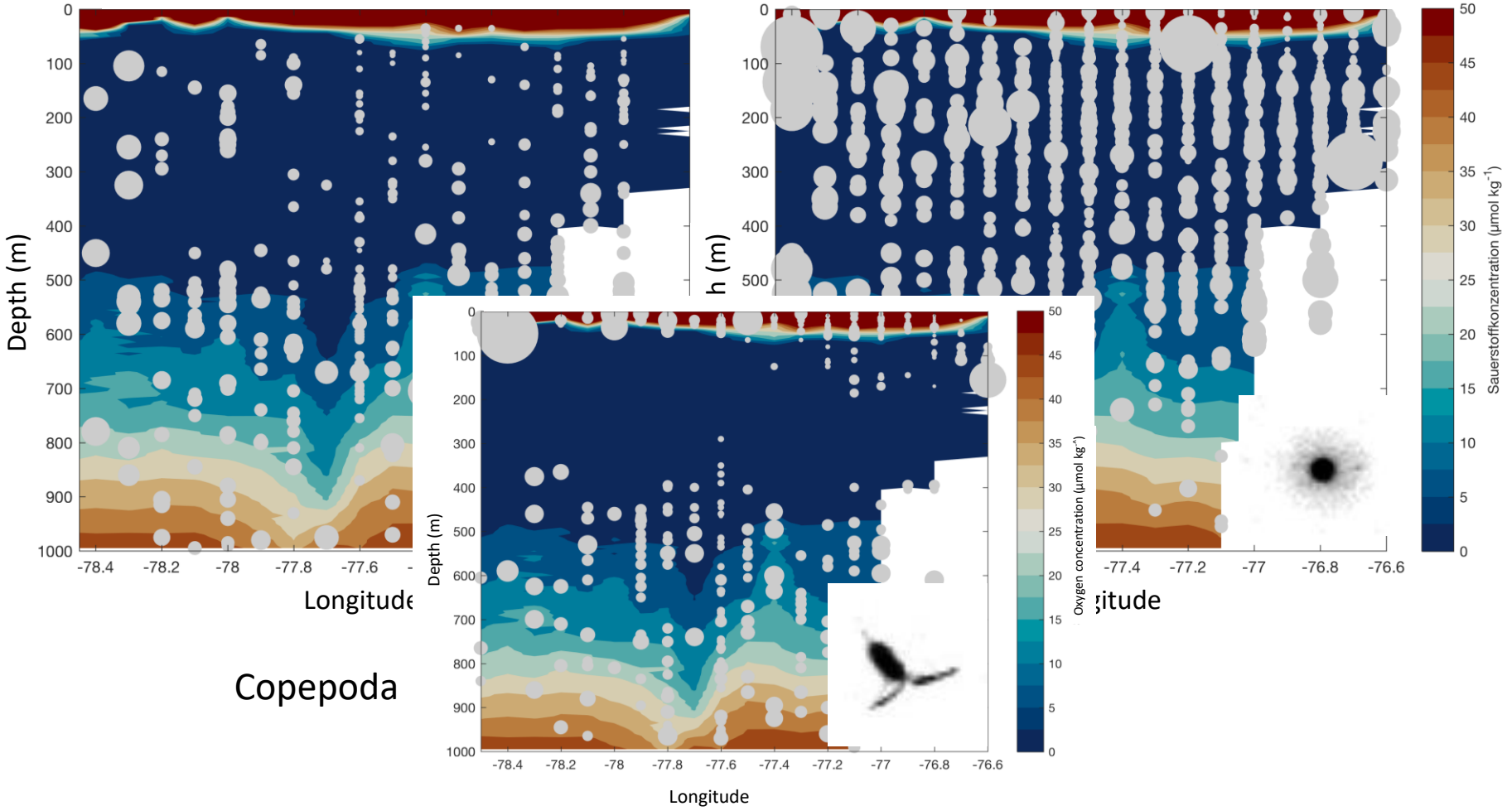
Aulosphaeridae

„Solitaryblack“



Copepoda

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