Fine-scale plankton distribution across the Ligurian Front from glider and UVP6

T. Panaïotis, A. Poteau, M. Picheral, C. Catalano, L. Coppola, J.O. Irisson

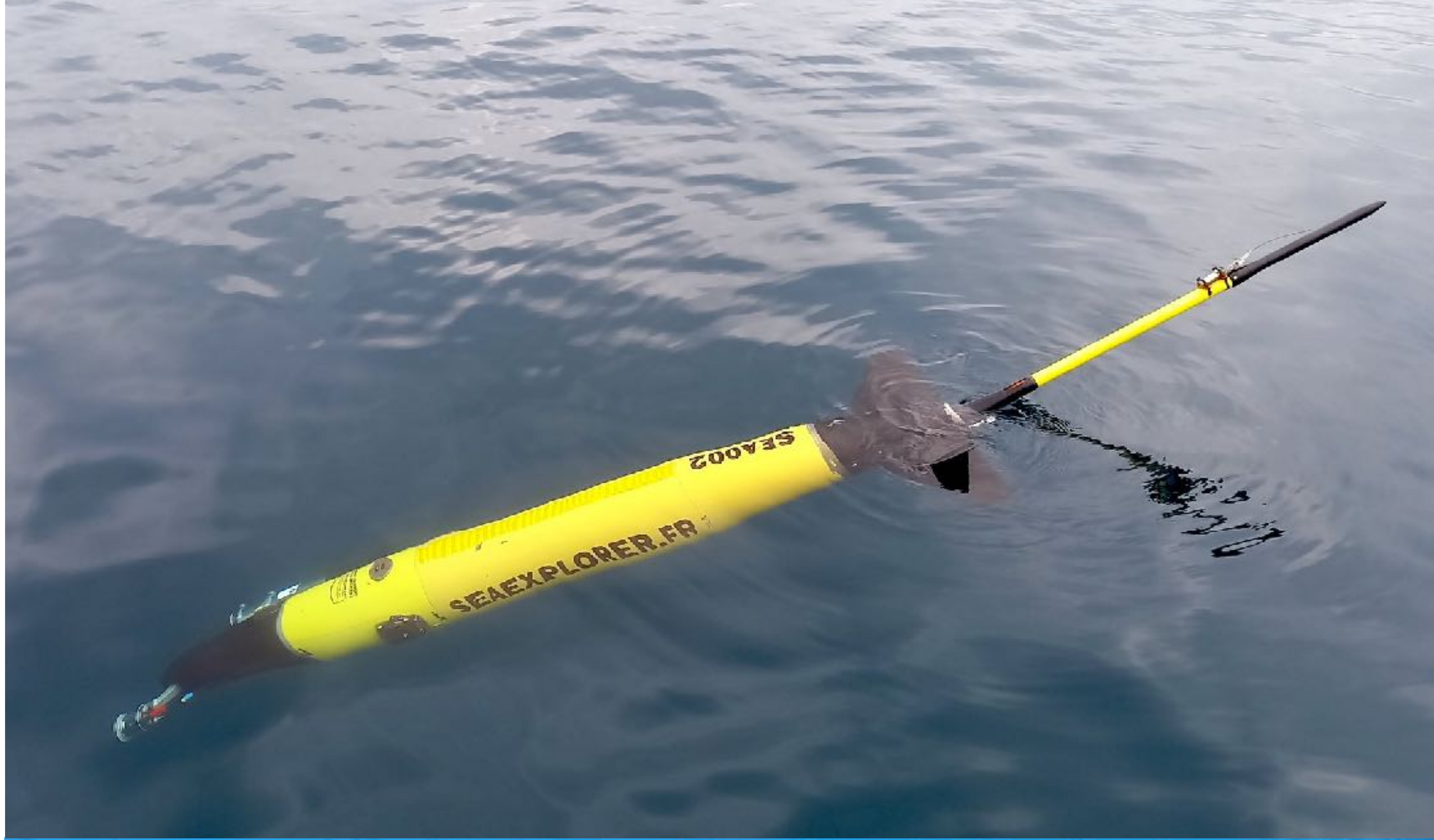
Computational Plankton Ecology (COMPLEx team)
Laboratoire d'Océanographie de Villefranche

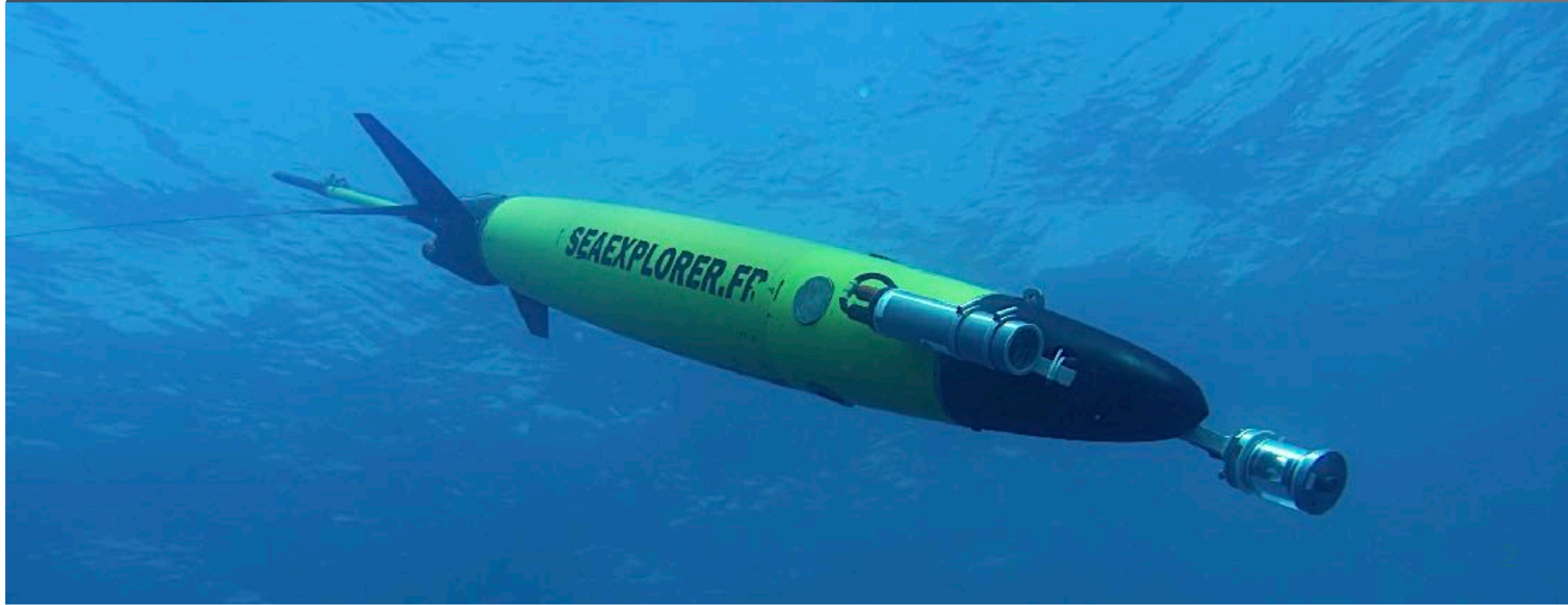
UVP user meeting
15/09/2022
Thelma Panaïotis

UVP6 and glider

UVP6 LP

- particles 60 µm - 2 cm
- organisms 1 mm - 2 cm
- imaging rate 0.5 - 1.3 Hz


SEA002
SEAEXPLORER.FR

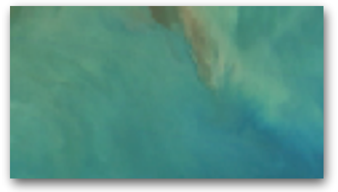

SEAEXPLORER.FR

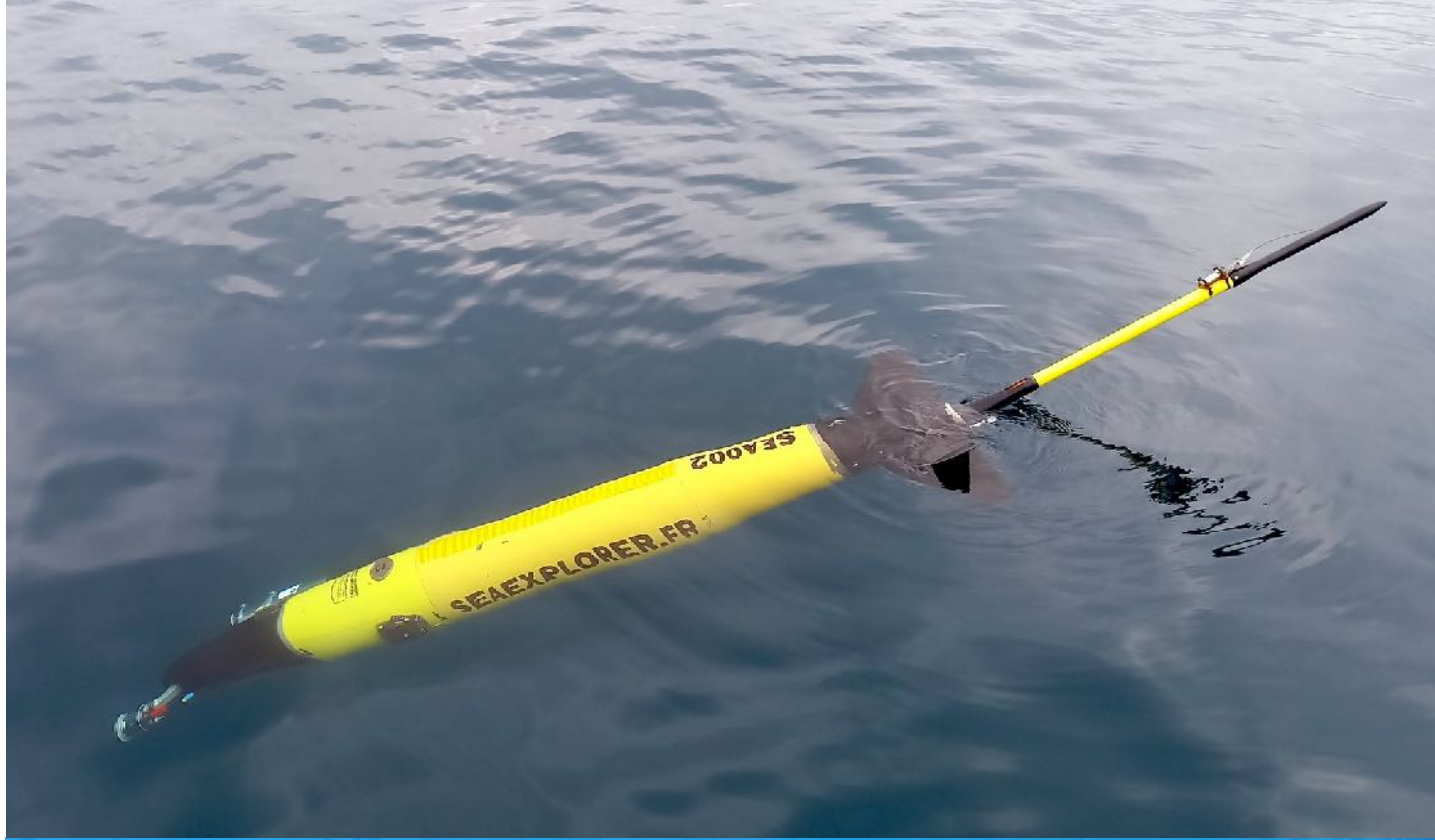
UVP6 and glider

UVP6 LP

- particles 60 µm - 2 cm
- organisms 1 mm - 2 cm
- imaging rate 0.5 - 1.3 Hz

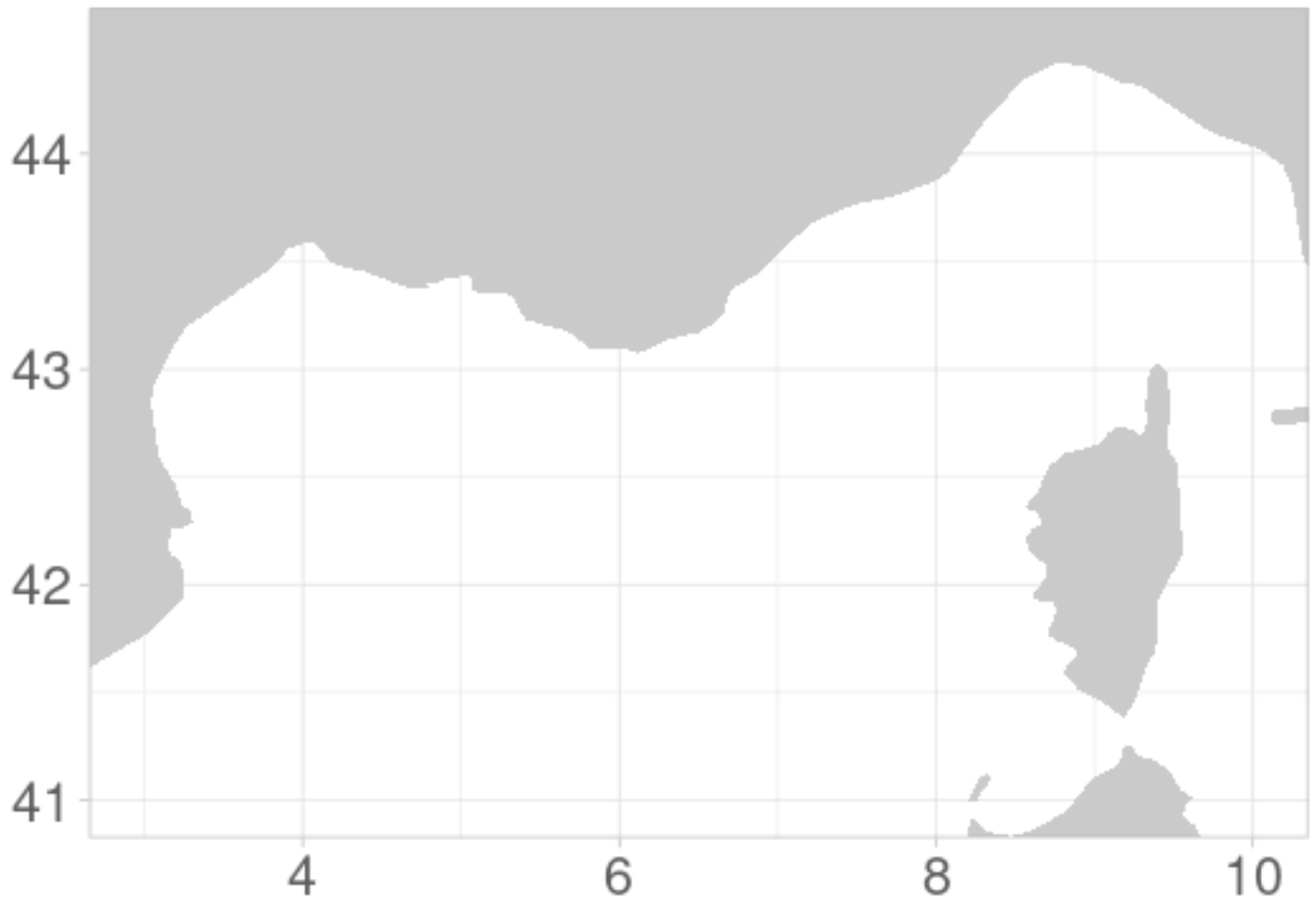
Seaexplorer glider

- temperature
- salinity
- chla [Chl a]
- oxygen O_2
- cdom 
- bb700



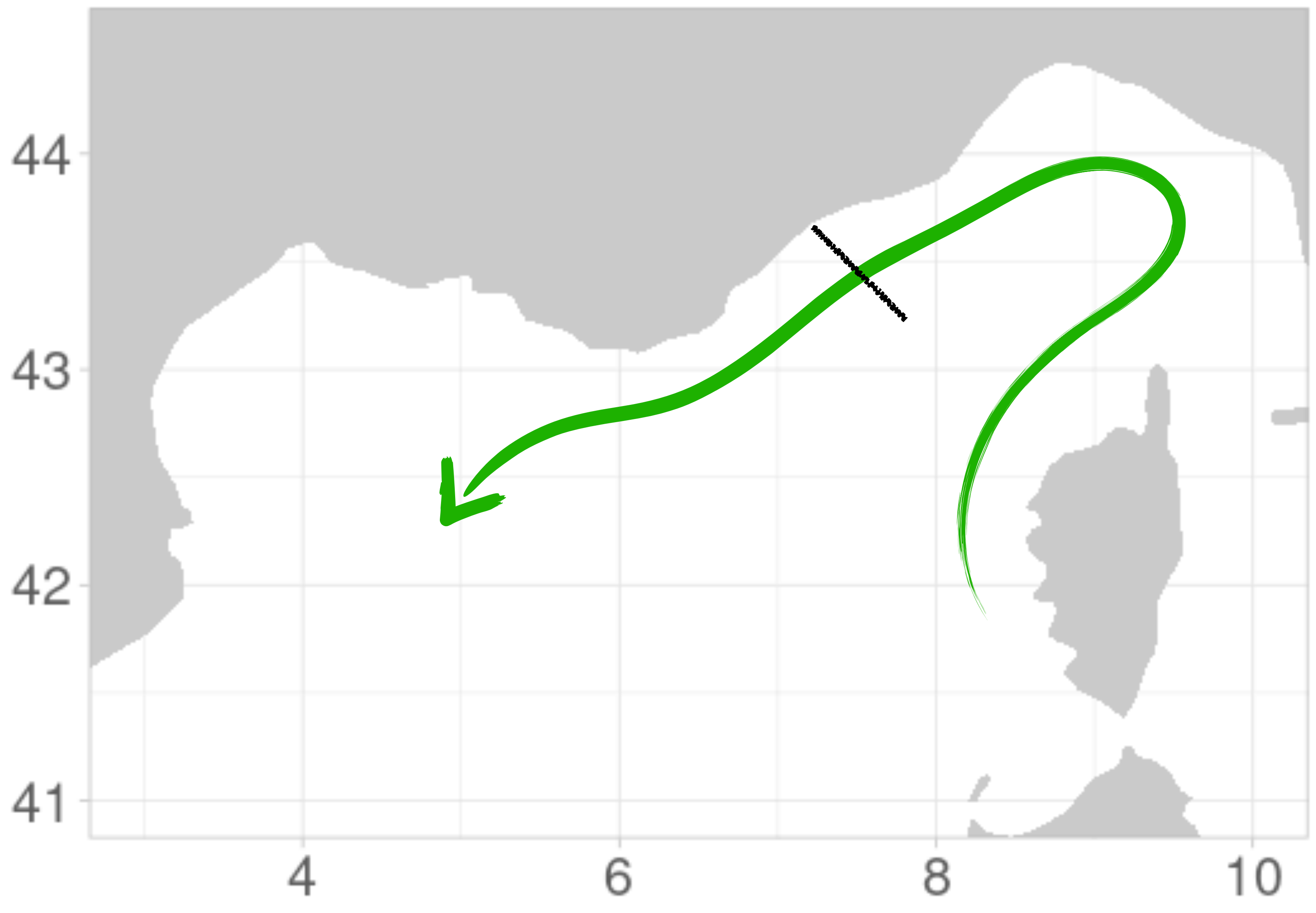
Study area

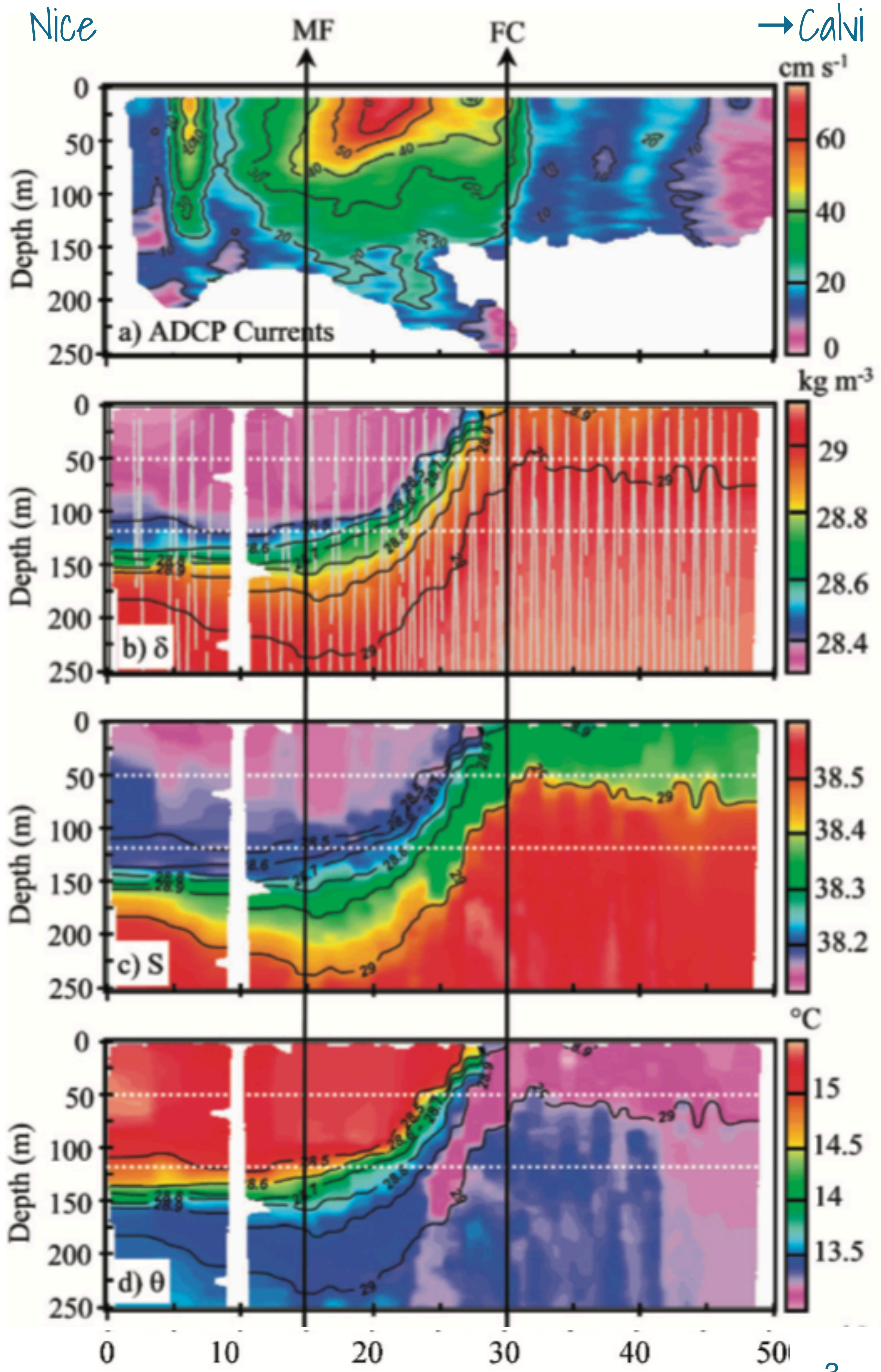
- NW Mediterranean Sea


44
43
42
41
4
6
8
10

Study area

- NW Mediterranean Sea
- Ligurian Current & Front
    - increased productivity and biomass
    - organisms aggregation



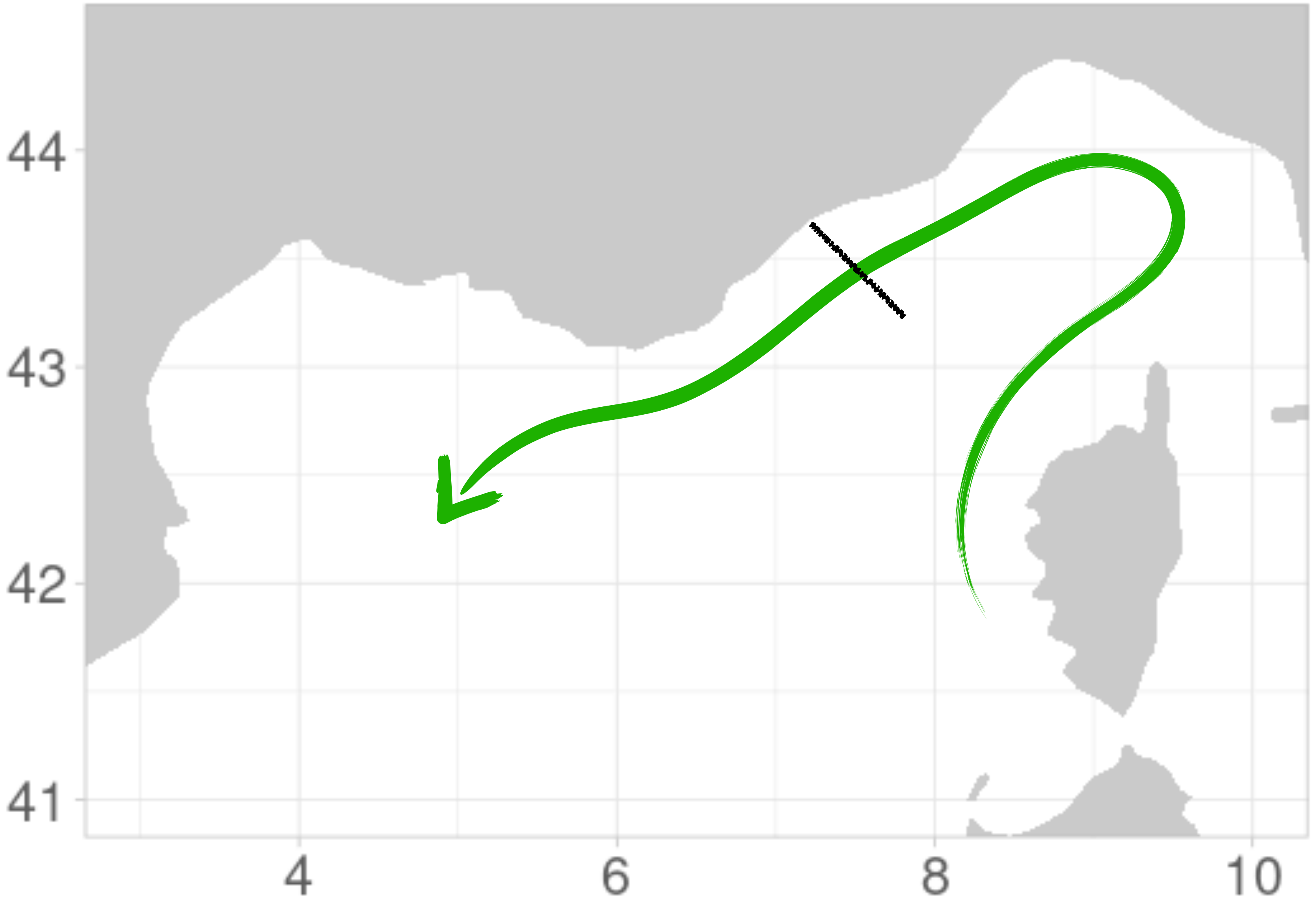


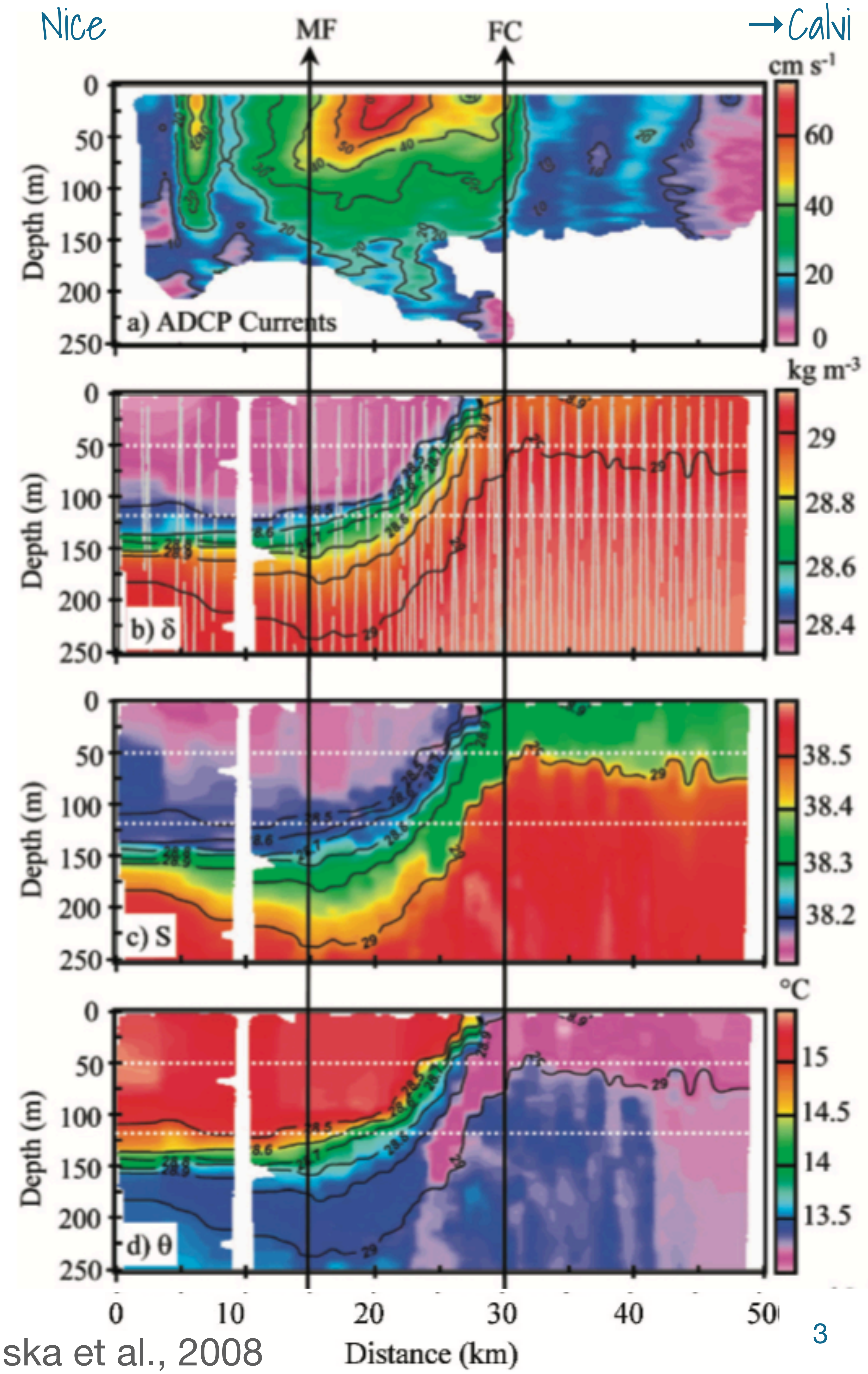
Niewiadomska et al., 2008

Study area

- NW Mediterranean Sea
- Ligurian Current & Front
  - increased productivity and biomass
  - organisms aggregation
- Plankton bloom dynamic

Modis, 1st march 2021



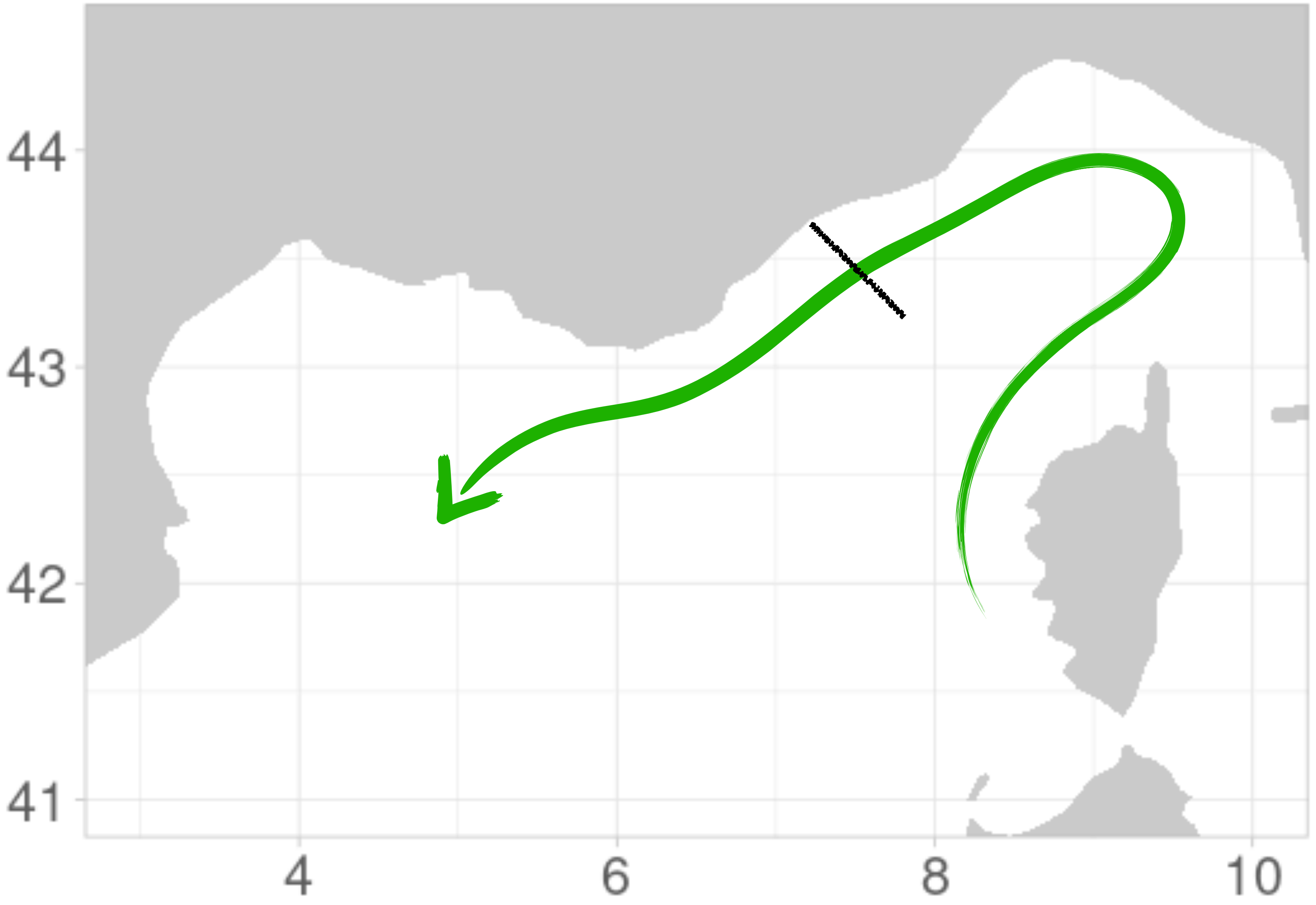


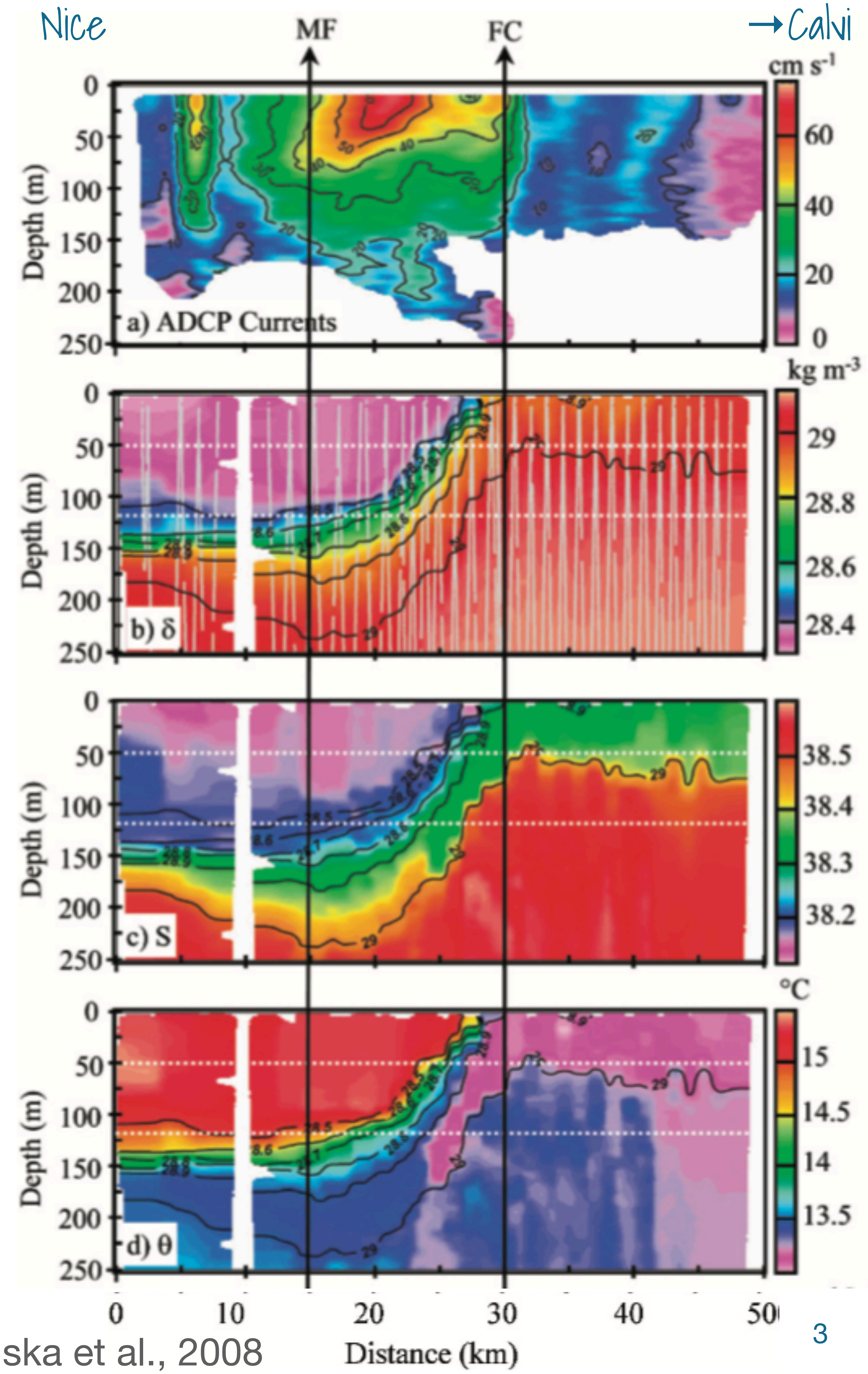
Niewiadomska et al., 2008

Study area

- NW Mediterranean Sea
- Ligurian Current & Front
  - increased productivity and biomass
  - organisms aggregation
- Plankton bloom dynamic
- Spring 2021

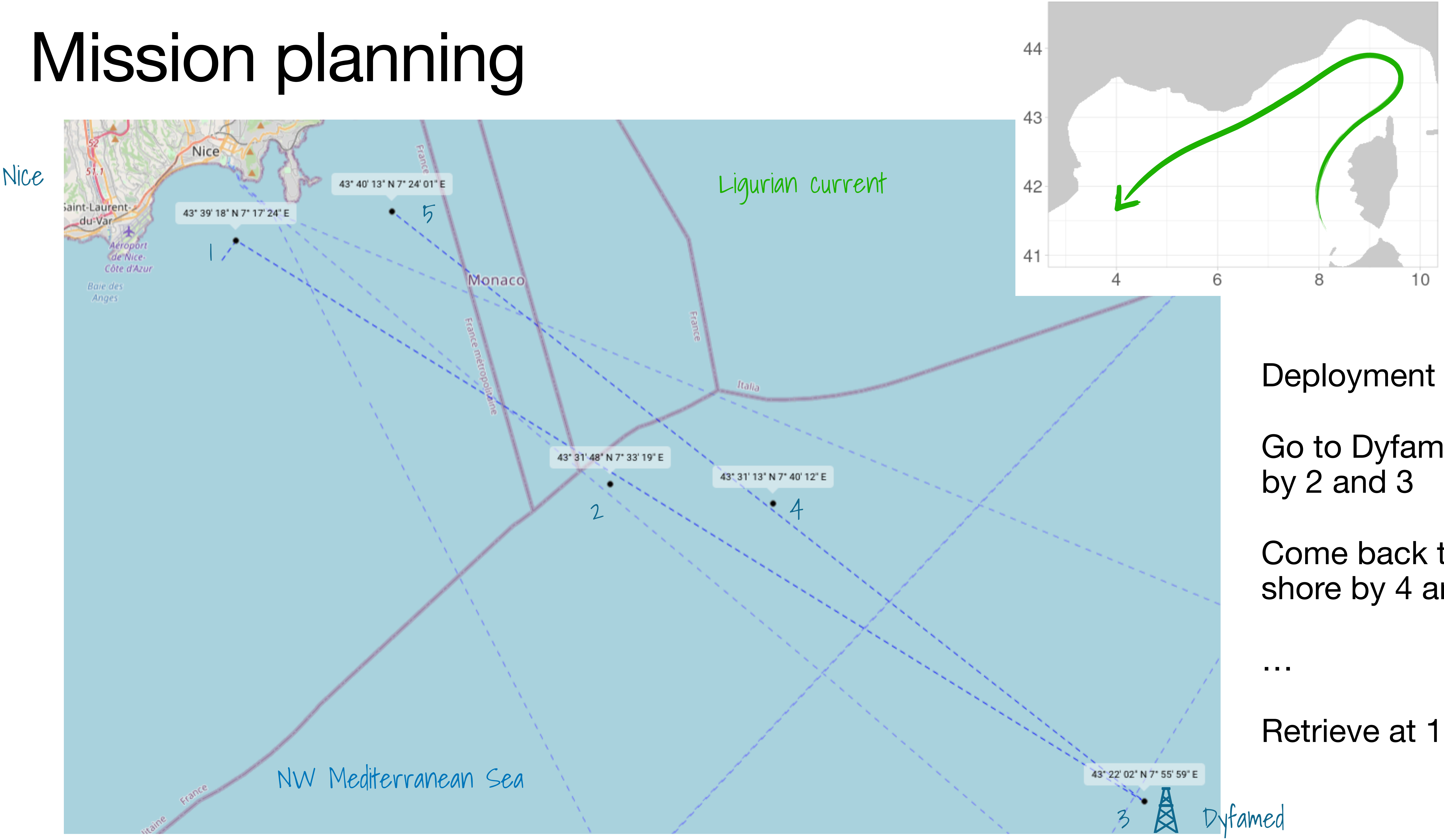
Modis, 1st march 2021





Niewiadomska et al., 2008

Mission planning


Nice
Saint-Laurent-du-Var
Aéroport de Nice-Côte d'Azur
Baie des Anges
43° 39' 18" N 7° 17' 24" E
1
43° 40' 13" N 7° 24' 01" E
5
Monaco
France
France métropolitaine
Italia
Ligurian current
43° 31' 48" N 7° 33' 19" E
2
43° 31' 13" N 7° 40' 12" E
4
NW Mediterranean Sea
43° 22' 02" N 7° 55' 59" E
3
Dyfamed
44
43
42
41
4
6
8
10

Deployment at 1

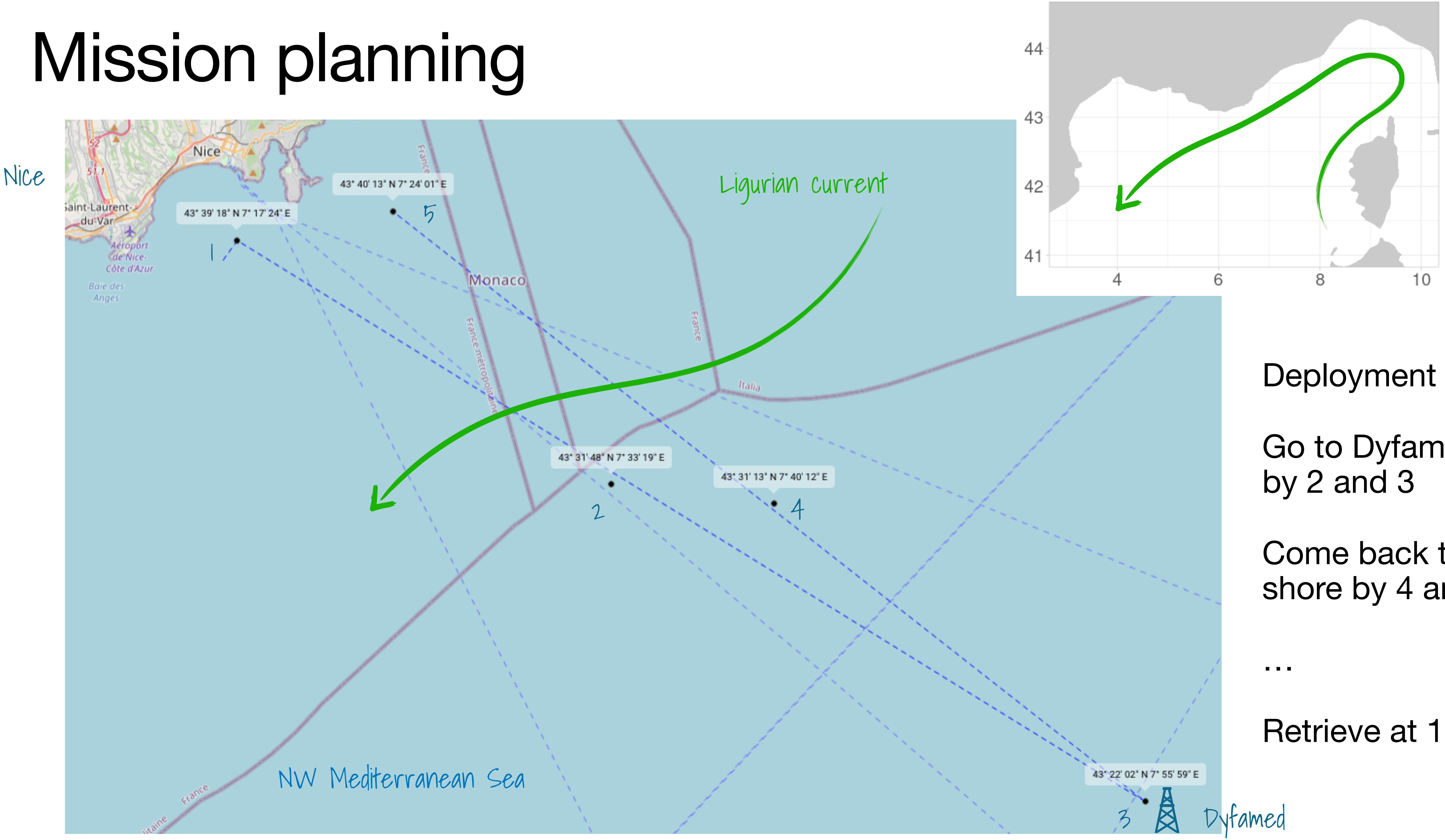
Go to Dyfamed by 2 and 3

Come back to shore by 4 and 5

…

Retrieve at 1

Mission planning


Nice
Saint-Laurent-du-Var
Aéroport de Nice-Côte d'Azur
Baie des Anges
43° 39' 18" N 7° 17' 24" E
1
43° 40' 13" N 7° 24' 01" E
5
Monaco
France
France métropolitaine
Ligurian current
Italia
43° 31' 48" N 7° 33' 19" E
2
43° 31' 13" N 7° 40' 12" E
4
NW Mediterranean Sea
France
43° 22' 02" N 7° 55' 59" E
3
Dyfamed
44
43
42
41
4
6
8
10

Deployment at 1

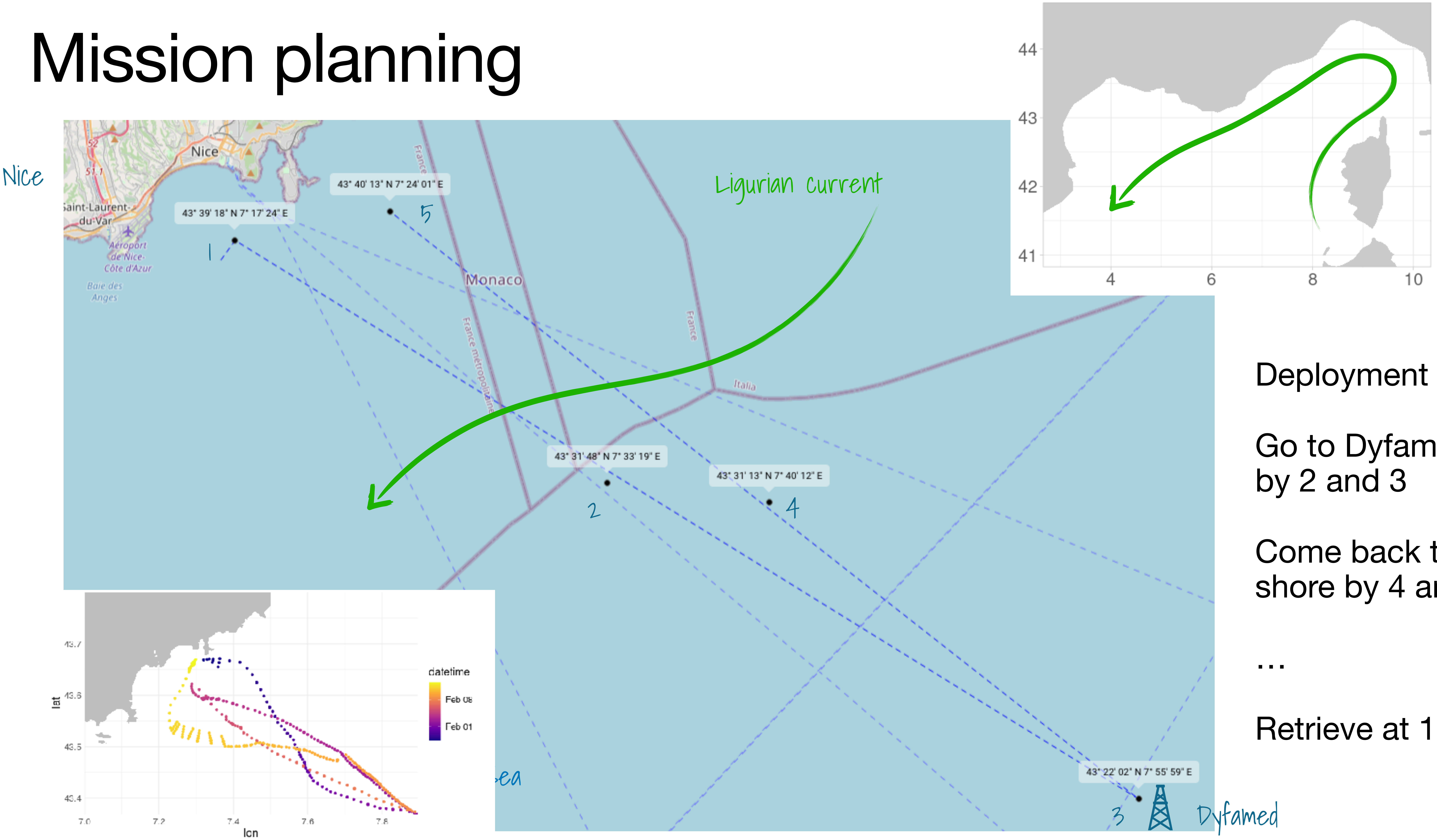
Go to Dyfamed by 2 and 3

Come back to shore by 4 and 5

…

Retrieve at 1

Mission planning


Nice
Nice
Saint-Laurent-du-Var
Aéroport de Nice-Côte d'Azur
Baie des Anges
43° 39' 18" N 7° 17' 24" E
1
43° 40' 13" N 7° 24' 01" E
5
Monaco
France
France métropolitaine
Italia
Ligurian current
43° 31' 48" N 7° 33' 19" E
2
43° 31' 13" N 7° 40' 12" E
4
43° 22' 02" N 7° 55' 59" E
3
Dyfamed
44
43
42
41
4
6
8
10
43.7
43.6
43.5
43.4
lat
7.0
7.2
7.4
7.6
7.8
lon
datetime
Feb 08
Feb 01

Deployment at 1

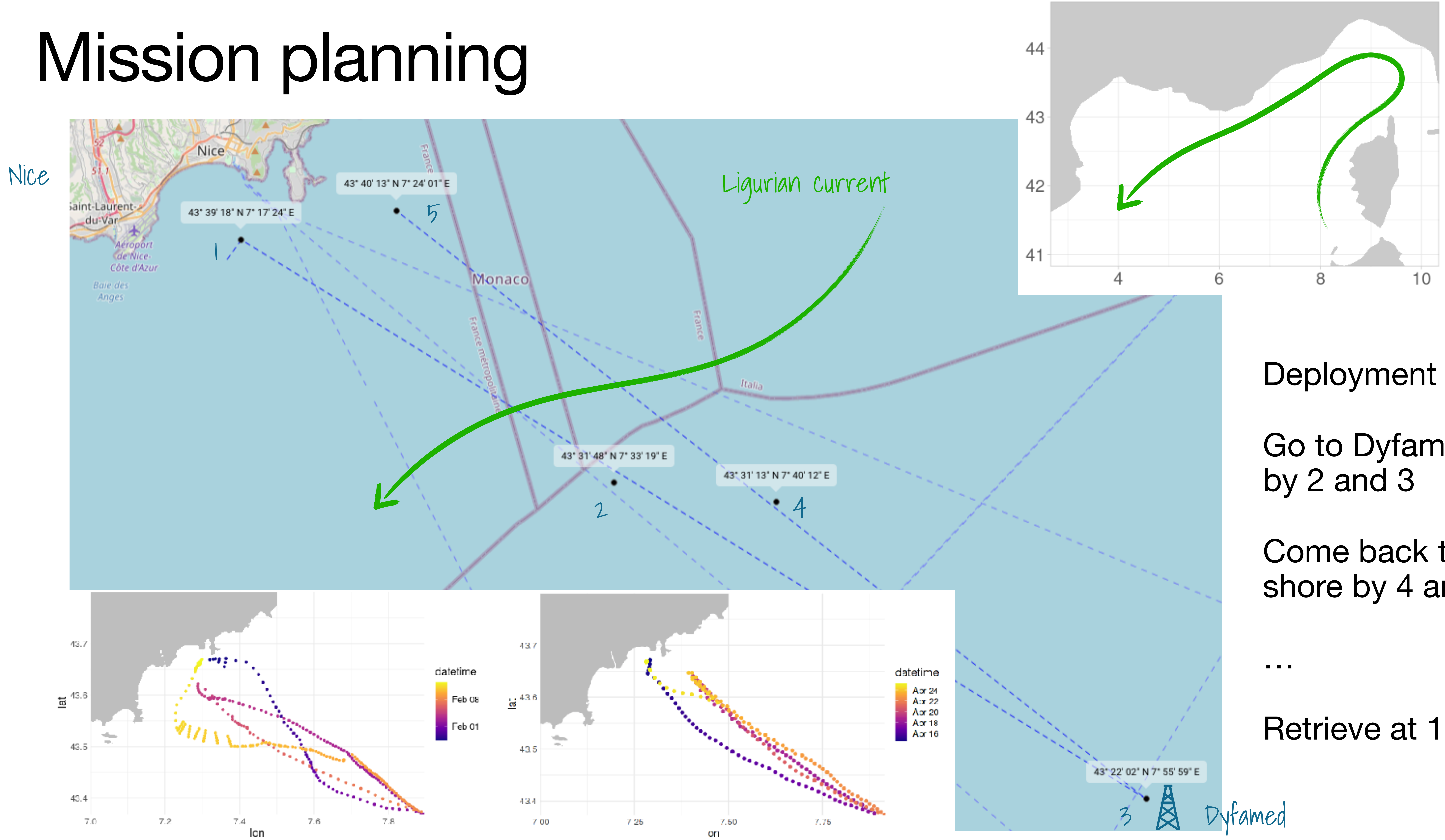
Go to Dyfamed by 2 and 3

Come back to shore by 4 and 5

…

Retrieve at 1

Mission planning


Nice
Ligurian current
43° 40' 13" N 7° 24' 01" E
5
43° 39' 18" N 7° 17' 24" E
1
Monaco
France
France métropolitaine
Italia
Saint-Laurent-du-Var
Aéroport de Nice-Côte d'Azur
Baie des Anges
43° 31' 48" N 7° 33' 19" E
2
43° 31' 13" N 7° 40' 12" E
4
43° 22' 02" N 7° 55' 59" E
3
Dyfamed
44
43
42
41
4
6
8
10
datetime
Feb 08
Feb 01
lat
lon
43.7
43.6
43.5
43.4
7.0
7.2
7.4
7.6
7.8
datetime
Apr 24
Apr 22
Apr 20
Apr 18
Apr 16
7.00
7.25
7.50
7.75

Deployment at 1

Go to Dyfamed by 2 and 3

Come back to shore by 4 and 5

…

Retrieve at 1

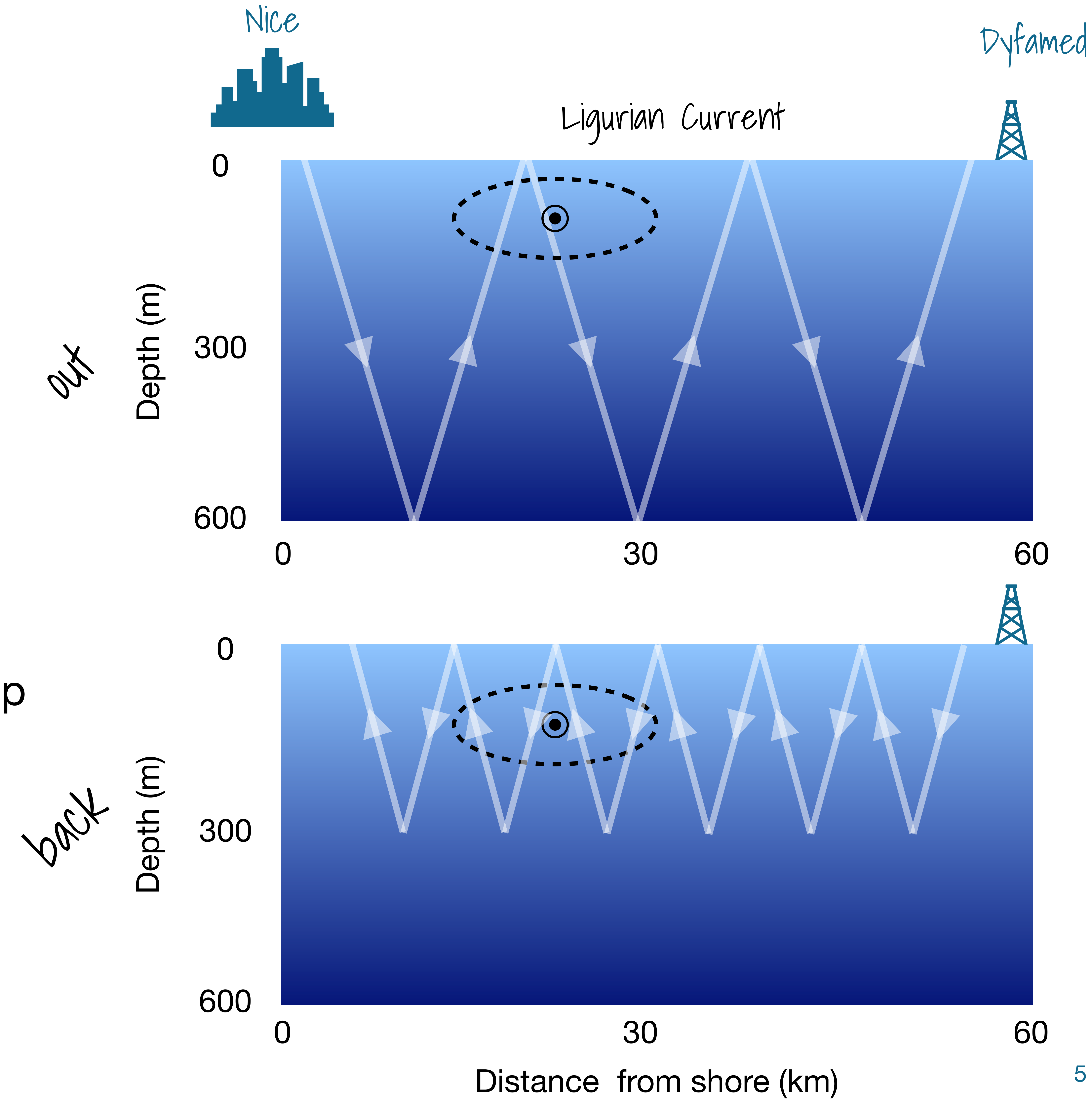
Mission planning

Round trip between Nice and Dyfamed

- out in 0-600 m: go bellow the current
- back in 0-300 m: better horizontal resolution

Ligurian current: 25 km offshore, 0-200 m deep

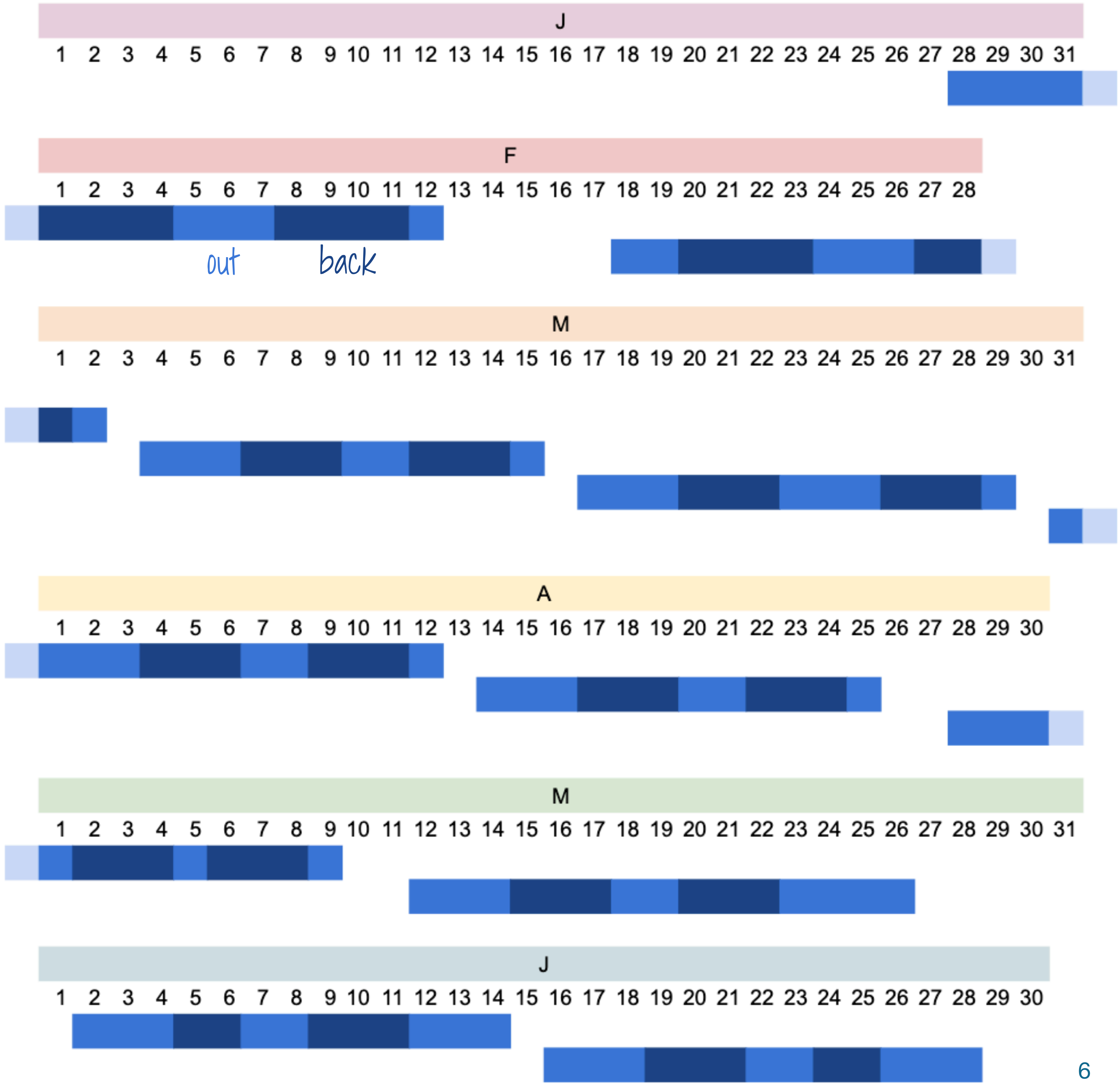
1 mission = 2 round trips


Nice
Dyfamed
Ligurian Current
out
Depth (m)
0
300
600
0
30
60
back
Depth (m)
0
300
600
0
30
60
Distance from shore (km)

Mission overview

- started on 28/01/2021
- ended on 28/06/2021
- 5 months duration

10 missions of 12-14 days each



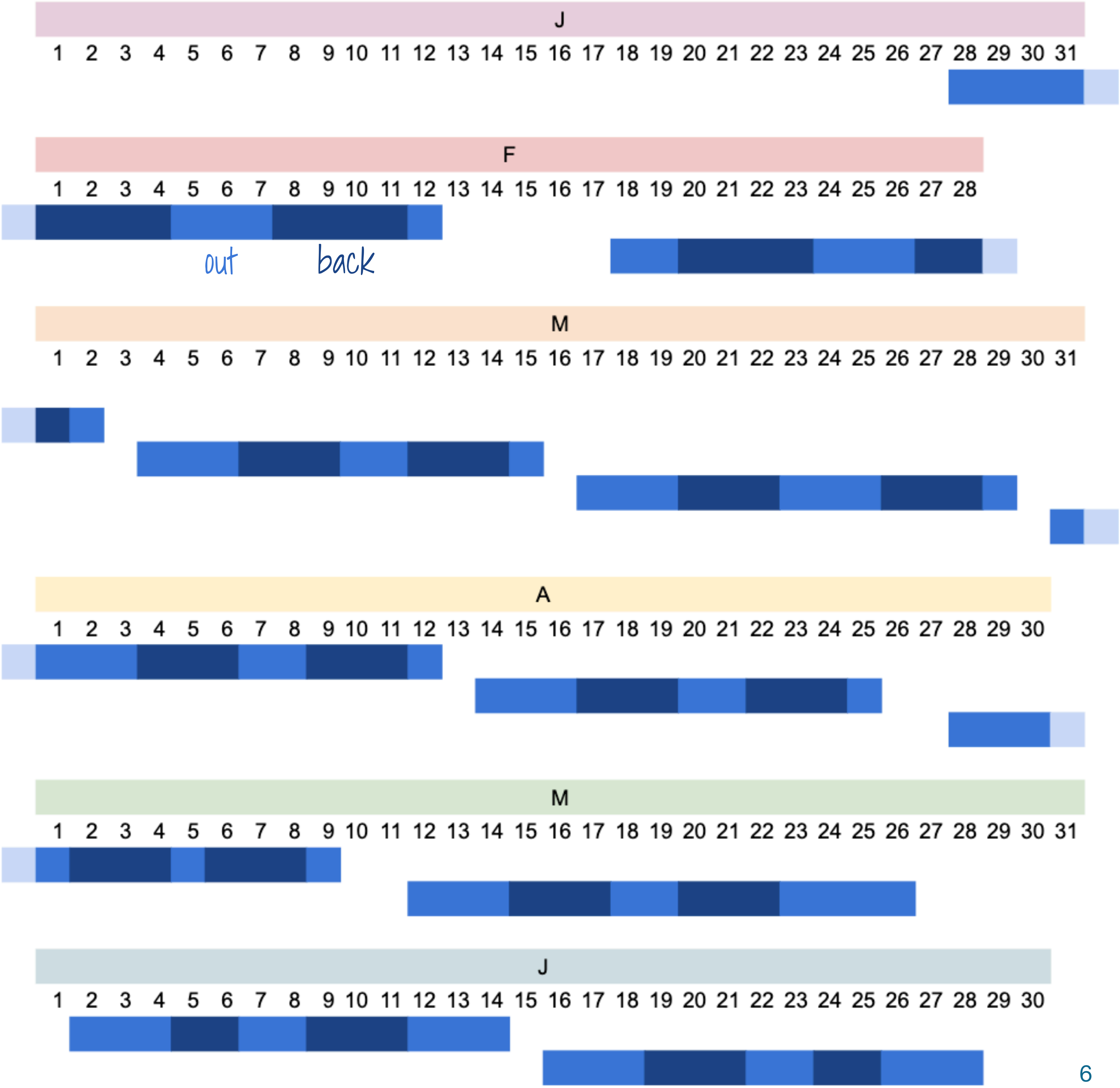
Mission overview

- started on 28/01/2021
- ended on 28/06/2021
- 5 months duration

10 missions of 12-14 days each

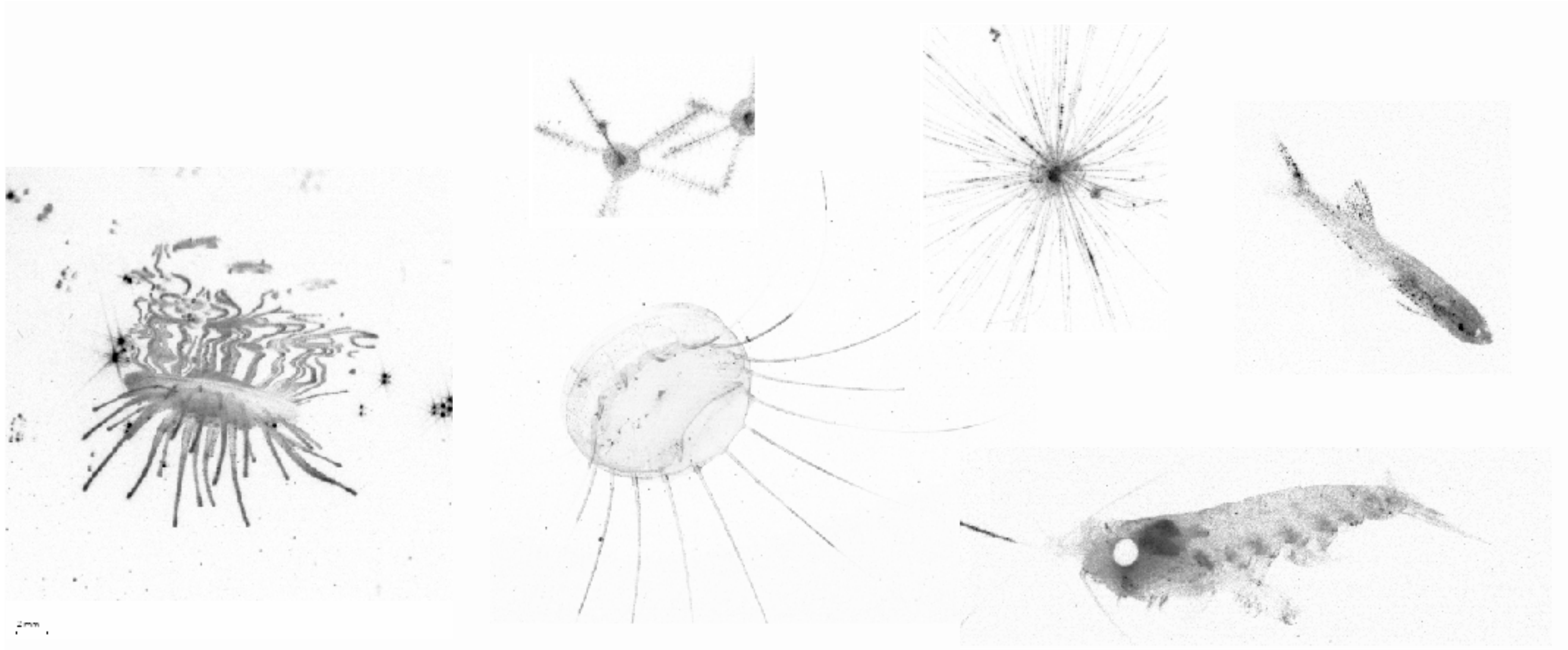
2 days needed between each mission

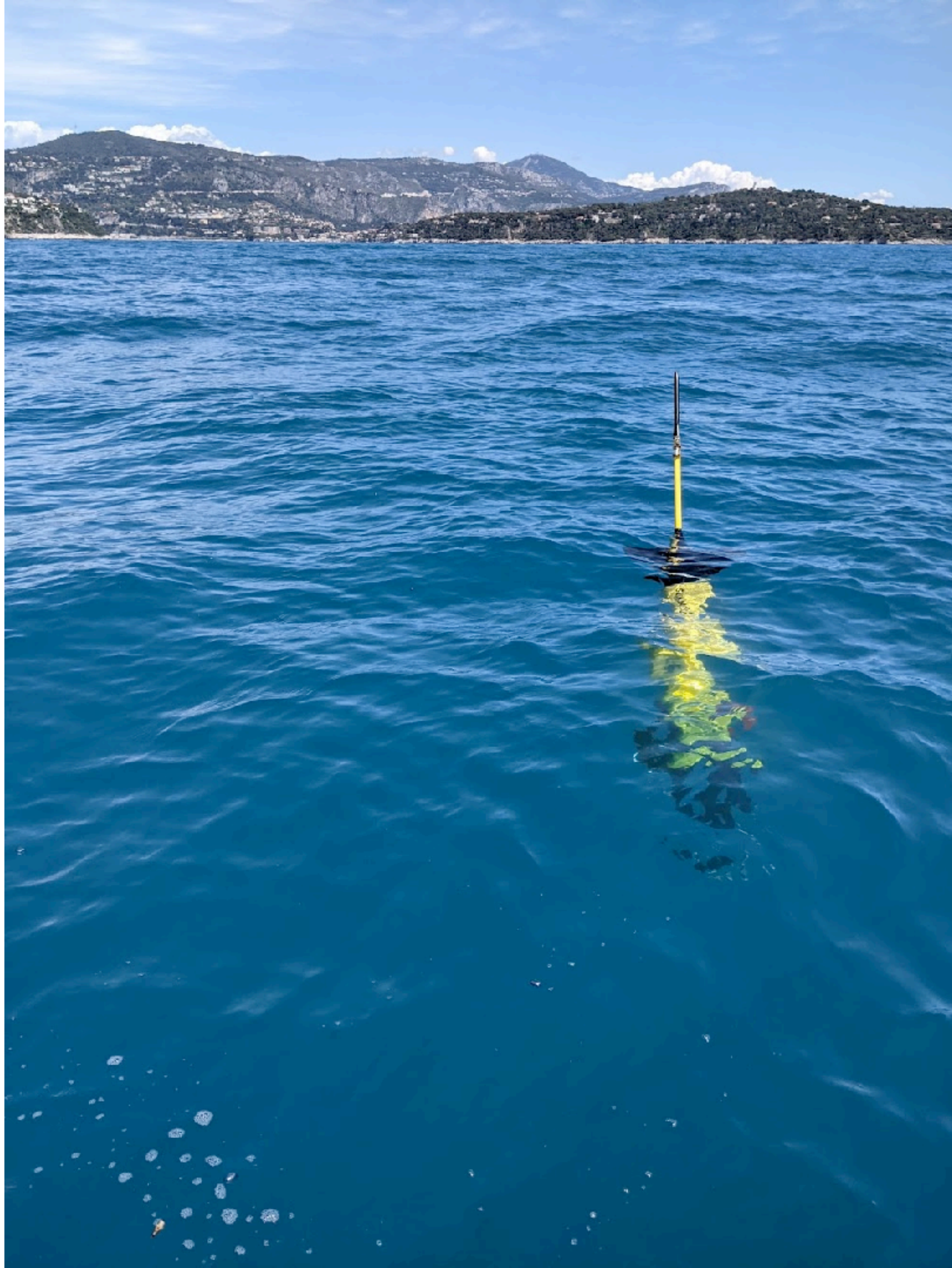
Also depends on weather conditions



A few numbers

- 10 missions
- 5000 profiles (1900 bellow 500 m)
- 1.1 million images
  - 785,000 during cruising
    - 435,000 in *back* transects (better horizontal resolution)





Sea explorer transect cutter

Output file name

uvp6_sn000003lp_2021_sea002_m490.csv

Cut transects

Transect 1

Type

Out

Included yos

4 – 54

Transect 2

Type

Back

Included yos

55 – 118

Transect 3

Type

Out

Included yos

119 – 155

Transect 4

Type

Back

Included yos

156 – 229

1
27
53
80
106
132
158
184
211
237
256

Cut transects | See saved transects | Erase saved transects

You have selected project uvp6_sn000003lp_2021_sea002_m490

Mission map
lat
lon
43.7
43.6
43.5
43.4
7.0
7.2
7.4
7.6
7.8
datetime
Apr 12
Apr 10
Apr 08
Apr 06
Apr 04
Apr 02
Mission map
part
out
back
transit
Max depth of yos
max depth
yo
0
-200
-400
-600
50
100
150
200
250
part
out
back
transit

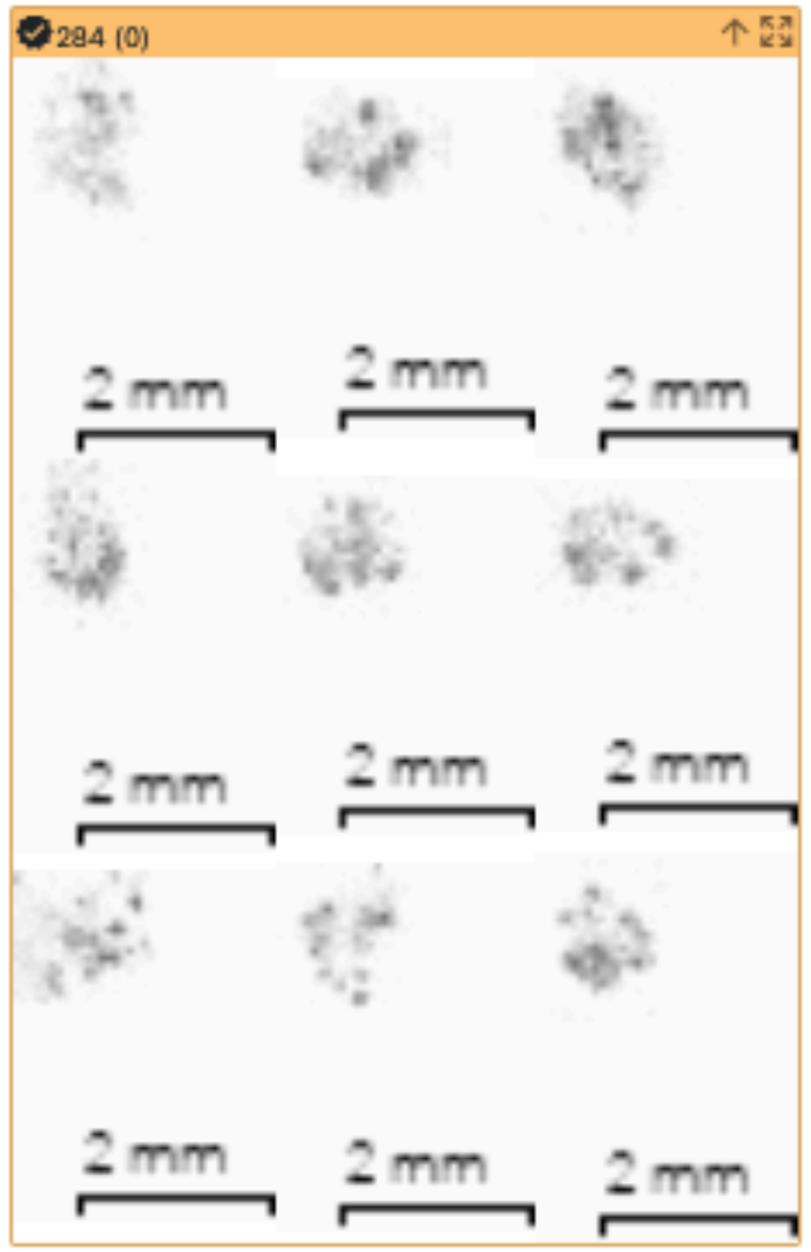
Subsampling rate

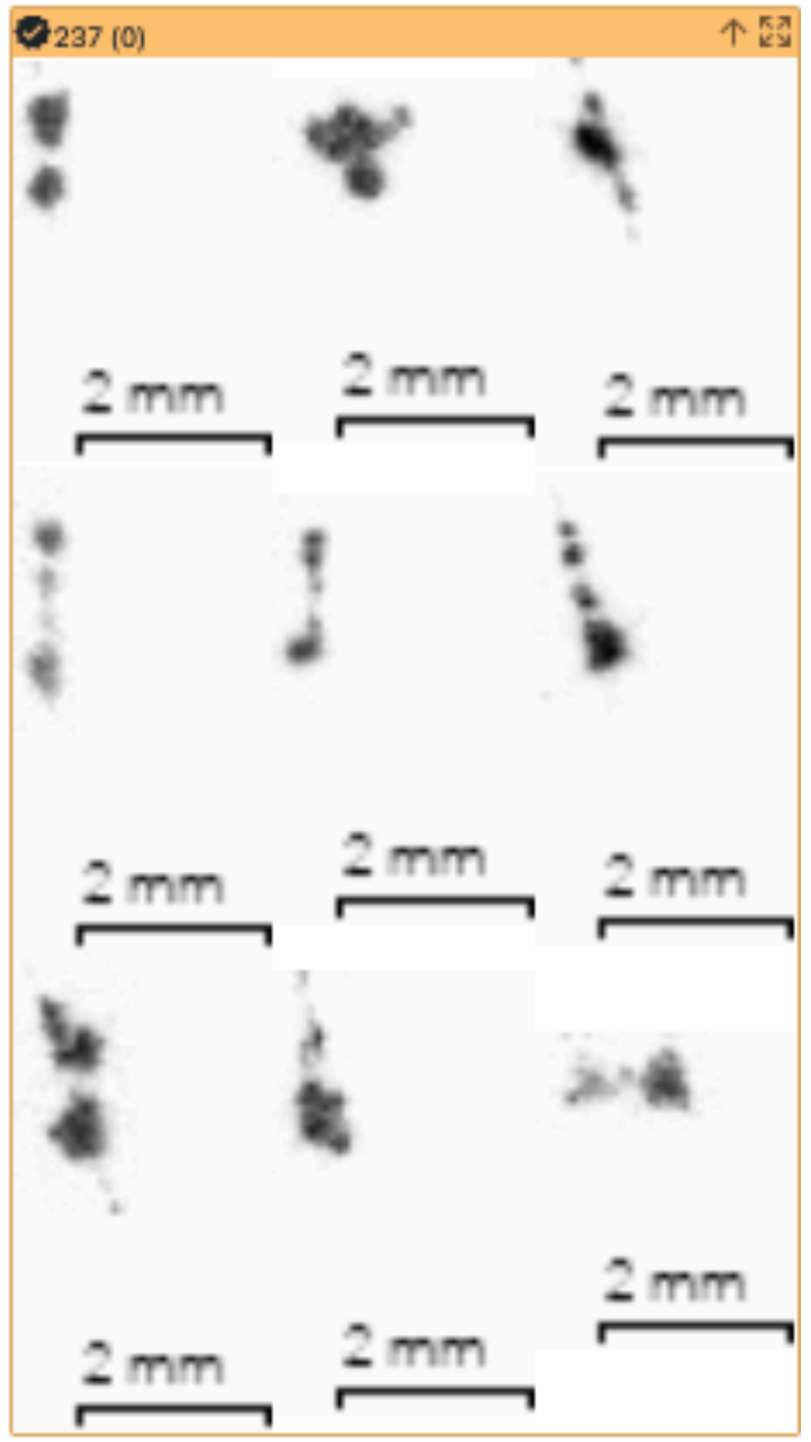
● 1/1
○ 1/2
○ 1/4

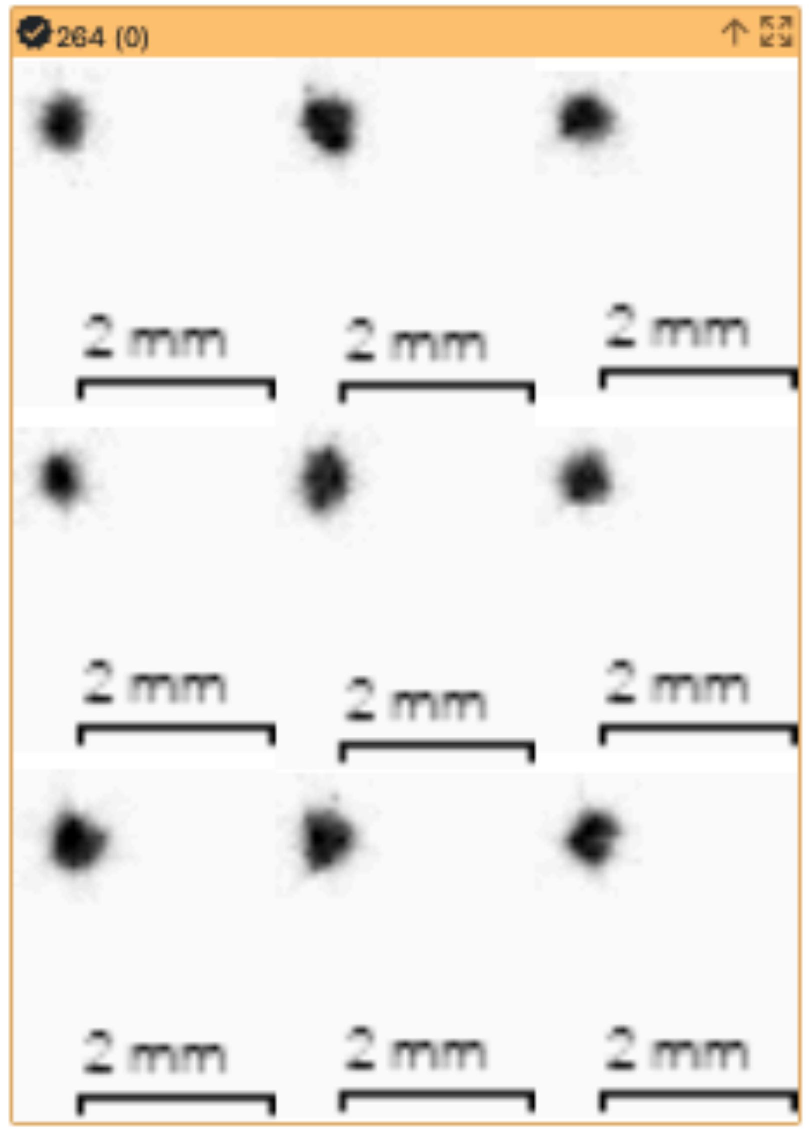
Pre-sorting with Morphocluster

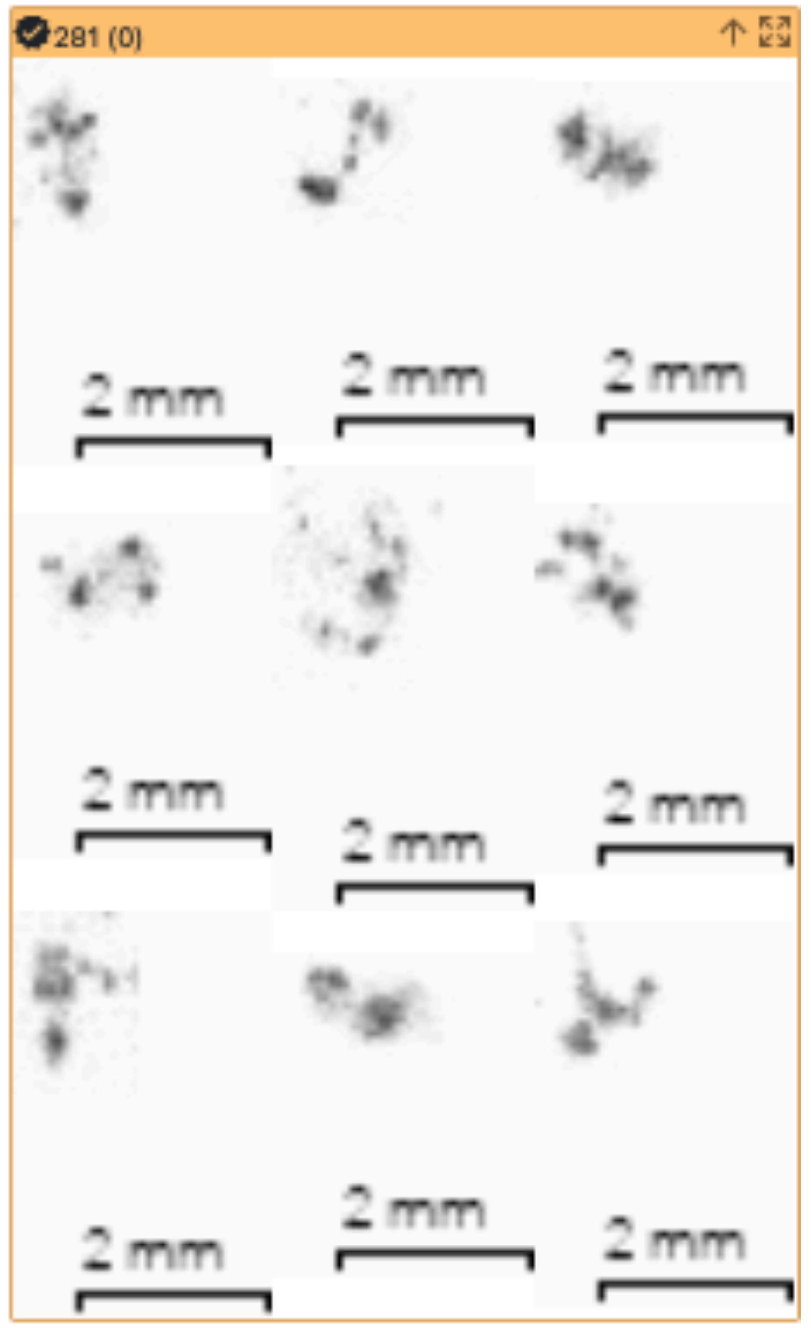
Data processing

- 785 000 objects to sort
  - 430 000 detritus sorted with Morphocluster





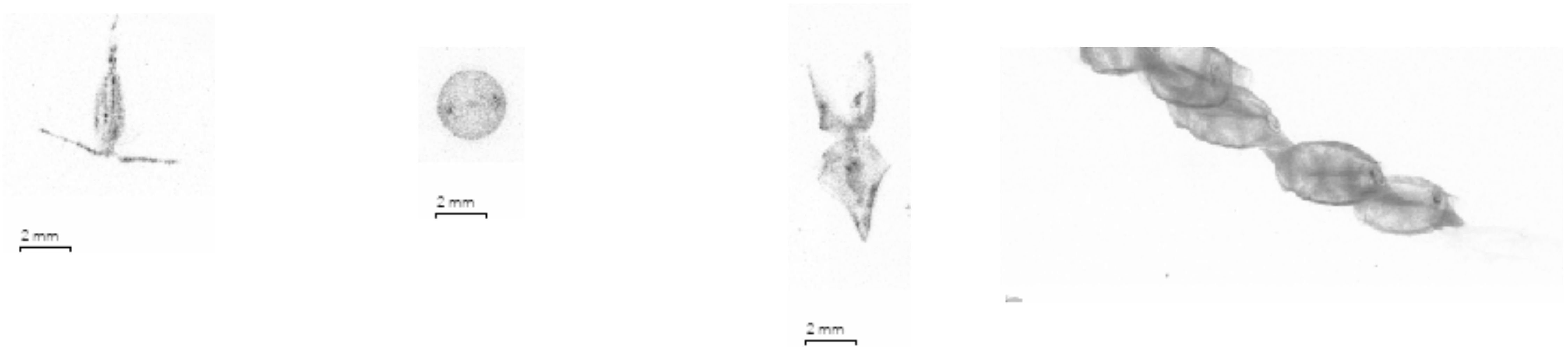


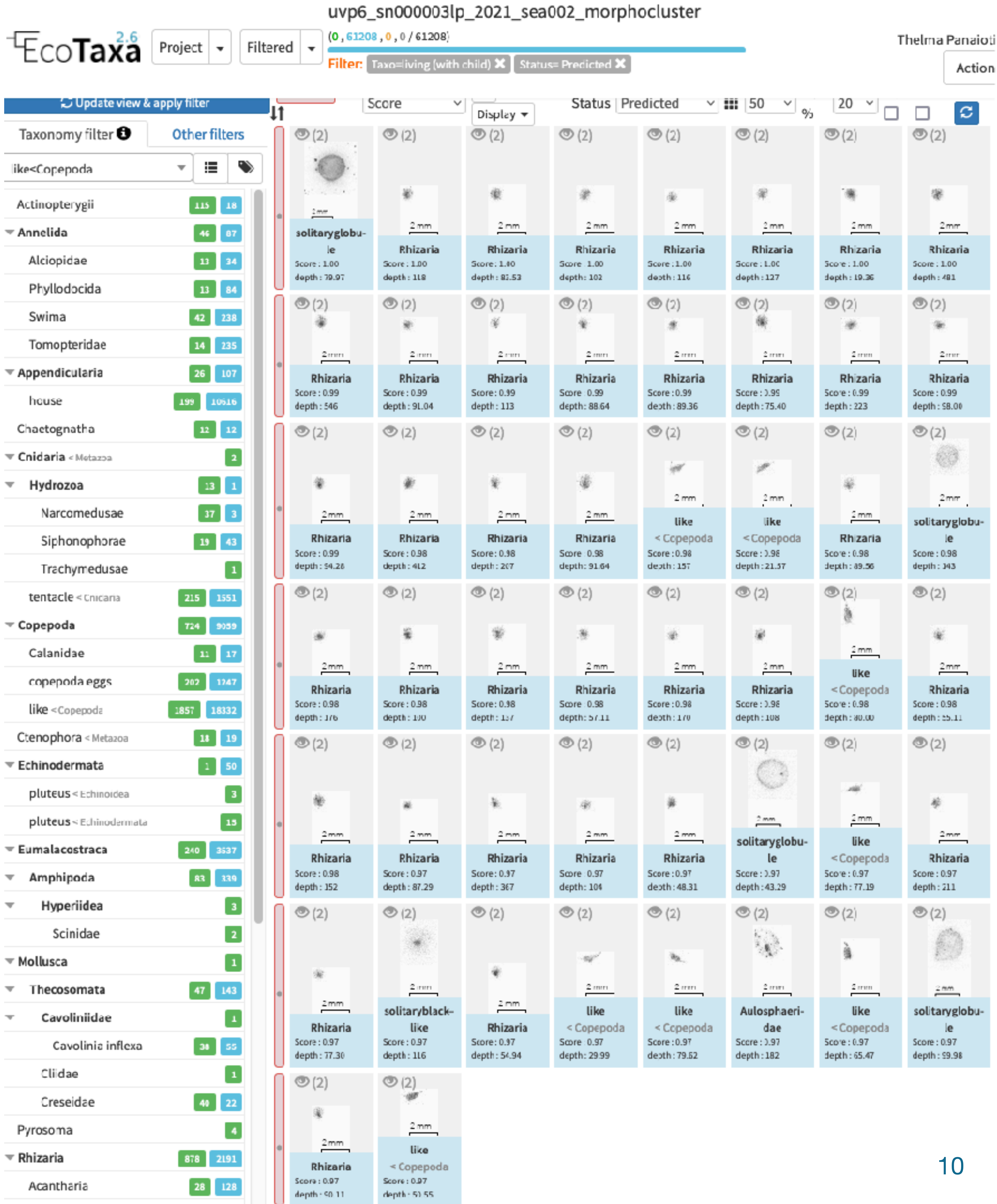


Fine-sorting with EcoTaxa

Data processing

- 785 000 objects to sort
  - 430 000 detritus sorted with Morphocluster
  - Other organisms to be sorted in EcoTaxa
    - 63.5% of objects validated
    - Copepoda, Collodaria, mollusca, salps…



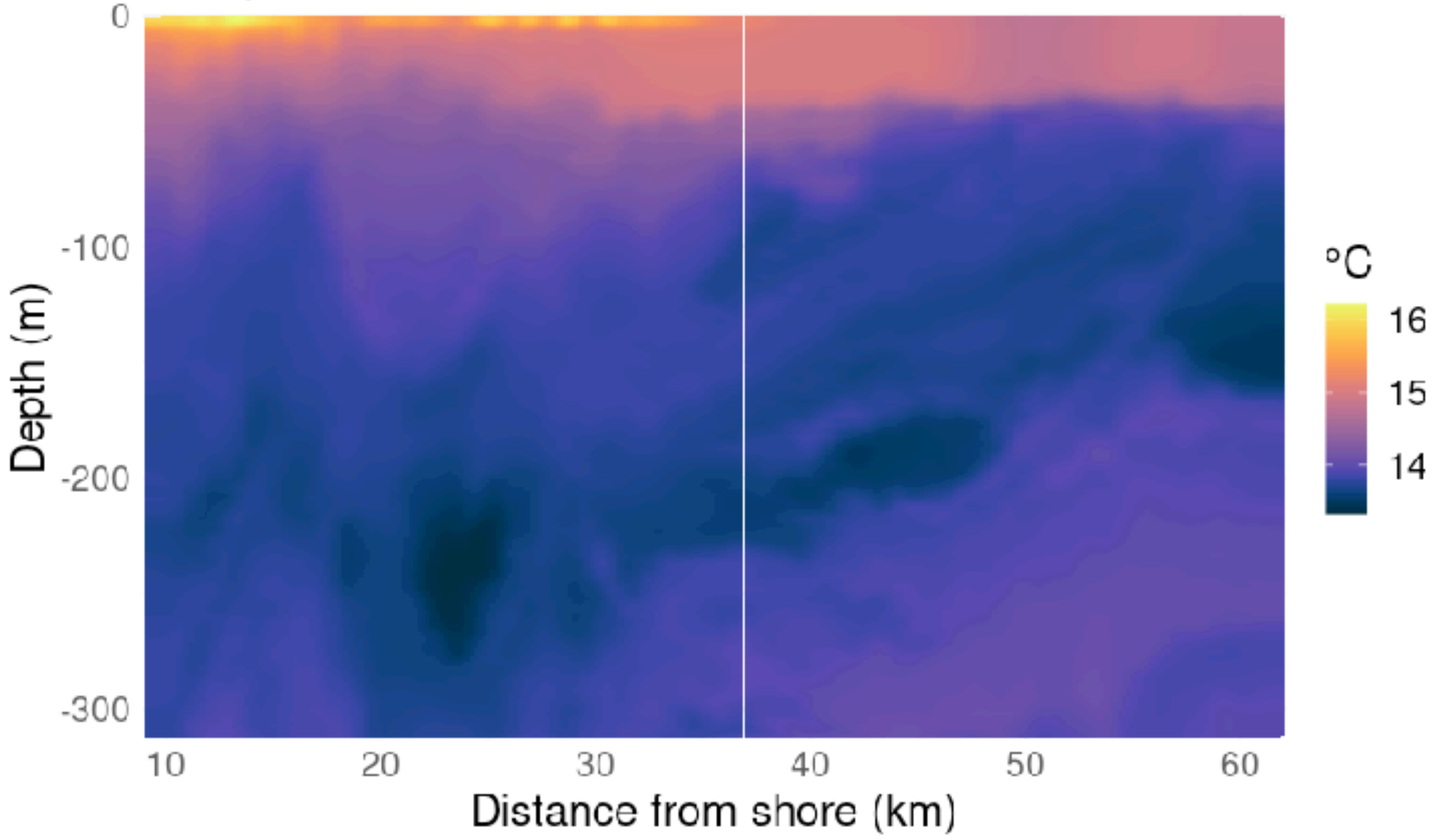

uvp6_sn000003lp_2021_sea002_morphocluster
EcoTaxa 2.6
Project
Filtered
(0, 61208, 0, 0 / 61208)
Filter: Taxo=living (with child) Status= Predicted
Thelma Panaioti
Action
Update view & apply filter
Score
Display
Status Predicted
50
20
Taxonomy filter
Other filters
like<Copepoda
solitaryglobule
Rhizaria
like <Copepoda
solitaryblack-like
Aulosphaeridae

Actinopterygii	115	18
Annelida	46	87
Alciopidae	13	34
Phyllodocida	13	84
Swima	42	238
Tomopteridae	14	235
Appendicularia	26	107
house	199	10516
Chaetognatha	12	12
Cnidaria < Metazoa		2
Hydrozoa	13	1
Narcomedusae	17	3
Siphonophorae	19	43
Trachymedusae		1
tentacle < Cnidaria	215	1551
Copepoda	724	9059
Calanidae	11	17
copepoda eggs	202	1747
like < Copepoda	1857	18332
Ctenophora < Metazoa	18	19
Echinodermata	1	50
pluteus < Echinoidea		3
pluteus < Echinodermata		15
Eumalacostraca	240	3537
Amphipoda	83	339
Hyperiidea		3
Scinidae		2
Mollusca		1
Thecosomata	47	143
Cavoliniidae		1
Cavolinia inflexa	38	55
Clidae		1
Creseidae	40	22
Pyrosoma		4
Rhizaria	878	2191
Acantharia	28	128

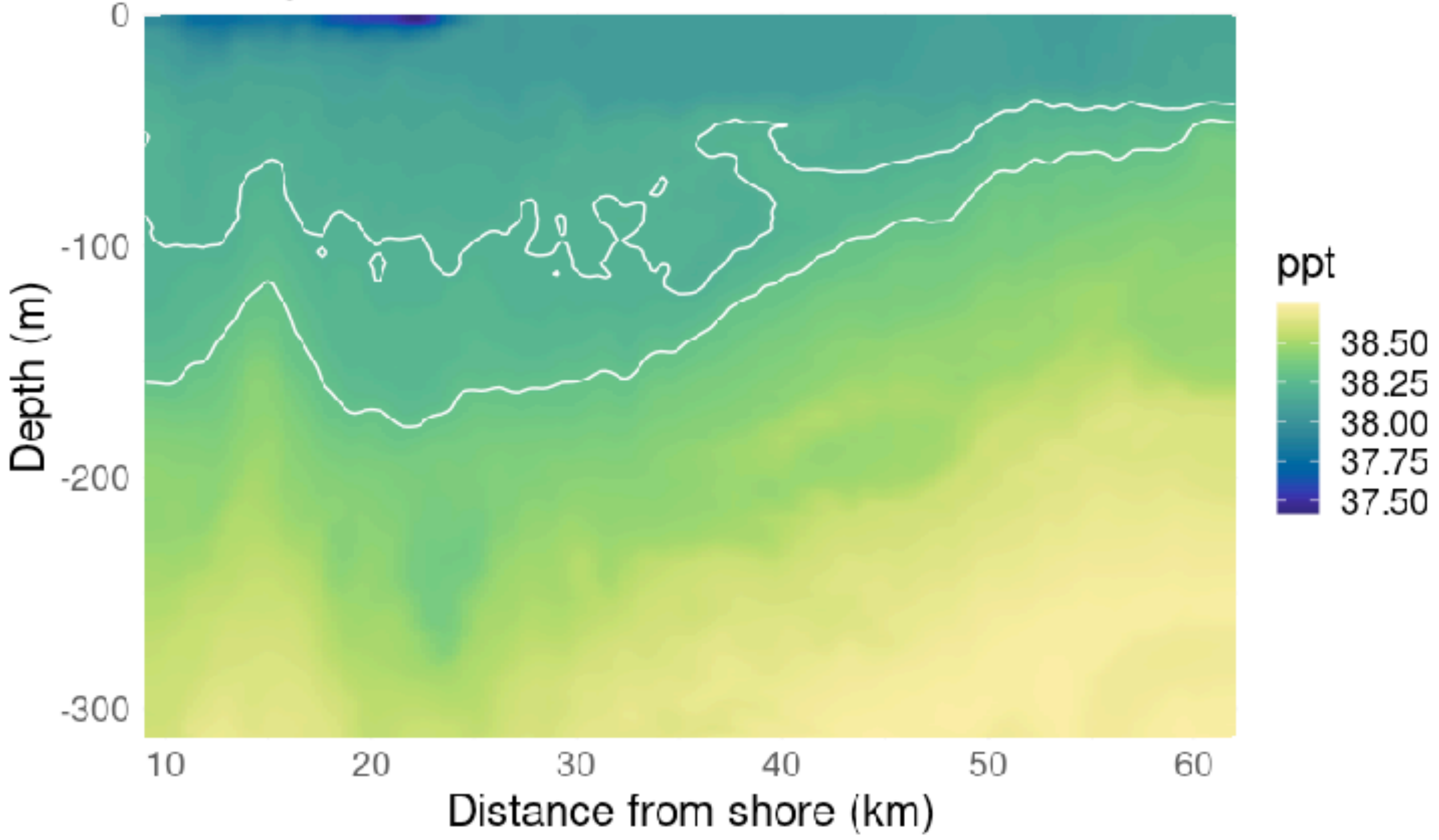
Environmental data along a transect

May 2nd, 2021

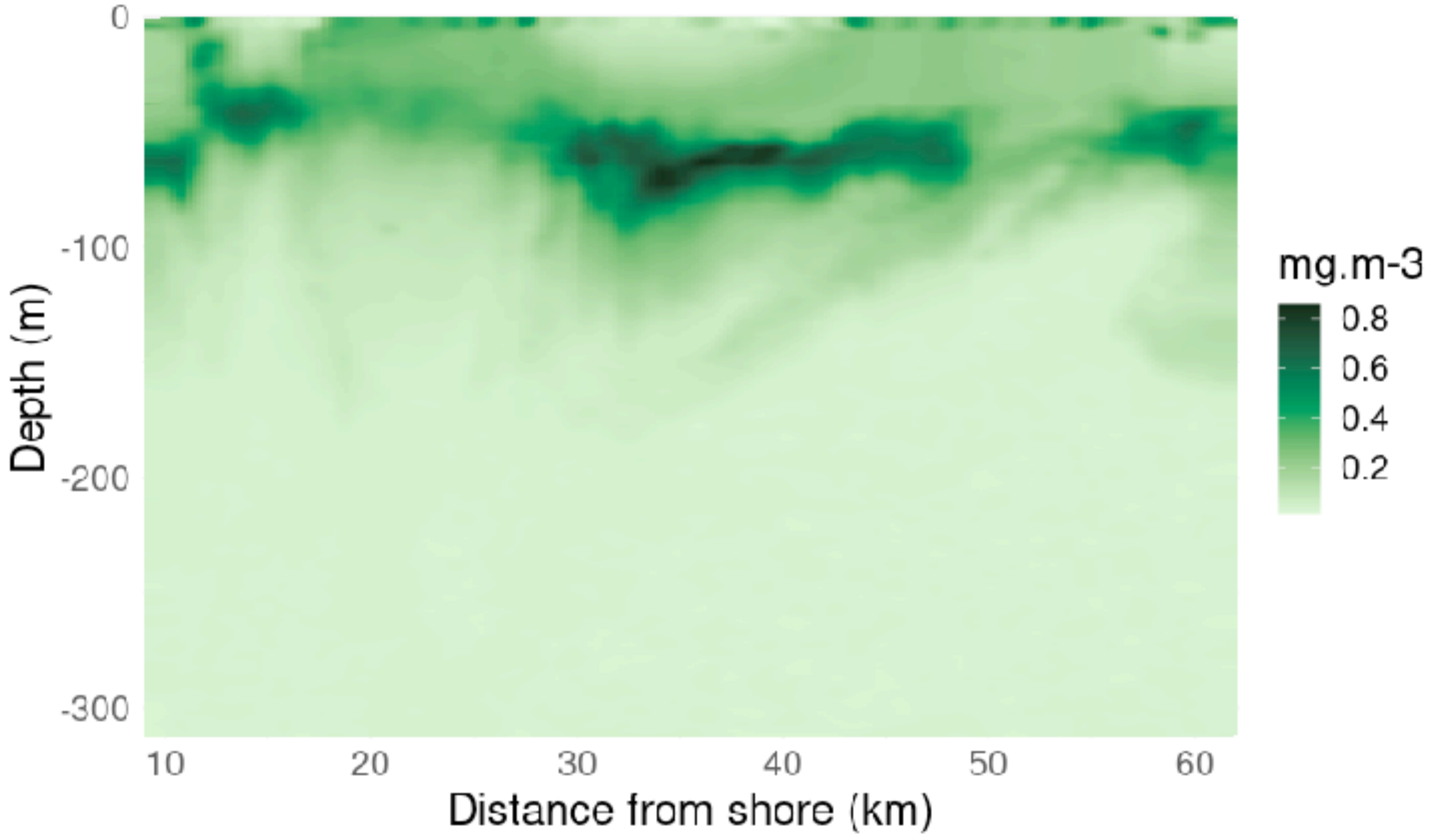
Temperature



Salinity

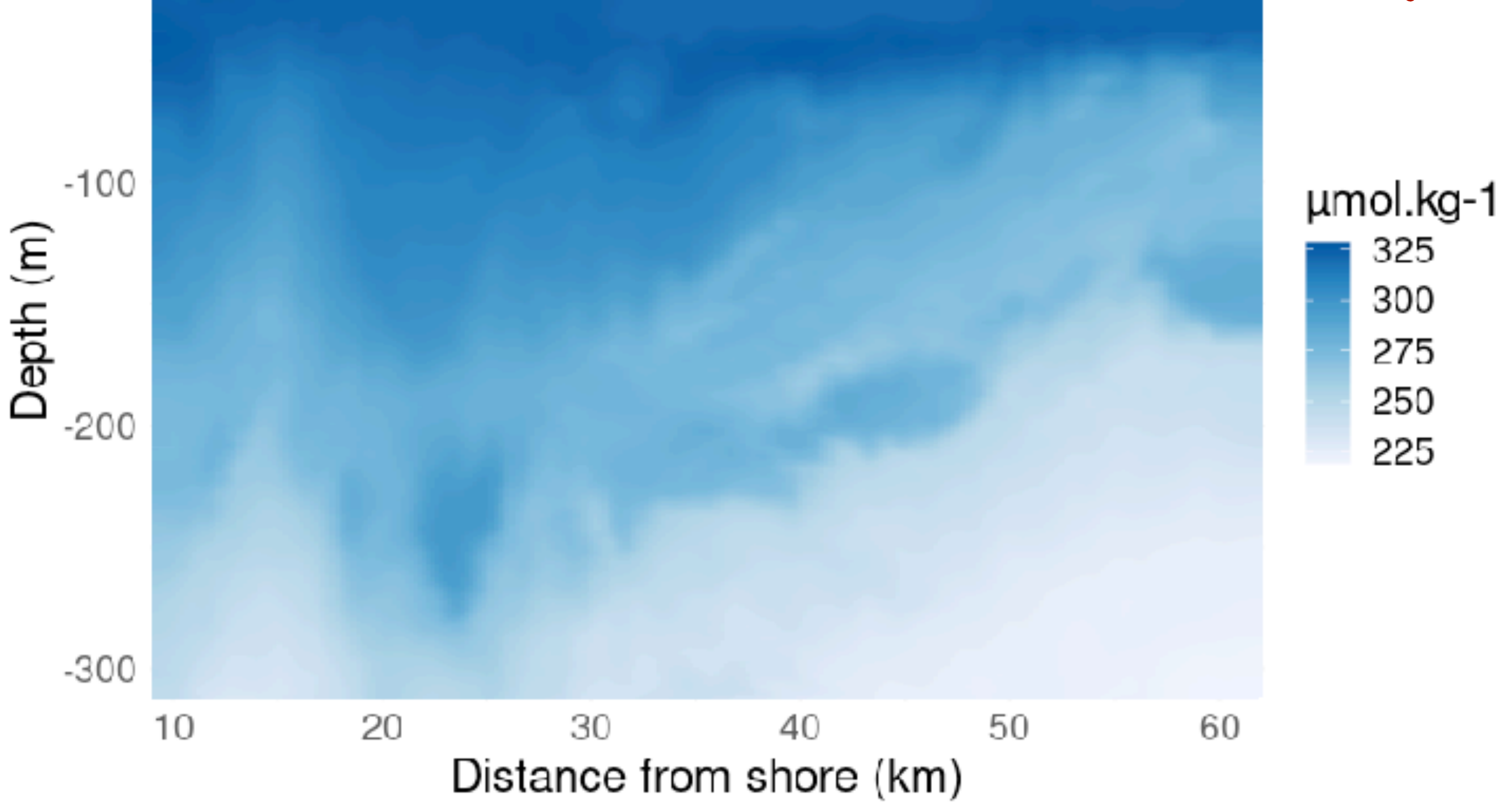


Chl a



Oxygen

Not calibrated

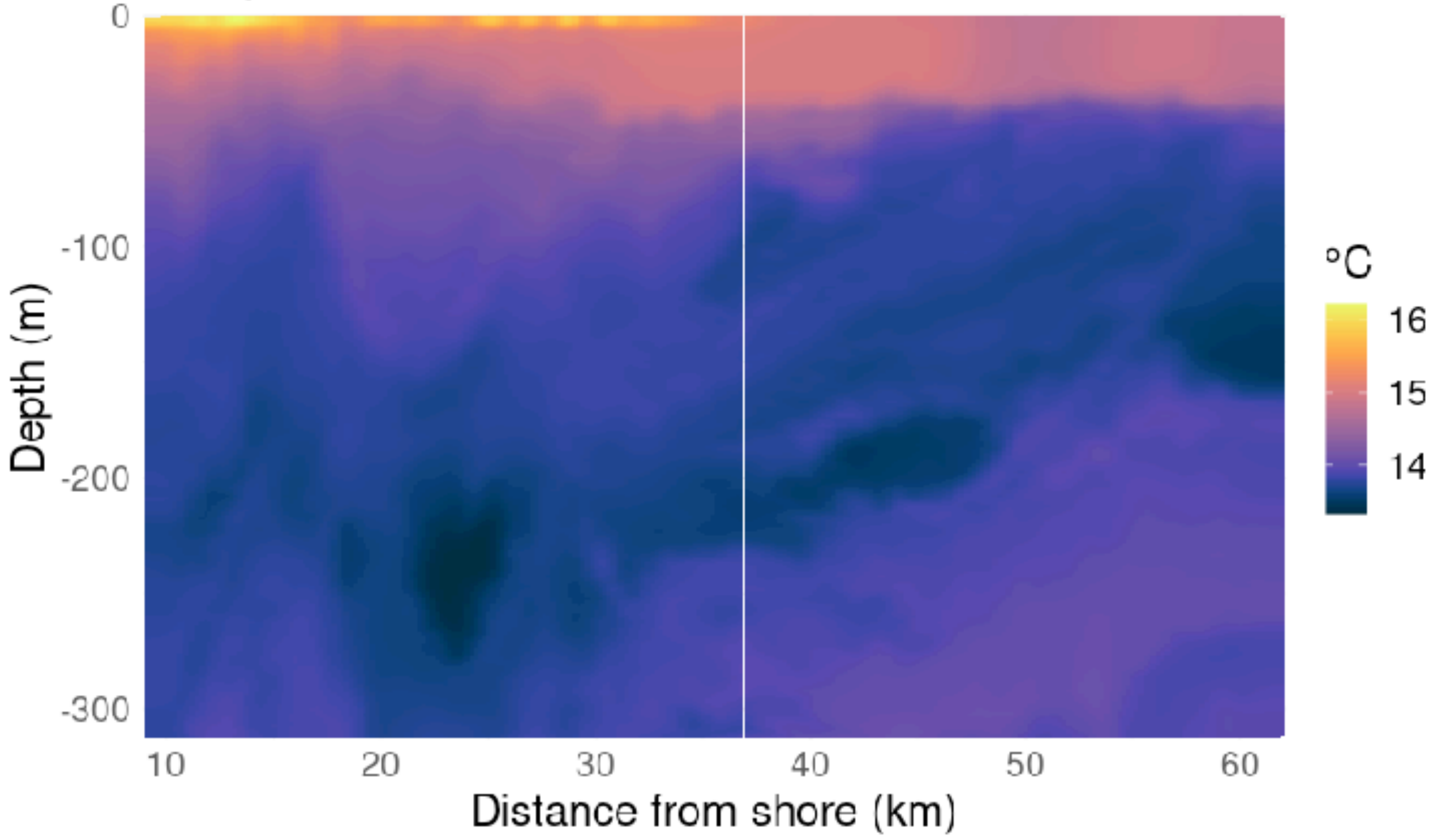


Environmental data along a transect

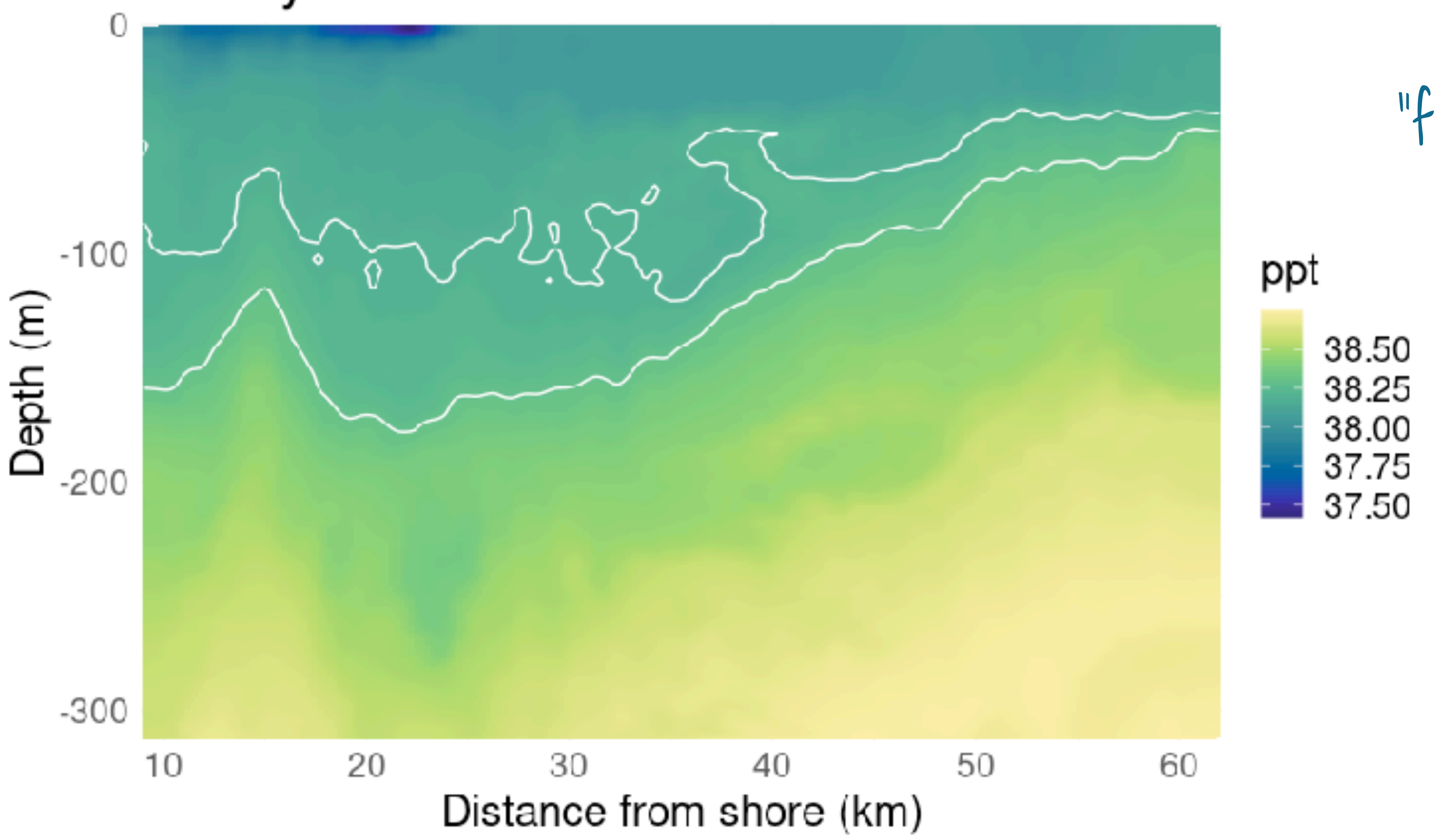
May 2nd, 2021

beginning of stratification

Temperature



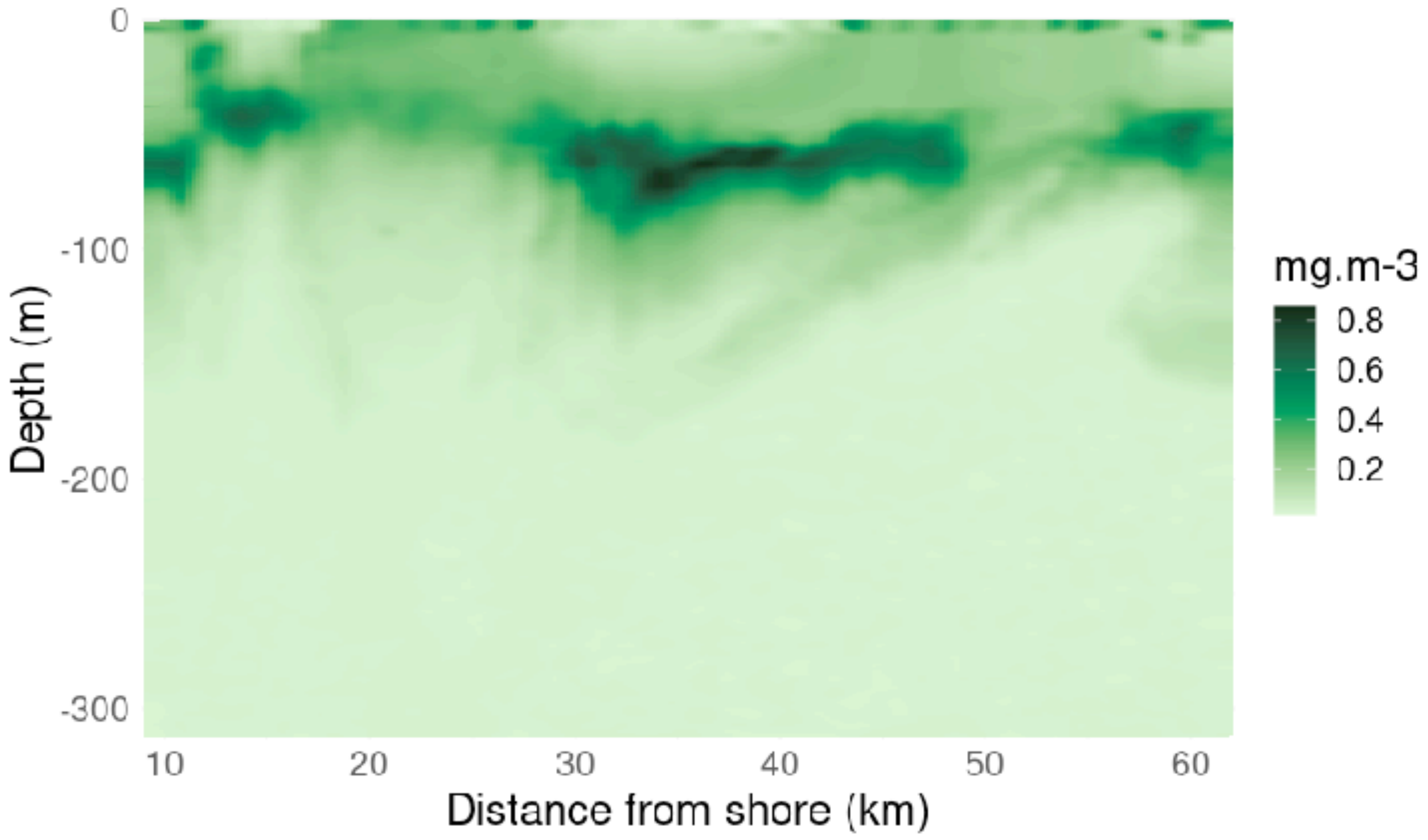
Salinity



"flat" front

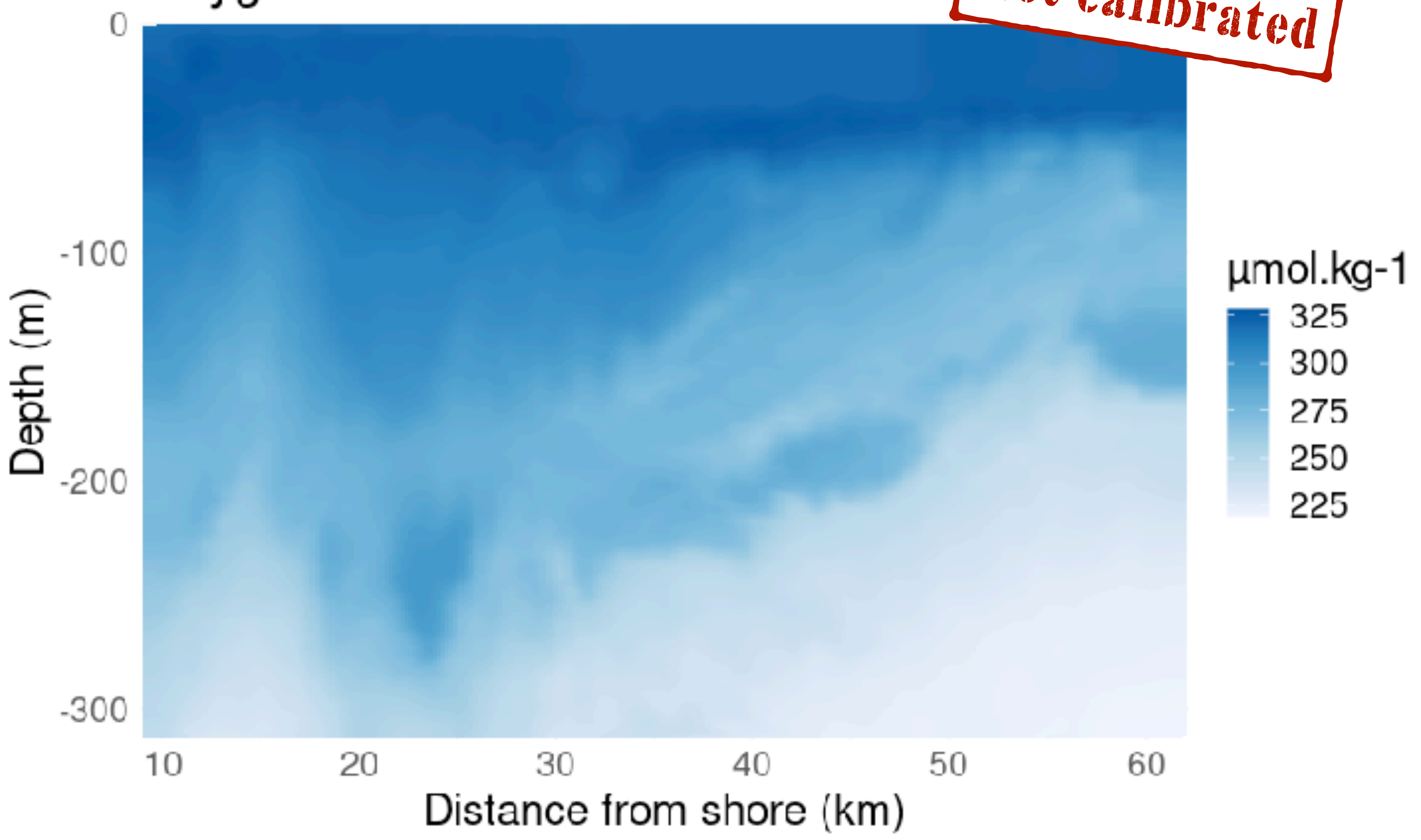
deep chlorophyll maximum

Chl a



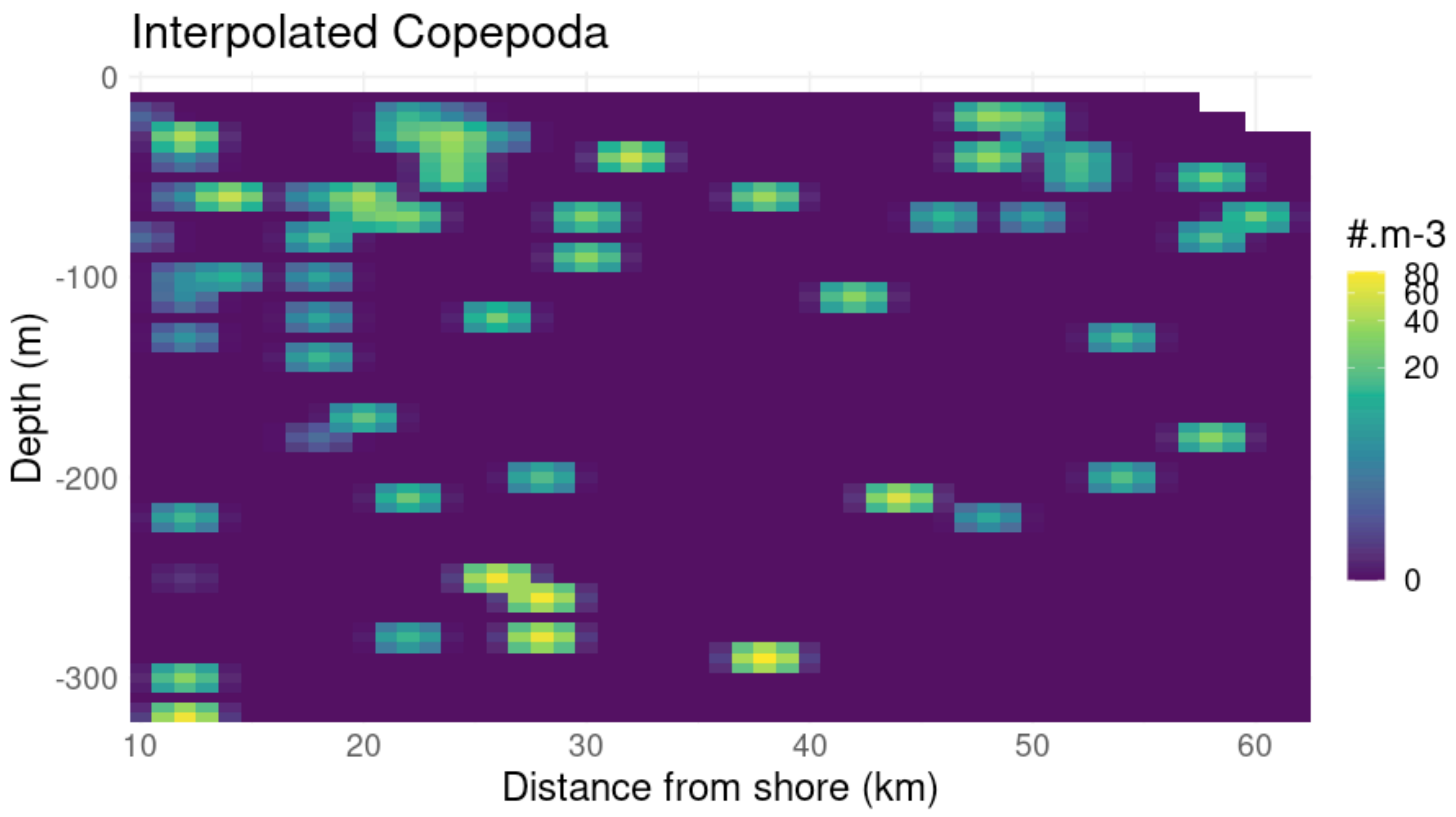
Not calibrated

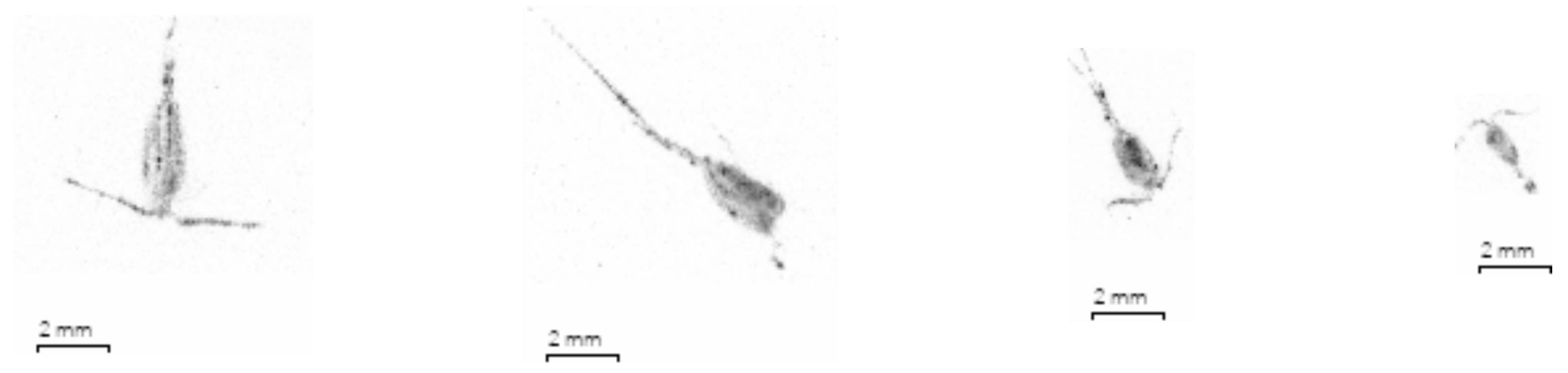
Oxygen



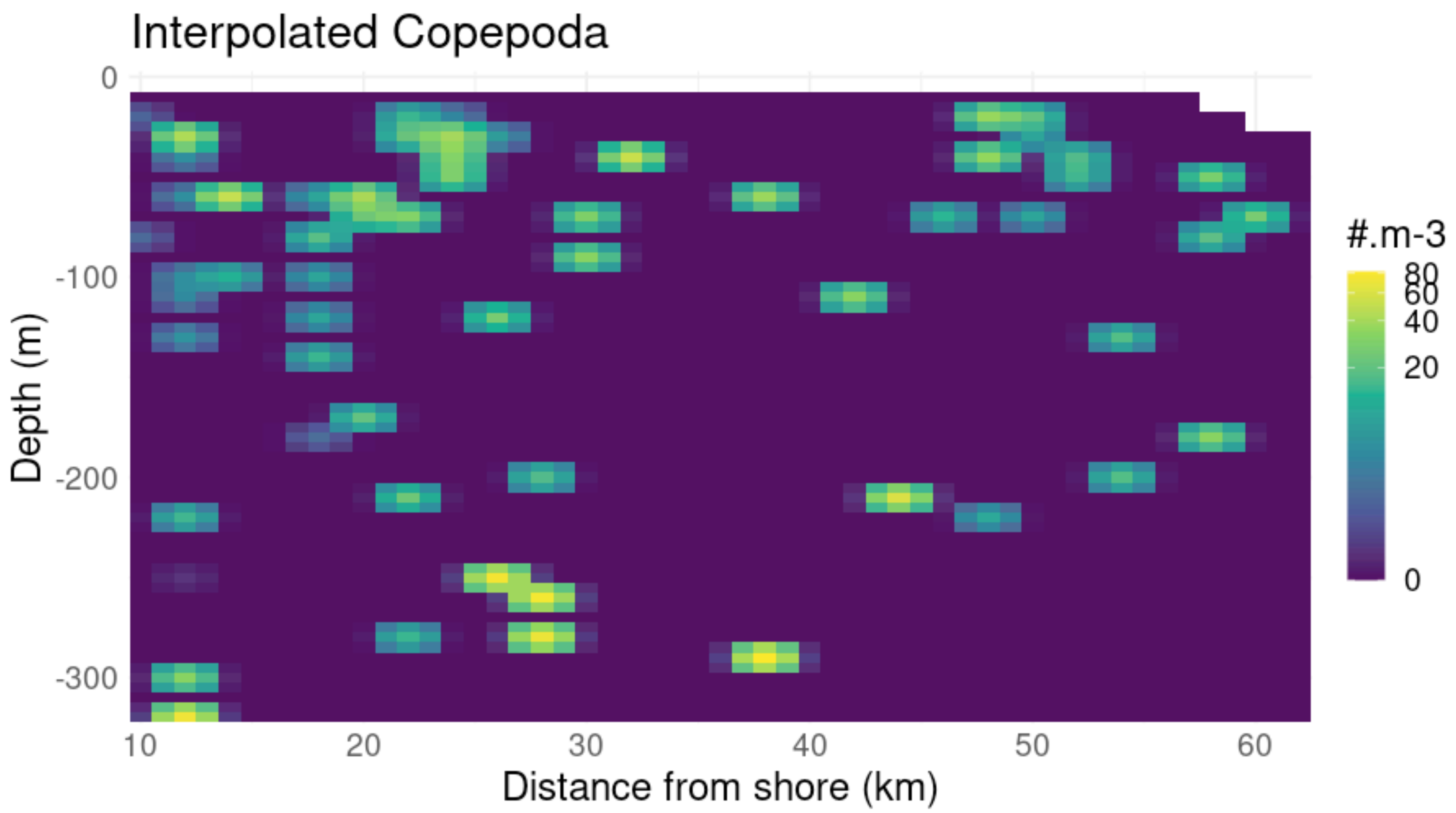
Fine-scale particles distribution

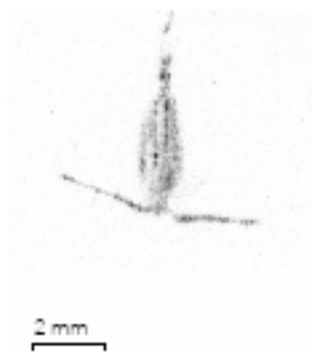
Fine-scale plankton distribution



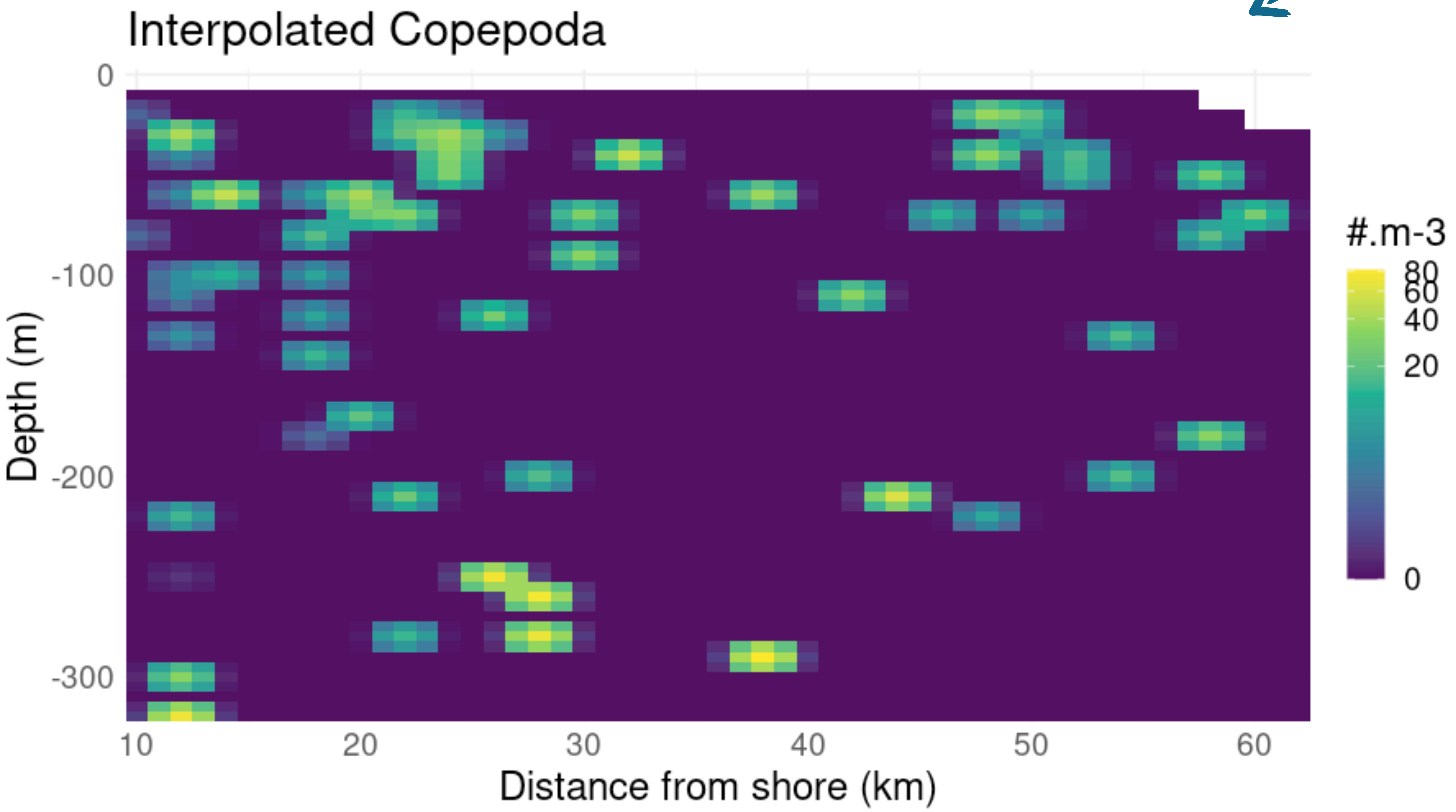

2 mm
2 mm
2 mm
2 mm

Fine-scale plankton distribution

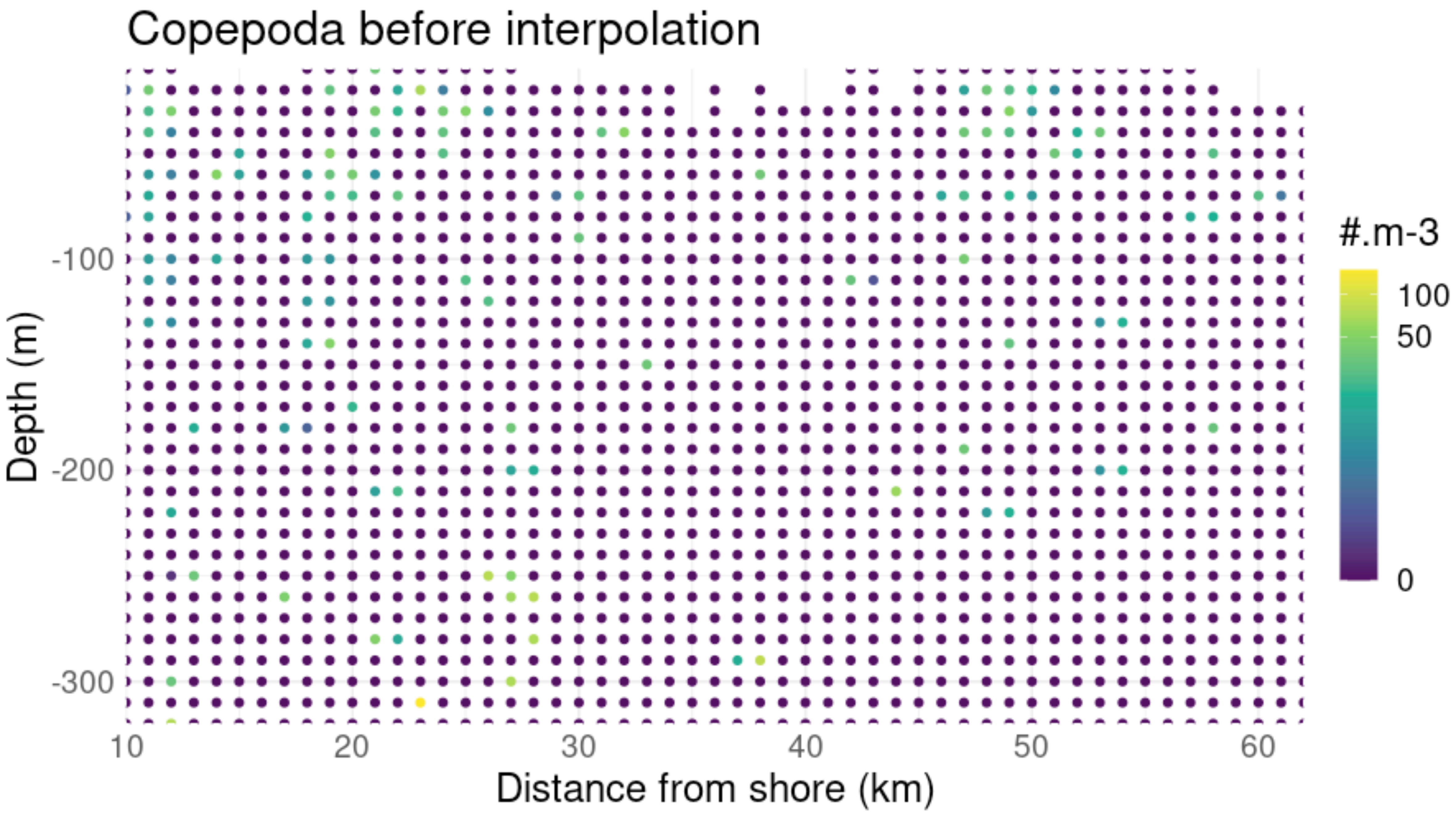

Interpolated Copepoda

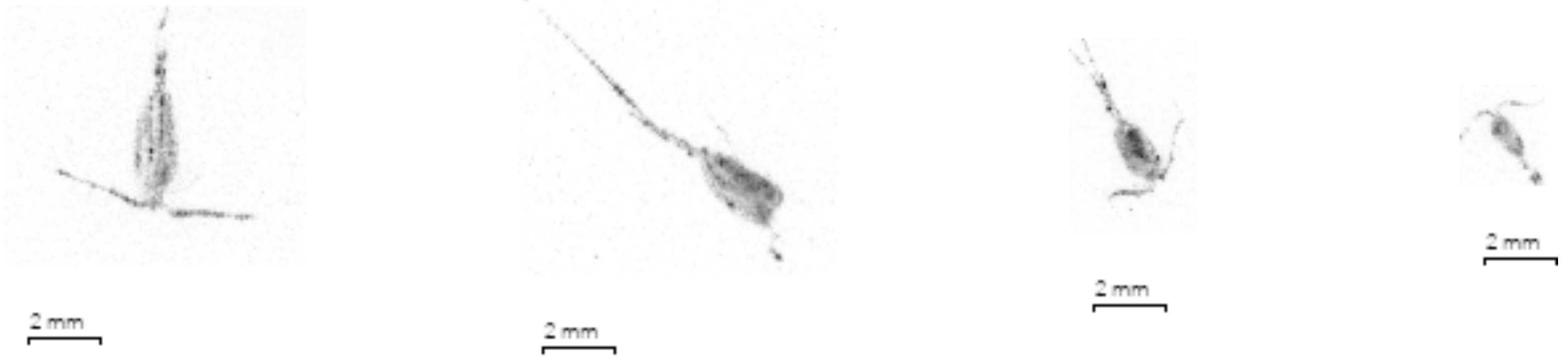


Fine-scale plankton distribution



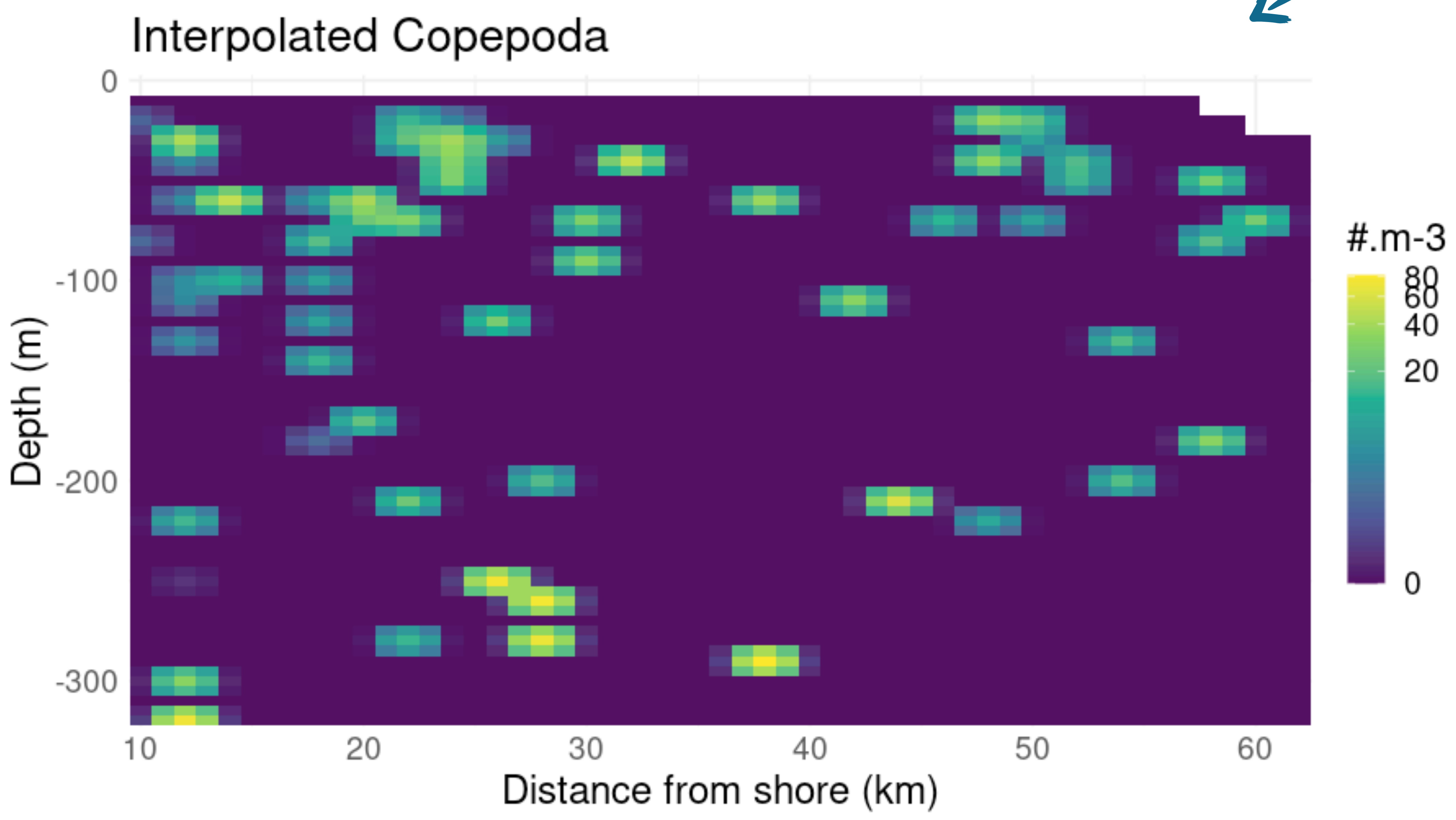
interpolated from

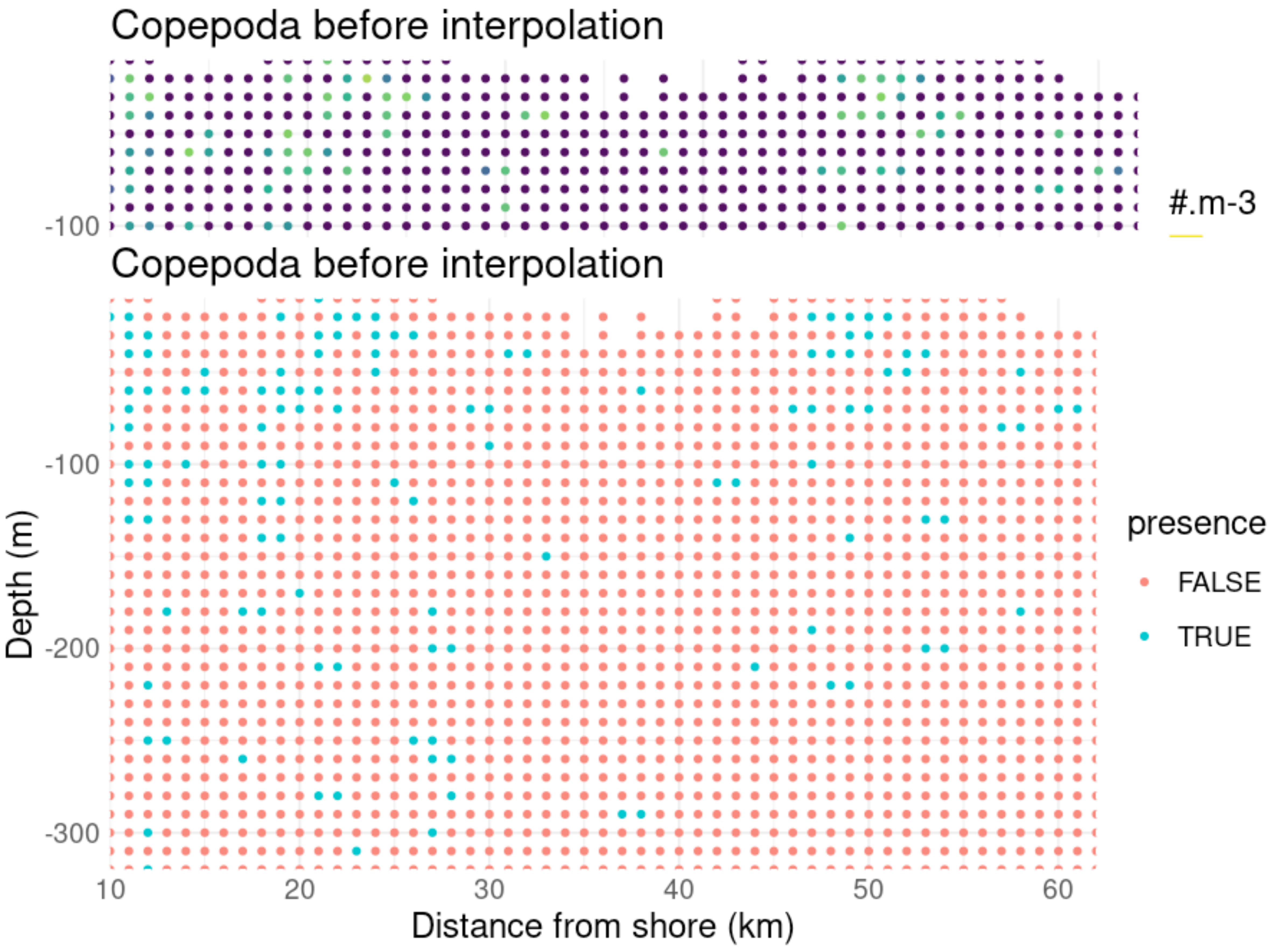



2 mm
2 mm
2 mm
2 mm

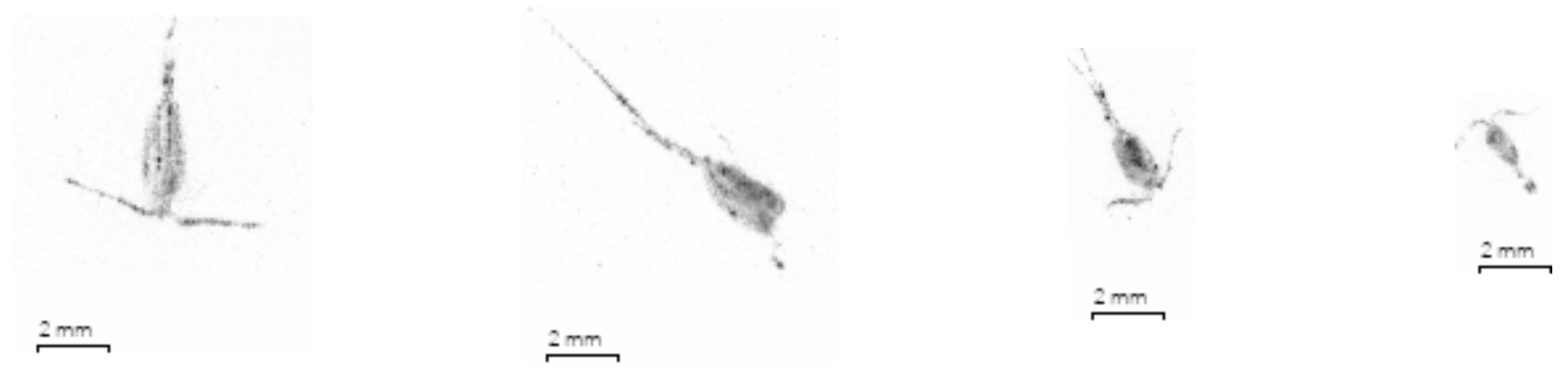
Fine-scale plankton distribution

interpolated from

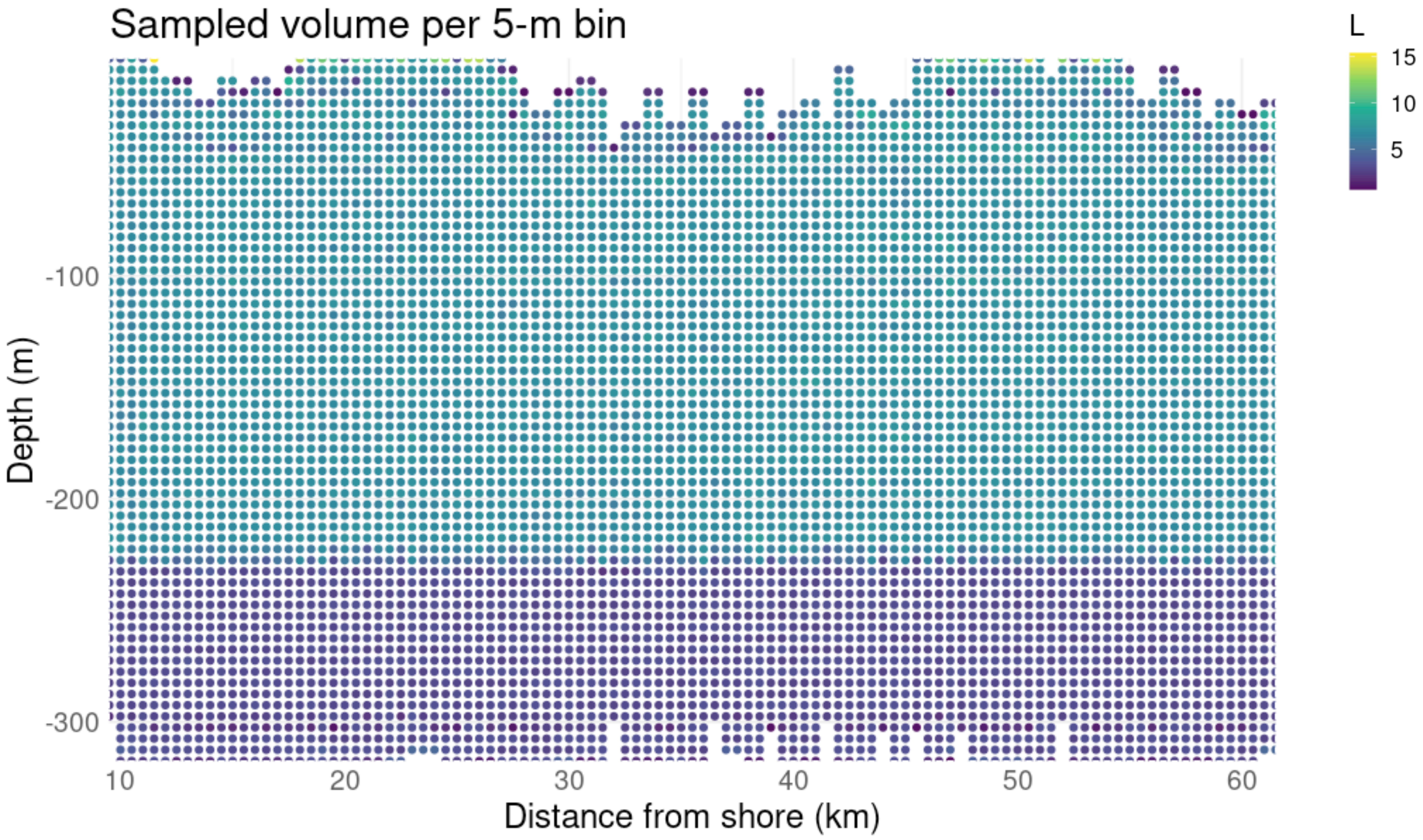

Interpolated Copepoda


Copepoda before interpolation

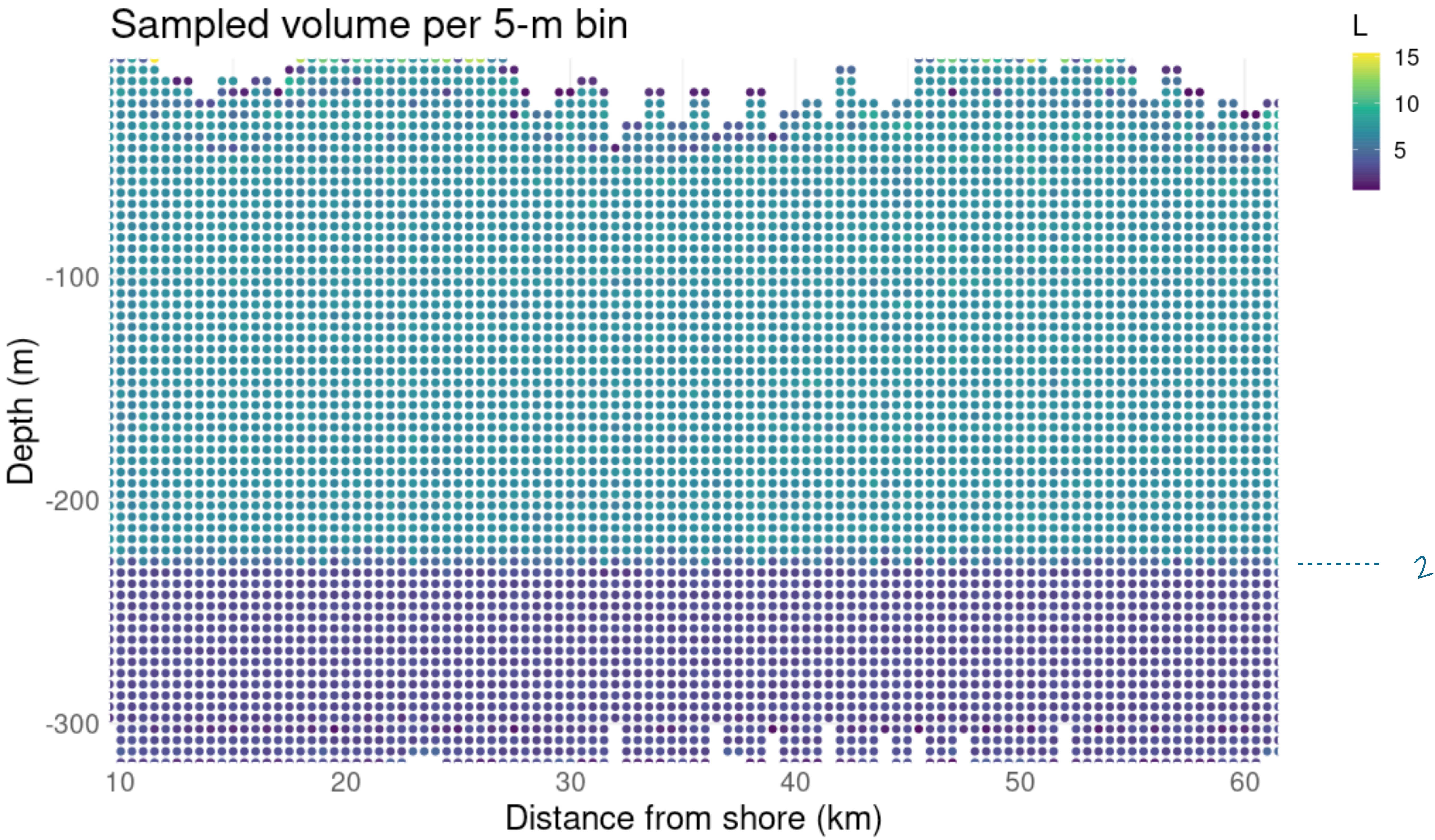
Copepoda before interpolation



Sampled volumes



Sampled volumes



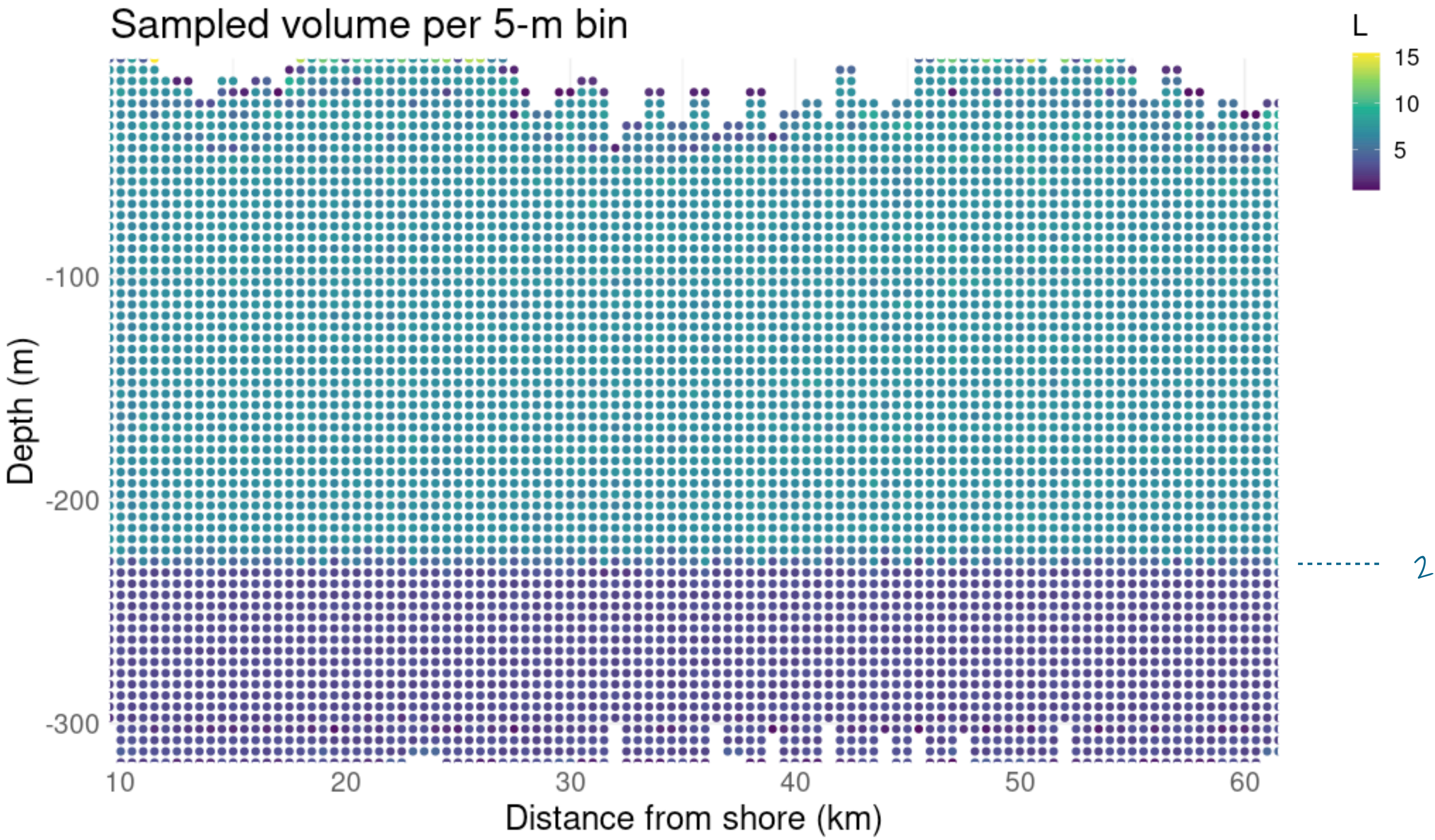
1.3 Hz ⟶ ~8.5 L per 5-m bin

220 m

0.5 Hz ⟶ ~3 L per 5-m bin

Sampled volumes

Sampled volume does not allow to resolve fine-scale plankton distribution…

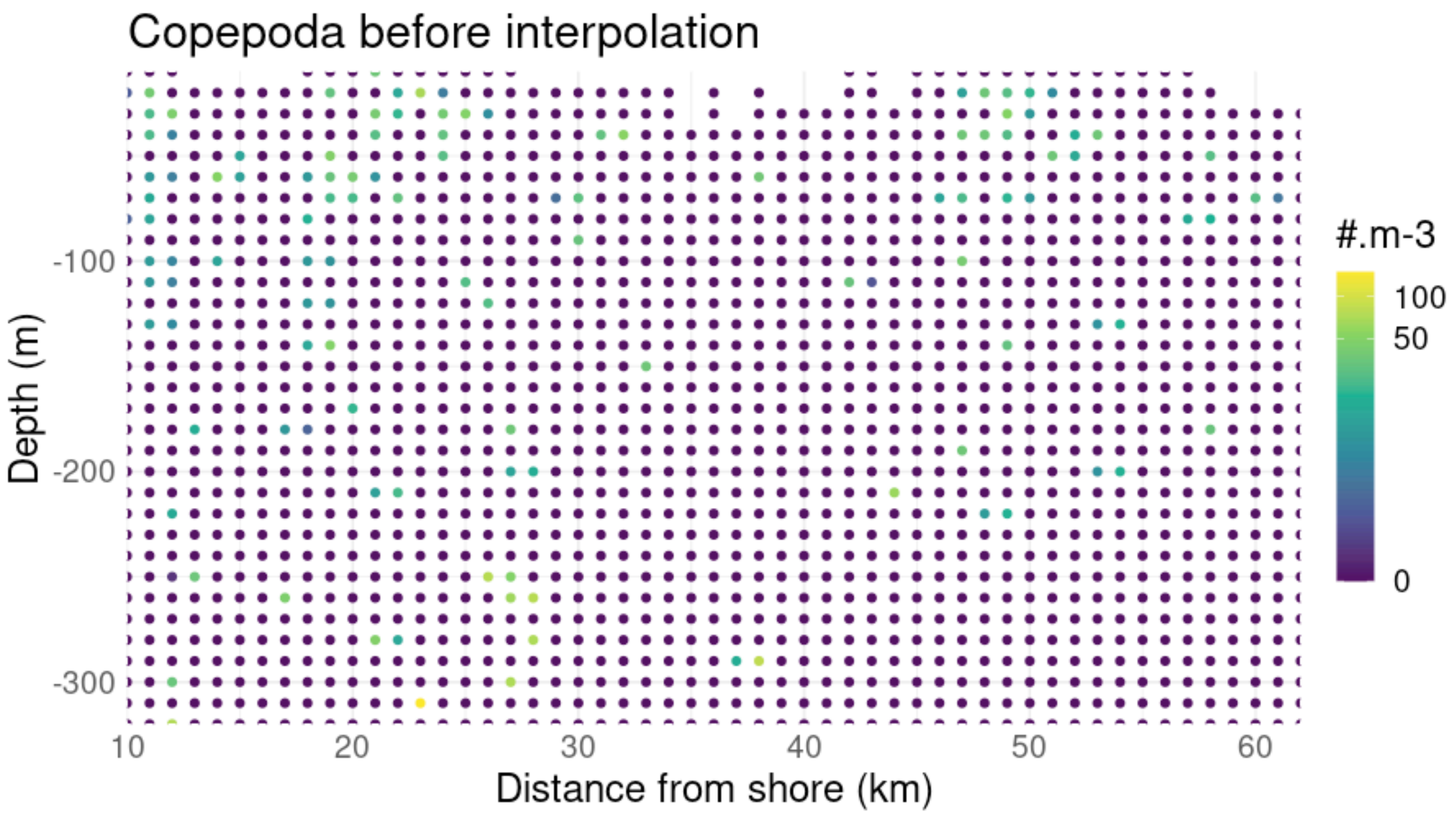


1.3 Hz → ~8.5 L per 5-m bin

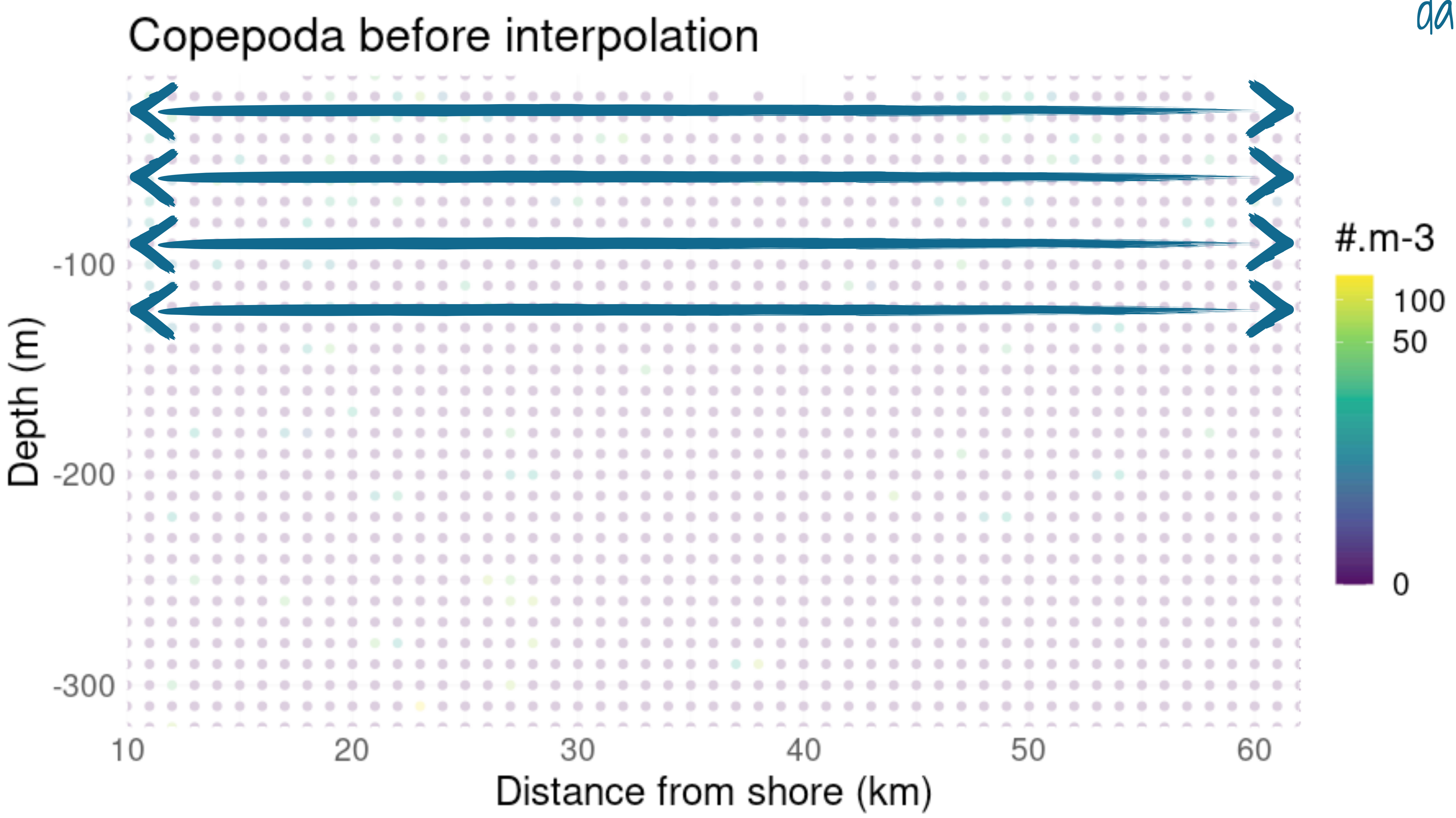
220 m

0.5 Hz → ~3 L per 5-m bin

Plankton distribution



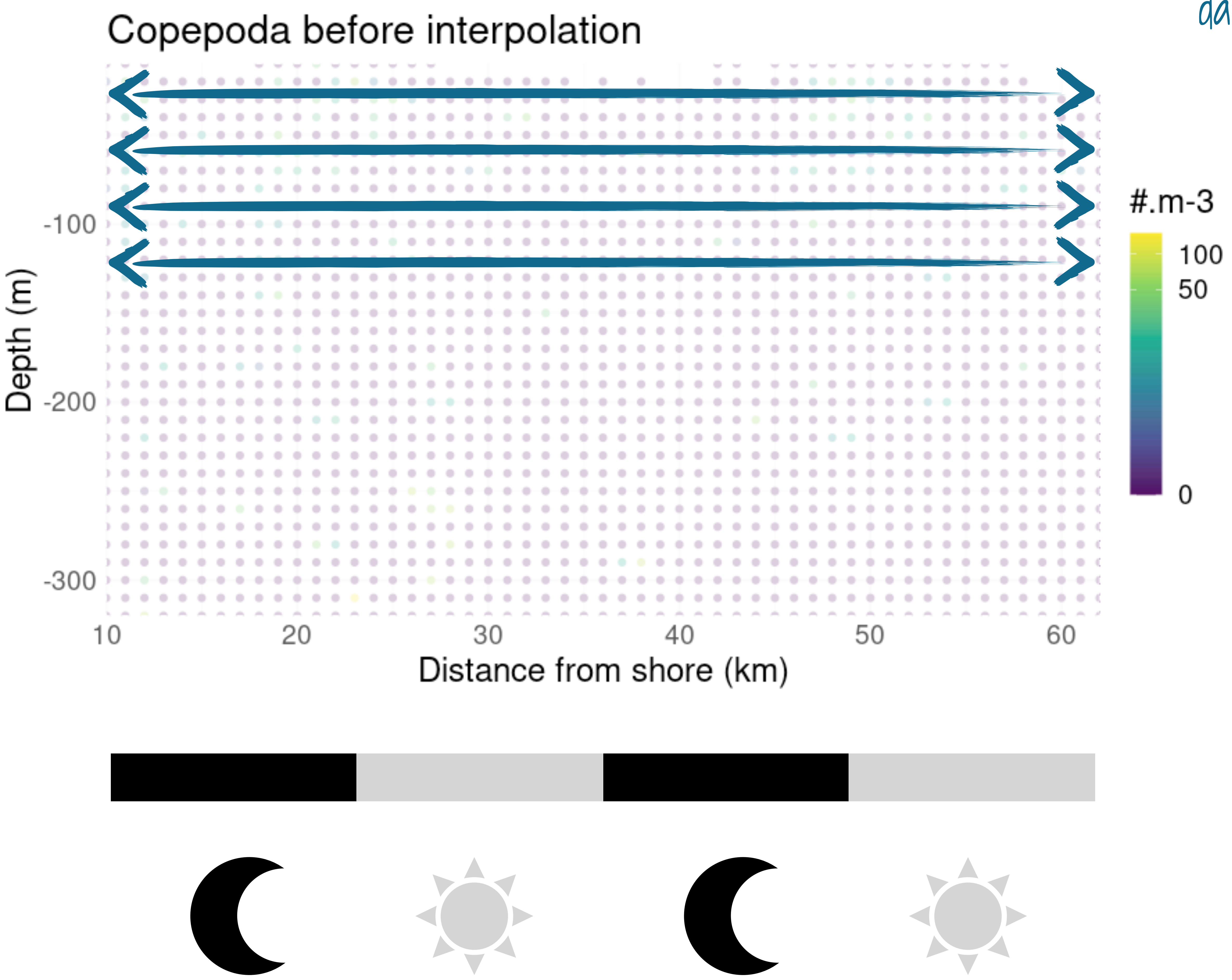
Plankton distribution



depth-wise integration

day and night separated

Plankton distribution

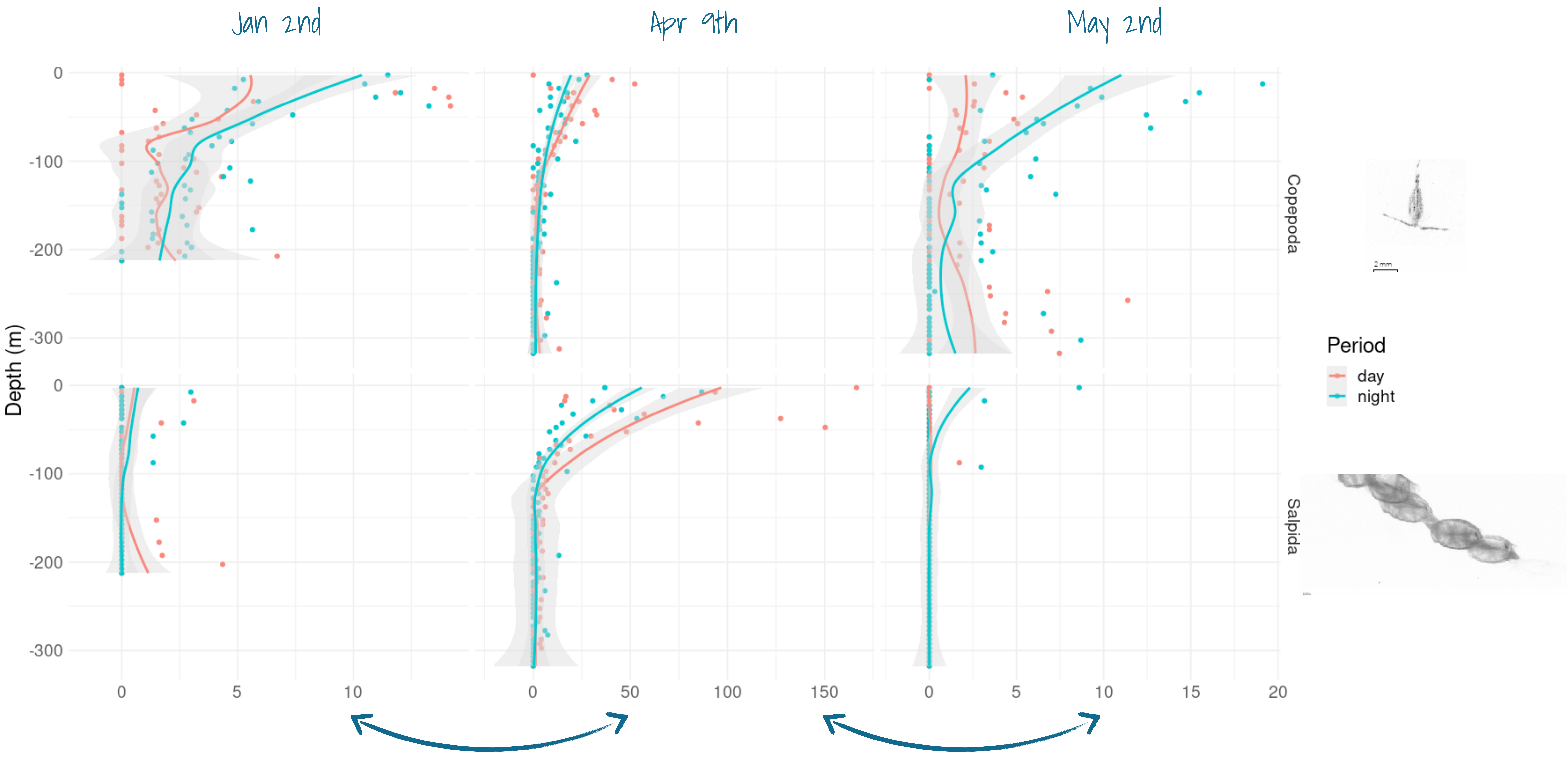


depth-wise integration

day and night separated

1 transect = 2 days

Plankton distribution



Jan 2nd

Apr 9th

May 2nd

≠ scale

Averaged concentration (#.m-3)

≠ scale

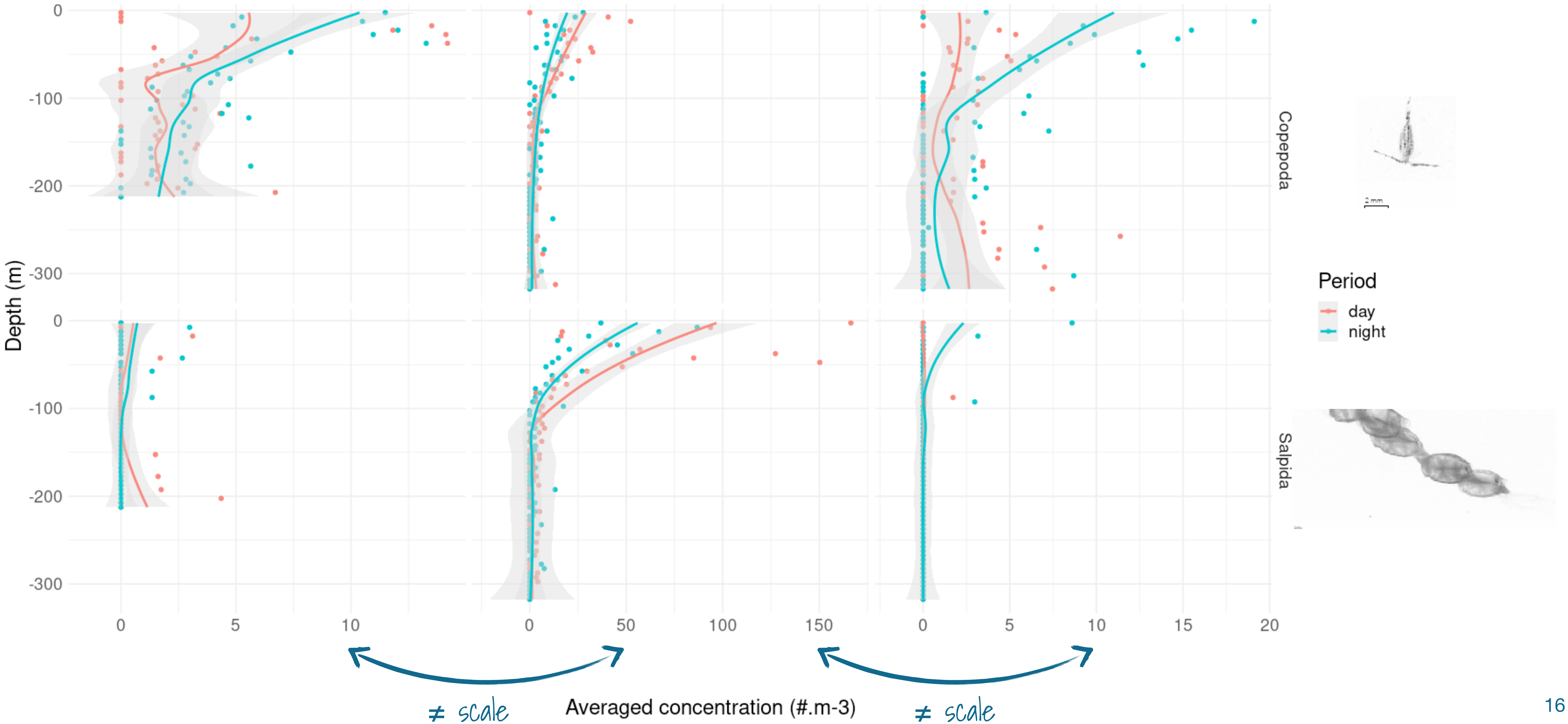
Plankton distribution

plankton bloom

Jan 2nd

Apr 9th

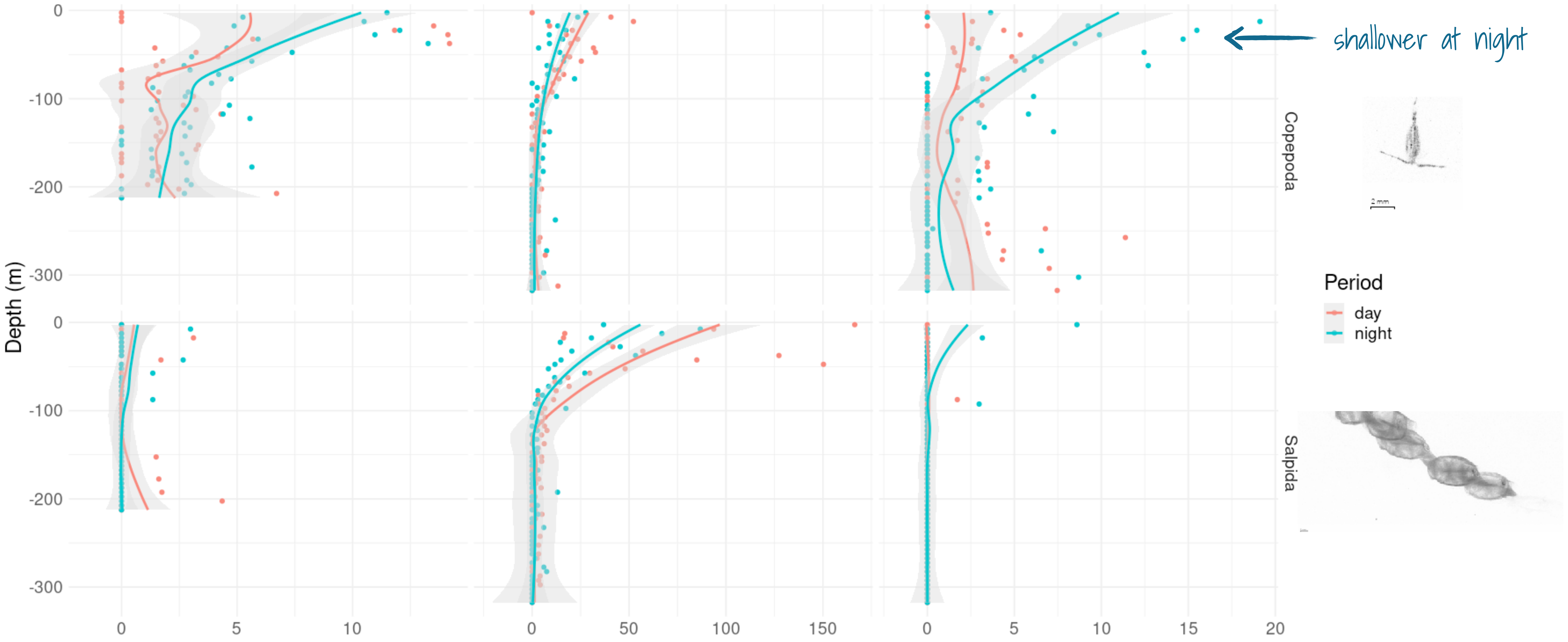
May 2nd



≠ scale

≠ scale

Plankton distribution



Jan 2nd

Apr 9th

May 2nd

plankton bloom

shallower at night

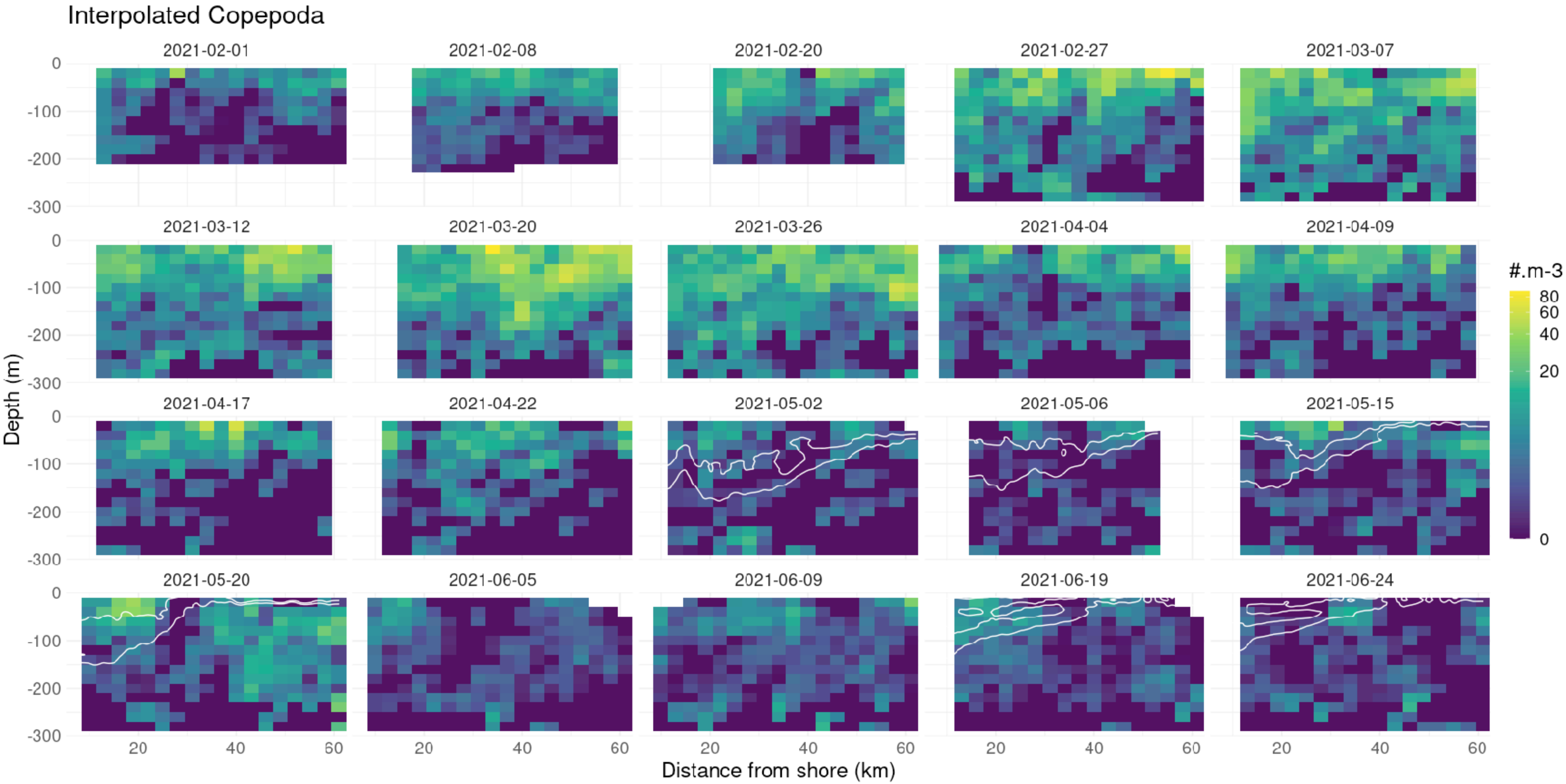
≠ scale

≠ scale

Plankton distribution

Larger bins, lower resolution

… but allows mesoscale studies



Sea002’s new friends

(2)
Actinopterygii
area : 204516
depth : 23.66

(2)
Actinopterygii
area : 203565
depth : 24.54

(2)
Actinopterygii
area : 197346
depth : 57.23

(2)
Actinopterygii
area : 174057
depth : 71.05

(2)
Actinopterygii
area : 160571
depth : 58.22

(2)
Actinopterygii
area : 325753
depth : 120

(2)
Actinopterygii
area : 304455
depth : 44.63

(2)
Actinopterygii
area : 275611
depth : 72.00

(2)
Actinopterygii
area : 257916
depth : 99.74

(2)
Actinopterygii
area : 245212
depth : 24.12

(2)
Actinopterygii
area : 227323
depth : 54.91

Thank you for your attention