

Multidisciplinary approach to assess the far-field effects of sand extraction in the Belgian part of the North Sea

Benjamin Van Roozendael

TURBEAMS



WHY?



Sand extraction
Dumping

Fishing
Offshore industry



Sediment plumes

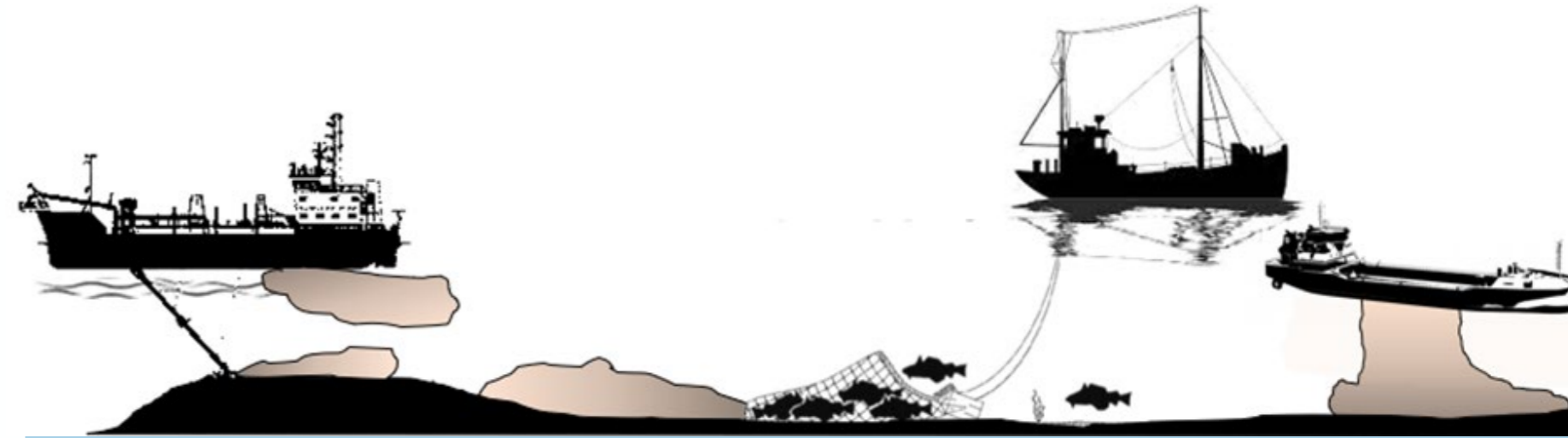
- Capacity of far-reaching impact
- Benthic/pelagic habitat disturbance



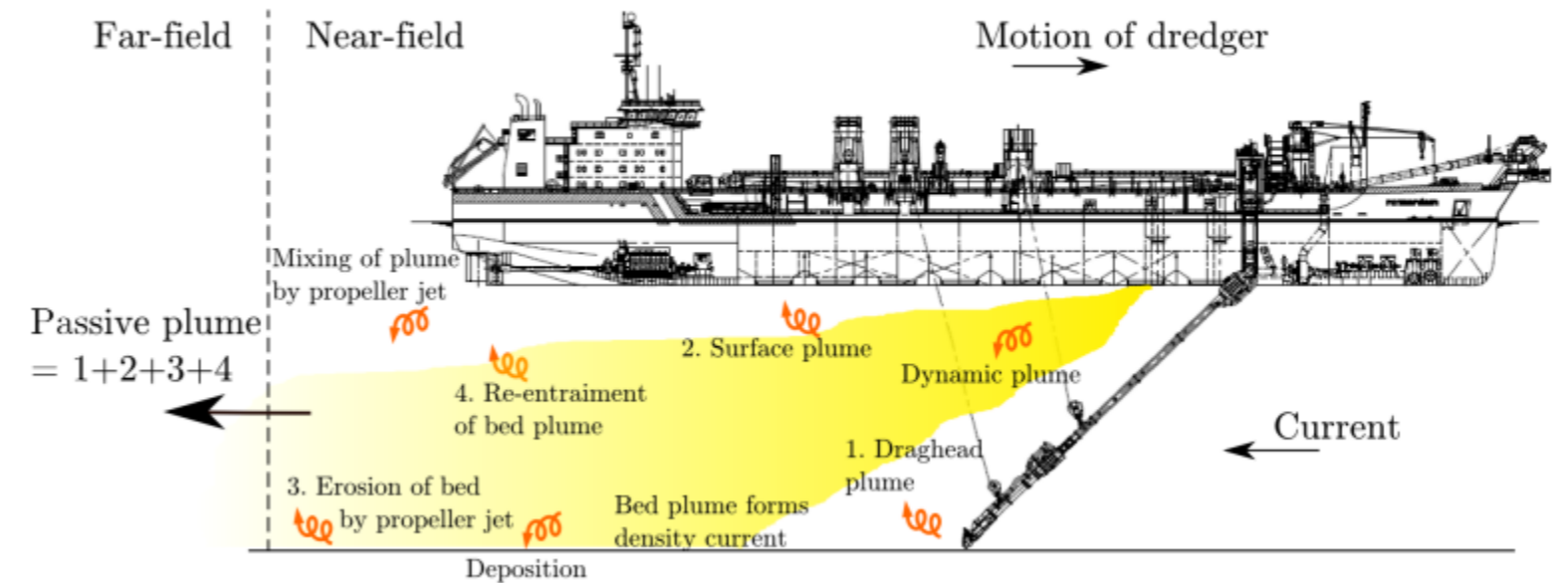
Model validation



Best practices for industry



Lars Kint, 2023



Taco Tuinhof, 2014

HOW?



RV Belgica



Acoustics

Kongsberg EM2040 MBES
Teledyne WHM600 ADCP
Simrad EK80 SBES
Aquascat 1000R



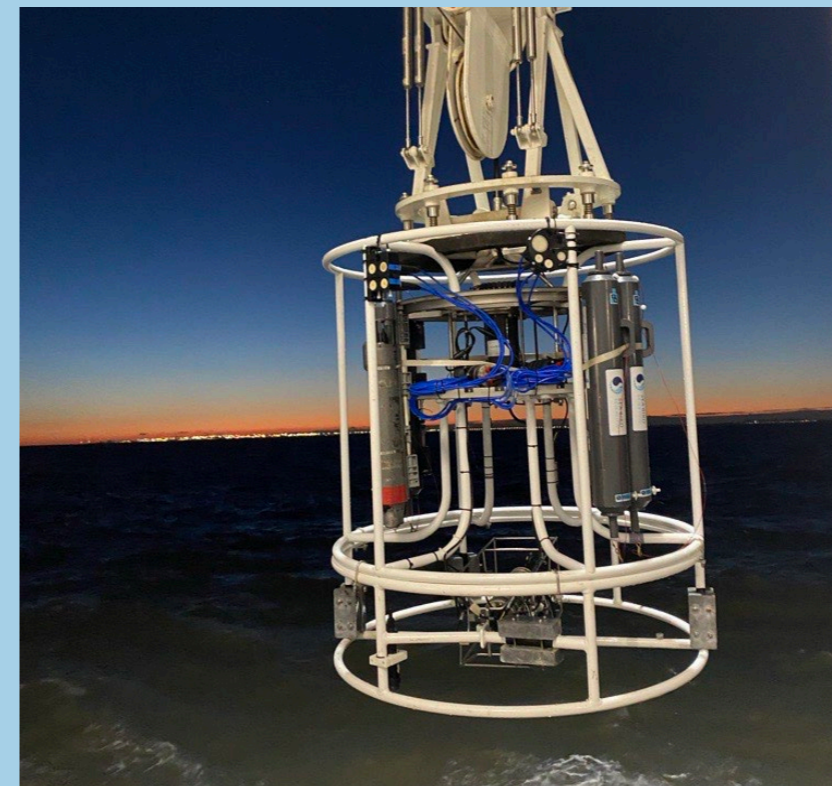
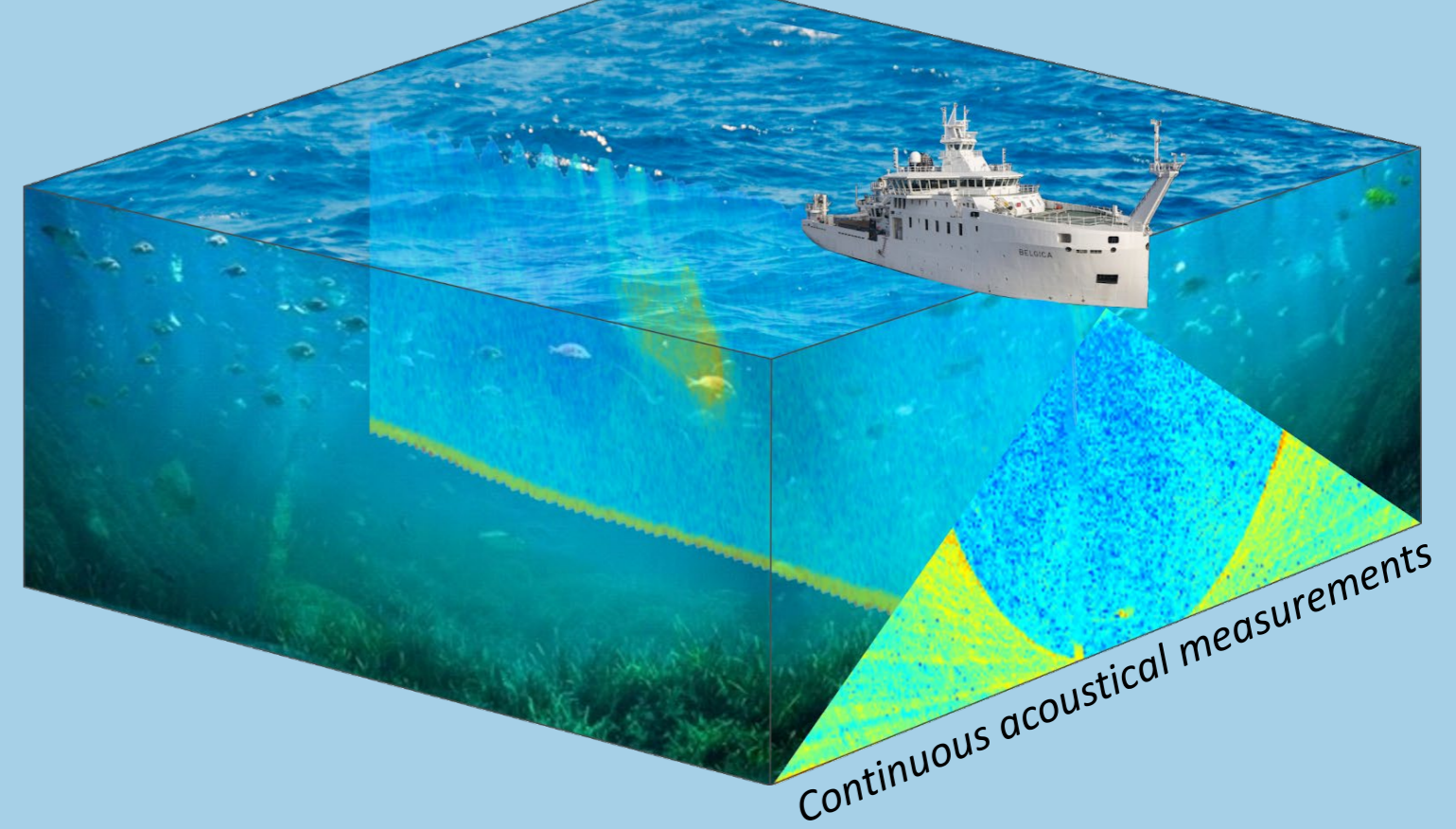
Optics

Sequoia LISST-200X
OBS
Hach turbidity
Imagery



Samples

Water samples
Sediment samples



CTD carousel



Video plankton recorder

Where/When?

First campaign (03 - 05/11/2022) :

→ 2 areas:

- Offshore Thorntonbank
- Nearshore Sierra Ventana

→ 2 activities:

- Dredging (Krakesandt)
- Dumping (Sanderus)

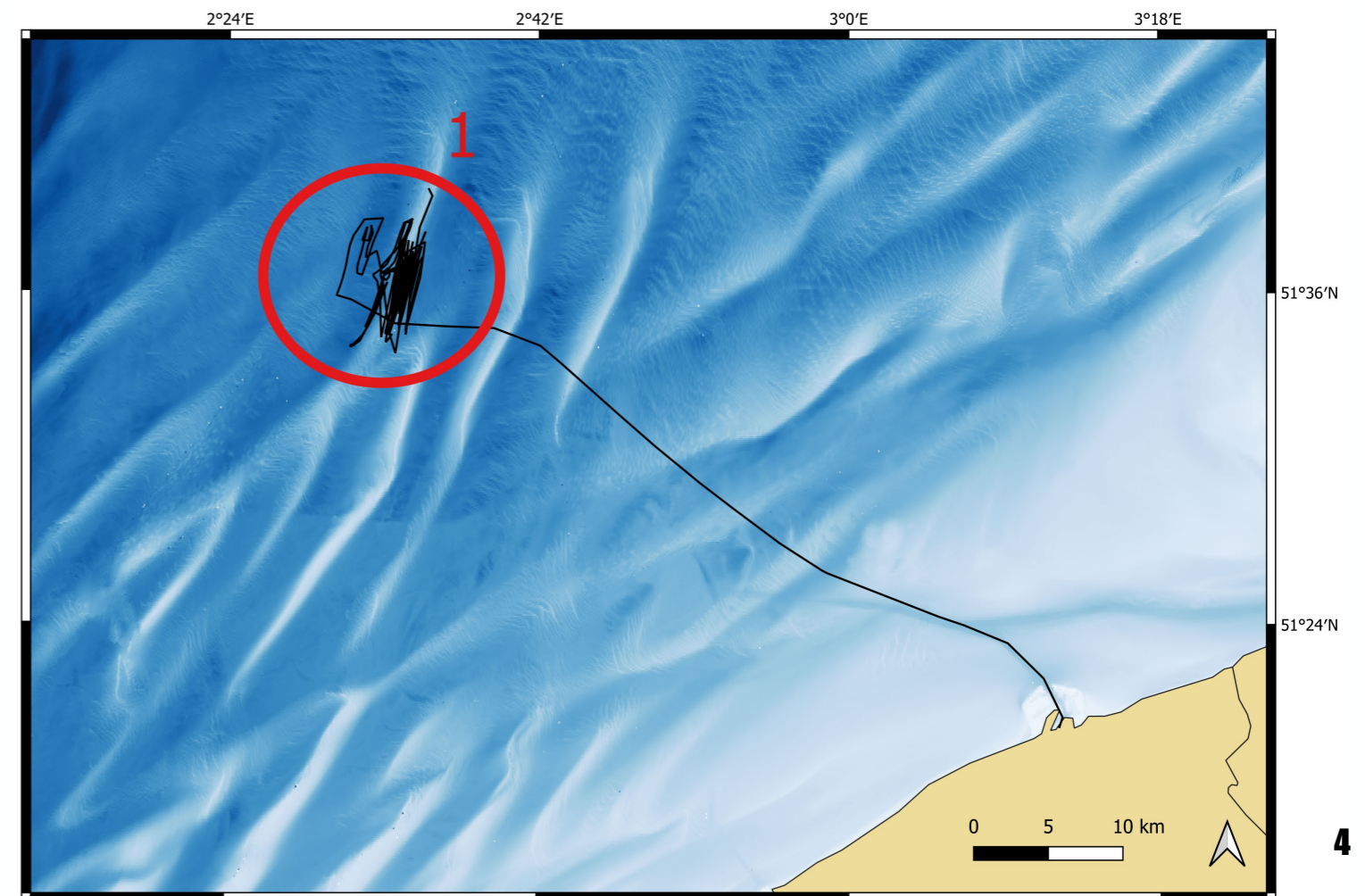
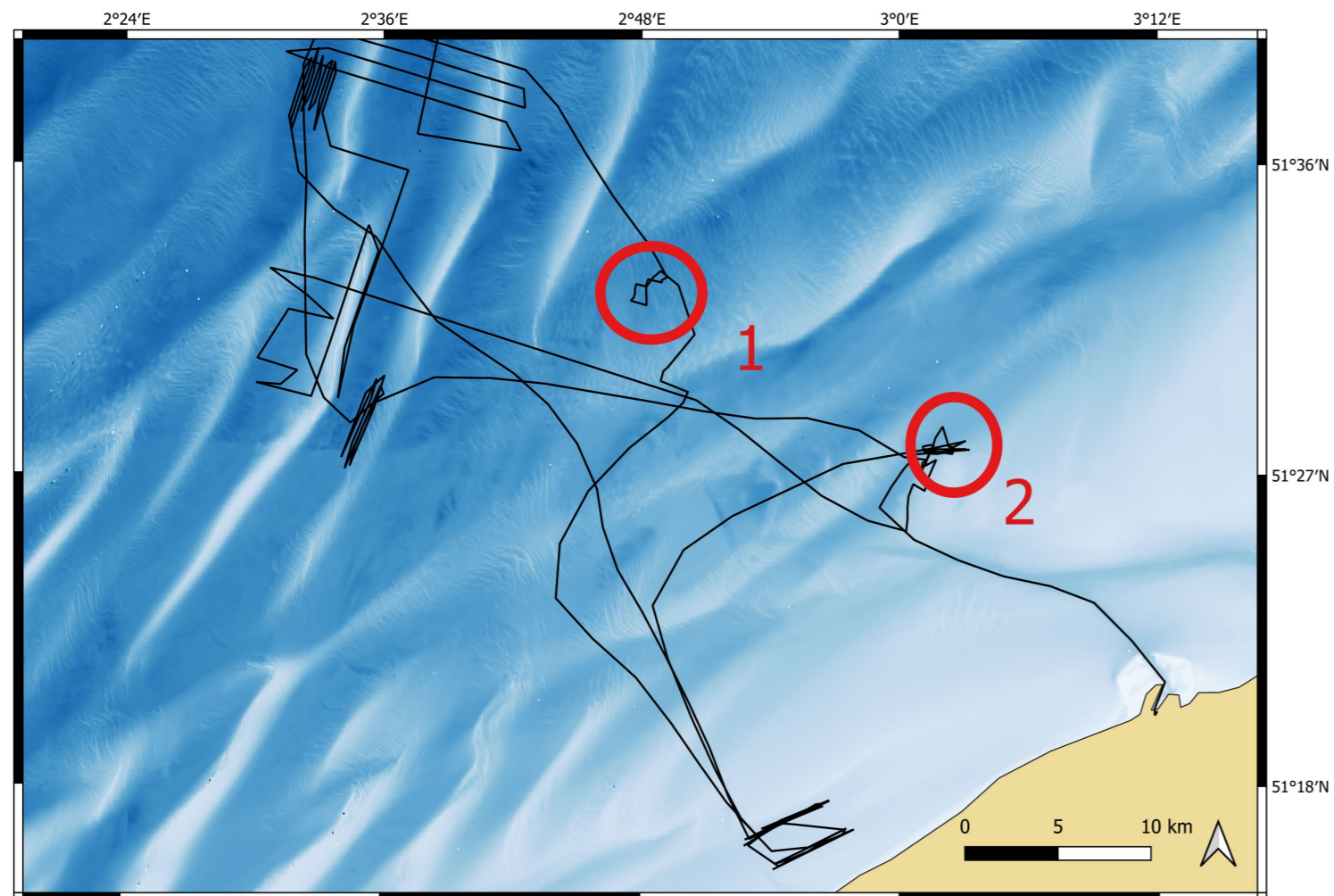
Second campaign (17-19/03/2023) :

→ 1 area:

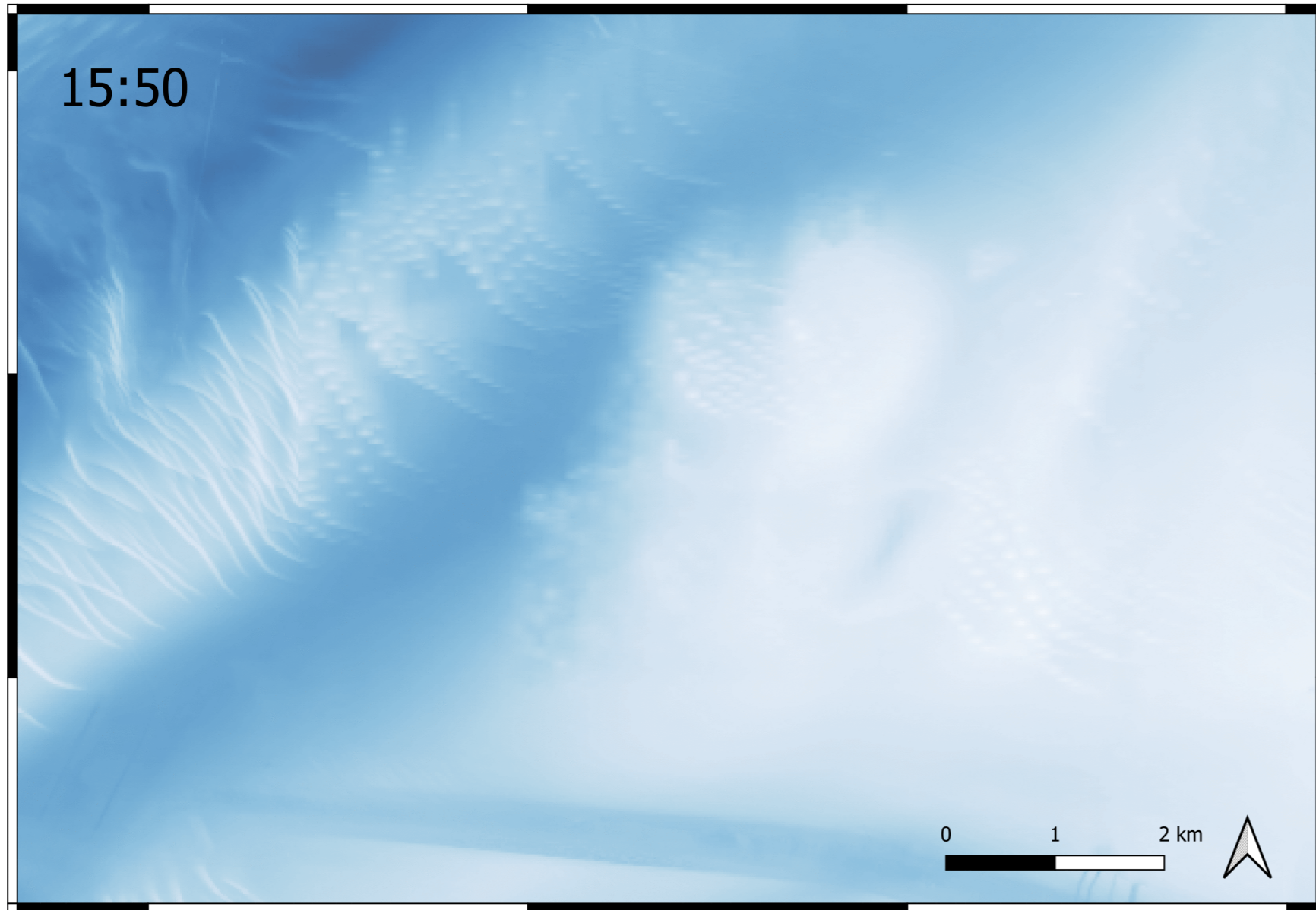
- Offshore Hinderbanken

→ 1 activity:

- Dredging (Pedro Alvares Cabral)



Dispersion model

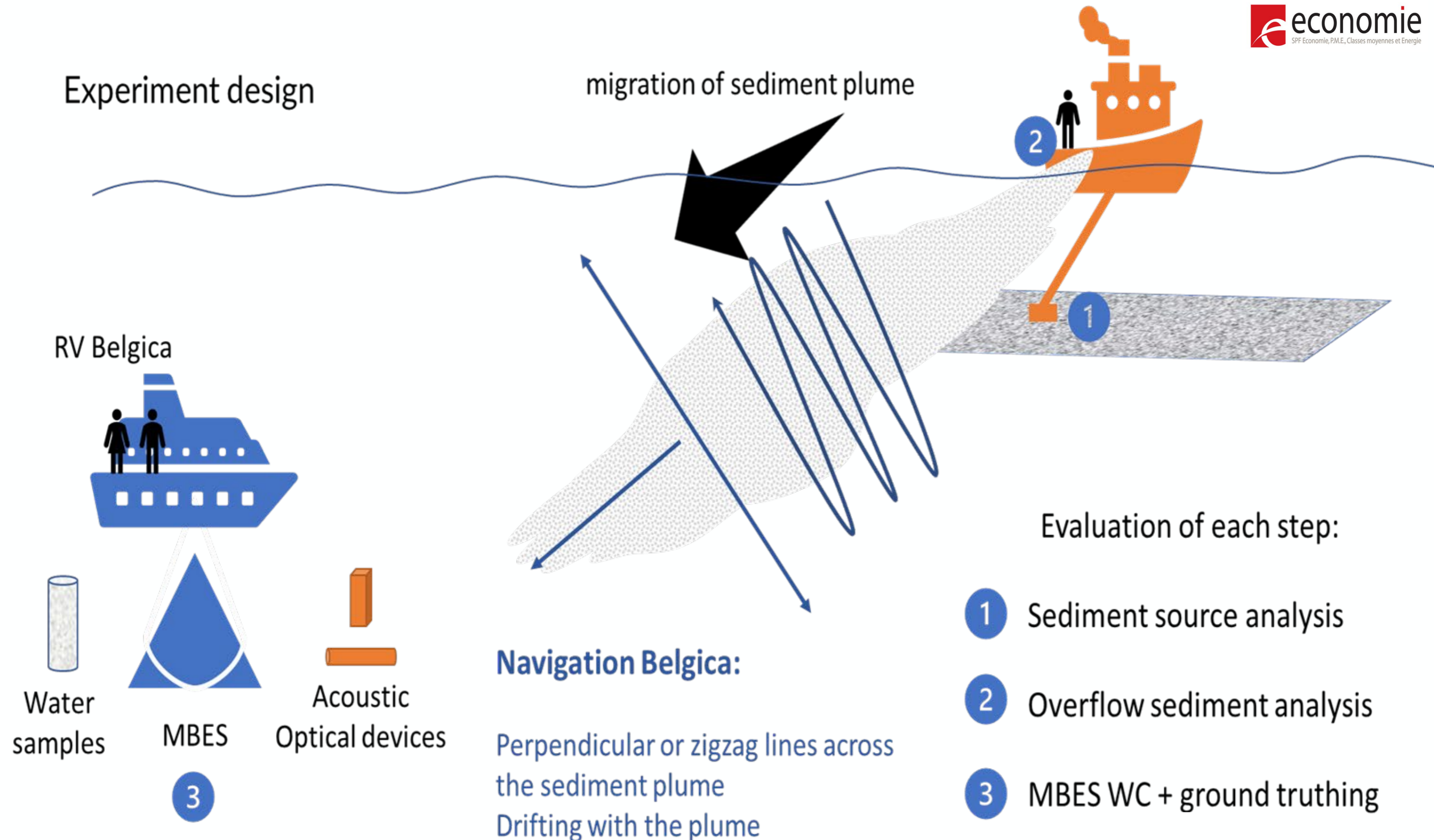


Example of a modelled sediment plume

- Lagrangian particle model
- Real-time simulations
- Based on hydrodynamic conditions
- Estimated sediment properties
 - Distinction between different size ranges

Experiment design

migration of sediment plume



Evaluation of each step:

- 1** Sediment source analysis
- 2** Overflow sediment analysis
- 3** MBES WC + ground truthing

Navigation Belgica:

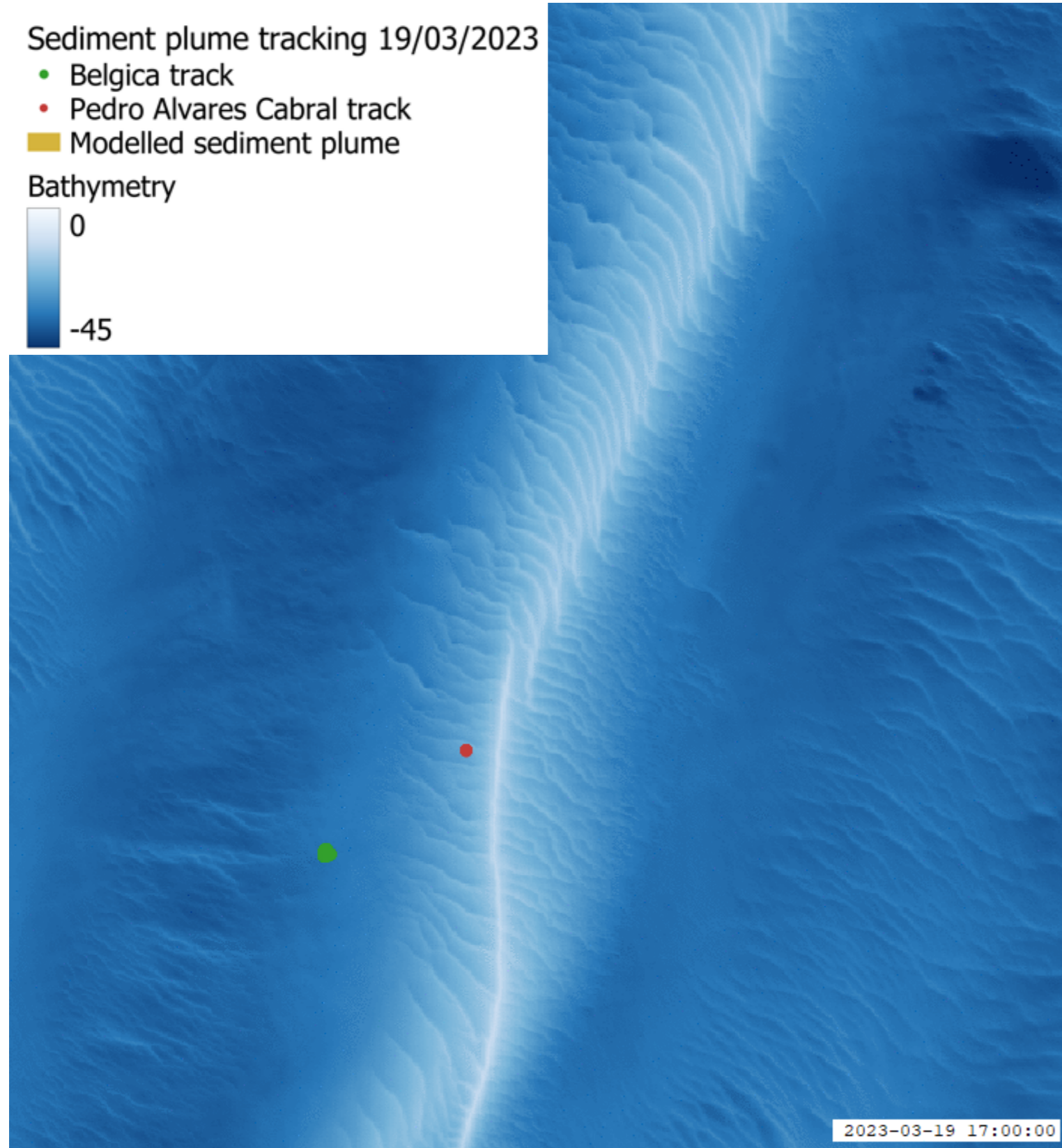
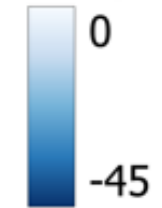
Perpendicular or zigzag lines across the sediment plume
Drifting with the plume

Real-time measurements

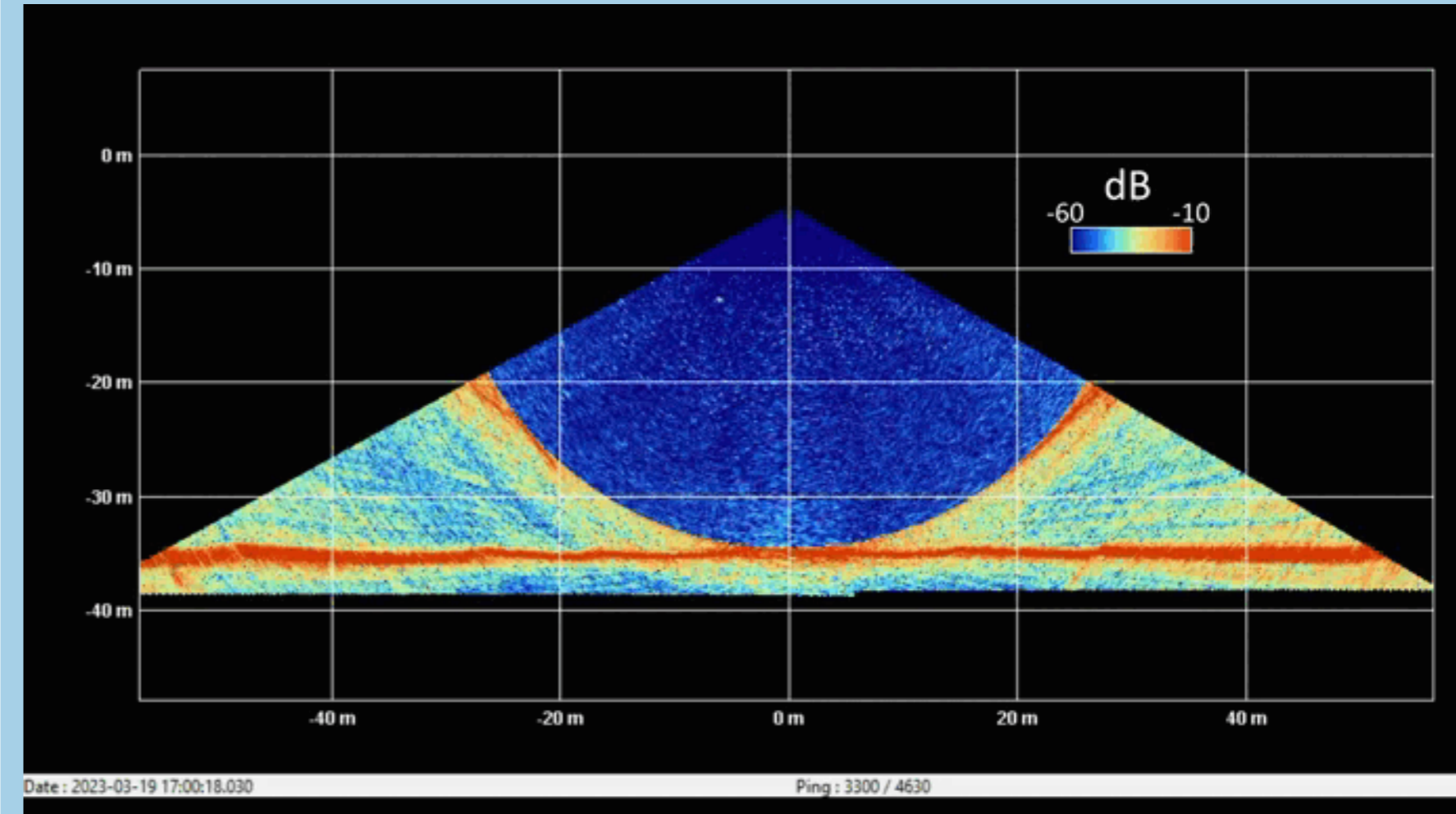
Sediment plume tracking 19/03/2023

- Belgica track
- Pedro Alvares Cabral track
- Modelled sediment plume

Bathymetry

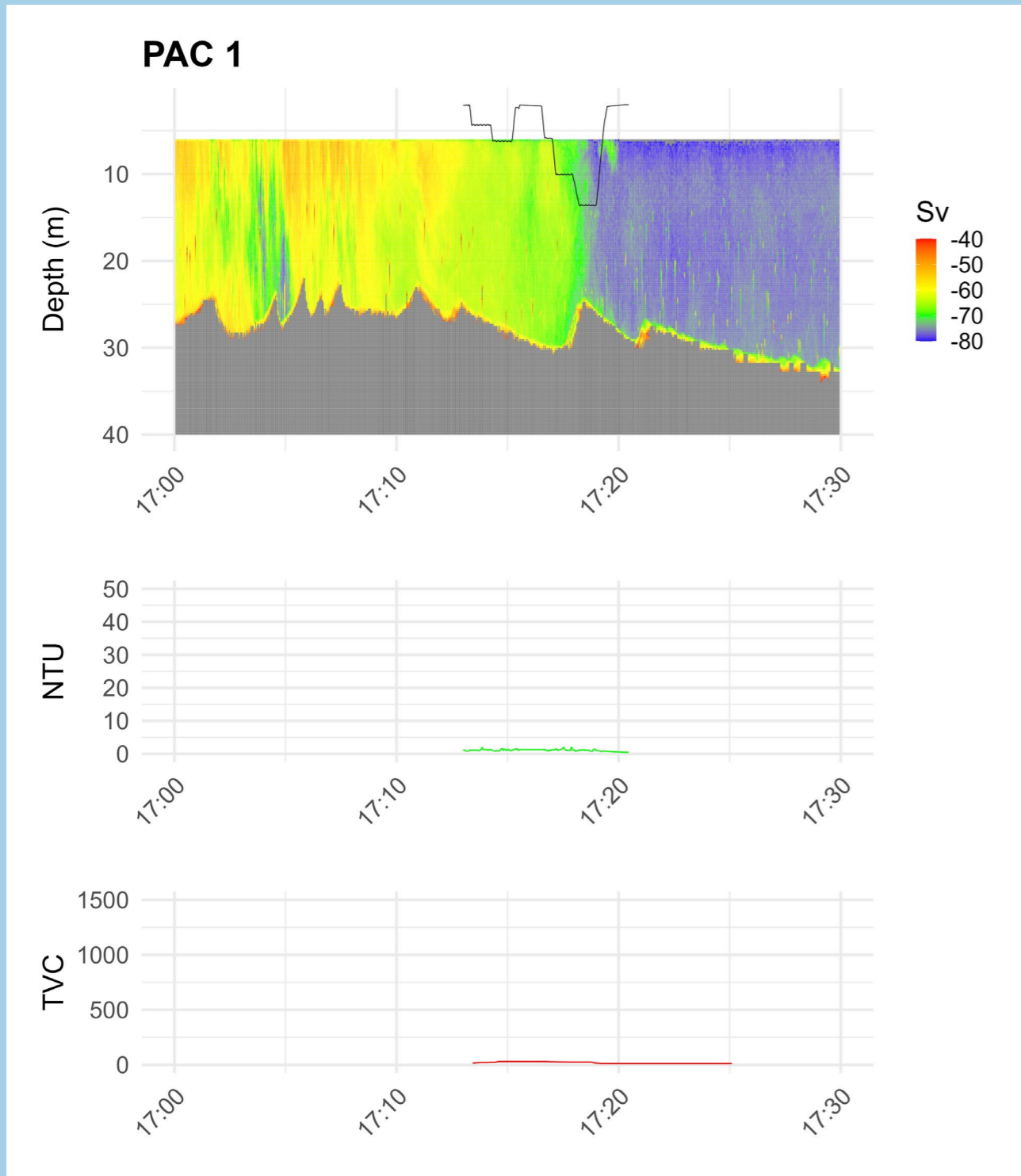


- Kongsberg EM2040 D MBES

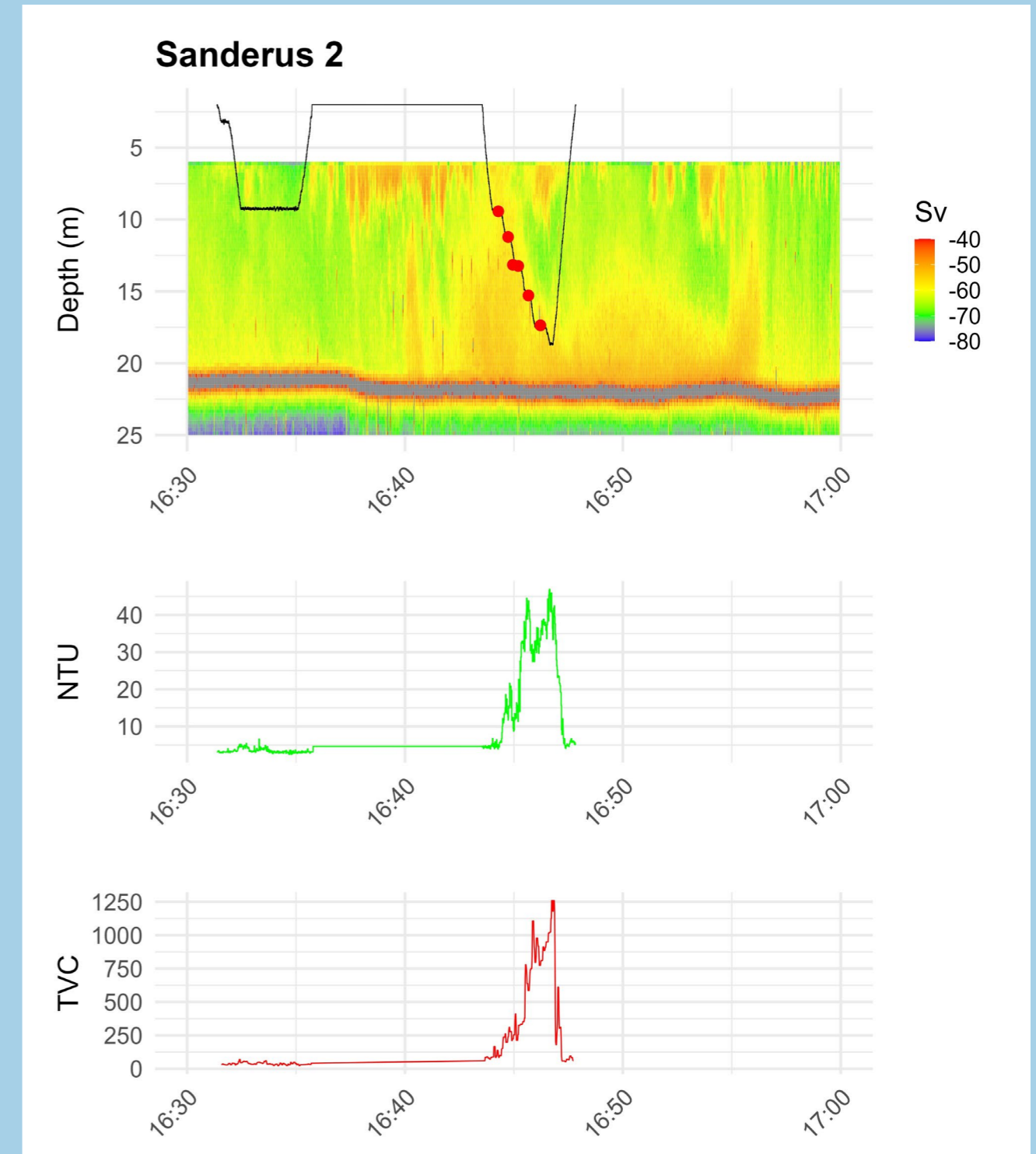


Results

Sand extraction



Dumping



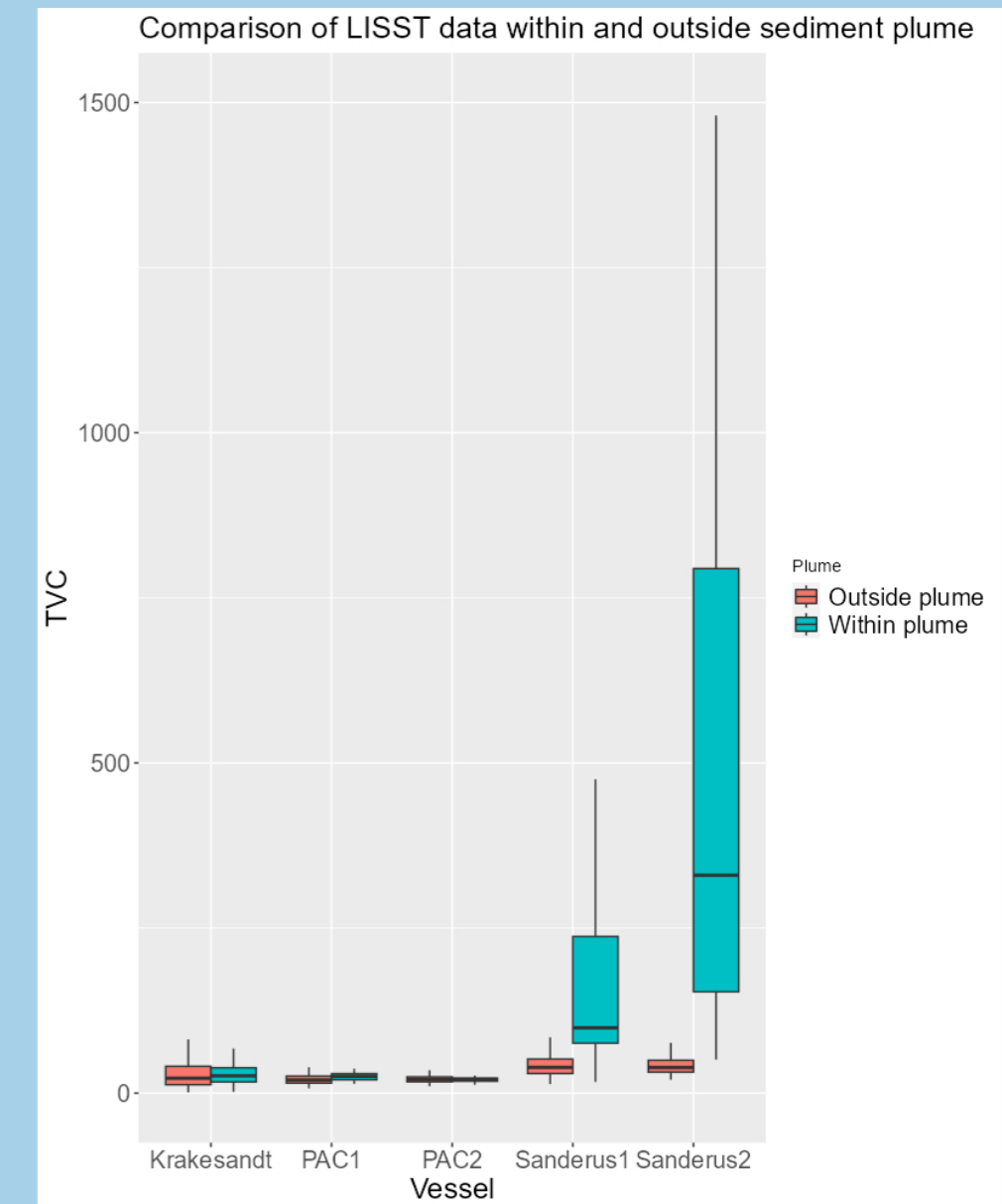
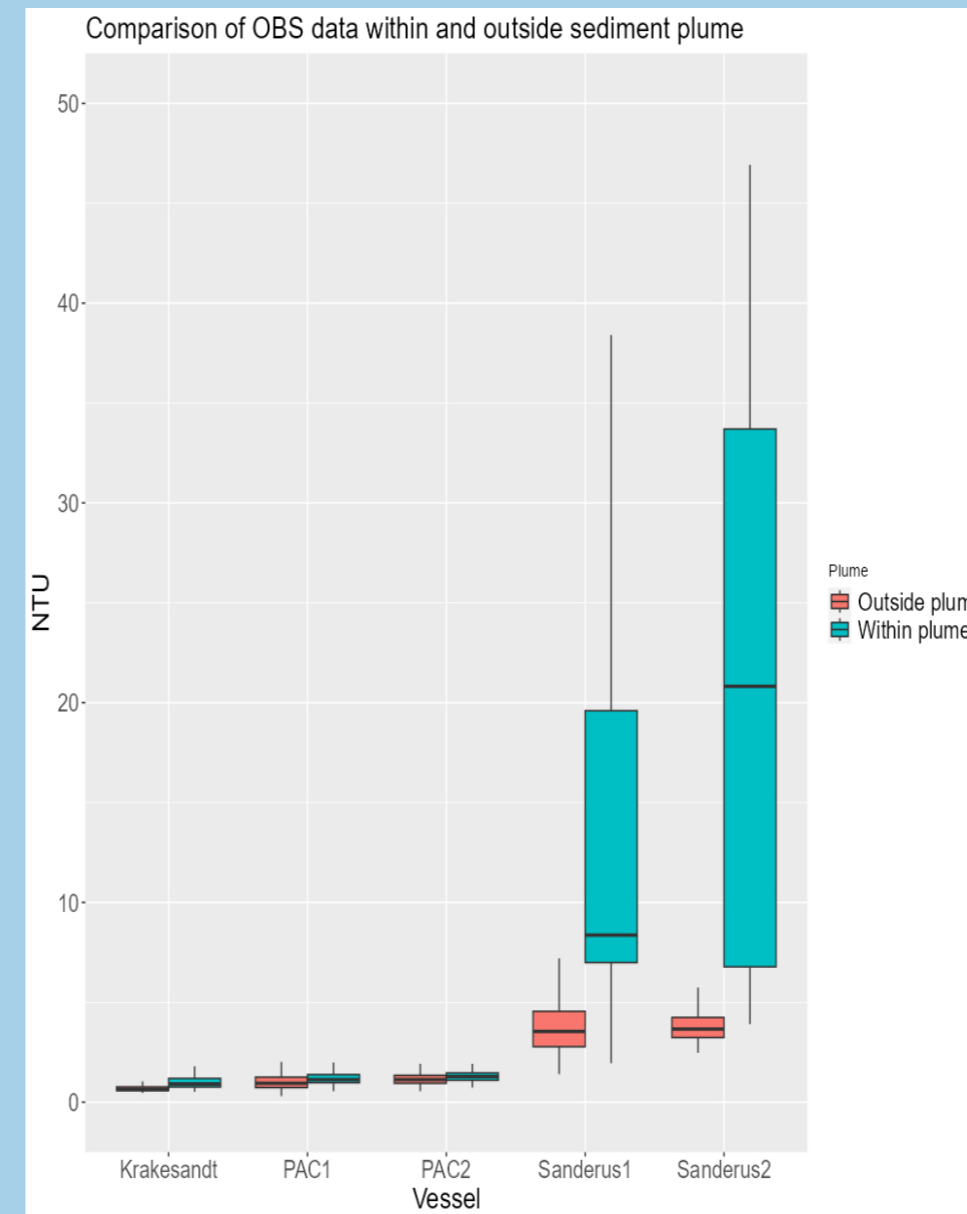
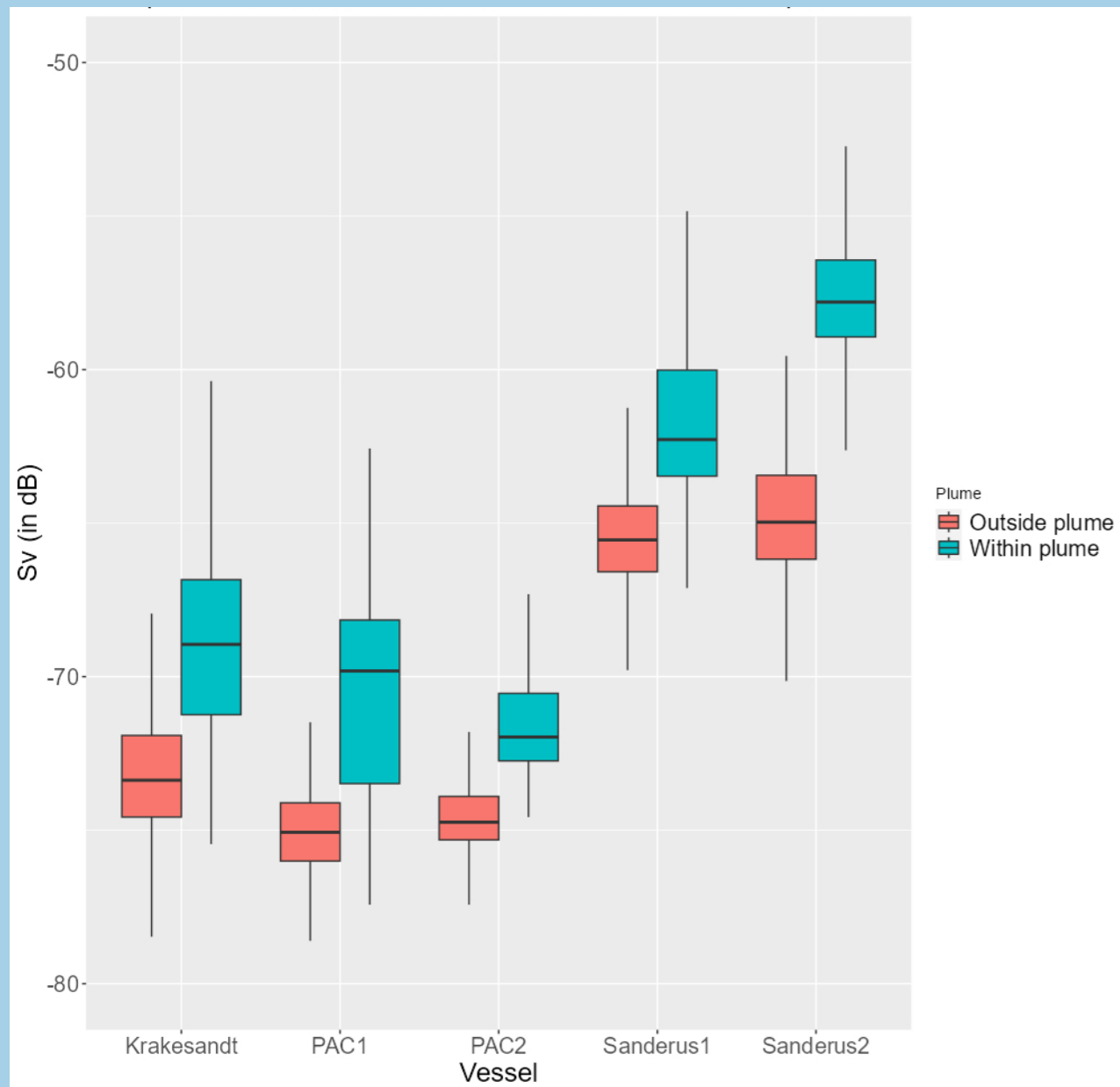
Results



- Acoustic instruments capture well plumes from both sand extraction and dumping events
- Optical instruments appear to be less sensitive to plumes from sand extraction events

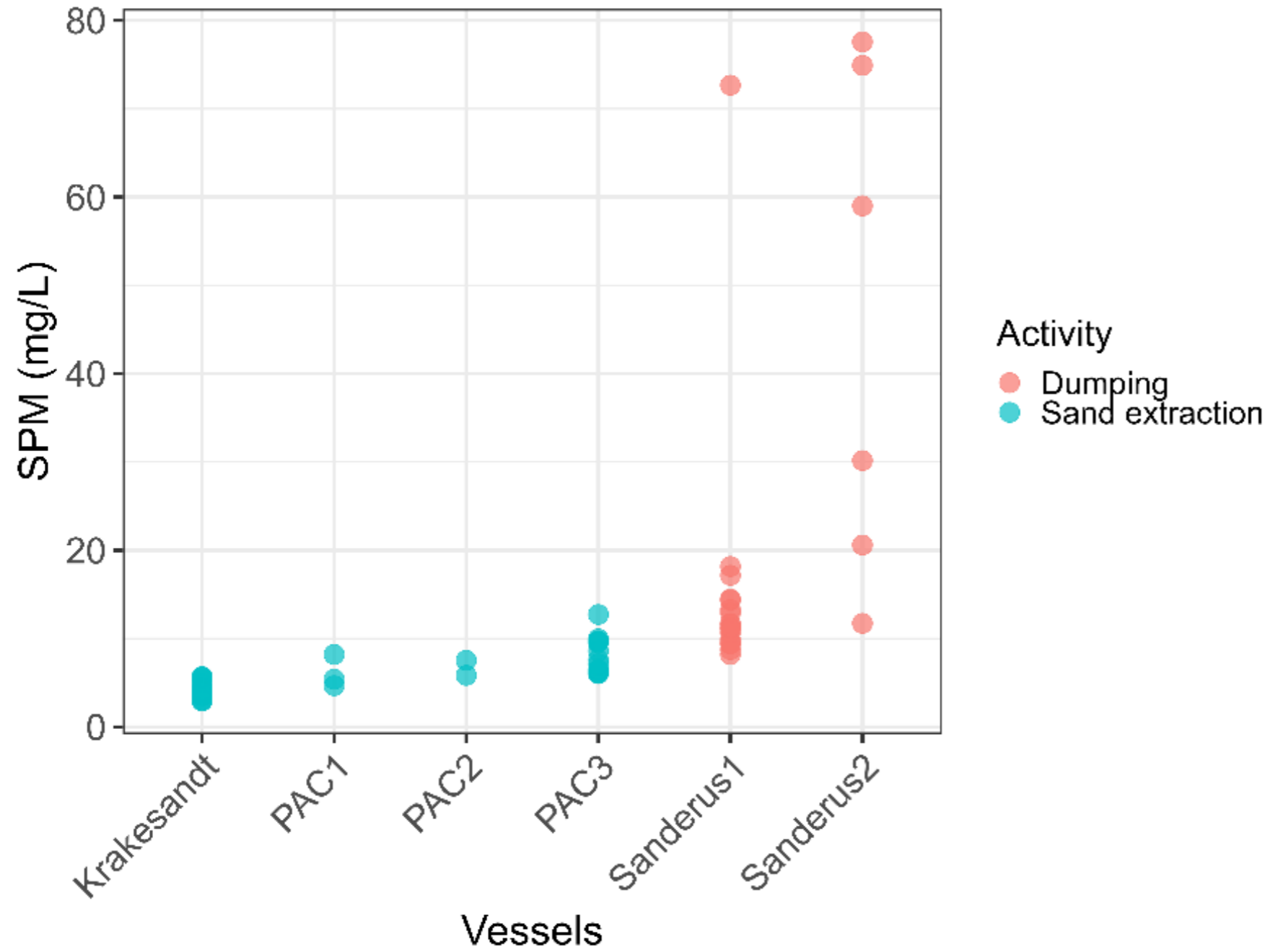
Acoustics

Optics

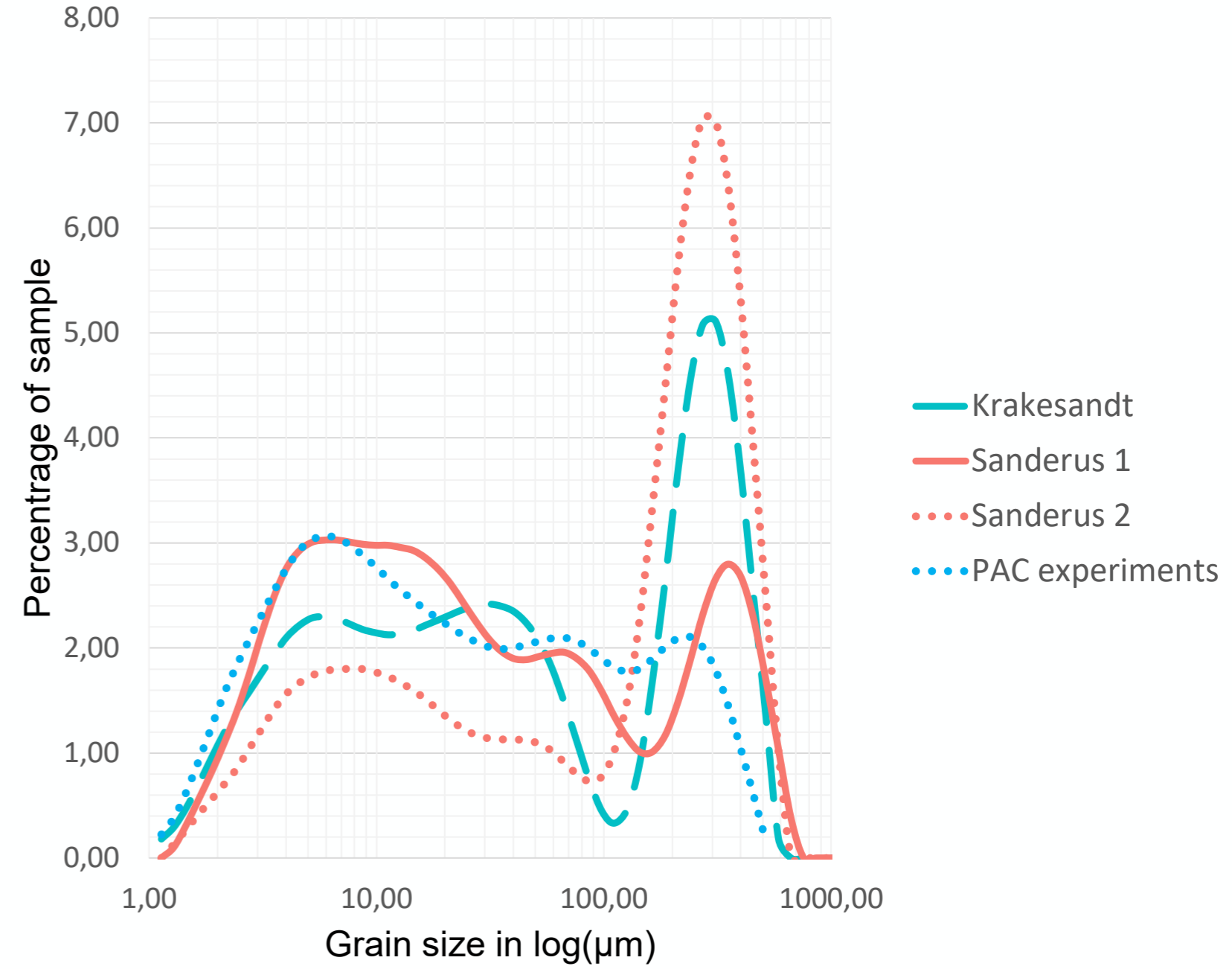


Results

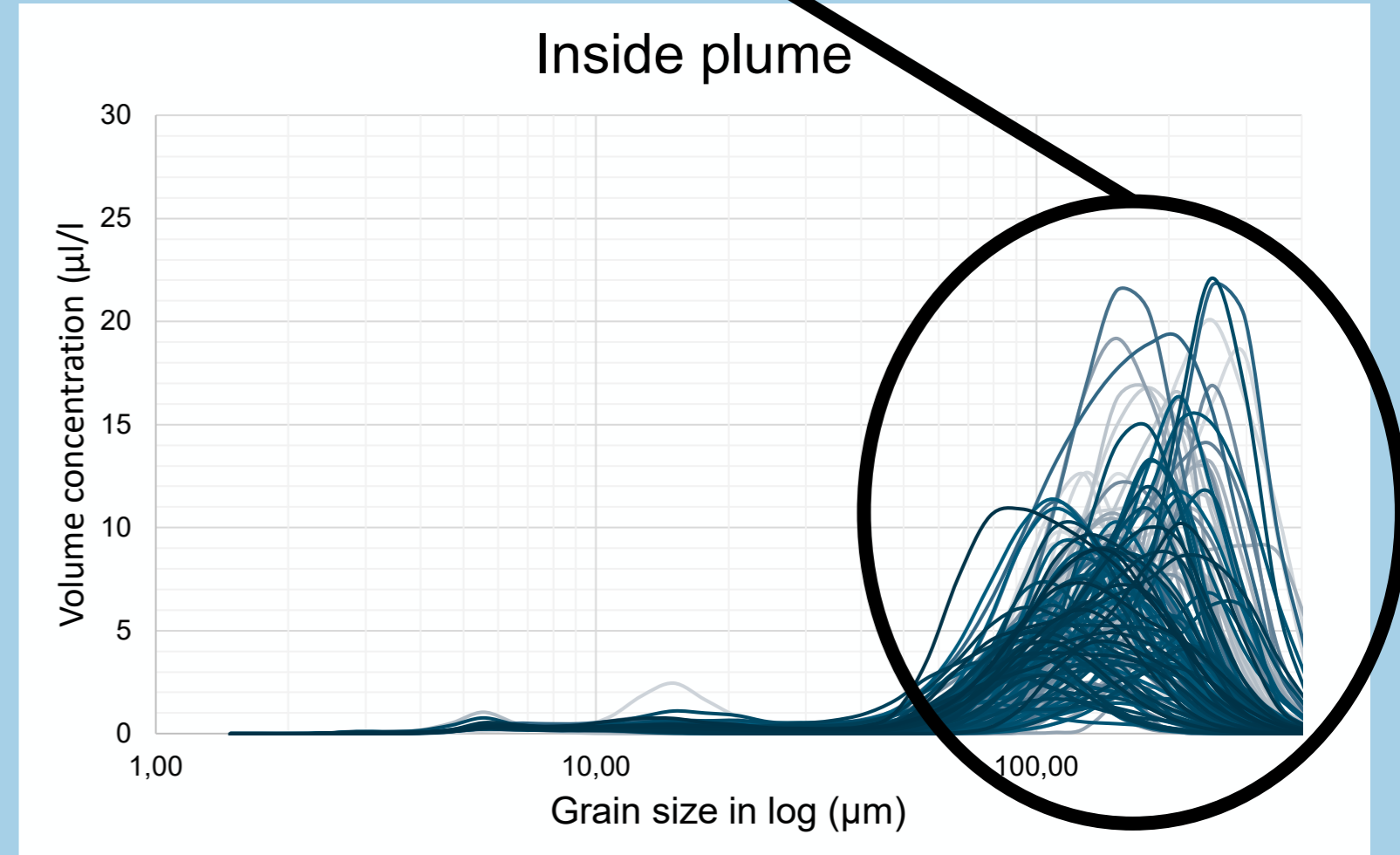
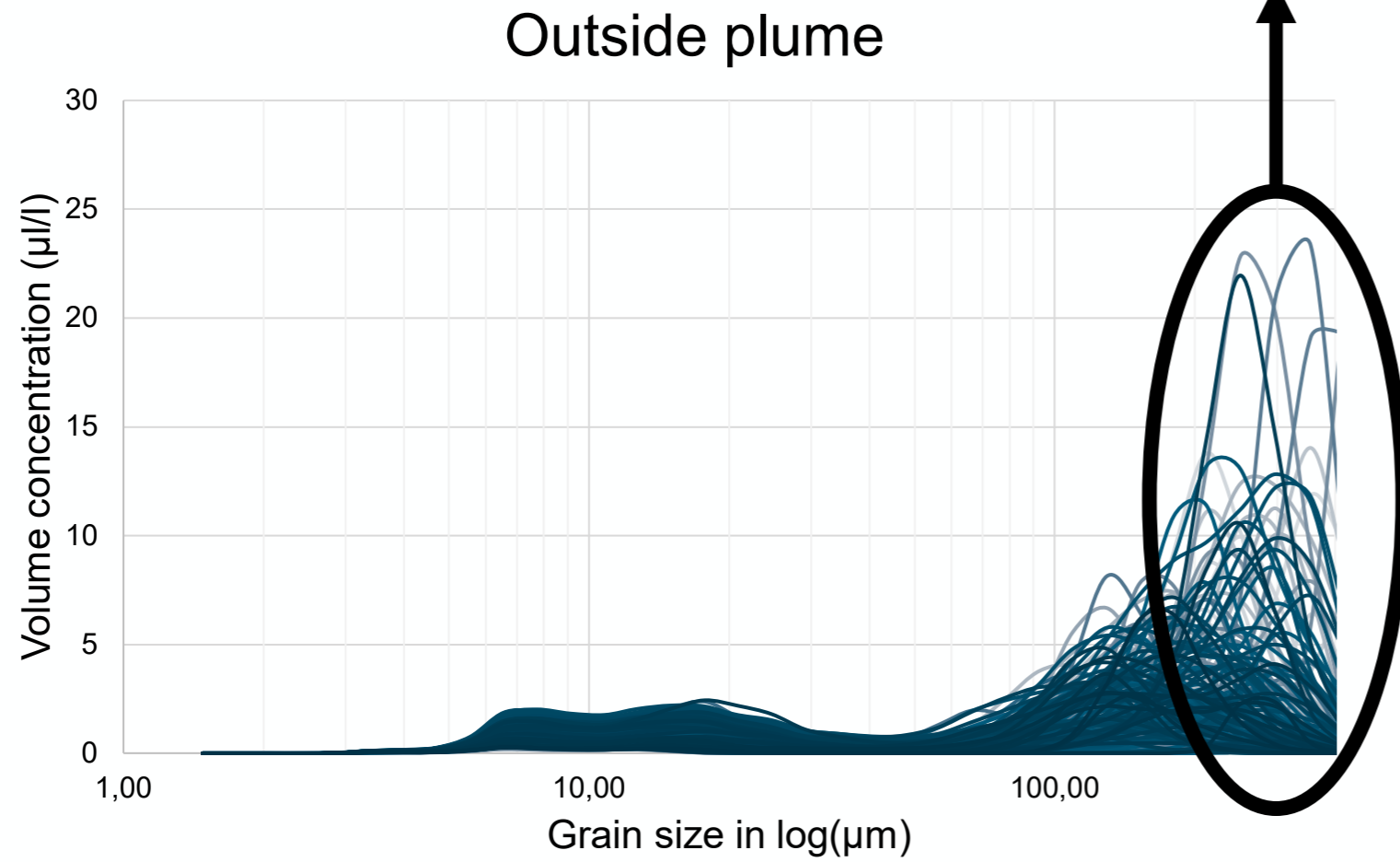
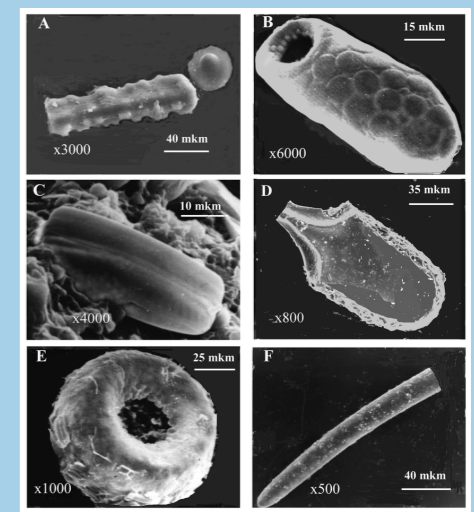
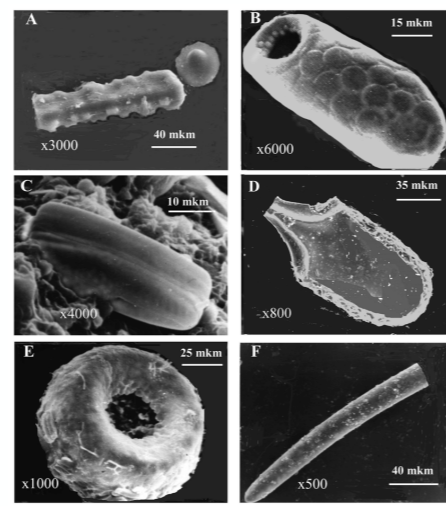
Filtration Results



Centrifuge samples

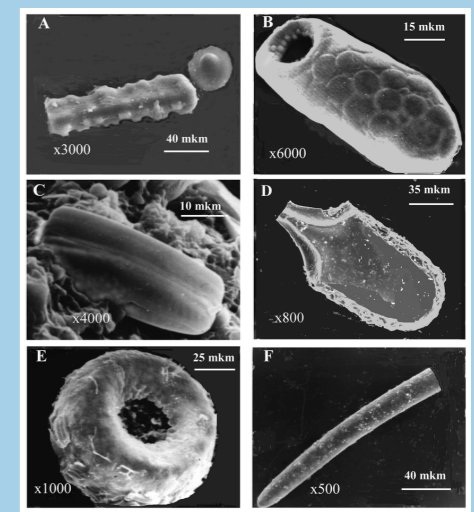
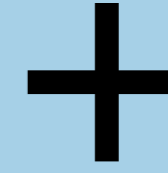
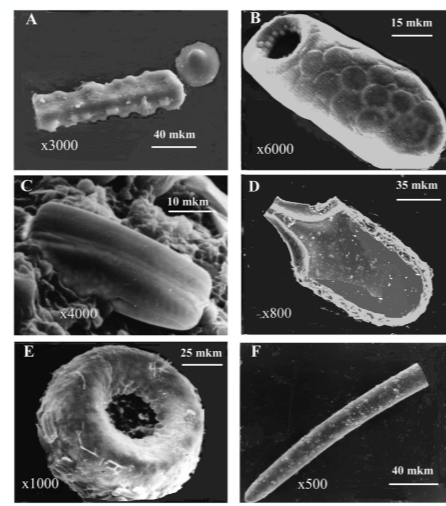


Krakesandt

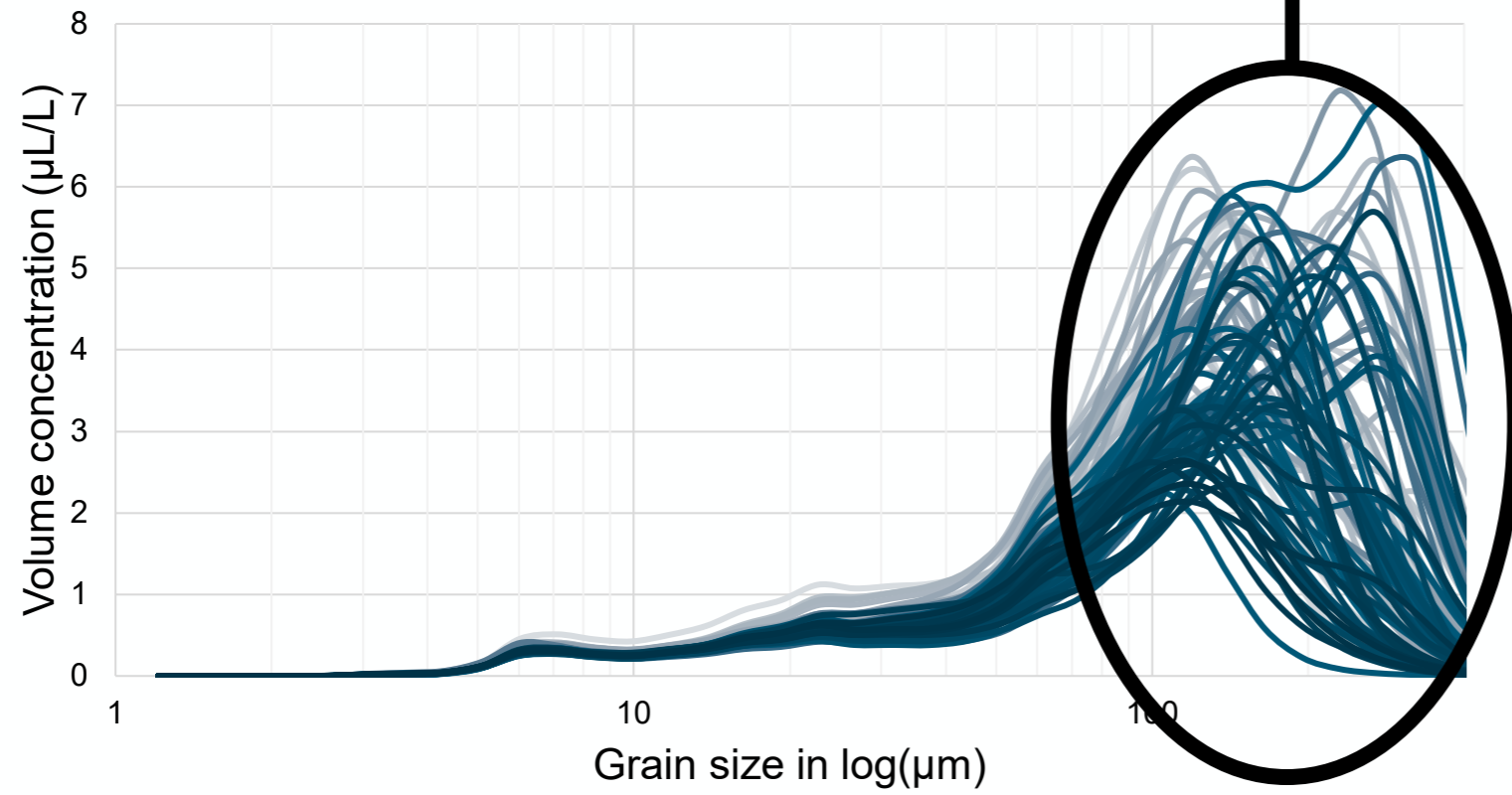


- No big differences observed in size classes between inside and outside of the plume and neither in volume concentration

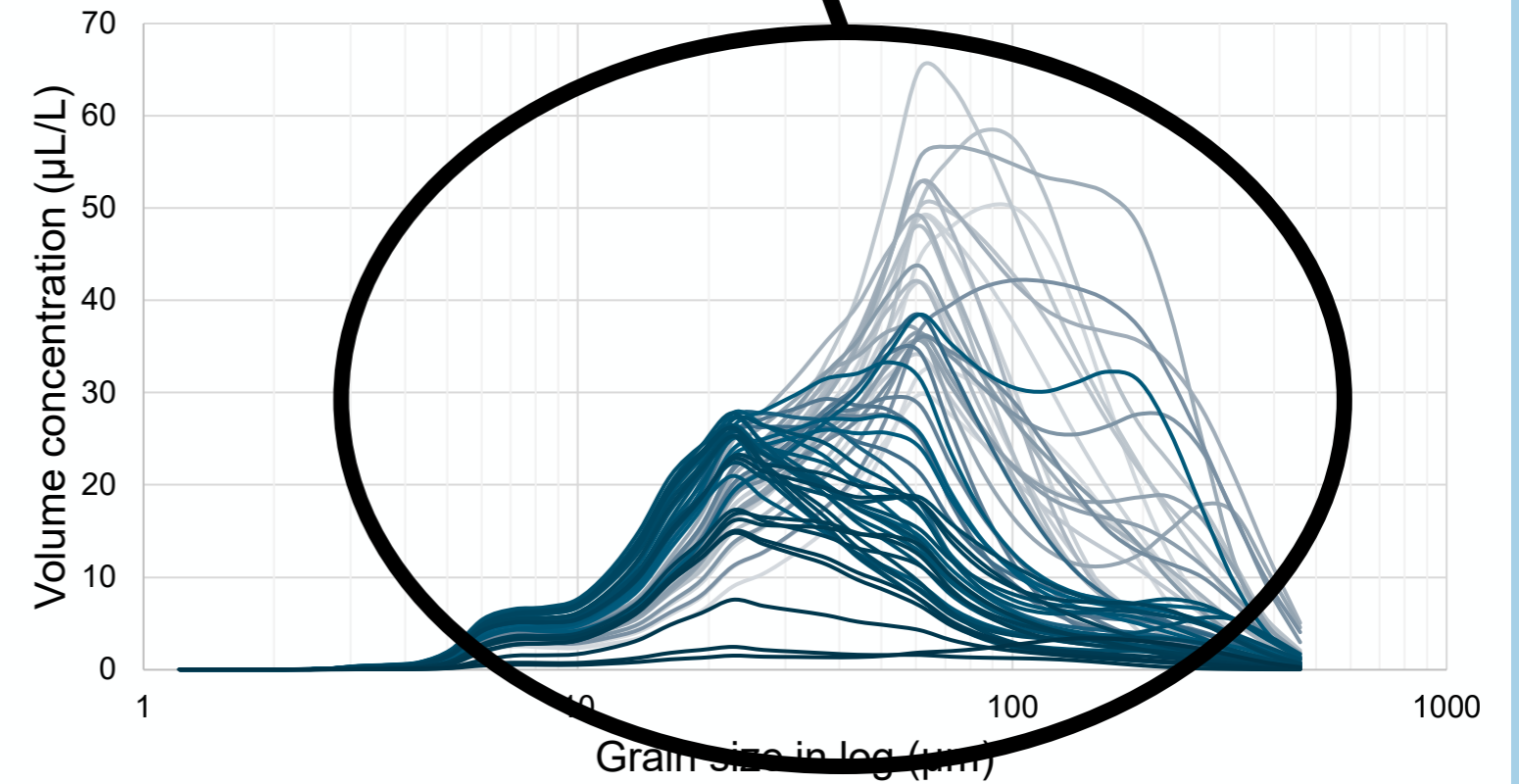
Sanderus 1



Outside plume

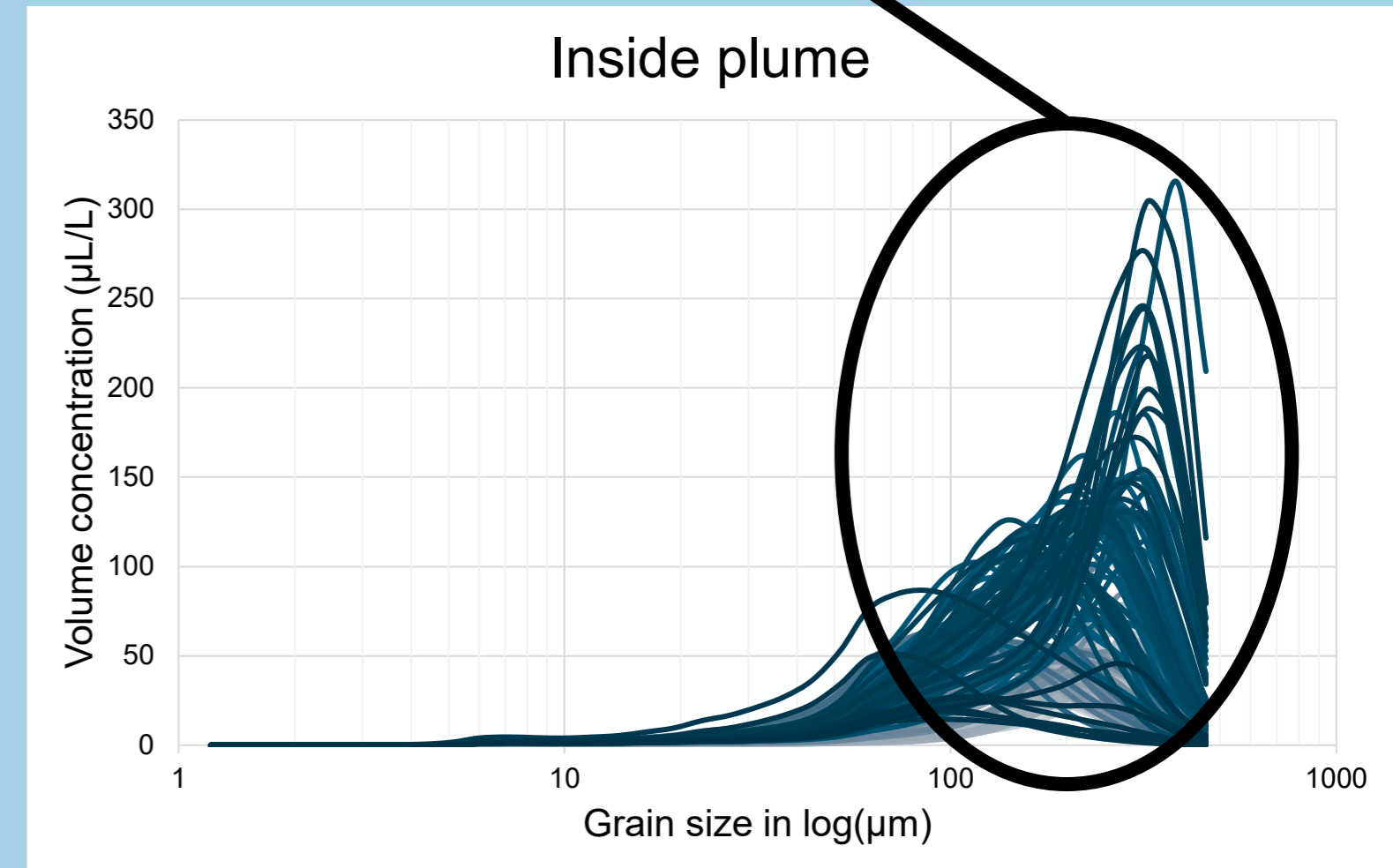
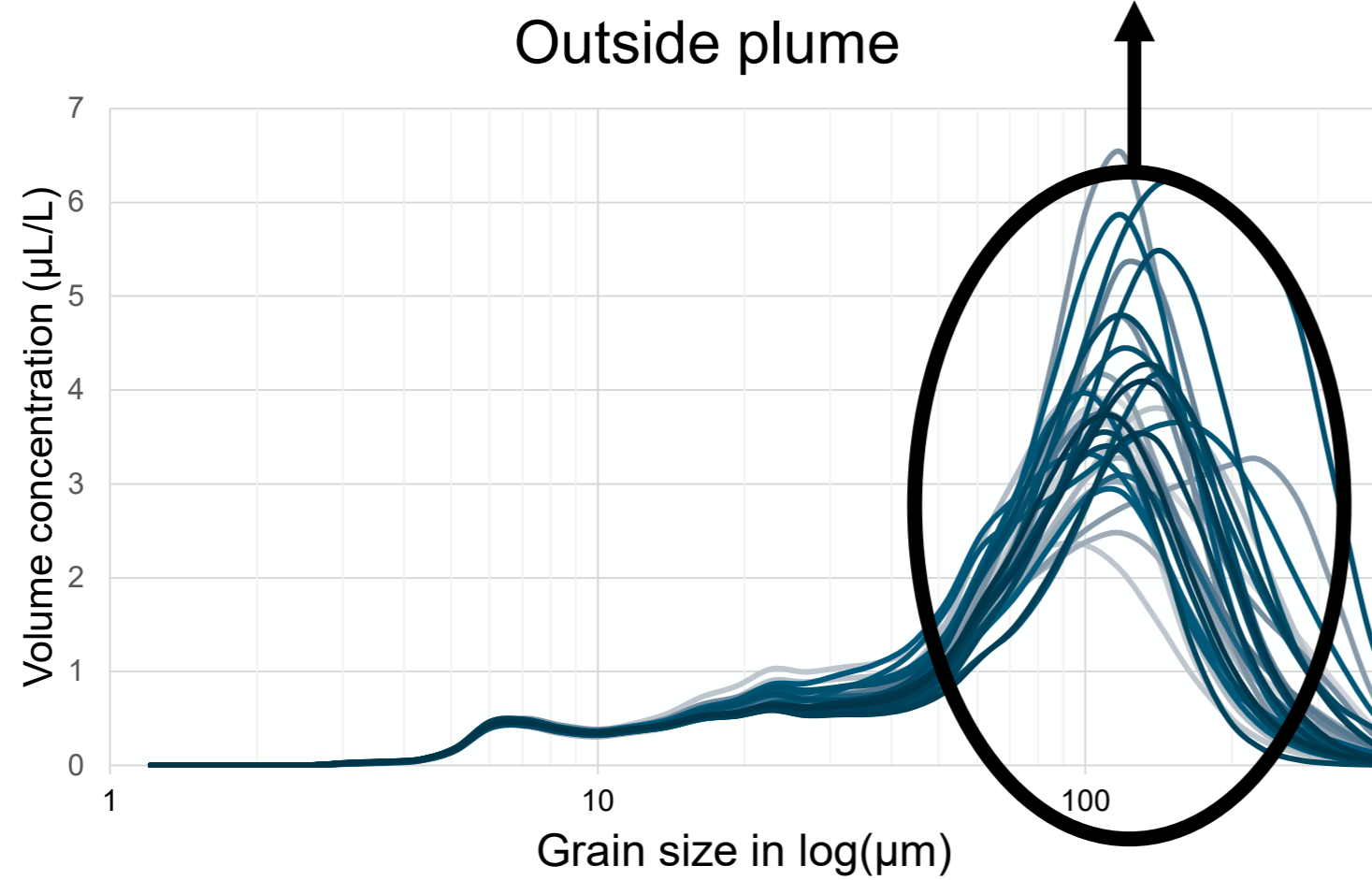
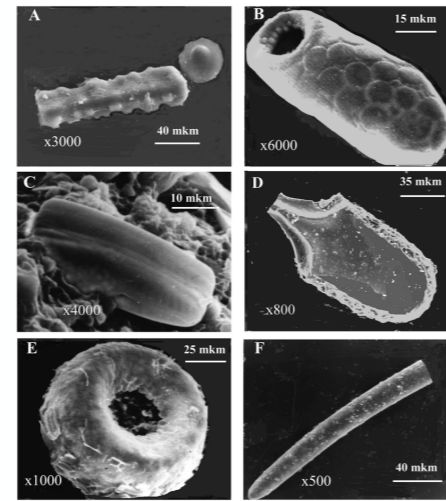


Inside plume



➤ Fining of the material

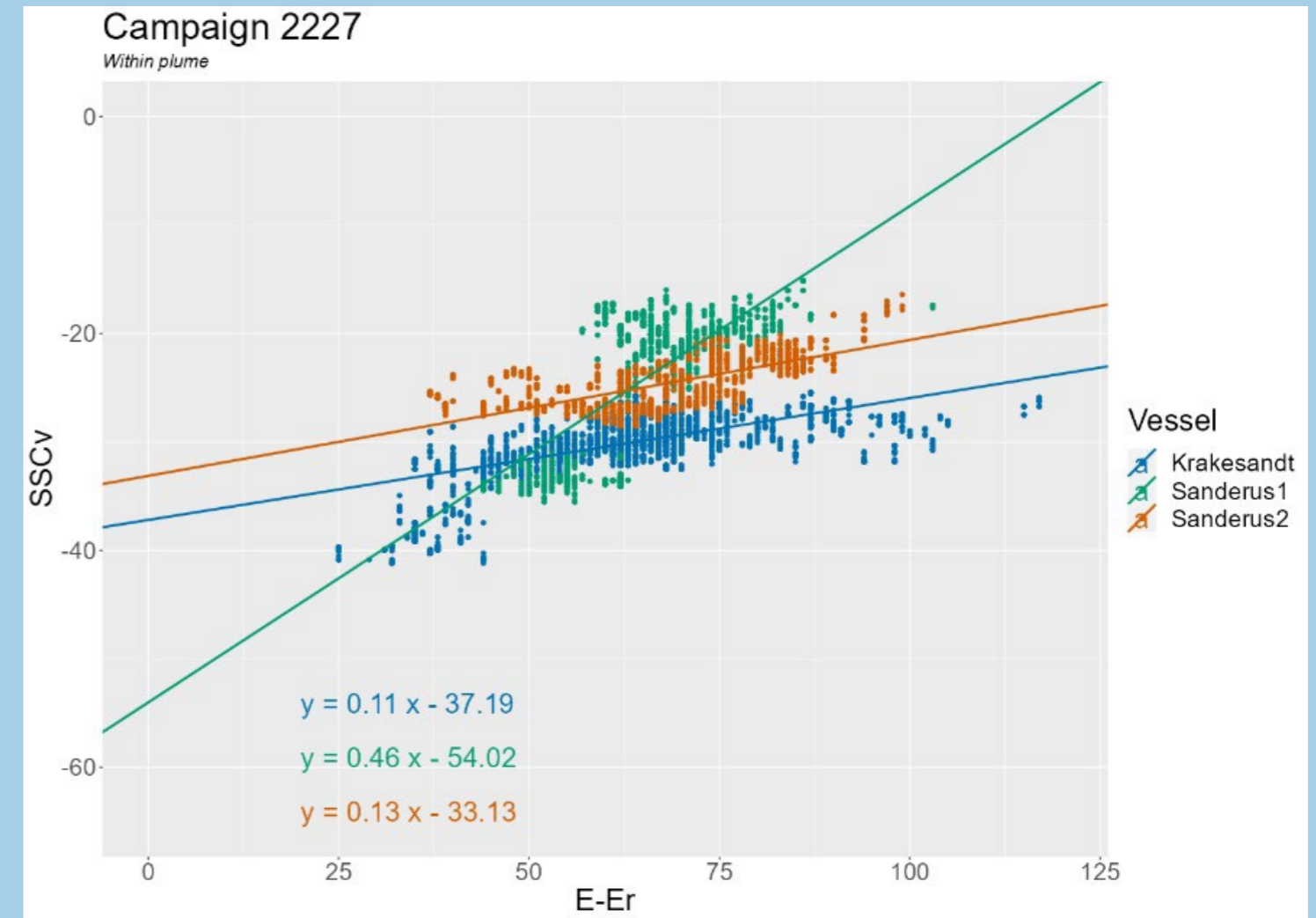
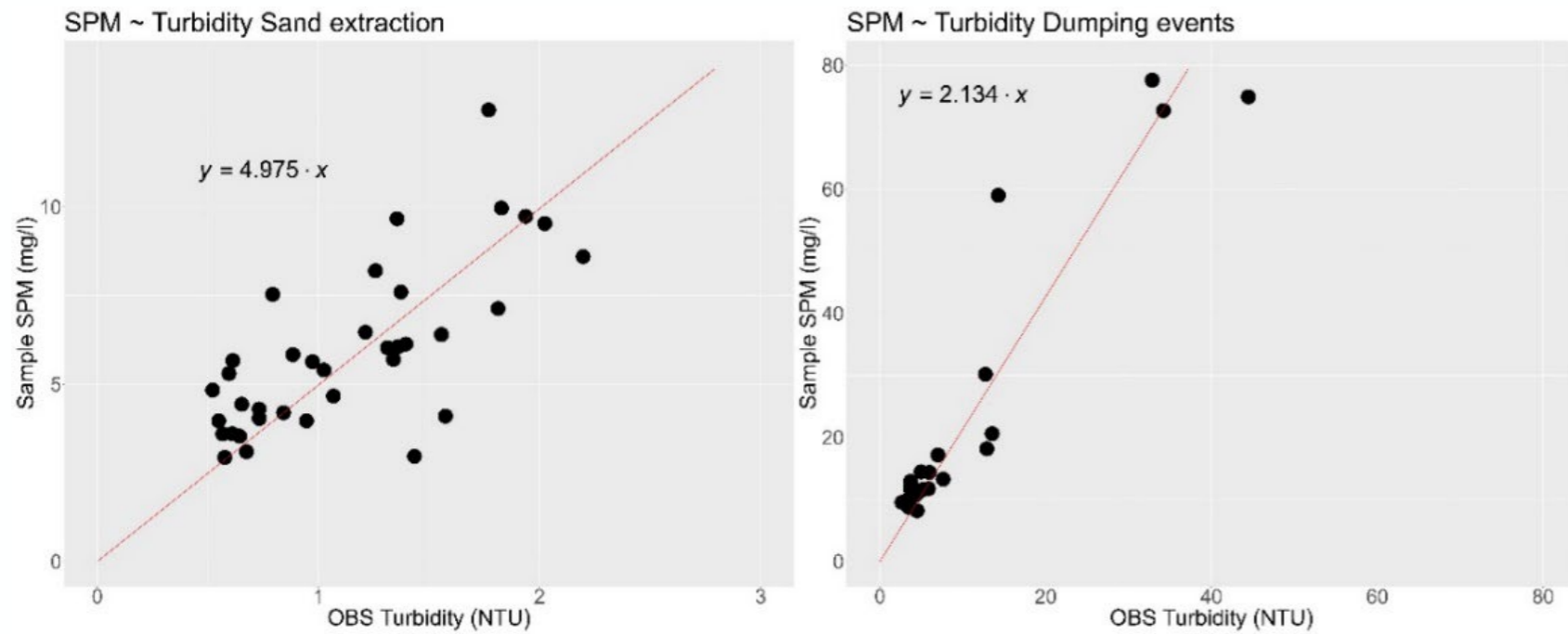
Sanderus 2



➤ Coarsening of material

Results

- Relationship between acoustics/optics and SPM concentration are sensitive to sediment type



Conclusion

- **Continuous acoustic measurements**
 - Able to capture sediment plumes.
 - Need for accurate ground-truthing to calibrate.
- **Optical instruments**
 - Capture fine sediments well.
 - Less effective for coarser sediments.
- **Combination acoustic + optics**
 - Could enhance knowledge on sediment type.
- **Challenges: in-situ measurements**
 - CTD-carousel complex; alternatives: VPR, towable platforms.
- **Predictive modeling**
 - Initial good accuracy declines over time and distance.
 - Need for in-situ data to improve predictions.



Benjamin Van Roozendael
O.D. NATURE — SUMO, PhD candidate

bvanroozendael@naturalsciences.be
T +32 (0)2 627 44 48
M +32 (0)472 09 93 41

Vautier Street, 29
1000 Brussels

Multidisciplinary approach to assess the far-field effects of sand extraction in the Belgian part of the North Sea

B. Van Roozendael, M. Baeye, K. Degrendele, F. Barette, V. Van Lancker H. Vandenreyken, A-S, Piette, K. Baetens, P. Urban, N. Praet and M. Roche

