Nye verktøy for kartlegging av partikkelspredning fra sjødeponi med eksempler fra Frænfjorden

NYKOS Informasjonsdag

Tromsø, 27 November 2018

Raymond Nepstad, SINTEF Ocean

Overview

- NYKOS WP5: New and improved modelling and measurement tools
- Frænfjorden STP studies
- Possible future developments

NYKOS WP5

Develop modelling and measurement toolbox for quantifying the transport, fate and effect of mine tailings in the sea

Frænfjorden, Omya Hustadmarmor
Calcium carbonate

What is the environmental impact and risk?
How to control & minimise?

Develop useful tools to:

- Map tailings distribution & transport
- Understand tailings behavior in the sea
- Predict impact, risk, potential problematic events
- Optimize discharge and monitoring

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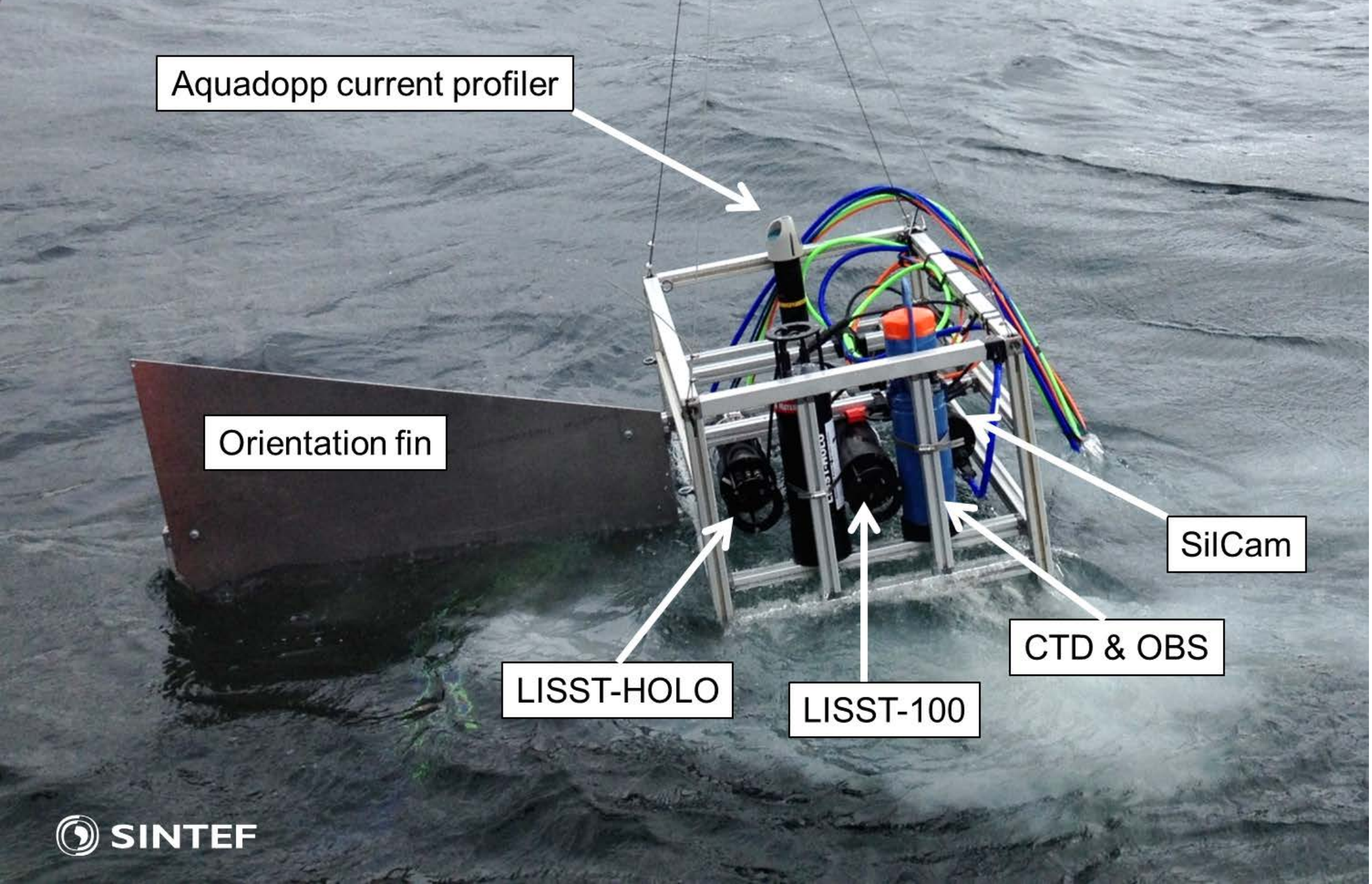
Silhouette camera system

- In-situ imaging system
- Quantify particles in a large size range (mikrons – centimeter)
- Open source processing and analysis software for automation
  - Image analysis
  - Aggregate statistics (e.g. concentration, particle size distribution)
  - Particle classification with deep neural networks

EJ Davies, PJ Brandvik, F Leirvik, R Nepstad (2017)

github.com/emlynjdavies/PySilCam



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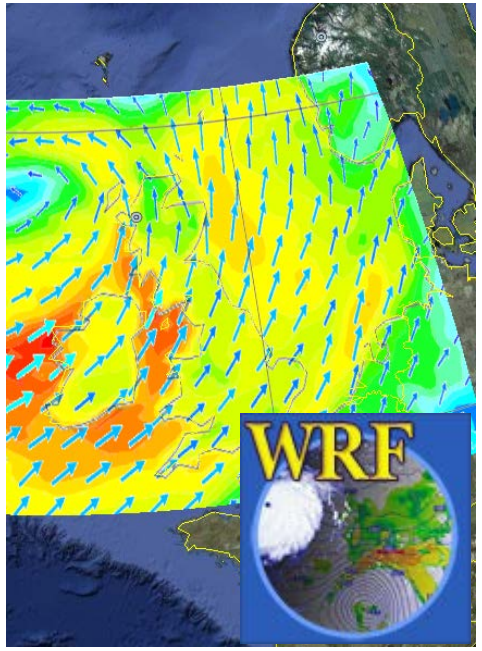
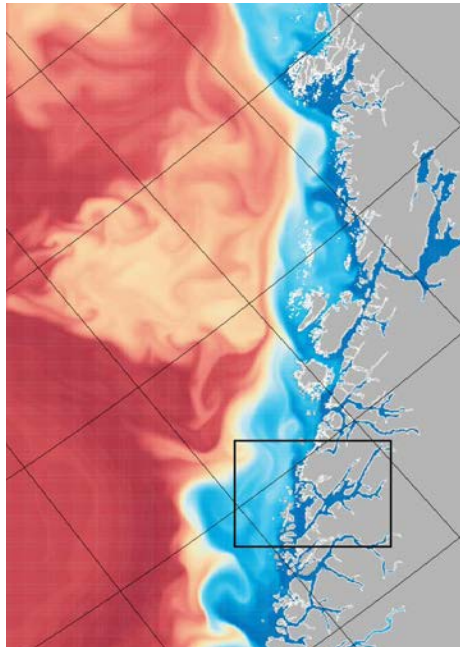
Modelling tools

www.wrf-model.org



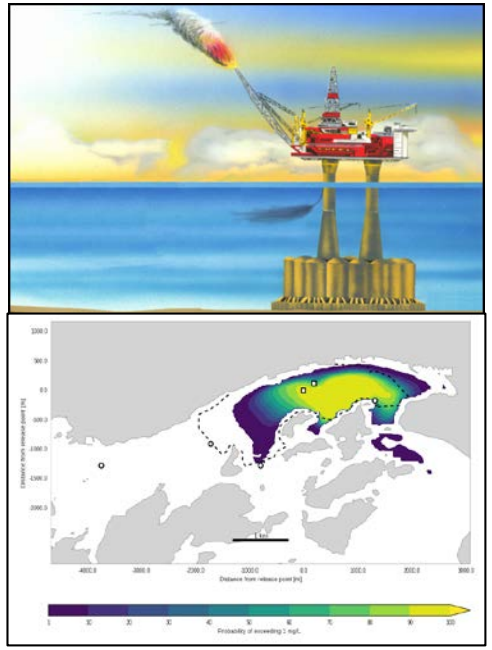
Atmospheric
forcing

www.sinmod.no



Hydrodynamics
Currents
Ecosystem

www.sintef.no/DREAM



Transport
Fate
Effects

Transport-fate model (DREAM)

Originally developed for O&G industry

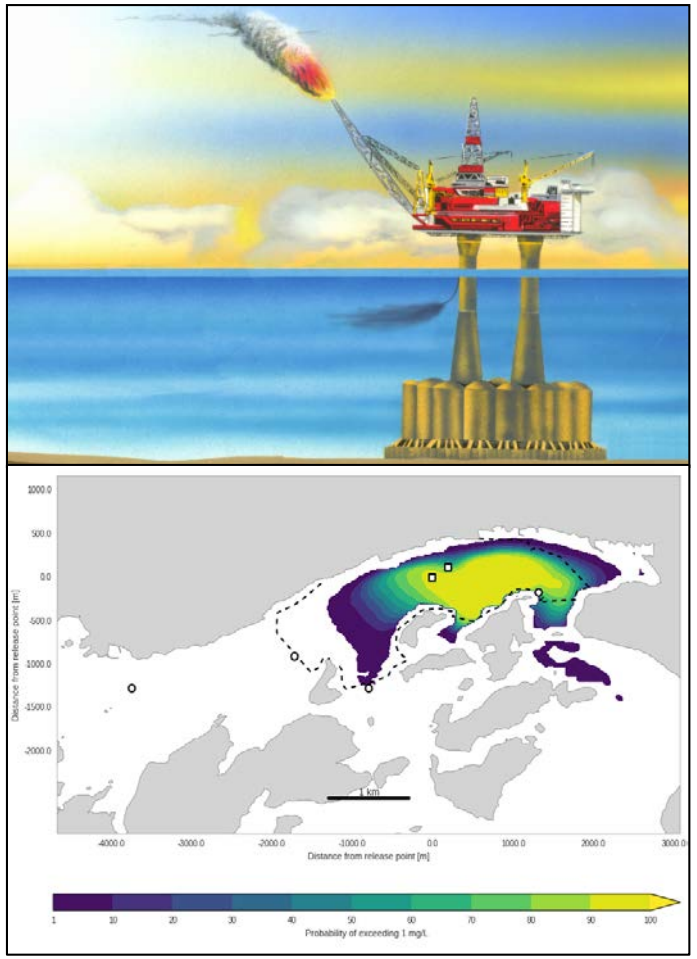
- Produced water discharges
- Drilling discharges

Three-dimensional Lagrangian transport model

- Multi-site, multi-component releases
- Chemical and biological fate processes
- Predict concentrations, sedimentation in space and time

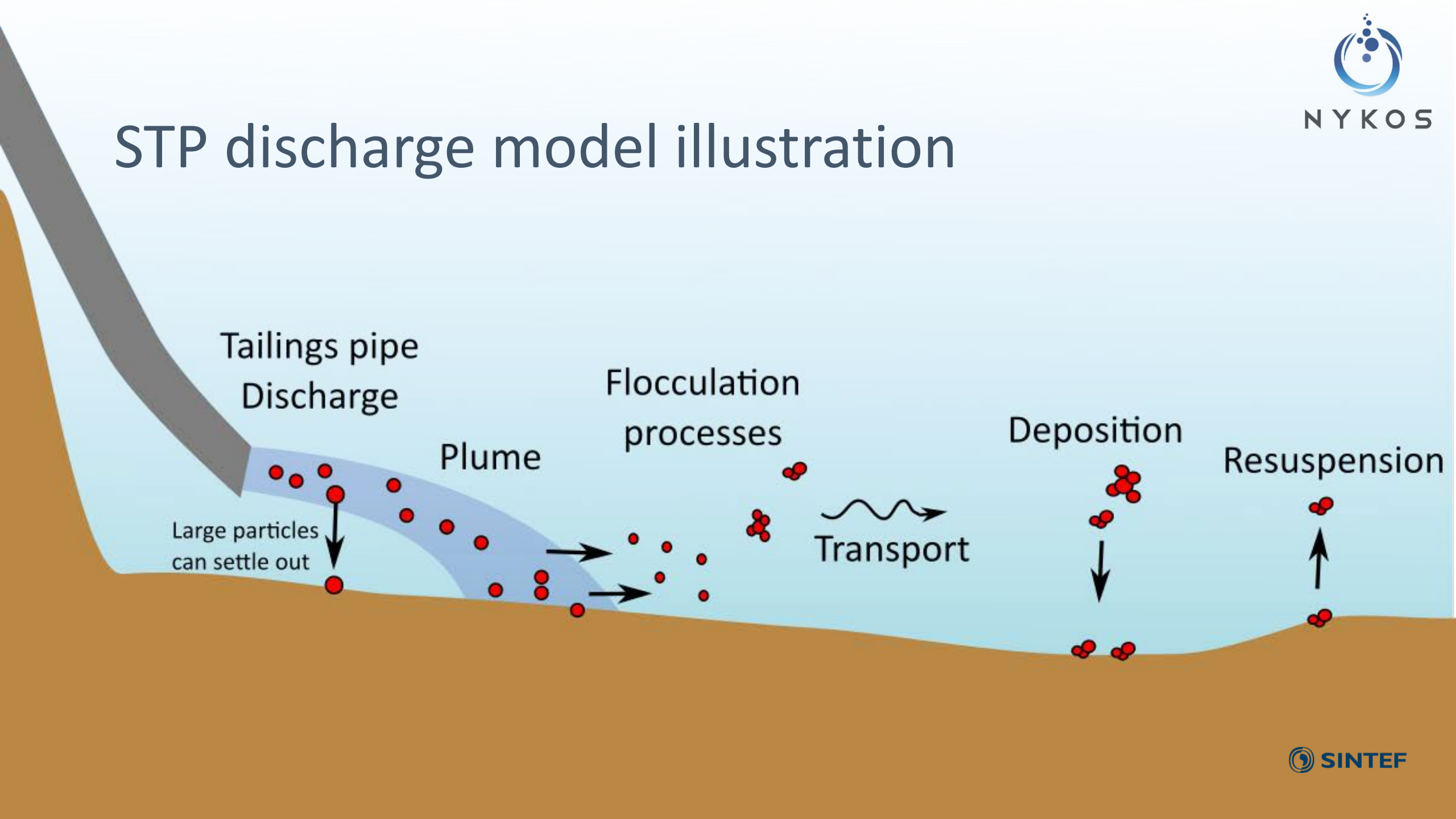
Also includes:

- Sediment erosion-resuspension
- Benthic fate model (pore water/oxygen/grain size change)
- Sediment toppling
- Flocculation (new)



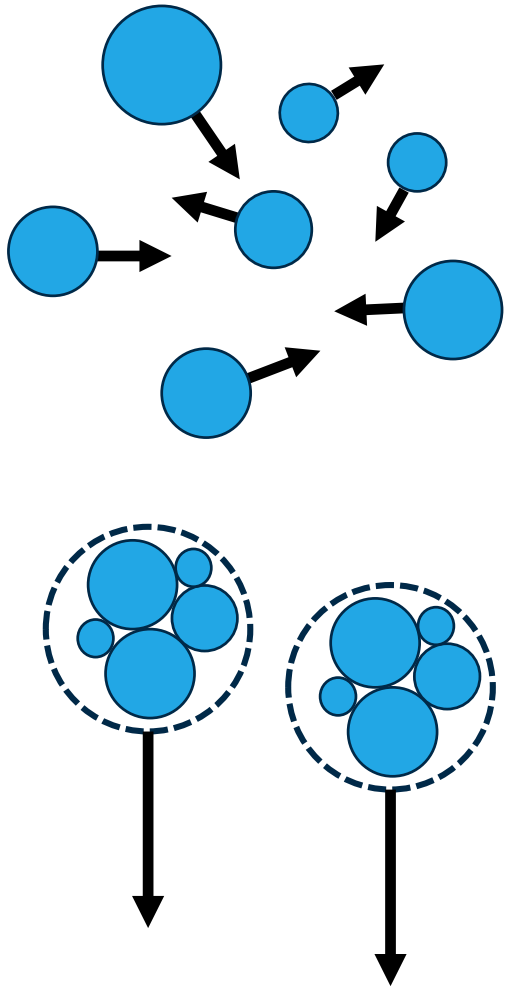
www.sintef.no/DREAM

STP discharge model illustration



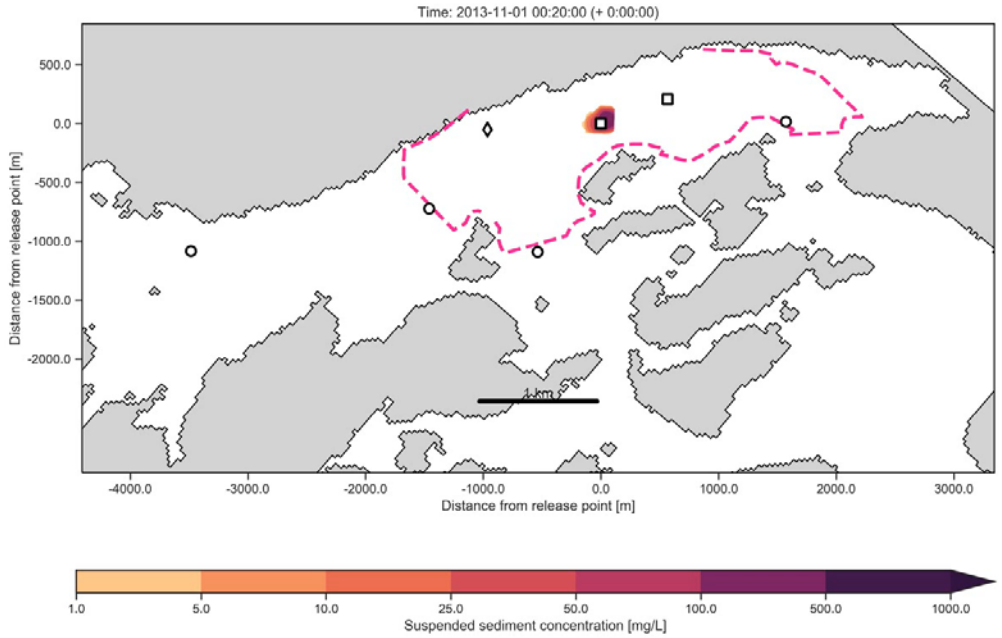
Flocculation model

- Flocculation: particles colliding and sticking together
  - Increased settling speed
  - Lower density
  - Relevant for mine tailings in sea water
- Model approximates effect of floccluation on settling speed
- Settling speed related to (high) concentration of particles

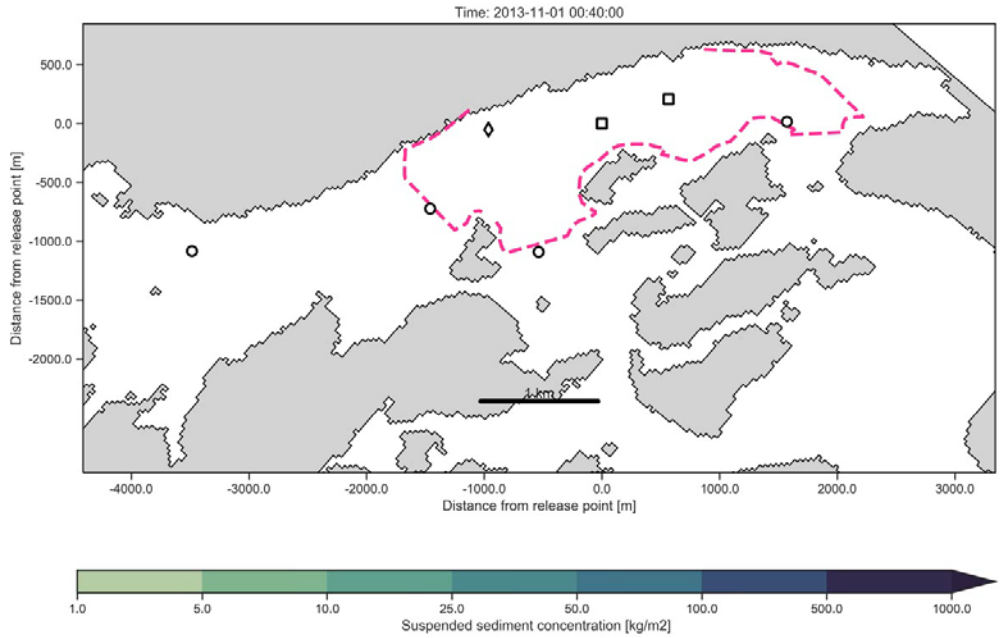


Frænfjorden STP studies

Suspended tailings concentration

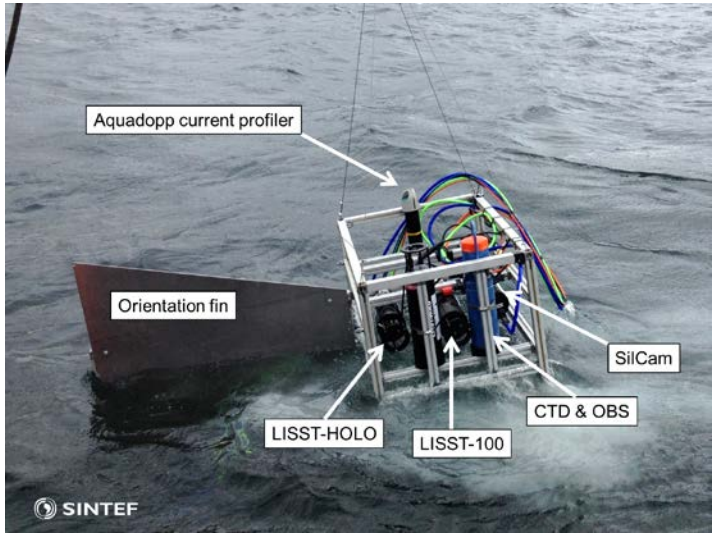


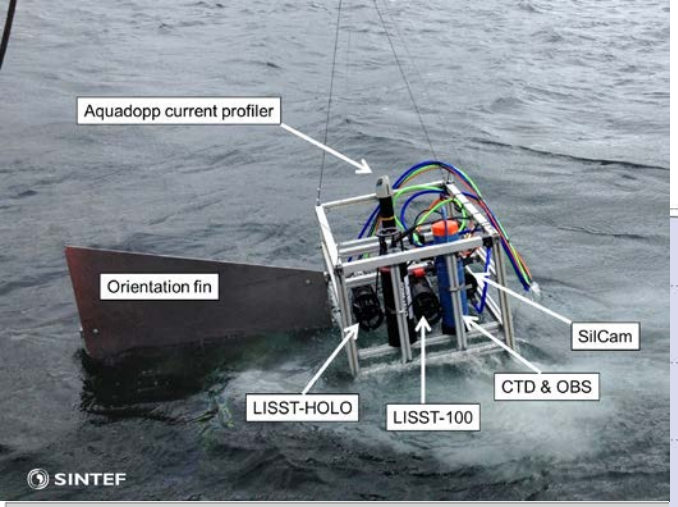
Sedimentation of tailings

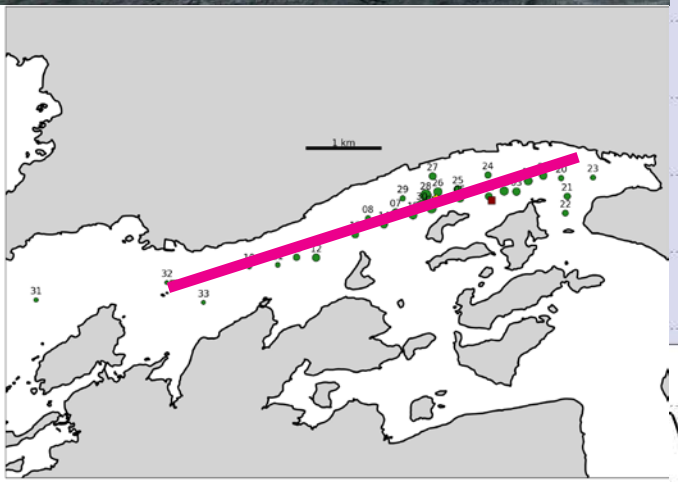


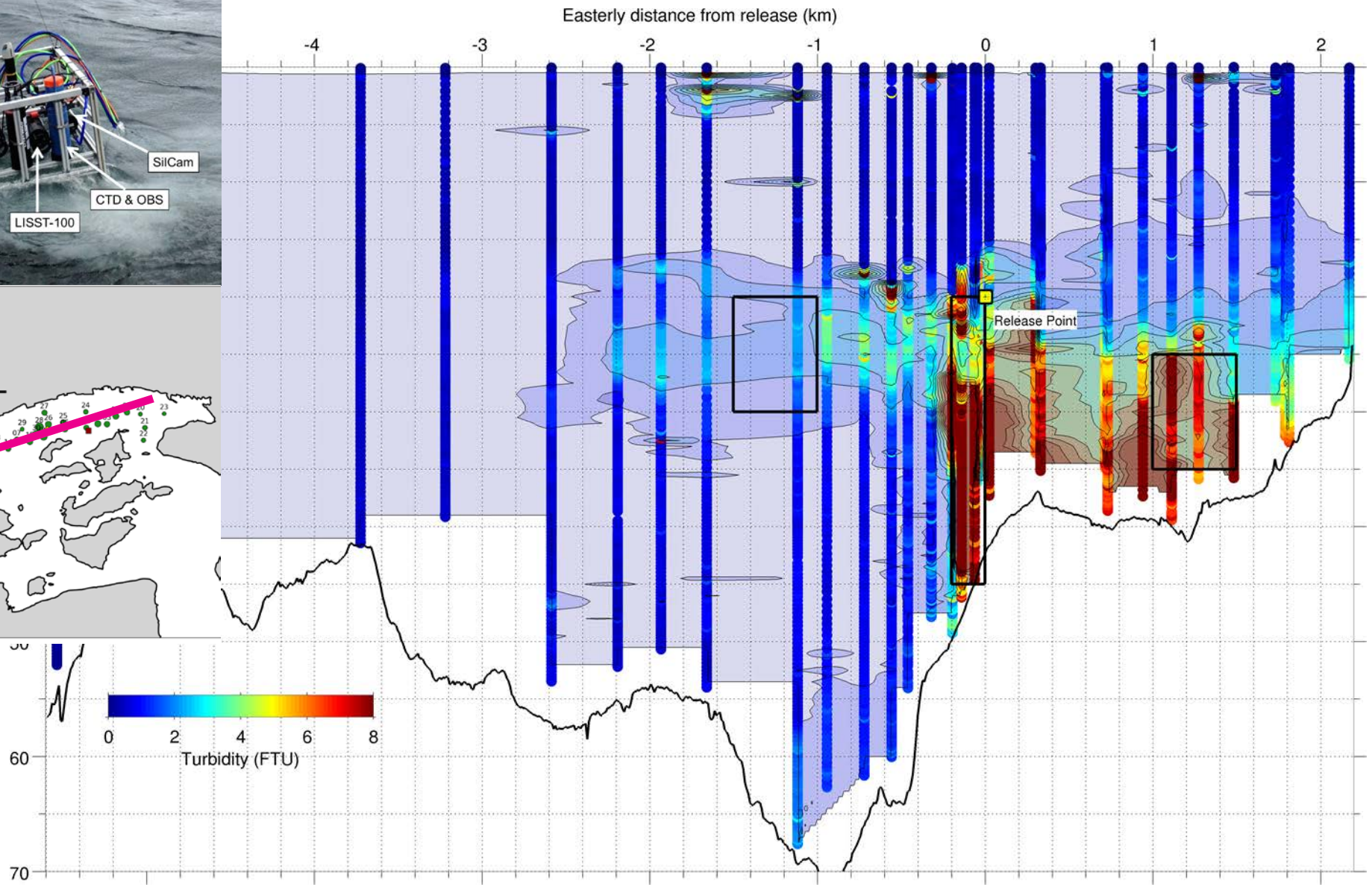
Modelling

Frænfjorden field work









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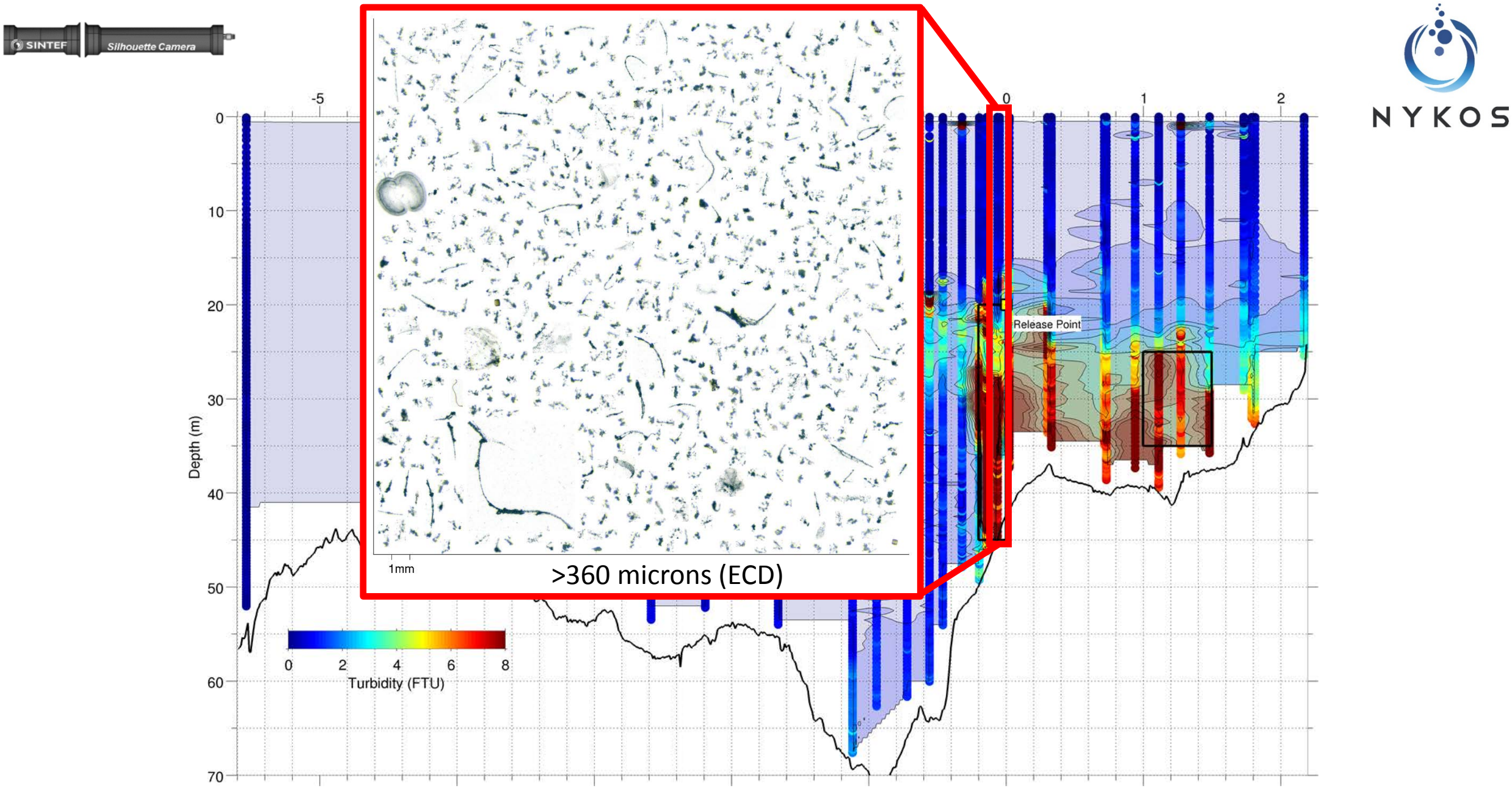
Measured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Silhouette Camera
NYKOS
>360 microns (ECD)
1mm
Release Point
Depth (m)
Turbidity (FTU)
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4
6
8
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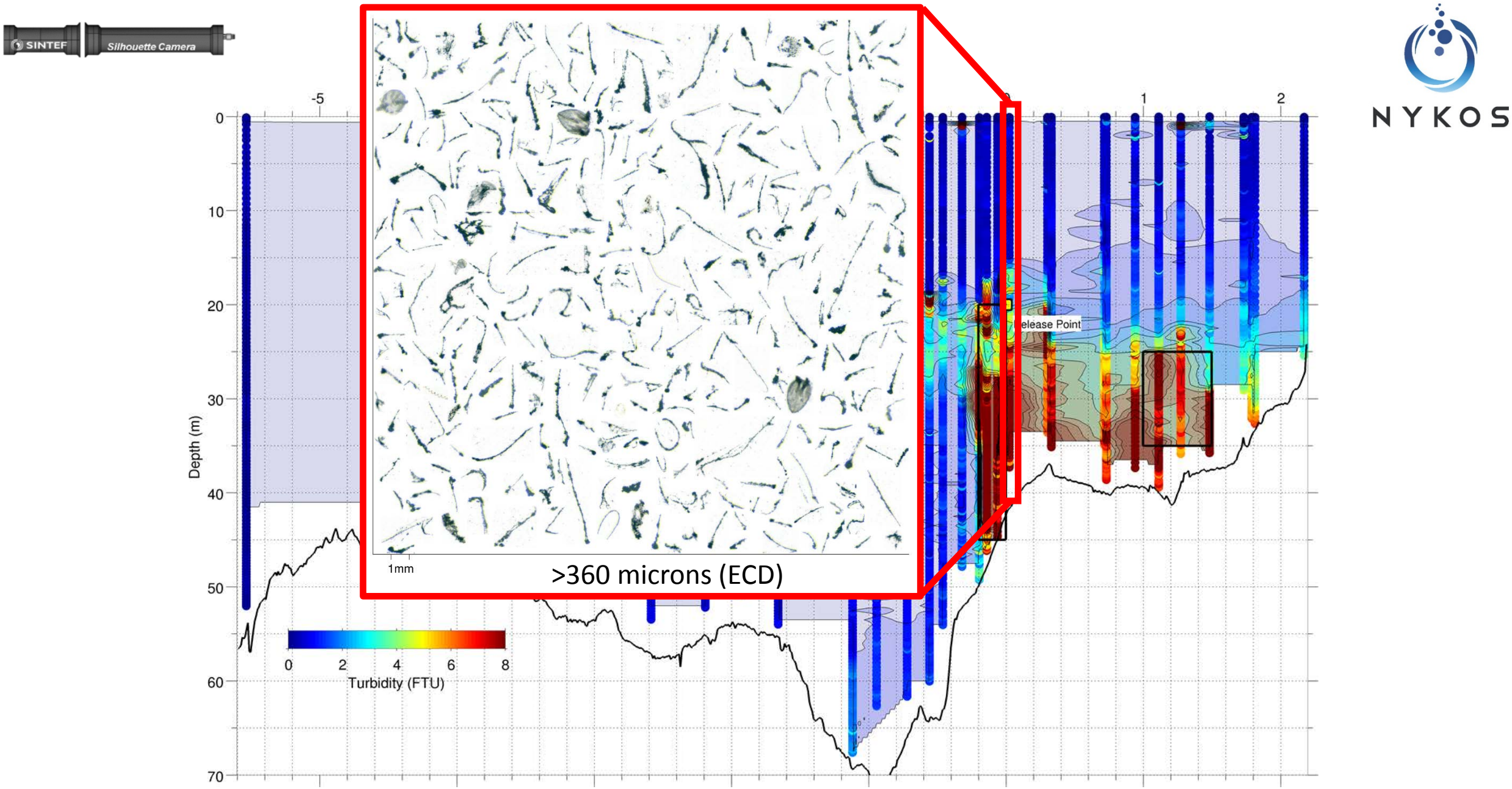
70
Measured
SINTEF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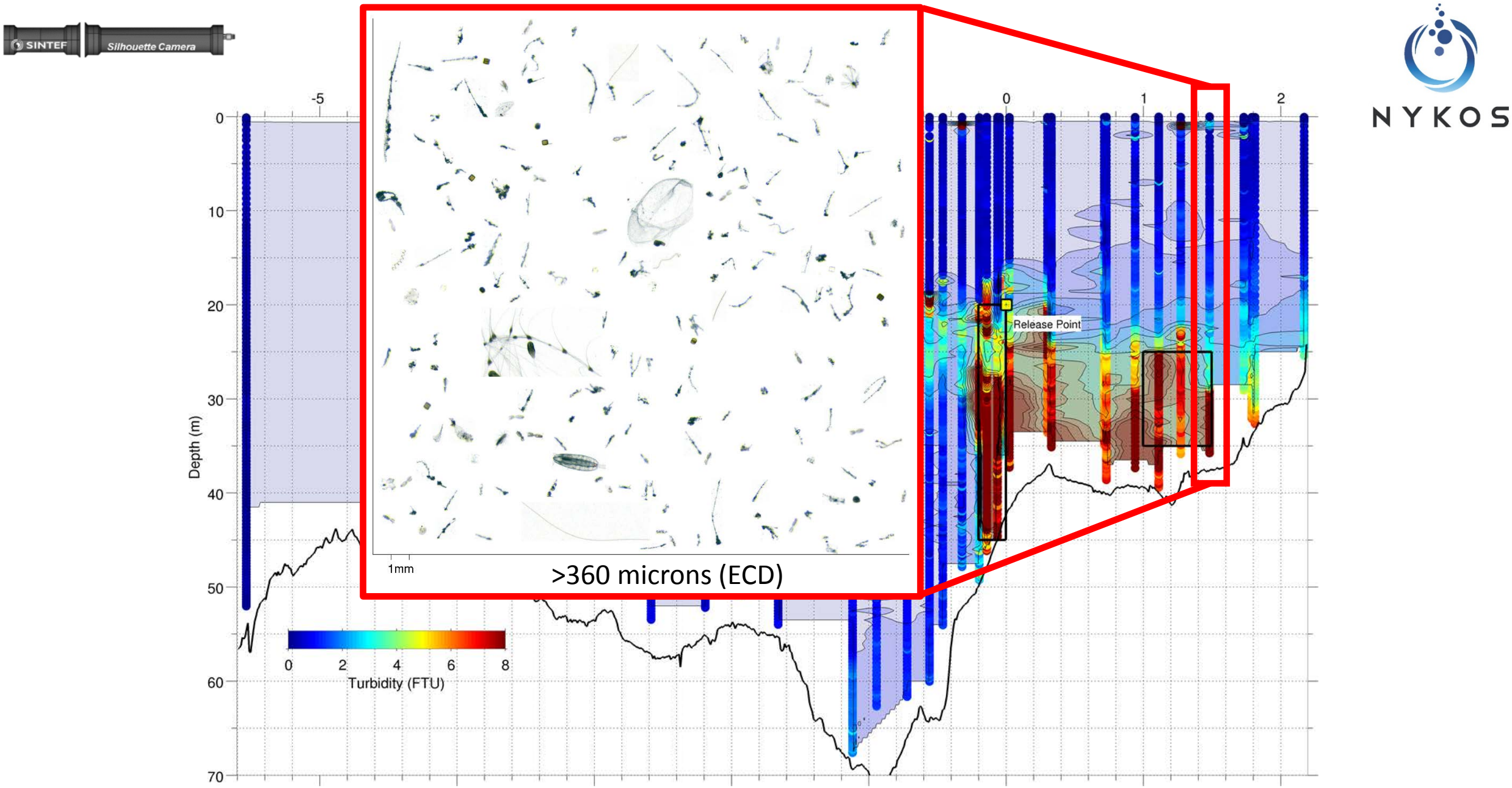
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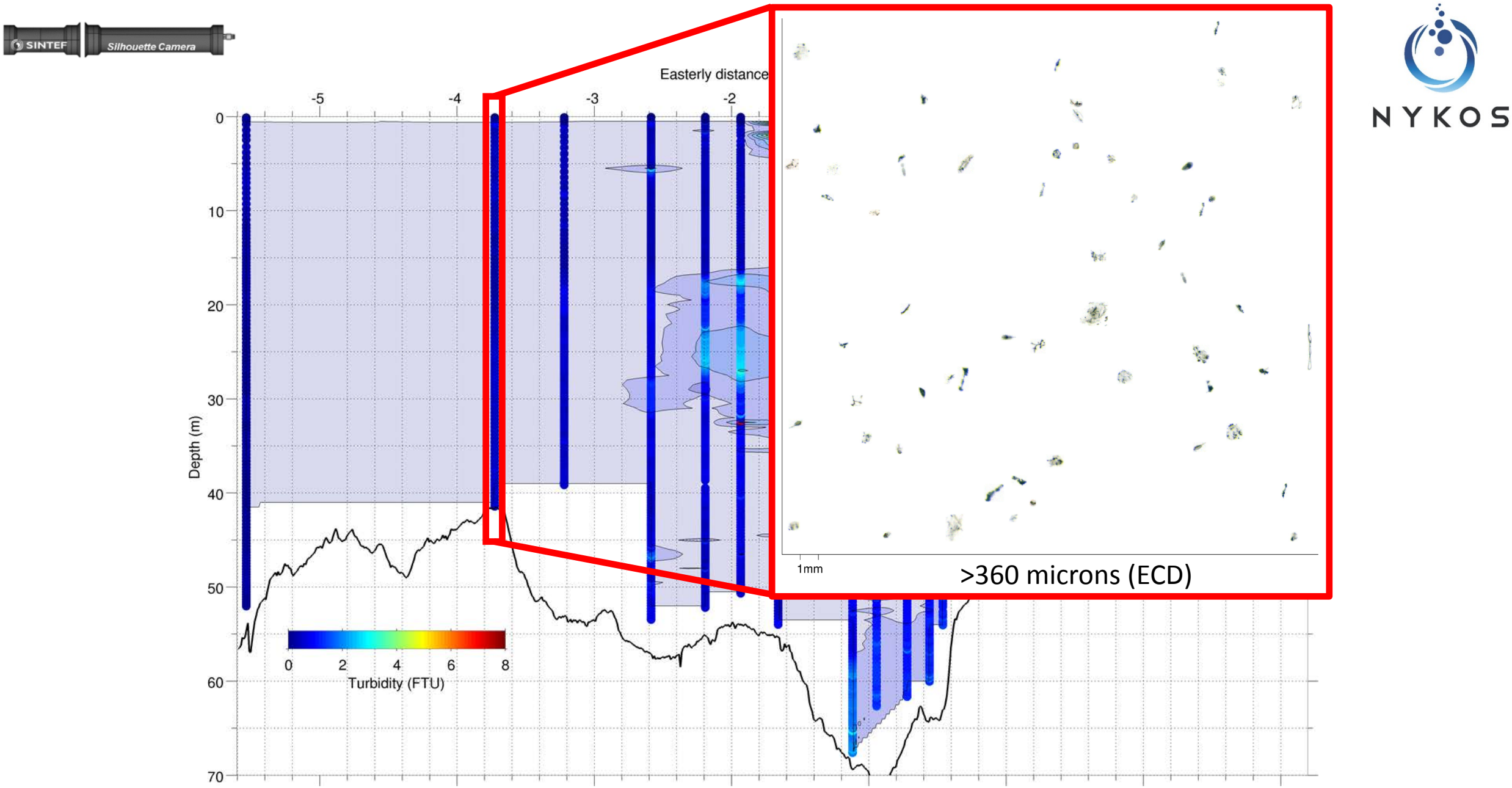

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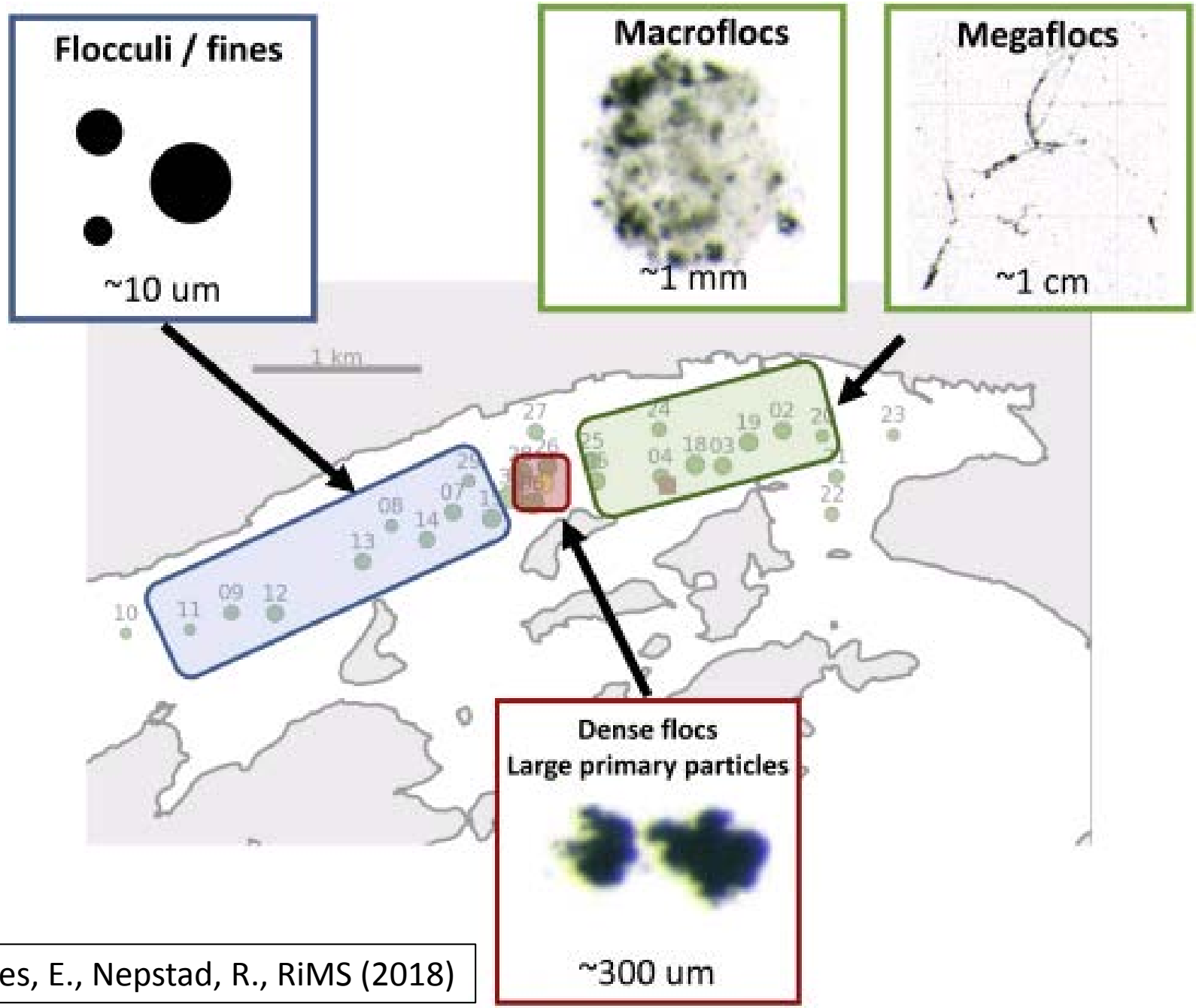
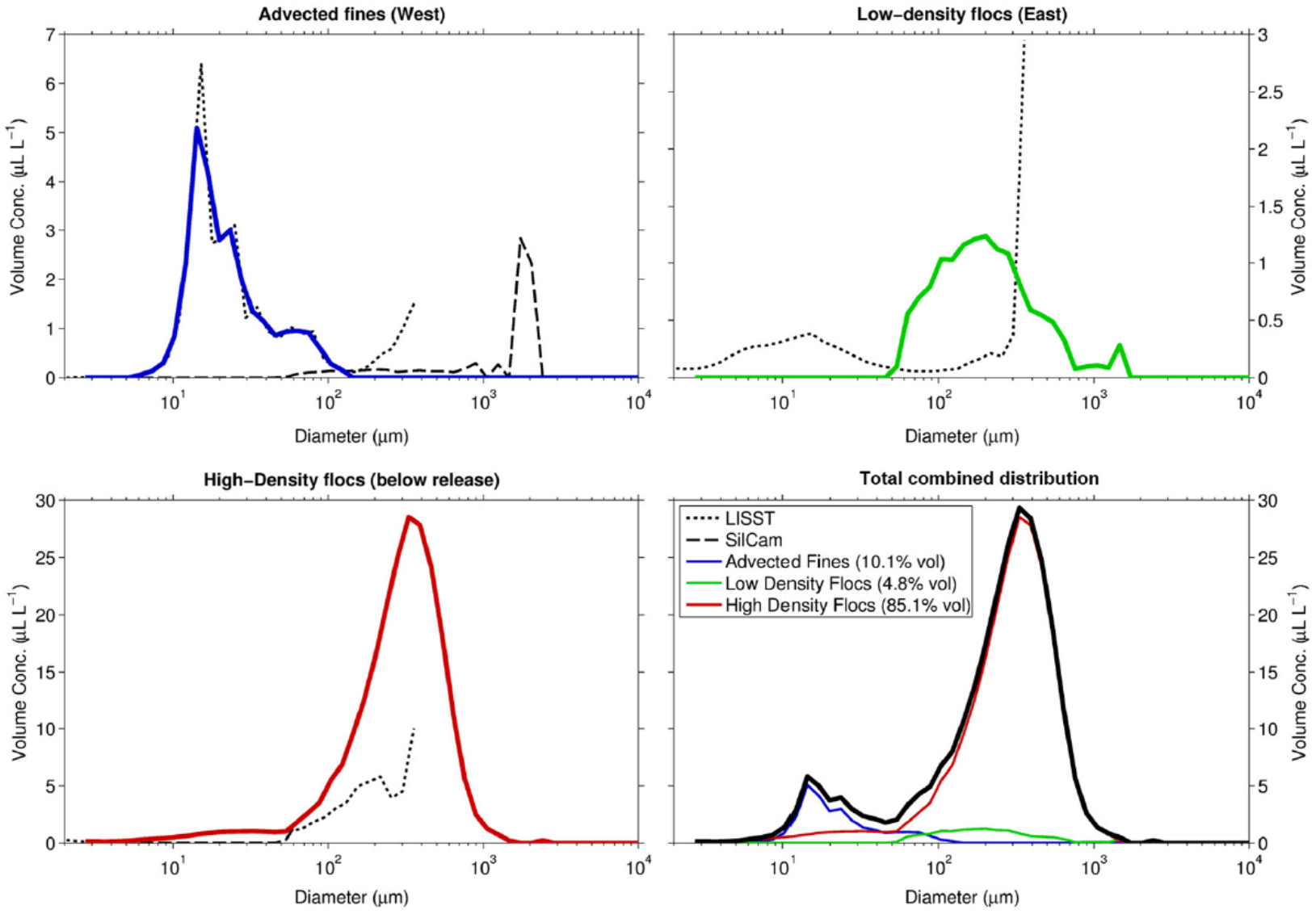


Measured

Davies, E., Nepstad, R., RiMS (2018)

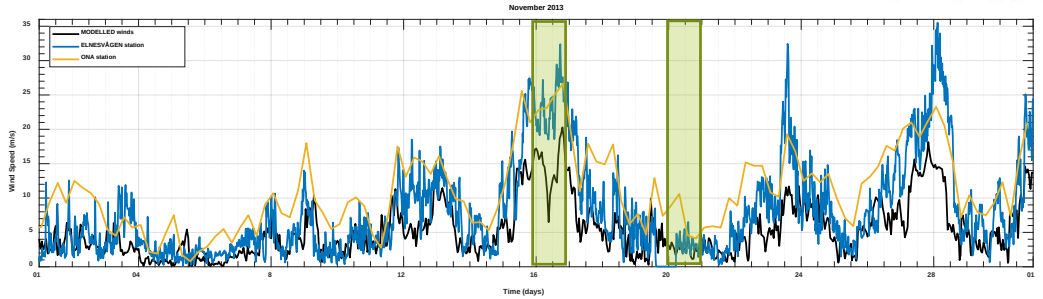


Measured

Davies, E., Nepstad, R., RiMS (2018)

High vs low wind conditions

24h mean concentration - model



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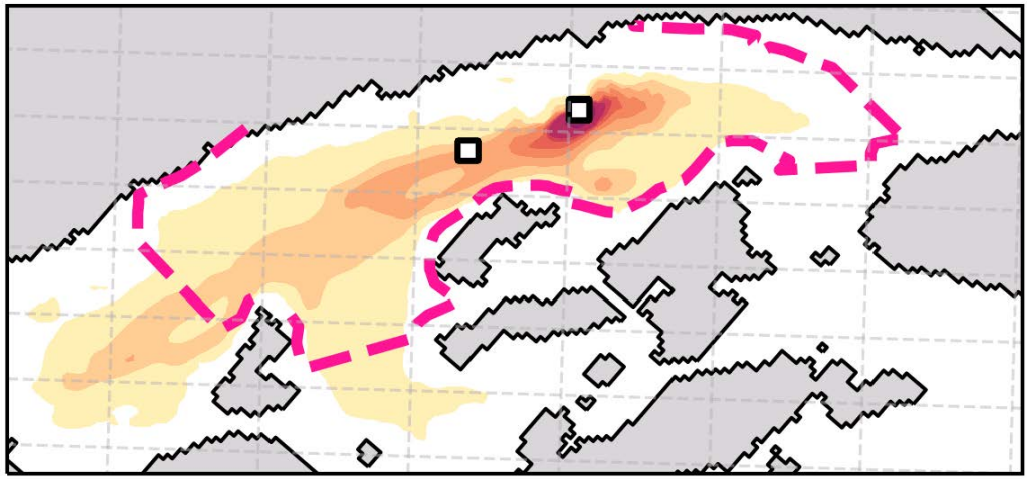

15-20 m/s

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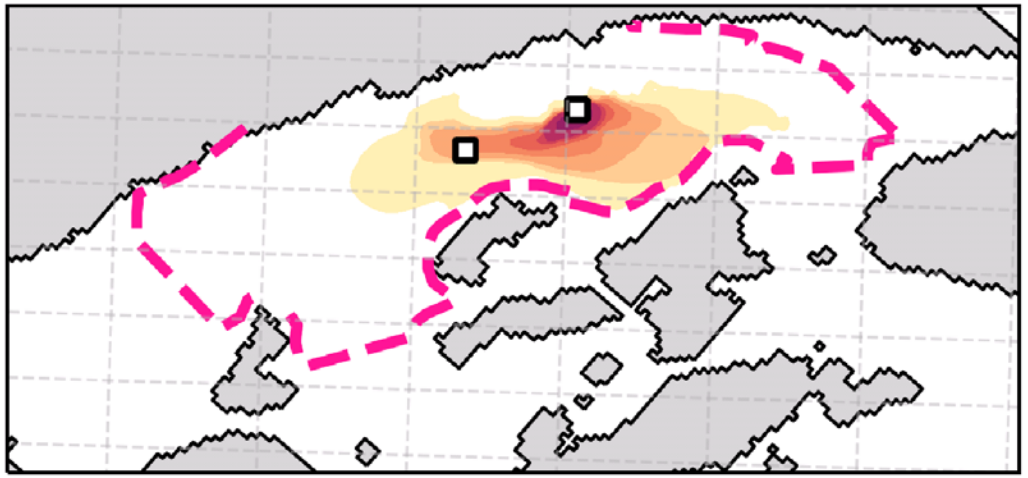
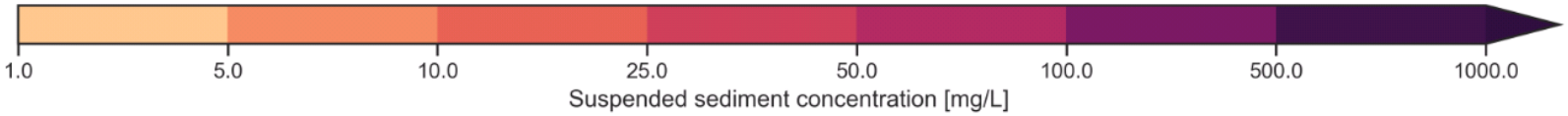


<5 m/s



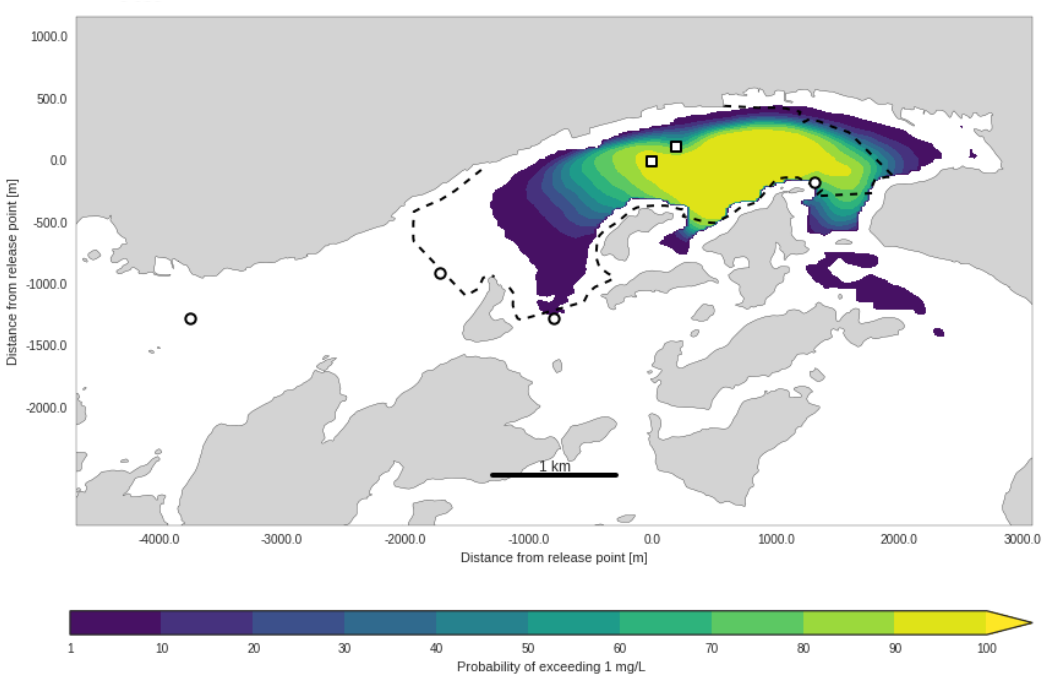
Modelling

Nepstad, Muñoz, *et al.* (in prep)

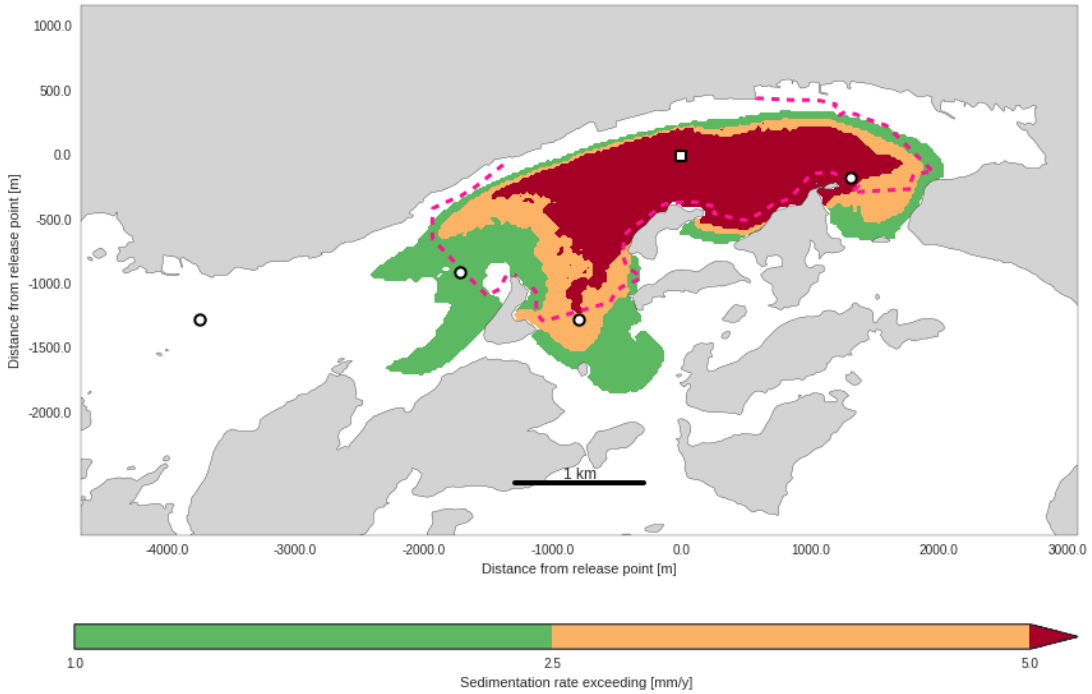
Estimating environmental impact

Example simulations

Impacted sea water volume

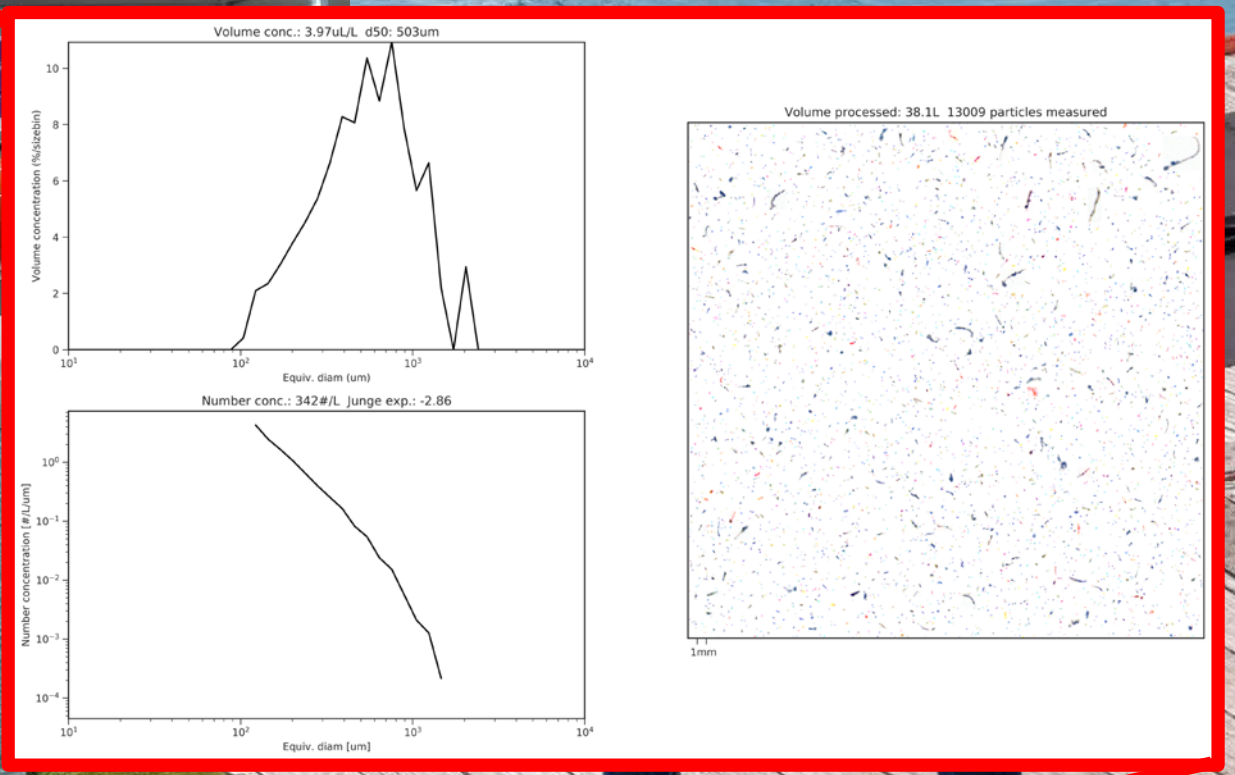


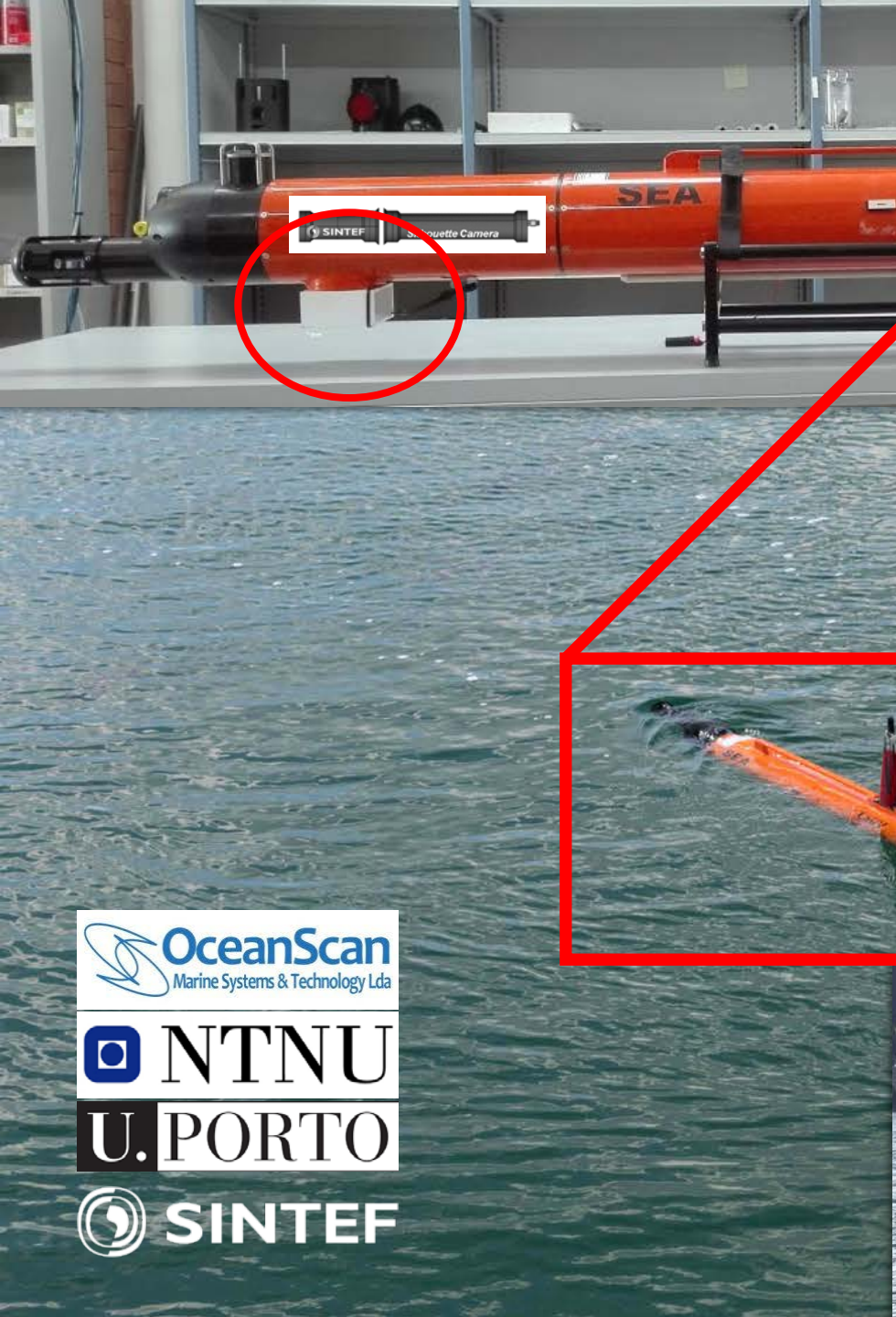
Impacted sediment area



Modelling

FUTURE DIRECTIONS





OceanScan Marine Systems & Technology Lda

NTNU

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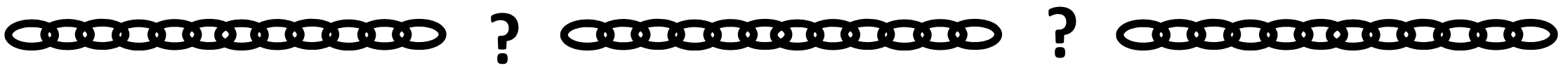
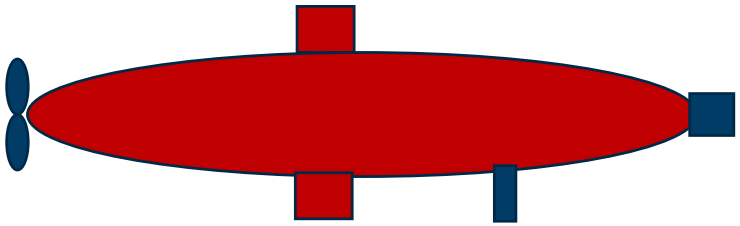
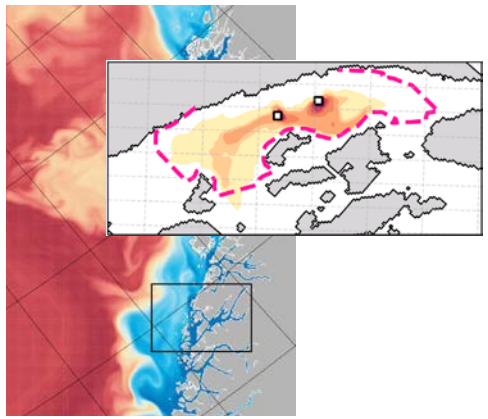
Smart autonomous monitoring and operational model forecasts

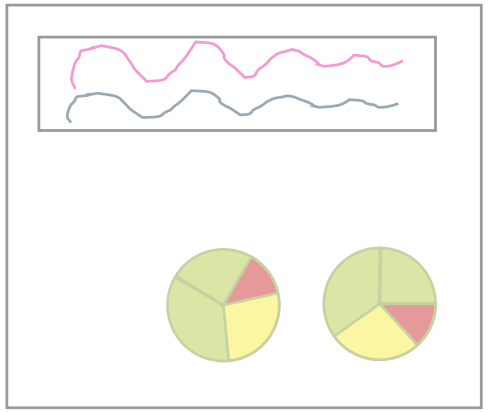




Instrumented AUVs



Operational model forecasts



Monitoring data system for decision support

SINTEF

Teknologi for et bedre samfunn