



REGIONALE
FORSKNINGSFOND

NORDLAND

Evidence of highly local marine litter sources in an Arctic archipelago (Lofoten, Norway)

SALT and Akvaplan-niva
Lofoten, Norway

22.11.2023

Vilde Sørnes Solbakken (SALT Lofoten AS)

Evidence of highly local marine litter sources in an Arctic archipelago (Lofoten, Norway)

SALT

Accumulation of litter

Deposition rate:

Amount of new litter deposited on the beach

+

Retention time:

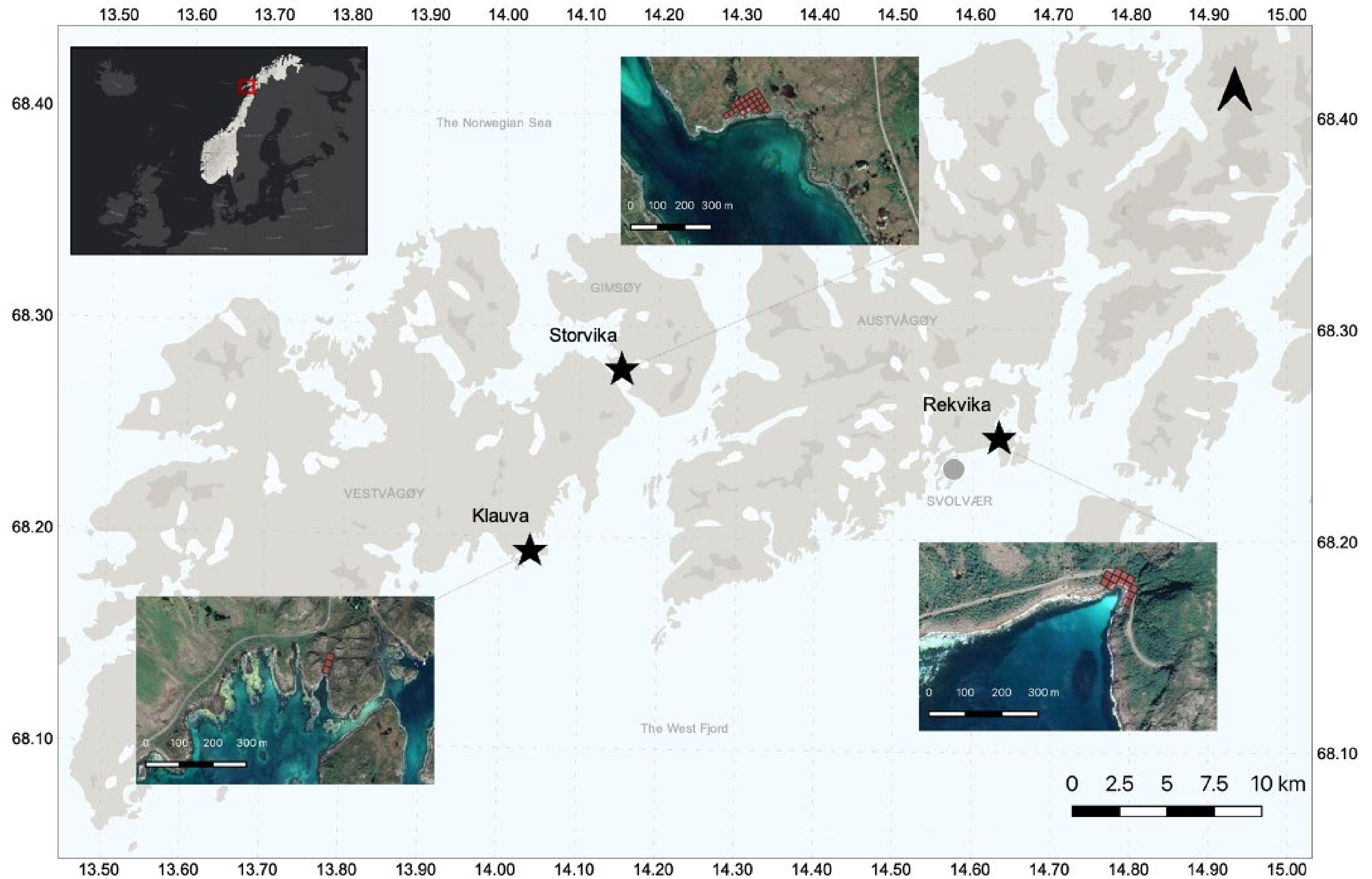
For how long litter is retained on the beach

=

Accumulation

What processes affects beach litter dynamics
and what drives the spatiotemporal variation in them,
in Lofoten (68°N)?

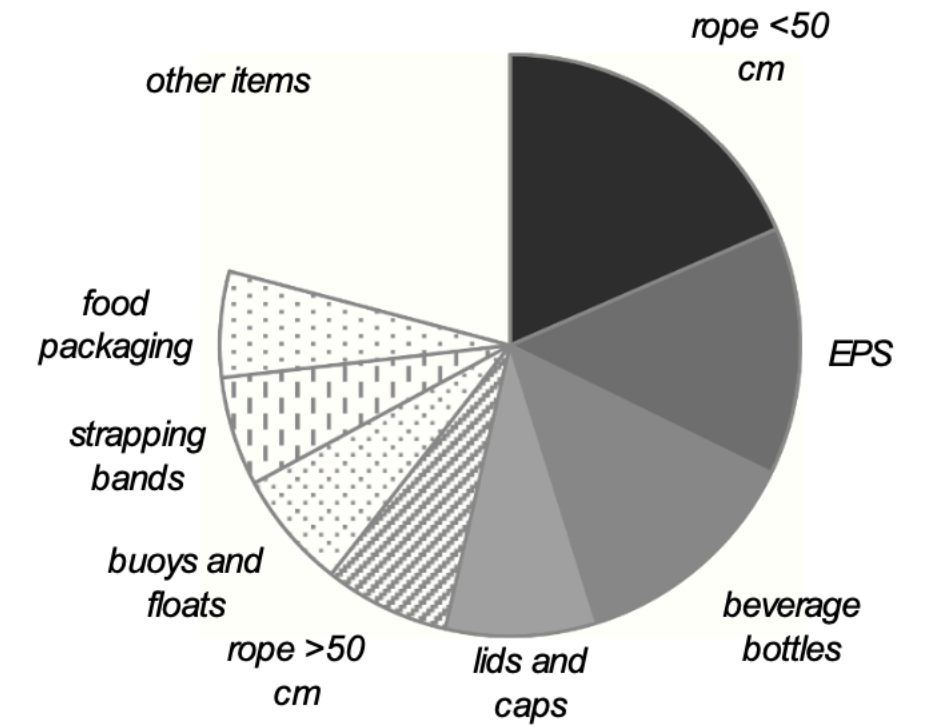
Methods



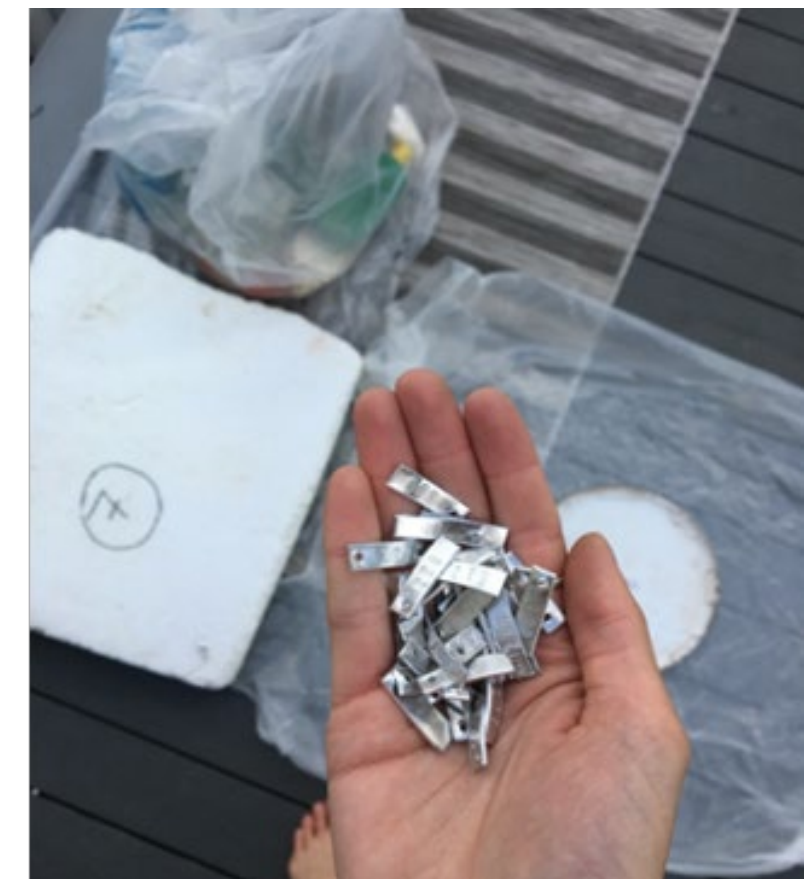
Litter marking and registration



Photo: Vilde Sørnes Solbakken



(Adapted from Haarr et al., 2020)



Evidence of highly local marine litter sources in an Arctic archipelago (Lofoten, Norway)

Bi-weekly sampling/sightings

Mark / Fresh deposits / Recapture



Photo: Vilde Sørnes Solbakken

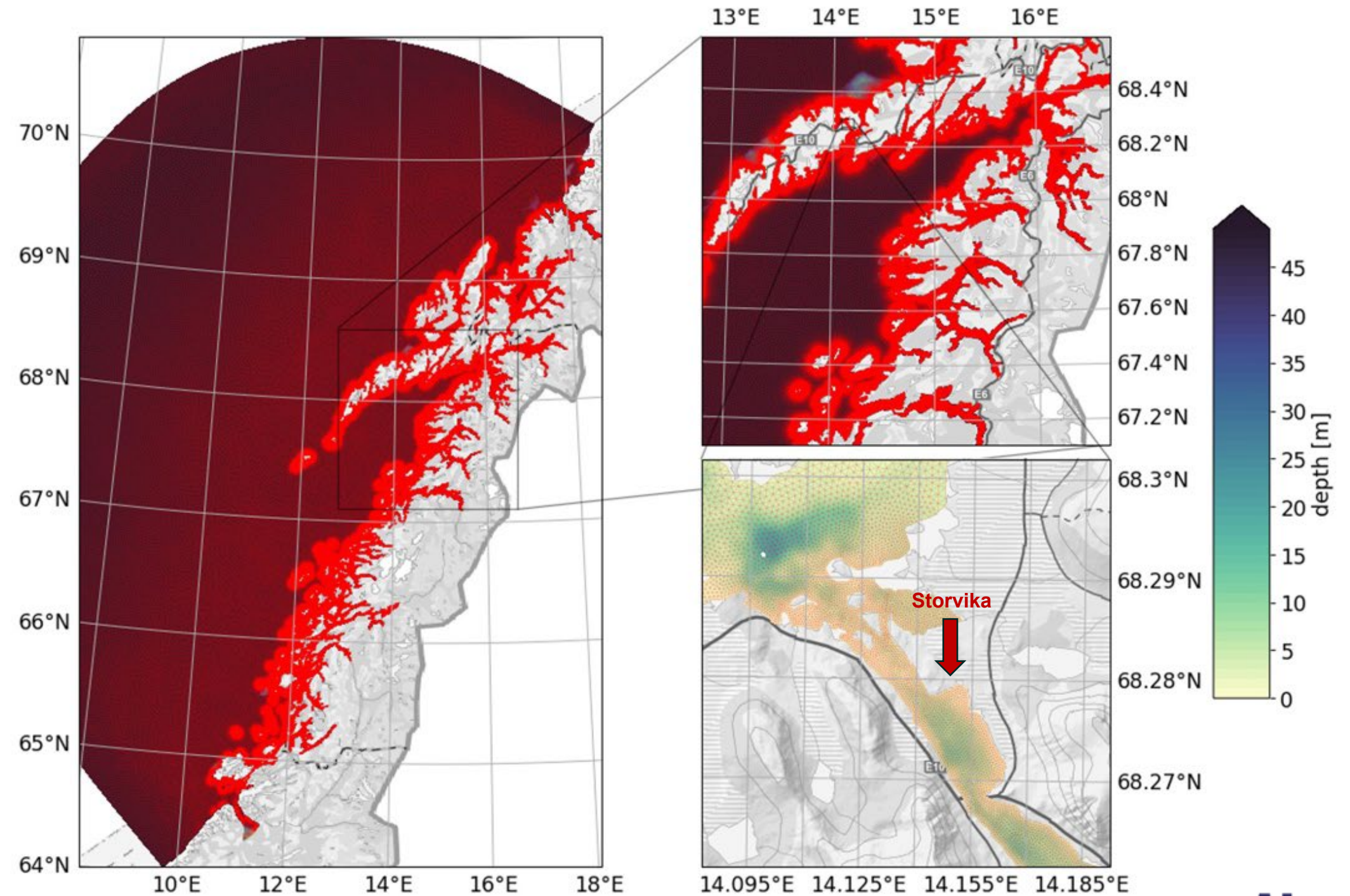
Field work:
May 2020 – May 2023

Incorporate drift modelling

Regional fine resolution coastal modelling: Finite Volume Coastal Ocean Model (FVCOM) covering the Nordland area

Increased resolution close to the study sites

Drift modelling is conducted with the OpenDrift model



Preliminary results



The pilot-study: May 2020 – December 2020

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Deposition rates and residence time of litter varies among beaches in the Lofoten archipelago, Norway

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Temporal variation
Turnover
Beach dynamics

ABSTRACT

A considerable portion of marine litter pollutes the world's coastlines. Its accumulation on beaches represents the product of deposition and retention, processes which are not well understood. A mark-recapture study was performed with a two-week sampling interval at three sites in Lofoten, Norway. Deposition and retention vary over relatively small spatial scales (approx. 13 km radius). No correlation was found among sites in the timing of high and low deposition events, suggesting these are governed by local factors. Contrastingly, the correlation in the timing of high and low retention events was generally stronger among sites, suggesting these may be affected by regional factors. The results underline the importance of customising cleanup frequency for different beaches as spatiotemporal variation in the relative importance of deposition and retention dictate the optimal frequency for maximal removal of litter from circulation in the local marine environment, which cannot be discerned from accumulation (*i.e.*, standing stock) alone.

Solbakken, V. S., Kleiven, S., & Haarr, M. L. (2022). Deposition rates and residence time of litter varies among beaches in the Lofoten archipelago, Norway. *Marine Pollution Bulletin*, 177, 113533.

<https://doi.org/10.1016/j.marpolbul.2022.113533>

Small-scale spatial variation in deposition rates and retention times

Fresh incoming litter at all sites during biweekly sampling – some local variations in composition

Deposition rate – local factors regulating

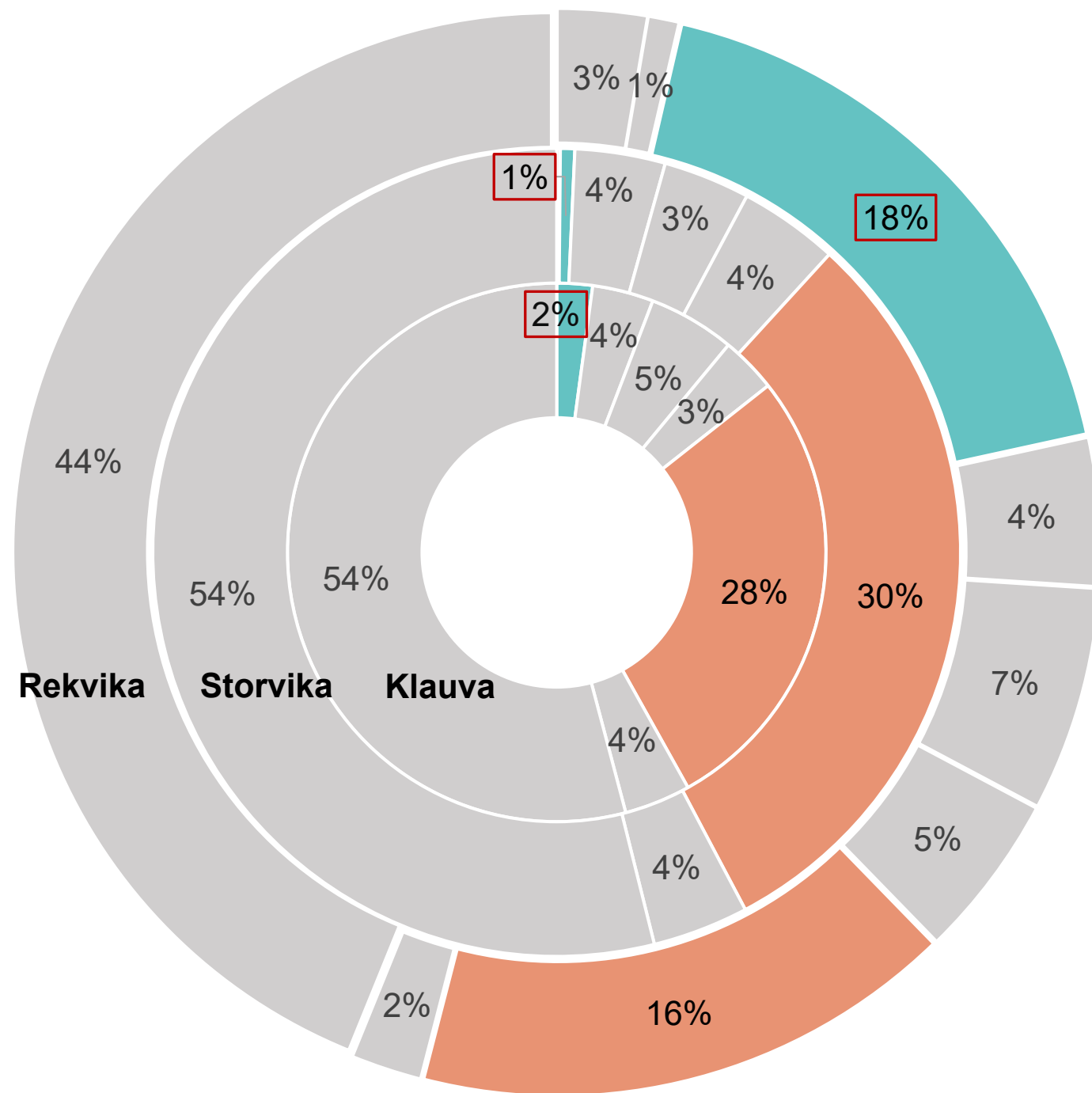
(e.g., local litter availability)

Retention rate – regional factors regulating (e.g., weather patterns)

Investigating local marine litter sources in Lofoten archipelago

Case study: Bio carriers in Storvika

Composition – local variations



- Beverage Bottles
- Buoys and Floats
- EPS
- Food Packaging
- Lids and Caps
- Rope Over 50 cm
- Rope Under 50 cm
- Strapping Bands
- Other

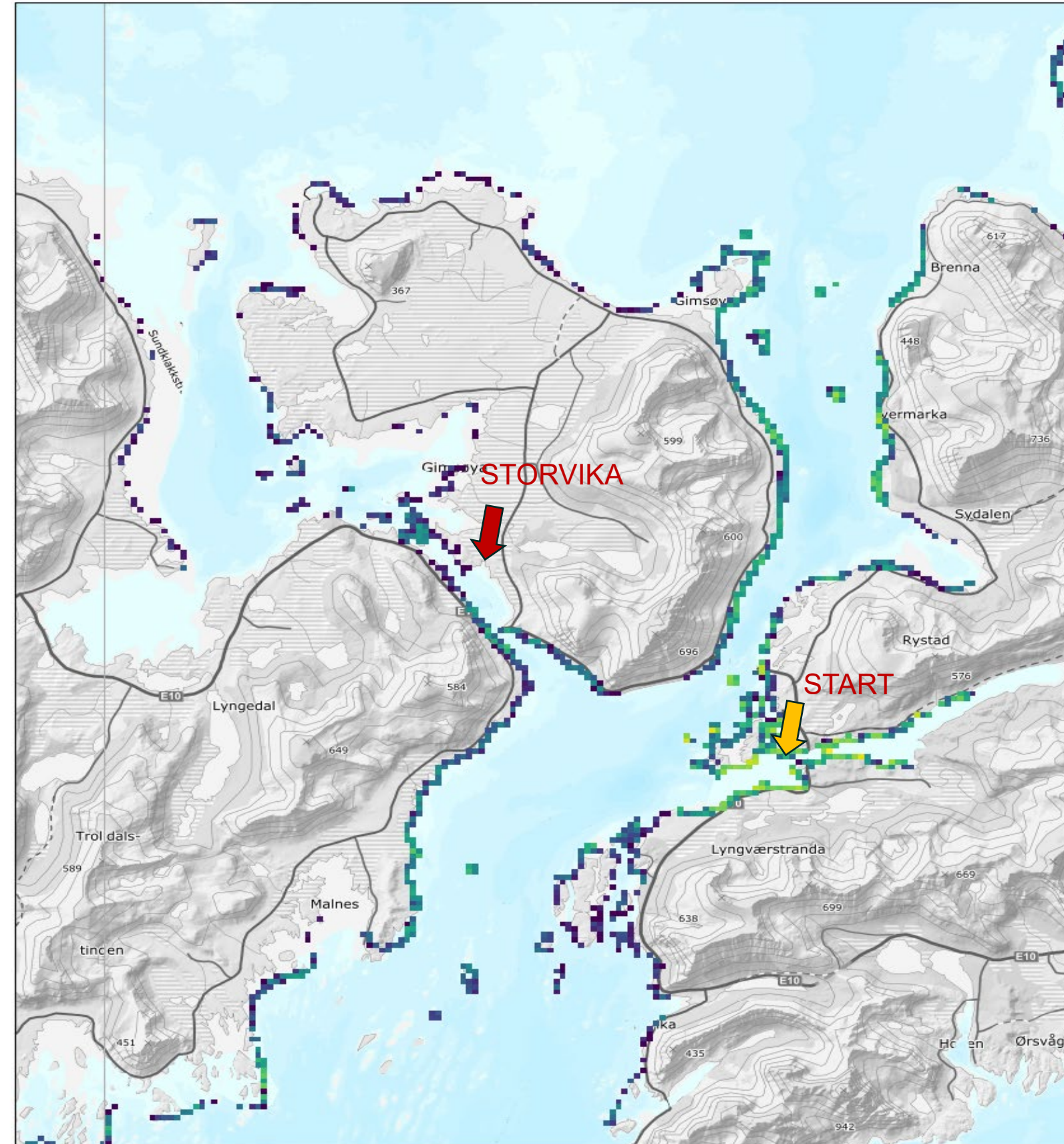


Drift modelling: forward drift simulation from aquaculture facility

Plastic particles on 10 cm deep

4872 particles released every third hour over 25 days (a total of 737 000 particles)

From: aquaculture facility («Start»)



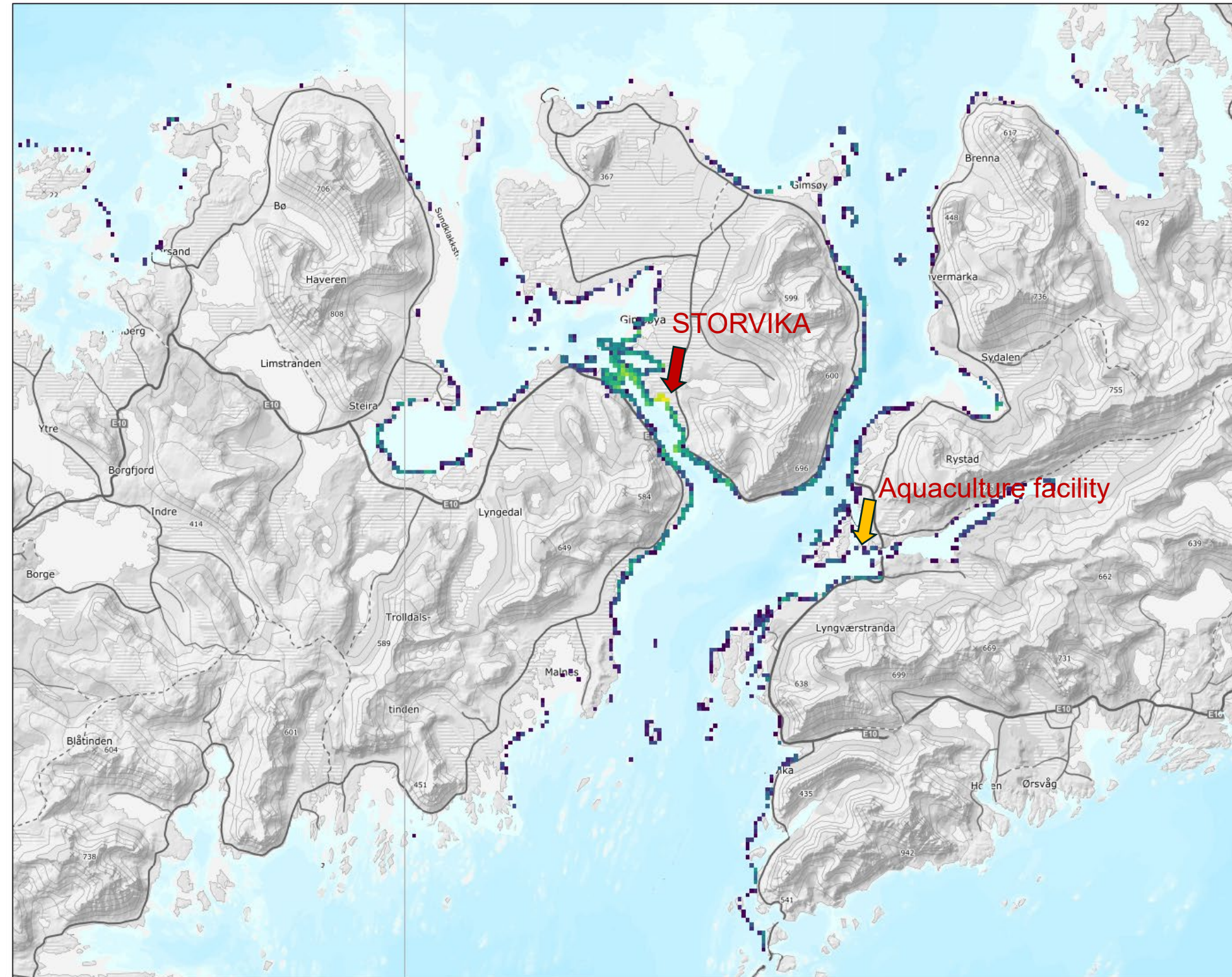
Akvaplan
niva

Drift modelling: Case study backtracking from Storvika (bio carriers)

Plastic particles on 10 cm deep

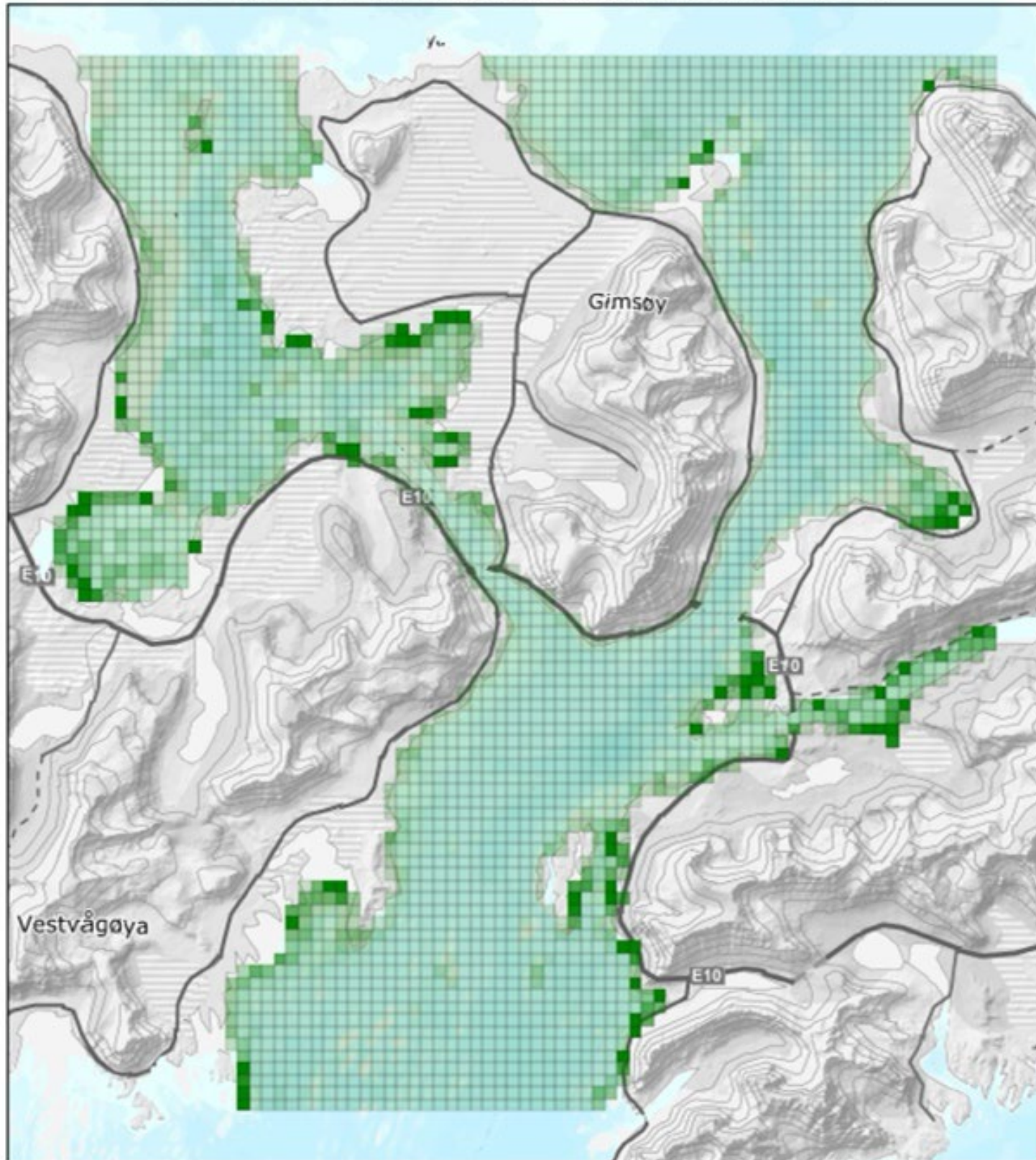
1984 particles released every third hour over 20 days (a total of 300 000 particles)

From: Storvika

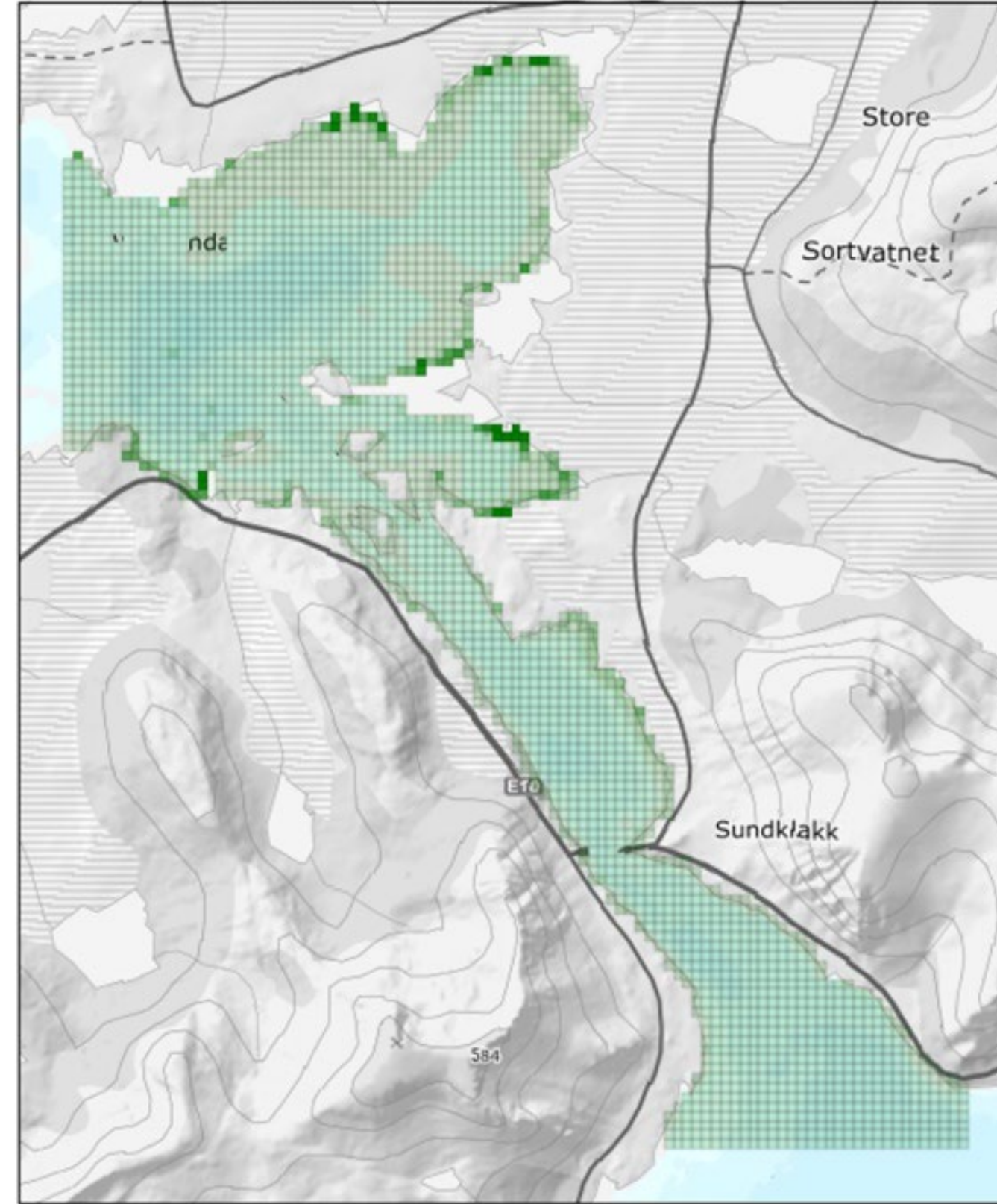


Channels as sinks along the coastline

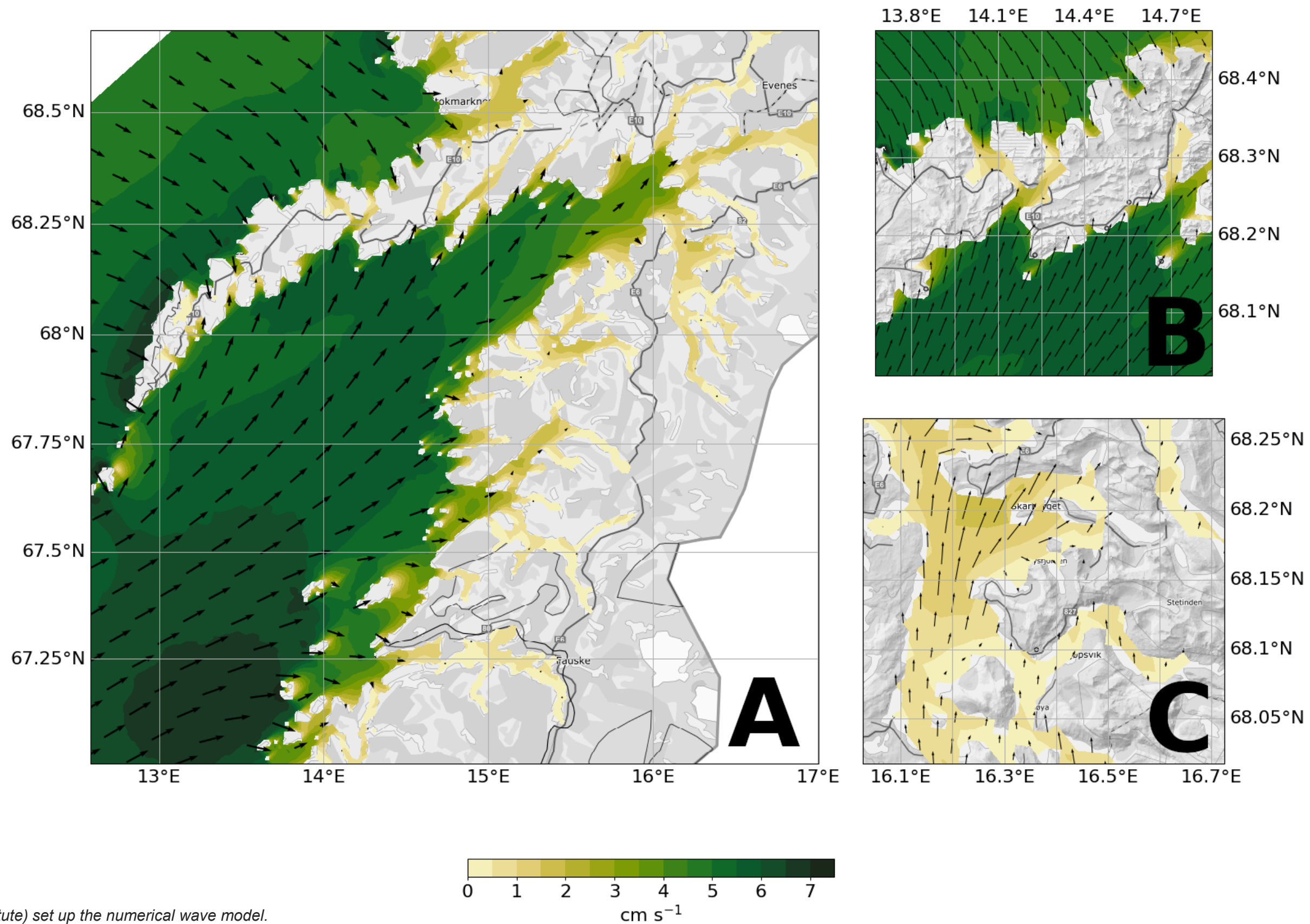
average time spent in boxes by particles, 3D FVCOM



average time spent in boxes by particles, 3D FVCOM



Drift modelling: Can litter be circulating locally over time?



Ana Carrasco (Norwegian Meteorological Institute) set up the numerical wave model.

A close-up photograph of a person's hand holding a small, black, ribbed plastic shell fragment. The background is slightly out of focus, showing a red jacket, a grey knit hat, and a dark jacket with a purple drawstring. The scene appears to be outdoors in a cold environment, possibly an Arctic archipelago.

Summary, and what's next?

Summary and what's next

Local variation in composition found within relatively small spatial scales (13 km)

Litter in tidal channel tend to drift towards land and bays

Beach litter can be tracked back to very local sources in a channel in Lofoten archipelago

Channels works as traps for litter along the coastline



The project continues:

All litter data, drift modelling results, seasonal and weather data, and GPS tracking data will be analysed and publications will be finalized by March 2024

We will continue studying the dynamic processes, spatiotemporal variation in them and composition of litter hopefully over greater areas, for greater effects of beach cleanups on the litter circulating in the environment, and for optimizing cleanup strategies.

Thank you for your attention!



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References

Haarr, M. L., Pantalos, M., Hartviksen, M. K., & Gressetvold, M. (2020). Citizen science data indicate a reduction in beach litter in the Lofoten archipelago in the Norwegian Sea. *Marine Pollution Bulletin*, 153, 111000. <https://doi.org/10.1016/j.marpolbul.2020.111000>

Solbakken, V. S., Kleiven, S., & Haarr, M. L. (2022). Deposition rates and residence time of litter varies among beaches in the Lofoten archipelago, Norway. *Marine Pollution Bulletin*, 177, 113533. <https://doi.org/10.1016/j.marpolbul.2022.113533>