



Anthropogenic particles in European Arctic marine environments: impacts from one of the northernmost settlements at 78° N

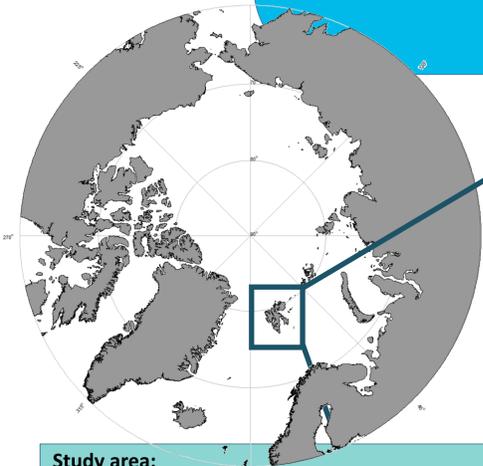
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Study area:

The settlement **Longyearbyen** is located at the inner part of the largest fjord system of the Norwegian archipelago **Svalbard**. Here, the fjord system of the **Isfjorden** is fed by inflowing water masses from the Fram Strait. We have investigated a tributary fjord to Isfjorden, **Adventfjorden** (see Fig. 1), where the settlement Longyearbyen is situated. This fjord is influenced by local runoff from rivers, surrounding glaciers and an untreated wastewater outlet (WWO) in a depth of 50 m at the seabed (Herzke et al. 2021). Previous studies have indicated a burden of predominantly anthropogenic fibers within the Adventfjorden (Herzke et al. 2021), but also close to other WWOs on Svalbard which are confirmed as local sources of microliter (Granberg et al. 2019).

Sample collection:

Samples of the surface water were taken in the inner part of Isfjorden and Adventfjorden, in June 2021.

- A CTD cast equipped with Niskin bottles was used
- 3 replicates per sample location
 - each replicate reflects 30L of sea water
- Samples were onboard sieved with a metal sieve (50 µm)
 - **size limit (50 µm) of all here investigated anthropogenic particles**
- Remains were rinsed with milliQ water in PP Nalgene® bottles and stored at -20 °C

Sample processing:

- Samples were processed with an established oil-extraction in a clean room after Corami et al. (2020 & 2021)
- The oil phase (Fig. 2) were vacuum-filtered on Anodisc filter (Fig. 3)
- Micro-FTIR Spectroscopy was used for polymer quantification & qualification (Corami et al. 2020)

QA/QC:

Blanks (incl. the onboard sample collection, laboratory environment, equipment and added compounds) were stored and processed at the same time and in the same manner than the water samples. To assure no overestimation by contamination, 25 instead of 22 fields per filter were investigated. Particles were compared and excluded regarding polymer match, size and color (see Quantification & Qualification box).



Fig. 2: Oil extraction of suspected APs with rice oil (Crudolio, Olio di Riso Naturale) in glass separatory funnels.

Fig. 3: Filtration onto Aluminium oxide filter (Anodisc, Whatman, Merck Darmstadt Germany, pore size: 0.2µm, 47mm in diameter).

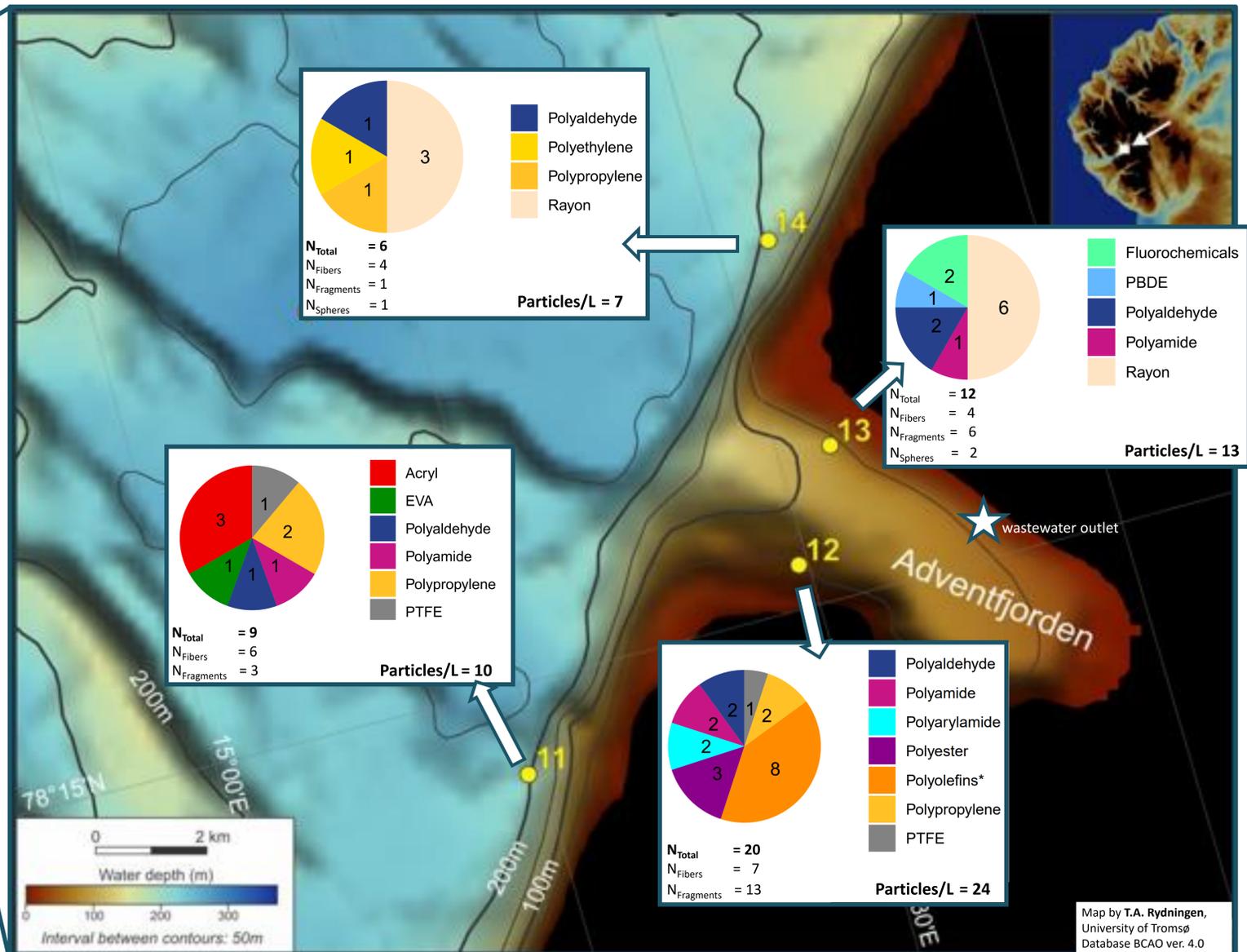


Fig. 1: Preliminary results from anthropogenic particles found in sea water samples taken in the Adventfjorden (Station 12 & 13) and the inner Isfjorden (Station 11 & 14) in June 2021. Only one replicate and belonging blank samples were here considered for each station. Calculation and evaluation was done after Corami et al. 2020 & 2021. *Polyolefins incorporate here ethylene/propylene co-polymers and matches for the result of polyolefin compounds.

Quantification & Qualification:

The **Micro-FTIR Nicolet™ iN™ 10** (Thermo Fisher Scientific) was used to identify anthropogenic particles. 22 fields of each filter (one replicate sample) were analyzed using a photomontage of 64 co-scans (spatial resolution 100 µm, aperture 100 µm x 100 µm) in the spectral range of 4000 – 1200 cm⁻¹. Particles and fibers were selected by utilizing WIZARDS section of the Omnic™ Picta™ software. Gained spectra were matched with different polymer reference libraries. Matches were only taken into account if the **match rate was ≥ 65%** of synthesized objects and the size was ≥ **50µm**. Polymer identification was investigated after Corami et al. 2020 .

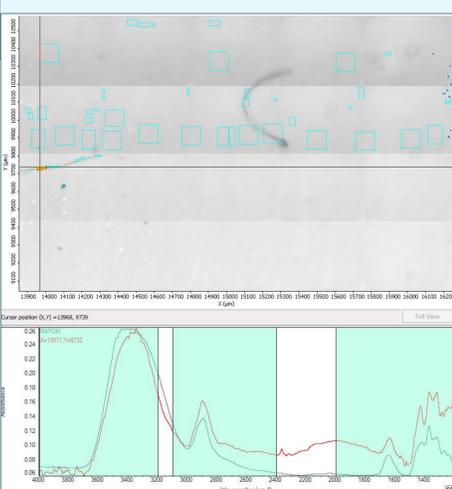


Fig 4: Example of a spectrum of a found Rayon fiber (red) in a replicate sample of station 14.

Preliminary results:

- **Inside of Adventfjorden: 24 & 13 Particles/L⁻¹**
- **Inner part of Isfjorden: 7 & 10 Particles/L⁻¹**
- **Specifics:**
 - **Less fibers on the northern coastline than on the southern coastline** disaccording to Herzke et al. (2021): the northern coast was more burdened with fibers, than the southern one in 2017 – all depending on size & density
 - **Higher amounts of anthropogenic particles were found within the Adventfjorden**
 - **Rayon was only found at the northern sample locations (13 & 14), and has the largest quantity of all identified polymers (19%)**
 - **Polyamide (Nylon) has the second highest share (8.5%)**

Outlook:

- All evaluated replicates will be combined to stabilize the results
- Information about the densities and weight of identified polymers will give further insights on the fate and transport of anthropogenic particles
 - Established modelling approaches will be used (Herzke et al. 2021) to estimate the fiber and fragment burden within the Adventfjorden, and the transfer to the Isfjorden
- Results can be compared with previous studies investigating this and other wastewater outlets
- Already established methods were applied, thus our study is comparable with similar approaches

Acknowledgments: We acknowledge *Troms og Finnmark fylkeskommune* and *Nordland fylkeskommune* for funding this research within the MiPoBa project financed by Arktis2030. Further thanks go to the internal funding from the Norwegian Polar Institute for partly funding this investigation. Further thanks go to the Research Council of Norway (Forskingsrådet; NFR) to fund the travel expenses for the study stay in University of Ca' Foscari to learn and apply the oil extraction method & subsequent µFTIR analysis via PLASTPOL 2021 (Funding No.: 322191, NFR). Additional thanks go to Tom Arne Rydningen (University of Tromsø) for giving the permission to use his created map of the Adventfjorden.



Troms og Finnmark fylkeskommune
Romssa ja Finnmárkku fylkkagielda
Tromsø ja Finnmárkku fylkinkomuuni



Nordland
FYLKESKOMMUNE

The Research Council
of Norway



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