Tracing the pathways of Atlantic Waters in the Santa Anna Trough using ^{129}I, ^{236}U and ε_{Nd}

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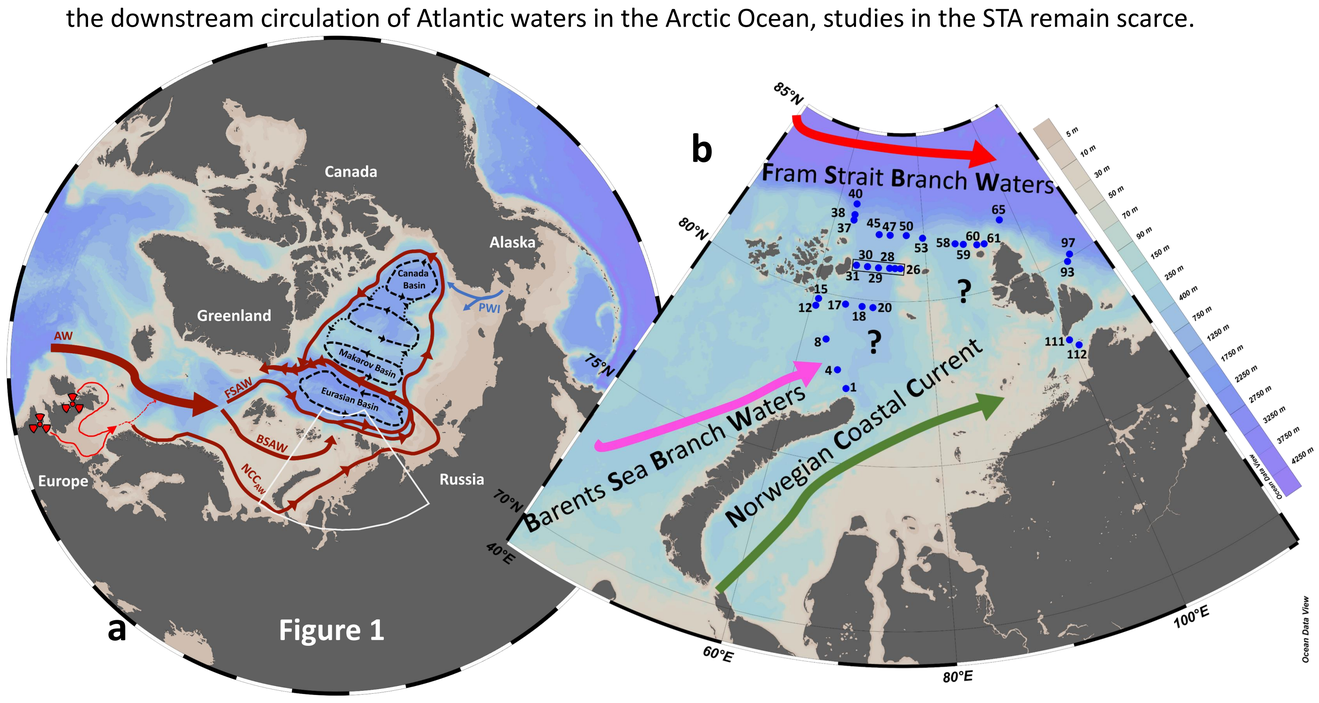
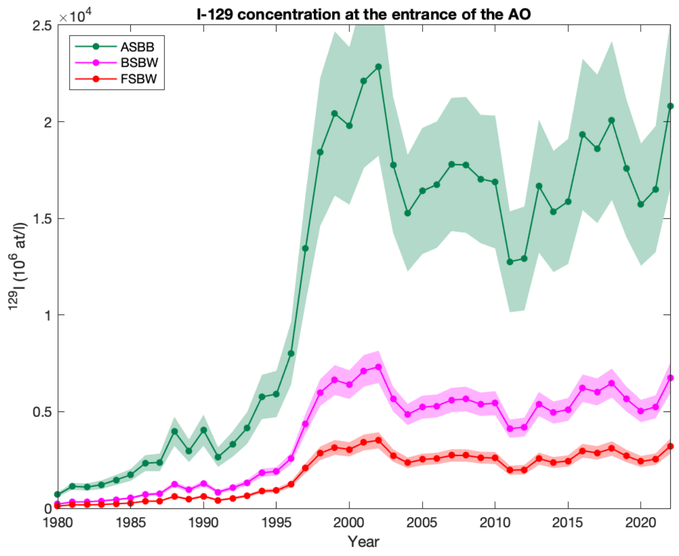
1. Rationale

The Arctic Ocean is warming faster than the global average, in part due to an increased entrance of ''warm'' Atlantic waters (AW). Almost half of the AW, flow along the Barents Sea and enter the deep Arctic Basin at the St. Anna Trough (STA; [1]). Despite its utmost importance of this region for the downstream circulation of Atlantic waters in the Arctic Ocean, studies in the STA remain scarce.



The anthropogenic radionuclides ^{129}I ($t_{1/2}$=15.7 Myr) and ^{236}U ($t_{1/2}$=23.5 Myr) have been introduced into the Arctic Ocean mostly by two European nuclear fuel reprocessing plants at a known rate (Fig. 1a; Fig. 2; [2]), making them reliable tools to track circulation in the Arctic. Additionally, neodymium isotopic composition ε_{Nd} has extensively been used as a quasi-conservative tracer of global circulation. However, its utility in continental margins is still being studied.

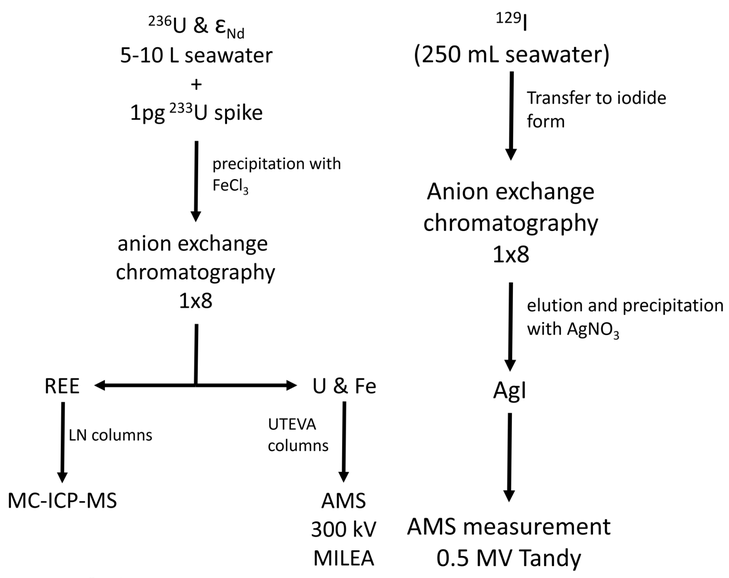


This project aims to:

- Better understand the pathways of AW into the Arctic Ocean and the mixing of FSBW and BSBW at the STA.
- Using tracer observations (^{129}I and ^{236}U) to better constrain input functions of Atlantic waters in the Arctic Ocean. This is crucial for the estimation of transport timescales and mixing.
- Exploring the potential of combining ^{129}I, ^{236}U and ε_{Nd} to characterize the composition of polar surface waters at this region, and beyond.
- Increase the knowledge on the role of BSBW in the formation of deep Arctic waters.

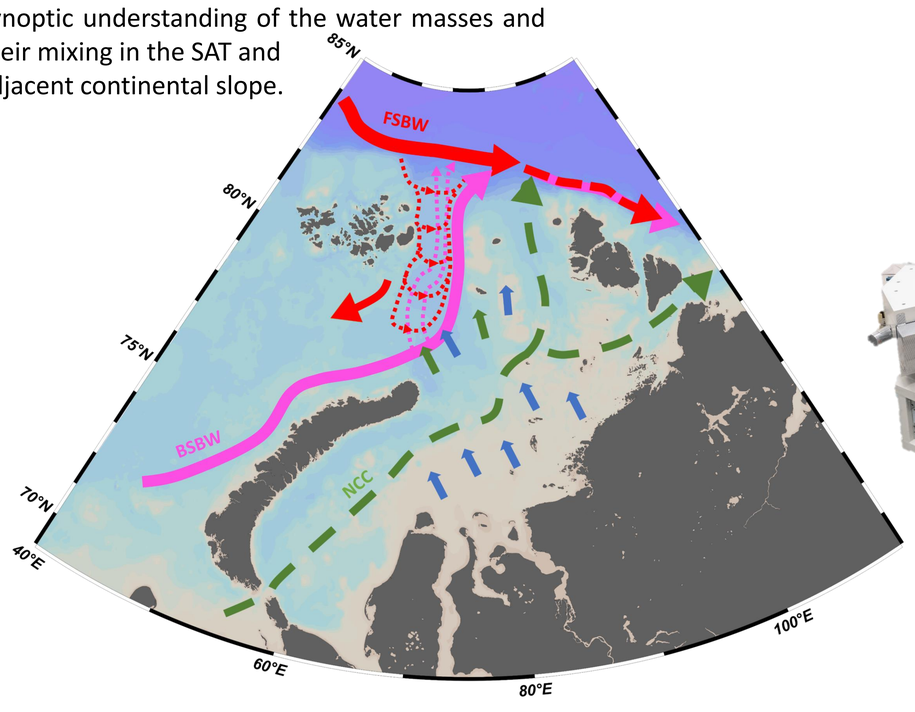
2. Methods

Samples were collected during the Arctic Century Expedition onboard the ice breaker Akademyk Tryoshnikov, from the 5/Aug to 6/Sept of 2021 (Figure 1b).



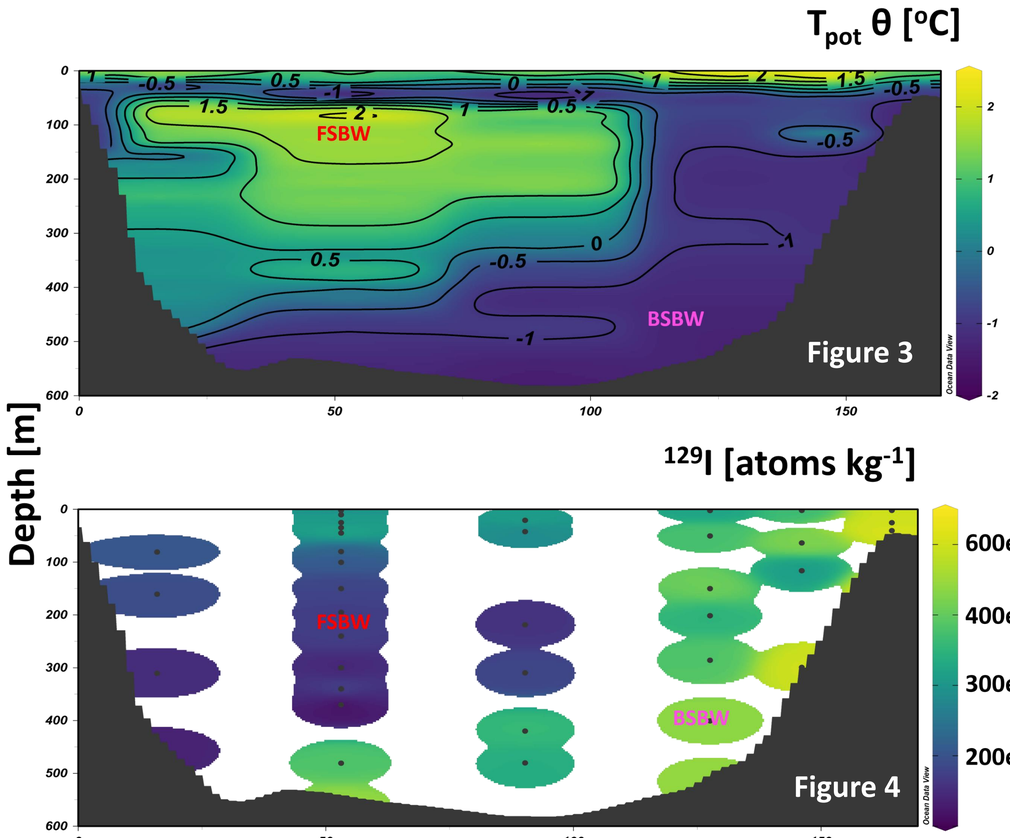
Work in progress…

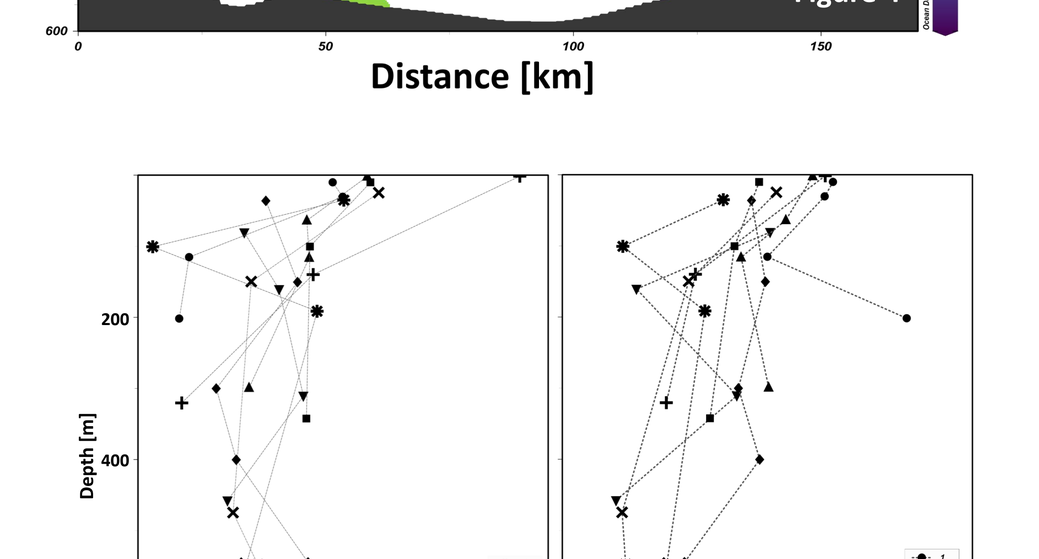
- Analysis of ^{236}U and εNd – will allow to better discriminate the different sources of water to the SAT, especially to the surface layers.
- We expect that εNd will keep the signature of the Atlantic waters as in the Barents Sea [3]. However, subtle differences will provide information on riverine or glacial inputs.
- ^{129}I and ^{236}U will allow to estimate transit times and to corroborate our input functions to the Arctic.
- Synoptic understanding of the water masses and their mixing in the SAT and adjacent continental slope.

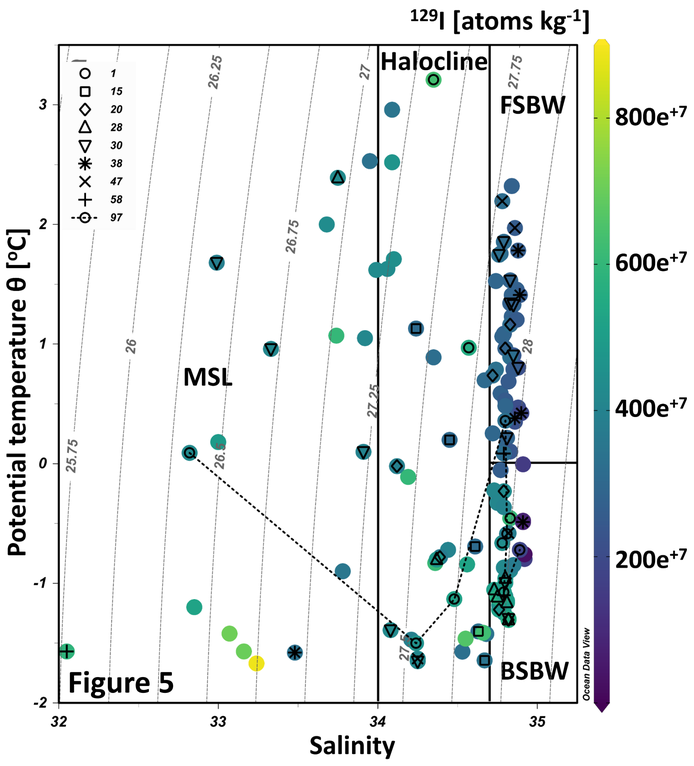


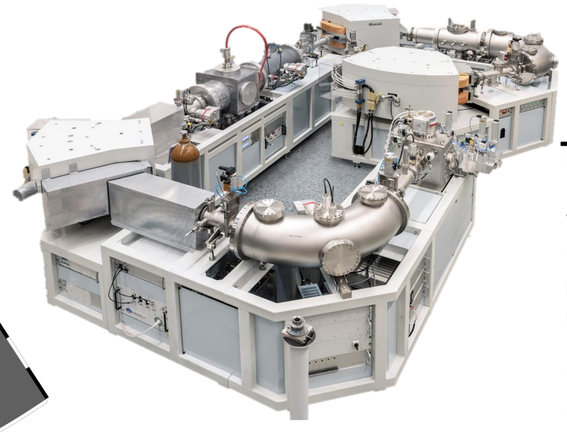
3. Results

- Intrusion FSBW in western and reaching southern SAT (Figure 3&4).
- Northward flow of BSBW below FSBW and dominating eastern flank of SAT (Figure 3&4) .
- Increased surface ^{129}I, [Nd] and temp. suggest riverine/coastal source (Figure 5) .
- REE concentrations and ratios confirm that the Arctic margin is not a source of dissolved REE (Figure 6).









The MILEA facility at ETH

The **M**ulti **I**sotope **L**ow **E**nergy **A**MS facility at ETH-Zurich is one of the 6 AMS systems available at the Laboratory of Ion Beam Physics. We collaborate with numerous national and international partners from different fields of research, including marine science, geology, forensic science and archaeology.

We are active part of numerous projects including MetroPOEM an European consortium focused on the harmonization of the mass-spectrometry techniques to measure radioactive pollutants in the environment.

[1] Osadchiev A, et. al. (2022) Structure and Circulation of Atlantic Water Masses in the St. Anna Trough in the Kara Sea. *Front. Mar. Sci.*
[2] Casacuberta, N., et al. (2018). Tracing the three Atlantic branches entering the Arctic Ocean with 129I and 236U. JGR: Oceans
[3] Laukert et al. (2019)Water mass transformation in the Barents Sea inferred from radiogenic neodymium isotopes, rare earth elements and stable oxygen isotopes. Chem. Geol

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