

Manuscript: Circulation timescales of Atlantic Water in the Arctic Ocean determined from anthropogenic radionuclides

**Response to editor comment on revised version of the manuscript:**

Dear Editor,

Thank you for your comments and suggestions.

We have incorporated your comments into the revised version. Please see point-by-point responses below.

On behalf of all co-authors,

Anne-Marie Wefing

Both reviewers were overall positive about the submitted manuscript (many thanks to both for their constructive comments), with reviewer 1 suggesting only minor revisions, but reviewer 2 suggested a major revision including updating the structure to improve the clarity of the manuscript. I thank the authors for engaging well with the reviews. However, given the major changes, I would like to ask the reviewer(s) to take another look at the revised manuscript. But before that, I have a few minor issues that I would like to ask the authors to resolve. For the tracked-changes version, please could you continue working from the current tracked-changes document, so that all changes since the original submission are shown.

The tracked-changes document contains all changes made since the original submission of the manuscript.

The abstract should essentially follow the structure of the paper in a shortened format – the revised version lacks any introduction / context / motivation at the start, instead starting directly with the methods. Please update to add a couple of introductory sentences.

We added the following two sentences in the beginning of the abstract:

“The Arctic Ocean is changing rapidly and Atlantic Water circulation plays a key role in the warming, sea-ice decline, and ecosystem changes observed in the Arctic. Still, we only have limited understanding of the pathways and circulation times of Atlantic Water in the Arctic Ocean and how they evolve over time.”

Reviewer 2 was concerned about the lack of a clear motivation or research question. Within the introduction, the revised section 1.1 is where this is addressed. In my view, there is still not a clear research question here. The section mentions a few relevant ideas, but the reader still has to join the dots and guess exactly what the question might

be. I suggest the authors try to make the question and motivation more explicit here (or elsewhere within the introduction), and to more clearly connect these points together, before I send this back out to review.

We changed the last paragraph of section 1.3 to the following to clarify the research objectives of this study:

“This study aims to assess the circulation pathways and timescales of Atlantic Water in the central Arctic Ocean in 2021, with particular focus on the Lincoln Sea north of Greenland - a strategic location where waters from the Eurasian and Amerasian Basin converge before exiting the Arctic through the Nares or Fram Strait. By combining new I129 and U236U data collected in 2021 with historical data from similar locations, we constrain transport times and mixing processes of Atlantic-derived waters, characterize the composition of surface waters with particular emphasis on the extent of Pacific Water, and evaluate temporal changes in circulation over the decade from 2011 to 2021. This study contributes to the understanding of how changes in the Atlantic Waters entering the Arctic Ocean affect the Arctic system and how these waters mix with Pacific-origin waters in the upper water column.”

Another major concern of reviewer 2 was that many parts that belonged in the methods or results sections were instead in the discussion. It looks like many of these issues have been fixed in the revised manuscript. However, could the authors please double check on section 4.3 – all except the final paragraph might be more results than discussion.

We have moved parts of section 4.3 to the results, to a new section with the title “Temporal Changes in <sup>129</sup>I Concentration in PSW” (section 3.3). We have split former Fig. 10 into a new Fig. 6 (in section 3.3) and a new Fig. 11 (in section 4.3).

Please could the authors check carefully how dates are referred to throughout, to make sure they are clear. For example, in lines 72-74, does ‘over the past 16 years’ refer to 2009-2025, or rather to 2005-2021 (as the study period was 1991-2021)? In line 561, was the decrease in the strength of the boundary current observed from the mid-1990s to 2015 or were the tracer studies written from the mid-1990s to 2015?

Line 74: “over the past 16 years” changed to “between 2005 and 2021”

Line 561: changed to “A decrease in the strength of the boundary current between the mid-1990s and 2015 has been observed in tracer studies”

Please refer to the tracked-changes manuscript for further changes of dates to be more precise.

Line 623 “To this aim” does not make sense; should be e.g. “To this end” or “To achieve

this aim". And especially in the surrounding paragraph (lines 615-624), but also throughout, please check capitalisation (e.g., carbon and argon should not have capital first letters).

Lines 623: changed to "To this end"

Capitalization has been checked and corrected throughout the manuscript.