

## Reviewer 2

Review of the manuscript: "A dataset for investigating socio-ecological changes in Arctic Fjords."

This work manuscript presents the compilation of various data from Arctic Fjords, to investigate the socio-ecological changes in 7 Arctic Fjords. The manuscript is very clear and well written, the dataset is well presented and useful for several type of studies. However, this dataset is just a compilation of datasets already available in several databases, although I think that much more data are available but maybe not publicly. I suggest publishing it after major revisions. Please find my comments beneath.

We thank the reviewer for taking the time to provide a considered and detailed review of both the manuscript and the dataset it documents. All comments have been considered at length and acted upon accordingly. Specific comments have been addressed below and changes to the manuscript have been made. While the dataset itself is already published on PANGAEA, all of the reviewers comments w.r.t. data have been documented and will be implemented in v2.0 of the dataset, which will be submitted for publication early next year. That being said, a live version of the dataset will be directly benefiting from your comments, and is available via a user interface that may be accessed via the [WP1 website](#) by clicking the 'Data access' tab.

Main comment:

My main comment is about the added value of this dataset. I understand that this is a compilation of already publicly available datasets. Although of interest for some studies I think such a compilation of data should aim for more than 7 fjords in the arctic, and rather try to compile all available data for Greenland and Svalbard fjords for example. A lot of data is available in a lot of fjords in Greenland, but maybe not easily available indeed. However, considering those data will add a lot of value to this dataset, that could be used to assess for example the impact of climate change on the Arctic Fjords.

We agree with the reviewer that many more sites and datasets for them could be added to this amalgamation of published data. We think the reviewer would agree that it is necessary to define a specific scope for the data collection, as there is simply too much data for the wider Arctic to amalgamate. All of the fjords for Greenland and Svalbard is certainly an ideal target, but we argue that for the purpose of the investigation of socioecological changes, one must select sites with data for as many of the 14 key drivers as possible. We also posit that at some point there would be rapidly diminishing returns on the effort put into the amalgamation. For example, while it would require months to be confident that all FAIR data were amalgamated for a given site, it would not

be particularly helpful to socioecological investigations to include sites which have primarily hydrographic data (e.g. Rijpfjorden), but are lacking data for most of the other categories (e.g. biological, social, etc.).

Even with this consideration, there are very few EU Arctic fjords with the full range of key drivers sampled. It was therefore established as another primary criterion that a range of fjords which might best represent the different stages of the changing Arctic climate be chosen. For example, Young Sound is not yet significantly affected by climate change, unlike Kongsfjorden and Isfjorden, which are rapidly borealising. Porsangerfjorden is now relatively ice free. Each of the seven chosen fjords has a reason why they were selected, and when taken together we think they cover a valid and interesting scientific range of investigations, while still remaining feasible for a small team of two people to manage. This is why we settled on these seven fjords and why we think this dataset should remain limited to them. We have added this more detailed explanation to the Intro section.

Minor comments:

How do the authors define the Arctic? Is it the Arctic circle? I am a bit surprised that a fjord in Northern Norway is included in the manuscript. Please clarify.

We thank the reviewer for pointing out this oversight in the manuscript. The range for the EU Arctic used here is taken from the [Copernicus definition](#), which closely matches the [AMAP definition](#) of the Arctic circle. This has now been stated explicitly in the Intro section.

L30: 'range of habitats for many important species': do you have any reference for that?

The references for the following sentence are meant to support the statement made in this sentence. We have reduced the strength of the statement, and combined the two sentences to more clearly cite the reference.

L34: Please delete 'extreme'

Agreed, replaced with 'polar'.

L37: This sentence argues that most of the sampling in the Arctic is performed by large cruise ships. I think it should be clarified here that you are talking about the coastal Arctic and I guess about surface data. In my knowledge, the central Arctic Ocean is mainly occupied by research ship so far, and most of the data come from autonomous platforms.

We thank the author for pointing out this inconsistency in the text. The use of the expression 'cruise ship' was an error. We meant to say 'research ship', and the text has been corrected accordingly. We have also updated the sentence to mention the use of autonomous platforms for data collection.

I.134: The manuscript explained the source of the data and the type of data, but for the ocean temperature for example, how are the data organized? Are they daily averaged or is it just a compilation of all available data in the fjord? For example, in Kongfjorden, several temperature datasets are available, moorings but also CTD from ships for example... Is that indicated in the dataset?

Thank you for highlighting the lack of clarity on this point. While it is mentioned in the caption of Figure 2 that the counts shown are for daily data points, it is not detailed explicitly in the text. We have therefore added two sentences to the end of Section 2.2 to make it clear that all data in this dataset are either daily, monthly, or annual. And that if data were available at a finer resolution, daily averages were created.

L.183: Did the author look at the arctic data center for more datasets? Is it on purpose that the fjords are only located on the Eurasian side of the Arctic. I could expect that quite a few data are also available in the Canadian Archipelago.

While none of the initial datasets required for this project, as detailed in the Intro section, were hosted on the Arctic Data Centre (ADC), this repository was identified and flagged as useful during the broader data amalgamation process. The ADC contains very few datasets within the 7 study sites outlined for this work with data that fall within the 14 drivers of interest, and of those that do (e.g. moorings) were already sourced via the sources detailed in Section 2.3. That being said, we will continue to monitor the datasets available on the ADC and ensure that during the creation of v2.0 of the dataset that all relevant data are included.

I.210: 'The first of these is the UNIS database': please add a reference

Added in text reference and citation:

Skogseth, R., Ellingsen, P., Berge, J., Cottier, F., Falk-Petersen, S., Ivanov, B., ... Vader, A. (2019). UNIS hydrographic database [Data set]. Norwegian Polar Institute. <https://doi.org/10.21334/unis-hydrography>

I.210: 'which is a collection of all the moorings': Is this database only composed of moorings? To my knowledge this database is also composed of repeated ship CTD transects.

The reviewer is correct, the database is composed of ship transects, in addition to mooring data. We have corrected the text accordingly. Specifically, the UNIS database aims to provide users with temperature+salinity profiles.

I.250: in the datasets, instead of correcting the already available data, I think it will be better to flag those data.

This is an important point, and one we discussed at length before submitting the manuscript. We agree that it is outside of the scope of a project like this to correct values in already published data however; it is anticipated that most users of this dataset will not consider any flags on the data, but will rather use the data 'as is'. Indeed, there are so many different types of data amalgamated together in this dataset that constructing a consistent unified flagging scheme would itself be a new project. Looking back over our records, it appears that in the end we did not perform any systematic corrections on any published data. Opting instead to not include the problematic datasets. The text has been corrected to make it clear to the reader that rather than flagging data, dubious data points or entire datasets are rather removed from the amalgamation.

I.299: How is a 4 km resolution ice cover representative of the sea ice cover in a fjord? Is this resolution good enough for the size of a fjord?

One may see the resolution of the 4 km ice cover product within the fjords via the pop-out windows in Figure 1. The use of these data within Young Sound, and perhaps Kongsfjorden, is dubious, but it is certainly high enough resolution for the other 5 study sites. It is however necessary to have a consistent product across all 7 sites, with as long of a time series as possible, which is why it was finally decided to use the ice cover product in question. A comparison was made to the 1 km product, which has a much shorter time series, and the values correlated very closely. In preference, therefore, of the longer time series, the 4 km product was chosen. The drawback of using this dataset is explicitly mentioned in the revised manuscript.

I.301: in addition to the sea ice cover, it will be of great interest to get the sea ice thickness. Combined with the sea ice cover, this will give an estimate of the sea ice volume, the real indicator of the sea ice loss in the Arctic. Does this dataset gather this information too?

We agree with the reviewer that the knowledge of sea ice thickness would be ideal, but to our knowledge no such product exists. We learned during the creation of this amalgamated dataset that there is no consistent *in situ* measuring of sea ice cover and/or thickness throughout the Arctic. The MASIE 4 km sea ice extent product is the longest running complete measurement of sea ice. It is unfortunate that it lacks a thickness data layer. The revised manuscript indicates this gap.

I.335: why is the unit of the nutrients  $\mu\text{mol/L}$ ?  $\mu\text{mol/kg}$  will be consistent with the units of TA and DIC.

The difference between the two is due to the necessity for the precision of the density of seawater when calculating various aspects of seawater carbonate chemistry. Because the salinity and temperature of seawater can have an effect on the calculation of TA etc., these values are generally given as  $\mu\text{mol/kg}$ . For nutrients however this is not the case. So the simpler to measure  $\mu\text{mol/l}$  is used. Also considering that most nutrient sampling is done in tandem with other biologically oriented water samples, which tend to be measured in units of litres, rather than kilograms.

It is also an issue that one needs temperature+salinity to convert from litres to kg, but one doesn't always have these values with biological data, so the conversion is not possible, even though that is the best practice. This explanation (and reference) has been added to the text.

Jiang L-Q, Pierrot D, Wanninkhof R, Feely RA, Tilbrook B, Alin S, Barbero L, Byrne RH, Carter BR, Dickson AG, Gattuso J-P, Greeley D, Hoppema M, Humphreys MP, Karstensen J, Lange N, Lauvset SK, Lewis ER, Olsen A, Pérez FF, Sabine C, Sharp JD, Tanhua T, Trull TW, Velo A, Allegra AJ, Barker P, Burger E, Cai W-J, Chen C-TA, Cross J, Garcia H, Hernandez-Ayon JM, Hu X, Kozyr A, Langdon C, Lee K, Salisbury J, Wang ZA and Xue L (2022) Best Practice Data Standards for Discrete Chemical Oceanographic Observations. Front. Mar. Sci. 8:705638. doi: 10.3389/fmars.2021.705638

I.337: I am surprised that there are no data for the biology drivers in Storfjorden. There has been several cruises in the region that collected biology drivers. How do you decide which data are merged in your dataset?

We agree with the reviewer that it is unfortunate that there is a lack of biology data for Storfjorden. We are aware that there are biological data being collected, but to our knowledge and at the time of this writing, these data are not publicly available on any of the data portals we use. Decision on what to merge in the dataset is first guided by the 14 key drivers of change in EU Arctic fjords, then by the data found at the primary data portals. Data that are not FAIR are not able to be merged into this dataset.

Table 3: what is Q?

Q is a measurement of flow rate ( $\text{m}^3 \text{s}^{-1}$ ). It is used primarily to measure river flow rates, but is also used for glacial runoff. I have made a note of this in the caption for table 3.

Figure 5: I am not sure about the interest of this figure. There is indeed correlation in between those variables, but this does not imply causality, and there is no explanation of the correlation between the variables in the manuscript.

We agree, this figure has been replaced with one showing an analysis that can more directly explain a causal relationship between two variables.

I.419: I don't really see the point of Section 5, as it just shows some correlations but does not explain them really.

We agree with the reviewer and have removed this section from the main body of the text. Due to the internal variability of this model forecast dataset for the FACE-IT consortium it was deemed desirable to use it in a publication. But considering that these data are not actually included within the data amalgamation being documented here, it is extraneous to the manuscript.

That being said, these results may be of interest to researchers working in these specific fjords, so this section has been moved to the supplementary. We have also included a short paragraph to the discussion that summarises these findings to the reader/user.