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# *Interactive comment on* "Geostrophic Currents in the northern Nordic Seas from a Combination of Multi-Mission Satellite Altimetry and Ocean Modeling" *by* Felix L. Müller et al.

**Anonymous Referee #1**

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## 1 General comments

The article describe a new dataset constructed using altimetry, along-track measurements with the outputs a high-resolution numerical model in the "northern Nordic Seas". Overall the article is clearly written and all the details concerning the processing is provided. Nevertheless I formulate 3 main comments regarding the present version of the manuscript:

1. The innovation: the manuscript would be enriched if the authors add a brief justification of the advantages of their new dataset with respect to results of numerical



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Discussion paper

simulations in the same area.

2. The dataset itself: while it is clear that the FESOM model is based on finite elements, having the different variables on such an unstructured grid may not be the easiest option for most of the users.

3. The notations: starting from the schema (Figure 3), the way the different variables are defined make the developments difficult to follow.

Suggestions are provided in the specific comments. I believe that the overall quality and the readability would be improved if the authors can address these 3 points.

## 2 Specific comments

P1 L9: it is stated that the presented method differs from data assimilation because it substitutes altimetry data with the model output; however it is not clear in the manuscript what is the advantage over the dataset obtained with a pure assimilation approach.

P1 L14: the by altimetry obtained annual signal
→ the annual signal obtained by altimetry

P1 L17: and the temporal variability of the altimetry along-track derived DOT heights
→ specify the temporal resolution (1 day according to the netCDF)

P1 L21: what justifies the difference in the order of magnitude (0.004 vs 0.02 m/s) for the zonal and meridional components?

P2 L1: drifter location interpolated combined geostrophic velocity components
→ combined geostrophic velocity components interpolated onto the drifter locations

P2 L2: a general map with the main geographical features would help the readers unfamiliar with the region of interest.

P2 L18: by altimetry derived geostrophic ocean currents
→ geostrophic ocean currents derived by altimetry or altimetry-derived geostrophic ocean currents

P2 L29: CMEMS stands for "Copernicus Marine Environment Monitoring Service"

P2 L32: and underlying mathematical functions
→ mathematical formulations

P2 L31: information of the ocean dynamics
→ information on/about the ocean dynamics

P3 L2: about the FESOM model
→ indicate the version of the code and maybe a DOI referring to that version

P3 L25: the regional extent could be added on a map with the main features (see a previous comment)

P3 L33: there are other satellites available during that period, why not use them?

P4 L1: The data pre-processing from ERS-2 and Envisat observed ranges to derived DOT heights and follows the descriptions of Müller et al. (2019).
→ it seems a verb is missing

P4 L4: high resolved and with in-situ data combined
→ high resolution and combined with in-situ data

P4 L7-8: The manuscript refers to several of the altimetric variables (SSH, SLA, DOT, DWH, ADT, . . . ) and it would make the reading easier of the mathematical relationships between them was indicated.

P5 Figure 2: Figs 1 and 2 could be merged into a single one where the dots of Fig. 1

are overlayed on Fig. 2 with a common colorbar. Doing so, the comparison would be straightforward and the offset mentioned in the figure caption more obvious.

P5 L8-9: for traceability purpose, indicate the product number from the CMEMS catalog.

P5 L9: same comment concerning the meaning of CMEMS acronym.

P5 L17: must be corrected enabling
→ must be corrected in order to enable

P6 L30: define 'differential water height" (see previous comment concerning the different altimetric variables).

P7 Fig. 3: what is the relation between DOT and DWH?

The colors don't really improve the readability of the flow charts: it seems clear that the altimetric data and the FESOM simulations are the 2 inputs and that blue boxes represent combination (since they receive information from 2 other boxes).

The choice of having uppercase for the variables defined on the grid and lowercase for the along-track variables is maybe not necessary, since you write $coord_{obs}$ or $coords_{sim}$ before the variable name.

The variable names could conserve the same name (with uppercase) but then the spatial coordinates could be X, Y for the grid and x, y for the along-track measurements. Doing so, one avoids the use of $coord_{sim}$ and $coord_{obs}$.

P8 L8-16: for the determination of the number of modes that will be conserved, there is not a real justification. Instead of selecting 50 modes and then computing the resulting RMSE, another approach could be: select the minimal number of modes than ensure that the RMSE is below a given threshold. Figure 4 tends to show that the higher-order modes almost don't contribute to the variance.

P9 Eq. 2: similarly to other comments: the notations can be improved, for instance

avoiding using 3 subscripts ($pc_{comb_i}$). Why not something like $P_i(t)$ instead (for example)?

P9 L21: interpolated to observation coordinates
→ which interpolation method is used?

P10 Fig. 5: this figure could be discarded easily by adding the numbers (1-4) to Figure 3.

P11 L3: which prevents further smoothing effects
→ please explain shortly why the finite element method prevents this.

P11 L5: Comparison with external datasets
→ couldn't you consider a comparison with the altimetric measurements acquired by the satellites not used in this study?

P14 Figure 7: Please note the changed scale of the differences.
→ the changed range?

P15 L15: Whereas the obtained spatial resolution is given by FESOM, characterized by local refinements in ocean current active areas smaller than 1 km.
→ missing verb (or is part of the previous sentence, then should be separated by a comma).

P15 L16: Finite Element mesh
→ sometimes finite element is capitalised, sometimes not, please make uniform.

P17 L6: uncompressed FESOM geostrophic currents
→ define what is the "uncompressed currents".

P17 Data access: the URL relative to ERS-2 points to a news, not to the actual dataset.

p18 Appendix A: this appendix is rather short and could be included directly in the text, hence ensuring the continuity of the calculations.;

## 3 Comments on the data files

Adding the netCDF attributes *standard_name* for the coordinates (longitude, latitude and time) and for the variables. This does not require a full reprocessing but can be done using for instance the nco operator (http://nco.sourceforge.net/), in particular the ncatted command allows one to edit the attributes and can be called as:

```
ncatted -O -h -a standard_name,lon,o,c,longitude 1995_NEGO.nc
ncatted -O -h -a standard_name,lat,o,c,latitude 1995_NEGO.nc
...
```

Concerning the time variable:

The *long_name* is generally specified as "time" and the "units" should be indicate the days (or seconds) since a given date (following the recommendation from the CF conventions: http://cfconventions.org/Data/cf-conventions/cf-conventions-1.7/cf-conventions.html#time-coordinate).

A possible concern is related to the data format: the netCDF is fine and tools are available for reading in many languages, but the finite-element mesh may not be the easiest option for the users, as it may require a regridding. I would suggest to have a similar dataset but provided on a regular grid with a resolution similar to the unstructured grid, or an example (code) of how to go from the unstructured grid to a regular grid.

In the Pangaea preview, the map displays 2 markers labeled 1 and 2, but it is not clear what they are. If it is the spatial coverage, a "rectangle" would be more explicit.

Also in the Pangaea page, it seems the coverage is not exactly the same as in the netCDF for the longitudes:

**Pangaea:** South-bound Latitude: 72.000000 * West-bound Longitude: -29.000000 * North-bound Latitude: 82.000000 * East-bound Longitude: 29.000000

**netCDF:** South-bound Latitude: 72.000000 * West-bound Longitude: -29.803572 * North-bound Latitude: 82.000000 * East-bound Longitude: 29.99896

**Keywords:** the region is specified as "Arctic Ocean" while the article title mentions "the Nordic Seas".

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