

Response to Reviewer #2 on the submission: ***Intercomparison of data-driven and learning-based interpolations of along-track Nadir and wide-swath Swot altimetry observations***".

I thank the reviewer and the editor for their review of the paper. I tried to provide an answer to each comment.

The reviewers comments made by the reviewer appear in black and my comment/response is in red. Should you have any additional comment or question after this discussion and the reading of the new version, please let me know.

1 Response to reviewer #2

1.1 General comments

Most interesting result of the paper is related to evaluation efficiency of a new neural networks-based learning framework approach that was applied successfully earlier to the interpolation of SST data. It is shown that the proposed neural networks-based learning framework approach provides advantage against the standard AVISO OI technique and other data-driven interpolation technologies in filling data free regions. An ability of the neural networks-based learning framework to extend resolved scales up to 50 – 60 km is manifested in case of joint use of nadir and SWOT altimeters which is better than in case of OI application. Thus, paper results show prospects of a new interpolation methodology to improve quality of interpolated altimetry products after the launch of SWOT mission.

1.2 Suggestions and questions for authors

I have some general comments, which may be helpful for better presentation of the paper significance.

1. I think that it may be good to include some simple explanation of advantage of the neural networks-based learning framework application to make the paper reader-friendly for broader range of readers.

I added in the header of Section 3.3: "Neural networks-based learning methods becomes more and more popular over the last years in Oceanography and satellite data processing. They can embed complex modeling of the geophysical dynamics with large number of parameters and learn from large training datasets how to reconstruct a given target according to a cost function to minimize. After training, the model can be used on other similar input datasets. In particular, it can efficiently be applied to real-time events."

I also hope the references throughout the text might help the readers.

2. It is not clear from the text of the paper how OI technique was applied for interpolation of nadir altimeters and SWOT data. Does OI interpolated an anomaly field with properly evaluated covariance matrix?

The OI is here used as a black-box from the DUACS system, which directly works on the SSH (not its anomaly) with a sophisticated estimation of the covariance matrix, see also the references in the paper. I updated Section 2.4 accordingly

3. It is shown that different kind of the learning strategy should be applied depending on the energy of natural variability with respect to the observational noise. Is it possible to discuss how this fact should be taken into account in a practical algorithm?

To stick with a unique plus and play solution, we are currently working on this topic and an interesting idea would be to explicitly implement multi-scale NN directly with different operators accounting for the different resolution of the dynamical process. This should help to better reconstruct the fine scales whatever the dynamical regime of the region and the observational errors. We added this comment in the text.

4. Authors have a hope that the use of longer learning base will increase efficiency of the proposed methodology. However, do you need some kind assumption about stationarity of natural processes during the learning period?

Not especially. It is clear that stationary processes would make the learning process easier but with only one year of data available, it is still difficult for the NN to fit a dynamical process with large variability due to its geographic position. that is why we hope to better account for the spatio-temporal distribution of nadir+SWOT merged data over a longer dataset

5. I guess that it is possible to omit Appendix A and pictures from Appendix B because there is no not discussion of their differences

I would rather keep the two Appendices if possible because several references are made in the text, especially regarding Appendix B, to ease the comparison when no observation error is used in the interpolation

Some editorial comments:

1. It will be easier to compare graphs if to make the same marks on the left coordinate axe of Fig.5 a,b,. Also good to have the same marks on Fig. 6.

I think the marks on Fig.6 are consistent. Unfortunately, I do not have anymore the file to reproduce Fig.5 with same marks due to a lost of files on the cluster I am currently working on. I thus manually corrected some problems on this Figure (see your comment below) also pointed out by other reviewers, such as simplifications of the notations. It is not perfect but I guess it already improves the quality of both Figures and texts.

2. 5 right axe – does it percent or fraction?

I modified the right Y-axis so that it is consistent with %

3. It is not clear why the level of barplots for nadir data is different on Fig. 5 and 6?

You are right it is a mistake on Fig. 5 that uses 5-days accumulated along-track nadir and not 0-days. I made the modifications in the legend of Fig.5. The reason for the difference between the two graphs is also that Fig.6 uses methods with different accumulation strategies (0 for AnDA, 5 for GENN)

4. Color bars does not explained on Fig. 2 and 10.

I added units in the legend

5. Is it possible make clearly the difference between 20 –days and 80 -days validation periods that appears in the text?

To avoid any misunderstanding, I removed all the references to 80-days validation period along the text and replace by four 20-days validation period, as presented in Section 4.1

6. Is it possible to explain terms “supervised” and “unsupervised” on page 8 should?

Yes, I modified this section with the following sentence: “we have to preliminary define if the NN-based interpolator will be used under a supervised learning strategy, i.e. with gap-free SSH anomaly maps used as targets in the training phase, or under an unsupervised setting, with single observations used as targets for the reconstruction criterion. Overall, six possible configurations were tested and listed in Table 2: two supervised versions using either the gap-free maps (Supervised 1) or the pseudo-observations (Supervised 2) as input and the Unsupervised version with both input and target only made of the pseudo-observations. These three configurations are also tested when adding the DUACS OI product as a covariate for input data, because we think that this may give a prior information about how the anomaly field dx is distributed.”, and the corresponding Table 2

7. Page 11, discussion of Fig. 8,9. Where are “unnecessary artefacts”? What part of pictures reader needs to look at?

I clarify the sentence: "The latter clearly oversmooths the true field and also exhibits some unnecessary artefacts far from the direct vicinity of the along-track and/or wide-swath data on the SSH gradient thus explaining the noisy-related small scale energies on the spectra"

8. Page 14, 2-nd paragraph "and" repeated twice
Modification done
9. Fig's 14, 15 not discussed in the text of the paper
I added comments at the end of Section 4.3