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## ***Interactive comment on “Detailed temperature–salinity distribution in the Northeast Atlantic from ship and Argo vertical casts” by I. Bashmachnikov et al.***

### **Anonymous Referee #2**

Received and published: 11 September 2014

The Authors do gather data of 3 data sources and further refine existing mapping methods and append them with novel ideas to develop a climatological hydrographic map of the NE Atlantic. The manuscript is divided in briefly two parts, one describing the new climatology, the other the regional features of the North East Atlantic. This division makes it hard for the reader to follow trough the manuscript. The authors should put more emphasize on a continuous story, focusing more on either topic. In my opinion the manuscript would improve in readability if it describe the climatology in detail, with the results of regional features interspersed within the appropriate comparison paragraphs. Despite their promising results and valuable ideas, the current manuscript lacks in detailed description of the methods applied. Yet it is not possible to reproduce

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or follow the authors through their filtering and mapping procedures with the details provided.

Concerning the language: It would be preferable if the complete manuscript would be written in present, not varying between present and past. The use of climatic is a bit confusing, would it be more appropriate to use climatological? If possible, have a native speaker proof read the manuscript (this does not impact my scientific opinion of your work, which is very interesting!)

My comments and questions in detail:

Abstract: The two-parted abstract is confusing for the reader, while the first part is solely on the mapping, the second part is very regional. The Authors should try to focus the abstract on one of these topics. E.g. Focus on the data set and describe the climatology with a brief comparison of the regional features discussed, or focus on the regional features and describe the climatology more focused.

Introduction: The introduction does not fit to the abstract, while the abstract starts with the climatology, the introductions extensively deals with regional features.

p1474-17: more - more than what?

p1475-7 'was felt necessary' - please rephrase

Methods: The methods lack in necessary detail of the steps taken to compute the climatological fields, please be significant more precise!

p1479-4-7 'comparing' - you write you compare the profiles but give no information of how you compare them, please be precise.

p1479-7 'a part of the profile' how do you define 'part' is there a minimum or maximum length? data points? percentage of data points limit?

p1479-7 'spike' - since you talk about density inversions I assume you mean density spike? What about spikes in T & S that are density compensating?

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p1479-9 'deviates from the climatological mean profile for more than 5 standard deviations' - standard deviation of what data? Which climatology? How is this mean profile computed, derived? Why is 5 standard deviations used? Was this analysis used on isopycnals, if on isopycnals, how do you deal with the outcropping?

p1479-9 'top 100m and the MW layer' why are these layers excluded? Since they have significant larger data spread from the start, a 5 standard deviation filter should work here as well. - How is the MW layer defined here? Is the MW layer not filtered in your whole domain?

p1479-14: 'the attempt to correct' - please describe how you correct data!

p1479-17: 'eye-checked to make an expert decision' - please state the criteria for this procedure, why is it necessary? How many profiles were removed and why? Were all profiles visually controlled, since you state 54429 profiles in table 1, I doubt it is possible to visually inspect all of them.

p1479-22: 'polynomially': which order polynomial? Why not linear?

p1479-22: the blanking of bad parts of the profile and interpolating over the gaps: How do you deal the top or the bottom of a profile? And what do you do if the gaps are larger than 200m?

p1480-1" below 1900m: this is due to the Argo float diving depths. It would be worth adding the data source amount in figure 1 as a stacked plot. Thus the reader can easily access the distributions by source.

p1480-4 temperature data-points: since you do an isopycnal mapping further below, why do you, and how do you use temperature data with missing salinity data? Shouldn't be all T data with missing S data be blanked?

p1480-10 'were eliminated': How? please be significant more precise in your data handling. Further more it would be helpful to state the reason for this approach here. Why do you eliminate them and what is the benefit of this, how would the results be if

you do not eliminate them?

p1480-13: 'was excluded' why was this excluded, what is the reason for this and how is the area defined, which bathymetry used for this criterion?

p1480-15: 'Further experiments' - what kind of experiments? The reader does not know what you did here to come to your conclusion.

p1480-19-23: The sum of T & S deviations - compared to which climatology, deviations between the profile and what data? What does 'close to zero' mean, which threshold did you use? Why do you assume a random error, please discuss this hypothesis. What about systematical biases like: if one data source is more commonly used in one season while the other is year round etc? Since one data source is significantly biased towards historical data, might it be that you filter out correct data from a different oceanic state?

p1480-23: Iterative filtering: what is this and how did you do it ...

p1480-24: How was the degradation of the salinity sensor of PFLs determined? Please be precise about your data handling!

p1480-25: 'Further gridding' - why further? So far no gridding was described.

p1480-26-28: I don't understand the paragraph, neutral density was computed for each data point of a profile, but what kind of 'following' neutral density surfaces are used?

p1481-1 which ones were selected. using a maximum distance of 50m in the surface is quite large, if you plan on mapping 25m in the vertical.

p1481-3 'an additional filter' what kind of filter? how and on what data points was it used?

p1481-8 'parameters' which parameters?

p1481-10, please define all terms in formulas used. dl is not defined. is dz used in

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between all available isopycnals, or over a larger vertical range?

p1481-10-19: if you use varying  $dV$ , please show a map how this varies and justify the use of such an approach. Please discuss how your results would vary if this filter would not be applied, are your results biased by a locally strongly adjusted filtering?

p1482-1: Since it is crucial for your mapping, please define your e-folding scale  $R$  and discuss your reasons for using the  $R$  you do use.

p1482-3-10: please make sure all terms of your equations are defined. They are not yet, currently the reader has to assume some of your abbreviations and terms in the equations!

p1482-13: provide reference.

p1482-17 reference of formula?

p1482-21: 'stretched' how did you stretch the Gaussian weight function along isobaths? Schmidtke et al. use a bathymetry following algorithm, is the same applied here, how do you define the distance between data points over rough topography? Which topography is used?

p1482-22: 'automatically' - how? What does automatically mean in this context?

p1483-9:  $w$  (see below) - where below?

p1483-18-20: please give references for your values used.

p1483-22: 'Care has been taken' - how?

p1484-8: give reference!

p1484-29: How do you deal with coastal regions with less than 30 data points? Or near steep topography when less than 30 data points are available on a given isopycnal layer. - Same for the upper ocean, near outcropping of any given isopycnal, how is the outcropping region handled?

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p1485-1 How is your R defined? this is described below, please rewrite so the reader can follow easier through the manuscript.

p1485-19: why are R values a proxy for eddy radii? The definition of R in the paragraph above states that R is more a proxy for data density, especially in the vertical!

p1486-1st paragraph: why this extensive eddy size discussion?

p1486-17: 'our results': I cannot follow how and why this study to this point in the manuscript can conclude about eddy sizes.

p1486-24: 'twice' - twice the size of what?

p1486-27: '1900m layer ( $G > 27.96$ )' - what was used, an isobaric or isopycnal criterion? Since the neutral density surface is varying in depth over the size of your domain, these are not identical or close everywhere.

p1486-29ff see comment above. Further more are these increases of R done as a step function or linearly increased over increased rho (or depth, depending on what you did?!).

p1487-3 'smooth transition is assured' - how?

p1487-10 prior to the final reg-ridding on density surfaces if would be interesting / necessary to describe how you performed isopycnal mapping at the surface and at the bottom of a profile. – While e.g. Gouretski and Kolterman (2004) do an isobaric mapping of the top 100m layer and isopycnal mapping below, Schmidtko et al. (2013) do a separate mixed layer mapping and stitch that product to the interior. Since isopycnal mapping has its caveats at the top and bottom this part of the mapping should be described in detail! How do you deal with outcropping isopycnals at the top and the bottom of your mapped profile (data of any given isopycnal only to one side of your mapped location, due to e.g. seasonal variations in density, internal waves near steep topography etc.) ?

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p1487-7 please show the full depth sections. - this is especially crucial, to see how your R transition near 2000m does work and how you compensate the significant decrease in data, due to missing float data below.

p1488-7ff for the comparison with WOA13 and MIMOC it would be helpful to know which season of the given climatologies were used? Did you compute the annual average? How large would you expect the seasonal cycle in 600/1200m to be. Is there a seasonality in eddies, that could bias the results?

p1488-10: figures 7-9 should have identical regions for all panels or ordered differently. Further more a different color map for difference-maps would be helpful.

p1489-17: these differences, are they due to better mapping or mapping bias? Since this is a crucial point in your manuscript, please show a vertical mapped profiles of identical locations with WOA13, MIMOC and MEDTRANS and the complete unfiltered raw data within 30-50km as background (similar to your Fig. 9d with one panel each for each region and raw data included). Only such an approach can guarantee that your results are statistically significant and not biased due to applying a significant amount of filters based on eddy occurrences and topography!

p1489-28 geostrophic currents are computed for what season? which month, annual average? same with the AVISO data set, is this the annual average, which years of data? Since the hydrographic data set is composed of data since 1950 or even older, the AVISO data set is using a different period.

p1491-19: 30 or 50% how was this increase precisely determined.

p1491-24: a comparison to WOA and even MIMOC in the seasonality would be of significant interest, since both climatologies do put significant emphasize on the seasonal variations and the computation of those. What does you make to choose May-October for summer? Why only the computation of 2 seasons and not 4 like WOA? or 12 months like MIMOC?

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p1495-9-14, since you cover neither the polar nor equatorial regions, why is this necessary here?

p1495-15, Schmidtko et al do a zonal stretching only within 15° latitude of the equator, thus not in the area discussed in this manuscript.

Table1: please extend the table to indicate further more profiles with more than 75, 90, 99% of good data, to better detail the amount of data points that were removed by your data handling.

Figures:

F1d - how comes the increase in data at 2500m, did you stop mapping at 2500m?

F2 please use different color and possibly add contour lines to better see the differences. why is the colorbar extending to negative values and above 1? Please label axes.

F3a does show the obvious locations of regular hydrographic ship based sections due to sudden decrease of window size. Please discuss the bias introduced to this in the text.

F3c - please add uncertainty, like standard deviations to the lines. an additional panel showing window size over bathymetry depth would be interesting.

Fig4 this decorrelation scale plot is for which data point, which depth, which location? This is, if I understand the text correctly, computed individually for each grid point. Is this one of the best, or why was this chosen? please give spread of correlation scales in figure. - the bars of the histogram are not described in the figure caption, is a 2nd y-axis necessary?

Fig5a&b: please use different color map and possibly add contour lines of 100, 200, 300 and 400 km.

Fig6. why is the plot limited to 2000m, fig 1 indicates 2500m. Further more, please add

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a more detailed plot of the top 300m for both sections, since isopycnal mapping near the surface needs special handling. Why does the data pass through the topography?

Fig7 please reorder the panels to make a visual comparison easier.

F8, see F7

F9: see F7

F9b, this panel is very interesting and deserves an additional figure, with WOA profiles and raw data added. Please see my comment above in the text.

F10 - why is WOA09 used here, while all other figures use WOA13?

F11, 13 please plot only every 2nd, or 3rd arrow and increase arrow size for a better comparison. Further more please add reference arrows in all panels.

Missing figures: While the isobaric layer comparison of the climatologies was performed in detail, it would be necessary to compare at least one, if not 2 (meridional and zonal) sections and compute the differences. Further more a figure dealing with the comparison in a theta-S diagram, showing the difference in isopycnal and isobaric mapping, in particular for the region of significant eddy activity.

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Interactive comment on Ocean Sci. Discuss., 11, 1473, 2014.

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