We are most grateful for the very careful reviews and the many helpful comments by the two reviewers.

Interactive comment on "Near-ice Hydrographic Data from Seaglider Missions in the Western Greenland Sea in Summer 2014 and 2015" by Katrin Latarius et al.

Anonymous Referee #1
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SPECIFIC COMMENTS

L32 (P1): For consistency in the sentence that refers to figure 1, add "in West Spitsbergen Current (WSC)" after "along their eastern rim".

For consistency in the sentence and for a complete description of the flow along the eastern rim, we add the West Spitsbergen Current as well as the Norwegian Atlantic Current; the Norwegian Atlantic Current is also introduced in Figure 1!

New Text:

The Nordic Seas are shaped by a strong near-surface salinity contrast arising from the northward flow of saline Atlantic Water along their eastern rim in the Norwegian Atlantic Current (NwAC) and West Spitsbergen Current (WSC) and the southward flow of fresh Polar Water and sea ice along their western rim in the East Greenland Current (EGC) (Fig. 1).

Figure 1 caption: I suggest the acronym definitions get moved to the bottom of the figure caption, below the description of the red arrows. Additionally, L48 (P1): consider rewording this sentence. The gradient in the red arrows is what is indicative of the cooling, so this should be stated first. Suggested rewording: "The red to yellow arrows indicate the relative cooling of the warm, saline Atlantic Water as it flows through the Nordic Seas and Arctic Ocean."

Changes are made as suggested.

New text and Figure:

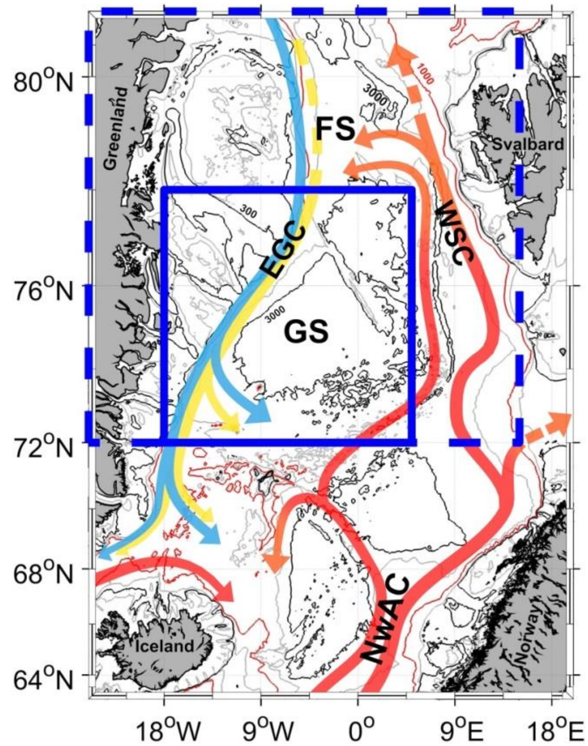


Figure 1: The map shows the Nordic Seas. Topographic contours are given on the basis of RTOPO2 (Schaffer et al., 2016): the 1000 m contour is marked in red, the 3000 m and 300 m contours in black, and the 2000 m, 500 m and 200 m contours in gray. The inlet marked by the full blue line shows the area of Fig. 2, the inlet marked by the dashed blue line shows the area of Fig. 3.
Red to yellow arrows indicate the cooling of the warm and saline Atlantic Water as it flows through the Nordic Seas and Arctic Ocean. The blue arrows indicate the flow of cold and fresh Polar Water through the Nordic Seas.
EGC – East Greenland Current, WSC – West Spitsbergen Current, NwAC – Norwegian Atlantic Current, FS – Fram Strait, GS – Greenland Sea, NT – Norske Trough.

L52-56 (P2-3): This paragraph should be more descriptive and/or reorganized. A few brief clarifying statements could help. The first sentence lacks temporal context (are the numbers listed a general average? Are the numbers listed percentages of total output over a year, during a specific season, or?). You then mention the temporal variability in freshwater transport in the EGC; how does this variability relate to the EGC's contribution to total freshwater output (the 50-75% you mention)? Additionally, variability in freshwater transport can be due to either variability in current speeds and/or variability in total volume fraction of freshwater to total seawater. Which (or both) is more influential here?
Rewritten.
We focus on the expected long-term development of Arctic outflow of freshwater with the EGC and only mentioned variability and measurement uncertainties. This paragraph is now more detailed than the rest of the Introduction. We think that describing variability and uncertainties in even more detail is beyond the scope of the manuscript.
New text:
Freshwater leaves the Arctic with the EGC in liquid form and as sea ice. For the liquid export de Steur et al. (2014) estimated 2100 km³/yr over the period 2000-2010. The Fram Strait export of freshwater in sea-ice, averaged over the winters 2003-2008, is estimated to have been 2100 km³/yr (Spreen et al., 2009). The annual average for 2000-2010 is 1900 km³/yr, when data gaps are filled using the average seasonal cycle (Hain et al., 2015). Haine et al. (2015) related these fluxes to other fluxes into and out of the Arctic as well as to the freshwater reservoir of the According to these considerations, liquid and sea ice fluxes with the EGC to the Nordic Seas account for almost 50 % of the total freshwater outflow from the Arctic for 2000 to 2010, with almost no changes in relation to the time span 1980 to 2000. Haine et al. (2015) expect an increase of the liquid outflow through Fram Strait by around 100 % for the next century, as at present the freshwater reservoir of the Arctic is increasing due to increasing river runoff and precipitation minus evaporation and due to ice melt. The sea ice outflow is expected to decrease due to the reduction of sea ice in the Arctic. This overall trend is anticipated to be superimposed by seasonal, interannual and decadal variability, mainly forced by variability in the wind-field (for a detailed discussion of wind-forced variability see Hain et al., 2015). Additional variability in the sea ice flux is introduced by the interplay of sea ice thickness, velocity and area (Smedsrud et al., 2011; Hansen et al., 2013; Spreen et al., 2009). Finally, large uncertainties are associated with this estimates, as the liquid freshwater flux, particularly the part close to the surface, as well as the different components of the sea ice flux are difficult to observe (Hansen et al., 2013; Spreen et al., 2009, de Steur et al., 2009; Hain et al. ,2015; and references included).

L140-142 (P5-6): The parenthetical description of "roll" does not help to clarify this sentence. "Turn to the left/right" could refer to roll or yaw. Either eliminate, or use the actual axis of rotation in your description.
We clarified the section about steering of the gliders. The terms 'pitch' and 'roll' are terms of the glider manuals (but not 'yaw'). Therefore, I would like to use them here also.
New text:

To control the roll of the instrument an additional weight is fixed axial asymmetric at the battery pack. As gliders behave like an "under-water sailplane", turning the battery to the right or left forces the glider to turn horizontally to the right or left accordingly.

Section 2.3 (P6): Table 1 is very thorough and contains a lot of good information. You should summarize more of the pertinent information in the text portion of this section. Consider moving the last paragraph of section 2.2 to section 2.3. Your first explanation of the reasoning behind the mission planning is too general (L146-147); include more specifics up front. L154: "but later concentrated on a southeast to northwest section" – why? Also, please explain the voltage-cutoff and unstable flight behavior during summer 2014 (glider 127). What were the causes? It appears these issues were resolved for the second deployment of glider 127 but this is not well explained.

We included more information about the motivation for the mission design and about the course of the missions.

We observed different flight behavior between gliders and also of glider 127 between summer 2014 and 2015, but the explanation of these differences is difficult. Glider 127 is our oldest glider and we refused to upgrade important components of it during refurbishment. Instead we trust in our knowledge about malfunctioning and how to deal with it. The stability of the flight in a certain mission also depends on a smooth transportation from the refurbishment to the mission and the nuances of success of ballasting and trim during an individual refurbishment. But the description of these things is beyond the scope of the paper.

New text:

During summers 2014 and 2015, Seaglider missions were carried out in the western GS. The goal was to capture the spreading of freshwater from the western rim into the inner Nordic Seas. For this goal we run the glider(s) along a section between the deep GS basin and the EGC. Repeating the section in 2015 allowed observation of the variability of the spreading both during the course of the individual summers as well as between the two summers.

In 2014, the measurements started with an east to west section. Because of the ice coverage in the early summer, the mission had to be changed later to a southeast to northwest section (Fig. 2) perpendicular to the isobaths. For comparability, the southeast to northwest section was carried out in 2015 too (from 75°N/2°W to 76°N/6°W in 2014 and to 76°30'N/7°20'W in 2015). Only the last section conducted with glider 127 in 2015 was displaced to the north to capture also the Norske Trough. Table 1 summarizes information about both missions.

Section 2.4 (P7): Your description of the differences in ice regimes between the two seasons is well detailed. What are the implications to the datasets in terms of their capabilities, comparability with each other and with other datasets, etc?

We added a few sentences to give a perspective, but we consider it is beyond the scope of this manuscript to analyze this in detail.

New text:

The glider missions in summer 2014 and summer 2015, give insight into the distributions of temperature and salinity in the upper part of the water column. In summer 2015, the distribution was also observed in regions, where the ice coverage just disappeared. The observations can be interpreted in relation to the different ice coverage (see section 4).

Figure 3 (P8-9): On P9 why is one of the glider tracks represented by a dotted line but this is not described in the figure caption?

This is the track of 558 at the end of the mission to the recovery position, where still measurements were taken. We added a description in the figure caption.

New text:

For each year, a sketch of the respective glider sections is added to the map (red lines and blue dots; the red dashed line in the bottom left map shows the track of glider 558 to the recovery position).

L228 (P10): Explain how the glider data are comparable to CTD data (in sample frequency,

resolution?).
We rewrote the beginning of the section.
Details about frequency and vertical resolution of the glider measurements compared to ship CTD measurements were given below in the list (now L298-315)
New text:
A glider measures temperature, conductivity and pressure while it is moving vertically and horizontally through the water. The relation between horizontal and vertical movement during our missions was 2:1 and an approximate localization of each measurement is possible with the start and end position of each dive. During the processing, the data were handled like ship-based CTD measurements consisting of temperature and conductivity reading related to ideally monotonously increasing pressure readings. Thus, the processing for these data basically follows the processing for ship-based CTD data.

L280-281 (P12): Describe your matchup criteria (spatial and temporal) quantitatively (what does "close" mean?). I see the spatial criteria is listed in B.7 but should be mentioned here (or B.7 referenced).
We did not implemented this comment, as we don't want to mix up the different sub-sections. The idea was to have first (3.2) the motivation for our effort, second (3.3) a preferably general description of the different steps of the data processing and last (3.4) specific details concerning the data sets processed here, concerning problems faced during the processing and decisions made to solve the problems.

B.4 (P15): Is the variable 'numrec' the same as 'NOBS[#]'? The latter is what is used in the dataset available on PANGEA. This final column in the published dataset has missing values for select entries (ie PS93_SG127_hydrography profile 348, 8dbar, Direction 1). What does this mean? How can there be < 1 obs used for a line entry, when all other fields are populated?
We changed the name to NOBS. I did not realize that the names were changed in the final data set at PANGAEA. An explanation for empty NOBS is added.
New text:
In the final data set the variable NOBS gives the number of observations from which 2 dbar-means were calculated. If NOBS is empty for a certain line of data, values for temperature, conductivity, salinity and density were interpolated.

B.5 (P16): The steps outlined here seem circular. Why not smooth conductivity? Do you have a reference for this method and can you describe why you chose the thresholds that you did? What is the mean difference between original and recomputed values?
This way of smoothing was motivated by the fact that we expect to have a stable stratification away from mixing zones.
New text:
Particularly there were small instabilities in the density stratification, which we considered not to be real.

L333-335 (P18): Why did you choose not to include quality flags in your dataset, especially since you chose to leave uncorrected spikes? It seems this should be indicated in the dataset for the user in some way, either as a header note or (preferably) quality flags.
Although quality flag standards are developed comparable to Argo standards within the EGO community (https://www.ego-network.org/), no standard data processing and quality control is established yet. Thus, setting flags would be subjective. The changes made in B.4 allow identification of interpolated values. Additionally, we incorporated an Annex with a list of the profiles with spikes in the thermo/halocline.
New Text:
In the final data set the variable NOBS gives the number of observations from which 2 dbar-means were calculated. If NOBS is empty for a certain line of data, values for temperature, conductivity, salinity and density were interpolated.

Annex:
List of individual profiles with spikes in the thermo/halocline.
For details see Section 3.4.3.

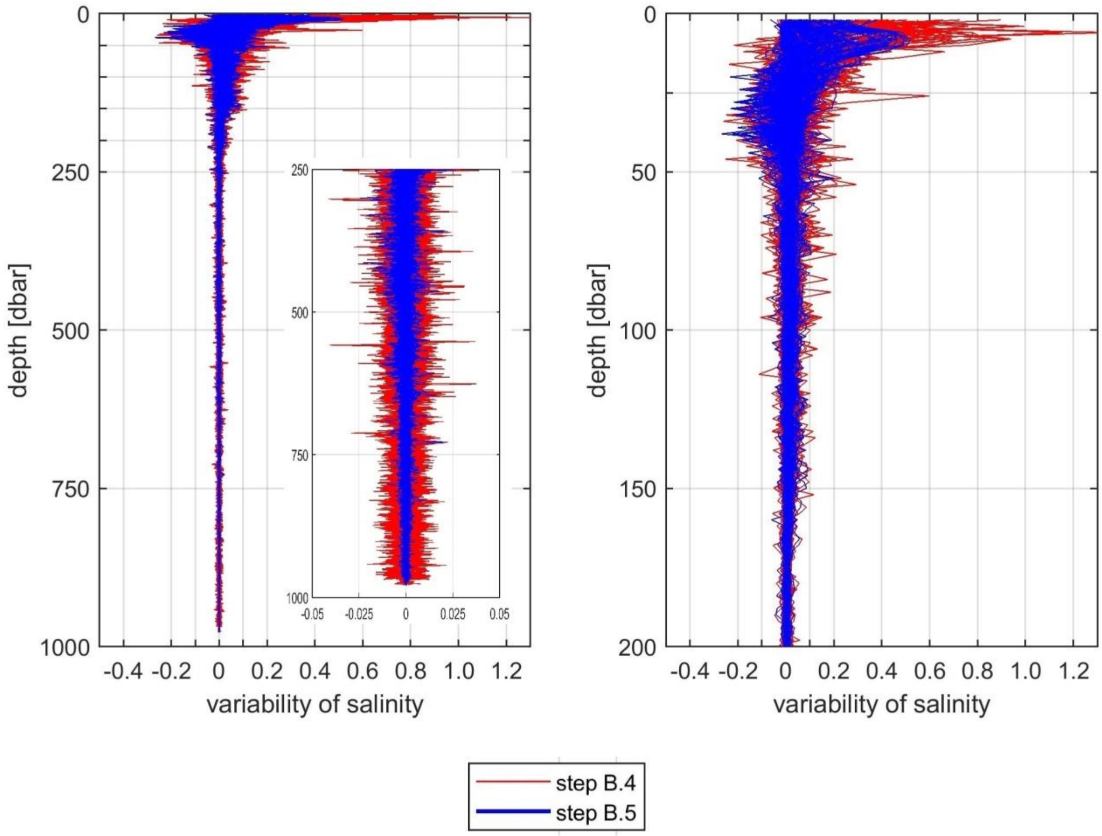
Glider 127 2014:
Dive no: 10-13, 17, 11, 24, 76, 82, 206-208, 212-214, 220-227, 229-231, 233-234

Glider 558 2014:
Dive-no: 1, 3-13, 15-25, 85-86, 91-93, 101-103, 110-112, 116-121, 125-127, 390

Glider 127 2015:
Dive-no: 2-7, 9-17, 19-32, 34-67, 75-77, 106-107, 109-115, 117-124, 167-226, 230, 233, 329-420.

The dive-no is named *observation number* in PANGAEA.

L395 (P21) and Figure 6: Your final statement of a reduction in salinity variability of 50% is too vague. It really only applies to Figure 6, glider 127, mission 2015 in the deep layer (which is difficult to see in the plot). Your plot should better exemplify this (zoom in on deep layer instead of surface?), and text should be more descriptive (is it an average reduction, and what is the std of the difference in variability?). Similarly, in table 4 'variability reduction of salinity' should better describe the where the numbers came from, I assume they are averages of the differences in variability at each depth interval? I see an average reduction of mean variability of between _8-10%, _30-60%, and _13-48% in the three layers, respectively, and across all missions.
We rewrote part of Section3.4.4.2 and added some comments and numbers in Table 4. We think it will not help to clarify this paragraph, if we additionally introduce the std of the variability. A new version of Figure 6 is included with extracts of 250 to 1000 dbar.
New text:
To quantify the noise reduction resulting from step B.5, where the criterion of stable density was applied, we calculated the variability of a profile before and after the step. The variability is defined here as the difference between consecutive values of salinity in a profile. Figure 6 shows the variability for all individual salinity profiles; again, glider 127 during the mission 2015 was used as an example. In the upper 80 dbar the noise reduction is of order 10 %, but between 45% and 63% below. The average reduction for the whole depth range is 22 % for glider 127 in 2014, 13 % for glider 558 in 2014 and 33 % for glider 127 in 2015.



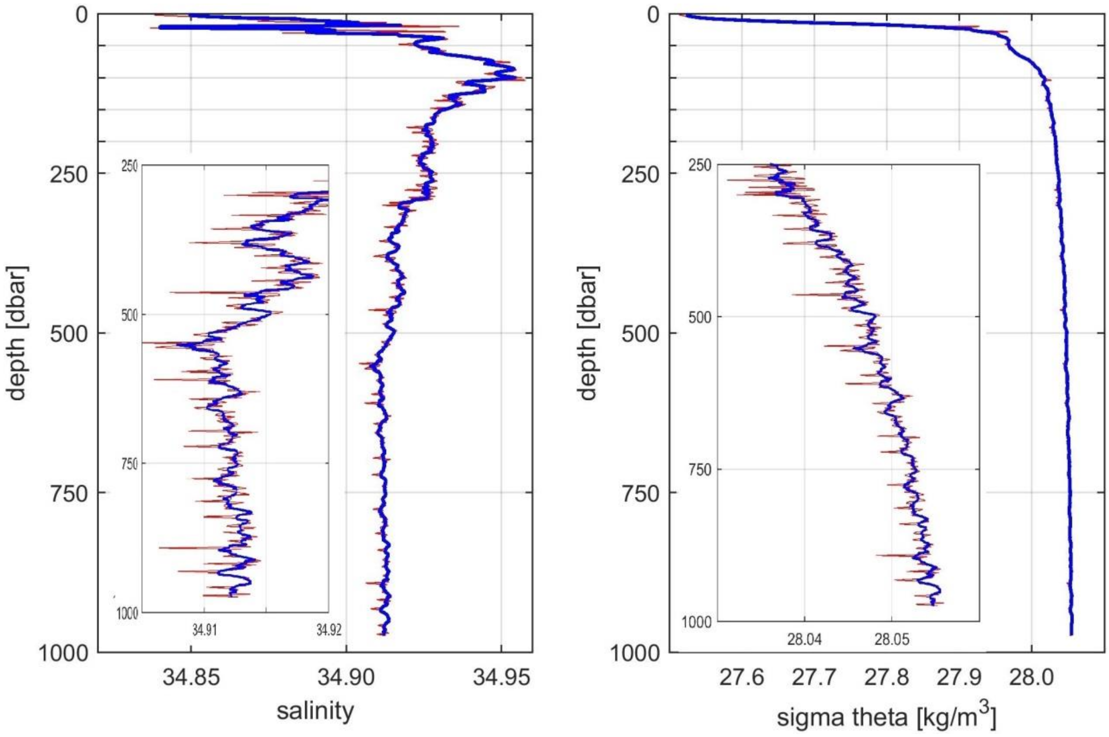


Figure 6: (Top) Variability for all individual salinity profiles before (red) and after (blue) smoothing of density, (left) for the total profile depth, (right) for the upper 200 dbar; again, glider 127, mission 2015 was used as an example. (Bottom) an individual salinity (left) and density (right) profile before (red) and after (blue) smoothing of density. Extracts of 250 to 1000 dbar are inserted.
New part of Table 4:

Average variability* of salinity in the surface layer, below, and in the whole depth range before step B.5 → after step B.5, and variability reduction in percentage. (step B.5, see Section 3.4.4.2) *variability is defined as the difference between consecutive values of salinity in a profile (see Section 3.4.4.2)	0-80 dbar 0.051 → 0.046 → 10 % 80-1000 dbar 0.0019 →0.0007 → 63 % 0-1000 dbar 0.0058 → 0.0045 → 22 %	0-80 bar 0.073→ 0.067 → 8 % 80-1000 dbar 0.0011 → 0.0006 → 45 % 0-1000 dbar 0.0069 → 0.0060 → 13%	0-80 dbar 0.028 → 0.025 → 11 % 80-1000 dbar 0.0025 → 0.0013 → 48 % 0-1000 dbar 0.0046 → 0.0031 → 33 %

L407-409 (P22): Great.

Table 4 (P24): Given the data quality and accuracies you outline in table 4, what are the limitations (are there any?) to use of the dataset, in terms of better understanding fluctuations/dynamics of changing freshwater fluxes in Nordic Seas?
Section 4: Interesting observations stemming from this dataset; the multi-year span provides great context for comparisons. This section lacks any concluding remarks.
At the end of section 4 conclusive remarks are added, which also relate to section 3.4.
New text:
The presented distributions of temperature and salinity, measured along sections from the inner GS to the EGC during summer 2014 and summer 2015, show signs of freshwater intrusions close to the surface. The development within a single summer as well as the interannual differences are demonstrated. The freshwater intrusions are not masked by the inaccuracies of the measurements, as we described in detail in Section 3, as the absolute difference between the Polar Surface Water and the Arctic Intermediate Waters is of order 4-6 K for

temperature and 2-4 for salinity. For further analyses, one has to take into account that in opposite to ship-based CTD sections, glider sections are never "quasi-synoptic". Thus, the combination of low time resolution and high spatial resolution provided by glider measurements must be considered, when deriving quantitative conclusions from the observed distributions.

TECHNICAL CORRECTIONS

L48 (P1): Improper use of semicolon. Remove the semicolon
Done

L55 (P3): Commas (or parentheses) needed after EGC and frozen: "EGC, both liquid and frozen, varies".
Done

L67 (P3): Poor sentence structure. Suggested correction: "However, it is also possible that liquid".
Done

L112-113 (P5): The sentence starting with "During winter" has poor structure.
Changed.

L122-123 (P5): Replace "his" with "its". "way of data sampling" is poor word choice.
Changed. "Its data sampling scheme" instead of "way of data sampling"

L133 (P5): Comma required after "If requested". "current" should be plural.
Done

L135 (P5): "lesser" should be "less". L184 (P7): Replace "have been" with "were". "Large part" should say "A large part".
Done

L194 (P8, Figure 3 caption): Poor sentence structure.
Rewritten.
New text:
Figure 3: The development of the ice cover in the western Greenland Sea during the time span of the glider missions in summer 2014 and summer 2015.
Left column for summer 2014, right column for summer 2015. Month and day of the individual ice concentration maps are given in the upper left corner. The maps are based on ice concentration data made available by DRIFT&NOISE (driftnoise.com). For each year, a sketch of the respective glider sections is added to the map (red lines and blue dots; the red dashed line in the bottom left map shows the track of glider 558 to the recovery position). Black contours give the 3000 m, 1000 m and 300 m depth contour based on RTOPO2 (Schaffer et al., 2016). The location of the map is shown as inlet in Fig. 1 with a blue dashed line.

L204 (P10): Only SN 127 is equipped with an oxygen sensor, per table 2. Either it is missing in the table for SN 558, or this line should be modified, ". . .conductivity, pressure, oxygen (SN127 only) and optical parameters. . ."
Done

L226 (P10): The Section 3.2 header is confusing and should be revised.
Changed to:
3.2 Glider data processing

L239 (P11): "byt" should be "by".
Done

L371-373 (P20): This sentence is poorly worded and should be revised.

Done

Figure 5 (P21): I think there are too many colors used in this figure. I suggest eliminating black (use red and green solid and dotted for the upper plots), or use red and blue only in both subplots (including dotted in the upper plots).
We would like to leave the line colors/styles in Figure 5 as it is, because using only red and green in the top figures doesn´t allow to separate the lines between down- and up-cast.
We choose different colors for the bottom figures to realize that not temperature and conductivity but a different quantity is shown there. We could replace red in the bottom figure by another color but red, green, blue and black are the most visible ones.

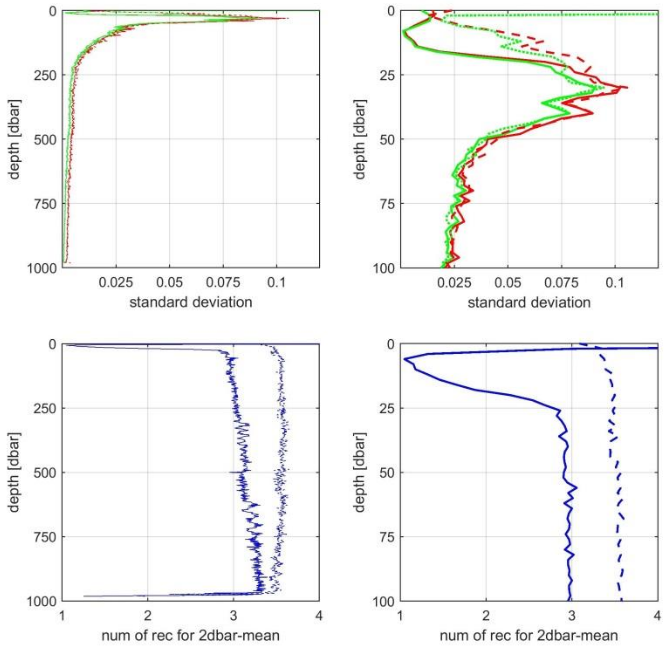


Table 4 (P24):

Please double check your references to processing steps in column 1. Many of them reference the wrong processing step (ie B.5 instead of B.7 in the last row).
Done, changed.