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Ocean Science
Discussions

Interactive comment on "Recirculation in the Fram Strait and transports of water in and north of the Fram Strait derived from CTD data" *by* M. Marnela et al.

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We thank the referees for their comments and advice. Below we address the points mentioned by them for needing improvements.

Referee #1:

General: Restructuring – Some of the material from section 3 will be placed in an appendix in order to produce a more compact paper. Sections 3 and 4 are reorganized to increase the fluency and logic of the paper. Some small changes will be made in section 5.

Major points:

- Fig. 3 will be worked on to improve the details and some of its panels will be removed.

- Some of the method section will be placed in an appendix.

- Some of the many tables will be moved to an appendix, changed to graphical form or removed.

Particular points:

- 3128-9 The sentence is changed to "Heat is lost to the atmosphere and the heat loss from the area between the sections averaged over the four years is about 10 TW. The net . . ."

- 3130-23 Fig. 3 will be referred to more often in the text. The 1997, 2001 and 2003 temperature and salinity sections will be removed.

- 3131-5 The material in sections 3 and 4 (and perhaps 2) will be reorganized and the tables will be renumbered. Fig. 3 will be split in two, with the zonal sections in the first figure and the velocity sections from the meridional sections in the other.

- 3132-6 "might be" will be replaced with "is".

- 3132-22 "surface" will be added before "meteorological fluxes". In the next sentence (3132-23) instead of "surface fluxes" it will read "surface net solar and thermal radiations, surface latent and sensible heat fluxes, precipitation and evaporation".

Section 3 Method: Most equations from 3.1, 3.2.1 and 3.2.2 will be reformulated and/or moved to an appendix.

Section 3.1 A figure of a velocity profile and the Jacobsen-Jensen extension will be added. The specific volume anomaly difference between stations decreases linearly toward the bottom of the deeper cast. Equation 2 calculates velocity, which is then modified in the next section. There is an error/typo in Equation 2, correcting it will

make the section more understandable.

Section 3.2 Equation 3 will be rewritten and Sw, Vd, Vm, Sm, θm and Vs will be replaced with zeros for clarity. No diagram will be added, but a reference to Fig. 3 will be added. The constraints are shown in Fig. 3 with yellow. The caption will be improved.

Section 4 Results: Table 3 will be removed and its content will be presented in an expanded version of Fig. 6. Table 4 will be removed. Most of the information in Table 4 is presented in Fig. 6, the heat and freshwater transports for each water mass will not be shown.

3142-4 "gotten warmer" is replaced with "become warmer"

3142-15,19-20,21 AW and dAW will be used instead of the full names after they have been defined.

3144-3-6 The correlation or lack of it between ADCP and geostrophy may or may not mean something important. Perhaps someone else will be able to make a connection.

3149-3 The unfinished sentence will be removed.

3149-22-25 The unclear part of the sentence will be removed. The sentence will read “Temporal variance this large is possible, as seen in the net volume flow from mooring data and also captured by the models (Fieg et al., 2010, Fig. 9).”

Section 5.1.2 will be combined with the two paragraphs before it as part of the restructuring required by both referees.

3151-18-21 The possible connection between the 1997 and 2002 pre-constraint transport imbalances and the time lag between the northern and 79° N section will not be discussed. All the transports through the northern section give similar results, 3.7 to 4.9 Sv, but across the 79° N section 1984 and 2004 give 1.4 and 1.5 Sv and 1997 and 2002 4.1 and 4.4 Sv so the different pre-constraint imbalances could be connected to the transport through the 79° N section. 2002 transport imbalances are discussed in

section 6, 1st paragraph.

Figures:

Fig. 3: The figure will be split in two, with the zonal sections in the first figure and the velocity sections from the meridional sections in the other. The meridional (1997, 2001 and 2003) temperature and salinity sections will be removed. The figures will be referred to more often in the text. The key-colors used to reference each section to maps in Figs. 2 and 4 will be explained in the caption. The small schematic for meridional sections will be better explained in the caption. The station spacings will not be added to Fig. 3, they would make the figure less clear and would not add much since the individual stations are already shown on the maps (currently Figs. 2 and 4). The minus signs will be removed from the pressure axis labels.

Fig. 5: The assumption is correct. “Northern section” is added vertically to the left of the upper three panels and “79°N section” vertically to the left of the three lower panels to clarify this.

Fig. 6: The results from the northern and 79° N sections will be presented in separate panels. The circles will be arranged so that the smallest circle is on top if they still overlap. Convergence and divergence will be added. A mask with the water masses defined will be added.

Fig. 7: Yes. This information will be added to the caption.

Referee #2:

General: Special attention will be given especially to the parts that have been mentioned as not easily understandable by either referee #1 or #2. Sections 3 and 4 are reorganized to increase the fluency and logic of the paper. Some small changes will be made in section 5.

1. Table 3 will be removed and its content will be presented in an expanded version of Fig. 6. Table 4 will be removed. Most of the information in Table 4 is presented in Fig.

6, the heat and freshwater transports for each water mass will not be shown. Table 10 will be moved to an appendix.

2.- Accuracy limitations - An example will be provided on how much the results differ between those presented and those computed with the maximal salinity error. - The visual estimation of the sea ice edge is used on p. 3147 r. 24. A reference to the data source will be added there. The ERA Interim ice information is used for determining the areas over which the meteorological fluxes are computed (table 8). The two are not used in conjunction nor is it claimed that they would be.

3. The way the constraints are presented both in text and in Fig. 3 will be clarified. A figure of a velocity profile and the Jacobsen-Jensen extension showing how the level of no motion is chosen for each station pair will be added. The sections include shallow shelves and slopes so choosing a constant level of no motion for the whole section would force it close to the surface instead of close to the bottom. The initial condition, although altered by the constraints (and hence not constant in the end anyway), does affect the results, so it is chosen to use the information about the flow direction available from the current mooring results to make the initial "guess" as good as possible. No schematic with boxes and arrows will be added, more references to Fig. 2 (map with stations) and Fig. 3 (sections with constraints) will be added if needed after the improved caption to Fig. 3 and reorganizing of sections 3 and 4. In equation (3) Sc, Vc, Vc, Sc, θc and Vc will be replaced with zeros for clarity. It will be added to the text that Lambda are Lagrangian multipliers (Lanczos). A reference will be added to Wunsch. The difference between the cast depth and bottom depth will be made clear throughout the manuscript e.g. by writing "at the bottom of the cast" instead of "at the bottom".

4. In Section 3.2.3 no diagram will be added, but a reference to Fig. 3 will be given. The constraints are shown in Fig. 3 with yellow. The caption will be improved. Fig. 3 will be split in two, with the zonal sections in the first figure and the velocity sections from the meridional sections in the other. The meridional sections will only show velocities and will therefore more naturally be presented later.

5. Northward flow will be made positive and southward flow negative throughout all the figures and tables. Tables 1, 2, 9 and 10 will be modified.

6. In Section 4.1.1 "averaged over the four east-west section pairs" is rephrased as "averaged over the four northern and four 79° N sections".

7. It is stated in the text that without having a mass balance the heat transports can't really be computed. Still these transports are often presented and the results shown here are computed using the reference temperature and salinities often used in literature for this area. An alternative way using varying reference salinities and temperatures is also presented. The reasoning is given in the text, Sect. 4.2.1, last par. The difference between having individual sections or a closed volume will be emphasized.

8. Section 4.2.2: the equations on 3146 will be slightly modified. This will also affect the texts. The captions to Tables 8a and 8b will be clarified and a reference to table 8b will be added besides the reference to table 8a.

9. Section 5.2.2: This is an arbitrary assumption, yet less daring than to assume a value different from zero. A value from literature is given for the transports on the Greenland shelf. An estimate for the transports on the Svalbard side of the section will be added. The width for the unsampled region will be provided, the region can also be seen on the map in Fig. 1. An estimate of the deformation radius will be given based on 2003 data.

10. The order of Tables 5 and 6 will be changed. "v=0 at the bottom" will be removed from current Table 6.

11. In Fig. 11 the colours will be modified and any colour used will be explained in the caption. Arrows will be added to the converging lines.

12. Fig. 3: The high and low salinity areas in the sections stand out well this way and the colour scale for salinity will not be changed. The velocity range is –61-+77 cm/s and the scales are kept same for all velocity sections for clarity. The velocity scale will

be modified to have a uniform color, red above 40cm/s and blue below –40cm/s. The results for 1984 and 2004 and again for 1997 and 2002 are similar and it is important to show all the sections so the reader has a possibility to see how similar or dissimilar the sections are. From the meridional sections only velocities will be presented. The schematic for meridional section velocities (currently Fig. 3, but the figure will be split in two) will be explained in detail in the caption. L=left and R=right and arrowheads mark the positions where the meridional part of the section starts / ends.

13. In Fig 5 "Northern section" is added vertically to the left of the upper three panels and "79°N section" vertically to the left of the three lower panels. A small a, b and c will be added to the corners of the three panels (top left) and caption will then read "...of volume (a) ... net heat (b) and freshwater (c)...".

14. Fig. 6 will be redrawn and expanded. The convergence and divergence dots will be added. The convergence and divergence are mentioned both on p. 3149, r. 16-17 and p. 3152, r. 24-28.

15. The typos found will be corrected. The incomplete sentence will be removed. "Also" on page 3149, r. 18 is removed. P. 3151, r. 2 also is moved from the beginning to "may also occur". P. 3151, r. 9 "Also" is kept in the beginning for clarity. We will do our best to improve the grammar.

Interactive comment on Ocean Sci. Discuss., 9, 3127, 2012.