

## ***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.***

### **Anonymous Referee #1**

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The authors present a thorough circulation and transport analysis of hydrographic section data collected in the Fram Strait, and present important new estimates of heat(temperature), salt and volume transports; identify and evaluate local recirculation; and offer the intriguing conclusion that if their calculated volume flux is correct then transports through the other gateways to the Arctic might need to be examined in further detail. The common analysis of multiple years of data also allows a better indication of variability, and the analysis of sources of errors is a really useful inclusion in the paper. On these grounds I think this paper should be published in Ocean Science. However I think the paper needs significant restructuring to ensure that it is readable. There is probably too much in the paper that is nice to include but not really

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required in the main narrative of the paper. If restructured a much sharper paper would be produced, without losing the comprehensive nature of the work.

#### **Major points:**

Too many figures (or at least one figure with too many pages!)... Figure 3 has too many panels with too little in the caption and the use of them in the paper is limited. I can see some value in the reader being able to view the sections but they do not really figure very highly in the text...Could these not be included as an annex, or provided in a linked data publication.

I do not quite understand why the method section is so detailed given that the paper is not developing a new method. The papers that are referred to for the method are not all in easily accessible journals, so that might be a good reason to keep it all in some form.

Why does the paper's narrative need so many tables? Might they be presented differently (in figs) to give the reader some help, or could some of them be removed?

#### **Particular points.**

3128 - 9 specifies 4 boxes, but as this is the abstract the reader has no real idea what this means.

3130 - 23 reference to Fig 3— a huge figure but not really referred to afterwards.

3131 - 5 refers to figure 4 but I think this fig would come better before fig 3 (however fig 3 needs significant changes)

3132 - 6 'where it might be as large as 0.005' – the use of 'might' seems strange why don't you know? is it varying on each cast? If you think the error is 0.005 then just state this as the number.

3132 - 22 'meteorological fluxes' – maybe specify these? surface heatflux, Precip - evap, Ekman too?

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### Section 3 Method:

I wonder whether more of this should be included in an annex to the paper, particularly as the paper is not really developing this as a new method but applying it. So I wonder whether Sections 3.1, 3.2.1 and 3.2.2 could be split with the main theory component in an annex leaving just the specifics of your application in the main text.

**Section 3.1** - Really useful to have the Jacobsen and Jensen (1926) details laid out (whether here or in an annex), I think at the end of the sentence on 3133 lines 10-12 you should add in the description of the basic assumption of JJ (I think this is a linear decrease in shear, to zero at the depth of the deepest cast, based on the idea of constant slope of specific volume anomaly within a bottom triangle?). Is equn 2 calculating velocity or shear? I would expect discussion of the geostrophic method to include reference to shear but in this section it is not mentioned. As equn2 is laying out the JJ method in specific anomaly terms for the bottom triangle it would be useful to include the calculation of  $v$  (or shear) in the same terms for the rest of the water column ( would it be something like  $\rightarrow v = \Delta\delta_i/Lf$  ?).

**Section 3.2** - I cannot give a detailed review of this method. But I found section 3.2.1 more difficult to follow than it should be. This section needs to be particularly clear and unambiguous as it sets up section 3.2.2. It should layout exactly what the constraints are – what do  $S_{cw}$ ,  $V_{cd}$ ,  $V_{cm}$ ,  $S_{cm}$ ,  $\theta_{cm}$ ,  $V_{cs}$  actually mean? The way the 6 constraint equations read at the moment (equn 3) looks like LHS = middle step = RHS so for constraint 2 (for example) does this mean that the depth independent volume transport in this part of the water column into the box =  $V_{cm} = 0$ ?. Can a simple diagram be used to illustrate to the box constraints.

### Section 4

There are a lot of tables in this section, if another way to present some of these results were possible then the paper as a whole would be more readable. Table 4 is particularly difficult to use in its present form, does this need to be in the main body of the paper?

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3142 - 4 'gotten' should be replaced with 'become'

3142 lines 15,19-20,21 the terms Atlantic water - AW and dense Atlantic water - dAW are defined and used before this point but here revert to full names, I would prefer them to keep consistent all the way through.

3144 - 3-6 Does the lack of correlation on the northern section with ADCP versus the good correlation on the 79N Section mean anything important?

**Section 4.2** is well written and clear (both 4.2.1 and 4.2.2)

### Section 5

Generally a good discussion appropriate to the paper findings.

3149 - 3 The sentence is unfinished

3149 - 22-25 Sentence needs clarification, I think it means that the model results cited have opposing flow to the moorings over the same period.

**Section 5.1.2** -this seems a bit short to be given a whole subsection?

**Section 5.2** - detailed discussion of the terms of error is a very good inclusion in the paper.

3151 18-21 Is it interesting that 1997 and 2002 have the lowest pre constraint imbalances but have sections taken more than 2 months apart?

**Section 6** Good clear summary and conclusion.

### Figures:

**Figure 3** - As discussed before this figure has too many panels over too many pages and does not do enough 'work' in the narrative of the paper. The caption is very short given the material in the figures, and does not explain the key-colours used to reference each of the sections to the map in fig 2 or fig 4. The small schematic of the layout of meridional box sections is useful but needs explanation. The small box section panels

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are collected by section while the zonal sections are collected by parameter. It would also be useful to be able to see the station spacing, perhaps the easiest way is with tick marks on the distance axis at 0 dbar. The pressure axis labels are negative numbers where they should be positive.

**Figure 5** - should specify which section is which in the caption or on the figures. I assume the upper panels are North and the lower panels are 79N.

**Figure 6** - On some panels the north nwd spot disappears behind all the other spots. Is there any way to show its position? Where it is invisible it might be the smallest spot so could be brought to the front without obscuring the other spots. Conv and div are in the legend and referred to in the caption but I can't see them on the figures.

**Figure 7** - the red arrows are, in places not in the same direction as the black arrows, I guess the ADCP is resolved onto a standard section normal, whilst the red arrows are normal to the individual station pair?

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