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Ocean Science Discussions

Interactive comment on "Combining in-situ measurements and altimetry to estimate volume, heat and salt transport variability through the Faroe Shetland Channel" *by* B. Berx et al.

Anonymous Referee #2

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General Comments:

This paper is very well written and an impressive effort to pin down the total transport through the Faroe Shetland Channel using hydrography, ADCP and altimeter. This is focused on the Atlantic water inflow to the Nordic Seas in both the Shetland branch and a recirculation of the Faroe branch. They combine all three types of measure to estimate a mean value for the period since 1995, and then they combine all three again (but principally ADCP and altimetry) to examine variability and determine whether there is a 15-20 year trend.

There is a lot of work here and in trying to cover all the bases I think they leaving a

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number of questions hanging particularly not fully justifying some of the assumptions or choices (particularly i: 5degC isotherm boundary, ii:core interpolation and iii:beta). I almost think the paper could work as a pair of papers a) mean transport & b) variability which could add a bit more detail on sensitivity to the choices that have been made for both. But it does work as one paper, if you can add a bit of extra detail.

I also worry that the two halves of the paper might be making slightly circular validations - Sections 3 and 4 use ADCP and altimetry to reference long term average geostrophic shear profiles while Section 5 creates a transport time-series from altimetry using ADCP data but then also adjusting the mean to match the long term average in Sections 3&4, the ADCP timeseries has a weaker dependence to the 2 other datasets, but uses the long term mean 5degC isotherm (from hydrography) and sets its end points using the AW altimeter corrected velocity. Essentially are there 3 independent transport estimates, or by using all three data sets in all three calculations have the degrees of freedom been reduced?

This is a very important topic and a very important set of measurements so the results will have important implications as they re-budget previous (their own) estimates of the total Atlantic inflow to the Arctic Mediterranean down from 8.5Sv to 7.0Sv. It is important that the results in this paper, following revision, are published.

Specific Comments

1. Introduction:

p155 line 10-11 I think there are others that could be referenced here Im thinking particularly of Schlitzholz&Jankowski 1998, you could reference them here but not essential. More importantly their estimates are not Table 5b... was there a reason? They are at the low end 1.0Sv and 1.8Sv. van Aken and Becker, 1996 may be another, again low at around 2Sv

2. Data and methods:

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This section is clear and well written. The availability of 99 hydrographic sections makes me wonder whether more could be done to look at variability in the geostrophic shear based transport estimates, but that may be for another study.

3. Observational Results:

3.1 Temperature and salinity

This is a very brief discussion of the T&S findings well written and concise, I agree you do not need too much detailed analysis of the hydrography for its own sake here.

p159 line 22 - p160 line5 suggests this data confirms findings in other papers /reports but are they are the same basic datasets in one form or another? So the confirmation is unsurprising?

p160 line 6 Here is where the reader might benefit from some more detail. There is weak justification for the choice of 5degC as the AW boundary. The fluxes could be very sensitive to this choice and it is different to the other investigations cited in Table 5b. Why didnt you go for isopycnal 27.8 or 550m or S=35? You have the data it should be fairly simple to test the sensitivity of the transports in Section 3&4 to this choice.

3.2 Atlantic water velocities from ADCP data

The AW velocity is calculated between 325m and 0m, and I can see the rationale for this, but looking at the ADCP ranges in Figure 3a this looks like significant chunk (10-30% ?) is based on extrapolation. I think this is ok the extrapolation is explained earlier but should be clear that this is the case in this section too.

3.3 Combining...

p162 lines 1-15 Can you clarify, is the average geostrphic profile calculated and then its upper 325m average matched to the AW. Or is every individual geostrphic shear profile matched to this velocity? Would it make any difference either way around? If it is the long term average geostrophic shear is that calculated for each set of data or

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do you use the average T&S fields? Would that make any difference? Maybe I have misunderstood but by referencing the geostrophic shear tothe AW velocity in the top 325m are you saying that the transport in this part of the water column is effectively set by the ADCPs.

p162 lines 15-25 I think the justification for the Core interpolation method is not explained in enough detail, why here and not on the Faroe side around X? The use of Core interpolation around E adds almost 0.5Sv about 20% to the AW inflow. For such a large effect I think more justification is needed.Later on I think this is folded into the uncertainty but is this potentially more like a bias.

4 Long-term average...

p163 line 1 'Once the interpolation scheme has been chosen...' should be more explicit that the Core method has been chosen.

There is a paragraph here on net volume transport, and water colder than 5deg C but not a summary para on AW only its heat and salt transports.

5 Temporal variations...

5.1 Transport variations ADCP data

p165 line 10 Explain in a little more detail why setting the edges as constant is necessary, and whether it has an effect on the results.

p 165 line 24 the period where X is used looks (in Fig 7) to have a lower transport than when B is used. Might that be important?

Overall Im not quite sure why the ADCP mean is so different to the ADCP referenced geostrophic shear mean. Have I misunderstood the strong control that the alt adj ADCP AW velocity has on the results in section 4?

5.2 Transport variations altimetry data.

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p 167 lines 18 to 24 How big an effect does choosing the higher beta have? I think this is another choice that is not justified strongly. The mean altimetry transport is set later so would any impact be felt primarily in the std of the altimeter calculated transport?

p168 lines 6-8 how big is the adjustment needed? Is this Q_0 in equ 4?

6.Discussion

The discussion is well written and uses the results as calculated well. But because the sensitivity to different choices is not really examined I think the paper misses valuable information out on how uncertain and how difficult it is to make robust transport estimates even when the area is data rich.My questions on this section almost all come back to those asked above so are not repeated. The long term mean 2.7Sv is much greater than the very recent estimate of Rossby and Flagg 1.5 Sv and a bit of discussion on the difference would be valuable. If the transports in this paper were of water above 27.8 would they also be lower?

p 173 line 24 -25 Why with 100 sections can't the temporal variation of 5degC be examined?

Tables:

Table 5b Schlitzholz&Jankowski 1998 and van Aken & Becker 1996 are not included in the list.

Schlichtholz, P., & Jankowski, A. 1993. Hydrological regime and water volume transport in the Faeroe Shetland Channel in summer of 1988 and 1989. Oceanologica Acta, 16, 11.

van Aken, H. M., & Becker, G. 1996.Hydrography and throughflow in the north eastern North Atlantic Ocean: the NANSEN project. Progress in Oceanography, 38, 297-346.

Table 7 column 5 units should be Sv /cm

Figures Figure 4 - colour scale makes it difficult to see the variations in T and S. I

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find a number of colour classes rather than a fully smoothed colour scale easier to understand. Could a density section be included.

Technical corrections

Table 7 column 5 units should be Sv /cm

Interactive comment on Ocean Sci. Discuss., 10, 153, 2013.