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Interactive comment on “Increasing transports of volume, heat, and salt towards the Arctic in the Faroe Current 1993–2013” by B. Hansen et al.

Anonymous Referee #2

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Overall Comments:

This study improves the estimates of the Faroe Current transports by using ADCP and hydrographic measurements in combination with satellite altimetry. A continuous time series of the fluxes is achieved for the entire 20-year period of altimetry (1993–2014), and upward trends are highlighted. This is useful for researchers working on various aspects of the climate of the Nordic Seas. But I feel the current manuscript still needs some improvement in the presentation which at places somewhat sloppy. I have a series of points to make, which I will list below

Major Comments:

1. To obtain the 20-year time series of volume/heat/salt, a vast number of methods

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are used. Although the methods are clear, the entire manuscript rely heavily on a technical report which seem to include all the important details. I suggest that these details (calculations, Figs, and tables) that are important to the paper to be included in a supplementary material. Continuously referring to the technical report does not cut it!

2. The authors are convinced that the decline in the subpolar gyre (SPG) strength is driving the observed 1993-2013 trends. The weakening of the SPG started after 1996 (e.g. Hatun et al. 2005, Fig. 2) , but figure 5 gives the impression that the trend was already underway, which I suspect is due to the 3 year running mean. Firstly, the annual means of Atlantic water temperature and salinity should be added to Fig. 5 (see comment 17). Secondly, I suggest adding a time series of the SPG index, either in the same or in a separate figure. Thirdly, a discussion on the decadal/natural variability of the SPG and its linkage to the Atlantic water in Faroe Current is strongly recommended; very little is said about this in the manuscript.

3. I do not see a motivation for why, in equation 1, adding a constant U_k^0 for each interval to make the anomalies absolute? What is the logic here? When using altimetry one would, from a dynamical point of view, add the mean dynamic topography (MDT) which already includes a set of measurements (geoid, MSS) and in-situ observations to obtain the absolute values. The authors should instead consider adding the MDT from AVISO and re-calculate the fluxes, or at least provide an analysis that the calculated absolute values are comparable to those of absolute dynamic height. If the relationship is poor, this also needs to be well motivated.

4. In table 4, only flux estimates by Berx et al. (2013) are compared. How about the estimates by Rossby and Flagg 2012 that show only a difference of 0.3 Sv between the IFR and FSC. It seems that the authors compare with only Berx et al. (2013) to make the point that the Faroe Current is much more important. The authors know the literature well and, therefore, advised adding other relevant studies that have made an attempt to estimate the fluxes into the Nordic Seas to table 4. Of course, I see the

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subsection in the discussion about this, but also there the authors do not provide any numbers.

Minor comments

5. It is highly recommended to simplify the sentences, which are quite lengthy at times.
6. Section 2.3: Although satellite altimetry is central, the authors do not give any details at all about the altimetric dataset used. This needs to be done, and the relevant papers should be cited.
7. Section 2.3, Page 1018, line 20: clarify which variable you are performing EOF analysis on.
8. Section 3.2.1, line 20-24: Why using two different definitions to get the AW time series? Please be consistent, either use the core of Atlantic water or the average between 100-150 for both temperature and salinity.
9. What confidence test is used throughout the paper? This needs to be mentioned!
10. Section 3.3.2, line 14: change “was below 10 % of the average” to “was 10 % below the average”
11. Section 3.4, line 25-28: The authors need to lighten up the reader why it is important to know the outflow temperature?
12. Section 4.1, Page 1031, line 8: Recommend to provide the estimates from the papers cited in line 6 (Rossby and Flagg, 2012 and Childers et al. 2014).
13. Section 4.1, Page 1031, line 9-10: What are the volume/heat/salt fluxes from these models?
14. Section 4.2, Page 1032, line 27: Suggest to add the paper by Skagseth and Mork, 2012: Heat Content in the Norwegian Sea, 1995-201 (ICES journal of Marine Science). Which discusses the increase in relative ocean heat content due to advection

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of warmer Atlantic water.

15. Section 4.2, Page 1033, line 8: No need for the AMOC abbreviation here.

16. Fig. 4: Suggest to add a realistic bottom topography, and change the color bar. Instead of a continuous color scale, assign one color to each contour.

17. Fig. 5: To be consistent with Figs 6-9, thin lines of the annually averaged Atlantic water temperature and salinity should be added.

18. Fig. 5: Recommend rephrasing the second sentence in the caption.

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