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Discussions**

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Interactive comment on "Observed and simulated estimates of the meridional overturning circulation at 26.5° N in the Atlantic" *by* J. Baehr et al.

J. Baehr et al.

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Thank you very much for your constructive review. We reply to each of the comments below.

GENERAL COMMENTS:
1) Terminology: My first general comment has to do with the terminology which is not clear. It is not clear where the eastern and western wedge transport fit in. Is there a distinction between the mid-ocean geostrophic transport and the mid-ocean transport and when does the mid-ocean transport include the wedge current and when not. To illustrate that these terms are not clearly defined nor used consistently, I'll give some examples from the paper.

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We now define:
mid-ocean transport = mid-ocean geostrophic transport + western boundary wedge transport.

For the observations, the mid-ocean geostrophic transport is based on the density profiles at the eastern and western boundary (no Mid Atlantic Ridge).

For the models, it is impossible to distinguish between mid-ocean geostrophic transport and the wedge transport (as the wedge is not resolved). We therefore only refer to the mid-ocean transport.

No eastern boundary wedge is considered.

- Page 1338 bottom and 1339 top: Here the authors seem to say that the geostrophic mid-ocean transport is that which is calculated from the density profiles through the thermal wind equation. The western wedge is calculated from current meters and not the geostrophic method so one would assume here it is not included in the midocean geostrophic transport. It is also dynamically not more geostrophic than the Florida current so more reason to think it is not included in the mid-ocean geostrophic transport. Is it included when the authors refer only to the mid-ocean transport or is mid-ocean transport just short for mid-ocean geostrophic transport?

Changed according to the definition described above.

- Page 1338, line 17-20 seem to reinforce that the wedge transport is not included in the mid-ocean geostrophic transport per se as it is mentioned separately and added here.

Changed according to the definition described above.

- Page 1344, line 8-20: Given the above and the fact that the transport from the density gradients is discussed here I assume that the mid-ocean transport does not include the wedge? Or does it because the geostrophic adjective is not used here before midocean? Also, it is stated that it is derived from the density field and nothing is said about the wedge transport. On the other hand it is compared to the full mid-ocean transport in the models. Perhaps the wedge transports are not important in terms of magnitude or variability but this is not clear to the reader. In fact, some idea of the magnitude and variability of both the eastern and western wedge transports should be included somewhere in paper. It should be clear when the wedge transports (either or both) are included and when not.

Changed according to the definition described above.

- Page 1345, lines 20-25: Again, what is meant with the geostrophic transport here? It is important because there is talk of small disagreement between this transport plus the Ekman and Florida current and the full MOC.

Changed according to the definition described above.

- I can go on and on. Please define all these terms clearly and use it consistently. I suggest that the authors define the mid-ocean transport (MOT) as the sum of the geostrophically calculated transport (GCT) and the wedge transport (WT) derived from current meters and then refer either to the MOT, GCT or WT as and when appropriate.

See above.

2) Calculation of Mid-Ocean transport: I have a few problems with this section.

- Page 1345, line 20: What is meant with 'certain depths'?

Changed to 'vertically'.

- Page 1345, line 20-25: The authors talk about the discrepancy between the mid-ocean transport + Ekman transport + FC and the MOC. Please define what is meant with the MOC. Is this the total net northward transport at a latitude integrated to a depth where this transport is a maximum? It seems here that sometimes MOC refers to the full depth dependent transport and sometimes to the maximum of the overturning streamfunction.

'MOC' now refers to the timeseries of the maximum MOC throughout the entire manuscript. Also, the following was extended in the introduction:

'The basin-wide mass transport is typically considered in form of the meridional overturning circulation (MOC), the zonally and vertically integrated meridional transport as a function of latitude and depth. MOC timeseries represent the northward transport at a certain latitude. Here, we use the term 'MOC' for a timeseries of the maximum northward transport, i.e., the northward transport integrated to a depth where this transport reaches a maximum.'

- What is the likely cause of the discrepancy mentioned in these lines based on? Is the difference due to the mid-atlantic ridge, the wedge transport, the assumption of a level of no mention, or unresolved time-variability, or mesoscale eddies? Some mention of the major error/s would be appropriate.

We included the following in the text:

'The differences between the two methods mostly indicate to what extend the mid-ocean transport can be estimated by the east-west density gradient (similar to what has been analysed by e.g. Hirschi et al, 2003; Baehr et al., 2004). Therefore, the

limitations of the dynamical method are those of a thermal wind calculation (level of no motion, bottom triangles, ...). Here, however, the focus is less on testing thermal wind, but identifying the appropriate method to compare modelled and observed MOC estimates.'

- In the definition of the dynamic method it is said that the full meridional transport is southwards at all depths. What full meridional transport is meant here? It cannot include the Ekman and Florida transport surely so why call it 'full'?

We use 'full meridional transpor't to include any (small) ageostrophic components. As this wording was apparently misleading, and the ageostrophic component small, we deleted the bracket.

- It is not surprising to me that this definition in which the depth is set to be where the velocity goes to zero does not give as accurate results as the kinematic definition. It's probably not so bad because it correspond approximately to the depth of the Florida current.

The results for the dynamic definition are not very much dependent on using the depth of the MOC maximum or where mid-ocean transports are close to zero.

3) Are the mooring over the mid-Atlantic ridge used at all in these estimates?

The Mid Atlantic Ridge moorings are not used in the estimates, and we clearly state this in section 2 now. Note that the Mid Atlantic Ridge morrings have little impact on the variability of the mid-ocean transport (Kanzow et al., 2007, Supporting Online Material).

SPECIFIC COMMENTS:
- Page 1336, line 15: What kind of forcing is included in the forward run? Is it run with

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the same surface forcing as the same month of the year before?

For 2005, we use the forcing for this period as provided by the re-analysis products.

- Page 1342, line 1-12: State at which moorings and/or longitudes the east-west differences are evaluated. Also in caption of Fig 2.

The description of the merged profiles is included in section 2.1 (for the observations), and 3.1 (for the models). In the figure caption it is noted that 'merged' profiles are used, since it would be too long for a figure caption to repeat the details.

- Page 1351, line 6: What is meant with density-driven component?

With density-driven component, we refer to the mid-ocean transport. We have included this in the text.

- Page 1351, line 23; Delete spurious question mark.

Deleted.

Interactive comment on Ocean Sci. Discuss., 6, 1333, 2009.

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