

R E V I E W
of the manuscript (OS-2012-82) entitled
“Observations of water masses and circulation in the Eurasian Basin of the Arctic Ocean from
the 1990s to the late 2000s” by B. Rudels et al.

The topic of the manuscript is very interesting and of high importance. The analysis is focused on the role of the Barents Sea branch of the Atlantic Water. The authors suggest that this branch contributes (at least) as much water into the Arctic Ocean as the Fram Strait branch. I disagree with this statement and find that the authors’ evidence for this claim is not sufficient. At the same time the manuscript has a lot of useful information, which (after reshaping the manuscript) may lead to a valuable contribution. Based on this, I recommended rejection, with possibility for resubmission of the revised manuscript. My comments are provided below. They are related to the major claim of the authors only (i.e. the dominant role of the Barents Sea branch).

Comments :

It looks like there are two possible approaches which can be used to define the relative contribution of the Barents Sea and Fram Strait branches. One is based on direct measurements of currents through the major gateways connecting the Arctic Ocean with the Nordic Seas. The second one is based on analysis of water parameters (e.g. temperature and salinity) in the Arctic Ocean basins. The authors utilized these both approaches in their manuscript.

Analysis of water transport through Fram Strait and the Barents Sea. This part of the manuscript is based on review of the existing literature. I found this part of the manuscript very confusing.

a. The authors refer to work of Nansen stating that even in his times Nansen already knew about the dominant role of the Barents Sea branch. This kind of statement poses a question of how critical is the authors’ evaluation of existing literature. I have no doubt that Nansen was the greatest polar explorer. However, how much information has he had at hand to cast such a conclusion? Even now, with an extensive suite of modern observations, we debate this topic. That is why I question this reference: it looks like the use of the name of the great polar man for the sake of discussion.

b. Nearby the reference to Nansen, there is a reference to the book by Nikiforov and Shpaikher 1980 with a statement that the Russian researchers largely supported the notion that the two branches were of comparable magnitude. I had sent a request for clarification to my colleagues from the Arctic and Antarctic Research Institute (AARI) and here is what I got from the AARI:

“In the book, Nikiforov uses results of Moretsky’s calculations for water transport through Nordkap-Bear Island, particularly mean estimate of 50 thousand km³/year (page 95) [10 thousand km³/year = 0.317 Sv, Reviewer comment]. But he remarks that Timofeev had a different estimate of 70 thousand km³/year. In Figure 26 (page 93) transport of Atlantic water into the Barents Sea is given as 50 thousand km³/year, and the one through Fram Strait is 115 thousand km³/year. Thus, there is no statement in the book that the inflow of Atlantic water through the Barents Sea is close to that through Fram Strait. ... Just the opposite, according to the estimates presented in the book, the inflow of Atlantic water through Nordkap-Bear Island section is two times weaker than through Fram Strait.”

Again, I would like to stress the important point that these estimates should be viewed critically. For example, why do these and other early estimates differ so significantly from the modern estimates presented in papers by Dr. Schauer with her colleagues (2004 and 2008)? Is the cause of such a difference hidden in strong natural variability? Or is this because the early estimates were mostly based on dynamical method, which does not take into account the barotropic component of the Fram Strait inflow (the dominant component, according to Dr. Schauer et al.’s works)? In the synthesis study like this under review this discrepancy should be explored in depth.

c. Discussion of modern estimates needs clarification either. The authors state that transport of Atlantic Water through Fram Strait is estimated by Schauer et al. (2004, 2008), Rudels et al. (2008) and Schauer and Beszczynska-Moeller (2012) as 3-5 Sv. From Schauer et al. (2004) I find 9-10 Sv and from Schauer et al. (2008, Section 3.3.3) I find 12 Sv for the Atlantic Water inflow. Page 14 of the manuscript under review states that the inflow is 2-4 Sv. I would like to see consistent analysis and critical evaluation of these numbers.

Analysis of water temperature and salinity. This part of the manuscript deals with modern CTD ship-based observations. I also have a lot of questions/comments to this part of the authors' analysis. Here I formulate just a few critical comments.

a. For this part of the analysis I would like to see clearly defined regional criteria used to separate the two branches.

b. This analysis is far from being complete. I would like to see volumetric analysis of water masses, which would (hopefully) show relative contribution of these two branches to the water mass census.

c. I would also like to see a comment why Atlantic Water temperature and salinity measured in the Amundsen Basin bear no sign of the seasonal signal, which should be strong in the Barents Sea branch if this basin is filled exclusively by the Barents Sea branch water, as the authors state.

d. It is of importance to present evaluation of sensitivity of the authors' estimates to errors, data gaps and limited amount of available data used in the analysis.