

R E V I E W

of the manuscript (os-2011-1) entitled
"Mixing, heat fluxes and heat content evolution of the Arctic Ocean mixed layer"
by A. Sirevaag, S. de la Rosa, I. Fer, M. Nicolaus, M. Tjernström, and M.G. McPhee.

I found this study very interesting, well written and organized. New measurements of heat fluxes in the upper mixed layer, through ice and in the upper atmosphere are of high value and demand. That is why I think that the manuscript should be published. I have several rather minor comments and suggestions, which are summarized below. Addressing these issues will not require tremendous efforts but would help the authors build a nice story. From the comments, my identity (Igor Polyakov) may be quite obvious.

Comments:

1. The abstract is well written.
2. The last paragraph of the Introduction stands out. May require better transition.
3. Line 139 states 2m whereas Figure 3b states 3.8m.
4. Line 146. Please remove space between 2 and %.
5. Line 161, please remove «)».
6. Line 195. Please define the value of v .
7. Line 232. I am not a native English speaker, but «aligned manually towards» does not sound as the best choice of words here.
8. Line 237. Are there any estimates of sensitivity of the authors' results to selected width of the window (15' window is mentioned).
9. Lines 310-311. The authors state «The temperature minimum» and put both T and S in the brackets. Rewording may help.
10. Lines 365-366. Please define the depth range for pycnocline. «over the 8m thick layer centered at D» is difficult to read.
11. Lines 383-385. This statement is true in the absence of advection which, according to the authors, play some role in their analyses.
12. Lines 394-395. In Fig. 10, please show depth ranges of both mixed layer and upper cold halocline.
13. Line 400. Please define the relation between FWC and latent heat content.
14. Line 408. Related to Q13 question: please define how it was defined that 1139 MJ/m^2 is due to both sensible and latent heat fluxes.
15. Lines 410-413. I would argue that this statement may not reflect the whole story. According to our study, ice melting/production and intensity of draining of freshwater from the Arctic Ocean in response to winds are the key contributors to the freshening/salinification of the upper Arctic Ocean. (Polyakov et al. 2008, JCLI). River runoff and E-P are too small to trigger changes of FWC in the central basin. These findings may be corroborated by Figure 1, which shows FWC anomalies based on 2007 observations. Red color indicates anomalies corresponding to salinification. I would argue that a plausible explanation for freshening found by the authors in the Amundsen Basin would be advection of fresh water from the Canadian Basin, not from the northern Laptev Sea (where 2007 estimates of FWC showed salinification).
16. Lines 413-414. According to analyses by Kwok, there was no significant trend of ice export through Fram Strait. See green line in Figure 2 as an example.
17. Eq. 7. H used for heat content is somewhat confusing since very often H is used for depth. I suggest Q instead.
18. Line 548. Why the authors chose 20m?
19. Lines 550-551: this sentence is difficult to read (probably because of too many «from»).

20. Figure 3. «Heading» sounds somewhat confusing.
21. Figure 4. These profiles look very smoothed, practically without any fine structure. Is it a result of averaging or the original profiles do not have fine structure?
22. Figure 6. Caption states that Figure 6b shows ϵ whereas color map is for $\log_{10}(\epsilon)$. I would like to see more comprehensive comparison of MSS and TIC measurements (i.e. at least means, correlation and standard deviations).
23. Figure 9. Please provide depth ranges for the mixed layer and pycnocline in the caption.
24. Figure 11. Why do the authors use normalized depth? For the bottom panel: do not you think that defining the change of heat content as the difference between two neighboring profiles would work better?

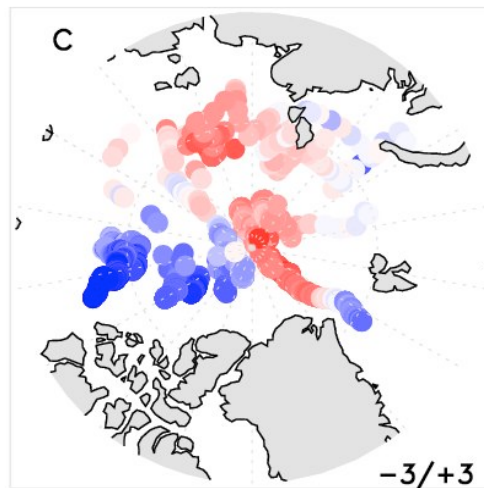


Figure 1. 2007 freshwater content (FWC, m) anomalies in the subsurface 25-75m layer of the Arctic Ocean. Colors indicate linear change of FWC anomalies between their maximum and minimum values, which are shown in the right bottom corner of the panel.

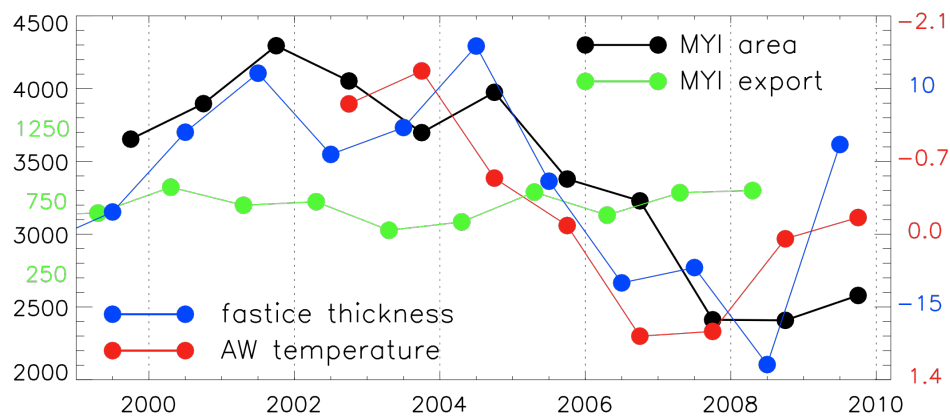


Figure 2. Arctic Ocean multiyear coverage and export (black and green, 10^3 km^2) and atmospheric (blue) and oceanic (red) thermodynamic forcing. Atmospheric forcing is expressed as average fast-ice thickness anomalies (cm) from six arctic stations flanking the Laptev Sea. The oceanic thermodynamic forcing is expressed as the composite time series of normalized intermediate Atlantic Water (AW) temperature anomalies ($^{\circ}\text{C}$, reverse vertical axis is used) obtained by averaging time series derived from four continental slope observational sites located at $\sim 30^{\circ}\text{E}$, 105°E , 125°E , and 142°E .