

Interactive comment on “On the permeability of barrier layers” by J. Mignot et al.

Anonymous Referee #1

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General comments

This manuscript presents a revised global ocean climatology of monthly mean barrier layer thickness. Barrier layers are important because they inhibit heat exchange between the sub-surface ocean and the atmosphere. The authors seek to improve their previous method to account for the uneven distribution of BLs that ultimately influences the impact of BLs on the permeability of ocean heat to the atmosphere. It is of a high scientific merit and therefore I recommend that it be accepted for publication after some revision/clarification of the text and structure of the paper and the inclusion of an initial figure demonstrating a barrier layer.

Specific comments

1. I wonder if the use of the phrase ‘the permeability of barrier layers’ is entirely accurate to what this revised climatology offers. Are the Barrier Layers ‘permeable’, or is

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it more accurate to say that it is the uneven distribution of Barrier Layers, or even the absence of Barrier Layers that increases the permeability of turbulent heat exchange between the atmosphere and the ocean. I would suggest using 'On the distribution of barrier layers'.

2. The Introduction would benefit from an initial figure showing a typical example of a barrier layer from vertical profiles of density, salinity and temperature.

3. It is explained why Barrier Layers are important (inhibiting heat exchange between the atmosphere and the subsurface ocean), but it would be interesting to know why they form relative to the standard ocean mixed layer structure. This is touched upon later when the formation and destruction mechanisms are mentioned, but it would be useful to explain what these mechanisms are. This may help predict presence/absence of boundary layers.

4. More explanation/clarification is needed earlier in the manuscript to distinguish between the 'patchiness' of BLs in time, or space, or both. The term 'persistence' used for the ratio R suggests time. Can the authors quantify/speculate whether spatial or temporal patchiness is more important?

5. I'm a little surprised that the cruise in 2008 was the first time patchiness in BL distribution was observed, or became evident. Were all previous observations before this different, or has this patchiness been present all along.

6. Separate 'Results' from 'Discussion' and reduce the length of the 'Summary/Conclusion'. Try to keep the presentation of results as concise and to the point as possible. The discussion should concentrate on how this new method differs from the old method and limit the comparison with other studies already detailed in the previous papers by the authors.

7. A key question that is not posed by this paper is whether there is any long-term trend in BL thickness detectable from the data presented here. Obviously this will be limited

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by the available data, but perhaps some attempt could be made to examine this in the more data-rich regions?

Minor corrections/suggestions

Abstract:

1. Add one line at the very beginning explaining what a barrier layer is.
2. P800, L5 – remove ‘in order to take into account’. Suggest ‘that addresses’.
3. P800, L5 – see comment above about whether Barrier Layers are permeable, or if their distribution influences permeability?
4. P800, L6 – consider using ‘uneven’ instead of ‘patchy’.
5. P800, L7 – state clearly what the climatic impacts of the increased permeability resulting from the patchiness of Barrier Layers will be.
6. P800, L9 – consider ‘small’ instead of ‘weak’.
7. P800, L9 – consider ‘However the former approach can significantly underestimate’.
8. P800, L11 – consider ‘for Barrier Layers’ instead of ‘for the ones’.
9. P800, L13 – expand ITCZ.
10. P800, L13 – consider ‘and equatorward of the sea surface salinity subtropical maxima where the distribution of BLs is uneven’.
11. P800, L14 – consider ‘therefore requires a description of the robustness of BL distribution to assess the overall impact of BLs on the permeability of heat exchange between the surface mixed layer and the atmosphere’.

Introduction:

1. P801, L13 – ‘alternated’ is inaccurate, suggest ‘it became evident that there was spatial variability in not only the thickness of BLs but also their presence/absence.’

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2. P802, L9 – again, here you refer to a thick BL as a permeable BL, but this goes against the idea that BLs inhibit permeability.

Data and Methodology:

1. P802, L20 – placing web addresses in the text becomes unsightly in the publication format – considering using a reference instead and putting the details in the bibliography.

2. P802, L24 – replace ‘2007’s’ with ‘2007’.

3. P802, L25 – replace ‘available at some places’ with ‘available in some locations’.

4. P803, L1 -remove sentence beginning ‘Since about’ and just state ‘Extending the data period from Jan. 2006 to Sept. 2008 provides an additional 200 000 profiles and therefore improves the application of statistical analysis’.

5. This section would benefit from inclusion of a diagram showing the parameters described.

6. Consider dropping the term BLT and just using BL thickness instead.

7. P804, L13 – move web address to reference in bibliography.

8. P804, L19 – change ‘Tropics’ to ‘tropics’.

9. P805, L1 – change to ‘the more uneven the distribution of the BL with respect to the space/time scale considered, the greater the permeability of the region’.

Results and Discussion

1. Try if possible to avoid beginning a paragraph topic sentence with ‘Figure . . .’.

2. P805, L6 – remove ‘does indeed’.

3. P805, L9 – change ‘Tropics’ to ‘tropics’.

4. P805, L14 – restructure sentence to avoid ‘)(’.

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5. P805, L16 – change ‘rivers and seasonal precipitations’ to ‘river outflow and precipitation’.
6. P805, L25 – suggest ‘their climatic impact is probably limited because they occur at greater depths, ...’.
7. P806, L3 - Stay consistent between using ‘Fig.’ or ‘Figure’.
8. I wonder if it might be better to separate the Results from the Discussion, as I quickly get bogged down in the some of the Discussion elements presented here.
9. P806, L6 – Where is it indicated that there were a total of 4 profiles available? Figure 2?
10. P806, L18 – this should be discussed more, in particular how to resolve this limitation of this study.
11. P806, L24 – I think Durand et al., (in prep.) should suffice, and leave the wordy title to the bibliography. Or consider a Pers. Comm.
12. P807, L24 – consider ‘mid-latitudes’.
13. P807, L26 – ‘developed’.
14. P807, L27 – ‘developed’.
15. P807, L29 – move web address to a reference in the bibliography.
16. P808, L16 – change to ‘tropics’.
17. Try placing Figure references at the end of sentence for improved readability.
18. P808, L8 – consider ‘realistic’ instead of ‘physical’.

Summary and Conclusion

1. Overall this section needs to be tightened. Elements of discussion should be moved into a Discussion section prior to this. This section should simply summarise the main

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features of the global BL permeability and thickness, the key regions of difference with the previous method, and conclude with the next step in this work to address the shortcomings, hopefully detailed at the end of the Discussion.

Figures

Overall the Figures are of a very high standard. One broad suggestion is to duplicate the panels in Figure 3 and 4 to assist in making the patterns discussed in the text more clear. For example, in Figure 3 define three 'permeability' ranges for low, medium and high permeability as discussed in the text and then show the 4 seasonal maps for each case (3 x 4 panels). Then it may be worth using these data ranges to split Figure 4 into 3 sets of four panels.

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