

## ***Interactive comment on “Variability of the ocean heat content during the last millennium – an assessment with the ECHO-g Model” by P. Ortega et al.***

### **Anonymous Referee #1**

Received and published: 18 October 2012

Review of “Variability of the ocean heat content during the last millennium – an assessment with the ECHO-g Model”

by P. Ortega et al.

Major Comments:

This manuscript examines some elements of the variability in ocean heat content using a suite of coupled AOGCM simulations with (mostly) realistic forcing. This is a critically important issue and has received insufficient attention to date. Therefore, the present manuscript is welcomed.

I did find the manuscript rather heavy going, being difficult to read and some of the diagrams being very difficult to see and identify the important features. However, overall, the manuscript is useful and I would recommend publication after attention to the detailed comments below.

Detailed comments:

Page 4225, line 5: Add recent Gleckler et al. reference Gleckler, P. J., B. D. Santer, et al. (2012). "Human-induced global ocean warming on multidecadal timescales." *Nature Clim. Change* 2(7): 524-529.

Line 14: This flattening is controversial. For example von Schuckmann and Le Traon indicate an ongoing ocean warming. von Schuckmann, K. and P. Y. Le Traon (2011). "How well can we derive Global Ocean Indicators from Argo data?" *Ocean Sci.* 7(6): 783-791.

Line 20: While these papers offer additional ways to balance the Earth's energy budget, the magnitude of these two mechanisms is small and they have not demonstrated that they quantitatively can balance the Earth's energy budget.

Page 4226, Line 2: Should refer to the first detection of these instrumental problems. Gouretski, V. and K. P. Koltermann (2007). "How much is the ocean really warming?" *Geophysical Research Letters* 34: L01610, doi:01610.01029/02006GL027834.

Page 4228, Line 6: 2002 in the references

Page 4232, line 29: Note the Jevrejeva et al. time series has only 3 gauges to base their global average on before about 1860. A lot of subsequent discussion seems to depend on the accuracy of this record. I think some caution is required.

Page 4233: I am not really sure what the meaning of the first two paragraphs on this page is.

line 4: Kemp et al. and Jevrejeva et al. are not in good agreement. Indeed there has

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been a published exchange between the two groups. Perhaps of importance here is the difference in the time when the acceleration of sea level started.

Line 7 and line 10: On line 7 it says 18th century and then on line 10 it says 1800-1900 (ie the 19th century). Which is it? See also the Caption to Figure 4.

Page 4234, line 7: Since 1955, the models seem to indicate the thermal expansion was about a third of the observed rise.

Line 9: This 75% seems misleading. You can only arrive at this number if the potential ice sheet contribution is ignored.

Line 13: Suggest "(Fig. 3), we will focus on"

Line 15: Should this be Figure 1?

Line 20: Wasn't El Chichon in 1982?

Page 4236, Line 14-29: Suggest this needs to be rewritten to bring out the most important points.

Page 4237, Line 17: Delete "Besides"

Page 4238, line 22: Delete

Page 4239, Line 1: Proposed by whom?

Page 4240, Lines 1-20: Not sure what this adds at the moment. It is hardly new or surprising that there are regional distributions of heat with climate modes. What this could add would be to more accurately quantify them, and how the global averaged heat content has fluctuated in the model with climate modes. I suggest the material here needs strengthening.

Page 4242, Lines 1-3: What is the significance of this. Perhaps it needs to be explained better.

Page 4243, line 25: For the solar variability, there is a 20 year lag, when the oscillation

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has about a 11 year period. Can you explain please?

Page 4244, line 14-15: This global signal seems to contradict the last line of the previous page when it says the signals are local. This needs a proper discussion.

Page 4246, Line 21: the year is 2000 not 200.

Page 4251, Table 1: Sorry, I do not understand how the radiative forcing accounts for such a low percentage of variance. Doesn't heat have to be conserved in the climate system.

Page 4253, Table 3: The observed thermal expansion coefficient is low compared with recent estimates. The early part of the period has very large uncertainties because of limited data. A weighted fit gives larger numbers.

Figure 1: The Mt Agung forcing seems to be small?

Figures: The maps were indistinct and hard to see.

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Interactive comment on Clim. Past Discuss., 8, 4223, 2012.

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