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## ***Interactive comment on “2-D reconstruction of past sea level (1950–2003) using tide gauge records and spatial patterns from a general ocean circulation model” by W. Llovel et al.***

**Anonymous Referee #2**

Received and published: 16 April 2009

Review of “2-D reconstruction of past sea level (1950-2003) using tide gauge records and spatial patterns from a general circulation model”

by W. Llovel et al.

General Comments:

This paper attempts to estimate the regional field of sea level trends over the 1950 to 2003 period by combining EOFs determined from ocean model simulations with sea level from coastal and island tide gauges. This additional attempt to estimate regional sea level trends is a welcome development and should be further encouraged. I particularly welcome the use of EOFs from model data and the longer time series for

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determining the EOFs that can be obtained from model results. Demonstrating the value of longer time series for determining EOFs is a useful contribution.

The present manuscript is however deficient in several respects.

Firstly, the focus appears to be primarily on the regional distribution of sea level rise. If this is the focus, it should be stated more clearly.

Secondly, I am unconvinced that the reconstruction method developed is optimum, even when the focus is not on the mean but the long-term regional variation. In particular, it has been noted previously that how the global averaged trend is treated is critically important. This is true for both the mean rise and the regional variation. If attention is not paid to this issue and the EOFs contain a significant non-zero global average, then the global trend will be represented by one or more of the EOFs, irrespective of the regional distribution. A more appropriate method is to specifically recognize this issue and include an additional constant in the reconstruction and preferably set the global average of all of the EOFs to zero. Note that this still allows a regional pattern to emerge but it reduces the mapping of any global average trend (as will be in the tide gauge data) into one or more specific EOFs.

Thirdly, there are a number of comments that the results from particular simulations are similar. However, no quantitative backup to these words is offered, and I would dispute the description – see below.

Finally, there are a number of relatively minor comments and wording issues.

I recommend a revised manuscript, after the authors have tested and responded to the criticisms/suggestions included in this review, be re-reviewed.

#### Detailed Comments:

Page 1111, line 3: This description of the non-uniform rate of sea level rise is inappropriate. The regional variability as observed from satellite altimetry comes primarily from interannual variability associated with ENSO and other phenomena and is associated

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with the vertical movement of the thermocline.

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Line 15: Suggest “data set alone cannot”

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Line 21: No justification is offered for the description of these fields as “improved”

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Page 1112, line 24: Cross validation is not an alternative reconstruction methodology. It is an attempt at an independent verification technique.

Page 1113, lines 15-20: Please specify clearly how the mean is dealt with. See above comments.

Page 1114, Line 12-13: Why can’t the first different approach be used here?

Line 14: Suggest “subtracting from each”

Page 1115, line 1-4: I assume these data contain the recently quantified XBT biases.

Lines 10-15: Please give more details on the assimilation.

Page 1116, line 19: Suggest “between the first two cases” Also reword line 1117-1118.

Lines 20-28. Please quantify the level of agreement. I would actually suggest that the field in Figure 2a is more similar to the field in Church et al. (2004), but this would need to be quantified.

Page 1117, line 1: In an earlier version of this manuscript I reviewed, 15 years of altimeter data was used. Why is 11 years now used?

line 5: Since these fields come from a sum of specified EOFs, the results must be the input EOFs with a different time series.

Lines 10 to the end of the page: Note here a long term trend is mapped into one particular EOF that may or may not be a good representation of the long term spatial trend – see the above discussion.

Lines 25 to 30: Agreed, especially if the means are not dealt with adequately.

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Page 1118, line 12: I disagree that the trends are similar. I can see a number of regions (for example the Indian Ocean east of Madagascar) where the sign of the trends in the two fields are of opposite sign. Indeed, I am surprised at how different the fields look. Please quantify the level of agreement.

Figure 9: (a) looks like it has a very low correlation after the mean from both series is removed and there is no (b) in my copy.

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