

Interactive comment on “The timescale and extent of thermal expansion of the oceans due to climate change” by S. Marčelja

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Overview: Based on the time-dependent advection-diffusion equation with constant vertical diffusion and upwelling velocity, the author developed a simple method to estimate the ocean thermal expansion with the sea surface temperature (SST). By using the measured GISS data from 1880, the total ocean heat content change and sea level change were calculated. The results showed that the method is validated by consistency with the estimation based on in situ data (Domingues et al., 2008). The manuscript was very well organized and written. The reviewer recommends that this manuscript be published after minor revisions listed below:

Comments: 1) The long term trend of global ocean heat content change and sea level change in figures 5-7 showed agreement with the measured data, but the variability is
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much weaker and disagreement with the in situ data. This may reflect the limitation of this simple method because it ignored the variations of global mean vertical velocity and diffusion. It is important to further improve the method. I suggest that the author points out or discuss this point in the final version.

2) Previous studies showed that the mixing played a minor role in the deep-ocean heat budget, but the downwelling is one of the most important processes for the deep ocean heat budget (Marotzke and Scott, 1999; Huck et al., 1999; Scott and Marotzke, 2002). So by using the vertical diffusion-upwelling model, the contribution of the deep ocean warming to the ocean thermal expansion is underestimated. This is another limitation of this simple method. I would like to suggest the author to mention or discuss this point in the next version.

3) The future projection (Fig. 8) should also be a very important part of this paper. It is not proper to project the future thermosteric sea level rise based on the observed SST from 1880-2008. I suggest the author replot Fig. 8 by using the SST data from CMIP3 scenario database and compare with the IPCC projection. This result will be much more interesting the readers.

4) p.2977-line 8: “Rahmstor (2008)” should be “Rahmstorf (2007)”.

5) p.2889-2990: Fig. 5 and Fig. 6 can be combined to one figure.

Reference:

Scott, J. R., and J. Marotzke, 2002: The location of diapycnal mixing and the meridional overturning circulation. *Journal of Physical Oceanography*, 32, 3578-3595. [37]
Marotzke, J., and J. R. Scott, 1999: Convective mixing and the thermohaline circulation. *Journal of Physical Oceanography*, 29, 2962- 2970. Huck, T., A. J. Weaver, and A. Colin de Verdière, 1999: On the influence of the parameterization of lateral boundary layers on the thermohaline circulation in coarse-resolution ocean models. *Journal of Marine Research*, 57, 387-426.

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