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Earth System Dynamics Discussions

Interactive comment on "Climate change under a scenario near 1.5 deg;C of global warming: monsoon intensification, ocean warming and steric sea level rise" *by* J. Schewe et al.

Anonymous Referee #2

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This paper shows some interesting results, particularly in relation to the rate of cooling after peak temperatures are reached for the RCP3 scenario but is not as clear as it could be and the focus on the most interesting results is not as strong as it could be. I recommend this paper for publication but I believe that some clarification of structure and emphasis is needed before that would be appropriate. There are no major problems with the paper but there are a number of issues that should be addressed before publication.

General comments

The paper structure could be improved to allow the material to be read more easily and

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to focus the reader's attention on the more important results. The results concerning the mid-ocean warming and consequent dynamic ocean effects on long-term global temperature stand out as particularly important. Section 4 refers many times to figures and results from section 3, some restructuring of these two sections could improve the layout. Some figure panels were not referred to in the text (figure 2b, 3b) and not discussed whilst unique material was presented in the figure captions that would have been more appropriately placed in the main body of the text (e.g. figure 5 and 7). There is also a mistake in that figure 8 is referred to as figure 5 in the text.

There should be some expansion of the section on changes in ocean circulation and AMOC, to allow further explanation of the mechanisms and consequences. The following questions on the AMOC results should be addressed in the text or in response to this review. How does the AMOC in CLIMBER-3A compare to the AMOC in IPCC models? Is it stronger or weaker than the IPCC model average and what effect would a weaker/stronger AMOC have on the results? What are the hydrological changes (precipitation and runoff) in the North Atlantic region and what impact do these have on the AMOC results? Is the AMOC in CLIMBER-3A stable in the long run? The intensity of the AMOC increases after 2300 for the RCP3-PD, why is this?

It does not seem necessary to include the results on the monsoon response in this paper, which draws attention away from the stronger results on the impacts of ocean warming and circulation change on global temperature and thermosteric sea-level rise. The monsoon is an important impact of climate change but perhaps this model is not the best tool to assess it, with very coarse atmospheric resolution (22.5 x 7.5) and using a statistical-dynamic atmosphere model. If this section is kept a comparison of the model with the IPCC AOGCMS for precipitation, particularly in monsoon regions would be a valuable addition. In addition the inclusion of more explicit caveats or discussion of the impacts that the low resolution and the statistical dynamical model have on the monsoon results would be of benefit.

The title does not reflect the focus of the paper very well and does not mention the

ESDD

1, C116–C121, 2010

interesting mechanism for the slow-down in global cooling after peak temperatures are reached. As a suggestion: “Climate change under the RCP3-PD scenario: Ocean Warming, Slow Global Cool-Down and Steric Sea-Level” would highlight the results that were most important from the paper and the fact that almost all the results relate to the RCP3 scenario. The slow cool down should be mentioned in the title as it seems to be the key result.

It is not clear whether the paper focuses solely on the RCP3-PD scenario or gives a broader overview of all the scenarios. Most of results are related to the RCP3-PD scenario with some comparison with the RCP8.5 scenario, however in the text some results for the other scenarios are discussed and section 2 suggests that all the scenarios were investigated.

Further explanation of the ocean dynamic changes and how they relate to the changes in ocean mixing and regional sea-level change would be of value. For example, the second paragraph of section 3.5 could be split to allow a longer explanation and to highlight the effect of these ocean dynamic changes on the ocean-atmosphere heat exchange and the consequent slow-down in global cooling.

Some of the points made in the general comments are repeated as specific comments showing in the text where they occur.

Specific comments

1. page 298, around line 15 – helpful to compare sea level rise on the same year for both scenarios.

2. Page 300, line 20 – Comment on precipitation and monsoon response in comparison with the CMIP3/AR4 models.

3. Page 301, line 1 – not clear what the phrase ‘compute the emulated temperature ranges for the RCP scenarios’ means.

4. Page 302, line 6 – ‘emulation of the AOGCMs’, it would be better to use a consistent

ESDD

1, C116–C121, 2010

phrase throughout the text, earlier the phrase 'MAGICC 6 emulations' was used.

5. Page 302, around line 20 – no mention of figure 2b or 3b in the text.

6. Page 303, line 5 – what are the effects of freshwater input from the land and from precipitation? Do these play a significant role?

7. Page 303, line 10 – it is not clear what the sentence beginning 'depending on the scenario. . .' refers to, which scenario? Which scenarios are the upper/lower values correlated with?

8. Page 303, line 25 – expand on the caveats for the monsoon results. What is the effect of the coarse resolution? How dependent are the results on the use of a statistical-dynamical model?

9. Page 304, line 26 – A sentence explaining the relationship between ocean circulation changes and local sea-level rise would be useful.

10. Page 305, around line 15 – Material from the caption of figure 7 may be more appropriately included at this point.

11. Page 305, lines15-25 – The explanation of the changes in mixing should be expanded and clarified. The explanation is clearer in the conclusion: Page 309, line 15.

12. Page 305, line 25+ - consider splitting paragraph to highlight the role of the heat anomalies at intermediate depths on the slow down in global cooling.

13. Page 306, line 15 – This is the first mention of the climate sensitivity, adding this earlier when discussing global temperature trends or in the model description would be useful.

14. Page 308, line 18 – elaborate on the caveats for the statistical dynamic model and the resolution. How do these affect the results? What will their influence be on the robustness of the monsoon results? This could be addressed earlier in the text rather than here.

ESDD

1, C116–C121, 2010

15. Page 309, around line 20 – For the second half of the last paragraph, are the conclusions about the importance of studying mid-ocean warming specific to the results of this study?

16. Page 316, figure 2 – It may be more appropriate to show the true resolution of the model and not use smoothing, as the resolution is very coarse and this may mislead the reader.

17. Page 317, figure 3 – Comment on the increased intensity of the AMOC above the modern value from 2300 onwards in the main text.

18. Page 317, figure 3 – what is the longitude of the Labrador coast? "SPG" on figure 3B needed? Figure 3B is not referred to in the main text.

19. Page 318, figure 4 d,e,f – is the temperature reported the summer or annual value?

20. Page 318, figure 4 a,b,c – How different are these results from the global average values?

21. Page 319, figure 5 – improve the axes on the inset graph and consider using markers for certain key dates, i.e. peak emissions, etc.

22. Page 319, figure 5 – consider adding the Vermeer and Rahmstorf 2009 projections to the main figure.

23. Page 319, figure 5 – important information in the figure caption does not appear in the text, consider moving to main text.

24. Page 320, figure 6 – these results differ significantly in the atlantic from the IPCC WG1 results in chapter 10, figure 10.32. What are the reasons for this?

25. Page 321, figure 7 – Move or copy the middle sentence of the caption from figure 7 to the main text.

26. Page 324, figure 9 – This is a very complicated figure, it needs an expanded

ESDD

1, C116–C121, 2010

explanation. It may also help to add markers for key dates, e.g. indicating the year of peak CO2, peak Temperature, or a marker every 25 years. This will allow the reader to follow the figure more easily.

Technical Corrections

1. References – There are 2 papers matching the description: Stouffer et al. 2006, double check the references for other duplicates and mistakes.

2. Page 306 – all the references to figure 8 have been mistakenly made to figure 5.

Interactive comment on Earth Syst. Dynam. Discuss., 1, 297, 2010.