**Geoscientific
Model Development
Discussions**

Interactive comment on "The efficient global primitive equation climate model SPEEDO" *by* C. A. Severijns and W. Hazeleger

Anonymous Referee #2

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— General Comments

The paper by Severijns and Hazeleger presents a new coupled Climate Model of Intermediate Complexity (CMIC). [I intentionally use CMIC instead of EMIC - where E stands for Earth - as I think that an Earth System model should require some representation of land processes and carbon cycle, which are clearly missing in SPEEDO]

The model appears to have benefited from years of development and use in its different modules, coupled or not. Only a handful of such models exist; thus SPEEDO is welcomed as an important contribution to the climate modelling community and a very useful tool.

The paper is generally well structured, presented and written. Also, the code is made

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available to the scientific community.

I found the paper very interesting and within the scope of GMD. I only have a few remarks/questions that I would like to see clarified before publication.

— Specific Comments

Model Description- I understand that a detailed description of the model formulation and parameters is given elsewhere (Molteni, 2003; Hazeleger et al., 2005), however it would help the reader if you could discuss some of the basic features of this version of the coupled model SPEEDO; after all, this is a model description paper.

I assume the atmospheric model did not change much, but what about the ocean model? are you including the Gent and McWilliams (1990) parameterization? what kind of tuning did you perform? what is the vertical diffusivity in the ocean? etc. All this could easily be included in a single paragraph or a table.

Also, looking at Hazeleger et al. (2005) it appears that you've changed ocean model component. Any particular reason for doing this? is the previous version still available? It would be really interesting to have two coupled models with different ocean model formulation: it would provide the community with a great benchmark for climate variability and biases.

Page 1119 Line 25- Is there a parallelized version of the code?

Page 1121 Line 5- I am not sure the lack of drift in T_{2m} would tell you if the model is spun-up or not, nor the global mean ocean temperature. What about the bottom ocean temperature? or the strength of the oceanic deep cell. It seems odd for the ocean to be in an equilibrated state after only 2000 yr (page 1120 line 4). What were the initial conditions for the ocean?

Page 1123 Line 20- The AMOC is quite weak (about 50% compared to the obs you are citing): did you perform any tuning trying to improve this? it should/could reflect in changes in your ocean heat transport (see Fig. 6) and SST biases (see Fig. 5 left

panel).

Page 1124 Line 1- To support this and previous statements you could add to your Fig. 6 data from reanalysis (e.g. Trenberth and Caron, 2001)

Page 1127 Line 5- the AMOC strength in your 2xCO2 does not seem to recover. Given the computational efficiency of your model is a shame you have not ran the model for more than 200 yr.

— Technical Corrections

Page 1122 Line 13- 'fairly well': what does this mean? please use quantitative measures when possible.

Page 1122 Line 20- $m^3 s^{-1}$: you could define a Sverdrup here ...

Page 1123 Line 18- The 41 year mean: what section of the run does this refer to?

Page 1124 Line 1- 'seems good': what does this mean? please use quantitative measures when possible.

Page 1124 Line 15- 'The anomalies are with respect to the ensemble mean in order to suppress the global warming signal': please clarify.

Page 1125 Line 18- Please show the AR(1) estimate and 95% confidence in the plot.

Figure 3- Could you add a colorbar or contour interval?

Figure 5- Could you add a colorbar or contour interval to the panel on the left?

Figure 5- It would be useful to show the global MOC, and the Southern Ocean MOC in particular.

Figure 6- It would be useful to show reanalyses data on this plot, as well as the heat transport for the Indo/Pacific basin

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