

Interactive comment on “The CSIRO Mk3L climate system model version 1.0 – Part 1: Description and evaluation” by S. J. Phipps et al.

Anonymous Referee #1

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This paper describes the Mk3L climate system model, and gives some evaluation of the model performances for the pre-industrial climate. The paper is clear and nicely written.

1 - The model description is a good compromise between the need to be comprehensive, and the need to be concise. Full model description is given in the model documentation. I appreciate that this documentation is attached to the paper. Anyway, I didn't review these 237 pages with care.

2 - The paper then presents an evaluation of the mean state and the seasonal cycle of the atmospheric part (forced by SST), and of the oceanic part (forced by flux and surface restoring). An evaluation of the variability in coupled mode is given.

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This way of performing the model evaluation is not relevant with the paper title (“... climate system model ...”). The evaluation of the model in coupled mode should be given. With the flux adjustments, one may guess that the model climatologies in forced and coupled mode are close. But its only a guess, because the paper gives no indication about that. And how close are forced and coupled modes ? Author cites Sausen et al. (1988) as unique reference for the flux adjustment method. This 1988 paper states: “The difficulty with the fully coupled approach is that the differences between the equilibrium climates computed in the decoupled and coupled modes are generally too large to apply linearized theory”. Due to these non-linearity, there probably is a difference between forced model components and the full climate system model, and this should be perfectly clear in such a paper. If there is a difference, coupled climatology should be shown instead of forced ones.

As presently organized, the paper is then not an evaluation of the “climate system model”. That’s my main concern about this paper.

3 - The paper presents the model variability without any word about the impact of the flux adjustments method. Several papers have addressed this issue, for instance : Brown, J., M. Collins, A. W. Tudhope, and T. Toniazzo, 2008: Modelling mid-Holocene tropical climate and ENSO variability: towards constraining predictions of future change with palaeo-data. *Climate Dynamics*, 30, 19-36. Kitoh, A., T. Motoi, and S. Murakami, 2007: El Nino-Southern Oscillation simulation at 6000 years before present with the MRI-CGCM2.3: Effect of flux adjustment. *Journal of Climate*, 20, 2484-2499.

This subject should be addressed, with relevant references.

4 - The model is designed for palaeoclimate research. I clearly doubt that a model with flux adjustments can be used for different climates. Even for climate which may seem no so different from pre-industrial : Holocene is characterized by large changes of the seasonal cycle (amplitude and phase), particularly in the monsoon region. Flux adjustments will prevent any change of season length, phase shift, etc ... You cannot

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hide this strong limitation, and maybe you should explain what kind of palaeoclimate research could be done with this model (and which could not). Other major comments

Part 2.5 The model resolves the diurnal cycle. The text states that this improves the simulated climate in the tropics. However, papers cited use a vertical resolution of 10m in the upper ocean, and a TKE scheme for the vertical turbulence. Diurnal cycle in the upper ocean is strongly linked to these features. Is this sensitivity observed in coupled models with a 25m vertical resolution in the ocean, and a fixed vertical diffusivity? It seems that the model has no penetrative solar radiation, which can also impact the diurnal cycle representation.

The flux adjustments should be a part of the model evaluation. Please give a figure showing flux adjustments, for each field. Is the adjustment in annual mean, seasonal, ...? Please describe how the flux adjustments are computed.

* Minor comments *

About the Model documentation. A clickable PDF would be appreciable (links in table of contents, bibliographic references, figure references, etc ...)

As the model “is freely available to the research community” (part 8, line 4), the licence type (GPL, LGPL, other) should be mentioned.

Part 2.1 The radiation is computed every 2 hours. That means that the “model time step” is 2 hours, not 20 mn, even though some model processes are computed more often, because all processes are updated every 2 hours. What is the “20 mn” time step given line 16: physics time step, are also dynamics ?

Part 2.1 The transport scheme is a semi-lagrangian. What are its properties of conservation?

Part 2.4 Tracer diffusivity is isoneutral. Please specify whether there is an horizontal background diffusivity or not.

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