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**Geoscientific
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Discussions**

Interactive comment on "The HadGEM2-ES implementation of CMIP5 centennial simulations" *by* C. D. Jones et al.

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Anonymous Referee 1

General comments *This paper addresses how authors have implemented and setup the CMIP5 experimental protocol for the centennial simulations in the Met Office HadGEM2-ES earth system model. It explains what forcings and configurations are used in these experiments corresponding to each sections of CMIP5, and the reasoning behind this. Some of these centennial experiments with coupled carbon-cycle ESMs are very new type of trial in Coupled Model Intercomparison Project (CMIP), so requires fully detailed description of the setting because of the possible diversion among modeling groups caused from the interactive nature of chemistry, dynamic vegetation, and uncertainty in handling of anthropogenic land use. Specifically, treatment*

of land use forcing and land use emission is well described in this paper. Difference of setting among Last Millennium experiment and 20C3M-RCPs simulations is clearly written.

Also it describes important aspect of selection criteria of the initial condition of ensemble simulations. In the discussion section, there is comprehensive comment about the way to conduct detection and attribution studies in EMS simulation, which should enhance further studies in these area by ESMs community.

The paper is written clearly, and will serve as an important document for the CMIP5 and ESMs community, and will be essential for those who quantify and understand model spread and uncertainties of the future climate projections. I would recommend this paper for publication in GMD after the authors have addressed some questions and minor comments which I have listed in specific comments section below.

We thank the reviewer for these very positive comments, and their detailed reading of the text. We have addressed all of the minor corrections recommended below.

Specific comments *Page 692, line 18: Description about Figure 1 in the paragraph doesn't match the actual figure. It seems the text is for Figure 3 in Taylor (2009), so please rewrite for the actual figure.*

That is correct - we replotted the figure to avoid copyright issues of using Taylor's original. We will rewrite the text specifically for the new figure.

Page 698, paragraph from line 5 There is no description about whether fossil fuel and land-use CO2 emission data used for RCP8.5 emission driven simulation is spatially gridded or not. If gridded emission is used, please provide detailed method and data in addition here, like you've written about the historical forcing.

Yes, the future emissions are also gridded by using the 2005 spatial pattern and scaling (fossil and land-use separately) to give the RCP global totals into the

future. We will add to the text to describe this.

Page 712, line 10 McGuire et al. 2008 is not listed in references section. And, this may be McGuire et al. 2001 GBC?

Yes, this was meant to be McGuire 2001 - we will add this to the references.

Page 712 line 24 and thereafter: There is no notation about Figure 11 and 12 in the paragraph. Please place them in the appropriate sentences.

OK, we will refer to these figures in the text. The logical place to do this is now on page 713, at line 12 for figure 12 and line 23 for figure 11. Hence we will swap the order of these two figures.

Page 722 line 6: This should be Fig. 21?

At this stage we could refer to either the red lines in figure 20, or the red circles in figure 21. so we will keep the text as it currently is.

Page 723 line 23: This should be Table 5?

OK - thanks.

Page 741 Table 4: MOSES2 is not described in the main document. Does MOSES2 mean TRIFFIED?

TRIFFID is the dynamic vegetation component which is a sub-set of MOSES2 which is the land-surface scheme in the model. This table will be better to simply refer to the vegetation types within HADGEM2-ES.

Page 759 Fig. 17: It seems the figure is showing smoothly interpolated data. This should be the original data of fractional area changes in the HadGEM2-ES grid as in the Figure 11.

The figure used a contouring algorithm, so although the data had not been smoothed it might have appeared that way. We have re-plotted without this ap-

parent smoothing.

Anonymous Referee 2

The manuscript presents a very comprehensive description of the Hadley Centre contribution to the CMIP 5 centennial (including AMIP and PMIP) simulations. The authors have chosen to let free more feedbacks than usual in their model, which leads to a scientifically original climate simulation. The price to pay to this originality is the need to describe much more than the CMIP5 standards available at PCMDI. This paper succeeds greatly to fulfil this need and thus is worth publishing in GMD.

We thank the reviewer for these very positive comments, and their detailed reading of the text. We have addressed the minor corrections recommended below.

My minor remarks are:

1) Section 2.1.1 first paragraph. The design of the two methodologies is not clear for me. Does the first experiment consist of a standalone run of the carbon model with atmosphere/ocean forcing and the second one of a GCM run with imposed CO2 ? I presume reading Gregory et al (2009) helps a lot, but please have mercy on the quick reader

Not quite. There are no offline simulations required here. Each CMIP5 experiment can be achieved through a single simulation with the full GCM. We will update the text to make this clearer, but in essence, the decoupled experiments require minor code changes to control what parts of the model are passed different forcing data: in the "BGC" simulation the carbon cycle code is given time-varying CO2 levels as an input whilst the radiation code is given constant (pre-industrial) CO2 levels as an input, and hence we can separate out the carbon-cycle response to CO2 from the climate response. Conversely for "RAD" only the radiation code is passed time varying CO2, with the carbon cycle model components only seeing constant CO2 levels.

2) Section 8.2 last paragraph. How are generated these river routing data ? I assume that above the present sea level, the rivers are unchanged. Under this level, do you use the present bathymetry to reach the sea level of the palaeo period ? Automatically or manually ?

Unlike all the other simulations reported here, the LGM simulation is not yet conducted and as such we describe how it will be carried out. We have updated the text to mention this. The river routing ancillaries are in the process of being updated, and this is now described in the text.

3) Section 9.2. There is a rumor in CMIP5 that for AMIP simulations some AGCMs have been slightly re-tuned wrt the version in the coupled runs. Can you confirm the AGCM is identical or which changes did you make ?

The reviewer's information is correct (and very up to date!). At the time of writing, we had intended that the AMIP simulations would be with an identical model, but subsequently we decided to slightly re-tune the dust emissions model given that the AMIP and coupled -AO versions had different climatologies. Hence the AMIP simulations we will submit to CMIP5 are subtly different (only in the dust emissions parameters). We will add a paragraph to describe the need for this.

Interactive comment on Geosci. Model Dev. Discuss., 4, 689, 2011.