

Interactive comment on “Development and evaluation of an Earth-system model – HadGEM2” by W. J. Collins et al.

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General Comments

This paper describes and evaluates the components of the Earth System Model that the Met Office Hadley Centre is running for the Coupled Model Intercomparison (CMIP5). It is important that this is documented and the authors have done a good job in explaining how the different components interact. It is always challenging in this type of paper to include every detail that is potentially of interest to a reader, but below I have noted a few gaps which are of interest to this reader at least!

Specific Comments

Chemistry scheme and methane: In Sec 2.6 NO_x lightning emissions and methane

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wetland emissions are mentioned but there is no discussion of other emissions that I assume would be included e.g. anthropogenic emissions (though there is some mention of methane emissions on p1016). An extra sentence or two might be helpful to indicate what is used and, for example, whether the emissions used are assumed constant across the globe or are spatially explicit. I would have expected to see higher methane concentrations in the northern hemisphere than the southern hemisphere in Fig 2, but perhaps this is lost in the colour scale that is used? If so, perhaps a variable colour scale could be used? It would also be helpful if the right hand axis could be labelled with an approximate pressure scale.

The comment on Fig 2 on p1008 notes the rapid decrease in methane above the tropopause. Is this considered too rapid? Is it because the methane is too low that the methane oxidation above the tropopause does not affect stratospheric water vapour? The Corbin and Law technical report (references, p1032) discusses some issues they found with low stratospheric methane which might be relevant here.

Inundation and methane wetland emissions: On p1016 the model is described as reproducing the geographical pattern of inundation but I am not completely convinced. The pattern across North America doesn't look very good and perhaps this at least warrants a comment? It might also be worth adding a sentence to this paragraph noting that the impact on the methane emission scheme will be discussed in 4.3. In Sec 4.3, the problems with the inundation pattern in N America are also seen in the JJA methane emissions for that region so, again, that may be worth a comment alongside the comment on Amazonia. On p1019, line 21-22 I found this sentence ambiguous. What is consistent? The location of the seasonal maxima?

Aerosols: In Sec 4.2/Figure 8 the observations are not cited - where did they come from? In Fig. 8 I would suggest using the same y axis range on all panels. Also, what does the shading represent and why is there no shading for Cape Grim?

Impacts of vegetation distribution on climate: I wonder if there is a figure that could be

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shown to help justify the statement that simulations 'with and without interactive vegetation show little overall difference in the surface climate' (p1028). While a reference is given (HadGEM2 development team, 2011) that paper seemed to focus on large-scale measures and didn't appear to show anything that could allow a specific region to be checked e.g. Australia.

Technical Corrections

p999, line 29: Booth et al not in references

p1001, line 9: Cox et al 2001 only has 1 author in references so et al not needed

p1002, line 5: 'therein' not 'therin'

p1003, line 6: delete 'in' after 'approach'

p1004, line 6-7: suggest add comma before 'under' and after 'soil'

p1005, line 2-3: suggest move this sentence to p1004, line 27 after Fig 1 is introduced. Also 'change in sea level of ~ 10 m per century' is unclear.

p1005, line 18-25: I think this paragraph could be rewritten to avoid listing many of the aerosols twice. Also the start of the next paragraph repeats some of the same information.

p1006, line 8: delete 'for instance'

p1007, line 4: Add 'et al.' to Balkanski reference

p1007, line 15: it would be helpful to explain what is meant by 'a preferential source term'

p1012, line 5-8: it might be helpful to note what timestep TRIFFID uses since many dynamic vegetation models run some components on a daily timestep and others on an annual timestep e.g. how often is the vegetation distribution updated?

p1013, line 23: 'replaced' instead of 'replace'

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p1015, line 2: insert 'the' before 'soil'?

p1017, line 7: suggest replace 'and' with comma

p1017, line 28: 'in spite' (2 words)

p1018, line 1: insert 'there' before 'may'

p1018, line 19: delete 'of'

p1022, line 2: delete 'correct' before 'magnitude'

p1022, line 21: personally I would describe this as 'at the lower end of this range' rather than 'comfortably within'

p1024, line 3: either 'The figure' or 'Fig. 17'

p1024, line 6-7: It would be helpful to name the lines e.g. 'Pre-industrial HadGEM2 line' rather than just 'blue', 'solid black'

p1025, line 12: It would be good to add a sentence here indicating what model change is most responsible for the improvement - if this is known.

p1026, line 26: 'assess'

p1030, line 14: 'conditions' rather than 'condition'?

p1032, line 18: It would be helpful to add the URL for the Corbin and Law reference: http://www.cawcr.gov.au/publications/technicalreports/CTR_035.pdf

p1035, line 9: The Jones reference can be updated to the GMD version

p1037, line 3: Olson reference - is '741' supposed to be part of the title? Should there be multiple authors for a PhD thesis?

p1038, line 19: Taylor not referenced anywhere?

Figure 7 is difficult to read - I wonder if it would be better not to show the dark blue points

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that are zero or very close to zero, so that the more significant discharges become easier to see?

Fig 10 caption: add '(AODs)' after aerosol optical depths in line 2

Fig 18: Is it worth increasing the y-range on the top left panel so that it also spans 400 gC/m²/mon so that the errors in this panel don't look larger than in the component fluxes?

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