

## ***Interactive comment on “The carbon cycle in the Australian Community Climate and Earth System Simulator (ACCESS-ESM1) – Part 1: Model description and pre-industrial simulation” by R. M. Law et al.***

### **Anonymous Referee #2**

Received and published: 14 January 2016

This is an important study describing the behavior of the Australian Community Climate and Earth System Simulator (ACCESS) for pre-industrial simulations of the coupled global carbon climate system. The paper is well suited for publication in GMD however there are a number of short comings to the paper in the current form. The main concern is in the assessment of the CABLE land carbon simulations. While the paper contains a long history of the development of the CABLE model with many references to the various versions of the model and input files, the comparisons between the model versions provides no assessment of the simulated carbon cycle against other models

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or against observations.

The lack of systematic model evaluation results in a limited framework for the reader to assess the usefulness of the model for historical or projected future climate carbon simulations. The description and evaluation contain unnecessary detail in some areas such as page 8 lines 1 to 16. The climate assessment of the various versions of ACCESS on page 17 is particularly complex and uninformative. It requires the reader to assess a range of unknown models against each other without any observations to assess model bias and variability.

The land carbon assessment comparing the prescribed LAI version of the model against the prognostic carbon model investigates the relative differences in the terrestrial carbon cycle of the models but misses more fundamental metrics. In the introduction the authors refer to two important studies for assessing land carbon simulations and their fluxes to the atmosphere (Anav et al. 2013 and Shao et al. 2013). The paper could be greatly improved by simplifying the model description and the carbon cycle evaluation using the framework and metrics found in these papers. This would provide much needed objective assessment of the ACCESS model against other earth system models and global estimates of the terrestrial carbon cycle.

In many parts of the paper the authors digress into thought experiments about the lack of carbon conservation or unusual behavior in the model but provide no metrics or statistical relationships to support these hypotheses. Therefore in order for this paper to be ready for publication I would recommend the authors simplify the model description down to the relevant information and then provide a systematic assessment of the carbon cycle model against other CMIP5 models and global carbon cycle estimates.

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Interactive comment on Geosci. Model Dev. Discuss., 8, 8063, 2015.

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