**Biogeosciences
Discussions**

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Interactive comment on "GCM characteristics explain the majority of uncertainty in projected 21st century terrestrial ecosystem carbon balance" *by* A. Ahlström et al.

Anonymous Referee #2

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REVIEW: GCM characteristics explain the majority of uncertainty in projected 21st century terrestrial ecosystem carbon balance

General:

This work endeavors to evaluate the influence of GCM characteristics on long-term terrestrial carbon cycling. Four GCMs and three emission scenarios were used to drive a single DGVM, LPJ-GUESS, and results were analyzed using an insightful and novel (for this field) statistical method (SVD). The results were used to generate a statistical emulator, which was applied to more rigorously explore the role of GCM characteristics on uncertainty in the terrestrial carbon balance.

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In general, the work presented here is publishable. The methods applied represent a combination of novel techniques and rigorous analysis that comes at the problem from multiple perspectives. Unfortunately, the merits of the work are obfuscated by the presentation, which is frequently difficult to follow and appears to lack a cohesive narrative thread to guide the unfamiliar reader.

The paper would benefit from some earlier and clearer explanation for why certain variables are being defined, and how these fit into the larger purpose of the work. While variable definitions are provided, their greater purpose often is not. In a paper that employs such a variety of methods, some of which are clearly difficult to succinctly describe, the link between variables as they are defined in the methods and as they are evaluated in the results needs to be stronger. In most cases, the significance of a variable to the narrative of this work is only made clear after the methods section, and sometimes as late as the discussion or even conclusions. This is particularly so for alpha, which is introduced with little emphasis yet turns out to be crucial to this work's key results. Gamma is similarly obscure until it suddenly jumps into the limelight during discussion. In a paper as dense in method as this we need some indication, at first mention, of what we should expect to return with special significance in the results section.

As another reviewer has already mentioned, most readers will not be familiar with SVD or the technical jargon that accompanies it. The impact of many results is undermined by the ubiquitous presence of the term "mode" - a very fuzzy word with a very specific meaning in this context. Please provide some insight into the practical meaning of this statistical jargon. Additionally, no information about initialization or validation of the statistical model is provided.

The final 2 paragraphs of section 2.4 need to be revised to more clearly explain how the various elements presented in this section are integrated to create the 192 carbon balance trajectories. Additionally, some clearer explanation of just what insights ANOVA testing of alpha and gamma will offer is required.

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Finally, though LPJ-GUESS is a widely applied and well-tested tool, it is not reality. The authors are encouraged to keep this distinction present throughout the paper. Once LPJ-GUESS has been introduced it all but disappears from the papers vocabulary, and results and their implications are discussed as though they pertain to reality and not the reality of LPJ-GUESS. There is of course an overlap here, but this excellent analysis is ultimately exploring a specific DGVM. Some acknowledgement of the weaknesses (and strengths) of LPJ-GUESS would be good to see, and would offer an excellent segue into some discussion on the how the implications of these LPJ-GUESS-specific results may be extrapolated more generally.

Specific comments Introduction: 13687:23 Suggested citation: Friendlingstein et al 2006: Climate–Carbon Cycle Feedback Analysis: Results from the C4MIP Model Intercomparison.

Methods: 13689:23 "We focused on sea-surface temperature (SST) an an overall indicator of those aspects of GCM-simulated climate of importance in terms of impacts on global ecosystem carbon balance." What are "those aspects" and what justification (evidential or discursive) can you provide for the choice of SST for this purpose? Simply stating this choice seems to be a weak foundation on which to build this entire paper.

13690:4 Are there any pertinent differences between SVD and EOF that we should be aware of?

13690:5-10 The concept of modes needs to be explicitly addressed and explained if readers not familiar with the details of SVD are to grasp the significance of both the method and the results you have obtained by applying it.

13690:10 What are the "3 products"? Spatial loading patterns, time series and singular values?

13690:15-27 As presently described, the acrobats explained in this paragraph are be-

wildering.

13691:1 "Where" should not be capitalized

13691:9 Employing alpha values without some explanation for what they are only adds additional confusion to an already challenging paragraph. This section requires attention to better elucidate why is a scenario-independent measure of SST is required.

13692:1 "Where" should not be capitalized

13692:7 Why was alpha set to zero during the historical period?

Results: 13695:5 Some specific indication of what in the figures appears to represent "ENSO patterns" would be worthwhile.

Fig 2: Correlation of -1 and +1 are both indicated by black - how do we tell whether the figure is indicating +1 or -1? Additionally, people who are colorblind cannot distinguish between red and green.

Fig 6: Overlapping colors obscure the actual extent of red and blue and green. This may be difficult to resolve given the nature of the figure and results.

Supplementals: Entire first page is one single paragraph, which makes for heavy reading.

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