

Interactive comment on “Estimating maximum global land surface wind power extractability and associated climatic consequences” by L. M. Miller et al.

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Received and published: 4 February 2011

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Interactive Discussion

Discussion Paper

Author response to A. Speranza "Interactive comment on 'Estimating maximum global land surface wind power extractability and associated climatic consequences' by L.M. Miller, F. Gans, and A. Kleidon"

L.M. Miller, F. Gans, and A. Kleidon

A detailed response to A. Speranza's review is included as supplementary material.

We thank A. Speranza for his time and effort in reviewing our submitted manuscript. Here we will clarify several points in the manuscript that he noted require additional description and respond to his main concerns on the phenomenological approach we used.

Overall, it is our interpretation from his review that A. Speranza is particularly concerned that our study tries to quantify the exact quantity of maximum wind power extractability over land. Instead, it was and continues to be, our sincere aspiration to provide a series of estimates that are firmly based on the generation rate of kinetic wind energy in the atmosphere based on thermodynamic constraints. We apologize that our submitted manuscript may have been received a different way and will rectify this with a significantly enhanced final version to directly address this confusion.

Author's Conclusions

A. Speranza raises a number of interesting points and comments in his review. There are a number of additional descriptors that need to be included in the final manuscript for clarification and reproducibility. We also believe his more general opinion of "the proposed estimations are, in my opinion, drastically inadequate" are based on a misunderstanding that we are trying to estimate wind speeds to estimate global wind power — this is not directly the case. Our 'top-down' estimate assumes that to estimate the realizable wind power potential on a global scale, the generation rate and induced wind power extraction processes that may alter this rate, are critically important. We encourage the replication of this study with higher-resolution general circulation models but believe the critical processes are included here. To substantiate these conclusions, we have completed additional general circulation model simulations at T21 with 20 vertical levels, T42 with 10 vertical levels, and T42 with 20 vertical levels — all result in a similar estimate range that is also within the range suggested by the process-based hierarchy and simple momentum balance model estimates. In the final manuscript, we will clearly note that all of our estimates include simplifications that do not adequately represent the true complexity of Earth. In support of our conclusions though, we will also make our theoretical viewpoint clear — should future estimates from any simulation significantly exceed our range of estimates or exceed the global generation rate of kinetic energy in the atmosphere (≈ 900 TW by Kleidon, 2010), those estimates should be seriously reconsidered.

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