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Earth System Dynamics Discussions

Interactive comment on "Jet stream wind power as a renewable energy resource: little power, big impacts" *by* L. M. Miller et al.

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Interactive Comment

Response to comment by J.C. Bergmann

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We thank J.C. Bergmann for his comment and appreciate the opportunity to clarify a few points.

Our submitted manuscript explores a sensitivity analysis of jet stream wind power, defined in our analysis as a wind velocity $> 25\ m/s$. On p.450, we state, "The simulations that we conducted represent an extreme scenario, and therefore our maximum estimate should be seen as very much an upper limit." The simulation that yields the maximum kinetic energy extraction for the last 20 of the 30 simulation years was identified as that of 'peak extraction.' The resulting global climate from the 7.5 TW of peak jet stream energy extraction is very different from the modeled present-day climate.

Understanding that the peak extraction simulation has some distinct climate differences from the control case, J.C. Bergmann correctly identified that the y-axis in our submitted paper's Fig. 6b was reversed in his first comment, and in his more recent comment states, "the inverted-v-axis argument on page 4 [of our comment response] is completely wrong if the usual convention that northward velocity is positive is applied." According to footnote (2) on p. 4 in Wallace and Hobbs (2006), "Dictionaries offer contradictory definitions of these terms, derived from different traditions." Therefore, we will use the definition defined on p.4 in Wallace and Hobbs (2006), "...positive and

negative meridional velocities are referred to as *southerly* and *northerly* winds (in both northern and southern hemispheres[)], respectively[2]." This definition is in agreement with our corrected plot. To prevent this regrettable confusion with other future readers, we will change the y-axis label of this plot to 'southerly wind velocity (m/s)' in the final submitted manuscript.

Regarding J.C. Bergmann's critical comments regarding the parameterization of the 'thought experiment' in the submitted manuscript, we are not using the thought experiment to estimate specific climatic variables that we will then derive and compare using more complex estimate methods. Instead, we use the thought experiment to understand the 1^{st} order dynamics that should be expected if the jet streams were influenced by an additional drag. This approach is not meant as a substitute for more complex general circulation model experiments, but more generally suggests what dynamics should be expected from any general circulation model modified to approximate jet stream wind energy extraction. As such, given its stated intention and its utilization within the text and figures of our submitted manuscript, the thought experiment in its submitted form achieves this purpose. This thought experiment provides a simple understanding as to why the jet streams result in 'little power and big impacts' as suggested in the title. It also reinforces why the estimated values of the thought experiment are not discussed in the Results or Discussion sections — understanding the dynamics of jet stream wind power while expecting similar dynamics from any general circulation model is its only purpose.

While there are limitations of both methodologies, given the previous confusion surrounding this topic, our manuscript's approach of not only using a thought experiment (of whatever complexity) or an individual general circulation model to validate our conclusions that differ so significantly with others (*e.g.* Roberts et al. (2007); Archer and Caldeira (2009); Vance (2009)) is required.

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