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Earth System Dynamics Discussions

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

D.B. Kirk-Davidoff (Referee)

dankd@atmos.umd.edu

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Jacobson and Archer seem to be working from the assumption that wind farm climate impacts result from the kinetic energy dissipated into thermal energy by the turbines. This effect is, as they point out, trivial. But in the model simulations they discuss, the climate impacts are caused not by mean changes to the global energy budget, but by redistribution of heat and moisture from one place to another, caused by wind pattern changes in response to the wind turbines. Thus, Miller et al. (2010) find no significant changes in mean temperature, but note some (rather modest) patterns of warming and cooling.

There has been extensive experimental work on the impact of distributed roughness elements on flow. The net loss of momentum has been shown repeatedly to be well modeled by an increase in the roughness length, which in turn leads to a net loss of momentum from the flow (e.g. Frandsen, 2007; Calaf et al. 2010). The climate impacts discussed in Keith et al. (2004), Kirk-Davidoff and Keith (2008), Wang and Prinn (2010), and in Miller et al. (2010) have nothing to do with chaos, but result, rather, from linear and predictable stationary wave responses to the momentum lost at the model surface.

Chaotic effects can be of interest when wind farm roughness changes over time- these changes can introduce perturbations to the atmospheric flow that can grow in regions of baroclinic instability, so that in principle, manipulation of a very large wind farm's effective roughness (e.g. by adjusting the pitch of turbine blades) could have predictable down stream weather impacts. These effects were discussed in Barrie and Kirk-Davidoff (2010) in this journal.

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