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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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This paper attempts to set an upper limit to the mechanical work able to be extracted by wind turbines placed aloft, in the midst of the jet stream. It includes a very valuable heuristic model and discussion of the tenuous relationship between extractable wind power and observed wind speed of the unobstructed jet. By conducting numerical experiments using a general circulation model the authors are able to conclude that the addition of objects that induce a substantial drag within the jet would causes a large climate shift that would tend to sharply reduce not only jet stream winds, but surface winds as well, poisoning the well for surface wind power.

The paper is very clearly written and presented. I think it would be improved by consideration of the following issues:

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Interactive Discussion

Discussion Paper

1. Practical plans for generating electricity from winds aloft usual focus on the region from 1 km to 3 km in elevation. This is not only for technological reasons reasons (fewer concerns about interference with aviation, lower cost, mass of the kite tether) but also because decreasing atmospheric density with heigh means that for turbines of a given size, available power is not much greater at 10 km than at 3 km (Lansdorp and Ockels, 2005). It would be interesting to see how turbines more directly related to actual proposed systems would influence the winds aloft.

2. More generally, the enormous ratio between the 480 TW of atmospheric and surface dissipation lost due to the elevated wind turbines and the feeble 7 TW of wind power generated by the turbines suggests that something about the placement of the turbines in the study is very far from optimal for wind generation purposes! One suspects that the algorithm of choosing to place the turbines in region of highest winds at each instant results in a particularly strong impact on the jet. It would be interesting to see results from a set of fixed-location kite experiments at different altitudes and latitudes. One generally thinks of the Lorenz Energy cycle as being driven by the large scale (Lorenz, 1955). We should aim to tap energy from the system in locations somewhat removed from the main loci of conversion from kinetic energy of the mean flow to eddy kinetic energy (as shown in the figures in Li et al., 2007). Since the jet is one of those centers, it may be that Miller et al. have placed their wind generators in exactly the worst place to tap wind energy without interfering with the sources of surface wind energy.

References:

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