

Interactive comment on “The problem of the second wind turbine – a note on a common but flawed wind power estimation method” by F. Gans et al.

Anonymous Referee #2

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This paper presents an analysis of the effects of inclusion or exclusion of kinetic energy consumption by $N=150$ wind turbines on the assessment of the overall wind power resource using a heuristic "tunnel" model. Of course, the sign of the effect of inclusion is obvious without any detailed modeling. Wind turbines remove non-turbulent kinetic energy. Therefore, absent infinitely rapid replenishment of near-surface kinetic energy (e. g. by downward transport from above), the turbines necessarily lower the resource. The authors' application of their heuristic model provides a semi-quantitative assessment, and the results are reasonable and serve to provide some useful insights into the behavior of a line of turbines arrayed along the prevailing wind direction. However, the tunnel model does not include the expected enhanced downward transport

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of momentum and kinetic energy that would help offset, at least in part, the affects of the extracted power. This would constitute an additional term in equation 5. This effect should be discussed in sections 2.1 and 2.2 and some quantitative aspects of it addressed.

The extension of the authors' discussion to much larger scales in section 2.3 is comparatively deficient. At the very large scale of deployment needed to generate, for example, 5TW of electric power globally, Wang and Prinn (2010), using a 3D general circulation climate model, have already shown that the resource (computed as the kinetic energy per unit mass in the boundary layer in the land installation regions) was reduced by 10-20% due to the installations (see their Figure 4 and associated text). Section 2.3 should include discussion of this work and whether or not the authors' analysis is consistent with it (note that Wang and Prinn appear in the references but are not cited in the text).

To better clarify which previous wind power studies have neglected wind power consumption on the resource, it would be useful to add "using observed or re-analysis wind fields" after "estimates" on line 1, and to place quotation marks around "common methodology" on line 25 and around "common method" on line 19 to differentiate them clearly from the Keith et al (2004) and Wang and Prinn studies that include consumption effects. Something is missing after "and" on line 14 (Wang and Prinn perhaps?).

Interactive comment on Earth Syst. Dynam. Discuss., 1, 103, 2010.

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