Geophysical Research Abstracts, Vol. 9, 04881, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04881

Downstream synoptic impact of time-varying windfarm roughness

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Keith et al. (2005) showed that large-scale wind-turbine installations could have an appreciable effect on equilibrium climate, including changes in surface temperature of up to 1 K. These effects turns out to be mostly due to a complicated interplay of changes in cloudiness and thermal advection caused by diversion of mean winds by the wind farms. In this work, we show that plausible time-dependent changes in wind farm characteristics (caused, for example, by a simultaneous change in the attitude of turbine blades over a wide region) can have significant remote impacts on the atmospheric circulations.

We use the NCAR Community Atmosphere Model to simulate the effect of a sudden change in wind farm roughness. The model is run for ten years with a large simulated wind farm installation in place. At monthly intervals, branch runs are launched in which the wind farm roughness is reduced by about 1/2. We then observed the divergence of the original run and the branch over the following 30 days. We find a characteristic pattern of Rossby wave radiation follows the instantaneous change in surface roughtness. This leads to, for instance, noticeable changes in storm size and strength downstream of the wind farm show within 5 days of the beginning of the branch run.