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Large eddy simulation study on the effect of vertical staggering in large-scale wind farms[1] RICHARD STEVENS, MARK ARENDSHORST, MENGQI ZHANG, University of Twente — We present results from large eddy simulations (LES) of extended aligned windfarms. We vary the hub height of consecutive downstream turbine rows in order to create vertically staggered windfarms and we study the effect of streamwise turbine spacing, turbine rotor diameter, and the hub height difference between consecutive rows on the average turbine power output. The results show that the production of the second turbine row increases when the first turbine row is lower than the second row. Consequently, we find that the average turbine power output increases significantly in the entrance region of the windfarm. However, we find that the relative benefit of vertical staggering, compared to the non-staggered case, decreases further inside the windfarm. The reason is that the vertical kinetic energy transfer, which brings high velocity fluid from above the windfarm towards the hub-height plane, does not significantly increase by vertically staggering wind turbines. This limits the potential benefit of vertical staggering in extended windfarms. We find, for a fixed hub height difference between consecutive rows, that vertical staggering is more beneficial for the average windfarm power output when the streamwise turbine spacing and turbine diameter are smaller.

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