Geophysical Research Abstracts
Vol. 19, EGU2017-18074, 2017
EGU General Assembly 2017


# Wind Farm Layout Optimization through a Crossover-Elitist Evolutionary Algorithm performed over a High Performing Analytical Wake Model

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Wind turbine wakes can significantly disrupt the performance of further downstream turbines in a wind farm, thus seriously limiting the overall wind farm power output. Such effect makes the layout design of a wind farm to play a crucial role on the whole performance of the project. An accurate definition of the wake interactions added to a computationally compromised layout optimization strategy can result in an efficient resource when addressing the problem. This work presents a novel soft-computing approach to optimize the wind farm layout by minimizing the overall wake effects that the installed turbines exert on one another.

An evolutionary algorithm with an elitist sub-optimization crossover routine and an unconstrained (continuous) turbine positioning set up is developed and tested over an 80-turbine offshore wind farm over the North Sea off Denmark (Horns Rev I). Within every generation of the evolution, the wind power output (cost function) is computed through a recently developed and validated analytical wake model with a Gaussian profile velocity deficit [1], which has shown to outperform the traditionally employed wake models through different LES simulations and wind tunnel experiments.

Two schemes with slightly different perimeter constraint conditions (full or partial) are tested. Results show, compared to the baseline, gridded layout, a wind power output increase between 5.5% and 7.7%. In addition, it is observed that the electric cable length at the facilities is reduced by up to 21%.

[1] Bastankhah, Majid, and Fernando Porté-Agel. "A new analytical model for wind-turbine wakes." Renewable Energy 70 (2014): 116-123.