A new wind-farm parameterization for large-scale atmospheric models

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In this study, a new model is developed to parameterize the effect of wind farms in large-scale atmospheric models such as weather models. In the new model, wind turbines in a wind farm are parameterized as elevated sinks of momentum and sources of turbulence. An analytical approach is used to estimate the turbine-induced forces as well as the turbulent kinetic energy (TKE) generated by the turbines inside the atmospheric boundary layer (ABL). In addition, the proposed model can take into account not only the effect of wind-farm density, but also the effect of wind-farm layout and wind direction. The performance of the new model is tested with large-eddy simulations (LESs) of ABL flows over very large wind farms with different turbine configurations. The results show that the new model is capable to accurately predict the turbine-induced forces as well as the TKE generated by the turbines inside the ABL.