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A generalized top down model for Equivalent Roughness of Fully Developed Wind Farm[1] HUAN ZHANG, MINGWEI GE, YONGQIAN LIU, State Key Laboratory of Alternate Electrical Power System with Renewable Energy Sources, North China Electric Power University, Beijing, China, 102206, XIANG I. A. YANG, Mechanical Engineering, Penn State University, State College, PA, USA, 16802 — In mesoscale numerical simulations, wind farms are often parameterized as surface roughness using the top-down model. The top-down model (Phys. Fluids 22 (1), 46–56) works well for fully developed wind farms with moderate turbine spacing but its performance deteriorates for farms with large streamwise or spanwise turbine spacing. In the present study, we propose a parameterization to characterize flow non-uniformity at the hub height. This parameterization is subsequently incorporated in the top-down model, and solved by coupling the Jensen model and the wake layer model to match the mean flow from the two models at the hub-height. Predictions of our model are compared with other models and a suite of large-eddy simulation (LES) data. We find that the new model is able to predict the equivalent roughness height of fully developed wind farms more accurately than the conventional top-down model.

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