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Numerical Simulation on the Local Impact of an Operating Wind Turbine

Wind energy is commonly considered to be a clean and environmentally friendly renewable energy resource, as they do not pollute our atmosphere with greenhouse gas, nor do they cause any radioactive problems compared to nuclear energy. However, there are still some environmental impacts due to the installation and operation of the wind turbines that cannot be ignored, such as noise, visual and climatic impact. Especially, the observed local climate change in some wind turbine areas has attracted general concern in recent years. Experts suspected that the a long time operation of the wind turbines in an area can cause changes to the local precipitation, the speed of the water evaporation of the earth surface, the frequency of the drought happens and so on. Nevertheless, we still cannot figure out whether these changes will be caused by wind turbines or not. Because of the big geometry size of the commercial wind turbine, the experiment method is very limited to conduct this research. Numerical simulation by CFD is considered to be a suitable approach to investigate the local impacts of an operating wind turbine. This paper provides an overview of the potential environmental impacts of wind turbines and describes a valid 3-D numerical simulation approach to model the operation of a wind turbine, in which the frozen blade method is used to model the rotation of the wind blades. In this research, a wind-tunnel test has been undertaken before the numerical simulation, which is to validate the wind turbine model and the research method in CFD computation. More, two inlets, wind inlet and rain inlet, are given in this modeling to effectively obtain and analyze the local impact on the environment, like effects on the wake flow, humidity, temperature and direction of rain drop of the operating wind turbine.