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Numerical study of ocean wave effect on offshore wind farm[1] LIAN SHEN, Department of Mechanical Engineering and St. Anthony Falls Laboratory, University of Minnesota, DI YANG, CHARLES MENEVEAU, Department of Mechanical Engineering, Johns Hopkins University — Wind power at sea has become increasingly important in renewable energy study. For energy harvesting, winds over oceans have many advantages over winds on land, for example, larger and open surface area, faster wind speed, and more wind resource close to high population regions. On the other hand, the presence of ocean waves introduces complexities to wind turbines. There is a critical need to study the dynamical interactions among marine atmospheric boundary layer, ocean wave field, and floating turbines. In this research, we study offshore wind farm by performing large-eddy simulations for winds coupled with potential-flow-theory based simulations for broadband irregular waves, with the wind turbines represented by an actuator disk model. Our results show that windseas at different development stages result in different sea-surface roughness and have an appreciable effect on wind profile and the energy extraction rate of the turbines. If swells are present, swell-to-wind momentum and energy transfer further changes the wind field to introduce oscillations in as well as modify the mean of the wind power.

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