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A study on the shielding effects among wind-power generators in a floating wind farm

Ryu Ogata, Hiroshi Kagemoto, Tsuguki Kinoshita, Yoshiaki Akutsu and Takayoshi Kato

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Summary: As the wind power is now considered as one of the most promising renewable energy resources, the total amount of electricity produced worldwide by wind-power generators is increasing quite rapidly. In Japan, since land spaces suitable for wind-power generations are quite limited, the feasibility of wind-power generations in offshore areas is now being studied extensively. Among various possible types of offshore wind-power generations, a floating wind farm, which consists of large floating structures and an array of wind-power generators mounted on each of the floating structures is considered to be an adequate type for Japan because the water depth tends to become large steeply even in the close proximity of shores. It is known that, in such a floating offshore wind farm, the construction cost of the floating structures, on which an array of wind-power generators are to be mounted, accounts for a major part of the total construction cost. It is therefore quite vital for the reduction of the power-generation cost that the number of wind-power generators mounted on a unit area of a floating structure could be increased. On the other hand, however, a larger number of wind-power generators per unit area of a floating structure usually results in the lower amount of average power produced by each generator, because the wind speed incident to power-generating blades tends to be reduced due to the shielding effects among the congregated wind-power generators.
In the present study, the shielding effects among the generators in an offshore floating wind farm are investigated through extensive experiments and the trade-off effects on the generation cost due to the increase of the number of generators mounted on a unit area of a floating body and the increase of the shielding effects among generators are quantified. It has been found out through the experiments that the interaction effects between adjacent wind-power generators when they are placed side-by-side against wind direction are much smaller than generally conceived, and thus wind-power generators could be mounted in an

offshore wind farm with significantly higher density than that of conventional wind farms. Finally, an offshore floating wind farm free from the shielding effects among the mounted generators is proposed.