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On the effects of turbine geometry on the far wake dynamics of an axial flow hydrokinetic turbine[1] FOTIS SOTIROPOULOS, XIAOLEI YANG, St. Anthony Falls Laboratory, Dept. of Civil Engineering, University of Minnesota, SEOKKOO KANG, Dept. of Civil Engineering, Hanyang University, South Korea — In large-eddy simulation (LES) of multi-turbine arrays actuator disk (AD) or actuator line (AL) models are employed to simulate individual turbines. Such parameterizations do not take into account the details of the turbine geometry and, therefore, cannot be expected to accurately resolve the flow in the near wake. We investigate the performance of AD and AL models by comparing their predictions with laboratory measurements and with LES resolving the geometrical details of the turbine. We simulate the flow past an axial flow hydrokinetic turbine in a fully-developed turbulent flow in an open channel using: turbine-geometry resolving LES (LES-TG) and LES-AD and LES-AL parameterizations. We show that LES-TG reveals very complex large-scale dynamics in the near wake, driven by the interaction of a counter-rotating to the turbine hub vortex and the top-tip shear layer, which appears to influence both the mean flow characteristics and the intensity of wake meandering several rotor diameters downstream. The LES-AD and LES-AL results cannot capture the geometry-induced complex near wake phenomena and yield flows that exhibit important differences with the LES-TG results in the far wake. The mechanisms that give rise to and modeling implications of these differences will be discussed.

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