Abstract Submitted
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Advancing marine hydrokinetic turbine arrays towards large-scale deployments in sandy rivers: a laboratory study.[1] MIRKO MUSA, St. Anthony Falls Lab, CEGE, University of Minnesota, CRAIG HILL, University of Washington, MICHELE GUALA, St. Anthony Falls Lab, CEGE, University of Minnesota — A staggered array of twelve axial-flow marine hydrokinetic (MHK) turbine models was investigated at the St. Anthony Falls Laboratory under live-bed sediment transport conditions. In particular, the interaction between the MHK power plant and the complex migrating bedforms was monitored using a state-of-the-art high-resolution submersible laser scanning device able to provide spatio(x,y)-temporally(t) resolved channel bathymetry z(x,y,t). Results revealed both a local signature of each individual turbine and a cumulative array effect that extends farther from the site. Single turbine localized scour results from the blockage effect of the operating rotor and the consequent flow acceleration between the lower rotor tip and the erodible bed. The resultant shear stress enhancement around the device protects the turbine during extreme sediment transport conditions, ultimately preventing the blades from impacting the incoming bedforms. A turbine failure case was simulated to illustrate the consequence of such event, which can irreversibly bury and damage the turbine. Additionally, velocity and turbine performance estimates provided a preliminary description of the power plant energy output, revealing similar features already observed in experimental wind farm models.

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Mirko Musa
St. Anthony Falls Lab, CEGE, University of Minnesota

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