Abstract Submitted
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Meandering patterns in the wake of horizontal-axis wind and river turbines[1] MICHELE GUALA, KEVIN HOWARD, ARVIND SINGH, CRAIG HILL, MIRKO MUSA, CHRISTOPHER FEIST, FOTIS SOTIROPOULOS, CEGE, SAFL University of Minnesota - Minneapolis — Energy harvesting devices with rotor axis oriented with the flow generate a wake which is unstable due to the complex interactions among turbulent structures from the incoming flow, root, hub and tip vortices (see Foti et al. APS/DFD 2014). Experiments in wind tunnel and open-channel flow with erodible surface show similar meandering patterns in the velocity field, which are responsible for the far wake expansion and the incoming turbulence experienced by down-wind/stream units. Wake meandering statistics were observed to depend on the operating turbine conditions (tip speed ratio), upstream device siting (turbine – turbine interaction) or specific turbine kinematics (floating turbine under waves). In addition, for wall boundary conditions defined by an erodible surface, where sand grains respond to local shear stress by moving (erosion) or settling (deposition), turbines were observed to induce dynamic topographic perturbations also exhibiting meandering patterns. This occurred in limited mobility conditions and under migrating bedforms, with large scale topographic features amplified under specific asymmetric turbine configurations. The work opens up the possibility to place turbines in complex flows optimizing their performance while maintaining, or reshaping, the surrounding topography by specific control or siting strategies.

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