Abstract Submitted
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Large-eddy simulation of wind turbine wake interactions on locally refined Cartesian grids[1] DIONYSIOS ANGELIDIS, FOTIS SOTIROPOULOS, St. Anthony Falls Laboratory, Department of Civil Engineering, 2 Third Avenue SE, Minneapolis, MN 55414, USA — Performing high-fidelity numerical simulations of turbulent flow in wind farms remains a challenging issue mainly because of the large computational resources required to accurately simulate the turbine wakes and turbine/turbine interactions. The discretization of the governing equations on structured grids for mesoscale calculations may not be the most efficient approach for resolving the large disparity of spatial scales. A 3D Cartesian grid refinement method enabling the efficient coupling of the Actuator Line Model (ALM) with locally refined unstructured Cartesian grids adapted to accurately resolve tip vortices and multi-turbine interactions, is presented. Second order schemes are employed for the discretization of the incompressible Navier-Stokes equations in a hybrid staggered/non-staggered formulation coupled with a fractional step method that ensures the satisfaction of local mass conservation to machine zero. The current approach enables multi-resolution LES of turbulent flow in multi-turbine wind farms. The numerical simulations are in good agreement with experimental measurements and are able to resolve the rich dynamics of turbine wakes on grids containing only a small fraction of the grid nodes that would be required in simulations without local mesh refinement.

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