Urban DES Windfield Simulations of the University Campus in Tübingen

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Abstract

Small wind turbines in urban areas can increase the local production of renewable electric energy close to the customer with high energy demand. This enables a leaner design of the electric infrastructure and the distribution network. For the design of small urban wind turbines Detached Eddy Simulations (DES) simulations are chosen for an efficient way to resolve the turbulent eddies in the wind flow which are necessary to simulate the loads of a wind turbine. The simulation consists of a two-step approach with an outer larger domain (1), representing the urban district, and a smaller inner domain (2) with the buildings of interest including the wind turbine. The results from domain 1 are transferred onto the inlet plane as a boundary condition of domain 2. In order to test and validate the simulations a LiDAR (Light Detection And Ranging) campaign is performed by the SWE (Stuttgart Wind Energy) at the university campus in Tübingen to measure the wind speeds in several planes upstream of the building complex. These data should be used to define a transient boundary condition for the DES simulation inflow plane. Since the complex terrain is taken into account the usual assumptions applied for offshore or flat grounds cannot be used here to reconstruct the 3D wind field from LiDAR data. Additional simulations are performed to obtain the vertical velocity components and the wind direction for a proper wind field reconstruction. The reconstructed LiDAR data are prepared and transferred onto the inlet plane of the computational domain. The simulation is validated with the Lidar data measured downstream of the building sector.

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