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Large-eddy simulation of the flow in downtown Oklahoma City[1]
CATHERINE GORL, Stanford University, CLARA GARCA-SNCHEZ, Stanford University / von Karman Institute — CFD modeling of urban canopy flow is of interest for a variety of applications, ranging from pedestrian wind comfort and air quality, to wind loading on buildings. The complexity of the flows complicates validation of simulation results, and uncertainty quantification (UQ) is indispensable to draw conclusions on the predictive capabilities of numerical tools. In previous work, we investigated inflow and turbulence model form UQ for the flow in Oklahoma City, comparing the results to field measurement data from the Joint Urban 2003 measurement campaign. In the present study, we performed a LES of the same configuration to further investigate the turbulence model form uncertainties, and determine opportunities for improving the predictions using high-fidelity simulations. Quantitative comparison of the LES results and the experimental data for mean velocity showed some local improvements compared to RANS, especially for the velocity magnitude. However, when comparing the results at all available measurement stations, a similar performance for the LES and RANS was found. The LES does capture the turbulence spectra at the measurement locations well, which is a substantial benefit over RANS for applications that need accurate predictions of the turbulence statistics. The lack of an improvement in the mean prediction with LES occurs particularly in areas that were previously shown to have a large uncertainty related to the inflow boundary condition in RANS.

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