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Roughness model for LES of turbulent flow over multiscale fractal urban-like topography. XIAOWEI ZHU, WILLIAM ANDERSON, UT Dallas — Urban-like topographies are composed of a wide spectrum of topographic elements, which results in a multiscale, fractal-like surface height distribution. This presents unique challenges for large-eddy simulation (LES), since the corresponding low-pass filtered details of the topography are spatially resolved, while affects associated with the high-pass filtered topography must be modeled with some closure. For truly fractal landscapes, we show that the affects of descendent topographic generations of terrain can be captured through application of the equilibrium logarithmic law. In the present study, LES has been used to investigate flow over fractal-like topographies, where the number of topographic generations and fractal dimension were systematically varied. For any fractal dimension, the roughness length increases dramatically for the first few generations, before converging to a constant value. To leverage the self-similar nature of the fractal-like topography, we demonstrate that a fixed constant of proportionality can be used a priori to relate roughness length and root-mean-square topographic height, topography skewness, and fractal dimension. We validate the model by accurately predicting mean streamwise velocity profiles.

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