Abstract Submitted
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A dynamic subgrid-scale parameterization of the effective wall stress in atmospheric boundary layer flows over multiscale, fractal-like surfaces[1] WILLIAM ANDERSON, Johns Hopkins University, CHARLES MENEVEAU, Mechanical Engineering and Center for Environmental and Applied Fluid Mechanics, Johns Hopkins University — A dynamic subgrid-scale parameterization for hydrodynamic surface roughness is developed for large-eddy simulation (LES) of atmospheric boundary layer (ABL) flow over multiscale, fractal-like surfaces. The model is tested on surfaces generated through superposition of random-phase Fourier modes with prescribed, power-law surface-height spectra. Surfaces are generated at fine-grained resolution and subsequently spatially filtered to various affordable LES resolutions. The lower boundary condition is prescribed based on the logarithmic law of the wall, where the unresolved roughness from the fractal surface is modeled as the product of local root- mean-square (RMS) of the unresolved surface height and an unknown dimensionless model coefficient. This coefficient is evaluated dynamically by comparing the plane- average wall-stress at two resolutions (grid- and test-filter scale, Germano et al., 1991). The results show that the method yields convergent results and correct trends. Limitations and further challenges are highlighted.

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