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Scaling and dynamics of turbulent flows over sparse canopies AKSHATH SHARMA, RICARDO GARCIA-MAYORAL, University of Cambridge — We study turbulent flows over sparse canopies using direct numerical simulations. We find that these canopies affect the surrounding flow via two mechanisms. The first is through the flow induced by the presence of the canopy elements. The second, which can dominate, is through a change in scale for the background turbulence. When the element-induced flow is filtered out, the remaining background turbulence exhibits a balance of the viscous and the Reynolds shear stresses within the canopy layer similar to that over smooth walls. We propose a scaling for the background turbulence based on the sum at each height of the viscous and the Reynolds shear stresses, τ_f, as in Tuerke & Jimenez (2013). Using this scaling, the background-turbulence fluctuations within the canopies also show similarities to those over smooth walls. This suggests that the background turbulence scales with τ_f at each height, rather than the conventional scaling based on the total stress. We show that this effect can be captured by substituting the canopy by a drag that acts on the mean flow alone, aiming to produce the correct τ_f without modifying the fluctuations directly. This forcing produces better estimates for the turbulent fluctuations than a conventional, homogeneous-drag model.

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