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Coherent structures and momentum transport at various scales above an array of multiscale structures[1] KUNLUN BAI, JOSEPH KATZ, CHARLES MENEVEAU, Johns Hopkins University — Detailed PIV measurements are carried out to study the turbulence and coherent structures at various scales above a canopy composed of multiscale fractal tree-like objects. The fractal tree has five generations, each consisting of three branches. To study the turbulent structures and momentum transport at large scales, quadrant analysis of fluctuation velocity is carried out. It shows that close to the canopy, sweeping events have larger contribution to the Reynolds shear stress than ejections. Away from the canopy, on the other hand, sweeping contributes less to shear stress than ejection. When the ejection is at present, the flow is disturbed greatly, and the inclined angle of vortices packets can be more than 30 degree. Close to the canopy, the correlation spectrum , i.e. $-E_{uw}/(E_{uu}E_{ww})^{0.5}$ (where E_{uw} is the co-spectrum and E_{uu} and E_{ww} are spectra of streamwise and vertical velocities, respectively), first decreases and then lifts up as wavenumber increases or scale decreases. It indicates the presence of small-scale coherent structures close to the canopy that contribute, at small scales, to momentum transport. A physical space filtering technique is applied to the velocity field to study such structures and the associated large-scale flow patterns.

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