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Flow within and above heterogeneous and homogeneous canopies. ALI M. HAMED, MATTHEW J. SADOWSKI, LEONARDO P. CHAMORRO, University of Illinois at Urbana-Champaign — The flow development above and within homogeneous and heterogeneous canopies was studied using planar and stereo PIV in a refractive-index-matching open channel. The homogeneous model is constituted of elements of height h arranged in staggered configuration; whereas the heterogeneous canopy consisted of elements of two heights h1 = h + 1/3 h and h2 = h - 1/3 halternated every two rows. Both canopies had the same roughness density, element geometry, and mean height. The flow was studied under three submergences H/h =2, 3, 4, where H denotes the flow depth. Turbulence statistics complemented with quadrant analysis and proper orthogonal decomposition reveal richer flow dynamics induced by height heterogeneity. Topography-induced spatially-periodic mean flows are observed for the heterogeneous canopy. In contrast to the homogeneous case, non-vanishing vertical velocity is maintained across the entire length of the heterogeneous canopy with increased levels at lower submergence depths. The results indicate that heterogeneous canopies exhibit greater vertical turbulent exchange at the canopy interface, suggesting a potential for greater scalar exchange and greater impact on channel hydraulic resistance.

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