

**Spatially-averaged flow statistics
within a canopy of large bluff bodies:
Results from direct numerical simulations**

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A b s t r a c t

The flow within a canopy of large bluff bodies is highly turbulent and spatially heterogeneous. Results from direct numerical simulations over groups of cubical obstacles are analysed using the double-averaging methodology. The obstacles occupy a significant fraction of the canopy space; this gives rise to substantial dispersive stresses within the canopy. The underlying bluff-body turbulent dynamics is different from typical canopy turbulence, and this is reflected in the double-averaged statistics. The spatially-averaged velocities, stresses and drag force depend significantly upon the layout of the obstacles. An ongoing challenge is to parameterise these spatially-averaged quantities in terms of the obstacle geometry and layout.

Key words: bluff bodies, direct numerical simulations, double-averaging methodology, rough-wall channel flow, turbulent channel flow.