Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Scale interactions in velocity and pressure over urban-like roughness MANUEL FERREIRA, BHARATHRAM GANAPTHISUBRAMANI, University of Southampton — An integral description of a boundary layer developing over a large-cube array is obtained using velocity data to reconstruct the underlying pressure field via 2D-TH. Coupled-statistics of the pressure forces acting on a target roughness element provide insight into the relevant mechanisms responsible for surface drag. This is complemented by conditional analysis and extended POD of the pressure field based on velocity modes to further understand the velocity-pressure interrelations. Coherent motions, at different scales, leave a strong imprint on the pressure field. Larger turbulent features dominate pressure variance, but their direct contribution to surface drag appears to be mitigated by the relative size of the roughness obstacles that are considerably smaller. Pressure waves induced by the passage of alternating high and low-momentum regions evenly affect the flow field over a wide region, coupling the forces on the windward and leeward sides of the cube which, in turn, partially cancel each other out. This suggests that uncorrelated, intermediate and small-scale pressure fluctuations are more important to the drag force variance. Large-scale structures are nonetheless significant for the role they play in modulating the small-scale pressure events in the near wall region.

Manuel Ferreira
University of Southampton

Date submitted: 01 Aug 2019 Electronic form version 1.4