Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

A Study of the Mean Force Structure of Rough-Wall Turbulent Boundary Layers[1] FARAZ MEHDI, JOSEPH KLEWICKI, University of New Hampshire — Analysis of existing data by Mehdi, Klewicki & White [Physica D 239(2010)] provides evidence that the traditional classifications do not fully account for the combined effects of roughness and Reynolds number. We continue to explore this further, and in the present talk report on experiments that used 24-grit sandpaper and pea gravel for roughness over an 8m fetch. Two-component LDV measurements are used to acquire well-resolved mean velocity and Reynolds stress profiles over a modest range of Reynolds numbers. These data are used to estimate the terms in the appropriate mean statement of dynamics, which directly reveals the operative time-averaged balance of forces. The present results further reinforce the previous observation that the mean viscous force retains dominant order above (and often well-above) the roughness elements. Force balance data are shown to be usefully organized relative to the length scale that defines the region from the wall to where the leading order mean dynamics are described by a balance between mean advection and the mean effect of turbulent inertia. In the smooth-wall flow, this length scale is only a function of Reynolds number. In rough-wall flows, the data indicate it to be a function of roughness and Reynolds number.

[1]The support of the ONR (N000140810836, grant monitor Ronald Joslin) is gratefully acknowledged.

Faraz Mehdi
University of New Hampshire

Date submitted: 02 Aug 2011 Electronic form version 1.4