Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Assessing the role of spanwise roughness heterogeneity and establishing conditions for application of Townsend's hypothesis of outer-layer similarity.[1] JIANZHI YANG, WILLIAM ANDERSON, UT Dallas — In the present work, turbulent secondary flows in turbulent channel flows are forced by virtue of passive-actuator-like topographic features. The topographies are constructed with streamwise-repeating pyramidal topographic elements which create "rows" with infinite streamwise extent; then, the spacing between such rows is systematically varied. The spanwise spacing is varied from 0.2 to 6.4. For spanwise spacing exceeding double the channel half-height, free domain-scale secondary flows are observed. The domain-scale secondary flows exist in the Reynolds-averaged statistics, and remain permanently positioned such that downwelling and upwelling occurs above the elements and flat region, respectively (i.e., we have introduced low- and high-momentum pathways; Ken Christensen et al.). At the element scale, counter-rotating vortices flank the roughness elements, with rotational sign opposite to the larger-scale circulations. When spanwise spacing is less than double the channel half-height, the domain-scale secondary flows attenuate, while the element-scale secondary flows remain for all spacings. Since the domain-scale circulations alter the outer-layer turbulence statistics, we are working to assess spacing as a control on the efficacy of Townsend's hypothesis of outer-layer similarity in turbulent channel flow.

[1]Air Force Office of Scientific Research, Grant FA9550-14-1-0394

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Date submitted: 20 Jul 2016 Electronic form version 1.4