Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Atmospheric boundary layer flow over transverse roughness transitions: induced mixing and flow characterization DAVID WILLINGHAM, WILLIAM ANDERSON, Baylor University — The response of turbulent atmospheric boundary layer flow to abrupt surface roughness heterogeneities has been discussed extensively in previous literature. However, many prior studies exclusively consider cases in which the streamwise flow is aligned perpendicular to the roughness heterogeneity, representing the noted smooth-to-rough or rough-to-smooth transition. This work seeks to identify the affects of parallel-aligned roughness transitions on turbulent boundary layer flow and determine whether these effects are non-negligible. To this end, a set of large eddy simulations have been performed over surfaces composed of parallel strips of high roughness adjacent to low roughness. The width of these strips, as well as the ratio of high to low roughness lengths were systematically varied between simulations. Close to the surface, there is a transverse gradient in streamwise velocity owing to the differing roughness lengths, and this gradient induces transverse mixing which serves to introduce an important secondary flow in the boundary layer. Low and high momentum pathways (Mejia-Alvarez et al.) are observed to form in the upper region of the boundary layer above the low and high roughness regions, respectively. Associated with this is the formation of boundary layer-scale counter-rotating vortices, adjacent to the high roughness strips. Interestingly, we find that even modest differences between the high and low roughness length is adequate to induce this process.

William Anderson
Baylor University

Date submitted: 05 Aug 2013 Electronic form version 1.4