Abstract Submitted
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Turbulent boundary layer over a grooved bump[1] EDGARDO GARCIA, ERIC STOUT, FAZLE HUSSAIN, Texas Tech Univ — The dynamics of a turbulent boundary layer over a bump due to passive surface modulations (i.e. longitudinal square grooves on a bump) are studied by DNS of a channel flow using the immersed boundary method. Mean (spanwise averaged) and phase-averaged flow statistics at several streamwise positions before, on, and after a bump are compared with those for a smooth bump. Surprisingly, the separated region on the rear of the bump is (z-averaged) 70% larger due to reversed flow persisting within the grooves; for only above the grooves, the separated region is 15% smaller. The peak turbulence production is shifted downstream 100 wall units and the magnitude of the peak decreases by 15%. The grooves cause 0.5% skin-friction drag reduction and 13% form drag reduction as compared to the smooth bump. We find that upstream of the bump, flow enters the grooves and leaves them downstream; on the rear of the bump, the departure point in the grooves is upstream of the separation bubble on top of the grooves. This variation in the detachment point causes quasi-periodic streamwise vortical structures, which are shed from the corners of the grooves in the rear of the bump, that increase wall-normal momentum transport. These interactions between grooves and bumps enables better understanding of flows over sand dunes and mountains.

[1]Numerical simulations were performed on the Texas Advanced Computer Center

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