

Abstract Submitted  
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**LES of channel flow with wall roughness** N. SAITO, D.I. PULLIN, California Institute of Technology, H.M. BLACKBURN, Monash University — We describe LES, using a spectral-element method, of turbulent channel flow with sub-grid wall roughness at moderate to large Reynolds numbers. The wall-model of Chung and Pullin (*JFM*, 2009) is extended to account for local subgrid roughness by the addition of a single empirical roughness function  $u_\tau \Delta^+(k_s^+)$ , where  $k_s^+ = k_s u_\tau / \nu$  and  $k_s$  is the equivalent sand roughness. This term is used in both the inner-scaling ansatz used to reduce the unsteady term of the wall-normal integration of the stream-wise momentum equation and also in the derivation of the “log-like” profile used to provide the outer slip velocity, as a boundary condition for the LES, at a raised virtual wall. In these LES, standard expressions for  $\Delta^+(k_s^+)$  of the Colebrook type are used. The LES produce results that include the mean velocity profile and some turbulence statistics as a function of Reynolds number for fixed ratio of  $k_s$  to the channel half height.

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