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Amplitude modulation of streamwise velocity fluctuations in the roughness sublayer: evidence from large-eddy simulations[1] ANKIT AWASTHI, WILLIAM ANDERSON, UT Dallas — Large-scale motions in the logarithmic region of turbulent boundary layers amplitude modulate the viscous sublayer (Marusic et al., 2010: Science; Mathis et al., 2009: J. Fluid Mech.). This finding has promising implications for large-eddy simulation of wall-bounded turbulence at high Reynolds number (wherein the turbulence integral length exhibits linear proportionality with wall-normal elevation). Existing amplitude modulation studies have addressed smooth wall flows, though high Reynolds number rough wall flows are ubiquitous. Under such conditions, roughness-scale vortices ablate the viscous sublayer and result in the roughness sublayer. The roughness sublayer depth scales with aggregate element height, k, and is typically 2k $\sim$ 3k. Above this, Townsend's Hypothesis dictates that the logarithmic layer is unaffected by the roughness sublayer. Here, we present large-eddy simulation results of turbulent channel flow over rough walls. We follow the decoupling procedure of Mathis et al., 2009: J. Fluid Mech., and present evidence that outer-layer dynamics amplitude modulate the roughness sublayer. Below the roughness element height, we report enormous sensitivity to element proximity. Above the elements, but within the roughness sublayer, topography dependence rapidly declines.

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