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The Transition in Structure of the Atmospheric Boundary Layer from Neutral with Surface Heating JAMES BRASSEUR, BALAJI JAYARAMAN, Penn State University — The scales, strengths and detailed structure of atmospheric boundary layer (ABL) turbulence are strongly dependent on the relative contributions of buoyancy-driven vertical motions from surface heating and shear driven motions from geostrophic winds at the mesoscale, as characterized by the global stability state parameter $-z_i/L$. In the shear-dominant neutral limit, the ABL is characterized by streamwise-elongated coherent eddies of negative fluctuating horizontal velocity As surface heating is increased, buoyancy drives vertical fluctuations strongly correlated with shear-driven motions that eventually organize to generate streamwise rolls that couple upper with lower boundary layer. We use large-eddy simulation (LES) to study this transition between "near neutral" and "moderately convective" by quantifying correlations and integral scales as a function of -z_i/L.The interactions between outer and the surface layer eddies generate surprising turbulence dynamics that includes a special transitional stability state with unusually enhanced streamwise coherence. The transitional process includes a critical phenomenon with sudden dramatic change in ABL structure, and high sensitivity in horizontal fluctuations to surface heating at a low $-z_i/L$. *Supported by DOE.*

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