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Avalanche of drag-inducing near-wall vortices due to streak transient growth in turbulent channel flow ERIC STOUT, Texas Tech University, XUERUI MAO, University of Nottingham, FAZLE HUSSAIN, Texas Tech University — A key question in turbulent boundary layers is the evolutionary dynamics of the coupling of near-wall streamwise vortices and streaks. A single low-speed streak in a large (L_x^+ =900 by L_z^+ =900) channel flow is triggered with the typical spanwise perturbation to excite streak transient growth (STG) at Re_τ =220, and reveals an avalanche of streamwise vortices, as well as very long structures. Development of hairpin vortices, hook vortices, arched vortices, and very long streamwise vortices (VLSM, much longer than x^+ of 300) reveal the avalanche dynamics involved in the spread and development of the near-wall structures. Lift up of near-wall fluid by the streamwise vortices generate new streaks and hence STG, revealing a sequence of dynamical events involving complex interactions between streaks and streamwise vortices, undiscovered in previous studies. The interaction between the growing streamwise vortices and the quiescent regions aid in understanding the growth of near-wall dynamics, even also of turbulent spots. Visualization reveals evolution of very long streamwise vortices – a promising finding that may reveal the enigmatic genesis and dynamics of VLSM in turbulent boundary layers.

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