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Structure and spectra of self-sustaining turbulence in a restricted nonlinear model[1] DENNICE F. GAYME, VAUGHAN THOMAS, Johns Hopkins Unversity, BRIAN FARRELL, Harvard University, PETROS IOANNOU, University of Athens — In this work we study a restricted nonlinear (RNL) model for plane Couette flow. This model is derived directly from the Navier Stokes equations and permits higher resolution studies of the dynamical system associated with the stochastic structural stability theory (S3T) model, which is a second order approximation of the statistical state dynamics of the flow. The RNL system was previously shown to exhibit self-sustaining turbulence that closely resembles DNS of turbulence but has the computational advantage of being supported by a small number of streamwise modes. Here, we further examine the structures underlying RNL turbulence. In particular, we focus on the roll and streak structures that are known to be critical in the self-sustaining process of wall-turbulence. We compare the RNL structures to those obtained from DNS by examining the temporal spectra of their streak and roll energies as well as the spectral densities of these structures at different wall-normal positions. The results show close correspondence between the structure and spectra of the rolls and streaks as well as agreement between the mean velocity profiles obtained from RNL simulations and DNS.

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