Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Eddy-Based Model for Wall-Bounded Turbulent Flows[1] BRIAN ROSENBERG, ALEXANDER SMITS, Princeton University, SEAN BAILEY, University of Kentucky — Here we extend the wall-bounded turbulence model of Smits (2008). The original model identifies three eddy motions ubiquitous in wall-bounded flows and captures their energy scaling in wavenumber space. The coherent structures identified are near-wall longitudinal vortex-like streaks, the Large Scale Motions related to packets of hairpin vortices, and the Very Large Scale Motions, interpreted as either outer-layer bulges in boundary layers or meandering superstructures in internal flows. The three eddy functions are summed, neglecting nonlinear interactions, and the Reynolds stress behavior is obtained by integrating over all wavenumbers. While the original model utilizes Gaussian representations of the eddy motions in wavenumber space, we instead construct wavelet-based representations in physical space. The new eddy functions are expected to offer a better physical basis for modeling since the velocity signatures of simple eddies closely resemble wavelets. Simulations at various Reynolds numbers are then compared with the original model and experiments.

[1]Supported under AFOSR Grant FA9550-09-1-0569.

Brian Rosenberg
Princeton University

Date submitted: 03 Aug 2010 Electronic form version 1.4