Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Characteristics of 1d spectra in finite-volume large-eddy simulations with 'one-dimensional turbulence' subgrid closure RANDY MCDERMOTT, University of Utah — In this talk we illuminate the reasons behind curious characteristics of the one-dimensional (1d) spectra for coupled 'one-dimensional turbulence' (ODT) and large-eddy simulations (LES) and propose a means of correcting the "spectral dip" in the ODT transverse 1d spectrum. When the ODT model of Kerstein et al. [JFM 2000] is used as a subgrid closure for LES the characteristics of the three-dimensional (3d) LES spectrum significantly impact the shape of the ODT 1d spectra in the wavenumber range close to the LES grid Nyquist limit. For isotropic fields the 1d spectra (e.g., E22(k1)) will contain contributions from the 3d spectrum, E(k), from wavenumbers k = k1 to k = infinity. If the LES field is filtered using a spectral cutoff, Gaussian, or box filter then the attenuation of the 3d spectrum at high wavenumbers produces a "spectral dip" in the ODT 1d spectrum near the LES Nyquist limit. This problem can be alleviated by using a different LES filter kernel. Fortuitously, the resulting shape (i.e., "implied filter") of the 3d spectra produced by the Harlow and Welch numerical method [Phys. Fluids 1965] (i.e., second-order staggered energy conserving scheme without explicit filtering) eliminates the dip problem.

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Date submitted: 15 Aug 2005 Electronic form version 1.4