Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Designing LES of the High Reynolds Surface Layer to Account for Numerical Friction in the Algorithm. JAMES BRASSEUR, GANESH VIJAYAKUMAR, Penn State Univ, MATTHEW CHURCHFIELD, NREL, ADAM LAVELY, Penn State Univ, ERIC PATERSON, PATRICK MORIARTY, NREL — Numerical friction stabilizes large-eddy simulation (LES), but also impacts accuracy. We explore this issue using a theory (Brasseur & Wei 2010) where the LES is designed in a 3-parameter space that quantifies the level of friction in the SFS stress model (Re_{LES}), the relative content of resolved to SFS stress ($\Re$), and surface layer resolution. To achieve law-of-the-wall in the mean, the LES must be in the "high-accuracy zone" (HAZ) of the $\Re - Re_{LES}$ parameter space. Using rough-wall channel flow and atmospheric boundary layer LES, we analyze simulations that are identical except for spectral vs. finite volume (FV) algorithms. Numerical friction shifts the LES away from the HAZ in the $\Re - Re_{LES}$ parameter space consistent with changes in mean shear-rate. The effective low pass filter from numerical friction shifts the total stress from resolved to subfilter-scale contributions, and effect that is more apparent when the spectral version of the LES is in the HAZ. A consequence is the enhancement of streamwise coherence in turbulence structure, particularly apparent in the integral scales. We shall discuss the requirements to adjust the FV LES to match a corresponding spectral LES in the HAZ, and differences in efficiency and accuracy. *Support: NSF, DOE.*

James Brasseur
Penn State Univ

Date submitted: 05 Aug 2011 Electronic form version 1.4