A new anisotropic dynamic model for LES: Application to stable boundary layers

F. Porté-Agel (1,2,3), R. Stoll (1,3) and L. Chamorro (1,3)

(1) Saint Anthony Falls Laboratory, Minneapolis, USA, (2) National Center for Earth-surface Dynamics, (3) Department of Civil Engineering, University of Minnesota, Minneapolis, USA (contact: fporte@umn.edu)

Flow anisotropy associated with stably stratified conditions poses an important burden on subgrid-scale (SGS) models used in Large-Eddy Simulations (LES). Eddy-viscosity/diffusivity SGS models often assume near-isotropic flow conditions at the subgrid scales. However, this assumption breaks down in highly stratified regions, where the flow is anisotropic even at relatively small scales. In this study, an anisotropic subgrid-scale eddy-viscosity/diffusivity model is introduced and tested in simulations of the GABLS LES intercomparison case (Beare et al., 2006). The model coefficients for both the SGS stresses and heat fluxes are calculated dynamically. The new model yields turbulence statistics (averages, fluxes and spectra) that are more realistic and less resolution dependent than the ones obtained with standard (isotropic) dynamic models.