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A modulated gradient model for large-eddy simulation: application to a neutral atmospheric boundary layer[1] HAO LU, FERNANDO PORTE-AGEL, Dept. Civil Engr., UMN — It is known that in LES of high-Re atmospheric boundary layer (ABL), standard eddy-viscosity models poorly predict mean shear in the near-wall region and yield erroneous velocity profiles. A modulated gradient model is proposed. It is based on the Taylor expansion of the SGS stress and uses local equilibrium hypothesis to evaluate the SGS kinetic energy. To ensure numerical stability, a clipping procedure is used to avoid local backscatter. Two approaches are considered to specify the model coefficient: a constant value of 1, and a simple correction to account for the effects of the clipping procedure on the SGS energy production rate. The model is assessed through a systematic comparison with well-established empirical formulations and theoretical predictions of a variety of flow statistics in a neutral ABL. The statistics of the simulated velocity field obtained with the model show good agreement with reference results and a significant improvement compared to simulations with standard models. For instance, it is capable to reproduce the expected log-law profile and power-law energy spectra. It also yields streaky structures and near-Gaussian PDFs of velocity in the near-wall region.

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