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One-equation LES modeling of rotating turbulence HAO LU, CHRISTOPHER RUTLAND, Department of Mechanical Engineering, University of Wisconsin - Madison, LESLIE SMITH, Department of Mathematics, Univeristy of Wisconsin - Madison — Experiments and DNS of rotating turbulence forced at small scales exhibit transfer of energy to large scales in the form of cyclonic vortical columns. We examine the ability of various LES sub-grid stress (SGS) models to reproduce this phenomenon. In particular, one-equation SGS models allow the input of sub-grid kinetic energy that can be transferred to resolved scales via a production term. We have studied SGS models from two main perspectives: (i) consistency with the constraints of material frame indifference (MFI), and (ii) the capability to capture the cyclonic vortices. Two MFI one-equation SGS models that require no assumptions regarding isotropy are tested and compared with the Smagorinsky model, the dynamic Smagorinsky model, the scale-similarity model, the gradient model and the sub-grid kinetic energy viscosity model. In a-priori tests of isotropic decay and forced rotation, the new models perform better when comparisons are made of the regression coefficients. The models also perform better in a-posteriori tests of decaying isotropic and rotating turbulence. Preliminary simulations of rotating turbulence forced at small scales show that the models are able to capture the important flow characteristics.

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