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Sonic eddy model of the turbulent boundary layer ROBERT BREIDENTHAL, PAUL DINTILHAC, OWEN WILLIAMS, University of Washington — A model of the compressible turbulent boundary layer is proposed. It is based on the notion that turbulent transport by an eddy requires that information of nonsteady events propagates across the diameter of that eddy during one rotation period. The finite acoustic signaling speed then controls the turbulent fluxes. As a consequence, the fluxes are limited by the largest eddies that satisfies this requirement. Therefore "sonic eddies" with a rotational Mach number of about unity would determine the skin friction, which is predicted to vary inversely with Mach number. This sonic eddy model contrasts with conventional models that are based on the energy equation and variations in the density. The effect of density variations is known to be weak in free shear flows, and the sonic eddy model assumes the same for the boundary layer. In general, Mach number plays two simultaneous roles in compressible flow, one related to signaling and the other related to the energy equation. The predictions of the model are compared with experimental data and DNS results from the literature.

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