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Epsilon Equation: Derivation from a Two-point Closure Model

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The epsilon equation has traditionally been constructed using the kinetic energy equation as a template. It contains three coefficients in front of the shear, buoyancy and dissipation terms. These coefficients are determined using heuristic arguments. Here we present the first derivation of the epsilon equation using a parameter-free, two-point closure turbulence model (Canuto-Dubovikov, 1993-1999), which is integrated over all wavenumbers and combined with an improved split-spectrum method. In this study we limit ourselves to buoyancy driven flows. The resulting epsilon equation has the same structure as the phenomenological one and the calculated coefficients are in good agreement with the empirical values. Moreover, as production approaches dissipation, both coefficients acquire the same value thus solving, in the homogeneous case, the inconsistency problem with the kinetic energy equation that has existed for years.