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Modeling turbulent flow over fractal trees with Renormalized Numerical Simulation (RNS)[1] STUART CHESTER, CHARLES MENEVEAU, Johns Hopkins University, MARC B. PARLANGE[2], Ecole Polytechnique Federal de Lausanne (EPFL) — Ideas from dynamic LES and renormalization group theory are applied to the problem of modeling SGS branch drag for turbulent flow over trees. The drag on SGS branches is modeled using a drag coefficient, which is not known a priori due to the complexity of the flow. The drag coefficient is determined by making measurements within the simulation at resolved scales and using dimensional analysis to downscale this information for application at sub-grid scales. This Renormalized Numerical Simulation (RNS) strategy is tested by comparing coarse RNS to high-resolution, branch-resolving simulations. Two idealized fractal geometries are used: one with all branches aligned across the mean flow, and one with additional branches that point upstream and downstream. The overall drag on the tree is well-predicted by the RNS, and non-trivial differences in drag coefficients for branches with different orientations are observed. Results from two formulations, one using direct calculation and the other using an analogue of the Germano identity (Germano et. al., 1991), are also compared.

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