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A Comparison of Turbulent Thermal Convection Between Conditions of Constant Temperature and Constant Flux: Simulation Methods
HANS JOHNSTON, University of Massachusetts - Amherst, CHARLIE DOERING, University of Michigan - Ann Arbor — We report the results of high resolution direct numerical simulations of two-dimensional Rayleigh-Bénard convection for Rayleigh numbers up to $Ra = 10^{10}$ in order to study the influence of temperature boundary conditions on turbulent heat transport. Specifically, we consider the extreme cases of fixed heat flux (where the top and bottom boundaries are poor thermal conductors) and fixed temperature (perfectly conducting boundaries). Both cases display identical heat transport at high Rayleigh numbers fitting a power law $\nu \approx 0.138 \times Ra^{.285}$ with a scaling exponent indistinguishable from $2/7 = 0.2857\ldots$ above $Ra = 10^7$. The overall flow dynamics for both scenarios, in particular the time averaged temperature profiles, are also indistinguishable at the highest Rayleigh numbers. The findings are compared and contrasted with results of recent three-dimensional simulations.

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