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Turbulent convection against rough walls: Manipulating a broken symmetry SRIKANTH TOPPALADODDI, University of Oxford, Yale University, SAURO SUCCI, Istituto Applicazioni Calcolo, CNR Roma, JOHN WETTLAUFER, University of Oxford, Yale University — We present results from well resolved numerical simulations of turbulent convection in a cell with rough walls in two dimensions. In order to examine hypotheses regarding the interaction between the boundary layers and the interior of the flow, we study classical Rayleigh-Benard convection with the top plate having a sinusoidal roughness distribution. The amplitude of the roughness is such that it is always larger than the thermal boundary layer thickness for all Rayleigh numbers (Ra) considered here. The lattice Boltzmann method is used to model the Navier-Stokes and heat transport equations within the Boussinesq approximation. We observe a scaling law, for the Nusselt number (Nu), $Nu \sim Ra^{1/3}$ over three decades in Ra, from $Ra = 10^6$ to $Ra = 10^9$, at a Prandtl number of 1. The scaling law obtained is in good agreement with recent experiments. We discuss the effects of the additional top-down broken symmetry on the mean temperature in the core-flow region, the plumes generated at the rough surface, and the two-point temperature correlation function at different heights. It is found that the correlation length scales as the wavelength of the roughness distribution.

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