Abstract Submitted
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Patterned surfaces pattern convection[1] SRIKANTH TOPPALADODDI, Yale University, JOHN WETTLAUFER, Yale University and Nordic Institute for Theoretical Physics — Turbulent convection over rough surfaces is ubiquitous in many engineering, geophysical and astrophysical settings. However, the effects of a rough surface on the turbulent transport of mass, momentum and heat are not well understood. To this end, we use highly resolved numerical simulations to study turbulent Rayleigh-Benard convection in a cell with sinusoidally rough upper and lower surfaces in two dimensions for $Pr = 1$ and $Ra = [4 \times 10^6, 3 \times 10^9]$. By varying the wavelength λ at a fixed amplitude, we find an optimal wavelength λ_{opt} for which the Nusselt-Rayleigh scaling relation is $(Nu - 1 \propto Ra^{0.483})$ maximizing the heat flux. This is consistent with the upper bound of Goluskin and Doering (J. Fluid Mech. 804, 2016) who prove that Nu can grow no faster than $\mathcal{O}(Ra^{1/2})$ as $Ra \rightarrow \infty$, and thus the concept that roughness facilitates the attainment of the so-called ultimate regime. When $\lambda \ll \lambda_{opt}$ and $\lambda \gg \lambda_{opt}$, the planar case is recovered. The enhancement in the heat transport is shown to be due the increased production of plumes at the rough walls, thus manipulating the interaction between the boundary layers and the core flow.

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