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Thermal Convection over Fractal Surfaces[1] SRIKANTH TOPPALADODDI, ANDREW WELLS, University of Oxford, CHARLES DOERING, University of Michigan, JOHN WETTLAUFER, Yale University NORDITA — We use well resolved numerical simulations with the Lattice Boltzmann Method to study Rayleigh-Bénard convection in cells with a fractal boundary in two dimensions for $Pr = 1$ and $Ra \in [10^7, 10^{10}]$. The fractal boundaries are functions characterized by power spectral densities $S(k)$ that decay with wavenumber, k, as $S(k) \sim k^p$ $(p < 0)$. The degree of roughness is quantified by the exponent p with $p < -3$ for smooth (differentiable) surfaces and $-3 \leq p < -1$ for rough surfaces with Hausdorff dimension $D_f = \frac{1}{2}(p+5)$. By computing the exponent β in power law fits $Nu \sim Ra^{\beta}$, where Nu and Ra are the Nusselt and the Rayleigh numbers for $Ra \in [10^8, 10^{10}]$, we observe that heat transport scaling increases with roughness over the top two decades of $Ra \in [10^8, 10^{10}]$. For $p = -3.0$, -2.0 and -1.5 we find $\beta = 0.288 \pm 0.005, 0.329 \pm 0.006$ and 0.352 ± 0.011, respectively. We also observe that the Reynolds number, Re, scales as $Re \sim Ra^{\xi}$, where $\xi \approx 0.57$ over $Ra \in [10^7, 10^{10}]$, for all p used in the study. For a given value of p, the averaged Nu and Re are insensitive to the specific realization of the roughness.

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