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Penetrative Convection at High Rayleigh Numbers SRIKANTH TOPPALADODDI, Yale University, JOHN WETTLAUFER, Yale University, NORDITA, and University of Oxford — We study penetrative convection of a fluid confined between two horizontal plates, the temperatures of which are such that a temperature of maximum density lies between them. The range of Rayleigh numbers studied is $Ra = [10^6, 10^8]$ and the Prandtl numbers are $Pr = 1$ and 11.6. An evolution equation for the growth of the convecting region is obtained through an integral energy balance. We identify a new non-dimensional parameter, Λ, which is the ratio of temperature differences in the stable and unstable regions of the flow, and show that the characteristics of the flow depend sensitively upon it. We study the effects of Λ on the flow field using well-resolved lattice Boltzmann simulations. The Nusselt number is found to scale with Ra as $Nu = A(\Lambda) \times Ra^{1/4}$, where $A(\Lambda)$ is a function of Λ, for $\Lambda = 0.25$ and 2, showing that the presence of the stable layer can be modelled as a geometric effect for the values of Λ considered.

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