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New variational bounds on convective transport. II. Computations and implications[1] ANDRE SOUZA, Georgia Tech, IAN TOBASCO, CHARLES R. DOERING, Univ of Michigan - Ann Arbor — We study the maximal rate of scalar transport between parallel walls separated by distance h, by an incompressible fluid with scalar diffusion coefficient κ. Given velocity vector field $\mathbf{u}$ with intensity measured by the Péclet number $Pe = h^2\langle|\nabla\mathbf{u}|^2\rangle^{1/2}/\kappa$ (where $\langle\cdot\rangle$ is space-time average) the challenge is to determine the largest enhancement of wall-to-wall scalar flux over purely diffusive transport, i.e., the Nusselt number Nu. Variational formulations of the problem are studied numerically and optimizing flow fields are computed over a range of Pe. Implications of this optimal wall-to-wall transport problem for the classical problem of Rayleigh-Bénard convection are discussed: the maximal scaling $Nu \sim Pe^{2/3}$ corresponds, via the identity $Pe^2 = Ra(Nu-1)$ where Ra is the usual Rayleigh number, to $Nu \sim Ra^{1/2}$ as $Ra \to \infty$.

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