Optimal wall-to-wall transport by incompressible flows
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We consider optimal wall-to-wall transport of a passive scalar by incompressible flows: given an enstrophy budget we construct flows that transport at nearly optimal rates in the large budget limit. More precisely, we construct steady divergence-free no-slip velocity vector fields that saturate the known upper bound for all such enstrophy-constrained flows up to logarithmic corrections. This result is obtained by exploiting a connection between the wall-to-wall optimal transport problem and a closely related class of singularly perturbed variational problems arising in the study of energy-driven pattern formation in materials science. We discuss implications for search for the best absolute upper limits on the rate of heat transport in turbulent Rayleigh-Bénard convection.

This is a joint work with Ian Tobasco.