Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Mixing and transport in the presence of a source BRYAN OAKLEY, JEAN-LUC THIFFEAULT, University of Wisconsin - Madison — A common topic in mixing is the initial value problem $\partial_t\theta + u(x,t)\cdot\nabla\theta = D\Delta\theta + s(x,t)$ where u is an incompressible flow stirring the mean-zero passive scalar concentration θ and s is a mean-zero internal source. The initial concentration is unmixed and, for $s = 0$, will relax to the zero steady state. This convergence is typically maximized by a flow that increases the gradients of the passive scalar, dissipating variance via molecular diffusion. For $s \neq 0$, the passive scalar still relaxes to a steady state, but variance can now also be reduced — sometimes optimally [3] depending on the distribution of the source — by transporting hot spots to cold spots. We compare the optimality of gradient production to transport for various source distributions by employing multiscale asymptotics [1,2] and observing that the two mechanisms decouple when the length scale of the source is strongly separated from the length scale of the gradient producing stirring. [1] P. R. Kramer and S. R. Keating. Chin. Ann. Math., 30B(5):631-644, 2009. [2] A. J. Majda and P. R. Kramer. Physics Reports, 314:237-574, 1999. [3] J.-L. Thiffeault. Nonlinearity, 25(2):R1-R44, 2012.

Bryan Oakley
University of Wisconsin - Madison

Date submitted: 03 Aug 2020 Electronic form version 1.4