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Mixing and enhanced dissipation in incompressible flows

Fluid mixing generically refers to a cascading mechanism that transfers information to smaller and smaller spatial scales, in a way that is time reversible and conservative for finite times but results in an irreversible loss of information at infinite time. In simple terms, mixing is what is observed when stirring two liquids together, resulting in the creation of a homogenized mixture, but it can also be thought as a more complicated stabilizing mechanism for certain stationary structures, generating damping effects.

In this mini-course I will review several aspects linking stochastic analysis, random dynamics, and fluid mixing, in the context of passive scalars driven by deterministic or random velocity fields. These will include fluctuation dissipation scalings, inviscid limits and enhanced dissipation.