Center for Environmental & Applied Fluid Mechanics

"(Eulerian) Route to (Lagrangian) Chaos: Insight from Analytical Solutions to the Problem of Passive Scalar Mixing in the Presence of Planar Shear Flows"

Miguel Jimenez-Urias

Johns Hopkins University

Earth & Planetary Sciences

Enhanced passive scalar decay and transport in a flow result from the interaction between molecular diffusion and differential advection, a multiscale process that can lead to highly complex tracer fields even under laminar advection. Since Taylor's work on laminar pipe flows, "enhanced diffusion" has continued to play a central role in the development of parameterizations of subgrid transport processes, given the common objective of estimating effective diffusivities associated with an observed process. However, an effective diffusivity does not always exist, meaning the transport is not always Fickian. The advection diffusion problem of a (passive) tracer presents many of the similar challenges as the problem of fluid turbulence while remaining a linear system. In this talk, I will present some insights from analytical solutions to the governing equation for arbitrary initial conditions, when the advection flow is defined at any given time, by a plane parallel shear flow. This is a broad class of flows, from steady to time-oscillating, and even renewing (renovating) shear flows, with a wide range of applications.

Spring 2023 CEAFM Seminar Series

March 31, 2023 ✦ 3:00 PM ✦ Gilman Hall 50

JOHNS HOPKINS WHITING SCHOOL of ENGINEERING