ME568 / OC674 Model data for Assignments 3-5

Data (Matlab) are provided on Canvas from one of Bill Smyth's direct numerical simulations of a 2-layer stratified shear flow. If you need a different format for data, let us know. We will use these data throughout the rest of the term as an example dataset to assess various aspects of turbulent flow. The flow is initially uniform, but it is susceptible to shear instability, so forms an unstable Kelvin-Helmholtz billow that evolves in time into a fully turbulent state. I have provided a series of cross-sections (spatial snapshots) of this low-Re turbulent flow at various times in the flow's evolution. I've included a demo_dns.m Matlab script to demonstrate how to plot these data. Smyth et al (2001) paper provide more details of the simulations, and I also included a Smyth & Moum (2012) article that might also be of interest.

The data span roughly a 4-m (horizontal) by 2-m (vertical) domain and are at 1-cm resolution. We've provided three adjacent 2-D sections (each separated by d*y*=1 cm) so that you can calculate gradients in all directions. So we have *x* (1:384), *y* (1:3), *z* (1:201) and *u, v, w, rho* each as matrices of size (384,3,201) at 16 different timesteps.

We will explore the turbulent properties of stratified turbulence using these data throughout the remaining assignments, as the K-H instability is a prototypical instability in our geophysical world, and there are lots that can be learned from these about both stratified and unstratified flows.

Please take a look at these data and use them to explore a variety of aspects of the kinematics and dynamics of turbulent flow, and how these relate to the equations we've been looking at in class. We will use them in upcoming assignments to investigate the structure and evolution of quantities like tke, dissipation, vorticity, stresses, production, isotropy, length-scales, spectra, etc. and we wanted to provide these to you now so you can start exploring at your own paces.

These are great data to be able to ask "What if I only sampled X? Would I be able to determine Y or Z? And to what uncertainty?"