ReadMe
Research Data supporting
“The structure and lifecycle of stratified mixing by shear instabilities in continuously forced flows" (2026)

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We detail the contents of the zipped folders provided below:

```
├── 01_transects_data_and_code
├── 02_transects_movies
├── 03_temporal_evolution_movies
├── 04_simulation_movie_and_code
├── 05_lab_experiment
├── 06_figures_high-res
├── 07_figures_supplementary
```

01_transects_data_and_code

Contains full hydrodynamics and acoustics data from the transects T0 (AUV-based) and T1, T2, T3 (shipboard) and example plotting codes to reproduce figures 1, 2, 4, 5, 6, 7, 8, 9, 10, 12.
Recommended workflow:

`plot_T0.m`
→ plots transect T0 by loading `T0_full.mat` and `T0_zoom.mat`(figures 1, 12)

`plot_T1-T3.m`
→ plots transects T1, T2, T3 by loading `T1.mat`, `T2.mat` and `T3.mat`
Note that in the .mat files, the suffix _a refers to the temporal grid of the ADCP. Similarly, `_r` = (finer) temporal grid of the RBR (CTD); _s = temporal sonar grid; `_i` = spatial (x,z) grid of the sonar; _u = vertical grid of the ADCP; _5 = vertical positions of the five towed RBR sensors etc. Some variables exist with multiple suffix combinations as they have been interpolated on multiple grids for easier plotting.

`make_movies_of_T1-T3.m`
→ makes movies including of the multibeam data – the movies are provided in `02_transects_movies`

`find_slope_of_SI.m`
→ get the 30 shear instability (SI) events of figure 9 and estimate the slopes for figure 10

`plot_N_S_Rig_stats.m`
→ plot statistics of buoyancy frequency N, shear S, and gradient Richardson number Rig using data from directory N-S-Rig, for figure 8

02_transects_movies

Contains the three movies `T1.mp4`, `T2.mp4` and `T3.mp4` corresponding to figures 4, 5 and 6 showing the evolution of the multibeam data along the transects. Produced with the above code `make_movies_of_T1-T3.m`

03_temporal_evolution_movies

Contains shorter multibeam sequences from T2 and T3 used in figures 13 and 14 to highlight typical examples of the lifecycle of shear instability. We provide the origina signal and the one plotted in the paper after it has been rescaled by the transect-averaged background to enhance contrast.

04_simulation_movie_and_code

Contains `supplementary_movie_to_figure_15.mp4`, the julia code to run the two-dimensional DNS and output selected NetCDF snapshots. It also contains one example of such snapshot (`snapshot_t0050.00.nc`, taken at t=50, plotted in figure 15e-h), and the MATLAB code to convert to physical dimensions and plot such snapshots.
Recommended workflow:
`params.jl`: input the parameters you want to run the simulation at
`start_KH_from_params.jl`: run this to launch the simulation (will read `param.jl`)
The above can also be called with the example slurm script provided: `run_KH.slurm`
The simulation .txt output for the case in the paper is given in out/.... .txt (showin run time ~ 12 hours).
Note that the code will look for the linear stability calculation results to be used as initial conditions.
This lin stab file for the parameters in the paper is given in
`out/ KH_lin_stab_Re=8.0e+05_Ri=0.15_Pr=700_Lz=10_efgm=1.0e-04.jld2`
If a linear stability file is not present, it will call `lin_stab_from_params.jl` to perform it, which will itself call `code/SSF.jl`. In practice it was found that performing these eigenvalue calculations in advance on a workstation CPU was much faster and more convenient than on the cluster. These .jld2 outputs can then be loaded for use by the GPU job on the cluster.
The code will then run the simulation with oceananigans.jl and call plotting routines at the end.
`export_jld2_to_netcdf_snapshots.jl` can be called to export individual NetCDF snapshots from the large .jld2 output (.jld2 is convenient to store the entire output from the GPU job on the cluster, but lighter NetCDF files are preferred for subsequent analysis.)
In subdirectory `movies_showing_convergence_for_Nx=Nz=4000,8000,12000` we show three movies comparing the flow evolution for grid sizes of 4000^2, 8000^2 and 12000^2 (the latter one being the case shown in the paper and identical to `supplementary_movie_to_figure_15.mp4`).
These movies show that the dynamics are essentially independent of grid size for sufficiently fine grids.

05_lab_experiment

Contains experimental data from the SID facility: `SID_experiment_T2_rho_highres.mat`, corresponding to the case shown in figure 7 of Lefauve, *C. R. Phys.* 2024. In this case we provide only the four-dimensional (x,y,z,t) density field from a single experiment (referred to in the literature as T2, see Lefauve, Partridge & Linden, *J. Fluid Mech.* 2019). A much larger dataset (complementary velocity data for this experiment, and many more experiments) is given in this 2019 repository (and subsequently this 2022 repository, where the movie shared here `SID_experiment_T2_movie.mp4` was taken from). Note that the density data we provide here is at slightly higher spatial resolution than T2.mat from the 2019 repository. This increased resolution is possible due to Laser Induced Fluorescence (LIF) imaging typically being at much higher resolution than Particle Image Velocimetry (PIV), though in practice the difference is modest because LIF data is subsequently smoothed by a Gaussian filter. The 2019 and 2022 datasets provided LIF (rho) and PIV (u, v, w) fields on the same grid for convenience, but a higher resolution density field was available and is shared here for an improved visualisation of fine-scale structure in salinity variance dissipation (chi) needed in figure 16e-f.
We also provide the MATLAB code `plot_SID_experimental_data.m` to convert the non-dimensional data to the physical dimensional framework in the paper and plot figure 16e-f.

06_figures_high-res

Contains high-resolution .png versions of figures 1-16 and A1.

07_figures_supplementary

Contains supplementary figures related to figures 1, 4, 5, 6, 9, 11 and 12, providing complementary information. This includes for figure 1: a broader view of the AUV data (including the AUV depth and speed along T0); for figure 4c, 5c, and 6c: the T1-T3 echosounding without the semi-transparent instability locus overlay; for figure 9: the 30 individual high-resolution frames and annotated frame where the braid angles were measured; for figure 11: the corresponding middle beam reconstruction to be compared with the multibeams; and for figure 12: a high-resolution, 1:1 aspect ratio view of the main shear instability train imaged along T0.