FLUIDS 2

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II. INSTABILITIES

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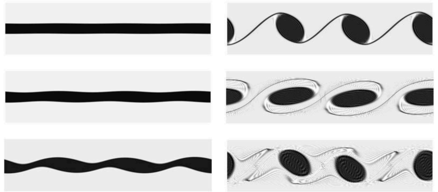
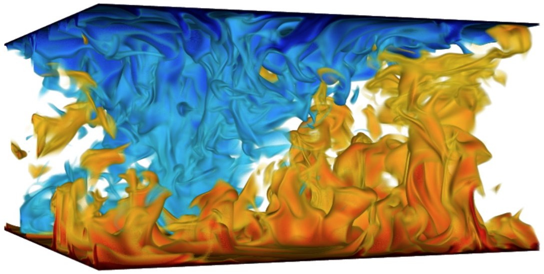
II. INSTABILITY

II.1. Concept of stability

II.2. Kelvin-Helmholtz Instability

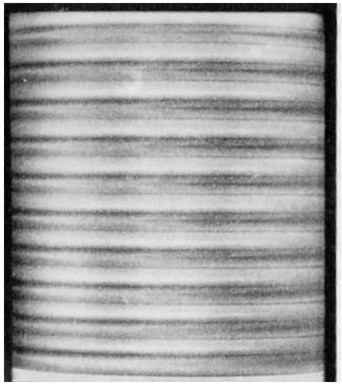


II.3. Parallel Shear instability



II.3. Convective instability

(Rayleigh–Bénard)



II.4. Taylor–Couette

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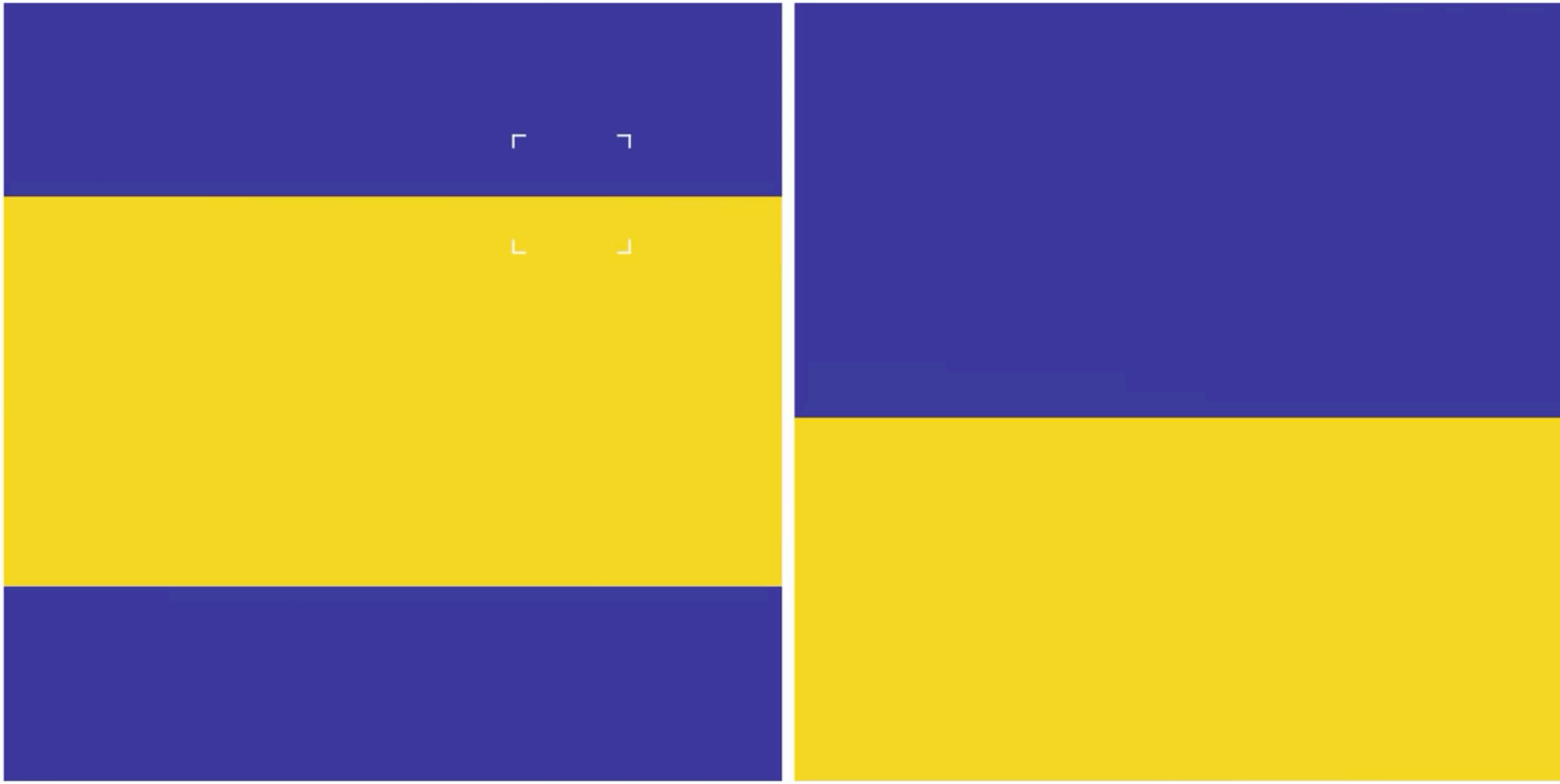

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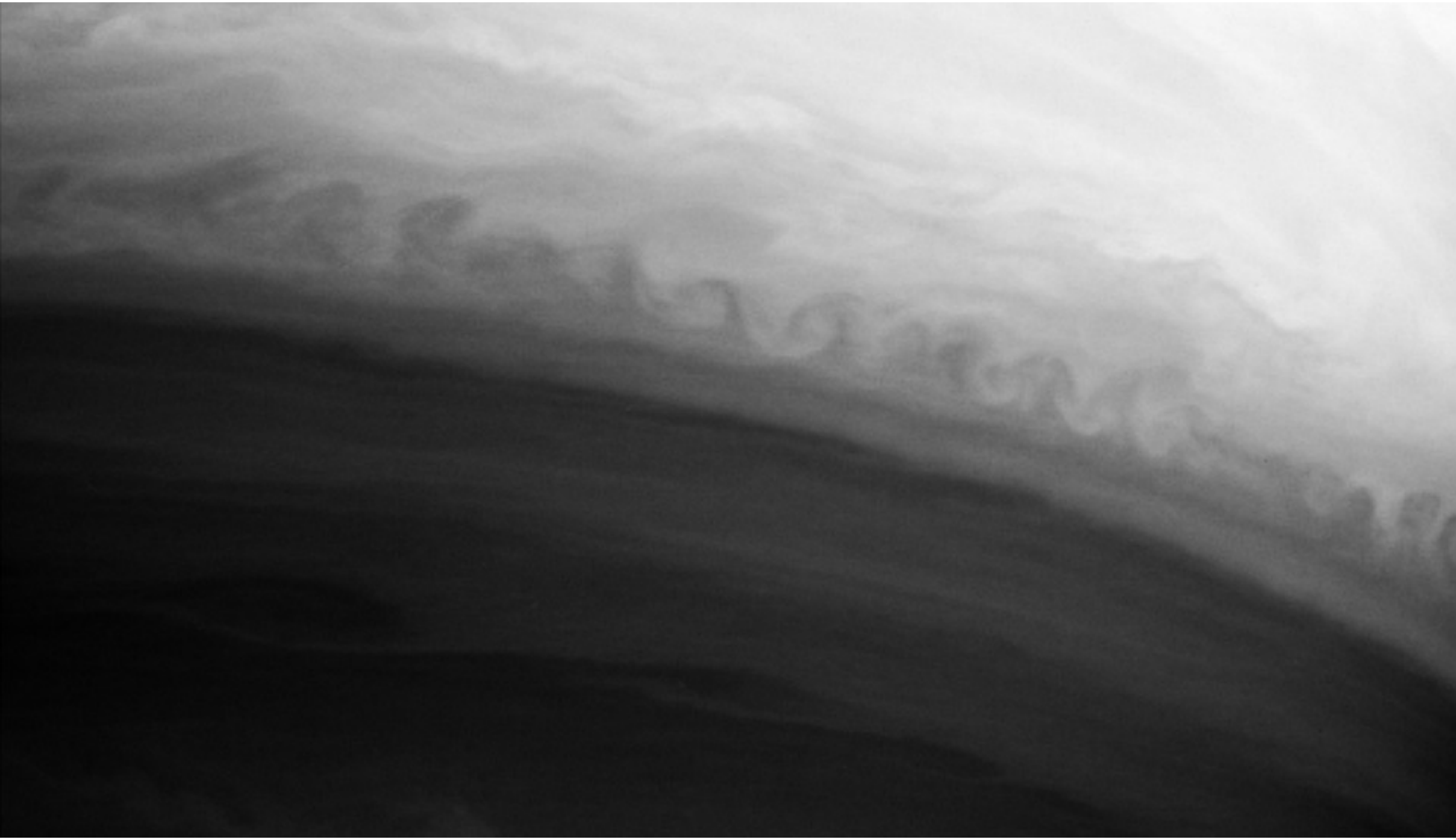

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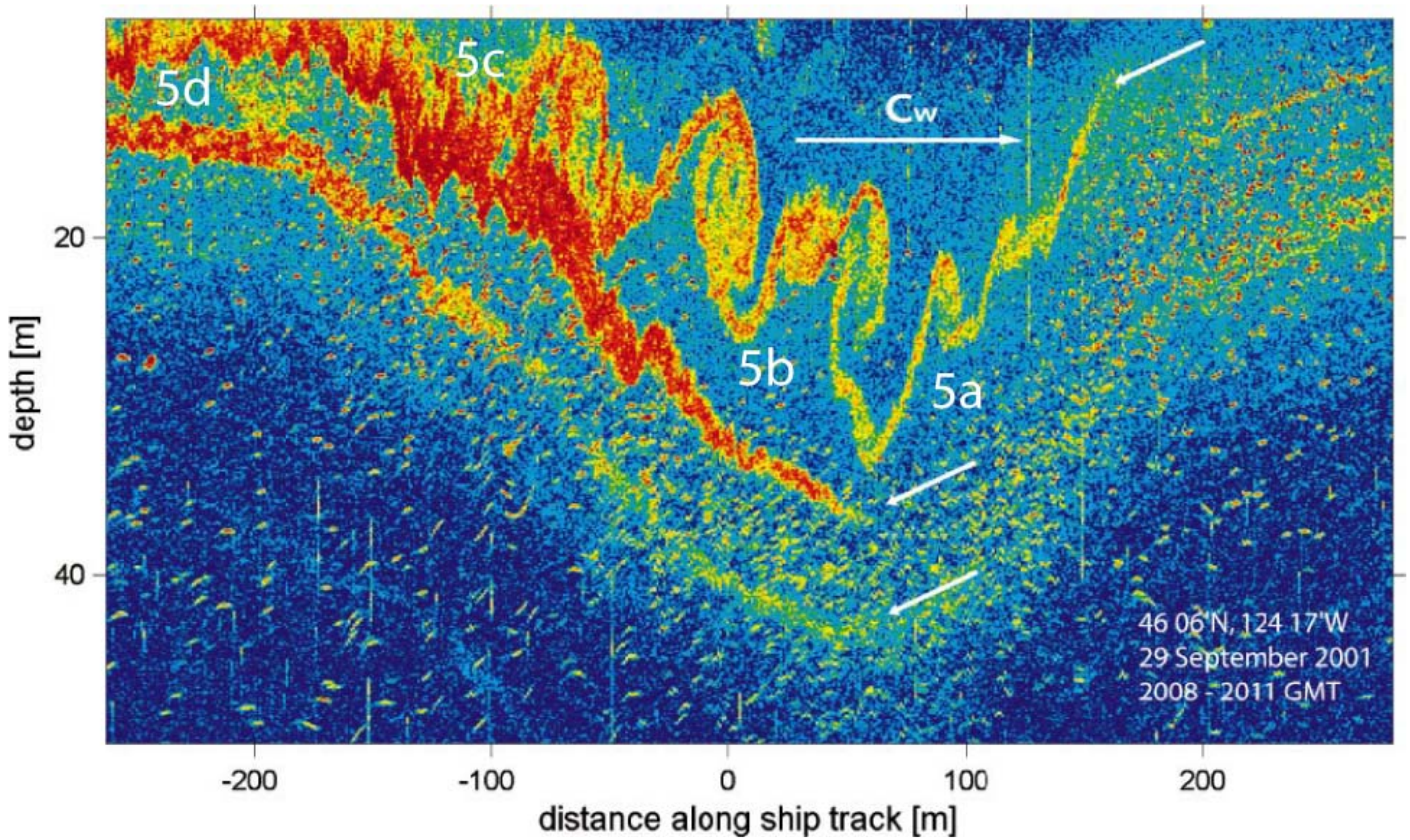

Acoustical snapshot of a nonlinear internal gravity wave approaching the Oregon coast. Near the surface the current flows from left to right, the direction of wave propagation, while the underlying fluid flows left to compensate. The resulting current shear generates the Kelvin-Helmlholtz billows and turbulence. ***[Moum et al, 2003]***

II.2. Kelvin-Helmholtz Instability

- Let’s derive some equations!

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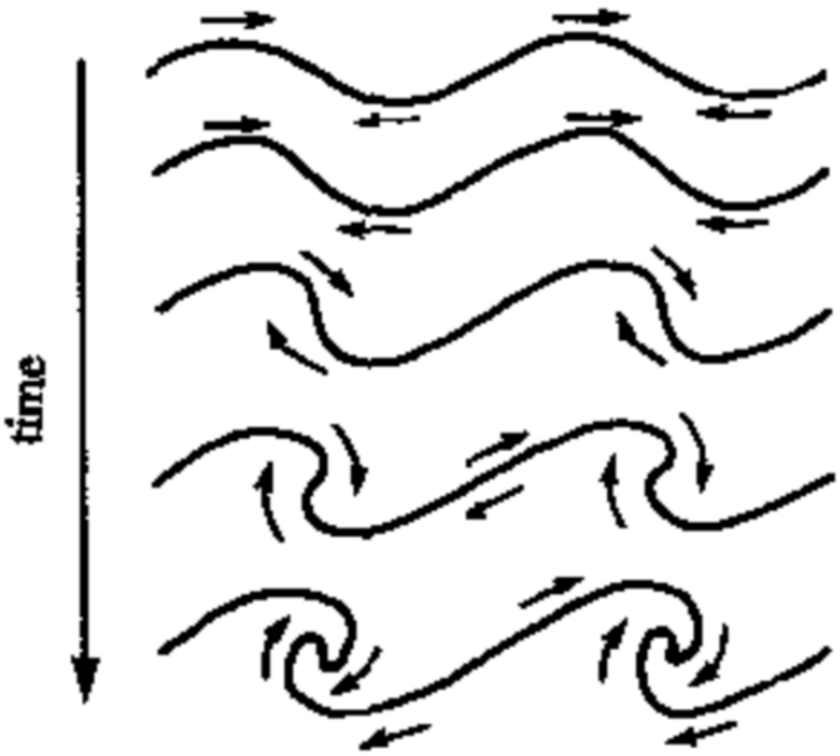

(b)

Figure 11-2 Kelvin–Helmholtz instability: (a) initial perturbation of wave number l, (b) time evolution of an unstable perturbation. The system is always unstable to short waves, which steepen, overturn, and eventually cause mixing. As waves overturn, their vertical and lateral extents are of comparable magnitudes.

II.2. Kelvin-Helmholtz Instability

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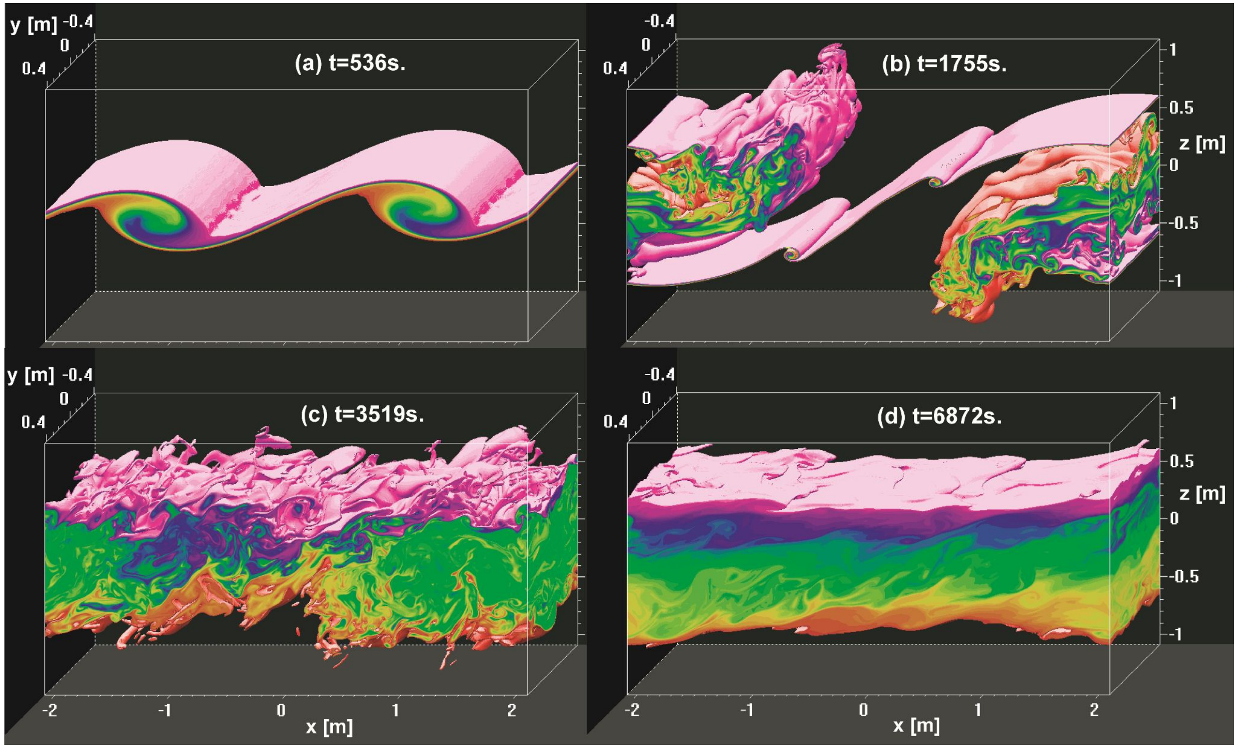
Most of the energy is transferred to turbulent kinetic energy, a fraction is transferred to potential energy (raising the center of gravity of the mixed fluid), and a fraction can be radiated as secondary internal waves (with horizontal scales related to billows scale)



Direct numerical simulation mixing across an interface in the ocean. Colors indicate intermediate values of salinity found in the interfacial layer ***[W. Smyth]***

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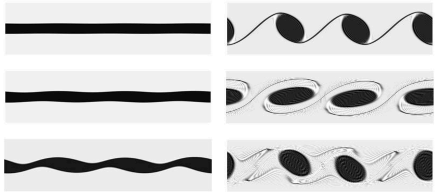

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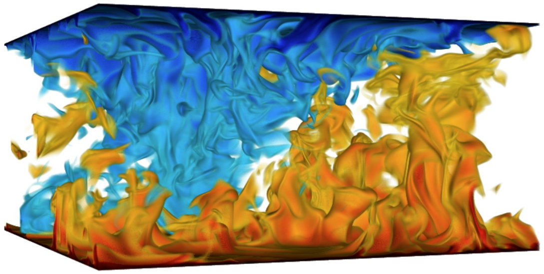

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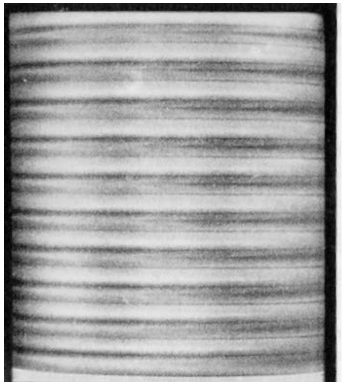

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