Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Turbulent Mixing Efficiency in Stratified Couette Taylor Flow

BRUCE RODENBORN, GUENTHER EBERT, HARRY L. SWINNEY, Center for Nonlinear Dynamics, Dept. of Physics, UT Austin — Ocean mixing is critical to sustaining the meridional overturning circulation. Global ocean and climate models must parameterize ocean mixing because it occurs at scales well below the resolution of the models. The current understanding of ocean mixing requires about 20% of the kinetic energy in a turbulent flow to be converted into a change in the fluid's gravitational potential energy. Laboratory work on mixing efficiency has used towed grids and other means to create turbulence, but this turbulence is not sustained and its relation to the turbulent patches observed in the oceans is not known. We study mixing in a linearly stratified fluid contained between two counter-rotating cylinders. An initial density variation of up to 200% over the height of our system is achieved using sodium polytungstate salt. Measurements are made for laminar to fully turbulent flows - Reynolds numbers from a few hundred to 10,000. The flow pattern is visualized using Kalliroscope, and the characteristic vertical length scale is determined from spatial fourier transforms of images. The power input is determined by measuring the torque and rotation rate of both cylinders. The fluid's gravitational potential energy is determined by measuring density as a function of height. We find that mixing efficiency is strongly dependent on the total Reynolds number and the total initial density variation.

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Date submitted: 05 Aug 2010 Electronic form version 1.4