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Penetrative Convection in Stratified Fluids: Velocity Measurements by Image Analysis

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Models of the structure of stratified oceans and lakes as well as the atmosphere use bulk parameters to predict a variety of processes that control the ecology of natural systems. The success of such approach in predicting even small scale phenomena has not a parallel in modeling turbulent. Particularly the interaction of convective turbulence and the density interface is not well understood. Analytic solutions for such turbulent motion are not available and there appears to be little hope of finding such solutions in the near future. The present experiments simulate the deepening of a convective mixed layer in a stratified lake. LIF visualizations, temperature measures and velocity field detection through Particle Tracking Velocimetry and Feature Tracking were employed to examine the effect of convective-driven perturbation at the mixed layer when no vertical shear occurs. The model used for laboratory experiments is a tank with glass sidewalls of dimension $40\times40\times41$ cm^3 in the two horizontal and vertical directions respectively. The working fluid is distilled water. Pollen is used as passive tracer. A stable stratification, e.g. a positive vertical temperature gradient, is generated by means of two connected tanks. After being stratified, the chamber is heated from below, to simulate the solar radiation effects and to cause penetrative convection. Temperature profiles are measured inside the tank by mobile thermocouples.

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