Geophysical Fluid Dynamics Laboratory - Research School of Earth Sciences

Sidewall Heating of a Salinity Stratification

1) Use the double bucket system to fill the rectangular tank with a salinity stratification, noting the initial water temperature T_0. Inject dyes of different colours into the system at several different depths.

2) Carefully draw samples of stratified water from 5 different depths and measure their densities. Calculate the stratification $\frac{d\rho}{dz}$ and the buoyancy frequency $N = \sqrt{\frac{g}{\rho_0}\frac{d\rho}{dz}}$.

3) Drop some dye crystals into the tank and time the vertical oscillations generated by their falling wakes.

4) Fill the adjoining metal chamber with hot water of T_h, noting this temperature.

5) Observe the resulting structures that grow in the stratified environment. Estimate the layer thickness h.

Dimensional analysis can be used to obtain a prediction for the layer thickness h_0 as,

$$h_0 = \rho_0 \alpha \Delta T \left(\frac{d\rho}{dz}\right)^{-1},$$

where ρ_0 is the reference density (ρ_0 = 1000kg/m^3), α is the thermal expansion coefficient, and $\Delta T = T_h - T_0$ is the temperature difference between the stratified water temperature and the hot water in the metal chamber.

Produce a plot comparing the measured layer thickness h to the predicted thickness h_0.