SMS-303: Integrative marine sciences III.

Lab 3, Mixing.

Stations and activities:

I. Convective mixing:
You have two tanks. In one you have two heating elements one near the surface and one at the bottom.
Q: Which do you expect to cause the most mixing through entrainment of adjacent waters? What oceanic process can these sestups represent?

Plug both heating element and use food coloring to trace the waters.
In the other tank float a colored ice chunk.
Q: Which of the two heating elements is it a close analogue of? Observe the circulation and speculate where in the oceans does such a circulation takes place.

Candice and Lindsay observe convection plumes driven by a heating element in the bottom of the cylindrical tank.

II. Kelvin-Helmholz billows:
In a long skinny cylinder you have water overlaid by mineral baby oil. You are about to lift one side (the right one) and observe what happens at the interface between two fluids flowing in opposite directions (why do will they flow in opposite direction?).
Q: What do you think will happen at the interface between the two fluids?
Lift the right side 10-20cm above the table and observe the interface.
Q: Why don't the two fluids mix?

Amanda and Veronica observe billows formed between two fluids (oil and water) when shear is high.

III. Mixing of dyed water:
Fill a small rectangular tank with water from the tap. Put a divider between both sides of the tank and put 4 drops of green food coloring in one side and 4 drops of yellow food coloring at the other side. Mix each side and wait until the fluid is at rest.
Q: What will happen when you raise the barrier between the two sides?
Raise slowly the barrier and observe what happens. Write carefully the time when you opened the barrier on the tank and come periodically to observe the evolution of the fluid.

Caroline, Veronica, Amanda, Amber, Nick and Laura observe diffusion of colored fluids of the same density. It took a very long time for the color to homogenize (more then an hour).

IV. Diffusion of momentum:
You have two round vessels full of water one of which is on a rotating table.
Q: How will the fluid react when you start/stop the rotating tank?
Q: Assuming a fluid is in solid body rotation (rotates at the same rate as the rotating table), how will lateral mixing be affected?
Use dye to check your answers. Compare the rotating and non-rotating tanks. Use the ping pong ball to determine how fast the fluid is rotating.

Michael, Ed, Anne, Amanda, Veronica, Caroline and Sheena observe intense mixing near the boundaries of a rotating tank when the rotation rate is changed abruptly.

V. Wind mixing:
You have two tanks filled with water and a hair dryer. One tank is stratified the other is not.
Q: How can you use the food dye to determine which is stratified?
Q: How different will the mixing be in the stratified tank compared with the non-stratified one?

Mixing with a hair dryer is easy to do in a non stratified fluid (See Veronica and Amanda on the right) but very had in a stratified fluid (as observed by Anne, Candyce and Lindsay on the left)

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