SMS-303: Integrative marine sciences III.

Lab 1, Coriolis.

Stations and activities (some of which will be demo given the time it takes to spin the experiments and the number of rotating tables we have):

Rotating table 1 (demo with 3-4 groups):
I. Rotating flow over topography, Taylor columns (from: http://www.ocean.washington.edu/courses/oc512/lab2-2004.pdf also in introduction to GFD, by Cushman-Roisin).

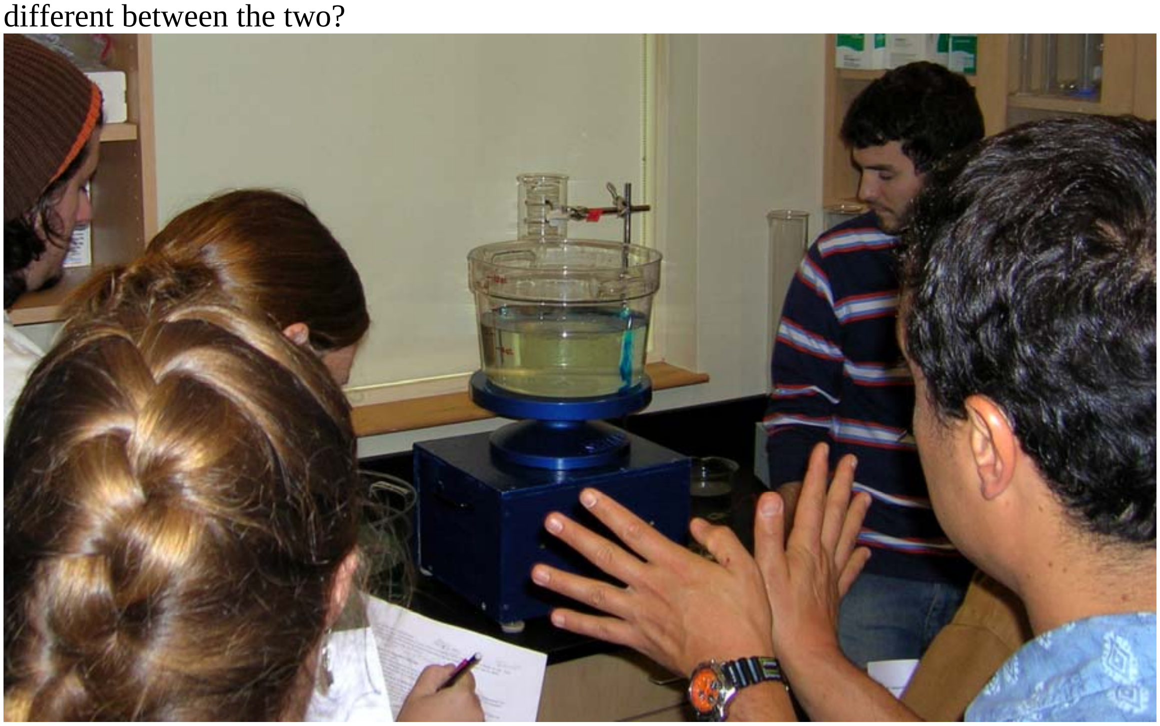
III. Rotating table Coriolis:
Spin the table and, when you can, release the ball into it through the duct on its side (it will take you a little time to get used to this simple setup).
Predict to what direction the bead will be deflected as function of the direction of rotation. Now, observe how the deflection direction and intensity varies with the spin direction and intensity.
What in this setup is different from the previous experiment (think about the relative velocity of the ball compared to the fluid when they leave the syringe/cannon)?

Joe^2, Ron and Chris (left) and Dominique and Sarah (right) observe a marble on a rotating table both in the lab framework (looking at it) and in the rotating framework (looking at a screen which gets its image form a camera turning with the table).

Station 1: Computer exercise.
VI. Coriolis applet
http://profhorn.meteor.wisc.edu/wxwise/kinematics/testwind2.html
Geostrophic balance: when no friction is present, the force due to pressure differences (or gradient) is balanced by Coriolis and the resultant winds are parallel to lines of constant pressure (isobars).
Explore geostrophy at different latitude.

- For a given pressure gradient how does the magnitude of the velocity changes as you go closer to the poles compared to the equator?
- Now add friction. Predict what will happen and compare to what happens.
- In the ocean and atmosphere, where would you expect friction to be most important? How will it vary vertically?


Morgan, Dan and kyle observe how changes in latitude, pressure gradient and friction will change the wind pattern in both north and south hemisphere.

Station 2: Rotating table 2.
VII. Taylor sheets.
Put dye in a rotating tank and a non rotating tank. Observe how the dye spread. Why is it different between the two?

Students (Phillip, Dan) observe how dye within a rotating fluid spread very differently than in a non-rotating fluid due to the stiffness imparted to the rotating fluid by its

angular momentum. Fluid cannot freely move in the direction of the axis of rotation (center). Pushing it in that direction will cause it to be pushed back to its original ‘latitude’ resulting in inertial oscillations.

VIII. Ekman dynamics.
Bring a rotating tank with tea leaves on the bottom to solid body rotation. Accelerate or slow down the rotation rate (by changing the voltage to the rotating table). How are the tea leaves moving? Why?

Sarah, Dominique and Emmanuel observe the motion of tea leaves to and away from the center of the cylinder depending on the direction of the stress the bottom imparts the fluid. When the stress is in opposite direction to rotation (desceleration) the fluid moves towards the center while when it is in the same direction as rotation (acceleration) the fluid moves outwards.

Station 3: Rotating table 3 (manual).
IX. Coriolis deflection
Rotate the table by hand and release the bead on the duct. How is the trajectory changing with rotation intensity, and direction? How does it compare with what you learned on Coriolis? How will it change if you insert the ball in from a non-rotating source? Try it.

Sarah, Brianne and Erin predict the direction a marble will go upon entering the rotating table from a channel attached to it. Changing the rotation direction changes the deflection direction.