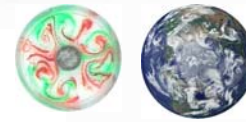


Modelling Wind-Driven Ocean Effects



Weather in a Tank

A Laboratory Guide to Rotating Tank Fluid Experiments and Atmospheric Phenomena

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See <http://paoc.mit.edu/labguide/>

Introduction

We present demonstrations to illustrate Ekman transport, its convergence and divergence using the "Weather in a Tank" lab setup: see <http://paoc.mit.edu/labguide/>

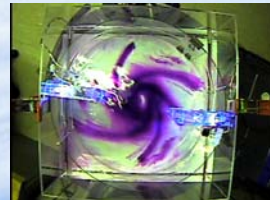
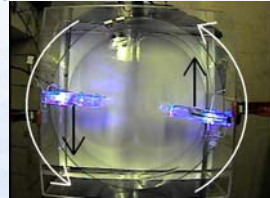
Cyclones & Anticyclones

The snapshots on the right demonstrate the Ekman ageostrophic circulation driven by the fans.

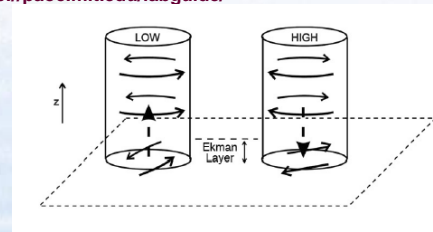
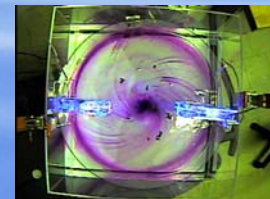
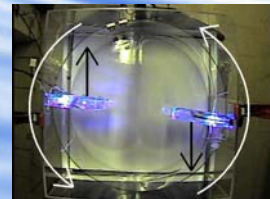
Procedure

- Two fans are attached to the edge of the tank in the middle, where the circular insert touches the square tank.
- The fans are mounted perpendicular to the side of the square tank and placed across from each other, pointing in opposite directions.
- The tank is filled so that water level is just below the bottom of the fans.
- The table is set into cyclonic rotation at about 10 rpm. Let the water get into solid body rotation for about 10 minutes before turning the fans on. Then let the fans run for another 10 minutes before adding potassium permanganate crystals or colored dye.
- If the fans are mounted such that the wind stress is applied cyclonically, the Ekman transport at the surface is towards the walls, and creates a divergence at the surface. This can be seen with the use of paper dots.
- If the fans are mounted such that the wind stress is anticyclonic, this creates Ekman convergence near the center of the tank at the surface, which forces fluid down, and creates an anticyclone near the bottom of the tank.

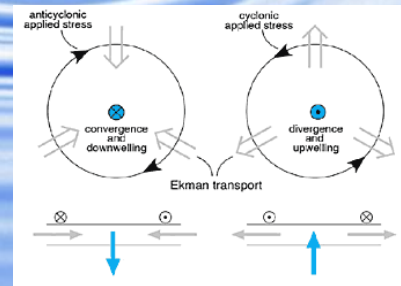
Cyclone



Anticyclone



Frictionally induced flow in the Ekman layer created by the atmospheric low and high pressure systems. Flow into the low induces rising motion, and flow out of the high induces rising motion.

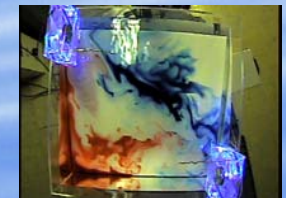


Anticyclonic wind stress acting on the ocean produces convergence at the surface and downwelling at the center. Cyclonic wind stress produces divergence at the surface and upwelling at the center.

Western Boundary Currents

The beta effect is simulated by using a slanted bottom insert. The shallow end of the tank represents north. One fan blows across the deep end to create tropical easterlies. The other fan blows across the shallow end to create midlatitude westerlies. The use of dye clearly reveals swift poleward currents in the west. The equatorward flow is slow and spread fairly evenly over the interior of the tank.

This demonstration of wind-driven gyres is still under development.



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