

Atmospheric Science 441, Supplement to Homework 6

S1. A small drain is opened in the center of a very large tank in which the water is *completely* at rest initially. Suppose that some time later, the water in a ring 0.5 cm out from the center of the drain is swirling cyclonically around the drain, completing one full 360° rotation every second. Suppose this ring of fluid has been drawn symmetrically in toward the drain and treat the water as an incompressible fluid. What was the initial radius at which this ring of fluid was located when the drain was first opened?

S2. Suppose the fluid in the tank was not in fact quiescent when the drain was opened, but rather the same loop of fluid at the initial position computed in S1 had anticyclonic circulation. What mean tangential velocity at the radius of this initial loop of fluid would be required to exactly reverse the direction of the drain swirl? (That is, what mean tangential velocity would be required to produce exactly the opposite result: that upon reaching a radius of 0.5 cm from the drain, the fluid ring was swirling *anticyclonically* and completing one full revolution every second.

Assume the tank is located at a latitude where $f = 10^{-4} \text{ s}^{-1}$.