

ATM 500: Atmospheric Dynamics

Homework 5

Due Thursday October 6 2015

1.
 - a. A kicker misses a game-winning field goal and blames the Coriolis force. He kicks the football a horizontal distance of 50 m in 5 s. The football field is at latitude 45°N . If he misses the right upright by 0.1 m, is his claim valid?
 - b. At what speed would the kicker have to kick the football in order to actually miss the upright by 0.1 m due to the Coriolis force?

To answer these questions, suppose the Coriolis force is the only force acting on the ball.

2. In Homework 3 you looked at the *total energy* budget (kinetic plus internal plus potential) per unit volume for an inviscid, adiabatic, compressible fluid, and you worked out the details of the derivation in section 1.10.2 of Vallis.
 - a. Thinking about the energetics of a fluid in the *rotating frame*, show that the Coriolis force cannot change the kinetic energy of a fluid parcel.
 - b. When we derived the *primitive equations* we threw away some terms that might affect the total energy budget. So we would like to verify what, if any, form of energy is conserved in a fluid obeying the primitive equations. Answer question 2.13 in Vallis:

Show that the inviscid, adiabatic, hydrostatic primitive equations for a compressible fluid conserve a form of energy (kinetic plus potential plus internal), and that the kinetic energy has no contribution from the vertical velocity. You may assume Cartesian geometry and a uniform gravitational field in the vertical direction.