ATM 500: Atmospheric Dynamics
Homework 4
Due Thursday October 8 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. If you haven't already, read section 1.10 of Vallis on the energy budget of a fluid. In particular, section 1.10.2 gives a general derivation of conservation of *total energy* (kinetic plus internal plus potential) per unit volume for an inviscid, adiabatic, compressible fluid.

   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.*