

PHYS/OCEA 4411/5411 “Atmospheric Dynamics 1”

Assignment #3

Due: Monday, 9 November 2009, at the beginning of class

- 1) Show that the Laplacian in spherical “geophysical” components is composed of Cartesian-like terms and curvature terms.
- 2) A ship is sailing northward at a rate of 10 km/h. The surface pressure increases toward the northwest at a rate of 5 Pa/km. What rate of pressure change is recorded at a nearby island station if the pressure aboard the ship decreases at a rate of 100 Pa every three hours?
- 3) A common misconception is that the Coriolis force is responsible for the direction water drains in a sink. Show that the Coriolis force cannot possibly be important at those scales.
- 4) Dust on the blades of a fan is not blown off when the fan is operated. This is attributed to air moving with the fan blades. Is this a viable explanation given the scales involved?
- 5) Show using scale analysis and the full Navier-Stokes equations that the atmosphere is to a very good approximation in hydrostatic equilibrium.
- 6) a) Show that centrifugal force due to the Earth’s orbit around the sun is comparable to the horizontal pressure gradient force.
b) Why does the centrifugal force from the Earth’s orbit not show up in the Navier-Stokes equations?