ESCI 342 – Atmospheric Dynamics I
Answers to Selected Exercises for Lesson 8

1. Suppose the magnitude of the pressure gradient for a circular regular low is given as

$$\left|\frac{\partial p}{\partial n}\right| = A\cos\left(\frac{\pi R}{L}\right): \quad R \le L$$

$$\left|\frac{\partial p}{\partial n}\right| = 0: \quad R > L$$

where $A = 2.5\times10^{-3}$ Pa m^{-1}, $L = 250$ km, and R is the distance from the center of the low.

Using a computer program such as Excel, IDL, Matlab, or other software of your choice, make graphs of the following:

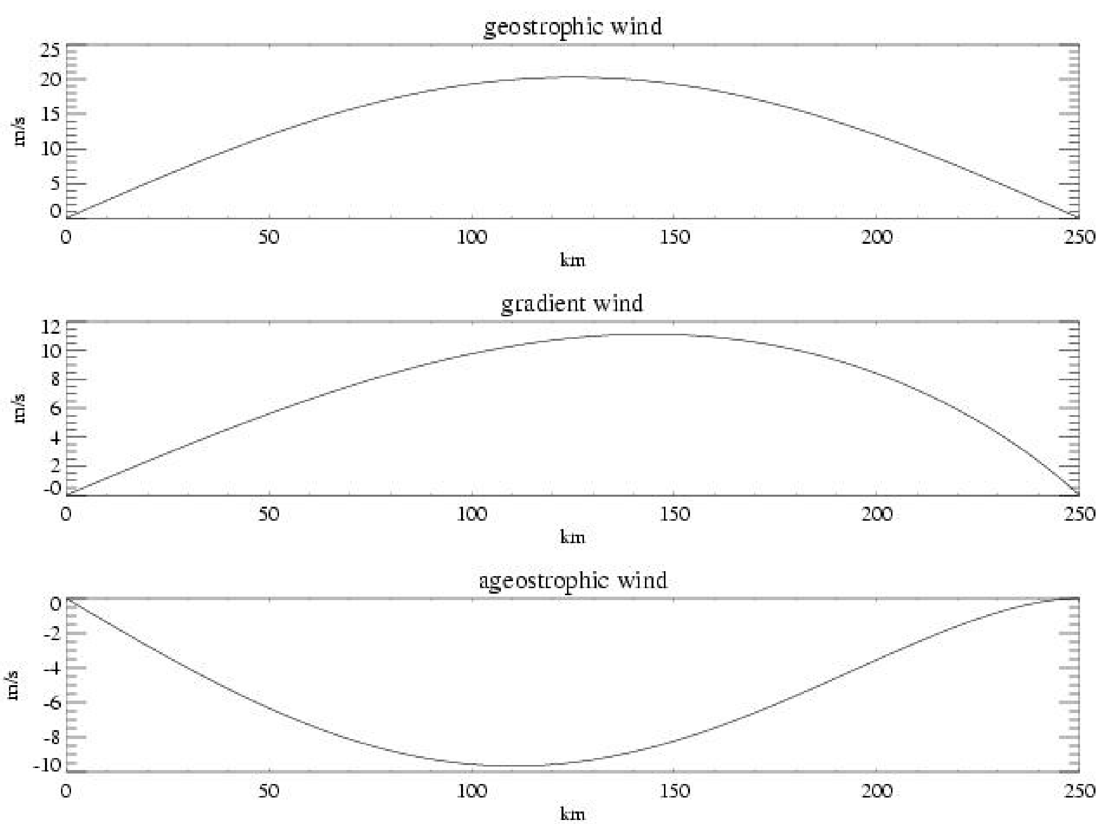
a. The geostrophic wind as a function of R, for $0 \le R \le L$

b. The gradient wind as a function of R, for $0 \le R \le L$

c. The ageostrophic wind as a function of R, for $0 \le R \le L$

Use values for density and Coriolis parameter of $\rho = 1.23$ kg m^{-3} and $f = 10^{-4}$ s^{-1}.

Answer:



3. a. If p_0 is the pressure in the center of a circular high pressure, find the radial pressure profile, $p(r)$, that will give the maximum allowable pressure gradient at each radius, r, from the center of the high.

Answer: $p(r) = p_0 - \frac{f^2\rho}{8} r^2$

b. Using the pressure distribution you calculated from part a., sketch the gradient wind speeds for the regular and anomalous high as a function of distance from the center of the circulation. Use $\rho = 1.23$ kg m^{-3} and $f = 10^{-4}$ s^{-1}.

Answer: Both are straight lines with slope $fR/2$.

c. How does the answer to part b. compare to pure inertial flow?

Answer: Speed is half as much as for inertial flow.