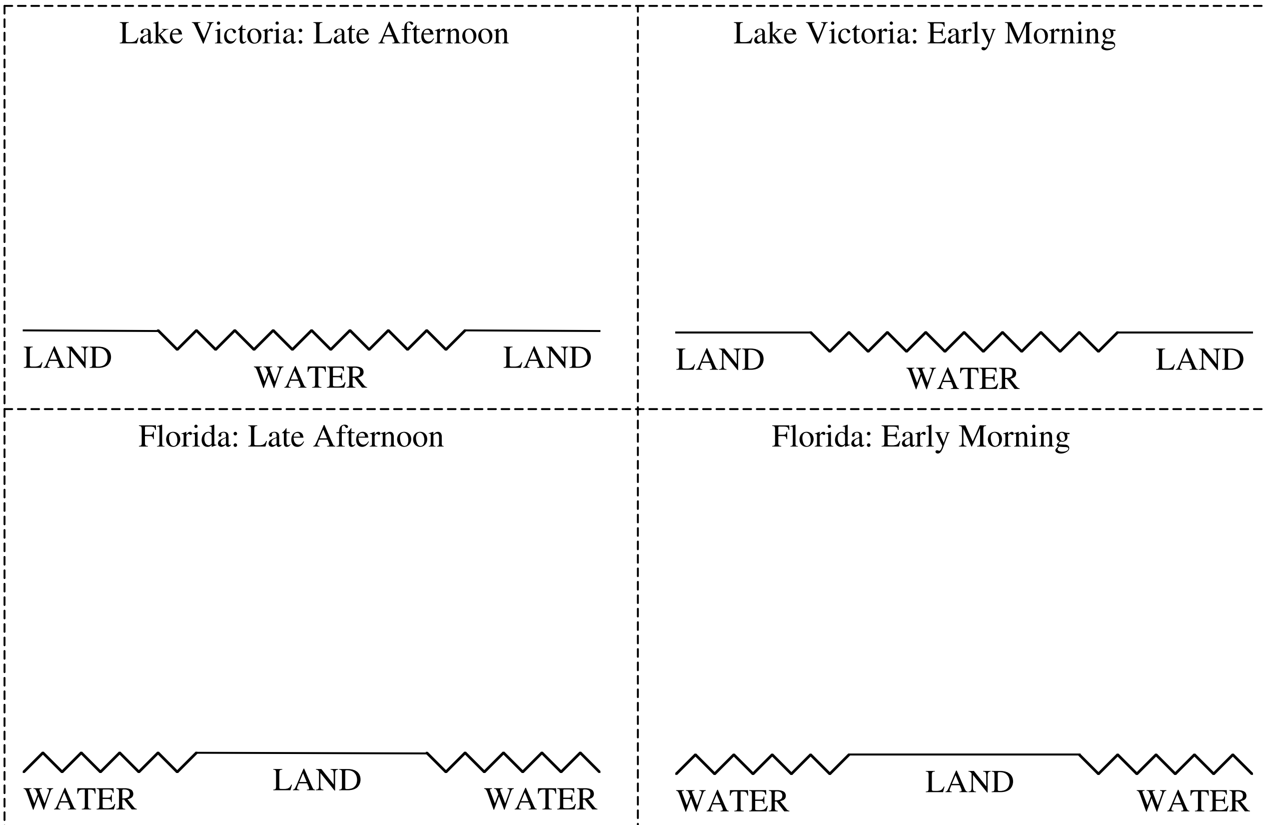
Atmospheric Sciences 101

Mini-Homework Assignment #6 (assigned 2/18/99, due in class 2/25/99)

1. The following cross-sections represent the atmosphere above Lake Victoria (Africa) and Florida at two different times of day. For each situation, label high and low pressure (both near the surface and aloft), and warm versus cold air. Draw the horizontal winds (surface and aloft), vertical motion, and clouds. Label each situation as either a "land breeze" or a "sea breeze."



2. a) The jet stream is a region of strong westerly winds located near the tropopause. Consider an air parcel trapped in the jet stream and circling the Earth. Assume that the parcel follows a circular path with a radius of about 4000 km (this corresponds to a latitude of about 50°N). Calculate the distance traveled by the parcel in making one complete revolution around the Earth. (Hint: circumference of a circle = $2\pi \times$ radius.)

b) Assuming that the jet stream is blowing at an average speed of 120 m.p.h., how long does it take for the parcel to travel once around the planet? (1 m.p.h. = 0.45 m/s = 1.61 km/hour.)

c) Assuming that this wind is in *geostrophic balance*, calculate the pressure gradient ($\Delta p/\Delta x$) near the tropopause at 50°N. (Use the equation we gave you in class). The rotation rate of the earth is $\Omega=7.29\times10^{-5}$ 1/s, and near the tropopause the density is about $\rho=0.3$ kg/m^3. Your answer will have units of kg/m^{2}s, which you can turn into mb/km using: 100,000 kg/m^{2}s = 1 mb/km.

3. The surface pressure map for February 29, 1999 is drawn on the back of this page. Draw arrows representing PGF_H (the horizontal pressure gradient force), the Coriolis "force", and the geostrophic wind at each point on the figure (we drew a sample over Seattle). Make the length of each arrow proportional to the magnitude. Label each arrow or use color coding (red=PGF, blue=Coriolis, black=wind). Ignore the effects of friction. **Bonus**: For extra credit, draw and label the *frictional force* (or use green if you are using color coding) and draw the wind arrow including the effect of friction in pencil next to the non-frictional wind arrow.