Lab 1 – Observed Structure of the Atmosphere

This exercise requires access to the internet via a browser on any computer, any operating system.

Follow the instructions step by step. Some of steps require a response from you; some do not. Your writeup can consist a sheet or two of paper with numbered responses where required.

1. Open a browser (e.g., Firefox) and go the following URL: `http://weather.uwyo.edu/upperair/sounding.html`

2. Make sure that the menu entries read as follows: `North America` and `Text:List` followed by the date and time of the most recent sounding. If no data are found in the steps that follow, you might have to set the time back by 12 hours.

3. On the map of North America, find the identifier for Green Bay, WI (GRB). This is the upper air station most representative of conditions at Madison, WI.

4. Click on the identifier. Raw data for the balloon sounding from that station will be displayed in text form in a separate browser tab. Open that tab and view the results. The columns that matter for this lab are those labeled `PRES` (pressure), `HGHT` (height), `TEMP` (temperature), `DRCT` (wind direction measured clockwise from north), and `SKNT` (wind speed in nautical miles per hour).

5. At the beginning of your writeup, make sure you indicate exactly which sounding date(s) and time(s) you used when completing the exercises that follow.

6. Find the sounding level corresponding to ground-level conditions. This is the level with the highest pressure (and the lowest height) for which the temperature and other data are not missing.

   (a) What is the pressure and what is the height at the surface? Which of these two variables do you expect to stay the same from day to day?

   (b) What is the temperature and the wind speed at the surface? What does this temperature translate to in degrees Fahrenheit?

7. Scanning down the relevant columns, identify the levels, altitudes, or other request variables meeting the following conditions:

   (a) The pressure level in hPa and height in meters corresponding to the freezing level (i.e., where the temperature is 0.0°C). You will probably have to *interpolate* between two levels to estimate these two values.

   (b) The pressure level, height, and temperature at the coldest level in the sounding. What does the temperature translate to in °F?

(c) The temperature and pressure at the level closest to 10.0 km, which is a typical cruising altitude for a transcontinental passenger jet. What is the temperature in °F? What is the pressure expressed as a percentage of the surface pressure?

(d) The pressure level, height, and wind direction and speed at the level reporting the highest wind speed in the column. How does this compare with the surface value?

8. Now repeat steps 6 and 7(a–b) for two more stations: Resolute, Canada (YRB) and Hato, Curacao (TNCC; off the coast of Venuzuela in South America), recording your results as before. Then answer the following questions:

9. Which of the three stations recorded the coldest surface temperature? The warmest? Are these results in line with your expectations? Why?

10. Which of the stations recorded the coldest minimum temperature anywhere in the vertical column? The warmest minimum temperature? Compare these results with those of the previous question.

11. Going back to the main web page, pick a date and time that is exactly six months earlier than the one you used for the first part of this exercise. Record that date and time.

12. Repeat steps 6, 7(a–b) and 8. Then compare your winter and summer results for those steps.

    (a) For which station is the six-month difference in the surface temperature greatest? Where is it least?

    (b) For which station is the six-month difference in the minimum column temperature greatest? Where is it least?

    (c) Is there anything unexpected (or at least counterintuitive) about the *sign* of any of these differences? Do you believe your results are typical or atypical? Explain. If you're not sure, try looking at other times and locations, and record your findings.

13. For each of the six soundings you have looked at, compute the *average lapse rate* (°C/km) between the surface and the coldest level recorded in steps 6(b) and 7(b). Note that if the temperature *decreases* with height, then the lapse rate is considered to be *positive*.

14. The global average lapse rate in the troposphere is often taken to be about 6.5°C/km. Comment on the degree to which this "standard" lapse rate seems like a reasonable approximation to actual lapse rate you determined from the sounding.