How to solve the Lapse Rate problem in Lab 2

After you plot the points from the dataset onto the graph, you can locate the tropopause and understand where the troposphere ends. Then use the change in temperature (from sea level (0 km) to the top of the troposphere (11 km)) and divide this by the change in altitude to determine the lapse rate.

10. Based on the data provided, calculate the lapse rate for the troposphere. Recall the lapse rate is the decrease in temperature with altitude. Follow the instructions below.

a. Find the total temperature change from the surface to the tropopause:

11km — -56.5°
0 — 15°
15 − -56.5 = 71.5°

b. Find the total distance from the surface to the tropopause:

11km
0
11 km

c. Divide your answer from (a) by (b). This is your lapse rate in °C/km.

71.5° / 11km = 6.5°/km

16

Now that you have found the lapse rate for this area/date, you can proceed to the next step.

11. The lapse rate can be used to estimate temperatures above the surface in the troposphere. Suppose today you decide to take a trip from Salem to Mt. Washington in New Hampshire. Based on the current temperature in Salem, you could predict what the temperature at the top of the mountain will be. The elevation of Mt. Washington is 6289 ft (1917 m). Using the current temperature in Salem and the lapse rate, what would be the temperature on the top of Mt. Washington? Salem has an elevation of 26 ft (8 m). Hint: make sure to keep an eye on your units where °C = (°F-32)/1.8.

6.5°C /

Here you must calculate the altitude change between Salem (8 m) and Mt. Washington (1917 m). This will be the altitude you will calculate your temperature change from.

Remember, there are 1000 m per 1 km, so… 6.5°C / 1 km → 6.5°C / 1000 m

Now you'll use this rate to determine the change in temperature from Salem to Mt. Washington.

Current Salem = 16°F → -8.9°C

MT. WASHINGTON ELEVATION 1917m
Salem Elevation 8m
1917 − 8 = 1909m

Lapse rate = 6.5°C / 1 km
1 Kilometer = 1000 meters
6.5°/1000m × 1909 m = 12.41°C
We are moving up, therefore we will get 12.41° COLDER
-8.9° − 12.41° = -21.31°

You can find the temperature on top of Mt. Washington (-11°F) from the packet of weather data distributed in class. However, it is given in Fahrenheit, not Celsius degrees. Thus you will need to convert the temperature into Celcius.

To convert temperatures from Fahrenheit to Celsius:

subtract 32 and multiply by .5556 (or 5/9) Example: (50°F - 32) x .5556 = 10°C

Now using the same methodology, we used to figure out the change from Salem **UP TO** Mt. Washington, we will now determine the temperature change from Mt. Washington **DOWN TO** Salem. Remember, moving upwards, the air will **COOL**, while moving downwards, the air will **WARM**!

12. Visit www.mountwashington.org. What is the current temperature at the summit of Mt. Washington? Compare this to your answer for 11 above. What might be a reason for any differences between these two values?

Current Mt. Washington Temp = $-11^{\circ}F \rightarrow -23.89^{\circ}C$

The difference was just over $2^{\circ}C$. Considering that we used a devised ELR from limited data this is quite close. Also Mt. Washington is more that 150 miles North of SSU, and thus is would be expected to be colder than Salem regardless of the elevation.