Unit 10 ATM401, ATM601, Chem601

1. Undergraduate students: In this exercise, we will consider an actual atmospheric sounding (see data of 1200 GMT in the table below) to examine the vertical profile of its potential temperature. This task serves to discover the advantages of the θ profile in displaying various aspects of atmospheric vertical structure.

Pressure (mb)	Height (m)	Temp. (ºC)	Dew Point (ºC)	q_v (g/kg)	θ (K)	∂T/∂p (K/hPa)	∂θ/∂p (K/hPa)	RH (%)
991	329	-6.9	-7.7	2.17				
946	698	2.8	-12.2	1.59				
925	879	1.4	-12.6	1.58				
850	1551	-4.9	-13.9	1.54				
820	1832	-7.5	-14.5	1.52				
804	1985	-8.9	-14.9	1.50				
765	2373	-5.9	-32.9	0.32				
700	3067	-6.7	-40.7	0.16				
648	3658	-10.4	-42.8	0.14				
500	5610	-24.1	-54.1	0.05				
400	7200	-35.5	-49.5	0.10				
250	10280	-61.5	-67.5	0.02				
218	11120	-65.9	-71.9	0.01				
150	13460	-57.5	-78.5	0.01				
100	16030	-56.9	-81.9	0.00				

Calculate the potential temperature to fill in the table. Plot or sketch the vertical profiles of temperature, potential temperature and dew point temperature on the same page. Use pressure (decreasing upward) as the vertical axis and temperature as the horizontal axis. Compare and discuss how the variables vary with height. Based upon the conservative properties of θ, discuss and explain where air is the "warmest". Compute the air temperature and potential temperature lapse rates as well as relative humidity for each layer of the sounding. Identify inversions, if any. Recall the definition of a temperature inversion,

$$-\frac{\partial T}{\partial z} < 0 \text{ or } \frac{\partial T}{\partial p} < 0 .$$

What happens to potential temperature in the inversion layers compared to that in other parts of the sounding?

Inversion	Pressure Layer	Type of Inversion
1		
2		
3		
…		

Is there a cloud? If so, where?

Cloud	Pressure Layer	Type of cloud
1		
2		
3		
…		

Give the lapse rate of potential temperature in the layer from 925-804 hPa. Explain why it differs from the layers above and below. Give the distribution of moisture in this layer and explain how this layer might have achieved this structure. How would you interpret the data?