AOSC201: Weather and Climate Lab

Week 1: Atmospheric Basics

Section 103/105

Instructor: Agniv Sengupta

UNIVERSITY OF MARYLAND 18 56
DEPARTMENT OF ATMOSPHERIC & OCEANIC SCIENCE

Course Info

- AOSC201 course webpage: https://www.aosc.umd.edu/~asengupta/AOSC201/

- AOSC201 course outline: https://www.aosc.umd.edu/~tcanty/aosc201/

- Textbook: *Weather and Climate Laboratory Manual* (1st Edition) by Tim Canty and Travis Sluka.

- Having the textbook is a requirement. Lab forms in any other format will not be accepted.

- You will need a scientific calculator to complete some of the labs.

About Grades

Grades:

There are 12 total lab exercises. Each lab will be graded out of a possible 50 points. The lowest score will be dropped.

Here's how letter grades will be assigned:

Points	Letter Grade
98 – 100	A+
92 – 97.9	A
90 – 91.9	A–
88 – 89.9	B+
82 – 87.9	B
80 – 81.9	B–
78 – 79.9	C+
72 – 77.9	C
70 – 71.9	C–
68 – 69.9	D+
62 – 67.9	D
60 – 61.9	D–
below 59.9	F

Attendance Policy

Attendance is required and each lab will be completed in class. If you miss one class period, this will be considered your lowest grade and the score will be dropped. If you miss a second lab, you may be allowed to make it up under the following circumstances:

Sickness: A note from a health practioner is required. Self written notes will not be accepted.

Time conflict: Lab make-ups may be allowed under exceptional circumstances such as funerals, religious observances, participation in university activities. Verifiable documentation is required.

To make-up a lab in a different lab section you must get permission from BOTH instructors beforehand.

If you are ill or have a conflict, you must let your instructor know before lab.

Students who notify the TA of a conflict after class has met will not be allowed to make it up. Students have no more than one week to make arrangements for a make-up. We will not allow students to make up labs once we have handed back the labs to the rest of the class.

If you miss a third lab, you will not be allowed to make it up under any circumstances. No exceptions.

We reserve the right to refuse lab make-ups to anyone at any time.

Computer Access

- Login to the lab computers with your UMD Directory ID and Password
- **__NO PERSONAL LAPTOP and CELL PHONE USAGE DURING LAB__**
- If you're unable to log in to the lab computer, it is because you do not have "TerpConnect" activated.

__Please follow the steps below to activate TerpConnect__:

1) Go to ter.ps/e9b
2) Log in with your UMD Directory ID and Password
3) Check the box next to "TerpConnect" in order to activate it
4) The activation request may take a while to work (1-3 business days)

Week 1 Lab: *Atmospheric Basics*

- Lab#2 of Lab Manual (pages 9-13)

- You will need a pencil, a ruler and a scientific calculator for completing this exercise.

Temperature profile of atmosphere

- Troposphere ~ 10 kms deep, extends from surface (1000 mb) to about 200 mb.
- Stratosphere extends from 10 to 50 km (200 mb to 1 mb).
- Temperature Inversion: temperature increasing with height; *inverse* of the normal situation.

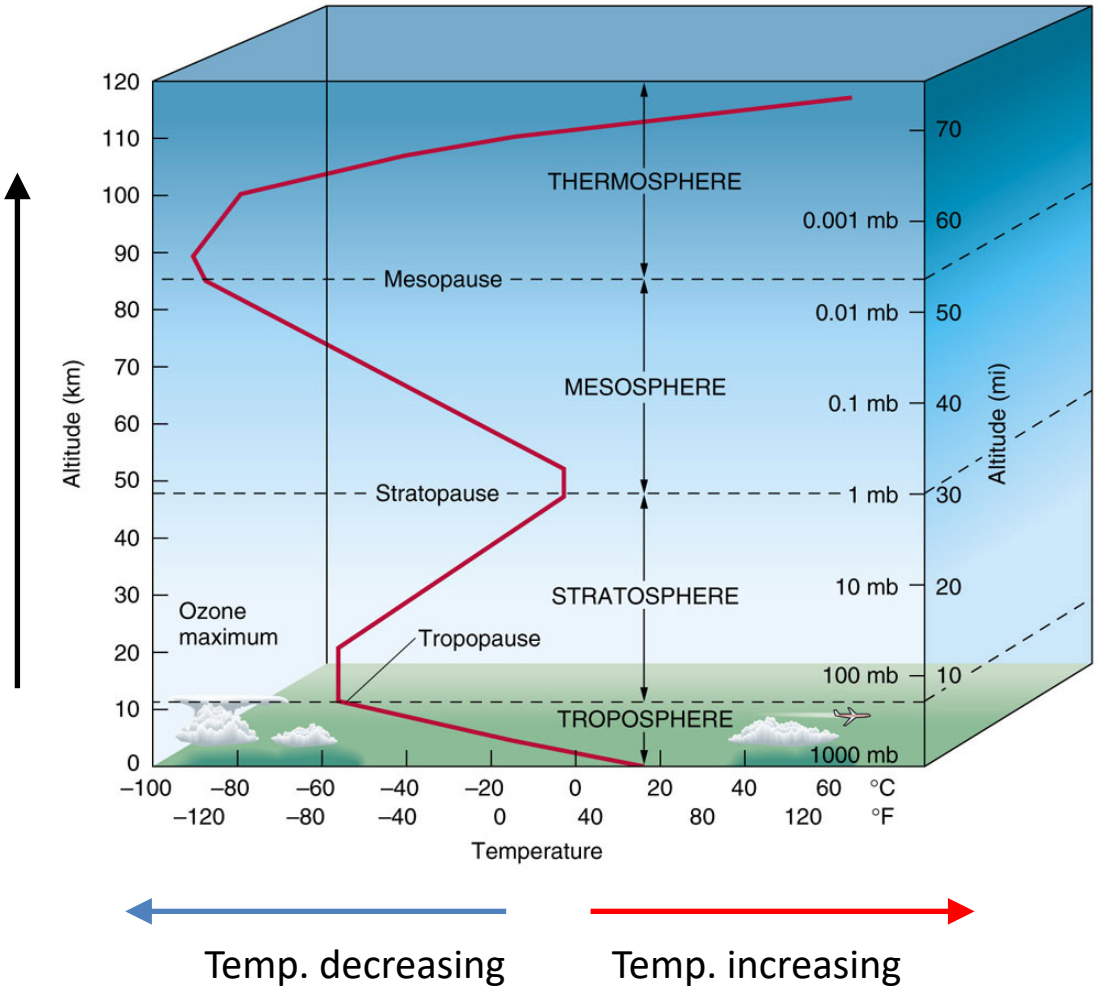
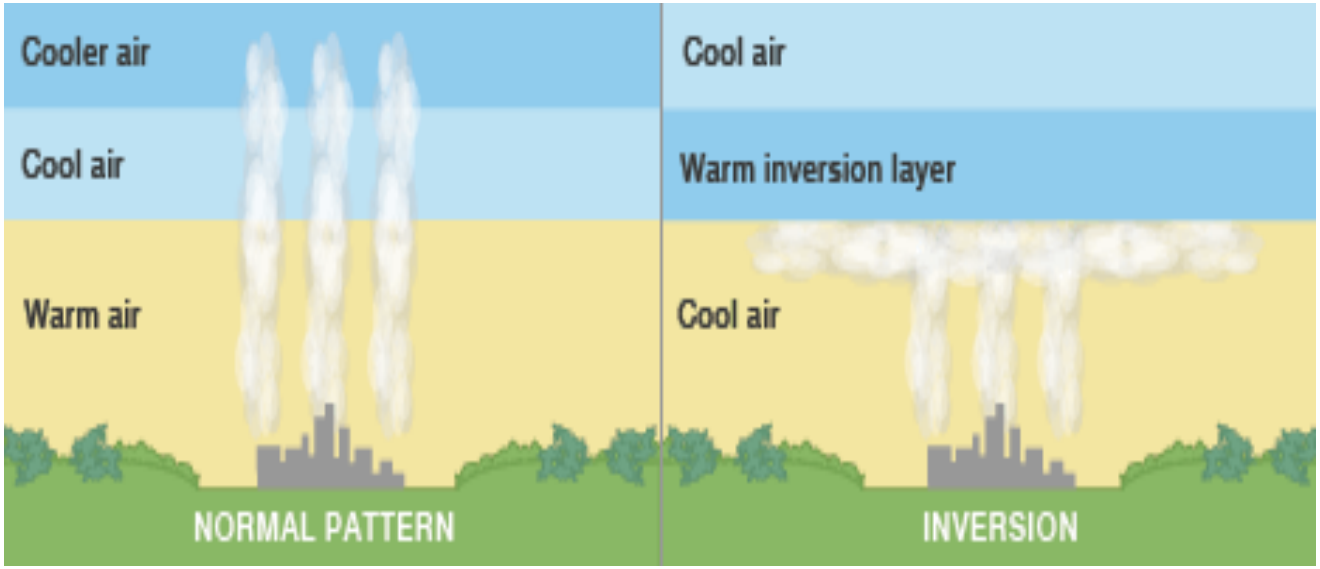


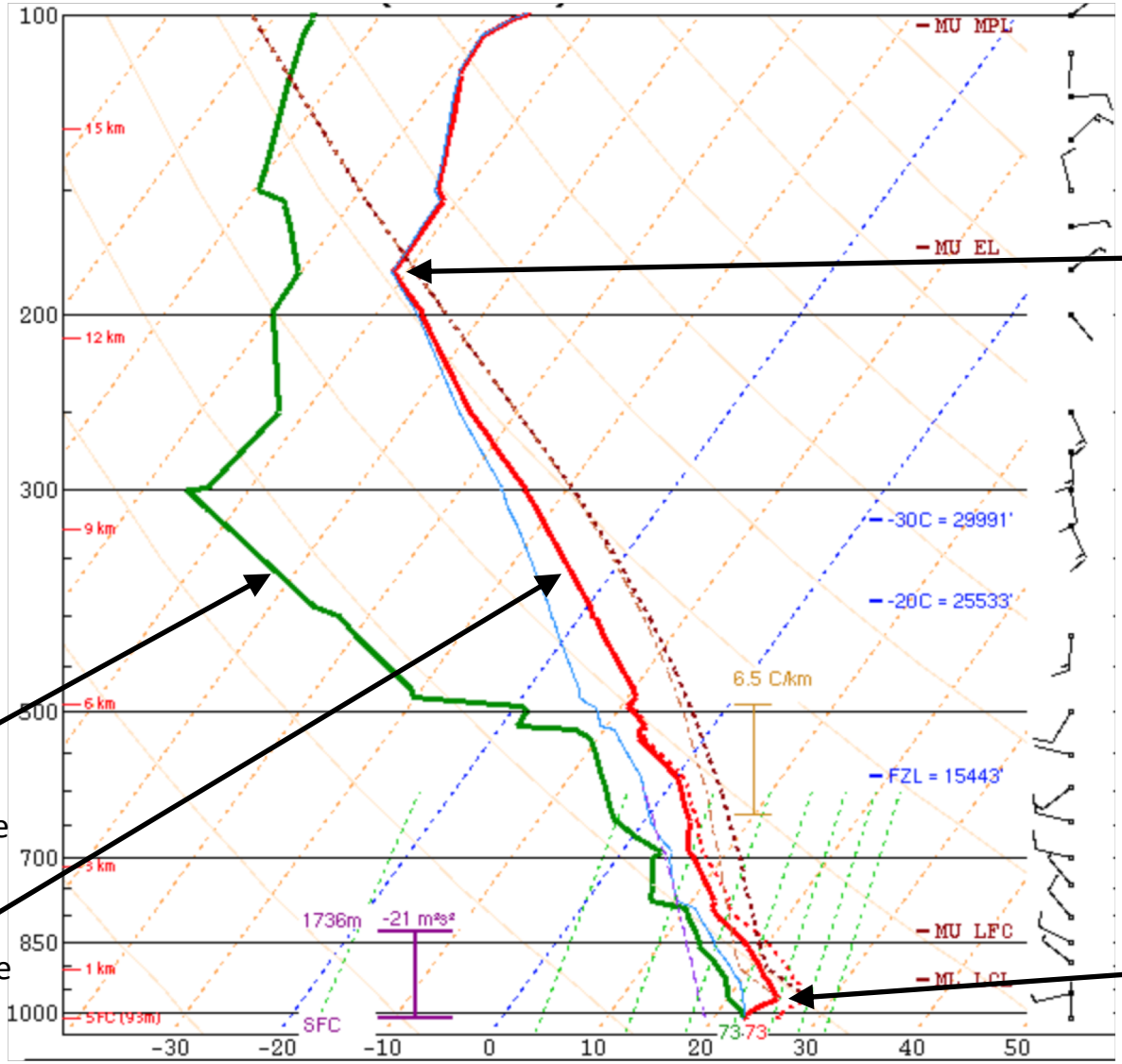
Figure. *Average vertical profile of the atmosphere*

[6]

Temperature Inversion



Temperature vs. Pressure Diagram



Tropopause

Dew Point Temperature

Temperature

Near-surface temp. inversion

Temp. decreasing

Temp. increasing

[8]

Ideal Gas Law

(i) $PV = nRT$,

where, P = pressure, V = volume, n = number of moles of gas, R= ideal gas constant, T = temperature

(ii) Another form of the equation: **$p = Nk_bT$**

Where, p = pressure (mbar), N =number density (molecules/cm^3), k_b = 1.38 x 10^{-19} mbar K^{-1} cm^3 , T = temperature (Kelvin)

While using this form of the equ^n, please note temperature should be in Kelvin.

Conversion from °C to Kelvin: **T(in K) = 273.15 + T(in °C)**

[9]

Ideal Gas Law

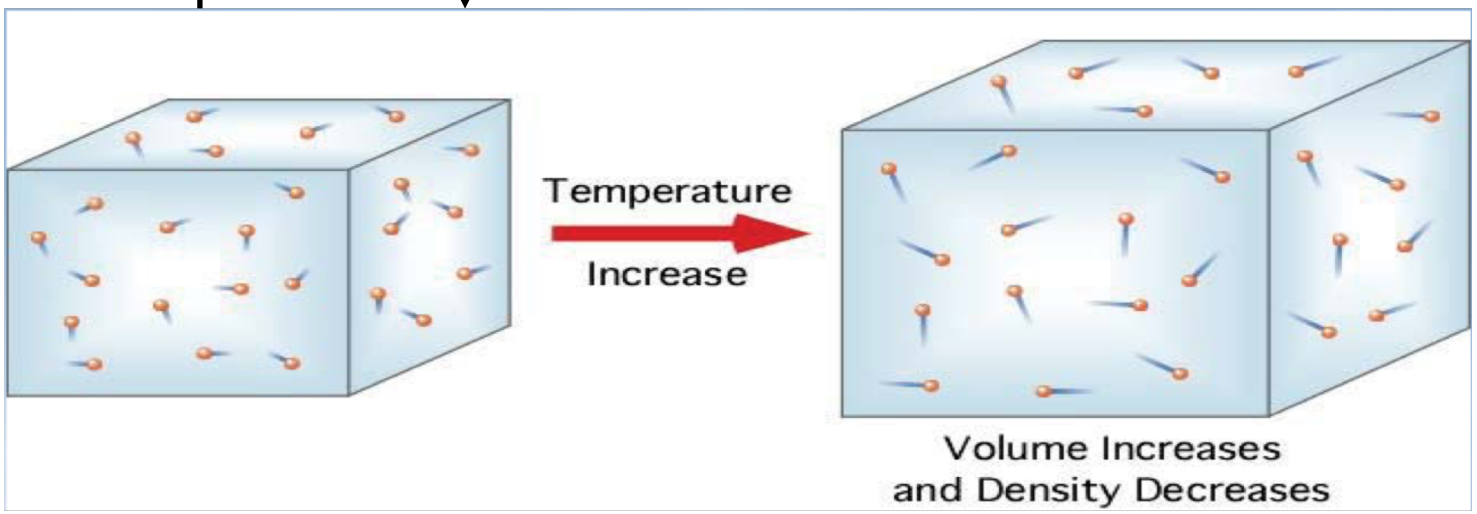
(i) Pressure x **Volume = constant** x **Temperature**,

thus, as Temperature ↑, either pressure or volume ↑

(ii) Another form: **Pressure = Density** x **Temp** x **constant**

thus, **Density = Pressure/(Temperature** x **constant)**

As Temperature ↑, Density ↓



Week 1 Lab: *Atmospheric Basics*

Question 1 (20 points) Directions:

- DO NOT use the data from Table 1.
- Use the sounding data provided on my website under Week#1 Lab to plot a *Temperature vs. Pressure* profile.
- DO NOT draw in Figure 1 of the Lab Manual, but in the larger printout version of the graph that I have distributed.
- Please write your name on the graph as well.
- Indicate the temperature inversion near the surface and the beginning of the tropopause with arrows.

Week 1 Lab: *Atmospheric Basics*

Question 2 (2 points) Directions:

- By "*the points you have indicated*," we mean the top of surface inversion and the beginning of the tropopause.
- Write down the pressure values (in millibar) at these two locations.

Week 1 Lab: *Atmospheric Basics*

Question 3 (5 points) Directions:

- DO NOT use the profile in Figure 2 of Lab Manual.
- USE the *Temperature vs. Pressure* profile you just plotted in the graph that was distributed.
- Show your work. *Pick two points around the same slope*.
- Express lapse rate in units of °C/km
- Make an educated guess when answering what this might indicate.

Week 1 Lab: *Atmospheric Basics*

Question 4 (9 points in total – 3 points each for a, b, & c) Directions:

- Show all work.
- Think critically *about which equation you are using* to solve this problem.
- Remember pressure at the surface is *1000 mb*.
- Use scientific notation (for e.g., 2,000,000 = 2 x 10^6)
- WRITE proper units.

Week 1 Lab: *Atmospheric Basics*

Question 5 (3 points) Directions:

- Hint: Look at the equation you used in Question number 4 and think about what happens to density when you *increase the temperature* variable.

Week 1 Lab: *Atmospheric Basics*

Question 6 (6 points in total – 2 points each for a, b, & c) Directions:

- Show all work.
- Hint: amount of oxygen is 20% of the total atmosphere.
- WRITE proper units.

[16]

Week 1 Lab: *Atmospheric Basics*

Question 7 (5 points) Directions:

- Hint: Think about density as a function of temperature.

Thank you

Questions ?