# AOSC201: Weather and Climate Lab

## *Week 5: Atmospheric Soundings*

Section 103/105

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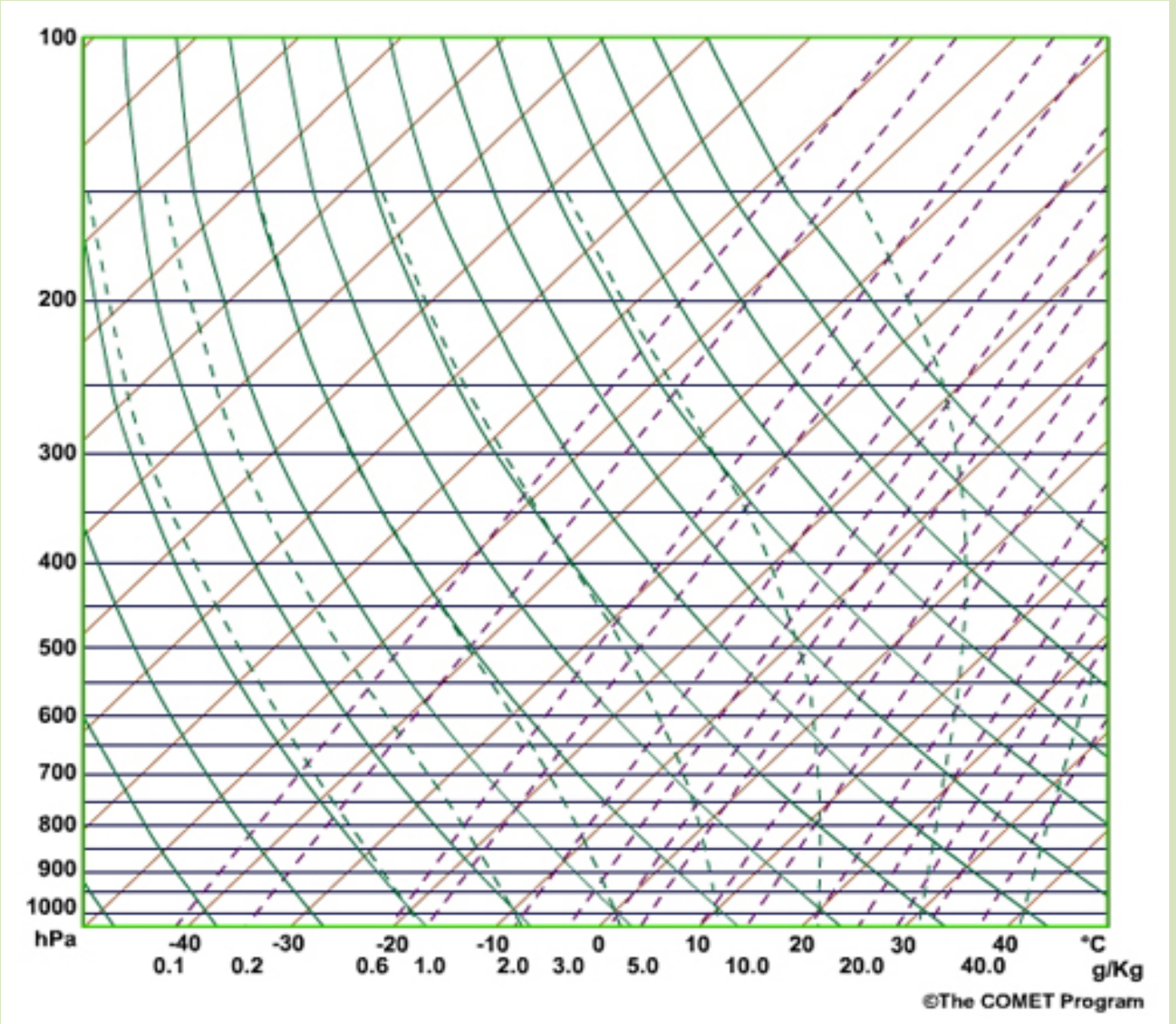
# Week 5 Lab: *Atmospheric Soundings*

- Lab #5 of Lab Manual (pages 25-31)
- 50 points in total
- INDIVIDUAL Work for the entire lab
- **You MUST read the background material (pgs. 25-26) very carefully before getting started with this lab.**

# Skew-T diagrams

- ***Isobars***
- ***Isotherms***
- ***Dry adiabats***
- *Moist adiabats*
- *Mixing ratio*

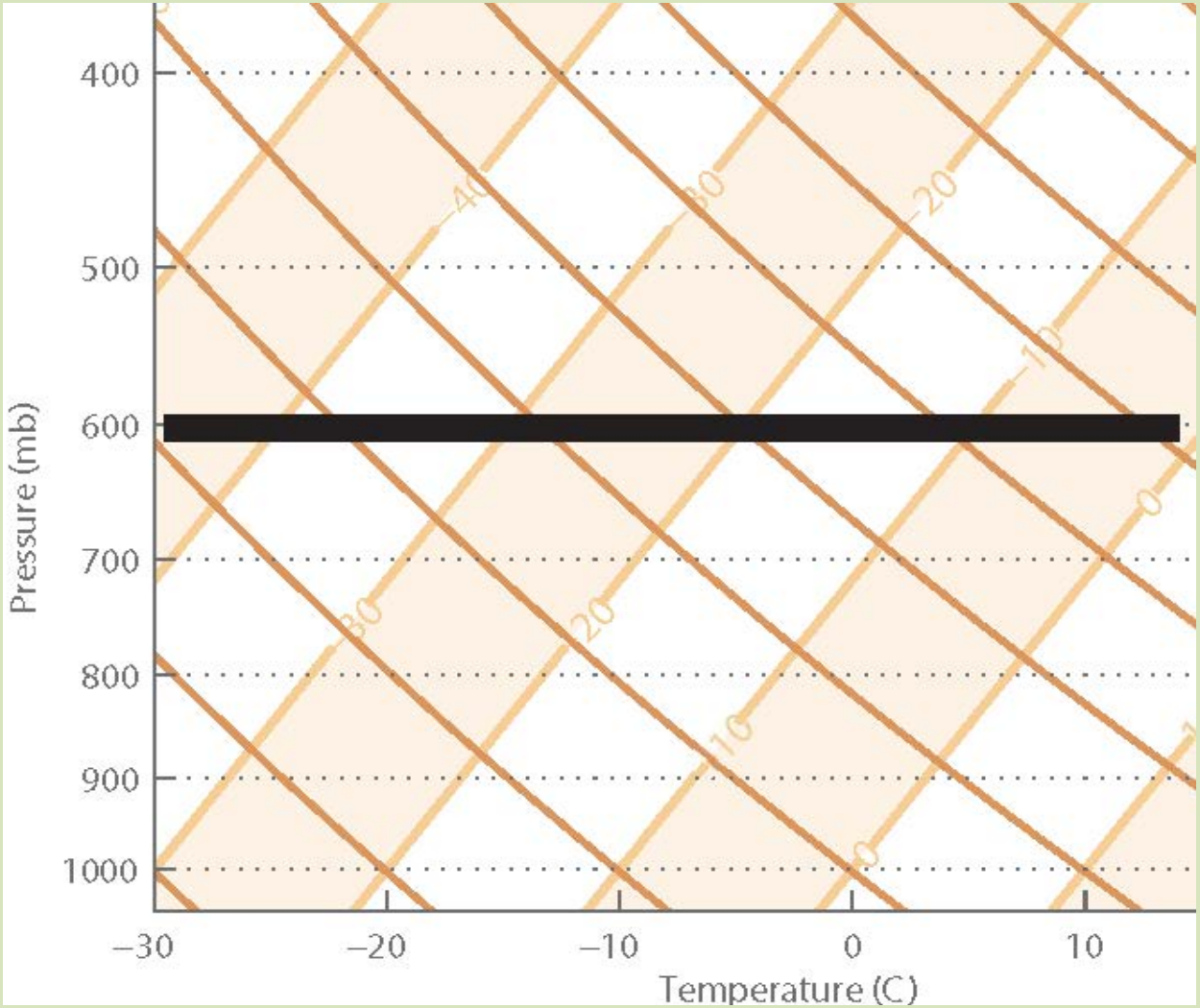


# Skew-T diagram: (i) Isobars

- ***Isobars***

- Lines of equal pressure

- Pressure at the surface can be assumed as 1000mb

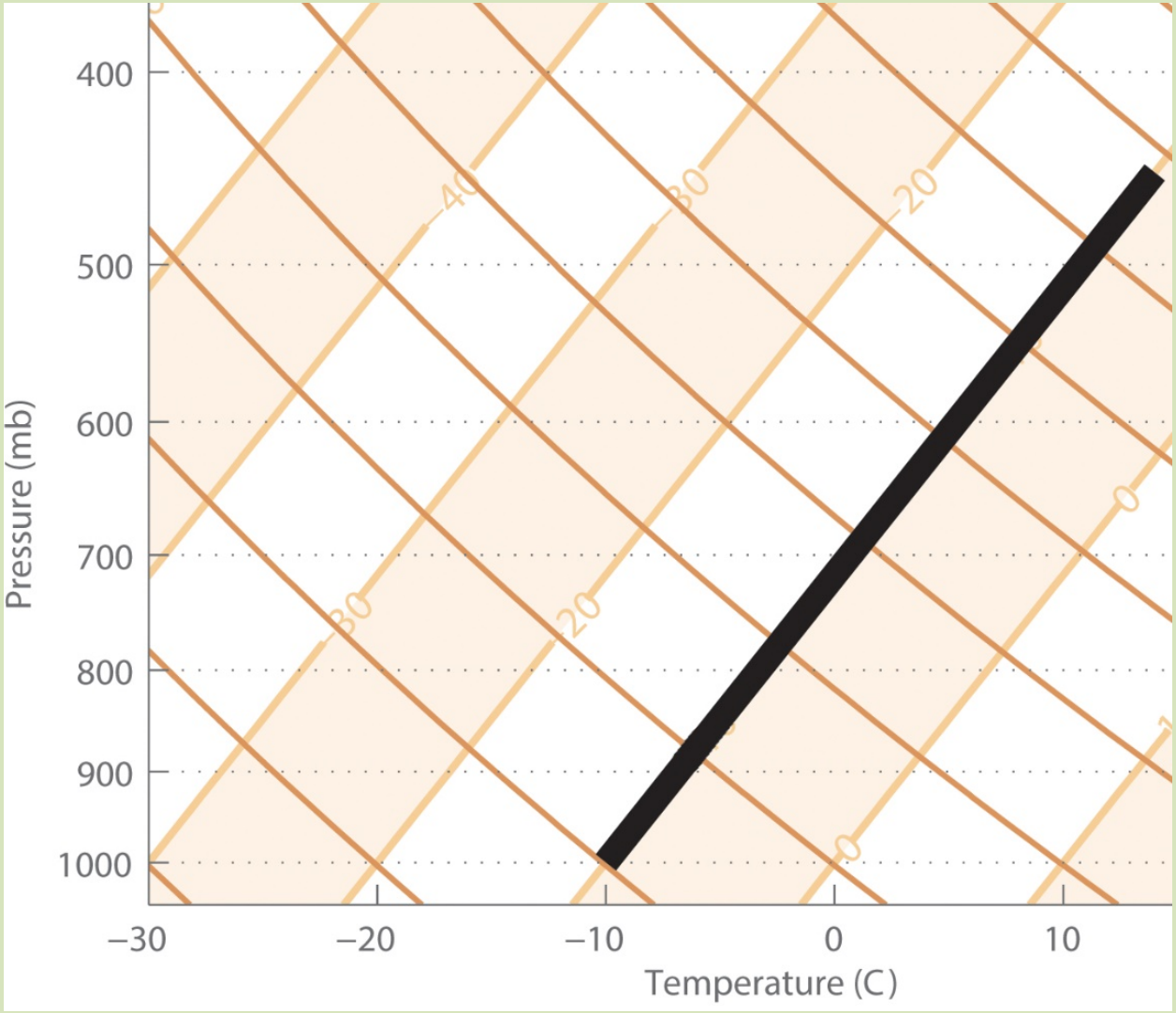


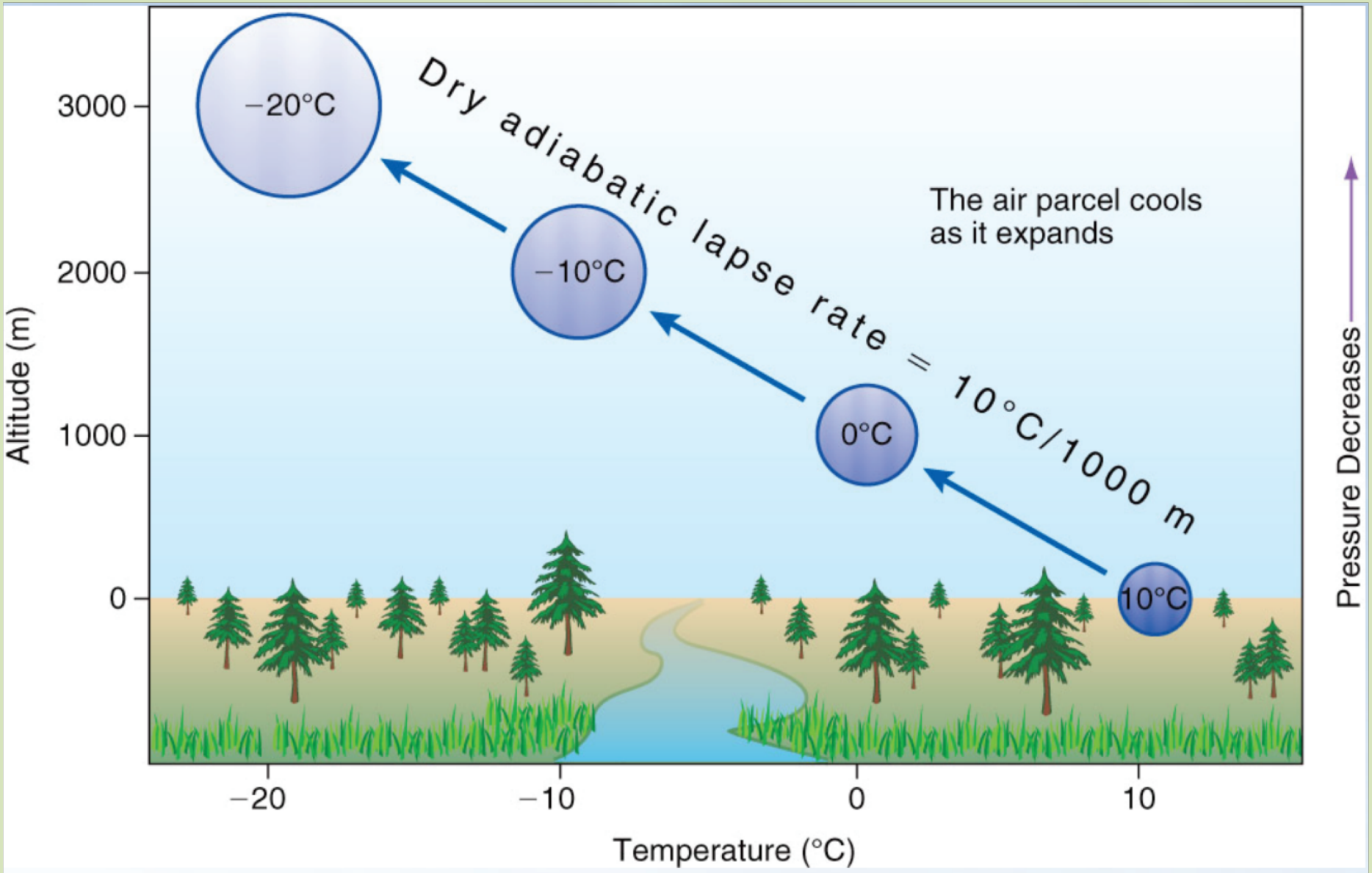
# Skew-T diagram: (ii) Isotherms

- ***Isotherms***

- Lines of equal temperature

- Lines are skewed in this case.






**Dry adiabatic lapse rate: if no cloud forms, air will cool at 10°C per kilometer.**

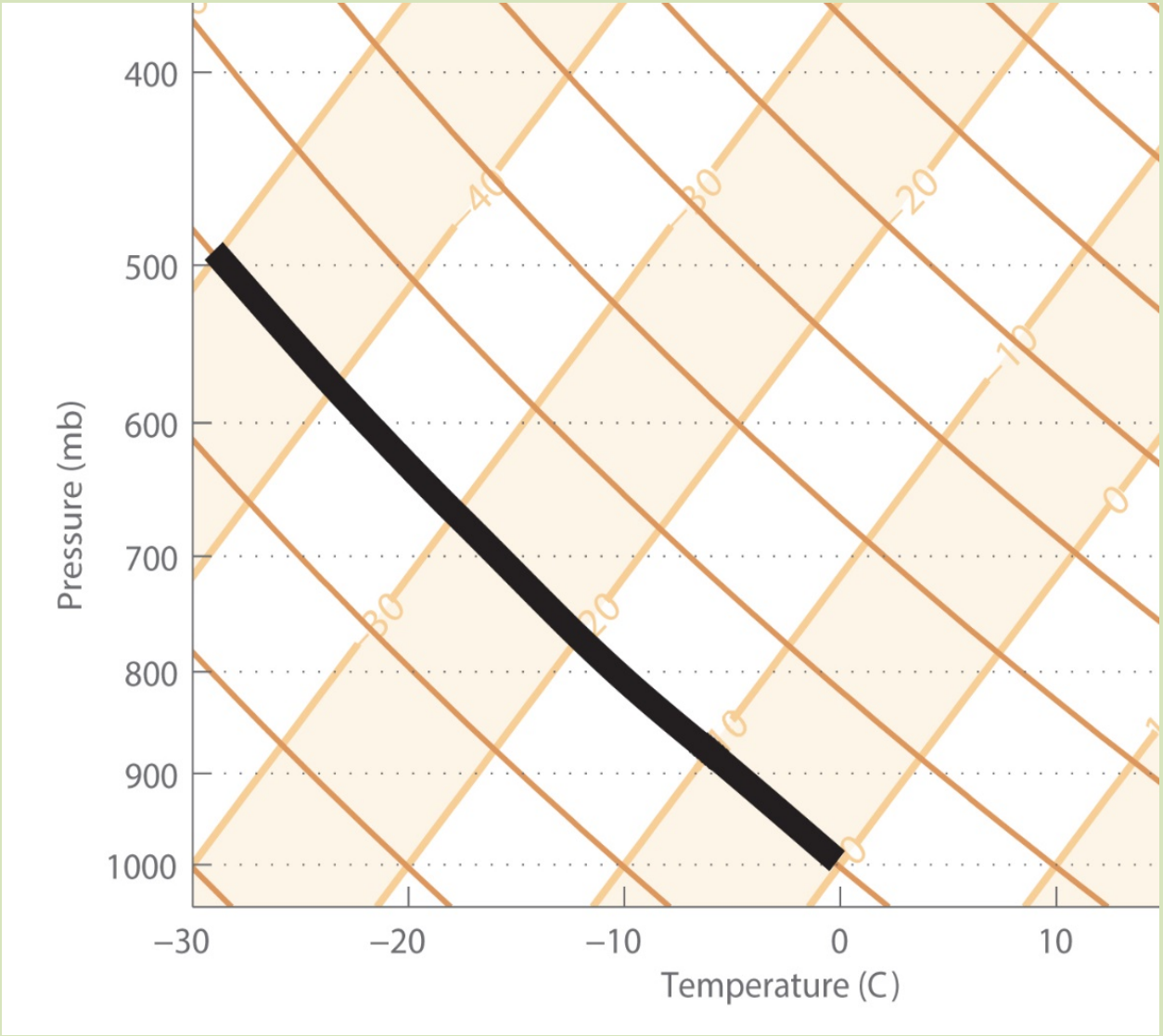
# Skew-T diagram: (iii) Dry Adiabats

- ***Dry Adiabats***

- Dry adiabatic lapse rate = -10°C per km

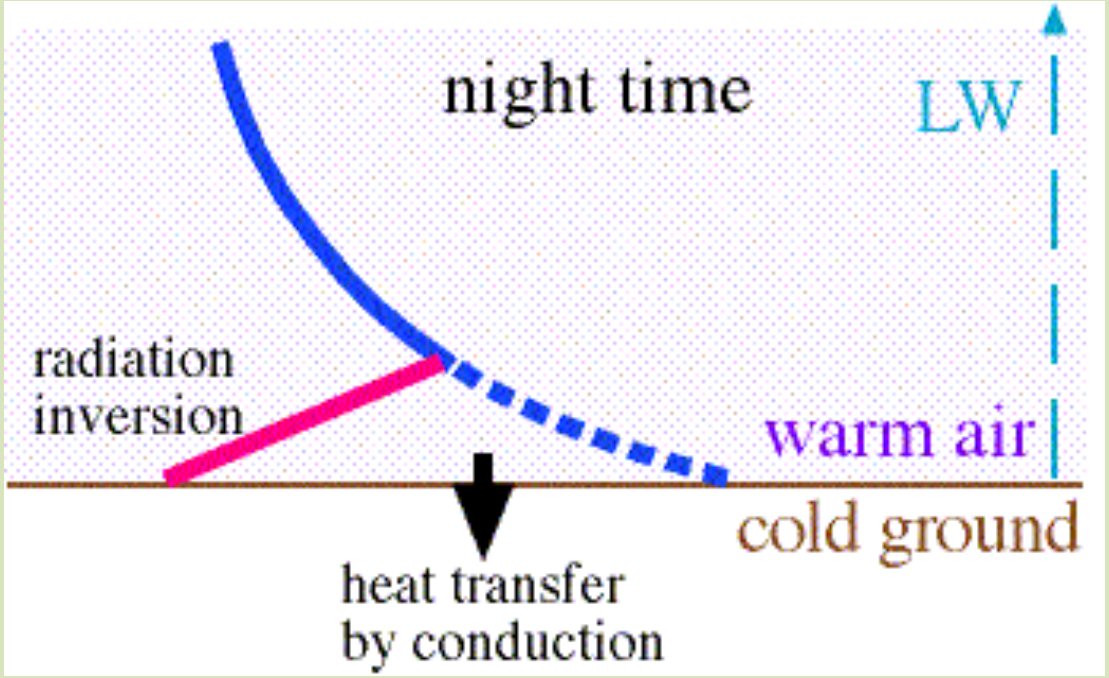
- Rate at which dry air cools with altitude

- "Adiabatic" means no heat exchange with surroundings



# Inversion: (i) Nocturnal

- Occurs overnight.
- Surface is cooling and emitting longwave (Infrared) energy, making the surface cooler than the air above.

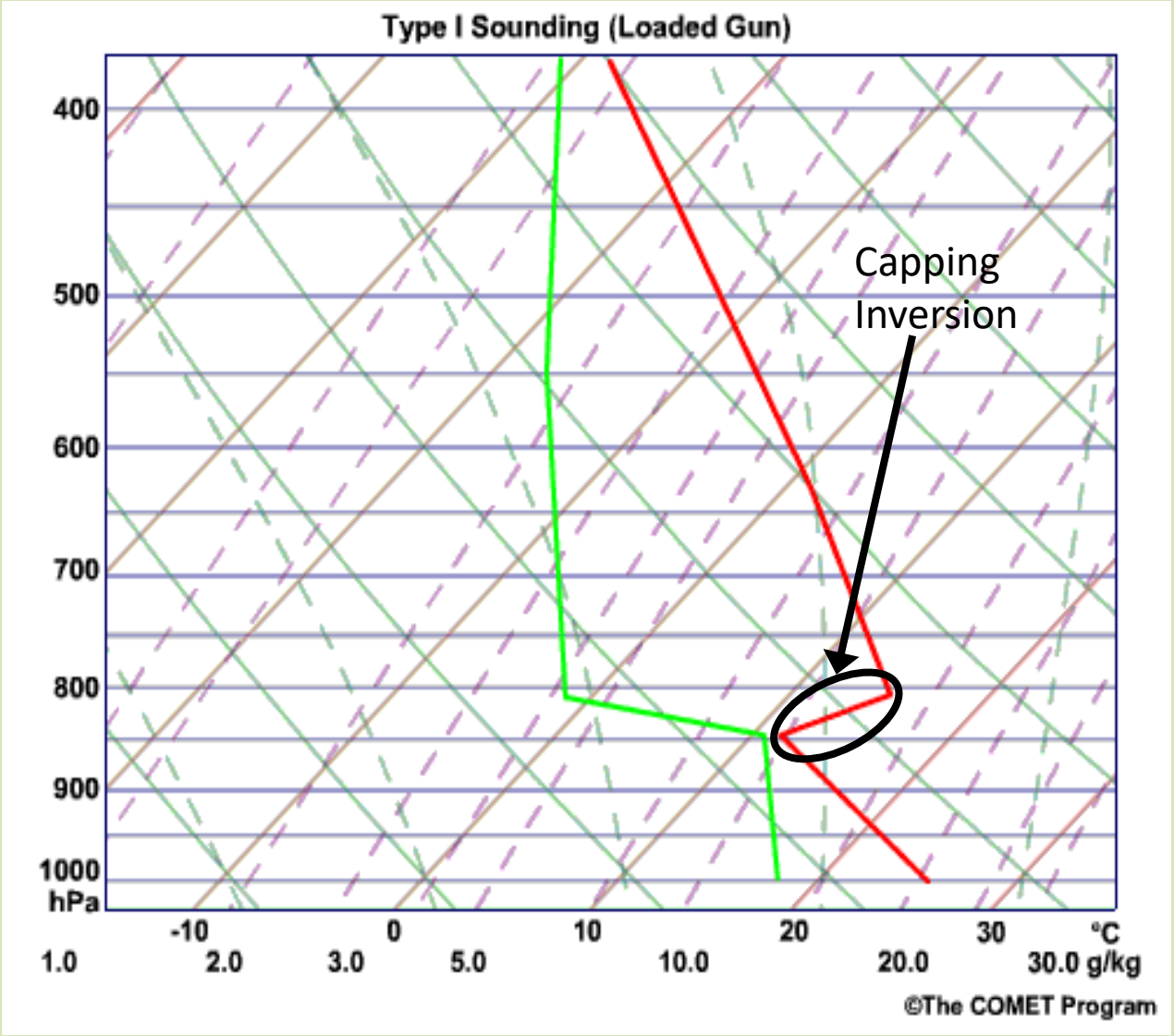


# Inversion: (ii) Capping/Subsidence

- Occurs in the troposphere (typically the lower troposphere) if there is sinking air.

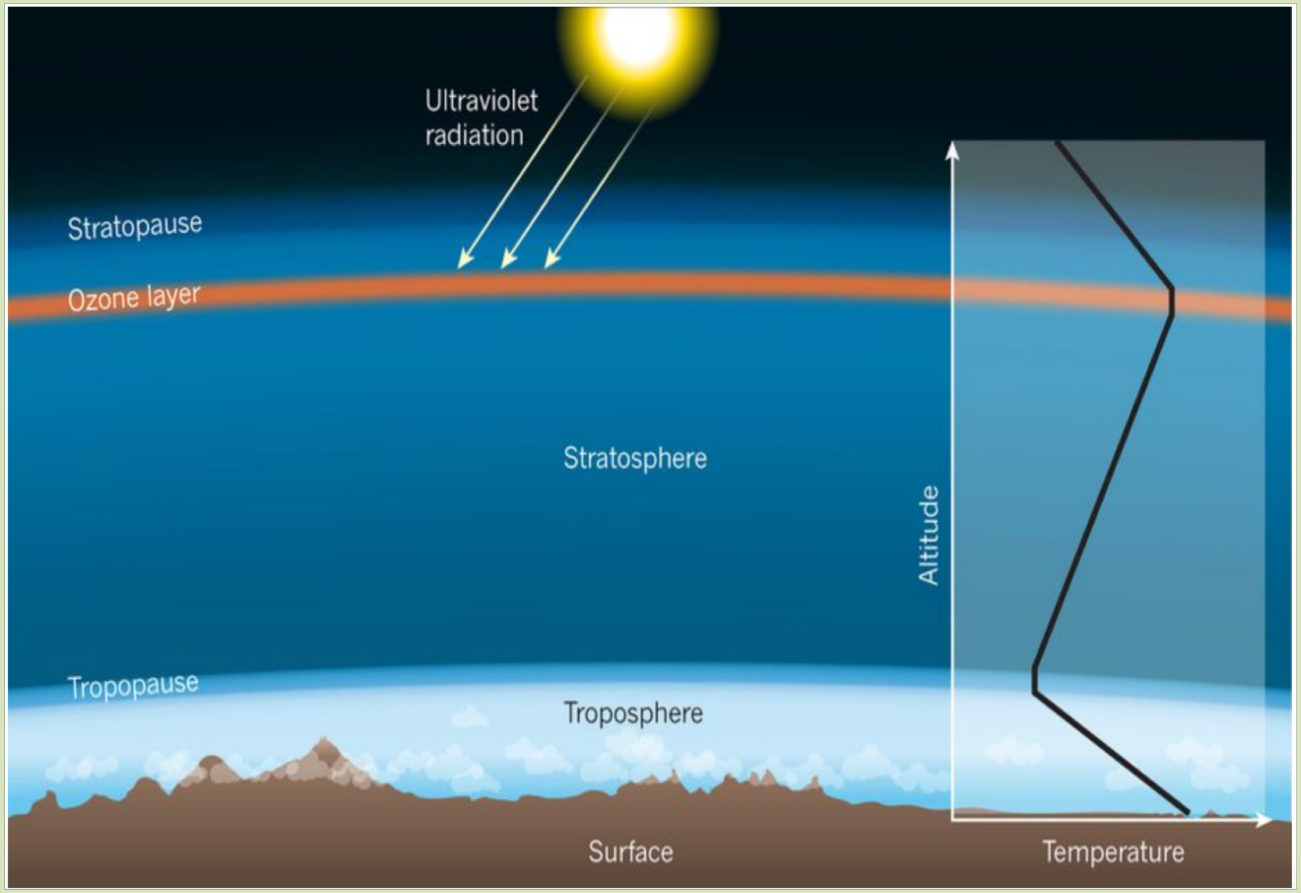
- Air cannot rise above this inversion.

- Pollution is trapped beneath this inversion, leading to adverse health effects.



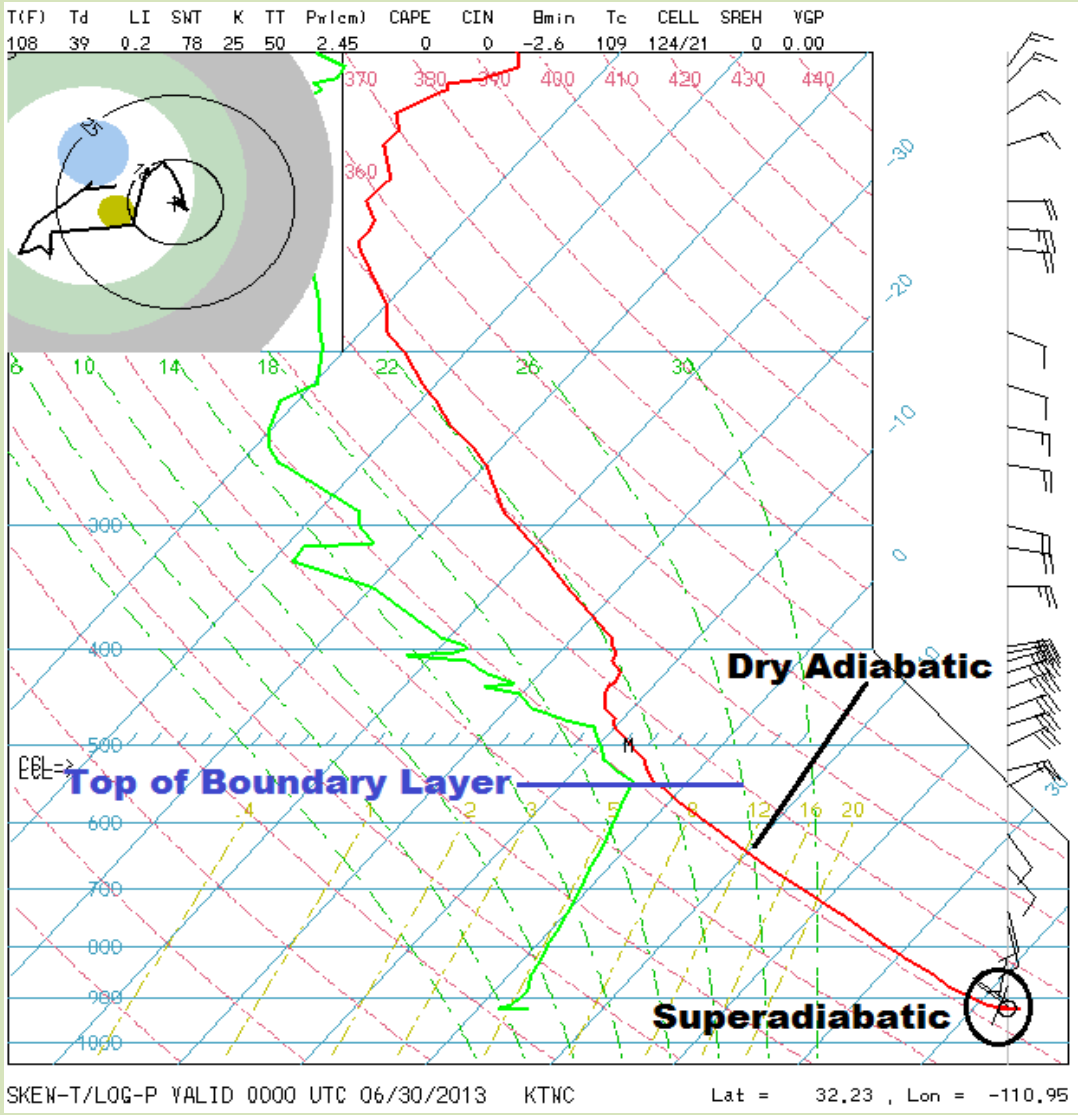
# Inversion: (iii) Stratospheric

- Normally occurs between 100mb and 300mb.
- Air is isothermal (constant temperature) at tropopause.
- Temperature increases with height in the Stratosphere.



# Boundary Layer

- Boundary layer is a well-mixed layer where:
  - Temperature is decreasing around the dry adiabatic lapse rate
  - Dew point is relatively constant
- Part of atmosphere that is greatly affected by Earth's surface



# Week 5 Lab: *Atmospheric Soundings*

Question 1 (3 points)

Question 2 (20 points) Extra Directions:

- Plot on Figure 5 using data in Table 1.

Question 3 (2 points) Extra Directions:

- Tell me the moistest level and the driest level (in units of mbar)

Question 4 (2 points) Extra Directions:

- Tell me the level(s) (in units of mbar) where you might expect cloud formation

Question 5 (1 points) Extra Directions:

- This is a range (for e.g. 975-925 mbar), not just a single pressure.

# Week 5 Lab: *Atmospheric Soundings*

## Question 6 (3 points) Extra Directions:

- Inversion layers should once again be expressed in terms of RANGES in pressure.
- For different types of temp. inversions, refer back to my introductory slides or page 26 of lab manual.

## Question 7 (3 points) Extra Directions:

- Use the skew-T on the back page of the lab where you drew your sounding.

## Question 8 (1 points) Extra Directions:

- By height of the boundary layer, I mean the top of the boundary layer (in units of mbar).

# Week 5 Lab: *Atmospheric Soundings*

## Question 9 (4 points) Extra Directions:

- For initial temperature, refer Table 1.
- For part (b), follow along the dry adiabat.
- For part (c), refer Table 1 for temp. of environment at 700mb.
- For part (d), a parcel of air is positively (negatively) buoyant when the parcel is rising (sinking).

## Question 10 (2 points)

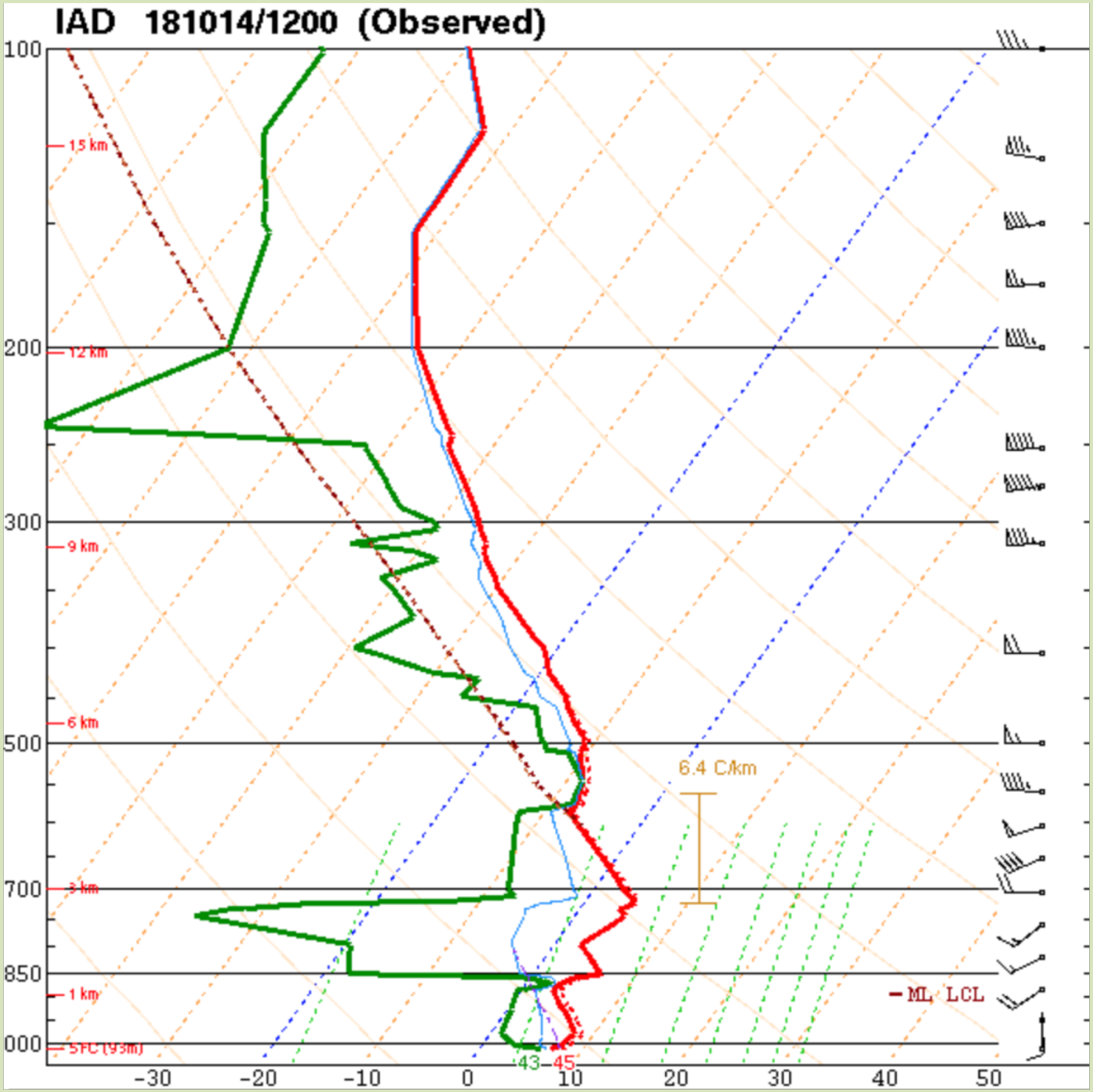
# Week 5 Lab: *Atmospheric Soundings*

Question 11 (9 points) Extra Directions:

- Answer the following based on the sounding below:

1) Name any inversions you see, including the range of pressures at which they are present.
2) Where is it relatively moist ?
3) Where is it relatively dry ?

- The sounding is provided on the next page:


IAD 181014/1200 (Observed)
100
200
300
500
700
850
000
15 km
12 km
9 km
6 km
3 km
1 km
SFC (93m)
6.4 C/km
ML LCL
-43 -45
-30
-20
-10
0
10
20
30
40
50

Thank you

Questions ?