Name:_____ Section:_____

Atmospheric Sciences 101, Spring 2008
Homework 5 (Due at the beginning of your section, Thursday May 15th or Friday May 16th)

Turn in by 4:30 PM on the due date to receive 75% of possible credit
No assignments accepted after 4:30 PM on the due date

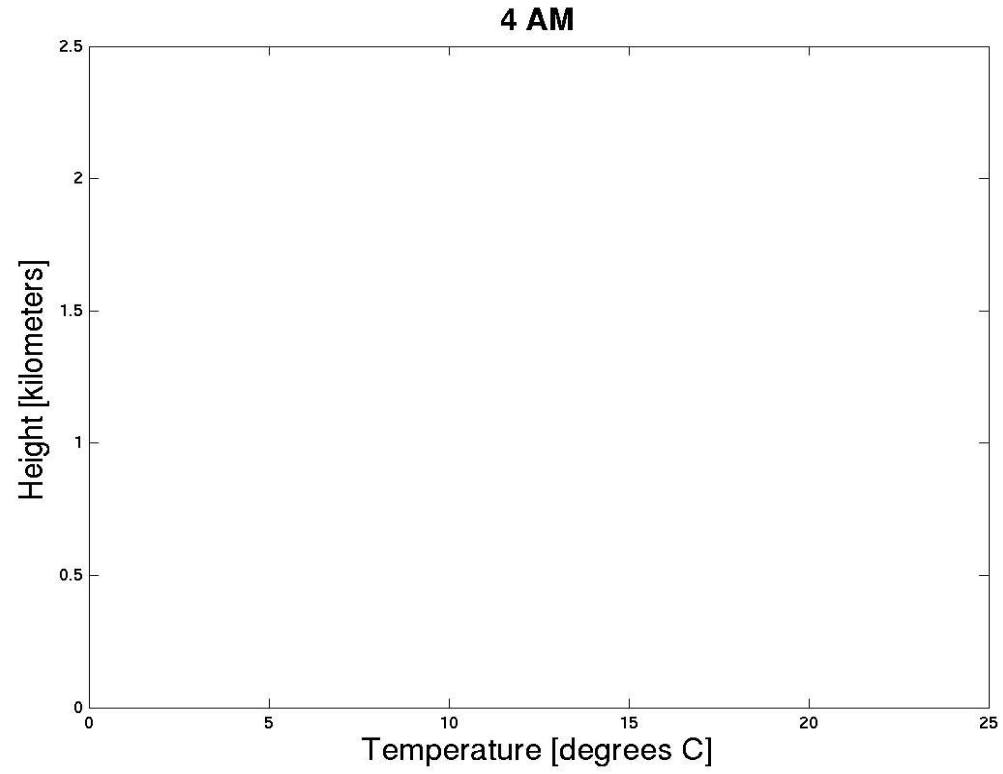
1. Stability, continued

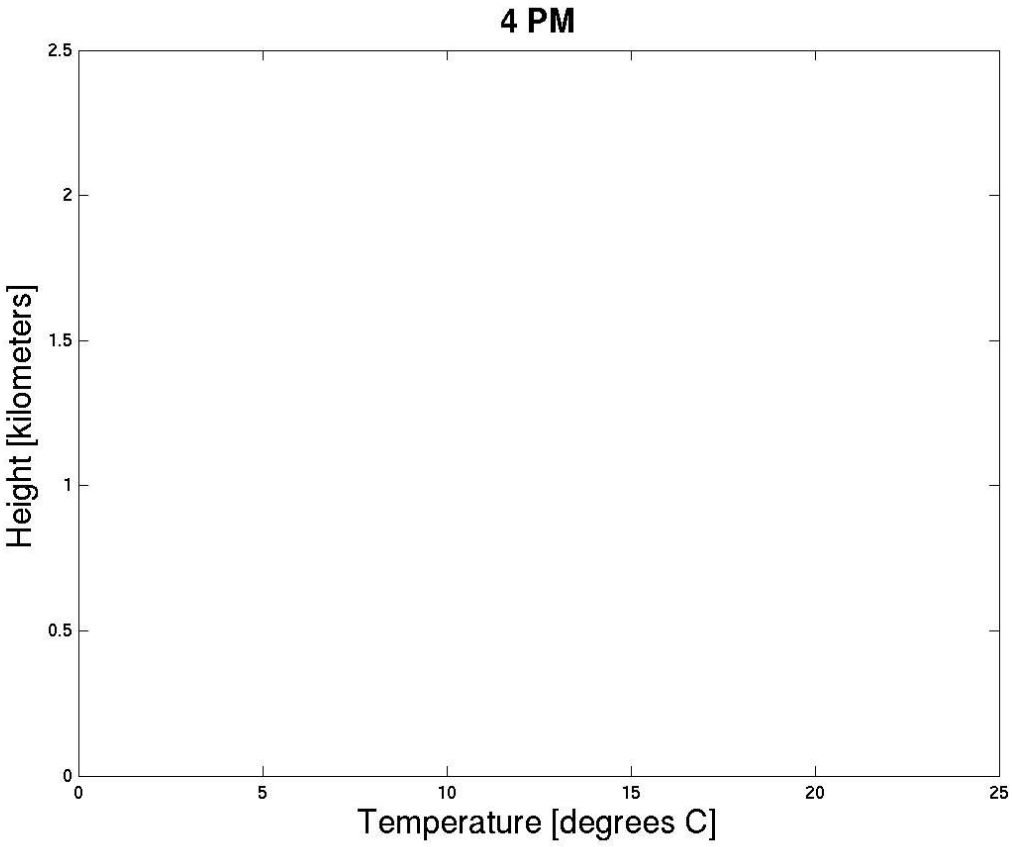
A. At 4 AM in Salem OR, the temperature at the surface is 10°C and your weather balloon reports that at 1 km the temperature is 12°C and at 2 km elevation is 7°C. Plot these on the charts on the following page just as we've seen in all our plots of temperature variation with height. Refer to Homework 4, question #3 if you need an example. This plot you're making is known as a "sounding" of the environmental temperature profile.

B. By 4 PM, a storm is approaching with colder air aloft arriving a bit earlier than the clouds. This means it is cooling at high altitudes, but the sun is still warming the ground. The surface temperature is now 19°C. You launch another weather balloon and it reports that the temperature at 1 km is still 12°C but at 2 km it has cooled to 5°C. Plot the afternoon "sounding" on a new chart the same way you did in part A.

C. In different colors, plot the temperature of both a dry and a moist (saturated) parcel brought from the ground up to 2 km, on top of both the 4 AM and 4 PM temperature "soundings". In both cases, start the parcels at the same temperature as the surrounding environment (10°C at 4 AM and 19°C at 4 PM) and cool them as they rise at the appropriate lapse rate, either dry or moist adiabatic.

D. Is the environment stable, unstable, or conditionally unstable at 4 AM? What about at 4 PM?


4 AM
Height [kilometers]
Temperature [degrees C]
0
0.5
1
1.5
2
2.5
0
5
10
15
20
25


4 PM
Height [kilometers]
Temperature [degrees C]
0
0.5
1
1.5
2
2.5
0
5
10
15
20
25

2. Precipitation/Cloud Formation:

The following are ways to form precipitation or cloud drops:

A. Collision and Coalescence
B. Condensation onto CCN
C. Rapid ice crystal growth due to differences in saturation vapor pressure over ice vs. water surfaces

During the following scenarios, which of the above concepts (A, B, or C) best describes how precipitation drops form, or in the absence of precipitation, how cloud drops form: (one letter per scenario, you will use one concept more than once)

i. Large raindrops are formed in a tropical thunderstorm. The surface temperature is 30°C (86°F).

ii. Snow falls from a stratus cloud over Juneau, Alaska.

iii. A buoyant, moist updraft rises and cools to its dewpoint forming fair weather cumulus.

iv. A cold rain falls from a stratus deck over Portland, Oregon. The surface temperature is 1°C. (34°F).

3. Precipitation Formation:

(a) Cloud droplets grow as water vapor condenses onto the surface of the droplet. Explain why condensation processes cannot be solely responsible for raindrop formation.

(b) What else must happen in warm clouds to produce raindrops?

(Question 3 continued)
(c) How are raindrops formed in cold clouds?

4. Coriolis Force and Geostrophic Balance:

Underline the best answer for the following scenarios. All scenarios refer to a flow that is in approximate geostrophic balance.

(a) The winds will be (faster/slower) on a constant pressure map where the height contours are further apart.

(b) A larger pressure gradient causes a (stronger/weaker) wind and a (stronger/weaker) Coriolis force.

(c) In the southern hemisphere, the Coriolis force acts to turn the winds to the (right/left).

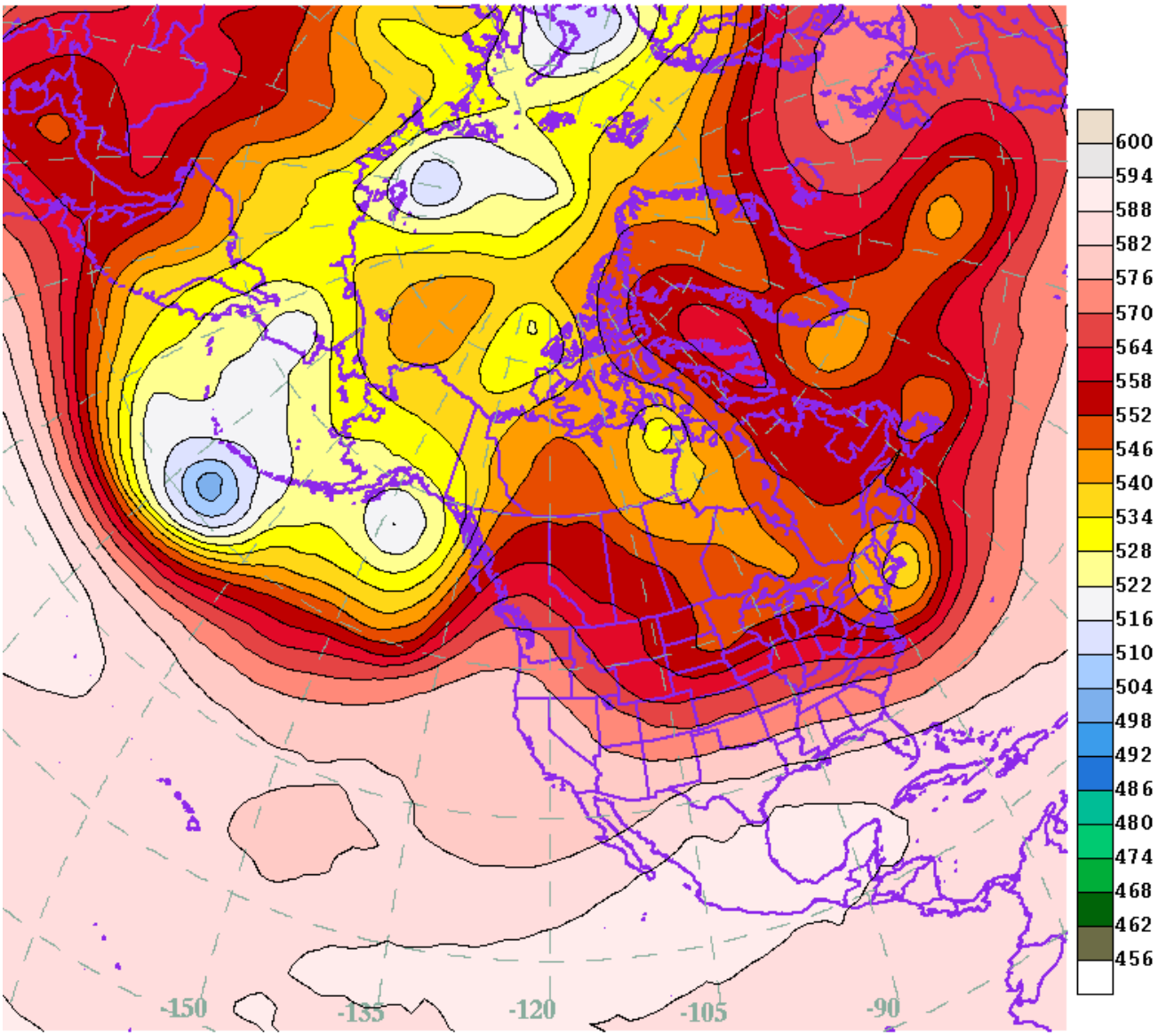
(d) The (vertical/horizontal) pressure gradient is almost perfectly balanced by the force of gravity.

5. Winds Aloft:

Using the map of the 500 mb height surface on the following page, circle the region of strongest wind speed and show its direction using an arrow. Also draw arrows on your map showing the pressure gradient force (PGF) and Coriolis force (CF) at that location.

138 Hr Fcst 500 MB Heights (dekameters) valid 06Z Tue 13 May 2008

(initialized 12Z Wed 07 May 2008)



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