AOS 630: Introduction to Atmospheric and Oceanic Physics
Lecture 12 Fall 2021
Moist Processes on a Skew-T

Ángel F. Adames-Corraliza
angel.adamescorraliza@wisc.edu

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

Announcements

Skew-T a day is due today. Please upload by the end of the day.

No skew-T a week will be assigned this week. Focus on reading paper and on HW

This Thursday we will discuss Held and Soden (2006): **Robust Responses of the Hydrological Cycle to Global Warming.**

Please come ready for a discussion again. It will complement HW3. See Canvas file “Held&Soden2006.pdf”

Announcements

Fixed an unfinished sentence in HW3 and added more hints and reuploaded. Please check.

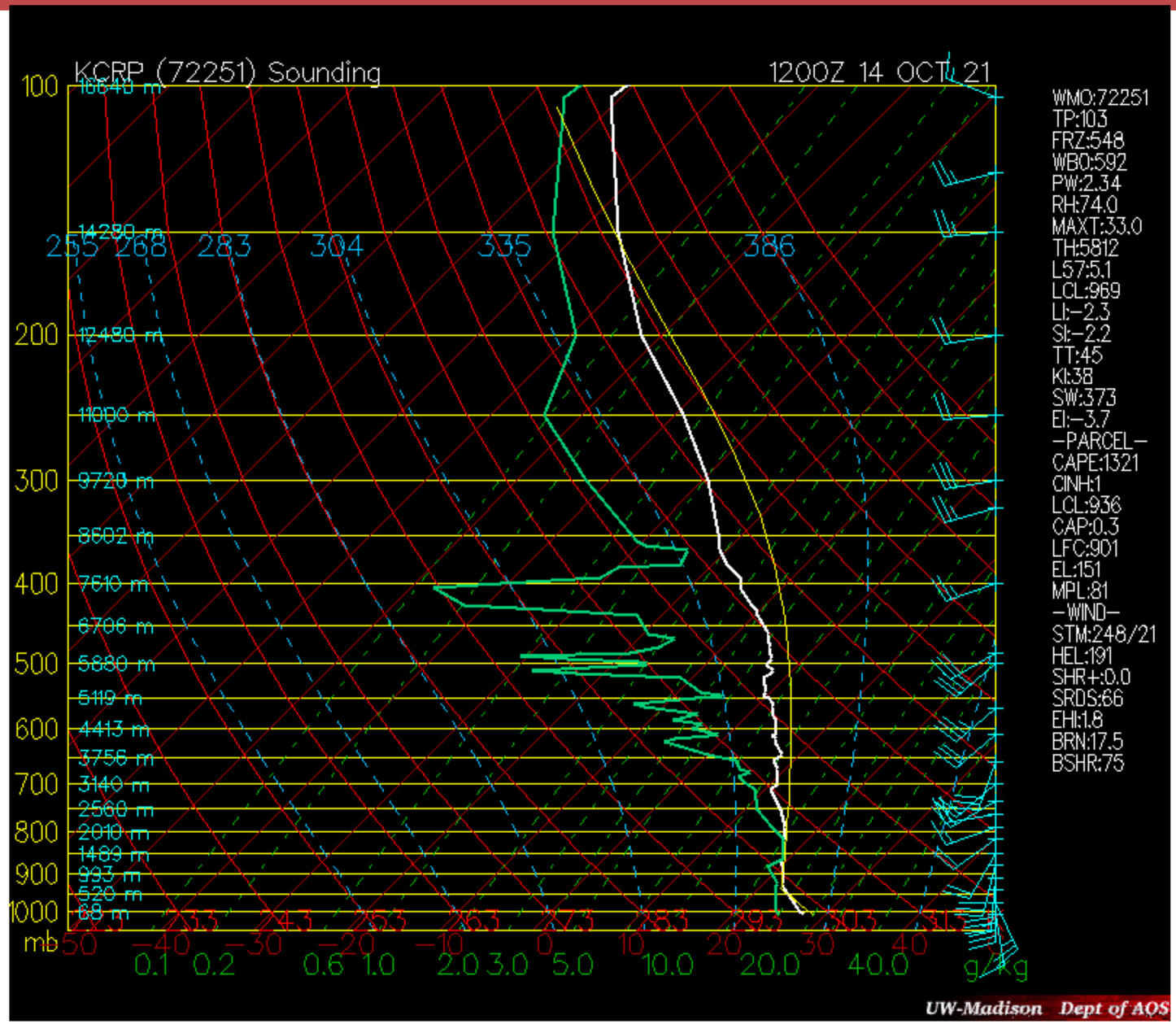
Please choose your topic for your final project.

Last Class

Dew Point depression

$$\Delta T_d = T - T_d$$

Separation between temperature and dew point

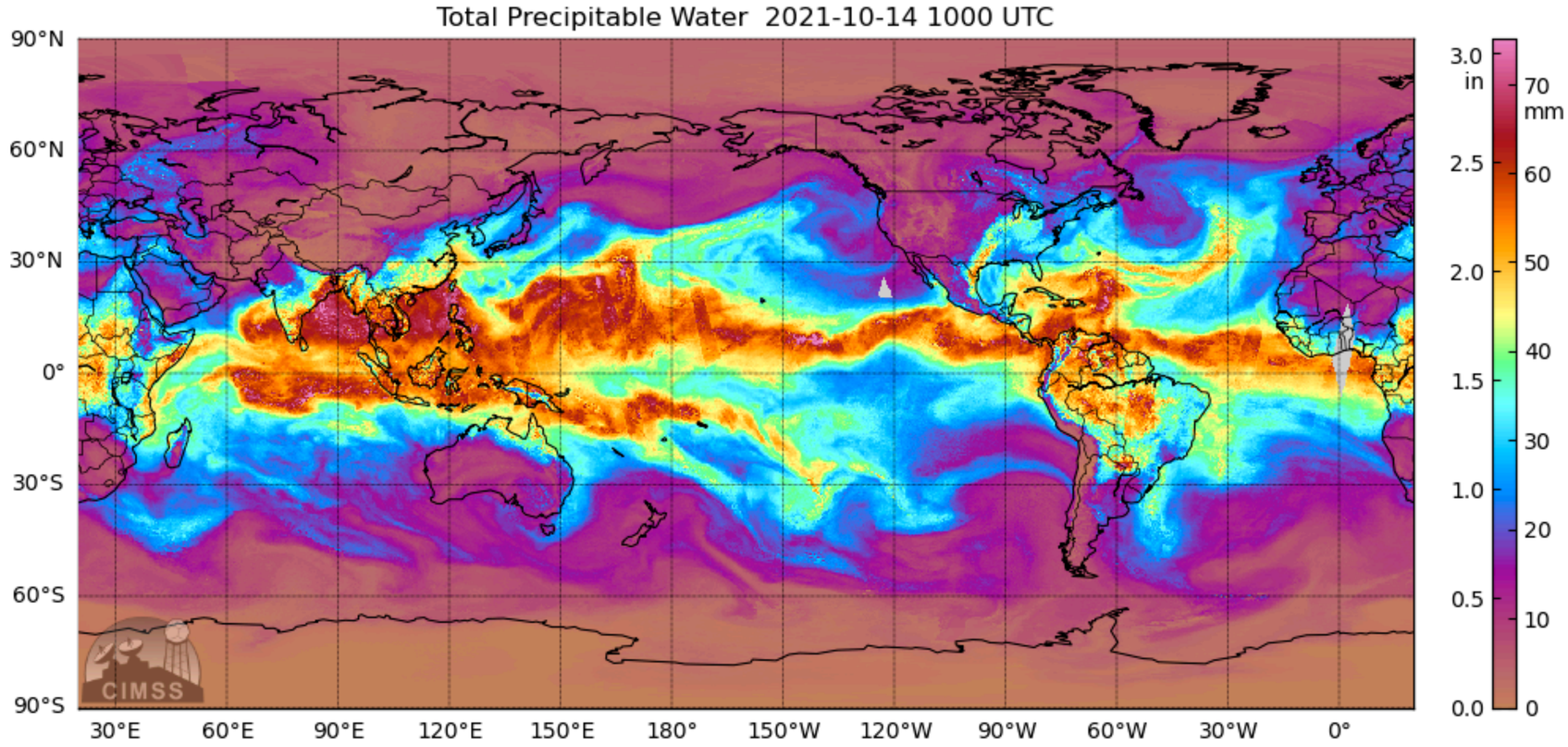


Importance of Clausius-Clapeyron (CC)

To a good approximation, saturation humidity scales with CC

$$\frac{dq_s}{dT} \simeq \frac{L_v}{R_v T^2}$$

$$\mathrm{RH} = \frac{q_v}{q_s}$$



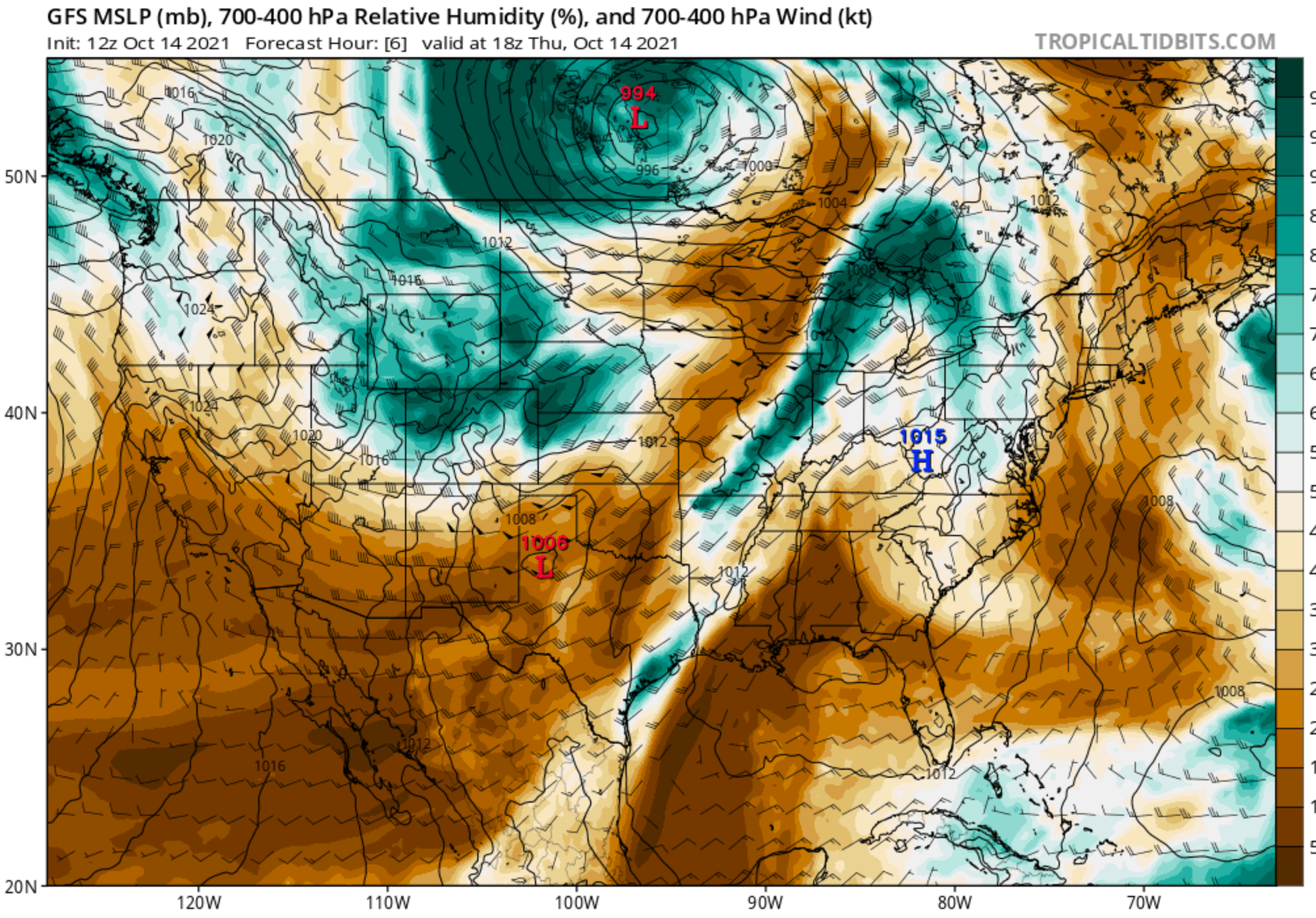
RH vs dew point

The RH tells you how close you are to being saturated

$$\mathrm{RH} = \frac{q_v}{q_s}$$

Dew point tells you the absolute value of moisture content.

They are different, but useful



https://earth.nullschool.net/#current/wind/isobaric/700hPa/orthographic=-224.45,0.37,489

Today

Review moist variables on a skew-T

Supplementary reading

Petty Section 7.5

The lifting condensation level

The level in which a parcel that is adiabatically lifted from the surface becomes saturated.

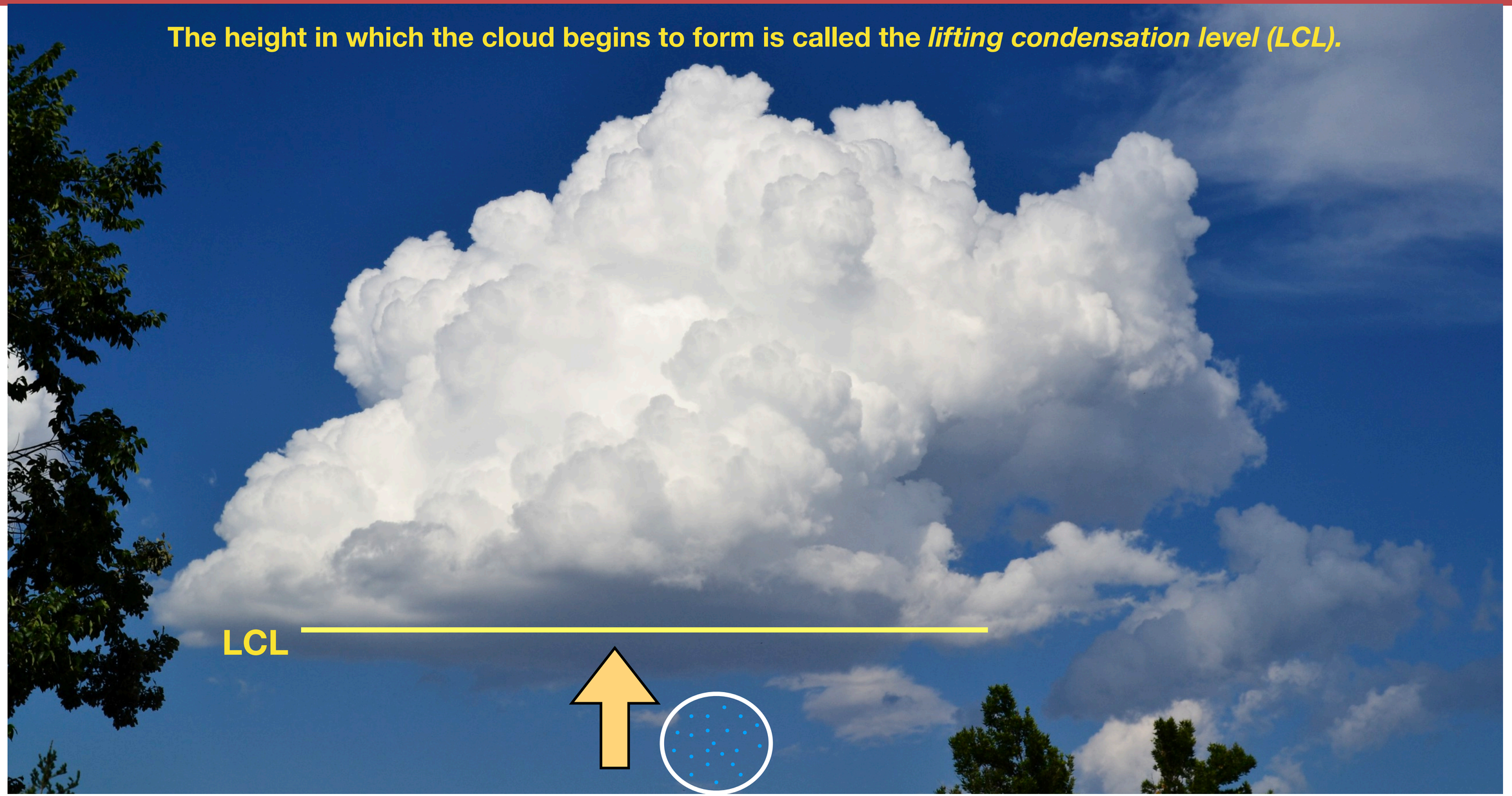
Rule of thumb:

$$z(\mathrm{LCL}) = (T - T_d)/8$$

Formula is in km.

We will discuss more exact formulas shortly

The lifting condensation level



Isentropic condensation temperature

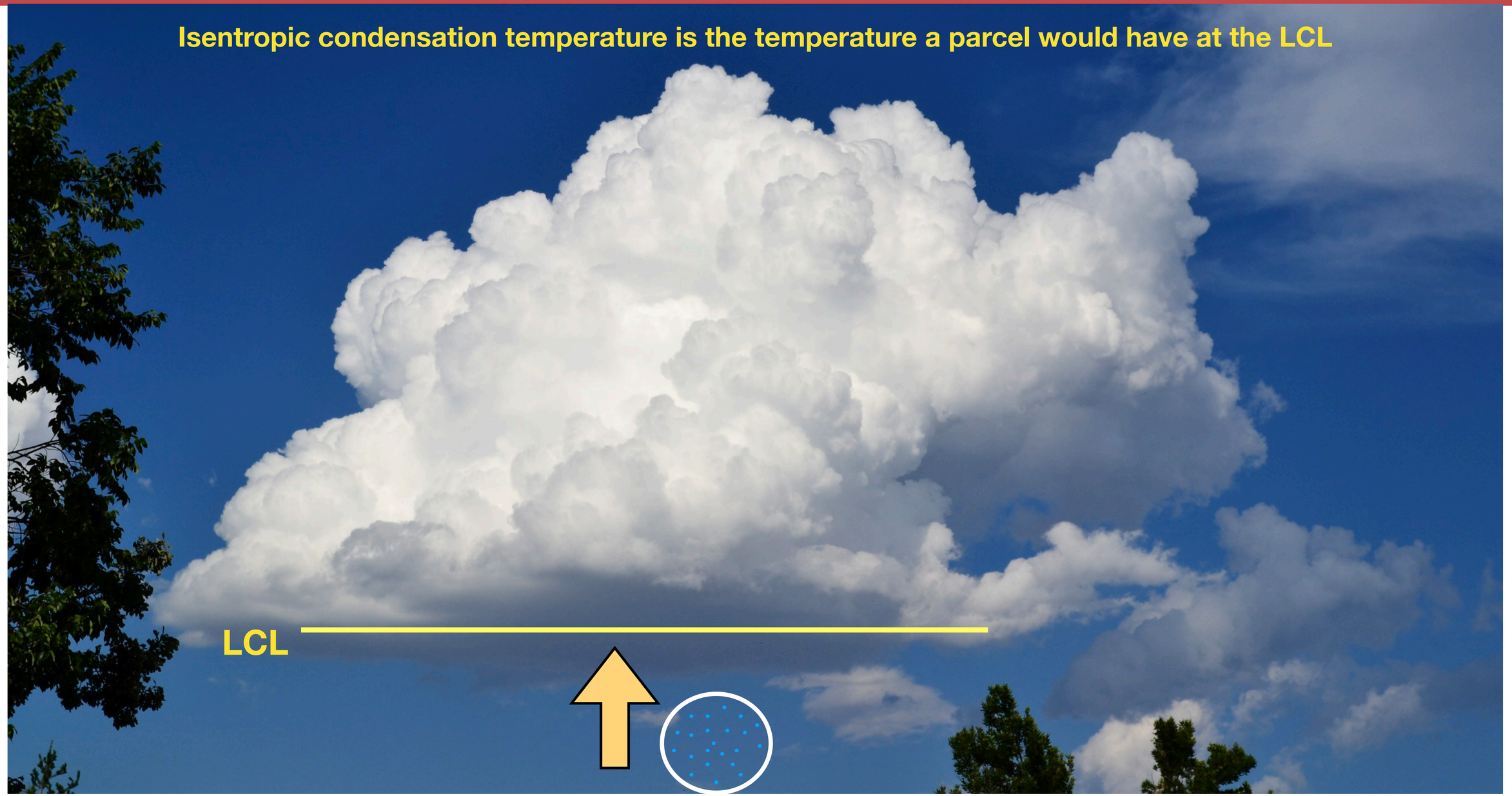
The temperature at which saturation is reached if a parcel is lifted dry adiabatically with a constant mixing ratio

$$T_c = B/\ln\left[\frac{A\epsilon}{r_v p_0}\left(\frac{T_0}{T_c}\right)^{\frac{c_p}{R_d}}\right]$$

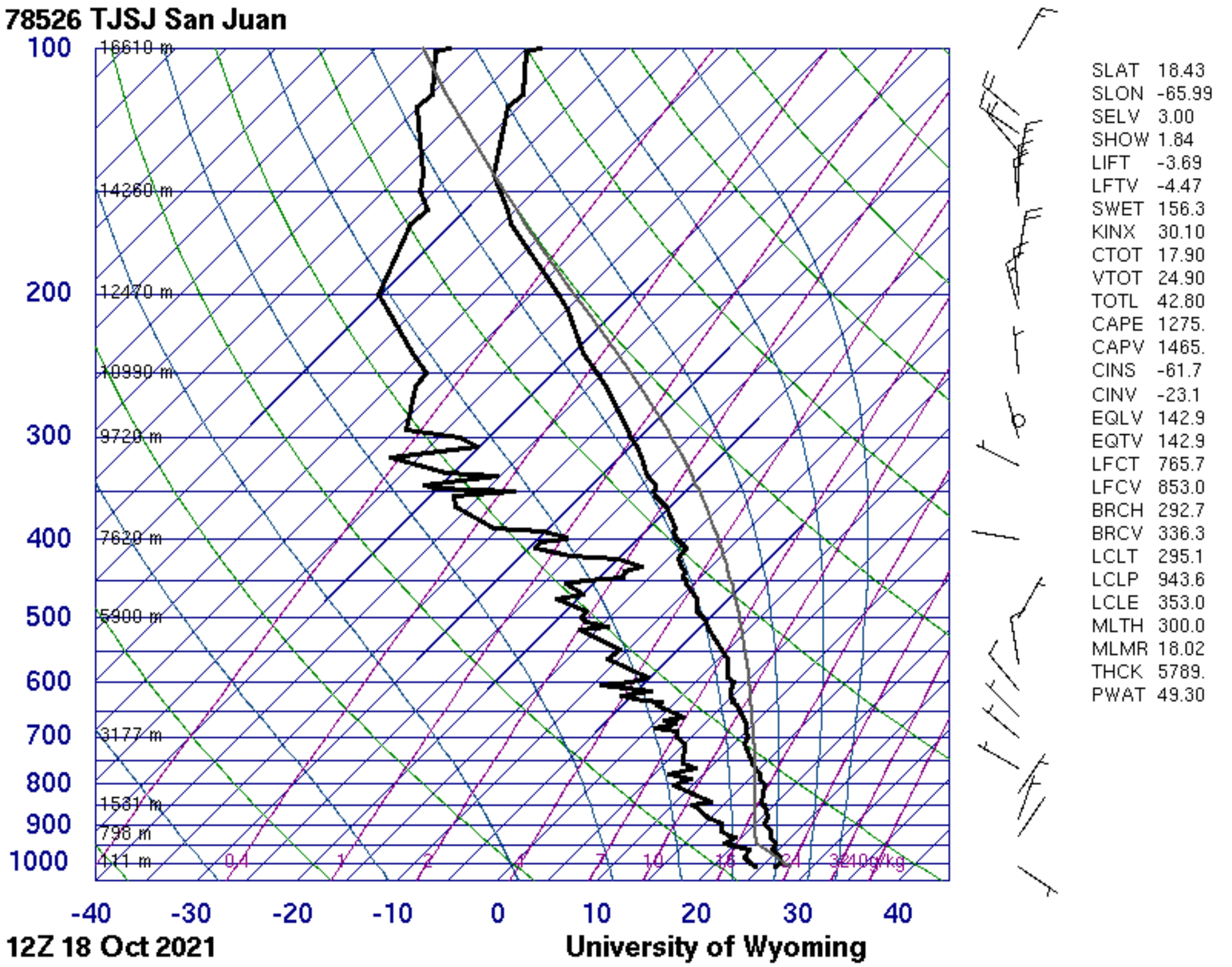
An approximate formula where Tc is only on the left-hand side is given by

$$T_c \simeq \frac{2840}{3.5\ln T - \ln e - 4.8} + 55 \qquad T \text{ in K, and } e \text{ in hPa}$$

Isentropic condensation temperature



On a Skew-T


78526 TJSJ San Juan
100
200
300
400
500
600
700
800
900
1000
16610 m
14260 m
12470 m
10990 m
9720 m
7620 m
5900 m
3177 m
1581 m
796 m
411 m
0.4
1
2
4
7
10
16
24
32
40g/kg
-40
-30
-20
-10
0
10
20
30
40
12Z 18 Oct 2021
University of Wyoming
SLAT 18.43
SLON -65.99
SELV 3.00
SHOW 1.84
LIFT -3.69
LFTV -4.47
SWET 156.3
KINX 30.10
CTOT 17.90
VTOT 24.90
TOTL 42.80
CAPE 1275.
CAPV 1465.
CINS -61.7
CINV -23.1
EQLV 142.9
EQTV 142.9
LFCT 765.7
LFCV 853.0
BRCH 292.7
BRCV 336.3
LCLT 295.1
LCLP 943.6
LCLE 353.0
MLTH 300.0
MLMR 18.02
THCK 5789.
PWAT 49.30

Exercise:

Find a colleague that has a Skew-T that is different from yours and form a group. Answer the following questions and compare your answers with that of your group mates.

1. Find the temperature, dew point, saturation mixing ratio, and dew point depression near the surface.

2. Find any temperature inversion (increase in temperature with height) in your Skew-T.

3. Find the LCL.

4. Calculate the isentropic condensation temperature. How different is it from the dew point?

5. Calculate the LCL by using the rule of thumb formula and by using the isentropic condensation temperature with the dry adiabatic lapse rate. How do they compare?

6. How do these results vary for the four geographical areas given to your group.