13.Clouds2

Monday, October 8, 2018 7:46 PM

Today: More Clouds
Skew T, stable vs unstable, relative humidity

Facilitators for Clouds Critique?

Skew-T continued:
Tells stability, and thus cloud type: **STABLE=flat clouds, stratus types**. **UNSTABLE = puffy clouds, cumulus varieties**
Also predicts cloud elevations; low, middle (alto), high (cirro)

Where are clouds? Where temperature is close to dew point, i.e. where the two heavy black lines come together.
Also, kink CW towards more steep in T line suggests clouds at that level.
Condensation = warming (opposite of evaporation = cooling on your skin)

Can also get **local cloud height** from ATOC CU Boulder observation:
http://skywatch.colorado.edu/ or Flowvis.org>Links>Weather

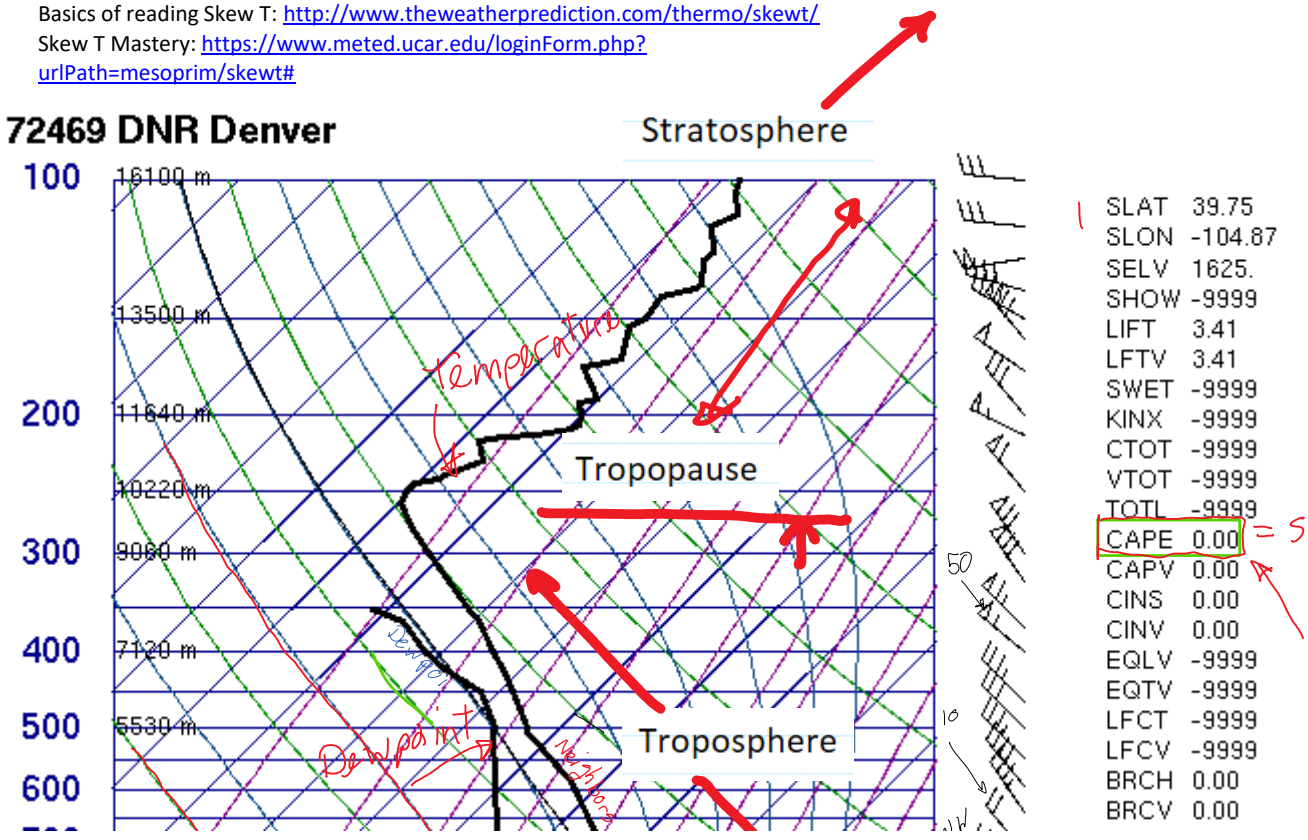
Can get current and predicted cloud heights plus winds and other weather from Windy phone app and http://Windy.com . A bit tricky to navigate, though.
Choose location, then Meteogram tab at bottom.

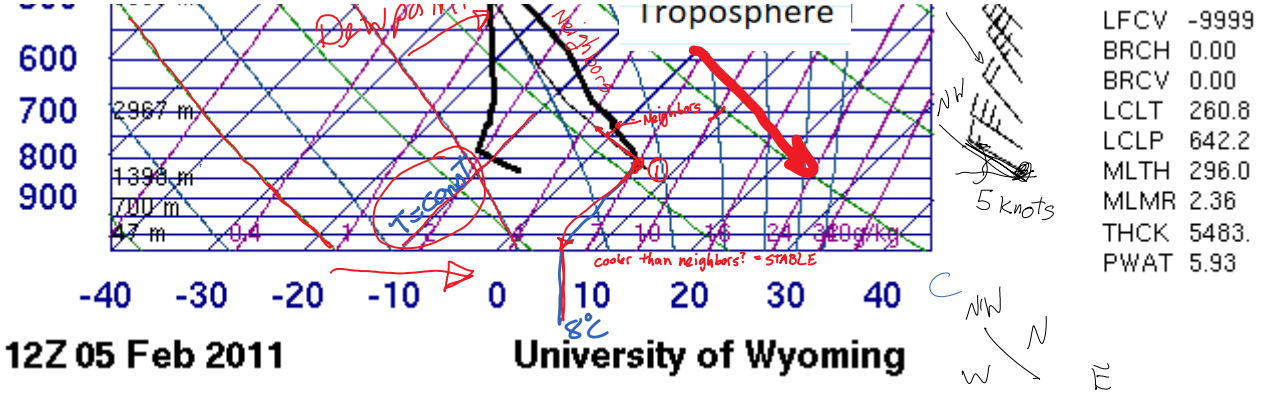
NO VERTICAL GRID?

So many lines! How many kinds?

Horizontal blue	Constant pressure isobar
Angled blue	Constant temperature; isotherm. Angle ↗ SKEW T
Angle/curve green	Dry adiabat. A dry parcel will follow this temperature line if lifted adiabatically (without heat transfer)
Angle/curve blue	Moist, saturated adiabatic lapse rate. Air in a cloud will follow this temperature line if lifted adiabatically
Purple	Lines of constant mixing ratio; absolute humidity for saturation.
Heavy black	Right line is temperature profile. Left line is dew point
Light black	Adiabat starting at the top of the boundary layer

Basics of reading Skew T: http://www.theweatherprediction.com/thermo/skewt/
Skew T Mastery: https://www.meted.ucar.edu/loginForm.php?urlPath=mesoprim/skewt#





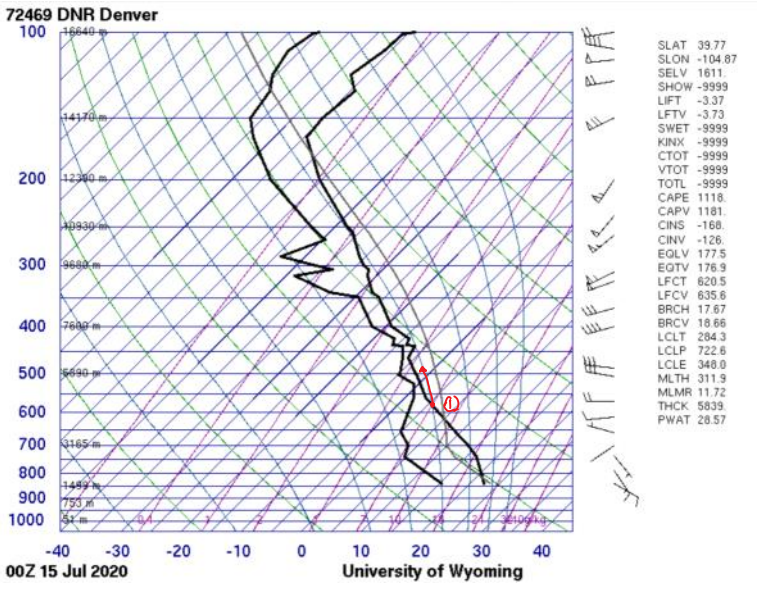
1. Starting parcel
2. Raise it, cool it adiabatically (move up along the adiabat), perturb the system
   Check it, is my parcel warmer or cooler than the actual neighboring parcels?
   i. Cooler; more dense, wants to sink again, go back to origin STABLE
   ii. Warmer; less dense, wants to keep going up! UNSTABLE

Can start at any point on the actual temperature line. Go parallel to the adiabats. Choose dry adiabat (green) if below likely cloud level or wet (blue, saturated) if in a cloud.

Stable clouds = flat STRATUS type
Unstable clouds = puffy CUMULUS family

Atmosphere is all **stable if CAPE = 0** Convective Available Potential Energy
Has unstable layers if CAPE > 0. Thunderstorms if CAPE > 500 or so.

Unstable Skew-T example



From 1 follow moist adiabat; is probably in a cloud (above LCLP at 722 mbar). Stays warmer than neighbors: UNSTABLE

What was the surface weather on a given day?
https://www.wunderground.com/history

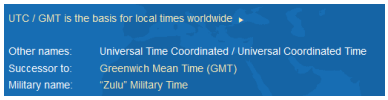
RH

Dew point: Temperature a parcel would have to be cooled to in order to get condensation (dew)
Relative humidity: How much water the air currently holds compared to how much it could hold at this temperature. For a given absolute water vapor concentration, RH is high for low temperatures (close to dew point) and low for high temperatures. So T and RH time plots move opposite.

Other info on Skew-T: wind indicators, lifting condensation level. Cumulus have flat bottoms at this altitude.

OK, now look at skew-T for your date:
http://weather.uwyo.edu/upperair/sounding.html

Skew-T download tips: Skew-T Times:

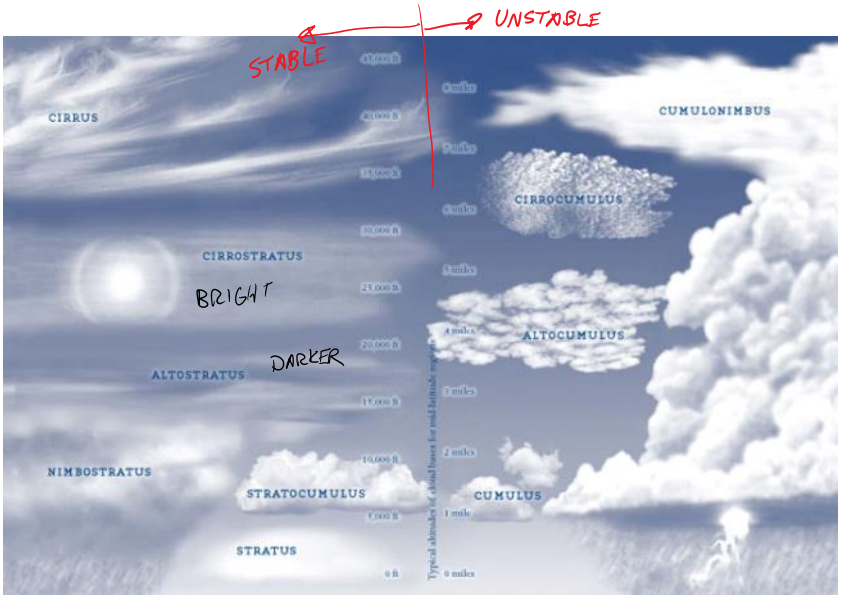


12Z, Feb 14 = ~6 am Feb 14 here. Sunrise.
00Z, Feb 1**5** = ~6 **p**m Feb 14 here. Sunset.

1. Choose correct date. 12z Feb X is the 6 am sounding, 00z X+1 is the 6 pm sounding for date X
2. Choose plot, not text
3. Will open in next browser tab

Clouds = droplets or ice MOVING UPWARDS

Lift mechanisms:
1. Instability
2. Orographics: terrain, mountains
3. Synoptic scale weather systems. Both at warm and cold fronts; cold air pushes under in a cold front, warm air overruns in a warm front.
4. Convergence: shoreline temperature differences



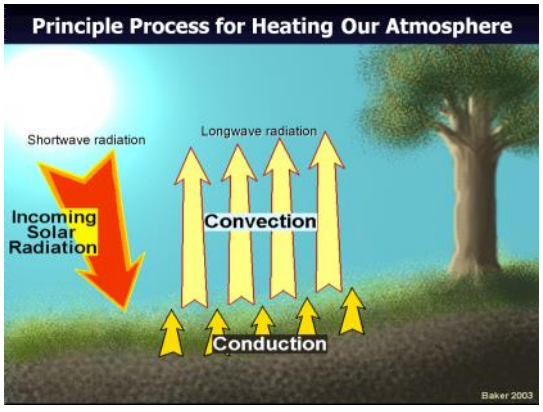
Clouds classified by
A. **Structure**: stratus = flat layers, cumulus = clumps
B. **Base height**: (2km)
   a. low: up to 6500 ft (above ground, not from sea level) and vertically developed (includes cumulonimbus)
   b. middle: 6500 to 23,000 ft (2-7 km)
   c. high: 16,000 to 45,000 OVERLAP (4.9 - 14 km)
   Cirrostratus: bright, no observable thickness, thin, uniform veil
   Altostratus: darker, may have noticeable thicker regions

- Cloud image submission: Include
1) your edited image — canvas
2) your original (unedited) image — canvas
3) the appropriate Skew-T diagram — in report
4) a short statement of cloud type and stable or unstable atm. — in report
5) Post on Flowvis.org. Edit your post date to match your cloud date and time.

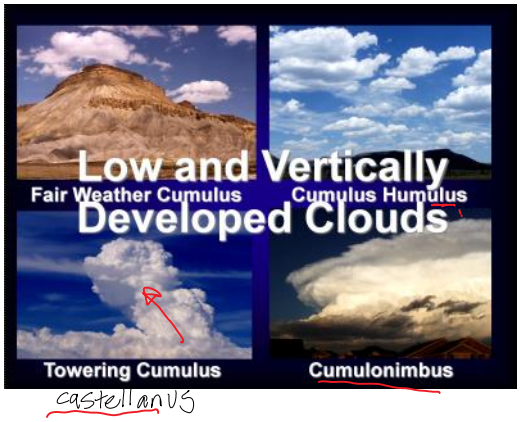
Clouds = droplets or ice MOVING UPWARDS

Lift mechanisms:
1. Instability: creates Cumulus clouds
2. Orographics: terrain, mountains
3. Synoptic scale weather systems; local instability. Both at warm and cold fronts; cold air pushes under in a cold front, warm air overruns in a warm front.
4. Convergence: shoreline temperature differences and cyclonic uplift

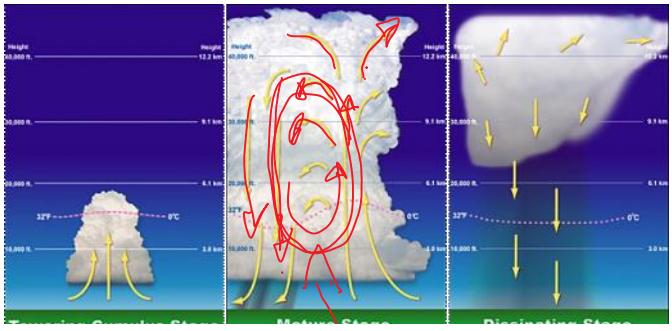
1. Instability driven clouds



If atmosphere is UNSTABLE, the heated air will continue to go up!



castellanus



Vault

http://www.k3jae.com/wxstormdevelopment.php

Dark ground (plowed field etc.) can create local hot spot, starting a thermal. Mountain uplift can also trigger start of cycle.

Thunderstorm anatomy, visible in Mike Olbinski's time lapse *Monsoon IV*: https://vimeo.com/239593389?ref=fb-share&1 or his *Pursuit*: https://vimeo.com/226958858

Pyrocumulus = cloud formed at the top of a wildland fire smoke plume.

2: Orographic clouds, caused by topography, i.e. mountains

Orography (from the Greek όρος, hill, γραφία, to write) [Wikipedia]

Most common interesting cloud in winter and spring is the

Altocumulus lenticularis (higher than 6500 ft above local ground level) or
Stratocumulus lenticularis (lower)
or
Mountain Wave Cloud, trapped or lee

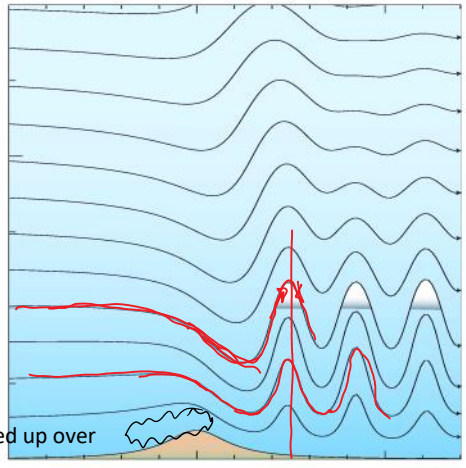
standing

ACSL

requires STABLE atmosphere: note exception to unstable/cumulus pairing

STANDING WAVE

Clouds Produced by Vertically ***Trapped*** Mountain Waves



Thomas Carney et al., *AC 00-57 Hazardous Mountain Winds and Their Visual Indicators* (Federal Aviation Administration, 1997), http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/780437D88CBDAFD086256A94006FD5B8?OpenDocument.

Clouds that sit right on the Divide = FOEHN cloud wall. From air being forced up over the mountains

Fayne

Altocumulus lenticularis. Typically 1 to 5 wave crests.

Clouds stay stationary, but may move off and reform periodically

Ben Britton, FV 2010