11.Clouds1

Friday, October 5, 2018 3:26 PM

Today: Clouds 1

Admin:

- Scott Kittelman is still available if your team wants to do the ATOC experiments.
- New lighting equipment: Umbrellas with CFL lights, LED panels, very bright, with tripods. Large white, black backdrops are available. Reflective panels, flash diffuser.
- Get Wet reviews are due next week. Assignments are in Get Wet Report in Canvas
- Team Second plan due today. As before, everybody on the team should submit the plan. No selfies needed this time.
- Next week attendance required for Weds: FYFD author Nicole Sharp.

CLOUDS

Learning Objectives:

1. Be able to identify cloud types
2. Describe air motion and atmospheric stability that govern the appearance of basic cloud types.
3. Interpret weather data with respect to likely clouds, including Skew-T plots and wind soundings.

- Cloud first image due Monday. Great if you can ID your cloud.
- ***Required: be able to state stable vs unstable atmosphere during critique.***

Name Race: in one minute, in your group of 3-4 students, how many separate cloud names can you recall? No internet allowed!

cumulonimbus =Thunderhead
altocumulus
cumulus

stratus
nimbostratus
cirrus
alto stratus

Best clouds physics book, easy read:

- Gavin Pretor-Pinney, *The Cloudspotter's Guide* (Perigee/Penguin, 2006). Guest lecturer, April 18

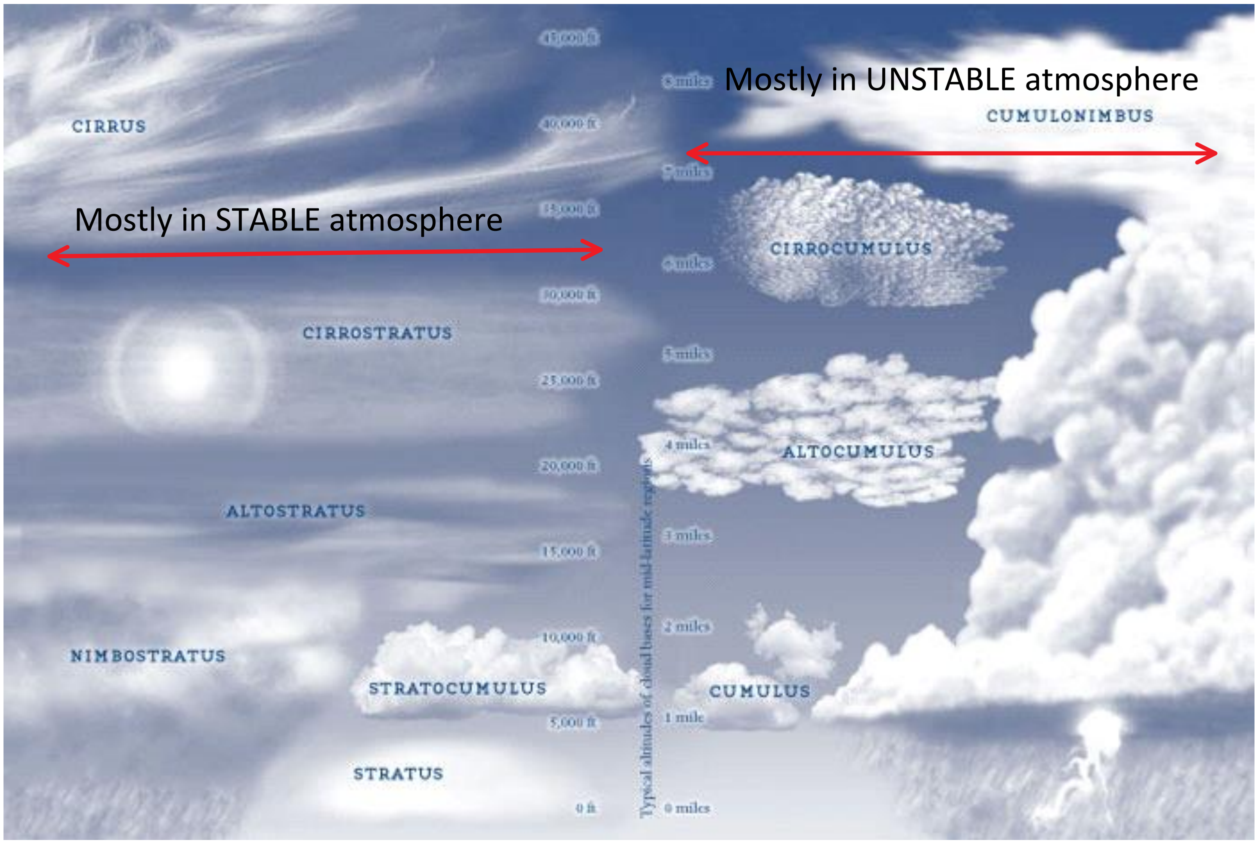
Next, (for free)

- 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.
- https://www.metoffice.gov.uk/binaries/content/assets/mohippo/pdf/r/cloud_types_for_observers.pdf

Join the Cloud Appreciation Society

Other cloud and atmospheric science books available for checkout; my office.
Office hours ECME 220. Usually Thursdays 1 pm, but not Oct 11; I'm on travel
TONS of online info, most is OK.
Also, CloudSpotter phone app.

Following info partially adapted from Mike Baker, local NOAA Weather Service forecaster.



Pretor-Pinney, Gavin. *The Cloudspotter's Guide*. Perigee/Penguin, 2006.

Clouds = droplets or ice MOVING UPWARDS

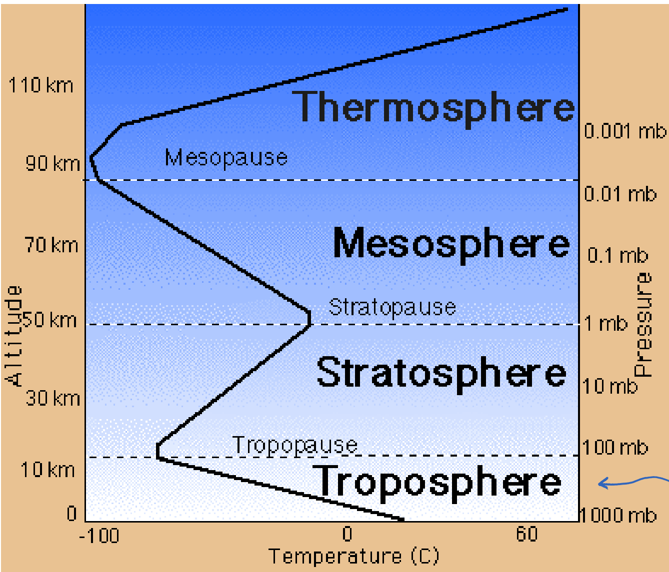
Lift mechanisms determine appearance:

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

1. Instability

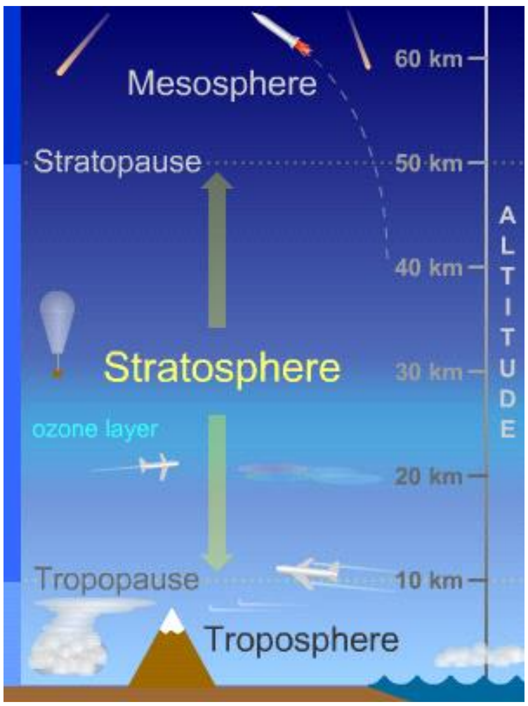
Is most complicated. Start with background physics.

Layers of the atmosphere:



http://www.aerospaceweb.org/question/atmosphere/atmosphere/layers.gif

All weather happens in troposphere.
Driven by what happens at 500 mb level.



http://www.windows2universe.org/earth/Atmosphere/stratosphere.html

O_3 absorbs sunlight, heats stratosphere
Warm over cold
Less dense over more dense = STABLE. Hold that thought.

Back to SCALES; how big….

How big is this?

Do you estimate in metric or in English units?

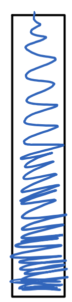
< Minute paper: In your head, 10 km = X miles, = Y thousand feet.
Be approximate, 1 sig fig.

http://www.wolframalpha.com/input/?i=10+km+in+miles
http://www.wolframalpha.com/input/?i=1+mile+in+kilometers

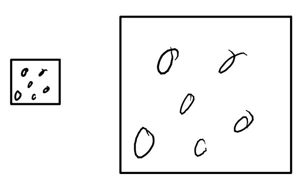
33k ft

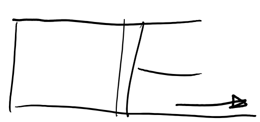
Temperature change with altitude in troposphere:
Minute paper in groups: *Why* is it colder on top of a mountain than at the foot? Hint: it's not the ideal gas law.

Start with pressure profile in atmospheric column: highest at surface, decreases going up.
Comes from hydrostatics; gravity balanced by pressure.



Consider a parcel of air (imaginary little cube).
Same temperature as its neighbors.
Reduce its pressure (surface forces), while allowing no heat transfer.
It expands = *adiabatic* expansion
In expanding, it *does work* on its neighbors
Loses internal energy; cools.
= Conservation of Energy, 1st Law of Thermo.
NOT the Ideal Gas Law



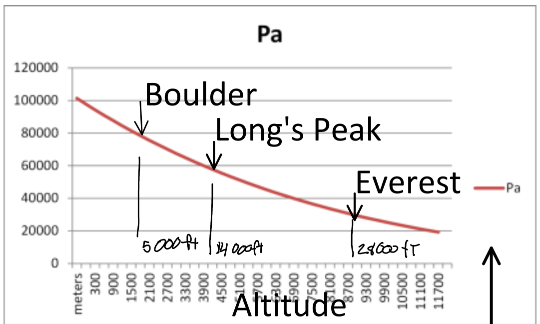


Piston/cylinder

Rising parcels expand, *do work* and therefore cool.

Vice versa is true too; descending parcels get compressed (work is done on them) and warm up.

Pressure profile in the atmosphere
http://www.engineeringtoolbox.com/air-altitude-pressure-d_462.html



1 ATM =
1 bar =
1000 mb
14 psi
101 kPa
Memorize this

top of troposphere

Actual temperature profile in the TROPOSPHERE
Comes from *sounding data*; weather balloons

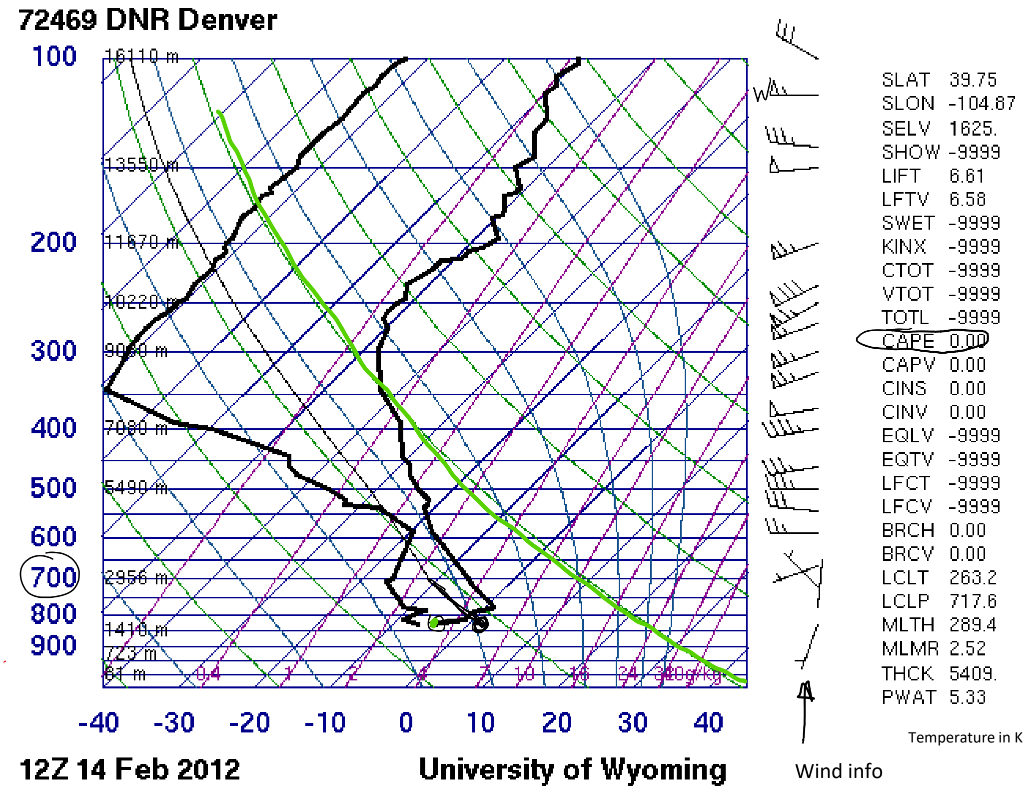
Modern radiosondes measure or calculate the following variables:

- Pressure
- Altitude
- Geographical position (Latitude/Longitude)
- Temperature
- Relative humidity
- Wind (both wind speed and wind direction)
- Cosmic ray readings at high altitude

Pasted from <http://en.wikipedia.org/wiki/Radiosonde>

Here's what it looks like: SKEW-T
http://weather.uwyo.edu/upperair/sounding.html
YOU will do this for the date of your image

Pressure in millibars



Temperature in c

Definitions

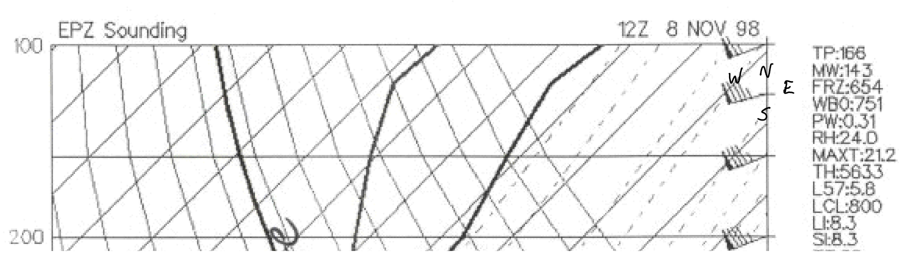
http://weather.uwyo.edu/upperair/indices.html#CAPE

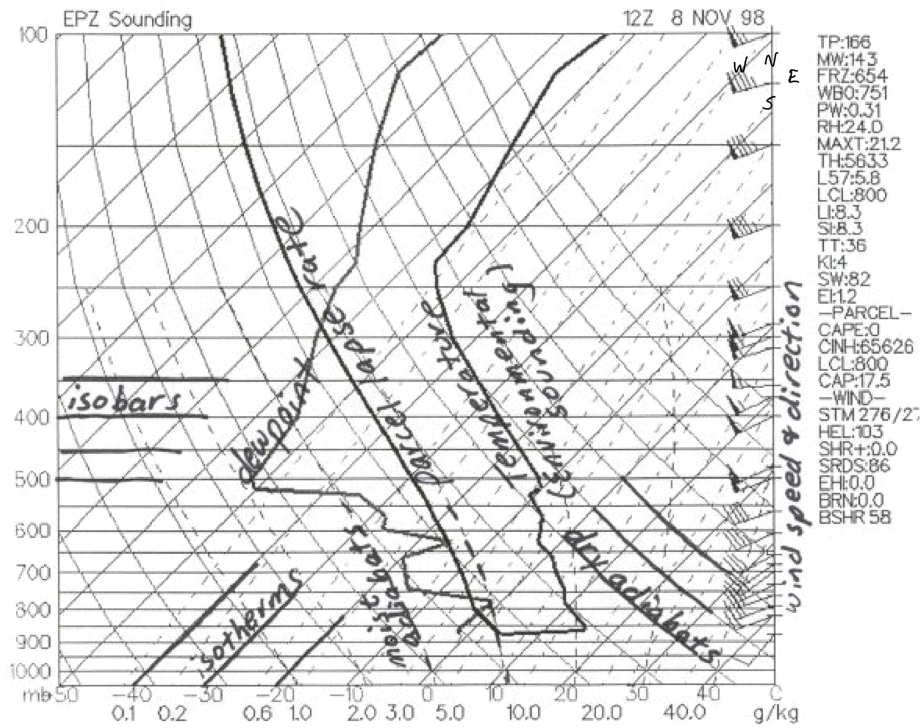
NO VERTICAL GRID?

So many lines! How many kinds?

Horizontal blue	Constant pressure
Angled blue	Constant temperature; isotherm. Angle SKEW T
Angle/curve green	Dry adiabat. A dry parcel will follow this temperature line if cooled adiabatically
Angle/curve blue	Moist, saturated adiabatic lapse rate
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: http://www.theweatherprediction.com/thermo/skewt/
Skew T Mastery: https://www.meted.ucar.edu/loginForm.php?urlPath=mesoprim/skewt#




EPZ Sounding
12Z 8 NOV 98
isobars
isotherms
dewpoint
parcel lapse rate
moist adiabats
Temperature (Environmental sounding)
dry adiabats
wind speed & direction
W N E S
TP:166
MW:143
FRZ:654
WBO:751
PW:0.31
RH:24.0
MAXT:21.2
TH:5633
L57:5.8
LCL:800
LI:8.3
SI:8.3
TT:36
KI:4
SW:82
EI:1.2
—PARCEL—
CAPE:0
CINH:65626
LCL:800
CAP:17.5
—WIND—
STM 276/27
HEL:103
SHR+:0.0
SRDS:86
EH:0.0
BRN:0.0
BSHR 58
mb
g/kg