14.Clouds1

Monday, January 31, 2011 2:26 PM

Admin:

Today: Clouds, 1 of 3 lectures

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.

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

Cumulus
Stratus
Cumulonimbus
Nimbostratus
Altostratus
Cirrus
Lenticularis
Mammatus
Undulatus
Roll cloud
Rain

Best clouds physics book, easy read:

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

Join the Cloud Appreciation Society

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.

Other cloud and atmospheric science books available for checkout; my office.

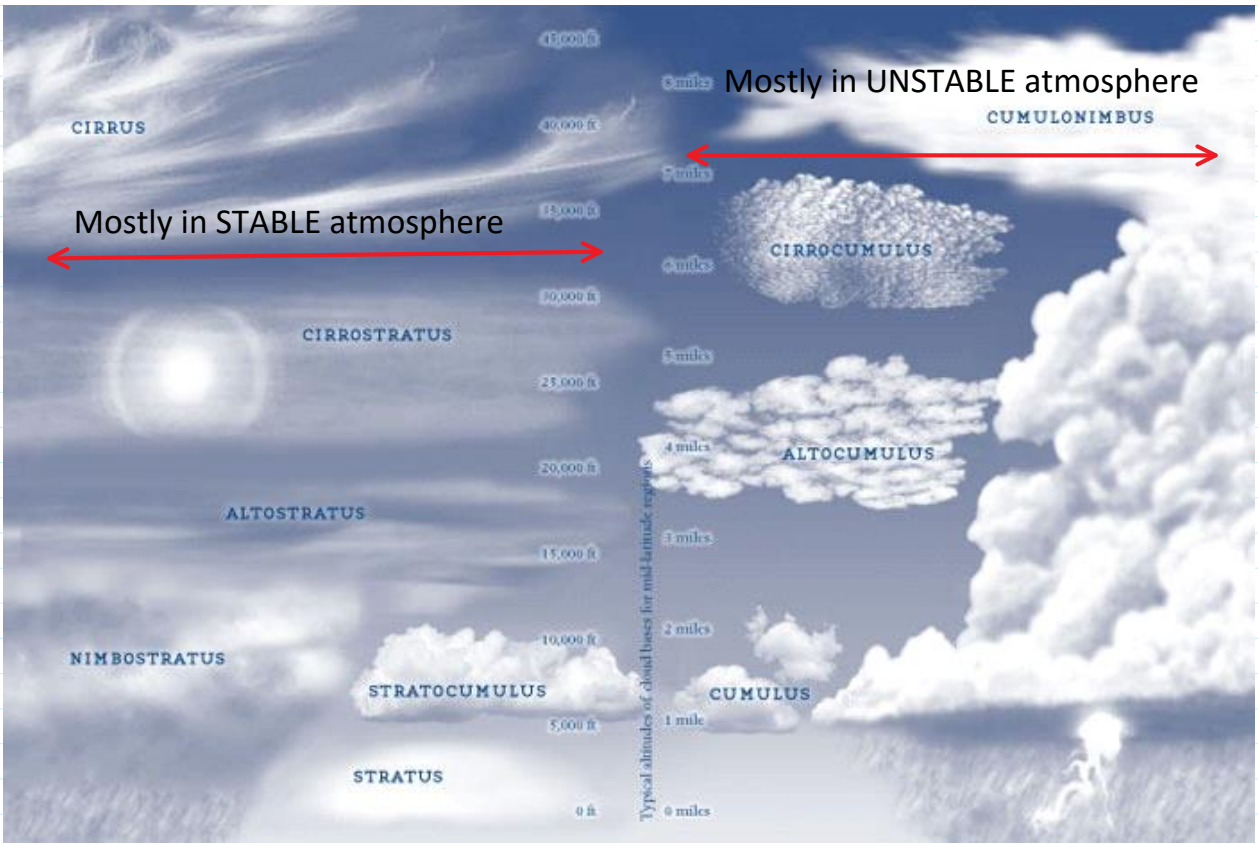
Office hours Monday 2-3, ECME 220

TONS of online info, most is OK.

Also, CloudSpotter phone app.

Following info partially adapted from Mike Baker,

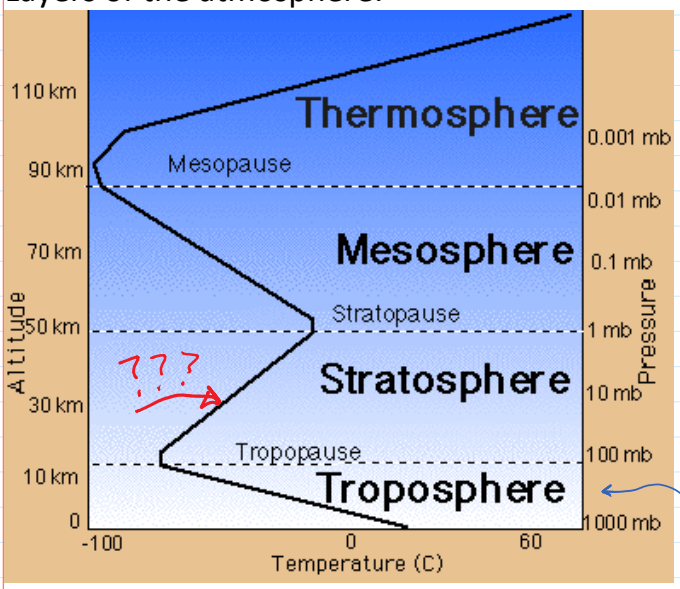
local NOAA Weather Service forecaster.



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

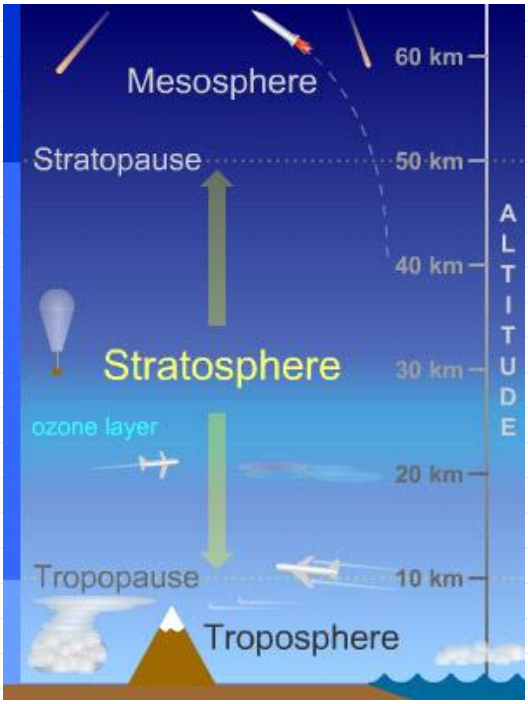
Cloud types depend primarily on atmospheric stability. Need background to understand how.

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.



$O_3 + UVC \rightarrow O + O_2 + heat$

Lower $O + O_2 \rightarrow O_3$

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….

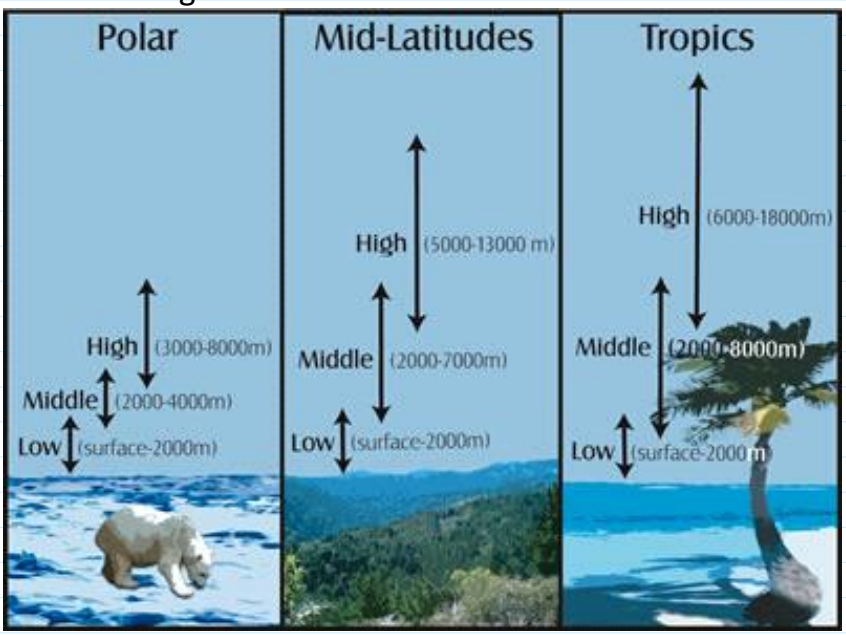
How big is this?

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

Order of magnitude estimates are VERY USEFUL.



colder, denser
shorter atm.

Sea level air pressure = uniform worldwide, except +/- 2% due to weather (high, low pressure systems)

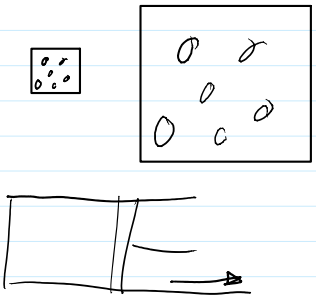
Height of atm goes with seasons too; higher in summer with hot air.

Temperature change with altitude in troposphere:

Minute paper in groups: *Why* is it colder on top of a mountain than at the foot?

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

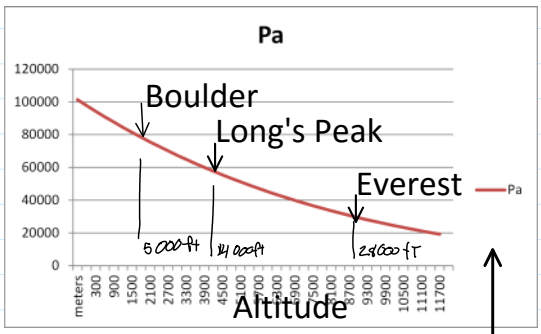


Piston/cylinder

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

top of troposphere

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

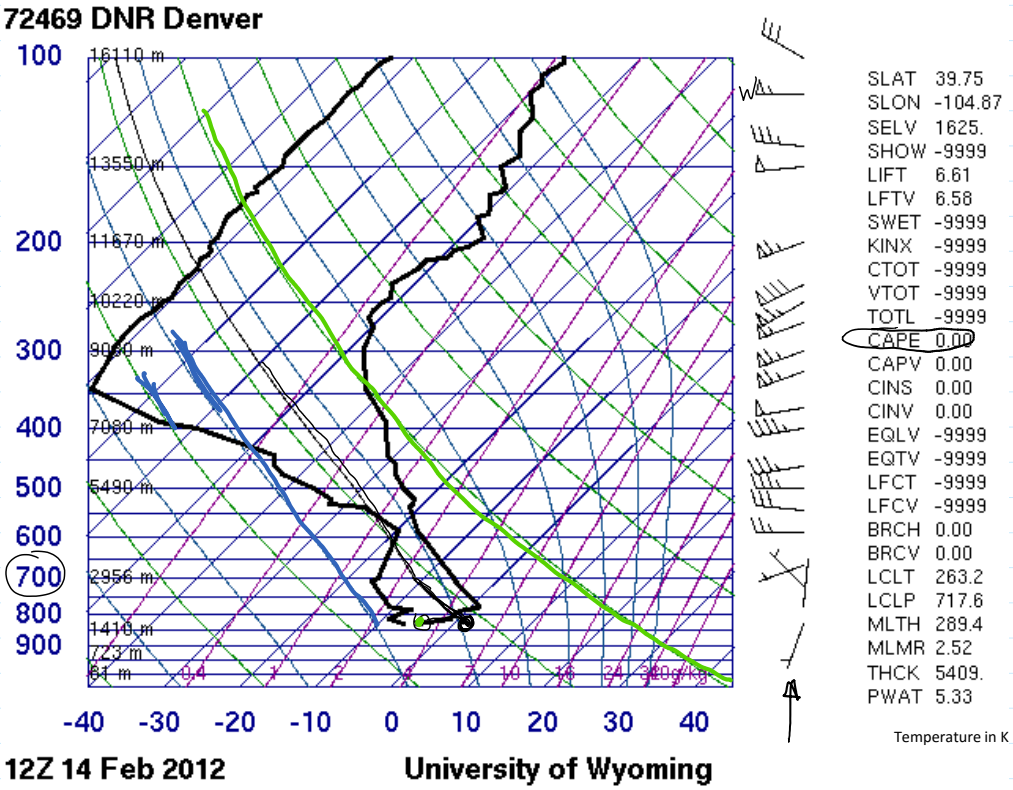
Modern radiosondes measure or calculate the following variables:

- 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



Definitions

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

Temperature in c

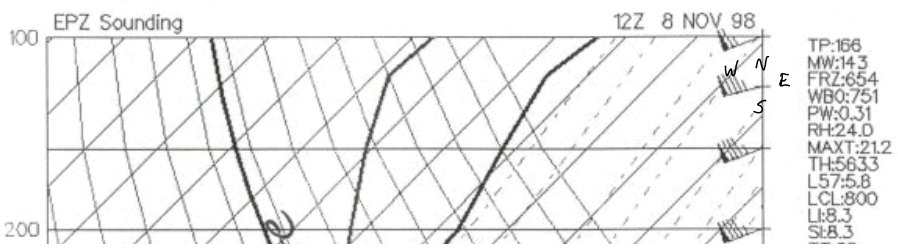
NO VERTICAL GRID?

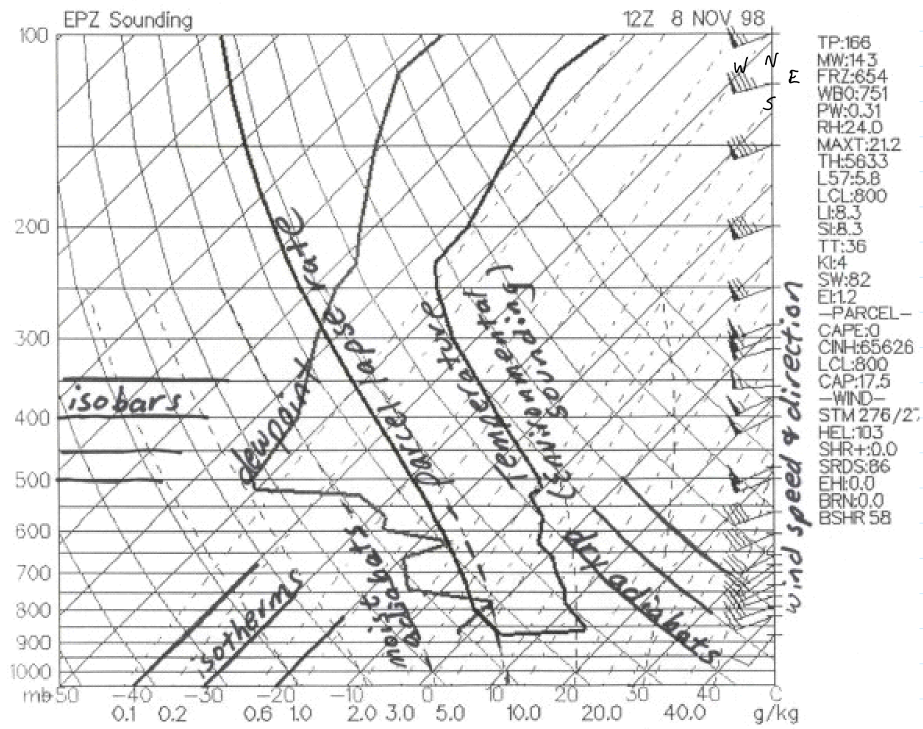
So many lines! How many kinds?

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
100
200
300
400
500
600
700
800
900
1000
mb
50 −40 −30 −20 −10 0 10 20 30 40 C
0.1 0.2 0.6 1.0 2.0 3.0 5.0 10.0 20.0 40.0 g/kg
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
EHI:0.0
BRN:0.0
BSHR 58
W N E S
isobars
isotherms
moist adiabats
dewpoint
parcel lapse rate
Temperature
(Environmental sounding)
dry adiabats
wind speed & direction