Admin:
Finish GW image critique
For now, will keep critique as is. Anonymous
posting is allowed, but optional.
Resubmissions of images and reports: Welcome!

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.

   Minute paper, individual: What do you already
   know about cloud types? List, sketch, describe
   them.

 Best clouds physics book, easy read:
   Gavin Pretor-Pinney, *The Cloudspotter's Guide*
   (Perigee/Penguin, 2006).
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_Li
   brary/rgAdvisoryCircular.nsf/0/780437D88CBDA
   FD086256A94006FD5B8?OpenDocument.

   Other cloud and atmospheric science books
   available for checkout; my office.
   Office hours 4:30-5:30 Tuesday, 1-3 Friday
   TONS of online info, most is OK.

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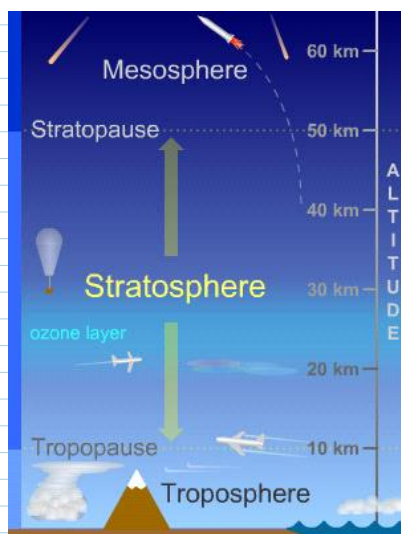local NOAA Weather Service forecaster.

Mostly in UNSTABLE atmosphere

Mostly in STABLE atmosphere
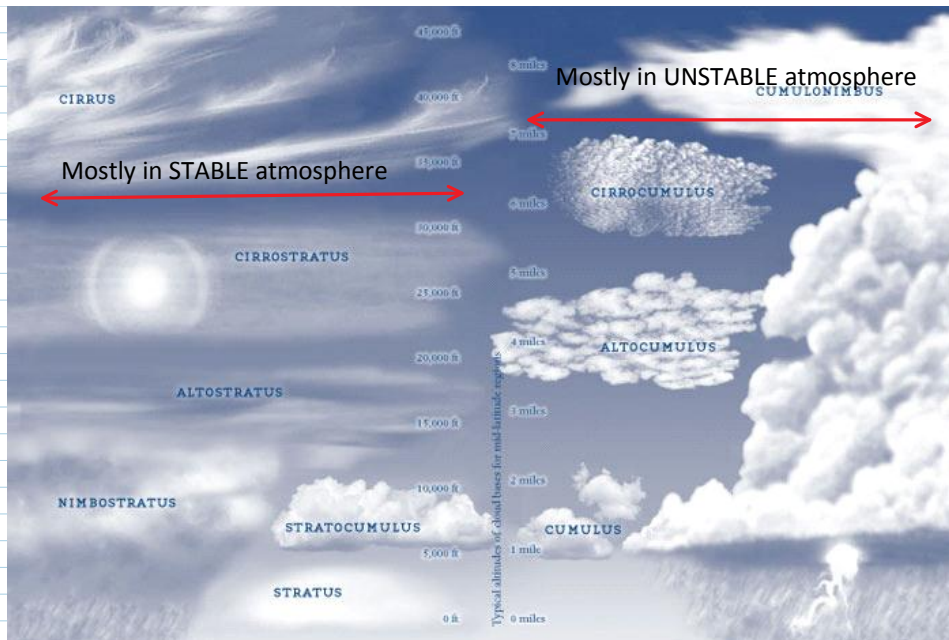
Cloud types depend primarily on atmospheric stability. Need background to understand how.

Layers of the atmosphere:

http://www.aerospaceweb
.org/question/atmosphere
/atmosphere/layers.gif
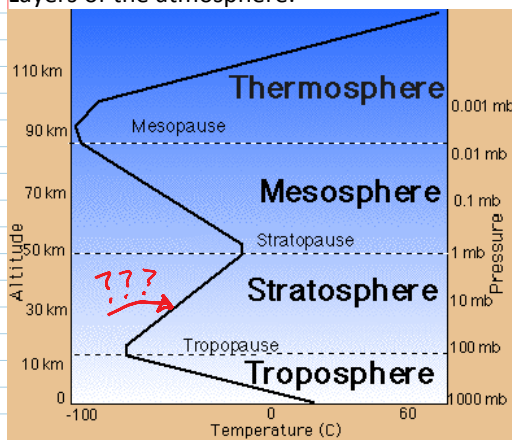
All weather happens in troposphere.
Driven by what happens at 500 mb level.

http://www.windows2universe.or
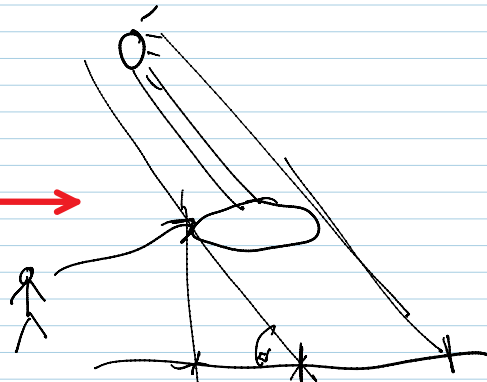g/earth/Atmosphere/stratosphere
.html

O_3 absorbs sunlight, heats stratosphere

stratosphere
Warm over cold
Less dense over more dense =
STABLE. Hold that thought.

Back to SCALES; how big….

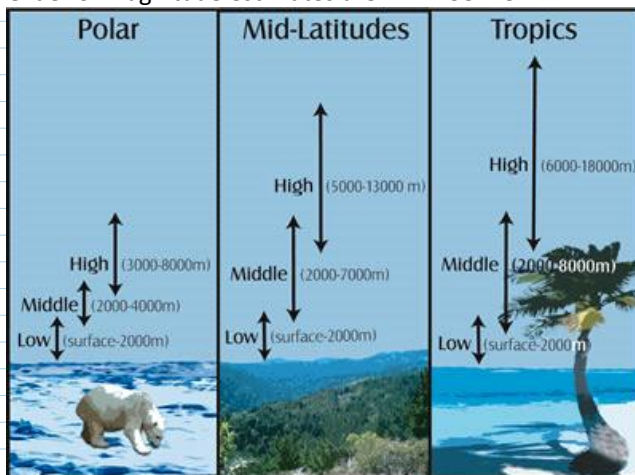How big is this?

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)

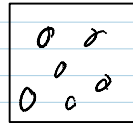Height of atm goes with seasons too; higher in summer with hot air.

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 <u>no</u> heat transfer.
It expands = *adiabatic* expansion
In expanding, it *does work* on its neighbors
Loses internal energy; cools.
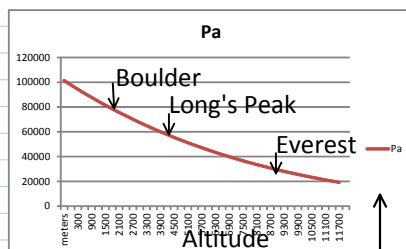= Conservation of Energy, 1st Law of Thermo.
NOT the Ideal Gas Law

Piston/cylinder

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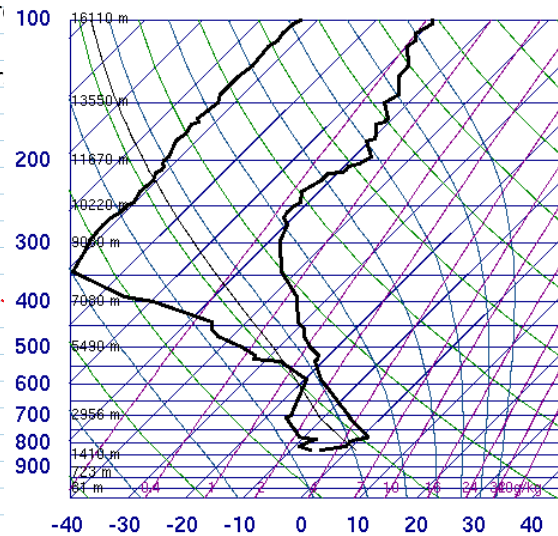
Pasted from <http://en.wikipedia.org/wiki/Radiosonde>

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

72469 DNR Denver

Pressure in millibar

SLAT   39.75
SLON -104.87
SELV 1625.
SHOW -9999
LIFT   6.61
LFTV 6.58
SWET -9999
KINX -9999
CTOT -9999
VTOT -9999
TOTL -9999
CAPE 0.00
CAPV 0.00
CINS 0.00
CINV 0.00
EQLV -9999
EQTV -9999
LFCT -9999
LFCV -9999
BRCH 0.00
BRCV 0.00
LCLT 263.2
LCLP 717.6
MLTH 289.4
MLMR 2.52
THCK 5409.
PWAT 5.33

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

Definitions

12Z 14 Feb 2012   University of Wyoming

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#