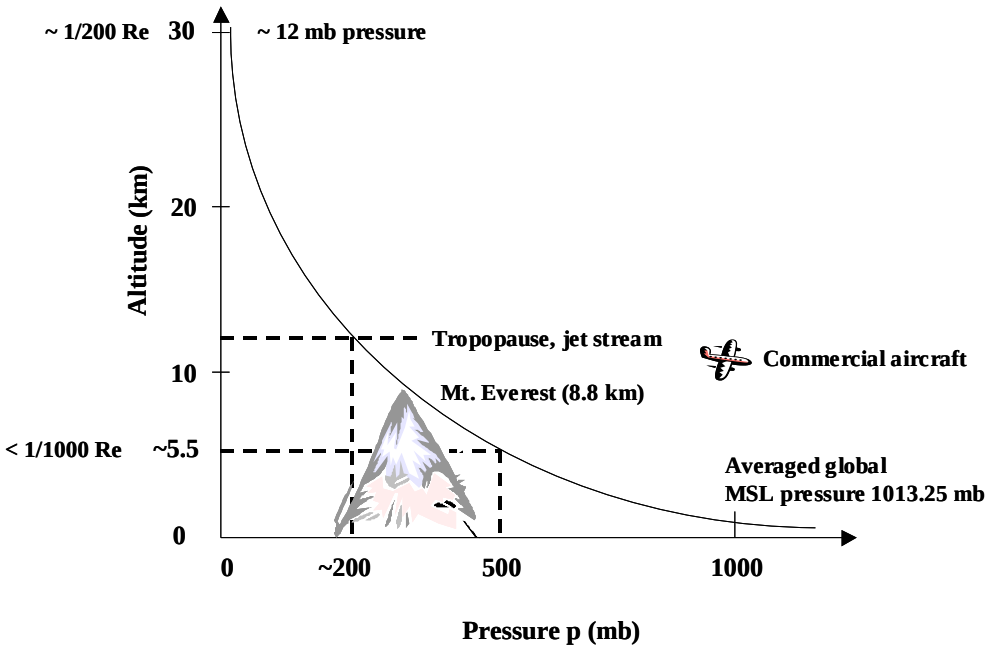
Terminology and definitions

The atmosphere:

The envelope of gasses surrounding the earth is bound to it more or less permanently by the earth's gravitational field.

As the atmosphere extends from the surface to an indefinite height, density and pressure asymptotically approaching that of interplanetary space.



The radius of the earth (Re) ~ 6370 km

Atmospheric density ρ also decreases in an approximately exponential fashion and, if measured in $g\,m^{-3}$, would appear numerically to match the above diagram quite closely. If, indeed, we assume that pressure and density decrease exponentially with height, we can write

$$p(z) = p(0) \cdot e^{-z/H}$$

$$\rho(z) = \rho(0) \cdot e^{-z/H}$$

where the quantity H, with dimensions of a length, is called the scale height of the atmosphere and is approximated equal to 8.5 km for troposphere. At this height, pressure and density are equal to 1/e (0.37) of their sea level values. z is the height above sea level. P(0) and $\rho(0)$ are p and ρ at the sea level. (will derive scale height in the future. Note: don't apply linear interpolation to pressure and density fields)

- Show vertical variation of pressure and density.

Note: The equations above are strictly valid only if the atmosphere were isothermal (constant in temperature) and dry whereas, in fact, temperature is a strong function of height above the earth's surface and the atmosphere is not dry.

In large measure, the atmosphere rotates with the earth as it rotes in space such that, averaged over the globe, there is no net motion towards the east or the west relative to the earth's surface. Note that, at the equator, the earth's surface is moving towards the east at a rate of about 1000 miles/hr.

1 mile=1609 m

$$\text{speed} = \frac{2 \cdot \pi \cdot R}{24\,\text{hr}} = \frac{2 \times 3.141596 \times 6370/1.609}{24} = 1036\ \text{miles/hr}$$

$$\text{speed} = \frac{2 \cdot \pi \cdot R}{24\,\text{hr}} = \frac{2 \times 3.141596 \times 6370}{24} = 1668\ \text{km/hr}$$

At approximately what latitude is the earth's surface traveling at 500 miles/hr? (60^o)

= speed x cos 60^o

We are at latitude 38^o N, how fast are we moving toward the east? (800 miles/hr or 1314 km/hr)

= speed x cos38^o

Meteorology:

The study of the phenomena of the atmosphere.

In ancient times, however, the Greeks applied the term "meteorologia" to all heavenly phenomena. It derived from "meteoron" which meant phenomenon in the sky. Nowadays, "meteor" is used as a term for the phenomena accompanying a body from space, a meteoroid, in its passage through the atmosphere. A meteorite is a meteoroid that reaches the surface.

Note: There is no distinction between "meteorology" and "atmospheric science", although, at times, "meteorology" has been used to refer the aspects of the atmosphere related to weather phenomena. This is not a universal definition.

Weather:

The state of the atmosphere, mainly with respect to its effects on life and human activities. Weather is normally thought of in terms of a number of weather elements:

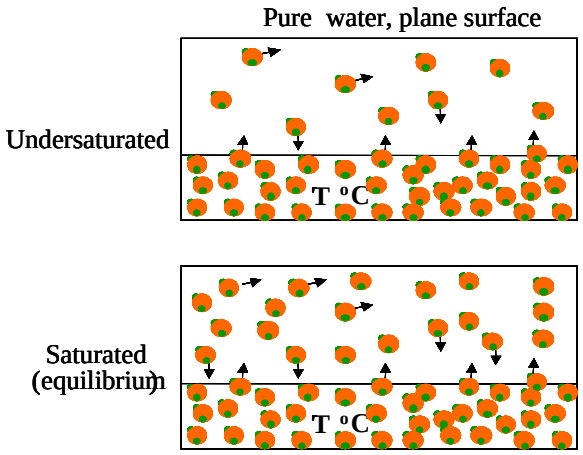
Temperature
Humidity
Precipitation (type, intensity)
Cloudiness, fog (cover, density, height, type)
Brightness
Visibility
Wind (speed, direction, gustness)
Pressure

While we respond directly, but to varying degrees to the first seven of these elements, pressure is considered important because pressure patterns largely govern atmospheric motions and the passage of storm systems. (See weather map symbols, Appendix B of Ahrens)

Note: Explain vapor pressure, saturation vapor pressure, and dew point here

Vapor pressure

Saturated air



Water vapor evaporates so that water vapor pressure in the air increases. Eventually an equilibrium state will be reached where

evaporation rate from the water = condensation rate on the water

The air is then saturated.

Dew point

is the T to which air must be cooled at constant pressure in order for it to become saturated with respect to a plane surface of water.

Climate:

The long-term manifestations of the weather. It is represented by the statistical collective of weather conditions over a specified (long) interval of time, usually several decades (e.g., 30 years).

Hence, climatology (a division of meteorology) and climatic classification (division of the earth's climates into a system of contiguous regions- marine, Mediterranean, tropical etc.)