Understanding the properties of water is central to understanding climate

Water is a dipole

Physical consequences of water's dipole structure

Relative humidity

Atmospheric Composition

Atmosphere is a mixture → gases, aerosols, water droplets

results from exchange between atmosphere and Earth surface

Physical processes

Biological,

Geochemical

Vertical Structure of Atmosphere

Thickness of Atmosphere

No well-defined upper boundary - difficult to establish
Density decreases with altitude: @ 16 km (10%), 50 km (1%)
Thin layer enveloping Earth where weather occurs
set 100 km as upper limit – 99.99% of atmosphere, 2% of Earth's radius
Relatively thin but with great mass (5.14 x 10^{15} kg)

Atmospheric Pressure

Atmosphere – exerts large downward pressure

Gravity – compresses air near surface (increase density)

Mass of atmosphere below 5500 m

Sea level pressure = 1kg/m2; 1013.2 mb; 101.32 kPa

Permanent gases

•Major gases: N_2 and O_2
•Minor gases (Ar, Ne, Kr, Xe) plus Hydrogen (H) and Helium (He)

Mean residence time (MRT)

Atmospheric MRTs

Permanent gases have long MRTs

N_2 13 million years

O_2 10,000 years

Mixing time of atmosphere is about 4.8 years

Gases with MRTs greater than mixing time are evenly distributed

Variable gases have short MRTs

Carbon Dioxide (CO_2) MRT= 4-5 years

Water vapor (H_20) MRT= 10 days

Ozone (O_3) MRT= 3-7 days

Aerosols (Particulate Matter)

Small solid particles and liquid droplets

Normal conc. = 10,000 particles/cm^3

Associated with human and natural processes

Smallest particles have radii = 0.1um from sulfate gas convert to liquid/solid

Practice with some atmospheric calculations

Do these in groups of two or three. Check your answers with us before you're done.

1. Calculate the MRT for water in humans with the following examples. Water gains are about 40 ml/kg per day body weight for both genders. Male: 70 kg, 60% water; Female: 56.6 kg, 50% water.

2. Lifting of air masses cools them according to the adiabatic rate (dry adiabatic rate -10°C/ 1000m, wet rate is -6°C/ 1000m). Here in the PNW, orographic lifting (lifting of air due to topography forcing it up) is responsible for much of the rainfall we receive on the west side. At what elevation would clouds and rain begin to form for air that is at 16°C and 74% RH at sea level (dewpoint is 11°C). What would the air temperature be at Paradise (1676 m)? Calculate the temperature on the east side of the mountains for the same elevation where clouds formed on the west side. Assume all heating/cooling is due to elevation changes only. (1m = 3.28 ft)