Introduction to the Atmosphere

by MC DocW

Atmosphere

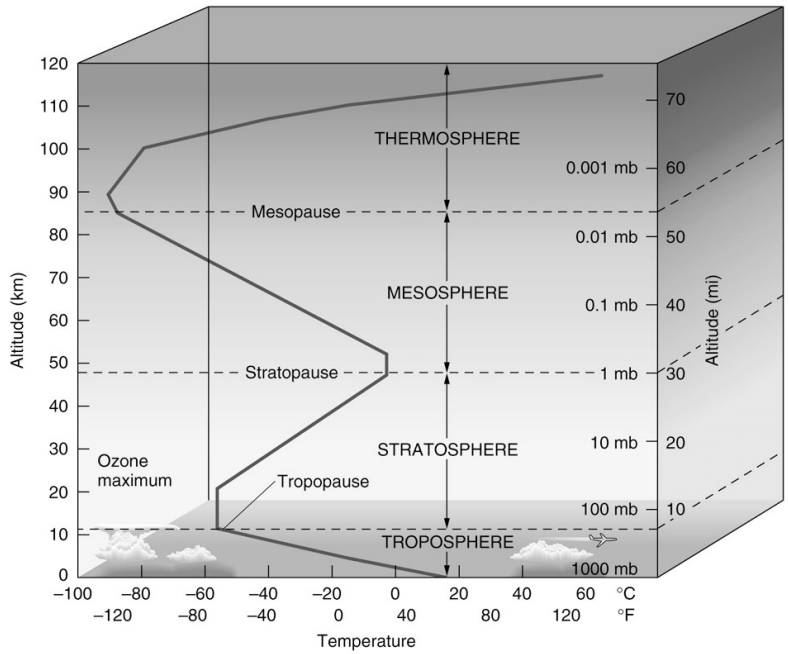
- Clean, dry air contains:
  - 78% nitrogen (N_2)
  - 21% oxygen (O_2)
  - 0.93% argon (Ar)
  - 0.036% carbon dioxide (CO_2)
  - tiny traces of other gases
- Actual air also contains variable amounts of other substances:
  - water vapor (H_2O), up to 4%
  - ozone (O_3)
  - aerosols (microscopic solid particles and liquid droplets)
  - pollutants (CO, SO_2, NO_2, etc.)

Atmosphere Layers

- *Troposphere*—0-12 km above surface
  - Essentially all weather phenomena happen here
- *Stratosphere*—12-50 km
  - "Ozone layer" is at about 25 km
- *Mesosphere*—50-80 km
  - Meteors burn up in the mesosphere

Atmosphere Layers

- *Thermosphere*—80 km on up
  - The *Karman line* (100 km = 62 miles) is the edge of "space"; above this altitude, spacecraft get essentially no lift from flying through the atmosphere
  - Solar radiation ionizes molecules in the lower thermosphere, forming the *ionosphere* (important in radio propagation, as you'll see)
  - Charged particles from the Sun, striking atmospheric molecules in the thermosphere, produce *auroras* ("Northern Lights")



Auroras in the thermosphere, as seen from the ground. . .

Auroras in the thermosphere, as seen from the Space Shuttle!

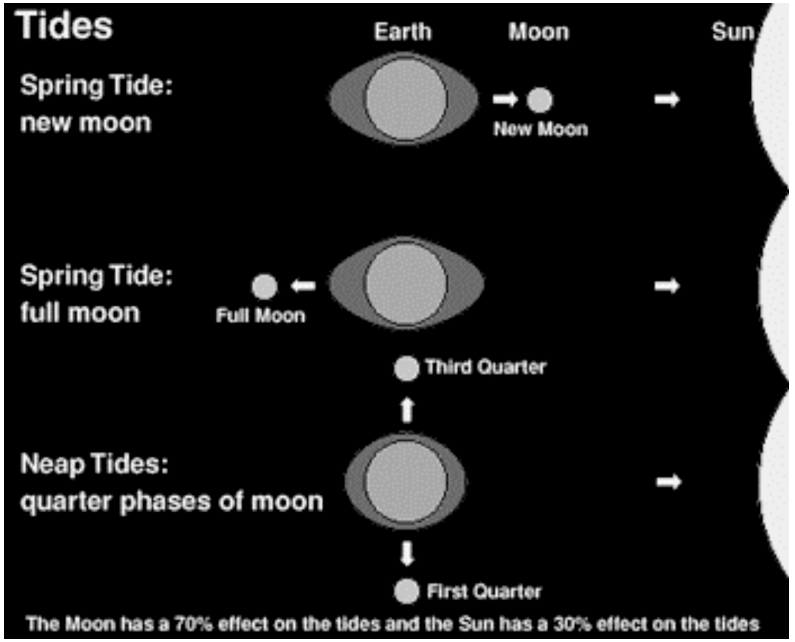
A meteor burning up in the mesosphere. . .

A balloon launched from Holloman AFB, New Mexico, on its way to the stratosphere. . .

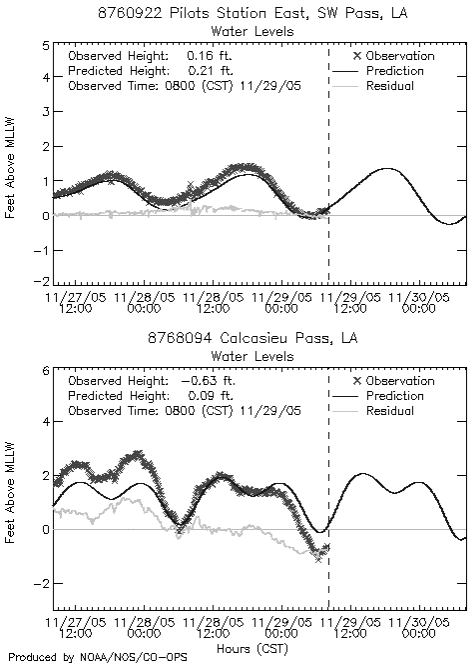
. . . and some heavy weather in the troposphere!

Weather

- Driving force of all atmospheric activity is ultimately the Sun
- Sun's unequal heating of the Earth ultimately drives all winds and ocean currents
- So we need to look at the Earth-Sun-Moon system. . .



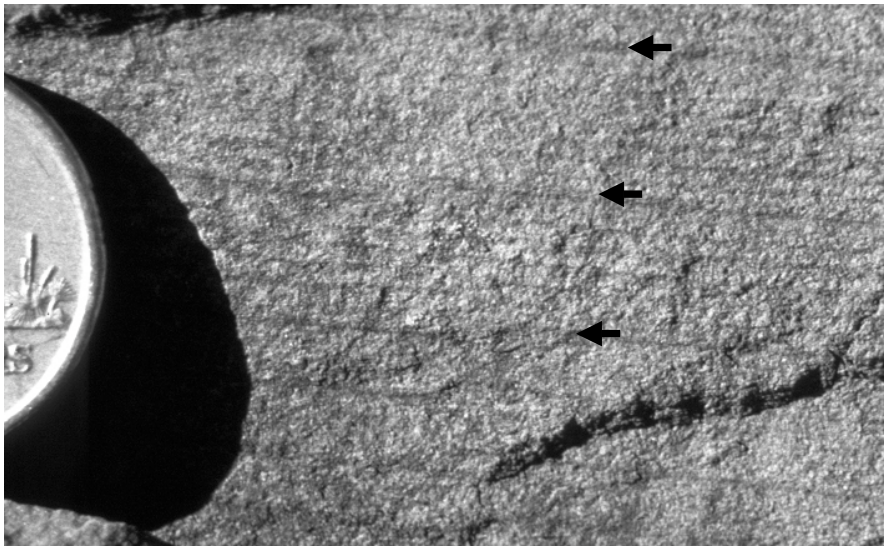
Low and high tides at the Bay of Fundy, Nova Scotia



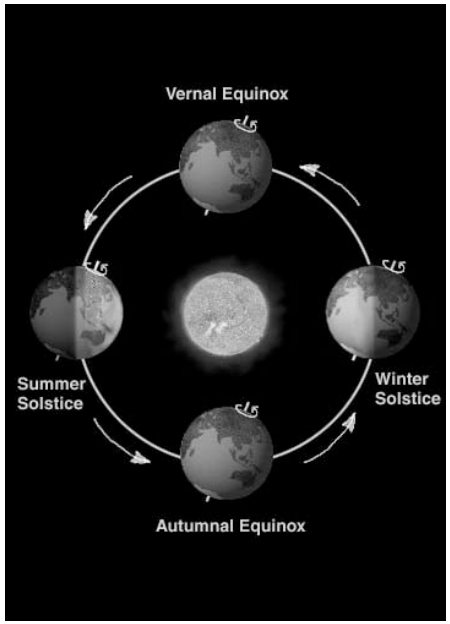
You would predict that each area should experience one high and one low tide with each revolution of the Earth. But because of irregularities in the shapes of the oceans, some areas get two high and two low tides each day. (Graphs are of the tides at two different stations on the Louisiana coast, from NOAA)

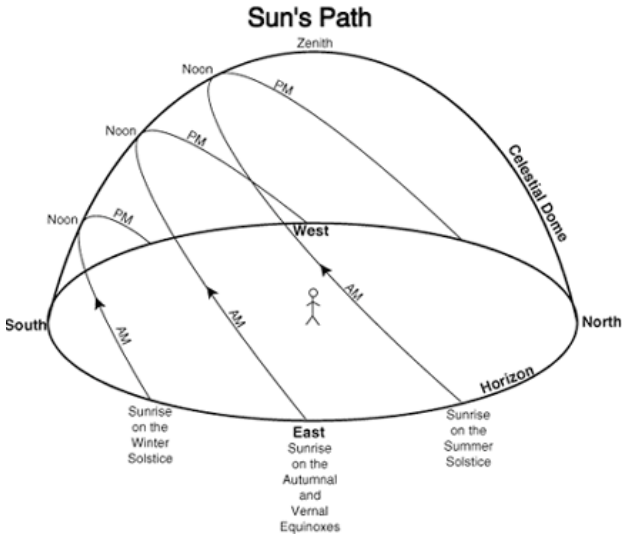
Tides laid down this very regularly banded sedimentary rock, a *rhythmite* (~580 million years old, South Australia)

Close-up of that tidal rhythmite. The stronger bands (light green arrows) correspond to spring tides



Seasons are ultimately caused by the tilt of the Earth's axis—in winter, the axis is pointed away from the Sun, and in summer, the axis is pointed towards the Sun.





Because of this tilt, the path that the Sun appears to travel through the sky shifts from season to season: lowest in the winter, highest at in the summer.