ATM 210 The Standard Atmosphere

Fall, 2023 – Fovell

The "standard atmosphere" is obtained by averaging from equator to Pole, winter to summer, land to sea, and day to night. The figure below presents the vertical structure of this averaged atmosphere. The atmosphere is subdivided into four layers, distinguished by how temperature varies with height. The figure below is somewhat more accurate than the simplified version sketched in class, but still should not be used for precise calculations.

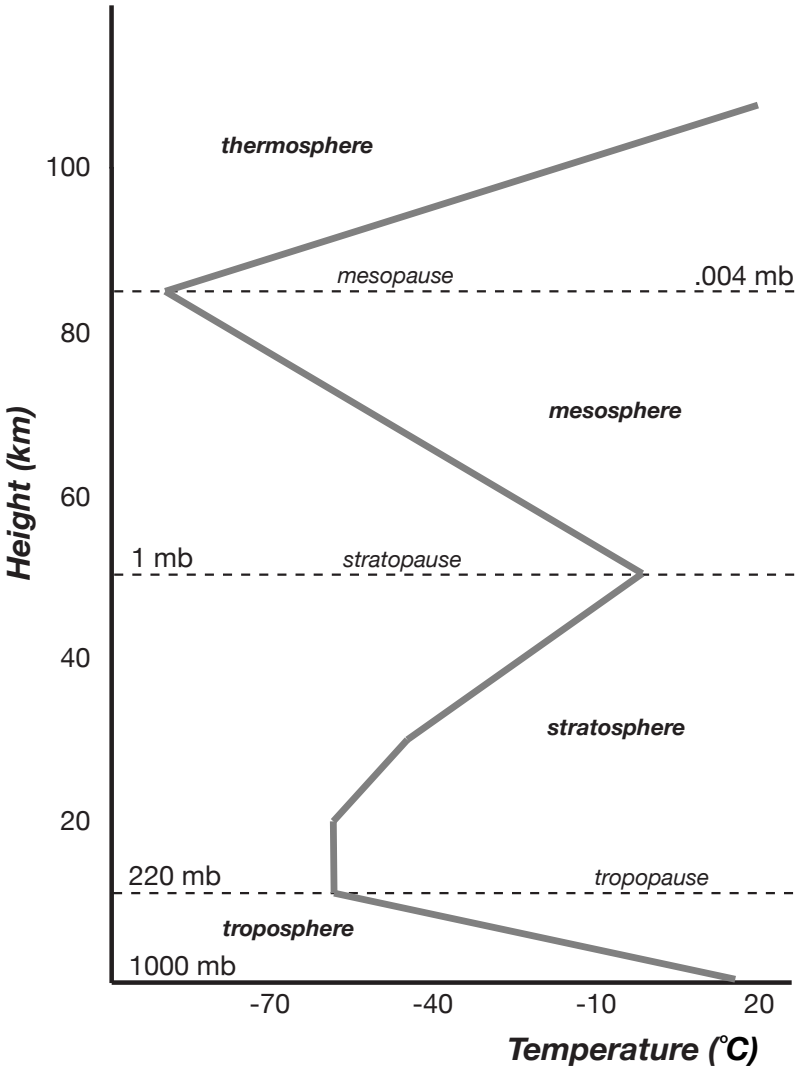

Figure 1: Temperature vs. height in the standard atmosphere.

The **troposphere** is the lowest part of the atmosphere, representing ≈ 80% of the atmosphere's mass. Temperature decreases swiftly with height in this region. Its top, the *tropopause*, lies about 11-12 km or so above sea-level. The troposphere is considerably deeper in the warmer tropics, and shallower at the colder poles. The name comes from the Greek *tropos*, meaning "to turn". Along with *strophe* – "to bend, twist, turn" – this Greek word appears repeatedly in meteorology. *Turning*, in this instance, implies changeability, variability, *weather*. The *weather sphere*.

The **stratosphere** is characterized by temperature generally increasing with height, a consequence of ultraviolet absorption by O_2 and O_3. Its name issues from the Latin *stratum*, connoting something spread thinly. The temperature increase with height makes the stratosphere an extremely stable layer, resisting vertical displacements (up or down). As a result, cloud formations in this layer (including contrails from airplanes) tend to spread thinly and horizontally. 99.9% of the atmosphere's mass resides below the *stratopause*. In this class, we will be concerned with the troposphere and lower stratosphere.

The **mesosphere** was named using the Greek word *mesos*, meaning "middle", and is part of what is usually termed the "middle atmosphere". Less than 0.1% of the atmospheric mass, however, resides in and above the mesosphere. Temperature decreases with height in this layer, principally owing to the lack of O_3.

The **thermosphere** is ostensibly a hot place, with temperatures exceeding 1000°C degrees possible during periods of above-normal solar activity. However, there is so little mass in the thermosphere that these high temperatures do not represent a significant heat content. Air density in this region is smaller than that inside a typical incandescent light bulb, which purports to represent a vacuum.