OUR ATMOSPHERE

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Introduction

Our atmosphere is a sea of air held to the surface of our planet by gravity. Air, a mixture of gases, has a uniform composition throughout the planet, it does vary locally due to emissions from people, plants, natural disasters, automotive vehicles, and industrial emissions.

The Atmosphere

The atmosphere is divided into several concentric layers separated by narrow transition zone.

Closest to the ground is the **troposphere.** It contains the largest mass of air of the total atmosphere. This is where all weather phenomena occurs, with some turbulence extending into the lower stratosphere. Also, 99% of the water vapor in the atmosphere is contained in the troposphere.

The temperature of the troposphere decreases, on the average, by 6°C for each 1000 m (1 km) of vertical elevation reaching a minimum of about -56.7°C.

A narrow zone, called the **tropopause** separates the troposphere from the next laver, called the stratosphere.

The **stratosphere** extends from approximately 10,000 m (10 km) to 50,000 m (50 km). The lower part of the stratosphere is where jet aircraft fly to avoid the weather turbulence of the troposphere. The temperature remains fairly constant in the lower stratosphere, but increases to a maximum of approximately -1°C at the stratopause.

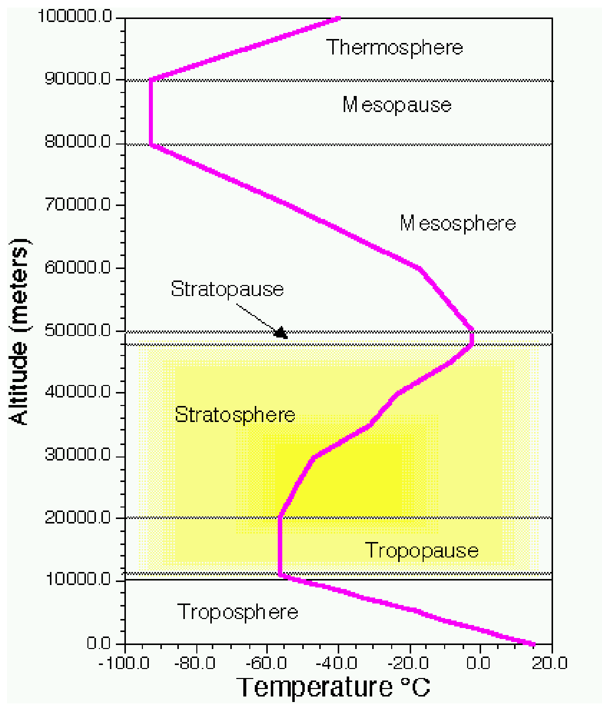


Figure 1. The temperature of the different layers of the atmosphere. The shaded portion indicates where ozone is located. Reference: Michael Pidwirny, Living Landscapes, 1996, http://royal.okanagan.bc.ca/mpidwirn/atmosphereandclimate/atmslayers.html

The **ozone layer** is located in the stratosphere. Ozone occurs in the troposphere, but its concentration increases to a maximum at approximately 20,000 m (20 km) above the earth's surface and decreases to near zero in the stratopause. (See Figure 2) Ozone is formed when the intense ultraviolet radiation from the sun causes oxygen molecules, O_2, to split into single oxygen atoms, O. Single oxygen atoms are very reactive and combine with oxygen molecules to form ozone, O_3.

$$O_2 + \text{UV radiation} \rightarrow O + O$$

$$O + O_2 \rightarrow O_3$$

Ozone absorbs much of the solar ultraviolet radiation in the 290 nm – 320 nm wavelength range. The absorbed radiation is converted to kinetic energy resulting in the heating of the stratosphere.

The **mesosphere** extends from approximately 50,000 m (50 km) to 80,000 m (80 km). In this region, the temperature decreases to approximately -90°C at the mesopause. The air pressure in the mesosphere is low and the composition of the air is mostly nitrogen and oxygen enriched with the lighter gases.

The **thermosphere** extends from approximately 90,000 m (90 km) to 200,000 m (200 km). The temperature of this region increases reaching a maximum of 1200°C. This temperature increase is due to absorption of intense solar radiation by the small amount of molecular oxygen present in this region.

Above the thermosphere is the **exosphere**, which extends up to about 1000 km. This area is the transitional zone between the Earth's atmosphere and what we call interplanetary space.

In the upper atmosphere, many of the atoms are ionized by the solar radiation. This area is sometimes referred to as the **ionosphere**. Figure 3 shows the concentrations of atoms and molecules in the upper atmosphere.

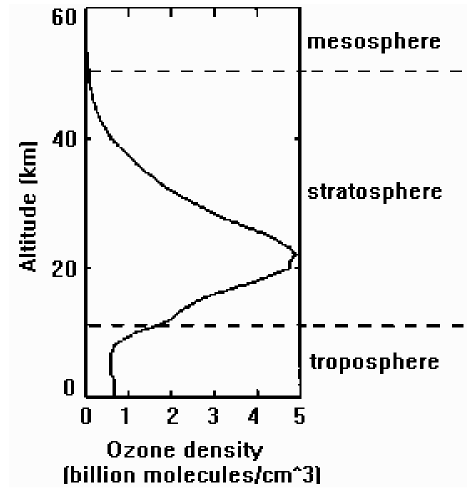
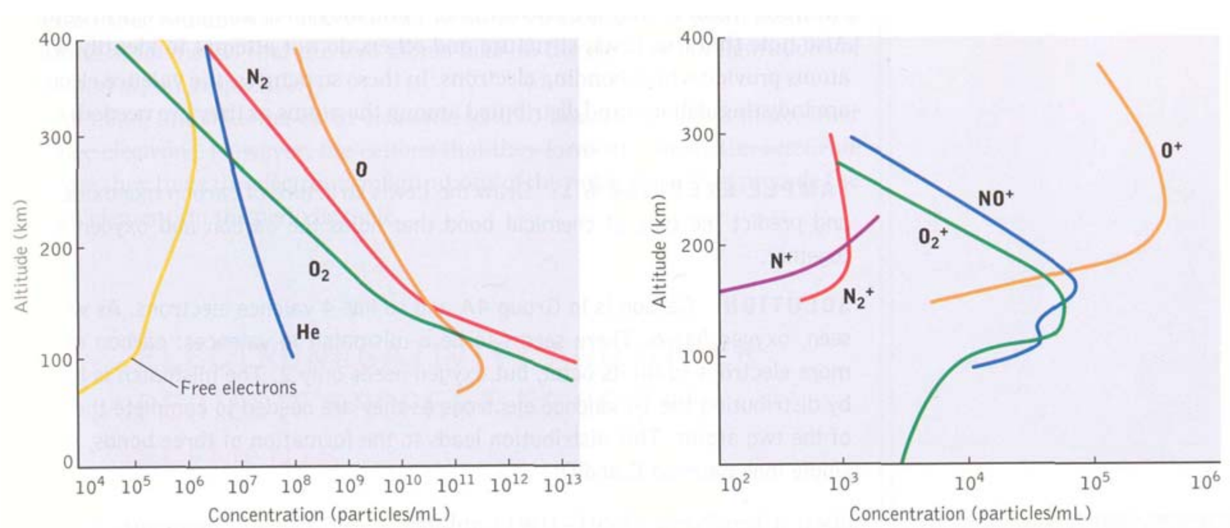


Figure 2. The ozone density in the troposphere and stratosphere.



(a) (b)

Figure 3. (a) The concentrations of the principle atoms and molecules of the upper atmosphere. (b) The concentrations of the products of the photoionization of the atoms and molecules in the upper atmosphere. Reference: Gilbert, Kriss, and Davies, *Chemistry: The Science in Context*, W. W. Norton & Co., 2004, page 291.