Introduction to Ozone Depletion

Description of the process depleting the ozone layer and the threats to the environment and humankind

Site: UNITED NATIONS INFORMATION PORTAL ON MULTILATERAL ENVIRONMENTAL AGREEMENTS
Course: Introductory Course to the International Legal Framework on Ozone Depletion
Book: Introduction to Ozone Depletion

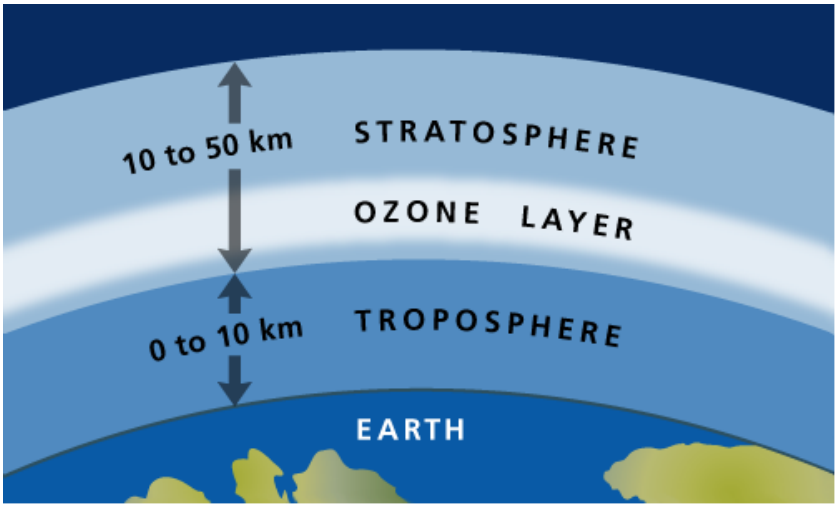
Table of contents

1. . What is the Ozone Layer?

The Earth's atmosphere is composed of three regions:

1. troposphere, which extends up to about ten kilometres from the Earth's surface;
2. the stratosphere, which is found between approximately ten and fifty kilometres from the Earth's surface; and
3. the ionosphere, which extends up to 350 kilometres from Earth.

Most ozone (approximately 90%) is found in the stratosphere. This stratospheric ozone is commonly known as the "ozone layer." The remaining ozone is contained in the troposphere, also known as surface-level ozone.



2. Which are the effects of ozone molecules on us?

The ozone molecules in the two regions are chemically identical; however, they have different sources and their effects are very different on humans and other living organisms.

Surface-level ozone is a result of chemical reactions involving emissions from vehicles, industrial pollution and sunlight. Because ozone reacts strongly with other molecules, high levels of ozone are toxic to living systems. Several studies have documented the harmful effects of ozone on crop cultivation, forest growth and human health. Low-lying ozone is a key component of photochemical smog, a common problem in many cities around the world. Higher amounts of surface level ozone are increasingly being observed in rural areas as well.

Stratospheric ozone, in contrast, plays a highly beneficial role. It absorbs most of the sun’s biologically damaging ultraviolet radiation and only allows a small amount to reach the Earth's surface. The ozone layer screens out almost all the harmful ultraviolet rays of the sun and thus can be described as our planet’s sunscreen.

3. The Ozone Hole

During the 1970s, scientists observed a significant destruction of ozone in the stratosphere. The emergence of evidence peaked in 1985, when a large “ozone hole” was discovered above Antarctica. This has reappeared annually during the springtime, generally growing larger and deeper each year. In 1992, ozone over Antarctica had depleted by 60% from previous observations; and the size of the hole had increased, covering twenty-three million square miles. The overall decline in stratospheric ozone levels was estimated at 3% per decade. By the mid-1990s, ozone depletion extended over latitudes including North America, Europe, Asia, and much of Africa, Australia and South America. Thus, ozone depletion had become an issue of global concern.

3.1. What are the threats of the Ozone Hole?

Any damage to the ozone layer leads to increased UV radiation reaching the Earth's surface. This can cause a variety of human health problems such as skin cancers, eye cataracts and a reduction in the body's immunity to disease. A 1% decrease in ozone would lead to about a 4% increase of skin cancer and 100,000 to 150,000 additional cases of cataract blindness.

Ultraviolet radiation can also affect plant life, damage forests and certain varieties of crops including rice and soya. Ultraviolet radiation can be damaging to microscopic life in the surface oceans (such as plankton, fish larvae, shrimp, crab, and aquatic plants) that form the basis of the world's marine food chain.

3.2. Is the Ozone Hole human-made?

Yes, scientific evidence has shown that human produced chemicals are responsible for the observed depletions of the ozone layer. These chemicals are used in solvents, foam, aerosol, mobile air conditioning, refrigeration and fire protection and contain various combinations of chemical elements, of which chlorofluorocarbons (“CFCs”) are most prominent.

CFCs are so stable that only exposure to strong ultraviolet (“UV”) radiation breaks them down. When this happens, the CFC molecule releases atomic chlorine. One chlorine atom can destroy over 100,000 ozone molecules, depleting ozone faster than it is naturally created. Chlorine that reaches the stratosphere is also produced by natural occurrences such as volcanic eruptions or large fires, with high concentrations of chlorine fluctuate. It has been shown, however, that natural sources only create approximately 15% of chlorine in the stratosphere and thus have minimal impact on the depletion of the ozone layer.

3.3. Can the Ozone Layer be fixed?

Several methods have been investigated regarding the replacement of ozone lost in the stratosphere, starting with options such as shipping low-level ozone out of smog burdened cities or producing new ozone and introducing it into the stratosphere. Since ozone reacts strongly with other molecules, however, it is too unstable, expensive and impractical to transport into the stratosphere. Therefore, the only cure to the problem of ozone depletion is to regulate and eliminate the production of CFCs and other ozone-depleting substances.

4. The Artic and the Ozone Layer

The Arctic & the Ozone Layer: Stabilizing our environment and climate. In 2011, extremely low ozone levels were recorded in the Arctic region. This episode in the North Pole - the Arctic - has triggered concerns on the trend of the ozone layer's recovery, expected to fully happen by mid century. With the support of the Government of Norway, UNEP is investigating the causes of this depletion and the scieintific explanations for such an unexpected episode in the Arctic. This 16-minute documentary reports the impacts on the region's ecosystem and the foreseen risks of the changes in the Arctic that may affect human life also in mid-latitudes. This video output is jointly branded by the WMO (World Meteorological organisation) and brings to light some of the so much discussed inter-linkages between the climate and ozone issues on the voices of internationally know scientists.