focus on

The Ozone Layer

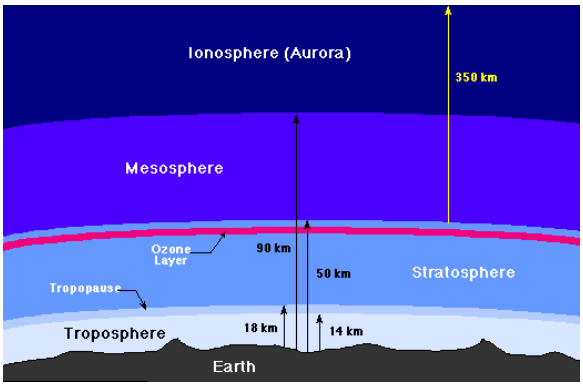
Introduction

The earth is part of a wonderfully complex solar system. The sun provides us with light and energy, however not all of it is helpful. The sun's energy contains ultraviolet radiation (UV) that can be harmful to humans, animals, crops and aquatic life. The ozone layer is a thin layer in our atmosphere that helps protect us from these harmful UV rays. It captures and reflects UV radiation back in to space, thereby protecting the earth's surface.

During the 1980s, scientists discovered a decrease in the thickness of the ozone layer, which meant more UV rays were getting through to Earth's surface. Countries around the world rallied together to take action to stop destroying the ozone layer. This effort continues today.

Background

The atmosphere is not a uniform layer of gases. The atmosphere's layers are defined by temperature. The layer closest to the earth is the troposphere. The next layer, the stratosphere (about 15 to 35 km above the earth), contains the ozone layer.



The stratosphere contains 90 per cent of all natural ozone in a layer about 20 kilometers thick. Natural ozone (O_3) is a strong-smelling bluish gas made up of 3 oxygen atoms that is formed when rays from the sun break airborne water molecules apart. The oxygen atom combines with oxygen molecules (O_2) to make ozone (O_3). When ozone absorbs solar energy, it breaks back down into O_2 and a free oxygen ion. This process happens continuously in the earth's stratosphere, so the amount of ozone stays relatively constant.

Natural ozone can occur at ground level during thunderstorms. Lightning can split air molecules, which then combine to form a trail of ozone leaving behind

a sharp, clean smell that soon disappears after a storm. However, most of the ground level ozone is created by human activity and is a serious ground level pollutant. It can damage human health and agricultural crops in or near large urban areas.

Ground level ozone is formed from air pollutants (mostly exhaust from motor vehicles and gasoline vapours), which collect over large cities on hot summer days. This can result in a thick blanket of ozone-laden smog that causes and aggravates asthma and other respiratory problems.

The Issues

Ozone absorbs most of the sun's damaging ultraviolet rays. If greater amounts of these rays reach the earth, scientists predict an increase in some forms of skin cancer. Ultraviolet light can also increase skin and eye aging and can interfere with the human immune system, leading to less resistance to disease. Many agricultural crops are affected by ultraviolet radiation, including most of the world's major food sources like wheat, rice, corn and soybeans. Aquatic life is also susceptible to ultraviolet radiation and too much exposure could disrupt natural fish production in the oceans.

The UV Index is a measure of the intensity of the sun's ultraviolet radiation in the sunburning spectrum. As the UV Index increases, the sun's rays can do more harm to your skin, eyes and immune system. On days with a high UVI, it's even more important to protect yourself from harmful rays.

UV Index	Category
+11	Extreme
8 to 10	Very High
6 to 7	High
3 to 5	Moderate
0-2	Low

The UV Index ranges from 0 to 16+. The highest values are found on mountaintops at the equator. In Canada, the UVI normally varies from 0 to 10. Generally, the further south the higher the UV Index, however, the UV Index is also dependent on altitude, reflection and clouds.

Ozone is a very unstable substance that can be easily destroyed by contact with industrial chemicals. It may seem hard to believe, but some activities on earth are having an effect 35 kilometers straight up. Air pollutants reach the stratosphere (where the ozone layer is) in one of two ways. They either move up slowly from the lower atmosphere or are discharged directly into the stratosphere from high altitude aircraft and space vehicles. While airplane pollution is a serious issue and is being studied by the National Oceanographic and Atmospheric Agency (NOAA) and the United Nations Environment Program (UNEP), there is still very little known about the effects of airplane travel on the stratosphere.

The major culprit for ozone depletion is found much closer to home. Research discovered that chlorofluorocarbons (CFCs) used in aerosol sprays were harming the ozone layer. Aerosols were widely used as propellants in spray cans and in fire retardants. By the late 1970s, the use of CFCs in spray cans was reduced and in 1980, Canada banned the use of this major propellant altogether. The ban translated into a 45 per cent reduction of the total CFC usage across Canada.

While CFCs were being eliminated from spray cans, they're use in a variety of industrial processes was increasing. CFCs were used as coolants in refrigerant and air conditioning equipment, as blowing agents in foam product manufacturing and as cleaning solvents for electrical components. By the mid 1980s, worldwide levels of CFCs in the atmosphere were increasing and scientists were warning us what this could mean for the ozone layer.

When introduced, CFCs were considered to be environmentally safe. What scientists did not know at the time is that CFCs are very stable compounds that break apart ozone molecules. One CFC molecule can stay in the atmosphere for up to 120 years and break up over 100,000 ozone molecules. Studies show that a one per cent depletion in ozone would result in about a four per cent increase in one type of skin cancer and could cause a significant decrease in crop growth.

As concerns were being expressed about the increasing use of CFCs, a group of scientists made an alarming discovery. A "hole" in the ozone layer was detected over the South Pole in the Antarctic. The extreme cold temperatures in Antarctica (as cold as -80^{o}C in the winter) allow clouds to form in the stratosphere. When these stratospheric clouds containing airborne pollutants like CFCs, build up in the atmosphere, they speed up ozone destruction creating holes in the ozone layer, which appear in September and then gradually fill back in over the next few months. Ozone layer holes are actually areas where the ozone layer has thinned enough to be observed with satellites and instrument readings. At its largest, the Antarctic "hole" is about 1.5 times the area of the United States!

In 1986, Canadian scientists discovered a similar hole over the Arctic. The Arctic hole is not stationary like its Antarctic counterpart. The Arctic hole

shifts, following the movement of cold polar air. While the hole is not as large as the one over the South Pole, there is one big difference - the north is populated. New studies have found ozone depletion occurring over North America, Europe, Russia, Australia, New Zealand and parts of South America. This poses a serious increased risk of skin cancer for the millions of people living in these areas.

What is Being Done?

Ozone depletion, like climate change (See ***Focus on Climate Change***) is a global issue. In 1989, Canada and 24 other nations, signed the Montreal Protocol on Substances that Deplete the Ozone Layer. There are now 189 countries around the world that have signed on to the protocol and committed to taking action to control ozone-depleting substances like CFCs.

The Montreal Protocol, since amended several times, was developed under the United Nations Environment Program. The protocols achievements include:

- January 1, 1996, developed countries eliminated the production and importation of the most damaging Ozone Depleting Substances (ODS) including CFCs.
- Developed countries have adopted “phase out” and elimination targets for remaining ODSs.

Canadian efforts to comply with the protocol include 100 per cent elimination of the following chemicals:

- Halons by January 1, 1994
- Carbon tetrachloride by January 1, 1995
- Methyl bromide by January 1, 2005
- CHCs, methyl chloroform, HBFCs by January 1, 1996
- HCFCs by January 1, 2030 with an interim target of 65% reduction by January 1, 2010

These achievements are possible through cooperation between governments, industries, environmental groups and the scientific community. Ongoing effort is needed to continue scientific research, develop alternative substances and technologies, promote technology transfers to developing countries and improve public education.

Alberta supports the Montreal Protocol and has endorsed the recommendations from the 1988 international conference in Toronto on "The Changing Atmosphere: Implications for Global Security" that called for complete elimination of CFCs by 2000. In 1993, Alberta established the Ozone Depleting Substances Regulation to control CFCs in Alberta. This regulation was amended in 2000 to improve controls on all ozone depleting substances including halocarbons.

What Can You Do?

The best strategy for ozone protection is to avoid purchasing products containing ozone-depleting substances. Ask before you purchase fire extinguishers, foam products, refrigerators and air conditioners. Refuse to purchase products containing ozone-depleting substances if alternatives are available.

Some older products like air conditioning systems and refrigerators purchased before the ban may contain CFCs and other ozone depleting substances. Proper maintenance of these items can help prevent ODS from being released into the atmosphere.

Leaking seals in car and home air conditioning units should be replaced. Do not break the seals on old refrigerators; store them carefully and have any fluids drained by a certified company or individual who will dispose of them properly.

Ground level ozone is a serious pollutant produced by exhaust emissions from motor vehicles. Reducing the use of vehicles and increasing our use of public transit, car-pooling and riding bikes can help reduce ground level ozone pollution in our cities.

Conclusion

Scientists are keeping watch over the ozone layer at both ends of the earth. International agreements between countries are looking for practical ways to reduce the use of harmful substances. Individuals can make lifestyle changes and choices as well as supporting companies whose products don't harm the environment. Everyone has a role to play in making sure the ozone layer continues to protect us.

For More Information:

Alberta Environment and Sustainable Resource Development:
www.ESRD.Alberta.ca and search "Ozone"
Environment Canada's Stratospheric Ozone:
http://ec.gc.ca and search "Ozone Layer"
The Ozone Hole: www.theozonehole.com/index.htm
National Oceanographic and Atmospheric Agency (NOAA)'s Stratospheric Ozone: www.ozonelayer.noaa.gov
Canada's UV Index and forecast: exp-studies.tor.ec.gc.ca/e/ozone/forecasts.htm

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