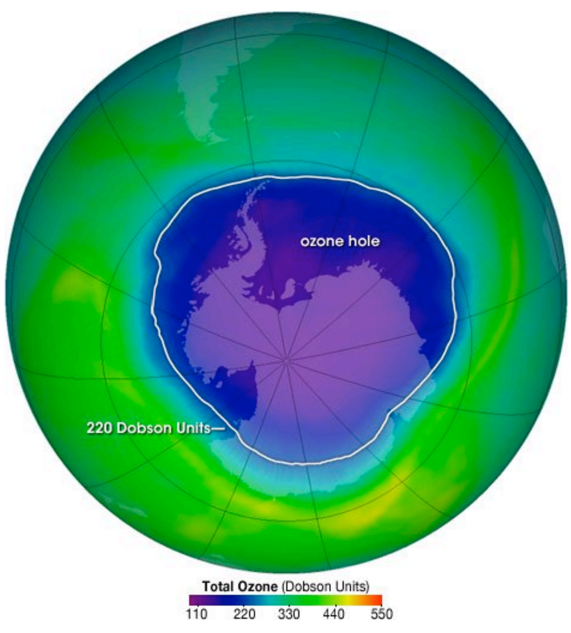
MECHANISM OF OZONE HOLE

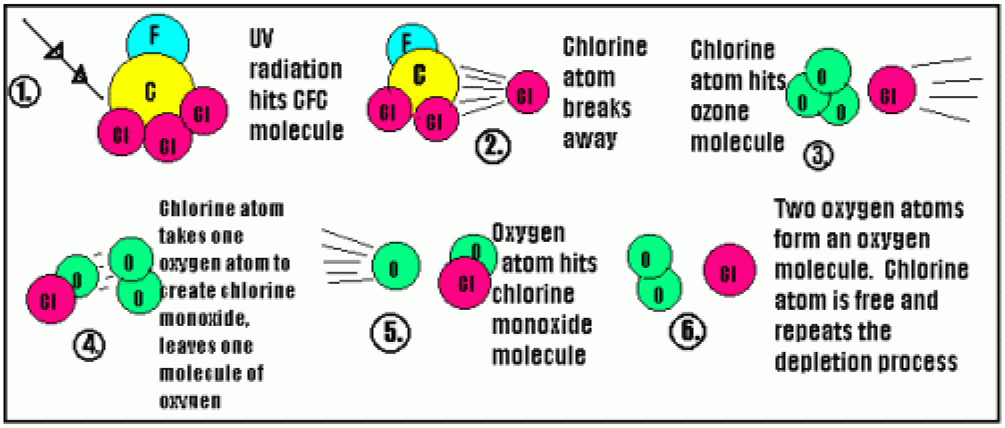
The criticality of ozone layer can be understood from the fact that, only 10 or less of every million molecules of air is ozone. The majority of these ozone molecules reside in a layer between 10 and 40 kilometers above the surface of the Earth known as stratosphere. Each spring in the stratosphere over Antarctica (spring in the southern hemisphere is from September through November.), atmospheric ozone is rapidly destroyed by chemical processes. As winter arrives, a vortex of winds develops around the pole and isolates the polar stratosphere. When temperatures drop below -78°C, thin clouds form of ice, nitric acid, and sulfuric acid mixtures. Chemical reactions on the surfaces of ice crystals in the clouds release active forms of CFCs. Ozone depletion begins, and the ozone "hole" appears.

Over the course of two to three months, approximately 50% of the total column amount of ozone in the atmosphere disappears. At some levels, the losses approach 90%. This has come to be called the Antarctic ozone hole. In spring, temperatures begin to rise, the ice evaporates, and the ozone layer starts to recover.



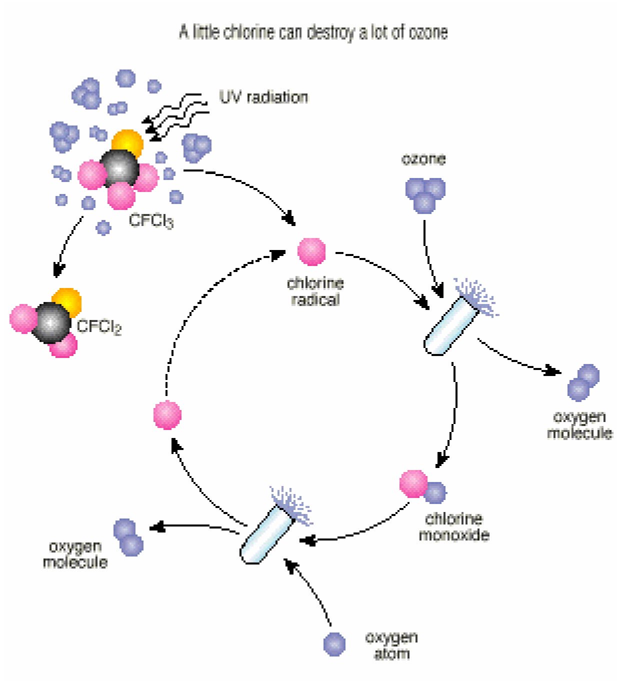
Thus, ozone "hole" is a reduction in concentrations of ozone high above the earth in the stratosphere. The ozone hole is defined geographically as the area wherein the total ozone amount is less than 220 Dobson Units. The ozone hole has steadily grown in size and length of existence over the past two and half decades. Now, the size of ozone hole over Antarctica is estimated to be about 30 million sq. km.

It has been observed that, man-made chlorines, primarily chloroflourobcarbons (CFCs), contribute to the thinning of the ozone layer and allow larger quantities of harmful ultraviolet rays to reach the earth.



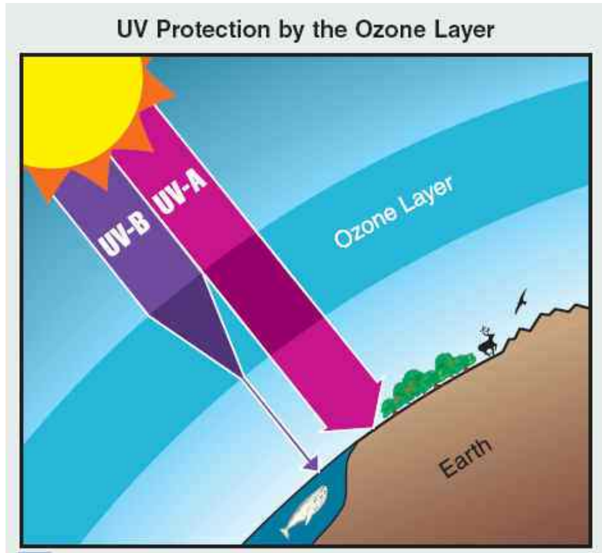
A pictorial explanation of how the interaction of CFCs and UV radiationdamage the ozone layer

Human activities are mostly responsible – Human activity is by far the most prevalent and destructive source of ozone depletion, while threatening volcanic eruptions are less common. Human activity, such as the release of various compounds containing chlorine or bromine, accounts for approximately 75 to 85 percent of ozone damage. Perhaps the most evident and destructive molecule of this description is chloroflourocarbon (CFC). CFCs were first used to clean electronic circuit boards, and as time progressed, were used in aerosols and coolants, such as refrigerators and air conditioners. When CFCs from these products are released into the atmosphere, the destruction begins. As CFCs are emitted, the molecules float toward the ozone rich stratosphere. Then, when UV radiation contacts the CFC molecule, this causes one chlorine atom to liberate. This free chlorine then reacts with an ozone (O_3) molecule to form chlorine monoxide (ClO) and a single oxygen molecule (O_2). This reaction can be illustrated by the following chemical equation: $Cl + O_3 \rightarrow O_2 + ClO$. Then, a single oxygen atom reacts with a chlorine monoxide molecule, causing the formation of an oxygen molecule (O_2) and a single chlorine atom ($O + ClO \rightarrow Cl + O_2$). This threatening chlorine atom then continues the cycle and results in further destruction of the ozone layer. Measures have been taken to reduce the amount of CFC emission, but since CFCs have a life span of 20-100 years, previously emitted CFCs will do damage for years to come.



Bromine compounds also play a key role in destroying the ozone layer. Some chemical compounds like Nitrous Oxide and other Nitrogen compounds also have a damaging affect on the ozone layer.

Effects of ozone layer depletion - UV-B (the higher energy UV radiation absorbed by ozone) are generally accepted to be a contributory factor to skin cancer. In addition, increased surface UV leads to increased troposphere ozone, which is a health risk to humans. The increased surface UV also represents an increase in the vitamin D synthetic capacity of the sunlight. The cancer preventive effects of vitamin D represent a possible beneficial effect of ozone depletion. In terms of health costs, the possible benefits of increased UV irradiance may outweigh the burden. In other words, a thinning of the ozone layer is the key factor in the greenhouse effect, and exposes life on Earth to excessive ultra violet radiation, which can increase skin cancer and cataracts, reduce immune-system responses,



As far as effect on plant is concerned, an increase of UV radiation would be expected to affect crops. A number of economically important species of plants, such as rice, depend on cyanbacteria residing on their roots for the retention of nitrogen. Cyanobacteria are sensitive to UV light and they would be affected by its increase. Thinning of the ozone layer also interfere with the photosynthetic process of plants,

Increased ultraviolet radiation reaching the Earth's surface can have significant detrimental impacts on animal and plant life. The radiation damages cells, causing damage to DNA and can lead to cell death or mutation and cancers. Radiation can also cause photochemical reactions in freshwater and marine waters, forming radicals (such as peroxide and hydroxide) that can cause further biological damage. Marine ecosystems in the Southern Ocean are most at risk. Zooplankton and phytoplankton, the foundation of the marine food chain, are particularly susceptible to certain types of ultraviolet radiation and impacts have flow-on effects to fish stocks and larger organisms such as whales. On land, increased ultraviolet light can cause significant damage to native vegetation and agricultural crops, such as reduced plant height, reduction in foliage area and changes to tissue composition.

Research has shown a widespread extinction of oceanic phytoplankton (a crucial source of food to aquatic life) is because of thinning of ozone layer. Researchers speculate that the extinction of plankton was caused by a significant weakening of the ozone layer at that time when the radiation from the supernova produced nitrogen oxides that catalyzed the destruction of ozone. Plankton is particularly susceptible to effects of UV light, and is vitally important to marine food webs.

Environmental Effects of Ozone Depletion – As discussed, ozone acts as a shield to protect the Earth's surface by absorbing harmful ultraviolet radiation. If this ozone becomes depleted, then more UV rays will reach the earth. Exposure to higher amounts of UV radiation could have serious impacts on human beings, animals and plants, such as the following:

(a) Harm to human health:

* More skin cancers, sunburns and premature aging of the skin.

* More cataracts, blindness and other eye diseases: UV radiation can damage several parts of the eye, including the lens, cornea, retina and conjunctiva.

* Cataracts (a clouding of the lens) are the major cause of blindness in the world. A sustained 10% thinning of the ozone layer is expected to result in almost two million new cases of cataracts per year, globally.

* Weakening of the human immune system (immunosuppression). Early findings suggest that too much UV radiation can suppress the human immune system, which may play a role in the development of skin cancer.

(b) Adverse impacts on agriculture, forestry and natural ecosystems:

* Several of the world's major crop species are particularly vulnerable to increased UV, resulting in reduced growth, photosynthesis and flowering. Many agricultural crops are sensitive to the burning rays of the sun, including the world's main food crops, rice, wheat, corn and soyabean.

* Many species of crops like sweet corn, soyabean, barley, oats, cow peas, carrots, cauliflower, tomato, cucumber, peas and broccoli are highly sensitive to UV-B radiation. As a result, food production could be reduced by 10% for every 1% increase of UV-B radiation.

* The effect of ozone depletion on the Indian agricultural sector could be significant.

* Only a few commercially important trees have been tested for UV (UV-B) sensitivity, but early results suggest that plant growth, especially in seedlings, is harmed by more intense UV radiation.

(c) Damage to marine life:

* In particular, plankton (tiny organisms on the surface layer of oceans) are threatened by increased UV radiation. Plankton are the first vital step in aquatic food chains.

* Decreases in plankton could disrupt the fresh and saltwater food chains, and lead to a species shift.

* Species of marine animals in their growing stage, including young fish, shrimp larvae and crab larvae, have been threatened in recent years by the growing UV-B radiation under the Antarctic ozone hole. Loss of biodiversity in our oceans, rivers and lakes could reduce fish yields for commercial and sport fisheries.

(d) Animals:

* In domestic animals, UV over exposure may cause eye and skin cancers.

Materials:

* Wood, plastic, rubber, fabrics and many construction materials are degraded by UV radiation.

* The economic impact of replacing and/or protecting materials could be significant.

Conclusion – Under the auspices of United Nations Environment Programme (UNEP), Governments of the world, including the United States have cooperatively taken action to stop ozone depletion with the

“The Montreal Protocol on Substances that Deplete the Ozone Layer”, signed in 1987. Scientist’s are concerned that continued global warming will accelerate ozone destruction and increase stratospheric ozone depletion. Ozone depletion gets worse when the stratosphere (where the ozone layer is), becomes colder. Because global warming traps heat in the troposphere, less heat reaches the stratosphere which will make it colder. Greenhouse gases act like a blanket for the troposphere and make the stratosphere colder. In other words, global warming can make ozone depletion much worse right when it is supposed to begin its recovery during the next century.

Maintain programs to ensure that ozone-depleting substances are not released and ongoing vigilance is required to this effect. In fact, global warming, acid rain, ozone layer depletion, and ground-level ozone pollution all pose a serious threat to the quality of life on Earth. They are separate problems, but, as has been seen, there are links between each. The use of CFCs not only destroys the ozone layer but also leads to global warming. Power stations can cause global warming, ozone layer depletion and acid rain: their CO_2 emissions cause global warming; while their SO_2 emissions are either converted into sulphuric acid, which causes acid rain, or become sulphate aerosols, which deplete the ozone layer. Measures to reduce SO_2 emissions from power stations tend, for a given power output, to increase their CO_2 emissions. The situation is complex; but some things are clear. By reducing our dependence on fossil fuels we help prevent both acid rain and global warming. With appropriate reforestation we can help reduce the effects of acid rain, while at the same time increasing the uptake of CO_2 from the atmosphere. Regarding ozone layer depletion, the answer is simple: stop the manufacture and use of CFC’s and HCFC’s, a measure which, fortunately, most governments are taking steps to ensure.

Source : http://saferenvironment.wordpress.com/2008/12/03/ozone-layer-%E2%80%93-effective-checking-of-its-thinning-would-reduce-global-warming-and-enhance-standard-of-environment/