Good essay on ozone layer depletion

Environment, Earth

Abstract

Ozone layer depletion is a phenomenon in which ozone layer in the stratosphere thins out making it possible for the direct penetration of UV rays into the Earth's surface. This can lead to an array of harmful effects on human health, plants, and animals and can even trigger climate change. Chlorofluorocarbons are recognized as the primary cause accounting for 80% of ozone depletion. Though a lot of steps have been taken around the world to reduce ozone depletion, it may take about few decades more to completely heal the ozone layer due to the long standing stability of CFCs in the stratosphere. This paper has mainly highlighted the causes and effects of ozone depletion, the possible solutions to reduce the phenomenon and varying opinions whether or not ozone depletion is possible.

Introduction

Ozone layer depletion refers to the thinning out or reduction of the ozone in the stratosphere. Ozone, which is a colorless gas comprised of three atoms of oxygen (O3), has its presence in the stratosphere. The Earth's atmosphere consists of a set of layers. At 10-50 kms above from the surface of the Earth, the stratosphere is the second layer the lowermost region of which contains ozone gas. Ozone gas is also found in the lowest region of the atmosphere called the troposphere. However, ozone gas found in the surface level of the Earth derives from a chemical reaction between nitrogen oxides, volatile organic compounds and sunlight(Sivasakthivel and Reddy 2011). This ground level ozone is actually a pollutant, harmful for human health. Though ozone gas, both in the troposphere and stratosphere, consists of the same

molecules, its presence in different atmospheric level leads to different consequences. The ozone layer in the stratosphere gives protection to the Earth and all the animals and humans living in it by absorbingabout 93-99% of the harmful UV radiation of the sun(Sivasakthivel and Reddy 2011). This paper will discuss the causes and effects of ozone depletion, the possible solutions and varying opinions whether or not ozone depletion is possible.

Causes of Ozone Layer Depletion

Chlorofluorocarbons (CFCs) are recognized as the primary cause of ozone depletion. Though natural causes may contribute to temporary ozone loss, it is the man-made CFCs that are considered to be the main reason of ozone holes. CFCs are non-flammable, non-toxic, and non-carcinogenic compounds (Sivasakthivel and Reddy 2011). CFCs are used usually in refrigeration, solvents, foam, aerosol spray cans and air-conditioners. CFCs can live in the atmosphere for up to 20-100 years. They don't fall back into the Earth as rain or get destroyed by reacting with other chemicals. Resultantly, due to CFCs being heavier than air, they travel into the stratosphere by wind over a period of 2-5 years(eSchool Today 2010). The harmful UV ray of the sun breaks apart the CFCs leading to the release of chlorine atoms. Chlorine atoms break down the molecules of ozone layer creating holes. Thus one chlorine atom can wreak havoc in the ozone by breaking apart over 100, 000 ozone molecules, causing gradual ozone depletion. Besides CFCs, there are other harmful compounds like methyl chloroform used in manufacturing industrial solvents, methyl bromide used in pesticides and halons used in fire extinguishers(eSchool Today 2010). All these are ozone depleting substances attack the ozone layer in a similar manner as CFCs by releasing either

chlorine or bromine atoms. However, among all the ozone depleting substances, the contribution of CFCs accounts for 80% of all the ozone depletion in the stratosphere (Coffey 2010).

Effects of Ozone Depletion

The ozone layer protects the living organisms of the Earth from the harmful effect of UV rays. Depletion of ozone layer means that direct UV radiation would penetrate the atmosphere affecting humans, plants and marine ecosystems unpredictably, which in chain reaction, might bring about a drastic ecological change. Below are discussed some of the harmful effects of ozone depletion.

Effects on Plants and Human Health

An increased amount of UV exposure may cause an array of problems in humans including cataracts, skin cancer, damage of the immune system, damage to DNA, sunburn, premature aging, photosensitivity, and other infectious diseases(CMU). UV radiation is also very bad for animals as it may damage their immune system, cause skin cancer and other problems.

Effect on Aquatic Ecosystem

Humans receive 30% of the animal protein from different sea animals. However, high rate of UV radiation can totally mess the productivity of aquatic systems by interfering with the photosynthesis process (CMU). High level of UV radiation may also ruin the harmonious distribution of phytoplanktons that forms the cornerstone of aquatic food webs. The UV radiation may also damage the DNA of several aquatic animals like fish, crab, shrimp and amphibians affecting their reproductive system and larval

development(Sivasakthivel and Reddy 2011). Increased UV radiation also results in the reduction of bacterioplankton which are bacteria found in the upper ocean. They play a significant role in aquatic system by absorbing dissolved carbon and sending it back into the environment(CMU). They also are primary producers of long food webs.

Effect on Plants

The increased rate of UV radiation may mutate the cells of plants affecting their form and growth structure. It also can damage the photosynthesis process of plants. Over the last few decades, different experiments have shown lower yields of food crops like soy beans, rice and sorghum (Mpoloka 2008).

Climate Change

Though there is no direct impact of ozone layer depletion on global warming and climate changes, there are some indirect connections between the two phenomena. Ozone is actually agreenhouse gas. When CFCs react with ozone in the stratosphere, then ozone breaks into normal oxygen molecule. Normal oxygen is not a greenhouse gas. So after the ozone depletion, the stratosphere cools down. Stratospheric cooling leads to the formation of PSCs or polar stratospheric clouds which create ozone holes over Antarctica (Fergusson 2001). On the other hand, due to the increased presence of CFCs and carbon di-oxide in the atmosphere, the amount of ozone in the troposphere has increased causing the troposphere temperature to go up. According to some scientists, this cycle in long run can increase the

greenhouse gas on the earth surface contributing to climate change (Sivasakthivel and Reddy 2011).

Steps Taken to Phase out Ozone Depletion

Montreal Protocol

It was in the early 1980s that scientists through different satellite and ground-based measurements began to realize the thinning out of the ozone layer. The most affected region by the creation of ozone hole was Antarctica. Scientists also discovered that 80% of the ozone depletion was caused by the human made ozone depleting substances like CFCs. Upon the realization of the gravity of the situation, the scientific community sought immediate remedial actions in an international convention in Vienna in 1985(Sivasakthivel and Reddy 2011). This led to the creation of an international treaty in 1987 known as Montreal Protocol. Ratified by 197 countries, Montreal Protocol focused on the phase-down of the use of ozone depleting substances like CFCs, methyl chloroform, halons and the like. Montreal Protocol was a landmark event as it triggered an environmental movement on an international level. For the first time it was decided that all the participating countries were legally liable to reduce the use of CFCs and other ODSs. Any country failing to comply with the agreement would receive penalty(CIESIN). All the countries agreed that they would try to stop using CFCs and other harmful ozone depleting compounds within a given schedule. However, some relaxation of the rule was applied to developing countries which didn't have monetary arrangement as well as technological advancement to replace CFCs by bringing in new technologies (Sivasakthivel and Reddy 2011).

The Clean Air Act and EPA

In USA, EPA or Environmental Protection Agency is responsible for enforcing the Montreal Protocol. The Clean Air Act of 1990 made it mandatory for EPA to design a program for the phase-out of the production and the use of ODS. The Clean Air Act also encourages the production of ozone-friendly substitutes for ODSs. USA has stopped its production of harmful chemicals like CFCS, methyl chloroform and halons by 1996 (EPA 2012). However, ODSs are quite stable and live in the atmosphere for up 20-100 years. Therefore, it will take about few decades more to have the stratospheric ozone layer healed.

The Australian CFC Management Strategy

Like EPA, the Australian CFC Management Strategy provides a framework for the responsible management and use of CFCs in Australia. Though ACMS has almost phased out the majority of the CFC production by introducing less harmful ODSs, some pharmaceutical labs still need to use CFCs in their experiments, but Australia plans to phase out the production of CFCs in its entirety gradually(Sivasakthivel and Reddy 2011).

Individual Efforts

Besides the policies and agencies trying to prevent ozone depletion, some individual efforts should be taken by every responsible citizen of the world because ozone layer depletion is a global phenomenon that can affect each and every one of us. Instead of polluting the air through vehicular emissions which create smog contributing to ozone deterioration, we must take public transport or use bicycle for regular commute (Green Diary 2014). We also

should try walking to cover short distance. Furthermore, we must make sure to use eco-friendly and ozone friendly cleaning products that are free of any harmful chemical hazardous to ozone layer. We must also depend less on pesticides and more on natural resources.

Ozone Layer Depletion and the Balancing Act

There are two differing views on whether the ozone layer can be depleted or not. It is a well-known fact that with the increase in CFCs ozone layer depletes. Most of the scientists believe that even a moderate level of CFCs in the air can completely deplete the ozone layer. However, many other scientists believe that ozone layer has its own balance and cannot be easily depleted. They are of the view that when ozone layer is depleted then more and more UV rays reach the earth surface and also troposphere heats up. As the temperature of troposphere goes up less and less, CFCs reach ozone layer as they react more easily with other molecules at troposphere(Fergusson 2001). As less CFCs reach ozone layer, the depletion rate of ozone layer reduces and in fact starts to produce some more ozone. This process keeps the balance of ozone layer.

Conclusion

Ozone layer depletion refers to reduction of the ozone in the stratosphere. Chlorofluorocarbons (CFCs) recognized as the primary cause of ozone depletion contributes to 80% of ozone depletion. Ozone layer depletion triggers an array of harmful effects for human health like skin cancer, sunburn, premature aging and cataract. High level of UV radiation can totally ruin the productivity of aquatic systems by interfering with the

photosynthesis process and cause the reduction of bacterioplankton. Internationally, the Montreal Protocol was the first step taken towards the reduction of ozone depletion by legally binding the participating countries to reduce and stop the production of CFCs and other chemicals harmful to ozone. In USA, EPA makes sure design programs for the phase-out of the production and the use of ODS. Australia also tries to reduce CFCs production by introducing the Australian CFC Management Strategy. Though there are some varying opinions among scientists whether or not ozone depletion is possible, most of the scientific researches show that ozone layer depletion is a phenomenon mainly caused by man-made instruments. Therefore, concerns and cooperation should be shown by all the countries to mitigate this phenomenon.

Works Cited

Sivasakthivel, T. and Reddy, K. K. Siva Kumar. 2011Ozone Layer Depletion and Its Effects: A Review. International Journal of Environmental Science and Development, Vol. 2, 2010-0264. Viewed on 13th February 2014

ORACLE Think Quest. Ozone Depletion. Viewed on 13th February 2014

eSchool Today. 2010. What is Ozone Depletion?. Viewed on 13th February 2014

Coffey, Jerry. 2010. Causes Of Ozone Depletion. Universe Today. Viewed on 13th February 2014

Central Michigan University (CMU). Effects of Ozone Depletion. Environmental Science in Today’s World. Viewed on 13th February 2014

Mpoloka, S. W. 2008. Effects of prolonged UV-B exposure in plants. Department of Biological Sciences. University of Botswana. African Journal of

Biotechnology Vol. 7 (25), 4874-4883, Viewed on 13th February 2014

Center for International Earth Science Information Network (CIESIN). The Montreal Protocol on Substances That Deplete the Ozone Layer. CIESIN Thematic Guides. Viewed on 13th February 2014

Fergusson, Angus. 2001. Ozone Depletion and Climate Change: Understanding the Linkages. Meteorological Service of Canada. Viewed on 13th February 2014

EPA. 2012. Protecting the Stratospheric Ozone Layer. Viewed on 13th February 2014

Green Diary. 2014. 5 Ways to prevent ozone depletion. Viewed on 13th February 2014