Effect of ozone layer depletion on health and environment

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Abstract

The ozone layer acts as a natural filter, absorbing most of the sun's burning ultraviolet rays. Stratospheric ozone depletion leads to an increase in ultraviolet radiations that reach the earth's surface, where it can disrupt biological processes and damage a number of materials. The health impacts of excessive exposure to UV-B go beyond just getting burned. Exposure to UV radiation has been linked to many human health problems, including skin cancer. Scientists also indicate that increased exposure to UV-B rays affects the human immune system and causes premature aging of the skin. It is important to note, however, that UV-B radiation has always had these effects on humans. An increase in the levels of UV-B reaching the Earth as a result of ozone depletion may compound the effects that sun worshipping habits have already created. The depletion in ozone layer affects skin, eyes, immune system, environment and overall health also.

Introduction

The ozone layer or ozone shield is a region of Earth's stratosphere that absorbs most of the Sun's ultraviolet radiation. It contains a high concentration of ozone (O_3) in relation to other parts of the atmosphere, although still small in relation to other gases in the stratosphere. The ozone layer contains less than 10 parts per million of ozone, while the average ozone concentration in Earth's atmosphere as a whole is about 0.3 parts per million. The ozone layer is mainly found in the lower portion of the stratosphere, from approximately 15 to 35 kilometers (9 to 22 mi) above Earth, although its thickness varies seasonally and geographically (Matsumi and Kawasaki, 2003). Ultraviolet (UV) radiation is divided into three categories of increasing energy: UV-A, UV-B and UV-C. UV-A is a low energy form of UV and has only minimal biological effects. UV-B, a higher energy form, causes the most damage to living organisms and materials. UV-C is absorbed by the oxygen in the atmosphere and never reaches us. Ozone layer depletion is a major concern and is associated with a number of factors. The main causes responsible for the depletion of the ozone layer are chlorofluorocarbons, unregulated rocket launches, nitrogenous compounds and natural causes.

Review of Literature

Ozone is a stratospheric layer that plays important role in providing support to humans for their survival. It is an essential factor for many global, biological and environmental phenomena. There are many situations where human activities have significant effects on the environment. Ozone layer damage is one of them. The objective of this paper is to review the origin, causes, mechanisms and bio effects of ozone layer depletion as well as the protective measures of this vanishing layer. The chlorofluorocarbon and the halons are potent ozone depletors. One of the main reasons for the widespread concern about depletion of the ozone layer is the anticipated increase in the amounts of ultraviolet radiation received at the surface of the earth and the effect of this on human health and on the environment. The prospects of ozone recovery remain uncertain. However, the future behavior of ozone will also be affected by the changing atmospheric abundances of methane, nitrous oxide, water vapor, sulphate aerosol, and changing climate. The current situation of ozone depiction demands urgent remedial measures to protect lives on this earth (Lee *et al.*, 1999).

The causes, mechanism and bio-effects of ozone layer depletion on humans were addressed. It is revealed that introduction of Chloroflourocarbons (CFCs) in the environment is the most rated cause of said depiction. Ozone depletion is allowing the UV radiation to earth surface. The exposure to these radiations is severely affecting all life forms on earth, especially the humans and plants. Permanent or temporary blindness, skin cancer and immunity suppression are the main effects of these radiations reported by various researchers on humans. The prospects of

ozone recovery are still undiscovered. The current situation of ozone depiction demands urgent remedial measures to protect lives on this earth (Anwar *et al*., 2016).

Ozone depletion occurs when the natural balance between the production and destruction of stratospheric ozone is disturbed. Although natural phenomenon can cause ozone depletion but human activities such as CFCs are now accepted as major cause of depletion. All ozone depleting chemicals contain chlorine and bromine. CFCs are highly volatile and non combustible so they are very quickly evaporated and can easily reach in stratosphere where ozone is present here they start depleting ozone molecules. These CFCs have also adverse affects on human health. According to the chemical model for ozone destruction proposed about 20 years ago, the photolysis of Cl_2O_2 is key to ozone depletion reaction. But now atmospheric researchers studied that the rate of this reaction is not extremely high as it was thought previously so we can no longer say that CFCs are the main cause of ozone depletion (Angell and Korshover, 2005).

Results and Discussion

The depletion of ozone layer affects the human health and environment in one way or other. Exposure to solar UVB radiation has been shown to affect both orientation and motility in phytoplankton, resulting in reduced survival rates for the organisms. Scientists have demonstrated a direct reduction in phytoplankton production due to ozone depletion-related increases in UVB. UVB radiation has been found to cause damage to early developmental stages of fish, shrimp, crab, amphibians, and other marine animals. The most severe effects are decreased reproductive capacity and impaired larval development. Small increases in UVB exposure could result in population reductions for small marine organisms with implications for the whole marine food chain.

Increases in UVB radiation could affect terrestrial and aquatic biogeochemical cycles, thus altering both sources and sinks of greenhouse and chemically important trace gases (e.g., carbon dioxide, carbon monoxide, carbonyl sulfide, ozone, and possibly other gases). These potential changes would contribute to biosphere-atmosphere feedbacks that mitigate or amplify the atmospheric concentrations of these gases.

Atmospheric ozone has two effects on the temperature balance of the Earth. It absorbs solar ultraviolet radiation, which heats the stratosphere. It also absorbs infrared radiation emitted by the Earth's surface, effectively trapping heat in the troposphere. Therefore, the climate impact of changes in ozone concentrations varies with the altitude at which these ozone changes occur. The major ozone losses that have been observed in the lower stratosphere due to the human-produced chlorine and bromine-containing gases have a cooling effect on the Earth's surface. On the other hand, the ozone increases that are estimated to have occurred in the troposphere because of surface-pollution gases have a warming effect on the Earth's surface, thereby contributing to the "greenhouse" effect.

In comparison to the effects of changes in other atmospheric gases, the effects of both of these ozone changes are difficult to calculate accurately. Carbon dioxide concentrations are increasing in the atmosphere primarily as the result of the burning of coal, oil, and natural gas for energy and transportation. The atmospheric abundance of carbon dioxide is currently about 30% above what it was 150 years ago. The relative impacts on climate of various other "greenhouse" gases are also shown on the figure.

There is an additional factor that indirectly links ozone depletion to climate change; namely, many of the same gases that are causing ozone depletion are also contributing to climate change. These gases, such as the chlorofluorocarbons, are greenhouse gases, absorbing some of the infrared radiation emitted by the Earth's surface, thereby effectively heating the Earth's surface.

Conversely, changes in the climate of the Earth could affect the behavior of the ozone layer, because ozone is influenced by changes in the meteorological conditions and by changes in the atmospheric composition that could result from climate change. The major issue is that the stratosphere will most probably cool in response to climate change, therefore preserving over a longer time period the conditions that promote chlorine-caused ozone depletion in the lower stratosphere, particularly in polar regions.

Small amounts of UV are beneficial for people and essential in the production of Vitamin D. UV radiation is also used to treat several diseases, including rickets, psoriasis, eczema and jaundice. This takes place under medical supervision and the benefits of treatment tend to outweigh the risks of UV radiation exposure. Overexposure to solar radiation may result in acute and chronic health effects on the skin, eye and immune system. Many believe that only

fair-skinned people need to be concerned about over exposure to the sun. Darker skin has more protective melanin pigment, and the incidence of skin cancer is lower in dark-skinned people. Nevertheless skin cancers do occur with this group and unfortunately they are often detected at a later, more dangerous stage.

The risk of UV-related health effects on the eye and immune system is independent of skin type. Eyes - adverse effects on the eye - increasing frequency of acute reactions such as 'snow blindness', increasing cataract frequency and severity,, incidence and mortality from ocular melanoma and squamous cell carcinoma of the eye. The depressed resistance to certain tumors and infectious diseases, potential impairment of vaccination responses, increased severity of some autoimmune and allergic responses. Also may be some beneficial responses such as decreasing severity of certain immunologic diseases/conditions such as psoriasis and nickel allergy.

UVB radiation affects the physiological and developmental processes of plants. Despite mechanisms to reduce or repair these effects and an ability to adapt to increased levels of UVB, plant growth can be directly affected by UVB radiation.

Indirect changes caused by UVB (such as changes in plant form, how nutrients are distributed within the plant, timing of developmental phases and secondary metabolism) may be equally or sometimes more important than damaging effects of UVB. These changes can have important implications for plant competitive balance, herbivory, plant diseases, and biogeochemical cycles.

Ozone is mostly produced photochemically from anthropogenic precursor gases such as Volatile Organic Compounds and Nitrogen Oxides which are emitted by vehicles. Ozone can cause considerable harm to both human and ecosystem health. The phytotoxicity of ozone has been shown to damage photosynthesis, reduce gas exchange, induce early leaf senescence, and retard growth in both natural vegetation and crops. As plants play vital roles in regulating the ambient environment, ozone-induced damage in plants may further accelerate environmental degradation, with severe consequences for human health (Andrady *et al*., 2017).

Conclusion

It can be concluded that depletion of ozone layer affects almost the parts of the ecosystem. Proper care should be taken care of to reduce the environmental pollution to protect the ozone layer. It absorbs most of the sun's ultraviolet radiation, limiting the amount of this radiation that reaches the surface of the Earth. Because this radiation causes skin cancer and cataracts, the ozone layer plays an important role in protecting the animals, plants and overall environment.

References

1. Andrady, A. Aucamp, P.J., Austin, A.T., Bais, A.F. and Zepp, R.G. (2017): Environmental effects of ozone depletion and its interactions with climate change: Progress report, 2016. Photochem. Photobiol. Sci.; 16(2): 107–145.
2. Angell, J.K. and Korshover, J. (2005): Quasi-Biennial and Long-Term Fluctuations in Total Ozone. Monthly Weather Review, 101, 426-43.
3. Anwar, F., Chaudhry, F.N., Nazeer, S., Zaman, N. and Azam, S. (2016): Causes of ozone Layer Depletion and Its Effects on Human: Review. Atmospheric and Climate Sciences. 6 (1): 129-134.
4. Lee, K.W., Meyer, N. and Ortgwerth, B.J. (1999): Chromatographic Comparison of the UVA Sensitizers Present in Brunescent Cataracts and in Calf Lens Proteins Ascorbylated in Vitro. Experimental Eye Research, 69, 375- 384.
5. Matsumi, Y. and Kawasaki, M. (2003) : Photolysis of atmospheric ozone in the ultraviolet region. Chem. Rev. 103 (12): 4767-4781.