Role of Ozone Hole on Life on Earth and Countermeasures

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Abstract. The purpose of this paper is to investigate the protection of the ozone layer and the extensive effects of the hole diffusion on the life on Earth. First, the ozone layer is a layer in the atmosphere that absorbs ultraviolet radiation from the sun and protects life on earth from ultraviolet damage. UV radiation is destructive to living organisms and can cause health problems such as skin cancer, eye damage and even genetic mutations. Therefore, the existence and health of the ozone layer is directly related to the survival and health of organisms on Earth. Next, we will study the formation and diffusion of the ozone hole. The hole in the ozone layer is caused by the destruction of the ozone layer caused by human activities such as the release of chemicals such as chlorofluorocarbons (CFCS). When these destructive factors enter the atmosphere and are irradiated by ultraviolet light, they break down into active free radicals, which destroy ozone molecules. Over time, these destructive factors accumulate in the atmosphere, causing the ozone layer to gradually thin and eventually form the ozone hole. Finally, we will discuss in detail the effects of these ozone holes on life on Earth. The existence of the ozone hole allows ultraviolet radiation to reach the Earth's surface, posing a direct threat to living organisms. Studies have shown that UV radiation can cause problems such as stunted plant growth, death of Marine life, and skin damage to animals. In addition, ultraviolet light can accelerate the Earth's climate change, causing more extreme weather events, such as floods, droughts and storms, which will have a broader and far-reaching impact on Earth's life. Through the discussion in this paper, we can clearly understand the impact of the ozone hole diffusion on the earth's organisms. In order to protect our home and biodiversity, we must take active measures to reduce the damage of human activities to the atmosphere in order to maintain a healthy and stable ozone layer. This requires our global efforts to take scientific and effective measures to solve this problem. Only in this way can we ensure that life on Earth can continue to live healthy and safe on the blue planet.

Keywords: Ozone layer; Ozone hole; Diffusion; Ecosystem; Impact.

1. Introduction

The spread of the ozone hole poses a great threat to the earth's ecosystem. The outbreak of these hazards makes this problem come into people's view and even be regarded as a crisis. Among them, the diffusion of the void has the greatest impact on the Earth's biosphere. It's not just animals, its plants, its microbes, it's places we can't see. These hazards will bring us no small trouble and pain in our daily life. As man-made pollution continues to exacerbate climate change, there are growing problems. There is very limited understanding of the spread of the ozone hole and how rapid and unpredictable climate pollution can be. Therefore, it is essential to raise awareness, conduct damage control, address existing problems and prevent potential problems [1].

There are a variety of studies on the harm of the ozone hole to the earth's organisms, which have made contributions to the earth's environment, and have reviewed this topic and given a good explanation. However, there is still much missing information from the diffusion of the ozone hole for further analysis and improvement measures. On the basis of the previous studies of many scholars, the research results are classified according to the causes, effects and improvements, aiming at collecting the latest information and summarizing the status quo of the harm of ozone hole diffusion to the earth's ecology.

The ozone hole is the main focus of this review. This paper discusses climate change from the causes, effects and solutions of ozone hole diffusion. Firstly, the causes of the destruction of the ozone layer, such as the emission of fluorine chloride, are introduced. Both natural and human factors are

crucial to the outcome of cavity repair. Then the effects of ozone hole diffusion on the environment, animals, plants and microorganisms are discussed. Finally, it lists possible solutions, hoping to provide people with better ideas and inspiration.

2. Causes of Ozone Hole Spreading

In recent years, the ozone hole diffusion, as the most urgent environmental problem in the world, has attracted the attention of most countries in the world. In the 1980s, British scientists represented by Farmen creatively raised the issue of the ozone hole over Antarctica. Decades of observation data from the Halley Bay Observatory in Antarctica show that since 1957, the ozone over Antarctica has begun to appear large-scale depletion, after decades of depletion, the concentration of the ozone layer over Antarctica has been extremely thin, and the ozone content has been far lower than the surrounding area, forming a "hole" with a diameter of thousands of kilometers [2]. There are many factors that destroy the ozone layer, and the types of these factors are increasing rather than decreasing, so the trend of ozone depletion over the Antarctic is still worsening, and I will describe these destructive factors in this paragraph.

2.1. Destruction of Ozone by Chlorofluorocarbons

There are many factors that destroy the ozone layer, the most important of which is the chlorofluorocarbon complex (CFCS), which replaces hydrogen atoms in alkanes with fluorine or chlorine to produce compounds with fluorine, chlorine and carbon. Its chemical properties are very stable, it is not easy to be broken down, and it is widely used in spray propellants and blowing agents. Not only is it responsible for destroying the ozone layer, but it also traps heat and causes temperatures to rise. Any one chlorine atom in CFCS can destroy about 100,000 ozone molecules [3].

2.1.1 Industrial Production

The destruction of ozone layer by industrial production is mainly caused by halogenated hydrocarbons. These substances are mainly derived from fluorine, chlorine, bromine, iodine and other carbon compounds produced and used in the industrial field. When these substances are released and enter the stratosphere, they are exposed to ultraviolet light, either through catalytic cycles between nitric oxide and nitrogen dioxide, or through the breakdown of halogen free radicals, which have a rapid chain reaction with ozone.

2.1.2 Domestic Emission

The ozone layer damage caused by daily life mainly comes from the emission of human activities, especially the emission of nitrogen oxides and halogens. These pollutants will decompose halogen free radicals under photolysis and catalysis, and carry out a rapid chain reaction with ozone, resulting in a decrease in the total amount of ozone. In addition, the production of NO catalyzed by the high temperature in the aircraft engine and the NO produced by the photolysis of nitrous oxide emitted by the denitrification process accelerated by the application of nitrogen fertilizer in agriculture are also one of the factors of ozone layer destruction. At the same time, substances such as chlorofluorocarbons (CFCs) in refrigerants have a damaging effect on the ozone layer. These substances are exposed to ultraviolet light in the stratosphere, releasing chlorine free radicals that catalyze the decomposition of ozone. According to statistics, since 1985, the global ozone layer hole with an area of nearly 10 million km^2 will appear from September to November every year, and this phenomenon has a trend of expansion and growth year by year. In addition, because halogenated hydrocarbons are mainly derived from fluorine, chlorine, bromine, iodine and other carbon compounds produced and used in the industrial field, industrial production is also one of the important factors leading to the destruction of the ozone layer [4, 5].

In order to protect the ozone layer, countries signed the Montreal Convention, which requires phasing out the use of chemicals that harm the ozone layer, such as chlorofluorocarbons (CFCs, HCFCs), bromomethane (CH_3Br), and carbon tetrachloride (CCl_4). However, despite strict

compliance by countries and regions with the Montreal Treaty, the ozone hole has shown an overall increase in the thickness and breadth of the polar ozone layer, new ozone-depleting substances have been discovered, and the threat to the ozone layer has not diminished. Therefore, the protection situation of the ozone layer is still serious and needs to be implemented for a long time.

2.2. Destruction of Ozone by Nitrogen Oxides

Generally, the ozone hole refers to the phenomenon of the reduction of the stratospheric ozone layer caused by the emission of air pollutants from human sources, especially the emission, photolysis and catalysis of pollutants such as nitrogen oxides and halogenated hydrocarbons. The main sources of nitrogen oxides are: (i) the production of NO catalyzed by high temperature in aircraft engines; (ii) Nitrogen fertilizer applied in agriculture accelerates the photolysis of nitrous oxide emitted by denitrification process II. Halogenated hydrocarbons are mainly derived from fluorine, chlorine, bromine, iodine and other carbonization produced and used in the industrial field. It's a combination. When these substances are released and enter the stratosphere, they are exposed to ultraviolet light, either through catalytic cycles between nitric oxide and nitrogen dioxide, or through the breakdown of halogen free radicals, which have a rapid chain reaction with ozone [6].

Nitrogen oxides are also one of the important factors in the destruction of the ozone layer, nitrogen oxides (NO_x) damage to the ozone layer is mainly caused by the reaction with ozone to consume ozone, breaking the balance of the ozone layer. Ozone in the atmosphere can react with many substances to be consumed and destroyed. NO_x can react with ozone in the ozone layer and consume a large amount of ozone. NO_x then reacts with ozone in the stratosphere to produce nitric oxide and oxygen, and nitric oxide and ozone further react to produce nitrogen dioxide and oxygen, thereby breaking the ozone balance, reducing the ozone concentration and leading to the depletion of the ozone layer [6].

2.3. Destruction of Ozone by Free Radicals

In the stratosphere, highly oxidizing free radicals are the main substances that destroy the ozone layer. Free radical molecule or atom plays an important catalytic role in the molecular decomposition of ozone in the stratosphere, Y participates in the ring reaction end to end, and the reactant Y that begins to be consumed is formed in the subsequent reaction. This results in a drop in ozone concentration [6].

3. Harm to Living Things

The Earth's ecosystem and its environment are seriously affected by the diffusion of the ozone hole. Due to human factors, the Earth's ecosphere is undergoing unprecedented changes, putting unprecedented pressure on the Earth's ecosphere at all levels. It not only brings disease and pain to the earth's organisms, but also has a certain impact on the human society and economy. In this section, we will discuss the effects of the diffusion of the ozone hole on the Earth's biosphere from the aspects of animals, plants and plankton.

3.1. Zoon

Human living environment can not be separated from ultraviolet light, the right amount of ultraviolet light has a positive effect on the environment, but long-term exposure to excessive ultraviolet radiation will cause DNA mutations in the cell, increasing the chance of serious disease. Animal experiments have shown that excessive ultraviolet radiation can reduce people's immune response to skin diseases, such as the increase of ultraviolet UV-B segment can increase people's risk of skin diseases, especially in children, and can lead to skin cancer in severe cases; Excessive exposure to UV rays can also affect the lens and cornea, resulting in blurred eyes; When it radiates around the eye, it will cause changes in the cells of the retina, which can cause eye tingling and tears, and can cause permanent corneal damage in severe cases. A 1% reduction in the ozone layer in the

stratosphere would increase the number of cataracts on Earth by about 8%, resulting in 10,000 people going blind. Excessive exposure to ultraviolet rays can also increase the risk of skin cancer, measles, chickenpox, herpes and other diseases. The excessive radiation of ultraviolet rays also has a great impact on aquatic life, American oceanographer Zeng Jing pointed out that "the ozone layer over the Antarctic continent has begun to thin, resulting in ultraviolet rays directly through the ozone layer into the ocean, causing a serious impact on aquatic life." Ultraviolet radiation will lead to the development of aquatic organisms is not sound, fecundity decline, on the Marine biological chain, ecological balance and water self-purification force has a great impact [5].

3.2. Plant

Life on Earth reacts strongly to ultraviolet light at wavelengths of 280-320 nanometers, and scientists have tested the sensitivity of 200 different plants, nearly two-thirds of which are affected, such as cotton, beans, melons, and some vegetables that have effects on hormones and chlorophyll, all showing slow growth [7]. Because ultraviolet light will make the leaves of the plant smaller, thus reducing the area of capture photosynthesis, so that the production rate is reduced [8].

3.3. Plankton

Phytoplankton is the base of the food chain in Meiyang ecosystem. Preliminary studies of phytoplankton have shown that UV-B radiation can reduce the intensity of photosynthesis. Experiments off the coast of Africa have shown that photosynthesis by phytoplankton can reduce frost in the presence of increased UV-B radiation. Enhanced UV-B radiation levels can also alter freshwater ecosystems by killing microorganisms, thereby reducing the natural purification efficiency of water bodies. UV-b radiation can harm fish, shrimp, and crabs in their larval stage, and results show that when stratospheric ozone is reduced by 9%, the number of eel larvae is reduced by about 8% [9]. At the same time, due to the destruction of the ozone layer by halomethanes and other greenhouse gases, the global temperature is rising, and as one of the regions in the world with the most drastic increase - Antarctica, the growth of the Antarctic tundra has a huge impact on the animals and Marine life in the Antarctic region [10].

4. Measures

With the progress and development of human science and technology, we are gradually discovering the impact of our activities on the earth's environment. Among them, the ozone hole has become a worldwide environmental problem.

With the continuous progress and development of human science and technology, we gradually realize the profound impact of our own activities on the earth's environment. In this process, the phenomenon of the ozone layer hole has aroused widespread concern around the world, and has become a worldwide environmental problem.

The ozone layer is an area in the atmosphere with a high concentration of ozone, which can absorb the sun's ultraviolet radiation and protect Earth's organisms from ultraviolet damage. However, due to the large use of chemicals such as refrigerants and solvents, these substances will gradually thin the ozone layer after being released into the atmosphere, forming the ozone layer hole.

The formation of the ozone hole not only has a serious impact on the Earth's ecosystem, but also poses a potential threat to human health. Increased UV radiation can lead to an increased risk of health problems such as skin cancer and cataracts, as well as negative impacts on ecosystems such as plant growth and aquatic life.

Therefore, we must take proactive measures to slow the expansion of the ozone hole and work to repair the already damaged ozone layer. This requires a global effort to develop and enforce effective environmental protection policies, reduce emissions of air pollutants, and strengthen regulation of chemical use. At the same time, the public also needs to raise environmental awareness, actively participate in environmental protection actions, and jointly protect the earth home.

4.1. Production and Life

Reducing the use of halogen-containing compounds such as freon: Since the 1980s, the mass production and use of halogen-containing compounds from industrial sources (such as freon, bromomethane, chloroform, etc.) has catalyzed the decomposition of the stratospheric ozone layer. Therefore, we need to reduce the use of these halogen-containing compounds to reduce the damage to the ozone layer.

4.2. Scientific Research

Promote scientific and technological innovation: Scientific and technological innovation is the key to solving environmental problems. We need to strengthen scientific and technological innovation to develop more environmentally friendly, efficient and safe technologies and products to replace traditional, environmentally harmful technologies and products.

4.3. Government Department

Raise public awareness: The public is an important force in environmental protection. We need to raise public awareness of environmental protection through publicity and education, and encourage the public to actively participate in environmental protection actions.

4.4. International Cooperation

Strengthening international cooperation: Global environmental problems require global cooperation to solve them. We need to strengthen international cooperation to jointly address global environmental issues and promote global sustainable development.

5. Conclusion

The ozone hole is a global environmental problem that requires the joint efforts of all countries in the world to solve. Although the Montreal Convention has achieved some success, we cannot ignore the emergence of new ozone-depleting substances. Therefore, we need to continue to strengthen scientific research and find new solutions to protect our Earth's environment. At the same time, it is also necessary to strengthen public education, so that more people understand the harm of the ozone layer hole and the importance of environmental protection, and work together to protect the earth's environment.

References

[1] Jian J.F., Low temperature and the polar vortex destruction of the arctic ozone layer [N]. China meteorological news, 2020, 003.

[2] Jiang H., Ozone and ozone depletion and its protective mechanism analysis [J]. Low carbon world, 2017 (3): 27-28.

[3] Wang S., Fu C., Research on influencing factors of ozone layer destruction and monitoring technology of environmental pollution. Environmental Science and Management, 2019, 46(03): 111-115. (in Chinese)

[4] Hu X., For the serious damage of the earth "poles" ozone layer exploration [J]. Journal of anhui agricultural sciences, 2015, (4): 263-265.

[5] Jiang L., The trend of environmental refrigerant replacement in refrigeration industry to cope with climate change [N]. Government procurement information, 2021, 016.

[6] Dai Qiuting. Assessment of global natural source emissions of bromine methane using box model [J]. Science and technology innovation herald, 2019 (33) : 119-121 + 123. DOI: 10.16660 / j.carol carroll nki. 1674-098 - x. 2019.33.119.

[7] Zhang H., Guang H., Impact of ozone layer destruction on environment and preventive measures [J]. Resources Conservation and Environmental Protection, 2020(05): 6-7.

[8] Ozone hole causes plant variation [J]. Science and Technology Communication, 2011(19): 209. (in Chinese)

[9] Qian Y., Xiao X., Atmospheric ozone layer destruction to the ecological impact [J]. Journal of environmental science, 1990, (02): 7-10.

[10] Zhang W.Y., Process and mechanism of source sink of halomethanes and carbonyl sulfur in Antarctic tundra [D]. University of science and technology of China, 2021.