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Review Article

OZONE DEPLETION: A CHALLENGING GLOBAL POLLUTION ISSUE

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Abstract: The detection of the ozone hole in the 1980s is considered one of the most important scientific discoveries of the past fifty years. Since then, it has been recognized as having a significant impact on the global atmospheric system, and in particular on Antarctic climate. It has recently been discovered that the Antarctic Polar Vortex, which forms during the polar winter as a result of ozone depletion, has played a major role in maintaining the stability of the East Antarctic Ice sheet over the last 50 years. Work is currently being undertaken to investigate the likely evolution of the Antarctic ozone hole in the future, in particular how a reduction in size might impact on Antarctic climate. It is possible that as the Antarctic Polar Vortex weakens the continent will no longer be shielded from the warming that has been occurring over the rest of the globe. As a result of this it is predicted that stratospheric temperatures could rise by up to 9° Celsius and that sea ice could decline by up to a third, if the size of the ozone hole is reduced to pre-1980 levels, as it is predicted to do by the end of the twenty-first century.

Key Words: Ozone hole, Polar vortex, Antarctic climate, Stratosphere, CFC.

Introduction

The first unmistakable sign of human-induced change in the global environment arrived in 1985 when a team of British scientists published findings that stunned the World Community of atmospheric chemists. Joseph Farman, reported in the scientific journal *Nature* that concentrations of Stratospheric Ozone above Antarctica plunged more than 40 per cent from 1960s baseline. Most scientists greeted the news with disbelief. But it was found correct after measuring with total Ozone mapping spectrometer fitted with Nimbus-7 satellite by NASA. Now the question is that–what processes were causing the hole? Would the thinning of the Ozone layer spread to other latitudes, or was it confined to the latitudes, or was it confined to the Antarctic. Basically it was found that industrially produced chemicals containing chlorine or bromine are damaging the earth's protective ozone layer and increasing the intensity of ultraviolet radiation at the earth's surface.

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Chemistry of the ozone layer

Oxygen molecules abundant throughout the atmosphere which constitute nearly 20 per cent are split into individual atoms (O+O) when energized by the radiation from the sun. These atoms are free to collide with other oxygen molecules to form ozone where three oxygen atoms are present. The particular configuration of the Ozone molecules allows them to absorb the sun's radiation in ultraviolet wave lengths that are totally harmful to life if they penetrate to the earth's surface.

Studying the Antarctic Ozone hole

Before the discovery of Ozone hole, scientists are of the opinion that increasing use of CFC might cause reduction in the total Ozone at higher altitudes. But when the Antarctic Ozone hole was first discovered, then scientists were able to measure a broad range of atmospheric compounds such as Chlorine monoxide, Chlorine dioxide, hydrochloric acid, nitric acid, nitric oxide, nitrogen dioxide and nitrous oxide which are also responsible for Ozone depletion. For most of the year, the atmosphere over Antarctica has fairly high Ozone concentration. The Ozone molecules are formed over the tropics and are delivered along with chlorine to the Antarctic region.

Ozone depletion in other latitudes

With Ozone levels over the South pole dropping up to 50 per cent or more for several months each year, Scientist are eager to know whether the same processes are operating to deplete Ozone over other latitudes. Measurements from satellites and ground-based stations reveal Ozone losses of about 5 to 10 per cent at northern high latitudes. This is much smaller than in the Antarctic for several reasons.

Effects on life

The Ozone layer is essential to life because it shields it from damaging ultraviolet radiations. Now, much less is known about the biological effects of increased ultraviolet radiations than about the chemical processes of Ozone depletion in the atmosphere. Researchers are trying to learn how humans, vegetation and aquatic eco-systems each may be affected by Ozone depletion. Scientists do know that direct exposure to ultraviolet radiations can damage the human immune system, cause cataracts, and increase the incidence of skin cancer. Not only animals, plants are also affected by the radiations. Soybean, bean, pea, squash, melon and cabbage are easily effected by the ultraviolet radiations include reduced leaf size, stunted growth, poor seed quality, and increased susceptibility to weeds, disease, and pests.

Nations joining to protect the Ozone layer

The strong scientific consensus that CFCs deplete the ozone layer prompted nations to come together. The Montreal Protocol negotiated in September 1987, calls for a 50 per cent reduction in CFC production by 1999. Forty-nine nations including Canada, US, Japan, and many nations in Europe which together consume 80 per cent of the chemicals joined and ratified the protocol. The Montreal protocol may prove to be a model for actions that span national boundaries and interests as the World is facing with green-house effect, global warming and global climate change.

A new global Ozone diplomacy

Perhaps the most poignant image of our time is that of earth as seen by the space voyagers; a blue sphere, shimmering with light and life, alone and unique in the cold vastness of the cosmos. From these perspectives, the maps of geopolitics vanish, and the underlying interconnectedness of all the components of this extraordinary living system-animal, plant, water, land and atmosphere-becomes strikingly evident.

Experimenting with planet earth

Humanity has learned that the activities of modern industrial economies driven by consumer demands can alter delicate natural balances. We can no longer pretend that nothing will happen as the planet is subjected to billions of tones of pollutants. The Antarctic Ozone hole conveyed a warning. A 1986 report by NASA observed that “we are conducting one giant experiment on a global scale by increasing the concentrations of trace gases in the atmosphere without knowing the environmental consequences”.

Dilemmas for policy-Striking a Balance

Because co-operation among sovereign states is essential for developing effective policies to address these issues, requirement of suitable and analogue method is essential in the realm of international relations. The negotiations of the Vienna convention and the Montreal protocol faced issues like climate change. Government policymakers face a dilemma in attempting to deal with these new environmental challenges. Balance in making policy between developed, underdeveloped and developing countries are also a challenging task.

Lessons for a new Diplomacy

The international community was successful in its approach to the problem of protecting the stratospheric Ozone layer. The experience gained from this process suggests several new kind of diplomacy outlined below.

1. Scientists must play an unaccustomed but critical role in international Environmental negotiations.
2. Governments may have to act while there is still scientific uncertainty, responsibly balancing the risks and costs of acting or not acting.
3. Educating and mobilizing public opinion are essential to generate pressure on hesitant governments and private companies.
4. Multilateral diplomacy, involving coordinated negotiations among many governments, is essential when the issues have planetary consequences.
5. Strong leadership by a major country can be a significant force for developing international consensus.
6. It may be desirable for a leading country or group of countries to take pre-emptive environmental protection measures in advance of a global agreement.
7. The private sector including citizen groups and industry is very much involved in the new diplomacy.
8. Economic and structural inequalities among countries must be adequately reflected in any international regulatory regime.
9. The effectiveness of a regulatory agreement is enhanced when it employs market incentives to stimulate technological innovation.
10. The signing of a treaty not necessarily the decisive event in a negotiation; the process before and after signing is critical.

Toward Action on Climate Change

It is seen that the overwhelming proportion of carbon emissions from fossil fuels and deforestation is concentrated in a relatively small number of industrialized and developing nations. Indeed, the major industrialized countries, which are primarily responsible for the world's current precarious ecological condition, could make a vital contribution by agreeing on pre-emptive actions even before a broader climate treaty is negotiated. The United States and Canada, the Soviet Union, the European Community, and Japan together account for about 60 per cent of carbon emissions from fossil fuels. By not delaying actions to increase energy efficiency and reduce carbon dioxide emissions, these countries could significantly slow the warming trend. Doing this would buy time for innovation in energy efficient technologies and renewable energy sources that could be shared with developing and Eastern European countries to add them in assuming their own responsibility.

Global Stewardship

Mustafa Tolba has described the Montreal Protocol as "the beginning of a new era of environmental statesmanship". The history of the Ozone treaty reflects a new reality: nations must work together in the face of global threats, because if some major actors do not participate, the efforts of others will be vitiated. For all of this the Montreal Protocol should prove to be a lasting model of international cooperation. It may thus be the forerunner of an evolving global diplomacy, through which nations accept common responsibility for stewardship of the planet.

Conclusion

Increasingly both science and policy are being driven by the recognition that the atmosphere cannot be seen as a collection of separate compartments in which different things happen in isolation. Instead, researchers and policy makers are adopting a more comprehensive view of the atmosphere, seeing it as a single dynamic whole whose state at any given time depends on a maze of interactions not only between its different parts and processes but also with those of other parts of the ecosphere. To take proper account of these interactions, atmospheric scientists are increasingly thinking outside the confines of their particular specialties and collaborating more closely with experts in other areas. The evolution of integrated approaches to ozone depletion and climate change – and to other atmospheric issues as well – is now enhancing our ability to understand and moderate the enormous changes that human activities have imposed on the earth's atmosphere over the past two centuries. Not only will these approaches help us deal more effectively with today's problems, but they will also give us a much better chance of anticipating and controlling any further human threats to the atmosphere that might occur in the future.

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