Ozone layer

Science, Astronomy

Introduction

What is Ozone?

The chemical formula for ozone is O_3. The molecule of ozone constitutes three atoms of oxygen. Ozone is an allotrope of oxygen and is less stable than the diatomic species O_2. Ozone is highly reactive form of oxygen. Ozone in the upper layer of the atmosphere protects the ultraviolet rays from reaching the earth surface on the other hand ozone in the lower layer of the earth surface causes respiratory problems in living organisms. About 90 percent of ozone is present in the stratosphere (15 to 50 km altitude). Ozone has two vital functions. First, it is responsible for filtering out large wavelength band of ultraviolet solar radiation, radiation which would be lethal to the creatures of the earth if it arrived, the earth surface in full intensity. Second, ozone warms the upper layer of the stratosphere, which is an important part of the mechanism of the weather phenomena of the earth atmosphere. The presence of ozone in the upper atmosphere was first recognized by Cornu in 1879 and Hartley in 1880.

Formation of ozone layer

The formation of ozone layer is photochemical mechanism. The ultraviolet rays strike the oxygen molecules splitting the oxygen molecule into two independent unstable atoms of oxygen. These unstable oxygen atoms in search of stability combine with the unbroken oxygen molecules to form less stable ozone. Since ozone is less stable, ultraviolet rays further split it yielding oxygen molecule and oxygen atom. This process forms a chain and gets repeated again and again. This is a never ending process. Ozone is a trace gas in the atmosphere. Even in the stratosphere where it is most concentrated, it forms only a few parts per million of the local atmospheric composition.

Discovery of ozone hole

The Antarctic ozone hole was discovered in 1985. A team of scientists from the British Antarctic survey reported a very larger seasonal fall in ozone values measured over their station at Halley Bay in Antarctica. Every year in September and October, ozone levels were falling significantly, by about 25 percent but sometimes by as much as 60 percent. The decline probably started around 1976. Data showed no significant changes during 1957 and 1975 but there were apparent changes from 1977 to1984. When scientists reported the Antarctic Ozone hole and, more importantly, that the impact of ozone depletion would include increased risk of cataract and skin cancer and of reduced body immunity, the public, especially in the north, became worried.

Depletion of ozone in the stratosphere

The debates point towards the oxides of nitrogen and water-vapor from the exhaust of high flying aircraft. This was followed by a widely published argument that inert chlorine containing compounds might significantly deplete stratospheric ozone. By 1985, the concerns about nitrogen oxides were largely laid to rest.

The Montreal Protocol to the 1985 Vienna Convention for the protection of Ozone layer, signed on September 16, 1987 is one of the small numbers of international environmental agreements that have had rapid and concrete impacts on the actions of the nations and other groups responsible for the quality ofenvironment.

While the 1985 Vienna Convention only urged States to adopt measures to reduce their consumption of harmful chemicals, Parties to the Montreal Protocol agreed to reduce consumption, of key Chlorofluorocarbons (CFCs) to 50 percent of 1986 levels by 1988. Through the effort of industry, government and public interest groups, and motivated by improvements in scientific understanding, technical capability and a willingness to overcome social and economic barriers, reductions in use and phase-outs have progressed further and faster than expected while the list of controlled chemicals has expanded. At meetings in London in 1990 and Copenhagen in 1992, Parties accelerated the original reduction schedules and added the new substances to the list. Three years later, at the seventh meeting of the Parties in Vienna, Parties agreed to phase-out methyl bromide.

Incremental Costs

Many actions that help protect the global environment incur incremental costs. For example, the choice of more expensive (but non-ozone-depleting) technologies and chemicals to provide a given level of refrigeration yields a global environmental benefit in the form of protection for the ozone layer in the Stratosphere. This global benefit has not been valued monetarily but had been judged implicitly to exceed the costs of phasing out ozone depleting substances (ODSs). Incremental costs are being incurred to protect global biodiversity, reduce the risk ofclimate change, and prevent thepollutionof international waters. Benefits of protecting the global or regional environment accrue to many nations, rather than only to the country that incurs the cost of action. To minimize the global incremental costs, that is to achieve a given level of ozone-depleting substances phase out at the lowest cost to the world community.

Future impacts

The negotiations concerning Ozone between 1982 and 1992 have launched and developed a new type of diplomacy, which can rightly be called global environmental diplomacy. While it is certainly true that the Montreal Protocol involved many countries with strong views on what should be done, there was always a willingness to take one step at a time. The phasing out of CFCs are could not be agreed upon in 1987, it was accepted 50 percent. The agreement to phase out methyl chloroform by 2000 was not agreed upon in London, it was accepted in 2003. Of course, countries agreed to the interim steps because they believed they could come back another time and make the step more stringent, which is what happened at every stage. But, the spirit of compromise was critical to the success of the Protocol.

Likely, future demand for each ODS use was projected to the year 2010 (2015 for 1, 1, 1-trichloroethane) in the absence of any limitations imposed by the Montreal Protocol. The resultant unconstrained demand forecasts provided the baseline estimate of the quantities of the ODSs to be substituted if demand for products is to be fulfilled, thus maintaining the domestic benefit. Given the uncertainties associated with forecasting, especially so far into the future, the projections were only indicative of likely future trends.

The future state of the ozone layer will remain still because it will be controlled not only by chlorine and bromine loading but also by the atmospheric abundance of nitrous oxide, methane, sulphate particles, carbon dioxide and water vapor and by the climate of the earth. It is essential to clarify the mechanisms potentially delaying the recovery of the ozone layer. Such work should be followed by research for predicting the future of the ozone layer, as well as risk assessments and countermeasures, taking into account the above mentioned uncertainties. It is also important to study the possible impacts of ozone layer destruction on humanhealthand ecosystems.

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