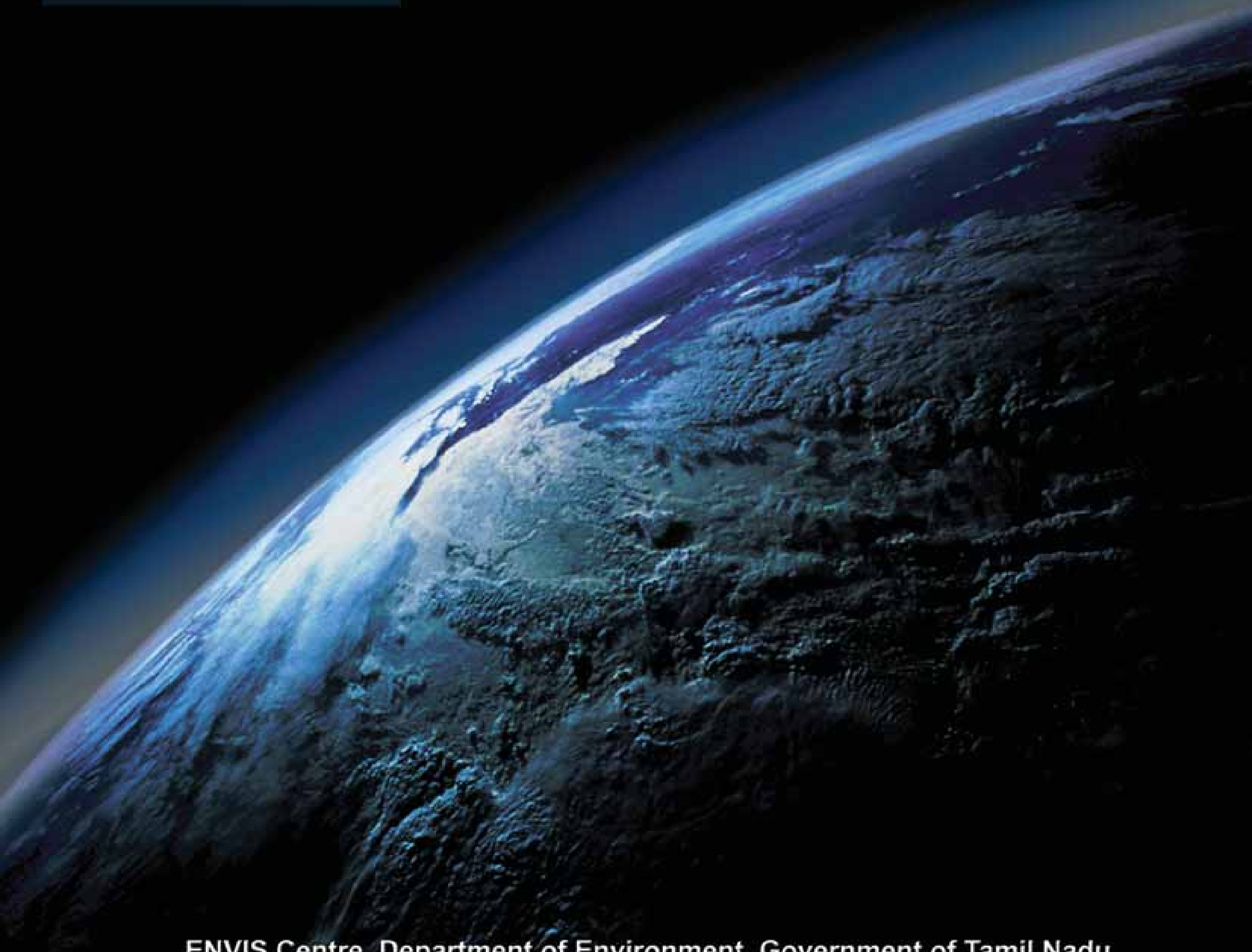
ENVIS
Newsletter

on State of Environment
Supported by Ministry of Environment and Forests, Govt. of India

Vol. 7 No.2 September 2010 A quarterly issue ISSN 0974 133x

OZONE



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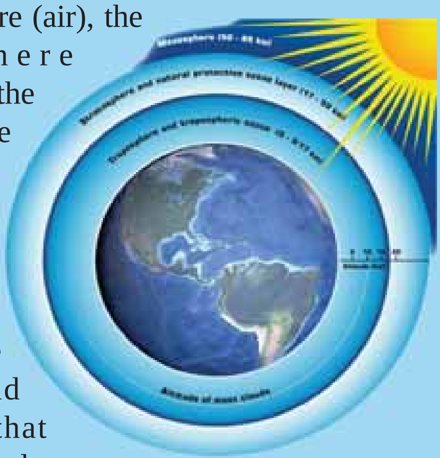
The Atmosphere and the Ozone Layer

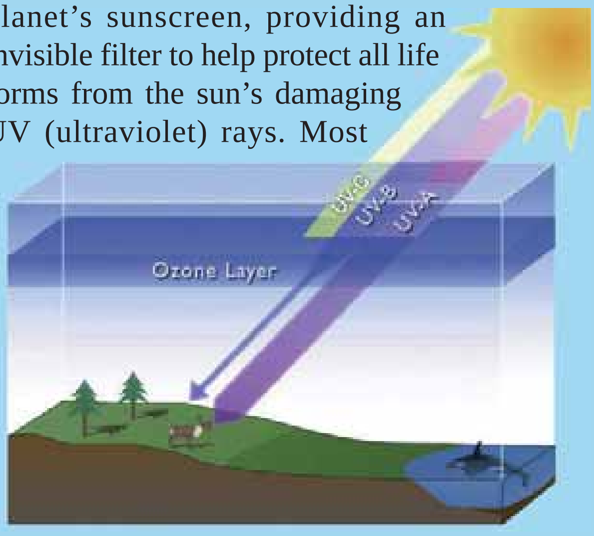
We live on the only planet in our solar system and possibly in the galaxy where life is known to exist. All life exists within thin film of air, water, and soil about 15 km deep. This spherical shell of life is known as the biosphere. The bioshpere can be divided into three layers; the atmosphere (air), the hydrosphere (water), and the lithosphere (rock and soil) .



The atmosphere is a mixture of gases and particles that surround our planet. When seen from space, the atmosphere appears as thin seam of blue light on a curved horizon. It is made of layers that surround the Earth like rings. However, 99% of its total mass lies in two regions within the first 50 km above the Earth's surface; the troposphere and the stratosphere. A part of the atmosphere which contains a high density of ozone lies in the stratosphere and is called the ozone layer.

Ozone and its functions

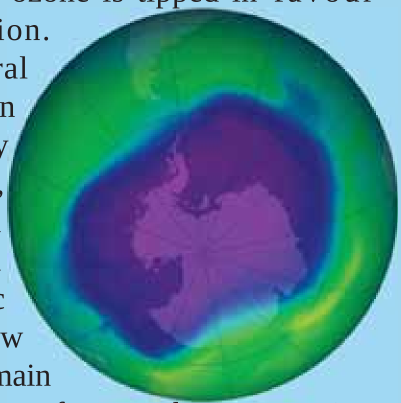
Ozone is a form of oxygen. Oxygen occurs in three different forms in the atmosphere; as oxygen atoms (O), as oxygen molecules (O_2) and as ozone (O_3). Ozone's unique physical properties allow the ozone layer to act as our planet's sunscreen, providing an invisible filter to help protect all life forms from the sun's damaging UV (ultraviolet) rays. Most



incoming UV radiation is absorbed by ozone and prevented from reaching the Earth's surface. Ultraviolet radiation is one form of radiant energy coming out from the sun, which is invisible, and is so named because it occurs next to violet in the visible light spectrum. The three categories of UV radiation are: UV-A (between 320 and 400 nm), UV-B (between 280 and 320 nm) and UV-C (between 200 and 280 nm). Of these UV-B and C are highly energetic and are dangerous to life on earth. UV-A being less energetic is not dangerous. Fortunately, UV-C is absorbed strongly by oxygen and also by ozone in the upper atmosphere. UV-B is also absorbed by ozone layer in the Stratosphere and only 2-3% of it reaches the earth's surface.

Ozone Depletion

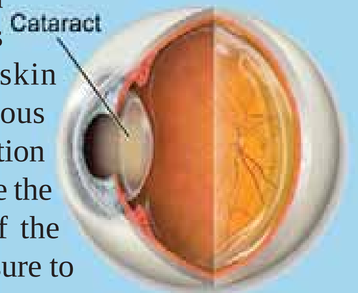
Ozone depletion occurs when the natural balance between the production and destruction of stratospheric ozone is tipped in favour of destruction. Although natural phenomenon can cause temporary ozone loss, chlorine and bromine released from synthetic compounds is now accepted as the main cause of a net loss of stratospheric ozone in many parts of the world since 1980.There is strong evidence that global ozone depletion is occuring. The evidence is in the observations of the Antarctic ozone "hole"and atmospheric records indicating seasonal declines in global ozone levels. The term "ozone hole" refers to a large and rapid decrease in the abundance of ozone molecules, not the complete absence of them.



The Antarctic "ozone hole" was first reported by the British Antarctic Survey Team in May 1985. Ozone concentrations over Halley Bay, Antarctica, had declined 40% from levels during the 1960s. Any disturbance or depletion of this layer would result in an increase UV-B and UV-C radiation reaching the earth's surface leading to dangerous consequences.

Effects on Human Health

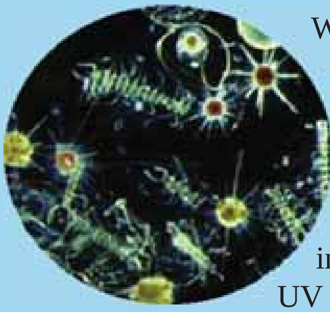
Increased penetration of solar UV-B and UV-C radiation is likely to have profound impact on human health with potential risks of eye diseases, skin cancer and infectious diseases. UV radiation is known to damage the cornea and lens of the eye. Chronic exposure to UV-B could lead to cataract of the cortical and posterior sub-capsular forms. UV-B radiation can adversely affect the immune system causing a number of infectious diseases. In light skinned human populations, it is likely to develop non-melanoma skin cancer.



Effects on Terrestrial Plants

Physiological and developmental processes of plants are affected by UV-B radiation. In forests and grasslands increased UV-B radiation is likely to result in changes in species composition (mutation) thus altering the bio-diversity in different ecosystems. UV-B could also affect the plant community indirectly resulting in changes in plant form, secondary metabolism, etc. These changes can have important implications for plant competitive balance, plant pathogens and bio-geochemical cycles.

Effects on Aquatic Ecosystems



While more than 30% of the world's animal protein for human consumption comes from the sea alone, it is feared that increased levels of UV exposure can have adverse impacts on the productivity of aquatic systems. High levels of exposure in tropics and subtropics may affect the distribution of phytoplanktons which form the foundation of aquatic food webs. Reportedly a recent study has indicated 6-12 % reduction in phytoplankton production in the marginal ice zone due to increases in UV-B. UV-B can also cause damage to early development stages of fish, shrimp, crab, amphibians and other animals, the most severe effects being decreased reproductive capacity and impaired larval development.

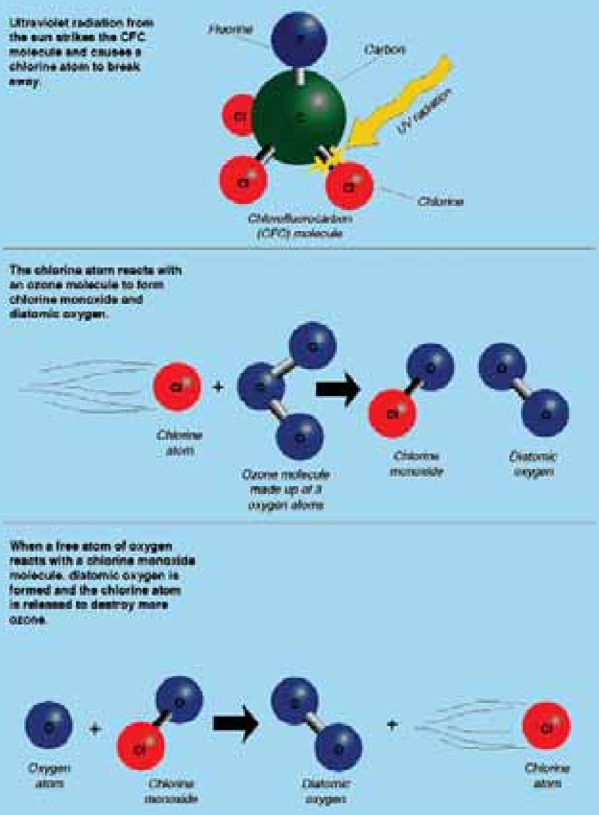
Effects on Bio-geochemical Cycles

Increased solar UV radiation could affect terrestrial and aquatic bio-geochemical cycles thus altering both sources and sinks of greenhouse and important trace gases, e.g. carbon dioxide (CO_2), carbon monoxide (CO), carbonyl sulphide (COS), etc. These changes would contribute to biosphere-atmosphere feedbacks responsible for the atmosphere build-up of these gases. Other effects of increased UV-B radiation include: changes in the production and decomposition of plant matter; reduction of primary production changes in the uptake and release of important atmospheric gases; reduction of bacterioplankton growth in the upper ocean; increased degradation of aquatic dissolved organic matter etc. Aquatic nitrogen cycling can be affected by enhanced UV-B through inhibition of nitrifying bacteria and photodecomposition of simple inorganic species such as nitrate. The marine sulphur cycle may also be affected resulting in possible changes in the sea-to-air emissions of COS and dimethylsulfied (DMS), two gases that are degraded to sulphate aerosols in the stratosphere and troposphere, respectively.

Ozone depleting substances and their role in Ozone depletion

Ozone depleting substances (ODS) are those substances which deplete the ozone layer and are widely used in refrigerators, air-conditioners, fire extinguishers, in dry cleaning, as solvents for cleaning, electronic equipment and as agricultural fumigants. The most commonly used ODS are Chlorofluorocarbons (CFCs), Halon, Carbon tetrachloride and Methyl chloroform. Ozone depletion is caused when there is an increase in the level of free radicals such as hydroxyl radicals, nitric oxide radicals and atomic chlorine and bromine.

These compounds are very stable in the lower atmosphere of the Earth, but in the stratosphere, they break down to release a free chlorine atom due to ultraviolet radiation. A free chlorine atom reacts with an ozone molecule (O_3) and forms chlorine monoxide (ClO) and a molecule of oxygen. Now chlorine monoxide reacts with an ozone molecule to form a chlorine atom and two molecules of oxygen. The free chlorine molecule again reacts with ozone to form chlorine monoxide. The process continues and the result is the reduction or depletion of ozone in the stratosphere.



Evolution of Vienna Convention & Montreal Protocol

The urgency of controlling the Ozone Depleting Substances (ODS) particularly CFCs was slow to pick up. CFCs were so useful that society and the industry were reluctant to give up consuming them. The first international action to focus attention on the dangers of ozone depletion in the stratosphere and its dangerous consequences in the long run on life on earth was focused in 1977 when in a meeting of 32 countries in Washington D.C. a World plan on action on Ozone layer with UNEP as the coordinator was adopted.

This later led to an international agreement in 1987 on specific measures to be taken in the form of an international treaty known as the Montreal Protocol on Substances that Deplete the Ozone Layer. Under this Protocol the first concrete step to save the Ozone layer was taken by immediately agreeing to completely phase out chlorofluorocarbons (CFC), Halons, Carbon tetrachloride (CTC) and Methyl chloroform (MCF) as per a given schedule.

The treaty was opened for signature on September 16, 1987, and entered into force on January 1, 1989, followed by a first meeting in Helsinki, May 1989. Since then, it has undergone seven revisions, in 1990 (London), 1991 (Nairobi), 1992 (Copenhagen), 1993 (Bangkok), 1995 (Vienna), 1997 (Montreal), and 1999 (Beijing).

It is believed that if the international agreement is adhered to, the ozone layer is expected to recover by 2050. Due to its widespread adoption and implementation it has been hailed as an example of exceptional international co-operation, perhaps the single most successful international agreement to date.

Key Achievements of the Montreal Protocol

While the work of the Montreal Protocol is not done and much more remains to be accomplished before it can assure the protection of the ozone layer for this and future generations, the Parties to the Protocol have accomplished a great deal since the treaty was originally agreed to.

Truly global participation: In 2009 the Montreal Protocol became the first United Nations treaty to achieve universal ratification, demonstrating the world's commitment to ozone protection, and more broadly, to global environmental protection;

Elimination of ozone depleting substances: As of the end of 2009, the Parties to the Protocol had phased out the consumption of 98% of all of the chemicals controlled by the Protocol;

Healing the ozone layer: Global observations have verified that atmospheric levels of key ozone depleting substances are going down and it is believed that with implementation of the Protocol's provisions the ozone layer should return to pre-1980 levels by the middle of this century;

Supporting developing countries: With the assistance of the Multilateral Fund for the Implementation of the Montreal Protocol, developing countries had, by mid 2010, permanently phased out over 270,000 tonnes of ozone depleting substances that had been used to produce various products and have eliminated virtually all of their production of CFCs and halons;

High rates of compliance: Taking into account all the Parties and all their phase-out commitments, the Parties to the Montreal Protocol have achieved a compliance rate of over 98%. Further, in the process of phasing-out, many countries, both developed and developing, have met their phaseout targets well ahead of schedule;

2010 phase-out milestone: 1 January 2010 was the date by which all the Parties phased-out the consumption and production of chlorofluorocarbons, halons, carbon tetrachloride and other hydrogenated ozone depleting substances.

India's Commitment to Montreal Protocol

India acceded to the Montreal Protocol on 17th September 1992 and also ratified the Copenhagen, the Montreal and the Beijing Amendments on 3rd March, 2003. India's per capita consumption of Ozone Depleting Substances is at present less than 3 grams and did not cross 20 gms between 1995-97 as against 300 gms permitted under the Protocol. In 1993, India prepared a detailed India Country Programme (CP) to phaseout of ODS in accordance with its national industrial development strategy. The CP also ensured that the phaseout will be done without undue economic burden to both consumers and industry and provided India with the opportunity to access the Protocol's Financial Mechanism.

The Government of India has entrusted the work relating to ozone layer protection and implementation of the Montreal Protocol to the Ministry of Environment and Forests (MoEF) which is the coordinating Ministry in India for all matters relating to the Montreal Protocol. The MoEF has set up an Ozone Cell as a national unit to look after and to render necessary services to implement the Protocol and its ODS phaseout programme in India.

International Ozone Day celebrations 2010 at Nagercoil

The Department of Environment, Government of Tamil Nadu, celebrated the International Ozone Day at S.L.B. Govt., Hr. Sec. School, Nagercoil on the 16th September 2010. Around 120 students and 75 teachers from Nagercoil District participated in this celebration. A seminar was conducted to enlighten the Teacher co-ordinators on the need for conserving the environment. Experts were invited to give lectures on selected topics which highlighted environmental preservation and conservation. The Director of Environment, Thiru T.S. Srinivasamurthy, I.F.S., welcomed the gathering and the teachers were engaged by the lectures given by the experts like Dr.A.D. Sobhanaraj, Dr. C. Sivasubramaniam, Dr.V.Chelladurai and Prof. Nagarajan who spoke on topics like Biodiversity, Birds, Medicinal plants and Climate Change. The programme went on till 1.00 PM after which lunch was served to the participants.

In the afternoon a cultural programme was organized in which folk songs, folk dance and street plays were used as tools to enlighten the audience on various issues related to the environment and the role common man can play in preserving nature. In the evening the Environmental awards distribution function was conducted.

The Government of Tamil Nadu has constituted three categories of environment awards (3 prizes) and one award for the best research paper to recognize excellence in the different fields of Environmental education and awareness, Environmental protection and Environmental management. This year, the Hon'ble Minister for Environment Thiru.T.P.M. Moideen Khan, distributed the Environmental awards to the winners. A half an hour video CD on biodiversity conservation prepared by the ENVIS Center, Dept. of Environment was released by the Hon'ble Minister for Environment Thiru.T.P.M. Moideen Khan. To spread awareness on the eco-friendly activities the department of Environment released a cloth shoulder bag. Slogans related to environment conservation were printed on the bag and the Minister for Tourism and Registration Department Hon'ble Thiru. N. Suresh Rajan released the bag.

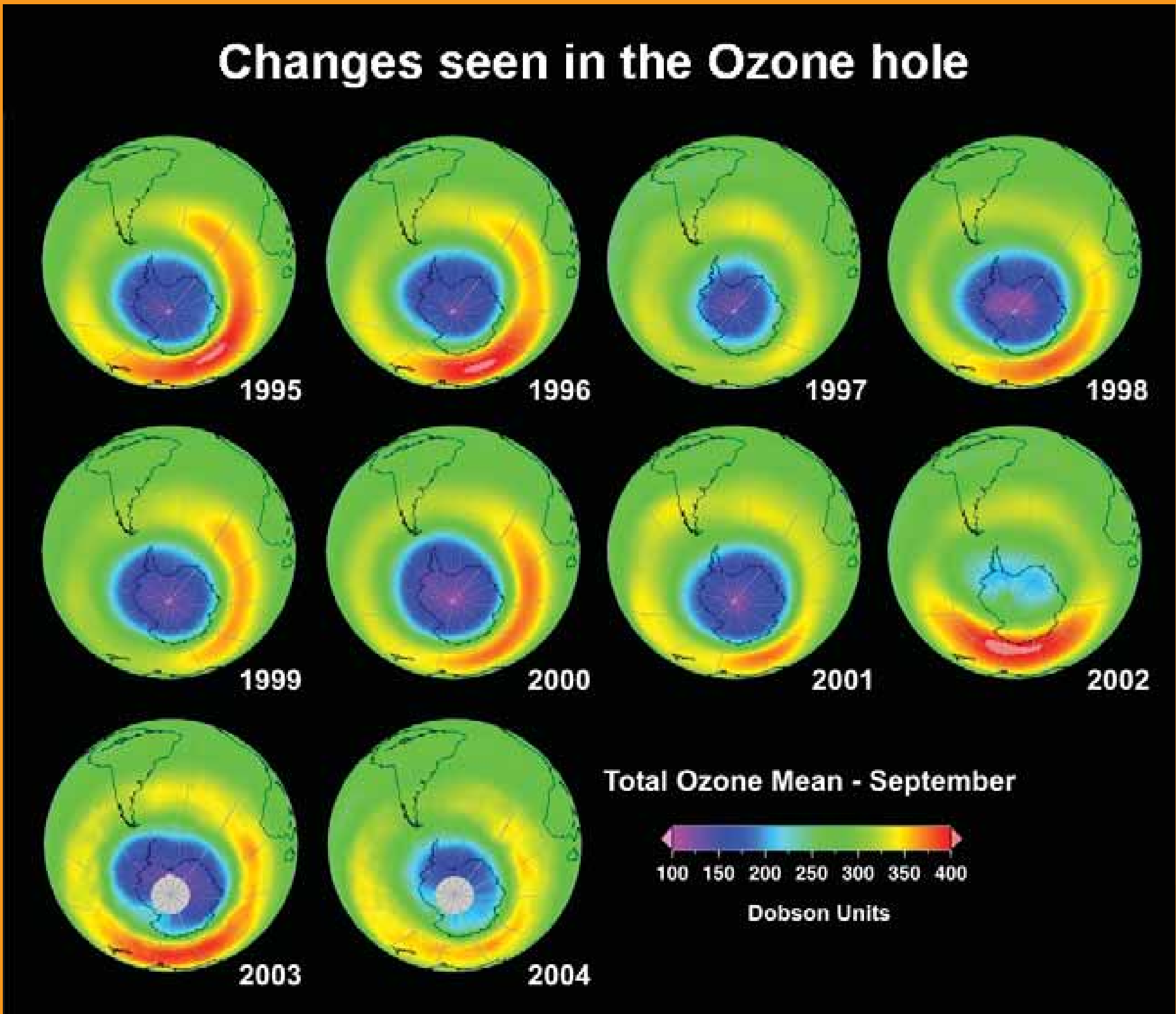
During the award function, District Collector, Kanyakumari District Thiru. Rajendra Rathnoo delivered the key note address. Thiru. V. Sundarraju I.F.S., District Forest Officer, Kanyakumari District spoke on Forestry and Environment. Thiru A. Rajan, M.L.A., presided and delivered a special message.

Thiru. G.M. Sha, President, District Agricultural Marketing Society, Tmt. D. Ajitha Manothangaraj, District Panchayat President also delivered their messages. All the participants took oath on “Environmental Protection” which was read by Thiru. K.Vijayakumar, District Eco-club Co-ordinator, Kanyakumari District.

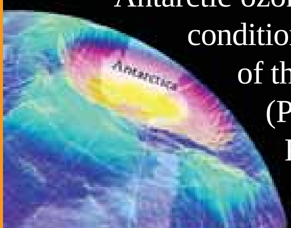
At the end of the function the dignitaries on the dais were honored with shawl and mementos and the programme closed with the National anthem. To mark the Ozone day tree sapling were planted around the school premises. The Minister of Environment, Minister for Tourism & Registration and District Collector planted the tree saplings.

Winners of the Environmental awards 2010

Environmental Education and Awareness	
Padma Seshadri Bala Bhavan	Aringnar Anna Virudhu
Thiru Joe Prakash	Sutrusuzhal Sudaroli Virudhu
Thiru M. Yoganathan	Sutrusuzhal Seyal Veerar Virudhu
Environmental Protection	
Thiru. A. Gnanaprakasam	Dr. Gurusamy Mudaliyar Virudhu
Thiru. S.K.M. Mayilananthan	Sutrusuzhal Kavalar Virudhu
Dr. Babu Abdullah	Sutrusuzhal Seyal Veerar Virudhu
Environmental Management	
Periyar Maniammai University	Karma Veerar Kamarajar Virudhu
Thiru. A. Balasubramanian	Sutrusuzhal Puravalar Virudhu
Dr. S. Paulsamy	Sutrusuzhal Seyal Veerar Virudhu
Best Research Paper on Environmental Issues	
Dr. T. Jeyasekar	



Why has an "ozone hole" appeared over Antarctica when ozone-depleting gases are present throughout the stratosphere?



Ozone-depleting gases are present throughout the stratospheric ozone layer because they are transported great distances by atmospheric air motions. The severe depletion of the Antarctic ozone layer known as the "ozone hole" forms because of the special weather conditions that exist there and nowhere else on the globe. The very cold temperatures of the Antarctic stratosphere create ice clouds called polar stratospheric clouds (PSCs). Special reactions that occur on PSCs and the relative isolation of Polar stratospheric air allows chlorine and bromine reactions to produce the ozone hole in Antarctic springtime.