EP

United Nations
Environment
Programme

Distr.
LIMITED
UNEP/CCOL/5/5
1 September 1981
Original: ENGLISH

Co-ordinating Committee
on the Ozone Layer
Fifth Session

Copenhagen, 12-16 October 1981

WORLD PLAN OF ACTION ON THE OZONE LAYER

As adopted by the UNEP Meeting of Experts Designated
By Governments, Intergovernmental, and Non-Governmental
Organizations on the Ozone Layer, Washington, D.C. 1-9 March, 1977

World Plan of Action on the Ozone Layer

1. The Natural Ozone Layer and its Modification by Man's Activities

The natural stratosphere and its ozone layer have been the subject of extensive research over the last fifty years. The need for jet aircraft to fly at high altitude has long spurred the interest of the world's meteorological community. The curiosity of atmospheric physicists and chemists has provided the main thrust to illuminate the dynamics and photochemistry of the ozone layer.

In recent years research, associated with the accelerating pace of man's activities in the stratosphere and space, has greatly modified our perception of ozone photochemistry. It is widely accepted that natural ozone photochemistry is controlled to a large extent by the action of nitric oxide derived from nitrous oxide which emanates from the earth's surface as a result of denitrification processes. This has added a new dimension to the ozone problem and new interest in studies of the earth's nitrogen cycle. It is now thought that stratospheric ozone is influenced by a variety of naturally occurring substances such as methane and methyl chloride. A continuing long-term programme is essential to our further understanding of these natural phenomena and as a basis for evaluating new effects.

Quite recently the impact of other substances such as the nitrogen oxides from aircraft exhausts and the man-made chlorofluoromethanes (CFMs) has been receiving intense scrutiny. As these are all trace substances with atmospheric concentrations as low as a fraction of a part per billion, the problems of measurement, analysis and modelling have changed by an order of magnitude from those encountered when our understanding was based on the assumption of the simple Chapman (pure oxygen) system. Our knowledge and understanding have been greatly increased by a number of intensive national programmes, and there is a large measure of agreement on the model predictions that current aircraft emissions have minimal effects on the ozone layer but that the effects of continuing emissions of CFMs at the 1973 or higher levels are a matter of concern.

There are many known gaps in our knowledge of factors affecting the ozone layer, and there may be factors that are as yet unrecognized. An intensive and well co-ordinated monitoring and research programme related to the occurrence of trace substances in the atmosphere, to test the model predictions and narrow their range of uncertainty, is particularly important.

Recommendations:

The co-ordinated research and monitoring programme, already initiated by the World Meteorological Organization, to clarify the basic dynamical photochemical and radiative aspects of the ozone layer and to evaluate the impact of man's activities on the ozone balance should be encouraged and supported.

Specifically this should include action to:

Monitor Ozone (WMO)*

1. Design, develop, and operate an improved system (including appropriate ground-based, airborne and satellite subsystems) for monitoring and prompt reporting of global ozone, its vertical, spatial and temporal variations, with sufficient accuracy to detect small but statistically significant long-term trends.

---

* Included between brackets after the leading to each recommendation are the acronyms of first, the lead organization for implementation of the recommendation and second, the co-operating organizations. Where co-operating organizations are not listed the lead organization will make appropriate arrangements for co-operation.

Monitor Solar Radiation (WMO)

2. Design, develop, and implement a system (including appropriate ground-based, airborne and satellite subsystems) for monitoring the intensity and spectral distribution of solar radiation at ground level and extraterrestrially to better understand the formation of ozone, to determine variations of solar flux and to clarify the influence of such variations on the earth's radiation budget and on the interpretation of ground-based measurements.

Simultaneous Species Measurements (WMO)

3. Design, develop, and implement an intensive short-term programme of simultaneous measurements of selected species in the odd-nitrogen, odd-hydrogen and odd-chlorine families to provide a better understanding of the ozone balance and to test the model predictions. This should be supported by a longer term programme on all reactive species including their temporal and spatial variations and base line inventories.

Chemical Reactions (WMO)

4. Design, develop, and implement a broad programme to accurately determine chemical and photochemical reaction rates and quantum yields at appropriate temperatures and pressures; to provide accurate atomic and molecular line strength and location data for use in laboratory and remote sensing measurements of trace species; and to assess the sensitivity of chemical reaction schemes used in atmospheric models.

Development of Computational Modelling (WMO)

5. Develop a hierarchy of improved (1-D, 2-D, 3-D) computational models by which the interrelationships of chemical, radiative, hydrodynamic and thermodynamic processes controlling the troposphere and the stratosphere in both their natural and perturbed states, may be established.

Large-Scale Atmospheric Transport (WMO)

6. Undertake studies to better describe and quantify large-scale atmospheric circulation and transport. Particular emphasis should be given to representation of vertical transport and transfer between the troposphere and the stratosphere.

Global Constituent Budgets (WMO)

7. Develop a much improved understanding of the budgets of atmospheric constituents which affect the ozone balance, including their sources and sinks. At present this should give particular emphasis to the chlorine and nitrogen systems.

2. The Impact of Changes in the Ozone Layer on Man, the Biosphere and Climate

A prediction of depletion of ozone and increased UV-B due to man's activities would have little meaning unless it could be shown, at least qualitatively, that it would have significant effects on man and his environment.

It has been demonstrated that excessive exposure to ultraviolet radiation at 254 nm (radiation of a shorter wave-length than the UV-B which reaches the ground) causes tumors in laboratory animals and has deleterious effects on certain plants. Extensions of the studies to that part of the UV-B band from 290-320 nm have been made by theoretical and experimental work and by a series of epidemiological studies. There is some evidence that increased UV-B would be associated with an increase in skin cancer and possibly in eye damage in susceptible sections of the human population. It is also likely that large increases in UV-B would cause biological damage including damage to nucleic acids and proteins and thereby have deleterious effects on terrestrial and aquatic communities, but the effects of smaller changes in UV-B are highly uncertain because of the capability of biological ecosystems to compensate, to a certain extent, for harmful influences. Although it is clear that significant progress has been made in a wide range of related research activities in the biological and medical sciences there are still many gaps in our knowledge of the effects of increased UV-B. Other effects of modification of the ozone layer, e.g. climatic effects might be relevant for the biosphere. The problem being extremely complicated, research results are not yet accurate enough to indicate the possible nature to these effects.

Recommendations:

A wide variety of investigations of the impact of ozone layer modification and increased ultraviolet radiation (UV-B) on man, the biosphere and climate should be encouraged, supported and coordinated. Specifically it is proposed that action be undertaken to:

1. UV Radiation

(i) Monitor UV-B Radiation (WMO, WHO, FAO)

Monitor as far as possible, using best available technology, the spectral distribution and intensity of the UV-B radiation at the earth's surface. This should be done for at least a complete solar cycle at globally distributed sites (and where possible at stations where ozone is being measured and/or skin cancer data being collected and/or plant effects being studied).

(ii) Develop UV-B Instrumentation (WMO, WHO, FAO)

Develop improved instrumentation and methods, including improved artificial sources, for measuring and providing precise levels of UV-B irradiance (both broad-band and narrow-band).

(iii) Promote UV-B Research (WMO, WHO, FAO)

Develop standardized methodologies for conducting UV-B research. Promote investigations to enable a better understanding of the spectral distribution of UV radiation, effects of flux and effects of factors other than ozone such as atmospheric conditions, ground albedo, etc., in determining the amount and wavelength of UV reaching the ground.

2. Human Health

(i) Statistics on Skin Cancer (WHO)

Obtain improved worldwide statistics of skin cancer incidence and analyze such data in relation to latitude (with particular emphasis on locations where UV and total ozone can be measured simultaneously), types of cancer, age of onset, morbidity and mortality rates, location of cancer on body, sex, degree of skin pigmentation, genetic and ethnic background, occupation and lifestyle. Develop internationally agreed upon protocols for design, collection and analysis of skin cancer data and develop improved data storage, retrieval and dissemination mechanisms.

(ii) Research on Induction Mechanisms (WHO)

Conduct experimental and theoretical studies at the molecular, cellular, and tissue levels of the mechanisms of damage of UV-B including induction of skin cancer, skin aging, eye damage and possible effects on DNA as functions of dose, dose rate, and wave-length, with attention to possible repair mechanisms, synergistic and antagonistic factors including other wavelengths.

(iii) Other Health Aspects (WHO)

Study potential impact of increased UV-B on aspects of human health other skin cancer; develop a model for predicting human photo-biological response for various skin types, genetic and ethnic background and environmental factors; and conduct research and modelling on the mechanisms of Vitamin D production and effects.

3. Other Biological Effects

(i) Responses to UV-B (FAO)

Conduct studies on the physiological, biochemical, and structural responses, as exemplified by changes in photosynthesis and nitrogen fixation, to increased UV-B radiation of selected native and agricultural plants, animal species, and microorganisms and to develop predictors of UV-B sensitivity. These should emphasize dose-response, reciprocity, synergisms, antagonisms, action spectra and interactions of UV-B and other stress factors on these organisms.

(ii) Terrestrial Ecosystems (FAO)

Study the effect of changes of UV-B radiation on terrestrial ecosystems (both agricultural and natural) inter alia by means of modelling studies of the impacts of UV-B radiation.

(iii) Aquatic Ecosystems (FAO)

Study the effect of changes of UV-B radiation on aquatic plants and animals emphasizing those related to primary productivity in the oceans; develop improved measurements of UV-B penetration into aquatic environment and study its effects on plankton.

(iv) Other Agricultural Effects (FAO)

Study the effects of changes of UV-B radiation on the stability of agricultural chemicals and the resulting impacts on crop yields and agricultural chemical usage patterns.

4. Effects on Climate

(i) Development of Computational Modelling (WMO)

Further develop modelling capability to assess the effects of ozone changes and also those of CFMs and other compounds with similar effects on the earth's radiation balance and the global climate. A data base for testing such models should be provided.

(ii) Regional Climate (WMO)

Conduct research on regional climate and its variability to provide better evaluations of the effects of the above changes on critical climatic regions.

3. Socio-Economic Aspects

To provide a more useful contribution to policy formulation, the assessment of a potential environmental hazard should include not only an evaluation of its costs and benefits to society but also the costs and benefits that would result from a reduction of the hazard. The available data are inadequate to properly assess the socio-economic effects of stratospheric pollution or of measures taken to control it. Much work has been done on the costs of alternative courses of action particularly with respect to possible limitations on total CFM emissions. However, further elaboration of methodology is needed before a complete evaluation of man-made effects upon the ozone layer can be made at the desirable level of confidence.

Recommendations:

Studies of the socio-economic impact of predicted ozone layer depletions and of alternative courses of actions to limit or control identified ozone-depleting emissions to the atmosphere should be supported at the national and international level. Specifically it is proposed that action be undertaken to:

1. Production and emission data (UNEP, ICC, OECD, ICAO)

Obtain more detailed data on man's present and projected activities in and near the stratosphere and on global production, emission and use of substances that have the potential to affect stratospheric ozone. These data are required to model stratospheric changes as well as to evaluate socio-economic alternatives.

2. Methodology for comprehensive assessment (UNESA, OECD, ICAO, FAO, WHO)

Develop improved methodologies including multidisciplinary systems analysis for assessing the costs and benefits associated with various levels potential modifiers of the stratosphere, whether controlled or not.

4. Institutional Arrangements

1. The Action Plan will be implemented by UN bodies, specialized Agencies, international, national, intergovernmental, and non-governmental organizations and scientific institutions.

2. The UNEP should exercise a broad coordinating and catalytic role aimed at the integration and coordination of research efforts by arranging for:

- collation and dissemination of information on ongoing and planned research activities
- presentation and review of the results of research
- identification of further research needs
- appropriate encouragement of such research

3. In order for UNEP to fulfil that responsibility it should establish a Co-ordinating Committee on the Ozone Layer composed of representatives of the agencies and non-governmental organizations participating in implementing the Action Plan as well as representatives

of countries which have major scientific programmes contributing to the Action Plan. The Committee should meet with sufficient regularity to meet its responsibilities. The Committee should be provided with secretariat services adequate to carry out the activities noted in the above section.

The Committee should make recommendations relevant to the continuing development and co-ordination of the Action Plan to the Executive Director who will report these to the Governing Council.

4. While much of the work included in the Action Plan is being and will be undertaken at the national level, and is the financial responsibility of countries, there is a continuing need for co-ordination of the planning and execution of monitoring and research related to particular segments of the Action Plan. This need can most effectively be met by the specialized Agencies as indicated in the recommendations.

5. Each Agency should arrange for the provision of scientific advice relevant to its needs and those of the Co-ordinating Committee on the Ozone Layer. In addition, the Executive Director of UNEP may from time to time convene a multidisciplinary panel of experts to provide broadly-based scientific advice on the Action Plan.

6. UNEP should consider the need for and feasibility of establishing special co-ordinating mechanisms or procedures for certain areas of inter-disciplinary research included in the recommendations, such as photobiology, which presently lack such co-ordinating facilities.

* * * *