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Ad Hoc Working Group of Legal and
Technical Experts for the Elaboration
of a Global Framework Convention for
the Protection of the Ozone Layer
Second part of the second session
Geneva, 11-15 April 1983

POSSIBLE CONTENTS OF ANNEXES AND/OR PROTOCOLS

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I. RESEARCH AND MONITORING */

1. Recognizing the importance of research and monitoring to the protection of the ozone layer, and of international scientific assessments to the development of international scientific consensus, the Contracting Parties agree to support, individually and collectively, research, monitoring and scientific assessments appropriate to their expertise, geography, and available resources.

2. The Contracting Parties shall co-operate in:

(a) Conducting research and publishing in peer-reviewed literature information developed on understanding the physics and chemistry of the earth's upper atmosphere and of its susceptibility to change, in particular on the state of the ozone layer and on environmental and climatic effects which would result from changes in either the total column content of the vertical distribution of ozone;

(b) The assessment of research results and the development of recommendations for future research;

(c) The sharing of information on planned and on-going research, both government and private, to facilitate the co-ordination of research programmes so as to make the most effective use of available national and international resources;

(d) The development and implementation of multi-national satellite and ground-based global measurement systems.

3. Areas of research and monitoring that the Contracting Parties recognize as important include:

(a) Research in the physics and chemistry of the atmosphere

(i) Comprehensive theoretical models: the continued development of multidimensional interactive models of radiative, chemical and dynamical processes; studies of the simultaneous effects of various species, e.g. CFCs, chlorocarbons, CO_2, N_2O, NO_x and CH_4, upon atmospheric ozone; interpretation of satellite and non-satellite field measurement data sets; studies of the radiative effect of ozone and other minor species which affect ozone photochemistry and atmospheric dynamics, potentially resulting in climatic impact; the evaluation of trends in atmospheric and geophysical parameters, in particular relating to ozone, temperature and precipitation data, and the development methods for attributing changes in ozone data to specific causes;

(ii) Laboratory studies of: rate coefficients, absorption cross-sections, quantum fields, and reaction mechanisms of tropospheric and stratospheric chemical and photochemical

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*/ Submitted by the United States of America.

processes over the relevant pressure and temperature ranges, including the search for additional reactions which may affect atmospheric chemistry; line positions, line widths, broadening coefficients, line strengths and line identification to support field measurements in the ultra-violet, visible, infra-red and microwave spectral regions;

(iii) Field measurements: simultaneous measurements of the concentrations of photochemically related compounds of the various families using in situ and remote sensing instrumentation from ground, aircraft, balloon, rocket-borne, and satellite platforms; emphasis should be placed on extending the measurements of radical species down to the tropopause; the intercomparison of different sensor; obtaining 3-D fields of key trace constituents, solar flux, and meteorological parameters in the stratosphere using satellites; co-ordinated correlative measurements for satellite instrumentation; atmospheric dynamics studies using aircraft and ground-based radar;

(iv) Instrument development, including: reliable operational satellite sensors for accurate measurements of the vertical distributions of ozone, water vapor and temperature over the complete altitude range of the stratosphere; reliable operational satellite sensors for the total column content of ozone and solar flux (wavelength-resolved) including the continued development of in-flight calibrations; improved ground-based, balloon- and rocket-borne sensors for integration into a Global Ozone Observing System and for performing correlative measurements for satellite ozone measurements (column content and vertical distribution); in situ or remote sensors for key constituents for which instrumentation currently does not exist;

(b) Research in health and biological effects

(i) The relationship between human exposure to solar ultra-violet radiation and the development of non-melanoma skin cancer, and the possible relationship between sunlight and melanoma skin cancer, including social and environmental conditions;

(ii) Biological effects of UV-B, including the wavelength dependence, upon agricultural crops, forests and other ecosystems, in different geographical locations and under local growing conditions;

(iii) Aquatic effects studies extended to the natural water environment to gain knowledge of the effect of enhanced solar UV-B, including the wavelength dependence, on aquatic food productivity;

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(iv) The mechanisms by which UV-B radiation acts on biological species and ecosystems including: the relationship between dose, dose rate, and response; photorepair, adaptation, and protection;

(v) Studies of biological action spectra and the spectral response using polychromatic radiation in order to include possible interactions of the various wavelength regions;

(vi) The influence of existing and enhanced UV-B radiation on: the sensitivity and activities of insects important to the biospheric balance (animal food chain, plant cross-fertilization, etc.); micro-organisms, such as those causing plant and animal diseases; primary processes such as photosynthesis, biosynthesis, etc.; the photodegradation of herbicides, pesticides, fertilizers and similar agricultural chemicals;

(c) Monitoring

(i) The status of the ozone layer (i.e. the spatial and temporal variability of the total column content and vertical distribution) by making the Global Ozone Observing System based on the integration of satellite and ground-based systems, fully operational. This requires a significant improvement in the quality and quantity of vertical distribution measurements, and an upgrading and calibration of Dobson and M-83 type instruments;

(ii) The tropospheric and stratospheric concentrations of source gases for the HO_x, NO_x, and ClO_x, families including H_2O, CH_4, N_2O, $CFCl_3$, CF_2Cl_2, CCl_4, CH_3Cl, CH_3CCl_3, CHF_2Cl and other chlorinated compounds. In addition, similar measurements of CO_2, and CO are required;

(iii) The temperature from the ground to the mesosphere, utilizing both ground-based and satellite systems;

(iv) Wavelength-resolved solar flux entering the earth's atmosphere, utilizing satellite measurements;

(v) Wavelength-resolved solar flux reaching the earth's surface in the ultra-violet range with biological effects (UV-B), in conjunction with total ozone measurements;

(vi) Aerosol concentrations from the ground to the mesosphere, utilizing both ground-based and satellite systems;

(vii) Improved methods for analysing global monitoring data on trace species, temperatures, solar flux, and aerosols.

II. INFORMATION EXCHANGE */

1. The Contracting Parties recognize that the sharing of information is an important means of implementing the objectives of the Convention and of assuring that any actions taken are appropriate and equitable. In developing annexes and protocols under the Convention, the Contracting Parties shall draw upon the following Guidelines for Information Exchange.

1. INFORMATION TO BE EXCHANGED

2. The Contracting Parties recognize that they will need to consider the following types of information in taking actions under the Convention: scientific, technical, business/commercial, legal and socio-economic.

(a) Scientific information

3. This includes information on the nature, status, and results of work described in annex I, as well as information regarding emissions due to human activities or natural events which may affect the ozone layer. Types of information to be exchanged include:

(a) Reports and literature on the ozone depletion theory and the effects of ozone depletion on health and the environment;

(b) Studies which are under way or planned, for purposes of co-ordinating world testing programmes;

(c) Assessments of results and recommendations for future work performed by national or international bodies;

(d) Information on the emissions of various substances, as well as production and use data needed in modelling;

(e) Model results;

(f) Raw data, especially from field measurements, as well as their archiving, as feasible and appropriate.

(b) Technical information

4. This includes information on:

(a) The availability and cost of substitute and new technologies;

(b) Research, planned and on-going on technologies for reducing modification of the ozone layer;

(c) Business/commercial information

5. This include information regarding the production, use, and emission data needed for modelling and monitoring studies and for the assessment of economic effects of contemplated actions.

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*/ Submitted by the United States of America.

(d) Legal information

6. This includes information regarding:

(a) Licensing and patent protection;

(b) National laws or administrative measures concerning production, work practices or emissions;

(c) Laws giving administrative bodies the authority to regulate production, work practices or emissions;

(d) International agreements, including bilateral agreements, concerning production, work practices, or emission controls, especially those involving imports or exports.

(e) Socio-economic information

7. This includes information regarding:

(a) The risks and benefits of human activities which may modify the ozone layer;

(b) The socio-economic effects of possible ozone depletion;

(c) The consequences of regulatory actions taken;

(d) Import/export and international marketing information.

2. CO-OPERATION IN THE EXCHANGE OF INFORMATION

8. The Contracting Parties recognize that when they decide to limit particular emissions, it is to their mutual benefit to share knowledge as to the availability of certain techniques, equipment, or substitutes. The Contracting Parties agree to co-operate by:

(a) Facilitating the licensing and sale of alternative technologies among countries;

(b) Providing information on alternative technologies and equipment, including supplying manuals and guides;

(c) Stationing necessary monitoring equipment and facilities;

(d) Providing appropriate training of scientific and technical personnel.

9. The Contracting Parties recognize that co-operation under this annex will be subject to national laws regarding patents, trade secrets, and protection of confidential information.

10. In deciding what information is to be collected, the Contracting Parties shall take into account the usefulness of information and the costs of obtaining it.

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III. LIST OF SUBSTANCES CAPABLE OF MODIFYING STRATOSPHERIC OZONES */

1. Recognizing that certain chemical substances may be capable of modifying the spatial and temporal distribution and abundance of stratospheric ozone, the contracting parties agree to support, as appropriate, individually and collectively, research and monitoring as outlined in Annex 1 on the substances which are listed below.

2. This annex is a compilation of chemical substances of natural and anthropogenic origin released at the earth's surface or from aircraft exhaust which are currently thought to have the potential to modify the chemical, physical or radiative properties of the earth's atmosphere in quantities believed sufficient to cause changes in the chemical composition or the physical properties of the atmosphere.

3. The major scientific issues associated with continued stratospheric pollution revolve around: (a) modification of the total column content of ozone which would result in a change in the amount of solar UV-B radiation that reaches the earth's surface with potential consequences for human health and ecological organisms and systems; and (b) modification of the vertical distributio of ozone which could change the temperature structure of the stratosphere with potential consequences for weather and climate. In addition there could be direct modification of the thermal structure of the atmosphere due to the addition of gases that absorb infra-red radiation, e.g. carbon dioxide (CO_2); methane (CH_4); nitrogen oxide (N_2O); chlorofluoromethanes, (CFMs); and tropospheric ozone.

4. The chemical substances are discussed by family, i.e. carbon, nitrogen, chlorine, bromine, etc.

4.1 Carbon substances

4.1.1 Carbon monoxide (CO)

CO has significant natural sources (oxidation of naturally occurring hydrocarbons and combustion of vegetation biomass) and anthropogenic sources (fossil fuel burning and the oxidation of anthropogenic hydrocarbons). While CO is not believed to play a significant role in stratospheric ozone photochemistry, it is thought to play a major role in tropospheric photochemistry by controlling the hydroxyl radical (OH) and ozone concentrations. Reaction with CO is believed to be the dominant loss mechanism for OH. The OH radical reacts with and thereby limits the atmospheric residence times of numerous species, e.g. methane (CH_4) methyl chloride (CH_3Cl); methyl chloroform, (CH_3CCl_3); methyl bromide, (CH_3Br); non-methane hydrocarbons (NMHC); Hydrogen sulphide (H_2S); dimethyl sulphide ($(CH_3)_2S$); sulphur dioxide (CO_2; etc. Therefore, any significant increase in the atmospheric concentration of CO, which would reduce the OH radical concentration, could influence stratospheric ozone by increasing the flux of those species into the stratosphere.

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*/ Submitted by the United States of America.

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4.1.2 Carbon dioxide (CO_2)

Carbon dioxide has significant natural and anthropogenic (fossil fuel burning and deforestation) sources. Atmospheric CO_2 is currently increasing at a rate of about 14 ppm a year (3 x 10 15g/yr). CO_2 does not influence stratospheric ozone through chemical reactions, but increasing concentrations of CO_2 should decrease the temperature of the stratosphere, altering rates for several key reactions, resulting in an increase in ozone.

4.1.3 Methane (CH_4)

The sources of methane are believed to be natural (wetlands, animal enteric fermentation, and oceans), and anthropogenic (domestic animal enteric fermentation). These sources need to be quantified in order to understand the global atmospheric budget of CH_4. There is strong evidence that the concentration of atmospheric CH_4 has risen over the past decade (1-2 per cent/year) and some debatable evidence for an increase dating back to the sixteenth century. However, the cause for the increase is unknown. CH_4 has a relatively long photochemical lifetime (approximately 10 years, governed by tropospheric OH) and is important in stratospheric photochemistry. It affects stratospheric ozone because it limits the catalytic efficiency of chlorine by the reaction of atomic chlorine with methane, and contributes to the HO_x radical and water vapour concentrations through its oxidation products.

4.1.4 Non-methane hydrocarbon species (NMHC)

NMCHs includes alkanes (e.g. C_2H_5); alkenes (e.g. C_2H_4); alkynes (e.g. C_2H_2); Aldehydes (e.g. CH_2O); Peroxyacetyl Nitrate ($H_{3.}CO)OONO2$); isoprene; and terpenes. Alkanes, alkenes and alkynes have both natural (natural gas) and anthropogenic sources, while isoprene and terpenes are emitted from vegetation. The remaining NMHC atmospheric species result from the chemical transformation of these emitted species. The photochemical lifetimes of NMHC species are normally short due to their reactivity with the OH radical which limits the flux of these species into the stratosphere. Consequently, NMHC species play a vital role in tropospheric photochemistry, but their direct impact on stratospheric processes is relatively minor.

4.2 Nitrogen substances

4.2.1 Nitrous oxide (N_2O)

The dominant source of N_2O is natural (nitrification and denitrification), but there may be increasingly important anthropogenic contributions (combustion and agricultural fertilization). The atmospheric concentration is currently increasing at a rate of approximately 0.2 per cent per year, but the exact source is still open to question. N_2O has no known removal mechanisms in the troposhere. It is the primary source of stratospheric NO_x (i.e. NO plus NO_2), which plays a vital role in controlling the abundance of stratospheric ozone. Increased levels of N_2O are currently believed to decrease the concentration of ozone in the stratosphere.

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4.2.2 Nitrogen oxides (NO_x)

NO_x denotes the nitrogen oxides NO and NO_2. The magnitudes of the natural (including lightning and soil microbial processes) and anthropogenic (combustion, biomass burning, aircraft exhaust and nuclear explosions) sources are poorly defined. Ground-level sources of tropospheric NO_x do not contribute to the stratospheric budget of NO_x, due to the heterogeneous removal of inorganic nitrogen species (HNO-$_3$; HNO-$_2$; NO-$_2$; NO; N_2O_5; HO_2NO_2) in the troposphere (i.e. by rain-out processes). Consequently, there is no direct influence of ground level sources of tropospheric NO_x on stratospheric photochemical processes which control the concentrations of OH and O_3. Therefore, tropospheric NO_x may have an important indirect influence on stratospheric photochemistry.

Injection of NO_x close to the topopause by aircraft exhaust or by explosion of nuclear weapons can lead directly to a change in lower stratospheric and upper tropospheric ozone levels.

4.3 Chlorine substances

4.3.1. Fully halogenated alkanes (e.g. CCl_4, $CFCl_3$, CF_2 Cl_2, etc)

The sources of the fully halogenated alkanes is solely anthropogenic. The atmospheric concentrations of carbon tetrachloride (CCl_4), Fluorocarbon -11, ($CFCl_3$) and fluorocarbon -12 (CF_2Cl_2) are such that they are presently the greatest anthropogenic contributors to the stratospheric ClO_x conctration, where ClO_x denotes Cl and ClO. The stratospheric ClO_x concentration is currently increasing primarily due to release of $CFCl_x$ and CF_2Cl_2 because of the long atmospheric lifetimes of these species. There are no known tropospheric removal mechanisms for these species. Stratospheric ClO_x is thought to play a vital role in ozone photochemistry, especially in the 30-50 km altitude region. Increasing by level of stratospheric ClO_x are currently believed to decrease the conctration of ozone in the stratosphere.

4.3.2. Partially halogenated alkanes (e.g. CH_3Cl, CHF_2Cl, CH_3CCl_3)

The sources of CH_3Cl is not quantitatively well understood but it is thought to be primarily due to biospheric processes arising in the tropical oceans. CH_3Cl has a relatively short atmospheric lifetime due to reaction with CH in the troposhere. It is presently the single greatest natural contributor to the stratospheric ClO_x concentration. Other partially halogenated alkanes (e.g. CHF_2Cl, CH_3CCl_3), are anthropogenioc in origin. The flux of these gases to the stratosphere is determined by their source strengths and their atmospheric lifetimes which are largely controlled by reaction with tropospheric OH.

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4.3.3 Halogenated alkenes (e.g. C_2HCl_3, C_2Cl_4)

These gases are anthropogenic in origin but their flux to the stratosphere is relatively unimportant due to their very short lifetimes. Again, like the partially halogenated alkanes, their lifetimes are controlled by reaction with tropospheric OH.

4.3.4 Hydrogen chloride (HCl)

HCL has borth anthropogenic and natural (release from sea salt) sources. However, tropospheric sources do not significatnly contribute to stratospheric ClO_x due to rain-out in the troposphere.

4.4. Bromine substances

4.4.1 Fully halogenated alkanes (e.g. CF_3Br)

The source of these gases is anthropogenic with no known tropospheric removal-mechanisms for these species. However the source strengths are though to be much smaller (several orders of magnitude lower) than their chlorine analogues. BrO_x is currently believed to be at least as efficient as ClO_x on a per molecule basis, in controlling stratospheric ozone.

4.4.2 Partially halogenated alkanes (e.g. CH_3Br)

The only substance in this class observed in the atmosphere is CH_3Br, which is natural in origin. The source strength is unknown. The flux of CH_3Br, or any substance in this class, to the stratosphere is limited by its reaction with OH in the trophospthere.

ANNEX CONCERNING MEASURES TO CONTROL, LIMIT AND REDUCE THE USE AND EMISSIONS OF FULLY HALOGENATED CHLOROFLUORCARBONS (CFC:s) FOR THE PROTECTION OF THE OZONE LAYER */

Article 1. The contracting parties shall take all appropriate measures to end the use of CFC-11 and CFC-12 in aerosol cans, except for essential uses. Each contracting party shall decide on a target date for terminating the use of CFC-11 and CFC-12 in aerosol cans, except for essential uses.

Each contracting party shall inform the secretariat of the uses it considers as essential.

Article 2. The contracting parties shall agree on and implement measures to control, limit and reduce emissions of fully halogenated CFCs by developing and using the best paracticable technologies to limit emissions in the sectors of foam plastic, refrigeration, solvents and others.

The contracting parties shall co-operate in providing assistance to developing States in order to enable them to participate in these actions.

Article 3. Each contracting party shall provide the secretariat with:

(a) Relevant figures concerning its production and production capacity in regard to fully halogenated CFCs;

(b) Relevant figures concerning its use of CFC-11 and CFC-12 in the production of aerosol cans;

(c) Information on its experience in limiting emissions of fully halogenated CFCs in the sectors of foam plastics, refrigeration, solvents and others;

(d) Information on the target date provided for in article 1.

This transfer of information shall start within six months after the entry into force of this convention, or in case where a party accedes to the convention at a later date, six months after its entry into force for that party. It shall be repeated at intervals to be agreed upon by the conference of the parties.

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*/ Submitted by Finland, Norway and Sweden.