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**Seventh meeting of the Conference
of the Parties to the Vienna
Convention for the Protection
of the Ozone Layer**

Dakar, 12–16 December 2005

Item 3 (b) of the provisional agenda*

**Consideration of Vienna Convention and joint Vienna Convention/Montreal Protocol
issues: presentation and consideration of the report of the sixth meeting of the
Ozone Research Managers to the Vienna Convention**

**Recommendations of the sixth meeting of the Ozone Research
Managers of the Parties to the Vienna convention for the Protection
of the ozone layer**

Note by the Secretariat

1. The sixth meeting of the Ozone Research Managers of the Parties to the Vienna Convention for the Protection of the Ozone Layer took place at the Vienna International Centre in Vienna, Austria, from 19 to 21 September 2005. The meeting was organized by the Ozone Secretariat of the United Nations Environment Programme (UNEP) in cooperation with the World Meteorological Organization (WMO), in accordance with decision I/6 of the Conference of the Parties to the Vienna Convention. The meeting adopted the recommendations reproduced in the annex to the present note, as contained in chapter 11 of the WMO Global Ozone Research and Monitoring Project report No. 48, for transmission to the Conference of the Parties to the Vienna Convention at its seventh meeting.

* UNEP/OzL.Conv.7/1.

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Annex

Recommendations of the sixth meeting of the Ozone Research Managers of the Parties to the Vienna Convention for the Protection of the Ozone Layer, held in Vienna, Austria, from 19 to 21 September 2005

11. ADOPTION OF THE RECOMMENDATIONS AND THE REPORT

11.1 Introduction

11.1.0 The basis for the recommendations presented in this report is derived from information contained in the national reports presented at the 6th Meeting of Ozone Research Managers, progress and strategy reports from various international programs and projects, and reports from recent and ongoing assessment activities. It is not the purpose of these recommendations to reproduce this information, but, rather, to draw from it. In particular, shortcomings in existing observation systems are documented in the national reports.

11.1.1 Although considerable progress has been made over the last decade in understanding the role of halogen chemistry in stratospheric ozone loss, there are a number of uncertainties whose resolution define the need for present and future observations and research. The effectiveness of the provisions of the Montreal Protocol and its Amendments has been clearly observed in the declining atmospheric abundances of many ozone-destroying species. In fact, the abundance of effective equivalent stratospheric chlorine (EESC) has been declining slowly for more than five years. Nevertheless, the abundances of many of the replacements for ozone-depleting substances (ODSs) still are increasing, and EESC will remain above pre-1980 levels for several decades. Hence, stratospheric ozone will remain vulnerable to chemical depletion for much of the current century. This vulnerability is highly dependent on climate-induced atmospheric changes. Further, the vulnerability would increase as a result of enhanced atmospheric aerosol loading resulting from major volcanic eruptions. This ozone vulnerability is coupled to continuing risks associated with the effects of increased UV radiation on human health and ecosystems.

11.1.2 Observations and analyses indicate that the rate of stratospheric ozone depletion at midlatitudes has slowed in recent years; however, over the polar regions, while some indicators show reductions in ozone depletion, these have not been unambiguously attributed to changes in stratospheric halogen loading (i.e., declining EESC). At midlatitudes and in the polar regions, other changes in atmospheric composition and dynamics also may be responsible. Continued research and observations are critical to quantifying the chemical and dynamical components of these changes in ozone and, thus, to labeling such changes as ozone recovery associated with anthropogenic halocarbons. Ozone recovery will occur in an atmosphere that is markedly different from pre-1980 conditions. Climate change associated with increased abundances of greenhouse gases is expected to alter the nature and timing of ozone recovery. Specifically, cooler stratospheric temperatures resulting from climate change will enhance ozone-loss processes, thereby increasing ozone vulnerability in the polar regions, particularly in the Arctic. Observations have shown that cold Arctic winters have been characterized by lower minimum temperatures in the stratosphere. Further, some greenhouse gases pose additional direct threats to ozone through other chemical-depletion cycles. Ozone is a greenhouse gas, and quantifying its role in climate change requires continued high-quality measurements of both total abundance and vertical profile. The strong coupling between climate change, ozone production and loss, and accompanying changes in UV radiation at the ground places more stringent demands on long-term research and measurement needs, many of which are documented in The Integrated Global Atmospheric Chemistry Observations (IGACO) theme report (September 2004) prepared by WMO and ESA under the auspices of the Integrated Global Observing Strategy (IGOS).

11.1.3 As stated in paragraph 11.1.1, ozone vulnerability raises concerns about the adverse effects of increased UV radiation on human health and ecosystems. While a number of regional UV observational networks have been put in place in recent years, there remains a need for a stable, long-term observational capability that is geographically balanced. Without such a capability, the

necessary high-quality UV data record cannot be obtained. Various atmospheric effects of climate change (e.g., cloud cover, aerosol abundance, albedo, temperature) on ground-level UV may actually be larger than ozone-induced effects. This recognition places increased demands on improving the observational capabilities for tracking such UV changes, and thereby providing necessary data for effects research. Further, biological effects due to increasing UV may be affected by increased temperature associated with climate change.

- 11.1.4 The considerable advances achieved in scientific understanding have been used by some to suggest a lessening need for long-term observational systems. On the contrary, the complexities of ozone and UV science highlighted above require the continuation and expansion of systematic measurement and analysis capabilities for tracking the evolution of ozone- and climate-related source gases and parameters, for detecting and tracking the stabilization and expected recovery of stratospheric ozone, for attributing changes in radiation forcing to changes in the ozone profile, and for deriving a global record of ground-level UV radiation.
- 11.1.5 The Sixth Meeting of the Ozone Research Managers, in recognition of the above issues, adopted the following recommendations. In doing so, they noted that international funding and cooperation are essential for their implementation, and noted once again that past recommendations have not received sufficient attention due to the absence of such funding and cooperation. This has exacerbated problems associated with the maintenance of existing instruments and networks, and with the development and implementation of new capabilities. Further, the implementation of the recommendations requires research and observational capabilities throughout developed and developing countries. Several international global-change initiatives have been formulated recently. Their success requires scientific capabilities at all national levels. Hence, intensified capacity building in developing countries and countries with economies in transition (CEITs) is required. Such capacity building is in the interests of all Parties, since the creation of a scientific community in developing countries will not only contribute to global ozone and UV science, but it will serve as the basis to provide local policymakers with scientific arguments on long-term implementation of the Montreal Protocol and its Amendments. Further, such expertise will enable the participation of experts from developing countries in the international assessment process.

11.2 Systematic Observations

Evaluation of the state of the ozone layer and an understanding of ground-level UV radiation require a stable, integrated global observing system consisting of ground-based, airborne, and satellite measurements. While synoptic-scale measurements are mainly derived from satellite data, ground-based and airborne measurements add increased temporal and spatial resolution, and provide critical validation of satellite sensors. Continuing validation of all observational components is necessary to insure the high quality of the data products. The continuity and long-term stability of these highly complementary measurements are necessary to assess the onset of ozone layer recovery, to monitor its evolution, and to track changes in ground-level UV radiation associated with ozone and climate.

- Provide financial and institutional support to maintain and to expand well-calibrated ground-based measurement networks for column ozone, including both spectral and filter instruments. This includes the maintenance and preservation of aging instruments, the deployment of unused instruments to developing countries and CEITs, the application of new technologies, and the development and maintenance of adequate regional calibration facilities including, but not limited to, the M-124 instrument network.
- Provide financial support to continue existing long-term profiling of ozone, and to enhance these measurements in data-sparse areas, particularly in the tropics.
- Provide resources to continue and extend the long-term global column ozone trends record provided by validated and quality-controlled space instruments. This requires the continued development of a homogeneous data record from multiple instruments.
- Provide financial support to maintain both ground-based and space-borne measurement capabilities for climate- and ozone-related trace gases and atmospheric parameters. This includes ground-based networks, such as NDSC and WMO GAW, and existing space instruments.
- Continue the implementation of ozonesonde standard operating procedures, and extend these procedures to other ozone and UV instrument types.

- Maintain the radiosonde network, and expand it into areas with inadequate coverage, especially the tropics. Network funding should accommodate the reporting of higher-resolution radiosonde data to the World Data Centres, and the recovery, reprocessing, and archiving of historical radiosonde records.
- Maintain and expand UV networks, including both spectrally resolved and broadband instruments, to achieve geographical balance and to maintain long-term stability. This requires financial support for the establishment and/or expansion of calibration facilities on regional and global scales.
- Provide financial support to conduct regularly scheduled intercomparisons of instruments, algorithms, and standards associated with measurements of ozone, ozone- and climate-related trace gases, and UV radiation in order to maintain long-term data quality and integrity.
- Continue operations of unique high-latitude measurements and facilities, both in the Arctic and the Antarctic. This includes the reactivation of measurement sites recently closed due to funding reductions.

11.3 Research Needs

There are a number of new unanswered questions with respect to expected ozone recovery and the interrelationship between ozone and climate change. The ability to predict future ozone behavior requires quantification of the roles of chemical and dynamical processes responsible for ozone production, loss, and distribution, and their uncertainties. The development of realistic scenarios of the future abundances of anthropogenic and biogenic trace gases also is required. The parameterization of these processes in chemical transport models remains challenging. In addition, these processes are occurring in a continually changing atmosphere. Further research is needed on the response of ground-level UV to changes in ozone, as well as to climate-driven changes in other atmospheric parameters. Research is required not only to study biological vulnerability to increased levels of UV radiation but also other stress factors (i.e., integrated stress assessments).

- Support studies to quantify the chemical and dynamical components of polar and mid-latitude ozone loss in order to understand ozone evolution in a changing atmosphere. These include:
 - Studies examining the effects of climate change on ozone production, loss, and distribution, as well as possible feedbacks.
 - Studies investigating the dynamical coupling between the upper troposphere and lower stratosphere, particularly as it applies to water vapour, short-lived halogen species, and ozone.
 - Studies of aerosol and polar stratospheric cloud microphysics, and of cirrus in the tropical transition layer.
- Support studies aimed at understanding the budgets of ozone- and climate-related trace gases. This includes studies of the effects of climate change on the sources, sinks, and lifetimes of these gases.
- Support studies on the atmospheric effects of climate change (e.g., cloud cover, aerosol abundance, albedo, temperature) on ground-level UV radiation.
- Support studies on the consequences of interactions between ozone and climate on human health and ecosystems, including longer exposure to increased UV radiation due to a delayed recovery in the stratospheric ozone layer, the effects of increased temperature on the incidence of UV-induced skin cancer, and other biological impacts.

11.4 Data Archiving

The archiving and accessibility of ozone and UV data are as important as the measurements themselves. WMO's World Ozone and Ultraviolet Data Centre (WOUDC), operated by the Meteorological Service of Canada in Toronto, is the primary repository of the world's ozone data. However, additional ozone and UV measurement data are held at individual stations and often are archived at other data centre facilities. It must be recognized that data archiving is a resource-intensive activity; hence, it is important that funding provided for research and observations be adequate to include data archiving activities. Further, it is important that efforts be undertaken to transfer all ozone and UV data to the WOUDC, as well as to conduct re-evaluations of historical data.

- Encourage the submission of near-real-time data for column ozone, ozone profiles, ancillary ozone-

and climate-related data, UV radiation, and campaign data to the appropriate local and world data centres. Funding for such data archiving activities should be included in the resources provided for research and observations.

- Urge all data centres to develop procedures for the prompt submission of their ozone, UV, and ancillary ozone- and climate-related data to the World Ozone and Ultraviolet Data Centre (WOUDC). Data archiving must include detailed metadata that describe the quality of the measurement and the instrument history.
- Provide funding for archiving raw data from various observational networks, either at the local institution or at the WOUDC, as appropriate. It is understood that archiving raw data does not replace the archiving of final data products.
- Provide continued support for the re-evaluation of the historical ozone, UV, and trace-gas data, in order to preserve and improve the long-term records.

11.5 Capacity Building

Many of the world's ozone- and UV-measuring stations are located in developing countries and CEITs. The instruments used require sophisticated calibration and maintenance, much of which is unavailable without international capability. At present, there is an insufficient number of regional centres for research, calibration, and validation in developed and, especially, in developing countries. Therefore, it is vitally important that sufficient resources are made available to maintain the current global network of observations, and to expand it to uncovered areas.

- Support and encourage regional and bilateral cooperation and collaboration among developed and developing countries and CEITs to provide a global expertise in ozone and UV measurements and research.
- Provide resources for scientific and technical training, at and beyond the instrument-operation level, thereby allowing instrument operators and other scientific personnel in developing countries and CEITs to use their data, other available data, and models in both regional and international research areas. This should include:
 - Resources for the exchange of visits among personnel from monitoring stations in developed and developing countries and CEITs in order to ensure technology transfer and sustained measurement programmes.
 - Resources to permit the participation of representatives from developing countries and CEITs in regional and international validation and intercomparison campaigns.
- Provide resources to establish systems for public dissemination of information about the effects of ozone and UV changes on human health and the environment. This dissemination, which includes education and outreach programmes, is especially important in developing countries and CEITs. Network facilities, such as those of the UNEP Division of Trade, Industry and Economics (UNEP/DTIE), could be utilized for this purpose.
- Provide resources for the establishment of regional centres for research, calibration, and validation in developed and, especially, in developing countries.
- Urge the Parties to extend the life of and make contributions to the Trust Fund for Observation and Research (established by Decision VI/2). This fund is critical to enabling the capacity-building activities that have been highlighted above. Presently, this fund is far short of satisfying these needs.