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Item 3 (a) of the provisional agenda of the preparatory segment*

Consideration of Vienna Convention and combined Vienna Convention and Montreal Protocol issues: presentation of and discussion on the report of the seventh meeting of the Ozone Research Managers of the Parties to the Vienna Convention

Recommendations of the seventh meeting of the Ozone Research Managers of the Parties to the Vienna Convention

Note by the Secretariat

The seventh meeting of the Ozone Research Managers of the Parties to the Vienna Convention was held in Geneva from 18 to 22 May 2008. The annex to the present document contains the recommendations made by the Ozone Research Managers at that meeting. The full report is also available to the Conference as a background document and can be consulted online at http://ozone.unep.org/Meeting_Documents/research-mgrs/7orm/7orm-report.pdf. The recommendations are reproduced as contained in that report and have not been formally edited.

* UNEP/OzL.Conv.8/1-UNEP/OzL.Pro.20/1.

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Annex

Recommendations of the seventh meeting of the Ozone Research Managers of the Parties to the Vienna Convention[1]

Recommendations

Research Needs

There are a number of new questions with respect to expected ozone recovery from the influence of ozone depleting substances (ODSs) and the interrelationship between ozone and climate variability and change. The ability to predict future ozone behaviour requires quantification of the roles of chemical and dynamical processes responsible for ozone production, loss, transport, and distribution, and their respective uncertainties. The development of realistic scenarios of the future abundances of anthropogenic and biogenic trace gases in the stratosphere and troposphere is required, particularly with respect to a changing climate. Further research is needed on the response of ground-level UV to changes in ozone and other atmospheric parameters in response to changes in ODSs, air quality, and climate-forcings. Research is required on both human and biological vulnerability to increased levels of UV radiation and other stress factors (i.e., integrated stress assessments).

A number of general issues are emerging. Coupled chemistry-climate models (CCMs) are becoming more mature, but it is clear that more effort must be devoted to model development and validation, including through international programmes. Earth System Models are now being developed that include crude stratospheric ozone parameterizations, and these models should begin to incorporate improved CCM treatments of the dynamics, radiation, and chemistry of ozone. In addition, long-term measurements represent an extremely important resource and the continued, and increased, exploitation of these data for scientific process studies is strongly commended. Finally, there is some concern that capacity for fundamental laboratory studies may be decreasing.

- Provide support for studies that quantify the chemical, radiative, and dynamical factors contributing to ozone layer evolution in a changing atmosphere (i.e., ozone recovery), including studies of the unintended consequences of climate change mitigation and adaptation strategies. These include:
  - Studies examining the effects of climate change on ozone production, loss, transport, 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, and leading to improved understanding of stratospheric temperatures, the stratospheric overturning circulation and their connection to climate change.
  - Studies of aerosol and polar stratospheric cloud microphysics, and of cirrus in the tropical transition layer.
- Provide support for laboratory, photochemical, kinetic, and spectroscopic studies that relate to ozone evolution and its monitoring.
- Support studies aimed at understanding the emissions (both natural and anthropogenic), banks, and tropospheric and stratospheric evolution of ozone depleting substances and their substitutes and other climate-related trace gases. This includes studies of the effects of climate change on the sources, sinks, and lifetimes of these gases and the study of very short-lived species.

[1] Published as WMO Global Ozone Research and Monitoring Project (Report No. 51), under publication symbol WMO/TD No. 1437.

- Support studies to investigate the role and impact of changes in stratospheric ozone and ODSs on surface climate. Also, support studies of the influence of these stratospheric changes on tropospheric processes which are influenced by stratosphere-troposphere exchange and UV penetration.
- Support studies that allow quantitative disaggregation of the factors affecting UV radiation at the surface so that the influence of factors other than ozone (such as cloud cover, aerosol abundance, albedo and temperature) can be better assessed.
- Support studies on the effects of stratospheric ozone change on human health, ecosystems, and materials through exposure to UV radiation.
- Support the development of new and innovative instrumentation, algorithms, and analyses as a means of reducing measurement uncertainty and increasing the global observational capacity with regard to ozone, UV, ODSs, and related variables.

Systematic Observations

Data Networks

Systematic observations are critical to understanding and monitoring the long term changes in atmospheric ozone and associated changes in surface UV. These networks provide the backbone of our understanding of ozone and UV, and involve many nations around the world. The operations of these networks also provide the training for atmospheric scientists around the world, including those in developing countries. The demands on these networks are high, in that they provide the basis for understanding trends and understanding the processes controlling ozone. These networks fall into two broad categories, surface networks (including balloon-borne) and satellite networks.

Surface Networks

These networks span a broad range of surface based observations using numerous techniques such as UV instruments (e.g. Brewer, Dobson, Umkehr, M124), in situ instruments, UV/visible spectrometers, FTIR, Lidars, microwave observations, and sonde networks. These networks must be maintained, and have a significant need for growth in various regions of the globe. Most of these areas include developing countries such as those in the tropics, central Asia, and the mid-latitudes of the southern hemisphere. The networks at high latitudes are also critical and need to be maintained as they give direct observations of polar ozone processes. There are numerous recommendations related to the maintenance and growth of these networks. These include:

- Priority to be given to the tropics, Central Asia, and southern mid-latitudes for filling data gaps in geographic coverage. We should consider the redistribution of observation sites from areas highly populated with instruments to those areas that are poorly populated. This requires infrastructure support in these areas.
- The parts of the world currently operating the former USSR network of M124 instruments should have at least some of those instruments slowly phased out or co-located with Brewer or relocated Dobson instruments.
- Brewers are the preferred instrument for all expansion efforts around the globe where a new Ozone and UV monitoring programme is to be established. Unused Dobson instruments are a more economical way to expand these networks and to introduce observations into new sites or programmes.
- There is a need to continue and further expand Umkehr sites to maintain this time series in the upper stratosphere. Umkehr observations represent the primary ground technique to observe the upper stratosphere since sondes cannot reach these altitudes.
- We need to maintain the continuity of ground based in situ observations of ozone depleting species (ODSs) and their substitutes, as well as continued

observations of N_2O and CH_4 (which are both GHGs and ODSs).

- Key networks that obtain altitude profile information of ozone related species from instruments like lidars, FTIR, SAOZ, DOAS, and microwave radiometers, should be maintained as they form the primary ground based observations for many of these key species.
- Balloon sonde networks provide critical observations which give vital high resolution vertical profiles of ozone and water vapour that are needed for multiple scientific activities in ozone research and therefore need to be maintained and increased. Specific suggestions include:
  - Archived data reports of ozone sondes should also include the simultaneous water vapour profiles within the data submissions.
  - Water vapour profiles measured by meteorological radiosondes should be more openly available for ozone research and monitoring.

Satellite Networks

The other critical networks are those obtained from satellite programmes associated with a number of nations. These networks include the vast and critical solar backscatter observations in the UV that have established the trends in mid-latitude and polar total ozone since the 1970s. These observations must be continued. The other critical satellite network is that of limb sounding observations (including occultation, emission, and scattering) that provide high vertical resolution data of ozone and key ozone related parameters which are critical for understanding the science behind changes in ozone in the context of changing climate. In particular, these limb observations provide the types of observations required to fully characterize ozone changes in the critical altitude regions of the upper troposphere/lower stratosphere (UTLS), as well as the upper stratosphere. Based on current space agency plans, there will be a serious gap in these types of observations from satellites. Many of these satellite observations provide key meteorological data that are needed to fully understand stratospheric transport which controls the distribution of ozone and evolution of the ozone hole. Improved satellite observations of atmospheric transport are required to improve this understanding. Specific recommendations for satellite networks include:

- The continuation of the solar backscatter UV observations must be ensured as they constitute a key baseline set of measurements. All of the planned missions with solar backscatter instruments are needed to maintain this continuity of observations and maintain the required redundancy.
- Satellite observations of high vertical resolution profiles using limb viewing for O_3 and key molecules like HCl, CFCs, ozone relevant radicals and reservoirs, tracers of atmospheric motion, and H_2O are required in order to more accurately understand the changes in O_3 as CFCs decline and climate change occurs.
- Gap filling missions providing high vertical resolution of ozone and ozone related parameters using techniques such as solar occultation FTS or microwave limb emission instruments should be considered as a low cost gap filler between the current limb satellite observations and the future missions currently planned by the various space agencies.

Consistency and complementarity of data sets

- There needs to be systematic understanding of the differences between different data observation techniques so that the data can be combined in an appropriate way.
- Intercomparison missions are desirable because they assist in defining and reducing the systematic differences in both identical and different measurement techniques. Examples include the SAUNA campaigns in 2006/7 that were designed to understand calibration and stray light issues and improve techniques for the comparison of remotely sensed data.

Re-evaluation of data records

- Some data sets exist that are not currently analysed. An effort needs to be made to analyse these sets and archive the data.
- Many data sets need to be reanalysed based on improvements in analysis techniques or further understanding of instrument characteristics, and then archived to ensure the highest quality of the data available in archives.
- A technological workshop should be organized to bring together managers of the archived data sets that require reprocessing and provide guidance on how best to perform this work, following which the reprocessing should then take place. This process should be arranged under the guidance of the Scientific Advisory Group for Ozone monitoring.
- A workshop on reanalysis of total ozone time series should be organized in 2009 or 2010.

Integration of new instrumentation

- The networks should make an effort to increase the use of more sophisticated instrumentation (e.g., UV-VIS, FTIR. Microwave, lidar, airborne). As with established instruments, definition of Standard Operating Procedures and metadata records for all operational instruments should also be available.

Spectroscopic standards

All observational operations that rely on the optical properties of atmospheric constituents are only as good as the spectroscopic parameters obtained by laboratory spectroscopic studies.

- Data archives should include documentation of the spectroscopic parameters used for the analysis of the data.
- There need to be continued studies to improve the standardization and consistency of cross sections for ozone and related species in different wavelength regions (e.g., UV, IR, microwave).

Coordination of existing infrastructures and coordinating bodies

- The various observation networks should continue and increase their level of collaboration to ensure economy of scales, shared facilities, increased coverage and other benefits.
- These networks and coordinating bodies include GAW, NDACC, IGACO, GCOS, CEOS, AGAGE and NOAA ESRL.

Global UV monitoring system

There are multiple calibration sites around the world that are not sufficiently tied together, hence;

- An international calibration infrastructure should be created. It should promote a quality assured protocol such as that used by the NDACC network.
- The data sets resulting from such observations should not be restricted and should be widely deposited into WOUDC.
- Public information services need to be further implemented.
- The above activities should be coordinated and supported by the Scientific Advisory Group for UV monitoring.

Data Archiving

The near real-time transmission of observational ozone and UV data is becoming a critical need of NMHS for assimilation in forecast models. While this data use is recognized as an important aspect to the observation of these variables, the data is not generally of a quality necessary for trend analyses, satellite validation and model development. Therefore, before being archived, data must be quality assessed to ensure that it is of the highest possible quality and includes the metadata necessary to be of value for multiple uses by a variety of users today and in the future. Data submitters must continue to adhere to existing data submission protocols, particularly information on standard operating procedures and calibration histories, in order to maintain the overall quality and therefore the reputation of the entire archive. It is acknowledged that obtaining data of this quality is costly and time-consuming but is nonetheless an essential task and so data providers should be adequately funded and recognized for their efforts in providing this data to global archives for the furtherance of ozone and UV science. In order to aid in both the development of appropriate data quality assurance and submission procedures and the timely access by data users to this information, it is recommended that:

1. As not all the recommendations of the 6th ORM have yet to be fully implemented, efforts be continued to assure that these be met before the next ORM.

   a. *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.*

   b. *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.*

   c. *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.*

2. Increased efforts be expended on the recovery and assessment of historical data and associated metadata records. Governments and agencies are encouraged to provide resources to undertake data salvage as a priority activity.

3. Standard data quality assurance procedures be developed and freely distributed to all data providers (O_3, UV, ODSs, etc.) in order to increase the overall quality of data through standardization. These procedures would be agreed upon through the appropriate advisory group (e.g., WMO GAW SAG) before implementation.

4. Enhancements be made through the WMO and other international organizations in order to adequately link various data centres (e.g., Ozone, UV-radiation, GHG, meteorological) as a means of ensuring all necessary data required for validation and modeling efforts be available in an easily retrievable format (e.g., WMO WIS is a potential system).

5. The very important observations obtained through regional process studies be archived in such a manner that they can be made freely accessible to scientists and the general public within a reasonable period of time.

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 training 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. There is also a large need to develop competence and expertise in developing countries and CEITs.

- Support and encourage regional and bilateral cooperation and collaboration (twinning) among developed and developing countries and CEITs to extend global expertise in ozone and UV measurements and research. Several twinning collaborations are already on-going through in-kind contributions. Successful existing twinning collaborations should be identified and expanded with additional funds.
- Provide resources and opportunities 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 and visits of personnel from monitoring stations in developed and developing countries and CEITs in order to ensure technology and knowledge transfer and sustained measurement programmes.
  - A mechanism, through UNEP and WMO, for scientists from developing countries and CEITs to spend some months at an institution in a developed country. To start with, the aim should be to support two to three such visits per year. The proposal should be written jointly by the visitor and the hosting institution and should include a plan for the continuation of the work after the visitor returns home.
  - Resources to permit the participation of representatives from developing countries and CEITs in regional and international validation and intercomparison campaigns. In addition participation as observers needs to be supported at focused workshops dealing with instrument characterisation and development of standard operating procedures. Such activities are critical to human resource development.
  - Institutions that organise measurement campaigns in developing countries and CEITs are urged to involve local scientists and students.
  - The WMO-GAW Training and Education Centre (GAWTEC) established in Germany has been successful in providing training in measurements and instrument calibration to scientists from 46 countries throughout the world. There is a need to expand such targeted training to other regions of the world and also to include ozone observations as a theme. The ultimate goal is to establish GAWTEC centres in all WMO regions.
  - Resources should be provided to support to scientists from developing countries and CEITs to attend conferences and workshops.
- Provide resources for sustainable, long-term operation of regional centres for research, calibration, and validation in developed and, especially, in developing countries. Several regional centres for Dobson and Brewer instrument calibration have been established. It is of vital importance that these centres receive sufficient support to arrange regular calibration exercises for the instruments in their respective regions.
- Educational activities, such as the Brewer workshops organised by Environment Canada, are highly appreciated by the participants and should be organised more frequently and in various regions of the world.
- All Parties are urged to make continued contributions to the Trust Fund for Observation and Research (extended by Decision VII/2) which is critical to enabling the capacity-building activities that have been highlighted above. Presently, this fund is far short of satisfying these needs. There is a need for both monetary and in-kind contributions. In the reports on the Trust Fund to the Parties, specific in-kind contributions that are directly targeted at the ozone and

UV activities should also be quantified. Past experience and foreseeable needs require a minimum expenditure of USD 100,000 per year in addition to various types of in-kind support.

- All Parties are urged to submit proposals that seek funding from the Vienna Convention Trust Fund for Research and Systematic Observations or other relevant in-kind support. Proposals can be submitted throughout the year and advice of the WMO-GAW Science Advisory Group will also be sought in the evaluation of the project proposals.
- UNEP's Compliance Assistance Programme (CAP) under the Montreal Protocol should also include support for capacity building in ozone observations, for example, by inviting scientists and WMO experts to participate in the ODS Officers' network meetings to provide information and knowledge on ozone science, research and monitoring issues.