## Instrument intercomparisons and calibrations

### *What has been accomplished recently?*

All nine Dobson spectrophotometers in WMO RA I (Africa) participated in an instrument comparison, which was held in February/March of 2004 at Dahab, Egypt, near the Red Sea. Experts from the World Dobson Calibration Center (Boulder) and the Regional Dobson Calibration Center for Europe (Hohenpeissenberg and Hradec Kralove) organised and conducted this intercomparison.

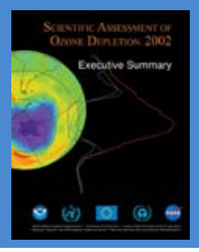
The performance of the participating instruments, and subsequently their data quality, had been improved significantly since the last campaign in Pretoria, South Africa in 2000. However, there are still some problems with individual instruments, such as instrument maintenance and skill of the operators. It turned out to be necessary to send the Kenyan Dobson No. 018 to Germany for complete refurbishment, as it was not possible to repair it on the spot. The other eight instruments got final calibrations, which enables measurements of total ozone at the African Dobson sites within the error limits of ±1%. This activity was funded through the Vienna Convention Trust Fund for Research and Systematic Observations.

### *What are the needs?*

- The ground-based ozone observing system consists of several instrument types, such as the Dobson and Brewer spectrophotometers and the M-83 and M-124 filter instruments.
- All these instruments need to be calibrated against standard instruments on a regular basis, i.e. every two to four years.
- There is now a long list of instruments deployed in third world countries and CEITs that need repair and/or calibration. The following are just examples from the long list of stations that need calibration visits: Ferraz, Brazil; Artigas, Uruguay; Bangkok and Songkhla, Thailand; Isfahan, Iran; Katmandu, Nepal; Bandung, Indonesia.
- Approx. USD 150,000 is needed over the next two years for Brewer calibrations.
- Dobson intercomparisons will be held in Australia, Japan and Argentina in 2006 and more will be needed the next few years.
- The filter instrument network needs to be calibrated.
- In order for developing countries and CEITs to be able to deliver data of the quality that one needs to verify the expected recovery of the ozone layer, it is estimated that the need for support over the next four years will be approx. USD 500,000.

## Participation in the Scientific Ozone Assessments

The WMO/UNEP Scientific Assessments of Ozone Depletion constitute the most authoritative overview of the stratospheric ozone problem that is available. The authors who write these assessments as well as the reviewers are almost exclusively scientists from the developed countries. In order to increase the awareness of the importance of compliance with the Montreal Protocol, it is of vital importance that each Party to the Protocol has resident expertise in ozone matters. This can be obtained through transfer of knowledge from the industrialised world to the developing countries. One way to accomplish this is through the establishment of monitoring programmes that will produce observational data of value to the assessment process. Researchers from developing countries should be encouraged to take part in analysis of data and scientific publications where their data is used. Many developing countries are located in the tropics, and this is also an area of the globe where there is a lack of observations.






# Capacity building for ozone monitoring in developing countries

## Filling the gaps in our global network is a priority under the Vienna Convention for the Protection of the Ozone Layer

World Meteorological Organization
Weather • Climate • Water

UNEP
Ozone Secretariat

July 2006

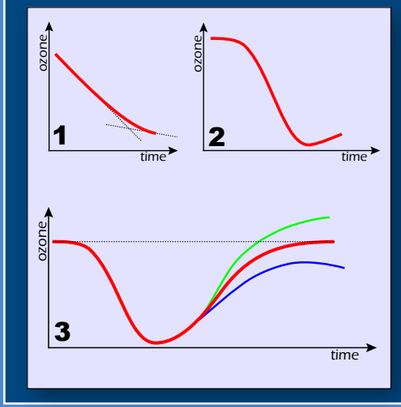
Capacity building for ozone monitoring and research in developing countries and in countries with economies in transition comes from the general commitments anchored in the Vienna Convention. The Parties under the Vienna Convention established the Trust Fund for Research and Systematic Observations for funding activities consistent with the objectives of the Vienna Convention and the recommendations of the Ozone Research Managers' Meetings. Those aims are also consistent with the Strategy for the Implementation of the Global Atmosphere Watch Programme (GAW) of the World Meteorological Organization (WMO) under which limited funds are available. Enhancement of the GAW ozone monitoring network in all continents and creation of local scientific communities contributing to the world ozone science are the main goals of the capacity building.

# It will still be decades before the ozone layer recovers

### *We must maintain our vigil*

- Support for ozone research in many parts of the world has declined in the mistaken belief that declining stratospheric chlorine levels achieved by the Montreal Protocol guarantees that the ozone layer will recover.
- Much remains in doubt: While the concentrations of CFCs and reactive chlorine in the atmosphere are declining as a result of the Protocol, there are still many challenges ahead before we can see clear evidence of ozone recovery.
- Failure to comply with the Montreal Protocol could delay or even prevent recovery of the ozone layer.
- Observations from all parts of the globe are needed in order to have the necessary data material for detecting ozone recovery and for understanding ozone variability in a changing climate.

## The three phases of ozone recovery




In our search for the restitution of the ozone layer we have to distinguish between the three phases of recovery:

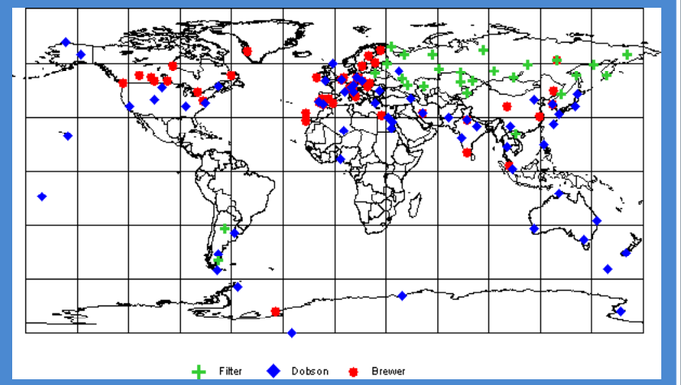
- The first phase (upper left) is when the decline is less steep than earlier.
- The second phase (upper right) is when one has passed the minimum and ozone is starting to increase again.
- The third phase, complete recovery, (lower panel) is when ozone is back at the levels before 1980.

Scientists have found signs of the first phase of recovery at mid-latitudes. Complete recovery is expected around the middle of this century, but there is uncertainty whether the ozone layer will ever return to the pre-1980 state because of the different chemical composition of the atmosphere in 2050 compared to 1980. In particular, the stratospheric contents of $CO_2$, methane, nitrous oxide and water vapour will be significantly different in 2050 from what it was in 1980.

# Large gaps in the observing system

### *More measurements needed in the tropics*

- Many ozone- and UV-monitoring stations are located in developing countries and countries with economies in transition (CEITs).
- The instruments require calibration and maintenance, much of which is unavailable without international capability.
- There is an insufficient number of regional centres for research, calibration, and validation, especially in developing countries.
- It is vitally important that sufficient resources are made available to maintain the current Global Atmosphere Watch (GAW) network, and to expand it to uncovered areas, such as the tropics.
- Satellite measurements are very valuable but need to be checked against ground based observations in order to be qualified as data of sufficient quality for trend analyses and detection of ozone recovery.
- Hence, ground based measurements are needed in all regions of the world in order to validate the satellite observations.
- There is a need for more modern technology in the tropics and in the terrrotories of the former Soviet Union. The trend in the future is toward many measurements throughout the day.
- Funds for relocation, maintenance and calibration are lacking.
- In order to modernise and fill the gaps in the global network, there is a need to deploy 2-4 new instruments per year over the next several years. Over the next ten years this will cost approx. USD 4 million.




*The map shows that large regions of the world are uncovered. This gap can be partly filled by relocation of ozone spectrophotometers from Europe and USA that are now available for donation to developing countries and CEITs.*

# Relocation of instruments

### *What has been accomplished recently?*

- Many stations that used to observe the thickness of the ozone layer with Dobson spectrophotometers have switched over to the more automatic Brewer spectrophotometer.
- After some years of overlapping measurements, the Dobson instruments are no longer needed at these sites and can be relocated to sites in developing countries.
- Such relocation is a very cost effective way of transferring knowledge and observing capacity to developing countries since the instrument is obtained at no cost.
- However, there is a need for calibration, transport and training of the personnel at the site that receives such instruments.
- Recently, unused Dobson instruments have found new homes in Armenia, Botswana and Kenya.

### *What are the needs and future plans?*

Ten Dobson/Brewer spectrophotometers are available for relocation. Candidates for receiving such instruments are: China, Mongolia, Russia and Vietnam. The cost for each relocation is approx. USD 15,000. This includes training of personnel to operate the instruments.

*Training of personnel in Nairobi by an expert from the Czech Hydrometeorological Institute.*

*A Dobson spectrophotometer is being repaired and put into working order. Where?*

# Twin cooperation

### *What has been accomplished recently?*

There are several examples of developed countries offering instruments and training to institutions in developing countries. Some are listed here:

- NASA (USA) provides funding and training for the Southern Hemisphere Additional Ozonesondes (SHADOZ) network.
- MeteoSwiss collaborates with the Kenya Meteorological Department on total and profile ozone measurements at the GAW stations in Nairobi and on the slope of Mt. Kenya (photo).
- Finnish, Spanish, Italian and US institutions collaborate with Argentina on ozone and UV measurement at southern high latitude stations.
- The Netherlands Meteorological Institute offers instrumentation and training for the GAW station in Paramaribo, Suriname.
- The Czech Hydrometeorological Institute has provided training for personnel at observatories in developing countries.

These bilateral collaborations prove very efficient and contribute significantly to the measurement programmes of GAW and contributing networks. It also helps building resident expertise in the countries receiving such aid.

### *What are the needs?*

Expert institutions in developed countries are urged to establish twin cooperation with relevant institutions in developing countries and CEITs. Such cooperation should include instrumentation, practical training and scientific collaboration on analysis and interpretation of observations, leading to joint scientific publications.