ARAB REPUBLIC OF EGYPT
STATE MINISTRY FOR ENVIRONMENTAL AFFAIRS
EGYPTIAN ENVIRONMENTAL AFFAIRS AGENCY

# 8th Meeting of the Ozone Research Managers of the Parties to the Vienna Convention

**Geneva, 2 to 4 May 2011**

# NATIONAL PROGRESS REPORT

**By:**

**Dr. Ezzat Lewis**

**&**

**Dr. Mounir W. Labib**

**&**

**Dr. Wafik M. Sharobiem**

# *Montreal Projects in Egypt*

Egypt lies in the northern corner of Africa. It is bounded by the international frontiers of the Mediterranean Sea in the North, the Red Sea in the East, Libya in the west and Sudan in the south[1]. Figure 1, presents the map of Egypt.

**Figure 1,** Egypt Map


## *Area and Capital:*

The total area of Egypt is about 1.02 million $Km^2$ and the Capital is: Cairo.

## *Geography*

---

[1] Egyptian Environmental Affairs Agency: Website, http://www.eeaa.gov.eg/

***Topography***:

Egypt is geographically divided into four main divisions:

- The Nile Valley and Delta (approx. 33,000 $Km^2$)- It extends from the North Valley to the Mediterranean Sea and is divided into Upper Egypt and Lower Egypt, extending from Wadi Halfa to the south of Cairo and from North Cairo to the Mediterranean Sea. The River Nile in the north is divided into two branches, Damietta and Rachid embracing the highly fertile agricultural lands of the Delta.
- The Western Desert (approx. 680,000 $Km^2$) - Extends from the Nile Valley in the East to the Libyan borders in the west, and from the Mediterranean in the north to the Egyptian southern borders. It is divided into: The Northern Section, it includes the coastal plain, the northern plateau and the Great Depression, the Natroun Valley and Baharia Oasis. The Southern Section, it includes Farafra, Kharga, Dakhla, and El-Owainat in the far south.
- The Eastern Desert (approx. 325,000 $Km^2$): It extends from the Nile Valley in the West to the Red Sea, Suez gulf, and Suez Canal in the East, and from Lake Manzala on the Mediterranean in the North to Egypt's southern borders with Sudan in the south. The Eastern Desert is marked with the Eastern Mountains that range along the Red Sea with peaks that rise to about 3000 feet above the sea level. This desert is a store of Egyptian natural resources including various ores such as gold, coal, and oil.
- Sinai Peninsula (approx. 61,000 $Km^2$): Sinai has a triangular shape having its base at the Mediterranean in the North and its apex in the South at Ras Mohammed, the Gulf of Aqaba to the East and the Gulf of Suez and Suez Canal to the west. It is topographically divided into three main sections. The southern section, it involves extremely tough terrain that is composed of high-rise granite mountains. Mount Catherine rises about 2640 meters above sea level, thus making it the highest mountaintop in Egypt. The Central section, it comprises the area bounded by the Mediterranean to the North. At-Teeh plateau to the south, it is a plain area having abundant water resources derived from rainwater flowing from southern heights to the central plateau.

## *Climate:*

The Egyptian climate is influenced by the factors of location, topography, and general system for pressure and water surfaces. These aspects affect Egypt's climate dividing it into several regions. Egypt lies in the dry equatorial region except its northern areas located within the moderate warm region with a climate similar to that of the Mediterranean region. It is warm and dry in the summer and moderate with limited rainfall increasing at the coast in winter. The annual average day and nighttime temperatures in Lower and Upper Egypt is 20 and 25, and 7 and 17 respectively[2].

Table 1, summarizes monthly-average meteorological parameters for GC over the past 30 years. Through most of the year, wind speed is fairly consistent from the north (ENE to NNW) sector. However, during winter and spring (Nov. – Mar.), somewhat higher average winds are seen in the WSW sector. These often represent desert wind storms (Khamaseen winds) which transport dust from the deserts to the west and produce elevated PM concentrations in GC. Table 1, presents a quick and approximate data for the meteorological elements of the GC area.

[2] Mawaheb Abou El-Azm, Mounir W. Labib and Ahmed Abou El-Soud," **Control Measures to Reduce Pollutant's Levels in the Greater Cairo Area", |**Air and Waste Management Association, Paper # 424, USA, 2008.

**Table 1,** Monthly-average meteorological data in the greater Cairo (GC) area for the past 30 years

| Month | Relative Humidity (%) | Visual Distance (Km) | Cloud Cover | | Temperature (ºC) | | Wind Speed (Knots) and Direction [a] | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | % | Cloud Base (m) | Max | Min | E-NE | N-NW | W-SW | S-SE |
| January | 58 | 9 | 50 | 1845 | 18.1 | 8.6 | 9* | - | 12** | - |
| February | 56 | 9 | 50 | 1756 | 19.5 | 9.4 | 9* | - | 11** | - |
| March | 51 | 9 | 50 | 2164 | 23.4 | 11.2 | 9** | 9* | 12* | - |
| April | 45 | 9 | 50 | 3068 | 28.1 | 14.5 | 10** | 9* | - | - |
| May | 45 | 9 | 50 | 3677 | 31.8 | 17.2 | 10* | 9* | - | - |
| June | 49 | 9 | 50 | 1454 | 34.3 | 19.9 | 10* | 9** | - | - |
| July | 57 | 9 | 50 | 875 | 34.2 | 21.5 | 8* | 8** | - | - |
| August | 61 | 9 | 50 | 731 | 33.6 | 21.8 | 8* | 8** | - | - |
| September | 61 | 9 | 38 | 827 | 32.3 | 20.2 | 9* | 9** | - | - |
| October | 60 | 9 | 38 | 1628 | 30.0 | 18.0 | 9** | 8* | - | - |
| November | 58 | 9 | 38 | 1663 | 24.4 | 14.0 | 9* | - | 10* | - |
| December | 59 | 8 | 38 | 2472 | 20.3 | 9.9 | 8* | - | 10** | - |

[a] A double asterisk (**) indicates a "most probable" value while a single asterisk indicates a less probable value.

Meteorological data (temperature, relative humidity, and wind speed and direction) from Cairo International Airport are available on an hourly basis from the U.S. NOAA National Climatic Data Center. Data from other locations may be obtained upon request to Egyptian agencies. Studies conducted by Lowenthal et al. (2001) and Abu-Allaban et al. (2007) showed that $PM_{10}$ concentrations in GC were higher in fall than in winter, 1999 or during summer, 2002. Surface meteorological data were examined to try to explain differences between fall and winter of 1999[3]. Seasonal-average temperature and vector-averaged wind speed and direction were calculated for four sites in GC. The average winter temperature ranged from 13.7 to 15.4 $^{o}$C while the average fall temperature ranged from 19.4 to 20.6 $^{o}$C. Thus, the seasonal variation was approximately 5 $^{o}$C. The vector-averaged wind direction ranged from 312 to 6 degrees, i.e., from the north, in both seasons at the four measurement locations. The seasonal variation in concentration was thus unrelated to wind direction. The seasonal vector-averaged wind speed ranged from 1.2 to 2.8 mph in winter and from 0.72 to 1.86 mph in fall. The average ratio of winter to fall wind speed was 1.8±0.8. The lower wind speeds during fall along with increased emissions from agricultural burning may explain the higher PM concentrations during that season because lower ventilation associated with low wind speeds may allow for buildup of pollutants in the vicinity of the sources in Cairo[4].

[3] Abu-Allaban, M., Gertler, A.W., and Lowenthal, D.H., 2002: "**A preliminary apportionment of the sources of ambient $PM_{10}$, $PM_{2.5}$, and VOCs in Cairo**". *Atmos. Environ.* ***36***, 5549-5557.
[4] Abu-Allaban, M. Lowenthal, D.H., Gertler, A.W., and Labib, M., 2007: **"Sources of $PM_{10}$ and $PM_{2.5}$ in Cairo's ambient air**". *Environ. Monit. Assess.*, **133**, 417-425.

# *Montreal Protocol (MP)*

## *Background*

The **Montreal Protocol on Substances That Deplete the Ozone Layer** (a protocol to the Vienna Convention for the Protection of the Ozone Layer) is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances believed to be responsible for ozone depletion.

Due to its widespread adoption and implementation it has been hailed as an example of exceptional international co-operation with Kofi Annan quoted as saying that "perhaps the single most successful international agreement to date has been the Montreal Protocol"[5]. It has been ratified by 196 states[6].

## *Terms and purposes*

The treaty[7] is structured around several groups of halogenated hydrocarbons that have been shown to play a role in ozone depletion. All of these ozone depleting substances contain either chlorine or bromine (substances containing only fluorine do not harm the ozone layer). For a table of ozone-depleting substances see:

For each group, the treaty provides a timetable on which the production of those substances must be phased out and eventually eliminated.

## *Multilateral Fund (MLF)*

The **Multilateral Fund for the Implementation of the Montreal Protocol** provides funds to help developing countries to phase out the use of ozone-depleting substances.

The Multilateral Fund was the first financial mechanism to be created under an international treaty[8]. It embodies the principle agreed at the United Nations Conference on Environment and Development in 1992 that countries have a common but differentiated responsibility to protect and manage the global commons.

The Fund is managed by an executive committee with an equal representation of seven industrialized and seven Article 5 countries, which are elected annually by a Meeting of the Parties. The Committee reports annually to the Meeting of the Parties on its operations.

Up to 20 percent of the contributions of contributing parties can also be delivered through their bilateral agencies in the form of eligible projects and activities.

The fund is replenished on a three-year basis by the donors. Pledges amount to US$ 2.1 billion over the period 1991 to 2005. Funds are used, for example, to finance the conversion of existing manufacturing processes, train personnel, pay royalties and patent rights on new technologies, and establish national ozone offices.

---

[5] The Ozone Hole-The Montreal Protocol on Substances that Deplete the Ozone Layer
[6] http://ozone.unep.org/Ratification_status/
[7] The full terms are available from http://ozone.unep.org/Publications/MP_Handbook/Section_1.1_The_Montreal_Protocol
[8] http://www.multilateralfund.org/about_the_multilateral_fund.htm

## *Ozone Depleting Substances (ODS's)*

Ozone layer is a natural filter and a shield that surround the Earth to protect all creatures from the harmful part of Ultra Violet – B rays that threaten man's health and safety.
The source of threat is the result of actions and technology developed by man with the development of civil life and the development of new chemical substances. This led to the emission of gases from substances that cause the depletion to the ozone layer.

Since the Montreal Protocol came into effect, the atmospheric concentrations of the most important chlorofluorocarbons and related chlorinated hydrocarbons have either leveled off or decreased. Halon concentrations have continued to increase, as the halons presently stored in fire extinguishers are released, but their rate of increase has slowed and their abundances are expected to begin to decline by about 2020. Also, the concentration of the HCFCs increased drastically at least partly because for many uses CFCs (e.g. used as solvents or refrigerating agents) were substituted with HCFCs. While there have been reports of attempts by individuals to circumvent the ban, e.g. by smuggling CFCs from undeveloped to developed nations, the overall level of compliance has been high. In consequence, the Montreal Protocol has often been called the most successful international environmental agreement to date. In a 2001 report, NASA found the ozone thinning over Antarctica had remained the same thickness for the previous three years, however in 2003 the ozone hole grew to its second largest size[9].The most recent (2006) scientific evaluation of the effects of the Montreal Protocol states, "The Montreal Protocol is working: There is clear evidence of a decrease in the atmospheric burden of ozone-depleting substances and some early signs of stratospheric ozone recovery."[10]

Unfortunately, the hydrochlorofluorocarbons, or HCFCs, and hydrofluorocarbons, or HFCs, are now thought to contribute to anthropogenic global warming. On a molecule-for-molecule basis, these compounds are up to 10,000 times more potent greenhouse gases than carbon dioxide. The Montreal Protocol currently calls for a complete phase-out of HCFCs by 2030, but does not place any restriction on HFCs. Since the CFCs themselves are equally powerful as greenhouse gases, the mere substitution of HFCs for CFCs does not significantly increase the rate of anthropogenic global warming, but over time a steady increase in their use could increase the danger that human activity will change the climate.[11]

Policy experts have advocated for increased efforts to link ozone protection efforts to climate protection efforts. Policy decisions in one arena affect the costs and effectiveness of environmental improvements in the other.

## *Global Warming Potentials (GWP) of ODS's*

The global warming potential (GWP) represents how much a given mass of a chemical contributes to global warming over a given time period compared to the same mass of carbon dioxide. Carbon dioxide's GWP is defined as 1.0. A GWP is calculated over a specific time interval and the value of this must be stated whenever a GWP is quoted or else the value is meaningless.

[9] "Top Story - 2001 Antarctic Ozone Hole Similar in Size to Holes of Past Three Years, NOAA and NASA Report - October 16, 2001". www.gsfc.nasa.gov. http://www.gsfc.nasa.gov/topstory/20011016ozonelayer.html. Retrieved 2010-09-16
[10] Scientific Assessment of Ozone Depletion: 2006, http://www.esrl.noaa.gov/csd/assessments/2006/report.html
[11] "EIA - Emissions of the Greenhouse Gases in the United States 2005". www.eia.doe.gov. http://www.eia.doe.gov/oiaf/1605/ggrpt/other_gases.html. Retrieved 2010-09-16

Why are there three values given for the GWP and atmospheric lifetime?

All GWP values represent global warming potential over a 100-year time horizon. Dashes indicate that the source did not include a GWP value for the given compound. The first value in each of the second and third columns is from the Scientific Assessment of Ozone Depletion, 2002. The second and third values in each of these columns are from the Intergovernmental Panel on Climate Change IPCC) Second, Third & Fourth Assessment Reports.

For more specific information on how many of these chemicals are used as substitutes for ozone-depleting substances, the Significant New Alternatives Policy (SNAP) Program's web site presents useful information about it.

The substances subject to restrictions in the Kyoto protocol either are rapidly increasing their concentrations in Earth's atmosphere or have a large GWP.

The GWP depends on the following factors:

- the absorption of infrared radiation by a given species
- the spectral location of its absorbing wavelengths
- the atmospheric lifetime of the species

Thus, a high GWP correlates with a large infrared absorption and a long atmospheric lifetime. The dependence of GWP on the wavelength of absorption is more complicated. Even if a gas absorbs radiation efficiently at a certain wavelength, this may not affect its GWP much if the atmosphere already absorbs most radiation at that wavelength. A gas has the most effect if it absorbs in a "window" of wavelengths where the atmosphere is fairly transparent.

Because the GWP of a greenhouse gas depends directly on its infrared spectrum, the use of infrared spectroscopy to study greenhouse gases is centrally important in the effort to understand the impact of human activities on global climate change.

## *Calculating the global warming potential*

Just as radioactive forcing provides a simplified means of comparing the various factors that are believed to influence the climate system to one another, Global Warming Potentials (GWPs) are one type of simplified index based upon radioactive properties that can be used to estimate the potential future impacts of emissions of different gases upon the climate system in a relative sense.

GWP is based on a number of factors, including the radioactive efficiency (infrared-absorbing ability) of each gas relative to that of carbon dioxide, as well as the decay rate of each gas (the amount removed from the atmosphere over a given number of years) relative to that of carbon dioxide[12].

The **radioactive forcing capacity** (RF) is the amount of energy per unit area, per unit time, absorbed by the greenhouse gas that would otherwise be lost to space.

The Intergovernmental Panel on Climate Change (IPCC) provides the generally accepted values for GWP, which changed slightly between 1996 and 2001 Third Assessment Report (TAR). The GWP

[12] Mathew Elrod, "Greenhouse Warming Potential Model", Based on Journal of Chemical Education, Vol 76, pp. 1702-1705, December 1999.

is defined as the ratio of the time-integrated radioactive forcing from the instantaneous release of 1 kg of a trace substance relative to that of 1 kg of a reference gas.

Since all GWP calculations are a comparison to $CO_2$ which is non-linear, all GWP values are affected.

## *Montreal Protocol Projects in Egypt*

Montreal Protocol projects in Egypt can be summarized in different sectors. Different projects were conducted to minimize and stop using of these ODS, these projects can be summarized in the following:

### 1- Foam Projects in Egypt:

Table 1, presents all projects conducted in Egypt in the foam sector, including the Ozone Depleting Potential ODP (Tons) and the Global Warming Potential (GWP) in $CO_{2e}$ metric tons.

| Project Code | Project Title | ODS | ODP (Tons) | GWP (CO2e MT) |
|---|---|---|---|---|
| EGY/FOA/08/INV/05 | Phase-out of CFC-11 in manufacture of flexible polyurethane foam at Misr Foam Co. | CFC-11 | **121.0** | **566,280.0** |
| EGY/FOA/08/INV/06 | Phase-out of CFC-11 in the manufacturing of molded, flexible, semi-rigid and rigid polyurethane foam at Taki-Vita factory | CFC-11 | **50.0** | **234,000.0** |
| EGY/FOA/08/INV/07 | Phase-out of CFC-11 in the manufacture of molded polyurethane foams at Technopol Egypt SAE | CFC-11 | **55.0** | **257,400.0** |
| EGY/FOA/09/INV/10 | Elimination of CFC-12 in the manufacture of extruded polystyrene foam at Al-Sharif Plastic Factories | CFC-12 | **75.0** | **804,000.0** |
| EGY/FOA/09/INV/12 | Phase-out of CFC-11 in manufacture of molded foam at Misr Foam Co. | CFC-11 | **28.0** | **131,040.0** |
| EGY/FOA/10/INV/15 | Elimination of CFC-11 in the manufacture of molded flexible polyurethane foam at Modern Building Carpentry Co. (Mobica) | CFC-11 | **20.0** | **93,600.0** |
| EGY/FOA/10/INV/17 | Elimination of CFC-11 in the manufacture of molded rigid polyurethane foam at Cairo Light Industries Co. (Olympic Electric) | CFC-11 | **75.0** | **351,000.0** |
| EGY/FOA/11/INV/18 | Conversion to CFC-11 free technology in the manufacture of rigid polyurethane foam (PUF) at Specialized Engineering Contracting Co. | CFC-11 | **15.0** | **70,200.0** |
| EGY/FOA/11/INV/19 | Conversion to CFC-11 free technology in the manufacture of flexible polyurethane foam at Alex Foam (formerly Dekheila Chemical Industries Co.) | CFC-11 | **130.0** | **608,400.0** |
| EGY/FOA/11/INV/20 | Conversion to CFC-11 free technology in the manufacture of flexible polyurethane foam (PUF) at Horse Foam Co. | CFC-11 | **120.0** | **561,600.0** |

| | | | | |
|---|---|---|---|---|
| EGY/FOA/12/INV/22 | Conversion to CFC free-technology in the manufacture of flexible polyurethane foam at Foam Industrial and Hyma | CFC-11 | **170.0** | **795,600.0** |
| EGY/FOA/12/INV/26 | Conversion to CFC free-technology in the manufacture of rigid molded and miscellaneous PUF at 5 plants: Tiba Air, Egat Company, Solar Energy Company, Ismailia Aluminum Company, and Fu Tech Company | CFC-11 | **44.2** | **206,856.0** |
| EGY/FOA/12/INV/27 | Conversion to CFC free-technology at Scib Chemical Company | CFC-11 | **12.4** | **58,032.0** |
| EGY/FOA/12/INV/28 | Conversion to CFC free-technology at El Fateh | CFC-11 | **59.0** | **276,120.0** |
| EGY/FOA/12/INV/29 | Conversion to CFC free-technology at Industrial Engineering Company for Construction and Development (Icon) | CFC-11 | **51.0** | **238,680.0** |
| EGY/FOA/15/INV/36 | Conversion to CFC-free technology in the manufacturing of rigid PUF at seven enterprises: GMC, Petrojet, Modern Products, Cairo General Contractors Co., Egyptian Solar Energy, Tawifika, Helwan | CFC-11 | **69.0** | **322,920.0** |
| EGY/FOA/18/INV/48 | Conversion to CFC free technology in the manufacture of flexible molded PUF and integral skin foam at El Shabrawi | CFC-11 | **16.0** | **74,880.0** |
| EGY/FOA/22/INV/64 | Phase-out of the remaining ODS consumption in the foam sector (11 enterprises) | CFC-11 | **319.0** | **1,492,920.0** |
| EGY/FOA/10/INV/16 | Elimination of CFC-12 in the manufacture of extruded polystyrene foam in Advanced Chemical Engineering Systems (Advechems) | CFC-12 | **183.3** | **1,964,976.0** |

\

## 2- Refrigeration Projects in Egypt:

Table 2, presents all projects conducted in Egypt in the refrigeration sector, including the Ozone Depleting Potential ODP (Tons) and the Global Warming Potential (GWP) in $CO_{2e}$ metric tons.

| Project Code | Project Title | ODS | ODP (Tons) | GWP (CO2e MT) |
|---|---|---|---|---|
| EGY/REF/08/INV/09 | Phase-out of CFC in refrigeration at Koldair Company | CFC-12 | **18.0** | **192,960.0** |
| EGY/REF/12/INV/30 | Conversion to CFC free-technology Reftruck Company | CFC-11 | **25.0** | **117,000.0** |
| EGY/REF/12/INV/31 | Conversion to CFC free-technology at Misr Panel (Egyptian Company for Cold Storage Industries) | CFC-11 | **74.4** | **348,192.0** |
| EGY/REF/15/INV/44 | Elimination of CFC in the manufacture of commercial refrigeration equipment at Royal Engineering, Co. | CFC-11 | **20.3** | **95,004.0** |
| EGY/REF/15/INV/45 | Elimination of CFC in the manufacture of commercial refrigeration equipment at Port Said Metal Work, Co. (MOG) | CFC-11 | **11.8** | **55,224.0** |
| EGY/REF/18/INV/49 | Elimination of CFC-11 and CFC-12 in the manufacture of commercial refrigeration equipment at United Investment Corporation Inc. | CFC-11 | **48.7** | **227,916.0** |

| | | | | |
|---|---|---|---|---|
| EGY/REF/18/INV/50 | Elimination of CFC-11 and CFC-12 in the manufacture of commercial refrigeration equipment at Refcat Company Inc. | CFC-11 | **26.8** | **125,424.0** |
| EGY/REF/20/INV/58 | Elimination of CFC-11 and CFC-12 in the manufacture of commercial refrigeration equipment at El-Mohandes | CFC-11 | **13.0** | **60,840.0** |
| EGY/REF/29/TAS/75 | Implementation of the RMP: establishing a national recovery and recycling network | CFC-12 | **100.0** | **1,072,000.0** |
| EGY/REF/13/INV/32 | ODS phase-out at Delta Industrial Co. | CFC-11 | **117.0** | **547,560.0** |
| EGY/REF/15/INV/41 | Phasing out ODS at Societe Mondiale pour Refroidissement (Alaska) domestic refrigeration plant | CFC-11<br>CFC-12 | **55.0** | **423,500.0** |
| EGY/REF/13/INV/33 | ODS phase-out at Electrostar for Refrigeration Co. | CFC-11<br>CFC-12 | **51.0** | **392,700.0** |
| EGY/REF/13/INV/35 | ODS phase-out at Kiriazi Refrigeration Manufacturing Co. | CFC-11<br>CFC-12 | **137.0** | **1,054,900.0** |
| EGY/REF/15/INV/38 | Phasing out ODS at Helwan Company for Metallic Appliances domestic refrigeration plant | CFC-11<br>CFC-12 | **7.5** | **57,750.0** |
| EGY/REF/15/INV/40 | Phasing out ODS at Islamic Company for Industrialization (Siltal) domestic refrigeration plant | CFC-11<br>CFC-12 | **26.0** | **200,200.0** |
| EGY/REF/15/INV/42 | Phasing out ODS at International Co. for Refrigeration and Appliances (Iberna) domestic refrigeration plant | CFC-11<br>CFC-12 | **19.0** | **146,300.0** |
| EGY/REF/15/INV/43 | Phasing out ODS at El Nasr Company for Electric and Electronic Apparatus (Philips) domestic refrigeration plant | CFC-11<br>CFC-12 | **22.5** | **173,250.0** |
| EGY/REF/15/INV/39 | Phasing out ODS at Super Bosh Factory domestic refrigeration plant | CFC-11<br>CFC-12 | **13.0** | **100,100.0** |

## 3- Halon Management Bank in Egypt:

Table 3, presents the Halon Management Bank in Egypt, including the Ozone Depleting Potential ODP (Tons) and the Global Warming Potential (GWP) in $CO_{2e}$ metric tons.

| **Project Code** | **Project Title** | **ODS** | **ODP** (Tons) | **GWP** (CO2e MT) |
|---|---|---|---|---|
| EGY/HAL/32/TAS/81 | Halon management bank programme | Halon-1211 | **251.3** | **467,480.0** |

## 4- Methyl Bromide Project in Egypt:

Table 4, presents the Methyl Bromide project in Egypt, including the Ozone Depleting Potential ODP (Tons) and the Global Warming Potential (GWP) in $CO_{2e}$ metric tons.

| **Project Code** | **Project Title** | **ODS** | **ODP** (Tons) | **GWP** (CO2e MT) |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| EGY/FUM/38/INV/86 | National phase-out of methyl bromide in horticulture and commodities fumigation | MB - CH3Br | **309.3** | **1,546.7** |

## 5- Medical aerosol Project in Egypt:

Table 5, presents the Meter Dose Inhaler (MDI) project in Egypt, including the Ozone Depleting Potential ODP (Tons) and the Global Warming Potential (GWP) in $CO_{2e}$ metric tons.

| Project Code | Project Title | ODS | ODP (Tons) | GWP (CO2e MT) |
|---|---|---|---|---|
| EGY/PHA/46/INV/91 | National CFC phase-out plan (first tranche) | CFC | **237.5** | **2,088,100.0** |

## 6- Overall Montreal Project in Egypt:

Table 6, presents the overall Montreal Projects in Egypt, including the Ozone Depleting Potential ODP (Tons) and the Global Warming Potential (GWP) in $CO_{2e}$ metric tons.

| Sector | Total ODP ( Ton ) | Total GWP ( CO2e Metric Ton ) |
|---|---|---|
| FOAM | 1,612.9 | 9,108,504.0 |
| Refrigeration | 786.0 | 5,390,820.0 |
| Halons | 251.3 | 467,480.0 |
| Methyl Bromide | 309.3 | 1,546.7 |
| MDI | 237.5 | 2,088,100.0 |

**Figure 2**, ODP Tons of all Montreal Projects in Egypt

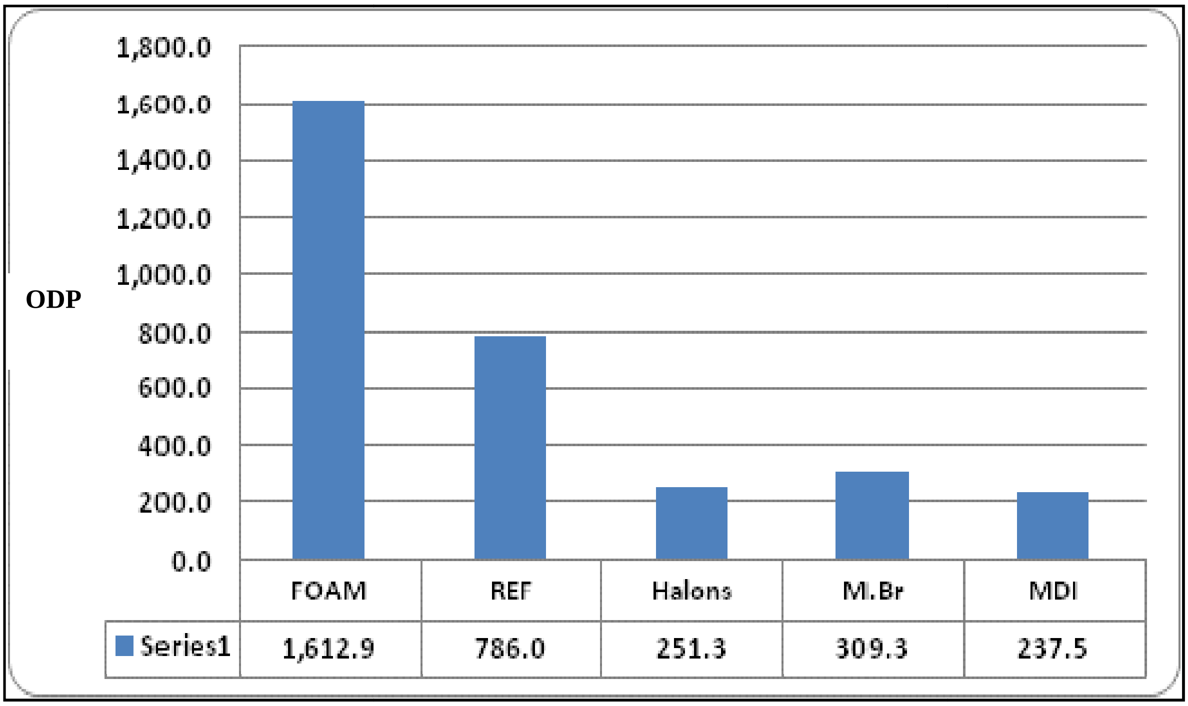
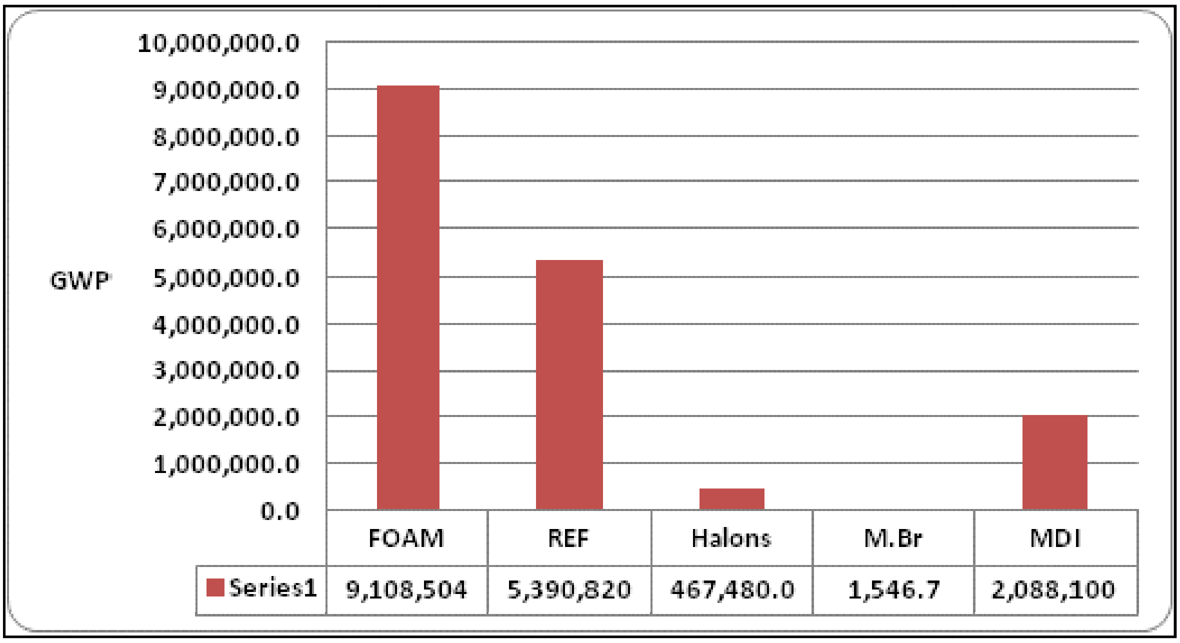



**Figure 3**, GWP of all Montreal Projects in Egypt ($CO_{2e}$ metric tons)



## Egypt Consumption of ODS's from 1992 - 2009 comparison with Base Line

**Figure 4**, Consumption of CFCs

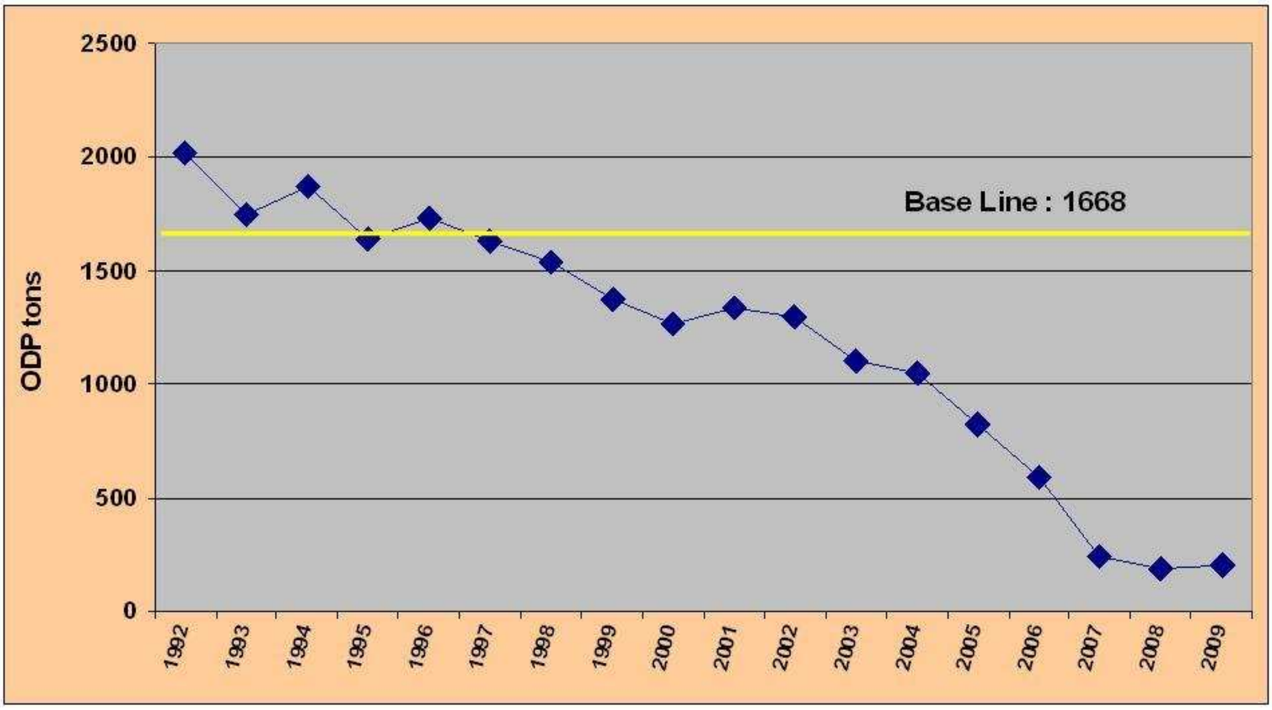



**Figure 5**, Consumption of Halons

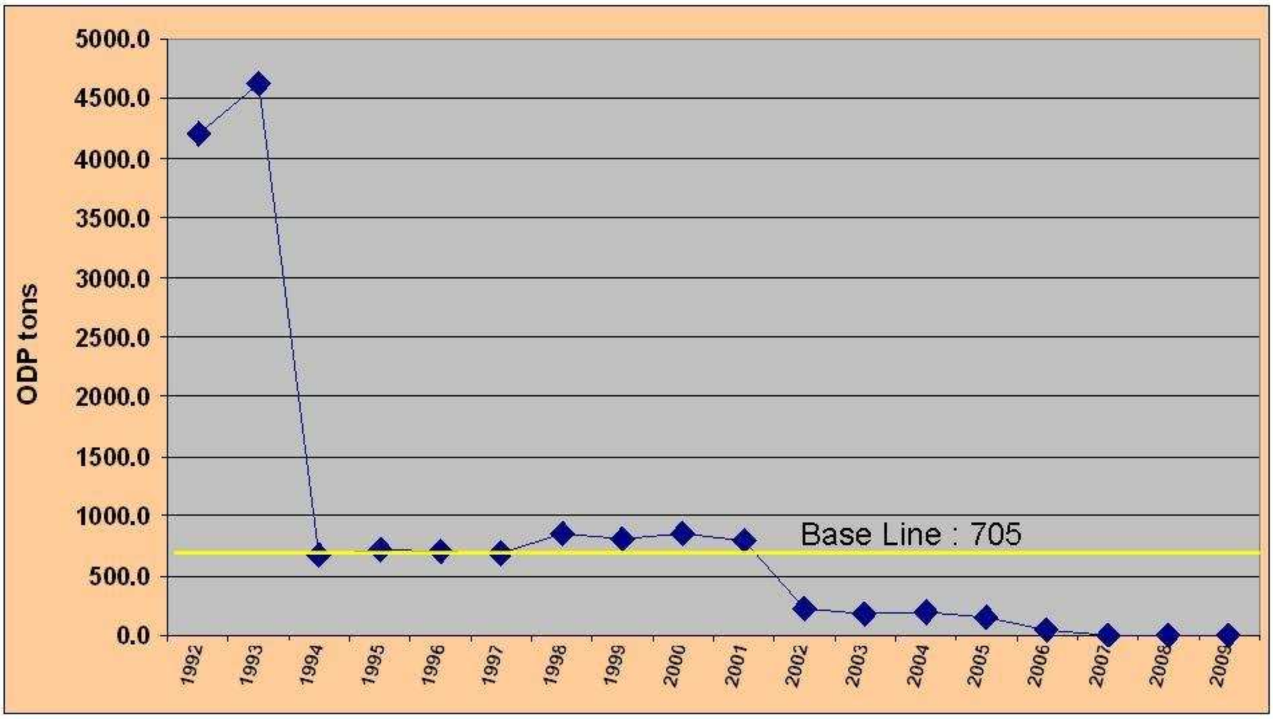


**Figure 6**, Consumption of Carbon Tetra Chloride

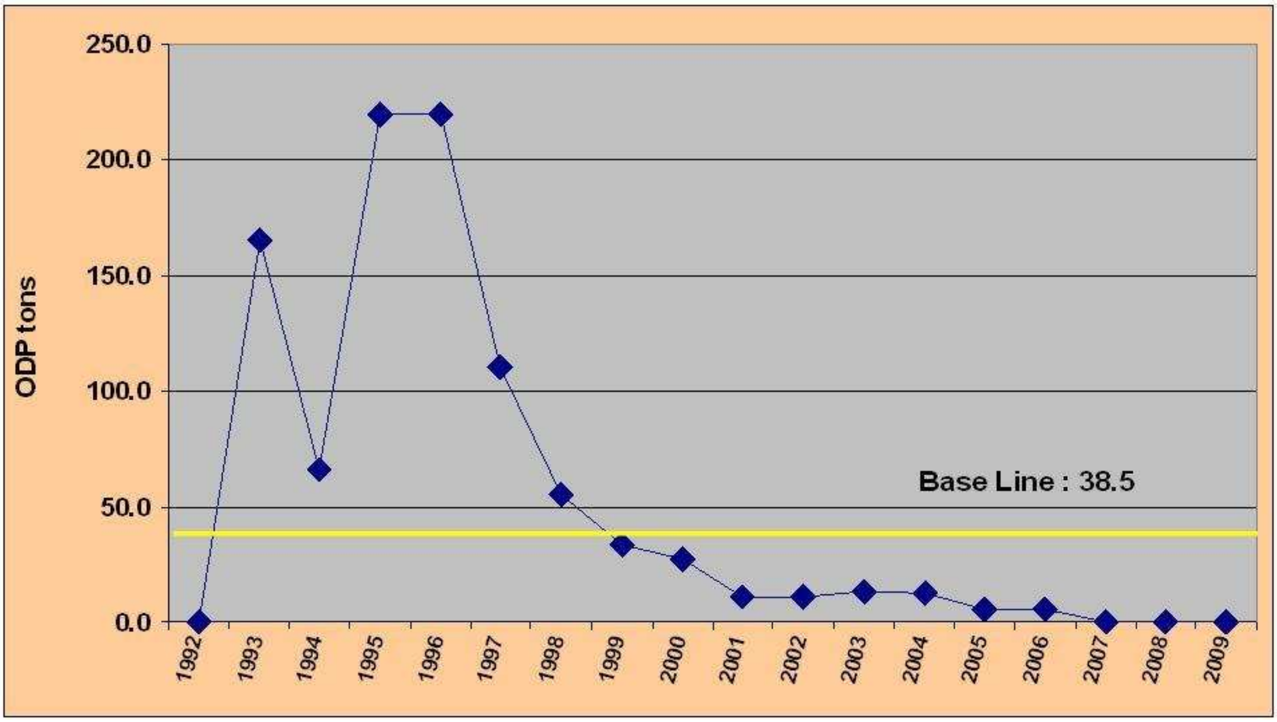



**Figure 7**, Consumption of Methyl Chloroform

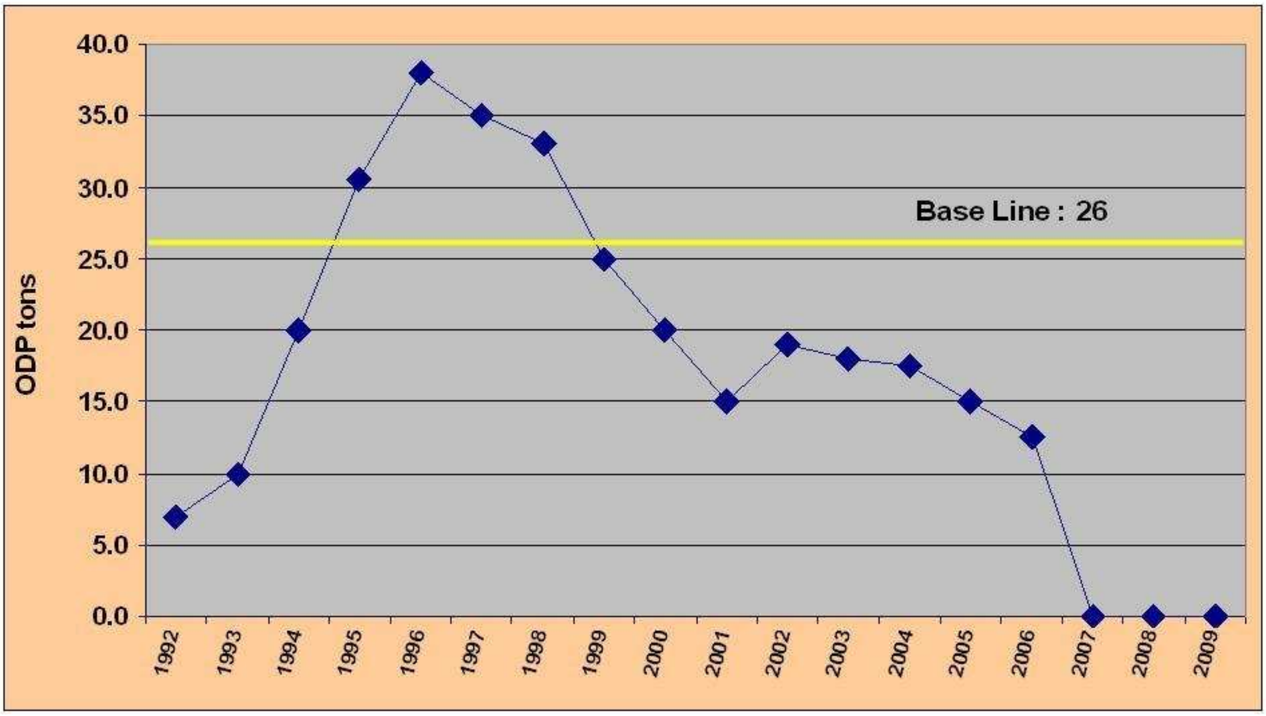


**Figure 8**, Consumption of HCFCs

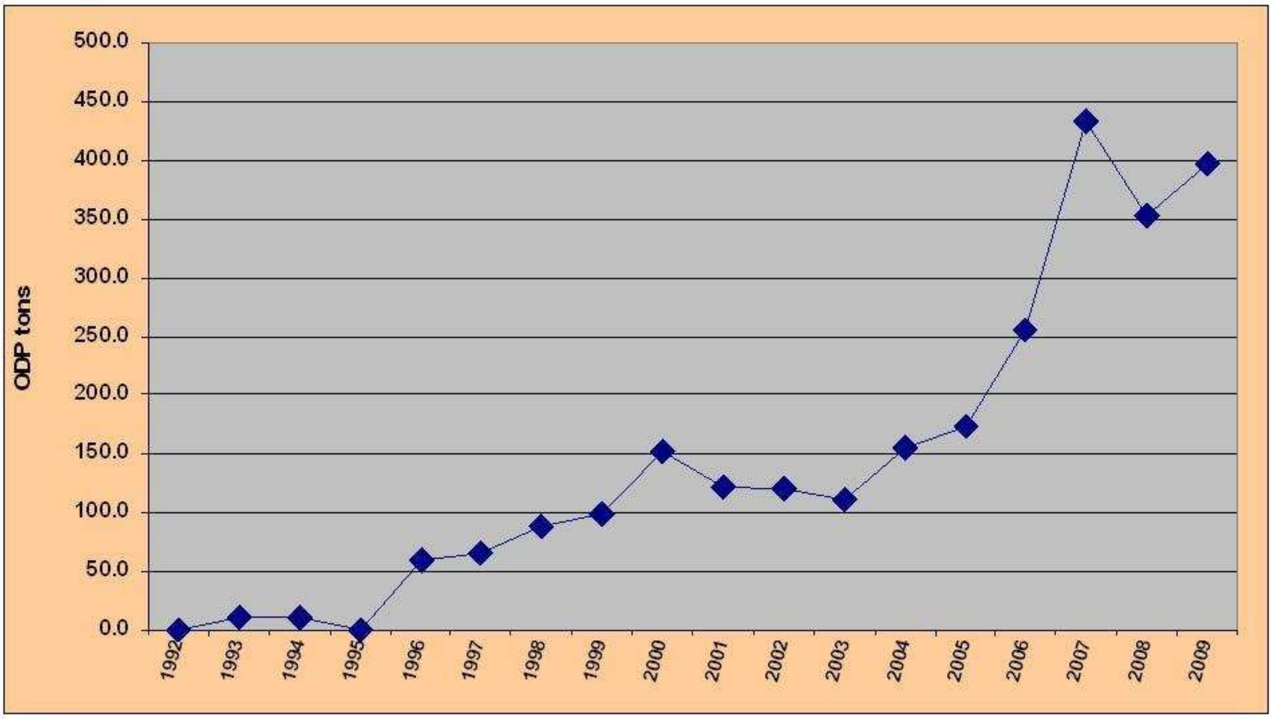
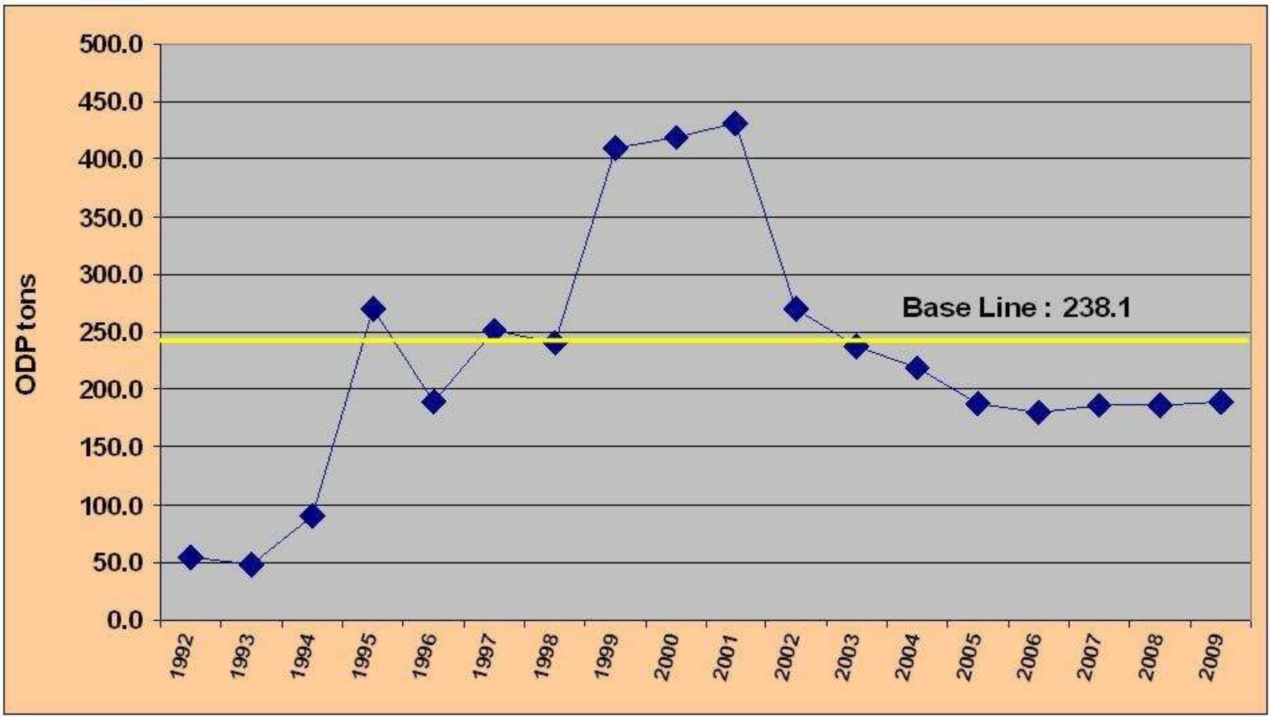



**Figure 9**, Consumption of Methyl Bromide



# *Ozone measurements in Egypt*

## Measurements of Ozone and UV radiation

Egyptian Meteorological Authority (EMA) is responsible for measurements of column ozone amount and operates the main total ozone-monitoring network. Long-term daily observations of total ozone have been performed at the regional ozone center of EMA at Cairo (30.08ºN, 31.28ºE) with the Dobson Spectrophotometer (D096) since 1967. Since 1984; second Dobson instrument (D069) has been maintained at Aswan (23.97ºN, 32.87ºE) to measure the amount of ozone over tropical area.

As early as October 1967 EMA introduced regular monitoring of ozone at Cairo using the Dobson Spectrophotometer No. 96. At 1973 Cairo became Regional Ozone Center (ROC) for ozone stations at North Africa and Middle East. The part of ROC studies the variation of ozone over Egypt. Therefore, EMA started to measure ozone over Aswan (Upper Egypt), Matrouh (coastal station) and Hurghada (GAW station). Table 7, presents the Egyptian Ozone stations.

At the late of 1998 Brewer Spectrophotometer mark II (B143) has been maintained at Matrouh (31.33ºN, 27.22ºE) to measure the total ozone and SO2 over northwest coast area of Egypt. With the end of 1999 third Dobson Spectrophotometer (D059) has been maintained at Hurghada (27.28°N. 33.75ºE) to measure the amount of ozone over Red sea area.

**Table 7,** The Egyptian Ozone Stations.

| | **Aswan** | **Hurghada** | **Cairo** | **Matrouh** |
|---|---|---|---|---|
| WMO No. | 62 414 | 62 464 | 62 376 | 62 306 |
| Ozone ID. | 245 | 409 | 152 | 376 |
| Latitude | 23.97°N | 27.28°N | 30.08°N | 31.33°N |
| Longitude | 32.87°E | 33.75°E | 31.28°E | 27.22°E |
| Height (m) | 195 | 007 | 037 | 035 |
| Instrument | Dobson #069 | Dobson #059 | Dobson #096 | Brewer II #143 |
| Started at | Dec. 1984 | Nov. 2000 | Oct. 1967 | Nov. 1998 |
| International Calibration | UK, 1984<br>Czech, 1993<br>Swiss, 1999<br>Egypt, 2004<br>Germany, 2010 | Germany, 2000<br>Egypt, 2004<br>Germany, 2009 | Poland, 1977<br>Swiss, 1986<br>Greece, 1997<br>Germany, 2001<br>Egypt, 2004 | Canada, 1997<br>Egypt, 2005<br>Egypt, 2008 |

## Measurements of Stratospheric Ozone

## Dobson observations:

Measurements of total ozone amount and its vertical distribution by Umkehr Method (whenever sky conditions permit) are taken by Dobson at three observatories: Cairo, Aswan and Hurghada. Direct sun (DS) and zenith sky (ZB) or cloud sky (ZC) observations will be taken more than 7–time at different zenith angles (airmasses) daily, using BP-scale. Regular tests by Mercury and standard lamps and Adjustments of ETC, R-N tables and Q-table. (*DOBSON/DOBSTOOL software package used for processing of the observations of the all stations by ROC*).

## Brewer observations:

Measurements of O3 and SO2 and UVB, 9-times daily by Brewer instrument at Matrouh observatory. Whenever sky conditions permit, Umkehr observations are made. Routine daily HG and SL and weekly external UV-lamps tests. Routine processing of observations by the SCI-TEC software.

## Surface ozone:

EMA measure surface ozone outside urban regions, at Hurghada which is an official WMO Global Atmospheric Watch (GAW) station. Also EMA measure surface ozone at Sidi Branni (31.37ºN, 25.53ºE). South Valley University (SVU) in cooperation EMA has been measured surface ozone at Qena.

## UV measurements:

EMA take the measurements of broadband UV solar radiation and the biologically effective solar UV-B at different sites. Also EMA in cooperation with University of South valley have been measured the broadband UV radiation at Qena since 2000. The present network of measurements of UV and UVB radiation at Aswan, Qena, Cairo, Rafaah (31.22ºN, 34.20ºE), shown in Table 8.

**Table 8, The** Egyptian UV and UV-B radiation Stations

| | **Aswan** | **Qena** | **Cairo** | **Rafaah** | **Matrouh** |
|---|---|---|---|---|---|
| UV Instrument | Eppley Radiometer | Eppley Radiometer | Eppley Radiometer | - | - |
| Started at | **Aug. 1989** | **Apr. 2000** | **Mar. 1989** | | |
| UV-B Instrument | UVB-1 Pyranometer | UVB-1 Pyranometer | UVB-1 Pyranometer | UVB-1 Pyranometer | Brewer MII No.143 |
| Started at | **Sep. 1998** | **Apr. 2000** | **May 1996** | **Jun. 2000** | **Jan. 1998** |

## National Cooperation's:

Scientists of ozone from EMA taking into consideration the maintenance and calibration of the ozone instruments regularly. The ozone data collected from the network at ROC. Data files of ozone are transmitted regularly with SO2 to World Ozone Data Center (WOUDC) in Toronto, Canada.

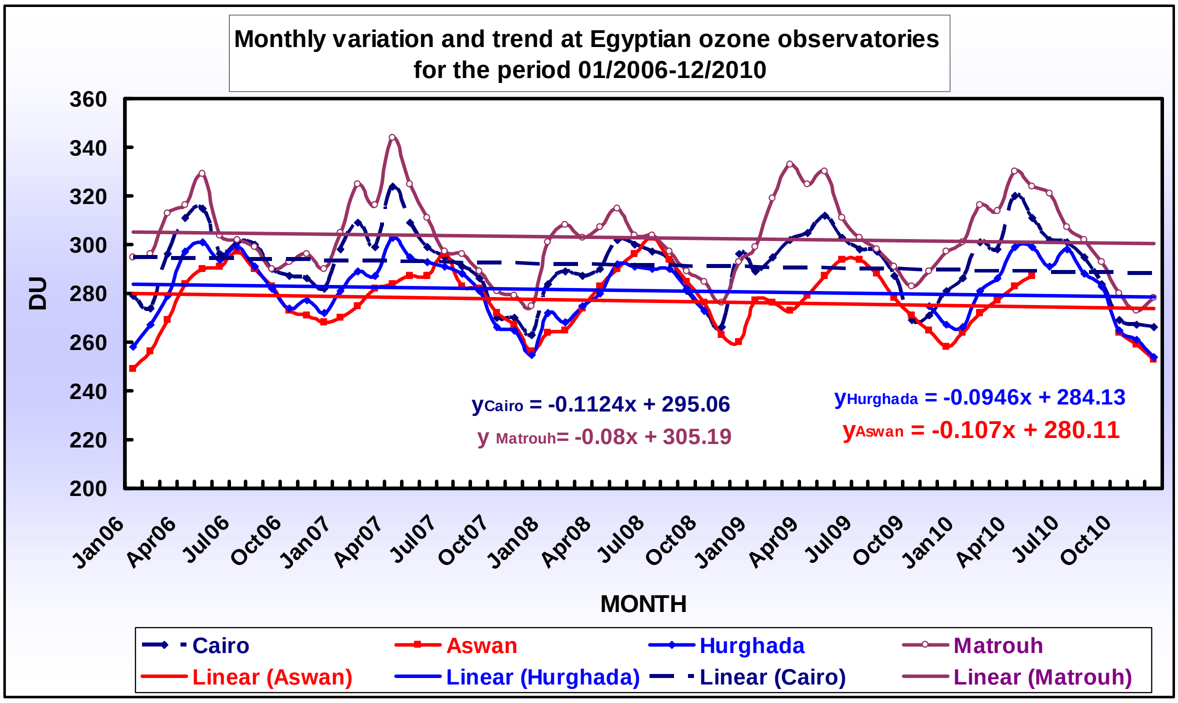
- Ozone EMA cooperates with National Ozone Centers at Germany, Czech Rep., Greece, Canada and Japan and USA

- ROC researchers promote the main activities in ozone research.
- EMA in co-operation with WMO carries out a training program for operators of ozone Arab countries.
- WMO and EMA in close cooperation and assistance of Canada International Ozone Services Inc. organized the International comparison of the Brewer No. 143 operated in Matrouh observatory with standard Brewer No. 17 at 2005 and 2008. WMO and EMA and assistance of NOAA organized the Intercomparison of the Dobson ozone instruments operated in the Africa region at Dahab, Egypt at 2004.

# RESULTS FROM OBSERVATIONS AND ANALYSIS

Monthly variation and trend of ozone for last five years over Egyptian ozone observatories are represent by Figure 10. The figure shows that the linear trend is negative at all station.

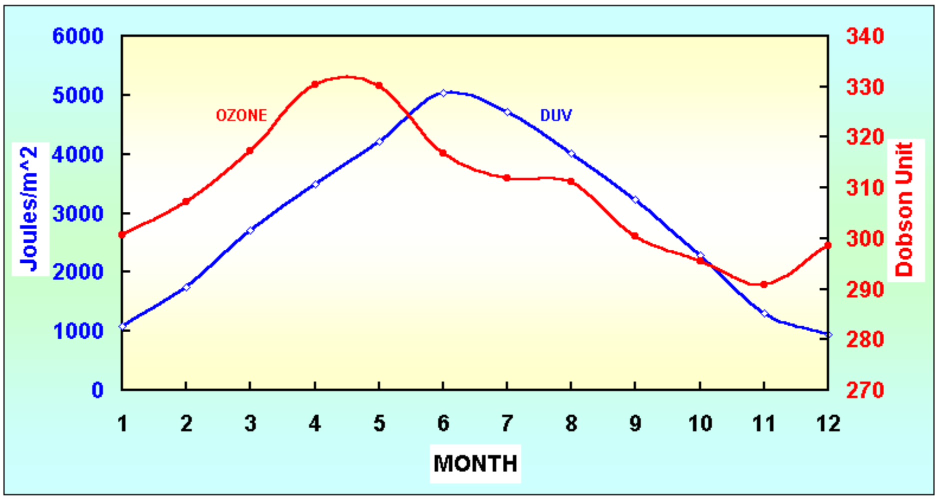
**Figure 10,** Monthly variation and tren of ozone at Egyptian stations from 01/2006-12/2010




## Variation of ozone damage UV at northwest of Egyptian:

Monthly variation of total ozone amount and the total integral effect of the UV (weighted Erythema UV) radiation coming to the ground level during the day (dose) at Matrouh shown in Figure 11. It shows that ozone varies seasonally with a maximum in spring and DUV varies seasonally with a maximum in summer.

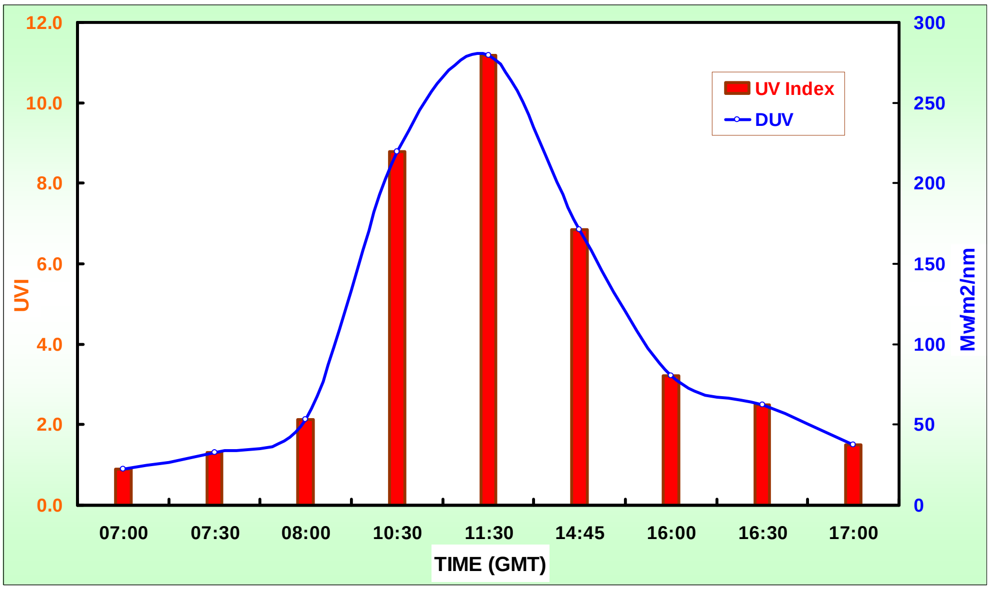
**Figure 11,** Monthly variation of ozone and weighted Erythema UV at Matrouh




## UV index at northwest of Egyptian:

UV-index forecasts, based on Brewer total ozone measurements at Matrouh (northwestern coast), were initiated at EMA summer 1999. Figure 12, shows the hourly variation of dangerous UV with its Index over northwestern coast of Egypt at summer. UVB protection is critical during summer and especially so in the hours around solar noon. A person being out in the sun during midday hours more than ten minutes if you are without protection.

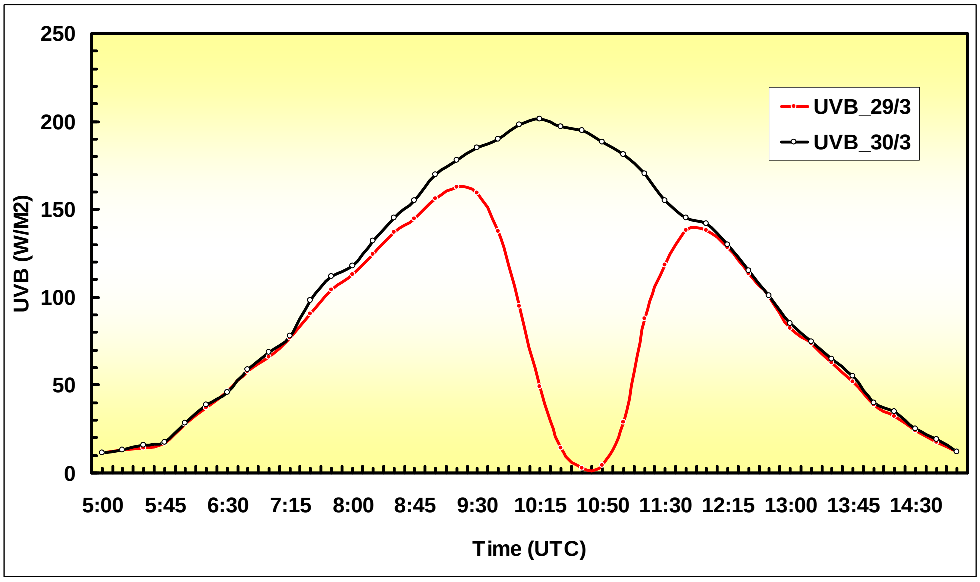
**Figure 12,** Hourly variation of DUV and UV index at summer over costal area (Matrouh)



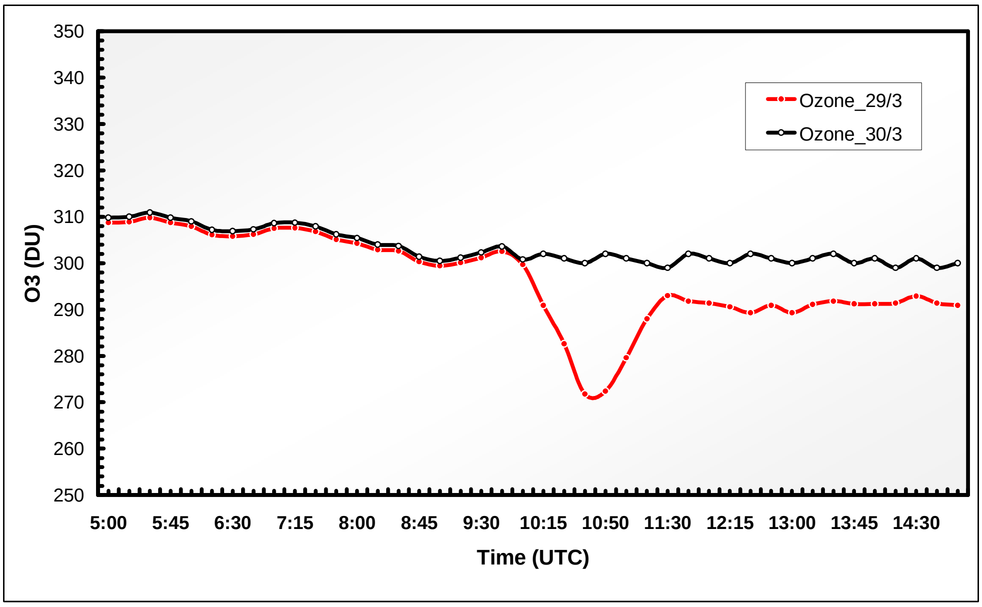

## Ozone and Solar Radiation variation during the Solar Eclipse of 29 March 2009

Northwestern Egypt is likely to be the primary destination for eclipse observers. Matrouh as Salloum has a high frequency of sunshine, with 75% of the maximum possible recorded in March. The instant of greatest eclipse occurs at 10:40UT. Sharp drop in the global solar radiation and UVB irradiances were observed during eclipse of 29 March 2009. The total ozone reduction of more than 30 DU can be artificially introduced in routine total ozone measurements with Brewer spectrophotometer, see figures. Figures 13, presents the hourly variation of UVB at eclips day (29 March) and normal day (30 March) while Figure 14, presents the hourly variation of ozone at eclips day (29 March) and normal day (30 March).

**Fi gure 13,** Hourly variation of UVB at eclips day (29 March) and normal day (30 March)




**Fi gure 14,** Hourly variation of ozone at eclips day (29 March) and normal day (30 March)




## CONCLUSIONS and RECOMMENDATIONS

**Montreal Protocol** is important for the ozone layer (and implicitly for climate change) but does not address emissions.

The **Kyoto Protocol** is important for climate change, and this addresses emissions and emission reductions. Replacement strategies under both Montreal (CFC, HCFC) and Kyoto (HFC) are important for the atmosphere.

**Multi Lateral Fund** (MLF) provided financial & technical assistance to Egypt, 40 investment projects has been carried out by UN implementing agencies namely UNDP, GTZ and UNIDO during the period of 1992 through 2009.

Egypt is in compliance with the ODS phase-out targets, and with those targets achieved, the time was ripe to look into the future and work to phase out the hydrochlorofluorocarbons (HCFCs), drawing on lessons learned in phasing out other ozone-depleting substances.

Calculations of ODP & GWP of these 40 projects implemented in Egypt from 1992 – 2009 indicated that the ODP of all projects is 3197 Tons while the GWP is 17,056,450.7 $CO_{2e}$ metric tons.

One of the main problems faced by the Egyptian ozone Unit is the lack of adequate funding to maintain such activities over time. This is particularly relevant since at this stage the ozone layer seems to have reached the peak state of its depletion and sensitive monitoring and important research is necessary to determine the future evolution and the start of the possible recovery ozone layer and ozone hole. Also, it is needed to fund cooperative programs between Ozone Unit in Egypt (funded by Montreal Protocol) and the Central Department of Climate Change (CCCD) in Egypt which had some fund through Kyoto Protocol to conduct research programs and fund building database (DB) for both programs. This database aim to involve:

- This DB will involve all related data and information from the different sites managing the work from abroad (as UNDP-UNIDO- GEF-UNFCCC-IPCC- Montréal Protocol- …). It will take care of all activities inside Egypt which deals with related activities as Line Ministries, Custom Authority, NGOs, Universities, Research Institutes, Associations, Factories and other stockholders who are dealing with phasing out ODS,s and related activities.
- The DB intends to include inputs from engineering facilities and energy contracting providers, investors, financial institutions, and government and private sector stakeholders in the region. Hence, the approach proposed taking actions related to the two multilateral environmental agreements, namely, the Kyoto Protocol on Climate Change and the Montreal Protocol.
- Exchange electronic data & information between Egyptian Meteorological Authority (EMA) of Egypt and Ozone Unit in EEAA.
- Egypt needs the fund for having this DB including servers, terminals, system software and other relevant equipments.
- We will appreciate assistance to start measurements of vertical ozone distribution advice to elaborate a by ozonesonde especially at Aswan station (tropical area).

It is strongly recommended to conduct Clean Development Mechanism (CDM) for the upcoming Chillers project in Egypt and inform UNFCCC through the Designated National Authority (DNA) of Egypt before start implementing the project.

Much work needs to be carried out to understand many aspects of the ozone evolution and change, including impact of HCFCs, ozone-climate relationships, UV relationships, etc. The international cooperation and assists for improvement the research level and quality are appreciated especially for African countries.

It is recommended to support awareness programs to increase the use of ODS alternative substances with low or negligible global warming potential.

Implementation of ISO standards for data quality assurance is needed for all instruments and observation technologies used for monitoring of ozone and UV in the global networks.
This includes manly definition and implementation of traceable calibration systems/chains, Standard Operating Procedures (SOPs) and maintenance of relevant metadata files.

It is recommended to take care of problems on operation of instruments and stability of data quality persist at some strategic ozone stations located mainly in developing countries in the tropics and in the Southern Hemisphere. To solve the situation the WMO/GAW and the UNEP Programs should reinforce their key role in the capacity building and in maintenance of the global ozone and UV monitoring infrastructure.

It is recommended to study on atmospheric chemistry in relation to ozone layer depletion and climate change, and to develop climatic models to predict the climatic change over Egypt.

It is strongly recommended to support dissemination program for the data and information related to Ozone to the public (newspapers, reports, workshops, radio & TV programs and other resources).

The data shows that the total amount of ozone measured in Egyptian ozone measurement stations network until 2009 tended to increase slightly. This indicates that the ozone layer above Egypt is not very much affective by the reduction occurring in the north and south polar airs.