

ARAB REPUBLIC OF EGYPT
Egyptian Meteorological Authority



National report
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INTRODUCTION:

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. The total area of Egypt is about 1.02 million Km² and the Capital is Cairo. Egypt is geographically divided into four main divisions: The Nile Valley and Delta (approx. 33,000 Km²) - The Western Desert (approx. 680,000 Km²) - The Eastern Desert (approx. 325,000 Km²) - Sinai Peninsula (approx. 61,000 Km²).

Egypt became a Party to the Vienna Convention in September 1988 and was a signatory to both the Vienna Convention and the Montreal Protocol, as well as a start-up member of the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol representing Article 5 Parties from 1991 to 1994. It is classified as an article 5 Party to the Montreal Protocol.

The Amendments to the Montreal Protocol were further early acceded/ ratified by Egypt as follows:

Multilateral Environmental Agreement	Date of Ratification	Date of Entry into Force for Egypt
Vienna Convention on the Protection of the Ozone Layer (Signed: 22 March 1985)	9 May 1988	22 September 1988
Montreal Protocol on Substances that Deplete the Ozone Layer (Signed: 16 September 1987)	2 August 1988	1 January 1989
London Amendment	13 January 1993	13 April 1993
Copenhagen Amendment	28 June 1994	6 September 1994
Montreal Amendment	20 July 2000	18 October 2000
Beijing Amendment	6 March 2009	4 June 2009
Kigali Amendment	22 August 2023	21 November 2023

1- OBSERVATIONAL ACTIVITIES

Egyptian Meteorological Authority regularly monitors the column atmospheric ozone, UV solar radiation at different stations representing different regions in Egypt, and stores the data in the central database of EMA. From 1968 up to now

1.1 Column Measurements of Ozone

EMA has been involved in the long-term monitoring of the ozone layer for more than 40 years. Measurements of the total ozone amount and ozone vertical profile using the Umkehr method by means of the Dobson spectrophotometer No.96 started in 1967 at Cairo, and in 1973 Cairo became a Regional Ozone Center (ROC) for ozone stations in North Africa and the Middle East., from 2022 , dobson 096 has been removed to new station rto the 10 of Ramadan station away from Cairo 40 km , After discovering the ozone depletion, in 1984 EMA established another ozone observatory at Aswan, measuring the total ozone amount and ozone vertical profile closed to the tropics region by means of the Dobson spectrophotometer No.69. In 1998 and 2000, EMA established another two ozone observatories in both Matrouh and Hurghada, respectively to enhance its ozone-monitoring network covering the Egyptian sky. Table (1) illustrates the information of the Egyptian ozone-monitoring network.

1.2 Profile Measurements of Ozone

Both Dobson and Brewer Spectrophotometers (Umkehr method) are used to measure the ozone vertical profile at stations of Aswan, Matrouh and Hurghada. The N-values are stored in the ozone database at EMA and they are deposited in (World Ozone and Ultraviolet Radiation Data Centre) in Toronto, Canada (WOUDC) for final processes.

Table (1): The total ozone-monitoring network in Egypt

	Cairo	Aswan	Matrouh	Hurghada
WMO No.	62371	62414	62306	62464
Ozone ID.	152	245	376	409
Latitude	30.08°N	23.97°N	31.33°N	27.28°N
Longitude	31.28°E	32.78°E	27.22°E	33.75°E
Height (m)	037	193	035	007
Instrument	Dobson #096	Dobson #069	Brewer #143	Dobson #059
Elements	O ₃	O ₃	O ₃ ,UVB, AOD, SO ₂	O ₃
Started at	October 1967	December 1984	November 1998	November 2000

1.3 UV measurements

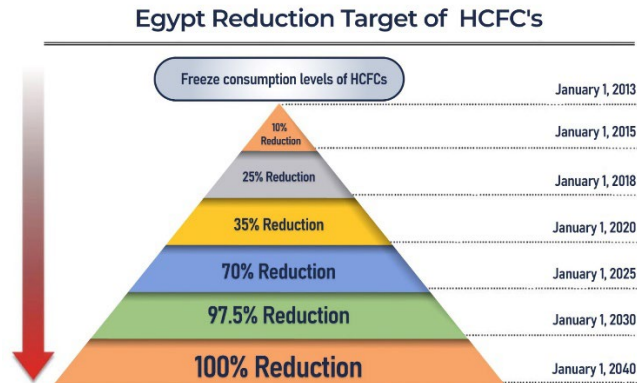
EMA measures the broadband UV solar radiation due to its biological effect at different sites. In addition, EMA in cooperation with University of South valley have measured the broadband UV radiation at Qena since 2000, The general information of Egyptian network for monitoring the UV and UVB radiation at Cairo, Aswan, Qena , and Rafah. Recently ema start monitoring UV and UVB with new 4 station Siwa , Borge Arab , Sha latten, Abu Simbel is illustrated in Table (2).

Table (2): The Egyptian UV and UV-B radiation Stations

	Cairo	Aswan	Abu simbel	Shalten	Qena	Rafaa h	Borg arab	Matrouh	Siwa
Start	Mar. 1989	Aug. 1989			Apr. 2000	-	Apr 2023	-	Mar 2023
UV-B Instr.	UVB-1	UVB-1	Eko	Eko	UVB-1	UVB-1	Apr2023	Brewer MII	Eko
Start	May 1996	Sep. 1998	May 2023	May 2023	Apr. 2000	Jun. 2000	Apr 2023	Jan. 1998	Mar 2023

1.4 Measurements of substances controlled under the Montreal Protocol

Egypt is a proud nation to implement the obligations under Montreal Protocol in right time and it has successfully achieved 100% reduction target of CFCs in 2010 and will achieve 70% reduction in HCFCs consumption by 2025. It has also amended rules and regulations and established an efficient licensing system, Egypt is now in full compliance in accordance with Montreal Protocol obligation.



1.5 Calibration activities

- The Dobson spectrophotometers have been regularly calibrated using Mercury and Standard lamps to adjust ETC, R-N tables and Q-table. In this way, their intercomparison stability can be checked and evaluated (4).
- Dobson spectrophotometers No.96 has been participated in different international intercomparisons which took place at Poland in 1974, at Boulder Colorado (USA) in 1977, at Arosa Observatory (Swiss Meteorological Institute) in 1986, at Greece in 1997, at Germany 2001, at Dahab (Egypt) in 2004, and at Hohenpeissenberg Observatory (Germany) in 2011 and Spain in 2017. recently in July 2023 in Hohenpeissenberg with support of WMO
- The Brewer spectrophotometer mark II No.64 was calibrated against the reference instrument Brewer No.17 maintained by the International Ozone Corporation (Canada) at the Matrouh observatory in 2005 and 2008, 2015. And need to be calibrated as the last calibration was in 2015 .

2 RESULTS FROM OBSERVATIONS AND ANALYSIS

2.1. Variation of ozone over Egypt

Annual variation and trend of ozone for long records over Egypt are presented in Figure (1), which shows that the linear trend is positive at all stations except over Matrouh, it is slightly negative.

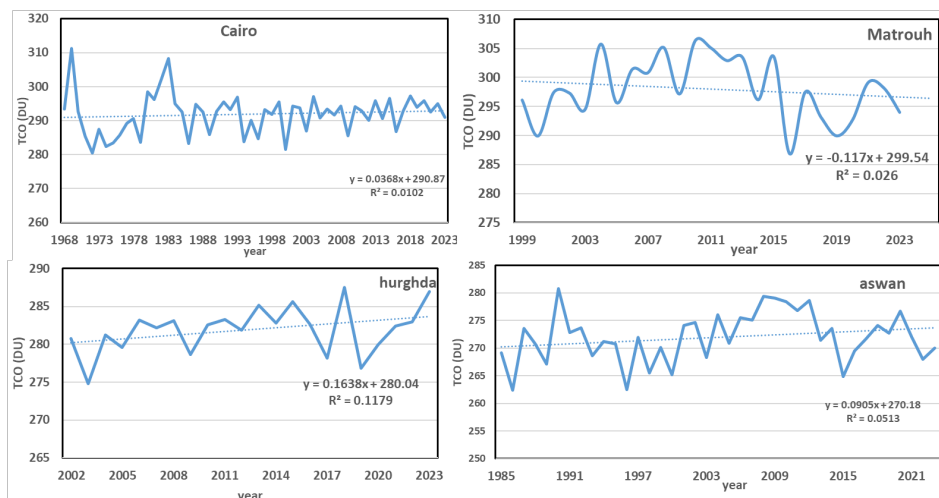


Fig.(1): Annual variation and trend of ozone at Egyptian ozone stations

UV index at northwest of Egyptian

Hourly UV radiation was determined for the entire period evaluated in this study. Figure (2) presents the hourly variation of dangerous UV with its Index over coastal northwest of Egypt (Matrouh). The amount of UVB light at ground level is determined by the solar elevation, the amount of ozone in the atmosphere and the cloudiness of the sky. When the sun rises higher in the sky the amount of atmosphere its rays have to pass through before striking the ground lessens. Therefore, UVB protection is critical 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. A person should wear protective clothing and use sunscreen, a hat with a brim and sunglasses [4].

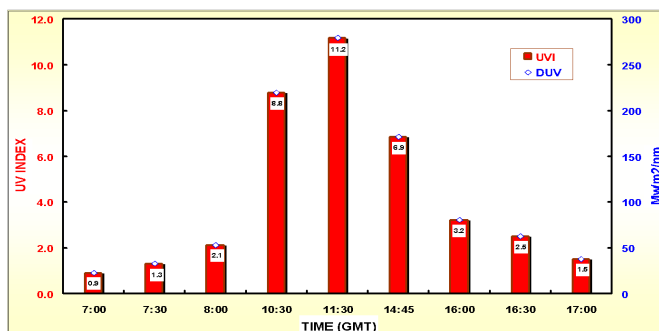


Fig. (2): Diurnal variation of Dangerous UV on a clear summer day over Matrouh

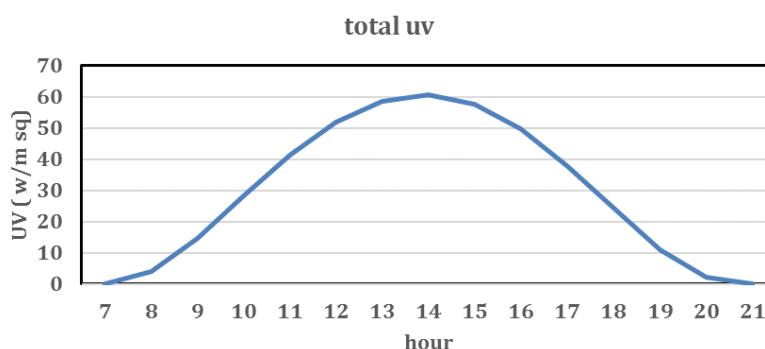


Fig (3): Diurnal variation of Dangerous total UV on a clear summer day over Siwa

3 THEORY, MODELLING, AND OTHER OZONE RELATED RESEARCH

Surface ozone measurements are conducted by EMA in Cairo station, and outside urban regions at Hurghada, Qena, El-Farafra (27.05°N, 27.99°E), and Sidi Branni (31.37°N, 25.53°E), recently EMA added new station in red sea zone in Dahab and by EEAA through the urban monitoring network. Monthly and annual reports issued by EMA and EEAA on the levels of surface ozone and other reactive gases. Besides, EMA has a system of numerical weather prediction including air quality models to forecast the concentrations of other gases.

4. DISSEMINATION OF RESULTS

4.1. Data reporting

All total column ozone data are regularly submitted to WOUDC. Besides EMA measures the surface ozone and submits the data to WDCRG (World Data Center of Reactive Gases) in Norway.

4.2. Information to the public

EMA publishes a quarterly Ozone report containing measurements of UV index over the North of Egypt. Also EMA issues a daily air quality report containing a forecast for Air Quality Health Index based on surface ozone concentration.

4.3. Relevant Scientific Papers

Through the last three years Scientists at EMA carry out a large number of papers have been published in various journals. Most recent ones are:

Motirh Al-Mutairi, Modhi O. Alotaibi, Heshmat AbdelBasset, Abdallah Abdeldym, Ayman Badawy, **Global ozone variability**, Journal of Atmospheric and Solar-Terrestrial Physics, Volume 253, 2023, 106162, ISSN 1364-6826, <https://doi.org/10.1016/j.jastp.2023.106162>.

Salah, Z. Sensitivity Study of Daily Dust Forecast over the Mena Region Using the RegCM4.4 Model. *Environ. Sci. Proc.* 2023, 27, 35. <https://doi.org/10.3390/ecas2023-15484>.

Mohamed, Marwa S., et al. "Validation of UV-Index retrieved from three satellites against Ground-Based measurements at different climates in Egypt." *The Egyptian Journal of Remote Sensing and Space Science* 26.2 (2023): 361-367.

Masoud, Alaa A. "Spatio-temporal patterns and trends of the air pollution integrating MERRA-2 and in situ air quality data over Egypt (2013–2021)." *Air Quality, Atmosphere & Health* (2023): 1-28

PROJECTS, COLLABORATION, TWINNING AND CAPACITY BUILDING

- ROC researchers in EMA promote the main activities in ozone research, with collaboration with few academic institutions such as Cairo University, EL Azhar University and South Valley University.
- EMA in co-operation with WMO carries out a training program for operators of ozone Arab countries.
- EMA participate in ENBIOSOL research proposal with Research Centre for Atmospheric Physics and Climatology, Academy of Athens, Greece.
- EMA must also acknowledge its many international collaborators with specific references to international programs as:
 - The World Meteorological Organization (WMO) for support to attend international intercomparisons and training courses, and to organize the intercomparison of the Dobson ozone instruments operated in the Africa region at Dahab from 22/2-12/3/2004.n which 21 specialists and 11 instruments from 10 countries.
 - USA NOAA ESRL, Boulder for maintenance of the ozone instruments.
 - WOUDC, Toronto, Canada for scientific cooperation.
 - Training assistance from the CZECH SOO-HK, in Hradec Kralove
 - Germany DWD (European Dobson Calibration facility).
 - The state Meteorological Agency of Spain (AEMET) for offering the Brewer training course.

6. IMPLEMENTATION OF THE RECOMMENDATIONS OF THE 11th OZONE RESEARCH MANAGERS MEETING

- With fund support from WMO Dobson 096 was calibrated in (meohp-German) 2023
- Unfouruntly we could not get fund to calibrate brewer spectrophotometer 143 in Mersa Matrouh as it was not calibrated from 2015

- Egypt participate in ENBIOSOL (Effects of Climatic and Air Quality Changes on Solar Energy and Biologically Effective) research proposal with Research Centre for Atmospheric Physics and Climatology, Academy of Athens, Greece.
- EMA plane to extend ozone network according install new one in west Desert in Frafra station.
- EMA added new 4 stations to monitoring UV and UVB variability , and one measure trace gases and surface ozone in Dahab

7. FUTURE PLANS

- EMA aims to issue the daily UVI forecast over Egypt
- EMA aims to calibrate brewer 143 MKII in Matruh with WMO support

8. NEEDS AND RECOMMENDATIONS

8.1. Training, Maintenance and Calibration

- Brewer 143 should be calibrate as the last calibration was on 2015
- EMA needs more financial support for training to increase efficiency of station observers. In addition, to increase the efficiency of the instruments, EMA needs a continued maintenance and calibration of instruments such as Dobson, Brewer spectrophotometers and UV sensor with the support of WMO is important.
- In order to provide more opportunities for maintenance and calibration for the African and Middle East countries, Egypt welcomes host international calibration of ozone measurement.

8.2. Systematic Observation

- It is highly appreciated to get financial support to start measuring ozone vertical distribution by ozone-sond in both Aswan and Matrouh and Farafra upper air stations.
- 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.

8.3. Research and Collaboration

- Participate in a scientific research program for ozone and climate change based on observations and climate models.
- It is recommended to support awareness programs to increase the use of ODS alternative substances with low or negligible global warming potential.

REFERANCES

- 1) *M. 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.*
- 2) *Abu-Allaban, M., Gertler, A.W., and Lowenthal, D.H., 2002: "A preliminary apportionment of the sources of ambient PM10, PM2.5, and VOCs in Cairo". Atmos. Environ. 36,5549-5557.*
- 3) *Abu-Allaban, M. Lowenthal, D.H., Gertler, A.W., and Labib, M., 2007: "Sources of PM10 and PM2.5 in Cairo's ambient air". Environ. Monit. Assess. 133, 417-425.*
- 4) *Egyptian Environmental Affairs Agency – Ozone Unit: Website, <http://www.eeaa.gov.eg/>*
- 5) *[http://www.io3.ca/Calibrations/Location/Marsa_Matrouh.](http://www.io3.ca/Calibrations/Location/Marsa_Matrouh)*