National Report

Islamic Republic of Iran

9TH UNEP Ozone Research Managers Meeting

14-16 May 2014, Geneva, Switzerland

1. Observational Activities

This report contains the updated information on the ozone and UV observation and research activities, which have been pursued in Iran through the past two years since the 7th meeting of the WMO/UNEP Ozone Research Mangers.

For the past three decades, the Meteorological Organization (MO) and Geophysics Institute of the University of Tehran have been taking over and performing UV-B and ozone monitoring and research activities in Iran.

Research and monitoring activities are based mainly on and through continuous cooperation and exchange of information between these centers and other research entities, i.e. the universities and related research institutes.

In spite of long history of atmospheric observation and research, the country still lacks sufficient capacity to effectively realize its objectives in the field of ozone and UV observation and networking, which forms only part of the country's atmospheric research and monitoring platform.

1.1. Column measurements of ozone and other gases/variables relevant to ozone loss.
There are three stations in which the ozone measurement facilities are installed and in use. The following stations are operating under the supervision of the Meteorological Organization (MO) and the Geophysics Institute of the University of University of Tehran:

1)Esfahan
2) Geophysics
3) Firouzkooh

Data on the above stations are provided in the Table 1.

Table 1.stations active in the ozone and UV measurement and monitoring actives in Iran

Station	Type		Coordination			Measurement Facilities		
	Synoptic	Upper Atmospheric	Latitude	Longitude	Altitude (metric)	Surface	vertical	Total
Esfahan	Yes	Yes	32° 37'N	51° 40' E	1550	Yes	Yes	Yes
Geophysics	Yes	No	35° 44'N	51° 33' E	2986	Yes	No	Yes
Firoozkooh	Yes	No	35° 43'N	52° 34' E	1419	Yes	No	No

Spatial distribution of the stations in Iran, related to above table that measures ozone column is shown in the figure 1.
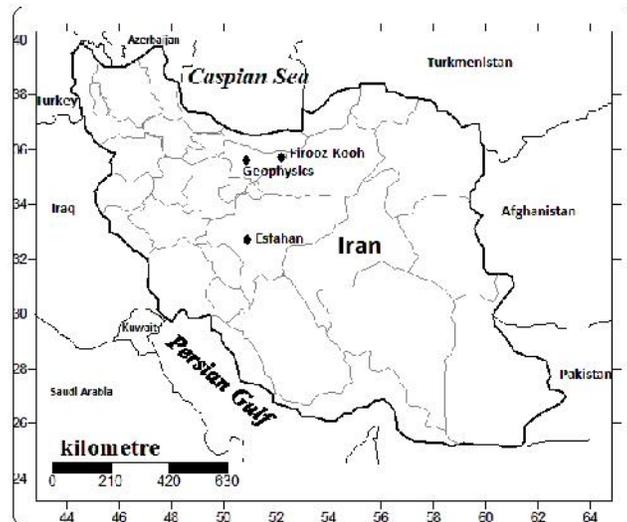

Figure 1. The locations of different stations in Iran with measurements of ozone column contents

Esfahan Ozone Station:

This station is recognized by an international 336 codes and is connected to the global networking system. Total ozone is being measured using Dobson system since January 2000. Since April 2000, Brewer

equipment was installed and has been operating at Esfahan station. This system measures total ozone in vertical column in an area of 1 cm^2 by attracting solar and sky radiation. In addition, the system measures UV-B, SO2, and NO2. Esfahan station is recognized by an OIFM code and measures on a daily basis the upper atmospheric conditions between 11 to 12 GMT. This station is also equipped with Radiosonde (RS80) and Hydrogen balloon (totex 600gr) in order to study the Upper Atmosphere.

Geophysics institute station:

The institute is mainly responsible for total ozone monitoring, data recording and processing, networking with World Ozone and Ultraviolet Radiation Data Center (WOUDC) and conducting networking, training and public awareness campaigns on stratospheric and surface ozone. The center is equipped with a Dobson photo-spectrometer and ancillary data processing and analysis hardware and software systems. The institute has been in cooperation with Tehran Municipality in air pollution monitoring activities through the established network of pollutants monitoring stations. As of 2000, total ozone has been measured using Dobson system for 30 minutes (from 8am to 7pm). Results of the

measurements are regularly calibrated using satellite data. The data recorded at the above stations is being reported to the WOUDC and are available through the center's web pages.

Firroozkooh Station:

Of the above station, Firoozkooh has not reportedly been active in the field of stratospheric ozone measurements for the past two years. Surface ozone outside urban area has been measured at Firooz-Kooh. The station is a reference station and official connected to the World Meteorological Organization's (WMO) Global Atmospheric Watch (GAW).

Esfahan and Geophysics stations are mainly involved in the ozone and UV observation in surface ozone measurement activities.

1.2 Profile measurements of ozone and other gases/variables relevant to ozone loss

(e.g. ozonesondes, ozone lidar)

Profile measurement of ozone needs employment of special equipment, which are not available at the existing station. In order to study the Upper Atmosphere, radiosonde (RS80) and hydrogen balloon (Totex 600gr) are in use at Esfahan station. Data recorded by these instruments then is transmitted to the global telecommunication system using a switching system. Esfahan station is connected to the global network of ozone observation and reports the data back to the WOUDC on a regular basis.

1.3 UV measurements

UV-B is only being measured at Esfahan. UV is measured at the wavelengths between 320 and 330 nm including UV-B. there are several other locations reported as high risk spots in terms of exposure to UV. UV monitoring in these high risk spots are of utmost importance and need establishment and use of new UV measurement equipment and facilities.

1.4 Calibration Activities

Data recorded by the stations is regularly checked for their validation and consistency. In the case of data inconsistency the equipment are sent to the WMO for calibration. Currently monitoring equipment at Geophysics and Esfahan stations are not calibrated and arenot properly in operation.

Equipment installed at the Firooz-kooh station was damaged and not in use for the last seven years. In order to maintain the continuity of ozone data series, the station will need to fix the damaged apparatus and to improve its measurement system. This station only records surface ozone data. An strategy is in place to change the station' systems to European standards.

Calibration of equipment in Geophysics station has been last made in February 2006 in Japan. In an agreement with the Japanese atmospheric research center, the Dobson apparatus at Geophysics station will be calibration, data collected by the Geophysics equipment has 3% deviation from the satellite data recorded for the same period, which is considerably acceptable.

The ozone and UV-B radiation measurement equipment at Esfahan Station has not been recently calibrated. From May 2013 onwards, the machine is not working and needs to be calibrated. so far, despite the correspondence with the respective international organizations, unfortunately no action has been performed yet.

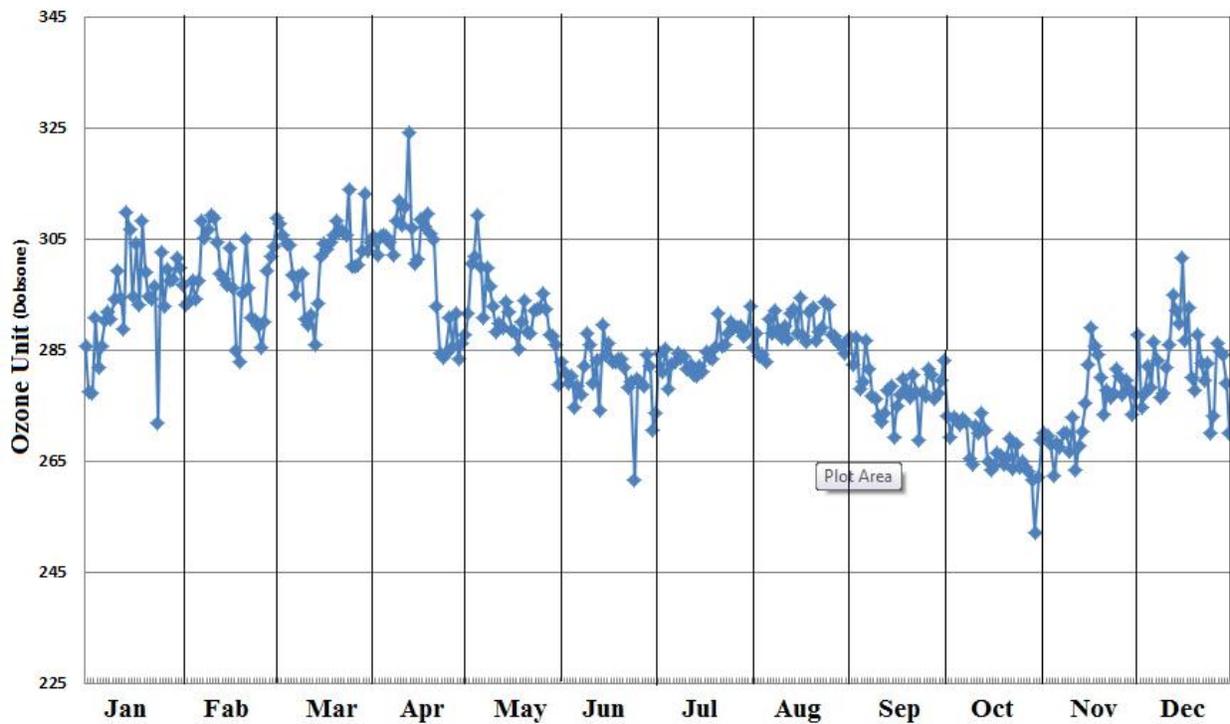## 2. Results from Observations and analysis using data of Esfahan station.

Figure 2. Daily variation of total ozone for the Long- Term duration over Esfahan station (the average data has been calculated for the period from 2000 to May 2013 in every month)
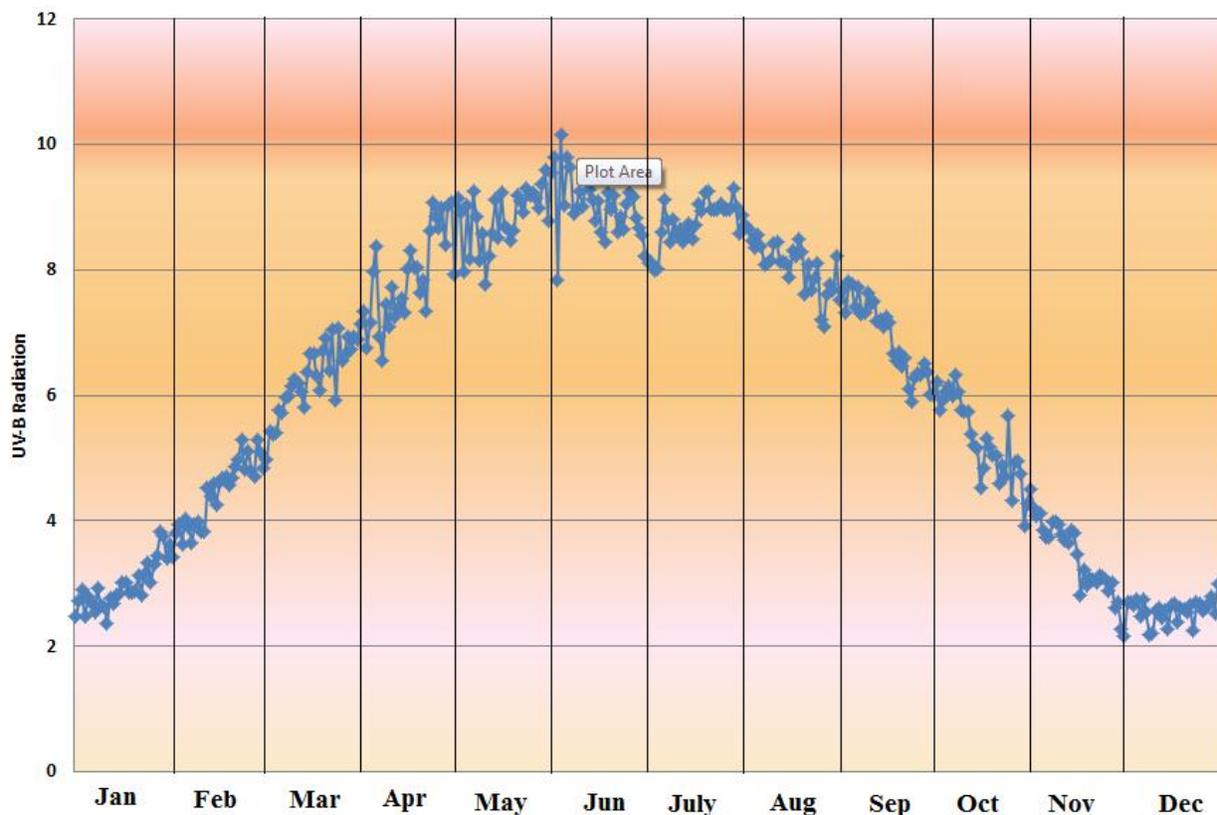
Figure 3. Daily variation of UV-B for the Long- Term duration over Esfahan station (the average data has been calculated for the period from 2000 to May 2013 in every month)

3. Theory, Modeling and other research

Two research units are active and affiliated to Meteorological Organization as follows:

- Esfahan Ozone and Atmospheric Chemistry Research Center;
- Atmospheric Chemistry and Air Pollution Research Group of the Meteorological Science Research Center

These centers are linked to the Esfahan and Forooz-Kooh stations and provide necessary research programs of assistance for the Centers.

Computer software is available at the Iranian Geophysics Center and Esfahan station for processing and modeling of the atmospheric ozone and photo-chemicals. These facilities have only been utilized for data processing and analysis. Models developed thus far have only for the simulation and analysis of air pollution in urban areas and so far no model has been developed specially applicable for ozone and UV analyses.

The first Iran- Korea joint workshop on climate modeling, Co-hosted by climatological Research Institute (CRI) and Meteorological Research Institute (MERI) was held on November 16- 17 2005. The program consisted of invited and contributed oral presentations from both countries and issues related to the subjects of the workshop were discussed in full. The workshop covered theoretical and applied topics of climate modeling as follows:

- Long- Term Forecasting
- Climate Change and Variability
- Extreme Events
- Application of climate Information
- Tele connections
- Paleoclimatology

4. Dissemination of results

4.1 Data reporting

Firooz-Kooh and Esfahan stations are refence stations connected to the global network of atmospheric watch. Total and vertical ozone data in WMO format are being regularly reported to the World Ozone and Ultraviolet Data Center in Canada (WOUDC). The data recorded by the stations also being archived at the related centers. Data on Ozone and UV recorded at Esfahan station is reported to WOUDC in Canada once every two months. The Firooz-kooh data is reported to the same center on a monthly basis.

4.2 Information to the public

As its routine procedure, the Geophysics institute provides assistances to the graduate and post graduate students through their MSc and PhD research programs on air pollution and atmospheric research. These assistances are in the form of long term meteorological data series and processed information. Reports of the student's theses are normally available for use by other researchers. The Long- Term Ozone Observation Data are also available at the web-sites of the Geophysics Institute. Information is also provided at the above web-site for the public use. (URLs for the web-sites are: http:// geophysics.ut.ac.ir/En/ for Geophysics Institute).

4.3 relevant scientific papers

5. Projects and Collaboration

The following research programs have been completed by the Geophysics research institute:

- The correlation between Total Ozone and troposphere/Stratosphere parameters(1991)

- o Correlation between Total Ozone and ground-base UV(1999)
- o Trend analysis of Surface Ozone data collected at Geophysics Synoptic Station in 2002 (2007)
- o Total Ozone change analysis with respect to the periodic solar activities(1983)
- o Analysis of interaction between the Total Ozone recorded at a random Meteorological station and regional weather systems (1999)
- o Comparative analysis of Ozone change through an eleven- year period of activities(1994)
- o Study of relation between Ozone and Humidity
- o Investigation of Ozone pollution in the earth (2003)
- o The study of Stratospheric / Tropospheric exchange by means of ground Ozone measurement (1978)
- o Temporal and spatial variability of Total Ozone in Central plateau of Iran revealed by ground-based instruments(2007)
- o Analysis of correlation between total ozone and upper air meteorological parameters in the Middle East (2010)
- o Investigation of total ozone seasonal distribution over Iran area for 2007-2008 (2013)

The Geophysics Institute and Meteorological Organization are in continuous cooperation with other academic and non- academic research units for the study of atmospheric phenomena.

6. Future Plans

The Meteorological Organization and Geophysics Institute are in demand for improvement of their research, Observation and data recording and reporting systems through regular UV Monitoring and analysis as well as public awareness campaigns.

There is a strong for scientific research on environmental impacts of increased UV due to the ozone depletion in different parts of country covering effects of UV radiation on:

- o Human health
- o Terrestrial and aquatic ecosystems
- o Biogeochemical cycle
- o Air quality
- o Materials

Development and improvement of "data networking system" is considered by the Meteorological Organization as an important component of the existing Ozone/UV monitoring system. Atmospheric Modeling is another area of interest that requires professional training and advanced hardware and software facilities.

A new atmospheric research center is also under construction in Esfahan for purpose that will need advanced equipment and networking systems.

7- Needs and Recommendations

- Development of advanced research programs on the UV/Ozone analysis and impacts;

- Development of National UV Observation and Monitoring Network
- Organization of regional and national training workshops for officials and experts from relevant UV/Ozone monitoring organizations and public seminars on Ozone /UV changes and its effects on terrestrial life;
- Thematic meetings on UV/Ozone Observation and monitoring will be needed to be included in the UNEP/ROAP networking system. This can be accomplished back to back to the annual network meetings;
- Capacity Building and provision of necessary advanced equipment and facilities to the existing stations including;

A) Equipping Geophysics station with the following instruments:

    1) Sky Radiometer (POM-02)

    2) Sky Radiometer (POM-01L)

    3) Grating Sunphotometer(PGS-100)

    4) Multichannel Data Logger (PMMS-100)

    5) Brewer Spectrophotometer

    6) Automation of existing Dobson Photo- Spectrometer for improved and precise measurements;

B) Renovation of Firooz-Kooh station;

C) Development of new UV monitoring stations in high risk UV spots;

D) Provision of upper-atmospheric observation and research facilities to Esfahan and Firooz-Kooh station

E) Provision of technical assistance and training to the centers for advanced atmospheric research and modeling;

- Systematic calibration of surface and upper –atmospheric Ozone measurement instruments at existing station;