TURKEY

Turkish State Meteorological Service is responsible for observing and promoting research activities on measurements of ozone and UV radiation.

OBSERVATIONAL ACTIVITIES

Two methods are commonly used for ozone measurements in Ankara. One method is to use the Electrochemical Concentration Cell (ECC) ozonsonde. The second method is using Brewer Spectrophotometer.

UV radiometers are used to measure UV radiation at 10 stations in narrow band and at 1 station in broad band with varied instruments.

Column measurements of ozone and other gases/variables relevant to ozone loss

Brewer Spectrophotometer

Station	Instrument	Institution	Latitude	Longitude	Start date of observation
Ankara	Brewer MKIII-188	TSMS	39° 57’ (N)	32° 53’ (E)	Sep.,2006 to present

Brewer spectrophotometer is deployed on a solar azimuth tracker which allows daily automatic measurements of total ozone, zenith sky and direct sun in Ankara station which is the component of WMO-Global Atmosphere Watch Programme.

All data measured by Brewer MK III Spectrophotometer #188 are stored in the database of Research and Data Processing Section of TSMS and are also sent to be recorded at the World Ozone and UV radiation Data Center (WOUDC) in Toronto, Canada.

Profile measurement of ozone and other gases/variables relevant to ozone loss

Ozonesonde

Station	Instrument	Institution	Latitude	Longitude	Start date of observation
Ankara	Ozonesonde(ECC)	TSMS	39° 57’ (N)	32° 53’(E)	Sep.,2006 to present

Research and Data Processing Section of TSMS has been making ozone vertical profile measurements through the atmosphere using balloon borne ozonesondes since 1994 in Ankara station.

Data obtained from ozonsonde are received from Vaisala ground receiving station located in Ankara.

UV measurements

Broad band measurements

Station	Instrument	Institution	Latitude	Longitude	Start date of observation
Ankara	Solar Light 501	TSMS	39° 57’ (N)	32° 53’ (E)	1997 to present
Antalya	Solar Light 501	TSMS	36° 42’ (N)	30° 44’ (E)	1997–2003

UV-Biometer Model 501 is used for broad band UV radiation measurements.

Narrow band filter instrument

Station	Instrument	Institution	Latitude	Longitude	Start date of observation
Akçaabat	Middleton Solar UVR1-B Radiometer	TSMS	41° 01’ (N)	39° 35’ (E)	2009 to present
Aksaray	Middleton Solar UVR1-B Radiometer	TSMS	38° 23’ (N)	34° 03’ (E)	2009 to present
Elazığ	Middleton Solar UVR1-B Radiometer	TSMS	38° 60’ (N)	39° 28’ (E)	2009 to present
Göksun	Middleton Solar UVR1-B Radiometer	TSMS	38° 01’ (N)	36° 30’ (E)	2009 to present
Mardin	Middleton Solar UVR1-B Radiometer	TSMS	37° 30’ (N)	40° 73’ (E)	2009 to present
Oltu	Middleton Solar UVR1-B Radiometer	TSMS	40° 33’ (N)	41° 59’ (E)	2009 to present
Sivas	Middleton Solar UVR1-B Radiometer	TSMS	39° 75’ (N)	37° 02’ (E)	2009 to present
Tarsus	Middleton Solar UVR1-B Radiometer	TSMS	36° 55’ (N)	34° 54’ (E)	2009 to present
Tokat	Middleton Solar UVR1-B Radiometer	TSMS	40° 30’ (N)	36° 57’ (E)	2009 to present
Van	Middleton Solar UVR1-B Radiometer	TSMS	38° 45’ (N)	43° 32’ (E)	2009 to present

UVR1-B Global Spectral Radiometers are used for narrow band UV radiation measurements.

Spectroradiometers

Spectral UVB measurements (290-325 nm) by Brewer spectrophotometer #188 MK III have started from 09 Sep.,2006 in Ankara station.

Station	Instrument	Institution	Latitude	Longitude	Start date of observation
Ankara	Brewer MKIII–188	TSMS	39° 57’ (N)	32° 53’(E)	Sep.2006 to present

Calibration activities

Calibration of Brewer spectrophotometer #188 MK III has been performed biennially. First Brewer S. calibration was carried out by International Ozone Services Inc. (IOS) which provides worldwide ozone and UV calibration services to customers with Brewer Ozone Spectrophotometer instruments. IOS used Brewer Ozone Spectrophotometer #017 as a reference instrument on 07–12 October 2008 in Ankara station.

Figure 1. First calibration of Brewer MKIII #188 with the reference Brewer MKIV #017 in Ankara station.

Figure 2. Second calibration of Brewer MKIII #188 with the reference Brewer MKIII #158 in Ankara station.

Second Brewer S. calibration was carried out by Kipp& Zonen on 22–29 September 2010. Kipp& Zonen used Brewer Ozone Spectrophotometer #158 as a reference instrument in Ankara station.

RESULTS FROM OBSERVATIONS AND ANALYSIS

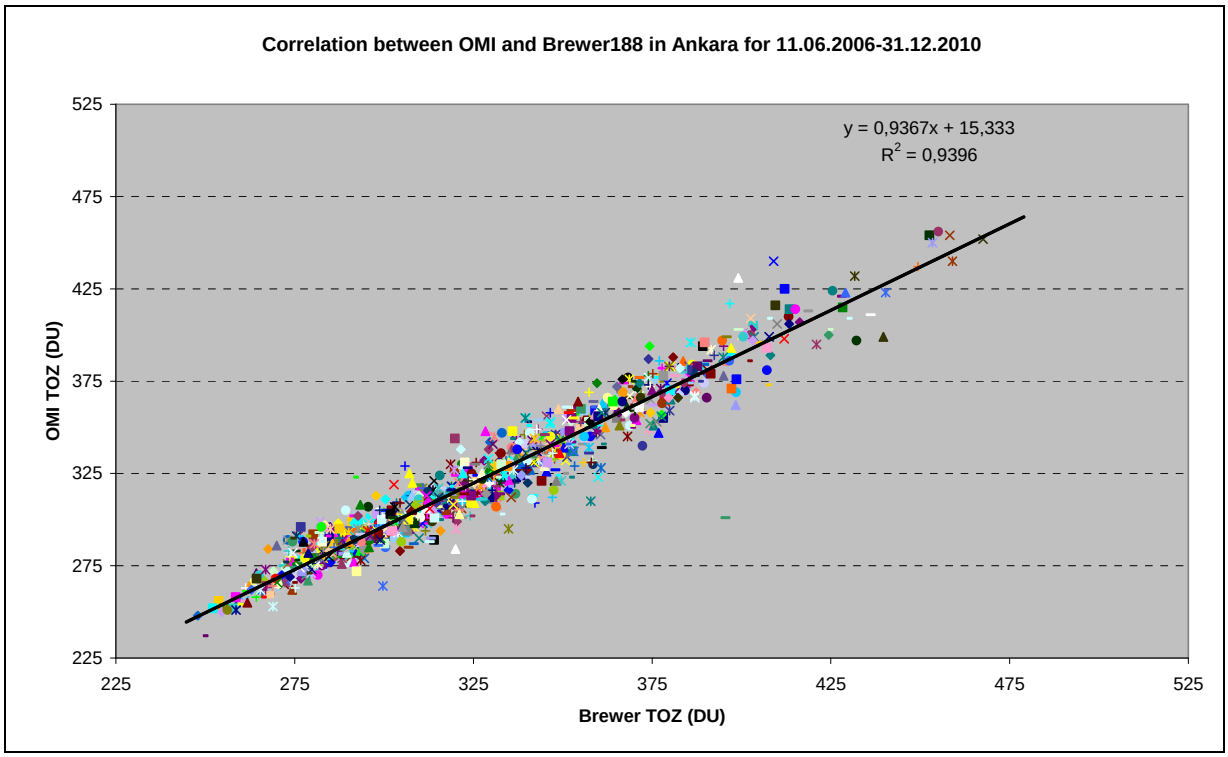


Figure 3. Comparison of OMI_TOMS from satellite with the total ozone measurements of Brewer S.#188 between 11 June 2006 and 31 December 2010.

In figure 3, Relationship between total ozone measurements of Brewer #188 and OMI_TOMS observed total ozone data from satellite indicates high correlation. Correlation coefficient is R=0.97 and R^2=0,9396.

DISSEMINATION OF RESULTS

Data reporting

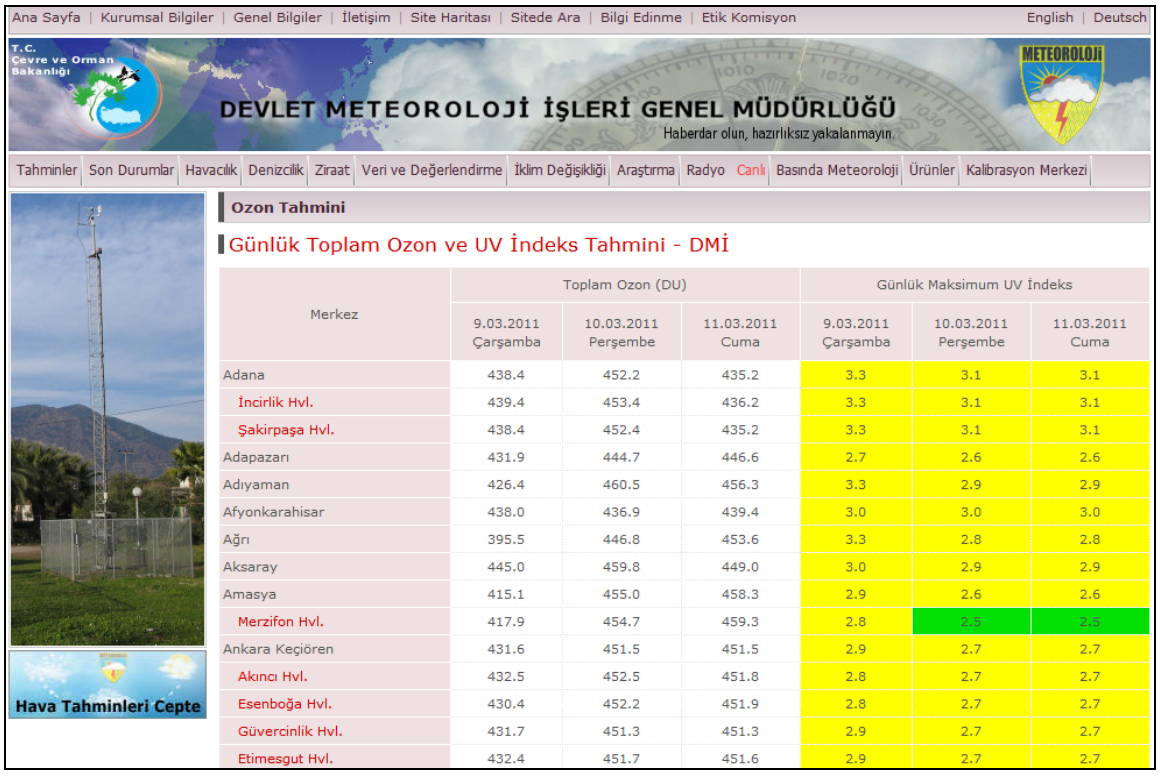
Products of ozone and UVB radiation measurements are stored at the Research and Data Processing Section of TSMS and can be accessible through intranet to users.

All data measured by Brewer MK III Spectrophotometer #188 and ozonsonde are sent regularly to the World Ozone and UV radiation Data Center (WOUDC). They are archieved and published with the station number 348 in Toronto, Canada.

Information to the public

A TUBITAK project, under contract no.105G032 titled "Observing the Variability in the Troposferic and Stratosferic Ozone and UVB measurements and Analyzing the Results", was conducted at TSMS under the collaboration with some scientist from Istanbul Technical University and completed in 2008. As a result, a statistical model was developed to forecast daily total ozone and UV index.

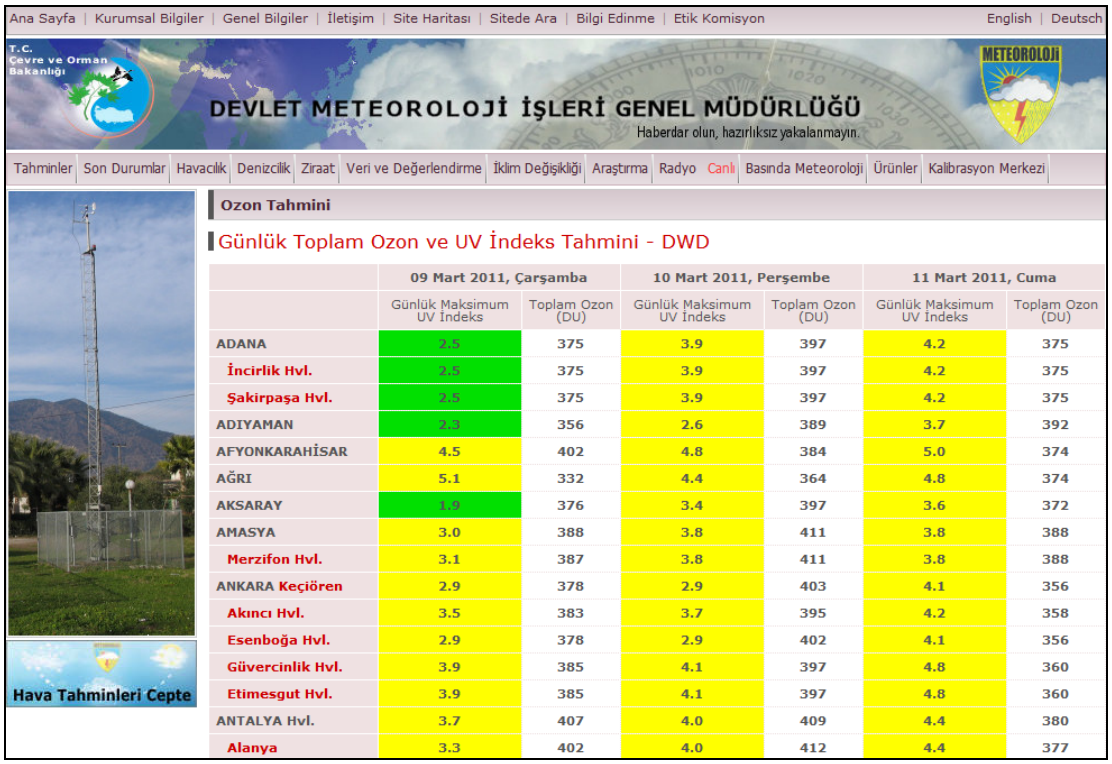
The model runs for 125 stations in Turkey and 5 stations in the Turkish Republic of Northern Cyprus and the model results are published through internet web site. http://www.dmi.gov.tr/kurumici/tahmin-ozon-dmi.aspx



Merkez	Toplam Ozon (DU)			Günlük Maksimum UV İndeks		
	9.03.2011 Çarşamba	10.03.2011 Perşembe	11.03.2011 Cuma	9.03.2011 Çarşamba	10.03.2011 Perşembe	11.03.2011 Cuma
Adana	438.4	452.2	435.2	3.3	3.1	3.1
İncirlik Hvl.	439.4	453.4	436.2	3.3	3.1	3.1
Şakirpaşa Hvl.	438.4	452.4	435.2	3.3	3.1	3.1
Adapazarı	431.9	444.7	446.6	2.7	2.6	2.6
Adıyaman	426.4	460.5	456.3	3.3	2.9	2.9
Afyonkarahisar	438.0	436.9	439.4	3.0	3.0	3.0
Ağrı	395.5	446.8	453.6	3.3	2.8	2.8
Aksaray	445.0	459.8	449.0	3.0	2.9	2.9
Amasya	415.1	455.0	458.3	2.9	2.6	2.6
Merzifon Hvl.	417.9	454.7	459.3	2.8	2.5	2.5
Ankara Keçiören	431.6	451.5	451.5	2.9	2.7	2.7
Akıncı Hvl.	432.5	452.5	451.8	2.8	2.7	2.7
Esenboğa Hvl.	430.4	452.2	451.9	2.8	2.7	2.7
Güvercinlik Hvl.	431.7	451.3	451.3	2.9	2.7	2.7
Etimesgut Hvl.	432.4	451.7	451.6	2.9	2.7	2.7

Figure 4. The TSMS Model outputs for daily forecasted total ozone and UV index in Turkey.

A joint efforts between the TSMS and Deutscher Wetterdienst (DWD) lead to publishing information on daily forecasted total ozone and maximum UV index to the public at the TSMS web page: http://www.dmi.gov.tr/kurumici/tahmin-ozon-dwd.aspx



	09 Mart 2011, Çarşamba		10 Mart 2011, Perşembe		11 Mart 2011, Cuma	
	Günlük Maksimum UV İndeks	Toplam Ozon (DU)	Günlük Maksimum UV İndeks	Toplam Ozon (DU)	Günlük Maksimum UV İndeks	Toplam Ozon (DU)
ADANA	2.5	375	3.9	397	4.2	375
İncirlik Hvl.	2.5	375	3.9	397	4.2	375
Şakirpaşa Hvl.	2.5	375	3.9	397	4.2	375
ADIYAMAN	2.3	356	2.6	389	3.7	392
AFYONKARAHİSAR	4.5	402	4.8	384	5.0	374
AĞRI	5.1	332	4.4	364	4.8	374
AKSARAY	1.9	376	3.4	397	3.6	372
AMASYA	3.0	388	3.8	411	3.8	388
Merzifon Hvl.	3.1	387	3.8	411	3.8	388
ANKARA Keçiören	2.9	378	2.9	403	4.1	356
Akıncı Hvl.	3.5	383	3.7	395	4.2	358
Esenboğa Hvl.	2.9	378	2.9	402	4.1	356
Güvercinlik Hvl.	3.9	385	4.1	397	4.8	360
Etimesgut Hvl.	3.9	385	4.1	397	4.8	360
ANTALYA Hvl.	3.7	407	4.0	409	4.4	380
Alanya	3.3	402	4.0	412	4.4	377

Figure 5. DWD model products showing information on daily forecasted total ozone and maximum UV index to the public at the TSMS web page for Turkey.

Relevant scientific papers

1- B. Aksoy, S. Incecik, S. Topcu, D. Demirhan Bari, C. Kahya, Y. Acar, M.Ozunlu, M. ***Ekinci "Total ozone over Ankara and its forecasting using regression models",*** International Journal of Remote Sensing, Vol. 30, Issue 17, 2009, pages 4387-4400.

2- Topcu, S., D. Demirhan Bari, C. Kahya, S. Incecik, Y. Acar***, "Climatology of erythemal UV radiation in Ankara, Turkey",*** Asia Oceania Geosciences Society (AOGS), Singapore, August, 10-15 2009 (oral presentation).

PROJECTS AND COLLABORATIONS

The ground-based Brewer data #188 and model predicted output data on total ozone and UV index have been compared systematically with satellite observations.

FUTURE PLANS

- to establish a Brewer Spectrophotometer Network to cover and to represent whole Turkey for measuring total ozone and UV index by purchasing more Brewer Spectrophotometer.
- to examine tropospheric ozone profile.
- to examine stratospheric ozone profile.
- to study on interactions between stratospheric ozone and climate change.
- to examine variation in ozone and UV index in time.
- to evaluate interaction between ozone change and climate change.
- to contribute to ozone assessments by sharing information.
- to seek for research at the European level implemented through the Framework Programmes for research and technological development (FPs)of European Commission.
- to participate seminars, conferences and meetings related with global ozone research and international monitoring programme.

NEEDS AND RECOMMENDATIONS

Providing a continued maintenance and calibration of instruments such as Brewer S. and UV sensor with the support of WMO is important.