TURKEY

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

OBSERVATIONAL ACTIVITIES

Ozone measurements are made by Brewer Spectrophotometer in Ankara.

Ultraviolet radiation measurements are made in totally 15 stations with different specification instruments which of one is broad band and others are narrow band.

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.

Data is measured by Brewer MK III Spectrophotometer and the measured data are stored in the database of The Data Processing Department of TSMS and are also sent to the World Ozone and UV radiation Data Center (WOUDC) in Toronto, Canada and are archived in there. And since 2016 the data of Brewer 188 has started to share with data base of EUBrewnet Project that is the supported by WMO and GAW as a COST project.

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 Marc 2013

Ozone profile measurements were made by TSMS Research Department in the method of ozonesonde between January 1994 and March 2013 in Ankara for 19 years.

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
İstanbul, Florya	PMA1102	MGM	40° 59 (N)	28° 45 (E)	2012 to present
İzmir, Güzelyalı	PMA1102	MGM	38° 43 (N)	27° 17 (E)	2012 to present
Antalya, Kale	PMA1102	MGM	36° 15 (N)	29° 57 (E)	2012 to present
Afyon, Çay	PMA1102	MGM	38° 35 (N)	31° 02 (E)	2012 to present

UVR1-B Global Spectral Radiometers and PMA1102 UV detector are used for narrow band UV radiation measurements.

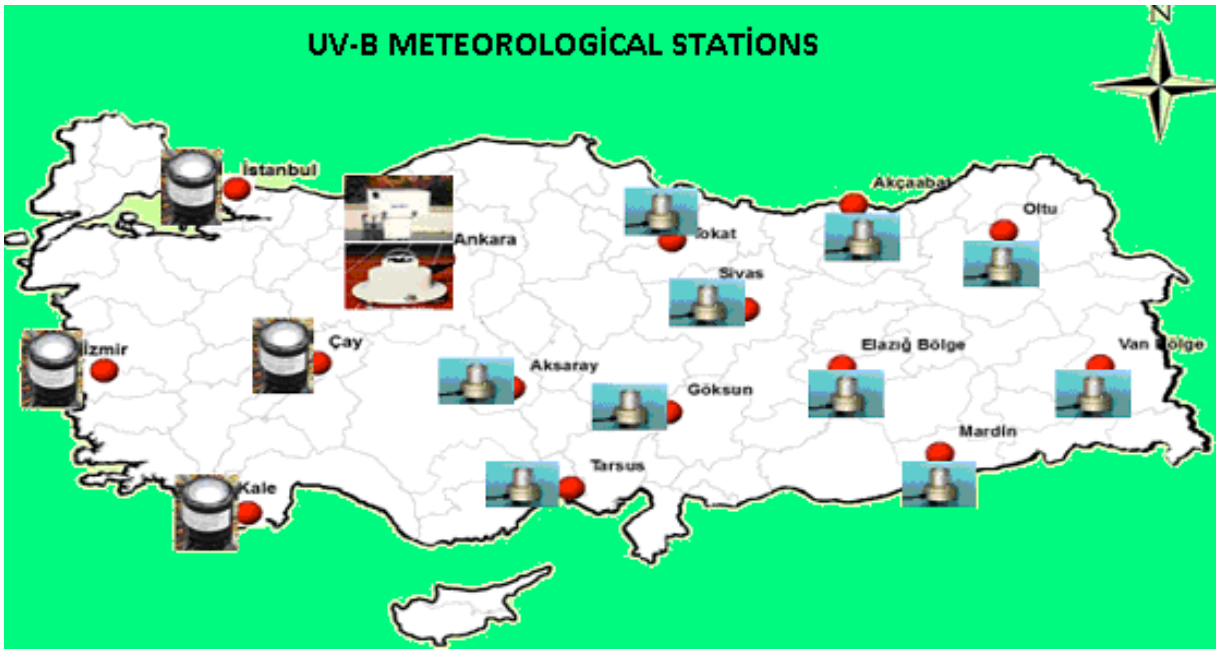


Figure 1. Turkey, UV-B Meteorological Stations

Spectroradiometers

Spectral UVB measurements (290-325 nm) by Brewer spectrophotometer #188 MK III have started from 09 September, 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 has performed since it was installed in 2006. 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 2. *First calibration of Brewer MKIII #188 with the reference Brewer MKIV #017 in Ankara station.*

Figure 3. *Second calibration of Brewer MKIII #188 with the reference Brewer MKIII #158 in Ankara station.*

Figure 4. *Third calibration of Brewer MKIII #188 with the reference Brewer MKIII #158 in Ankara station.*

Figure 5. *Fourth calibration of Brewer MKIII #188 with the reference Brewer MKIII #158 in Ankara station.*

Second calibration of Brewer S. #188 was carried out on 22 - 29 September in 2010 and Third calibration of Brewer S. #188 was carried out on 23 - 27 September in 2013 by Kipp& Zonen. Kipp& Zonen used Brewer Ozone Spectrophotometer #158 as a reference instrument during calibration in Ankara station. As well as the third calibration, the fourth calibration was also

made by Kipp& Zonen personel Mr. Oleksii Marianenko and used the same reference instrument #158 on 23-27 May 2016.

OBSERVATIONS AND ANALYSIS RESULTS

Brewer Ozone Variability Over Ankara, Comparison Between OMI and Brewer Ozone Measurements for Ankara (2007-2016)

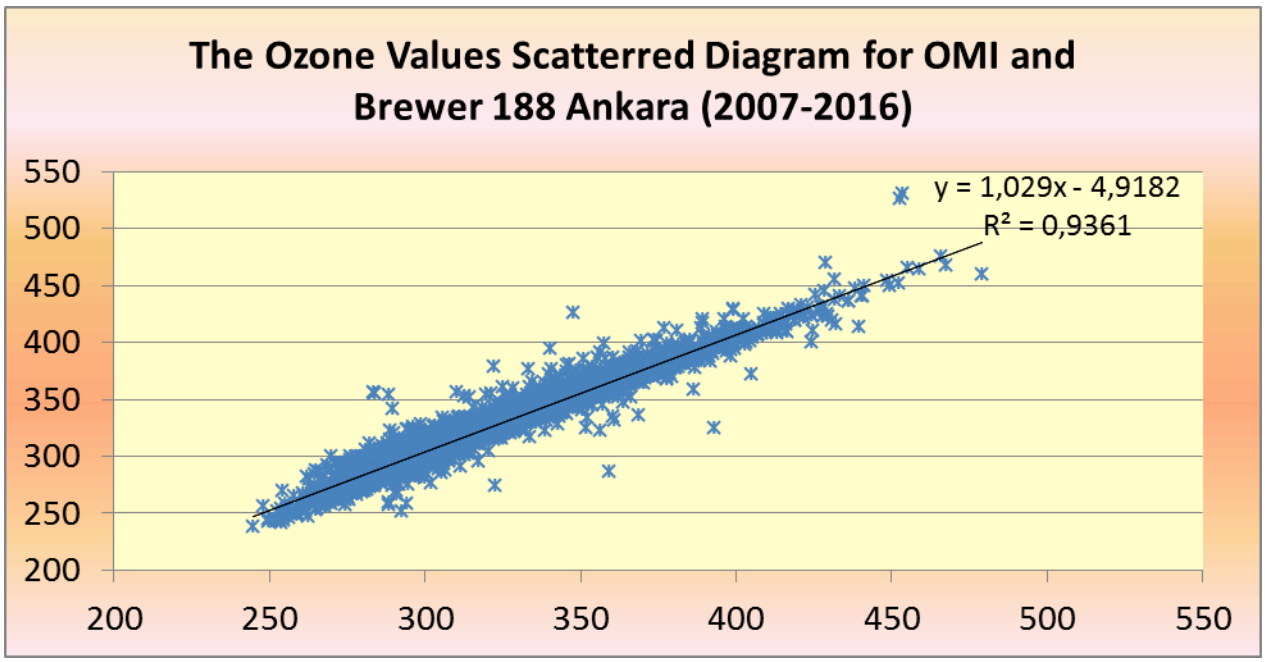


Figure 6: Comparison of OMI from NASA Aura Satellite with the total ozone measurements of Brewer S. #188 for 01 January 2007 and 31 December 2016 period.

In figure 6, relationship between total ozone measurements of Brewer #188 and OMI_TOMS observed total ozone data from satellite indicates high correlation. Correlation coefficient is R=0,96 and R^2=0,9361.

Turkey's Total Ozone Satellite (TOMS-OMI) Data Assessment for Long Period (1979-2016)

TOMS-OMI satellite ozone data used in this study is selected from the global data set which is in http://ozoneaq.gsfc.nasa.gov/ NASA's web address. Data is range Turkey's 25 ° - 45 ° East Longitude and 34 ° - 42 ° North Latitude, data resolution is 1°x1.25° and data grid consists of 82 points.

Data time range covers from 1979 to 2016 (37 years). The data set which is consist of total 3034 data and is belong to Turkey domain. 984 of data are used for monthly comparison and 328 of data are used for seasonal comparison.

Average total ozone value has been found in 316 DU from data set which is used in mapping. The lowest average value is 291 DU in point 37 °N and 44 °E in 1993. The highest average value is 351 DU in point 42°N and 28°E in 1991.

The average total ozone is approximately 305 DU at Turkey's southern latitudes and in northern latitudes is approximately 330 DU. The average total ozone difference is also 25 DU between the northern and southern latitudes in Turkey.

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. At the same time, Ankara station is a part of the Global Atmosphere Watch Programme (GAW).

Eubrewnet; Descriptions are provided by the Actions directly via e-COST. This proposal will coordinate Brewer Spectrophotometer measurements of ozone, spectral UV and aerosol optical depth (AOD) in the UV within Europe. Around 50 Brewer Spectrophotometers are deployed in Europe, independently funded by national agencies. Brewer 188, Ankara is also included by the EuBrewnet Project since 2013 and the measurements of Brewer 188 are shared to EuBrewnet Data Base by TSMS.

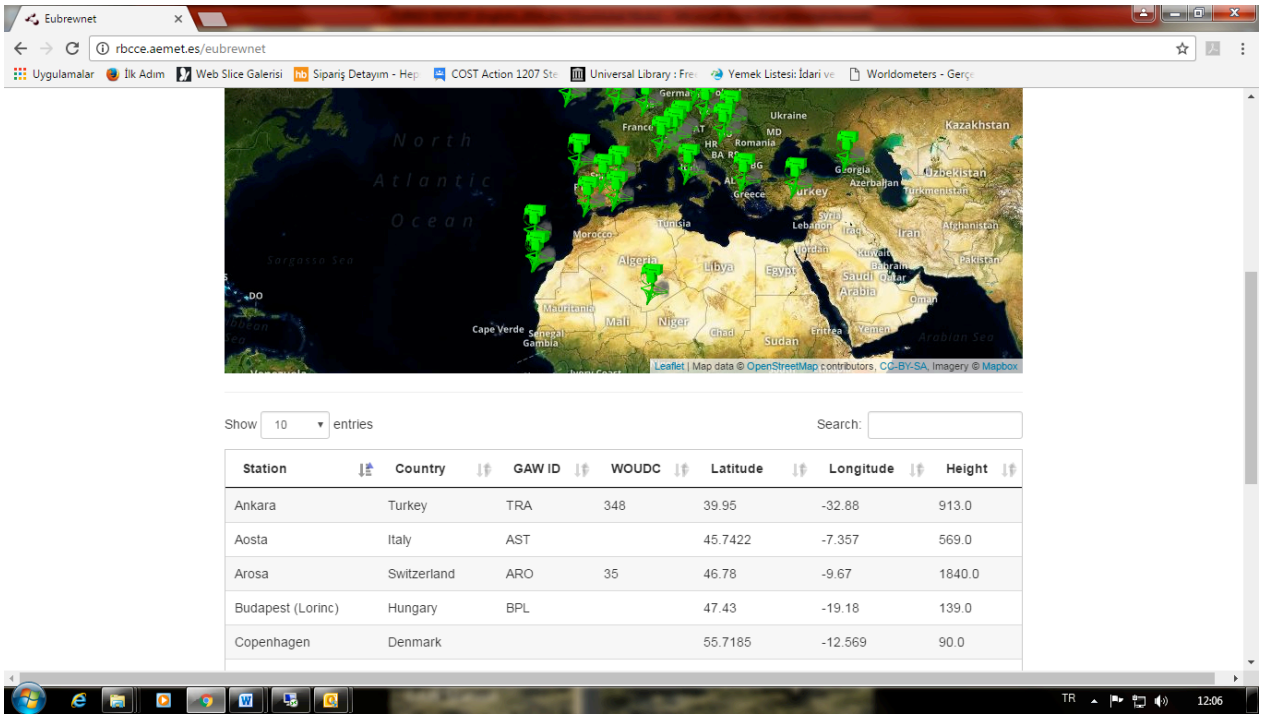


Figure 7: The European Brewer Stations in COST EuBrewnet Project.

Information for the Public

Since 2008, daily total ozone and ultraviolet index forecast information**,** which is derived by using a statistical model in Turkey's 125 points and Northern Cyprus Turkish Republic (TRNC)'s 5 points**,** are published through internet web site. http://www.mgm.gov.tr/kurumici/tahmin-ozon-mgm.aspx

T.C.
Orman ve Su İşleri Bakanlığı
Meteoroloji Genel Müdürlüğü

Kurumsal Bilgiler | Genel Bilgiler | Bilgi Edinme | Etik Komisyon | İletişim

Sitede Ara

English | Deutsch

Ana Sayfa | Tahminler | Son Durumlar | Denizcilik | Havacılık | Ziraat | Analizler | Araştırma | İklim | Radyo

Günlük Toplam Ozon ve UV İndeks Tahmini - MGM

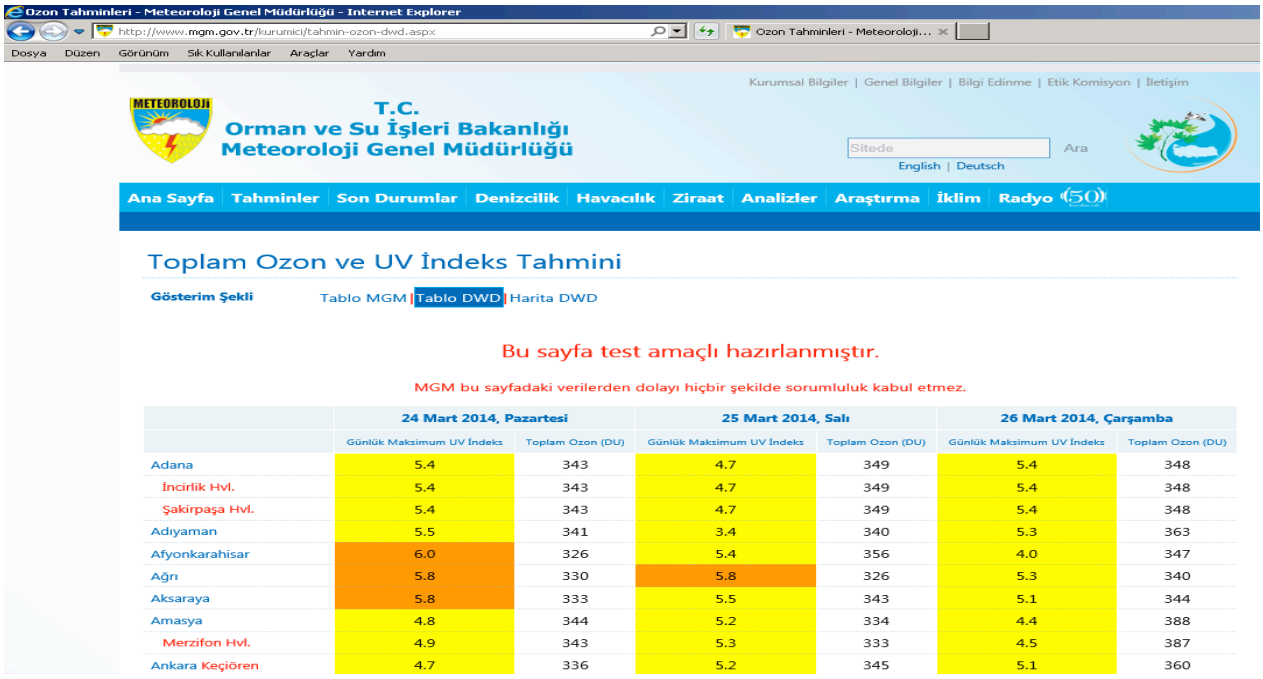
Gösterim Şekli: Tablo MGM | Tablo DWD | Harita DWD

Bu sayfa test amaçlı hazırlanmıştır.

Merkez	Toplam Ozon (DU)			Günlük Maksimum UV İndeks		
	24.03.2014 Pazartesi	25.03.2014 Salı	26.03.2014 Çarşamba	24.03.2014 Pazartesi	25.03.2014 Salı	26.03.2014 Çarşamba
Adana	408.1	411.0	400.5	4.6	4.6	4.6
İncirlik Hvl.	407.9	410.9	400.3	4.6	4.6	4.6
Şakirpaşa Hvl.	408.1	411.0	400.6	4.6	4.6	4.6
Adapazarı	380.7	391.3	392.6	4.3	4.1	4.1
Adıyaman	411.6	420.7	409.8	4.4	4.3	4.3
Afyonkarahisar	385.9	391.6	391.9	4.6	4.5	4.5
Ağrı	391.2	418.3	415.0	4.3	4.0	4.0
Aksaray	409.6	410.7	404.6	4.4	4.3	4.3
Amasya	405.8	412.3	409.8	4.0	3.9	3.9
Merzifon Hvl.	403.8	411.2	408.5	4.0	3.9	3.9

Figure 8: The TSMS Model outputs for daily forecasted total ozone and UV index in Turkey.

In Addition, TSMS and the German Meteorological Service (DWD) have been cooperation for ozone and ultraviolet index forecast. Daily total ozone and ultraviolet index forecast information, which is produced by DWD for Turkey's 125 points and Northern Cyprus Turkish Republic (TRNC)'s 5 points, are published through internet web site.
http://www.mgm.gov.tr/kurumici/tahmin-ozon-mgm.aspx



T.C.
Orman ve Su İşleri Bakanlığı
Meteoroloji Genel Müdürlüğü

Kurumsal Bilgiler | Genel Bilgiler | Bilgi Edinme | Etik Komisyon | İletişim

Sitede Ara

English | Deutsch

Ana Sayfa | Tahminler | Son Durumlar | Denizcilik | Havacılık | Ziraat | Analizler | Araştırma | İklim | Radyo

Toplam Ozon ve UV İndeks Tahmini

Gösterim Şekli: Tablo MGM | Tablo DWD | Harita DWD

Bu sayfa test amaçlı hazırlanmıştır.

MGM bu sayfadaki verilerden dolayı hiçbir şekilde sorumluluk kabul etmez.

	24 Mart 2014, Pazartesi		25 Mart 2014, Salı		26 Mart 2014, Çarşamba	
	Günlük Maksimum UV İndeks	Toplam Ozon (DU)	Günlük Maksimum UV İndeks	Toplam Ozon (DU)	Günlük Maksimum UV İndeks	Toplam Ozon (DU)
Adana	5.4	343	4.7	349	5.4	348
İncirlik Hvl.	5.4	343	4.7	349	5.4	348
Şakirpaşa Hvl.	5.4	343	4.7	349	5.4	348
Adıyaman	5.5	341	3.4	340	5.3	363
Afyonkarahisar	6.0	326	5.4	356	4.0	347
Ağrı	5.8	330	5.8	326	5.3	340
Aksaraya	5.8	333	5.5	343	5.1	344
Amasya	4.8	344	5.2	334	4.4	388
Merzifon Hvl.	4.9	343	5.3	333	4.5	387
Ankara Keçiören	4.7	336	5.2	345	5.1	360

Figure 9: DWD model products showing information on daily forecasted total ozone and maximum UV index to the public at the TSMS web page for Turkey.

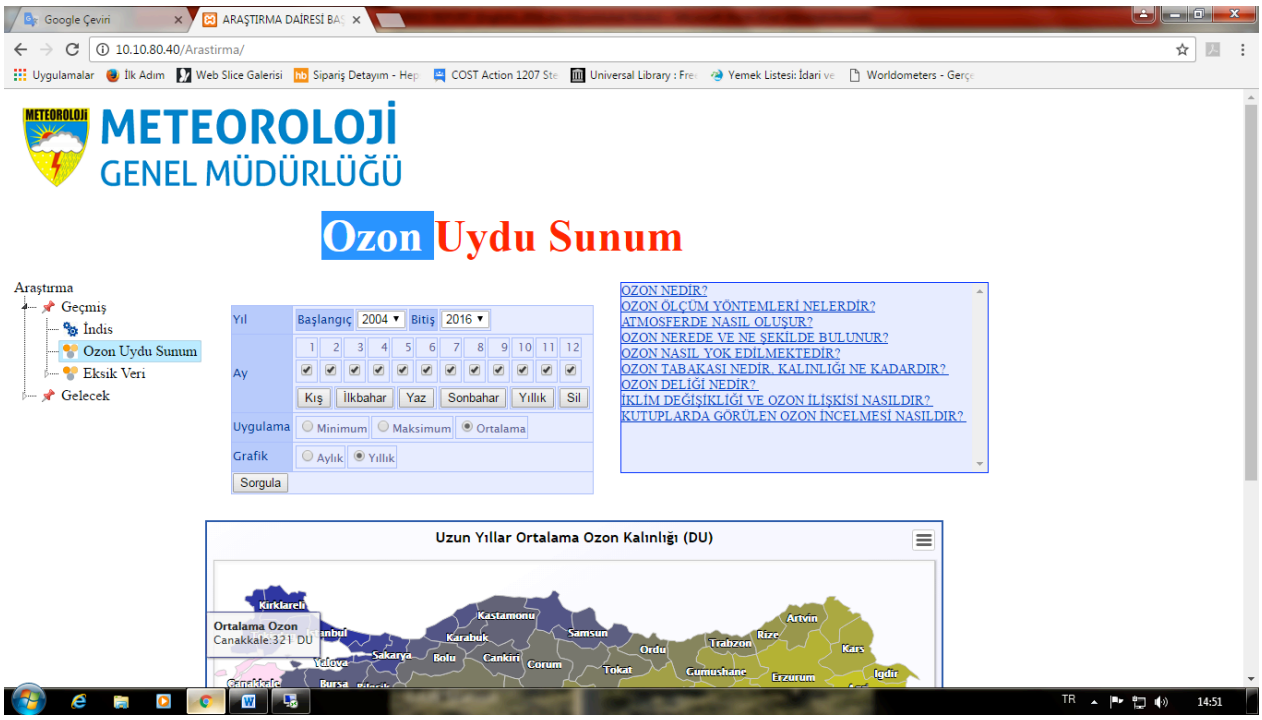


Figure 10: Information about general ozone and illustration of monthly, seasonal and annual ozone data

In Research Department Server, there is a new test page that is illustrated to last users the satellite ozone data for all Turkey as monthly, seasonal, annual and minimum, maximum and average values of the ozone as well. On the other hand, the last users could have informed about meta data, knowledge about general ozone information in this page (Figure 10).

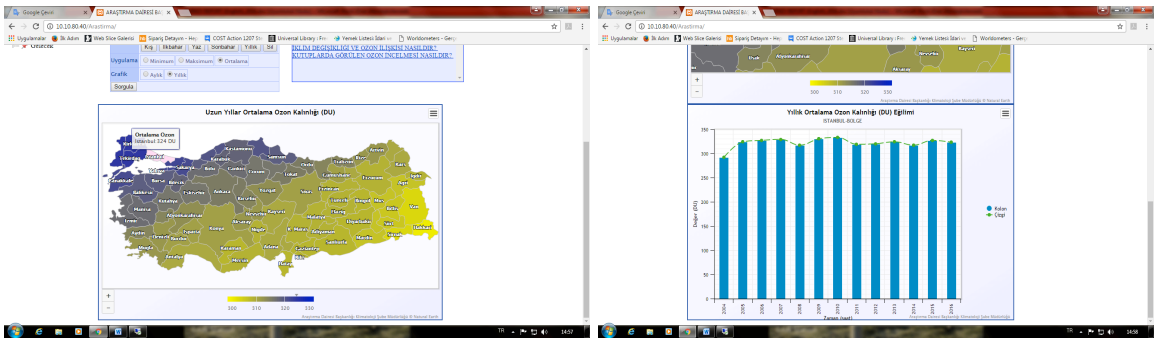


Figure 11: The İllustrations of satellite ozone data of all Turkey and a graphic of any province

In this page, any user could obtain the illustration of Turkey ozone map. In this map, any user could see the the ozone average of any province in Turkey and also if any user clicks on a province over the map, who can obtain the ozone graphic of that province (Figure 11).

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 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 Programs for research and technological development (FPs)of European Commission.
- To attend seminars, conferences and meetings related with global ozone research and international monitoring program.
- To share all ozone and UV Radiation data and all products to the public. Would like to develop new test pages as soon as possible.

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.

Relevant Scientific Papers

1- Barı D.D., Topcu S., Aksoy B., Kahya C., Incecik S., Acar Y., Ozunlu M., Ekici M., *"A Study Of Daily Total Column Ozone Forecasting Based On Toms Data And Meteorology*". Perugia, Italy. (IUGG), 2007.

2- 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.

3- Topcu, S., D. Demirhan Bari, C. Kahya, S. Incecik, Y. Acar*, "Climatology of erythemal UV radiation in Ankara, Turkey",* Asia Oceania Geosciences Society (AOGS),6th Annual Meeting, Singapore, 11.08.2009-15.08.2009).

4- Topcu, S., D. Demirhan Barı, C. Kahya, S. İncecik, Y. Acar*, "Ankara'nın Erythemal UV radyasyon klimatolojisi",* Asya Okyanus Yerbilimleri Topluluğu (AOGS), Singapur, Ağustos, 10-15 2009.

5- Demirhan Bari D, Kahya C, Topcu S., İncecik S., Aksoy B, Acar Y., Ozunlu M., Ekici M, *"Estimating of Daily Erythemal UV Irradiation in Ankara, Turkey with an Empirical Model,",* 2009, Quadrennial Ozone Symposium (QOS),, Tromsø, Norway, 29.06.2009 - 05.07.2009.

6- Acar, Y., Ekici, M.*, "Ankara'nın Brewer Eritemal UV (EUV) Ölçüm Verileri İle Model Eritemal UV (EUV) Tahmin Verilerinin Karşılaştırması"* (Makale-1.Meteoroloji Sempozyumu), 2010.

7- Ekici, M., Acar, Y., *"Ankara İçin Brewer Spektrofotometre ve OMI Uydu Toplam Ozon Verilerinin Karşılaştırması*" (Makale,1.Meteoroloji Sempozyumu), 2010.

8- Acar, Y., Ekici, M, Yağan, S., Akçakaya, A., *"Brewer Spektrofotometresi (188) Ozon Profil Verilerine Göre Ankara Üzerindeki Ozonun Dikey Dağılımı",* MGM, Teknik Rapor, Şubat 2013, Ankara, Türkiye.

9- Mithat EKİCİ, Osman ESKİOĞLU, Yılmaz AÇAR, Mesut DEMİRCAN, Alper AKÇAKAYA, "Toms ve OMI Uydu Türkiye Ozon Verilerinin CBS Ürünleriyle Analizi (1979-2012)", III. İklim Değişikliği Kongresi, TİKDEK 2013, İstanbul, 3-5 Haziran 2013.

10- Yılmaz AÇAR, Serpil YAĞAN, Mithat EKİCİ, Salim ERSOY, Alper AKÇAKAYA, Osman ESKİOĞLU, "Türkiye Üzerine Gelen Hava Kütlelerinin Ankara'nın Toplam Ozon Kalınlığı Üzerine Etkisi", III. İklim Değişikliği Kongresi, TİKDEK 2013, İstanbul, 3-5 Haziran 2013.

11- Ekici, M., "*Brewer Ozone Variability Over Ankara And Comparison Between OMI And Brewer Ozone Measurements For Ankara (2007-2013)"* COST Action ES1207 EUBREWNET Open Congress/14TH WMO-GAW Brewer Users Group Meeting, Tenerife / SPAIN, 25-28 March 2014.

12 - Ekici,M., Eskioğlu, O., Acar, Y. *"Toms ve Omi Uydu Türkiye Ozon Verileri Analizi (1979-2015) ve Ankara Brewer Spektrofotometre Ozon Verileri (2006-2015) ile Karşılaştırması"* II. Meteorolojik Uzaktan Algılama Sempozyumu 3-5 Kasım 2015 Antalya.