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Investigation of the Air Quality Effects of Forest Fires around Antalya Province

KONYA TECHNICAL UNIVERSITY, FACULTY OF ENGINEERING AND NATURAL SCIENCES

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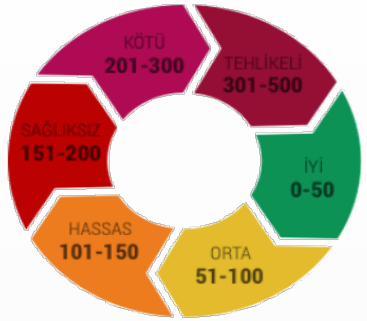
Abstract

The air quality of a region changes depending on the density of air pollutants originating from heating, transportation and industry, and can also spread according to meteorological events. For this reason, measuring the air quality of a region is of great importance for the quality of life of people living in that region. A long-term and comprehensive study is required to determine the air quality level in urban areas. When determining the air quality of a region, measurement stations should be established in sufficient numbers to represent the air quality level of that region. Fire-related air pollution and especially particulate matter exposure can cause respiratory tract irritation, decreased lung capacity, bronchitis, asthma, heart failure and premature death. Although the particulate matter emitted from forest fire smoke is in different sizes, approximately 90% of it consists of $PM_{2.5}$. After forest fires, it causes the release of thousands of separate pollutants and components such as carbon dioxide, carbon monoxide, nitrogen oxides and an increase in the amount of ozone. Fires usually occur when the relative humidity is low and the air temperature is high, and accordingly the moisture content of the combustible material decreases. It is reported that there are significant increases in the number of fires and the amount of burned area, especially in periods when the air temperature is above seasonal norms. As a result of the evaluation made for the forest fire that occurred in Antalya Province in this study, it was seen that the fire lasted for 10 days and affected an area of approximately 55 thousand hectares, and approximately 55% of this occurred in the first two days. Although Antalya is the 7th province in Türkiye according to the level of development, it remains below the Turkish average in terms of industry. The main reason for this can be shown as the prominence of tourism and agriculture in Antalya. In addition, Antalya is one of the regions where air pollution caused by industrialization can be experienced with these two economic activities. It is thought that forest fires occurring in the region have economic effects as well as affecting air quality. If there is a decrease in air quality, especially in the days following forest fires, this should be determined first, and the degree of impact should be revealed with appropriate methods.

İndex

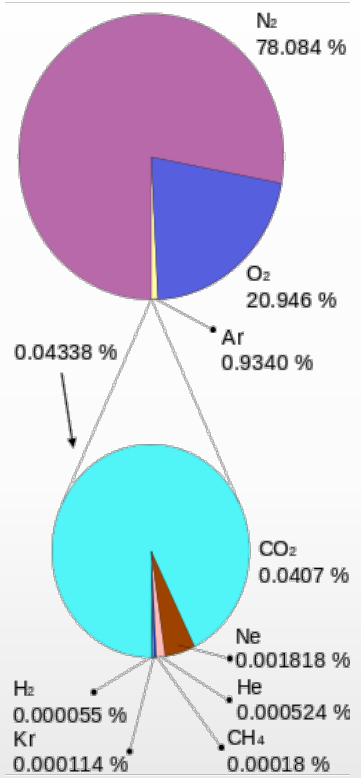


Atmosferdeki Sabit Gazlar	Sembol	Kuru Havada Oran (%)	Atmosferdeki Değişen Gazlar	Sembol	Kuru Havada Oran (%)
Nitrojen	N_2	78.08	Su buharı	H_2O	0 - 4
Oksijen	O_2	20.95	Karbondioksit	CO_2	0.037
Argon	Ar	0.93	Metan	CH_4	0.00017
Neon	Ne	0.0018	Nitrojen Oksit	N_2O	0.00003
Helyum	He	0.0005	Ozon	O_3	0.000004
Hidrojen	H_2	0.00006	Partiküller (Duman, kurum vb)	PM	0.000001
Xenon	Xe	0.000009	Kloroflorokarbon	CFC_3	0.00000002

AIR POLLUTION

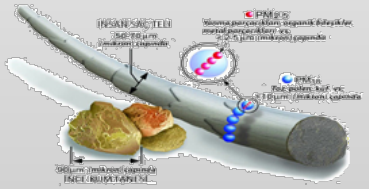
- Air pollution is the contamination of the outdoor and/or indoor atmosphere with any agent that disrupts its natural structure and changes its properties. Among the pollutants that pose a danger to public health;

CO	It is produced from the incomplete combustion of fuels. It is released into the air without complete combustion. More than half of the emissions come from vehicles on the road.



SO_2	Produced when fuels containing sulfur are burned or when metals are extracted from sulfur-containing ores. Sulfur is oxidized to form SO2. Improper burning and combustion of fossil fuels.

PM	These particles suspended in the air are acids, organic chemicals, metals or soil. Some particles are formed through atmospheric reactions of gases such as sulfur dioxide or nitrogen dioxide. All particles with a diameter of 10μm and smaller are considered PM10, and all particles with a diameter of 2.5μm and smaller are considered PM2.5.



NO_2	It is formed by the reaction of nitrogen (N2) in the air with O2 during fuel combustion.Combustion processes motor vehicles and equipment.

O_3	There is no direct source of ozone. It is formed by a chemical reaction caused by sunlight. Its sources are transportation, natural gas wells, and landfills.

AIR POLLUTION

➢ Forest fire

- It is in natural air pollutant sources.
- Forest fires cause a large amount of air pollutants, especially particulate matter, thousands of separate pollutants and components such as carbon dioxide, carbon monoxide, nitrogen oxides to be released into the atmosphere and the amount of ozone to increase.

- The reason for the emergence and spread of forest fires is that the air temperature reaches high points, the relative humidity drops below 30% and the drying winds that reduce the direction, intensity and humidity of the wind.
- It can be concluded that meteorological factors have a great effect on air pollution.

AIR POLLUTION

Hava Kalitesi Indexi (AQI) Değerler	Sağlık Endişe Seviyeleri	Renkler	Anlamı
Hava kalitesi İndeksi bu aralıkta olduğunda	..hava kalitesi koşulları..	..bu renkler ile sembolize edilir..	..ve renkler bu anlama gelir.
0-50	İyi	Yeşil	Hava kalitesi memnun edici ve hava kirliliği az riskli veya hiç risk teşkil etmiyor
51-100	Orta	Sarı	Hava kalitesi uygun fakat alışılmadık şekilde hava kirliliğine hassas olan çok az sayıdaki insanlar için bazı kirleticiler açısından orta düzeyde sağlık endişesi oluşabilir.
101-150	Hassas	Turuncu	Hassas gruplar için sağlık etkileri oluşabilir. Genel olarak kamunun etkilenmesi olası değildir.
151-200	Sağlıksız	Kırmızı	Herkes sağlık etkileri yaşamaya başlayabilir, hassas gruplar için ciddi sağlık etkileri söz konusu olabilir.
201-300	Kötü	Mor	Sağlık açısından acil durum oluşturabilir. Nüfusun tamamının etkilenme olasılığı yüksektir.
301-500	Tehlikeli	Kahverengi	Sağlık alarmı: Herkes daha ciddi sağlık etkileri ile karşılaşabilir.

İndeks	HKİ	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (µg/m³)	O_3 (µg/m³)	PM_{10} (µg/m³)
		1 Sa. Ort.	1 Sa. Ort.	8 Sa. Ort.	8 Sa. Ort.	24 Sa. Ort.
İyi	0 – 50	0-100	0-100	0-5500	0-120	0-50
Orta	51 – 100	101-250	101-200	5501-10000	121-160	51-100
Hassas	101 – 150	251-500	201-500	10001-16000	161-180	101-260
Sağlıksız	151 – 200	501-850	501-1000	16001-24000	181-240	261-400
Kötü	201 – 300	851-1100	1001-2000	24001-32000	241-700	401-520
Tehlikeli	301 – 500	>1101	>2001	>32001	>701	>521

- Air Quality Assessment and Management Regulation

- The regulation aims to prevent the negative effects on the environment and public health, to increase air quality and to prevent the air pollution problem by defining targets. This study is based on the regulation.
- The air quality index, which is created according to the air quality standards applied in our country, is classified according to the concentration of pollutants in the air and the effects on living things are determined.

AIM OF THE STUDY

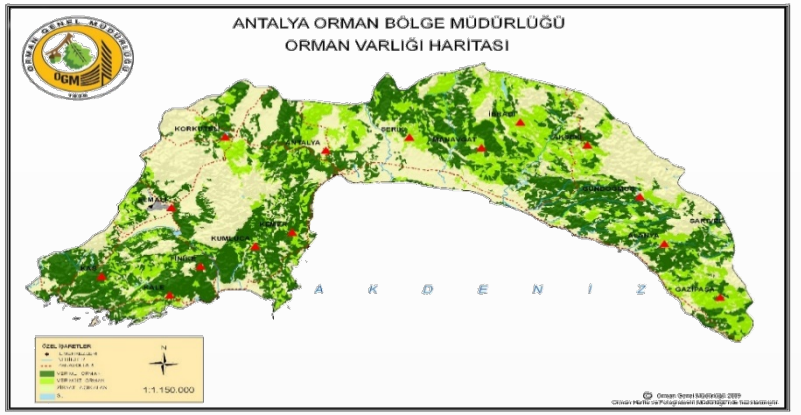
- This study aims to evaluate the impact of forest fires that occurred in Antalya Manavgat District in 2021 due to unknown reasons on air pollution throughout Antalya province within the framework of the regulation.For this purpose, the data of pollutant parameters measured from eight continuous air quality monitoring stations belonging to the Ministry were used.The comparison of the fire period of 28/07/2021-06/08/2021 with other months was made by modeling with the kriging method in the Surfer program.In order to make the evaluation more meaningful, the parameters measured by the air quality station in Manavgat District, where the fire broke out, which is considered to be the region where air quality was most affected, were taken into consideration.In addition, it was aimed to draw attention to the impact of the graphics created by considering variables such as air temperature, humidity, wind speed and precipitation amount belonging to the measurements of the General Directorate of Meteorology on forest fires.

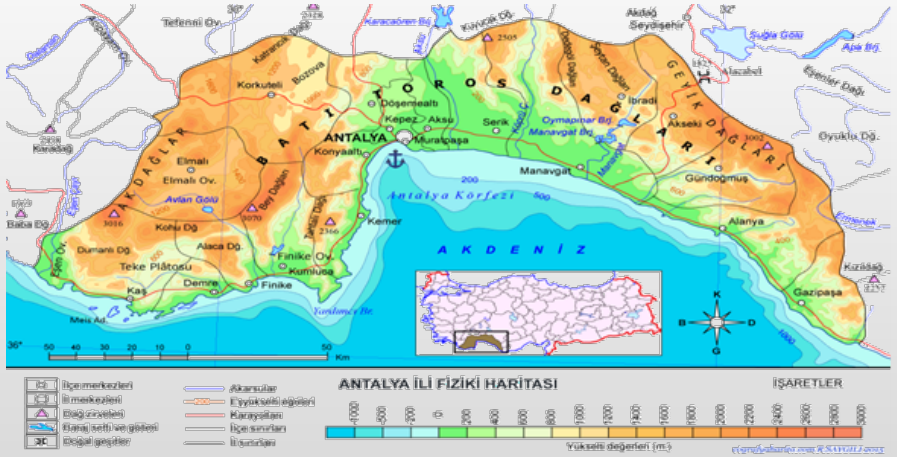
STUDY AREA

- It has been determined that the forest fires that occurred and spread in our country in large numbers in the summer months of 2021 affected and damaged areas exceeding 150,000 hectares.
- The most important of these fires, the fire that occurred in the Manavgat district of Antalya province; It was also the subject of the thesis study because it took about 10 days to be brought under control and it was the first to occur.

STUDY AREA

- Although the region's location on the Mediterranean coast provides a location feature that increases air quality, the steep mountain ranges located parallel to the sea in the north of the region also cause the region to have a potential for air pollution.





- Antalya province forest area constitutes 56% of the city’s surface area and 5.4% of our country. 57% of these forest areas are productive.

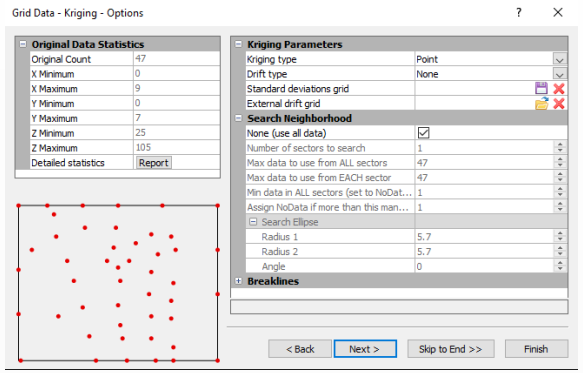
ANTALYA PROVINCE AIR QUALITY MEASUREMENT STATIONS

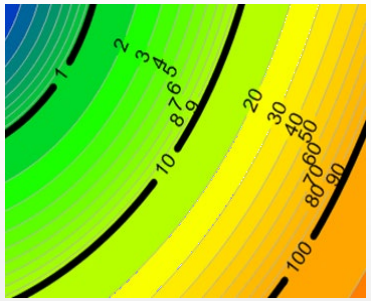
- In 2021, a total of 8 air quality monitoring stations belonging to the Ministry of Environment, Urbanization and Climate Change are operating in Antalya province, and simultaneous data is sent to the Ministry's Continuous Monitoring Center (SIM) database. Antalya Gazipaşa Measurement Station; Since it started measuring after the fire, modeling could not be addressed.

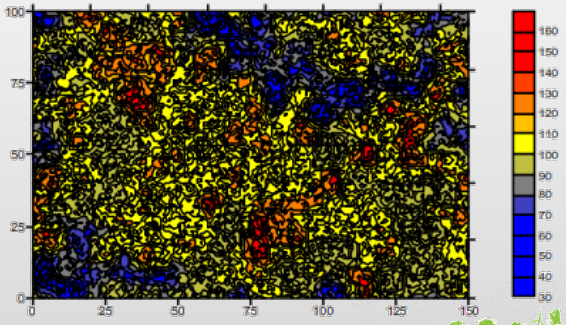
STATION NAME	STATION TYPE	MEASURED AIR POLLUTANTS PARAMETERS						
		PM10 ($\mu g/m_3$)	PM2.5 ($\mu g/m_3$)	SO_2 ($\mu g/m_3$)	CO ($\mu g/m_3$)	NO_2 ($\mu g/m_3$)	NO_X ($\mu g/m_3$)	O_3 ($\mu g/m_3$)
Antalya - Alanya	Warming	X				X		
Antalya - Gazipaşa	Rural	X	X	X		X	X	X
Antalya - Kumluca Sanayi	Urban Industry	X	X	X	X	X	X	X
Antalya - Manavgat	Warming	X		X		X		X
Antalya - Merkez	Warming	X	X	X	X	X	X	X
Antalya - Muratpaşa	Warming	X		X		X	X	
Antalya - Serik	Warming	X		X	X	X	X	
Antalya - Trafik	Urban Trafic	X	X		X	X	X	X

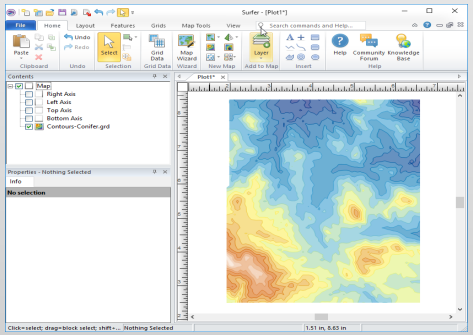
SURFER: MODELING AND GRAPHICS PROGRAM

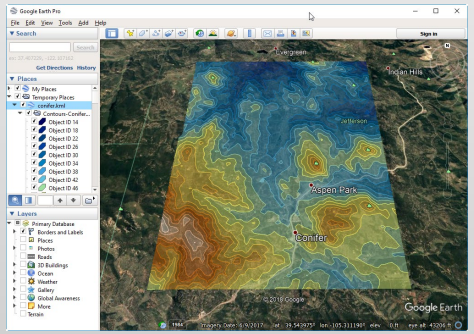
- It is a modeling program used to create grid-based, two-dimensional contour maps and three-dimensional surface maps of recorded scattered data at different points. The Kriging method is a predictive, geostatistical interpolation method used spatially. It does this using the XY location and the relevant Z value.
- After all statistical calculations are made by gridding the data prepared in the XYZ format, the map type is selected and the graphic is created.
- In addition; After setting the coordinate system of the created maps, it is possible to display them spatially on Google Earth with the export button.





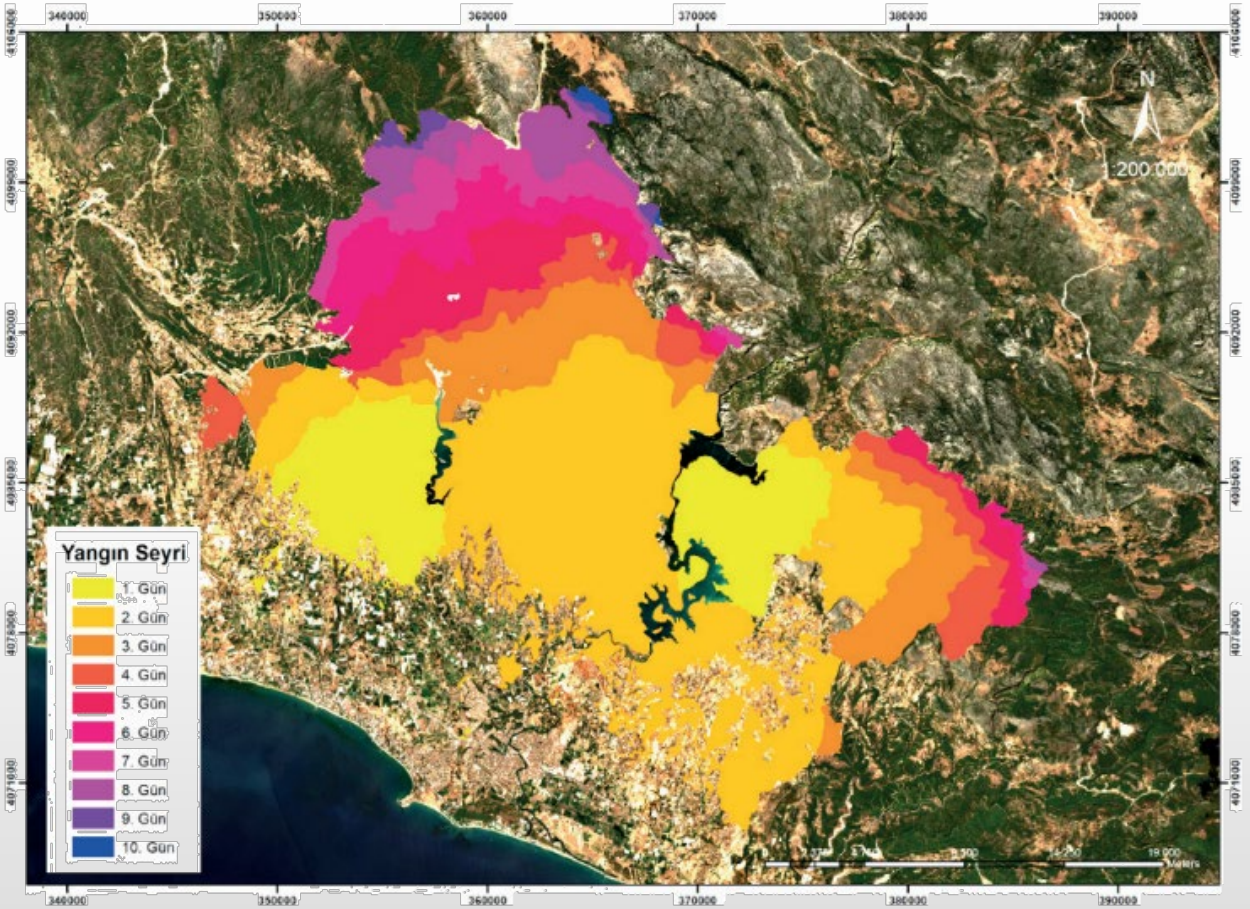






ANTALYA PROVINCE FIRE COURSE

- The fire that occurred lasted 10 days (July 28 - August 6, 2021) and affected an area of approximately 55 thousand hectares, and approximately 55% of this occurred in the first two days.
- On July 28 and 29, when the strong north wind was effective for the Manavgat district, the hourly average relative humidity dropped to 6% and the air temperature rose to 41°C.



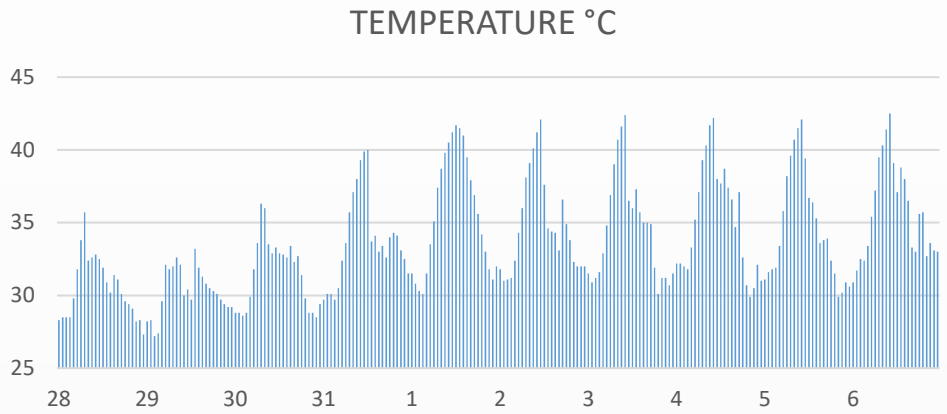
DURING THE FIRE PERIOD; DAILY CHANGE OF HUMIDITY AND DOMINANT WIND DIRECTION

Gün	Tarih (10:00-18:00 Saatleri)	Ortalama İnce Ölü Yanıcı Madde Nemi (%)	Hâkim Rüzgâr Yönü	Ortalama Meteorolojik Yangın İndeksi (MYİ)	Yorum*
1	28.07.2021	2,6	Yıldız-Poyraz	87	Çok Yüksek
2	29.07.2021	5,4	Yıldız-Poyraz	60	Yüksek
3	30.07.2021	5,9	Keşişleme-Gündoğusu	56	Orta
4	31.07.2021	6,5	Keşişleme	53	Orta
5	1.08.2021	7,3	Keşişleme-Kıble	50	Orta
6	2.08.2021	6,4	Keşişleme-Kıble	53	Orta
7	3.08.2021	7,0	Keşişleme-Kıble	52	Orta
8	4.08.2021	8,4	Keşişleme-Kıble	48	Orta
9	5.08.2021	11,5	Keşişleme	39	Düşük
10	6.08.2021	11,8	Keşişleme-Gündoğusu	39	Düşük

*MYİ Sisteminin sağladığı yangın risk ve tehlike potansiyelini ifade etmektedir. Yangın Risk ve Tehlike Potansiyeli: Çok Yüksek (MYİ>75), Yüksek (75≥MYİ≥60), Orta (59≥MYİ≥41), Düşük (40≥MYİ≥20), Çok Düşük (19≥MYİ).

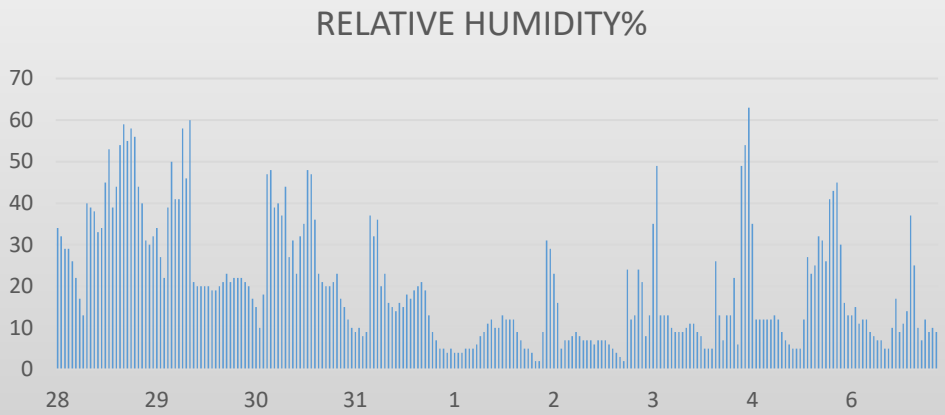
Tarih	Yanma Şiddeti	Yanan Alan (ha)	Toplam Yanan Alan (ha)
30.07.2021 (Yangın Esnası)	Düşük	4.852,90	28.327
	Orta/Düşük	4.539,94	
	Orta/Yüksek	5.774,09	
	Yüksek	13.160,26	
14.08.2021 (Yangın Sonrası)	Düşük	4.905,91	47.824
	Orta/Düşük	6.894,36	
	Orta/Yüksek	10.256,43	
	Yüksek	25.767,72	

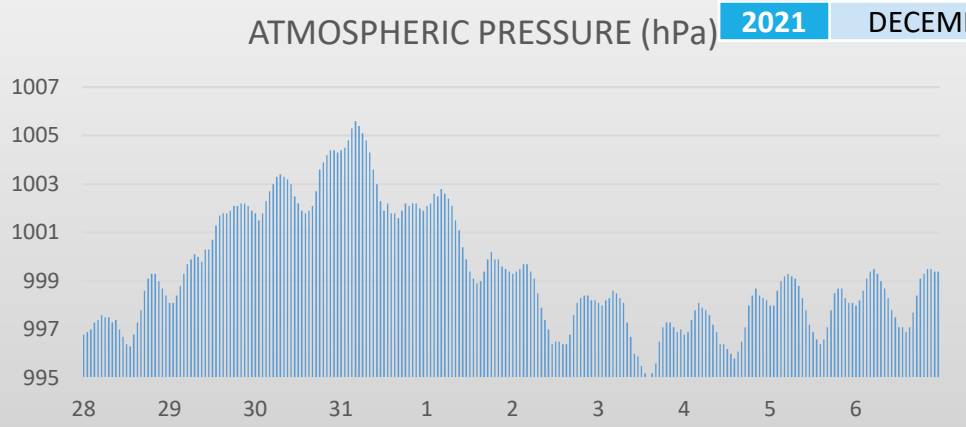
GDM 2021 METEOROLOGICAL MEASUREMENT DATA



General Directorate of Meteorology Monthly Average Measurement Data for 2021

YIL	MONTH	HUMIDITY%	TEMPERATURE °C	RAIN mm
2021	JANUARY	62,93	12,66	0,22
2021	FEBRUARY	53,17	13,94	0,05
2021	MARCH	46,12	13,92	0,09
2021	APRIL	55,36	17,43	0,00
2021	MAY	58,64	22,85	0,01
2021	JUNE	53,39	25,29	0,02
2021	JULY	40,26	30,74	0,00
2021	**YANGIN DÖNEMİ**	**23,13**	**34,45**	**0,00**
2021	AUGUST	40,94	30,83	0,06
2021	SEPTEMBER	44,10	26,32	0,01
2021	OCTOBER	37,82	22,41	0,07
2021	NOVEMBER	51,53	18,86	0,07
2021	DECEMBER	62,92	13,12	0,42





COMPARISON OF FIRE SEASON WITH OUTDOOR AND SUMMER SEASON

Fire period and outdoor period, hourly average, min. and max. values of the parameters

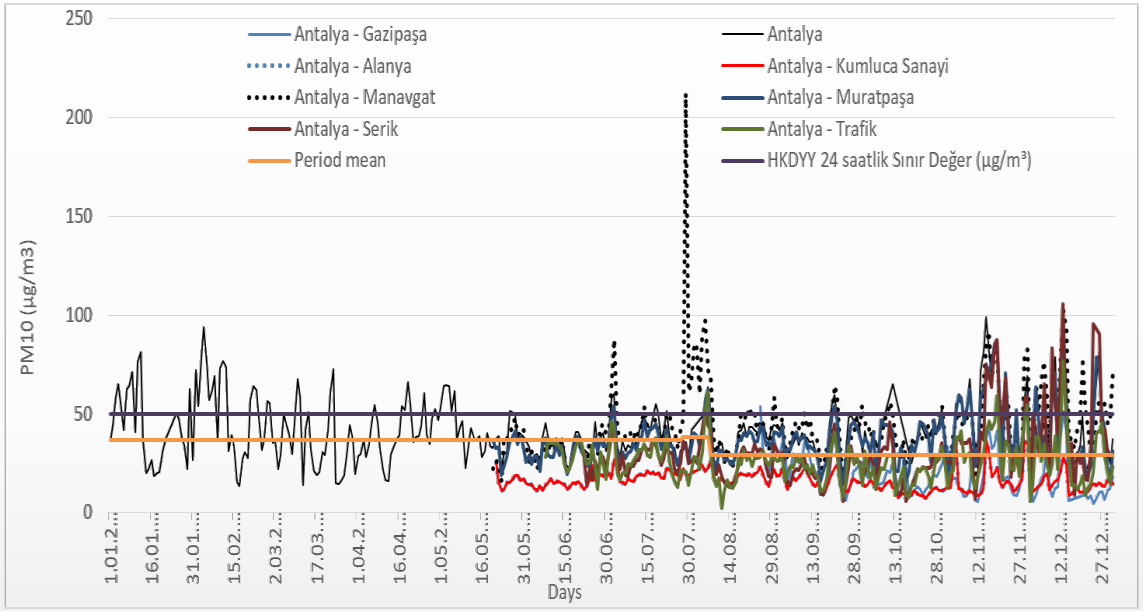
Parametreler	Ölçü Birimi	Ortalama	Yangın Dönemi Ortalama	Standart Sapma	Yangın Dönemi Standart Sapma	Minimum	Yangın Dönemi Minimum	Maksimum	Yangın Dönemi Maksimum
PM_{10}	$\mu g/m^3$	30,16	39,59	22,28	43,82	0,00	4,12	647,76	966,59
$PM_{2.5}$	$\mu g/m^3$	18,10	19,43	8,83	9,43	0,00	5,27	106,07	98,96
SO_2	$\mu g/m^3$	4,04	3,51	3,38	2,90	0,01	0,32	50,62	28,79
CO	$\mu g/m^3$	444,00	327,42	452,90	290,57	0,00	16,09	9709,83	3317,05
NO_2	$\mu g/m^3$	31,00	34,31	30,76	32,25	0,00	2,81	338,75	177,83
NO_x	$\mu g/m^3$	50,01	44,19	64,86	49,94	0,00	3,56	824,26	302,55
O_3	$\mu g/m^3$	48,53	60,23	27,54	32,32	0,00	0,6	168,64	146,92
Rüzgar	km/sa	1,38	1,18	1,31	0,58	0,00	0	30,4	3,2
Sıcaklık	°C	20,35	34,45	6,99	3,78	3,80	28,2	42,5	44,1
Nem	%	51,34	23,13	24,49	22,25	4,00	2	99	89
Yağış	mm	0,09	0,00	0,82	0,00	0,00	0	41,6	0

Fire period and summer period, hourly average, min. and max. values of the parameters

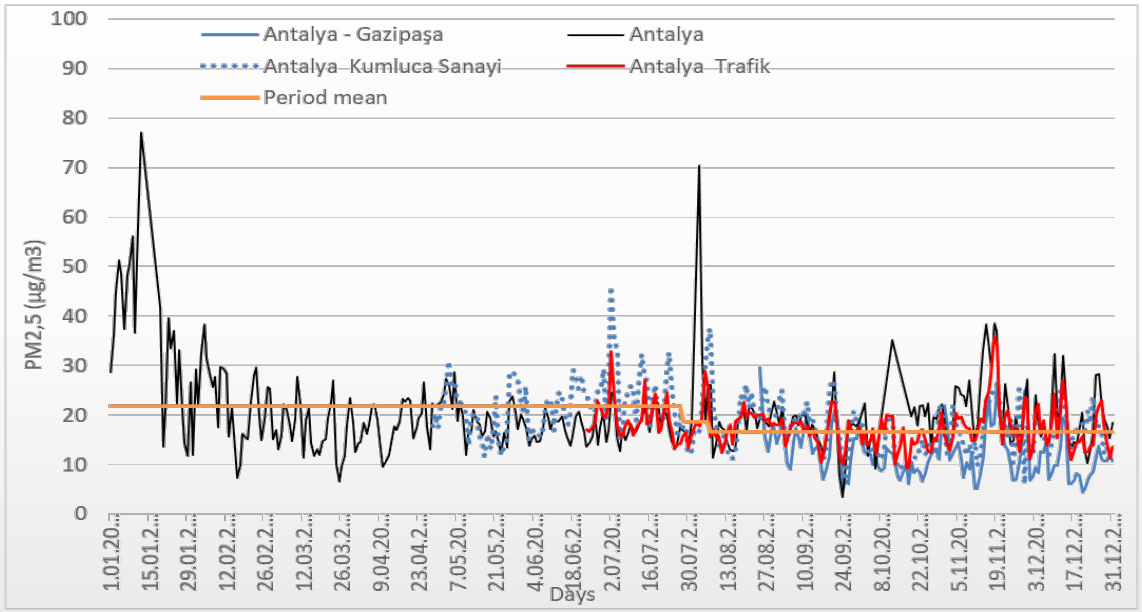
Parametreler	Ölçü Birimi	Ortalama	Yangın Dönemi Ortalama	Standart Sapma	Yangın Dönemi Standart Sapma	Minimum	Yangın Dönemi Minimum	Maksimum	Yangın Dönemi Maksimum
PM_{10}	$\mu g/m^3$	28,43	39,59	15,27	43,82	0,00	4,12	498,6	966,59
$PM_{2.5}$	$\mu g/m^3$	19,60	19,43	7,45	9,43	0,00	5,27	84,82	98,96
SO_2	$\mu g/m^3$	4,02	3,51	3,80	2,90	0,01	0,32	47,07	28,79
CO	$\mu g/m^3$	336,46	327,42	234,78	290,57	19,86	16,09	3010,32	3317,05
NO_2	$\mu g/m^3$	24,75	34,31	23,76	32,25	0,00	2,81	217,23	177,83
NO_x	$\mu g/m^3$	35,85	44,19	40,53	49,94	0,00	3,56	398,73	302,55
O_3	$\mu g/m^3$	59,27	60,23	27,35	32,32	0,00	0,6	168,64	146,92
Rüzgar	km/sa	1,28	1,18	0,86	0,58	0,00	0	5,4	3,2
Sıcaklık	°C	28,33	34,45	4,37	3,78	17,50	28,2	42,5	44,1
Nem	%	47,41	23,13	22,71	22,25	4,00	2	99	89
Yağış	mm	0,03	0,00	0,74	0,00	0,00	0	30,8	0

- For the PM10 parameter, it can be said that it peaks during the fire period, and according to the index, it gives a health alarm, and the air quality conditions are dangerous hours;
- For the NO2 parameter, when the average value is considered, it is high during the fire period, and for the maximum values, health effects may occur;
- For the NOx parameter, according to the annual average in the regulation, it is 30 µg/m3 and exceeds the limit value;
- For the O3 parameter, it can be said that these are the hours when health concerns may generally occur.
- When the temperature, humidity and wind that are effective in the spread of the fire are evaluated, it is seen that the temperature increases and the humidity drops to two.

DAILY AVERAGE VALUE CHARTS



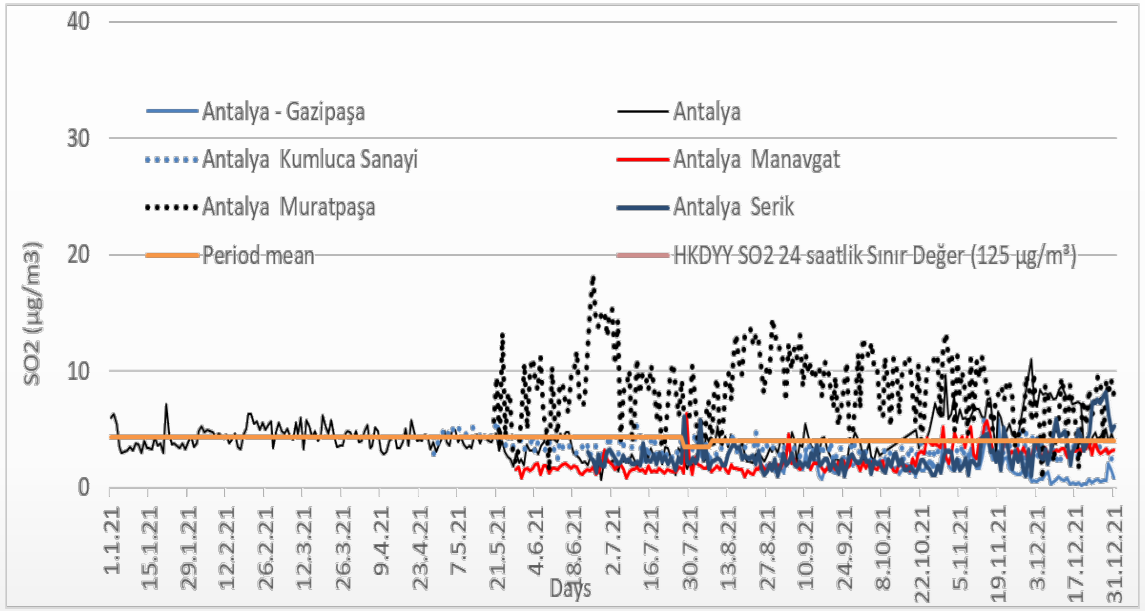
Daily average value graph obtained from stations for PM10 parameter in 2021



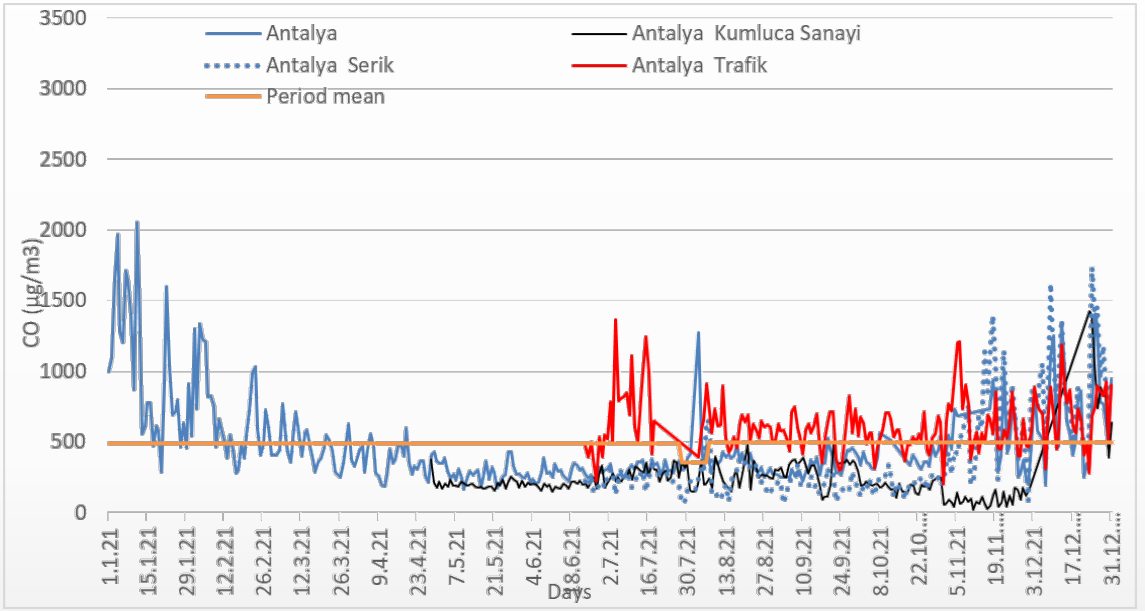
Daily average value graph obtained from stations for PM2.5 parameter in 2021

İndeks	HKİ	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (µg/m³)	O_3 (µg/m³)	PM_{10} (µg/m³)
		1 Sa. Ort.	1 Sa. Ort.	8 Sa. Ort.	8 Sa. Ort.	24 Sa. Ort.
İyi	0 – 50	0-100	0-100	0-5500	0-120	0-50
Orta	51 – 100	101-250	101-200	5501-10000	121-160	51-100
Hassas	101 – 150	251-500	201-500	10001-16000	161-180	101-260
Sağlıksız	151 – 200	501-850	501-1000	16001-24000	181-240	261-400
Kötü	201 – 300	851-1100	1001-2000	24001-32000	241-700	401-520
Tehlikeli	301 – 500	>1101	>2001	>32001	>701	>521

DAILY AVERAGE VALUE CHARTS



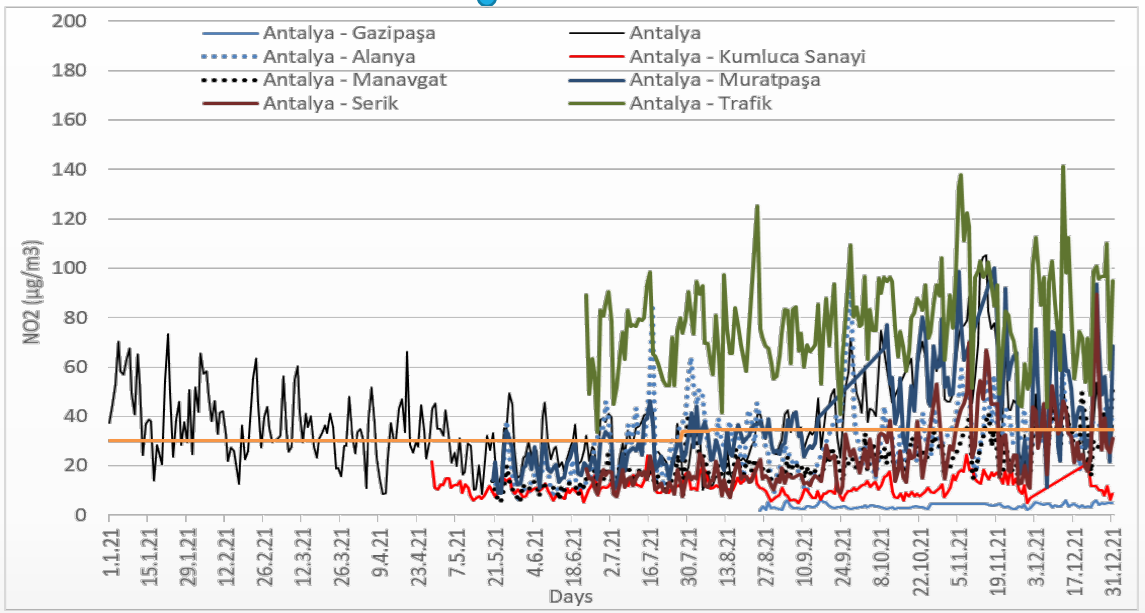
Daily average value graph obtained from stations for the SO2 parameter in 2021

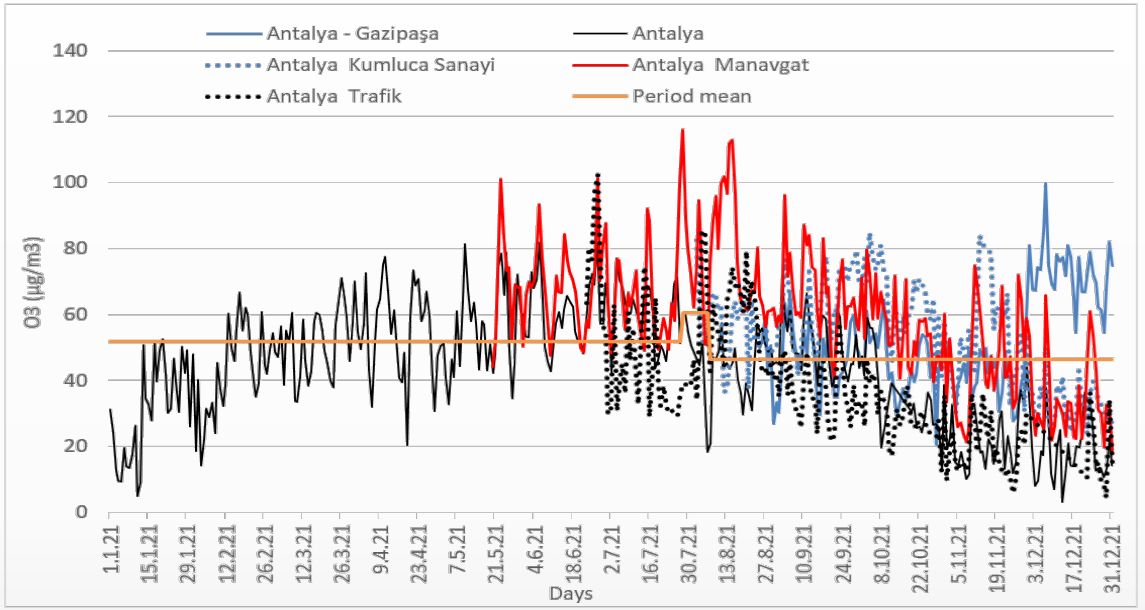


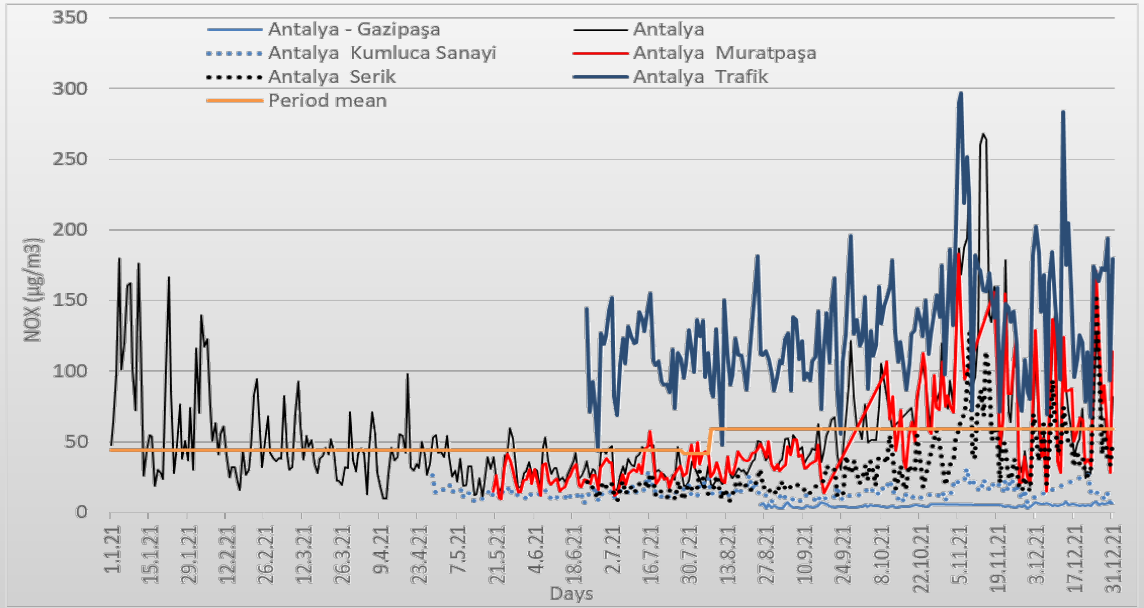
Daily average value graph obtained from stations for the CO parameter in 2021

İndeks	HKİ	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (µg/m³)	O_3 (µg/m³)	PM_{10} (µg/m³)
		1 Sa. Ort.	1 Sa. Ort.	8 Sa. Ort.	8 Sa. Ort.	24 Sa. Ort.
İyi	0 – 50	0-100	0-100	0-5500	0-120	0-50
Orta	51 – 100	101-250	101-200	5501-10000	121-160	51-100
Hassas	101 – 150	251-500	201-500	10001-16000	161-180	101-260
Sağlıksız	151 – 200	501-850	501-1000	16001-24000	181-240	261-400
Kötü	201 – 300	851-1100	1001-2000	24001-32000	241-700	401-520
Tehlikeli	301 – 500	≥1101	≥2001	≥32001	≥701	≥521

DAILY AVERAGE VALUE CHARTS







İndeks	HKİ	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (µg/m³)	O_3 (µg/m³)	PM_{10} (µg/m³)
		1 Sa. Ort.	1 Sa. Ort.	8 Sa. Ort.	8 Sa. Ort.	24 Sa. Ort.
İyi	0 – 50	0-100	0-100	0-5500	0-120	0-50
Orta	51 – 100	101-250	101-200	5501-10000	121-160	51-100
Hassas	101 – 150	251-500	201-500	10001-16000	161-180	101-260
Sağlıksız	151 – 200	501-850	501-1000	16001-24000	181-240	261-400
Kötü	201 – 300	851-1100	1001-2000	24001-32000	241-700	401-520
Tehlikeli	301 – 500	≥1101	≥2001	≥32001	≥701	≥521

MONTHLY AVERAGE PARAMETER DATA

Monthly average of particulate matter (PM10) data (PM10 annual limit value 40 40 µg/m^3)

PM10 (µg/m3)	Antalya - Gazipaşa	Antalya	Antalya - Alanya	Antalya - Kumluca Sanayi	Antalya - Manavgat	Antalya - Muratpaşa	Antalya - Serik	Antalya - Trafik
Oca.21		43,16						
Şub.21		51,89						
Mar.21		35,14						
Nis.21		39,86						
May.21		41,72	16,56	16,56	34,88	33,08		
Haz.21		33,95	15,12	15,12	32,07	30,02	23,21	28,83
Tem.21		39,87	19,31	19,31	50,69	35,50	28,95	26,71
Yangın Dönemi		43,98	21,38	21,38	87,49	39,98	34,48	30,09
Ağu.21	32,61	39,45	19,05	19,05	48,78	36,80	27,56	25,27
Eyl.21	23,52	37,20	16,13	16,13	38,95	34,92	22,00	23,36
Eki.21	17,63	38,66	11,64	11,64	40,64	35,84	22,77	20,37
Kas.21	21,72	53,99	17,09	17,09	50,13	47,75	41,89	31,66
Ara.21	16,04	43,37	14,56	14,56	53,37	38,90	43,83	26,77
Yıllık ortalama	**22,30**	**41,52**	**16,18**	**16,18**	**43,69**	**36,60**	**30,03**	**26,14**

Number of days when particulate matter (PM10) exceeds the limit

PM10 (µg/m3)	Antalya - Gazipaşa	Antalya	Antalya - Alanya	Antalya - Kumluca Sanayi	Antalya - Manavgat	Antalya - Muratpaşa	Antalya - Serik	Antalya - Trafik
Oca.21		10						
Şub.21		16						
Mar.21		5						
Nis.21		7						
May.21		8						
Haz.21								
Tem.21		5			6	1		
Yangın Dönemi		2			9	2	1	2
Ağu.21	1	2			11	2	1	2
Eyl.21		2			4	1		
Eki.21		2			5			
Kas.21	2	17			13	13	8	2
Ara.21	1	9			17	7	8	2
Yıllık ortalama	**4**	**85**			**65**	**26**	**18**	**8**

İndeks	HKİ	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (µg/m³)	O_3 (µg/m³)	PM_{10} (µg/m³)
		1 Sa. Ort.	1 Sa. Ort.	8 Sa. Ort.	8 Sa. Ort.	24 Sa. Ort.
İyi	0 – 50	0-100	0-100	0-5500	0-120	0-50
Orta	51 – 100	101-250	101-200	5501-10000	121-160	51-100
Hassas	101 – 150	251-500	201-500	10001-16000	161-180	101-260
Sağlıksız	151 – 200	501-850	501-1000	16001-24000	181-240	261-400
Kötü	201 – 300	851-1100	1001-2000	24001-32000	241-700	401-520
Tehlikeli	301 – 500	≥1101	≥2001	≥32001	≥701	≥521

MONTHLY AVERAGE PARAMETER DATA

Monthly average of particulate matter (PM2.5) data (annual 5 µg/m³, 24-hour 15 µg/m³ in WHO)

PM2,5 (µg/m3)	Antalya - Gazipaşa	Antalya	Antalya Kumluca Sanayi	Antalya Trafik
Oca.21		36,10		
Şub.21		22,97		
Mar.21		16,74		
Nis.21		18,24	18,55	
May.21		19,35	20,65	
Haz.21		17,09	21,97	19,19
Tem.21		17,97	23,55	18,75
Yangın Dönemi		26,54	19,70	18,89
Ağu.21	18,14	20,75	20,34	18,68
Eyl.21	13,85	17,03	17,80	16,59
Eki.21	10,90	19,24	13,73	15,27
Kas.21	13,89	23,19	16,95	19,57
Ara.21	9,94	18,66	16,41	16,72
Yıllık ortalama	**13,34**	**20,61**	**18,88**	**17,82**

Monthly average of sulfur dioxide (SO2) data

SO2 (µg/m3)	Antalya Gazipaşa	Antalya	Antalya Kumluca Sanayi	Antalya Manavgat	Antalya Muratpaşa	Antalya Serik
Oca.21		3,94				
Şub.21		4,82				
Mar.21		4,68				
Nis.21		4,06	3,46			
May.21		3,68	4,46	1,42	6,48	
Haz.21		3,20	3,33	1,74	9,59	2,38
Tem.21		2,44	3,33	1,72	8,49	2,52
Yangın Dönemi		2,84	3,29	2,27	6,32	3,08
Ağu.21	1,62	3,38	3,32	1,69	9,41	2,50
Eyl.21	1,87	3,42	3,11	2,02	9,28	2,20
Eki.21	2,02	4,52	2,76	2,50	9,56	1,98
Kas.21	2,20	5,86	3,41	3,60	8,08	2,66
Ara.21	0,69	6,50	3,24	3,20	6,54	4,57
Yıllık ortalama	**1,68**	**4,21**	**3,38**	**2,24**	**8,43**	**2,69**

İndeks	HKİ	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (µg/m³)	O_3 (µg/m³)	PM_{10} (µg/m³)
		1 Sa. Ort.	1 Sa. Ort.	8 Sa. Ort.	8 Sa. Ort.	24 Sa. Ort.
İyi	0 – 50	0-100	0-100	0-5500	0-120	0-50
Orta	51 – 100	101-250	101-200	5501-10000	121-160	51-100
Hassas	101 – 150	251-500	201-500	10001-16000	161-180	101-260
Sağlıksız	151 – 200	501-850	501-1000	16001-24000	181-240	261-400
Kötü	201 – 300	851-1100	1001-2000	24001-32000	241-700	401-520
Tehlikeli	301 – 500	>1101	>2001	>32001	>701	>521

MONTHLY AVERAGE PARAMETER DATA

Monthly average of carbon monoxide (CO) data

CO (µg/m3)	Antalya	Antalya Kumluca Sanayi	Antalya Serik	Antalya Trafik
Oca.21	998,60			
Şub.21	690,54			
Mar.21	450,45			
Nis.21	368,28	256,26		
May.21	282,60	198,51		
Haz.21	279,17	201,09	196,94	429,96
Tem.21	317,22	280,27	235,21	803,01
Yangın Dönemi	495,66	246,90	240,26	637,57
Ağu.21	390,56	266,17	257,12	599,48
Eyl.21	334,55	309,32	200,66	571,43
Eki.21	391,01	182,72	205,05	537,68
Kas.21	544,83	92,84	638,07	655,59
Ara.21	688,01	832,71	877,48	693,38
Yıllık ortalama	**477,99**	**291,10**	**372,93**	**612,93**

Monthly average of nitrogen dioxide (NO2) data (annual limit value 40 µg/m³)

NO2 (µg/m3)	Antalya Gazipaşa	Antalya	Antalya Alanya	Antalya Kumluca Sanayi	Antalya Manavgat	Antalya Muratpaşa	Antalya Serik	Antalya Trafik
Oca.21		43,30						
Şub.21		39,21						
Mar.21		33,80						
Nis.21		32,39		14,42				
May.21		25,49	15,28	10,67	10,23	19,69		
Haz.21		27,44	17,35	9,70	12,32	21,67	14,78	67,80
Tem.21		28,36	31,76	12,83	17,29	26,03	13,87	71,63
Yangın Dönemi		19,53	45,98	14,84	26,79	32,79	15,41	81,26
Ağu.21	3,13	23,16	32,34	12,26	20,07	30,90	15,28	72,57
Eyl.21	3,59	40,19	28,50	8,64	19,81	31,86	17,90	74,60
Eki.21	3,25	55,29	28,01	10,50	24,24	55,65	26,28	81,88
Kas.21	3,57	59,85	38,23	15,03	25,12	57,34	35,04	85,68
Ara.21	4,34	33,90	36,12	10,84	34,27	47,52	34,82	85,10
Yıllık ortalama	**3,58**	**36,87**	**28,45**	**11,65**	**20,42**	**36,33**	**22,57**	**77,04**

Annual average limit of 30 µg/m³

İndeks	HKİ	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (µg/m³)	O_3 (µg/m³)	PM_{10} (µg/m³)
		1 Sa. Ort.	1 Sa. Ort.	8 Sa. Ort.	8 Sa. Ort.	24 Sa. Ort.
İyi	0 – 50	0-100	0-100	0-5500	0-120	0-50
Orta	51 – 100	101-250	101-200	5501-10000	121-160	51-100
Hassas	101 – 150	251-500	201-500	10001-16000	161-180	101-260
Sağlıksız	151 – 200	501-850	501-1000	16001-24000	181-240	261-400
Kötü	201 – 300	851-1100	1001-2000	24001-32000	241-700	401-520
Tehlikeli	301 – 500	≥1101	≥2001	≥32001	≥701	≥521

MONTHLY AVERAGE PARAMETER DATA

Monthly average of nitrogen oxide (NOx) data (Annual average 30 µg/m3)

NOx (µg/m3)	Antalya Gazipaşa	Antalya	Antalya Kumluca Sanayi	Antalya Muratpaşa	Antalya Serik	Antalya Trafik
Oca.21		78,13				
Şub.21		59,52				
Mar.21		43,22				
Nis.21		40,33	18,34930556			
May.21		30,27	13,68	23,01		
Haz.21		31,57	12,17	24,55	17,16	99,96
Tem.21		32,60	15,30	29,76	16,45	113,28
Yangın Dönemi		23,88	17,96	38,08	18,03	114,65
Ağu.21	4,68	30,50	15,15	36,81	18,20	108,31
Eyl.21	4,32	53,24	10,95	36,61	21,96	118,86
Eki.21	4,54	75,66	13,31	73,56	32,62	130,78
Kas.21	4,62	124,88	18,63	89,28	52,77	156,90
Ara.21	5,90	64,81	12,99	74,67	52,70	147,99
Yıllık ortalama	**4,81**	**55,39**	**14,50**	**48,53**	**30,27**	**125,15**

Monthly average of ozone (O3) data

O3 (µg/m3)	Antalya Gazipaşa	Antalya	Antalya Kumluca Sanayi	Antalya Manavgat	Antalya Trafik
Oca.21		31,21			
Şub.21		42,19			
Mar.21		51,70			
Nis.21		55,39			
May.21		55,55		68,27	
Haz.21		60,76		69,40	76,53
Tem.21		59,04		67,77	41,80
Yangın Dönemi		47,35	61,92	76,71	51,53
Ağu.21	45,15	43,62	55,99	75,35	57,65
Eyl.21	47,95	51,59	62,93	66,43	36,83
Eki.21	44,90	35,36	63,86	56,57	29,69
Kas.21	41,78	22,10	54,54	44,89	19,11
Ara.21	72,53	18,93	32,62	33,70	17,47
Yıllık ortalama	**50,46**	**43,95**	**53,99**	**60,30**	**39,87**

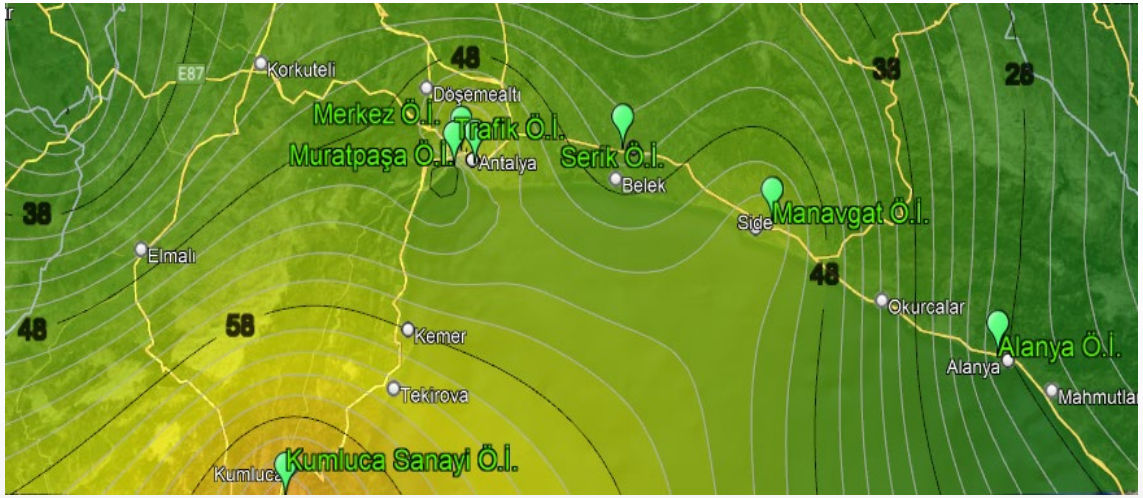
İndeks	HKİ	SO_2 (µg/m³)	NO_2 (µg/m³)	CO (µg/m³)	O_3 (µg/m³)	PM_{10} (µg/m³)
		1 Sa. Ort.	1 Sa. Ort.	8 Sa. Ort.	8 Sa. Ort.	24 Sa. Ort.
İyi	0 – 50	0-100	0-100	0-5500	0-120	0-50
Orta	51 – 100	101-250	101-200	5501-10000	121-160	51-100
Hassas	101 – 150	251-500	201-500	10001-16000	161-180	101-260
Sağlıksız	151 – 200	501-850	501-1000	16001-24000	181-240	261-400
Kötü	201 – 300	851-1100	1001-2000	24001-32000	241-700	401-520
Tehlikeli	301 – 500	≥1101	≥2001	≥32001	≥701	≥521

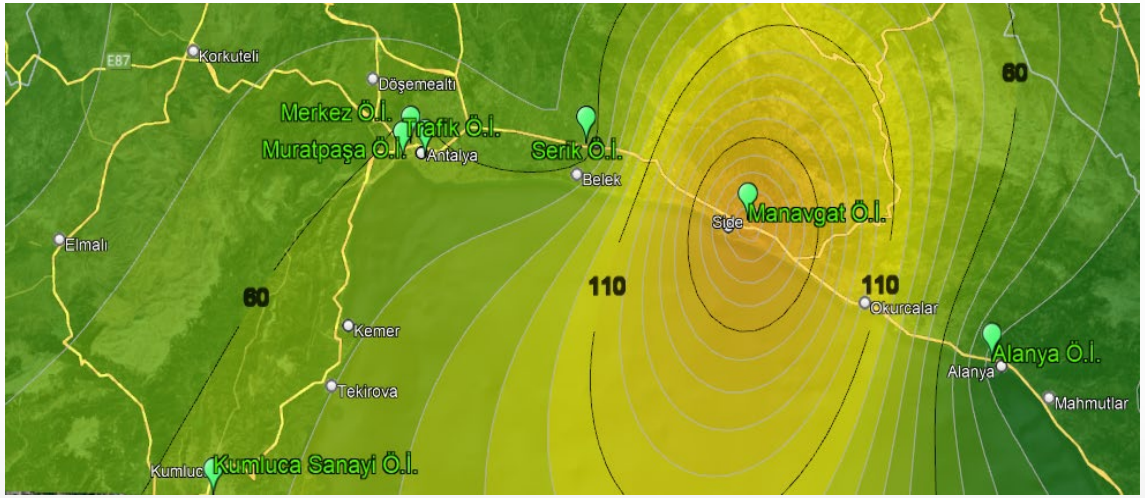
Air Quality Index Obtained from Maximum Data

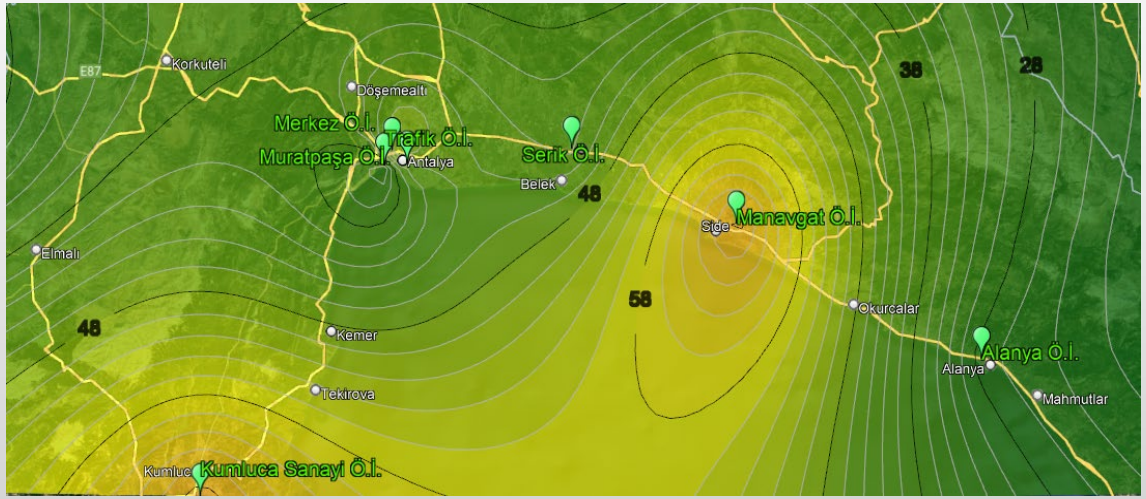
İSTASYONLAR		SO2 max (µg/m3) 1 Sa.Ort.	Veri Sayısı	NO2 max (µg/m3) 1 Sa.Ort.	Veri Sayısı	CO max (µg/m3) 8.Sa.Ort.	Veri Sayısı	O3 max (µg/m3) 8 Sa.Ort	Veri Sayısı	PM10 max (µg/m3) 24Sa.Ort	Veri Sayısı
ANTALYA-GAZİPAŞA	Yangın Öncesi	-		-		-		-		-	
	Yangın Esnası										
	Yangın Sonrası	11,64	3011	22,06	2530			104,3	385	61,77	124
ANTALYA	Yangın Öncesi	23,22	4969	142,69	4973	2865,14	623	99,37	623	94,09	205
	Yangın Esnası	6,09	162	61,25	164	1211,34	21	65,43	20	63,63	8
	Yangın Sonrası	12,54	2863	161,32	3244	2502,03	371	85,6	406	98,87	138
ANTALYA-ALANYA	Yangın Öncesi	-		114,19	1578	-		-		28,47	68
	Yangın Esnası			140,33	236					24,33	10
	Yangın Sonrası			154,07	2991					36,79	146
ANTALYA-KUMLUCA SANAYİ	Yangın Öncesi	11,75	2137	63,81	2144	417,43	241	-	-	140,26	68
	Yangın Esnası	6,82	237	61,75	237	460,52	22	90,65	13	64,39	10
	Yangın Sonrası	11,54	3440	77,33	2968	2218,04	315	104,53	431	81,03	146
ANTALYA-MANAVGAT	Yangın Öncesi	21,9	1441	81,17	1636	-		126,9	204	87,49	68
	Yangın Esnası	28,79	238	115,2	239			123,66	30	212,14	10
	Yangın Sonrası	44,75	3459	189,01	3500			127,67	438	102,24	147
ANTALYA-MURATPAŞA	Yangın Öncesi	32,72	1511	156,97	1633	-		-		54,18	69
	Yangın Esnası	21,37	222	124,32	239					62,10	10
	Yangın Sonrası	47,07	3287	312,08	2638					87,42	144
ANTALYA-SERİK	Yangın Öncesi	5,84	822	74,28	819	370,4	103	-		44,66	36
	Yangın Esnası	8,71	226	77,03	226	1705,65	27			51,80	10
	Yangın Sonrası	50,62	3418	223,6	3272	4319,05	424			105,81	146
ANTALYA-TRAFİK	Yangın Öncesi	-		217,23	820	2504,08	71	117,76	99	45,72	49
	Yangın Esnası			177,83	239	941,57	9	112,47	28	61,24	10
	Yangın Sonrası			338,75	3353	1622,41	429	97,66	355	76,80	147

PM10 PARAMETER

Pre-Fire AND Post-Fire Summer Period

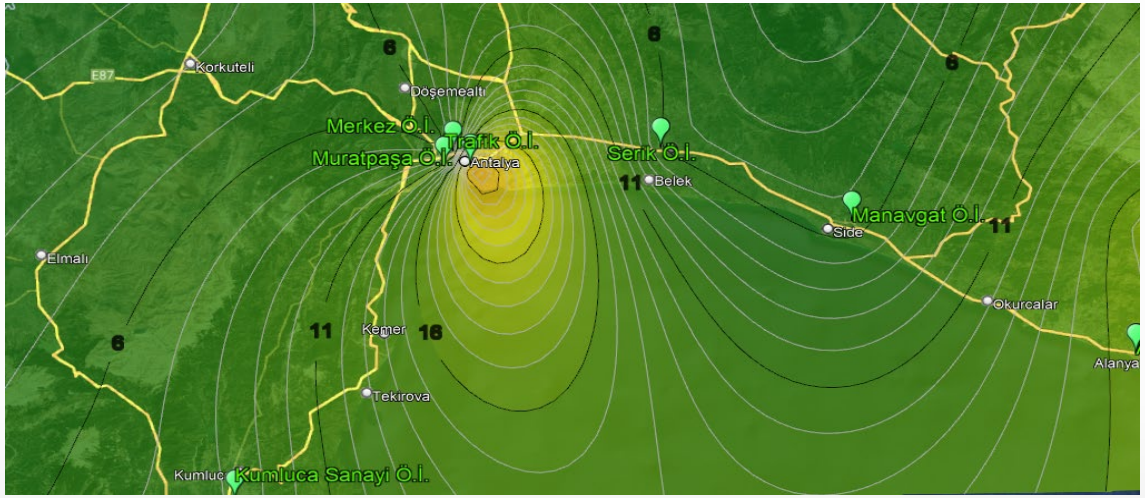


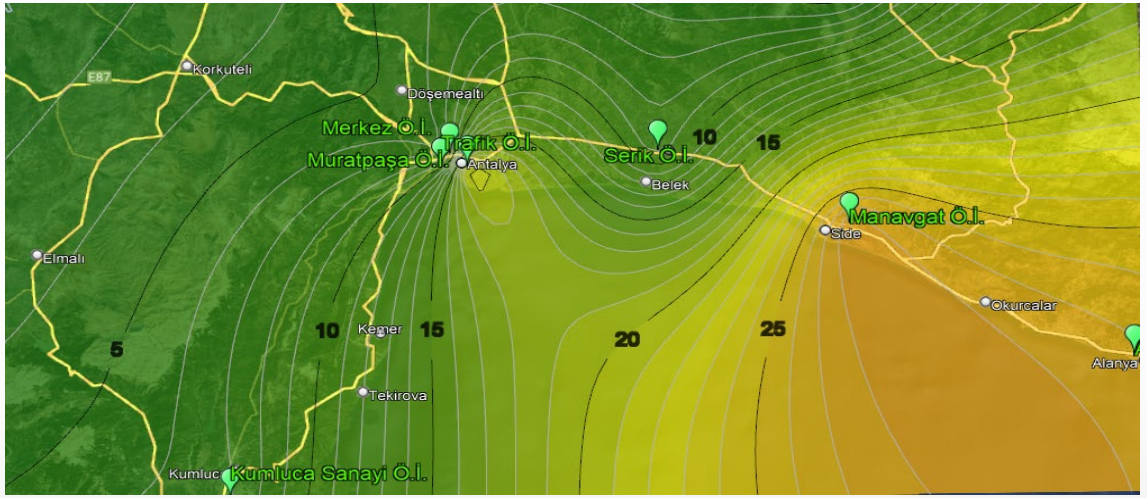


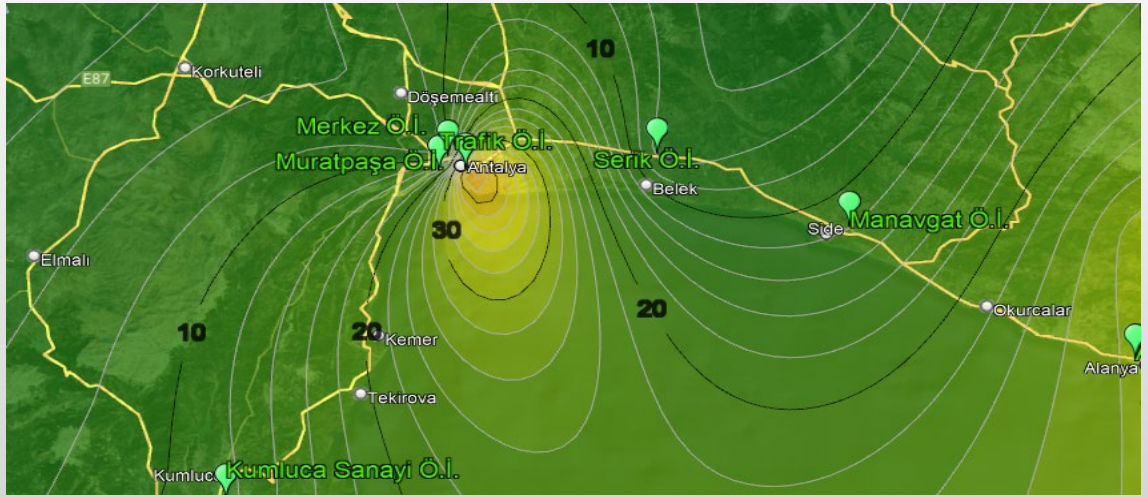


SO2 PARAMETER;

Pre-Fire AND Post-Fire Summer Period

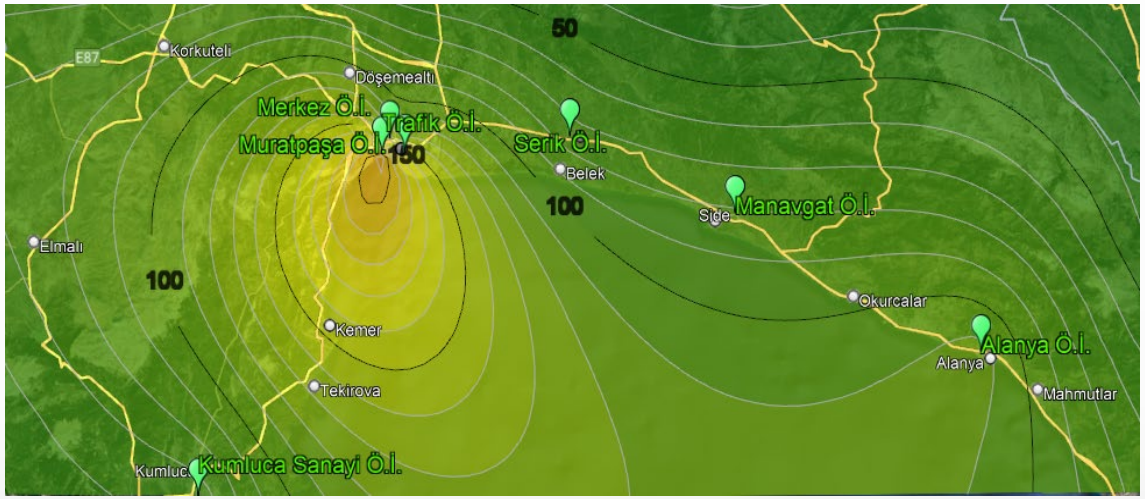


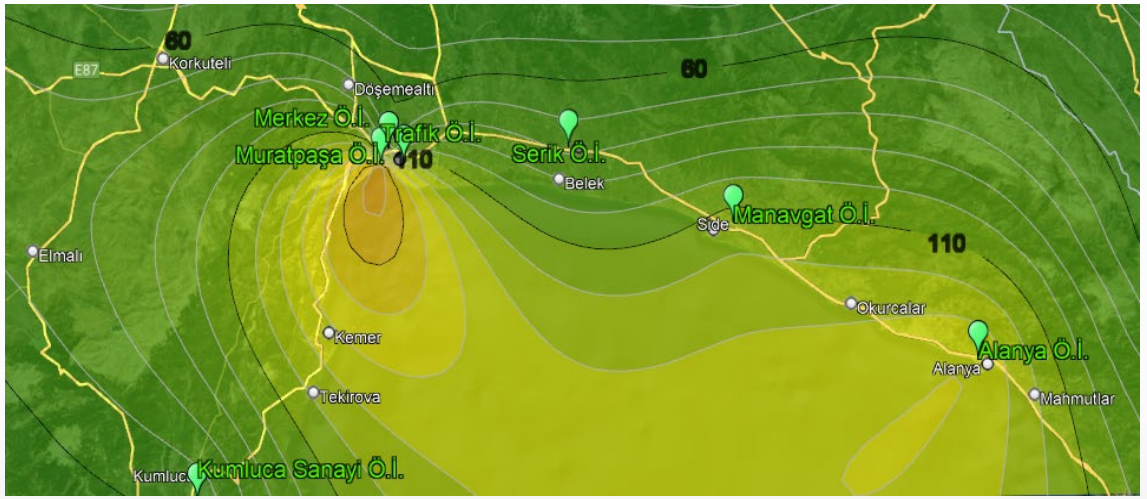


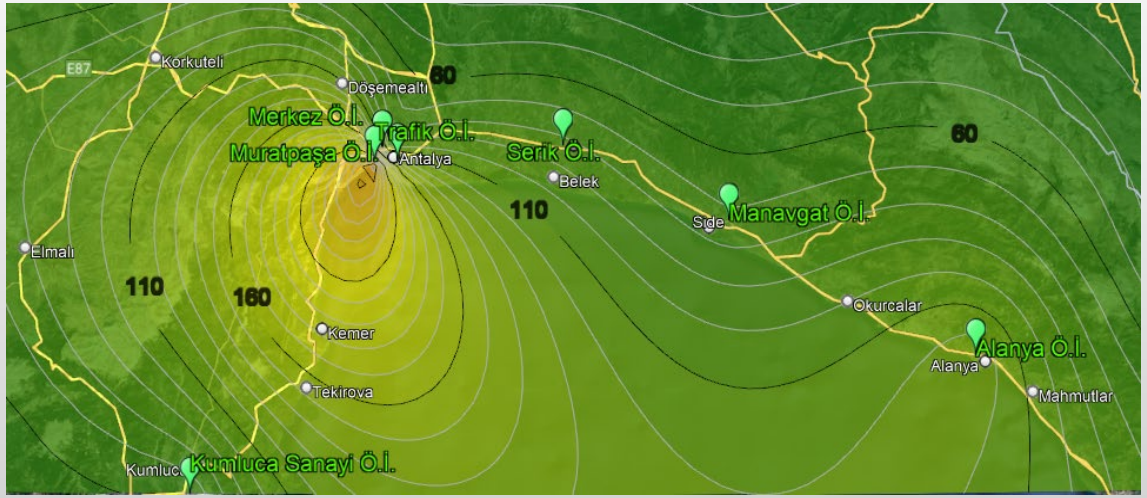


NO2 PARAMETER;

Pre-Fire and Post-Fire Summer Period

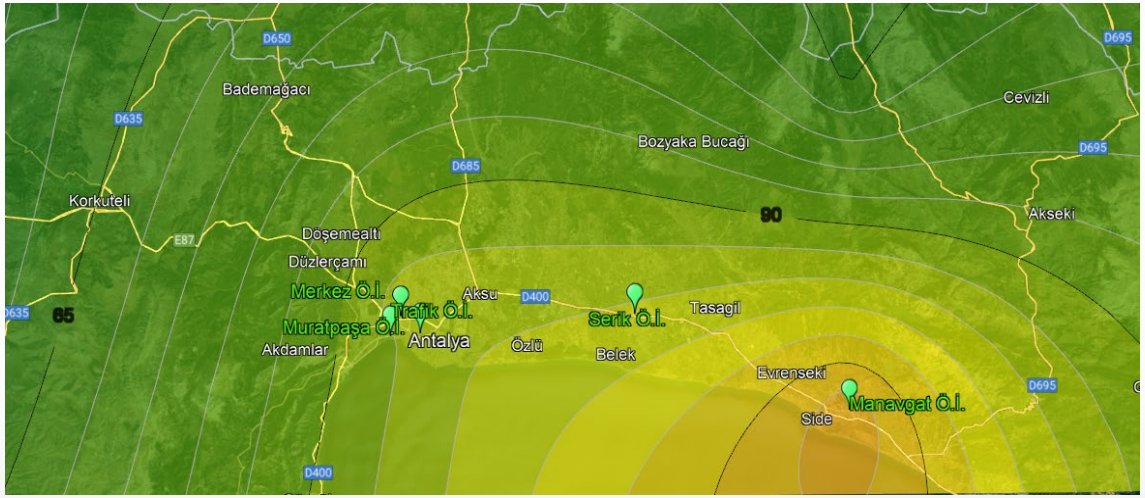


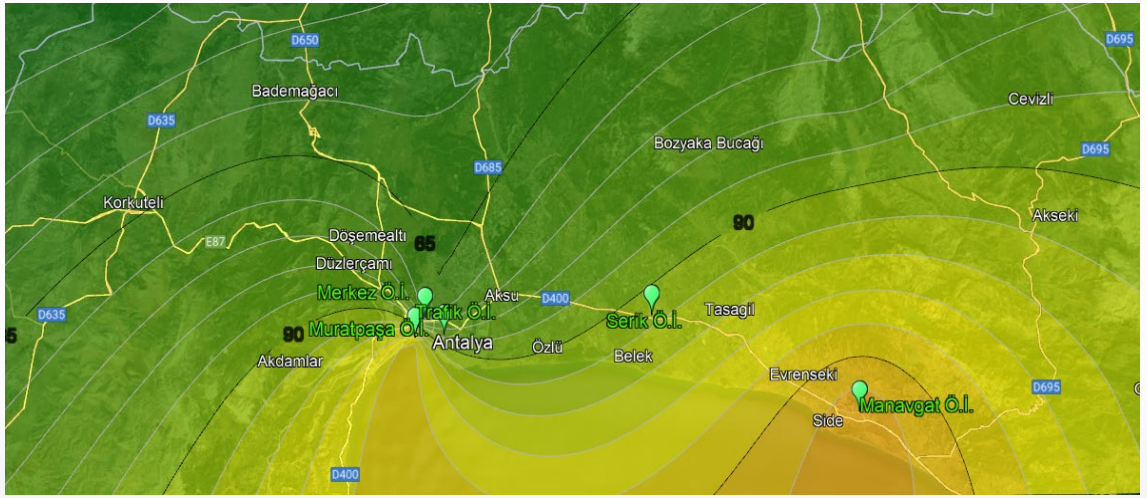


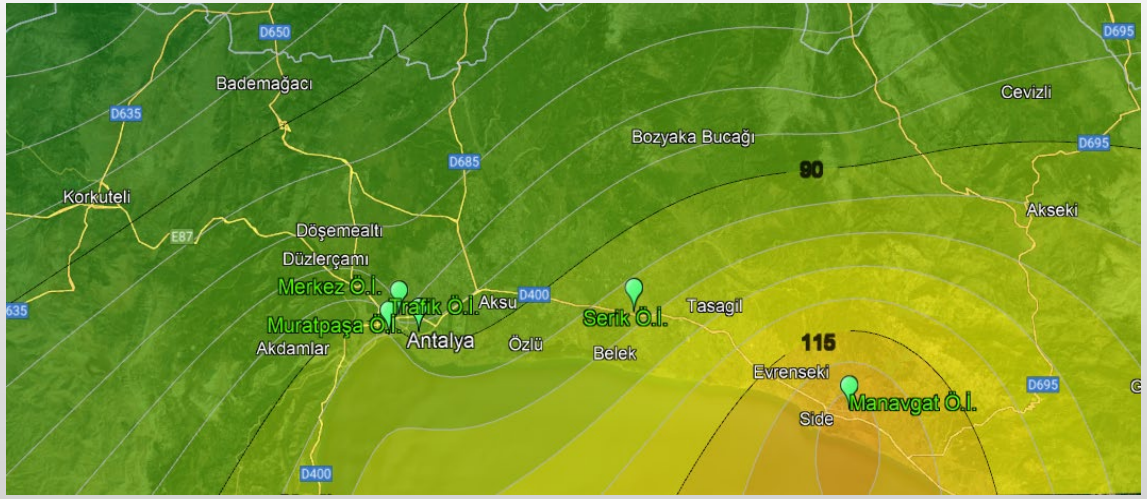


O3 PARAMETER;

Pre-Fire and Post-Fire Summer Period







RESULTS

- It was estimated that the air pollution during the fire period was visible and could reach very risky levels in terms of health. However, with the modeling study obtained with the measurement data, it was determined that especially the high levels of particulate matter did not have serious health effects when the regulation average values were taken as basis.
- Based on this, it was concluded that the extent of air pollution and its health effects on living beings could not be fully determined due to the locations and small numbers of the stations belonging to the Ministry where air pollution measurements were made.

RESULTS

- It is possible to say that the reason why the fire could not be extinguished for a long time such as 10 days and spread over a large area is due to the tree species in the region. Because it is known that the wind speed did not reach very high levels at that time.

SUGGESTIONS

- It is known that 56% of the region consists of forestland. Considering that there is a risk of fire at any time, the necessary precautions should be taken, and the necessary equipment should be available and sufficient to prevent a fire immediately.
- It is known that 11% of the causes of forest fires are natural and the rest are human activities. In order to prevent forest fires, the public should be informed, training should be provided on this subject, and its importance should be mentioned.
- Meteorological factors are always a matter that should be taken into consideration. In particular, it is important to announce information to the public about wind speed and direction, which have a great effect on the distribution of air pollution caused by fire.
- In order to obtain more reliable data and take the necessary precautions; the number of air quality measurement stations should be increased and they should be distributed spatially.

Thank you for listening..