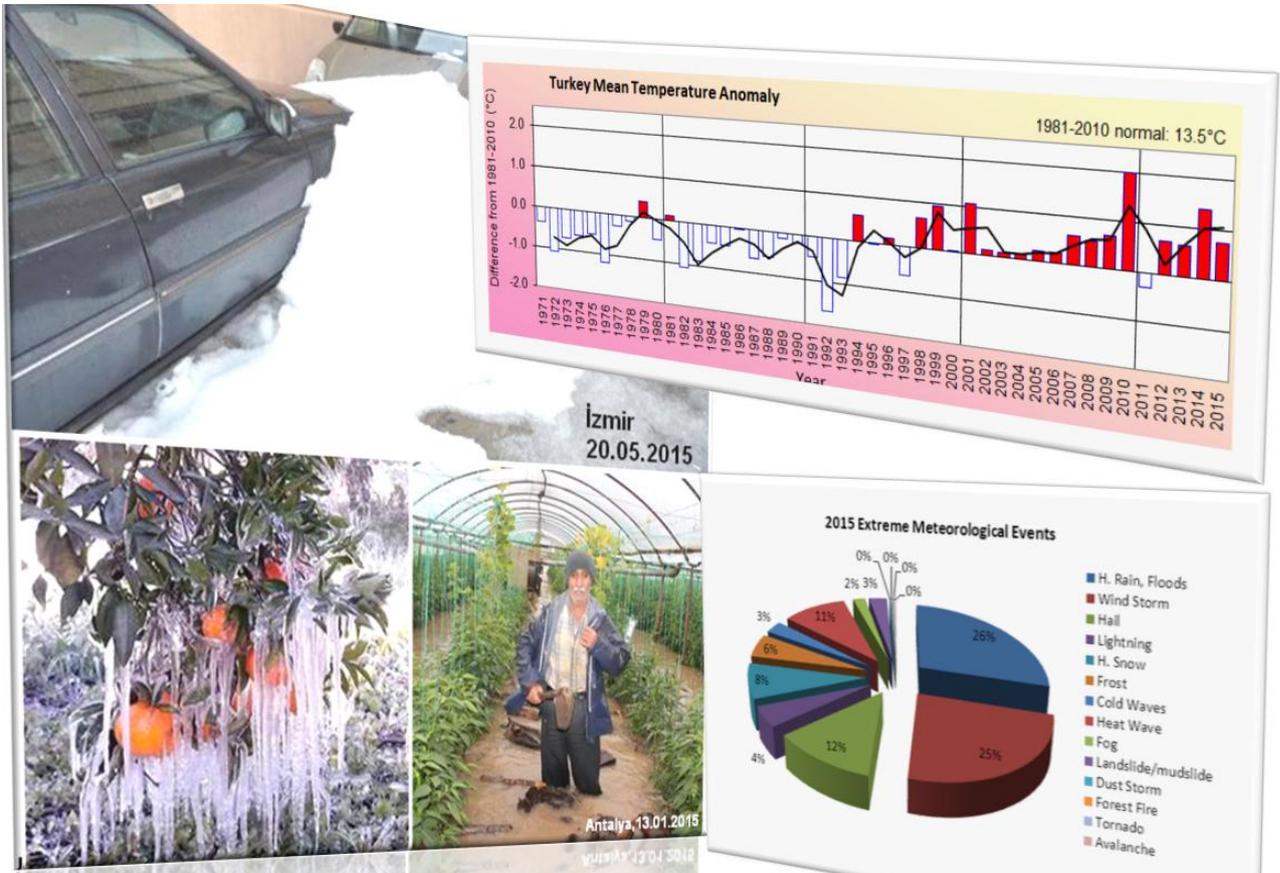




State of the Climate in Turkey in 2015



Research Department

January 2016

Ankara

REPUBLIC of TURKEY
MINISTRY of FORESTRY and WATER AFFAIRS
TURKISH STATE METEOROLOGICAL SERVICE

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CONTENT

	<u>Page</u>
1. State of the Climate in Turkey in 2015.....	1
2. Temperature	2
2.1. Monthly temperature	3
2.2. Seasonal temperature	3
2.3. Heat and cold waves in 2015	4
2.4. Extreme temperatures in 2015	4
3. Areal Precipitation	6
3.1. Monthly precipitation	7
3.2. Seasonal precipitation	7
3.3. Extreme rainfall	8
4. Notable events	9
4.1. Hail	11
4.2. Frost, Floods	11
4.3. Sand and Dust Storm	12
5. Ozone observation and analysis	13
References	14

1. State of the Climate in Turkey in 2015

Turkey annual mean temperature in 2015 has been 14.3°C. This value is 0.8°C above from 1981-2010 normal (13.5°C). This makes 2015 the fifth warmest year since 1971. Generally most of the country had above normal temperature except for Bitlis, Batman, Kırkkale, Balıkesir and İzmir which they were slightly below anomaly (Fig. 2.2).

Monthly mean temperatures of 2015 were above normal in most of the months except April, June and December which they were below it (Fig. 2.3).

All the seasons temperatures were above normal (1981-2010). Among them, winter and autumn temperature anomalies were particularly striking.

72 stations had heatwaves (some of them more than once), 28 stations had both heat and cold waves in 2015 mainly in January, May, September and November. One station (Manavgat) had only cold wave in January 2015. Other cold waves occurred in January, April, June and December 2015.

Lowest temperature in 2015 was in January with -28.8°C in Ağrı while highest temperature was in August with 47.4°C in Cizre. 27 stations have broken their monthly extreme maximum temperature records and one station (Simav) has broken its monthly extreme minimum temperature records in 2015 (Table 1).

Average areal precipitation is 577 mm in 2015, average areal precipitation for long years is 574 mm thence observed rainfall is near normal in this year for Turkey.

Although serious differences consisted among the regions, occurred areal precipitation in 2015 is nearby normal. The highest rainfall is observed on October and June and also July, November and December months are the driest according to normal. In terms of precipitation distribution, observed rainfall at west of Turkey is higher than east.

Monthly precipitations in 2015 were above the 1981-2010's average in January, February, March, June, August and October while below it in April, May, July, September, November and December. All the seasons precipitation was above normal (1981-2010) except autumn.

The number of extreme events in 2015 reached 959 (Fig. 4.1). There is an increasing trend in extreme event (41events/decade).

During 2015 most hazardous extreme events were heavy rain/floods (26%), wind storm (25%), hail (12%), heat wave (11%), heavy snow (8%), frost (6%), lightning (4%), cold wave (3%), landslide/mudslide (3%) and fog (2%) respectively (Fig. 4.2). Although rare, 1 forest fire, 2 dust storm, 1 avalanche and 4 tornados also occurred in 2015.

On 7-12 September, 2015 South Eastern Anatolia experienced dust transport coming from the Egypt and Syria. This was the longest time (5 days) dust storm in Turkey.

Total column ozone observed in Ankara as 322 DU which is slightly over 2007-2015 average (319 DU).

2. Temperature

Turkey annual mean temperature in 2015 has been 14.3°C. This value is 0.8°C above from 1981-2010 normal (13.5°C) (Fig.2.1). This makes 2015 the fifth warmest year since 1971.

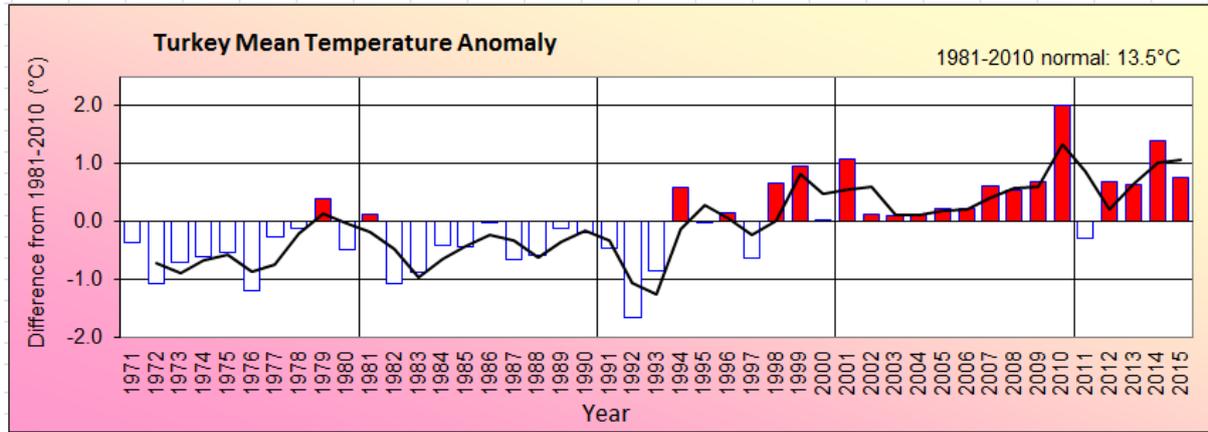


Figure 2.1. Annual mean temperature anomalies in Turkey (Url 1)

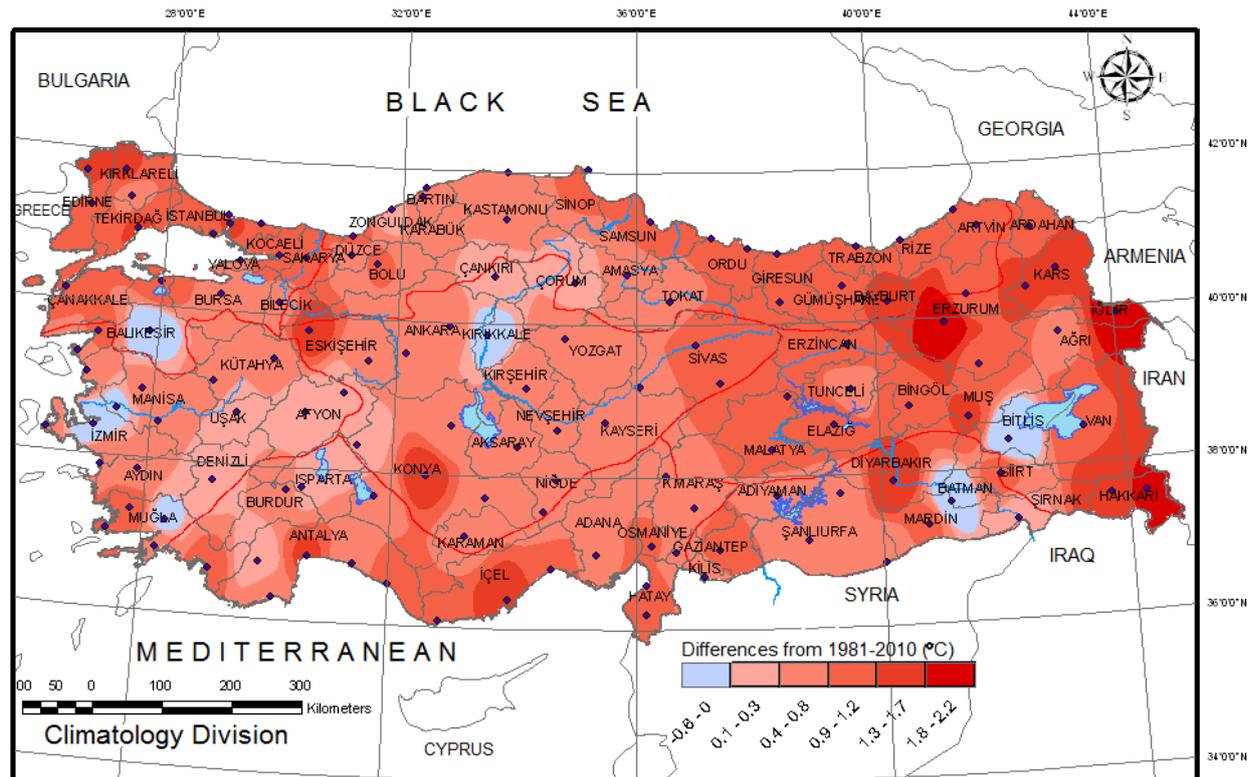


Figure 2.2. Spatial distribution of mean temperature differences in Turkey in 2015(Url 1).

Generally most of the country had above normal temperature except for Bitlis, Batman, Kırıkkale, Balıkesir and İzmir which they were slightly below anomaly (Fig. 2.2).

2.1. Monthly temperature

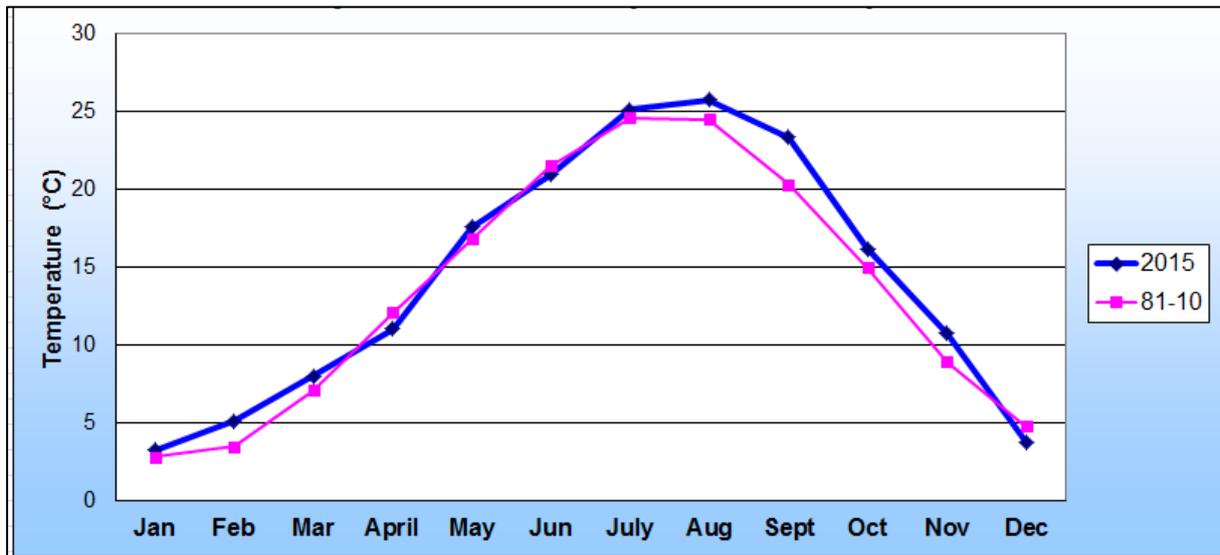


Figure 2.3. Monthly mean temperature differences in Turkey in 2015

Monthly mean temperatures of 2015 were above normal in most of the months except April, June and December which they were below it (Fig. 2.3).

2.2. Seasonal temperature

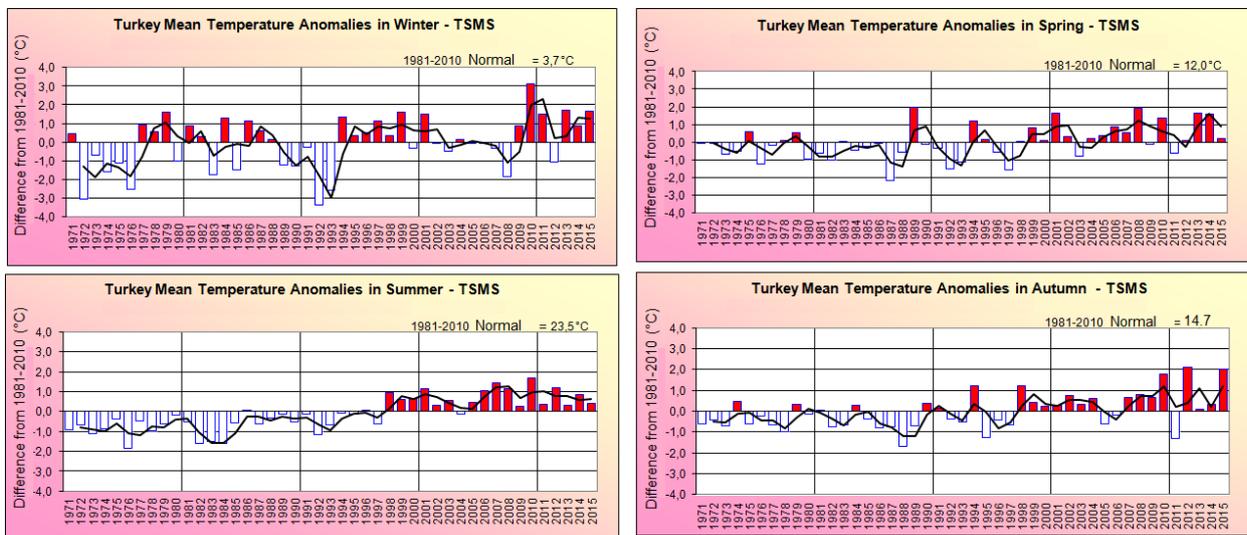


Figure 2.4. Seasonal temperature anomalies in Turkey in 2015

All the seasons temperatures were above normal (1981-2010). Among them, winter and autumn temperature anomalies were particularly striking.

2014-2015 mean winter temperature was 5.4°C which is 1.7°C above normal (3.7°C).

2015 mean spring temperature was 12.2°C which is 0.2°C above normal (12.0°C).

2015 mean summer temperature was 23.9°C which is 0.4°C above normal (23.5°C).

2015 mean autumn temperature was 16.8°C which is 2.1°C above normal (14.7°C).

2.3. Heat and cold waves in 2015

Heat wave is daily maximum temperature on more than five consecutive days exceeding the average maximum temperature by 5°C (Frich et al., 2002). Cold wave is daily minimum temperature on more than five consecutive days below the average minimum temperature by 5°C.

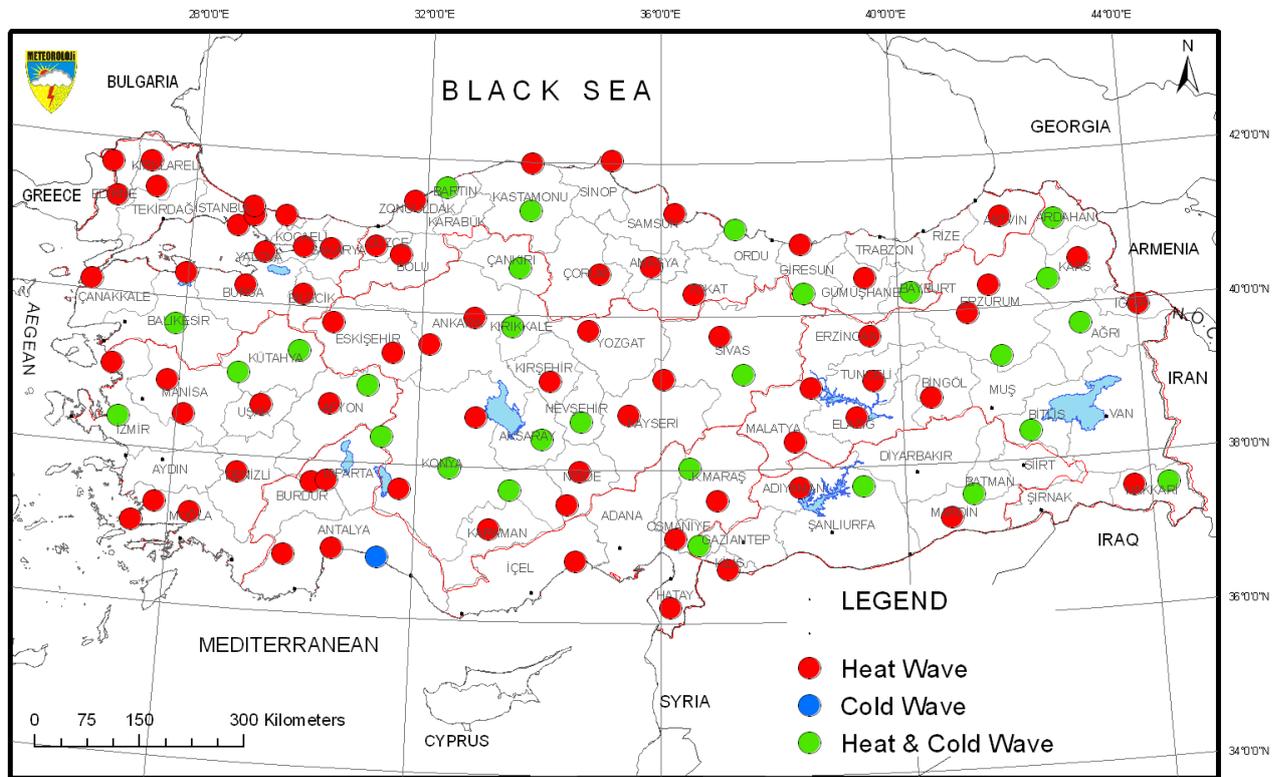


Figure 2.5. Heat and cold wave spatial distribution in 2015

72 stations had heatwaves (some of them more than once), 28 stations had both heat and cold waves in 2015 mainly in January, May, September and November. One station (Manavgat) had only cold wave in January 2015. Other cold waves occurred in January, April, June and December 2015 (Fig. 2.5).

2.4. Extreme temperatures in 2015

Lowest temperature in 2015 was in January with -28.8°C in Ağrı while highest temperature was in August with 47.4°C in Cizre. 27 stations have broken their monthly extreme maximum temperature records and one station (Simav) has broken its monthly extreme minimum temperature records in 2015 (Table 1).

Table 1. Stations broken their extreme maximum and minimum temperature records in 2015

Date	Station	Long Term Maximum Temperature (°C)	2015 Maximum Temperature (°C)	Difference
23.01.15	Kırklareli	18,1	18,6	0,5
23.01.15	Uzunköprü	19,1	20,8	1,7
23.01.15	Dikili	21,4	22,7	1,3
23.01.15	Edremit	21,8	22,7	0,9
20.05.15	Tokat	36,1	36,4	0,3
24.07.15	Akhisar	44,6	44,7	0,1
30.07.15	Hınıs	37,2	38	0,8
30.07.15	Malatya	42,2	42,5	0,3
03.08.15	Osmaniye	42,0	43,2	1,2
06.09.15	Bandırma	38,0	39,5	1,5
04.09.15	Çanakkale	35,4	35,9	0,5
06.09.15	Edirne	37,8	39,9	2,1
06.09.15	Kırklareli	37,0	38,8	1,8
06.09.15	Kumköy	34,2	37,7	3,5
06.09.15	Lüleburgaz	38,3	39,1	0,8
06.09.15	Sakarya	38,4	38,6	0,2
06.09.15	Tekirdağ	34,5	39,7	5,2
04.09.15	Uzunköprü	36,4	39,1	2,7
07.09.15	Bodrum	40,0	42,6	2,6
06.09.15	Milas	41,1	44,1	3
11.09.15	Burdur	37,0	38,1	1,1
11.09.15	Elmalı	35,6	36,5	0,9
12.09.15	Karapınar	36,2	37,2	1
06.09.15	Akçakoca	31,7	35,4	3,7
06.09.15	Amasra	34,8	34,9	0,1
06.09.15	Bartın	36,0	37,8	1,8
24.12.15	Milas	24,6	25,8	1,2

Date	Station	Long Term Minimum Temperature (°C)	2015 Minimum Temperature (°C)	Difference
9.1.2015	Simav	-18,4	-21,7	3,3

3. Areal Precipitation

Average areal precipitation is 577 mm in 2015, average areal precipitation for long years (1981-2010) is 574 mm then observed rainfall is near normal in this year for Turkey (Fig. 3.1).

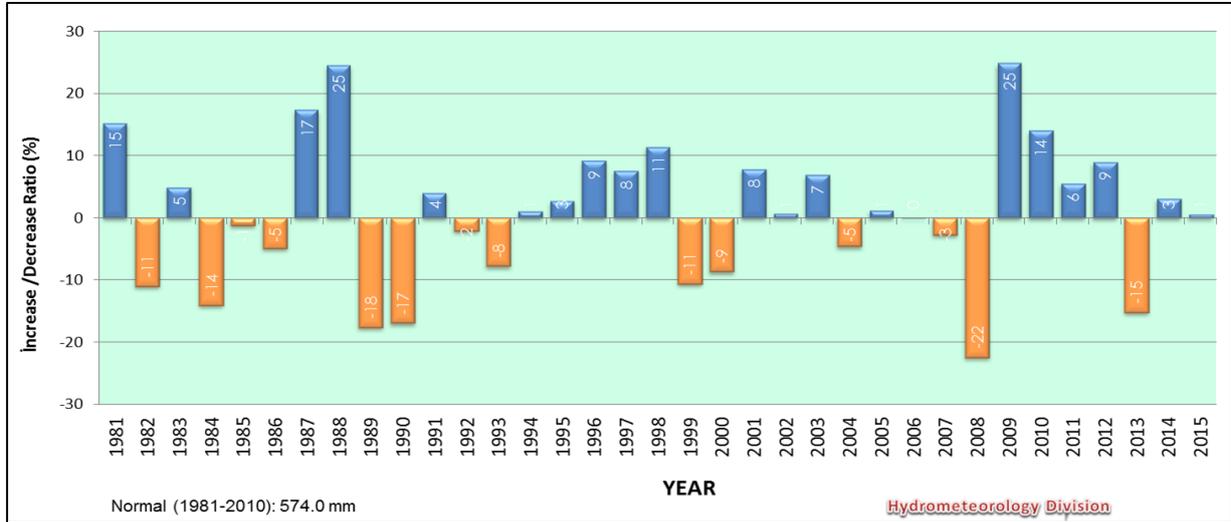


Figure 3.1. Annual areal precipitation anomaly in Turkey in 2015 (Url 2)



Figure 3.2. Spatial distribution of mean precipitation anomalies in Turkey in 2015

Although serious differences consisted among the regions, occurred areal precipitation in 2015 is nearby normal. The highest rainfall was observed on October and June and also July, November and December months were the driest according to normal. In terms of precipitation distribution, observed rainfall at west of Turkey is higher than east (Fig. 3.2).

3.1. Monthly precipitation

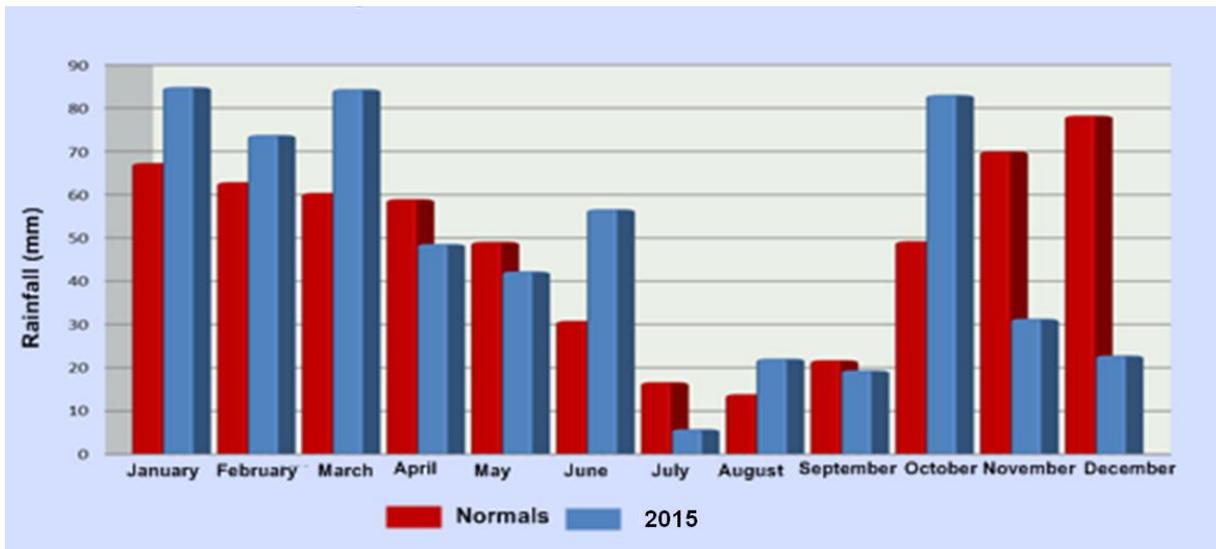


Figure 3.3. Monthly areal rainfall in Turkey in 2015

Monthly precipitations in 2015 were above the 1981-2010's average in January, February, March, June, August and October while below it in April, May, July, September, November and December (Fig. 3.3).

3.2. Seasonal precipitation

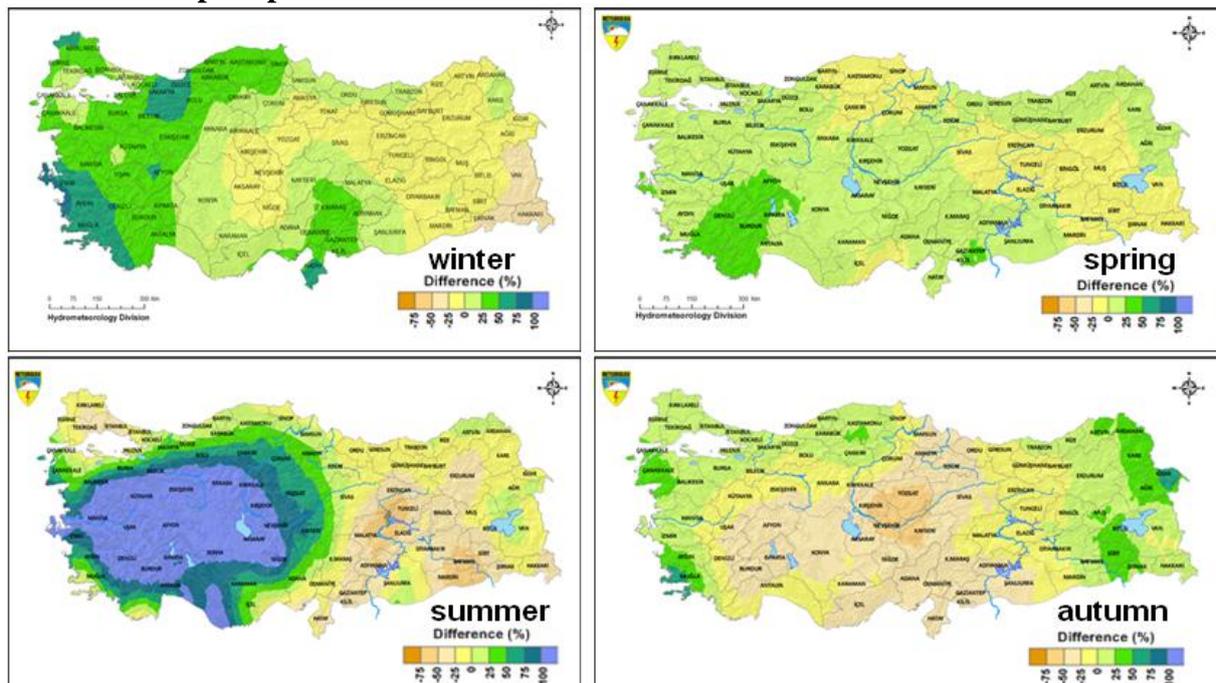


Figure 3.4. Seasonal areal rainfall differences in Turkey in 2015.

All the seasons precipitation was above normal (1981-2010) except autumn.
 Average areal precipitation for winter season was 247 mm, 18% above normal (219 mm)
 Average areal precipitation for spring season was 176 mm, 4% above normal (169 mm)
 Average areal precipitation for summer season was 85 mm, 38% above normal (62 mm)
 Average areal precipitation for autumn season was 134 mm, 6.4% below normal (143 mm)

3.3. Extreme rainfall

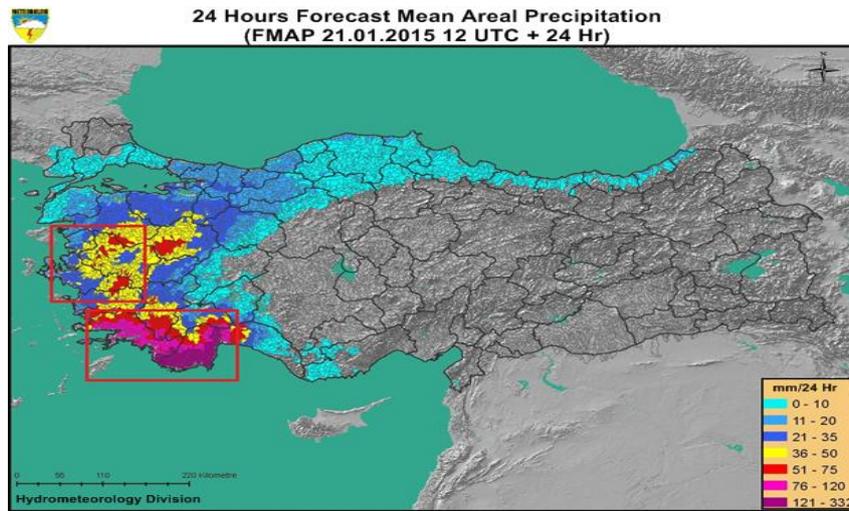


Figure 3.5. Hours Forecast Mean Areal Precipitation (21.01.2015 12:00 UTC + 24 Hr)

According to Black Sea Middle East Flash Flood Guidance System (FFGS) products which is used in TSMS, it is estimated that intensity precipitation for province of Antalya/Kas at 21 January 12:00 UTC. On the next day, 232.5 mm rainfall is observed in 24 hours which is over 100 year return period. Consequently, inundation events occurred in the town, highway was covered by mud and gravel pieces due to flood.

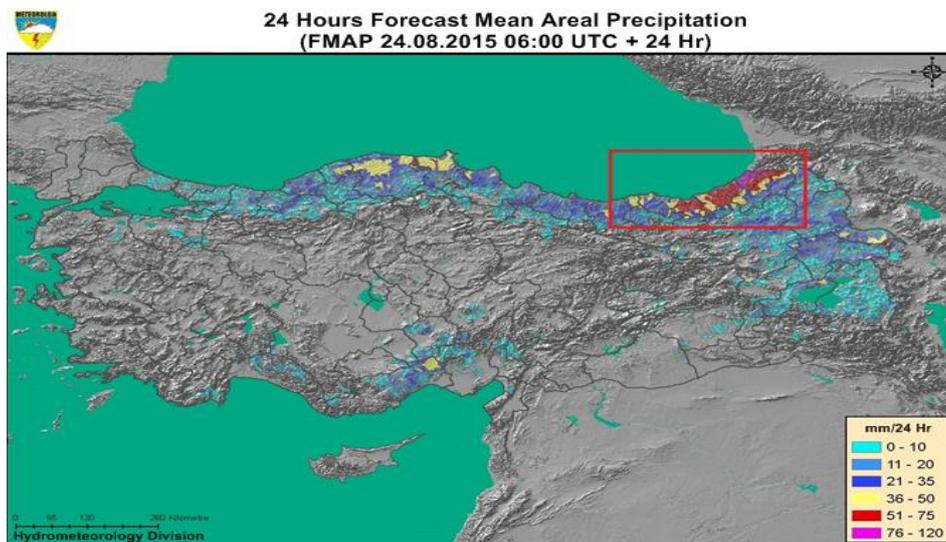


Figure 3.6. Hours Forecast Mean Areal Precipitation (24.08.2015 06:00 UTC + 24 Hr)

According to FFGS products, it is estimated that extreme precipitation for province of Artvin/Hopa at 24 August 06:00 UTC. On the next day, 287.2 mm rainfall is observed in 24 hours which is over 100 year return period. As a result of this extraordinary situation, a few rivers overflowed, about 400 workplaces and homes and 300 vehicles damaged by flood and landslides took place in the town due to downpour.

4. Notable events

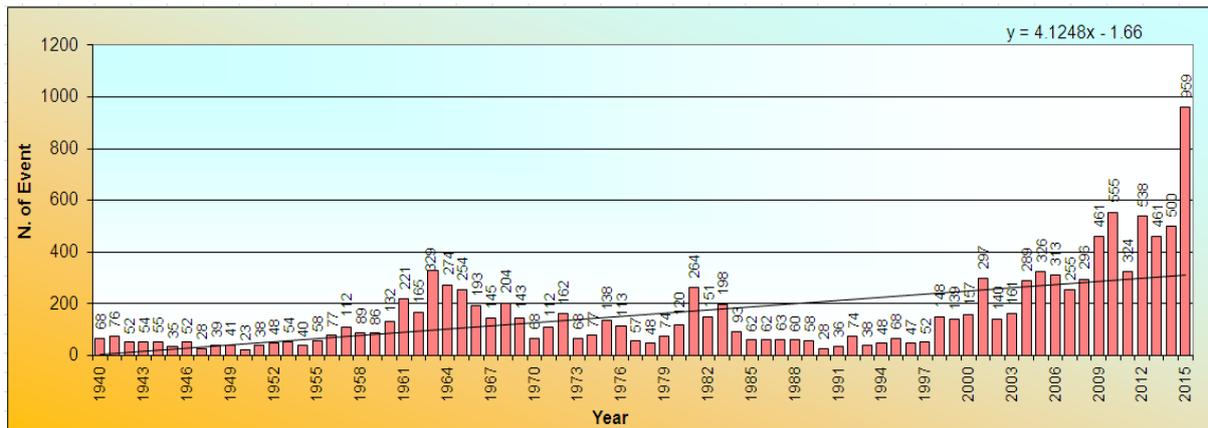


Figure 4.1. Annual count of extreme events in Turkey in 2015

The number of extreme events in 2015 reached 959 (Fig. 4.1) (URL 3 and URL7). There is an increasing trend in extreme event (41events/decade).

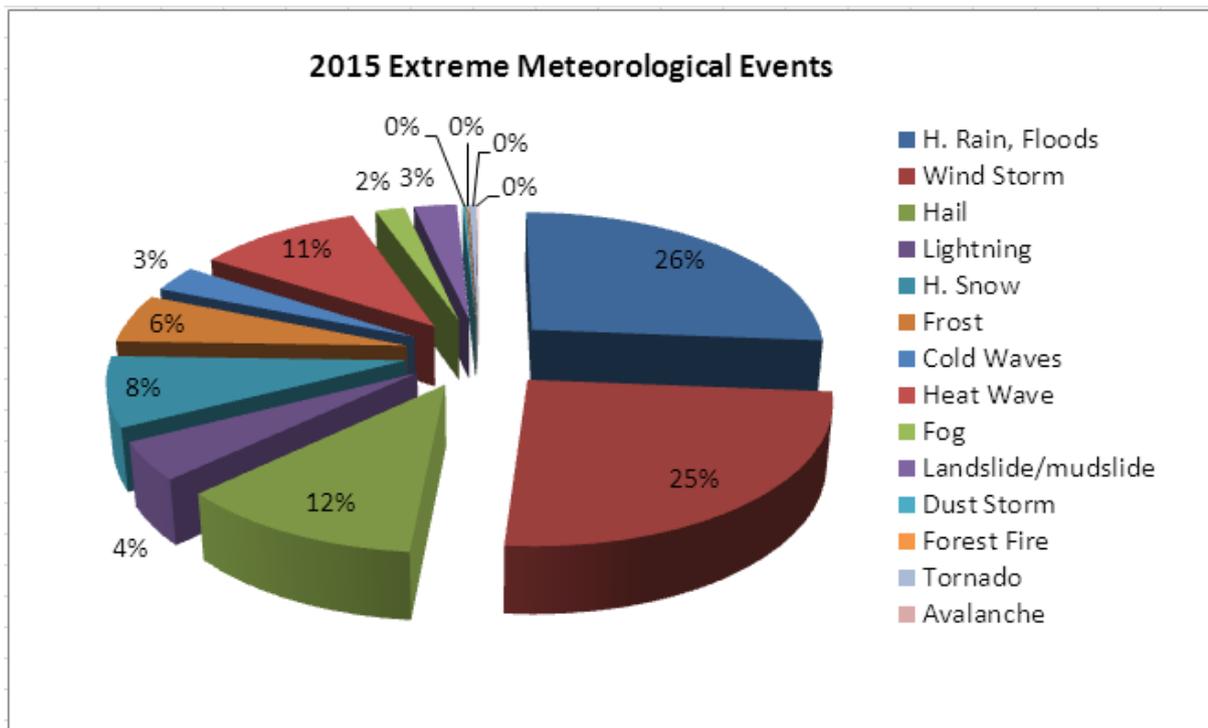


Figure 4.2. Distribution of extreme events types in Turkey in 2015, (URL 3 and URL7)

During 2015 most hazardous extreme events were heavy rain/floods (26%), wind storm (25%), hail (12%), heat wave (11%), heavy snow (8%), frost (6%), lightning (4%), cold wave (3%), landslide/mudslide (3%) and fog (2%) respectively (Fig. 4.2). Although rare, 1 forest fire, 2 dust storm, 1 avalanche and 4 tornados also occurred in 2015 (URL 3 and URL7).

Several people died from chimney poisoning due south-westerly wind (Lodos) (Url 8). 9 people died from lightning. Also 1 people from landslide, 1 people from flood and 1 people from snow-load, were lost their life.

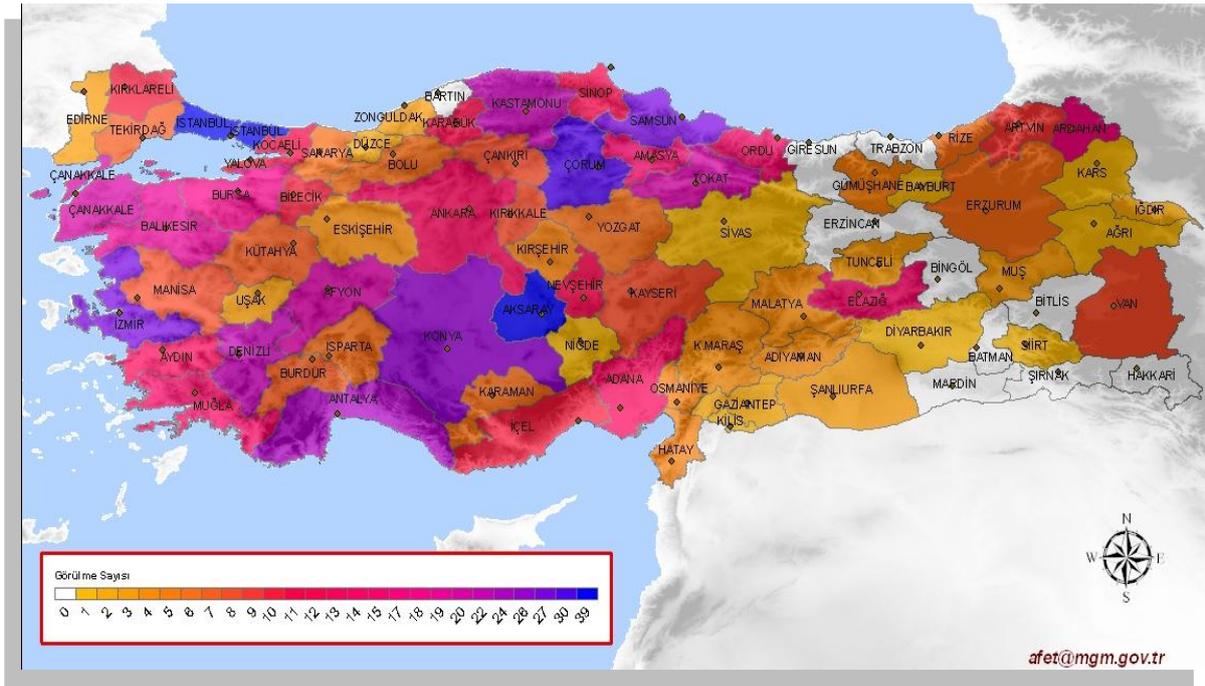


Figure 4.3. Number of event in the cities

Most extreme event occurred in Marmara, western Black Sea, and Mediterranean Regions inland Anatolia and northern part of the country. The most disaster cities are İstanbul, Aksaray and Çorum with the 39 events happen in 2015. Number of event in İzmir and Antalya is 27 and Konya is 30.

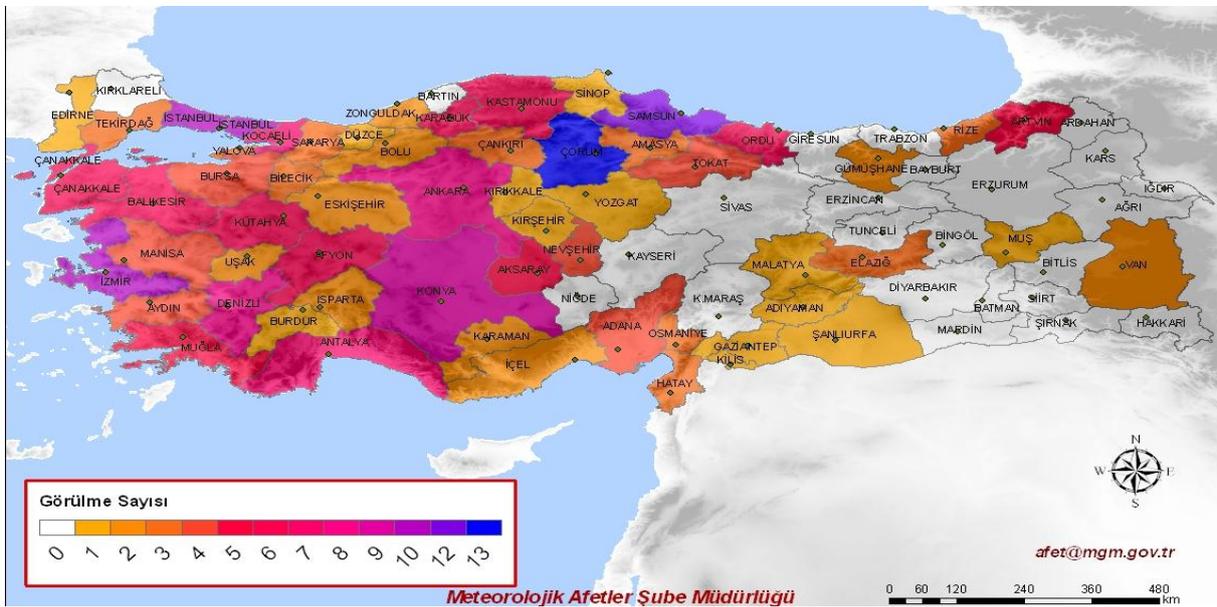


Figure 4.4. Number of heavy rainfall and floods event in the cities

In 2015 most hazardous event was heavy rainfall and floods events with 27% and the regions are Black Sea, Marmara and Mediterranean Region. In Çorum 13 flood events were happen. İstanbul, İzmir and Konya provinces follow this.

4.1. Hail



Figure 4.5. Hail storm on 20 May 2015 in İzmir (Url 3).

Hail storm caused floods and disruption in traffic in İzmir.

4.2. Frost and Floods



Figure 4.6. Frost damage in Finike (left), Floods in Greenhouse, Demre, Antalya (right) (Url 6).

Frost caused big damages on orange trees in Finike, Antalya, 100 km/h storm broken power lines and greenhouses were flooded in Demre on 13 January 2015.

4.3. Sand and Dust Storm

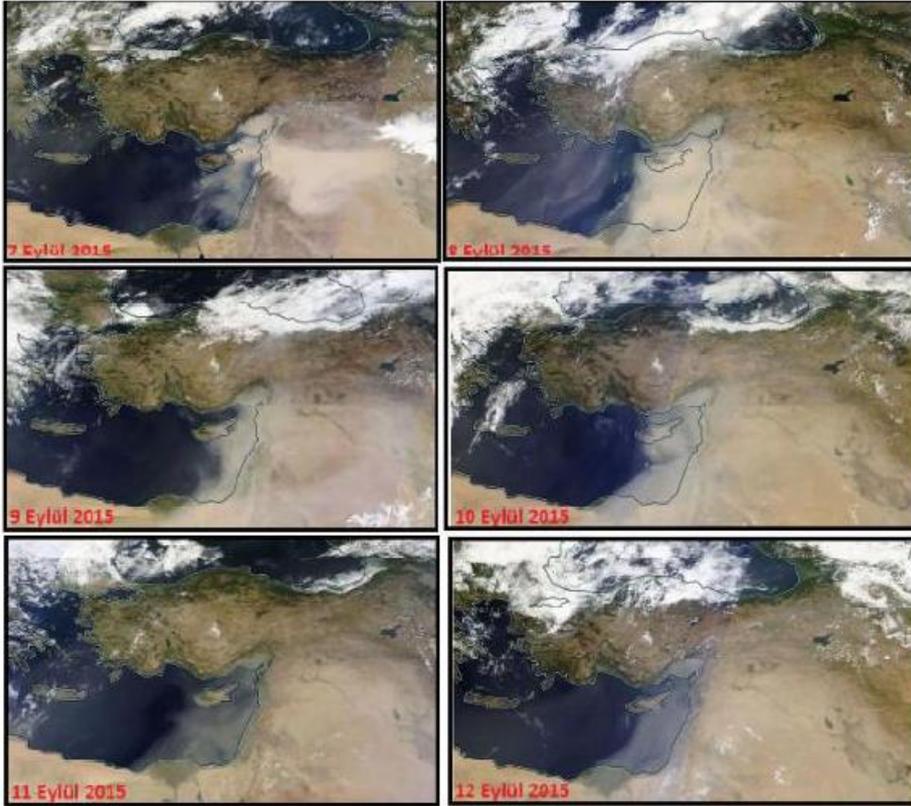


Figure 4.7. MODIS real time images for 07-12 September 2015 (Oğuz et al, 2015).

On 7-12 September, 2015 South Eastern Anatolia experienced dust transport coming from the Egypt and Syria. This was the longest time (5 days) dust storm in Turkey.

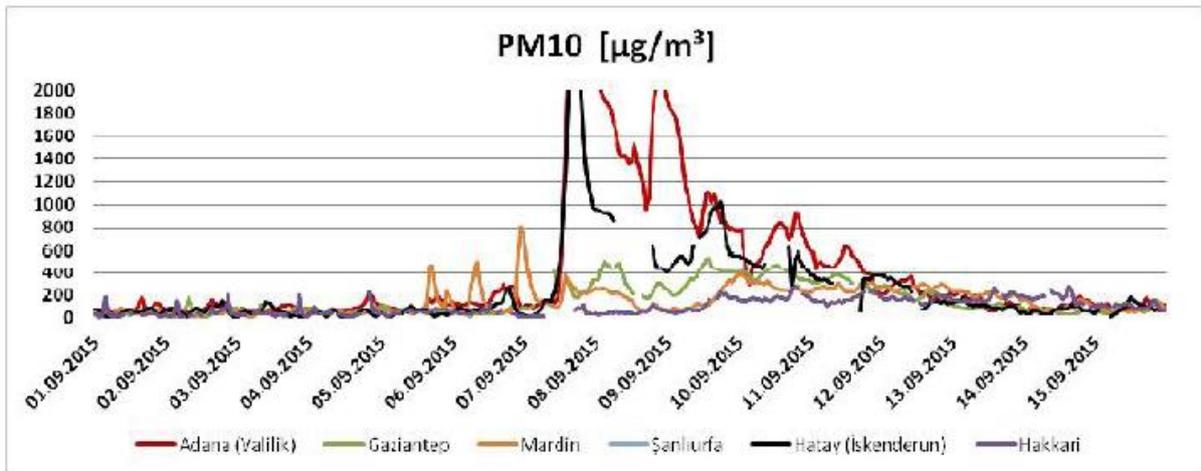


Figure 4.8. Particulate Matter (PM10) observation for 6 centers

Especially in Hatay and Adana particulate matter concentration has reached 2558 and 2774 $\mu\text{g}/\text{m}^3$ respectively (Oğuz et al, 2015).

5. Ozone measurements and analysis for Ankara, Turkey

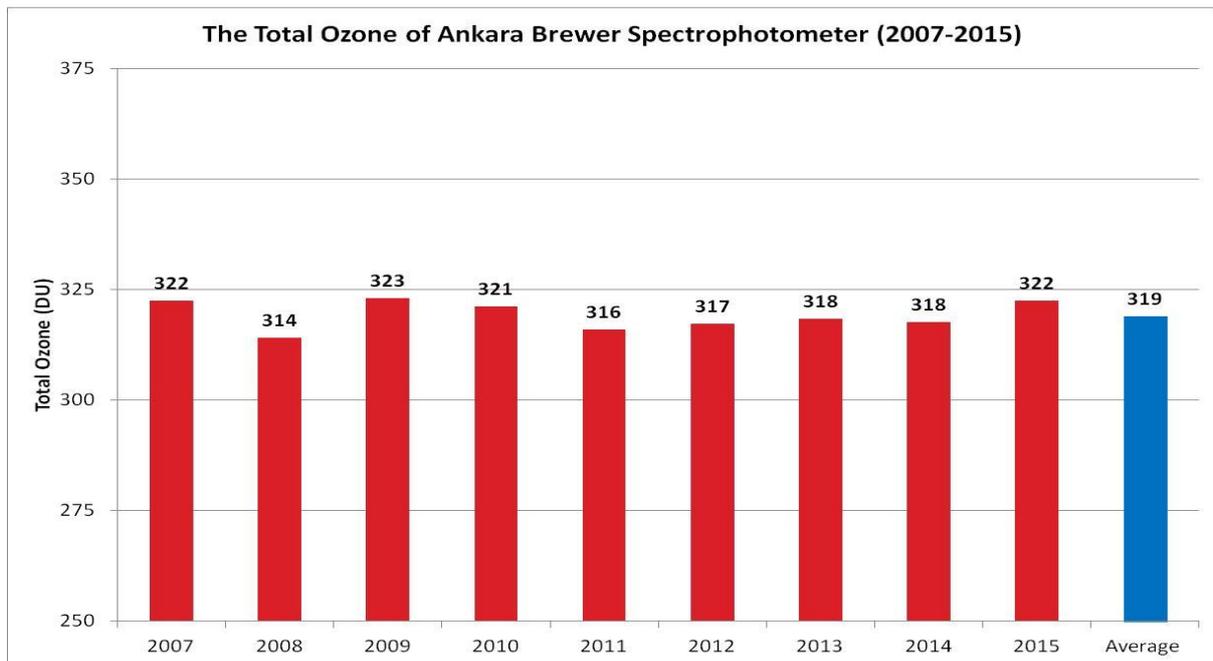


Figure 5.1. Total Ozone of Ankara Brewer Spectrophotometer (2007-2015)

Total column ozone has 319 DU average for the period of 2007-2015 over Ankara. The minimum total ozone value is seen in 2008 as 314 DU and the maximum value of total ozone amount is 323 DU in 2009.

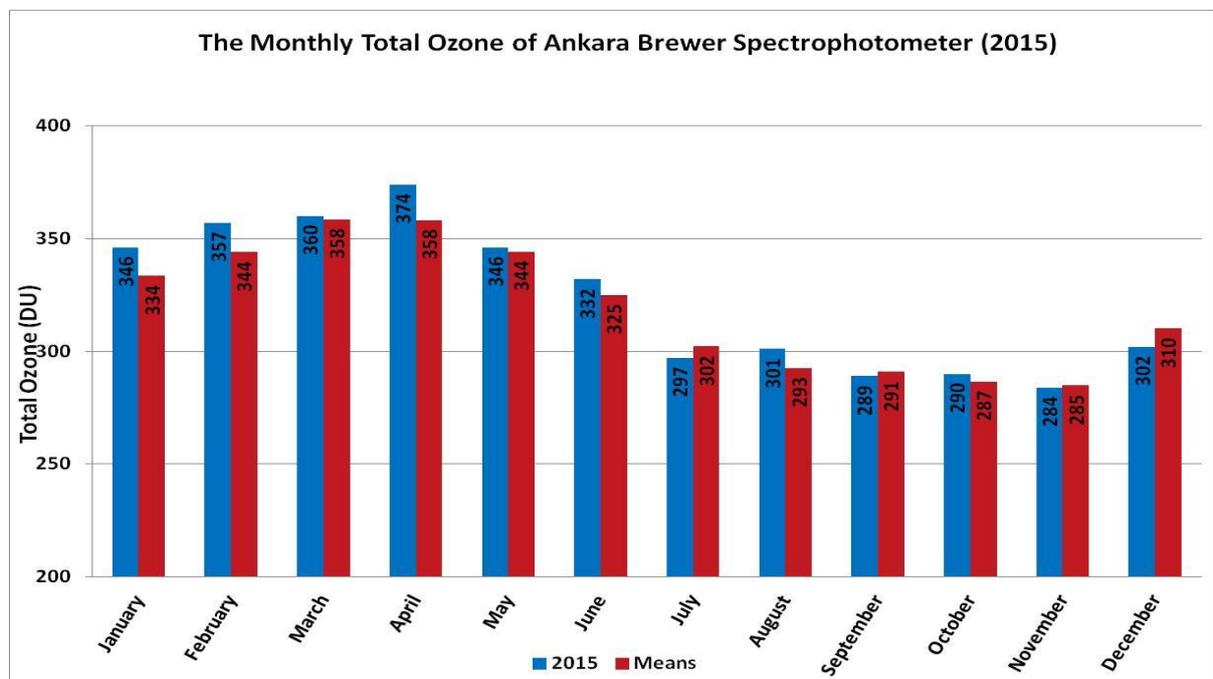


Figure 5.2. The monthly Total Ozone of Ankara Brewer Spectrophotometer in 2015

The monthly Brewer total ozone values of Ankara in 2015 were similar to the general trend in northern mid-latitudes. They were highest March and April: 360 and 374 DU, and lowest in September and November, 289 and 284 DU (Url 5).

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