



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



State of the Climate in Turkey in 2017



Research Department

**February 2018
Ankara**

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in 2017**

RESEARCH DEPARTMENT

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CONTENT

1. Introduction.....	1
2. Temperature	2
2.1 Monthly temperature	3
2.2 Seasonal temperature	4
2.3 Extreme temperatures in 2017	6
2.4 Heat and cold waves indices in 2017.....	8
3. Precipitation	11
3.1 Monthly precipitation	12
3.2 Seasonal precipitation.....	12
4. Extreme Meteorological Events.....	14
4.1 Heavy rain/floods	15
References	16

1. Introduction

Turkey's annual mean temperature in 2017 was 14.2°C. This value is 0.7°C above from 1981-2010 normal (13.5°C), which makes 2017 the ninth warmest year since 1961.

Monthly mean temperatures in 2017 were above from 1981-2010 normal in most of the months except January and October which were the below normal and May which was near the normal.

All the seasonal temperatures were above the normal (1981-2010), except winter which was the below normal.

Lowest minimum temperature in 2017 was in February with -31.9°C in Ağrı while highest maximum temperature was in August with 46.9°C in Cizre. 71 stations have broken their monthly extreme maximum temperature records in 2017.

Annual mean areal precipitation in 2017 was 506.6mm. This value is 11.7% below from 1981-2010 normal (574 mm). The lack of precipitation caused drought especially central and eastern parts of Anatolia.

Monthly precipitation in 2017 was below from the 1981-2010's normal in February, July, September, November and December and near normal in March and April. It was above from normal in January, May, June, August and October.

All seasonal precipitation were below the normal with exception of spring. Spring precipitation were 8.8% above from the 1981-2010's normal.

The number of extreme events in 2017 reached 598. There is an increasing trend in occurrences of extreme events (4 events/year).

Most hazardous extreme events during 2017 were wind storm and tornadoes (36%), heavy rain/floods (31%), hail (16%), heavy snow (7%) and lightning (~ 4%).

2. Temperature

Turkey's annual mean temperature in 2017 was 14.2°C, 0.7°C above from 1981-2010 normal (13.5°C) (Fig.2.1). That makes 2017 the ninth warmest year since 1971 (Fig. 2.2).

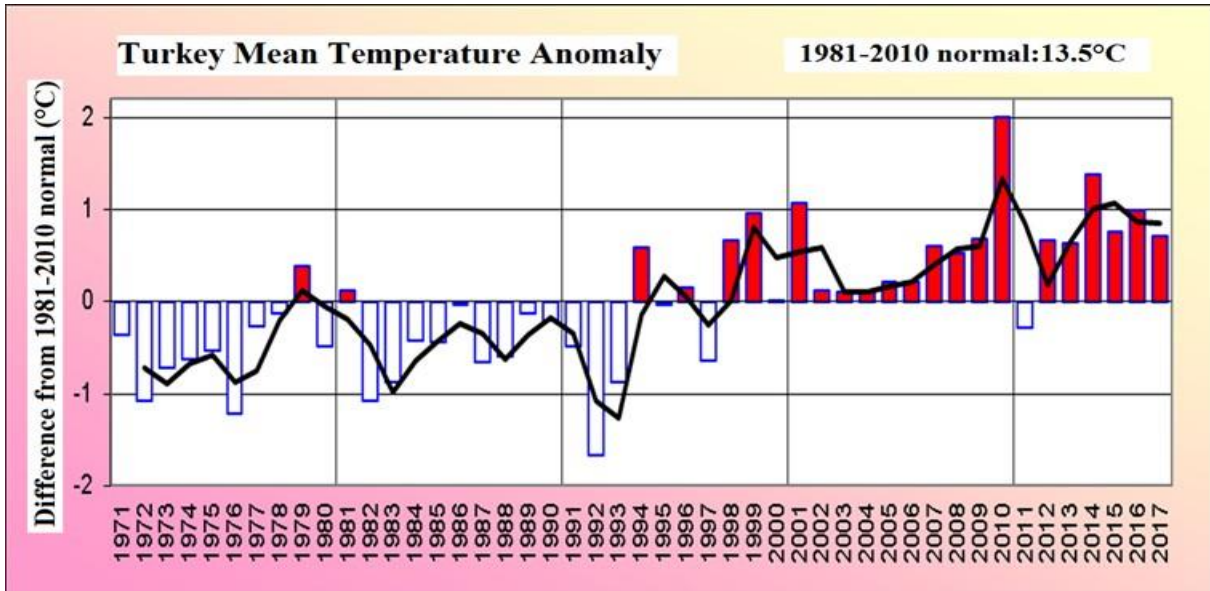


Figure 2. 1 Annual mean temperature anomalies in Turkey (URL 1)

Since 1998, there are consistent positive anomalies in Turkey's mean temperatures except year 2011. The warmest year was 2010 with 2.0°C temperature anomaly.

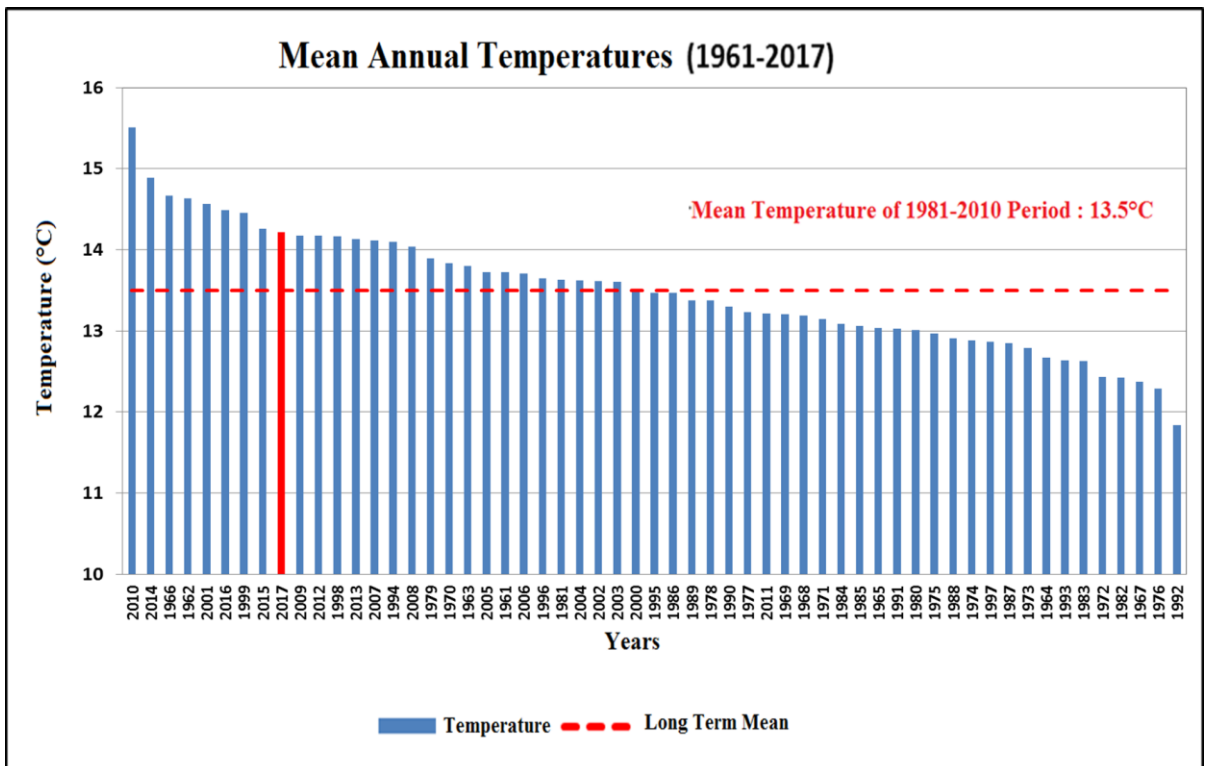


Figure 2. 2 Rank of warmest years to coldest (URL 1)

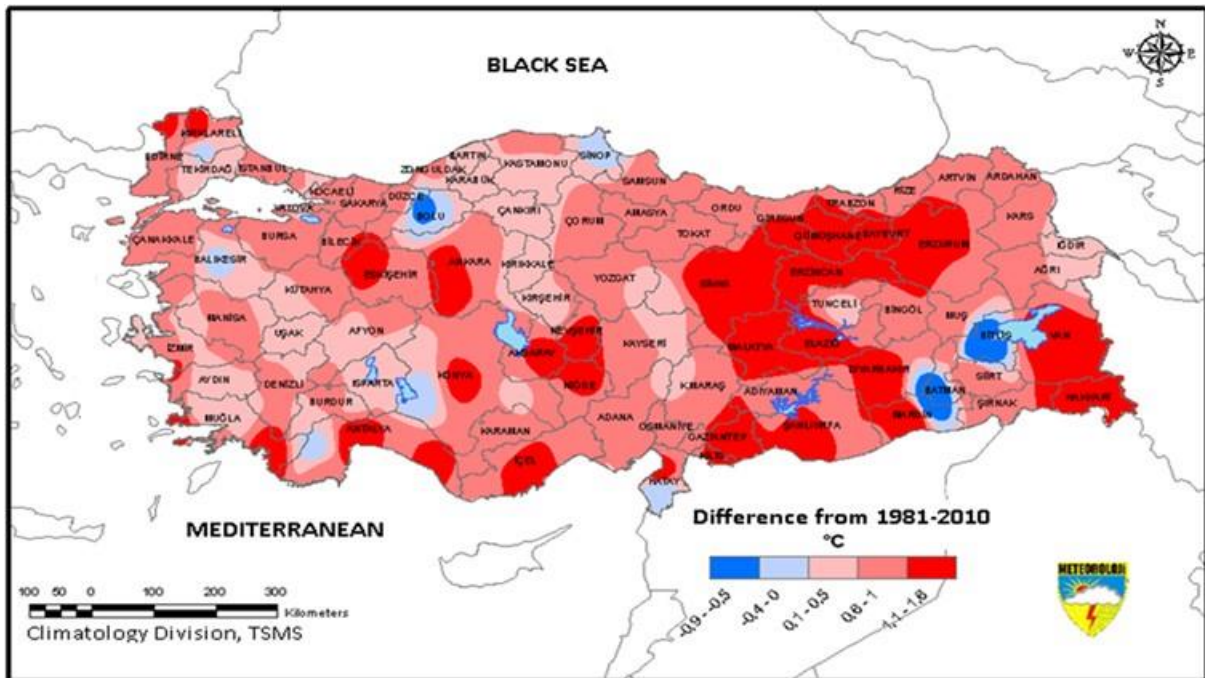


Figure 2. 3 Spatial distribution of mean temperature differences in Turkey in 2017 (URL 1).

In general, most of the country had above normal temperatures except Balıkesir, Lüleburgaz, Hatay, Beyşehir, Elmali, Bolu, Sinop, Bitlis and Batman which were below normal (Fig. 2.3). Temperature anomalies in some central and eastern parts of Anatolian locations are greater than 1.0°C.

2.1 Monthly temperature

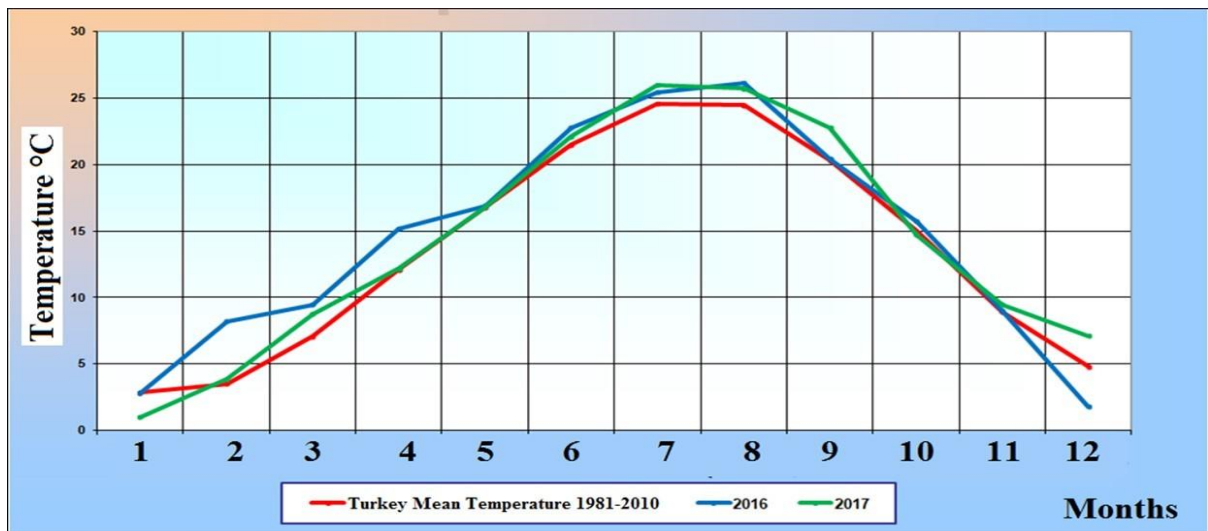


Figure 2. 4 Monthly mean temperature differences in Turkey in 2017 (URL 1)

Monthly mean temperatures of 2017 were below their normals in January and October, near the normal in May, above the normal in February, March, April, June, July, August, September and November and December based on the 1981-2010 monthly temperature normal (Fig. 2.4).

2.2 Seasonal temperature

All the seasonal temperatures were above the normal (1981-2010), except winter season. The winter temperature was 1.5°C below from its normal and summer was 1.1°C above from its normal values (Figure 2.5, 2.6, 2.7 2.8).

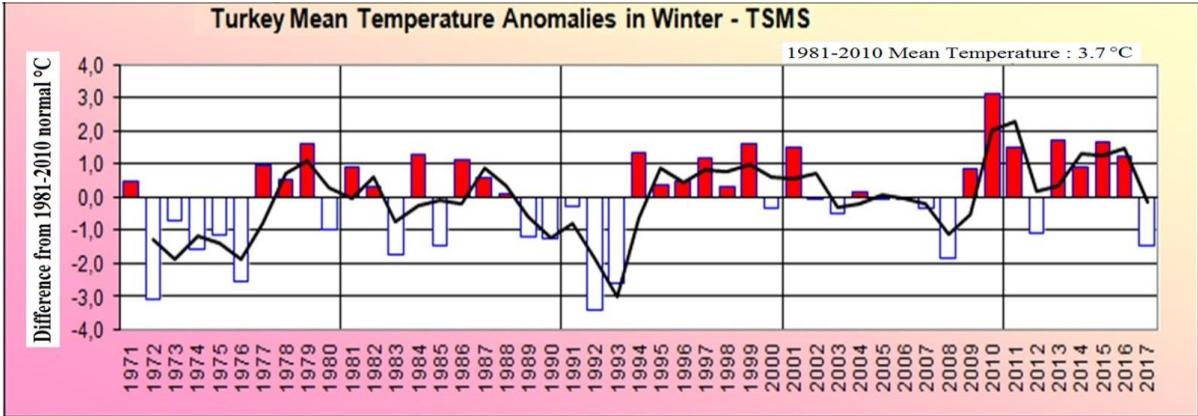


Figure 2. 5 Winter temperature anomalies in Turkey in 2017 (URL 1)

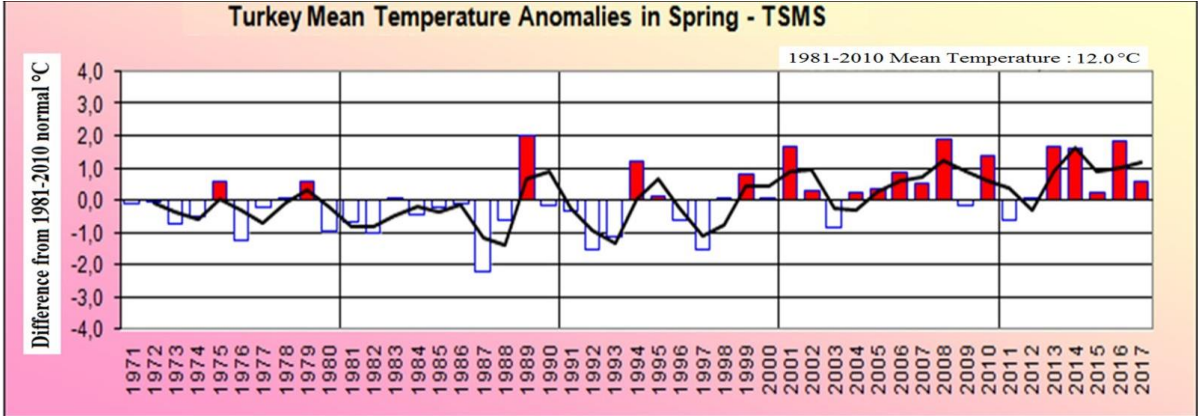


Figure 2. 6 Spring temperature anomalies in Turkey in 2017 (URL 1)

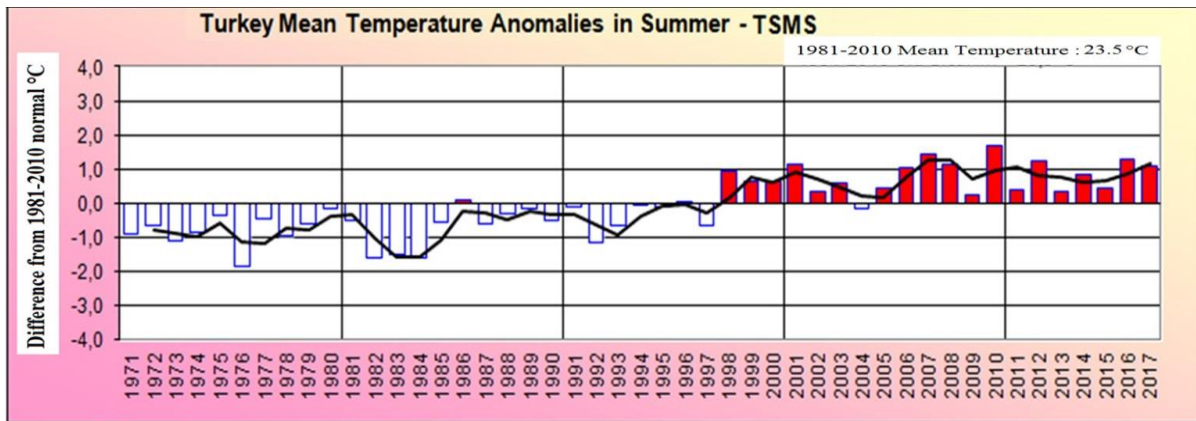


Figure 2. 7 Summer temperature anomalies in Turkey in 2017 (URL 1)

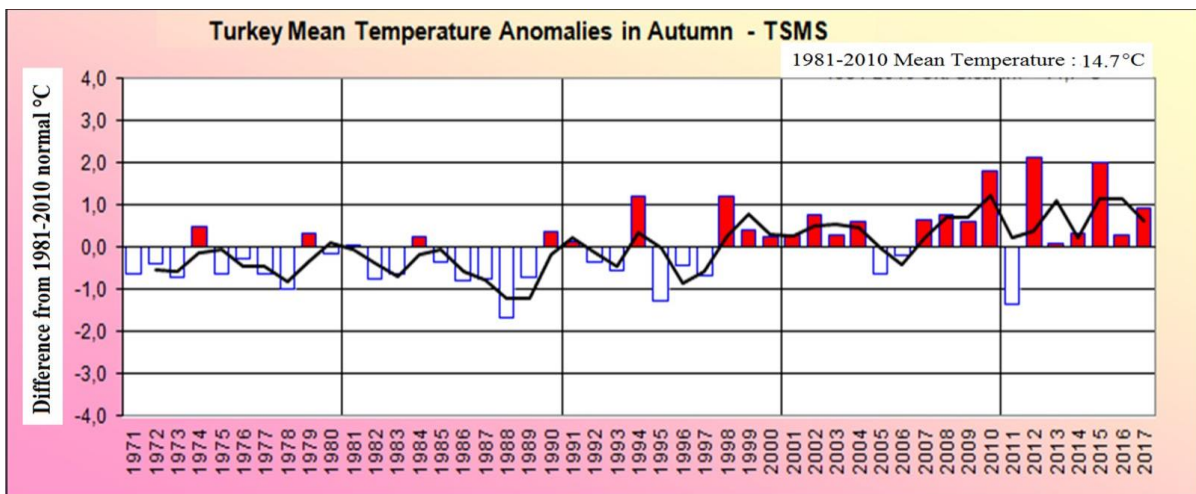


Figure 2. 8 Autumn temperature anomalies in Turkey in 2017 (URL 1)

- 2015-2016 mean winter temperature was 2.2°C, 1.5°C below normal (3.7°C) (Figure 2.5).
- 2016 mean spring temperature was 12.6°C, 0.6°C above normal (12.0°C) (Figure 2.6).
- 2016 mean summer temperature was 24.6°C, 1.1°C above normal (23.5°C) (Figure 2.7).
- 2016 mean autumn temperature was 15.7°C, 1.0°C above normal (14.7°C) (Figure 2.8).

2.3 Extreme temperatures in 2017

Lowest minimum temperature in 2017 was in February with -31.9°C in Ağrı while highest maximum temperature was observed in August with 46.9°C in Cizre. A total of 15 stations broke their yearly extreme maximum temperature records and 71 stations broke their monthly extreme maximum temperature records (Table 1, 2 and 3) (Figure 2.9 and 2.10).

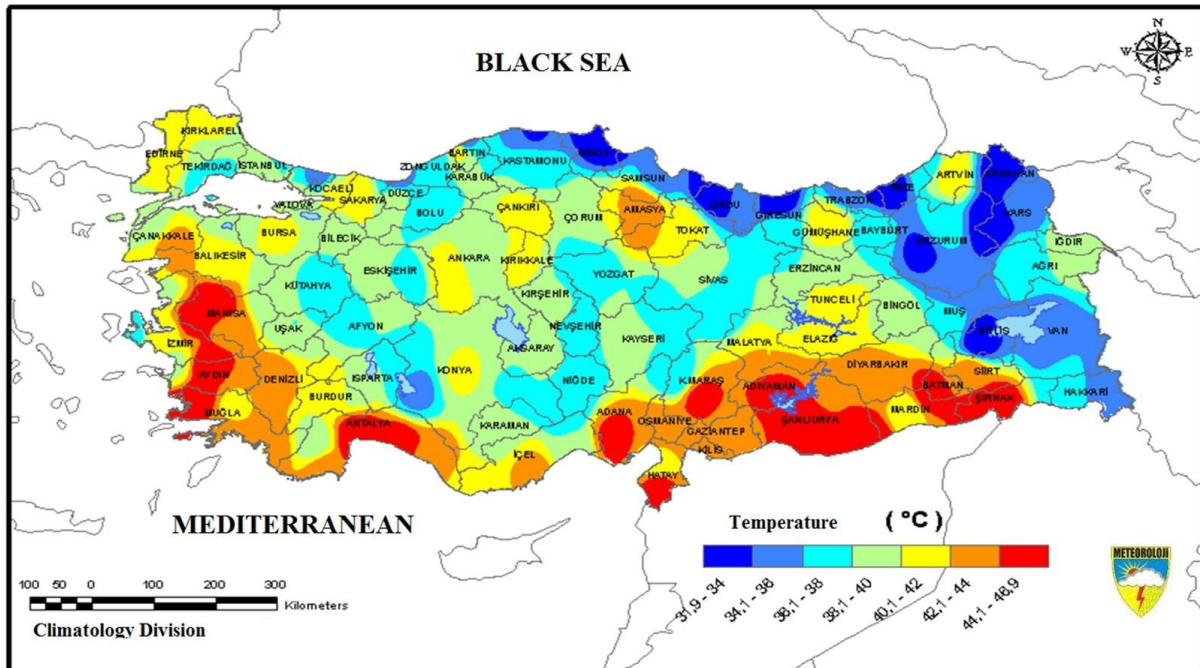


Figure 2. 9 Spatial distribution of maximum temperatures in Turkey in 2017 (URL 1)

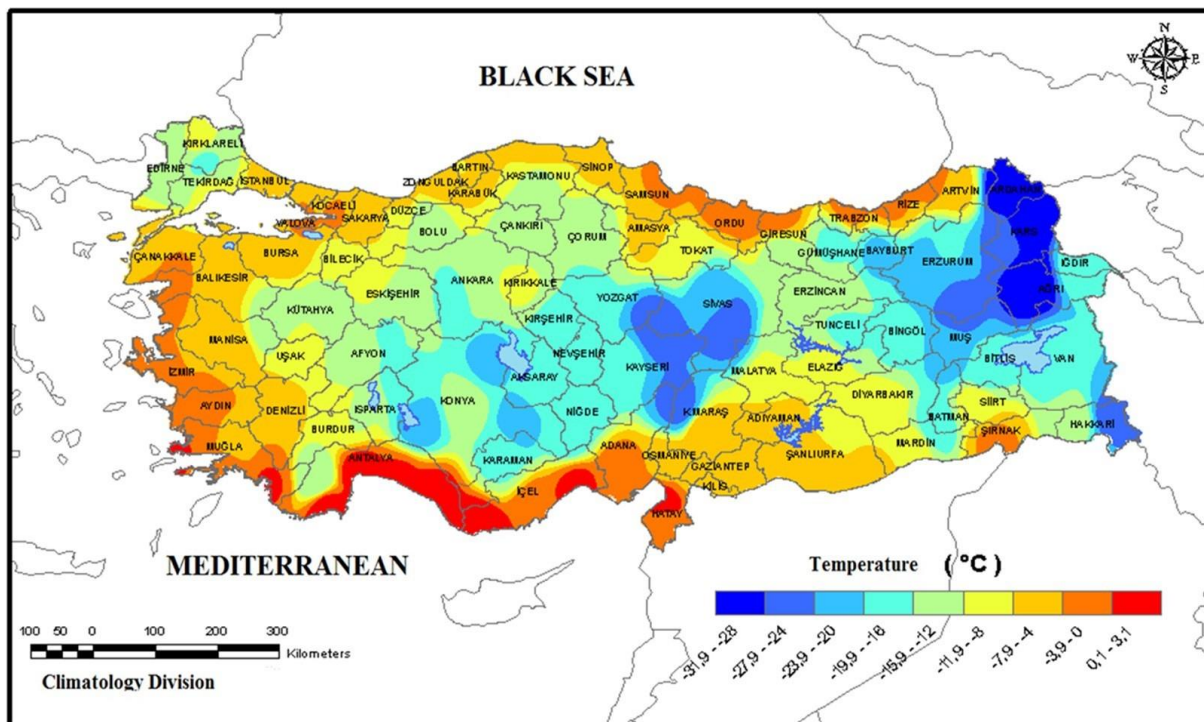


Figure 2. 10 Spatial distribution of minimum temperatures in Turkey in 2017 (URL 1)

Table 1. New yearly extreme maximum temperature records in 2017.

Stations	Long Term Maximum Temperature (°C)	2017 Maximum	Anomaly
ÇANAKKALE	39.0	39.1	0.1
FLORYA	38.6	39.5	0.9
AKHİSAR	44.7	45.2	0.5
AYDIN	44.6	44.8	0.2
BODRUM	45.0	46.8	1.8
EDREMİT	42.8	43.3	0.5
ALANYA	41.9	43.7	1.8
ANTAKYA	43.9	44.6	0.7
ANTALYA	45.0	45.4	0.4
BURDUR	41.0	41.0	0.0
MANAVGAT	43.8	44.9	1.1
OSMANİYE	43.2	43.6	0.4
BAYBURT	37.1	37.2	0.1
GÜMÜŞHANE	41.0	41.1	0.1
BURDUR	41.0	41.0	0.0

Table 2. New monthly extreme maximum temperature records in 2017.

Date	Station	Long Term Maximum Temperature (°C)	2016 Maximum Temperature (°C)
13.05.2017	BURDUR	34,1	34,5
13.05.2017	ELMALI	32,0	32,8
30.06.2017	KIRKLARELI	39,8	40,4
30.06.2017	UZUNKÖPRÜ	40,2	40,6
30.06.2017	AKHISAR	43,9	44,7
30.06.2017	BODRUM	42,8	44,7
30.06.2017	MARMARIS	42,2	42,4
30.06.2017	BURDUR	38,1	38,7
30.06.2017	FETHIYE	42,7	43,4
30.06.2017	FINIKE	42,5	43,3
30.06.2017	MANAVGAT	43,8	44,9
27.06.2017	BAYBURT	32,4	32,5
27.06.2017	ERZINCAN	35,6	35,8
27.06.2017	HAKKÂRİ	33,7	34,4
28.06.2017	KARS	31,4	31,6
27.06.2017	TORTUM	33,0	34,0
02.07.2017	AKHISAR	44,7	45,2
02.07.2017	AYDIN	44,6	44,8
01.07.2017	AYVALIK	40,4	41,3
02.07.2017	BODRUM	44,2	46,8
01.07.2017	EDREMIT	42,8	43,3
02.07.2017	ADANA	44,0	44,4
01.07.2017	ALANYA	40,8	43,7
02.07.2017	ANTAKYA	43,4	44,6
01.07.2017	ANTALYA	45,0	45,4
02.07.2017	BURDUR	40,7	41,0
02.07.2017	ELMALI	39,2	39,4

Table 2. New monthly extreme maximum temperature records in 2017 (Cont.).

Date	Station	Long Term Maximum Temperature (°C)	2016 Maximum Temperature (°C)
01.07.2017	İSKENDERUN	40,0	40,1
02.07.2017	MANAVGAT	43,7	44,5
01.07.2017	MERSİN	37,3	38,1
02.07.2017	SILIFKE	42,2	42,3
06.08.2017	ÇANAKKALE	38,7	39,1
08.08.2017	OSMANIYE	43,2	43,6
09.08.2017	ULUKIŞLA	36,1	36,2
11.08.2017	BAYBURT	37,1	37,2
02.08.2017	GÜMÜŞHANE	40,0	41,1
09.08.2017	MALATYA	41,5	41,9
09.08.2017	ADİYAMAN	44,2	44,5
17.09.2017	ADİYAMAN	40,3	42,2
17.09.2017	AFYONKARAHİSAR	35,6	36,1
17.09.2017	AKSARAY	36,7	37,3
04.09.2017	AKŞEHİR	35,0	35,9
18.09.2017	ANKARA	36,0	37,7
06.09.2017	ARDAHAN	30,6	31,3
12.09.2017	BARTIN	37,8	40,5
17.09.2017	BURDUR	38,1	39,0
20.09.2017	BURSA	40,1	40,3
17.09.2017	CİHANBEYLİ	37,5	37,7
16.09.2017	ÇANKIRI	37,8	37,9
12.09.2017	DÜZCE	38,3	38,7
20.09.2017	FLORYA	36,6	39,5
06.09.2017	İĞDIR	38,1	38,4
17.09.2017	ISPARTA	35,6	37,1
12.09.2017	İNEBOLU	31,8	34,0
17.09.2017	İSLAHİYE	40,4	40,5
16.09.2017	K.MARAŞ	41,3	42,5
17.09.2017	KANGAL	33,4	34,3
18.09.2017	KIRIKKALE	37,0	38,2
16.09.2017	KIRŞEHİR	36,2	37,8
20.09.2017	KOCAELİ	38,7	40,2
17.09.2017	KÜTAHYA	34,6	35,9
17.09.2017	MARDİN	38,8	39,3
16.09.2017	NEVŞEHİR	35,2	35,7
16.09.2017	NİĞDE	34,6	35,1
17.09.2017	POLATLI	37,3	37,7
20.09.2017	SAKARYA	38,6	40,7
17.09.2017	SİVRİHİSAR	35,0	35,2
16.09.2017	ŞANLIURFA	42,0	42,1
17.09.2017	UŞAK	35,7	36,5
17.09.2017	YOZGAT	33,9	34,6
12.09.2017	ZONGULDAK	34,0	36,2

2.4 Heat and cold waves indices in 2017

Heat wave is defined as daily maximum temperature on more than five consecutive days exceeding the average maximum temperature by 5°C. Similarly, cold wave is daily minimum

temperature on more than five consecutive days below the average minimum temperature by 5°C (Frich et al., 2002).

Heat and cold waves indices calculated from 224 stations based on 1981-2010 reference period for 2017. 143 stations were identified with heat wave occurrences while 10 stations were in common for the both heat wave and cold wave occurrences (Figure 2.11). Cold waves alone were detected in 3 stations. There were no heat wave occurrences in January and May of 2017.

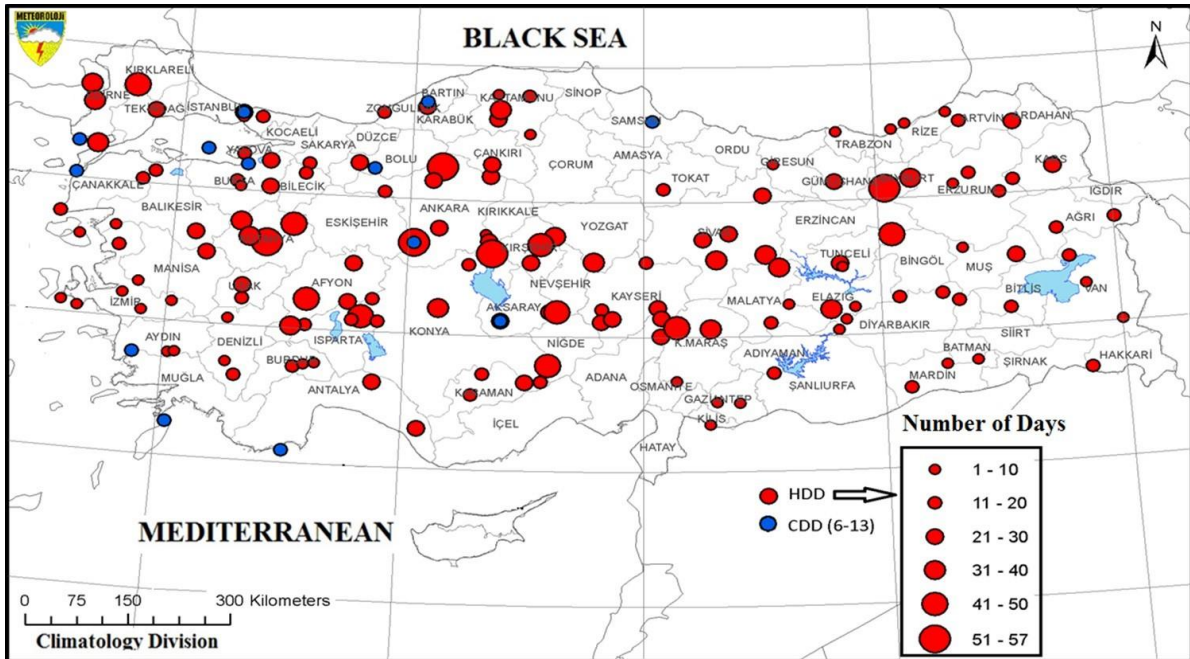


Figure 2. 11 Spatial distribution of heat wave occurred locations in 2017 (based on 1981-2010 normal)

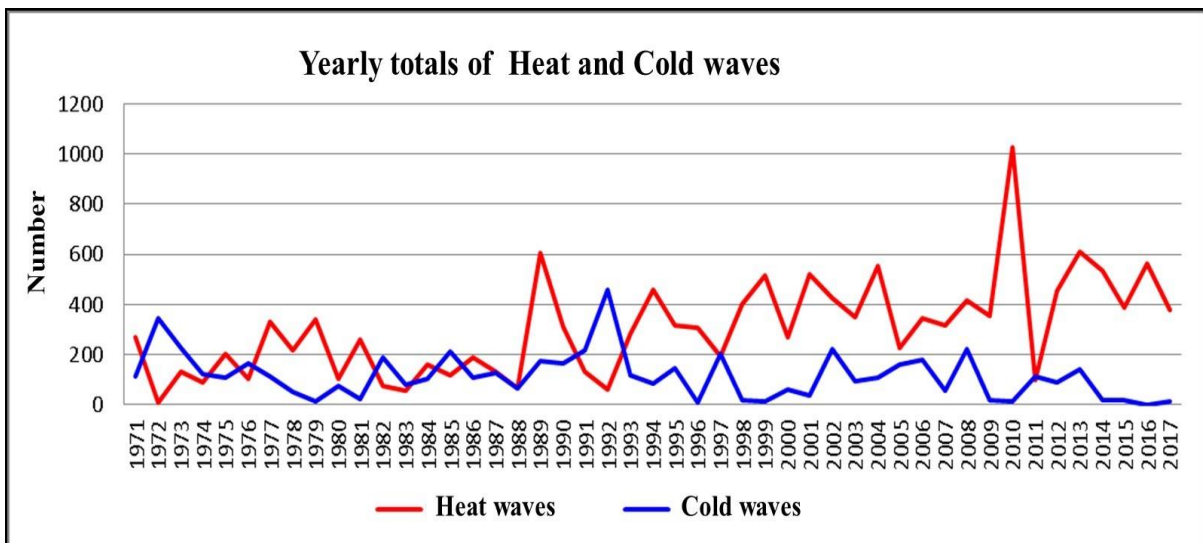


Figure 2. 12 Annual Number of Heat & Cold Waves in Turkey

Historically, highest number of heat waves was observed was 1027, which occurred in 2010. Highest number of cold wave incidents was reported in 1992 which was the coldest year in Turkey after Pinatubo Volcano eruption (Figure 2.12).

3. Precipitation

Turkey annual mean areal precipitation in 2017 was 506.6 mm. This value is 11.7% below from 1981-2010's normal (574 mm) (Fig.3.1).

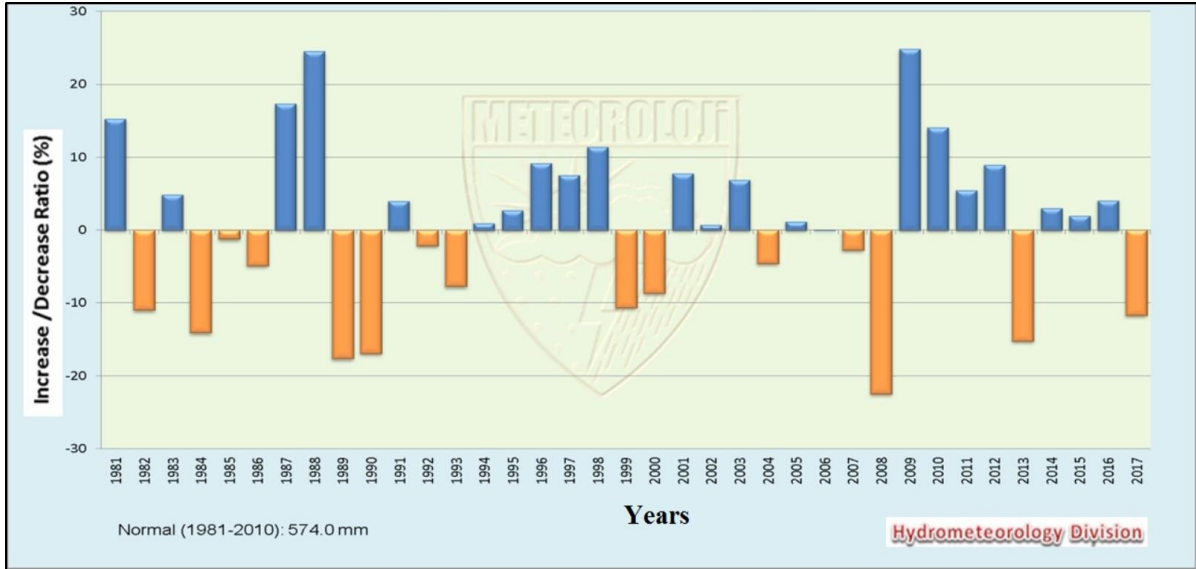


Figure 3. 1 Annual areal precipitation anomaly in Turkey in 2017 (URL 2)



Figure 3. 2 Spatial distribution of mean precipitation anomalies in Turkey in 2017 (URL 2)

Generally 2017 precipitation anomalies were below the 1981-2010's normal, except northern part of Turkey which was 4.1% above its normal. The lack of precipitation caused drought especially in central and eastern parts of Anatolia during 2017 (Figure 3.2).

3.1 Monthly precipitation

Monthly precipitation in 2017 were below from the 1981-2010's normal in February, July, September, November and December and near the normal in March and April and above from the normal in January, May, June, August and October (Figure 3.3).

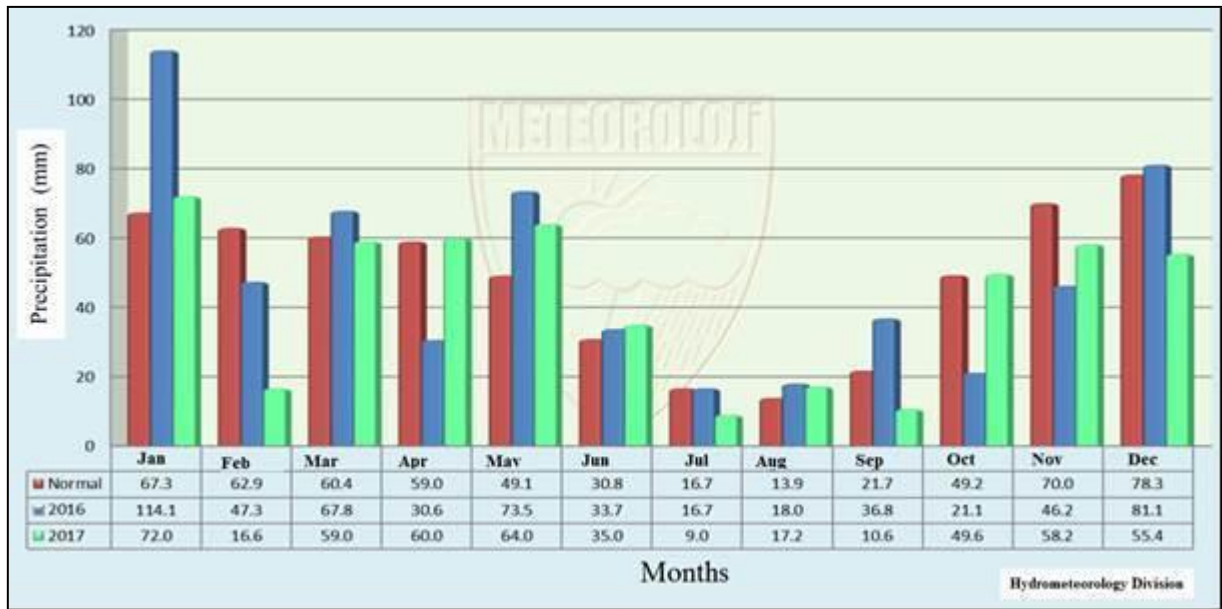


Figure 3. 3 Monthly areal rainfall in Turkey in 2017 (URL 2)

3.2 Seasonal precipitation

All seasonal precipitation were below normal except spring. The spring precipitation was 8.8% above from the 1981-2010's normal (Figure 3.4).

- Average areal precipitation for winter season was 167.7 mm, 19.5% below normal (208.4 mm)
- Average areal precipitation for spring season was 184 mm, 8.8% above normal (169.1 mm)
- Average areal precipitation for summer season was 61.1 mm, 1% below normal (61.5 mm)
- Average areal precipitation for autumn season was 119.4 mm, 16.4% below normal (142.8 mm)

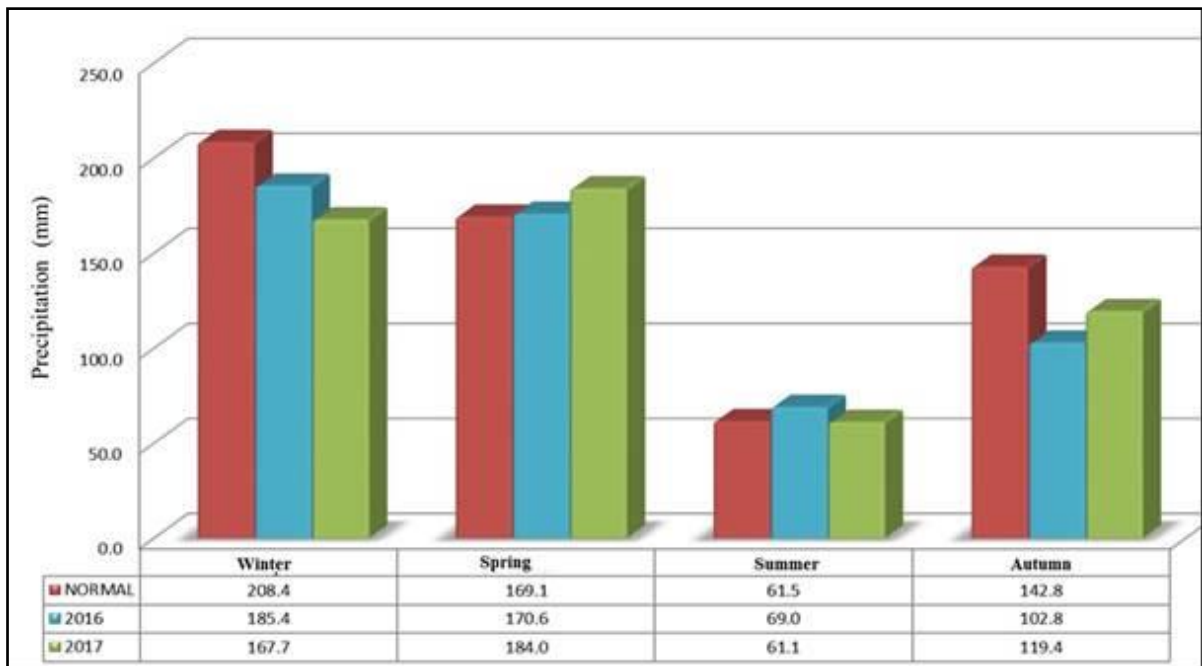


Figure 3. 4 Seasonal areal rainfall differences in Turkey in 2017 (URL 2)

4. Extreme Meteorological Events

The number of extreme events in 2017 reached 598 (Fig. 4.1). There is an increasing trend in extreme event occurrences especially during the last two decades (4.0 events/year).

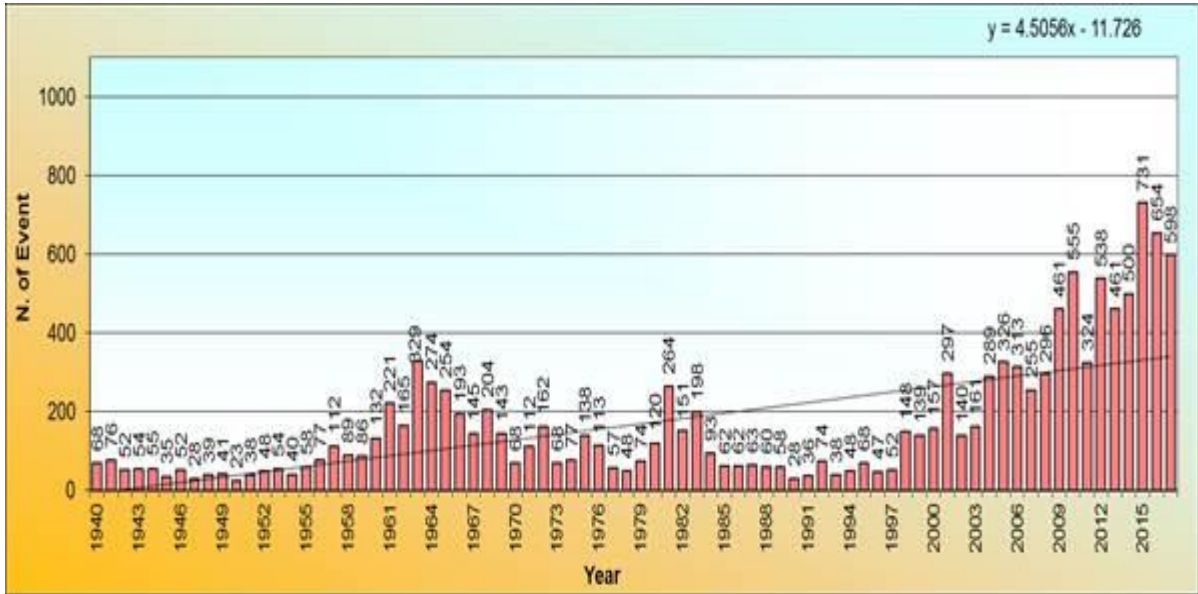


Figure 4. 1 Annual number of extreme events in Turkey in 2017 (URL 3)

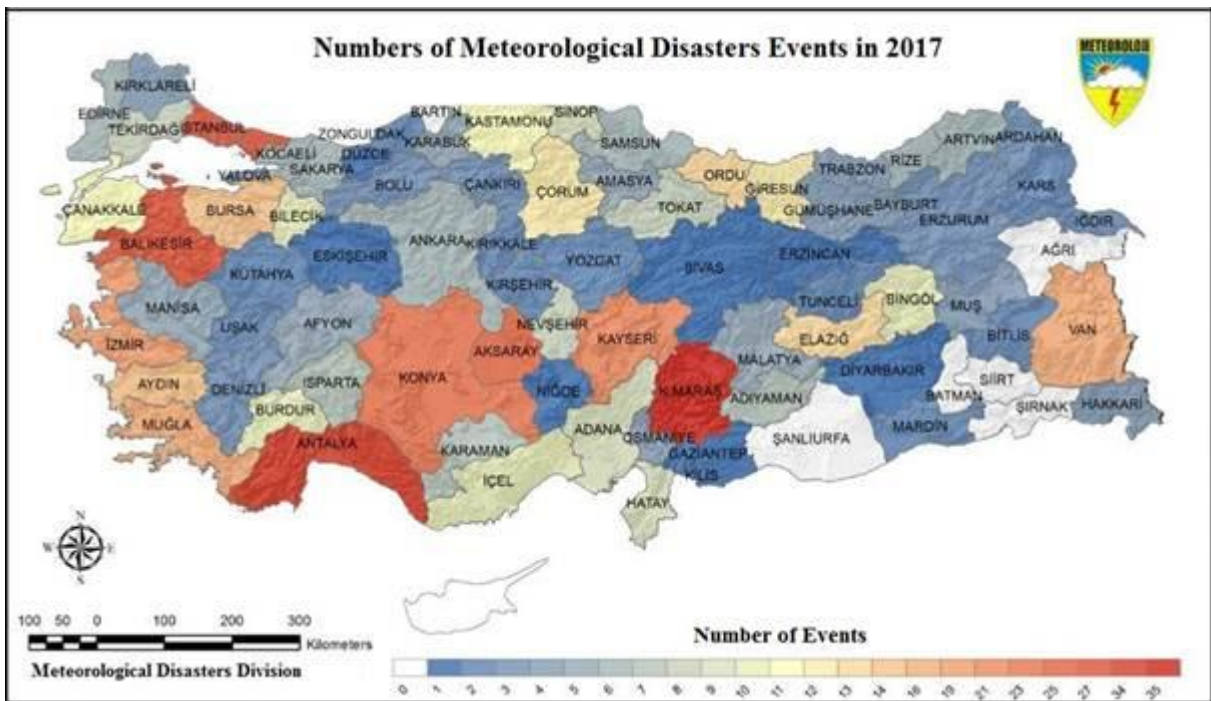


Figure 4. 2 Spatial distribution of number of extreme events in Turkey in 2017 (URL 3)

Most hazardous extreme events recorded in 2017 were wind storm and tornadoes (36%) and heavy rain/floods (31%). The others were hail (16%), heavy snow (7%), lightning (~ 4%), avalanche and frost (~ 1.5%) and heat waves, drought, forest fire and fog (<1%) (Figure 4.3).

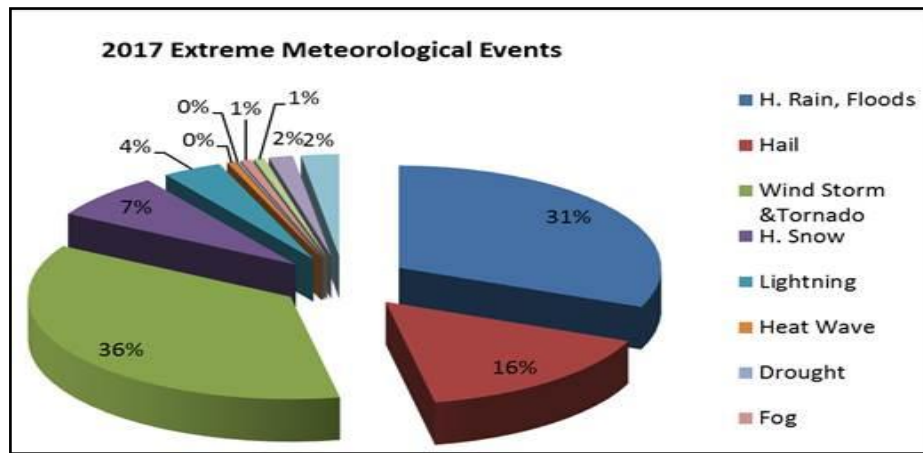


Figure 4. 3 Distribution of extreme events types in Turkey in 2017 (URL 3)

4.1 Heavy rain/floods

In 2017, daily maximum rainfall exceeding 100mm was observed in Rize, Artvin, Ordu, Kocaeli, Istanbul, Mugla, Antalya, Mersin and Osmaniye (Figure 2.17; 2.18). In some coastal stations at northern Black Sea and Mediterranean regions, the daily maximum rainfalls approached 200 mm.

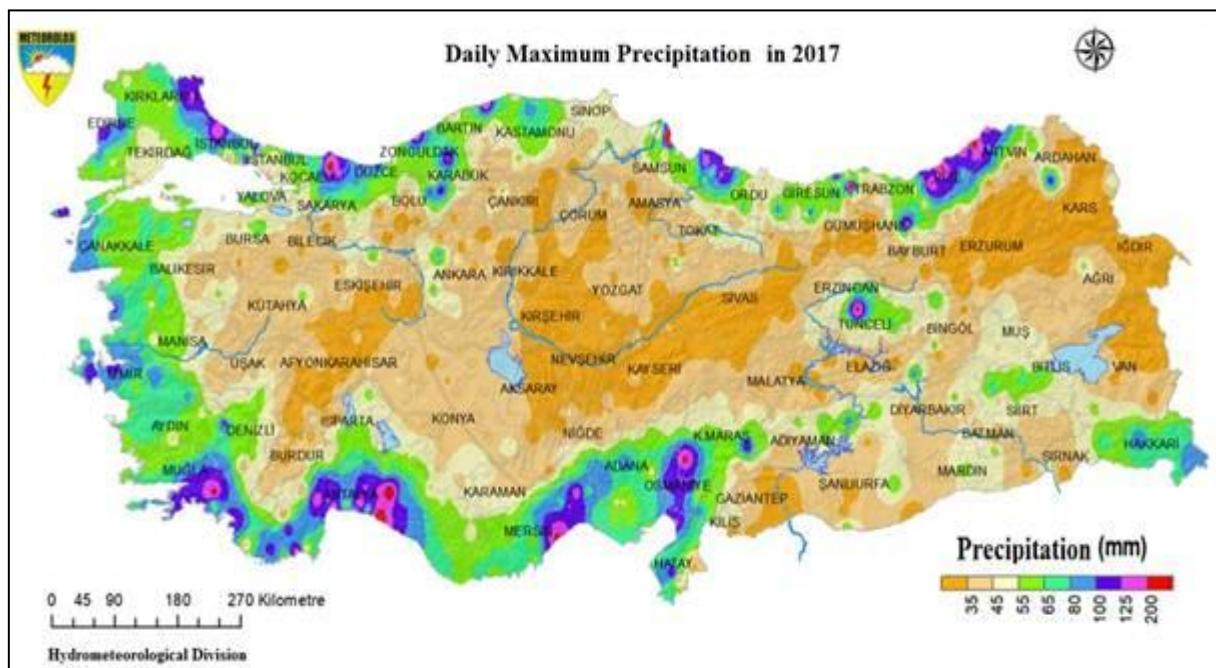


Figure 4. 4 Spatial distribution of daily maximum precipitation in 2017

References

1. Frich, A.; L.V. Alexander, P. Della-Marta, B. Gleason, M. Haylock, A.M.G. Klein Tank, and T. Peterson (Ocak 2002). "Observed coherent changes in climatic extremes during the second half of the twentieth century" (PDF). *Climate Research* 19: 193–212. doi:10.3354/cr019193
2. NOAA National Centers for Environmental Information, State of the Climate: Global Climate Report for Annual 2017, published online January 2018, retrieved on January 19, 2018 from
3. URL 1, Turkish State Meteorological Service, temperature analysis <http://www.mgm.gov.tr/veridegerlendirme/sicaklik-analizi.aspx>, 22 Ocak 2018
4. URL 2, Turkish State Meteorological Service, precipitation analysis
5. <http://www.mgm.gov.tr/veridegerlendirme/yagis-raporu.aspx>, 22 Ocak 2018
6. URL 3, Turkish State Meteorological Service, Kardelen, meteorological extreme event database <http://kardelen.mgm.gov.tr/Bultenler/Klima/FevkHsrGor.aspx?ist=17095&fvkNo=adbe577b-3170-46ff-992c-203f294da206>, 22 Ocak 2018