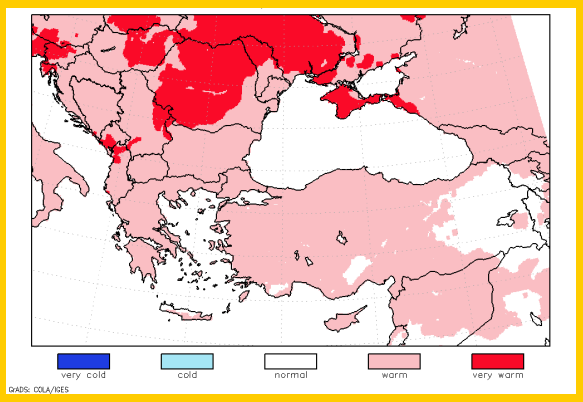
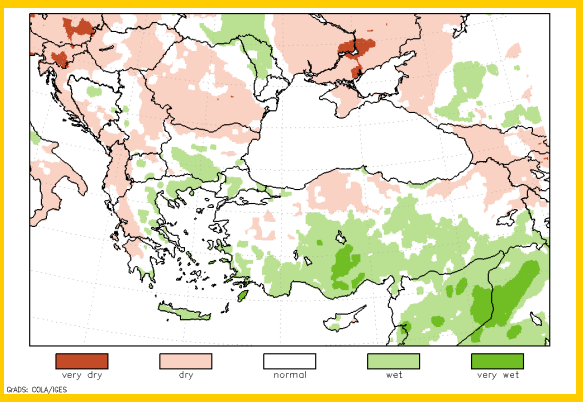
DROUGHT MONITORING BULLETIN

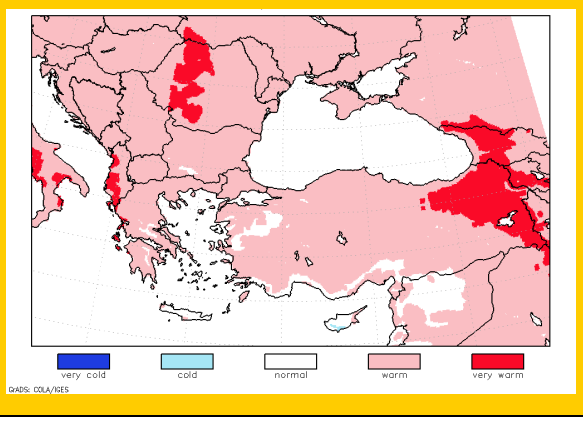
Overview from February to September 2017

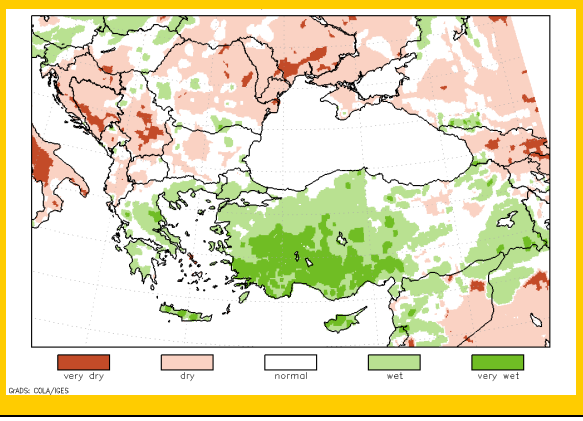
HOT SPOT





Main characteristic of 2017 season was two sets of drought that hit all countries in the region. Figures present anomalies of mean monthly **air temperature and surface water balance in percentile classes** for **March 2017** (above) and **August 2017** (below). Dry winter months along with above-average air temperatures resulted in spring drought across the region. It greatly reduced good sowing conditions and set ground for following summer drought. In spite some cold and wet period in late spring, drought intensified in early summer through several heat waves and scarce precipitation level. It reached its peak early in August: several towns in the region reported of new highest temperature records and in the Alpine region of Slovenia first ever tropical night in mountains above 1500 m was recorded. As drought continued over summer months, it developed into hydrological drought over most countries in the region and left different sectors heavily affected, from agriculture and water bodies to energy production and river transport.





AIR TEMPERATURES AND SURFACE WATER BALANCE

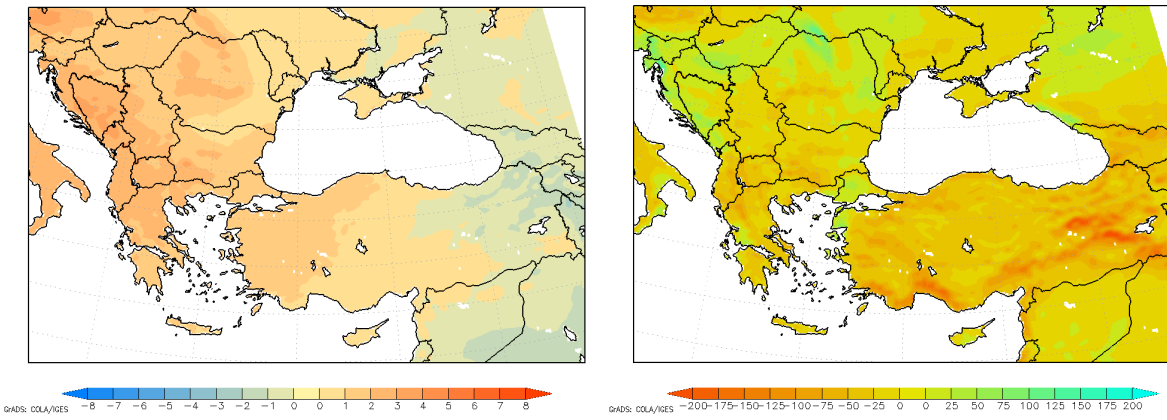
*Figures in this section present anomalies of monthly **air temperature** and accumulated **surface water balance** from the average from **February to September 2017**.*

Year 2017 began with extremely cold air temperatures across the entire region as air temperatures in first 10 days of **January** were up to 3 °C below the long–term average over eastern half of Turkey and between 6 °C and 8 °C below the average over most of Balkan Peninsula. It remained colder than usual in the region throughout the month with values of mean monthly air temperatures classifying in coldest 5% of the record over most of Balkan Peninsula. While Bulgaria, FYR Macedonia, Greece and western parts of Turkey experienced wet month with values of water balance mostly over 100 mm, it was dry across the rest of the region with water balance deficit of up to 75 mm.

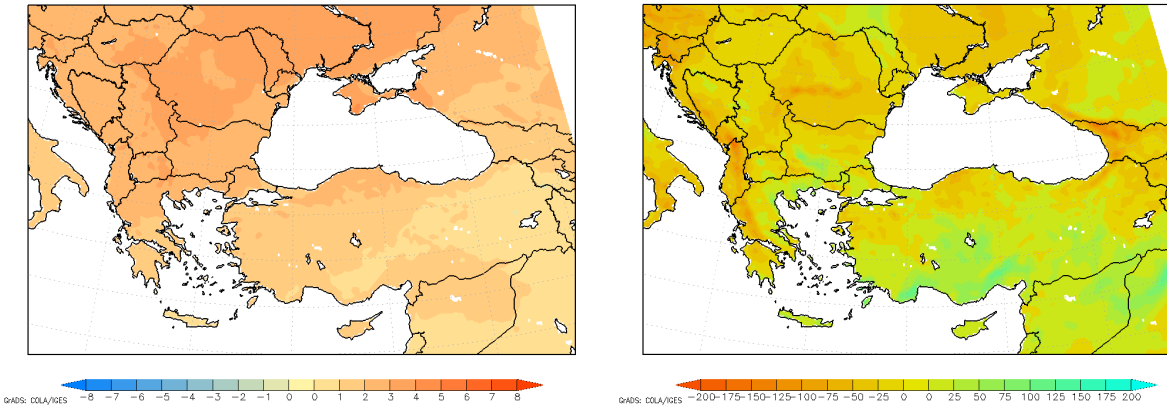
AVERAGE AIR TEMPERATURE ANOMALY [°C]

SURFACE WATER BALANCE ANOMALY [mm]

FEBRUARY 2017



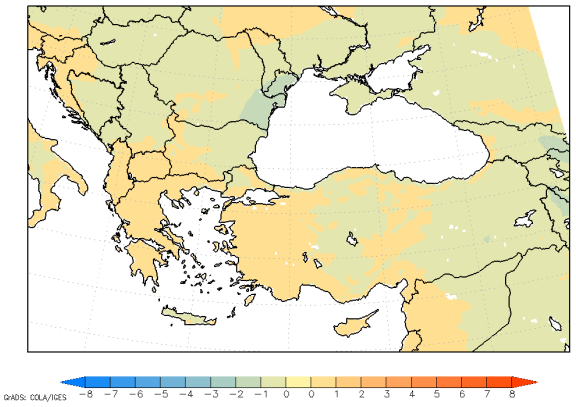
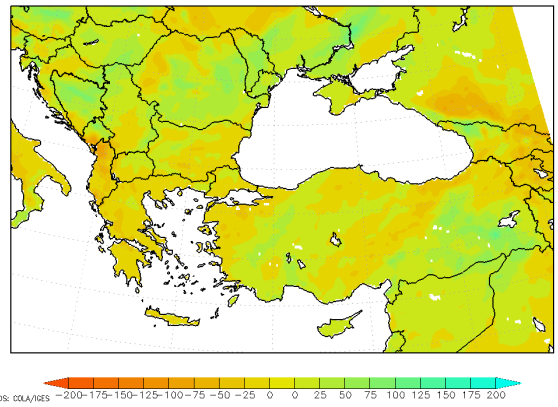
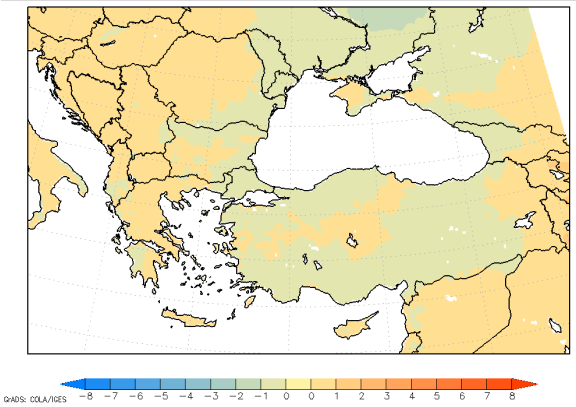
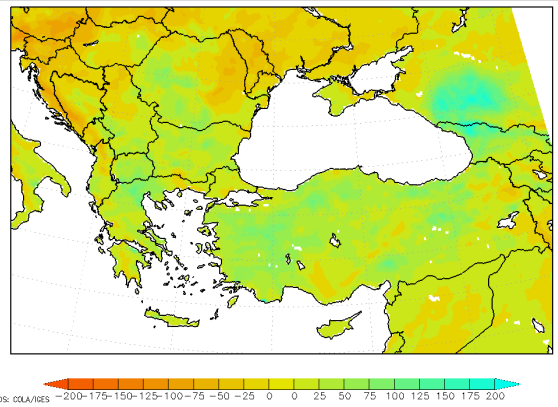
MARCH 2017



After cold January came warm and dry February and March, bringing spring drought to the region. Above–average air temperatures of **February** that were first present in areas along the Adriatic and Aegean seas, stretched over the entire Balkan Peninsula by the end of the month. Mean monthly values ranged from 1–2 °C above the average in its eastern half to 3–4 °C above the average in its western areas. Along with warm air temperatures, areas of central and southern Balkan Peninsula experienced dry conditions with values of accumulated water balance of up to –75 mm. In Turkey, air temperatures were lower than usual in first half of February but rose

to warmest 5% of the record in its western part by the end of the month. Due to lack of rain over entire country, values of water balance ranged from –50 mm in central Turkey to between –125 mm and –175 mm in mountain areas, bringing extreme drought to the country.

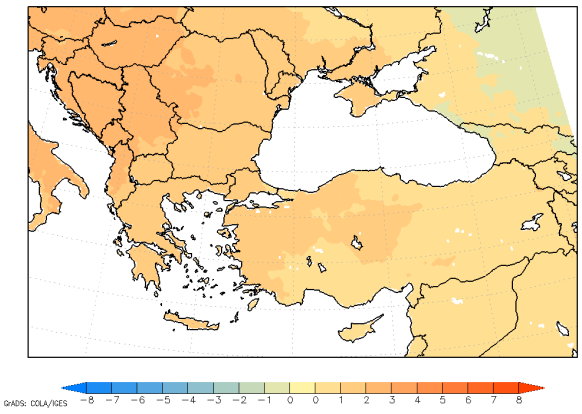
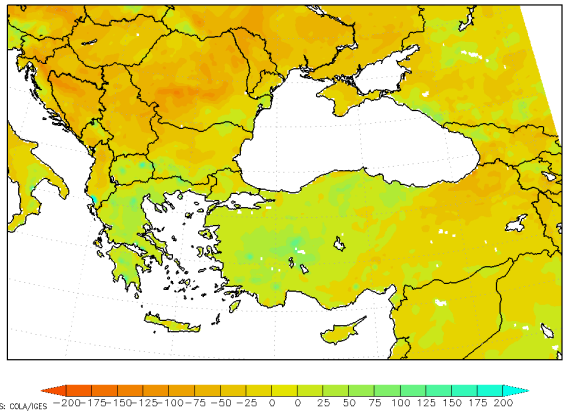
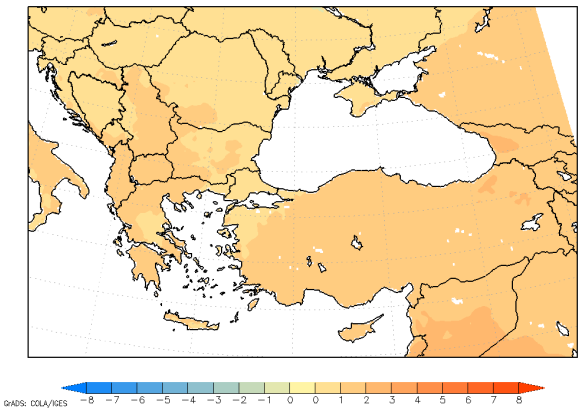
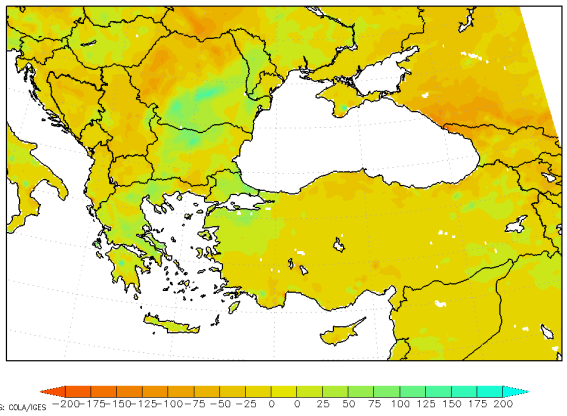
Warm February conditions across the region only intensified in **March** as air temperatures were 1–2 °C higher than usual in southern Greece in Turkey and 3–4 °C above the average over the rest of the region. While favourable precipitation level over central and southern Turkey ended drought conditions in that part of the country, dry conditions intensified throughout March over Balkan Peninsula. Monthly water balance deficit reached values of even up to 100 mm along the Adriatic Sea and the Carpathians and, combined with very warm air temperatures, brought spring drought to Balkan Peninsula.

AVERAGE AIR TEMPERATURE ANOMALY [°C]	SURFACE WATER BALANCE ANOMALY [mm]
APRIL 2017	
	
MAY 2017	
	

April brought cooler conditions to the region. Air temperatures over northern Balkan Peninsula remained 3–4 °C higher than usual in its first 10 days and kept stimulating early vegetation growth. Sudden drop of air temperature helped end spring drought by mid-April in that part of the region but developed into frost by the end of the month when air temperatures were up to 3 °C, locally even up to 4 °C below the long-term average. On the other hand, change of air temperatures was not as sudden in southern half of the region where anomalies from the average varied between –2 °C and 1 °C throughout the month. April's favourable rainfall rate helped overcome dry conditions: in northern half of Balkan Peninsula and southeastern Turkey water surplus reached values as high as 100 mm while Albania, Greece and most of Turkey remained

dry although monthly-accumulated water deficit was lower than in March, up to –25 mm.

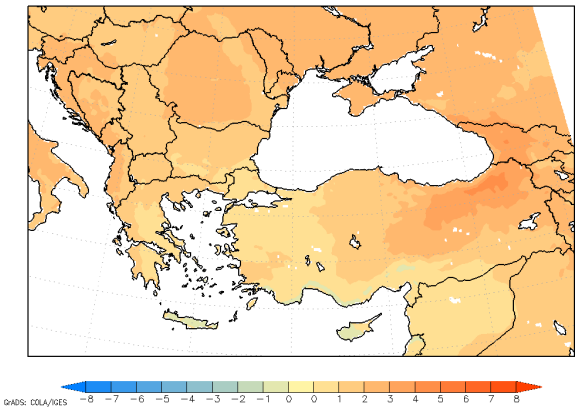
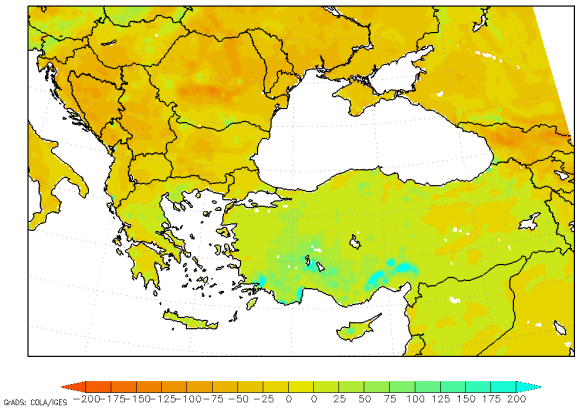
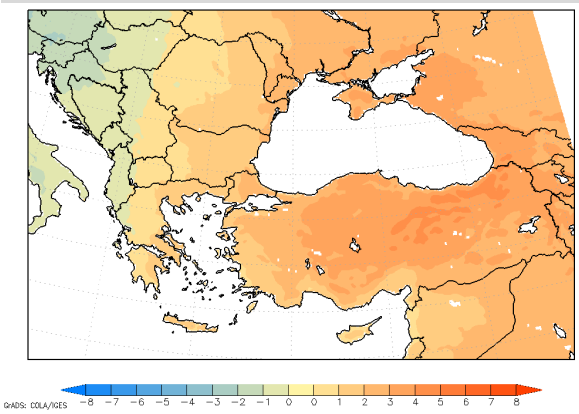
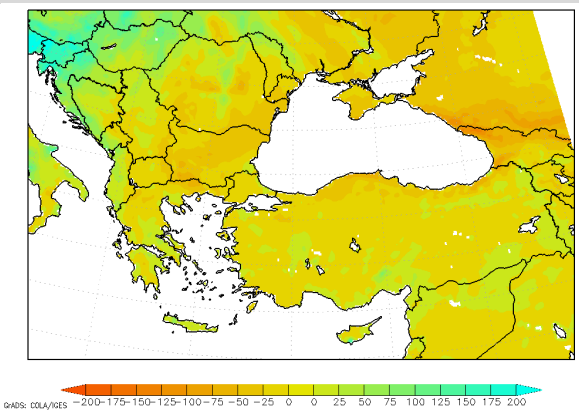
Another set of changes in air temperatures and water balance came in **May**. Air temperatures gradually increased in Slovenia, Croatia and western Hungary throughout May, going from cold spell with anomalies from –2 °C to –3°C in first week of May, to air temperatures up to 2 °C above the long-term average by the end of the month. At the same time, those countries experienced dry conditions again with monthly surface water balance deficit of up to 75 mm which, along with increasing air temperatures, indicated beginning of summer drought in that part of the region. The opposite effect occurred in countries along the Black and Aegean seas: air temperature continuously decreased throughout May with anomalies going from 1–2 °C to –3 °C over eastern Romania, Bulgaria, FYR Macedonia and Greece, and from 2–3 °C to between –3 °C and –4 °C in Turkey by the end of May. At the same time, May was fairly wet in those countries, resulting in surface–layer water surplus between 50–100 mm.

AVERAGE AIR TEMPERATURE ANOMALY [°C]	SURFACE WATER BALANCE ANOMALY [mm]
JUNE 2017	
	
JULY 2017	
	

First summer wave of hot weather hit the region in early **June** already: entire Balkan Peninsula experienced air temperatures 2–3 °C higher than usual, locally daily temperatures exceeded 30 °C even in northern part of the region. In Turkey and Greece, cold end of May was followed by sudden increase of air temperatures when air temperatures exceeded the average for 1–3 °C in first days of June. Chill of around-average air temperatures that came in mid-June was only short lasting as extreme heat spread across Balkan Peninsula at the end of the month. Last 10 days of June saw air temperature rise high above the long–term average with anomalies between

4–5 °C across all countries northern of Greece, classifying air temperatures among hottest 5% of the record for that time of year. In central part of Balkan Peninsula, maximum air temperatures of even up to 37 °C were recorded. Accompanied high evapotranspiration together with lack of precipitation intensified drought conditions in countries northern of FYR Macedonia: most of the area experienced monthly water deficit of 50–100 mm while it stretched even up to 125 mm over Moldova, Bosnia and Herzegovina and the Carpathians. Meanwhile, FYR Macedonia, Greece and western half of Turkey remained wetter than usually with surplus of monthly water balance between 25–50 mm.

Alternation of heat waves and intense thunderstorms across the region was main characteristic of **July**. Periods of extremely hot weather were interrupted by intense thunderstorms, bringing hail and floods that caused lots of damage to vegetation and infrastructure. They temporary cooled the extreme heat but hot weather continued through number of heat waves. In its first days, air temperatures were 2–3 °C, locally even up to 4 °C above the average across the region and maximum air temperature in areas along Aegean Sea exceeded 40 °C. While in Turkey, air temperatures remained 2–3 °C higher than usual until the end of the month, they varied around normal values in mid-July in countries of Balkan Peninsula but began to rise above the long-term average in last days of the month. Although difference between monthly precipitation level and evapotranspiration shows slight improvement of water balance across the region, vegetation remained under drought stress as high rainfall rate through thunderstorms was spread unevenly throughout July and mostly resulted in surface runoff.

AVERAGE AIR TEMPERATURE ANOMALY [°C]	SURFACE WATER BALANCE ANOMALY [mm]
AUGUST 2017	
	
SEPTEMBER 2017	
	

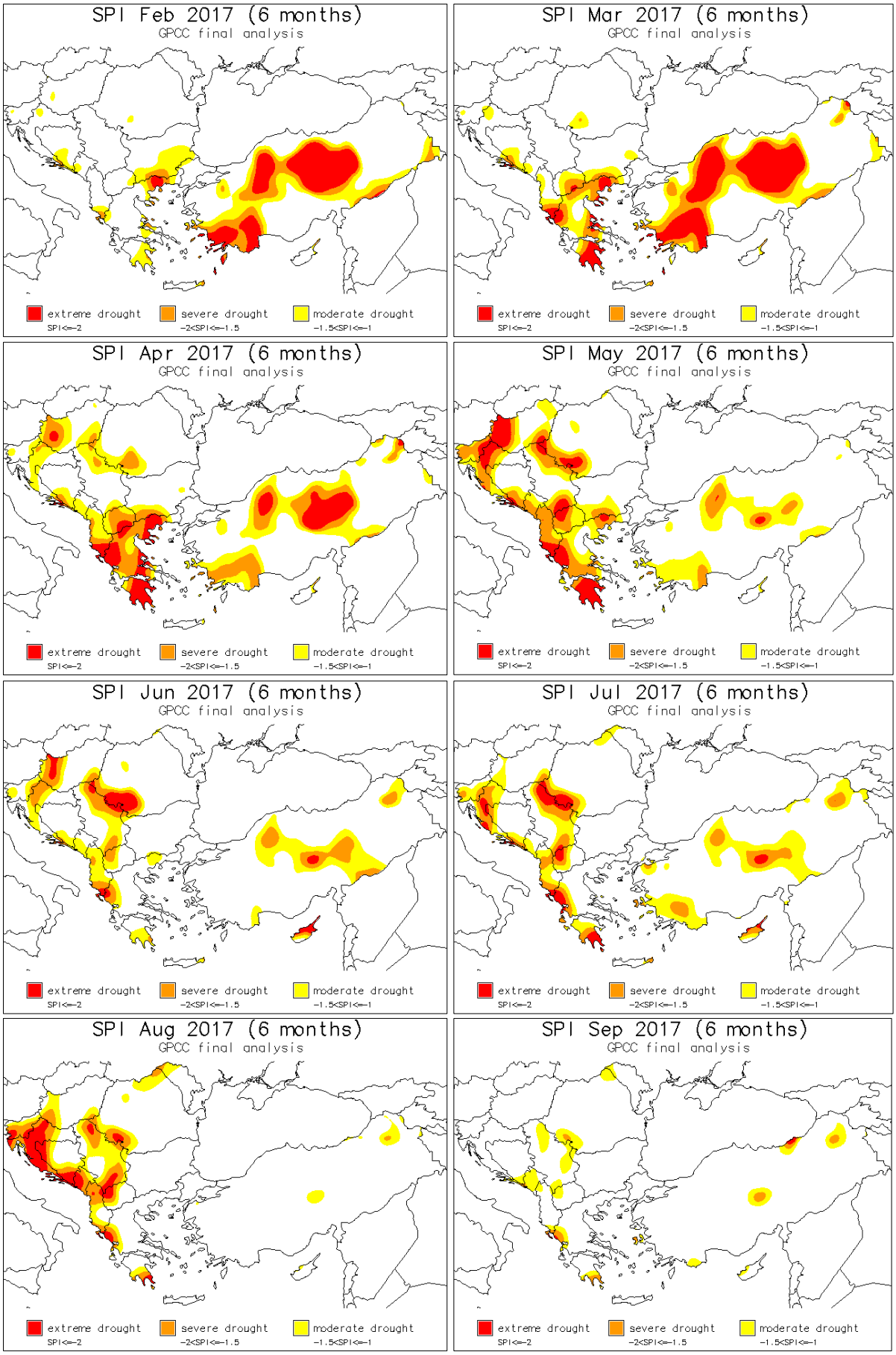
Unusually warm weather that started building up in second half of July across Balkan Peninsula intensified into another heat wave that reached its peak in first days of **August**. Northeastern Turkey and all countries northern of Greece experienced extreme air temperatures. They exceeded the long-term average for 4–6 °C and brought daily maximums of 38–43 °C. Accompanied rainless period and very high evapotranspiration worsened drought situation, leaving majority of Balkan Peninsula in water balance deficit of up to –75 mm, in Bosnia and Herzegovina and over the Carpathians of even up to –125 mm on monthly total. Water balance in Greece did not change much from July and remained in normal to wet conditions throughout August. On the other hand, western half of Turkey experienced wet month as high precipitation level resulted in monthly water balance surplus of 50–75 mm, locally even up to 175 mm. With exception of northeastern Turkey where air temperatures remained 3–4 °C above the average, extreme heat gradually declined throughout the month, bringing normal air temperatures again.

They remained near-normal across the entire region in first days of **September** as well with anomalies deviating between –1 °C and 2 °C from long-term average. Mid-September saw sudden changes in air temperatures across the region: while its northwestern part experienced unusually cold air temperatures, they were unusually warm in its eastern half and Turkey. That time, anomalies from normal state ranged from 2 °C below the average over Slovenia which experienced air temperatures as cold as 10–12 °C, and gradually increased in south-west direction as they stretched even up to 6–8 ° above the average across central Turkey, bringing air temperatures as high as 35–38 °C again. Over the last days of September, air temperatures decline across the entire region. Cold spell first present only over Slovenia in mid-September spread across entire western half of Balkan Peninsula by the end of the month with air temperature anomalies ranging between 1–3 °C below the average. Meanwhile, Moldova and Turkey remained warmer than usually although anomalies were lower compared to mid-September conditions, stretching from 2–5 °C above the long-term average. High precipitation level and low air temperatures resulted in very wet conditions over Slovenia, Croatia and Hungary where water balance surplus ranged from 75–150 mm, in Alpine area even up to 200 mm. On the other hand, September was very dry across eastern Romania and eastern half of Turkey, classifying rainfall rate within lowest 5% of the record for that time of year and resulting in water balance deficit of up to –75 mm.

STANDARDIZED PRECIPITATION INDEX

Drought situation with regard to precipitation accumulation is presented by Standardized Precipitation Index (SPI). The SPI calculation is based on distribution of precipitation over long–time period (30 years, in our case long–term average 1961–1990 was used). SPI can be calculated at various time scales which reflect impact of drought on availability of water resources. The long–term precipitation record is fit to probability distribution which is then normalised so that the mean (average) SPI for any place and time period is zero. SPI values above zero indicate wetter periods while values below zero indicate drier periods. Only the dry part of the extreme anomalies is presented on the maps.

Maps of SPI for one and three months, which can be used for estimation of meteorological and agricultural drought respectively, have already been published in monthly bulletins during vegetation season 2017. Maps below present SPI for 6 months which can tell us more about hydrological conditions throughout the year.


SPI Feb 2017 (6 months)
GPCC final analysis
SPI Mar 2017 (6 months)
GPCC final analysis
SPI Apr 2017 (6 months)
GPCC final analysis
SPI May 2017 (6 months)
GPCC final analysis
SPI Jun 2017 (6 months)
GPCC final analysis
SPI Jul 2017 (6 months)
GPCC final analysis
SPI Aug 2017 (6 months)
GPCC final analysis
SPI Sep 2017 (6 months)
GPCC final analysis
extreme drought
SPI<=-2
severe drought
-2<SPI<=-1.5
moderate drought
-1.5<SPI<=-1

The sequence of spring and summer droughts striking in the region left year 2017 very dry across most of southeastern Europe. Winter months were extremely dry over central and southwestern Turkey while at the same time, SPI6 for February already indicates first signals of spring drought also across Balkan Peninsula. Moderate to extreme drought conditions in March that first developed over southern Greece and Bulgaria as well as scattered areas along Adriatic Sea, spread across Greece, Albania, FYR Macedonia in spring months and intensified over southeastern Pannonian Plain, Slovenia, northern Croatia and western Hungary. SPI6 for May shows spring drought conditions decreased over most of Turkey but developed further over Balkan Peninsula, especially over its central parts and in areas of a belt stretching from western Hungary along the Adriatic to southern Greece. According to SPI6 for June and July, dry conditions eased in late spring, however, areas mentioned above remained moderately to severely dry. As summer came to the region, precipitation level was favourable in Turkey and eastern half of Greece but it worsened drought conditions over central and western Balkan Peninsula, bringing severe to extreme drought to Slovenia, Croatia, western Bosnia and Herzegovina, Montenegro, Albania and parts of Serbia. Elsewhere in western, central and southern Balkan Peninsula as well as over northern Romania and Moldova, moderate drought was detected. Improved precipitation level saw intense summer drought come to an end in September across most of the region.

IMPACT REPORTS

HUNGARY

Hungary experienced warm end of winter period which resulted in early start of vegetation growth but overly wet areas experienced delay[1]. By the end of June, Hungarian Meteorological Service reported of drought affecting more and more land in rural areas of the country. It began to leave negative impacts on maize and sunflower and became increasing concern also for fodder[2,3].

In mid-July, Hungarian Meteorological Service reported that heat wave fattened the areas already experiencing drought conditions. Especially its northern and northwestern part and the Great Plain were left severely to heavily affected by drought[4]. Experiencing one of the hottest summers since 1975, yields of maize, sunflower, potato and sugar beet in Hungary were all below-average. At the end of vegetation season, moderate and severe drought was present over southeastern and southwestern part of Hungary[5,6].

SLOVENIA

Slovenian Environmental Agency reported of dry, warm and often windy conditions at the beginning of spring that persisted for several weeks and accelerated drying of surface soil layer. Also decreased groundwater level was reported in spring due to scarcity of snow over winter months[7]. In late March, Administration of RS for Civil Protection and Disaster Relief

[1] https://ec.europa.eu/jrc/sites/jrcsh/files/jrc-mars-bulletin-vol25-no3.pdf
[2] http://www.met.hu/idojaras/agrometeorologia/elemzes/index.php?id=1911
[3] http://www.met.hu/idojaras/agrometeorologia/elemzes/index.php?id=1915
[4] http://www.met.hu/idojaras/agrometeorologia/elemzes/index.php?id=1939&hir=Meleg,_valtozekony_hetvege
[5] https://ec.europa.eu/jrc/sites/jrcsh/files/jrc-mars-bulletin-vol25-no9.pdf
[6] OMSZ, DriDanube project partners
[7] https://www.rtvslo.si/okolje/novice/padavine-preskromne-susa-se-nadaljuje/419161

issued high fire risk alert for southwestern Slovenia[8]. Agricultural drought in Slovenia worsened over June and July. Most affected were regions of northeastern and southern half of Slovenia where maize completely stopped in growth and dry stream discharge was recorded on several rivers across the country. Lost or heavily reduced were yields of maize crops, severely affected were also fruit, olive trees and vine as yield was reduced by 30-50%. Hay production was seriously affected as well: in eastern Slovenia, only two thirds of hay was harvested in comparison to previous years, even worse was in SE Slovenia[9,10]. Farmers expressed concern over securing fodder elsewhere since it was heavily affected across most of the country[11]. Summer drought whose roots went back to spring was declared a natural disaster by the government and left direct damage of 65 mio EUR in agricultural production[12,13,14].

In June, arid state of stream discharge was reported on several rivers in Slovenia due to lasting lack of precipitation. Most affected were rivers of western and southwestern Slovenia where levels of stream discharge classified in lowest 5th percentile[15]. Over summer months, agricultural drought developed into hydrological drought as groundwater level was low to very low across great part of the country. Hydrological drought conditions were most intense in southern and eastern Slovenia where stream discharges reached levels as low as back in years 2003 and 1993 and some river-beds reported completely dried out. In that part of the country, groundwater level reached lowest values of the record, classifying 2017 as a year of extreme hydrological drought[16]. Few municipalities in eastern and southeastern Slovenia reported of drinking water shortages which made them take urgent measures: in municipality of Kozje, firefighter units had to be activated to supply households with water while in municipality of Oplotnica drinking water supply was interrupted during night-time (10pm-7am) in order to let water reservoir replenished again at night[11,17].

CROATIA

European Drought Observatory reported several heat waves of this summer hit also major agricultural areas in Croatia[18]. Agricultural yield losses were reported above 30% of usual production across most of the country, in some regions of even up to 80%. In continental part of the country, most affected were maize, sugar beet, soybean and orchards while over Adriatic region drought mostly affected olive trees and vegetables[19]. Due to extreme heat and dry ground, severe wildfires occurred along southern Adriatic coast[20].

Problems emerged also due to drying up of springs, wells, lakes and accumulations and many parts of the countries suffered from local water supply shortages. Livestock farming, fish farming and bee keeping were also affected due to lack of food and/or water. In total,

[8] http://www.sos112.si/slo/clanek.php?catid=1&cal_year=2017&cal_month=3&cal_sel_year=2017&cal_sel_month=3&cal_sel_day=31
[9] http://www.arso.gov.si/novice/datoteke/037977-Hidrometeorolo%C5%A1ke%20razmere%202007%202017.pdf
[10] https://www.rtvslo.si/okolje/vreme-in-podnebje/susa-pesti-jugovzhod-slovenije-obilnejse-padavine-niso-napovedane/427857
[11] https://radioprvi.rtvslo.si/2017/07/susa-je-katastrofalna/
[12] https://www.rtvslo.si/okolje/novice/posledice-suse-bodo-presegle-prag-za-razglasitev-naravne-nesrece/430273
[13] http://www.mkgp.gov.si/si/medijsko_sredisce/novica/9506/
[14] http://www.mkgp.gov.si/si/medijsko_sredisce/novica/9528/
[15] http://www.arso.gov.si/novice/datoteke/037798–su%C5%A1a%20junij%201.pdf
[16] http://meteo.arso.gov.si/met/sl/agromet/drought/
[17] https://novice.si/page/oplotnicani-zaradi-pomanjkanja-pitne-vode-ponoci-brez-vode/
[18] https://ec.europa.eu/jrc/sites/jrcsh/files/jrc-mars-bulletin-vol25-no9.pdf
[19] DHMZ, DriDanube project partners
[20] http://www.reuters.com/article/us-croatia-wildfire-idUSKBN1A21IB

economic losses due to drought in 2017 were around 125 mio EUR[19].

BOSNIA AND HERZEGOVINA

In Bosnia and Herzegovina, unfavourable agrometeorological conditions during summer accelerated the processes of ripening the crops so that harvest of certain mature crops began earlier than usual. Despite some precipitation period, soil moisture in deeper layers remained very low[21,22]. Although intensity of drought effects varied across the country, most affected were areas with intensive agricultural production where direct damage resulted in yield loss and decline in quality of products. Summer drought left damage also in an indirect form such as decline in productivity of livestock and drying of soil. Significant damage was left mostly on maize and soybean on shallow lands (yield reduced by up to 50% and up to 30% respectively) as well as vegetables and fruit trees without irrigation. Damage was noted also on open-field areas with irrigation systems since hot weather condition left effects of irrigation as "cooking" the products. In some areas, farmers also ran out of water for irrigation. In addition to reduced yield, fruit had poorer quality, meaning most of the production ended up in processing.

Fodder production was heavily reduced as well. Second yield of hay was reduced by 50% while third yield on shallow lands was reduced by 90-100%. On natural meadows and pastures, losses in hay yield due to unfavourable weather conditions were estimated to 90%. Along with unfavourable weather condition, fodder production was additionally reduced by several wildfires spread along southern parts of the country. Extreme drought and heat waves in 2017 caused yield losses of around 60%, resulting in total losses in agricultural production of around 128 mio EUR[23].

Drought brought also water supply problems in Gacko municipality of southern Bosnia and Herzegovina where restraint restrictions have been tightened over summer months and only consumers in the city and suburban settlement Avtovac remained on the network[24]. Also in Trebinje, firefighting units supplied households with 297 tanks of water over June and July which is a record number in recent year[25]. Very dry summer caused one of the lowest levels of Bileć Lake since its inception. Dragging water revealed a part of the former settlement in the village of Čepelica where houses, coves and fences appeared from the water[26].

SERBIA

In their monthly agrometeorological bulletin for June, Republic Hydrometeorological Service of Serbia reported of negative impacts of drought on agricultural plants in last decade of June, stating high daily air temperatures and deficiency of precipitations were not suitable for maize, sunflower, soybean and sugar beet. Lack of precipitation caused development backlog in many crops which had negative impacts on the quality of fruit and reduced yield. On a large number of agricultural areas, mild precipitation of August arrived too late, especially for maize[27]. Dry period during generative phases has badly affected crop yield,

[21] http://rhmzrs.com/assets/images/meteorology/Agrometeorology/Agrometeorolo%C5%A1ka%20informacija/bilten%2004.09.-10.09.2017.pdf
[22] http://rhmzrs.com/assets/images/meteorologija/Agrometeorologija/Mjesecni%20bilteni/bilten%2018.09.-24.09.2017.pdf
[23] RHMZ RS, DriDanube project partners
[24] http://mojahercegovina.com/susa-u-gacku-poprima-zabrinjavajuce-razmjere-za-vikend-veci-dio-grada-bez-vode/
[25] http://mojahercegovina.com/nezapamcena-susa-trebinjci-cisternama-vode-za-pice/
[26] http://mojahercegovina.com/povlacenje-bileckog-jezera-otkrilo-nekadasnje-naselje-foto/
[27] http://www.hidmet.gov.rs/podaci/agro/mesec.pdf

primarily maize and soybean as yield was reduced by 50% in some regions[28]. Summer 2017, being one of the driest and the second warmest of the record in Serbia, reduced maize yield to 4.5 million tons, in comparison to yield of 8 million tons in 2016[29,30]. According to the estimates of the Republic's Bureau of Statistics, Serbia's gross domestic product in 2017 was reduced by 1% due to drought-related losses in agriculture sector[31].

Moderate to extreme drought conditions left negative impacts also in hydrology sector. Water levels of Tisa, Sava, Velika Morava and Danube rivers were in mid-low to low values as stated in Republic Hydrometeorological Institute's weekly meteorological bulletins in July. Drastic drop in water levels across the country became threat also for fish stock[32,33,34,35]. As a result of growing concern over more frequent droughts, construction of 4 irrigation systems out of 11 planned began in the summer[36].

MONTENEGRO

Long-lasting lack of precipitation over early spring and summer months resulted in level of accumulating lakes near minimum and shift in low water level two months earlier than normal, in August instead of October. Grape harvest began a month earlier than normal while yield of several agricultural crops were reduced by at least 30%, especially tomatoes and orchards[37]. Very dry weather provided favourable conditions for forest fires that spread across vast part of Montenegro in July[38,39]. Dry conditions that developed into hydrological drought, reduced production of Montenegrin hydro power plants by 40-50% in 8 months over spring and summer in comparison to same time period of last year[40]. Ministry of Agriculture explained that in 2017 they supported producers who expressed interest in building irrigation systems. They are planning to further help farmers with investments in construction of irrigation systems as well as building tens of wells in order to create conditions for irrigation of additional 160 ha[41].

[28] RHMSS, DriDanube project partners

[29] http://www.novinite.com/articles/182748/Drought+has+Caused+Serbia+Damage+of+EUR+600+Million

[30] https://beta.rs/ekonomija/ekonomija-srbija/70712-agrostrucnjak-steta-od-suse-u-poljoprivredi-preko-milijardu-dolara

[31] http://aktuelno.net/vesti/srbija/Susa-nam-srezala-rast-BDP-a-na-1-9-odsto/c/3191748

[32] http://www.hidmet.gov.rs/podaci/meteorologija/bilten_rana_najava/Bilten%20rane%20najave%20klimatskih%20ekstremnih%20pojava%20i%20anomalija%208.7.2017.pdf

[33] http://www.hidmet.gov.rs/podaci/meteorologija/bilten_rana_najava/Bilten%20rane%20najave%20klimatskih%20ekstremnih%20pojava%20i%20anomalija%2014.7.2017.pdf

[34] http://www.hidmet.gov.rs/podaci/meteorologija/bilten_rana_najava/Bilten%20rane%20najave%20klimatskih%20ekstremnih%20pojava%20i%20anomalija%2021.7.2017.pdf

[35] http://www.hidmet.gov.rs/podaci/meteorologija/bilten_rana_najava/Bilten%20rane%20najave%20klimatskih%20ekstremnih%20pojava%20i%20anomalija%204.8.2017.pdf

[36] https://beta.rs/ekonomija/ekonomija-srbija/70203-pocinje-gradnja-cetiri-sistema-za-navodnjavanje-u-vojvodini

[37] IHMS, DriDanube project parnters

[38] http://www.nato.int/nato_static_fl2014/assets/pdf/pdf_2017_07/20170725_OPS-EADRCC-2017-0166.pdf

[39] http://www.mup.gov.me/rubrike/vanredne-situacije/174691/Izvjestaj-o-stanju-pozara-u-13-casova.html

[40] http://aktuelno.net/vesti/svet/Susa-smanjila-proizvodnju-crnogorskih-hidroelektrana/c/3062795

[41] http://www.privredniportal.me/portal/poljoprivrednici-pretrpjeli-ogromnu-stetu-zbog-suse-rod-gotovo-prepolovljen/

MOLDOVA

Due to very high air temperatures and worrying water levels in rivers and lakes, yellow code for drought was declared across the country in late July and again in mid-August. To ease negative impacts on population due to extreme air temperatures, Civil Protection and Emergency Situations Service created 13 heat rehabilitation points across the country where around 5000 people were addressed daily. Water levels continued to drop throughout August as well and population and especially economic agents were urged by Ministry of Environment to rationally consume water resources[42,43,44].

ROMANIA

Although higher air and soil temperatures intensified vegetation rhythm of field crops and vine in spring, heat waves and limited water supply negatively affected agricultural crops later on. Prolonged to long-lasting drought of varying degrees, vegetation state of non-irrigated maize and sunflower gradually declined by the end of summer and resulted in poor maize harvest and drying of sunflower seeds. Especially affected were parts of southwestern Romania with only 2-3 mm of precipitation level over June and July and no irrigation system. Authorities estimated that of 118.000 hectares cultivated with maize, more than 70% were destroyed due to lack of precipitation. Similarly affected were also soybean, sugar beet and lucerne crops[45,46,47,48,49]. Along with water scarcity in soil layers, over 111.000 ha of pastures and meadows in western Romania were heavily affected by mid-summer already. It resulted in not enough food on the fields for livestock which forced farmers to use their winter supplies to feed them or sell them for low prices at fairs. Related to that, also milk production dropped by about 20-25%[50,51,52].

Lack of rain also affected Danube river level. At Galati city, its level was greatly reduced in June already. It kept decreasing, making an island of a length of stadium appear in the middle of the river, forcing crossing ships to take a detour. By the end of summer, drought conditions reduced Danube river flow at Galati city to 63% of its normal levels, making it reach historic minimum in terms of water level and flow[53,54,55]. Subsequently, severely affected were cereal business as flow of the Danube river was very low and barges could not land in ports to load cargo[56], as well as production of cheap energy from hydro power plants, making authorities use more expensive resources such as coal which reflected also in higher electricity prices[57].

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[42] http://unimedia.info/stiri/cod-galben-de-seceta-pe-tot-teritoriul-tarii-canicula-se-mentine-si-maine-136838.html
[43] https://www.timpul.md/articol/cod-galben-seceta-hidrologica-in-toata-ara--cat-va-dura-113139.html
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BULGARIA

Dry summer conditions reduced sunflower yield by 20% in eastern parts of the country and reduced quality of seed in flowers. In towns of western Bulgaria, oilseed rape yield was reduced by more than half[58,59,60,61]. In late August, water supply regime had to be introduced in several towns in northern and northeastern Bulgaria, including Prelom, Targovishte, Omurtag, Sevlievo. Due to long-lasting drought causing strong decrease of water flow in that part of the country, drinking water was supplied only certain part of the day (night-time, day-time)[62,63,64]. Water supply regime became stricter in Sevlievo in September when drinking water in the city was available from 8am-10am in the morning and 6pm-10pm in the evening, while for surrounding villages it began being supplied in plastic aquifers[65]. In Panagurishte in western half of Bulgaria, state of emergency was declared in mid-September due to shortage of drinking water[66].

FYR MACEDONIA

Unfavourable dry weather conditions and insufficient soil moisture left farmers struggling with drought at the height of spring sowing. Weaker development was noted on plants and at the end of the season yield was much lower than in 2016, in some regions there was no harvest at all[67,68]. Agricultural yield was reduced also in Macedonia, especially fodder crops and grain with expected 60–70% decrease in some parts of the country, as well as vegetable and fruit yields while alfalfa was decreased up to 40% due to restricted irrigation caused by the low water level in accumulation[69]. Long dry period negatively affected also vineyards in Kavadarci region where grapes looked like burnt and yield decreased by 70%[70]. Affected were also rivers and lakes. Due to water level of Kalimanci Lake dropping below the critical, fish fund was endangered and disappearance of young fish occurred. Although water level was below the critical point, there was huge pressure from farmers for water demand for irrigation[71].

ALBANIA

Most noticeable were hydrological consequences of severe drought in Albania. Drastic decline in water level of Shkodra Lake in northern Albania following one of the worst droughts in decades has brought to light a 19th century Austro-Hungarian steamship[72]. Water level of Fierza Lake decreased throughout summer months and reached its critical level in early August. Its level at hydro power plant reached 268 m, the lowest in last 15 years, and

58 https://www.capital.bg/politika_i_ikonomika/sedmicata/2017/09/18/3044296_vecherni_novini_18_septemvri/
59 http://www.bta.bg/bg/c/BO/id/1642503
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61 http://www.bta.bg/bg/c/BO/id/1655423
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72 http://www.tiranatimes.com/?p=133667

worsened energy balance in the country[73,74]. In June already, electricity had to be imported to overcome domestic production shortages caused by drought[75]. Continuous hydrological drought led to energy supply having to be imported during all summer months. In 2017, drought-triggered electricity imports cost Albania 200 mio EUR[76,77,78].

GREECE

Spring drought appeared to have affected both quality and quantity of durum wheat while occasional rainy periods did not ease the situation. Instead, they caused further damage on the "ready" wheat[79,80]. In June and July, Hellenic National Meteorological Service General Secretariat for Civil Protection in Greece issued daily heat wave alerts as well as several extreme fire risk alerts over the month. One death was reported due to extreme heat stress. Indirect consequence of hot and dry weather in Greece this July were several wildfires that hit extensive areas of coastal Greece and its islands[81,82]. The extensive period of drought this year that hit the main olive-growing zones also affected domestic production of olive oil as concentration of olive oil in the fruit was notably reduced[83,84].

TURKEY

Turkey experienced the worst drought in 44 years in 2017 due to substantial decrease in rain levels, according to Ministry of Water Affairs and Forestry. Lack of rain was most noticeable over winter months that brought very dry conditions to the country[85,86]. During summer, the ruins of an 816-year-old Seljuk inn have emerged from waters of the Altınapa dam which provides drinking water to the Central Anatolian province of Konya[87]. The Ministry of Forestry and Water Affairs is set to recycle water used in households, industry, tourism, energy production and agriculture and propose new ideas to use water sources more efficiently in order to reduce the effects of drought which has become a global issue in recent years[88].

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[74] http://24-ore.com/?p=139591
[75] http://esc.albaniaenergy.org/en/2017/07/01/albania-import-electricity-due-drought-balkan-green-energy-news-26th-june-2017/
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Methodology

Drought monitoring bulletin is based on numerical weather prediction (NWP) model simulations over SE Europe, SPI index calculations and remote sensing. Precipitation data is provided by Global Precipitation data Centre (GPCC; gpcc.dwd.de). NWP simulations are performed with Non–hydrostatical Meso–scale Model (NMM, see: http://www.dtcenter.org/wrf–nmm/users/). Historical DMCSEE model climatology was computed with NMM model for time period between 1st January 1979 and 31st December 2016. European Centre for Medium Range Weather Forecast (ECMWF) ERA–Interim data set (see: http://www.ecmwf.int/en/research/climate–reanalysis/era–interim) was used as input for simulations. Long term averages (1979–2016), used for comparison of current weather conditions, are obtained from simulated data set. Comparison of current values to long term averages provides signal on potential ongoing drought severity.