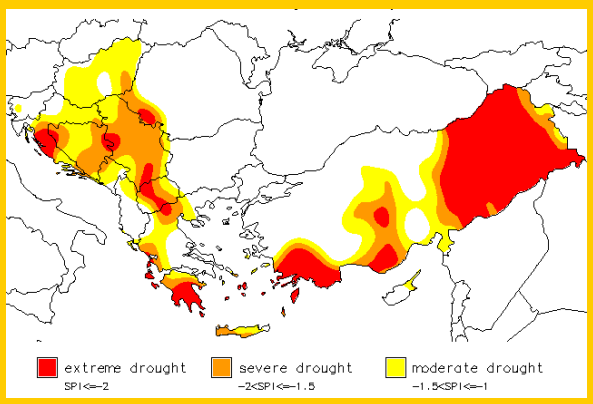
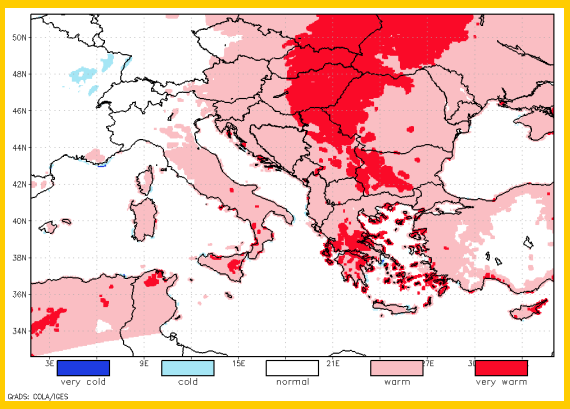
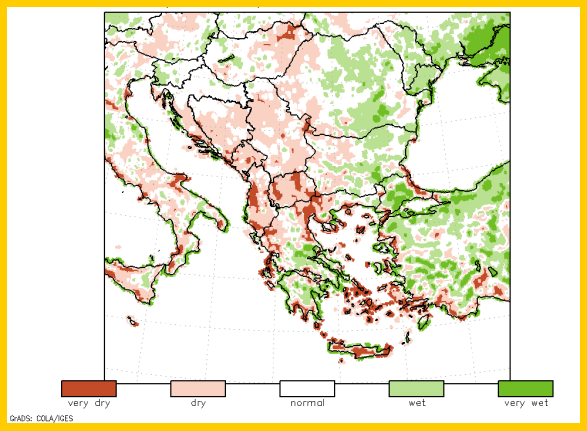
DROUGHT MONITORING BULLETIN

Overview from February to September 2021

HOT SPOT







SPI3 for the April-June period *(top left),*
July air temperature *in percentile classes (top right) and* ***April-September accumulated surface water balance*** *in percentile classes (bottom left).*

The autumn-winter period 2020/21 from October to March saw several months drier than normal across the region, most noticeably over Turkey and southern Greece, later on also over central and western Balkan Peninsula, resulting in decreased water storage in topsoil layer prior to the coming of spring and summer. In such conditions, Turkey and southern Greece then faced April and May of considerable lack of rain, while June brought extreme precipitation deficit to western half of Balkan Peninsula. Dry conditions in early summer were aggravated by higher than normal air temperatures in July, the peak period of vegetation season across most of the region. Between July and September, precipitation deficit persisted across central and western Balkan Peninsula, and although the level of dry conditions classified as moderate to severe, it was their continuous presence over the later months that resulted in greatly decreased surface water balance conditions compared to long-term across a wider part of Balkan Peninsula.

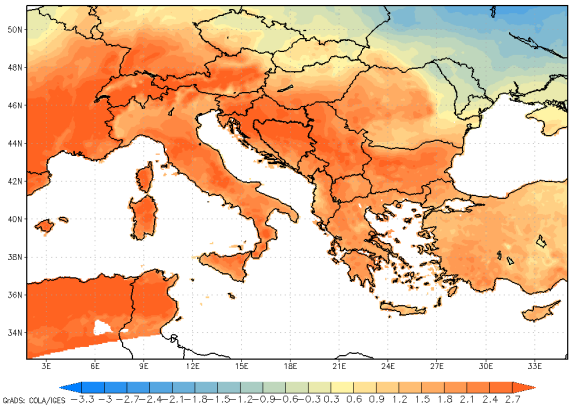
AIR TEMPERATURES AND SURFACE WATER BALANCE

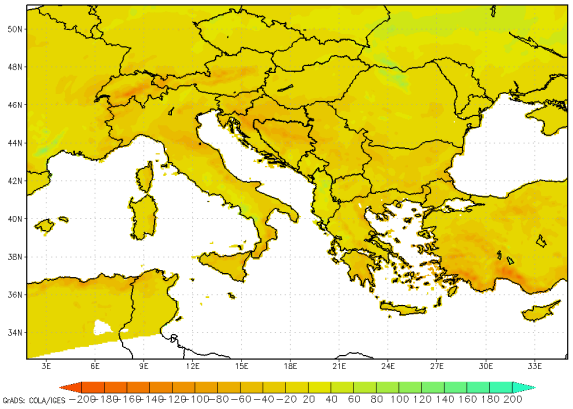
Figures in this section present anomalies from the average of 1991-2020 period of monthly ***air temperature*** *and accumulated* ***surface water balance*** *from* ***February to September 2021.***

AVERAGE AIR TEMPERATURE ANOMALY [°C]

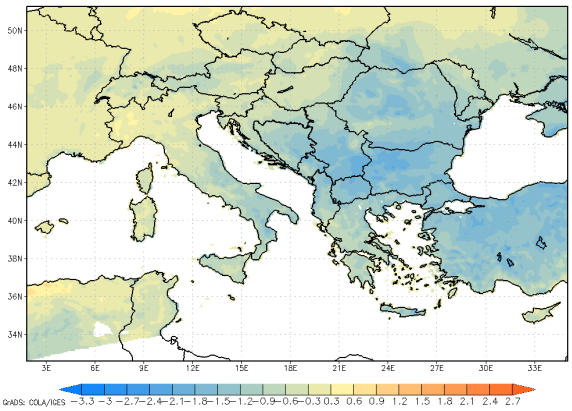
SURFACE WATER BALANCE ANOMALY [mm]

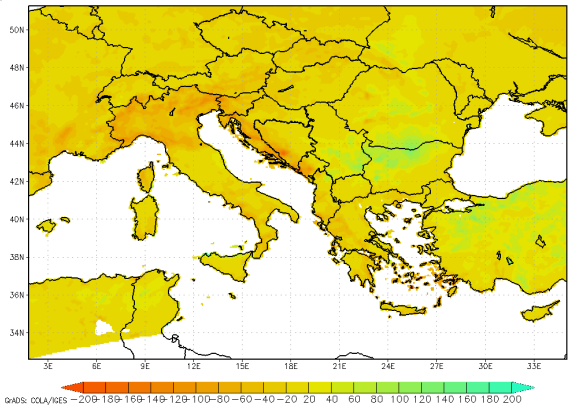
FEBRUARY 2021





MARCH 2021





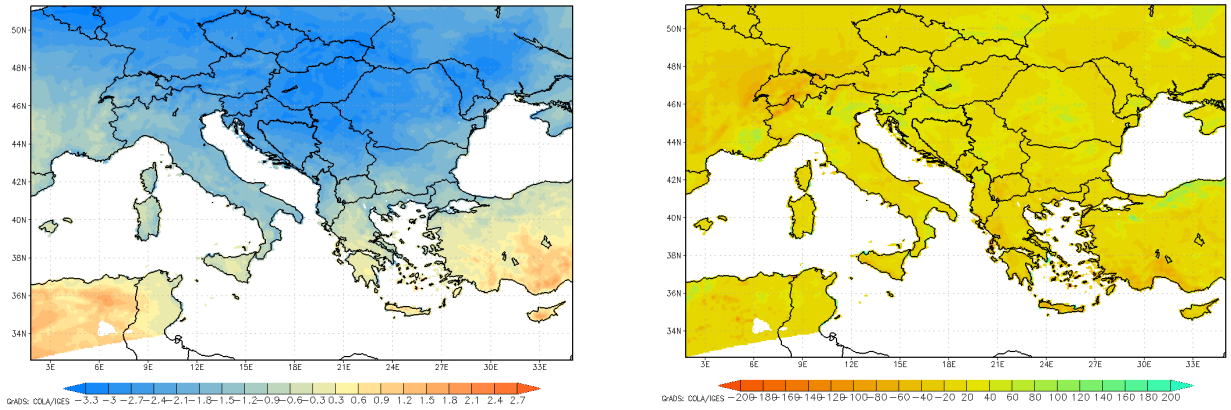
The year began with unusually warm January but anomalies from the average were even greater in **February**. Especially warm were first 10 days of the month across the entirel region, with the exception of its northernmost belt, as daily maximums at many locations approached 18-20 °C and ranked among the warmest 5 % of local data. Last week of February also saw unusually warm weather, most noticeably in all countries along the Adriatic Sea. In areas along the Dinaric and Balkan mountain chains, February mean was 3 °C or more higher than normal, in western Turkey, Albania, Greece and central Romania 2-2.5 °C. Only in northeastern Romania and Moldova, February was colder than normal, up to 1 °C. Increased evapotranspiration along with under-average precipitation amount over central Balkan Peninsula from Slovenia to Bulgaria and Turkey resulted in mostly up to 60 mm drier than normal February across that area, in continental Croatia and Bosnia and Herzegovina up to 100 mm, locally in southwestern Turkey up to 160 mm. Noticeable monthly surplus was present only across Albania and northern Romania, of 60-80 mm. In Turkey and Greece, above-average air temperatures, although to a lesser degree, continued until mid-**March**, while central and northern Balkan Peninsula began experiencing a longer spell of generally colder than normal air temperatures which, with short breaks, lasted until early June. March mean air temperature was below-average over the entire region, with minimal anomalies

present across Slovenia, Hungary and northern Moldova, of up to -1 °C. Elsewhere, deviations into the cold were higher, mostly between 1.2-1.8 °C, in border area between Serbia and Bulgaria up to 2.1 °C. In unusually cold weather, it was mostly the contribution of precipitation component that shaped March surface water balance. March was drier than usual over Hungary and Greece with deficit of up 60 mm, and along the Adriatic Sea from Slovenia to Montenegro monthly surface water balance was up to 100 mm lower than normal. On the other hand, surplus of up to 60 mm was present over central Turkey, southeastern Serbia and central Romania. Over northern Bulgaria surface water balance exceeded its average March values for up to 100 mm.

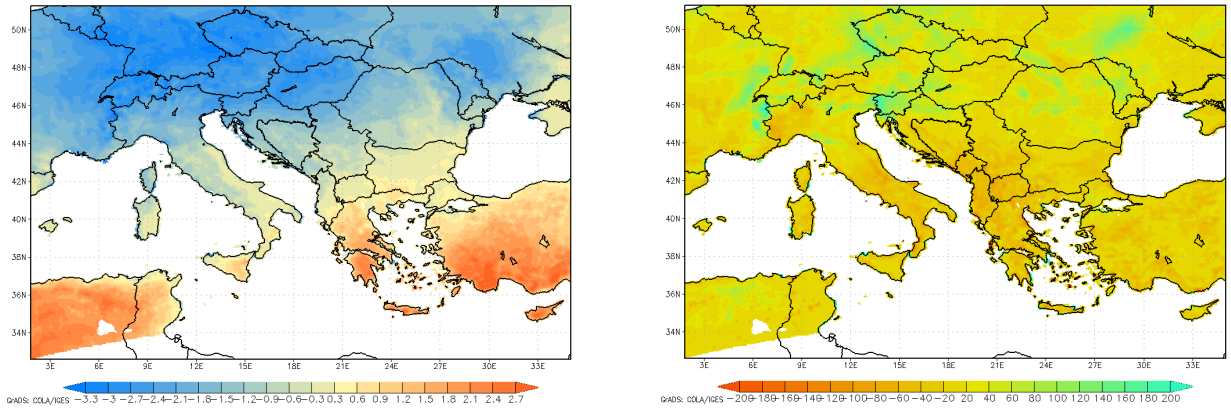
AVERAGE AIR TEMPERATURE ANOMALY [°C]

SURFACE WATER BALANCE ANOMALY [mm]

APRIL 2021



MAY 2021



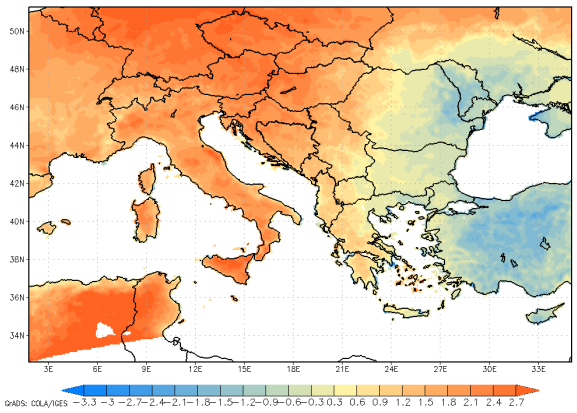
Colder-than-usual air temperatures continued into **April**. They began normalizing in mid-April from southern Greece and Turkey northward, and by the end of the month extended across southern half of Balkan Peninsula, while in southern Greece and Turkey they already well exceeded the average. In northern half of the region down to Romania, central Serbia and Montenegro, air temperatures remained under-average throughout all April. In changing air temperature conditions across Greece and Turkey, April mean air temperature ended up 1-1.5 °C higher than normal across their southern parts, while negative anomalies extended over the rest of the region, from up to 1.5 °C across Albania and North Macedonia, to between 2 and 3.3 °C across other countries. In April too, surface water balance was mainly driven by precipitation, which was normal across most of the region, in scattered localised areas above-average for up to 60 mm, along northern Turkey up to 120 mm. Monthly deficit was recorded only in North Macedonia and western and southern Greece of up to 60 mm, and over southern half of Turkey of up to 80 mm.

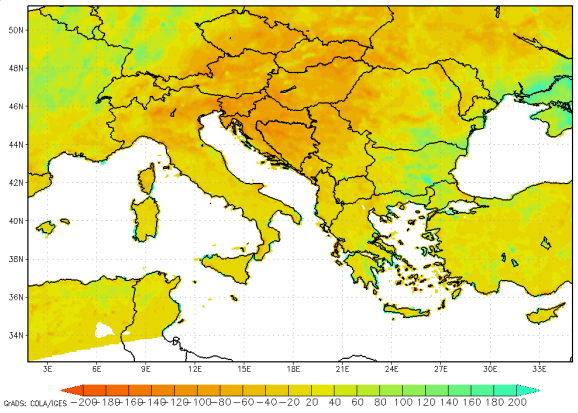
Over northern half of Balkan Peninsula, cold spell continued throughout all **May**, resulting in May air temperature 2-3 °C colder than usual in Slovenia, Hungary and Moldova, and 1-2 °C colder in area between Croatia, Romania and Montenegro. On the other hand, in Greece and Turkey May was in general warmer than usual, especially in its first days when high air temperatures ranked among the warmest 5 % of local records. Monthly mean rose 2-2.5 °C above its long-term average across their central parts, and up to 3 °C over their southern areas. May saw a north-south division of the region also precipitation-wise. Considerable deficit coupled with high evapotranspiration upon warmer than normal weather resulted in surface water balance deficit spread across the entire southern half of the region. In this area, some of which already experienced water balance deficit in April, May brought additional deficit of mostly up to 60 mm, locally in Turkey, Greece and North Macedonia up to 80 mm. On the contrary, May was considerably wetter than normal across northern belt including Slovenia, Hungary, central Romania and Moldova where monthly accumulated surplus reached mostly 80-100 mm, in western Slovenia up to 160 mm.

AVERAGE AIR TEMPERATURE ANOMALY [°C]

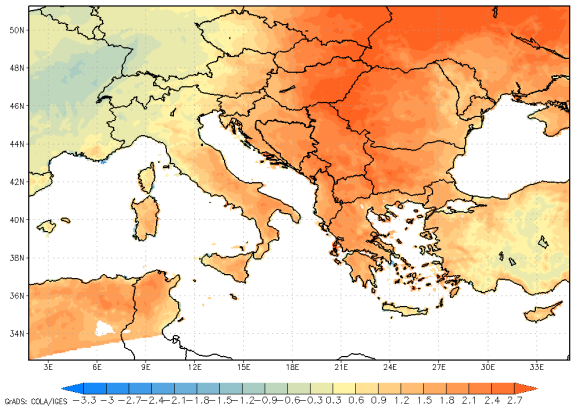
SURFACE WATER BALANCE ANOMALY [mm]

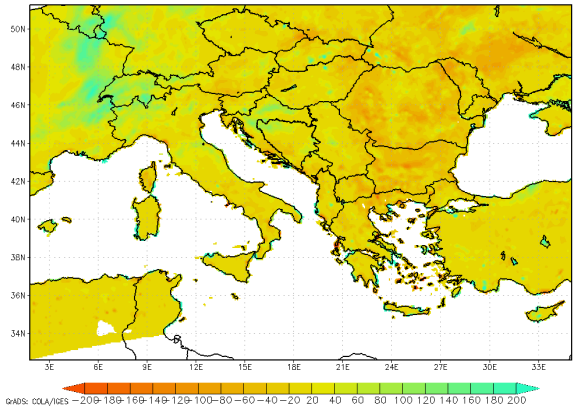
JUNE 2021





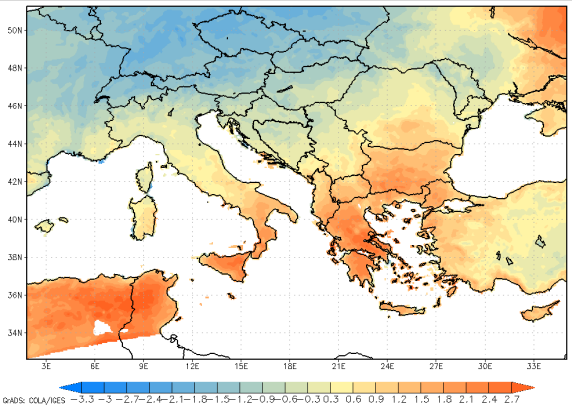
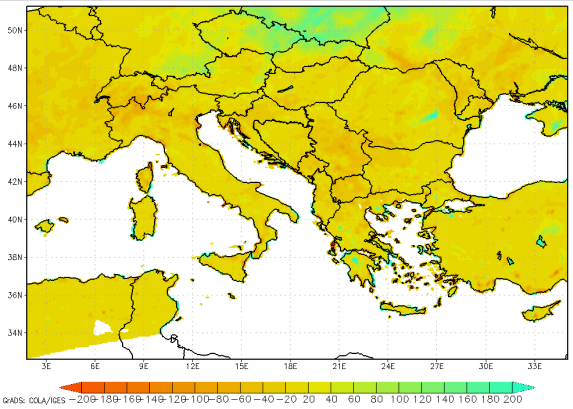
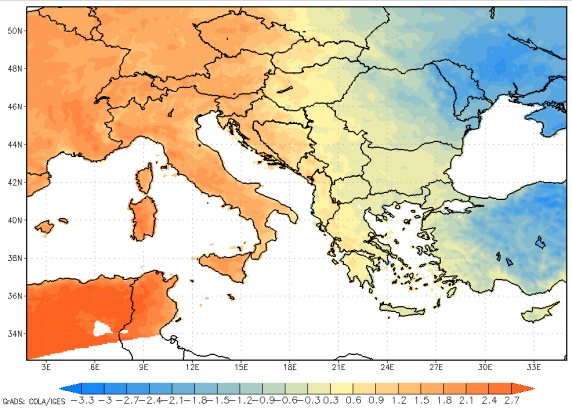
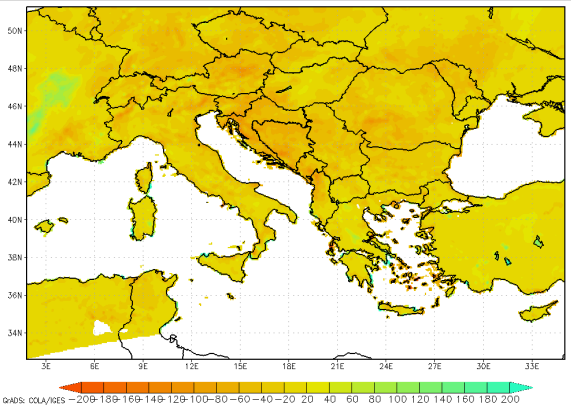
JULY 2021





In **June**, a shift in air temperature conditions occurred across the region. Over the north-west they began normalizing in early June, with some delay also over central and northeastern part of the region, and continued to rise to well above-average by the end of June for the first time since March. On the other hand, after warm May colder temperatures prevailed in Greece, North Macedonia and Turkey until mid-June, while in last dekad they experienced a sudden rise to above-average air temperatures again. In western third of the region, June ended up 2-3 °C warmer than normal, in central third from eastern Hungary to Montenegro and continental Greece mostly 1-1.5 °C warmer, while in eastern third, June mean air temperature was 1-1.8 °C below the average.

Precipitation level across the region nearly followed air temperature conditions: northwestern half of the region experienced very dry June with increased evapotranspiration, resulting in monthly deficit of surface water balance of 80-120 mm. While in the southeastern half, June was wet and brought with mild evapotranspiration, leaving most of that area in normal water balance, across eastern half of Romania and especially Bulgaria, it even exceeded June average for 120-200 mm. Unusually warm weather persisted in the region throughout **July**. Periods of additional increase to one of the warmest of the record were experienced in early July over the Aegean Sea and in mid-July over central-northern part from Moldova to Hungary and Bulgaria. July was mostly 2-2.5 °C warmer than normal, over the Hungary-Romania-Serbia border area more than 3 °C. In region's outer parts including southern Moldova, Slovenia, most of Croatia and Turkey, anomalies from the average were smaller, up to 1.5 °C. Precipitation level was scarce over southern half of Balkan Peninsula and over Romania while in the north-west, July was normal to wet compared to long-term. In very high evapotranspiration, monthly surface water balance was up to 100 mm lower than July average in northern Moldova, and up to 80 mm lower in Romania, Bulgaria and eastern parts of North Macedonia and Greece. Elsewhere it was more or less average, only over continental Croatia and northern Bosnia and Herzegovina, surplus of up to 120 mm was recorded.

AVERAGE AIR TEMPERATURE ANOMALY [°C]	SURFACE WATER BALANCE ANOMALY [mm]
AUGUST 2021	
	
SEPTEMBER 2021	
	

In early **August** very high anomalies stretched across Greece and Bulgaria, in second dekad over Serbia and areas along the Adriatic and Ionian seas while in Turkey air temperatures dropped to below-average in mid-August. Last 10 days of the month saw sudden decrease in air temperatures spread across northern half of Balkan Peninsula, while in Turkey they rose to above-average again.

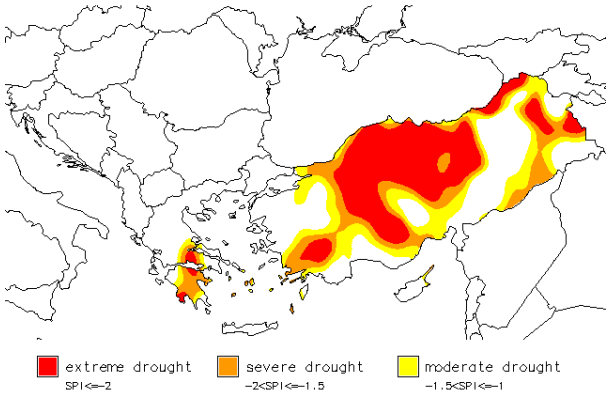
Monthly mean reflected north-south division of most intense air temperature situation in August: in central Turkey and countries along the northern belt from Bosnia and Herzegovina to Moldova, August was around 1 °C colder than normal while in Bulgaria and Greece monthly mean exceeded the average for 2-2.4 °C. Although precipitation-wise August was drier than expected across wider central Balkan Peninsula, from continental Croatia across Serbia to Albania, not as intense evapotranspiration as expected for August prevented further aggravation of surface water balance. Its level ranged about the average across most of the region, with slightly higher deficit, up to 60 mm, present over southwestern Hungary, Serbia, North Macedonia and Moldova.
Under-average air temperatures spread across all Balkan Peninsula in early days of **September**, and were replaced by warmer weather again in mid-September when colder spell reached Turkey. Late September again saw shift to colder air temperatures across northeastern half of the region, from eastern Hungary to central Turkey, while countries along western coasts remained in warmer than normal air temperatures. Monthly mean shows west-to-east spread of the anomalies: September was up to 1.8 °C warmer than usual over Slovenia and Croatia, up to 1 °C in a belt from western Hungary to western Greece, while areas along the Black Sea experienced September up to 2 °C colder than normal, over Moldova and central Turkey up to 3 °C. September was scarce with precipitation across nearly the entire Balkan Peninsula with the exception of central Hungary and central Greece. In northwestern Balkan Peninsula where also warmer weather prevailed, monthly accumulated surface water balance was up to 120 mm lower than September mean, deficit of up to 80 mm was present also across the central belt from Serbia, over southern Romania to Moldova. Elsewhere, September surface water balance did not deviate much from the average.

STANDARDIZED PRECIPITATION INDEX

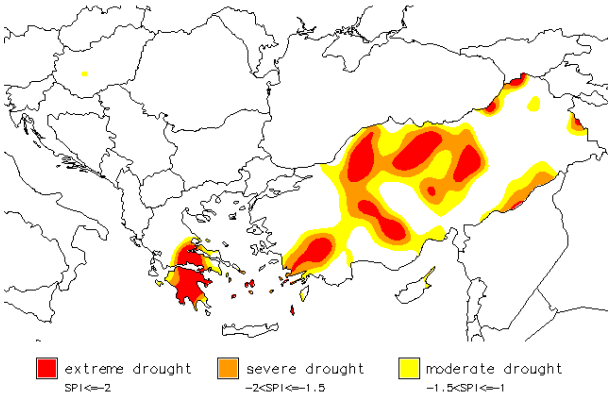
Drought situation with regard to precipitation accumulation is presented by Standardized Precipitation Index (SPI). The SPI calculation is based on distribution of precipitation over long–time period (30 years, in our case long–term average 1961–1990 was used). SPI can be calculated at various time scales 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 than normal. 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 of vegetation season 2021. Maps below present SPI for 6 months, which says more about hydrological conditions throughout the year.

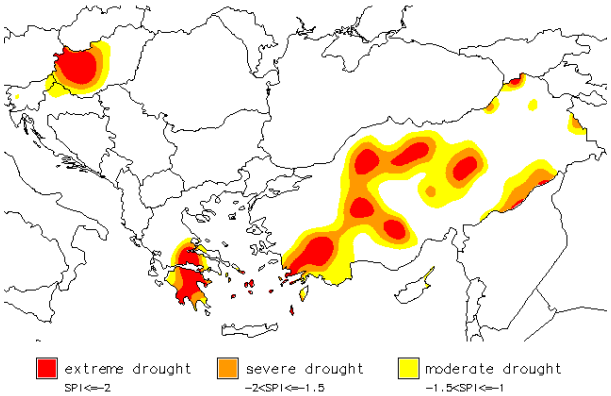
SPI Feb 2021 (6 months)
GPCC first-guess analysis



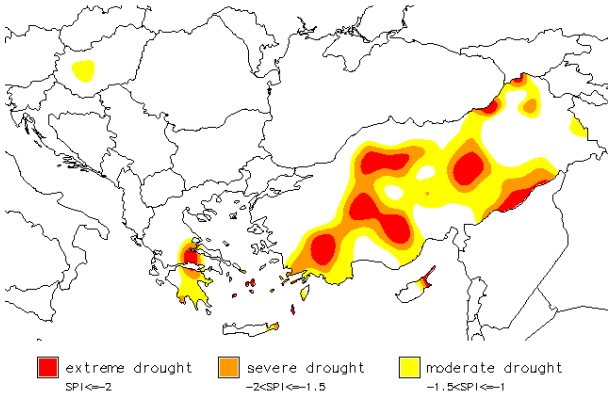
SPI Mar 2021 (6 months)
GPCC first-guess analysis



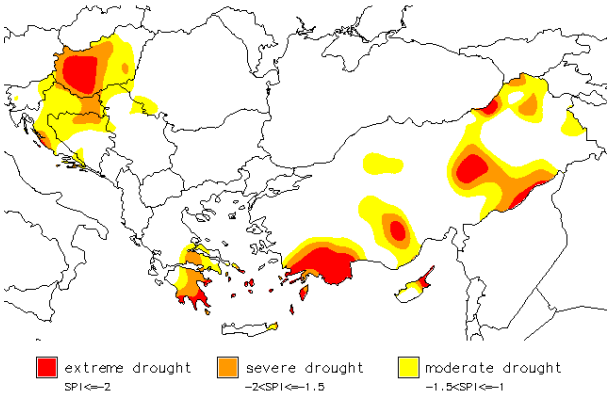
SPI Apr 2021 (6 months)
GPCC first-guess analysis



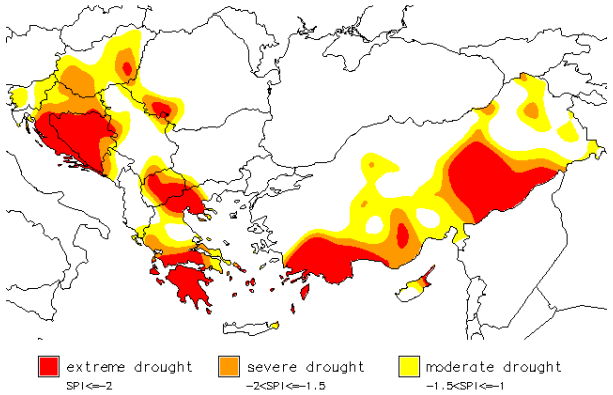
SPI May 2021 (6 months)
GPCC first-guess analysis



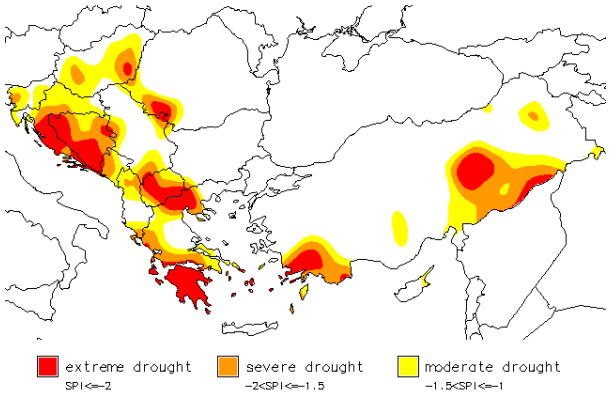
SPI Jun 2021 (6 months)
GPCC first-guess analysis



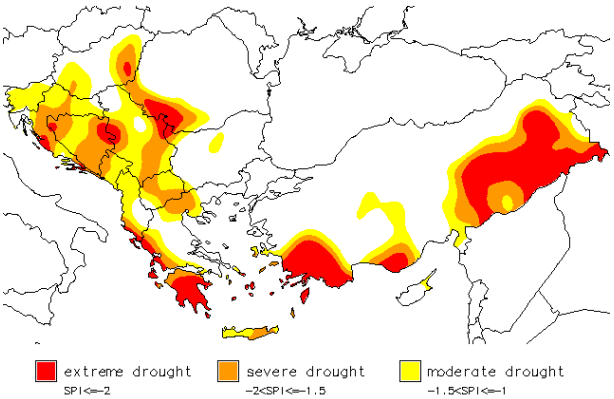
SPI Jul 2021 (6 months)
GPCC first-guess analysis



SPI Aug 2021 (6 months)
GPCC first-guess analysis



SPI Sep 2021 (6 months)
GPCC first-guess analysis

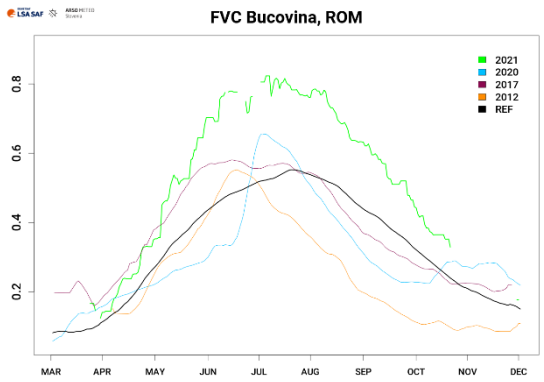


SPI6 for February reveals that winter half of the year was very poorly supplied with precipitation across vast part of Turkey and southern Greece. October, December and January all brought precipitation amount considerably lower than expected across nearly all Turkey, especially its wider central third, while southern Greece recorded severely to extremely dry November and February. After a short relief in April, drought conditions in Turkey remained more or less stagnant until May, then severe to extreme level of drought remained limited to southern half of the country until September. In southern Greece, severely to extremely dry conditions lasted throughout all vegetation season with slight relief to moderate-to-severe level in May and June. The rest of the region was a subject to intensive changes in precipitation level, thus experienced a sequence of drought conditions throughout the vegetation season. November and March saw such scarce precipitation level across the north-west that their intensity reflected in extremely dry November to April period. Precipitation level of April and May did not add to the negative accumulations but June then again saw very low rainfall rate, which reflected in drought conditions appearing again in June, according to SPI6. With such extremely low precipitation amount in March and June, and moderate deficit from July through September, drought conditions of various degree, depending on local characteristics, remained present across central and northern part of Balkan Peninsula until the end of vegetation season. Only Moldova, Romania with the exception of its southwestern part and Bulgaria were not a subject to a lasting period of drought conditions.

REMOTE SENSING – FRACTION OF VEGETATION COVER

Fraction of vegetation cover (FVC) is a vegetation index, based on multi–channel remote sensing measurements (data from Eumetsat's LSA SAF database is used for products in this bulletin). FVC shows fraction of the total pixel area that is covered by green vegetation, which is relevant for applications in agriculture, forestry, environmental management and land use. Values vary according to the vegetation stage and of course to the damages of possible natural disasters (including drought). FVC values are lower at the beginning of the growth season, the highest at the full vegetation development, then FVC slowly drops with vegetation senescence. Line shape depends on sort of the vegetation. Index deviation from the long-term average (reference line) has proved useful for drought monitoring.

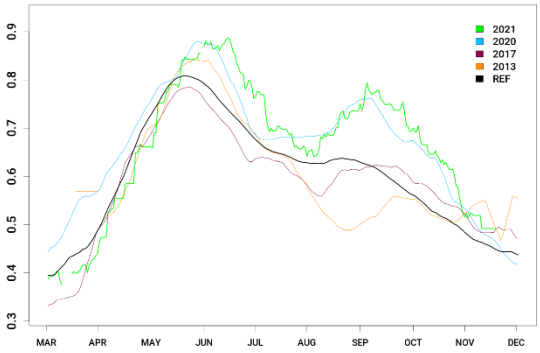
Graphs below present **vegetation development** from **March to November 2021** at 13 locations across southeastern Europe, as indicated by FVC index. FVC values for year 2021 are presented as green line. Graphs also include reference line (2004–2020) in black, and lines in light blue (year 2020), magenta (year 2017, or 2013 for Slovenia) and orange (year 2012) for comparison. Possible missing values or sharp decline of values could be a result of a prolonged cloudy weather, extreme weather events, snow blanket or changes to product by product provider.



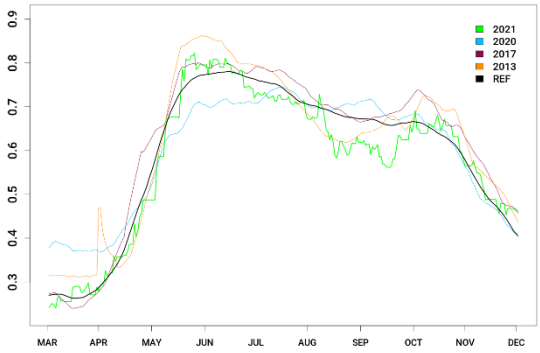
Graphs of FVC at the following locations (from top left to bottom right):

Romania – Bucovina;
Slovenia – Murska Sobota, Nova Gorica;
Serbia – Vršacko vinogorje, Smederevsko vinogorje;
Bosnia and Herzegovina – Laktaši, Bijeljina, Trebinje;
Montenegro – Podgorica;
North Macedonia – Lozovo, Kavadarci;
Greece – Larisa, Kalamata.

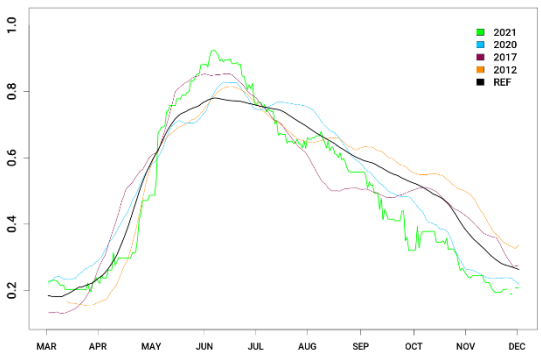
FVC Murska Sobota, SVN



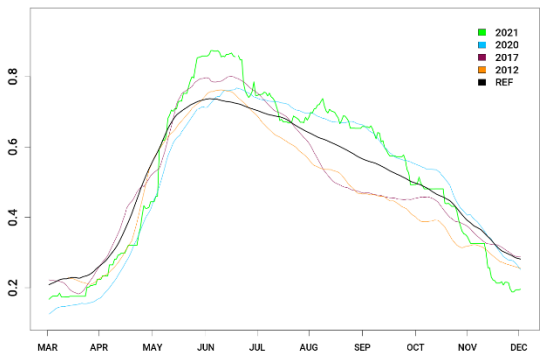
FVC Nova Gorica, SVN



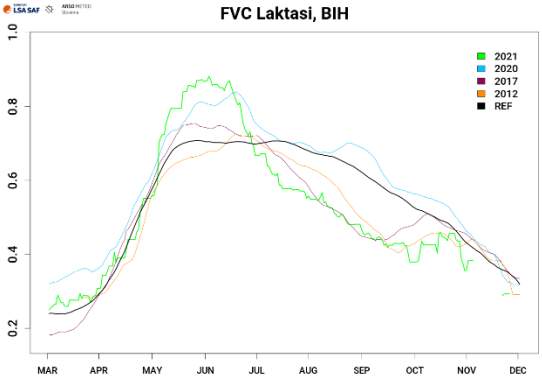
FVC Vrsacko vinogorje, SRB



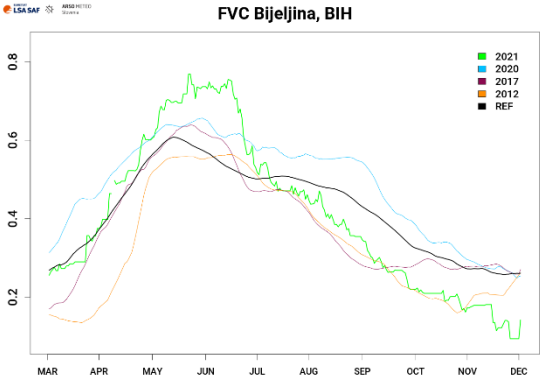
FVC Smederevsko vinogorje, SRB



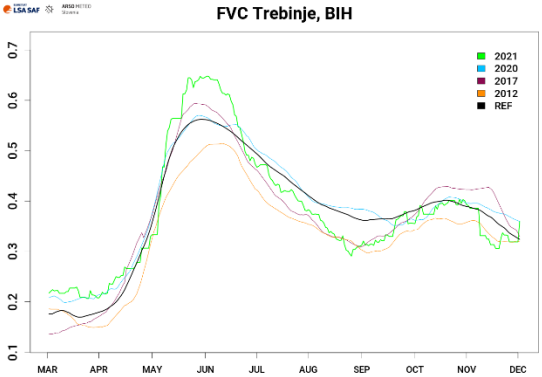
FVC Laktasi, BIH



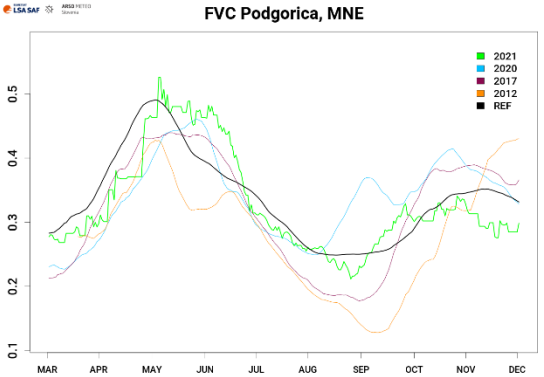
FVC Bijeljina, BIH

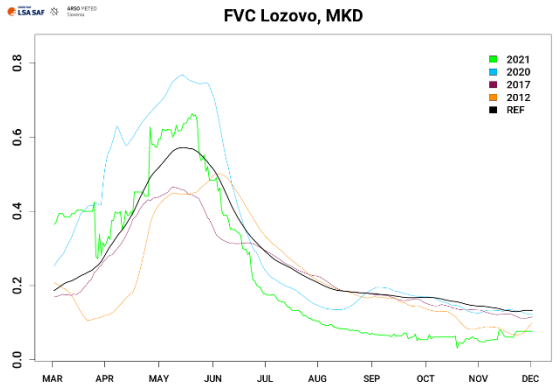


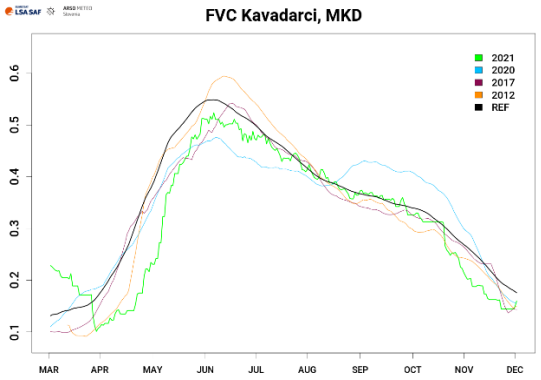
FVC Trebinje, BIH

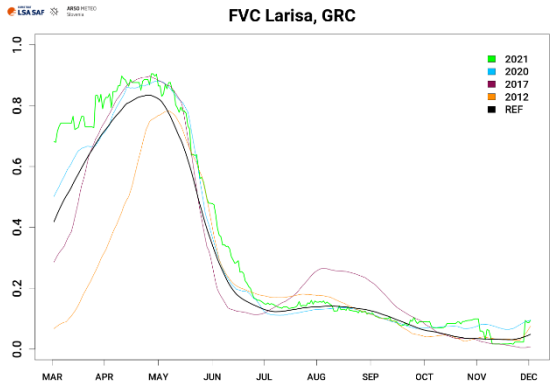


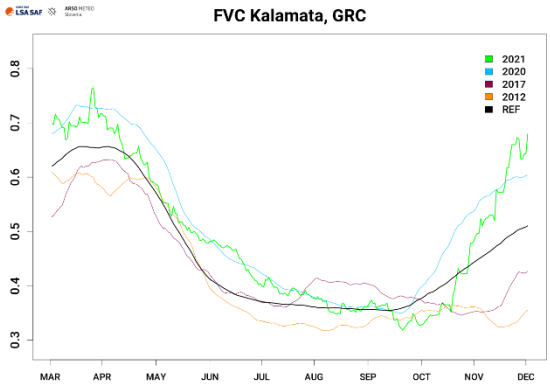
FVC Podgorica, MNE











IMPACT REPORTS

HUNGARY

In June, serious water shortage across the country was indicated by the Hungarian Ministry of the Interior's official declaration of drought over the entire territory of the country [1]. According to the Chamber of Agriculture, also farmers were threatened by severe drought with critical situation almost throughout the country [2]. Poor crop harvest in July did not improve already difficult fodder situation in the livestock sector. Most concerns included the yield of fodder, also sunflower, soybeans, but especially corn. According to a grain market report from the Institute of Agricultural Economics, price for feed wheat was in the second week of July 23 % higher than a year ago, while old-grain corn was on average 60 % more expensive. Price for full-fat soybeans was increased by 30 %, for rapeseed by 38 %. Cow and pig feed rose by 12 % in June compared to June 2020 and 4 % from May this year [3].

[1] https://index.hu/belfold/2021/07/01/aszaly-vizhiany-ontozes/
[2] https://168.hu/itthon/sulyos-aszaly-fenyegeti-a-gazdakat-lepett-az-agrarkamara-206939
[3] https://index.hu/gazdasag/2021/07/25/megy-az-arharc-a-baromfiszektorban-is/

SLOVENIA

Hot and dry June affected mostly non-irrigated areas with vegetables, crops and orchards, with grasslands also severely affected, much less so vineyards. Damage was seen on corn, oil pumpkins, potatoes, soybeans and sown grassland, to a lesser degree by crops of sunflowers. Drought caused forced ripening in oilseed rape and wheat, with negative impacts reflected in reduced yields and poorer crop quality. In Pomurje region, northeastern Slovenia, barley yield was lower by up to

20 %. For potatoes, June drought came at the tube filling stage, with damage to the quality observed also for irrigated potatoes. Loss of yield was likely also for bulbs, cabbages and fruit trees, which require regular watering. Even in irrigated orchards, burns on fruits and leaves were visible. Damage on most affected agriculture crops is estimated at 20-50% [1, 2]. According to the Administration for Civil Protection and Disaster Relief, a longer run of rainless and windy days dried up low vegetation and topsoil layer in many parts of the country, which created favorable conditions for the occurrence of wildfires as was reflected in the increased number of detected fires and firefighting interventions [3]. In September, Lake Cerknica was completely drained for the first time in the last 18 years due to a prolonged hydrological drought. Slovenian largest intermittent lake was supposed to be present again at that time of year but its water level lied as low as 22 meters below the surface of the lake, as explained by officials from the Notranjska Regional Park [4]. Due to critical hydrological conditions, the management board of Fishing Family Cerknica in early September announced temporal prohibition of sport fishing in Lake Cerknica and in Rakov Skocjan. The prohibition was lifted in last week of September [5, 6].

[1] https://www.kgzs.si/novica/prve-posledice-suse-so-ze-tu-2021-07-09
[2] https://www.rtvslo.si/okolje/kmetijstvo/susa-prizadela-skoraj-vse-poljscine-in-travinje-manj-vinograde/587066
[3] https://www.rtvslo.si/okolje/zaradi-suse-nevarnost-pozarov-v-naravi/585540
[4] https://sta.si/2944552/cerknisko-jezero-izsuseno-do-22-metrov-pod-povrsjem?q=su%C5%A1
[5] https://rdcerknica.si/novice/obvestilo-18/
[6] https://rdcerknica.si/novice/ribolov-spet-mozen/

CROATIA

Drought in early summer and accompanied strong heatwaves gradually dried up the topsoil layer, and plants with a shallow root system were suffering from water shortages. Heat and water stress left negative impacts on agricultural crops, especially corn, soybean and sugar beet. In early summer, yield was affected the most in Slavonia and Baranja regions, eastern Croatia. Vegetable production and citrus trees were damaged due to not enough water for irrigation, and in addition due to the high prices of water for irrigation. It altogether resulted in increasing green market prices. A state of natural disaster due to drought and high temperatures were declared in counties Virovitica-Podravina and Bjelovar-Bilogora, northeastern Croatia [1, 2, 3]. In August, drought was present also in Istria and at the southern Adriatic coast. Drying of vegetation in Dalmatia, southern Croatia, created the conditions for forest fires. In the Neretva River valley, which was experiencing reduced inflow of water from the Neretva River, salty sea water penetrated into the canals in August, having an adverse effect on plants and yields as well as the whole area which became increasingly saline. In the Koprivnica stream, northern Croatia, fish died due to lack of water and lack of oxygen in the water [4]. In September, a natural disaster due to drought and high air temperatures was declared in Medzimurje Country, northern Croatia. The plants withered despite the irritation, with great damages in field and vegetable crops. Corn, cabbage and potato crops suffered the most, with the potato yield in Medzimurje reduced up to 70 %. The state of natural disaster due to drought was declared in parts of the counties of Varazdin, Koprivnica-Krizevci, Bjelovar-Bilogora and Slavonia. Drought also left its mark on vineyards in Zadar County, and it continued to be present in the Dubrovnik-Neretva County. Olives began falling off branches, and some plants reached the point of wilting. Increase in market prices for fruit and vegetable was observed [5, 6].

[1] https://radar.dhz.hr/~stars2/bilten/2021/bilten0621.pdf
[2] https://radar.dhz.hr/~stars2/bilten/2021/bilten0721.pdf
[3] https://meteo.hr/klima.php?section=klima_pracenje&param=spi&el=karte_suse&Week=210722
[4] https://radar.dhz.hr/~stars2/bilten/2021/bilten0821.pdf
[5] https://radar.dhz.hr/~stars2/bilten/2021/bilten0921.pdf
[6] https://meteo.hr/klima.php?section=klima_pracenje&param=spi&el=karte_suse&Week=210930

BOSNIA AND HERZEGOVINA

June's high air temperatures and drought, which came in delicate phases of plant development such as bloom and pod formation, damaged a large part of agricultural production in Republika Srpska. Significant damage was done to cereals and most of the vegetables. Wheat and corn, a strategic crop for production of fodder-silage, were particularly at risk as drought left impacts in both yield and grain quality [1, 2, 3, 4, 5]. Corn yield was 30-70 % lower than last year, certain places in northeastern Bosnia and Herzegovina were not expected to bear even 10 % of the yield [6, 7, 8, 9, 10]. Felds of wheat at various locations in the country's north-east were nearly fully compensated [7]. Farmers in Lijevce polje, central-eastern Bosnia and Herzegovina reported of considerable drought damage also on other cereals including barley and oats [11]. According to the Association of Farmers of Tuzla Canton, the sunflower yield was reduced by up to 50 % compared to last year, and an increase in the price of sunflower oil was certain [12, 13]. Greatly affected by drought this year was also soybean, with its yield nearly halved and with several plots damaged to a degree not worth entering fields with a combine harvester. Purchase prices were record high [14].

Livestock sector including milk production was also among those heavily affected by drought. Highly unfavorable weather conditions reduced the yields of fodder, likely to be by more than half. Meadows, which were normally mowed three times a year, were mowed only once this year, while the rest was in great portion damaged by drought. Lack of fodder especially affected those keeping dairy cows, bulls and pigs, which require a lot of food. Also affected were cattle themselves, resulting in a number of cattle deaths during summer months due to severe heat. The amount of fodder yield was not always sufficient for the existing livestock, thus some farmers were forced to reduce the number of cattle or even give up livestock breeding [15, 16]. According to the Agency for Statistics of Bosnia and Herzegovina, in July 2021 milk production was lower by 18 % compared to the same month last year. The number of slaughtered cows increased by 49 %, sheep by 38 % and pigs by 17 %, compared to the same period in 2020. As a result of increasing risk and impacts of drought as well as rising feed price, people across the country began closing farms en-masse [17, 18]. Drought damage, most reflected in production of cereals, vegetables, fruit growing and also livestock, resulted in consequent enormous jump in produce prices [6, 5, 19, 20, 21]. According the Association of Agricultural Producers' estimates, damage amounted to about 1.5 billion marks [22]. Faced with severe drought on fields, farmers encountered problems also with water availability for irrigation since many canals and smaller watercourses dried up and the groundwater level dropped [5]. River levels were observed to drop as well across Republic of Srpska, resulting in reduced electricity production of the Bocac and Trebisnjica hydropower plants. Their combined production was approximately 60 % of the planned, and during the outage of one of them, an import of the electricity was required to meet the consumption needs [23]. In mid-August, the water levels of most rivers in Republika Srpska were at the minimum, leading to increase in temperature and decrease in the presence of oxygen in the water, having negative effect on the river ecosystems. The water levels on some rivers, including the Bosna River, were close to the historical minimum and smaller watercourses were drying up, which negatively impacted in fish population [24].

[1] https://mondo.ba/info/Ekonomija/a1054186/cijene-hrane-poskupljenje-na-jesen-susa.html
[2] https://www.nezavisne.com/ekonomija/agrar/Susa-sprzila-sve-na-njivama-u-Srpskoj/670885
[3] https://mondo.ba/info/Ekonomija/a1052785/poljoprivreda-susa-visoke-temperature.html
[4] https://www.blic.rs/vesti/republika-srpska/susa-pustosi-oranice-smanjeni-prinosi-ce-izazvati-rast-cena-hrane/g2z76q8
[5] https://www.nezavisne.com/ekonomija/agrar/Susa-sprzila-zito-zapalice-i-cijenu/668677
[6] https://www.politika.rs/sr/clanak/485266/Susa-i-pandemija-uticu-na-cenu-hrane
[7] https://avaz.ba/vijesti/bih/674847/dramaticno-stanje-u-poljoprivredi-susa-opustosila-polja
[8] https://www.akta.ba/vijesti/uz-prepolovljene-padavine-i-steta-na-usjevima-od-30-do-70-posto/138807
[9] https://www.akta.ba/kapital/susa-spalila-i-do-70-prinosa-kukuruza-u-bih/137894
[10] https://www.akta.ba/vijesti/susa-ce-znatno-uticati-na-usjeve/138330
[11] https://avaz.ba/kantoni/republika-srpska/665795/velika-steta-za-poljoprivredu-susa-unistila-ratarsku-proizvodnju-u-lijevce-polju
[12] https://www.akta.ba/kapital/susa-pokosila-suncokret-u-bih-i-jos-zagrijava-cijenu-ulja/138811
[13] https://www.nezavisne.com/ekonomija/agrar/Susa-pokosila-suncokret-u-BiH-i-jos-zagrijava-cijenu-ulja/678676
[14] https://www.nezavisne.com/ekonomija/agrar/Rod-soje-duplo-manji-cijene-otkupa-rekordne/681397
[15] https://www.akta.ba/vijesti/stocari-na-mukama-presusila-hrana-za-stoku-farmama-u-bih-prijeti-katanac/138379
[16] https://www.nezavisne.com/ekonomija/agrar/Prijeti-smanjenje-stocnog-fonda-i-zatvaranje-farmi-u-BiH/676631

[17] https://www.akta.ba/vijesti/zbog-posljedica-suse-i-rasta-cijena-stocne-hrane-ljudi-masovno-zatvaraju-farme/139915
[18] https://avaz.ba/kantoni/republika-srpska/666280/poljoprivrednici-ocajni-nakon-sto-je-susa-zaprijetila-povrcu-zabrinuti-smo-mnogi-ce-morati-zatvoriti-farme
[19] https://www.nezavisne.com/ekonomija/trziste/Huseinbegovic-Zbog-suse-rastu-cijene-poljoprivrednih-proizvoda/680565
[20] https://avaz.ba/vijesti/bih/674847/dramaticno-stanje-u-poljoprivredi-susa-opustosila-polja
[21] https://avaz.ba/vijesti/bih/666253/susa-diktira-cijene-voca-i-povrca-na-zelenoj-pijaci-buranija-medu-najskupljim-povrcem
[22] https://www.akta.ba/vijesti/gubici-zbog-suse-veci-od-milijardu-i-po-km/138607
[23] https://www.blic.rs/vesti/republika-srpska/opao-nivo-reka-susa-smanjila-i-proizvodnju-struje-u-srpskoj/x77kn15
[24] https://www.nezavisne.com/ekonomija/privreda/Susa-ugrozila-riblji-svijet/675685

SERBIA

This year, precipitation was not evenly distributed across Serbia, leaving certain placed more affected by drought than others and in inevitable loss of yield [1]. Where present, rainless periods and extremely high air temperatures of about 40 °C during the summer months reduced the yield of almost all fruit, vegetable and field crops, except for wheat which was harvested before the dry period. Of the field crops, the greatest damage was left on soybean and corn crop, with expected yield loss of about 50 % and 30-50 % respectively. Damage of a lesser degree was observed for sunflower yield, up to 15 % [2, 3, 4, 5, 6, 7, 8, 9, 10]. Estimated yield was at around 5.9 tons/ha, altogether bringing approximately 2 mio tons less grain than expected which was enough for domestic use but affected the export. Also soybean yield were not expected to be sufficient for export [11]. Potatoes in the Uzice region, western Serbia also suffered serious drought conditions with little rainfall until flowering, which greatly affected the yield. Most of the farmers produce potatoes in hilly and mountainous areas with no irrigation, thus production relied on precipitation and yield and quality were much lower than expected [12]. Drought and high daily temperatures took toll also on mint crop. After the first mowing in June, the producers of mint, used as a medicinal plant in Serbia, reported halved yield, with increased prices for a kilogram of mint in bulk [13]. According to the president of the Association of Raspberry and Blackberry Producers in Serbia, the raspberries yield was at most about 35 % of the average yield [14]. The impacts resulted in greatly increased prices for crops, i.e. corn was sold at 14-15 dinars/kg in 2020, while this year it was sold at 25-26 dinars/kg [15, 16]. A rise in prices was observed also for vegetables [17]. According to the Ministry of Agriculture, certain fields had nothing to harvest, and where fields bore yield farmers encounter problems with quality in addition to quantity. Overall economic damage is estimated at at least 500 million dollars [18]. In hopes to alleviate the negative impacts of drought, irrigation was highly in use, although the excessive use of water for irrigation caused water shortages in the suburbs of Belgrade. In June, the Vodovod water supply company observed a two to three times higher than normal water consumption in the peripheral Belgrade settlements [19]. In addition, the conditions for insect breeding were favorable to a point there were three or four generations more than usual [20]. Cattle breeders too were negatively affected, as drought and extremely high air temperatures almost destroyed all the pastures, including Vojvodina, northern Serbia. Cattle breeders were forced to use fodder kept for winter stock, which raised concerns for autumn and winter [6, 21]. At the same time, also fodder became more expensive, as both corn and soybean saw great increase in market price, thus ensuring sufficient livestock feed became a great challenge [22]. On Suva Planina, southeastern Serbia, a herd of 800 cows and 200 horses grazing there were reported dying of thirst after the only water spring there completely dried up. Cattle breeders from the area reported the spring did not have enough water for months before it completely dried up, and the Serbian Army, the municipality of Gadzin Han and local inhabitants came together to transport water to the area [23, 24].

Prolonged drought and high, often above-average daily temperatures this summer affected the river water levels across Serbia. According to the Republic Hydrometeorological Institute, the water level of tributaries of the Morava River, the Kolubara River, smaller rivers on the Banat watercourses as well as the Jadar River in wider central belt of Serbia were in August worryingly low with further decline observed. Many small and medium-sized rivers were stagnant at the biological minimum, leaving both flora and fauna at risk of lack of oxygen. The water levels in

upper course of the Sava River were also declining, presenting risk for navigation. Due to the extremely low water level of Rzav in western Serbia, an emergency situation was declared and restrictive measures came into force in five local governments supplied with water from the Rzav system - Cacak, Arilje, Pozega, Lucani and Gornji Milanovac [25, 26, 27]. Islands and islets were formed on the longest Serbian river, Velika Morava, through Pomoravlje. According to fishermen, in most places the water was abundant in decaying algae and plants, slowed down, and in some places it looked more like a pond [28]. Worryingly low were also Sava River near Sabac and Sremska Mitrovica where water levels were up to 2,5 m lower than normal, which made river navigation unsafe in that area. In the area of Vojvodina, northern Serbia, Moravica and Brzava almost dried up, and pumping from the Danube-Tisa-Danube canal needed to be carried out [29]. Mayor of Mionica municipality reported springs were drying up and some villages did not have enough water even to feed the cattle. Drinking water needed to be provided with cisterns and a decision was made on a strict ban on the use of drinking water for irrigation and other purposes, and the inspection was ordered to intensify supervision on the ground [30, 31, 32]. Due to the long-lasting drought in Nova Varos, southwestern Serbia, the town springs were at their minimum and water use restrictions came into force. Water in the tourist zone on Zlatar and the city settlements of Milanovac, Sanac, Branosevac and Razista was turned off from 22:00 to 05:00 [33]. In early September, water restrictions were re-introduced over the whole territory of Bajina Basta municipality due to minimum level of springs after a prolonged drought. During that time, households saw water turned off from 23:30 to 05:30 [34]. Due to excessive discharge of water in order to produce electricity but also the drought that lasted for months, the water level of Zavojsko Lake in southeastern Serbia was greatly reduced in autumn. According to free estimates from the scene, water level fell by about 25-30 meters [35].

[1] http://www.tanjug.rs/full-view.aspx?izb=674779
[2] https://beta.rs/ekonomija/ekonomija-srbija/149208-strucnjaci-susa-ce-smanjiti-prinos-kukuruza-u-srbiji-a-navodnjavanje-je-nemoguca-misija
[3] https://aktuelno.net/vesti/srbija/Zega-i-susa-vec-prave-stetu-kukuruzu-soji-suncokretu/c/6160302
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[5] https://www.novosti.rs/republika-srpska/vesti/1021422/kukuruz-vapi-kisom-susa-uzima-danak-semberskim-poljima
[6] https://www.rts.rs/page/stories/sr/story/125/drustvo/4464882/banat-usevi-stanje-susa-vrucina.html
[7] https://www.rts.rs/page/stories/sr/story/125/drustvo/4482621/sudja-zitarice-rod-navodnjavanje.html
[8] https://www.glas-javnosti.rs/ekonomija/susa-obara-standard-sok-cene-za-kukuruz-secser-7388
[9] https://nova.rs/vesti/biznis/susa-udarila-na-prinos-kukuruza-u-pomoravlju/
[10] https://www.b92.net/lokal/jagodina/ekonomija-susa-u-pomoravlju-umanjila-prinos-kukuruza-30-odsto-1920976
[11] https://www.novosti.rs/vesti/ekonomija/1034869/susa-desetkovala-zitarice-zetva-kukuruza-krece-desetak-dana-soje-suncokreta-zbog-loseg-vremena-prekinuta
[12] http://www.glaszapadnesrbije.rs/vest109609.html
[13] https://aktuelno.net/vesti/srbija/Susa-prepolovila-rod-mente-skocila-cena/c/6213691
[13] https://aktuelno.net/vesti/srbija/Zbog-suse-i-nevremena-desetkovan-rod-maline-u-Srbiji/c/6177297
[15] www.politika.rs/scc/clanak/488340/Србија-ће-ове-године-извести-око-3-1-милион-тона-кукуруза
[16] https://www.novosti.rs/republika-srpska/vesti/1050386/semberija-bijeljina-susa-rast-cena-skok-cena
[17] https://mondo.rs/Info/Ekonomija/a1519542/Cene-povrca-ce-zbog-suse-i-dlaje-rasti.html
[18] https://beta.rs/ekonomija/ekonomija-srbija/151972-susa-umanjila-rod-svih-poljoprivrednih-kultura-u-srbiji-steta-najmanje-500-miliona-dolara
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[20] https://beta.rs/ekonomija/ekonomija-srbija/151009-povrce-u-srbiji-zbog-suse-sve-skuplje
[21] https://www.rts.rs/page/stories/sr/story/57/srbija-danas/4481063/zbog-suse-manje-trave-na-pasnjacima-u-vojovidni.html
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[24] www.politika.rs/scc/clanak/487781/Стигла-вода-за-жедне-краве-и-коње
[25] https://www.rts.rs/page/stories/sr/story/125/drustvo/4480995/susa-opadanje-reka-srbije.html
[26] https://www.rts.rs/page/stories/ci/story/124/drustvo/4476959/vanredna-situacija-cacak-rzav.html
[27] https://www.glas-javnosti.rs/drustvo/zapadna-srbija-presusila-zedna-su-ljudi-stoka-zemlja-2704
[28] https://www.politika.rs/sr/clanak/485531/Susa-formirala-ostrva-na-Moravi
[29] https://www.politika.rs/sr/clanak/486167/Suva-recna-korita-u-Srbiji
[30] http://www.tanjug.rs/full-view.aspx?izb=675993
[31] https://www.novosti.rs/srbija/vesti/1026236/vojska-poslala-cisterne-pomaze-vodosnabdevanje-ugrozenih-opstina
[32] https://www.novosti.rs/srbija/vesti/1027185/delu-opstine-mionica-vanredna-situacija-zbog-suse-sest-sela-bez-vode-stizu-cisterne
[33] https://www.novosti.rs/srbija/vesti/1024281/presusilo-nebo-suve-slavine-dok-iscekuju-padavine-novoj-varosi-prinudjeni-restrikcije-vodosnabdevanju
[34] http://www.rina.rs/item/8498-n-a/
[35] https://www.juznevesti.com/Drushtvo/Nivo-Zavojskog-jezera-opet-nizak-prioritet-proizvodnja-struje.sr.html

MONTENEGRO

Dry taps, yellowed meadows in the mountainous areas of Zabljak and Sinjavina and dried-up springs seen in August were some of the result of a huge deficit of precipitation in the whole of

Montenegro since March, as well as extremely high air temperatures this summer. Several springs in Sinjajevina, central Montenegro, dried up so cattle breeders were forced to bring water on horses from remote areas. Some rural areas too were without water for days, as there was simply not enough of it in the system. In Martinici, southern Montenegro, water pump functioned for an hour and a half per day as water supply from the Slatina spring was at a minimum [1].

[1] https://www.vijesti.me/vijesti/drustvo/562700/susa-zatvorila-cesme-presahla-izvore-pozutjela-livade

NORTH MACEDONIA

In August, agrometeorologists reported of drought damage on corn and sunflower, as well as on rainfed vegetable crops where yields were very low, and some areas were not expected to bear yield at all. Endangered due to drought were also the vines and fruits that had so far drawn water from the deeper layers [1].

[1] https://republika.mk/vesti/ekonomija/ovoshkite-i-vinovata-loza-najzagrozeni-od-sushata-vo-opasnost-se-i-pchenkata-i-sonchogledot/

GREECE

This summer in Greece was characterized by several days with high temperatures. The major heatwave that started in the last days of July and continued until the first days of August, together with a succession of several days without precipitation in most of the country, created favorable conditions for forest fires in various areas [1]. The most extensive forest fires occurred in Attica, Evia and Peloponnese [2, 3, 4, 5], and caused significant damages in forest and agricultural areas. In the Peloponnese, the estimations showed a rapid recovery of ecosystems, especially flora. However, in Evia, around 400 000 hectares might never return to their previous state, while in Attica the ecosystem will hardly recover [6]. Losses of livestock and losses of beehives and hives were critical. The president of the Federation of Beekeeping Associations of Greece, for the beekeepers of Evia, who represent half of the beekeepers in Greece and whose production accounted for 70 % of all Greek production, described the situation as a disaster: the beehives were reduced to ashes; thousands of bee swarms were lost; and the forest of North Evia will take more than 30 years to become productive to its previous levels. Losses of the famous pine honey of Evia are estimated at 5–10 000 tones. People engaged in resin harvesting from pine trees also faced important losses [7, 8]. The Insurance Agency of the Ministry of Rural Development and Food reported estimates according to which over 9 000 bee swarms were severely damaged by the fires [8].

[1] http://www.hnms.gr/emy/el/pdf/heatwave_2021.pdf
[2] https://www.ertnews.gr/eidiseis/ellada/live-stis-floges-i-voreia-attiki-efialtiki-i-katastasi-se-afidnes-kryoneri-ippokrateio-politeia/
[3] https://www.in.gr/2021/08/23/greece/vilia-mainetai-nea-fotia-ekkenonontai-oikismoi-anisyxia-gia-tous-isxyrous-anemous/
[4] https://www.ethnos.gr/ellada/169871_fotia-eyboia-terastia-oikologiki-katastrofi-ti-deihnoyn-ta-stoiheia-tis-ypiresias
[5] https://www.ertnews.gr/eidiseis/ellada/pyrina-metopa-stin-ileia-apeiloyntai-choria-stin-archaia-olympia/
[6] https://www.kathimerini.gr/society/561464104/to-vary-perivallontiko-apotypoma-ton-pyrkagion-se-eyvoia-attiki-kai-peloponniso/
[7] https://www.in.gr/2021/08/13/greece/fotia-stin-eyvoia-xathikan-xiliades-smini-melisson-oloklirotiki-katastrofi/
[8] https://www.ethnos.gr/ellada/171733_fotia-se-apognosi-oi-melissokomoi-kaikan-9000-melissosmini-kai-hathikan-10000-tonoi

TURKEY

In January, major cities across Turkey were at risk of water shortages for following months, with Istanbul at worst with water supplies for less than 45 days. Izmir and Bursa, Turkey's second and third largest cities, were also at risk with their reservoirs at around 36 % and 24 % respectively. Farmers in wheat fields in Konya, southwestern Turkey and Edirne, northwestern Turkey also warned of their yield being in danger [1]. In May, the Union of Chambers of Agriculture of Turkey stated that the number of provinces affected by drought increased to 41 as May rains were insufficient and demanded a grant of 200 liras per decare to the producers. The crops that in May suffered from drought the most were barley, wheat and red lentil, and products such as newly

planted corn, sugar beet, potatoes, chickpeas, green lentils, paddy and forage crops were also affected by drought [2]. Drought consequences were observed also in autumn as the return journey of the breeders grazing their animals on the plateau started much earlier than normal. They usually wait for the end of October to return, but were this year returning in mid-September due to no grass left in the region as a result of early cooling of the weather and lasting drought conditions [3]. In September, the Cal Canyon was completely dried up for the first time in history. Until last year, the water level in the canyon stood at 2 m but continued to decrease due to prolonged precipitation deficit and drought. As the water level declined, many fish remaining in the pits died in ponds without oxygen. The drying up of this canyon presented danger also for wider natural life of this place. The surrounding 7 thousand decares of agricultural land also relied on canyon's water for irrigation irrigated [4]. In October, also Lake Tuz, the second largest in Turkey, completely dried up due to drought and climate change. At 1665 km^2 in size, the lake was home to several species of birds. It was additionally hit by agricultural practices which, according to experts, exhausted the underground water supply. A study based on satellite images showed that the water level of Lake Tuz began to fall in 2000, and that it completely disappeared this year due to high temperatures, increased evaporation and insufficient rain. Several other lakes across Turkey also dried up or the amount of water in them was reduced to alarming levels [5].

[1] https://www.lifo.gr/now/world/xirasia-stin-toyrkia-i-konstantinoypoli-mporei-na-xemeinei-apo-nero-se-45-imeres
[2] https://www.haberturk.com/tzob-genel-baskani-semsi-bayraktar-mayis-ayi-kuraklik-raporunu-acikladi-3088510-ekonomi
[3] https://www.haberturk.com/kuraklik-onlari-da-vurdu-donuyorlar-3217099
[4] https://www.haberturk.com/son-dakika-kuraklik-kapiyi-cal-di-efsane-vali-yazicioglu-ile-duyulmustu-3185363
[5] https://www.blic.rs/vesti/svet/jezero-tuz-u-turskoj-presusilo-zbog-klimatskih-promena-50000-flamingosa-ostalo-bez/yft5b22

Methodology

DMCSEE Drought monitoring bulletin is based on numerical weather prediction (NWP) model simulations over SE Europe, SPI index calculations, remote sensing and public media drought impact reports. Precipitation data is provided by Global Precipitation Climatology Centre (GPCC; https://www.dwd.de/EN/ourservices/gpcc/gpcc.html). NWP simulations are performed with Non-hydrostatical Mesoscale Model at ~7 km spatial resolution (NMM; http://www.dtcenter.org/wrf-nmm/users/). Historical DMCSEE model climatology is computed with NMM for time period between 1 January 1991 and 31 December 2020. European Centre for Medium Range Weather Forecast (ECMWF) ERA5 dataset (http://www.ecmwf.int/en/forecasts/datasets/reanalyses-datasets/era5) is used as input for simulations. Long-term averages (1991-2020), used for comparison of current weather conditions, are obtained from simulated dataset. Comparison of current values with long-term averages provides a signal on potentially ongoing drought.