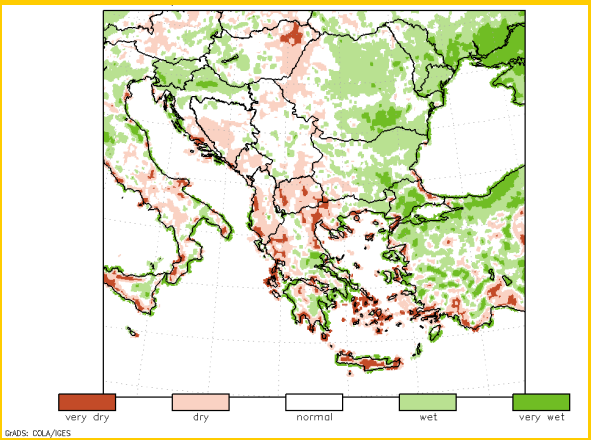
DROUGHT MONITORING BULLETIN

July 2021

HOT SPOT

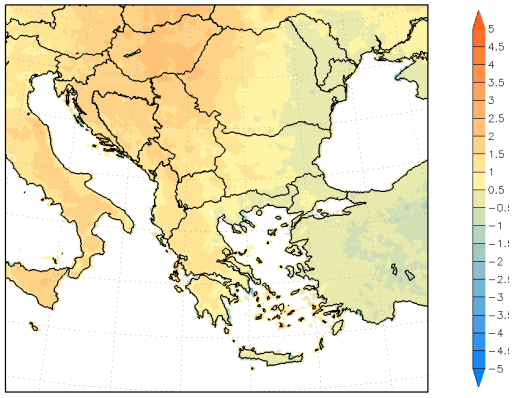


A map of **accumulated surface water balance between 1 April and 29 July 2021 in percentile classes** indicates the first four months of the vegetation season brought varying precipitation and evapotranspiration conditions across the region. Areas in the region's north-west and vast part of its east saw above-average surface water balance level over the past four months, while eastern half of Hungary, countries along the south Adriatic Sea, North Macedonia and most of Greece recorded noticeable deficit over that time in comparison to the past 30 years.

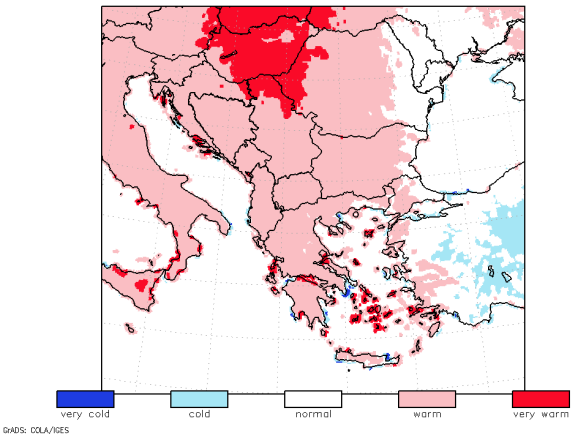
AIR TEMPERATURES AND SURFACE WATER BALANCE

*Figures in this section present anomalies of the average air temperature and accumulated surface water balance as well as classified values of the average **air temperature** and **surface water balance** in percentile classes for 60-day period **from 31 May to 29 July 2021**.*

AVERAGE AIR TEMPERATURE ANOMALY (°C)
31 MAY – 29 JULY 2021



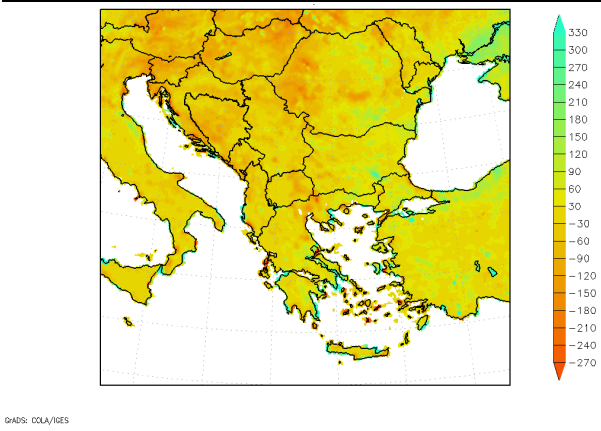
AVERAGE AIR TEMPERATURE PERCENTILE CLASSES
31 MAY – 29 JULY 2021



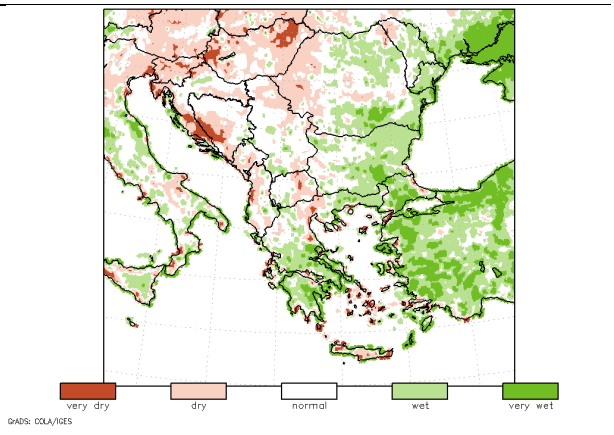
In general, July was warmer than usual across the entire Balkan Peninsula, while western half of Turkey saw air temperatures within the normal range most of the month with the exception

of mid-July. Throughout the month, above-average air temperatures were the highest across the northern and wider central part of Balkan Peninsula. In first days of July, air temperatures across nearly all of the Balkan Peninsula were on average up to 2 °C higher than usual, in eastern half of Hungary bordering over to western Romania as well as over the Aegean Greece up to 3 °C. Second dekad brought even higher air temperature anomalies. Over Slovenia and Croatia anomalies of up to 2 °C prevailed, elsewhere along the Adriatic Sea and, Greece and Turkey up to 3 °C, while the rest of the region experienced air temperature between 4 °C and 6 °C warmer than normally, classifying them among the hottest 5 % of local historic records. The abnormal heat eased in late July, however, air temperatures continued to exceed the average for up to 2 °C across most part of Balkan Peninsula excluding Aegean Greece and areas along the Black Sea. The 60-day average of air temperature covering June and July between 1.5 °C and 2.5 °C warmer than normal over the northwestern quarter of Balkan Peninsula, most noticeably over central Hungary resulting in one of the hottest June-July periods of local records. Also central and southern part of Balkan Peninsula, from central Romania, across central Serbia to southern Greece, experienced June-July period up to 1.5 °C warmer than normal, while the 60-day mean air temperature was up to 1 °C lower than the long-term average across central Turkey.

ACCUMULATED WATER BALANCE ANOMALY (mm)
31 MAY – 29 JULY 2021



ACCUMULATED WATER BALANCE PERCENTILE CLASSES
31 MAY – 29 JULY 2021

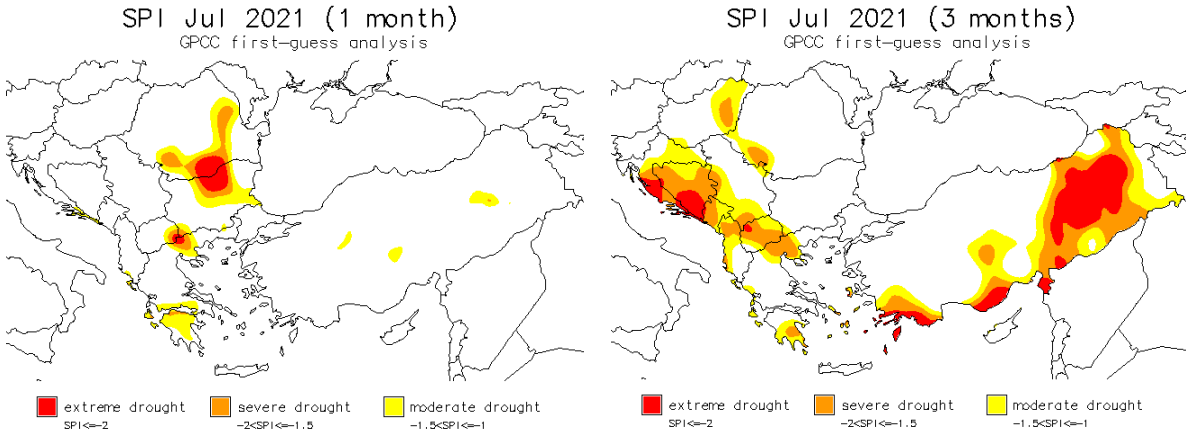


At the beginning of July, the level of 60-day accumulated surface water balance across the region covering May-June period showed west-east polarity, with countries in the west half of Balkan Peninsula up and including Hungary, Serbia, North Macedonia and northern Greece experiencing noticeable surface water balance deficit, while wetter-than-normal surface water balance levels was present in countries in the eastern half including southern half of continental Greece. Throughout the month, 60-day accumulated surface water balance conditions shifted clockwise, causing the intensification of the deficit across northern half of Balkan Peninsula, especially along the Adriatic Sea, Slovenia and Hungary where deficit of the June-July period reached up to -150 mm, in eastern Hungary up to -180 mm. Also, negative anomalies of up to -120 mm were brought to western and central Romania and northern Moldova and up to -90 mm to western Bulgaria, as well as surplus earlier present over wider part of Bulgaria was brought down to average values. On the other hand, July saw intensification of surface water balance surplus across western half of Turkey and over southern parts of continental Greece, exceeding the usual values of the June-July period for up to 120 mm, across Turkey's northern coastline up to 180 mm, locally creating very wet surface water balance conditions.

STANDARDIZED PRECIPITATION INDEX

The drought situation with regard to the precipitation accumulation is presented by Standardized Precipitation Index (SPI). The SPI calculation is based on the distribution of precipitation over long time periods (30 years, in our case long-term average 1961-1990 was used). The SPI can be calculated at various time scales which reflect the impact of the drought on the availability of water resources. The long term precipitation record is fit to a 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 and values less than zero indicate drier periods. Only the dry part of the extreme anomalies is presented on the maps.

Standardized precipitation index for **July 2021** is shown in figures below. SPI for a one-month period indicates possible drought conditions which can have impact on vegetation, while SPI for a three-month period can be indicative also for surface water status.



Precipitation-wise, July brought considerably lower than normal amount of rain to parts of eastern and southern Balkan Peninsula. Most noticeable was the lack of rain in area stretching across southwestern half of Romania and eastern half of Bulgaria, indicating severely to extremely low July precipitation level. Unusually low rainfall rate indicating moderate drought conditions was present also northeastern Greece, over its southern areas and cross parts of central Turkey, according to SPI for July.

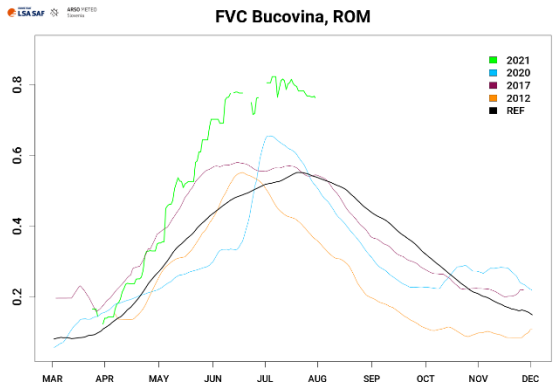
Past three months were diverse in terms of precipitation level brought to different parts of the region. After May being severely to extremely dry across North Macedonia, Greece and most of Turkey, followed by extremely dry June across the entire northwestern quarter of Balkan Peninsula and eastern third of Turkey, July saw the smallest portion of area in the region under noticeable lack of rain over the past three months. In that view, a 3-month accumulations of precipitation conditions between May and July show severely to extremely low rainfall rate across the entire eastern third of Turkey and along its south, over areas in a wider belt from Croatia to northern Greece, but locally also in southern Greece, eastern Hungary and southwestern Romania.

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 data base 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, it has also proved to be useful for drought monitoring. 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.

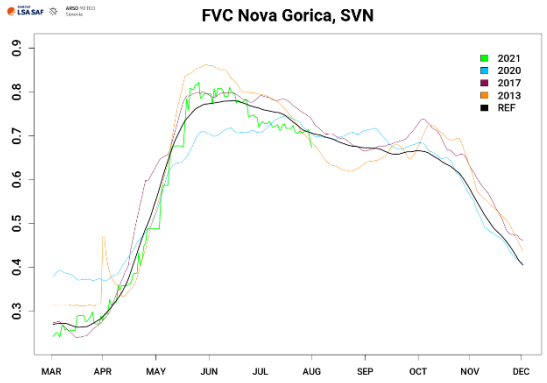
Graphs below present the **vegetation situation** as recorded **on 31 July 2021** in some regions of Southeastern Europe. FVC values for year 2021 are presented as a green line. Graphs also include reference line (2004–2020) in black, and lines in light blue (year 2020), magenta (year 2017) and orange (year 2012, or 2013 for Slovenia) for comparison. Possible missing values or sharp decline of values could be a result of prolonged cloudy weather, extreme weather events or snow blanket.

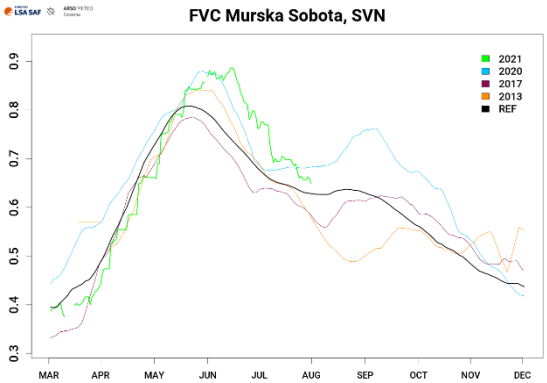
ROMANIA



FVC values for Bucovina, northern Romania have been above-average since the beginning of the season. Vegetation growth reached its peak in early July, slightly ahead of its usual time, with its coverage exceeding the average for approximately 25 %. FVC values for second half of July indicate that vegetation senescence have already begun at its usual rate. At the end of July, vegetation cover remained more than 20 % above the reference for this time of year.

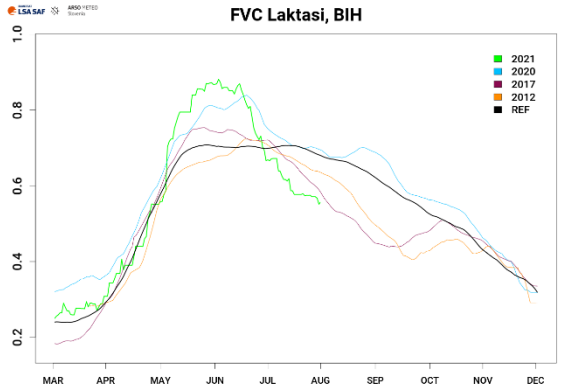
SLOVENIA

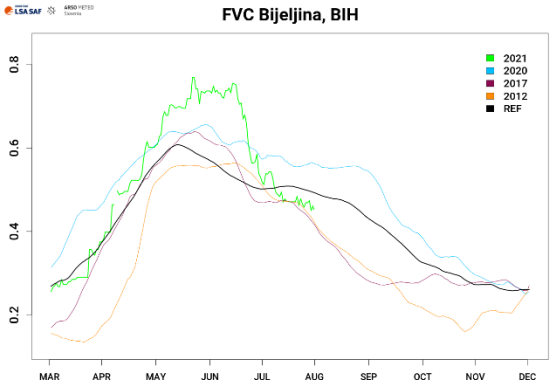


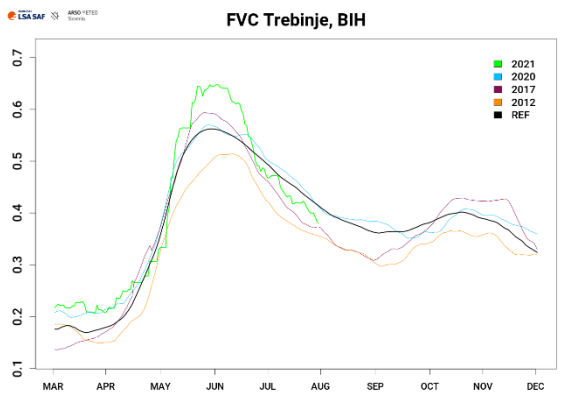


Vegetation growth in Nova Gorica, western Slovenia and in Murska Sobota, northeastern Slovenia followed its usual pattern of development until mid-May when further boost in growth can be observed, according to FVC, resulting in vegetation cover exceeding their peak values later on. In Nova Gorica, this boost was of lower intensity and length, as a decline in vegetation cover began in late June but July weather conditions seemed to alleviate the decline. In Murska Sobota, vegetation growth continued well into June, almost a month longer than normal time and exceeding its peak coverage for nearly 10 %. June weather conditions resulted in rapid senescence which lasted throughout July as well, bringing level of vegetation cover closer to its usual one for late July.

BOSNIA AND HERZEGOVINA (REPUBLIC OF SRPSKA)

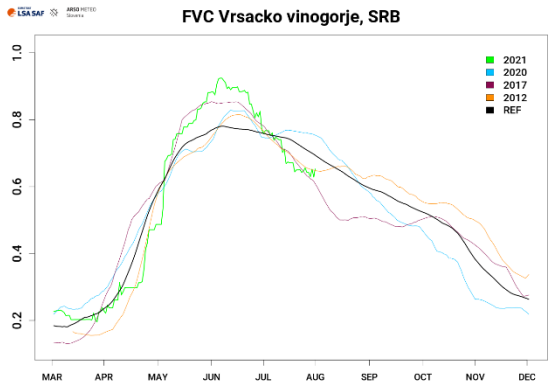


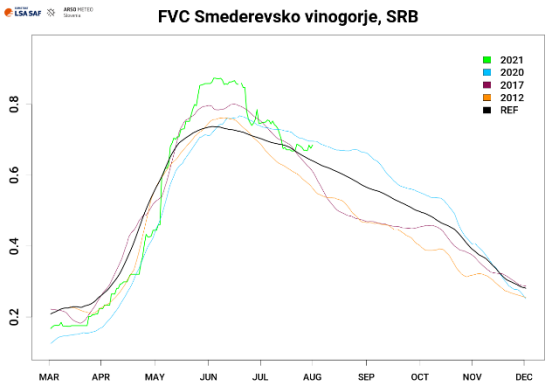




Vegetation at all three locations across Bosnia and Herzegovina recorded normal development pattern in first months of the season. Weather conditions proved favourable for further growth and expansion during May and June, their peak time, exceeding the regular peak vegetation cover for approximately 15-20 %. Although June normally sees beginning of vegetation senescence, at all three locations it occurred at a much higher rate than normal. FVC values dropped from well above average in early June to average in early July, and continued to drop at a higher-than-normal rate until the end of the month. In Bijeljina and in Trebinje, northeastern and southern part of the country respectively, FVC values at the end of July indicate only slight negative deviation from their usual level at this time of year, while in Laktasi in the country's north-west, the drop of FVC values throughout July indicates vegetation cover is approximately 15 % smaller than it normally is at the end of July.

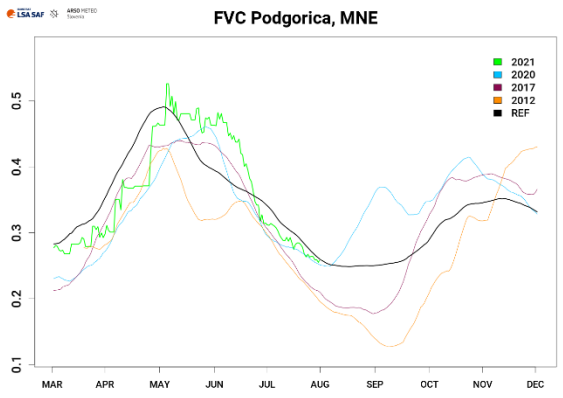
REPUBLIC OF SERBIA





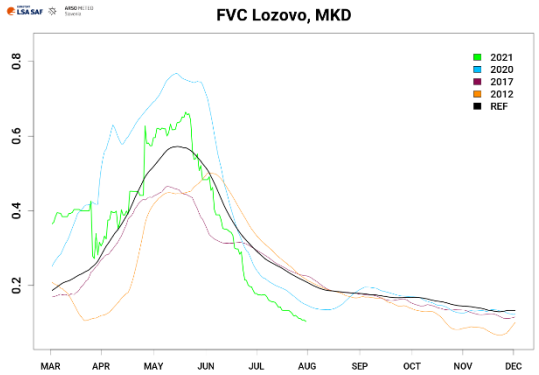
In first two months of the season, vegetation development in Vrsacko vinogorje, northeastern Serbia saw some slight stagnation, especially during April, and in Smederevsko vinogorje, central Serbia it was slightly lagging behind its usual level of development early into the season. Favourable weather conditions in late spring resulted in boosted vegetation growth, with FVC values eventually exceeding the average cover in mid-May. By early June in its peak time, fraction of vegetation cover at both location was well higher than normal, for approximately 15-20 %, however, June weather conditions resulted in rapid decline in level of vegetation cover, at the rate similar to the one experienced during 2017 summer drought. Vegetation in Smederevsko vinogorje experienced temporal cease of decline in early July, which seem to prevent the level vegetation cover to fall below the average. While in Vrsacko vinogorje, July weather conditions sustained the unusually high rate of vegetation senescence that began in June, with FVC values below the average at the end of July.

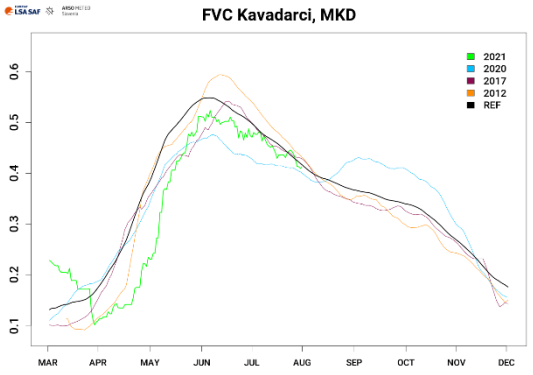
MONTENEGRO



Vegetation season began later than normal in Podgorica, southern Montenegro, as indicated by a delay observed in FVC values. Late spring weather conditions proved favourable for vegetation growth as it caught up to reach its peak at its usual time and level of coverage, furthermore they maintained good level of vegetation cover throughout all May and first half of June, up to a month later than normal. June weather conditions sped up vegetation senescence, which was slowed down in July. Despite the rapid changes in vegetation cover, FVC at the end of July stood at their average level.

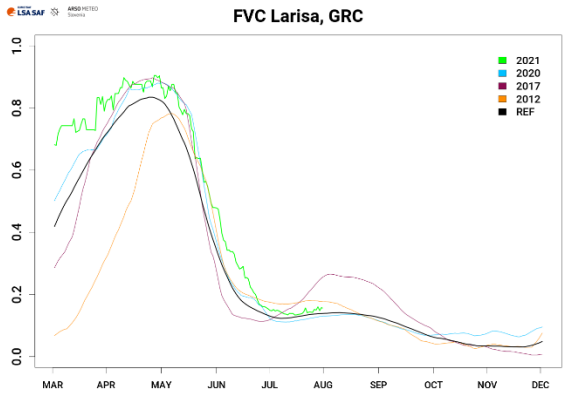
NORTH MACEDONIA

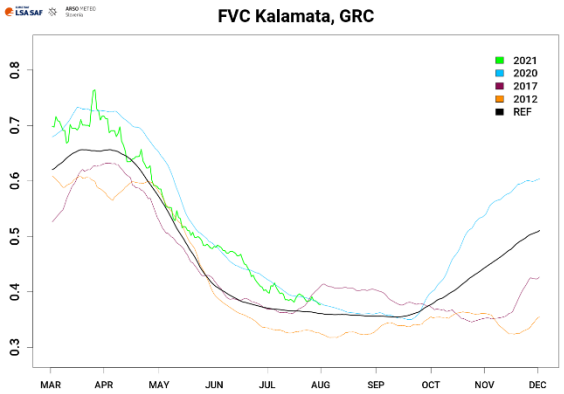




In Lozovo, central part of North Macedonia, vegetation development progressed at its usual rate for most of first half of vegetation season and reached its peak coverage at the usual time in mid-May. Vegetation senescence began in June, however, it progressed at the higher rate than normal, resulting in a continuous decline from average vegetation cover in early June to approximately half its usual coverage at the end of July. In Kavadarci, southern part of North Macedonia, vegetation season began approximately alter than normal but favourable weather conditions helped vegetation growth to progress well and reach its peak at only slightly lower level of coverage than normal. June and July weather conditions did not bring surprises in progress of vegetation senescence, as according to FVC it follows its usual rate.

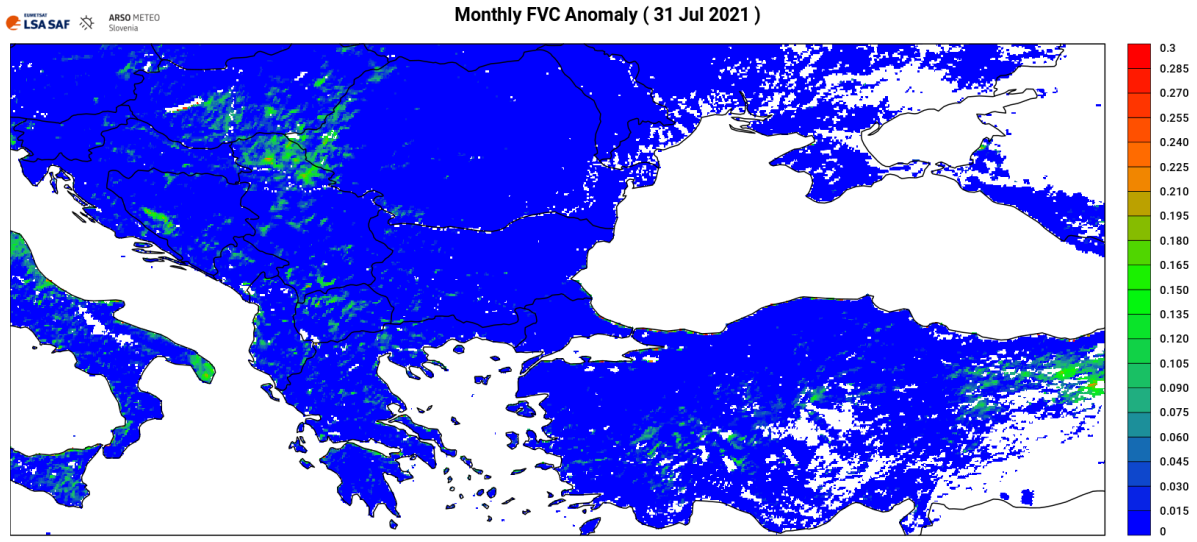
GREECE





According to FVC values, vegetation at both locations in Greece appears to have a good season in terms of its development and growth, with peak values exceeded for 5-10 % at both locations. The senescence part of the season also follows its average progress in Larisa, central Greece, with FVC values well exceeding the usual level of coverage throughout May and June, and July saw some normalization to its average coverage. In Kalamata, southern Greece, vegetation senescence progressed at a slower rate than normally throughout May and June, similar to the year 2020, resulting in vegetation cover up to 10 % higher than normal for this time of year. It continued at the similar rate also in July, slowly reaching its dormancy level approximately a month and a half later than normal.

Figure below shows negative anomaly of **accumulated 30-day FVC values** as recorded **on 31 July 2021** in comparison to the past 17 years (2004-2020), and is used experimentally.



Despite changing vegetation development patterns throughout this vegetation season in various parts of the region, accumulated FVC anomalies at the end of the month reveal vegetation across most of the region stood at their usual levels of coverage for this time of year. Noticeably lower than normal level of vegetation cover appear to be present all across northern Serbia and southern Hungary, for up to 18 %, locally also in scattered areas across southern Serbia, across the border to North Macedonia and in western Bosnia and Herzegovina. According to FVC, level of coverage with green vegetation appeared to be smaller than normal also across vast part of northeastern Turkey.

IMPACT REPORTS

HUNGARY

Poor crop harvest in early summer did not improve already difficult fodder situation in the livestock sector in Hungary. According to a recent 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. The rise in feed prices affected all livestock sector and it is not certain yet how summer weather conditions will affect autumn harvest of fodder, also sunflower, soybeans, but especially corn [1].

[1] https://index.hu/gazdasag/2021/07/25/megy-az-arharc-a-baromfiszektorban-is/

CROATIA

Drought, which began in May, and summer heatwaves affected all crop yield in eastern Croatia (Slavonia and Baranja regions) and the damage was counted in millions HRK [1]. It was

estimated that maize, soy and sugar beet yield will be significantly to substantially reduced [2]. A state of natural disaster due to drought and high temperatures during June and July was declared for the area of Virovitica-Podravina County [1, 4]. Irrigation system in Croatia is still poor and insufficient. Drought was also detected in other parts of Croatia while in Istria and at the southern Adriatic coast, reduces in crop and fruit yield are estimated as likely. At the southernmost meteorological stations Dubrovnik and Lastovoa, dry spell of 36 days was recorded (began in June and continued in July). Even more, in Dubrovnik, there was only one rainy day (with 2.1 mm) in otherwise a 49-day long dry period [3, 4].

[1] https://meteo.hr/proizvodi.php?section=publikacije&param=publikacije_publikacije_dhmz&el=bilteni (publication is in preparation)
[2] https://meteo.hr/klima.php?section=klima_pracenje&param=spi&el=karte_suse&Week=210805
[3] https://meteo.hr/klima.php?section=klima_pracenje&param=spi&el=prspi
[4] https://meteo.hr/klima.php?section=klima_pracenje&param=ocjena

BOSNIA AND HERZEGOVINA

High 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, and as a result, reduced yields as well as poor product quality are expected. Most of wheat was collected before the worst state of drought and heat, but corn, soybeans and sunflower are under great question [1]. Drought negatively affected also vegetables, potatoes, onions, carrots, which were in the ripening stage, thus yields will certainly be far from expected. Potatoes were reported small and of poor quality, and beans, which were in the stage of flowering and pod formation, was also affected by drought. Many cabbage seedlings dried in heat in the fields of Sprecko polje and Semberija, eastern Bosnia and Herzegovina. Most concerning was the conditions of corn, a strategic crop for the production of fodder-silage. It is expected that corn yield will be 50 % lower [2]. Farmers in Lijevce polje, central-eastern Bosnia and Herzegovina, reported of considerable drought damage on cereals including barley, oats, wheat and corn, and expect their yield to be the worst in last half a century. Slightly better situation was observed on plots where irrigation was possible, however, 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 has dropped [3]. According to the president of the Association of Agricultural Producers of Republika Srpska, other agricultural branches, such as fruit growing and vegetable growing, were in no better situation. Although farmers might have an irrigation system, with such high temperatures and a certain amount of water, "cooking" of plants is caused [1]. As a result of drought, the prices of fruits and vegetables on the Bijeljina green market in northeastern Bosnia and Herzegovina were observed significantly above the usual average in mid-July. As far as fruit is concerned, raspberries, blackberries and blueberries were the most sought after, apart from watermelon [4].

[1] https://www.nezavisne.com/ekonomija/agrar/Susa-sprzila-sve-na-njivama-u-Srpskoj/670885
[2] https://avaz.ba/kantoni/republika-srpska/666280/poljoprivrednici-ocajni-nakon-sto-je-susa-zaprijetila-povrcu-zabrinuti-smo-mnogi-ce-morati-zatvoriti-farme
[3] https://avaz.ba/kantoni/republika-srpska/665795/velika-steta-za-poljoprivredu-susa-unistila-ratarsku-proizvodnju-u-lijevce-polju
[4] https://avaz.ba/vijesti/bih/666253/susa-diktira-cijene-voca-i-povrca-na-zelenoj-pijaci-buranija-medu-najskupljim-povrcem

SERBIA

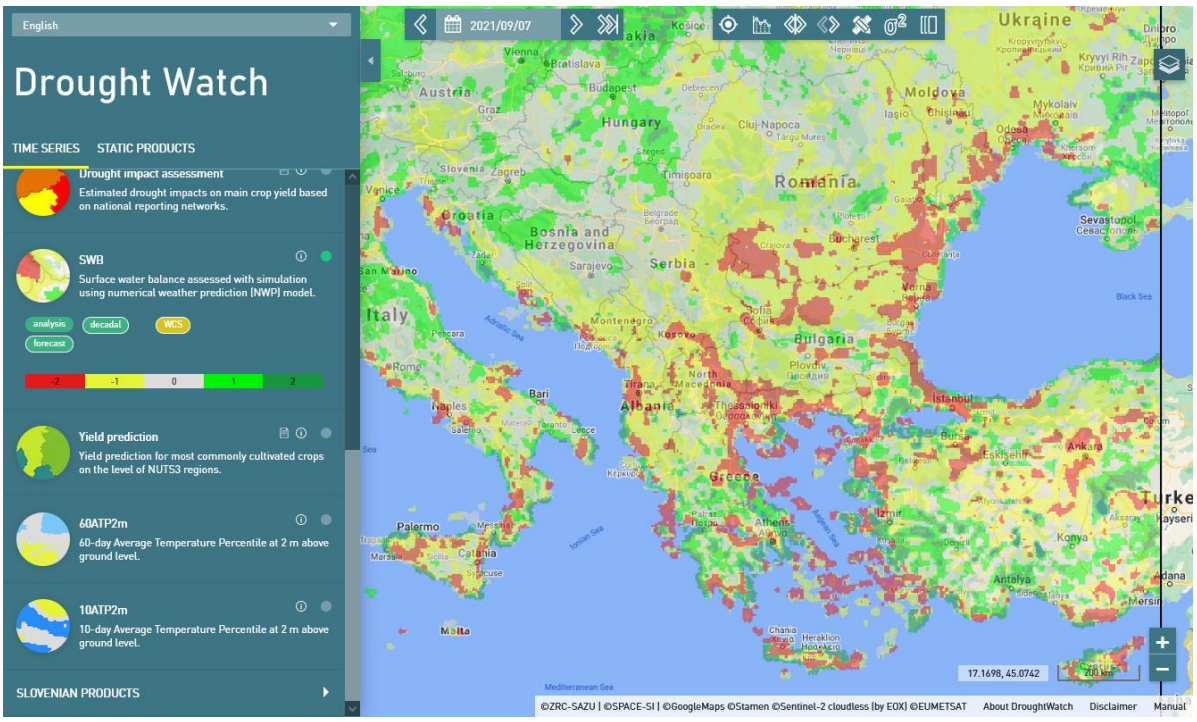
Corn is among the most affected agricultural crop also in Serbia. Due to the serious lack of precipitation in June and extremely high air temperatures in the first half of July, corn production was in poor conditions on many plots in Serbia, so even heavy rain in late July

could not significantly improve the situation [1]. Unfavorable conditions for pollination and pouring of grain left a large number of corn stalks without fruit, so it is estimated that some plots will bear no harvest. This year, situation with corn appeared similar to the one in drought years 2012 and 2017 [2]. 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, report halved crop, with increased prices for a kilogram of mint in bulk [3]. According to the president of the Association of Raspberry and Blackberry Producers in Serbia, this year the raspberries yield will be at most about 35 % of the average yield [4]. 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. The Vodovod water supply company observed a two to three times higher than normal water consumption in the peripheral Belgrade settlements [5].

[1] https://aktuelno.net/vesti/srbija/SUSA-UZELA-DANAK-I-KUKURUZU-Obilne-kise-proteklih-dana-vise-su-nego-dobrodosle-nasim-usevima-ali-su-okasnile-za-mnoge-parcele/c/6179322
[2] https://www.novosti.rs/republika-srpska/vesti/1021422/kukuruz-vapi-kisom-susa-uzima-danak-semberskim-poljima
[3] https://aktuelno.net/vesti/srbija/Susa-prepolovila-rod-mente-skocila-cena/c/6213691
[4] https://aktuelno.net/vesti/srbija/Zbog-suse-i-nevremena-desetkovan-rod-maline-u-Srbiji/c/6177297
[5] https://www.blic.rs/vesti/beograd/susa-pravi-probleme-mestanima-oko-beograda-snalaze-se-za-zalivanje-voca-i-povrca-a/7b30ry9

OUTLOOK

Figure below presents model simulations of the **60-day accumulated surface water balance anomaly** in historical percentile classes for the time period **from 10 July to 7 September 2021**, as seen in Drought Watch tool[1].



[1] https://www.droughtwatch.eu/

Level of accumulated surface water balance will remain above-average across central Greece and southwestern part of Turkey, a welcome change from dry to wet surface water balance conditions is expected across the region's north-west including Hungary, Slovenia, Croatia and northern parts of Serbia and Bosnia and Herzegovina. In other areas in the region, especially across central third of Balkan Peninsula, surface water balance levels of dry to very dry classification will prevail. Compared to the June-July accumulated surface water balance, this means continuation of dry water balance conditions over the southern Adriatic Sea area, intensification of dry conditions over North Macedonia, and a change from wet to dry or even very dry across most of the eastern Balkan Peninsula, from Moldova to northern Greece, with the exception of the Carpathian area.

Methodology

DMCSEE 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; see: https://www.dwd.de/EN/ourservices/gpcc/gpcc.html). NWP simulations are performed with Non-hydrostatical Mesoscale Model with cca. 7 km spatial resolution (NMM; see: http://www.dtcenter.org/wrf-nmm/users/). Historical DMCSEE model climatology was computed with NMM model for time period between 1 January 1991 and 31 December 2020. European Centre for Medium Range Weather Forecast (ECMWF) ERA5 data set (see: http://www.ecmwf.int/en/forecasts/datasets/reanalyses-datasets/era5) was used as input for simulations. Long term averages (1991-2020), 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.