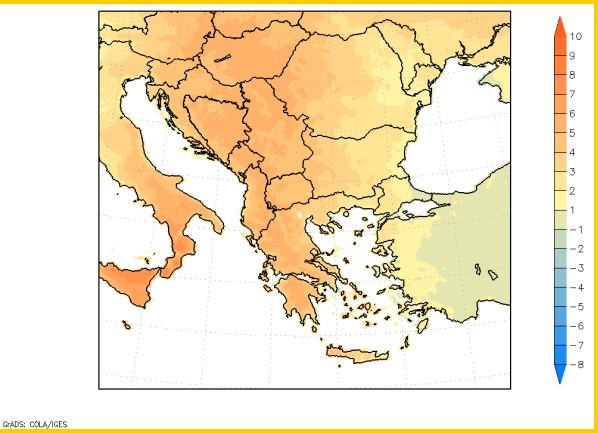
DROUGHT MONITORING BULLETIN

June 2021

HOT SPOT

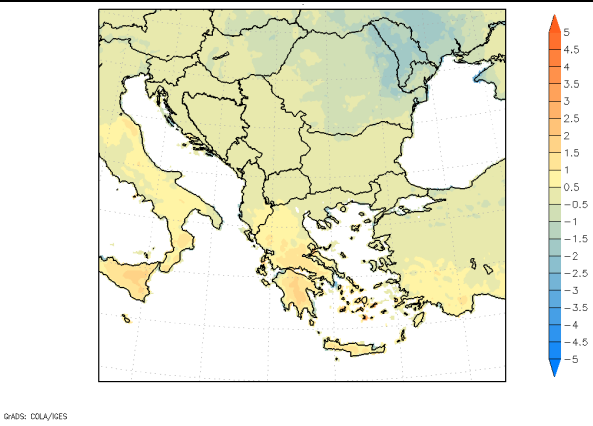


Air temperatures were abnormally high all across Balkan Peninsula in last days of June. Figure of the left, showing **anomalies of the 10-day mean maximum air temperature [°C] in period 20th-29th June 2021**, reveals the highest air temperatures still exceeded the local average maximum by up to 7 °C in wider Pannonia Basin and in central Greece, and up to 6 °C elsewhere across the western half of Balkan Peninsula. Only in a small part of the region along the Black Sea they were about average for this time of year.

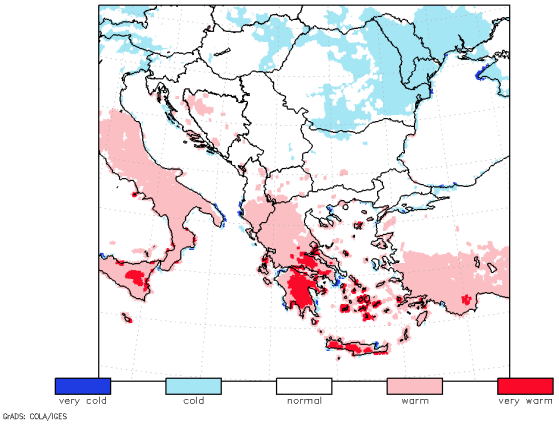
AIR TEMPERATURES AND SURFACE WATER BALANCE

*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 1 May to 29 June 2021**.*

AVERAGE AIR TEMPERATURE ANOMALY (°C)
1 MAY – 29 JUNE 2021



AVERAGE AIR TEMPERATURE PERCENTILE CLASSES
1 MAY – 29 JUNE 2021

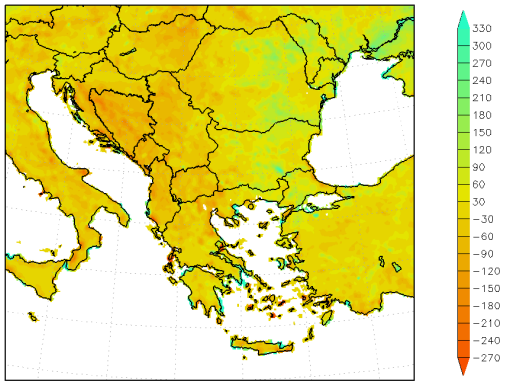


June began as much colder than normal across most of the region. With the exception of its northwestern part, including western Hungary, Slovenia, Croatia and Bosnia and Herzegovina, air temperatures in first dekad of June were up to 3 °C colder than usual, across Moldova, far

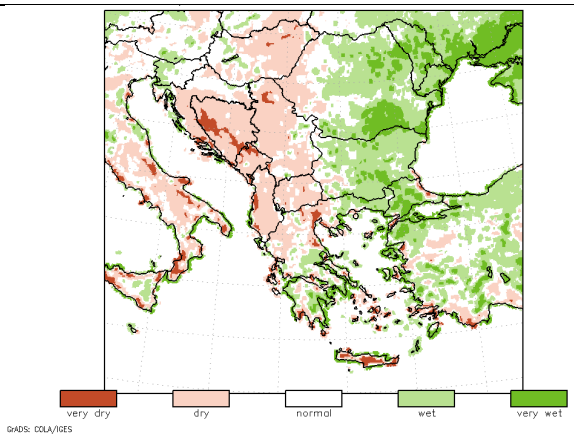
eastern Romania and central Turkey even up to 4 °C colder. The grip of such colder-than-normal air temperatures remained across the region even in mid-June, keeping the entire southern half of the region, Moldova and Romania in air temperatures mainly up to 3 °C. Locally in Romania and Moldova they were up to 4 °C colder than normal in mid-June, classifying them among the coldest of the local records. In that time, however, warmer air temperatures started spreading across the region from north-west, resulting in above-average air temperatures of up to 2 °C over western Slovenia in mid-June at first, but which in last dekad of June brought unusually high air temperatures to the entire Balkan Peninsula. Western half of the region experienced one of the highest air temperatures of the record as anomalies stretched up to 6 °C above the average in a wide belt across central Balkan Peninsula, from Hungary to southern Greece, and mostly between 3-5 °C elsewhere across the peninsula. Only its eastern part from Moldova to eastern half of Bulgaria saw above-average air temperatures of smaller anomalies, however, the rapid change in warmer air temperature is noticeable there in the view of below-average air temperatures in mid-May over that part of the region.

With May anomalies stretching from colder than normal across the northern countries to much warmer than normal in Greece and Turkey, followed by above-average June in western half of the region and below-average June in far-east of the region, anomalies from the 60-day mean air temperature balance out across vast part of the region. On a 60-day overview, noticeable anomalies from the average were present in Moldova and eastern Romania where May-June period was up to 2 °C colder, and across the rest of the region's north-east from eastern Hungary to southeastern Romania where May-June period was up to 1 °colder. On the other hand, the two-month period was 1-2 °C warmer than normal in central and southern Greece due to above-average air temperature persisting over the Aegean Sea area in May as well as June.

ACCUMULATED WATER BALANCE ANOMALY (mm)
1 MAY – 29 JUNE 2021



ACCUMULATED WATER BALANCE PERCENTILE CLASSES
1 MAY – 29 JUNE 2021



In June, precipitation map divides the region in two halves in a similar west-to-east direction as the air temperature one, resulting in areas of high evapotranspiration nearly coincide with the areas of noticeable lack of rain. May precipitation conditions were much different across the region, dividing it north-to-south, meaning most parts of the region experienced the opposite precipitation conditions in May to those in June. Only the areas along the Adriatic Sea including Albania experienced both months as dry to very dry, as well as Romania and Moldova where conditions were wet to very wet in May as well as June.

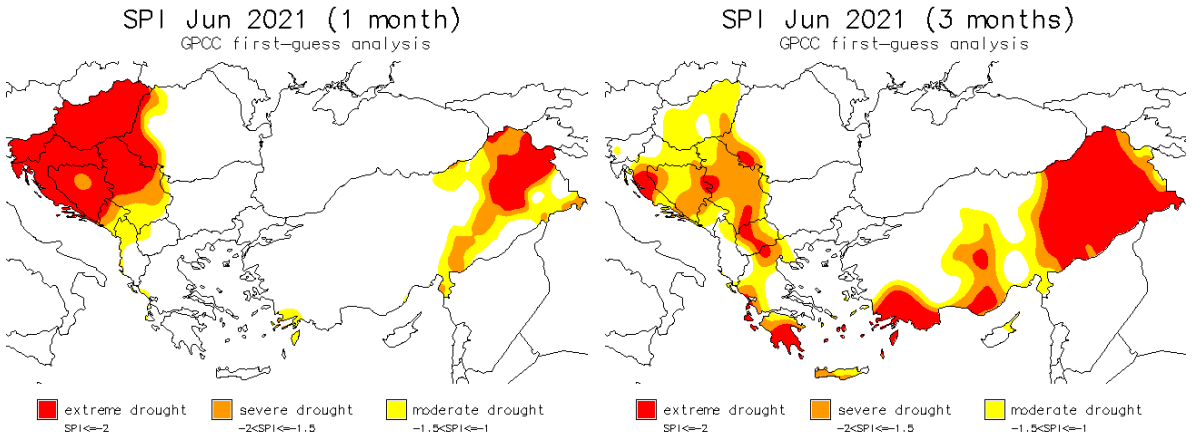
The 60-day accumulated surface water balance shows noticeable deficit over most of the western half of the region. Negative anomalies were the greatest in northeastern Hungary, over

all of Bosnia and Herzegovina, Montenegro and in parts of southern Albania and northern Greece, where accumulated deficit ranged between -120 mm to -180 mm. Elsewhere across the western half of Balkan Peninsula, surface water balance was mainly up to 90 mm lower than normally in the May-June period. 60-day accumulations of surface water balance show barely any noticeable deviation from the average over Turkey, while Moldova, Romania with the exception of its western part and Bulgaria ended a two-month period with surface water balance surplus. It exceeded the local average for up to 90 mm in Bulgaria and up to 120 mm in Moldova and Romania, locally over northeastern Romania, surplus reached up to 180 mm.

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 **June 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 amount in June was the highest in wider area along the western part of Black Sea, including Moldova, most of Romania and Bulgaria, and northwestern Turkey. However, on the other hand SPI reveals June was extremely dry in northwestern quarter of Balkan Peninsula and over eastern Turkey. In terms of percentile analysis, June precipitation level over these parts of the region classified among the lowest 5 % of the local records, indicating extreme drought conditions. Under-average precipitation amount that indicated moderate to severe drought conditions according to SPI was present also over southern Serbia and over to northern Albania, in limited area in southwestern Turkey and across the south-east part of the country.
A 3-month overview reveals a great part of the region experienced noticeable under-average precipitation level on a cumulative basis from April to June. The entire eastern third of Turkey experienced severe to extreme lack of rain over the course of all 3 months under review, resulting in extreme drought conditions, indicated by extremely low SPI3 values, over that part of the country. Cumulative precipitation deficit ranks as extreme also over its south-west and

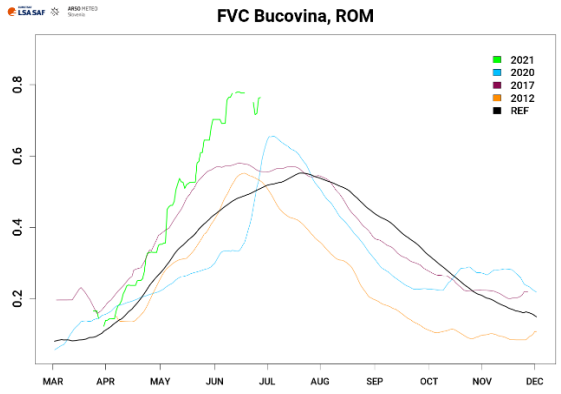
southern-central part of the country as well as over southern Greece, mostly on the account of extremely dry April and May. Western half of Balkan Peninsula also ended a 3-month period with a cumulative precipitation deficit, with lack of rain indicating mostly moderate to severe drought conditions, locally also extremely dry conditions, mostly on the account of extremely dry June and over North Macedonia on the account of extremely dry May.

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.

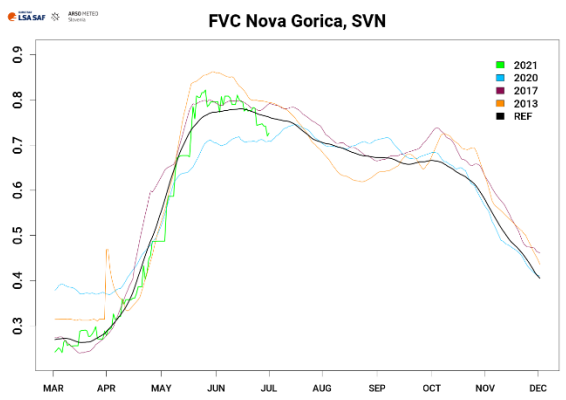
Graphs below present the **vegetation situation** as recorded **on 30 June 2021** in some regions of Southeastern Europe. FVC values for year 2021 are presented as a green line. Graphs also include reference line (2004–2020) in black, and lines in light blue (year 2020), magenta (year 2017) and orange (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.

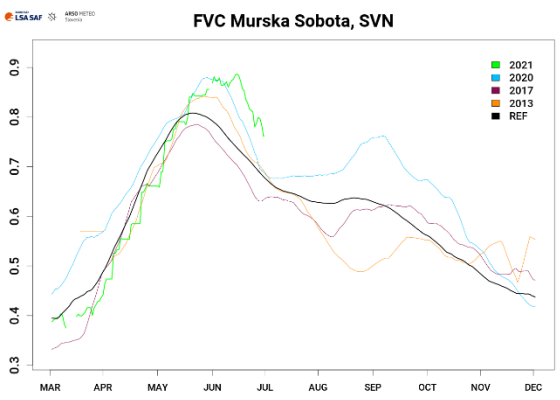
ROMANIA



Vegetation season began as usual in Bucovina, northern Romania, and saw favourable weather conditions for a higher-than-normal vegetation growth rate throughout all season so far. At the beginning of June, vegetation cover was already greater than normal for additional 30 % of the cover, and which after a short lasting decline remained at the similar level by the end of the month.

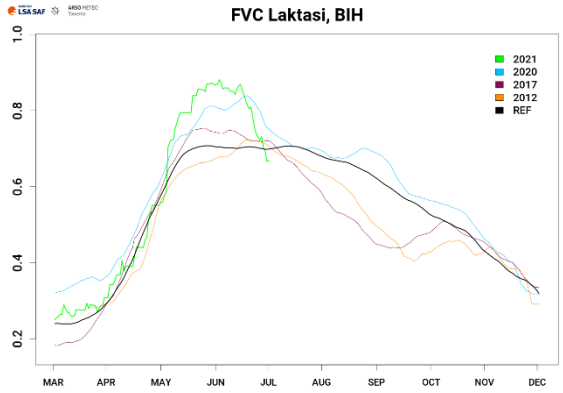
SLOVENIA

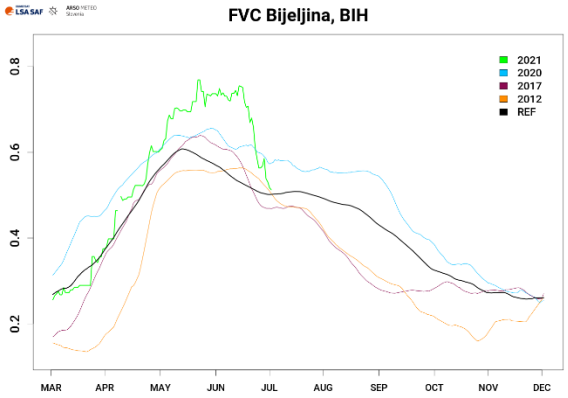


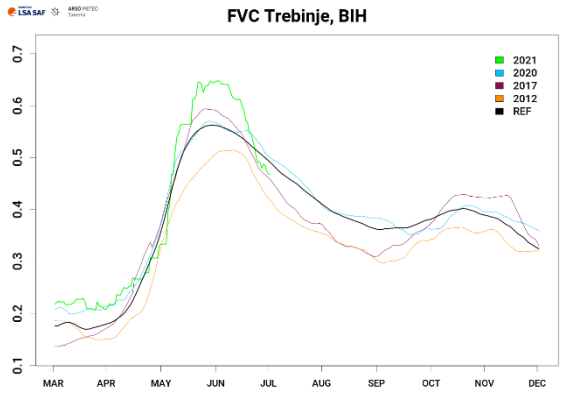


Vegetation development began as usual in Nova Gorica, western Slovenia and also progressed at its expected rate in first part of the season. Its peak value, which normally comes in early June, was even slightly exceeded, however, senescence seemed to progress at the higher rate than expected in second half of June, resulting in under-average FVC values by the end of the month already. Second half of the month saw unusually high senescence of vegetation also in Murska Sobota, northeastern Slovenia which experienced favourable weather conditions for vegetation growth and development up until June and even exceeded its peak coverage for approximately 10 %. June weather conditions proved unfavourable for vegetation in that part of the country as well. Senescence of a rate much higher than normal can be observed in second half of June as FVC values dropped for approximately 15 % over the course of two weeks.

BOSNIA AND HERZEGOVINA (REPUBLIC OF SRPSKA)

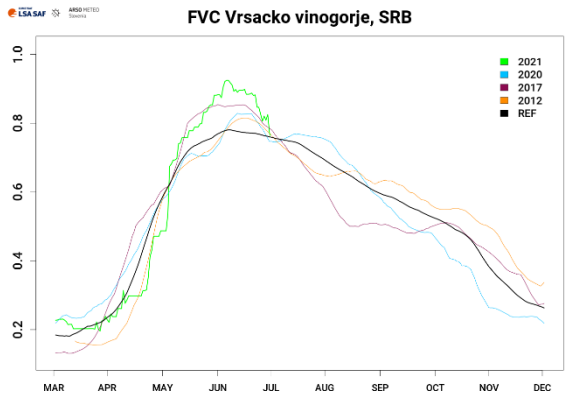


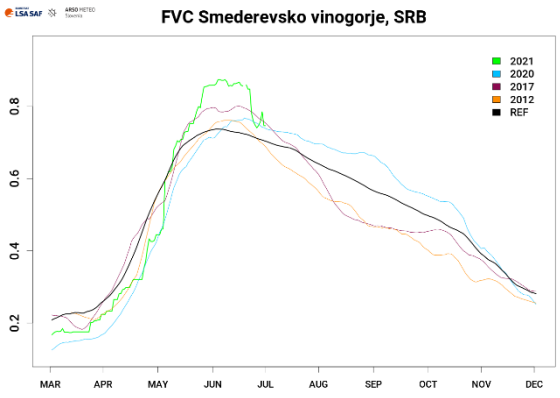




A similar overall pattern to vegetation growth and development in Slovenia can be observed also for vegetation in three different location across Bosnia and Herzegovina. FVC values for vegetation in Laktasi in the north-west, in Bijeljina in the north-east and in Trebinje in southern part of the country all show more or less normal vegetation growth from March to May, a promising continuation of high growth rate throughout end of May and beginning of June which at all three locations resulted in greatly exceeding peak values, although slightly delayed, for approximately 15-20 %. In all of the three locations, unusually warm and rainless June weather conditions brought the surplus of vegetation growth to an end before the end of the month, with FVC values for Laktasi and Trebinje FVC standing slightly below the long-term average at the end of June.

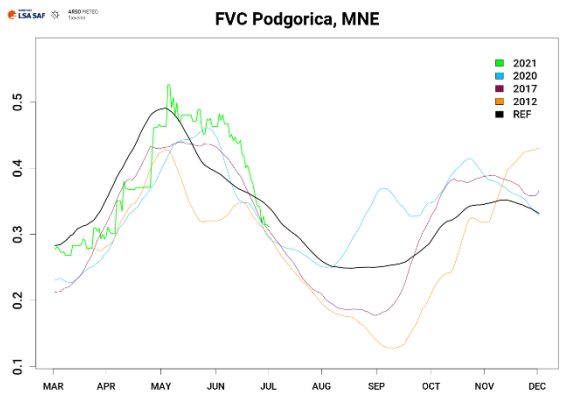
REPUBLIC OF SERBIA





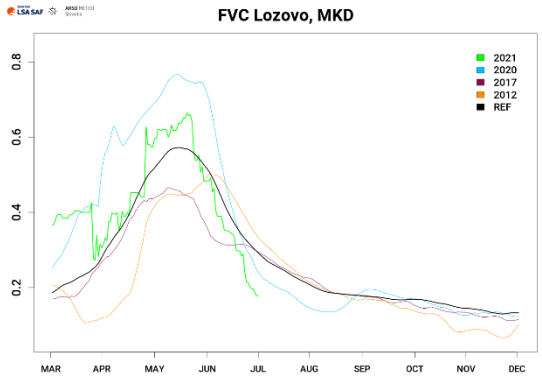
Vegetation development in Vrsacko vinogorje, northeastern Serbia progressed as expected at the beginning of the vegetation season, then the weather conditions hindered further development for a short time in mid-April. Nevertheless, it progressed at the expected rate from late April onward and late spring weather conditions proved favourable as peak values in early June were greatly exceeded, FVC values were up to 15 % higher than normal. June brought unfavourable weather conditions which resulted in a decline of FVC values in second half of the month. The senescence thus occurred at the much higher rate than normally, balancing out the surplus of vegetation cover gained in the previous month. Similar pattern of vegetation development can be observed also in Malo Orasje, central Serbia: vegetation development began as usual in early April, although the base coverage from late winter was slightly lower than normal. May saw further vegetation growth, occurring at a higher-than-usual rate, resulting in coverage expansion approximately 10 % higher than long-term average at its peak time. However, it was mostly lost by the end of June as seen from a sharp decline of FVC values in late June upon unfavourable weather conditions of that month.

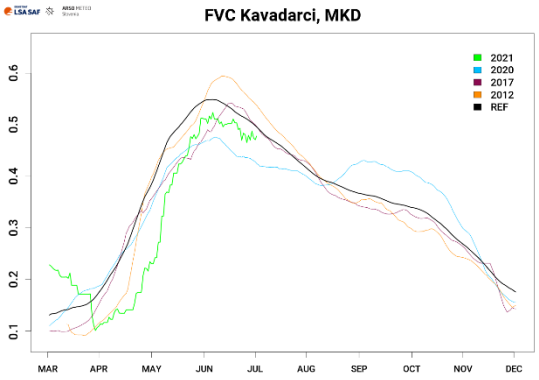
MONTENEGRO



In Podgorica, southern Montenegro vegetation saw a slow beginning into a new season as it legged behind its usual level of development throughout March and early April, followed by a period of hindered development in mid-April. Late April and early May saw rapid vegetation growth and a slightly above-average peak values in first half of May. Vegetation cover remained high for longer than usual, throughout all May, and senescence did not begin until mid-June when a drop of FVC values occurred at a rate much higher than normal. At the end of June, FVC values stood just below the average

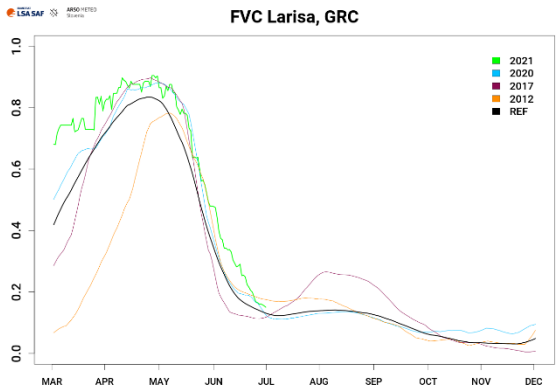
NORTH MACEDONIA

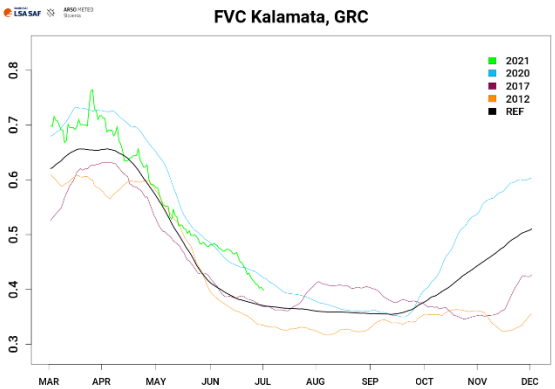




In Lozovo, central part of North Macedonia vegetation cover in early March was much higher than normal for this time of year. However, FVC values indicate the scale of vegetation cover suddenly dropped to average level at the beginning of April, but late April and early May saw boost in vegetation growth that exceeded its peak value coverage in mid-May for approximately 10 %. Since then, vegetation saw continuous decline in FVC values at the rate higher than normal for this time of year, and it continued to drop also in late June when the rate of vegetation senescence would normally slow down. At the end of the month, FVC values were approximately 10 % below the average. In Kavadarci, southern part of North Macedonia, vegetation development began later than normal, then followed its expected rate of progress until early June. Unfavourable weather conditions in early summer did now allow further growth, resulting in under-average FVC values at its peak time. Vegetation senescence thus began at its usual time although its rate was much more mild compared to that present in central part of the country and even slower compared to its usual for that time of year. According to FVC, vegetation cover for Kavadarci is near-average at the end of June.

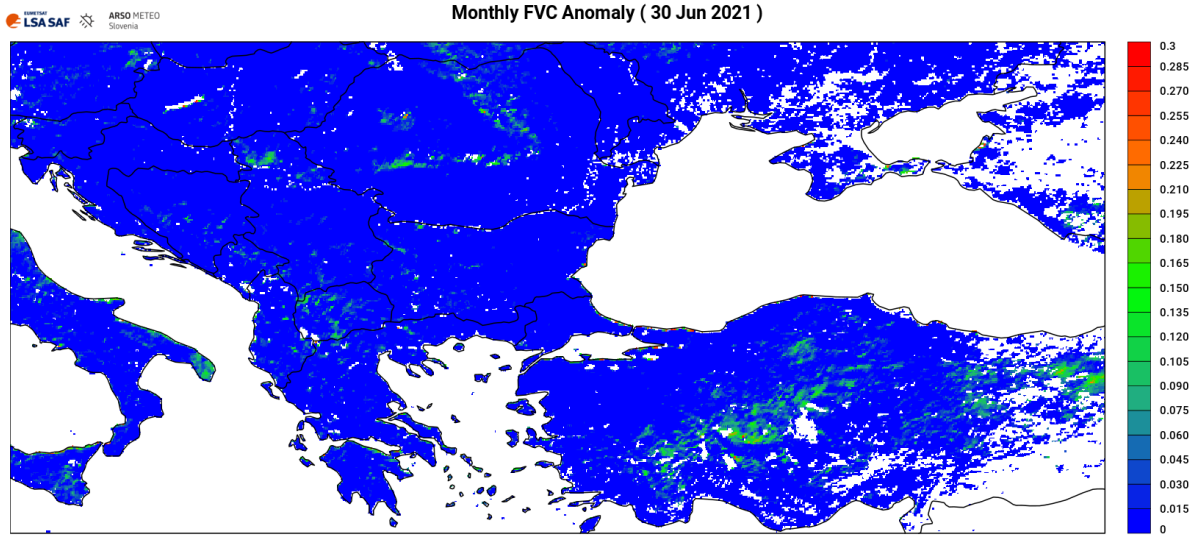
GREECE





In Larisa, central Greece as well as in Kalamata, southern Greece, vegetation cover was well above-average at the beginning of March before its peak time. Even the peak values were exceeded, more noticeably in Kalamata where FVC in early April were approximately 10 % higher than normal. There can be no sign of negative weather impacts observed at neither of the locations, as also vegetation senescence began as usual at both locations. From mid-May to mid-June, FVC values were not declining as fast as then normally would, especially in Kalamata, resulting in temporal up to 10 % above-average coverage with green canopy in comparison to long-term for this time of year. Late June saw further progressed in senescence, resulting in FVC values only slightly above the average at the end of the month.

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



Monthly accumulations of FVC anomalies at the end of June show no major decline from the usual vegetation coverage across Balkan Peninsula, with the exception of localized areas in northern Serbia and parts of North Macedonia where FVC values are observed to be up to 15 % lower than normal at the end of June. However, under-average FVC values of a similar anomaly across a much greater area were detected over central part of Turkey, stretching from its south-west to north-east.

IMPACT REPORTS

HUNGARY

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].

[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

SLOVENIA

Hot and dry June affected mostly non-irrigated areas with vegetables, crops and orchards, with grasslands also severely affected, much less so vineyards. The greatest damage was seen on corn, oil pumpkins, potatoes and soybeans, also sown grassland, less signs of damage were shown 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, but damage to the quality is expected also for irrigated potatoes. Loss of yield is expected 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 topsoils in many parts of the country. This created favorable conditions for the occurrence of wildfires, which was reflected in the increased number of detected fires and firefighting interventions [3].

[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

CROATIA

According to the Maps of estimated drought impact on main crop yield in Croatia, first drought impacts were detected at the end of June. They were mostly observed on cereals across continental Croatia, locally also on forest vitality. High temperature and significant drying of the soil negatively affected the main crop yield in Virovitica-Podravina County where this June was the driest since 1951 [1,2].

[1] https://meteo.hr/klima.php?section=klima_pracenje&param=spi&el=karte_suse&Week=210708
[2] https://meteo.hr/klima.php?section=klima_pracenje&param=ocjena&el=msg_ocjena&MjesecSezona=6&Godina=2021

BOSNIA AND HERZEGOVINA

Drought and high temperatures caused significant damage to vegetables and cereals. Some farmers observed that vegetables dried out during the day regardless of the irrigation. According to agricultural producers from Republic of Sprska, the yields of certain agricultural plants have already been reduced by up to 20 %. The most endangered were onions, cabbage, potatoes, watermelon, peppers, also eggplant, cauliflower and kale. According to the Association of Vegetable Growers, rising of prices for all vegetables is inevitable [1, 2, 3]. Regarding cereals, wheat and corn were particularly at risk. Yield is expected to be reduced 15-20 % as drought left impacts in both yield and grain quality. June high temperatures caused wheat to ripen abruptly, leading to poor quality but also lower yields, while corn already began twisting the leaves in defense to drought [4]. Although larger fruit growers introduced irrigation systems in their orchards, the fruit also suffers significant damage due to the heat [1].

River levels were observed to drop as well in Republic of Sprska, 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 an import of the electricity was required to meet the consumption needs [5].

[1] https://mondo.ba/info/Ekonomija/a1054186/cijene-hrane-poskupljenje-na-jesen-susa.html
[2] https://mondo.ba/info/Ekonomija/a1052785/poljoprivreda-susa-visoke-temperature.html
[3] https://www.blic.rs/vesti/republika-srpska/susa-pustosi-oranice-smanjeni-prinosi-ce-izazvati-rast-cena-hrane/g2z76q8

[4] https://www.nezavisne.com/ekonomija/agrar/Susa-sprzila-zito-zapalice-i-cijenu/668677
[5] https://www.blic.rs/vesti/republika-srpska/opao-nivo-reka-susa-smanjila-i-proizvodnju-struje-u-srpskoj/x77kn15

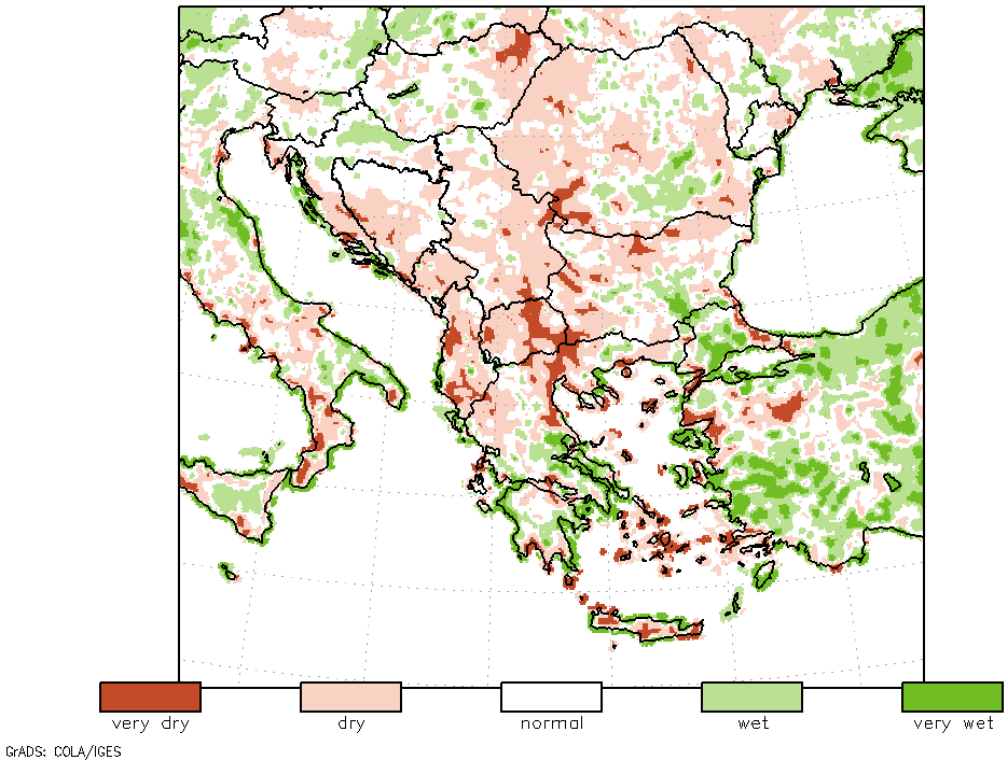
SERBIA

June heat and drought were left damaging corn, soybeans and sunflowers also in Serbia, with especially yield of corn in Serbia expected to be significantly reduced. Head of the marketing department at the Zemun Polje Maize Institute estimated that this year will be similar to 2012 and 2017, when not even a full ton of corn per hectare was harvested on certain plots, while the average is 4.5 to 5 tons [1, 2].

[1] https://beta.rs/ekonomija/ekonomija-srbija/149208-strucnjaci-susa-ce-smanjiti-prinos-kukuruza-u-srbiji-a-navodnjavanje-je-nemoguca-misija
[2] https://aktuelno.net/vesti/srbija/Zega-i-susa-vec-prave-stetu-kukuruzu-soji-suncokretu/c/6160302

OUTLOOK

Figure below presents model simulations of the **60-day accumulated surface water balance anomaly** in historical percentile classes for the time period **from 20 June to 18 August 2021**.



The surface water balance outlook shows a wide part of Balkan Peninsula is expected to be drier than normal for this time of year, in parts of Albania, North Macedonia, northern Greece and over the Aegean Sea area, but also elsewhere locally, even much drier than normal. Surface water balance of usual or rather wet-classified values will mostly be present in northwestern and partially along the eastern Balkan Peninsula, including southern Moldova, central Romania and southeastern Bulgaria.

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.