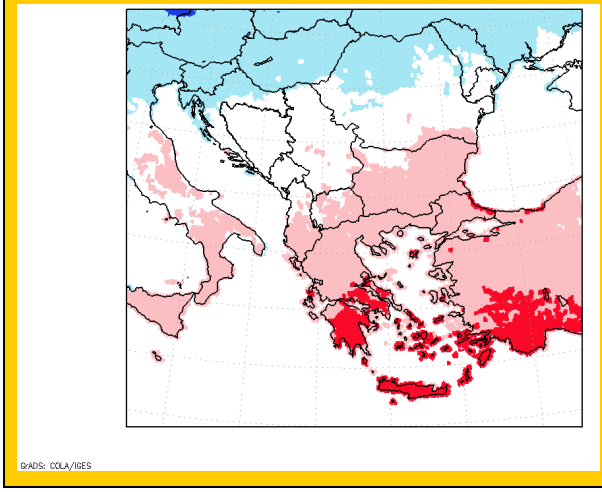
DROUGHT MONITORING BULLETIN

May 2021

HOT SPOT

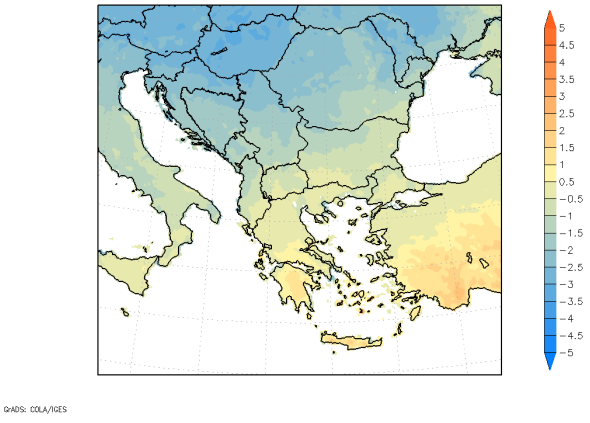


Unusually warm air temperatures of late April over southern part of the region intensified in early May. Central Greece saw temperatures up to 5 °C warmer than normally, southern Greece and southwestern Turkey up to 6 °C, ranking them as one of the hottest of local records for early May. Figure on left shows **mean air temperature of 1st-10th May 2021 period in percentile classes**. Blue colour indicates cold conditions, white colour normal conditions, in pink are areas with warm conditions and in red are areas with very warm conditions compared to long-term records.

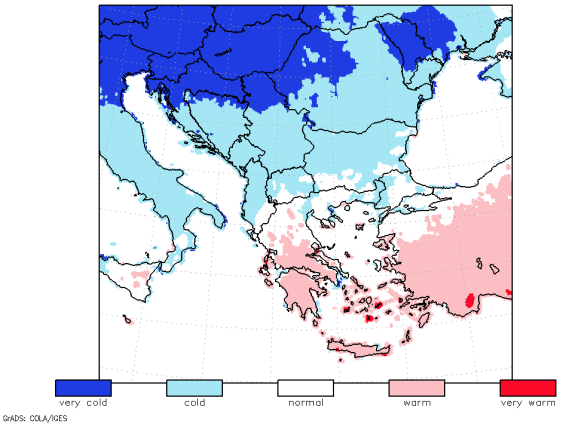
AIR TEMPERATURES AND SURFACE WATER BALANCE

*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 April to 30 May 2021**.*

AVERAGE AIR TEMPERATURE ANOMALY (°C)
1 APRIL – 30 MAY 2021



AVERAGE AIR TEMPERATURE PERCENTILE CLASSES
1 APRIL – 30 MAY 2021

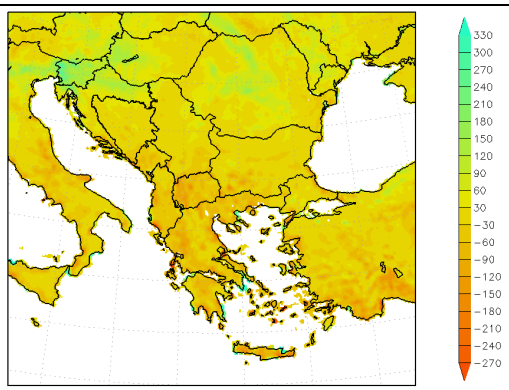


In general, May could be described as cold and wet across northern part of the region, and as warm and dry in its southern part. The scale of air temperature bi-polarity across the region was the greatest in first 10 days of May far northern belt stretching from the Alps, northern parts of

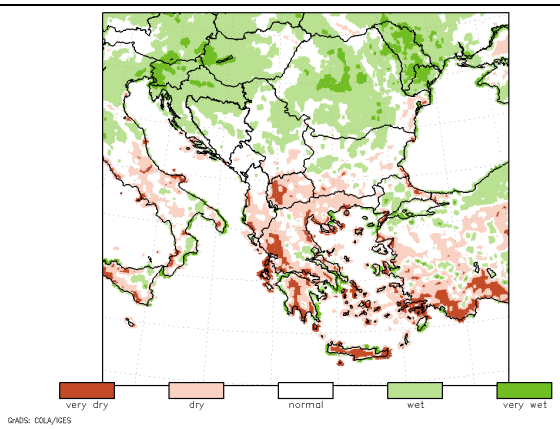
Hungary and Romania, to northern Moldova were up to 3 °C colder than normally, while Greece and western Turkey recorded warmer-than-usual mean air temperatures, from up to 3 °C warmer in their northern parts to even 6 °C warmer in their southern areas. Mid-May was up to 3 °C colder than normal over most of the region, most noticeably in areas along the Adriatic Sea, central Balkan Peninsula and over Moldova, and air temperature slightly higher than normal were present only across central Turkey where they exceeded the local average for up to 2 °C. The two extremes intensified in last dekad of the month. Northern part of the region, including Slovenia, Croatia, Hungary, northern Serbia and Moldova, experienced air temperatures of 2-4 °C colder than normal, north-western quarter of Hungary even up to 5 °C colder which classified it among the coldest of the local records. While at the same time above-average air temperatures returned to southern part of the region, up to 2 °C warmer was in southern parts of Albania, North Macedonia, Bulgaria as well as Mediterranean Turkey, and up to 3 °C warmer over continental Greece.

A 60-day overview also reveals the north-south division of air temperature conditions. Most part of the region experienced a cold April-to-May period as negative anomalies prevailed across all countries but Greece and Turkey. April-May was up to 1 °C colder than normally in southern Albania, across North Macedonia and most of Bulgaria while anomalies increased to 3 °C colder than usual in northward direction, highest of them present across Slovenia, eastern Croatia, Hungary and northern Moldova. On the other hand, April-May was a warm period in southern Greece and southwestern quarter of Turkey where 60-day mean air temperature exceeded the usual values by up to 1.5 °C, locally in southwestern Turkey up to 2.5 °C.

ACCUMULATED WATER BALANCE ANOMALY (mm)
1 APRIL – 30 MAY 2021



ACCUMULATED WATER BALANCE PERCENTILE CLASSES
1 APRIL – 30 MAY 2021



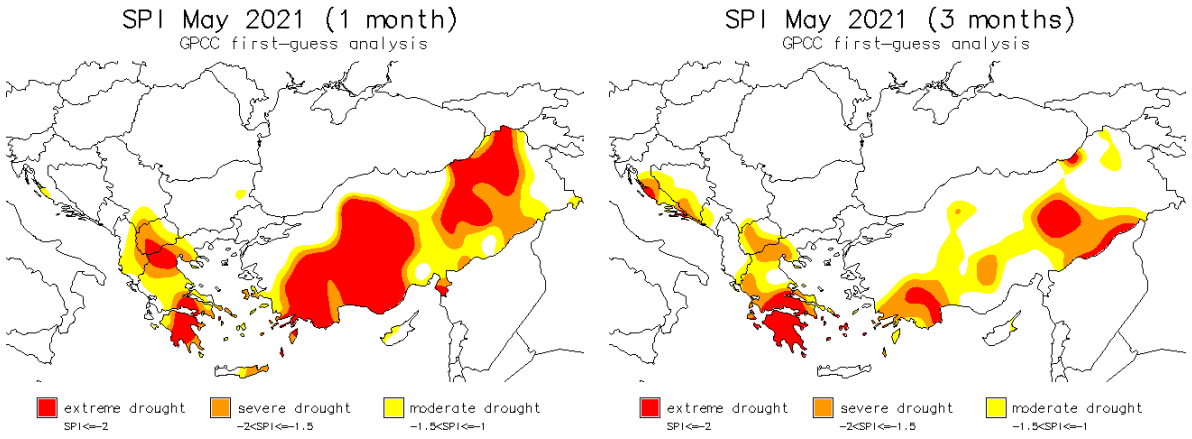
May brought both extremes to the region also in terms of water balance. Precipitation picture reveals high precipitation amount in the north-west and north-east of the region, including Slovenia, continental Croatia, central Romania and Moldova, while water balance conditions were dry to very dry in southern half of Balkan Peninsula and Turkey, especially in Montenegro, Albania and North Macedonia. On a 60-day water view from April to May, accumulated water balance ranged within usual range only in a belt across central Balkan Peninsula and up to eastern Hungary. Accumulated water balance indicated very wet conditions in the north-east, including Moldova and central Romania with surplus ranging between 90 mm and 150 mm, as well as over the region's north-west including continental Croatia, western Hungary and Slovenia where surplus of between 150 mm and up to 250 mm was present. Meanwhile, countries in the south half of the region recorded water balance deficit. Montenegro,

southwestern Bulgaria and most of western third of Turkey saw water balance level up to 90 mm lower than usual, while over most of Greece, Albania and Turkey accumulated water balance was up to 120 mm below the 60-day average, in North Macedonia up to 150 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 **May 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.



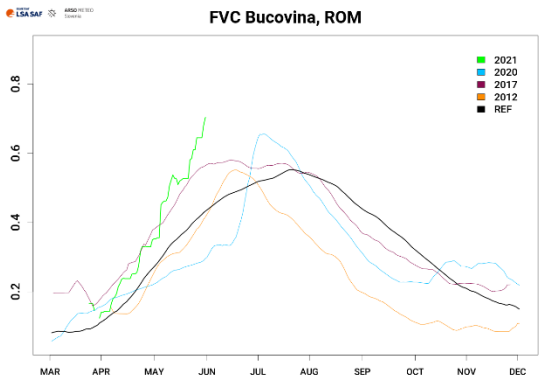
SPI1 reveals most of Turkey, Greece, North Macedonia and southern Albania experienced noticeable precipitation deficit in May. Across the majority of the area its severity indicated extremely dry conditions, in central Greece, southern Albania and along southeastern Turkey precipitation deficit was less extreme, indicating dry conditions of moderate to severe level.
A 3-month overview indicates a dry meteorological spring in areas along the Adriatic Sea, mostly a result of severe drought conditions in March, and over North Macedonia on the account of noticeably below-average precipitation level in May. Southern half of Greece, on the other hand, experienced a run of continuous precipitation deficit in all spring months, to a lesser spatial and severity extend in March, followed by a deficit of extreme level in April and May. While March did not prove to be considerably dry in Turkey, the country saw widespread intensification of precipitation deficit in April through to May, as in severity as well as spatial coverage from its southwestern and southeastern areas inward and northward, leaving areas in the south-west and south-east of the country in severe to extreme drought conditions, and central Turkey in moderately to severely dry 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 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.

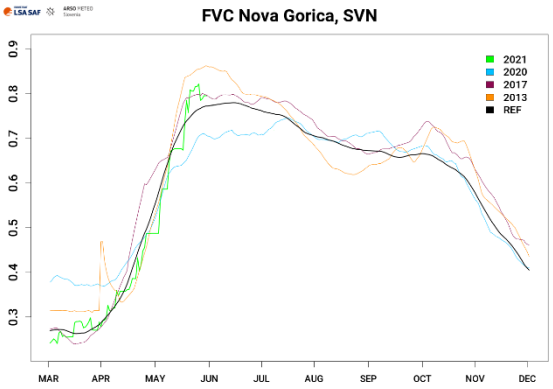
Graphs below present the **vegetation situation** as recorded **on 30 May 2021** in some regions of Southeastern Europe. FVC values for year 2021 are presented as a green line. Graphs also include reference line (2004–2020) in black, and lines in light blue (year 2020), magenta (year 2017) and orange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

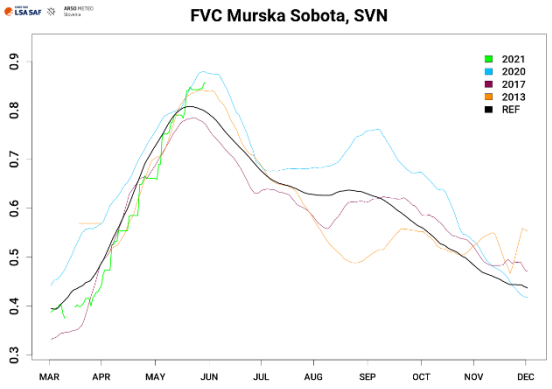
ROMANIA



Vegetation development in Bucovina, north Romania began as usual, with favourable weather conditions in spring months allowing vegetation to grow at a higher rate than normally. Such rate of growth continued throughout May with no gradual slow-down as usually, resulting in exceeding the average cover for more than 30 % at the end of May. The difference is even greater when compared to the previous, drought year as vegetation cover at the end of the month is a little more than twice as great as this time last year.

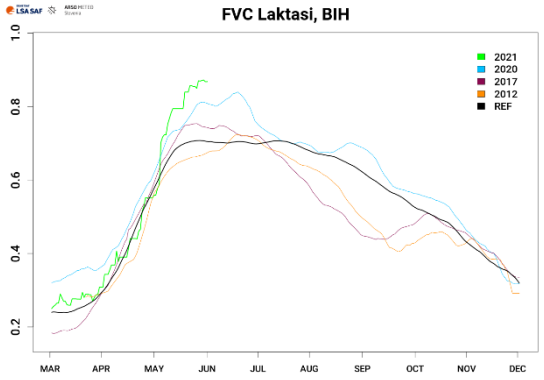
SLOVENIA

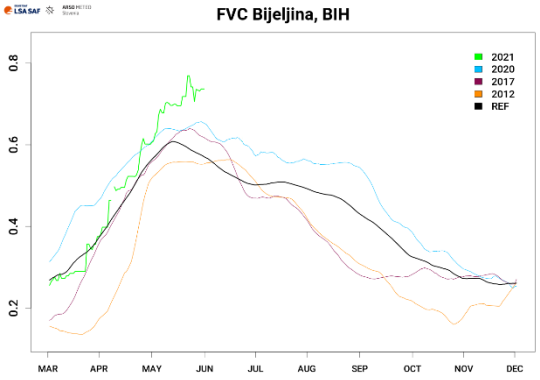


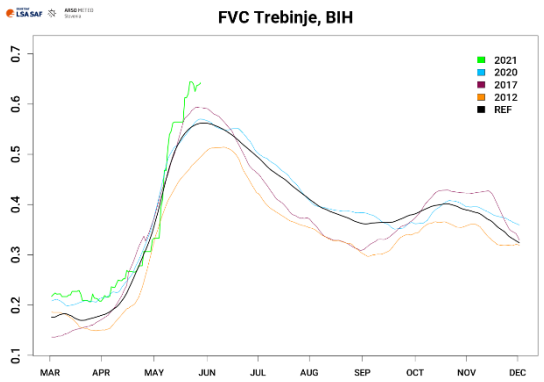


This spring, vegetation in Nova Gorica, western Slovenia began its development at its usual time and has been progressing as expected, well aligned to its reference pattern of development throughout all spring months. On the other hand, vegetation development began approximately 3 weeks later than normal in Murska Sobota, northeastern Slovenia but has quickly caught up to its usual level in early April, then continued to progress at its usual rate of growth. Weather conditions seem to prove favourable as vegetation development continued in second half of May and exceeded its usual peak coverage at the end of the month.

BOSNIA AND HERZEGOVINA (REPUBLIC OF SRPSKA)

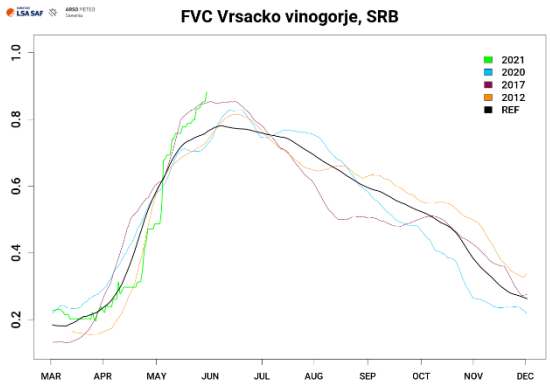


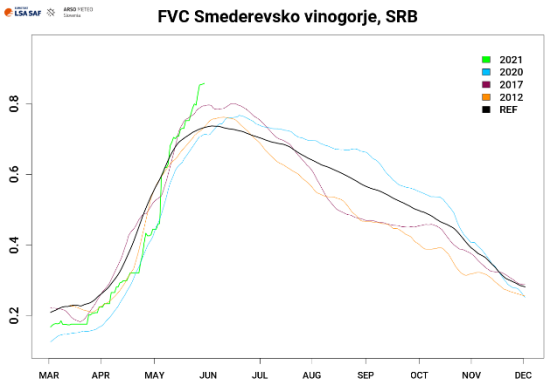




A similar pattern of vegetation development is observed in Laktasi, northwestern Bosnia and Herzegovina and in Trebinje, southern part of the country where vegetation cover in early spring was slightly above-average, vegetation development began as usual in April and progressed at the usual rate throughout April and into May. Favourable weather conditions maintained this rate of development throughout May, resulting in exceeding the peak vegetation coverage in Trebinje for approximately 10 %, and in continuation of vegetation growth in Laktasi well beyond its peak time in mid-May when a stagnation period usually starts taking place, exceeding its peak coverage by approximately 20 %. In Bijeljina, north Bosnia and Herzegovina vegetation season began slightly later than usual but then progressed at a slightly higher rate than normally, exceeding the regular values before mid-April and continued to grow and expand past its usual timing of senescence start. According to FVC, peak coverage was well exceeded, for approximately 15 %, and reached at the end of the month, slightly later than normally.

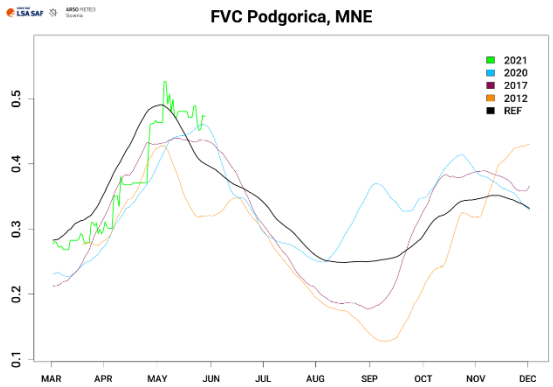
REPUBLIC OF SERBIA





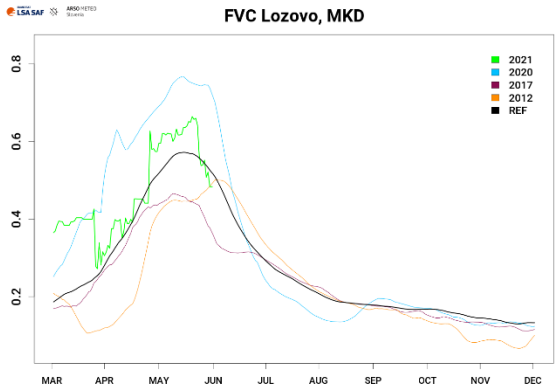
In Vrsacko vinogorje, northeastern Serbia vegetation development began as usual in March until mid-April, then experienced couple of periods with growth stagnation in second half of April and early May. It did not delay vegetation development much, as weather conditions were overall favourable for vegetation growth, especially throughout May which saw vegetation cover exceed the usual coverage at its peak time for approximately 10 % by the end of the month. In Smederevsko vinogorje, central Serbia, the beginning of vegetation development was slightly delayed in early spring, but then progressed at its regular rate and which did not cease in mid-May as it normally does but here too continued throughout May, resulting in approximately 15 % higher vegetation cover at its peak time than normal.

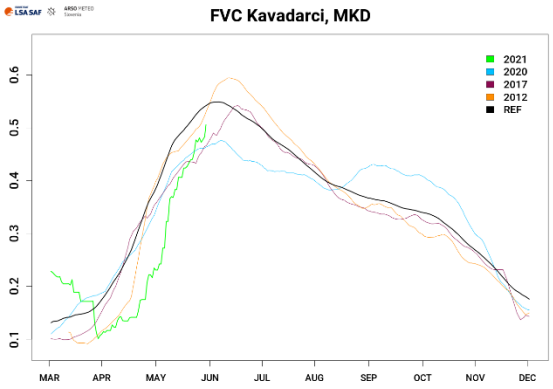
MONTENEGRO



Weather conditions in early spring were not favourable for vegetation development in Podgorica, southern Montenegro as spring growth began couple weeks later than normal. In April and May, vegetation development then progressed at its usual rate of speed and slightly exceeded its peak coverage in early May. After that, vegetation began its first senescence phase of the season although it is occurring at a slightly lower rate than normally, leaving vegetation cover at the end of May approximately 10 % higher than usual.

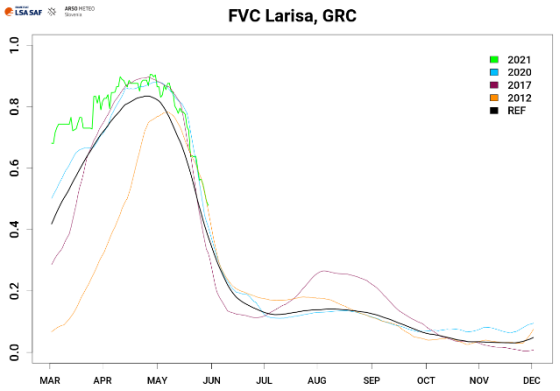
NORTH MACEDONIA

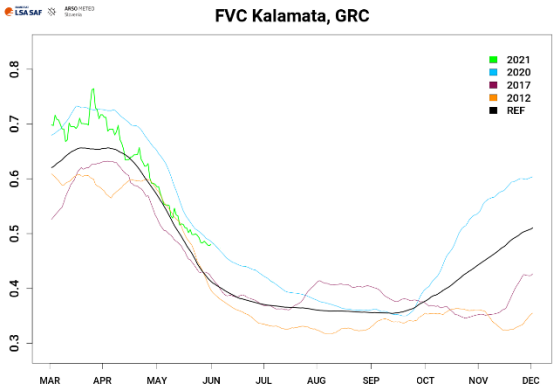




Vegetation cover at the end of winter was much higher than normal at both locations in North Macedonia, Lozovo in its central and Kavadarci in its southern parts. End of March saw a sudden fall of coverage with green canopy, however, weather conditions in April and May proved favourable and vegetation growth continued at its usual rate. At the end of May, vegetation cover in Kavadarci is only slightly below its usual peak value despite the sharp drop in March, while in Lozovo, May weather conditions boosted vegetation growth although another sudden decline in coverage is indicated by FVC values at the end of May.

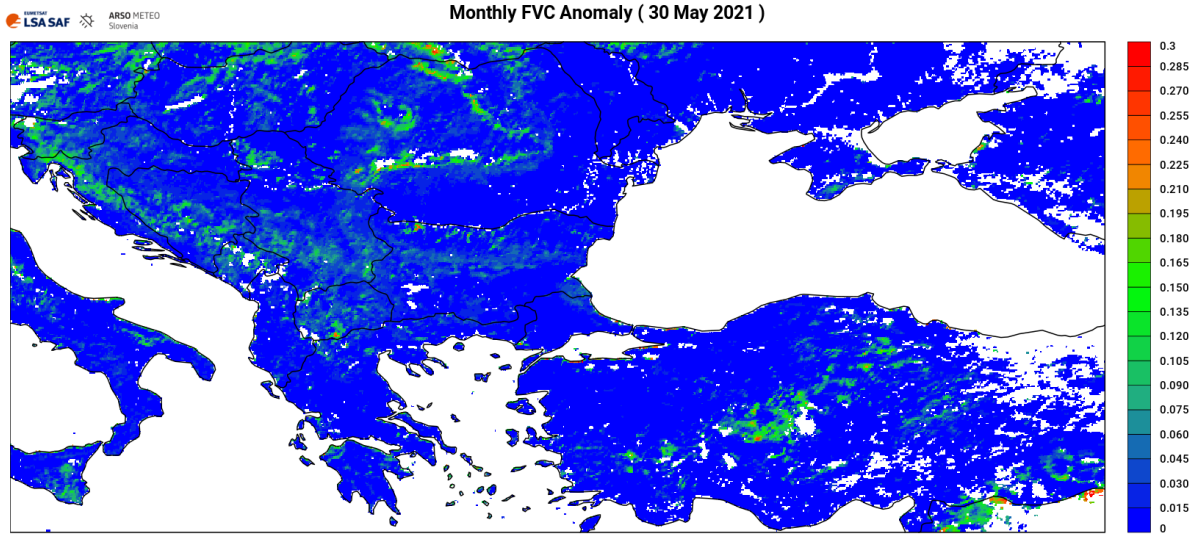
GREECE





Similarly as observed for locations in North Macedonia, vegetation cover in early March was much higher than normal also in Larisa, central Greece and Kalamata, southern Greece, exceeding their average cover for 25 % and 10 % respectively. In Kalamata, vegetation level remained high through March but early April saw it decline at much higher rate than usual for this time of year. However, according to FVC, vegetation senescence slowed down in second half of May, resulting in vegetation cover approximately 10 % higher than usual before the end of the month, similarly to a year before. In Larisa, vegetation growth continued throughout March and April although its rate was lower than usual, thus only slightly exceeding its peak despite good start to the season. In May, vegetation senescence began its expected course while vegetation coverage remain slightly above-average, according to FVC.

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



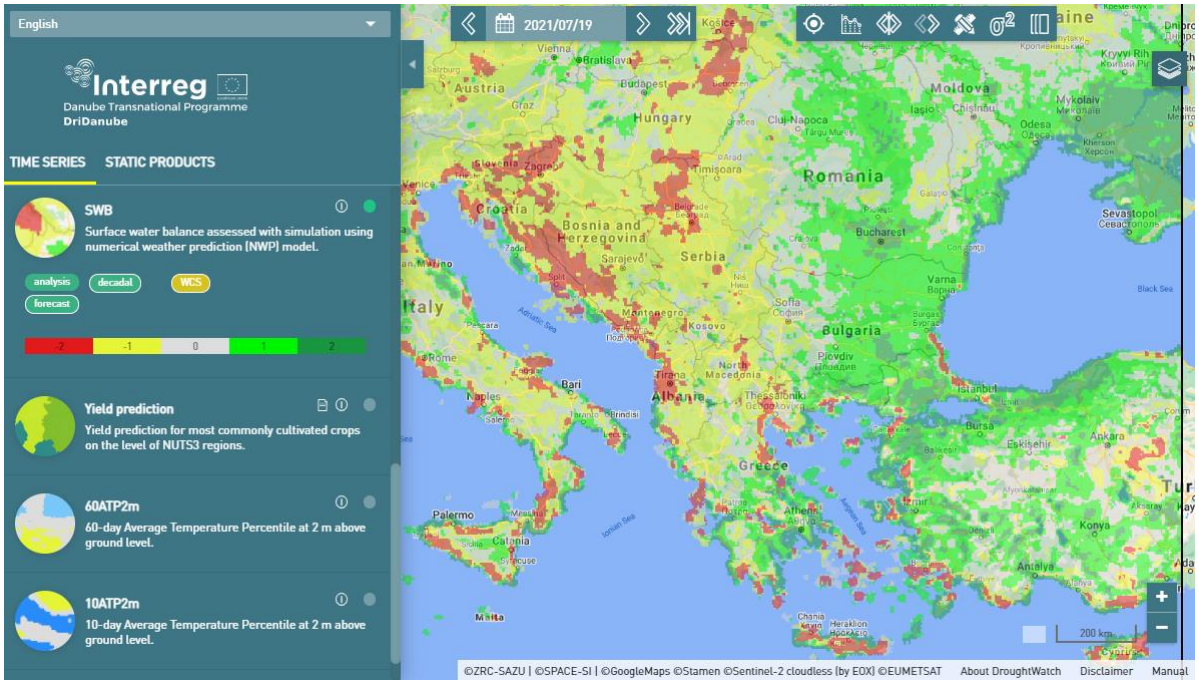
Accumulated over a 30-day period, negative anomalies in vegetation cover in May reached up to 18 % lower than normally in areas along the northern half of Adriatic Sea, across northern Hungary, over the Carpathians and in central Turkey. Vast part of Dinaric and Balkan mountainous area stretching across Bosnia and Herzegovina, Montenegro, southern half of Serbia, North Macedonia and Bulgaria also recorded accumulated deficit in FVC values of up to 10 % in May, in comparison to usual FVC values for this month. However, negative anomalies from the usual state come mostly as a result of delay in vegetation growth.

IMPACT REPORTS

No drought impacts on the environment were reported across the region.

OUTLOOK

Figure below presents model simulations of the **60-day accumulated surface water balance anomaly** in historical percentile classes for the time period **from 21 May to 19 July 2021**, as seen in Drought Watch tool[1].



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

Percentile comparison with the long-term reveals vast part of western half of Balkan Peninsula will experience dry to very dry water balance conditions, to extreme level over Slovenia, in areas all along the Adriatic Sea including northwestern Albania, as well as over northern Serbia and northeastern Hungary. In local areas over the Aegean Sea, extreme water balance deficit can also be expected, however, mostly wet conditions will prevail across most of southern and Aegean Greece. Wetter than normal water balance values are expected also across most of eastern half of the region including Turkey, most noticeably in great part of eastern Romania, eastern Bulgaria and around the Bosporus area where high precipitation level over the 60-day period will result in unusually high water balance levels.

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.