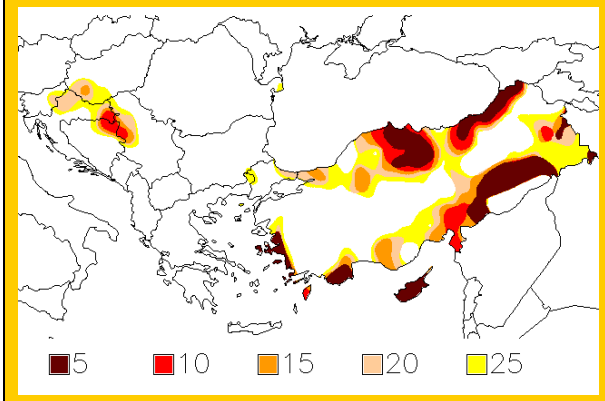
DROUGHT MONITORING BULLETIN

September 2020

HOT SPOT

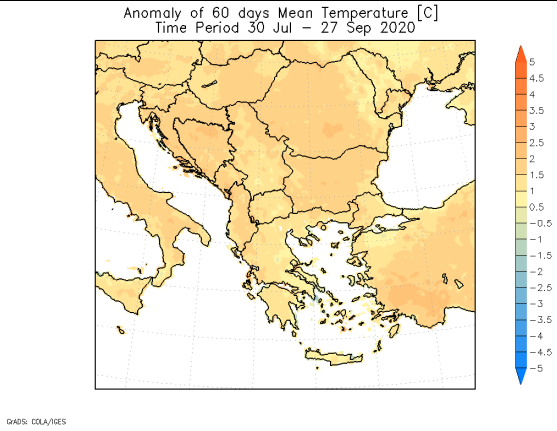


On one hand, September brought high precipitation amount to areas along Balkan Peninsula's western coast but on the other, it was a dry month across Turkey where monthly rainfall rate over vast areas classified below 15th percentile of local records. September rainfall rate was below-average also in part of northwestern and central Balkan Peninsula, as seen from the figure of **precipitation percentiles for September 2020**.

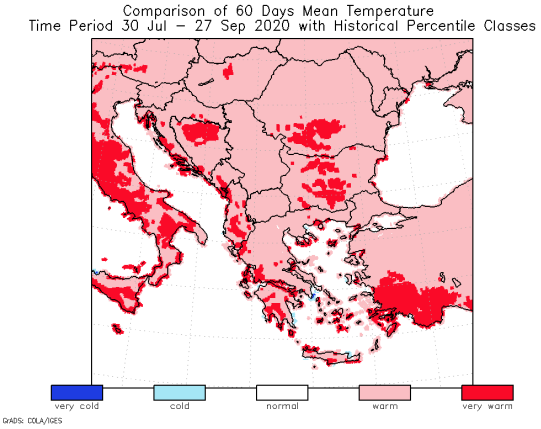
AIR TEMPERATURES AND SURFACE WATER BALANCE

*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 30 July to 27 September 2020**.*

AVERAGE AIR TEMPERATURE ANOMALY (°C)
30 JULY – 27 SEPTEMBER 2020



AVERAGE AIR TEMPERATURE PERCENTILE CLASSES
30 JULY – 27 SEPTEMBER 2020

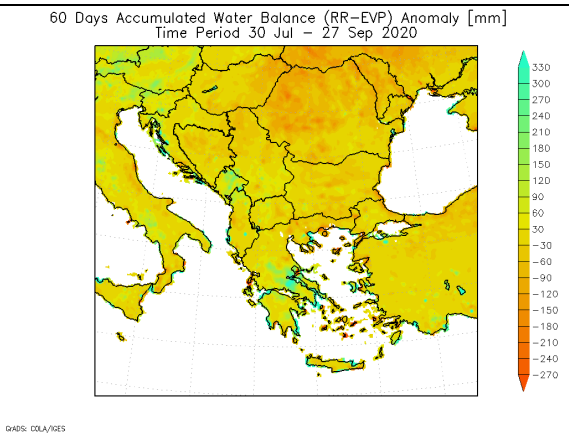


September began with much higher than normal air temperatures across the region's eastern half as the mean air temperature of first ten days exceeded the average temperatures for up to 4-5 °C across all of Moldova, Romania and Bulgaria and over southern and northeastern Greece. Air temperature anomalies of that time gradually decreased in westward direction as

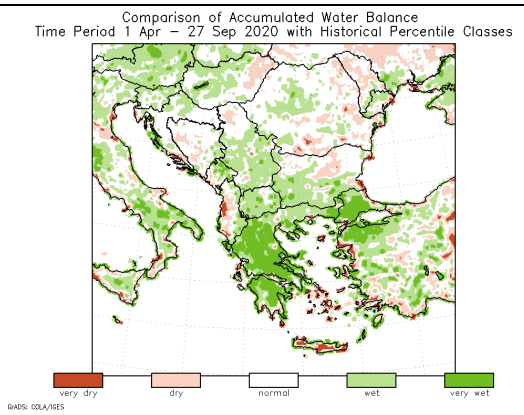
the region's north-west and along the Adriatic Sea coast experienced more or less usual air temperatures in early September. Mid-September saw anomalies of up to 4-5 °C above the average stretch across the entire region, along southern Adriatic Sea coasts even up to 6 °C. The only exception to this was the Aegean part of Greece where mean air temperature of that time was up to 2 °C warmer than normal. End of the month usual air temperatures to most of the western half of the region, from western Hungary to the Aegean Sea area, while in the region's eastern half and over Montenegro and Albania, air temperatures were mostly up to 2 °C warmer than normal. Meanwhile, localized areas in central and northern Romania and western half of Turkey continued to experience above-average air temperatures although to a lesser degree than earlier that month, up to 3 °C.

A 60-day average air temperatures resulted in warmer-than-normal August-September period across the entire region, with areas along the Adriatic Sea, Aegean Sea and in central-eastern part of Balkan Peninsula experiencing very warm August-September period. The anomalies were the highest, between 1.5 °C and 2 °C, in a belt stretching from Croatia to Albania and over the eastern parts stretching from central Hungary to Bulgaria and western half of Turkey. Elsewhere, the 60-day period was warmer than normal for about 1 °C to 1.5 °C.

ACCUMULATED WATER BALANCE ANOMALY (mm)
30 JULY – 27 SEPTEMBER 2020



ACCUMULATED WATER BALANCE PERCENTILE CLASSES
30 JULY – 27 SEPTEMBER 2020



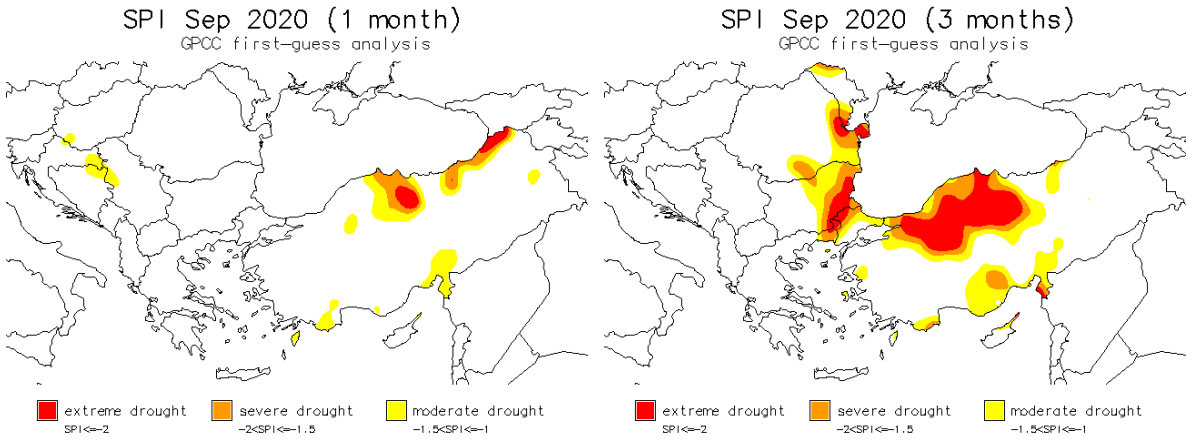
The 60-day overview of surface water balance level indicates a generally normal-to-dry conditions over vast part of northern half of Balkan Peninsula and central Turkey, where dry to very dry conditions were spread over Moldova, Romania and eastern Bulgaria mainly in August and over wider central Balkan Peninsula and Bulgaria in September. The negative anomalies from the average for the 60-day period were highest over the northeastern part of the region, stretching from Moldova to eastern Hungary and to the south of Carpathians where deficit of surface water balance ranged between 120 mm and up to 180 mm. Deficit of 60-120 mm stretched also wider outside this hotspot, including eastern Bulgaria and northeastern Greece, the Great Plain area across northern Serbia and southern Hungary. On the other hand, the region's north-west and its central part experienced relatively wet August-to-September period. Surplus of surface water balance was the highest over southern Greece where anomalies from

the average stretched above 300 mm in its south-east and its coastal south, while elsewhere in central and southern Greece and also over Montenegro the surplus mostly exceeded 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 **September 2020** 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.



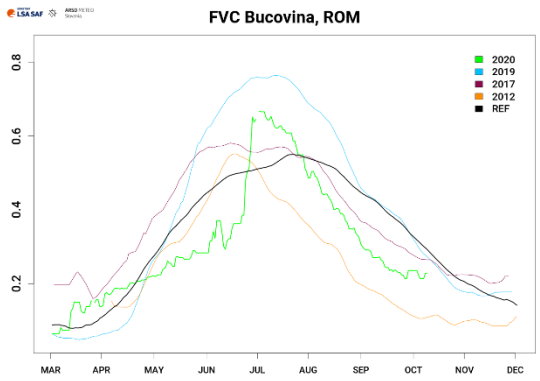
According to the precipitation maps, September precipitation amount was most scarce across northern Turkey, its south-east and over the country's Aegean coasts. Through the SPI1 index, lack of precipitation over the northern and northeastern Turkey indicated severe to extreme drought conditions over that area, while over the country's southern areas moderate drought conditions prevailed. A 3-month overview of precipitation conditions across the region singles out the vast part of northern Turkey, where very dry conditions were present throughout all past 3 months, from July onward, and areas along the western coasts of the Black Sea. Although that part of the region did not experience drought conditions in September, Moldova and northern and southeastern Romania experienced considerable lack of rain mostly in August and moderate ones in July, while eastern half of Bulgaria experienced severe drought conditions mostly in July, over its north-east lasting also into August.

REMOTE SENSING - FRACTION OF VEGETATION COVER

Fraction of vegetation cover (FVC) is 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 and then FVC slowly drops with vegetation senescence. Line shape depends on sort of the vegetation.

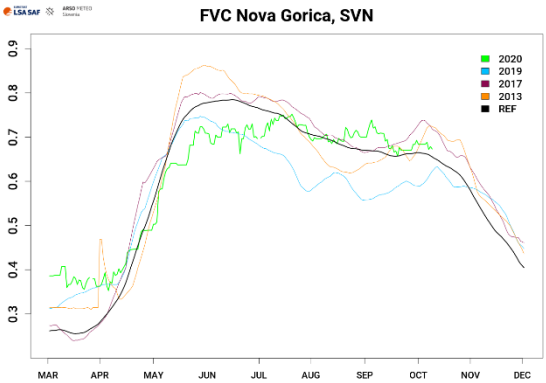
Graphs below present the **vegetation situation** as recorded **on 9 October 2020** in some regions of Southeastern Europe. FVC values for year 2020 are presented as a green line. Graphs also include reference line (2004–2019) in black, and lines in light blue (year 2019), magenta (year 2017) and orange (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.

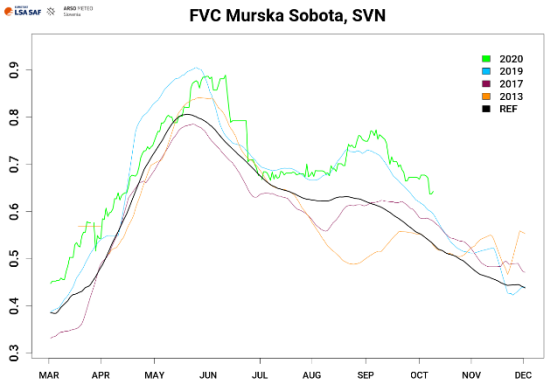
ROMANIA



Throughout spring, vegetation in Bucovina, northern Romania was developing at a much slower rate than normal, and at the end of it, the fraction of vegetation cover was at approximately two thirds of the average for this time of year. June weather conditions brought welcome boost in vegetation growth, although the recovery was only temporal. Between July and September, FVC index was decreasing at a higher rate than normal and at the end of September stood at the values normally reached at the end of October.

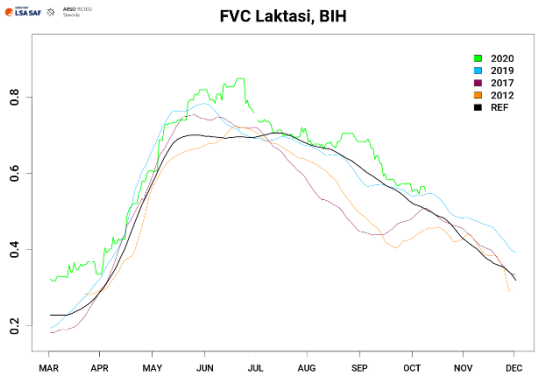
SLOVENIA

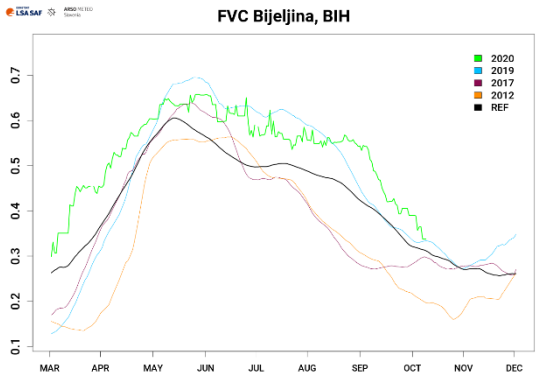


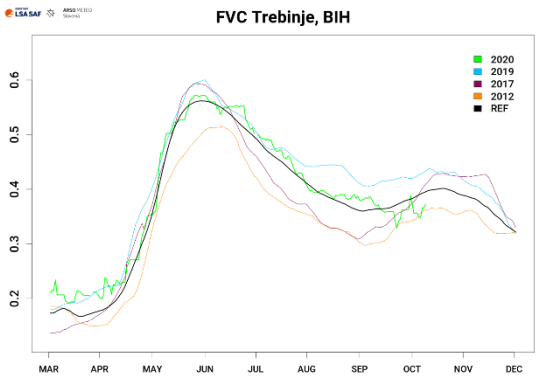


Early spring conditions boosted vegetation development in Nova Gorica, western Slovenia as well as Murska Sobota in north-east of the country. It did not progress as well in Nova Gorica throughout the rest of spring, with its development resulting in under-average level of vegetation cover in May and June. Summer weather conditions in Nova Gorica maintained this level of vegetation cover throughout the rest of the vegetation season, resulting in above-average FVC values in August and September. On the other hand, vegetation development was above-average throughout the entire vegetation season in Murska Sobota, including reaching the peak levels at higher FVC levels than normally. At the end of vegetation season, FVC values were approximately 15 % higher than normally for this time of year.

BOSNIA AND HERZEGOVINA (REPUBLIC OF SRPSKA)

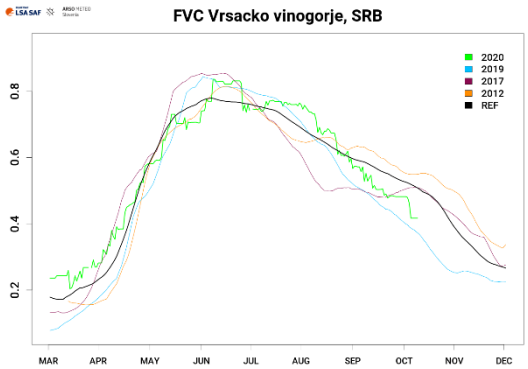


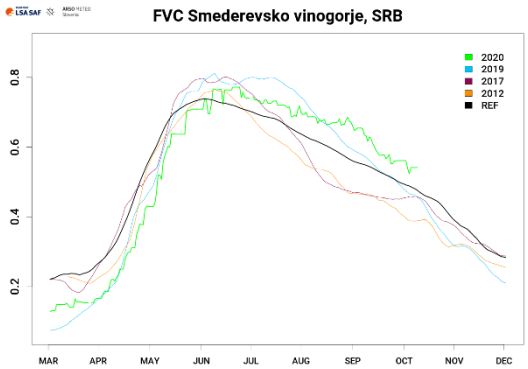




Similar favourable conditions for vegetation growth as for northeastern Slovenia were experienced in Laktasi and Bijeljina along the northern Bosnia and Herzegovina. According to FVC values, vegetation development was continuously exceeding the average level throughout the entire vegetation season, including exceeding the peak values for about 10 % in Laktasi, and the entire reference line all season for about 10-15 % in Bijeljina. At both locations, the above-average FVC values are approaching the normal level as for the early October. In Trebinje in far-south of the country, vegetation developed as expected throughout nearly all of the season, with only small sharp anomalies detected at the end of September.

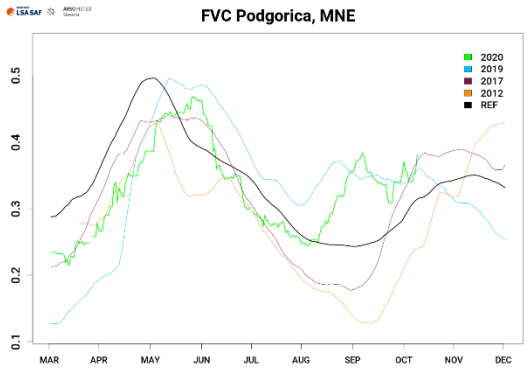
REPUBLIC OF SERBIA





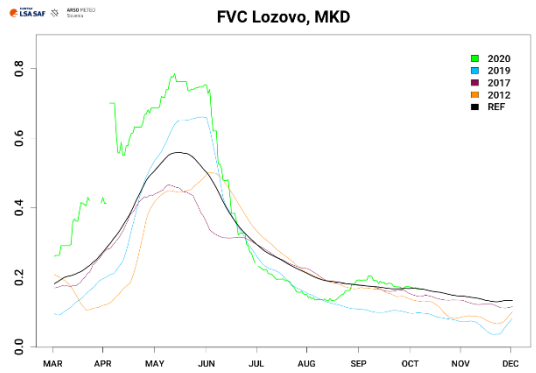
In Vrsacko vinogorje in northeastern Serbia, this year's vegetation season progressed as expected without any major deviations from the usual. Slightly above-average was vegetation growth in first half of spring, and sudden sharp declines detected at the end of June and early in October, were likely as result of phenomena other than drought. A look at FVC values for Smederevsko vinogorje in central Serbia reveals vegetation developed at its usual development pattern throughout all vegetation season, although delayed for approximately up to 2 weeks from April onward. Summer and autumn weather conditions seem to be favourable as they maintain slightly higher than normal level of vegetation cover.

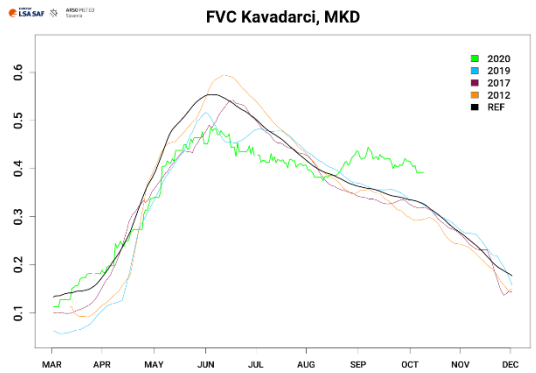
MONTENEGRO



In Podgorica, southern Montenegro, weather conditions in first half of the year did not prove favourable for vegetation growth, as it delayed its development for approximately a month and also the senescence after its peak occurred at higher rate than normally. On the other hand, mild summer weather conditions boosted vegetation growth much earlier than normally, making it reach its second peak in early September instead of in late autumn. FVC values in early October remain about the peak values and indicate a much longer than usual period of second vegetation cycle.

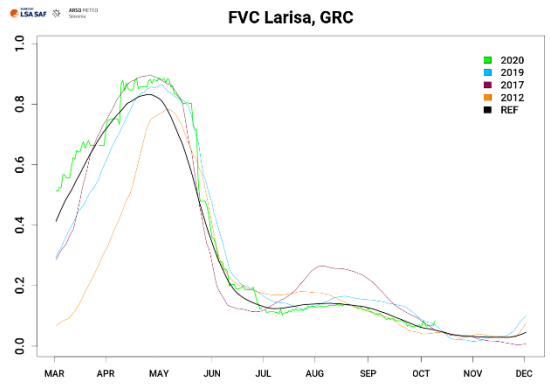
NORTH MACEDONIA

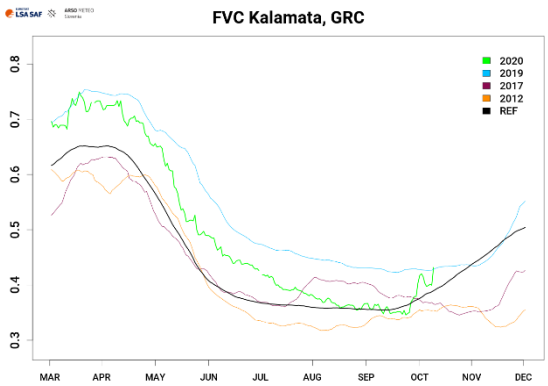




The opposite set of favourable-unfavourable halves of the year than in Podgorica can be observed from FVC graph for Lozovo, central part of North Macedonia. Weather conditions up until May supported well-above-average vegetation development. FVC values for first half of the year exceed the average for approximately 20 %. Weather conditions of summer months brought the end to it as, according to FVC values, vegetation cover dropped rapidly from a coverage of up to 80 % to below 20 % over the June-July period. Slightly temporal boost can be noticed at the end of August into September which brought FVC values back to average for this time of year. In Kavadarci in southern part of the country, vegetation developed at its usual rate only until April, while unfavourable summer weather conditions in that part of the country resulted in below-average vegetation development from May onward already. Weather conditions of late summer to autumn period brought additional boost in vegetation growth, unusual for Kavadarci for this time of year.

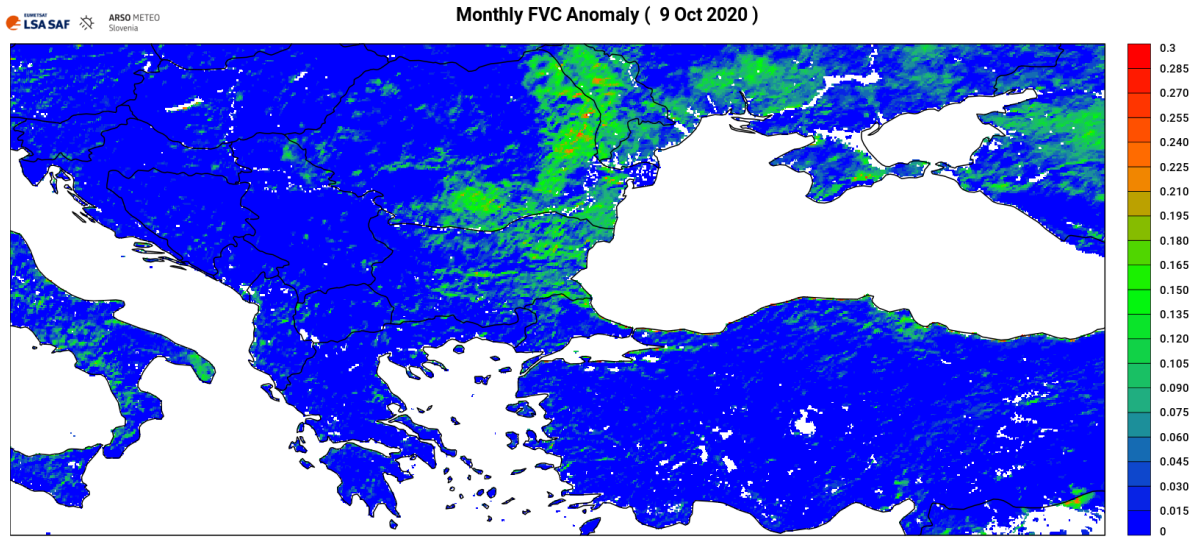
GREECE





In Larisa, central-eastern Greece, this year's vegetation season can be regarded as more or less average as vegetation development followed its reference line throughout all season, with the exception of vegetation boost observed over the peak period in April and May. Also in Kalamata, southern Greece, vegetation development experienced no periods of drought stress, quite contrary, vegetation cover was above-average most of the season, continuously exceeding its normal values for up to 15 % until the end of July, and nearing the usual values from August onward. Slight boost can be observed in early October, which can be seen to occur at a stronger rate than normally for this time of year.

Figure below shows negative anomaly of **accumulated 30-day FVC values** as recorded **on 9 October 2020** in comparison to the past 16 years (2004-2019), and is used experimentally.



Monthly-accumulated deficit in FVC values points out mostly to the areas along eastern part of Balkan Peninsula, covering the entire Moldova, eastern to southern Romania and across eastern half of Bulgaria. Although mostly-accumulated deficit over that part of the region is lower than in previous months, it ranged mostly between 10-20 % below the September average. However, areas with monthly deficit of vegetation cover of up to 25 % can be observed along eastern Romania and central Moldova.

IMPACT REPORTS

MOLDOVA

Drought caused tight agricultural production this summer. Corn, fruit and sunflower production are believed to be at the limit of national consumption [1]. Heavily compensated was sunflower yield and fruit harvest was significantly lower as well, approximately halved, at some places even smaller than that [2, 3]. According to the vice-president of the Dignity and Truth Platform Party, the situation of cereals in the second group (corn, sunflower, sugar beet) is worse than in the case of cereals in the first group affected by drought [4]. Severe drought in addition to spring frost and hail are the factors that caused the loss of about 30–50 % of the amount of grapes. The grape fruit is considered the smallest in the last decade. The latest data from the National Office of Vine and Wine show that in the first 7 months of the year, wine exports registered losses in volume of 5.5 million liters (6.5 %) and in value of 87 million lei (6.8 %) [5]. While the average yield is about 11 tons per hectare, this year it stands at about 14-15 tons per two hectares. Even in these conditions, the selling prices are very low, some of the winemakers fear they will not be able to cover their expenses [6]. Similar weather

conditions of this year are the reason for about 20 % drop in plum yield, leading to higher prices for final consumers [7]. This year, out of the 415 thousand ha of cereal crops, almost 200 thousand ha were affected by drought and other natural disasters to the proportion of over 60 %, presenting approximately 6 % of the country's territory [8]. According to data presented by the Ministry of Agriculture, the affected land is spread in proportion of 25 % across the northern region of the Republic of Moldova and up to 60-80 % in the central and southern parts. Continuous drought conditions also throughout autumn present a fear for problems next year as well - given that there has been no rainfall for so many months, land cultivation to sow winter cereals is complicated, according to the Prime Minister od Moldova [9].

The acute drought left significant impact also on grasslands. Especially in central part of the country there are places with no patches of green grass left at the pastures. Some still keep them in the gardens and feed them what they still have at home, but the fodder will not reach them until winter. Others began to send their animals to slaughterhouses as they no longer had anything to feed them or, although risking being fined, dare to put their flocks in the forests, so that the animals can graze at least on the falling leaves [10].

Due to the prolonged lack of precipitation over the past months, small rivers and water basins experienced hydrological drought with the maintenance of the yellow and orange codes, according to the State Hydrometeorological Service. At the end of September, the water flows at the hydrological stations on the Dniester River stood at just over 50 % of the average for September, and on the Prut River, in the middle, the water flow decreased to 20% of the average for September [11]. Hydrological drought across the country can be seen through several rivers and lakes, especially in the northern half of the country, completely drying up, and fountains and wells in several villages no longer have water in them. Also the level of the largest tributary of the Dniester River, the Raut River passing through the Balti in northern Moldova, has dropped considerably [12]. Specialists from the Environmental Protection Inspection from Balti stated that this year's drought was a decisive factor for the disappearance of some water basins and rivers in the country. Environmentalists point out that more than half of the small rivers in our country are on the verge of disappearing due to severe drought, but also the deforestation of forests. The situation is dramatic, among others, in the village of Bilicenii Vechi in district of Singerei in central-northern Moldova where the Ciuluc River used to flow. Locals say that ten years ago, the river was over five meters wide. Now, on some segments, the water has disappeared or at best drips. In response to the lack of water, some households have built illegal dams [13].

ROMANIA

According to the Minister of Agriculture and Rural Development, over one million hectares of corn and sunflower were affected by this year's extreme and severe agricultural drought, presenting 4 % of the country's territory. Of the 2.9 million ha sown in autumn, 1.18 million hectares were affected, and to a great proportion also what was sown in spring, primarily corn and sunflowers [14]. Romania is ranked first in the European Union in cultivated area and

sunflower production, but farmers estimate a 30 % decrease in national production this agricultural year, up to 2.4 million tons, due to the drought in spring across all of the country and summer drought in certain regions of the country. The agricultural drought most affected wheat and rapeseed crops, especially in southeastern Romania, where yields reached only 10 % of average production [15]. Great losses are experienced also across other parts of southern Romania, as yield was reduced by more than 50% compared to last year, and farmers fear not being able to cover even their investments. In addition, the lack of rainfall risks compromising autumn crops. Farmers from Mehedinți, southwestern Romania reported their sunflower production was lower by 60 % compared to the last year. If in 2019 they obtained almost 4 tons per ha, now they barely managed to harvest 1.3 tons per ha. Yield of corn production was reduced to a greater proportion, as farmers expect only 25-30 % of last year's production, i.e. of almost 10 tons per ha in 2019, farmers have reached 2.5 tons in 2020 [16].

The lack of rainfall this year has significantly reduced the grape harvest as the fruits are far from satisfactory. The berries appear as raisins and thebunches are few. The viticulturists from Vrancea in southeastern Romania, famous for Bahus' liqueur, say the production is so small they will not recover the money invested. In the absence of rain, the grapes are as sweet as honey. However, many growers fear that under these conditions the vineyards will remain stagnant. It has been 3 months since no rain has fallen in the Dumbraveni area in central Romania Regardless of the variety, either table grapes or wine, the grapes have withered and the damage is significant. Despite the low yield, the market prices for grapes are low, in Bucharest only 1.6 lei per kilogram while in the case of grapes for wine, the price is even lower, 90 bani per kilogram [17].

The representatives of Groupama Asigurari insurance company stated that in the agricultural year 2019-20, over 80 % of the damages were caused by extreme drought. They continuously register negative drought impacts across the south and the east of the country, areas that represent 75% of Romania's arable land [18]. The Alliance for Agriculture and Cooperation claim that the agricultural year 2019-2020 was the hardest in the last 50 years, being for the first time when both autumn and spring crops were affected by severe agricultural drought [19]. Some farmers consider giving up the area where the water shortage cannot be compensated even with the most modern irrigation solutions. In areas with prolonged lack of rain, even agricultural lands with irrigation systems did not prove economically viable due to the high amount of water required to save the crops [20].

The situation in Romania will have a negative impact on the EU market share on the international market. Practically, according to the European Commission, in the previous marketing year, Romania contributed 64 % to the total exports of 5.8 million tons of corn. And now, according to the latest US Department of Agriculture estimates, the EU will export 2.7 million tons of corn, 1 million tons less than estimated in the previous report and 2.1 million tons below the 2019-20 level, following the "reduction of production in Romania". Against the background of the prolonged drought in Romania, which was until this year the

largest European exporter of corn, the European Union will lose its influence on the world corn market. According to the estimates of the US Department of Agriculture, the corn production of Romanian farmers in 2020-2021 will be almost three million tons lower than last year, which could mean a revenue of 165 million euros less [21].

In addition to crop cultivating, also livestock sector was negatively affected, including sheep sector, pig and poultry farmers and beekeepers. [20] The main problem presented the lack of water for the animals to drink. The villagers from a Buzau locality in southeastern Romania needed the intervention of the firemen in order to be able to provide water to their animals. The critical situation is in the Scortoasa town, Buzau area where in the absence of rain the inhabitants had to look for water sources in 2-3 kilometers out of their villages and the local authorities asked for the help of firefighters. Three times this year the water needed to be transported to Scortoasa [22, 23].

Critical water situation is reported also for Techirghiol Lake in the coastal area, the largest salt lake in Romania. Prolonged drought is threatening its existence and the water level has already dropped by more than a meter. Specialists point out the increasing salt concentration, potentially threatening the lake's flora and fauna. The lake has not had such a low level since the 70's. Also Nuntasi Lake in the same area is affected by drought as it almost completely dried out [24].

BULGARIA

In Bulgaria, the most affected by drought is the coastal third of the country, especially the districts of Burgas, Dobrich, Varna, Silven and Shumen [25]. Drought conditions persisting through summer, spring and last autumn left the highest damage in production of wheat, barley and rapeseed, while in Sliven district lower yields due to drought are reported also of sunflower and corn [26]. The dry summer has shrunk this year's wheat harvest by more than 22 %, according to the Ministry of Agriculture, as main damage to the wheat and barley was caused by last year's autumn drought and this year's spring drought. Wheat was completely destroyed on 0.7 % of the total area of the country, barely on 0.33 % and rapeseed on 1.5 % of the total area in the country [25]. Drought reportedly left negligible harvest also among beekeepers who describe this year's honey production as tragic. The main reason for this is the significant summer drought that destroyed the pasture [27]. Among the affected are also livestock farmers, while the State support is also being considered for vegetable growers and fruit growers [28]. The ongoing drought prevents the pre-sowing treatments of the arable areas intended for sowing with winter oilseed rape and winter cereals. Due to this objective reason, serious delays in autumn sowing are expected [29].

Due to the extreme drought and a new type of pest, unusual drying of forests over nearly 100 km from the protection belts in Dobrogea, northeastern Bulgaria is observed this year. Due to the lack of snow in winter and the small amount of precipitation in spring and summer, the trees in the belts have started to dry out en-masse. In response, planting of more drought-

resistant trees have begun [30].

Lack of rain to moisturize the soil and consequent drying up of the topsoil presented higher fire risk. Hundreds of acres of grain have been burned in summertime in the Haskovo region, southern Bulgaria, and firefighters had to intervene seven times to save the harvests of citizens. The last signal was for the burning of nearly 70 ha of grain fields near the village of Belitsa, and another 500 ha of sown rapeseed were endangered. It erupted due to a spark from agricultural machinery during the harvest time, which was enough to ignite the dry lands [31].

Drought is negatively impacting Bulgaria also in hydrological sense. A state of emergency has been declared in the municipality of Nedelino, southern Bulgaria due to the lack of water. The mayor stated that most of the reservoirs in the region were only up to 10-15% full with the exception of Dedelaynska Barchina Reservoir that held approximately 40 % of its total volume. Even the water schedule regime introduced at the beginning of September did not save enough water for drinking and household needs. The municipality requested for additional water to be diverted from neighbouring municipalities [32, 33]. Due to prolonged and severe drought, a state of emergency has been declared also in a district of Shumen, the Municipality announced. The water regime in Matnitsa district, in which water runs for only a few hours a day, has been in place for almost 4 months now, and there is almost not enough water in the higher parts of the district [34].

The last winter, which passed almost without snow, and the hot summer without rain caused Tundzha River, which springs in and runs mostly through Bulgaria, before reaching the sea through northeastern Turkey, to dry up near Edirne area in Turkey. Grass started covering its riverbed and the wider area around the used-to-be river began looking like a green plain [35].

Critically low water levels are reported also for dams across the eastern half of Bulgaria. At the beginning of October, Zhrebchevo Dam is at nearly 21 % of its total volume. Since the end of September, the water supply through the irrigation canals of the agricultural areas in the area of Zhrebchevo dam has been stopped [36]. Also the dams of Ticha, Yastrebino and Aheloy remained with the current volume below 50 % [37]. The situation is most critical with the Kamchia Dam which supplies Varna and Burgas cities as well as a large part of the Burgas region along the Bulgaria's east [38]. At the beginning of October, the available water volume of Kamchia Dam was 43.6 million cubic meters, which is less than 28 % of its total volume. The water restrictions on use of water from the Kamchia Dam were imposed due to the ongoing drought. The requests for higher water supply from the two cities, Varna and Burgas, were not met in full: of the requrested 4.2 million cubic meters Burgas received 3.5 million cubic meters approved, and of 3.4 million cubic meters requested by Varna, 2.5 were approved. The Water for Varna and Burgas from the Kamchia dam was additionally limited for the rest of October, as stated in the monthly bulleting of the Ministry of Ecology [37]. If the

drought conditions continue through the following months as well, it is predicted that the drinking water for the two cities from the dam will only suffice until May 2021 [38].

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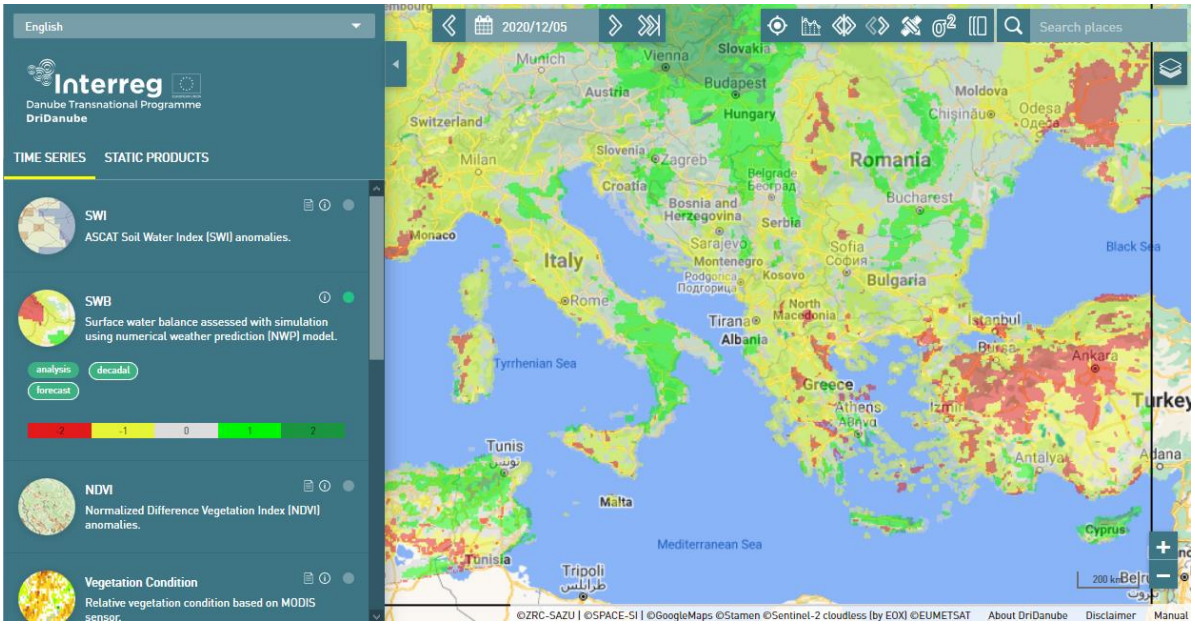
OUTLOOK

Figure below presents model simulations of the **60-day accumulated surface water balance anomaly** in historical percentile classes for the time period **from 8 October to 26 December 2020**, as seen in Drought Watch tool[1].



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

In terms of percentile comparison with the long-term records, wetter-than-normal accumulated surface water balance is expected over parts of the northern half of Balkan Peninsula, including central Hungary, northern Serbia, northwestern Bosnia and Herzegovina, eastern half of Romania and northeastern Bulgaria, and also over coastal area in southern Greece. Across most of the rest of the region, especially over western half of Romania, southern half of Balkan Peninsula and over Turkey, surface water balance will range in under-average values for the given 60-day period. Highest deficit from the average for this time of year is expected over scattered parts of northwestern Romania, North Macedonia and Greece, but also vast part of western Turkey.

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 1990 and 31 December 2019. 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 (1990-2019), 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.