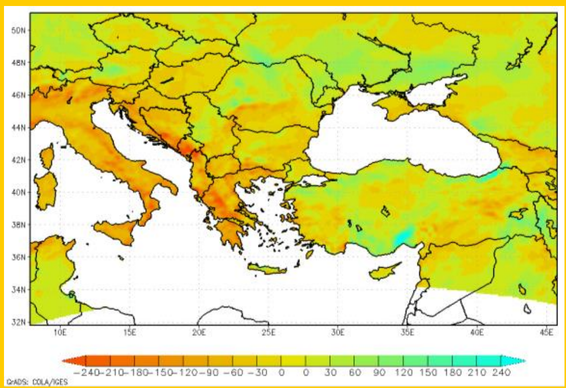
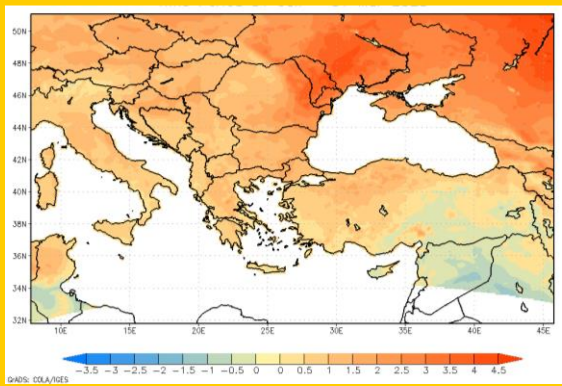
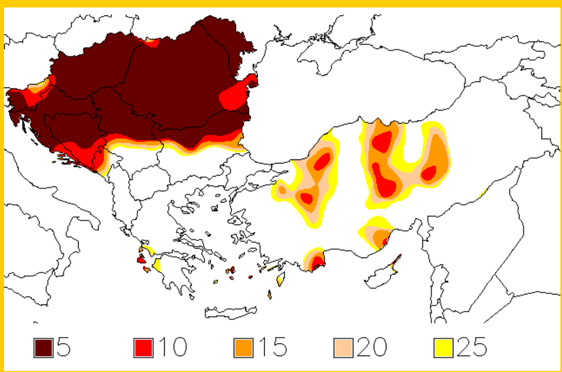
DROUGHT MONITORING BULLETIN

March, April 2020

HOT SPOT



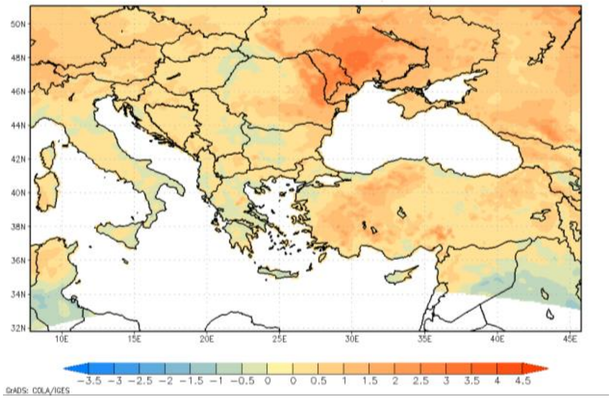
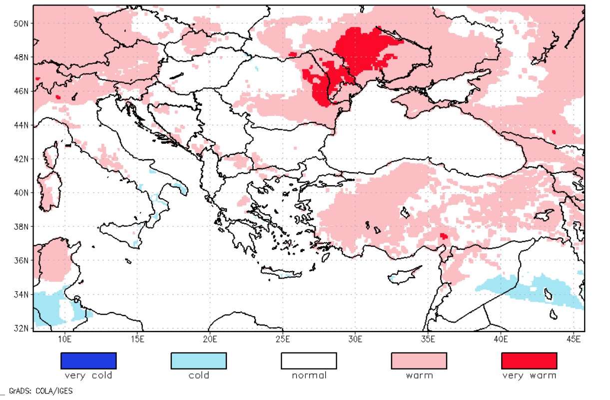




Year 2020 began with very dry January all over the region. Prolonged rainless conditions were present especially along the belt from the Alps to southern Greece, resulting in highly negative **accumulated surface water balance anomalies between 1 January and 1 March 2020 (top left figure)**. February and early March then brought also unusually high temperatures in the region with the exception of southeastern half of Turkey. The **average anomalies of air temperature between 31 January and 31 March 2020 (top right figure)** were up to 1.5 °C higher than normal for this time of year in the region, while over eastern Romania and Moldova they stretched up to 4 °C above the long-term average. The 20 °C mark was broken widely across Balkan Peninsula and Aegean Turkey at the end of February already. Warm early spring was followed by extremely dry April across the entire northern half of Balkan Peninsula and over central Turkey, as shown on the map of **precipitation percentiles for April 2020 (bottom left figure)**. Most of April was rainless over that area and monthly-accumulated precipitations in most places did not exceed 50 mm, neither over traditionally rainfall-rich Alpine area that received less than 25 % of its usual April precipitations.

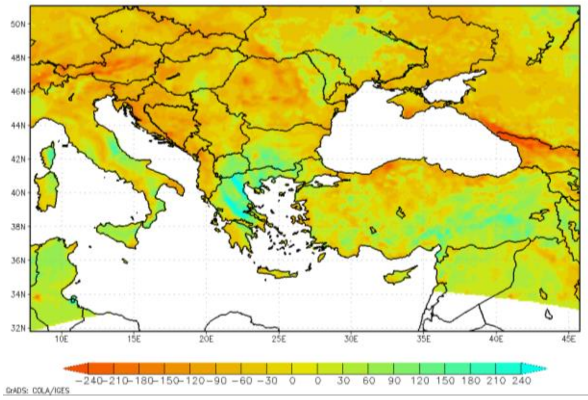
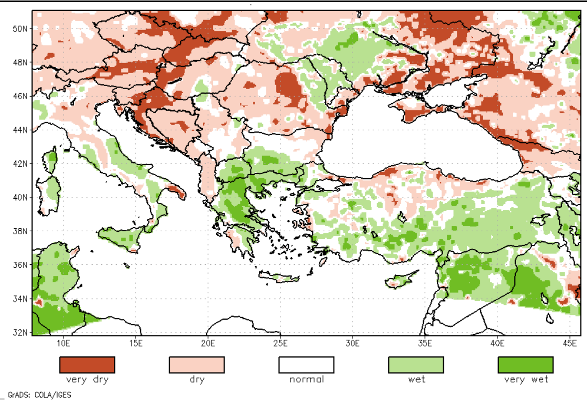
AIR TEMPERATURES AND SURFACE WATER BALANCE

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 2 March to 30 April 2020****.*

AVERAGE AIR TEMPERATURE ANOMALY (°C) **2 MARCH – 30 APRIL 2020**	AVERAGE AIR TEMPERATURE PERCENTILE CLASSES **2 MARCH – 30 APRIL 2020**
	

High air temperature anomalies from late February greatly intensified in areas along the Black Sea during first days of **March**, daily maximums rose as high as 21-24 °C. Mean air temperatures were 6-8 °C higher than normal, in southern Moldova up to 9 °C, resulting in one of the warmest air temperatures recorded locally for that time of year. Mid-March continued to be unusually warm across Balkan Peninsula with anomalies from the average this time more evenly distributed, between 1-3 °C over Greece and Bulgaria and 3-4 °C in other countries. However, at the same time central and western Turkey experienced a drastic drop in air temperatures where anomalies fell from 4-6 °C above the average in early March to 2 °C below the usual values in mid-March. Passing of a cold front across the region in late March brought frost days to parts of Balkan Peninsula, daily air temperature minimums dropping to -3 °C over its central and western parts, and to -5 °C in central Bosnia and Herzegovina. The anomaly of a 10-day mean air temperature at the end of March reveal above-average air temperatures of up to 2 °C over central Turkey while countries of Balkan Peninsula experienced anomalies of up to -4 °C below the average, in Croatia and Bosnia and Herzegovina even up to -6 °C.

In early **April**, the cold air mass brought very low air temperatures also to southern Bulgaria, Greece and across northern coastal Turkey where they ranged between 4 to 5 °C below the average. The rest of the region experienced below-average air temperatures too although to a lesser degree, up to 2 °C below the usual values, with the exception of Moldova where about-average air temperatures of late March rose up to 2 °C higher above the average in early April. Once cold front was over in the region, air temperatures in mid-April rose high above the average again over most of the region. Anomalies were the highest, up to 3 °C warmer than normal, in countries along the western half of Balkan Peninsula - from Slovenia, over Serbia to Greece -, eastern Romania and Moldova Only in late April did air temperatures normalize to its usual values for this time of year across all region. The only exception to this was northeastern Turkey where air temperatures were up to 2 °C colder than usual, and also eastern Romania and Moldova where air temperatures of up to 3 °C above the average persisted throughout all April. The mean air temperatures of the 60-day period over March and April shows only normal values across vast part of Balkan Peninsula, and averages out the highly dynamic change of air temperatures within that period, stretching rapidly from very high to very low and back. The exception to this is western half of Turkey and its far north-east where mean air temperature of the 60-day period exceeded the average for 1-2 °C, and southern Romania but most noticeably its eastern part and Moldova where March-April period was 2.5-3.5 °C warmer than normal.

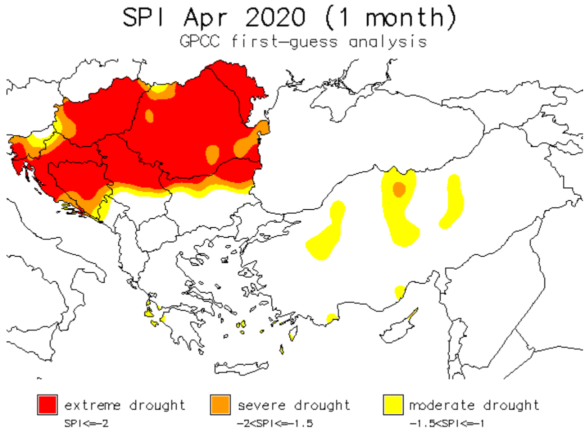
ACCUMULATED WATER BALANCE ANOMALY (mm) **2 MARCH – 30 APRIL 2020**	ACCUMULATED WATER BALANCE PERCENTILE CLASSES **2 MARCH – 30 APRIL 2020**
	

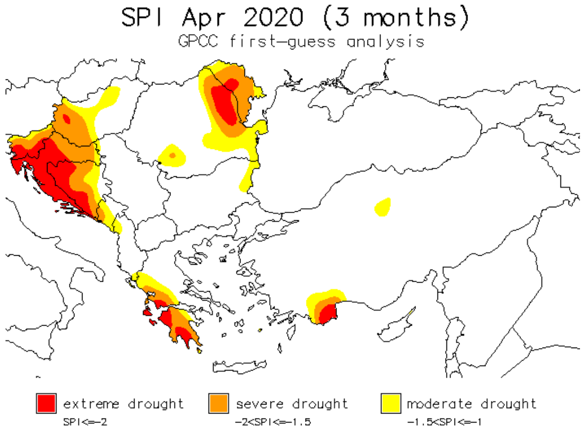
Mostly accumulated surface water balance for March reached more or less usual values across Balkan Peninsula and western Turkey, anomalies from the average ranged between -60 mm and 60 mm. Higher surface water balance surplus was present only across southeastern Turkey and locally over northeastern Greece. April, however, brought noticeable change. While precipitation level was very high across southeastern Turkey and central and northern Greece, scarce precipitations were April's main characteristics of all countries in northern half of Balkan Peninsula with the exception of Moldova. It resulted in the accumulated surface water balance deficit of March-April period ranging between -90 mm and -120 mm over northern half of Balkan Peninsula and northern Turkey, locally in western Hungary, coastal Croatia and over the Carpathians up to -150 mm where values classified among the driest 5th percentile. On the other hand, accumulated surface water balance exceeded the average values for this time of year for 120-180 mm across northeastern Greece and southeastern Turkey, in central Greece for more than 200 mm which saw the area experience one of the wettest periods of local records. Surface water balance across western Turkey remained in average values throughout April.

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 **April 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 SPI1, noticeable lack of rain in April created extremely dry conditions across entire northern half of Balkan Peninsula. Scarce precipitation level over most of the area classified among the driest 5 % of local historic records, over eastern Slovenia, southern Bosnia and Herzegovina and southeastern Romania among the driest 10 %. April precipitation levels were noticeably below the average – in driest quartile – also across central Turkey which created moderate drought conditions, according to SPI1.

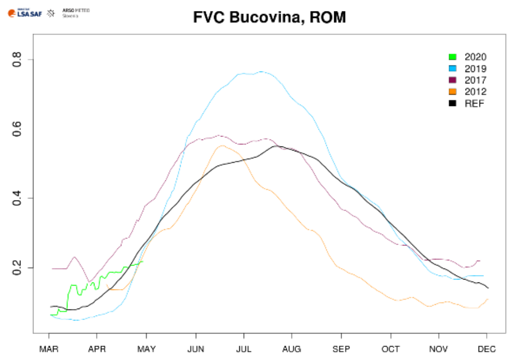
A 3-month overview of SPI reveals four separate areas where spring drought conditions were present during February-April period. In southwestern Greece, low SPI3 values are mainly a result of extremely dry February where precipitation level classify among the driest 10th percentile. February and March but mostly April were severely to extremely dry across northwestern Balkan Peninsula, the area where drought conditions prevailed the longest, since February. Indication of extremely dry conditions via SPI3 values for southwestern Turkey come after prevailing state of moderate to severe drought in March and April, while extremely low SPI1 values for April over eastern Romania and Moldova are reflected also in SPI3.

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.

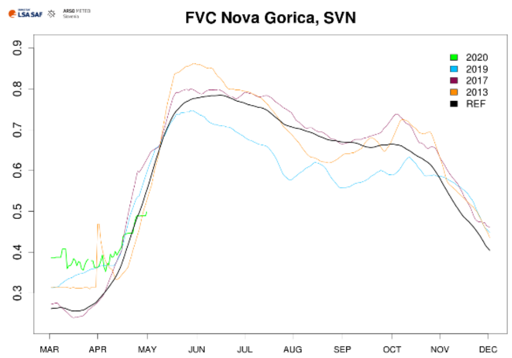
Graphs below present the **vegetation situation** as recorded **on 30 April 2020** in some regions of Southeastern Europe. FVC values for year 2020 are presented as green line. Graphs also include reference line (2004–2019) in black, and lines in light blue (year 2019), magenta (year 2017) and orange (year 2012, or 2013 for Slovenia) for comparison. Possible missing values or sharp decline of values could be a result of a prolonged cloudy weather, extreme weather events or snow blanket.

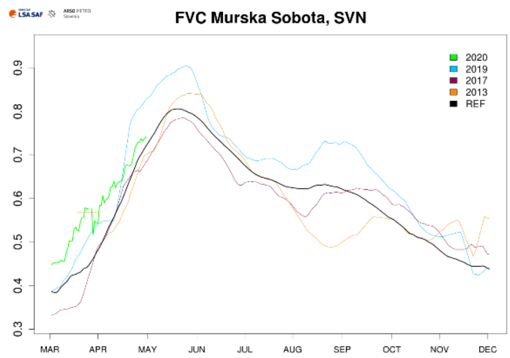
ROMANIA



FVC values for Bucovina in northern Romania show higher than normal vegetation coverage in early spring, which was likely due to well-above-average air temperatures which boosted vegetation growth in early spring. However, a slower growth rate can be observed throughout April due to prevailing high temperatures combined with extremely dry April, leaving FVC index at slightly below-average values at the end of the month.

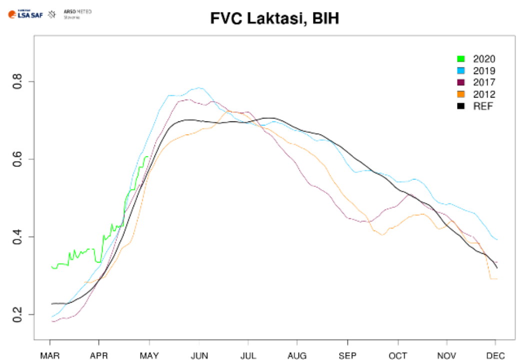
SLOVENIA

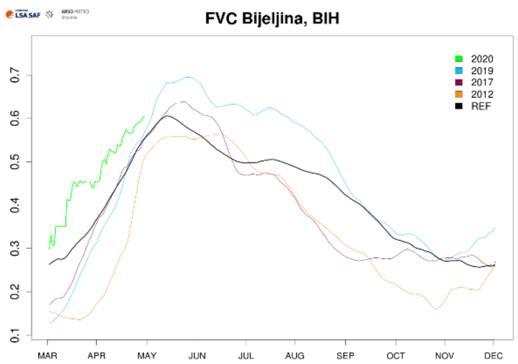


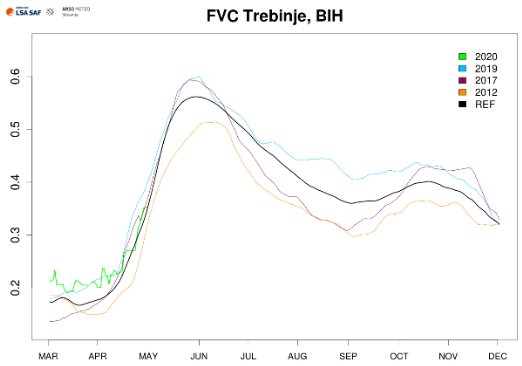


Also in Nova Gorica, western Slovenia, vegetation growth was boosted in early spring by higher-than-normal air temperatures. FVC values for March exceed the average for more than 10 % although the rate of further development was lower than normal later in April, likely due to persisting lack of rain throughout the month. In Murska Sobota, northeastern Slovenia, vegetation development started earlier than normal and have since then continued to exceed the average vegetation cover. Favourite conditions in March resulted in a high boost in vegetation growth later in March, although values started to normalize at the end of April.

BOSNIA AND HERZEGOVINA (REPUBLIC OF SRPSKA)

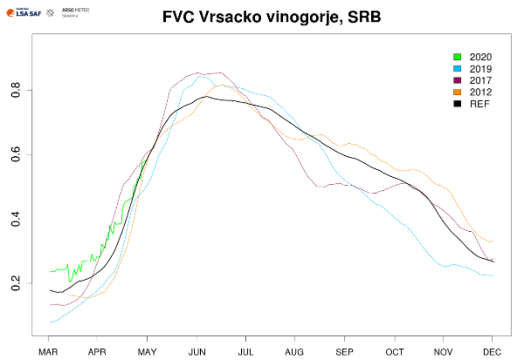


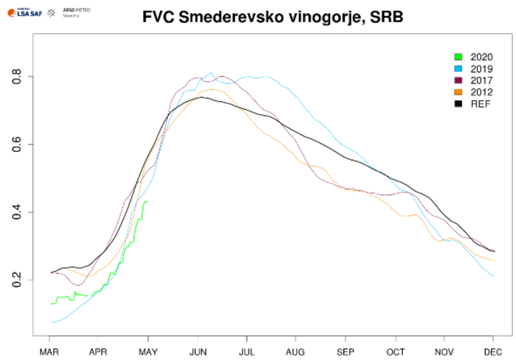




In Laktasi and Bijeljina along the northern Bosnia and Herzegovina, vegetation cover was higher than normal in early spring. In late March, FVC values exceeded the average for approximately 15 % and continued to be above-average in Bijeljina in north-east of the country, while in Laktasi in north-west they normalized by mid-April and continued to follow the average pattern. In Trebinje in southern Bosnia and Herzegovina, vegetation boost in early spring was only minimal, and followed the usual progress throughout April.

REPUBLIC OF SERBIA

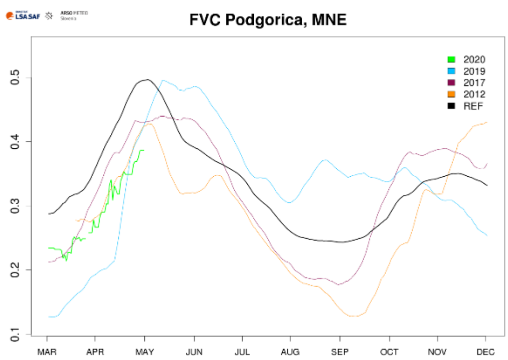




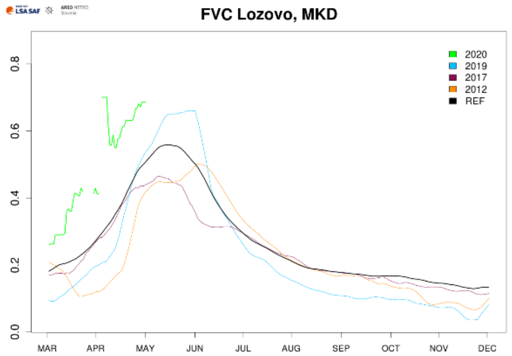
A pattern of vegetation development this year similar to the one in Trebinje can be observed also for Vrsacko vinogorje in northeastern Serbia. Higher than normal vegetation cover was present throughout all March and early April but normalized throughout the second half of April, likely due to below-average precipitation level that month. On the other hand, in Smederevsko vinogorje in central Serbia, vegetation cover in early March stood at only half its usual extent for this time of year. Although started with an approximately 2-week delay, vegetation development then followed its ordinary pattern.

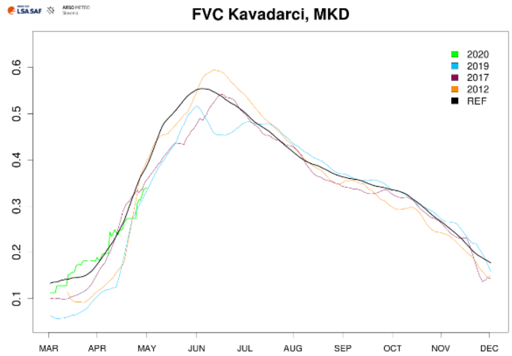
MONTENEGRO

Also in Podgorica in southern Montenegro, vegetation development was legging behind its ordinary pattern. FVC values indicate that vegetation cover was only a third of the average one for early March, then followed its usual pattern throughout March and April although with a 2-week delay. At the end of April, FVC values stand more than 15 % below the peak values normally experienced at this time of year, likely due to prolonged period of surface water balance deficit.



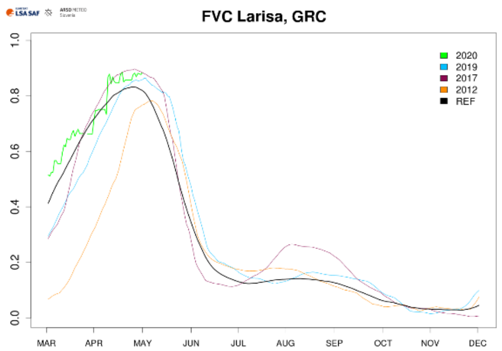
NORTH MACEDONIA

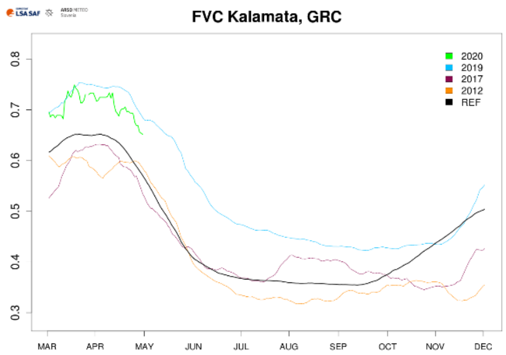




While vegetation in Kavadarci in southern part of North Macedonia seem to receive optimal conditions for its development in spring months, a slower rate of development can be observed at the end of April, indicating a decline in its growth lately. On the other hand, weather conditions of this year were favourable for above-average vegetation development in Lozovo in central part of North Macedonia, which this year has been continuously exceeding the average for approximately 15 %. Missing FVC values in early April can be a result of a prolonged cloud cover.

GREECE





With only a slight decline in first weeks of April, vegetation developed as usual in Larisa in central Greece through first months of spring, at even slightly higher than normal FVC values. Also in Kalamata in southern Greece, vegetation developed at its usual pattern although with higher coverage than normally, similar to its progress last year.

IMPACT REPORTS

MOLDOVA

Very dry autumn, warm and snowless winter and dry first months of this year paved the way for agricultural sector in Moldova to become seriously affected in spring months already [1, 2]. At the end of April, the accessible water reserve in the soil layer of 0-200 cm was three times lower than the multiannual average [4]. As a result, many crops have already been affected, mostly in southern and central regions, less so northern parts of the country [1, 2, 3]. Water stress and thermal stress have compromised the sowing of autumn grains located especially after the late forerunners such as: sunflower and corn in the cob and in some crops, especially cereals, the yield could be 50% lower than estimated [1, 4]. High temperatures and prolonged period of lack of essential precipitation throughout winter half of the year reflected also in hydrological drought. Water flow in the rivers and water basins in the country is 50% and lower than the multi-annual norm [5].

ROMANIA

Over 2.9 million hectares have been sown with agricultural crops in Romania but more than half of them have been affected by winter and spring drought [6]. Most affected were areas in eastern and southern Romania. In Moldavia region in the east and Dobruja region in coastal area, any of the crops planted the last autumn are said to be compromised to various extents [7]. In the south of the country, drought was reaching the level of damage. Wheat, corn and sunflower were in danger the most, while also newly sown corn and sunflower crops were at risk of drying out. While water demand for irrigation increased during that time, some of the functional stations were unusable due to the low flows of the Danube and the Siret rivers [8]. In Harghita region in central Romania, rain was consecutively insufficient for the past 8 months which grew concerns over massive losses in potato yield. In relation to that, potato was being sold for almost double the price compared to the same period last year [9]. The drought affected also the water supply of several communes in the country. In Gorj county in southwestern Romania, tap water was available only at certain times, a schedule set by local authorities and water supply operator. While some also use it for agricultural activities, water was scarce to keep even for food and personal hygiene. The level of water scarcity was reflected in some even stealing water at night. Due to continuous decrease of water level, the authorities the authorities decided to divide the locality of Smârdan in southeastern Romania in two, north and south, with each part receiving water every alternate day [10, 11].

SLOVENIA

Drought was present across all of the country although biggest damage was reported in Littoral area across western and southwestern Slovenia where rainless conditions were aggravated by strong winds, especially the bora wind, which further dried out the soil. The drought damage was seen in spring-planted cereals and clover crops, with significant damages on oilseed rape and winter cereals [12, 13]. Crops of sown vegetables without irrigation and early potatoes did not even sprouted or sprouted very slowly, and asparagus yield was noticeably lower than usual due to drought. Affected by prolonged drought were also orchards, especially apples [14]. Hops was lagging behind in growth, with first-year plantations being particularly affected. Cereals were most affected in Vipava valley in western Slovenia where arable land was so drained that fertilization and tillage were prevented [12, 13, 14]. The grassland was also badly affected, posing a serious concern for livestock farming. In lowlands of Littoral area, the first cut was already lost, meaning there are likely to be major feed problems later [13, 14]. At the same time, there was no water available for irrigation where possible, not even in dedicated reservoirs [13]. Prolonged drought conditions lasting throughout winter months and spring caused hydrological drought. Before the end of April, low water content was noted on the vast majority, as many as 80 %, of water measuring stations, with dry water content measured at 10 % of them, especially in southern Slovenia, while only 10 % of measuring station recorded medium water content. Individual streams and small rivers dried out [16]. Very low groundwater levels were recorded in several aquifers in northwestern Slovenia, with a declining trend toward extremely low values were monitored in eastern Slovenia since the beginning of the year [15, 16]. Firefighter units had to be activated in parts of western Slovenia and hilly areas without water supply. The number of water supplying has increased considerably in April, there has been almost twice as many shipments by mid-April already than the whole months the year before. Although in April, there was for that time still enough water for the inhabitants of Istria, southwestern Slovenia, the local water supply operator was on the brick of switching to the so-called summer regime [14].

SERBIA

Due to the lack of soil moisture corn, soybeans and sunflowers could hardly sprout or did not at all. Wheat was also lagging behind in development, which is expected to affect the yield later on [17].

[1] https://unimedia.info/ro/news/d7073a72ee15782f/situatia-din-agricultura-fara-precedent-potrivit-ministrului-perju-premierul-anunta-o-scadere-a-roadei-de-grau-cu-50.html
[2] http://24h.md/guvernul-va-elabora-un-set-de-masuri-de-diminuare-a-impactului-secetei-asupra-agriculturii/
[3] http://24h.md/seceta-loveste-puternic-in-productia-de-grau/
[4] https://unimedia.info/ro/news/022bff8066e87aba/toate-terenurile-agricole-semanate-cu-culturi-cerealiere-de-toamna-si-primavara-vor-fi-inventariate.html
[5] https://unimedia.info/ro/news/0d95f471b393f813/codul-galben-de-seceta-hidrologica-a-fost-extins.html
[6] http://stiri.tvr.ro/ministrul-agricultorii--adrian-oros--mai-mult-de-jumatate-din-culturile-insaman--ate-in-toamna-sunt-afectate-de-seceta_859652.html
[7] https://www.romaniajournal.ro/business/extreme-drought-in-moldavia-and-dobruja-3-million-ha-of-crops-compromised/
[8] http://stiri.tvr.ro/culturile-sunt-in-pericol--canalele-de-iriga--ii-sunt-goale--debitele-raurilor-sunt-scazute_860837.html
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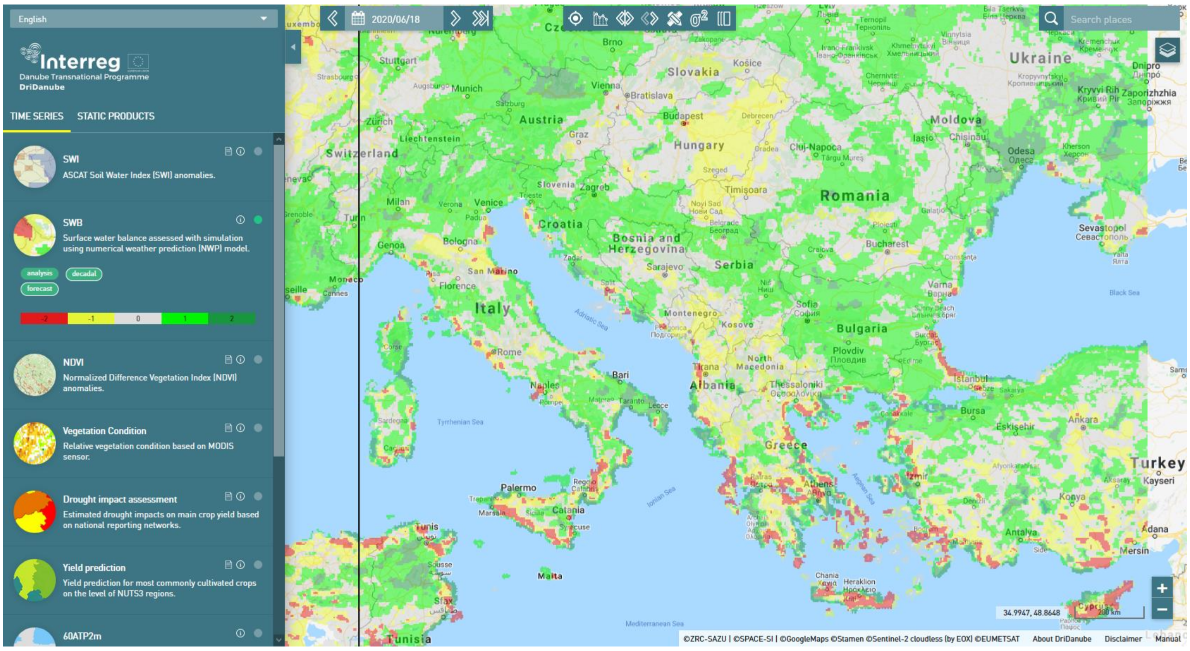
[14] https://www.rtvslo.si/okolje/novice/dolgotrajna-susa-ze-povzroca-resne-tezave-primorskim-kmetovalcem/521331
[15] http://meteo.arso.gov.si/uploads/probase/www/agromet/product/document/sl/HidrometeoroloskeRazmere_2020_04_16.pdf
[16] http://meteo.arso.gov.si/uploads/probase/www/agromet/product/document/sl/HidrometeoroloskeRazmere_2020_04_23.pdf
[17] http://www.novimagazin.rs/vesti/susa-ugrozava-nicanje-kukuruza-soje-i-suncokreta-i-rast-penice-u-srbiji

OUTLOOK

Figure below presents model simulations of the **60-day accumulated surface water balance anomaly** in percentile classes for the time period **from 21 April to 19 June 2020**, as seen in Drought Watch tool[1].



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

The outlook of 60-day accumulated water balance shows that wet conditions will prevail over most of the region, namely across vast part of eastern and western Balkan Peninsula along with northwestern Turkey. On the other hand, dry conditions will be present over plain areas in eastern half of Hungary across to northern Serbia as well as over part of southern Balkan Peninsula from Montenegro to northern Greece. Several scattered areas across coastal Greece and along coasts of western half of Turkey will experience very dry conditions.

Methodology

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; gpcc.dwd.de). NWP simulations are performed with Non-hydrostatical Meso-scale Model (NMM, see: http://www.dtcenter.org/wrf-nmm/users/). Historical DMCSEE model climatology was computed with NMM model for time period between 1st January 1979 and 31st December 2016. European Centre for Medium Range Weather Forecast (ECMWF) ERA-Interim data set (see: http://www.ecmwf.int/en/research/climate-reanalysis/era-interim) was used as input for simulations. Long term averages (1979-2016), 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.