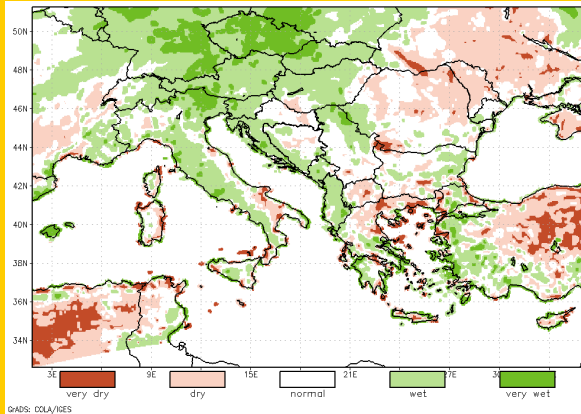


# DROUGHT MONITORING BULLETIN

August 2023

## HOT SPOT

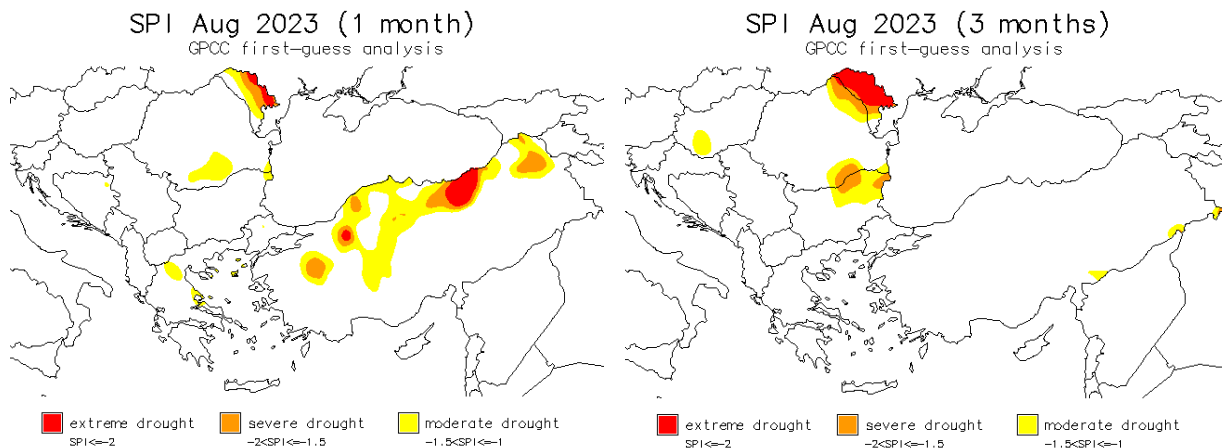


While August brought unusually high amount of rain to several parts of Balkan Peninsula and western Turkey, it was a dry month over its eastern part from Moldova to northern Greece and across central Turkey. Air temperature conditions of one of the warmest August months in local history further aggravated dry conditions in Turkey. Figure on the left presents **August surface water balance in percentile classes** on the base of 1991-2020, showing diverse surface water balance conditions this August.

## STANDARDIZED PRECIPITATION INDEX

Drought situation with regard to the precipitation level is presented by Standardized Precipitation Index (SPI). The SPI calculation is based on the distribution of precipitation over long time periods (at least 30 years) and can be calculated at various time scales that reflect the impact of 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 **August 2023** 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 August was considerably behind the long-term normal over much of Moldova, especially along its east, as well as across much of the northern half of Turkey where rainfall deficit caused severely dry conditions, locally this August was even extremely dry. Southern Romania, central-western Turkey and a part of northern Greece also received noticeably less rain than normal where monthly SPI indicated moderately dry conditions this August. Accumulated of the last 3 months, precipitation level this summer was one of the lowest across all of Moldova where according to the SPI3, summer months have rarely been this dry in the past three decades. The area stretching over the Romania-Bulgaria border near the Black Sea also experienced a very dry summer this year as vast part of the area recorded rainfall deficit indicating moderate to severe drought this summer. Other areas with precipitation deficit indicating moderately dry summer included southwestern Hungary and localised areas along southeastern Turkey.

## AIR TEMPERATURE AND SURFACE WATER BALANCE

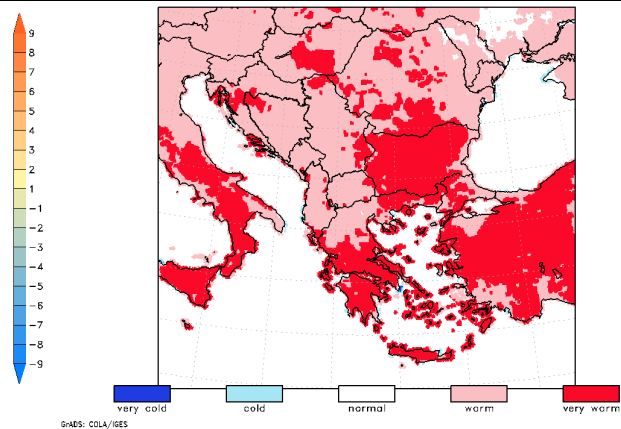
*Figures in this section present anomalies of the average air temperature and accumulated surface water balance as well as their classified values in percentile classes for a 60-day period from 30 June to 28 August 2023.*

AVERAGE AIR TEMPERATURE  
ANOMALY (°C)  
30 JUNE – 28 AUGUST 2023



SHADES: COLA/IGES

AVERAGE AIR TEMPERATURE  
PERCENTILE CLASSES  
30 JUNE – 28 AUGUST 2023



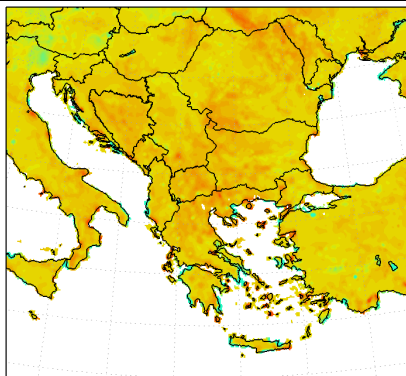
SHADES: COLA/IGES

Across much of Turkey, August was continuously warmer than normal as decadal mean air temperature regularly exceeded the average. Anomalies from the average were the smallest in early August, ranging between 1 and 3 °C, but intensified later on when mean air temperatures stood 3-5 °C above the long-term record. Meanwhile, Balkan Peninsula experienced much different run of air temperatures this August. In its first days, northwestern quarter of the region from Hungary to Albania were kept in air temperatures 2 to 3 °C colder than normal, over Slovenia and northwestern Hungary up to 4 °C colder. Later in mid-August, average air temperatures prevailed, except for the central Balkan Peninsula and central Greece where they stood up to 2 °C below the average. Final days of August saw hot air mass spread across the region bringing air temperatures at least 3 °C warmer than normal for this time of year, which were present over Greece, while most part of Balkan Peninsula experienced 4-5 °C warmer air temperatures, along its northern belt up to 6 °C warmer. Altogether it was one of the hottest end of August in the last decades across the entire region.

Considering July was much warmer than normal across central and southern Balkan Peninsula

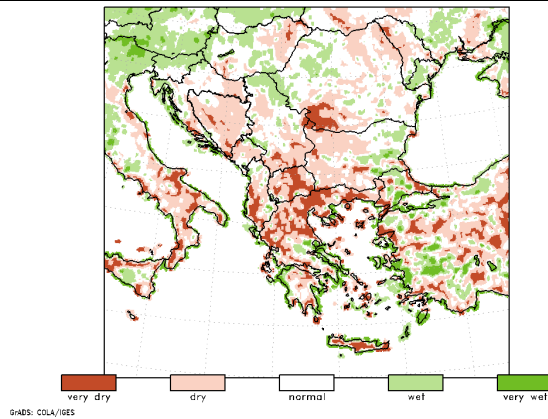
with monthly anomalies at least 2 °C above the long-term July average, while August anomalies were the highest across Turkey and parts of eastern Balkan Peninsula, the 60-day mean air temperature resulted in 1-2 °C above the long-term average across nearly all of the region, while central Turkey and Bulgaria experienced up to 3 °C warmer July to August period. In Moldova, on the other hand, the 60-day mean air temperature averaged out to normal for this time of year.

ACCUMULATED WATER BALANCE  
ANOMALY (mm)  
30 JUNE – 28 AUGUST 2023



GHRS: COLA/IGES

ACCUMULATED WATER BALANCE  
PERCENTILE CLASSES  
30 JUNE – 28 AUGUST 2023



GHRS: COLA/IGES

Nearly all of the region recorded various levels of surface water balance deficit in the July-August period, except for Slovenia, much of Hungary, northwestern Romania and Aegean Turkey. The former mainly came as a result of dry but also warmer than normal August across the eastern half of Balkan Peninsula and Turkey, and dry and warm July across western half of Balkan Peninsula. The 60-day deficit was across most of Turkey not greater than 60 mm, similarly also in central Romania and continental Croatia. Accumulated surface water balance over July and August was up to 90 mm lower than normal across Hungary, central Serbia, Albania, southern Greece and eastern Bulgaria while elsewhere across the Balkan Peninsula the two-month period brought even higher surface water balance deficit, of up to 150 mm, with the highest of it present across North Macedonia and eastern Greece, southwestern Romania and northern Moldova. Only scattered localised areas all across the region recorded wet to very wet surface water balance conditions.

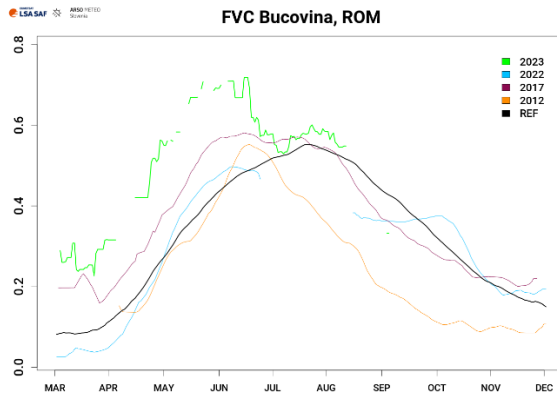
## REMOTE SENSING - FRACTION OF VEGETATION COVER

*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 to the damages of possible natural disasters (including drought). FVC values are in general low at the beginning of the growth season, the highest at full vegetation development, then FVC slowly drops with vegetation senescence. Line shape depends on the sort of vegetation at the given location.*

Graphs below present the **vegetation situation** as recorded on **1 September 2023** at selected locations across southeastern Europe. FVC values for year 2023 are presented as a green line. Graphs also include reference line (2004–2022) in black, and lines in light blue (year 2022), magenta (year 2017) and orange (year 2012, or 2013 for Slovenia) for comparison. Missing values or their sharp decline can be linked to prolonged cloudy weather, extreme weather

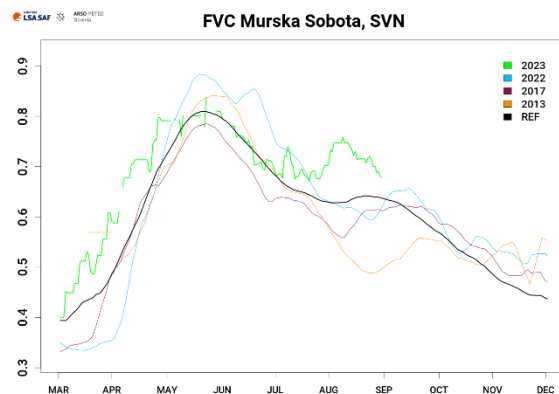
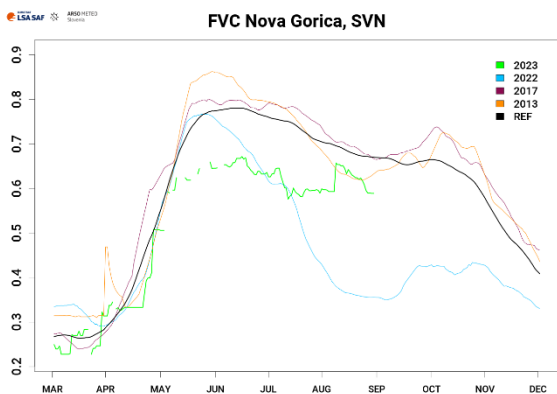
events, snow blanket or changes to product by the product provider.

## ROMANIA



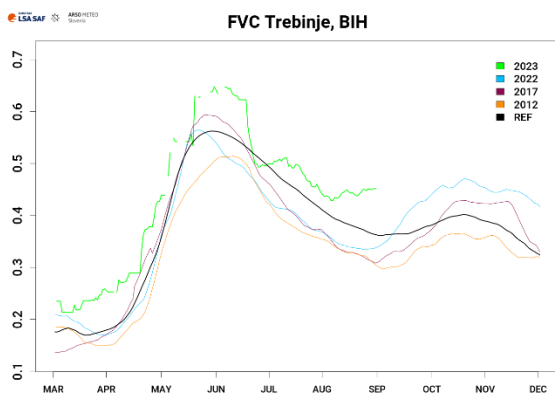
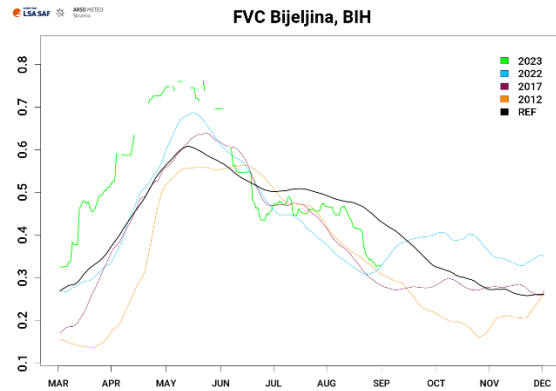
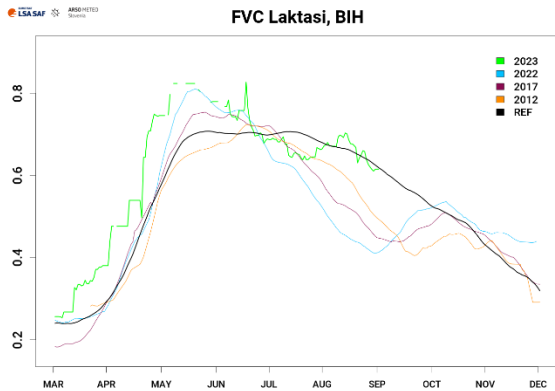
In Bucovina, northern Romania, weather proved favourable for vegetation growth this spring, resulting in reaching its peak values in mid-June already, well ahead of its usual time and well exceeding it too, with approximately 20 % greater fraction of unit covered with green vegetation. Early summer weather left considerable impact on further vegetation development, bringing the abundant vegetation cover down to the average by early July already, although weather in second half of summer slightly boosted vegetation growth again to keep it about the long-term average.

## SLOVENIA



In Nova Gorica, western Slovenia, weather conditions between March and mid-May appeared supportive for regular vegetation growth this season, however, the end of spring which normally presents seasonal peak saw vegetation growth halted at 60 % of the unit covered with green vegetation, without further expansion to the usual almost 80 % at its peak time. Early summer weather did not support further growth either, thus vegetation cover remained stagnated at this level through early June and began declining by the end of it. Unusually wet conditions in early August acted as a short-term boost, although FVC remained below-average nevertheless. Vegetation season in Murska Sobota, northeastern Slovenia began noticeably earlier than normal, in early March already, then followed well its regular rate of growth and development. Exceeding seasonal peak on this basis was prevented by unfavourable weather conditions in late spring, resulting in halting further growth in mid-May at the long-term average. Senescence phase that followed progressed as usual up to mid-July, when wetter than normal conditions encouraged further vegetation growth, resulting in second seasonal peak occurring a month earlier than normal and at up to 15 % greater fraction of vegetation cover than normal in early September.

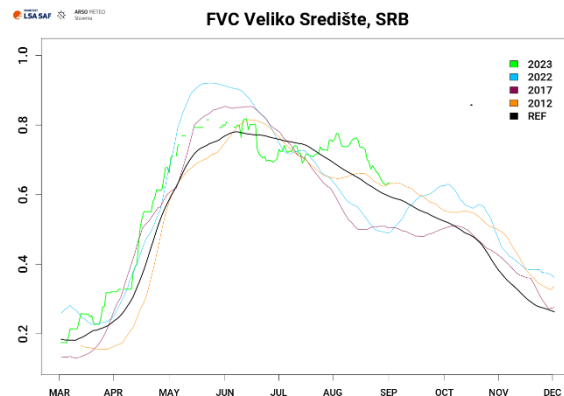
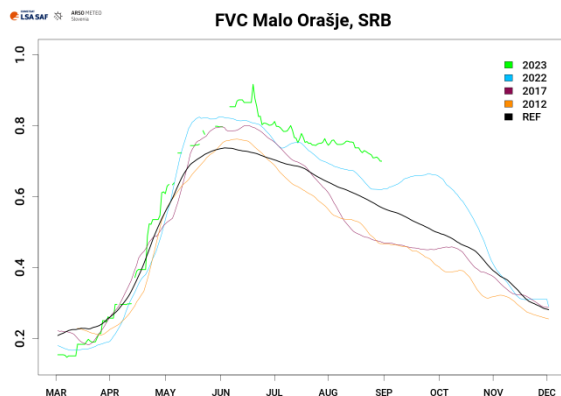
**BOSNIA AND HERZEGOVINA (REPUBLIC OF SRPSKA)**



In Laktasi and Bijeljina along the northern Bosnia and Herzegovina, favourable spring weather conditions encouraged earlier than normal vegetation development this season, which by its peak in mid-May exceeded the average fraction of cover with green vegetation by 10-20 %. Senescence phase that followed was intensified by unfavourable weather conditions in early summer, resulting in noticeable drop in FVC values down to up to 10 % below the average by mid-July.

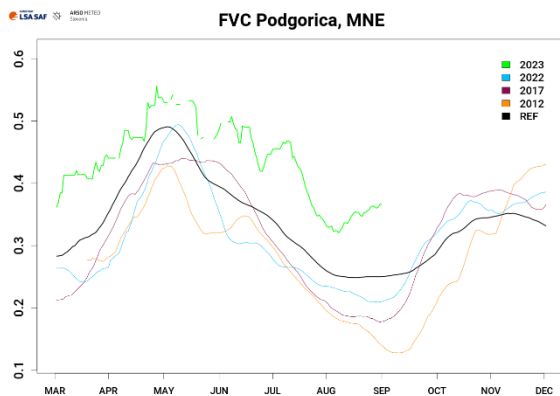
Weather conditions turned favourable again in second half of summer with a short-term boost in vegetation growth observed for Laktasi that brought FVC values back to the average, while in Bijeljina it acted as temporarily halting the senescence phase. Vegetation in Trebinje, southern Bosnia and Herzegovina, recorded slightly different season. After earlier than normal onset in March, further development was slow at first, adopting its regular rate of growth again only after mid-April. Wet weather conditions in late spring boosted further growth, resulting in exceeding its peak cover by up to 15 %. Similarly as for the northern locations, here too the early summer weather conditions brought down most of the exceeded growth, although afterwards senescence phase appeared to continue at the slower rate than normal since late June, resulting in a continuation of above-average level FVC values in second half of summer.

**SERBIA**



It was an average beginning of the vegetation season in Malo Orasje, central Serbia. Late spring with its favourable weather conditions supported the continuation of growth even beyond its peak time and into June, by which fraction of cover with green vegetation exceeded its usual extend by about 10 %. Consequently, senescence phase began 2-3 weeks later than normal and continued at its regular rate, meaning FVC values remained continuously above-average on the account of exceeded seasonal peak. In Veliko Srediste, northeastern Serbia, vegetation development began slightly earlier than normal and progressed at its usual rate of growth throughout spring months. Seasonal peak was consequently reached slightly ahead of its usual time although the level of cover with vegetation remained more or less average for the entire duration of the seasonal peak. A decline in FVC values was soon after intensified as a result of unfavourable weather conditions in early half of summer, although from mid-July onward a recovery in vegetation growth and extent of cover can be observed.

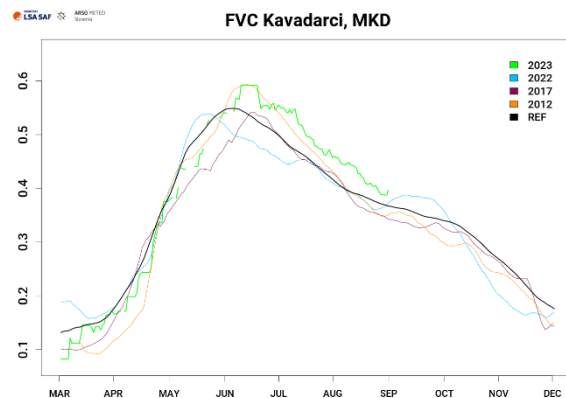
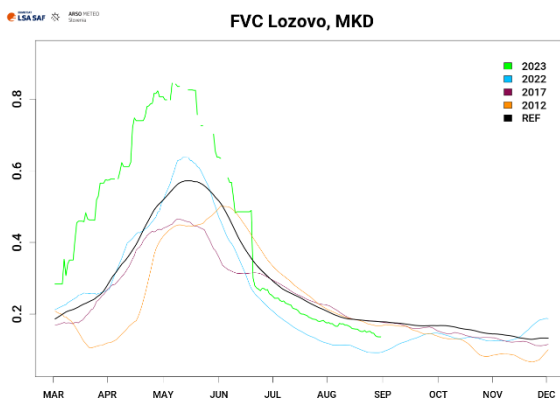
### MONTENEGRO



It has been a favourable season for vegetation development this year in Podgorica, southern Montenegro. After approximately a month earlier onset than usual and slightly greater than normal extend of cover with green vegetation at the beginning of March, growth and development was encouraged by favourable weather conditions this spring and resulted in exceeding its seasonal peak in early May. Senescence phase that followed was on average progressing at the slower rate than

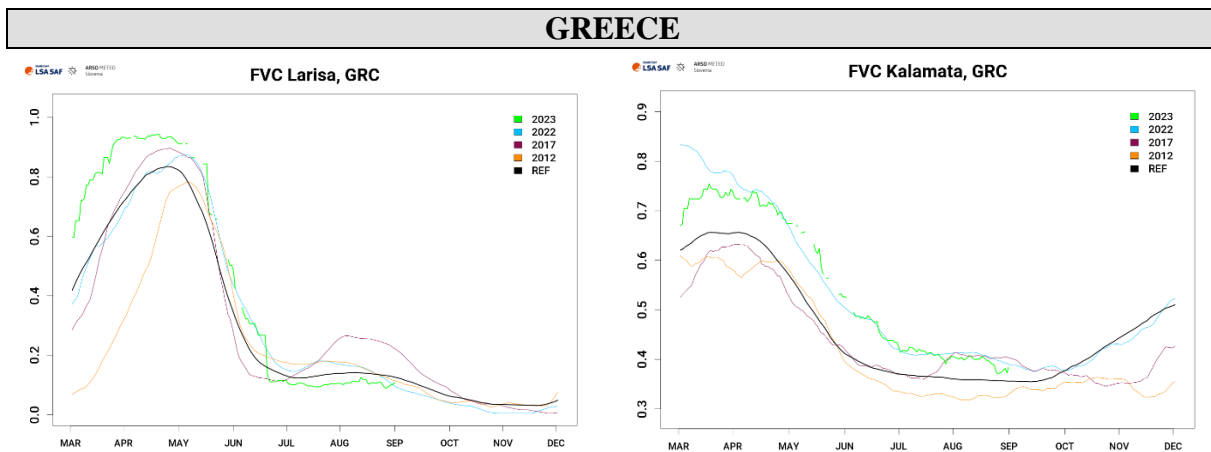
normal, although during that time, individual episodes of sharp decline and quick recovery can be observed. August weather conditions appeared similar to what is normally experienced in early autumn as second seasonal peak appeared to have begun almost two months earlier.

### NORTH MACEDONIA



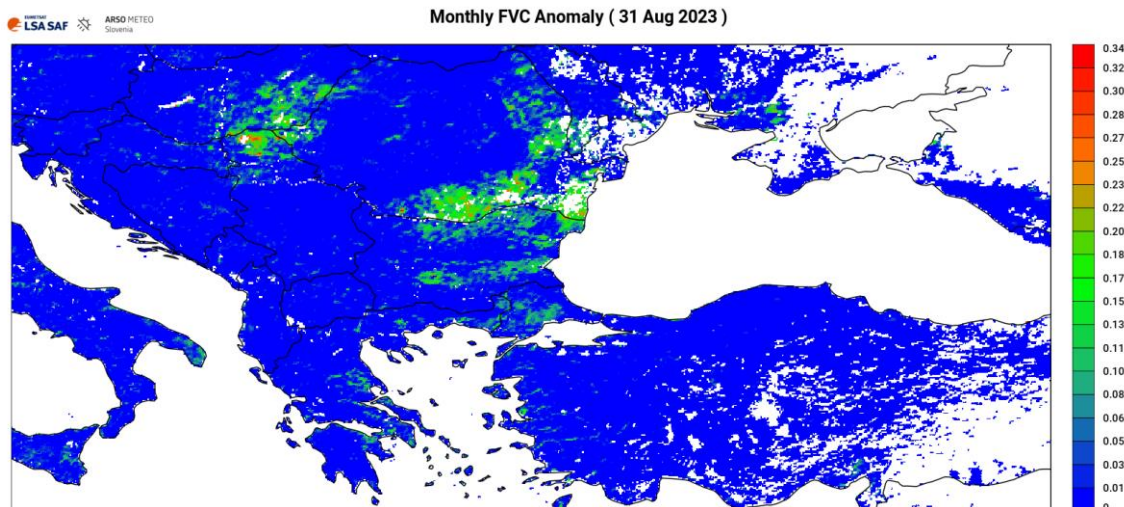
Vegetation in Lozovo, central North Macedonia experienced an abundant beginning of the season. Vegetation development began a month earlier than normal and even progressed at a slightly higher rate than normal, resulting in well exceeding its peak level of cover in mid-May. At that time, green vegetation was covering approximately 85 % of a unit which is about 30 % greater than normal. The rest of the vegetation season was not favourable for vegetation development, early summer weather conditions soon brought down the exceeded level of

cover with green vegetation as a rapid decline in FVC values can be observed, down to 30 % by mid-June. During the rest of the months, vegetation continued its senescence phase at its usual rate, altogether standing slightly below-average on the account of sharp decline in early summer. In Kavadarci, southern part of the country, vegetation season more or less followed its usual pattern of development, with the exception of longer-lasting seasonal peak when favourable early summer weather conditions made seasonal peak last for more than a month, from early June well into July. Consequently, the senescence phase began later than normal but has since then progressed at its usual rate, meaning level of cover with green vegetation was in Kavadarci slightly above-average for the entire summer.



Vegetation in Larisa, central Greece experienced an abundant second half of the growing season, with the level of cover continuously up to 20 % greater than normal throughout March and April. Seasonal peak was reached approximately a month earlier and was exceeded by approximately 10 % in fraction of cover, altogether lasting for about a month and a half, from early April to mid-May. Afterwards, during the senescence phase, the level of cover with green vegetation was in decline at the regular rate up until mid-June when unfavourable weather conditions caused an additional sharp decline in vegetation cover. FVC values remained nearly constant since then, in accordance with the usual vegetation rhythm for this time of the year. It was an abundant vegetation season in Kalamata too, southern Greece. Seasonal peak was exceeded for up to 15 % and lasted well into early May, resulting in delayed onset of senescence phase. Since then, vegetation cover began declining at its usual rate throughout the entire senescence phase till end of July although it remained up to 10 % above the average. It has since then remained constant which too is in line for this time of year.

Figure below shows negative anomaly of **accumulated 30-day FVC values** as recorded on **31 August 2023** in comparison to the past 19 years (2004-2022), and is used experimentally.



While vegetation development progressed well across much of the region in August, three distinctive areas with noticeably lower level of vegetation cover can be observed via FVC index. In central Pannonian Basin stretching across southern Hungary, northern Serbia and far western Romania, green vegetation covered up to 20 % smaller fraction of a unit this August than it normally does, across localised areas in northern Serbia the healthy vegetation covered even up to 30 % less fraction of a unit. Another distinctive area where the level of vegetation cover was greatly reduced stretched across much of the southern and eastern Romania and over to northern Bulgaria and southern Moldova respectively, where, according to the FVC index, the level of cover with green vegetation was this August up to 20 % below the long-term average, locally even more. Throughout August, healthy vegetation ended up covering up to 15 % lesser extent than normal also over the Balkan Mountains, southeastern Bulgaria and various localised areas across central and northern Greece.

## DROUGHT IMPACT REPORTS

### GREECE

The hot-dry-windy weather conditions of July 2023 continued also in August. Major fires occurred in western Attica close to Athens, but especially in Alexandroupoli-Evros and the Dadia Forest National Park, where the individual fires formed a mega-fire in the northeastern Greece. An analysis of high-resolution images of the Sentinel-2 shows that more than 5000 ha had been burnt by 22 August 2023 in Fyli, western Attica <sup>[1]</sup>. The fire in Evros caused severe damage with losses in livestock and arable land. According to Hellenic Agricultural Insurance Organization, until 21 August 2023, 1.200 beehives and hives had been burnt in a total of 26.264 and 910 small animals were charred, the majority of them being goats and sheep <sup>[2]</sup>. In the Dadia Forest National Park, one of the most important protected areas at the international, European and national levels, the disastrous fire that broke out for a second consecutive year poses a direct threat to the unique ecosystem, especially to the black grouse colony <sup>[3, 4]</sup>. Until 28 August 2023, over 82.600 ha had been burned in Evros <sup>[6]</sup>. It is the largest fire in the EU since 2000 when European Forest Fire Information System started recording data, and as of the end of August it was ongoing for the 13<sup>th</sup> day <sup>[5, 7]</sup>.

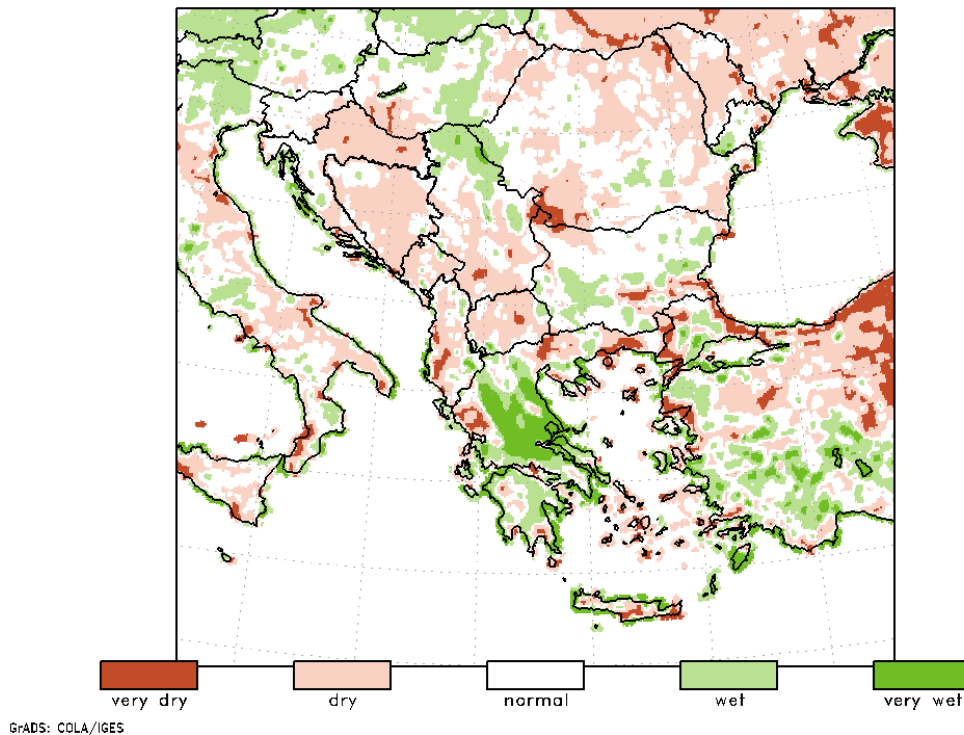
[1][https://www.real.gr/koinonia/arthro/perissotera\\_apo\\_617\\_000\\_stremmata\\_katekapse\\_mexri\\_simera\\_h\\_pyrkagia\\_ston\\_ebro\\_kai\\_pano\\_apo\\_50\\_000\\_sti\\_fyli](https://www.real.gr/koinonia/arthro/perissotera_apo_617_000_stremmata_katekapse_mexri_simera_h_pyrkagia_ston_ebro_kai_pano_apo_50_000_sti_fyli)



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 [2] <https://www.newsit.gr/ellada/fotia-stin-aleksandroupoli-anypologistes-oi-katastrofes-apanthrakothikan-910-zoa-terastia-zimia-se-ypodomes/3843496/>  
 [3] <https://www.enikos.gr/society/evros-fotia-sto-dasos-tis-dadias-apeileitai-amesa-i-apoikia-tou-mavrogypa-foto/2015068/>  
 [4] <https://www.tanea.gr/2023/08/23/greece/dasos-dadias-poi-os-einai-o-perivallontikos-thisayros-pou-paradothike-stis-floges/>  
 [5] <https://www.tanea.gr/2023/08/29/greece/komision-oi-megalyteres-dasikes-pyrkagies-pou-exoun-katagrafei-pote-stin-ee-aytes-stin-ellada/>  
 [6] <https://www.ertnews.gr/featured/evros-nea-112-se-sidiro-kai-giannouli-gia-isxyres-anazopyroseis-tragiki-i-katastasi-se-kotronia/>  
 [7] <https://www.ertnews.gr/eidiseis/ellada/anekselegkta-pyrina-metopa-ston-evro-proliptiki-ekkenosi-tis-perioxis-aspropoulia-stin-kalamata-apo-to-112/>

## OUTLOOK

Figure below shows model simulations of the **60-day accumulated surface water balance anomaly** in historical percentile classes for the time period **from 30 July to 27 September 2023**.



In comparison to the long-term, the forecast 60-day surface water balance will remain drier than normal across much of the western, central and northeastern Balkan Peninsula as well as central-northern Turkey, but which, in comparison to the July-August accumulated surface water balance, indicates some level of improvement, that means, less dry than during the two summer months. Very dry surface water balance conditions are expected to cease across much of the region, with the exception of southwestern Romania, where the area under such unfavourable conditions is expected to become smaller compared to the July-August period, as well as over northern Turkey where very dry conditions are expected to continue lasting. Considerable change in 60-day surface water balance is expected over Greece, mostly over its central part where the dry to very dry surface water balance conditions of the July-August period are going to be replaced by the opposite extreme. Also southwestern Turkey is expected to experience wetter than normal conditions. Elsewhere, levels of surface water balance would remain unchanged compared to the July-August period, or are expected to normalise.

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### Methodology

DMCSEE Drought monitoring bulletin is based on numerical weather prediction (NWP) model simulations over SE Europe, SPI index calculations, remote sensing product and public media drought impact reports. Precipitation data is provided by Global Precipitation Climatology Centre (GPCC; <https://www.dwd.de/EN/ourservices/gpcc/gpcc.html>) shown against the average of the 1961-1990 time period. NWP simulations are performed with Non-hydrostatic Mesoscale Model at ~7 km spatial resolution (NMM; <http://www.dtcenter.org/wrf-nmm/users/>). Historical model climatology in terms of air temperature and surface water balance is computed with NMM on the base of 1 January 1991 to 31 December 2020 time period, using European Centre for Medium Range Weather Forecast (ECMWF) ERA5 dataset (<http://www.ecmwf.int/en/forecasts/datasets/reanalyses-datasets/era5>) as input for simulations. Long-term averages (1991-2020), used for comparison of current weather conditions, are obtained from simulated dataset. Comparison of current values against long-term average or in percentile classes (the two extreme classes with a 5-percent range, and each of the middle three classes with a 30-percent range) provides a signal on potentially ongoing drought. Remote-sensing product in the bulletin is based on the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) Land SAF MSG Daily Fraction of Vegetation Cover product (<https://landsaf.ipma.pt/en/products/vegetation/fvc/>), presented for the checked and confirmed locations and using long-term averages from 2004 to the last full year (currently to 2022). Information on drought impacts are obtained from freely available online reports of national authorities and media newspapers.