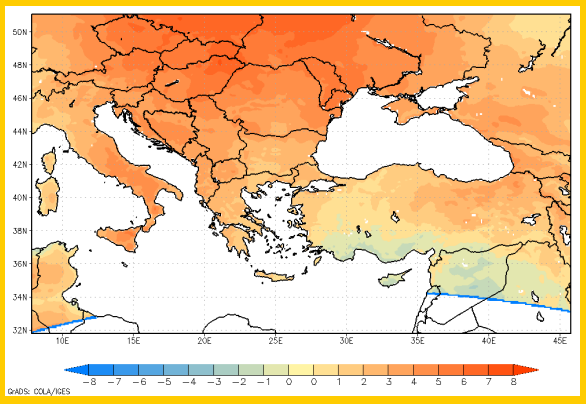
# DROUGHT MONITORING BULLETIN

*22nd July 2019*

## HOT SPOT

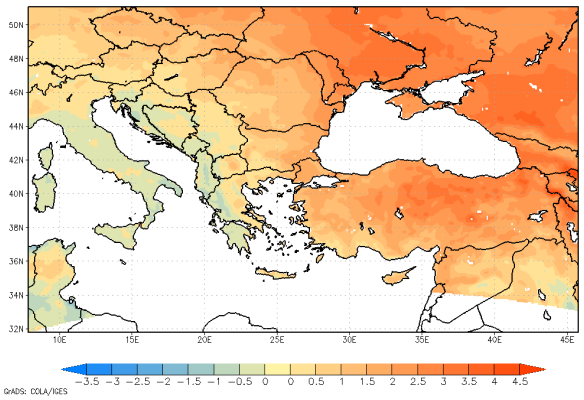


June was unusually warm in the region with vast area of local air temperature highs often classified among the hottest 5 % of their historic records. Especially first half of June was considerably warmer than usual as air temperatures exceeded 30 °C even across region's Alpine and northernmost part. Anomalies were the highest across central Turkey at the beginning of the month and then over Pannonian Basin and Moldova in mid-June when air temperatures stretched as high as 6–7 °C above the usual values. Figure on the left shows **anomalies of mean air temperature between 10th–19th June 2019**.

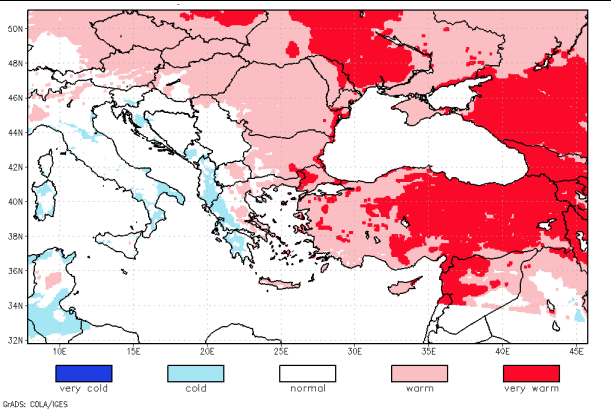
## AIR TEMPERATURES AND SURFACE WATER BALANCE

*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 1st May to 29th June 2019**.*

AVERAGE AIR TEMPERATURE ANOMALY (°C)
**1st MAY - 29th JUNE 2019**



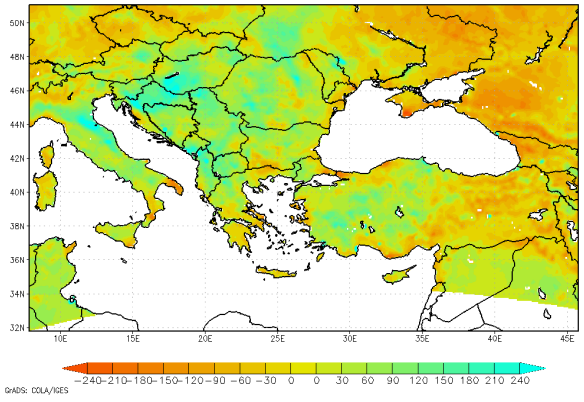
AVERAGE AIR TEMPERATURE PERCENTILE CLASSES
**1st MAY - 29th JUNE 2019**



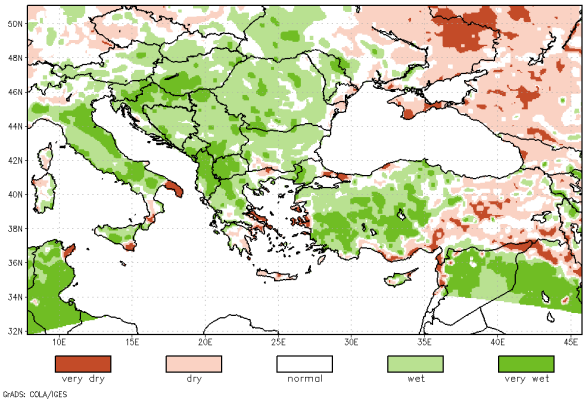

Cold spell, present in late May all over western half of the region, was in first week of June replaced by air temperatures of up to 3 °C above the average over Slovenia, Croatia and Hungary while they normalized over central Balkan Peninsula and negative anomalies slightly

lessened over Greece and Albania, standing up to 1 °C below the average. Eastern half of Balkan Peninsula and most of Turkey continued to experience air temperatures 2–4 °C warmer than usual while in far-eastern Turkey anomalies rose noticeably, from 2 °C in late May to up 5–7 °C in early June, classifying them in the hottest 5th percentile of historical local records.
Second decade of June eased down high air temperatures over Turkey, resulting in anomalies range from -2 °C across its Mediterranean part to up to 3 °C over its north-east. At the same time, air temperatures rose well above the average across entire Balkan Peninsula where minimal anomalies detected were of up to 3 °C present over Greece and southern Bulgaria but they exceeded the average for up to 6 °C over eastern Hungary, northern Romania and across entire Moldova. It remained much warmer than usual throughout the rest of June with anomalies 2–4 °C above the average across most of the region, although in Moldova, Hungary, Alpine Slovenia and far-eastern Turkey they stretched up to 5 °C above the average.
The 60-day overview covering May and June shows mean air temperatures across the region were about 2–4 °C higher in comparison to the previous, April-May window. As seen from the figure above, anomalies stood up to 1 °C below the average across areas all along the Adriatic and Ionian seas, and up to 1.5 °C above the average across Hungary, Romania and Bulgaria. Anomalies were the highest, 2–3 °C, across Moldova, coastal Romania and wide central and eastern part of Turkey.

ACCUMULATED WATER BALANCE ANOMALY (mm)
**1st MAY - 29th JUNE 2019**




ACCUMULATED WATER BALANCE PERCENTILE CLASSES
**1st MAY - 29th JUNE 2019**

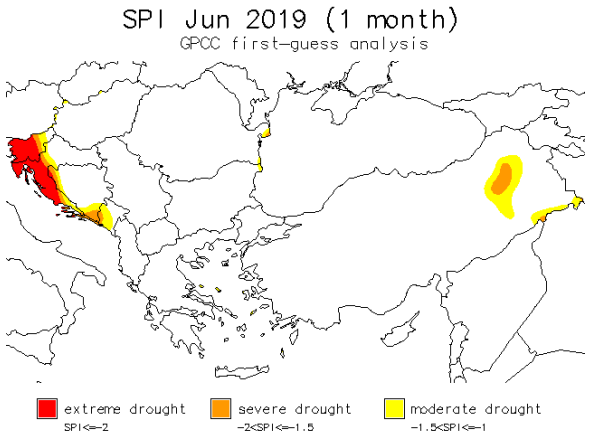


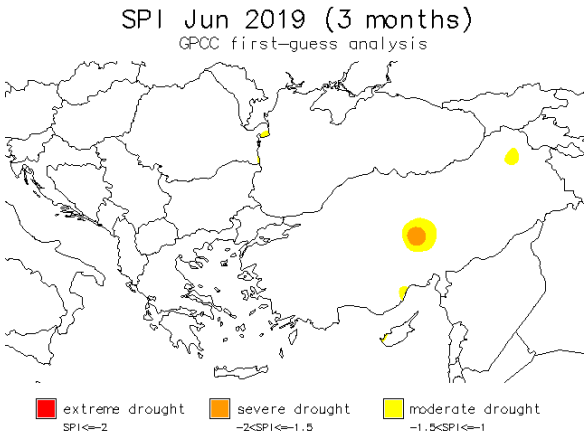

Although warm June air temperatures increased evapotranspiration, June was at the same time characterized by high precipitation level across most parts of the region, central Balkan Peninsula and northwestern Turkey especially. However, in Slovenia, coastal Croatia, Aegean islands and in parts of eastern and southeastern Turkey extremely low monthly rainfall rate was classified among the lowest 5th or 10th percentile. June situation is reflected well in the 60-day accumulated surface water balance, in comparison to April-May period. In Slovenia and Croatia, below-average rainfall rate decreased accumulated water balance but which resulted in welcome change from very wet to wet conditions, anomalies still ranged between 120–200 mm above the average. On the other hand, below-average rainfall rate over Aegean part of Greece and eastern half of Turkey resulted in water balance conditions further worsening to dry or very dry level. Negative anomalies from the average ranged between -60 and -120 mm over Aegean Greece and mainly between -90 and -120 over eastern Turkey. The rest of Balkan Peninsula and western half of Turkey continued to experience above-average water balance level: accumulated anomalies mainly ranged between 60–150 mm, while local anomalies of as high as 200 mm over Albania, Montenegro, Carpathians and wide areas across central-western Turkey contributed to increase of water balance level to very wet conditions.

## STANDARDIZED PRECIPITATION INDEX

*The drought situation with regard to the precipitation accumulation is presented by Standardized Precipitation Index (SPI). The SPI calculation is based on the distribution of precipitation over long time periods (30 years, in our case long-term average 1961-1990 was used). The SPI can be calculated at various time scales which reflect the impact of the drought on the availability of water resources. The long term precipitation record is fit to a probability distribution, which is then normalised so that the mean (average) SPI for any place and time period is zero. SPI values above zero indicate wetter periods and values less than zero indicate drier periods. Only the dry part of the extreme anomalies is presented on the maps.*

Standardized precipitation index for June is shown in figures below. SPI for one-month indicates possible drought conditions which can have impact on vegetation while SPI for three-month period can be indicative also for surface water status.




One-month view on precipitation conditions reveals that noticeable lack of rain indicating extremely dry conditions was present over most of Slovenia and coastal Croatia. Moderately to severely dry conditions, not previously present there in May, appeared also over southern Bosnia and Herzegovina, Montenegro and eastern Turkey. Aegean part of the region continued to receive under-average precipitation level also in June, however the extend of area and intensity of dry conditions reduced in comparison to May situation as moderate drought conditions were limited only to individual islands. SPI for a 3-month period indicates prevailing drought conditions were present locally over central Turkey, an area which experienced lasting severe lack of rain mainly in April and May.

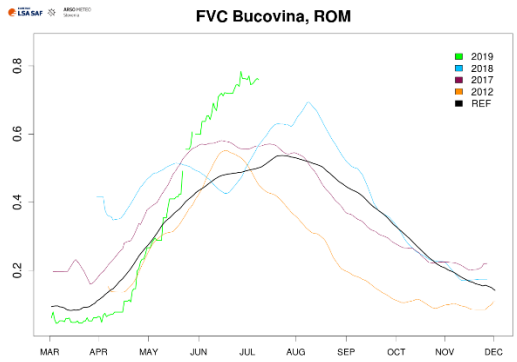
## REMOTE SENSING - FRACTION OF VEGETATION COVER

*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 8th July 2019** in some regions of Southeastern Europe. FVC values for year 2019 are presented as green line. Graphs also include reference line (2004–2018) in black, and lines in light blue (year 2018), magenta (year

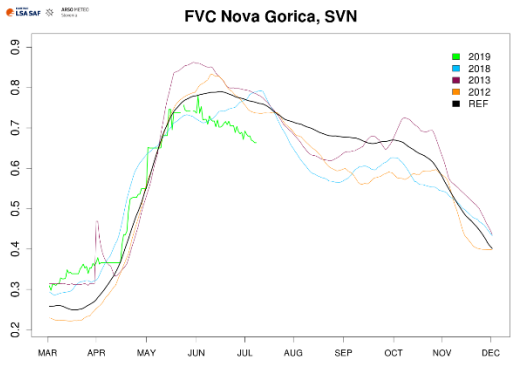
2017, or 2013 for Slovenia) and orange (year 2012) for comparison. Possible missing values or sharp decline of values could be a result of a prolonged cloudy weather, extreme weather events or snow blanket.

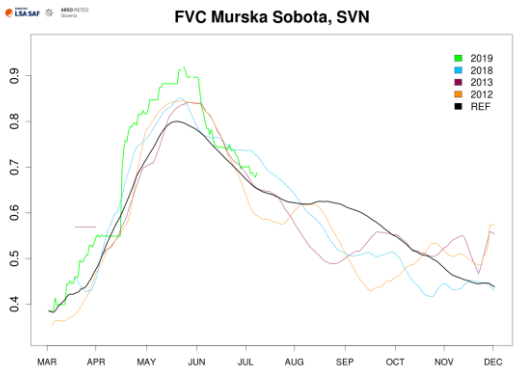
## ROMANIA




Wet and very warm June created favourable conditions for vegetation growth in Bucovina in northern Romania, as indicated by FVC. Vegetation growth continued throughout the month and at the rate much higher than normally. It exceeded the average values for almost 30 % at the end of the month, as it approaches its seasonal peak.

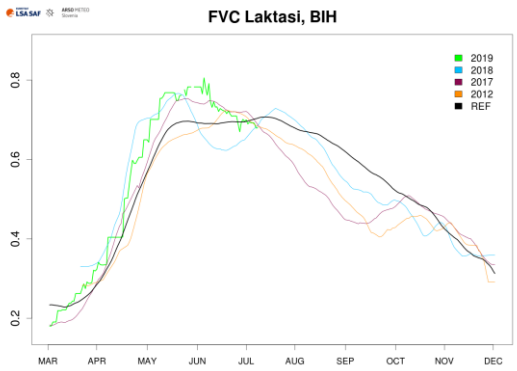
## SLOVENIA

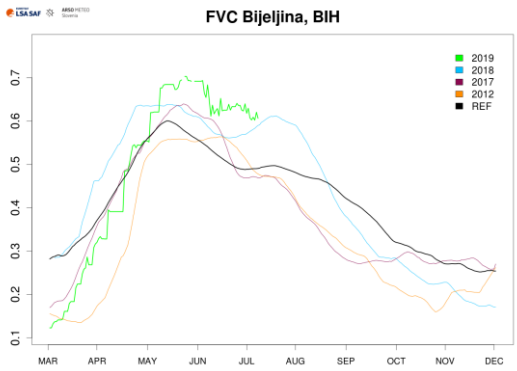


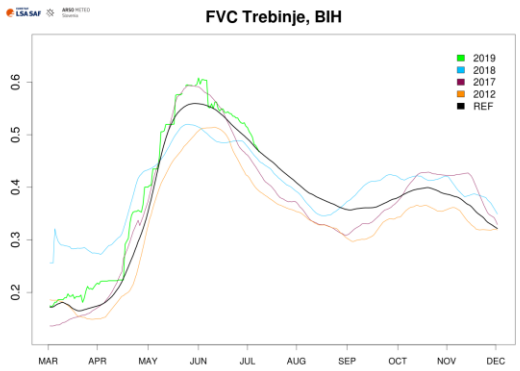




High June air temperature accompanied with lack of rain negatively affected vegetation development at both locations in Slovenia. In Murska Sobota in northeastern Slovenia, mid-June conditions ended boost of vegetation growth which lasted since mid-April, and while decline throughout June is expected for Murska Sobota, it occurred at considerably higher rate than normally. Vegetation in Nova Gorica in Littoral Slovenia did not experience such boost in spring months but followed the usual development progress until mid-May when it started to decline earlier than normally. June conditions further supported the decline, resulting in continuous under-average FVC values for approximately 10 % since mid-May.

## BOSNIA AND HERZEGOVINA (REPUBLIC OF SRPSKA)

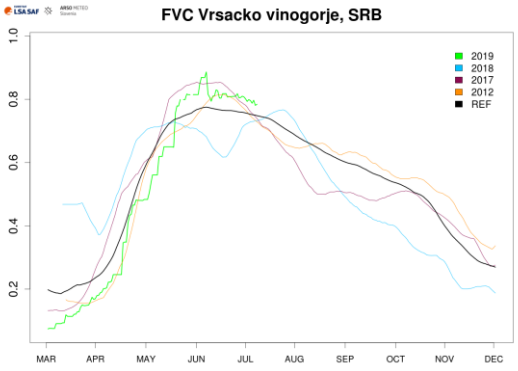


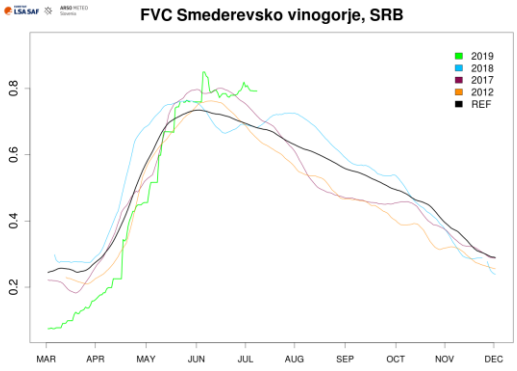




Vegetation development at all three locations in Bosnia and Herzegovina reached its seasonal peak as expected in May and even exceeded it for approximately 5–10 %. In Bijeljina in northeastern part of the country, the decline followed as expected, meaning June FVC values continue to exceed the average for almost 10 %. Vegetation in Trebinje in southern part of the country seemed to continue following well its usual development pattern, with some favourable conditions experienced around the time of its peak in late May. On the other hand, FVC values for Laktasi in north-west of the country indicate that this season vegetation follows its development pattern similar as in 2017: vegetation development, exceeding its peak values in May, experienced a decline in June which occurred at higher rate and earlier than normally.

## REPUBLIC OF SERBIA

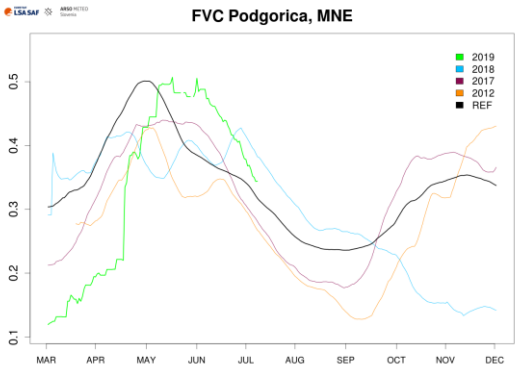


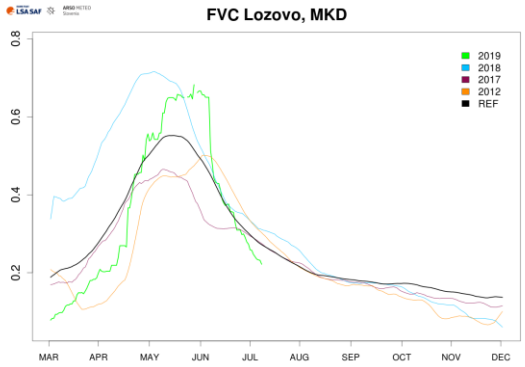

For both Vrsacko and Smederevsko vinogorje, vegetation development continued to reach its average values slightly later than normally throughout first months of spring. However, above-average warm and wet conditions in June, present especially across central Balkan Peninsula, seemed favourable for development of vegetation at both locations. They reached and exceeded its peak in early June and vegetation cover continue to for 5–10 % higher than normally.

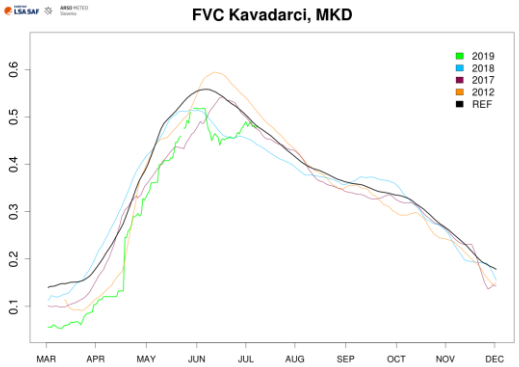
## MONTENEGRO

Unfavourable conditions for vegetation growth in early spring delayed its development in Podgorica in southern Montenegro. Since its boost in mid-April it returned to its expected rate and pattern of development, although with a noticeable delay. Its seasonal peak was reached in June, approximately a month later than expected.



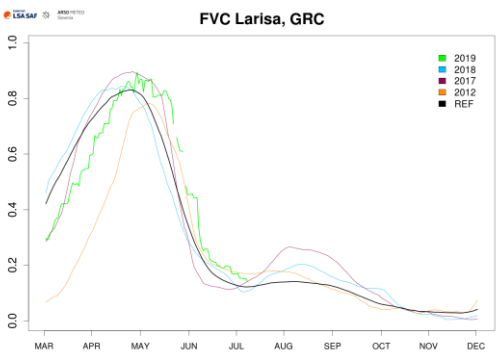

## NORTH MACEDONIA

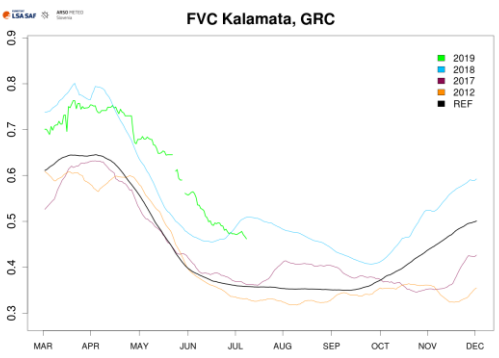



In Lozovo in central part of North Macedonia, initial under-development of vegetation was replaced by a boost in its growth since mid-April which lasted until the end of May, exceeding its usual peak value for approximately 10 %. A sudden sharp decline of FVC values for almost 20 % can be detected for early June despite warm and wet conditions, possibly a consequence of other reasons. Also in Kavadarci in southern part of the country, vegetation experienced initial under-development but then continued at the similar rate as usually, although delayed. It reached its seasonal peak in early June with FVC values lower than normally with further under-average development throughout the month.

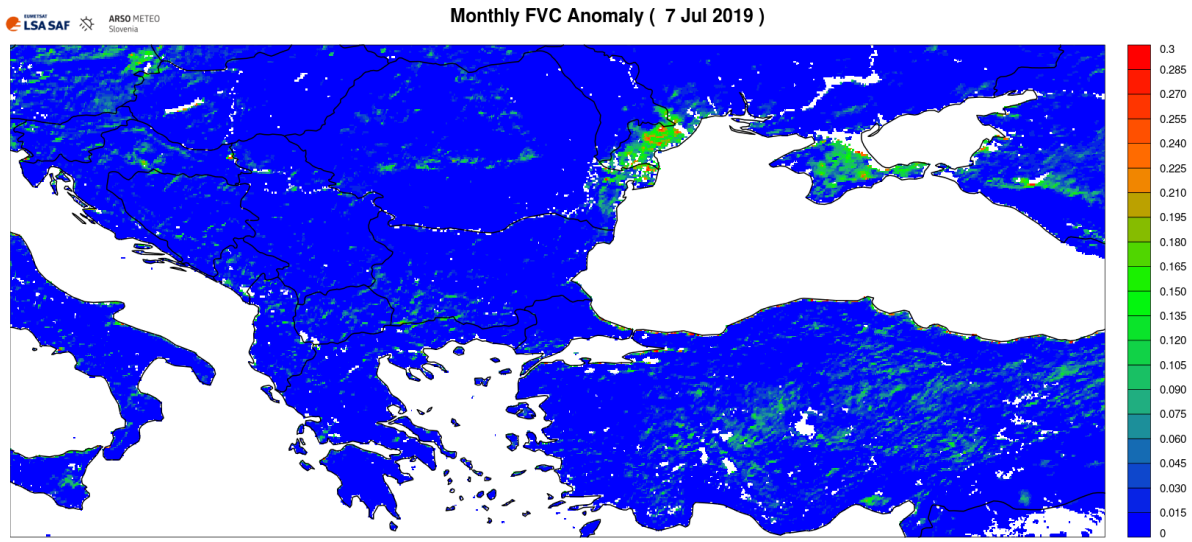
## GREECE



Even though vegetation season started late in Larisa in central-eastern Greece, it developed well throughout spring months and even slightly exceeded its seasonal peak level. Also the decrease of vegetation cover level followed its usual rate, perhaps only slightly later than normally. In Kalamata in southern Greece, vegetation development continues to follow its usual seasonal pattern throughout all season already with noticeable continuous exceed of average vegetation cover for approximately 10 %.

Figure below shows negative anomaly of **accumulated 30-day FVC** as recorded **on 7th July 2019** in comparison to the past 15 years (2004-2018) and are used experimentally.




Monthly FVC accumulations for June show highest level of negative anomalies over wide area across Danube delta and southern Moldova where level of vegetation cover, according to FVC, was approximately 25 % lower than local average, and scattered across extensive central third of Turkey where FVC accumulations were up to 15 % lower than normally. It goes in line with well-above-average air temperatures and prolonged water balance deficit that these two parts of the region experienced over the last 60-day period.

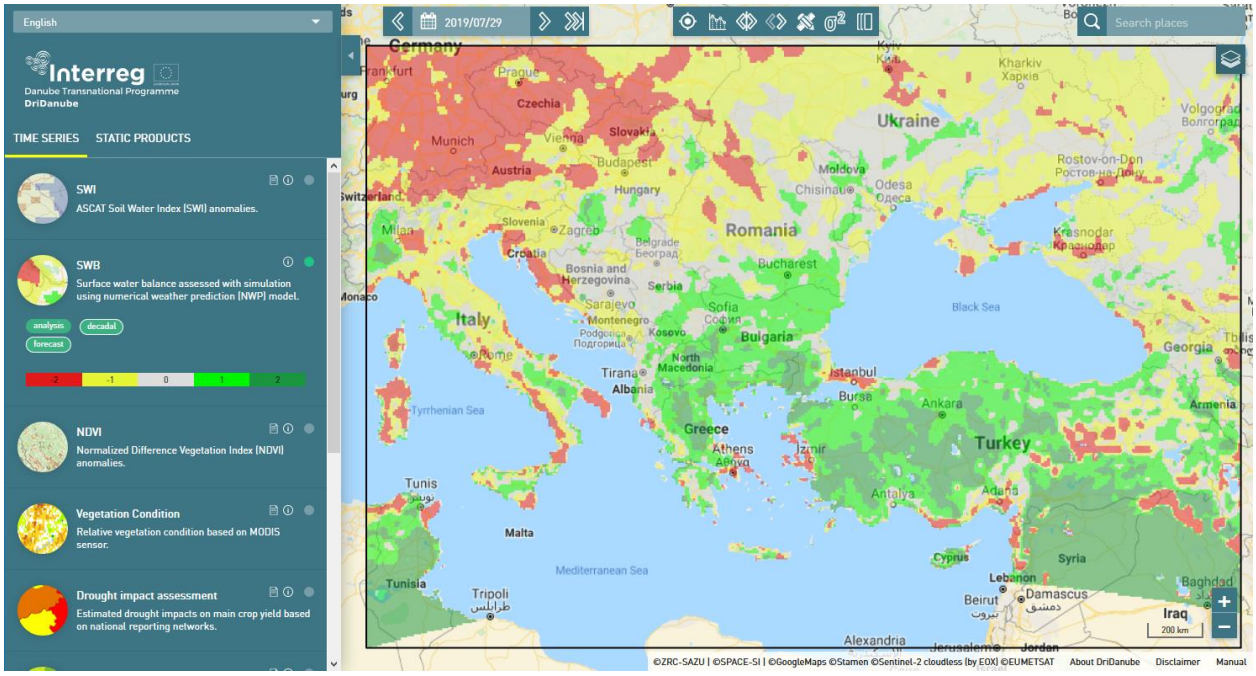
## IMPACT REPORTS

In Kirsehir and Kaman, important grain sowing regions in Central Anatolia, Turkey, wheat harvest started earlier due to prolonged period of dry conditions and temperature stress, stretching back to March [1]. At the same time, Kaman Chamber of Agriculture reports that barley harvest started to be troubled due to drought and high temperatures occurring during the flowering phase [2].

[1] https://www.aa.com.tr/tr/ekonomi/bugday-bu-yil-erken-olgunlasti/1507393
[2] http://www.milliyet.com.tr/ekonomi/bozkirin-tarlalarinda-hasat-zamani-2890506

## OUTLOOK

Figure below presents model simulations of the **60-day accumulated surface water balance anomaly** in historical percentile classes for the time period **from 31st May to 29th July 2019**, as seen in DroughtWatch tool.




In comparison to May-June period, surface water balance is expected to increase and bring very wet conditions to North Macedonia, continental Greece and most of Turkey. Across central third of Balkan Peninsula, from Bosnia and Herzegovina to Moldova and Black Sea area, water balance conditions will bring favourable decrease from wet and very wet conditions to normal-wet state. At the same time, northern parts of the region stretching from central Romania across Hungary to Slovenia and all along the Adriatic Sea, extreme change is expected from very wet to very dry conditions. Water balance conditions will worsen to very dry level also over Aegean islands and central-east Turkey.

**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.