South East European Climate Outlook Forum

SEECOF-24 ONLINE MEETING

ANALYSIS AND LARGE-SCALE VERIFICATION OF THE SEECOF-23 CLIMATE OUTLOOK FOR THE 2020 SUMMER SEASON FOR SOUTHEAST EUROPE (SEE)

Last update: 29 October 2020

Contribution by

WMO RA VI RCC Offenbach Node on Climate Monitoring

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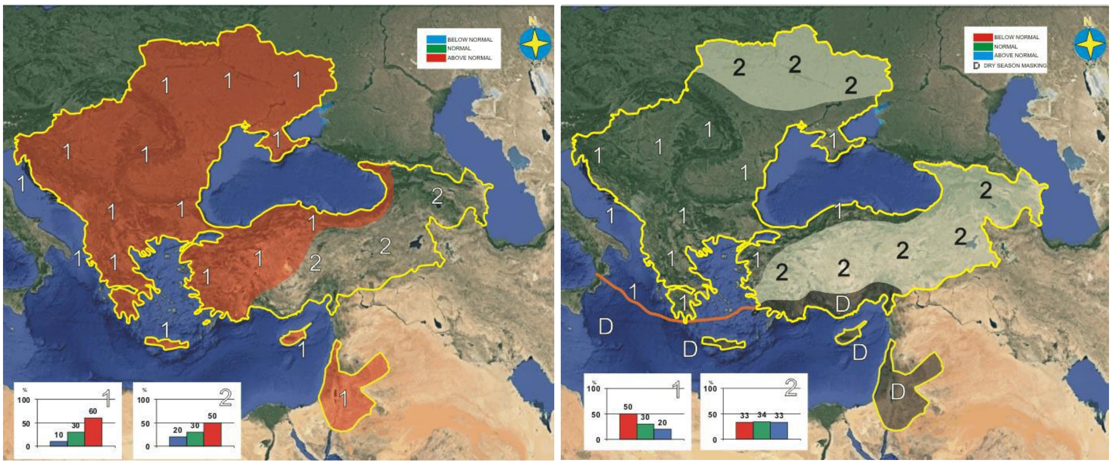
The following SEECOF verification report is based on

1. the outcome of the consensus forecast of SEECOF 23,
2. climate monitoring results of the RA VI RCC network.

1. SEECOF-23 Climate outlook for the 2020 summer season



(a) (b)

Figure 1: Graphical presentation of the climate outlook for the 2020 summer season for the SEECOF region
(a) Temperature Outlook; (b) Precipitation Outlook

Sea surface temperatures and general circulation

In spring 2020, observed sea surface temperature along most of the Tropical Pacific was slightly above normal (neutral El Niño conditions), with higher anomalies over the western part of the basin. Cold anomalies in subsurface suggested that a development of a La Niña event was starting, which was supported by most of the models. However, the majority of them still predicted normal conditions during the period June-August 2020. The Indian Ocean Dipole was neutral in spring 2020, but it was forecasted to become negative during summer.
Atmospheric response was consistent over the tropics, but less clear over the North Atlantic and Europe, with differences among models. In general terms, they seemed to favour higher pressure over Central and Southern Europe, and more intense westerlies over Northern Europe.
Some parts of Central Europe and the Balkan Peninsula had experienced significant drought in spring 2020, with soil moisture below normal in May. In case of anticyclonic situations, a dry soil was expected to enhance the risk of the onset of heat waves.

Temperature

As stated in the SEECOF-23 consensus statement for the seasonal climate outlook for the 2020 summer season, the probability for above-average summer temperature was decreasing across the SEECOF region from northern-northeastern toward southeastern parts.
In most of the SEECOF region, there was a high probability for above-average summer temperature (zone 1 in Figure 1a) relative to the continental parts of Turkey and the South Caucasus region (zone 2 in Figure 1a). The generalized relatively high warm signal was probably partly due to the background climatic warming trend.

Precipitation

Uncertainties in regional predictions are higher for precipitation than for temperature.
The uncertainty was high for the South Caucasus region, most of the continental parts of Turkey and northern parts of Ukraine (zone 2 in Figure 1b) – with approximately equal probabilities for below-,

near- or above normal-averages of summer precipitation sums. In contrast, most of the rest of the SEECOF region was likely to experience a precipitation deficit (zone 1 in Figure 1b).
It should be noted that certain parts of the domain, particularly mountain regions might have observed near- or above-normal summer precipitation due to episodes of enhanced convection accompanied by heavy precipitation. Due to dry season masking, it was not possible to forecast summer precipitation totals for the Eastern Mediterranean with belonging coasts and hinterland, Crete as well as Israel and Jordan.

2. Analysis of the 2020 summer season

Analysis of the summer season temperature and precipitation anomalies and general circulation are based on maps in the WMO region VI for the summer 2020 (WMO RA VI RCC Offenbach Node on Climate Monitoring: http://www.dwd.de/rcc-cm) and other sources taken from the web.

2.1. General circulation

2.1.1. Ocean

While the western tropical Pacific still was warmer than normal (1981-2010 reference) at the ocean surface in summer 2020, sea surface temperatures (SST) in the eastern tropical Pacific were colder than normal on seasonal average, particularly close to South American coast (Fig. 2). On the other hand, SST in the Indian Ocean remained above normal, without any significant west-east gradient.

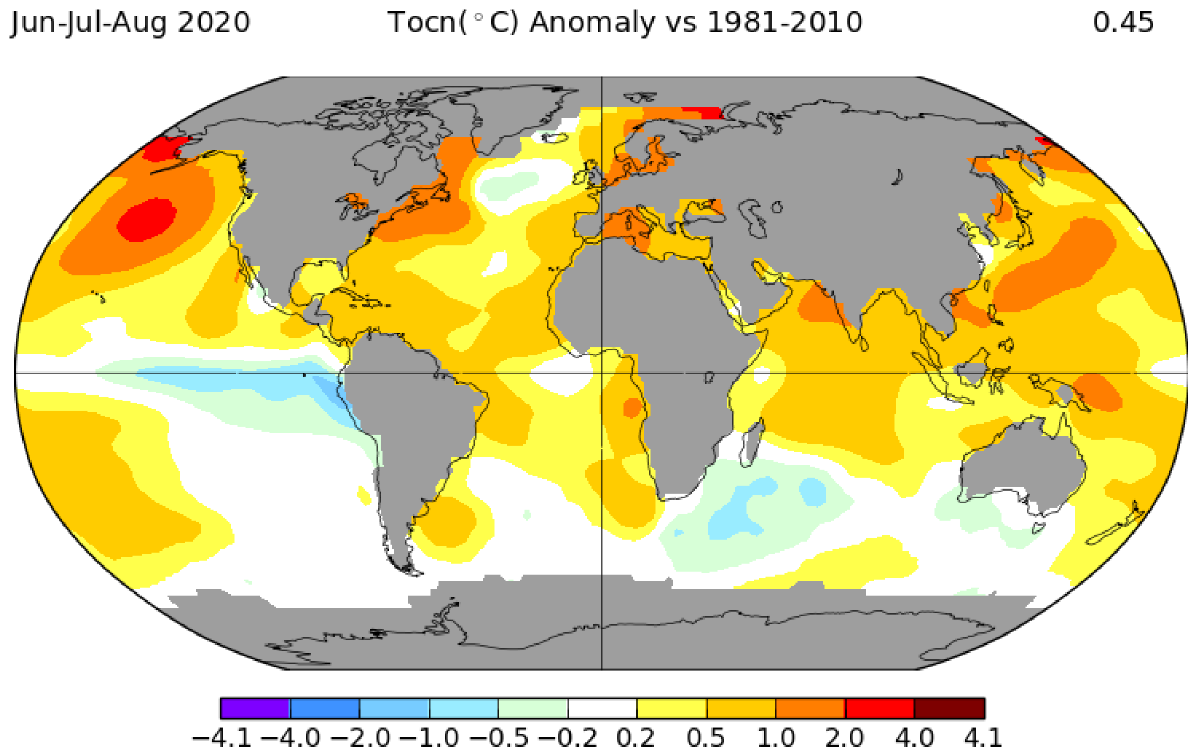


Figure 2: Sea surface temperature anomalies for boreal summer 2020 (June-August), 1981-2010 reference. Data from ERSSTv5 ocean model analysis with 250km smoothing, source: NASA GISS, https://data.giss.nasa.gov/gistemp/maps/

In June and July 2020, the equatorial Pacific Ocean experienced a warming at the surface and at the subsurface (Fig. 3), therefore the negative anomalies decreased compared to May 2020. In August 2020, however, a cooling in the central and eastern equatorial Pacific occurred down to a depth of 150-200m, which could be regarded as the beginning of the La Niña event.

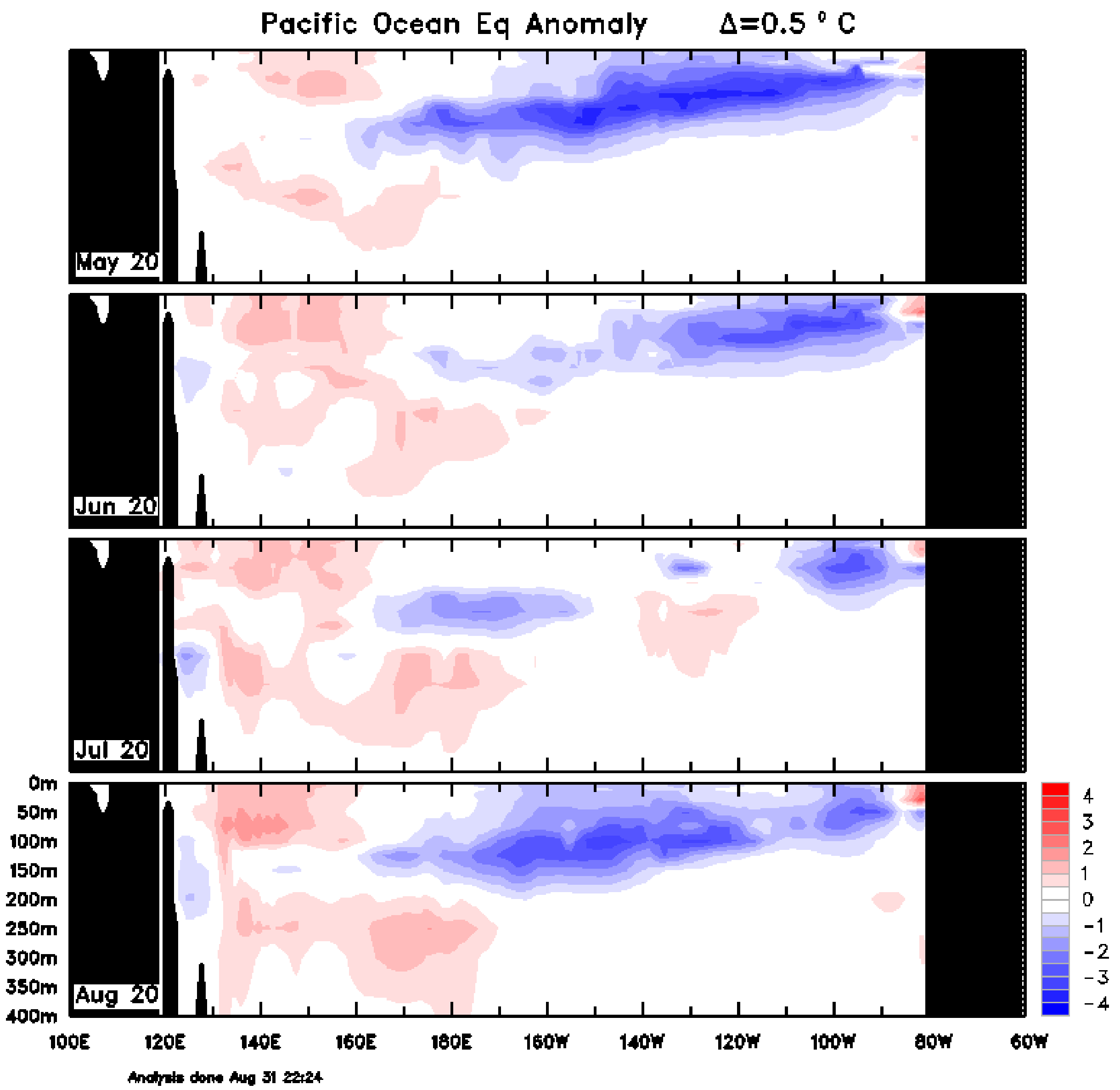


Figure 3: 4-month sequence of vertical temperature anomaly sections at the equatorial Pacific for May-August 2020. Source: Australian Government, Bureau of Meteorology (BOM), http://www.bom.gov.au/cgi-bin/oceanography/wrap_ocean_analysis.pl?id=IDYOC007&year=2020&month=08

Looking at the specific Niño regions (Tab. 1), SST remained below normal (1971-2000 reference) during summer in the eastern regions (1+2 and 3). In the western region 4, SST decreased from June to August, but remained around normal. The combined region 3.4 had negative anomalies in all three months, but SST fell only in August 2020 below the -0.5°C threshold of La Niña. This means that there was a development from neutral to La Niña conditions during summer 2020, but the seasonal mean was still neutral as forecasted.

MONTH	NIÑO 1+2		NIÑO 3		NIÑO 4		NIÑO 3.4	
	TEMP	ANOM	TEMP	ANOM	TEMP	ANOM	TEMP	ANOM
June 2020	22.13°C	-0.74°C	25.75°C	-0.68°C	29.07°C	0.23°C	27.30°C	-0.35°C
July 2020	20.44°C	-1.18°C	25.08°C	-0.54°C	28.83°C	0.02°C	26.89°C	-0.33°C
August 2020	19.69°C	-0.95°C	24.42°C	-0.57°C	28.47°C	-0.21°C	26.18°C	-0.64°C

Table 1: Sea surface temperature and anomalies for various Niño regions in boreal summer months 2020 (June-August), 1971-2000 reference. Data from ERSST.v5 ocean model analysis, source: NOAA, https://www.ncdc.noaa.gov/teleconnections/enso/indicators/sst.php with definitions of Niño regions.

The Indian Ocean Dipole (IOD) index switched from slightly positive to slightly negative values from June to August 2020 (Fig. 4) and was neutral on seasonal average, consistent to the quite homogeneous SST anomalies over the Indian Ocean. Thus, the forecasted negative IOD has not occurred, but a least there was a tendency to negative or lower values.

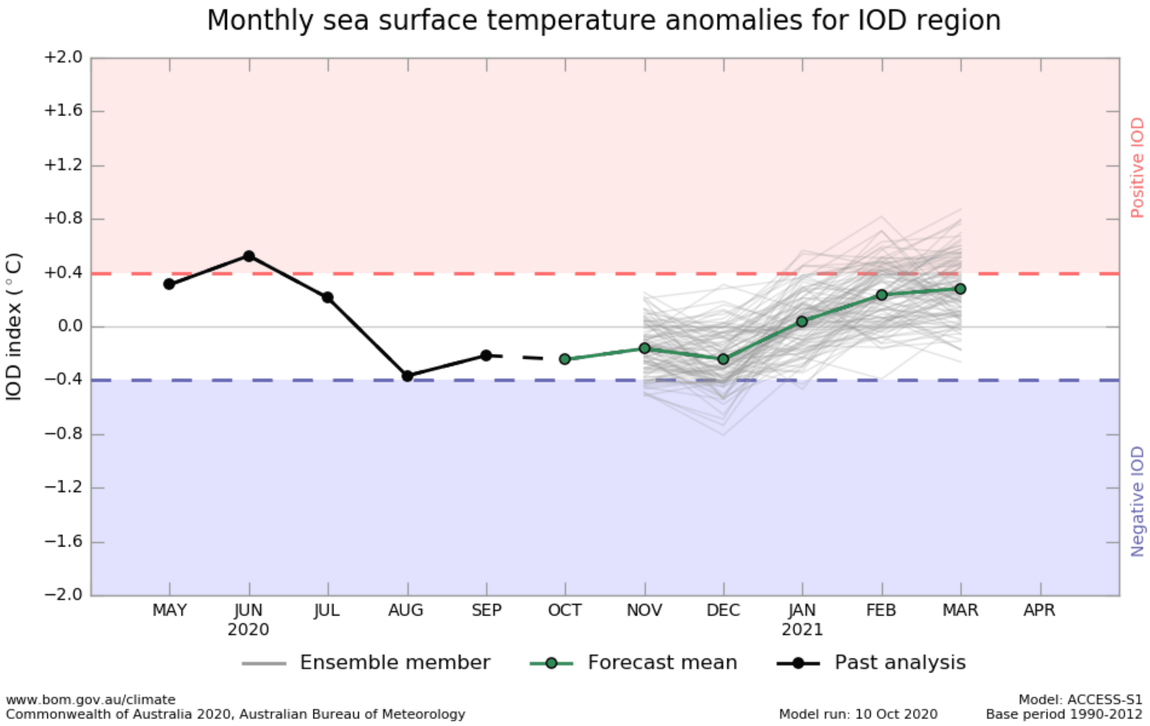


Figure 4: Monthly Indian Ocean Dipole (IOD) index. Source: Australian Government, Bureau of Meteorology (BOM), http://www.bom.gov.au/climate/enso/#tabs=Indian-Ocean

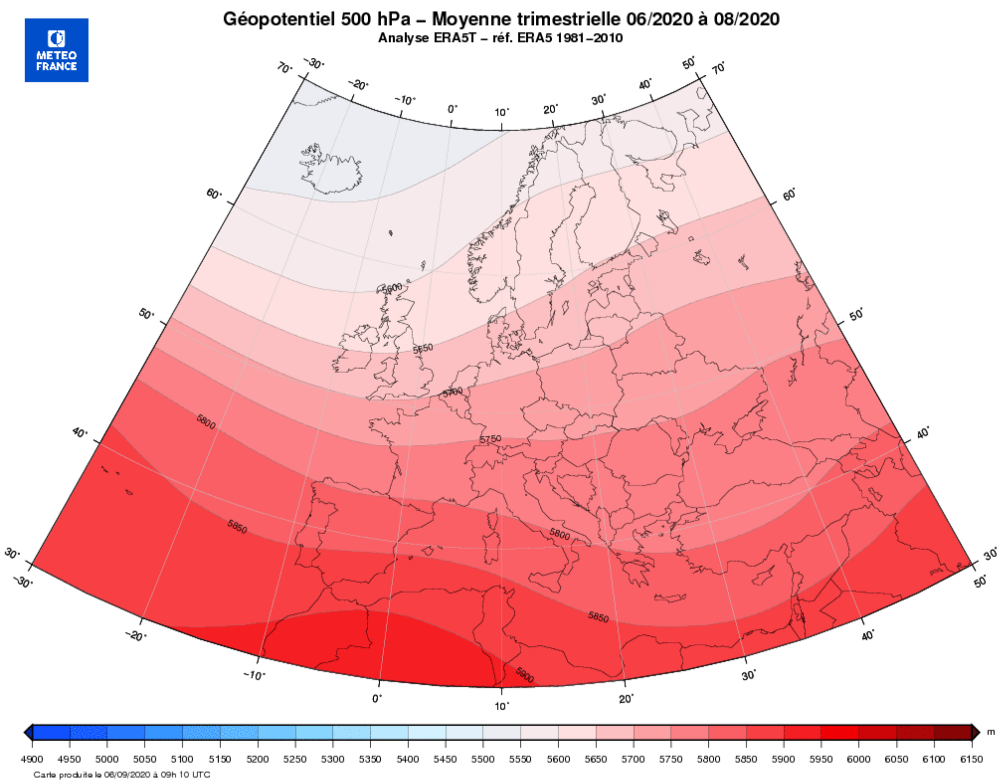
2.1.2. Atmosphere

Seasonal averages of 500-hPa geopotential in summer 2020 show a broad trough over the SEECOF region (Fig. 5), but they were mainly close to normal. Only the northeastern parts of the domain, namely the Ukraine had notably more anticyclonic conditions. However, there were strong fluctuations from month to month (Fig. 6). June had a very meridional pattern over Eastern Europe and was mainly cyclonic over the Balkans and the eastern Mediterranean, while an intense ridge extended over European Russia to the north. July and August had weaker anomalies, which partly compensated each other.

Sea level pressure had mostly a cyclonic anomaly over the SEECOF domain on seasonal average (Fig. 7), but again with large differences from month to month (Fig. 8). The general picture expected from the forecasts (higher pressure over Central and Southern Europe, more intense westerlies over Northern Europe) occurred only temporarily in summer 2020 (mainly in July), but not generally that summer, in June 2020 it was even vice versa.

The Météo France weather type classification showed a slight preference for summer blocking and Atlantic low types (Fig. 9), while the expected zonal type occurred only in July 2020 more frequently.

The NOAA CPC classification also reveals a change within the summer months (Tab. 2). In June 2020, a negative East Atlantic – West Russia pattern dominated (low pressure over the East Atlantic, high pressure over west Russia), but it weakened in July. Instead, a negative phase of a Scandinavia pattern (low over Scandinavia) came up in July and a positive phase of an East Atlantic pattern developed in August.



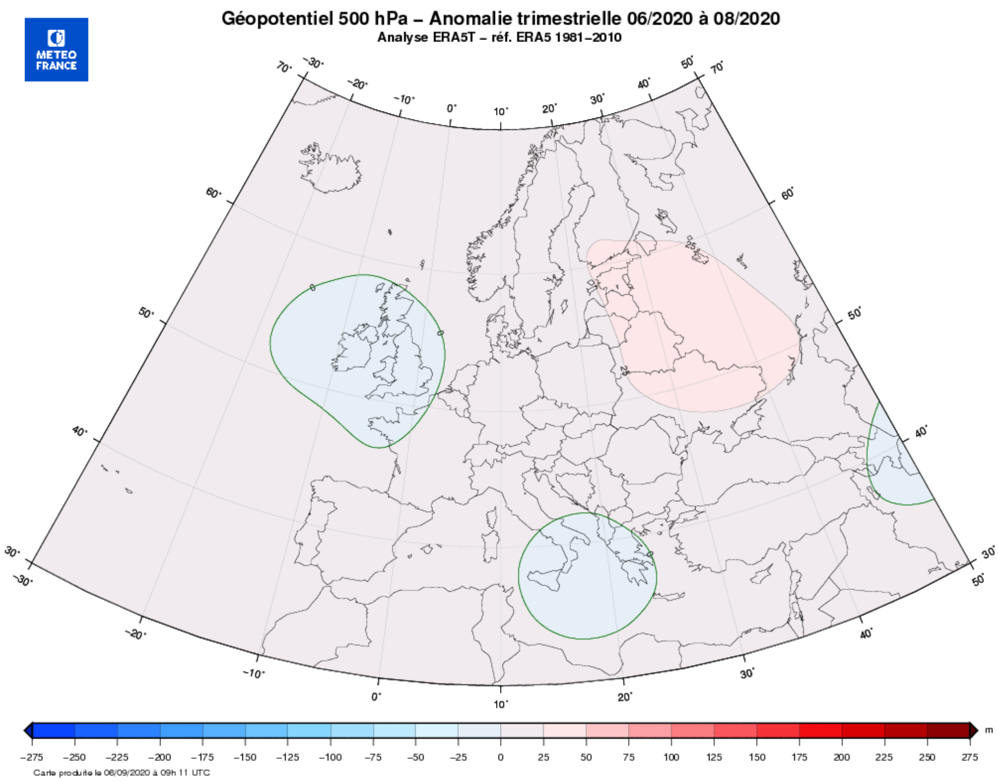


Figure 5: Seasonal mean and anomalies of 500-hPa geopotential for summer 2020 (1981-2010 reference). Source: Météo France, data source: ECMWF ERA5/ERA5T reanalysis, http://seasonal.meteo.fr/content/suivi-clim-cartes-ERA5

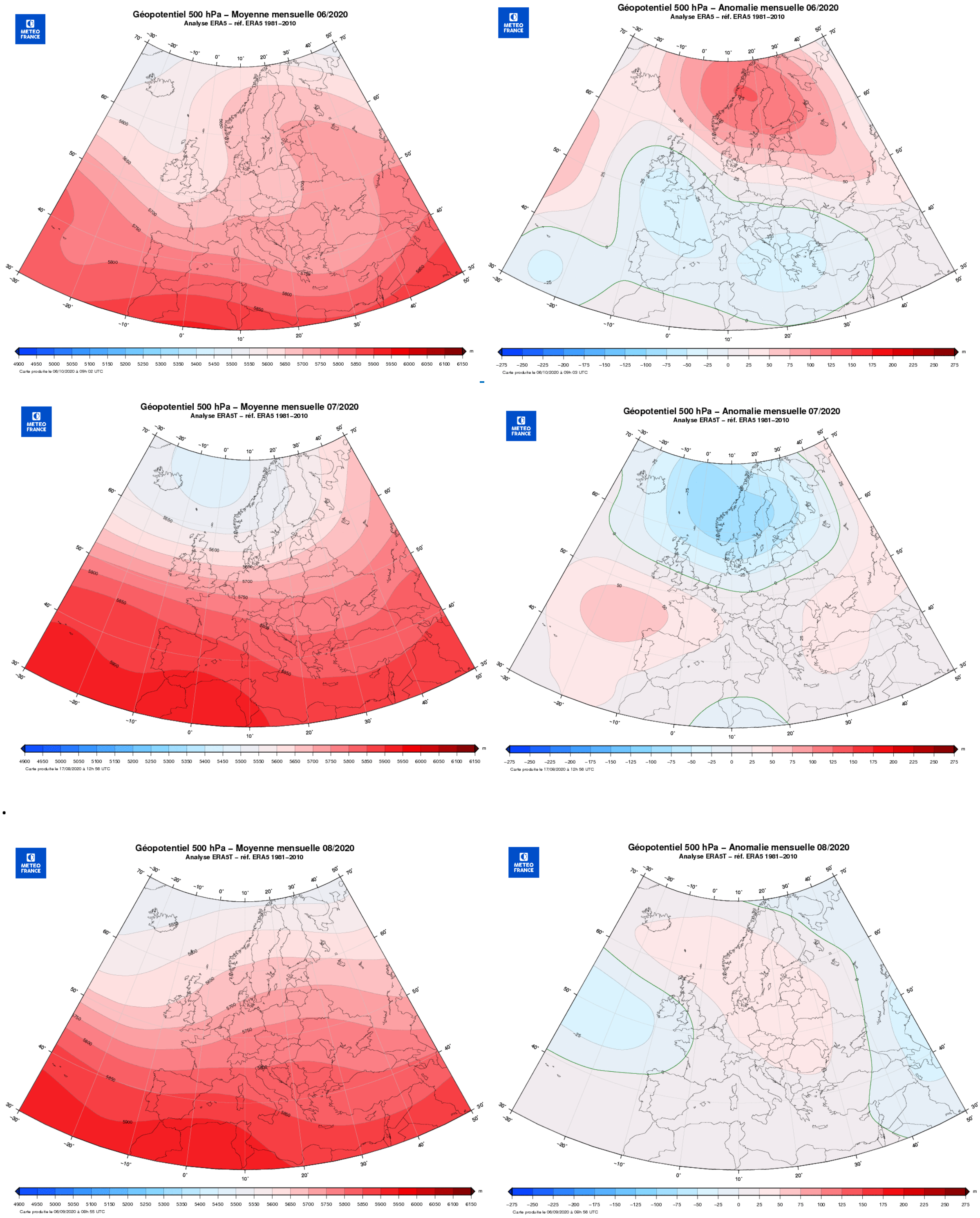
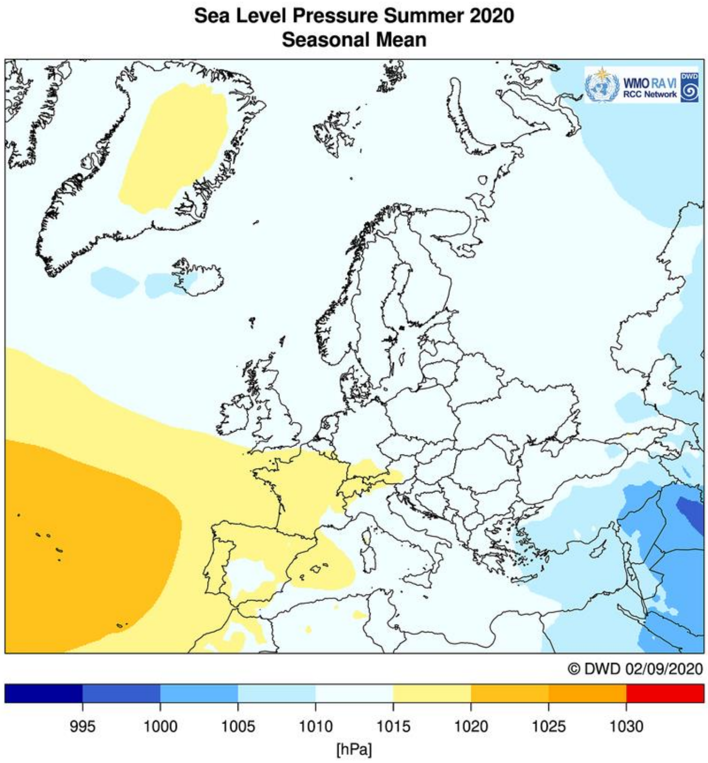


Figure 6: Same as Figure 5, but for the months June, July, and August 2020.



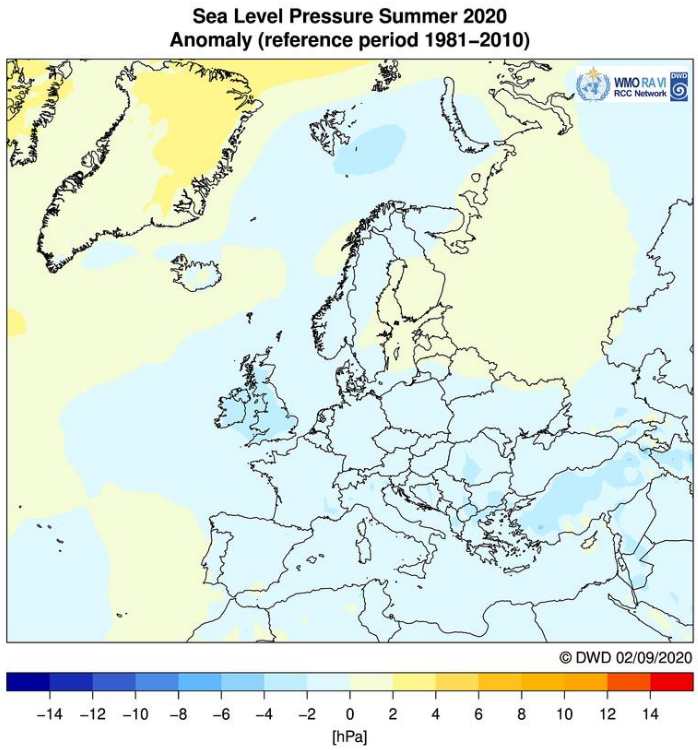


Figure 7: Seasonal mean sea level pressure (upper graph) and its seasonal anomalies (lower graph) for summer 2020 (1981-2010 reference). Source: Deutscher Wetterdienst (DWD), data source: DWD numerical ICON model analysis, http://www.dwd.de/EN/research/weatherforecasting/num_modelling/01_num_weather_prediction_modells/icon_description.html?nn=484268

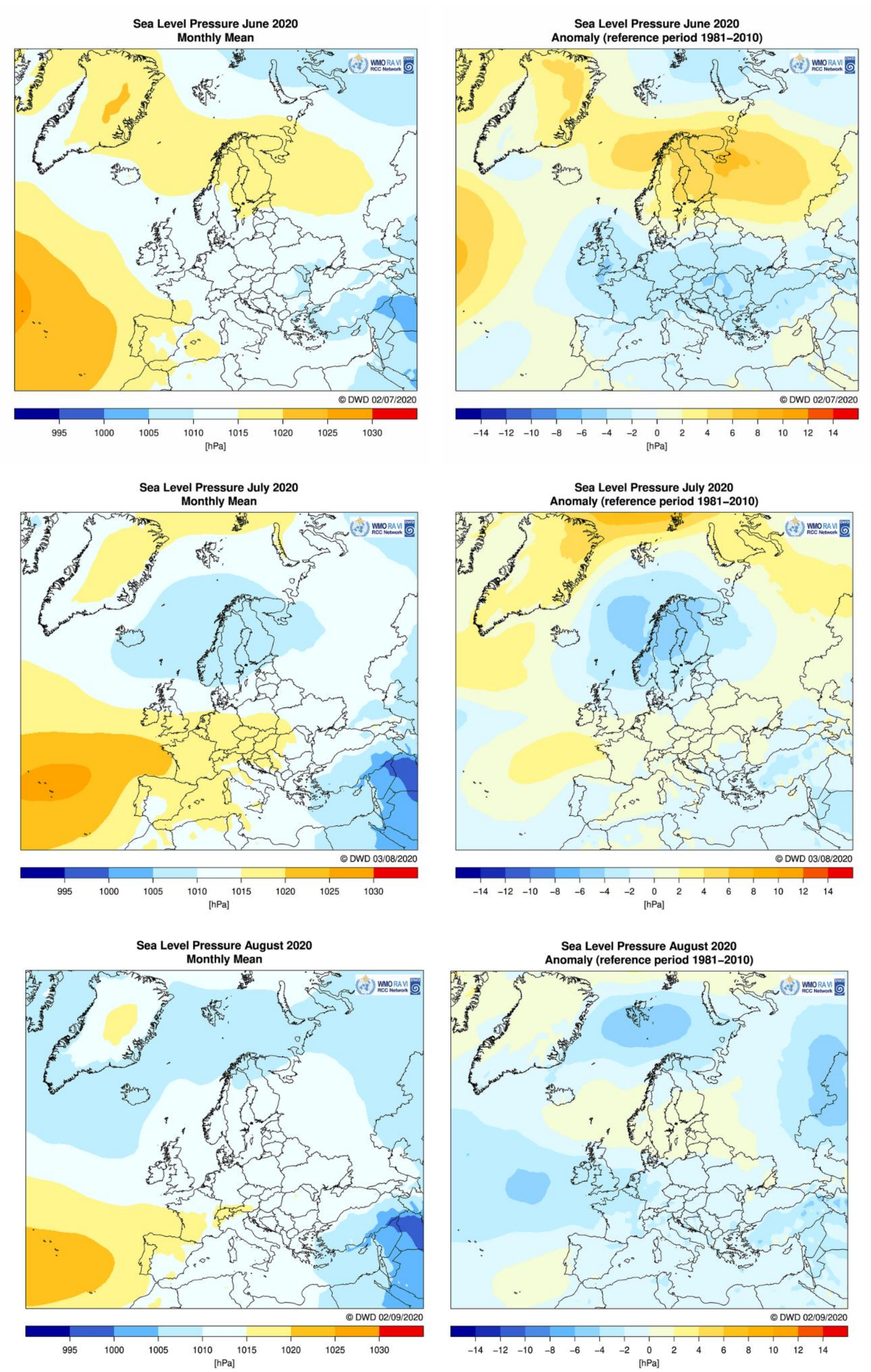


Figure 8: Same as Figure 7, but for the months June-August 2020.

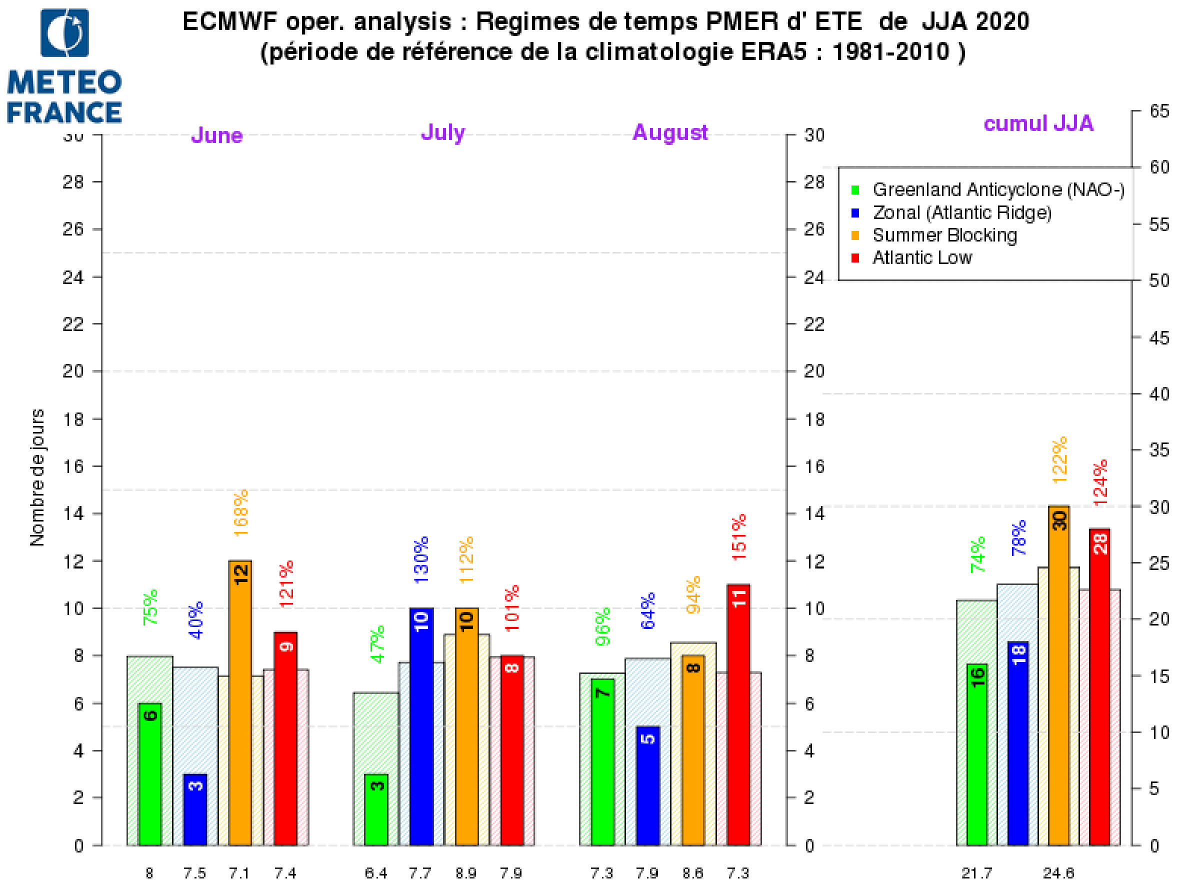


Figure 9: Number of days with circulation types of the Météo France classification for each month of the summer 2020 season and for the whole season (right), and in percent of the climatological frequency distribution 1981-2010. Source: Météo France, http://seasonal.meteo.fr/en/content/suivi-clim-regimes-trim

yyyy	mm	NAO	EA	WP	EP/NP	PNA	EA/WR	SCA	TNH	POL	PT	Expl.Var
2020	6	0.16	-0.08	-1.25	-0.69	0.86	-2.01	0.58	-99.90	-0.24	-99.90	55.5
2020	7	-1.19	0.46	-0.54	-1.97	1.20	-0.68	-2.29	-99.90	-0.08	-99.90	56.0
2020	8	0.03	1.57	-0.21	-2.39	1.80	0.64	-1.56	-99.90	-0.51	0.54	75.6

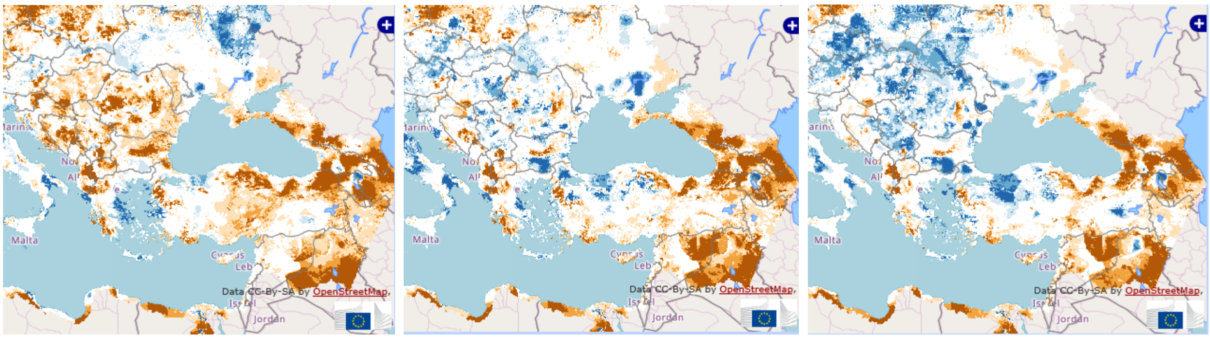
Table 3: Circulation indices of NOAA CPC patterns for the summer months 2020.

ftp://ftp.cpc.ncep.noaa.gov/wd52dg/data/indices/tele_index.nh

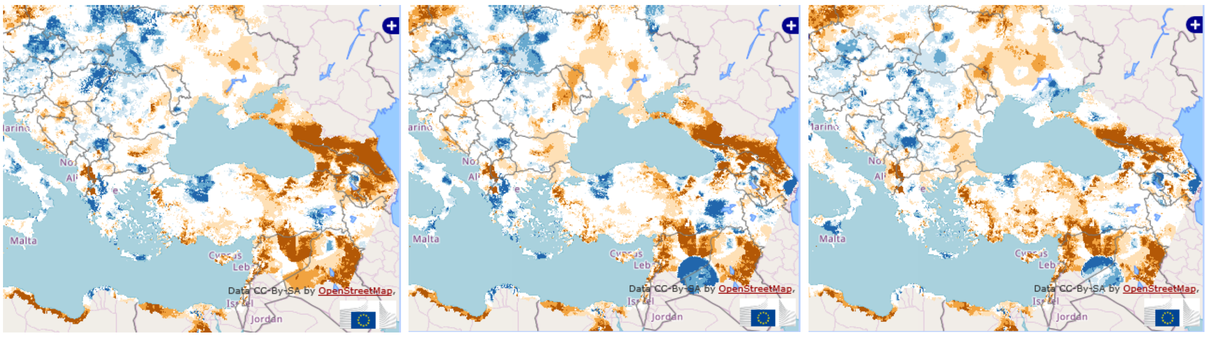
2.2. Soil moisture

Over the Balkan Peninsula, soil moisture was below normal in early June, but this did not persist during summer except for eastern Bulgaria. In contrast, the soils were dry in the South Caucasus region and parts of Turkey during much of the summer, later also in the Ukraine. This means, soil moisture had only partly an impact in the domain.

June 2020 first decade *second decade* *third decade*



July 2020 first decade *second decade* *third decade*



August 2020 first decade *second decade* *third decade*

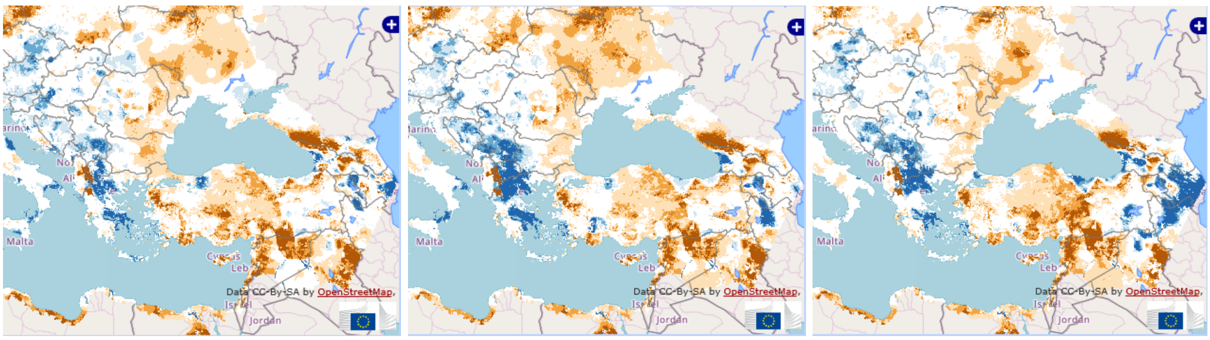


Figure 10: Soil moisture anomalies for 10-day periods in summer 2020 (brown: below normal, blue: above normal, 1995-2019 reference). Source: European Drought Observatory (EDO), https://edo.jrc.ec.europa.eu/edov2/php/index.php?id=1138

2.3. Temperature

Temperature was higher than the 1981-2010 normal in almost the entire SEECOF domain with anomalies around +1°C (Fig. 11). Seasonal mean temperatures in the lowlands ranged from around 19°C in the western Ukraine to around 30°C in southeastern Turkey, Israel and Jordan, in higher elevations mostly between 15 and 20°C.

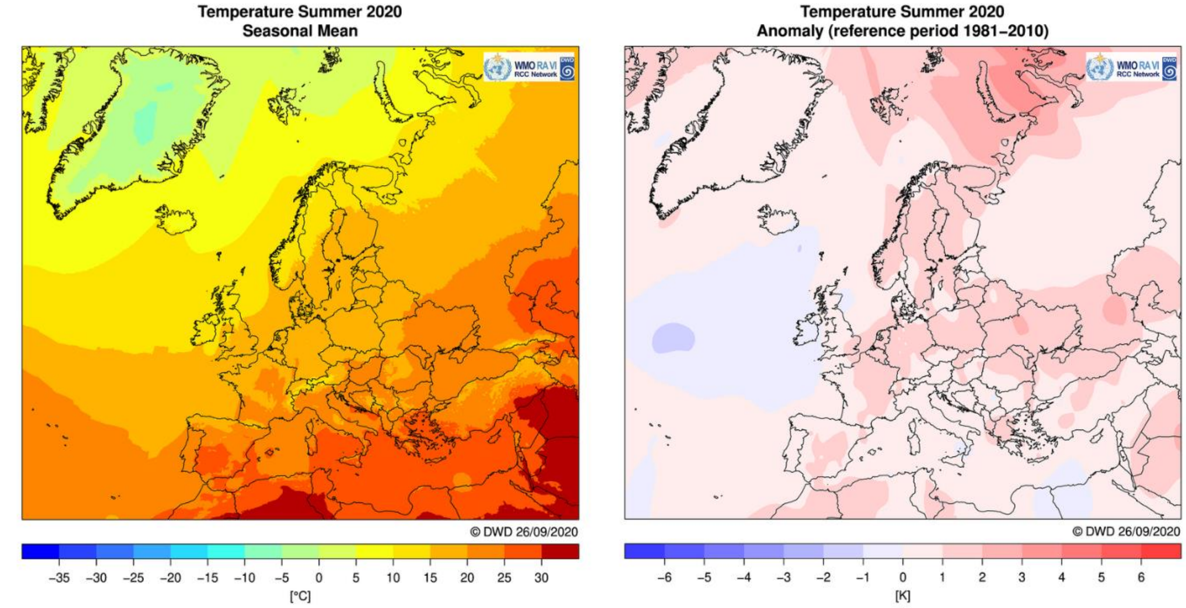


Figure 11: Surface air temperature for summer 2020. Left: seasonal mean, right: anomalies, 1981-2010 reference, source of both maps: WMO RAVI RCC, based on interpolated CLIMAT data, www.dwd.de/rcc-cm

In terms of terciles, in much of the SEECOF domain temperatures were in the upper tercile, partly even in the uppermost decile (Fig. 12). Only a few places in the southern Balkans, Greece, Cyprus, and South Caucasus had seasonal means in the middle tercile.

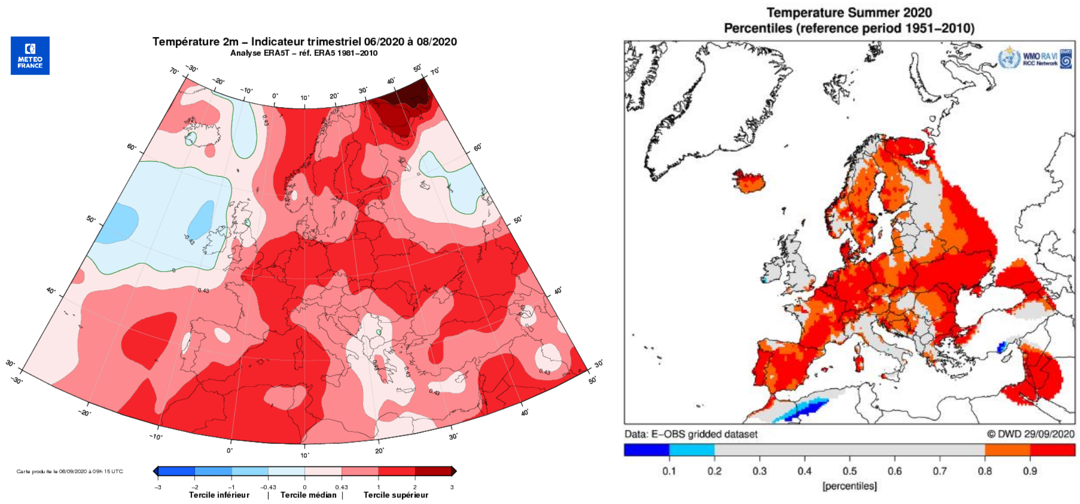


Figure 12: Left: Seasonal normalized temperature anomalies of summer 2020 surface air temperature based on ERA5T reanalysis data, 1981-2010 reference. The data range between -0.43 and +0.43 represents the middle tercile, below -0.43 the lower tercile and above +0.43 the upper tercile. Source: Météo France, data reference: https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5

Right: Percentiles of summer 2020 surface air temperature based on interpolated E-OBS gridded data, 1951-2010 reference. Source: DWD, data source: http://www.ecad.eu/

2.4. Precipitation

Precipitation was above normal in western parts of the Balkan Peninsula from Slovenia to northern Greece and in parts of the South Caucasus region, locally also in northeastern Turkey (Fig. 13). In contrast, precipitation was below normal in other parts around the Black Sea. Seasonal totals ranged from zero in Israel and Jordan to above 450mm in the Julian Alps and places in the western Balkans (western Serbia) and at the eastern Black Sea coast (Georgia).

In terms of percentiles, precipitation was in the upper tercile in parts of the Balkan Peninsula, places in Turkey and Azerbaijan. Parts of the central Ukraine were in the lower tercile.

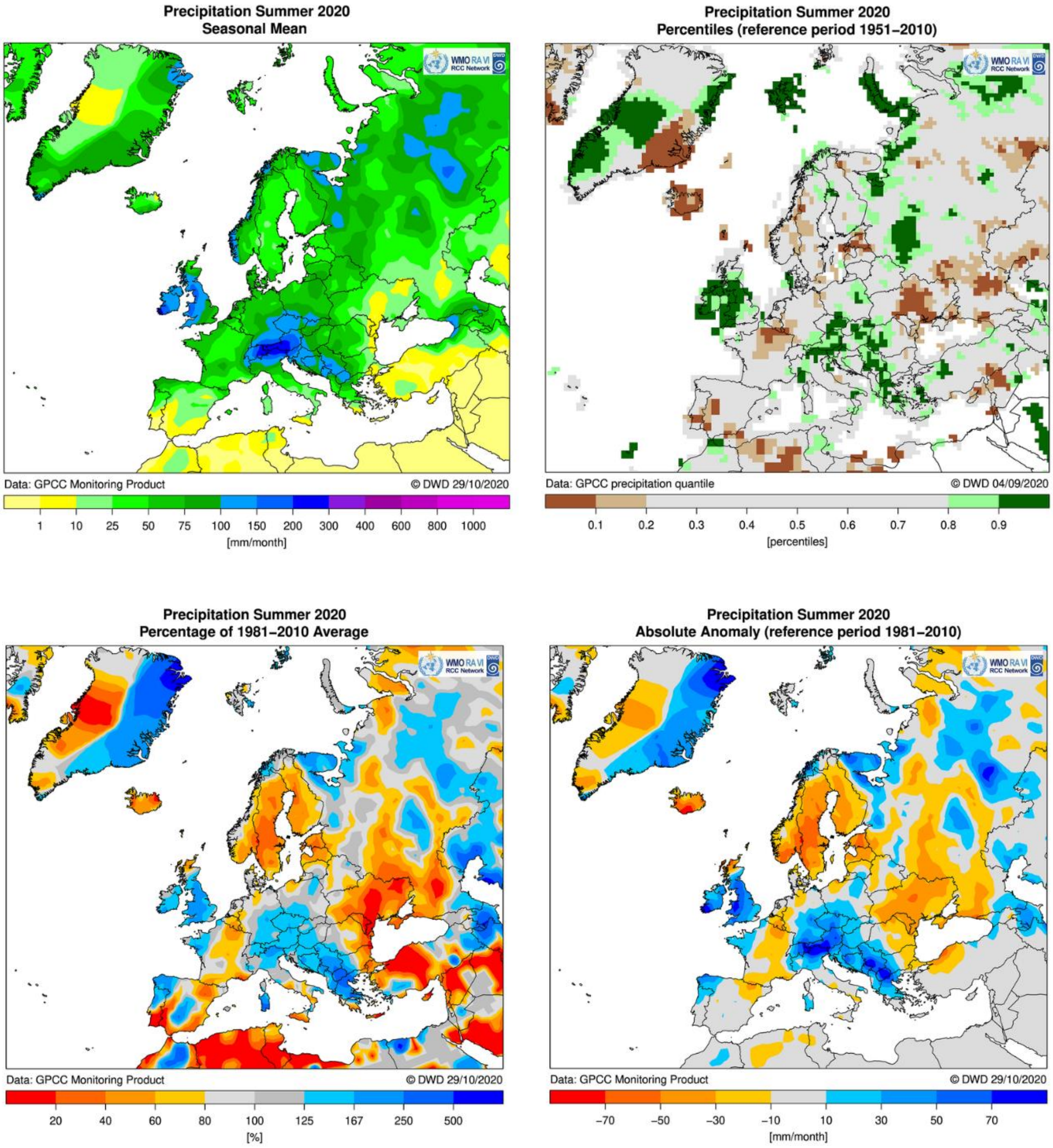


Figure 11: Precipitation for summer 2020 in Europe. Upper maps: seasonal total in mm/month and percentiles, lower maps: percentage of 1981-2010 average and absolute anomalies, source: WMO RAVI RCC, www.dwd.de/rcc-cm , data source: GPCC, http://gpcc.dwd.de

3. Verification of the SEECOF-23 climate outlook for the 2020 summer season

3.1. Temperature

The SEECOF-23 outlook favored the upper tercile for the whole domain, though with different probabilities (50 or 60%).

The warm scenario was predicted correctly for most of the domain. Only some smaller regions or places had temperatures in the middle tercile, though also above normal. These were the southern Balkans, and parts of Greece, Cyprus, Armenia and Azerbaijan.

3.2. Precipitation

SEECOF-23 outlook favored a dry scenario (lower tercile) on the whole Balkan Peninsula, further northeast up to the southern Ukraine, and in northern Turkey. For the northern and central Ukraine, much of Turkey and the South Caucasus, no privileged scenario was given, therefore climatology (middle tercile) was to be expected. Southern parts (Crete, southern Turkey, Cyprus, Israel and Jordan) were classified as dry zone, where no outlook was given.

The dry scenario was correct at least in parts of the southern Ukraine and west of the Black Sea. It was not correct in parts of the Balkans, Romania, Hungary and parts of the South Caucasus, where precipitation was in the upper tercile.

In summary, SEECOF-23 was correct for parts of the domain, but underestimated it in other, mostly western parts. Most likely reason was that the mean position of the high-pressure area was located further northeast than expected.

4. High impact events

DWD records high impact events in a so-called event calendar, which can be seen on the DWD website: https://www.dwd.de/DE/leistungen/rcccm/int/rcccm_int_sse.html. It is updated monthly.

The following events in the SEECOF domain have been recorded in summer 2020:

- Severe flooding of houses and wind damage occurred in Hungary on 13-15 June. At least one woman died in Hungary after being swept away by floodwaters near her home in Tótvázsony, Veszprém County. The station Szentkirályszabadja, situated about 20km east of Tótvázsony, recorded 61mm of rain in 12 hours. The storm also brought strong winds, heavy rain and hail to parts of Budapest during several hours. The strong winds damaged several shopping centres, cars and railway infrastructure, downed trees and power lines around the capital.
- Another area of thunderstorms and heavy rain formed over Bosnia, Serbia, Romania and western Ukraine a few days later. Serbia declared a state of emergency in some municipalities after days of heavy rain, causing widespread damage as rivers overflowed. Flooding inundated about 700 homes in western and central Serbia and damaged bridges, cut off road and downed power lines. Hundreds of families had to leave their homes. The flooding situation had a duration of several days, mainly 21-23 June. The highest daily precipitation total in Serbia that week was 210mm, measured at the climatological station Loznica on 23 June, the weekly total

was 304mm. Also in neighbouring Bosnia, heavy rain caused flooding and landslides, blocking a major road between Tuzla and Sarajevo. Authorities declared a state of natural disaster in the Tuzla region. Other parts of the country also had damage on roads, bridges and houses due to flooding.

- Heavy downpours on 22 June caused flooding in 90 locations across Romania. At least 3 people died, over 380 houses were damaged. Evacuations were carried out in the municipality of Aiud in Alba County and Oravița in Caraș-Severin County, over 150 people were concerned. The Prut River in Botosani County was more than 80cm above warning levels. The country saw already heavy rainfall with flooding the days before (17-20 June). Such extent of flooding had not occurred there for over 200 years.
- The western Ukraine also experienced overflowing rivers due to heavy rain on 22-23 June. Three people died in floods. Roads were blocked and areas cut off. Overflowing rivers destroyed bridges and roads. Power lines were damaged, about 7,500 homes were flooded. Over 350 people were displaced in Ivano-Frankivsk Province, over 120 in Lviv Province.
- Hungary observed thunderstorms on 29 June before a cold front came. Precipitation totals up to 95mm in 24 hours were measured, much of it within half an hour around 18 h local time. Gusts of 100 km/h occurred in Tarcal (northeastern Hungary).
- A hailstorm affected the region of Drama in northern Greece on 16 June, resulting in floods and major disruption to traffic. The hail layer was about 30-40cm thick in places. The storm lasted for more than half an hour, flooding basements and ground floors of homes and shops. Numerous trees were uprooted in many localities.
- Flash floods in Ankara (Turkey) on 11-12 June caused at least one fatality and widespread damage on around 250 buildings. Many streets of the city were swamped, forcing some drivers to leave their vehicles.
- Later in the month, at least 5 people died in floods after heavy rain in Bursa Province, northwest Turkey. Floodwater swept through narrow streets, followed by mud and debris. It caused major damage to houses, vehicles, and crops. Many huge trees were uprooted by the storm.
- Severe weather took also place in Istanbul on 23 June with at least one fatality due to flooding. Heavy rain caused flash flooding in the city, inundating streets; several homes were evacuated. Strong wind damaged roofs of buildings and downed trees and power lines, interrupting power supply in some areas. A tornado was seen in the western Büyükçekmece district, which is rare in that region.
- A rare tornado was also seen in the city of Gavar in Armenia on 11 June.
- Heavy rains caused strong inundation in Sofia, capital of Bulgaria during a storm in the night from the 6 to 7 of July. Large parts of the city were flooded and at least one person was injured. Parts of the roof from a supermarket collapsed and there were several power outages. Water entered into metro stations and many buildings and underpasses were submerged, but train services did not stop.
- A large wildfire broke out in the Luhansk region of Ukraine on Tuesday 7 July. At least four people were killed and 22 injured. The fire had destroyed 85 ha of forest and 110 residential properties. More than 350 firefighters were in charge to bring the fire under control. As a reason for the fire, an arson attack was suspected because of the rapid spread. After it had been 38°C for almost one week, even the fire protection belts could not prevent the fire from spreading over the large area of 85 ha.
- On July 21, a distinct cold front caused heavy thunder and hailstorms with high wind gusts up to 36.8 m/s, new national record for this day of year.
- Heavy rainfall caused damaging floods in the western region of Georgia on Wednesday, July 29. Worst affected area was the Upper Racha Province. Over 2000 residents were isolated from the outside after mudslides and water had inundated roads and bridges. At least 10 bridges and

many roads were washed away. The flooding caused numerous power outages and the water supply was disrupted to 400 families. On the country's Black Sea coast in the Guria region, agricultural fields, electric wires and roads were also damaged. In the municipality Sachkhere, floodwaters damaged inter-village roads.

- On July 29, a violent supercell produced a severe hailstorm over central Slovenia. Ice stones up to 10 cm in diameter caused great damage. The main storm was marked near Vodice. The hailstorms caused enormous damage from Vodice to Domzale and further southeast. Many cars and roofs were hit but no one was injured. It was the first giant hailstorm event of 2020 in Europe.
- An unseasonal low-pressure system caused showers and thunderstorms in Cyprus. Indeed, summer showers are nothing unusual but not in this intensity. At such a rate, those thunderstorms are common during the winter season.
- Heavy rains triggered flash flooding and landslides in northeastern Turkey on Sunday, July 12. At least 4 people lost their lives and heavy material damage was reported. Many vehicles were buried under the mud and debris. The meteorological agency registered 273 mm of rain in the district in a 24h period. The search and rescue missions turned out to be difficult due to the persistent heavy downpours.
- Because of a torrential rain and thunderstorm on the 8th and 9th of August, there was 200 to 300mm of rainfall in a few hours on parts of the island of Evia, which is equivalent to 80% of the annual rainfall. This led to some flash flooding, where at least 7 people lost their lives and dozens of houses were damaged.
- Heavy rain on 22 August caused flooding in northeast Turkey, where at least 4 people died and 11 went missing. Also, some buildings were damaged and dozens of roads had been closed. Some areas of Giresun recorded more than 130mm/24h of rain.
- On 3 August a strong storm system, which developed on the sea, affected Istria in Croatia, mostly Porec, Novigrad and Umag. In the centre of the storm, wind gusts reached up to 150 km / h. The storm caused fallen trees and significant material damage.

5. Users' perceptions of the SEECOF outlook

DWD uses seasonal forecasts internally for climate diagnostics. SEECOF outlooks are particularly welcome because they are based on expert consensus.

Seasonal forecasts are also distributed to some selected authorities by DWD, where SEECOF outlooks are considered when the target area is southeast Europe.

References:

SEECOF Online Forum: http://www.seevccc.rs/forum/

WMO RA VI RCC Node on Climate Monitoring Website with monitoring results: http://www.dwd.de/rcc-cm

Météo France climate monitoring products: http://seasonal.meteo.fr/en/content/suivi-clim-cartes (password protected)

ECA&D, E-OBS: http://www.ecad.eu

GPCC: http://gpcc.dwd.de