Drought in Europe, drought in the Danube basin

Parts of western, central, and eastern Europe are facing severe droughts, with above-average temperatures and below-average rainfall. The situation might stay critical at least until September.

Fig 1: Copernicus Sentinel-2 images show a stretch of the Danube River about 45 km north of Budapest, with the Danube River on the left on 4 August 2025 and on the right on 9 August 2026, at a lower water level (Contains modified Copernicus Sentinel data (2025/26), processed by ESA, licensed under CC BY-SA 3.0 IGO)

The Danube basin is Europe's second-largest basin, supporting over 80 million people across 19 countries and providing water for ecosystems, agriculture, industry, households, energy, navigation, and tourism. We are examining the current situation in the Danube basin using our hydrological modeling system, CWatM [1], and projects in the Danube basin [2][3]. Fig 1 shows the Danube River on the left on 4th August 2025 1 year ago, and on the right on the 9th August 2026, at a lower level. The Danube has fallen to a record low level, and the Budapest Rock of Starvation - Ínség-szikla - appeared out of the river, which in older times was a sign that crops were dying and that hunger was coming.

A sequence of heatwaves has led to a drought that has built up since early spring due to low rainfall and high temperatures, putting water resources, agriculture, energy, navigation, tourism, and ecosystems under growing pressure.

The World Meteorological Organization defines drought as a prolonged dry period in the natural climate cycle. Further, drought can be distinguished into three distinct phases of a dry spell: meteorological, agricultural, and hydrological drought.

Meteorological drought

A prolonged lack of precipitation and high temperatures define meteorological drought. Meteorological drought affects sectors and ecosystems that respond quickly to reduced precipitation and rising temperatures, e.g., human well-being due to higher temperatures and reduced air quality, higher wildfire probability, and plants and insects that absorb moisture directly from the air.

Temperature

This figure, based on ERA5 Land data, shows the number of days with daily maximum temperatures ≥ 30°C above/below the average number of days (1990-2025) for June and July 2026.

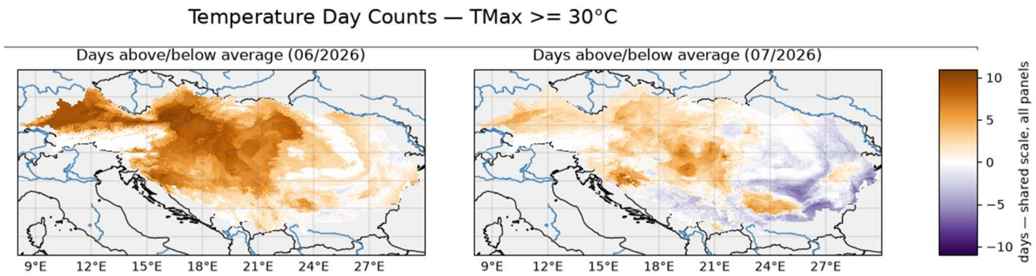

Fig 2: Temperature anomaly (days ≥ 30°C maximum temperature) for June and July 2026 compared to the average from 1990-2025 for June and July (based on ERA5 Land data)

Orange highlights that June 2026 had far more days ≥ 30°C than the period average (1990-2025).

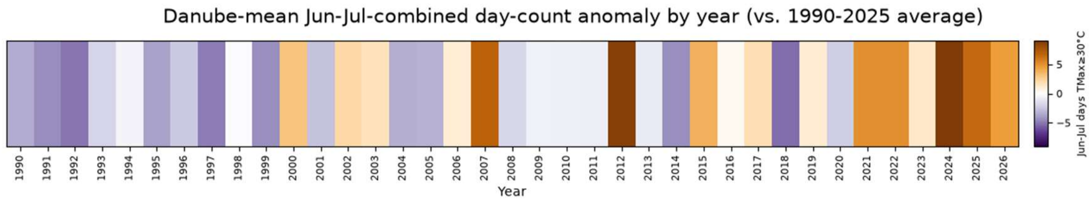

Fig 3: Color stripes of max. temperature anomaly ≥ 30°C for June and July for the period 1990-2026

The color stripes show that a very warm period already occurred in 2024 and 2025 and reveal a warming trend from 1990 to 2026, indicating climate change.

Precipitation

From April to July, precipitation shows an anomaly toward extremely low precipitation across most of the Danube basin. Fig 4 shows that from April to July, the amount of precipitation is far below the average precipitation (1990-2025 for these months)

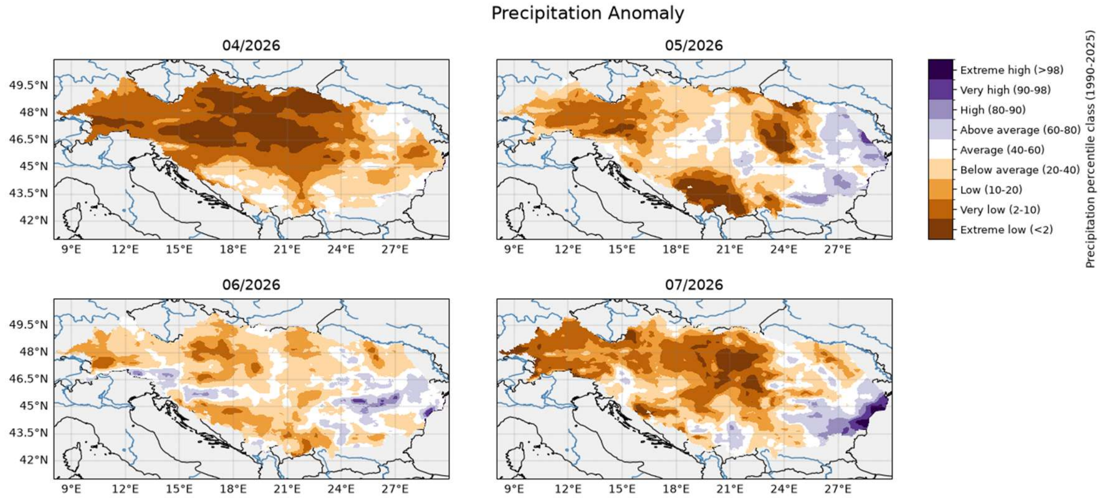

Fig 4: Precipitation anomaly - April to July 2026 accumulated precipitation compared to 1990-2025

The color stripes of fig 5 show the precipitation anomaly combined for the whole Danube basin. Blue indicates a wet period, orange a dry period. The year 2026 appears to be an extremely dry year for the Danube, like 2003, 2007, and 2022; however, this year's drought started earlier. For precipitation, the trend is less prominent than in the temperature time series, but our climate-projection research shows that wet and dry spells will occur more often in the future.

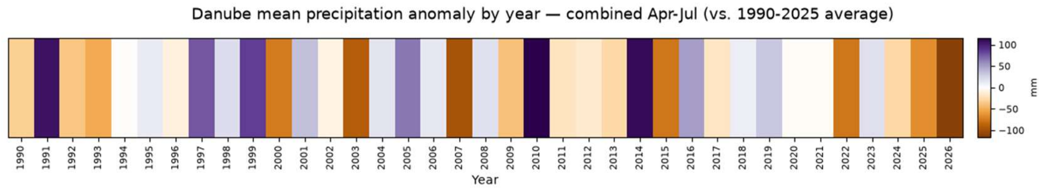

Fig 5: Color stripes of accumulated monthly precipitation anomaly for the Danube basin from April to July for the period 1990-2026 (based on ERA5 Land data)

Agricultural drought

Agricultural drought arises when soil moisture falls below the level required to meet crop water demand during the growing season.

An agricultural drought primarily affects sectors, ecosystems, and industries dependent on soil moisture and the immediate water needs of crops and livestock; for example, farmers' yields decrease or crops fail, pastures and rangelands dry up, and natural forage for livestock becomes scarce. Beneficial soil bacteria and fungi die or go dormant.

Soil moisture

We calculated soil moisture in the top 30 cm of soil using the hydrological model CWatM with ERA5 Land data from 1990-2026. The soil moisture anomaly indicates water availability in the root zone, with July showing extreme shortages across most of the Danube region, especially affecting agriculture and water stress levels.

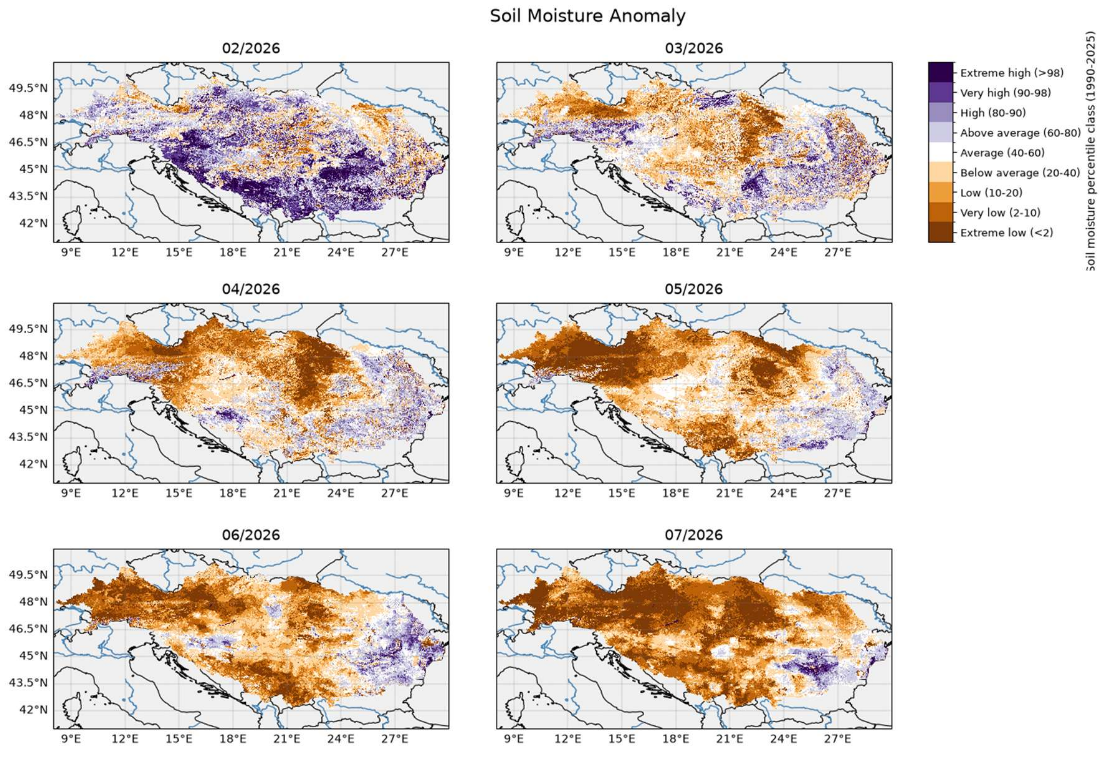

Fig 6: Soil moisture anomaly – for each month separately from February to July 2026, average monthly soil moisture compared to 1990-2025 (based on CWatM, ERA5 Land calculation)

After a relatively wet February, soil moisture started to dry out from March to July, reaching extreme water shortage in July in the root zone (dark orange) across most of the Danube region, except in the eastern to south-eastern area of the Danube. The combination of several heatwaves and water deficit increased water stress and led to decreased yields, especially in Austria, Czechia, and Hungary.

The color stripes in Fig. 7 show the soil moisture anomaly for the whole Danube basin. Blue indicates a wet period, orange a dry period. The year 2026 appears to be an extremely dry year for the Danube; only 2003 stands out as even more extreme. For soil moisture, most wet years occur in 1990-2007, while the more recent period seems drier. This aligns with our research on climate projections to 2050, which indicates a drier period more often in the future.

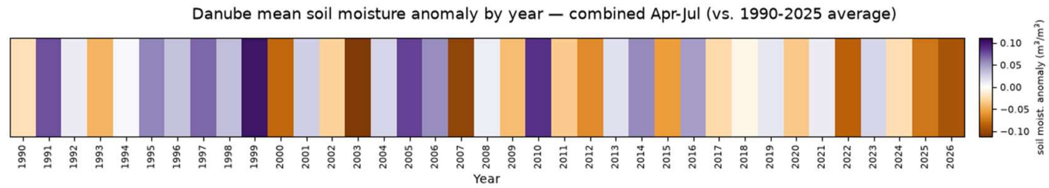

Fig 7: Color stripes of average monthly soil moisture anomaly for the Danube basin from April to July for the period 1990-2026 (based on CWatM, ERA5 Land calculation)

For comparison, we show the situation in June and July 2003 in fig 8. Here, the whole Danube basin was affected by drought, but in July the situation was less difficult for Austria, Czechia, and Hungary than in 2026.

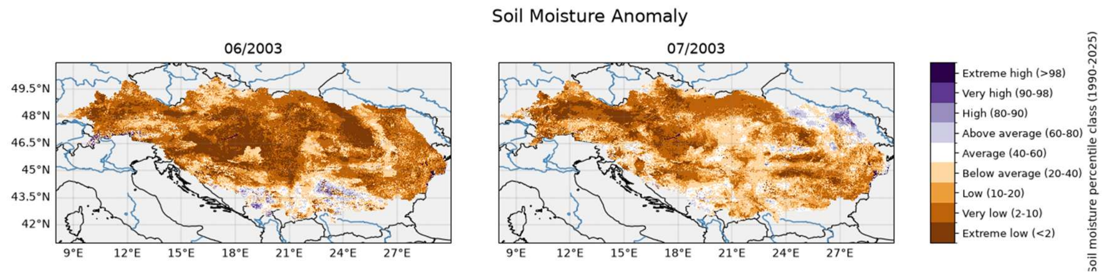

Fig 8: Soil moisture anomaly – June, July 2003, average monthly soil moisture compared to 1990-2025

Hydrological drought:

Hydrological drought denotes a deficit of water in the hydrological system, expressed as below-normal streamflow, lake and reservoir levels, and groundwater storage. Hydrological drought affects sectors, infrastructure, and ecosystems dependent on surface and subsurface water supplies, such as rivers, lakes, reservoirs, and groundwater aquifers. e.g., hydropower energy production, thermal and nuclear power plants, water-intensive industry, navigation, fisheries, households, and ecosystems.

Discharge

We calculated river discharge using the hydrological model CWatM with ERA5-Land forcing data from 1990- 2026. River discharge is the volume of water passing a cross-section per unit time. It is a strong indicator of hydrological drought because it integrates the catchment water balance — precipitation, evapotranspiration, soil moisture, and groundwater storage — across the entire contributing area.

Here we show the monthly minimum discharge anomaly; for example, we compare a given month against the average minimum discharge from 1990-2025. The low flow season in the Danube occurs from July to October, following the end of spring snowmelt. Therefore, we show the discharge anomaly map for July. Compared with July 1990-2025, July 2026 has the lowest minimum flow for the Danube and most of its tributaries. The Tisa has extremely low levels, though not the most extreme, and the Sava basin received some rain in June and is therefore below average.

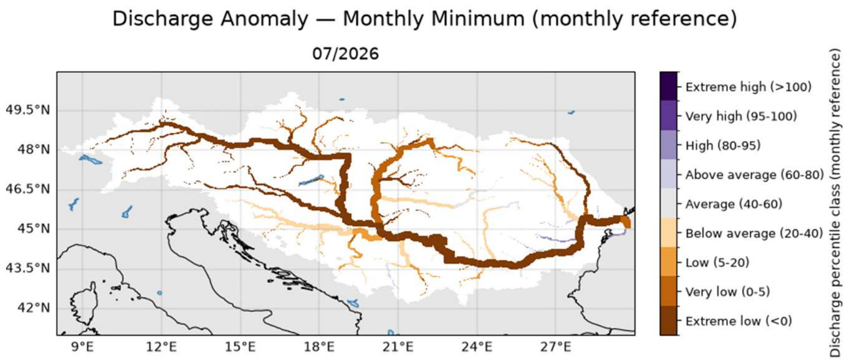

Fig 9: Minimum discharge anomaly - July 2026, compared to average monthly minimum discharge from 1990-2025 (based on CWatM, ERA5 Land calculation)

The color stripes in Fig. 10 also indicate that the low-flow situation in July 2026 is the most extreme in the period of our calculation (1990-2026), exceeding the hydrological drought of 2003. Fig. 11 compares the situation in July 2026 with 2003 and 2022. The Tributaries of the Lower Danube (e.g., Olt, Siret, Mures/Tisa) and the Sava showed a more extreme situation in 2022. Still, overall, the low-water situation from the source to the mouth of the Danube is most extreme in 2026.

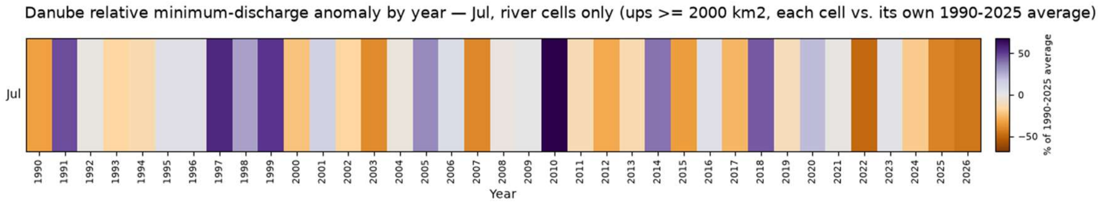

Fig 10: Color stripes of relative minimum monthly discharge anomaly for the Danube basin for July for the period 1990-2026 (based on CWatM, ERA5 Land calculation)

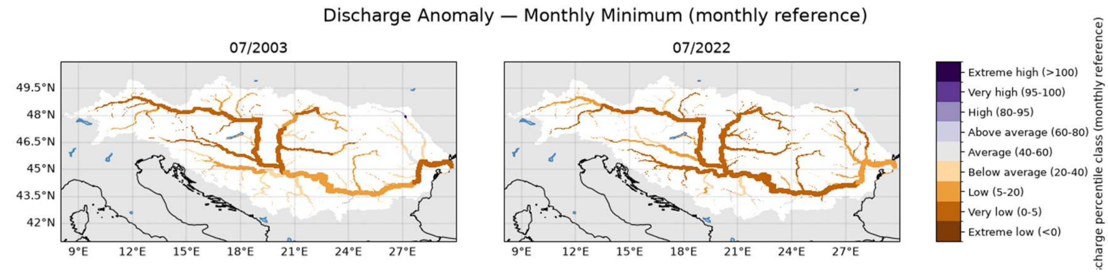

Fig 11: Minimum discharge anomaly - July 2003 and July 2022, compared to average monthly minimum discharge from 1990-2025 (based on CWatM, ERA5 Land calculation)

Table 1: 5 driest Jul years by relative anomaly, with the absolute figure alongside:

Year	Relative	Absolute
2022	-49.2%	-324 m^3/s
2026	-45.8%	-403 m^3/s
2025	-41.9%	-305 m^3/s
2007	-40.4%	-206 m^3/s
2003	-39.4%	-299 m^3/s

Navigation

For navigation on the Danube, the Wildungsmauer gauge near the Austrian/Slovakian border is important. Throughout the year (except in March), discharge (and water level) has been low in 2026. But in July/August it reaches levels that reduce transport on the Danube, as in 2018 and 2003.

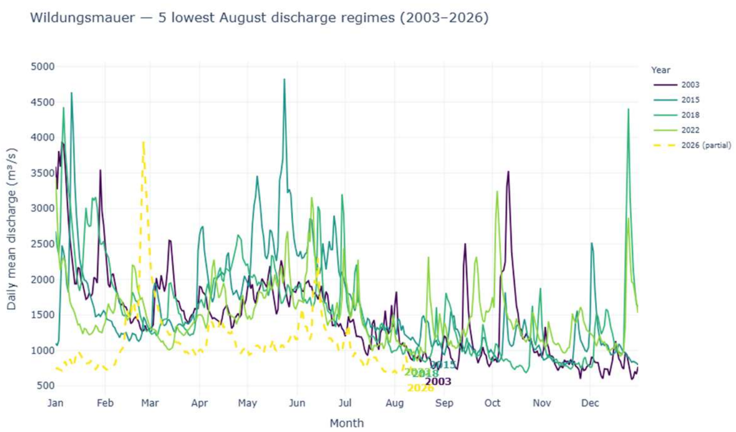

Fig 12: Gauge Wildungsmauer Danube. Source: https://www.noe.gv.at/wasserstand

The Danube's low water level has already caused energy and water shortages, the shutdown of a nuclear power plant, cruise lines, and ship transport interruptions, and has impacted ecosystems, with water temperatures rising while oxygen levels decline.

Summary

The recent drought in Europe is affecting the Danube region's economy and ecosystems. Driven by a prolonged lack of precipitation and several intense heatwaves, we are experiencing a major meteorological, agricultural, and hydrological drought. The drought event is already propagating from agricultural and hydrological deficits into socioeconomic drought, affecting food production, energy generation, and navigation across the basin, but whether it becomes a serious socioeconomic drought is a matter of policy, not climate alone.

Background

We are using ERA5-Land meteorological data (precipitation, temperature, radiation, wind, pressure) from 1990 to the present. We use Copernicus Climate Change Service data (https://cds.climate.copernicus.eu) and run the in-house hydrological model CWatM (https://cwatm.iiasa.ac.at), calibrated to the Danube, with these forcing data. Temperature and precipitation are coming directly from the ERA5-Land dataset; soil moisture, runoff, and discharge are outputs from a CWatM run. The analysis and indicators we use here are easier to understand than scientific indicators like SPI, SPEI, DSI, or PDSI. For an overview of indicators, see the Handbook of Drought Indicators and Indices (https://www.droughtmanagement.info/literature/GWP_Handbook_of_Drought_Indicators_and_Indices_2016.pdf).

In September, we will continue these analyses and present the August results.

References

[1] Hydrological Model CWatM - https://cwatm.iiasa.ac.at/

[2] SOS-Water EU-Horizon Project: https://www.sos-water.eu

[3] Danube Water Balance: https://interreg-danube.eu/projects/danube-water-balance

Interreg Danube Region
Co-funded by the European Union
Danube Water Balance