International Commission for the Hydrology of the Rhine Basin (CHR)

Annual CHR Report 2022

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Photo front page: River mouth Hinter and Vorder Rhine
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International Commission for the Hydrology of the Rhine Basin

The International Commission for the Hydrology of the Rhine Basin (CHR) works within the framework of the Intergovernmental Hydrological Programme (IHP) of UNESCO and the Hydrology and Water Management Programme (HWRP) of the World Meteorological Organisation (WMO). It is a permanent, independent, international commission and has the status of a foundation registered in the Netherlands. Members of the commission include the following scientific and operational hydrological institutions of the Rhine basin:

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- Office of the Vorarlberg State Government, Division VIId – Water Management, Bregenz, Austria,
- Federal Office for the Environment, Bern, Switzerland,
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1.1 Meteorological Characteristics

1.1.1 Austria

Source: Central Institute for Meteorology and Geodynamics (ZAMG)

Temperature

In 2022, as in previous years, the periods with unusually high temperatures prevailed and only a few times were clearly too cold. This fact is made particularly clear when comparing the year 2022 with the climate average of 1961-1990, which was not yet so strongly affected by global warming. Several months were extremely warm and a total of five months can be placed in the top 10. These include May (7th place), June (5), July (8), August (6) and October (1). The anomalies of these mentioned months were in the range from +3.0 °C to +4.2 °C to the average 1961-1990 or from +1.2 °C to +2.8 °C to the average 1991-2020. January, February and November were ranked 24, 14, and 19 and also unusually warm. April and September were in the mid range of the two and a half century long Austrian temperature time series.

With the abundance of warm to very warm months, 2022 was significantly warmer overall than most years of the past 255 years. The temperature deviation from the mean 1991-2020 is +1.0 °C and from the mean 1961-1990 +2.3 °C. Together with 2019, 2022 thus occupies third place behind 2018 (+1.3 °C) and 2014 (+1.1 °C). Together with 2015, it was the second warmest year in the mountains. Temperature deviation in the summit regions was +1.0 °C, which was only slightly lower than the warmest year, 2020.

The largest anomalies to the climatological average occurred in Vorarlberg and North Tyrol as well as in parts of the Inn district. In these regions, 2022 was too warm by 1.3 to 1.6 °C compared to the climatological average of 1991-2020. In all other parts of the country, temperature deviations were between 0.7 and 1.3 °C

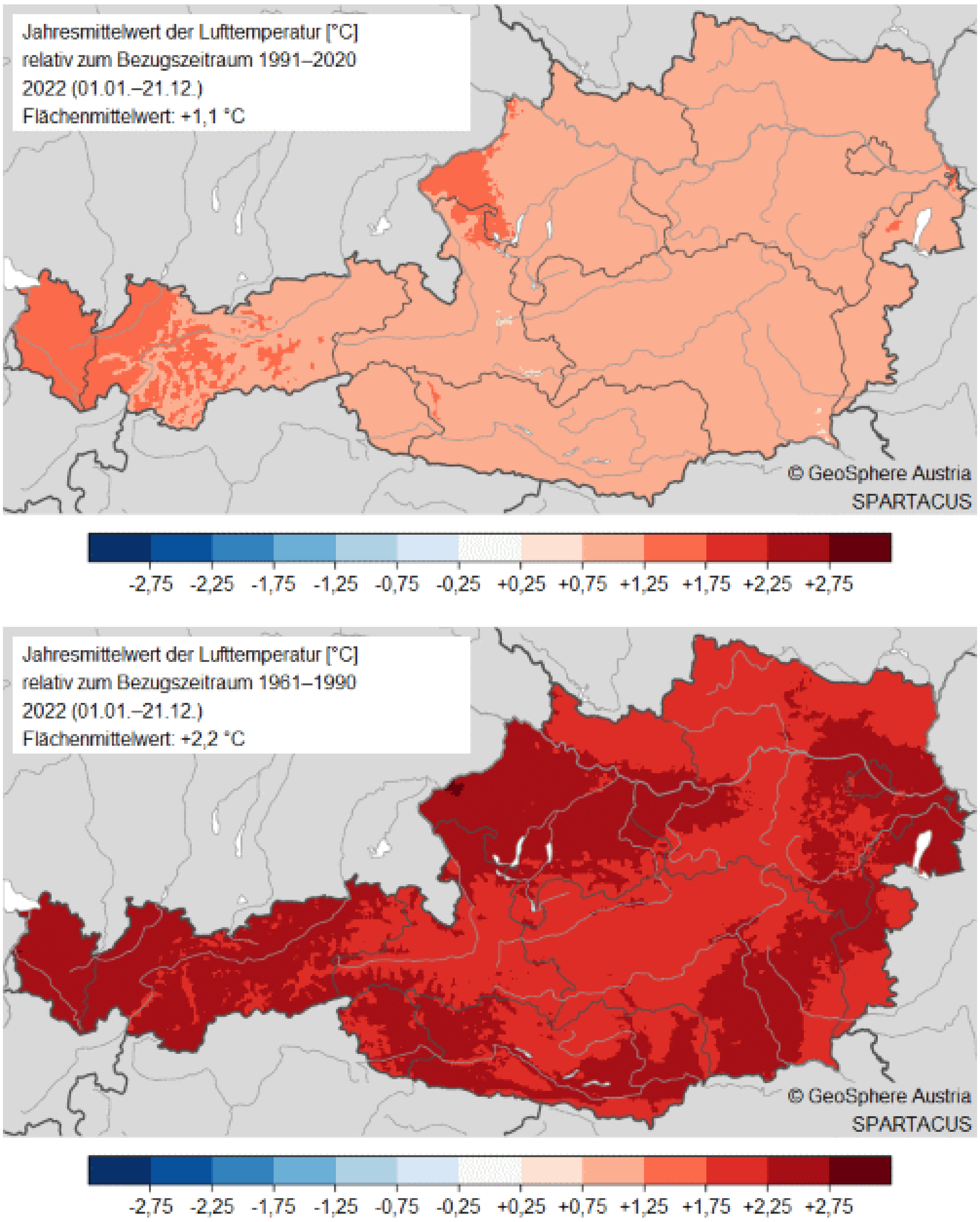


Figure 1: Temperature in Austria in 2022. Picture below compared to the average 1961-1990, picture above compared to the average 1991-2020. Source ZAMG

Precipitation

In Austria in 2022, there was hardly a month or a region in which rainfall reached or even exceeded the climatological average. In the southeast of the country (Lower Carinthia, West, Southeast and East Styria and Burgenland), there was only above-average rainfall in September. In the remaining months, precipitation levels were always below climatological averages. In the northwestern parts of the country, a comparatively large amount of precipitation fell (normal to slightly above average amounts compared to the long-term average) and there was increased precipitation in April, June, September, November and December.

At a few weather stations, new negative records were even set. In Eisenstadt, 2022, with 415 mm (dev. -40%) until now by 50 mm less precipitation than in 1952, the driest year to date. In the very west of Austria, on the other hand, in Bregenz, there was a surplus of 9 percent at 1,649 mm (as of 21/12). An eighth of the annual sum fell in Bregenz during a record precipitation event on 19 August, in which a rainfall of 212 mm accumulated within 24 hours. At 370 to 430 mm, the absolute driest regions of the country can be found around Lake Neusiedl, in the Marchfeld and south of Vienna. The wettest regions with 1,600 to 2,000 mm of precipitation were mainly Vorarlberg and in some places the Salzkammergut.

Across Austria, precipitation averaged 15 percent less. This meant that it was similarly dry as in 2015 and 2011, but there was slightly more precipitation than in 2003, which had 21 percent less precipitation. This makes 2022 one of the fifteen years with the lowest precipitation figures of the past 165 years. However, it was significantly drier in 1865 (dev. -33%), 1971 (-25%), and 1868 (-23%). The fact that the deficit was so high is mainly due to the fact that in the otherwise rainy summer months of July and August there was 29 and 16 percent less rain and March was particularly dry with a deviation of -73 percent.

Deficits of 23 to 40 percent occurred mainly along and south of the Drava, in the Lavant valley, in western and eastern Styria, in the Industrieviertel, in Vienna and in northern Burgenland. In the Weinviertel, Mostviertel, in Upper Styria, in the central part of Carinthia, in large parts of Salzburg and in the Innviertel as well as in Tyrol and Vorarlberg, the annual sum was 7 to 22 percent below the climate average. In the Tennengau and Pongau, in large parts of Upper Austria and in the Waldviertel, rainfall ratios in 2022 corresponded approximately to multi-year averages

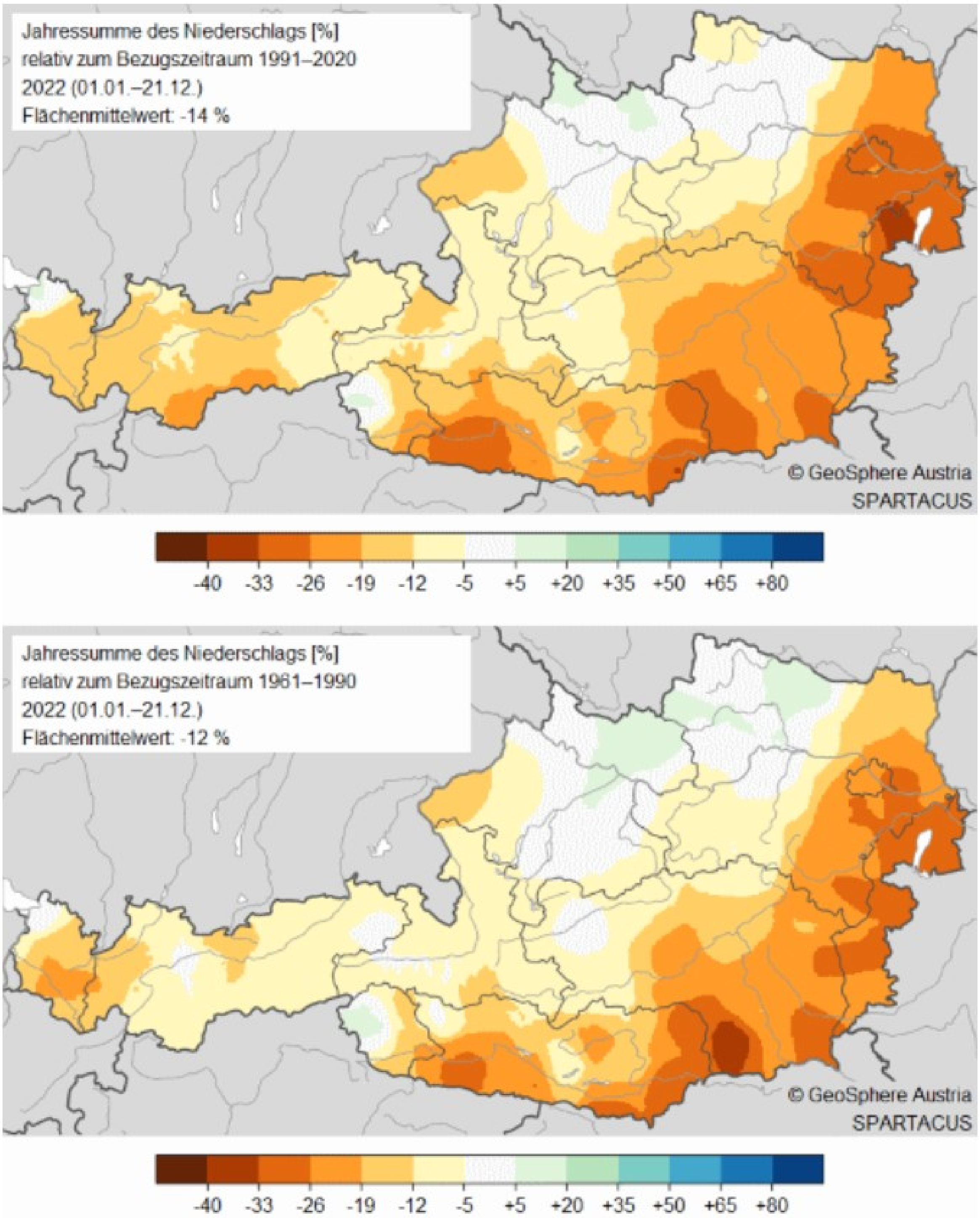


Figure 2: Precipitation in Austria in 2021: Deviation of precipitation from average. Picture below compared to the average 1961-1990, picture above compared to the average 1991-2020. Evaluation with SPARTACUS data until 21/12/2022.. Source ZAMG

Sun

The year 2022 was rich in sunshine in the west and south of the country. Especially in Vorarlberg, in the Tyrolean lowlands, in East Tyrol and in the Carinthian areas along and south of the Drava, the sun shone 5 to 15 percent longer compared to the climate average for 1991-2020. There were similar deviations from the average in the Upper Austrian central area as well as in the Waldviertel, Weinviertel and Nordburgenland. In all other parts of the country, deviations were between -5 and +5 percent.

A prominently sunny month in 2022 was March, which shows an anomaly of 53 percent compared to the average. Also sunnier than on average were the months of January, February, June, July, October and November, which were 9 to 17 percent sunnier. September (-23%) and December (expected -30%) received significantly less sunshine.

On average, the sun shone 6 percent longer throughout Austria, making 2022 the eighth sunniest of the past 98 years.

1.1.2 Meteorological characteristics for the Austrian Rhine region.

Source: Hydrographic Service Vorarlberg

In 2022, the annual rainfall in the Austrian part of the Rhine catchment area was below average, reaching only 88% of the long-term average. Only in August and September the monthly sums of precipitation were above the average for that month. The months of February, October and November recorded average rainfall, while the remaining months had significantly below-average rainfall (Figure 3). The droughts in spring and autumn were clearly prominent.

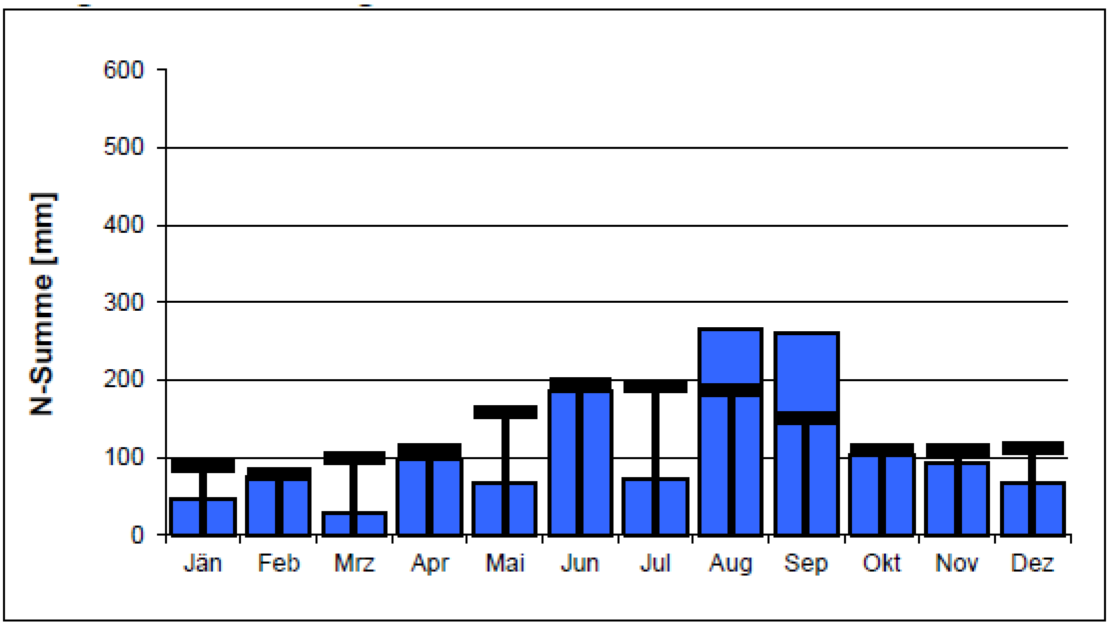


Figure 3: Monthly precipitation sums in 2022 (blue columns) compared to long-term monthly averages (1981 – 2010) at the Bregenz Altreuteweg measuring point.

In the Austrian Rhine catchment area, annual average air temperature was 1.5 °C above the long-term average of 1991-2020.

1.1.3 Switzerland

Source: Federal Office of Meteorology and Climatology (MeteoSwiss)

On the southern side of the Alps, all three winter months were low in rainfall. In the rest of Switzerland, winter precipitation reached between 90 and 120% of the standard 1991-2020.

In spring, precipitation levels remained well below the standard and were at record-low levels regionally. On the southern side of the Alps, this spring was locally the one with the lowest rainfall in more than 60 years, with less than 40% of the standard. Little precipitation fell, especially in the months of March and May. On the southern side of the Alps, locally only 10% of the March standard for 1991−2020 fell. In May, precipitation sums once again remained below the standard. At numerous measuring locations in western Switzerland, rainfall in May was the lowest since the beginning of the measurements.

Switzerland experienced the second warmest summer since the beginning of the measurements in 1864. The hot summer brought three heat waves: the first heat period began in mid-June, Switzerland was hit by a second heat period around mid-July, and the third heat period began in early August. Summer rainfall sums from June to August reached between 60 and 80% of the standard in many areas of Switzerland. In individual regions, especially in western Switzerland, less than 60% of the normal rainfall fell, while the southern side of the Alps, eastern Switzerland and the central plateau received more than 80% in some areas. In June, rainfall in Switzerland reached between 80 and 120% of the standard. Individual measuring locations recorded one of the wettest June months since the beginning of the measurements. In July, on the other hand, some regions of Switzerland received less than 30% of the normal rainfall, and locally less than 10%. In southwestern Switzerland, the lowest rainfall in July has been recorded in over 50 years. Together with the high temperature and the associated high evaporation as well as the lack of rain in the months before, this region experienced a great drought. In August, rainfall – with only 40 to 70% of the standard – once again remained below average in many areas of Switzerland. On the other hand, plenty of rain fell between Schaffhausen and Lake Constance with 130 to 180% of the standard.

In autumn, above-average rainfall fell north of the Alps. In western Switzerland and locally in the central Plateau, they rose above 130% of the standard. In many places in the Alps, values varied between 80 and 120%. In contrast, the southern side of the Alps and adjacent areas received only 60 to 90% of the 1991-2020 standard.

December was cool until after the middle of the month and snow fell several times in low altitudes. A strong warming subsequently caused the snowfall limit to rise to over 2000 m.

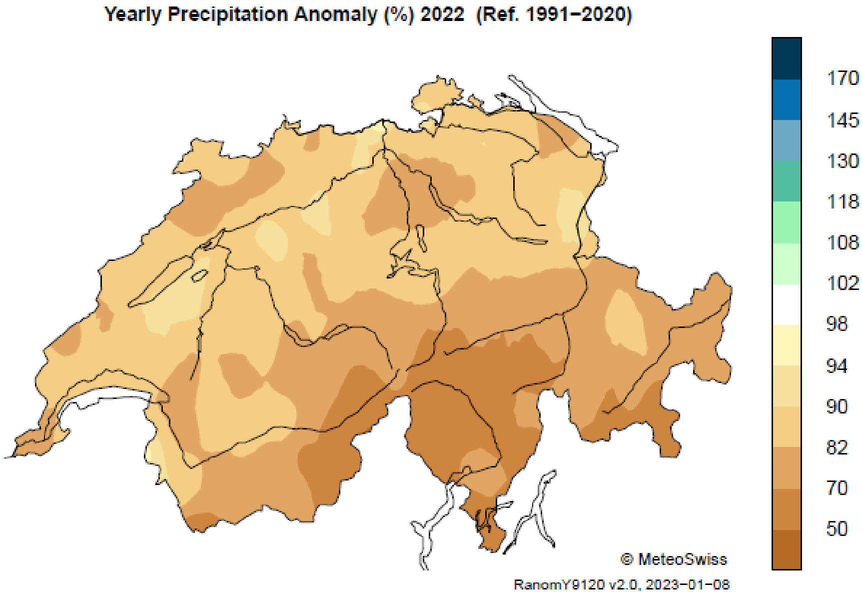


Figure 4: Annual precipitation total Switzerland 2022 as a percentage of the standard (1981-2010). Annual precipitation in 2022 reached 70 to 90% of the 1991–2020 standard. On the southern side of the Alps, the values were between 50 and 75% of the standard.

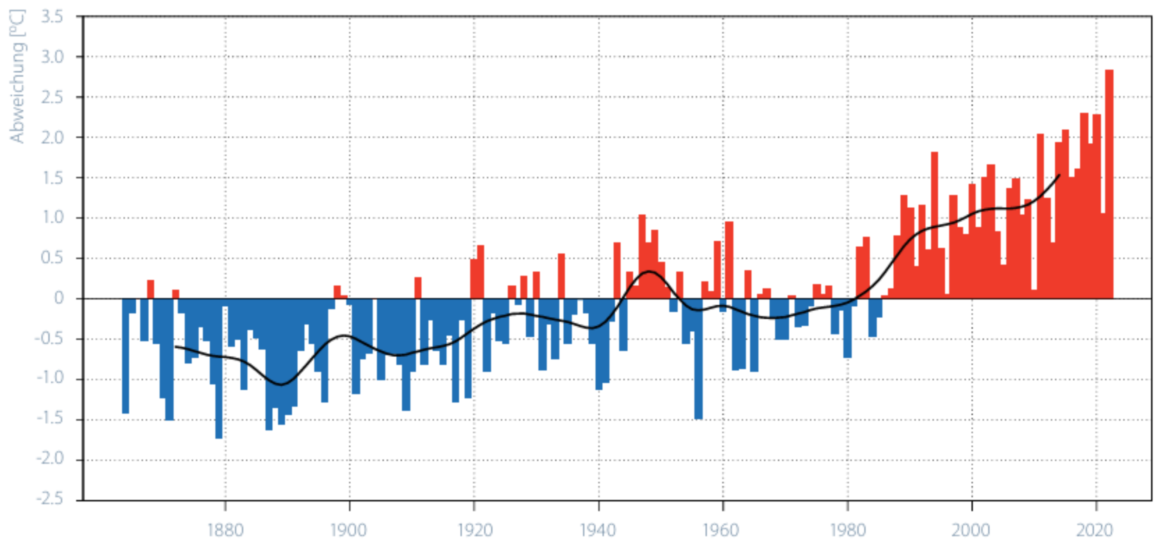


Figure 5: Long-term trend of the annual temperature averaged across the whole of Switzerland. Annual deviation of the temperature in °C from the standard 1961–1990 is shown (red = positive deviations, blue = negative deviations). The black curve shows the 20-year, weighted average. Image: MeteoSwiss.

Table 1: 2022 annual values at selected MeteoSwiss measuring stations compared to the 1991-2020 standard

Station	Altitude m a.s.l.	Temperature (°C)			Sunshine duration (h)			Precipitation (mm)		
		Average	Standard	Dev.	Total	Standard	%	Total	Standard	%
Bern	553	11.0	9.3	1.7	2143	1797	119	895	1022	88
Zurich	556	11.5	9.8	1.7	2149	1694	127	872	1108	79
Geneva	420	12.8	11.0	1.8	2342	1887	124	694	946	73
Basel	316	12.6	11.0	1.6	2119	1687	126	795	842	94
Engelberg	1036	8.4	6.8	1.6	1608	1380	117	1271	1568	81
Sion	482	12.2	10.7	1.5	2,400	2158	111	486	583	83
Lugano	273	14,4	13.0	1.4	2514	2120	119	1096	1567	70
Samedan	1709	3.5	2.4	1.1	1998	1767	113	571	710	80

Standard = Long-term average 1991-2020
Dev. = Deviation of the temperature from the standard
% = Percentage in relation to standard (standard = 100%)

1.1.4 Germany

Source: German Weather Service (DWD)

After the hydrological year 2021, which is to be classified as a "normal year" with 944 mm of annual precipitation, the sequence of the three previous low precipitation and very warm years 2018 to 2020 continued in the hydrological year 2022 (November 2021 to October 2022). This is evident in the two catchment areas of the Rhine area considered here (Basel gauge to Mainz gauge, 62,309 km² and Mainz gauge to Lobith gauge, 61,690 km²). Averaged over both sub-basins, only 76% of the multi-year rainfall average of the 1981-2010 time series was reached in 2022 with 786 mm (see Figure 6).

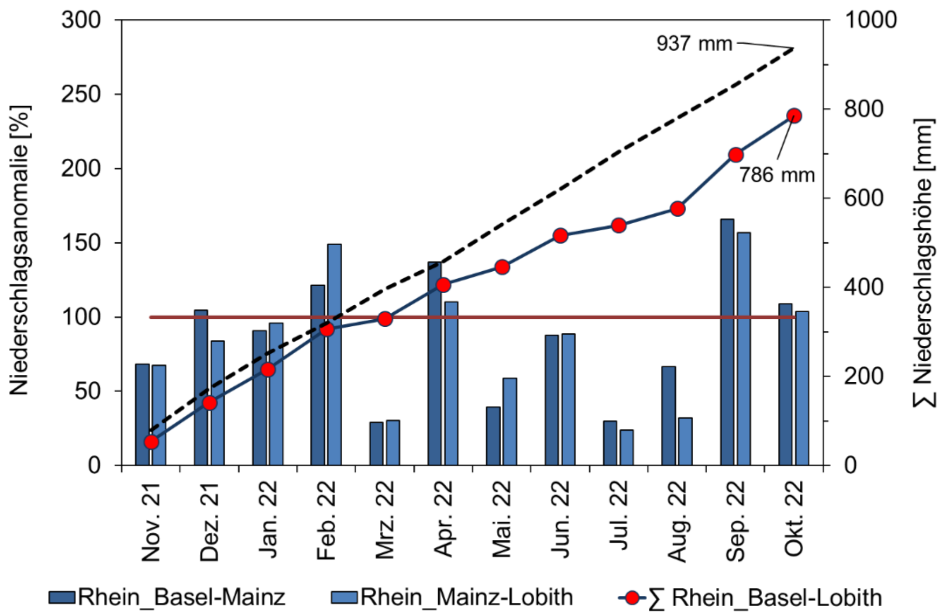
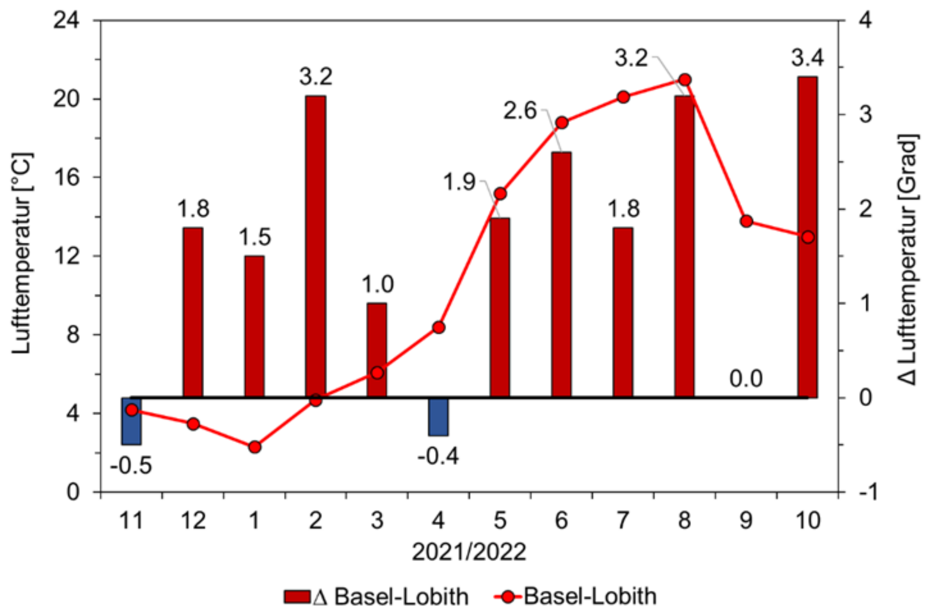


Figure 6: Monthly relative anomalies (blue bars) of the hydrological year 2022 precipitation levels in the Rhine area for the sub-basins of the Upper Rhine (Basel to Mainz including Mainz, 62,309 km²) and Middle and Lower Rhine (Mainz to Lobith, 61,690 km²) against the background of the multi-year averages of the reference series 1981 to 2010 (magenta horizontal). Plotted in black the summed monthly

rainfall levels for the Rhine region from Basel to Lobith (∑) for the hydrological year 2021 in comparison with the cumulative line of the time series 1981 to 2010 (dashed line) (data source: DWD and weather services of the neighbouring countries, provisional data, evaluation: Federal Institute for Hydrology) and weather services of the neighbouring countries, evaluation: Federal Institute for Hydrology)

The average annual temperature in the partial catchment area of the Rhine, which is limited by the Basel and Lobith gauges, was 10.9 °C, +1.6 degrees above the long-term average of 1981-2020. Compared to the years 2018, 2019 and 2020 with 10.7 °C, 10.5 °C and 10.8 °C, the annual average temperature was slightly warmer again. Only in the months of November and April was the temperature slightly below the climatic average. Otherwise, the temperatures moved in the majority of months, in some cases very significantly above the average. With deviations above +3 degrees, these were the months of February, August and October. However, June temperatures were also +2.6 degrees above average (see Figure 7).

Figure 7: Monthly average and monthly anomalies of the air temperature for the partial catchment area



of the Rhine from Basel to Lobith for the hydrological year 2022. The anomalies of the air temperature (Δ, right ordinate) refer to the time series 1981 to 2010 (data source: DWD and weather services of the neighbouring countries, evaluation: Federal Institute for Hydrology)

Only in the months of February, April and September did precipitation noticeably exceed the multi-year average. At +55% above the climate average, September was particularly humid in both sub-basins, ending a four-month drought that lasted from May. In the Middle and Lower Rhine region, taking into account the very dry month of March and the monthly total of precipitation, which is only slightly above the average, there is even a six-month drought. Clearly marked precipitation deficits occurred in several months. For example, in March and July, only 29% and 30% to 24% of the precipitation was registered. And even in the months of May and August, only less than half of the climatically expected precipitation levels fell (see Figure 6).

The weather character of the individual months can be characterised as follows:

The hydrological year 2022 began with a mostly cloudy November. Low pressure areas and their foothills initially dominated the weather. This was followed by a multi-day phase, which was characterised by low-pressure or gradient-weak weather conditions. November then ended with increased low-pressure activity with storms and first snowfall down to medium altitudes. For example, November, which was poor in sunshine, was colder (see Figure 7) and much too dry in some areas.

A December with storm, ice and snow ended very mildly. Low-pressure areas shaped the weather of the first ten days of December with sometimes heavy snowfalls (see Figure 8). After that, troughs mostly grazed the north and east of Germany, while large areas on the edge of western European high-pressure areas lay in a moist base layer with deep clouds. At the beginning of the third ten days, dry cold air dominated with sunny days and ice-cold nights, before the Arctic cold air was slowly displaced north-eastwards by mild sea air from the 23rd and December ended unusually mild and rainy. The month was poor in sunshine and was overall mild and dry in the parts of the Rhine basin considered here. Most of the precipitation fell during its first and last ten days. The southern Rhine region in particular recorded above-average rainfall levels.

At the beginning of the year, low pressure areas swirled the unusually mild temperatures. After a low on 4January, which had an impact on especially the southern Rhine region with abundant rain, on 8January an edge depression followed with snowfall to low altitudes (see Figure 8). From the second ten days onwards, high-pressure areas dominated. At the end of January, the foothills of several Scandinavian storm lows swept over Germany, of which a storm low on January 31 brought plenty of snow in congestion in the south. The predominantly sunny and mild January was too dry in large areas.

The wettest winter month was February in both subareas, where +21% more precipitation than the long-term average occurred in the sub-basin from Basel to Mainz and in the area downstream of +49% (see Figure 6). Stormy western weather conditions shaped the course of the weather. Nevertheless, overall the month was above average sunny.

March was then marked by an exceptionally long period of high air pressure. Weak troughs only brought a little rainfall on individual days. Viewed across Germany, March was the sunniest since records began in 1951. The monthly total of evaporation clearly exceeded total precipitation. Very dry air, with intense sunlight and large daily temperature fluctuations characterise the weather.

Under the influx of polar cold air, April started with snowfall down to low altitudes. Scandinavian storm lows brought unstable and stormy weather, in which a layer of snow formed in some areas. Overall, April was too cold and predominantly too wet with a balanced sunshine balance.

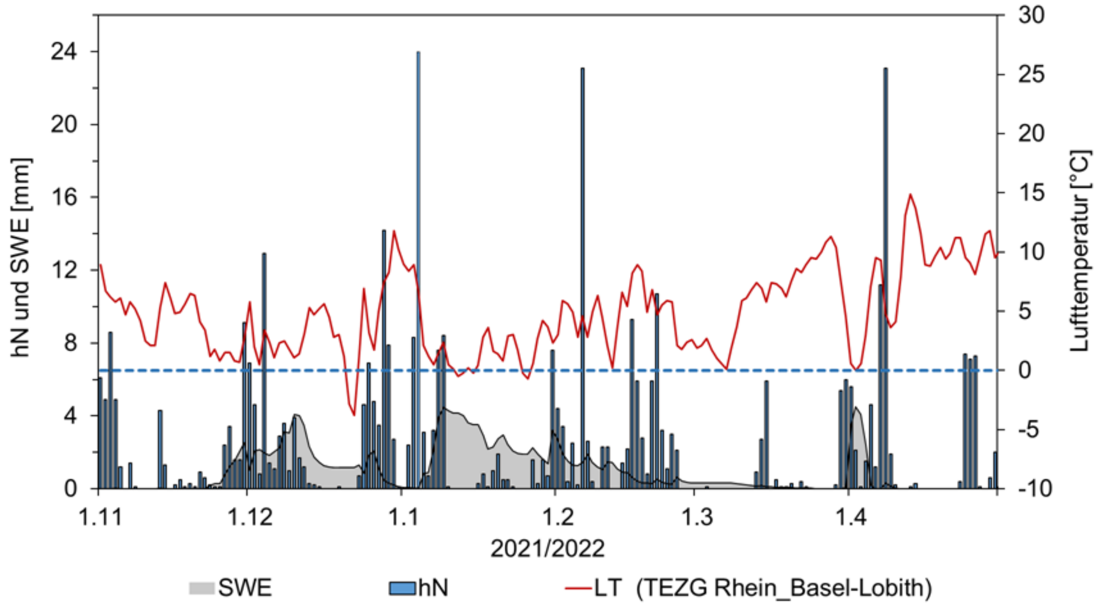


Figure 8: Daily values of precipitation (hN), snow water equivalent (SWE) and air temperature (LT) for the area average of the partial catchment area of the Rhine from Basel to Lobith for the hydrological winter half-year 2022 (1/11/2021 to 30/4/2022). The dashed red line represents the zero-degree line (data source: DWD and weather services of the neighbouring countries, evaluation: Federal Institute for Hydrology)

The daily precipitation levels and daily mean temperatures as well as the snow water equivalents calculated with the LARSIM-ME water balance model are shown for the hydrological winter half-year in Figure 8. Several phases of snow cover build-up are clearly visible: at the end of November/beginning of December and mid-December in 2021 as well as at the beginning of January and beginning of April 2022. This was followed by corresponding snowmelt periods due to the predominantly mild weather. In the winter half of the year, the individual days (4/1, 6/2 and 8/4/2022) with very abundant rain of 20 mm and more in the area average should also be highlighted.

In the hydrological summer half-year, the months of May to August were characterised by high pressure on many days with sunny and warm days. On the other hand, low-pressure areas or their cold fronts repeatedly crossed the area. At the air mass boundary between the cold and warm air masses, intense convective precipitation (thunderstorms and heavy rain) repeatedly formed, which, however, differed greatly in space and time, so that the overall balance in these months is still sunny and dry. An intense heat wave in June was also ended by a cold front passage, combined with a marked drop in temperature.

After September had started dry and sunny on the southern edge of a Scandinavian high, a low above the eastern Atlantic with a southwestern current diverted warm and unstable air to the southwest. Embedded low runners with strong showers and heavy thunderstorms gradually displaced the dry air north-eastwards. Short sunny high-pressure phases interrupted the dominant low pressure activity, the troughs of which brought large amounts of precipitation in some areas. The temperature level dropped continuously, and the first snow fell in the high altitudes of the Alps. So September was too cool and too wet with an even sunshine balance.

October was marked by a change from rainy low pressure influence to sunny, sometimes foggy high pressure phases. Western currents ensured a comparatively cool start to the month, before in the second ten days the current turned to the southwest and led very mild air to Germany.

The sunny October was clearly too warm. Across Germany, it was the warmest October in the series of measurements that had existed since 1881 (on par with 2001).

1.1.5 Netherlands

Source: Royal Netherlands Meteorological Institute (KNMI)

Temperature

With an average temperature of 11.6 °C, 2022 was the third warmest year since measurements began in 1901. Normally, the average temperature is 10.5°C. The lowest temperature, -10.6 °C, was measured on 13 December in Eelde and the highest temperature, 39.5 °C, was measured on 19 July in Beek. Only in April, September and December was the average temperature slightly below normal.

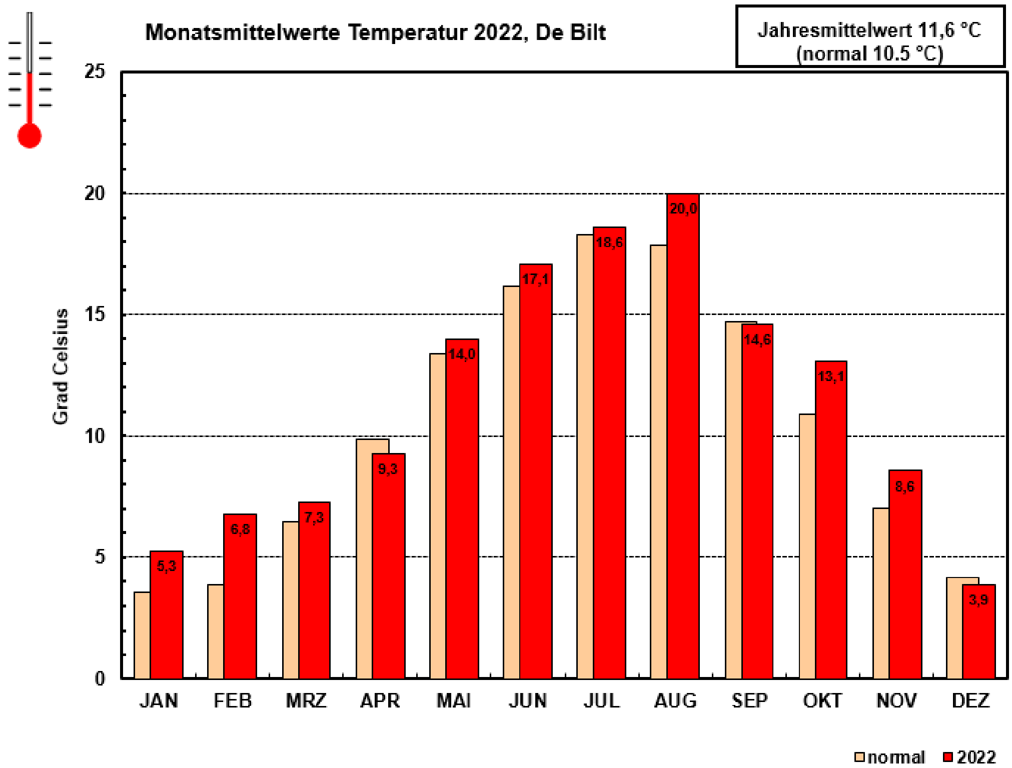


Figure 9: Monthly temperature averages at the station De Bilt 2022 compared to the long-term (1991-2020) average (source: KNMI)

Precipitation

With a national average of about 729 millimetres, 2022 was a dry year, especially in the east of the Netherlands. The normal national average was 795 millimetres. Never before in this century has it been as dry as in 2022. The driest KNMI station was Hupsel, where only 593 mm fell, about 180 mm less than normal. Terschelling was the wettest station with 856 mm, over 50 mm more than normal. On March 31 and April 1, there was a snow cover of 2 to 5 centimetres in many places. On December 5, there was about 5 cm of snow in the Limburgian hills. This summer, too, the drought was considerable. By September 5, the nationwide precipitation deficit had risen to 318 mm; never before has the precipitation deficit been so large in a single day. Despite the humid September, the nationwide rainfall deficit at the end of September was still above 220 mm on average.

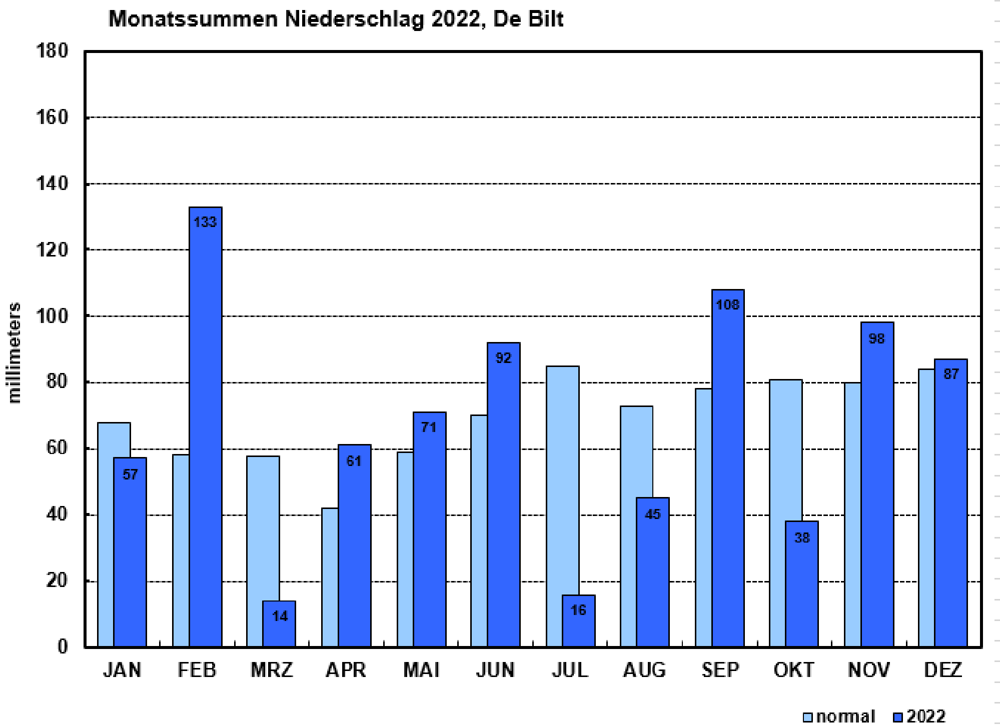


Figure 10: Monthly totals of precipitation at De Bilt 2022 station compared to the long-term (1991-2020) average (source: KNMI)

Sun

With a national average of 2,233 hours of sunshine, 2022 was the sunniest year since observations began. The normal average is 1774 hours. All months except January were sunnier than normal. The old record was already reached in October. It was sunniest in coastal regions: in De Kooy the sun shone for 2403 hours, 515 hours more than normal.

1.2 Snow and Glaciers

1.2.1 Snow

Source: WSL Institute for Snow and Avalanche Research SLF

Snowing took place throughout Switzerland at the beginning of November 2021 at altitudes above about 2200 m, in Graubünden even above about 1500 m. On the northern slope of the Alps, the wintry snow cover above 800 m spread on 26 and 27 November. Many more snowfalls in the following days and weeks contributed to the fact that individual stations in western Switzerland recorded record snow depths for this date at around 1300 m just before the middle of the month. One week before Christmas, the snow depths between 500 and 1500 m on the northern slope of the Alps were around two to four times as high as normal, and above 2000 m they were still around one and a half times as high as average.

The snow cover remained above 1000 m on the northern slope of the Alps until mid-March 2022. Thus, the number of days with snow cover was in the normal range until the end of March, with the exception of the altitude range between 600 and 900 m, where a slightly above-average number of days with snow could be recorded. In contrast, there was little snow in the Central Plateau. After an exceptionally long phase of around 30 days without new snow, 30 to 60% of the usual snow depth was still recorded at the end of March above 1500 m on the northern slope of the Alps and in the Engadine.

The situation on the southern slope of the Alps, in particular in Ticino and the Simplon region, was very different: at the end of March there was little or no snow below 1800 m. Due to the continued lack of precipitation since the beginning of winter, there has only been a thin permanent snow cover above 1800 m since November. Accordingly, the daily total of fresh snow since November was the smallest ever measured value at many stations in these regions.

Looking at the entire period from November 2021 to the end of March 2022, the average snow depths on the northern Alpine slope below 800 m were strongly below average due to above-average winter temperatures and on the southern Alpine slope below 1700 m due to simultaneous low precipitation. At stations Airolo (TI, 1140 m), Campo Blenio (TI, 1215 m), Bosco Gurin (TI, 1525 m) and San Bernardino (GR, 1640 m), for example, such a low average snow depth has never been measured since at least 1959. Above 2000 m, the average snow depths on the southern slope of the Alps were only around half as high as normal. Since 1 November, the average snow depths on the northern slope of the Alps and in the Engadine between 1200 and 2000 m have been at 80 to 100% and above 2000 m at 70 to 90% of the long-term standard values for 1991-2020.

Due to strongly above-average temperatures in May and June, thaw took place around one month earlier than normal at all altitude levels. The almost 90-year series of measurements on the Weissfluhjoch (GR, 2540 m) showed the second earliest date ever measured (6 June). Only in 1947, thaw took place three days earlier. In both years, several strong Sahara dust events were observed during the winter, which led to greater melting rates.

1.2.2 Glaciers

Source: Department of Geosciences at the University of Freiburg and Laboratory for Hydraulics, Hydrology and Glaciology (VAW) at ETH Zurich

The year 2022 was catastrophic for Swiss glaciers: With very little snow in winter and persistent heat waves in summer, all records of ice melting were broken. The melting rates far exceed the previous records from the heat summer of 2003: In 2022, the glaciers lost around three cubic kilometres of ice, which is more than six percent of the remaining volume. As a comparison: Until now, years with two percent ice loss have been described as "extreme". The loss was particularly drastic for small glaciers. The Pizol glacier SG, the Vadret dal Corvatsch GR and the Schwarzbachfirn UR have practically disappeared – the measurements have been discontinued.

In the Engadine and southern Valais, a layer of ice four to six meters thick disappeared at 3,000 meters above sea level. This is sometimes more than twice as much as the previous maximum. Even at the very highest measuring points (e.g. at the Jungfraujoch), significant losses were measured. The average ice thickness loss in all regions is around three metres, sometimes even reaching values above four metres (e.g. Griesgletscher (VS), Ghiacciaio del Basòdino (TI)). Observations show that many glacier tongues disintegrate, and rocky islands emerge from the thin ice in the middle of the glacier. These processes further accelerate decay.

The situation was already unusual in winter and spring: snowing occurred in the winter of 2021/22 for most glaciers at the beginning of November, which is roughly the norm. However, the snow cover disappeared around one month earlier than usual at all altitude levels. The snow depth in the Alps in spring had rarely been as low, especially in the south of Switzerland. In addition, there were large amounts of Sahara dust between March and May. The contaminated snow absorbed more solar energy and melted faster. As a result, the glaciers already lost their protective snow cover in early summer. The persistent, sometimes massive heat between May and early September therefore decimated the glacier ice.

1.3 Hydrological Situation in the Rhine Region 2022

1.3.1 Water Levels of Large Lakes in the Catchment Area of the Rhine

1.3.1.1 Austria

Source: Hydrographic Service Vorarlberg

From the beginning of the year to 12 March, water level of Lake Constance was above the long-term average of the series 1864 – 2020 for the respective calendar day. After that, the below-average precipitation of the months of January to July resulted in below-average water levels until October 24. Subsequently, water levels were in the range of the respective calendar day average until 23 December. The Christmas high water caused above-average water levels at the end of the year. The annual peak was measured on 10 June at 382 cm (see Figure 11) and was thus over one metre lower than in 2021.
The annual average of the water level in Bregenz was 324 cm, by 21 cm below the long-term annual average (345 cm).

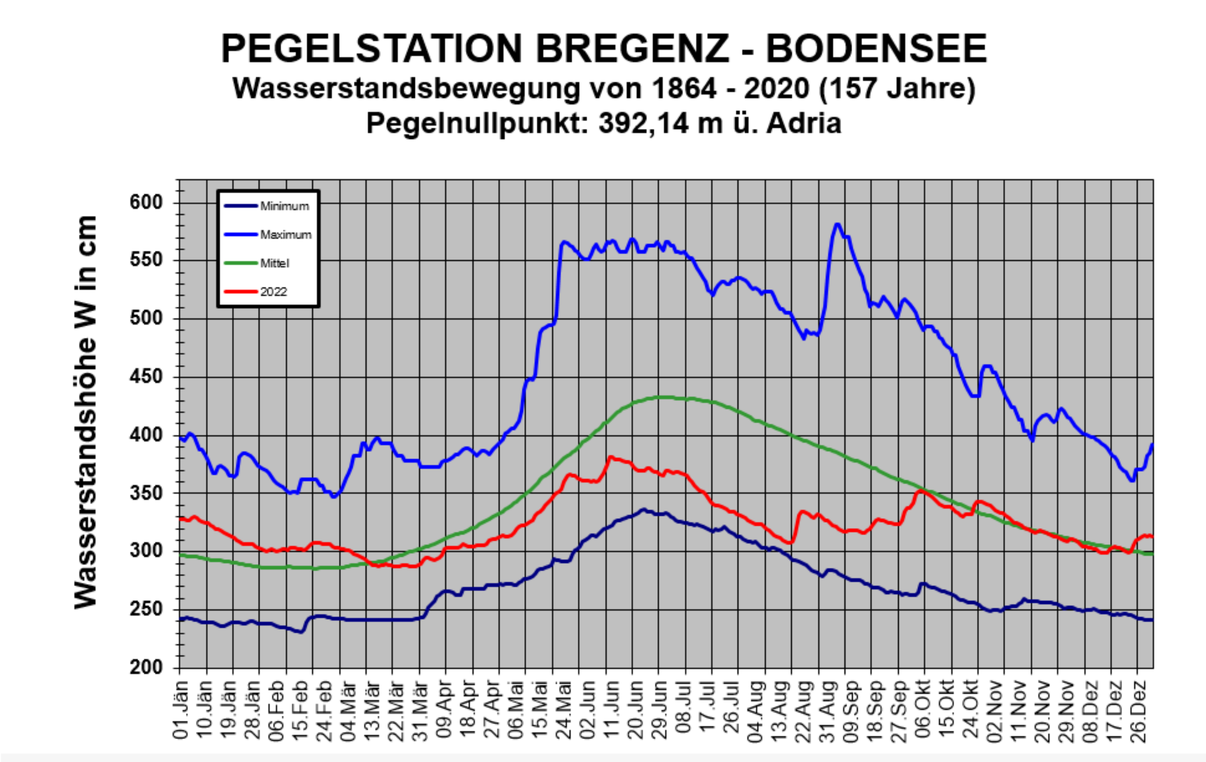


Figure 11: Hydrograph of the water level of Lake Constance at the Bregenz gauge in 2022 (red curve) compared to long-term minima, maxima and mean values

1.3.1.2 Switzerland

Source: Swiss Federal Office of the Environment (BAFU)

The persistent lack of rainfall and high temperatures in 2022 have also left their mark on the lakes. Of the large lakes, only Lake Geneva had an annual average water level which was significantly above the long-term average of the 1991-2020 standard period, by 3cm. It benefited from strongly above-average inflows from the glaciated catchment areas. In the case of half a dozen large lakes, the annual average corresponded almost exactly to the normal value. For the majority, however, the annual average in 2022 was significantly below the long-term average. The biggest undershoots were the gauges of the stations at the non-regulated lakes Walensee (-20 cm), Lake Constance-Romanshorn (-16 cm) and Lake Constance-Berlingen (-32 cm) as well as the two Ticino lakes Lake Lugano (-29 cm) and Lake Maggiore (-88 cm). Lake Maggiore has a water level of 192.61 m above sea level, the lowest annual mean value in the 80-year measurement series. It is more than 20 cm below the value from 1949. The value of Lake Lugano in 2022 is also a new record: it is the lowest water level in the almost 60-year series of measurements.

At Lake Lugano, the yearly course of the level with this very low annual average is very impressive: from January to September, there were new monthly lows at this lake. In mid-September, the level moved for the first time in 2022 into a normal range for the season. And at the end of October, a small plus was recorded. Despite the extremely low water levels, there was only a new monthly low on Lake Maggiore - in June. But even if there was only one new low, the picture of the course of monthly levels is very impressive: All twelve values remained significantly below the long-term average of the 1991-2020 period. The deviation from the standard was more than one meter in June, July and December. Only in August and September the level was less than 70 cm below the monthly normal value. Further new lowest monthly levels were measured at Lake Constance in Berlingen in July and August and at Lake Walen in August. The water level of Lake Constance at the beginning and end of the year was largely within the usual limits. From the middle of the year until autumn, the levels remained at a low to very low level for the season. The monthly average values from June to September were significantly below the long-term average values for these months.

In the first and last days of the year, the water level of Lake Neuchâtel was significantly above the level that would be expected in the corresponding season. In addition, the lake reacted to the individual precipitation events between mid-August and the end of October with significant increases in level. In contrast to the lakes of southern Switzerland, water level at Lake Geneva was often above the long-term average: from the beginning of the year to the end of April. Only in May was there a longer phase with below-average levels. From the middle of the year, the water level – with the exception of a few swings - was at the usual constant level.

In 2022, no new monthly maximum was registered on any of Switzerland's larger lakes. And on none of the larger lakes did the water level reach danger level 2

1.3.2 Water Levels and Discharges of Watercourses

1.3.2.1 Austria

Source: Hydrographic Service Vorarlberg

In 2022, the discharge of the Alpine Rhine was 28% below the long-term average. The two largest tributaries from Austria, the Bregenzerach and the Dornbirnerach, also had an below-average annual load. The average annual discharge compared to the long-term average was:

- at Bregenzerach 91% (MQ 2022 = 42.4 m^3/s, long-term MQ = 46.5 m^3/s, years 1951-2021);
- at Dornbirnerach 78% (MQ 2022 = 5.51 m^3/s, long-term MQ = 7.04 m^3/s, years 1984-2021);
- at the Alpine Rhine 72% (MQ 2022 = 167 m^3/s, long-term MQ = 231 m^3/s, years 1951-2021).

1.3.2.2 Switzerland

Source: Swiss Federal Office of the Environment (BAFU)

In 2022, the annual average values of the discharge in all large river areas in Switzerland were significantly below the long-term average of the 1991-2020 standard period. None reached more than 90% of the normal discharge. The Rhone at Porte du Scex came in at around 89%. At 10%, its catchment area has the highest degree of glaciation of the large river areas in Switzerland. The measurements at the station below the Aletsch Glacier show that the glacier melt has made its contribution to this relatively high discharge: the highest annual discharge in the 92-year measurement series was recorded at the Massa. In addition to the Rhone, only the discharge of the Inn reached a share of more than 80% of the standard. Between 70 and 80% were reached by the Reuss, the Alpine Rhine, the Thur, the Aare and the Limmat. Only about two-thirds of the normal amount of water was carried by the Birs and the Doubs. The situation on the southern side of the Alps was dramatic: with an annual average value of 33m^3/s, only a little more than half of the long-term average amount of water was discharged by the Ticino near Bellinzona. The value of 2022 is the lowest in the more than 100-year series of measurements. Even only a quarter of the normal discharge was measured at the Maggia near Locarno. This is also a new record in the almost 40-year series of measurements.

Among the medium-sized catchment areas, in 2022 there were only a few areas with normal (90 to 110% of the standard 1991-2020) and above-average discharge (110 to 130% and 130 to 150% of the standard). In the areas with above-average discharge, glaciation played a decisive role. As already mentioned, in 2022, Massa recorded a new highest annual outflow; it was 34% above the long-term average in this catchment area. The discharge at the Engelberger Aa near Buochs was also around 35% above standard. There, however, the annual discharge in 2022 is not a new high, but it is only marginally below the previous year's record. Discharge at the Lonza at Blatten and at the Rosegbach in Pontresina were just under 15% above the long-term average. There, too, higher annual average discharge values have already been measured in earlier years. The catchment areas with discharge in the range of 70 to 90% of the standard are for the most part on the northern side of the Alps, from western to eastern Switzerland. The areas with markedly below-average discharge can be found in central and north to north-eastern Switzerland as well as on the south side of the Alps. In these regions, there were new lowest annual average values at around 30 measuring stations of the FOEN measuring network. Three areas have extremely low annual averages: the Brenno near Loderio, the Cassarate near Pregassona and the Saltina near Brig supplied only around 45% of the annual discharge. However, the roughly 45% of the standard also meant a new low for the Saltina. The Cassarate 2003 and the Brenno 2005 have experienced years with even lower annual averages.

Behind low annual averages are low monthly and daily averages. In order for there to be new record values, it takes longer periods of low water. These existed in large parts of Switzerland in 2022. Discharge in June, July, August and – somewhat less pronounced – in September was well below the corresponding long-term averages. On the Rhine near Diepoldsau, monthly outflows from June to September reached no more than two-thirds of the standard. In July and August, they were just over 50%. The share of monthly values in 2022 in the long-term averages was never more than 60% on the Aare near Brugg in March, May, June, July and August. If you add April and September, the Aare had seven months of continuous, clearly below-average discharge. The Venoge at Ecublens had already started the year below average. From March to August, discharge then remained at a very modest level. In May and July, they did not rise above 40% of the standard.

The situation on the southern side of the Alps was even more extreme: both the Ticino near Bellinzona and the Maggia near Locarno had no monthly discharge in 2022 over the corresponding standard values of 1991-2020. In the Maggia, the proportion of the standard remained below 70% every month. The lowest shares were observed in May (14%), September and November (each around 15%). In total, this resulted in a new lowest annual mean value in both catchment areas, based on the entire measurement period.

In autumn, above-average rainfall fell on the northern side of the Alps. Water levels in most watercourses and lakes have recovered as a result.

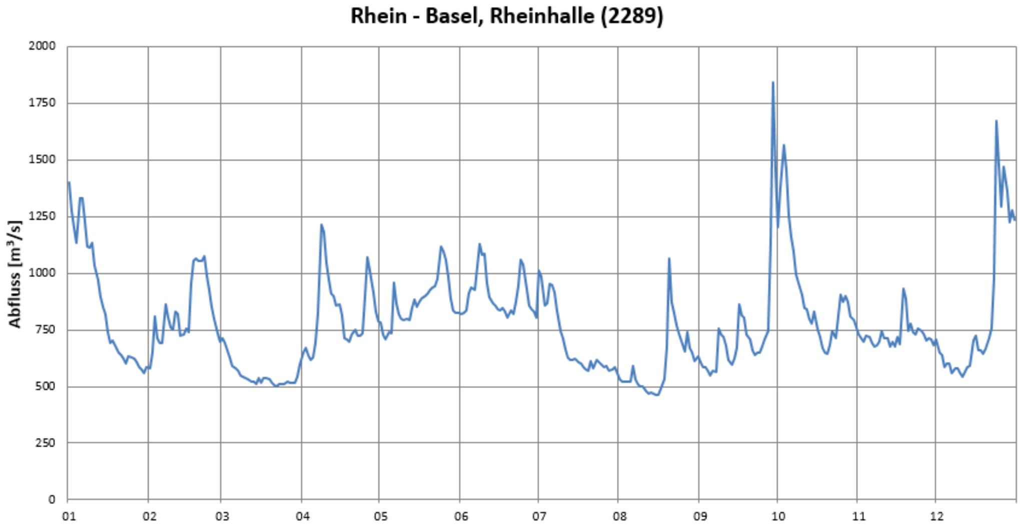


Figure 12: Discharge hydrograph at the Rhine - Basel, Rheinhalle gauge in 2022

1.3.2.3 Germany

Source: Federal Institute for Hydrology (BfG)

In accordance with the hydrometeorological framework, the hydrological year 2022 on the Rhine developed into a low-water year in all regions. Over the year, the flows at the gauges reached only about three quarters of the long-term average (see Table 2). Discharge in the summer half-year was particularly weak, where less than two-thirds of the seasonal discharge average was recorded. However, the winter half-year also remained 17 to 21% below the long-term normal values in terms of discharge (Table 2).

Table 2: Year-round and seasonal discharge averages for the hydrological year 2022 compared to the long-term reference values for the period 1961 to 2020 at the gauges Maxau /Upper Rhine, Kaub / Middle Rhine and Duisburg-Ruhrort / Lower Rhine (data basis: WSV)

hydrologische Jahre	MQ(1961/2020)	MQ(2022)		SoMQ(1961/2020)	SoMQ(2022)		WiMQ(1961/2020)	WiMQ(2022)	
	[m³/s]	[m³/s]	Verhältnis zum MQ(1961/2020 [%]	[m³/s]	[m³/s]	Verhältnis zum SoMQ(1961/2020 [%]	[m³/s]	[m³/s]	Verhältnis zum WiMQ(1961/2020 [%]
Maxau	1260	883	70	1350	839	62	1170	928	79
Kaub	1690	1230	73	1640	1050	64	1740	1420	82
Duisburg-Ruhrort	2260	1660	73	1970	1230	62	2550	2120	83

No high water level was reached at any time during the year in terms of daily discharge; even in the relatively strong January 2022, the multi-year MHQ level remained consistently well out of reach; the HQ(a) at the three example gauges was 18 (Duisburg-Ruhrort) to 30% (Maxau gauge) of the multi-year MHQ. Even the median water threshold was significantly lower than exceeded in the hydrological year 2022, with well over 300 days in each case (Table 3).

Table 3: Days below the long-term main values MQ (mean outflow) and MNQ (mean low water discharge) of the reference period 1961 to 2020 at the gauges Maxau /Upper Rhine, Kaub / Middle Rhine and Duisburg-Ruhrort / Lower Rhine (data basis: WSV)

hydrologisches Jahr 2022	Unterschreitungstage	
	MQ (1961/2020)	MNQ (1961/2020)
Maxau	329	35
Kaub	315	55
Duisburg-Ruhrort	306	69

As can be seen from Figures 13, 14 and 15 and Tables 4 and 5, the discharge extremes of the year were each quite uniform at the end of December/end of January (HQ(a)) and mid-August (NQ(a) and NM7Q(a)). The recurrence intervals of HQ(a) were always <1 year. Statistically, the low water phases are much more extreme, which also intensified from south to north. At the Lower Rhine (Duisburg-Ruhrort gauge), low water events at the level of 2022 are only to be expected every 50 to 100 years (Table 5).

Table 4: Average and extreme values of the discharge of the hydrological year 2022 compared to the long-term reference values for the period 1961 to 2020 at the gauges Maxau /Upper Rhine, Kaub / Middle Rhine and Duisburg-Ruhrort / Lower Rhine (data: WSV)

hydrologische Jahre	MQ(1961/2020) [m³/s]	MQ(2022) [m³/s]	MNQ(1961/2020) [m³/s]	NQ(2022) [m³/s]	NQ(2022) Datum	NM7Q(2022) [m³/s]	NM7Q(2022) Datum	MHQ(1961/2020) [m³/s]	HQ(2022) [m³/s]	HQ(2022) Datum
Maxau	1260	883	600	434	15.08.2022	456	17.08.2022	3240	2290	31.12.2021
Kaub	1690	1230	792	571	15.08.2022	583	19.08.2022	4330	3350	06.01.2022
Duisburg-Ruhrort	2260	1660	1040	669	17.08.2022	682	20.08.2022	6640	5490	07.01.2022

Table 5: Low water extremes NM7Q(2022) on the Upper, Middle and Lower Rhine and their recurrence intervals (data basis: WSV)

hydrologisches Jahr 2022	NM7Q [m³/s]	Wiederkehr-intervall [Jahre]
Maxau	456	10-20
Kaub	583	20
Duisburg-Ruhrort	682	50-100

The hydrographs in Figures 13, 14 and 15 show that the Upper Rhine (Maxau gauge) had below-average water flow over the entire hydrological year but was largely balanced in the area between MQ and MNQ. Atypical for the discharge regime of the Rhine, whose water supply is actually more balanced on average over many years as the river length increases, the water supply fluctuated more strongly in the flow direction in 2022. This means that the span between the (moderate) discharge peaks and the discharge minima increased in the course of the Rhine. This is mainly the result of the markedly negative anomaly of precipitation in the partial catchment area between Mainz and Lobith during the midsummer months, which was less pronounced in the southern catchment area, as can be seen in Figure 6 (Chapter 1.1.4).

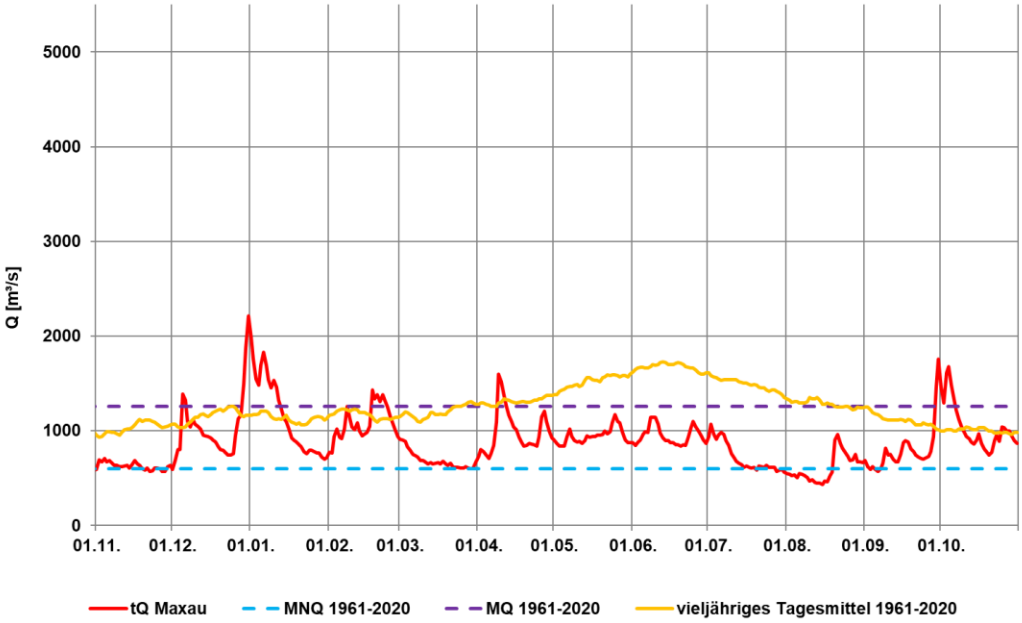


Figure 13: Daily discharges (tQ) at Maxau Upper Rhine gauge in the hydrological year 2022 against the background of the multi-year daily average and the MNQ and MQ values for the reference period 1961 to 2020

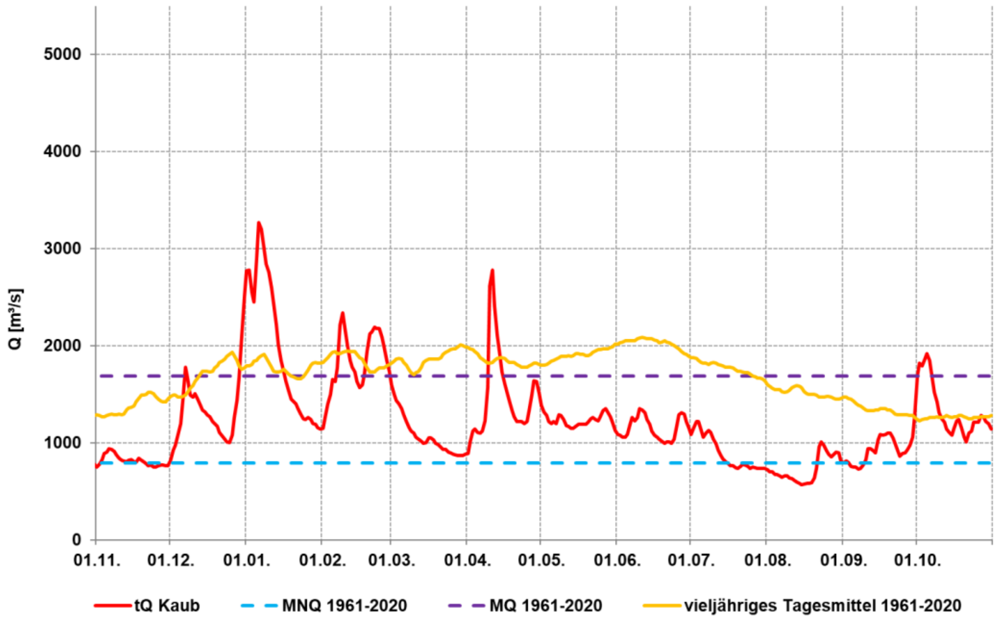


Figure 14: Daily discharges (tQ) at the Kaub Middle Rhine gauge in the hydrological year 2022 against the background of the multi-year daily average and the MNQ and MQ values for the reference period 1961 to 2020

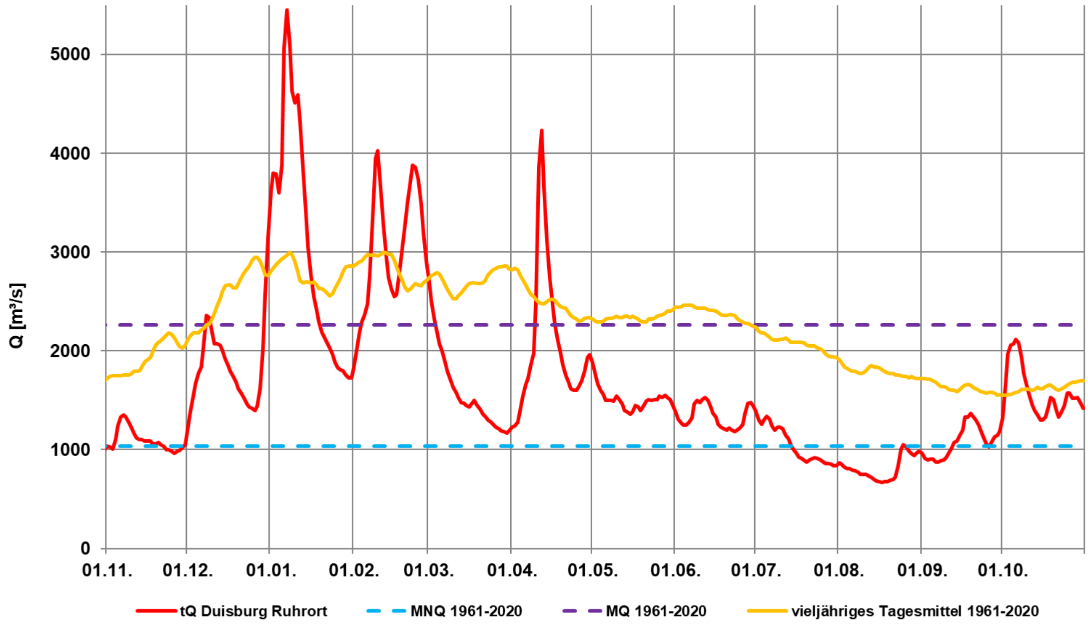


Figure 15: Daily discharges (tQ) at the Duisburg-Ruhrort Lower Rhine gauge in the hydrological year 2022 against the background of the multi-year daily averages as well as the MNQ and MQ values for the reference period 1961 to 2020

1.3.2.4 Netherlands

Source: Water Management Center, Rijkswaterstaat (RWS)

For the Rhine in the Netherlands, no status or high water reports were made in 2022. The highest measured discharge at Lobith occurred on January 8 with a daily average of 5,139 m3/s. This includes a water level of 12.81 m above sea level. The status report for the Rhine in the winter half-year starts at 13 m above sea level.

During almost the entire dry season, the Rhine had discharges below the long-term average. Discharge was even below 900 m3/s for 42 days. Once before, in 1921, this number of days was even higher. At that time, discharge was below 900 m3/s for 48 days. From mid-July to the end of August, discharge was very low. Thereafter, discharge fluctuated by 800 m3/s for weeks (the limit of the 5% lowest discharges is 1000 m3/s) with a low of 679 m3/s on 18 August. Then discharge gradually increased until the discharge was again above 1000 m3/s on 14 September. The average daily discharge of the Rhine at Lobith for the year 2022 is shown in Figure 16.

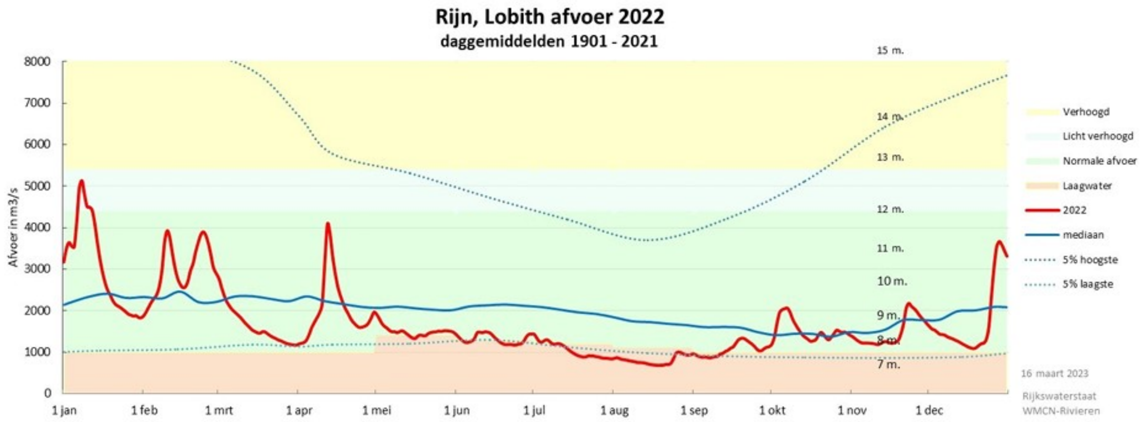


Figure 16: Hydrograph of the daily average discharge at Lobith gauge in 2022 (red curve) compared to long-term minima, maxima and averages of 1901-2021

1.3.3 Water temperatures

1.3.3.1 Austria

Source: Hydrographic Service Vorarlberg

The annual average of the water temperature of Lake Constance at the Bregenz harbour gauge was 14.1 °C, 1.9 °C above the long-term average of 12.2 °C. With few exceptions, the daily averages from the beginning of the year to the end of the year were above the daily averages of the 1976-2020 series (see Figure 17).

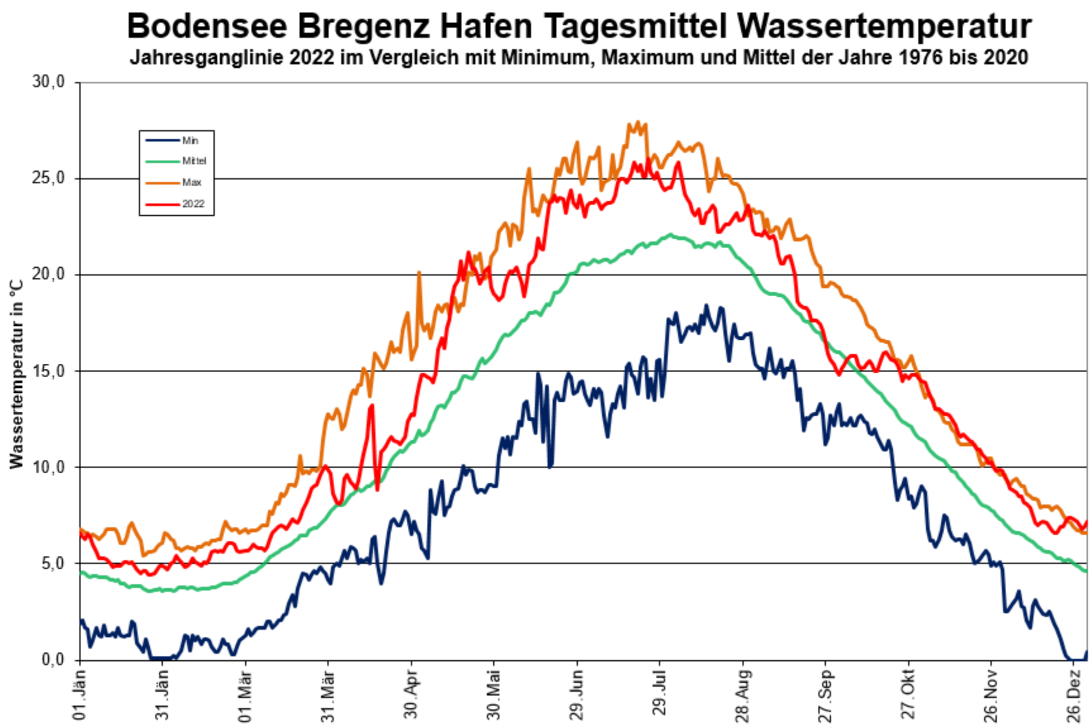


Figure 17: Graph of the water temperature of Lake Constance at the Bregenz gauge in 2022 (red curve) compared to long-term minima, maxima and mean values

1.3.3.2 Switzerland

Source: Swiss Federal Office of the Environment (BAFU)

The annual mean values of water temperature reached record highs in 2022. The mild spring, but above all the three seasonally pronounced heat periods with simultaneous low tide, had a significant impact on the progression of water temperatures. Exceeds of the previous annual average values were observed at almost one third of the FOEN stations. This is slightly less than in the last extreme year of 2018, but is now continuing the trend of temperature increase after the more balanced years (2019 to 2021). Especially in the Rhine region and in the inflow area of the Aare into the Rhine, the temperatures at virtually all stations exceeded the previous maximum values. There was no new highest annual average at the stations in the Jura Arc and in the western central Alps.

At the beginning of the first quarter of 2022, during the first days of January, water temperatures at many stations were significantly higher than the long-term measured values. Although air temperatures were exceptionally high throughout the quarter, this did not have an excessive effect on the number of exceedances of the previous maximum values of water temperatures for the months of January to April. On the other hand, in the extremely mild, low rainfall and area-wise very sunny May and especially in June, a striking rise in water temperatures was observed, which continued in the following summer months.

Especially in July and September, the long-term maximum monthly average was already exceeded at one third of the stations. The stations in the Jura Arc and in the western central Alps were again excluded from this.

In autumn, water temperatures at many stations remained above average for several months. However, there were new monthly maximum values only in the month of November at almost a quarter of the stations, especially in the Rhine region and in the inflow area of the Aare into the Rhine.

1.3.3.3 Netherlands

Source: Water Management Center, Rijkswaterstaat (RWS)

At Lobith, the average water temperature of 14.2 °C was about 1 °C higher than the calculated long-term average (1961-2020) (Figure 18).

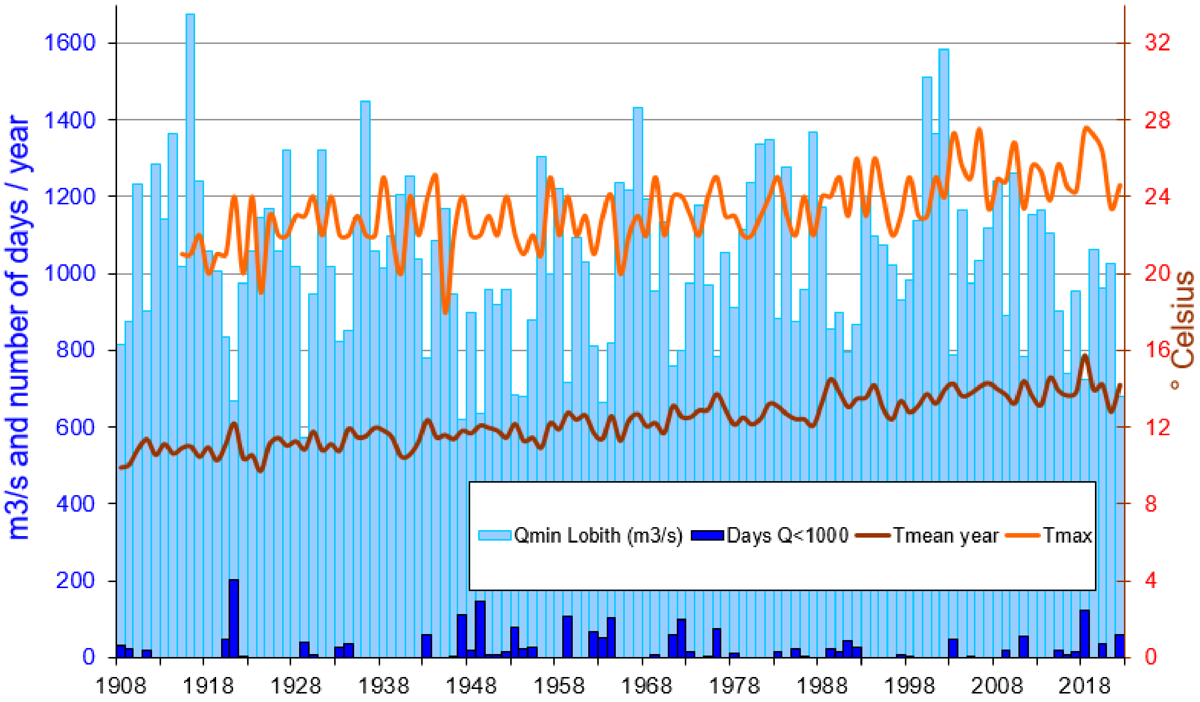


Figure 18: Average and maximum water temperatures 1908-2022 at the Lobith/Rhine gauge

1.3.4 Groundwater

1.3.4.1 Austria

Source: Hydrographic Service Vorarlberg

At the beginning of 2022, groundwater levels in the Austrian part of the Rhine region were above average. Due to the below-average precipitation from the beginning of the year to August, the groundwater levels fell until the high water on 19 August, with brief rises in the meantime due to the snowmelt. At some measuring points, the lowest groundwater levels have been reached since the beginning of the measurement. As a result of the heavy precipitation from 19 August and in September, groundwater levels rose.

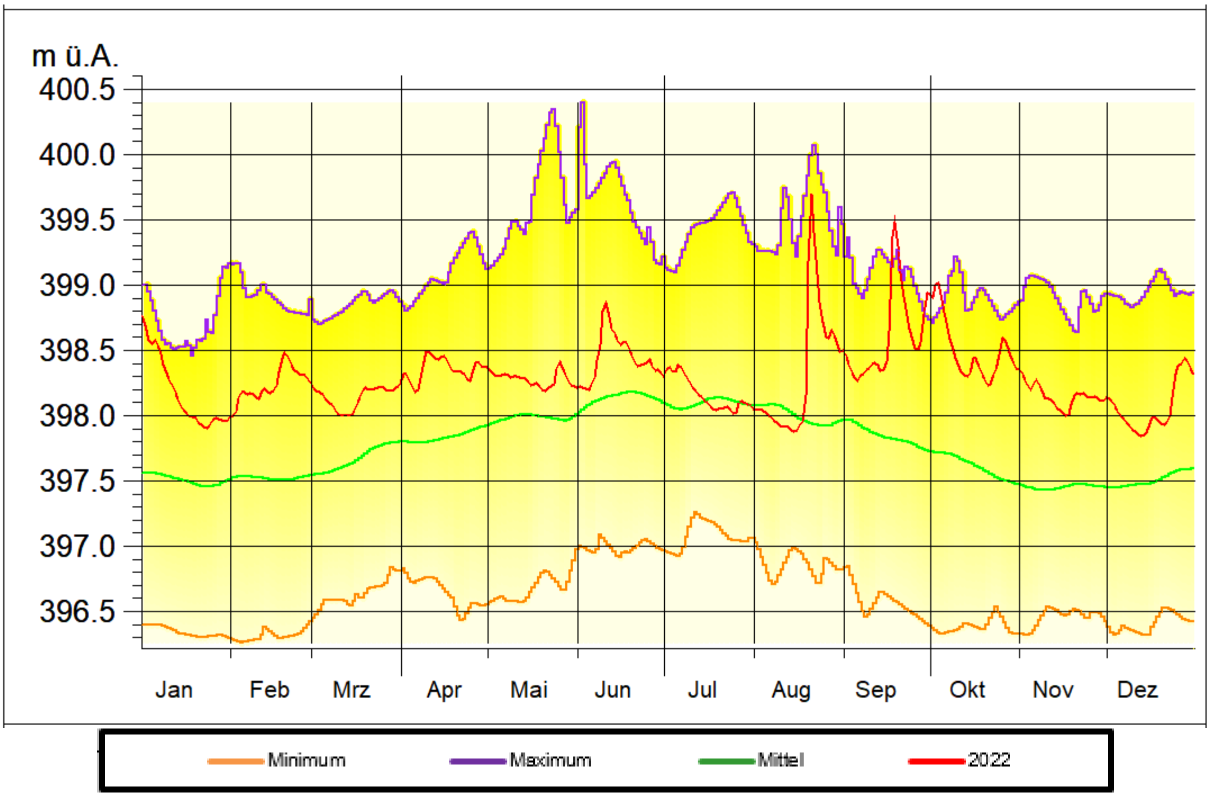


Figure 19: Hydrographs of the groundwater level in 2022 compared with long-term minima, maxima and mean values (1964 – 2021) Bregenz measuring point, folio 50.1.09 B

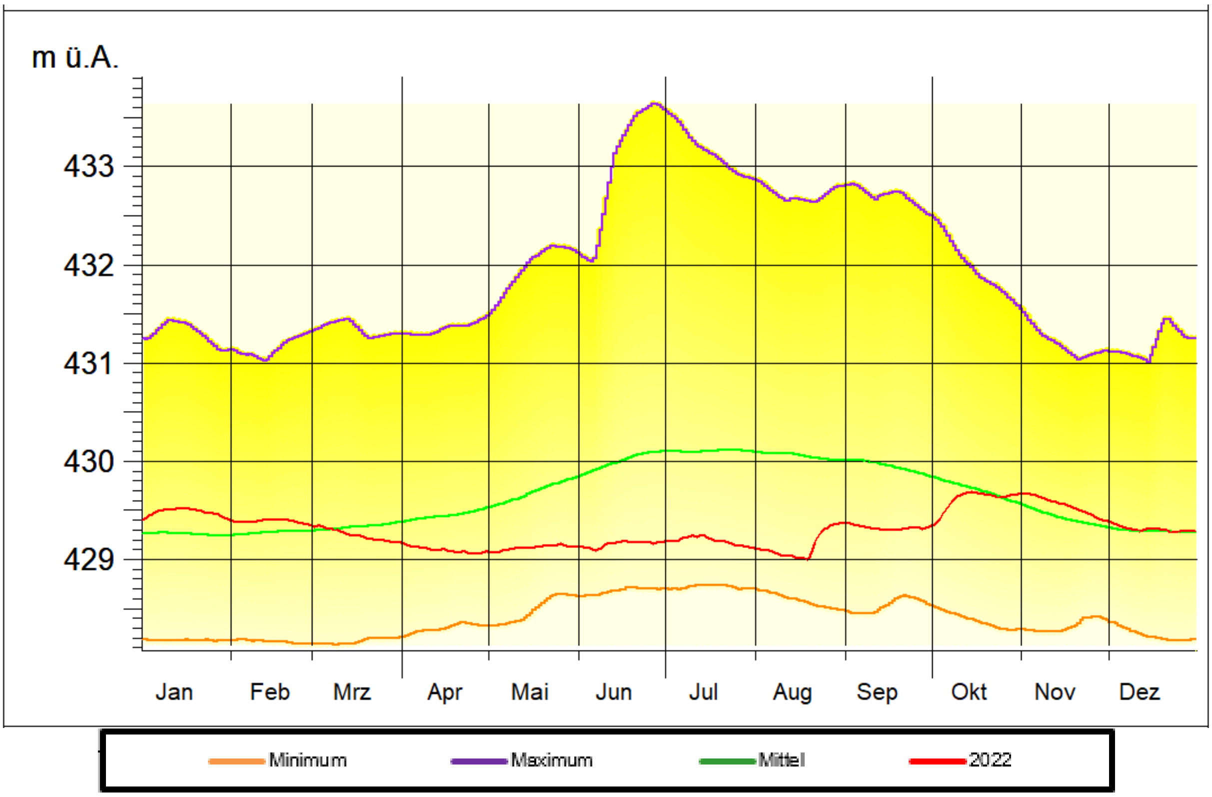


Figure 20: Hydrographs of the groundwater level in 2022 compared to long-term minima, maxima and mean values (1962 – 2021) Feldkirch-Altenstadt measuring point, folio 01.32.01 A

1.3.4.2 Switzerland

Source: Swiss Federal Office of the Environment (BAFU)

The continuous observation of groundwater level or spring runoff at about 100 measuring points as part of the NAQUA National Groundwater Observation makes it possible to map the current state and the development of the groundwater quantity at the national level compared to long-term data series. This can also indicate possible long-term effects on groundwater resources as a result of climate change, for example due to the predicted increase in extreme events such as floods and droughts.

According to the multi-year weather pattern (temperature and precipitation), longer periods with rather low or rather high quantitative states of groundwater conditions can often be seen in the groundwater of Switzerland. In this respect, 2022 is in a period with high groundwater levels and spring runoff compared to many years ago.

While December 2021 still had above-average rainfall on the northern side of the Alps, January 2022 had low rainfall throughout the country. Thus, at the beginning of February, normal groundwater levels and spring runoff with inconsistent tendencies were recorded. In the course of the overall below-average rainfall from January to May, low groundwater levels and spring runoff were observed at around every second measuring point at the beginning of June. Precipitation in September caused groundwater levels and spring runoff, especially from near-surface groundwater resources, to rise. Thus, in mid-October, normal groundwater levels and spring runoff with inconsistent tendencies were widely observed. While below-average rainfall fell in November, December began erratically. Thus, in December, normal groundwater levels and spring runoff with inconsistent tendencies were present.

1.3.5 Suspended Solids

1.3.5.1 Austria

Source: Hydrographic Service Vorarlberg

The annual load of suspended solids on the Alpine Rhine at the Lustenau measuring point in 2022 was around 0.95 million tonnes, well below the average for the 2010-2020 year series (around 2.3 million tonnes). The highest monthly load was determined for May at approx. 0.294 million tonnes. This corresponds to approximately 31% of the total annual load.

The largest day load was for the 24. May with a load of 115,130 tonnes (approx. 12% of the annual load) (see Figure 21).

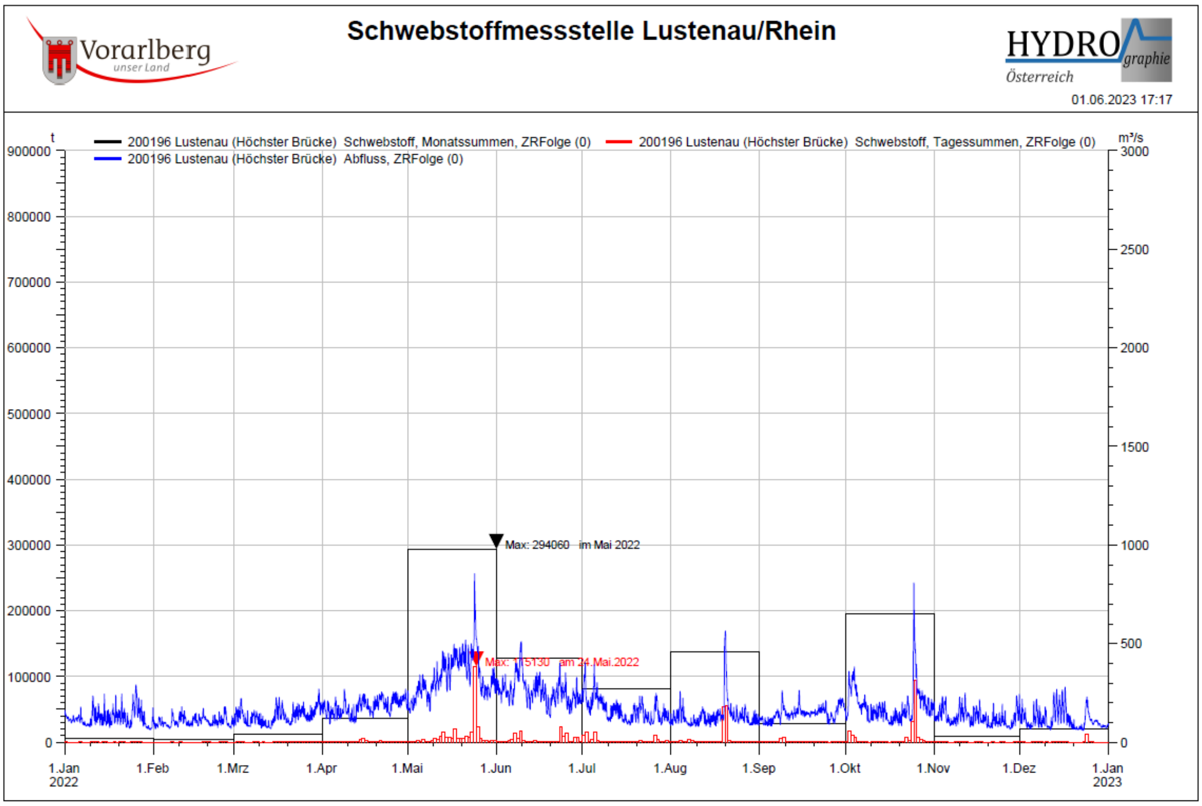


Figure 21: Monthly suspended solids loads of the Alpine Rhine at the Lustenau gauge in 2022 with day loads (red curve) and discharge hydrograph (blue curve).

2. Activities of the International Commission for the Hydrology of the Rhine Basin (CHR) in 2022

CHR meetings
Two official CHR plenary meetings took place in 2022. The spring meeting (No. 89) was held online on 17 and 18 March due to COVID-19 restrictions. The autumn meeting (No. 90) took place on 3 and 4 November in Antony-Paris (France).

Personnel changes within the CHR
The spring meeting was the last CHR meeting for Mr Gerhard Brahmer who is retiring. He will be replaced by Mr Sebastian Wrede, as well as from HLNUG (The Hessian Agency for Nature Conservation, Environment and Geology).
From mid-2022, Mr Johannes Cullmann of the WMO will take up another post. Ms Sulagna Mishra will henceforth represent the WMO within the CHR.

Ongoing activities in CHR projects

ASG-Rhein 2 (ASG2): Contribution of snow and glacier melt to the Rhine runoff
The second phase of the ASG project (ASG2) started in 2018. In ASG1, snow and glacier melt has been studied over the past 100 years. In ASG2, the focus is on how snow and glacier melt will develop over the next 100 years and how this will relate to the Rhine runoff. The final synthesis (final) report of ASG2 was published in spring 2022. Key findings from the report include:

- This project quantified daily proportions of drainage components for a future climate scenario in all tributaries and along the main stream.
- Driven hydrological model simulations show that the rain component will dominate the seasonal runoff fluctuations more strongly in the future than in the past.
- Snow melts earlier in winter and spring, resulting in lower seasonal water retention in the snowpack.
- The melting of the glaciers will continue and despite different retreat speeds of individual glaciers, the ice melting component in the main stream of the Rhine is projected to rapidly decrease and almost disappear by the end of the century.
- Overall, according to the simulations, the runoff variability and low water extremes will increase.

From the CHR's point of view, these new findings confirm the importance of a climate-resilient further adapt water management in the Rhine catchment. To conclude the ASG2 project, CHR organised a symposium in June 2022 in Olten (Switzerland) entitled: "*The River Rhine in a future climate: Changes from headwaters to lowlands*". Representatives from universities, governments and other organisations followed the presentation of the results with great interest. All scientists involved and CHR representatives hope that this study will contribute to a (more careful) use of water resources in the future.

Figure 22: Participants CHRs ASG2 symposium June 2022 in Olten Switzerland

Socio-economic Scenario's (SES) and influences on the low-water regime of the Rhine

Within the SES project, interviews within the CHR community (with representatives from the Rhine countries and commissions) took place in late 2021 and early 2022. These interviews centred on follow-up steps and ideas within the SES project. After all, the previous year had seen the development of a Rhine model (RIBASIM) that allows insights into effects of water use on Rhine discharge. Now it was necessary to define how to proceed concerns data collection and use of the model. The interviews show that it is difficult to obtain valid data regarding water use, for example from the agriculture sector. It also revealed the need to develop narratives and what if scenarios regarding water use in the catchment area.

In autumn 2022, prior to the CHR autumn meeting in Antony-Paris, CHR organised a small SES workshop. Here, a number of work packages were defined for follow-up such as 1. surveying national SES studies, 2. defining what-if scenarios and 3. organising comprehensive workshops with water use sectors.

As part of the SES project, Deltares started an inventory of impacts of cooling water consumption by power plants within the Rhine Basin in late 2022. These insights will contribute to the overall picture of water users within the basin and will provide input to the RIBASIM model.

Sediment

Early 2022, the BOKU University (Vienna, Austria) and Blueland (Dutch consultancy) finished their work on the CHR sediment project. This project consisted of an inventory for sediment regarding knowledge, activities, research and monitoring at catchment level. Therefore 22 interviews were conducted with experts from Switzerland, Austria, France, Germany, Luxembourg and the Netherlands. This has resulted in a state-of-the-art report which was published in spring 2022 and has been officially offered to the Rhine commissions ICPR and CCNR.

Possible follow-up actions identified in the state-of-the-art report include among others a. the effects of climate change on the sediment budget and b. updating the sediment balance and trends as well as sediment transport process. In coordination with our key stakeholders like the ICPR and CCNR, the CHR hopes to continue working on this. In this way, we hope to create an up-to-date knowledge base about sediment(balance) which is essential to establish a sediment management plan which is mentioned in the work programme 2040 of the ICPR.

Hydrological Memory of the Rhine

In the autumn meeting 2018, the CHR expressed its interest in a project in which historical data are collected and made available. It was decided to conduct a preliminary study first. To this end, a cooperation contract was signed in April 2022 between the BfG and the University of Bonn (Prof. Herget). Within this contract, progress was made in 2022 on data studies on the Rhine and Main, as well as a literature study on historical low-water events. In addition, research has taken place on documentation and measurements of some flood events using historical flood stones.

Furthermore, a multi-year plan (2022-2028) was shared during the CHR autumn plenary meeting 2022 in Antony-Paris. In it, ideas were shared for a thematic workshop in autumn 2023 and possible participation of CHR members in further actions.

CHR Information System

After the first joint ideas were inventoried within the CHR community in 2021, an online workshop led by German consult Mundialis was organised in early 2022. Within this workshop, the CHR steering committee expressed further focus and direction. Following this, the CHR commissioned Mundialis to develop first concept and prototype of the CHR information system. Initial results were presented at the CHR autumn plenary meeting 2022 in Antony-Paris. The prototype includes a first set of (historical) map material including a set of time series of a number of measurement sites along the Rhine. This first prototype was well received within the CHR and it was agreed to take the next steps towards the next user version of the CHR information system in 2023.

Stars4Water

The 4-year Stars4Water project was launched at the end of 2022. Funded by the European Horizon Framework Programme, this collaborative project aims to increase understanding of the impacts of climate change on water availability and vulnerability to ecosystems, society and the economy at river basin scale. Within the project, a consortium led by Deltares is working together within 7 different river basins in Europe to develop, among other things, models, information systems and data sets. Several CHR organisations are active in the consortium. The project may also provide an opportunity to support certain CHR projects such as the SES project where work can be done to improve the RIBASIM model or work out social economic scenarios. As of 2022, the CHR has as well designated a member to participate in the advisory board of the Stars4Water project.

Strategic Orientation of the CHR

Also in 2022, CHR operates in line with its strategy set for the period 2020-2030.

Public Relations

The new CHR website (www.chr-khr.org) was published at the beginning of April 2021. In 2022, some more improving updates were made and new content was posted on the website. Also, the secure part for CHR members (to share meeting documents) is still in use.

Publications of the CHR

The CHR has published the Hydrological Annual Report 2021 for the Rhine region in two languages. And as mentioned above, CHR published the final report of the ASG2 project in summer 2022.