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

Annual Report of the CHR 2008

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International Commission for the Hydrology of the Rhine Basin

The International Commission for the Hydrology of the Rhine Basin (CHR) operates within the UNESCO International Hydrological Programme (IHP) and the WMO Hydrology and Water Resources Programme (HWRP). It is a permanent, independent, international commission with the status of a trust, which is registered in the Netherlands. The following scientific and operational hydrological institutions of the Rhine Basin are members:

- Federal Ministry of Agriculture, Forestry, Environment and Water Management, Department VII/3 – Water Management (Central Hydrographic Office), Vienna, Austria,
- Agency of the Federal State Vorarlberg, Department VIId – Water Management, Bregenz, Austria,
- Federal Office for the Environment, Bern, Switzerland,
- CEMAGREF, Antony, France
- Federal Institute of Hydrology, Koblenz, Germany,
- Hessisches Landesamt für Umwelt und Geologie, Wiesbaden, Germany,
- IHP/HWRP office, Federal Institute of Hydrology, Koblenz, Germany
- Administration de la Gestion de l'Eau, Luxemburg
- Deltares, Delft, Netherlands
- Rijkswaterstaat – Centre for water Management, Lelystad, Netherlands.

1. Hydrological Overview for the Rhine Basin

Meteorological characteristics

In general, the year 2008 was considerably too warm across all regions. Only the temperatures in September were below the monthly average temperatures of the last years. In Austria, 2008 was the warmest year since the beginning of the recordings. In the Netherlands, it was the twelfth successive year that was too warm and with 0.8 K over the normal temperatures of the last years it was the ninth warmest year since 1901. In Germany and Switzerland, the yearly average temperature was above the normal temperature by 1.2 K and 1.0 K, respectively (tenth warmest year since 1901).

While there was little rain and snow in January and February, the months March and April were exceptionally wet. In the Rhine basin, 141% of the observed average precipitation of the years 1961-90 was recorded. In total, the amount of precipitation was 96% of the perennial average precipitation for the water year (Nov. 07 - Oct. 08) in the entire Rhine catchment basin. Here, 54% of the yearly total precipitation was recorded in the winter half-year. This is a considerable increase compared to the precipitation distribution observed over many years (winter 48.5%, summer 51.5%).

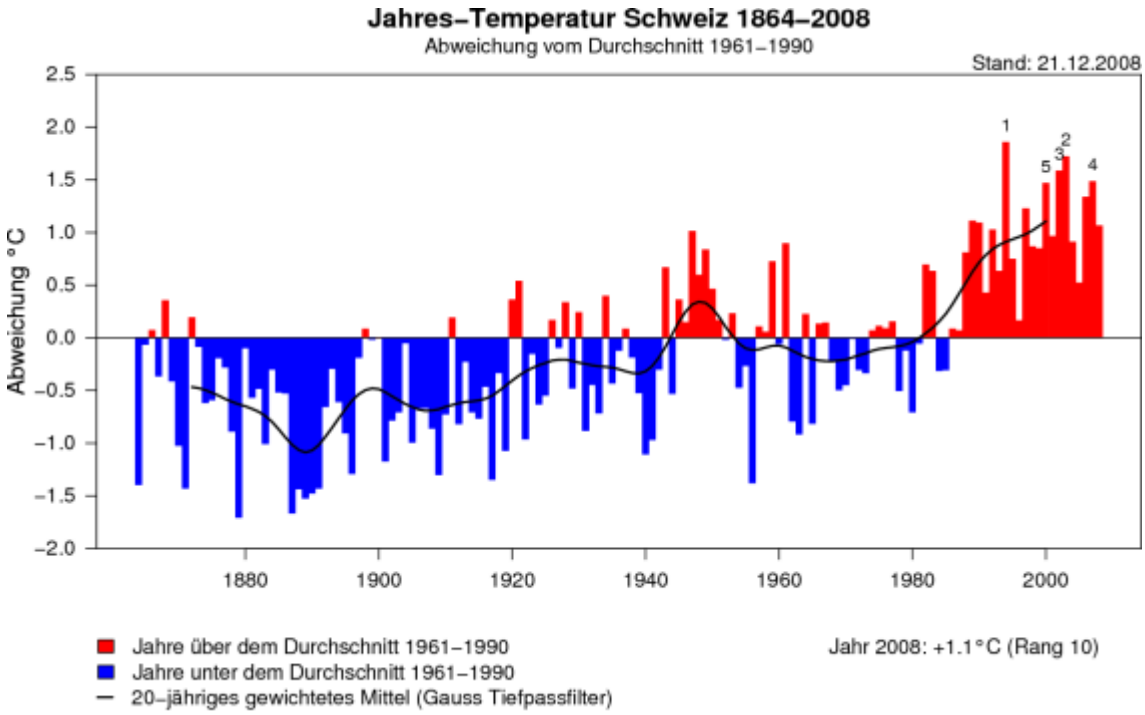

Figure 1: The yearly deviation of temperature from the perennial average in Switzerland (norm 1961-1990). The exceptionally warm years are indicated in red, the exceptionally cold years in blue. Continuous line: 20-year average value. Compared to this, the dotted line represents the 20-year average value of the land surface temperature in the northern hemisphere (reference: MeteoSwiss).

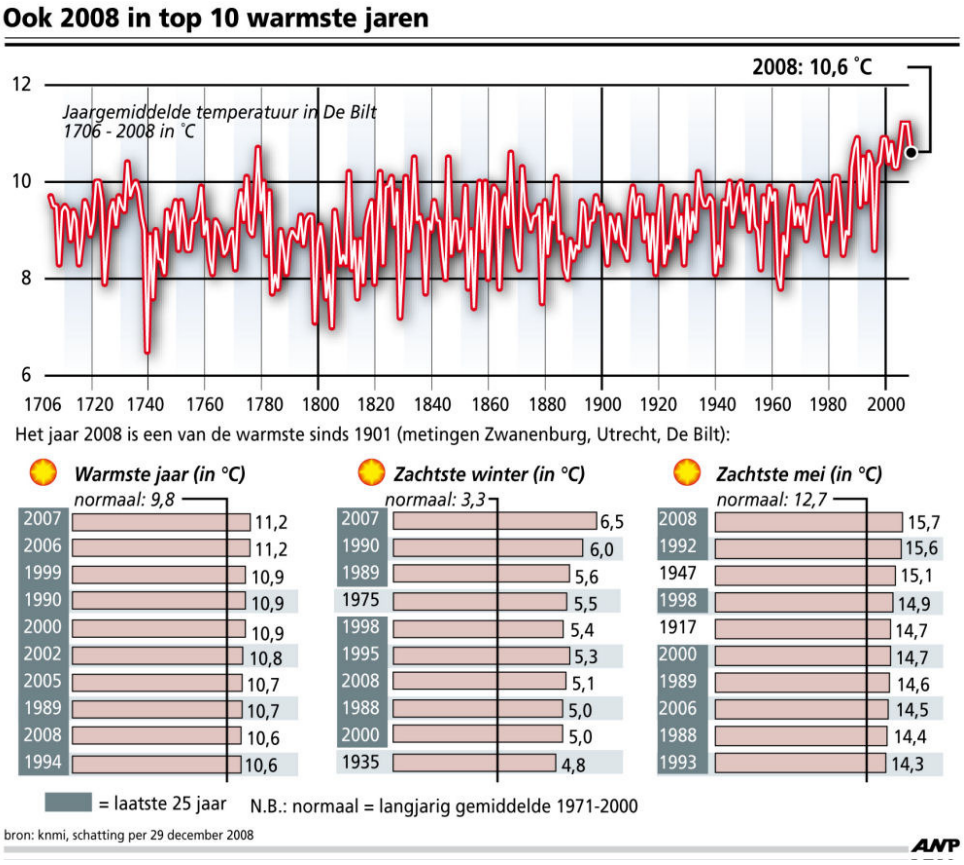

Figure 2: **Yearly average temperature values at the station De Bilt / Netherlands. In the lower area the 10 warmest years, the 10 warmest winters and the 10 warmest Mays of the last 25 years are shown (reference: KNMI).**

Hydrological situation in the Rhine basin in 2008

Water levels of the large lakes in the Rhine basin

The Lake Constance water levels were mainly below the respective daily average values of the observation sample 1864-2006 at the gauge Bregenz (see Figure 3).

In the year 2008, extreme water levels occurred only sporadically in Switzerland. The lake Lac de Neuchâtel reached a new August minimum. The similar responses of Lake Vierwaldstädtersee, Lake Walensee and Lake Constance are noticeable after a period of intense rain in the end of May, mid-July, mid-August and mid-September. After a fast rise to or above the perennial seasonal average the values decreased significantly - slightly more slowly - below the average, respectively.

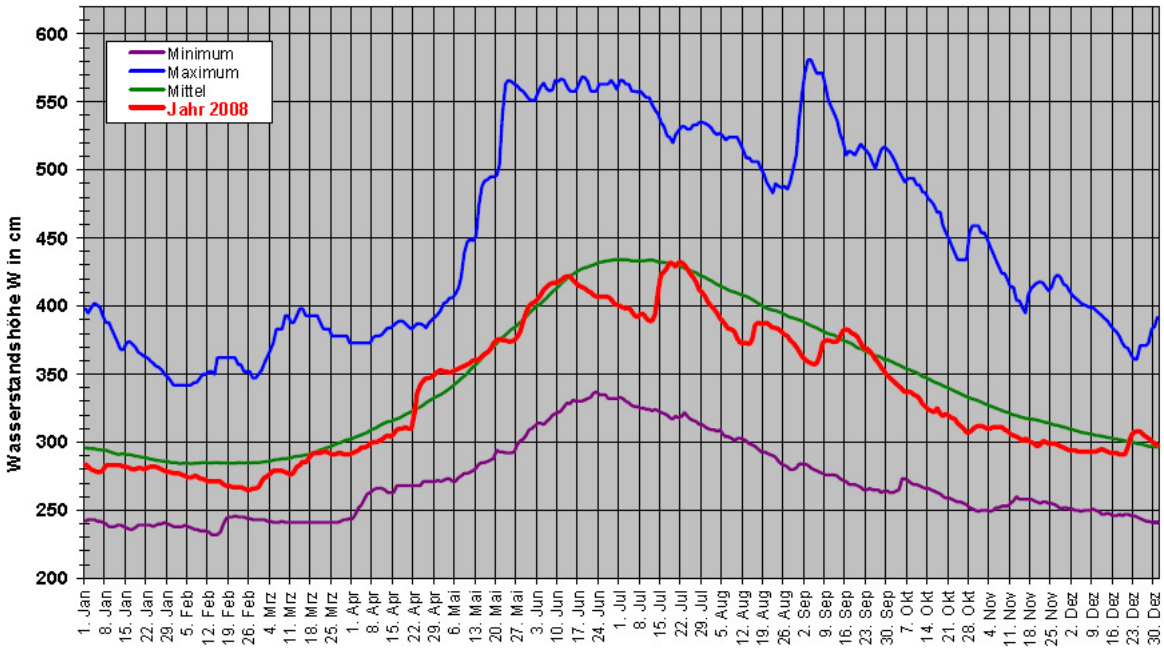

Figure 3: **Gauge station Bregenz/Lake Constance. Water level fluctuations of the year 2008 and main values of the period 1864 – 2007 (144 years) – gauge zero: 392.14 m above Adria.**

Water levels and discharges of the rivers

In 2008, the discharges of the most important Vorarlberg Feeder Rivers to Lake Constance were below the perennial average for the lower catchment areas and above the average for the higher catchment areas:

- at river Bregenzerach at 94% (MQ 2008 = 43.5 m^3/s, perennial MQ = 46.3 m^3/s);
- at river Dornbirnerach at 92% (MQ 2008 = 6.37 m^3/s, perennial MQ = 6.91 m^3/s);
- at river Rhine at 108% (MQ 2008 = 248 m^3/s, perennial MQ = 230 m^3/s).

Large parts of the Swiss Rhine basin had differing yearly precipitation with respective discharges. February was the only month which was nationwide too dry. Thus, discharges for February significantly below average can be listed for all stations in all parts of the country. Examples are river Thur near Andelfingen (55%), river Töss near Neftenbach (45%), river Glatt near Rheinsfelden (53%) or river Dünnern near Olten (36%). While the months May, July, September and November were mainly too wet at the south side of the Alps; there were only a few wet months at the north side of the Alps.

One of the wet months at the north side of the Alps was April. Long-lasting, intense rain on 22/04/08 resulted in flooded banks and the highest discharges of the year 2008 for some of the larger rivers. For example river Aare in Brugg (845 m^3/s), river Glatt in Rheinsfelden (75 m^3/s), river Töss in Neftenbach (179 m^3/s), river Thur in Andelfingen (675 m^3/s), and Rhine near Basel 3.062 m^3/s). The second largest discharge was recorded for Rhine-Basel due to high amounts of rain from 12th to 14th September in the Basel region and in the central Alps. There, the discharge of 2,800 m^3/s corresponds quite exactly to a two-year occurrence. Further two-year occurrences were also registered at the river Gürbe in Belp, river Reuss in Mellingen and river Birs in Münchenstein.

Considering the discharge hydrograph of the Rhine gauges Maxau, Kaub and Cologne, it has to be noted that the mentioned shift in precipitation distribution between winter and summer as well as the above-average temperatures were reflected in the discharge behaviour no earlier than downstream of the gauge Maxau.

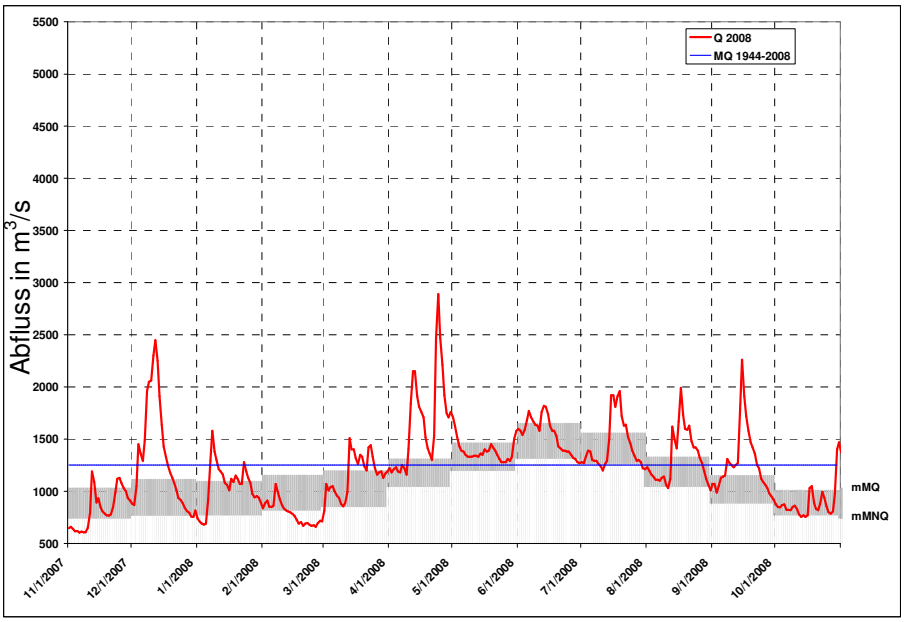

Figure 4: Discharge hydrograph (tQ) at the gauge Maxau (Rhine) in 2008 in m³/s (reference period for MQ mMQ and mMNQ: period 1944-2008)

The course of the yearly hydrograph at the gauge Maxau (Fig. 4) is mainly characterised by the nival discharge characteristics of the Alps as well as by the influences from Lake Constance and other artificial and natural reservoirs. This causes the seasonal distribution of the discharges at the gauge Maxau to be very constant. The distribution of the average values observed over many years in Maxau (MQ winter 1150 / MQ summer 1360 m³/s) was also apparent in the values calculated in the year 2008 (MQ winter 1140, MQ summer 1310 m³/s). The monthly MNQ determined over many years (mMNQ) were under-run in the winter half-year at the gauge Maxau for a total of 30 days.

Further downstream, the influences of low mountains occur; the discharge regime has increasingly pluvial characteristics. Considering the half-years, there is a higher discharge in the winter season than in the summer season.

The seasonal course of the daily discharges of the Rhine in Kaub and Cologne were similar in 2008 (Fig. 5). The amount of snow accumulated in November due to the low temperatures in the low mountains melted in the first half of December in connection with higher temperatures and intense precipitation. This resulted in one single noteworthy flood water, which remained considerably under a two-yearly probability of occurrence at the Rhine and its feeders.

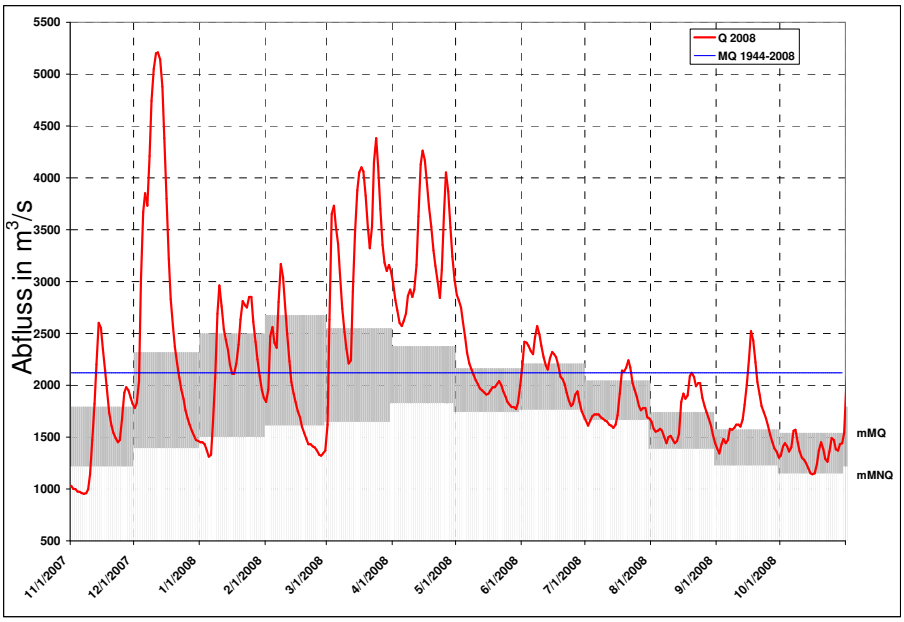

Figure 5: **Discharge hydrograph (tQ) at the gauge Cologne (Rhine) in 2008 in m³/s (reference period for MQ mMQ and mMNQ: period 1944-2008)**

The further course of the winter half-year was characterised by a steady fluctuation. Especially the months March and April were characterised by a constant overrun of the perennial winter half-year averages due to intense precipitation above average. In the further course of the summer half-year the daily discharges increased steadily only interrupted by occasional and short swellings. The discharge values fluctuated between the average values determined over many years (mMQ) and (mMNQ) below the gauge Maxau and at the feeder rivers. The monthly MNQ determined over many years (mMNQ) were under-run on a total of 40 days at the gauges Kaub and Cologne during the year.

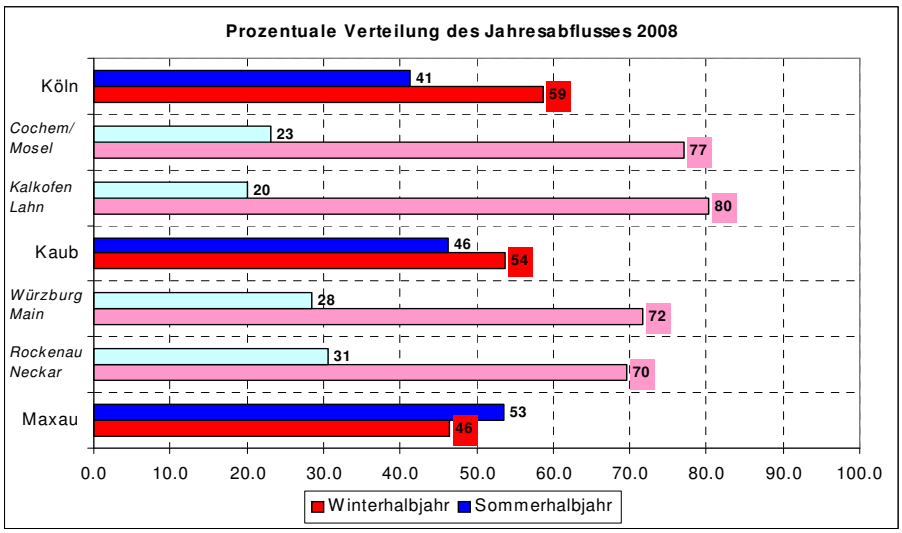

Figure 6: Percentage distribution of the yearly discharge related to winter and summer half-year

Considering the percentage distribution of the discharge related to half-years, it has to be noted that the affect of the pluvially influenced feeder rivers with their over-proportionally higher winter discharge becomes more noticeable downstream of Maxau (Fig. 6). On average, the proportions of the discharge in the winter season in the year 2008 were approximately 75% of the total yearly discharge for these rivers.

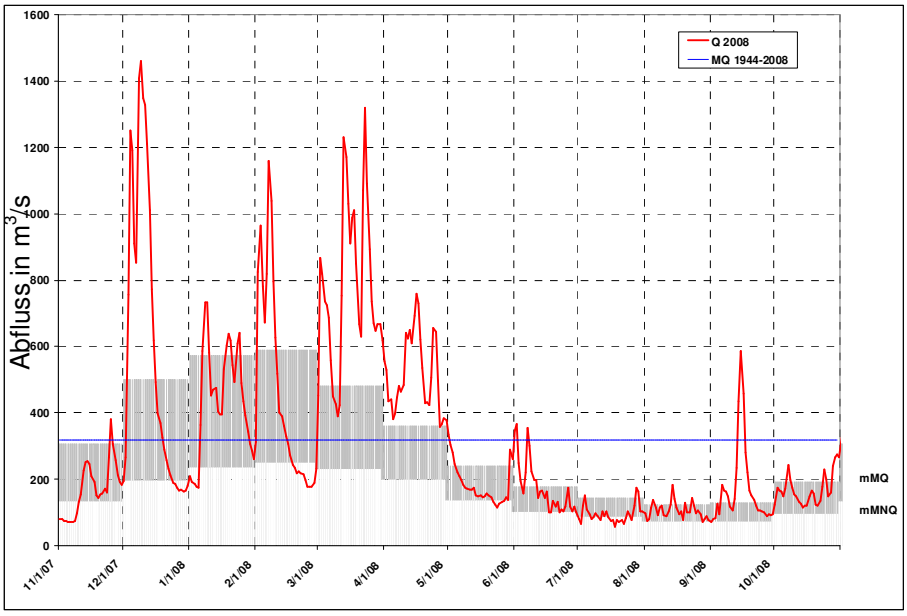

Figure 7: **Discharge hydrograph (tQ) at the gauge Cochem (Mosel) in 2008 in m³/s (reference period for MQ mMQ and mMNQ: period 1944-2008)**

In comparison to the perennial average values, backwaters downstream of Maxau has a 6% higher discharge in the winter half-year 2008. This reference value was ca. 1% in Maxau and 3% in Kaub and Cologne, respectively, at the Rhine gauges.

The yearly flow at the gauge Cochem/Moselle is shown in Fig. 7 to represent the course of the inflows.

Water temperatures

The yearly average water temperature of Lake Constance was 12.1° C and thus, significantly over the perennial average value of 10.4 °C (Fig. 8). However, the value of the previous year of 13.2°C was under-run by 1°C. In April and from mid-September to mid-October, the water temperature was below the perennial average value for the duration of one month, respectively. In the remaining year, the water temperature was mostly above average.

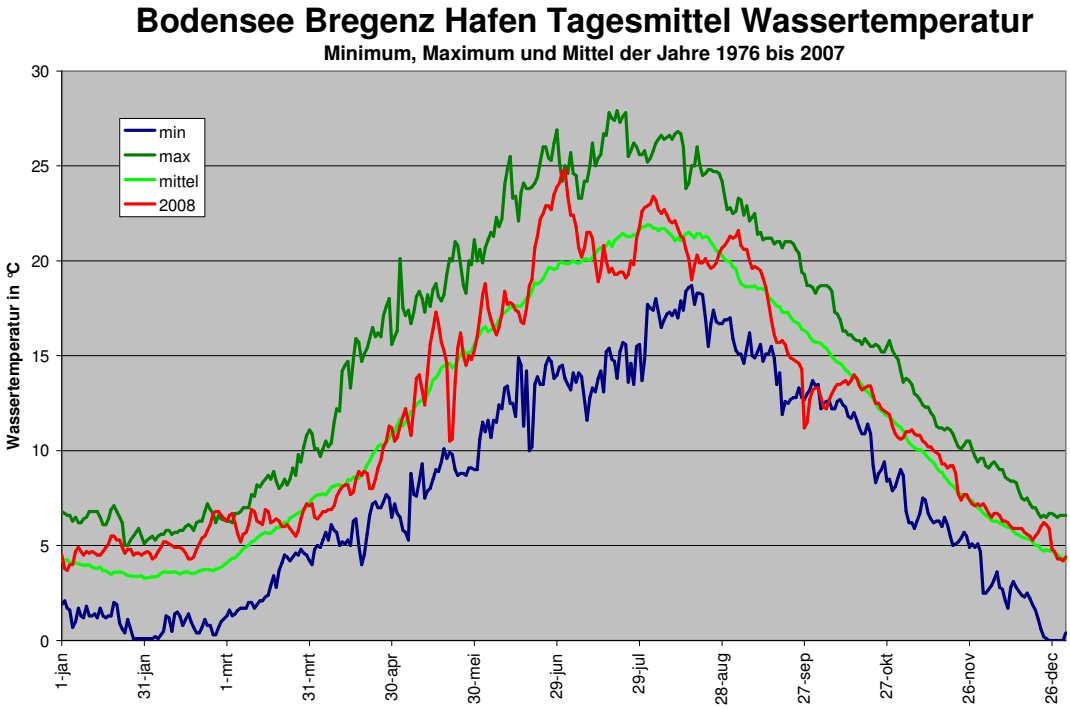

Figure 8: **Water temperatures 2008 of Lake Constance at the gauge Bregenz compared over many years**

In Switzerland, the yearly average water temperatures were within the values of the last 10 years in 2008 (Fig. 9). It has to be noticed, that new maximum values were detected at several stations at the end of February. Due to the dry weather, low discharge values were detected on these days, as well. On the lines of the air temperatures, the water temperatures were above average in the second half of May and during end of June / beginning of July but without exceeding the record values. The wet and cold weather during the summer is reflected by the average temperatures of the months June to August, which were mainly below the average compared to the perennial data.

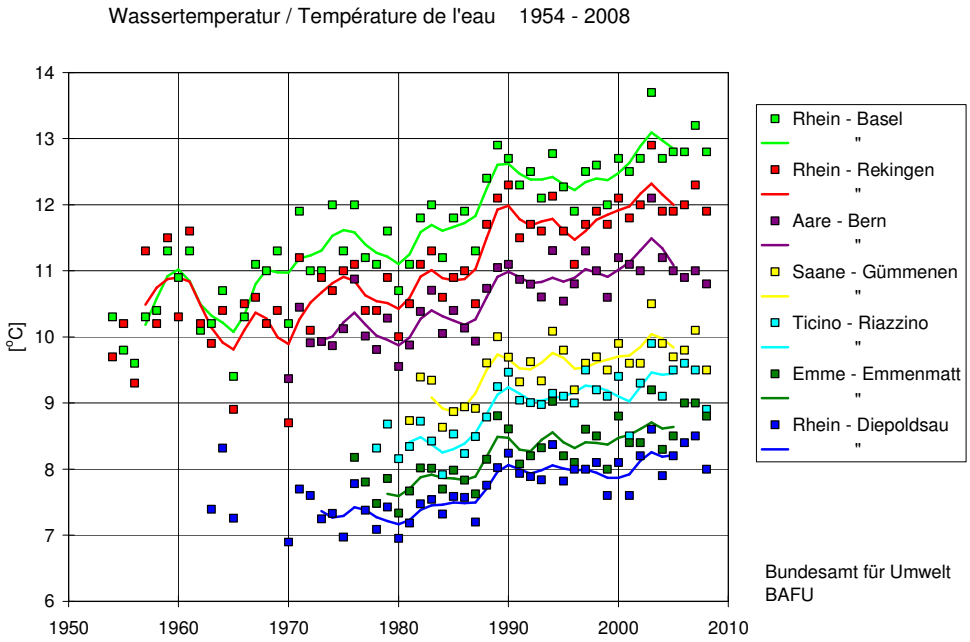

Figure 9: **Water temperatures 2008 at selected Swiss gauges compared over many years**

At the gauge Lobith/Rhine, the average water temperature of the year 2008 was one of the highest since 1900 (see Fig. 10). The yearly average temperature as well as the maximum value of the year 2008 complies with the trend of past years.

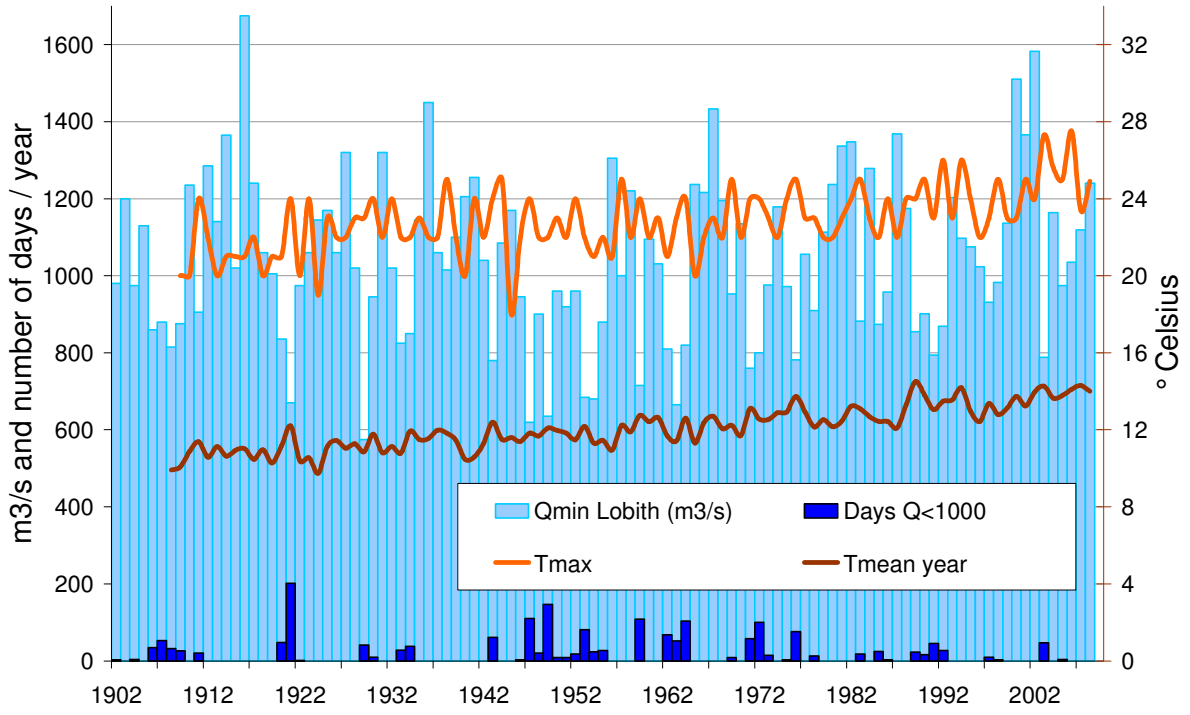

Figure 10: **Average and maximum water temperatures at the gauge Lobith**

Ground water

In the year 2008, the ground water levels and deliveries were around average in Switzerland due to the normal average total precipitation. The very wet April 2008 resulted in locally high ground water levels.

Course and characteristics of suspended load concentrations in Switzerland in the year 2008

In the year 2008, the median of the suspended load concentration was equal or lower than the value of the last decade. Only the station Rhein Diepoldsau exhibited a higher value. The estimated yearly amounts at the stations Rhein-Diepoldsau, Kleine Emme-Littau, Linth-Mollis and Maggia-Locarno are higher than the average amounts of the last ten years. New maximum values were registered in Diepoldsau, Mollis and Locarno (recordings in Locarno began in 2004). The estimated yearly amounts at other stations are smaller or close to the average amounts. A new minimum was recorded for the station Thur-Halden and Aare-Hagneck (recordings in Hagneck began in 2004). The yearly amounts in Halden were about one fifth of the average amounts of the last 10 years, the amounts in Hagneck were about 60% of the average of the last 5 years.

2. Activities of the International Commission for the Hydrology of the Rhine Basin (CHR) in 2008

The CHR had two meetings in the year 2008, on 18th and 19th March in Vienna (Austria) and on 1st and 2nd October in Einsiedeln (Switzerland).

Changes within the CHR

The Dutch representative of the CHR, Mr Frans Claessen left the CHR in March 2008. He was replaced by Mr Gerard Blom as new member. Mr Blom is head of the department 'Knowledge-Infrastructure' at the Centre for Water Management. The task of this department is the organisation of the cooperation between Rijkswaterstaat and the technological institutions in the Netherlands.

During the spring meeting of the CHR in March 2008, the French research institute Cemagref was present for the first time. Cemagref was represented by Mr Vazken Andréassian.

The president of the CHR, Mr Manfred Spreafico, retired from his post in the end of May 2008. He will be working at the University of Bern from June 2008. He will be concerned with international affairs in his new position. It was agreed that Mr Spreafico takes the presidency of the CHR to the University of Bern. Mr Hanspeter Hodel represents the Federal Office for the Environment since.

The Dutch research institute Deltares (formerly WL | Delft Hydraulics) joined the CHR as member in October 2008. Deltares is represented in the CHR by Mr Erik Ruijgh.

The Swiss EAWAG representative Mr Ueli Bundi left the CHR in October 2008. Mr Bundi retires.

Activities in the CHR projects

Changes in the flow regime

The final report of this project was published in January 2008 under number I-22 in the CHR series. The report can be ordered and downloaded in pdf-format on the CHR website (http://www.chr-khr.org/en/publications). An 'Extended Summary' was completed by the German science journalist Mr Sauer and was translated into English. A proposal for a leaflet was discussed. This leaflet will be released in 2010.

An article on the CHR project was published in the Neue Züricher Zeitung. Further publications in specialist journals are in preparation.

RheinBlick2050

The objective of this project is the preparation of balanced climate and flow projections for the international Rhine basin based on existing regional climate scenarios. The project was launched in January 2008. Participants are FOEN (CH), BfG, DWD (D), CRP-GL (Lux), Cemagref (F), RWS, Deltares, KNMI (NL). The duration of the project is two years.

The Minister Conference of the Rhine riparian states assigned the IKSR in October 2007 to prepare balanced climate scenarios for the Rhine basin. In the course of this, IKSR formed a project group, whose mission is almost identical with the project description of RheinBlick2050. The RheinBlick2050 project leader, Mr Klaus Görgen, and a number of

members of the project group represent the RheinBlick2050 project in the IKSR project group. The project group had meetings in January, May, September and December 2008.

An important part of the project is the creation of a hydrometeorological database with which the hydrological models can be driven. The BfG assigned the Deutscher Wetterdienst (German meteorological service) to compile meteorological date (data) of the Rhine basis based grids. This project named HYRAS commenced in 2008.

HYMOG

This project was prepared in 2008. Phase 1 of the project pursues the creation of a consistent hydrological database for the river Rhine from Lake Constance to Lobith. The assignment of this phase was started in 2008. This phase will commence in autumn 2009. It will last 1.5 years and will result in a data foundation that is suitable for various applications. The first phase of the project is managed by BfG (Mr Belz). An expert group with representatives from the Netherlands, BfG, FOEN, relevant German federal states and the Waterways- and Shipping Administration was formed.

The second phase of the project concerns the improvement of hydrological and hydraulic models with help of the database created in phase 1.

Rhine Alarm Model

An adaptation of the Rhine Alarm Model assigned by the Amsterdam Waternet was completed and a version of the model was sent to the users.

Sediment

The ISI Case Study Rhine with contributions from Switzerland, Germany and the Netherlands was completed. The report will be published mid-2009 in the green series of the CHR.

Publications and public relations

Events 2008

CHR workshop "Erosion, Transport and Deposition of Sediments", 28th to 30th April 2008 in Bern.
From 28th to 30th of April, the CHR hosted a workshop on erosion, transport and deposition of sediments in cooperation with UNESCO, FOEN and the University of Bern to bring together experts in the specialist field of sediment transportation. The core topics of the workshop were sediment management in the Rhine catchment basin and global exchange of experiences concerning sediment transport and sedimentation. The workshop was supported by the Hydrological Commission of Switzerland and the national IHP offices in the Netherlands, Germany and Switzerland. The final report is in English and German and can be accessed on the CHR website for download (http://www.chr-khr.org/en/workshop-erosion-transport-and-deposition-sediments-april-2008).