

Let it flow



50 YEARS CHR

*The people, the results,
the users, the future*

Let it flow

50 years CHR



CONTENTS

Hydro ... what matters?	4
The people	6
The results	15
The users	27
The future	33



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THE PEOPLE

THE RESULTS

THE USERS

THE FUTURE

Foreword

Only by working together we can improve river management.

The International Commission for the Hydrology of the Rhine Basin (CHR) was founded 50 years ago. In 1970, the riparian states brought together a group of scientists in order to understand the Rhine better, from source to sea. This resulted in unique products, such as the Monograph of the Rhine basin and the Rhine Alarm Model. At that time, joint knowledge development at the level of the Rhine river basin was a new concept.

The work produced by CHR has always been at the cutting edge of societal demands. I am proud that the Commission always succeeds in looking far ahead: which issues will the Rhine riparian countries have to deal with in the future and what knowledge is needed for this? Climate change is a major issue for the next 50 years and requires answers to questions such as 'how will high discharges develop?' and 'what do longer periods

of drought mean for water use?' It is important that we anticipate and look to the future: what is needed (in which direction) to support the other Rhine commissions (ICPR and CCRN) and decision-makers?

The Rhine, which in the past was often the scene of war, is now a lifeline connecting countries. We realise that we can only make good use of the river together. My ambition for the future is to collaborate and work together more closely with the other Rhine commissions, but also with society, especially with youth. We will search for new, contemporary ways to talk to them about our research.

The long cooperation within the CHR has not only yielded valuable knowledge, but also valuable friendships. I wish everyone in the commission and the new generation a wonderful time being part of this close partnership.

*Helmut Habersack
President of the CHR*

Hydro ... what matters?

GETTING TO KNOW THE RHINE TOGETHER

The Rhine and its tributaries flow through nine countries: Italy, Austria, Switzerland, Liechtenstein, France, Germany, Luxembourg, Belgium and The Netherlands. All these countries have to deal with high and low water levels, the spread of pollutants and deposits of gravel, sand and sludge. For that they need knowledge about how the river works. In 1970, six of these countries decided to deepen that knowledge together. Through their respective research institutes, they carried out collaborative research under the auspices of the International Commission for the Hydrology of the Rhine Basin (CHR).

WATER AND SEDIMENT

Water and sediment (gravel, sand, clay) are central to knowledge development in the CHR. The knowledge is intended for water management, waterway management and flood management. The studies concern, for example, predictions of water levels, the spread of pollutants, the development of the river bed and the effects of climate change and water use on river discharge. The CHR has its own research programme and sponsors research from other knowledge institutions that fit in with the goals of the CHR.



This is what the CHR does:

- investigate together (within the CHR and with the other international Rhine commissions);
- exchange information (measurement data, predictions, methods);
- develop standard procedures for measurements and analyses;
- publish results, including in their own CHR series;
- build river basin-wide information systems and models for a cross-border approach to issues.

THE REASON FOR CREATING THE CHR

Water is the most important natural resource to sustain life. In the 1960s, the international community became more aware of this fact, due to diminishing clean, fresh water resources. It was recognized that having hydrological knowledge for river catchment processes is essential for sustainable water resource management, as well as for dealing with floods and droughts.

For transboundary river basins like the Rhine, this knowledge can only be obtained with international cooperation. As a result, UNESCO recommended more intensive collaboration when it came to

river basins. This recommendation was a major incentive for founding the CHR in 1970. Since 1975, the CHR has been working within UNESCO's International Hydrological Programme framework, as well as with the Hydrology and Water Resource Programme of the World Meteorological Organization.

Recently, new issues, such as the impact of climate change and socio-economic developments on the discharge of the Rhine, have proved to be critical. The CHR has responded to these developments by adding new focus areas to its research programme.



The CHR logo shows the - strongly stylised - course of the Rhine, the committee's research objective. The French name of the commission is reflected in the river water in German: a reference to the international character of the river and the commission.

The people

PEOPLE MAKE THE CHR

The success of the CHR is the enthusiasm and energy of the people. The members of the Commission and the working groups love the Rhine and their professions. They want to share their knowledge and learn from each other. Working together in an international context is not always the quickest and the easiest way to achieve new results. But it is the only way to find common solutions for this intensively used river. That is what everyone is committed to.

THE COMMISSION

The Commission consists of representatives from governments and research institutes in Austria, Switzerland, Germany, France, Luxembourg and The Netherlands. The Commission elects a chairman every three years. The current chairman, Helmut Habersack, is from



The CHR celebrates the publication of the Monograph (The Hague 1978)

Austria. The Commission also includes observers from the International Commission for the Protection of the Rhine (ICPR), the Central Commission for Navigation of the Rhine (CCNR) and the World Meteorological Organisation. The Commission is supported by a secretariat. Lelystad (The Netherlands) is the home base.

The Commission meets twice a year and then discusses the progress of the research projects, current events and the programming of new investigations. In addition, Commission members meet regularly to discuss specific projects in depth, for example in a project or steering committee.



The organisations which are members of the CHR:

- Water Management Administration (Luxemburg)
- Deltares (The Netherlands)
- Federal Institute of Hydrology (Germany)
- Federal Ministry of Agriculture, Regions and Tourism (Austria)
- Federal Office for the Environment (Switzerland)
- Hessian Agency for Nature Conservation, Environment and Geology (Germany)
- International Center for Water Resources and Global Change (Germany)
- University Gustav Eiffel (France)
- National Research Institute of Science and Technology for Environment and Agriculture (France)
- Office of the Federal State of Vorarlberg Water Management Division (Austria)
- Rijkswaterstaat - Water, Traffic and Environment (The Netherlands)





THE RESEARCHERS

Ten organisations are associated with the CHR. A working group is compiled for each project. If necessary, the Committee also involves universities or other knowledge institutes in order to be able to deploy the best knowledge at all times. In addition, the CHR sponsors research from other parties that are relevant to the work of the Commission.



CHR Secretariat in action (1978)

Hans Moser, former President of the CHR (2012-2018):

“Speaking about the CHR requires reflection on the Commission’s title. It refers to the Hydrology of the Rhine Basin. The efficiency and reliability of the management of water resources systems depend, to a large extent, on the quality of hydrological knowledge. The management tasks are required on a basin scale and should be answered on a basin scale as well.

Therefore, one of the core values of the CHR is that it unites all the countries in the Rhine Basin, large and small. Let us imagine for a moment that scientific information was only provided by a single country. That would make it difficult for other countries to accept it as a basis for their political decisions. If they’ve all been involved throughout the whole process, however, they know they can trust the information. “Trust” is the most important word in this context.

The CHR is a means to an end. The purpose is managing water resources in the Rhine Basin wisely and collaboratively.

To me it has been an honour to have been involved in this important work. In my position, as President, I tried to intensify cooperation with the ICPR and the CCNR. These bodies are more politically-oriented. It has always been our responsibility to provide them with a sound scientific basis. I am glad that during my time, the CHR was able to attain observer status at those other commissions, and vice versa. The past decade saw intensification on climate change research, for instance, the effect of snow and glacier melt componentson the Rhine discharge. Another topic is related to sediment budgets. I remember a symposium held in Lyon, where a detailed sediment budget was presented for the entire river basin for the very first time. Around that time we also initiated socio-economic studies – another milestone.

The CHR generates knowledge that could not have been created in any other context: we always take a broader view, across various nations. That is what makes our work unique.”



HANS MOSER

former President of the CHR
(2012 - 2018)

“Trust is
the most
important
word in this
context’



MANFRED SPREAFICO
former President of the CHR
(1990 - 2012)

*‘Many of the
CHR people
have become
close friends
over the years’*

and cooperative monitoring studies. Over the years, the CHR's focus has gradually shifted to emerging issues such as climate change. Concurrently, the challenges have shifted as well, from data collection and standardisation in the early days to the development of scientifically sound models that help us predict future changes.

Another shift I have noted is from a mostly scientific and technological focus on water quantity towards ecological and socio-economic impacts. In my view that is particularly important in the face of climate change. Whereas we focused mostly on flood protection in the past, other issues are becoming increasingly important, such as drought, intense rainfall, water quality and sediment.

Also, over the years, there has been an increasing cooperation with other organisations and commissions, including other international river commissions such as for the Danube and Mekong rivers. That is something I have pushed for personally. In our globalising world, especially in the face of climate change, it is very important that we learn from each other and share our data, knowledge and expertise.”

Manfred Spreafico, former President of the CHR:

“Working for the CHR has been an absolute pleasure. It is quite a special commission. Being focused on technical issues, and working with very dedicated scientists, the CHR operates very fast and flexibly in comparison to commissions that are more politically oriented. That is very satisfying.

I have always enjoyed the good and profound discussions that we had, whether on the selection of activities or on the implementation of the projects. Many of the CHR people have become close friends over the years, and I still see them regularly.

Another thing that has kept me enthusiastic is the relevance of the work. CHR research has proven itself to be fundamental to important issues such as the sustainable use of water resources, environmentally sound water management, and integrated flood and low-flow management. The quality of this work has always been good, in my opinion. It has led to efficient exchange of hydrological data and products, standardised procedures,



From border conflict to cooperation

In the past, cooperation along the Rhine was not always self-evident. In 1840-1841, a border dispute between France and Germany raged: the Rhine crisis. In both countries, leading poets grabbed their pen to express their own right. CHR member Vazken Andréassian was inspired by the poems *Der Deutschen Rhein* (Nikolaus Becker) and *La Marseillaise de la paix* (Alphonse de Lamartine) to create contemporary versions to express the power of cooperation.

50. Geburtstag der KHR-Gründung

Wir woll'n es nicht erleben
Das Hochwasser am Rhein!
Auch wenn das Klima wechselt
Wir müssen tapfer sein!

Solang er ruhig wallend
Das grüne Binnenschiff trägt,
Solang die Schraube schallend
In seine Wogen schlägt.

Wir woll'n ihn nicht erleben
Den ausgetrockneten Rhein!
Den Hydrologen beben:
Ohne Wasser... kein Wein!

Solang in seinem Strome
Noch Sedimente liegen,
Solang sich hohe Dome
Im Einzugsgebiet wiegen!

Wir wollen sie nicht sehen
Die Hungersteine am Rhein!
Denn: "geh'n die Steine unter
gleich wird das Leben bunter".

Solang die Flosse hebet
Ein Fisch auf seinem Grund,
Solang ein Lied noch lebet
In seiner Sängers Mund!

Wir woll'n ihn nicht erfahren
Den regulierten Bodensee!
Denn uns're Schweizer Brüder
Sie schreien "Ach" und "Weh"!

Heute feiern wir die Gründung
Der Hydrologenkommission!
"Von der Quelle bis zur Mündung"
KHR gibt's seit langem schon!

Sie arbeiten zusammen
Und kennen den Rhein? Den tiefen Rhein!
Seit über fünfzig Jahren
Kein Hydrologe bleibt allein

Den freien Hydrologen
Wünschen wir ein langes Leben:
Bis Hochflut oder Trockenheit
Uns allen ein Ende geben!

Renate Westenrieder & Vazken Andréassian, May 2020



La Marseillaise de l'hydrologie

Réponse à la CHR

Roule libre et superbe entre tes larges rives,
Rhin, Nil de l'Occident, coupe des nations !
Et des hydrologues qui mesurent tes eaux vives,
Emporte les défis et les publications !

Grâce aux hydrologues, guerriers magnifiques,
Ton débit est connu, tes excès contrôlés,
Grâce à la CHR, institution héroïque,
L'égoïsme est vaincu, la coopération assurée.

Ils ne manqueront plus dans le cristal de ton onde,
Les sédiments alpins, les galets de ton fond,
Et tes ponts à jamais uniront nos deux mondes
Ancrés sûrement, résistants pour de bon.

Si des crues se propagent, elles seront prévues,
Si des sécheresses adviennent, elles seront anticipées,
Et les navires vivants dont le moteur est l'âme
Remonteront ton cours avec leurs crinières de feu;

Roule libre et splendide et pousse nos turbines,
Fleuve du Batave, de l'Helvétie, du Gaulois, du Germain !
Spreafico et Sprokkereef, campés sur tes collines,
T'ont bu sans t'épuiser dans le creux de leur main.

Vazken Andréassian, May 2020



ERIC SPROKKEREEF

*former Secretary of
the CHR (2002 - March 2020)*

*‘We are all
working
towards
common
objectives’*

Eric Sprokkereef, former Secretary of the CHR:

“The CHR is remarkably stable which is evident by the fact that in this network of colleagues, it has hardly changed over the years. We’re actually not so much colleagues, but rather friends who work on a shared passion.

I started working for the CHR Secretariat in 1985. It was my very first job, and I never left until now. I became Secretary in 2002, and I’ve never regretted it.

In its initial years, the CHR mainly worked towards fundamental understanding of the hydrology of the Rhine river. Nowadays, its focus is more on applied research. But of course, there will always be fundamental questions to be answered. That process is never complete. And that makes the work of the CHR so interesting: the combination of fundamental and applied work. It touches upon the very basis of how the river system works, but at the same time it has clear societal relevance. We are constantly dealing with new challenges: climate change, socio-economic changes, changes in sediment and riverbed morphol-

ogy... Not to mention increasing challenges relating to data management and availability. Against that background, the Commission is always assessing the current state of its knowledge and methods. Are there any gaps in current research, and if yes, how do we fund additional research?

One challenge over the years has been the financing of our work. We have taken on an increasing amount of work, without a corresponding increase in funding. It does make us more creative: how can we combine different objectives? How can we use our data most efficiently and cooperate with partner organisations to share the work? Can we find alternative sources of funding, for instance by tapping into national research budgets? That is why it is so important that we maintain these good connections within the riparian Rhine countries. After all, we are all working towards common objectives.

I miss the work since I stopped in March 2020 – although, of course, I’ve not really left. I will keep following the developments from the sideline. And I’m sure I will stay in touch with this remarkable network of people.”



The results

‘REAL’ HYDROLOGY AND MORE...

Since the founding of the CHR in 1970, knowledge about the Rhine has gained momentum. In the early years the emphasis was on ‘real’ hydrological topics: analyses of extremely low discharges (as in 1976) and extremely high discharges (as in 1988, 1993 and 1995), predictions of water levels and the way in which pollutants spread through the water.

In the 1990s, the CHR broadened its field of research to include sediment. Ultimately, gravel, sand and silt also migrate under the influence of water currents, as do pollutants. Where sediment accumulates or erodes, this has consequences for the water levels at high and low tide. Water use in the catchment area has also recently been put on the agenda. And climate change of course: this affects all subjects and gets more and more attention.

MONOGRAPH OF THE RHINE

One of the first products was the Monograph of the Rhine: a detailed description of all the characteristics of the Rhine and its catchment area of importance for hydrology. The book ensured that all the data and research results that were available at the time were presented in an unambiguous manner. To this day, the monograph forms an important basis for all other research at the CHR.

RHINE ALARM MODEL

In a fire at the chemical company Sandoz (1986), a large quantity of severely polluted fire extinguishing fluid was washed into the Rhine near Basel. A wave of pollutants moved through the river. The damage to the ecosystem up to The Netherlands was enormous and drinking water preparation was at a standstill for a long time. In 1988, the countries in the catchment decided to immediately work on a model to alert each other to this type of calamity: the Rhine Alarm Model.

At the end of 1988 the Model was ready for use. Since then, it has been possible to calculate very quickly when the front of a pollution wave passes a certain location along the Rhine and how high the concentrations of the harmful substances are. Water managers can now respond faster and take the right measures. The Rhine Alarm Model was developed by the CHR, together with the International Commission for the Protection of the Rhine (ICPR). It has been used many times since, for example, in 2008 when a tanker ran aground near Krefeld and 1,800 tons of nitric acid threatened to leak into the Rhine.

RHEINBLICK

Climate change has been high on the agenda of water managers since the beginning of this century. The CHR issued a comprehensive report in 2010 on the impact of climate change on the discharge of the Rhine and the main tributaries.

CHR series

The CHR wants to give everyone easy access to knowledge about the Rhine. Reports on all studies are published in the CHR series, often in several languages. All reports can be downloaded for free from www.khr-chr.org. The reports on investigations, sponsored by the CHR, can also be found here.



The researchers worked closely with the International Commission for the Protection of the Rhine.

For this study, the researchers used the international state-of-the-art knowledge on climate change in 2010. They combined different data files and models to translate meteorological scenarios into hydrological effects. Downstream from Koblenz, average winter discharge is likely to increase, while summer discharge is decreasing. The extremely high discharges show a clear increase. The picture of extremely low summer discharges was less clear: in some scenarios they increased and in others they decreased. The researchers emphasised in the report that the outcomes are clouded by great uncertainties and that knowledge about climate change changes rapidly. The CHR will update Rheinblick in the coming years.





JUDITH TER MAAT

water resources and delta
management expert at Deltares
in the Netherlands

‘It’s quite a complex story: how do you prioritise?’

Judith ter Maat, water resources and delta management expert at Deltares:

“Rhine discharges and the effects of climate change have been modelled quite extensively. Less work has been done on water usage along the river. How much water is actually abstracted from the Rhine, and how will this affect its discharges, now and in the future?”

In recent years, countries have come together to work on these questions within CHR context. An integrated overview has indicated that under future scenarios, total water consumption in the Rhine river basin could increase from 50-75 m³/s to 200-250 m³/s in summer, which is quite a significant change, especially during low discharge periods.

The consumption levels of two main sectors, being agriculture and energy production, have a relatively high impact on the river’s discharge, due to the evaporation of cooling water. Households and industry also use Rhine water, but in lower quantities. In addition, lakes and reservoirs are important factors in the

redistribution of discharge over time. The operation of reservoirs might be adjusted due to the energy transition. Thus, our most recent step in combining the CHR research focuses on these three factors in more detail.

All of these issues call for international cooperation. We do see, however, that our countries are very different in their focus and priorities. Reservoirs are important in water management in Switzerland, for example; in Germany, irrigated agriculture is an important water user. So, research priorities need to be determined cooperatively and transparently.

With the growing risk of extreme low water levels, this research is becoming increasingly important. How will farmers’ needs change due to climate change, and how will food markets react? Which sectors will be hit hardest, and how can we address this? How do we prioritise water allocation during droughts, taking into account the water needs in the total Rhine basin? It’s quite a complex story, but that in itself is a motivation to keep developing new knowledge together.”

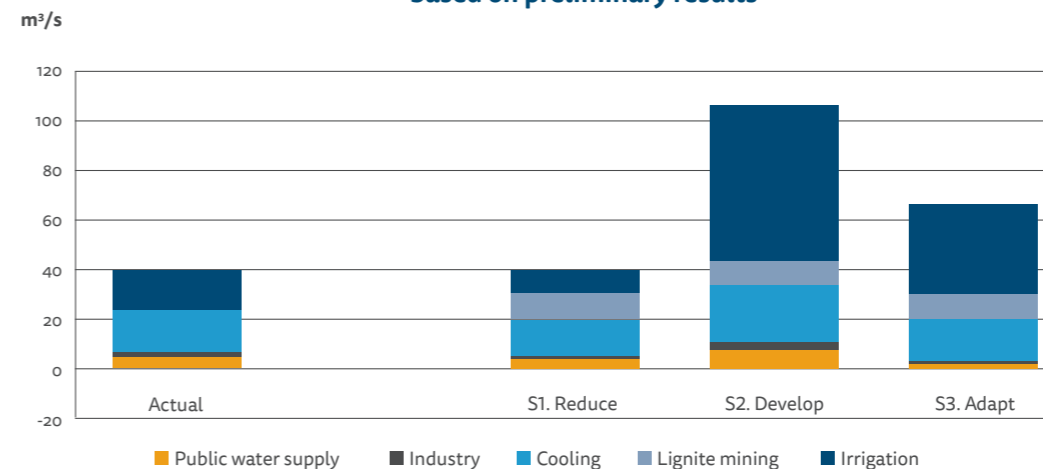
SOCIO-ECONOMIC ACTIVITIES AND WATER DISCHARGE: FIRST RESULTS

Residents and businesses in the Rhine basin use a lot of water: in households, for irrigation and for industrial production processes. Water use is partly at the expense of water discharge in the Rhine. Water consumption will change in the future due to social and economic developments and climate change.

A preliminary study came available in 2019. Researchers illustrated which activities have the greatest impact on Rhine discharge, now and in three different future scenarios. Water use by households and industries appears to have relatively little effect. The biggest impacts are power plants (cooling water) and agriculture (irrigation). In the future, quite some water will be needed to fill in lignite mines.

Due to changes in water use - especially the growing water demand for irrigation - the Rhine discharge will decrease in the future. The study indicates that the impact on low flows can be significant (up to 200 m³/s). Therefore, the CHR has started a long-term study to better estimate the water demand and the effect on Rhine discharge.

Yearly water consumption per sector under various scenarios based on preliminary results



Socio-economic developments and climate change can increase the use of water for cooling water, lignite extraction and irrigation. This is at the expense of Rhine discharge. S1, S2 and S3 represent three future scenarios.

[Source: Integrated overview effects socio-economic scenarios, 2019]

SNOW AND GLACIER RESEARCH

We all learn it at school: the Rhine is a combined rain and meltwater river. But *how much* rainwater and *how much* meltwater does the Rhine river's water consist of? That was not exactly known, and it has now become an urgent question. Thanks to the meltwater, the river always discharges a lot of water, even if it has been dry for a long time. Due to climate change, the glaciers may disappear. What does that mean for the navigability of the Rhine?

In the first phase of the Snow and Glacier Research, the CHR examined the contributions of rainwater and meltwater to the Rhine discharge in the period 1901-2006. In the second phase the changes in streamflow components of snow and glacier melt due to global warming and climate change have been estimated for the coming century.

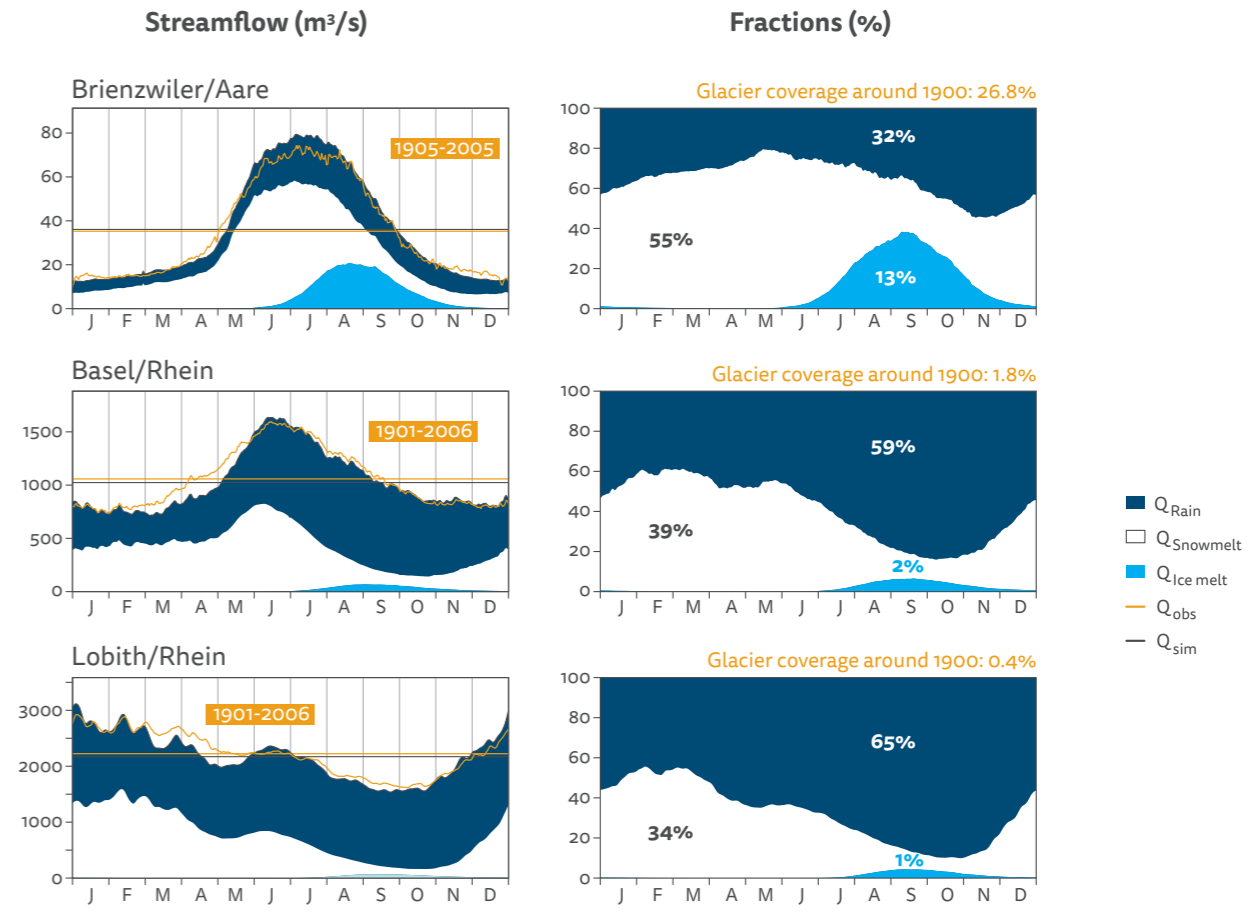
The researchers developed a model with which they could combine information about the weather, the glaciers



Rhône Glacier (September 2014)

and hydrology. The research shows that meltwater has so far been a significant proportion of low summer discharges. Even in The Netherlands, about one third of low water drainage consists of meltwater. If that component fails, it will have major consequences, for example

for water supply and shipping. In the past century, the amount of meltwater at the German-Dutch border has already decreased by 20 percent in early summer. By the end of the 21st century, low water discharges in the lower Rhine could decrease by up to 60% in summer.



The Rhine discharge consists largely of meltwater in the spring and early summer.



A consequence of long-term low river water levels in a floodplain along the Rhine. If the amount of meltwater decreases due to climate change, the water in the river will be extremely low more often and for longer periods.

CHANGES IN THE DISCHARGE REGIME

With this project (2007), the CHR investigated significant changes which have occurred in the discharge of the Rhine and its tributaries in the last one hundred years. The researchers found that the volume of water in the hydrological cycle for the entire Rhine area increased from 1901 to 2000. The flood-water extremes have, in many cases, increased, while low-water extremes tended to moderate during the century.

It was the first time that changes in discharge have been investigated in such a large river basin, over such a long period. It could be concluded that the “future is already here” in the Rhine area: climate change characteristics, predicted in the forecast models for Central Europe, have already been evident within the hydrological events of the last 100 years.

DISCHARGE MEASUREMENTS IN BORDER REGIONS

In the Rhine catchment basin - 185,000 km², spread over nine countries - drainage is measured at hundreds of locations. The measurements are the basis for the design of the hydraulic structures, (operational) water management and, above all, timely anticipation of floods and droughts.

In border regions, drainage is often measured by two or three neighbouring countries. Although each country measures as precisely as possible and uses sound measurement methods, disparities in measurement results do arise. This makes it tricky for the users of this data. For this reason, the CHR carried out a study on the measurements in border areas, in 1990. This has provided explanations for the disparities between the various measurement results, and facilitated recommendations to minimize differences.

SEDIMENT INVENTORY ON CATCHMENT SCALE: KNOWLEDGE, RESEARCH AND MONITORING

In this project (2020-2021), a coherent overview of current sediment activities in the Rhine basin has been generated (state of the art report). The aim was to identify gaps in knowledge and make appropriate recommendations for supplementary monitoring programmes and a new research programme. The overview addresses sediment-related aspects, corresponding sediment-related issues, research and knowledge developments, monitoring and management.

The information was collected through many interviews with different experts and organisations in the catchment area and through a desk study. The results of the study also form a scientific ‘building block’ for the activities in the ICPR on sediment management, an important issue in the Rhine 2040 Plan.

SEDIMENT FROM SOURCE TO RIVER MOUTH

Not only water flows through the Rhine, but also gravel, sand and clay. In some places, these sediments remain or erode. Along the way, new sediment is also added, for example from tributaries or sloping banks. In the study 'From source to river mouth', researchers have compiled sediment balances for the Rhine. A sediment balance is a kind of house-keeping book: the balance shows how much sediment enters a river stretch, how much flows out and how much net remains in the stretch. The researchers used data from the period 1991-2010.

The sediment flow is the largest in the Alpine route and mainly consists of clay. This sediment almost all settles within Lake Constance. Artificial movements of sediment, such as dredging and dumping, account for a large part of the sediment balance. The researchers discovered something remarkable: in the upstream parts of the Rhine net sediment remains, while the downstream parts lose net

sediment. In most rivers that is exactly the other way around. It is also surprising that much more sediment flows through the Rhine than was previously deduced from measurements. The results can be



Bedding sedimentary rock in the Alpine Rhine

used, among other things, to improve dredging and dumping strategies. They also show where the river intersects strongly; this can cause problems with the stability of infrastructure.

Kerstin Stahl, professor of Environmental Hydrological Systems at the University of Freiburg:

"The first phase of the CHR 'Snow and Glacier' Research Project focused on the relative contributions of rain and melt-water to the Rhine discharge from 1901 to 2006. In the second phase, which started in 2018, we aim to model those stream-flow components into the future.

Notably, we aim to upscale the effect of already known glacier changes in the Alps to the entire Rhine Basin. We have developed separate models for all glacierised headwaters. Individual glaciers behave differently, depending various local factors. Ice melt, snow melt and rainfall feed into one larger hydrological model. In the past, we were surprised to find that the ice melt components could still compensate somewhat for the lack of rain in warm and dry summers.

So far, our progress in Phase 2 has mostly been on the methodological side: how to downscale the climate scenarios, for example, to make them more locally relevant. For some catchments, we

do have some preliminary results. Our approach seems to be quite successful. Our most surprising finding? The fact that climate scenarios work out very differently on the local scale: they have a large impact on factors such as the number of days with sub-zero temperatures and the amount of precipitation. And these are exactly the factors that determine the behaviour of a glacier.

Most Alpine glaciers will disappear this century. Some as early as 2040, some more towards 2100. Will we have a hugely different Rhine then, a century from now? No, not really. When looking at the past, we found that the rainwater flow is by far the biggest component, followed by snow. The only significant impact will be during extended periods of drought, when the discharge really depends on glaciers.

For us, the added value of working in the CHR context is the accumulated knowledge that the commission represents. We have a very interested steering group that guarantees that we work with the best available data, and that our results are always critically assessed. That is really a huge advantage."



KERSTIN STAHL

professor of Environmental Hydrological Systems at the University of Freiburg

'Climate scenarios work out very differently at the scale of individual glaciers'



ROY FRINGS

Senior Advisor on River
Morphology at Rijkswaterstaat
in The Netherlands

*‘Nature still
controls the
morphodynamics
of the Rhine’*

Roy Frings, initiator of the CHR Sediment Project, currently Senior Advisor on River Morphology at Rijkswaterstaat:

“Following my PhD in The Netherlands on the sedimentology of the Rhine, I did similar research in Germany. During this time I realised that river managers tend to look at the river from a local perspective. And scientists all study bits and pieces. Wouldn't it make more sense, I thought, if we studied the sedimentology of the entire river basin? I wrote a research proposal and brought it under the umbrella of the CHR.

At the national level, knowledge is often scattered across governments, engineering firms, universities and other knowledge institutions. Through the CHR, it is much easier to obtain data and get in touch with the right people. I really enjoyed the many talks with colleagues abroad – not just during official meetings, but also when I travelled along the entire length of the Rhine, from source to mouth. The Rhine is such a beautiful river!

Two things surprised me in the outcomes of the Sediment Project. Firstly, the incredible volume of sediment transport in Switzerland. Even though the Rhine is much narrower there than it is in The Netherlands, it transports much more clay, sand and gravel in these upper regions. Most of this material is trapped by Lake Constance. It is fascinating to think about what The Netherlands would look like if all this sediment would reach our delta.

Secondly, I was surprised by the natural controls on morphology. We tend to believe that with all of our dikes, dams and dredging activities, we are controlling the river completely. In reality, however, natural factors such as tectonics and topography are still the main forces that shape the river. That is a humbling realisation.

Why it is important to gather all this knowledge? If we want to manage the river sensibly, and anticipate future changes, we need to really understand river processes and the underlying forces.”

The users

KNOWLEDGE FOR JOINT POLICY

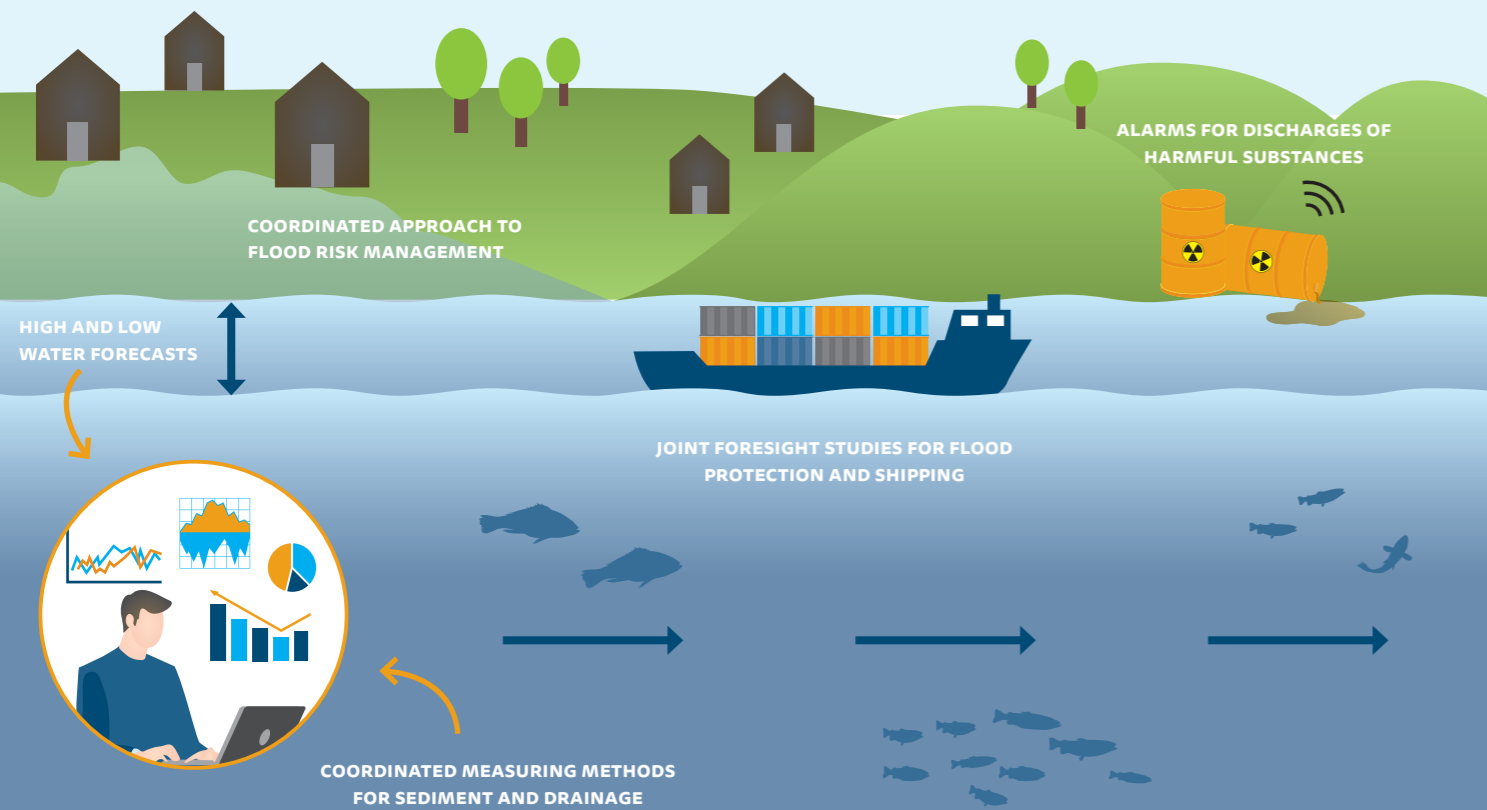
The countries in the Rhine catchment use CHR knowledge for a transboundary approach to issues in the Rhine. Important users are the International Commission for the Protection of the Rhine

(ICPR) and the Central Commission for Navigation of the Rhine (CCNR). In these Commissions, the countries make joint policies, for example for restoring river nature, improving water quality, flood protection and sufficient depth for shipping.

The individual countries in the river basin also use the results of the CHR as a basis for their national policies and management. Scientists use the results as reliable input for other studies that in turn provide new knowledge about the Rhine.



APPLICATIONS OF CHR RESEARCH: SOME EXAMPLES



Anne Schulte-Wülwer-Leidig, former Secretary of the International Commission for the Protection of the Rhine (2015-2019):

"The ICPR celebrates its 70th anniversary this year. Western European countries realised early on that the protection of river basins is very much a transnational affair. Given the mutual interdependencies, you need to coordinate your policies and measures from upstream to downstream and vice versa. There is no other possibility.

Our main challenge is combatting pollution. That was our original mandate given by the governments of the ICPR member states. In later years, fish migration and high and low discharge levels have become increasingly important issues for the ICPR, requiring transnational coordination too.

For many years we have closely cooperated with the CHR, given the considerable overlap in our work and objectives. For instance, we worked together on an Rhine Alarm Model in the late 1980s and 1990s. This model enables the prediction

of a pollutant wave in the Rhine after an accidental spill. It is still in use in all the riparian countries, and we'll update it in the coming years.

More recently, climate change has become an important overarching theme for us, since it impacts on all the issues that we work on. We worked intensively together with the CHR on the project RheinBlick 2050, which assesses climate change impacts on discharges in the Rhine river basin. And also more generally, the research projects of the CHR relating to climate change are very important to our work – for instance the glacier projects.

In my opinion, cooperation between the two Commissions has always been very smooth. We are observers to each other's meetings, which works very well, and have a large overlap in the network of experts that we consult with. I think this cooperation will get even stronger in the future, given the growing challenges that we face. We are working on a new version of our Climate Change Adaptation Strategy, for instance, which is also an incentive to strengthen our cooperation."



ANNE SCHULTE-WÜLWER-LEIDIG
former Secretary of the ICPR
(2015-2019)

'The protection of river basins is a transnational affair'



KAI KEMPMANN

Administrator at the Central
Commission for the Navigation of
the Rhine (CCNR)

‘Concerns about climate change unite us’

Kai Kempmann, Administrator at the Central Commission for the Navigation of the Rhine (CCNR):

“Founded in 1815, the CCNR focused in its initial years on the freedom and equality of navigation on the Rhine. All parties should have equal chances and rights of transporting goods on the Rhine, without any tolls or taxes. The CCNR also looked at infrastructure: to ensure that structures such as bridges and ship-mills did not pose any hindrance to inland navigation. We still do that, but today our role is much broader.

We now have for example a joint committee with the European Commission (CES-NI), which deals with standards for inland navigation in all of Europe, not just on the Rhine. We also have close cooperation with other river commissions, such as the Danube Commission, and work together to strengthen the sustainability of inland navigation.

In the cooperation with the CHR, there are two very important topics: low water levels and climate change. These factors

have a large impact on inland navigation – and to some degree on the industries that inland navigation serves. To better understand low water levels, and thus the discharge regime of the Rhine, we need the scientific reports that are produced by the CHR.

Climate change not only affects the discharge, but also the water temperature of the Rhine. In 2018, we have seen that low discharge and higher water temperatures have impact on industries and electricity production along the river. Why? Because they are dependent on Rhine water, for example on process or cooling water for their operations. And if these industries are impacted, that affects inland navigation and thus our Commission, since we also deal with the broader economic aspects of transportation on the Rhine.

So for us, the CHR reports, including the glacial meltwater reports, are of great importance. We’re also increasingly interested in riverbed changes, as we are committed to maintain a reliable waterway as key for successful operation of inland waterway transport.”





HAROLD VAN WAVEREN
Strategic Advisor Water Safety
at Rijkswaterstaat
in the Netherlands

‘High or low
water levels
don’t start at the
border’

Harold van Waveren, Strategic Advisor Water Safety at Rijkswaterstaat:

“In The Netherlands, I lead two national coordination Commissions that deal with our major rivers: one focusing on flood risk and one addressing low water levels. The former plays a crucial role in early warning in case of anticipated high water levels; the latter takes action during periods of drought and low river discharges, and when the demand for water exceeds the supply. Both those Commissions benefit from the work of the CHR. The Glacier Project is one example: the melt-water models that emanated from this project help us anticipate higher as well as lower water levels.

We also develop our own models at the national level. I don’t see that as a duplication of efforts, no. All models have inherent uncertainties, so when you collaborate with others and combine different models, at different scales, you can reduce those uncertainties. That is precisely what we do together with our colleagues in the CHR network. We exchange not just methodologies, but also raw data.

As a low-lying country, we are almost entirely dependent on our upstream partners when it comes to our riverwater levels. This in itself is a strong reason to collaborate on hydrological research. Working together in a network increases the available knowledge, but it also makes it easier to access this knowledge and exchange information and views. The advantages are clear: better knowledge and coordination allow for better water management at the national level. No doubt about that.

I believe climate change will be our main future challenge. Managing riverwater levels in a country that is partly below sea level already, and that is facing rising sea levels in the future, is a huge challenge. In addition, we have already experienced the consequences of severe periods of drought. However, we cannot solve all of our water problems nationally. High or low water levels don’t start at the border. Perhaps more than any other Rhine country, we will need ever-increasing levels of cooperation in the future.”

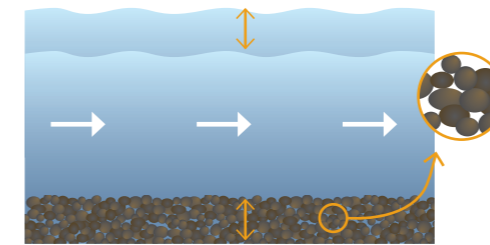
The future

STRATEGY 2020-2030

The world is changing rapidly. The countries have to deal with new issues about the Rhine, new research techniques are becoming available, and communication is changing. The CHR responds to this with the 2020-2030 Strategy. The new strategy sets three general objectives for the CHR’s research:

1. Keeping the knowledge base up to date

With the knowledge base the CHR means data and analyses that are needed for all issues, such as data on the elevation of the riverbed and bed material and statistics on discharges and water levels.



2. Responding to current issues

The CHR’s research is intended to arrive at a joint policy for the Rhine. That is why the CHR involves the international commissions for the Rhine in the selection of new investigations.



3. Actively unlocking, disseminating and discussing knowledge

The CHR investigations are freely available on the internet. The CHR will actively publicise new findings to knowledge institutions and knowledge users and organise discussions on research methods and outcomes.





Helmut Habersack, President of the CHR:

“The CHR’s fiftieth anniversary is a unique opportunity to reflect on what we have achieved over the years. We will keep the positive elements and adapt them to fit our current and future challenges. That has become our Strategy, as we go towards 2030. Our aim is to strengthen the role of the CHR. We see ourselves as a knowledge platform, the link between research and application. Through our projects, we gather and develop knowledge and pass it on to our “clients”, the decision-makers. This is why we would like to identify the ICPR and CCNR’s needs and determine which topics are currently the most pressing, and which issues will arise from climate change, for instance.

Climate change will be one of our main areas of focus in the coming years. How will it affect high and low discharges, or summer meltwater quantities, with the reduction of glaciers? Our aim is to improve our understanding of sediment transport and the morphological dynamics from the mountains to the coast. These factors are important determinants

of river navigation conditions, flood risk management and ecology.

All hydrological changes in the Rhine basin have economic implications. This is the reason for more attention being focused on socio-economic developments. The Rhine plays a key role in the transport of goods. The annual transport volumes amount to 100 million tonnes of goods. The Rhine’s water is used for drinking-water supply, agriculture, industry and energy generation. In almost all sectors, the demand for water is expected to increase, with climate change affecting all aspects of the hydrology. What will happen if extreme low flows become increasingly frequent? This issue is relevant question to society as a whole.

In my opinion, decision-makers should be able to understand the outcomes of our research without having to read the full reports and scientific papers. This calls for new communication formats, such as executive summaries with innovative layouts, or webinars that include short video clips. A central element of our new strategy is to use modern technologies to disseminate our knowledge more pro-actively.”



HELMUT HABERSACK
*President of the CHR
(since 2018)*

‘The CHR aims to be the link between research and application’

NEW RESEARCH EMPHASES

In the period 2020-2030, the CHR will focus research on the effects of climate change and socio-economic developments and on river sediment. With these studies, two important basic documents will be updated: the Monograph and Rheinblick.

Effects of climate change and socio-economic developments

The CHR deepens knowledge about the effects of climate change and socio-economic developments on hydrology. High water is and remains an important topic. Low water gets more attention because of current issues about navigability and the availability of water for households and businesses.

Update Monograph and Rheinblick

With the results of these and other studies, the CHR updates the Monograph of the Rhine: an up-to-date overview of all characteristics of the Rhine and its catchment that are relevant to the CHR study. The studies into the effects of climate change and socio-economic developments, together with the new IPCC scenarios, form the basis for an update of future expectations for the Rhine: Rheinblick 2.

Young Professionals

Young people have diverse and refreshing ways of approaching questions, research methods and outcomes. Their input is crucial if we are to advance the work of the CHR. Moreover, the young researchers of today will be the senior scientists and policy-makers of tomorrow.

Young professionals already contribute through PhD projects. By offering new activities, the CHR can be made to be even more appealing to them. Potential initiatives include webinars on specific topics, summer schools, or attractive extracurricular events at conferences. How about ... an annual CHR Rhine Swimming Event, for example?!

Jörg Uwe Belz, Project Leader Snow and Glacier Project ASG1, researcher at Bundesanstalt für Gewässerkunde in Germany:

“Some of the CHR projects may seem to lack an obvious, direct application in the field. ASG is an example. It’s a fundamental scientific research project which drives new methodologies, achieves new insights into relevant processes and generates new data. However, these results feed into projects and models that other groups develop. Even with these kinds of projects, the CHR meets the demands of its stakeholders.

I think this facilitating role will become increasingly important for the CHR in the future. The projects already reflect the needs of a wide range of stakeholders, including the CCNR and national ministries. The challenge is reaching out to all potentially interested parties, as well as new audiences. This calls for active engagement with all partners throughout the process and the translation of the results into meaningful information. I do think that there has been a broader

awareness of the CHR, as its work has increased over the years. Of course, there’s always room for improvement.

I have noted three substantive highlights in CHR context. Firstly, the publication on human influence on the Rhine in the early 1990s. In 2007, this was followed by a report (the first of its kind worldwide on such an important river basin) which identified and quantified changes in the flow regime during the 20th century. And then, of course, we developed future projections of our water resources, Rheinblick 2050. All of these are milestones and strong examples of how the CHR proved its added value.

For me, further highlights are in the CHR’s work processes and its philosophy of bringing scientists together to work collaboratively on common goals, and to take responsibility together. My hope for the future is that the CHR will continue its high-quality work, meeting practice-oriented demands through cross-border scientific collaboration and cooperation. No other international institution is taking on this role: using science to maximise the Rhine’s benefits for all those who live in its basin.”



JÖRG BELZ

Researcher at Bundesanstalt für Gewässerkunde in Germany

‘No other institution is taking on this role’



VAZKEN ANDRÉASSIAN
 Director of the Research Unit
 HYCAR, INRAE, France

‘What is the catchment’s ability to remember or to forget?’

Vazken Andréassian - Director of the Research Unit HYCAR, INRAE, France:

“Ten years ago, we published the results of Rheinblick I, about the impacts of worldwide climate change on Rhinewater discharges. Since then, the International Panel on Climate Change has adjusted its climate change projections several times. The current trend, as we are now observing, is approaching the initial worst-case scenario.

Why is it now time to update Rheinblick? Obviously, good-quality forecasts for the Rhine discharges are an essential component of our knowledge base. Moreover, climate adaptation will be one of the key issues for policy makers in the coming years, also in the ICPR. They will want to base their policies on the latest scientific insights. I think we will have to find new ways to make data accessible to them, including through innovative data design and infographics. Perhaps, even art forms such as poetry, could be an option.

The people who worked on Rheinblick I have all approached a respectable age. By updating Rheinblick regularly, we ensure the continuous involvement of new generations of experts, and keep the knowledge alive. In other words, we shouldn’t only update our knowledge, but also our experts.

I expect that the outcomes of Rheinblick II will be worrying to policy-makers. To scientists, however, they will be interesting. Personally, I am curious to see the impacts of increasing drought. How does the Rhine system’s memory function? What is the ability of this catchment, to remember, or to forget...?”



Fotocredits:

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- p. 10: CHR Secretariat
- p. 12-13: Roy Frings
- p. 15: Rijkswaterstaat
- p. 17: Bundesanstalt für Gewässerkunde
- p. 20: Matthias Huss
- p. 22: Rijkswaterstaat
- p. 24: Roy Frings
- p. 27: Roy Frings
- p. 31: Wilfried Wiechmann
- p. 34: Rijkswaterstaat
- p. 39: Roy Frings

The International Commission for the Hydrology of the Rhine basin (CHR) is an organization in which the scientific institutes of the Rhine riparian states formulate joint hydrological measures for sustainable development of the Rhine basin.



www.chr-khr.org