1st Rhine-Mekong Symposium
Climate Change and its Influence on Water and Related Sectors
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ACRONYMS & ABBREVIATIONS

ASEAN  Association of Southeast Asian Nations
BDS  Basin Development Strategy
BfG  Federal Institute for Hydrology
BMVI  German Federal Ministry of Transport
CCAI  Climate Change and Adaptation Initiative
CDM  Clean Development Mechanism
CHR  International Commission for the Hydrology of the Rhine Basin
CNMCS  Cambodia National Mekong Committee Secretariat
DSF  Decision Support Framework
FMMP  Flood Management and Mitigation Programme
GFCS  German Federal Ministry of Transport
ICPR  International Commission for protection of the Rhine
IKMP  Information and Knowledge Management Programme
IPCC  Intergovernmental Panel on Climate Change
IQQM  Integrated Water Quantity and Quality Simulation Model
IWRM  Integrated Water Resources Management
LNMCS  Lao National Mekong Committee Secretariat
MASAP  Mekong Adaptation Strategy and Action Plan
MRC  Mekong River Commission
NAPA  National Adaptation Programme of Action to Climate Change
PPCR  Pilot Programme for Climate Resilience
SIMVA  Social Impact Monitoring and Vulnerability Assessment
TNMCS  Thailand National Mekong Committee Secretariat
VNMCS  Vietnamese National Mekong Committee Secretariat
WMO  World Meteorological Organisation
WSV  Federal Waterways and Shipping Administration
ACKNOWLEDGEMENTS

We would like to express our gratitude to Professor Hans Moser and Mr Eric Sprokkereef of the International Commission for the Hydrology of the Rhine Basin (CHR), Mr Gustaaf Borchardt and Mr Ben van de Wetering of the International Commission for the Protection of the Rhine (ICPR), and Dr Philipp Magiera and Ms Anja Waldraff of the Mekong River Commission - Deutsche Gesellschaft für Internationale Zusammenarbeit (MRC-GIZ) Cooperation Programme for the joint initiative and co-organisation of the 1st Rhine-Mekong Symposium. All presenters, facilitators and participants are deeply acknowledged for sharing the work results, experiences and views that contributed to fruitful discussions in the symposium.

The results of this symposium would not only benefit the two transboundary river basins in terms of scientific and technical aspects related to climate change and its influence on the hydrological regime and related sectors, but this occasion has also provided ideas for future cooperation for the benefits of the people living in the two basins.
1. BACKGROUND

The International Commission for the Hydrology of the Rhine Basin (CHR), the International Commission for the Protection of the Rhine (ICPR) and the Climate Change and Adaptation Initiative (CCAI) of the Mekong River Commission (MRC) are currently conducting similar works in the area of climate change and adaptation. The sharing of knowledge on approaches and methodologies suitable for large transboundary river catchments between the two river basins will provide benefits to enhance understanding and guide future actions.

Initial exchanges between the CHR and CCAI took place in Delft, the Netherlands, on 30 November 2012 and with the ICPR in Luxembourg on 6 December 2012 in the framework of the CCAI roundtable discussions and the study visit to Europe. In June 2013, the CCAI was approached by the Federal Institute of Hydrology, Germany, on behalf of the CHR and ICPR, with the proposal to organize a Rhine-Mekong Symposium together with the MRC.

As a result, the Symposium took place in Koblenz, Germany on 8-9 May 2014 on the premises of the Federal Institute for Hydrology (BfG). The Symposium was attended by 64 delegates from both the Lower Mekong and Rhine riparian countries (see Annex 1 and 2a for list of participants and agenda, respectively).

2. OBJECTIVES OF THE SYMPOSIUM

The broad aim of the Symposium was to exchange and deepen understanding on scientific and technical aspects related to climate change and its influence on the hydrological regime and related sectors of the two river basins.

The objective of the Symposium was to initiate a technical dialogue between MRC, CHR and ICPR on key questions and approaches regarding the assessment of climate change, its influence on the hydrological regime, and consequent impacts on relevant sectors and people in the basin in a transboundary context. These results shall lead to the identification of possible options for further collaboration between MRC, CHR and ICPR.
3. **KEY POINTS PRESENTED & DISCUSSED**

The Symposium was organized in eight parts (see Agenda in Annex 2), which include: common knowledge of both basins; the Rhine and country examples; the Mekong and country examples; common challenges and differences; formulation of transboundary climate change and adaptation strategy; and Rhine-Mekong cooperation.

In total, the two-day symposium included: 16 presentations from the Rhine, Mekong and riparian countries; two group discussions to identify common and different challenges and areas for cooperation; and a panel discussion. At the end of the Symposium, the common challenges and differences and the potential for further cooperation between the two basins were summarized in the 1st Rhine-Mekong Symposium Conclusions (see Annex 3). The 2nd Rhine-Mekong Symposium is expected to convene in September 2015, with the aim of addressing the common challenges and differences.

The key points presented and discussed in the Symposium are summarised below. Details on each presentation/discussion are given in Annex 4 and speakers’ profiles in Annex 5.

**3.1 Introduction of the Rhine and Mekong Basins and Transboundary Cooperation**

The presentations illustrated the differences in natural and socio-economic as well as in political conditions between the two river basins. A similar level of economic development of all riparian states within the Rhine basin was identified as one significant advantage for the management of the Rhine River in contrast to the Mekong.

In the Mekong basin, the two upstream countries, China and Myanmar, are currently only dialogue partners to the Mekong River Commission, while in the Rhine basin, there is in-depth exchange and cooperation with the most relevant upstream country, Switzerland.

It was pointed out that transboundary cooperation is a long, ongoing process that requires constant efforts and which can perpetually be improved. Therefore, there are always further challenges to be solved. At the same time, this laborious and demanding effort is the only feasible and sustainable way to successful river basin management. In both basins, the involvement of stakeholders in decision-making process is considered crucial and at the same time essential for sustainable water resources management.
3.2 Common knowledge on the Rhine and country examples

Major activities of CHR (RheinBlick2050), BfG (KLIWAS) and ICPR (Expert Group KLIMA) as well as of the Netherlands (sea level rise and floods) and Germany (drought and agriculture) were presented. An observation was made that the socio-economic impacts of climate change are not yet a major focus in the Rhine basin. The water-energy-food nexus does not play a major role in studies conducted in the Rhine basin, while it is of relevance in the Mekong basin. The presented projects focused on specific sectors (e.g. KLIWAS on navigation) and did not take into account further water uses. A next step in research may be joint impact studies. Since low-water management is a relatively new topic, further research in this respect may also be initiated in future.

With respect to the management of low water situations, the question was raised as to whether a basin-wide approach (such as the ICPR’s Flood Action Programme) was needed, or one on a regional/local scale. Since the proportion of discharge from upstream countries may be very large during low flow, the countries are highly interdependent, and transboundary cooperation is needed in this field.

3.3 Common knowledge on the Mekong and country examples

CCAI and FMMP were presented as current work of MRC on climate change in the basin as well as Cambodia (on flood), Lao PDR (agriculture), Thailand (drought) and Viet Nam (sea level rise). The organisation of transboundary cooperation was the main discussion topic. Coordinated transboundary emergency response in the LMB has not yet been established. However, along the Mekong mainstream there are hydromet stations, which measure the water volume for the region and can serve flood management work. Also, there are relevant bilateral agreements, such as for sharing information on flood issues between Thailand and Cambodia.

There is regular exchange and communication with upstream countries (China and Myanmar). Although mechanisms are already in place for cooperation, including with respect to reservoir management, there is always room for improvement.
3.4 Common and different challenges and issues (group discussion)

Topics of common challenges and issues discussed include: saline intrusion, flooding and inundation, low flows and droughts, biodiversity, navigation, sedimentation and (delta) morphology, increased variation of climate, temperature increase, impacts of climate change, land subsidence, unequal distribution of water resources in time and space, groundwater management (protection, sustainability, quality and quantity), management in the future of water production and water quality due to rising living standards.

For different challenges and issues, the topics discussed included: natural factors; institutional frameworks and cooperation history; monitoring and data, financial support and mechanisms; development level and stage that influence priority setting; low water and water quality; and approaches to flood.

3.5 Climate change adaptation strategy

The CCAI of MRC presented the Roadmap for Formulation of the Mekong Adaptation Strategy and Action Plan while the ICPR presented the roadmap for adaptation strategy to climate change in the Rhine catchment. Although the adaptation strategies of the two basins are being developed with a similar approach, the starting points are different. Substantial basin-wide research has been conducted in the Rhine and has just started in the Mekong.

The strategic focus is also different. With respect to the Rhine Basin, water temperatures and possible changes have been assessed, which are of particular importance for power production because the river water is used for cooling and drinking water supply.

With respect to the Mekong Basin, the MRC has to date investigated the impacts of climate change on wetlands as well as the impact on irrigation and agriculture, but not yet on water temperatures. However, the water temperatures in the Mekong River are already within a much higher range than in the Rhine, and aquatic species may also be less sensitive to higher temperatures.

The adaptation strategy of the LMB is being developed to be linked to the Mekong Basin Development Strategy. In the Rhine basin, there are two umbrella conventions: The Rhine 2020 Action Programme and EU legislation (Water Framework Directive, Floods Directive, etc.).
The timeframe for the Rhine adaptation strategy is governed by the Water Framework Directive. Once every six years a river basin management plan has to be issued. The second plan, which is due as a draft version in 2014, also includes the issue of climate change.

### 3.6 Areas for cooperation

Although the contexts in both basins differ, it was generally acknowledged that cooperation can be fruitful and that it is desirable to gain new impulses for the way of working. It was recognized that mutual learning can be successful and helpful for the management of both basins.

The cooperation amongst countries in the basin, both for the Rhine and Mekong, must be built on mutual trust and confidence. There are not always mechanisms to enforce international cooperation. Therefore, political commitment can to a large extent be decisive for successful cooperation. The same applies for cooperation among both river basins.

There are plans to institutionally restructure the MRC. This requires a comprehensive organisational reform process, which includes a commitment towards a smaller secretariat. Therefore, MRC may also be inspired and may benefit from knowledge exchange with respect to the institutional organization in the Rhine basin.

It is recognised that the best available information on climate change and its impacts is not comprehensive, thus is recommended to share lessons learnt from tested and developed approaches. In both basins, albeit challenging, sharing data and information is deemed necessary. Relevant areas of cooperation between institutions from both basins should be more concrete, and follow-up work must continue.

### 3.7 Feedback from participants and evaluation

Evaluation forms were distributed at the end of the Symposium in order to collect feedback. The Symposium achieved a very good overall rating, with an average score of 8.5 out of 10. Most participants commented that further cooperation of the Rhine and Mekong should be continued. Selected Symposium photos are presented in Annex 6.
## ANNEX 1 | LIST OF PARTICIPANTS

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### 8 May 2014

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
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<tbody>
<tr>
<td>09.30 – 10.00</td>
<td>Arrival and registration of participants at Federal Institute of Hydrology (BfG) headquarters, Koblenz, Germany</td>
</tr>
<tr>
<td>10.00 – 10.45</td>
<td><strong>PART 1: Opening and introduction</strong></td>
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<tr>
<td>10.00 – 10.30</td>
<td>- Welcome speeches</td>
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<tr>
<td></td>
<td>- Director General of BfG (5 min): Michael Behrendt</td>
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<td>- President of ICPR (5 min): Gustaaf Borchard</td>
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<td>- Chief Executive Officer of MRCS (5 min): Hans Guttman</td>
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<td>- Representative of BMZ (5 min): Stefanie Ruff</td>
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<td>- President of CHR (5 min): Hans Moser</td>
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<td>10.30 – 10.45</td>
<td>- Introduction to the symposium and expected outputs</td>
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<td>- Overview of Agenda and objectives (10 min): Kai Gerlinger, Moderator</td>
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<td>- Short overview of participants (5 min): Kai Gerlinger</td>
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<tr>
<td>10.45 – 13.15</td>
<td><strong>PART 2: Common knowledge on both catchments</strong></td>
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<tr>
<td>10.45 – 11.45</td>
<td>- Introduction to both catchments and transboundary cooperation</td>
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<td>- <strong>Rhine</strong> (20 min +10 min Q&amp;A): Introduction to the Rhine river basin (natural factors, cooperation), Manfred Spreafico, former President of CHR</td>
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<td>- <strong>Mekong</strong> (20 min +10 min Q&amp;A): Introduction to the Mekong river basin (natural factors, cooperation), Tien Truong Hong, Director of Environment Division, MRC Secretariat</td>
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<td>11.45 – 13.15</td>
<td><strong>LUNCH BREAK</strong></td>
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<tr>
<td>13.15 – 14.20</td>
<td><strong>PART 3: Common knowledge of the Rhine and country examples</strong></td>
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<tr>
<td>13.15 – 14.20</td>
<td>- Overview of current work of CHR, BfG and ICPR on climate change in the basin</td>
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<td>- Research projects RheinBlick2050 (CHR) (Eric Sprokkereef), KLIWAS (BfG) (Sebastian Kofalk) and Expert Group KLIMA (ICPR) (Adrian Schmid-Breton) (20 min)</td>
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<td>- Examples of expected climate change impacts (knowledge to date, challenges, need for cooperation)</td>
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<td>- Country example Rhine (15 min): Sea-level rise and floods, Netherlands, Ralph Schielen</td>
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<td>- Country example Rhine (15 min): Drought and agriculture, Germany, Enno Nilson</td>
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<td>- Q&amp;A (15 min)</td>
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14.20 – 15.35
- **Overview of current work of MRC on climate change in the basin**
  - MRC’s Climate Change and Adaptation Initiative (CCAI) (Nguyen Huong Thuy Phan) (10 min)
  - MRC’s Flood Management and Mitigation Programme (FMMP) (Nico Bakker) (10 min)
- **Examples of expected climate change impacts** (knowledge to date, challenges, need for cooperation)
  - Country example Mekong (10 min): Flood, Cambodia, H.E. Mr. Kol Vathana
  - Country example Mekong (10 min): Agriculture, Lao PDR, Vanxay Bouttanavong
  - Country example Mekong (10 min): Drought, Thailand, Chaiporn Siripornpibul
  - Country example Mekong (10 min): Sea level rise, Viet Nam, Nguyen Xuan Hien
- Q&A (15 min)

15.35 – 15.50
- TEA BREAK (exhibition of products/reports/posters)

15.50 – 17.00
- **PART 5: Common challenges and differences between the two basins**
  - Small group discussion: What are the common challenges? What are the differences?
  - Reporting back from groups
  - Wrap-up of Day 1

9 May 2014
09.00 – 09.15
- Recap of Day 1, Thanapon Piman

09.15 – 10.00
- **PART 6: Formulation of transboundary climate change adaptation strategy**
  - Mekong (10 min + 5 min Q&A): Roadmap for the Mekong Adaptation Strategy and Action Plan (MASAP) (Nguyen Huong Thuy Phan)
  - Rhine (10 min + 5 min Q&A): Roadmap for an adaptation strategy to climate change in the Rhine catchment (Ben van de Wetering, Secretary of ICPR)
  - Q&A (15 min)

10.00 – 15.25
- **PART 7: Rhine-Mekong cooperation**
  - A comparative overview of climate change and ways toward an adaptation strategy in the Rhine and Mekong basins (20 min + 10 min Q&A) (Kai Gerlinger)
<table>
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<th>Time</th>
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<tbody>
<tr>
<td>10.30 – 10.40</td>
<td>Introduction to the group discussions (Kai Gerlinger)</td>
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<tr>
<td>10.40 – 10.55</td>
<td>TEA BREAK (exhibition of products/reports/posters)</td>
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<tr>
<td>10.55 – 12.15</td>
<td>Parallel group discussion: Areas for cooperation</td>
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<td>12.15 – 13:30</td>
<td>LUNCH BREAK</td>
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<tr>
<td>13.30 – 14.30</td>
<td>Panel: Areas for cooperation on transboundary climate change adaptation</td>
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<td>Report group discussion results: Three representatives from parallel group discussion and representatives from CHR, MRC and ICPR</td>
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<td>14.30 – 14.45</td>
<td>Q&amp;A</td>
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<tr>
<td>14.45 – 15.15</td>
<td>TEA BREAK (exhibition of products/reports/posters)</td>
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<td>15.15 – 16.00</td>
<td>PART 8: Closing</td>
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<tr>
<td>15.15 – 16.00</td>
<td>1st Rhine-Mekong Symposium Conclusions (preliminary)</td>
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<td>Remarks by participants</td>
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<td>Closing of the 1st Rhine-Mekong Symposium (representatives from CHR, MRC, BfG, ICPR, GIZ)</td>
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Symposium Conclusions

1st Rhine-Mekong Symposium
“Climate Change and its Influence on Water and Related Sectors”
8-9 May 2014
Koblenz, Germany

Preamble

Representatives from the International Commission for the Hydrology of the Rhine Basin (CHR), the International Commission for the Protection of the Rhine (ICPR), and the Mekong River Commission (MRC), government representatives, experts and scientists met on 8 – 9 May 2014 in Koblenz, Germany, at the 1st Rhine-Mekong Symposium under the theme “Climate Change and its Influence on Water and Related Sectors”. This meeting enabled the river basin organizations to share knowledge and understanding on, and challenges of the different and common issues as well as to discuss areas for potential cooperation.

The Symposium recognised that climate change has taken its toll on hydrological regimes, livelihoods and economies in both the Mekong River Basin and the Rhine Basin, and acknowledged that mitigation of and adaptation to changing climate impacts are essential.

As the world’s tenth longest river, the Mekong supports an exceptionally diverse and productive freshwater ecosystem that provides livelihoods and food to around 60 million people. The rapidly-growing Mekong River Basin has experienced development pressures, such as changes in land use, intensive irrigation, hydropower development, development of flood control structures and other infrastructures. The region is
experiencing less predictable climate conditions and more extreme weather. Rising temperatures and unpredictable rainfall are bringing drought to some areas and flooding to others. Sea-level rise is increasing saltwater intrusion to farmland in the Mekong Delta.

The Rhine, the third biggest European river, accommodates approximately 60 million people and provides drinking water sources to 30 millions. For many centuries, the Rhine has played an important role in the social, political and economic development in Europe. Multiple uses, conflicting interests, and environmental and flood problems in and along the river have highlighted the importance of an integrated approach. Climate change is taking its toll in the basin. For example, rising water temperatures have forced power plants to reduce their production in recent years. Extreme changes in water flow, especially over long periods with very low discharges, will also have economic and social impacts. These extreme events, together with a range of other anthropogenic impacts, will bring about far-reaching consequences on the environment and economy in the Rhine countries.

Participants of this 1st Rhine-Mekong Symposium concluded that the two basins share common challenges and differences, which provide a basis for potential cooperation among their river basin organizations.

**Common challenges and differences**

1. The two river basins share many of the same challenges in addressing the impacts of climate change today and will continue to do so in the near future. Climate change in both basins can already be observed in the increase in temperatures, which have similar ranges (+0.08 to +0.18°C/decade). Whereas there are similar patterns in both basins for the observed sea level, recorded precipitation distributions remain more heterogeneous. However, there is a tendency in both basins of an increase of precipitation in the respective wet season. In spite of high uncertainty and a less precise model signal concerning future precipitation, an increase in heavy rain events is likely. Therefore, the hazards are similar in both basins, but risks in Europe are mainly of an economic nature, while in South East Asia risks are of a more social nature (food security, health and livelihoods).

2. Climate change impacts on the basins’ water resources, ecosystems and livelihoods are likely to be a significant and a long-term issue. Similar approaches were chosen for both basins in order to provide the necessary basis for the development of a basin-wide adaptation strategy. In both basins, comparable studies assessing the climate and hydrological changes in the past and in the future have been conducted or are currently underway. Impact studies are investigating the response to common hazards in the same fields of interest. Sharing the existing study results and experiences will lead to mutual benefits and will create synergies and potential savings.
3. Transboundary aspects of adaptation to climate change should be seen as an integral part of a broader development policy, and not merely as an environmental issue.

4. Transboundary cooperation addressing changing climate impacts can enhance a broader set of benefits and opportunities than approaches by individual countries.

5. The roadmaps for formulating transboundary climate change adaptation strategies for the Mekong and the Rhine have adopted similar approaches. There are differences between the legal framework of the Rhine Commissions and the Mekong Agreement. Common challenges in both basins exist with regard to the uncertainty associated with future impacts from climate change as well as in measuring the costs and benefits of adaptation. An adaptive management approach is therefore promoted in both basins.

The way forward

6. The participants recognise the common challenges and differences, as well as the potential for further cooperation. The participants invite the river basin organisations to convene the 2nd Rhine-Mekong Symposium with the view of addressing the common challenges and differences.

Koblenz, Germany, on 9 May 2014.
II.i Rhine Basin (presentation)

Introduction to the Rhine River Basin (Manfred Spreafico)

The Rhine originates in the Swiss Alps (Vorderrhein as main source from Lai da Toma, Hinterrhein from Paradise Glacier in Grison) and runs for over 1,320 km into the North Sea at Hoek van Holland, Rotterdam. The river is shared among nine countries (Switzerland, Liechtenstein, Austria, Germany, France, Luxembourg, Belgium, Netherlands and Italy). The basin area is 185,000 km²; the mean discharge is 2,200 m³/s; maximum flow, 13,000 m³/s; and minimum flow, 800 m³/s.

The main uses of the Rhine River are domestic and industrial water supply, navigation, hydropower production, fishery, agriculture, recreation/tourism and water drainage. Groundwater plays a dominant role, especially in Switzerland, where more than 70 percent of the drinking water is groundwater. Groundwater protection therefore plays an important role. The Rhine is one of the most densely occupied waterways of the world. For centuries, navigation has been an important user of the Rhine, providing economic benefits, but also incurring maintenance cost for the navigation channels. The importance of hydropower production varies from one country to another. In Switzerland, around 56 percent of electric power is generated by Hydropower, in Germany only three per cent.

For several decades, the environmentally sound management of the Rhine, as part of the Integrated Water Resources Management (IWRM), has been given very high priority, resulting in the implementation of the Rhine Action Programme in the basin. Significant efforts have been made in developing flood protection strategies in the riparian states, resulting in the Rhine Action Plan on Floods.

For 20 years, projects have been carried out to determine the impacts caused by global and climate change on the discharge in the Rhine River. Adaptation strategies have been developed.
The presentation can be found online:
http://www.chr-khr.org/sites/default/files/chreventdocuments/part_2_rhine_river_basin.pdf

II.ii Mekong basin (presentation)

Mekong River Basin and Transboundary Cooperation (Tien Truong Hong)

The Mekong river basin covers almost 800,000 km². The main stem of the river stretches around 4,800 km from the glaciers in the Chinese Himalayas, through Myanmar, Lao People’s Democratic Republic (Lao PDR), Thailand and Cambodia, meeting the sea in the vast delta in southern Viet Nam.

The history of cooperation on development planning of the Mekong River began in 1957 with the establishment of the Committee for Coordination of Investigations of the Lower Mekong Basin by the governments of four lower Mekong countries: Cambodia, Lao PDR, Thailand and Viet Nam. It aimed to promote, coordinate, supervise and control the planning and investigation of water resources development projects in the Lower Mekong basin. To meet the increasing needs of economic and social development of the countries in the basin, the governments of the four lower Mekong countries signed an Agreement on Cooperation for the Sustainable Development of the Mekong River Basin in 1995 (referred to as the 1995 Mekong Agreement) and established the Mekong River Commission (MRC). The 1995 Mekong Agreement serves as an important legal document setting basic principles and the overall cooperation framework for the Member Countries in the exploitation and protection of water resources and other related resources in the Mekong River Basin toward sustainable development, which contribute to the implementation of the socio-economic development strategies of the Member Countries.

Over the 57 years of cooperation, the following major achievements gained by the MRC and its member countries have been attained: dialogue has been strengthened on regional water resources development; a basin-wide, consultative planning process has been facilitated through an Integrated Water Resource Management approach; the risks of regular flooding have been reduced; international trade opportunities have been increased through safer and more effective river transport and legal frameworks for cross-border navigation; a balance has been defined between the opportunities and risks of proposed hydropower projects; environmental decision support has been provided; and a process has been initiated to help the people of the basin adapt to the consequences of climate change.
II.iii Key discussion outcomes

The presentations illustrated the differences in the natural and socio-economic conditions between the two river basins as well as in the political conditions.

A similar level of economic development of all riparian states within the Rhine basin was identified during the discussion as one significant advantage for the management of the Rhine River in contrast to the Mekong.

In the Mekong basin, the two upstream countries (i.e. China and Myanmar) are currently only dialogue partners to the Mekong River Commission, whereas in the Rhine basin, there is very comprehensive exchange and cooperation with the most relevant upstream country, Switzerland.

It was pointed out that transboundary cooperation is a long, ongoing process that requires constant efforts and which can perpetually be improved. Therefore, there are always further challenges to be solved. At the same time, this laborious and demanding effort is the only feasible and sustainable way to successful river basin management.

In both basins, the involvement of stakeholders in decision-making is considered crucial and at the same time essential for sustainable water resources management.

It became also clear that the usage and management of groundwater is highly significant also on a large scale in the Rhine basin, while usage is confined to smaller scales in the Mekong. Furthermore, water demand is expected to further increase in the LMB countries, while rather stagnating in the Rhine basin.

Part III: Common knowledge on the Rhine

III.i Overview of current work (presentations)

Introduction to the research project RheinBlick 2050 (Eric Sprokkereef)

Climate change leads to modified hydro-meteorological regimes that influence the discharge behaviour of rivers. This has variable impacts on managed (anthropogenic) and unmanaged (natural) systems, depending on their sensitivity and vulnerability.
(ecology, economy, infrastructure, transport, energy production, water management, etc.). Therefore, decision makers in these contexts need adequate information (i.e. informed options) on potential future conditions to develop adaptation strategies in order to minimize the adverse effects of climate change.

The RheinBlick 2050 project is a joint effort on the non-tidal catchment, initiated and coordinated by the International Commission for the Hydrology of the Rhine Basin, in close collaboration with the International Commission for the Protection of the Rhine. Data, methods, models and expertise of different institutions and research activities of riparian states of the Rhine River have been jointly combined in this meta-project with a runtime from January 2008 to September 2010.

The main research question of the RheinBlick 2050 project was: What are the impacts of future climate change on discharge of the Rhine River and its major tributaries?

The main findings from the RheinBlick 2050 project include:

- up to 2050 moderate changes in average discharge;
- up to 2100, the discharge projections in accordance with each other: a decrease of average discharge in summer, and an increase in winter;
- large spread in the discharge projections.

Moreover, uncertainties can be quantified.

_The presentation can be found online:_

**KLIWAS: The organizational aspects and the current work of BfG on climate change (Sebastian Kofalk)**

The expected climate change raised the question among the users of the waterways as to whether this transport mode will remain reliable in a long term. In this situation, politicians and decision makers in the German Federal Ministry of Transport (BMVI) and the Federal Waterways and Shipping Administration (WSV) needed reliable information to decide whether and when adaptation measures to climate change should be taken. The research programme “KLIWAS – Impacts of Climate Change on Navigation and Waterways – Searching for Options of Adaptation” studied these general issues, reflecting on different climate change scenarios and their uncertainties. Thirty projects were implemented, supplemented by numerous cooperation partners. They were guided by a Scientific Advisory Board that covered all fields of research, including economic analyses. The seven WSV directorates and operational offices were involved
as main stakeholders, as well as further governmental and non-governmental water management institutions.

KLIWAS organised integrated model chains including ecological and economical aspects. Two periods were under consideration: the near future (2021 to 2050) and the more distant future (2071 to 2100). Projections for more than 40 indicators, representing the system of waterways and the management objectives, were delivered. The portfolio of adaptation options also comprises engineering solutions.

Currently, the project reports, a synthesis and publications are being finalized. However, the results can be interpreted correctly only when the degree and the sources of the uncertainties they contain are known and communicated. Strong emphasis is placed on explaining the dimension of climate signals and impacts, and their relevance for response.

The BfG closes now the gap between operational forecasts and long-term projections by seasonal and decadal prognosis. Other tasks include applying the most recent global climate model projections to update the regional downscaling and developing consistent climate scenarios for all traffic modes.

*The presentation can be found online:*  

**Knowledge about direct climate change effects on the water regime and water temperature of the Rhine (Adrian Schmid-Breton)**

The ICPR has recently presented a report with an estimation of the effects of climate change on Rhine water temperature development in the near future (2021-2050) and in the far future (2071-2100) (ICPR Report No. 213 – summary and Report No. 214 – full version). This multi-model estimation is based on the air temperature development and other parameters as defined in the scenario study for the discharge regime of the Rhine (ICPR Report No. 188, 2011). This report supplements the ICPR publication on long-term Rhine water temperature development in the 1978-2011 period (ICPR Report No. 209, 2013).

In these reports, the development of the water temperature over time as well as the effect of discharges of cooling water was assessed. One important finding was that, on average, between 1978 and 2011, water temperatures rise by around 1 to 1.5°C.

One of the main indicators of the impact of climate change is the number of days on which the water temperature exceeds 25°C, because this will have negative consequences
the aquatic life. Both studies show a substantial increase of the number of days.

*The presentation can be found online:*

**III.ii Country examples (presentations)**

**Country example, Rhine: Climate change impacts and mitigation – the Dutch perspective (Ralph Schielen)**

Water management is crucial for the Netherlands. To protect its citizens and its economy, an advanced system of levees, dams and dunes has been constructed over the past centuries, making the Dutch Delta the best protected delta in the world. Programmes like “Room for the River” and regular maintenance programmes ensure that the current standards are maintained. However, to keep up with climate change and increased economic value behind the levees, it is necessary to re-examine whether the height of the current standards is still sufficient for the long term (2050 and beyond). This is performed in the Delta Programme, a policy project to study new safety standards in combination with anticipated climate change – and hence, increased discharge and sea level rise – and the appropriate measures to achieve these standards.

In this contribution, the new safety standards are based on an advanced cost-benefit analysis, taking into account climate and socio-economic scenarios for 2050. The new safety standards are also based on actual flooding probabilities of the levees (rather than exceeding probabilities of critical water levels). Furthermore, it resulted from this analysis that the current levees had a larger failure probability than anticipated, which indicates that additional coping measures have to be carried out.

Hence, for the future (i.e. 2050 at least, but later also extended to 2100), the challenge is at least threefold: measures are needed to ensure that the current safety standards are satisfied; measures need to be taken to achieve new (stricter) safety standards; and measures must be taken to address the climate problem. It is evident that the first part, ‘overdue maintenance’, is the first step. Looking at 2050, it results that achieving the safety standards requires more than addressing the climate problem in terms of water level rise. How to solve this problem (i.e. through dyke reinforcement, additional spatial measures or a combination of both) is the challenge of the Delta Programme. This challenge is taken up by the Government as well as the local stakeholders. This requires intensive dialogue with the local authorities such as water boards, provinces, etc., which need to ensure that the set of measures receives substantial support from society.
In this contribution, the process of getting to a balanced choice of measures, solving the combined problem of new standards and climate change will be explained. Also, some of the technical difficulties of computing the actual problem that needs to be solved in terms of increase flood water levels and reinforcing the dykes to comply with the new standards will be illustrated. This involves more than just making the levees higher, since we can intervene in different failed mechanisms of the levee and hence adapt the actual flooding probability. Another possibility is to make them stronger so that the flooding probability remains the same (but the nuisance behind the dykes might be larger). Intense communication with the local stakeholders and the Government, as well as the available budget for the coming decades, will determine the actual profile of the levee.

The presentation can be found online:
http://www.chr-khr.org/sites/default/files/chreventdocuments/part_3_2_climate_change_netherlands.pdf

Country example, Rhine: Drought and agriculture – climate changes impacts in Germany (Enno Nilson)

Compared to other regions of the world, Central Europe is not known as a region that is extremely prone to drought and water scarcity issues. In the German part of the Rhine River Basin during normal years only a very small percentage of the available water is abstracted for irrigation. Nevertheless, past drought situations (e.g. in 2003) resulted in a strong anomaly in net primary productivity in Europe. In Germany, yields of several crops declined by around 15 percent notwithstanding the increase of around 20 percent in resources spent on irrigation. Thus, in Central Europe agriculture is vulnerable to drought situations, and conflicts between agriculture and other sectors can occur.

With respect to possible future developments, the current IPCC report (IPCC AR5) states that regional to global-scale projections of soil moisture and (agricultural) drought remain relatively uncertain compared to other aspects of the water cycle.

Indeed, for Central Europe, robust changes (similar direction of change over climate multi-model ensembles) in hydrological and agricultural droughts have been projected only for the distant future (increased droughts in around 2071-2100), while there is no clear tendency in the next decades (until 2021-2050).

This presentation summarises some of the issues in defining, monitoring and modelling droughts using examples from research projects in Germany and the Rhine River Basin. Possible general challenges which may also apply to the Mekong River basin are highlighted. Suggested topics that need cooperation between Rhine and Mekong
commissions are:

- coordinated selection of drought definitions and indicators;
- common procedures in generating projections (technical aspects such as data availability, model bias correction, evaporation models);
- common procedures in creating drought scenarios (assumptions, uncertainty assessment, aspects covered, adaptation measures included).

The presentation can be found online:
http://www.chr-khr.org/sites/default/files/chreventdocuments/part_3_3_climate_change_germany.pdf

III. iii Key discussion outcomes

The main issue discussed was the fact that socio-economic impacts of climate change are not yet a major focus in the Rhine basin. The water-energy-food nexus does not play a major role in studies conducted in the Rhine basin, while it is of relevance in the Mekong basin. The presented projects focused on specific sectors (e.g. KLIWAS on navigation) and did not take into account further water uses. Further joint impact studies may be seen as a next step in research. Since low water management is a relatively new topic, further research in this respect may also be initiated in the future.

With respect to the management of low water situations, the question was raised as to whether a basin-wide approach was needed (like the ICPR’s Flood Action Programme), or it should rather be at regional/local scale. Since the proportion of discharge stemming from upstream countries may be very large during low flow, the countries are also highly interdependent, and transboundary cooperation is needed in this field.

Part IV: Common knowledge on the Mekong

IV.i Overview of current work (presentations)

MRC’s Climate Change and Adaptation Initiative (Nguyen Huong Thuy Phan)

Recognizing the needs of addressing transboundary impacts of climate change as well as the necessity for joint efforts in adapting to climate change, the MRC Council in 2007 requested the development of Climate Change and Adaptation Initiative (CCAI). In 2008, the framework of the CCAI was formulated for implementation over 17-year period (2009-2025). Among the current 12 programmes of MRC, CCAI is established as a regional collaborative initiative with main purpose to support the Member Countries in adapting to the impacts and new challenges posed by climate change. The approach that CCAI
Applies includes IWRM principles as well as the water-food-energy nexus. First, climate change needs to be investigated (what occurred in the past and what will occur in the future). Impacts on hydrology, water balance, extremes (especially flood and drought), river morphology and sediment will be determined. Also, impact assessment on food security (agriculture and fishery), impacts on hydropower (yield and operation) and impacts on ecosystems will be conducted. Another approach that CCAI applies across the basin-wide assessments and local demonstration projects is the CCAI Adaptation Planning and Implementation Framework, consisting of a scoping study, a vulnerability assessment, an identification of adaptation options and implementation. Moreover, since adaptation to climate change in the basin cannot be stand-alone, another key approach of CCAI is to mainstream adaptation into basin development. In this regard, the *Mekong Adaptation Strategy and Action Plan* will ensure that the *Mekong Basin Development Strategy* will be climate-proof. Last but not least, stakeholder engagement and gender responsiveness are given importance for CCAI implementation both at regional and national levels.

For CCAI at the current phase (2011-2015), the ultimate goal is to develop the Mekong Adaptation Strategy and Action Plan. In order to do this, understanding of the status of climate change in the LMB is needed to be in place, which requires basin-wide assessments on the impacts of climate change on food security, ecosystems, flood, drought and hydropower. A literature review of related issues in the Member Countries is required in order to provide current state of knowledge for the status report. Database and monitoring system are being built to provide data and information for further analysis. Building capacity and understanding of the Member Countries is needed in order to facilitate the decision-making process. In short, this phase of CCAI will focus on three groups of work: (i) data, information, models and tools; (ii) studies and assessments; and (iii) adaptation plans and strategy.

*The presentation can be found online:*
http://www.chr-khr.org/sites/default/files/chreventdocuments/part_4_climate_change_and_adaptation_initiative.pdf

**Flood Behavior and Climate Change Adaptation to future flooding in the Lower Mekong Basin (Nico Bakker)**

The Mekong Flood consists of a single annual flood hydrograph generated by the Southwest (SW) Monsoon. Tropical typhoon incursions into the basin from the East Sea across southeast Viet Nam and southern China generate individual peaks on the monsoonal hydrograph. The onset dates and duration of the dry season, transition seasons and flood season are remarkably consistent. While the strength of the SW
Monsoon defines the overall character of the flood season, it is the typhoons and tropical storms that typically generate the extremes and most damaging events.

MRC’s Flood Management and Mitigation Programme (FMMP) and the Climate Change and Adaptation Initiative (CCAI) are incorporating climate change into short- and long-term flood management while climate change adaptation is systemised in the Regional Flood Management and Mitigation Centre and the MRC Member Countries. An Initial Assessment (May 2012) recommended improvements to climate change data, hydrological and hydraulic modelling, together with training and capacity-building activities. The suggested approach and methodology were discussed in the Regional Technical Workshop (September 2012). FMMP, CCAI and the Information and Knowledge Management Programme (IKMP) jointly developed monthly change factors, based on existing climate modelling results for high, medium and low categories, to be used to generate primarily rainfall inputs required for the ten sub-SWAT run-off models and, with the IQQM routing model, the discharges, required as inputs for the hydrodynamic ISIS model. In 2013, additional country data were collected, time series and rating curves, topographic and hydrographic data updated, model versions tested, and 12 years of hourly tidal data processed to extract the tidal harmonics and storm surge values, while values for sea level rise were formulated.

The upgrading of the MRC Toolbox models under MRC’s Decision Support Framework (DSF) is almost completed, and flood simulation modelling for three time periods 2020s, 2050s and 2080s will be initiated in June/July 2014. At the same time, the climate change adaptation piloting will soon start up in the Member Countries; results are expected by December 2014. For 2014 and 2015, implementation is scheduled for three demonstration projects (one in Thailand, one in Lao PDR, and one transboundary project between Cambodia and Viet Nam), addressing the impacts of climate change and sea level rise, upstream and floodplain developments to develop Strategic Directions for the management of future and residual flood risks. These initiatives will contribute to the basin-wide overview and understanding of flood risk in the Lower Mekong Basin.

The presentation can be found online:
IV. ii Country examples (presentations)

Country example, Mekong: Climate change and water resources management in Cambodia (Kol Vathana)

Climate change is recognised as a national and global issue. Cambodia faces frequent floods and droughts resulting from climate change, which seriously damage and threaten human lives, property, crops and infrastructures. The poor are the most vulnerable because they have weak adaptive awareness and capacity. The negative effects are mainly health impacts, food insecurity, economic and development impacts, etc., and it is recognised that they accelerate people’s poverty and severely obstruct socio-economic development.

The government line agencies and civil society have paid attention to and engaged in the climate change response after Cambodia ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1995 and the Kyoto Protocol in 2002 through, inter alia: the preparedness and implementation of the National Adaptation Programme of Action to Climate Change (NAPA); the 1st and 2nd National Communication; the relevant Clean Development Mechanism (CDM); climate change adaptation and mitigation projects; the Cambodia Climate Change Alliance (CCCA); the Pilot Programme for Climate Resilience (PPCR); and the boosting and implementation of carbon credit programme.

Many reports address gaps in awareness, technical capacity and capability to respond to climate change and other natural disasters, as well as participation from non-governmental organizations (NGOs) and civil society. There is a great need for better understanding and assessing the potential severe impacts from climate change and variability. There is also a great need to determine the options for adapting to these impacts; while mitigation options will be applied subsequently.

The presentation can be found online:
http://www.chr-khr.org/sites/default/files/chreventdocuments/part_4_1_cambodia.pdf

Country example, Mekong: The status of climate change adaptation in the agricultural sector of Lao PDR (Vanxay Bouttanavong)

Lao PDR is heavily dependent on its agricultural sector. Agriculture and forestry together account for 30.4 percent of the gross domestic product. The major expected impacts of climate change on agricultural sector are floods, droughts, pests and plant diseases. In Lao PDR, the Department of Disaster Management and Climate Change at the Ministry
of Natural Resources and Environment is the institutional focal point for climate change mitigation and adaptation. Several achievements in climate change policy have already been made, which include: the establishment of the technical working group on climate change, which involves eight different ministries; and the formulation of the National Climate Change Strategy, the Climate Change Action Plan 2013-2020 and the National Adaptation Programme of Action (NAPA), with several follow-up activities. The concrete adaptation measures in agriculture and forestry may locally differ, however, depending on, for example, geographical features and local farming system. A number of adaptation measures are being tested at different sites aiming at, inter alia, more efficient water management and soil fertility improvements.

The presentation can be found online:
http://www.chr-khr.org/sites/default/files/chreventdocuments/part_4_2_lao_pdr.pdf

Country example, Mekong: The FED Triangle, new hope for water resources management in the northeastern region, Thailand (Chaiporn Siripornpibul)

The northeast Region of Thailand covers an area of approximately 169,000 km² or one third of the country area, and its population is approximately 21.6 million, or one third of the entire country. The irrigation area is only 1.2 million ha, and the rainfed area is around 11.2 million ha. The gross regional product is around 10.5 percent of the gross national product. This figure illustrates that the region is the poorest area of the country. The population consists mainly of farmers whose living conditions heavily depend on variation of seasonal rainfall.

The major problems in this area are flood and drought as well as saline soil and salt water. Although this region has moderate rainfall of 1,348 mm/year, the capacity of existing reservoirs and storages are very low, causing flood and drought problems every year. Groundwater resources are developed mainly for domestic use but little for agriculture compared to its potential in many areas. Another problem is the salt water that occurs as groundwater flow systems dissolve rock salt underneath and flow upward to the surface in the discharge areas, thus causing both saline soil and salt water. The variation of both quantity and quality of water resources plays a major role and controls the socio-economic conditions of the region. The proposed new management, referred to by the presenter as “The FED Triangle: Linkages and Management of Water Resources”, links potential activities under three major issues: Flood (F), Environment or Ecology (E) and Drought (D). This may raise new hope for an appropriate management of the water resources. It will also help rural people to access and use water in dry season especially under the concept of ‘conjunctive water use’. Surface water is used in wet season and groundwater in dry season when the surface water sources dry out. Crop types have also carefully been selected to be suitable for the dry period and effective water uses
are applied, especially a micro irrigation technique. According to a technical review, there are many high potential areas in the northeast region to be developed where groundwater can be used following this concept.

The presentation can be found online:

Country Example, Mekong: Challenges of integrated water resources planning and management in the Mekong Delta (Nguyen Xuan Hien)

Fast development from upstream and sea level rise as an impact from climate change will certainly intensify current integrated water resources management issues in the Mekong Delta. Increased water abstraction due to increasing demand, construction of dams and sea level rise together will have direct impacts on the Mekong and its Delta, resulting in increased flooding, salinity intrusion and therefore decreased water quality. Saline intrusion threatens freshwater projects and freshwater storage, neutralizes dyke and drainage systems, and affects the duration and damages of flooding periods.

This presentation examines and assesses several combined impacts of these issues. The presentation also suggests adaptation initiatives, emphasizing the importance of a "good combination between structural measures and non-structural measures" in addressing the impacts of upstream development and climate change, with minimized investment cost. Combined adaptation measures include: making use of and improving existing structures while maintaining the diverse ecosystem of the Mekong Delta; establishing new dykes and resettlement areas; protecting and developing coastal mangroves forests; adapting crops to the potential impacts; focusing on climate change in a working agenda and in studies; creating strategic plans based on the forecasted impacts; and developing and improving the legal system on water resources management.

In conclusion, the presentation illustrates the need to continue studies to have a clearer overall picture of changes in the Mekong River and impacts on populations around the river basin in order to find measures to cope with these impacts and ensure that water demand can be met. Finally, the complexity of the issue requires closed cooperation among riparian countries as well as international assistance.

The presentation can be found online:
IV.iii Key discussion outcomes

The organisation of transboundary cooperation evolved as a main discussion topic. Coordinated transboundary emergency response in the LMB has not yet been established. A dialogue on this topic was initiated in earlier years but attention has shifted to other fields. However, along the Mekong mainstream there are hydromet stations, which measure the water volume for the region and can serve flood management work. Also, there are relevant bilateral agreements, e.g. for sharing information on flood issues between Thailand and Cambodia.

There is regular exchange and communication with upstream countries (China and Myanmar). Although mechanisms are already in place for cooperation, including with respect to reservoir management, there is always room for improvement.

Furthermore, the Tonle Sap system was emphasised as a very complex natural buffer system, in particular for flood protection. Any artificial intervention poses risks to the ecosystems as well as to the livelihoods of the population, which are difficult to assess beforehand. Also, interventions such as abstracting water from the Tonle Sap Lake during the dry season for drought management should be avoided.

Part V: Comparison between the Rhine and Mekong basins

V.i Common and different challenges and issues (group discussion)

The objective of this group discussion was to identify commonalities and differences of the Rhine and Mekong basins in order to provide the basis for further identification of areas for cooperation.

In groups of approximately ten members each, participants were asked to identify the five most relevant common challenges and issues that they had as well as the five most relevant different challenges and issues, which the participants had collected during the introductory presentations on both river basins.

The results of all groups are categorised and summarised below. Certain issues have been raised by several groups, stressing the importance of those points.
Common challenges and issues in the Mekong and Rhine basins

Topics

- Saline intrusion, flooding and inundation, low flows and droughts, biodiversity, navigation, sedimentation and delta morphology, increased variation of climate, temperature increases, impacts of climate change, land subsidence, unequal distribution of water resources in time and space, groundwater management (protection, sustainability, quality and quantity), future management of water production and water quality due to the rise of living standards

- Generally, the same topics, but there are differences in the hydrological regimes.

Research

- Scientific basis on floods and droughts, etc.; need for good data and measurements; need for financial resources based on scientific results/studies; challenge of translating knowledge from scientific information to policy

- Many open questions: How to assess drought? How to assess sea level rise and salt intrusion? How to improve downscaling techniques? How to deal with uncertainties? How to differentiate between socio-economic and climate change impacts?

Transboundary cooperation

- Both the Rhine and Mekong have river basin organisations (RBOs) and procedures/rules for transboundary water management; committees and a platform for discussions; information and knowledge sharing as common practice; harmonization of procedures/data/standards; best practice in transboundary cooperation; transboundary flood forecasting including early warning, collaboration and mutual assistance in emergencies; water management depends on public support; national adaptation strategies/instruments have been developed – a need remains for a transboundary adaptation framework/strategy; decisions on the use of the water (sectors such as industry and irrigation may use the water in dry periods)

- How to bring member countries together and to improve cooperation.

Different challenges and issues in the Mekong and Rhine basins

Natural factors

- River morphology, seasonality (also for uses), ecosystems, discharge, monsoon environment, tropical climate vs. moderate climate, fish species.
Institutional framework and cooperation history

- Different political systems of member states; with a regional legal framework, comprehensive membership of riparian states; Mekong is border river over a long stretch, whereas the Rhine flows through several countries

- Rhine: Two commissions, scientific and political; all riparian countries have been part of the governance structure; cooperation since 1950; the EU serves as overall policy umbrella; close cooperation with the upstream country (Switzerland)

- Mekong: One commission; not all riparian countries are part of governance structure; development of cooperation with China and Myanmar; different standards (e.g. for navigation).

Monitoring and data

- Rhine: Dense hydromet network, high level of using scientific monitoring systems standards

- Mekong: Sparse hydromet network, data sharing between countries still a challenge.

Financial support and mechanisms

- Financial and funding capabilities are different (adaptive capacity).

Development level and stage – influence on priority setting

- Rhine: Development in the past/almost completed; various infrastructure and protection measures along the river; management and protection topics of major concern; climate change adaptation being implemented in the Rhine basin

- Mekong: Highly dynamic development at present, the problem of land-use change; low flexibility for farming operations (Mekong Delta); climate change adaptation pilot implementation.

Low water

- Rhine: Challenge for navigation

- Mekong: Negative effects on navigation in Mekong Delta may not be an issue because of sea level rise
Water quality/protection for different uses

- Rhine: Industrial use/cooling; navigation; natural heritage (UNESCO); use of groundwater on a large scale
- Mekong: Agriculture, fisheries, no groundwater system or only on a small scale.

Approach to floods

- Rhine: Living against floods, protection measures (dyke, restraint) in place and maintained, public only aware during high water
- Mekong: Living with floods; exploration of options for protection measures; floods needed for agriculture/fisheries.

Part VI: Climate change adaptation strategy

VI.i Mekong adaptation strategy (presentation)

Roadmap to formulate the Mekong Adaptation Strategy and Action Plan (MASAP) (Nguyen Huong Thuy Phan)

The Mekong Adaptation Strategy and Action Plan (MASAP) is an important output required for the MRC’s CCAI in the period of 2011-2015. The MASAP will establish strategic adaptation priorities and actions for transboundary climate change adaptation of the MRC. These strategic actions will be addressed in the MRC 2016-2020 Strategic Plan. The MASAP will be reviewed and updated every five years, following the five-year planning cycle of MRC.

At the national level, each MRC Member Country has developed its own national adaptation plan in order to address the impacts of climate change and vulnerability. CCAI will therefore conduct a policy review exercise to identify the entry point for transboundary adaptation actions as well as to make sure that the basin-wide adaptation strategy will not cause conflict but rather add value at the national level. At the regional level, ASEAN’s Adaptation Strategy (2012) is in place and focuses on sharing information and developing a work programme to address loss and damage, mitigation, issues on finance and investment, transfer of technology and capacity building. MRC is cited as a regional organisation to be cooperated with on climate change adaptation. According to a CCAI’s preliminary review, at the international level in Asia, Mekong is the only river basin that aims to have adaptation strategy. In North and South America, there are no
adaptation strategies. In Africa, the Nile is the only river basin with adaptation strategy, whereas four river basins in Europe have or are developing their adaptation strategy.

At the MRC, the Basin Development Strategy (BDS) and the MRC Strategic Plan (SP) are key tools for adaptation to climate change. MASAP will guide the way to integrate climate change adaptation into the BDS and the MRC SP. Therefore, the roadmaps for updating the BDS 2016-2020 and formulating the MASAP 2016-2020 must be linked. In the formulation of the MASAP, considerations will be given to: information on impact and vulnerability assessment; climate change scenarios for the next 30, 60, 100 years; agreement and synergies with national climate change adaptation strategies; and continuous updating of the adaptation plan. The process of MASAP formulation is in line with the CCAI Adaptation Planning and Implementation Framework. Stakeholder engagement, capacity building and decentralisation of core functions are considered in the whole process. Mechanisms on the formulation include the active involvement of all MRC Programmes, especially the Basin Development Programme (BDP), the CCAI Regional Technical Working Group (RTWG), national consultations, the MRC Informal Donor Meeting and Donor Consultative Group, the MRC Joint Committee and MRC Council. For the timeframe, there are four stages, i.e. preparation (which is where we are at present), formulation, finalisation and approval, which is targeted for December 2015.

The presentation can be found online:

**V.ii Rhine adaptation strategy (presentation)**

**Towards an Adaptation Strategy in the Rhine Catchment (Ben van de Wetering)**

Changes in climate values do have an impact on hydrological processes and the water regime. Accordingly, in 2007, the Conference of Rhine Ministers requested the ICPR to carry out the “Study of Scenarios for the Discharge Regime of the Rhine” and subsequently in 2013, to develop an adaptation strategy.

Following a review of available literature in 2009 (ICPR Report No. 174), a study on the direct effects of climate change on the water regime was published in July 2011 (ICPR Report No. 188). The results in the form of discharge scenarios for 2050 and 2100 resulting from climate scenarios have been evaluated within the different ICPR working groups with a view to assessing potential effects on ecology (ICPR Report No. 204) and on the water quality of the Rhine as well as on the risks of floods and low water.
Accordingly, the possible impact on different uses (e.g. during floods and during low flow combined with high temperature) is being assessed as well as possible measures to reduce these impacts. This assessment will be the basis for a preliminary adaptation strategy for the Rhine and its catchment, which should be finalized by the end of 2014.

The presentation can be found online: http://www.chr-khr.org/sites/default/files/chreventdocuments/part_6_roadmap_rhine.pdf

VI. iii Key discussion outcomes

Although the adaptation strategies of the two basins are being developed with a comparable approach, the starting points are different. Substantial basin-wide research has already been conducted on the Rhine and has just started on the Mekong.

The strategic focus is also different. One field that has already been analysed for the Rhine is water temperatures and assessment of possible changes in water temperature. These are of particular importance for power production because the river water is used for cooling purposes and for drinking water supply.

With respect to impact studies, to date, the MRC has investigated impacts of climate change on wetlands as well as impact on irrigation and agriculture, but not yet on water temperatures. However, the water temperatures in the Mekong are already within a much higher range than in the Rhine, and aquatic species might also be less sensitive to higher temperatures.

The adaptation strategy of the LMB is being developed to be linked to the Mekong Basin Development Strategy. In the Rhine basin, there are two umbrella conventions: The Rhine 2020 Action Programme and EU legislation (Water Framework Directive, Floods Directive, etc.).

The timeframe for the Rhine adaptation strategy is governed by the Water Framework Directive. Once every six years, a river basin management plan must be issued. The second plan, which is due in draft version in 2014, also includes the issue of climate change.

With respect to the uncertainty of climate change impacts, it emerged that it is difficult to derive recommendations for policy makers from assessment conclusions. There are, in principle, three types of responses:

- Do nothing and wait until impacts become apparent, which is not reasonable since it may later require very large investments within a very short time period.
- Prepare for the worst case scenario, which may not be an economic solution.
• Follow a no-regret and flexible adaptation strategy, which allows action despite uncertainty.

Part VII: A comparative overview of the Rhine and the Mekong (presentation)

Comparative overview of climate change and ways toward an adaptation strategy in the Rhine and Mekong basins (Kai Gerlinger)

To face the challenges posed by climate change through an effective adaptation strategy, a knowledge basis on the nature of climate change and related risks is needed. In order to avoid superfluous investments, transboundary cooperation of nations within one single catchment is desirable.

The first step in a comprehensive approach to adapt to climate change is therefore the identification of current transboundary knowledge on past and future climate change. Such review documents are available (Rhine basin) or are currently being prepared (Mekong basin) in both basins.

The temperature record analyses collected within this context on the Mekong and Rhine basins already show the influence of past climate change. Ranges of detected temperature increase are of the same order of magnitude in both basins. Reviewed changes in precipitation records are unequivocal, and no clear trends can be identified.

Projections of future climate change are usually obtained by a model chain consisting of an emission scenario, a general circulation model, possibly a downscaling procedure, and eventually, different impact models. There is already a broad variety of such climate projections for both basins.

The most recent, comprehensive climate projections available for the entire globe and thus allow a direct comparison of results for both basins are the projections presented in the Intergovernmental Panel on Climate Change’s (IPCC) Fifth Assessment Report (AR5).

The median of these projections points towards slightly stronger future temperature increases in Central Europe than in South-East Asia. Precipitation projections are highly heterogeneous for both regions, with a larger inter-model range covered in South-East Asia. The median of all projections indicates slight precipitation increases for both regions in their respective wet seasons.
Possible hazards deduced from climate change are considered in the AR5 – on a very large spatial scale – as comparable to both basins to some extent. The resulting risks are, however, more substantial in the LMB.

IPCC AR5 delivers coherent results for mean trends deduced from global circulation models. For effective regional and local adaptation, these results are too general. However, if a downscaling towards a higher spatial resolution is undertaken, the uncertainty and complexity of the results increases. Also, mean changes in climate parameters – such as described above for both regions – are interesting, but at the same time, information on extreme events is relevant for the development of an adaptation strategy. Projections of extreme events also show higher uncertainty and complexity. In order to increase adaptive capacity in different sectors, information on changing climate does not suffice. There is additionally a need for a model chain, which include impact models to assess the consequences of climate change. This extended model chain also implies growing uncertainties and complexities.

Although the Rhine and Mekong basins have many different characteristics, the way towards an adaptation strategy is similar. In both basins, several steps have already been undertaken from the analysis of climate and hydrological change via the assessment of its impacts towards policy issues of adaptation. Some examples are the above-mentioned literature reviews that build the foundation for further steps. Other steps are currently initiated and ongoing. It should be kept in mind that the approach towards adaptation is not a straight, linear procedure; instead, different steps must be tackled by appropriate measures at the same time.

The understanding that the approach to adaptation may be similar in both catchments offers possibilities for knowledge exchange and cooperation. Ultimately, the fact that climate change assessment is always associated with considerable uncertainties should not prevent decision making.

The presentation can be found online:
http://www.chr-khr.org/sites/default/files/chreventdocuments/part_7_comparative_climate_change_overview_0.pdf

Key discussion outcomes

It was clarified that the impact model and an impact assessment are usually applied and carried out together. However, the impact assessment must not necessarily be based on a modelling approach. One example is the Social Impact Monitoring and Vulnerability Assessment (SIMVA) study conducted by MRC based on surveys.
Part VIII: Areas for cooperation

Areas of joined cooperation (group and panel discussion)

This group discussion was intended to identify possible areas of cooperation between the Rhine organisations and the Mekong River Commission on the way towards respective climate change adaptation strategies.

The previous presentation formed the knowledge basis for the group discussion, in which the approach towards an adaptation strategy was identified. The different working steps of the approach were grouped under three different topics and separate groups were tasked with identifying potential areas of cooperation for each of these three topics (see also Figure 1).

- Group 1: Climate and hydrological changes and assessment including flood and drought
- Group 2: Addressing climate change impacts and assessment in water-related sectors
- Group 3: Transboundary and policy issues in climate change adaptation

Three common guiding questions for all groups identified:

- What has been achieved to date?
- What is currently taking place?
- What are the starting points and the issues for cooperation?

The results elaborated by all working groups were presented and discussed in a panel discussion. The outputs are summarised below.

Figure 1. Group division based on the working steps of an approach towards an adaptation strategy
Group 1: Climate and hydrological changes and assessment including flood and drought

Facilitators: Wolfgang Grabs and Thanapon Piman

The group discussion topics included historical hydro-meteorological data (including trend analysis and reanalysis data), climate change indicators, climate projections and hydrological modelling.

Generally, the current status of work on these topics in both basins was first briefly reported, and then followed by a comparison of further relevant concerns and necessary working steps. There were some key challenges identified for each field, which have to be tackled in both river basins. This forms the basis for potential cooperation, although the natural, socio-economic and political preconditions may differ substantially.

The following issues have been agreed upon by members of Group 1:

**Data issues**
- Data quality management: Storage and access to data, Preparedness of member countries to share information
- Concern: diminishing information collected from private operators of dams and reservoirs.

**Issues relating to indicators**
- How to measure climate change and characterize adaptation impacts
- The development of robust indicators
- Definition of threshold levels.

**Climate projections**
- Comparable approaches to dynamical downscaling
- Fostering of cooperation with centres of excellence in riparian countries
- Comparable approach to the selection of models
- Strengthening of decadal observation-driven projections.

**Water balance model**
- Use of hydrological ensembles
- Cooperation on modelling
- Strengthening of information on consumptive water use for water resources management
- Development of a dynamic approach to water resources assessment.
Group 2: Addressing climate change impacts and assessment in water-related sectors

Facilitators: Johannes Cullmann and Tran Mai Kien

The facilitators proposed the group to discuss potential impacts of climate change by sectors and pay attention to priority sectors for each river basin, with the aim of identifying common issues rather than differences as in the previous group discussion. The discussion was also facilitated, with an orientation towards the possibility for taking adaptation actions and by comparing the two basins to draw on lessons learned.

The priority sectors proposed and agreed on by participants were: agriculture and fisheries, which are linked to food security and considered the most important for the Mekong but not much for the Rhine; navigation, which is considered the most important for the Rhine and having high potential in different parts of the Mekong; and the environment, which includes water quality and biodiversity. The most serious and common risks are extreme events leading to flood and droughts, sea level rise (for the deltas and estuarine/coastal zones of both river basins) and environmental degradation.

The participants from the Mekong basin began discussions on the impact of climate change on fisheries (both captive fisheries and aquaculture) since such impacts may cause fish populations and the number of fish species to decrease. They also added that an increase in temperature can adversely affect habitats, breeding zones and fish feed, which in turn can lead to changes in migration pattern or shift to new habitat. At the same time, the participants from Rhine stated that fish was not an issue for the Rhine.

The group also discussed the climate change impact on food security and emphasized that this issue is very broad and interconnected with many sectors. They mentioned that climate change can cause outbreaks of diseases affecting crop and fish. Another impact of climate change is a change in water flow and sea-level rise, which leads to salinity intrusion, land degradation and erosion in the Mekong Delta; the most serious negative impacts will be on agricultural production. One of the solutions was to build dyke and salinity preventive sluice systems to prevent water intrusion, while at a small scale (e.g. in Mekong Delta), natural coastal protection by mangrove forest can be effective to some extent.

Navigation was another topic that the group brought to the discussion. The Mekong group recognized that overall in the Mekong, climate change is not a major issue since there is enough water for navigation in both dry and wet seasons in most of the navigable zones. On the other hand, the Rhine group emphasized that climate change-
related extreme water level and flow (very high or very low) may cause a strong impact on the navigation. During the dry and low-water level period, shipping may be difficult due to narrow waterways, while during flood time, transportation is difficult because the ships can be damaged by hitting bridges or debris. This has led to rising prices for shipment during recent decades in Europe.

In addition to above-mentioned topics, water quality was raised during the discussion. The Mekong group mentioned that poor water quality in the Mekong Delta is likely to result from factories, agriculture and aquaculture, not from climate change. Unlike the Mekong, water quality in the Rhine River is very good, but in some sections it has been affected by thermal power plants located along the river, which use the river water as cooling water and release it directly to the river. This causes water temperature downstream of this area to increase, which can be harmful to biodiversity and fish in the river.

The Rhine group suggested carrying out concrete follow-up actions for potential collaboration with the Mekong, for example, to conduct studies water volume, modeling and joint research. Both groups suggested a possible collaboration between Mekong and Rhine for knowledge and technology transfer. The facilitators suggested having a mailing lists of all participants of this group (and possibly for all participants of the Symposium) to share findings and to establish a voluntary group with representatives from both Mekong and Rhine to list a number of potential collaboration options. Accordingly, four members volunteered: (i) Dr. Kien from CCAI/MRC; (ii) Mr. Paramin from Thailand National Mekong Committee; (iii) Ms. Menke from CHR; and (iv) Dr. Cullmann from BfG.

**Group 3: Transboundary and policy issues in climate change adaptation**

*Facilitators: Hans Moser and Nico Bakker*

The key outputs of the discussion of Group 3 were formulated as follows:

1) Climate change is of a basin-wide characteristic and affects all riparian countries. This creates the need to have a regional climate change adaptation strategy that reflects a common view among riparian countries.

2) At present, there is an adaptation policy/strategy in the Mekong region at the national level, which may neglect the importance of transboundary issues. For this reason, a transboundary or basin-wide adaptation strategy is required. Countries would need to share their documents on national climate change adaptation strategies.
3) For transboundary cooperation, there is a need to agree on an approach and methodology for climate change adaptation and on results in order to be able to bring the message back to the individual countries. It is important to bring the member countries into the transboundary discussion; countries should not only focus on the national priorities, but also on transboundary concerns.

4) There is a need for a common transboundary perspective before drafting a transboundary strategy, for instance, clarification on what needs to be protected and a definition of the area of cooperation.

5) Since knowledge is constantly expanding, we have to think in terms of processes. There must be a certain level of knowledge on the function of the river system to start and take actions. Knowledge gaps will be filled from time to time, and the climate change adaptation strategy should be updated.

6) In order for member countries (MRC) to accept the assessment results/ findings of studies, a participatory approach should be applied.

7) Agreements by consensus may take long; as an ICPR representative put it “for the Rhine we discuss until we agree”.

8) The following area of cooperation is proposed:

   Exchange of knowledge and experiences in the Rhine and Mekong river basins on regional cooperation among the riparian countries in climate change adaptation and in the approach of formulating the climate change adaptation strategy.
ANNEX 5  SPEAKERS’ PROFILES

PART 2: Common knowledge on both catchments

Introduction to both catchments and transboundary cooperation – Rhine

MANFRED SPREAFCO
Former President of CHR

Manfred Spreafico studied at the Department of Civil Engineering of the Federal Technical University at Zurich. In the past, he was Head of the Swiss National Hydrological Survey and now a professor at the Institute of Geography, University of Berne, as well as former President of the International Commission for the Hydrology of the Rhine Basin. Furthermore, he worked as Chairperson, Secretary and member of committees as well as of working groups in the fields of hydrology and IWRM in national and international organizations and institutions. He also has experience as a lecturer, trainer, project manager and project member in over 60 countries. He still works as a consultant for Integrated Water Resources Management, specialized in hydrometeorology, flood and sediment management.

Introduction to both catchments and transboundary cooperation – Mekong

TIEN TRUONG HONG
Director of the Environment Division, MRC Secretariat

Tien Truong Hong holds a degree in irrigation and drainage engineering from the Moscow Water Resources University, a Master’s degree in water resources development from the Asian Institute of Technology, and a doctorate degree in civil engineering and environment from Nagoya University, Japan, where he conducted post-doctoral studies in soil and groundwater contamination and remediation. In the past, he worked at the Viet Nam National Institute for Agricultural Planning and Projection, at the Regional Flood Management and Mitigation Programme of the MRC Secretariat, and as Deputy Director-General at the Viet Nam National Mekong Committee. Currently, he is the Director of the Environment Division of the MRC Secretariat.
PART 3: Common knowledge of the Rhine and country examples

Overview of current work of CHR, BfG and ICPR on climate change in the basin

ERIC SPROKKEREEF
International Commission for the Hydrology of the Rhine

Eric Spokereef is a civil engineer. He started working at Rijkswaterstaat as a technical assistant within the Secretariat of the International Commission for the Hydrology of the Rhine basin (CHR) and has over 25 years’ experience in operational river flood and drought forecasting for the Netherlands, first as member of the forecasting group and since 2000, as head of the Dutch river forecasting centre. Since 2002, he has worked as Secretary of the CHR. He was active in several international cooperation projects such as the European Flood Foresting System, the WMO RAVI Subgroup on Flood Forecasting and Warning, the EU working group Exchange Circle on Flood Forecasting and the European Flood Awareness System (EFAS). Furthermore, he is the project leader for the cooperation between the Netherlands and China on Flood Management and Protection.

SEBASTIAN KOFALK
Federal Institute of Hydrology, Germany

Sebastian Kofalk holds a PhD in agricultural sciences. Since 1999 he has been working at the German Federal Institute of Hydrology as Head of the project group Elbe-Ecology, among other roles. Currently, he is responsible for the management of the project KLIWAS. This project analyses the potential consequences of climate change for navigation on inland and coastal waterways, and formulates appropriate strategies for adaptation.
Adrian Schmid-Breton is a geographer with a specialization in natural risk management. Since 2010, he has been working as a scientific assistant within the Secretariat of the International Commission for the Protection of the Rhine, supporting and coordinating the international working group ‘Floods’ and its expert groups on transboundary flood risk management and climate change adaptation. He is particularly interested in integrated management, socio-economical, environmental and risk aspects of international rivers.

Ralph Schielen obtained his PhD in applied mathematics. Since 2000, he has been working for Rijkswaterstaat as an expert in river hydraulics and morphology. Between 2000 and 2005 he was involved in policy studies along the river Meuse in the Netherlands. Subsequently, he participated in the Room for the River project. Currently, he works for the Deltaprogramme (Subprogramme Rivers), whose aim is to keep the Netherlands a safe and reliable country to live in and to work in for the long term (up to 2100), taking into account the effects of climate change. He also holds a position for one day a week as associate professor at Twente University, at the Department of Civil Engineering and Management.

Enno Nilson holds a degree in Geography, Geology, Soil Science and Forestry from the University of Bonn and a doctorate in Physical Geography. Since 2007, he has worked as a researcher at the German Federal Institute of Hydrology. Within the Water Balance, Forecasting and Predictions (BfG-M2) Department, he is responsible for research and consultancy in the fields of water-related aspects of climate change. He coordinated the research activities on inland hydrology within the German research programme KLIWAS between 2007 and 2013.
PART 4: Common knowledge of the Mekong and country examples

Overview of current work of MRC on climate change in the basin

NGUYEN HOUNG THUY PHAN
*MRC’s Climate Change and Adaptation Initiative (CCAI)*

Phan Nguyen is the Programme Coordinator at MRCS in charge of the Climate Change and Adaptation Initiative, a regional cooperation initiative of the MRC to assist the Member Countries in policies and actions concerning climate change adaptation issues of the Lower Mekong Basin. She has a Doctorate in Engineering in Water Resource Development. She is a hydraulic engineer and a hydrodynamic and morphological modeller with over 20 years of combined experience in hydropower development projects, coastal engineering projects, and climate change risk assessment projects.

NICO BAKKER
*MRC’s Flood Management and Mitigation Programme (FMMP)*

Nico Bakker is the International Technical Advisor of MRC’s Flood Management and Mitigation Programme. He is a civil engineer and has worked for 27 years for the Netherlands’ Ministry of Transport, Public Work and Water Management. In parallel, he worked as a Water Management Specialist for the Netherlands’ Ministry of Foreign Affairs for international assignments for 18 years. He has joined the MRC since 2005.
H.E. Mr. KOL VATHANA
Deputy-Secretary General and National Coordinator for MRC’s Climate Change and Adaptation Initiative Programme (CCAI), Cambodia National Mekong Committee (CNMC), Cambodia

H.E. Mr. Kol Vathana holds a degree in forest science from the Royal University of Agriculture, Cambodia, and a degree in soil science from the University of Gent, Belgium. He worked for the Department of Forestry and Wildlife, Cambodia, as well as for the Department of Nature Conservation and Protection of the Cambodian Ministry of Environment. For the past 11 years he has been working for Mekong cooperation in the Cambodia National Mekong Committee (CNMC), where he is now Deputy Secretary-General and National Coordinator for the MRC Climate Change and Adaptation Initiative.

VANXAY BOUXTANAVONG
Deputy Director of the Climate Change Adaptation Division, Department of Disaster Management and Climate Change, Lao PDR

Mr. Vanxay Bouttanavong holds degrees in agriculture and business administration. He is Deputy Director of the Climate Change Adaptation Division in the Department of Disaster Management and Climate Change of the Ministry of Natural Resource and Environment of Lao PDR. For the past five years, he has been working on various climate change issues.

CHAIPORN SIRIPORNPIBUL
Deputy Director-General, Department of Water Resources, Ministry of Natural Resources and Environment, Thailand

Mr. Chaiporn Siripornpibul holds a degree in Geology from Chiang Mai University and a degree of Public Administration from Sripathum University, Thailand. From 2002 to 2010 he was Director of the Bureau of Groundwater Conservation and Restoration in the Department of Groundwater Resources of Thailand. Since 2010, he has been Deputy Director-General of the Department of Water Resources of the Ministry of Natural Resources and Environment of Thailand.
Mr. Nguyen Xuan Hien is a senior hydraulic modeller in the Southern Institute for Water Resources Planning in Viet Nam. He has extensive experience in working with hydraulic models. He has applied the VRSAP model for simulations of hydraulics and of salinity intrusion in many water resources projects in the Mekong Delta. In addition to his modelling experience, Mr. Hien also has many years of experience in water resources planning and management.

PART 6: Formulation of transboundary climate change adaptation strategy

NGUYEN HOUNG THUY PHAN
MRC’s Climate Change and Adaptation Initiative (CCAII)

See above
PART 7: Rhine-Mekong cooperation

Ben van de Wetering graduated as a chemical engineer at the Technical University Enschede in the Netherlands in 1975. He started his career at the National Institute for Public Water Supply. Then he worked for the National Institute for Inland Water Management and Waste Water Treatment. At this institute, he started his international career in 1984 as a national delegate in several international fora. In 1995, he was appointed as Executive Secretary of the OSPAR Commission on the Protection of the Marine Environment of the North East Atlantic. In the period 2001-2005, he was one of the lead authors at the European Commission for developing the European Marine Strategy Directive. In 2007, he was appointed Secretary General of the International Commission for the Protection of the Rhine.

Kai Gerlinger holds a PhD in engineering. From 1997 until 2007, he was employed as head of the Hydrology Department at Dr.-Ing. Karl Ludwig Consulting Engineers Hydraulics and Hydrology Engineering. His work included the development, programming and application of hydrological models in national and international contexts.

Since 2008, he has been the Director of HYDRON GmbH Hydrological and Environmental Consulting and Engineering. In 2013, he worked as a consultant to support MRC with respect to the technical aspects of flood management and climate change modelling. Furthermore, he conducted for MRC and ICPR literature reviews to distil currently available knowledge on the impacts of climate change on the water environment of the Rhine and Lower Mekong Basins.
ANNEX 6 | SELECTED SYMPOSIUM PHOTOS

Opening session of the Symposium. THE SECRETARIAT

Welcome address by the host (BfG). THE SECRETARIAT
Introduction on both catchments and the transboundary cooperation (Part 2). THE SECRETARIAT
Overall atmosphere in the Symposium. THE SECRETARIAT
His Excellency Te Navuth thanks CHR and ICPR for their welcome and hospitality extended to the Mekong delegates.
Exhibition activities. THE SECRETARIAT

His Excellency Te Navuth thanks CHR and ICPR for their welcome and hospitality extended to the Mekong delegates. THE SECRETARIAT