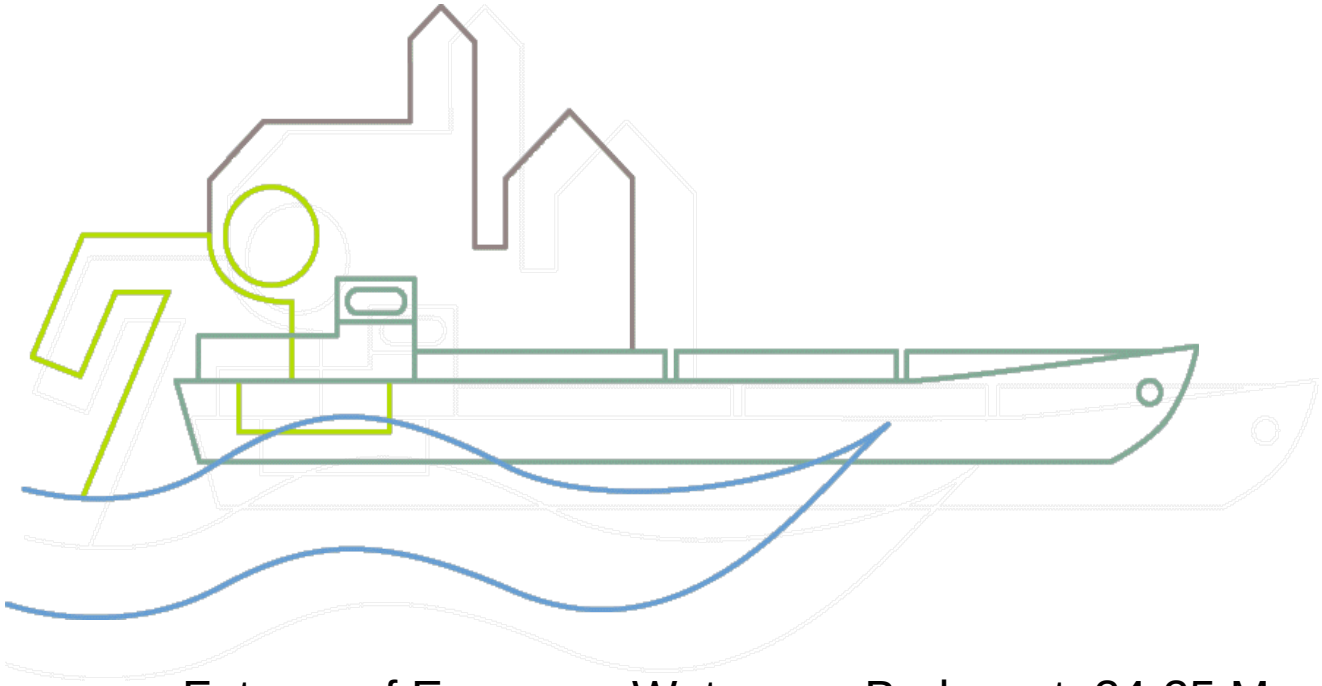


Futures of European Waters – Budapest 24-25 March 2011

Impacts of climate change on water resources - a European perspective in a changing world

Hans Moser
Division M – Quantitative Hydrology

Thomas Maurer
Department M2 - Water Balance, Forecasting and Predictions

Bundesanstalt für Gewässerkunde, Koblenz, Germany

Outline

Summary of EurAqua Symposium, 9 - 10 November 2010, Koblenz

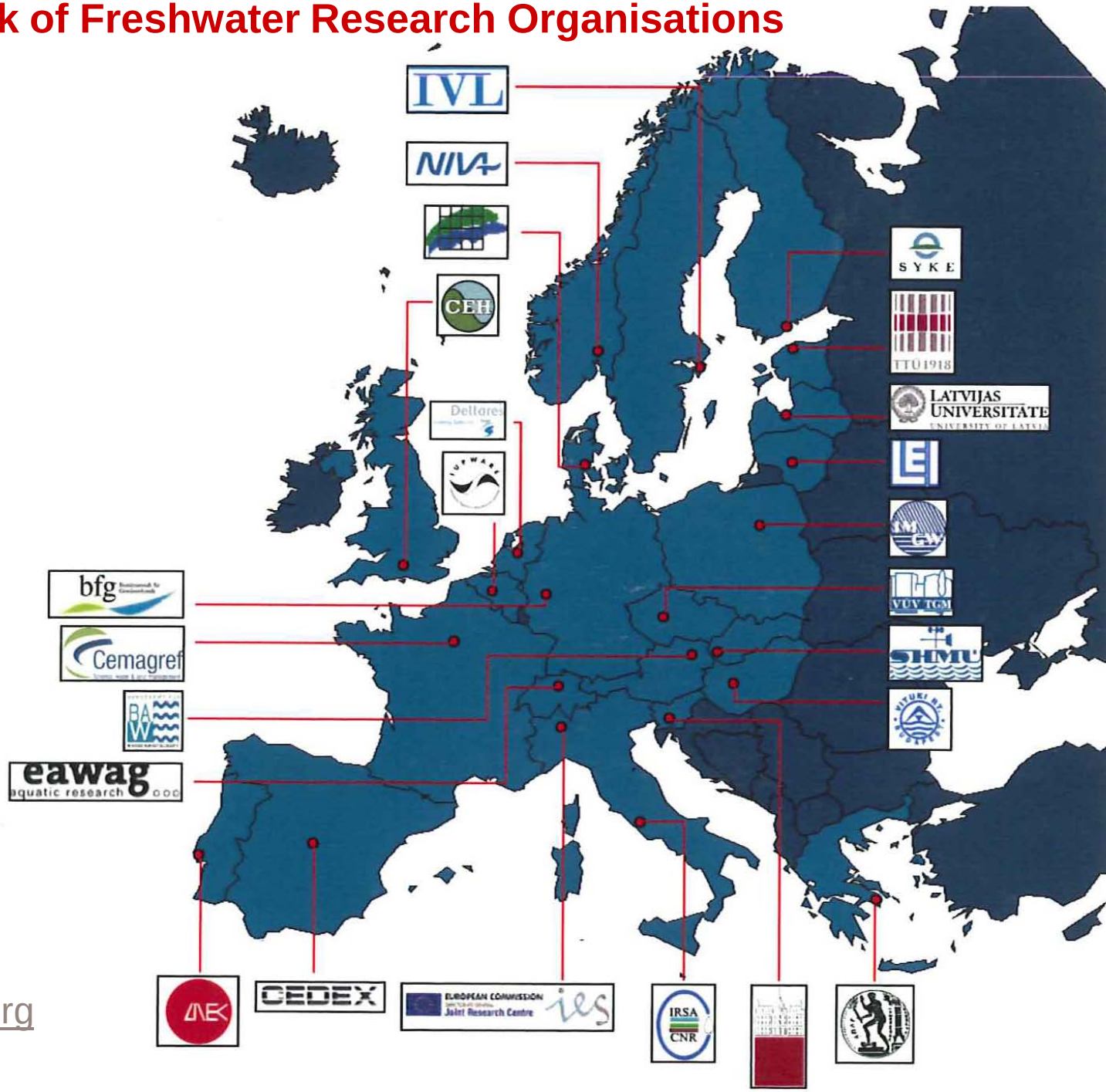
Case study Rhine: KLIWAS and the KHR-RheinBlick2050 project

Some take-home-messages / teasers for discussion

European Network of Freshwater Research Organisations

EurAqua

„EurAqua is the leading network for facilitating improved and co-ordinated water research, in support of knowledge-based water management and policy.“



http://www.euraqua.org

EurAqua Symposium

Impact of climate change on water resources – 200 years hydrology in Europe – a European perspective in a changing world

9 - 10 November 2010

German Federal Institute of Hydrology (BfG)

Koblenz, Germany

Bundesanstalt für Gewässerkunde

(Federal Institute of Hydrology)

Koblenz, Germany

Bundesanstalt für Gewässerkunde

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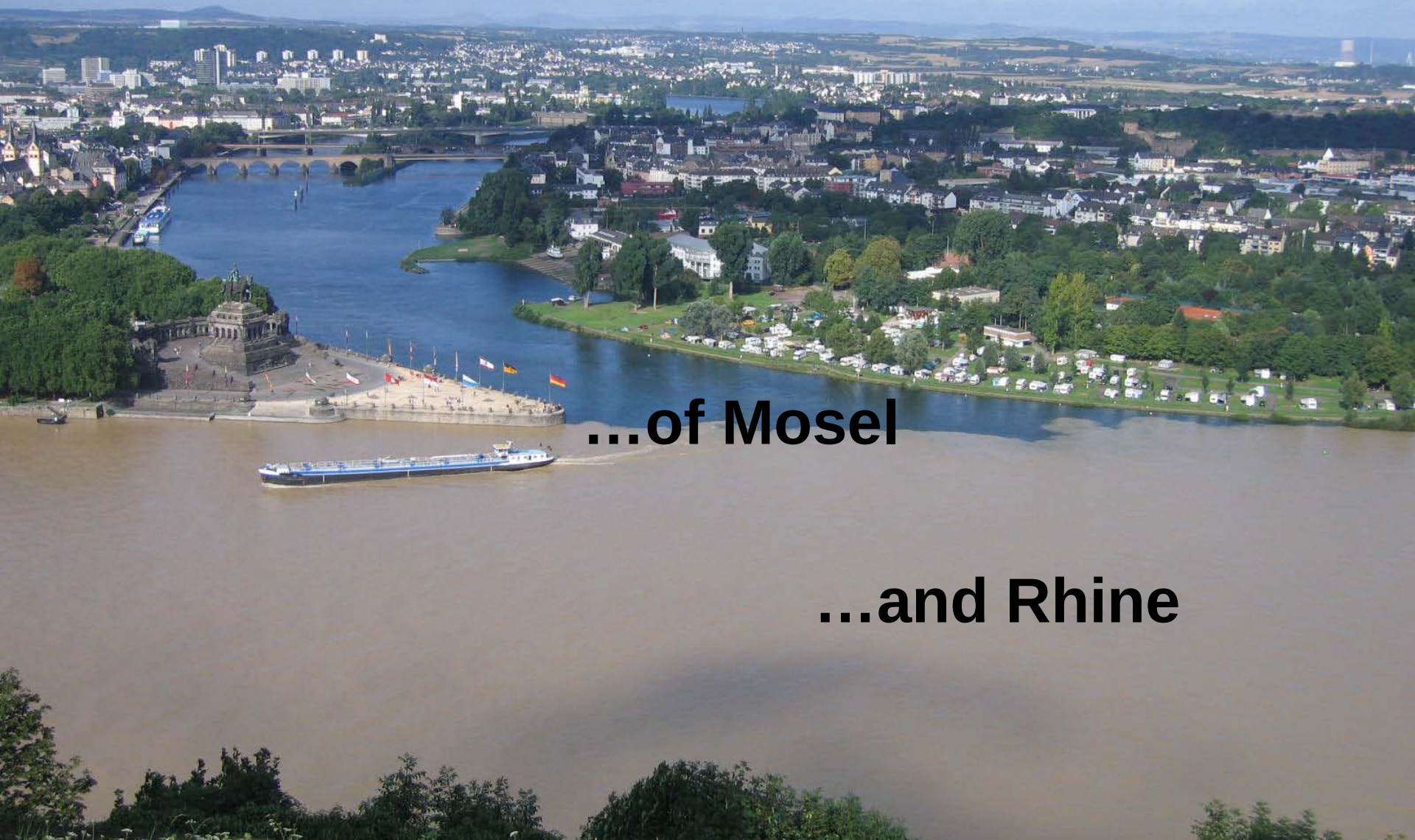
Koblenz = (lat.) **Confluence…**



…of Mosel

…and Rhine

EurAqua Symposium, Koblenz, 9 - 10 November 2010

EurAqua is the leading network for facilitating improved and co-ordinated water research, in support of knowledge-based water management and policy.

Germany is facing a 200 years official experience in hydrology started in 1810 by the enactment of the first gauging instructions. Reliable hydrological data in entire Europe is the prerequisite of scientific research. Hence the symposium will compile the state of the art and knowledge by the EurAqua-Partners regarding scientific policy advice and research on climate change and impacts. It will focus on inland waters with four themes.

The BfG contribution is based on the departmental research programme KLIWAS (www.kliwas.de). It is embedded in the national strategy on adaptation to climate change. The main objective of KLIWAS is to develop adaptation options for potential changing conditions for navigation but also other ecosystem services.

The symposium will give a historic retrospect on hydrology in Europe, an overview on strategies, existing research projects and results. It will reveal knowledge gaps and fields of research for mutual co-operation and proposals to .the EC.

Programme

Tuesday, 9 November 2010

13:00 **Welcome**
Michael Behrendt, Federal Institute of Hydrology (BfG), Germany

13:10 **Water and climate change in Europe: think global, act local, and work together at European level**
Jean Philippe Torterotot, Chair of EurAqua, Cemagref, France

1 **200 years hydrology in Europe – a European perspective in a changing world**

13:30 **Long-term time series and political advisory**
Hans Moser, BfG, Germany

13:50 **200 years of hydrology in France**
Pierrick Givone and Pierre Hubert, French National Committe of Hydrological Sciences (CNFSH), France

14:10 **Floods and droughts – the shape of things to come?**
Alan Jenkins, Centre for Ecology and Hydrology (CEH), United Kingdom

14:30 **River science in the light of climate change**
Huib de Vriend, Deltares, The Netherlands

14:50 *Discussion*

15:05 *Coffee break with snacks*

2 **Research efforts on climate projections and scenarios for water balances and run-off regimes**

15:50 **Ensemble- and multi-model-based low flow projections of the impact of climate change for the River Rhine within the research programme KLIWAS**
Thomas Maurer, BfG, Germany

16:10 **The RheinBlick2050 and Imagine2030 projects: a perspective on the hydrological impacts of climate change in two river basins in Europe**
Charles Perrin, Cemagref, France

16:30 **Climate change impact on mean annual river flows**
Mitja Brilly, University of Ljubljana, Slovenia

16:50 **The challenge of water balances and run-off projections in the Mediterranean hydrology**
Ivan Portoghese, Water Research Institute, National Research Council (IRSA-CNR), Italy

17:10 **Climate change impact on the river runoff series in the Baltic countries (past and future)**
Jurate Kriauciuniene, Lithuanian Energy Institute, Lithuania

17:30 **Discussion**

17:50 *End of first day*

19:30 *Evening meeting in a Koblenz restaurant*

Wednesday, 10 November 2010

9:00 **Preparing water-scenario's for the Dutch Delta Programme**
Ad A.B.M. Jeuken, Deltares, The Netherlands

3 **Research efforts on climate projections and scenarios for water quality**

9:20 **Impact of climate change on the pattern of organic contaminants in rivers**
Thomas Ternes, BfG, Germany

9:40 **Impact of climate change on freshwater ecosystems**
Nikolai Friberg, Niels B. Ovesen et al., National Environmental Research Institute (NERI), Denmark

10:00 *Discussion*

10:20 *Coffee break*

4 **Research efforts on climate projections and scenarios for rivers ecology**

10:50 **Climate change effects on the ecology of the large River Elbe**
Helmut Fischer, BfG, Germany

11:10 **Diadromous fish and climate change – a case study of the integration of projective distribution maps into the decision-making process**
Eric Rochard, Cemagref, France

11:30 **Climate change impact assessment on the ecological status of Spanish water bodies**
Manuel Toro, CEDEX, Spain

11:50 **Scenarios for water availability in Europe - SCENES results**
Seppo Rekolainen, Finnish Environment Institute (SYKE), Finland

12:10 *Discussion*

12:30 **General Discussion and outcomes: knowledge gaps and research tasks**
Hans Moser, BfG, Germany

13:00 **Symposium closure**

EurAqua Symposium, Koblenz, 9 - 10 November 2010

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Four Sessions:

(1) 200 years hydrology in Europe

Research efforts on climate projections and scenarios

(2) for water balances and run-off regimes

(3) for water quality

(4) for rivers ecology

EurAqua

quantity

Rhine

Garonne

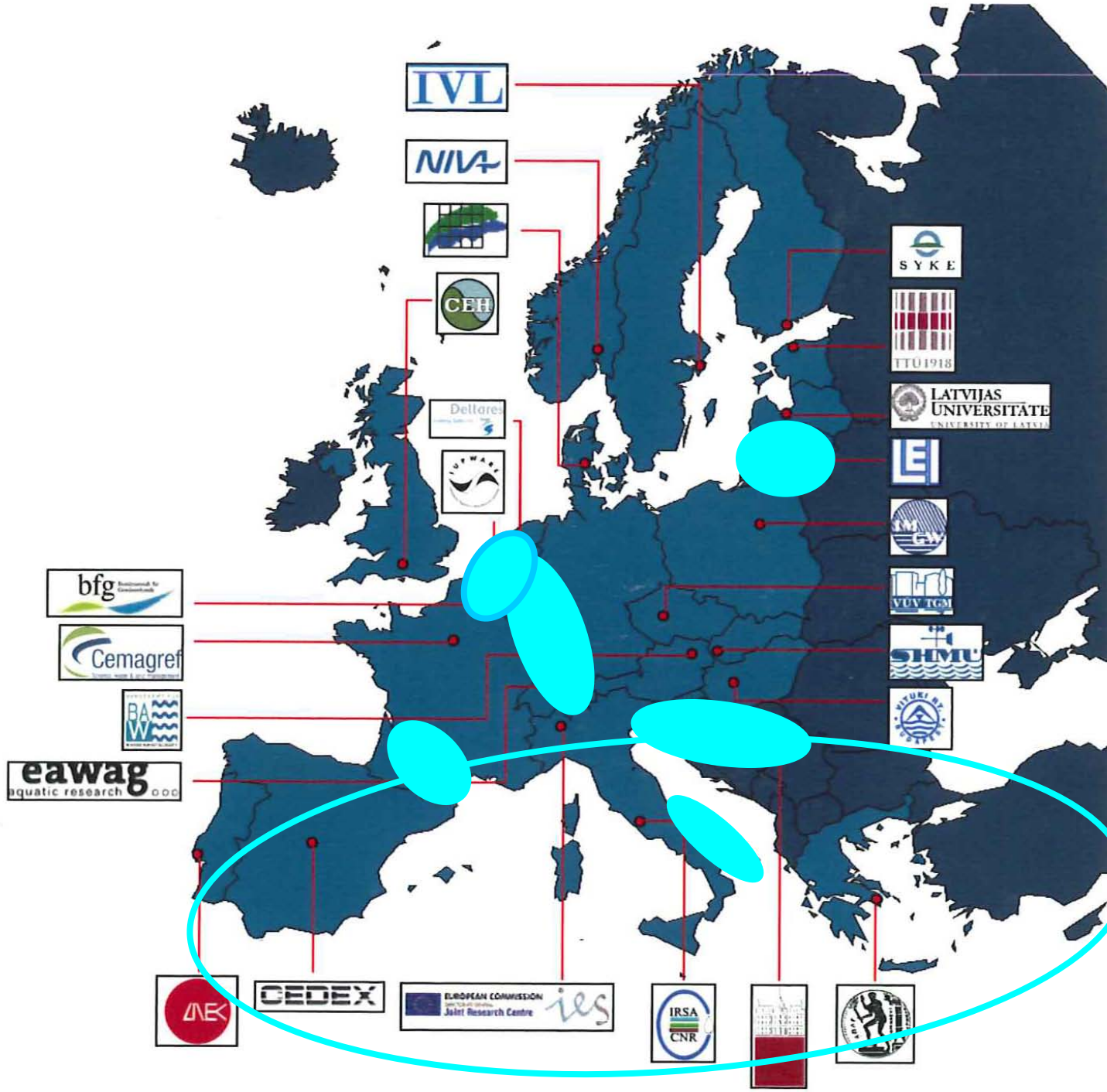
Sava

Mediterranean GW

Apulian GW

Nemunas

Netherlands



EurAqua

quantity

quality

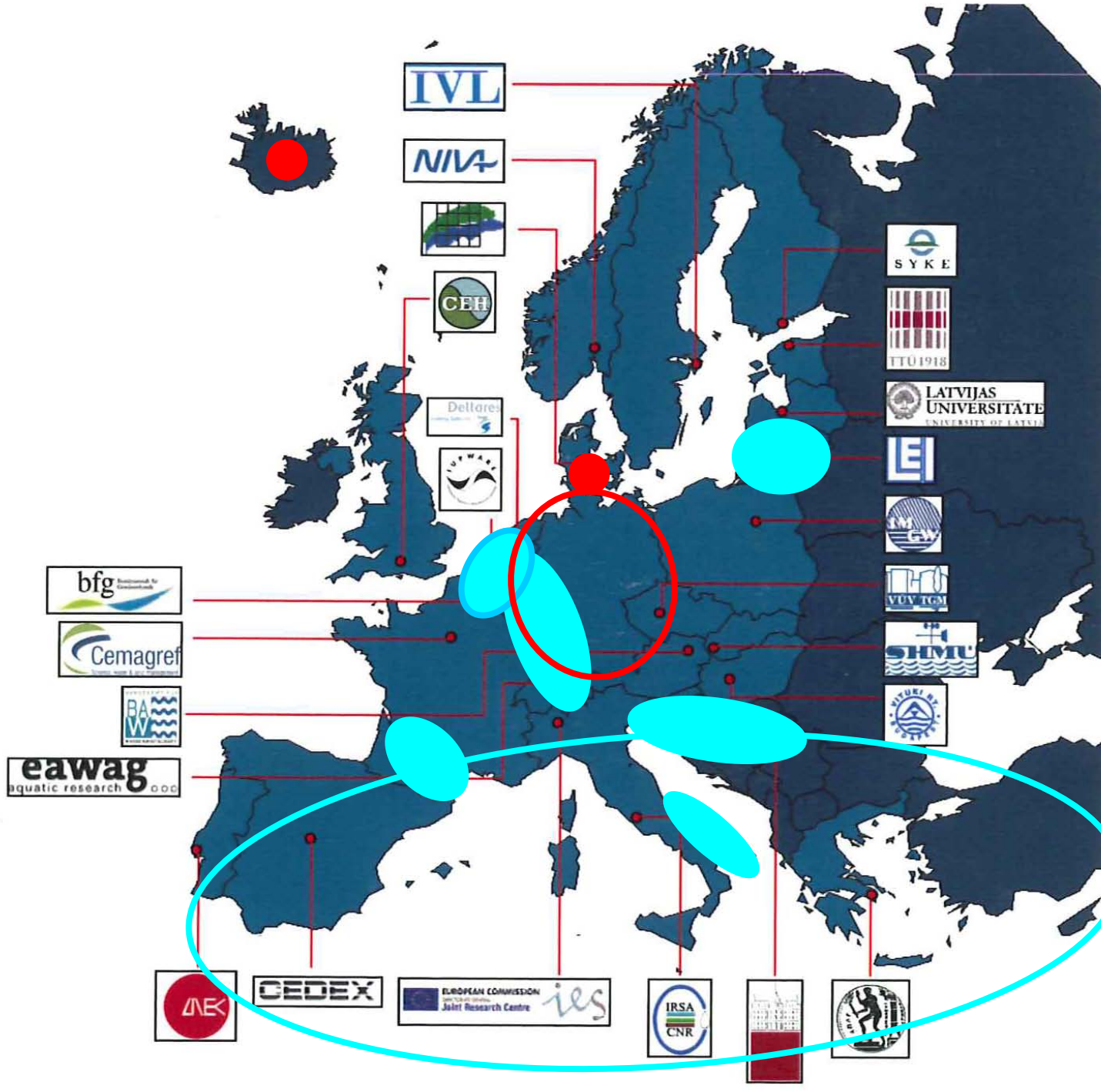
Germany

organic contaminants

Denmark

Iceland

nutrients



EurAqua

quantity

quality

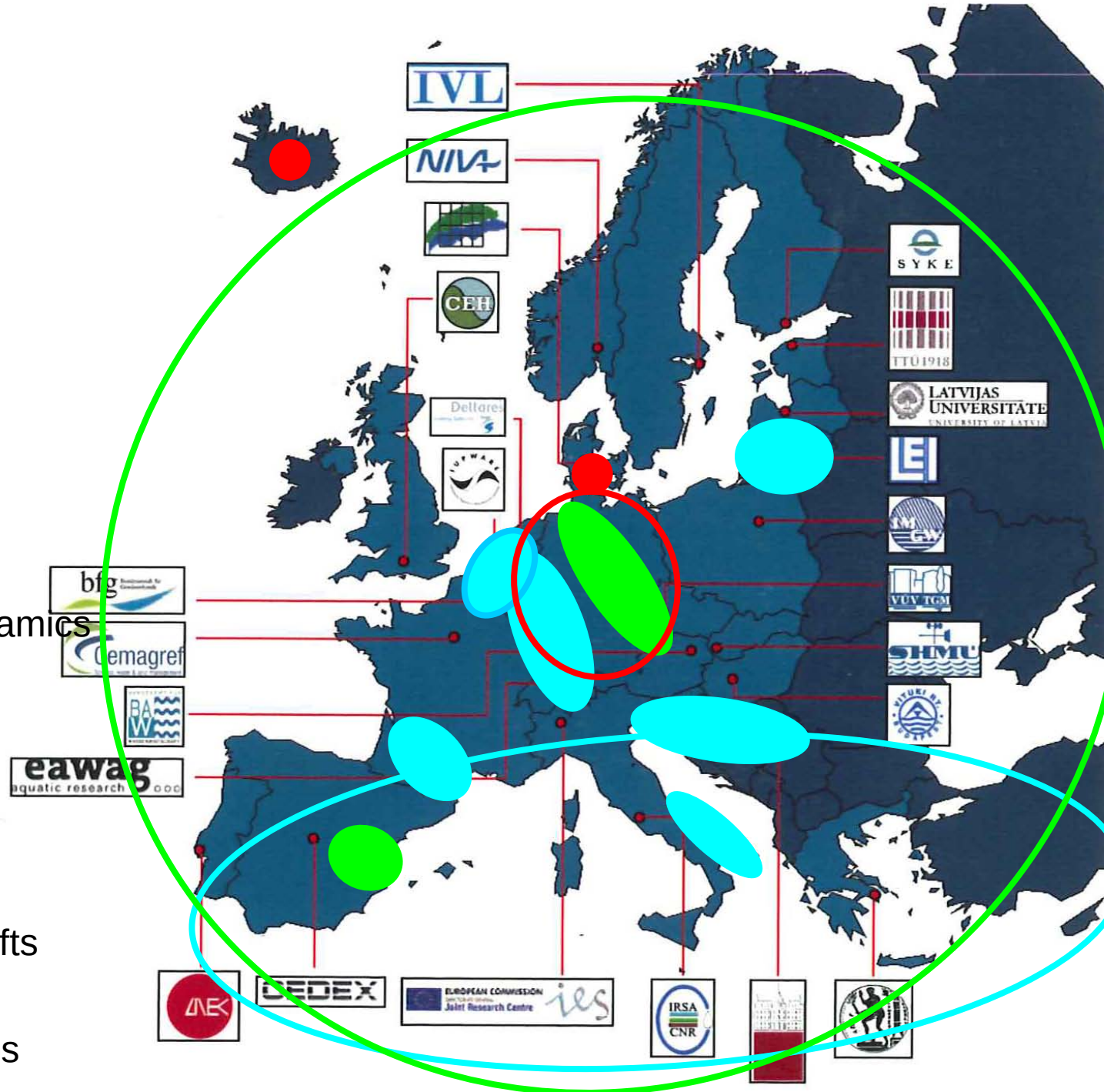
ecology

Elbe/Labe
Phytoplankton dynamics

Jucar
ecological status

Europe
Fish population shifts

European scenarios



Findings (1/2)

No single (pan-european) truth, not in observations nor in projections

Challenge to downscale (to „action“-scale)

Discrimination of different causes for observed changes (e.g. CC and WM)

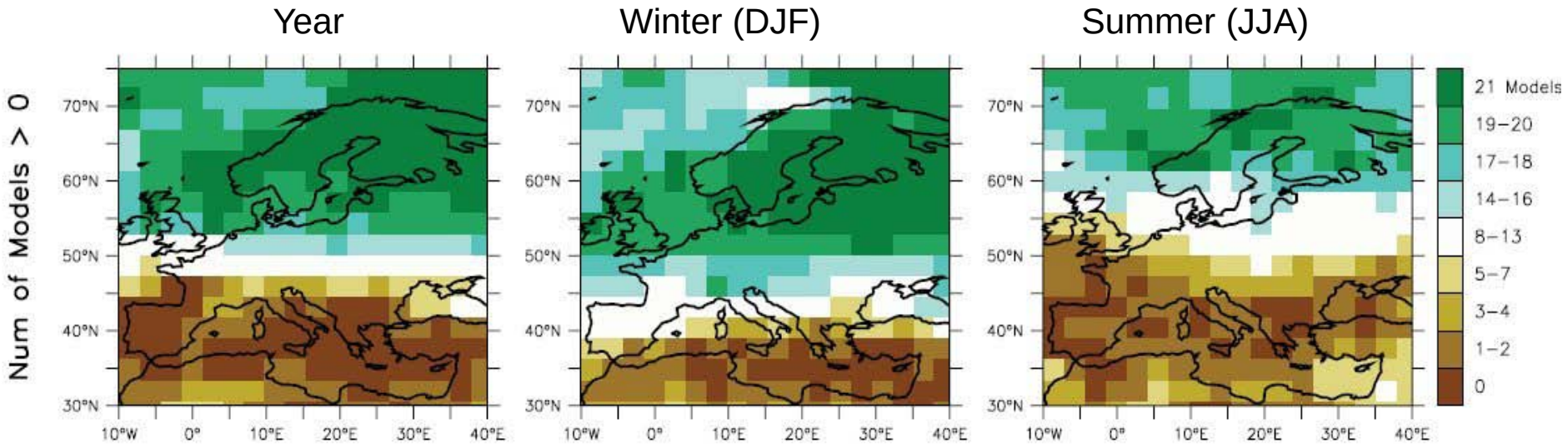
Precipitation/water variables much more uncertain than temperature
(need for bias correction, but non-linear processes)

"Pluvialisation" of discharge regime projected for far future:

Decrease of seasonality in nival regimes (in/close to mountains)

Increase of seasonality in pluvial/combined regimes.

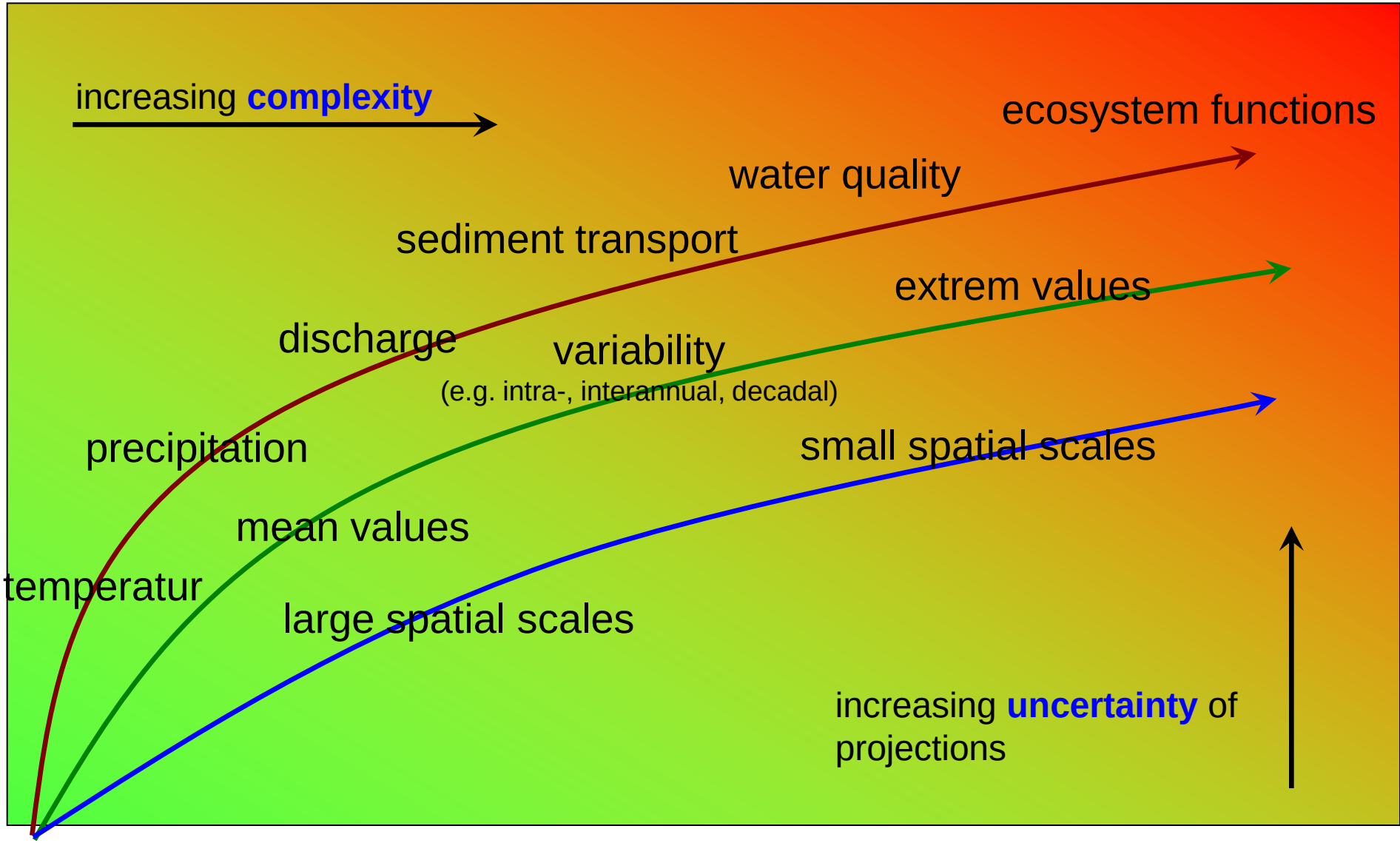
Number of models projecting an increase of precipitation (IPCC 4AR)



Comparison of period 1980-1999 and 2080-2099
Multi-Model Data (MMD), 21 global climate models, A1B Szenario, Grid size ca. 2,7° x 2,7°

(Christensen et al. 2007, Fig. 11.5)

Reliability of projections



Findings (2/2)

Not only look at (uncertain) water variables,
temperature rise alone may require action:

earlier start of growing season, more than one crop per year, potentially more use of pesticides and nutrients

elevated temperatures and increasing nutrients might increase and alter the algae bloom in European surface waters (e.g. algae toxins)

The major risk of climate change is not only the potential hazards themselves but the image of a country in the view of foreign investors

Derived statements (1/3)

To fully assess the possible impacts of climate change interdisciplinary exchange and integrated model chains (including ecological and economical aspects) are required.

Bundesministerium
für Verkehr, Bau
und Stadtentwicklung

KLIWAS
Klima · Wasser · Schifffahrt

BMVBS – Research Programme
(2007) 2009 - 2013

Impacts of Climate Change on Waterways and Navigation in Germany – Development of Adaption Options

bfg Bundesanstalt für Gewässerkunde

DWD

BSH BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

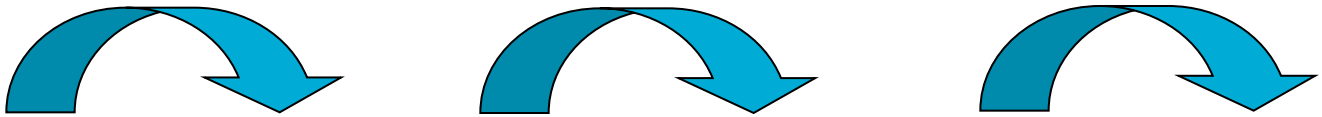
BAW

~ 40 x 5 = 200 person-years

+

national and international cooperations

Impact of CC: Research → Adaption



Inventory and Fundaments

- Data processing
- Climate projections

- Model generation
- Discharge and other projections
- …

Sensitivity analysis of sectors and sub-systems

- quantity
- quality
- ecology

inland + coast

Adaptation options and vulnerability

KLIWAS + WSV

Decision

not in KLIWAS

Planning and implementation of adaptation measures

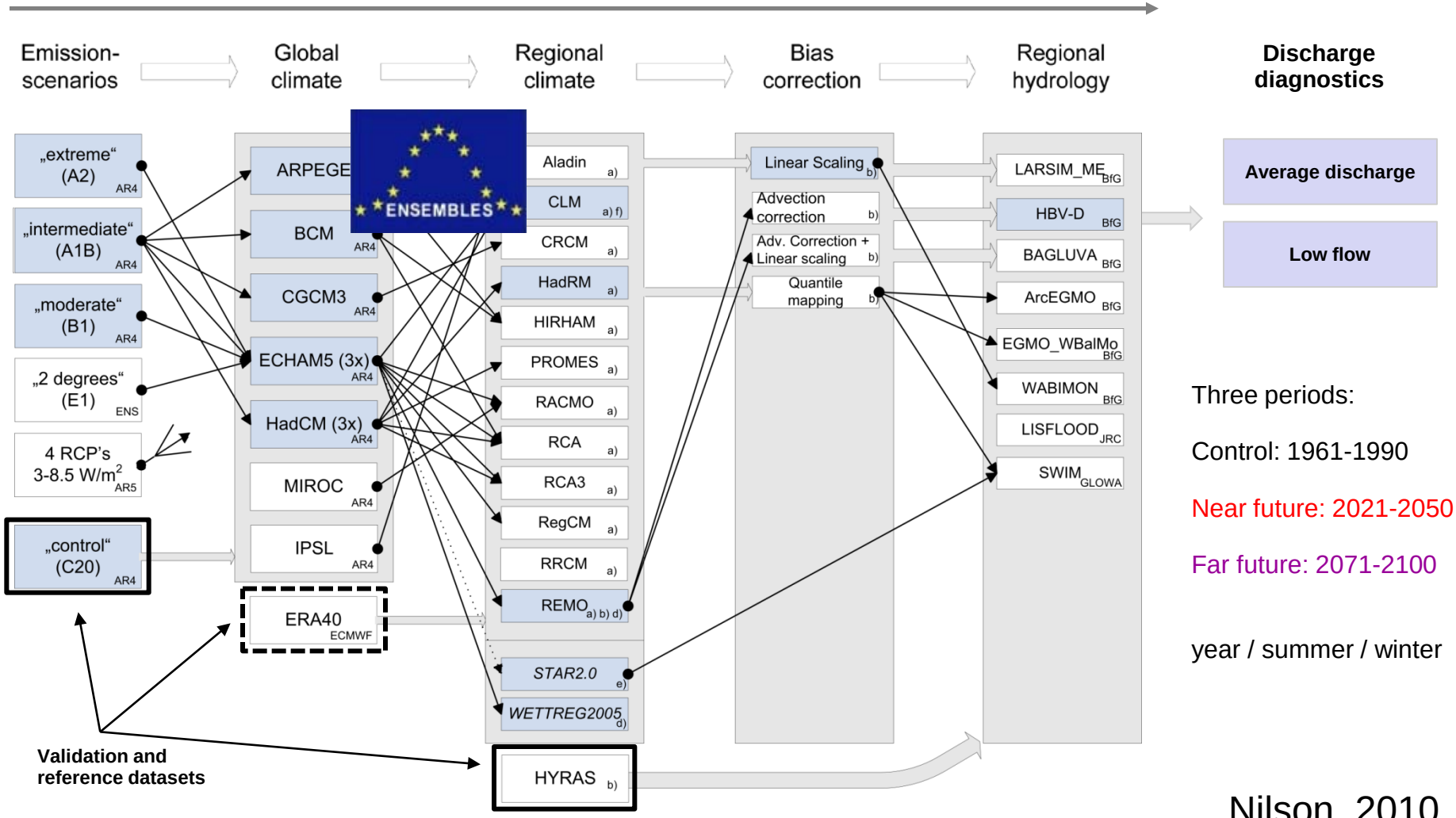
BMVBS +
BfG, BSH, BAW + WSV

KLIWAS 2009-2013

Adaptation strategy

Model chain

Multi-Model approach is a key concept for uncertainty assessment.



Three periods:

Control: 1961-1990

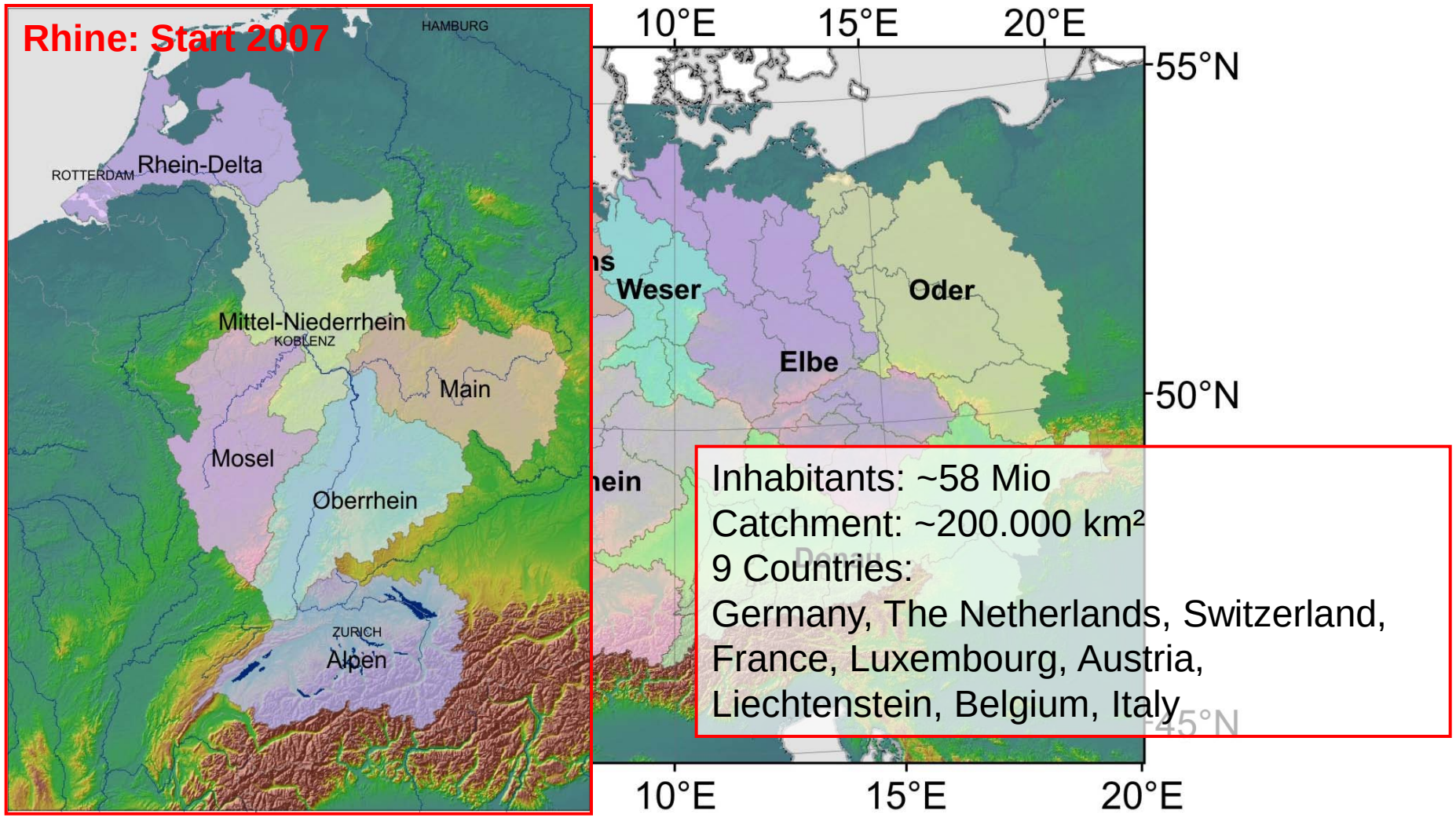
Near future: 2021-2050

Far future: 2071-2100

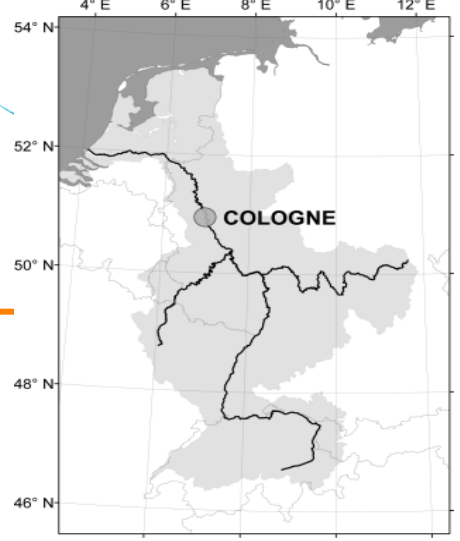
year / summer / winter

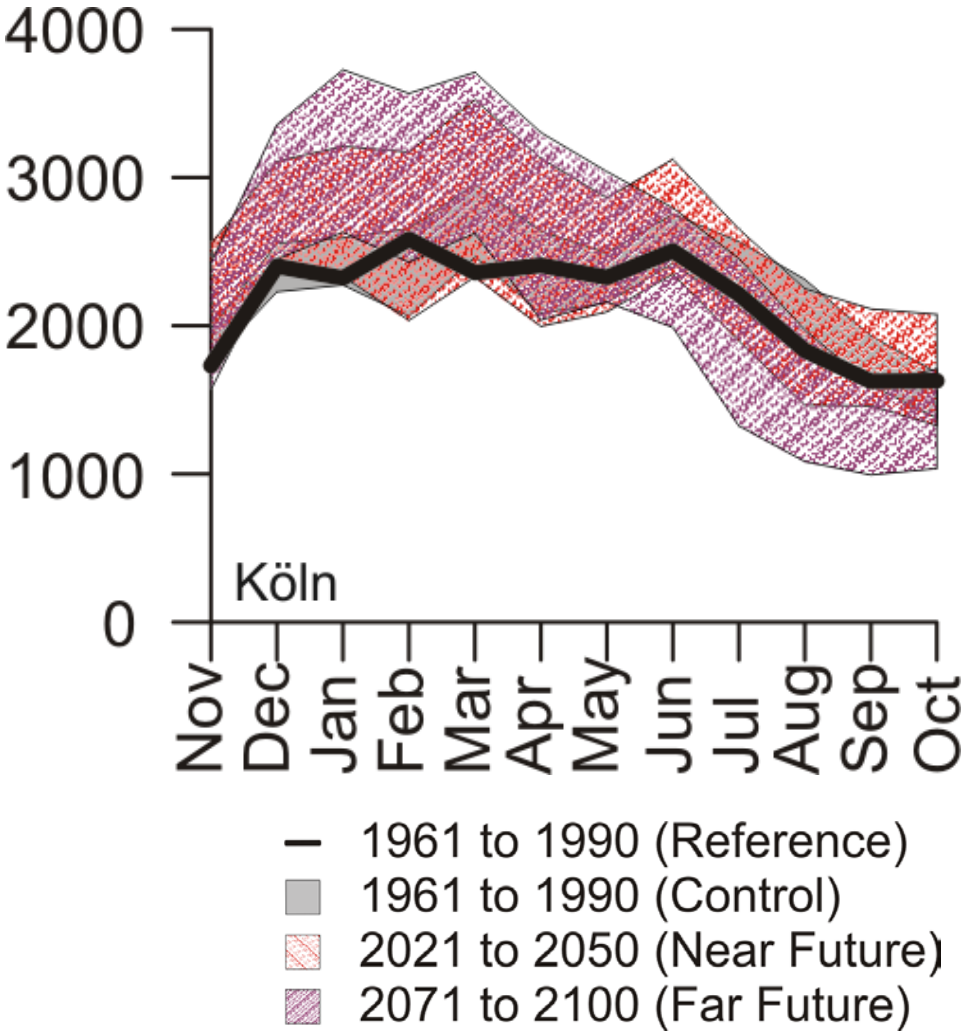
Nilson, 2010

Area of interest



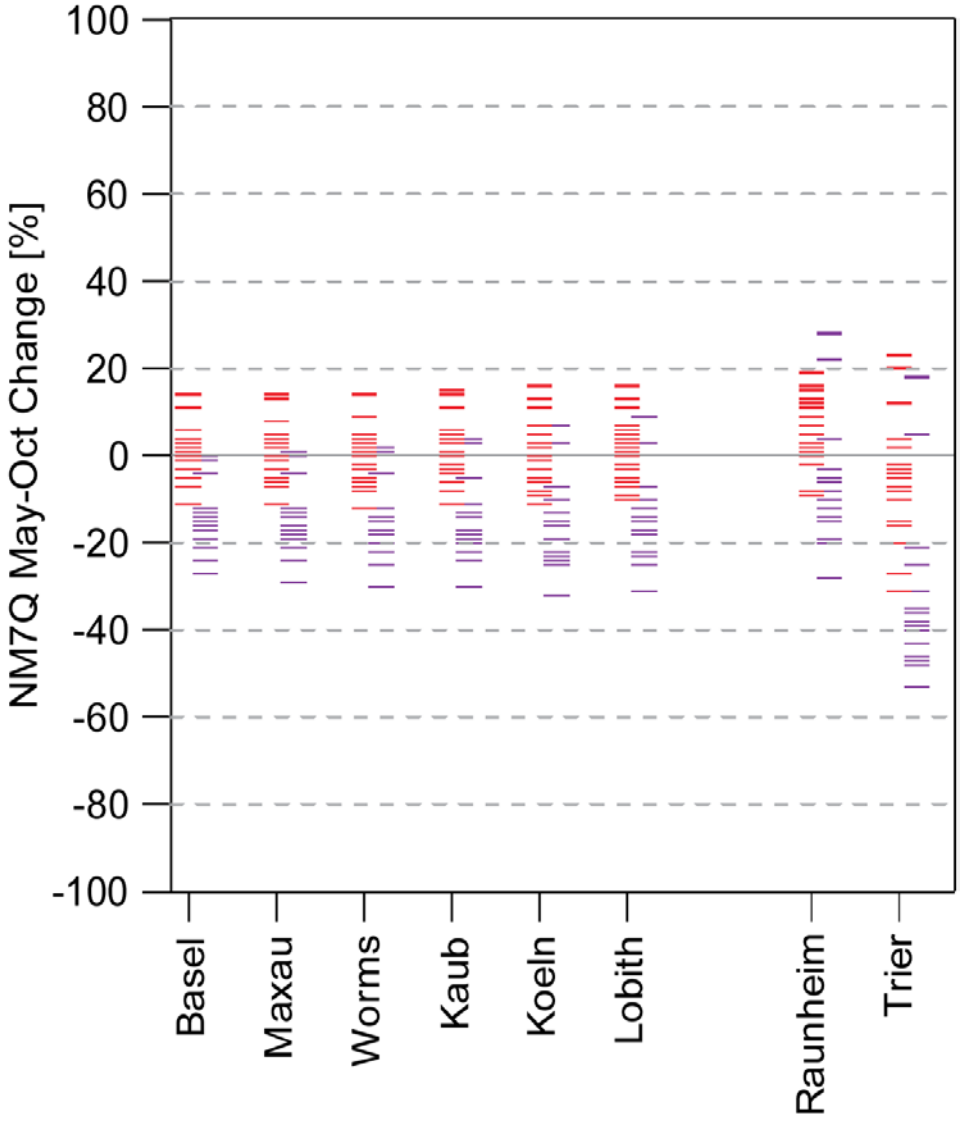
Projections and scenarios of MoMQ (Multi-annual mean monthly discharge)





- Near future: no clear change of seasonality
  - Winter MQ 0% to +25%
  - Summer MQ no tendency
- Far future: Increase of seasonality
  - Winter MQ 5% to +45%
  - Summer MQ -5% to -30%

Low flow indicator NM7Q - Summer



NM7Q <season>

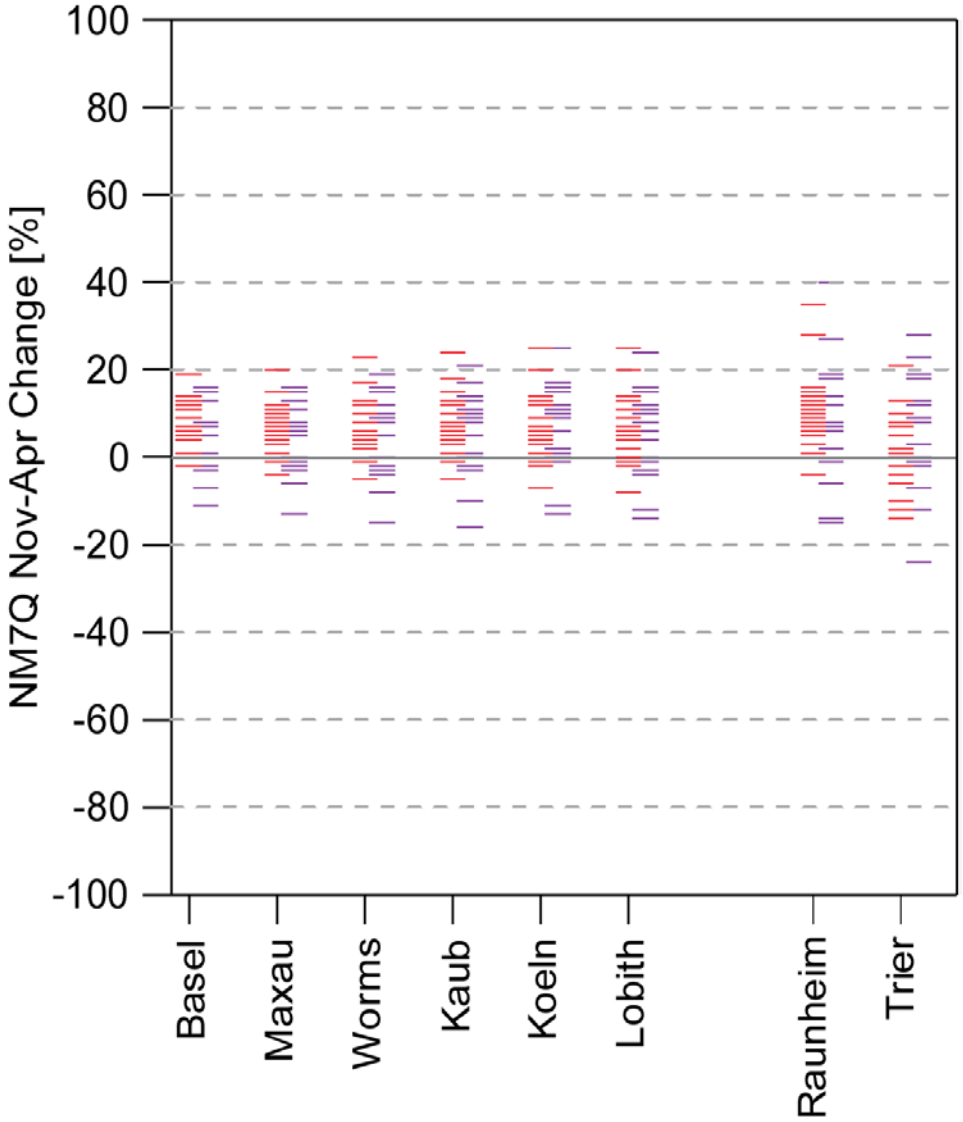
30 year mean of seasonal lowest 7-day mean discharges

near future (2021 to 2050; 20 members)

far future (2071 to 2100; 17 members)

with reference to
control period (1961 to 1990 = zero line)

Low flow indicator NM7Q - Winter



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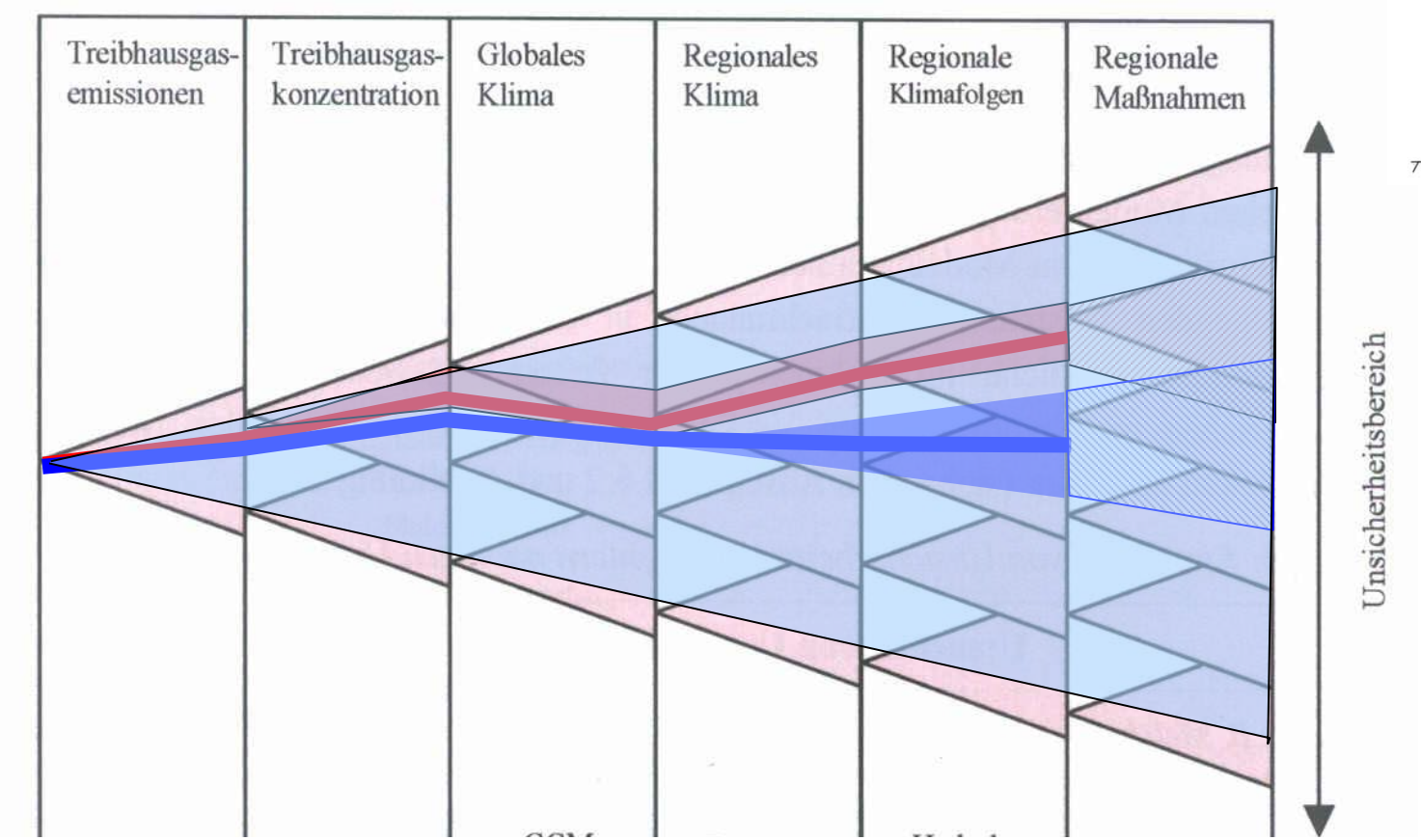
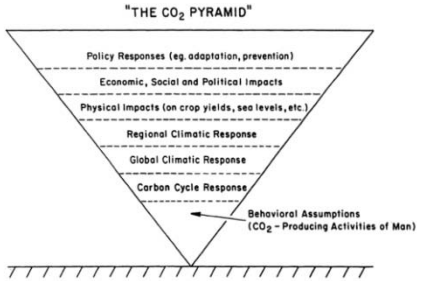
„Cascading pyramide of uncertainty“

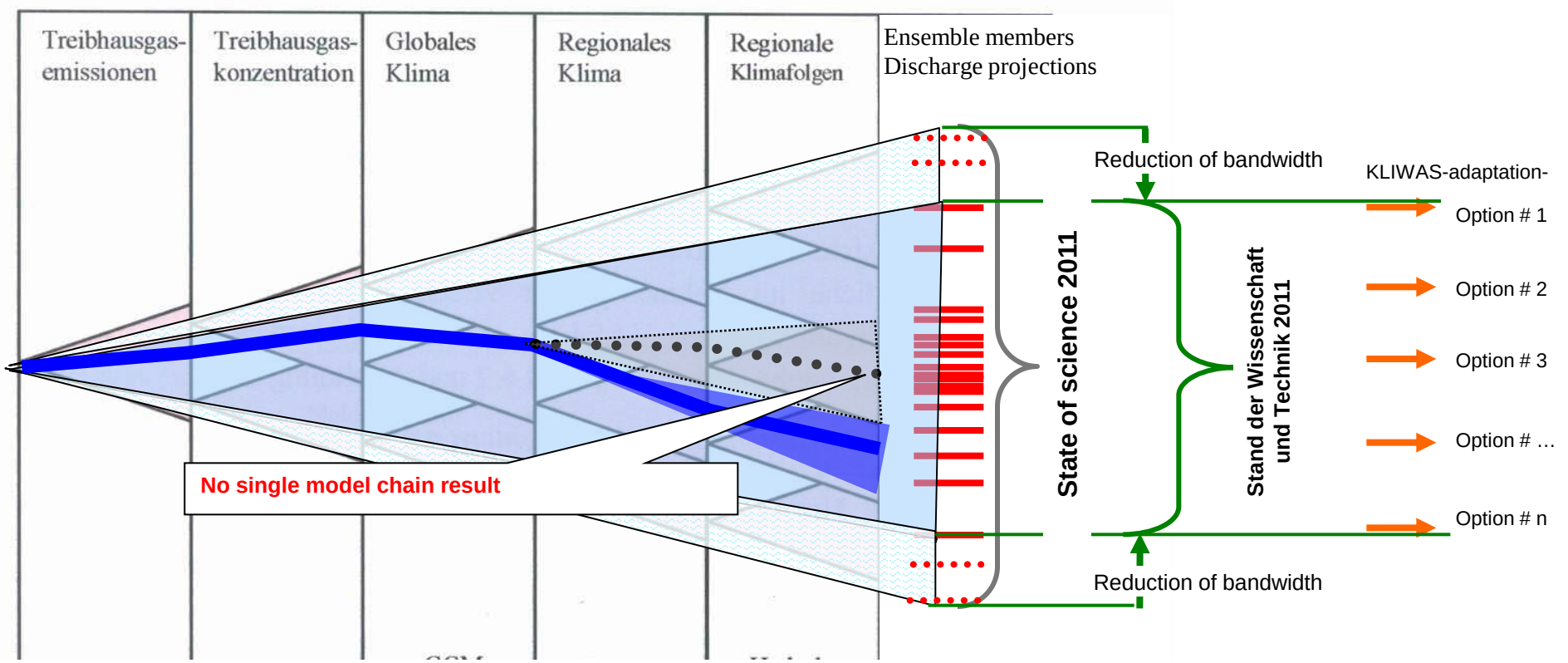
(Schneider, 1983)





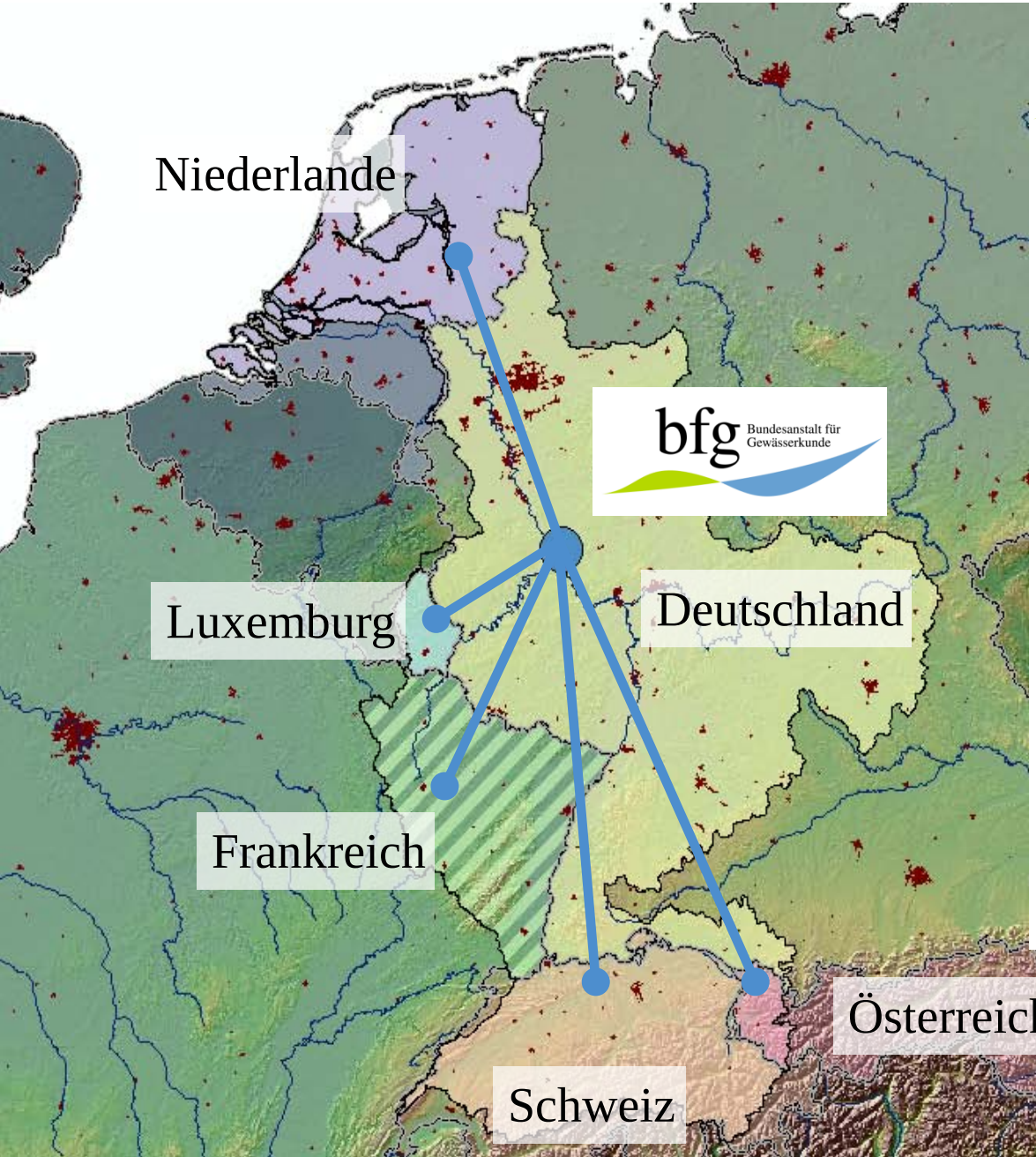
Viner, D. (2002): A Qualitative Assessment of the Sources of Uncertainty in Climate Change Impacts, Assessment Studies: A short discussion paper, Adv. in Global Change Research, 10, 139-151.

Expand + (possibly) reduce uncertainty



- Scientific service
- Bandwidth = scientifically based, flexible „decision space“

Transformation of Research into Policy



bfg Bundesanstalt für Gewässerkunde → KLIWAS

→

International Commission for the Hydrology of the Rhine Basin

CHR KHR

→

Expert Group „KLIMA“ of the International Commission for the Protection of the River Rhine

IKSR CIPR ICBR

Derived statements (2/3)

To fully assess the possible impacts of climate change interdisciplinary exchange and integrated model chains (including ecological and economical aspects) are required.

Long time series of observed data of hydrometeorological and hydrological variables are crucial to describe and understand the various hydrological processes affected by climate change.

Derived statements (3/3)

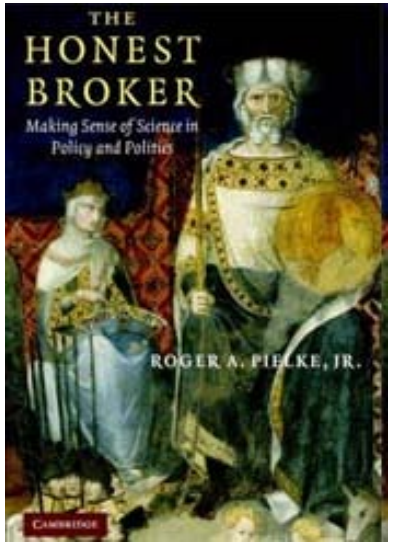
To fully assess the possible impacts of climate change interdisciplinary exchange and integrated model chains (including ecological and economical aspects) are required.

Long time series of observed data of hydrometeorological and hydrological variables are crucial to describe and understand the various hydrological processes affected by climate change.

Given the uncertainty of climate (impact) projections a „re-engineering“ of the science-policy interface is needed in order to account for state-of-the-art results of climate research.

Science-policy interface

Types of experts/scientists (Pielke, 2007)



„Issue Advocate“ or „Stealth Issue Advocate“

own, value-oriented political agenda (potentially hidden), narrows scope of choices

„Honest Broker“

expands and explains bandwidth, seeks to present reasoning objectively, thus enabling decision makers to choose „solution“ wanted by society (and not the one or few promoted by an advocate).

Conclusion 1/5 - Models

- without models there are no projections of possible futures
- However: „number crunchers“ need analysis (calibration, validation, at scales of interest, for variables and statistical indicators of interest => requires observations)
- Looking at single model chains corresponds to make projections by throwing dices (gambling)
- Examination of multi-model-ensembles allows to estimate uncertainties and prove that looking at single model chains does not deliver a sound decision basis.
- However, also a band width derived by multi-model-ensembles may not be regarded absolut.

Conclusion 2/5 - Future

- There is *no* certain single future
- Decision makers have to get used to idea of several possible futures.
- Science has to focus available information and improve communication of uncertainty
- Science thus provides orientation (rational basis)
- Political decisions are relativ to what science delivers, but need to take into account additional aspects…

Conclusion 3/5 - Risk

- The need for decision making under uncertainty is not new.
- Integrated risk management instead of a pure strategy of prevention (e.g. EU flood risk management directive)

  Risk = probability of occurence x potential damage
  integrated over all thinkable states

  Quantification is difficult, but attempt is inevitable
  - Cost-benefit consideration
  - Determination of protection levels
  - Planning of protection, prevention,mitigation, preparation measures
  - Management of residual risk, i.e. actively making plans for *all* states, even the very unlikely

Conclusion 4/5 - Strategy

- „Tie-in“-Strategy (Schneider, 1983)
  - Measures, which increase „elasticity“ of systems
  - Measures that can flexibly adjusted
  - Measures that feature „co-lateral-benefit“
  - No- or Low-Regret measures
  - Win-Win-Situations

- Water Resources Planning and Engineering = Techniques of civilisations for adaptation to the variabilitity of water (in space and time)
  - Developed instruments for adaptation exist („toolbox“).
  - Limitations:
    - Large scale availability of (potential redistributable) water
    - Financial resources
    - Political will / value system of society

Conclusion 5/5 – Global vs. CC

There are other drivers of Global Change:

- Trends / changes / developments of
  - Climate
  - Demography
  - Regulation of water resources management
  - Energy supply
  - Agriculture
  - Human consumption patterns
  - Technology
  - Economy
- All are interacting => Earth System Science + Models + Partnership

Thank you!

bfg Bundesanstalt für Gewässerkunde

KLIWAS
Klima · Wasser · Schifffahrt

Heinrich Leutemann (1824-1904)

Ressortforschungsprogramm
- Deutscher Wetterdienst (DWD)
- Bundesamt für Seeschifffahrt und Hydrographie (BSH)
- Bundesanstalt für Gewässerkunde (BfG)
- Bundesanstalt für Wasserbau (BAW)

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Bundesministerium für Verkehr, Bau und Stadtentwicklung