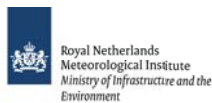


RheinBlick2050

Joint climate and discharge projections for the Rhine



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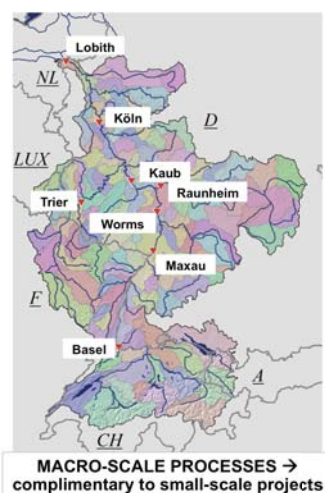
With contributions from: G. Brahmer (Hessisches Landesamt für Umwelt und Geologie – HLUG, Germany), H. Buiteveld, R. Lammersen (Rijkswaterstaat Centre for Water Management – RWS, The Netherlands), D. Volken (Federal Office for the Environment – FOEN, Switzerland)

1. Motivation and project goals

- Regional climate change modifies hydrological processes, the water balance and discharge in the Rhine River basin and its tributaries
- This has variable impacts, depending on respective sectors' sensitivities and vulnerabilities
- Decision makers need suitable information for adequate adaptation strategies
- Often the focus is only on sub-catchments, a small regional climate change projection ensemble size or there is a missing link to stakeholders (i.e. water managers)
- Need for common coordinated discharge projections for the complete catchment
- Coordinating role of CHR in hydrological research in the Rhine River catchments
- Linkage to and cooperation with the ICPR / AG-H / EG Klima

- Goals
- Development of a common, consistent research framework
 - Creation (acquisition, pre-processing, evaluation, bias-correction) of state-of-the-art regional climate change projection ensemble for analyses and as forcing data to hydrological models to generate specific discharge projections (macro-scale)
 - Compilation of partly heterogeneous information into applicable information (synchronized with stakeholders) and quantifiable statements through scenario bandwidths and tendencies of future changes in meteorological and hydrological key diagnostics (mean, low and high flow statistics) for time-spans up to 2050 and 2100, "meta" project, based on existing ongoing projects, results and data of the partners (e.g. KLIWAS)

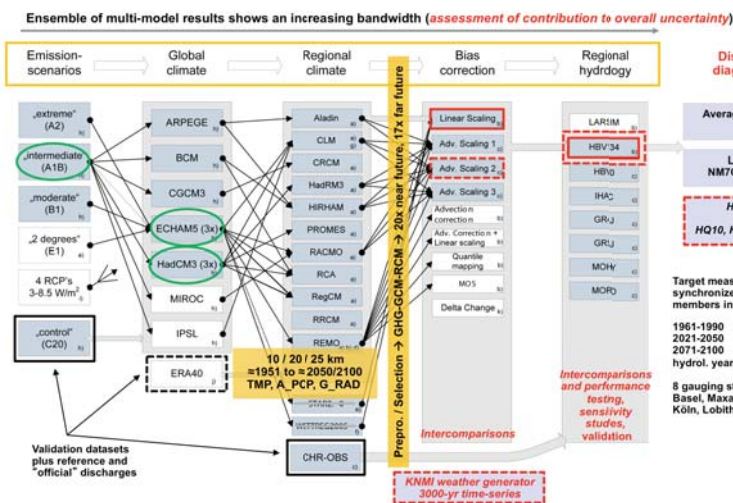
2. Experiment design, data and methods



Analyses are done for 8 highlighted gauges along the Rhine, Main and Moselle rivers

The semi-distributed HBV-96 is the main model used, inputs: daily precipitation, air temperature and evapo-transpiration

The Rhine River basin is separated into 134 (see colour-coding) model catchments



RheinBlick2050 processing chain, a typical hydrological impact study

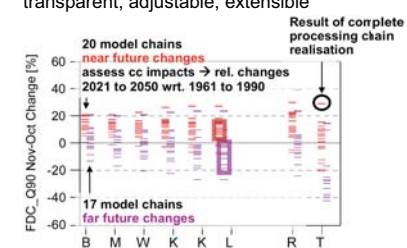
From available data only those marked blue are used

Extensive bias-correction and hydrological model inter-comparisons

Selection of RCM results, no weighing of results; suitability is considered

All diagnostics are validated, reliable results for complete modelling chain

Results evaluation and interpretation via "scenario bandwidths and tendencies" → Quantitative and qualitative, retain full information, narrow bandwidth, transparent, adjustable, extensible

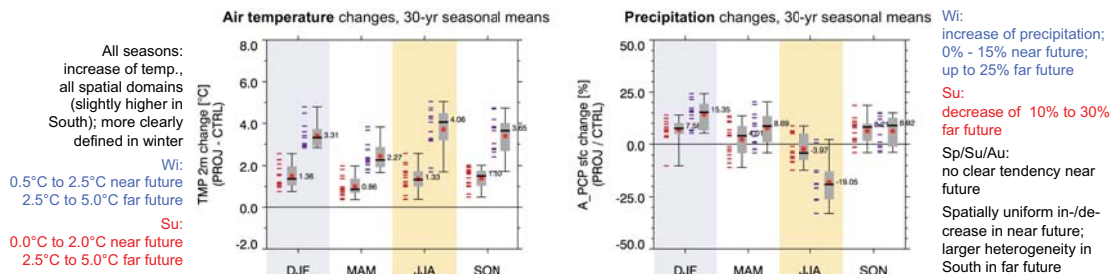


"Translation" into overview tables, synchronized with stakeholders

Gauging station	2021 to 2050	2071 to 2100
Basel	-5 to +15%	-5 to +15%
Maxau	-5 to +15%	+/-10
Worms	-5 to +15%	+/-10
Kaub	-5 to +15%	-10 to -5%
Köln	-5 to +15%	-10 to 0%
Lobith	+5 to +15%	-20 to 0%
Raunheim	-5 to +25%	+/-10
Trier	-5 to +15%	-40 to -25%

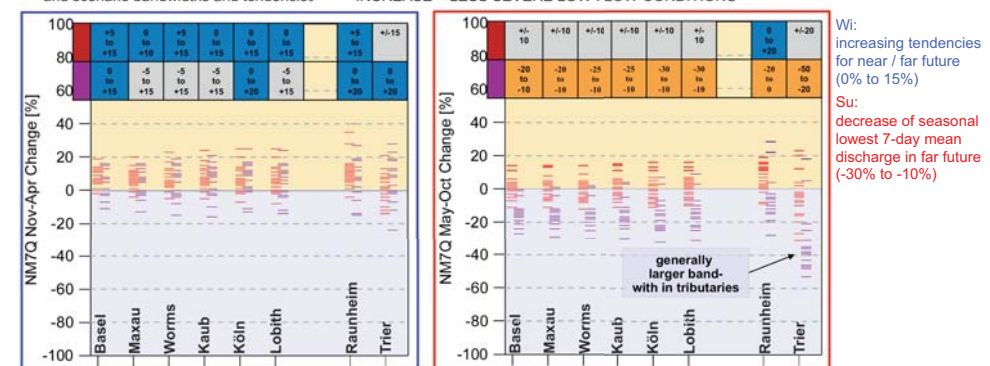
3. Results, impacts of regional climate change on hydrology (high flow not shown)

Meteorological drivers – basin-wide



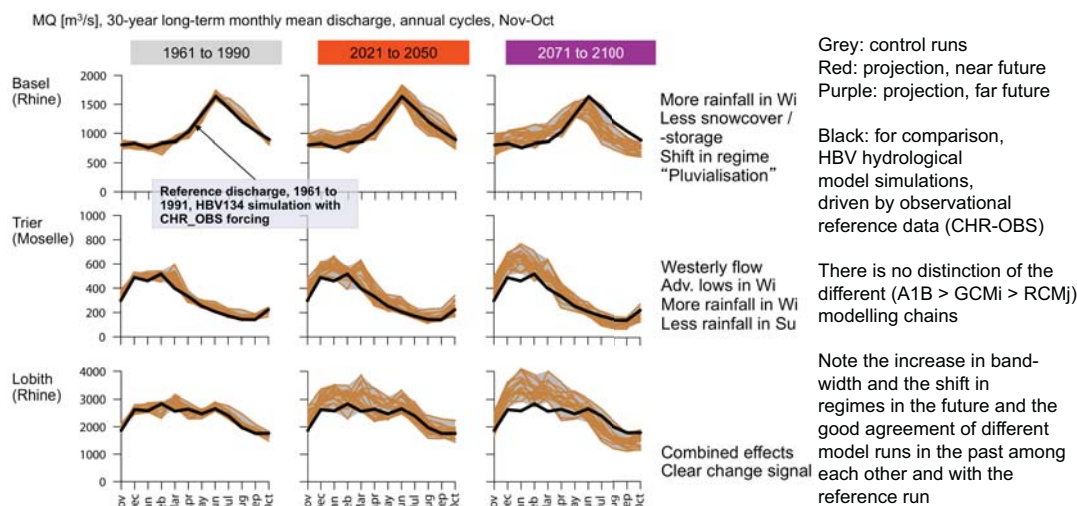
Low flow changes, NM7Q

Projected relative changes of 30-year long-term mean hydrological winter / summer NM7Q and scenario bandwidths and tendencies

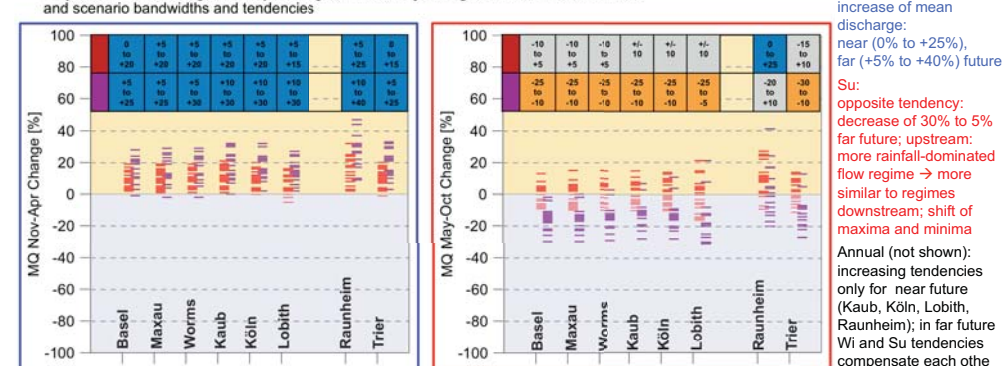


Mean flow changes

(modified discharge regime throughout the basin)



Projected relative changes of 30-year long-term mean hydrological winter / summer MQ and scenario bandwidths and tendencies



4. Conclusions

- A concerted, international view of regional climate change impacts on the discharge regime in the Rhine River basin is derived, complimentary with other projects
- A common research framework / institutional network is developed and ready for further studies
- Changes in the regional climate system manifest themselves in the hydrology of river systems in the Rhine River catchment; directions and magnitudes (bandwidths) are consistently determined
- Individual results (mean, low, high* flow) have different magnitudes of uncertainties and reliabilities
- Hydrological projections and model chain components are based on a large proportion of currently available data, based on current understanding of climate system and hydrology
- Many uncertainties and limitations still exist
- Discharge analyses / scenario bandwidths and tendencies have been fed – among inputs from other projects – into the political process at ICPR / EG Klima

References

Görgen, K., Beersma, J., Brahmer, G., Buiteveld, H., Carambia, M., de Keizer, O., Krahe, P., Nilson, E., Lammersen, R., Perrin, C. and Volken, D. (2010) Assessment of Climate Change Impacts on Discharge in the Rhine River Basin: Results of the RheinBlick2050 Project, CHR report, I-23, 229 pp., Lelystad, ISBN 978-90-70980-35-1.

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