

# RheinBlick2050

## Future High Flows and Floods

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# Rhine basin

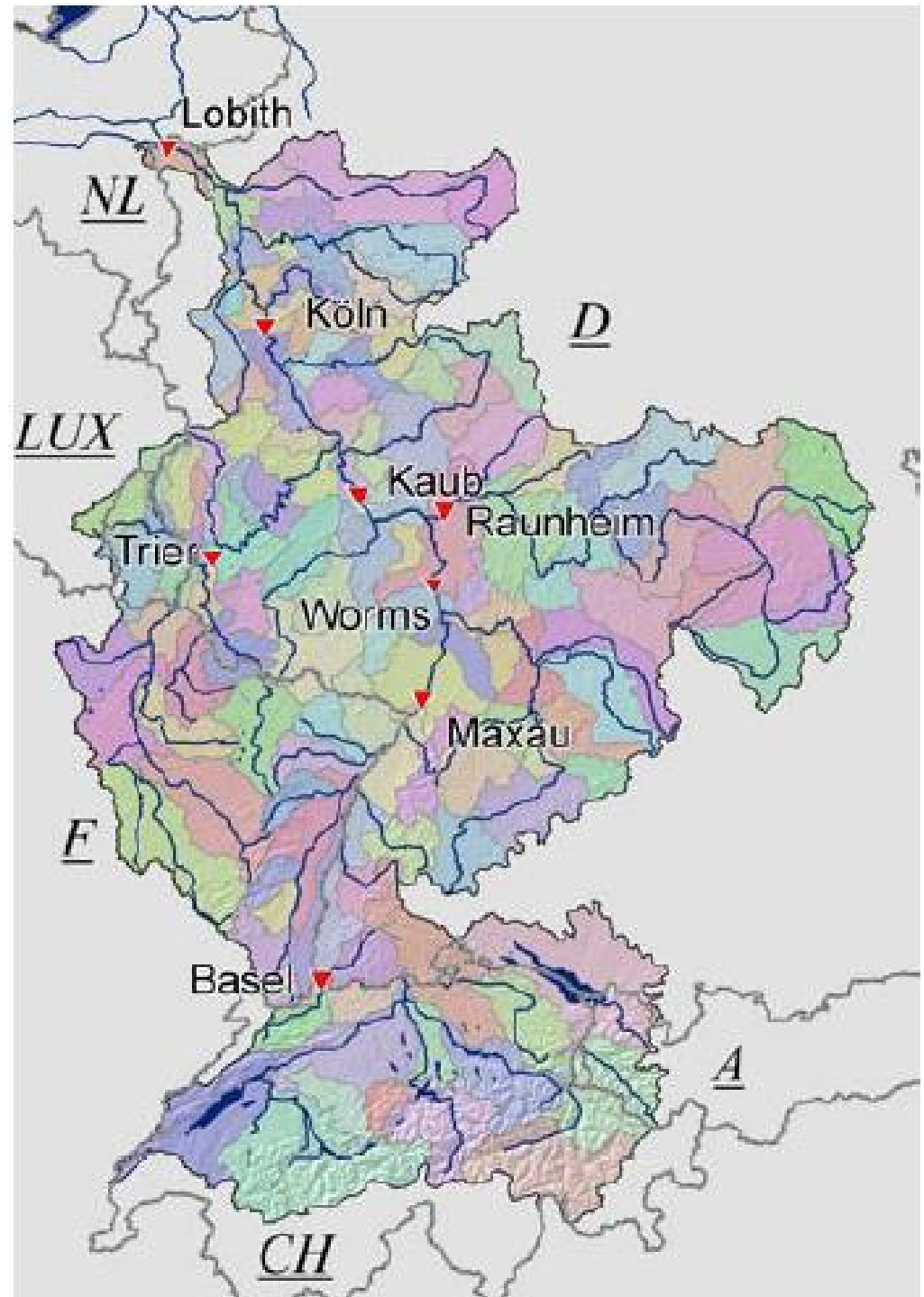
(upstream from Lobith)

Assumption often made:

Change in mean month discharge

EQUALS ?

Change in extreme river discharge



## Structure of the presentation



- Methodology for high flow calculations
- Validation
- Projected changes
- Comparison with KNMI-06 based
- Conclusions

# Sub-selection of Rheinblick Ensemble



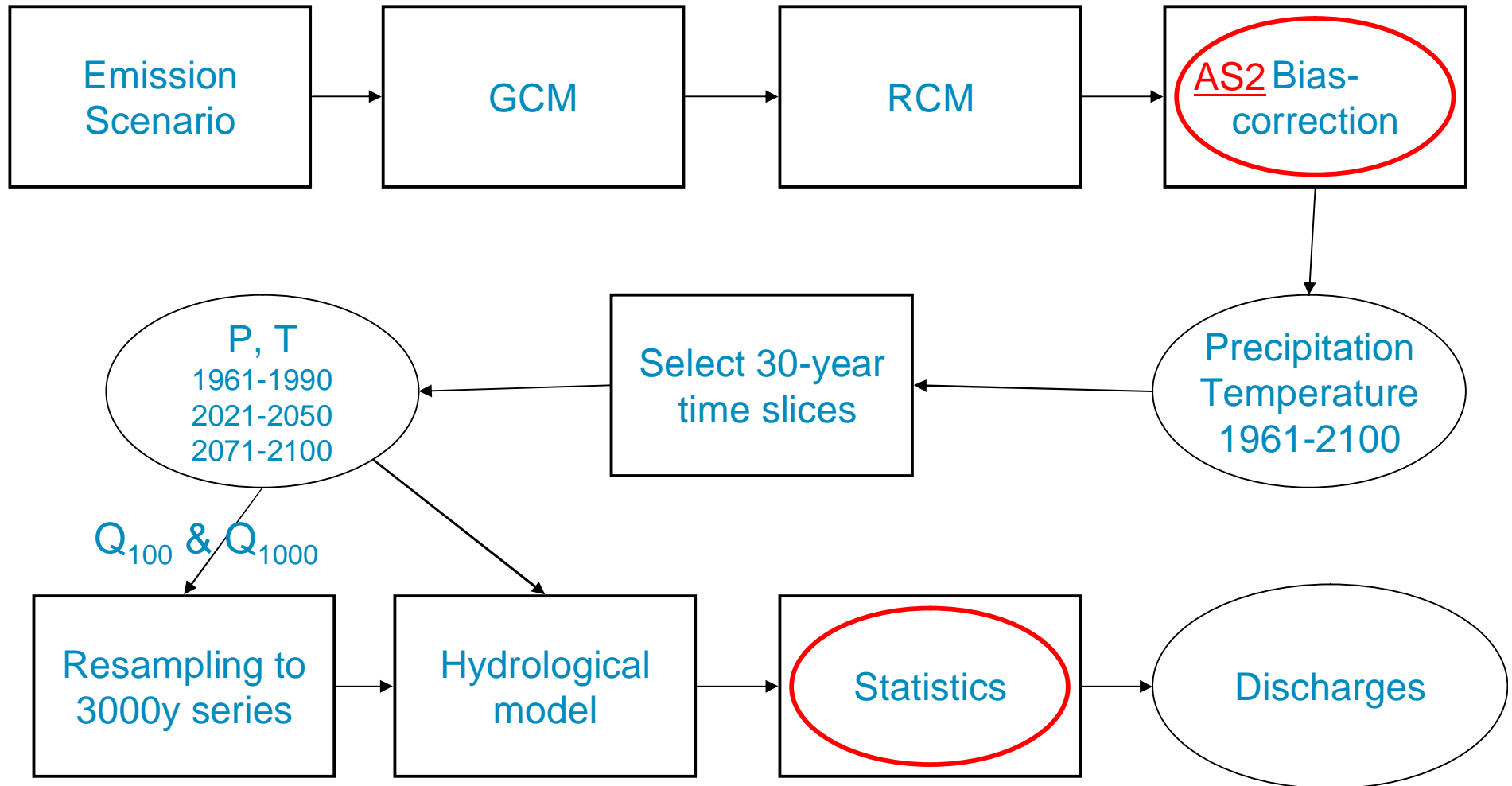
<i>GCM</i>	<i>RCM</i>
ARP	Aladin45
	HIRHAM5
EH5r1	REMO_10
EH5r3	RACMO
	REMO
HADCM3Q0	CLM
HADCM3Q3	HADRM3Q3
<del>HADCM3Q16</del>	<del>HADRM3Q16</del>

Source: FP7 Ensembles project

Emission scenario: A1B

Note that these climate projections represent large part of bandwidth contained in overall ensemble

# Modeling framework



## Flood routing



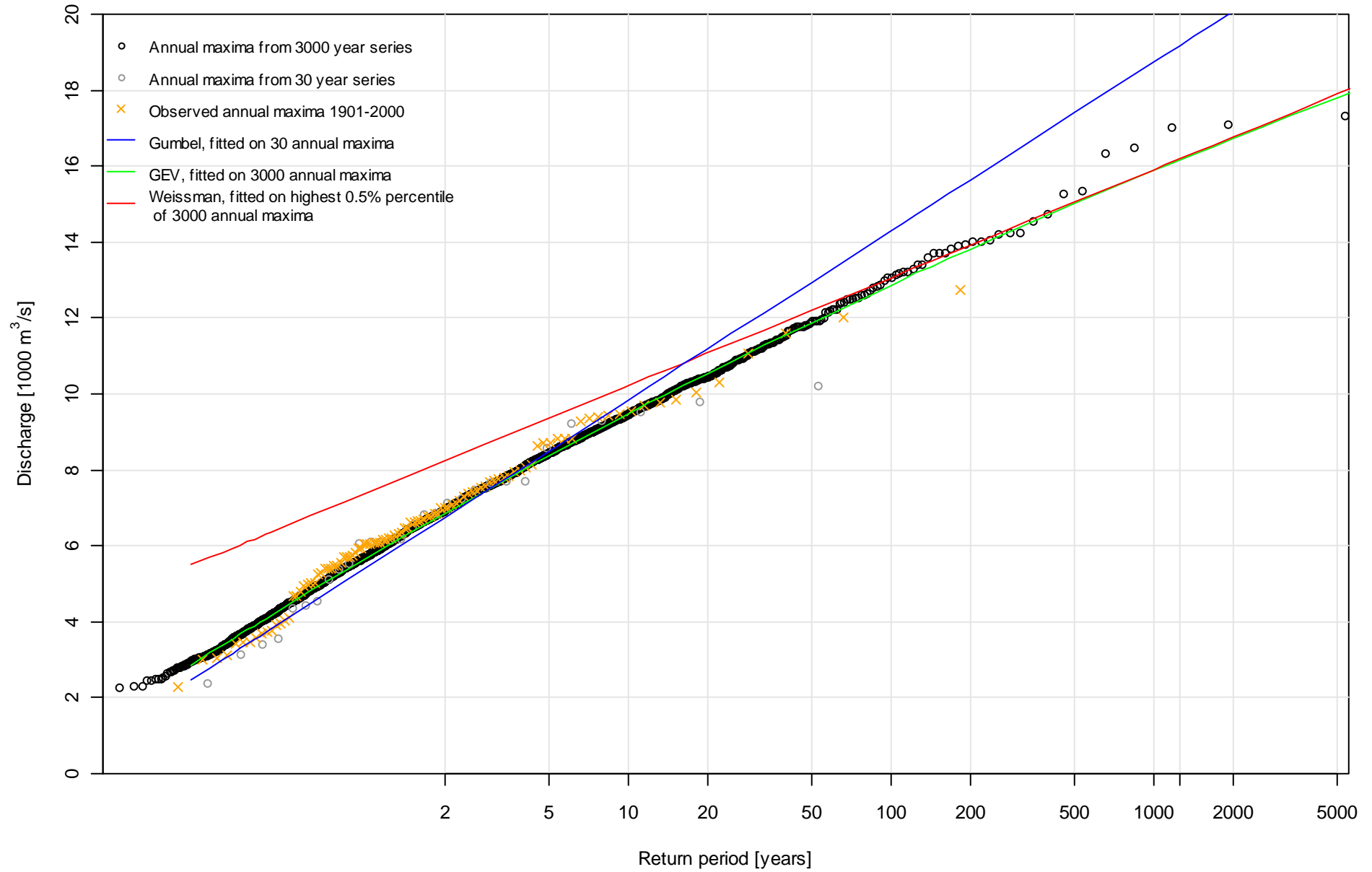
- The effect of upstream overtopping of dikes is not included... calculated extreme floods will possibly be lower in reality

Some effects are included in a simplified manner:

- No hydro-dynamic modeling is done... the routing module in HBV accounts for this but is not physically based.
- Swiss lakes are not modeled explicitly. Validation however shows that results for Basel are very reasonable.

# Time series extra- and interpolation

Lobith

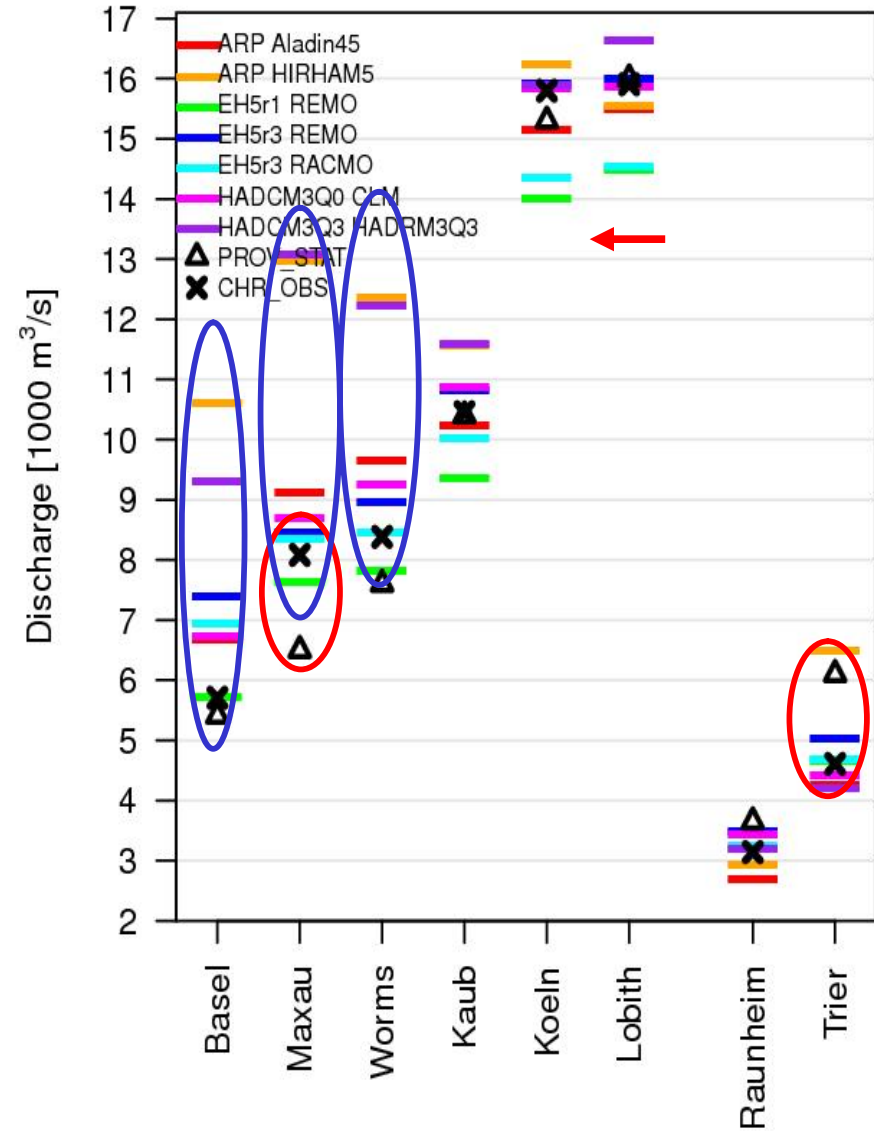
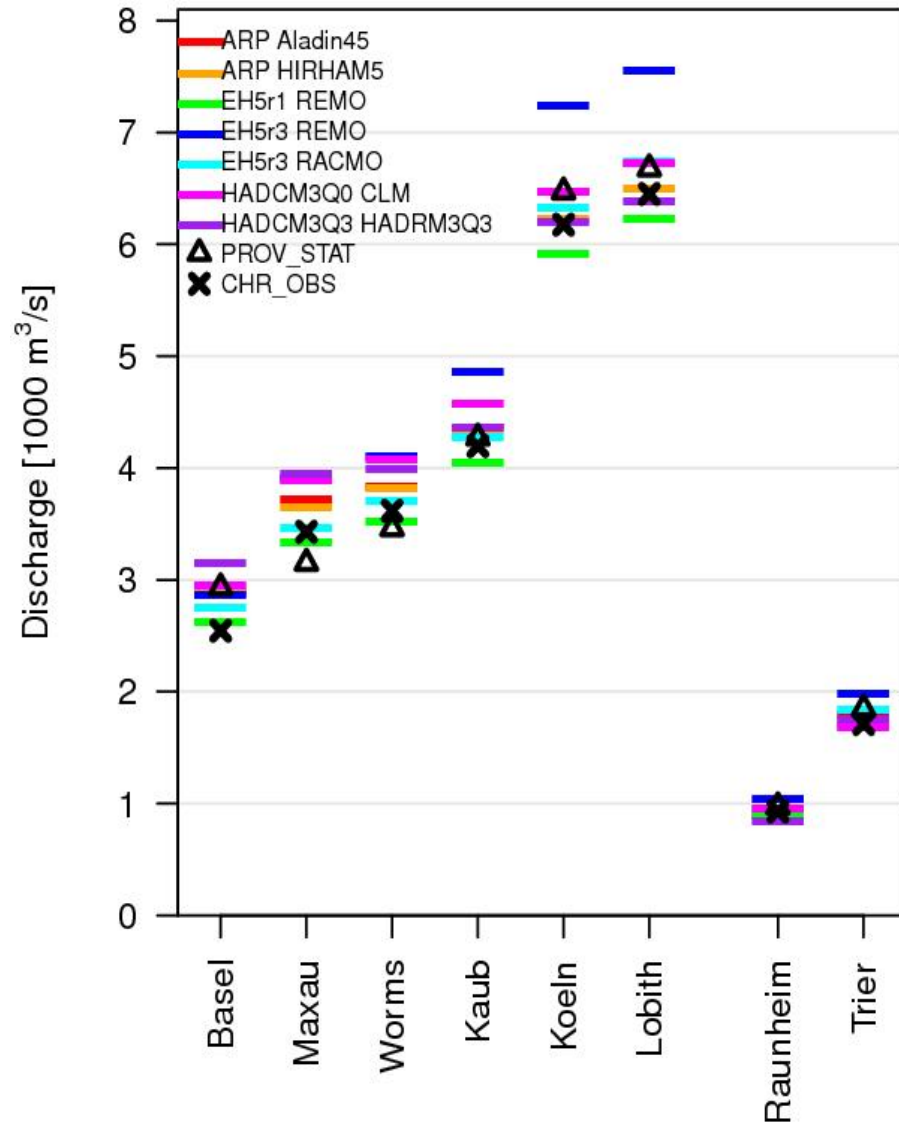


# Validation



## MHQ (1961 – 1990)

## HQ1000 (1961 ← 1990)

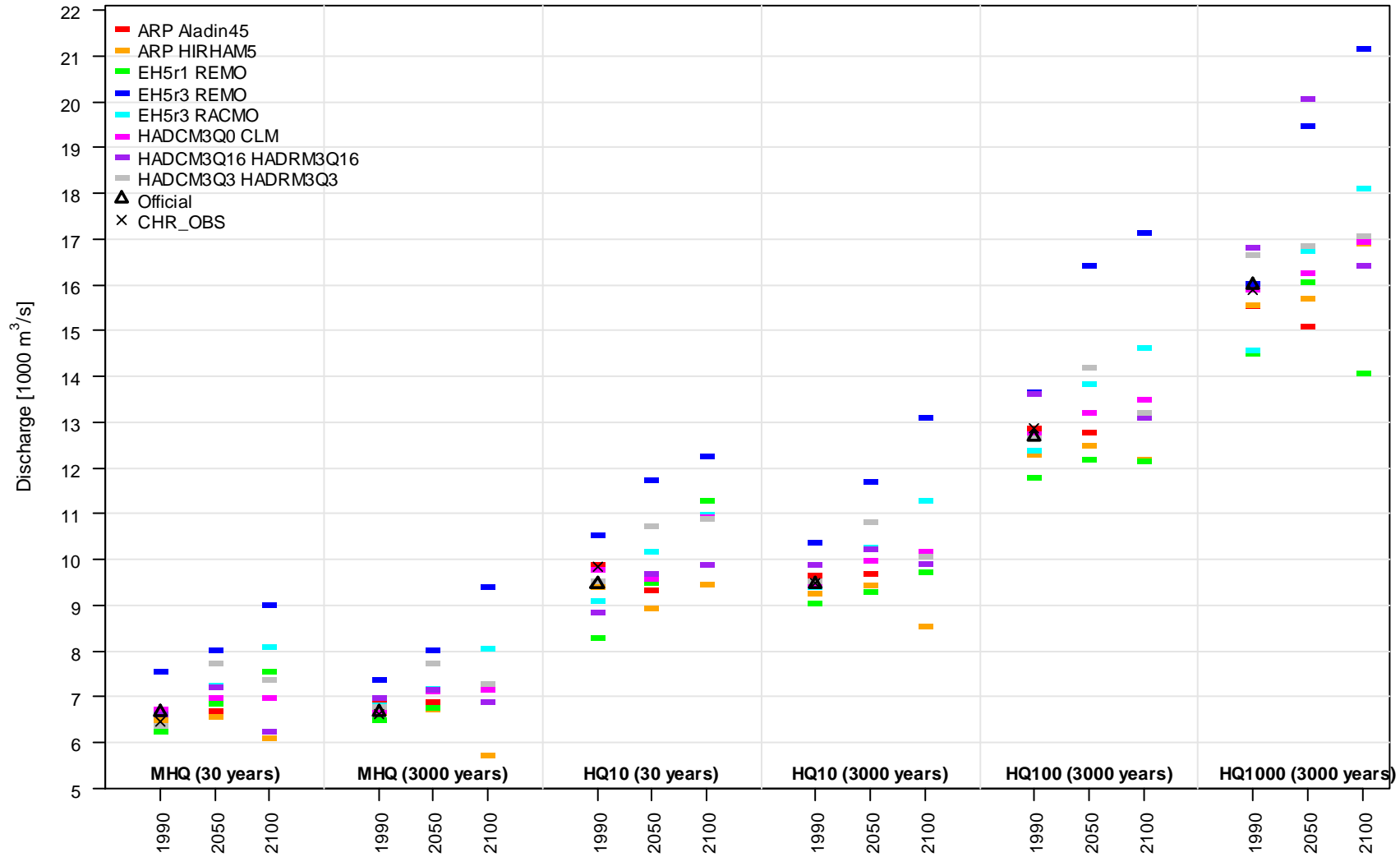




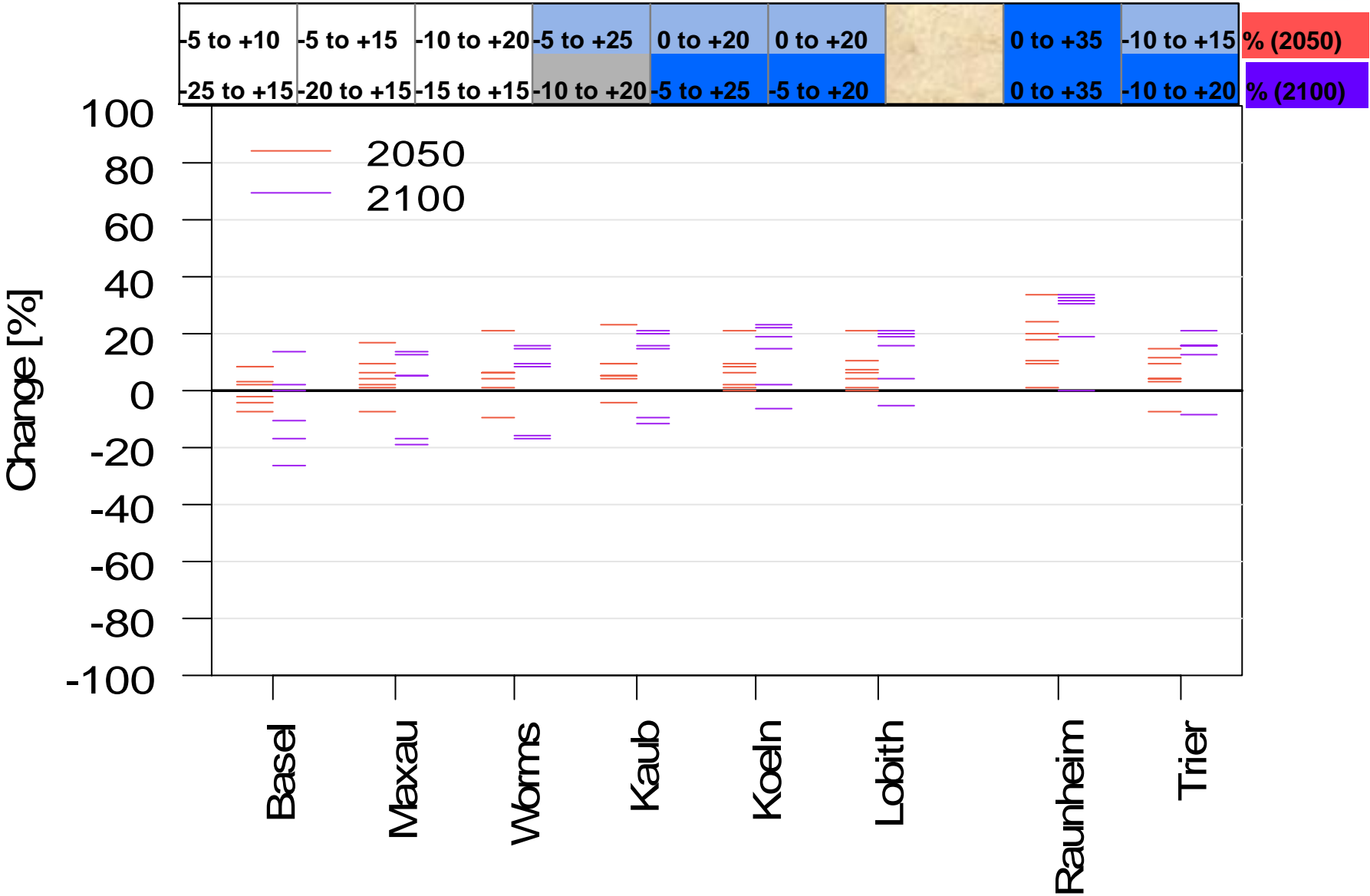
# Results



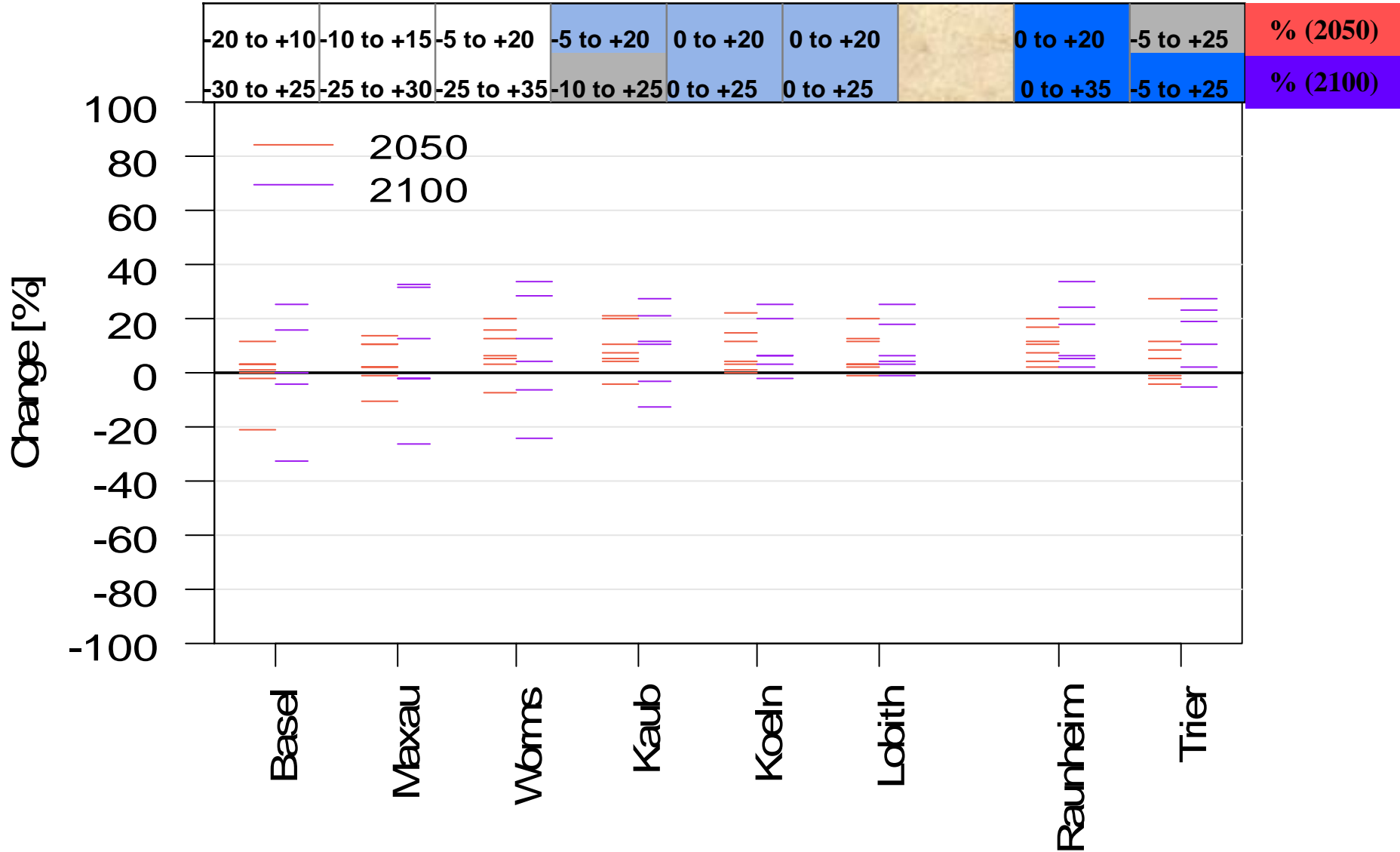
## Lobith



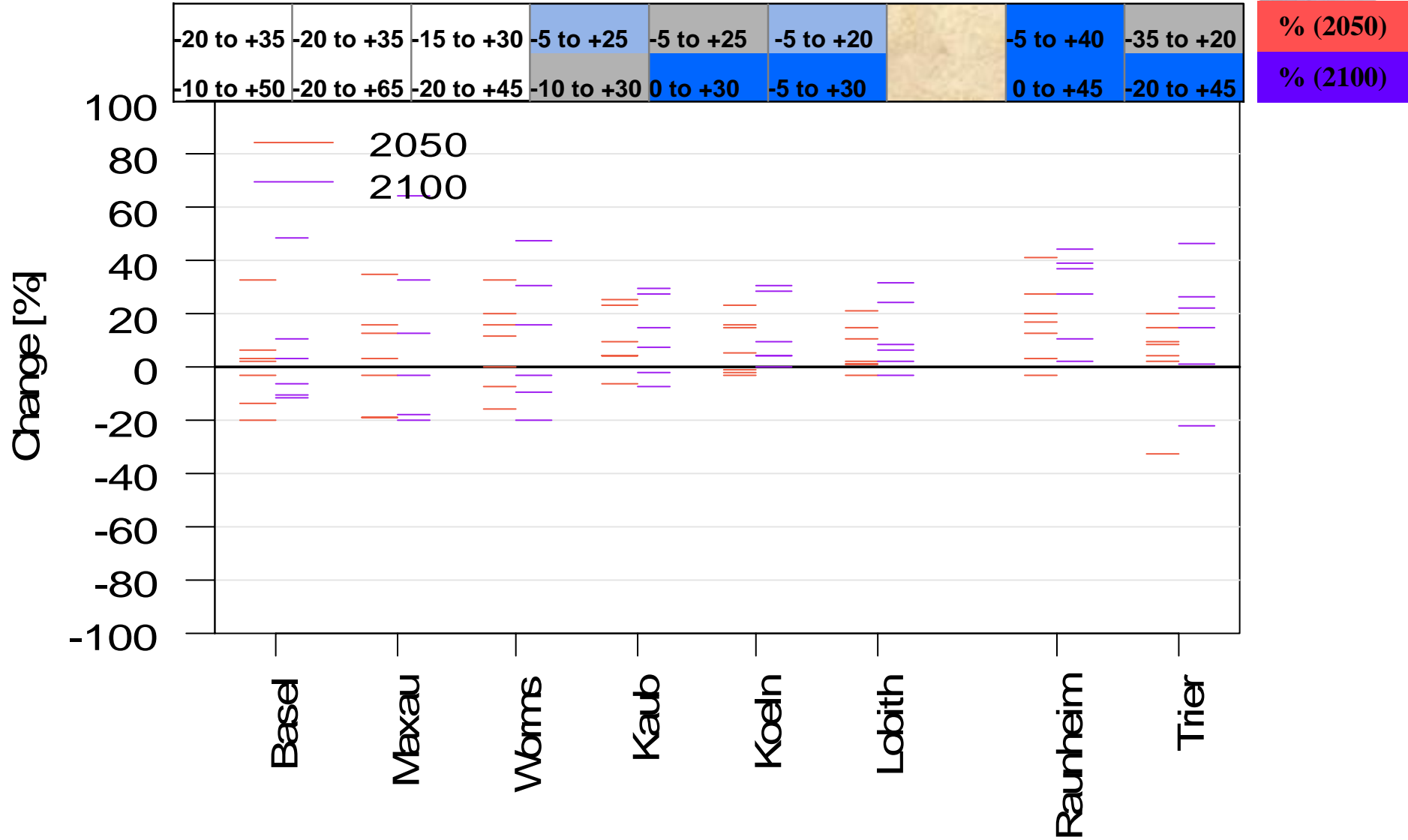
# Mean maximum discharge



# 100-year return flow



# 1000-year return flow



# Results



<b>Lobith</b>	<b>2021 to 2050</b>	<b>2071 to 2100</b>
MHQ	0 to +20 %	-5 to +20 %
HQ10	-5 to +15 %	0 to +35 %
HQ100	0 to +20 %	0 to +25 %
HQ1000	-5 to +20 %	-5 to +30 %

<b>Kaub</b>	<b>2021 to 2050</b>	<b>2071 to 2100</b>
MHQ	-5 to +25 %	-10 to +20 %
HQ10	-15 to +15 %	-5 to +40 %
HQ100	-5 to +20 %	-10 to +25 %
HQ1000	-5 to +25 %	-10 to +30 %

# Rheinblick results compared to earlier results for Lobith



At Lobith:

	<b>2021-2050</b>		<b>2071-2100</b>	
	<b>Rheinblick</b>	<b>KNMI 06</b>	<b>Rheinblick</b>	<b>KNMI 06</b>
MQ <sub>jan-mar</sub>	+5 to +20	+5 to +15	+10 to +35%	+15 to +30%
MHQ	0 to +20 %	+5 to +15%	-5 to +20 %	+10 to +25%
HQ1000	-5 to +20 %	+3 to +19 %	-5 to +30 %	+6 to +38%

## Conclusions



- High flows are projected to increase in the tributary rivers and in the lower part of the Rhine river (Köln and Lobith);
- For the upstream part of the Rhine River (Basel, Maxau, Worms) no conclusions could be drawn;
- Scenario bandwidths are larger for the far future and for the less probable events;

## Recommendations for research



- Robust non-linear bias correction
- Objective criteria to reject climate projections from analysis
- Improve hydrological model, in particular upstream of Maxau
- Climate robust hydrological models
- Hydrodynamic model based on realistic future river morphology and including effects like overtopping of dikes during extreme events
- Research on dealing with uncertainties in policy processes from an adaptation perspective, as uncertainties cannot be expected to reduce shortly



# RheinBlick2050

<http://www.chr-khr.org> > Projects > RheinBlick2050

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