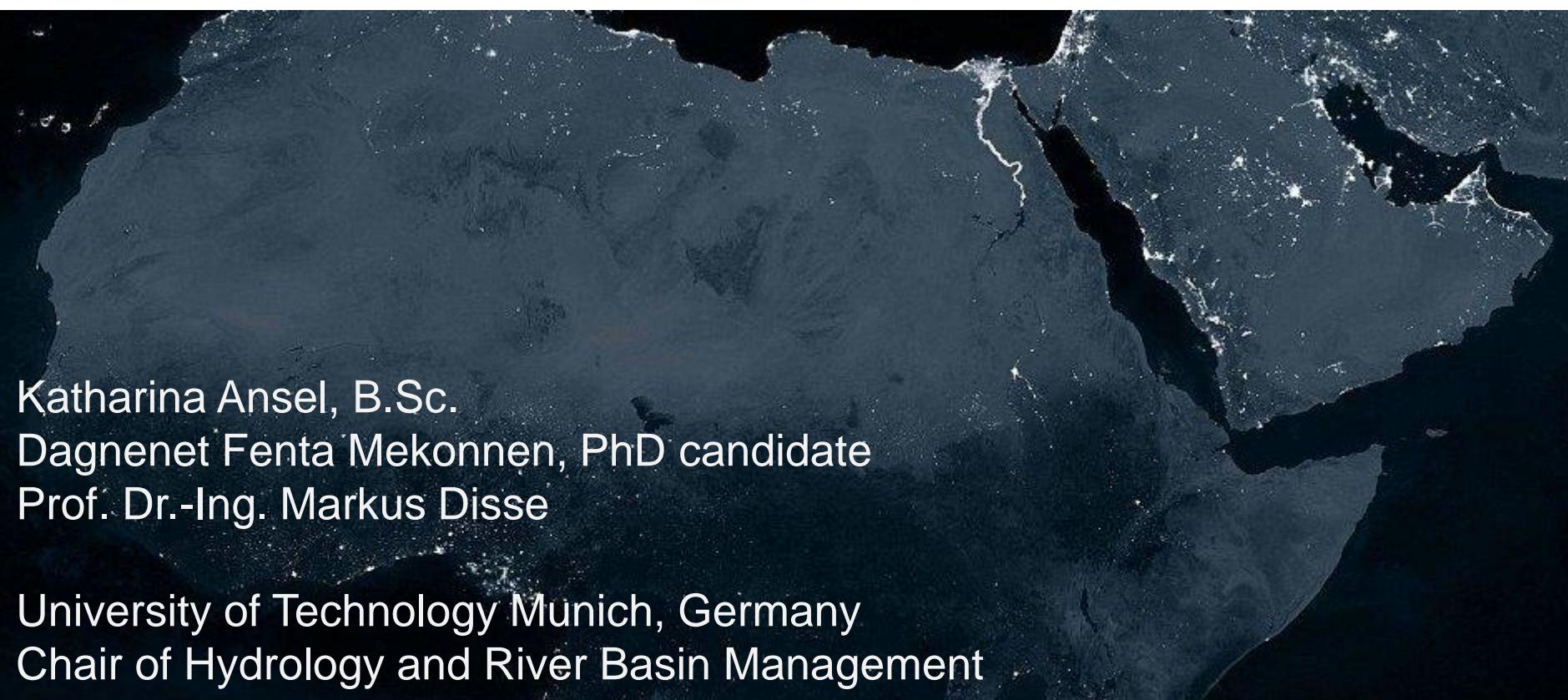


Hydrological modelling in data scarce regions

- How to get reliable results?



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How to get reliable results?

The basic Idea – Research questions?

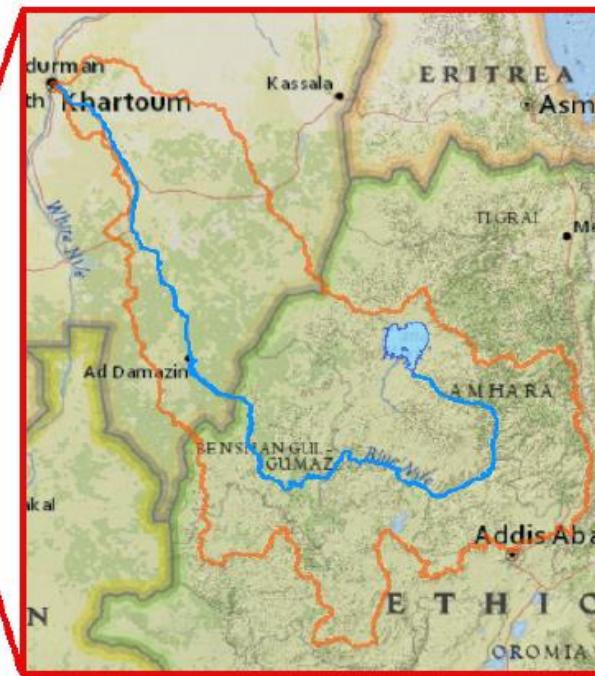
- Is the calibration decisive?
- What model complexity is reliable?





Study site

The Upper Blue Nile Basin Lake Tana



Map source: H. Huber (2015)



Objective

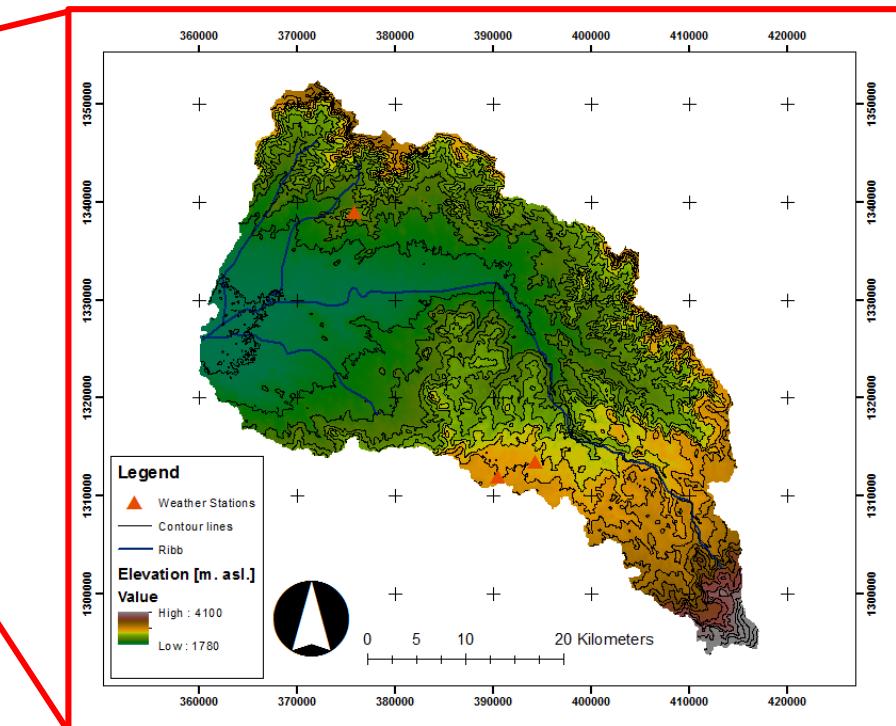
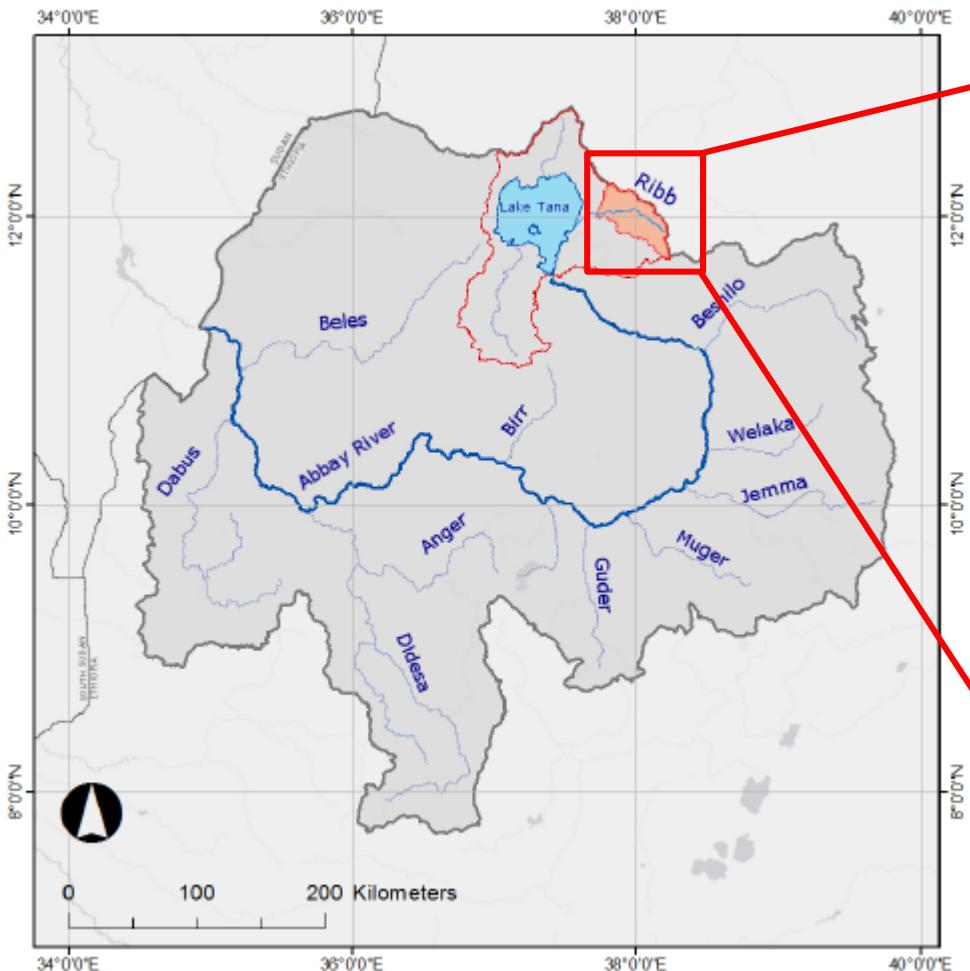
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Study site

Ribb River



Map source: H. Huber (2015)



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HBV-light model

Input:

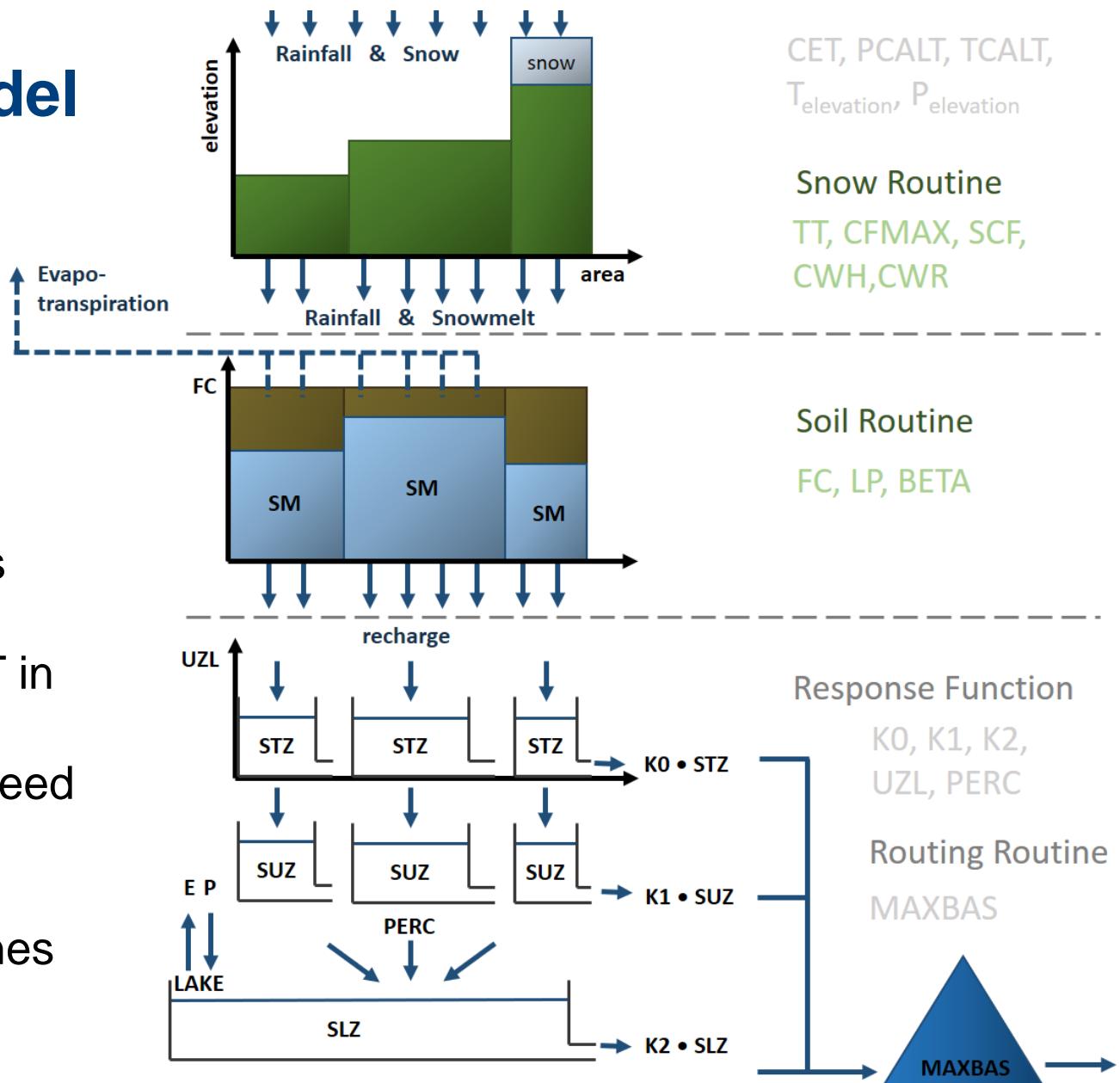
- Precipitation
- Temperature
- Discharge
- ETP

Advantages:

- Tested in various climates
- Distributed P & T in elevation zones
- Low input data need

Limitations:

- 3 Vegetation zones
- No included preprocessing



Calibration Strategies

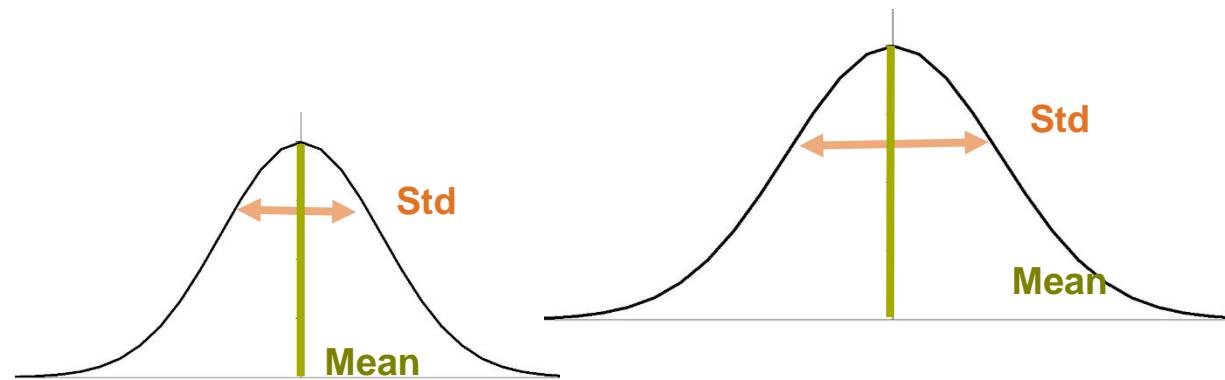
Monte Carlo Simulation

Set 1
Set 2
Set 3
Set 4
Set 5
...
...
...



N results

Set n

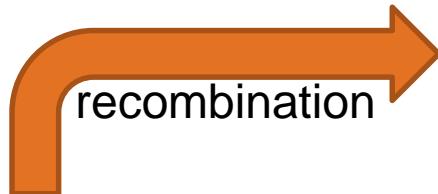
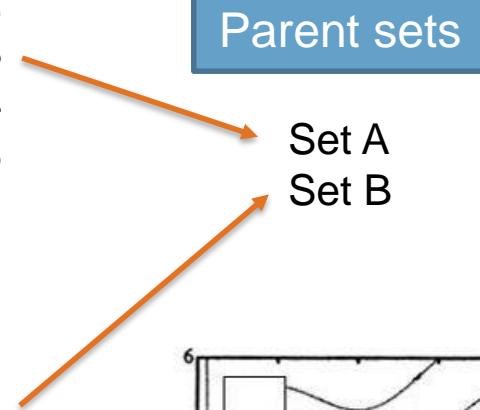


Calibration Strategies

GAP optimization (genetic algorithm)

Population(s)

Set 1
Set 2
Set 3
Set 4
Set 5
...
......

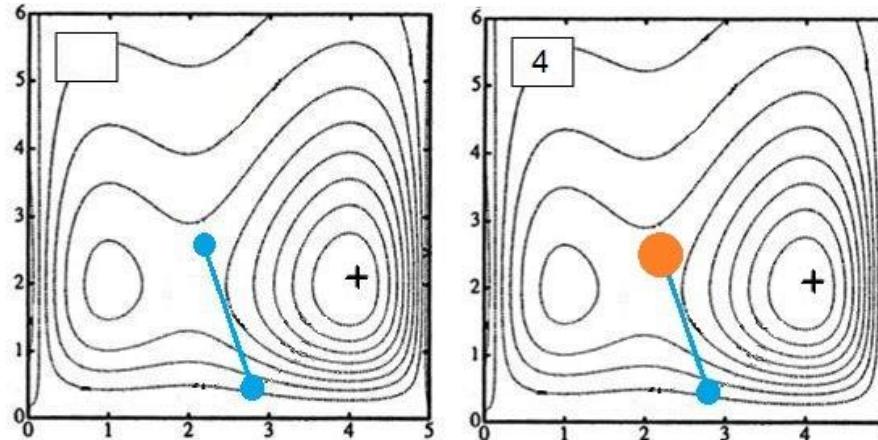


New generation

Set 1
Set 2
Set 3
Set 4
Set 5
...
......

Powell's local optimization

Set n

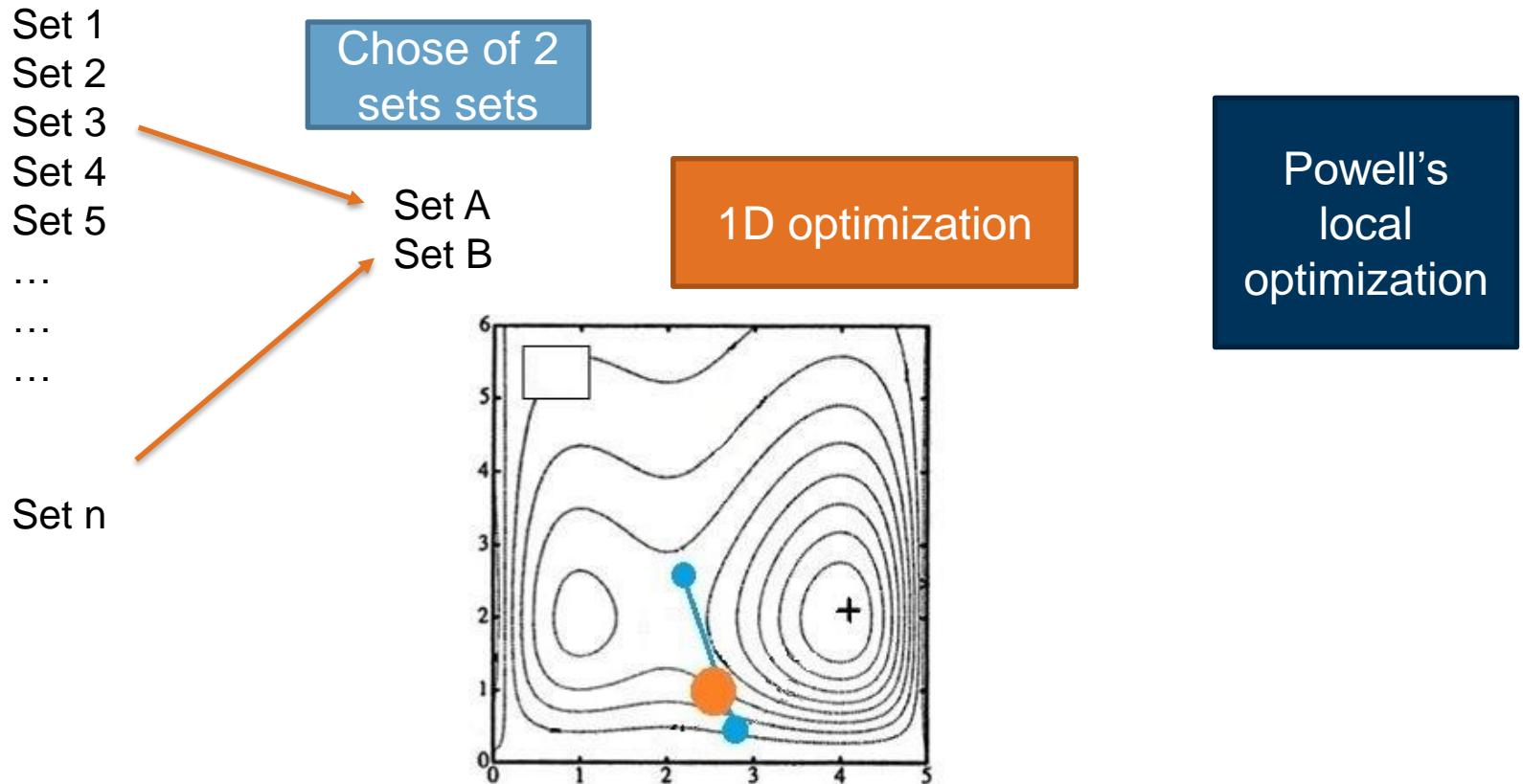


Set n



Calibration Strategies

Brent's method



Modelling Results - GoF

Ribb River

HBV-light model



GoF	Calibration 1980 - 1999		Validation 2000 - 2006	
	NSE	R ²	NSE	R ²
Manual	0.60	0.64	0.74	0.84
MC	0.67	0.68	0.87	0.88
GAP	0.68	0.69	0.88	0.88
Brent	0.68	0.69	0.87	0.87



Modelling Results - GoF

Ribb River

HBV-light model



	Calibration 1980 - 1986		Validation 1987 - 2006	
GoF	NSE	R ²	NSE	R ²
MC	0.69	0.70	0.68	0.71
GAP	0.71	0.71	0.64	0.72
Brent	0.66	0.70	0.66	0.72



Modelling Results - GoF

Ribb River

HBV-light model



	Calibration 1980 - 1993		Validation 1994 - 2006	
GoF	NSE	R ²	NSE	R ²
MC	0.62	0.64	0.78	0.79
GAP	0.63	0.62	0.80	0.80
Brent	0.60	0.63	0.77	0.78



Modelling Results - GoF

Ribb River

HBV-light model



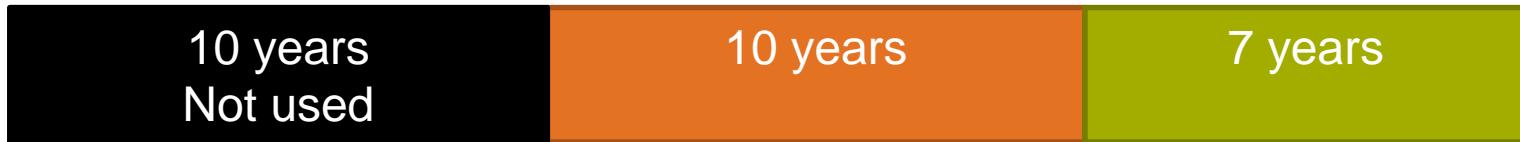
	Validation 1980 - 1993		Calibration 1994 - 2006	
GoF	NSE	R ²	NSE	R ²
MC	0.55	0.63	0.83	0.84
GAP	0.56	0.63	0.84	0.83
Brent	0.55	0.63	0.83	0.84



Modelling Results - GoF

Ribb River

HBV-light model

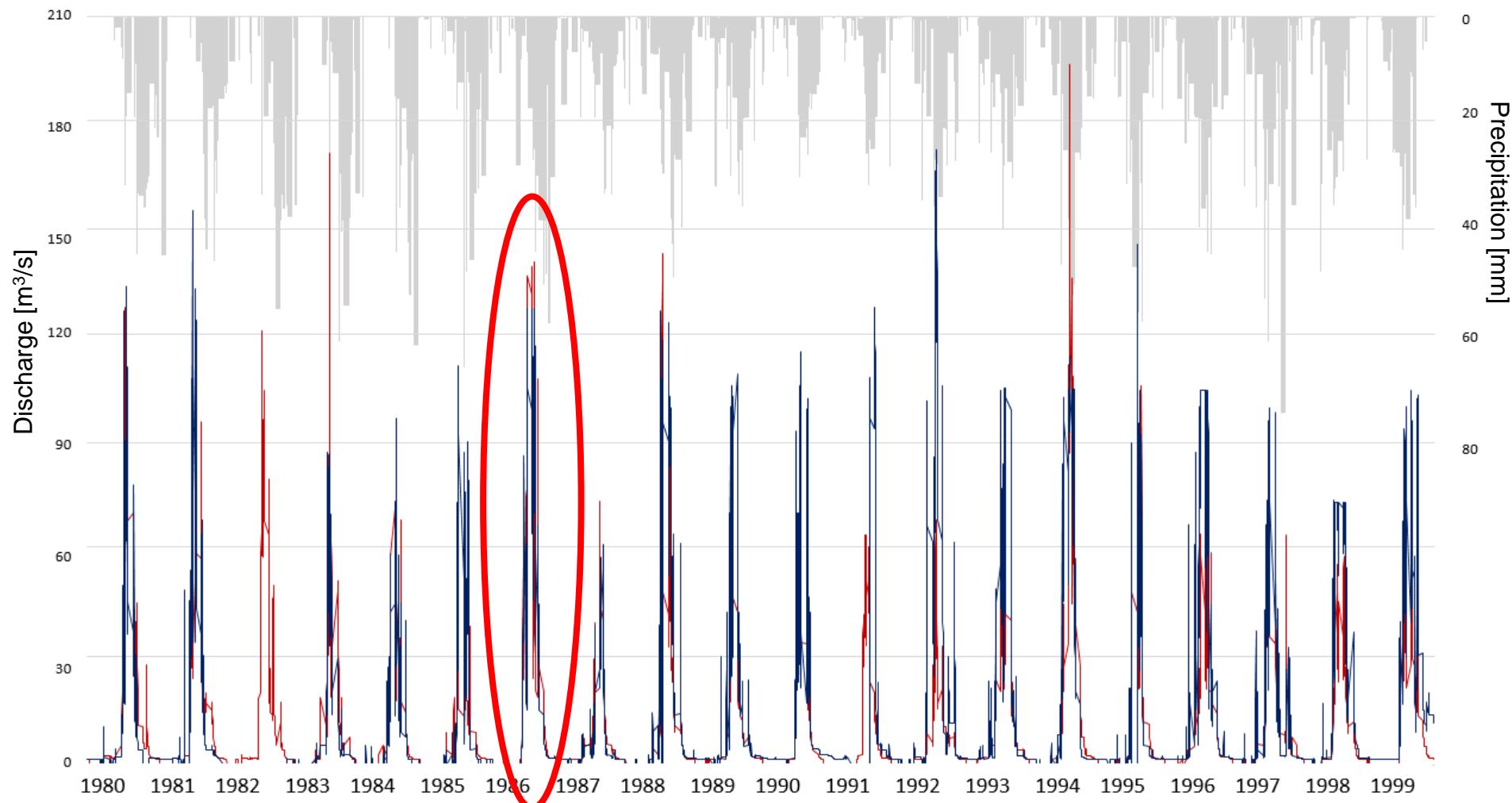


	Calibration 1990 – 1999		Validation 2000 - 2006	
GoF	NSE	R ²	NSE	R ²
MC	0.72	0.72	0.88	0.87
GAP	0.73	0.73	0.85	0.88
Brent	0.72	0.73	0.83	0.88



Modelling results – Discharge time series

Ribb River 1980 - 1999



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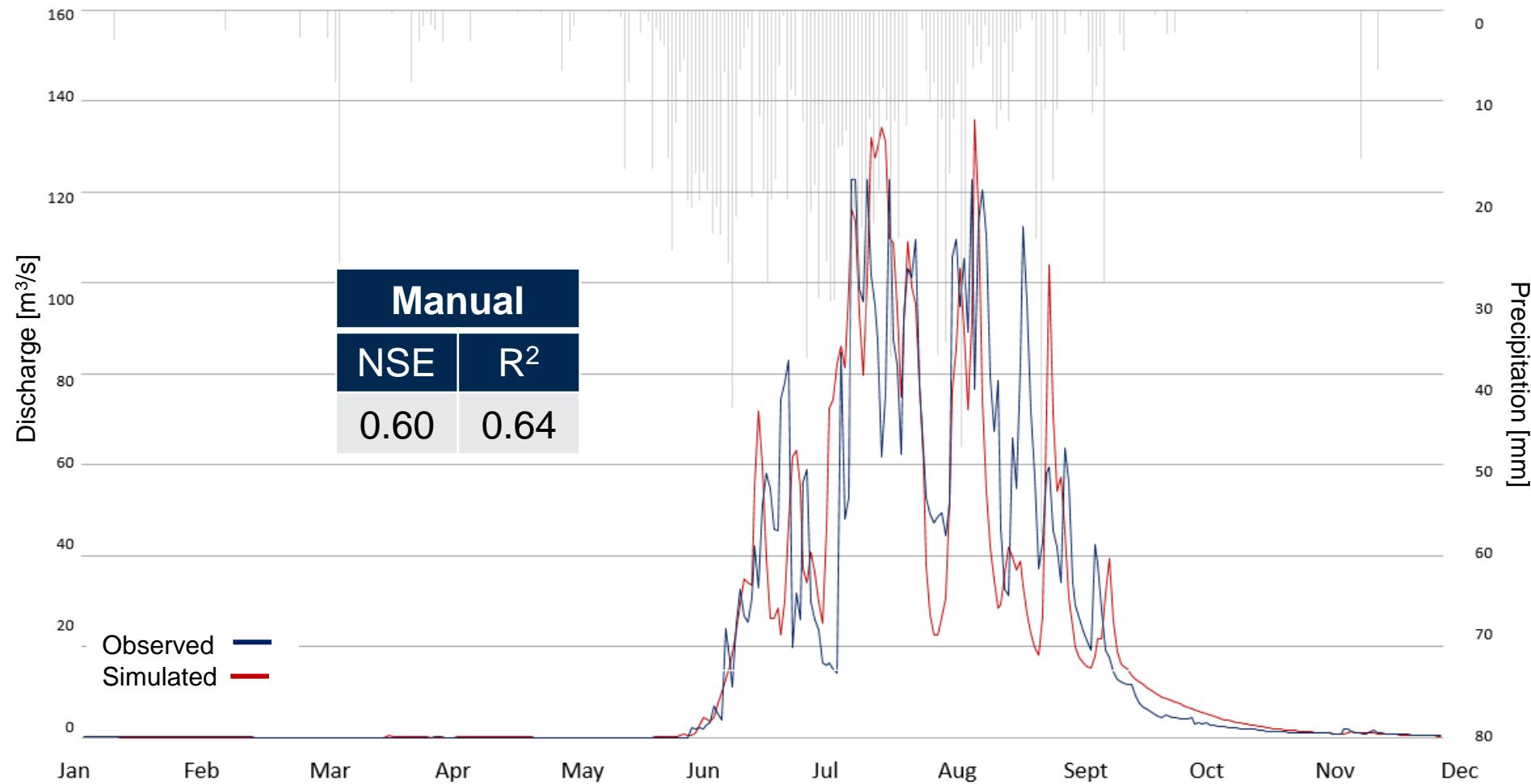
k.ansel@tum.de

TUM

Modelling results – Discharge time series

Capturing Dynamics

1986



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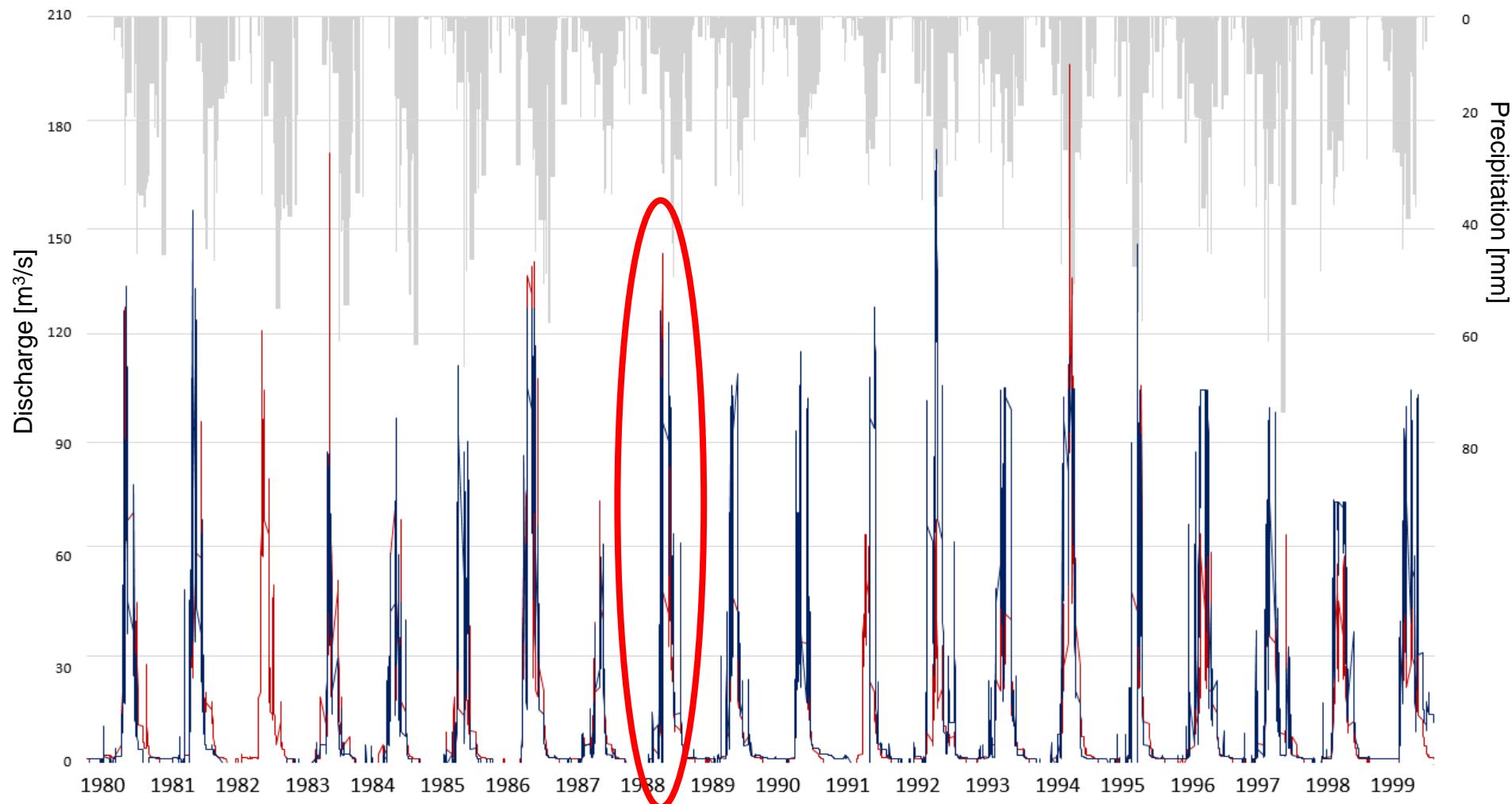
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Modelling results – Discharge time series

Ribb River 1980 - 1999



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Modelling results – Discharge time series

Discharge - Good Fit of NSE and R²

1988



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Conclusions

Evaluation weighting system

- Is the calibration decisive?

	Weight	MC	GAP	Brent	Manual
Best GoF	2	●○○	●●●	●●○	○○○
Dynamics best met	3	●○○	●●○	●○○	●●○
Computational effort	1	●●○	○○○	●○○	●●●
Water balance	3	●●●	○○○	○○○	●●●
Equifinality problem	3	●●○	●●○	●●○	●●○
Time consumption	2	●●●	●●○	●●●	○○○
Peaks	1	●○○	○○○	○○○	●●○
Personal Favor	2	●●○	●●●	○○○	●●●
Sum	17	●●○	●●○	●○○	●●○



Modelling Results

Results Ribb

SWAT

H. Huber (2015)

Helena Huber: "Investigation of Hydrologic Response Unit Discretization for Erosion Modelling with SWAT in the Upper Blue Nile Basin"
Master Thesis, 2015

	Calibration 1992 - 1996		Validation 2004 - 2006	
GoF	NSE	R ²	NSE	R ²
SUFI-2	0.60	0.60	0.66	0.70

Results Ribb

SWAT

Setegn et al. (2008)

Shimelis G. Setegn, Ragahavan Srinivasan and Bijan Dargahi: "Hydrological Modelling in the Lake Tana Basin, Ethiopia Using SWAT Model" in The Open Hydrology Journal, 2008

	Calibration 1981 - 1992		Validation 1993 - 2004	
GoF	NSE	R ²	NSE	R ²
SUFI-2	0.51	0.59	0.48	0.55
GLUE	0.50	0.58	0.48	0.55
Parasol	0.55	0.59	0.45	0.57



Conclusions

Evaluation weighting system

- What model complexity is reliable?

	Weight	HBV	SWAT
Computational effort	1	●●●	●○○
Preprocessing effort	1	●○○	●●○
Water balance	2	●○○	●●○
Model performance	1	●●●	●●○
Modelling Possibilities	3	●●○	●●●
Personal Favor	3	●●●	●○○
Sum	11	●●○	●●○



Hydrological modelling in data scarce regions

- How to get reliable results?



Thank you for the attention

Your questions and comments are
very welcome



Sources

- Helena Huber: "Investigation of Hydrologic Response Unit Discretization for Erosion Modelling with SWAT in the Upper Blue Nile Basin" Master Thesis, 2015
- Shimelis G. Setegn, Ragahavan Srinivasan and Bijan Dargahi: "Hydrological Modelling in the Lake Tana Basin, Ethiopia Using SWAT Model" in *The Open Hydrology Journal*, 2008
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