FloodEvac

Bilaterale Forschungszusammenarbeit für die zivile Sicherheit zwischen Deutschland und Indien
BMBF-Verbundprojekt: Verletzbarkeit von Transport-Infrastrukturen - Warnung und Evakuierung bei Hochwasser

Indo-German Initiative for Civil Security Research

INTERACT Dissemination Event 25.01.2018

The University Of Sheffield.

BMBF Project FloodEvac

Workpackage 2:

Flood Modeling and Flooded Areas

Jorge Leandro, Markus Disse, Amin Kanwal, Iris Konnerth, Punit Bhola

Technical University of Munich

Chair of Hydrology and River Basin Management

FLOODEVAC

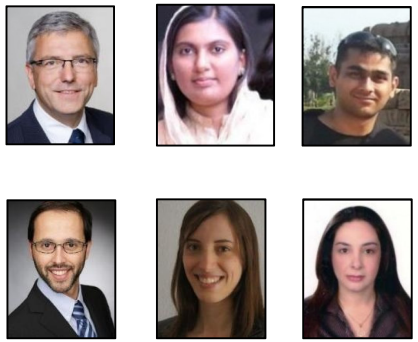
Transfer methodologies between India and Germany

FloodEvac - Flood Modeling and Flooded Areas

Coordination and Administration

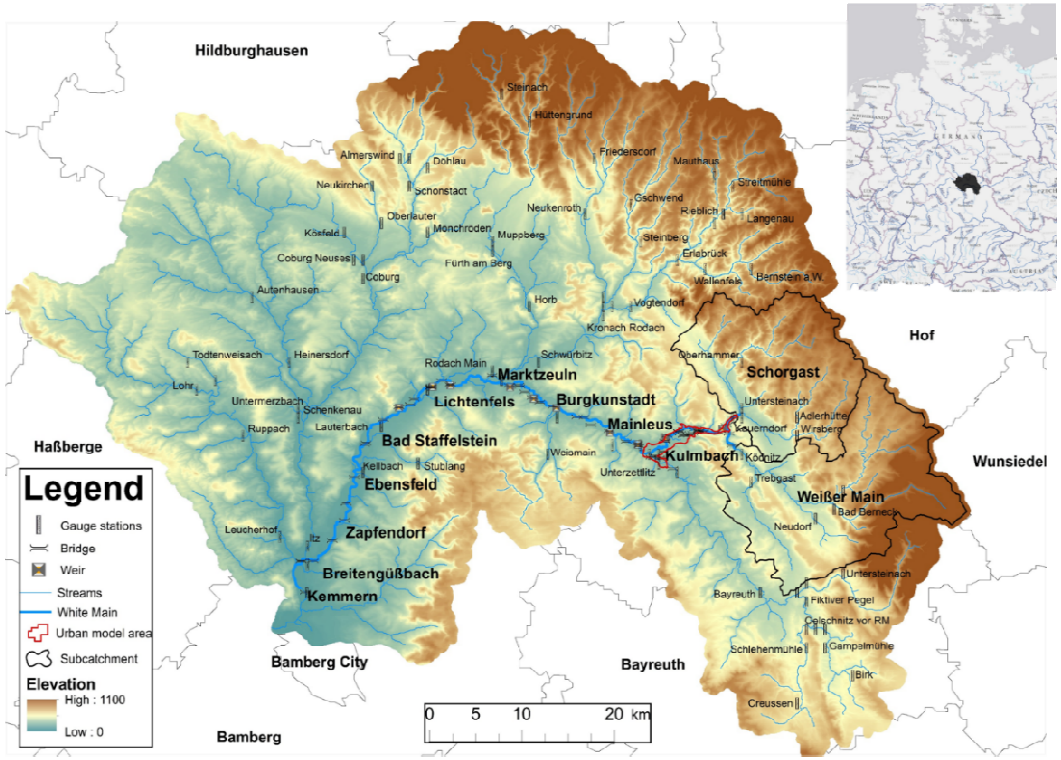
HWMod	TransInfra	UUV	SmabaSenf	RobEZiS	KatKult	AVVU	IITD

- AP1: Estimation of model uncertainties
- AP2: Interpolation of precipitation information
- AP3: Combination of uncertainties
- AP4: Evaluation of the Prec.-Runoff-Modelling
- AP6: Hydrodynamic 2D modelling
- AP7: Production of dynamic inundation maps
- AP8: Realization of the WebGIS application



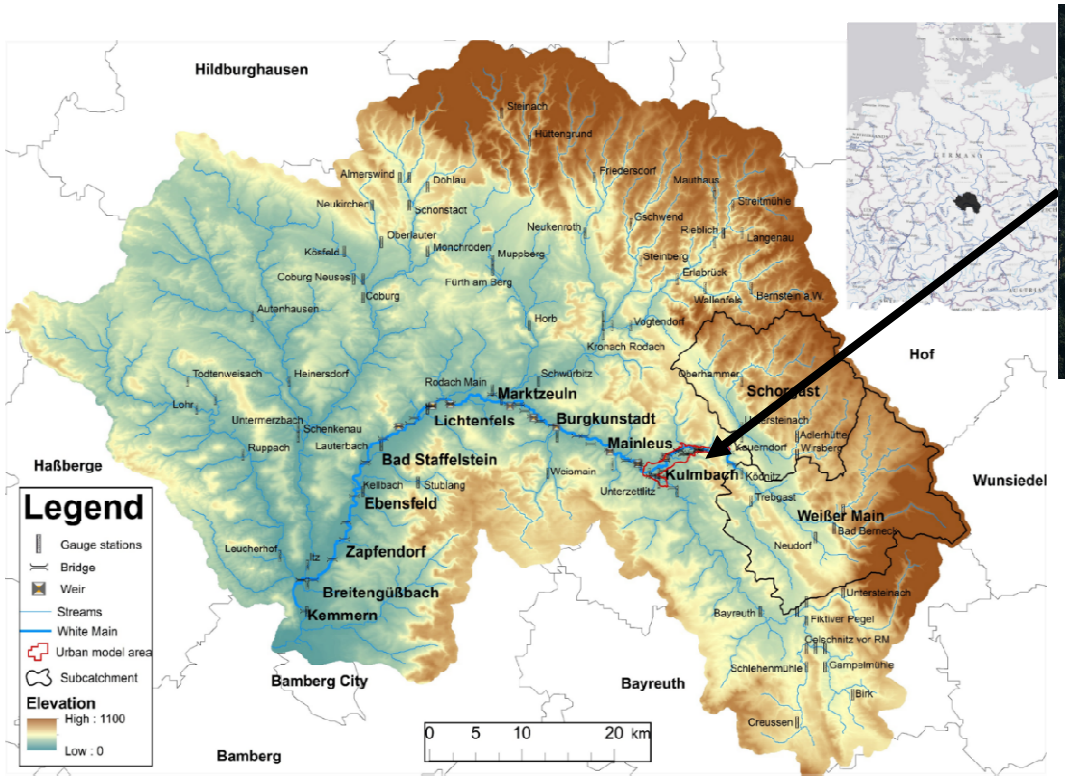
City of Kulmbach and Upper Main Catchment

Case study



City of Kulmbach and Upper Main Catchment

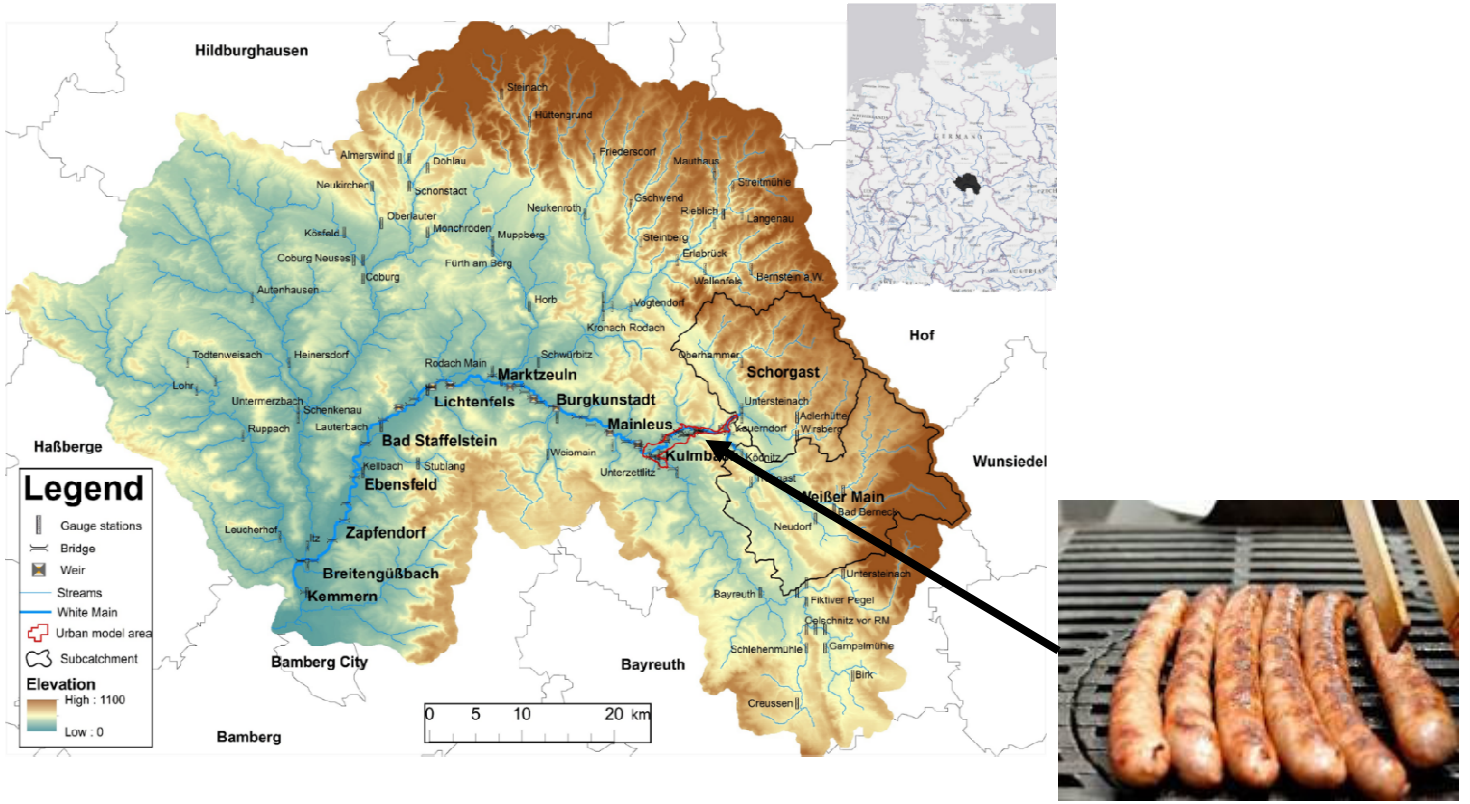
Case study



Plassenburg Castle

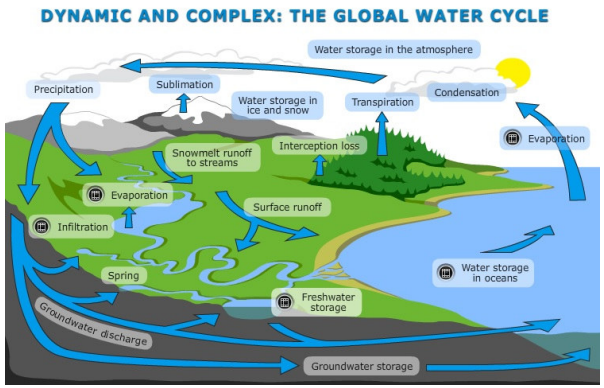
City of Kulmbach and Upper Main Catchment

Case study

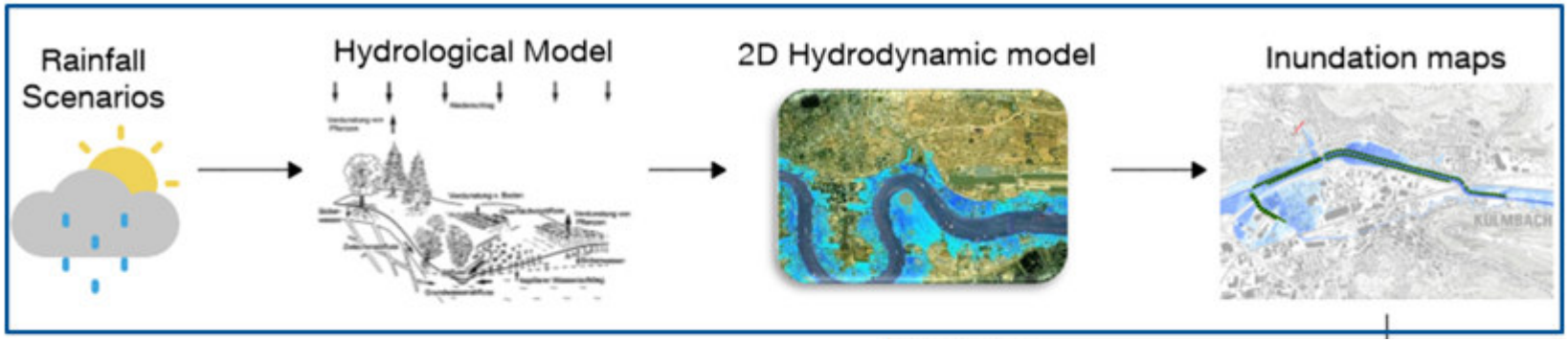


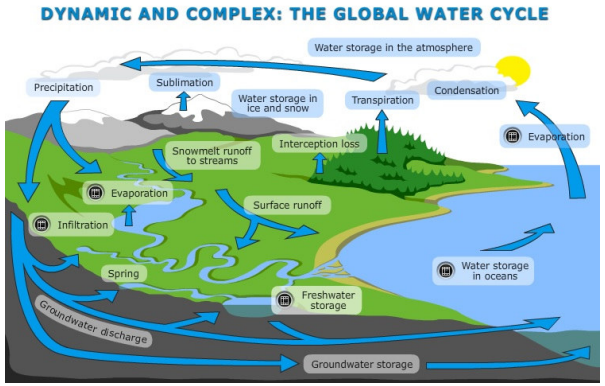
Bratwurst

Model Concept

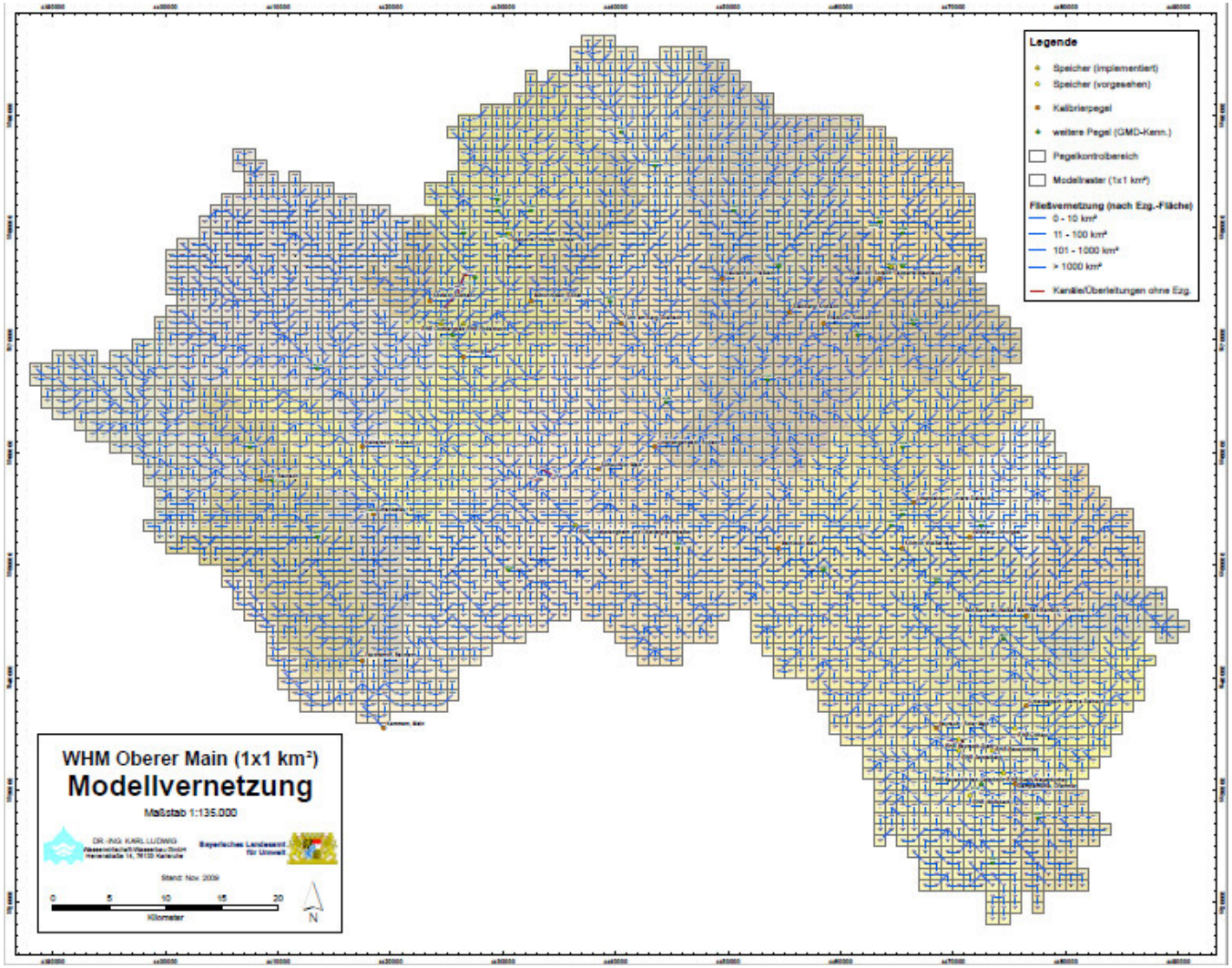


Model Concept



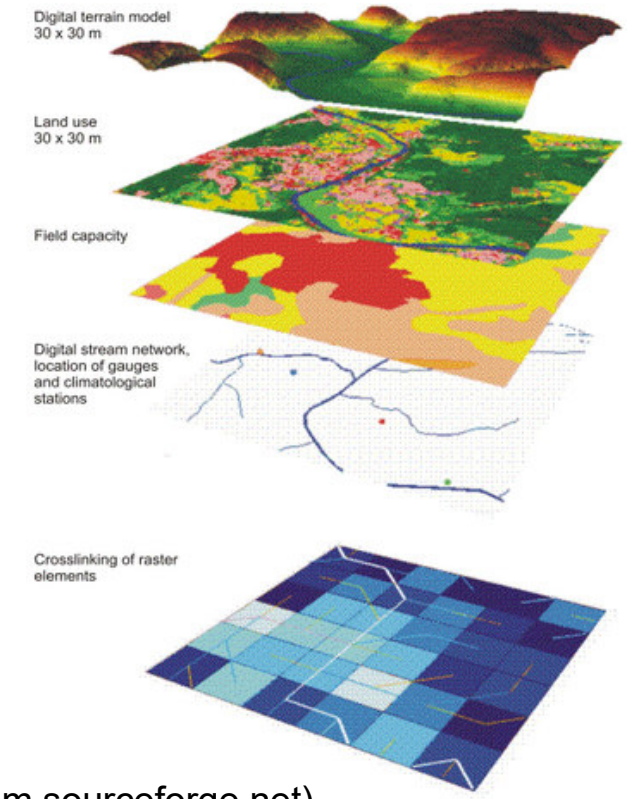


Hydrological Model Input (LARSIM)



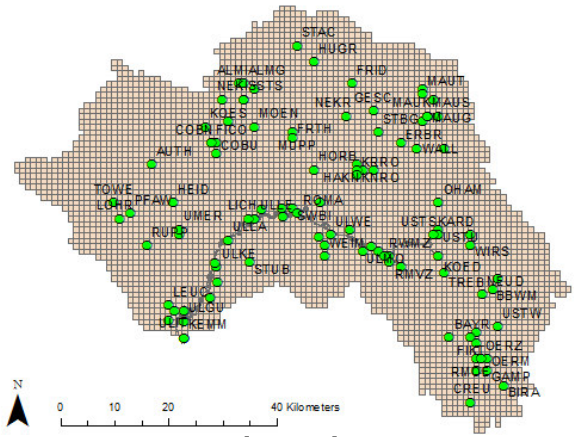
Hydrological Model Input (LARSIM)

- Ground level, slope, land use, field capacity, stream geometry



(http://larsim.sourceforge.net)

- climatological gauges

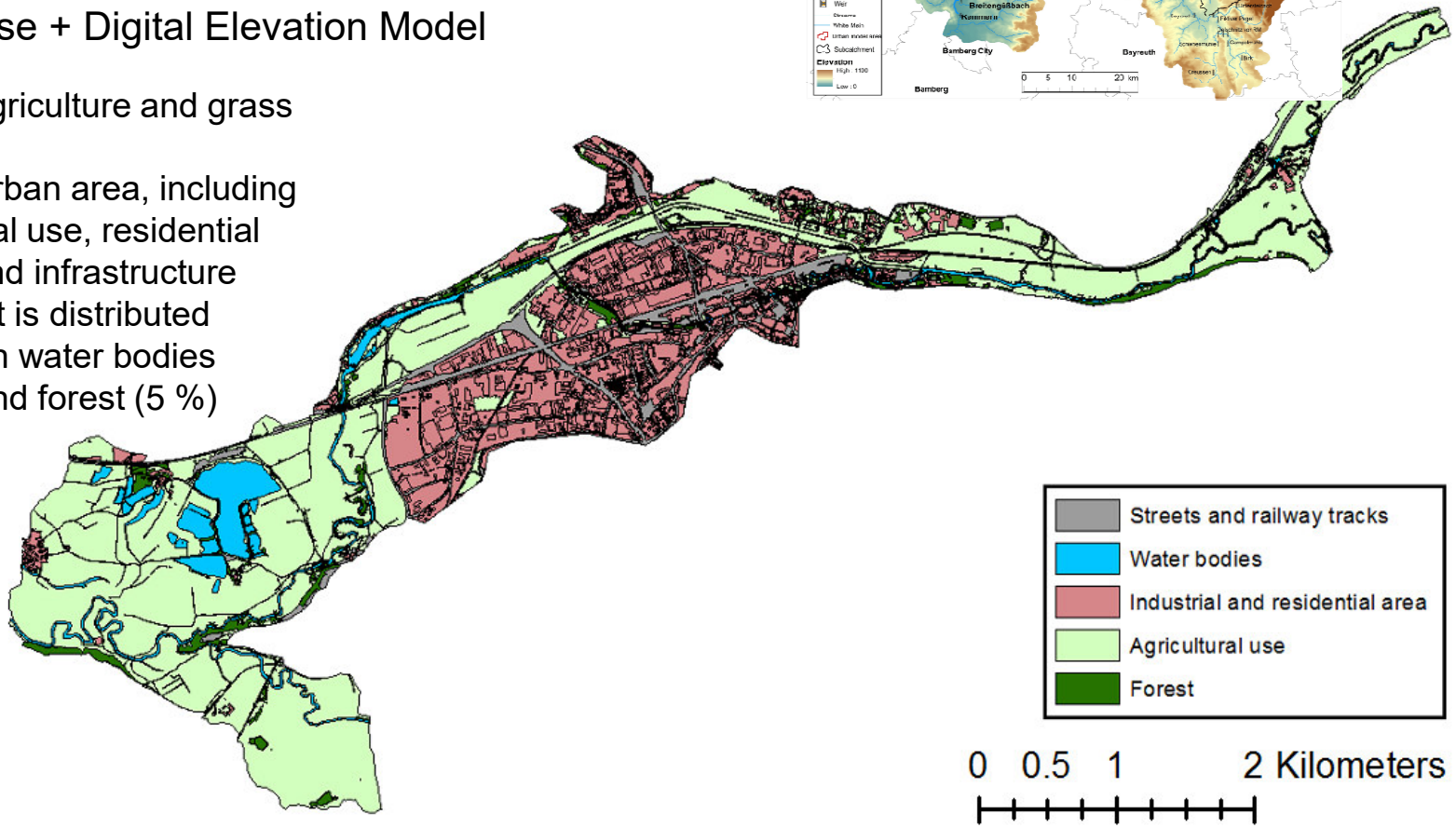


- water level gauges

Hydraulic Model Input (HEC-RAS 2D, Hydro-AS 2D)

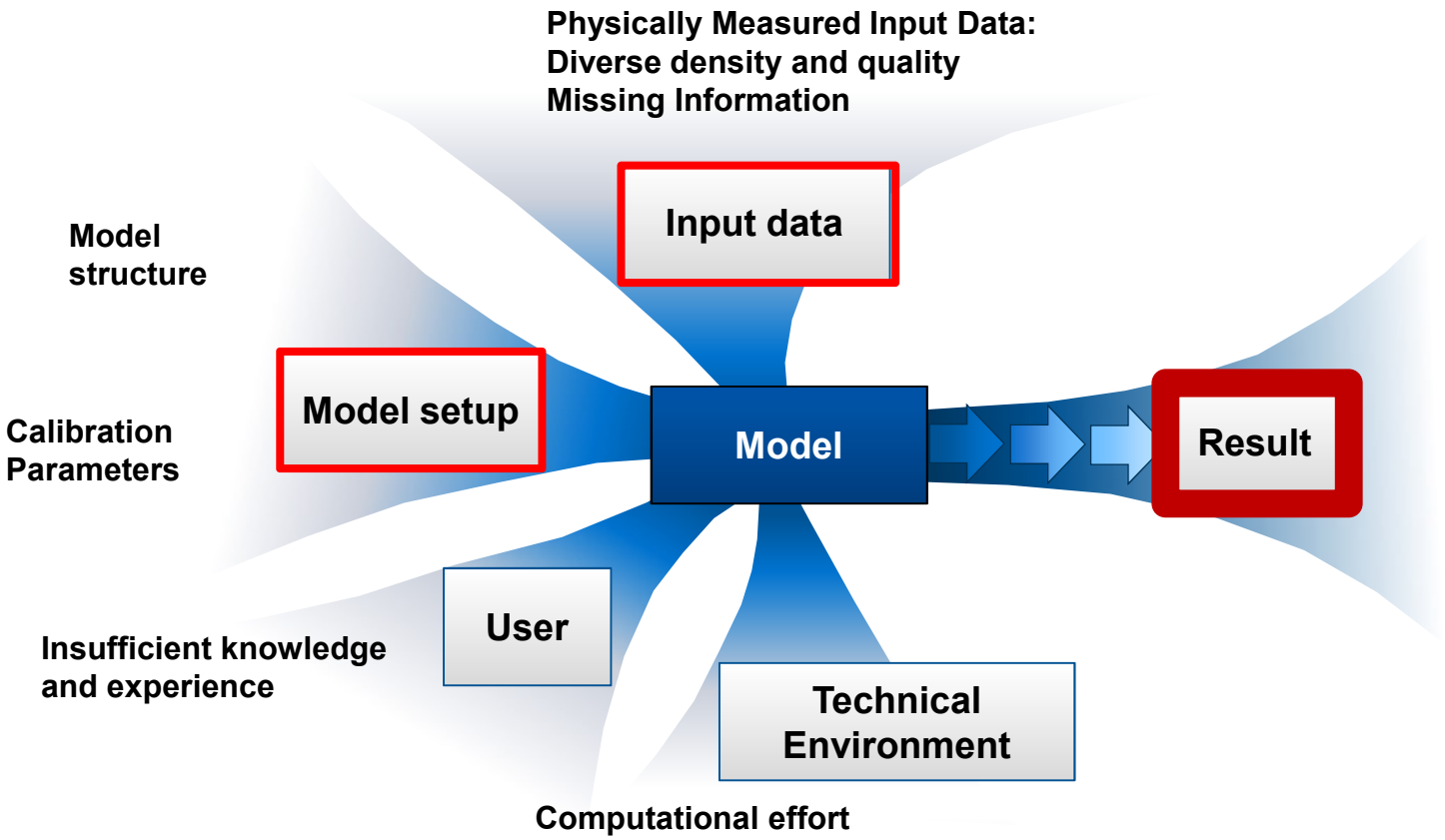
Land use + Digital Elevation Model

- 62 % Agriculture and grass land
- 26 % Urban area, including industrial use, residential area, and infrastructure
- The rest is distributed between water bodies (7 %) and forest (5 %)

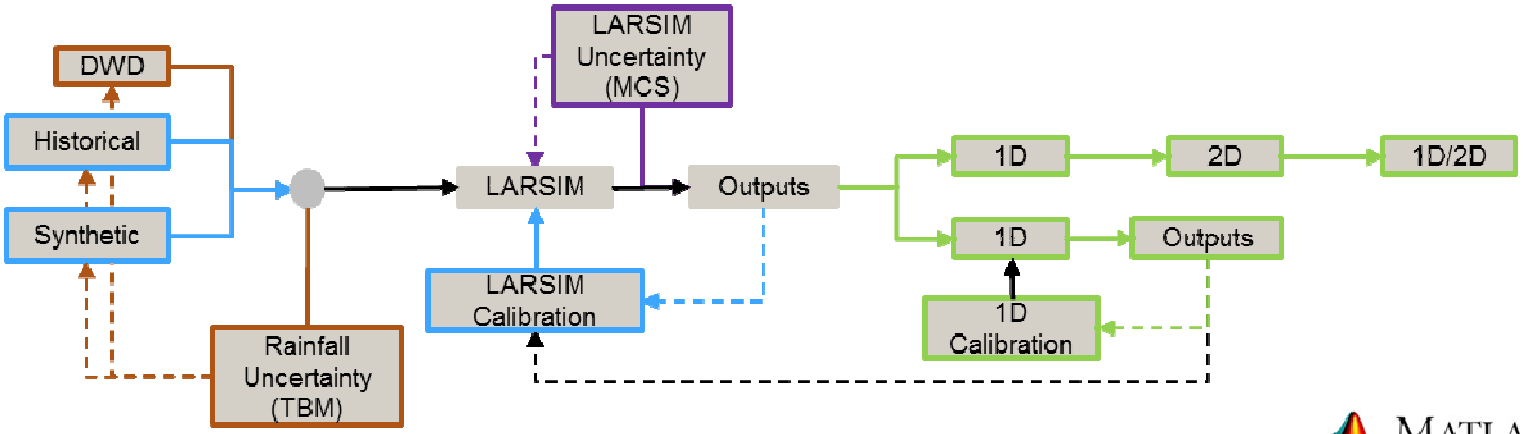


Sources of Uncertainty

Sources of uncertainties (modified Buchholz, 2000)



Model Concept
uncertainty chain into forecasts

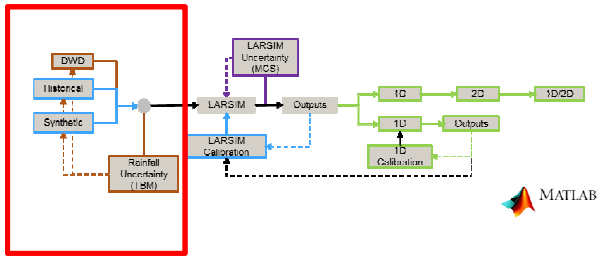


MATLAB

FloodEvac-Tool

Rainfall Uncertainty **Hidrological Uncertainty** **2D Uncertainty**

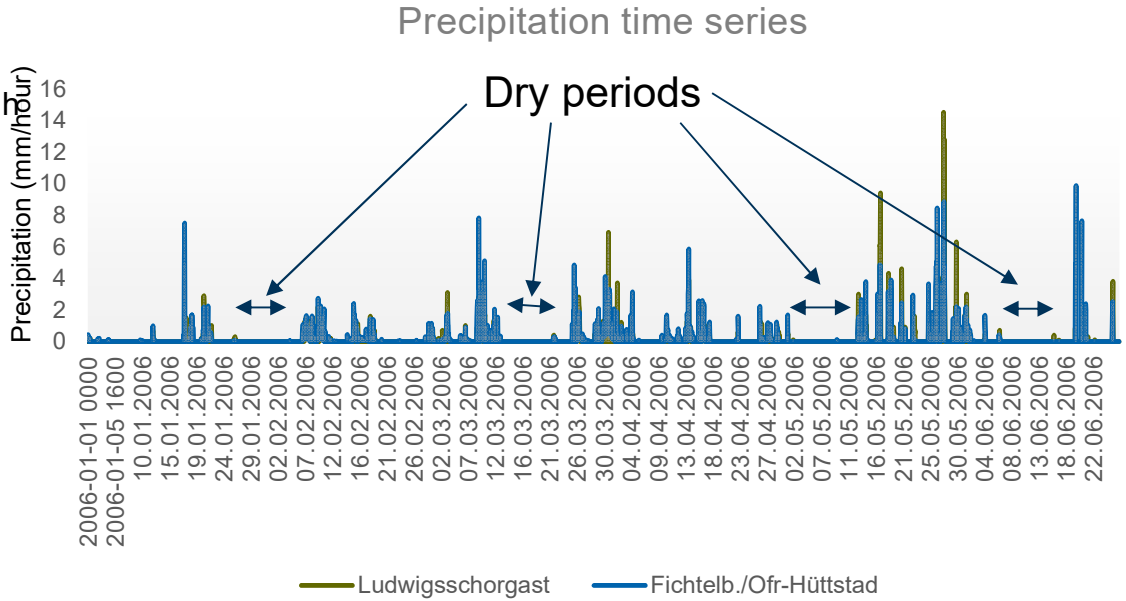
Historical Rainfall



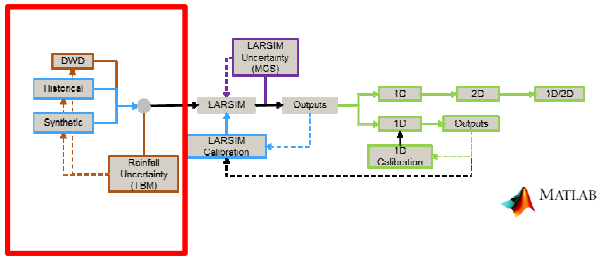
- Realistic scenarios based on the observed precipitation time series
- Independent of the return period
- Inclusion of the spatial uncertainty

1. Separation of wet and dry periods
2. Rescaling of rainfall events to generate h

$$y = (x - min) / (max - min)$$



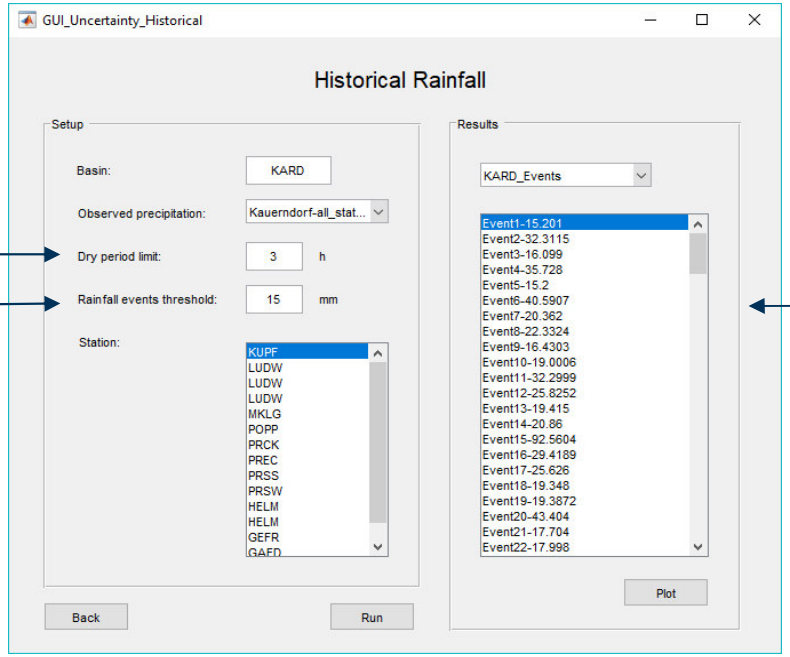
Historical Rainfall



Dry period

Precipitation **Threshold**

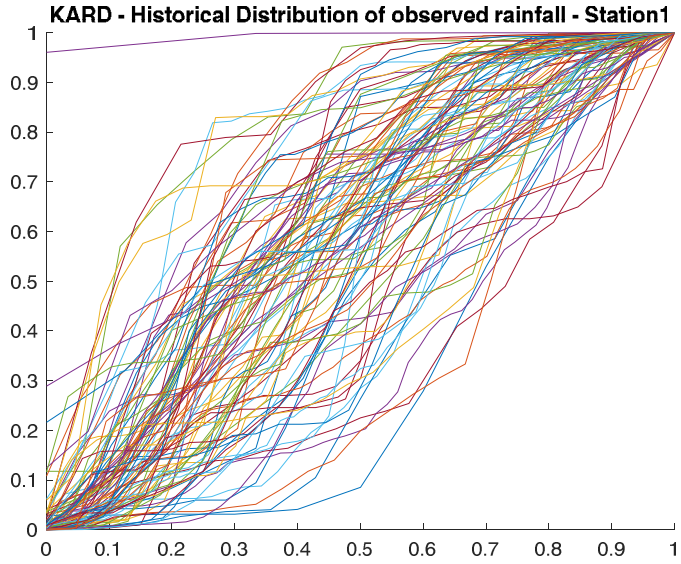
Select gauges for rainfall events selection

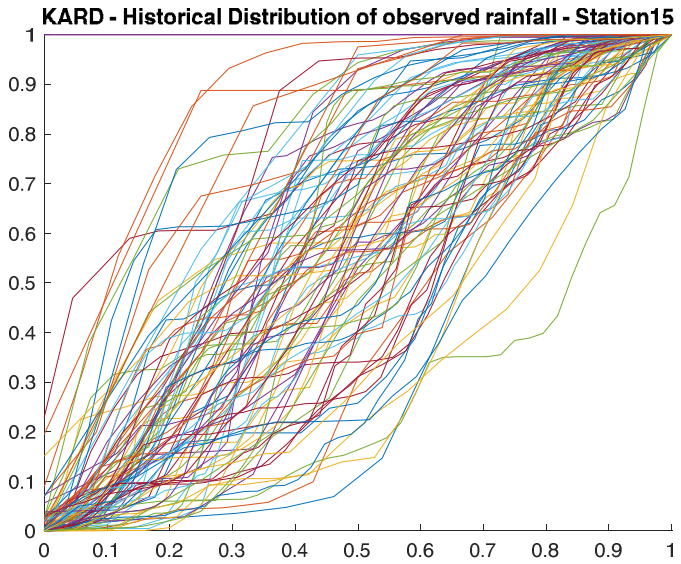


Events selection for further analysis

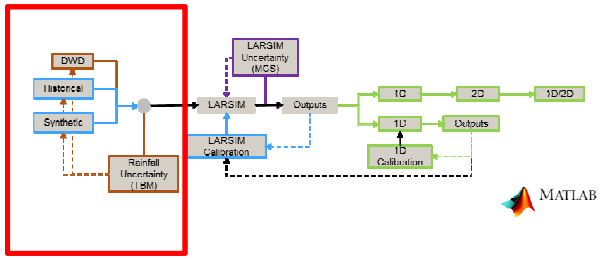
Historical Rainfall

Rainfall temporal distributions

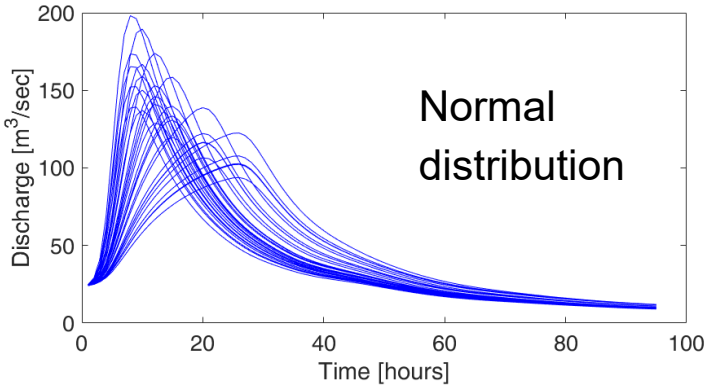


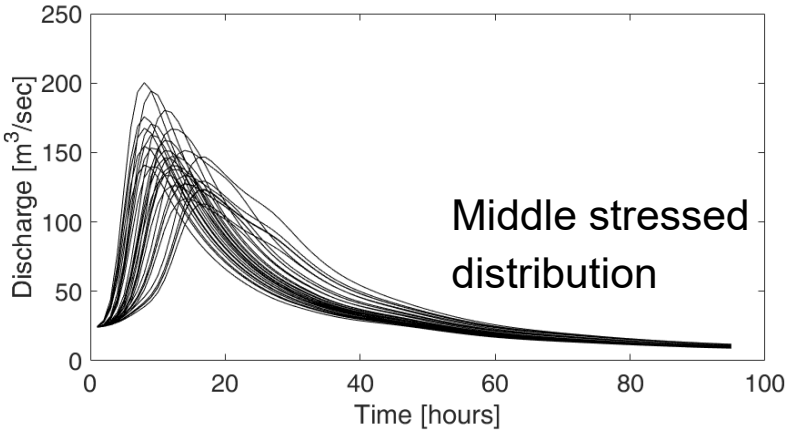


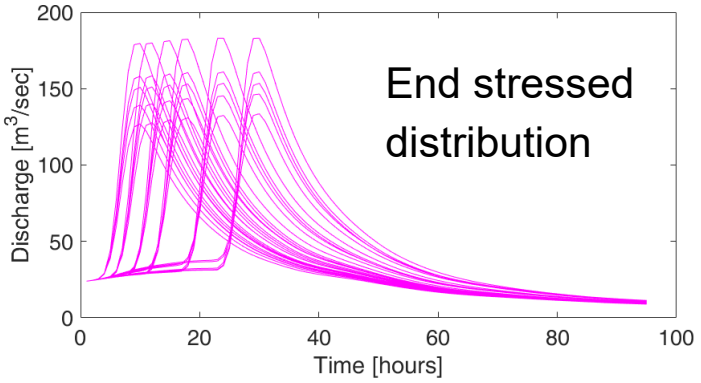
Synthetic Rainfall Scenarios



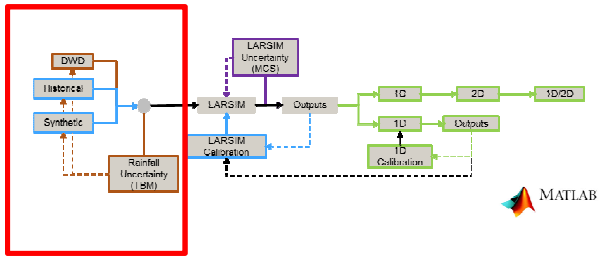
Catchment: Ködnitz







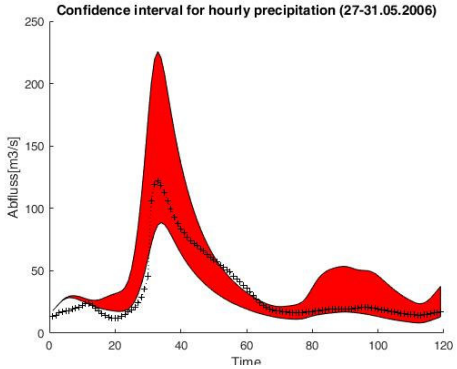
Spatial precipitation uncertainty



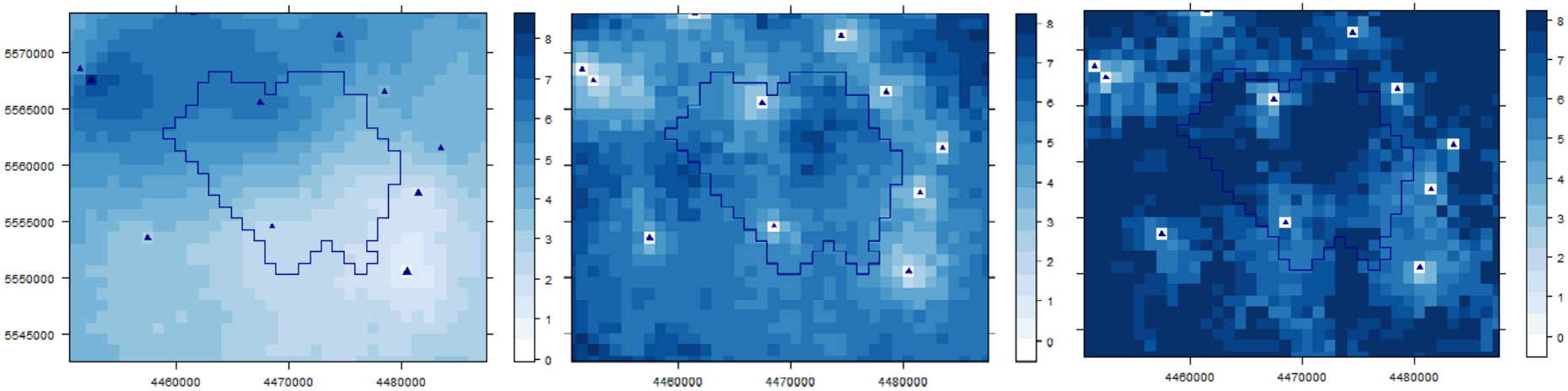
Number of stations = 11

Number of TBM lines = 15

Time Period = 27-05-2006 22:00



Kauerndorf subcatchment



Mean of 100 realizations:

Inter-quantile range:

$R_{95\%\ quantile} - R_{5\%\ quantile}$

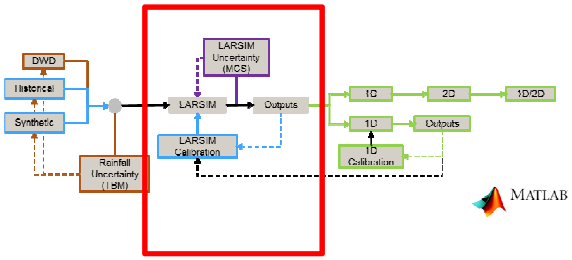
Range plot:

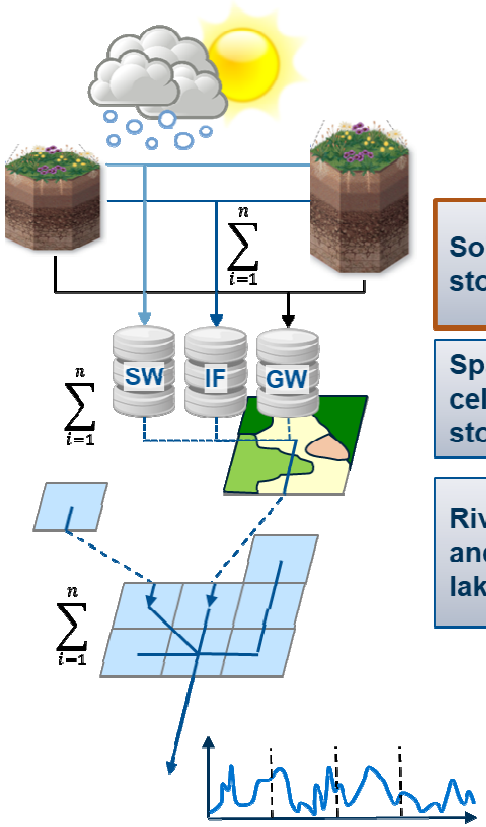
$R_{max} - R_{min}$

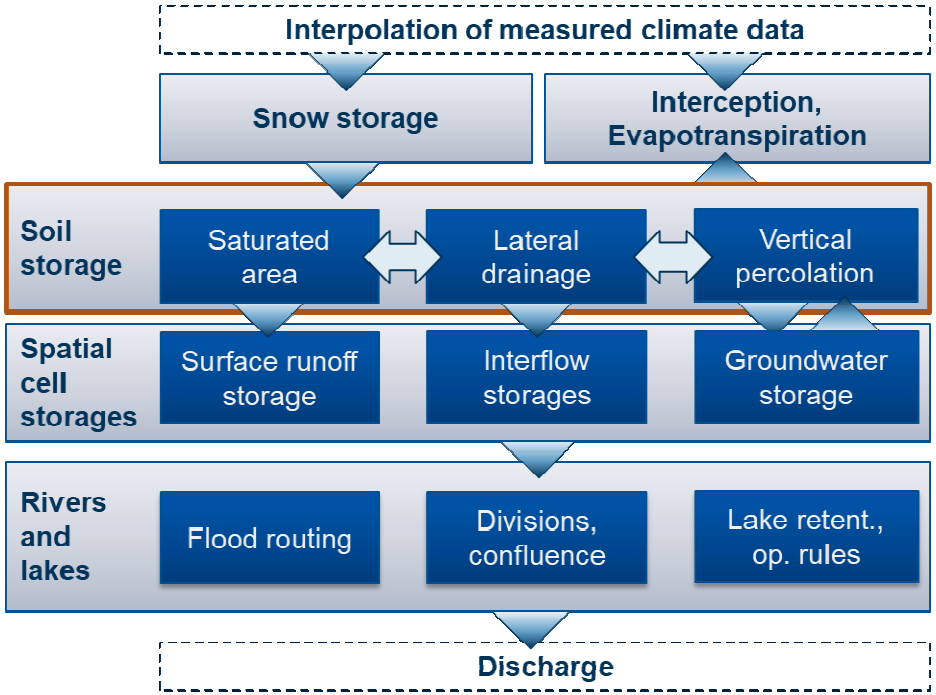
LARSIM

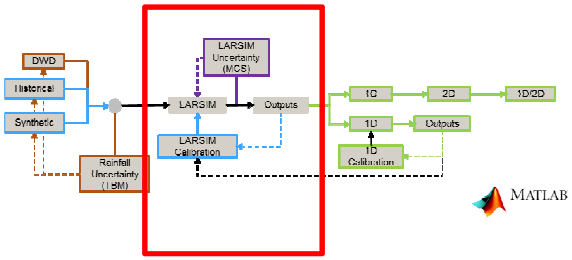
(Large Area Runoff Simulation Model)

Model Structure



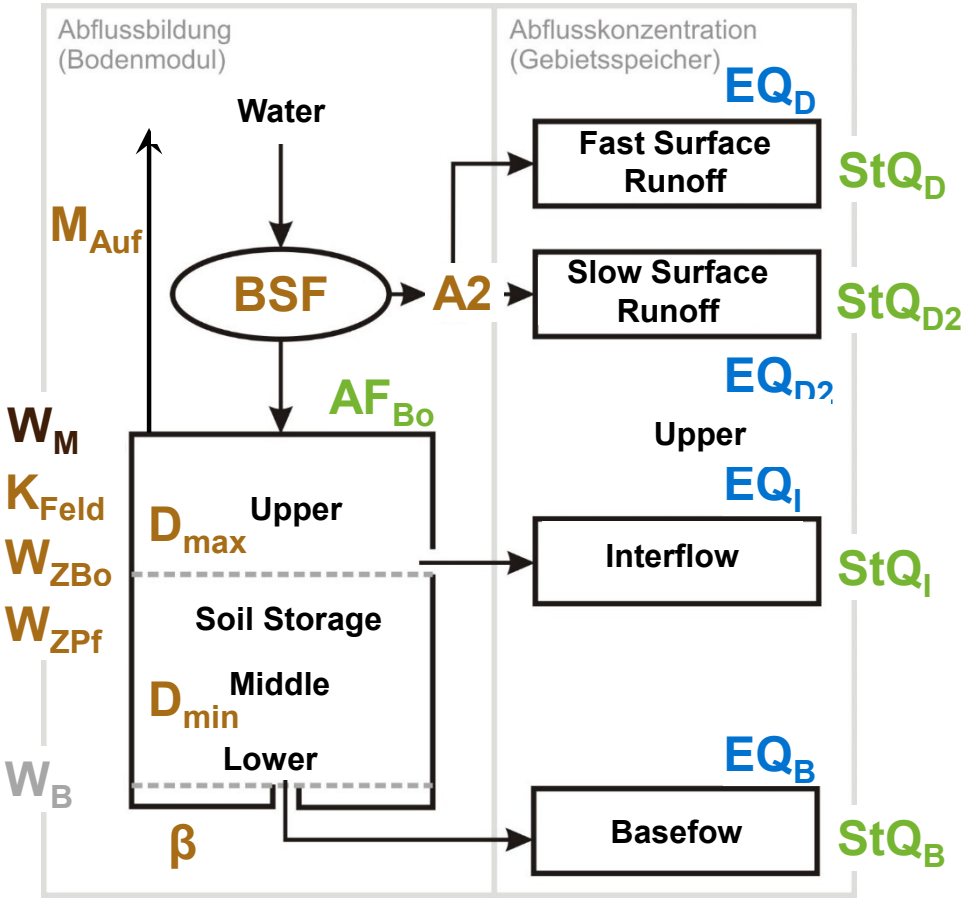






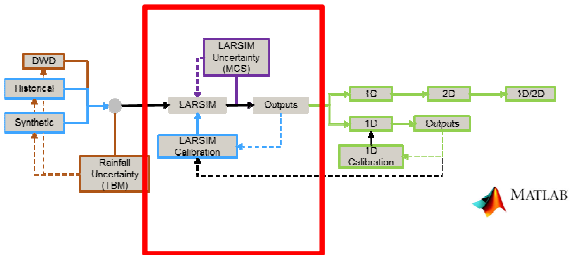
LARSIM Soil Module

Parameters of the soil module



LARSIM (Large Area Runoff Simulation Model)

- Initial conditions
- Calibration (cell level)
- Calibration (soil storage)
- Fixed parameters
- Data input

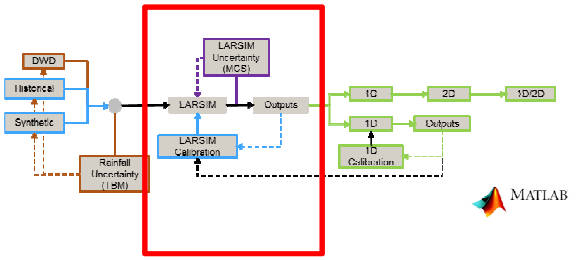


Parameter Sensitivity

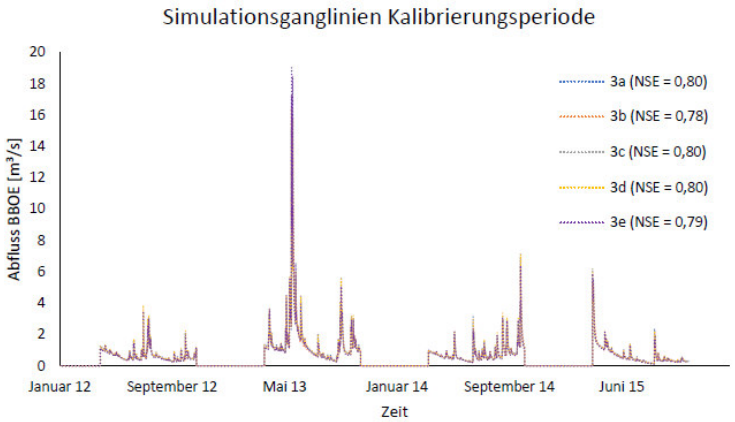
Tabelle 2: Parametersenitivität –Sensitivitätsindex – Grenzwert HQ1

Parameter	SI Köd-nitz HW	SI Kauern-dorf HW	SI Kem-mern HW	SI HW Mittel	SI Köd-nitz NW	SI Kauern-dorf NW	SI Kem-mern NW	SI NW	SI Köd-nitz	SI Kauern-dorf	SI Kem-mern	SI Mittel Gesamt	Kom-mentar
EQD	1.003	1.008	0.772	0.947	0.340	0.363	0.321	0.371	0.340	0.363	0.321	0.380	
beta	1.120	0.896	0.919	0.893	0.953	1.003	1.027	1.068	0.953	1.003	1.027	1.080	
TGr	0.927	0.932	0.534	0.728	0.166	0.185	0.152	0.180	0.166	0.185	0.152	0.186	
KG	0.501	0.390	0.400	0.387	0.335	0.317	0.350	0.335	0.335	0.317	0.350	0.341	
KWD	0.443	0.353	0.361	0.343	0.272	0.259	0.288	0.270	0.272	0.259	0.288	0.275	
EQD2	0.417	0.412	0.121	0.321	0.012	0.013	0.017	0.013	0.012	0.013	0.017	0.014	Nicht genutzt
Dmax	0.580	0.305	0.196	0.308	0.224	0.165	0.182	0.214	0.224	0.165	0.182	0.220	
A1	0.211	0.240	0.191	0.267	0.024	0.039	0.031	0.039	0.025	0.039	0.031	0.041	
SRet	0.190	0.360	0.208	0.260	0.028	0.035	0.030	0.040	0.028	0.035	0.031	0.041	
WZBo	0.449	0.449	0.200	0.251	0.304	0.338	0.239	0.295	0.304	0.338	0.239	0.302	Nicht genutzt
A0	0.136	0.159	0.152	0.210	0.022	0.028	0.024	0.033	0.022	0.028	0.025	0.035	
EKL	0.136	0.159	0.152	0.210	0.022	0.028	0.024	0.033	0.022	0.028	0.025	0.035	
EKR	0.136	0.159	0.152	0.210	0.022	0.028	0.024	0.033	0.022	0.028	0.025	0.035	
KEZG	0.200	0.200	0.199	0.174	0.200	0.200	0.200	0.196	0.200	0.200	0.200	0.200	
BSF	0.191	0.099	0.083	0.154	0.276	0.232	0.220	0.267	0.276	0.232	0.220	0.271	
EKM	0.266	0.082	0.517	0.153	0.074	0.045	0.150	0.057	0.074	0.045	0.150	0.057	
A2	0.284	0.186	0.085	0.139	0.015	0.013	0.013	0.011	0.015	0.014	0.013	0.012	
EQI	0.090	0.223	0.113	0.092	0.175	0.239	0.155	0.202	0.175	0.239	0.155	0.207	
Abso	0.063	0.102	0.057	0.062	0.014	0.017	0.012	0.016	0.014	0.017	0.012	0.016	
EQB	0.015	0.018	0.034	0.025	0.320	0.344	0.343	0.355	0.320	0.343	0.341	0.355	
Dmin	0.019	0.012	0.017	0.016	0.030	0.030	0.033	0.045	0.030	0.030	0.033	0.045	
WZPf	0.028	0.014	0.020	0.016	0.064	0.067	0.065	0.067	0.064	0.067	0.065	0.067	
MAuf	0.003	0.001	0.002	0.003	0.022	0.036	0.029	0.052	0.022	0.036	0.029	0.052	
NKor	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Kfeld	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Nicht aktiv
KBoFeu	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Nicht aktiv

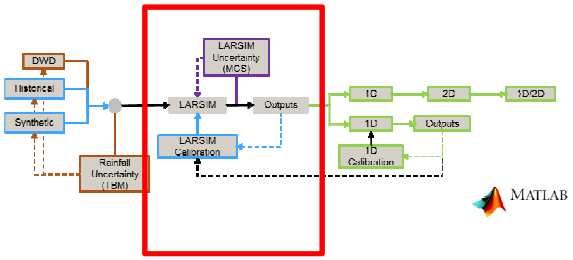
Calibration



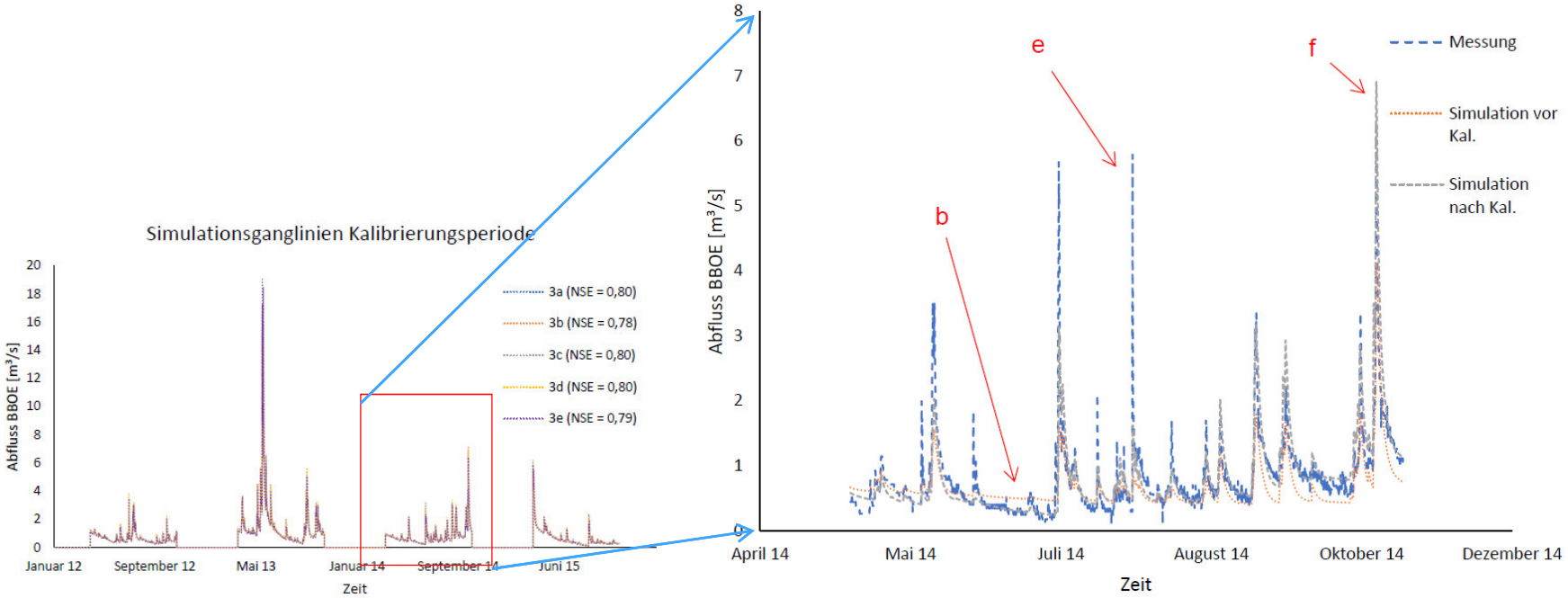
Shuffled-Complex-Evolution-Algorithmus (SCE-UA)

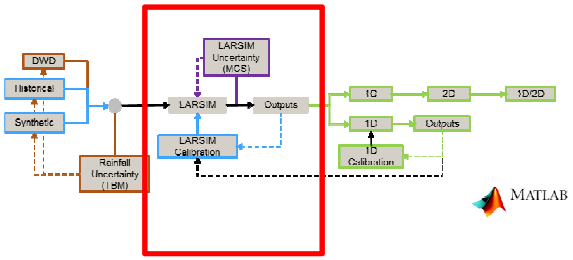


Calibration



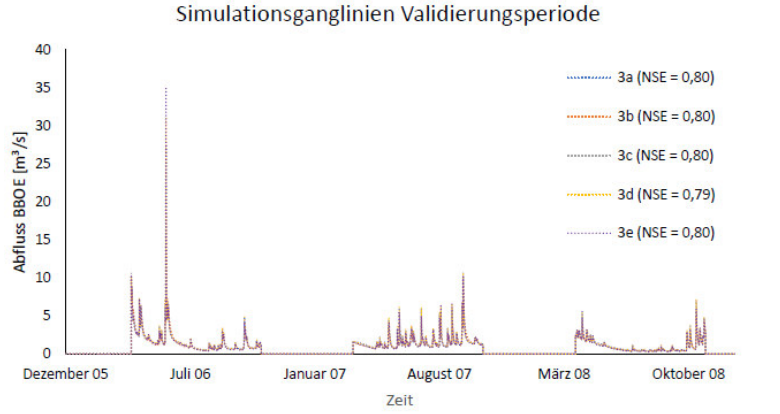
Shuffled-Complex-Evolution-Algorithmus (SCE-UA)

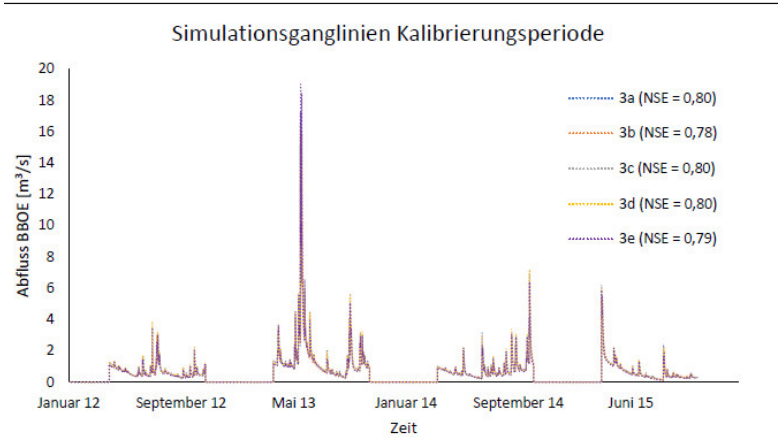


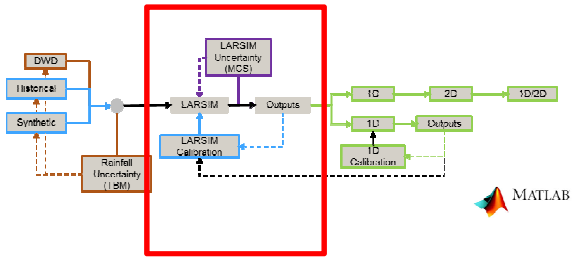


Calibration and validation

Shuffled-Complex-Evolution-Algorithmus (SCE-UA)

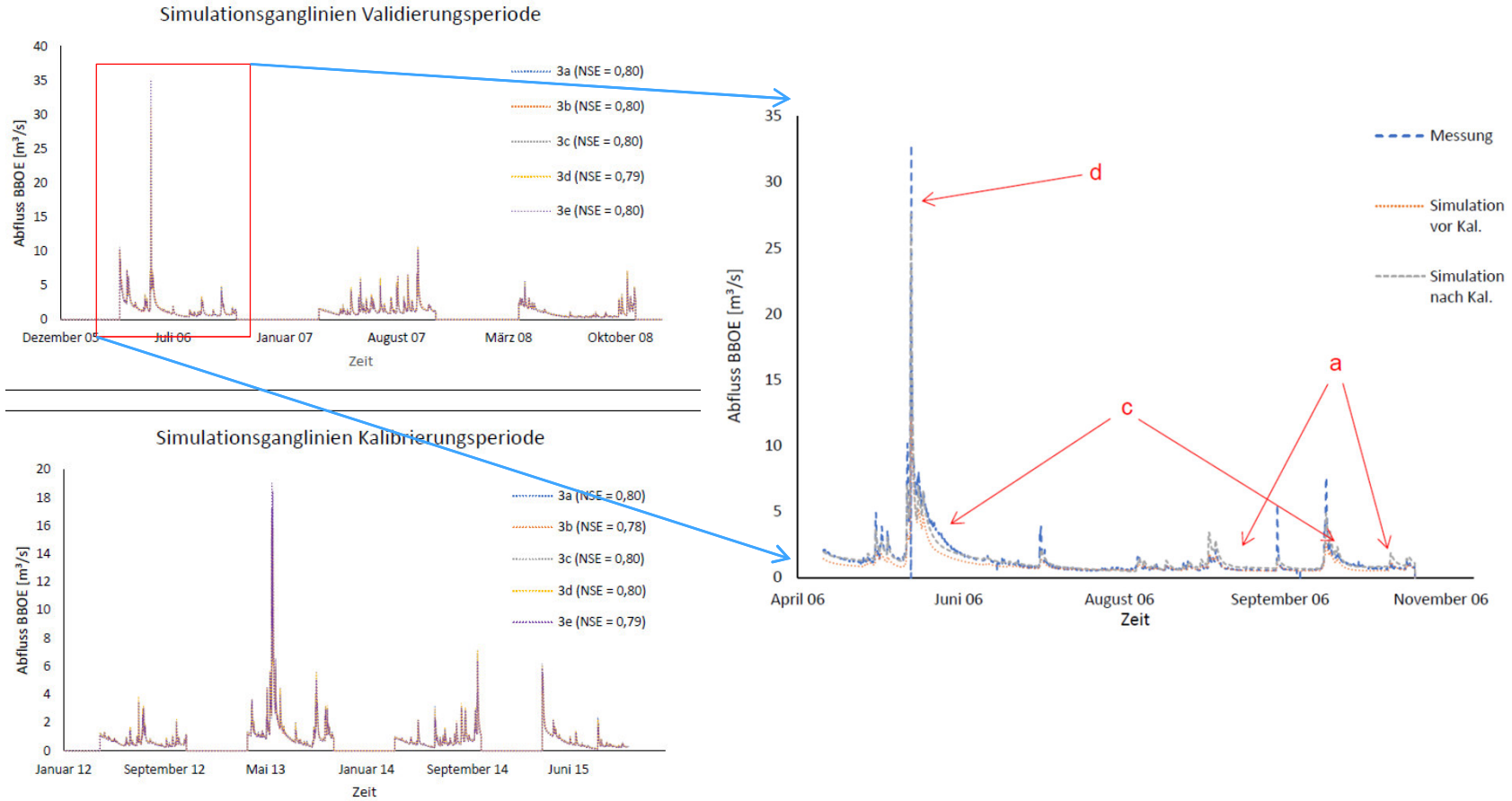




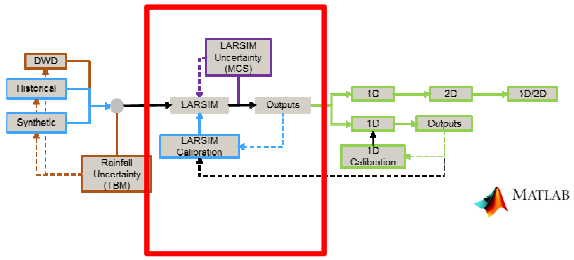


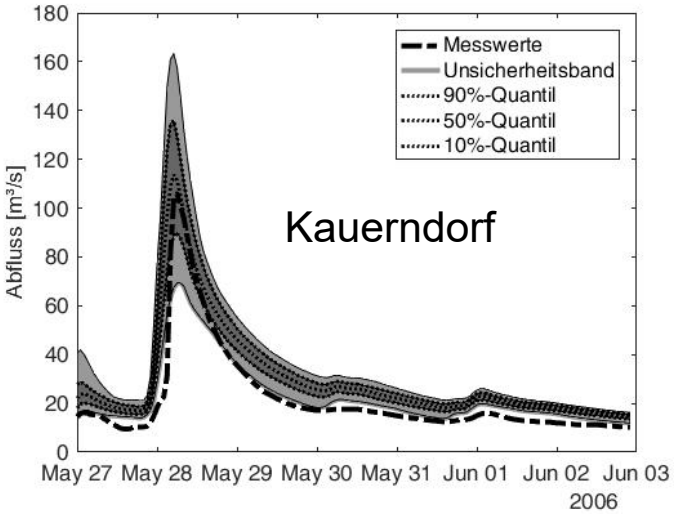
Calibration and validation

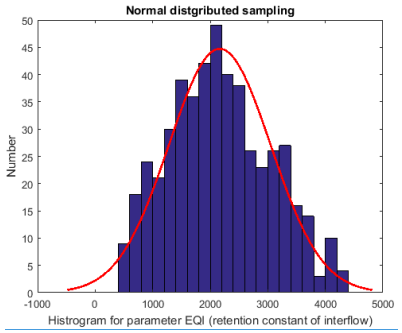
Shuffled-Complex-Evolution-Algorithmus (SCE-UA)

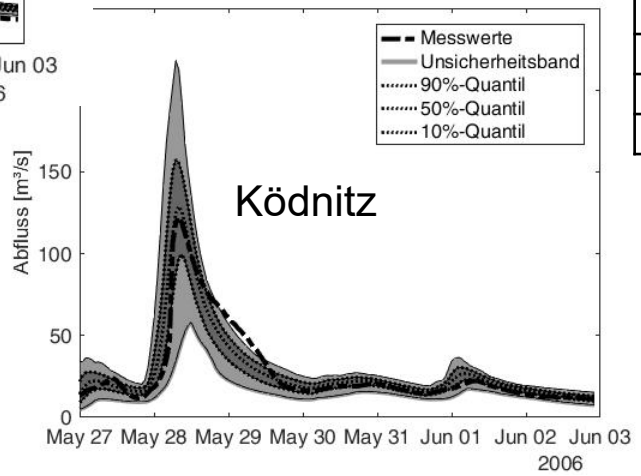


Uncertainty Estimation with Monte-Carlo-Simulations



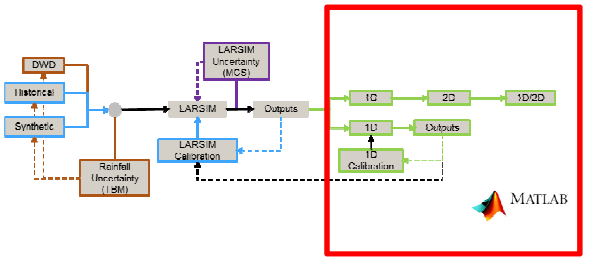




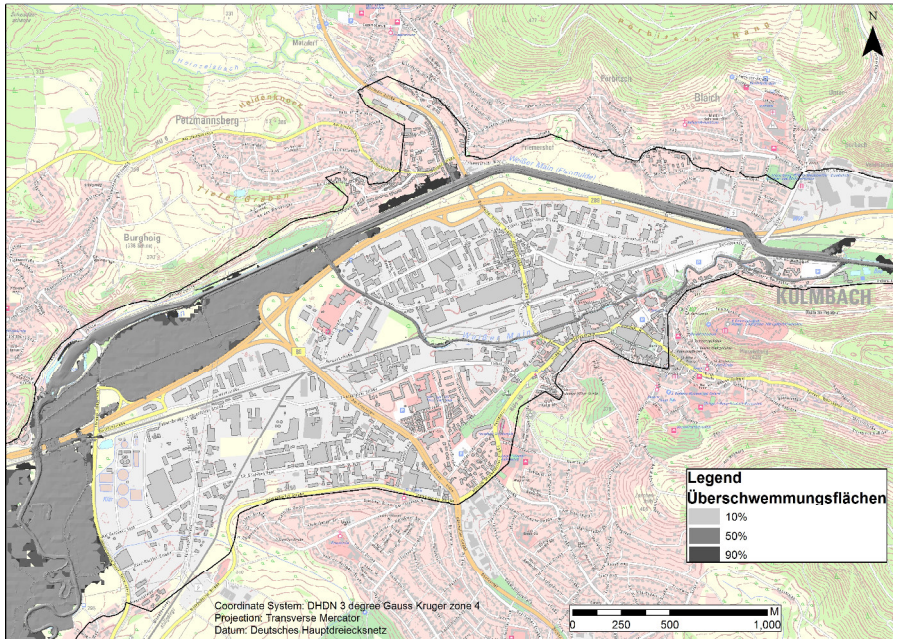


Parameter	Range after Haag et al., 2016		Modified Range	
	Minimum	Maximum	Minimum	Maximum
EQB	10000,0	80000,0	8000,0	70000,0
EQI	500,0	15000,0	500,0	5000,0
EQD	50	1500,0	100,0	1500,0
EQD2	10,0	1000,0	10,0	1000,0
A2	1,0	4,0	1,0	3,0
BSF	0,01	0,3	0,01	0,6
beta	0,0005	0,02	0,001	0,06
Dmax	0,0	10,0	0,1	3,0

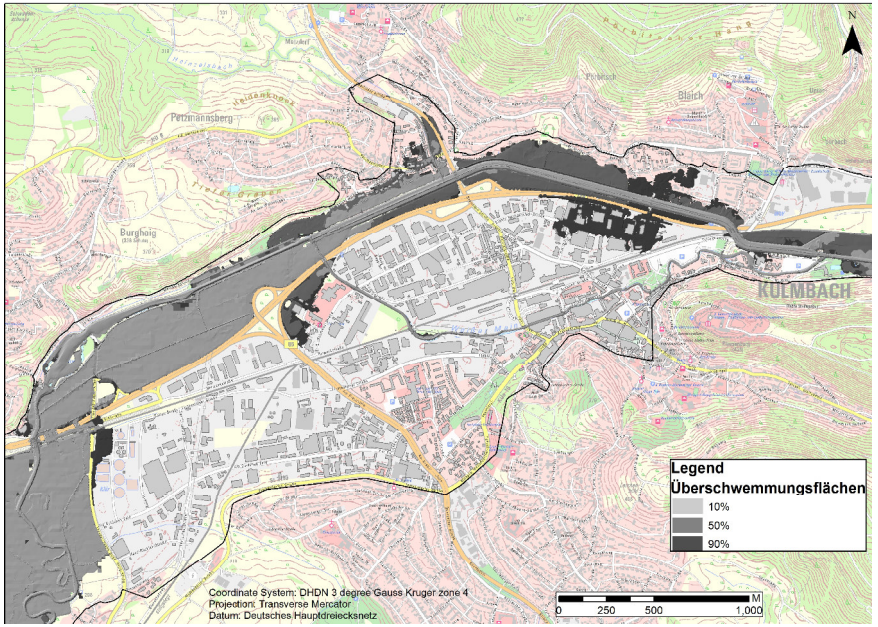
Dynamic Inundation Maps



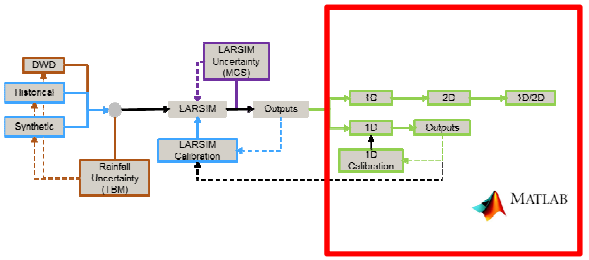
Kulmbach 2006-05-28 19:00:00



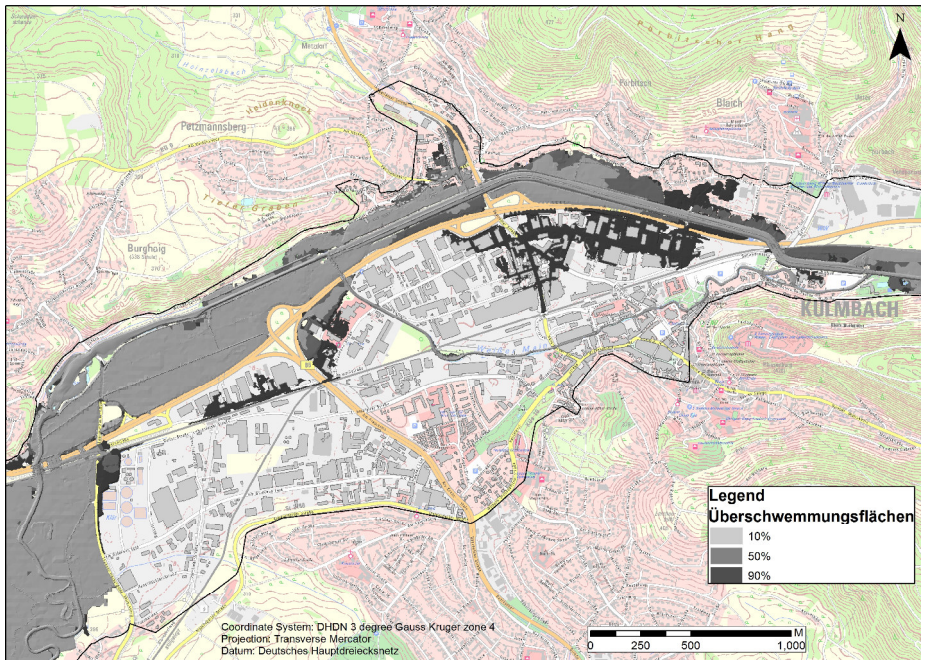
Kulmbach 2006-05-28 23:00:00



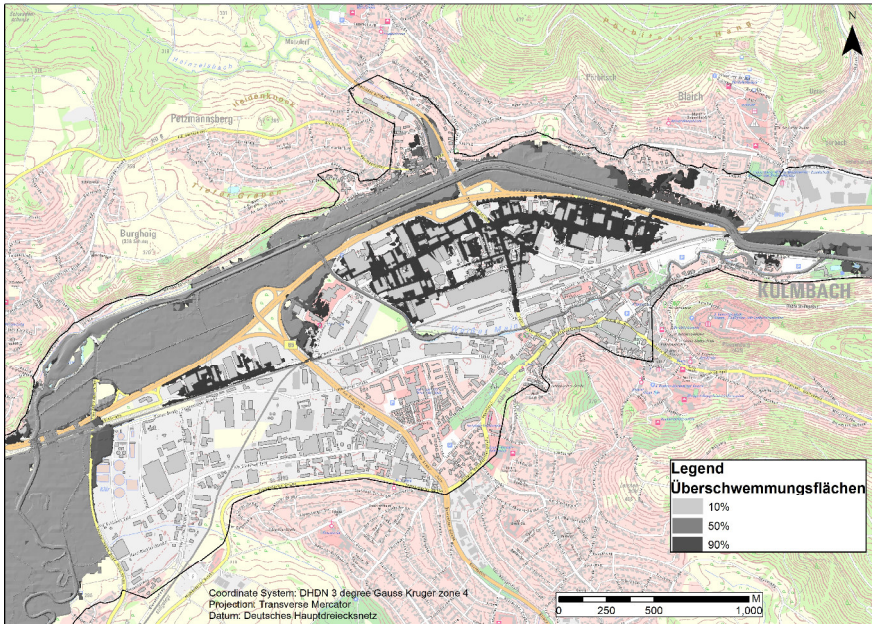
Dynamic Inundation Maps

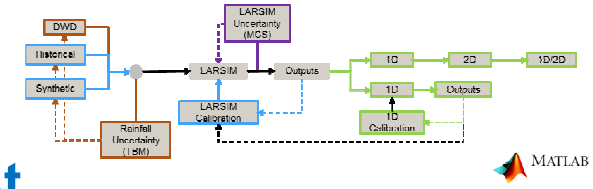


Kulmbach 2006-05-29 01:00:00



Kulmbach 2006-05-29 03:00:00

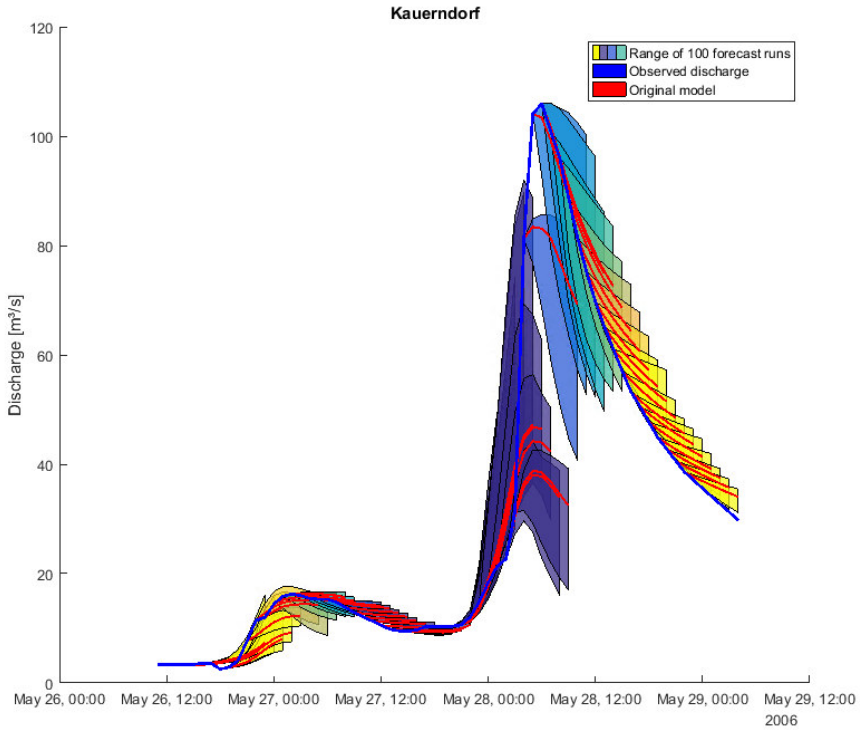


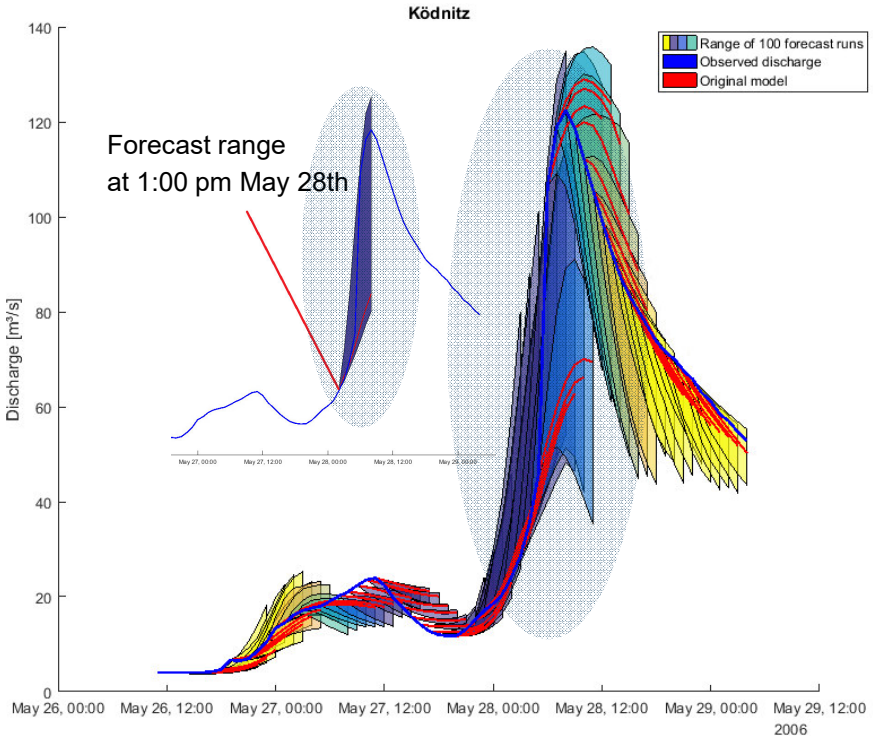


Uncertainty Bands for Flood Forecast

May 2006

Forecast modus (under development)

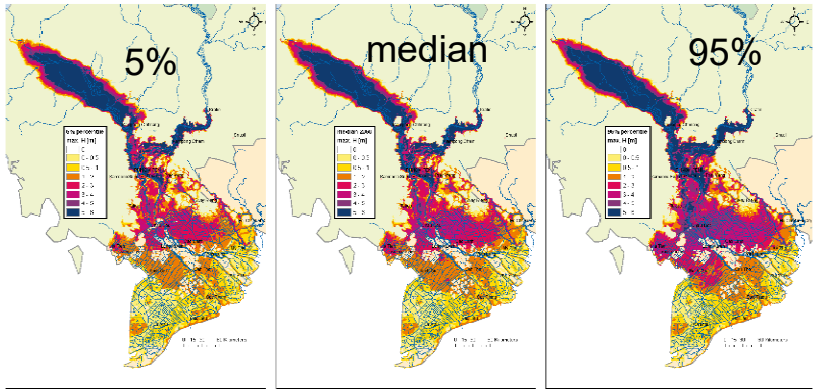




Outlook

- Maps of time-dependent water depth and flow velocities as separate maps

- Database to retrive the flood maps
  - Hourly updated maps for a flood event



Source: WISDOM, M. Misik et al 2015

FloodEvac

Bilaterale Forschungszusammenarbeit für die zivile Sicherheit zwischen Deutschland und Indien
BMBF-Verbundprojekt: Verletzbarkeit von Transport-Infrastrukturen - Warnung und Evakuierung bei Hochwasser

INTERACT Dissemination Event
25.01.2018

The University Of Sheffield.

Jorge Leandro, Markus Disse, Amin Kanwal, Iris Konnerth, Punit Bhola

Technical University of Munich

Chair of Hydrology and River Basin Management