

lifelineMDD

Climate Change / Hydrology

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INTRO

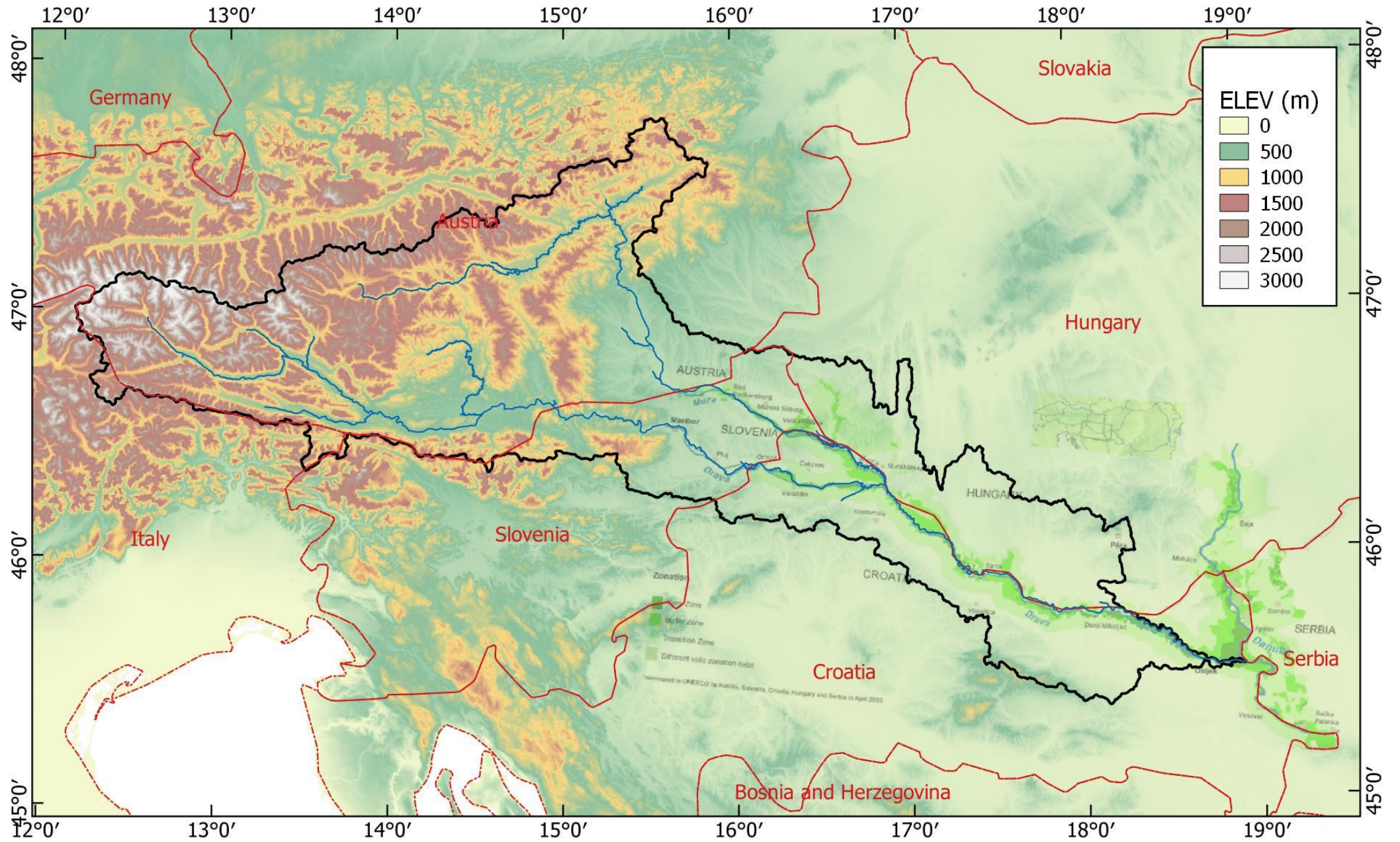
QUESTIONS ADDRESSED:

- How can we characterise the hydrological regime of the Mura and Drava rivers in the vicinity of the transboundary biosphere reserve?
- How does possible climate change affect the hydrological regime, with special emphasis on mean flows, low flows, flood flows, seasonality and flow duration?

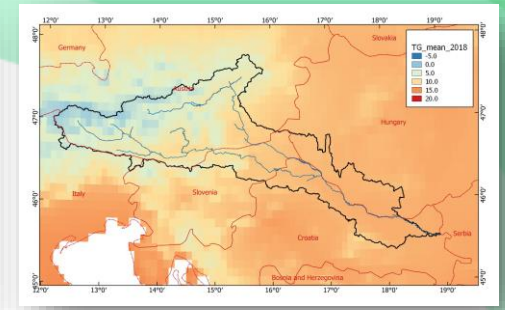
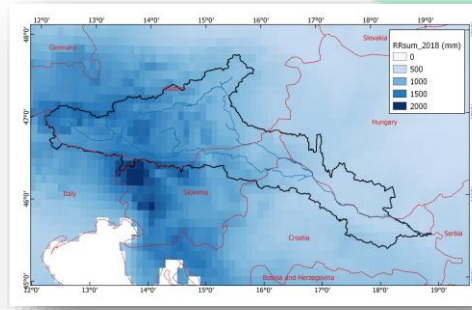


METHODOLOGY OF APPROACH

1. Review of existing data, reference materials, and data collection
2. Evaluation of hydrologic parameters based on observed data
3. Development, calibration and verification of hydrologic model
4. Run model with climate data for reference period
5. Run model with future climate scenarios
6. Hydrologic Assessment Report



INPUT DATA



OBSERVED METEEO DATA: **E-OBS** daily gridded meteorological data

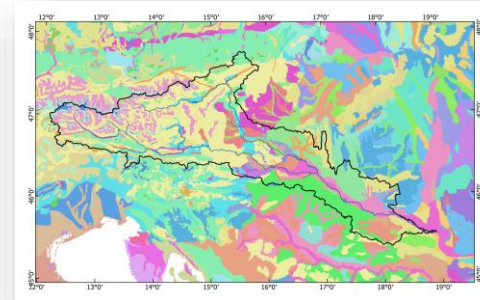
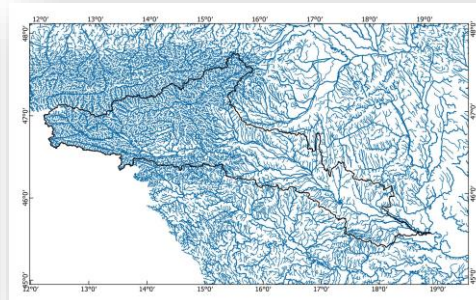
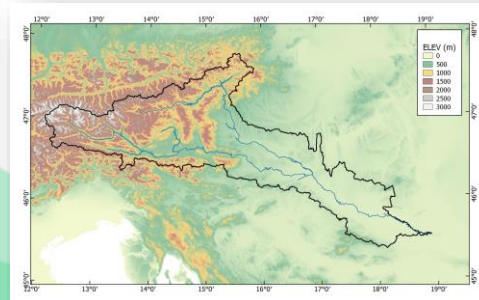
OBSERVED HYDRO DATA: **Hydmet services + Global Runoff Data Centre**

DEM: **EU-DEM**

RIVER NETWORK: **CCM River and Catchment Database 2.1 (CCM2)**

LAND COVER: **CORINE Land Cover V20**

SOIL MAP: **European Soil Database v2**



HYDROLOGIC REGIME (OBSERVED)

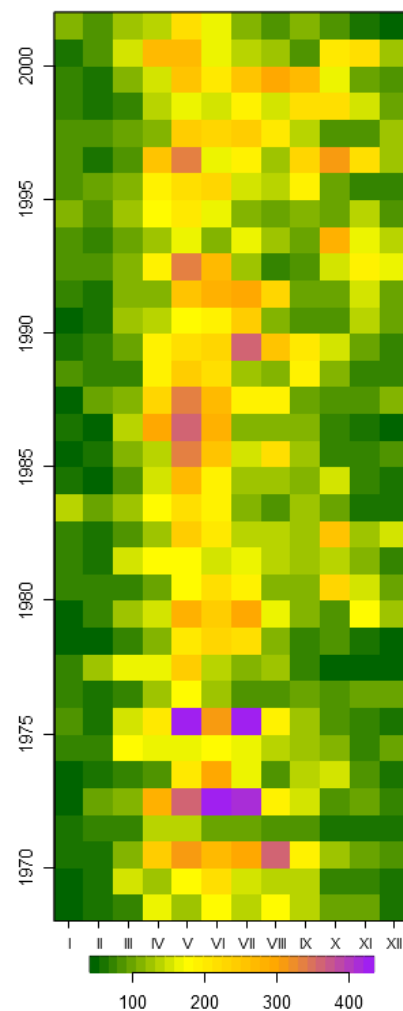
- For each of 58 stations:
 - Low flows
 - Mean monthly flows
 - Mean annual flows
 - High flows
- Results shown for some characteristic stations

STATISTICAL ANALYSIS

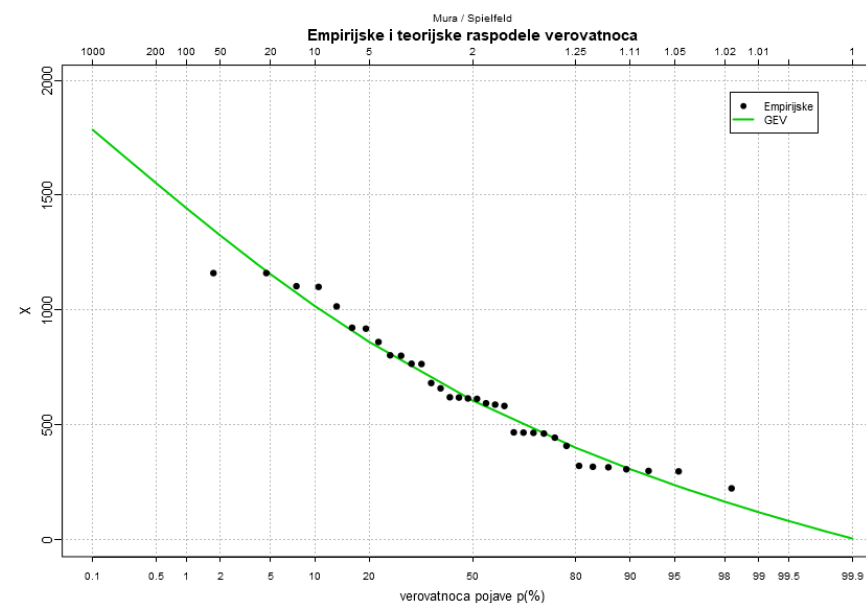
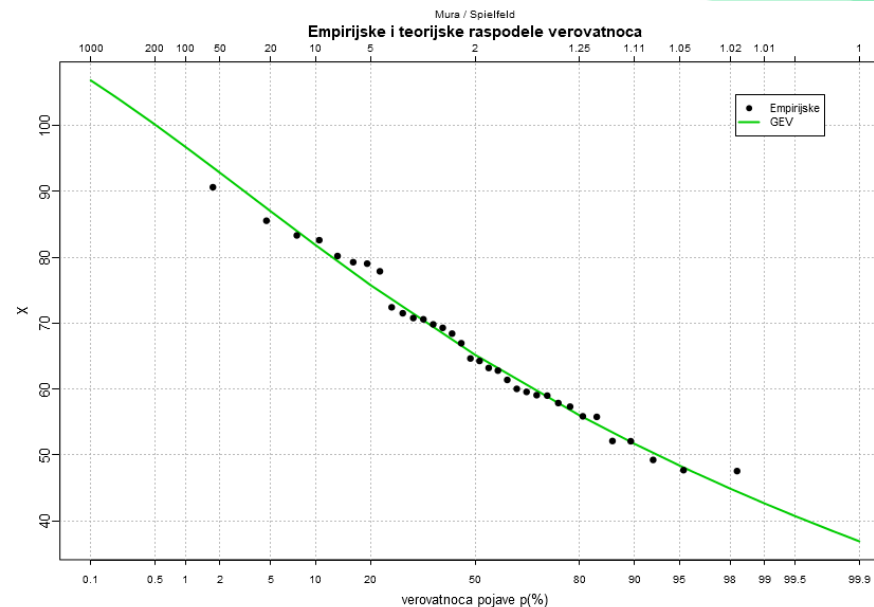
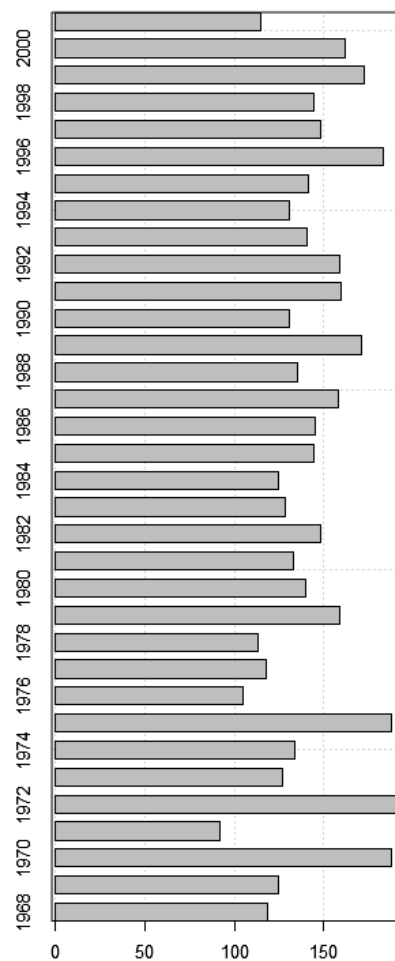
- Mura / Spielfeld
9480 km²

	(m3/s)
Qmin,95%	48.4
Qmean	143.5
Qmax,10%	1016
Qmax,2%	1325
Qmax,1%	1443

Mura / Spielfeld
Monthly discharge (m3/s)



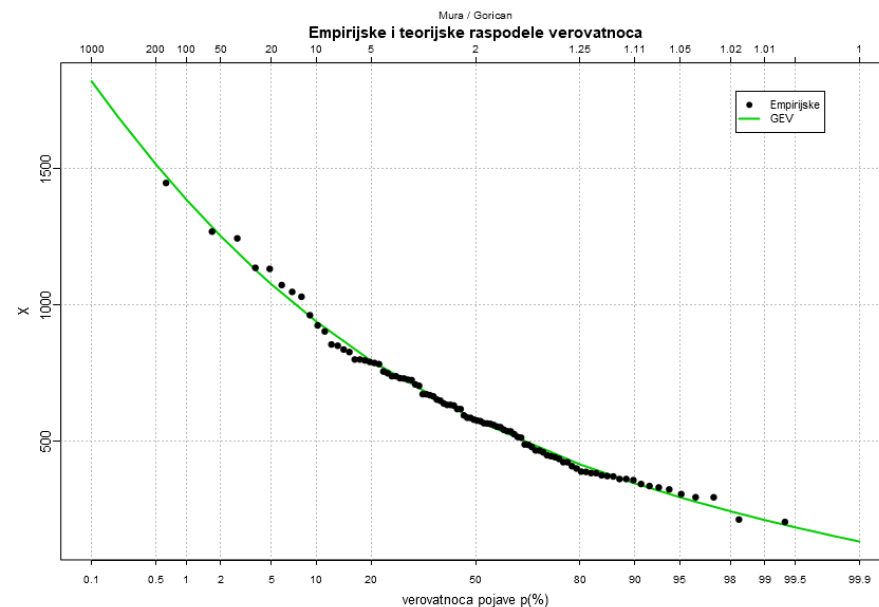
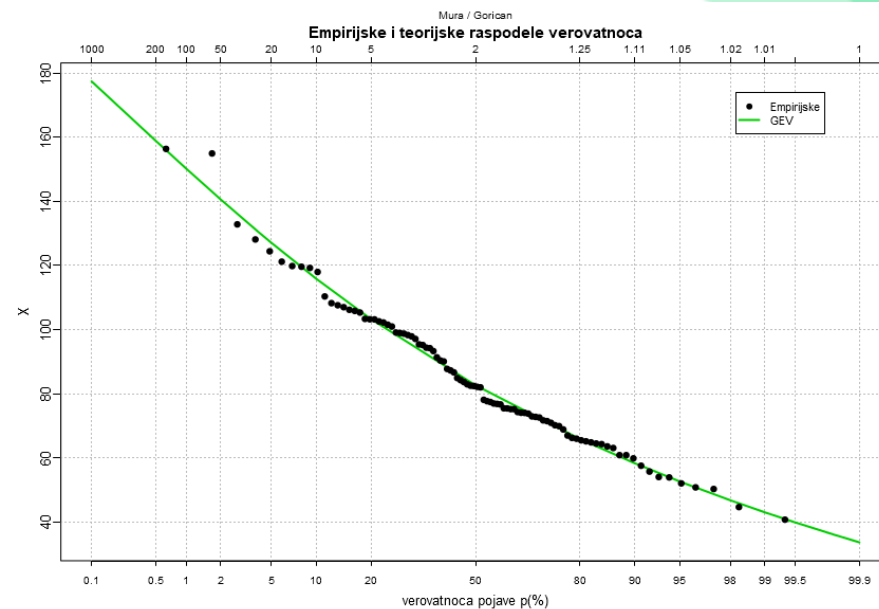
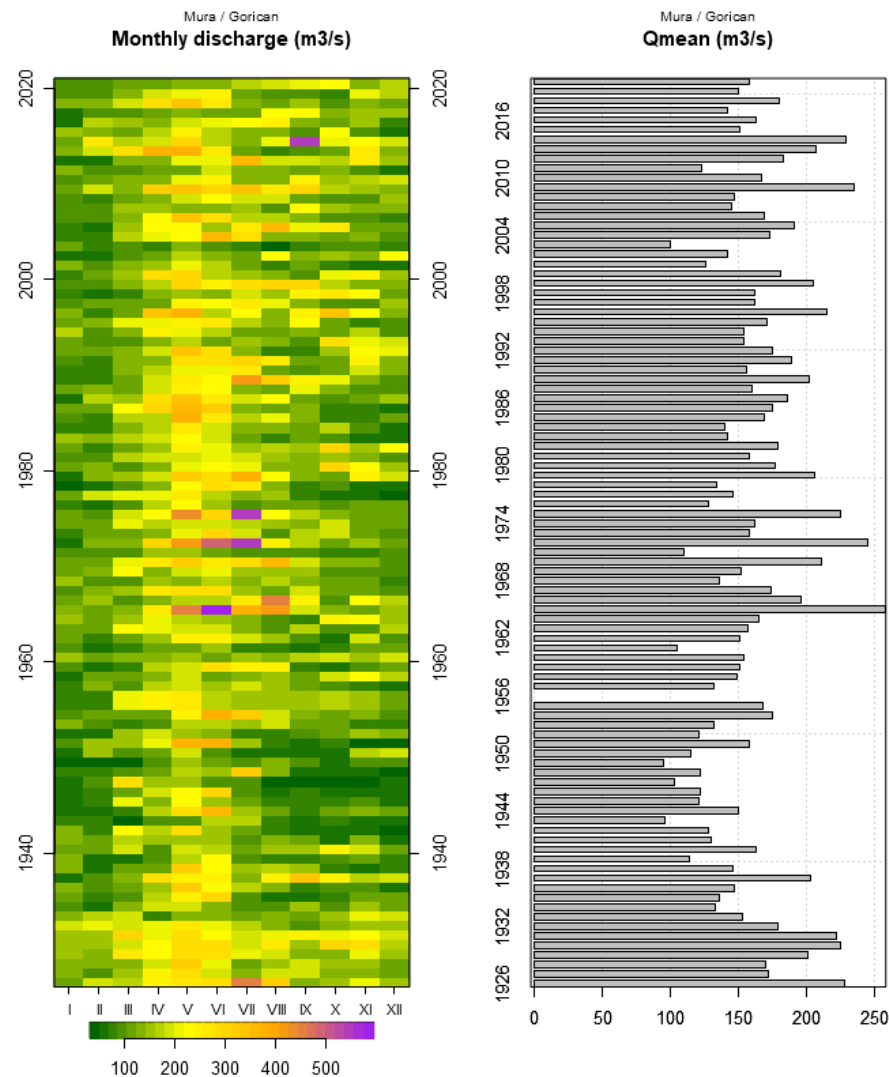
Mura / Spielfeld
Qmean (m3/s)



STATISTICAL ANALYSIS

- Mura / Goričan
13148 km²

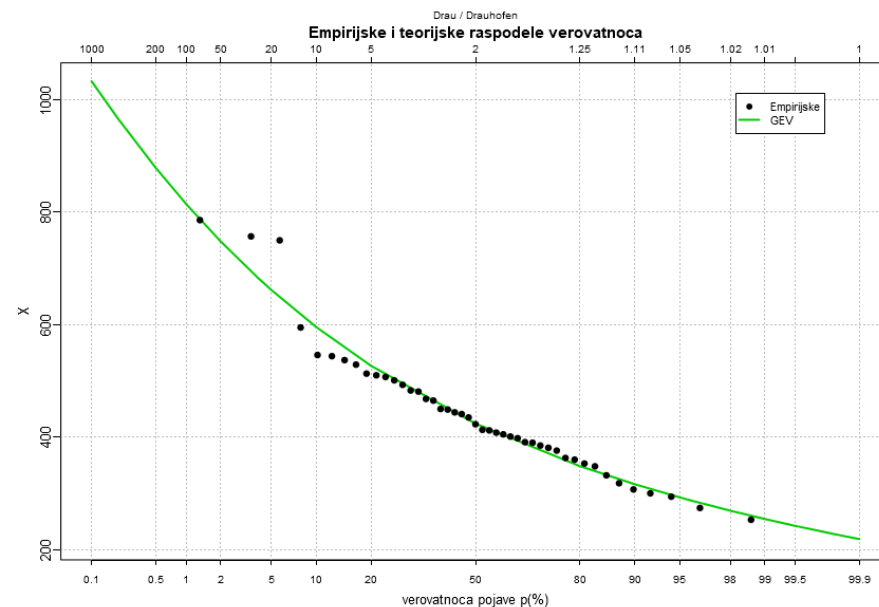
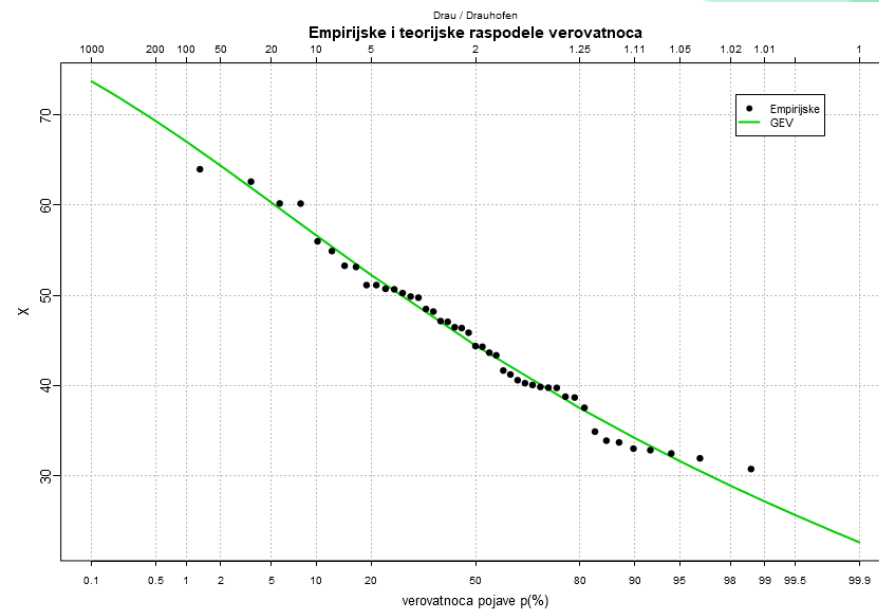
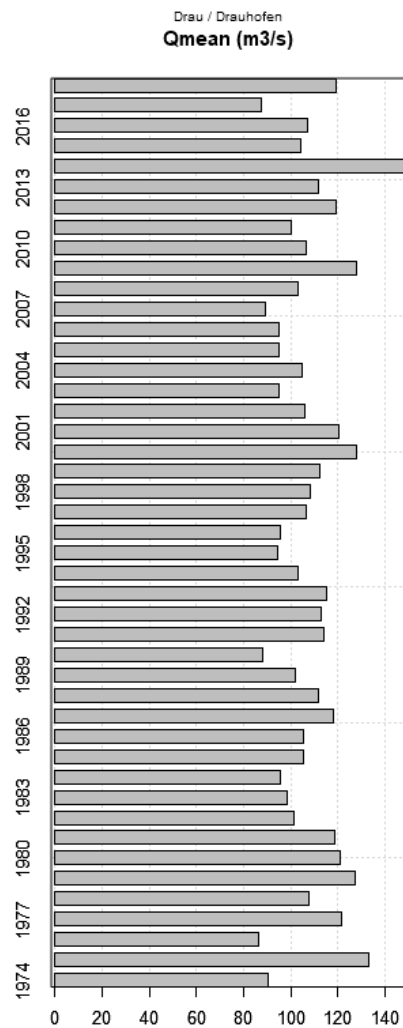
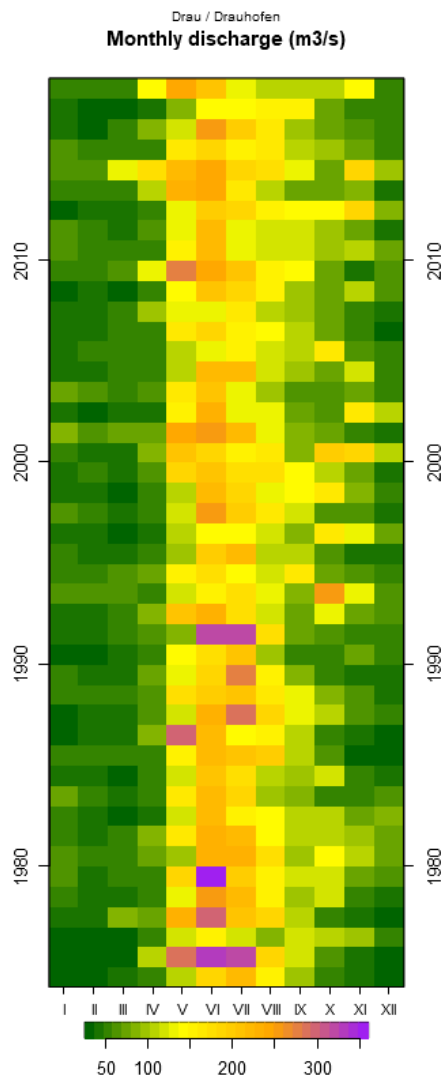
	(m ³ /s)
Qmin,95%	52.6
Qmean	161.9
Qmax,10%	939
Qmax,2%	1253
Qmax,1%	1386



STATISTICAL ANALYSIS

- Drau/ Drauhofen
3674 km²

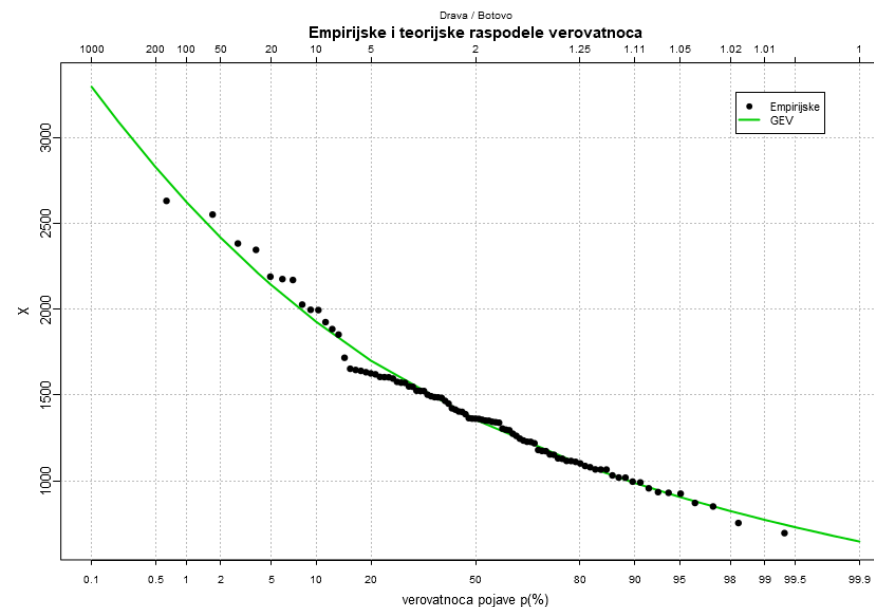
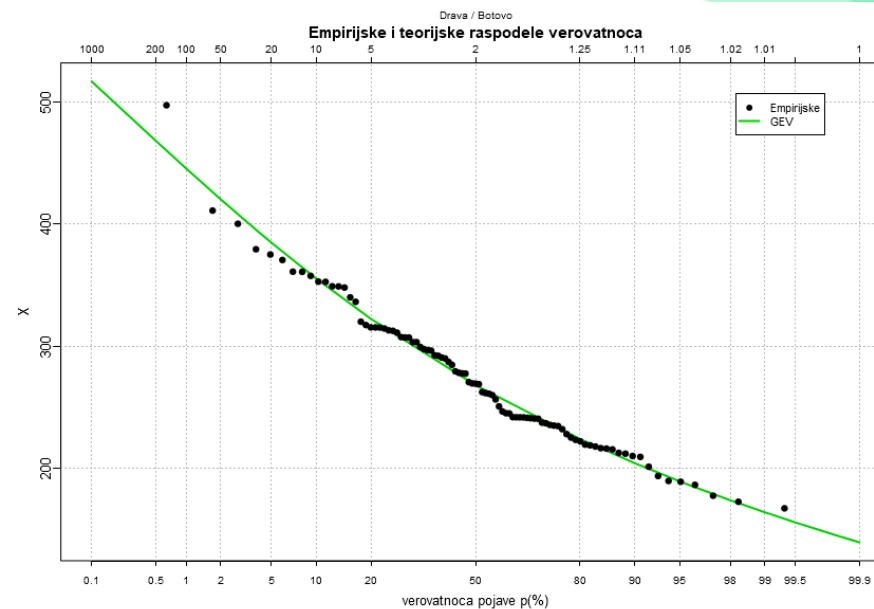
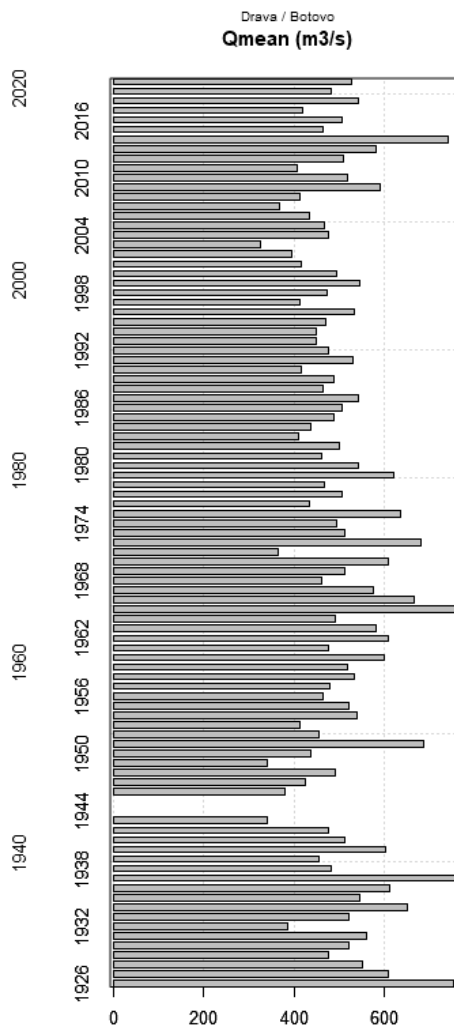
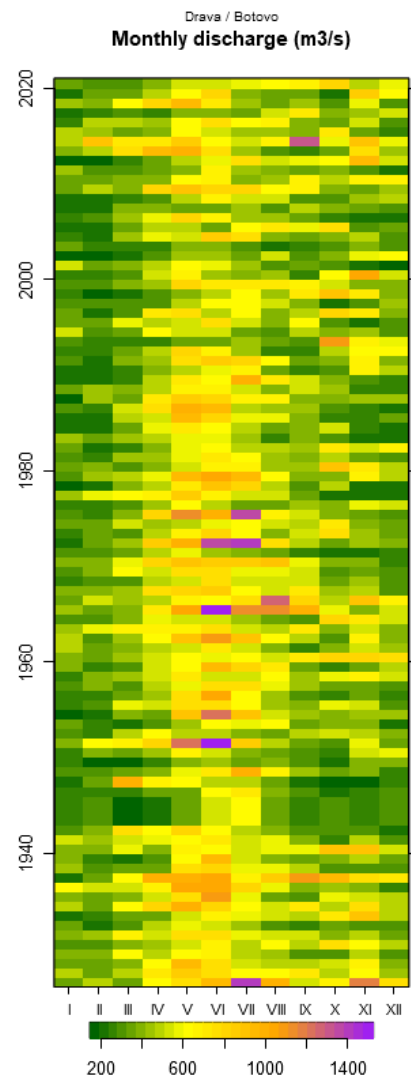
	(m3/s)
Qmin,95%	31.6
Qmean	108.1
Qmax,10%	596
Qmax,2%	749
Qmax,1%	814



STATISTICAL ANALYSIS

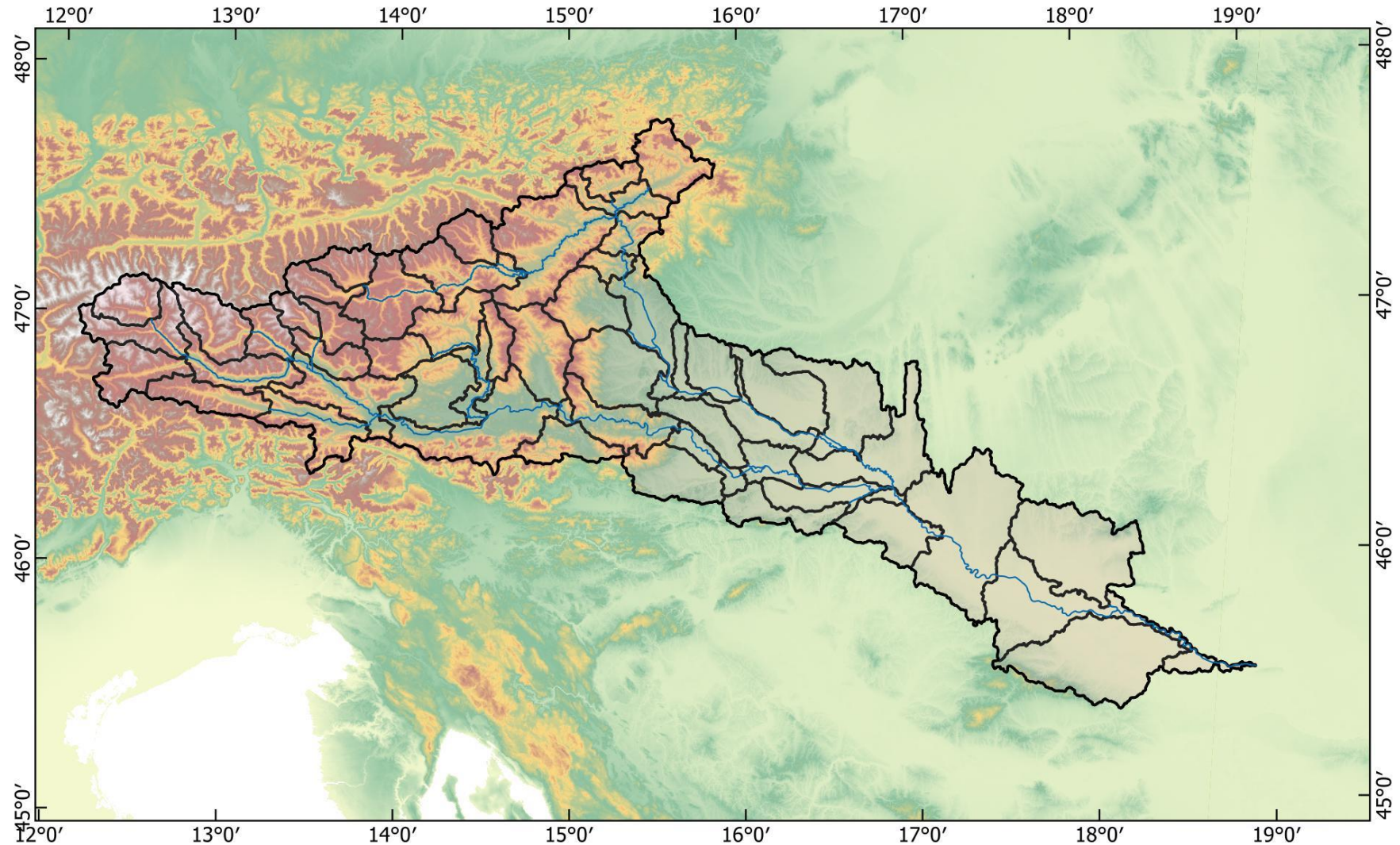
- Drava/ Botovo
31038 km²

	(m3/s)
Qmin,95%	189.1
Qmean	508.7
Qmax,10%	1926
Qmax,2%	2418
Qmax,1%	2624



HYDROLOGIC MODEL

- HEC-HMS
- 57 subbasins
(300-2000km²)
- 55 reaches

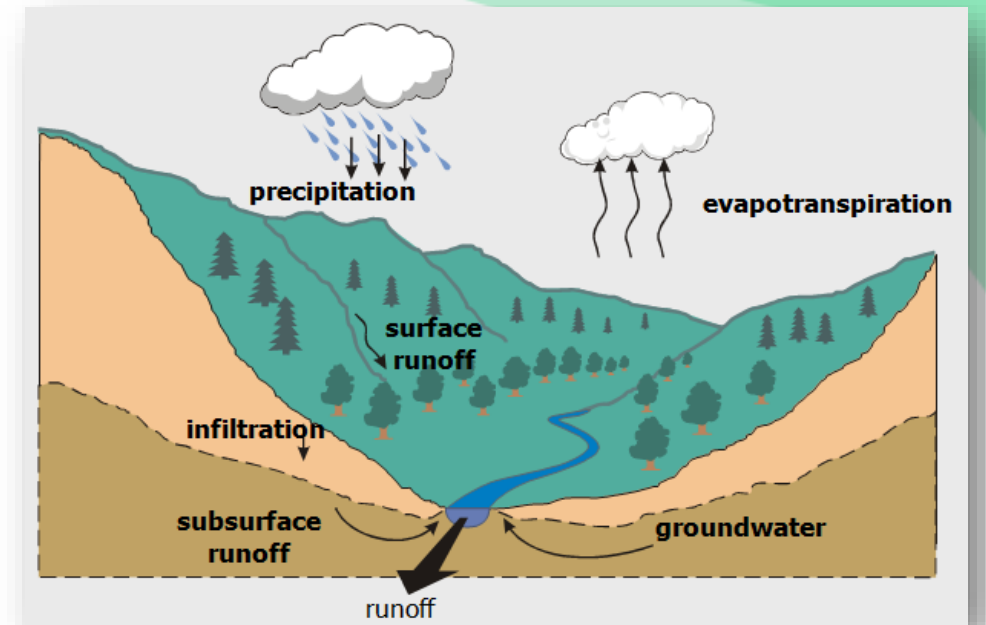


MODEL STRUCTURE (HEC-HMS)



MODEL PROCESSES

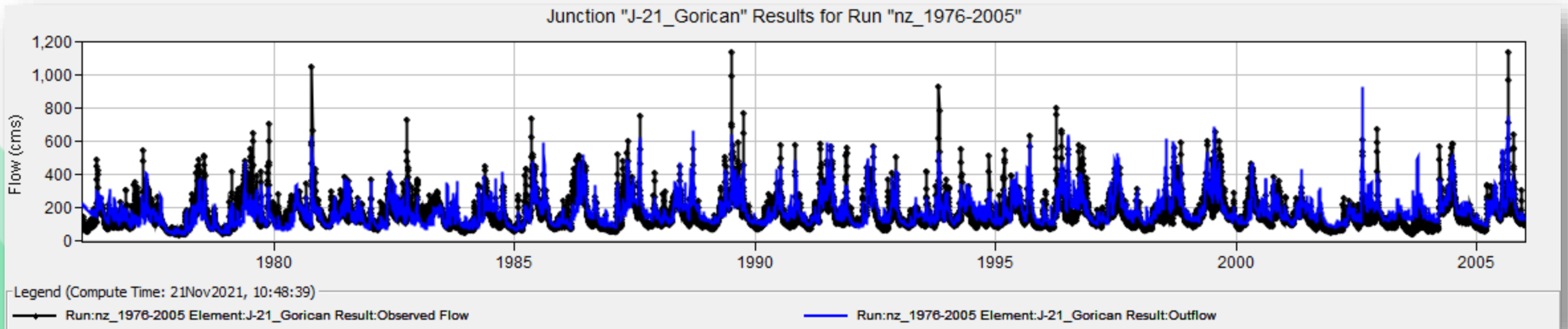
- Canopy (interception)
- Loss (infiltration)
- Transform (surface runoff)
- Baseflow (subsurface and groundwater)
- Evapotranspiration
- Snowmelt
- Flow routing



MODEL CALIBRATION

- Period: 1976-2020*
- Criteria: Nash-Sutcliffe efficiency (NSE)
- Priority: mean and monthly flows

River	Station	NSE
Mura	Mureck	0.500
Mura	Gornja Radgona I	0.475
Mura	Mursko Sredisce	0.521
Mura	Gorican	0.516
Drava	Donja Dubrava	0.447
Drava	Botovo	0.461
Drava	Novo Virje Skela	0.500
Drava	Terezino polje	0.530
Drava	Donji Miholjac	0.504
Drava	Belisce	0.457

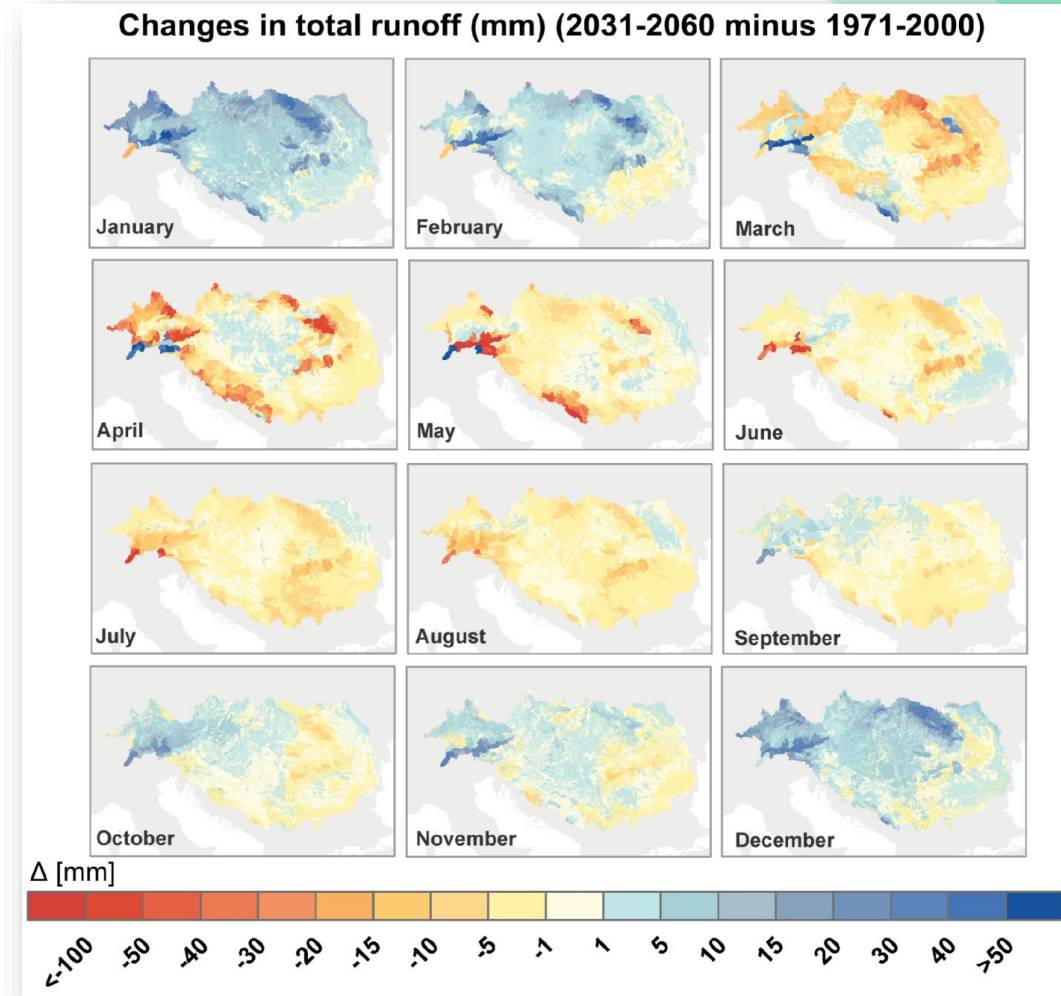


CLIMATE MODELS

No.	Driving GCM	RCM	Short-Name
1	CNRM-CERFACS-CNRM-CM5	CLMcom-CCLM4-8-17_v1	CNRM-CM5_CLMcom-CCLM4
2	IPSL-IPSL-CM5A-MR	SMHI-RCA4_v1	IPSL-CM5A-MR_SMHI-RCA4
3	MOHC-HadGEM2-ES	KNMI-RACMO22E_v2	HadGEM2-ES_KNMI-RACMO22E
4	MPI-M-MPI-ESM-LR	MPI-CSC-REMO2009_v1	MPI-ESM-LR_MPI-CSC
5	CNRM-CERFACS-CNRM-CM5	SMHI-RCA4_v1	CNRM-CM5_SMHI-RCA4

EXPECTED RESULTS

- decrease in summer flow
- increase in autumn and winter flows
- increased drought risk
- increased flood risk



(Stagl and Hattermann, 2015)

Thank you!

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