Application of an 1-D hydraulical model coupled with digital elevation model for modeling of riparian wetlands of the Upper Narew River.

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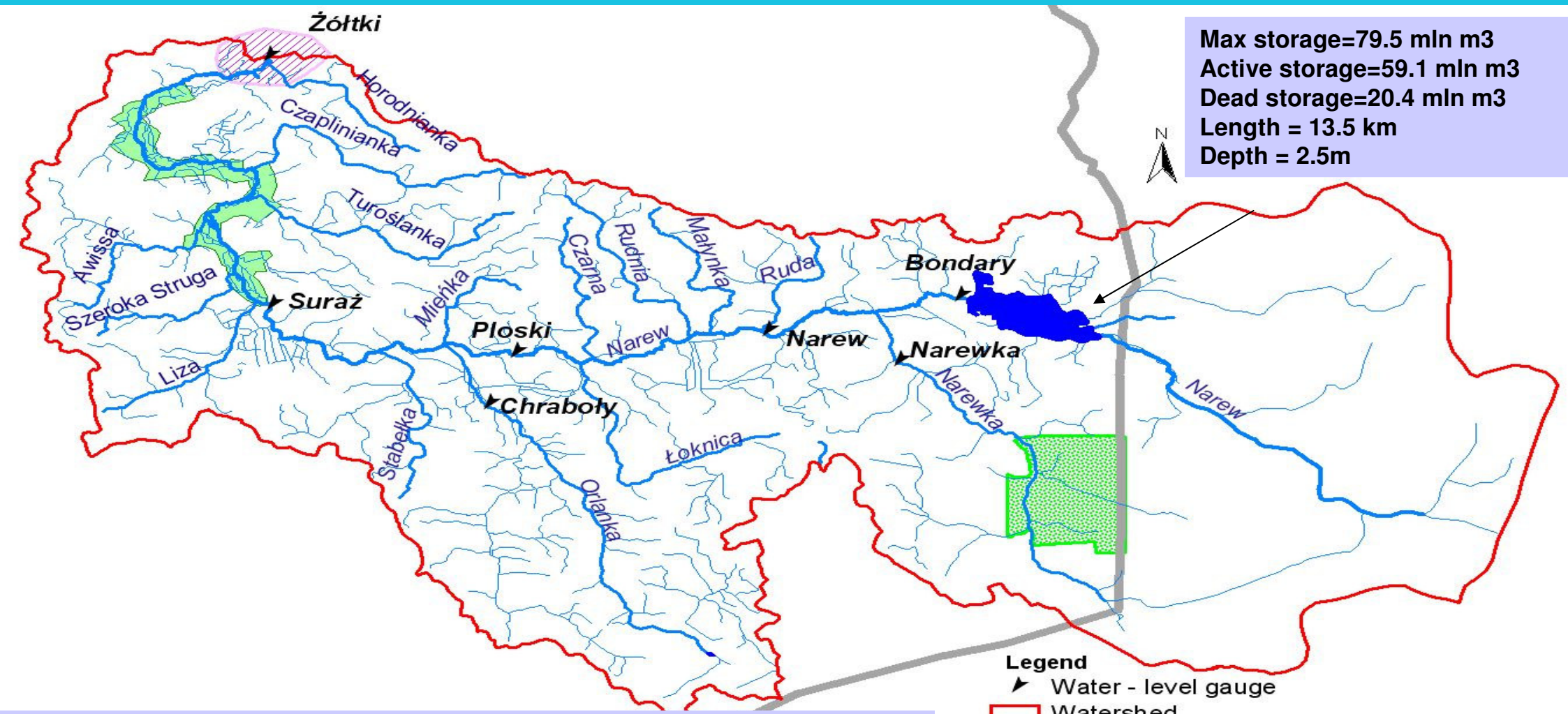
OUTLINE OF THE PRESENTATION

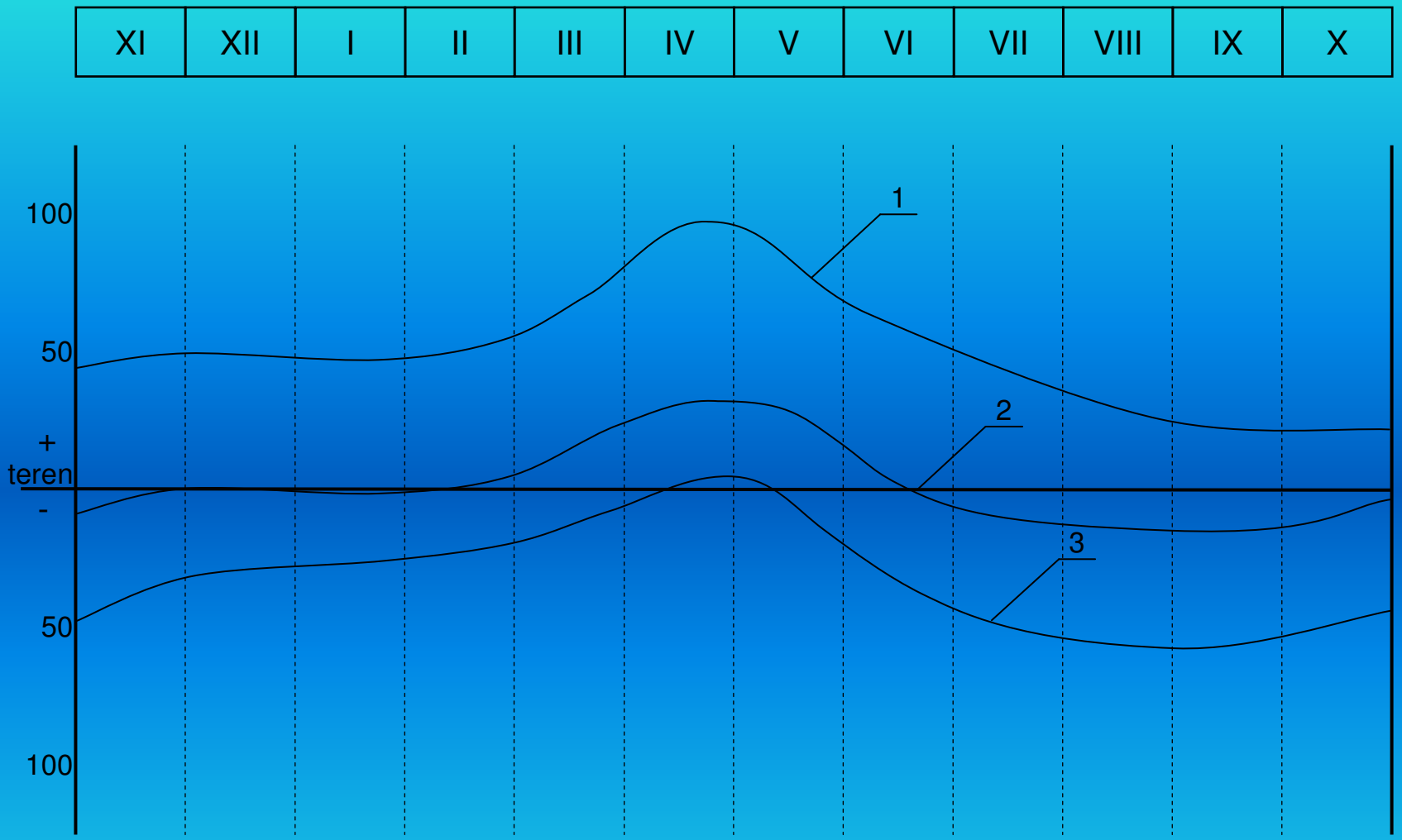
- Context
- System of the Upper Narew
- Modelling of the system
- Hydraulic model
- Conclusions

SYSTEM OF THE UPPER NAREW - HYDROLOGY



Name	Area [km2]	Level [m asl]	Qmin [m3/s]	Qav [m3/s]	Qmax [m3/s]
Bondary	1049.70	134.94	0.27	5.72	85.90
Narew	1978.00	130.37	0.95	9.81	153.00
Suraz	3376.50	116.03	1.52	15.50	250.00

Caricetum gracilis typicum

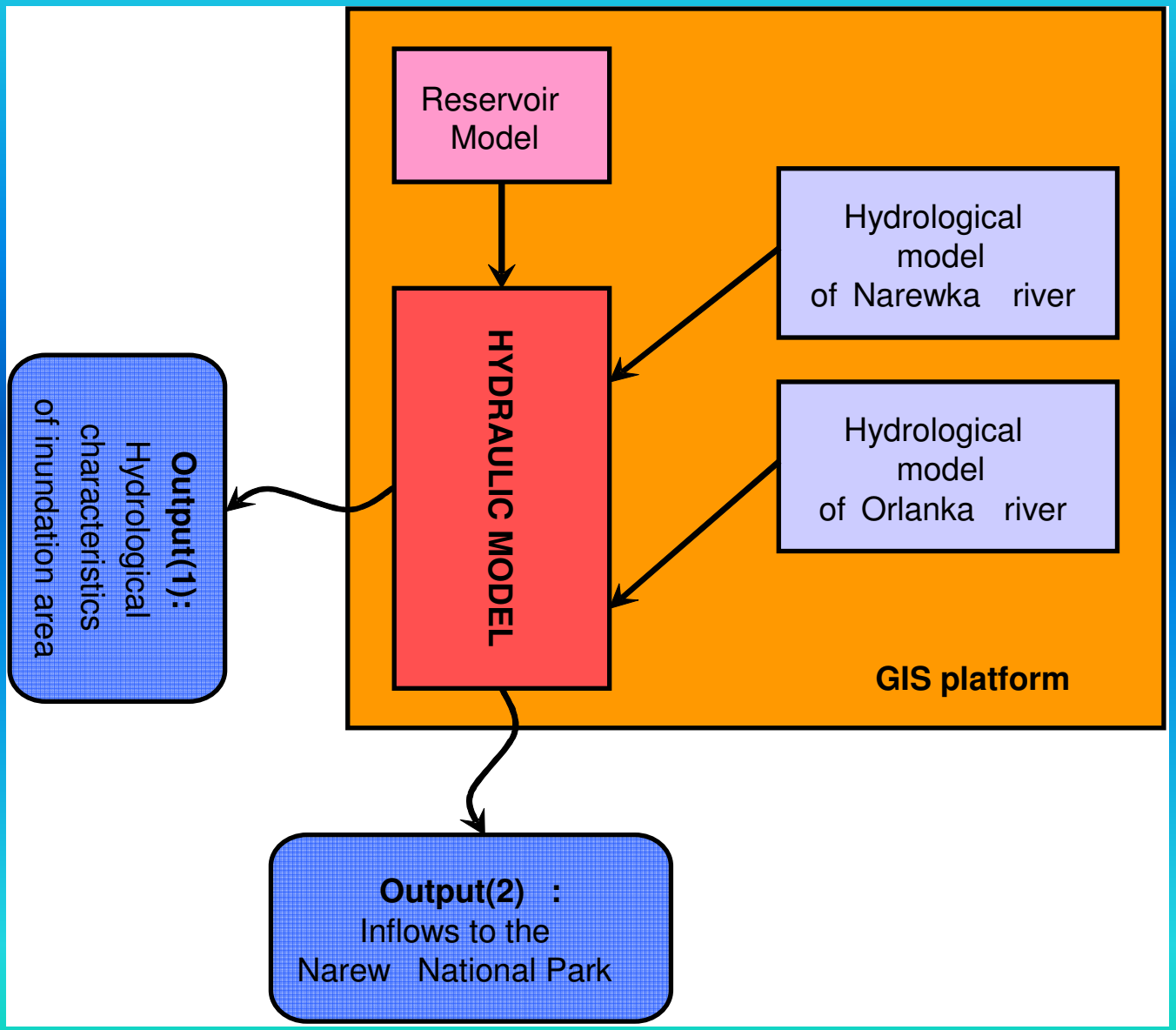


1 – stan maksymalny
2 – stan optymalny
3 – stan minimalny

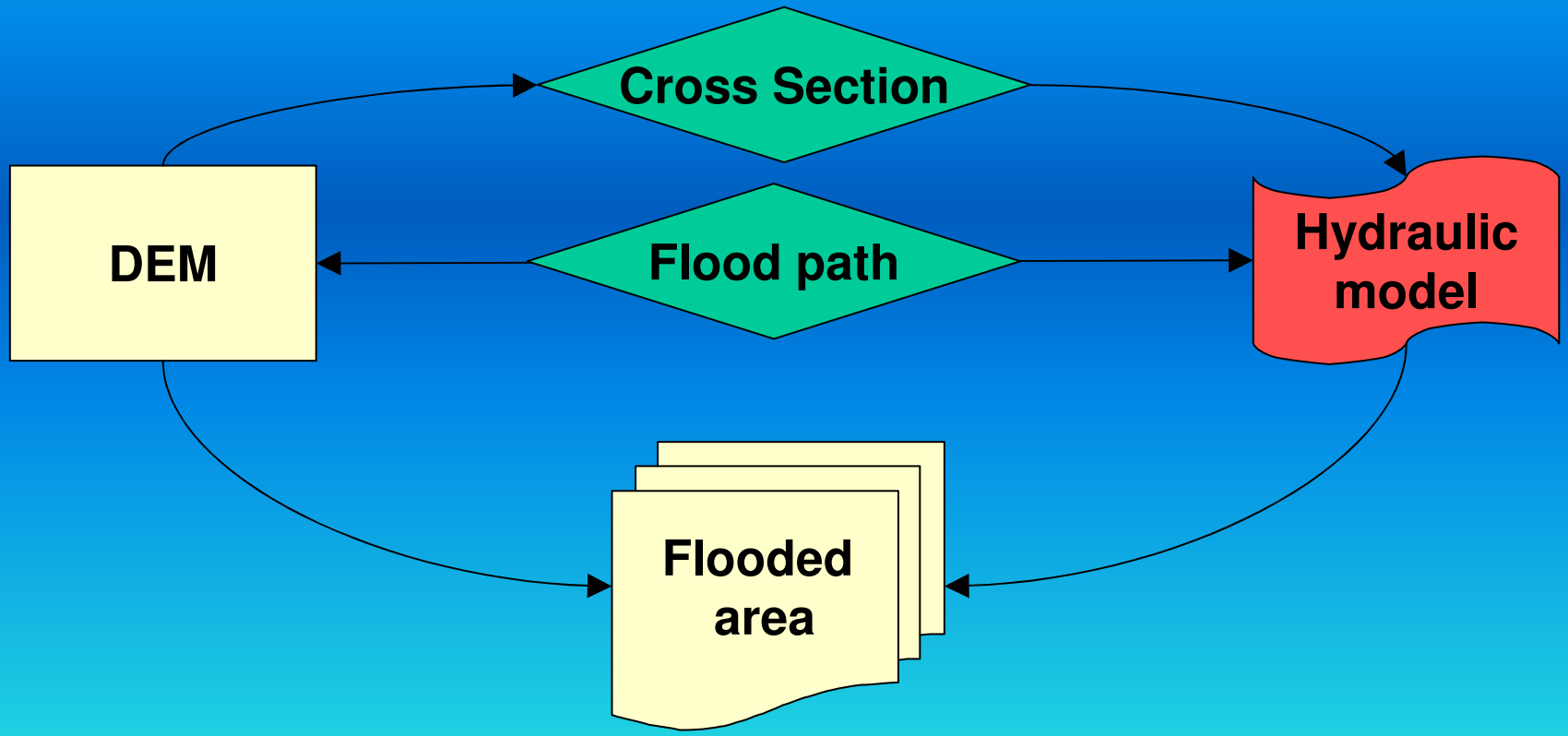
THE MAIN QUESTIONS TO BE ANSWERED IN OUR PROJECT:

- How far downstream the Siemianowka Reservoir can we control water flows in the Narew River during the flooding conditions?
- Can we optimize the water relies rules of the Siemianówka Reservoir, for high flow situation, in the way it will help forming the optimal water stages in the NNP?
- What is the extend of the inundated area in the floodplain downstream the Siemianówka Reservoir in different hydrological situation?

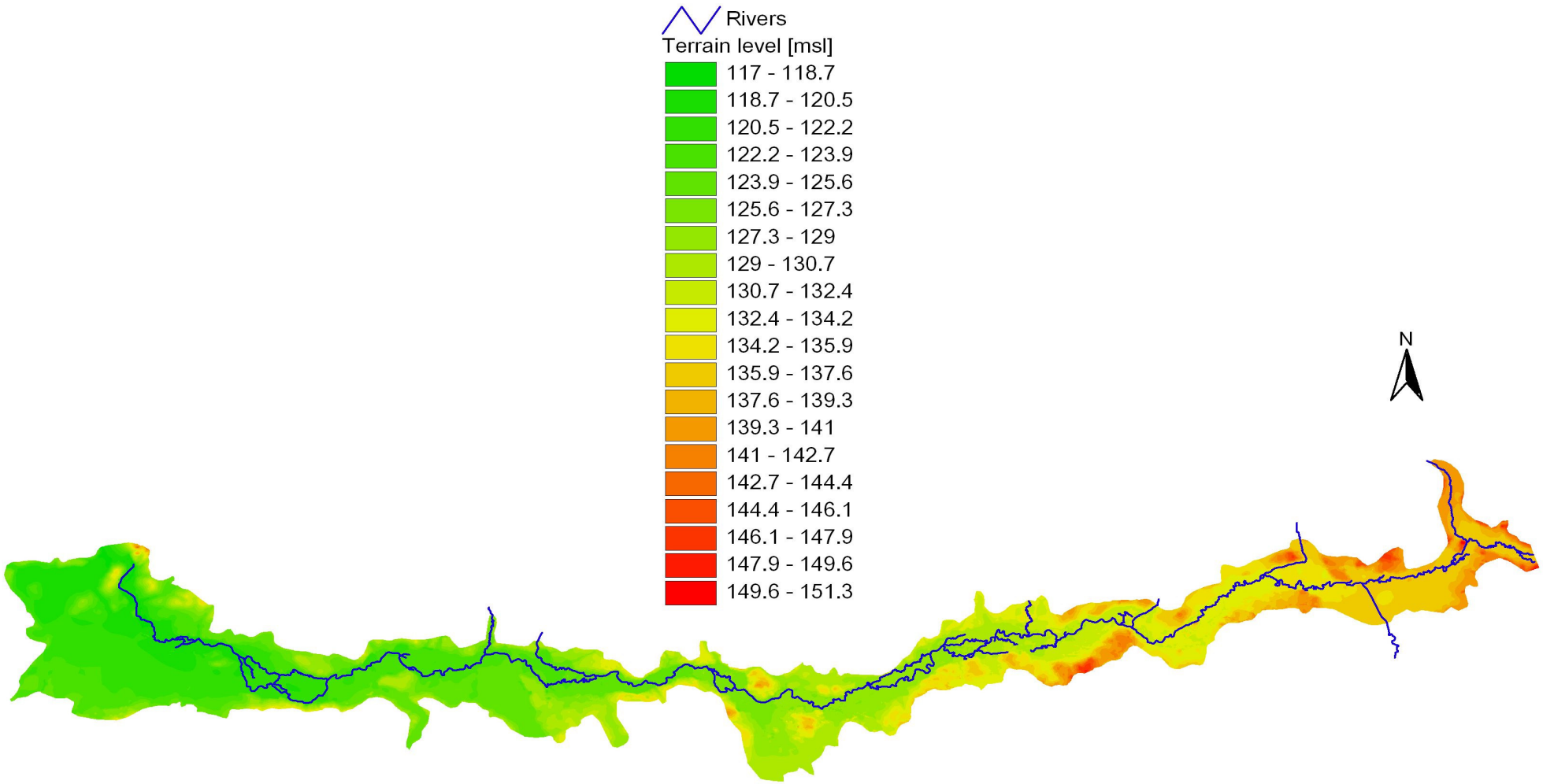
MODELLING OF THE SYSTEM



GIS - platform



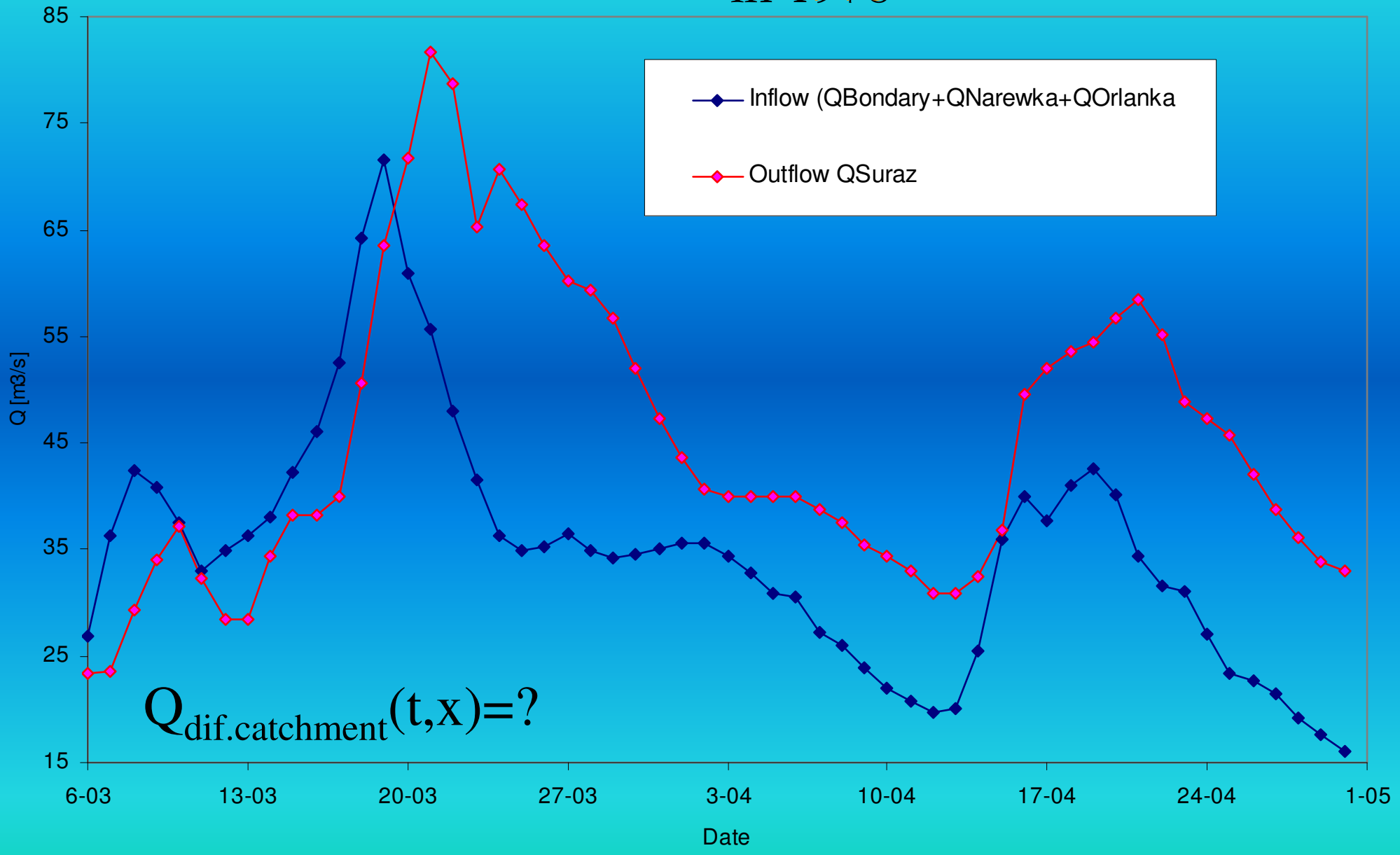
Digital Elevation Model



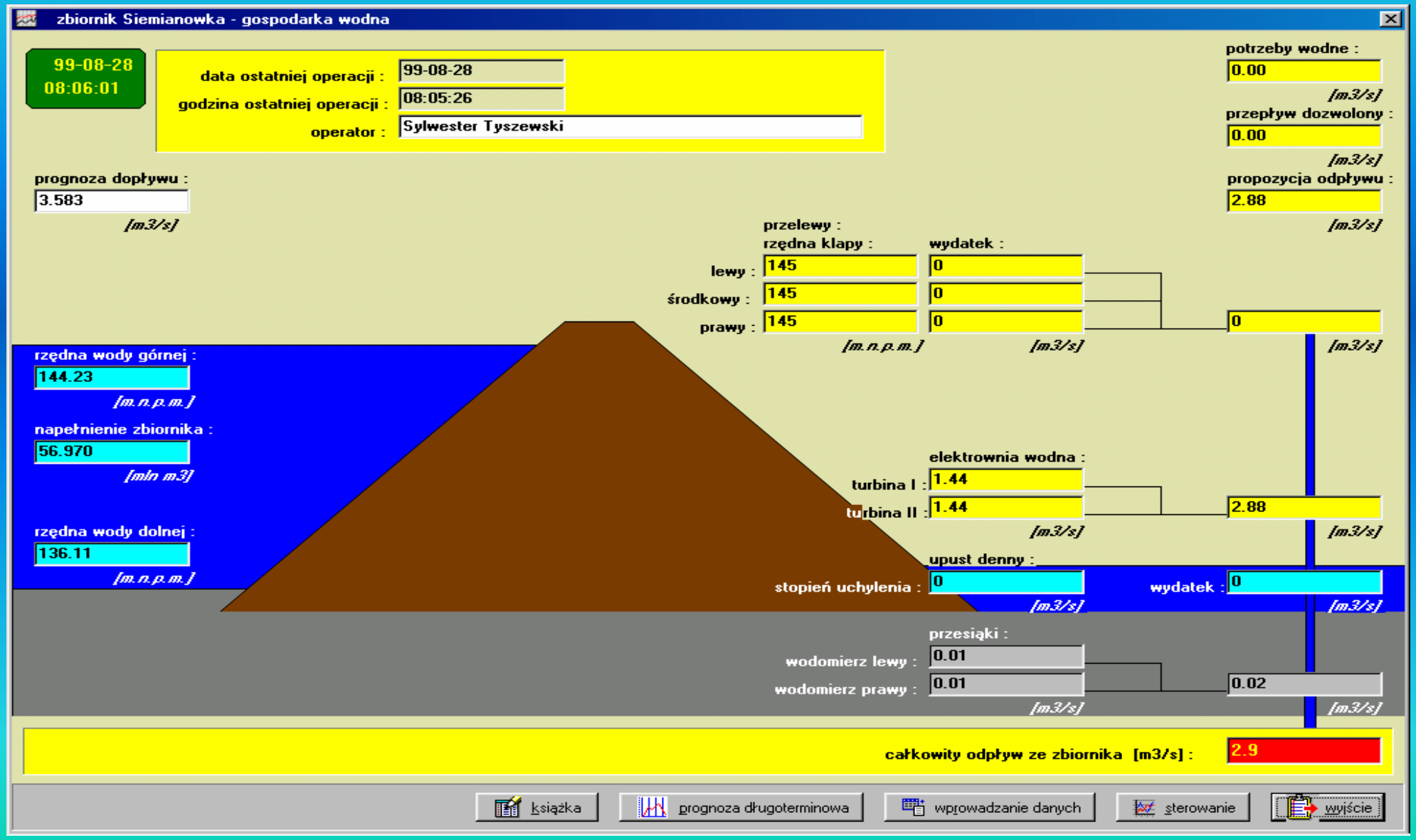
Hydrological Model
(average discharges for flood waves)

Date	$Q_{Bondary}$ [m^3/s]	$Q_{Narewka}$ [m^3/s]	$Q_{Orlanka}$ [m^3/s]	Q_{suraz} [m^3/s]	$Q_{dif.catch.}$ [m^3/s]	$Q_{dif.\ catch.t}/Q_{Suraz}$
1978 (03.06-04.30)	15.99	11.04	7.92	45.29	10.34	23%
1979 (03.21-05.25)	27.53	15.88	15.35	87.92	29.16	33%
1980 (03.29-05.12)	20.23	10.09	7.61	52.40	14.47	28%
1980 (07.03-09.06)	25.10	10.82	5.34	67.47	26.21	39%
1981 (12.10-01.12	20.87	11.15	7.35	68.67	29.30	43%

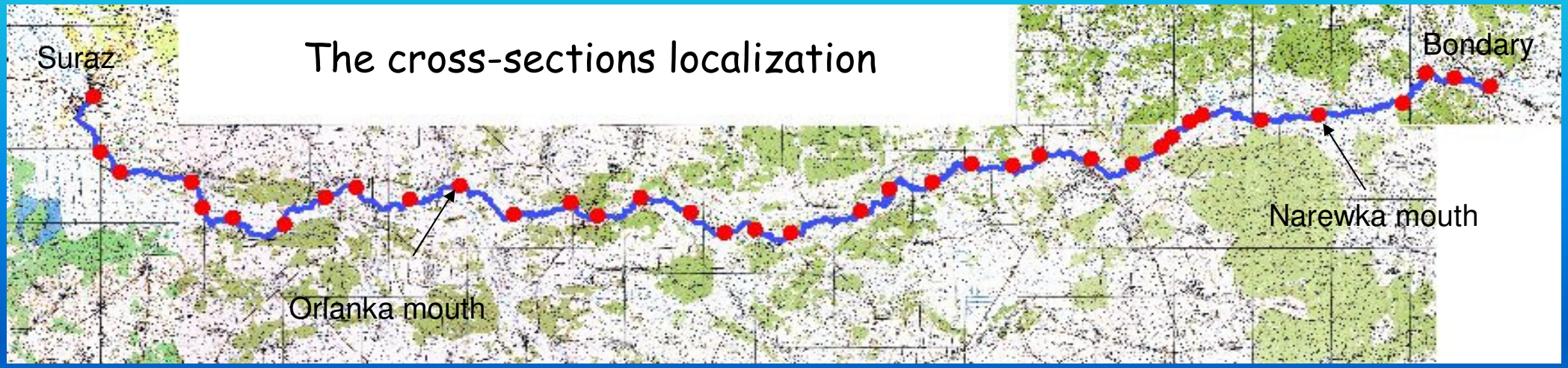
Discharge Hydrographs for flood event in 1978

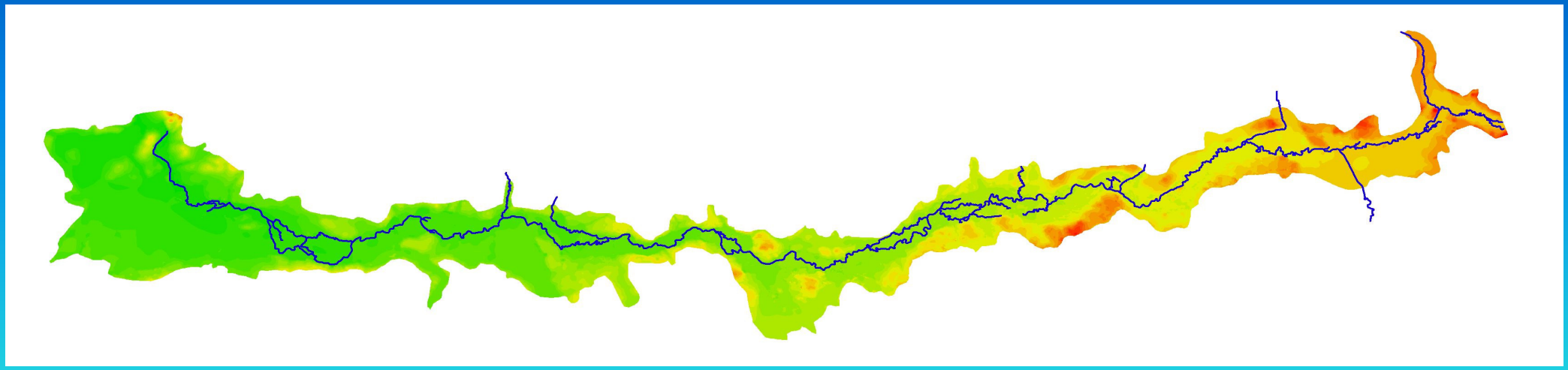


RESERVOIR MODEL
(rule base water relies policy)



HYDRAULIC MODEL





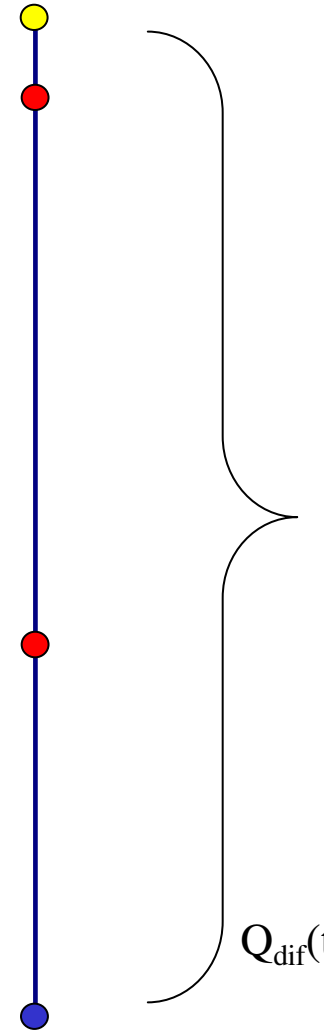
HYDRAULIC MODEL

Topological scheme and boundary conditions

Upstream boundary condition: Bondary flow hydrograph Q(t)

Lateral inflow from Narewka:
flow hydrograph $Q_N(t)$

Lateral inflow from Orlanka:
flow hydrograph $Q_O(t)$



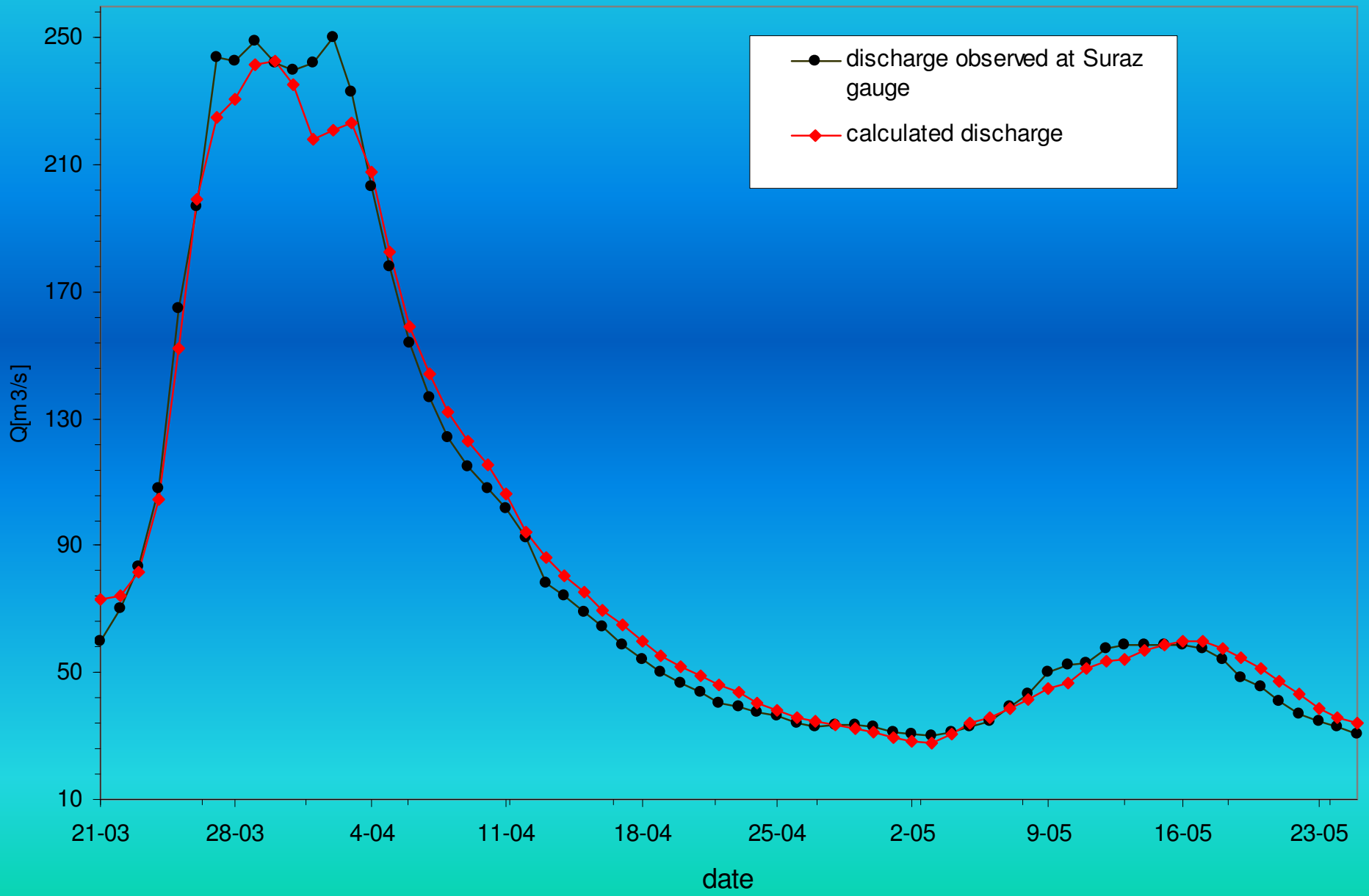
Uniform lateral inflow from differential catchment: flow hydrograph $Q_{dif}(t)$

$$Q_{dif}(t)=Q_{Suraz}(t+\Delta t)-Q_{inflow}(t)$$

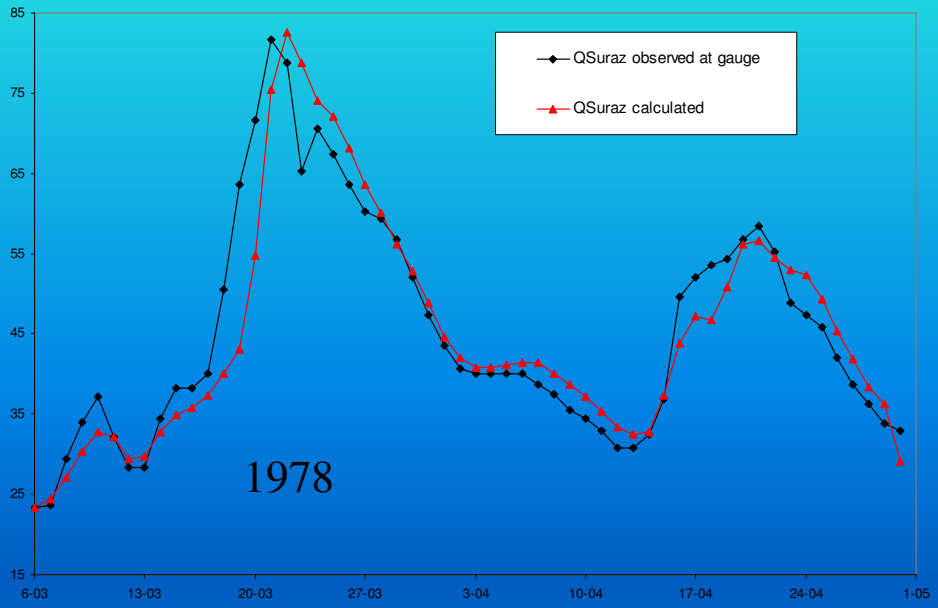
Downstream boundary condition: Suraz rating curve

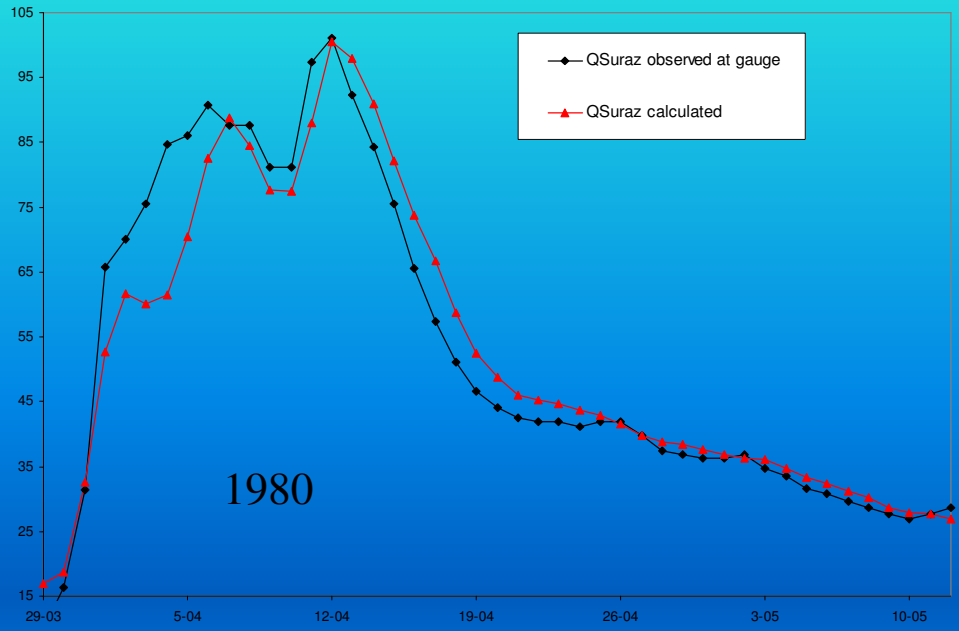
HYDRAULIC MODEL

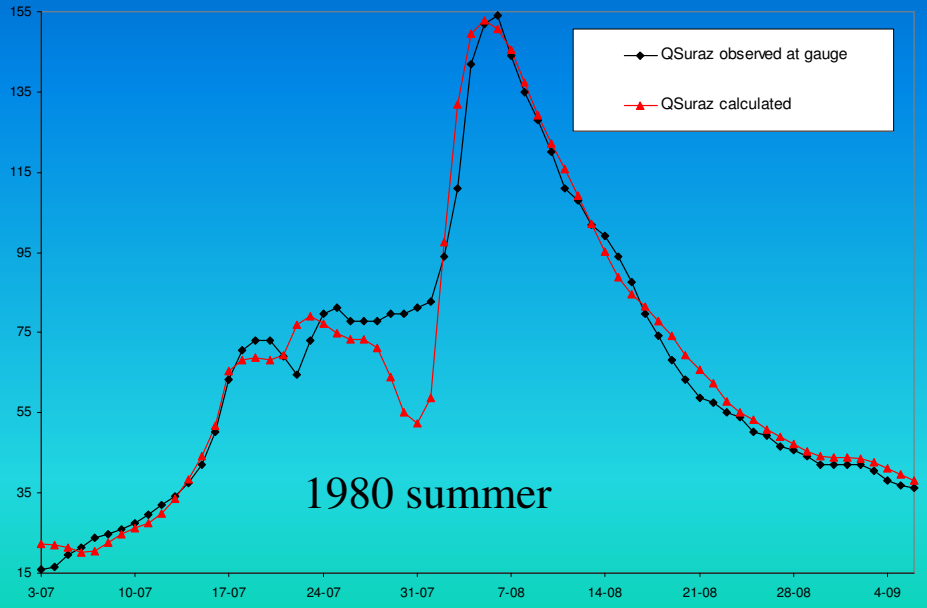
Calculated and observed discharge at Suraz gauge for flood event in1979

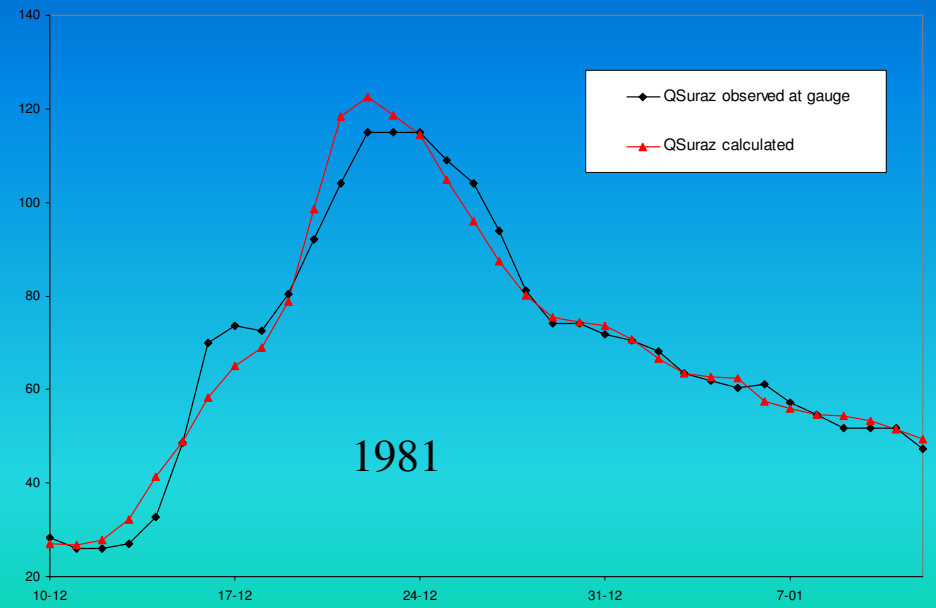


Hydraulic model validation









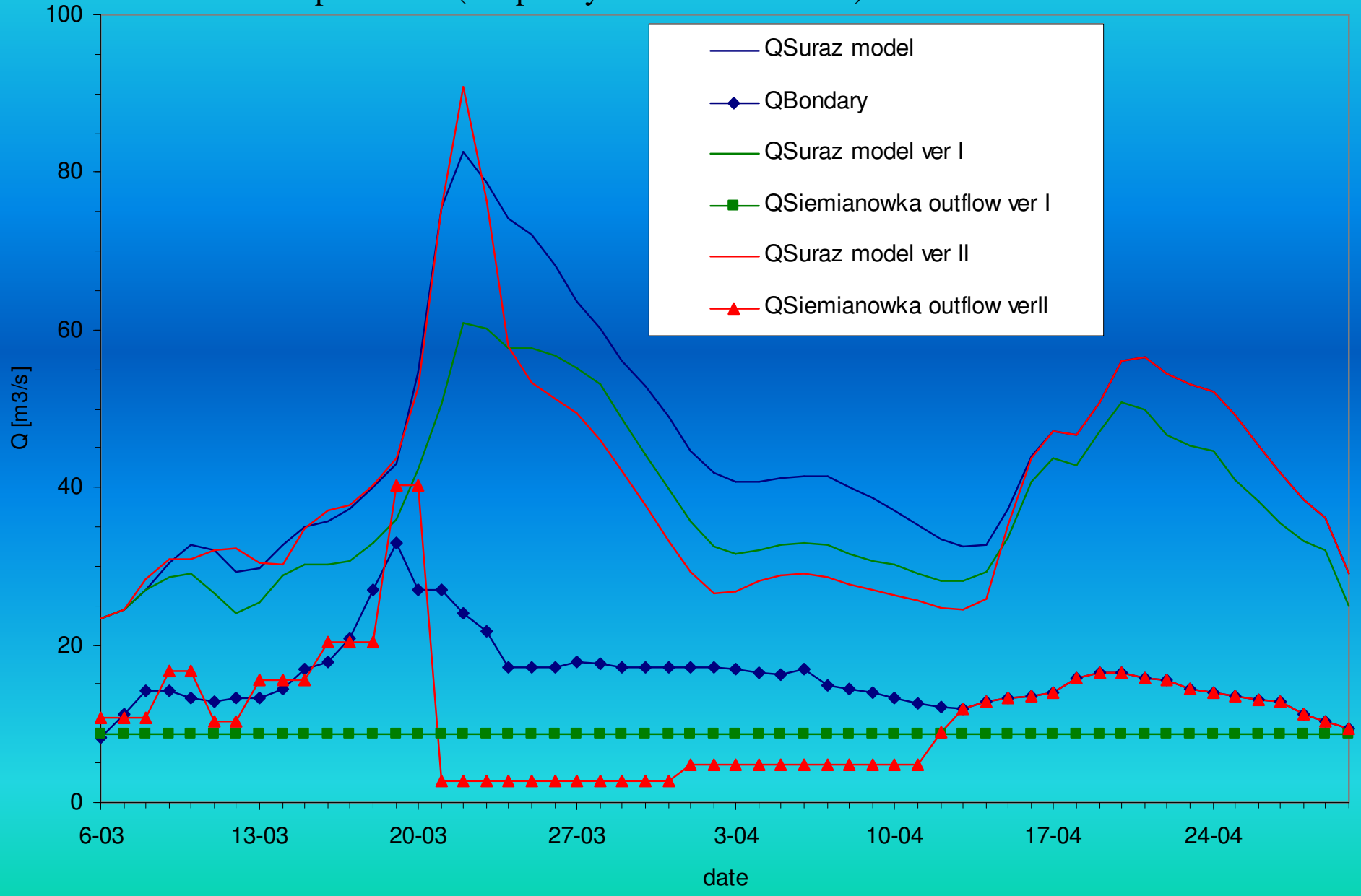
Hydraulic model validation

Date	Narew			Ploski			Suraz		
	RMSE [m^3/s]	Qave [m^3/s]	RMSE/ Qave	RMSE [m^3/s]	Qave [m^3/s]	RMSE/Q ave	RMSE [m^3/s]	Qave [m^3/s]	RMSE/ Qave
1978 (03.06-04.30)	4.74	31.29	15%	8.15	40.31	20%	5.12	45.29	11%
1979 (03.21-05.25)	6.73	49.78	14%	19.76	97.46	20%	7.29	87.92	8%
1980 (03.29-05.12)	3.31	31.7	10%	7.44	41.34	18%	6.60	52.40	13%
1980 (07.03-09.06)	6.71	36.74	18%	10.94	43.48	25%	7.38	67.47	11%
1981 (12.10-12.01)	5.06	38.01	13%	3.42	49.49	7%	4.90	68.67	7%

Calculated hydrographs at Suraz for flood event in 1978

Ver I – flood protection (safe outflow)

Ver II – wetland protection (temporary lift of safe outflow)



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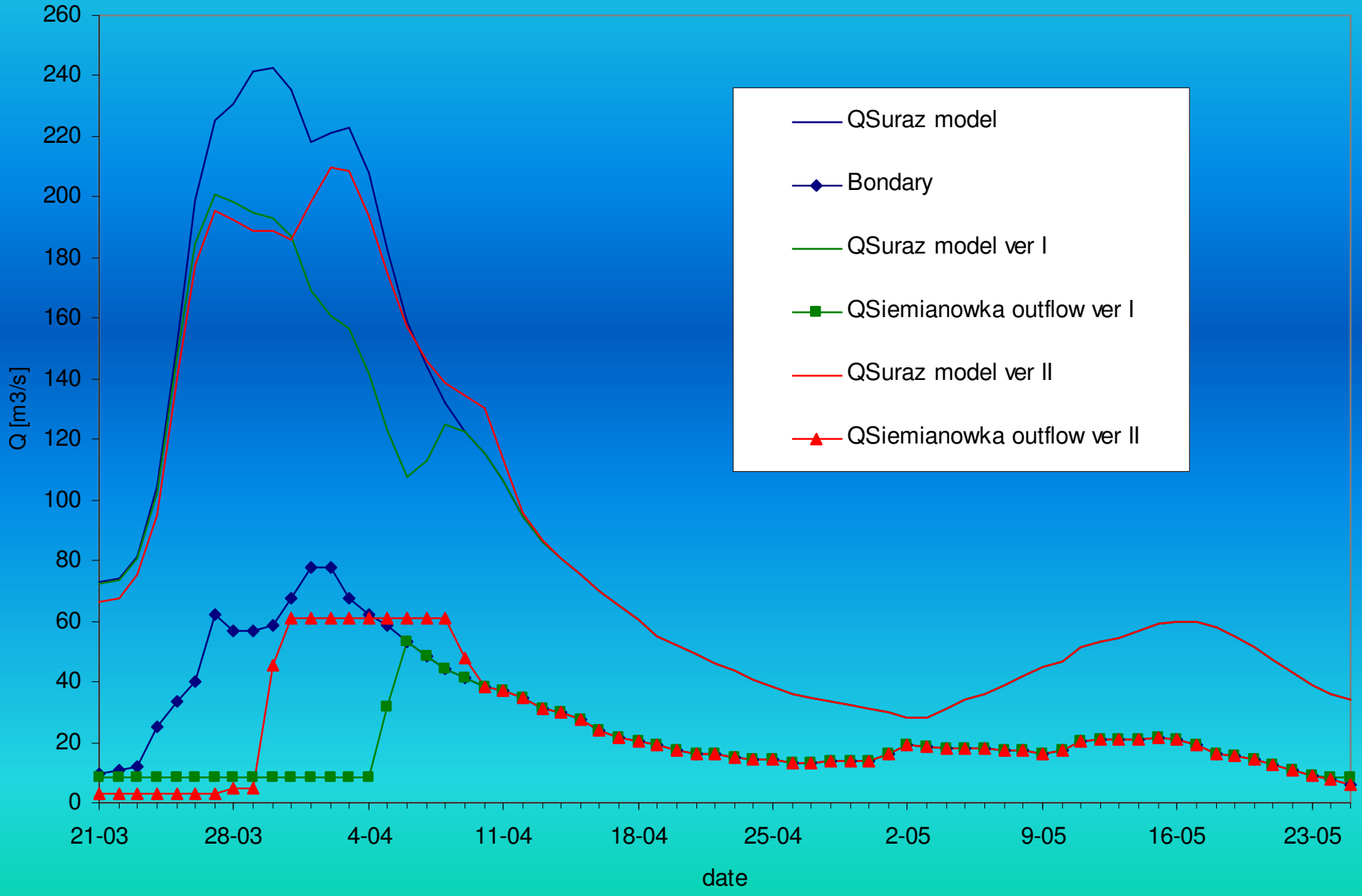

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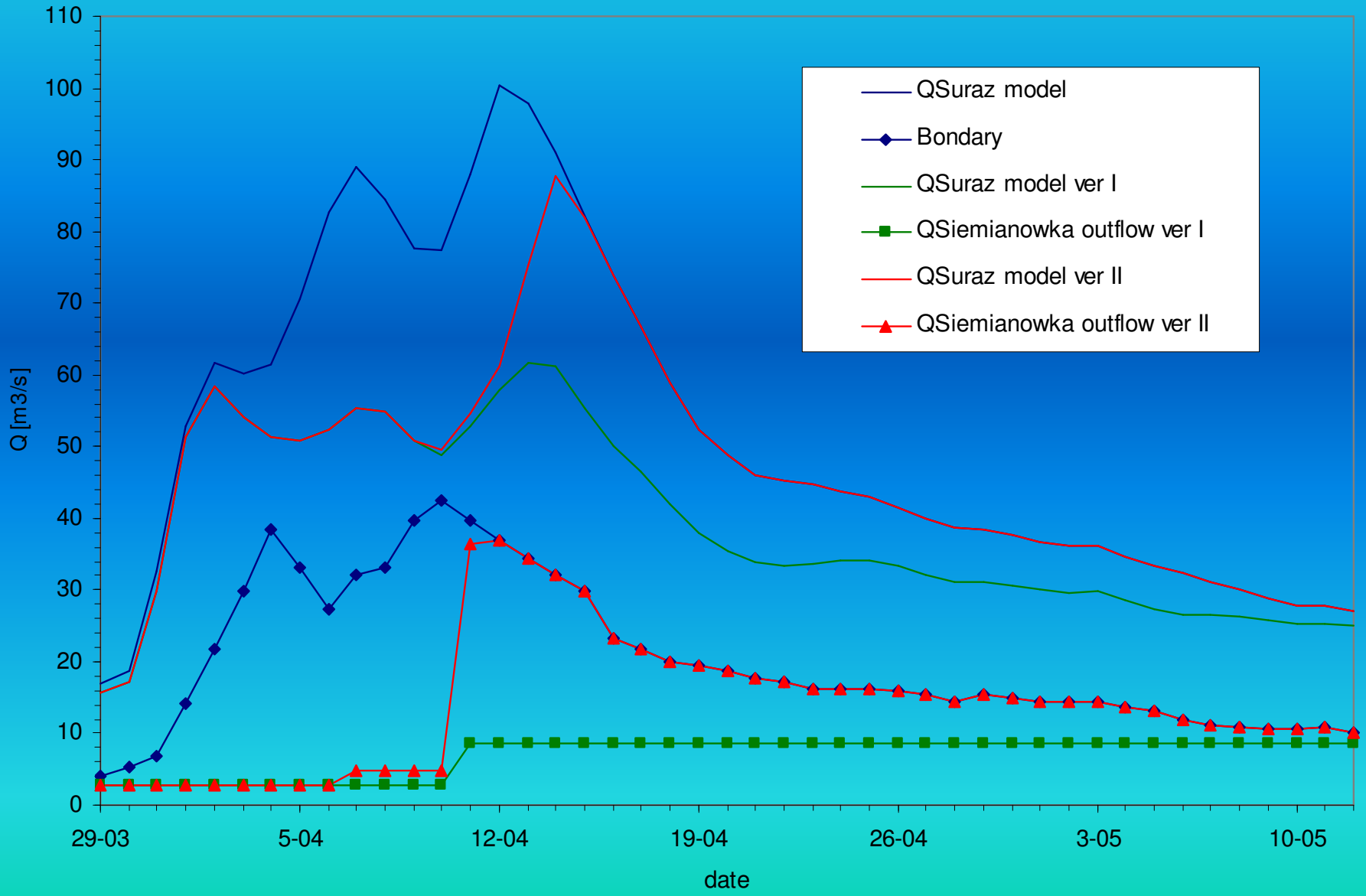
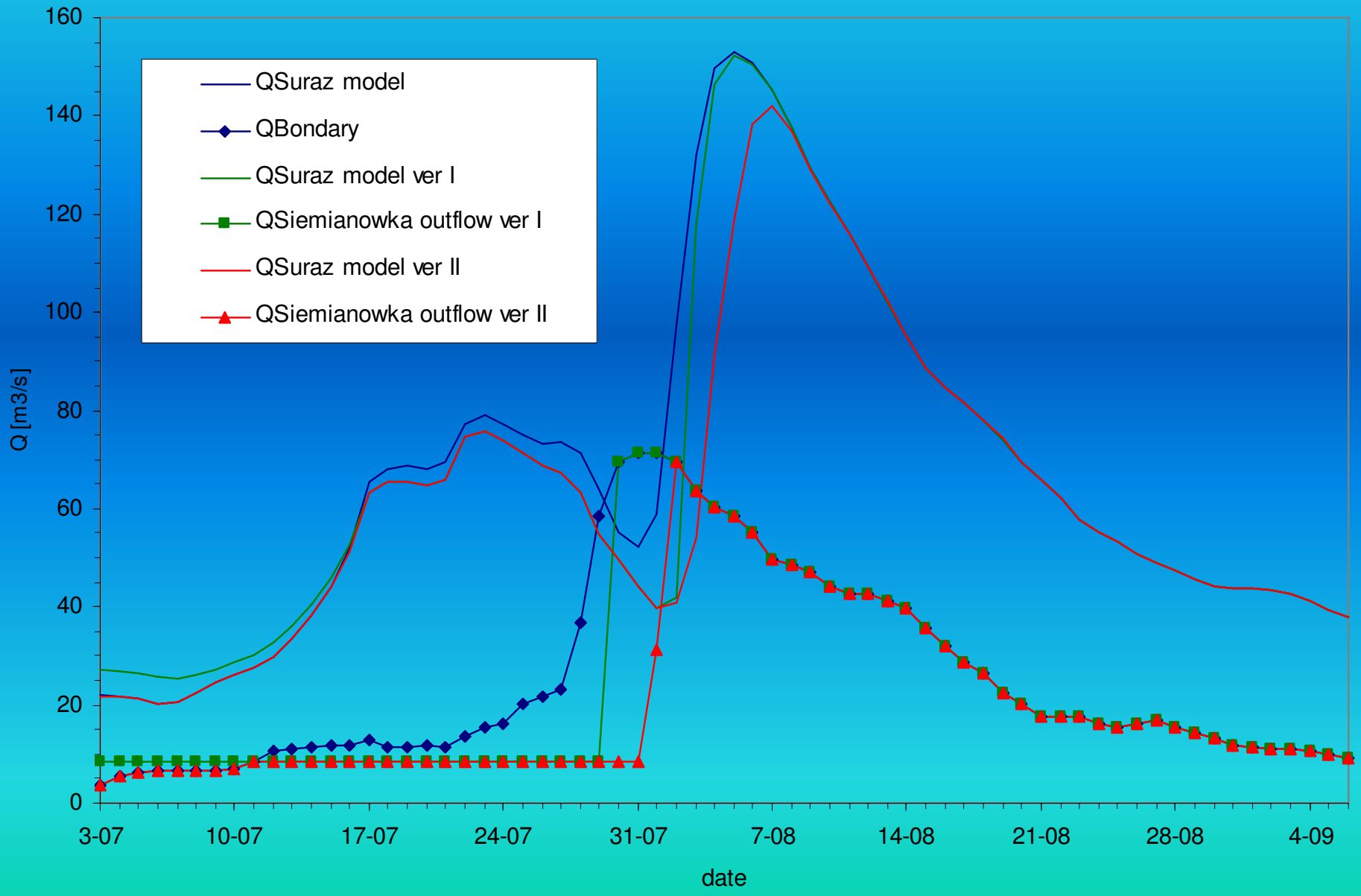


Calculated hydrographs at Suraz for summer flood event in 1980

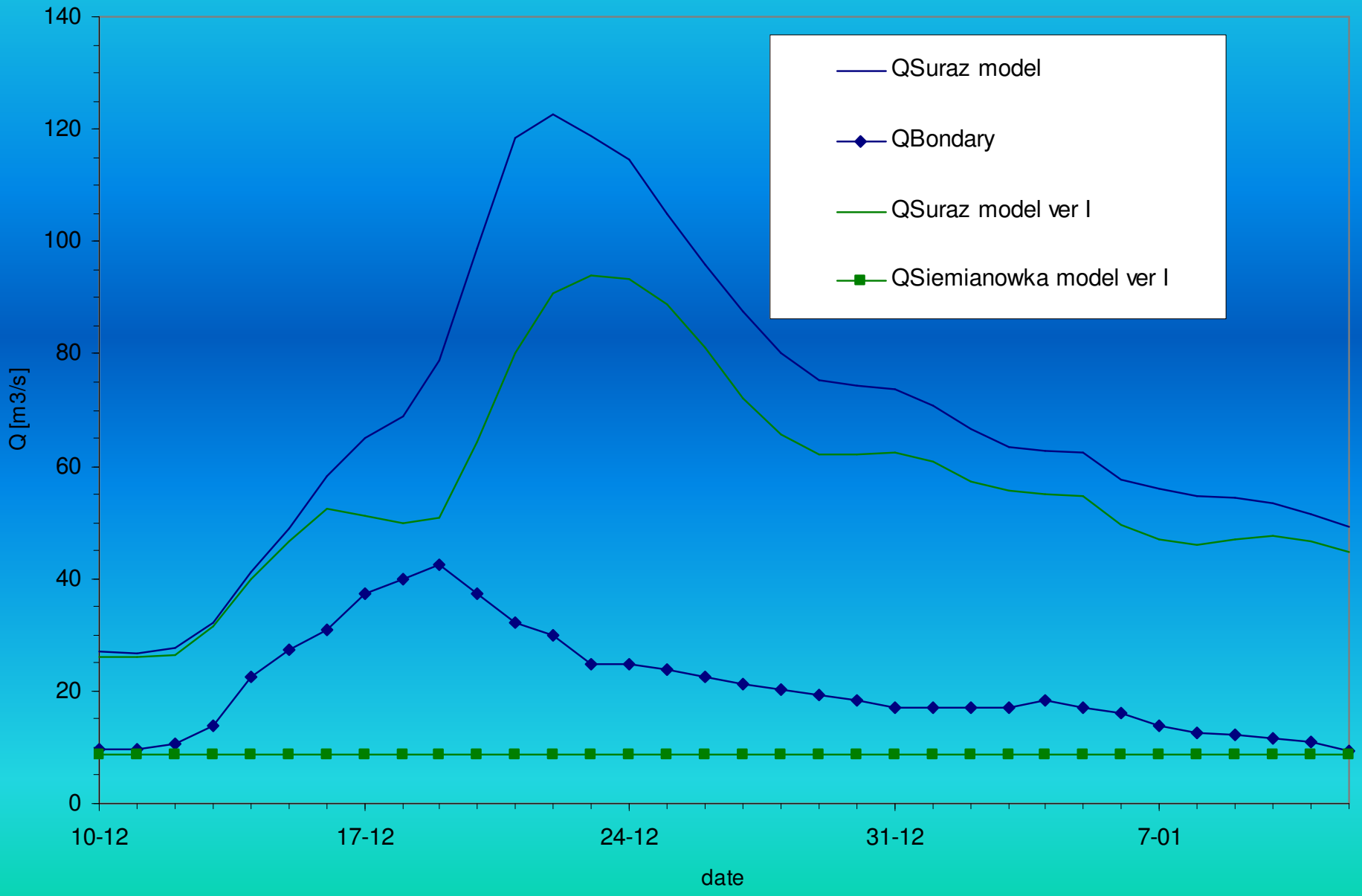
Ver I – flood protection (safe outflow)

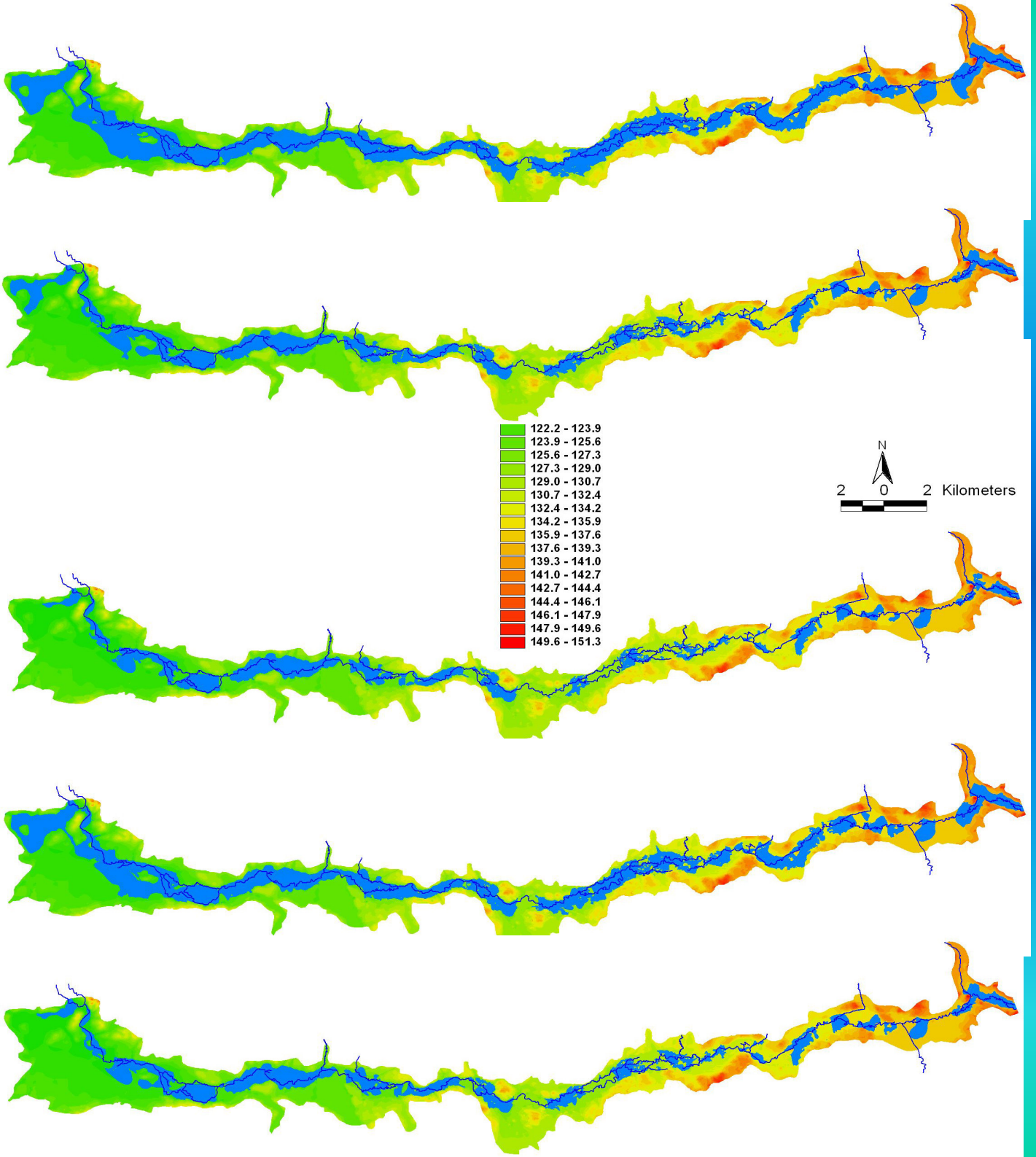
Ver II – wetland protection (temporary lift of safe outflow)



Calculated hydrographs at Suraz for flood event in 1981

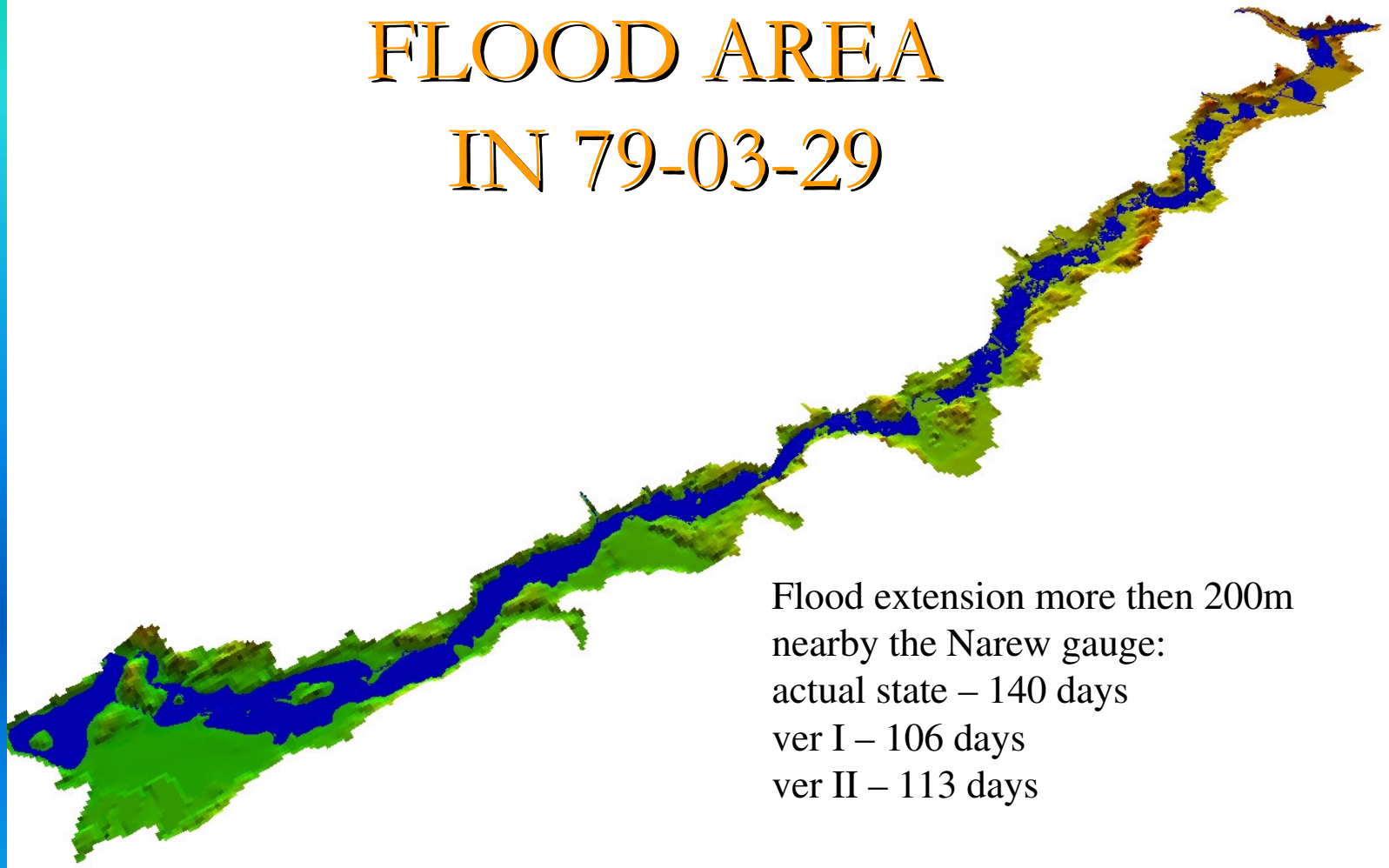
Ver I – flood protection (safe outflow)



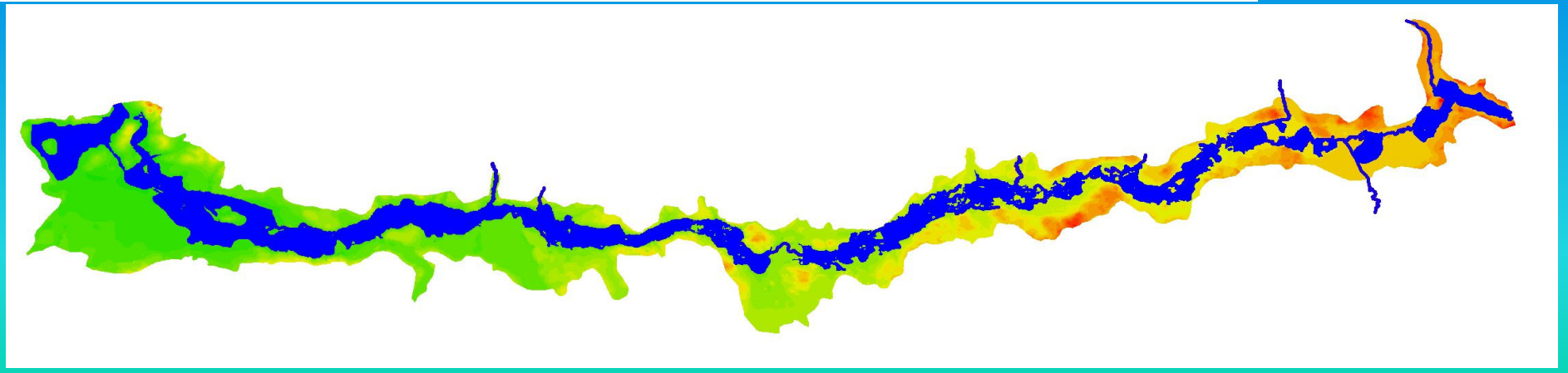


Area inundated during the floods of the different magnitude

FLOOD AREA IN 79-03-29



Flood extension more then 200m
nearby the Narew gauge:
actual state – 140 days
ver I – 106 days
ver II – 113 days



CONCLUSIONS

- The model has been verified in the terms of flows in Suraz only, the water level and flood extend will be compared in using the gauge data and Landsat images.
- 1 D model can have severe mistake in the dynamics on the floodplains, but we are going to calculate the hydrological characteristics,
- Siemianowka reservoir can control floods of certain magnitude (volume), the statistical analysis should be performed in order to asses its impact on habitats