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**Hydraulic and morphological modelling of the
SRB-CRO common stretch of the Danube River**

Task 1-2: Hydrological study

Stakeholder meeting

Bačka Palanka

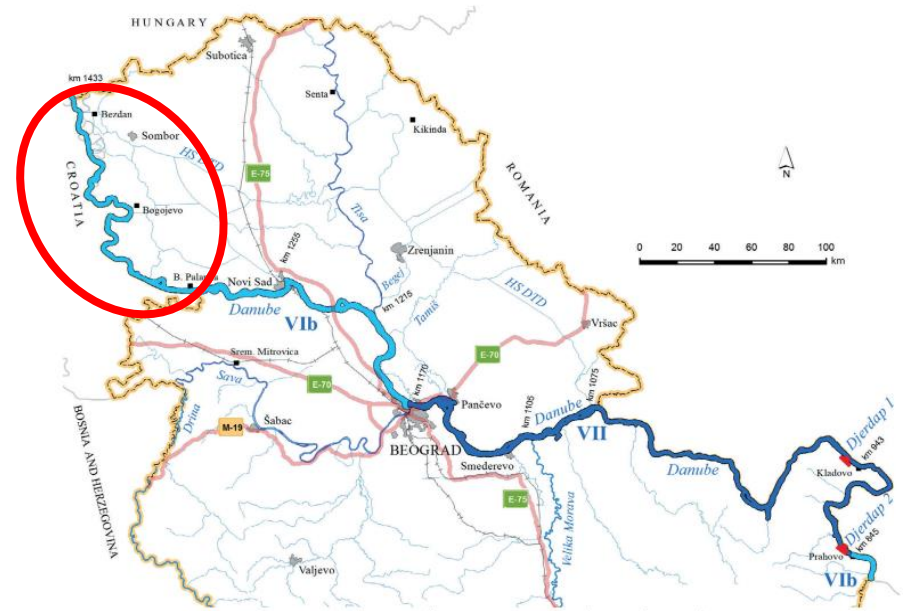
24.09.2024, Jasna Plavšić / Hidrozavod DTD

*Preparing FAIRway2 works in the Rhine Danube Corridor (2019-EU-TM-0262-S and 2019-HR-TMC-0263-S)
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Main goals



- ▶ Characterisation of hydrological regime of the Danube in the common SRB-CRO sector
 - mean flows, flood flows, low flows
- ▶ Computation of low and high navigable water levels (LNWL and HNWL)

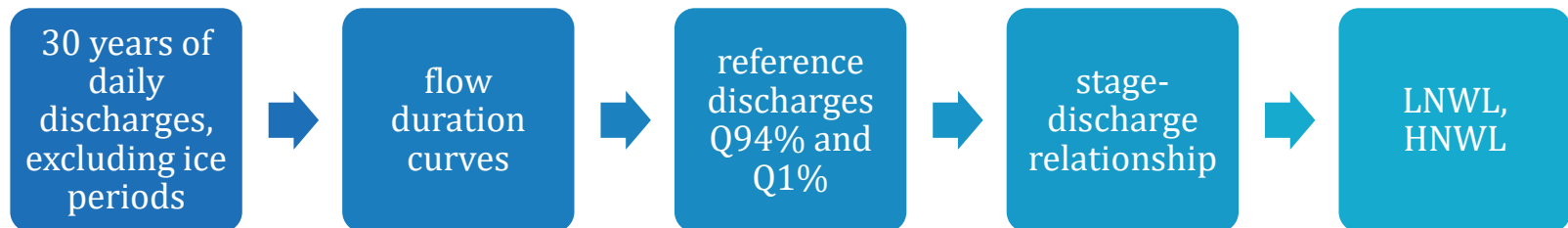


Source: <http://www.iscgm.org/gmd>

Definitions



- ▶ Glossary of the Danube navigation (2015)*:
 - **LNWL** is the water level having duration of **94%** in a year that is computed from data on the observed river discharges over a period of 30 years, excluding the periods with presence of ice
 - **HNWL** is the water level with duration of **1%**, based on the discharges observed during a period of 30 years, excluding the ice periods

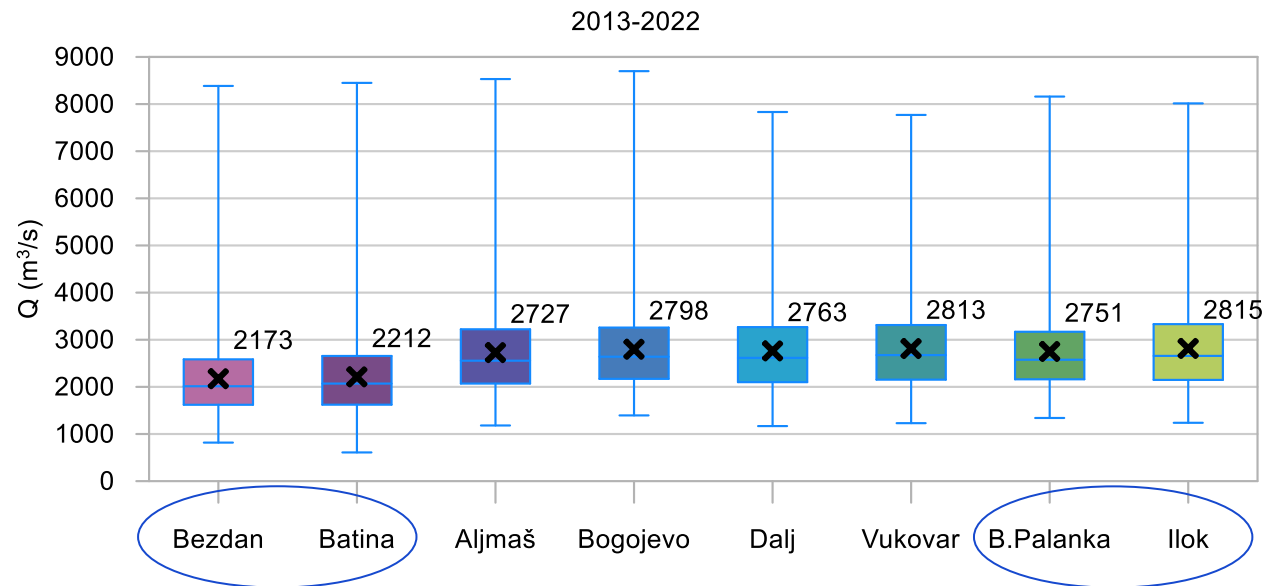


*<https://www.danubecommission.org/uploads/doc/publication/Glossary/Glossary%202015.pdf>

Data consistency



- ▶ How to compare discharges from different periods?
- ▶ Good general agreement, slight inconsistency in mean flows

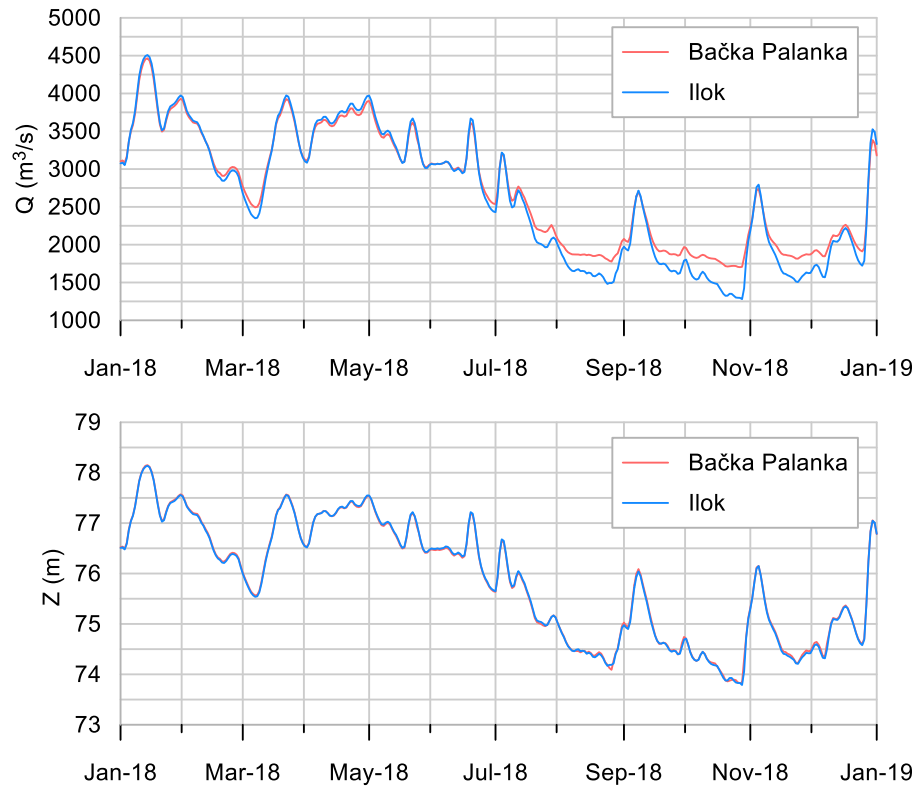


differences $\approx 2\%$

Data consistency



► Occasional significant differences in discharges and stages

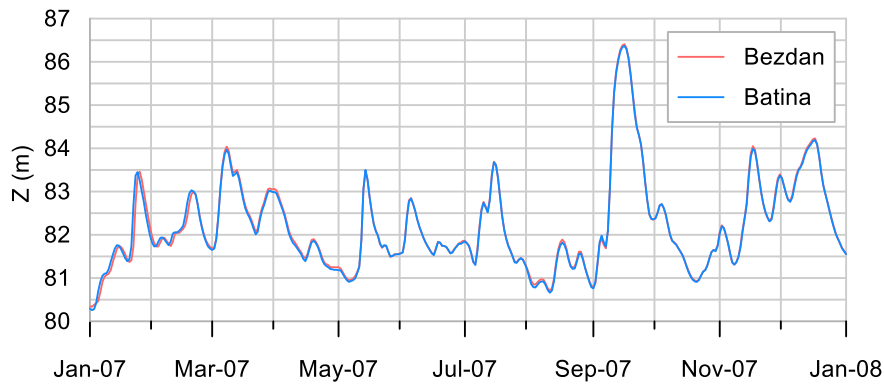


consistent water levels,
inconsistent discharges

Data consistency



► Occasional significant differences in discharges and stages



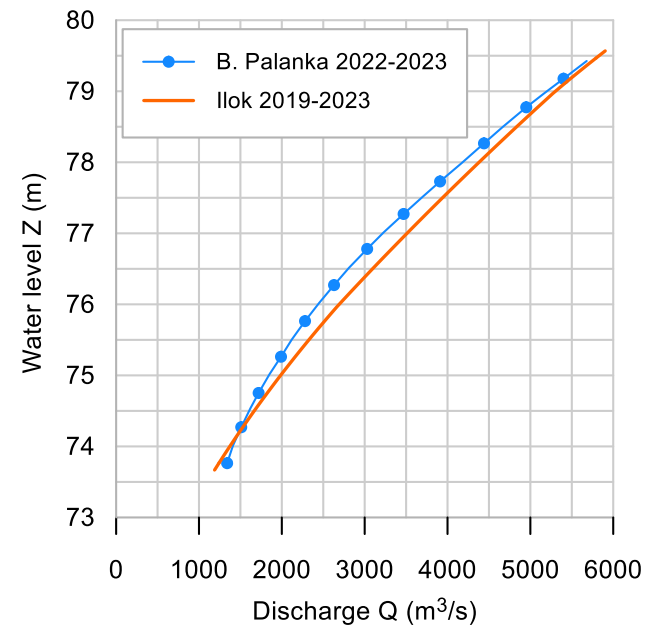
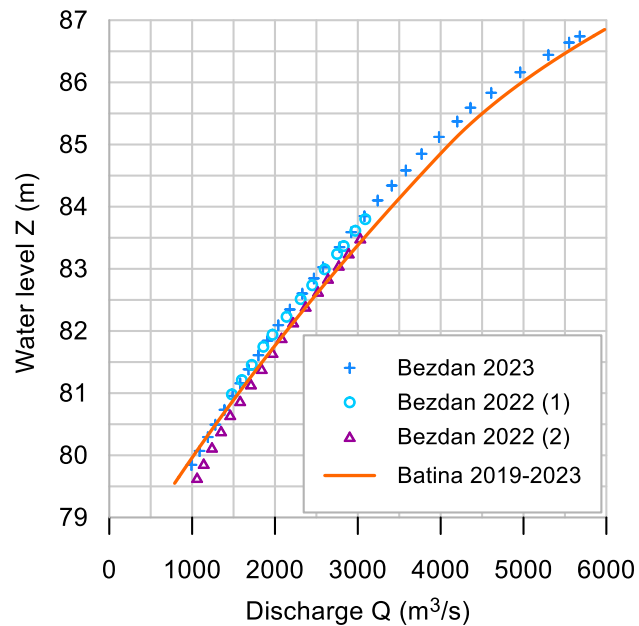
inconsistent water levels



Data consistency



- ▶ Main source of uncertainty: differences in stage-discharge curves



Flow duration curves

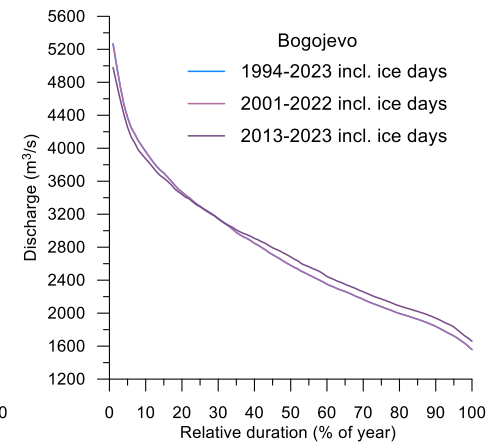
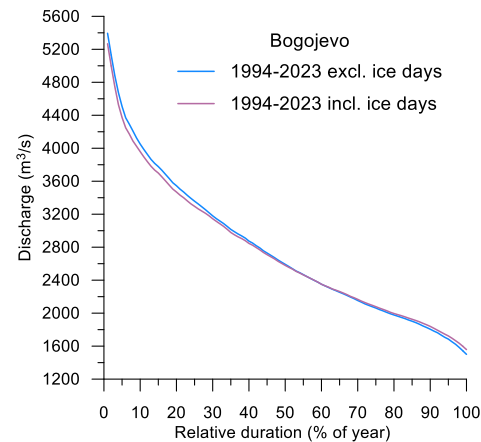
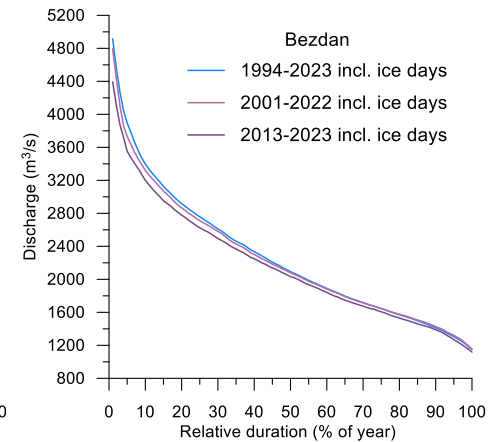
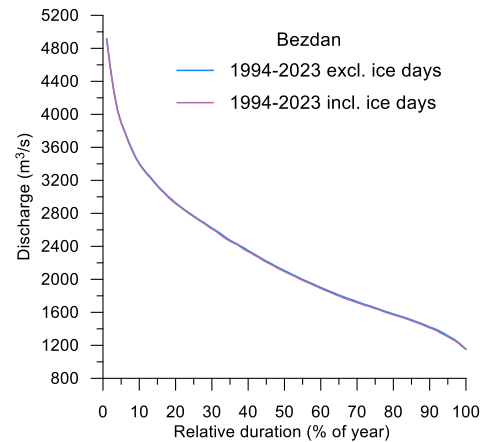


- ▶ Average curve for 1994-2023
 - based on daily discharges with periods of ice excluded
 - target: estimate reference discharges Q1% and Q94%
- ▶ Short records?
 - full record only for Bezdan, Bogojevo 26 years, B. Palanka 13 years, Croatian stations 22 years
- ▶ No data on ice at Croatian stations
 - does including ice periods makes significant difference?

Flow duration curves



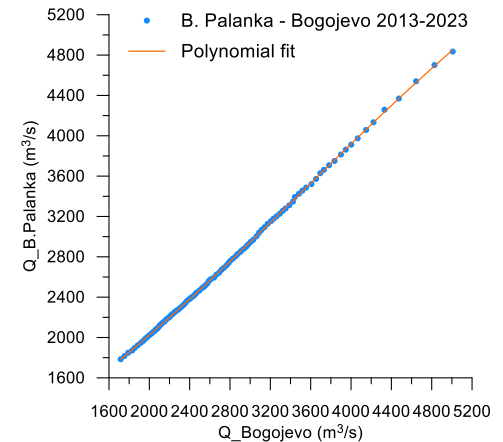
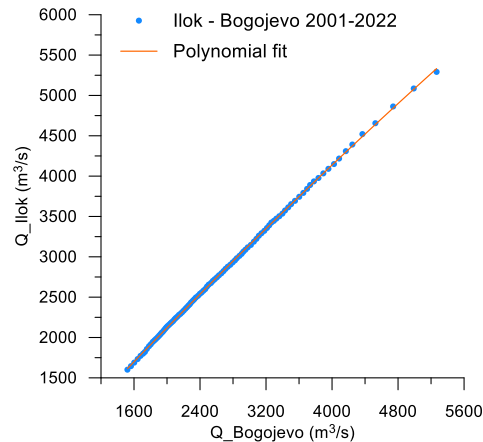
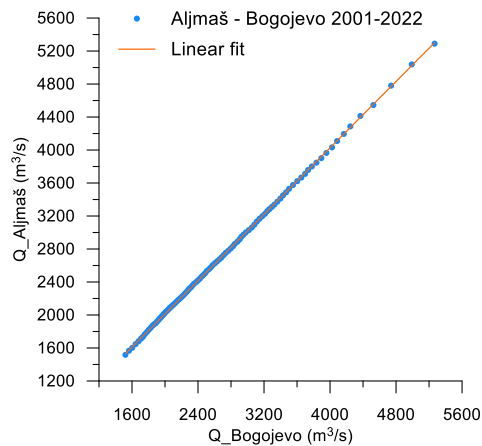
- ▶ Including/excluding ice periods makes (small) differences in duration curves
- ▶ Short record may cause significant differences in duration curves



Flow duration curves



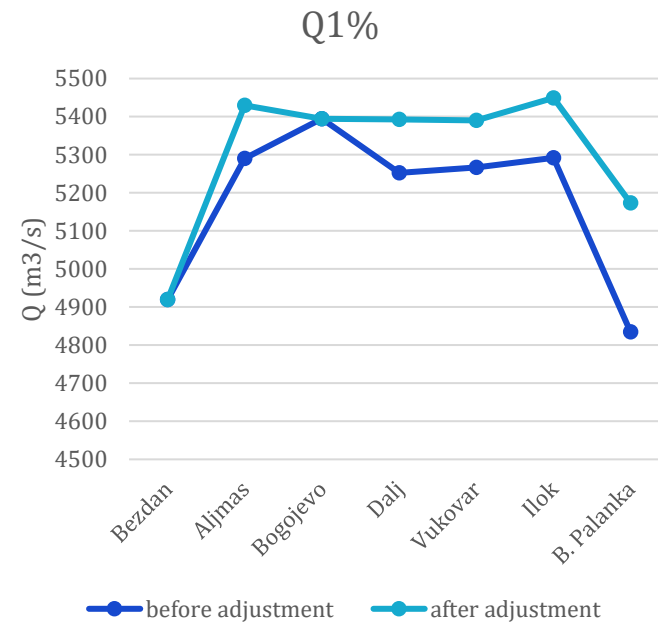
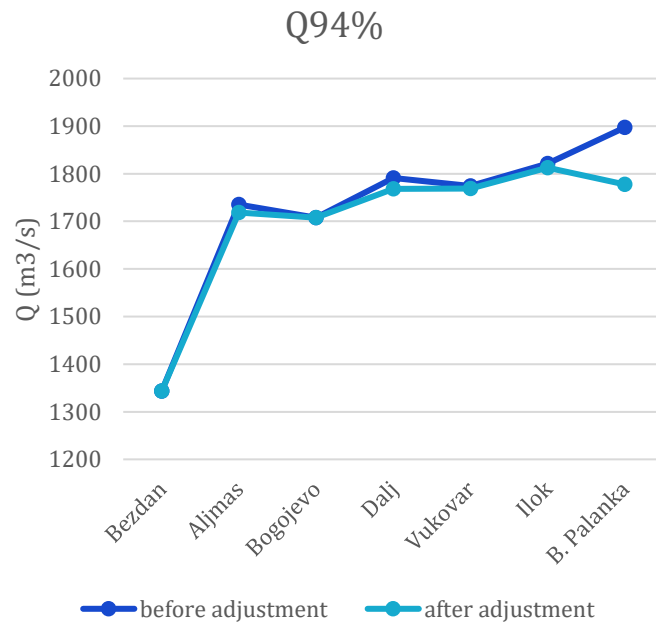
- ▶ Adjustment of duration curves for stations with short records
 - adjustment for including ice days for Croatian stations indirectly incorporated
 - based on transfer functions identified for the period of shorter record, Bogojevo as the reference station



Flow duration curves



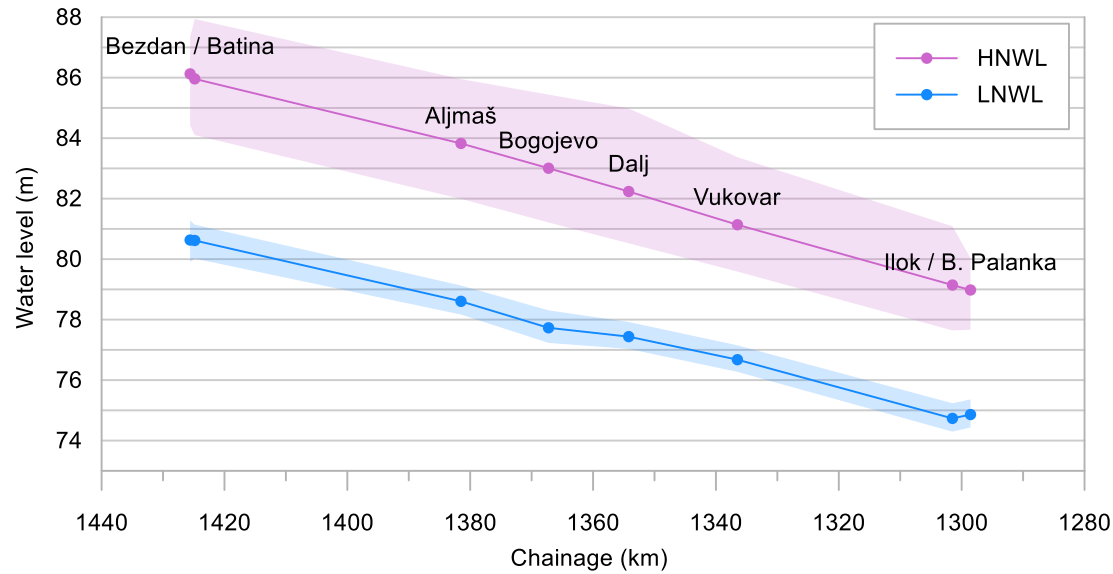
▶ Adjusted reference discharges



Navigable water levels



- ▶ LNWL and HNWL obtained from adjusted reference discharges and the most recent stage-discharge curves, with 90% confidence intervals

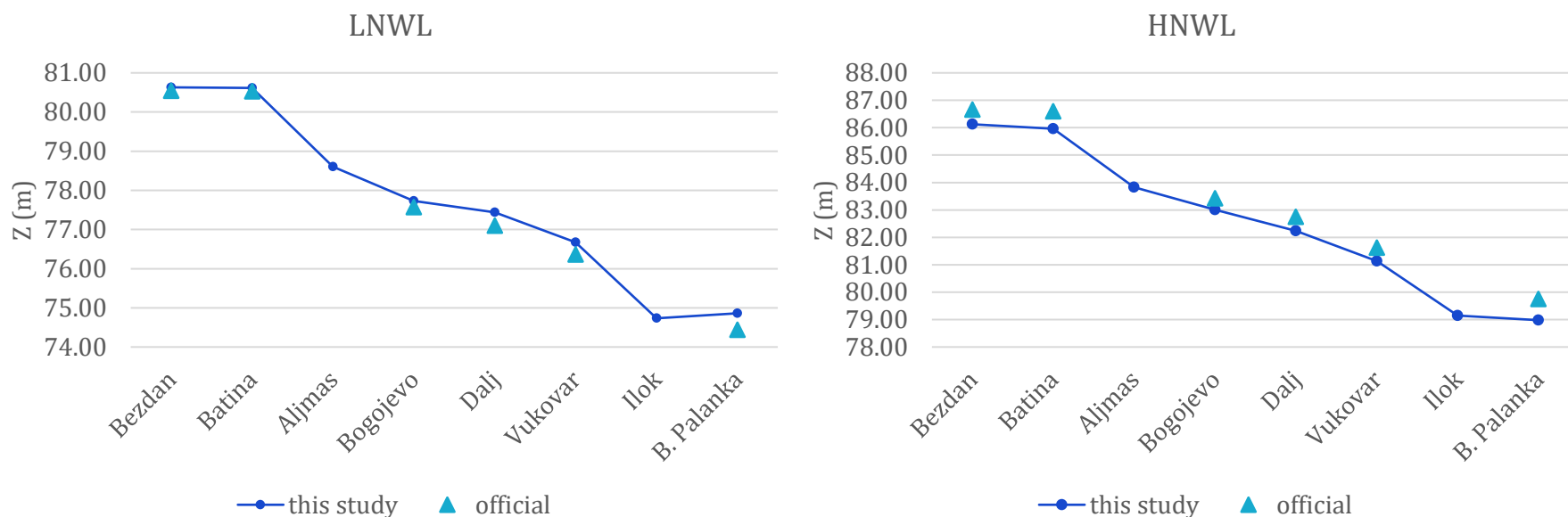


some inconsistency at B. Palanka and Ilok

Navigable water levels



► Comparison to previous reference levels



Stage (cm)	Bezdán	Batina	Aljmaš	Bogojevo	Dalj	Vukovar	Ilok	Bačka Palanka
LNWL	this study	-1	17	52	27	223	49	77
	official	-10	8		11	189	17	47
HNWL	this study	549	551	574	555	703	495	518
	official	602	615		596	754	544	578

Conclusions



- ▶ Data inspection shows differences at twin Serbian/Croatian stations
 - in water level measurements (occasionally very large)
 - in stage-discharge curves
- ▶ Short records do not provide reliable estimates of reference discharges
 - adjustments for short records applied
- ▶ Reference levels from stage-discharge curves fairly consistent
 - to be checked and adopted in hydrodynamic simulations
- ▶ Recommendations
 - Strong need for coordination between hydromet services of Serbia and Croatia and harmonization of data measurement and processing techniques
 - Further updates of reference discharges should be based on periods with simultaneous records at all stations for a minimum of 30 years



Thank you