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University of Belgrade
Faculty of Civil Engineering

Chair of Hydraulic and Environmental Engineering

Study program of Doctoral studies

with short presentation of thesis defended from 2007 till 2019 and ongoing research (1 to 2 slides per thesis)

Doctoral studies

Study program of doctoral studies on Civil Engineering – HEE department

3 years (6 semesters) program with 8 courses and PhD thesis

List of courses for the first semester:

1 obligatory: - Advance course in fluid mechanics

1 of 3 courses: - Risk and reliability analysis in civil engineering
- Optimization methods
- Measurement of non-electrical quantities in civil engineering

1 of 2 courses: - Solid waste management – advanced course
- Hydroinformatics

List of courses for the second semester:

3 of 7 courses: - Water quality –advanced course
- Flow in porous media
- Hydraulics of hydraulic structures
- Deterministic hydrologic models
- Management of hydrotechnical structures
- Computational hydraulics – advanced course
- Stochastic hydrology

Doctoral studies

List of courses for the third semester:

2 of 5 courses:
- Wastewater engineering-treatment and reuse
- Advanced Water Treatment
- Flood management
- Transport processes in hydraulic and environmental engineering
- Integrated urban water management

Fourth semester:

Doctoral dissertation – Laboratory research 1

Fifth and sixth semester:

Doctoral dissertation – Laboratory research 2

Doctoral dissertation – preparation and publication of papers

Doctoral dissertation – preparation and defense

Research – PhD thesis

List of PhD thesis defended at HEE from 2007 till 2019

- Numerical modeling of hypolimnetic oxygenation of lakes, Nenad Jaćimović (2007) Link
- Numerical investigation of river confluence hydrodynamics, Dejana Đorđević (2011) Link
- Development of methods and procedures for arsenic removal from drinking water, Branislava Lekić (2011) Link
- The effect of water quality on steel corrosion, Vladana Rajaković-Ognjanović (2011) Link
- Methodology for data validation of hydraulic and hydrologic measurements, Nemanja Branisavljević (2012) Link
- Modelling of Stochastic Structure of Flood Characteristics Derived From Peaks Over Threshold Series, Dragutin Pavlović (2013) Link
- An Integrated concept of the river basin and hydrographic network protection in the process of transformation the retentions in reservoirs for water supply, Milanko Ljujić (mentor: Jovan Despotović) defended 18.06.2013.

Research – PhD thesis

List of PhD thesis defended at HEE from 2007 till 2019

- Advances in methodology for evaluation and improvement of the water distribution system performance, Branislav Babić (2014) Link
- Supercritical flow in circular conduit bends, Milena Lučić (Kolarević) (2015) Link
- Hydrologic projections under climate change based on time series models, Milan Stojković (2015) Link
- Impact of calibration period on parameter estimates in the conceptual hydrologic models of various structures, Andrijana Todorović (2015) Link
- Methodology for the selection of optimum size of district metered areas (DMA) in water distribution systems, Ivana Ćipranić (mentor Marko Ivetić) defended 11.07.2015.
- Performance evaluation and indicators of the efficiency of drainage systems for management of the groundwater regime on agricultural land, Mile Božić (mentor Marko Ivetić/Miloš Stanić) defended 30.09.2016.
- Non-parametric stochastic generation of hydrologic series Đurica Marković (2016) Link

Research – PhD thesis

List of PhD thesis defended at HEE from 2007 till 2019

- Model for MicroPollutants In RaingardEns (MPiRe), Anja Randjelović (2016) Link
- Risk analysis methodology in water infrastructure asset management, Aleksandar Šotić (2016) Link
- Modelling of Urban Runoff Pollution Emission, Aleksandar Djukić (2016) Link
- SPH - Smoothed Particle Hydrodynamics, Nikola Rosić (2016) Link
- Flow in the Gradually Converging Stepped Spillway, Budo Zindović (2018) Link
- Hydrodynamic loads on stepped spillway and stilling basin, Bojan Milovanović (2018) Link
- Decision Support Algorithms for Sectorization of Water Distribution Networks, Željko Vasilić (2018) Link
- Assessment of the liquid flow rate in complex flow conditions with flat electromagnetic sensors, Damjan Ivetić (2019) Link

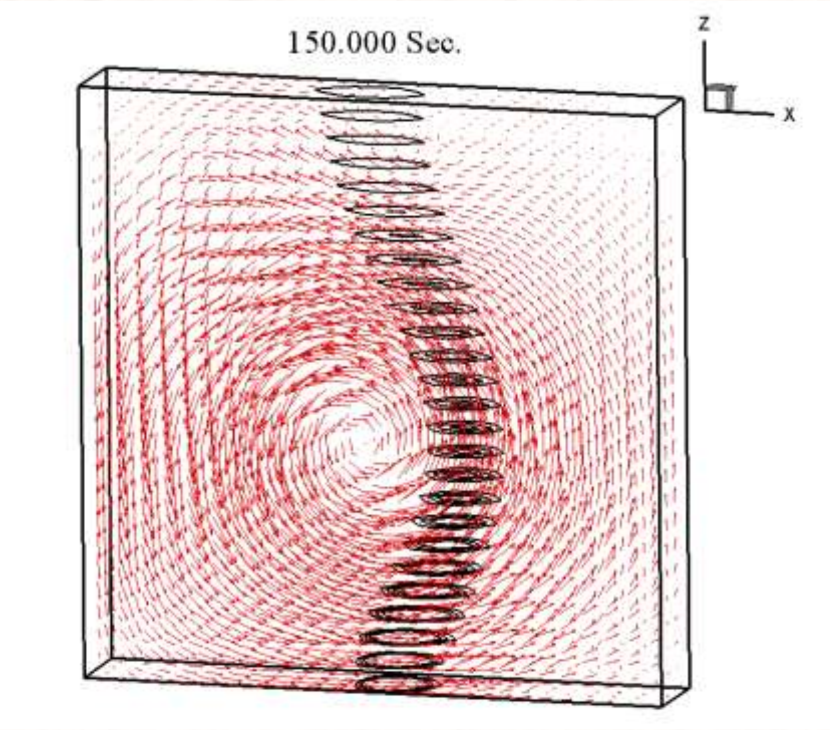
Research – PhD thesis

List of on-going PhD thesis at HEE

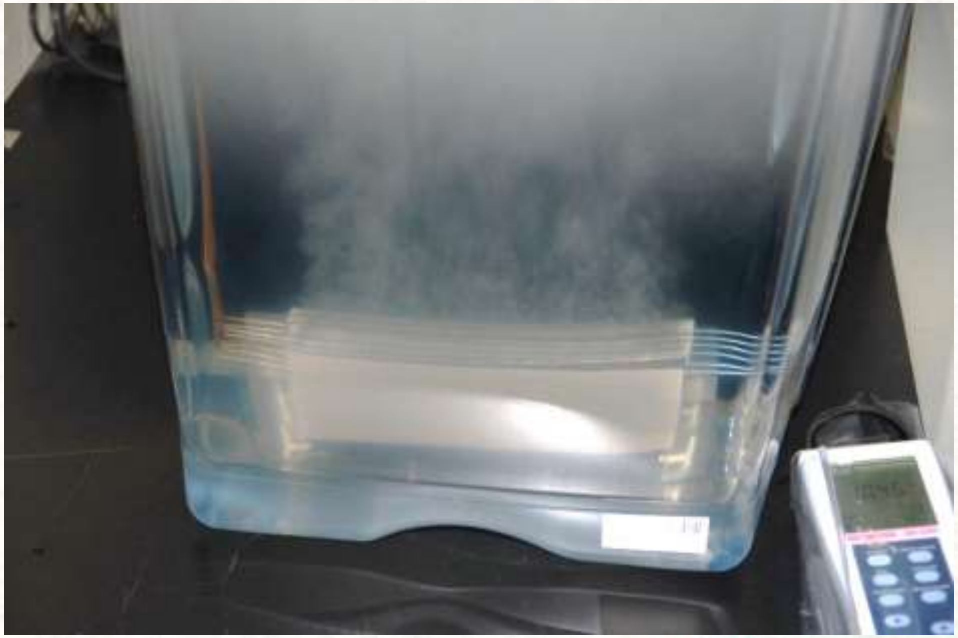
- Robust evaluation and calibration of monthly water balance models in changing climate conditions, Žana Topalović (ongoing research) Link
- Geomorphological unit hydrograph model for flood flow estimation in ungauged basins, Nikola Zlatanović (ongoing research) Link
- Flow in stilling basins of stepped spillway chutes, Robert Ljubičić (ongoing research) Link
- Methodology for fast data assimilation in open channel flow models, Miloš Milašinović (ongoing research) Link
- Impact of global changes on water resources and water supply in Serbia, Dejan Dimkić (accepted research subject 30.09.2019.)

Research - PhD

- Numerical modeling of hypolimnetic oxygenation of lakes (1)
  - Developed a 3D numerical model of two-phase (water-gas) bubble flow with consideration of dissolution process



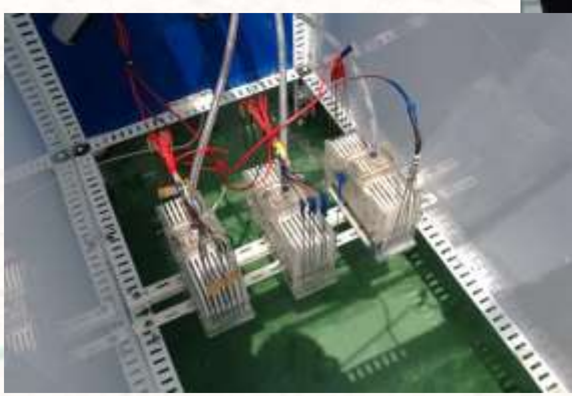
Lab experiments

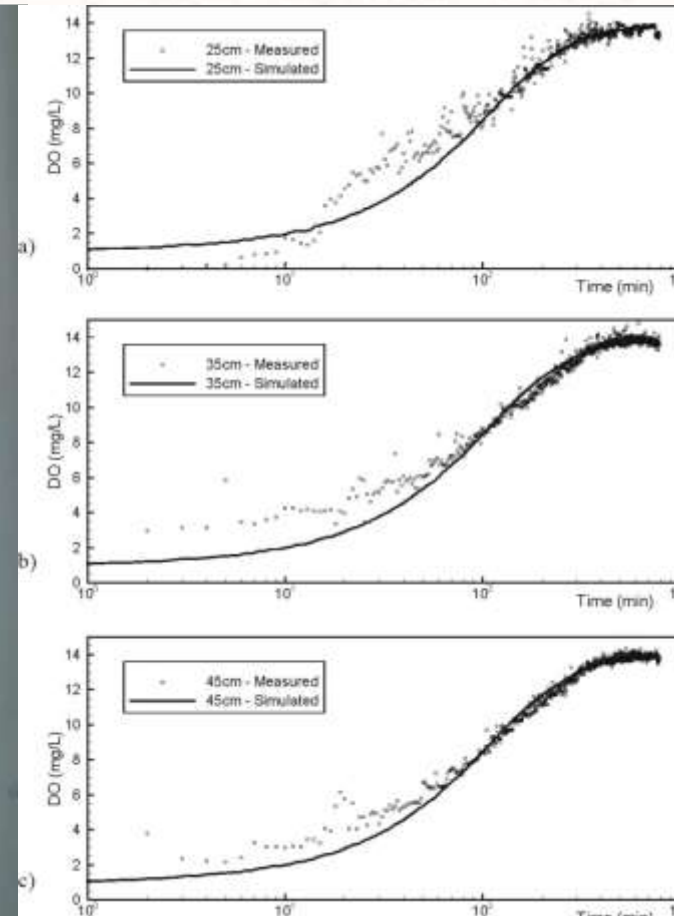


Nenad Jaćimović (supervised by Takashi Hosoda/Marko Ivetić), defended 2007

Research - PhD

- Numerical modeling of hypolimnetic oxygenation of lakes (2)
  - Field experiments and model results



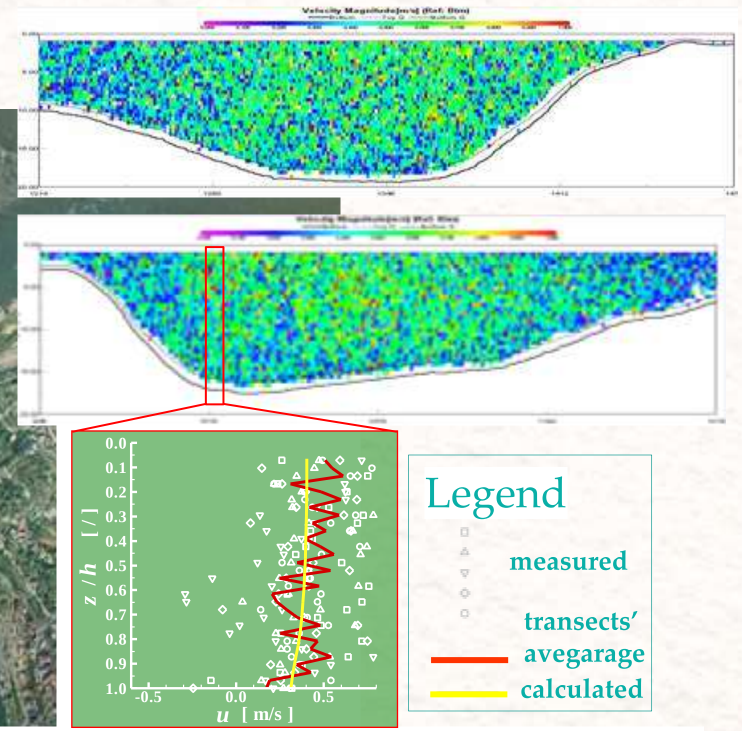


Nenad Jaćimović (supervised by Takashi Hosoda/Marko Ivetić), defended 2007

Research - PhD

- Numerical investigation of river confluence hydrodynamics (1)
  - 3D flow modelling using finite-volume model SSIIM2
  - Two equation turbulence model closure, solved on an unstructured multiblock grid
  - Field measurements using ADCP

Mixing processes at river confluences

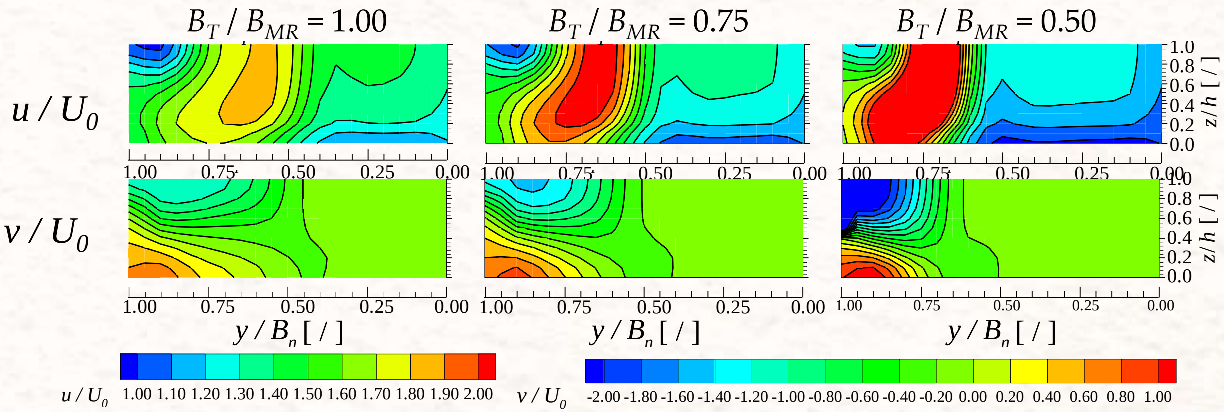


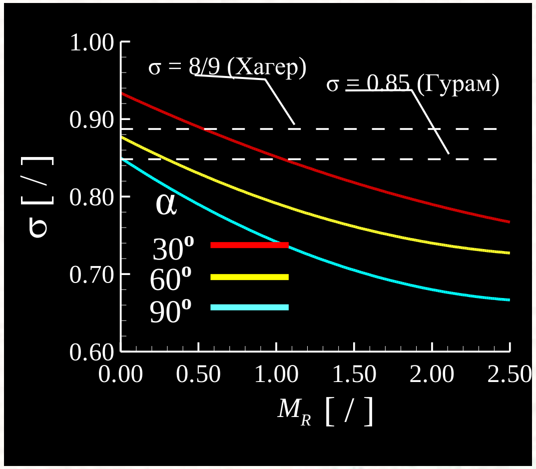
Field measurements at the confluence of Sava and Danube Rivers for 3D model validation

Dejana Đorđević (supervised by Miodrag Jovanović), defended 2011

Research - PhD

- Numerical investigation of river confluence hydrodynamics (2)
  - Investigation of the effect of bed elevation discordance in confluences with different junction angles, channel width ratios, curvatures (bend radius) under different flow scenarios – different momentum flux ratios MR
  - Results demonstrate that:
    - Hager's correction coefficient depends on the junction angle and MR ;
    - channel width ratio has an adverse effect on the bank stability;
    - in wide channels the effect of upstream planform curvature is negligible.

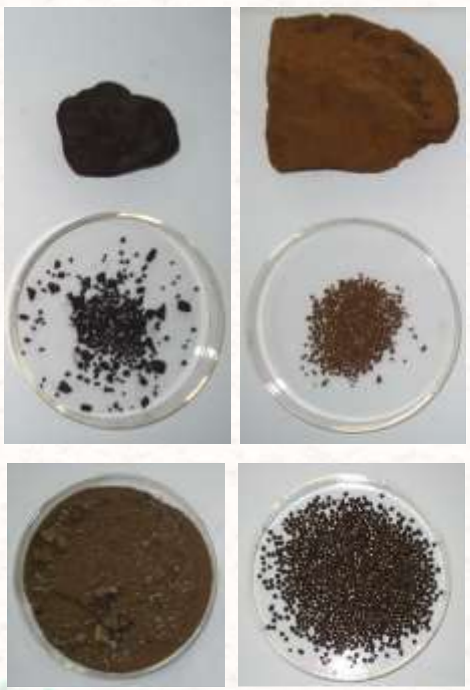




Dejana Đorđević (supervised by Miodrag Jovanović), defended 2011

Research - PhD

- Development of methods and procedures for arsenic removal from drinking water (1)
  - Efficiency of As(III) and As(V) removal from water by adsorption is investigated with natural and waste materials, afordable and esay to use in rural areas .



Natural clays, sand and zeolites

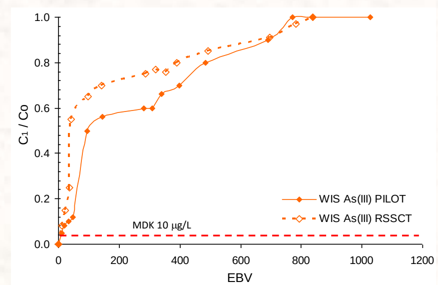
Fe/Mn ORES

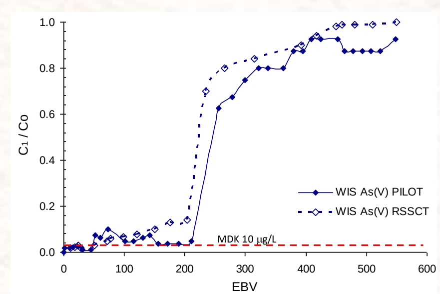
Blast furnance slags

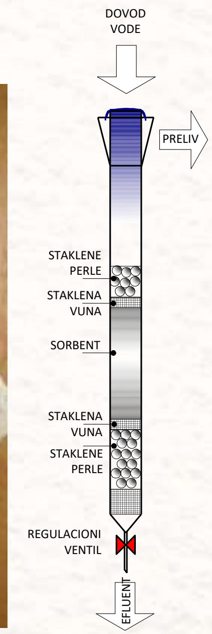
Fe/Mn FILTER SANDS

Activated sand/gac

Commercial





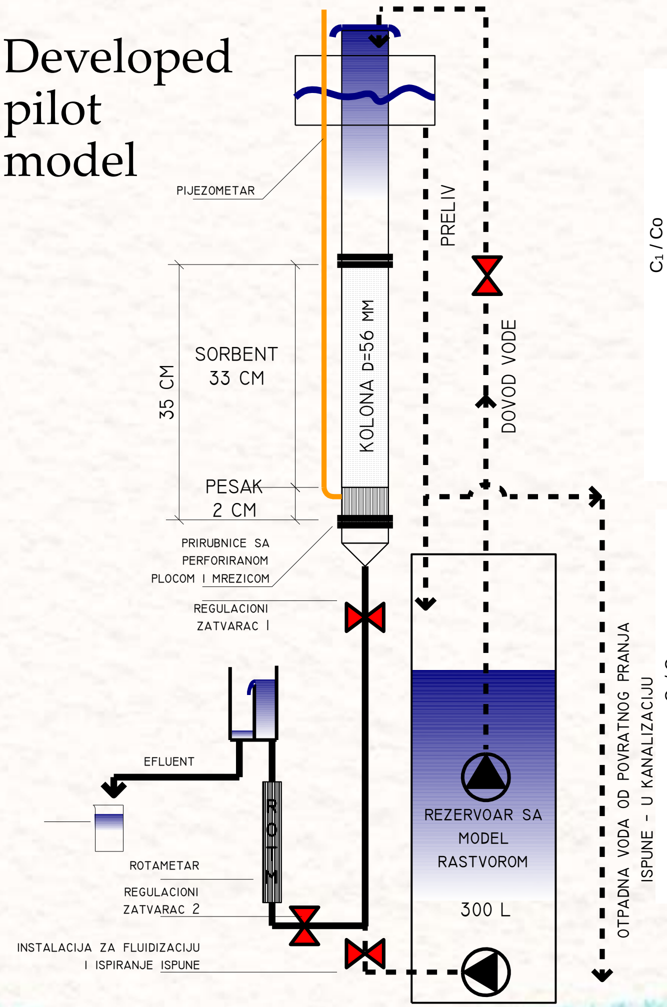


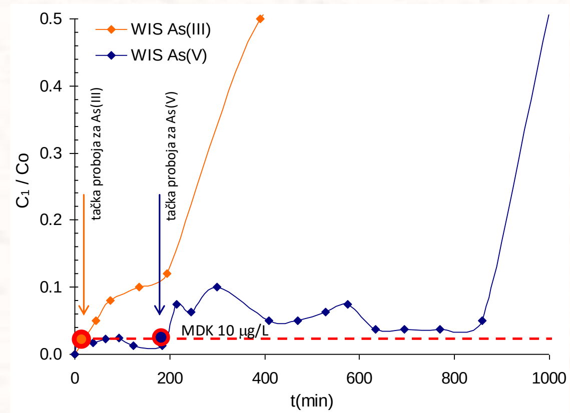
Rapid Small Scale Column Testing

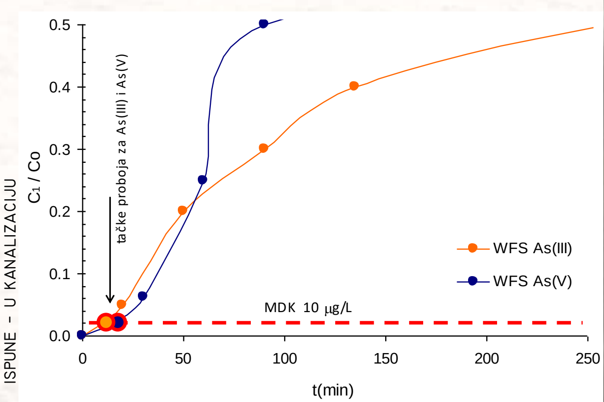
Branislava Lekić (supervised by Dejan Ljubisavljević/Ljubinka Rajaković), defended 2011

Research - PhD

- Development of methods and procedures for arsenic removal from drinking water (2)
  - Developed pilot model



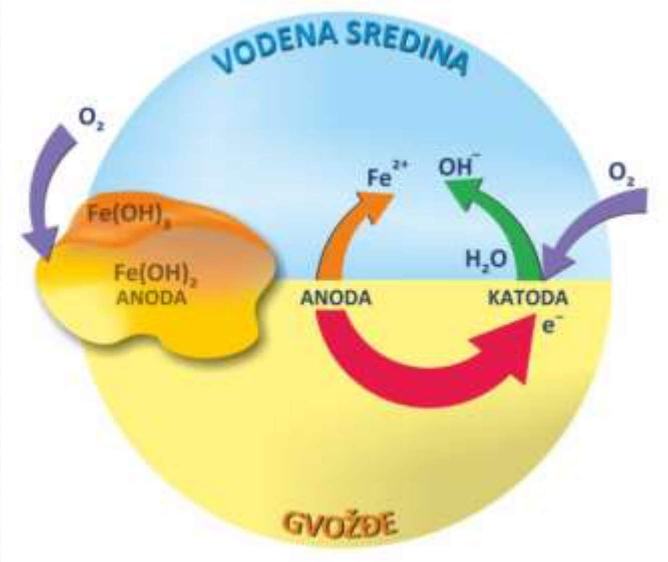


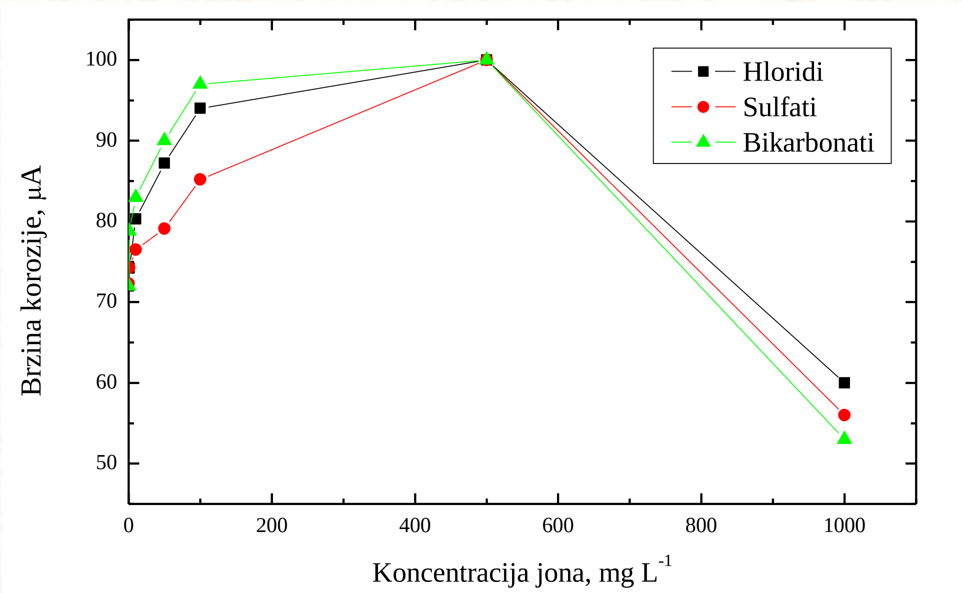


Branislava Lekić (supervised by Dejan Ljubisavljević/Ljubinka Rajaković), defended 2011

Research - PhD

- The effect of water quality on steel corrosion (1)
  - Main outcome: For corroded iron pipes there is no direct mathematical connection between iron release and corrosion of steel pipes.
  - Water quality can affect the iron release and the factors that are key-influencing are: dissolved oxygen, pH value, alcality, buffer capacity, water flow, temperature, water treatment and inhibitor presence.





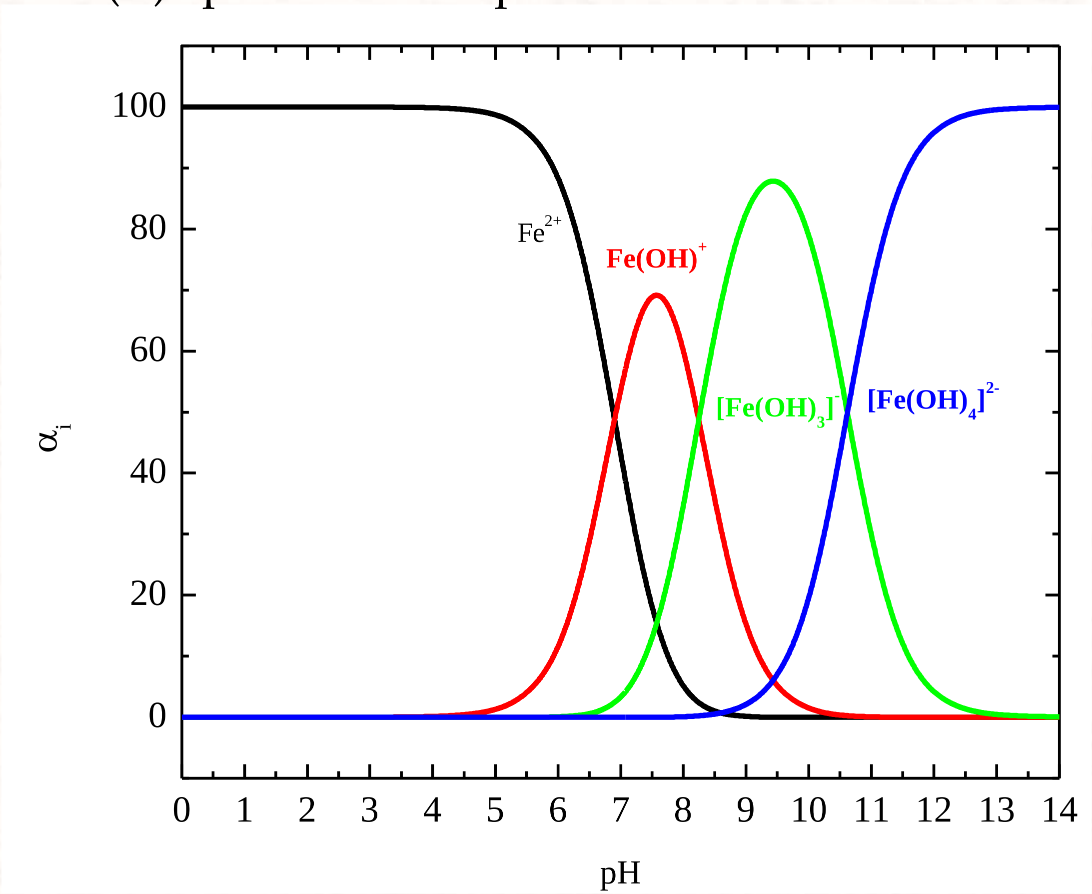
I: $2Fe + O_2 + 2H_2O \rightleftharpoons 2Fe^{2+} + 4OH^-$

II: $4Fe^{2+}(aq) + O_2(g) + 8OH^-(aq) + 2H_2O \rightleftharpoons 4Fe(OH)_3(s)$

Vladana Rajaković-Ognjanović (supervised by Branimir Grgur), defended 2011

Research - PhD

- The effect of water quality on steel corrosion (2)
  - Iron (II) species versus pH value

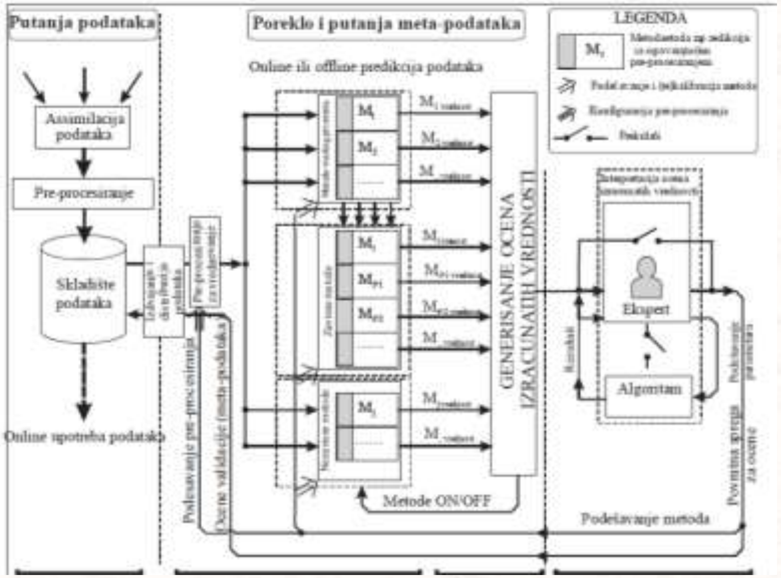


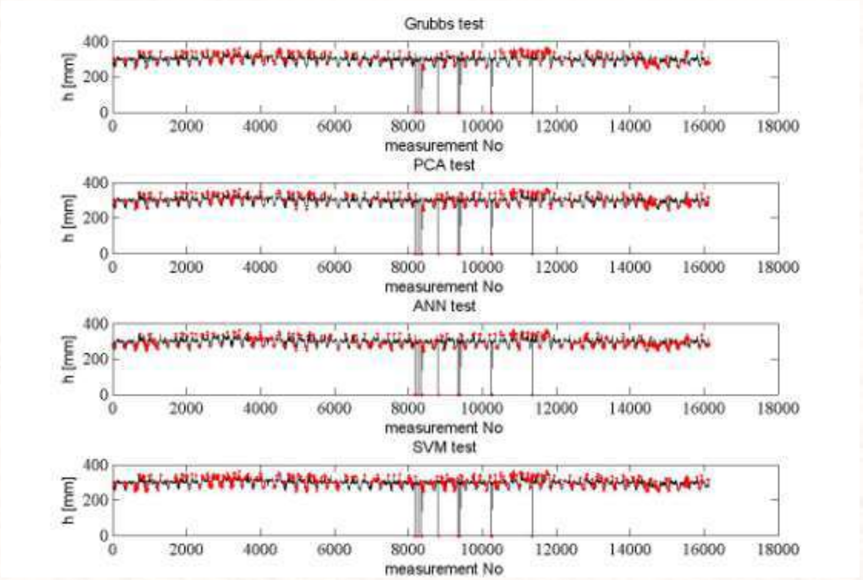
$$Fe^{2+} + 4OH^{-} \leftrightharpoons Fe(OH)^{+} + 3\,OH^{-} \leftrightharpoons [Fe(OH)_3]^{-} + OH^{-} \leftrightharpoons [Fe(OH)_4]^{2-}$$

Vladana Rajaković-Ognjanović (supervised by Branimir Grgur), defended 2011

Research - PhD

- Methodology for data validation of hydraulic and hydrologic measurements
  - Developed general automatic algorithm for data validation and data quality assessment suitable for all kind of environmental



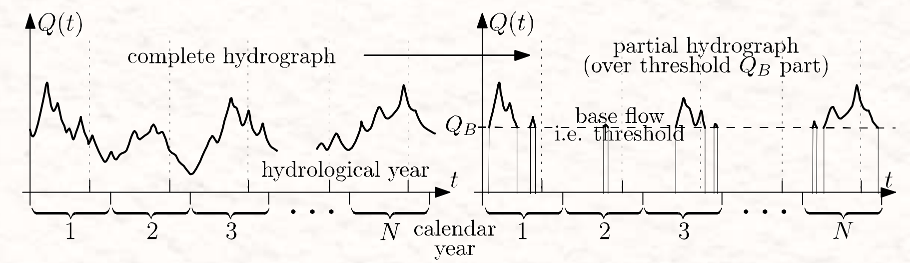


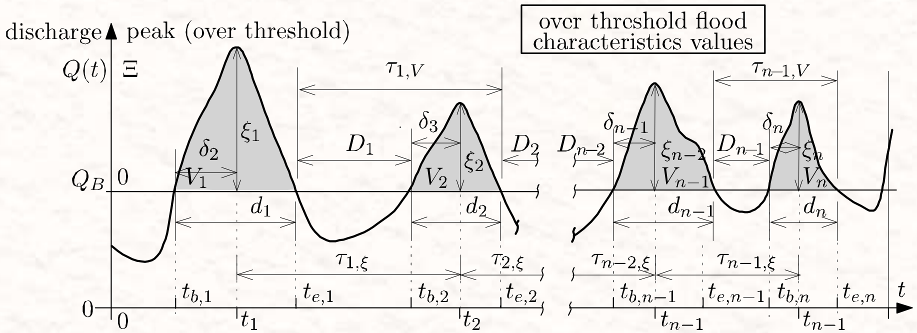
- Branisavljević N. et al. (2010): Automatic, semi-automatic and manual validation of urban drainage data, *WS&T*, Vol 62, No 5, doi:10.2166/wst.2010.350
- Branisavljević N. et al. (2011): Improved real-time data anomaly detection using context classification, *Journal of Hydroinformatics*, Vol 13, No 3, doi:10.2166/hydro.2011.042

Nemanja Branisavljević (supervised by Dušan Prodanović/Zoran Kapelan), defended 01.09.2012.

Research - PhD

- Modelling of Stochastic Structure of Flood Characteristics Derived From Peaks Over Threshold Series (1)



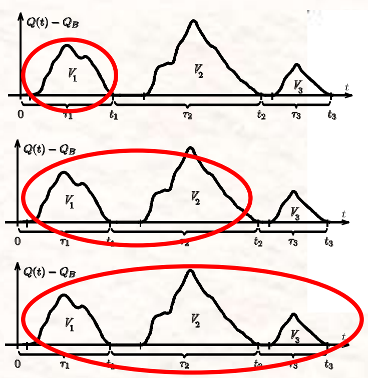


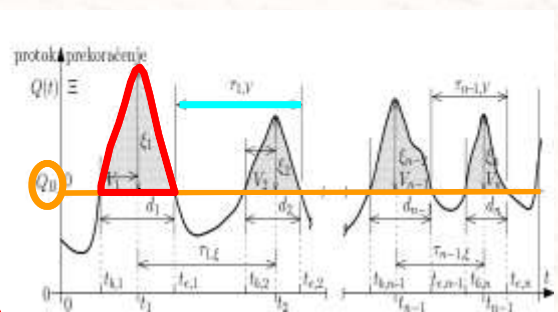
- ξ_i , peak over threshold (o.t.), $Q(\tau_i) - Q_B$,
- d_i , o.t. flood wave duration,
- V_i , o.t. flood wave volume, i.e. volume peak,
- t_i , peak instant,
- D_i , time between two exceedances
- $t_{b,i}$, beginning of o.t. flood wave,
- $t_{e,i}$, end of o.t. flood wave,
- δ_i , time from beginning of o.t. flood wave to peak,
- $\tau_{i,\xi}$, cycle duration between two peaks,
- $\tau_{i,V}$, cycle duration between two volume peaks.

A Stochastic Model for Series of Single and Aggregated Over Threshold Flood Characteristics Values

- **flood volumes,**
- **flood peaks,**
- **inter-arrival times**
- **exceedence durations.**

Based on Markov's chains, process intensity function, the independence of time and over threshold interrupts, continuous distributions of over threshold values and discrete distributions of occurrences in time and value parent domain.

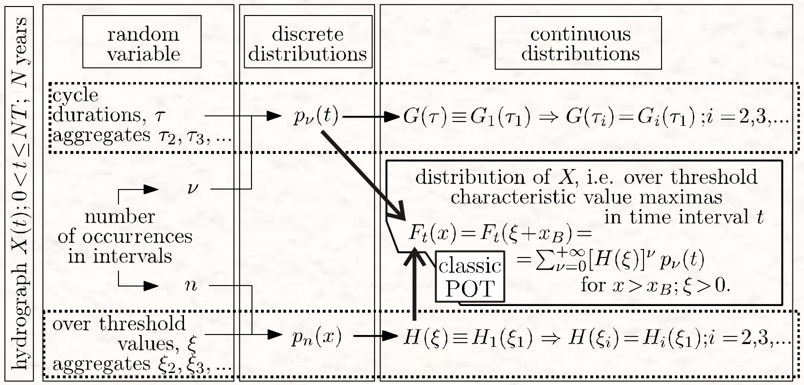




Dragutin Pavlović (supervised by Jasna Plavšić/Jovan Despotović), defended 27.12.2013.

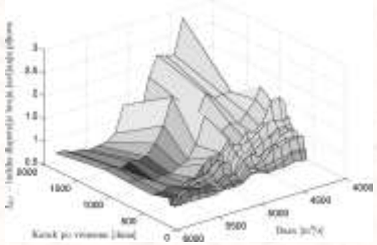
Research - PhD

- Modelling of Stochastic Structure of Flood Characteristics Derived From Peaks Over Threshold Series (2)



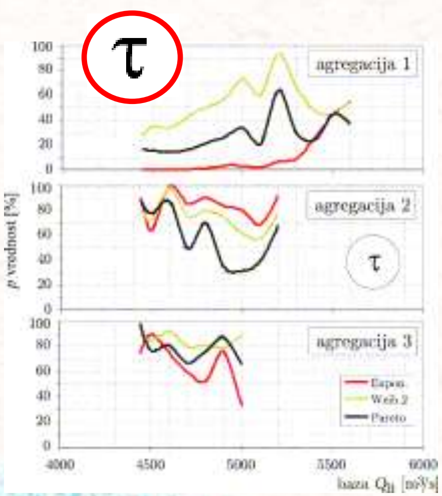
The $H_n(x)$, distribution functions of n consecutive over threshold flood volumes as a function of the form of the process volume intensity function $\kappa(x,n)$.

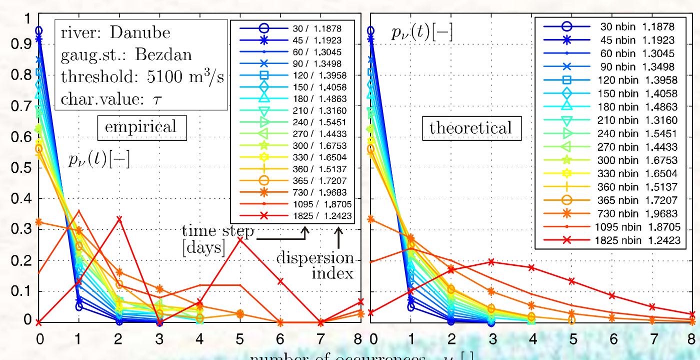
type	$\kappa(x,n)$	$H_n(x)$
1	$\kappa_1 = const$	$1 - e^{-\kappa_1 t} \sum_{i=0}^{n-1} \frac{(\kappa_1 t)^i}{i!}$
2	$\kappa(x)$	$1 - e^{-\mathcal{K}(x)} \sum_{i=0}^{\nu-1} \frac{\mathcal{K}(x)^i}{i!}$
3	$\kappa(x)(1+\frac{n}{a})$	$H_{n-1} - \frac{e^{-\mathcal{K}}}{(n-1)!} \{\prod_{i=1}^{n-1}(a+i-1)\}(1-e^{-\mathcal{K}/a})^{n-1}$, $n = 2,3,\ldots$
4	$\kappa(x)(1-\frac{n}{b})$	$H_{n-1} - \frac{e^{-\mathcal{K}}}{(n-1)!} \{\prod_{i=1}^{n-1}(b-i+1)\}(e^{\mathcal{K}/b}-1)^{n-1}$, $n = 2,3,\ldots$

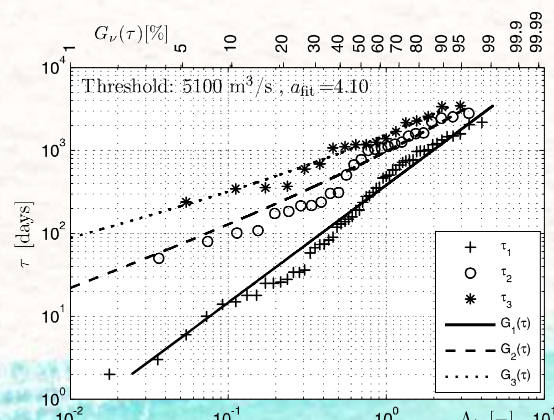


$$G_\nu = G_{\nu-1} - \frac{e^{-\Lambda_1}}{(\nu-1)!}\left\{\prod_{i=1}^{\nu-1}(a+i-1)\right\}(1-e^{-\Lambda_1/a})^{\nu-1}$$

for $\nu = 2, 3, 4, \ldots$







Dragutin Pavlović (supervised by Jasna Plavšić/Jovan Despotović), defended 27.12.2013.

Research - PhD

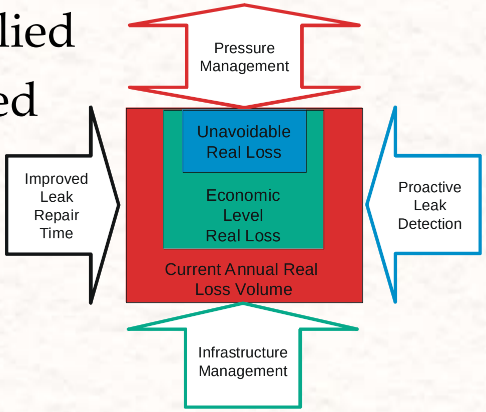
- Advances in methodology for evaluation and improvement of the water distribution system performance (1)

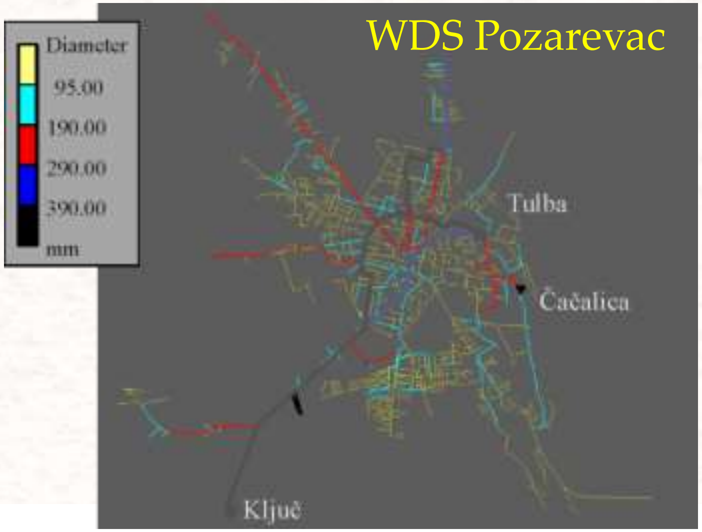
	Problem	Solution
1	• Uncertainty of input data • Propagation of uncertainty of input data to calculate the value of WB (water balance) components and PI (performance indicators)	• Specific activities to reduce the uncertainty of input data and components WB and the PI. • Developed method for monitoring the propagation of input data uncertainty on the uncertainty of the PI.
2	• Large uncertainty of apparent losses	• Developed a novel method for determination of the total apparent losses.
3	• Poor value of PI • Insufficiently investigated the impact of the pressure reduction on the reduction of water consumption	• The methodology for improving the PI Developed a new method for determination of the reduction of total water demand due to reduced operating pressure in WDS.

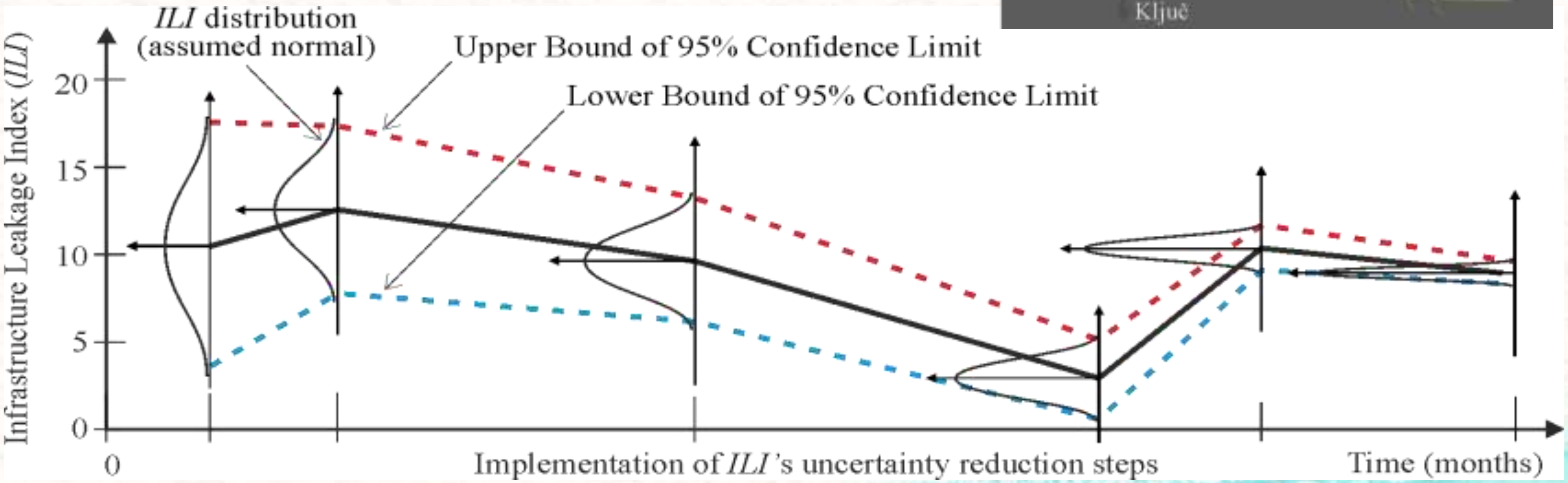
Branislav Babić (supervised by Dušan Prodanović), defended 13.10.2014.

Research - PhD

- Advances in methodology for evaluation and improvement of the water distribution system performance (2)
  - IWA methodolgy applied
  - *ILI* uncertainty reduced



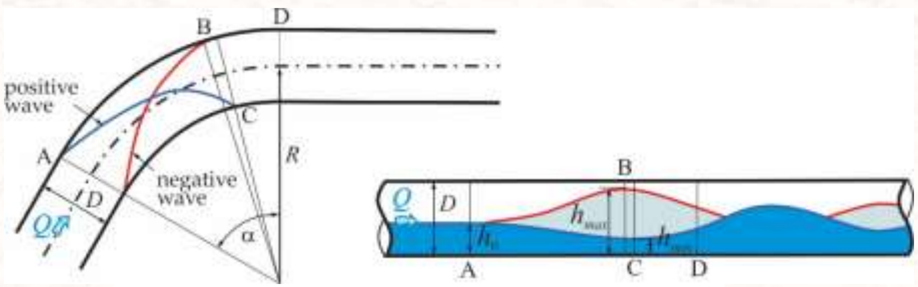




Branislav Babić (supervised by Dušan Prodanović), defended 13.10.2014.

Research - PhD

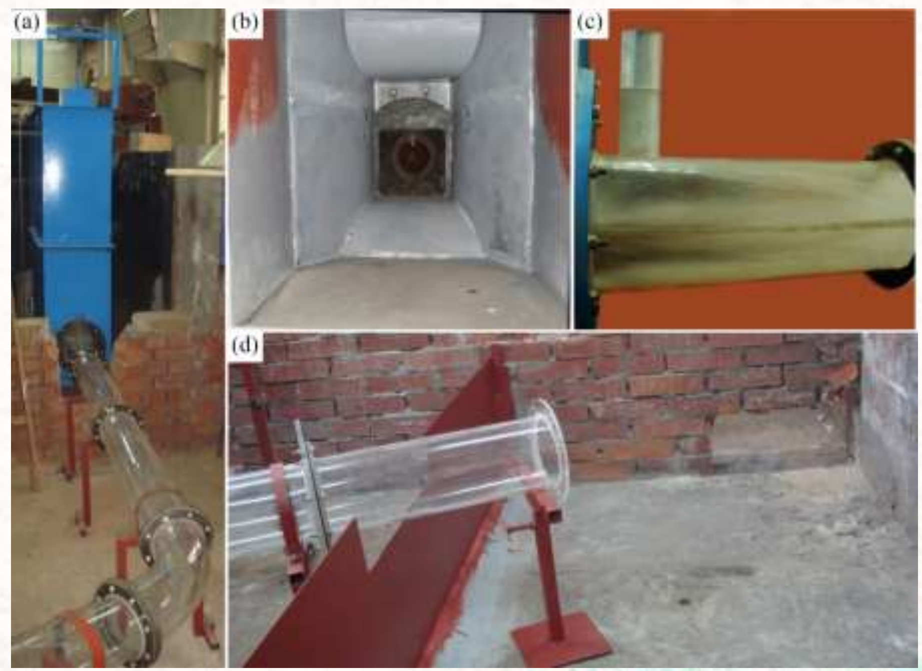
- Supercritical flow in circular conduit bends (1)
  - Scale model at IHE and numerical experiment
  - Effects of the curvature, deflection angle and approach flow conditions on inception of helical and choking flow



Propagation of positive and negative wave

Flow for different bend curvatures

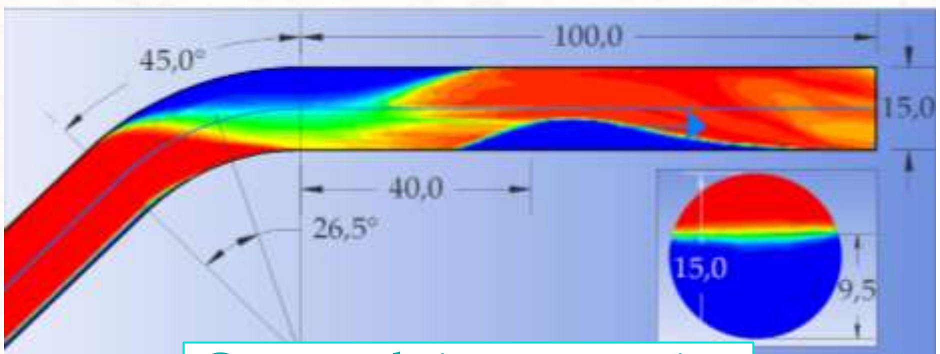
Laboratory installation



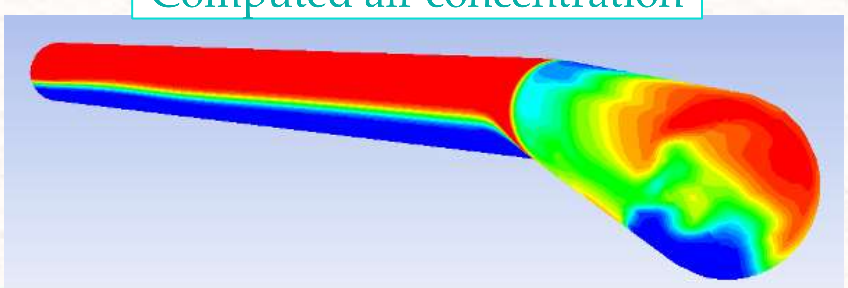
Milena Lučić (Kolarević) (supervised by Ljubodrag Savić), defended 15.10.2015.

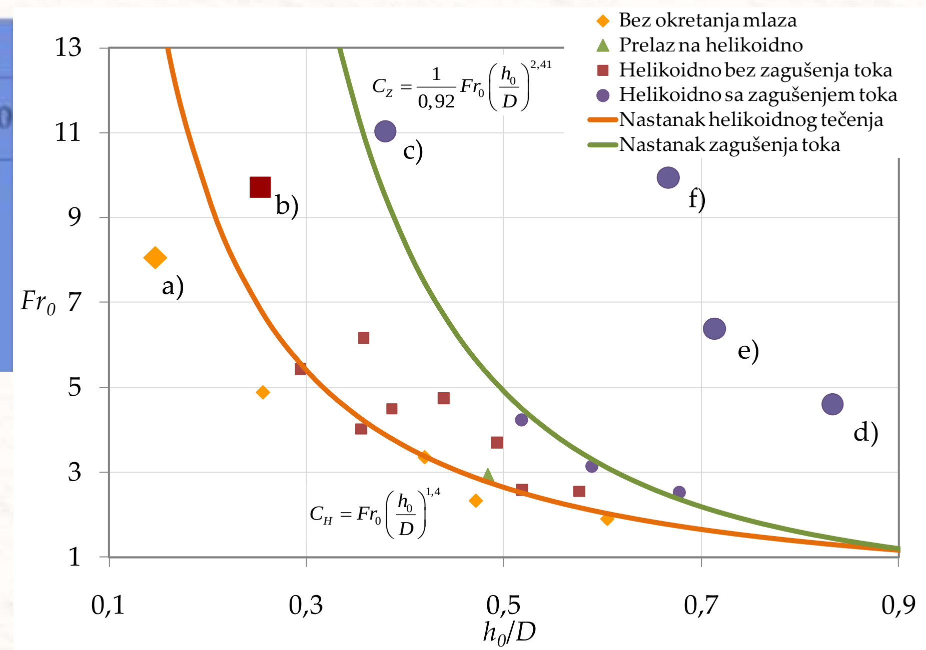
Research - PhD

- Supercritical flow in circular conduit bends (2)
  - Empirical relationships for prediction of helical and choking flow
  - Numerical CFD model using ANSIS FLUENT 3D model for two-phase flow
  - Calibration with scale model data
  - Influence of larger pipe-diameters, Froude numbers, etc.



Computed air concentration





Experimental data and empirical relationships

Milena Lučić (Kolarević) (supervised by Ljubodrag Savić), defended 15.10.2015.

Research - PhD

- Hydrologic projections under climate change based on time series models (1)

- Two-stage time series model based on transfer functions for long-term hydrologic projections
  - Transfer functions are stochastic models that use stochastic structure of independent variables to construct stochastic structure of a dependent variable
  - A double-input TF model was used where flows depend on precipitation and temperature

$$\hat{y}_t = \frac{\hat{\omega}_1(B)}{\hat{\delta}_1(B)} x_{1t} + \frac{\hat{\omega}_2(B)}{\hat{\delta}_2(B)} x_{2t} + \frac{\hat{\theta}(B)}{\hat{\phi}(B)} a_t,$$

Stojković M. et al. (2015) Stochastic structure of annual discharges of large European rivers, *J. Hydrol. and Hydromech.*, DOI: 10.1515/johh-2015-0009

Milan Stojković (supervised by Jasna Plavšić), defended 11.12.2015.

Research - PhD

- Hydrologic projections under climate change based on time series models (2)

Stage 1: Projections of annual flows

Annual precipitation and temperature → Standardized and differenced series → TF model → Annual flows

Stage 2a: Identify trend and long term periodicity from annual projections

Stage 2b: Introduce seasonal components

Trend (linear moving window) + Long-term periodicity + Seasonal periodicity + Stochastic component (TF model) + Random component = Monthly flows

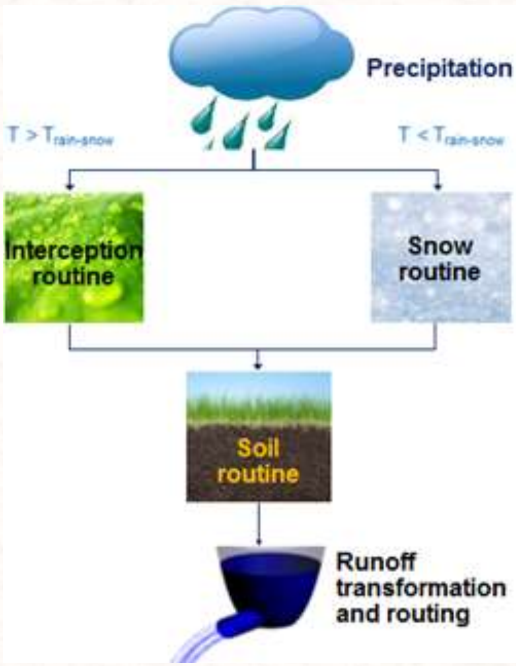
Annual scale

Monthly scale

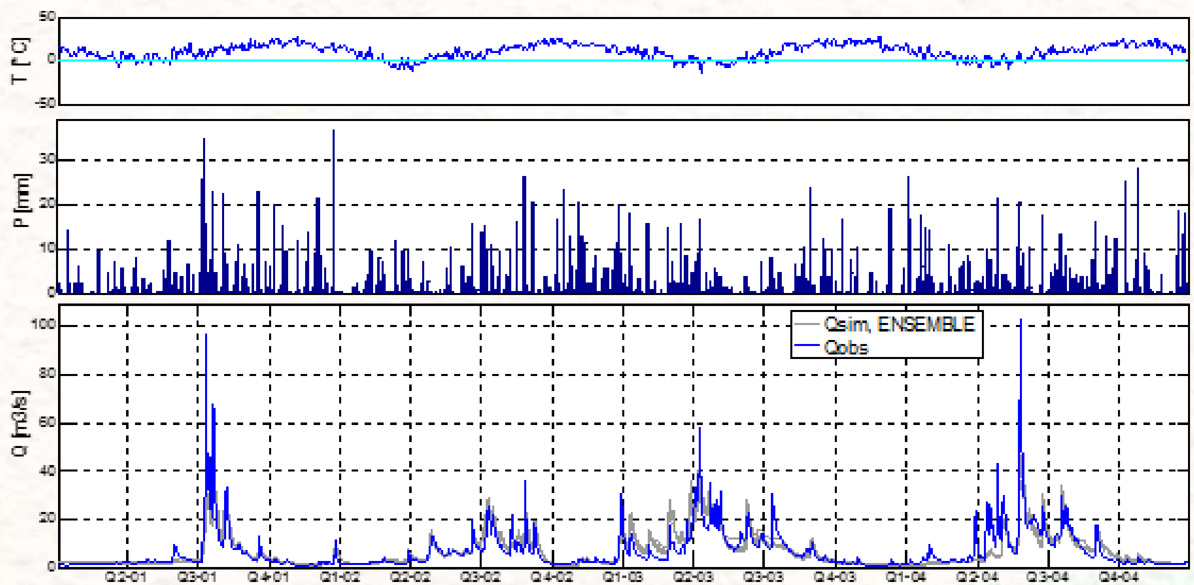
Milan Stojković (supervised by Jasna Plavšić), defended 11.12.2015.

Research - PhD

- Impact of calibration period on parameter estimates in the conceptual hydrologic models of various structures (1)
  - 3DNet-Catch – a hydrologic model developed at the Institute of Hydraulic and Environmental Engineering
    - Fully-distributed model aimed at continuous hydrologic simulations



3DNet-Catch – model routines



Flow simulations with the 3DNet-Catch model

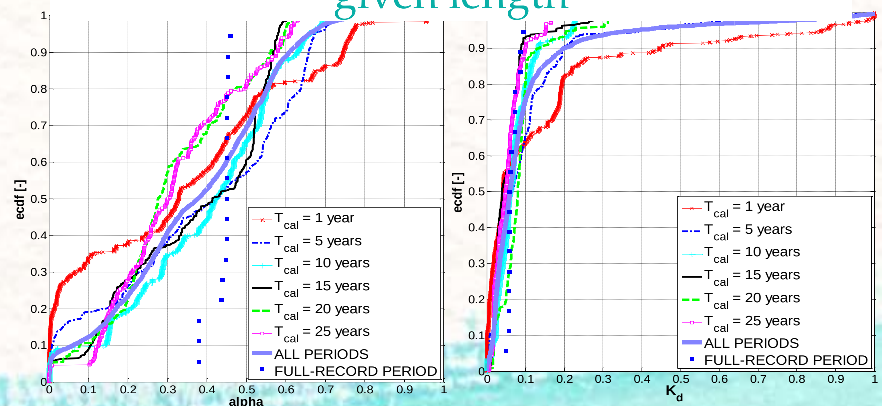
Andrijana Todorović (supervised by Jasna Plavšić), defended 12.12.2015.

Research - PhD

- Impact of calibration period on parameter estimates in the conceptual hydrologic models of various structures (2)
  - Dynamic model calibration
    - Calibration over various periods (subsets of the full record period)
    - Multi-objective model calibration using AMALGAM algorithm
    - Analysis of consistency in the Pareto-optimal parameters
  - Result: parameters are sensitive on the calibration period
    - Overparameterised models are more sensitive
    - Distributed models yield more consistent parameter estimates

Pareto front

Parameter posterior distributions obtained over all calibration periods of given length

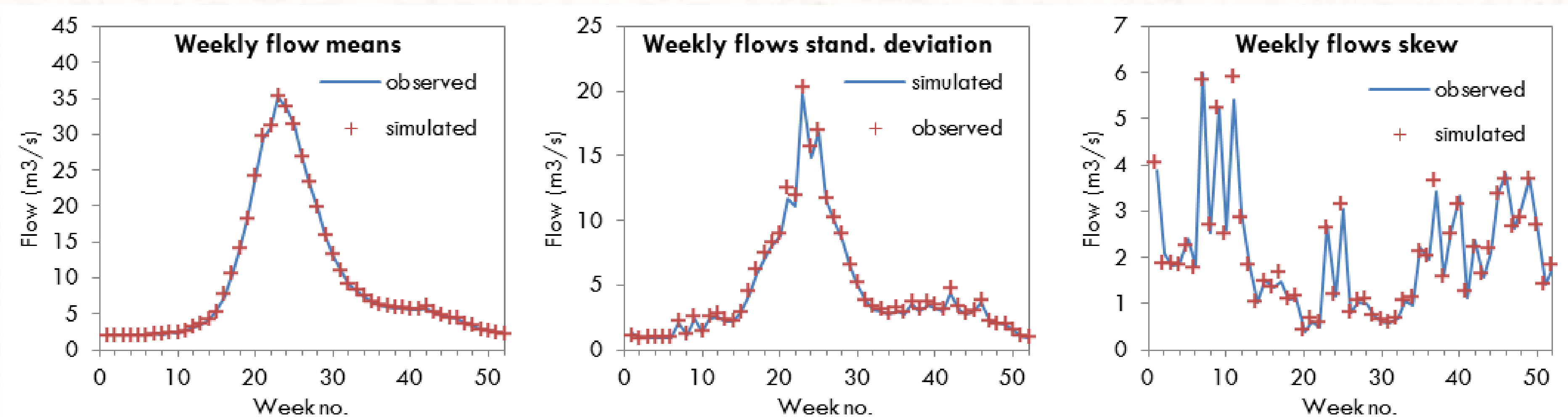


Andrijana Todorović (supervised by Jasna Plavšić), defended 12.12.2015.

Research - PhD

- Non-parametric stochastic generation of hydrologic series (1)

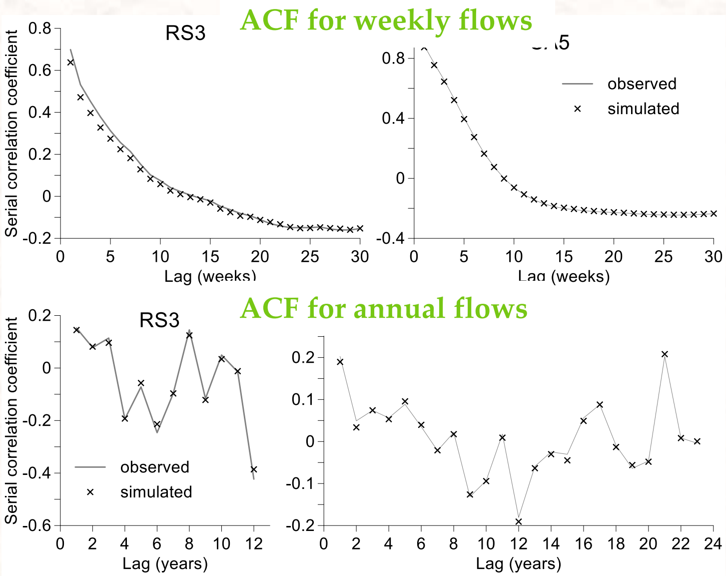
- A three-step non-parametric method for generating stationary multi-site hydrologic series capable of reproducing complete stochastic structure of the series at any time step
  - Step 1: Monte Carlo simulations of long (e.g. 1000 years) series of independent data (daily, weekly, monthly flows) with statistical properties matching the observed series using non-parametric distributions
    - The method is applied on the log-transformed data



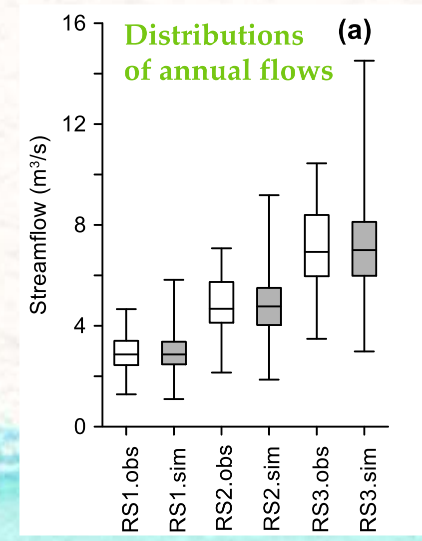
Đurica Marković (supervised by Jasna Plavšić), defended 18.05.2016.

Research - PhD

- Non-parametric stochastic generation of hydrologic series (2)
  - Step 2: Achieving target serial and cross correlations by rearranging the order of simulated data within each simulated year with the non-parametric Iman-Conover algorithm
  - Step 3: Adjusting correlation of data from one year to another and of annual flows



- The results show that the simulated data correspond to the observed data in all their stochastic properties and that they can be consequently used in the studies related to planning and design of reservoirs and other water management systems

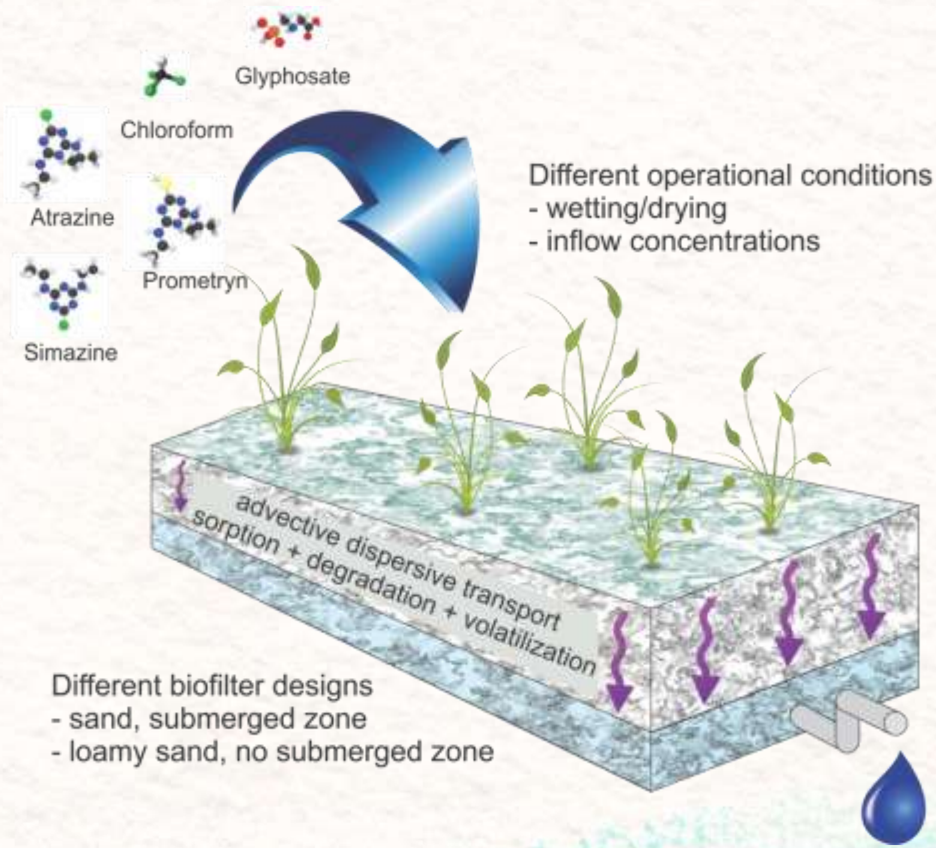


Marković Đ. et al. (2015) Non-parametric stochastic generation of streamflow series at multiple locations, *Water Resources Management*, DOI 10.1007/s11269-015-1090-z

Đurica Marković (supervised by Jasna Plavšić), defended 18.05.2016.

Research - PhD

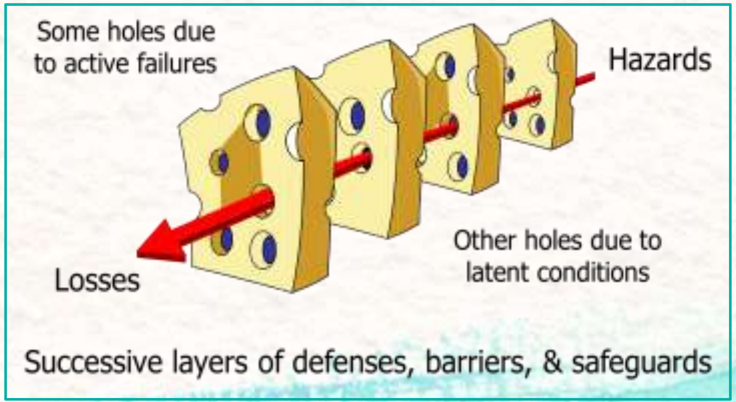
- Model for MicroPollutants In RaingardEns (MPiRe)
  - Water flow
    - 3 separate reservoirs: pond, filter, saturated zone
    - Inter reservoir flows physically determined
  - Pollutant transport
    - Advective-dispersive transport through porous media
    - Chemical non-equilibrium two-site sorption model
    - First-order bio-chemical degradation
    - Volatilization - pond surface
  - Tested in field conditions



Anja Randjelović (supervised by Nenad Jacimović/Ana Deletić), defended 16.07.2016.

Research - PhD

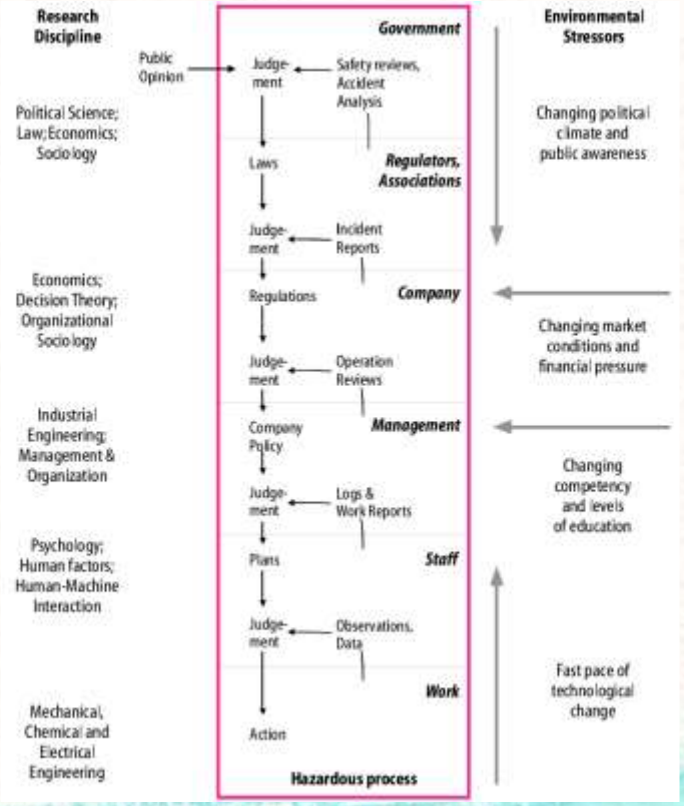
- Risk analysis methodology in water infrastructure asset management (1)
  - Requirements to explore possible ways to:
  - improving functioning of water supply systems in a systemic way
  - creating an environment for sustainable application of scientific and professional work techniques in practice
  - The focus and the essence of the thesis is an attempt to research perceptions and understanding the problem that is being addressed
  - The first step in solving any problem is to understand the problem
  - Fundamental question : 'Who is to blame for pipe failure?'
  - Actual concept: WHO Water Safety Plans - multibarrier approach
  - Traditional definition of risk:
  - RISK = PROBABILITY x CONSEQUENCE
  - Issues: Risk definition



Aleksandar Šotić (supervised by Marko Ivetić), defended 23.09.2016.

Research - PhD

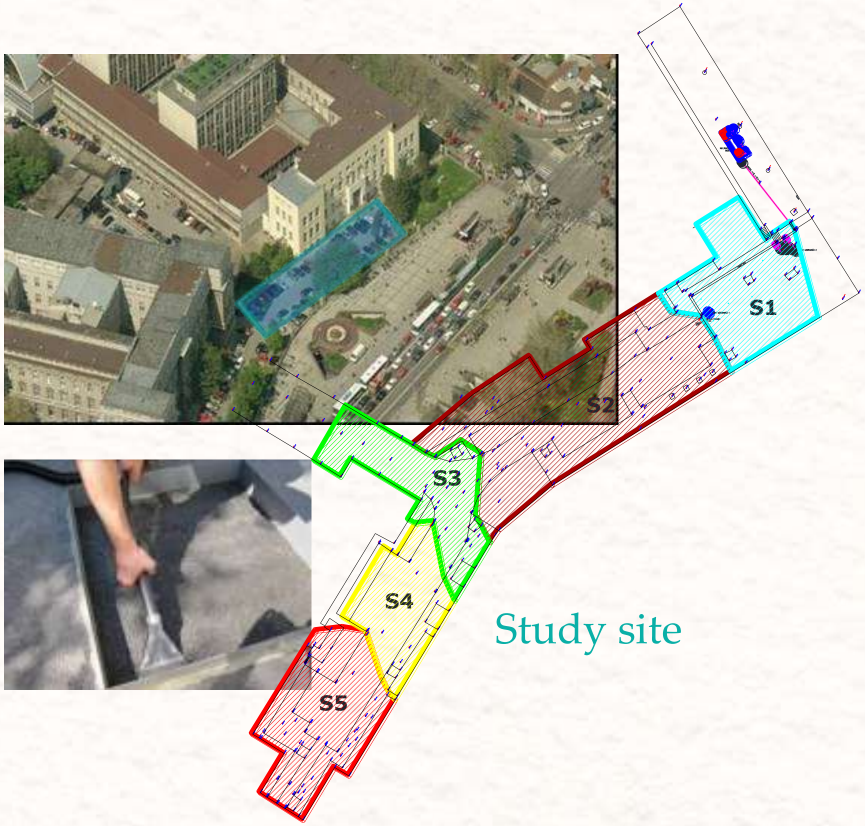
- Risk analysis methodology in water infrastructure asset management (2)
  - Paradigm shift
  - Water systems as complex, hierarchical, adaptive, resilient
  - From RISK (negative, unwanted events)
  - To SAFETY (positive, how it should be)
  - SOCIO-TECHNICAL context
  - Applying System & Control Theory
  - Basic concept is not event but constraint
  - SAFETY as emergment system property
  - Case Study: Vrutci reservoir, Bele Vode WTP

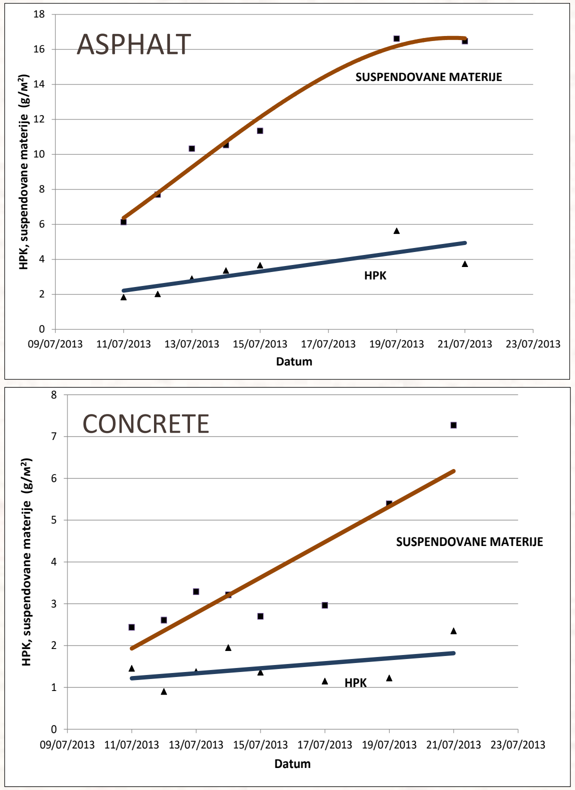


Aleksandar Šotić (supervised by Marko Ivetić), defended 23.09.2016.

Research - PhD

- Modelling of Urban Runoff Pollution Emission (1)
  - Contaminant Buildup, Distribution and Dynamics on Urban Surfaces





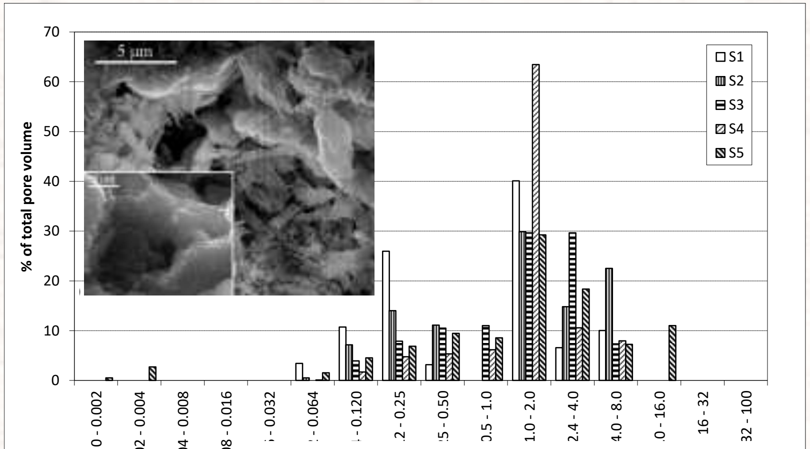
Contaminant buildup. SS, COD

- Djukić A. et al. (2016): Further insight into the mechanism of heavy metals partitioning in stormwater runoff, *Journal of Env. Man*, Vol. 168, doi: 10.1016/j.jenvman.2015.11.035 and doi: 10.1016/j.jenvman.2015.11.035 (supplementary data)

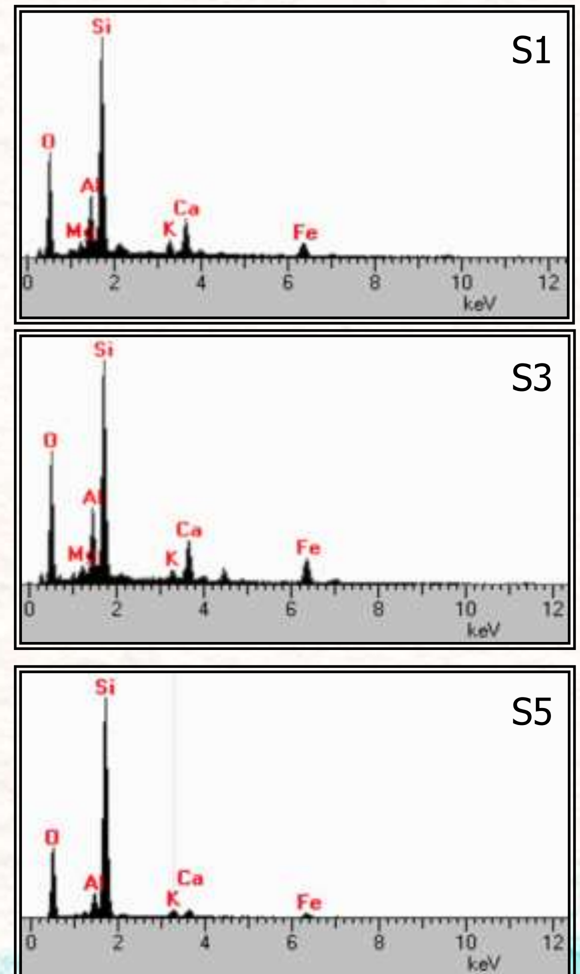
Aleksandar Djukić (supervised by Branislava Lekić/Zorana Naunović), defended 24.09.2016.

Research - PhD

- Modelling of Urban Runoff Pollution Emission (2)
  - Mechanisms of Heavy Metals Partitioning in Stormwater Runoff

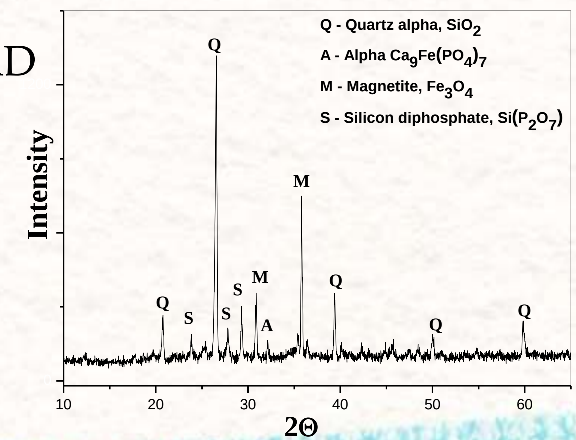


Pore analyses and SEM



EDS spectrum

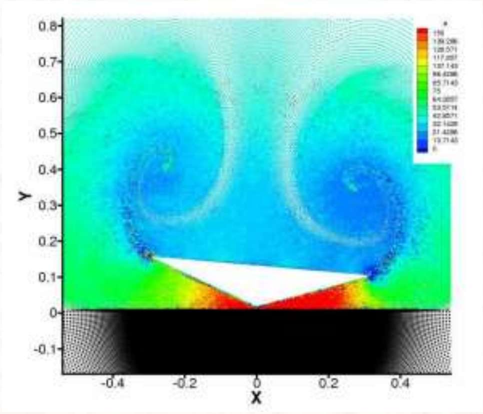
S3 – XRD

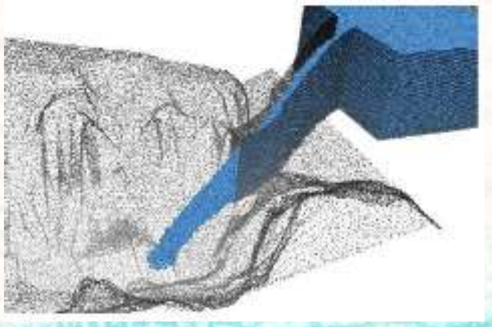


Aleksandar Djukić (supervised by Branislava Lekić/Zorana Naunović), defended 24.09.2016.

Research - PhD

- SPH - Smoothed Particle Hydrodynamics (1)
  - Mesh-free method
  - Lagrangian formalism
  - Interpolation theory
  - Initially developed for astrophysical problems
  - Free surface flows
  - Multiphase flows
  - Many questions remain unanswered on a theoretical ground (Convergence, Boundary conditions, Adaptivity…)
  - Key issues in this thesis: Numerical stability, Open boundary conditions, Wall boundary condition

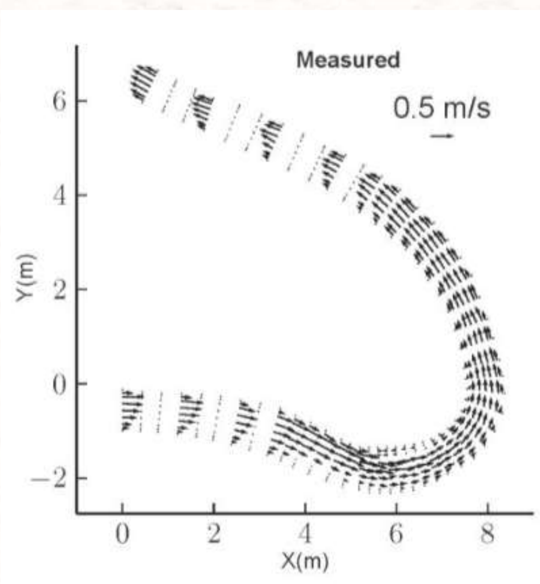


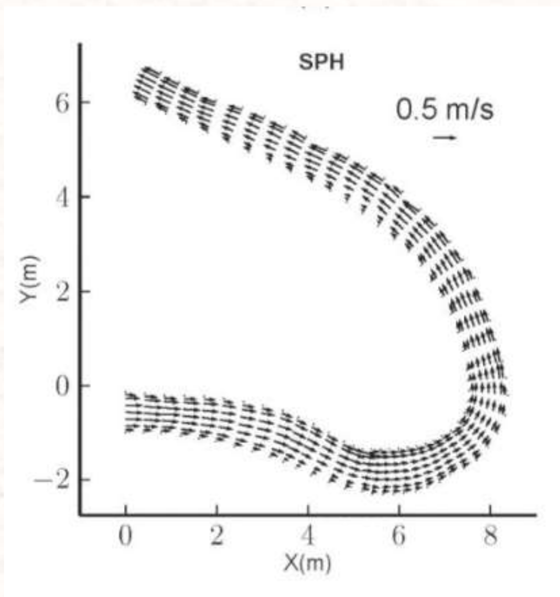


Nikola Rosić (supervised by Ljubodrag Savić), defended 26.09.2016.

Research - PhD

- SPH - Smoothed Particle Hydrodynamics (2)
  - Case study - Supercritical flow in pipe bends
  - Case study - 2D flow modeling in natural watercourses





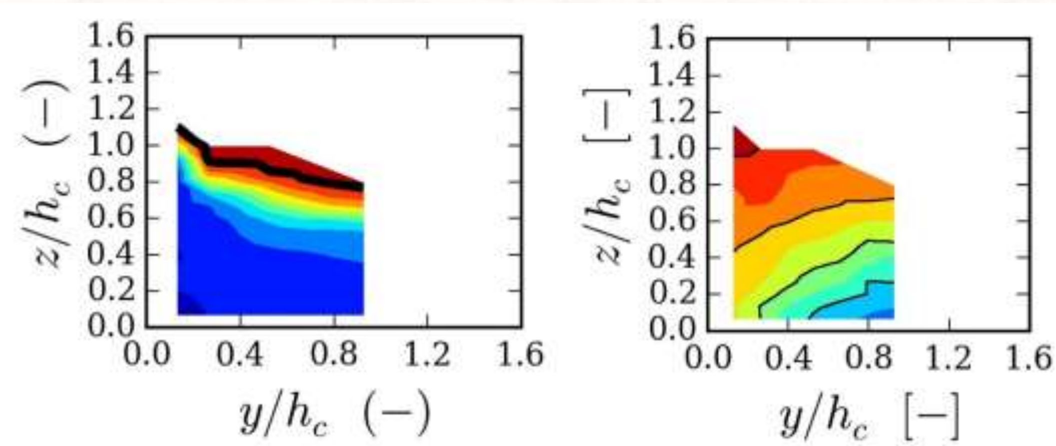
Nikola Rosić (supervised by Ljubodrag Savić), defended 26.09.2016.

Research - PhD

- Flow in the Gradually Converging Stepped Spillway (1)
  - Scale-modelling of air-water mixture flow at the IHE

Flow field in the side-wall region

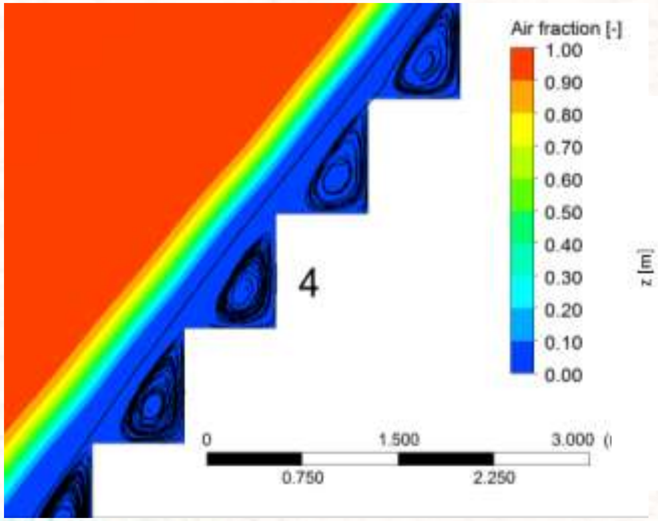
Air-fraction profile   Velocity profile



Budo Zindović (supervised by Radomir Kapor), defended 28.02.2018.

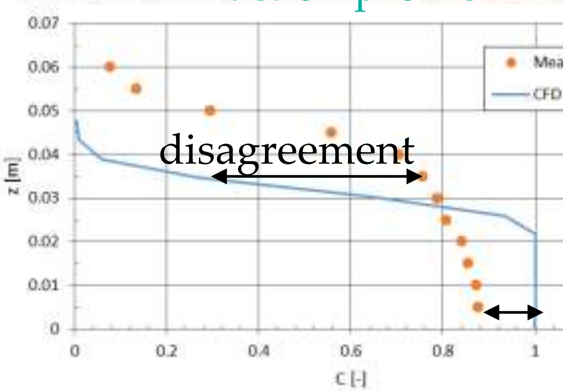
Research - PhD

- Flow in the Gradually Converging Stepped Spillway (2)
  - Numerical modelling of multiphase flow
  - Using finite-volume flow solvers: Ansys Fluent and OpenFOAM
  - Results show that:
    - side-wall convergence slightly reduces spillway energy-dissipation efficiency
    - disagreement between measured and simulated flow fields, need further improvement of existing numerical models

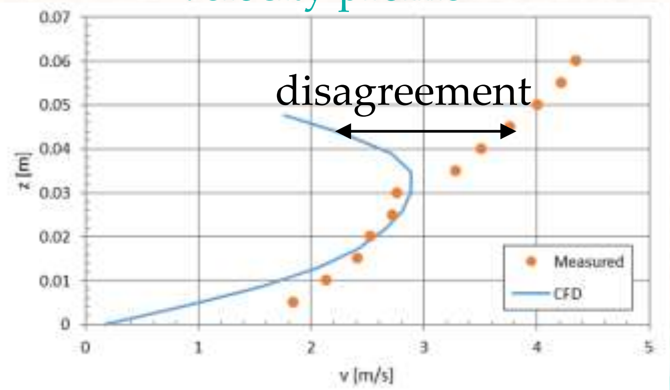


Comparison of measured and simulated flow fields

Air-fraction profile



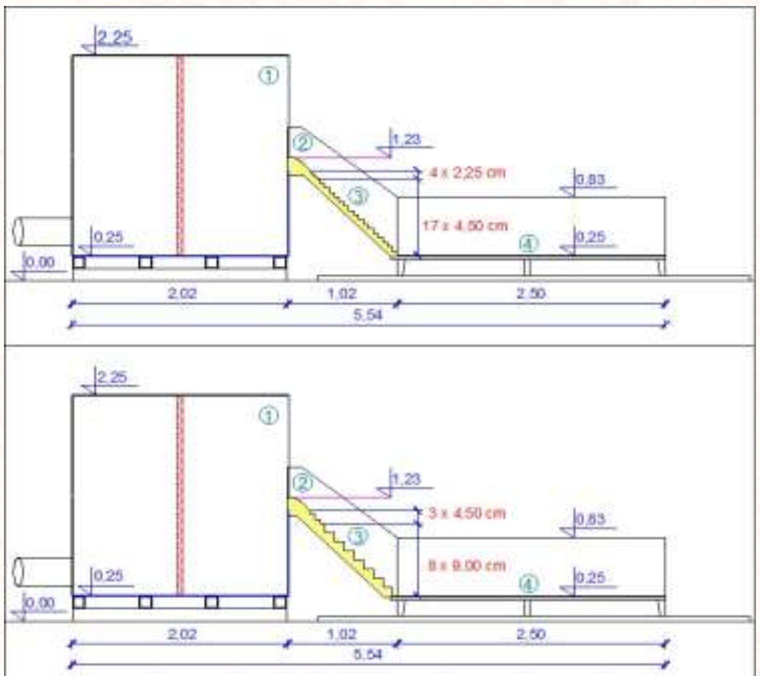
Velocity profile



Budo Zindović (supervised by Radomir Kapor), defended 28.02.2018.

Research - PhD

- Hydrodynamic loads on stepped spillway and stilling basin (1)
  - The influence of spillway geometry (i.e. the rate of narrowing and step height)
  - The influence of flow parameters (flow rate and tailwater)

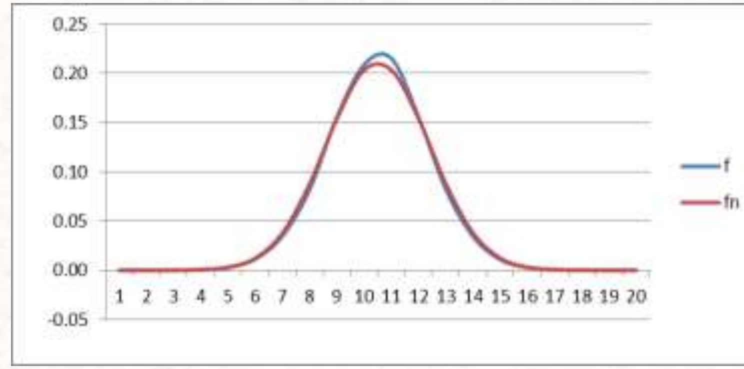


Scale model

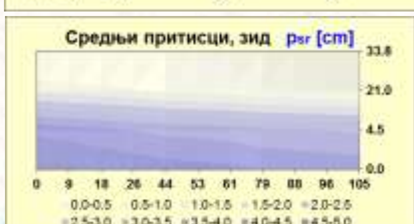
Bojan Milovanović (supervised by Ljubodrag Savić), defended 2018.

Research - PhD

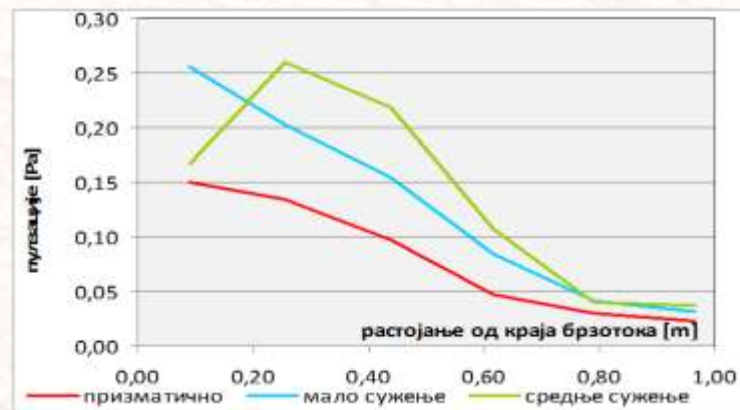
- Hydrodynamic loads on stepped spillway and stilling basin (2)
  - Measured distribution of hydrodynamic loads include
    - Mean Pressures
    - Mean Pressure Fluctuations
  - Measurements were performed at:
    - bottom of the stilling basin
    - side-walls along the stilling basin



Distribution of hydrodinamic preassures measured at a one points



Distribution of hydrodynamic loads on the scale model



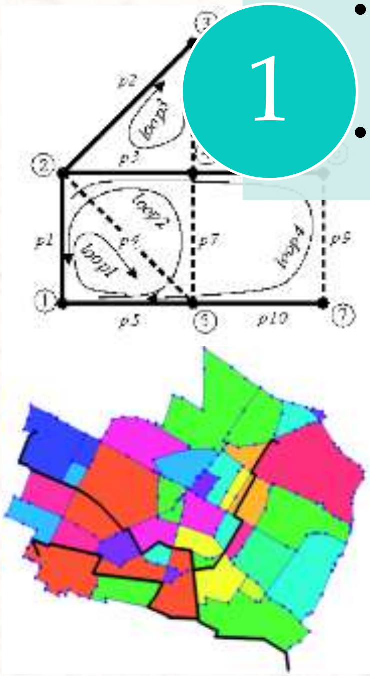
Analysis of results

Bojan Milovanović (supervised by Ljubodrag Savić), defended 2018.

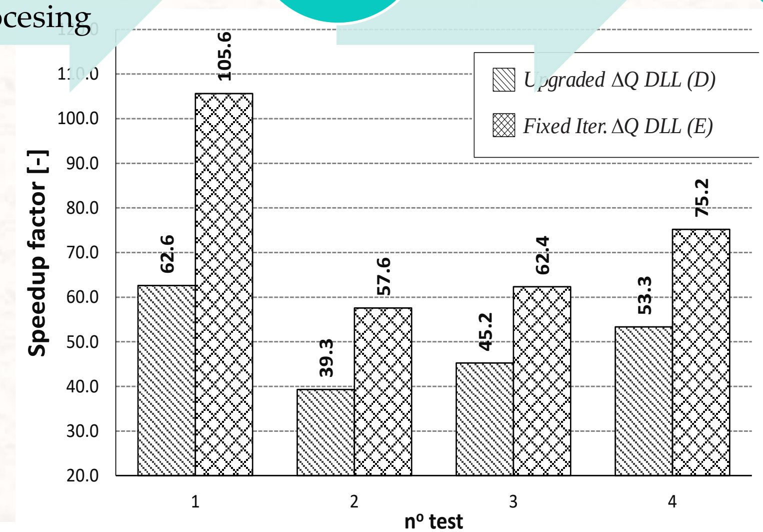
Research - PhD

- Decision Support Algorithms for Sectorization of Water Distribution Networks
  - Improvement of the ΔQ hydraulic solver for WDS networks
  - Network sectorisation into DMAs based on engineering criteria

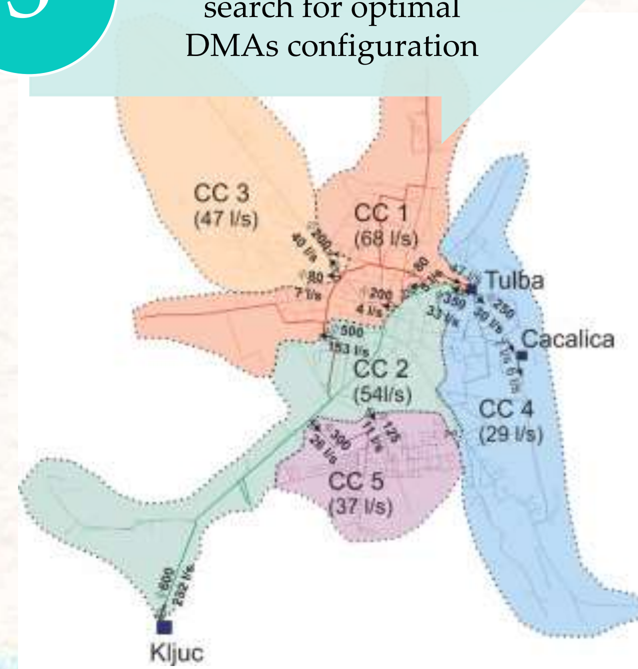
1. • Analyze networks topology
   • Pre-procesing
2. Efficient hydraulic solver
3. Use **2** for multiple optimization runs in search for optimal DMAs configuration



Detection of minimum basis loops



ΔQ Solver Speedup compared to GGA inside optimization algorithm

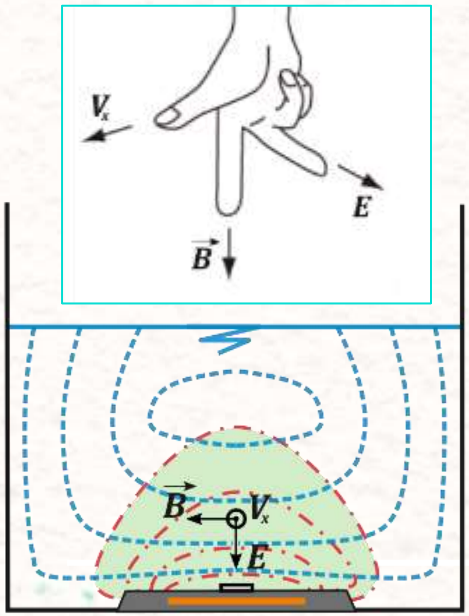


WDS Sectorisation into DMAs

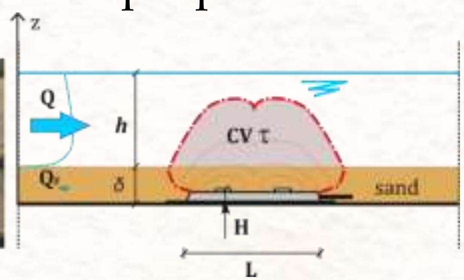
Željko Vasilić (supervised by Miloš Stanić), defended 27.12.2018

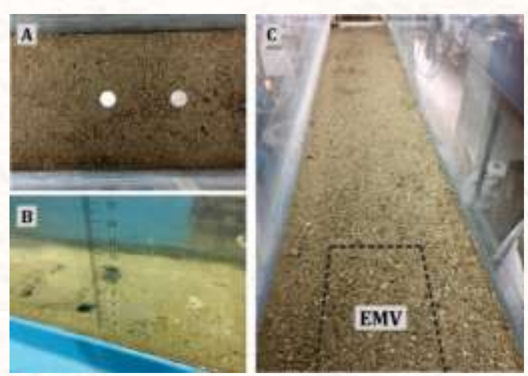
Research - PhD

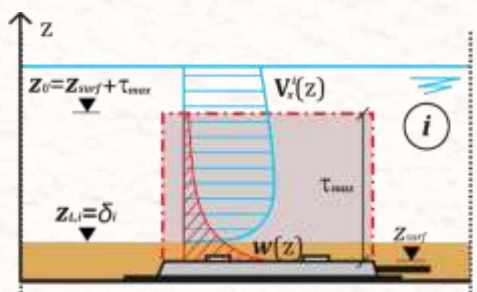
- Assessment of the liquid flow rate in complex flow conditions with flat electromagnetic sensors
  - Detailed investigation into the operating principle of the flat electromagnetic velocity meters (Flat EMV)
  - Laboratory benchmarking of the measurement uncertainty Flat EMV
  - Operation under sediment cover,
  - Simplified mathematical model is proposed



EMV



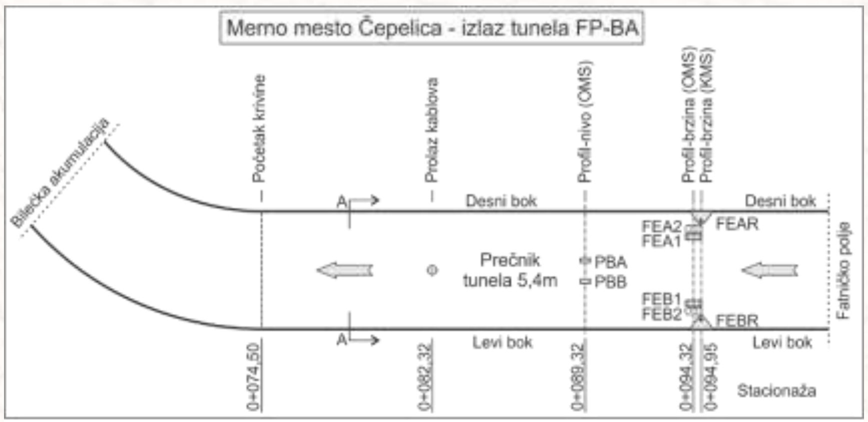


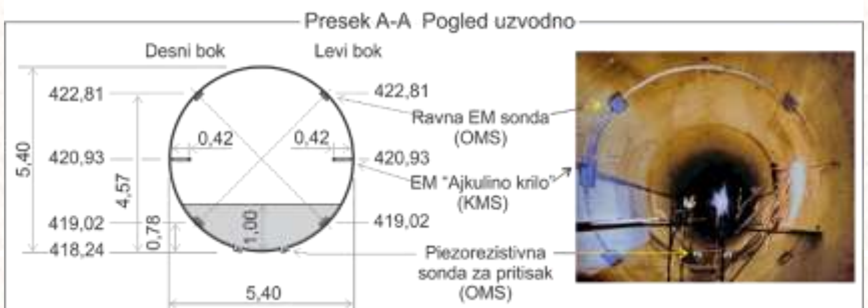


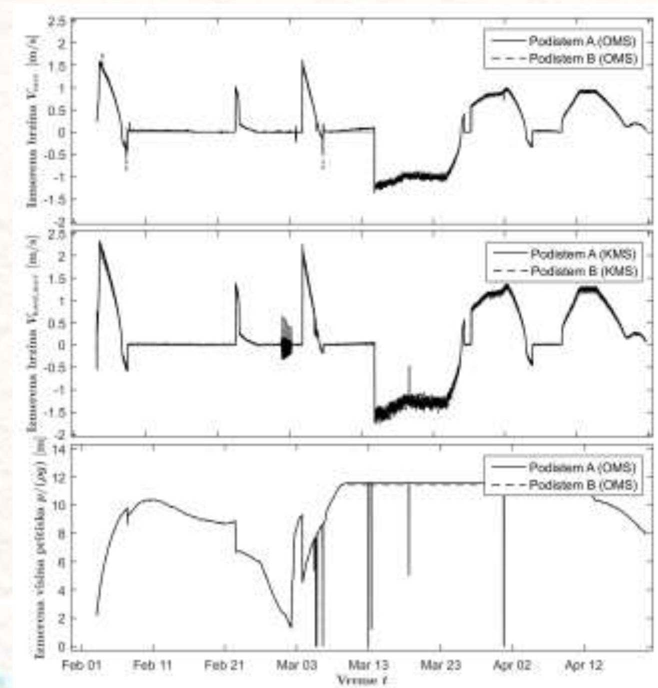
Damjan Ivetić (supervised by Dušan Prodanović), defended 1.10.2019.

Research - PhD

- Application in the HPS Gornji Horizonti
  - 3 measurement stations were designed
  - Each station is equipped with 4 Flat EMVs
  - Each Flat EMV is locally calibrated.







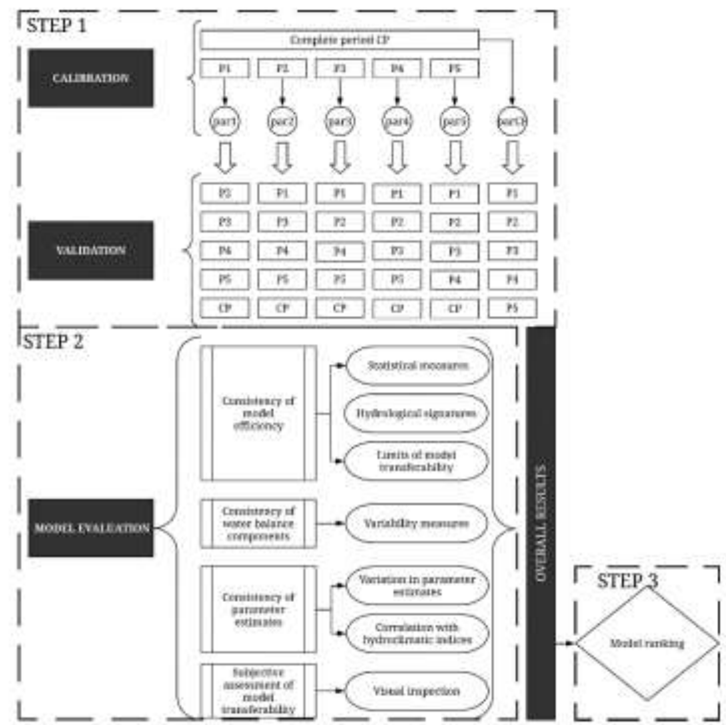
Damjan Ivetić (supervised by Dušan Prodanović), defended 1.10.2019.

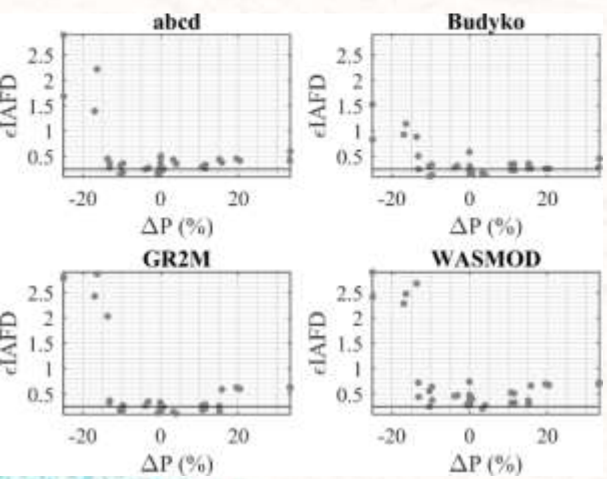
Research - PhD

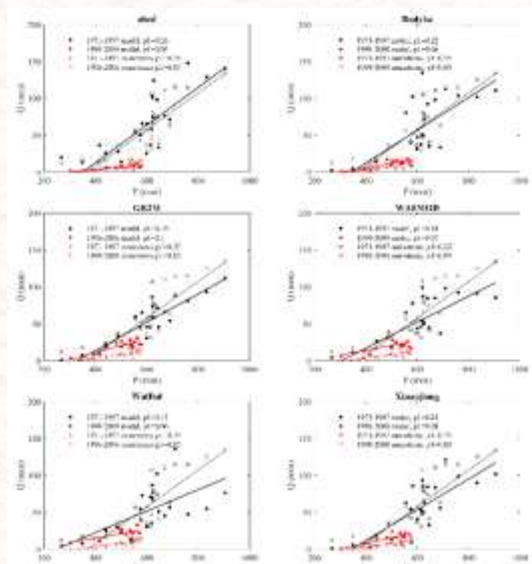
- Robust evaluation and calibration of monthly water balance models in changing climate conditions

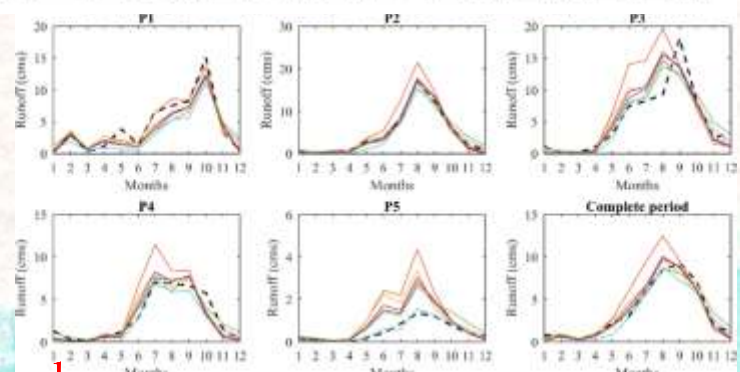
Development of the framework for robust calibration and evaluation of monthly water balance models under changing climate conditions

- **Calibration strategy: single- or multi-objective, calibration periods, combination of the objective functions-how many and what type (statistical and/or hydrological signatures)**
- **Evaluation framework for model efficiency and transferability testing by employing, amongst other evaluation steps, hydrological signatures and water balance components analysis – model diagnostics**
- **Possibilities of model structure improvement upon model diagnostics results**
- **Multi-model results analysis.**









Žana Topalović (supervised by Jasna Plavšić), ongoing research.

Research - PhD

- Geomorphological unit hydrograph model for flood flow estimation in ungauged basins

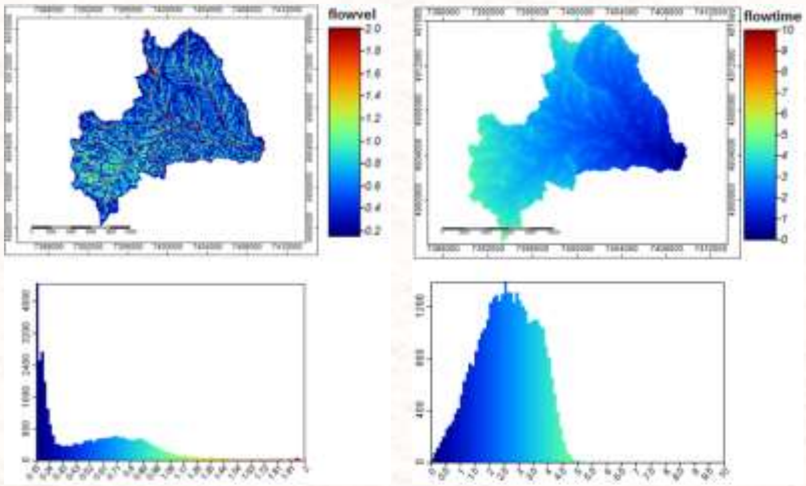
Rainfall-runoff modelling – unit hydrograph method for estimating design flood flows

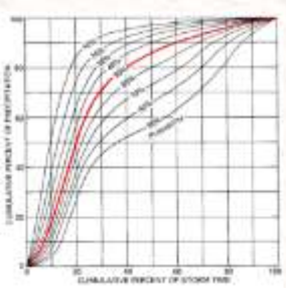
1. Develop geomorphological instantaneous unit hydrograph (GUH) based on distributed velocity method
2. Define:

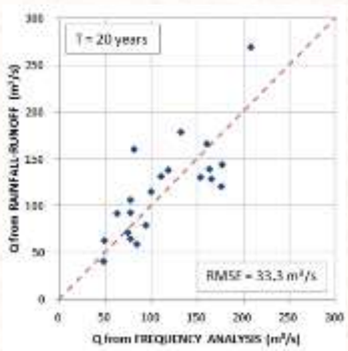
    - optimal use of Curve Number method

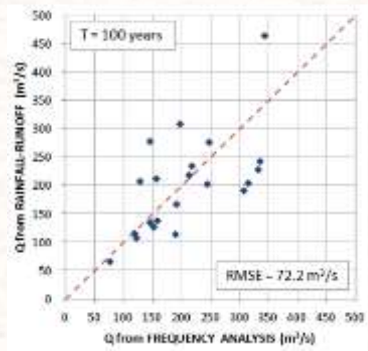
    - optimal design rainfall distribution and duration

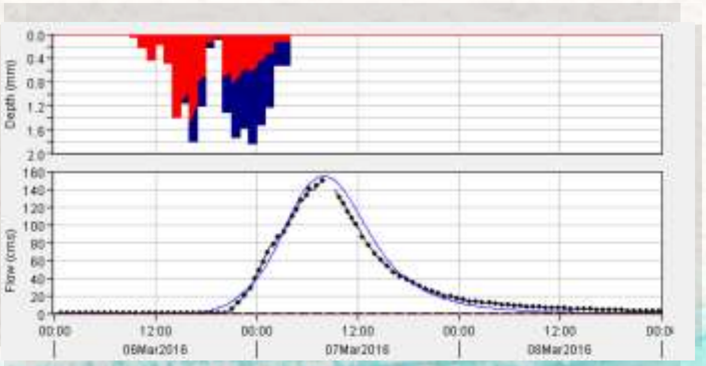
  for use with GUH to achieve best results, compared to observed hydrographs and frequency analyses







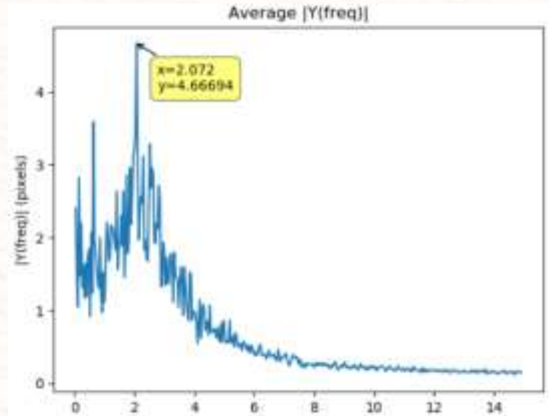


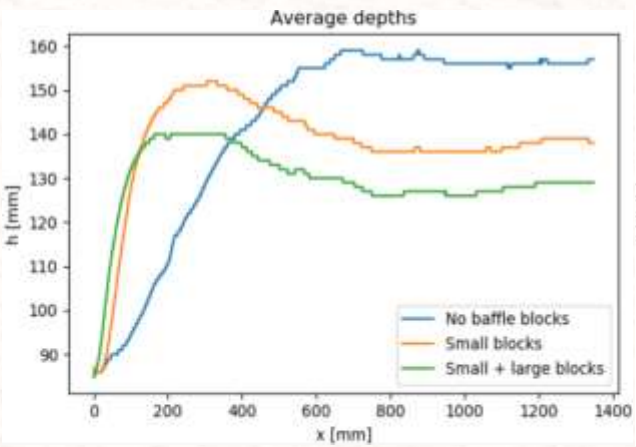


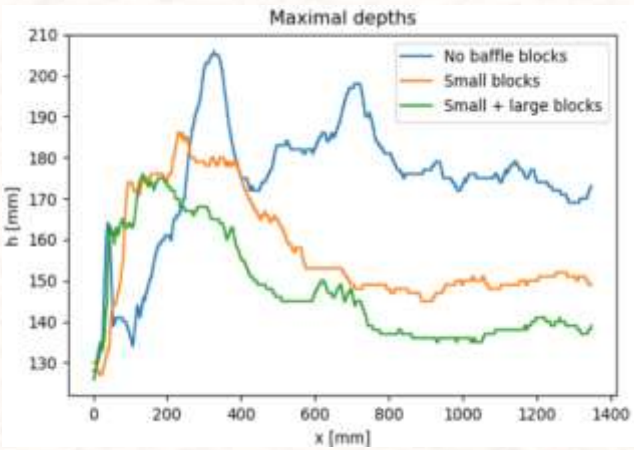
Nikola Zlatanović (supervised by Jasna Plavšić), ongoing research.

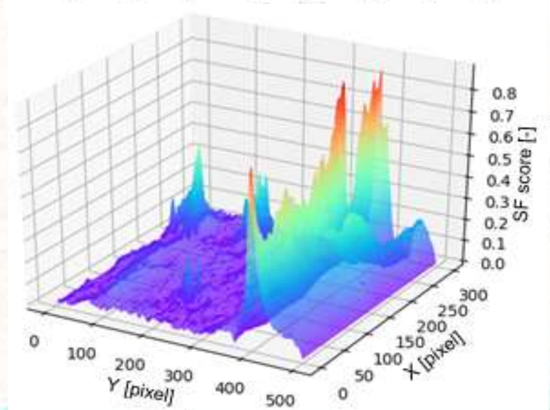
Research - PhD

- Flow in stilling basins of stepped spillway chutes
  - Experimental investigation of hydraulic jump behavior for stepped chutes
  - Measurement methods: traditional + computer vision techniques + image velocimetry (PIV) + Laser Doppler Velocimetry (LDV)
  - Different baffle block configurations
  - Horizontal and adverse slope basins





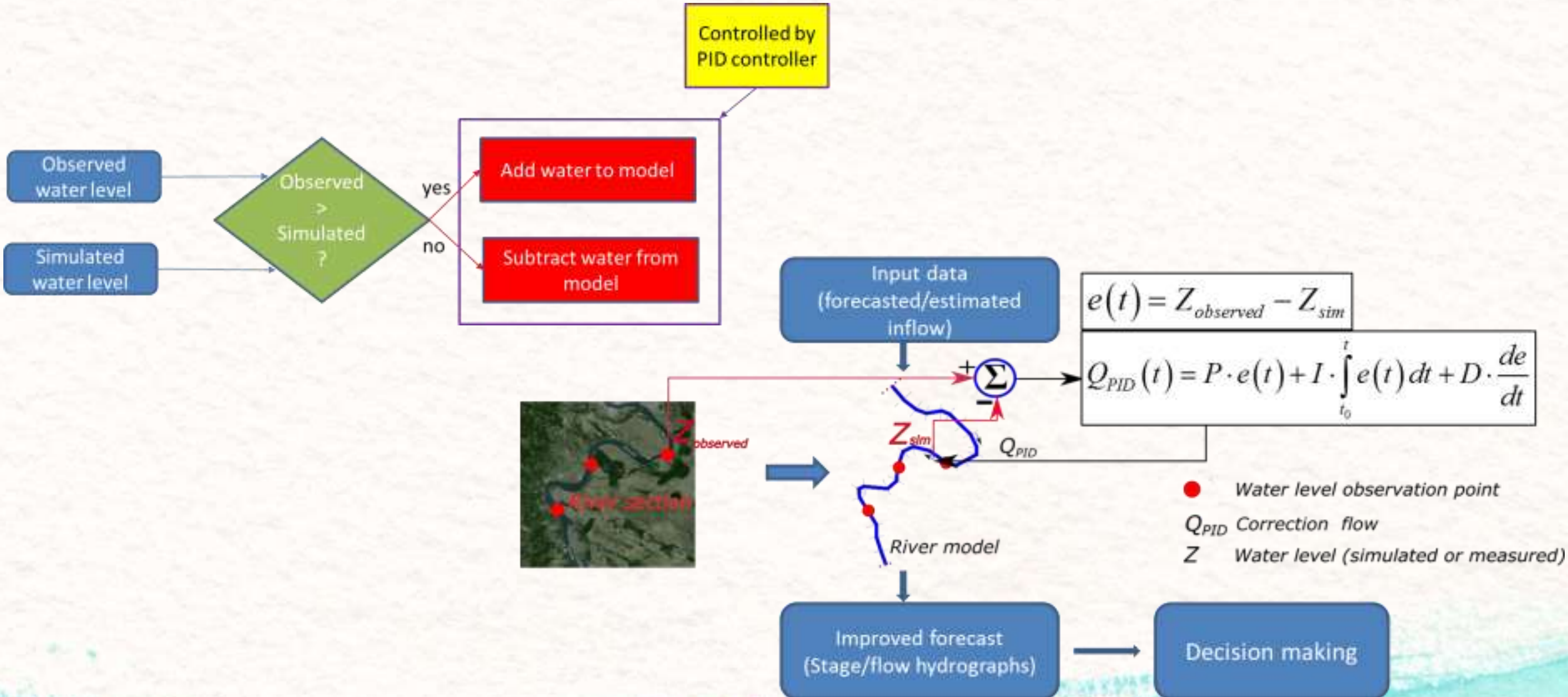




Robert Ljubičić (supervised by Ljubodrav Savić), ongoing research.

Research - PhD

- Methodology for fast data assimilation in open channel flow models
  - Improvement of short-term forecasting for water systems control
  - Novel data assimilation algorithm based on control theory approach



Miloš Milašinović (supervised by Dušan Prodanović), ongoing research.

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