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European Union European Regional Development Fund

FramWat

FRAMWAT FINAL CONFERENCE – teleconference, June 8th 2020

Pilot case: Kamniška Bistrica - Slovenia

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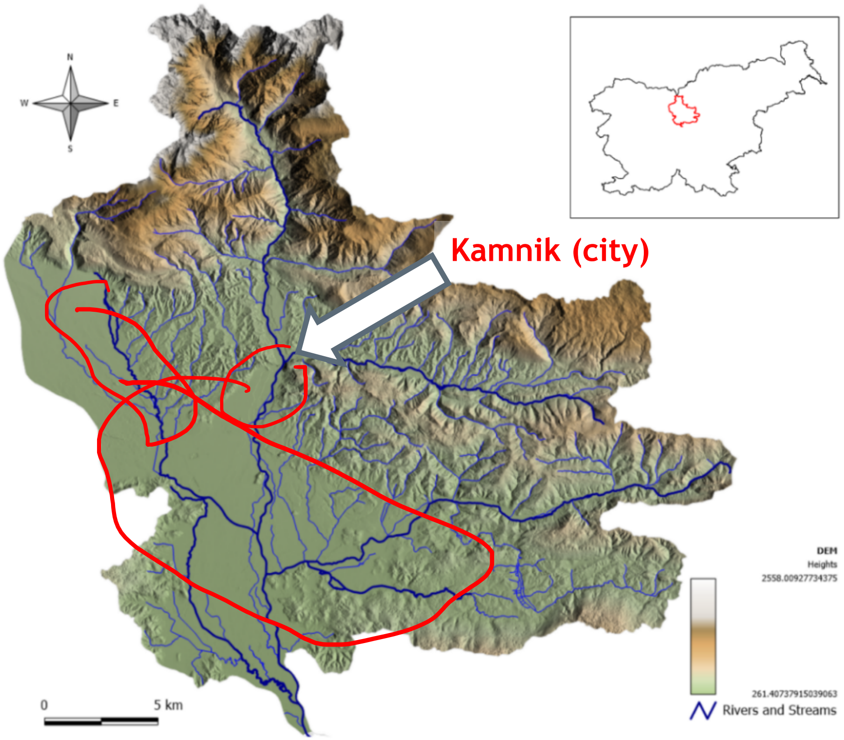
PILOT AREA - KAMNIŠKA BISTRICA CATCHMENT



Characteristic	Unit	Value
Character of the catchment		Upper part: highland; wooded, sparsely populated Middle and lower part: low-land; highly urbanized
Catchment size:	km²	539
Max/Min surface elevation	m a.s.l.	2558/261
Average flow low/avg/high*	m³/s	2.2/7.9/67.2
Extreme flow low/high*	m³/s	0.9/282
Annual precipitation low/avg/high*	mm	998/1383/1851
Annual air temperature min/avg/max*	°C	9/11/13
Agriculture area	%	34.5
Urban area	%	8.2
Forest area	%	54.1
Open spaces with little or no vegetation	%	2.8
Open Water area	%	0.4
Flooded area (1/100 years)	km²	39.2
Artificial drainage area	km²	12.7
Ecological status	Water body	Moderate (4/5) to very good (1/5)
Major problems to achieve good ecological status		Hydromorphological alteration

Key features:

- Area 539 km^2
- Complex, mountainous topography with alluvium planes
- Challenge: Floods, water quality in general is not an issue

OBJECTIVE

- Hydrological and hydraulic (HH) model as part of the FramWat dynamic tool:
  - Used for the analysis of the effects of the NSWRM
  - Comparing the effects with the results of simplified tools and general expectations
  - Analysis on the level of entire catchment
  - Used for the analysis of the action plan effects
  - Comparison of the methods among the partners
  - Identified measures – are constructive – having a necessary retention effects large retentions of several 10.000 m3 are necessary
- Modelling the entire Kamniška Bistrica catchment was quite a challenge requiring innovative approaches

METHOD

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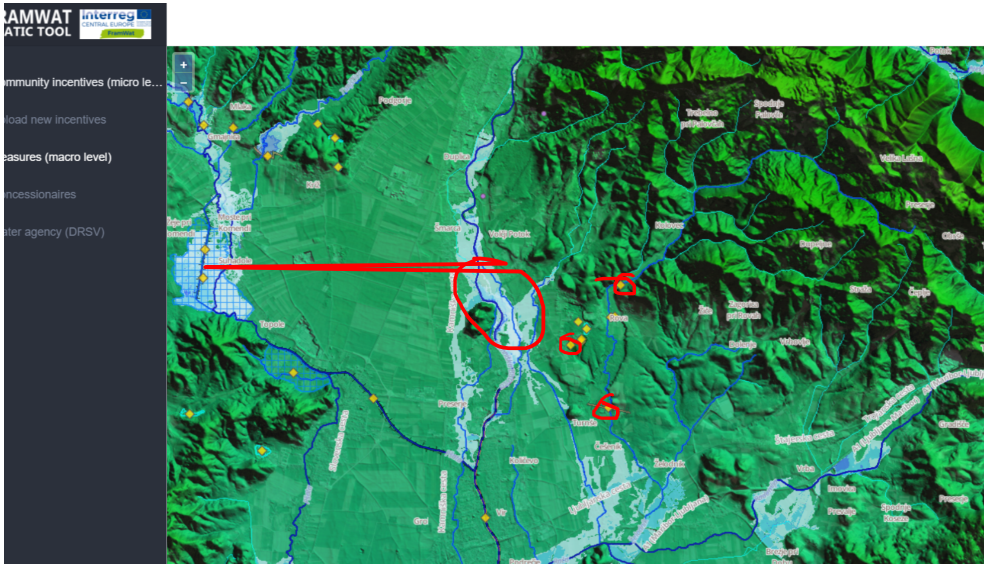
- Obtaining and elaborating the input data:
    - Digial terrain model (DTM – LIDAR based) – 1
    - Precipitation data and gauging station data (hydrological monitoring)
    - Land cover (CLC 2012)**
    - Soil types ***
    - Roughness coefficient, CN,…
- Development of **integrated hydrological and hydraulic model for the** pilot catchment of the current status
- Calibration/validation of the model for current status
- Modification of the model for the proposed NSWRM
- Evaluation of the model for proposed NSWRM
- Results of the model as an input for the next stages of FRAMWAT project

* DRSV, ** ARSO, ***UL BF

SUPPORTING APPLICATIONS

- Developed web tool for the joint multi-stakeholder identification of issues (national workshops)
- Collection of incentives for the measures, spatial positioning of the measures
- Link potential link to stakeholder – implementation of measures progress
- Also for broader public



SUPPORTING APPLICATIONS MCA

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- Multicriteria analysis – Analytical Hierarchical Process (AHP) tool was developed for prioritization of NSWRM measures as web application

- Then it was used for the communication process and harmonization of views of different stakeholders

This multicriteria analysis (AHP) is enabling user-freindly identification of individual priorities of the users regarding the application of different measures from the catalogue of measures

INTEGRATED MODEL (HYDROLOGY, HADAULICS)

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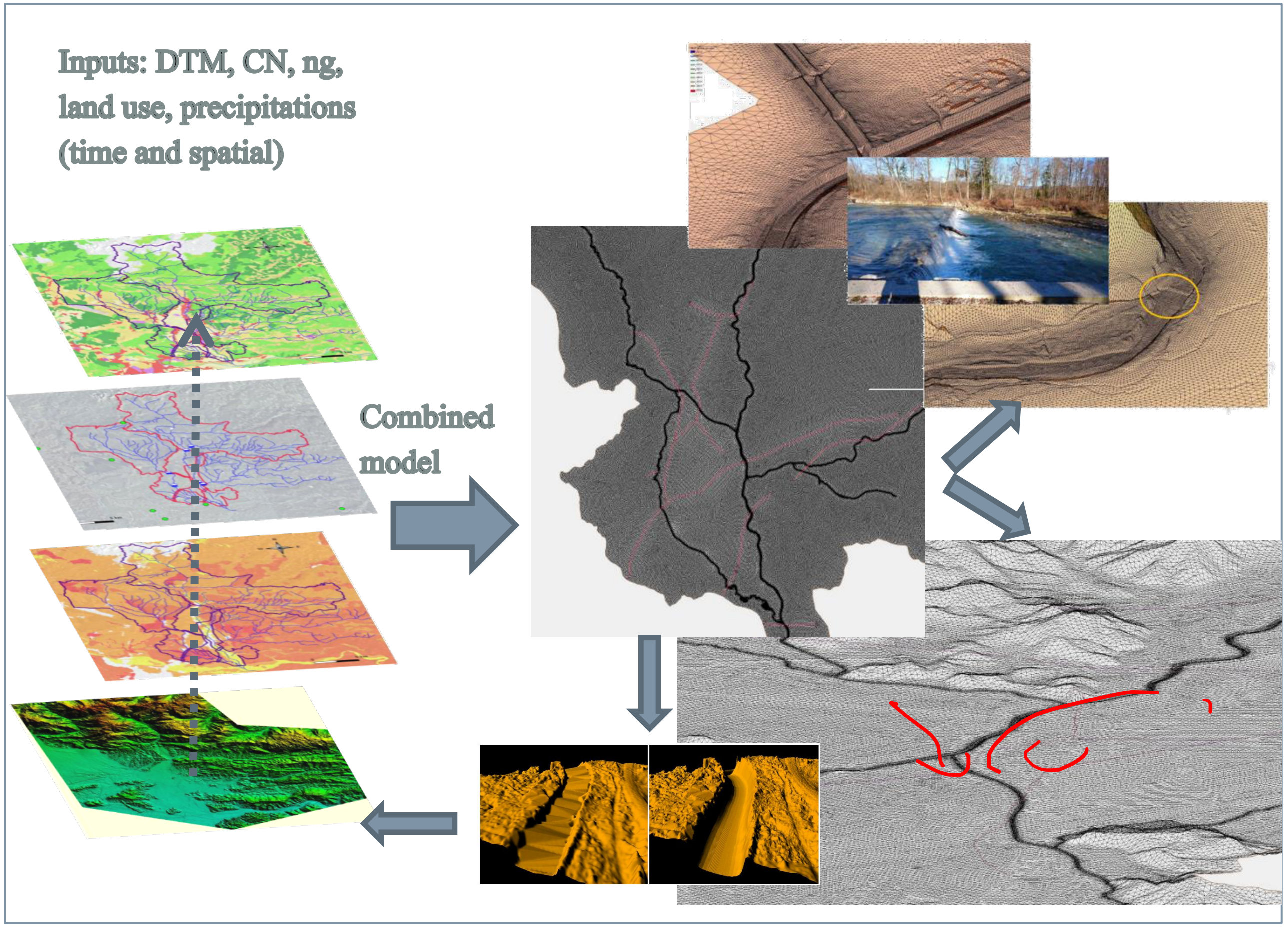
- Combined model enabling simultaneous modelling of hydrological processes and flood hydraulics
- Objective – robust, objective resolution and accuracy , effective and efficient
- 2.6 mio. Computing cells
    - GPU calculation procedures

6 h

- Adaptive meshing
- Key hydraulic structures are modelled
- Detailed modelling of key river reaches
- One upstream and downstream border condition
- Multiple iterative calculations to reach the objectives
- Advantages (single modelling tool!) and weaknesses (big model, issue: objective accuracy for the calibration/validation)

BUILDING THE MODEL



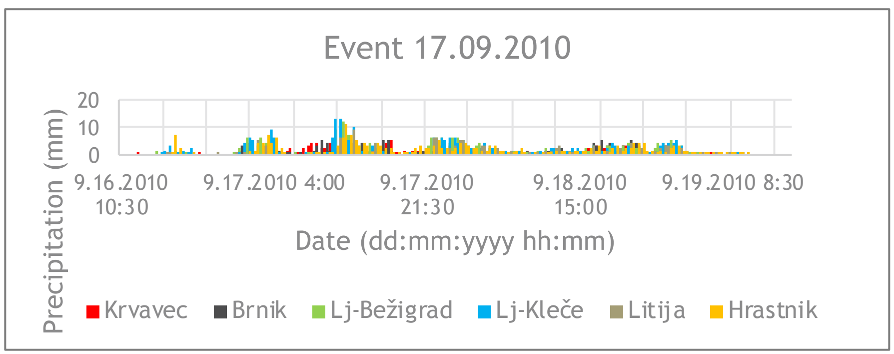
Simplified procedure for the development of the model on the pilot catchment

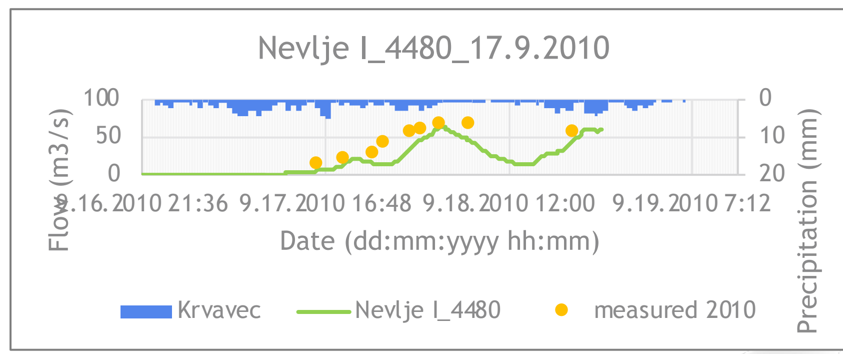
MODELLING RESULTS:

Catchment scale integrated modeling of runoff (hydrology) and hydraulics (flood propagation)

CALIBRATION, VALIDATION

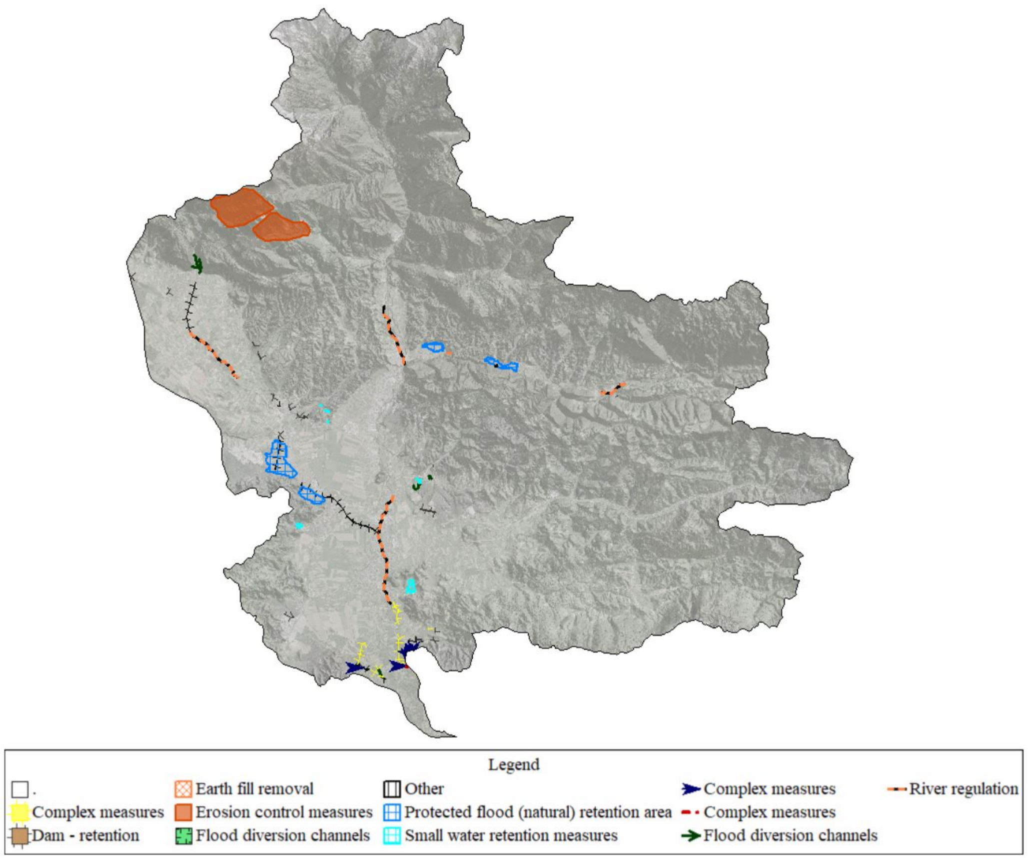
- Major flood events in the catchments in the years: 2007, 2010, 2012 in 2014, issues:
  - More gauging stations would be fine, gauging stations data reliability?
  - Calibration to the flood event of 2010
  - Validation to the flood event of 2007
  - Time resolution of precipitation – 30‘
  - Calibration to the Q-H curves of gauging stations
  - Critical assessment of the inputs and results





Model Calibration ✓

HYDRAULIC MODEL WITH MEASURES SCENARIO



- Calculations taking into consideration proposed measures
- 6, 15, 24 hour precipitation intensity – 100-year return period
- Uniform precipitation distribution
- **All measures are not suitable for modelling**

Important retention effects:

- Retention basins
- Combined measures

IDENTIFIED EFFECTS - RETENTION BASINS

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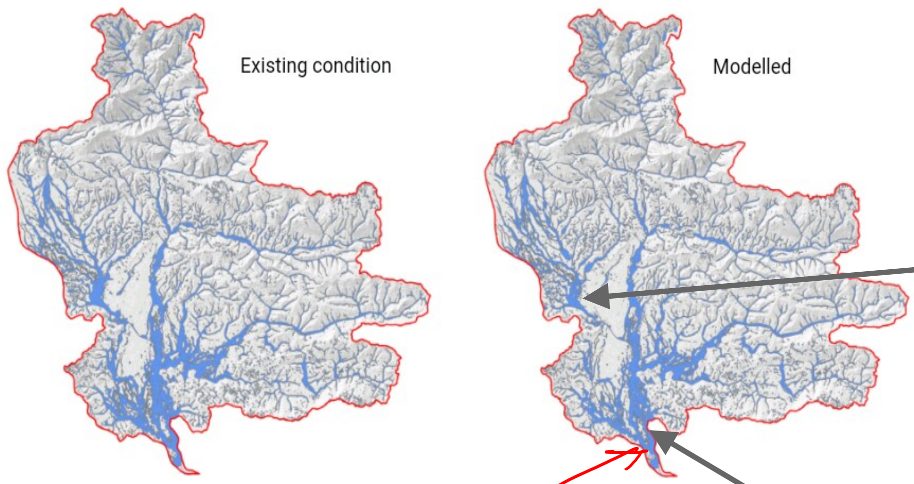
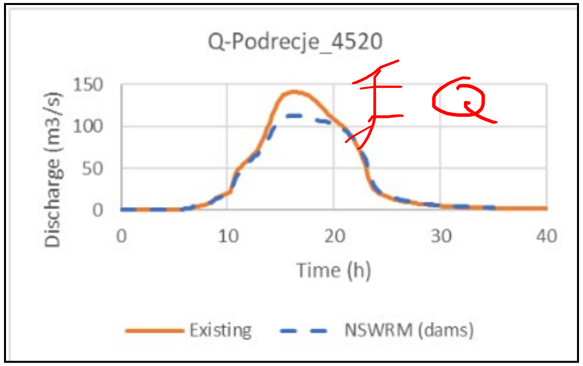
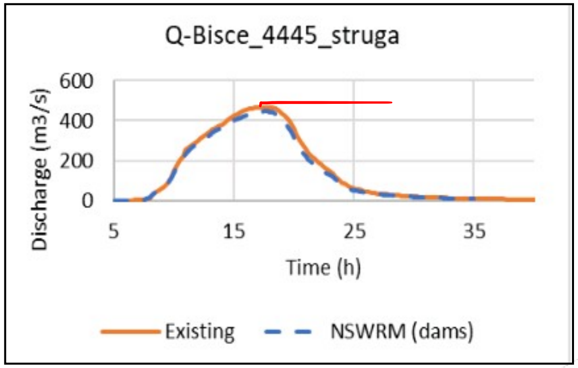


Figure 10: Graphical representation of calculated flooding for 15 hours event with 100year return period. Existing conditions flooding is on the left side, flooding with implemented proposed NSWRM (dams) is on the right. On first look, difference is negligible.

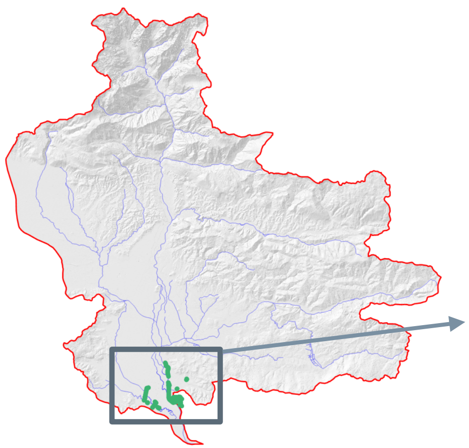


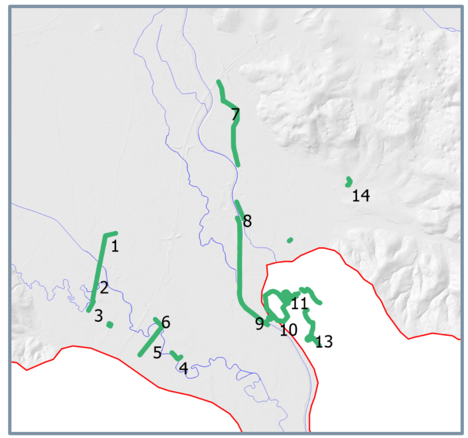


Expected:

- Impact of retentions most notable immediate downstream of the retention basin
- On the catchment level (catchment outlet) almost no impact

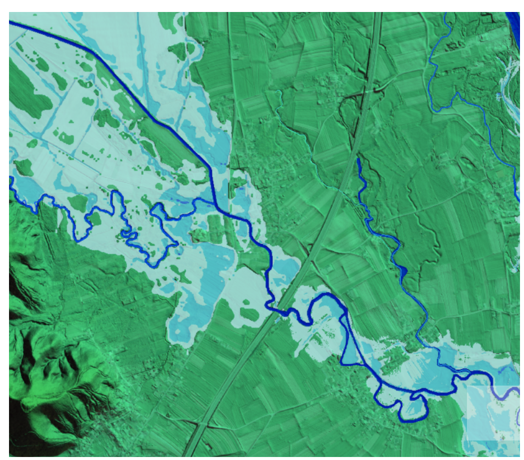
COMPLEX MEASURES – ANALYZED WITH SUB MODELS



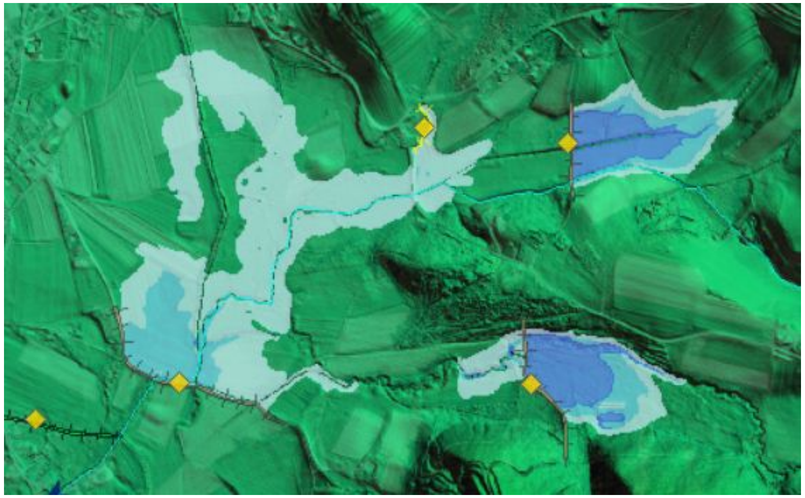


- Complex retention and flood routing mechanism

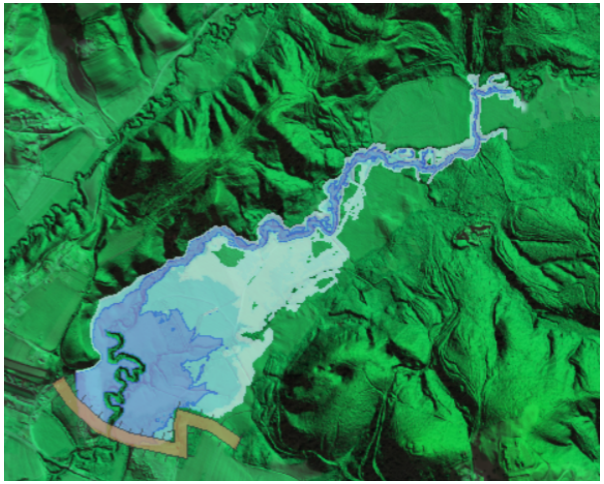
- Not suitable for the analysis on the level of entire catchment



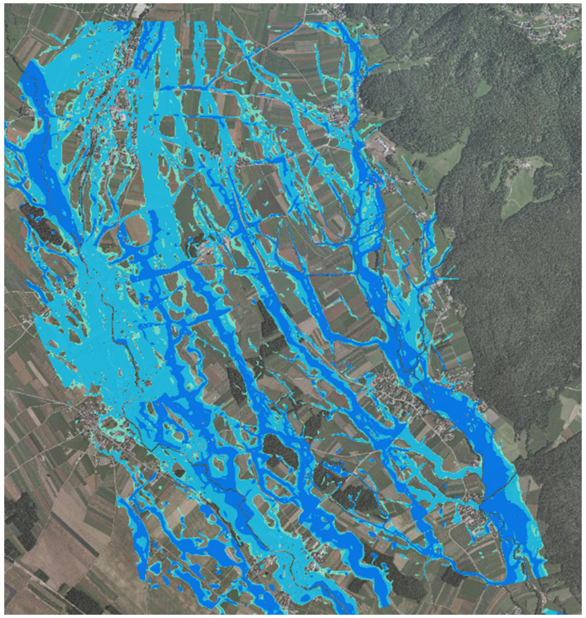
SOME MEASURES MODELLED - ANALYZED WITH SUB MODELS

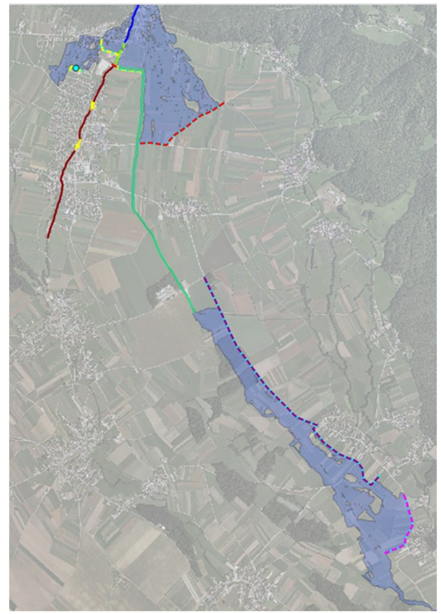


Retention basins

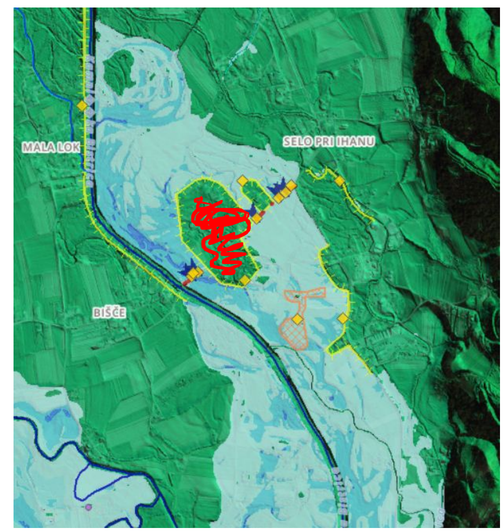


SOME MODELLED SCENARIOS - ANALYZED WITH SUB MODELS





Flood routing with retentions on the alluvial fan (Cerklje na Gorenjskem)



Target floodplains along the river (Domžale)

CONCLUSIONS

- Applied modelling approach is not easy, but it is enabling analysis of impact of the measures on entire, large catchment,
- With sub-models more detailed hydraulic analysis is enables
- Addressing trans-municipality decision making process
- Contributing to the EU Flood damage reduction programming process
- Cooperation among stakeholders and increased understanding
- Interpretation of the results is not always a straightforward process