Evaluation of floodplains along the Danube in Austria with the Floodplain Evaluation Matrix – Comparison of 1D and 2D models

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Abstract

For the preservation of floodplains within integrated flood risk management, the evaluation of floodplains and their effectiveness in flood risk reduction is of great significance. To apply the Floodplain Evaluation Matrix (FEM), hydrodynamic-numerical modeling results are needed. This work compares 1D/2D HEC-RAS models with HYDRO_AS-2D model results regarding the sufficient reproduction of floodplain retention during extreme flood events. The simplified FEM evaluation assigns high performance to all parameters and leads to the conclusion that all of the studied models are valid for the assessment.

Keywords: Flood risk reduction, floodplain evaluation method, floodplain retention, HEC-RAS.

Methods

Multifold uses of floodplains:
Conflicting needs of different sectors (flood protection, ecology, socio-economics) require evaluation of floodplains and their importance

FEM-Method

- Integrative approach
- Parameters for each sector – assignation of performance classes low/medium/high
- Based on hydrodynamic modeling results (100-yr flood wave)

Case study

- 76 km stretch of Austrian Danube with extensive floodplains
- Results from different models used to apply simplified evaluation approach (focus on hydrological parameters):

  Flood peak reduction **Δ Q**
  Flood wave translation **Δ t**

- HEC-RAS 1D and HEC-RAS 2D as alternatives to HYDRO_AS-2D (same DTM, calibrated to observed retention during flood event 2013 (> HQ100))
- Comparison of retention effectiveness/FEM-parameters

Results

100-yr simulations

- All parameters performed high (see Table 1) regarding defined thresholds for high performance:
  $\Delta Q_{rel} > 2$ %, $\Delta t > 5$ h
- Similar outflow hydrographs (Q out) at end of floodplain (see Figure 1)

Table 1: Comparison of FEM parameters

	ΔQ_{rel} (%)	Δ t (h)
HEC-RAS 1D	11.8	13.0
HEC-RAS 2D	12.6	18.0
HYDRO_AS-2D	12.3	20.5

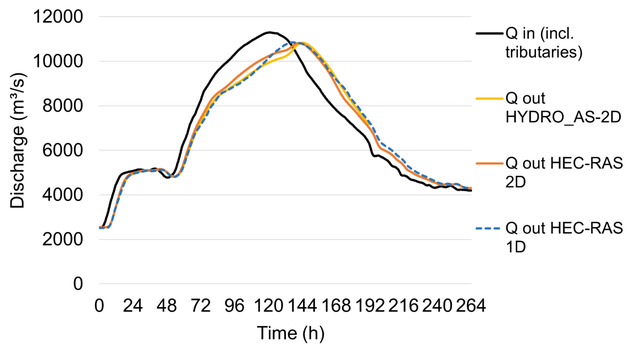

Figure 1: Comparison of modeled retention of 100-year event (scaled event 2013)

Conclusions

Generally, it is possible to sufficiently reproduce retention effects of certain floodplains using also the tested alternative models to apply the FEM-evaluation.

- Promising 1D calibration approach: balancing of roughness values, ineffective flow areas and lateral structure coefficients
- 1D Instability issues: unsteady simulations, heterogeneous flow situations (overflow sections/lateral structures, junctions)
- Uncertainties regarding influences of other model parameters on retention effects:
  simplified incorporation of weir geometry and gate operation, high roughness values in impounded sections to ensure lateral overflow at certain flow rates

Bibliography

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