Geologically-Driven Migration of Landmines and Explosives Remnants of War- A Feature Focusing on the Western Balkans

Bridge2MineMod

20th International Symposium Mine Action 2024

Dubrovnik (Croatia)

M.Eng. Marco A. Öttl

Partners

Cooperative State University Baden-Württemberg
Germany

University of the Armed Forces
Germany

University of Sarajevo
Bosnia and Herzegovina

University of Belgrade
Serbia

University of Zagreb
Croatia

DEMIRA e.V.
Germany

Mine Action Center of the Republic of Serbia (MACRS)
Serbia

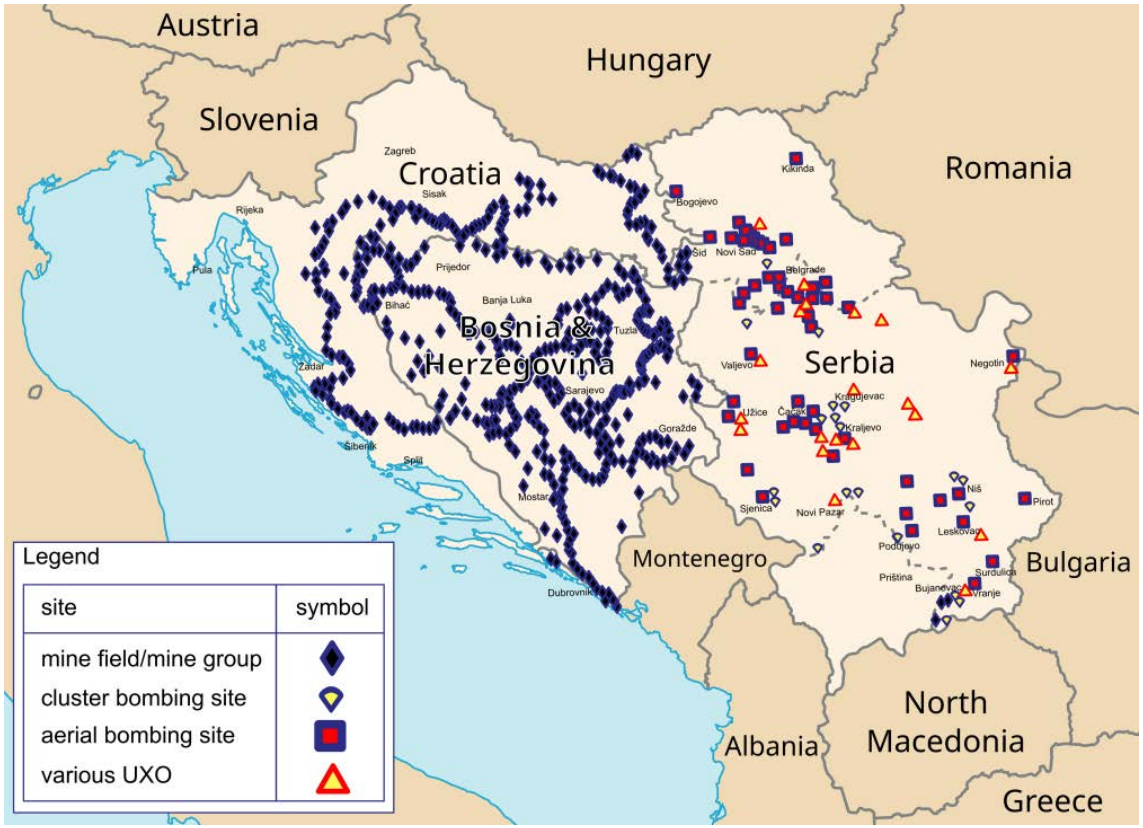
Bosnia and Herzegovina Mine Action Center (BHMAC)
Bosnia and Herzegovina

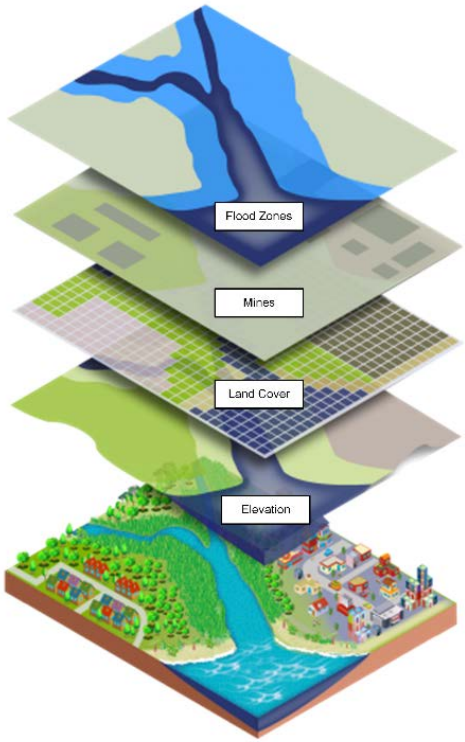
Armed Forces Germany Ordnance Defence School
Germany

Introduction

- Around 70 - 110 million landmines have been laid worldwide
- Many explosive devices were laid or dropped near watercourses
- Flood events can lead to the mobilisation of explosive devices, e.g.
  - 1998 in Central America by Hurricane Mitch
  - 1999/2000 Mozambique
  - 2010 in Kashmir region
  - 2014 in the Balkans

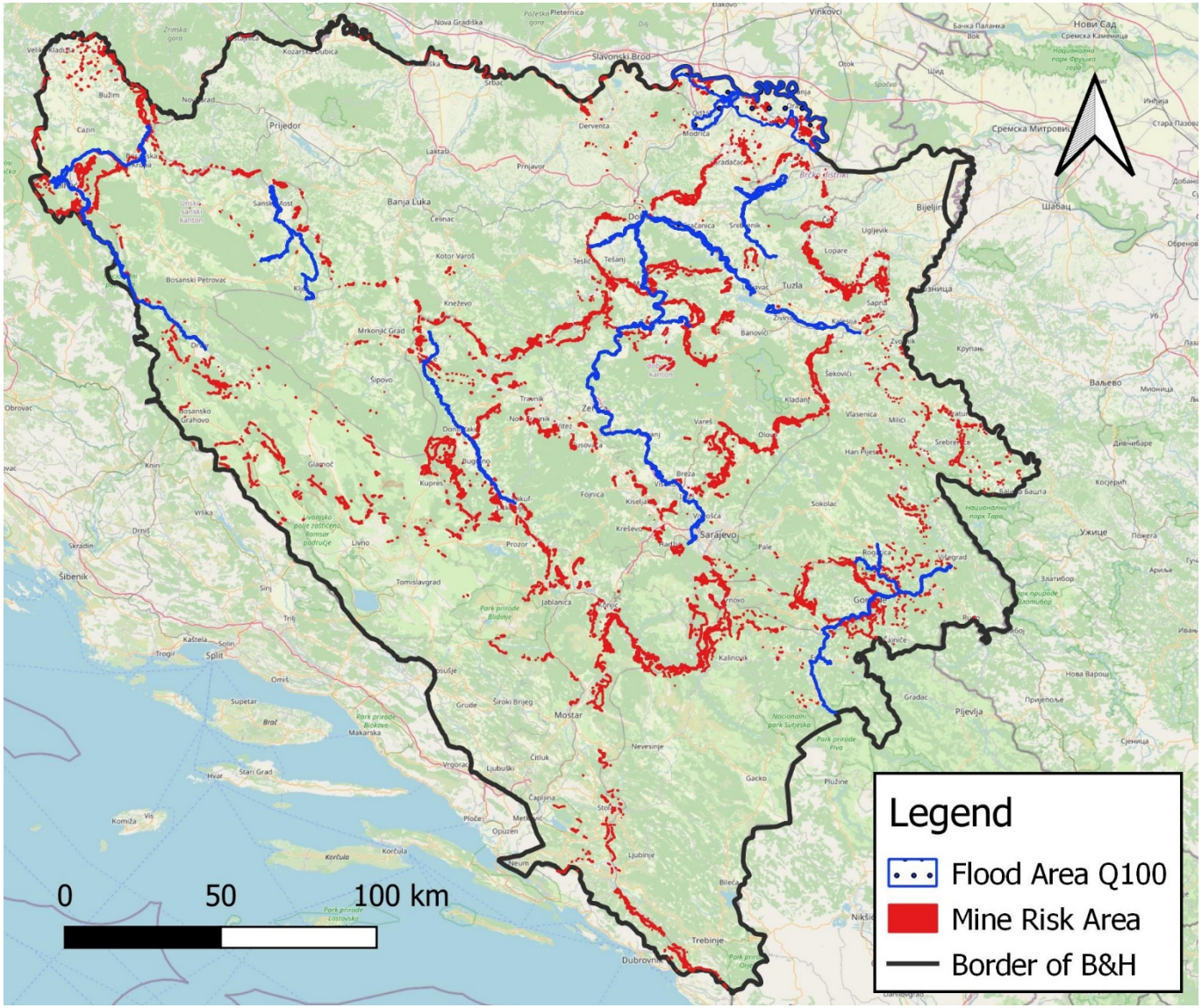
Introduction



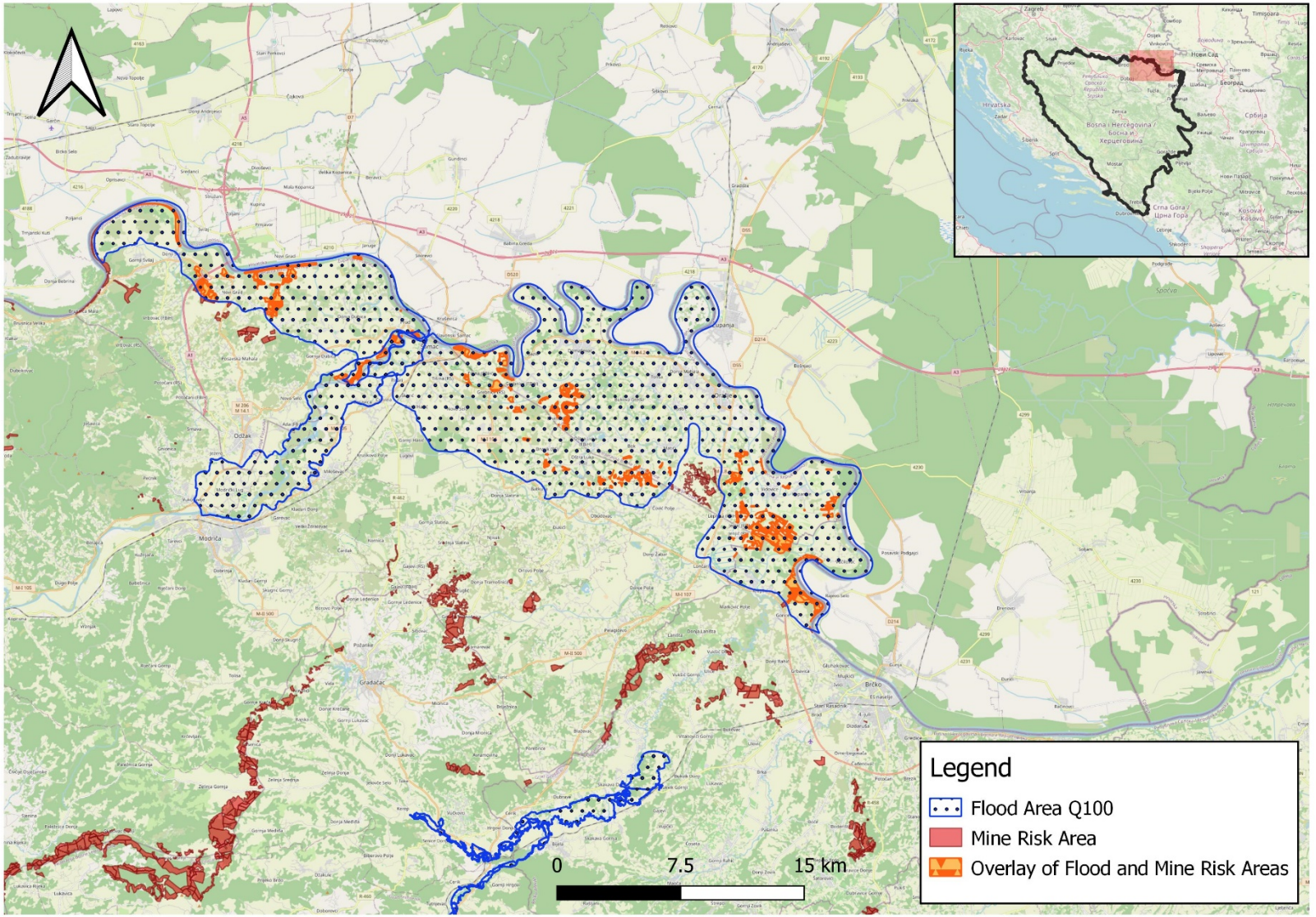


- Result: Previously free areas may get contaminated
  - Threat to humans and animals
  - Explosive devices pose a direct hazard to infrastructure

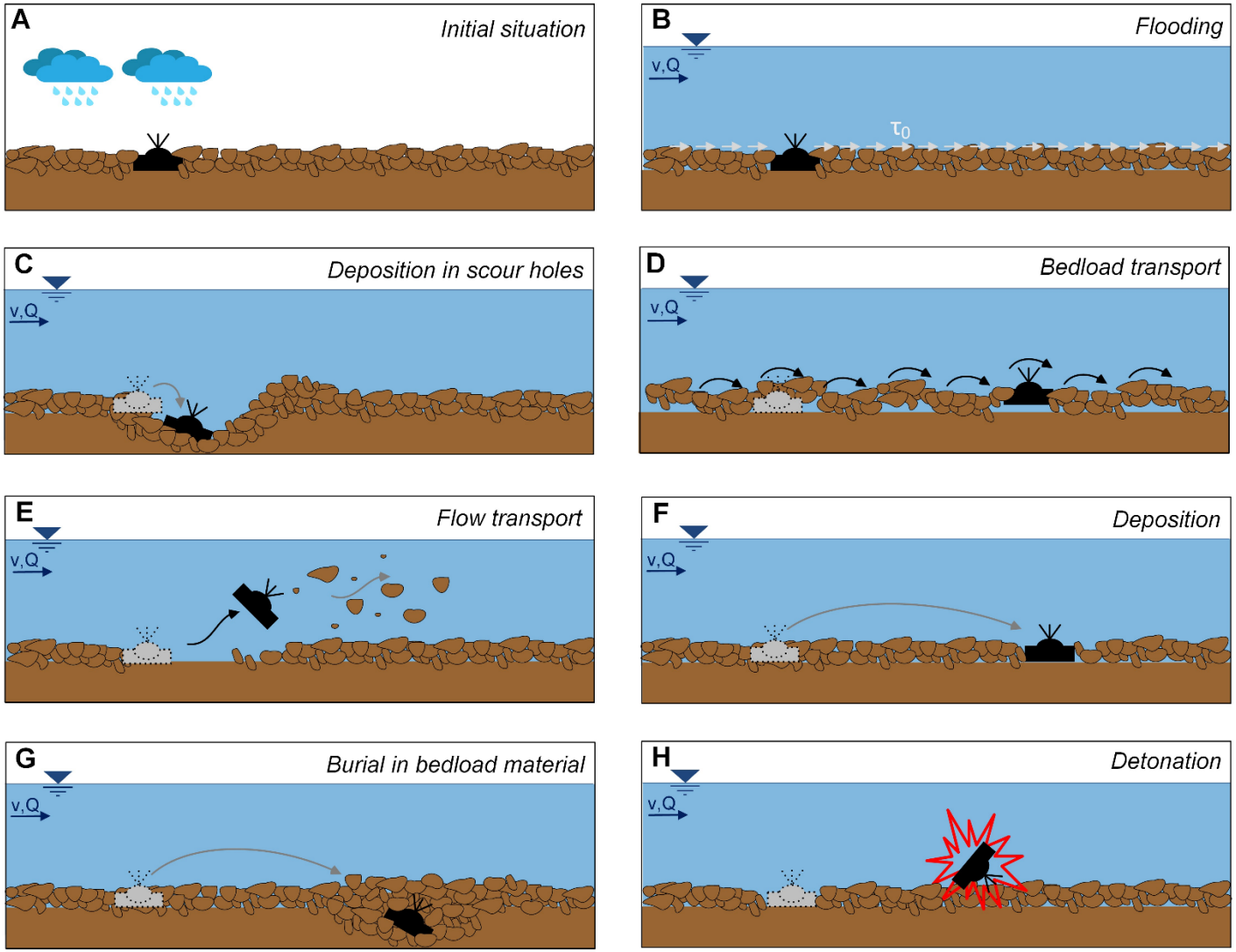
GIS-Analysis



GIS-Analysis



Background


A
Initial situation
B
Flooding
v,Q
τ_0
C
Deposition in scour holes
v,Q
D
Bedload transport
v,Q
E
Flow transport
v,Q
F
Deposition
v,Q
G
Burial in bedload material
v,Q
H
Detonation
v,Q

Methodology

To be learned

- Begin of Erosion and Mobilisation
- Behaviour in the current
  - Bed-load transport
  - Flow transport
- Deposition and Sedimentation
- Detonation

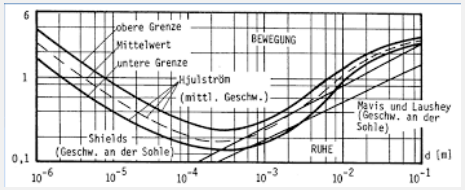
Math. description

$$\Phi = \frac{q_b}{\left(\left(\frac{\rho_s}{\rho} - 1\right) gD\right)^{\frac{1}{2}} D}$$

$$\Phi = k(\theta - \theta_c)^{\frac{3}{2}}$$

$$\tau_b = \rho g r_{hy} S$$

$$\theta = \frac{\tau_b}{(\rho_s - \rho) gD}$$



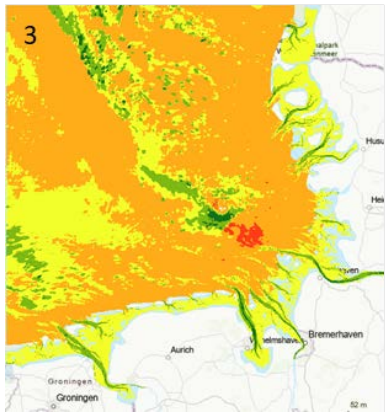
Methodology *(Adaptation from Naval Mines)*

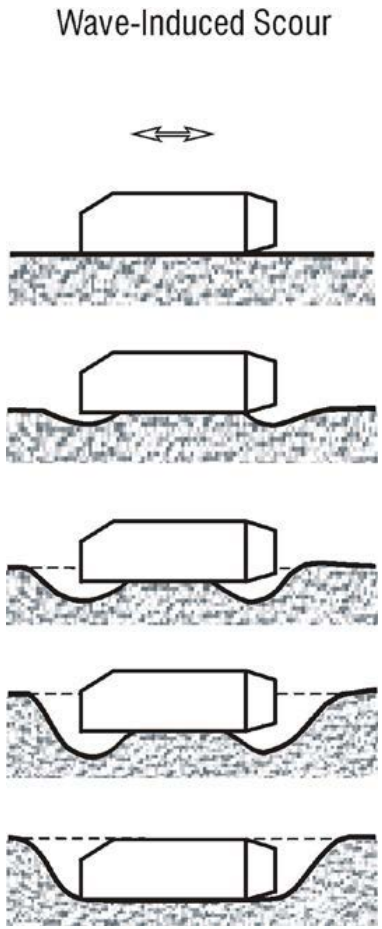
To be learned

- Begin of Erosion and Mobilisation
- Behaviour in the current
  - Bed-load transport
  - Flow transport
- Deposition and Sedimentation
- Detonation

Carstens and Martin (1963)

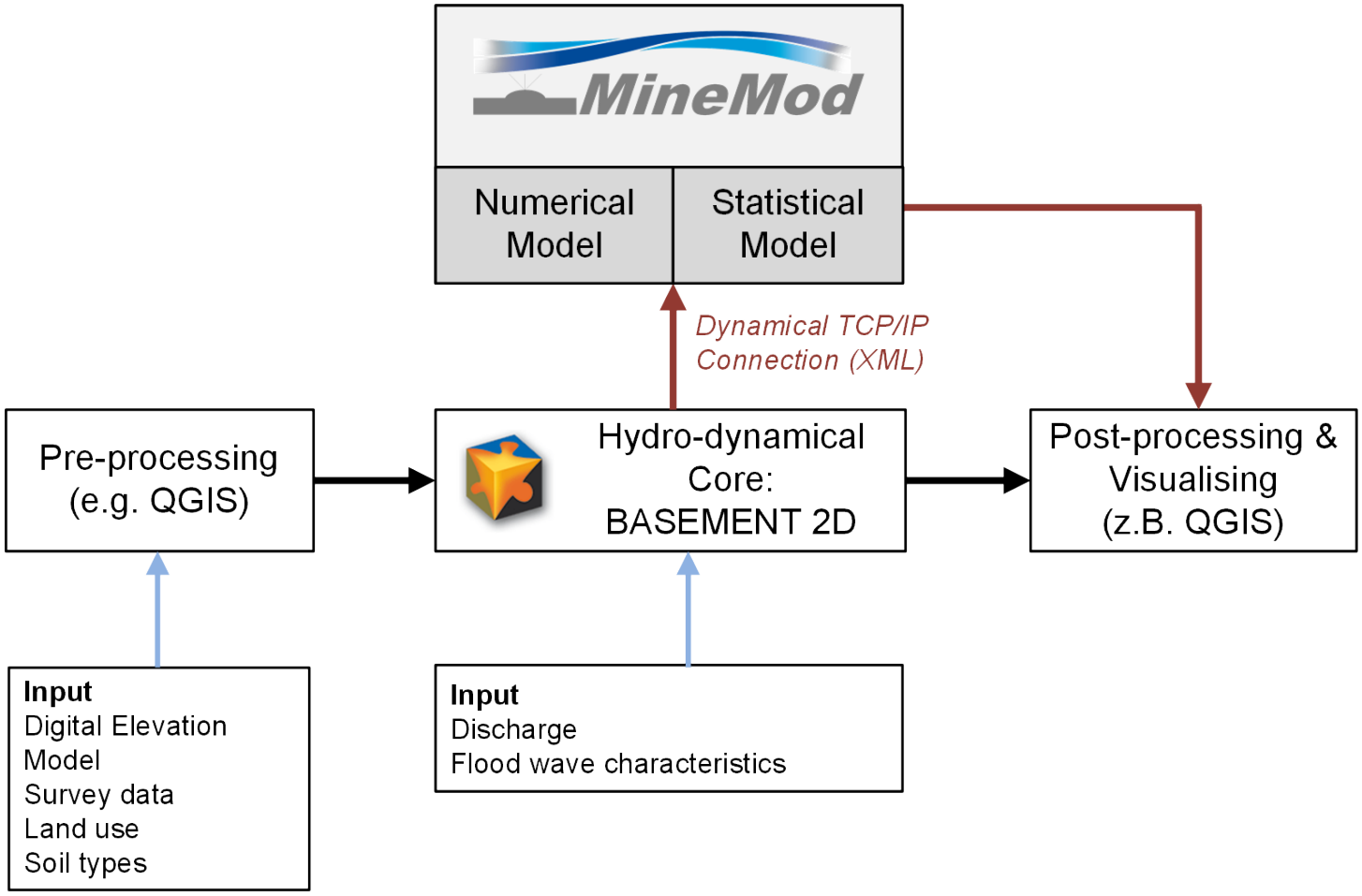
$$1.2 \cdot 10^{-7} Fr^{8} \int \frac{u_m}{D} dt + 5.2 \left(\frac{z_{vs,i}}{D}\right)^{0.63} = \frac{0.786}{\tan^2\phi} \left(\frac{z_{vs}}{D}\right)^{4} + \frac{4.45}{\tan\phi} \left(\frac{z_{vs}}{D}\right)^{3} + 7.07 \left(\frac{z_{vs}}{D}\right)^{2}$$





Goals

Development of a hydrodynamic-numerical Model (MineMod)



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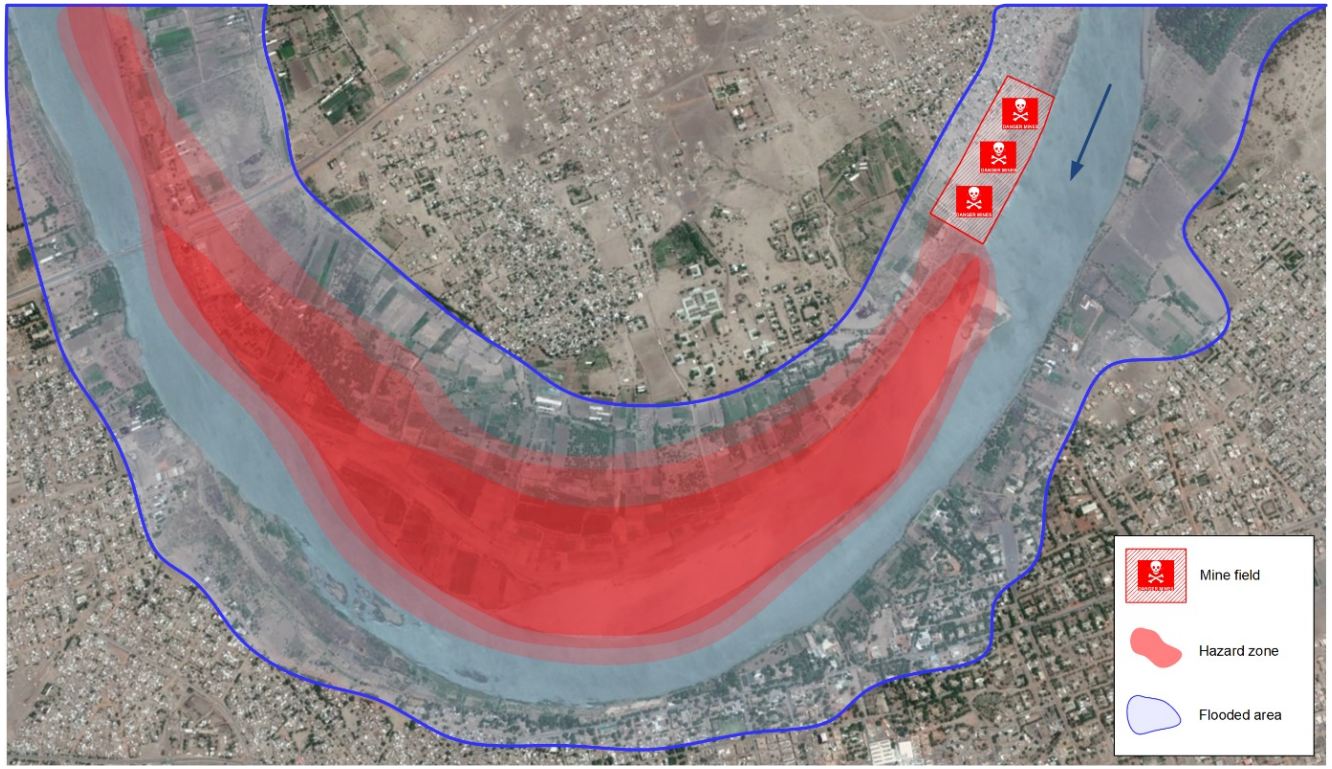


Benefits

- ✓ Newly contaminated areas downstream of a mine field can be identified
- ✓ Warning of affected people
- ✓ Coordination of clearance measures

Further Proceeding

30th November
Submission BMBF-Proposal
Bridge2ERA

Submission
EU-Proposal

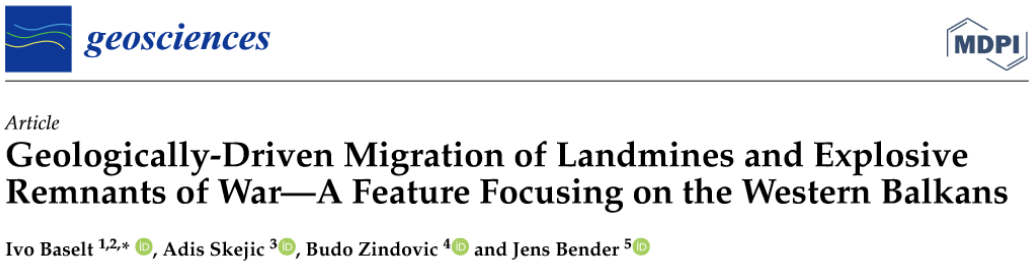
September 2023 – August 2025
BMBF-Programme *Bridge2ERA*

2022 | 2023 | 2024 | 2025

March 2022
Kickoff Meeting

June 2023
Feature-Paper

- Building up network
- Development of EU-Proposal (R&D)
- Workshops & Field studies
- Student exchange
- GIS analysis



Contact

Prof. Dr. Jens Bender
M.Eng. Marco A. Öttl
Cooperative State University Baden-Württemberg
Neckarburkener Str. 8, 74821 Mosbach
Germany

P +49 6261 939-528
M jens.bender@mosbach.dhbw.de
M marco.oettl@mosbach.dhbw.de