Geotechnical Aspects in the Vulnerability Assessment of Existing River Banks

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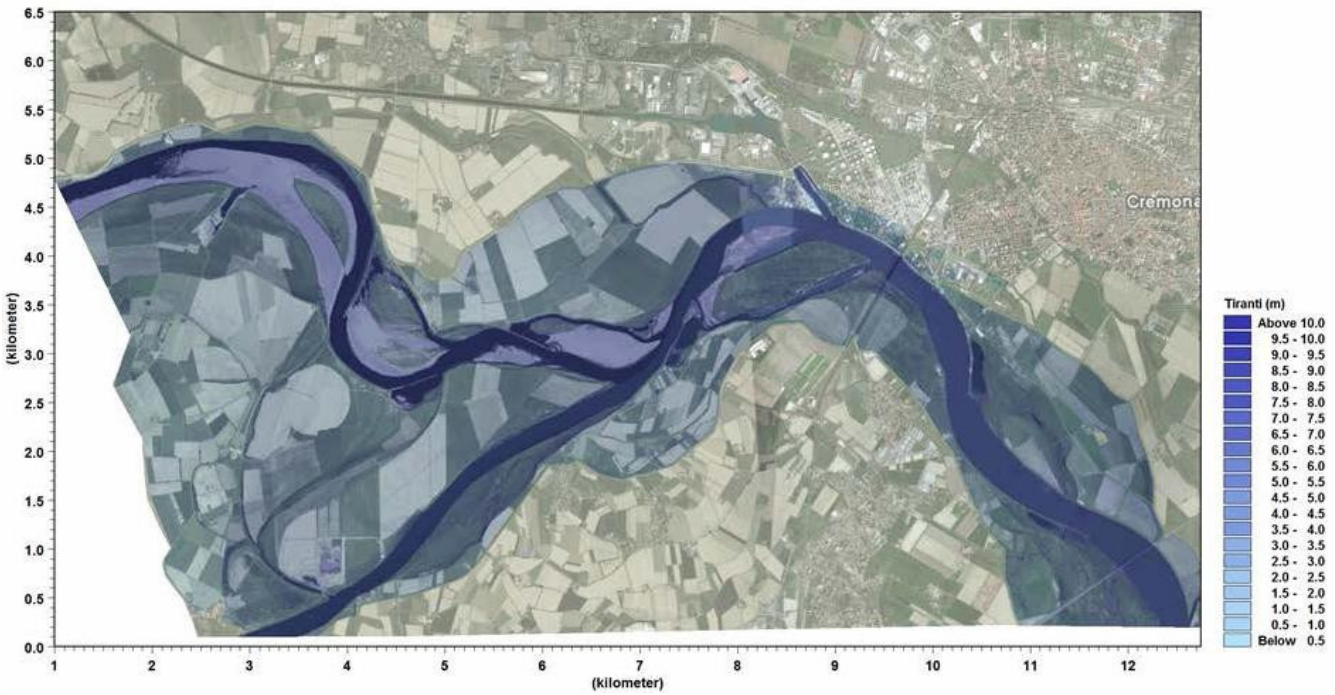
Flood risk maps in river areas protected by levees typically consider the only risk of overtopping, implicitly disregarding potential failures of the defence structures.

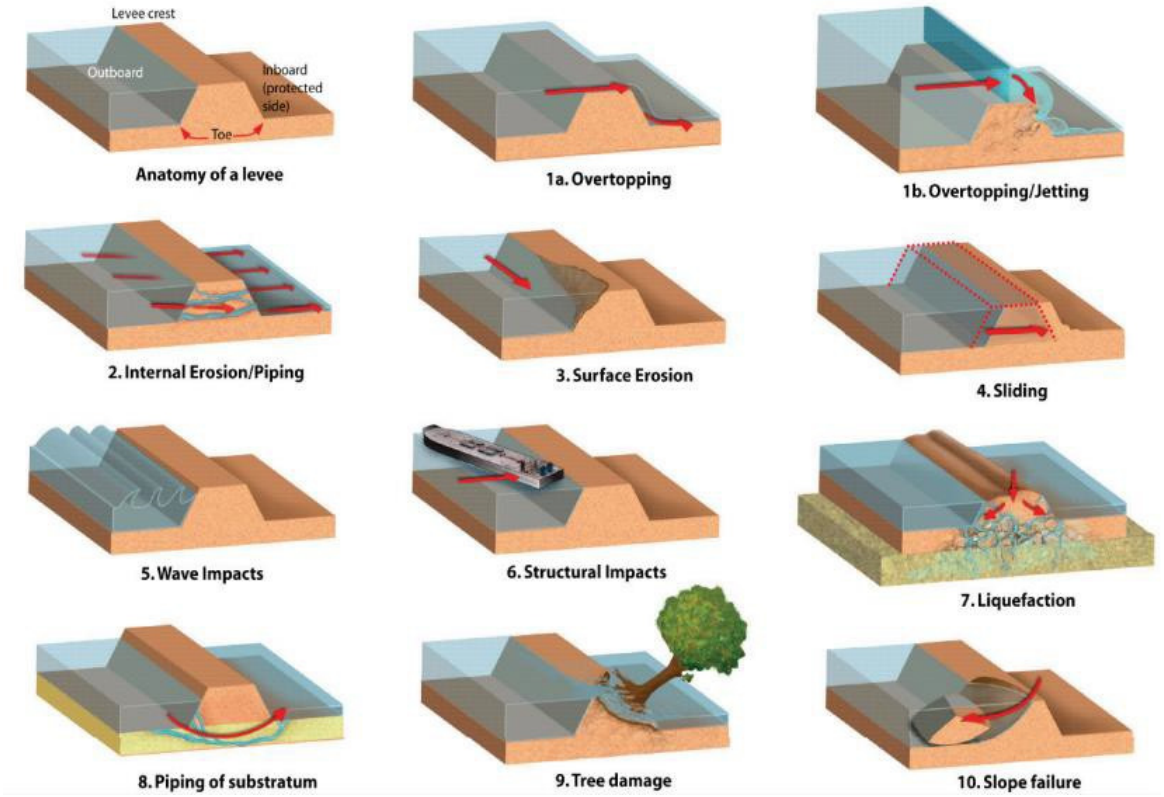


Example of Flood Hazard Map

Flood risk maps in river areas protected by levees typically consider the only risk of overtopping, implicitly disregarding potential failures of the defence structures.

From: The National Flood Risk Analysis for the Netherlands, Final Report

But levees problems are both hydraulic and geotechnical.



From: Zina Deretsky, National Science Foundation

But levees problems are both hydraulic and geotechnical.

Activation of piping phenomena during flooding events, Po river, 20.11.2014

But levees problems are both hydraulic and geotechnical.

Secchia river bank collapse, 19.01.2014

But levees problems are both hydraulic and geotechnical.

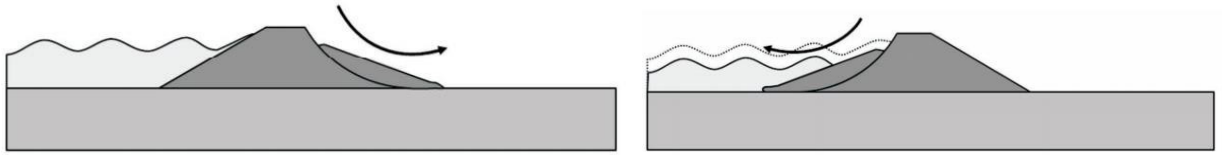
Secchia river bank collapse, 19.01.2014

The available data show that the probability of river bank failure is not negligible.

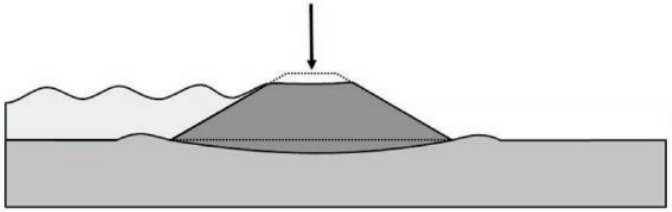
	Po River, from Cremona to Borgoforte	Tagliamento River, from Pinzano to the river mouth	Piave River, from Nervesa to the river mouth	Adige River, from Merano to San Michele
No. bank failures	24	166	82	69
Monitoring period	1800 to 1951	1800 to 1966	1800 to 1966	1872 to 2011
Length of the monitored river stretch (km)	98	91.4	65.1	50
Density of bank failures (failures/km/100 years)	0.16	1.1	0.8	1.0

Bank failures occurred in four Italian rivers of Northern Italy (Ranzi et al., 2013)

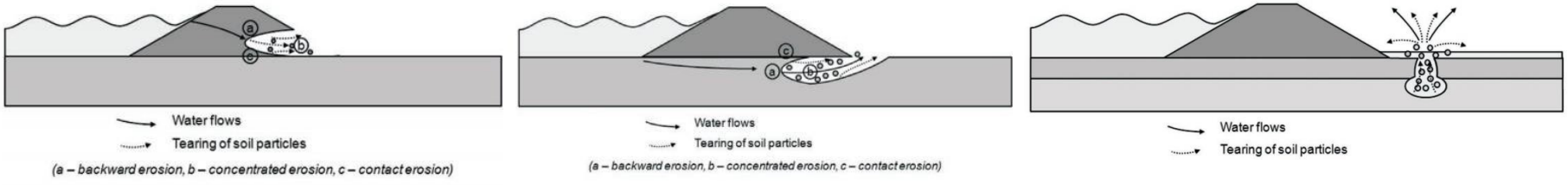
Examples of main causes of river bank collapse to be verified in geotechnics.



Global stability in static and seismic conditions.



Consolidation settlement of foundation.



Backward erosion piping.

Remarks

There is no perfect flood risk management plan.

Consider and combine three approaches:

- ✓ Prevention
- ✓ Risk reduction
- ✓ Response management

Not only focus on the hydraulical conditions but also take the stength of levees into account.

Levees are part of the built environment, which is constantly changing, in maintenance schemes this should be incorporated.

AGI **Guidelines** on geotechnical aspects of river banks design and maintenance.

- ✓ design criteria
- ✓ intervention criteria of adaptation and reinforcement
- ✓ maintenance
- ✓ monitoring and control

USACE (1999) - Risk-Based Analysis in Geotechnical Engineering for Support of Planning Studies

USACE (2000) - Design and construction of levees

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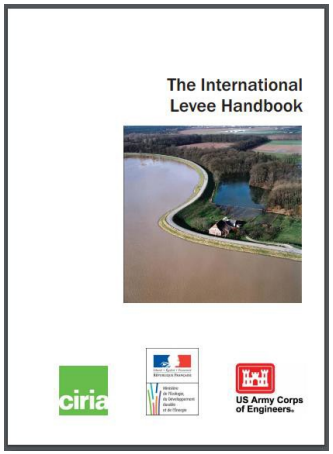
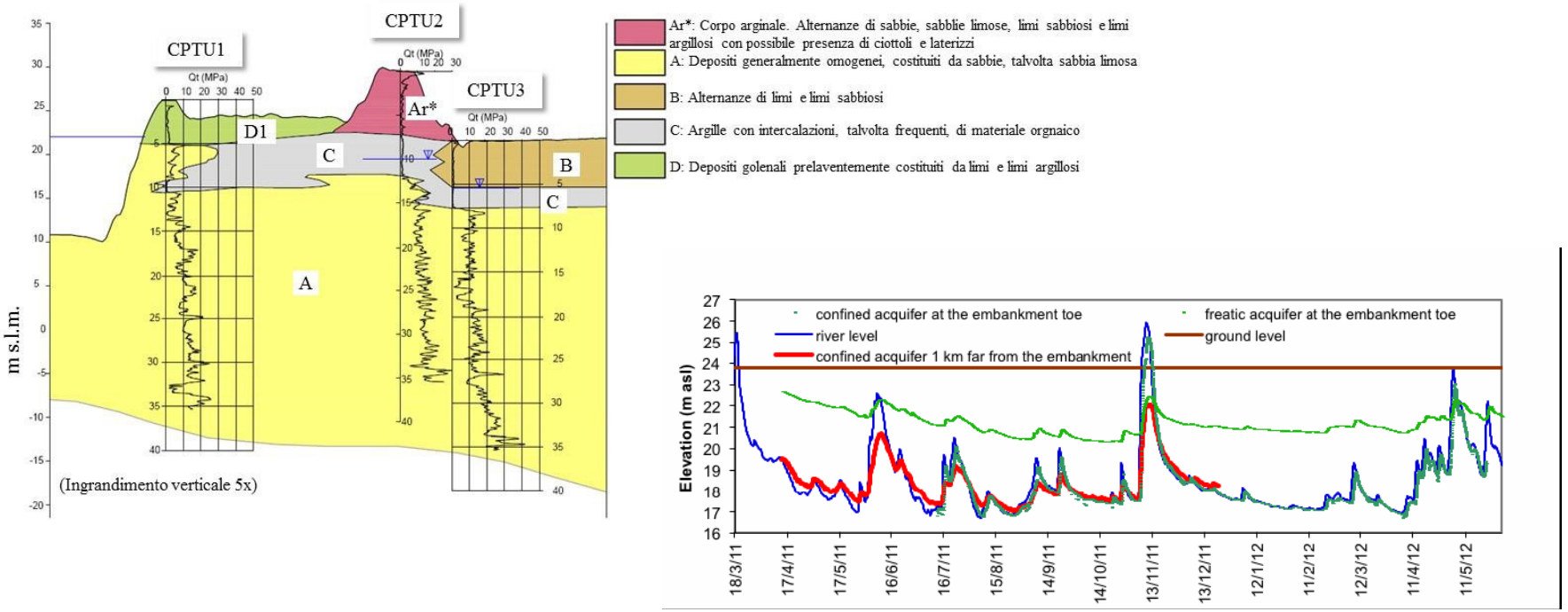


The International Levee Handbook
CIRIA, Ministry of Ecology, 2013

Focus on the importance of an accurate geotechnical model of the river bank system.



SISMAPO Project

Focus on the importance of monitoring and control systems.

Artificial levees are long-stretching structures that protect large areas from flood risk

Risk = f(p*I)

Probability of occurrence
(stable or increasing due to climate change)

Impact

Economic impact
(economic value of possible flooded property)

Human impact
(loss of lives, permanently injured)

Social impact
(risk aversion in the population)

European Commission. 2010 Risk Assessment and Mapping Guidelines for Disaster Management; Brussels

Focus on the importance of monitoring and control systems.

Impact=*Exposure*Vulnerability*

(increasing population, increasing anthropization of territory)

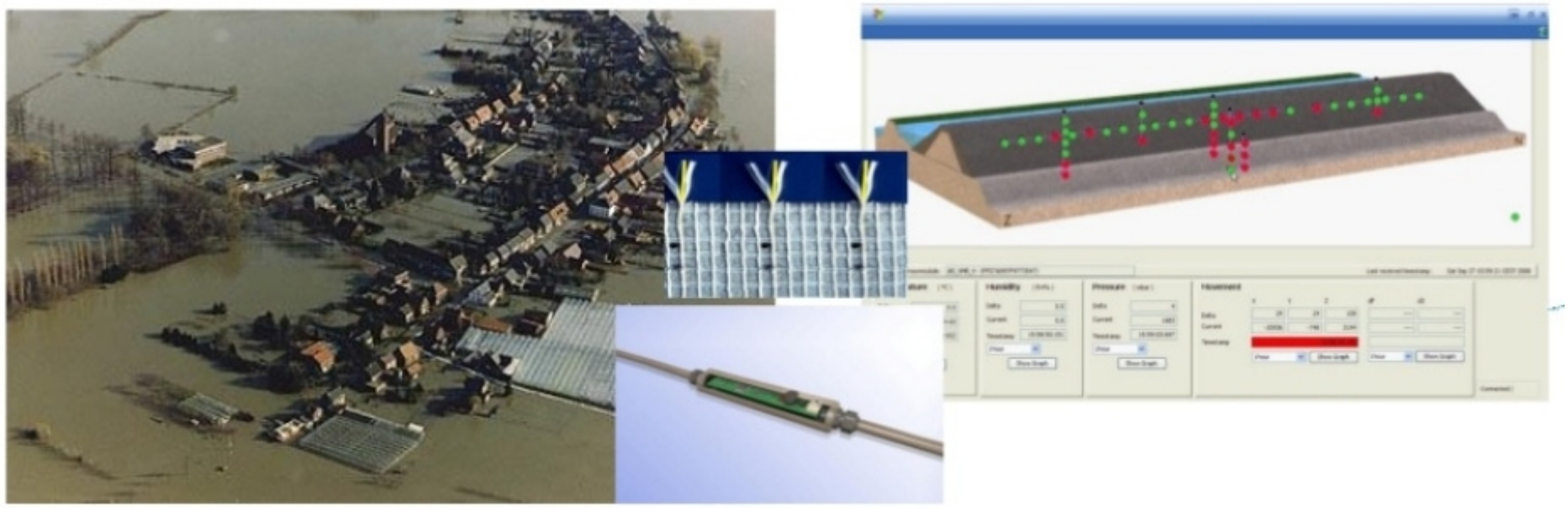
(**reduce vulnerability by increasing resilience and reliability of protection structures to *reduce the overall flood related risk***)

STRUCTURAL HEALTH MONITORING OF LEVEES

European Commission. 2010 Risk Assessment and Mapping Guidelines for Disaster Management; Brussels

STRUCTURE HEALTH MONITORING OF LEVEES

Combining dike & sensor technology for floodrisk management and real-time prognoses of dike stability.

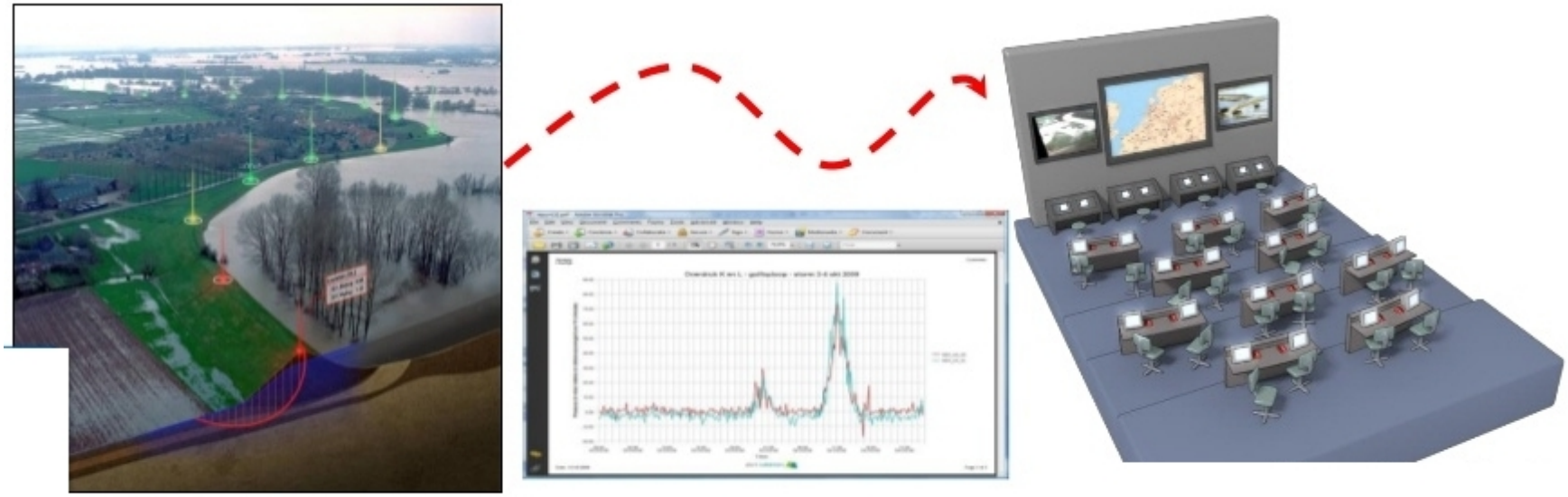


Smart Levees Project

Filippo Maria Soccodato
www.associazionegeotecnica.it

STRUCTURE HEALTH MONITORING OF LEVEES

Use information also to optimize levee maintenance and levee improvement programmes.



Smart Levees Project

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AGI TC Guidelines on geotechnical aspects of river banks design and maintenance

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