Construction and Built Environment: Future Horizons

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novel indicators for identifying critical **INFRA**structure at **RISK** from natural hazards

Dr. Mark Tucker

Roughan & O' Donovan Innovative Solutions (ROD-IS)

RODIS INNOVATIVE SOLUTIONS · Roughan & O'Donovan · GDG GAVIN & DOHERTY GEO SOLUTIONS · DRAGADOS · ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich · probabilistic solutions consult and training

CSIC Consejo Superior de Investigaciones Científicas · UCL · EPSJ · SINTEF · RCAB · iT innovation

Project Details

- **Funding Vehicle**

  EU 7th Framework Programme

- **Work Programme**

  2013 Cooperation Theme 6-Environment (incl. Climate Change)

- **Call Topic**

  Env.2013.6.4-4 Towards stress tests for critical infrastructure against natural hazards

- **Duration & Budget**

  October 2013 – September 2016

  approx. €2,8 million

Background to the Concept

- **Preparedness and resilience/vulnerability of society**
- **Natural hazards on the increase coupled with**
  - Increased land occupation
  - Eastwards expansion of the EU
  - Ageing infrastructure
  - Climate Change
  - Human activity
  - Pan European Networks

EU Concerns

Resilient Infrastructure

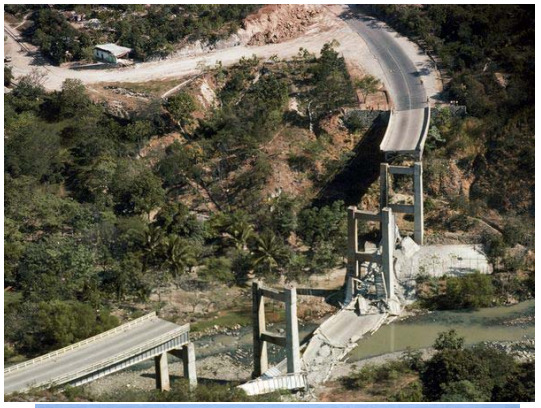
- Effective Road & Rail Transport Network
- Increased Traffic
- Ageing Infrastructure
- Budgets
- Resources

Goal of INFRARISK

- **Develop reliable stress tests to establish the resilience of Critical European Infrastructures to rare low frequency extreme natural hazard events**
- **To aid decision making in the long term regarding robust infrastructure development and protection of existing infrastructure**

Expected Impacts

- **Improved & more reliable stress tests of CI**
- **Support for decision making & Prioritisation in the field of mitigation options and support to preparedness.**
- **Pan European and Optimised risk assessment process**
- **Optimised operational risk assessment for maintenance and management**
- **Resilience to climate risks**
- **Decoupling of economic growth & energy use**



Consortium

Roughan & O'Donovan

RODS INNOVATIVE SOLUTIONS

ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich

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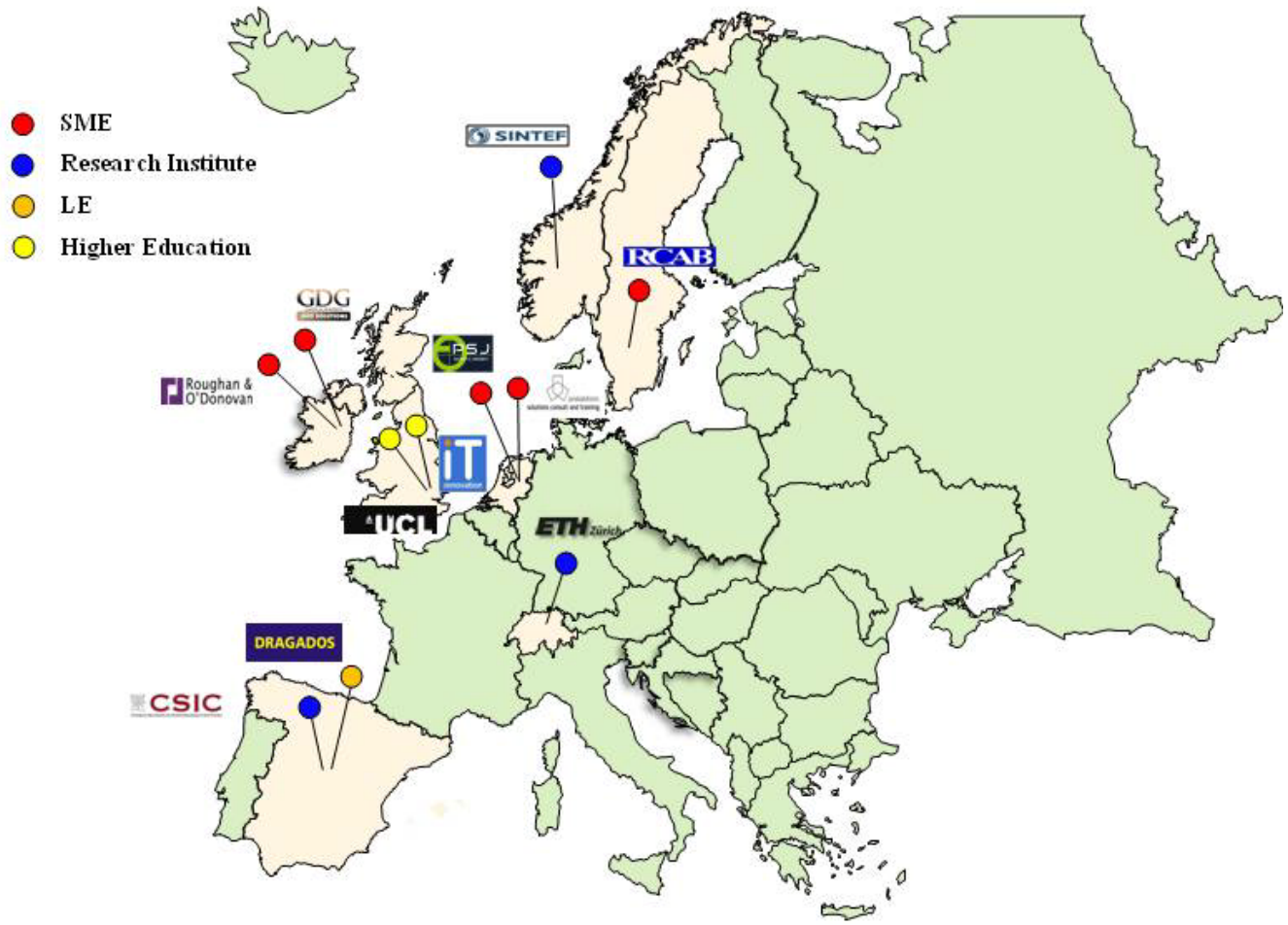
SME
Research Institute
LE
Higher Education
SINTEF
RCAB
GDG
Roughan & O'Donovan
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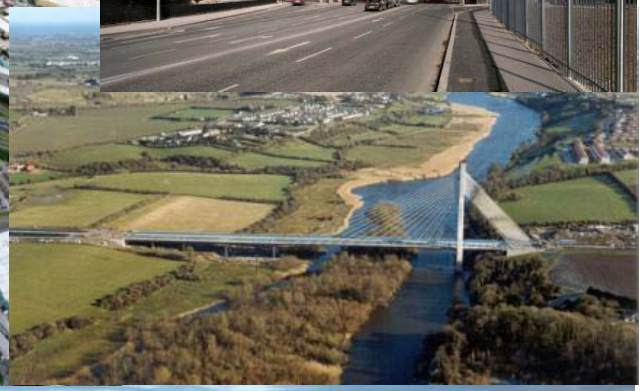
CSIC

Coordinators

- **Roughan & O' Donovan (ROD)**
  - Bridges
  - Transportation
  - Buildings
  - Environmental
  - Asset management
- **Roughan & O' Donovan Innovative Solutions (ROD-IS)**
  - SHM
  - Weigh-in-Motion
  - Traffic load modelling
  - Risk Based Asset Management



Important Factors

- Which Hazards?
- Type, Location, Components , Connectivity of infrastructure affected/disrupted?
- Types & extent of networks?
- Material utilised in infrastructure?
- Physical condition of infrastructure?
- Design Codes?
- Required Level of Service?
- Criticality descriptor?
- Post event response & communication?
- Level of preventive actions?

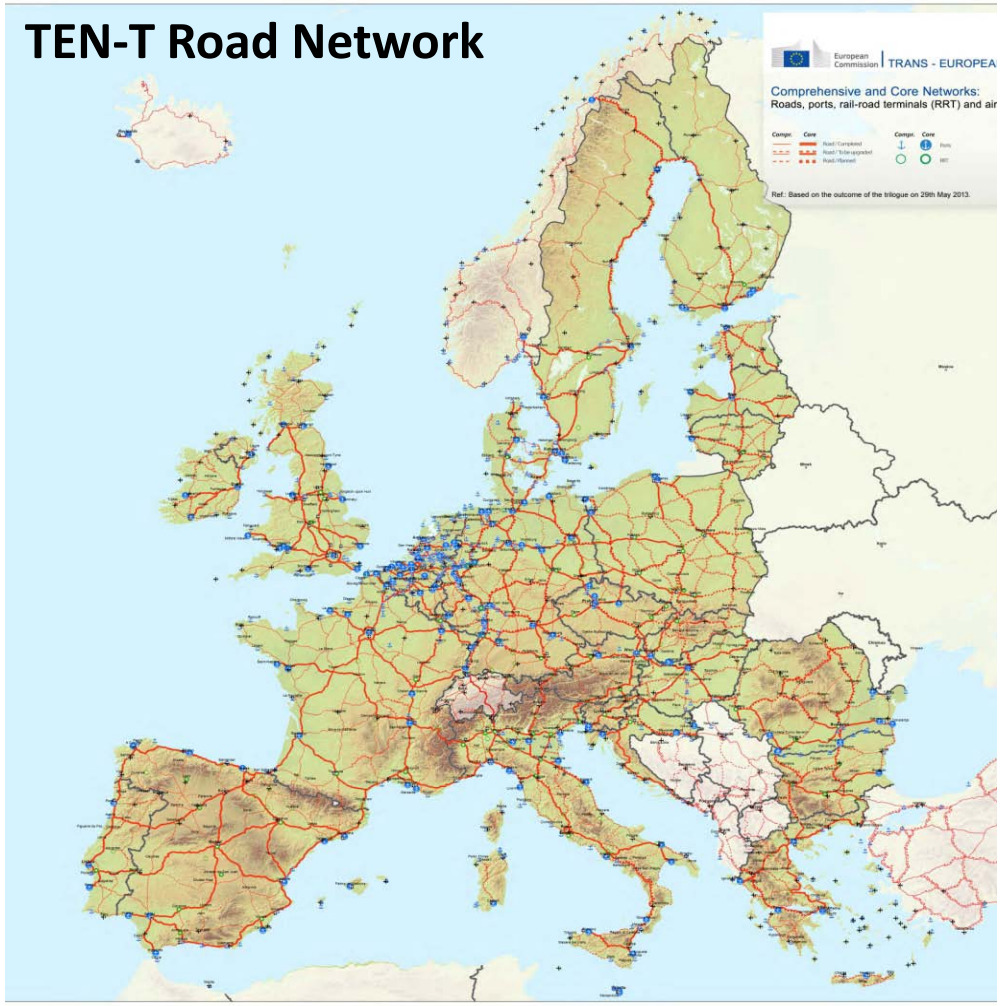
Output Considered

- Extent of consequences
- Structural damage
- Casualties / fatalities
- Environmental impact
- Rate of flow of traffic
- Restoration/recovery time
- Emergency services
- Cost of damage
- Cost of recovery

RODS INNOVATIVE SOLUTIONS Roughan & O'Donovan

Project Focus

- **INFRASTRUCTURE**
  - ➢ Road & Rail
    - Bridges
    - Surface
    - Tunnels
    - Embankments



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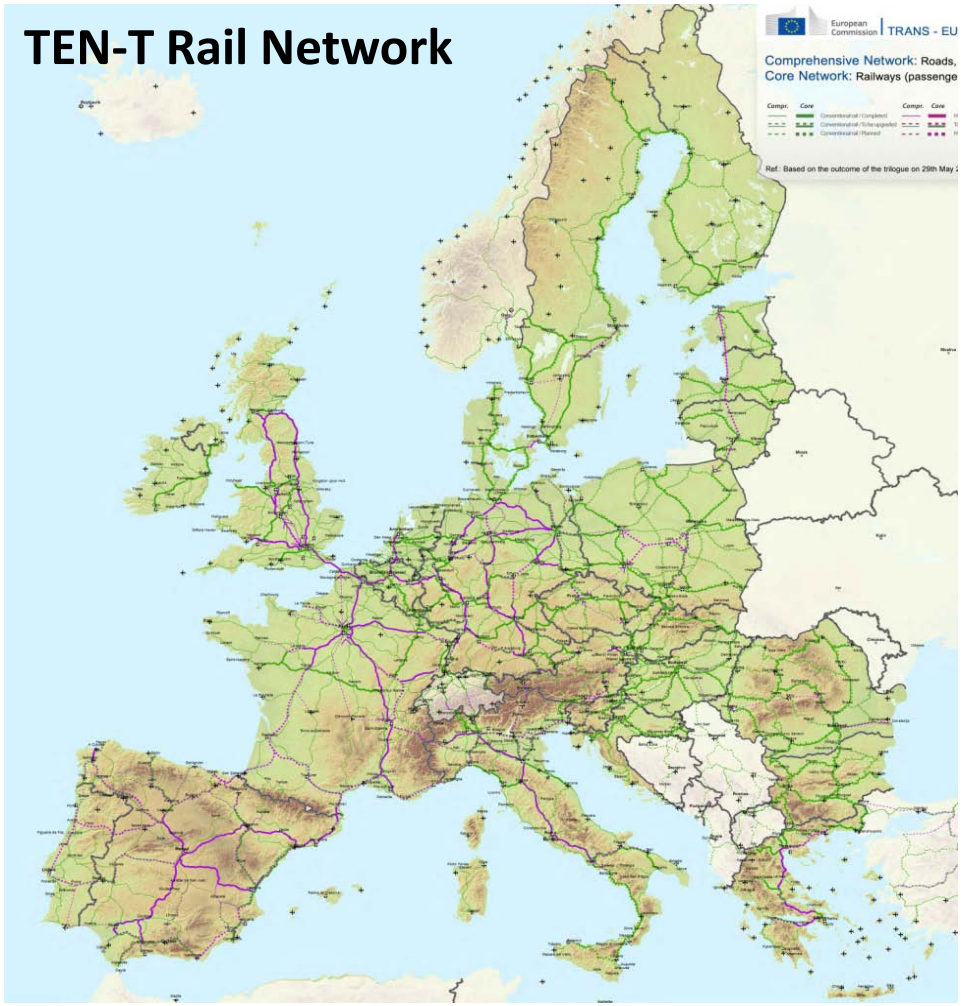
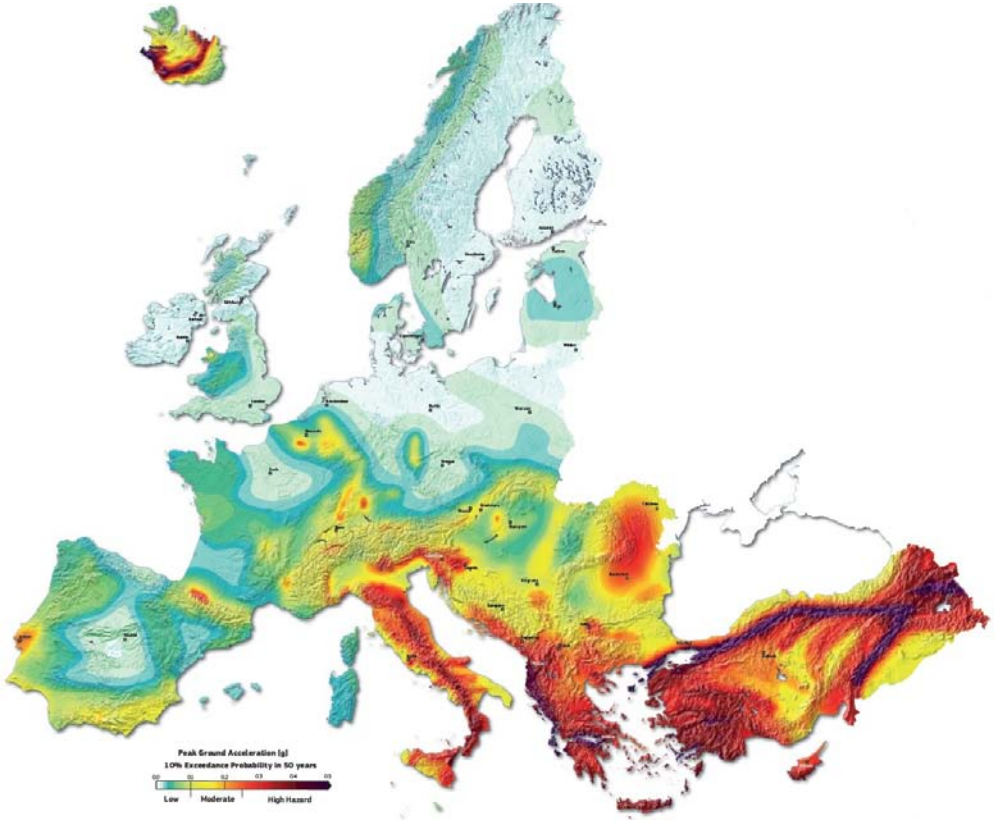


Project Focus

- **HAZARDS**
  - Seismic
  - Flood
  - Landslide
  - Trigger/Cascading Hazards



Giardini et al. 2013

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Alfieri et al. 2013

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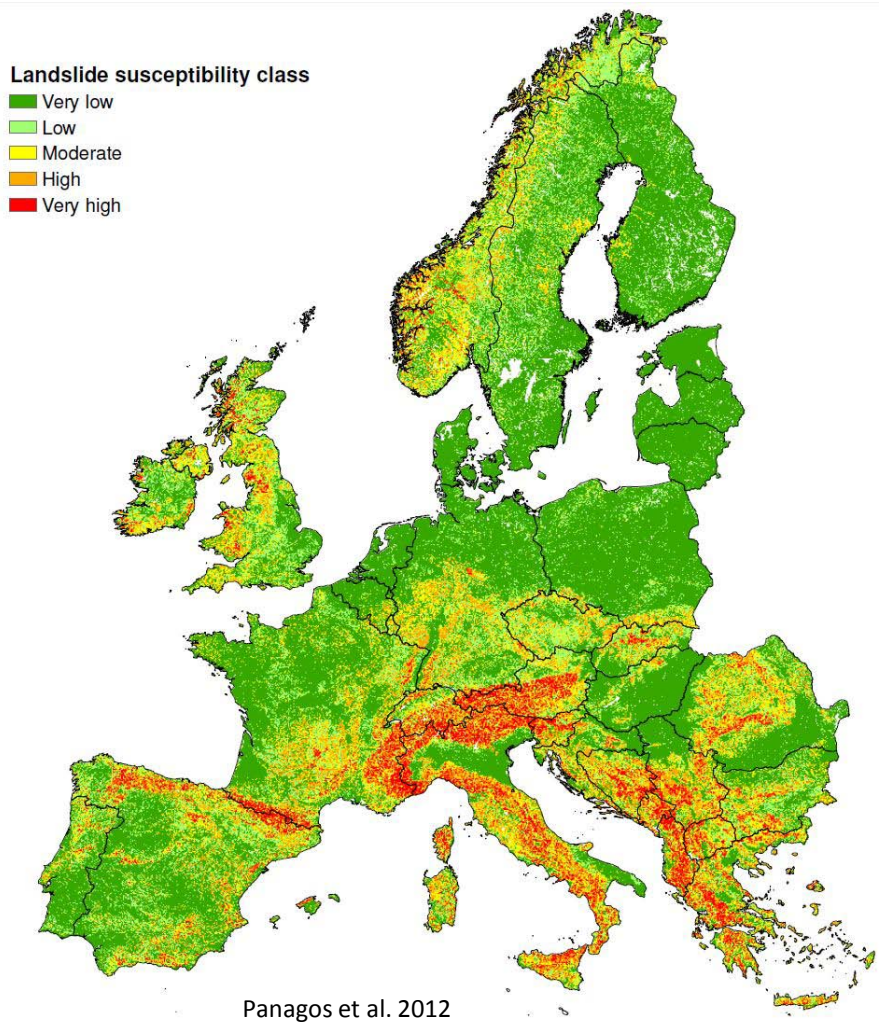
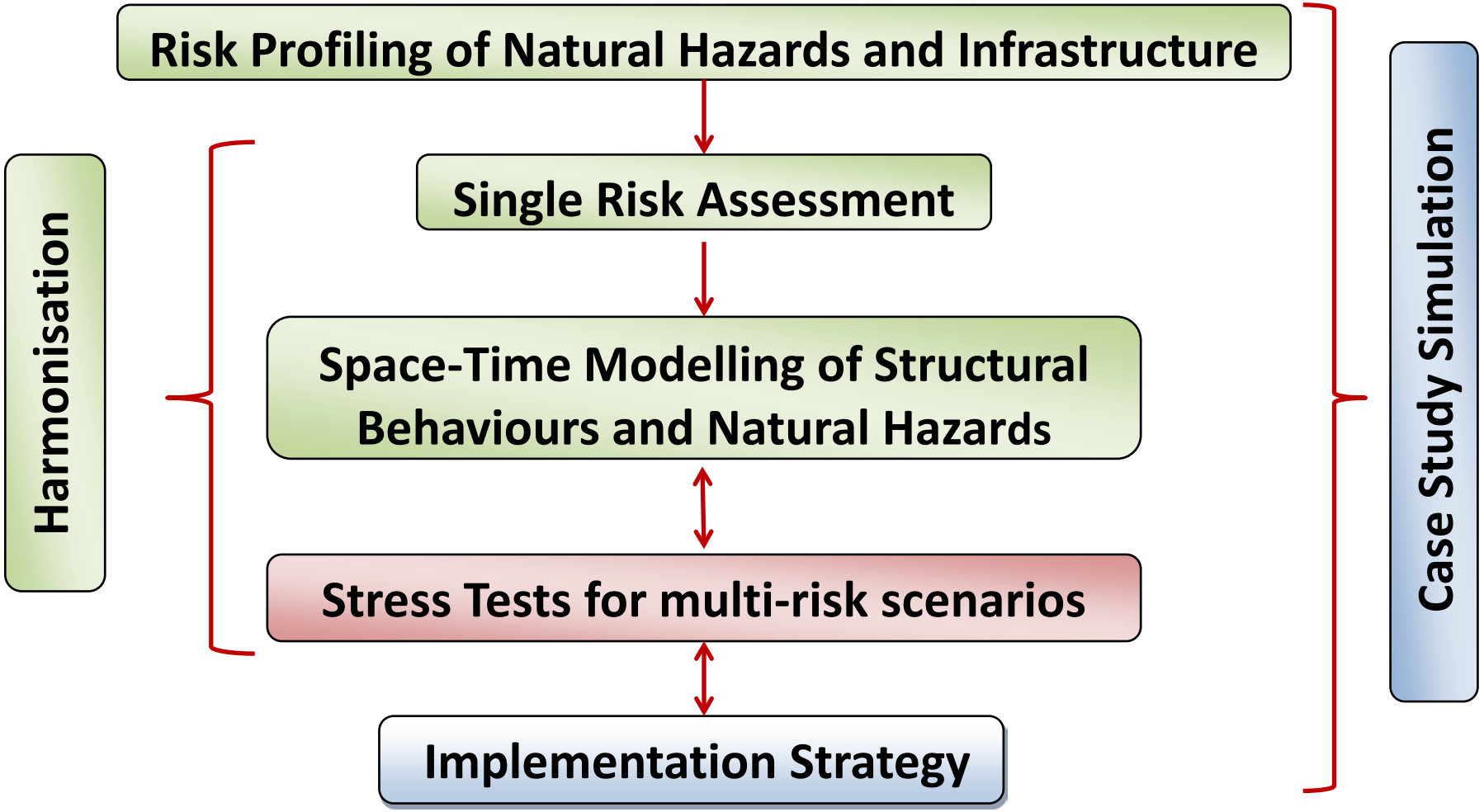


Panagos et al. 2012

Work Streams

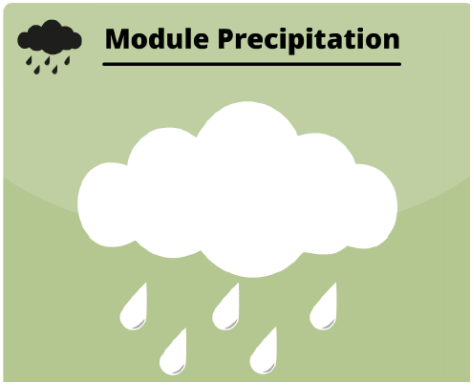


Methodology

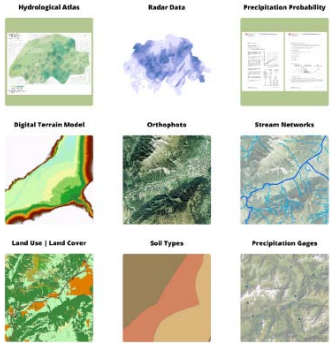
- **Step 1: Define problem**
- **Step 2: Define system**
- **Step 3: Identify Risk**
- **Step 4: Risk Analysis**
- **Step 5: Evaluate Risk**

Methodology

Module Precipitation

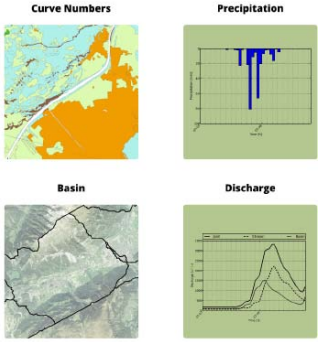


Input Precipitation

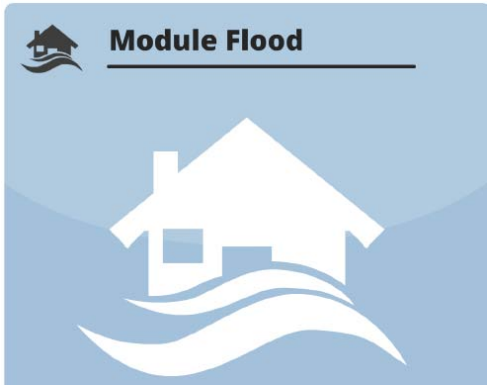


Model Precipitation

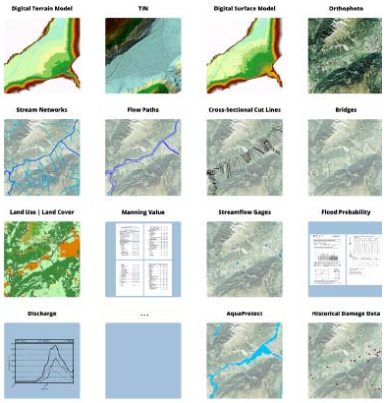
Output Precipitation



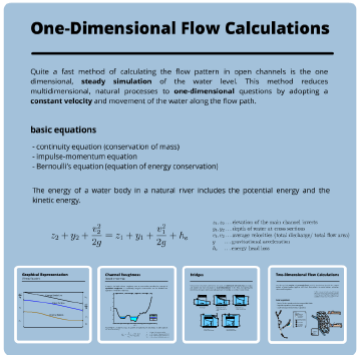
Module Flood



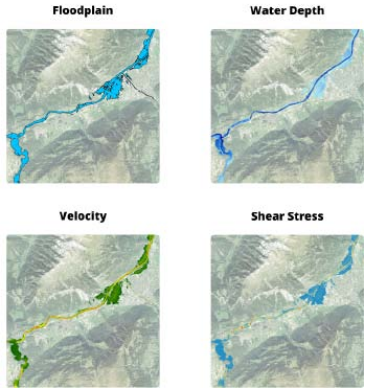
Input Flood



Model Flood



Output Flood



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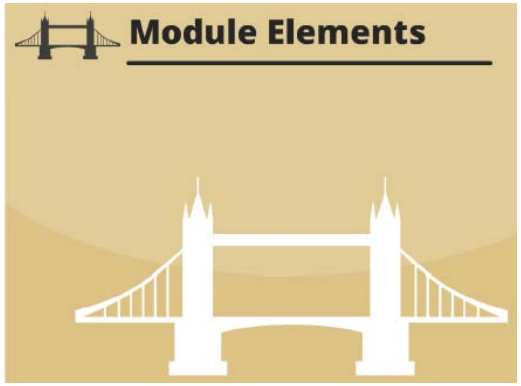
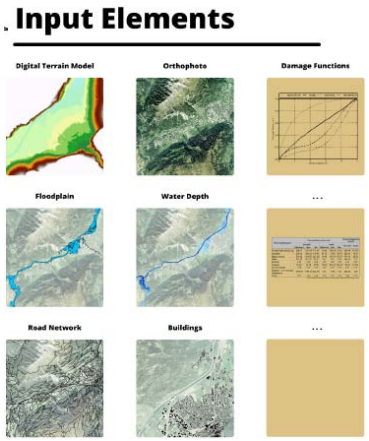
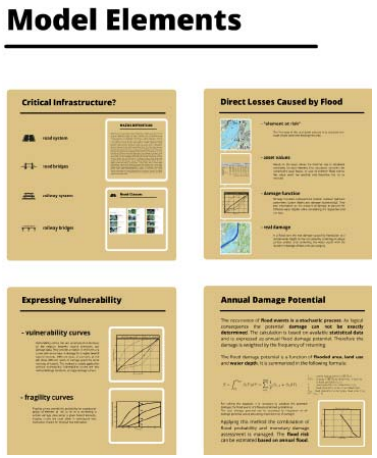
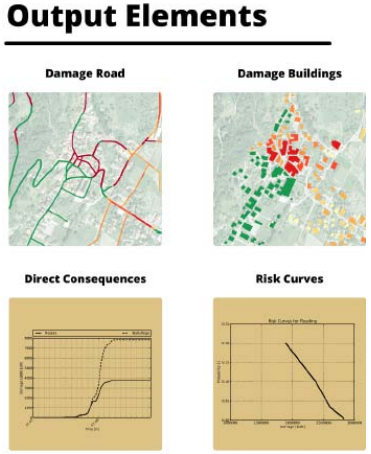
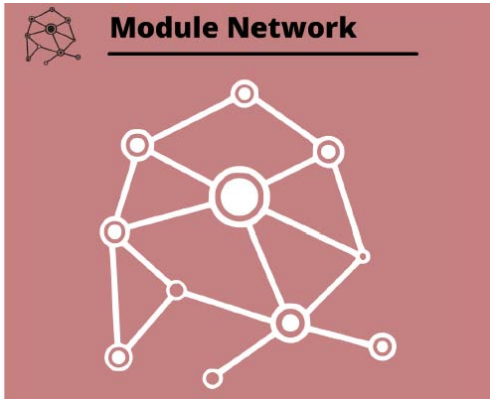
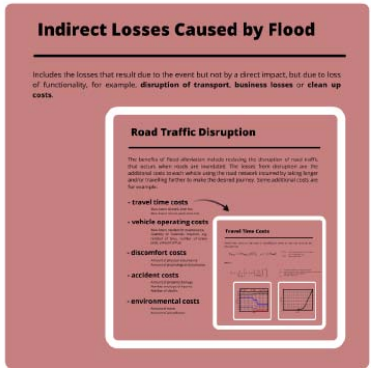


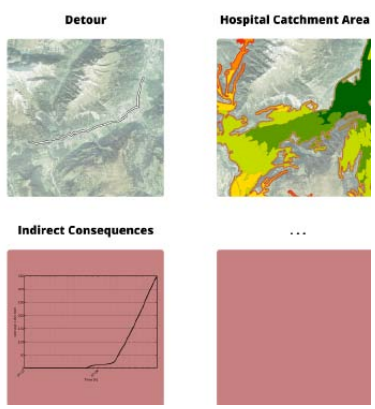


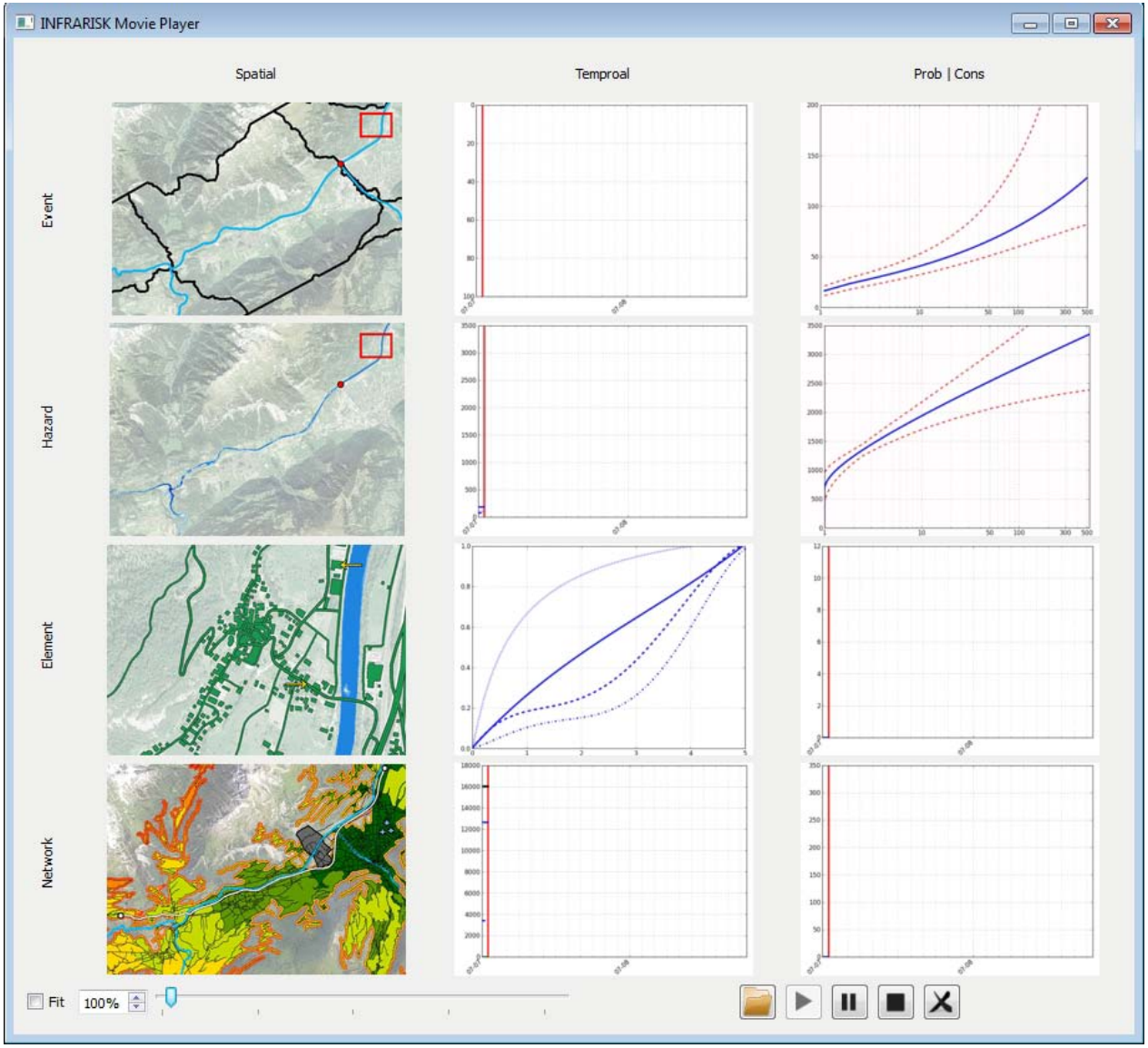




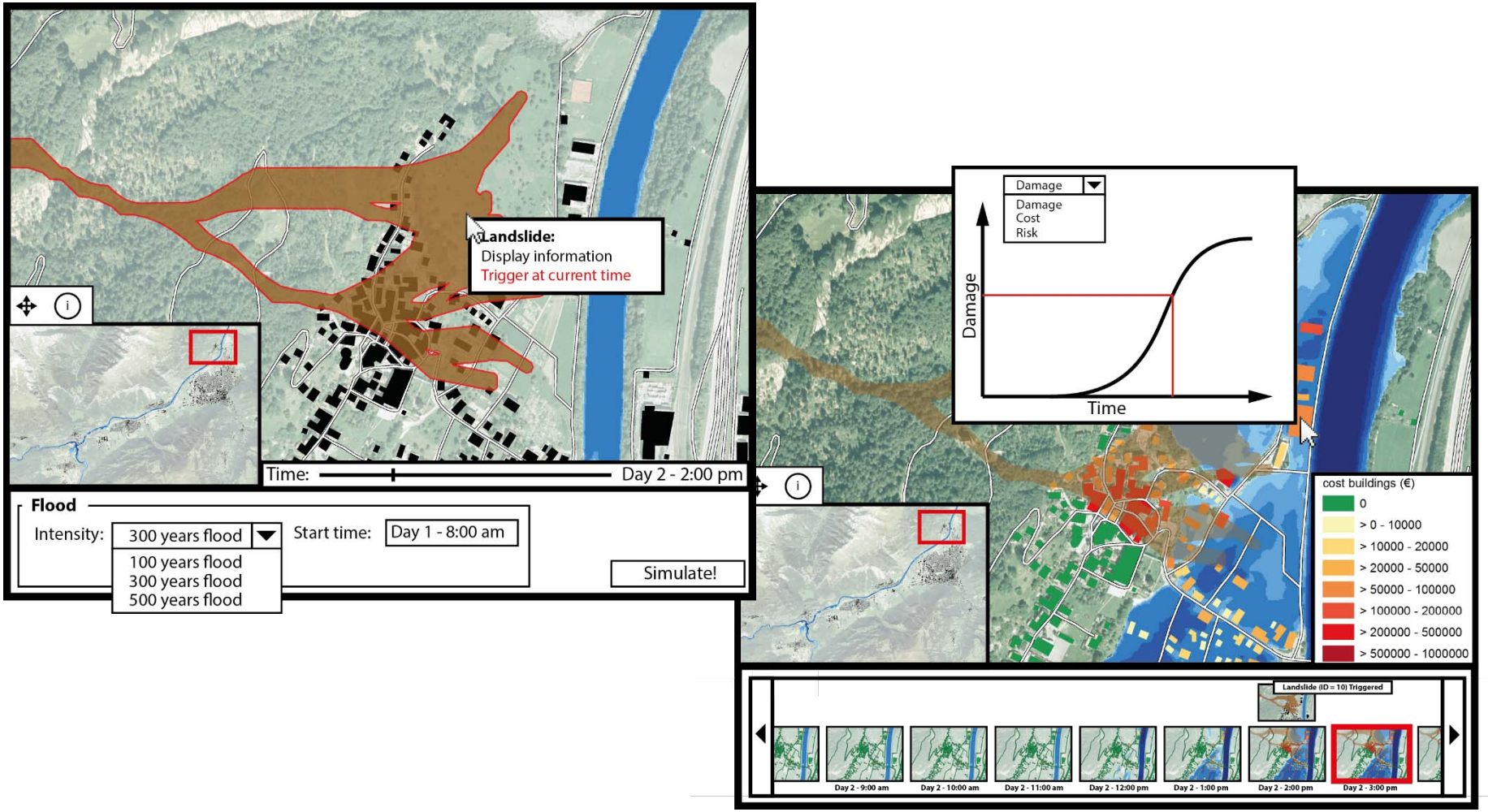







INFRARISK Movie Player
Spatial
Temproal
Prob | Cons
Event
Hazard
Element
Network
Fit
100%

Methodology



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Website

www.infrarisk-fp7.eu

Acknowledgement

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