The 2nd Kobe University Brussels European Centre Symposium

Panel Discussion

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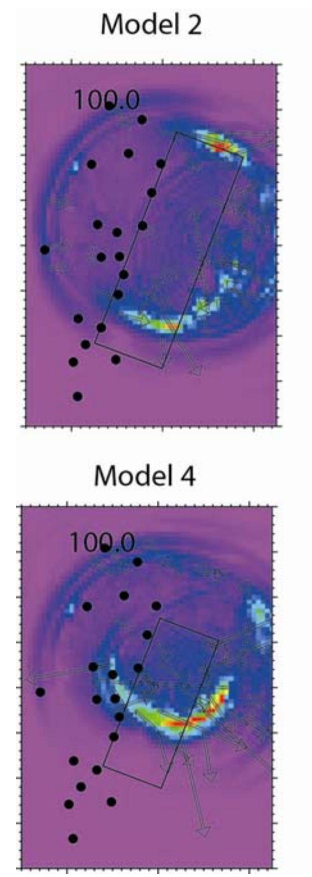
Scientific Perspectives following GEJET

> Comprehension of mechanism

- Analysis and modeling the seismic source
- Improving Tsunami generation models
- Analysis of Systemic Vulnerability (FP7: Syner-G)
- Risk Analysis including transient vulnerability, Cascading and Conjoint events (FP7 MATRIX)



> Knowledge transfer and capitalization from Japanese experience on Early Warning and Alert

- Elaboration of Early Warning Systems :
  - European : (FP7 : REAKT)
  - Regional : (RATCOM)

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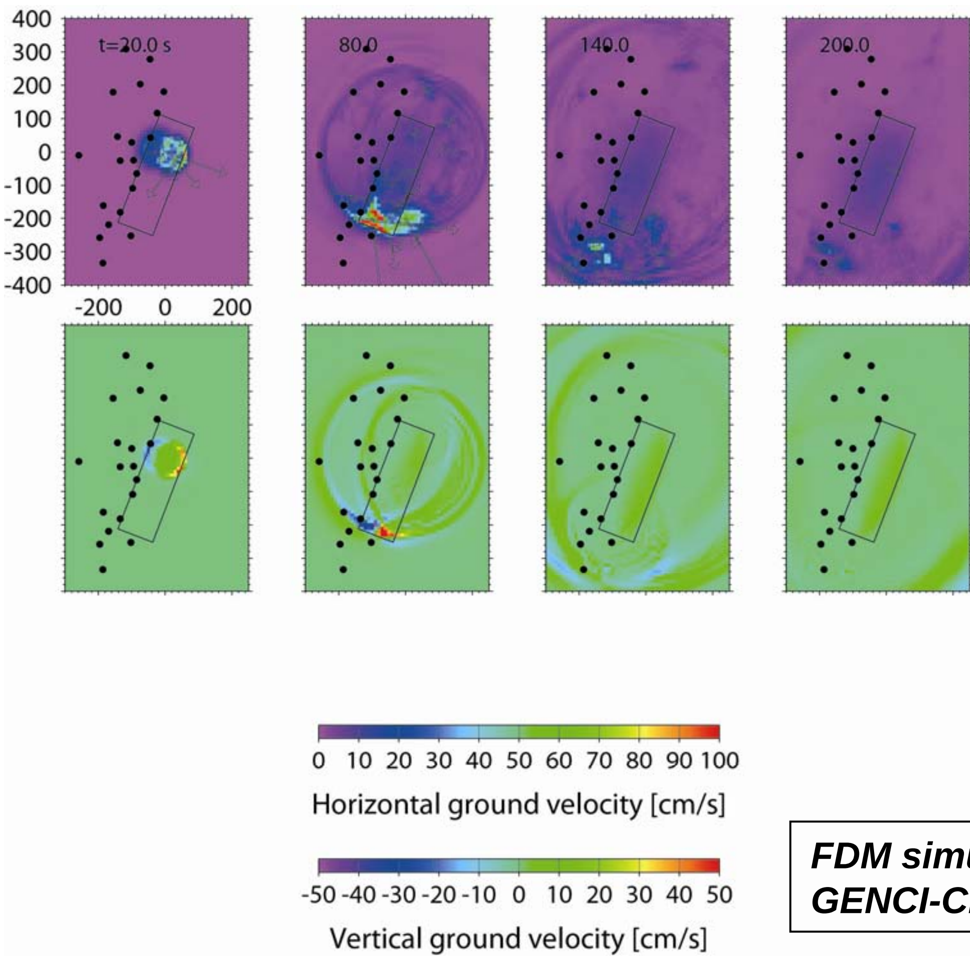
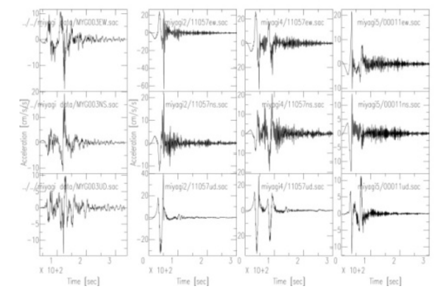
Numerical Seismic Source Modeling

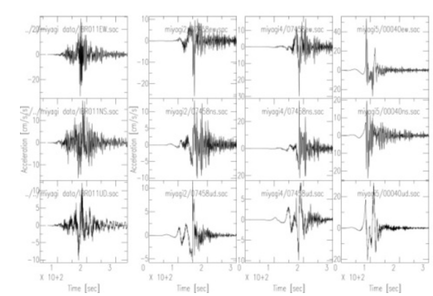
> Seismic motion in 3D



Miyagi (120 km East of the epicenter)



Ibaraki (400 km South-West of the epicenter)



FDM simulation
GENCI-CINES (128 proc)

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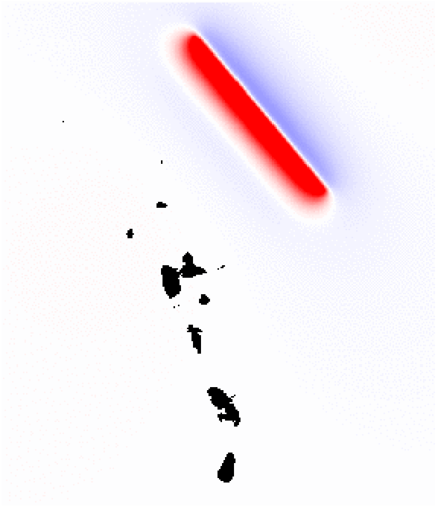
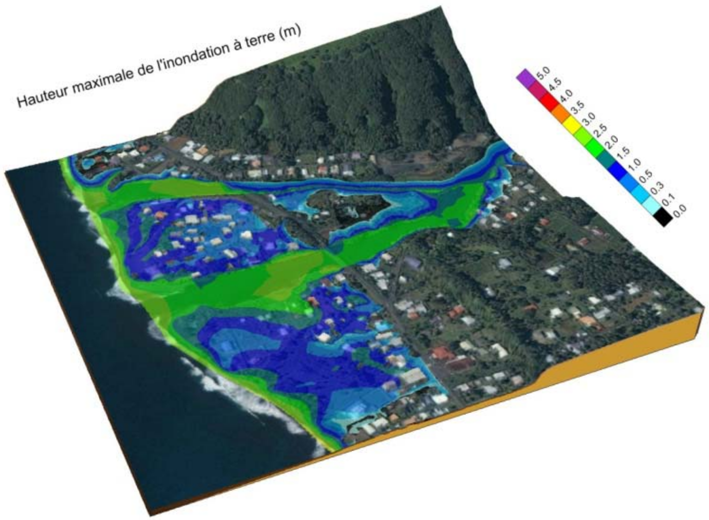
Tsunami modeling

- Generation
  - Example : Antilles (Barduda, M 8,3)



- Submersion
  - Example : Papenoo (Tahiti, PF)
  - Utilization of SurfWB
  - Taking into account buildings and land roughness
  - Better estimation of attained zones



Two examples of recent collaboration with Japon on Tohoku Earthquake

(Japan Science and Technology Agency (JST)/ French National Research Agency(ANR))

- **ONAMAZU** : Quantitative assessment of nonlinear soil response during the great 2011 Tohoku earthquake

with

  - Disaster Research Prevention Institute (DPRI), Hiroshi Kawase
  - National Research Institute for Earth Science and Disaster Prevention (NIED),Nelson Pulido
  - Shimizu Corporation, Kenichi Tsuda

- **DYNTOHOKU :** Dynamics of the 2011 Tohoku earthquake: from long term stress accumulation to asperities

with

  - National Research Institute for Earth Science and Disaster Prevention (NIED), Eiichi Fukuyama
  - University of Tokyo (UTOKYO) Satoshi Ide
  - Geospatial Information Authority of Japan (GSI) : Takuya Nishimura

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SYNER-G

Systemic Seismic Vulnerability and Risk Analysis for Buildings, Lifeline Networks and Infrastructures Safety Gain

Coordinator: Prof. Kyriazis Pitilakis, Aristotle University, Thessaloniki, Greece

Duration: 36 months (starting date: Nov. 1st, 2009)

Project Webpage: http://www.syner-g.eu/




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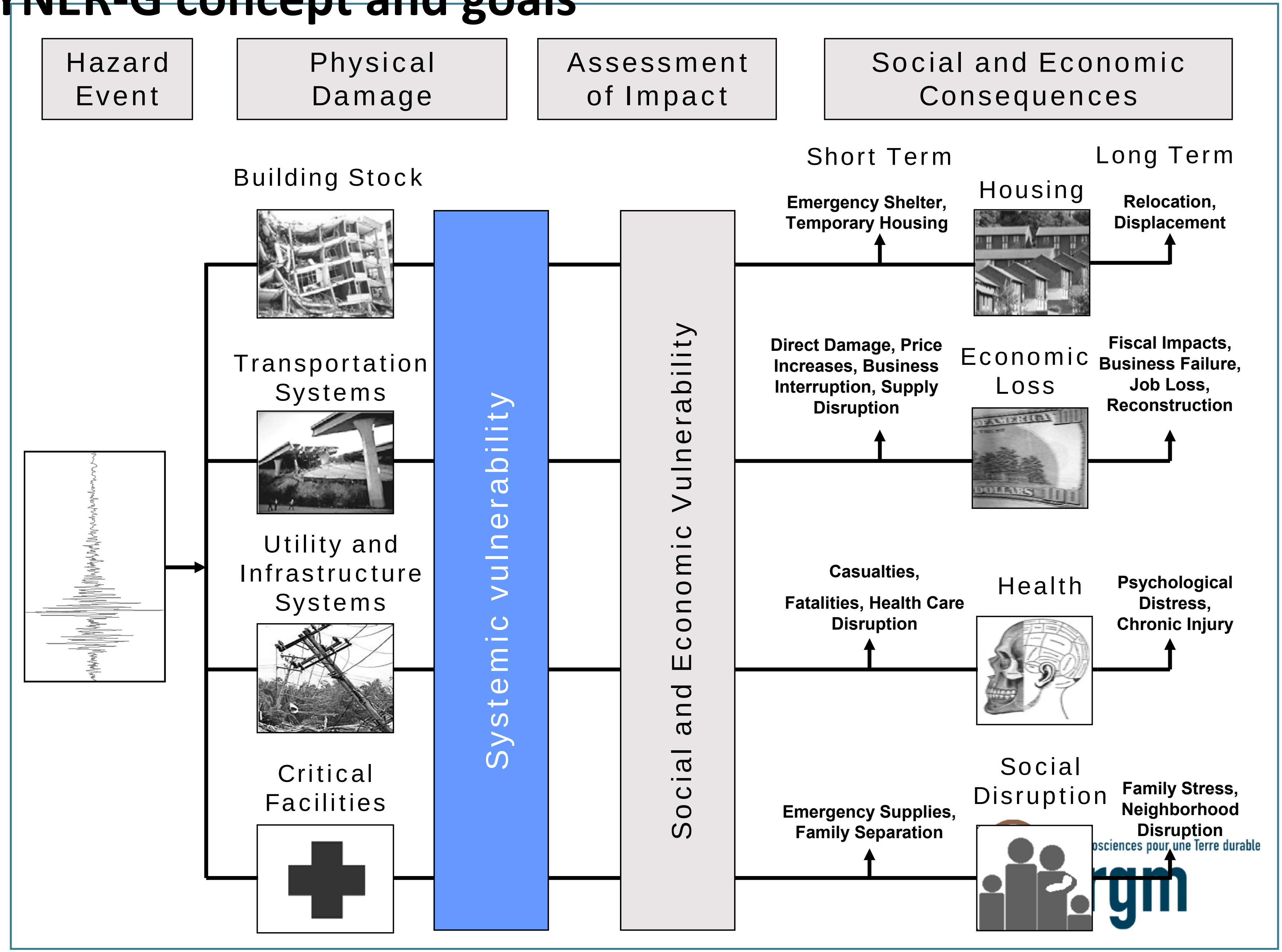
14 participants from 11 countries

GRE AUS FRA BEL NOR ITA TUR GER UK USA JAP

1	ARISTOTLE UNIVERSITY OF THESSALONIKI	AUTH	GREECE
2	VIENNA CONSULTING ENGINEERS	VCE	AUSTRIA
3	BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES	BRGM	FRANCE
4	COMMISSION OF THE EC - DIRECTORATE GENERAL JOINT RESEARCH CENTRE	JRC	BELGIUM
5	NORWEGIAN GEOTECHNICAL INSTITUTE	NGI	NORWAY
6	UNIVERSITY OF PAVIA	UPAV	ITALY
7	UNIVERSITY OF ROMA “LA SAPIENZA”	UROMA	ITALY
8	MIDDLE EAST TECHNICAL UNIVERSITY	METU	TURKEY
9	ANALYSIS AND MONITORING OF ENVIRONMENTAL RISKS, UNIVERSITY OF NAPLES FEDERICO II	AMRA	ITALY
10	UNIVERSITY OF KARLSRUHE	KIT-U	GERMANY
11	UNIVERSITY OF PATRAS	UPAT	GREECE
12	WILLIS GROUP HOLDINGS	WILLIS	UK
13	MID-AMERICA EARTHQUAKE CENTER, UNIVERSITY OF ILLINOIS	UILLINOIS	USA
14	RESEARCH CENTRE FOR URBAN SAFETY AND SECURITY, KOBE UNIVERSITY	UKOBE	JAPAN

SYNER-G concept and goals



SYNER-G three main objectives

- Select the most advanced **fragility functions** and methods to assess the **physical and societal-economic vulnerability** of all assets, improving and further developing new ones where necessary, considering **European distinctive features**
- Develop a **unified methodology** to assess **vulnerability at a system level** considering interdependencies between elements at risk (physical and non-physical), belonging to different systems and between different systems as a whole at city and regional scale
- Build an appropriate **open-source software and tool** to deal with systemic vulnerability

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SYNER-G project workflow

GENERAL METHODOLOGY

PHYSICAL VULNERABILITY & LOSSES
for elements and systems

SOCIO-ECONOMIC VULNERABILITY & LOSSES
for elements and systems

SYSTEMIC VULNERABILITY & LOSSES

- Buildings & Aggregates
- Utility Systems
- Transportation Infrastructures
- Critical facilities

Interdependencies

APPLICATION & VALIDATION

- Urban Scale
  Thessaloniki city
  Vienna city
- Utility - Transportation
  Pipeline network
  Motorway in Italy
  Electric network in Italy
  Harbor of Thessaloniki
- Critical Facilities
  Hospital facility in Italy

GUIDELINES & DISSEMINATION

SOFTWARE TOOLS

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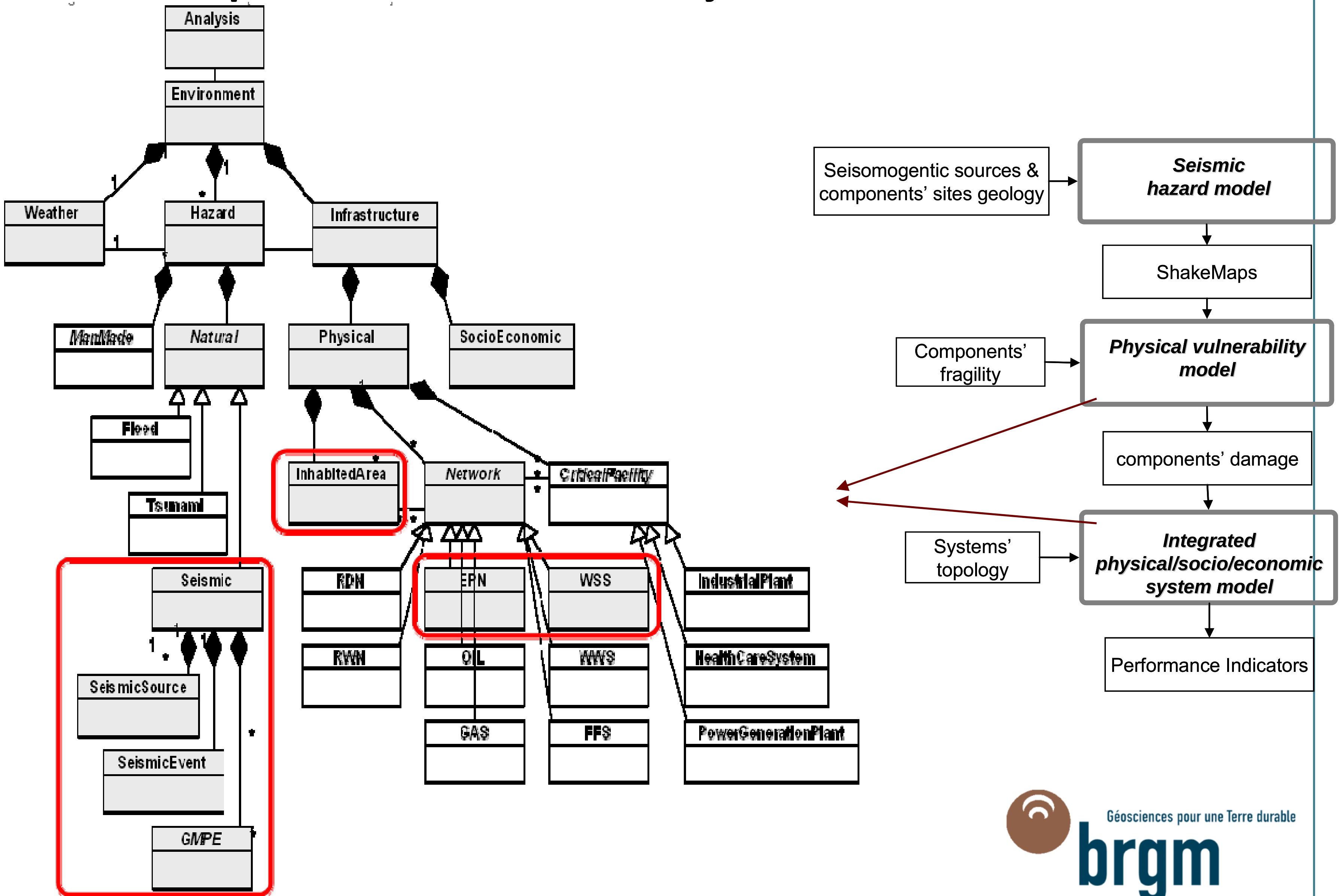
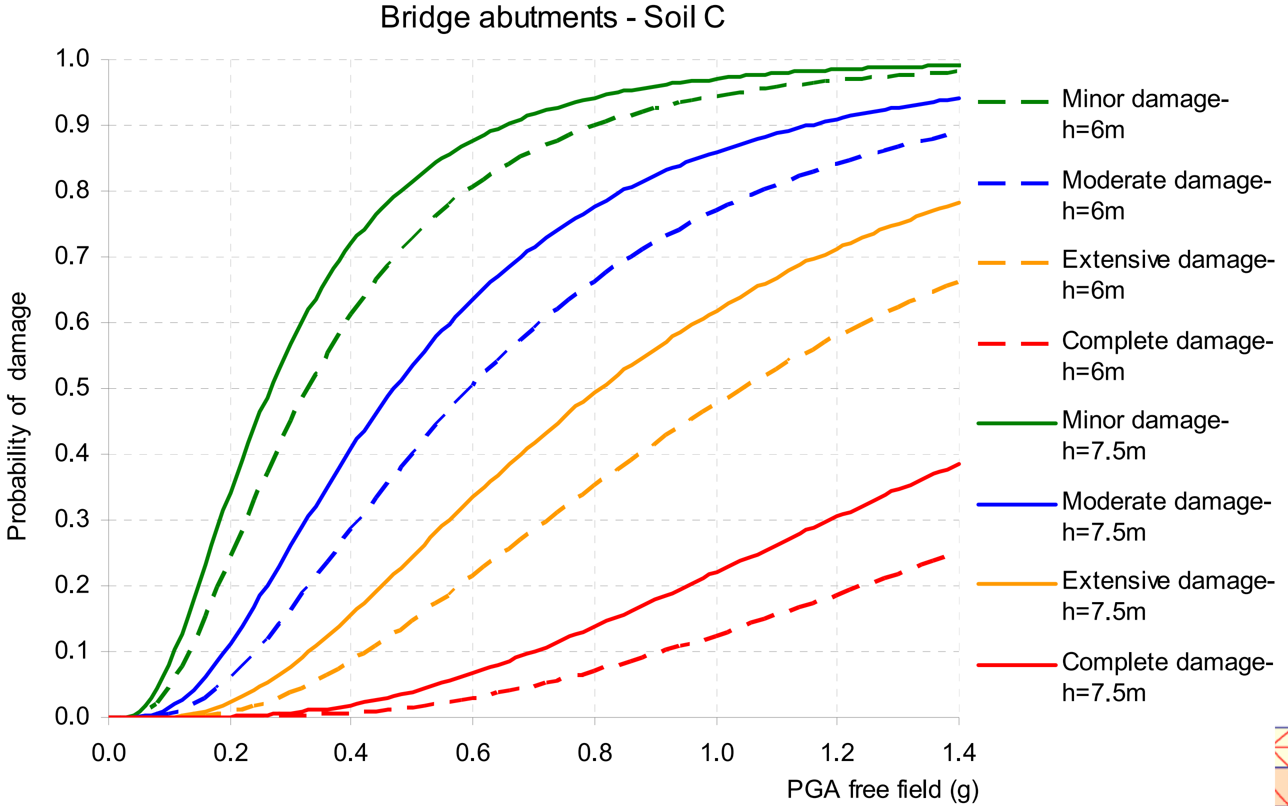
Representative results: Object-oriented Model

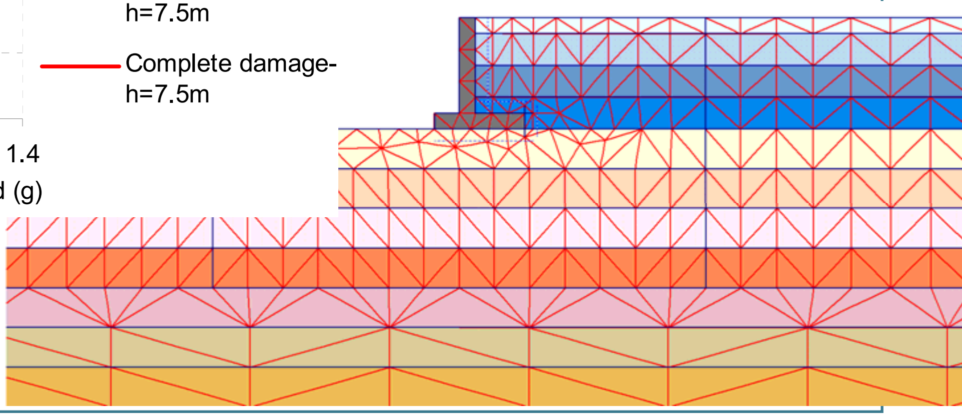


Representative results: Fragility Curves

New numerical fragility curves for bridge abutments based on 2D dynamic analyses for different soil types, abutment geometries and input motions

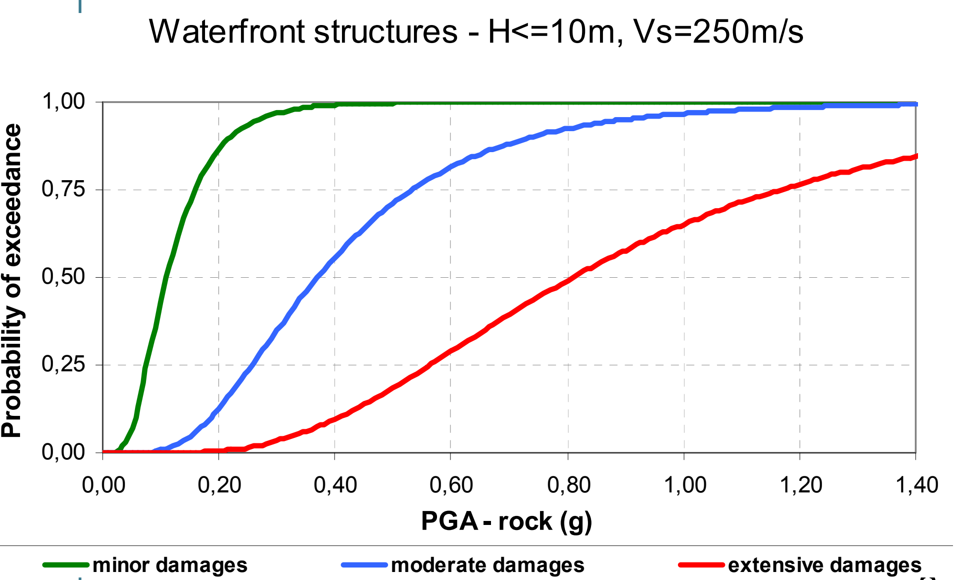


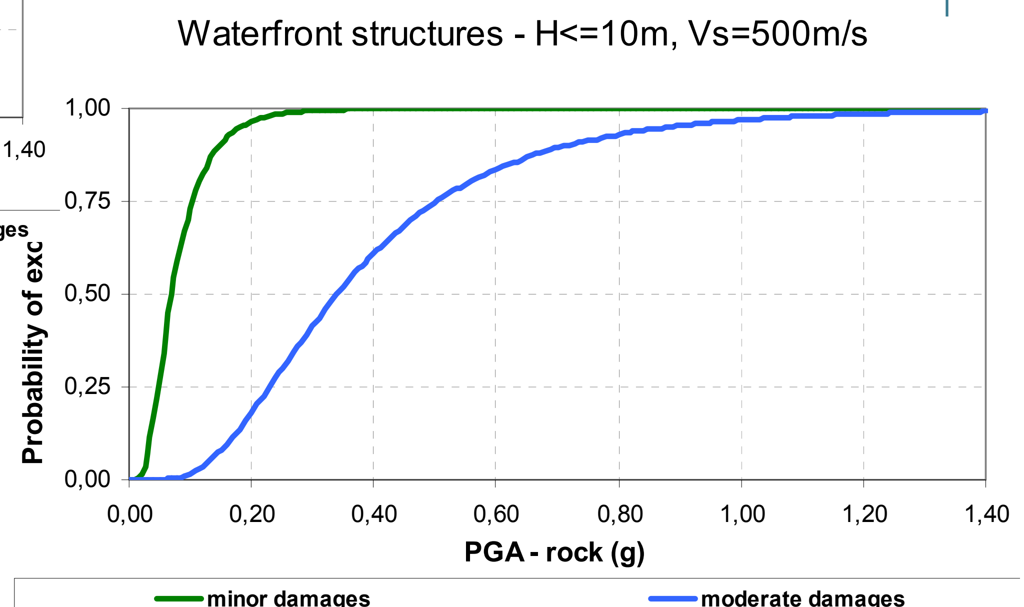
Soil types (EC8): C, D
Abutment heights: 6, 7.5m



Representative results: Fragility Curves

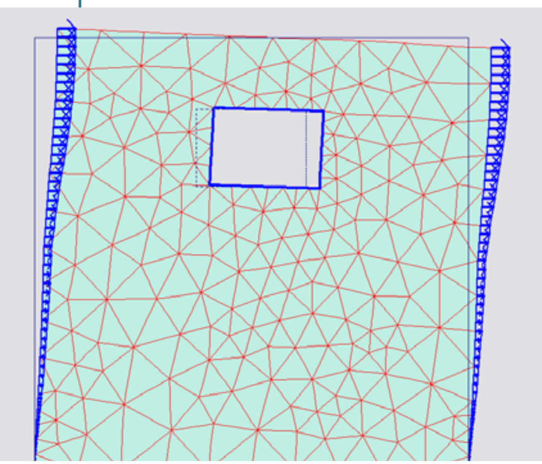
New numerical fragility curves for waterfront structures based on 2D finite element analysis for different wall heights (> and ≤10m) and soil foundation conditions

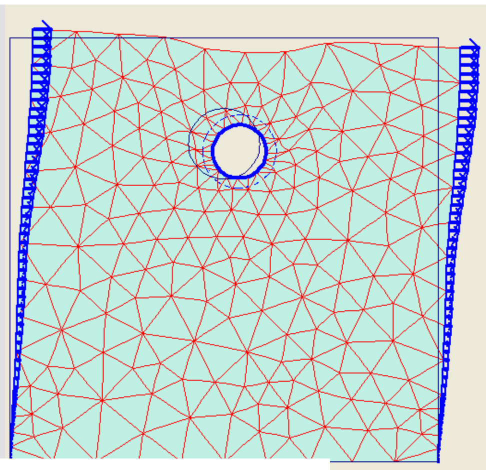


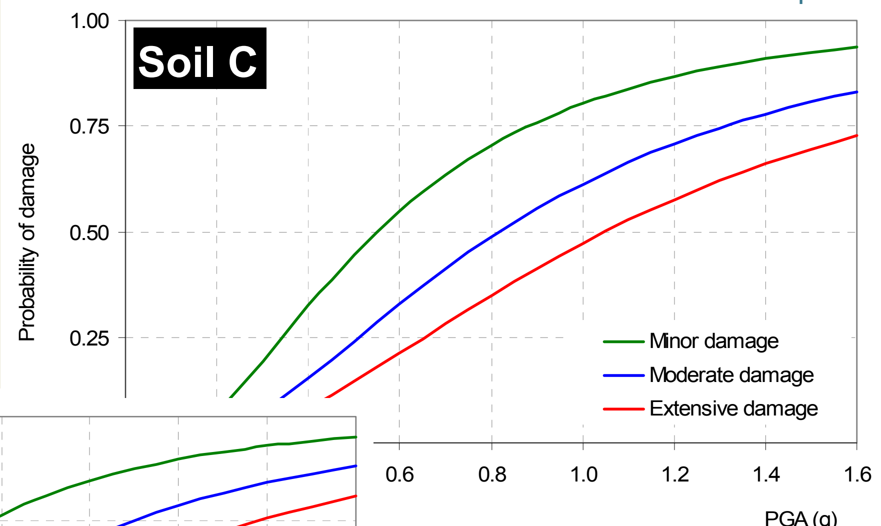


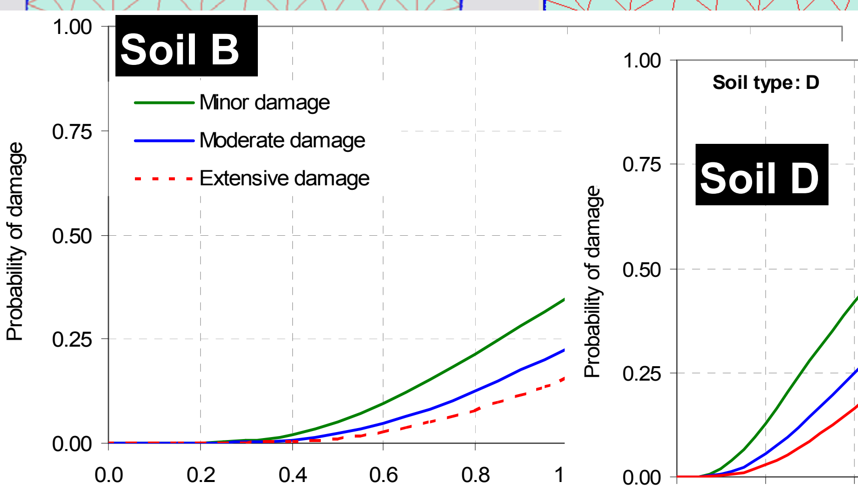
Representative results: Fragility Curves

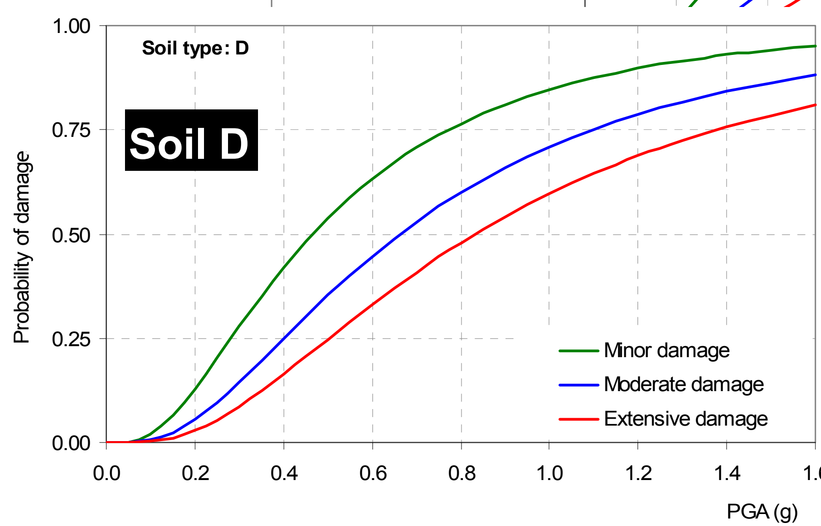
New numerical fragility curves for shallow tunnels in alluvial based on 2D quasi static analyses for different soil types, tunnel geometries and input motions











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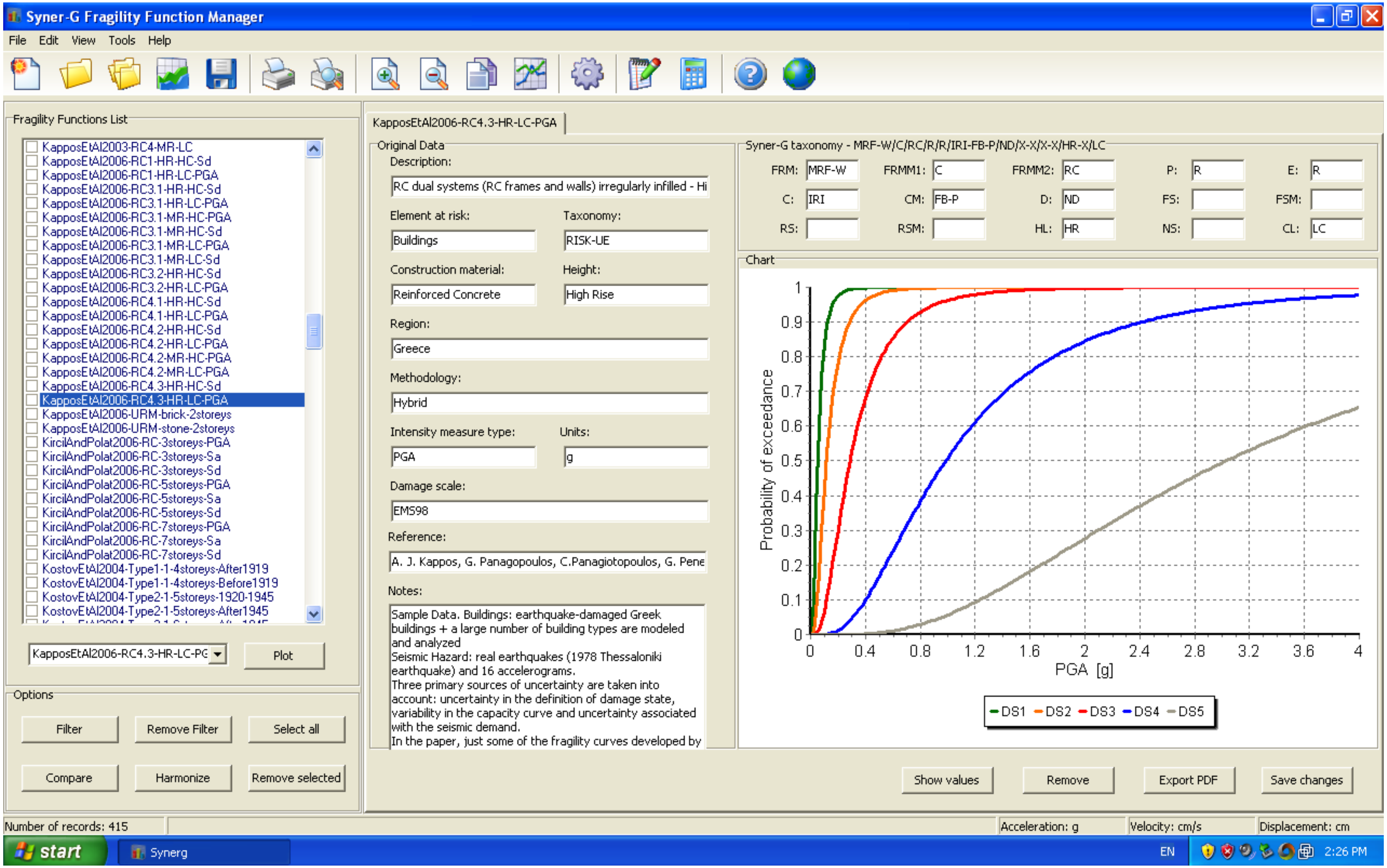
Circular/ Bored tunnels

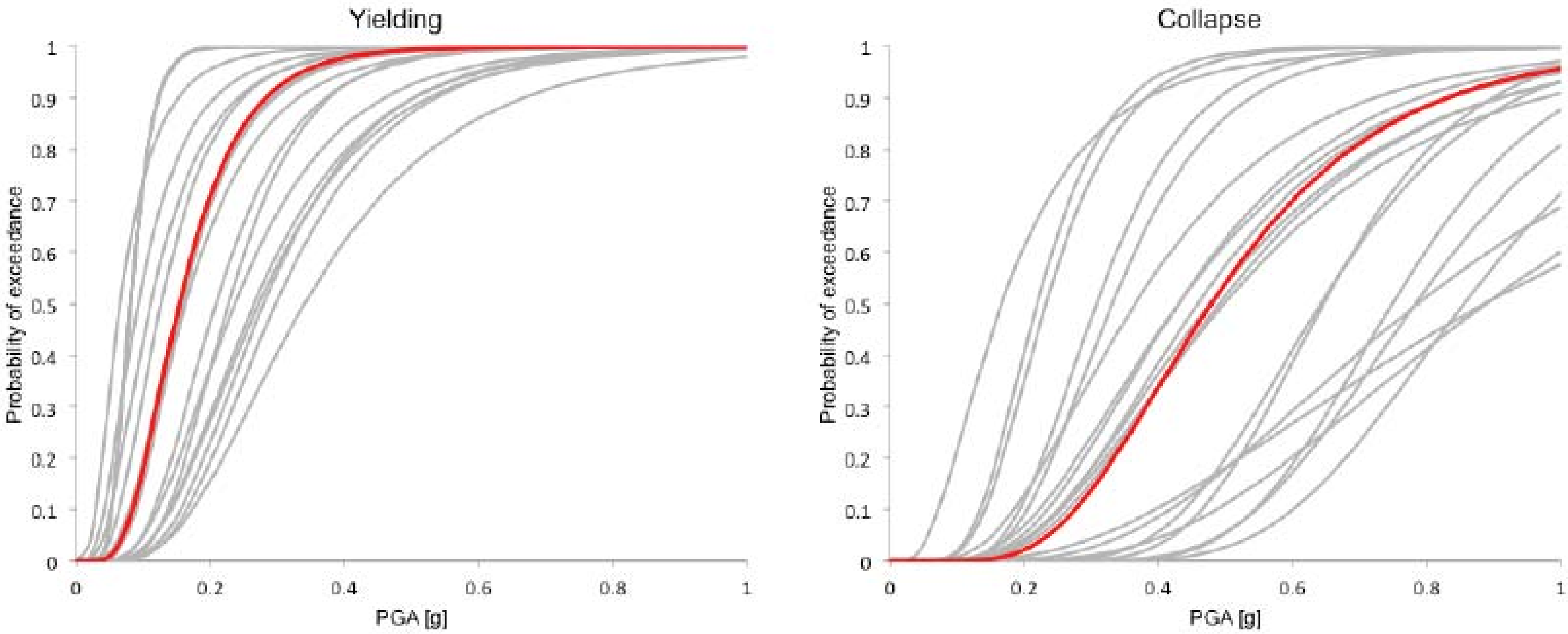
Representative results: Fragility Function Manager



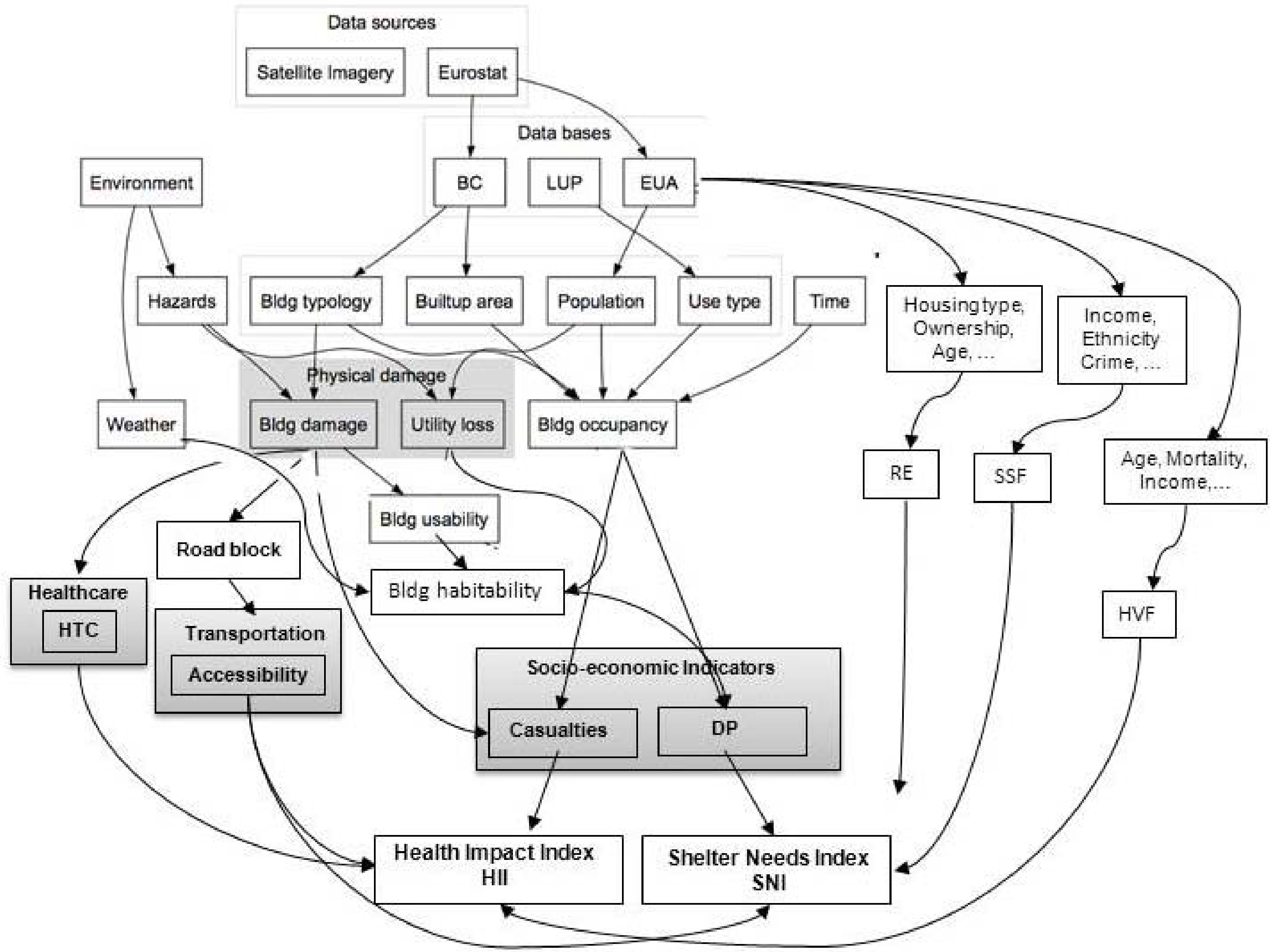
Representative results: Fragility Function Manager

Comparison of Functions

RC, MRF, mid-rise, seismically designed



Representative results: Integrated evaluation of physical and socio-economic performance indicators



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Representative results:

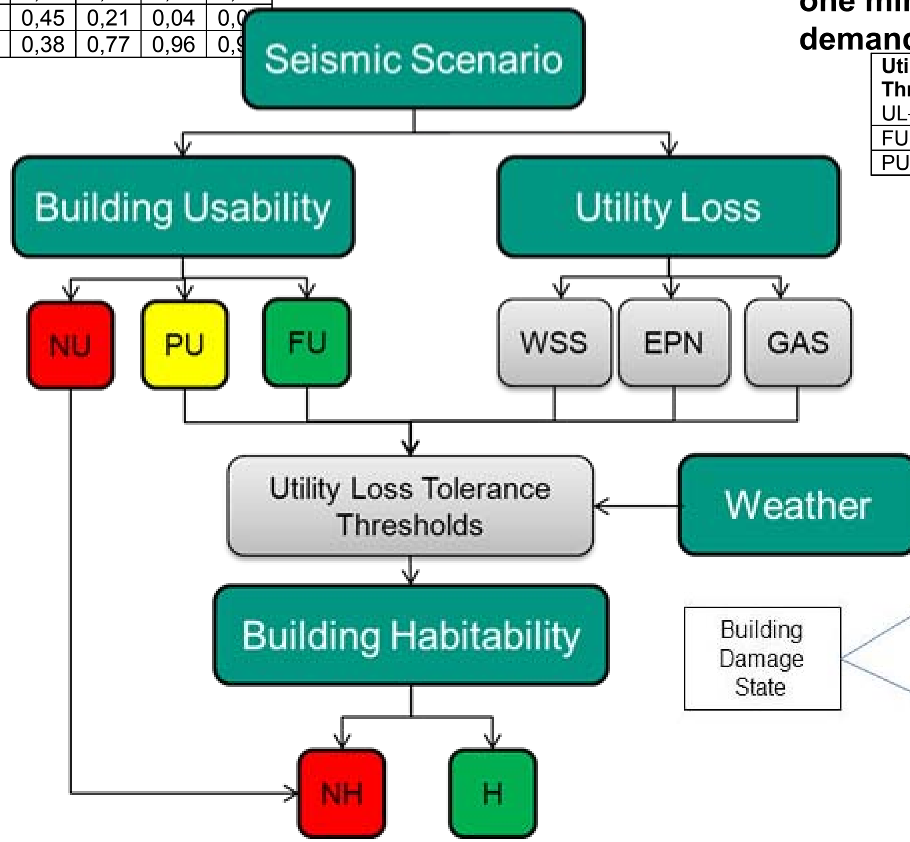
Displaced Population (Uninhabitable Buildings)

Usability Ratio	Damage Level					
	D0	D1	D2	D3	D4	D5
FU – Fully Usable	0,87	0,69	0,17	0,02	0,00	0,01
PU – Partially Usable	0,13	0,31	0,45	0,21	0,04	0,0
NU – Non Usable	0,00	0,00	0,38	0,77	0,96	0,9

$$N_{FU} = \sum_{i=1}^{5} N_i \, NO_i \, UR_i$$

$$N_{NU} = \sum_{i=1}^{5} N_i \, NO_i \, UR_i$$

$$N_{PU} = \sum_{i=1}^{5} N_i \, NO_i \, UR_i$$

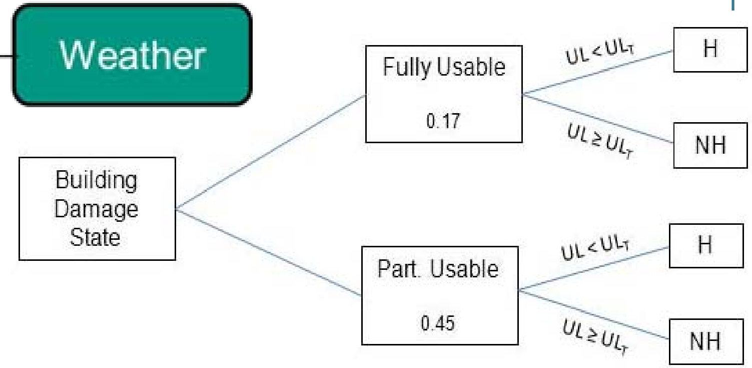


Utility Loss in each system *j* defined as one minus the ratio of satisfied to required demand

Utility Loss Tolerance Thresholds UL_T	Weather Conditions	
	Good	Bad
FU – Fully Usable	1.0	0.0
PU – Partially Usable	0.9	0.0

Weight Factor	Weather Conditions	
	Good	Bad
W_{EPN}	0.5	0.7
W_{GAS}	0.3	0.2
W_{WSS}	0.2	0.1

$$UL = \sum_{j=1}^{3} UL_j \times w_j$$



Displaced Persons (UB) $DP = (N_{FU} \times NH_{FU}) + (N_{PU} \times NH_{PU}) + N_{NU}$ [illegible]

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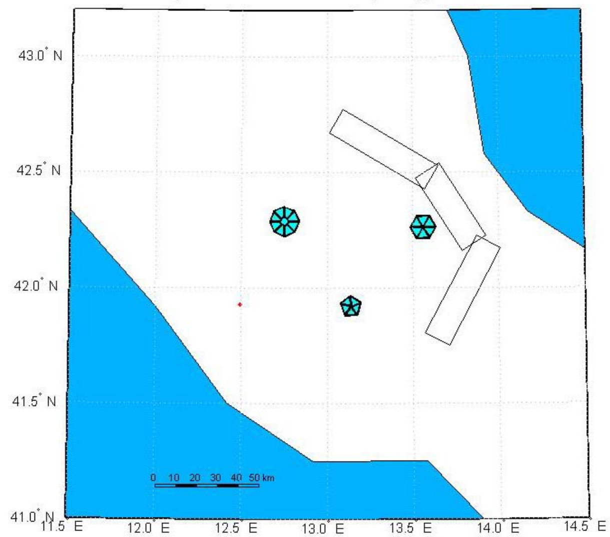
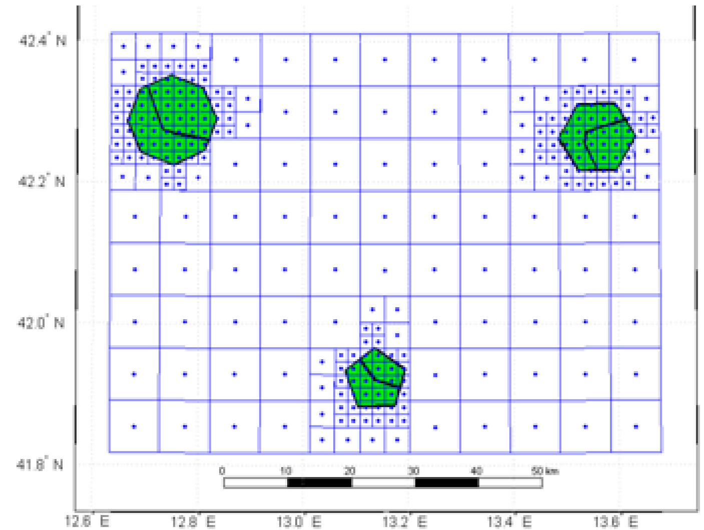
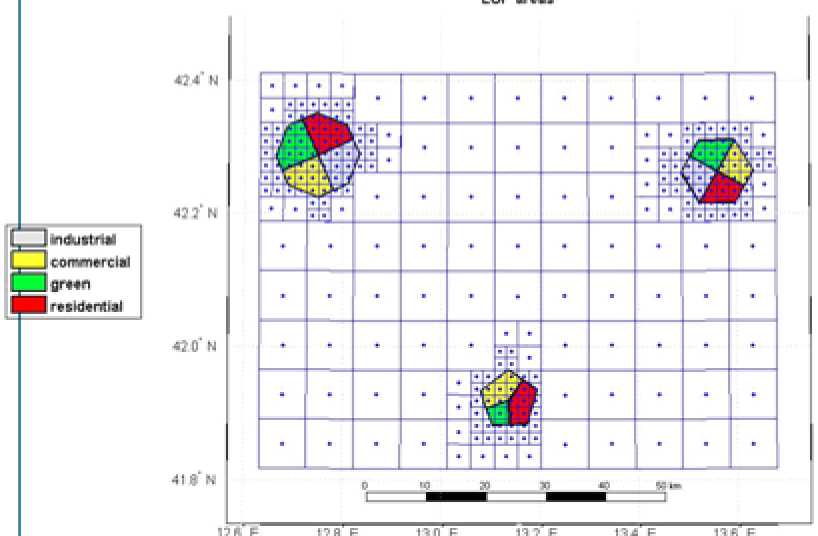
Representative results: Pilot cities' location and seismic sources

Central Italy and the three cities in the prototype Infrastructure

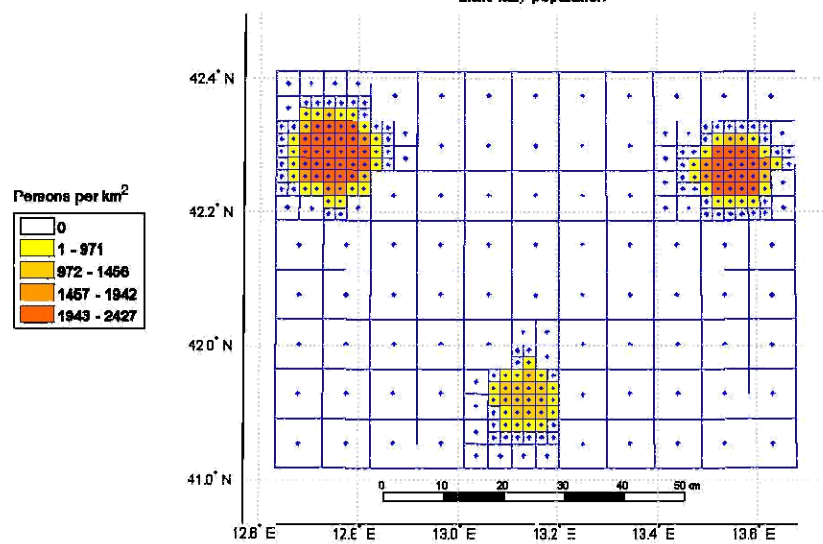




LUP areas

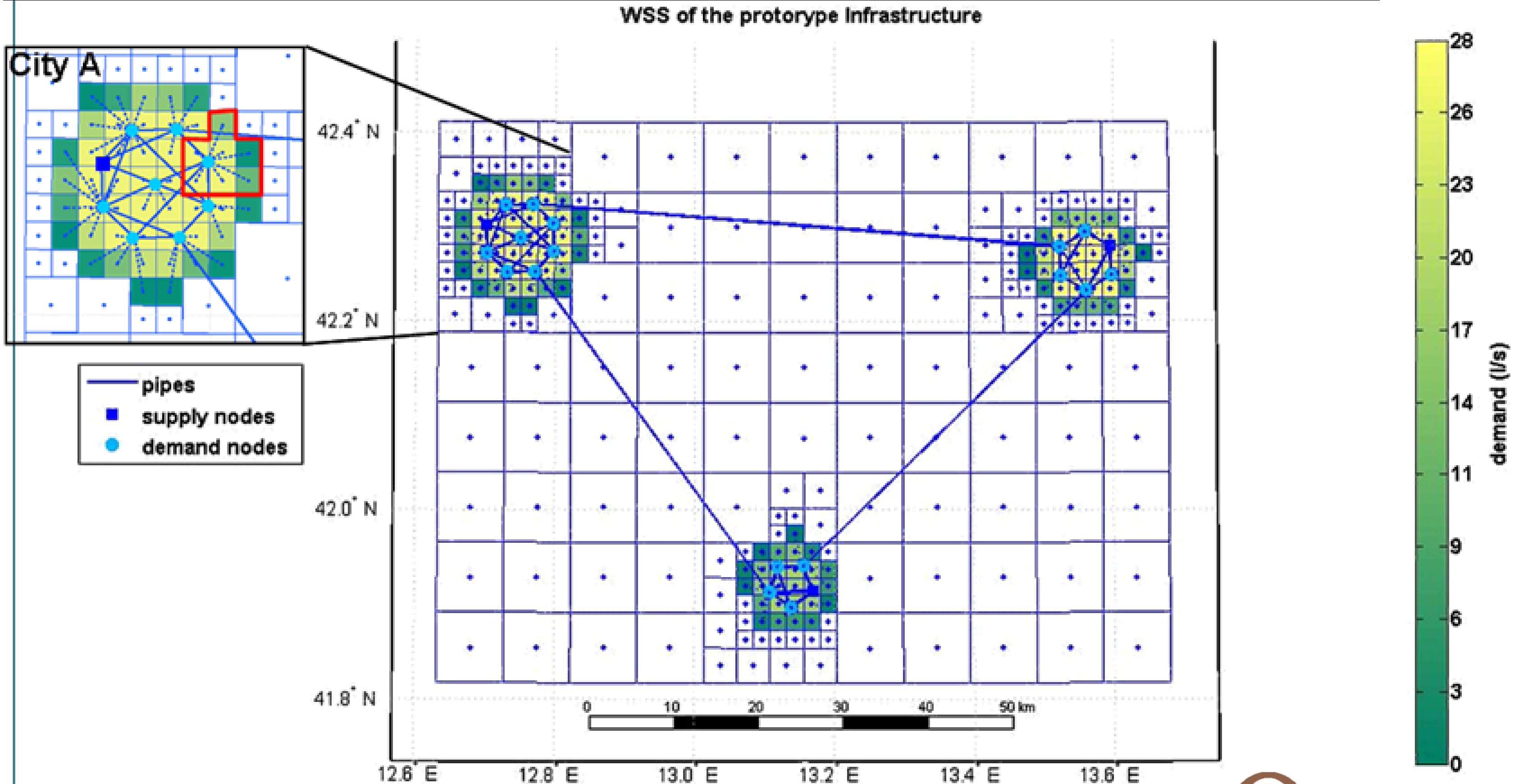


Little Italy population



Representative results: Pilot application

Demand in each grid cell proportional to population
Cell demands aggregated to reference node



WSS topology + demands evaluated at nodes

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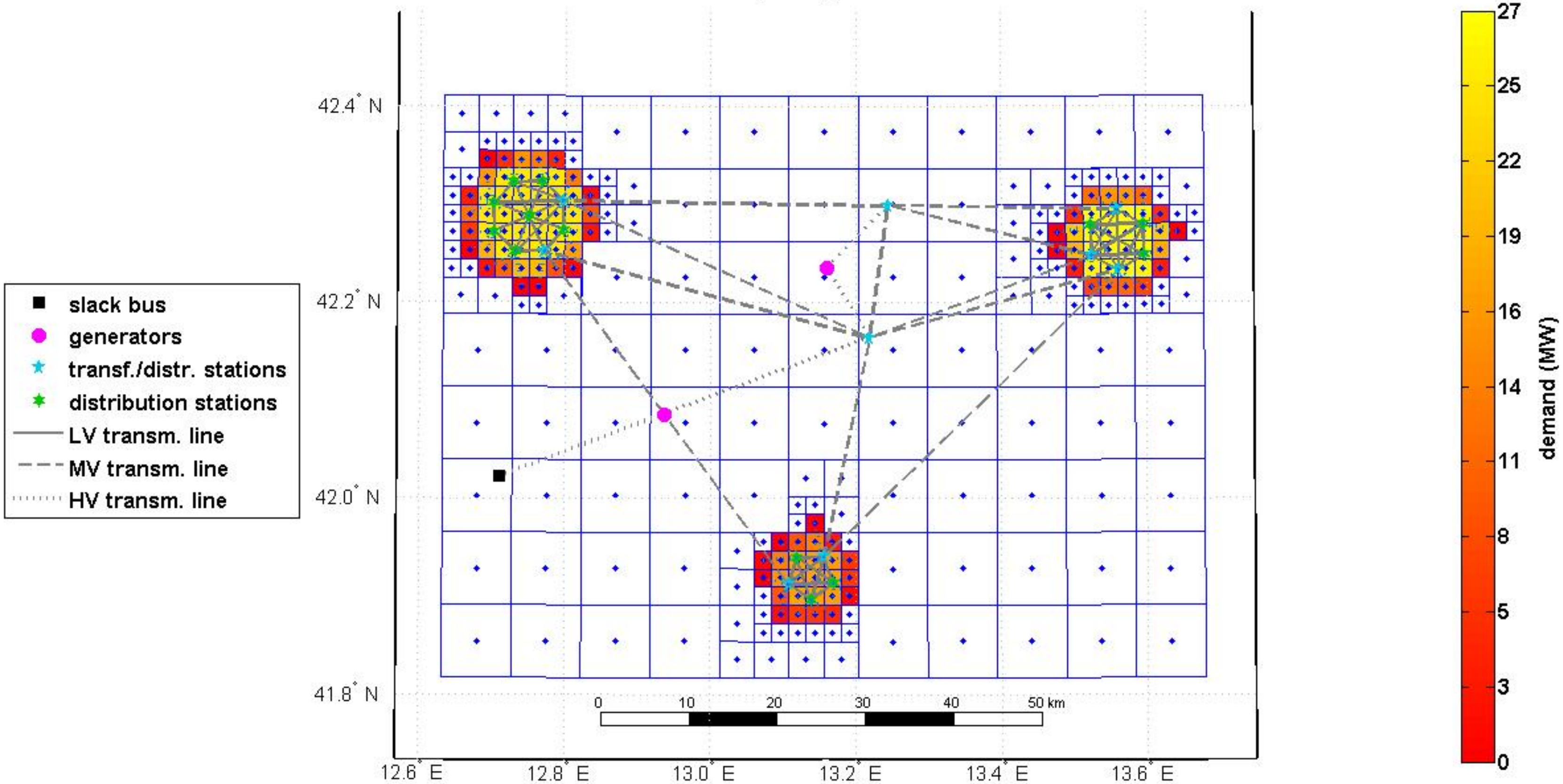
Representative results: Pilot

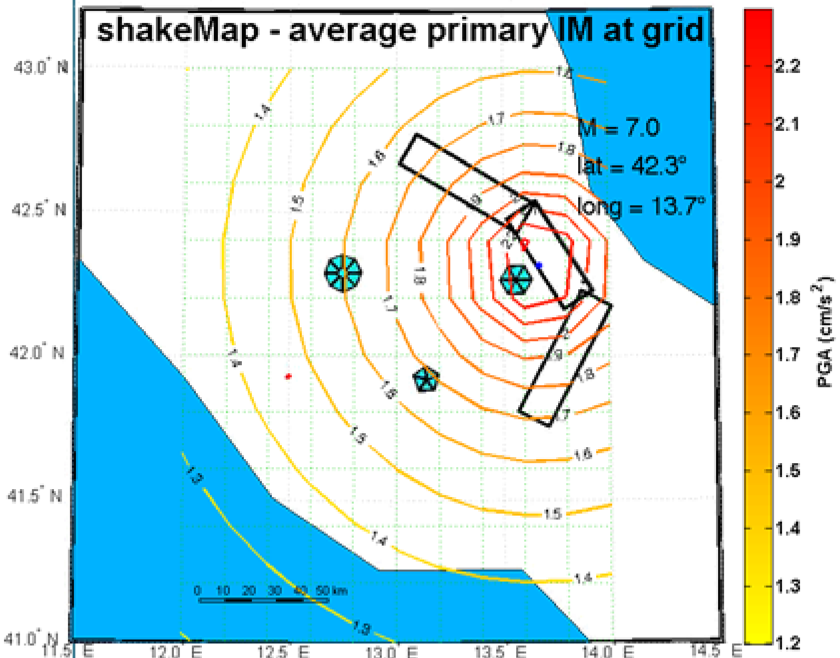
Demand in each grid cell proportional to population on activity (industrial/residential)
Cell demands aggregated to reference node

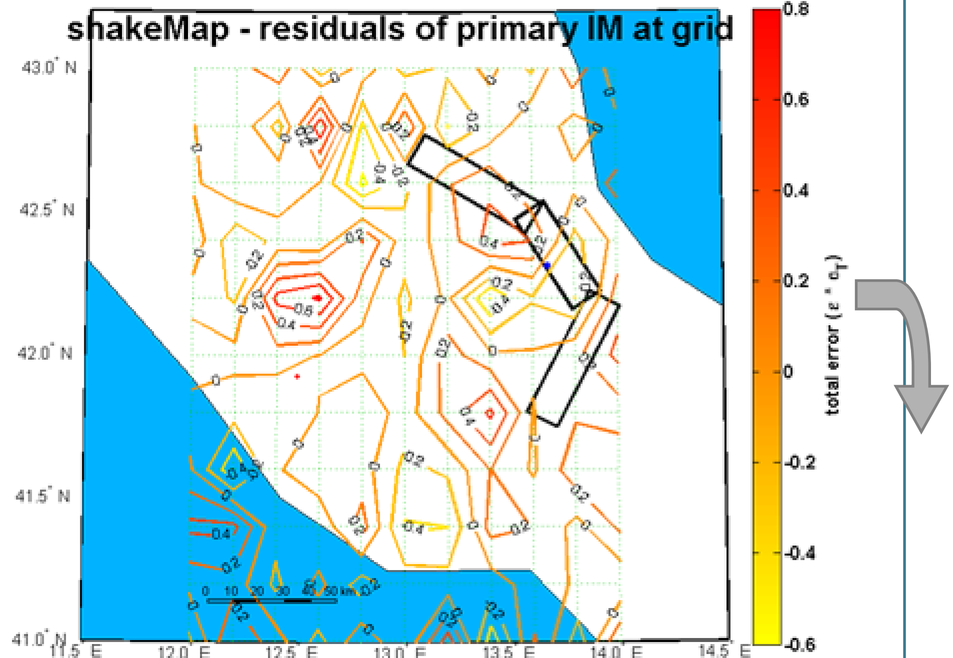


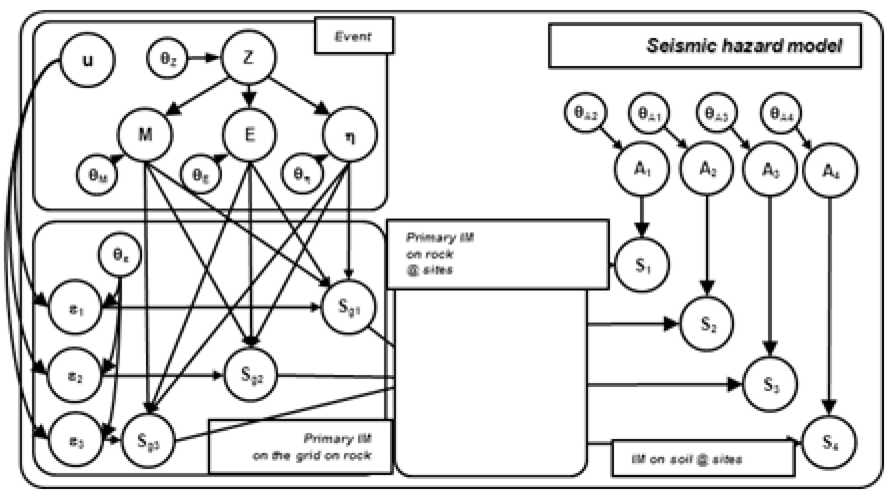
EPN topology + demand evaluated at nodes

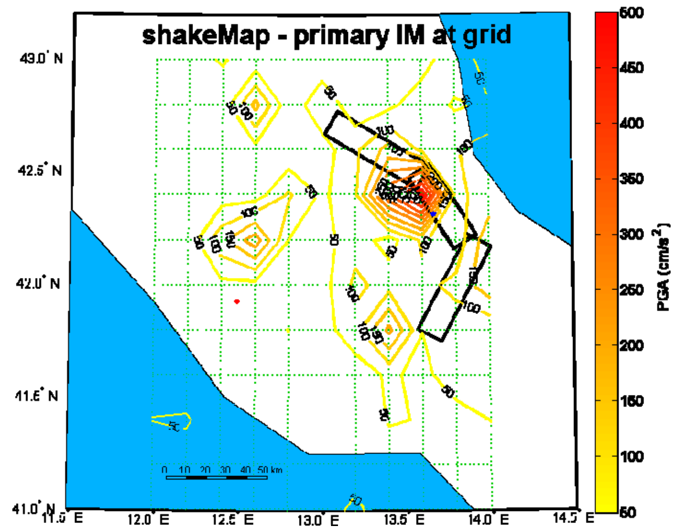
Representative results: Pilot

shakeMap for an M=7 scenario event



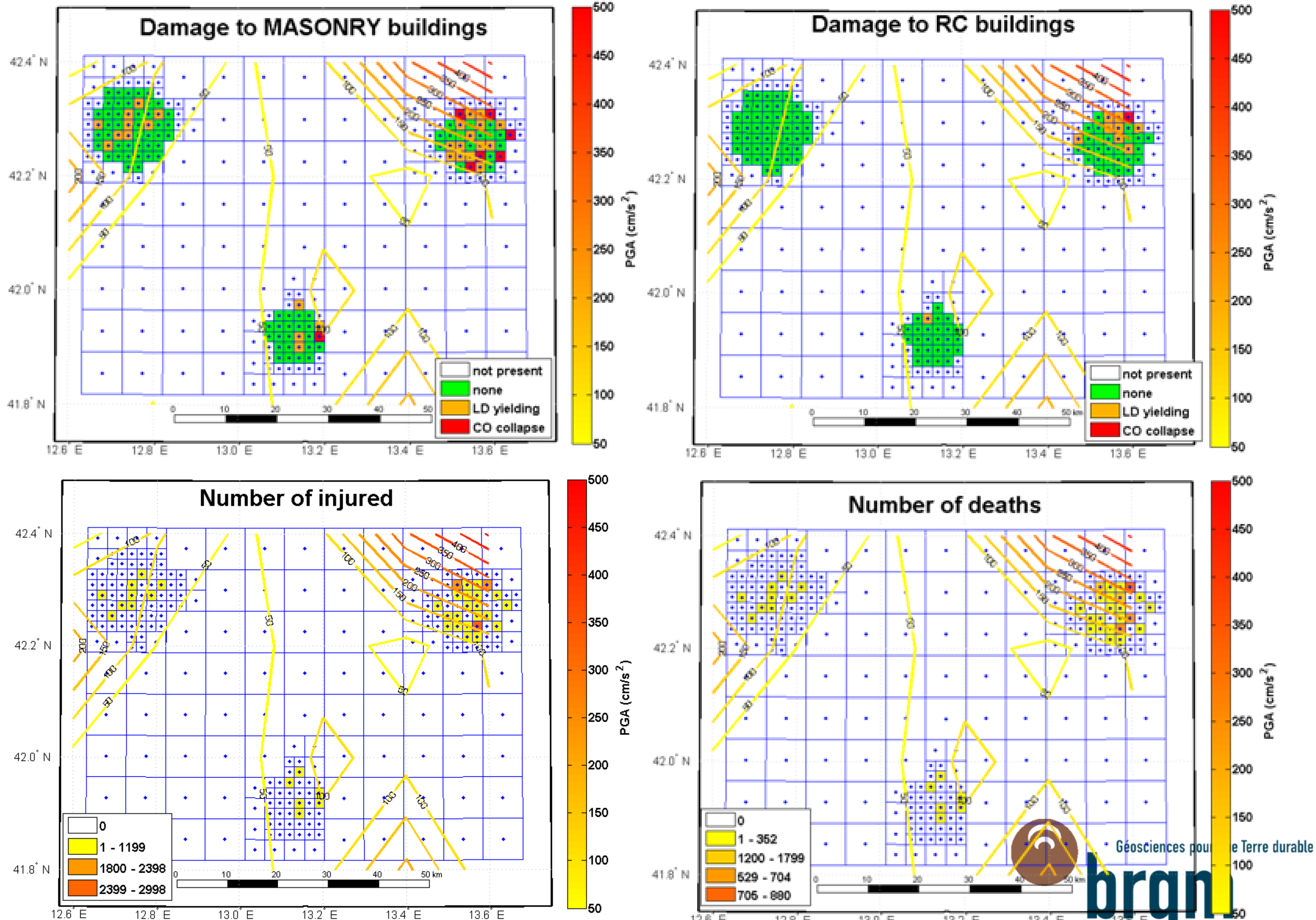






Representative results: Pilot application

M = 7 Scenario event on source 2



physical damage to blds, casualties & fatalities

ご清聴ありがとうございました

Dank u voor uw aandacht

Merci pour votre attention

Thank you for your attention

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