



The screenshot shows the STREST project homepage in a web browser. The browser's address bar shows 'strest-eu.org'. The page features the STREST logo and the tagline 'Harmonized approach to stress tests for critical infrastructures against natural hazards'. There are navigation links for HOME, METHODS, RESULTS, CONSORTIUM, and LOGIN. The main content is divided into three sections: 'Past events', 'STREST at a glance', and 'Latest News'. The 'Past events' section lists several workshops and meetings from 2013 to 2016. The 'STREST at a glance' section has a navigation bar with 'The Challenge' selected, and a paragraph describing the project's goals. The 'Latest News' section has a heading 'The STREST final results are online' and a paragraph about where to find the results. At the bottom right, there is a map of Europe with various partner logos overlaid, including TNO, ETH, Basler & Hofmann, EPRI, ELUCENTRE, INGVA, and amra. The European Union flag is also present in the bottom left corner of the page content.

STREST | HOME x +

Not secure | strest-eu.org ☆ ABP

HOME | METHODS | RESULTS | CONSORTIUM | LOGIN

STREST

Harmonized approach to stress tests for critical infrastructures against natural hazards

Past events

16 September 2016:
STREST Final Workshop, Ljubljana

14-15 September 2016:
STREST Final Meeting, Ljubljana

12-13 October 2015:
STREST 2nd Year Workshop, Thessaloniki

22 May 2015:
WP5 workshop, Zurich


19 December 2014:
WP4 workshop, Naples

29-31 October 2014:
STREST 1st Year Workshop, Ispra

26-28 February 2014:
Joint WPs3-4-5 workshop, Utrecht

14 January 2014:
WP2 workshop, Zurich

21-22 October 2013:
STREST Kick-off Meeting, Zurich

 STREST receives funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 603389.

STREST at a glance


The Challenge Objectives Methods Expected Results STREST in Numbers

Critical Infrastructures (CIs) provide essential goods and services for modern society; they are highly integrated and have growing mutual dependencies. Recent natural events have shown that cascading failures of CIs have the potential for multi-infrastructure collapse and widespread societal and economic consequences. Moving toward a safer and more resilient society requires improved and standardized tools for hazard and risk assessment of low probability-high consequence (LP-HC) events, and their systematic application to whole classes of CIs, targeting integrated risk mitigation strategies. Among the most important assessment tools are the stress tests, designed to test the vulnerability and resilience of individual CIs and infrastructure systems. Following the results of the stress tests recently performed by the EC for the European Nuclear Power Plants, it is urgent to carry out appropriate stress tests for all other classes of CIs.

Latest News

The STREST final results are online

For a summary of the STREST project results, you can go directly [here](#). For all the STREST results, including deliverables, peer-reviewed articles, videos, please visit our Results section. As for the 6 STREST European reference of the STREST European Reference Reports.



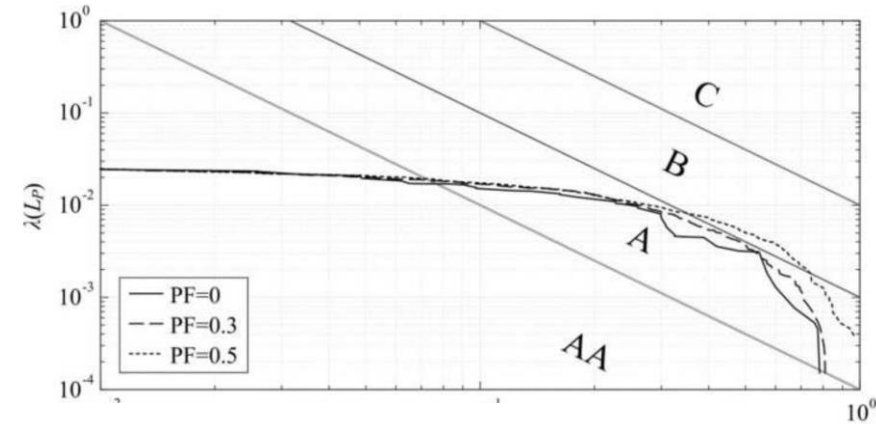
- CI-A: Single-site, high-risk, non-nuclear critical infrastructures
- CI-B: Geographically distributed, non-nuclear critical infrastructures
- CI-C: Multiple-site, low-risk, high-impact, non-nuclear critical infrastructures

STREST works with key European CIs, to test and apply the developed stress test methodologies to specific CIs, chosen to typify general classes of CIs. Six test sites have been chosen (Fig 1.3):

- CI-A1: Oil refinery and petrochemical plant, Milazzo, Italy (data obtained by AMRA from ENI/Kuwait)
- CI-A2: Large dams, Valais, Switzerland (in collaboration with EPFL and the Office of Dams in the Swiss Federal Office of Energy)
- CI-B1: Major hydrocarbon pipelines, Baku-Tbilisi-Ceyhan (BTC), Turkey (in collaboration with BU and BOTAS Int. Ltd.)
- CI-B2: Gas storage and distribution network, Netherlands (in collaboration with TNO and Gasunie)
- CI-B3: Port infrastructure, Thessaloniki, Greece (in collaboration with AUTH and the Port Authority of Thessaloniki, THPA SA)
- CI-C1: Industrial district, Emilia region, Italy (in collaboration with EUCENTRE and the Confindustria of Piacenza)



- Stress Test Level 1 (ST-L1): single-hazard CI component-only check;
- Stress Test Level 2 (ST-L2): single-hazard CI system-wide risk assessment; and
- Stress Test Level 3 (ST-L3): multi-hazard CI system-wide risk assessment.

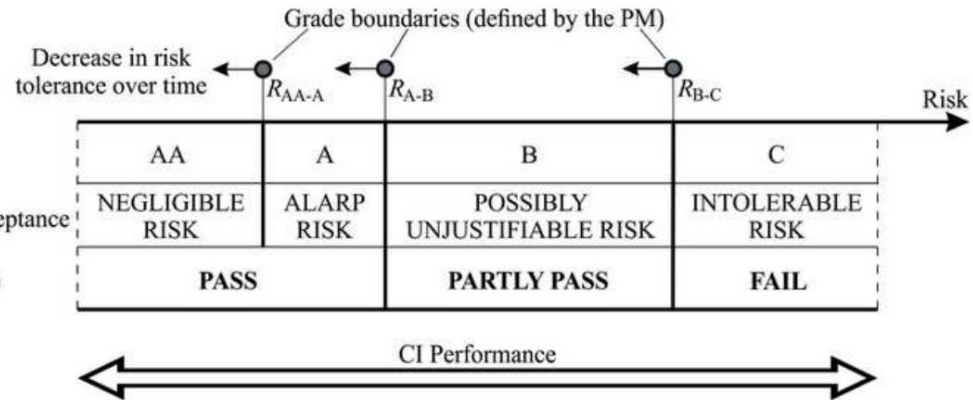


Journal of Infrastructure Systems
A risk-based multi-level methodology to stress test critical infrastructure systems
 --Manuscript Draft--

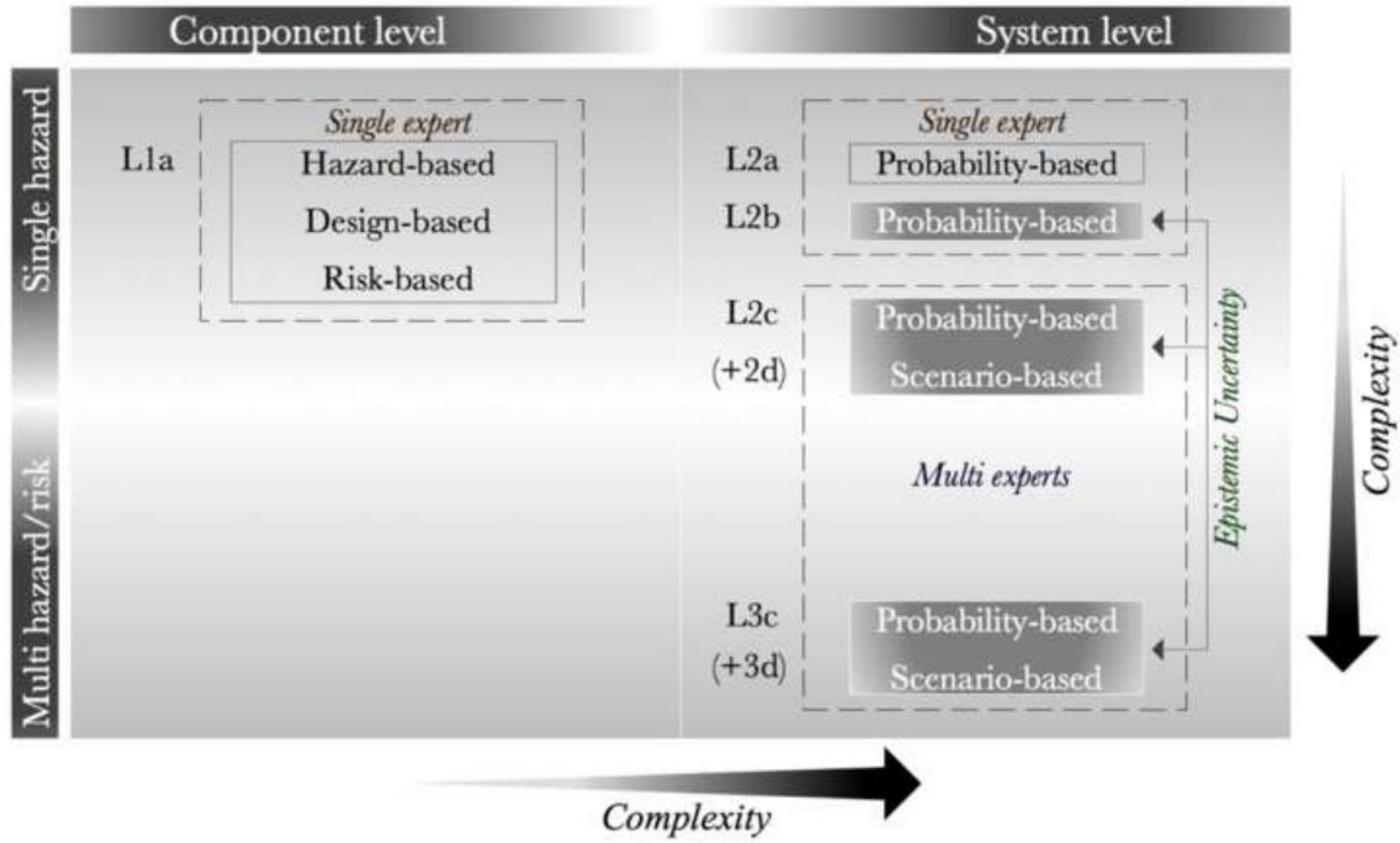
Manuscript Number: ISENG-1434R1
Full Title: A risk-based multi-level methodology to stress test critical infrastructure systems
Manuscript Region of Origin: SWITZERLAND
Article Type: Technical Paper
Funding Information: European Research Council (603389) Domenico Giardini

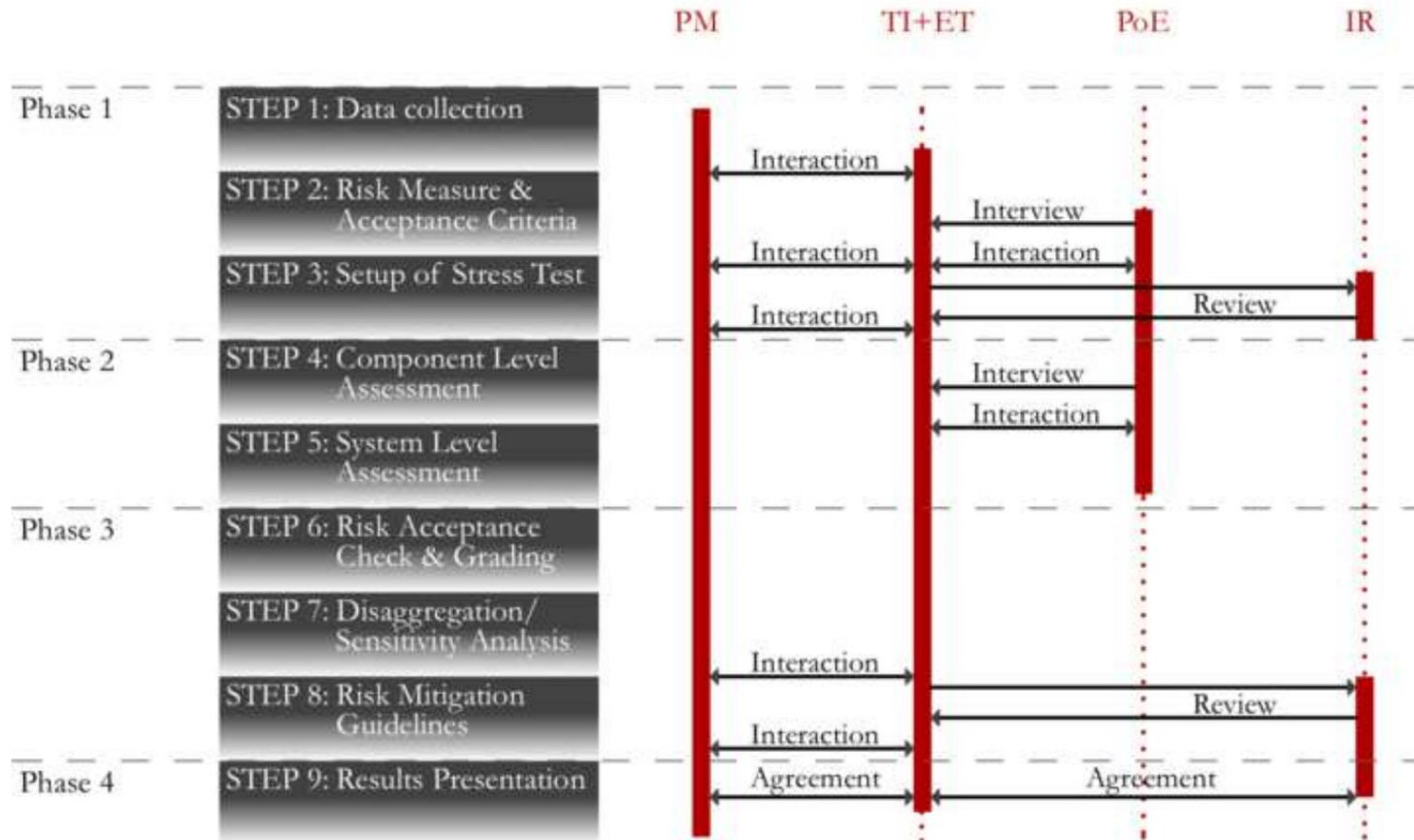
Abstract: Making communities safer requires better tools to identify, quantify and manage the risks. Among the most important tools are stress tests, originally designed to test the risk posed by nuclear power plants. A complementary, harmonized multi-level stress test for non-nuclear civil infrastructure systems against natural hazards is proposed. Each stress test level is characterized by a different scope and by a different level of risk analysis complexity to suite different civil infrastructure systems, different hazards and different risks. The stress test comprises the following phases. First, the goals and the methods for the risk analysis are defined. The test is then performed at the component and the system levels, followed by a verification of the findings. A penalty system is defined to adjust the output of the risk assessment according to the limitations of the risk analysis methods used. The adjusted risk assessment results are then passed to a grading system to determine the outcome of the stress test. Finally, the risk assessment results are reported and the stress test outcomes are communicated to stakeholders and authorities.

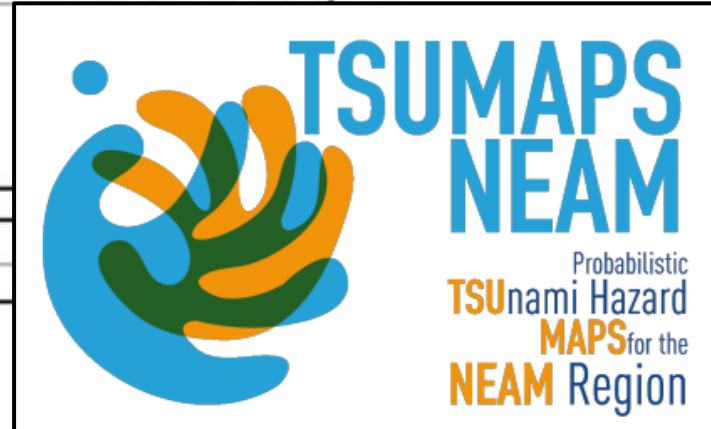
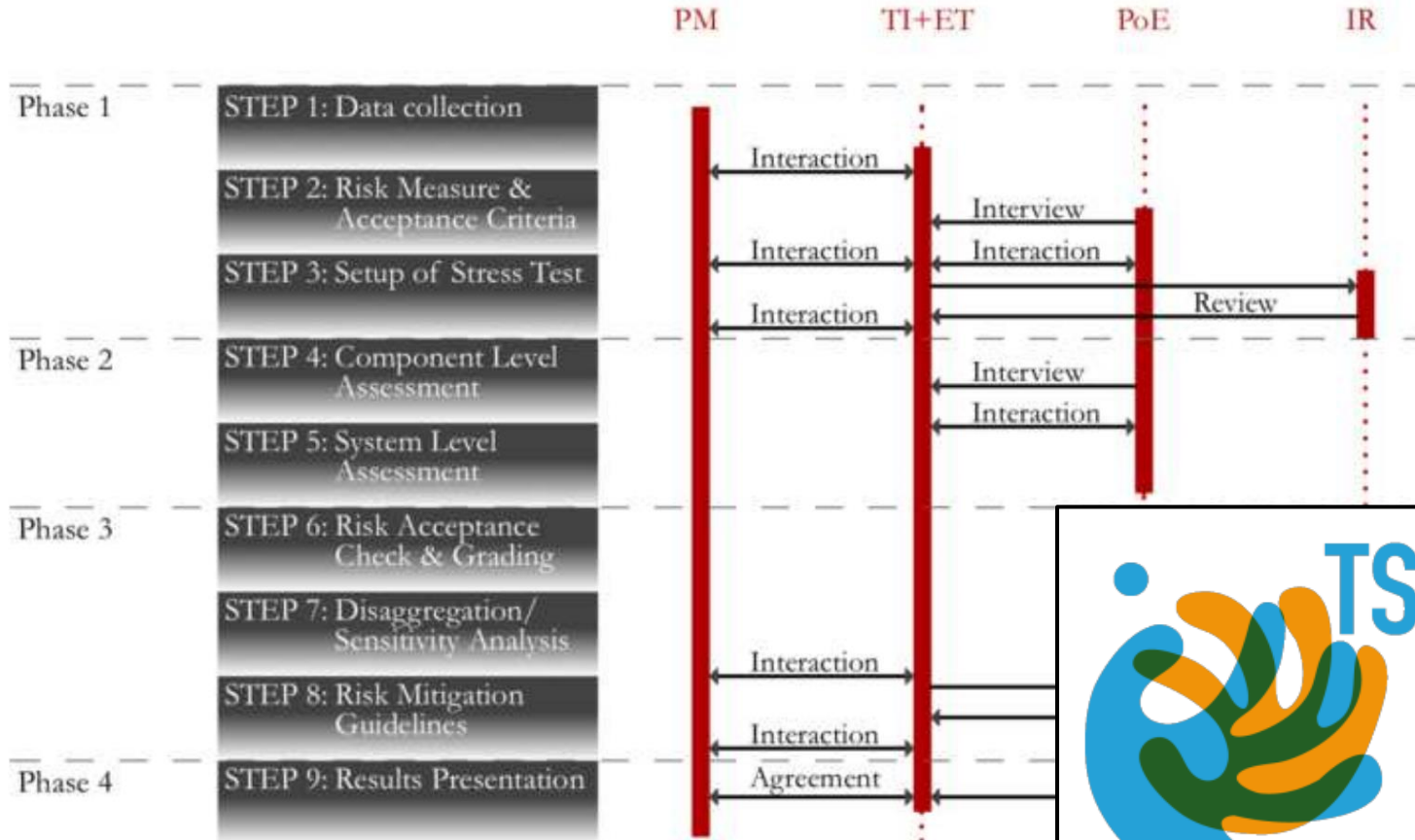
Corresponding Author: Simona Esposito
 Swiss Federal Institute of Technology Zurich
 zurich, SWITZERLAND
Corresponding Author E-Mail: simona.esposito@bkk.baug.ethz.ch
Order of Authors: Simona Esposito
 Bozidar Stojadinovic, Prof.
 Anze Babic, Dr
 Matjaz Dolsek, Prof.
 Sarfraz Iqbal, Dr
 Jacopo Selva, Dr
 Marco Broccardo, Dr
 Arnaud Mignan, Dr
 Domenico Giardini, Prof.



Increasing level...
 Single components → systemic vulnerability
 Single hazard → multi-hazard
 Single expert → multiple experts



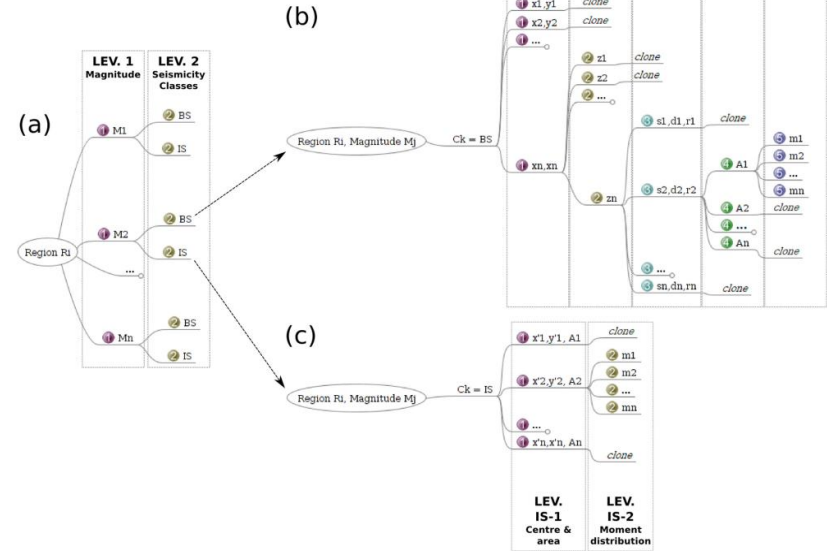
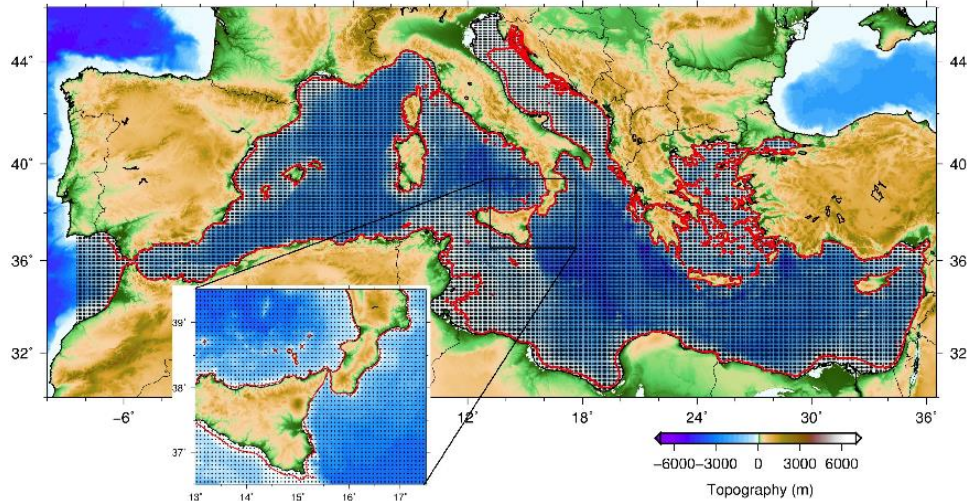




- 1) From regional to local PTHA
- 2) From single components to systemic vulnerability and risk of complex systems
- 3) From single to multi-hazard risk quantification
- 4) From single expert to multiple-experts for managing subjective choices

- 1) From regional to local PTHA**
- 2) From single components to systemic vulnerability and risk of complex systems
- 3) From single to multi-hazard risk quantification
- 4) From single expert to multiple-experts for managing subjective choices

1. FROM REGIONAL TO LOCAL PTHA



~10⁷ sources
~ 10² alternative implementations

Quantification of source uncertainties in Seismic Probabilistic Tsunami Hazard Analysis (SPTHA)

J. Selva,¹ R. Tonini,² I. Molinari,³ M.M. Tiberti,² F. Romano,² A. Grezio,¹ D. Melini,² A. Piatanesi,² R. Basili² and S. Lorito²

¹Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Bologna, Bologna, Italy; E-mail: jacopo.selva@inpg.it

²Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Roma 1, Rome, Italy

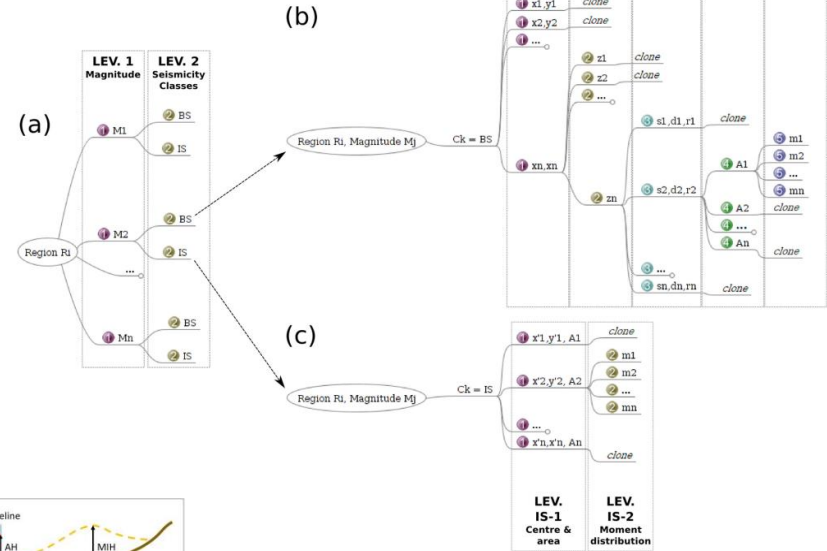
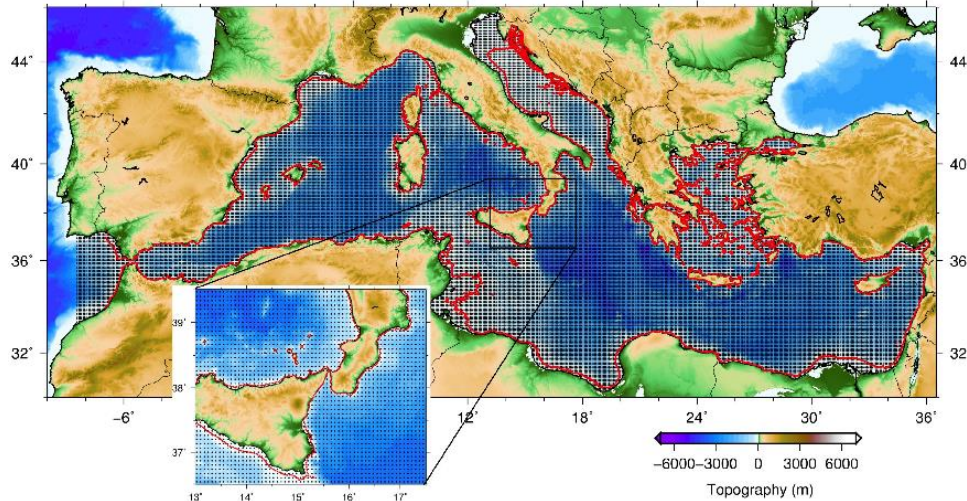
³ETH Zürich, Institut für Geophysik, Zurich, Switzerland

Accepted 2016 March 17; Received 2016 March 17; in original form 2015 August 9

SUMMARY

We propose a procedure for uncertainty quantification in Probabilistic Tsunami Hazard Analysis (PTHA), with a special emphasis on the uncertainty related to statistical modelling of the earthquake source in Seismic PTHA (SPTHA), and on the separate treatment of subduction and crustal earthquakes (treated as background seismicity). An event tree approach and ensemble modelling are used in spite of more classical approaches, such as the hazard integral and the logic tree. This procedure consists of four steps: (1) exploration of aleatory uncertainty through an event tree, with alternative implementations for exploring epistemic uncertainty; (2) numerical computation of tsunami generation and propagation up to a given offshore isobath; (3) (optional) site-specific quantification of inundation; (4) simultaneous quantification of aleatory and epistemic uncertainty through ensemble modelling. The proposed procedure is general and independent of the kind of tsunami source considered; however, we implement

1. FROM REGIONAL TO LOCAL PTHA



~10⁷ sources
~10² alternative implementations

Geophysical Journal International

Pure Appl. Geophys.
 © 2019 The Author(s)
<https://doi.org/10.1007/s00024-019-02091-w>

Pure and Applied Geophysics

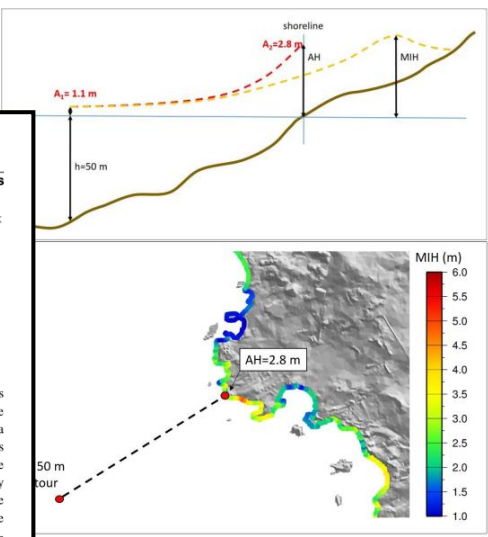
CrossMark

A New Approximate Method for Quantifying Tsunami Maximum Inundation Height Probability

S. GLIMSDAL,¹ F. LÖVHOLT,¹ C. B. HARRITZ,¹ F. ROMANO,² S. LORITO,² S. OREFICE,² B. BRIZUELA,² J. SELVA,² A. HOECHNER,³ M. VOLPE,² A. BABEYKO,³ R. TONINI,² M. WRONNA,⁴ and R. ONMIRA⁴

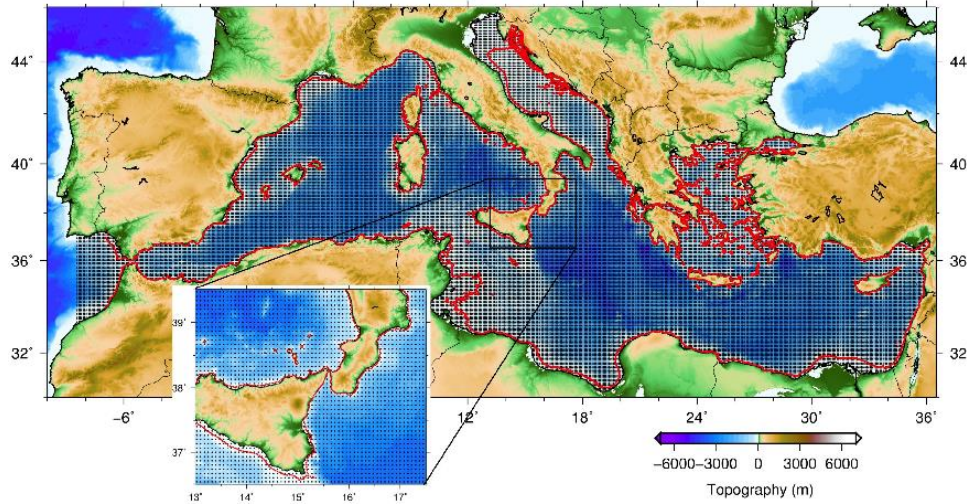
Abstract—Regional and global tsunami hazard analysis requires simplified and efficient methods for estimating the tsunami inundation height and its related uncertainty. One such approach is the amplification factor (AF) method. Amplification factors describe the relation between offshore wave height and the maximum inundation height, as predicted by linearized plane wave models employed for incident waves with different wave characteristics. In this study, a new amplification factor method is developed that takes into account the offshore bathymetry proximal to the coastal site. The present AFs cover the North-Eastern Atlantic and Mediterranean (NEAM) region. The model is the first

(NLSW) models that include drying-wetting schemes (Titov and Gonzalez 1997; LeVeque and George 2008; Løvholt et al. 2010; Dutykh et al. 2011; de la Asunción et al. 2013; Wronna et al. 2015; Macías et al. 2017). However, if the inundation needs to be quantified over large coastal stretches (e.g. country scale or larger), NLSW inundation simulations are most often not feasible. This is due either to the large computational cost or to the lack of required high-

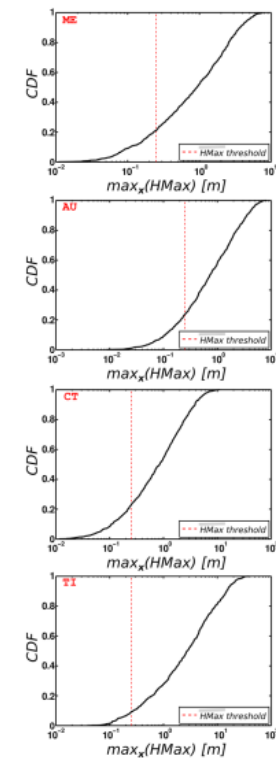


Propagation to 50m
Amplification distribution on coast
(Glimsdal et al., 2019)

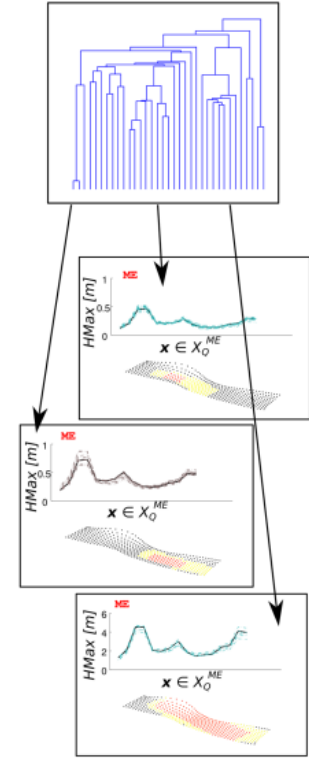
1. FROM REGIONAL TO LOCAL PTHA



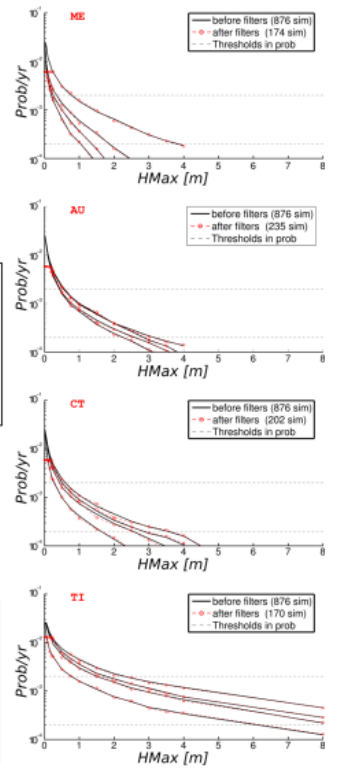
a) **FILTER 1**
empirical Cumulative Density Function



b) **FILTER 2**
Hierarchical Cluster Analysis



c) **HAZARD CURVES**



Geophysical Journal International

Geophys. J. Int. (2015) 200, 574–588
doi: 10.1093/gji/ggv005

© 2019 The Author(s)
https://doi.org/10.1093/gji/ggv005

Probabilistic hazard for seismically induced tsunamis: accuracy and feasibility of inundation maps

S. Lorito, J. Selva, R. Basili, F. Romano, M.M. Tiberti and A. Piatanesi

Istituto Nazionale di Geofisica e Vulcanologia, via diigna Marconi 605, I-00143 Roma, Italy; E-mail: infornia.lorito@ingv.it

Accepted 2014 October 16. Received 2014 October 16; in original form 2014 April 24

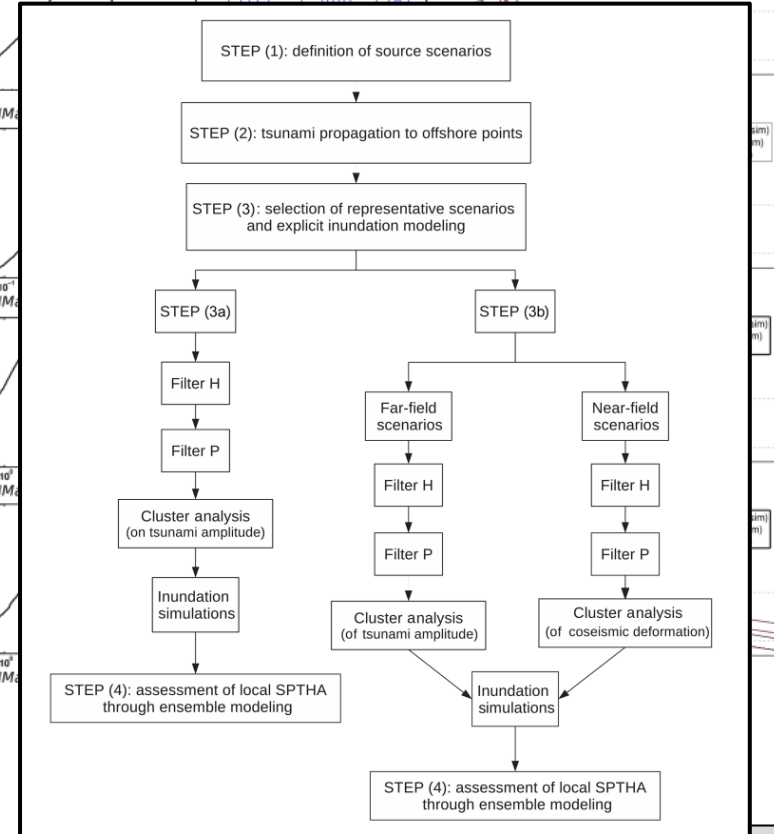
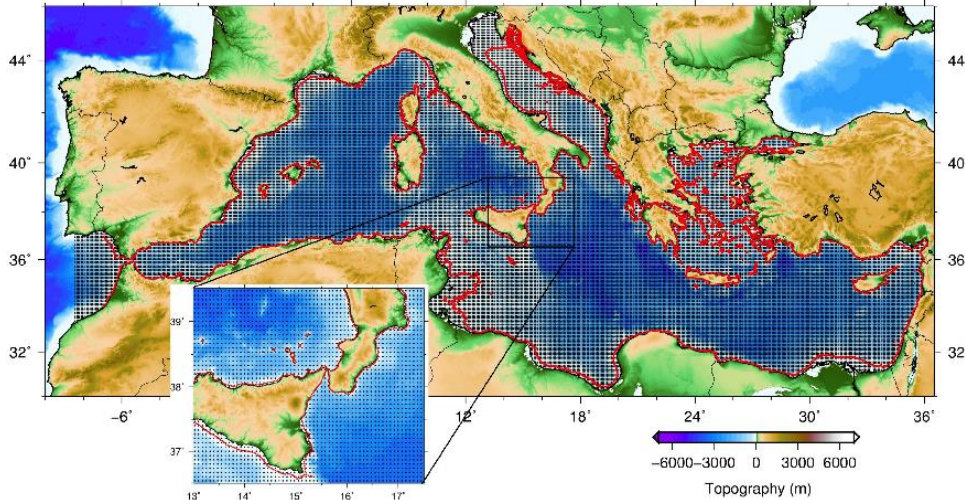
SUMMARY

Probabilistic tsunami hazard analysis (PTHA) relies on computationally demanding numerical simulations of tsunami generation, propagation, and non-linear inundation on high-resolution topo-bathymetric models. Here we focus on tsunamis generated by co-seismic sea floor displacement, that is, on Seismic PTHA (SPTHA). A very large number of tsunami simulations are typically needed to incorporate in SPTHA the full expected variability of seismic sources (the aleatory uncertainty).

We propose an approach for reducing their number. To this end, we (i) introduce a simplified event tree to achieve an effective and consistent exploration of the seismic source parameter space; (ii) use the computationally inexpensive linear approximation for tsunami propagation to construct a preliminary SPTHA that calculates the probability of maximum of fibre tsunami wave height (H_{Max}) at a given target site; (iii) apply a two-stage filtering procedure to these ‘linear’ SPTHA results, for selecting a reduced set of sources and (iv) calculate ‘non-linear’ probabilistic inundation maps at the target site, using only the selected sources. We find that the selection of the important sources needed for approximating probabilistic inundation maps can be obtained based on the offshore H_{Max} values only. The filtering procedure is semi-automatic and can be easily repeated for any target sites.

We describe and test the performances of our approach with a case study in the Mediterranean that considers potential subduction earthquakes on a section of the Hellenic Arc, three target sites on the coast of eastern Sicily and one site on the coast of southern Crete. The comparison

1. FROM REGIONAL TO LOCAL PTHA



Geophysical Journal International

Geophys. J. Int. (2019) 200, 574–588
Advance
© 2019 The
https://doi.org/10.1093/gji/gyz005

Probabilistic hazard for sea level rise and feasibility of inundation

S. Lorito, J. Selva, R. Basili, F. Romano

Accepted 2014 October 16. Received 2014 October 16; in final form 2014 October 16.

SUMMARY
Probabilistic tsunami simulations of the topo-bathymetric placement, that are typically needed for the assessment of the hazard. We propose a event tree to address the space; (ii) use the results to construct a probabilistic inundation map. We describe a method that considers points on the coast

Nat. Hazards Earth Syst. Sci., 19, 455–469, 2019
https://doi.org/10.5194/nhess-19-455-2019
© Author(s) 2019. This work is distributed under the Creative Commons Attribution 4.0 License.

From regional to local SPTHA: efficient computation of probabilistic tsunami inundation maps addressing near-field sources

Manuela Volpe¹, Stefano Lorito¹, Jacopo Selva², Roberto Tonini¹, Fabrizio Romano¹, and Beatriz Brizuela¹

¹Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy
²Istituto Nazionale di Geofisica e Vulcanologia, Bologna, Italy

Correspondence: Manuela Volpe (manuela.volpe@ingv.it)

Received: 9 July 2018 – Discussion started: 18 July 2018
Revised: 8 February 2019 – Accepted: 11 February 2019 – Published: 6 March 2019

Abstract. Site-specific seismic probabilistic tsunami hazard analysis (SPTHA) is a computationally demanding task, as it requires, in principle, a huge number of high-resolution numerical simulations for producing probabilistic inundation maps. We implemented an efficient and robust methodology using a filtering procedure to reduce the number of numerical simulations needed while still allowing for a full treatment of the specific signs of coastal displacement.

1 Introduction

Geophysical Journal International

Geophys. J. Int. (2019) 200, 574–588
Advance
© 2019 The
https://doi.org/10.1093/gji/gyz005

Probabilistic hazard for sea level rise and feasibility of inundation

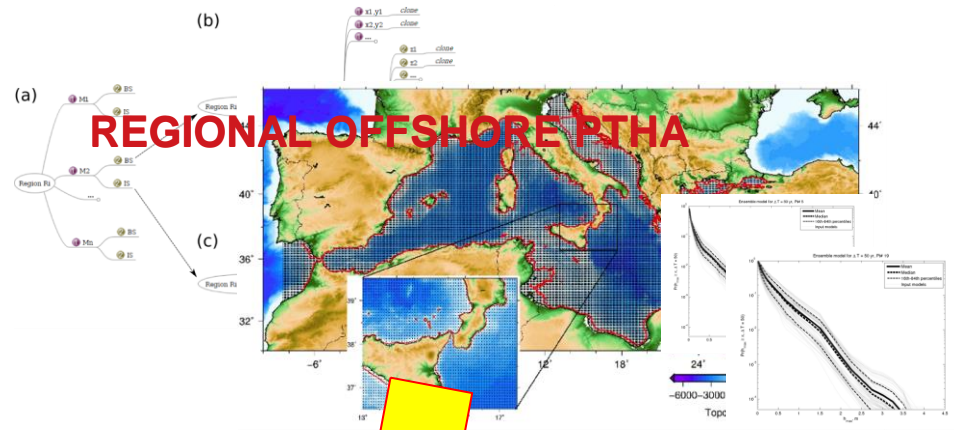
S. Lorito, J. Selva, R. Basili, F. Romano

Accepted 2014 October 16. Received 2014 October 16; in final form 2014 October 16.

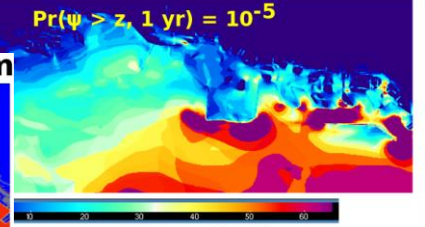
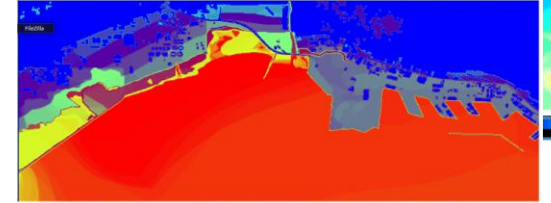
SUMMARY
Probabilistic tsunami simulations of the topo-bathymetric placement, that are typically needed for the assessment of the hazard. We propose a event tree to address the space; (ii) use the results to construct a probabilistic inundation map. We describe a method that considers points on the coast

1. FROM REGIONAL TO LOCAL PTHA

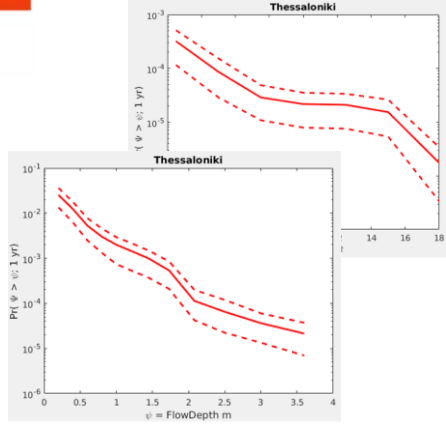
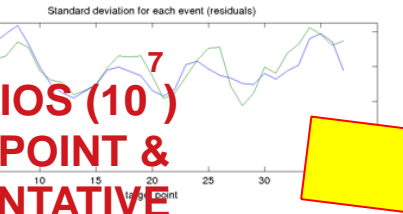
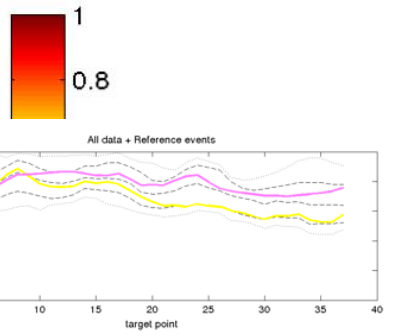
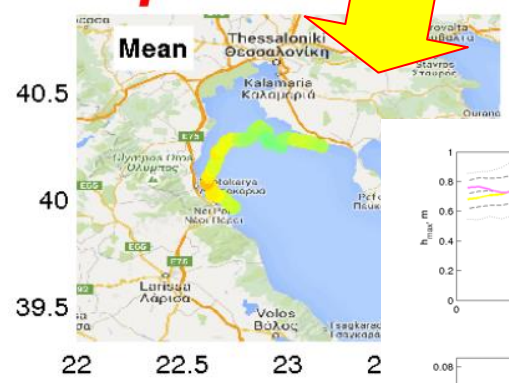
MEAN HAZARD MAP, 10⁵ YR MRP



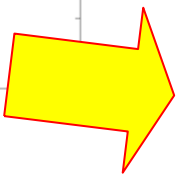
MEAN PROBABILITY MAP, > 1 m



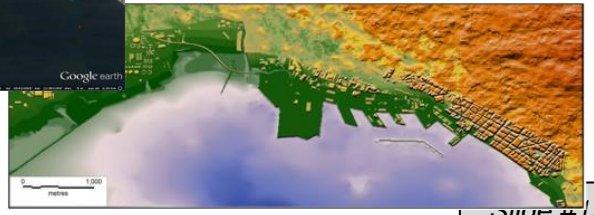
LOCAL HAZARD



**EXTRACTION OF SCENARIOS (10)
OFFSHORE THE TARGET POINT &
DEFINITION OF REPRESENTATIVE
SCENARIOS (10)**



**SIMULATION OF
INUNDATION**



1) From regional to local PTHA

2) From single components to systemic vulnerability and risk of complex systems

3) From single to multi-hazard risk quantification

4) From single expert to multiple-experts for managing subjective choices



$$f(x) = f_{SYS|PhVM}(x_{SYS}|x_{PhVM}) f_{PhVM|SH}(x_{PhVM}|x_{SH}) \times f_{SH}(x_{SH}) \quad (1)$$

COMPUTER-AIDED CIVIL AND INFRASTRUCTURE ENGINEERING

Computer-Aided Civil and Infrastructure Engineering 30 (2015) 524–540

Systemic Seismic Risk Assessment of Road Networks Considering Interactions with the Built Environment

Sotirios Argyroudis*

Department of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece

Jacopo Selva

Istituto Nazionale di Geofisica e Vulcanologia, Bologna, Italy

Pierre Gehl

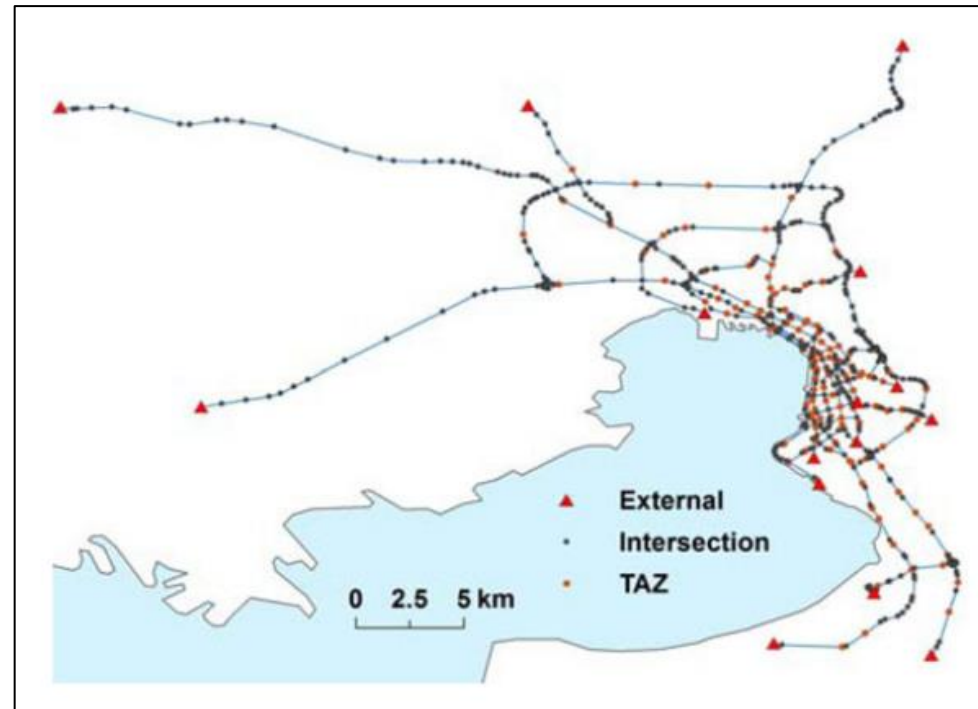
BRGM, Orleans Cedex 2, France

&

Kyriazis Pitilakis

Department of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece

Abstract: This article presents an integrated approach for the probabilistic systemic risk analysis of a road network considering spatial seismic hazard with correlation of ground motion intensities, vulnerability of the network components, and the effect of interactions within the area is calculated, specifically focusing on the short-term impact of seismic events (just after the earthquake). The potential of road blockages due to collapses of adjacent buildings and overpass bridges is analyzed, trying to individuate possible criticalities related to specific compo-





- hazard spatial distribution should be realistic:
 - single scenarios sampled e modeled separately
 - spatial correlation should be kept
- single configurations of damages should be sampled (not only average risk)
- all event-based risks should recombined probabilistically

COMPUTER-AIDED CIVIL AND INFRASTRUCTURE ENGINEERING
Computer-Aided Civil and Infrastructure Engineering 30 (2015) 524–540

Systemic Seismic Risk Assessment of Road Networks Considering Interactions with the Built Environment

Sotirios Argyroudis*
Department of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece

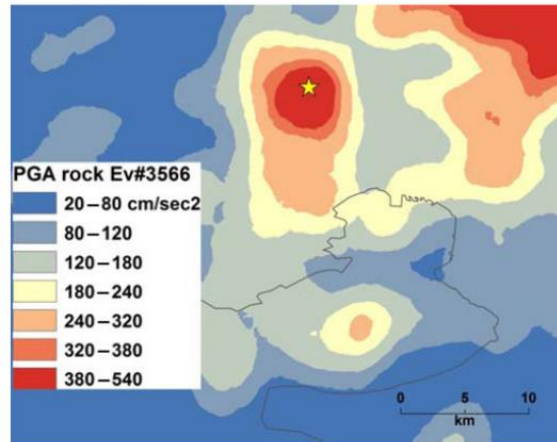
Jacopo Selva
Istituto Nazionale di Geofisica e Vulcanologia, Bologna, Italy

Pierre Gehl
BRGM, Orleans Cedex 2, France

&

Kyriazis Pitilakis
Department of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece

Abstract: This article presents an integrated approach for the probabilistic systemic risk analysis of a road network considering spatial seismic hazard with correlation of ground motion intensities, vulnerability of the network components, and the effect of interactions within the area is calculated, specifically focusing on the short-term impact of seismic events (just after the earthquake). The potential of road blockages due to collapses of adjacent buildings and overpass bridges is analyzed, trying to individuate possible criticalities related to specific compo-





- hazard spatial distribution should be realistic:
 - single scenarios sampled e modeled separately
 - spatial correlation should be kept
- single configurations of damages should be sampled (not only average risk)
- all event-based risks should recombined probabilistically

COMPUTER-AIDED CIVIL AND INFRASTRUCTURE ENGINEERING

Computer-Aided Civil and Infrastructure Engineering 30 (2015) 524–540

Systemic Seismic Risk Assessment of Road Networks Considering Interactions with the Built Environment

Sotirios Argyroudis*
Department of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece

Jacopo Selva
Istituto Nazionale di Geofisica e Vulcanologia, Bologna, Italy

Pierre Gehl
BRGM, Orleans Cedex 2, France

&

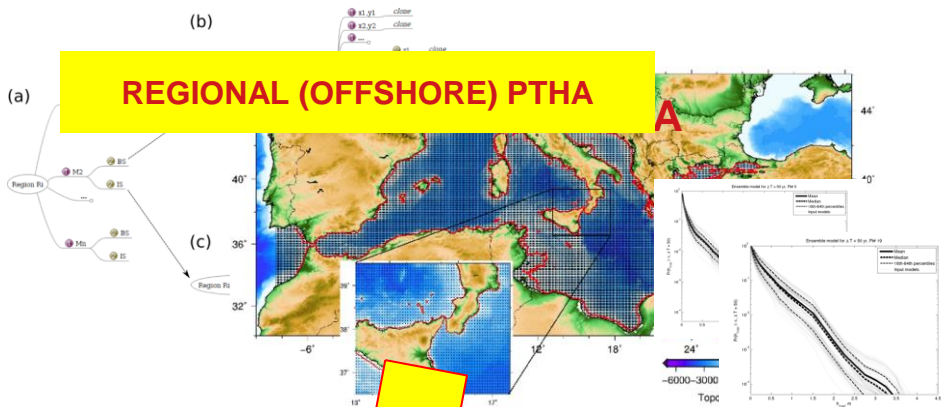
Kyriazis Pitilakis
Department of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece

Abstract: This article presents an integrated approach for the probabilistic systemic risk analysis of a road network considering spatial seismic hazard with correlation of ground motion intensities, vulnerability of the network components, and the effect of interactions within the area is calculated, specifically focusing on the short-term impact of seismic events (just after the earthquake). The potential of road blockages due to collapses of adjacent buildings and overpass bridges is analyzed, trying to individuate possible criticalities related to specific compo-

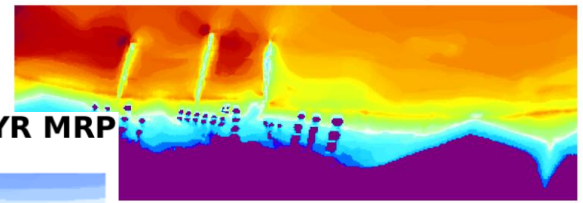
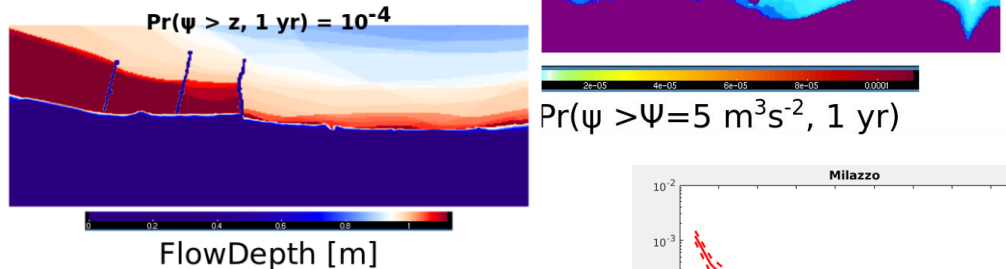


- 1) From regional to local PTHA
- 2) From single components to systemic vulnerability and risk of complex systems
- 3) From single to multi-hazard risk quantification**
- 4) From single expert to multiple-experts for managing subjective choices

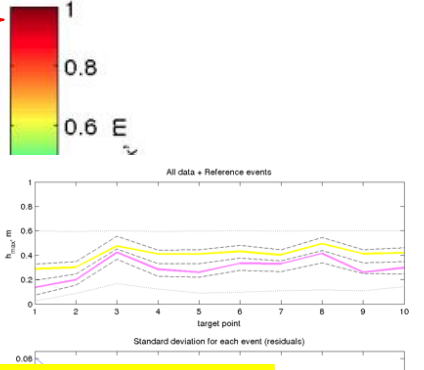
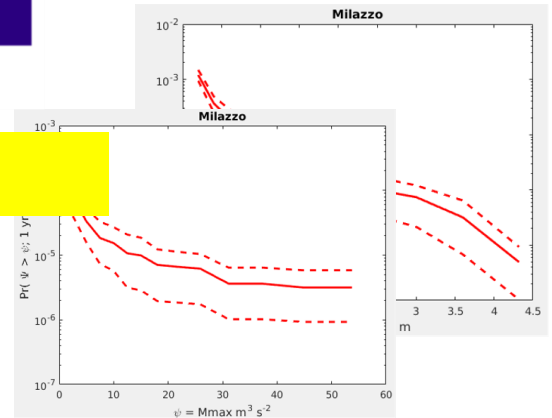
3. FROM SINGLE TO MULTI-HAZARD RISK



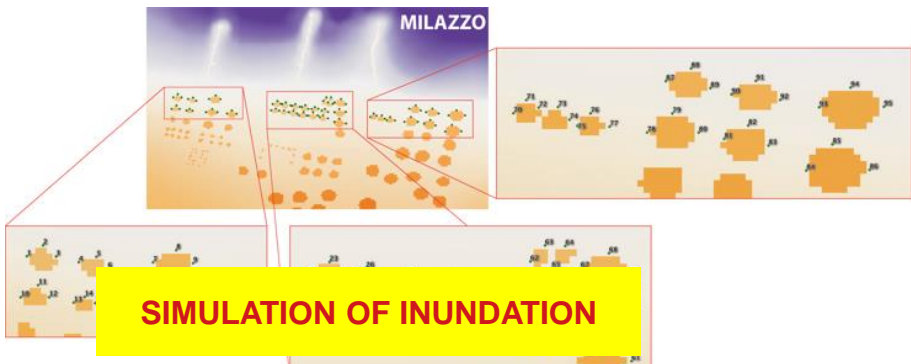
MEAN HAZARD MAP, 10⁴ YR MRP



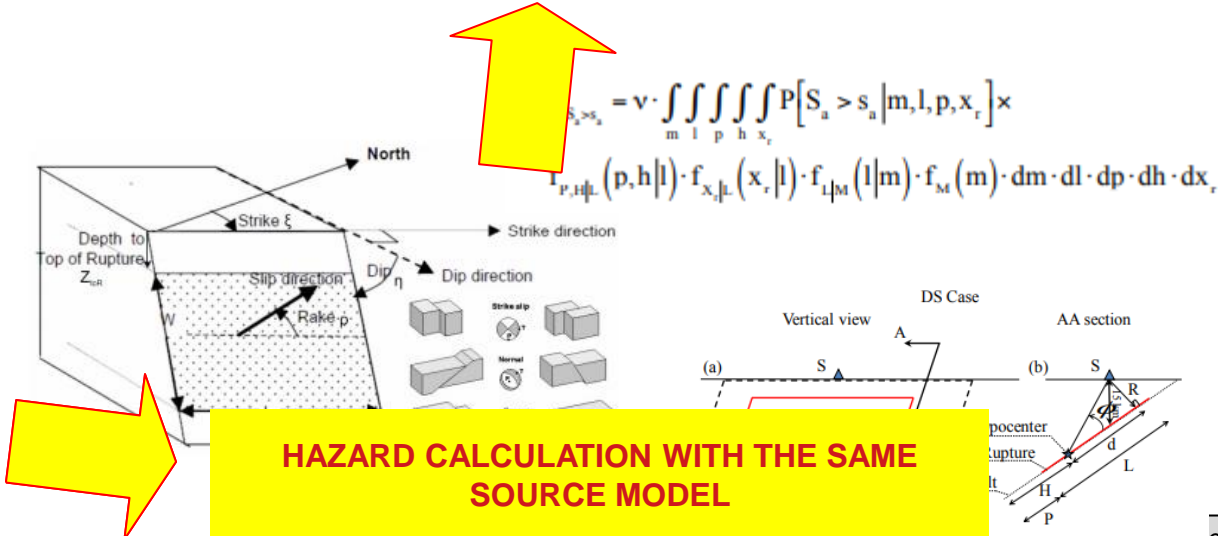
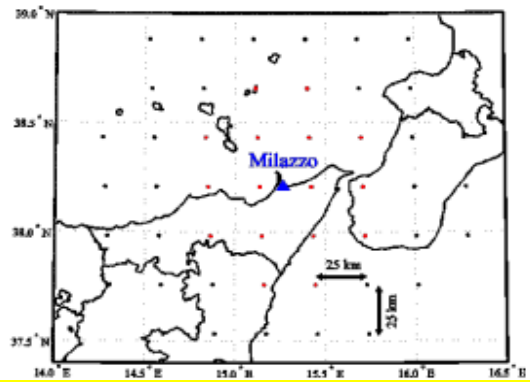
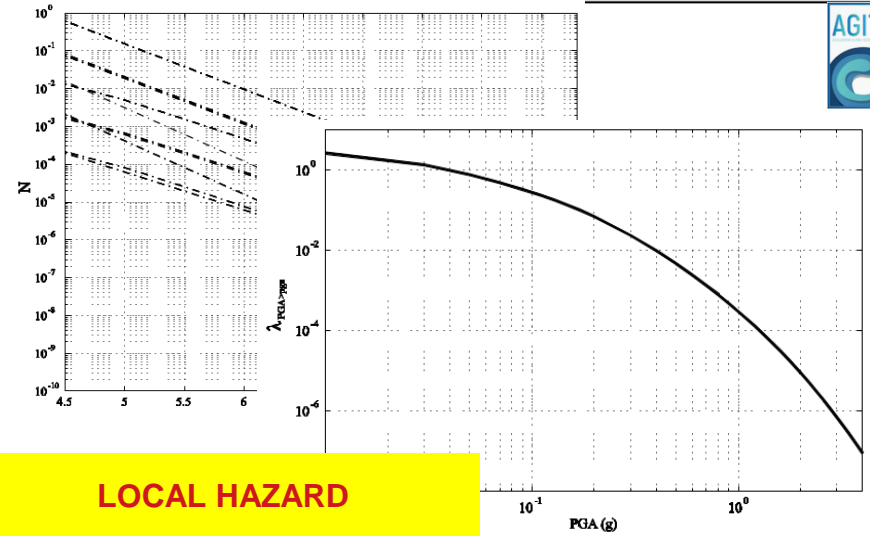
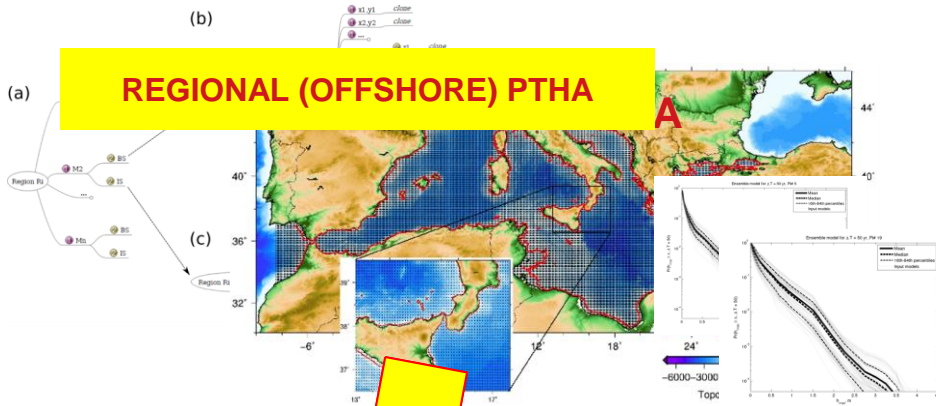
LOCAL HAZARD



EXTRACTION OF SCENARIOS (10⁷) OFFSHORE THE TARGET POINT & DEFINITION OF REPRESENTATIVE SCENARIOS (10³)



3. FROM SINGLE TO MULTI-HAZARD RISK



3. FROM SINGLE TO MULTI-HAZARD RISK

COMMON FRAMEWORK FOR RISK QUANTIFICATION

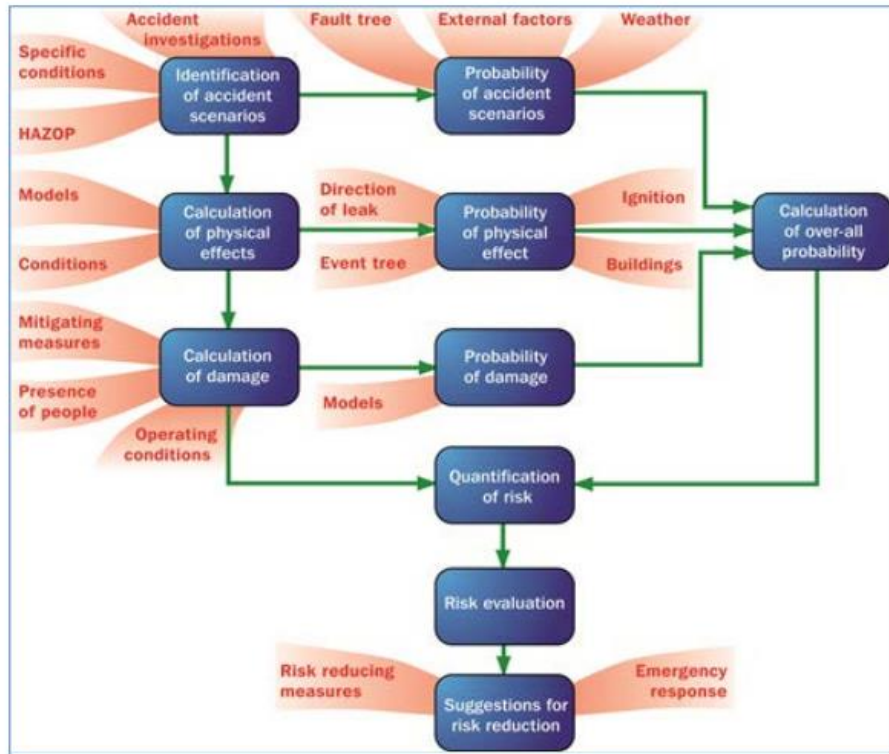
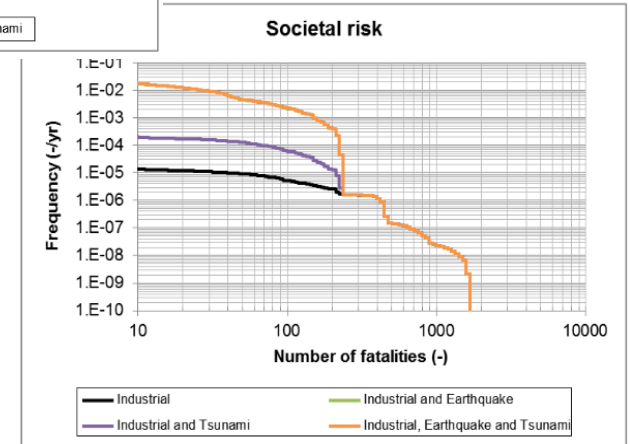
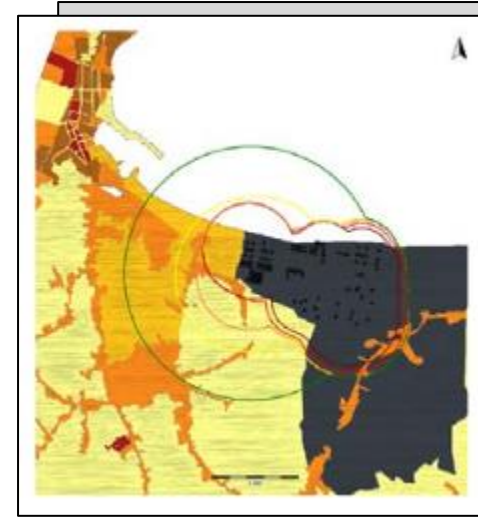
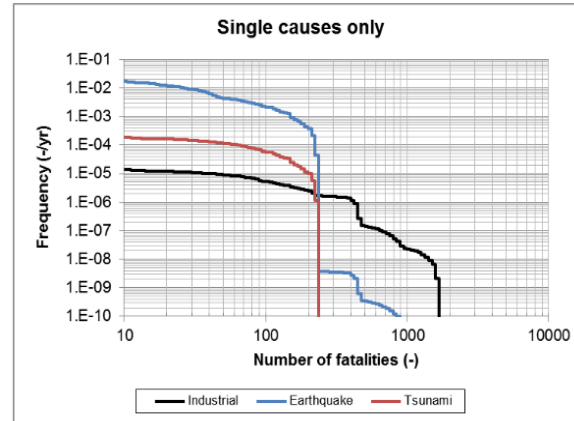


Fig. 2.14 Steps in a QRA and most important parameters



- **Coherent single-risk quantification**
 - **First order multi-hazard risk (no combined fragility curves)**

- 1) From regional to local PTHA
- 2) From single components to systemic vulnerability and risk of complex systems
- 3) From single to multi-hazard risk quantification
- 4) From single expert to multiple-experts for managing subjective choices**

NUREG/CR-6372
UCRL-ID-122160
Vol. 1

-
-
- Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts

Main Report

Manuscript Completed: April 1997
Date Published: April 1997

Prepared by
Senior Seismic Hazard Analysis Committee (SSHAC)
R. J. Budnitz (Chairman), G. Apostolakis, D. M. Boore, L. S. Cluff, K. J. Coppersmith, C. A. Cornell, P. A. Morris

Electric Power Research Institute (EPRI) found in attempting to characterize U.S. east of the Rocky Mountains. Most reports for most sites in the eastern U.S.

differed significantly. However, the median hazard results did not differ by nearly as much. We now understand that differences in both the inputs and the procedures by which the two studies dealt with the inputs were among the key reasons for the differences in the mean curves. At the time this was not understood, and the differences between the mean curves caused not only considerable consternation, but launched several efforts to understand what might underlie the differences and attempts to update the older work.

Ultimately, the inability to understand all of the differences between the LLNL and EPRI hazard results—

NUREG/CR-6372
UCRL-ID-122160

ISSUE DEGREE	DECISION FACTORS	STUDY LEVEL
A Non-controversial; and/or insignificant to hazard	<ul style="list-style-type: none"> •Regulatory concern •Resources available •Public perception 	1 TI evaluates/weights models based on literature review and experience; estimates community distribution
B Significant uncertainty and diversity; controversial; and complex		2 TI interacts with proponents & resource experts to identify issues and interpretations; estimates community distribution
C Highly contentious; significant to hazard; and highly complex		3 TI brings together proponents & resource experts for debate and interaction; TI focuses debate and evaluates alternative interpretations estimates community distribution.
		4 TFI organizes panel of experts to interpret and evaluate; focuses discussions; avoids inappropriate behavior on part of evaluators; draws picture of evaluators' estimate of the community's composite distribution; has ultimate responsibility for project

NUREG/CR-6372
UCRL-ID-122160

ISSUE DEGREE	DECISION FACTORS	STUDY LEVEL
A Non-controversial; and/or insignificant to hazard	<ul style="list-style-type: none"> •Regulatory concern •Resources available •Public perception 	1 TI evaluates/weights models based on literature review and experience; estimates community distribution
B Significant uncertainty and diversity; controversial; and complex		2 TI interacts with proponents & resource experts to identify issues and interpretations; estimates community distribution
C Highly contentious; significant to hazard; and highly complex		3 TI brings together proponents & resource experts for debate and interaction; TI focuses debate and evaluates alternative interpretations estimates community distribution.
		4 TFI organizes panel of experts to interpret and evaluate; focuses discussions; avoids inappropriate behavior on part of evaluators; draws picture of evaluators' estimate of the community's composite distribution; has ultimate responsibility for project

Needs of TSUMAPS

- Development of **alternative** scientifically acceptable choices (to represent the variability within the technical community)
- Weight the alternatives, as input to the ensemble
- We have to manage **subjective choices** to obtain **robust results**

Solution

- **Specific protocol** to manage subjectivity to quantify the community distribution (in TSUMAPS: alternatives + weights)
 - *Trackable decision making, forcing to use up-to-date method & expose limitations*

Multiple-expert integration process for managing epistemic uncertainty

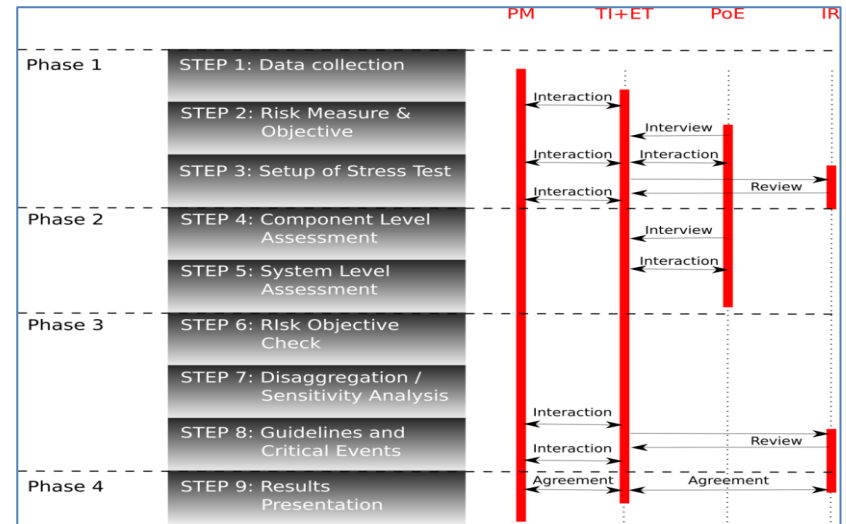
Goal: rational management of **critical choices** and consequent epistemic uncertainty, to increase credibility, stability and robustness of results.

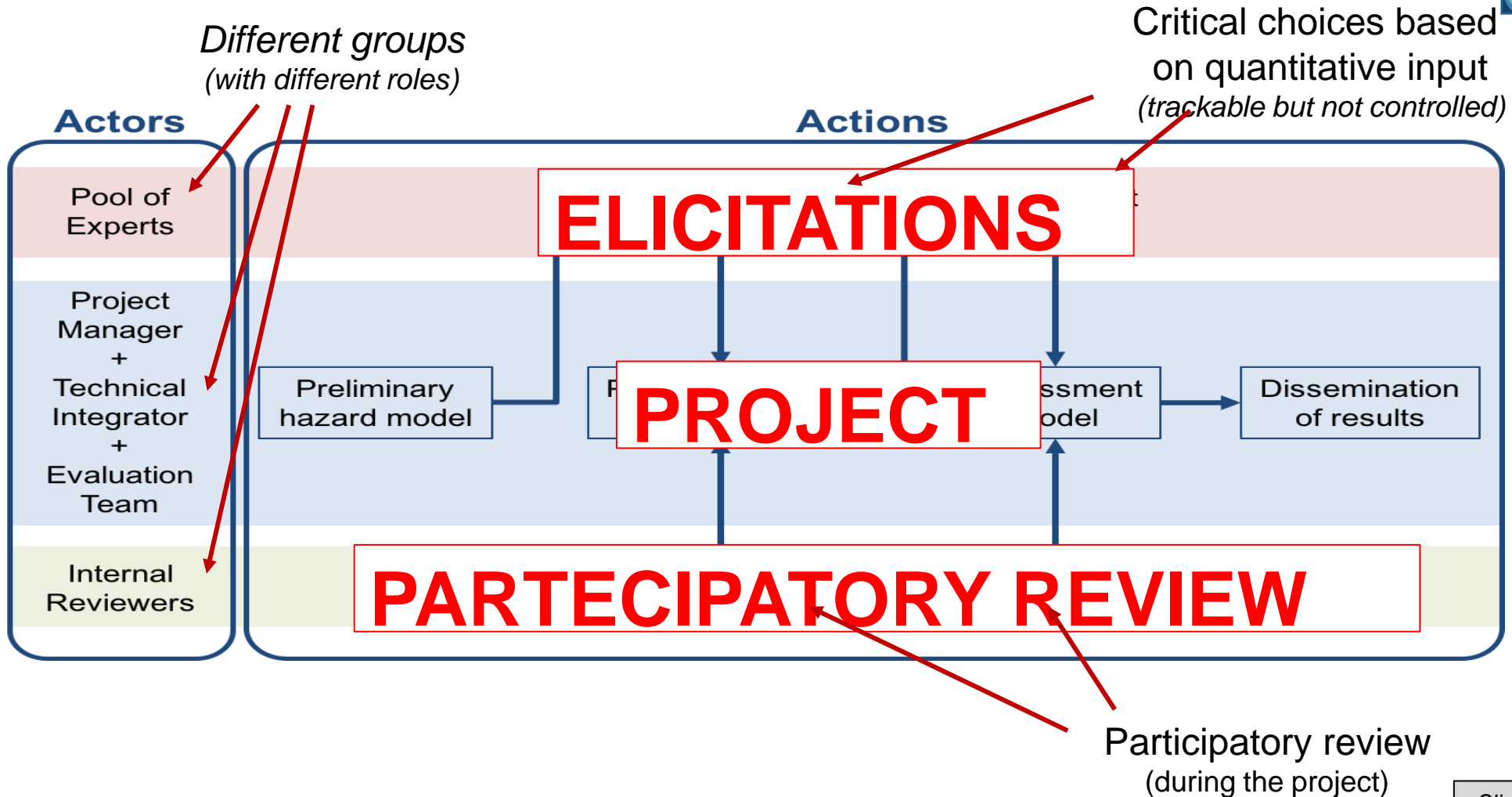
→ *similar to SSHAC Levels 2/3, with important differences (classical elicitations, extension to multi-hazard/risk,...)*

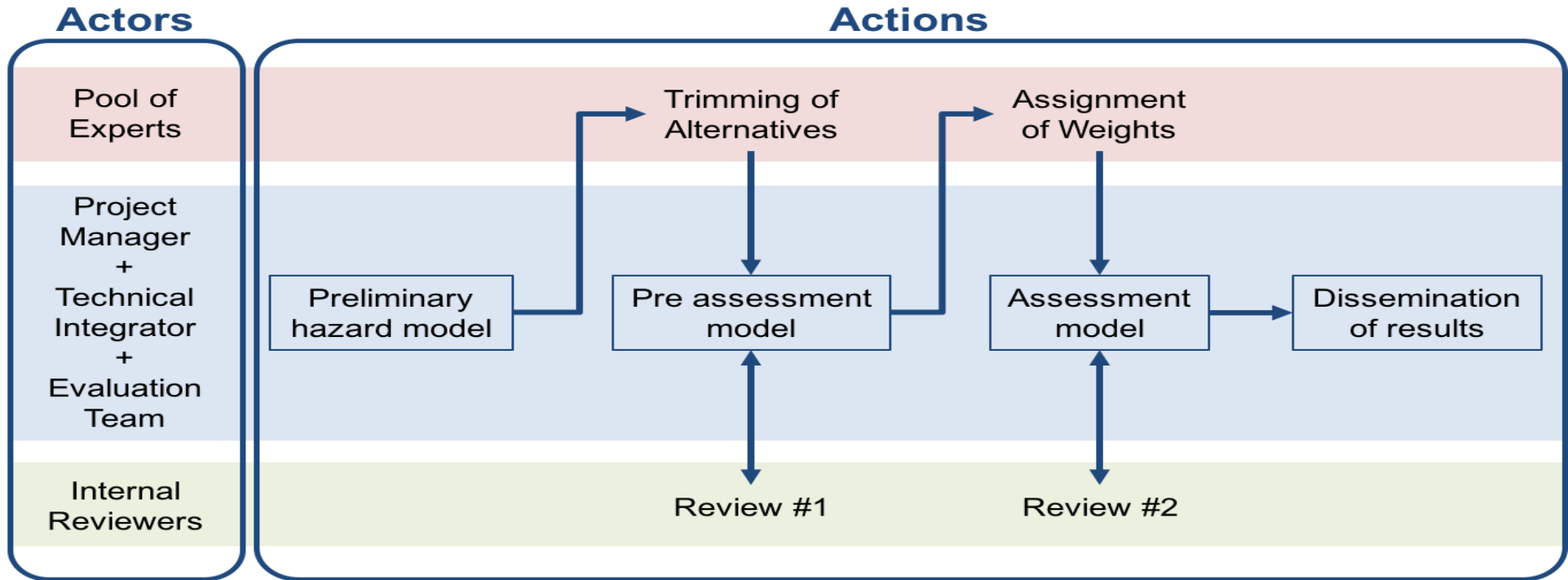
Actors: Project Manager (PM), Technical Integrator (TI), Evaluation Team (ET), Internal Reviewers (IR), Pool of Experts (PoE).

Key features:

- Definition of roles, **transparency & accountability**, independence
- Scalability and flexibility (depending on the complexity)
- Extensive use of structured **Expert Elicitation**
- Adaptable to **hazard, risk, multi-hazard/risk**







- STREST developed a **stress test framework** based on PRA
- Stress test **levels increase in complexity**:
 - from single component to system level analyses
 - from single to multi-hazard risk quantification
 - from single to multiple expert involvement to constrain epistemic uncertainty
- Within STREST, we developed:
 - A procedure to produce **local PTHA** based on inundation simulation
 - A “protocol” to manage subjectivity based on **multiple-expert participation**