Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

Centro di Ricerche Sismologiche
CRS

Matteo Picozzi

mpicozzi@ogs.it

L'OGS è un istituto pubblico di ricerca a orientamento internazionale le cui radici affondano nella **Scuola di Astronomia e Navigazione** fondata a Trieste nel 1753 dall'Imperatrice Maria Teresa d'Austria

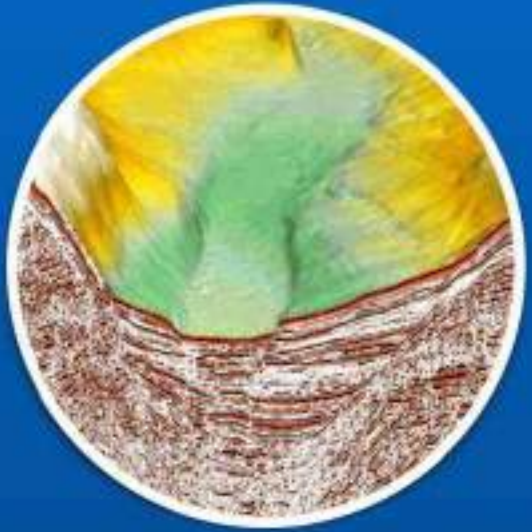
Section of Oceanography (OCE)

Physical Oceanography

Chemical & Biological Oceanography

Dynamics of Ecosystems & Computational Oceanography

142 total staff
73 permanent



92 total staff
55 permanent

Section of Geophysics (GEO)

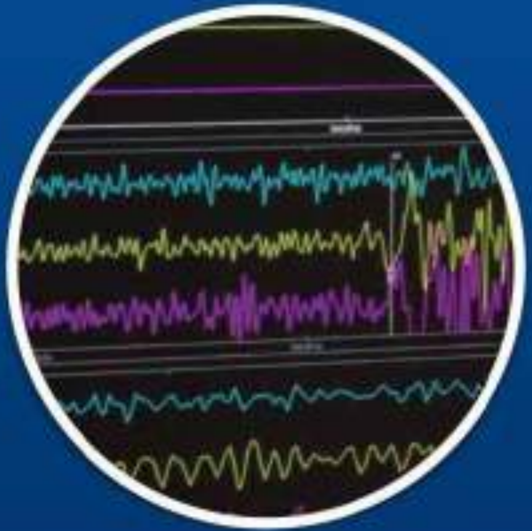
Geology & Marine Geophysics

Applied & Exploration Geophysics

Center for Seismological Research (CRS)

Seismology & Geodesy

Engineering Seismology



76 total staff
40 permanent

15 total staff
13 permanent

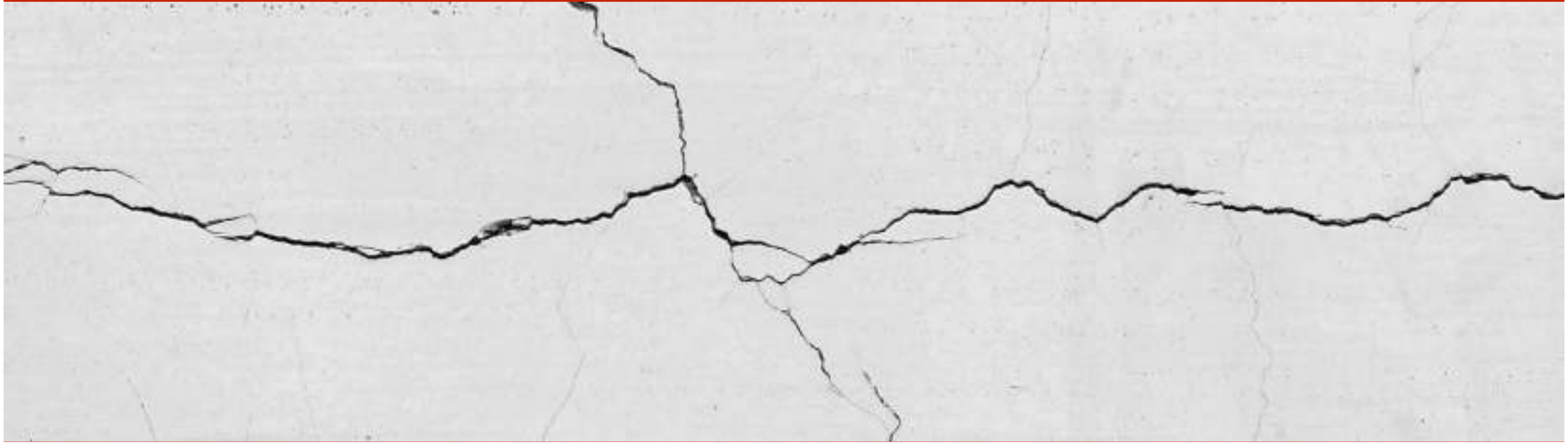
Centre for Management of Maritime Infrastructures (CGN)

Ship management

Mission 3

Understanding **Natural Risk** to build prepared & resilient communities

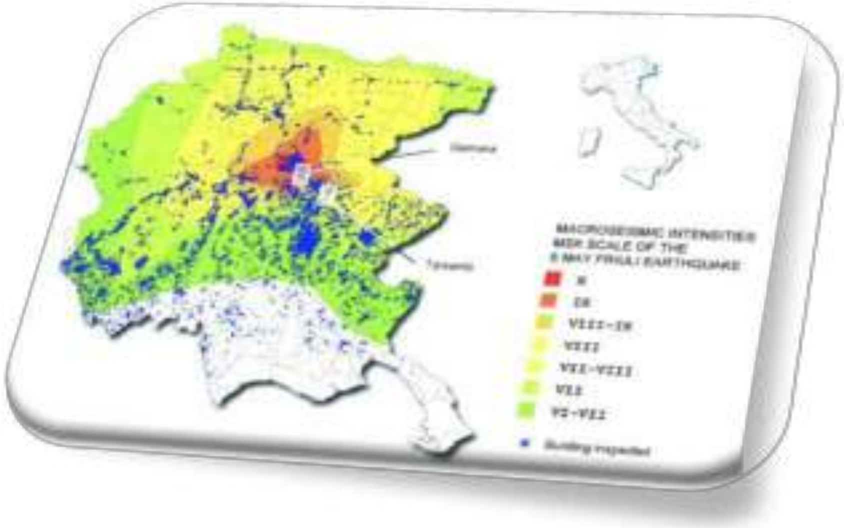
- Hazard processes and mechanisms
- Forecasting and risk scenarios
- Integrated multi-risk
- Impact assessment and risk mitigation
- Rapid emergency response



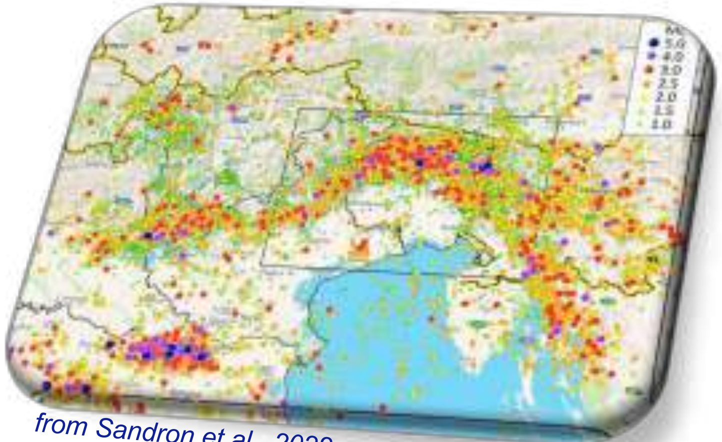
OGS

Seismological Research Centre of OGS a Near Faults Observatory

6 Maggio 1976



Seismology



from Sandron et al., 2022

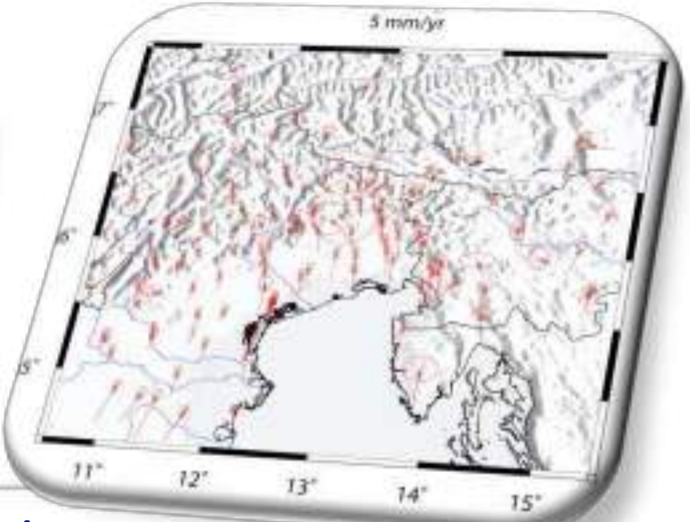
- La legge nazionale n. 828 del 1982 istituisce il Centro di Ricerche Sismologiche(CRS)

- La legge n. 399 del 30 novembre 1989 ha assegnato al CRS il compito istituzionale di "... svolgere, in autonomia scientifica, [...] con specifici progetti, ricerche sulla sismicità e sulla sismogenesi dell'Italia nord-orientale, gestendo e sviluppando inoltre la connessa rete di rilevamento sismico anche per fini di protezione civile".

Accelerometric Network

from G. Capotosti, 2025

Geodesy

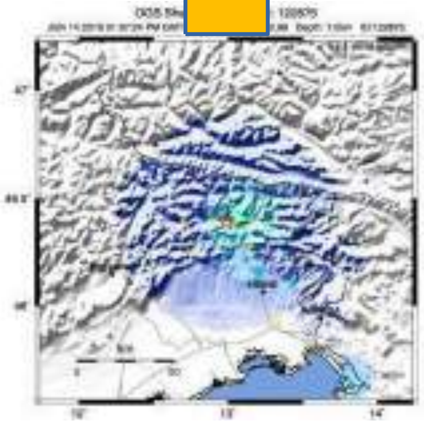


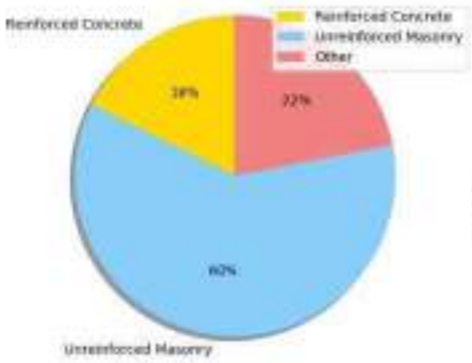
from Tunini et al., 2024

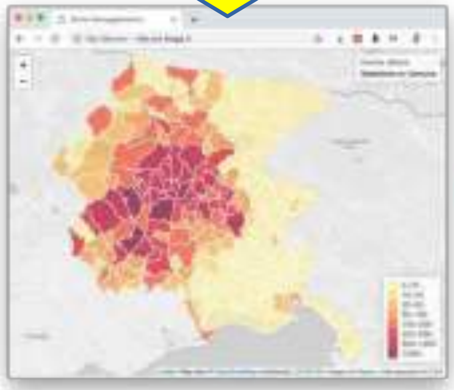
Seismic Risk

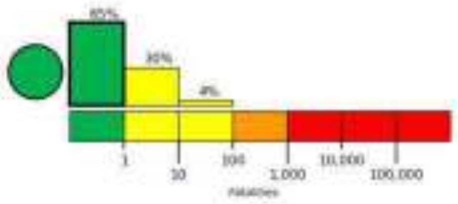
The ground shaking associated to a felt (few seconds after the event) or hypothetical (future) earthquake can then be used to simulate the potential impact on actual structures (e.g., damage, collapses) and population (losses, injuries) by locally-calibrated response models.

Background earthquake hazard → Seismic Exposure → Fragility Functions → **Expected Damage** → **Losses (human, material)**









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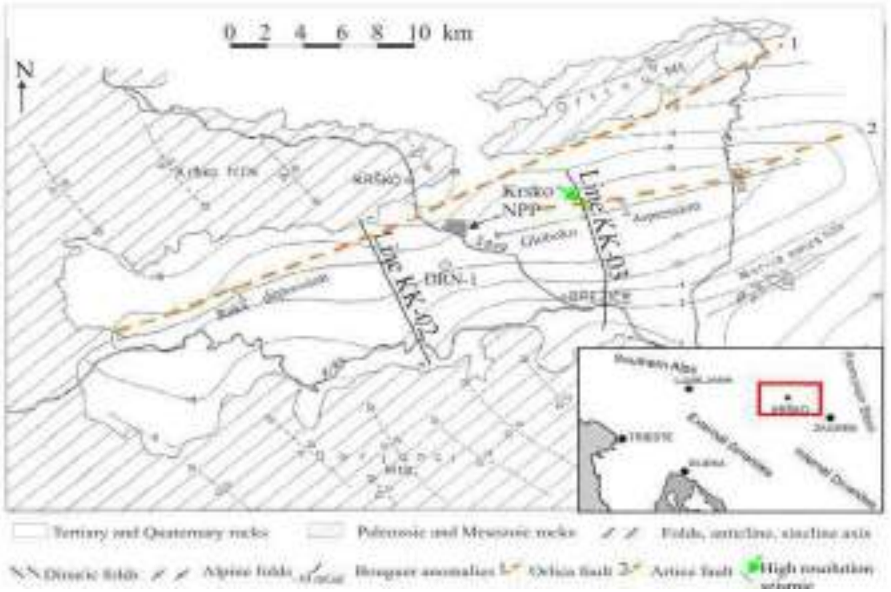
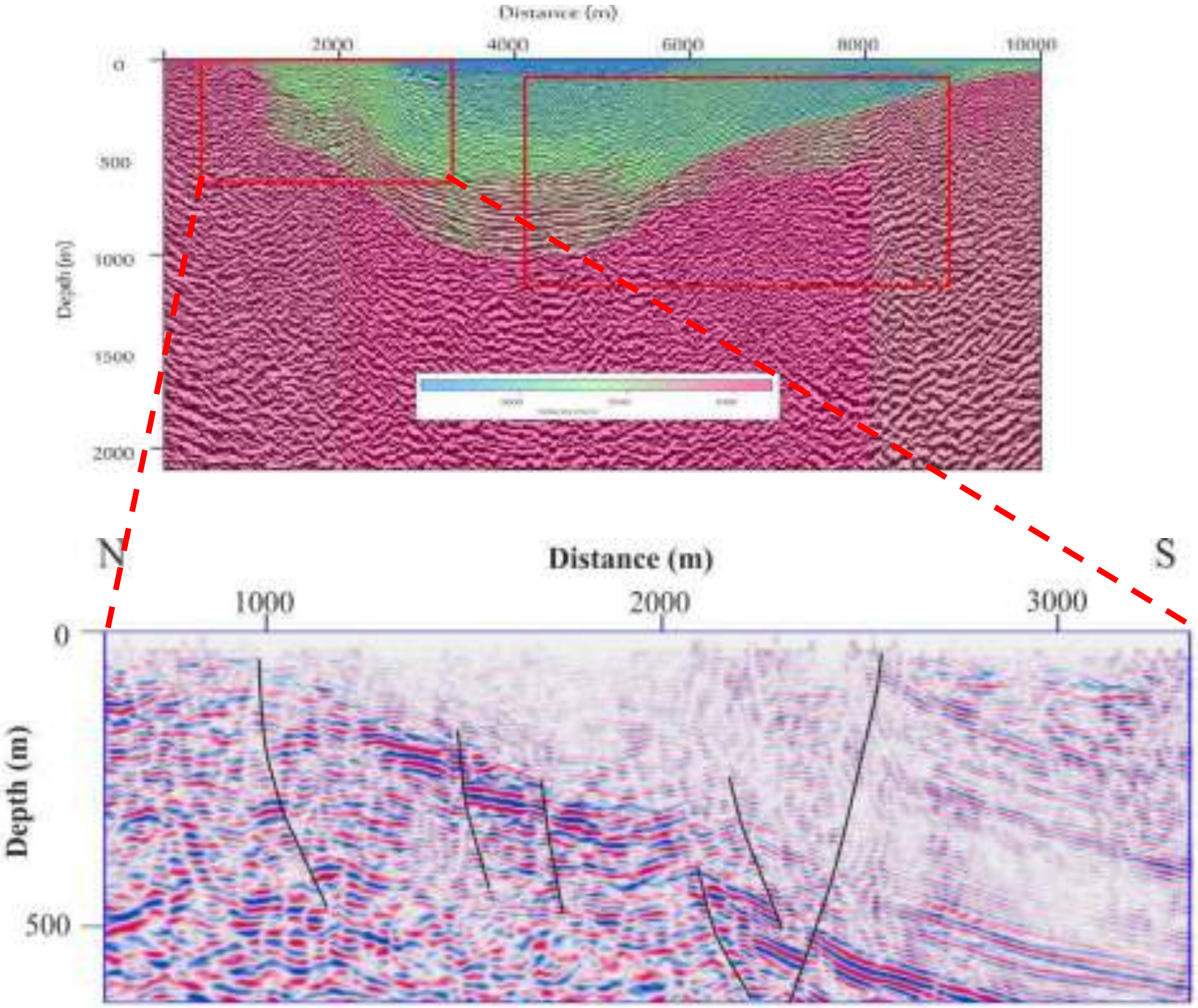
from V. Poggi, 2025 - ***CRS***

Contributi di OGS nel percorso autorizzativo e gestionale di NPPs

Migliorare il modello sismotettonico finalizzato alla valutazione dei rischi sismici





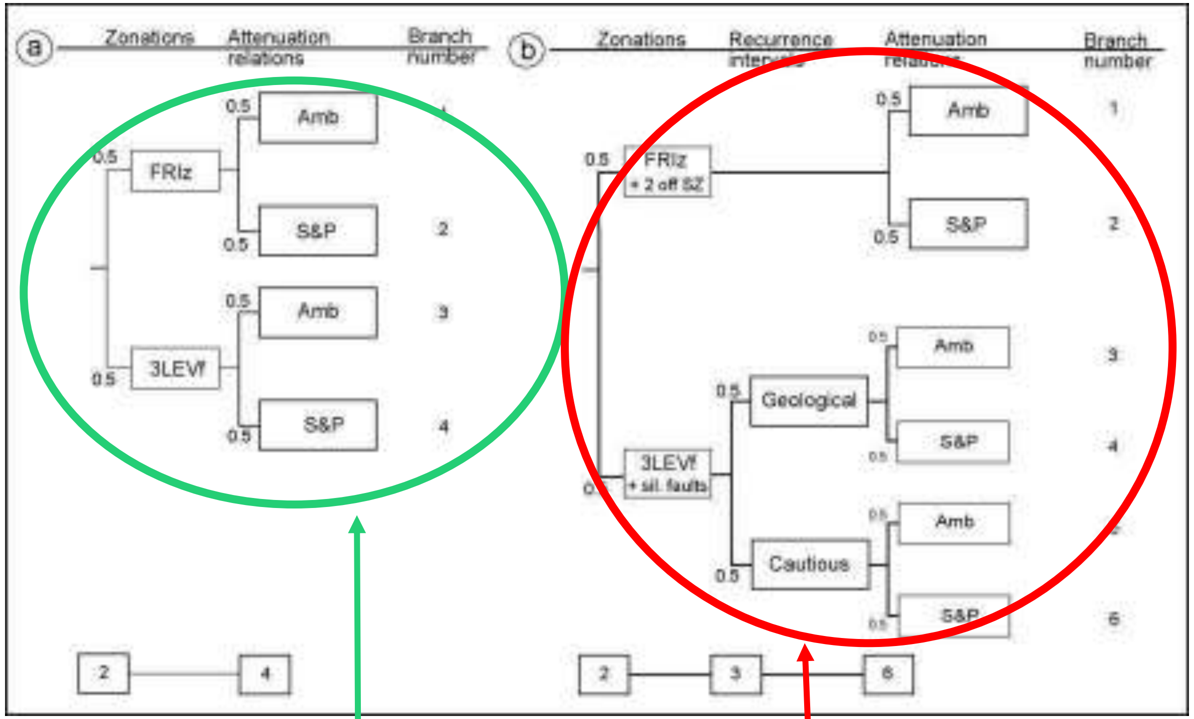
F. Accaino (faccaino@ogs.it) - GEO

OGS

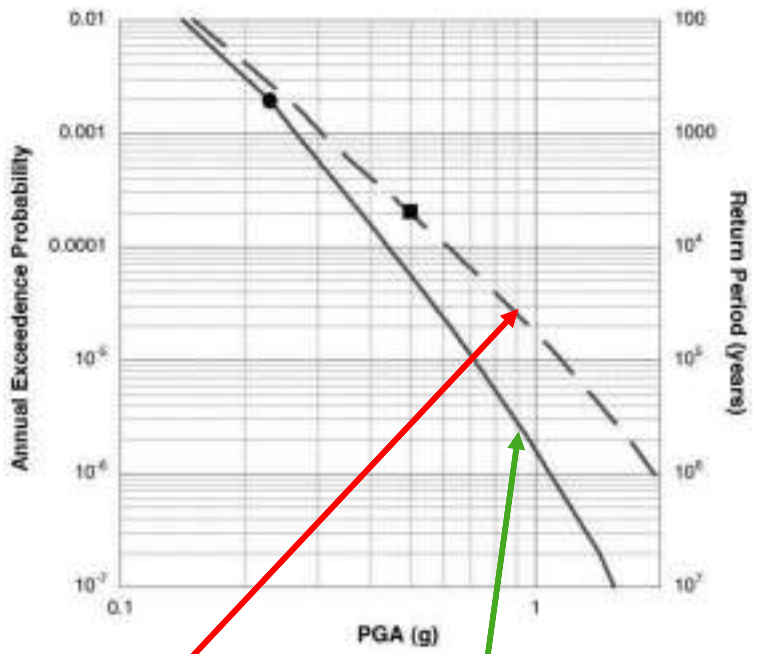
PSHA for critical facilities

D. Slejko (dslejko@ogs.it) - CRS

- **OBE (Operating Basis Earthquake)**: annual frequency = 10^{-2} for IAEA-2002.
- **SSE (Safe Shutdown Earthquake)**: annual frequency =10^{-4} for NUREG-2003, 10^{-4} for IAEA-2002 (10^{-8} for new NPPs, IAEA-2010).



Logic tree and seismogenic zonations used for standard building and critical facility



Final hazard curves and results from the different branches for the standard building and for the critical facility.

In the 2000s
PEGASOS Project, funded by NAGRA

National Cooperative for the Disposal of Radioactive Waste, Switzerland

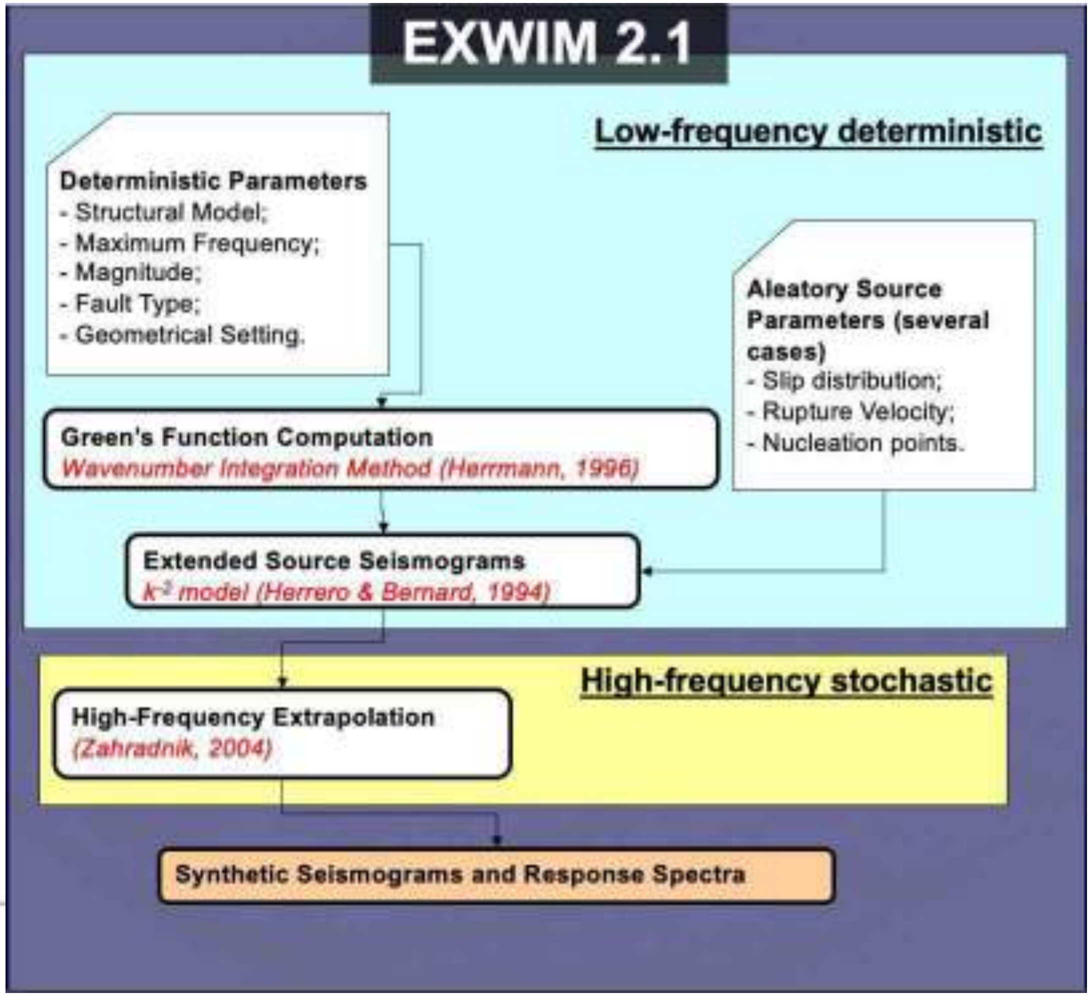
E. Priolo (epriolo@ogs.it) - CRS

Ground motion: extreme cases

Upper limit ⇦ for very low probabilities of interest extremely rare ground motions need to be taken into account.

Near-fault ⇦ only a limited amount of data is available at short distance from the source.

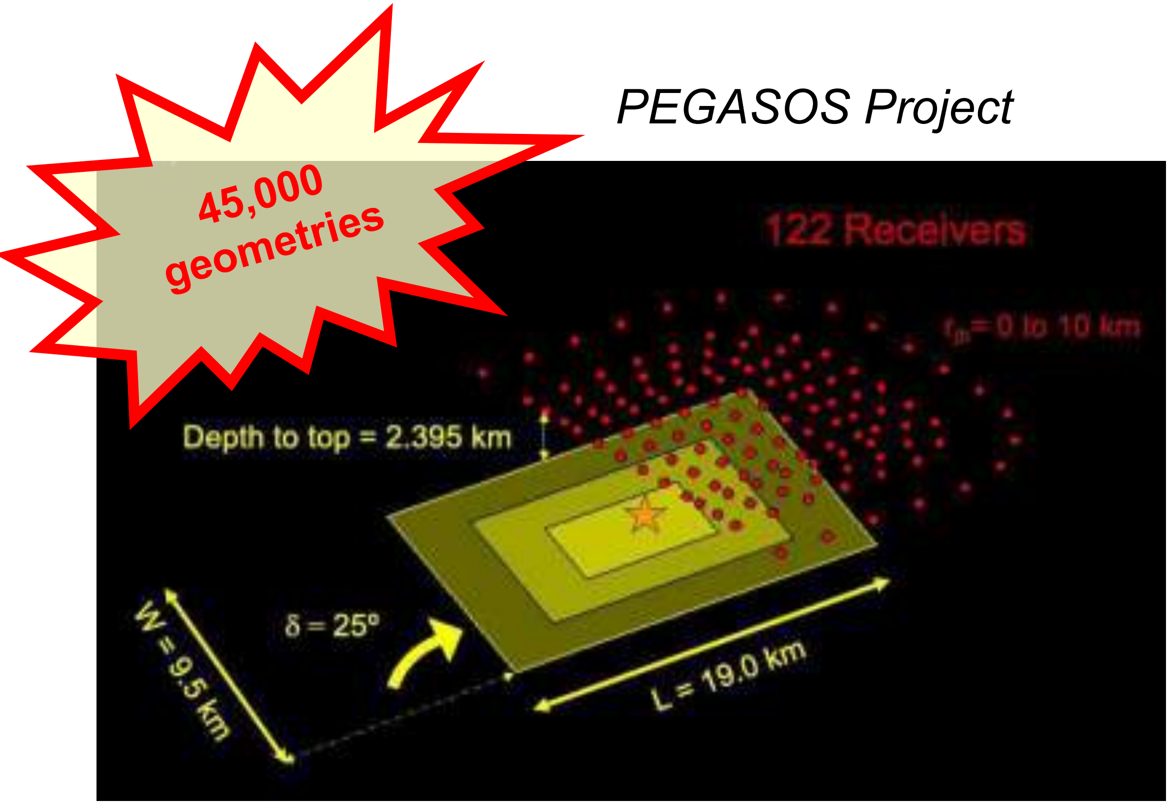
Numerical simulation methods, which solve the **physical processes** behind, represent the only tool available to assess the ground motion in these limiting cases.



Numerical simulations of the strong ground motion in Switzerland

E. Priolo (epriolo@ogs.it) - *CRS*

PEGASOS Project

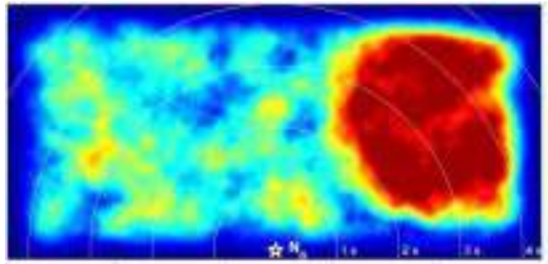


Parametric analysis to assess the most critical setting of:

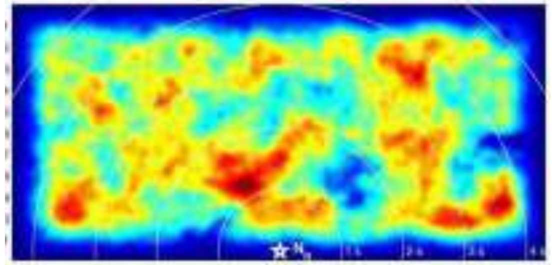
•source depth,
•fault dip,
•receiver azimuth, and
•rupture directivity.

The ground motion has been evaluated by computing: PGA, PGV, Housner and Arias intensity.

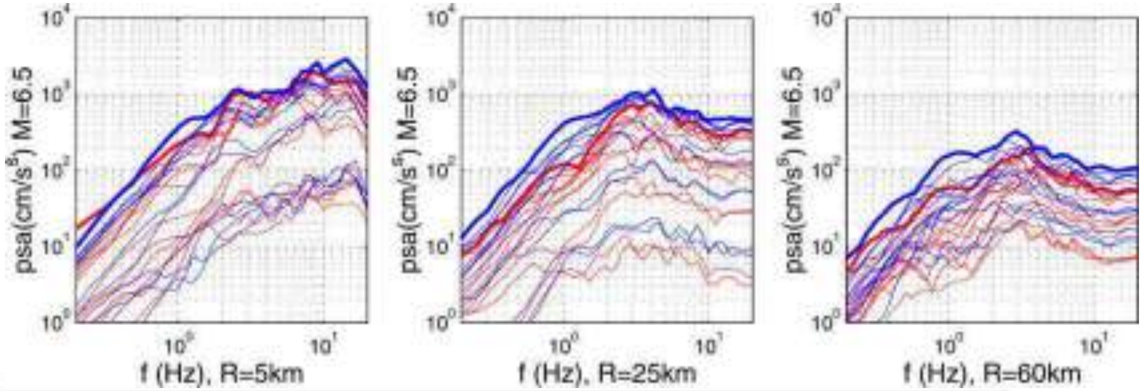
High" $\Delta\sigma$: one dominant asperity (Sommerville et al., 1999);



"Medium" $\Delta\sigma$: several, smaller asperities.



Acceleration Response Spectra



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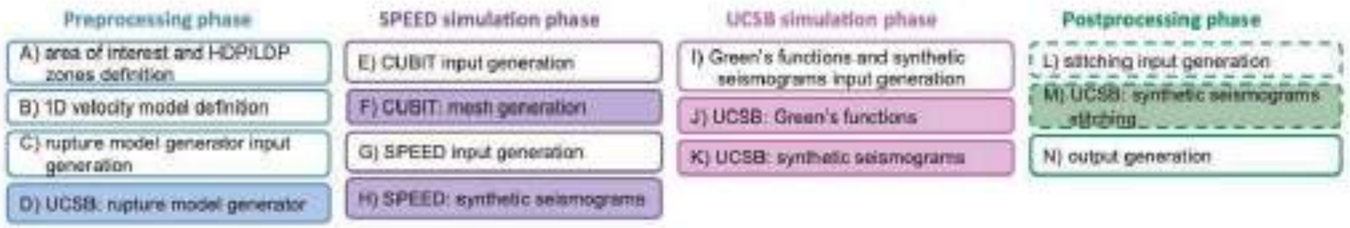
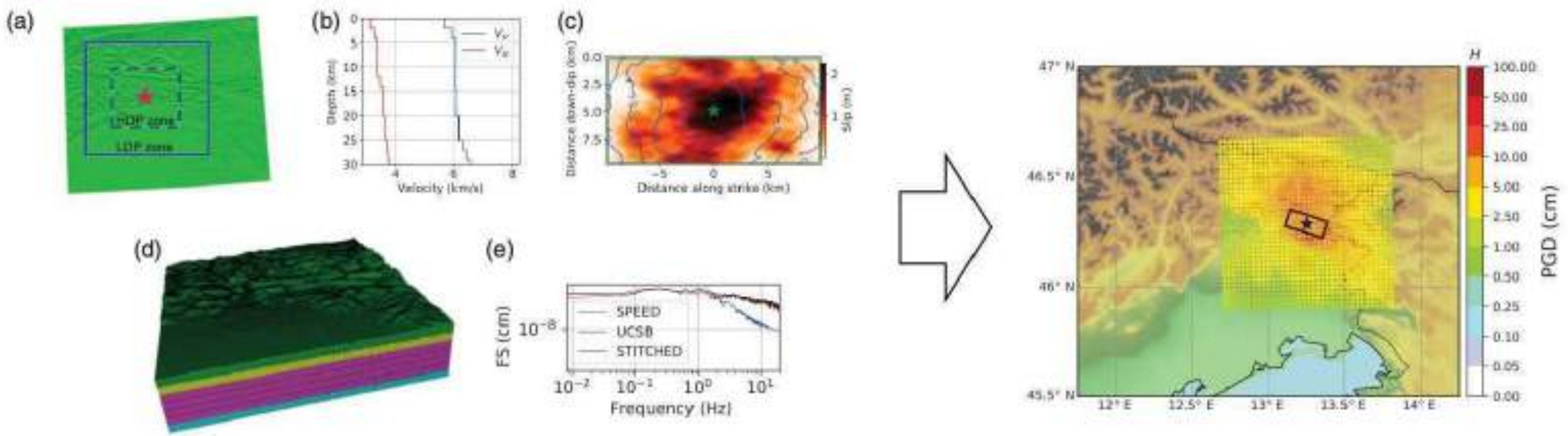
Modeling of Earth processes

Physics-Based Ground-Shaking Simulations



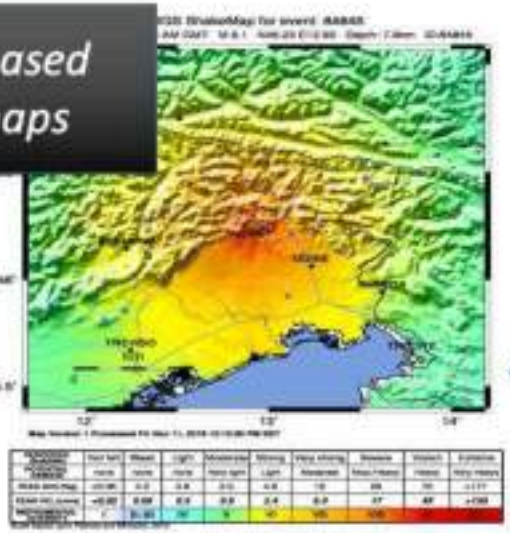


*Zuccolo et al., 2025 - **CRS***

Rapid Response System

by ***CRS***

GMM-based Shakemaps

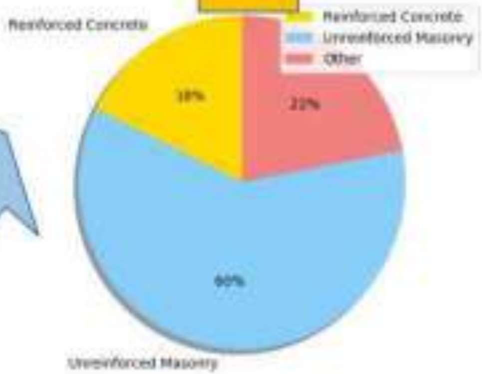


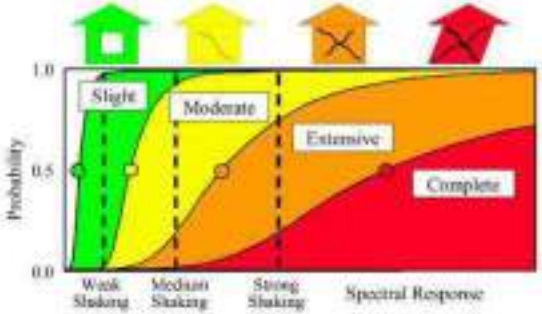
(RDSA System, Poggi et al., 2020)

Exposure
(building type and distribution)

Fragility
(dynamic behavior of structures)

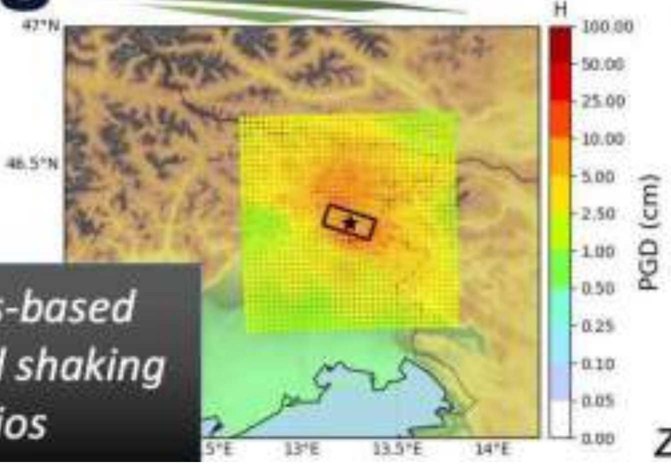
Expected damage





UNDER DEVELOPMENT

UrgentShake



Physics-based ground shaking scenarios

Zuccolo et al., 2025

Numerical simulation of seismic waves propagating in the Lower Sarca Valley

G. Laurenzano et al., 2025 - CRS

PROVINCIA AUTONOMA DI TRENTO

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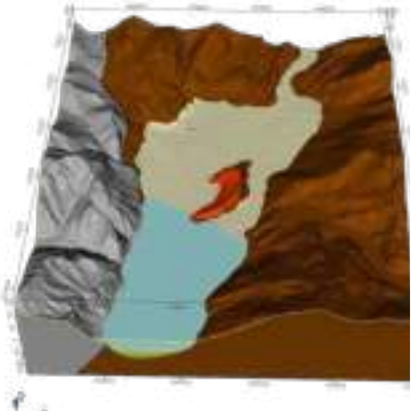
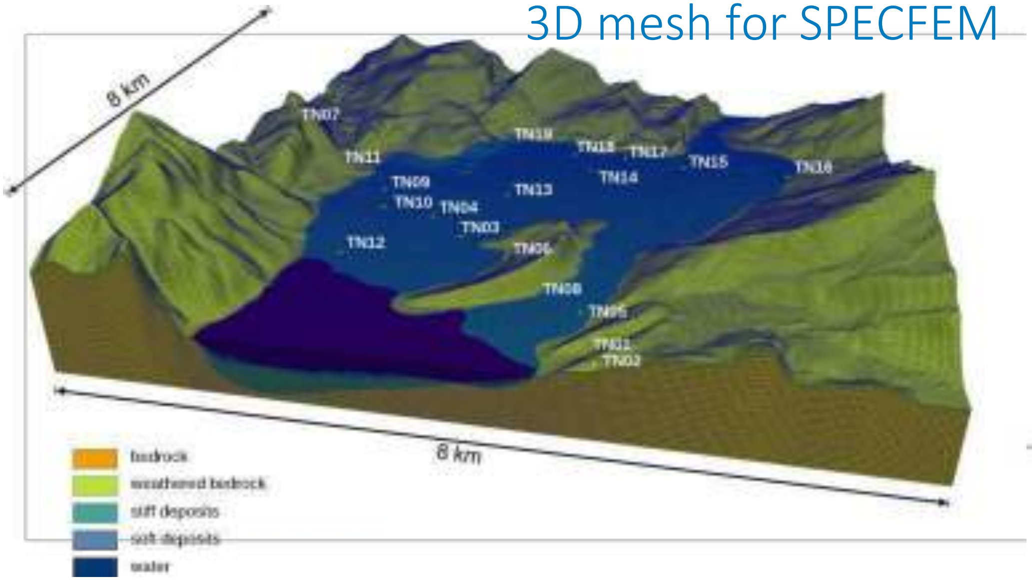
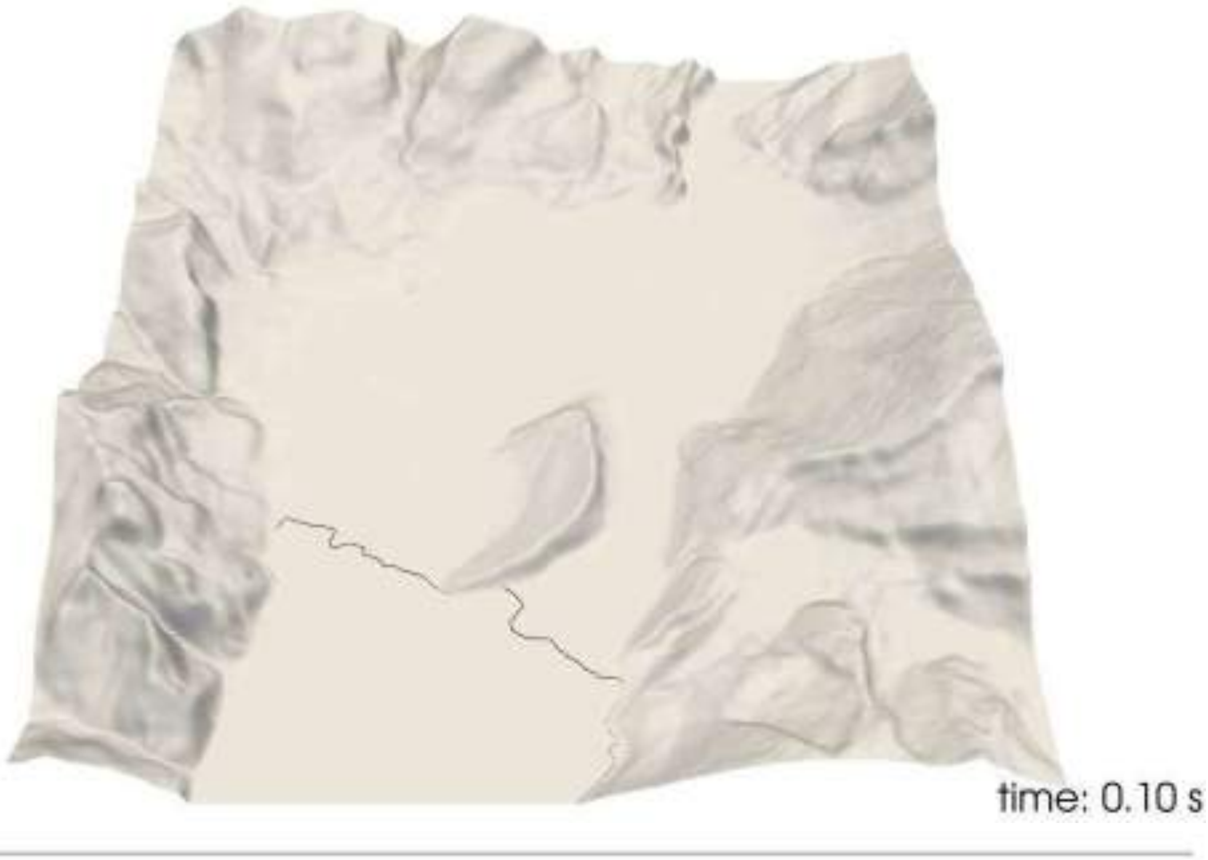
3D digital model



3D mesh for SPECFEM





from P. Klin, 2024 - CRS

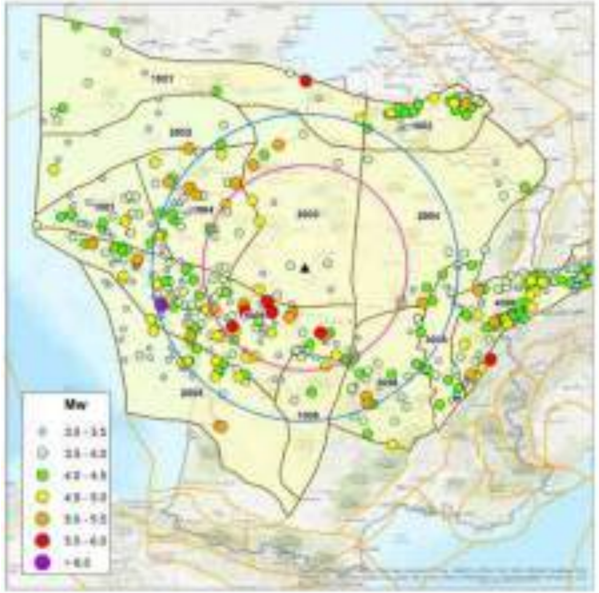
Saint-Laurent Nuclear Power Plant

2020 - ETUDE PSHA DU SITE DE SAINT-LAURENT

M. Santulin (msantulin@ogs.it) - CRS
A. Rebez (arebez@ogs.it)

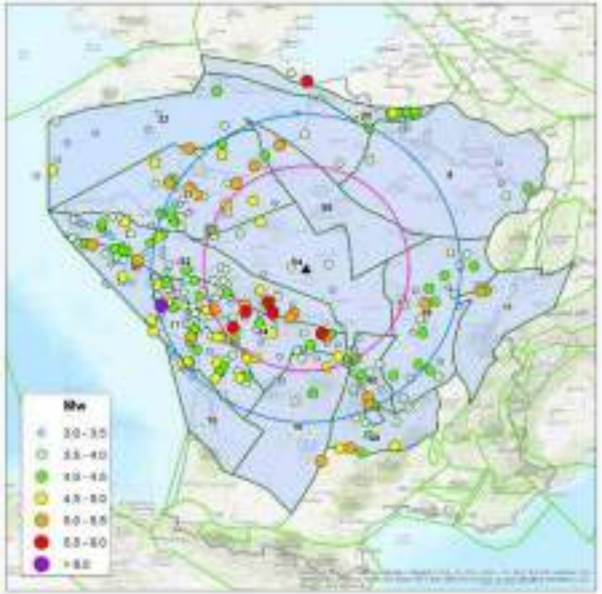
Seismotectonic Models & Seismicity

IRSN



GEOTER

EDF



PSHA Results

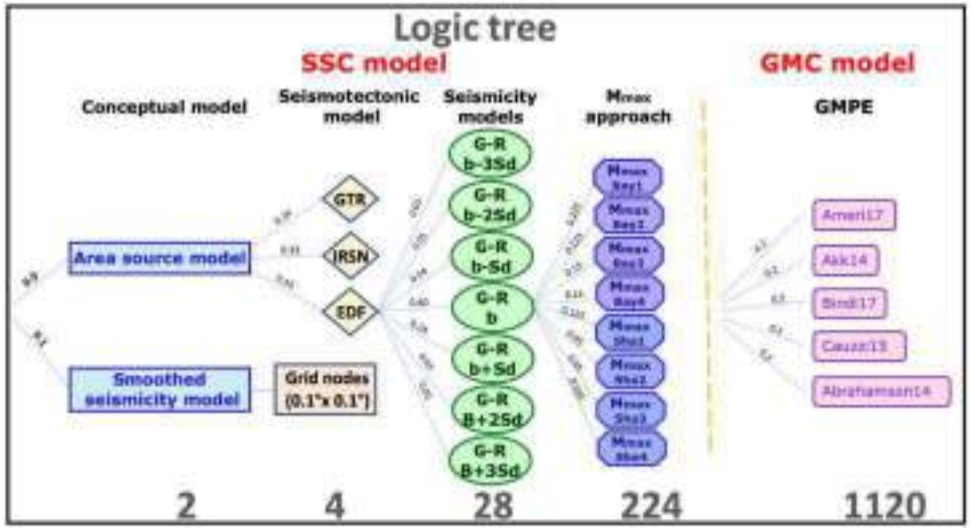


Fig. 3-2: Final logic tree for the PSHA of the Saint Laurent site.

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M. Santulin (msantulin@ogs.it) - CRS
A. Rebez (arebez@ogs.it)

UNIFORM HAZARD RESPONSE SPECTRA

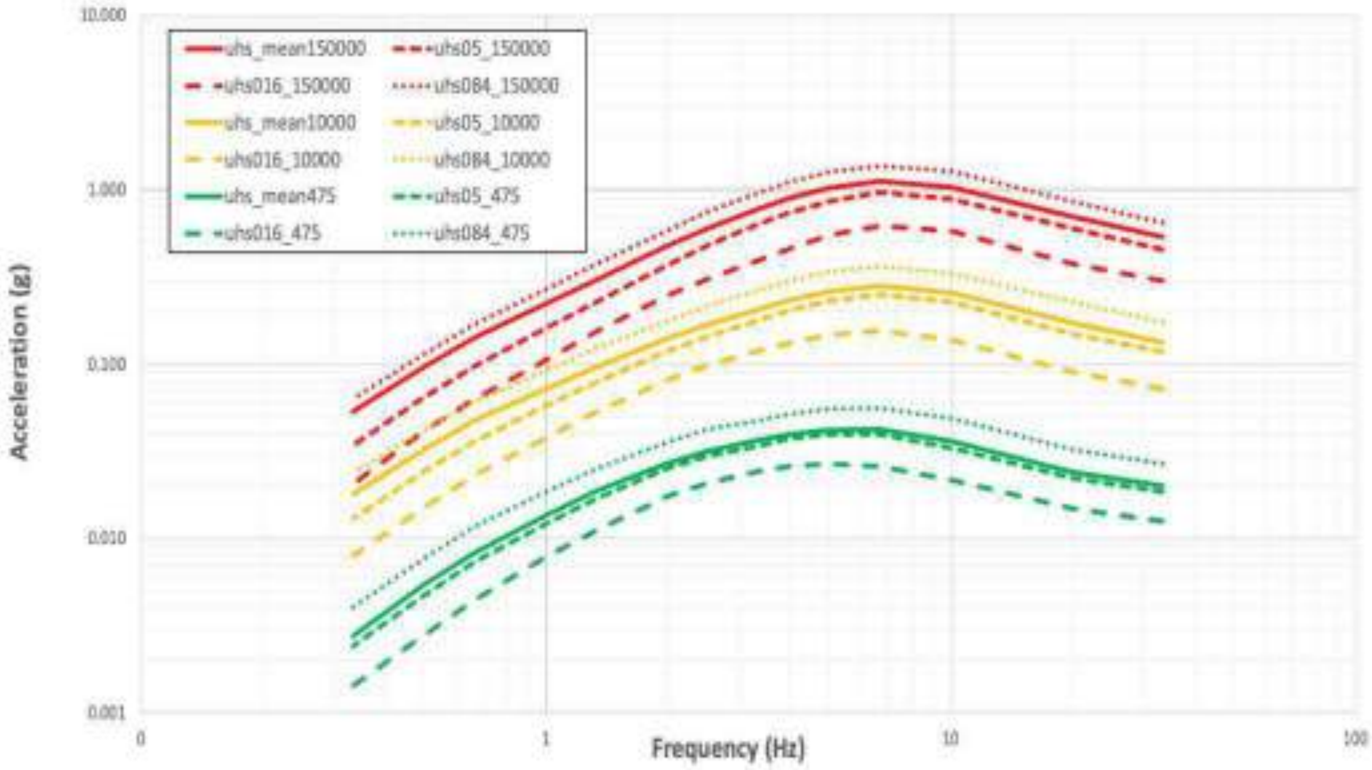


Fig. 4-6: Mean and quantiles stiff soil UHRS (Vs_{30} equal to 475 m/s) for the Saint Laurent site, for 475, 10,000 and 150,000 years return periods.

Stoccaggio di rifiuti radioattivi nelle Boom Clay (Belgio)

F. Ferraccioli, C. Bellezza, D. Gei - GEO

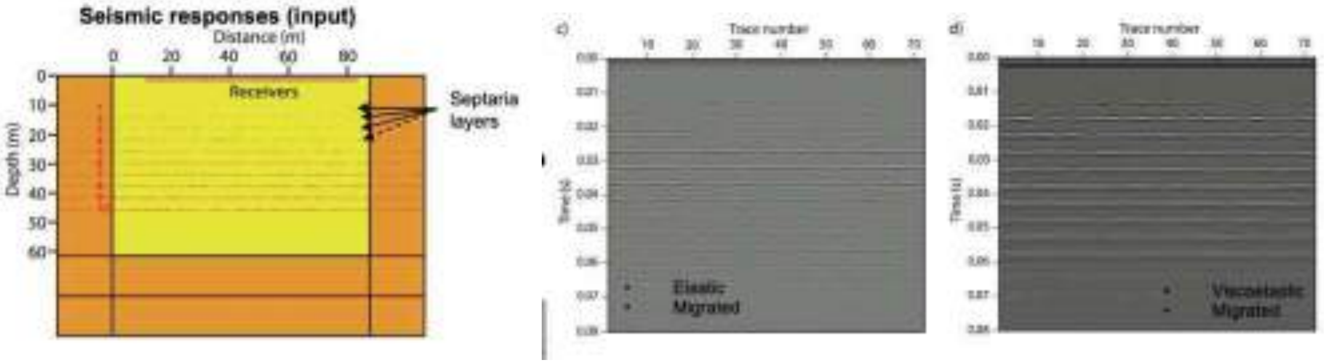
- **Committente**: ONDRAF/NIRAS (Belgian Agency for Radioactive Waste and Enriched Fissile Materials)
- **Scopo**: garantire la sicurezza dello stoccaggio nel tempo
- **Richiesta**: individuare le septarie (blocchi carbonatici) che presentano fratture le quali possono diventare vie di fuga per le scorie radioattive, provocando gravi danni alle persone e all'ambiente
- **Risoluzione**: metodi di indagine non convenzionali per fornire importanti indicazioni sulla posizione delle septarie nel sottosuolo

Dettaglio di Boom Clay con septaria, le cui dimensioni sono tipicamente dell'ordine del metro per una altezza di qualche decimetro

A calcareous septarium embedded in Boom Clay (width 60 cm approx) (from Vis and Verweij, 2014)

Outcrop showing the bedding of the Boom Clay (from Eddies, 2014)

Seismic numerical modeling



OGS

Real-Time Seismic Risk Mitigation

Risk

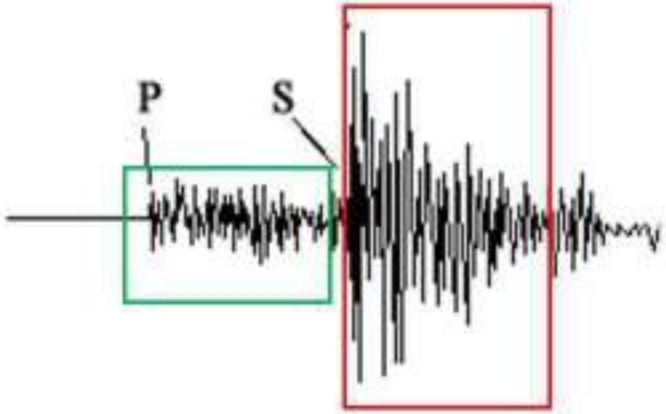
Hazard | Vulnerability | Exposure

Earthquake Early Warning (EEW) System

High Risk
Plant/Structure

School Alert

By-passing Location and Magnitude



Making Safe men at work

Vantaggi dell'EEW → Miyagi Oki Electric in Japan

Content of measures	Measures unexecution		Earthquake-proof measures (STEP1)	Early Earthquake System introduction (STEP4:ph.3)	
Generation Day	May 26 ,2003	July 26 ,2003	August 16 ,2005	June 14 ,2008	July 24 ,2008
Generation Time	18:24	7:13	11:46	8:43	0:26
Earthquake name	Sanriku southern earthquake	Miyagi-ken northen continuous earthquake	8.16 Miyagi earthquake	Iwate Miyagi inland earthquake	Iwate-ken coastal northern earthquake
Epicenter	Miyagi Pref offing	Miyagi Pref northern	Miyagi Pref offing	Iwate pref southern inland	Iwate Pref northern coast
Magnitude	7.0	6.2	7.2	7.2	6.8
High-voltage substation(※)	189gal	225gal	228gal	332gal	191gal
Restoration	17 days Complete 90days	13 days	7 days	4. 5 days (Complete)	3. 5 days (Complete)

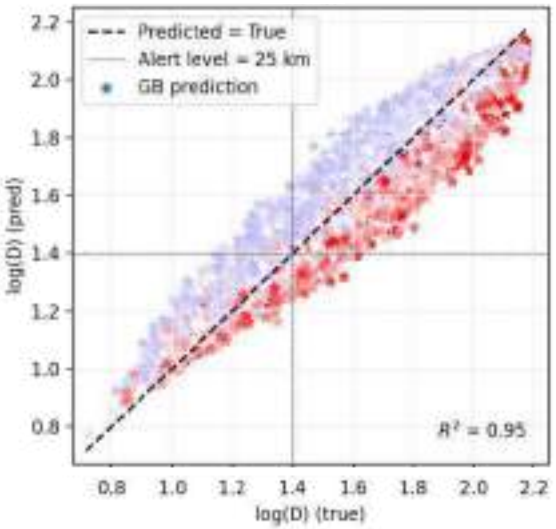
Millions in damage

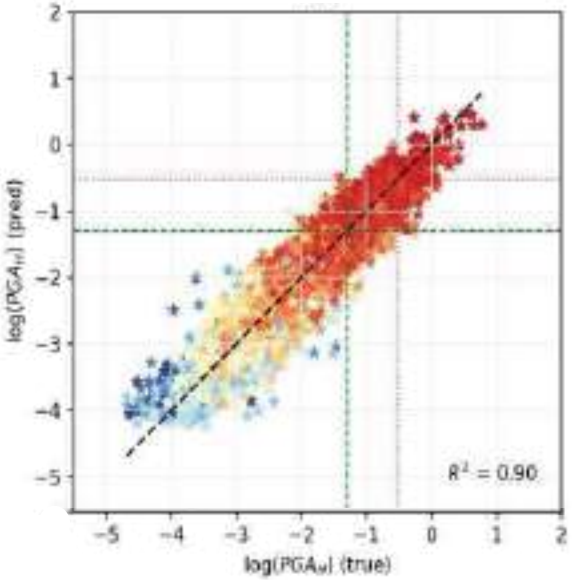
Tens of thousand in EEW

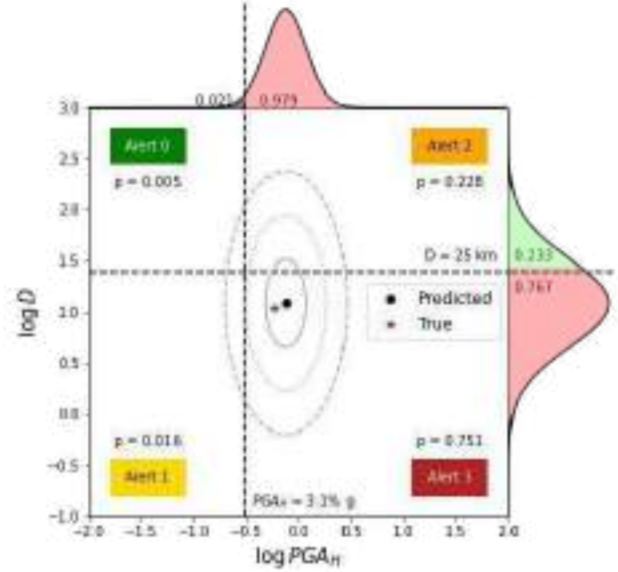
Earthquake Early Warning On-site with Machine Learning

Real-time Prediction of Distance and PGA from P-wave features using Gradient Boosting Regressor for On-Site Earthquake Early Warning Applications

Iaccarino et al. 2024, GJI

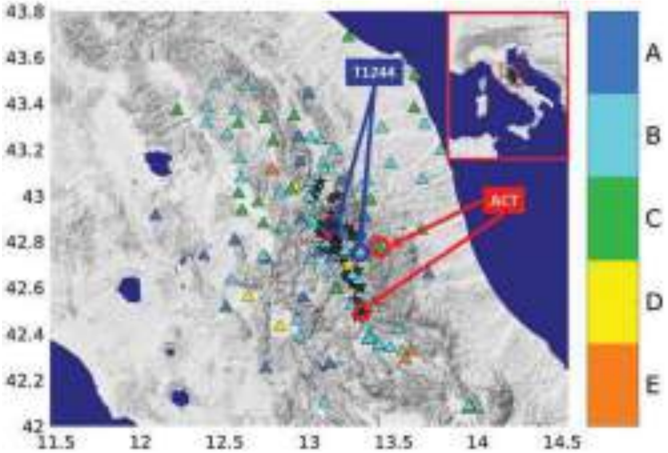


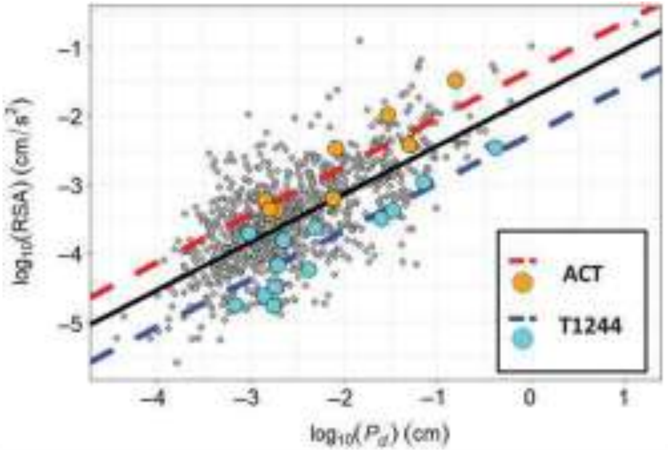


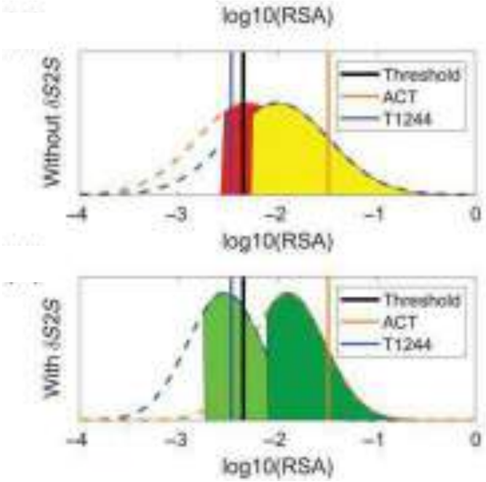


Onsite Earthquake Early Warning: Predictive Models for Acceleration Response Spectra Considering Site Effects

Iaccarino et al. 2020, BSSA







Thank you