



ISTOS

CENTRE FOR NATURAL
HAZARD MANAGEMENT

FINAL CONFERENCE

8 February 2024 – Nicosia



Cyprus
University of
Technology



ARISTOTLE
UNIVERSITY OF
THESSALONIKI



FREDERICK
RESEARCH CENTER



Crisis at Campi Flegrei Caldera: risk assessment activities in the emergency planning and management

Prof. Arch. **Giulio Zuccaro**

1987-2006

SEISMIC ANALYSIS AND PLANNING SECTION



RESEARCH ACTIVITIES RELATED TO NATURAL HAZARDS
IMPACT AND RISK ANALYSES, VULNERABILITY AND
MITIGATION MEASURES ASSESSMENTS



EARTHQUAKE



VOLCANIC
ERUPTIONS



HYDROGEOL.
EVENTS



MARINE WEATHER
EVENTS

SINCE 2006

PLINIVS STUDY CENTRE



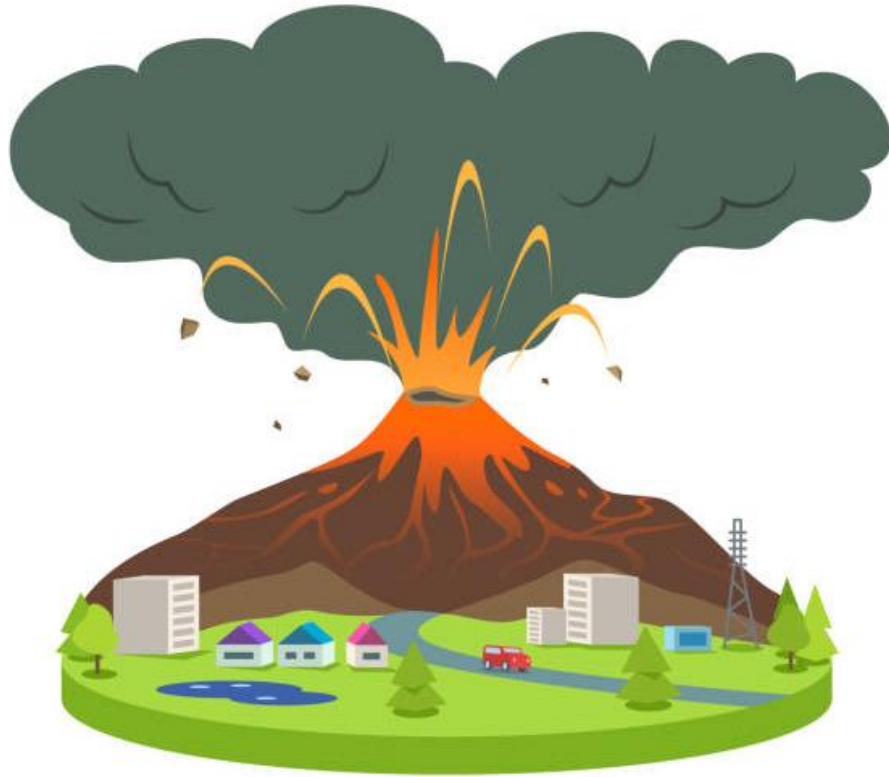
PLINIVS Study Centre for Hydrogeological, Volcanic and Seismic Engineering

National Competence Centre for Italian Civil Protection
Department for volcanic risk

Interdepartmental Centre of Research
Laboratory of Urban and Territorial Planning
Raffaele d'Ambrosio (LUPT)
University of Naples Federico II, ITALY

- Decreto del Capo Dipartimento della Protezione Civile n. 1922 del 15 Maggio 2006
- Decreto Presidenza del Consiglio dei Ministri, Dipartimento della Protezione civile, n. 20 luglio 2011 *Identificazione dei centri di competenza utili alla rete dei centri funzionali* - Aggiornamento elenco anno 2011.

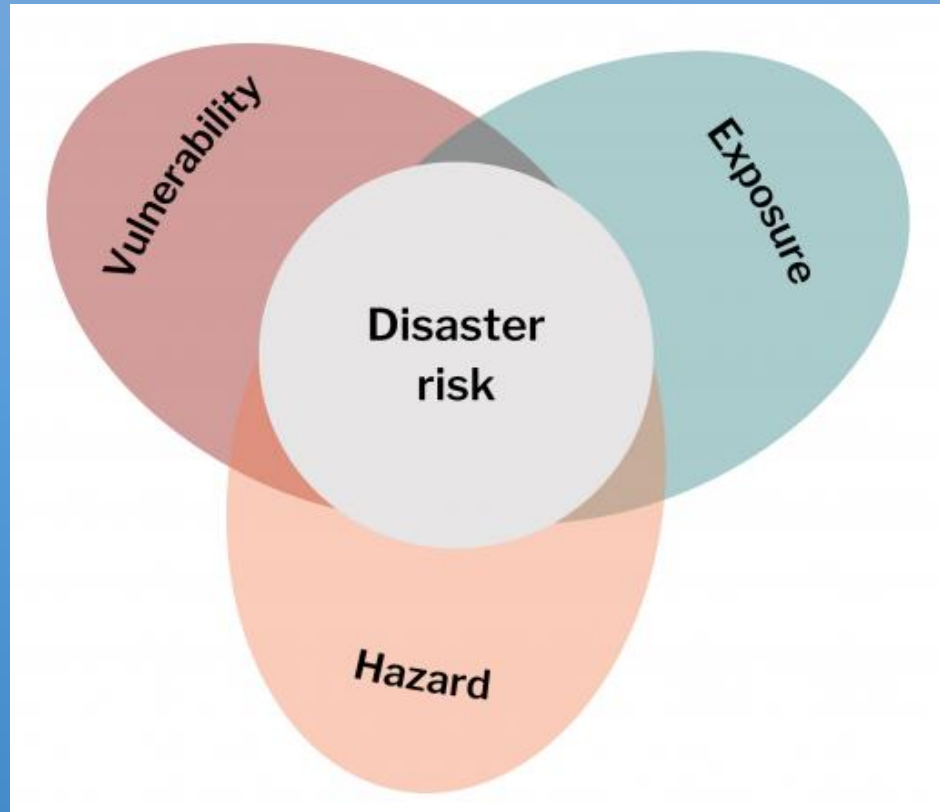
Volcanic Emergency Management



PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile



RISK ASSESSMENTS



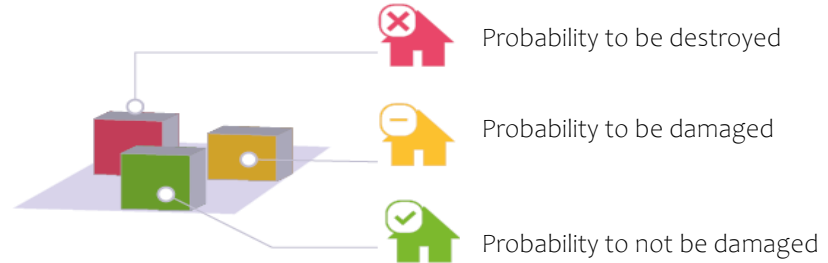
Hazard

X



Exposure
People and buildings in the area

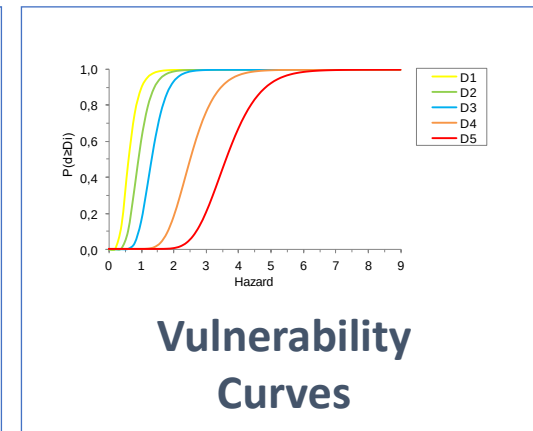
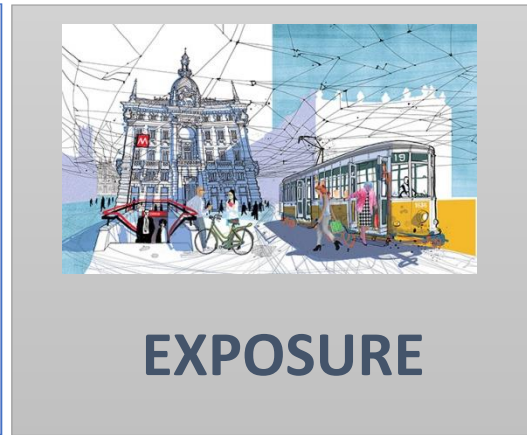
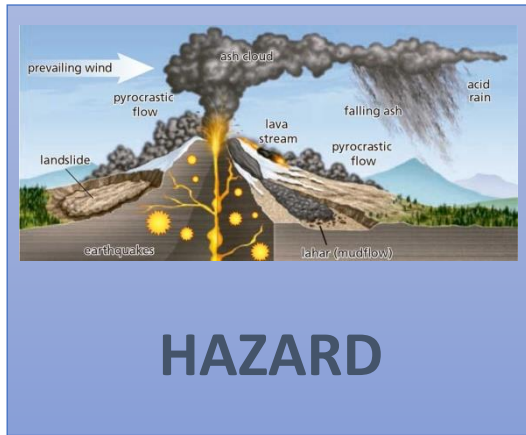
X



Vulnerability
Behaviour of people and buildings with respect to the event

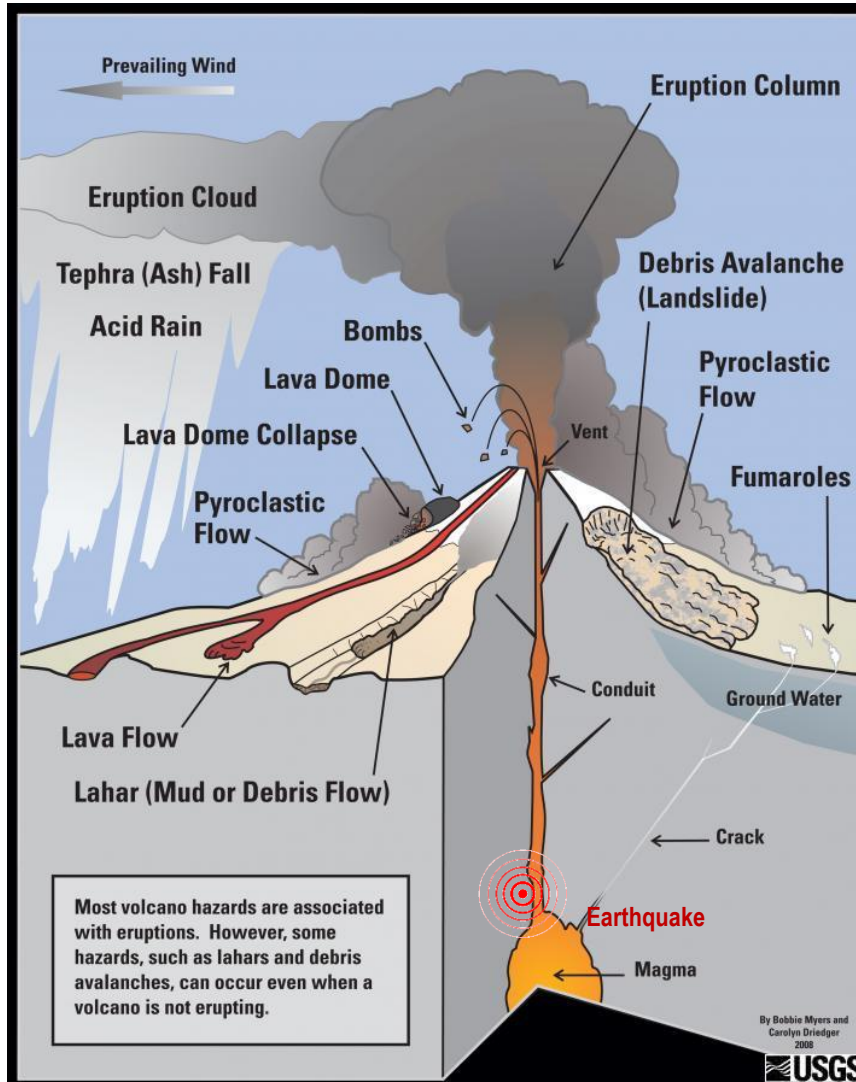
TOOL PLINIVS

- EASE. Ashfall.
- EASE. Earthquake/Buildings.
- EASE. Earthquake/Roads.
- DEB. Bradiseism



RISK ASSESSMENT | Hazard

EXPLOSIVE ERUPTIONS

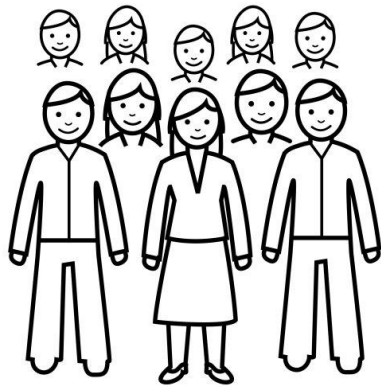


- Precursor earthquakes
- Ash Fall
- Pyroclastic flows
- Landslides
- Lahars (Vesuvius)
- Tsunami
- Bombs and Missile
- Bradyseism (Campi Flegrei)

ACTIONS CONSIDERED IN
THE PLANNING OF
VOLCANIC EMERGENCIES
AT VESUVIUS AND CAMPI
FLEGREI

RISK ASSESSMENT | Exposure

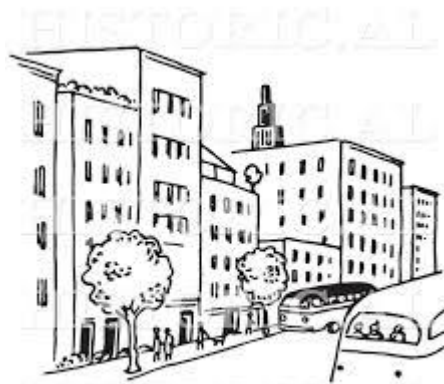
EXPOSURE. Quantitative and qualitative geographical distribution of risk elements (people, buildings, infrastructure, activities and cultural heritage, etc.) within an area. The condition and/or operation of the elements may be damaged, altered or destroyed as a result of the natural event.



PERSONE



- Earthquake (**EQ**)
- Ash fall (**AF**)



EDIFICI



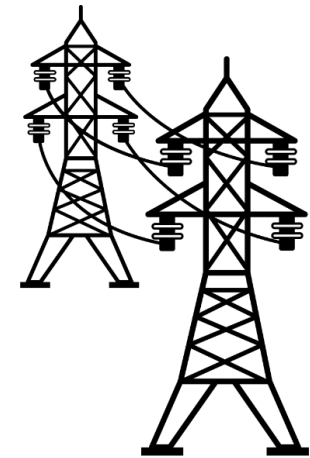
- Earthquake (**EQ**)
- Ash fall (**AF**)
- Bradisismo (**BR**)



STRADE



- Earthquake (**EQ**)



RETI



- Earthquake (**EQ**)
- Ash fall (**AF**)

RISK ASSESSMENT | Exposure

SCHEDA DI RILIEVO PLINIVS

dati tipologici sugli edifici per la classificazione di vulnerabilità rispetto ai fenomeni multi-hazard (Geologici & Cambiamenti Climatici)



SEZIONE 1 – ATTIVITÀ DI RILIEVO

ID RILEVATORE: DATA: ACCESSO RILIEVO: A ☐ diretto B ☐ indiretto
COMPLETAMENTO DELLA SCHEDA: A ☐ completata B ☐ parzialmente completata C ☐ vuota

SEZIONE 2 – IDENTIFICAZIONE

CODICE ISTAT REGIONE: CODICE ISTAT PROVINCIA: CODICE ISTAT COMUNE:
N. AGGREGATO: N. EDIFICIO: COMUNE:
PRESENZA DELLA GEOMETRIA DELL'EDIFICIO SULLA CTR: ☐ sì ☐ no

SEZIONE 3 – INFORMAZIONI GENERALI

TIPO DI EDIFICIO:

- | | | |
|--|--|--|
| A ☐ edificio ordinario | B ☐ baracca o assimilabile | C ☐ capannone |
| D ☐ impianto sportivo | E ☐ cabine balneari, strut. temp. | F ☐ gazebo, pensilina, tettoia |
| G ☐ edificio abbandonato, rudere | I ☐ edificio leggero in legno | L ☐ edificio leggero in lamiera |
| S ☐ serra | U ☐ deposito pesante | V ☐ box, garage |
| Z ☐ altro: spogliatoi, bungalow,... | ZZ ☐ non class. come edif. autonomo | |

DESTINAZIONE D'USO:

- | | | |
|---|---|---|
| A ☐ struttura agricola | ND ☐ negozi al dettaglio | NI ☐ negozi all'ingrosso |
| OM ☐ officine meccaniche | ST ☐ servizi tecnici professionali | B ☐ banche |
| H ☐ ospedali | HP ☐ cliniche e ambulatori | R ☐ intrattenimento e ricreazione |
| T ☐ teatri | PK ☐ parcheggi | S ☐ scuole |
| U ☐ università | P ☐ uffici pubblici | PI ☐ uffici per il pronto intervento |
| IP ☐ industrie pesanti | IL ☐ industrie leggere | IK ☐ industrie chimiche |
| IM ☐ industrie metallurgiche | IT ☐ industrie alta tecnologia | IE ☐ industrie per l'edilizia |
| CH ☐ chiese e organizzazioni no profit | RE ☐ residenza | RT ☐ alloggi temporanei |
| DD ☐ dormitori pubblici | HP1 ☐ casa di cura | H1 ☐ struttura ricettiva |
| DP ☐ deposito | NN ☐ non noto | |

UTILIZZAZIONE:

- A ☐ abbandonato NU ☐ non utilizzato PU ☐ utiliz. parzialmente U ☐ utilizzato

ESPOSIZIONE:

- S ☐ strategico (caserma, ospedali, scuole, prefetture, ecc.) P ☐ caratterizzato da particolare esp. (industria a rischio e simili) O ☐ ordinario

SEZIONE 4 – STATO

EPOCA DI COSTRUZIONE:

- | | | | |
|---|--------------------------------------|--------------------------------------|---|
| A ☐ prima del 1919 | B ☐ 1919-1945 | C ☐ 1946-1960 | D ☐ 1961-1971 |
| E ☐ 1972-1981 | F ☐ 1982-1991 | G ☐ 1992-2001 | H ☐ dopo il 2001 |

STATO DI CONSERVAZIONE DELLA STRUTTURA:

- | | |
|-------------------------------------|---------------------------------------|
| A ☐ scadente | B ☐ mediocre |
| C ☐ buono | D ☐ eccellente |

TIPOLOGIA DELLE FINITURE:

- | | |
|---------------------------------------|--------------------------------------|
| E ☐ economiche | O ☐ ordinarie |
| L ☐ lussuose | |

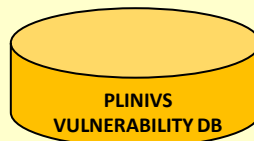


DATA COLLECTION
(field survey)

BUILDINGS: EXPOSURE



DB PLINIVS: Building-by-building collection



IN TIMES OF PEACE (approx. 95,000 buildings in approx. 250 municipalities)

- Typological features



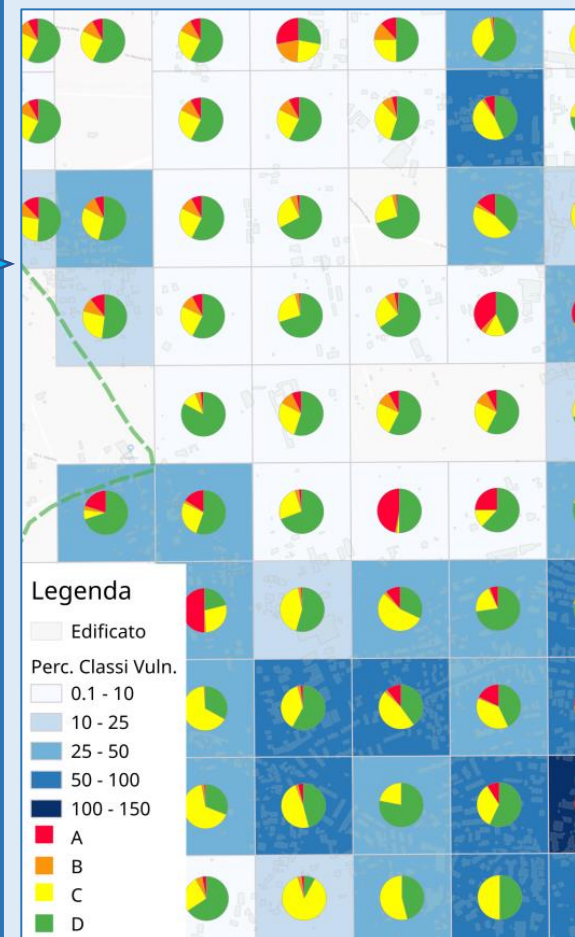
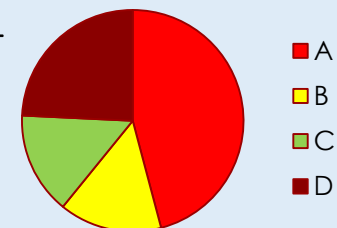
POST SEISMIC DAMAGE (approx. 170,000 buildings in approx. 500 municipalities)

- Typological characteristics
- Description of the damage



INVENTORY AT LOCAL SCALE

DISTRIBUTION OF
VULNERABILITY
CLASSES BY CELL



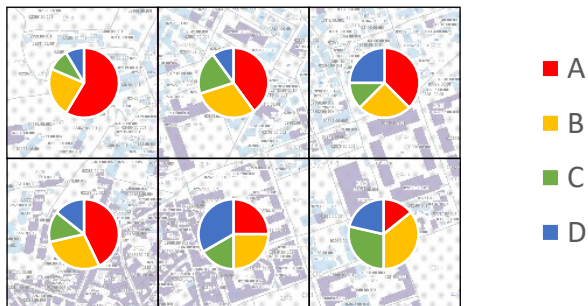
RISK ASSESSMENT | Exposure

INPUT data

- database **ISTAT** – provides aggregated data on buildings belonging to a specific census section;
- **PLINIVS FORMS** – provide typological and structural data of the buildings belonging to the investigated area.

OUTPUT data

- Vulnerability distribution on each cell



TOOLS

S.A.V.E. – Seismic Assessment of Vulnerability Expectation

It allows you to assign the vulnerability class of the buildings in the database considered based on their structural and typological characteristics;

B.I.N.C. – Building Inventory at National scale for Census area

It allows you to define the distribution in vulnerability classes of a specific geographical area belonging to the national territory.

RISK ASSESSMENT | Exposure

DEFINITION OF THE INTERESTED AREA

GRID CONSTRUCTION: 250 m x 250 m

DEFINITION OF THE BUILDINGS'
ALLOCATION ON THE CELLS

ESTIMATION OF THE VULNERABILITY
CLASS FOR THE BUILDINGS SURVEYED

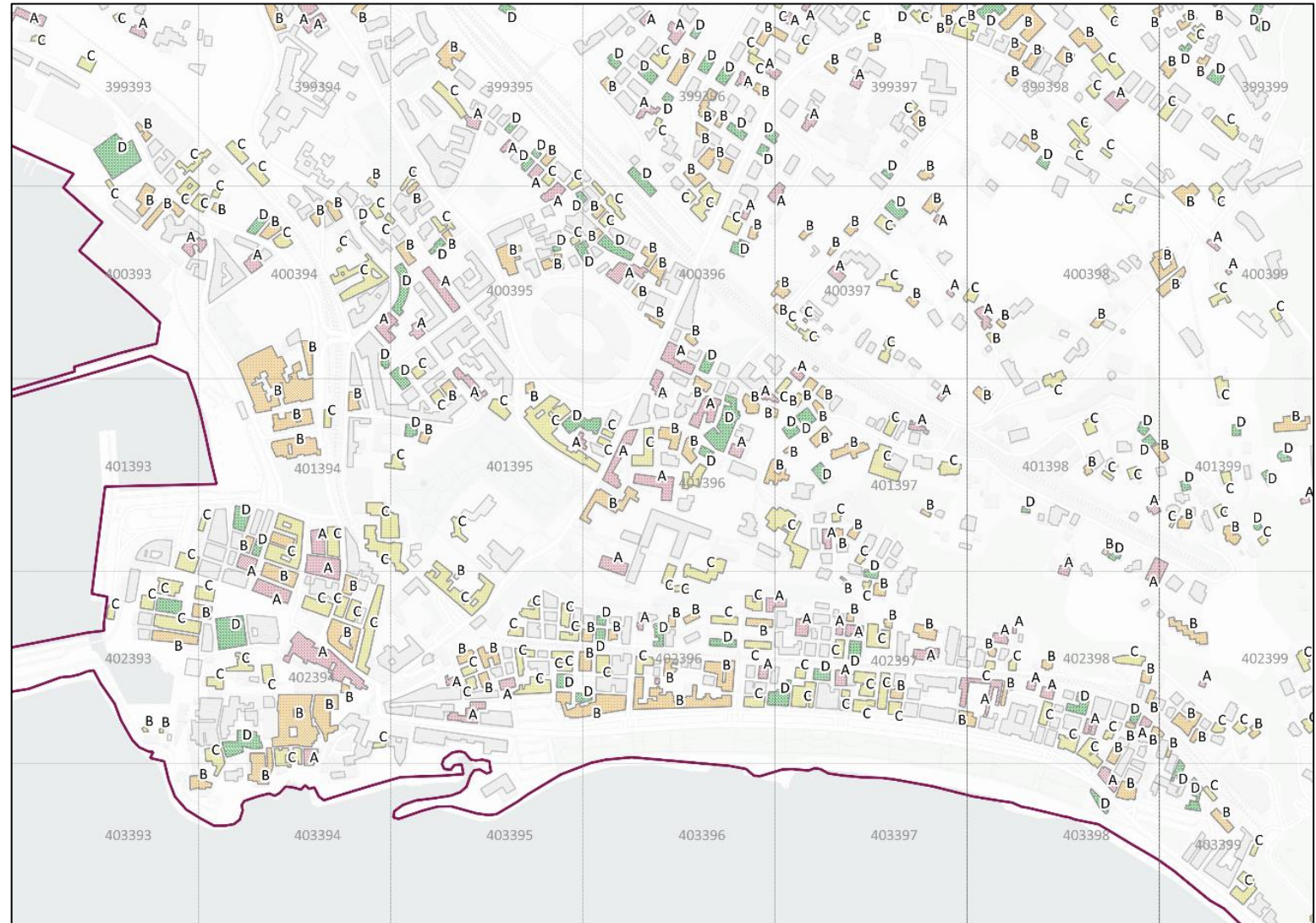
S.A.V.E. method

is a procedure developed by the
PLINIVS Study Center to define the
seismic behavior of a building with
known typological characteristics



ESTIMATION OF THE VULNERABILITY
CLASS FOR THE UNSURVEYED BUILDINGS

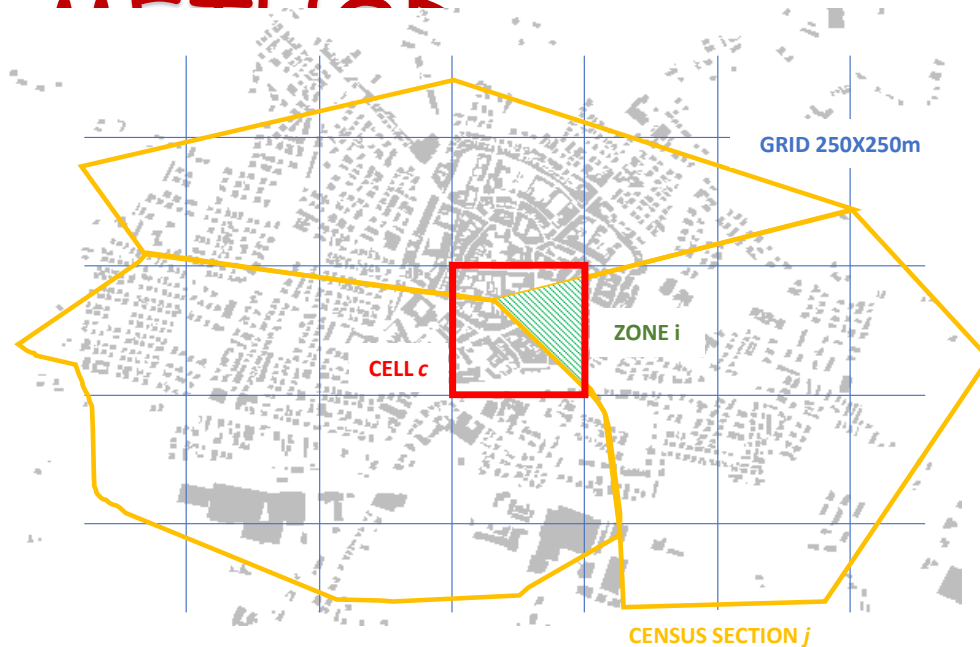
DEFINITION OF THE EXPOSURE
ON THE CELLS



RISK ASSESSMENT | Exposure

B.I.N.C.

is a procedure developed by the PLINIVS Study Center to estimate a distribution of relevant buildings on the vulnerability class by exploiting the **dataset ISTAT** (**dataset CENSUS**)



buildings of the zone i and census zone j with vulnerability class k :

$$E_{ij}^k = \begin{cases} E_{ij}^{k,R} & \text{when } E_j^{ISTAT} / E_j^R \leq 1 \\ E_{ij}^{k,R} + E_{ij}^{k,R} = E_{ij}^{k,R} + E_j^k / E_j^{ISTAT} \cdot (E_{ij} - E_{ij}^R) & \text{when } E_j^{ISTAT} / E_j^R > 1 \end{cases}$$

buildings of the cell c and vulnerability class k : $E_c^{k,ISTAT} = \sum_{i=1}^n E_{i,j}^{k,ISTAT}$

- c cell
- j census section
- i zone, intersection of the grid with the census section
- k vulnerability class ($k = A, B, C, D$)
- n number of zone in the cell c
- $E_{i,j}^{k,ISTAT}$ ISTAT buildings in the zone i belonging to the census zone j having class k
- $E_j^{k,ISTAT}$ ISTAT buildings with vulnerability class k of the census section j
- S_{ij} built area of the zone i belonging to census zone j
- S_j built area of the census zone j
- $E_c^{k,ISTAT}$ ISTAT building having vulnerability class k belonging to the cell c

RISK ASSESSMENT | Exposure

DEFINITION OF THE AFFECTED AREA

GRILLE CONSTRUCTION:
250 m x 250 m

DEFINING THE ALLOCATION OF
BUILDINGS ON CELLS

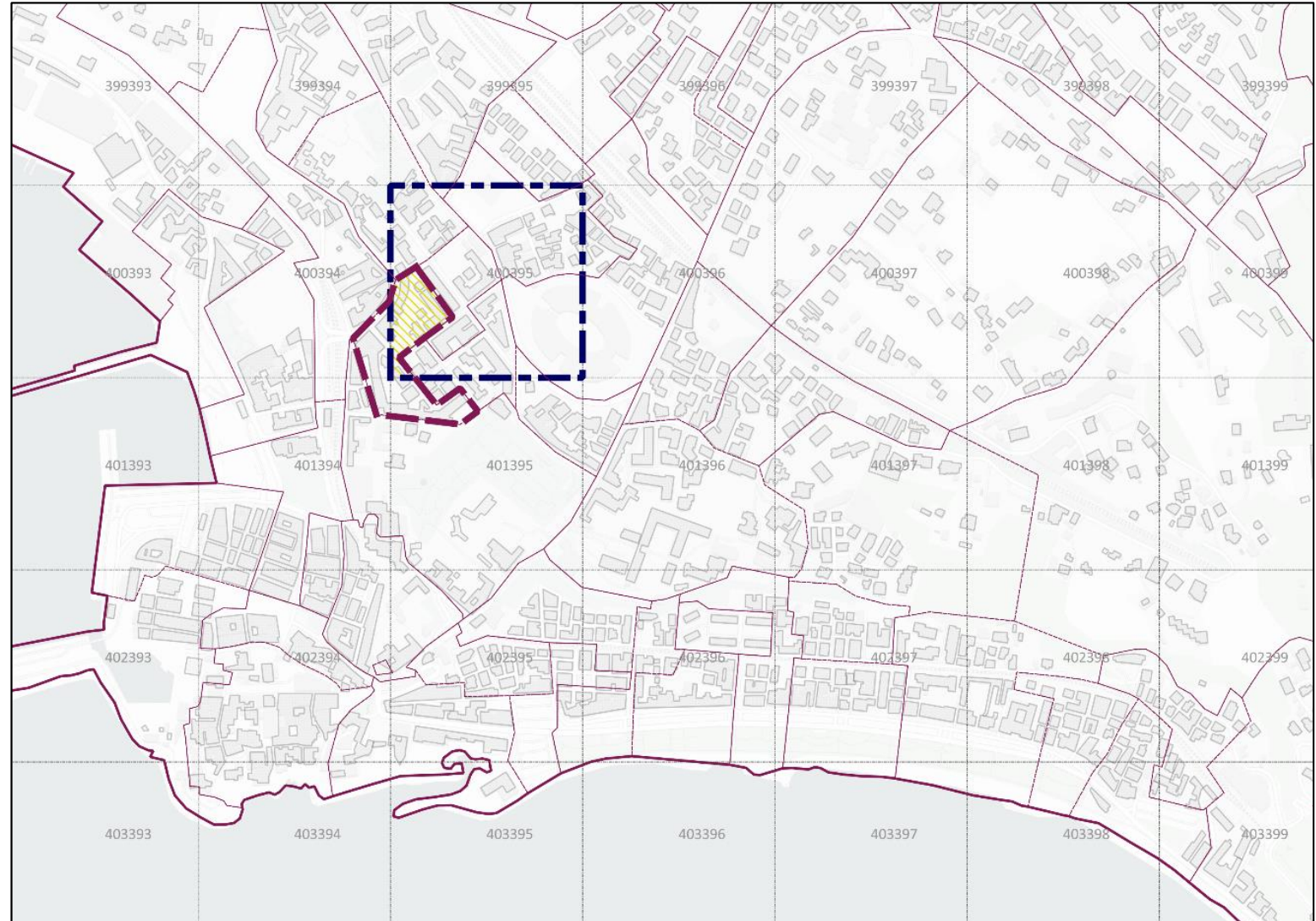
ESTIMATION OF THE VULNERABILITY
CLASS FOR THE BUILDINGS SURVEYED

ESTIMATION OF VULNERABILITY CLASS
FOR UNDETECTED BUILDINGS

B.I.N.C.

method
is a procedure developed by the
PLINIS Study Center to estimate a
distribution of relevant buildings on
the vulnerability class by exploiting
the ISTAT dataset (CENSUS dataset).

DEFINITION OF THE EXPOSURE
ON THE CELLS



RISK ASSESSMENT | Exposure

DEFINITION OF THE AFFECTED AREA

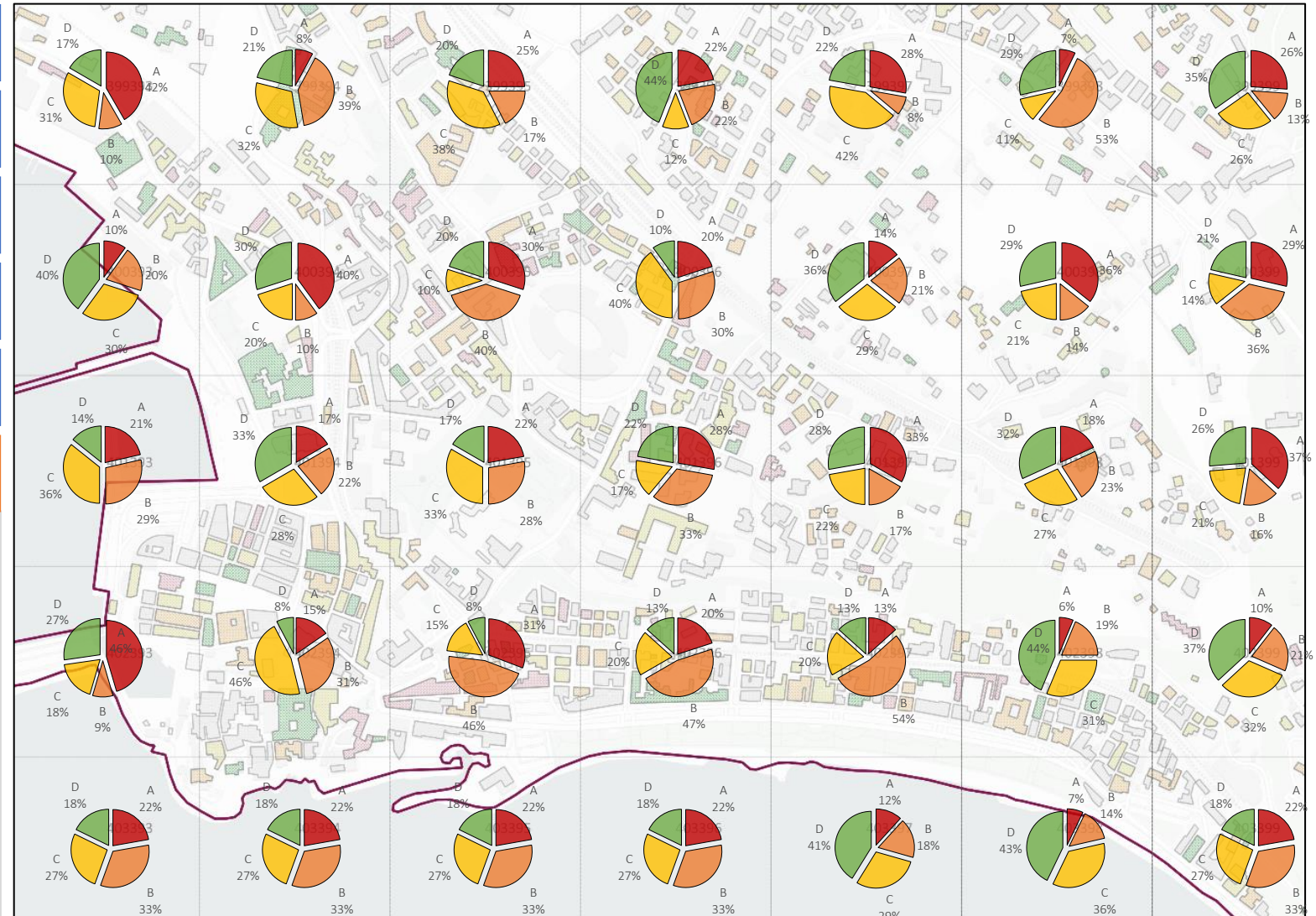
GRID CONSTRUCTION:
250 m x 250 m

DEFINING THE ALLOCATION OF
BUILDINGS ON CELLS

ESTIMATION OF THE VULNERABILITY
CLASS FOR THE BUILDINGS SURVEYED

ESTIMATION OF VULNERABILITY CLASS
FOR UNDETECTED BUILDINGS

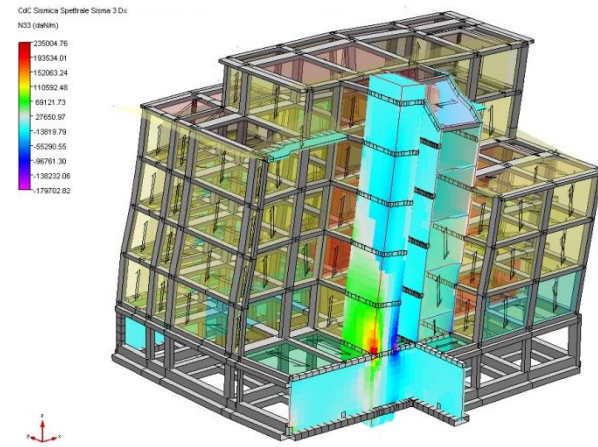
EXPOSURE DEFINITION
ON CELLS



RISK ASSESSMENT | Vulnerability

VULNERABILITY. Sensitivity of an element exposed to a natural event. Probability that the exposed element will suffer a certain level of damage or change in status, with reference to an appropriate scale, as a result of the occurrence of natural events of assigned intensity.

SINGLE BUILDING ANALYSIS

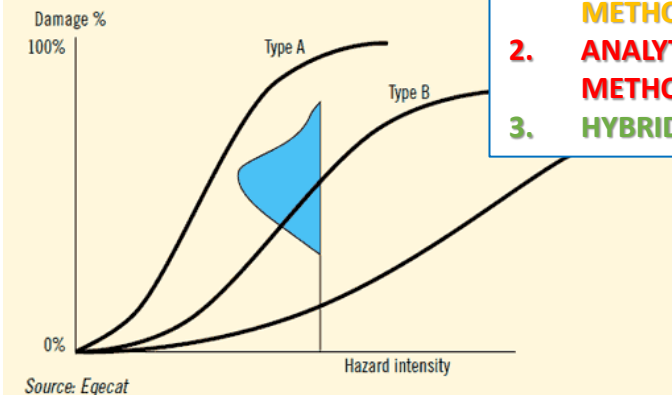


DETERMINISTIC ANALYSIS OF THE CAPACITIES OF THE INDIVIDUAL BUILDING

DESIGN/ BUILDING VERIFICATION

BUILDING CLASS ANALYSIS

Figure 1: Hypothetical vulnerability curve



1. **EMPIRICAL METHODS**
2. **ANALYTICAL METHODS**
3. **HYBRID METHODS**

STATISTICAL ANALYSIS OF THE CAPACITIES OF A CLASS OF BUILDINGS, CHARACTERIZED BY SIMILAR BEHAVIOR WITH REGARD TO SEISMIC EVENTS

VULNERABILITY

RISK ASSESSMENT | Vulnerability

VULNERABILITY. Sensitivity of an element exposed to a natural event. Probability that the exposed element will suffer a certain level of damage or change in status, with reference to an appropriate scale, as a result of the occurrence of natural events of assigned intensity.

EARTHQUAKES: VULNERABILITY OF ORDINARY BUILDINGS

VULNERABILITY CLASSES	HORIZONTAL STRUCTURES				
	Poor stiffness	Poor technology	Medium stiffness	Medium high stiffness	High stiffness
VERTICAL STRUCTURES	Metal sheet, vaults and/or wooden floor (without ties)	(e.g. "SAP" floor*)	Vaults and/or wooden floor (without ties)	Iron beam floor	Reinforced concrete and steel floors
Weak masonry	As	As	As	As	As
Rubble masonry neglected					
Medium quality	As	As	Bs	Bs	Bs
Rubble masonry maintained					
Good masonry	As	As	Bs	Bs	Cs
Squared masonry					
Framed structures (RC or steel)	-	Bs	-	-	Ds

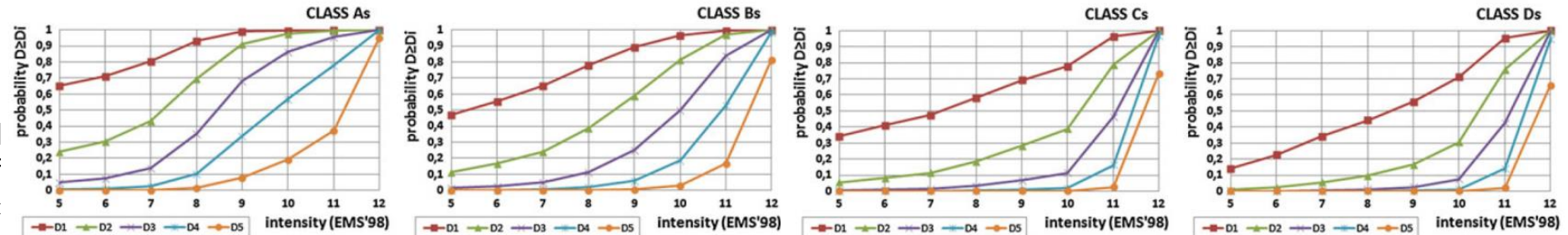
* SAP floor (self- supporting floor) is a typical Italian horizontal structure, made of clay/cement mix with smooth bars at intrados. This technology is considered very dangerous because of the cement casting superior slab does not cover the reinforcement bars inserted in the hollow tile.

VULNERABILITY

CURVES (empirical approach)

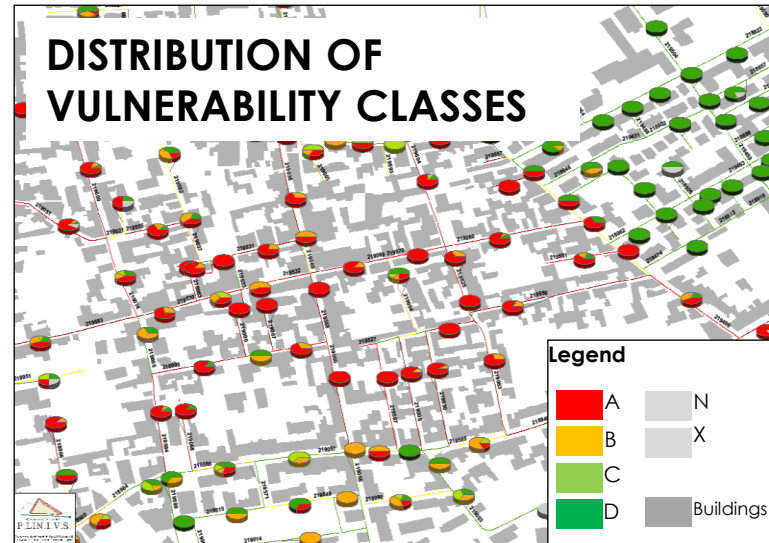
Observational probabilism

Approach based on statistical analyses of the distribution of damage related to tectonic earthquakes that occurred in the past.



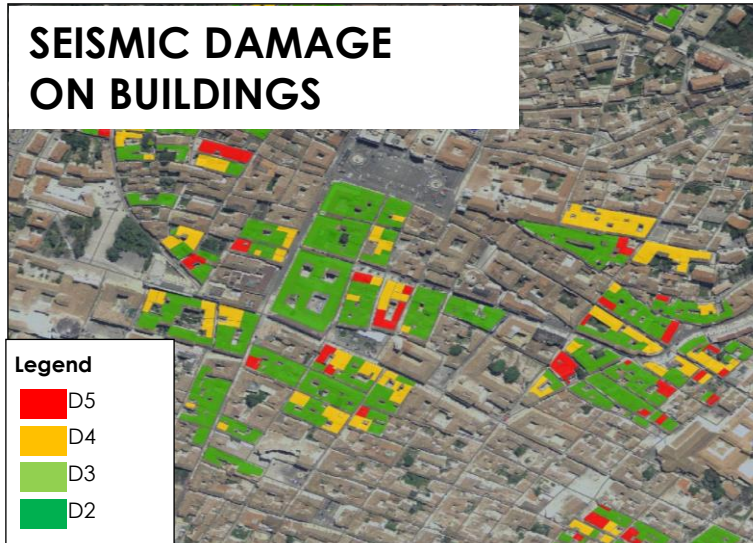
RISK ASSESSMENT | Vulnerability

EARTHQUAKES: VULNERABILITY OF ROAD SECTIONS

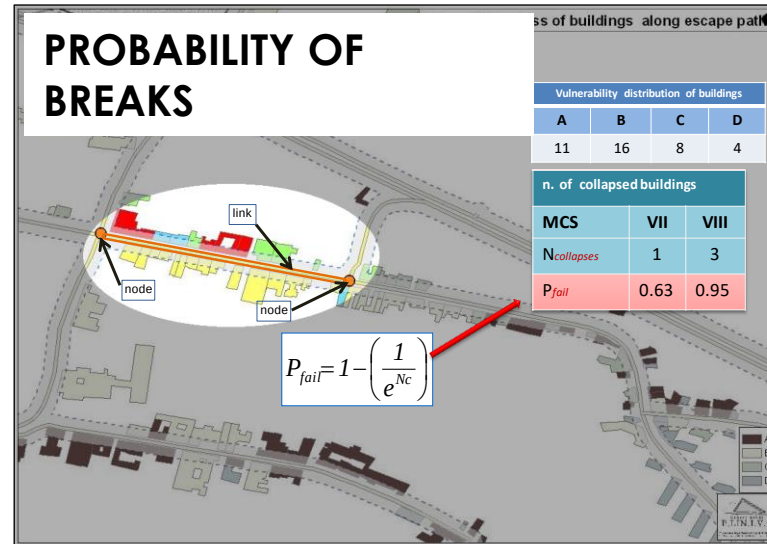


In risk analysis, the vulnerability of road sections exposed to a natural event is related to their impracticability. It could have serious repercussions on traffic and ordinary functions, even causing an obstacle to rescue or evacuation operations.

SEISMIC DAMAGE ON BUILDINGS



PROBABILITY OF BREAKS



Pre-eruptive phase (area near the crater):

Precursor earthquakes could occur with disastrous consequences such as the interruption of roads due to the partial or total collapse of the buildings in front.

RISK ASSESSMENT | Vulnerability

VULNERABILITY. Sensitivity of an element exposed to a natural event. Probability that the exposed element will suffer a certain level of damage or change in status, with reference to an appropriate scale, as a result of the occurrence of natural events of assigned intensity.

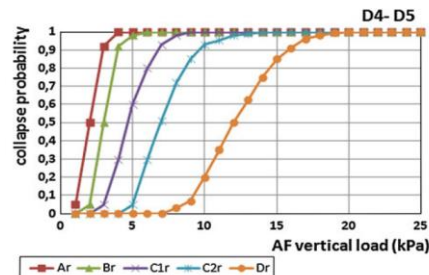
ASH FALL: VULNERABILITY OF ORDINARY BUILDINGS

VULNERABILITY CLASSES

ROOFS

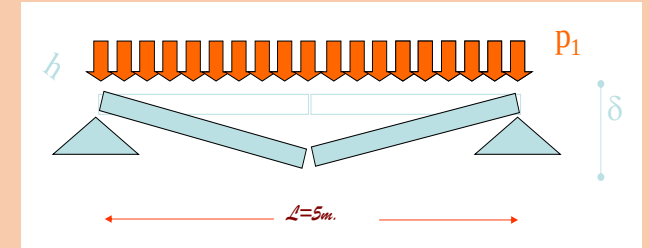
Type	Description
Ar	Weak pitched wooden roof
Br	Flat standard wooden roof
	Reinforced concrete flat roof- SAP type
C1r	Weak steel flat roof
	Old flat RC roof
C2r	Weak pitched steel roof
	Recent flat RC roof
Dr	Recent flat steel roof
	Recent pitched RC roof
Dr	Recent pitched steel roof

VULNERABILITY CURVES

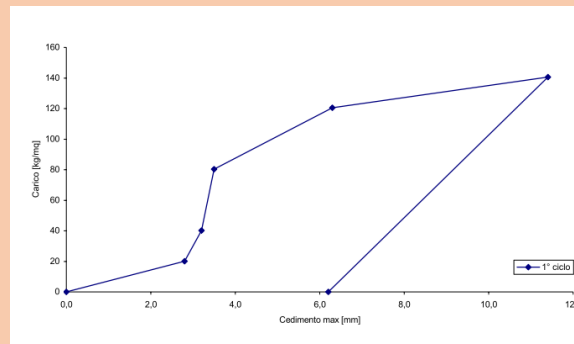


HYBRID APPROACH:

- Numerical analyses (collapse limit state)



- Experimental tests



BUILDINGS: VULNERABILITY- BRADYSEISM

EMPIRICAL APPROACH

Probabilistic observational approach based on the statistical analysis of the distribution of damage detected following the bradyseismic crisis of 1983-84.

EMPIRICAL VULNERABILITY CURVES OF THE PHLEGRAEAN BUILDINGS WITH REGARD TO OF BRADYSEISM LIFTING

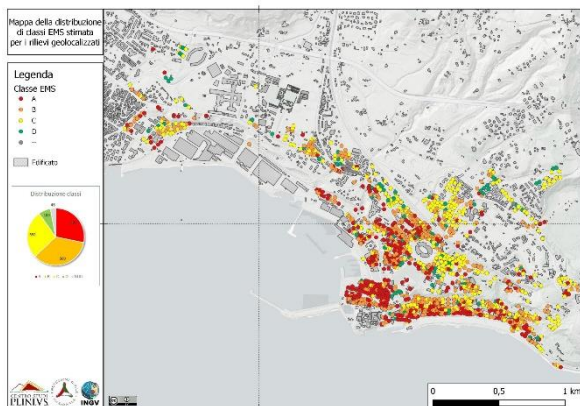
[illegible]

POZZUOLI FORMS



SCHEDE POZZUOLI

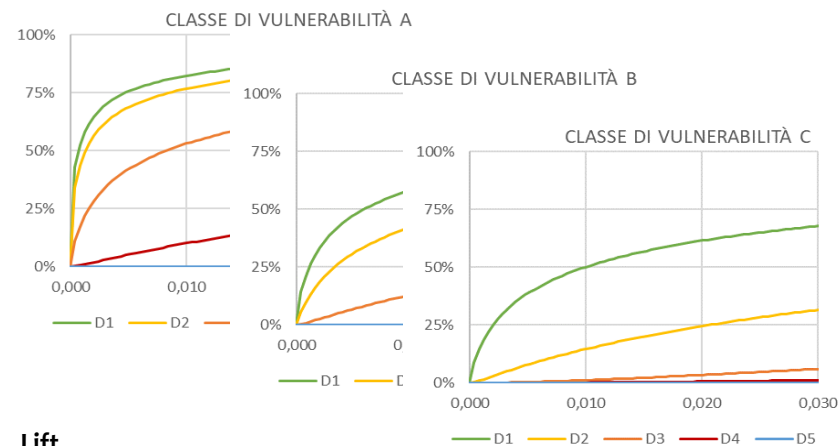
Schede di rilevamento del danno e della
vulnerabilità degli edifici per uso abitazione o misto
in Pozzuoli



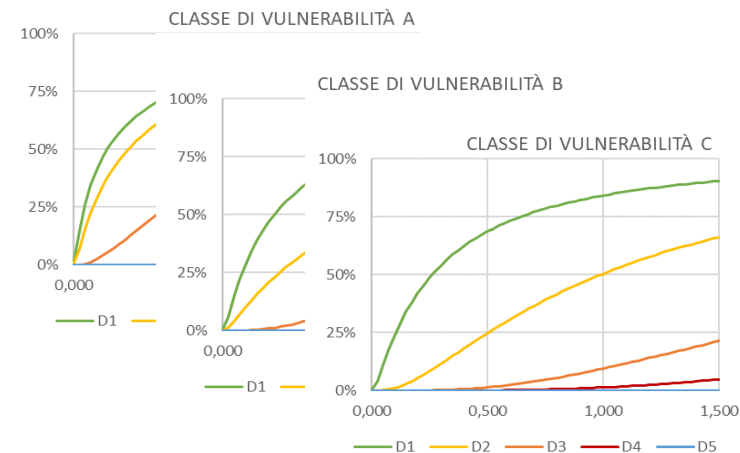
- Digitalizzazione di 3616 schede Pozzuoli
- Geolocalizzazione di 1144 schede
- Individuazione unità strutturali

VULNERABILITY CURVES (damage, slope/lift)

Slope



Lift



RISK ASSESSMENT | Vulnerability

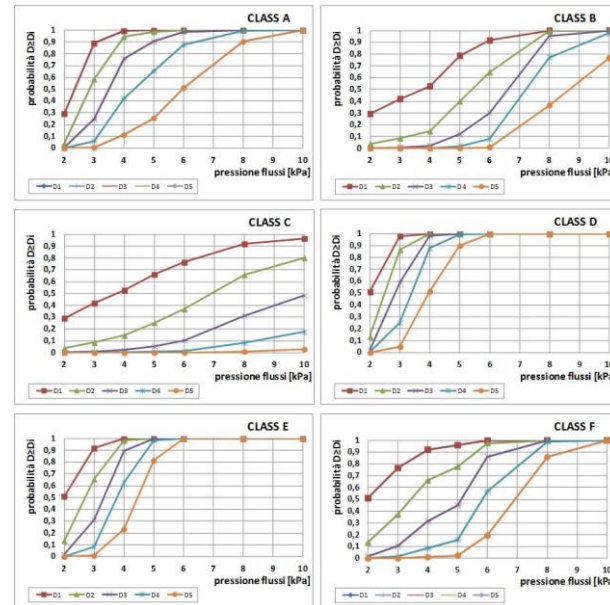
VULNERABILITY. Sensitivity of an element exposed to a natural event. Probability that the exposed element will suffer a certain level of damage or change in status, with reference to an appropriate scale, as a result of the occurrence of natural events of assigned intensity.

PIROCLASTIC FLOWS: VULNERABILITY OF ORDINARY BUILDINGS

VULNERABILITY CLASSES

	Classe	Descrizione
Masonry	A	3-4 storey weak masonry buildings with deformable horizontals
		Weak or resistant masonry buildings with more than 4 floors
	B	Medium-strength masonry buildings of 1-2 storeys with deformable horizontals
Reinforced concrete		Durable masonry buildings with more than 3 floors and rigid horizontals
	C	Strong masonry buildings of 1-2 storeys and rigid horizontals
	D	Non-seismic reinforced concrete building with more than 6 floors
	E	Non-seismic reinforced concrete building of 4-6 floors
	F	Non-seismic reinforced concrete building of 1-3 floors

VULNERABILITY CURVES

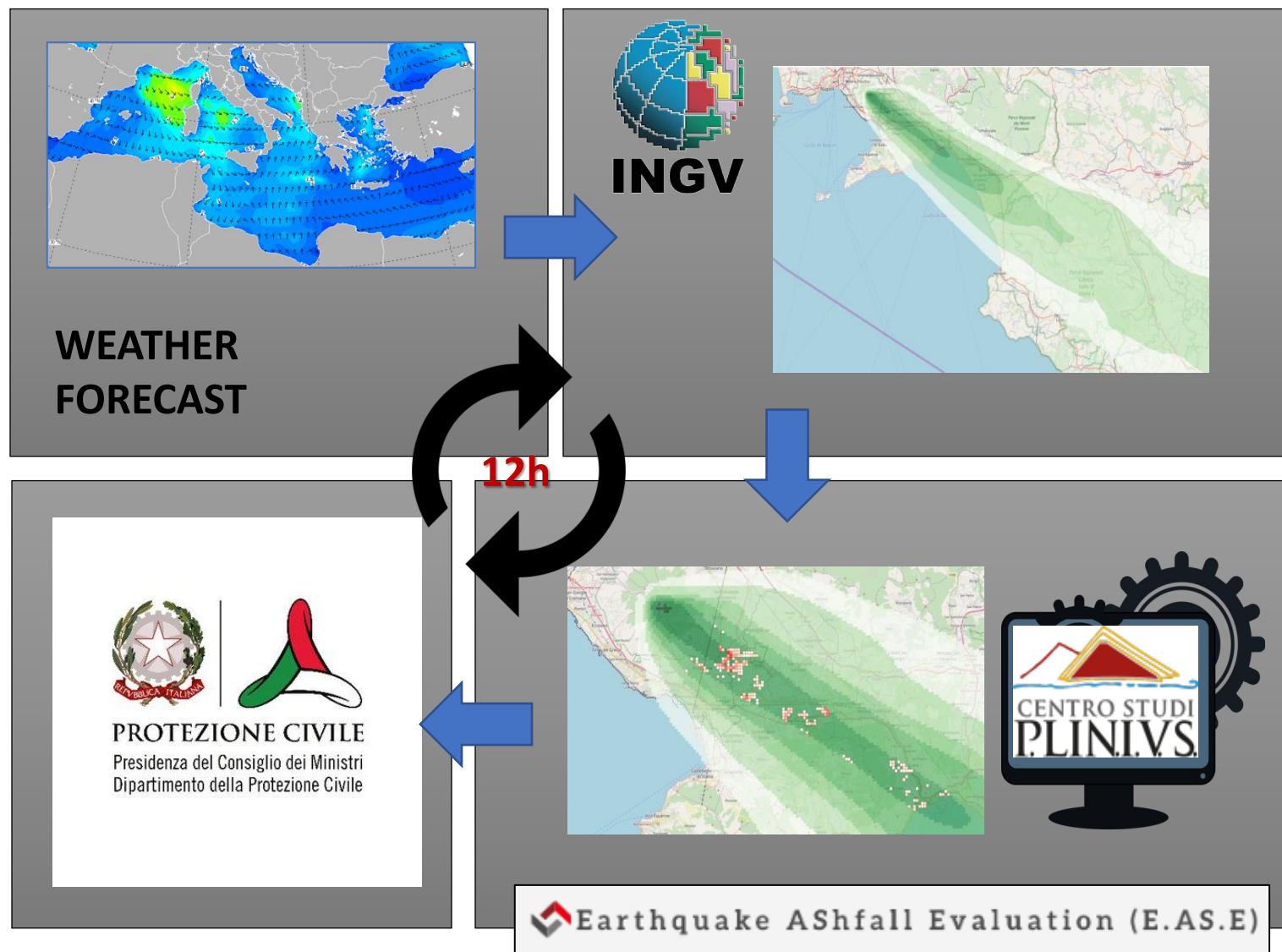


Livello di danno		Descrizione
D0	No damage	
D1	Light Damage	Negligible damage to structural elements Negligible damage to infills Breakage of large or weak openings
D2	Moderate Damage	Moderate damage to structural elements Moderate damage to weak infills Breakage of medium-strength openings
D3	Heavy Damage	Severe damage to structural elements Severe damage to weak infills. In a few cases, total collapse of the infills Breaking Strong Openings
D4	Partial collapse	Partial collapse of structural elements Breakage of strong infills
D5	Collapse	Total collapse



Access to the EASE application for ash fall scenarios

The automatic simulation model for ash fall (Ash Fall) allows to evaluate the damage to the roofs of buildings induced by the ground deposits estimated by INGV, thanks to a link between DPC-PLINIVS-INGV



Access to the EASE application for ash fall scenarios

 **Earthquake ASHfall Evaluation (E.A.S.E)**

Hai bisogno di accedere al sistema? [RICHIEDI ISCRIZIONE](#)

Earthquake ASHfall Evaluation (E.A.S.E)

Procedura automatica per lo sviluppo delle valutazioni di impatto in tempo reale per effetto di sequenza pre-eruttive e della ricaduta da cenere nelle aree del Vesuvio e dei Campi Flegrei

ARES 2017

Aggiornamento analisi di Rischio e di Scenario al Vesuvio e ai Campi Flegrei

COLLABORAZIONE



PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

CENTRO STUDI
PLINIUS
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

Accedi al sistema

E-mail / Username

Password

[Accedi](#)

-  Dashboard
-  Gestione Utenti
-  Modifica Password
-  Config. Sistema
-  Archivio Eventi EQ
-  Archivio Eventi ASH
-  Impatto Evento EQ
-  Impatto Evento ASH
-  Registro Simulazioni
-  Nuova Simulazione

Dashboard – ritorna al pannello principale con la visione d'insieme degli ultimi eventi acquisiti.

Gestione Utenti – solo per gli amministratori sistema.

Modifica Password – permette il cambio password dell'utente.

Config. Sistema – accede alle pagine di configurazione parametri di funzionamento del sistema (solo per amministratori)

Archivio Eventi EQ – consente l'accesso all'elenco degli eventi sismici acquisiti dai servizi INGV.

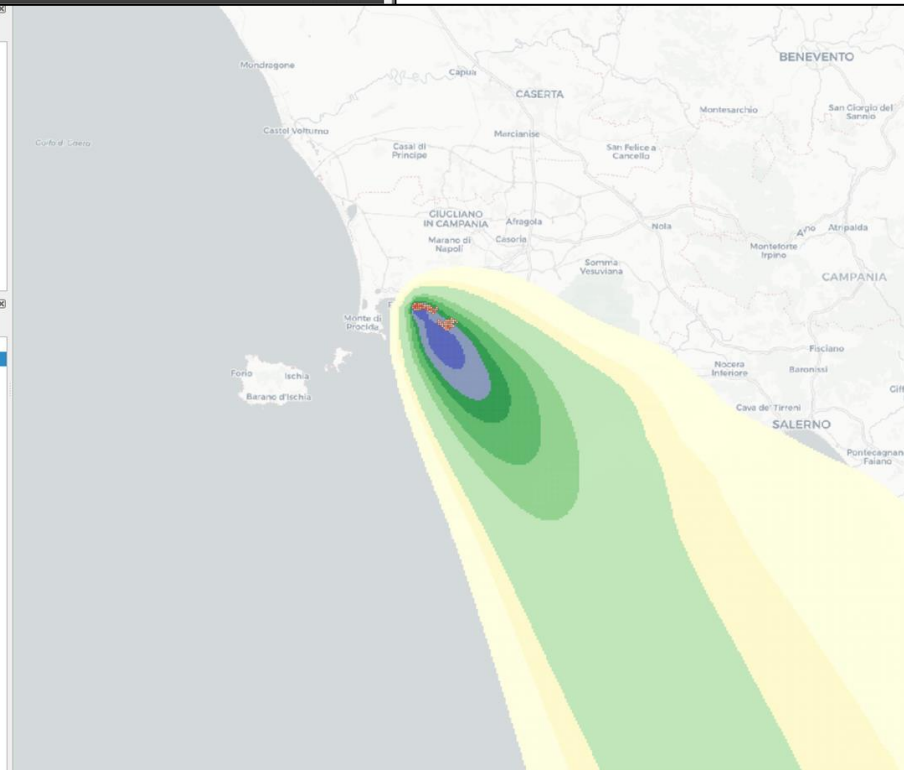
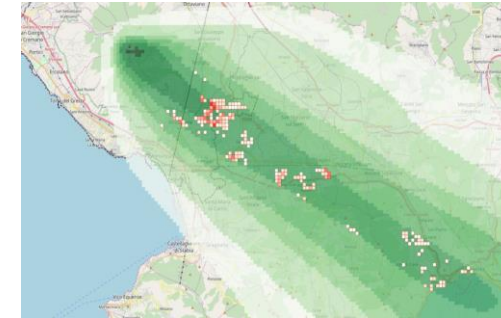
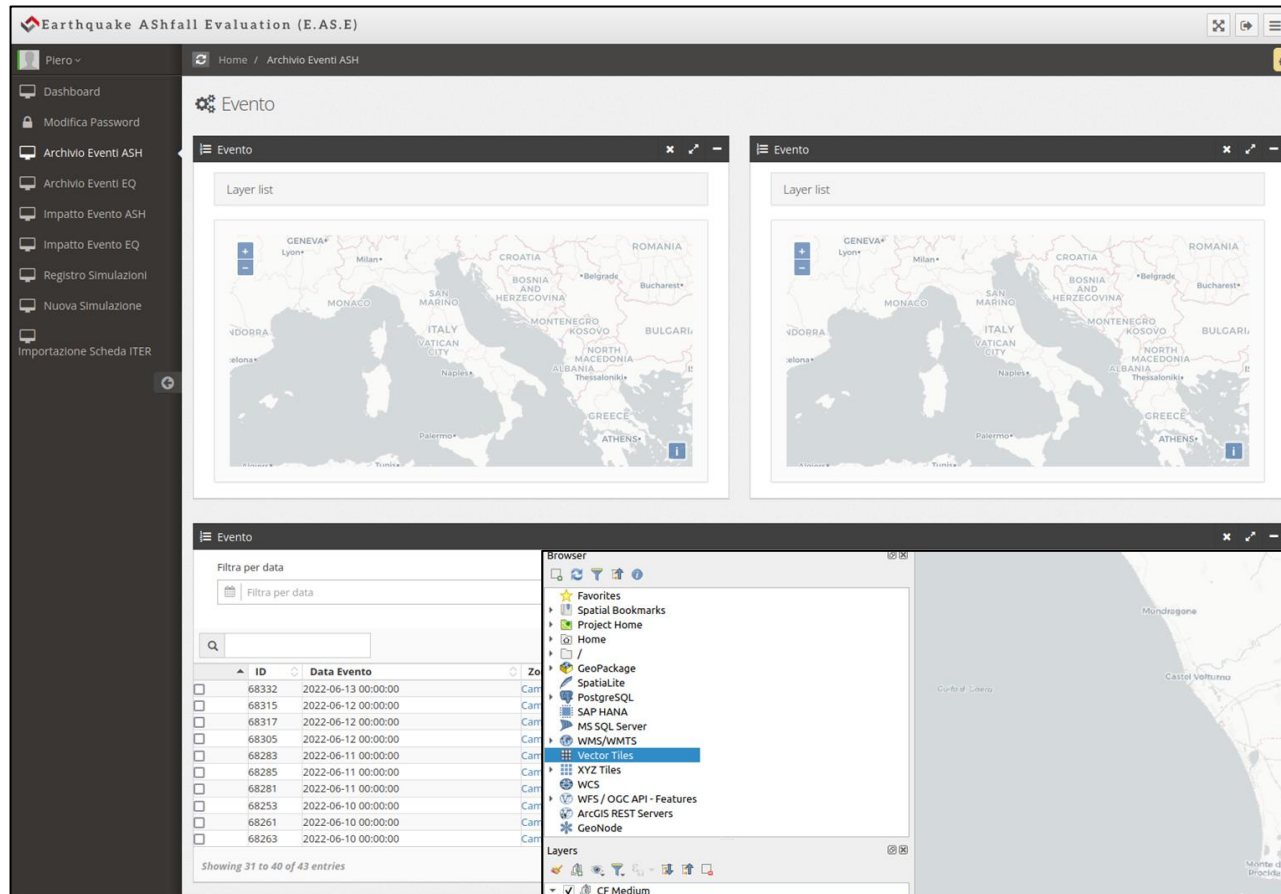
Archivio Eventi ASH – consente l'accesso all'elenco degli scenari di distribuzione cenere vulcanici acquisiti da INGV.

Impatto Evento EQ – porta alla sezione per la visualizzazione dei risultati di impatto scenario sismico.

Impatto Evento ASH - porta alla sezione per la visualizzazione dei risultati ti impatto scenario vulcanico.

Registro simulazioni – visualizza l'elenco delle simulazioni elaborate (amministratori)

Web Services for Ash Fall Scenarios



Section impact for
ASH

Web Services for Ash Fall Scenarios

The connection with INGV allows the elaboration of a map of the ground load from ash fallout in kg/m², as a function of the direction of the stratospheric winds and three possible eruptive scales (small, medium and large)

INPUT: ASH FALLOUT DUE TO ERUPTION AT CAMPI FLEGREI OF "MEDIUM" SCALE AT TIME T=0

P.LIN.I.V.S. | Centro Studi per l'Ingegneria Vulcanica Sismica e Idrogeologica
Centro Interdipartimentale di Ricerca L.U.P.T. "Raffaele d'Ambrosio"

SCENARIO EVENTO ASHFALL
Campi Flegrei
2019-10-18 00:00:00 ID:42118

NOTE
Fonte dati: dati di pericolosità valutati dall'INGV concernenti i fenomeni in caso di eruzione ai Campi Flegrei

Pericolosità: mappa della distribuzione del carico da ricaduta di cenere per eruzione ai Campi Flegrei di scala "Media"

Carico da ricaduta di cenere max per eruzione "media" $\geq 300 \text{ kgm}^{-2}$ [kgm⁻²]		
CODICE ISTAT	COMUNE	
63060	Pozzuoli	2150
63049	Napoli	1531

Carico atteso

- 1 - 5 kg/mq
- 5 - 10 kg/mq
- 10 - 50 kg/mq
- 50 - 100 kg/mq
- 100 - 200 kg/mq
- 200 - 300 kg/mq
- 300 - 500 kg/mq
- 500 - 1000 kg/mq
- > 1000 kg/mq

Zona rossa

0 10 20 km

The combination of repository data with PLINIVS models of vulnerability and exposure provides the estimation of DAMAGE, in terms of collapsed roofs and homelessness.

P.LIN.I.V.S. | Centro Studi per l'Ingegneria Vulcanica Sismica e Idrogeologica
Centro Interdipartimentale di Ricerca L.U.P.T. "Raffaele d'Ambrosio"

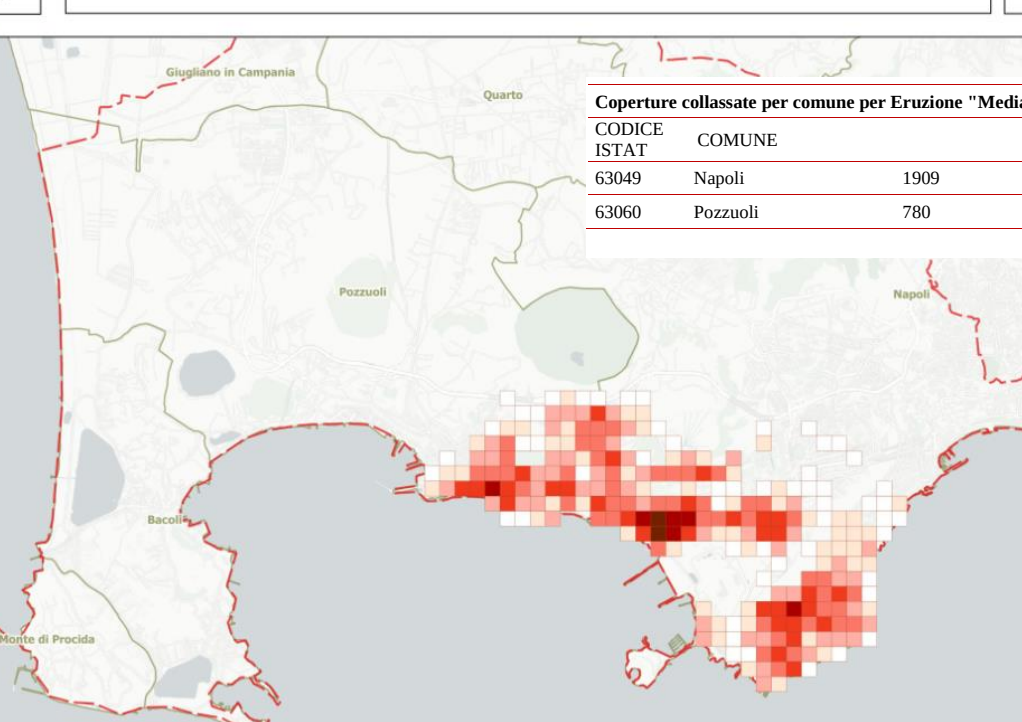
SCENARIO EVENTO ASHFALL
Campi Flegrei
2019-10-18 00:00:00 ID:42118





Mappa della distribuzione del numero di coperture collassate (D4/D5)

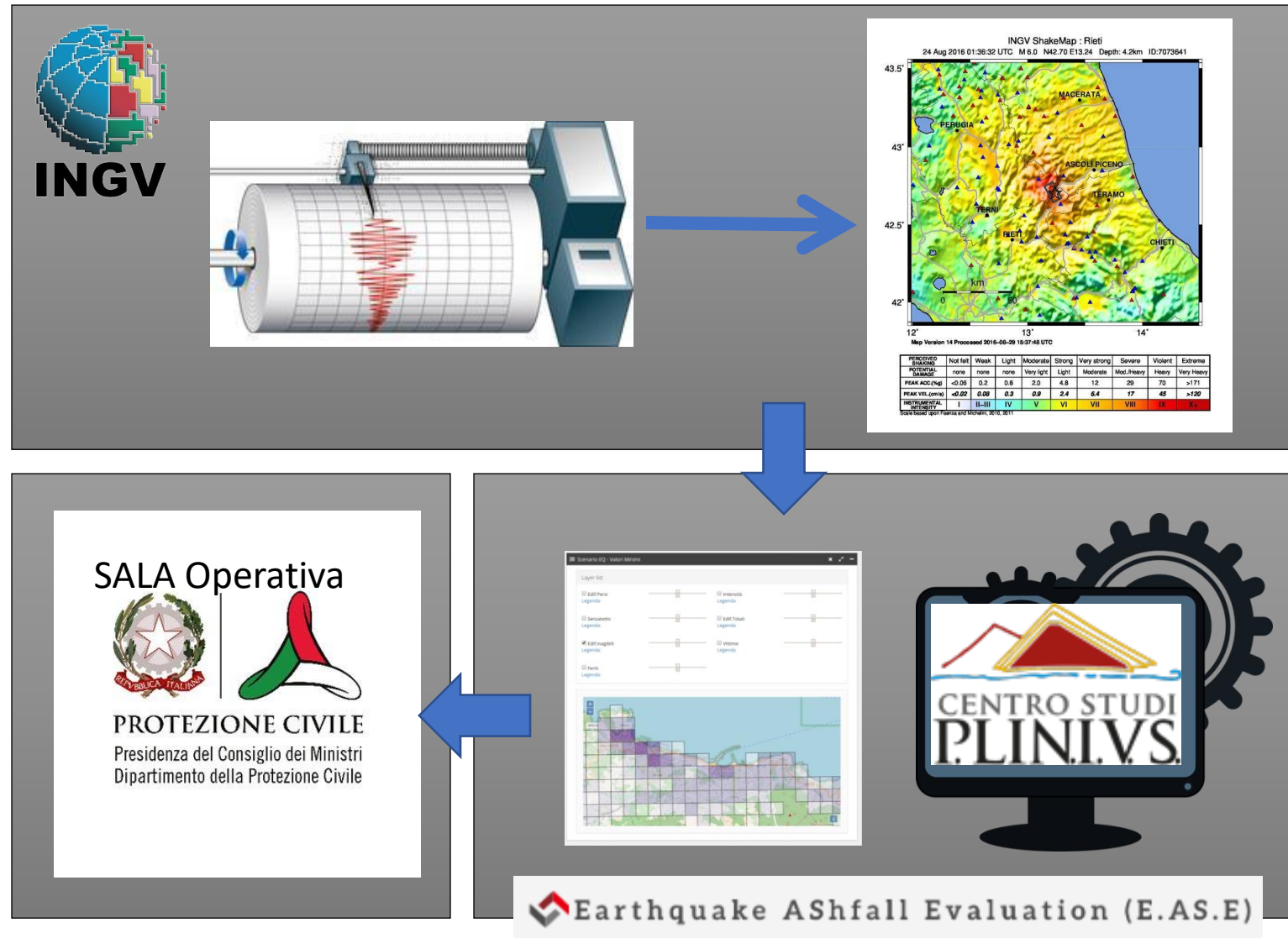
NOTE
 Fonte dati: dati di pericolosità valutati dall'INGV concernenti i fenomeni in caso di eruzione ai Campi Flegrei



Coperture collassate per comune per Eruzione "Media" [n°]		
CODICE ISTAT	COMUNE	
63049	Napoli	1909
63060	Pozzuoli	780

Access to the EASE application for seismic impact scenarios and related web services

The automatic simulation model for EARTHQUAKES allows to evaluate the damage to buildings and occupants induced by a seismic event recorded by INGV, thanks to a direct link between DPC-PLINIVS-INGV



Access to the EASE application for seismic impact scenarios and related web services

Dashboard

Gestione Utenti

Modifica Password

Config. Sistema

Archivio Eventi ASH

Archivio Eventi EQ

Impatto Evento ASH

Impatto Evento EQ

Registro Simulazioni

Nuova Simulazione

Nuova Simulazione PTS

Edificati

Importazione Scheda ITER

Earthquake Impact Evaluation

Scenario EQ - Valori centrali ID:18644

Scenario EQ - Valori Minimi ID:18644

Scenario EQ - Valori Massimi ID:18644

Scenario EQ - Intensità ID:18644

Layer list

Layer list

Layer list

Layer list

Earthquake Impact Evaluation

Filtra per data: Ultimi 7 gg

Magnitudo: Tutte

Profondità (maggiore di): Profondità (maggiore di)

Filtra per zona: 5

Trova

Q

Show: 10 - entries

ID	Fonte	Tipo Fonte	Zona	Regione	Comune	Data Evento	Lat	Long	Magnitudo(M)	Profondità(km)	Stato elaborazione
18655	PLUVIOS	SI	Campania	Pozzuoli		2022-06-24 10:00:00	40.8353	14.1270	2.4	2500	ELABORATO
18656	INGV	WS	Alto	Marche	Arquata del Tronto	2022-06-24 09:38:06	42.782	13.2913	2	9800	ELABORATO
18644	PLUVIOS	SI	Campania	Pozzuoli		2022-06-23 11:00:00	40.8409	14.0893	3.5	2000	ELABORATO
18643	PLUVIOS	SI				2022-06-23 10:00:00	40.8156	14.1325	3.6	2000	ELABORATO
18622	INGV	WS	Alto	Lazio	Cittanale	2022-06-21 16:30:07	42.0423	13.2143	3.1	10000	ELABORATO
18581	INGV	WS	Alto	Costa Albanese settentrionale	Costa Albanese settentrionale	2022-06-17 16:54:05	41.2637	16.5967	3.2	24100	ELABORATO
18550	INGV	WS	Alto	Calabria	Caulonia	2022-06-14 16:34:24	38.3976	16.3485	3.6	10800	ELABORATO
18529	INGV	WS	Alto	Costa Calabra sud-occidentale	Costa Calabra sud-occidentale	2022-06-12 19:31:14	38.785	15.7013	3	156000	ELABORATO
18508	INGV	WS	Alto	Marche	Acquasola Picena	2022-06-10 09:27:20	42.9603	13.7982	3.3	20900	ELABORATO
18497	INGV	WS	Alto	Costa Marchigiana Picena	Costa Marchigiana Picena	2022-06-09 23:27:23	42.9997	13.9697	3	34000	ELABORATO

Showing 1 to 10 of 1,048 entries

Previous 1 2 3 4 5 307 Next

Plusus 1.0/SHAPSHOT - OPC 02018

Browser

Preferiti

Segnalibri Spaziali

Home

GeoPackage

Spatialite

PostgreSQL

SAP HANA

MS SQL Server

VMS/VMTS

Vector Tiles

XYZ Tiles

WCS

Layer

EASE EQ d_edpersi_18644

0.1-0.5

0.5-1.0

1.0-2.0

2.0-2.5

2.5-5.0

> 5.0

EASE EQ d_edpersi_min_18644

0.1-0.5

0.5-1.0

1.0-2.0

2.0-2.5

2.5-5.0

> 5.0

EASE EQ d_edpersi_max_18644

0.1-0.5

0.5-1.0

1.0-2.0

2.0-2.5

2.5-5.0

> 5.0

Layer list

☐ Edif.Persi

Legenda

☐ Intensità

Legenda

☐ Edif.Totali

Legenda

☐ Edif.Inagibili

Legenda

☒ Senzatetto

Legenda

☐ Feriti

Legenda

☐ Vittime

Legenda

SENZATETTO

GID

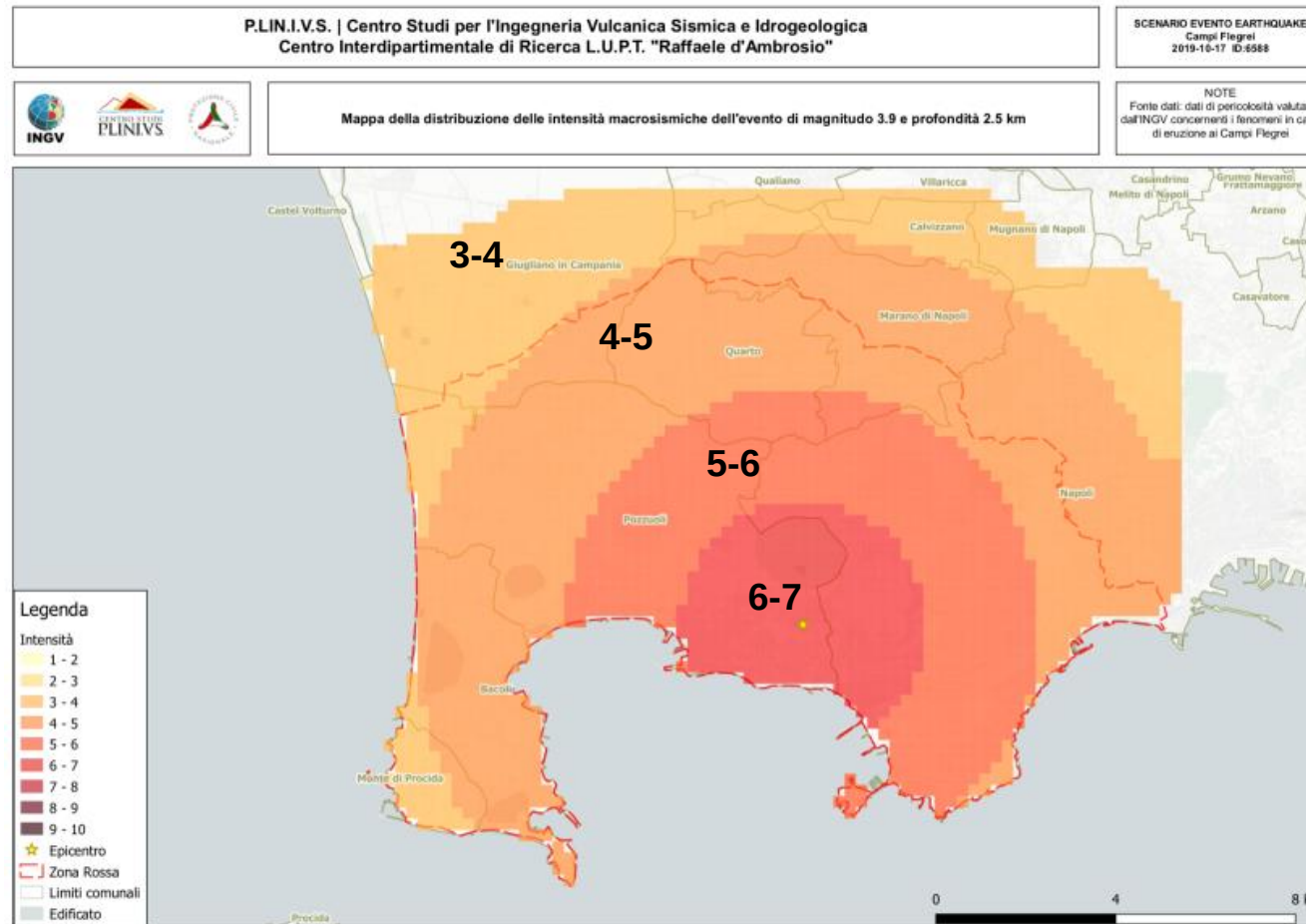
HOMELESS

394387

5.2169001605255705

Access to the EASE application for seismic impact scenarios and related web services

The connection with INGV allows a reading of the event and the elaboration of an Intensity/PGA map.
The figure shows the map of a seismic event at Campi Flegrei, used during the EXEFLEGREI Exercise



INPUT:

MAGNITUDE EVENT 4.2

DEPTH 2.5 KM

TIME 15.30, 18.10.2018

The combination of hazard data with PLINIVS models of vulnerability and exposure provides the estimation of DAMAGE, in terms of collapsed buildings, uninhabitable buildings, deaths, injuries and homelessness.



INPUT:
MAGNITUDE EVENT 4.2
DEPTH 2.5 KM

TIME 15.30, 18.10.2018

Access to the application for the evaluation of the probability of interruption due to seismic events of the estrangement paths and related web services

Impatto Evento EQ

Impatto Evento GTS

Registro Simulazioni

Nuova Simulazione

Nuova Simulazione Impatto Strade

Edificato

Importazione Scheda ITER

GTS - Valori Massimi ID:17133

Layer list

Scenario GTS - Intensità ID:17133

Layer list

Gates Impact Evaluation

Filtra per data

Tutto

Magnitudo

Tutte

Profondità (maggiore di)

Profondità (maggiore di)

Filtra per zona

Ricerca

Q

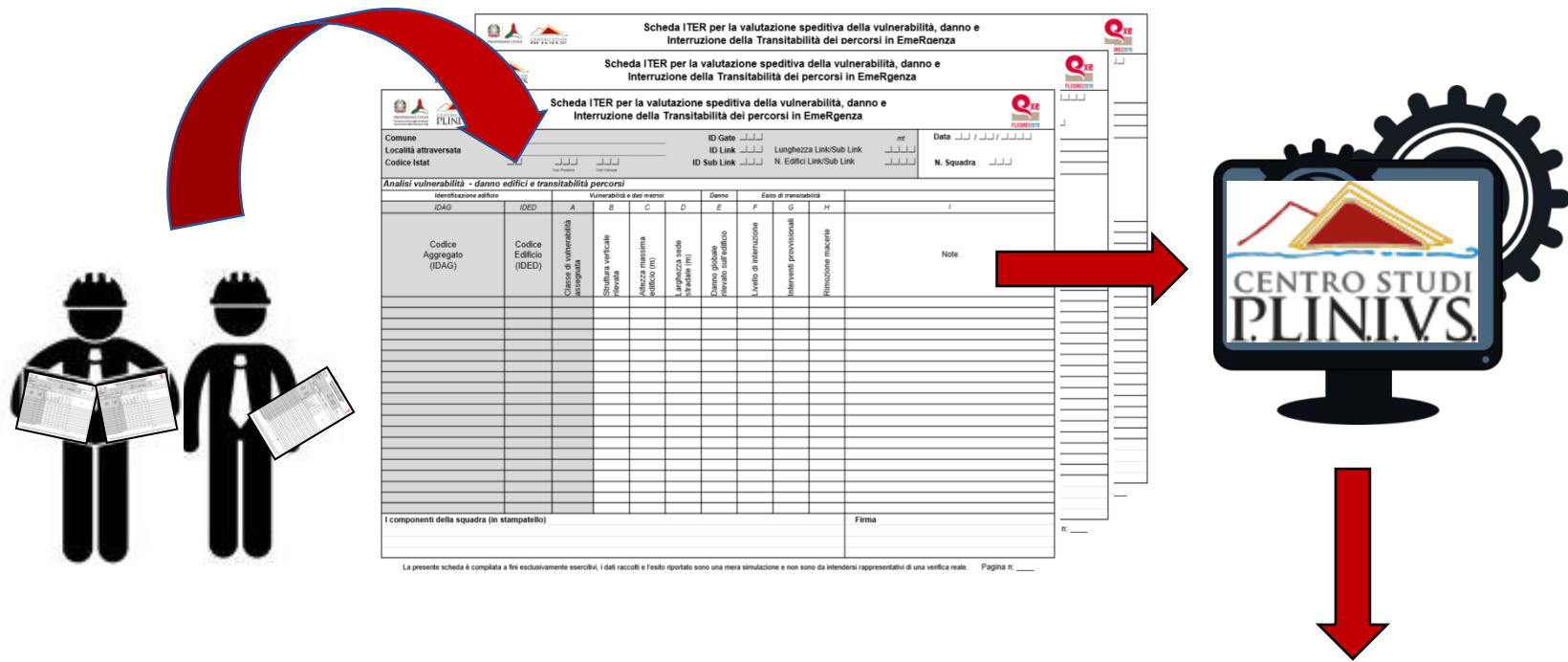
Show 10 entries

ID	Fonte	Tipo fonte	Zona	Data Evento	Lat	Long	Magnitudo(ML)	Profondità(m)	Stato elaborazione	Actions
17133	PLINIVS	GS	Campi Flegrei	2022-02-03 01:00:00	40.8490	14.13	4.2		ELABORATO	

Showing 1 to 1 of 1 entries

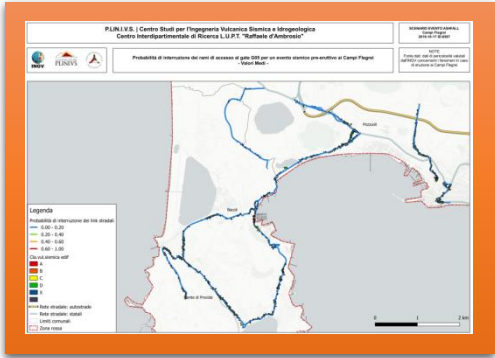
Previous 1 Next

EARTHQUAKE: ROAD SECTION INTERRUPTIONS. FIELD SURVEYS



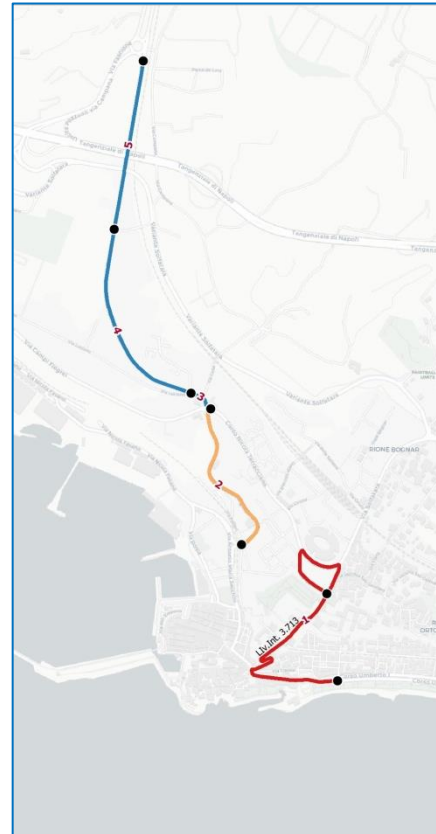
INPUT:
MAGNITUDO 4.2
DEPTH 2.5 KM

TIME 15.30, 18.10.2018



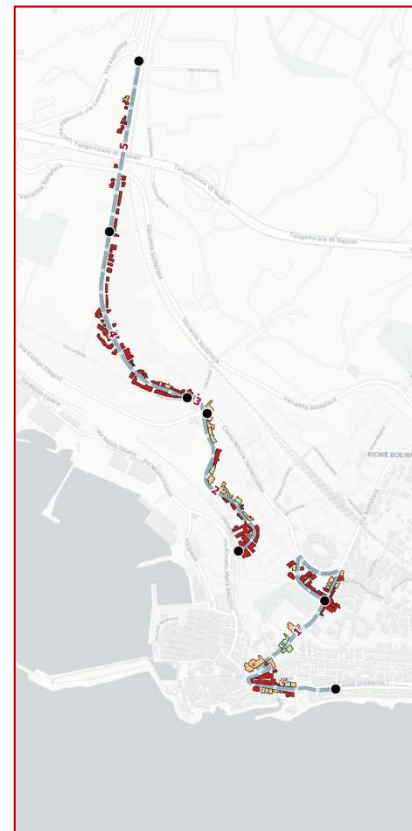
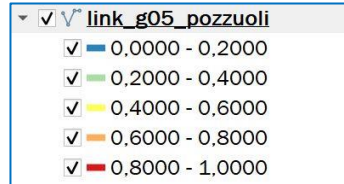
Access to the application for the evaluation of the probability of interruption due to seismic events of the estrangement paths and related web services

Based on the damage data to the building, the model also provides the **PROBABILITIES OF INTERRUPTION OF ROAD SECTIONS**, in order to support emergency management operations.

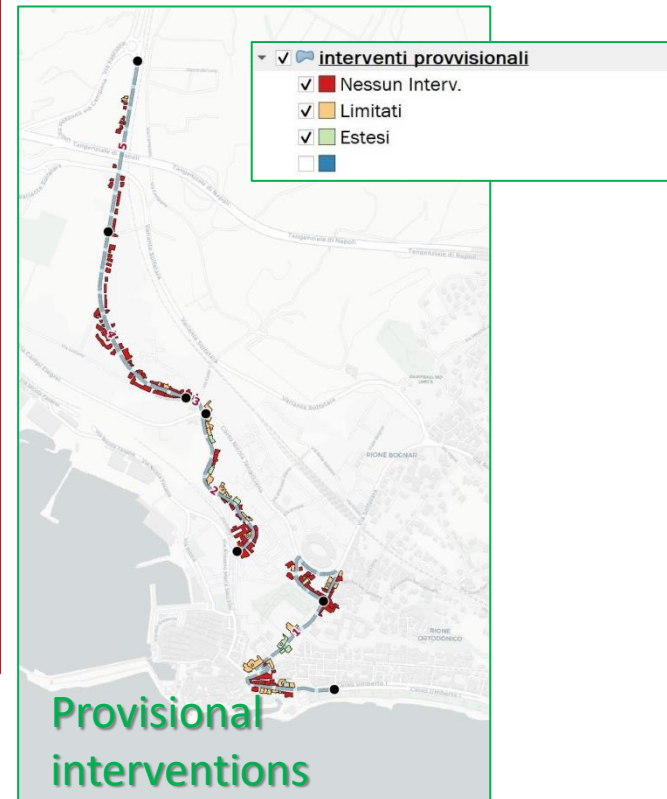


Probability of interruption

INPUT:
MAGNITUDE 4.2 EVENT
AND DEPTH 2.5 KM
3.30 P.M., 18.10.2018



Rubble removal



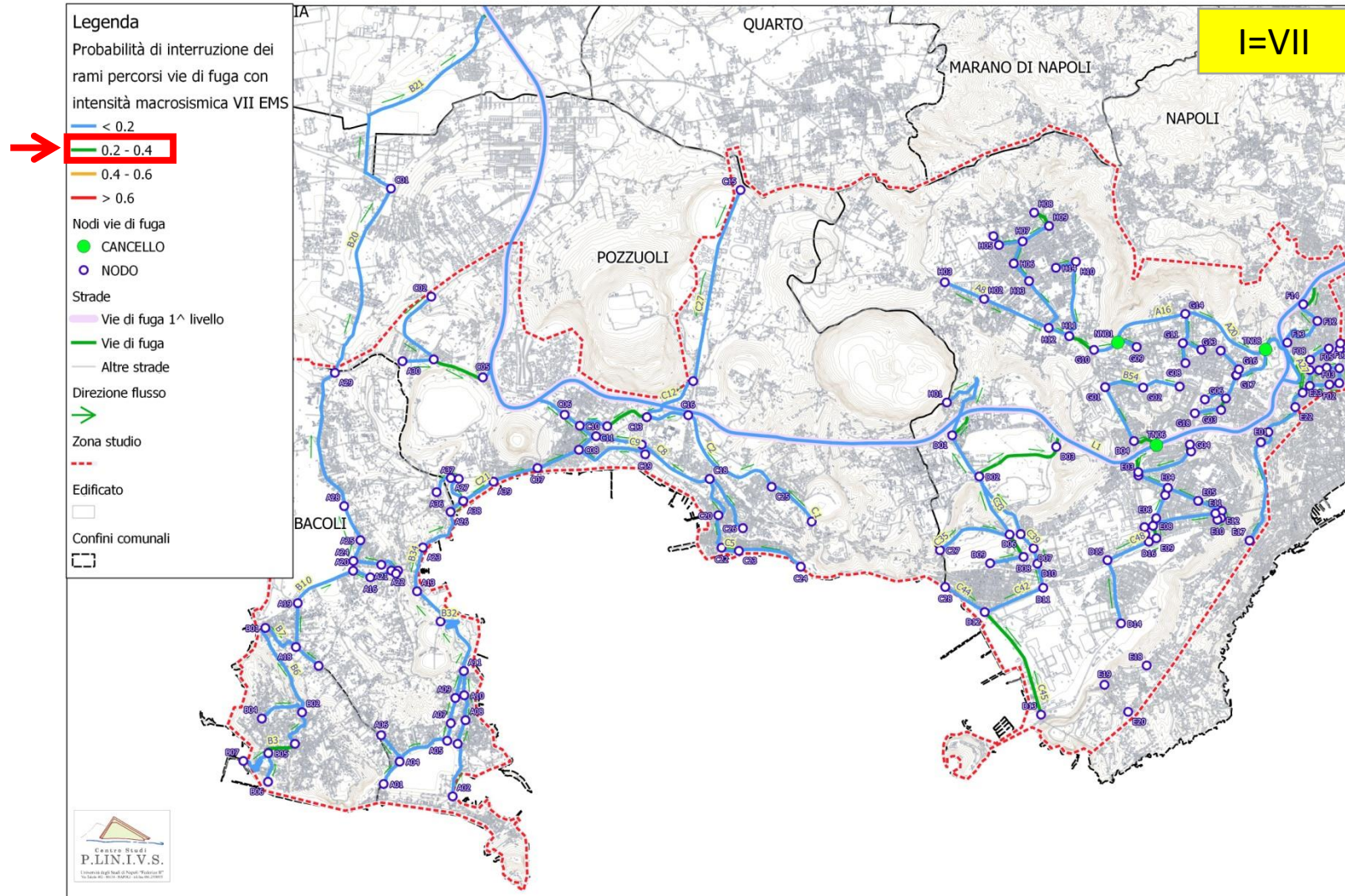
Provisional interventions



SCENARIO OF SEISMIC DAMAGE TO ROAD SECTIONS

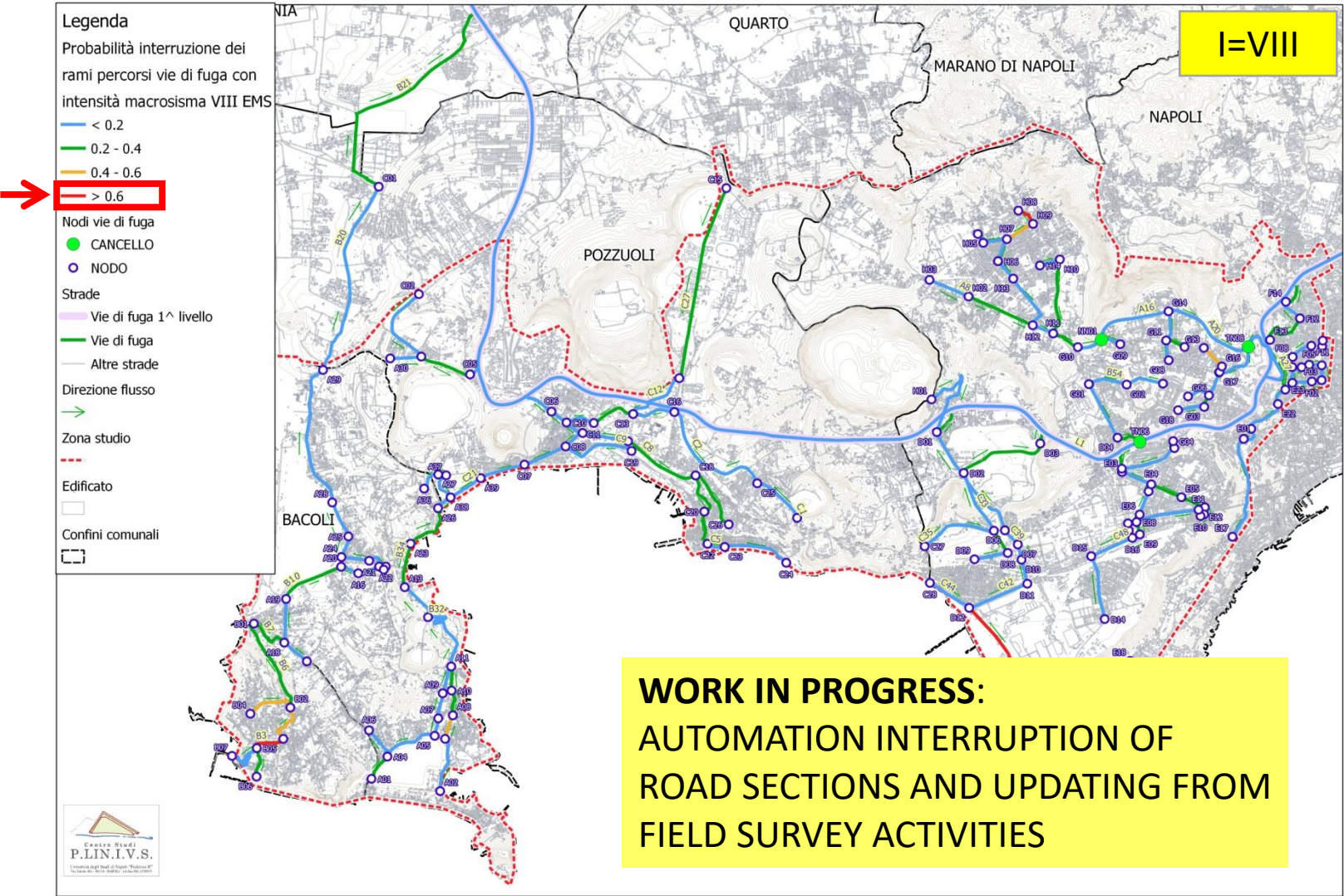
"Vecchio Grafo" produced by the University of Rome La Sapienza

CAMPI FLEGREI: MAP OF THE INTERRUPTION OF ESCAPE ROUTES



SCENARIO OF SEISMIC DAMAGE TO ROAD SECTIONS

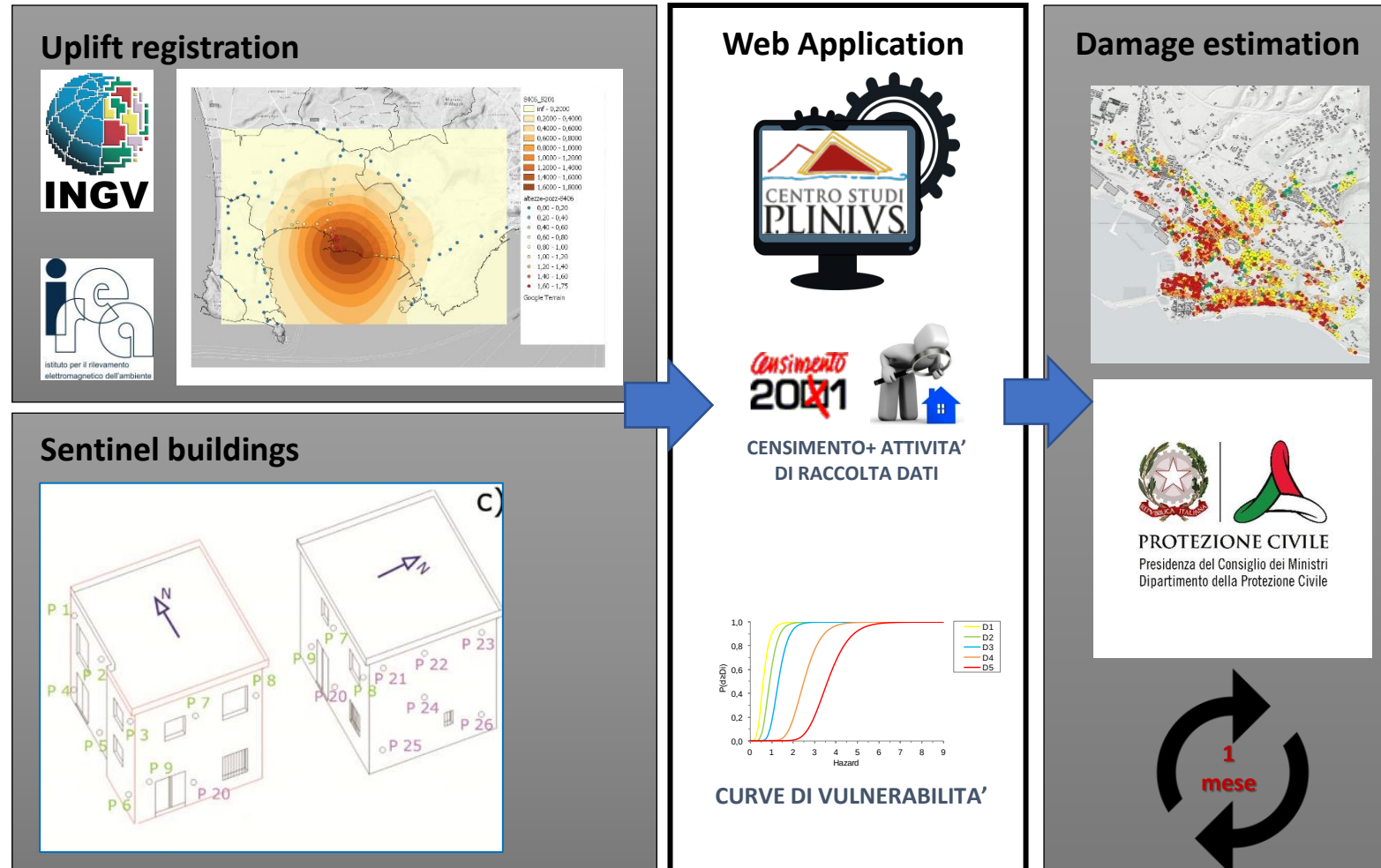
CAMPI FLEGREI: MAP OF THE INTERRUPTION OF ESCAPE ROUTES



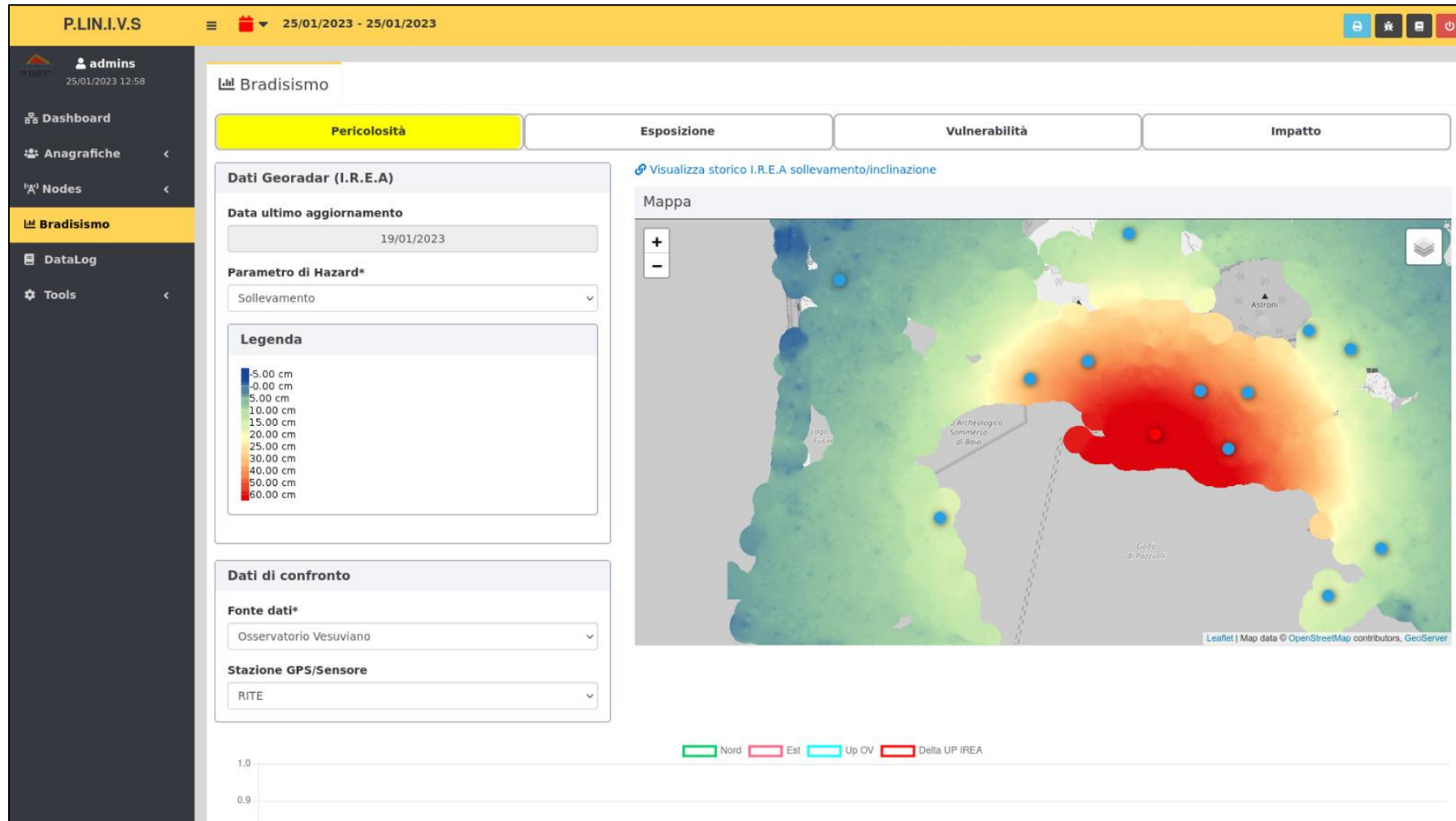
Access to the bradyseismic impact assessment application

WEB APPLICATION FOR THE MANAGEMENT OF THE PROCEDURE FOR THE EVALUATION OF THE BEHAVIOUR OF ORDINARY PHLEGRAEAN BUILDINGS TO THE PHENOMENON OF BRADYSEISM

The connection with IREA and INGV allows a reading of the lifts and the elaboration of a map of lifts/slopes.



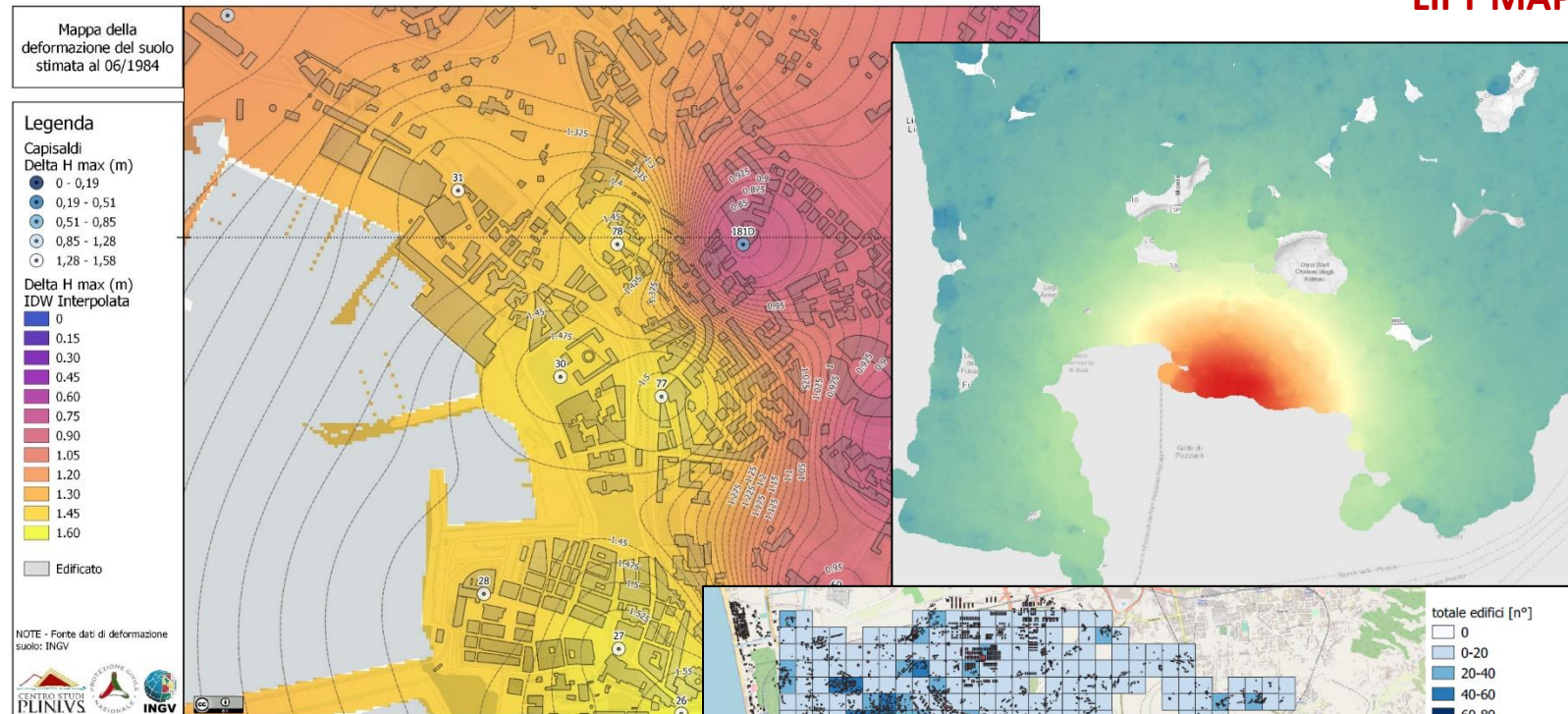
Access to the bradyseismic impact assessment application



Access to the bradyseismic impact assessment application

The combination of lift data with PLINIVS models of vulnerability and exposure provides an estimate of damage to buildings.

LIFT MAP

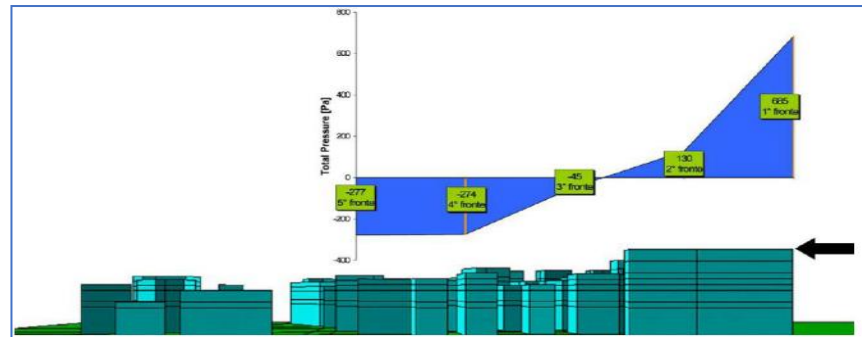
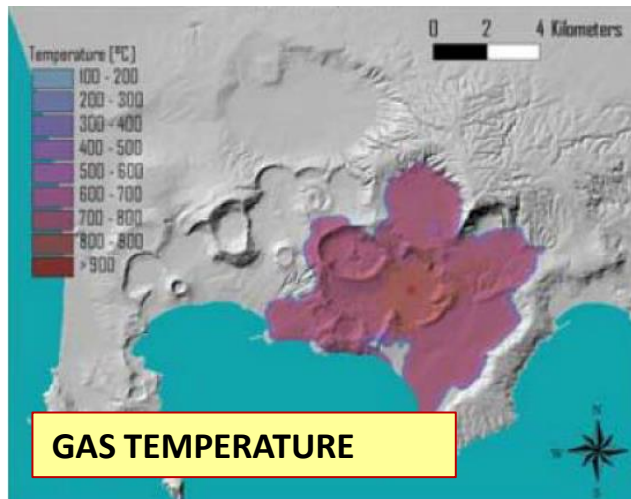
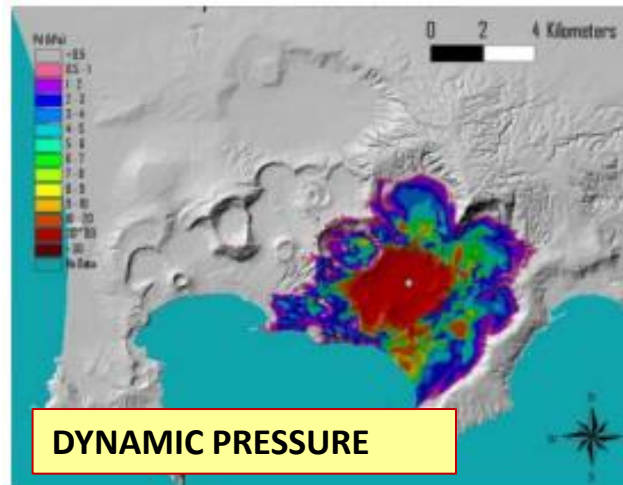
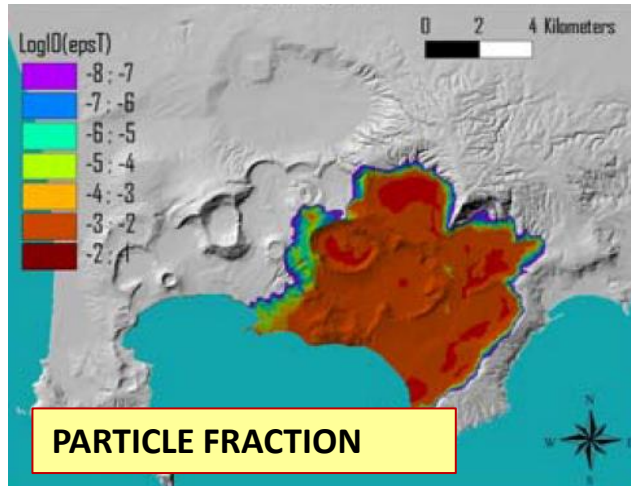


MAP OF GROUND DEFORMATIONS 1984

IMPACT MAP

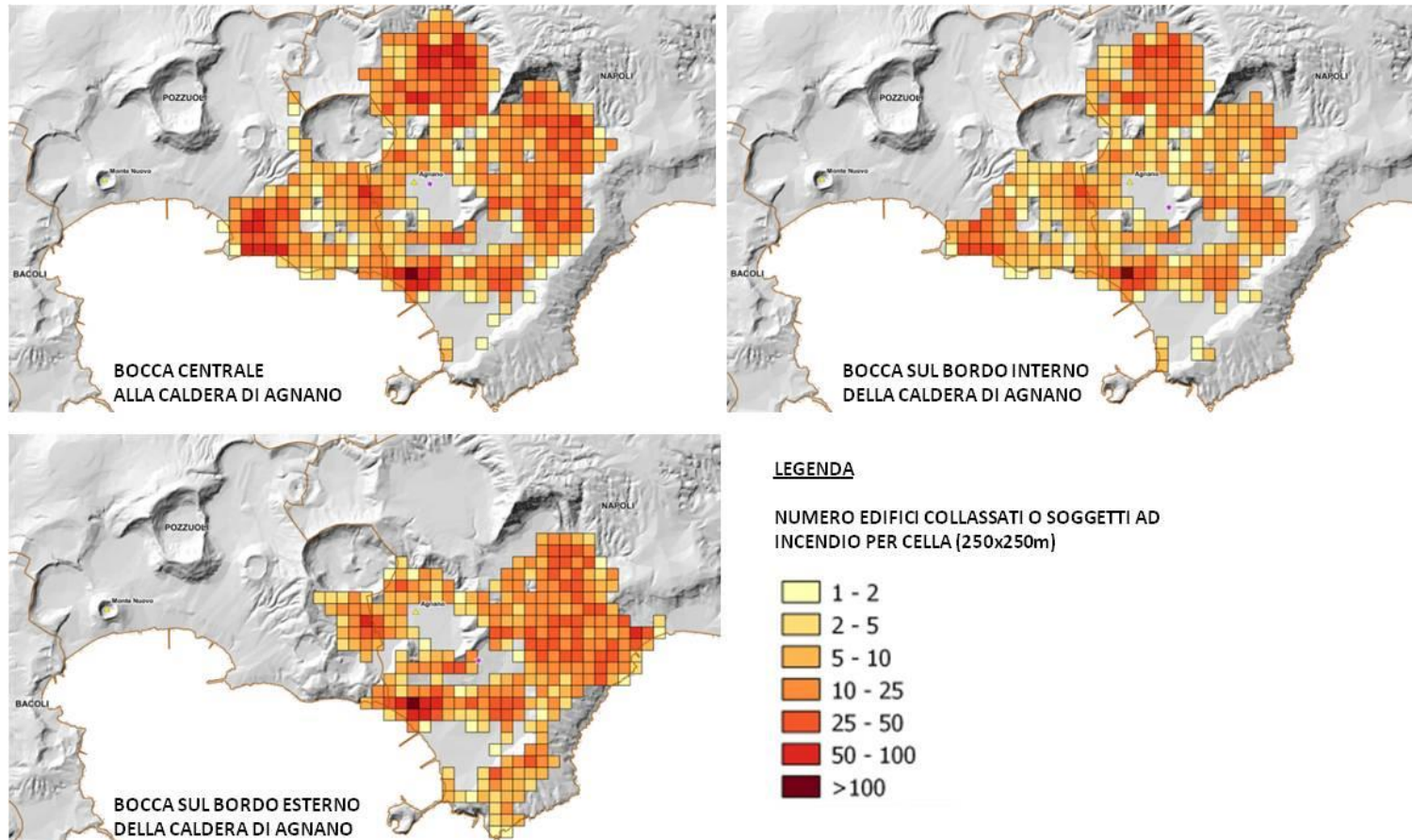
Scenarios from pyroclastic flows

PYROCLASTIC FLOW HAZARDS



Scenarios from pyroclastic flows

IMPACT FROM PYROCLASTIC FLOWS

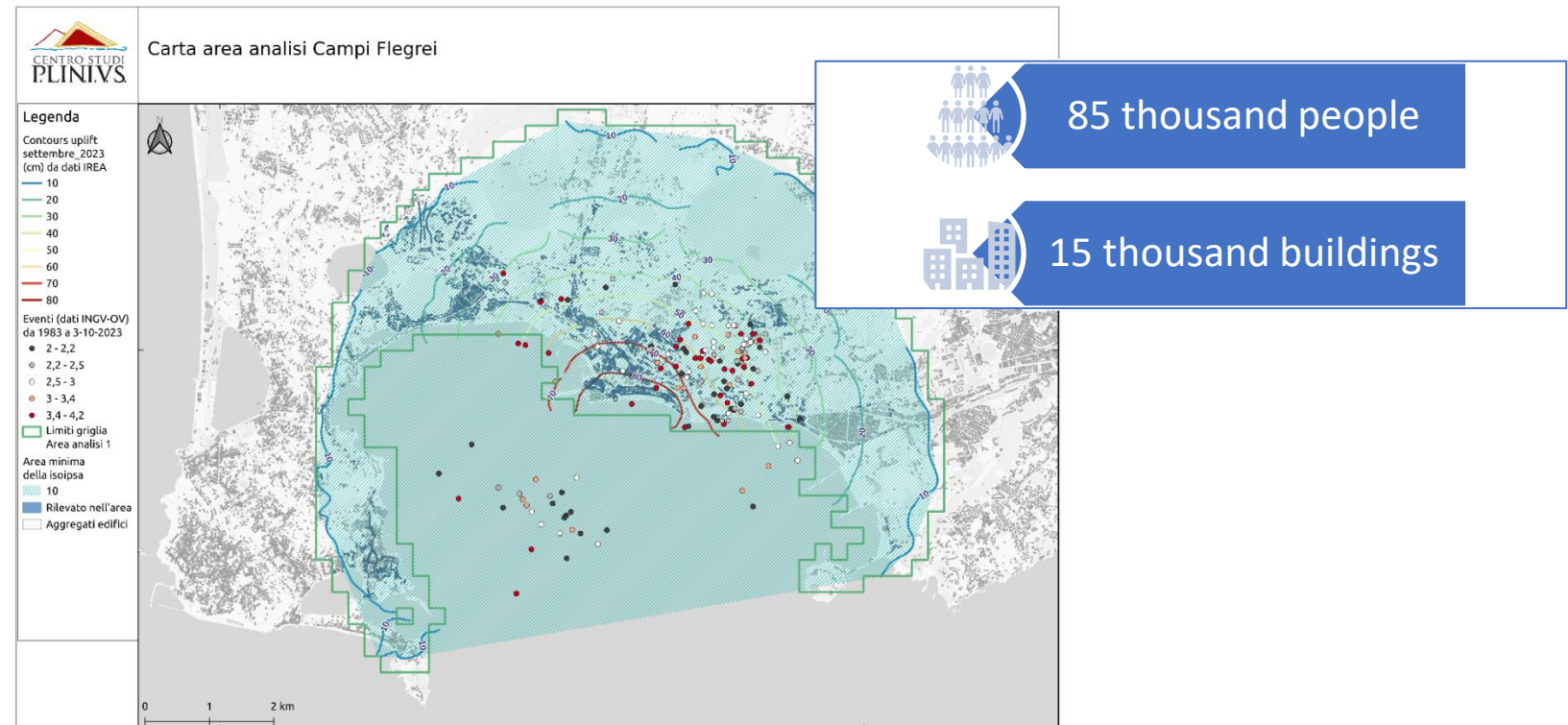


The only defense for the population is to move away from the area at greatest risk, i.e. the one that can be invaded by pyroclastic flows, before the start of the eruption, based on the analysis of the precursory phenomena monitored by the surveillance system of the Vesuvius Observatory.

PLINIVS activities for D.L.

In agreement with INGV-OV, the possible area of intervention was delimited, identifying the Phlegraean area characterized by:

- earthquakes with a magnitude greater than 2 since 1983(
(PLINIVS processing of INGV-OV data, <https://terremoti.ov.ingv.it/gossip>);
- and bradyseismic uplifts of not less than 10 cm starting from 2015,
corresponding to about 20 cm from 2006
(from PLINIVS processing of the data produced by CNR-IREA and updated in May 2023).



LEGENDA

- Curva pericolosità ceneri 300kg/mq, prob. 5% - Eruzione taglia MEDIA
- Zona Rossa (Del. Reg. n. 669, 23/12/2014)
- Zona Gialla (2015)
- Municipalità Comune di Napoli (2011)
- Limiti comunali (2011)
- Limiti regionali (2011)

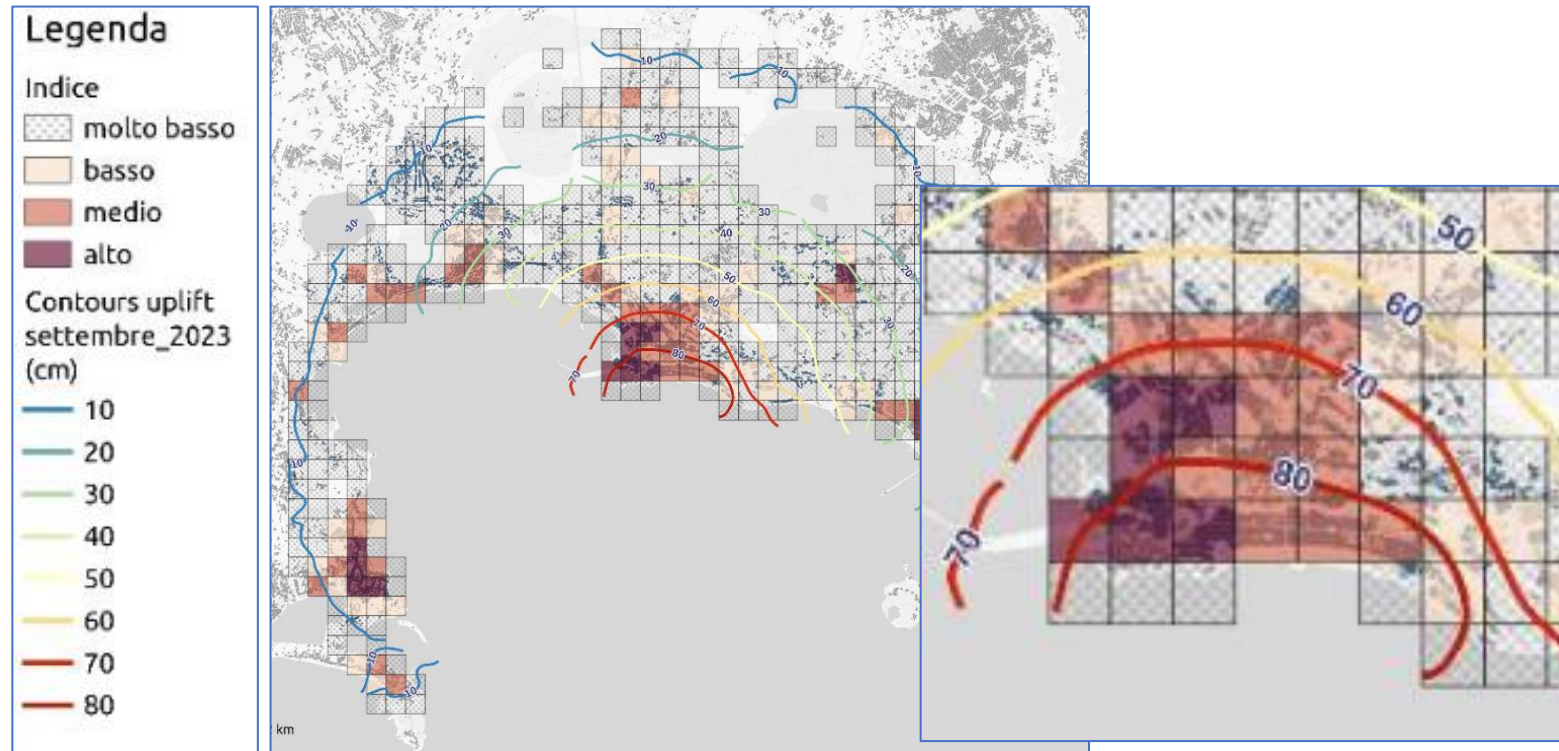
SCHEDA DI RILIEVO PLINIVS
dati topologici sugli edifici per la classificazione di vulnerabilità rispetto ai fenomeni multi-hazard (Geologici e Cambiamenti Climatici)

SEZIONE B – FACCIATA		
MATERIALE PREVALENTE - FINESTRE PICCOLE		
A □ Legno	B □ PVC	C □ Alluminio o legno-alluminio
D □ Ferro debole	E □ Ferro forte (es. blindato)	F □ Aperture senza infissi
PROTEZIONE PREVALENTE - FINESTRE PICCOLE		
A □ Legno	B □ PVC	C □ Alluminio o legno-alluminio
D □ Ferro debole	E □ Ferro forte (es. blindato)	F □ Aperture senza infissi
MATERIALE DEL RIVESTIMENTO DELLA FACCIATA:		
A □ Intonaco	B □ Laterizio	C □ Ceramica
D □ Marmo	F □ Verde	G □ Altro
COLORE DEL RIVESTIMENTO DELLA FACCIATA:		
A □ Giallo	B □ Rosso	C □ Verde
D □ Grigio	E □ Nero	F □ Bianco
SISTEMI FRANGISOLE		
A □ Legno	B □ Cotto	C □ Alluminio
D □ Altro	E □ Assente	
NUMERO DI CONDIZIONATORI IN FACCIATA: PANNELLI FOTOVOLTAICI: sì no		
SEZIONE 9 – REGOLARITÀ		
REGOLARITÀ IN PANTA: R □ regolare I □ irregolare		REGOLARITÀ IN ALZATO: R □ regolare I □ irregolare
PIANO DEBOLE:		ELEMENTI TOZZI (solo per edifici in C.A.):
A □ Assenza di porticato	B □ Presenza di porticato su parte del piano terra	A □ Assenti
C □ Piano terra completamente aperto (ad eccezione eventuale della scala)	D □ Piano debolte intermedio	B □ Scarsamente presenti
DISTRIBUZIONE ELEMENTI STRUTTURALI (solo per edifici in C.A.):		C □ Significativamente presenti
A □ tela monodir.		B □ tela bidir.
C □ pareti monodir.		D □ pareti bidir.
E □ pareti + telai		
SEZIONE 10 – NOTE		

PLINIVS activities for D.L.

The database of the Phlegraean building has allowed the definition of a vulnerability index for CELL (250x250m) of the INTERVENTION ZONE, on the basis of well-founded statistical procedures:

- on the analysis of the damage to the building occurred as a result of past seismic events (SAVE);
- on the correlations between the data collected and those of ISTAT (BINC).



Art. 2 del D.L. 140/2023

- Art. 2. Extraordinary plan for the analysis of the vulnerability of built-up areas directly affected by the bradyseismic phenomenon

It consists of:

a) seismic microzonation study;

b) analysis of the seismic vulnerability of private buildings, aimed at identifying mitigation measures and estimating the related needs;

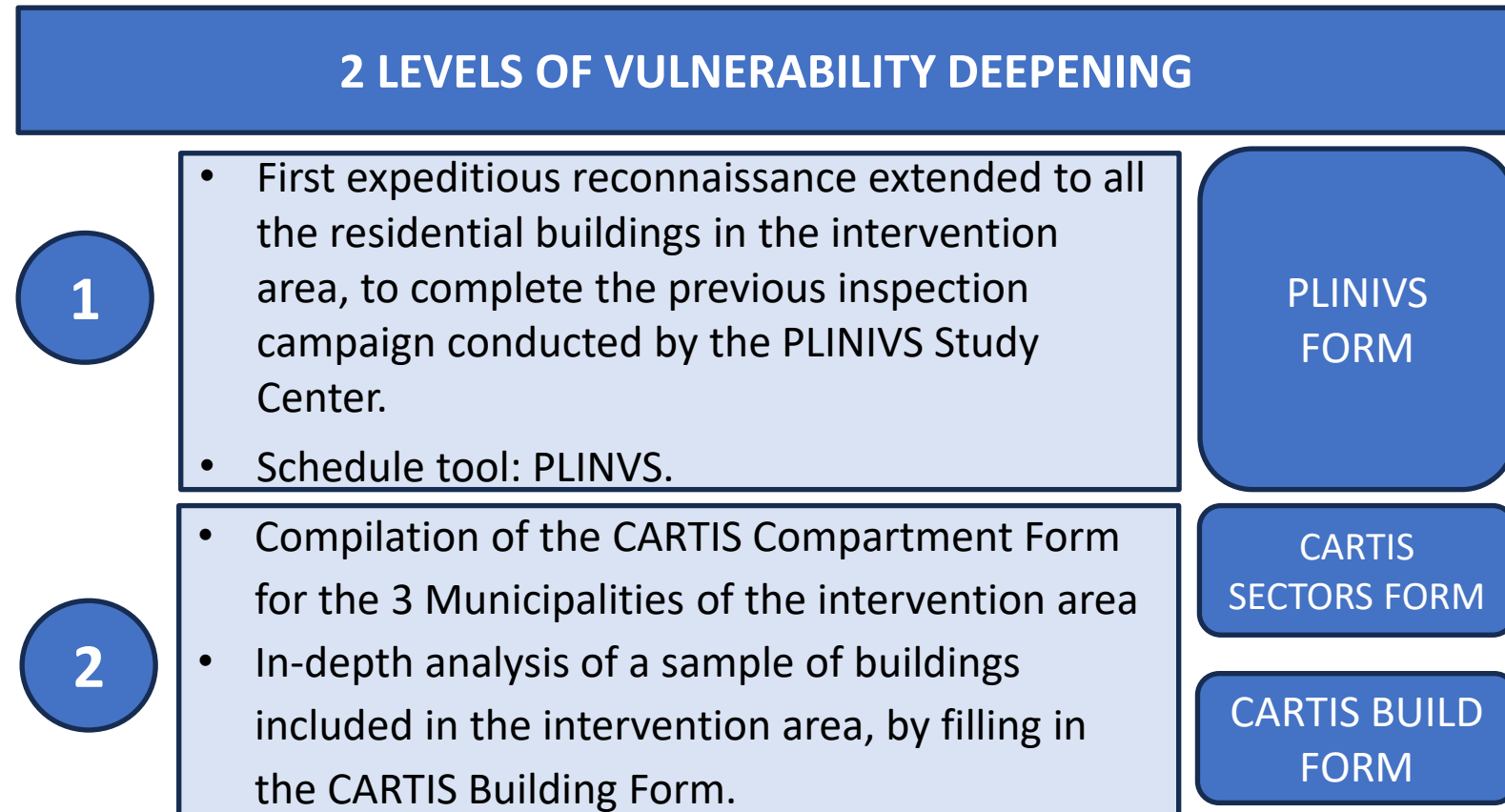
c) analysis of the seismic vulnerability of public buildings and, at the outcome, first plan of mitigation measures;

d) Seismic and structural monitoring implementation program.

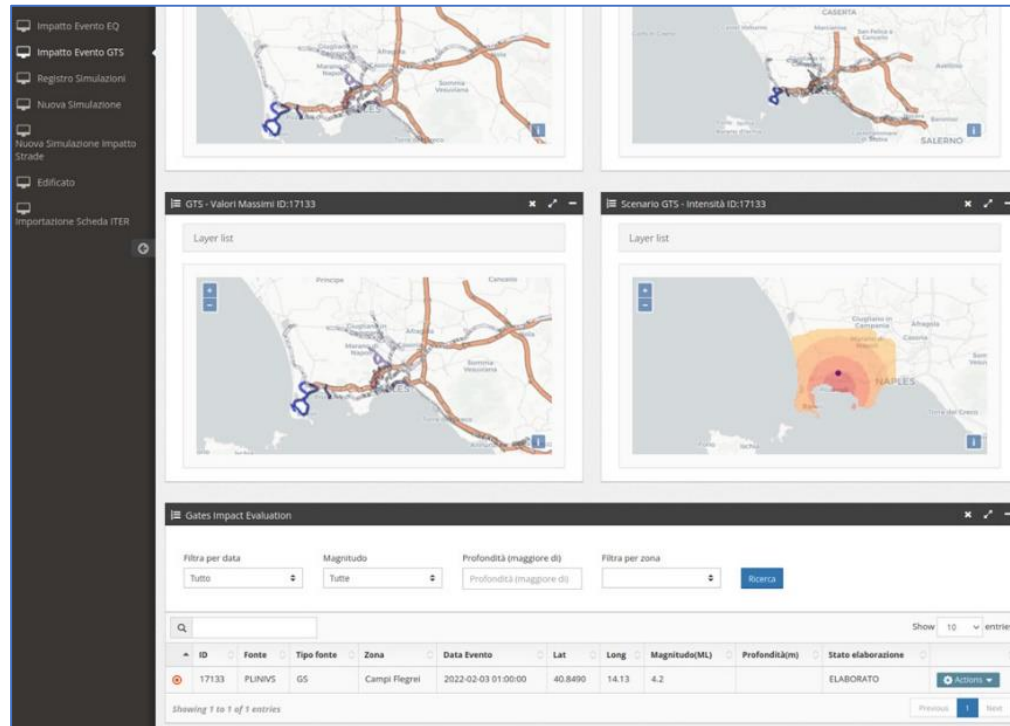
Art. 2b del D.L. 140/2023

Seismic vulnerability analysis of private buildings:

The field investigations are aimed at the typological-structural characterization of ordinary private buildings, containing the typological elements that are most related to their vulnerability characteristics, for the purpose of their classification into vulnerability bands.



Pathways of Distancing



The in-depth analysis of the vulnerability of ordinary buildings can have a positive impact on the improvement of the models for assessing the probability of interruption of road sections linked to the possible collapse of facing buildings induced by precursory earthquakes.

Possible rubble, potentially occupying the roadway, as a result of partial or total collapse of buildings in front of it, could prevent or slow down any rescue or evacuation operations in the area.

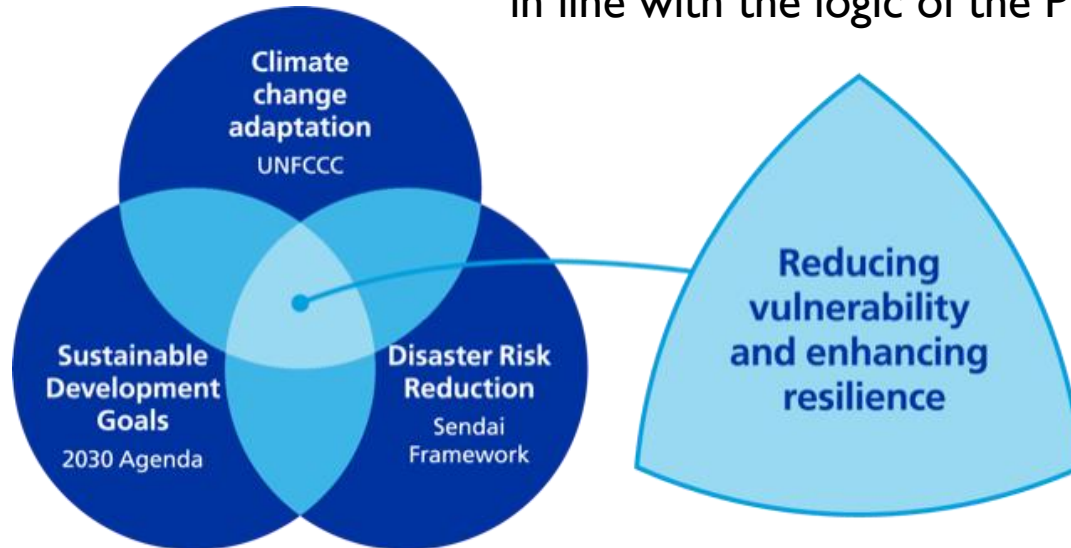


Multi-risk mitigation

BENEFITS of Deepening Vulnerabilities:

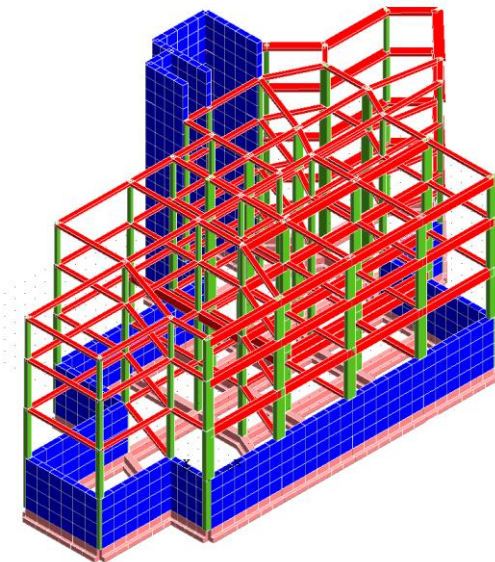
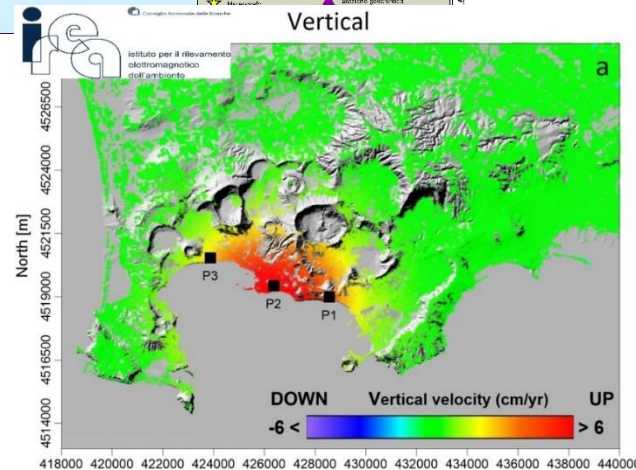
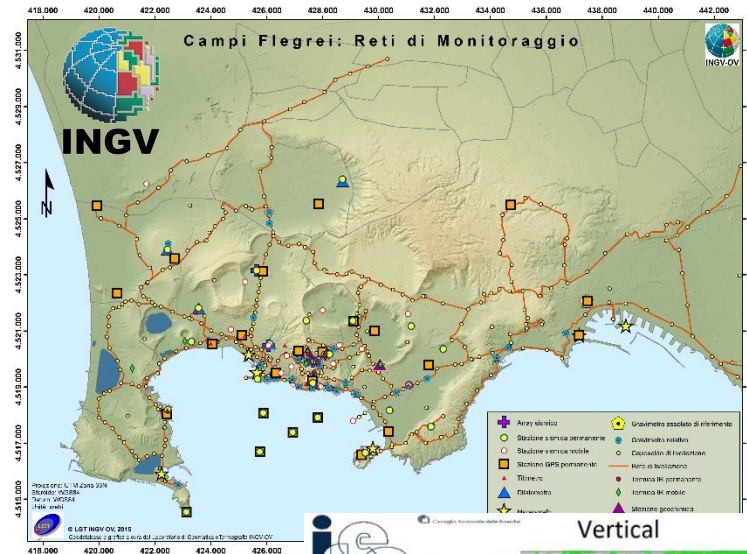


- Better knowledge of the building fabric with regard to seismic and volcanic phenomena.
- Risk reduction through the implementation of ad hoc mitigation measures.
- Opportunity to adopt integrated adaptation strategies that reduce the risk from geophysical and climatic phenomena, in line with the logic of the PNRR.



Monitoring

The accuracy of seismic and volcanic risk assessments in the Phlegraean area can be improved through the strengthening of **GEOPHYSICAL** and **STRUCTURAL MONITORING**



Thank you for
your kind
attention.

