Engaging and communicating with emergency managers

"Interaction and cooperation between scientists and decision makers. A case study from Campi Flegrei"

VUELCO short course: «Coping with volcanic unrest»
Quito (Ecuador), 12th November 2014

Stefano Ciolli, Chiara Cristiani – Department of Civil Protection, Italy

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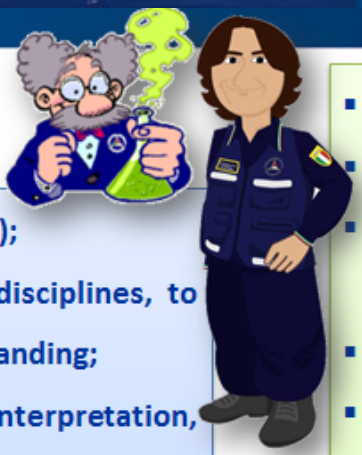
Volcanic risk management in
a perspective from a decisio

VUELCO workshop – *Interfa*
Colima (Mexico), 18th Nover

Stefano Ciolli – Italian Department o

THE WINNING TEAM



- Share data with others (Sc+CP);
- Be interested also in other disciplines, to have a better general understanding;
- Provide not only data, but interpretation, overall synthesis and scenarios;
- Give timely information, even if rough;
- Try to fix thresholds for parameters;
- Always provide quantitative probabilities of occurrence (compared to familiar events);
- Know Civil Protection language and system, understand and accept roles;
- Improve communication skills (related to their role).

- Understand science language and limits;
- Provide logistic and financial support;
- Protect scientists from unnecessary pressure (media, politic,...);
- Respect the roles;
- Share knowledge, responsibilities and decisions with local authorities, taking into account the communities' needs;
- Give people all the possible means to understand and decide themselves;
- Develop education and information campaign in "peace-time";
- Entrust experts not only in science, but also in social behaviour and in communication.

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ITALY

A DISASTER PRONE COUNTRY

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SOME FIGURES…

60
MILLIONS
POPULATION

8100
MUNICIPALITIES
(decision-makers)
72% < 5000 PEOPLE

70
MILLIONS
DAMAGE (USD)
Over the last 30 years

20
THOUSANDS
FATALITIES
Over the last 30 years

- ✓Hydrogeological (6000)
- ✓Seismic (5000)
- ✓Volcanic
- ✓Forest fire
- ✓Tsunamis
- ✓Industrial
- ✓Enviromental
- ✓Health related
- ✓Transports

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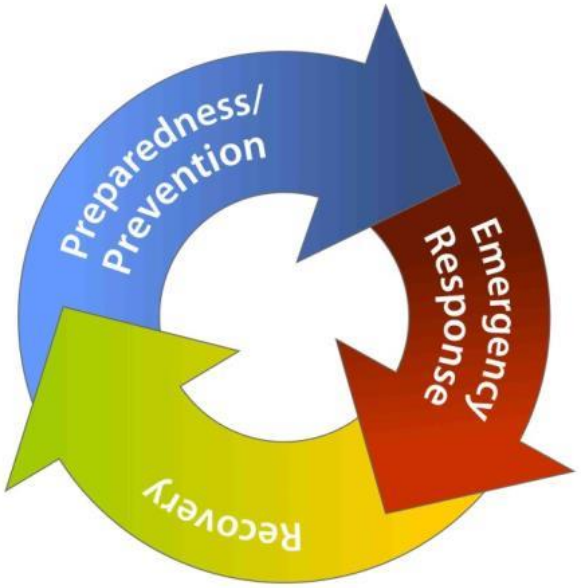
THE NATIONAL CIVIL PROTECTION SERVICE (law 225/1992)

PRESIDENCY OF THE COUNCIL OF MINISTERS

DEPARTMENT OF CIVIL PROTECTION



- **Interior**
  - National Fire-fighters Corps
  - Police
  - Prefectures
- **Foreign Affairs**
- **Environment**
  - ISPRA
- **Health**
  - 118
- **Economy and Finance**
  - Revenue Guard Corps
- **Defence**
  - Army
  - Navy
  - Air Force
  - Carabinieri
- **Productive Activities**
  - G.R.T.N.
- **Transportation and Infrastructures**
  - Costal Guard
  - ANAS
  - National Highway
  - National Railway
- **Cultural Heritage**
- **Education, University and Research**
  - INGV, National technical and scientific bodies, agencies and service providers
- **Communications**
- **Agricultural Policy and Forestry**
  - State Forest Corps
- **Regions**
- **Provinces**
- **Municipalities**

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VOLCANIC RISK IN ITALY

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THE NEAPOLITAN AREA

THE CAMPI FLEGREI CALDERA

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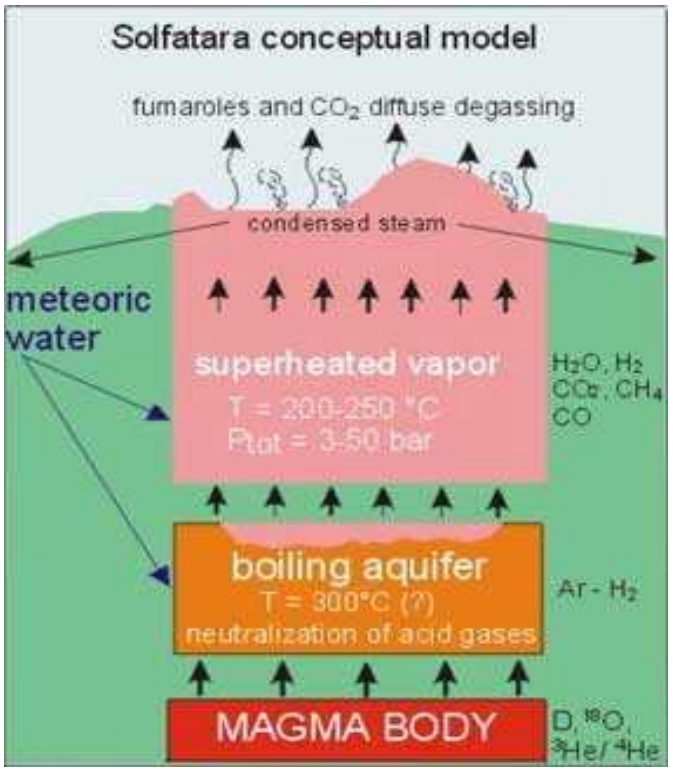
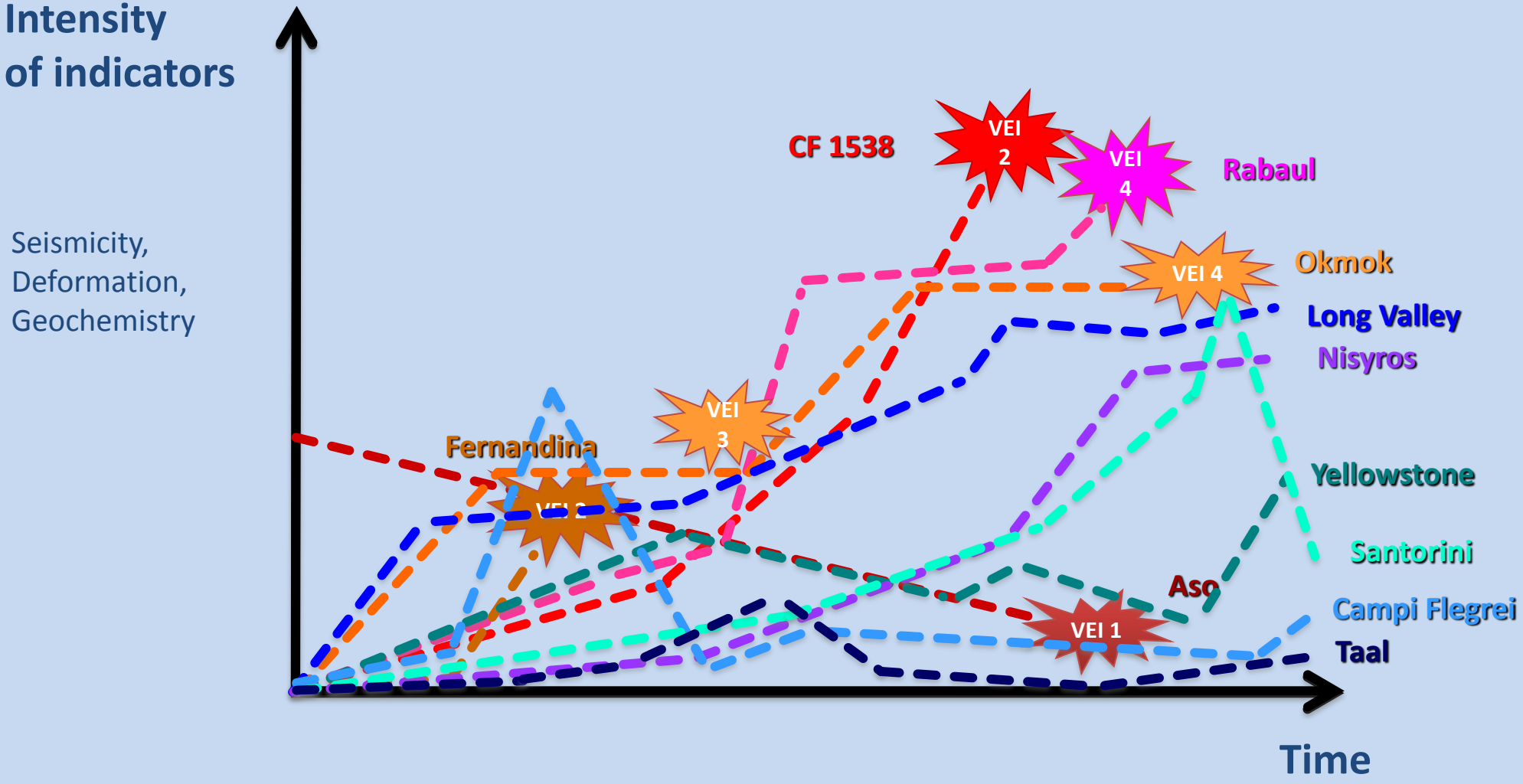
CALDERAS' PECULIARITY

- Unrest is often the norm, not the exception.
- Occurrence of high intensity precursors, usually leading to an eruption in central conduit volcanoes, often in calderas are not followed by eruptions at all.
- Despite a caldera history may show that no eruption occurred after periods of high intensity dynamic, the occurrence of lower intensity precursors can still lead to an eruption even in very short terms (e.g. Rabaul). [Long lasting unrest doesn't imply successfull crisis management]
- Great uncertainty on eruptive vent location (sometimes until few hours before the eruption onset).
- Possible occurrence of simultaneous eruptions from more vents (e.g. Rabaul, Campi Flegrei-Averno).
- First eruption after quiescence can be of low energy.
- Presence of hydrothermal system can cushion magma intrusions evidences, influence precursors observation (misinterpration), modify eruptive style (phreatic eruptions difficult to predict). [Water pumping can reduce filtering action].
- Many possible scenarios.
- Bradisism.
- Large area below sea level (poorly investigated, difficult to monitor)





Di Lorenzo, Acocella, Scandone, 2013 (redrawn)

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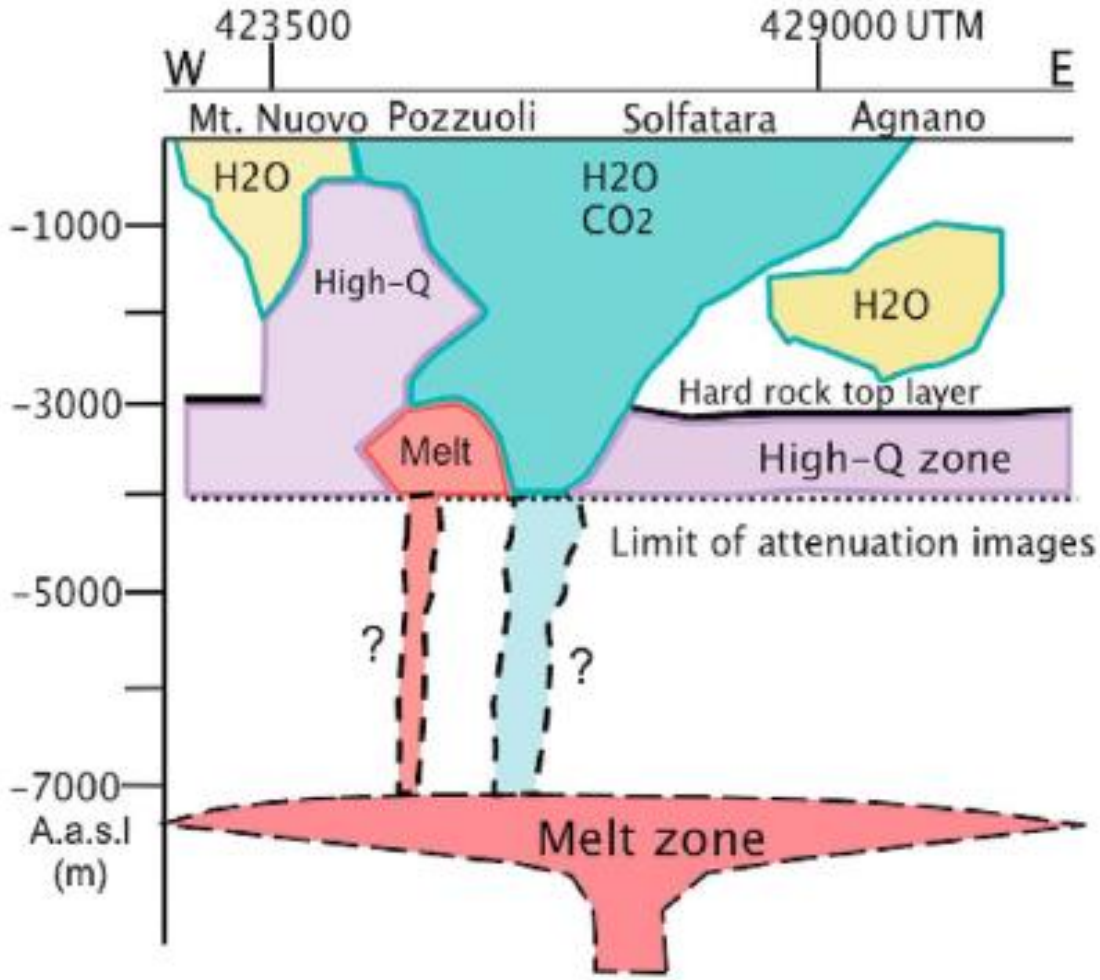
CAMPI FLEGREI CALDERA
structural scheme



- Big reservoir at 7-9 km depth
- Several smaller reservoirs at 2-5 km depth

Magma rises from bottom to shallower reservoirs.
Therefore eruption magnitude is not linked to the volume of the shallower reservoir, since more reservoirs at different depth can be interested.

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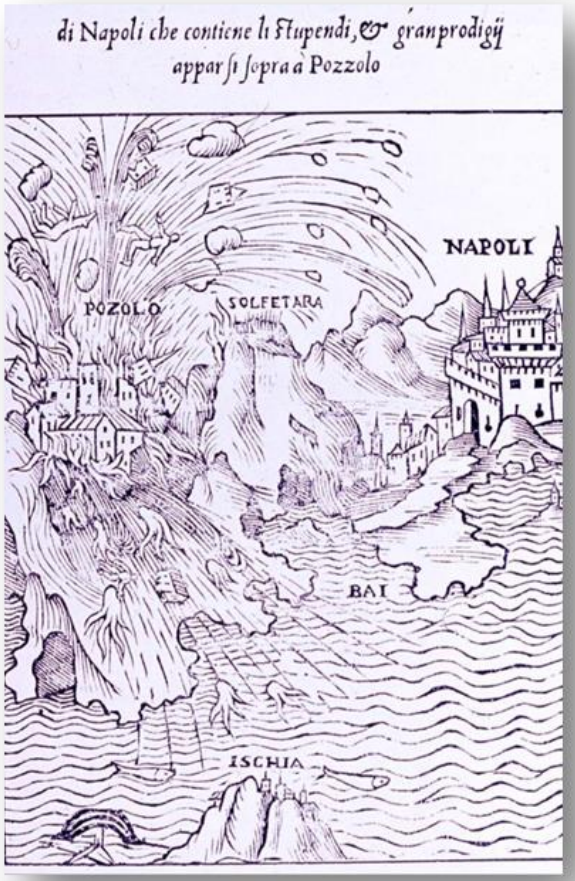
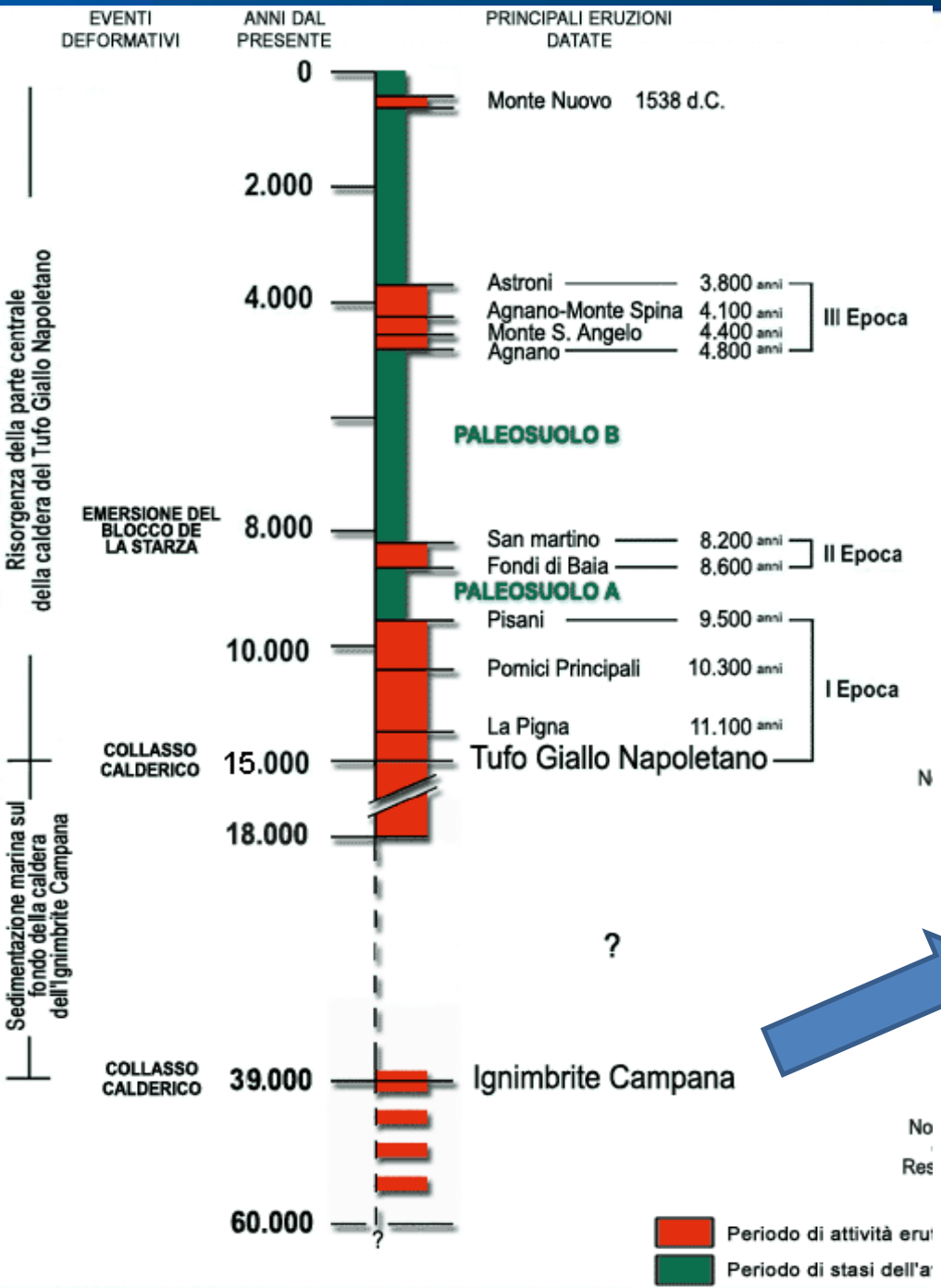
CAMPI FLEGREI CALDERA
social issues

- Very low risk percpetion among people (morphology doesn't help).
- Urbanization developed within caldera rims.
- High densely populated area.
- High buildings' vulnerability.
- Inadequate roads for massive evacuation.
- Frequently changes of mayors.



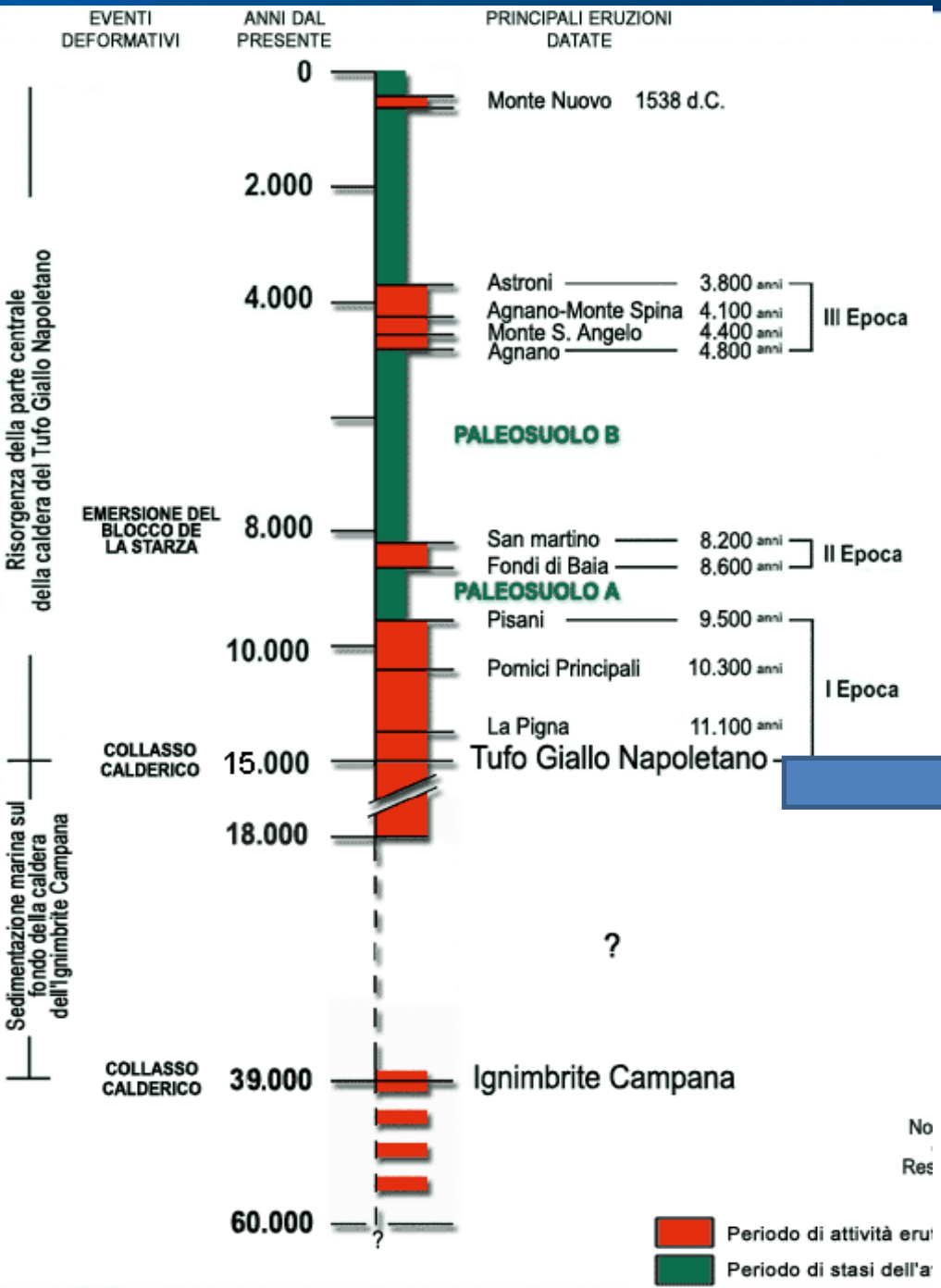
C.F.
ERUPTIVE HISTORY



Ignimbrite Campana (39 ky ago)

- biggest eruption in Mediterranean area over the last 200.000 years (app. 150 km^3 of magma VEI=7)
- caldera collapse
- involved area 30.000 km^2

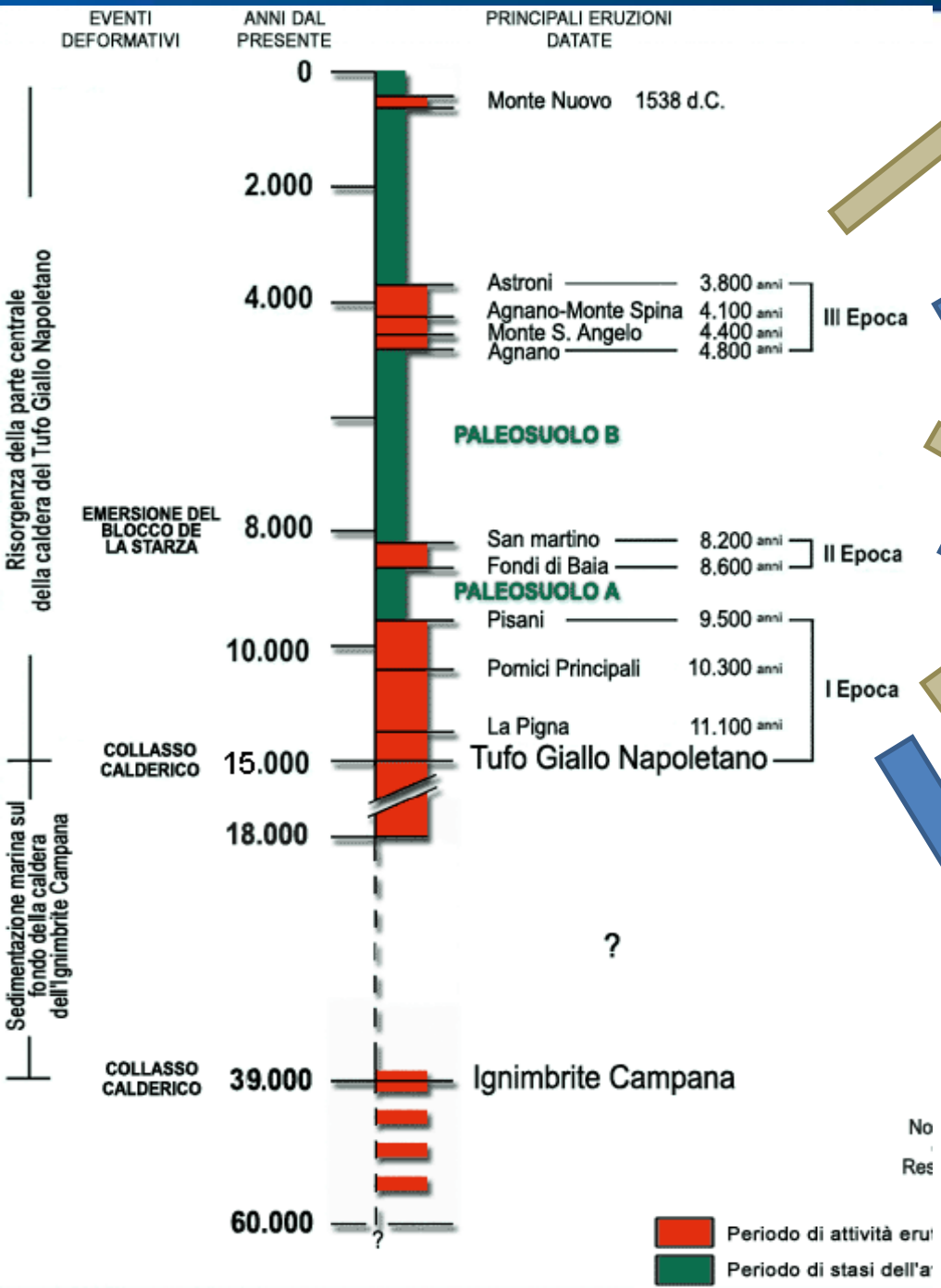
C.F.
ERUPTIVE HISTORY



Neapolitan Yellow Tuff (15 ky ago)

- 2nd biggest eruption (app. 40 km3 of magma VEI=6)
- caldera collapse
- involved area 1.000 km2

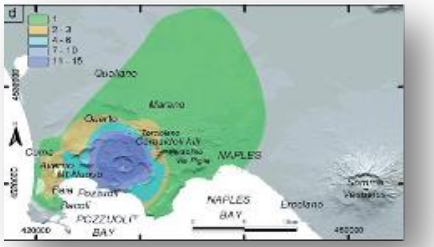
C.F.
ERUPTIVE HISTORY



3.300 years quiescence

3rd Epoch (4.800-3.800 years ago)

- 21 explosve eruptions
- 3 effusive eruptions
- avg 1/42 years



3.400 years quiescence

2nd Epoch (8.600-8.200 years ago)

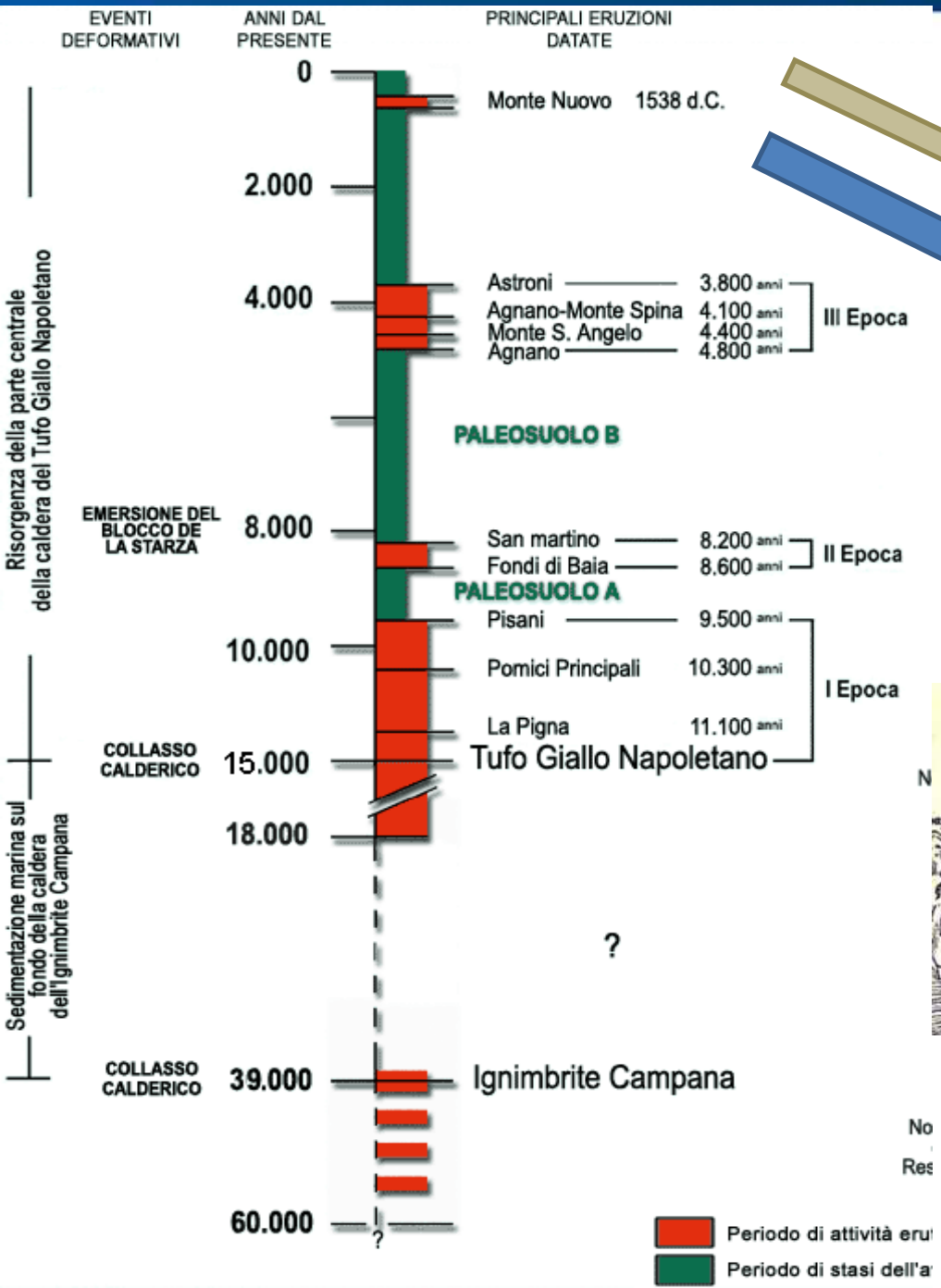
- 6 explosive eruptions
- avg 1/67 years

900 years quiescence

1st Epoch (15.000-9.500 years ago)

- 37 explosive eruptions
- avg. 1/150 years

C.F.
ERUPTIVE HISTORY



Nowadays ?

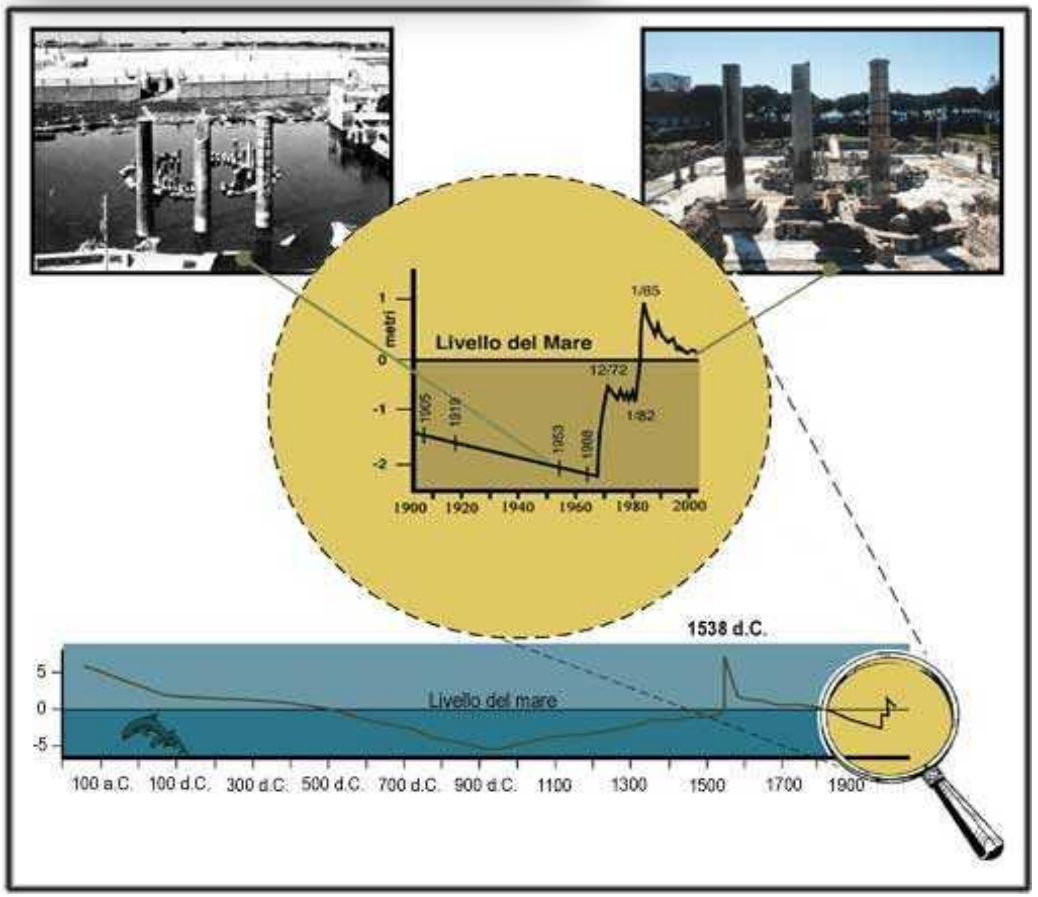
476 years quiescence

Monte Nuovo eruption (1538 A.D.)

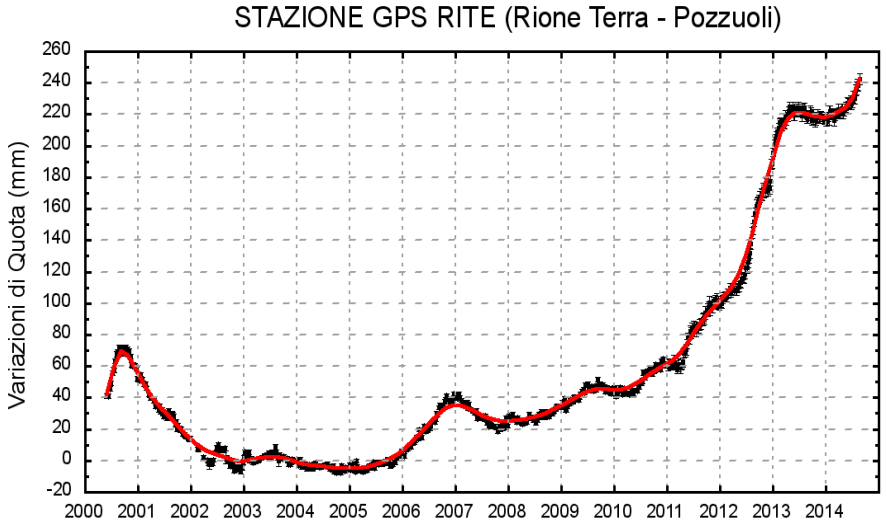
- after 3.000 years of quiescence
- one of the smallest eruptions (0,025 km^3 of magma)
- cone built up in 8 days (diameter 1 km, height 120mt)
- Is it the first eruption of a new epoch???

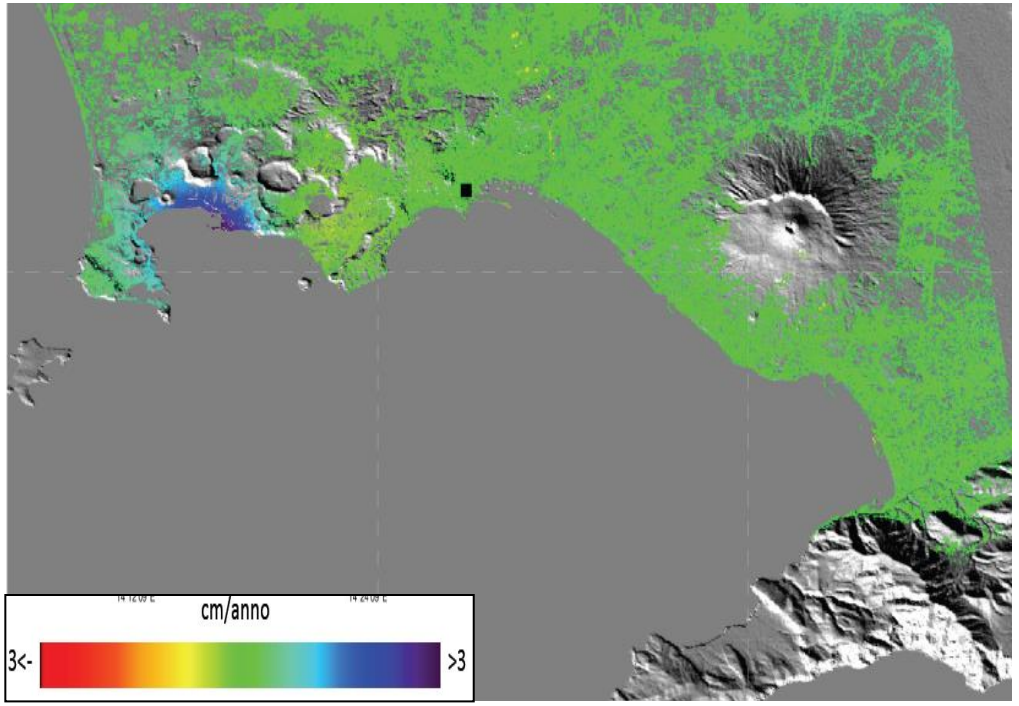
C.F. BRADISEISM

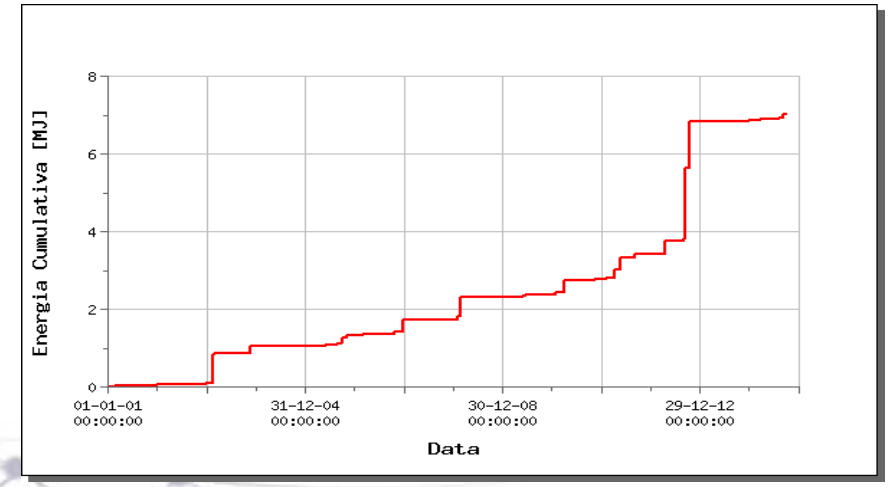
In 1970-72 and 1982-84 bradisesmic crises caused a ground uplift of 3,5 mt

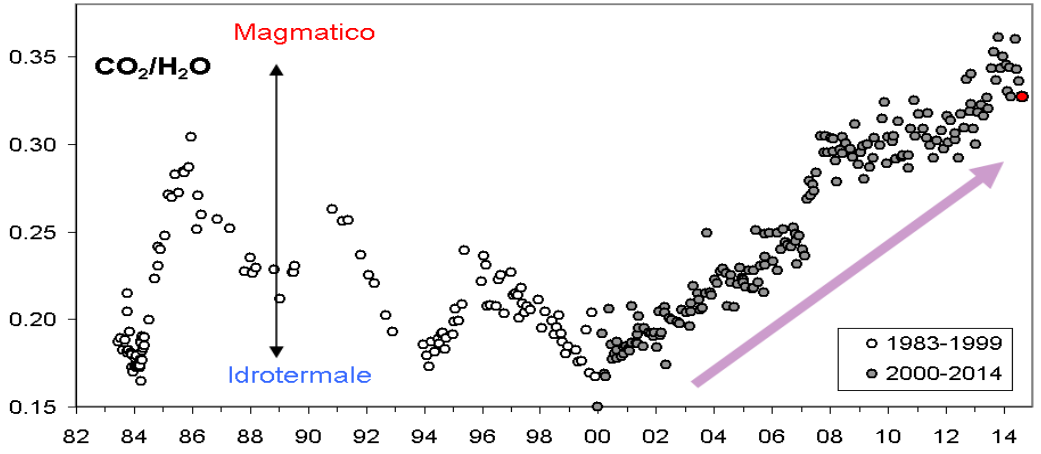


C.F. PRESENT STATE

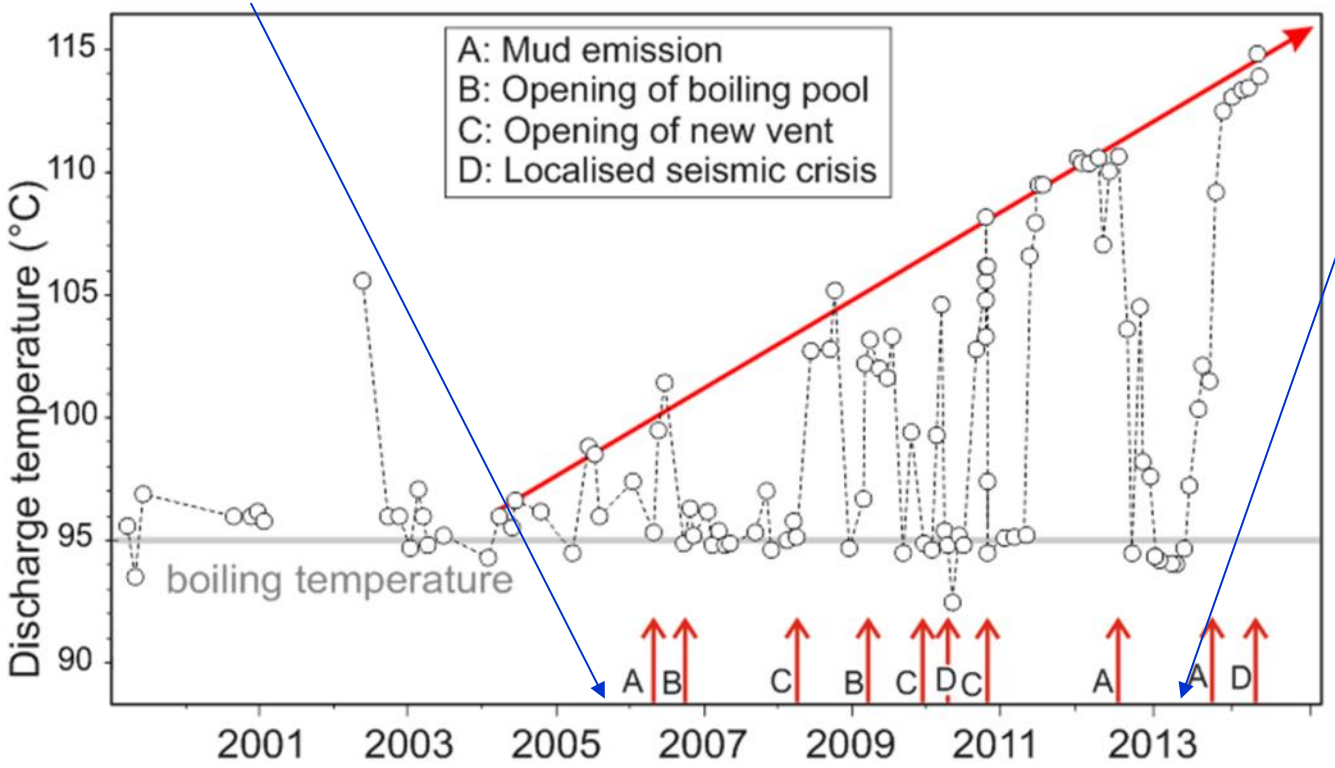








C.F. PRESENT STATE



Pisciarelli area (credits INGV–OV)

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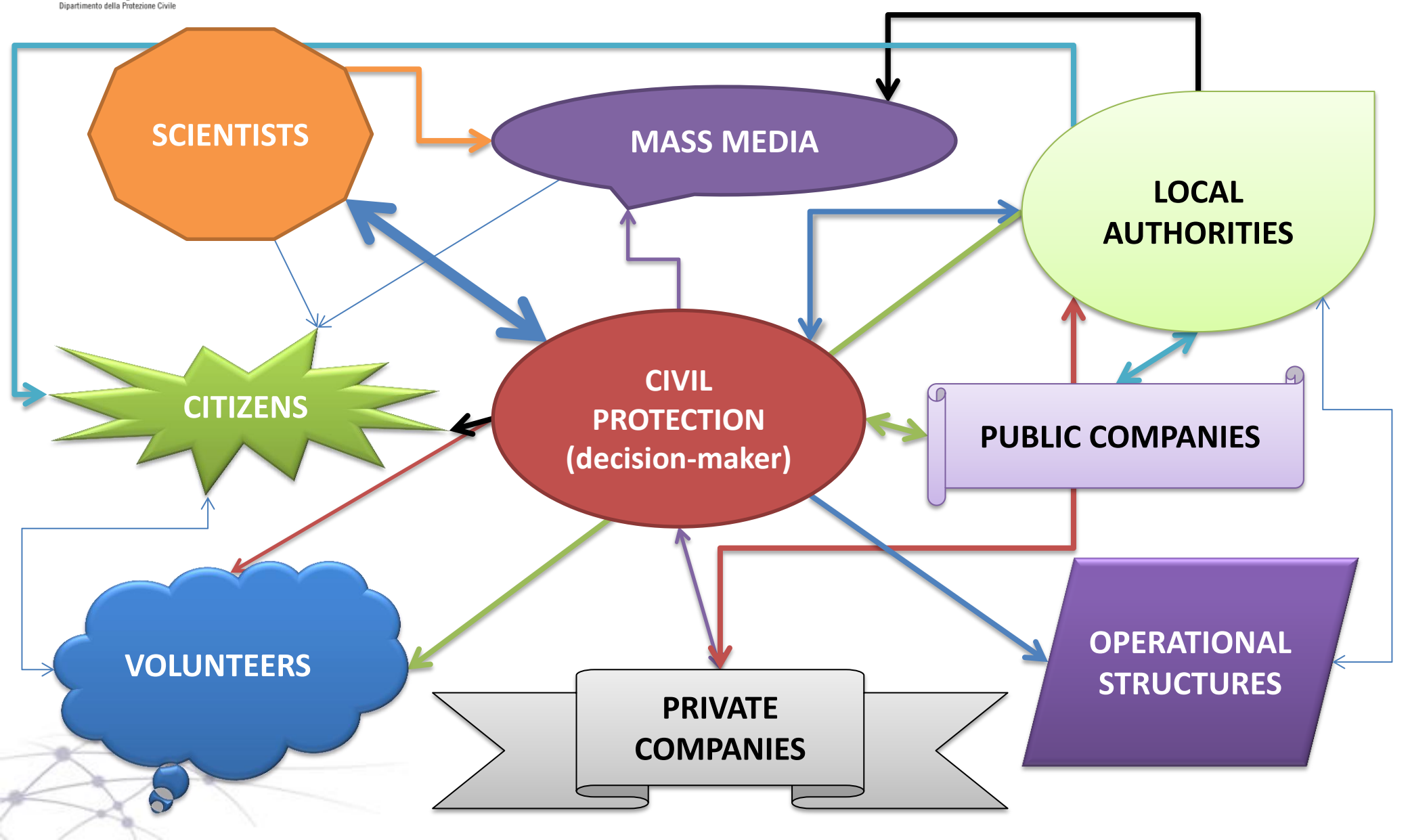
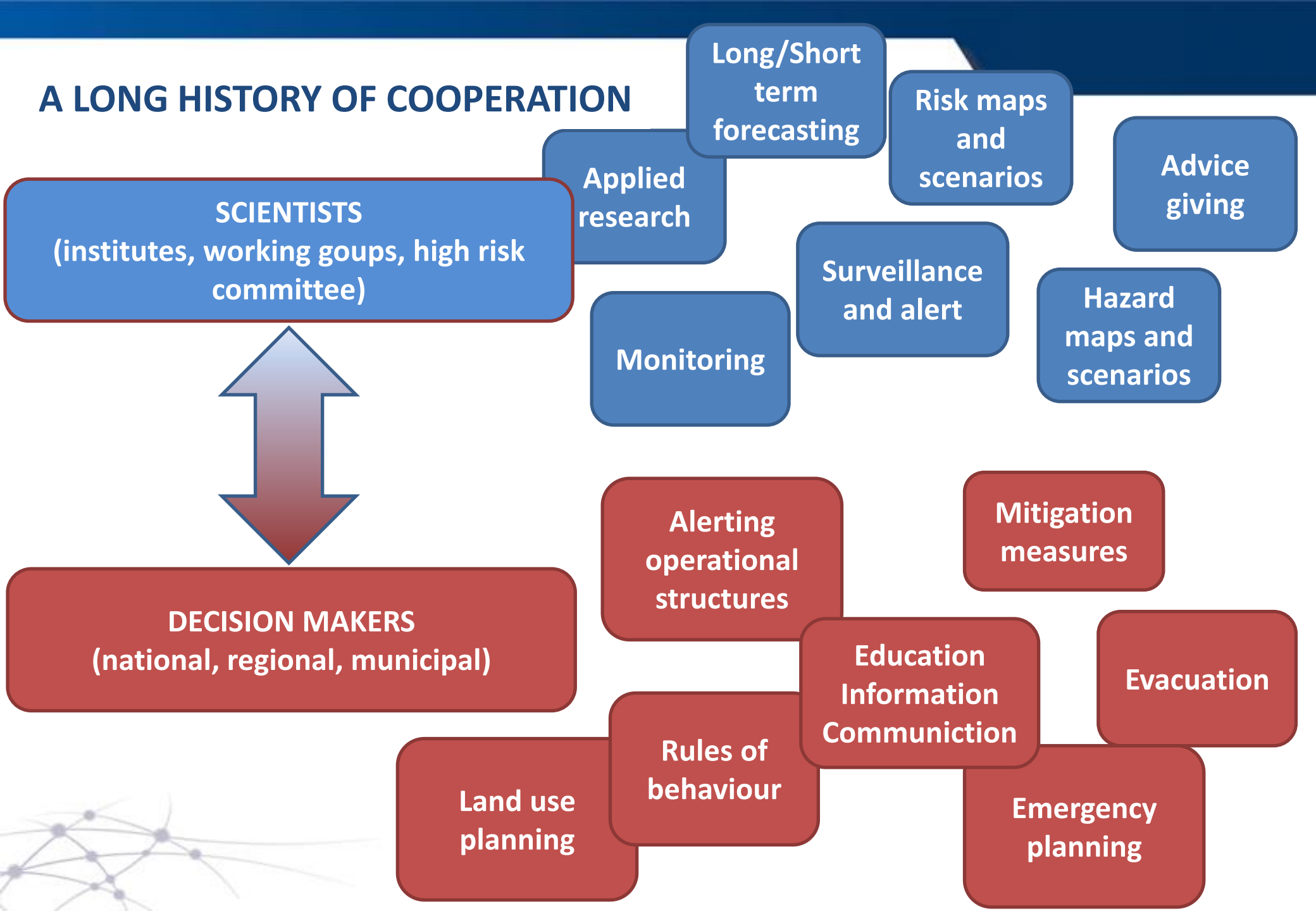
THE STAKEHOLDERS



A LONG HISTORY OF COOPERATION



APPLIED RESEARCH (DPC funding)

2000-2003

		Afferenza	Importo finanziato
TEMA 5: METODI INNOVATIVI ED INTEGRATI PER LO STUDIO DELLA STRUTTURA DEI VULCANI	Progetto 14: Metodologie sismiche integrate per lo studio della struttura dei vulcani attivi. applicazione alla caldera dei Campi Flegrei	Università di Napoli Federico II, INGV-OV Napoli INGV – Roma, INGV – Milano, IDPA-CNR Milano, OGS, Trieste Univ. Nice CNRS, France Università di Bari	601,156
TEMA 7: CAMPI FLEGREI	Progetto 16: Definizione e zonazione della pericolosità vulcanica della caldera risorgente dei Campi Flegrei e suoi effetti sull'uomo e sull'ambiente	INGV-OV Napoli INGV – Pisa CNR, Pisa Università di Napoli Università di Bari Università di Camerino Università di Pisa, Università di Trieste, Università di Torino Univ. of Munchen, Germany	873,328
	Progetto 17: Simulazione di scenari eruttivi ai Campi Flegrei sulla base di studi stratigrafici, di laboratorio e numerici e implicazioni di pericolosità vulcanica	INGV – Pisa, INGV- Roma, CNR, Pisa Università di Pisa, Univ. of Munchen, Germany	379,596

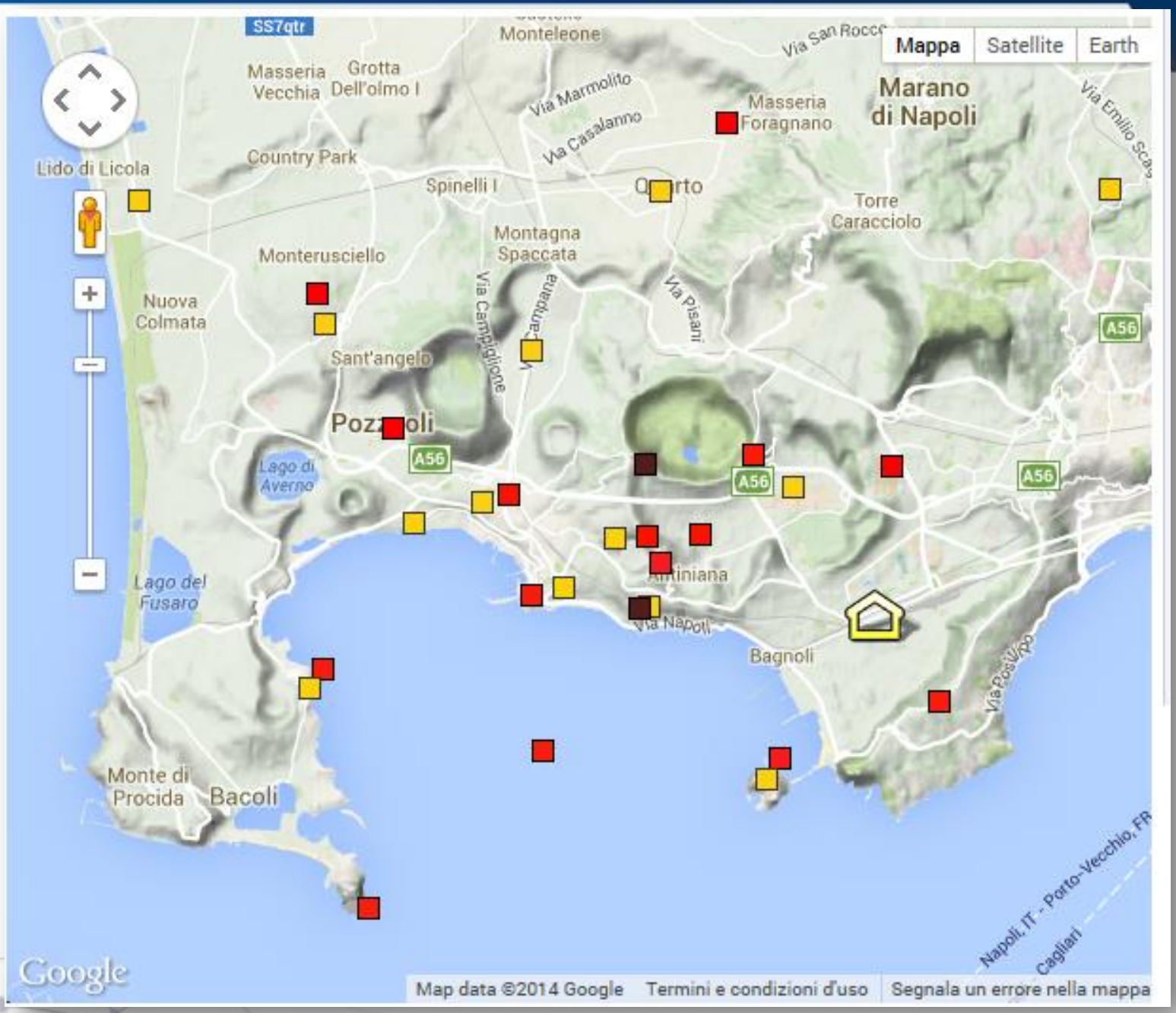
2004-2006

		Afferenza	Importo finanziato
RICERCHE SUI VULCANI ATTIVI, PRECURSORI, SCENARI, PERICOLOSITA' E RISCHIO Progetto V3_2 CAMPI FLEGREI	Valutazione della pericolosità attraverso lo sviluppo di tecniche geofisiche e geochimiche, indagini sulle proprietà chimiche e fisiche del magma, identificazione dei segnali precursori, ricostruzione della storia eruttiva e lo sviluppo di modelli fisici e numerici dei processi pre-eruttivi ed eruttivi.	INGV - Pisa INGV-OV Napoli Università di Napoli Federico II	834.500,00

2007-2009

		Afferenza	Importo finanziato
Progetto V1: UNREST	Realizzazione di metodologie integrate per la definizione delle fasi di unrest ai Campi Flegrei	INGV-OV Napoli Università di Napoli Federico II	740.050,00
Progetto V5: SPEED convenzione DPC- Regione Campania (2006)	Scenari di Pericolosità e Danno a Vesuvio e Campi Flegrei	INGV-OV Napoli Univ. Roma Tre	205.200,00

Framework Programs 2010-2012, 2012-2013, 2013-2014,...



MONITORING NETWORK DEVELOPMENT (DPC funding)

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THE EMERGENCY PLANNING PROCESS

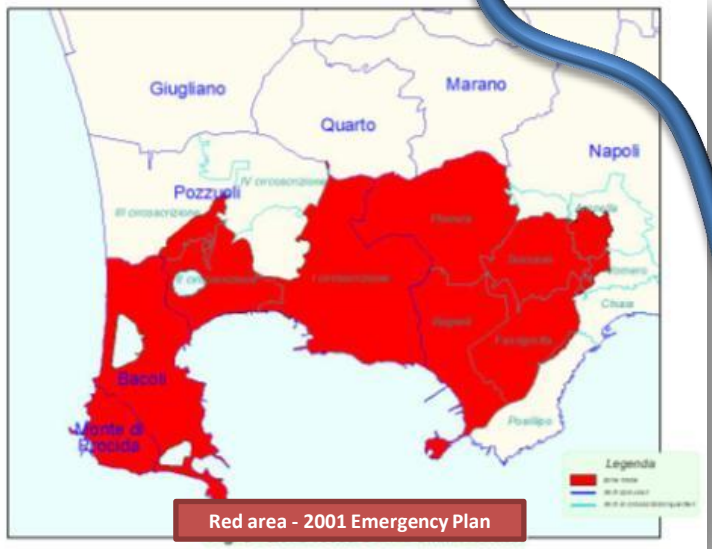
1984 – First “Emergency and evacuation plan in case of eruption in the Phlegraean area," developed after the bradyseismic crisis of the early '80s.

1996 – Appointment of the "Commission designated to update the emergency plans for volcanic risk in the Phlegraean and Vesuvian areas."

1998 – Vesuvius Observatory delivered the document “Volcanic hazard in the Phlegraean caldera” including scenario and alert levels, to the Commission .

2001 – The Commission adopted the "Basic elements for the national emergency planning of the Phlegraean area."

2002-2003 – A new National Commission is appointed.



Red area - 2001 Emergency Plan

2005 – Delivery of the “Study of the mobility evacuation plan" made by the Faculty of Engineering at the University "La Sapienza“ (Rome)

2009 – A new Working Group for the definition of the eruptive scenario and alert levels for emergency planning at Campi Flegrei is appointed.

2012 – Declaration of alert level yellow .

2013 – Delivery of the scenario and alert levels document.

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DECISION-MAKING PROCESS FOR THE NEW RED ZONE DRAWING

2009 - 2013 THE RESULTS OF THE SCENARIO AND ALERT LEVELS WORKING GROUP

(Analyses of outcomes of researches carried out in previous years)

Reference Scenarios

- ✓ **Scenario n.1**: Explosive eruption (small, medium, large, extralarge);
- ✓ **Scenario n.2**: Multiple eruptions (simultaneous eruptions from more vents);
- ✓ **Scenario n.3**: Phreatic eruption;
- ✓ **Scenario n.4**: Effusive eruption (rare and limited to final phase of explosive eruptions).

Eruptive scale	Conditional probability %
Effusive	11.9
Small	59.6
Medium	23.8
Large	4.0
Extra Large	0.7

Analyses showed that next eruption at Campi Flegrei will be 95 % a medium scale eruption or smaller.

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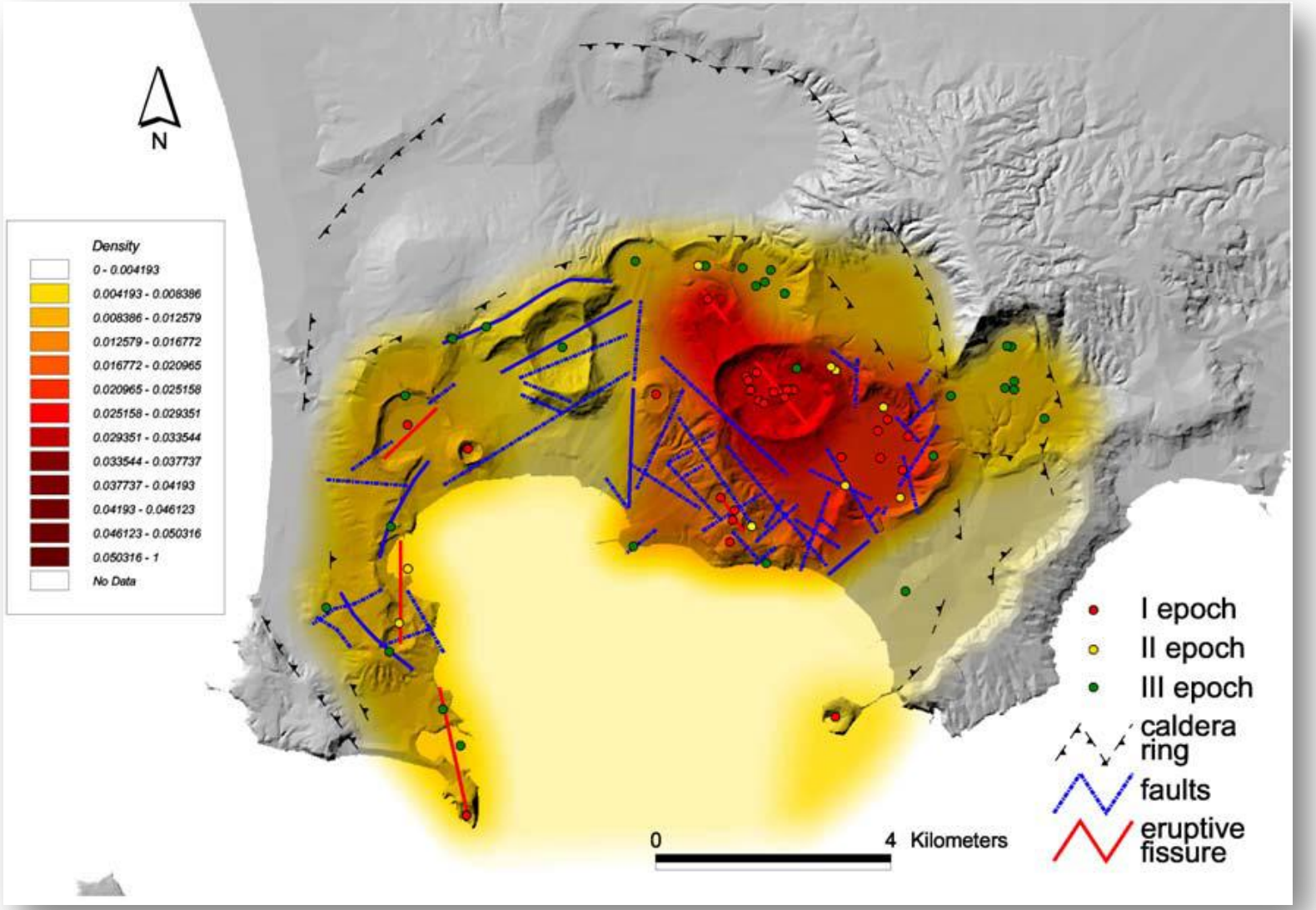

Vent opening probability map.

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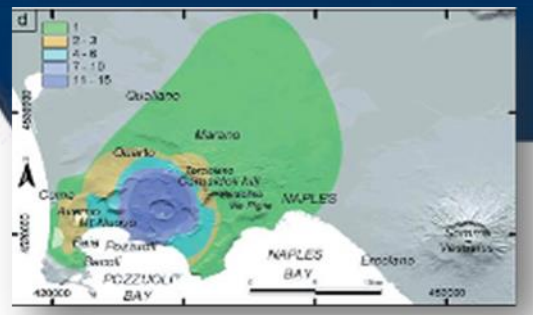


HIGH RISKS COMMISSION RECOMMENDATIONS

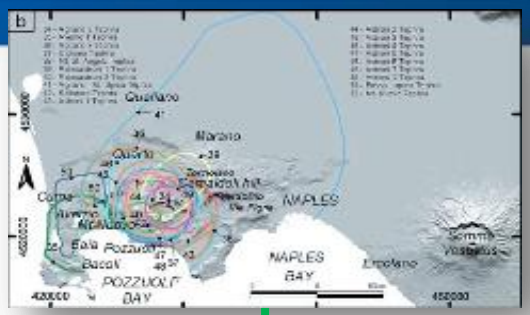
On May 31, 2013 the HRC examined the WG report and answered queries posed by DPC

- **The recommended probability of exceedance to take into account for Campi Flegrei is 5% (given the occurrence of an eruption);**

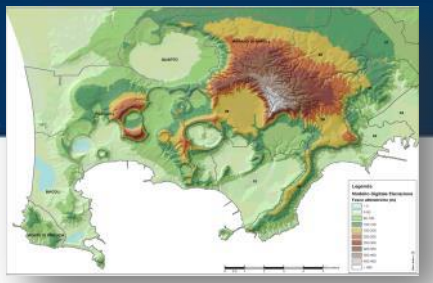
- **Thus, considering the last 5.000 years of activity and adopting the probability threshold of 5%, the Agnano-Monte Spina eruption (4.500 years) is NOT to be included;**

- **The line that envelopes pyroclastic flows deposits of the past 5.000 years except the Agnano-Monte Spina, is therefore a good proxy of the "red zone";**

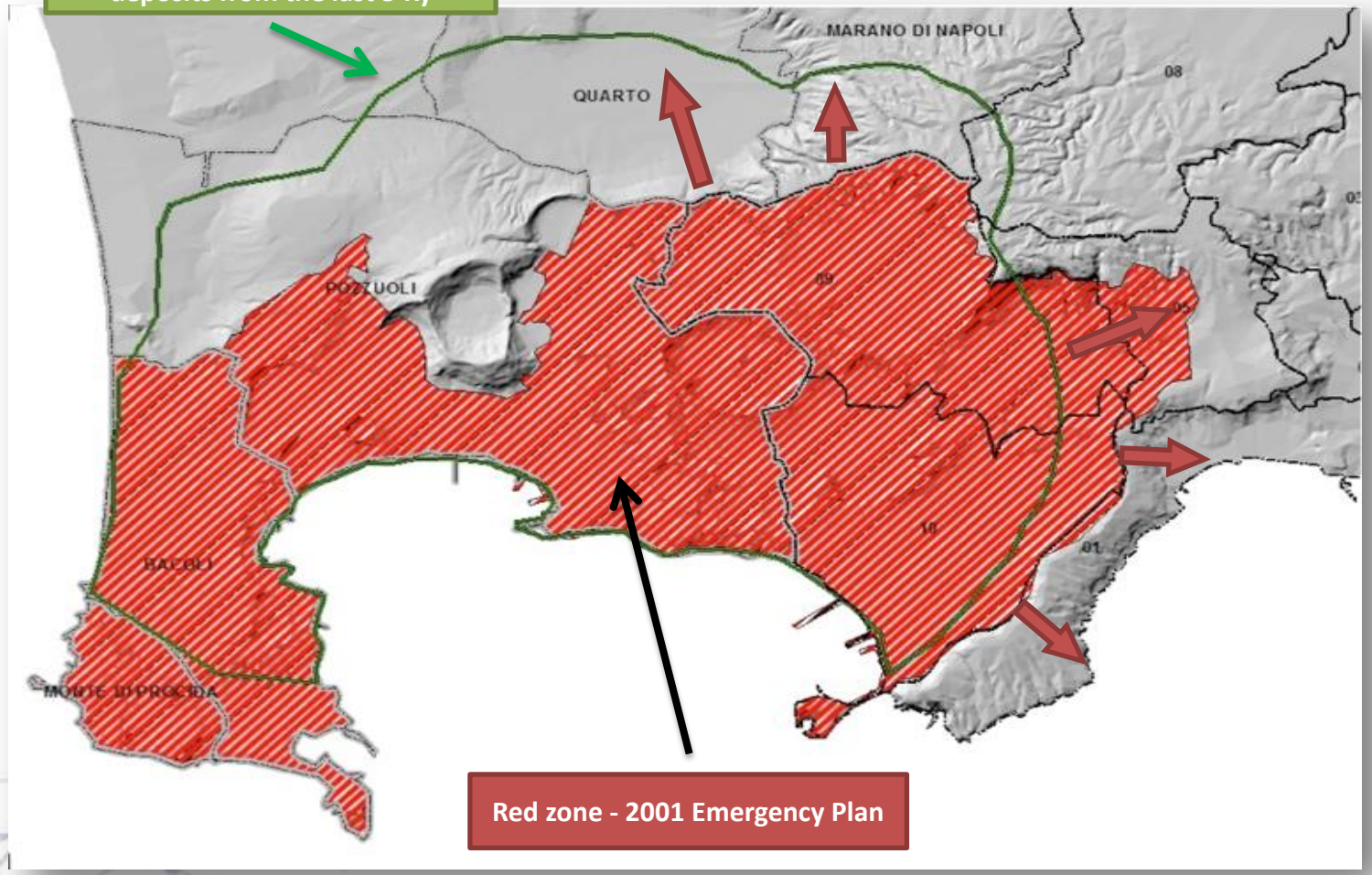
- **Possible vent opening near the caldera rim, as occurred between 15 ky and 9 ky ago, could extend the distribution of PDC deposits to the western area of Naples (Posillipo, Vomero and Arenella) and to NW toward Quarto and Marano areas.**



- PDC DEPOSITS ANALYSIS
  - ANALYSIS OF TOPOGRAPHIC FEATURES



Envelope line of pyroclastic flows deposits from the last 5 Ky



Red zone - 2001 Emergency Plan

- CHANGES RECOMMENDED BY HRC
  - FURTHER NUMERICAL SIMULATIONS

- CONSIDERATIONS ON ADMINISTRATIVE BORDERS

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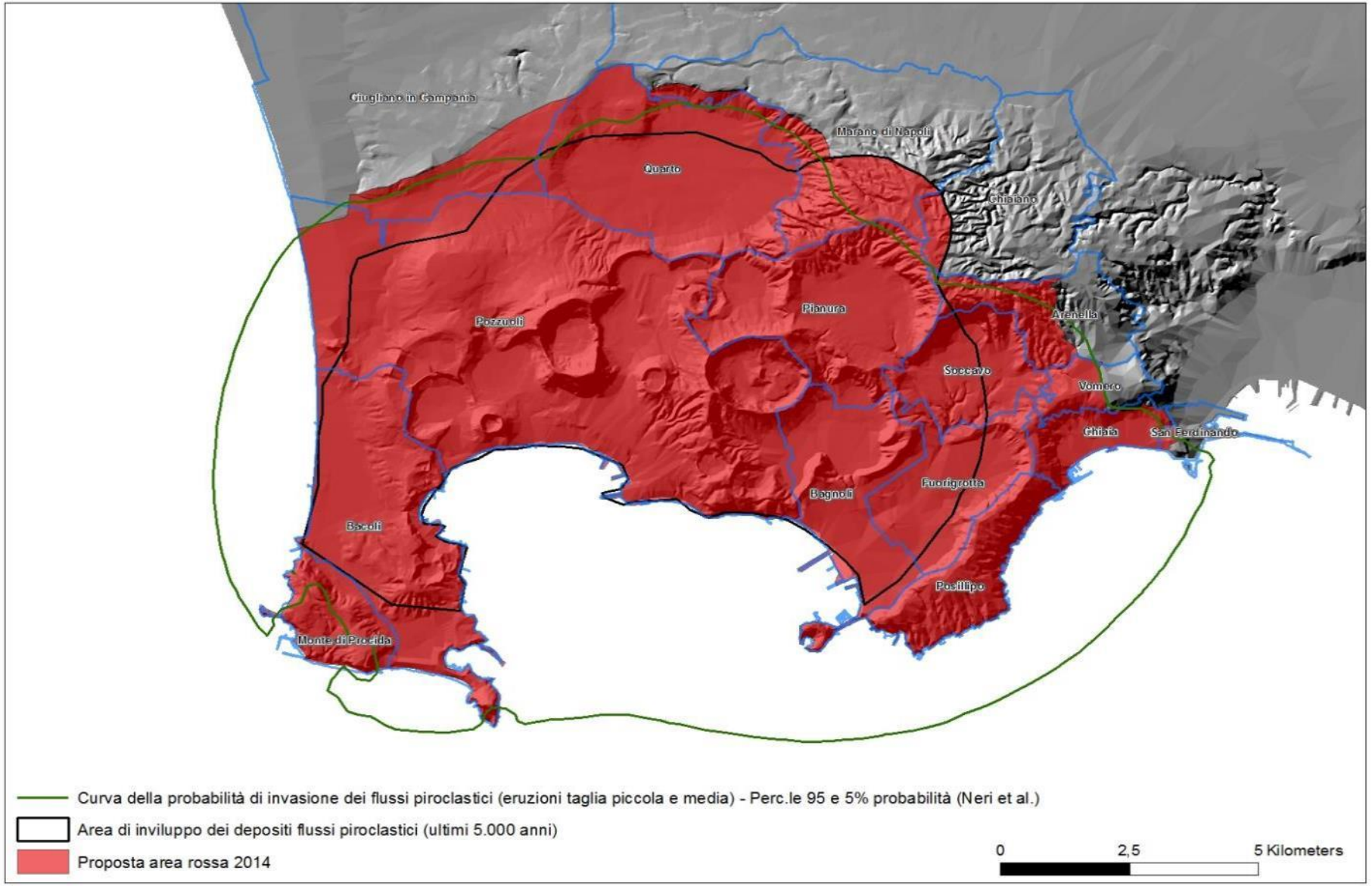
PROPOSAL OF THE NEW RED ZONE



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DECISION-MAKING PROCESS FOR RED-ZONE DRAWING

WG
- Delivery of scenario document and numerical simulations

HRC
- Recommendations and suggestions

DPC
- PDC analysis of the last 5ky
- Definition of new red zone including 5 municipalities of the Phlegraean area and 5 neighborhoods of the city of Naples.

CAMPANIA REGION
- A closer definition of the new red zone taking into account urban and territorial elements is ongoing in agreement between the Campania Region and the municipalities.

DPCM
- Official institution of the new red-zone

DPC
- Emergency planning

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CONCLUSIVE REMARKS

Taking into account also the best practices emerged from the 2nd VUELCO workshop.
(see www.vuelco.net)

- Decision-making take place not only in emergency phase, but also in planning (decide where a “red-line” of an emergency plan must pass, define alert levels, thresholds, …).
- Interaction scientists /decision-makers is therefore essential during non-crisis periods too.
- Scientists and DM, walking together since a long time, learn to understand languages, limits and needs of each other. This is an essential preparation for possible emergencies.
- Scientists should try to be as transparent as possible, clearly stating the assumptions at the basis of their evaluation, as well as the methods they followed to get to the results. They must communicate knowledge and assessment, as well as the related limitations and uncertainties.
- Although scientific assessment must be independent and not subject to possible influences, the process of decision-making needs to be shared among all the involved subjects.
- Scientists, civil protection and local authorities (hopefully with the help of sociologists and economists) are called to work together on the same matter to get to the best possible result; each one with a different well-defined role, but for the same goal.
- The involvement of local authorities (and communities) must be taken into account in defining emergency plans or mitigation measures.
- Uncertainty in science and Indecision in decision-making process are always present in some measure, but we must avoid Ambiguity in communication.

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Gracias

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