

# Vesuvius and Campi Flegrei Evacuation Plans Implications for Resilience and Sustainability of Neapolitans

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**Abstract.** The Evacuations Plans of Vesuvius and Campi Flegrei require the displacement of several million people in several days prior to the eruptions of Neapolitan volcanoes and resettle them all over Italy, but are unreliable from the technical, socio-economic, and cultural perspectives. These plans have been politicized through the regulatory capture of special interests and are institutionalizing fallacies that work in detriment to the achievement of resilience and sustainability for Neapolitans. Such massive deportation strategies are keeping the Neapolitans hostage to ignorance, slowing the development of resilience and sustainability science for the territory, and inviting disasters.

**Keywords:** Vesuvius, Campi Flegrei, Phlegraean Fields, evacuation plans, resilience, sustainability

## 1. Introduction

Vesuvius and Campi Flegrei (Phlegraean Fields, Campi Phlegraei) volcanoes in the Bay of Naples have been producing explosive eruptions for millennia and the neighboring populations managed to cohabit with these volcanoes since the dawn of civilization. During the past 30,000 years Vesuvius has produced a dozen of explosive eruptions with each eruption ejecting several cubic kilometers of material. In between of these eruptions the volcano produced an order of magnitude smaller explosive eruptions that terminated with effusive activities [1]. The Campi Flegrei volcanic complex has been active for at least 60,000 years and during this time produced two super eruptions, with each erupting 10-100 times more material than the largest eruptions of Vesuvius and on which the city of Naples is built [2]. The volcanic deposits around these volcanoes [3] are, however, poorly constrained, because of the urbanization that covers large parts of the areas where these deposits are located and absence of verifications of the studied deposits. The scenarios of future eruptions [4] also produce large uncertainties of the potential effects of eruption products on the built environments on the slopes of volcanoes, and the Vesuvius Observatory (Osservatorio

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Vesuviano) that monitors these volcanoes for seismicity, deformation of ground, and gas content is unable to associate the current ground uplift at Campi Flegrei and occasional rise of seismicity below Vesuvius with impending eruptions [5].

There are thus difficult choices for several million people cohabiting with Neapolitan volcanoes whose future eruptions are certain, but uncertain when they will occur. The Neapolitans can simply wait for the impending eruptions and then try to escape or can build resilient and sustainable habitats for cohabiting with volcanoes. The first choice pursues the *emergency culture* and has been politicized by the geologists through their Vesuvius [6] and Campi Flegrei [7] evacuation plans, with the objective of forcefully resettling several million people around the volcanoes in different Italian regions without first conducting a feasibility study whether such a strategy is acceptable to both the displaced people and to the people that should host the refugees for an undefined period of time. The second choice promotes the *security culture* and is called VESUVIUS 2000 [8]. This strategy calls for an interdisciplinary and transdisciplinary feasibility study to determine how resilience and sustainability can be achieved for Neapolitans, before implementing any seismic and volcanic risk mitigation plans that require territorial interventions.

The Vesuvius and Campi Flegrei Evacuation Plans discussed in this paper are unreliable from the technical, socio-economic, and cultural perspectives, and work against building resilience and sustainability for the Neapolitan area. The regulatory capture and institutionalization of fallacies of these plans are preventing the development of such solutions and are inviting severe consequences not only for the Neapolitans but also for the nation and for the European Union whose resilience and sustainability will suffer. In the following we will elaborate on these issues and conclude that we should abandon the policies of massive deportations and work instead to produce safe and prosperous habitats for the people who want to cohabit with these volcanoes.

## 2. Vesuvius and Campi Flegrei Evacuation Plans

Vesuvius and Campi Flegrei evacuation plans require resettlements of some two million Neapolitans in different Italian regions as shown in Fig. 1, but do not consider what to do with the one million people from the city of Naples nor specify how to deal with the abandoned territories or specify that the displaced populations can return to their former habitats after the eruptions. These plans also do not consider plinian and super eruptions of the volcanoes, do not address the reliability of evacuation means (vehicles, ships, trains) in the presence of earthquakes that shake the ground and cause the collapses of buildings and blockage of escape routes, only vaguely quantify the parameters (earthquakes, ground deformation, gas content) associated with alert and evacuation levels, do not consider the possible panic of population from the collapses of pre-determined plans, and do not address the interactions and consequences of complex system components where a small system failure can lead to the entire system collapse [6, 7, 9–11].



**Figure 1.** Vesuvius and Campi Flegrei evacuation plans require the resettlement of some three million Neapolitans in different Italian regions. Department of Civil Protection (Dipartimento della Protezione Civile) [6, 7, 9, 10].

When the Vesuvius evacuation plan was issued in 1995 it required the prediction of an eruption at least three weeks in advance in order to evacuate 600,000 people, but after it was criticized [12] that the scientists cannot reliably predict an eruption for this time window the geologists consulting the Civil Protection (Protezione Civile) changed this prediction window to three days in advance to be closer to two to three days associated with the predictions of eruptions of Mount St. Helens in 1980 and Pinatubo in 1991 [13, 14]. The two to three days prediction windows of eruptions of explosive volcanoes (Vesuvius and Campi Flegrei belong to this category) are based on the harmonic tremors of about 10 Hz, produced by the magma rising in conduits and the Vesuvius Observatory *has not been recording such signals* [5]. Instead, the recorded sporadic increases and decreases of seismicity of Vesuvius and Campi Flegrei are interpreted as arising from the local tectonics and exsolution of gases, if it is assumed that some magma already exists at several kilometers from the surface [15]. Furthermore, even the precise identification of the epicenters of earthquakes is often problematic, as recently demonstrated for the 2017 Ischia earthquake where the observatory made the wrong prediction of earthquake epicenter and caused damage to the tourist industry of the island and faced considerable criticisms of its operations [16].

A simple calculation shows that an evacuation of 600,000 people from the Central Station of Naples would require some 200 trains, or a train departing the station with 3000 people every 20 minutes during 72 hours. This is simply unreliable, not only because of the impossibility of carrying out such an engineering logistics nightmare in the absence of appropriate infrastructure, but also because of the high probability that the railroad tracks will go out of the alignment from the presence of frequent earthquakes and terminate train arrivals and departures. When this was also criticized [12] the Civil Protection opted for the evacuations with buses and private vehicles, and failed again to justify the transportation logistics, such as to demonstrate the reliability of the supply and distribution of fuel for road vehicles, coordination of state and private vehicles on the shaking territory maneuvering through the streets with collapsed buildings and bridges, clearing of abandoned vehicles for other vehicles to pass through, etc. The revisions of evacuation plans have been cosmetic [9, 10] and are not convincing who will give evacuation orders and on the basis of what levels of monitored parameters [11]. Moreover, if Vesuvius and Campi Flegrei volcanos were to erupt with one of their plinian or super eruptions the proposed evacuation strategies would be inadequate, because it would leave several million people on the Campanian Plain and bordering regions on the mercy of the volcanoes.

Assuming that the people can be evacuated from the immediate danger areas, will the evacuees safely arrive to the predetermined hosting areas and will the hosts accept the masses of people that lost everything, have been separated from their preferred environments, and have to rebuild their lives? Taking the recent lesson from Middle Eastern and African refugees in Europe it is an illusion to expect that the refugees will easily adapt to new environments, not only because the evacuees will demand equal opportunities in hosting areas and thus produce socio-economic consequences, but also because the assimilations

of different cultures take generations and in the process each culture strives to preserve its identity. There is also the danger that the cities hosting the evacuees will experience a significant reduction of their resilience and sustainability. Because of these issues many evacuees risk never arriving to their destinations and being housed in makeshift houses for years along the evacuation routes through the expenditures of significant National and European Union resources.

And what will happen to the abandoned territory? Can it be protected and for how long, should we be concerned with the destruction of the Neapolitan culture and changes of the cultures of hosting regions, should we allow or forbid (how) the influx of immigrants into the abandoned territories from the non-evacuated areas with high demographic pressures or from poor economic areas elsewhere? These concerns have been voiced since 1995 and have fallen on deaf ears with the mass media being unable or unwilling to present the issues to the population [12].

Vesuvius and Campi Flegrei evacuation plans have been institutionalized [17–19, and many others], and why bother with their consequences when the time scales of volcanic eruptions are inconsistent with life spans of evacuation plans' architects and proponents that also manage the Vesuvius Observatory? In 1995 the Observatory was the principal promoter of Vesuvius evacuation plan and ever since its researchers, and those of its parent institution INGV (Istituto Nazionale di Geofisica e Vulcanologia), have shown no interest in collaborating with those of us who are developing the alternative resilience and sustainability framework for the Neapolitan area [8, 20] and prefer instead to live dangerously [16] by bearing the responsibility for the consequences of their choice.

### 3. Implications for Resilience and Sustainability

The consequences of Vesuvius and Phlegraean Fields Evacuation Plans are: (1) replacement of resilience and sustainability with insecurity, stagnation of socio-economic development; (2) destruction of Neapolitan culture that even the volcanoes have not been able to accomplish in millennia; (3) corruption of weak researchers and public officials; (4) forcing the European Union to accept non resilient and sustainable policy for the Neapolitan area and generously supporting the research activities of the proponents of this policy; (5) marginalization of those who work in the direction of promoting resilience and sustainability for the territory; (6) suffocating interdisciplinary and transdisciplinary collaborations for risk management of complex systems; etc. The regulatory capture, spread of fallacies, and appeal to ignorance are the principal means by which the evacuation plans are succeeding in building the emergency culture and suffocating the development of the security culture in the Neapolitan area.

#### 3.1 Regulatory Capture

Regulatory capture is a form of government failure which occurs when a regulatory agency, created to act in the public interest, instead advances the concerns

of special interest groups that dominate the sector it is charged with regulating. In our situation the regulatory agency is the Italian Civil Protection and the special interest group comes from the Italian earth science community with strong lobbies in Brussels that ensure substantial supports for European earth science researchers associated with the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI). This is the “mondo scientifico” that is used to justify Vesuvius and Campi Flegrei evacuation plans and convince Civil Protection that “everything is under control” without specifying what exactly is *under control*.

When the architects of flawed evacuation plans impose on their clients the enforcements of these plans and silence dissenting views one can only expect disastrous outcomes. This happened in 2009 in l'Aquila with earthquakes [21] where 308 people died and in 2011 in Fukushima with nuclear reactor accidents [22] where the people evacuated in the direction of propagating radioactive cloud and the accident left 30,000 km<sup>2</sup> of Japanese territory polluted and 650 km<sup>2</sup> exclusion area around the reactors.

### 3.2 Fallacies

Aristotle [23] was the first to discuss fallacies. Fallacies are false premises, and some of the prominent ones are appeal to authority, appeal to ignorance, and ignoring the issues.

The fallacy of *appeal to authority* occurs when someone accepts a truth on blind faith just because someone admired said it. In our situation this someone are the architects of Vesuvius and Campi Flegrei evacuation plans who with the control of volcano monitoring instruments and similar international collaborators, apparently have all the authority to claim to be the “ultimate authority” on deciding what to do with the Neapolitans and deciding the scientific research on volcanoes.

The fallacy of *appeal to ignorance* occurs when someone asserts a claim that must be accepted because no one else can prove otherwise. In our situation again, the populations around the Neapolitan volcanoes have no experiences with eruptions and cannot properly judge their potential consequences or the consequences of massive evacuations. The proponents of such evacuations know this and thus thrive in this ignorance. Only an electorate educated on volcanic risk can force its elected representatives to work for its interests, but unfortunately we are far from reaching this goal [24].

The third fallacy of *ignoring the issues* is not only practiced in political and some scientific organizations when their members commit grave errors [25], but also by many mass media that prefer to follow the official lines to maintain their access to authorities rather than to expose their wrongdoings [12].

When fallacies become “truth” it takes an extraordinary event to change their spreading, because the people start demanding changes. Unfortunately, this becomes too late for many and leaves a dark mark on the society. And the society alone becomes responsible for the consequences when it allows its elected officials to operate in a risky manner.

### 3.3 Resilience and Sustainability Framework

Building resilient and sustainable Neapolitan area for large and small eruptions of Vesuvius and Campi Flegrei requires a reorganization of the Campanian Plain for short- and long-term time frames, and a framework for addressing this objective can be accomplished through the achievement of five major objectives called VESUVIUS–CAMPIFLEGREI PENTALOGUE [20].

This framework delineates exclusion, resilience, and sustainability areas surrounding each volcano, where no permanent habitats are allowed in the exclusion area and the people in the resilience belt, surrounding the exclusion area, can be temporarily evacuated into the sustainability area, surrounding the resilience belt, until the volcanic crisis subsides. After the volcanic crises most of the evacuated people should be able to return and rebuild their habitats.

According to this framework no massive deportations of people are required, there is no need to house evacuees in distant places and uproot them from their local environments, and no need to build and maintain massive evacuation infrastructure, because the people can simply walk to their temporary settlement on short notice. The *sense of place and belonging* is a central pillar of sustainability [26] and it has been structured in VESUVIUS 2000 and five of its central objectives VESUVIUS–CAMPIFLEGREI PENTALOGUE.

## 4. Conclusions

We discussed some critical issues associated with Vesuvius and Campi Flegrei evacuation plans and stressed that they are unreliable technically, socio-economically and culturally, and work in detriment to the accomplishment of resilience and sustainability in the Neapolitan area. Their existence is rooted in the regulatory capture of special interests and institutionalization of fallacies that will have long term negative consequences. For the time-scales of Vesuvius-type eruptions, the immediate areas surrounding the craters of Vesuvius and Campi Flegrei should be excluded from permanent habitation, the belts surrounding the exclusion areas should be made resilient, and the areas beyond the resilient belts should be made sustainable and capable of temporarily housing the populations from high danger areas during the volcanic crises. For the time-scales of Campi Flegrei super eruptions these belts should be extended further out into the Campanian Plain.

The ultimate danger of Vesuvius and Phlegraean Fields evacuation plans is that they exist for the benefit of special interests, give the elected officials excuses not to produce the Neapolitan area resilient and sustainable, corrupt weak researchers, give the stakeholders false hopes, and are depriving the Neapolitans from constructing better lives in the area reserved for social, economic, environmental, and institutional developments.

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