

Hydrogeological risk in Florence: memory and perception in the context of climate change

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ABSTRACT

This study investigates the relationship between memory and the perception of hydrogeological risk in the context of climate change, focusing on the metropolitan area of Florence, Italy. Adopting a mixed-methods approach that combines historical-literary analysis with a large-scale questionnaire survey (734 respondents) and statistical modelling, the research provides an original contribution to the understanding of how collective and individual memory shape risk perception, preparedness, and institutional trust. The results show that direct memory of past events reduces panic and enhances preparedness but weakens trust in institutions, while the absence of memory increases reliance on authorities but limits operational knowledge. Socio-demographic factors such as age, education, and degree of urbanization selectively influence risk perception, with floods and heatwaves perceived more strongly in urban areas and landslides in rural ones. By explicitly integrating memory as an analytical dimension within risk perception studies, the paper highlights a persistent gap between awareness and adaptive behaviour and underscores the need for territorially differentiated communication and governance strategies in local climate risk management.

1. Introduction and background

In recent decades, risk perception on the part of local communities has become a particularly relevant topic [1–5], and in Italy, analyses in the field have been enriched by in-depth studies focused on hydrogeological instability [6–9]).

This study draws on literature on the geography of risk in Italy [10–19], socio-environmental vulnerability [20–23], and the geographies of memory and space [24–26], including work on the historical reconstruction of riskscape [27,28]. Riskscape are conceived here as spatio-temporal configurations linking risk, space, and practice, and encompassing material, discursive, and action-oriented dimensions [27,28].

This analysis focuses on the context of “hydrosocial” landscapes, in which we encounter the dynamic and often contested territories where water management, technology, biophysical elements, social structures, and cultural practices interact to shape the flow and distribution of water [29,30]. In line with this perspective, the notion of the hydrosocial cycle discussed by Budds et al. [31] is a concept capable of perceiving and integrating the socio-political and biophysical processes that constitute water, while at the same time highlighting the limitations of traditional science and practice. The concept of the hydrosocial cycle is intentionally placed in opposition to that of the hydrological cycle which is a consolidated paradigm in the description of the physical states and flow

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dynamics of water, which, however, tends to represent hydrological processes as devoid of social, cultural, and political dimensions [31]. Indeed, the relationship between water and society has attracted considerable academic interest in recent years, and it is becoming increasingly important to investigate issues such as global water scarcity, the management of transboundary river basins, and water privatization as major social and cultural issues [32]. Interest in this approach stems from the awareness that water management cannot be considered solely a technical field to be addressed through the provision of infrastructure and scientific expertise, but rather a political field that involves human values, perceptions, behaviors, and organization [32].

Specifically, the relevance of these analyses can be appreciated in a context of increased spatial and temporal recurrence of instability phenomena that are exacerbated by the consequences of the current impacts of meteoroclimatic changes [33–38], characterized by increasingly multiscalar and multidimensional interactions and a social construction of nature [39–41].

Despite increasing attention from the perspectives of both memory and perception [42,43], risk reduction practices do not seem to be implemented in particular by policies at local scales, including that of the Italian municipal scale [44], thereby highlighting an important gap between the growing attention and/or information of policymakers and the population regarding climate change impacts on the one hand, and mitigation and/or adaptive practices concerning hydrogeological risk exposure and vulnerability reduction on the other [45,46]. And this, paradoxically, in contexts that, historically, have been subject to the same calamitous events – probably because the perception of risk is not limited to a sensory issue, but rather concerns attitudes and expectations [16,47–49] that are also shaped by the role of individual and collective memory and cultural and diachronic interpretations that influence spatial planning and awareness, viewed as the recognition/knowledge of the potential for hazards [50]. As Castagnoli recalled in 1997, although “information increases, the human populating of hazard zones intensifies, but the great earthquakes, landslides and floods that wipe out entire settlements occur in antiquity as much as in the present day with not dissimilar characteristics” [51, p. 219]. To correctly assess the risk inherent in a study area, therefore, it is essential to study the social perception of the community living in that area. Examining this perception helps us better understand one of the key dimensions for calculating risk: vulnerability. The term “vulnerability” appeared late in the scientific literature, replacing various terms such as “sensitivity,” “susceptibility,” and “fragility” [3]. Vulnerability is also a polysemous concept since, in terms of risk, it designates both damage and the possibility of suffering such damage. These are two concepts that result in two different approaches: the first, which is more of an applied science approach, measures the potential damage to elements exposed to natural hazards, while the second, which is a social science approach, promoted primarily by American geographers [22,51,52], seeks to determine the social, cultural, economic, institutional, and environmental conditions that led to the damage and, by extension, the threatened object's capacity to respond [3,19,53]. Risk perception indicates the potential vulnerability conditions linked to the socio-cultural context that a natural hazard could impact and cause damage. Based on the population's inclinations, preventative and adaptive interventions can be implemented, such as training individuals according to a risk governance model that prioritizes enhanced risk communication. Examining public perception and the elements of resilience and social vulnerability that arise from it would therefore allow us to develop a representative framework of the territorial dimension of risk [19].

This study thus sets out to explore such a paradox between the memory/perception of climate change and awareness of hydrogeological risks, through an analysis of the case of Florence (and its metropolitan area, although in the text we will only mention “Florence” for brevity) as the result of fieldwork carried out in the first half of 2025: the Tuscan capital is an emblematic case in that the historical memory of hydrogeological disasters, as will be seen, has not only left traces in urban space but also permeates local literary and iconographic production [54].

The results of the study, geographically examined through a mixed-method approach, are used to address the following specific research questions.

- 1) What is the role of direct and indirect memory of past hydrogeological events in shaping citizens' preparedness and emotional responses to new emergencies?
- 2) How does institutional trust interact with lived experience of disasters, and does direct memory strengthen resilience but weaken confidence in public authorities?
- 3) To what extent do socio-demographic factors such as age, education, and the degree of urbanization influence selective perceptions of risks associated with natural hazards (e.g. floods, landslides, heatwaves)?
- 4) How can the observed gap between risk perception, preparedness, and adaptive behaviours be addressed through more effective communication and governance strategies?

In order to answer these questions, the paper presents a methodology section dedicated to explaining the inquiry instruments: the questionnaire, the use of historical-literary and visual sources, and the approaches to treating the corpus. In the third section, there will be a presentation of the Florentine territorial context, describing its main extreme events and highlighting the connection with climate change, and also introducing the critical issues of the civil protection system and local planning. This will be followed by a discussion of the results and conclusions.

2. Materials and methods

With the intention of exploring the research questions underlying the structure of the study related to the value of the relationship between the memory/perception of climate change/hydrogeological risk, placed within the specific Florentine context, two lines of research were fundamental, carried out successively, related to different methodologies and approaches, and inspired by the different perspectives indicated at the beginning of the previous section.

The first phase of the research took place between January and February 2025. In order to reconstruct the cultural heritage linked to the floods and making operative the “collective historic memory”, as the set of narratives, symbols and artefacts that inform contemporary risk perception, an analysis of historical and literary sources was conducted, using catalogues, reviews, and almanacs that attested to the presence of recursive events and material and immaterial retentiveness, related to calamitous events attributable to floods in the urban space of Florence. This preliminary qualitative analysis of the content was carried out in order to identify certain categories (such as fear, preventive discourse, institutional blame, religiosity, fatalism, material indicators) used both to refine the questionnaire items and to interpret the results of the model. Relevant literary sources were consulted and, in addition, a study of devotional texts was carried out. This analysis was further enriched by field visits that enabled the collection of traces and artefacts recalling the flood events (e.g. plaques, monuments, and elements of toponymy), and places were selected based on the streets and neighbourhoods most affected by the recent floods. The review was based on an Italian website that features a collection of Italian prayers (<https://www.lepreghiere.it/>) and a selected corpus of Italian poets and writers whose focus is on Tuscany. The other tool used for collecting data, corresponding to the second phase (March–April 2025), was the distribution of a questionnaire, which was created through Google Forms and disseminated through online messaging platforms (e.g. WhatsApp or Facebook Messenger) and a specially created QR code. The questionnaire comprised a total of 28 questions (yes/no answers and multiple-choice answers on a five-point scale) divided into three main sections. Non-proportional quota sampling for residents from the metropolitan area of Florence was carried out using the “snowball” method, a non-probability research technique where initial participants recruit future subjects through their own social networks.

Section 1 covered socio-demographic information about the participants, such as their age, gender, nationality, municipality of residence, number and age of household members, possible presence of dependent persons, employment status, and educational qualifications, along with questions about the type of dwelling in which they lived and when it was constructed, its proximity to a watercourse, and the time taken to reach their place of work or study. Section 2 included questions pertaining to social perceptions of climate change and hydrogeological risk. In particular, the perception and awareness of climate change, the association of global and local phenomena with climate change, including in relation to human behaviour, opinion regarding actions taken by local, regional, and national governments, and sources of information on climate change and hydrogeological risk were investigated. Finally, Section 3 focused on psychological resilience in the face of an extreme natural event, with questions related to expected reactions and behaviours in cases of landslides or floods, trust in local government authorities in cases of extreme events, and perceptions of exposure to such events and their possible consequences. The data obtained from the anonymous questionnaire, which contained an informed consent box, were evaluated through elements of descriptive statistics, processed using Microsoft Excel software; additionally, a more in-depth analysis was conducted using a multinomial logit model to estimate the association between the covariate vector and the probability of a unit belonging to one of several nominal categories of outcome (without natural ordering), as explained in the following sections.

This research offers an original contribution to understanding the perception of hydrogeological risk in the Florence area. Some limitations should however be mentioned in terms of interpretative caution. The study covers a limited time frame and follows recent flooding events, which may have accentuated the vividness of respondents' memories and sensitivity, but at the same time it strongly reflects the social climate in which the memory of risk is formed and renewed. The collection of data through a questionnaire distributed mainly online favoured younger and more educated profiles, thus reducing the statistical representativeness of the entire

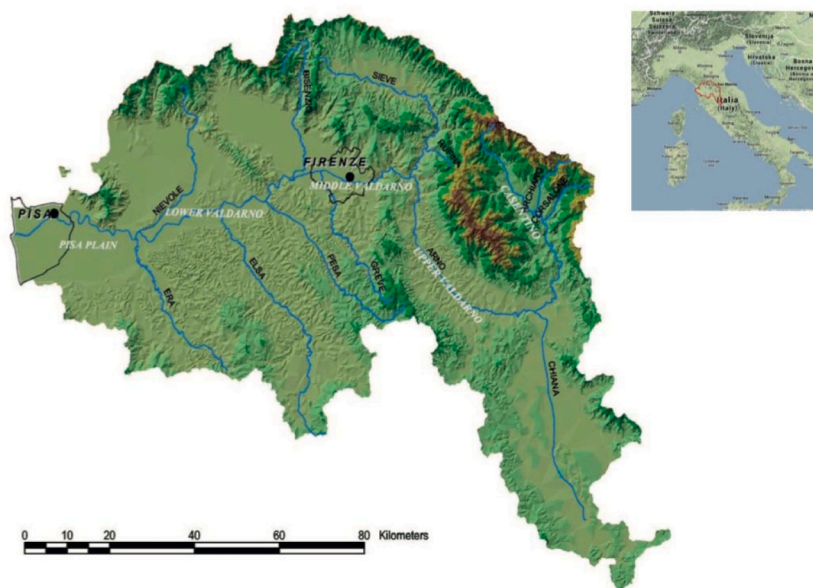


Fig. 1. The Arno River basin showing the main tributaries and the location map; location map adapted from Mazzanti, ITSC Meeting, 2014; as reported by Galloway et al., 2017 [55].

population; however, it made it possible to reach a significant number of citizens quickly, reinforcing the relevance of the survey to current events. Although not formally psychometrically tested, the scales used also made it possible to compare groups and highlight interpretative trends consistent with those emerging from the reference literature. On an analytical level, the choice of the multinomial logit model may appear restrictive with regard to the ordinal nature of some variables, but it has ensured an initial exploration of the relationships between perceptions, institutional trust, and expected behaviours, providing a basis on which to build more refined developments. Furthermore, the historical-literary and archival component was not only used as context, but as an interpretative lens to read the patterns that emerged in the models, particularly on institutional trust, symbolic/spiritual coping, and preparedness.

In this sense, rather than shortcomings, these elements should be seen as typical conditions of exploratory research, which aims to open up avenues for reflection and offer tools for interpretation that are useful to both the scientific community and institutional actors. Future studies, building on these foundations, will be able to refine sampling methods, validate measurement tools, and expand triangulation with objective data, but the present work already constitutes a significant step toward understanding how the population experiences and interprets hydrogeological risk in a territory deeply marked by its history of extreme events.

3. The geographical and historical context

3.1. The study area

The majority of the Arno River basin is located within the Tuscany region of central Italy. The river extends for approximately 241 km, draining a catchment area of about 8238 km², with a mean basin elevation of 353 m above sea level [55]. From a physiographic perspective, the Arno basin (Fig. 1) can be divided into four main reaches: the Casentino headwaters, the Upper Valdarno, the Middle Valdarno, which includes the Florence floodplain, and the Lower Valdarno, encompassing the Pisa plain. The Casentino sector drains a mountain valley bordered by the Alpe di Catenaia to the east, the Falterona range to the north, and the Pratomagno range to the west. In this upper portion, the river collects the waters of the Corsalone tributary. The Arno subsequently changes direction, receiving inflows from the Valdichiana near Arezzo, and enters the Upper Valdarno, which is delimited to the west by the Chianti Mountains [55].

Further downstream, after the confluence with one of its major tributaries, the Sieve River, the Arno bends westward and flows across the Florence plain, marking the transition into the Middle Valdarno. This sector drains the Tuscan-Emilian Apennines to the north, the Chianti range and Albano Mountains to the south-west, and the secondary reliefs bordering the Valdinievole to the west. Along this stretch, the river is fed by several tributaries, notably the Ombrone and Bisenzio from the northern side and the Greve from the south [55].

The river then enters the narrow Gonfolina gorge, a key geomorphological threshold separating the middle and lower basin. In the Lower Valdarno, the Arno receives additional tributaries, including the Pesa, Elsa, and Era on the left bank and the Nievole on the right bank. In its final course, the river crosses the Pisa plain before discharging into the Tyrrhenian Sea [55].

On November 2, 2023, a sudden and devastating flood struck the provinces of Prato, Pistoia, and parts of Florence, inundating numerous urban and industrial areas. The greatest damage occurred in the Florentine plain, due to the flooding of the Bisenzio River and other streams in particular, as well as in the provinces of Pisa and Livorno. The toll was tragic: eight lives lost, over 29,000 homes flooded, more than 10,000 businesses affected, and estimated damages amounting to €1.9 billion. Just over a year later, on March 14, 2025, another severe flood event hit the region, with torrential and concentrated rainfall affecting the provinces of Florence, Pisa, and Livorno, with precipitation levels comparable to those recorded during the catastrophic flood of 1966. Around 1500 people were evacuated, 250 were isolated, and major roads – including parts of the A1 motorway and the Florence–Pisa–Livorno expressway – remained closed for days. The railway network also suffered extensive disruptions. In the Florence metropolitan area alone, 8000 civil buildings were damaged, more than 430 businesses were impacted, and a total of around 375,000 people were affected. This event

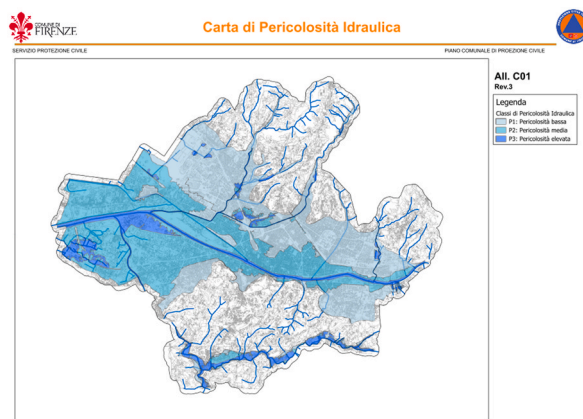


Fig. 2. Hydraulic hazard map, municipal plan of the Civil Protection Department.

Source: <https://protezionecivile.comune.fi.it/system/files/2024-05/C01%20-%20carta%20di%20pericolosit%C3%A0%20idraulica.pdf>

from March 2025 marked the sixth major flood in Tuscany within 18 months, signalling a structural trend toward increasingly frequent and intense extreme weather events [54]. The flood deeply affected public opinion, not least because it coincided with the anniversary of the 1966 flood, the most catastrophic in a long historical series [56].

Recent events exemplify the distinction between different flooding triggers in the study area. In particular, the November 2023 flood affecting Campi Bisenzio was associated with the overflow of local watercourses and riverine channels, consistent with a fluvial flood scenario [57]. In contrast, the widespread flood event of March 14, 2025 was predominantly caused by extreme and sustained rainfall, resulting in rapid inundation across Tuscany driven by intense precipitation [58].

These episodes are not isolated but are part of a geographical and morphological context that has always made Florence vulnerable to flood events, as can be seen from the official hydraulic hazard map provided by the Civil Protection department (Fig. 2).

The tectonic and geo-lithological features of the Central Apennines, combined with the specific characteristics of regional rainfall patterns, expose Florence – the capital of Tuscany and situated in the heart of the Central Apennines – to persistent hydrogeological instability, which has been well documented throughout history [59]. According to official data on the hydrogeological risk in Italy, within the Metropolitan City of Florence (total population: 990,527), approximately 60,115 residents live in areas classified as high flood risk, 358,776 in areas categorized as medium risk, and 678,961 in areas of low flood risk; in addition, 8175 people live in very high landslide risk probability areas, 26,212 in high risk areas, 95,461 in medium risk areas, 187,409 in moderate risk areas, and 3038 in caution areas [60,61]. Because of these features, Florence has experienced a series of extreme weather events, some of which have revived memories of the great historical floods that have marked the region for centuries. The research involved residents from the municipalities of the metropolitan area of Florence, namely Florence, Campi Bisenzio, Scandicci, Sesto Fiorentino, Bagno a Ripoli, Lastra a Signa, Signa, Calenzano, Vaglia, Pontassieve, Impruneta, Figline e Incisa Valdarno, Fiesole, Montelupo Fiorentino, Rufina, Reggello, San Casciano in Val di Pesa, Rignano sull'Arno, and Pelago.

3.2. The context of Florence: The broken pact with the river

The physical characteristics of the territory partly explain why the city has been the scene of numerous and often devastating floods over the centuries. One of the earliest and most comprehensive historical accounts of flooding in Florence is Ferdinando Morozzi's *Dello stato antico e moderno del fiume Arno* (1762), which provides a detailed chronicle of floods from 1177 to his time [62]. Morozzi documented 54 flood events: one in the 12th century, five in the thirteenth, nine in the fourteenth, six in the fifteenth, ten in the sixteenth, 14 in the seventeenth, and nine in the eighteenth century. His records were later extended by Giovanni Cavina to include one more flood in the eighteenth century (1780), four in the nineteenth, and one in the twentieth century, bringing the total to 60 floods [63].

However, the earliest documented flood in Florence occurred in 1177. While the chroniclers differ on the exact date (October 28 or November 4), the flood is most remembered for destroying the Ponte Vecchio, then the only bridge across the Arno (as the chronicle of Giovanni Villani recalls in his *Cronica* in 1348). The bridge was swept away and later rebuilt slightly downstream at its current location [64].

The most devastating flood was the one that occurred in 1333, which saw the collapse of all of the city's bridges and widespread destruction, exacerbated by the complete absence of flood control infrastructure. Even at the time, commentators noted that the severity of the calamity was worsened by rigid infrastructure that was incapable of flexibly withstanding flood forces, and by the lack of effective preventative measures implemented by local authorities [56]. As Frati notes, “despite the awareness of the causes of the damage (deforestation, exploitation [in terms of aggregates] of the riverbed) or, more simply, the fear that the catastrophe would be repeated, the Florentines did not have the strength to do anything because of the fragmentation of powers and competences along the course of the river: economic reasons (timber supply, food production, protection of the factories within the walls) prevailed therefore over ecological ones and soon the citizens [...] indulged in optimism by extolling their resilience, forgetting prevention and accepting nature's challenge from a fatalistic and superstitious perspective” [65] p. 60.

Among the events that occurred, the one of December 3, 1740 was exceptional in terms of the area inundated, surpassing those of 1547 and 1758, although it was smaller than the one in 1557, and the 1844 flood was the last major episode before the infamous event of November 4, 1966.

The 1966 flood struck early in the morning, after a powerful storm system passed over the region, and it stands as one of the most significant disasters in modern Italian history [66]. The damage was enormous, not only in Florence but across much of Tuscany. Contrary to the common perception that the event was confined to the historic city centre, the entire Arno basin was affected, with numerous suburban areas and rural communities being submerged, and many remaining isolated for days. The 1966 floodwaters exceeded the levels recorded in all previous events, making it the most violent and destructive flood in the city's history. Yet, owing to a series of fortunate circumstances, the death toll was limited to 35 victims, 17 of whom were in Florence itself [51; see also the repository: <https://www.sba.unifi.it/p1609.html>].

In addition to documents and historical data, literature has also contributed to keeping the memory of the Arno floods alive, offering symbolic and poetic interpretations of these dramatic events. Within the tangible and intangible collective heritage that shapes the collective memory of the flood risk in Florence, literary sources play a key role in testifying to the population's historical exposure to such threats. Even without investigating a detailed textual analysis of descriptions of the Arno and its perilous floods, or the role of the media in the description of flooding events [58], it is telling to recall how, as early as Strabo (60 BC – 24 AD), the riparian populations were described as being “fearful” of the river and its tributaries, and their potential overflow. Strabo warned of the respect owed to the river as an ecosystem and conveyed the idea of a symbolic pact between humans and nature: “There is a tradition, that when these rivers first descended from the mountains they were impeded by the inhabitants of the district, lest falling together they

should inundate the country; however, they promised not to inundate it, and they have kept their word” [67], book V, 5.

Centuries later, Lorenzo de’ Medici, the Magnificent (1449–1492) would echo this reverential fear in his poetry, depicting the Arno as a beautiful but dangerous force: “Leave old mother Falterona/and the caverns of the ancient mountain/my joyful Arno, with its green crown/of poplars encircling its azure brow;/murmuring, it speaks and laments/Arno, for having too fine a bridge;/Arno, striving with all its might and longing/to gain, like its brother, eternal fame” [68]. Further literary testimonies include that of Niccolò Machiavelli, who in the Pamphlet *De principatibus*, referring to actions that we might call preventive and/or mitigative, writes: “Still, the fact that a river is like this doesn’t prevent us from preparing for trouble when levels are low, building banks and dykes, so that when the water rises the next time it can be contained in a single channel and the rush of the river in flood is not so uncontrolled and destructive. Fortune’s the same. It shows its power where no one has taken steps to contain it, flooding into places where it finds neither banks nor dykes that can hold it back” [69] ch. XXV; 2014, p. 98.

In the modern era, writers such as Eugenio Montale have added their voices to this narrative. Montale, in a celebrated poem written after the 1966 flood, laments the sight of his books and furniture floating in muddy waters [70]: for him, the flood is “of an unbelievable and never believed reality”. Similarly, Mario Luzi, in verses inspired by the same event, writes: “‘Pray,’ he says, ‘for the submerged city/coming to meet me from the past/or from the future, a hidden soul/behind a torchlight that seeks me/in the sewage of the deserted street.’/‘Be silent,’ I implore, uncertain whether it is my voice that returns to its body, lost in the mud.” [71].

Religious memory, alongside literary accounts, has also contributed to shaping the collective imagination surrounding the Arno and its floods. From a devotional perspective, the memory of flood events is also preserved through religious rituals and practices. Notable among these is the Christmas Mass celebrated in memory of the victims of the 1966 flood by Pope Paul VI – a ceremony documented and preserved in the archives of RAI (Italian Television). Floods have also inspired religious and prophetic interpretations [72]. The flood of 1177, for instance, resulted in the loss of the statue of Mars mentioned by Dante Alighieri in 1321 (Canto XIII of the *Commedia*), which some later interpreted as a bad omen – an interpretation reinforced by the outbreak of the devastating Black Death just 15 years later: “O hear them round my ruin! I was born in the city that tore down Mars and raised the Baptist” [73]. Another powerful example is the religious tradition surrounding the Column of San Zanobi, located beside the Florence Baptistery. According to legend, during the translation of the saint’s relics, his body caused a withered elm tree to bloom. The wood from that tree was subsequently used for sacred works of art. The original column was destroyed in the catastrophic flood of 1333 and rebuilt the following year; it is now topped with a cross and stands as a symbol of popular devotion and Florentine historical identity.

In terms of urban traces, the city of Florence bears numerous physical markers commemorating floods. Most visibly, plaques indicating the water levels reached during historical floods are scattered throughout the city. Among the most documented are those from the 1844 and 1966 floods, often displayed side by side in a poignant visual comparison. Although rarer, plaques marking even earlier floods still exist and remain well preserved: these can be considered as examples of “epigraphic markers”, which can provide valuable information for reconstruction, modeling, and hazard assessment of floods [74–76]. Today, the memory of these events is also kept alive through digital tools: the app Arno66 TimeTravel allows users to explore the city through a curated photographic itinerary, offering side-by-side comparisons between archive images from 1966 and their present-day vantage points. This immersive experience reconstructs the most significant moments of the flood and invites a deeper reflection on Florence’s enduring vulnerability and resilience in the face of hazards.

In light of the evidence depicted in these plaques (Fig. 3), one can rhetorically ask: What became of that famous covenant described by Strabo? What happened to the memory of it? Why has it been forgotten, denied, or omitted? How does this memory shape the



Fig. 3. Flood memorial plaques in Florence.

Source: Pecorini (2025)

current risk perception and hazard awareness? What does this current use of the past imply? Why are people and communities so oblivious to the warning so clearly expressed by DeMatteis – that the reality we experience is not the earth, but the territory? [77], p. 98. It is in this context – marked by amnesia, reverence, and selective remembrance, but also by the tangible effects of climate change – that we turn to the results of our survey, seeking to understand how the memory of flooding continues to shape (or obscure?) contemporary risk perception.

Finally, since the historical-archival and literary corpus does not merely constitute a narrative framework, but allows us to isolate certain recurring cultural “scripts” through which the flood is remembered and made socially intelligible in Florence, we can highlight some recurring elements. In particular, the following emerge: first, a relational ‘pact’ with the river, which is both a resource and a threat; second, a ‘script’ of prevention, centred on embankments, works and government responsibility; third, evidence of institutional ineffectiveness, fuelled by representations of delays and insufficient intervention; then, religious-spiritual coping practices; finally, a ‘materialized memory’ through plaques, inscriptions, and urban markers. These motifs are reflected in the survey variables, which capture contemporary outcomes in terms of trust in institutions and policy evaluation, reliance on faith, procedural preparedness, as well as affective and behavioral reactions such as panic and information seeking, as it will be explained in the following sections.

4. Results

Starting from the rhetorical and research questions above, our focus was to investigate how Florentine citizens currently perceive hydrogeological risk, through a questionnaire designed on the basis of previous studies and adapted to the analysed context [78–80]. In this work, particular attention is devoted to hydrogeological risk perception, while the perception of climate change is considered only through basic descriptive statistics, with the intention of addressing it more extensively in subsequent studies. The survey involved 734 participants, and their characteristics are illustrated in Table 1.

4.1. Descriptive statistics

We illustrate below some of the results from the main three sections of the questionnaire (see ANNEX 1).

1. Almost all of the sample (93.7%) believe that climate change is happening, while only 6.3% deny it or say they do not know. The main concerns relate to the natural environment (65%), the world's populations (58.7%), and, to a lesser extent, their own community and family (41.3%) or Italy as a whole (7.3%). A small proportion (3.9%) say they are not concerned. In terms of generational differences, it is evident that younger people (aged 18–39) are more concerned about nature (68.5%) and their own community (44.8%), while those aged over 60 express greater concern about the global situation (63.3%) and that of Italy (8.7%).
 - a. The most frequent associations with climate change, at a global level, concern the increase in extreme events (74.8%), rising temperatures (69.2%), and the melting of glaciers with the rise in sea level (60.9%). Less frequently mentioned are the loss of biodiversity (26.3%) and migration or conflict (10.6%), the latter being more often mentioned by those with a university degree (14.7% compared to 6.3% of high school graduates).
 - b. At the local level, the population associates climate change primarily with storms that have a direct impact on people and property (86.7%), and heatwaves (74%). These are followed by water scarcity (39.8%) and fires (21%), with higher percentages among university graduates and young people under the age of 39.
 - c. Among the respondents, 44.6% believe that landslides and floods are caused by climate change, while 25.4% disagree and 30% remain neutral, with greater scepticism being shown by older and less educated people. However, the most widely accepted explanation is poor land management, highlighted by 69.6% (peaking at 74% among those aged 40–59). The idea that climate change is a “hoax” is rejected by over 90% of the sample. As for perceived safety, a feeling of vulnerability prevails, with almost 60% not considering their area safe, and particularly high levels of insecurity in Campi Bisenzio (75.5%). Perceptions of the role of lifestyles are more divided: 34.3% believe that they can reduce hydrogeological risks, 29.6% are neutral, and 26.1% disagree.

Table 1

A synthetic overview of the sample.

Variable	Categories (%)
Age	18–39: 31.7; 40–59: 47.6; 60+: 20.6
Gender	Women: 63.4; Men: 36.3; N.A.: 0.3
Nationality	Italian: 99.2
Municipality	Florence: 49.7; Campi: 14.6; Scandicci: 9.9; Sesto: 6.5; Others: 19.4
Household size	1 person: 11.6; 2–3: 57.4; 4–5: 29.7; 6+: 1.4
Family members present	≥1 under 14: 30.7; ≥1 over 65: 22.8; Non-self-sufficient: 7.0
Residence	Urban: 89.0; Rural: 11.0
House (year of construction)	Before 1970: 51.6; After 1970: 41.5; N.S.: 6.9
Type of housing	Standard: 80.3; High-end: 12.1; Social: 7.6
Close to waterways	Yes: 81.4
Work status	Employees: 60.8; Self-employed: 20.9; Retired: 9.6; Students: 4.3; Homemakers: 2.5; Unemployed: 1.9
Commuting time	≤15 min: 37.9; 15–60 min: 45.2; >60 min: 3.3; None: 13.6
Means of transport	Car/PT: 66.9; On foot: 13.9; Bicycle: 5.6
Education	University: 49.7; High school: 42.1; Middle school: 8.1; None: 0.1

- d. The majority of the respondents associate climate change with events such as floods (89.4%), droughts and heatwaves (91.6%), hurricanes (78%), coastal erosion (65.9%), and landslides (65.6%), while the association with earthquakes (22.7%), volcanism (16.5%), and tsunamis (47.7%) is less common. In this case, the level of education plays a role, as only 19.1% of university graduates link earthquakes to climate change, compared to 37.3% of those with only a middle school education.
- e. The risk of landslides is perceived as low in all municipalities (89.6% consider the risk to be low in Campi). The perception of flooding is different: in Florence, 41.1% feel very exposed, but in Campi the percentage rises to 90.5%. Exposure is also higher among those who live near waterways (52.1% compared to 26% of those who do not). Heatwaves are seen as a high risk by over 70% of residents in Florence, Scandicci, and Sesto Fiorentino, and by 62.2% in Campi.
2. Policies aimed at reducing hydrogeological risk are considered insufficient by 82.3% of respondents, while only 6.3% consider them adequate. In Sesto Fiorentino, no one responded positively. Institutional communication also appears to be lacking, with 67.3% saying they do not feel informed about the measures taken, compared to 23% who say the opposite.
3. The main sources of information are the Internet and social media (65.1%), followed by television (53%) and print media (50.1%). Civil protection is indicated by 28.9% of respondents, universities and experts by 25.2%, and local authorities by 25%. Family and friends (9.1%) and school (1.8%) are much less significant. There are clear generational differences: young people mainly use the web (72.4%) and their family network (17.7%), while the over-60s prefer TV (60%), newspapers (53.3%), and academic sources (32%). Graduates also stand out for their greater use of experts (32.2%) and lower use of TV (44.7%).
4. On an emotional level, 45.3% say they fear the effects of climate change, 31.9% feel frustrated by the lack of effective action, and only 14.3% are confident that landslides and floods will decrease (with slightly higher figures among the over-60s). In Campi Bisenzio, the following particular attitudes emerge: less fear (34%), more frustration (57.5%), and very little confidence (5.7%).
 - a. Almost half of the sample (45.5%) have never experienced a flood or landslide, but 29.7% have direct experience and 24.3% indirect experience through family members. In Campi Bisenzio, personal experience reaches 70.8%. In an emergency, 49.8% would seek information, 24.8% say they already know what to do (especially men, 32.1%), and 7.2% would wait for the authorities to intervene.
 - b. Among those with direct experience, almost half (43.6%) say they are ready to act. The most likely reactions include helping family members and close friends (80.5%), looking for escape routes (36.9%), and staying calm (28.2%). Trust in local authorities remains mixed: 44.6% say they do trust them, 27.5% say they don't, and 27.9% are undecided, with peaks of distrust in Campi (52.8%).
 - c. The most feared damage mainly concerns health and physical safety: 82.8% in the case of earthquakes, 79.6% for floods, 70.6% for landslides, and 87.6% for heatwaves. This is followed by damage to homes (up to 79% in earthquakes, 75.2% for floods, and 68% for landslides) and, to a lesser extent, psychological consequences (ranging from 6.6% for landslides to 21.7% for heatwaves).
 - d. There are significant differences between genders and territories: women are more concerned about physical damage and damage to their homes, and young people about psychological damage, while in Campi there is greater sensitivity to both damage to homes and psychological damage.

4.2. Memory and reaction intention

To complement the descriptive analyses, we propose a multinomial logit model [81] to estimate the association between the covariate vector x and the probability of unit i belonging to one of several nominal categories of outcome Y (without natural ordering). Let $Y_i \in \{r_0, r_1, \dots, r_K\}$ where we set the reference category r_0 for identification. The structural assumption of the multinomial logit is the independence of irrelevant alternatives, according to which the ratios $\Pr(Y = r)/\Pr(Y = r')$ are independent of the presence/attributes of the other alternatives. The multinomial logit specification assumes a normalized exponential transformation that converts linear scores into non-negative probabilities that add up to 1, in which α_r is the intercept and β_r is the vector of coefficients specific to each category r (with normalization $\alpha_{r_0} = 0, \beta_{r_0} = 0$). The conditional probability can be formally written as:

$$\Pr(Y_i = r | x_i) = \frac{\exp(\alpha_r + x_i^\top \beta_r)}{\sum_{h \in \{r_0, \dots, r_K\}} \exp(\alpha_h + x_i^\top \beta_h)}, \text{ with } r \in \{r_0, \dots, r_K\}.$$

Equivalently, the log odds relative to the base are linear:

$$\log \frac{\Pr(Y_i = r | x_i)}{\Pr(Y_i = r_0 | x_i)} = \alpha_r + x_i^\top \beta_r, \text{ with } r \neq r_0.$$

The estimation is performed using maximum likelihood; in application, the analysis is estimated on the overall sample, keeping the reference category and the set of covariates constant to ensure the comparability of the results, and robust standard errors are reported to mitigate heteroscedasticity and model misspecification. The results deriving from the multinomial model come in terms of relative-risk ratios, obtained as $\exp(\beta_r)$, which quantify the variation in the relative-risk ratio of falling into category r compared to the baseline r_0 as the covariates vary; for readability, we show the relative-risk ratios with predicted probabilities in terms of marginal effects (obtained via margins) on the individual categories in order to also show coefficients against the baseline r_0 .

Therefore, to interpret the results more accurately, we present the average marginal effects (AMEs), namely the expected changes in the probabilities of belonging to the outcome categories as the covariates vary. Unlike log-odds/relative-risk ratios, AMEs are

expressed directly in percentage points and are immediately readable; above all, in multinomial logit regression, they allow us to show the effects for all outcome categories, including the reference category (because we work on the probability scale, not on log odds, and the reference category is likewise important in our theoretical framework).

Denoting with $Y_i \in \{0, \dots, K\}$ the outcome for observation $i = 1, \dots, n$, with r a generic category, and with $\pi_{ir} = \Pr(Y_i = r | x_i)$ the probability estimated by the model (obtained from the normalized exponential transformation), we define AMEs as follows. In the case of a binary covariate, for a covariate $Z \in \{0, 1\}$, the AME on the probability of category r is the mean discrete variation between $Z = 1$ and $Z = 0$, namely:

$$AME_r(Z) = \frac{1}{n} \sum_{i=1}^n [\pi_{ir}(Z=1) - \pi_{ir}(Z=0)],$$

while in the case of multilevel categorical covariates (our main cases), let W be a covariate with levels $l \in \{0, 1, \dots, L\}$ and reference level l_0 (baseline). The AME of the effect of level l relative to baseline l_0 on category r is:

$$AME_r(W : l \text{ vs } l_0) = \frac{1}{n} \sum_{i=1}^n [\pi_{ir}(W=l) - \pi_{ir}(W=l_0)].$$

In all cases, AMEs are calculated by keeping the other covariates at the observed values of each unit, and then averaging over the sample. A useful property in the multinomial case is that, for any contrast (binary, level vs baseline), the effects on the different outcomes add up to zero, $\sum_{r=0}^K AME_r(\cdot) = 0$, because the probabilities add up to one. To display our results, we report the AMEs (in percentage points), the robust standard errors, and the 95% confidence intervals, exhibiting the results for all outcome categories (including the reference category) and for all levels of the covariates.

Before performing all of the regressions, we carry out some preliminary operations necessary to obtain a reliable sample. Therefore, we first recoded all the variables taken into consideration. With regard to the *MEMORY* variable, which is our dependent variable in the multinomial model, we assume that having experienced a disaster first-hand or indirectly may have created a memory of the event that could be useful in managing similar situations in the future. Therefore, since we have at our disposal one question in the questionnaire asking respondents to indicate whether they had personal, family, or no memory of past events, we use this question as the dependent variable of the model, coding it into three categories (no memory, memory of an event experienced first-hand, and memory of an event experienced indirectly by one's family or loved ones). Next, we use some questions from the questionnaire that asked respondents what kind of reactions or feelings they might experience when a new event occurs as covariates of the model, in order to assess the type of reaction/behaviour based on past memory. In addition to the three variables indicating intentions for reactions/behaviours, we add a further variable that measures the degree of trust in local institutions in the Florence area and its surroundings. This variable is considered in binary form, therefore it takes the value 0 if the respondent does not express trust, while it takes the value

Table 2

Average marginal effects computed on the multinomial logit models. Dependent variable: levels of memory based on past events.

	(i)	(ii)	(iii)
	Predicted outcome: <i>Rank 0</i> (no memory)	Predicted outcome: <i>Rank 1</i> (individual memory)	Predicted outcome: <i>Rank 2</i> (collective memory)
Reaction intention 1 (baseline: <i>Not worried about climate change effects</i>)			
<i>I'm worried about climate changes effects</i>	−0.170 (0.141)	0.126 (0.121)	0.044 (0.098)
<i>I am confident about the strategies adopted by the municipality of Florence and its surroundings to reduce landslides and floods</i>	−0.254 (0.163)	0.042 (0.145)	0.212 (0.137)
<i>I am frustrated because not enough is being done to reduce the hydrogeological risk in Florence and the surrounding area</i>	−0.228 (0.141)	0.170 (0.121)	0.057 (0.098)
Reaction behaviour 1 (baseline: <i>I don't know what to do</i>)			
<i>I know what I should do</i>	−0.323*** (0.076)	0.328*** (0.070)	−0.005 (0.063)
<i>I try to get information from media, experts, neighbours</i>	−0.127* (0.071)	0.072 (0.060)	0.055 (0.060)
<i>I put my trust in God</i>	−0.383*** (0.142)	0.021 (0.144)	0.362** (0.174)
Reaction behaviour 2 (baseline: <i>I don't know what to do</i>)			
<i>I help my family and others in need first</i>	−0.143 (0.115)	0.098 (0.109)	0.044 (0.101)
<i>I panic</i>	0.434*** (0.110)	−0.265** (0.104)	−0.169* (0.098)
<i>I rush to find a way of escaping</i>	−0.170 (0.116)	0.074 (0.111)	0.095 (0.104)
<i>I don't panic</i>	−0.213 (0.152)	−0.008 (0.136)	0.221 (0.151)
Trust in response capabilities and preparedness of local government authorities (baseline: no)			
<i>Yes</i>	0.169*** (0.050)	−0.153*** (0.049)	−0.016 (0.047)
Observation (full sample)	734		
Observation (effectively used)	409		
Pseudo-R ²	0.085		
Log pseudolikelihood	−401.2		
AIC	848.4		
BIC	980.7		

Robust standard errors computed with the delta method are in parentheses. Significance level: *** indicates $p < 0.01$; ** indicates $p < 0.05$; * indicates $p < 0.10$.

1 if the answer is positive. In the model, the value 0 will become the baseline, so any result must be expressed as a deviation from the covariate baseline. However, before proceeding with the estimates, we trimmed the sample, ensuring that none of the responses contained missing information or missing values in certain categories. Therefore, from the initial sample of 734 interviews, our final sample consists of 409 observations included in the multinomial model.

For these reasons, we believe that the choice of the multinomial model through predictive margins is the most appropriate, because it allows us to measure reactions/behaviours based on each previous level of memory (none, individual, collective). The results of the model are presented in Table 2.

The pattern that emerges when observing the coefficients appears very linear. First, we consider as the predicted outcome individuals who have no memory of past events related to landslides and floods in Florence (Model (i)). We do not note any significance with the categorical variables relating to the first block of reaction intentions, mainly linked to perceptions of climate change in general and the strategies implemented at municipal level to prevent such risks, both in the positive and negative aspects of the issue. Instead, when we look at reaction behaviours, we observe a negative and significant coefficient ($\beta = -0.323$, $p < 0.01$) in relation to the category “*I know what I should do*” compared to the baseline, which means that not having had any previous experiences greatly reduces the possibility of knowing how to behave during a possible future event of similar magnitude. Furthermore, within the same block of categories, we note that the absence of memory of such events also reduces the likelihood of seeking information through various channels ($\beta = -0.127$, $p < 0.10$) or relying on divine protection ($\beta = -0.383$, $p < 0.01$). Accordingly, in the second block of categories indicating the different probabilities of reacting to an event, we find a positive and highly significant sign ($\beta = 0.434$, $p < 0.01$) towards “*I panic*”, which means that not having experienced past events greatly increases the probability of panicking during a similar event. Finally, there is a further positive and highly statistically significant coefficient in relation to trust in local institutions ($\beta = 0.169$, $p < 0.01$), meaning that the less previous experience one has with these events, the greater the likelihood of trying to believe in the ability of local institutions to solve the problem.

In the second proposed model (Model (ii)), we observe the average marginal effects on the predicted outcome relating to the memory of a similar event already experienced first-hand. Similarly to (i), we do not observe any significance in the first block of categories, while in the second block relating to reaction behaviour towards a similar event, a positive and highly significant coefficient ($\beta = 0.328$, $p < 0.01$) emerges in relation to the response option “*I know what I should do*”, indicating that a previous memory of a related catastrophic event helps in managing future behaviour in similar circumstances, offering a sort of preparation for what to expect if a similar event occurs. For similar reasons, and in contrast to (i), a negative and statistically significant coefficient ($\beta = -0.265$, $p < 0.05$) is observed in relation to the second block of categories, with reference to the response type “*I panic*”; this means that in the case of previous memory of an event experienced first-hand, the probability of panicking when faced with a similar event decreases significantly.

Finally, unlike Model (i), where confidence in the ability of institutions to solve the problem emerged, in (ii) the opposite appears, with a negative and statistically significant coefficient ($\beta = -0.153$, $p < 0.01$). This is particularly emblematic because it indicates that those who have personal memories of a catastrophic event tend not to trust institutions, probably due to the lack of effectiveness in managing that event.

Finally, with reference to Model (iii), we observe the predicted probabilities of the last outcome, namely having memories of similar experiences already lived, but not first-hand, but rather through the lens of friends and relatives. In this case, we observe a pattern that in some ways aligns with that which emerges in Model (ii), albeit with less significance in certain cases. For example, the similarity to both (i) and (ii) is confirmed in relation to the first block of categories, where no significance emerges; however, unlike (ii), where the reaction behaviour for future events involves knowing how to behave, in this case – when the experience is not first-hand – it seems more likely that people tend to rely on spirituality ($\beta = 0.362$, $p < 0.01$). On the other hand, the trend found with (ii) regarding the decrease in the probability of being afraid when faced with a similar event is confirmed, with a negative and statistically significant coefficient ($\beta = -0.169$, $p < 0.10$), albeit with lower intensity. Unlike the other two cases, no significance, either positive or negative, emerges with regard to confidence in the ability of local governments to resolve the situation in the event of new similar events.

Overall, we can see that reactive behaviours, or intentions to react to a potential future event related to landslides or floods, within the city of Florence or in the municipalities that make up the metropolitan city vary greatly depending on whether there is already a consolidated memory of events of this magnitude. Furthermore, for those who have memories of these events, reactions vary substantially depending on whether the event was experienced first-hand or indirectly.

The results in Table 2 can also be interpreted more fully when considered in relation to the interpretative themes that emerged from the historical-archival and literary analysis (§3.2). Firstly, the association between indirect/collective memory and the statement “*I put my trust in God*” is consistent with the persistence, in local sources and practices, of devotional repertoires and providentialist frameworks that function as a coping resource in the face of uncertainty. Secondly, the tendency of those with direct memory to show less trust in institutions is part of a long-standing narrative which, in texts and public traces of memory, recalls fragmented decision-making, delays, and insufficient interventions, making this mistrust a socially entrenched rather than contingent outcome. Finally, the relationship between memory and “*I know what I should do*” suggests distinguishing between a primarily commemorative memory—stabilized by plaques, inscriptions, and urban markers—and a procedural memory linked to operational skills and preparedness practices: the visibility of memory in space alone does not automatically guarantee the ability to act in an informed manner during the event.

4.3. Socio-demographic determinants of perceived risk exposure

A further step in the analysis is to investigate the socio-demographic determinants of perceived risks associated with natural hazards. The survey asked respondents to report their perceived exposure to six types of risk (earthquake, landslide, flood, hurricane, heatwave, and frostwave), rating each on a five-point scale. Alongside these perceptions, we collected a set of socio-demographic variables, including age, gender, family composition, type of housing, degree of urbanization of residence, education, and trust in local and national government actions to mitigate risks. Since these characteristics are collected as categorical, we analysed how variations in respondents' profiles are associated with the perceived likelihood of exposure to each of the six risks.

For ordinal outcomes – such as items on subjective perceptions of exposure to risks associated with natural hazards, measured on

Table 3

Perception of risk exposure typology and main socio-demographic; ordered probit model.

	perception of risk exposure					
	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
	earthquake	landslide	flood	hurricane	heatwave	frostwave
Age (baseline: 18–39)						
40–59	–0.053 (0.117)	0.080 (0.123)	–0.192 (0.116)	0.618*** (0.136)	–0.107 (0.121)	–0.172 (0.116)
over 60	–0.083 (0.183)	–0.425** (0.188)	–0.391** (0.170)	0.380* (0.195)	–0.545*** (0.176)	–0.469*** (0.179)
Gender (baseline: female)						
male	–0.031 (0.101)	–0.043 (0.110)	0.046 (0.103)	–0.031 (0.108)	–0.112 (0.102)	–0.185* (0.102)
Location (baseline: Florence city)						
Florence metropolitan area	0.014 (0.097)	0.227** (0.103)	0.425*** (0.101)	0.052 (0.110)	–0.277*** (0.098)	–0.091 (0.100)
Family size (baseline: 1)						
2–3	0.262 (0.198)	0.164 (0.189)	–0.264 (0.172)	0.328 (0.216)	0.170 (0.203)	0.226 (0.163)
4 and over	0.156 (0.216)	0.217 (0.210)	–0.448** (0.190)	0.183 (0.230)	–0.082 (0.217)	0.227 (0.180)
Family composition (baseline: balanced)						
prevailing under 15	0.186 (0.115)	0.139 (0.150)	0.026 (0.116)	–0.077 (0.126)	–0.093 (0.123)	–0.092 (0.124)
prevailing over 65	0.047 (0.157)	–0.100 (0.125)	0.098 (0.142)	0.156 (0.155)	0.089 (0.144)	–0.114 (0.146)
Non-self-sufficient family members (baseline: no)						
yes	0.038 (0.073)	–0.684*** (0.234)	0.095 (0.218)	–0.101 (0.185)	–0.152 (0.193)	0.042 (0.160)
Degree of urbanization of home residence (baseline: rural)						
urban	–0.159 (0.158)	–1.044*** (0.175)	0.759*** (0.201)	–0.096 (0.153)	0.429*** (0.155)	–0.167 (0.150)
Home age (baseline: built after 70s)						
built before 70s	0.118 (0.099)	0.075 (0.104)	0.135 (0.101)	0.263** (0.109)	0.097 (0.100)	–0.020 (0.101)
Property type (baseline: owned civil dwelling)						
rented civil dwelling	0.141 (0.197)	0.841*** (0.203)	–0.064 (0.198)	0.242 (0.229)	–0.174 (0.238)	0.465* (0.240)
social housing	0.130 (0.192)	0.151 (0.207)	–0.193 (0.188)	0.540*** (0.195)	0.460*** (0.161)	0.190 (0.175)
stately dwelling	–0.047 (0.138)	–0.220 (0.162)	0.011 (0.175)	0.110 (0.167)	0.018 (0.149)	0.070 (0.150)
River proximity of habitual residence/workplace (baseline: no)						
yes	–0.215* (0.125)	–0.115 (0.123)	0.667*** (0.122)	0.164 (0.135)	0.049 (0.129)	0.060 (0.128)
Type of employment (baseline: unemployed)						
domestic	0.493 (0.536)	1.232* (0.733)	0.149 (0.494)	0.358 (0.650)	0.910** (0.437)	0.122 (0.614)
employee	0.471 (0.452)	1.520** (0.670)	0.369 (0.407)	0.315 (0.596)	0.609* (0.360)	0.461 (0.549)
self-employed	0.552 (0.457)	1.539** (0.680)	0.231 (0.417)	0.176 (0.608)	0.436 (0.374)	0.202 (0.559)
retired	0.226 (0.502)	1.460** (0.710)	0.191 (0.462)	0.326 (0.630)	0.667 (0.420)	0.236 (0.590)
student	0.292 (0.494)	1.496** (0.748)	0.616 (0.499)	0.428 (0.669)	0.559 (0.458)	0.655 (0.634)
Education (baseline: primary/no education)						
secondary education	–0.169 (0.179)	0.213 (0.194)	0.055 (0.202)	0.205 (0.217)	–0.203 (0.185)	–0.430** (0.179)
tertiary education	–0.102 (0.182)	0.438** (0.195)	0.051 (0.199)	0.230 (0.219)	–0.040 (0.182)	–0.622*** (0.182)
Trust in local government's actions against risk disasters (baseline: no)						
yes	0.029 (0.203)	0.158 (0.196)	0.261 (0.167)	–0.021 (0.195)	0.090 (0.172)	0.269* (0.152)
Informed on local and national governments' actions against risk disasters (baseline: no)						
yes	–0.063 (0.104)	–0.163 (0.115)	–0.218** (0.108)	0.041 (0.112)	–0.077 (0.113)	0.084 (0.113)
Observation (full sample)	734	734	734	734	734	734
Observation (effectively used)	515	515	515	515	515	515
Pseudo-R ²	0.013	0.066	0.058	0.039	0.040	0.032
Wald χ^2 (significance)	21.49	98.08***	83.56***	46.45***	57.53***	51.60***
Log pseudolikelihood	–716.9	–613.6	–727.5	–573.4	–693.8	–745.0

Robust standard errors are in parentheses. Significance level: *** indicates $p < 0.01$; ** indicates $p < 0.05$; * indicates $p < 0.10$.

multilevel scales (from 1 = “minimal exposure” to 5 = “maximum exposure”) – we used ordered logit regression models [82], which allow us to estimate the cumulative probability that the response will fall below or above certain thresholds, exploiting the natural ordering of the categories but without assuming that the distance between them is metric.

Formally, indicating with $Y_i \in \{1, \dots, C\}$ the dependent variable for unit i , with x_i as the vector of explanatory covariates, and with β as the vector of related coefficients, the model can be written as:

$$\Pr(Y_i \leq c | x_i) = \Lambda(\tau_c - x_i^\top \beta), c = 1, \dots, C - 1,$$

where: $\Pr(Y_i \leq c | x_i)$ is the cumulative probability that observation i will be at level c or lower, given the vector of covariates x_i ; $\Lambda(\cdot)$ is the standard logistic function, $\Lambda(z) = 1/(1 + e^{-z})$; τ_c are the thresholds (or cut points) that separate the ordinal categories; and $x_i^\top \beta$ is the linear predictor, with the intercept absorbed in the cut points. In this setting, the coefficients β do not vary for different thresholds (the assumption of proportional odds), which implies that the odds ratio for moving to a higher category compared to all lower ones is constant. Each covariate shifts the probability distribution towards higher or lower categories depending on the sign and magnitude of its coefficient.

The estimates are obtained using maximum likelihood and, in line with standard routine, we report robust standard errors. This approach allows us to assess how different socio-demographic and behavioural dimensions are associated with the perception of risk exposure, preserving the ordered nature of the response scales and without reducing the information to a simple binary model. Each coefficient proposed in the following models must always be interpreted as the deviation from the relative baseline. Furthermore, it should be noted that the Pseudo- R^2 values are to be understood as net of the variance that cannot be explained within the logistic models, as they express probability rather than quantifiable dimensions.

Table 3 shows the coefficients relating to the cumulative probability of feeling exposed to six risk dimensions compared to a series of socio-demographic covariates. In particular, Model (iv) focuses on the perception of earthquake risk: it can already be seen from the lack of significance of the chi-square that this risk does not appear to be perceived significantly by the sample of respondents, where no significance emerges among the various categories tested as covariates, apart from a weak significance in the case of individuals who live or work near a river.

Model (v), which focuses on landslide risk, emerges as the most significant, indicating that this is the type of risk most perceived by the population. Among other things, the chi-square is the highest compared to all other types of risk, indicating greater variance explained within the sample. In detail, it can be seen that landslide risk appears to be less perceived by individuals aged over 60, by people with disabilities in their families, and by those who live in urban areas; on the other hand, positive and statistically significant coefficients emerge for those who live outside the city of Florence, those who live in rented residential housing, those with a high level of education (tertiary level), and all types of employment status. In essence, these findings suggest that the risk of landslides is widely perceived, especially by those who do not live in urban areas but rather in the suburbs of the metropolitan city, while no significance emerges with regard to the composition of the household.

Model (vi) tests socio-demographic dimensions in relation to the perception of flood risk. In this case, some similarities and differences emerge with respect to landslide risk: for example, the over-60s category maintains a negative and statistically significant coefficient towards the outcome, while the dimension attributable to location outside the urban area maintains a positive and significant sign towards flood risk. On the other hand, other significant factors emerge in relation to other categories: for instance, the probability of perceiving exposure to flood risk decreases in the case of large families (four or more people) and in the case of a sufficient level of information acquired about local and national government activities put in place to combat risks. On the other hand, the perception of exposure to flood risk increases when the degree of urbanization of the place where one's home is located in an urban area (unlike landslide risk, which is perceived more in rural areas), and also when one's usual place of residence or work is located near rivers. However, no significant differences emerge in terms of the type of housing or employment status of the respondents. These findings appear to be fairly consistent with the literature on the perception of this risk.

With regard to hurricane risk (Model (vii)), although historically this is not an atmospheric phenomenon associated with the area under study, some significant findings emerge in relation to the risk perceived by individuals. In particular, it appears to be more strongly perceived in the 40–59 and over-60 age groups than in the baseline group (18–39), among individuals who say they live in a building constructed before the 1970s, and among those who live in social housing. These results are fairly consistent with the narrative that hurricanes are perceived as a greater risk depending on the age of one's home, since older buildings, such as social housing or buildings over 50 years old (and therefore with lower levels of environmental safety), can trigger the perception of exposure to hurricane risk.

A very clear pattern also emerges with regard to the risk of heatwaves (Model (viii)), which appears to be less perceived in areas outside the city centre and more in cases where the home is located in a highly urbanized area, demonstrating that the risk of heatwaves is more perceived where there is a high level of built-up environment. Furthermore, it emerges that the risk of heatwaves is perceived in the case of residents in social housing and among domestic workers and employees. On the other hand, it appears to be less perceived by the over-60s, who are often unaware of this type of risk and are also the subject of major awareness campaigns run by the media on heat risk management. These findings appear to be entirely consistent with the typical narrative that accompanies the perception of this risk.

The last risk in question is that relating to the perception of cold spells (Model (ix)). In this case, the significance does not appear to be very high compared to the types of risk most prevalent in the area, but some interesting findings do emerge. For example, similarly to heatwaves, the risk of frost is less perceived among the over-60s and also among men (compared to the baseline for women), while there is a slight positive significance among those who live in rented residential properties and those who have confidence in local and

national government actions aimed at addressing risks associated with natural hazards. On the other hand, a negative significance emerges among those with a medium (secondary) or high (tertiary) level of education.

5. Discussion

5.1. Perceived drivers of extreme natural events: balancing climate change and territorial neglect

Studies on social perception are not limited to the global climate dimension as they are rooted in local history, intertwined with experiences lived directly or transmitted through collective storytelling [83–94].

The literature confirms that perception depends not only on environmental factors but also on socio-demographic variables, level of education, trust in institutions, and preferred information channels [95,96]. In this sense, the data collected represent an original contribution, showing how historical memory and direct experience can strengthen the link between climate change and hydrogeological risk, even without bridging the gap between awareness and actual prevention and preparedness behaviours.

One of the most significant aspects emerging from the survey concerns the attribution of causes to extreme events. Although the vast majority of respondents recognize the existence of climate change and its link to the increase in the frequency and intensity of phenomena, a significant proportion of the sample tends to attribute primary responsibility to neglect of the territory, poor urban management, and a lack of infrastructure maintenance. This interpretation, already observed in other studies [97–103], highlights how disasters are perceived more as the result of institutional and governance deficits than as the inevitable consequences of global climate processes. A comparison between this survey and the one conducted by Zabini et al., in 2018 in the Tuscany region [54] highlights a significant evolution in the public perception of hydrogeological risk. Both studies underscore the decisive role of personal experience and geographical proximity to watercourses in shaping risk perception; however, while in 2018 only 28% of respondents reported being well informed about the risk of flooding and 51% felt prepared, by 2025 the spread of digital technologies had led to increased access to information, particularly through social networks and the Internet, especially among younger people. Nevertheless, there remains a disconnect between risk perception and actual preparedness behaviours – a gap already noted in the 2018 study: feeling exposed does not necessarily correspond to an effective response capacity. Furthermore, while in 2018 there was a widespread tendency to underestimate objective risk – with 64% of residents living in high-hazard areas – this underestimation appears to be less common in 2025, particularly in areas recently affected by extreme events (such as Campi Bisenzio).

The Florentine case therefore reflects a dual perspective: on the one hand, the population recognizes the reality of climate change and perceives its tangible effects on the territory, showing a higher level of awareness than surveys conducted in other regions; on the other hand, respondents strongly emphasize the managerial and political dimension of vulnerability, attributing responsibility to local authorities for failing to adequately prevent or mitigate the impacts of disasters.

This tension between climatic explanations and those linked to poor land management is not new, as several studies [78,87] have shown that the population tends to interpret disasters not only as an expression of natural or climatic dynamics, but also as failures of institutions, which are unable to protect citizens through effective planning and routine maintenance. In the Florentine context, this perception is reinforced by the shadow of the 1966 flood, which remains etched in the memory as a symbol of an event aggravated by inadequate risk management policies.

The result is a complex view, in which climate change and neglect of the territory are perceived as closely intertwined factors: the increase in the frequency and intensity of extreme events is attributed to global dynamics, but their transformation into disasters is attributed to the poor institutional capacity of the local government.

5.2. Climate change and natural hazards, institutional trust, information channels

Another element that emerges strongly from the survey is the persistent fragility of institutional trust. Most respondents consider the policies adopted to reduce hydrogeological risk to be insufficient, a view that reflects a widespread sense of inadequate protection. This mistrust concerns not only the ability to prevent events but also the effectiveness of institutional communication: citizens say they receive little information about the measures taken and the tools available to them.

The case of Campi Bisenzio represents an interesting exception. Despite being a highly exposed area, the resident population reports feeling relatively better informed than other parts of the Florentine hinterland. This can be attributed to the higher frequency of extreme events affecting the area, which has necessitated more frequent and targeted communication from local authorities. However, the statistical evidence shows that while direct experience strengthens risk perception and enhances individual preparedness, it also tends to reduce trust in institutional messages, especially when past event management is perceived as inadequate.

The issue of information is intertwined with that of the communication channels used. The data collected confirm a clear generational divide: while young people predominantly use the Internet and social networks (65.1% overall), those aged over 60 continue to rely mainly on traditional channels such as television, newspapers, and academic sources. This dichotomy, already documented by Newman et al. [96], raises the question of the need for multi-channel strategies capable of reaching different audiences through different means.

The literature on risk communication emphasizes that information should not be limited to moments of emergency but should rather be a continuous process based on transparency and inclusion [104]. In the absence of such continuity, institutional trust tends to erode, fuelling the belief that the responsibility for protection lies solely with citizens. Here too, the Florentine context is emblematic: the population shows a clear awareness of the risk, but the weakness of institutional communication contributes to an ongoing low perception of protection, exacerbating the gap between awareness and concrete preparedness.

5.3. Psychological attitudes and emergency behaviours

From a psychological point of view, the survey results paint an ambiguous picture. On the one hand, feelings of concern and frustration prevail: 45.3% of respondents say they are concerned about the effects of climate change, while 31.9% express dissatisfaction with the lack of concrete action. These emotions reflect a widespread awareness of the problem, but at the same time a sense of individual powerlessness in the face of the perceived ineffectiveness of public policies.

In terms of concrete behaviour, however, there is a significant gap between awareness and actual preparedness. Only 24.8% of the respondents say they know exactly how to behave in the event of a landslide or flood, compared to a large majority who say they are uncertain or unprepared. This finding is consistent with other surveys conducted in Italy [78,86,105,106], which have found that direct experience plays a decisive role in building individual resilience.

The estimated models confirm that the probability of “panicking” is significantly higher among those who have never experienced extreme events, while direct or indirect experience reduces this risk and increases the likelihood of more rational behaviour, such as remaining calm or implementing protective strategies (e.g. ensuring the safety of family members). This shows that experiential memory not only affects risk perception but also contributes to more effective attitudes during emergencies, in line with the findings of Antronico et al. [78].

Another relevant aspect concerns trust in institutions. The data show that individuals who have directly experienced disasters tend to have less trust in local authorities. This attitude may stem from previous experiences perceived as unsatisfactory in the management of an emergency and suggests that institutional trust depends not only on communication, but also on the quality of the responses offered.

In general, the behaviours reported by respondents fall into three main categories: altruism (helping family members and neighbours), immediately seeking escape routes, and, to a lesser extent, remaining calm. This hierarchy of responses confirms the central role of social networks in emergency management, but it also highlights the fragility of individual preparedness, which remains strongly influenced by past experience and the level of trust in institutions.

5.4. Risk perception and the role of memory: evidence from statistical analyses

Statistical analyses conducted using ordered and multinomial logit/probit models enable a deeper understanding of the relationship between risk perception, memory of events, and the socio-demographic characteristics of respondents.

With regard to the perception of the various risks associated with natural hazards (Table 3), significant differences emerge depending on the context. In particular, the risk of landslides is perceived to a greater extent in rural and peripheral areas, by individuals with higher levels of education, and by those who live in rented accommodation, while it is underestimated by the elderly and families with dependent members. Conversely, the perception of flood risk is concentrated mainly in urban areas and among residents living near waterways, confirming the link between geographical proximity and perceived vulnerability. In this case, institutional information has an interesting effect: those who say they are informed about risk reduction policies show a lower subjective perception of exposure, suggesting that communication may play a reassuring role.

Particular results emerge for risks that are less common in the Tuscan context. The perception of hurricanes is higher among adults and the elderly and among those who live in older homes or public housing, demonstrating how the structural vulnerability of buildings conditions the social representation of climatic events that are actually rare in the area. Heatwaves, however, appear to be a typically urban risk, felt above all by those living in densely built-up areas or public housing, as well as among employees and domestic workers, while being underestimated by the elderly. Cold spells, on the other hand, exhibit the opposite pattern: a higher perception among tenants and those who trust institutions, but a lower one among men and people with a medium to high level of education. Finally, the risk of earthquakes does not show any statistically significant associations, confirming its low salience in the respondents' perception.

At the same time, multinomial models on risk memory levels (Table 2) highlight the crucial role of experience in modulating expected behaviours in emergencies. The absence of direct memory is associated with a greater likelihood of panic and greater reliance on institutions, but less awareness of the actions to be taken. Conversely, those who have experienced an event first-hand show less propensity to panic and greater individual preparedness, but also a significantly lower trust in institutions, probably linked to experiences of inadequate management. Indirect memory, mediated by stories or social networks, also reduces the likelihood of panic but tends to translate into forms of symbolic or spiritual reliance, without an increase in practical skills. The literature widely recognizes that both direct and indirect experiences significantly affect the way individuals perceive and interpret risks [78,107–109]. Individuals who have directly experienced events such as floods or landslides, or who have observed their effects on their community, tend to develop a more vivid and accentuated perception of such risks [110,111].

Overall, the results confirm that the perception of risks associated with natural hazards and behavioural reactions are strongly influenced by both socio-demographic characteristics (age, level of education, housing conditions, urbanization) and memory of events. The study by Rufat et al. [112] also highlights how social vulnerability has a significant impact on the levels of perception of floods. While the urban context amplifies the perception of hydrogeological risk and heatwaves, direct experience of extreme events is a decisive factor in strengthening individual resilience, albeit accompanied by growing disillusionment with institutions.

The two surveys, conducted in 2018 and in 2025, also agree that institutional trust alone is not always sufficient to motivate proactive behaviour. The statistical models confirm that memory plays a decisive role: individuals with a direct memory of past events show greater preparedness and a lower likelihood of panicking, but also significantly less trust in institutions, reflecting disappointment with past management. Conversely, those with no such memory tend to rely more on institutions but are less capable of reacting

effectively in emergencies. In this sense, the asymmetry between perception, preparedness, and institutional trust is sharper in 2025 than it was in 2018, because socio-demographic differences (age, education, urban vs rural residence) now strongly shape both perception and behavioural intentions. In contrast, a recent study conducted in Türkiye by Okutan and Otay [95] highlights how institutional trust and credibility can enhance the legitimacy and reach of climate governance. Transparent, responsive, and inclusive institutions are therefore essential for promoting public trust and enabling meaningful engagement in local adaptation strategies.

6. Perspectives, policy implications, and conclusions

In light of the results emerging from the case study and the objective of the research – namely, to identify the paradox between memory, the perception of climate change, and knowledge of hydrogeological risks through the analysis of the case of the metropolitan area of Florence – it is possible to outline a series of operational implications, also connected to international literature, that are useful for strengthening hydrogeological risk management and climate governance in urban areas.

Analyses confirm that risk perception varies significantly among different socio-demographic groups and does not always coincide with actual exposure, as also highlighted by international studies, including the systematic review conducted by Ewa Lechowska in 2018 [113,114]. Ordered regression models show that floods tend to be perceived mainly in urban areas and along watercourses, while landslides are considered a more typically rural problem. Similar results emerge, for example, from research by Harlan et al., in 2019 [115] conducted in the United States, according to which characteristics related to social vulnerability (advanced age, female gender, belonging to ethnic minorities, low income), previous direct or indirect experiences of flooding, exposure to news about flood events, and potential exposure to danger (measured by the proportion of territory at risk) significantly increase the perception of risk of both urban flooding and landslides in rural areas. These dynamics had already been observed in Kauko's 2012 study in Norway [116].

Heatwaves emerge as a typically urban risk, underestimated by older people, while cold spells are minimized by men and more educated individuals. These findings indicate the need to modulate awareness and prevention strategies according to different territorial and social contexts, recognizing that perceptions are shaped by both environmental exposure and the sociocultural position of individuals; the same findings emerge in a study conducted in China in 2022 by Xiao et al. [117], who also believe that risk perception and social structure are the two key factors of social vulnerability in landslide disaster areas.

The role of memory is equally important, as shown by multinomial models. The absence of memory of past events is associated with panic reactions, poor preparedness, and greater dependence on institutions. Conversely, individual memory of catastrophic events tends to reduce the likelihood of panic and strengthen practical preparedness skills, but at the same time erodes trust in institutions. In contrast, collective or indirect memory mitigates fears, although this translates more into symbolic or spiritual reliance than into an actual increase in operational capabilities, as highlighted in the reviews by McEwen et al. [118] and Ridolfi et al. [6]. This evidence shows how memory should not be understood solely as an archive of past experiences, but rather as a crucial variable in the construction of adaptive behaviours and institutional legitimacy. Similar findings emerge from other studies: in Germany [119], Patagonia [120], and, more recently, in the work of Bandyopadhyay et al. [121] (2024) on the case of West Bengal, India, who emphasized how the intergenerational transmission of local knowledge about flood events and the active participation of communities make the latter central stakeholders in a bottom-up approach to risk mitigation.

On this basis, three main implications emerge. First, collective and individual memory should be recognized as a strategic resource and systematically integrated into risk governance processes, as also highlighted by Shuang et al. [122]. As Yuliardi [123] points out, collective memory manifests itself through material artefacts, community narratives, and digital practices, reinforcing a culture of preparedness, psychosocial resilience, and social solidarity; however, it is vulnerable to erosion of meaning, narrative fragmentation, and political manipulation unless it is constantly regenerated through participatory tools. The historical and recent memory of hydrogeological disasters in Florence constitutes symbolic capital that should be enhanced through educational programmes, awareness-raising initiatives, and participatory strategies, while also leveraging innovative digital tools (applications, augmented reality, urban QR codes). Second, institutional communication needs to be reformulated: risk governance cannot be limited to emergency warnings, but rather must be based on transparent, continuous, and multi-channel strategies that include environmental education and the regular dissemination of updates on mitigation and civil protection plans.

Third, differentiated educational approaches need to be developed, combining accessible scientific insights, practical exercises, and spaces for inclusive public discussion, in order to address inequalities related to age, education level, and geographical location. The paradox remains evident: a high perception of climate change and strong memories of hydrogeological events coexist with weak adaptive practices, persistent distrust of institutions, and uneven operational knowledge. This paradox rests on three main elements: (i) the discontinuity and inadequacy of institutional communication; (ii) the underestimation of the role of direct experience, cultural context, and narrative construction in shaping perception; and (iii) the persistence of real or perceived information asymmetry between citizens and policymakers.

While the dramatic memory of the floods of November 2023 and March 2025 has increased social awareness of hydrogeological risk and climate change, territorial disparities in perception and fragile trust in public policies show that experience alone is not enough to generate a resilient consciousness that can be transformed into a “common good” and “collective resource”. It is therefore crucial to rethink risk management strategies at the local level, taking full account of the cultural, symbolic, psychological, and communicative dimensions of risk. Only through an integrated approach that is capable of listening to communities, valuing memory, and promoting situated knowledge will it be possible to transform vulnerability into resilience and awareness into concrete action.

CRediT authorship contribution statement

Francesco De Pascale: Writing – review & editing, Supervision, Conceptualization. **Dante Di Matteo:** Formal analysis, Data curation. **Eleonora Guadagno:** Writing – original draft, Validation, Methodology. **Marco Pecorini:** Investigation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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ANNEX

Demographics	1) How old are you?	18–39 40–59 60 or older
	2) Gender	Male Female Other
	3) What is your nationality?	Italian Other (please specify)
	4) In which Municipality do you live?	Florence Other (please specify)
	5) How many members are there in your household?	1 2–3 4–5 6 or more
	6) How many members of your household are ...	... aged 14 or younger ... aged between 15 and 64 ... aged 65 or older
	7) Are there any non self-sufficient people in your household?	Yes, how many? No
	8) Do you live in an area that is ...	Urban Rural
	9) The dwelling where you live was built:	Before the early 1970s After the 1970s I don't know
	10) What type of dwelling do you live in?	Upscale or villa (owned) Upscale or villa (rented) Middle-class/civil (owned) Middle-class/civil (rented) Low-income/social housing (owned) Low-income/social housing (rented)
	11) The places you frequent (where you live, study, or work) are located near a river or a watercourse?	Yes No I don't know
	12) What is your current employment status?	Unemployed/not employed Student Retired Homemaker Employee Entrepreneur/freelancer
	13) How long does it usually take you to reach the place where you study or work?	15 min (on foot) 15 min (by bicycle) 15 min (by car or public transport) Between 15 and 60 min (on foot) Between 15 and 60 min (by bicycle) Between 15 and 60 min (by car or public transport) More than 60 min (on foot) More than 60 min (by bicycle) More than 60 min (by car or public transport) I neither study nor work
	14) What is your highest level of education?	No qualification

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Section I Climate change	15) Do you believe that climate change is occurring globally?	Primary school certificate
		Lower secondary school certificate
		Upper secondary school diploma
		Bachelor's or Master's degree
		Yes
	16) What are you most concerned about regarding the impacts of climate change? (max 2 answers)	No
		I don't know
		Myself, my family, and the community where I live
		My nation: Italy
		People worldwide
	17) In your opinion, which of the following global phenomena are associated with climate change? (max 3 answers)	Nature and the environment
		Not concerned at all
		I don't know
		Rising temperatures
		Melting glaciers and sea level rise
	18) Do you think the following extreme events are related to climate change? (yes/no/I don't know)	Ozone hole and greenhouse effect
		Increased frequency of extreme events
		Loss of biodiversity and extinction of species
		Increased migration and conflicts
		Drought and desertification
	19) In your opinion, which of the following local phenomena are associated with climate change? (max 3 answers)	I don't know
		Landslides
		Floods
		Earthquakes
		Coastal erosion
Section II Politics and Institutions	20) Do you believe that the political actions and measures of local, regional, and national governments are sufficient to reduce the risk of landslides and floods?	Volcanic eruption
		Hurricanes
		Tsunamis
		Drought and heat waves
		Cold waves
	21) Which of these statements do you personally agree with?	Increase in wildfires
		Decrease in agricultural and fishing production
		Water scarcity
		Spread of diseases
		Increase in immigration
Section III Information, emotions and behavior	22) What are your main sources of information on climate change and the risk of landslides and floods? (max 3 answers)	Economic damage and negative impacts on local tourism
		Increase in heavy rainstorms
		Increase in heat waves
		I don't know
		Yes
	23) If a landslide or flood were to occur, how do you think you would behave?	No
		I don't know
		I am frustrated because not enough is being done to reduce hydrogeological risk in Florence and surrounding areas
		I am certain that the correct strategies are being implemented to reduce hydrogeological risk in Florence and surrounding areas
		I am confident that the number of landslides and floods in Florence and surrounding areas will be reduced
	24) If landslides or floods were to occur, what might your reactions be? (max 2 answers)	I fear the possible effects of climate change
		I am not very concerned about climate change
		I don't know how to answer
		Family and friends
		Internet and social networks
		Universities, research bodies, experts
		School
		Region/Province/Municipality
		Civil Protection
		I am not informed
		I don't know
		I know what I should do
		I don't know what I should do
		I would seek information (TV, Internet, radio, neighbours, experts)
		I would wait for the intervention of authorities
		I would rely on God
		I don't know how to answer
		I would rush to find an escape route
		I would help my family and others in difficulty first
		I would panic
		I would not panic
		I would remain still

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25) If landslides or floods were to occur, would you trust the intervention capacity and preparedness of local government authorities?	I would remain indifferent				
	I don't know how to answer				
26) From 1 (not at all) to 5 (very much), how truthful do you consider these statements about hydrogeological risk?	Yes				
	No				
27) From 1 (not at all) to 5 (very much), how exposed do you think you are to each of these events in your area?	I don't know				
	The risk of landslides and floods is due to climate change				
28) Mark with an X the damages you fear most (max 2 per event).	The risk of landslides and floods is due to human-made infrastructures and lack of land maintenance				
	Climate change is a media and political fabrication				
	The area where I live and work is safe from the risk of landslides and floods				
	The risk of landslides and floods can be reduced by changing daily lifestyles				
	Earthquake				
	Landslide				
	Flood				
	Hurricane				
	Heat wave				
	Cold wave				
	Event				
	Personal physical harm				
	Damage to home/property				
	Workplace damage/unavailability				
	Personal psychological problems				
	Earthquake				
	Landslide				
	Flood				
	Hurricane				
	Heat wave				
	Cold wave				

Data availability

Data will be made available on request.

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