Tsunami risk perception state-of-the-art and the extensive survey in Italy

CAT-INGV
Social Science team

CENTRO ALLERTA TSUNAMI
ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

CAT-INGV Social Science team

The research team consists of researchers working in various institutions, deploying expertise in different disciplinary fields

Istituto Nazionale di Geofisica e Vulcanologia

Alessandro Amato, seismologist
Lorenzo Cugliari, sociologist
Massimo Crescimbene, psychologist
Federica La Longa, psychologist

University La Sapienza of Rome
The Department of Communication and Social Research (CoRiS)

Andrea Cerase, sociologist

National Research Council
Institute for Research on Population and Social Policies (IRPPS)

Loredana Cerbara, statistician

A global survey on tsunami risk perception

Cugliari et al., Frontiers in Earth Science, in press, 2022

- Seven surveys with focus on the Indian Ocean (IOTWS)
- Ten surveys with focus on the Pacific Ocean (PTWS)
- Six surveys with focus on the Mediterranean Sea (NEAMTWS)

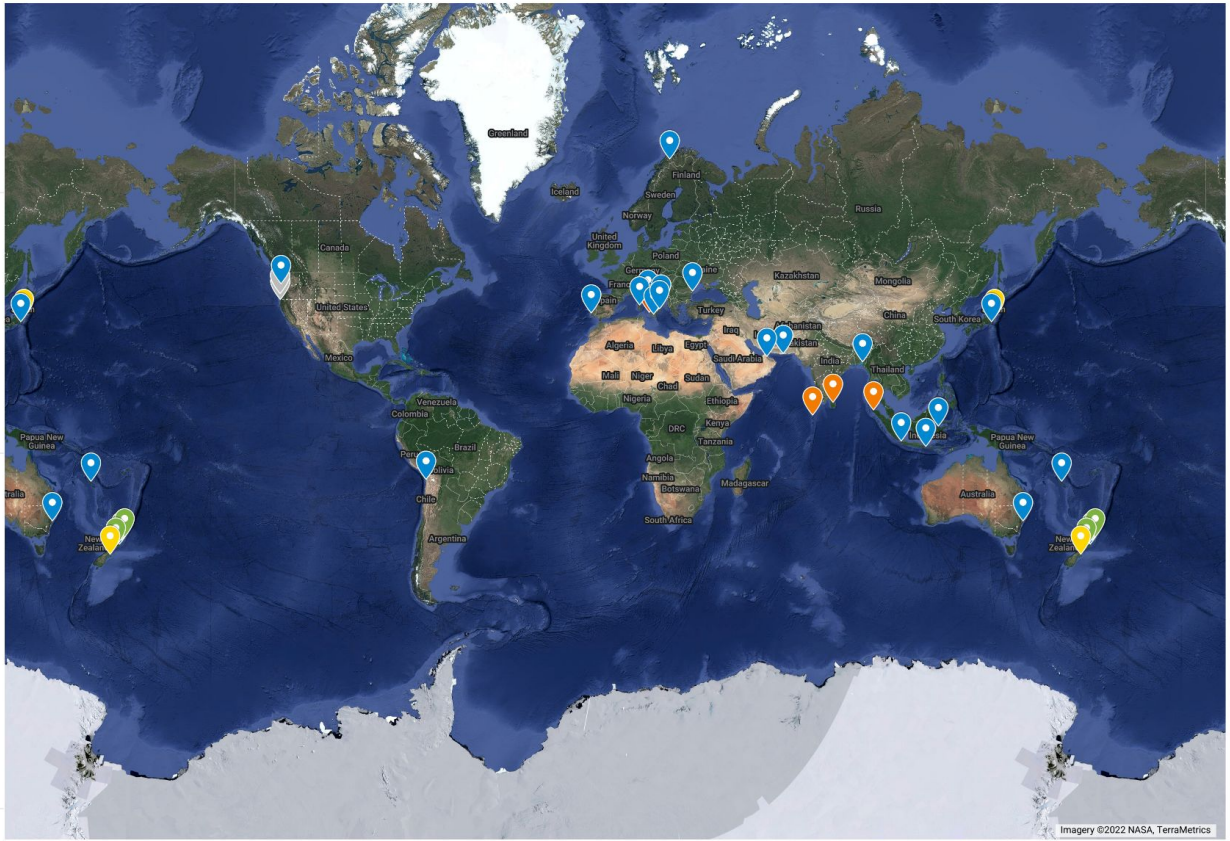
Tsunami Risk Perception

Italy - RPS
- Calabria
- Apulia
- Sicily
- Sardinia
- Campania
- Latium

IO_TWS
- Sri Lanka
- Indonesia
- Maldives
- Bangladesh
- Gulf of Oman
- Bali
- Banten
- Gwadar
- Palu City

P_TWS
- Sydney
- Iquique
- Kamakura
- Christchurch
- Hitachi
- Wellington
- Gisborne
- Hawke's Bay
- Seaside
- New Caledonia
- Coos Bay
- Crescent City
- Wairarapa

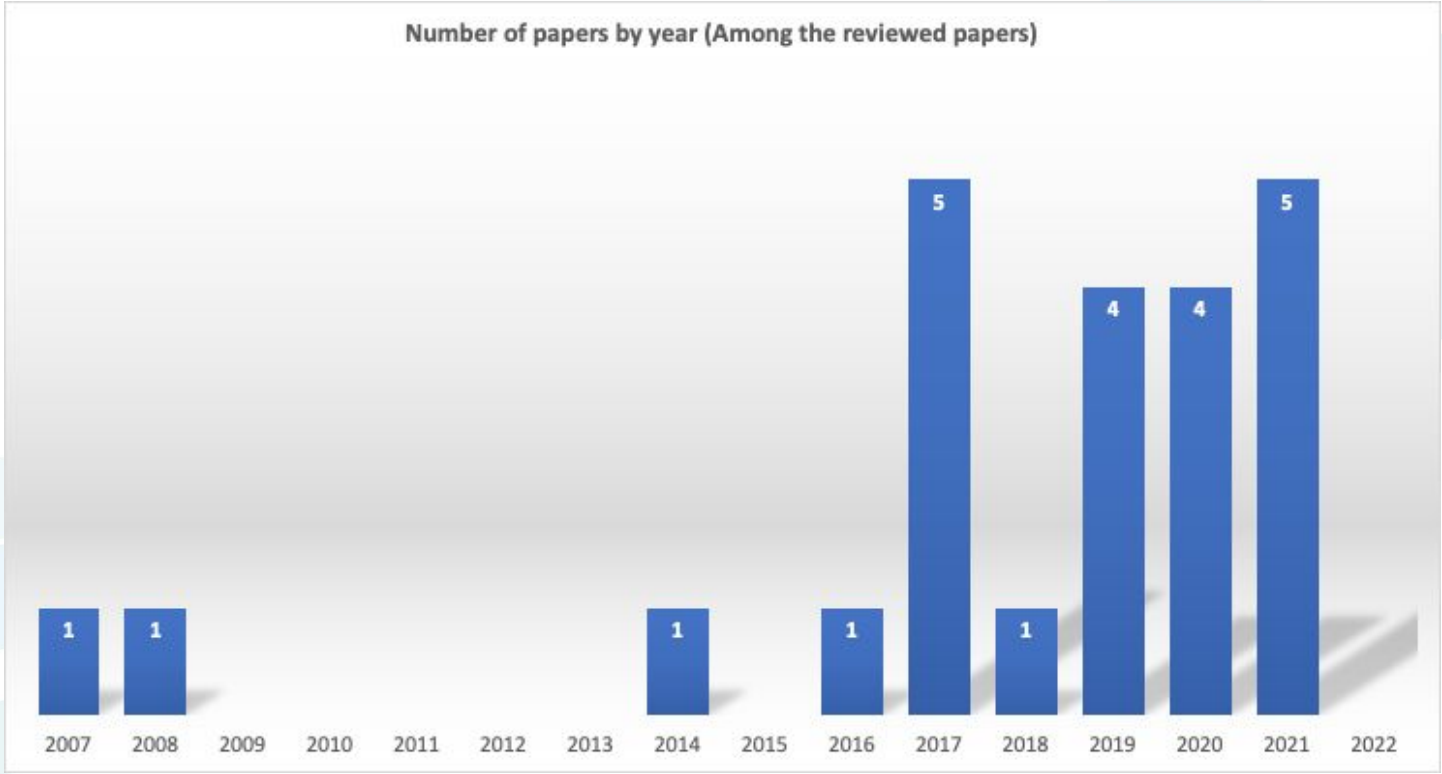
NEAM_TWS
- Lyngseidet
- Eforie Nord
- Sines



CENTRO ALLERTA TSUNAMI

In the NEAM region

Time distribution of the studies



A summary table

Reference	*Method*	*Sample*	*Place*	*Tsunami history*	*Strength*	*Weakness*	*Most important lesson to be learned*
Kurita et al. (2007)	Survey	3000 interviews	Indian Ocean (Sri Lanka, Maldives, Indonesia)	2004 Sumatra tsunami	First large scale survey; data highlight Simeulue as a relevant matter of interest	Descriptive statistics, does not provide explanatory model	Lack of pre-existing knowledge about tsunami, also from civil protection officers
Alam (2016)	Mixed methods (quantitative / qualitative)	30 interviews + in-depth interviews	Indian Ocean (Bangladesh)	1762 earthquake and tsunami	Joint use of different methods	Small, non-probabilistic sample	Low risk perception, religious based fatalism
Salah and Sasaki (2016)	Mixed method	153 questionnaires + in-depth interviews	Southern Iran (Gulf of Oman)	1945 Makram earthquake and tsunami	First survey in the area; relevance of survivors of past tsunami experience	Sample size (low number of cases)	Lack of awareness, low risk perception, role of religion, low trust in institutions
Hall et al. (2019)	Survey	Stratified sample, 304 interviews (tourist from 40 countries)	Indian Ocean (Bali, Indonesia)	2004 Sumatra tsunami	Investigates tourist's risk perception and their sources of information and knowledge	Subsamples were too small to have convincing data on single countries	Lack of available information sources on place, prior knowledge in their home country
Akbar et al. (2020)	Survey	174 interviews (victims of 2018 Sunda tsunami in Bantan)	Indian Ocean (Bantan district, Indonesia)	2018 Sunda strait tsunami	Considers people affected by a recent tsunami event	Questionnaire items are neither presented nor discussed, research is only on aggregate indicators	"the higher disaster risk perception of a person, the higher disaster preparedness level"
Mengal et al. (2020)	Survey	264 interviews	Balochistan, Pakistan (Gulf of Oman)	1945 Makram earthquake and tsunami	Considers information source and individual ability to address risk	Strong gender polarisation in sample, women were not allowed to participate survey	Strong use of smartphones as information source, individual ability to compare tsunami with other risk sources
Harnantyari et al., (2020).	Survey	197 valid interviews	Indian Ocean (Sulawesi, Indonesia)	2018 Sulawesi earthquake and tsunami	Considers people affected by a recent tsunami event, investigates individual response and mitigation measures	Official tsunami warnings failed to reach residents, road congestion resulted in further difficulties to evacuate (near-field tsunami)	High level of tsunami awareness, sometimes coming with a low understanding of phenomena. For 82.5% evacuation was triggered by witnessing others evacuating (imitation)

Motivations …

Summary of the main results

Strong heterogeneity in sampling methodology

Mostly residents involved (4/23 also tourists)

…

1. studying tsunami risk perception within different geographical, social, political and local contexts is, at the same time, a necessary and indispensable means to achieve an effective implementation of local (and intergovernmental) mitigation actions.

2. tsunami risk is not homogeneously perceived even within the same community, as it is affected by different socio-demographic variables such as gender, age, education level, average income and presence of children in the household/family (see Alam, 2016; Wei et al., 2017; Akbar et al., 2020; Buylova et al., 2020; Dhellemmes et al., 2021), as well as hazard proximity and social memory of past events
3. Third, tsunami risk perception is in part related to psychological features of individuals, and in part to local cultures.
4. Finally, some methodological considerations on social research should be kept into account, as sample size, research design, and questions' formulation could heavily affect validity and reliability of data.

5. As a general starting point, we can say that most of the cases reported here point out the low consideration of tsunami risk by people living in the coastal areas, independently from the region of the world and from the frequency of past tsunamis.
6. In many regions the risk posed by "small" tsunamis is strongly underrated.
7. the use of the term "tsunami" (as known, a Japanese language term) and of other terms traditionally used in the local language, such as for instance "maremoto" in Italian and Spanish (Cerase et al., 2019), or "flodbølge" in Norwegian (Goeldner-Gianella et al., 2017).
8. the importance of memory in people's perception of tsunami risk (Arias et al., 2017; Cerase et al., 2019; Wei et al., 2017). In this sense, the need for frequent drills has emerged in several areas (Gravina et al., 2019; Buylova et al., 2020; Chen et al. 2021), as important tools for stimulating the response of citizens towards the tsunami risk.
9. is the recognized importance of the so-called "natural warnings" that come before or along tsunami events, and the need to make people aware of them.
10. Another element emerging from some of the studies analyzed here is the importance of traditional media, mainly TV, as the main source of information for people (New Zealand, Italy, Romania, Norway), and as one of the preferred ways to receive alert messages.

No tsunami mitigation without studies on population

A key to mitigating tsunami risk effectively

Community studies

Knowledge (informations)

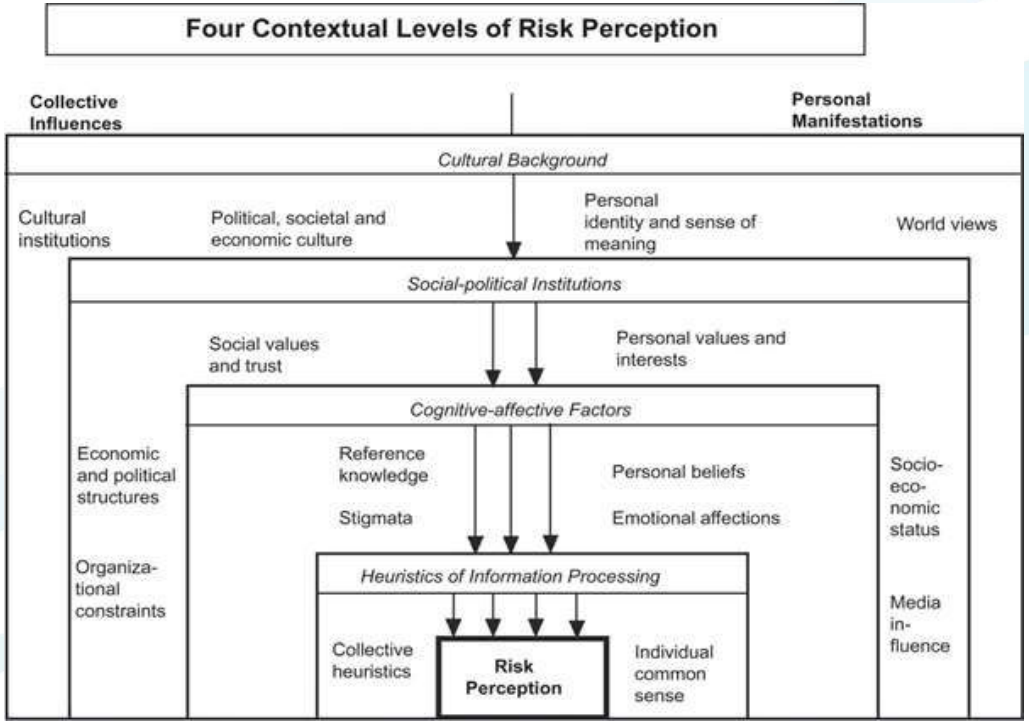
Awareness

Preparedness

Mitigation

Human behavior is driven by perceptions (Slovic, 1987) rather than scientific knowledge about "facts" (Renn, 1990).
Therefore, it becomes strategic for those involved in risk mitigation and communication to ground their strategies on data from **in-depth studies on the process that influences our ability to assess the risk of different natural phenomena** (Slovic, 1982) **including tsunamis**.

A brief theoretical definition of risk perception



Renn & Rohrmann, 2000

Why studying tsunami **risk perception** and **knowledge**?

- To provide both **empirical and statistically robust data** on people' s **perception** and **knowledge** of tsunami risk. This is also necessary to contribute to **reducing** the population **data gap** in the NEAM area.
- To survey **differences** in tsunami risk perception **by coastal area** and to study how much context: environmental, social, and psychological (including historical memory), may influence perception.
- To identify the most appropriate **channels** and techniques **to convey information** and effectively disseminate alert messages**;**
- To build or improve **multi-channel science communication** strategies and activities.

Methodological issues and solutions

For the purposes of this research, the challenges were at least two:

1. **To establish the type of information** to be included in the survey based on the reference literature and the aims of the project.

   Hypothesis: *construction of summary indicators capable of measuring the perception of tsunami risk at an individual level to be projected on the territory and compared with the known geo-morphological characteristics*

   Choice: *literature review, choice of indicators, construction of the questionnaire for administration with the CATI method and comparability with other international experiences*

2. **To intercept the most suitable reference universe** and and survey methods that allow the desired information to be obtained.

   Hypothesis: *the population most exposed to risk has priority for inclusion in risk perception studies and a different perception compared to the national average is assumed*

   Choice: *coastal population, i.e. resident in the coastal municipalities and national control sample*

The questionnaire

Consisting of **6 sections** and **27 items** that allow us to detect respondents' opinions regarding tsunami knowledge, risk perception, representation, cultural attitudes toward risks and through which channels respondents have been informed about tsunamis and would like to receive an alert in case of tsunami.

SECTION 1:
SOCIO-DEMOGRAPHIC DATA AND INFORMATION ON RESPONDENTS' BELONGING TERRITORY

SECTION 2:
LEVEL OF AWARENESS AND SOURCES OF KNOWLEDGE ABOUT TSUNAMI HAZARD

SECTION 3:
CONTEXTUAL PERCEPTION OF TSUNAMI HAZARD

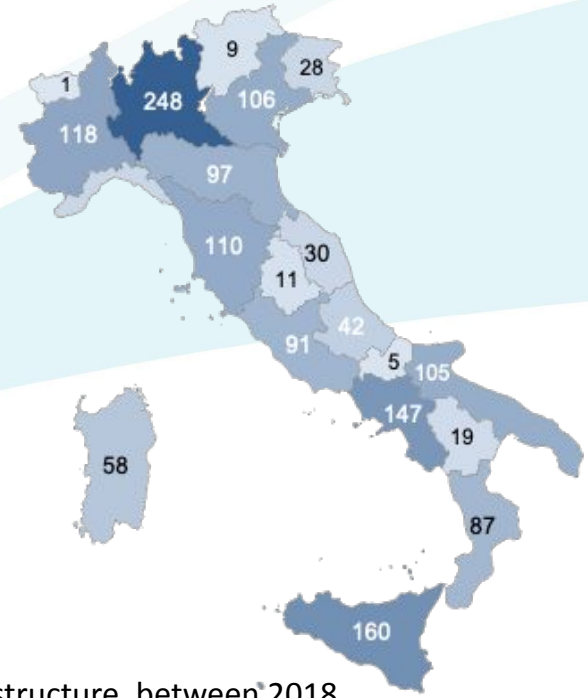
SECTION 4:
REPRESENTATION OF TSUNAMIS

SECTION 5:
CULTURAL ATTITUDES AND WORLDVISION

SECTION 6:
MESSAGES AND CHANNELS TO SPREAD TSUNAMI ALERT

Italian regions surveyed

Telepanel (National wide sample)



The sample was built in multiple waves, through a modular sample structure, between 2018 and 2020. In addiction a national survey using a telepanel was carried out in 2021.

Tsunami Risk Perception interviews distribution.

Blue shows interview distribution in the first phase of the survey

Red shows interview distribution in the second phase of the survey

In yellow, interview distribution in the third phase of the survey

2018

I^Phase

- Calabria
- Puglia
- **1021 questionnaire**
- Paper su NHESS (Cerase et al. 2019)

2020

II^Phase

- Eastern Sicilia
- Ionian and Tyrrhenian Basilicata
- Molise
- **614 questionnaire**
- Presentation of preliminary analysis and results at EGU 2020 (Cugliari et al.2020)

2021

III^Phase (December 20/January 21)

- Lazio
- Campania
- Sicilia
- Sardegna
- 4207 CATI questionnaire
- 1500 Telepanel (national sample)
- Preliminary analysis pres. @EGU 2021 (Cugliari et al.2021)

Some survey numbers

	1^ Stage		2^Stage			3^Stage				
Regions	**Apulia**	**Calabria**	**Molise**	**Basilicata**	**Eastern Sicily**	**Latium**	**Campania**	**Sicily** (except eastern)	**Sardinia**	**Total**
Total Residents	1.716.797	1.120.698	43.800	58.345	834.881	3.786.704	1.925.984	2.137.306	859.721	**12.484.236**
Coastal municipalities	67	116	4	7	29	20	40	96	71	**450**
No. Respondents	722	491	100	140	374	1.034	1.170	1.221	782	**5.842**
Total	**1021 Respondents**		**614 Respondents**			**4207 Respondents**				

2018 / 2020 / 2021 – Territorial distribution

Regions	No. of provinces	Coastal municipalities	Respondents	Km of coast surveyed
8	**37**	**69,8%** (450/645)	**5.842 (12.484.236 pop tot)**	**77,9% (6.166km)**

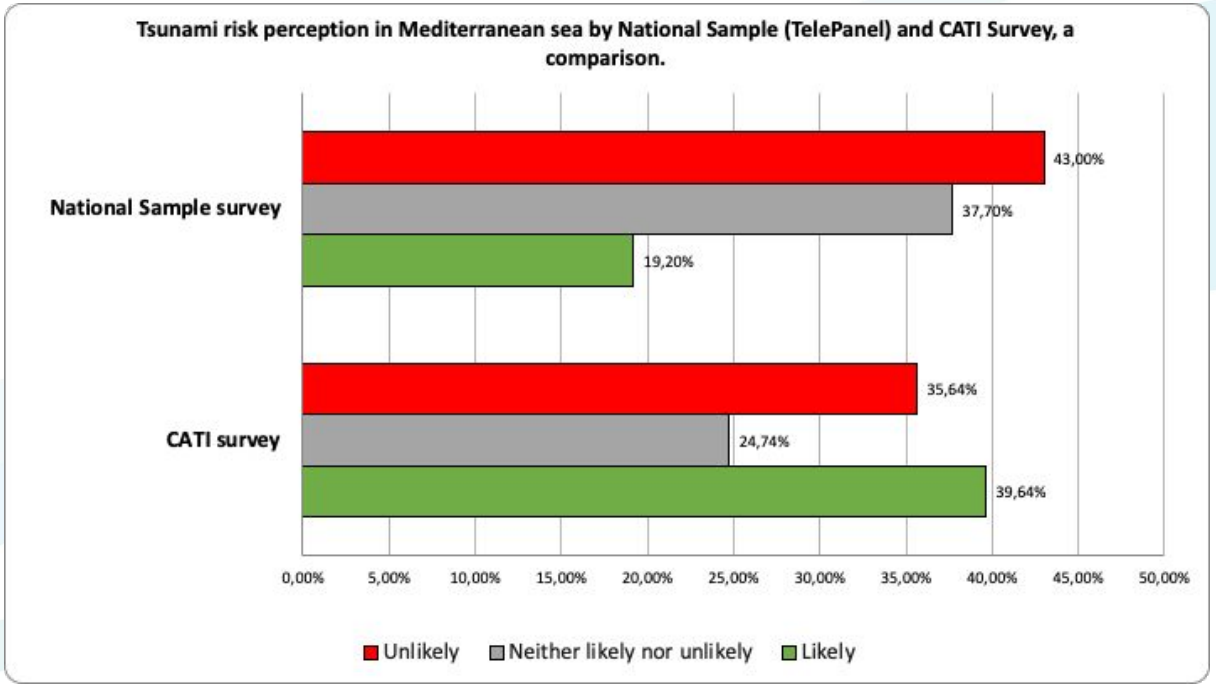
Sample validation and comparison

The four surveys can be used independently for statistical analysis of the results. However, an analysis based on **probabilistic hypothesis tests** on the average differences in the **three coastal samples** was performed to verify the possibility of aggregating them in a single survey, always leaving aside the one detected with the telepanel.

The tests made it possible to form a single sample of 5,842 units which allows the construction of territorial maps of perception of the tsunami risk.

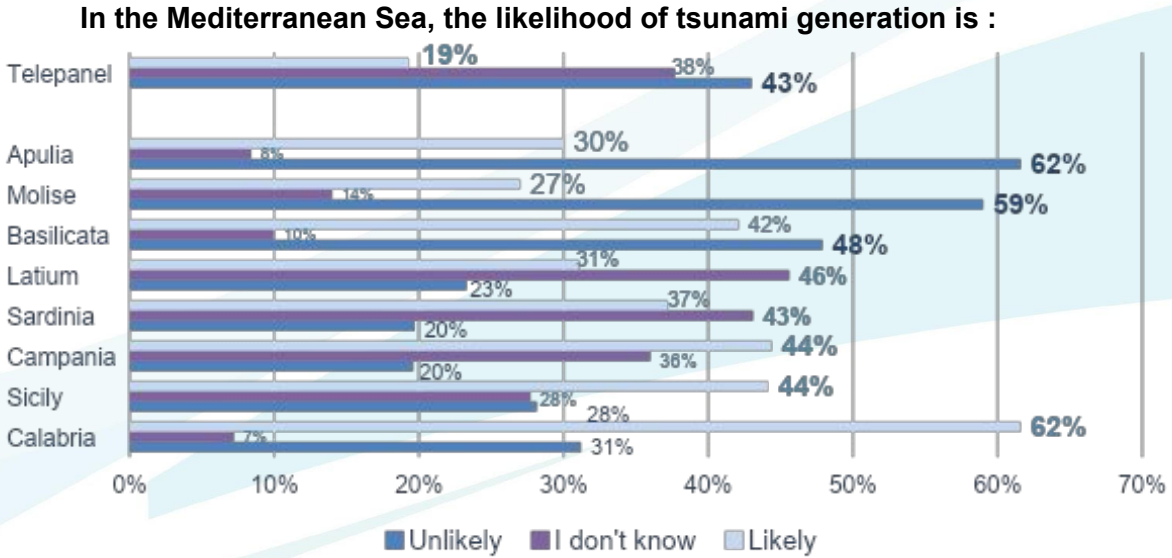
On the unified sample it was possible to carry out a statistical evaluation of the series of questions in order to build various instruments for measuring the perception of the investigated phenomena with a robust procedure.

Global comparison with national and coastal survey



General level and comparison with telepanel

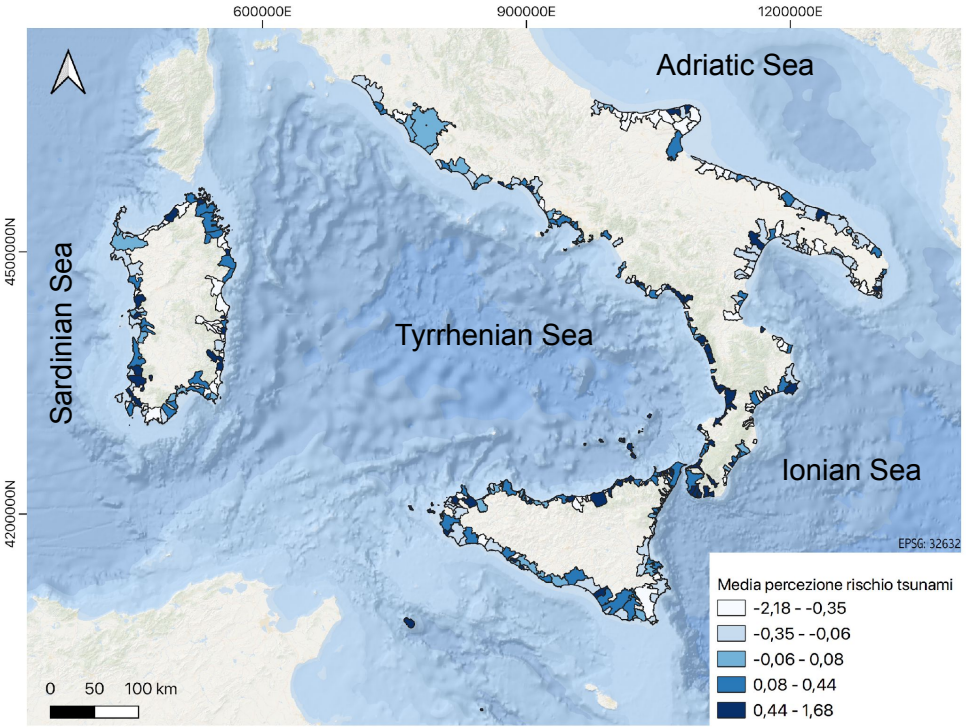
Tsunami risk perception **changes among coastal slopes** and **correlates with the national sample average** of responses (Telepanel)



Different tsunami risk perception.

- Those living in **Tyrrenhian slope coastal municipalities** (Campania, Calabria and Sicily) have a **greater** tsunami **risk perception**.
- Those living in Adriatic coastal municipalities (Molise e Puglia) has **a lower tsunami** risk perception.
- On the **national sample**, significant percentages of **low risk perception** and **low knowledge** about tsunamis emerge.

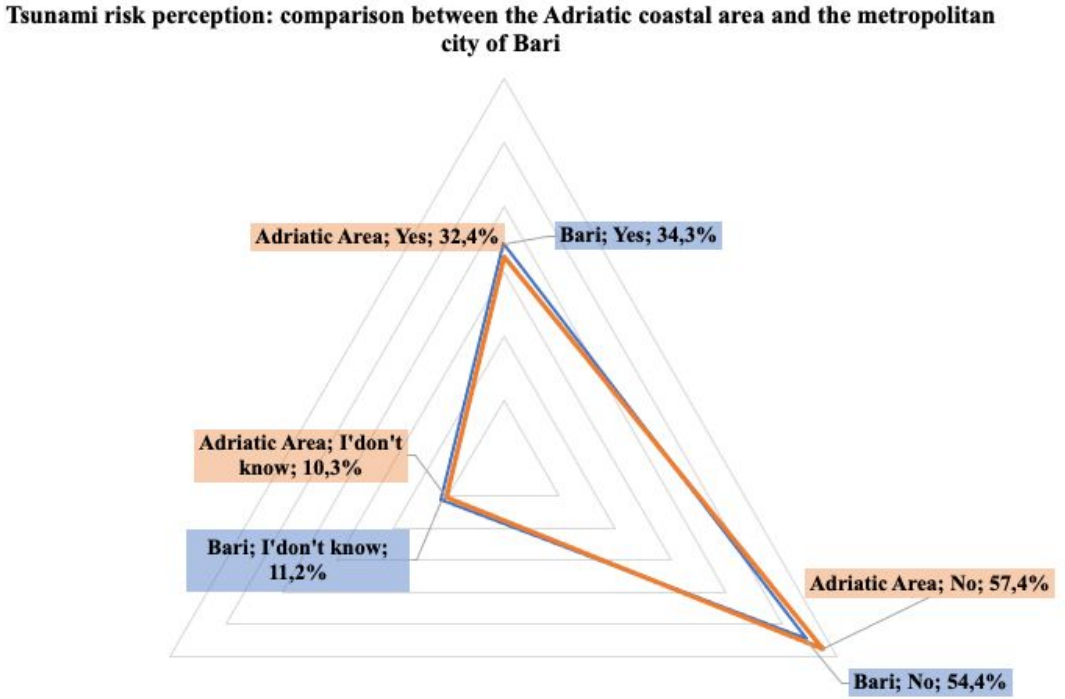
Municipality level: Tsunami risk perception in coastal municipalities



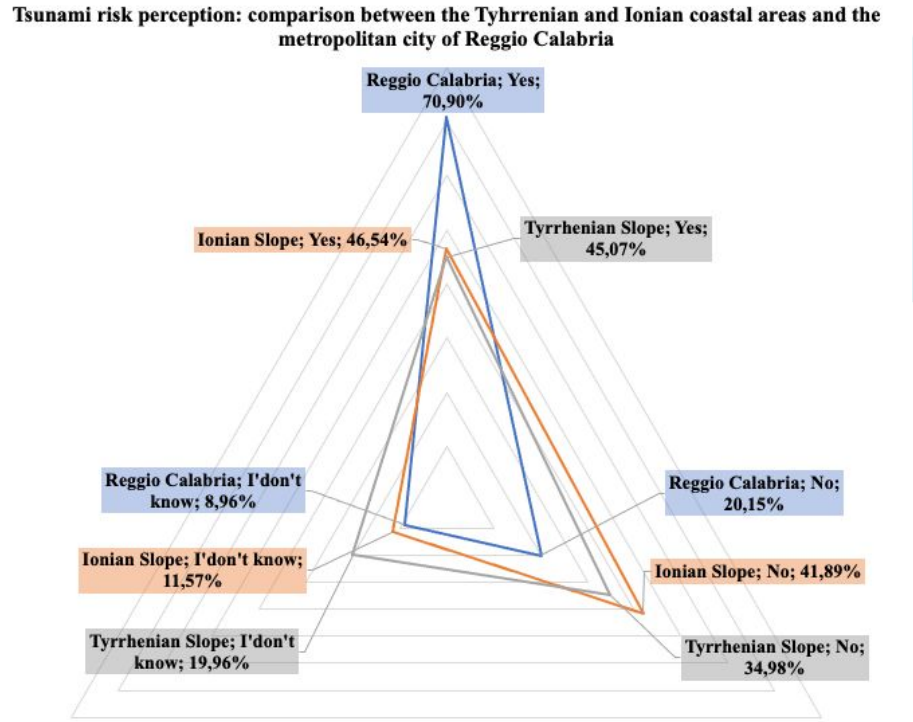
Metropolitan level: Focus on major cities involved

Region	Latium	Campania	Apulia	Calabria	Sicily
Metropolitan coastal city	**Rome**	**Naples**	**Bari**	**Reggio Calabria**	**Catania**
Sub demographic areas	6	5	2	5	2
Total municipalities	121	92	41	97	58
Total residents	4,342,000	4,250,000	1,261,000	549,000	1,068,000
Metropolitan city respondent	**824**	**938**	**169**	**134**	**155**
Seaside respondent	**3201**	**3201**	**549**	**910(Ionian)** **3201(Tyrrhenian)**	**910**

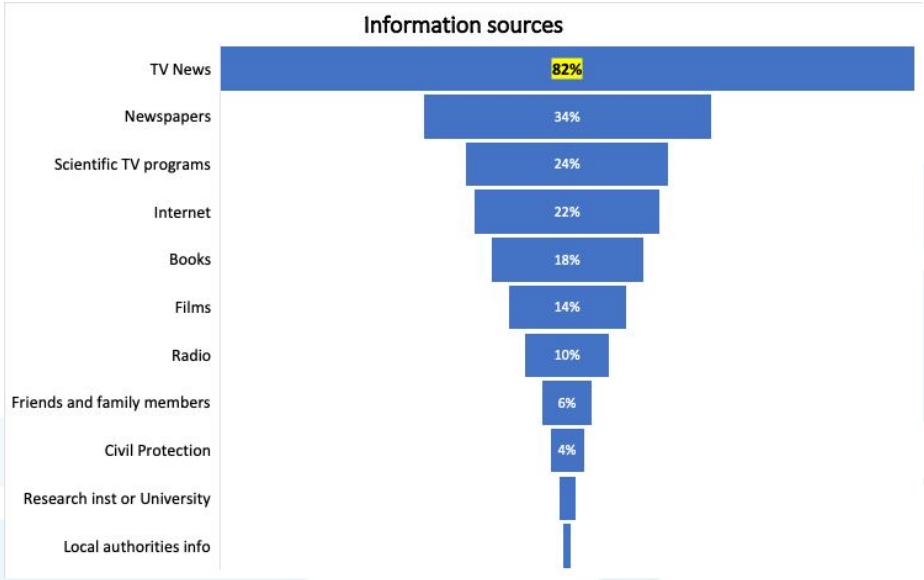
Area comparison level:
Adriatic coastal vs metropolitan city of Bari

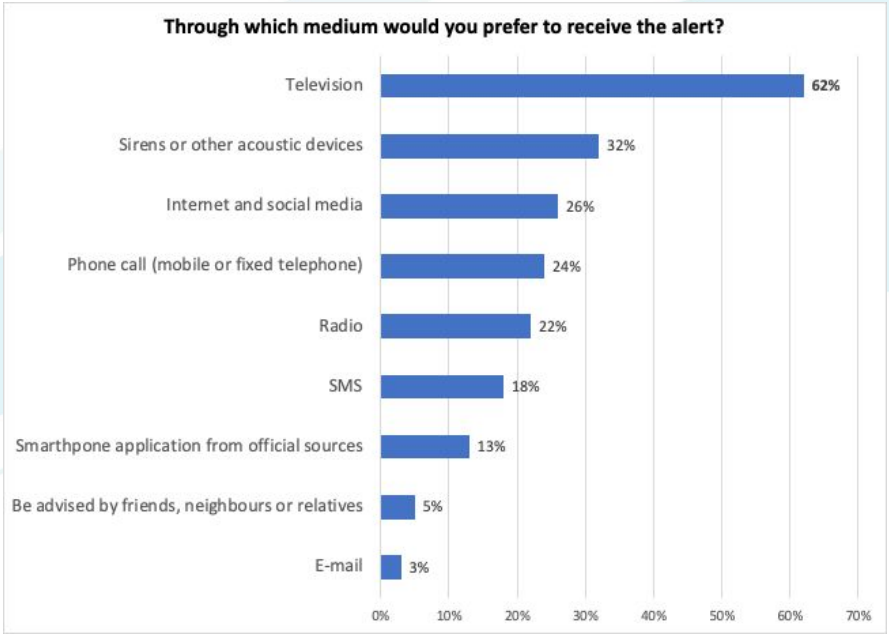


Area comparison level:
Tyrrhenian and Ionian coastal areas vs metropolitan city of Reggio Calabria



Global level: indicators on information sources





Respondents show strong attachment to mainstream media (TV).

- As an information source.
- As a tool for receiving early warning.

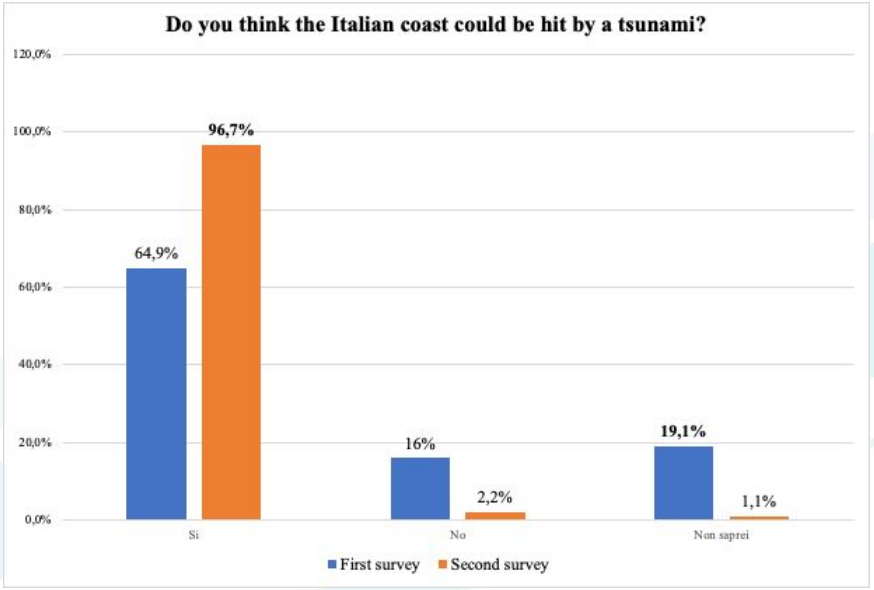
Awareness raising activities
Tsunami Risk Perception in School 2022

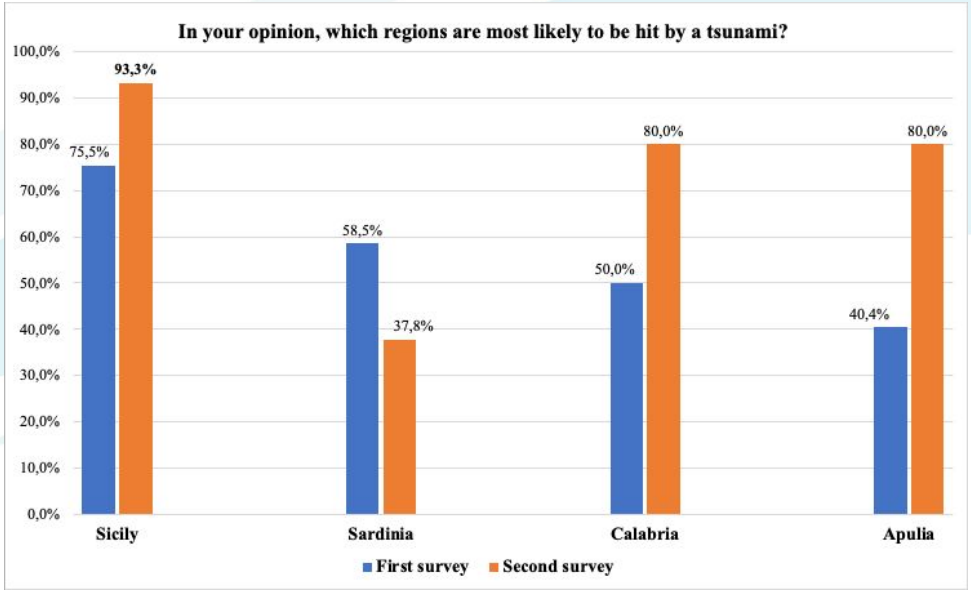
- ✔ 2022 - Online questionnaire on Google Form
- ✔ Suitable version for school administration
- ✔ 81 Questionnaires collected in Minturno (Joining Tsunami Ready Program)
- ✔ 94 Questionnaires collected in Tivoli (Risk perception study pilot school)

Tivoli (RM) Classroom

Minturno (LT) Main hall

On Line questionnaire


Do you think the Italian coast could be hit by a tsunami?
120,0%
100,0%
80,0%
60,0%
40,0%
20,0%
0,0%
64,9%
96,7%
16%
2,2%
19,1%
1,1%
Si
No
Non saprei
First survey
Second survey


In your opinion, which regions are most likely to be hit by a tsunami?
100,0%
90,0%
80,0%
70,0%
60,0%
50,0%
40,0%
30,0%
20,0%
10,0%
0,0%
75,5%
93,3%
58,5%
37,8%
50,0%
80,0%
40,4%
80,0%
Sicily
Sardinia
Calabria
Apulia
First survey
Second survey

Thanks for your attention