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MISAR: Proposal for "Climate Change Risk Management by improving the Individual and Social Awareness of Risk in Sicily"

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Abstract. Rapid climate change is expected to have enormous impacts worldwide, both in society and the natural environment. The MISAR project pursues to analyse awareness of individual and societal risks and apply disaster risk management rehearses throughout Sicily. To begin with, previous studies, available surveys and sentiment analysis will be conducted, then different methods including analysis of social media, their distribution, the development and design of applications and interactive games that increase people's understanding of the climate change risks will be evaluated. The dynamic of vulnerability and exposure to this phenomenon should be presented to the people, particularly the most vulnerable groups of people and the stakeholders by modern communication networks. The results are expected to advise the application of the Sendai Framework for Disaster Risk Reduction 2015-2030 and the EU adaptation strategies.

Keywords. Risk-Management, Resilience, risk perception, climate change, network

Introduction

Climate Change (CC) has wide impact both on the natural environment and on the wider society, through the complex interplay of chronic, long-term natural hazards, and shorter episodic events, from floods and rising sea levels to droughts and heat waves (Faas & Barrios, 2015; IPCC, 2018).

The effects of unsustainable development activities can have significant detrimental consequences in vulnerable areas such as coastal areas (Balasuriya, 2018). Healthy coast near urban areas can play a role in the city, affect urban identity, enrich the visual aspects of life there, and generally affect the quality of life (Cetin, 2016). These areas are very important because they protect the various biological networks with economic and biological importance and people. Many of these areas are exposed to catastrophic natural hazards due to proximity to the sea, high population traffic, and economic activities (Aslam et al., 2017; Islam et al., 2016; Sahoo & Bhaskaran, 2018).

In the pilot study area (i.e., Sicily, Italy), by referring to previous studies, hazards and vulnerabilities relating to climate change can be listed as: rising in temperature and sea-level, local subsidence, storm surge, flooding, drought, precipitation anomalies, coastal and soil erosion, firing and earthquake (Anzidei et al., 2021; Arnone et al., 2020; Baiamonte et al., 2019; Beltran et al., 2021; Nanni et al., 2021; Scicchitano et al., 2020). As such, if a multi-approach is to be mainstreamed within risk governance, forward-looking tools and methods are needed for decision-makers, particularly those that build

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on new technologies (e.g. Machine Learning, agent-based models, or system dynamics) capable of exploiting the increasing volume and velocity of available big data (Arslan et al., 2018).

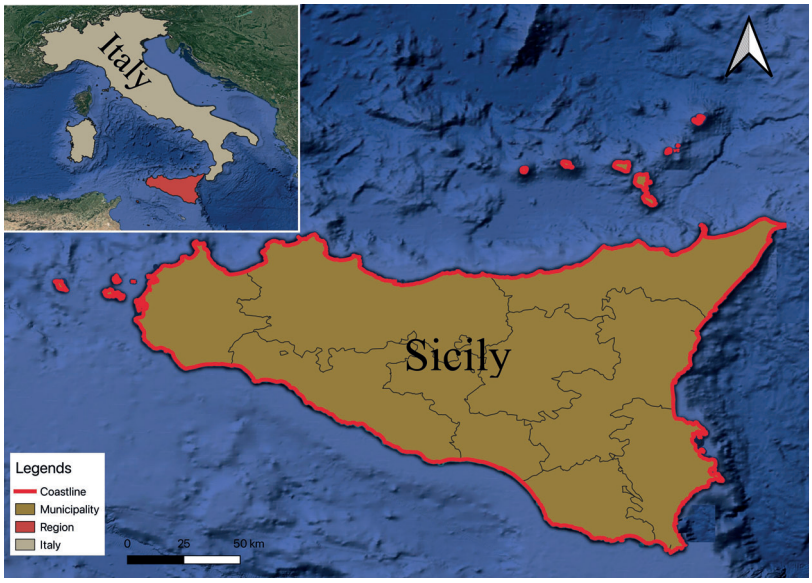

Fig. 1
Map of Pilot Study Area i.e. Sicily, Italy

Strengthening resilience in the face of hazards and climate change processes have certainly become a vital task for planners and policymakers (Barbarossa & Pappalardo, 2021). Individual behavior and risk perception are inseparable and strongly interrelated in global diseases (like COVID-19 circumstance). Therefore, higher risk perception can increase a

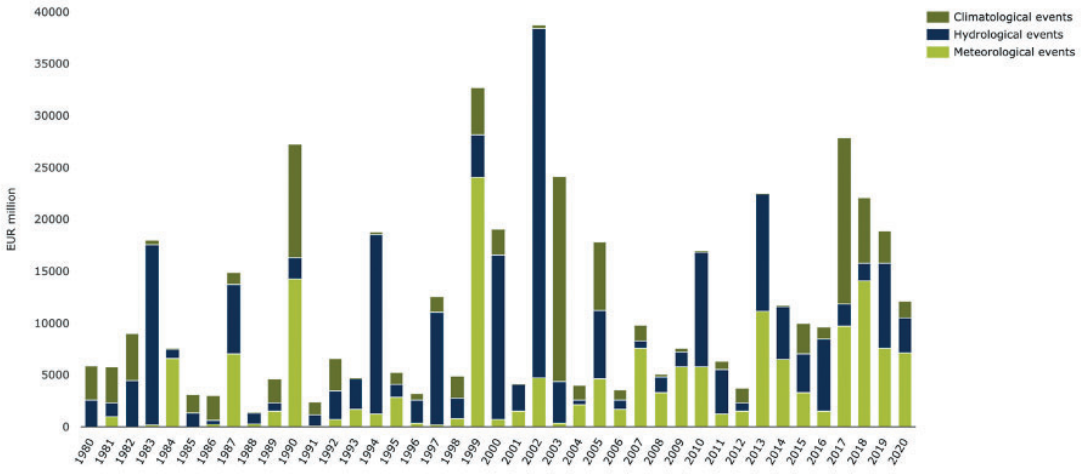

Fig. 2
Annual economic damage caused by weather and climate-related extreme events in the EU Member States (Source: EEA, 2022)

person's commitment to preventative measures (Savadori & Lauriola, 2021). There are some behavioral models such as Reasoned Action Theory (Fishbein & Ajzen, 1975) and Planned Behavior Theory (Ajzen, 1991) that debate the chance and the scale of a potential hazard (risk perception) as vital factors in determining risk behavior.

Henceforth, MISAR aims to explore the multiple risks by considering the climate change and natural hazards interaction to enhance the quality of environment across the land-sea edge. Furthermore, by utilising the Spatio-Temporal data in the frame of a combined framework, the interacting drivers and risks will be defined and weighed, and an unexpected risk scenario can be quantified. The expected results will guide the decision-makers for the climate change adaptation and align with the EU's new adaptation strategy (EC, 2021).

Economic losses from climate-related extremes are becoming more common from 1980-2020 and estimated totally around EUR 487 B within 27 European members (EEA,2022, Botzen et al., 2019) (Figure 1). Although climate change is not the only reason for the losses, due to recent IPCC report could cause greater losses without mitigating action (Seneviratne et al., 2021).

It needs to be considered that these damages are including direct economic damages into physical resources, and indirect losses resulting from cascading effects, ecosystem services and other such examples are omitted. Additionally, the role of risk perceptions and behavior are not well-fitted in these records and future protection. Neglecting the behavioral responses to risk and ignoring its key role play causes misleading in contemporary risk assessment (Aerts et al., 2018; Haer et al., 2016). Present computational social science methods make it possible to incorporate interactive aspect of people for making decision into multi-risk assessment. These methods exhibit complicated communication of people in diverse social domains and practice their social behavior for better disaster risk management policies (Conte et al., 2012).

1. Building disaster-resilient societies

Sendai Framework is stated that the potential adverse impact of hazardous events which could occur to a community depends on the combination of hazard itself, exposure, vulnerability and, moreover, of capacity (UNISDR, 2015). The capacity to deal with adverse conditions requires not only good crisis management from an institutional point of view, but also risk perceptions among the people and decision-makers, both in "ordinary" times and in times of catastrophe, to facilitate prevention and preparation.

The behavior of people, governments and civil society groups heavily relies on their risk awareness, which is varied due to many factors as geography, previous hazard exposure, attitudes, social trust, education level, gender, involvement in training, and economic contexts, as well as social media, resulting in huge differences in approaching disasters even within Europe since it is prone to a different type of natural and man-made hazards (EC and EEA, 2021).

All these considerations indicate a notion that growing the resilience of societies must necessarily be chased through a "holistic approach". This could be a turning point in disaster risk assessment and management to be more effective in risk reduction by combining the

technical and social disciplines. Therefore, we engage stakeholders including people, state/non-state actors to use new technologies through the network.

2. Concepts underpinning the MISAR project

MISAR will engage a broad-minded research design to exploit recent advancements in risk analysis and modeling, behavioral theories and totalling social science to contribute to building resilience.

2.1 From risk awareness to behavioral attitudes and choices

Through a wide-ranging desk review, we will categorise major insights from risk awareness studies and critically evaluate contrasting ideas and points of view, key conclusions about socio-demographic, personal, and cultural features. Additionally, current risk perception databases such as: Municipality of Sicily, the Eurobarometer, European Values Study (EVS), and European Social Survey (ESS) will be analysed.

Using information gathered by stakeholders, the sentiment analysis platform will automatically identify feelings and emotions from social and textual data (questionnaires). For instance, according to the Eurobarometer database, EU Civil Protection - Country Factsheets in Italy (EC, 2022), 61% of Italian are not aware of civil protection from the EU (Figure 3. left) which average is lower (48%) for EU countries. Moreover, in Figure 4. Right, based on the socio-demographic point of view, perceptions of Italian are lower as well.

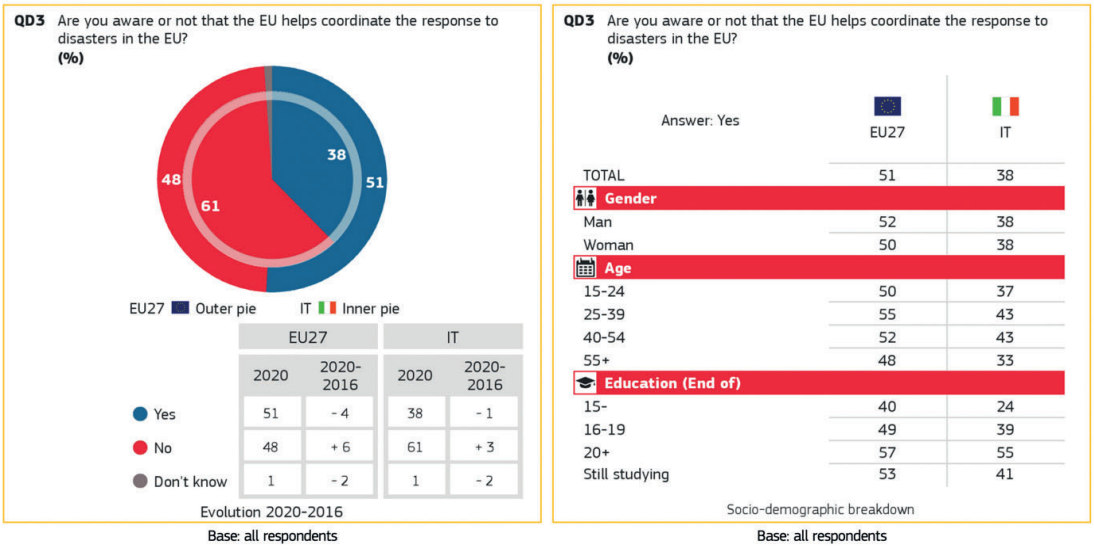

Fig. 3
Example from the Eurobarometer Surveys (Source: EC, 2022)

Furthermore, the next phase will be data extraction by converting the input data to text. Ultimately, text mining and natural language processing will be performed.

3. Methodology

To combine qualitative and quantitative tools and methods to build a resilience society, MISAR will focus on the following groups (Table 1):

Groups	Tools/Methods
OBSERVATION	Rapid Eye and Copernicus Emergency Management Service (CEMS)
PERCEPTION	Sentiment analysis of social media data
ASSIMILATION	Analysis of dynamic exposure and vulnerability with analysis tools (e.g., Agent-based models, Machine *Learning* Methods)
COMMUNICATION	Interactive Games
ENGAGEMENT	Social Learning Techniques

Tab. 1
MISAR Tools and Methods Groups

Thanks to 'Mediatoolkit' sentiment analysis platform for the short analysis regarding the risk perceptions in Italy from "01.03.2022 - 22.07.2022", results clarified that the number of mentions of the climate risk and hazards in social media is low (Figure 4) and the sentiment (i.e., positive, negative and neutral) ratio are almost equal (Figure 5). Social simulations and serious games will be used to identify barriers and bridges in communication between government organizations and citizens.

Nevertheless, the multi-risk analyses created by MISAR will combine information about the insights of citizens to natural and manufactured hazards and will define new multi-risk indicators based on the aggregated sentiment in the social media and textual data from several multi hazard occurrences. The indicators will take into account behavioral aspects such as an individual's capacity to recognize, evaluate, and respond to potentially dangerous circumstances as well as the general understanding of and willingness to abide by laws and procedures. The robustness of future information for disaster risk management planning could therefore be improved and increased by filling this multi-risk knowledge gap.

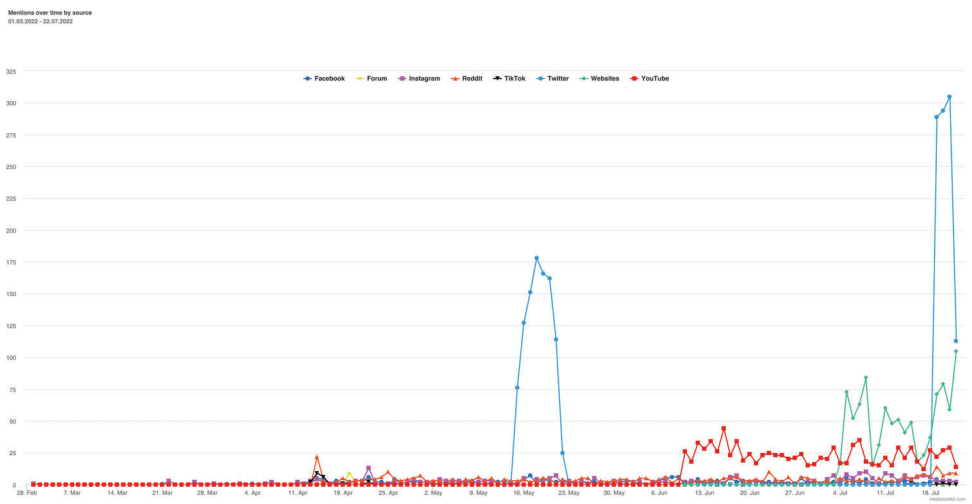

Fig. 4
Number of Mentions for Risk perception of climate change in Italy

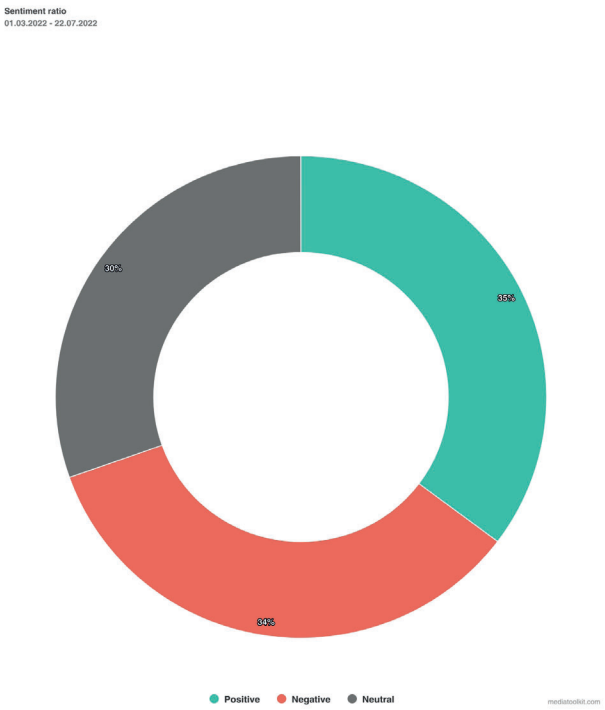

Fig. 5
Sentiment Ratio for the timeframe

3. Conclusion

The main thought of MISAR is how risk awareness can utilize the disaster risk management and prevention plans using the multi-risk assessment besides risk awareness analysis and sentiment analysis. To assess the multi-risk and hazard, agent-based modeling, dynamic models, and machine learning methods such as XGBoost, Bayesian Network and Random Forest will be performed.

This research will provide a view of how climate changes among individuals and communities would make a resilient society in Europe and it's corresponded to the Sendai Framework for Disaster Risk Reduction which aims to improve prevention, preparedness, and response to disasters.

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