

# A methodology for flood risk mapping at the local scale for Civil Protection purposes

Lucia Mortara, Luca Ferraris, Marina Morando, Chiara Franciosi, Marta Giambelli and Eva Trasforini

In the DRR context there is an ongoing need to implement effective mitigation strategies able to strengthen resilience at different territorial levels. This study aims to propose a methodology to better understand and analyse the vulnerability and capacity components of risk, in order to improve the Italian Civil Protection (CP) Plans and consequently the public awareness and self-protective response. By characterising the exposed elements with reference to the local context - through the active involvement of population, administrations and stakeholders -, it is possible to obtain a detailed mapping and characterisation of elements to be considered in the definition of risk mitigation strategies, additionally strengthening coordination and collaboration between institutions and citizens and then community resilience.

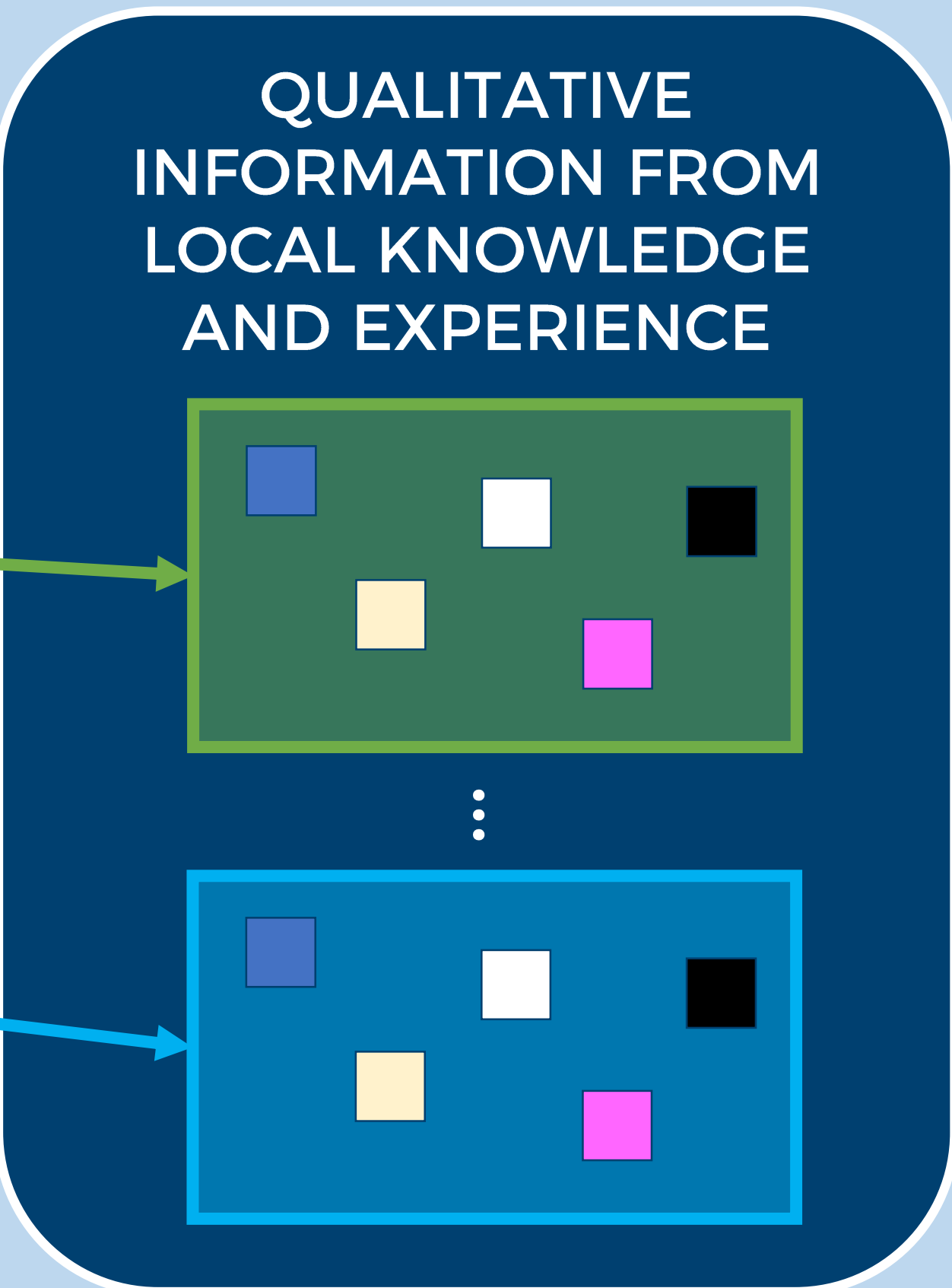
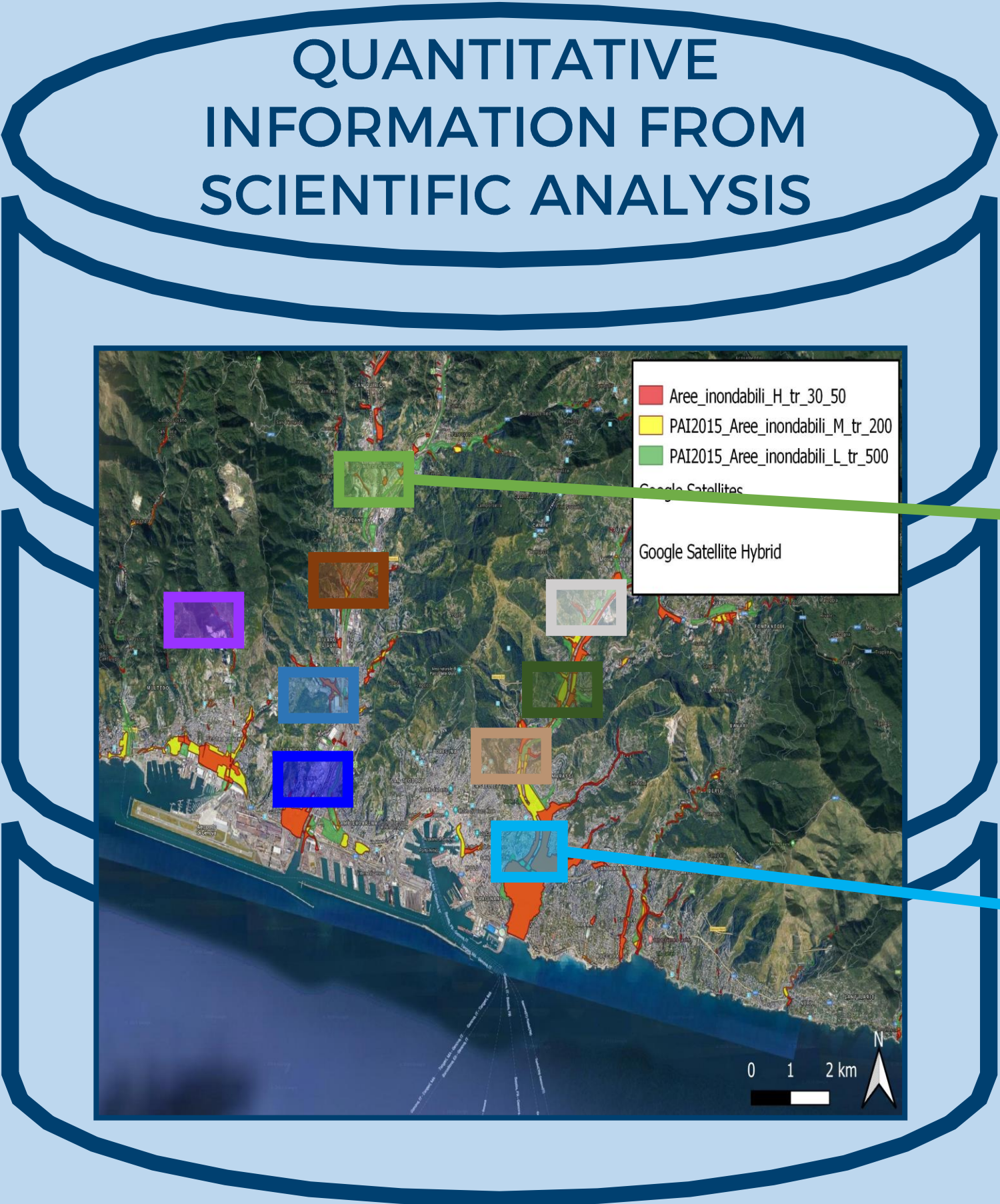


## NECESSITY OF STRENGTHENING CIVIL PROTECTION PLANNING → IMPROVING COMMUNITY RESILIENCE

Taking into account the local features and the Capacity component of risk, it is possible to obtain a more detailed *risk-oriented* territory view, targeted at defining the most suitable emergency management procedures



$Risk = f(Hazard, Exposure, Vulnerability, Capacity)$



Detailed risk mapping



### MUNICIPALITY OF SERRA RICCÒ (ITALY) - 7 SCHOOLS

SCENARIO FROM EU FLOODS DIRECTIVE

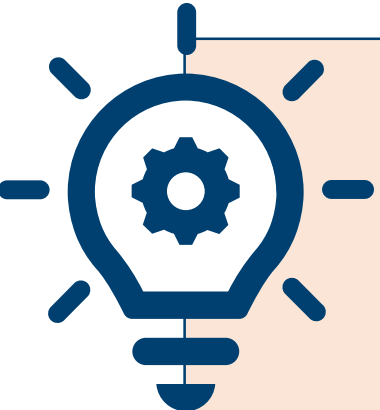
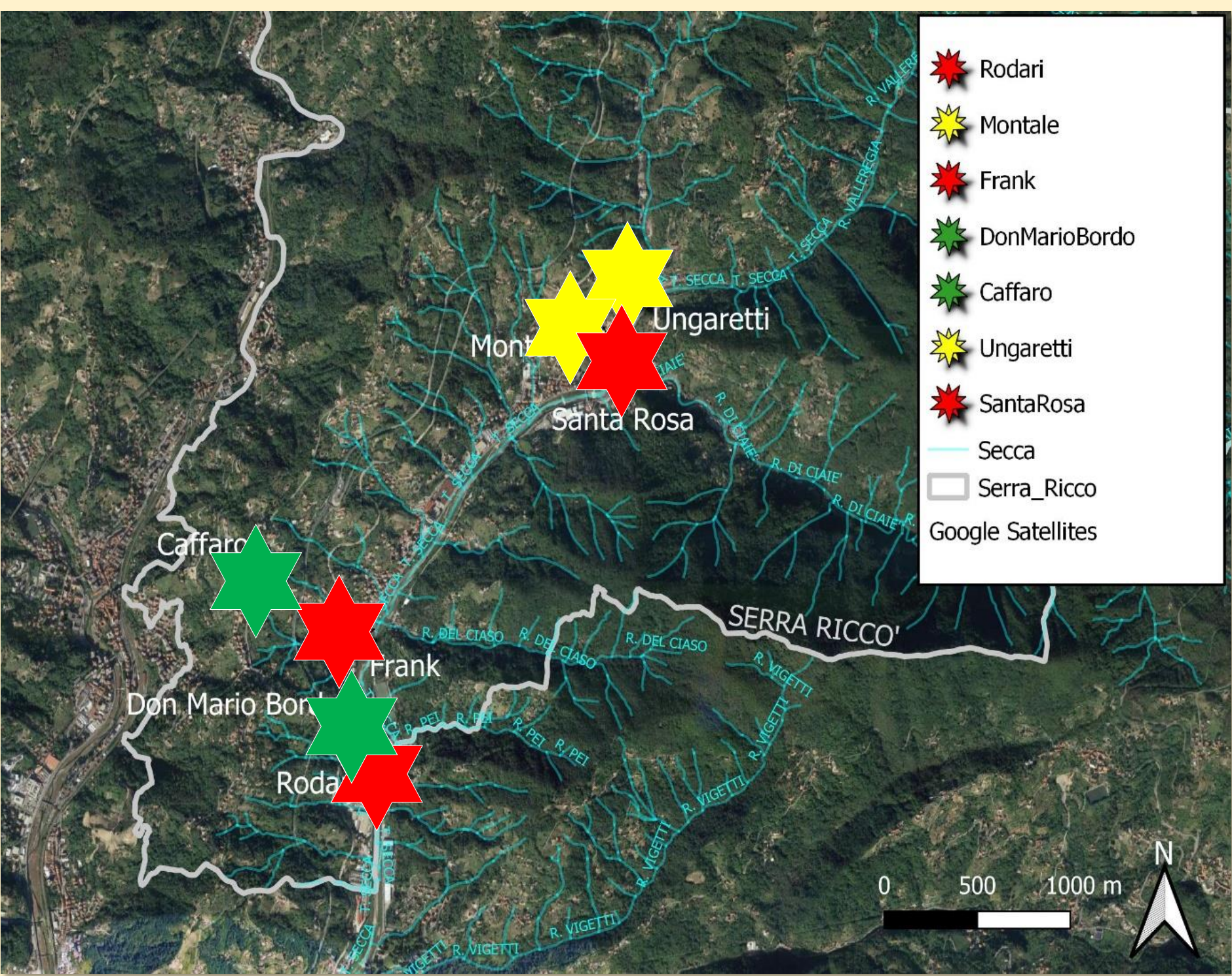
3 schools associated to risk classes according to EU Floods Directive

#### SCENARIO APPLYING THE NEW APPROACH

VULNERABILITY AND CAPACITY DATA ON POINT-BASED SCALE

CLASSIFICATION OF ELEMENTS ACCORDING TO CLASSES OF CIVIL PROTECTION RISK AND ACTIONS

7 schools associated to risk classes



ADDED VALUE OF THE NEW APPROACH

- Local scale
- Capacity
- Detail on vulnerability
- 'Hot spots' mapping

PERSPECTIVE

- Several assets to protect
- Replicable methodology
- Territorial context for decision making support



CIVIL PROTECTION PLANS SUITED TO THE TERRITORY AND ITS RESOURCES



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# APPENDIX

## A methodology for flood risk mapping at the local scale for Civil Protection purposes

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SCIENCE • AWARENESS • BEHAVIOURS

# TABLE OF CONTENT



## CIVIL PROTECTION PLANNING



## THEORETICAL APPROACH AND METHODOLOGY



## CASE STUDY



## FINAL CONSIDERATIONS AND PERSPECTIVES



# CIVIL PROTECTION PLANNING

*“Disaster management is the series of intervention operative procedures to cope with any expected calamity in a particular territory, allowing the authorities to prepare and coordinate the relief interventions to protect the population and the heritage in a risk area. [...] Civil Protection Plan is a continually updated document which must take account of the evolution of the territorial layout and of the variations in the expected scenarios.”*

(Italian Civil Protection Department)

## D. Lgs. 1/2018: ITALIAN CIVIL PROTECTION CODE

Civil protection planning is a **non-structural prevention activity** identifying the potential risk scenarios needed to alert the National Civil Protection Service and aims at:

- The definition of the **operational strategies** and the **intervention model** containing the organization of the structures for conducting, in a coordinated way, civil protection activities and operational response for the management of calamitous events foreseen or in progress, ensuring the effectiveness of the functions to be carried out
- Ensuring the necessary **information network** with the facilities responsible for alerting the National Service
- The coordination of **communication flows**
- The definition of the mechanisms and procedures for the **review and updating of planning activities**, for the organization of **drills** and relative **information spreading to the population**

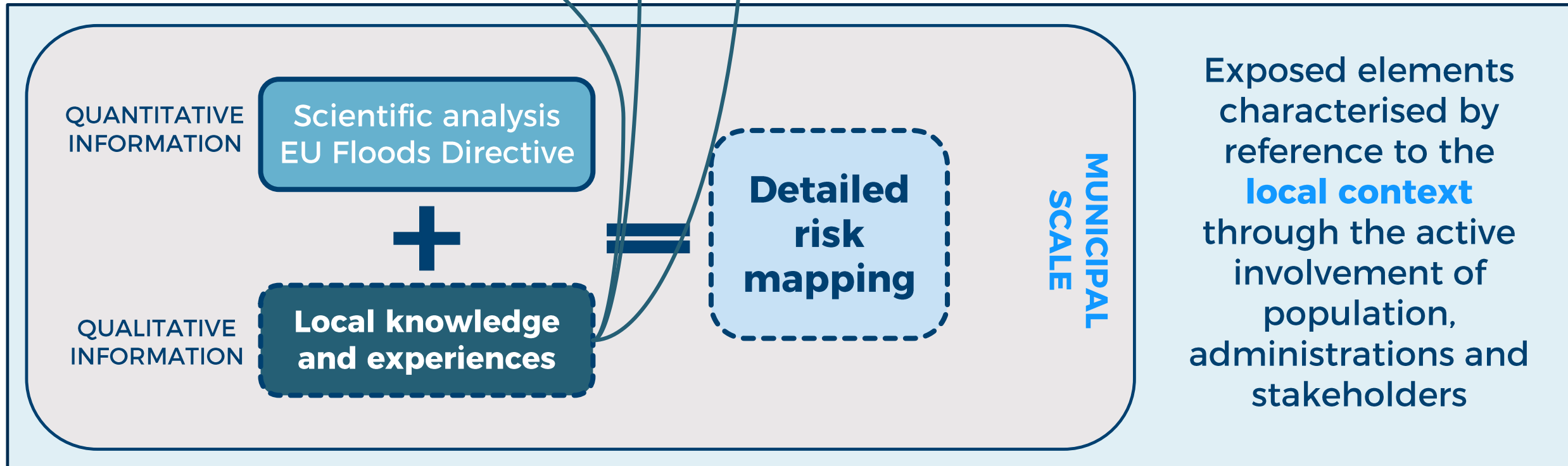


# THEORETICAL APPROACH

$$\text{Risk} = \text{Hazard} \times \text{Exposure} \times \frac{\text{Vulnerability}}{\text{Capacity}}$$

Risk considered in all its components of hazard, exposure, vulnerability and **capacity**

**MULTIDIMENSIONAL VARIABLE** → people, culture, procedures  
**ANTICIPATE, COPING, ADAPT**





# THE METHODOLOGY

1

## EX-ANTE SETTING

### Definition of expected outcomes

classes of civil protection risk and actions

### Reference scenario

EU Floods Directive 2007/60/CE

2

## LOCAL MAPPING WITH PARTICIPATIVE APPROACH

### Local hazard “hot-spots” mapping

- Technician knowledge
- PGRA flood hazard maps

### Local vulnerability and capacity mapping (element by element)

- Technician, stakeholders and citizens knowledge

3

## MODEL APPLICATION

### Model implementation with collected information

Vulnerability  
and capacity  
functions

- Safe access to building
- Emergency plans
- Safe floors
- Flood-proof systems
- Flood-prone floors
- Moving to safe floors
- Access to safe floors

FLOWCHART

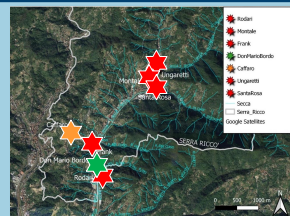
Classes of CP risk and  
actions

### Outcomes

Each exposed element is  
associated to a class of risk

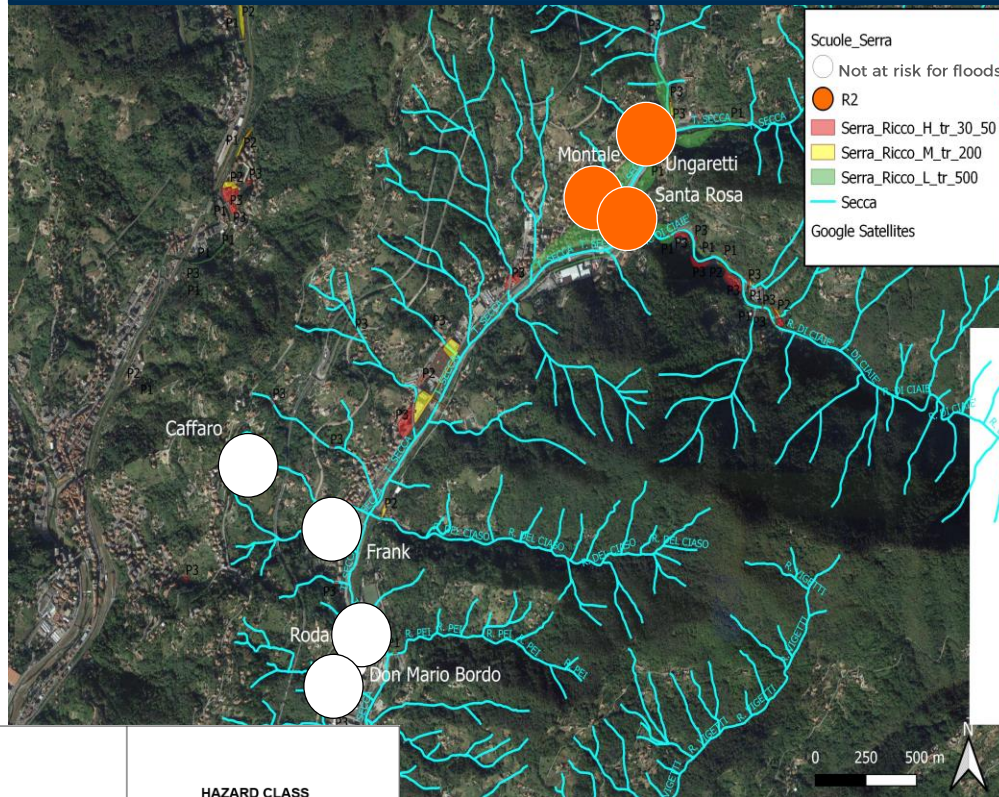
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## CIVIL PROTECTION PLANNING APPLICATION



Look at the overall situation on the territory to prioritise intervention and manage the outflow of municipal resources in the most efficient way, in order to define Civil Protection Plans procedures

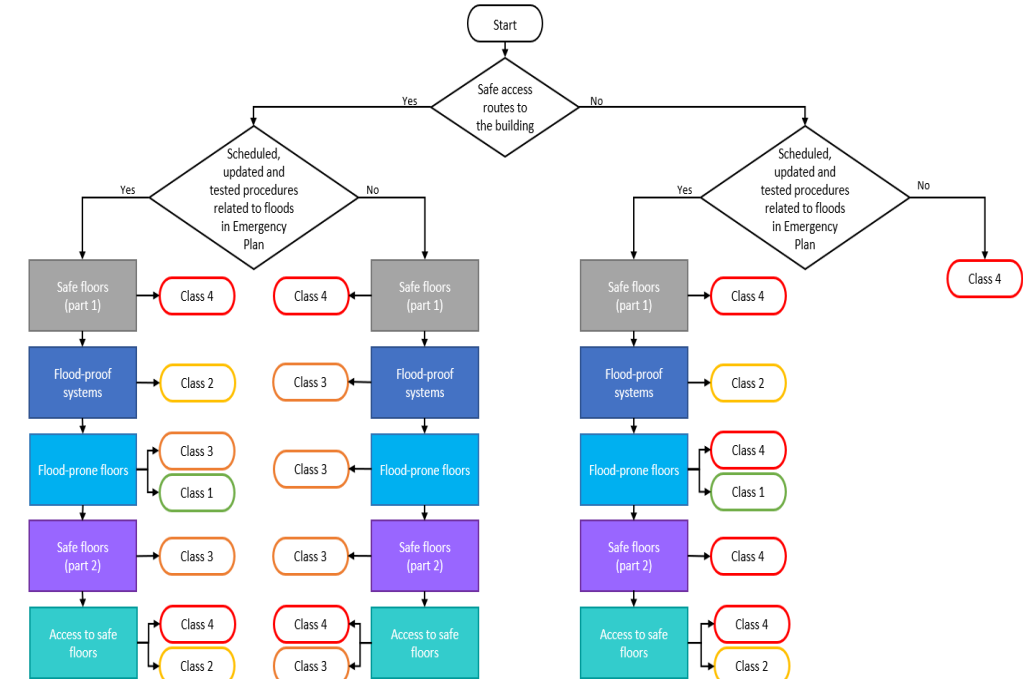
## Level of risk according to EU Floods Directive



## NEW APPROACH



- Local scale
- Capacity C
- Detail on V
- 'Hot-spots' mapping

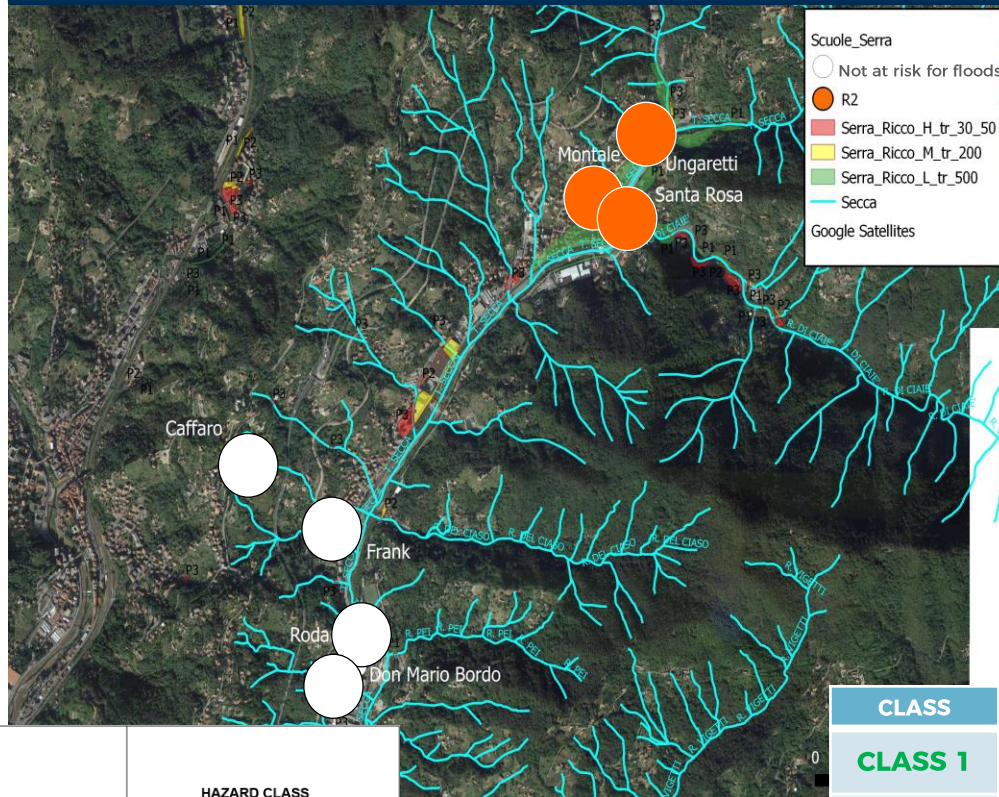


Model for the schools of Serra Riccò

RISK CLASS	HAZARD CLASS		
	P3 (H)	P2 (M)	P1 (L)
DAMAGE CLASS	D4	R4	R4
	D3	R4	R3
	D2	R3	R2
	D1	R1	R1



## Level of risk according to EU Floods Directive

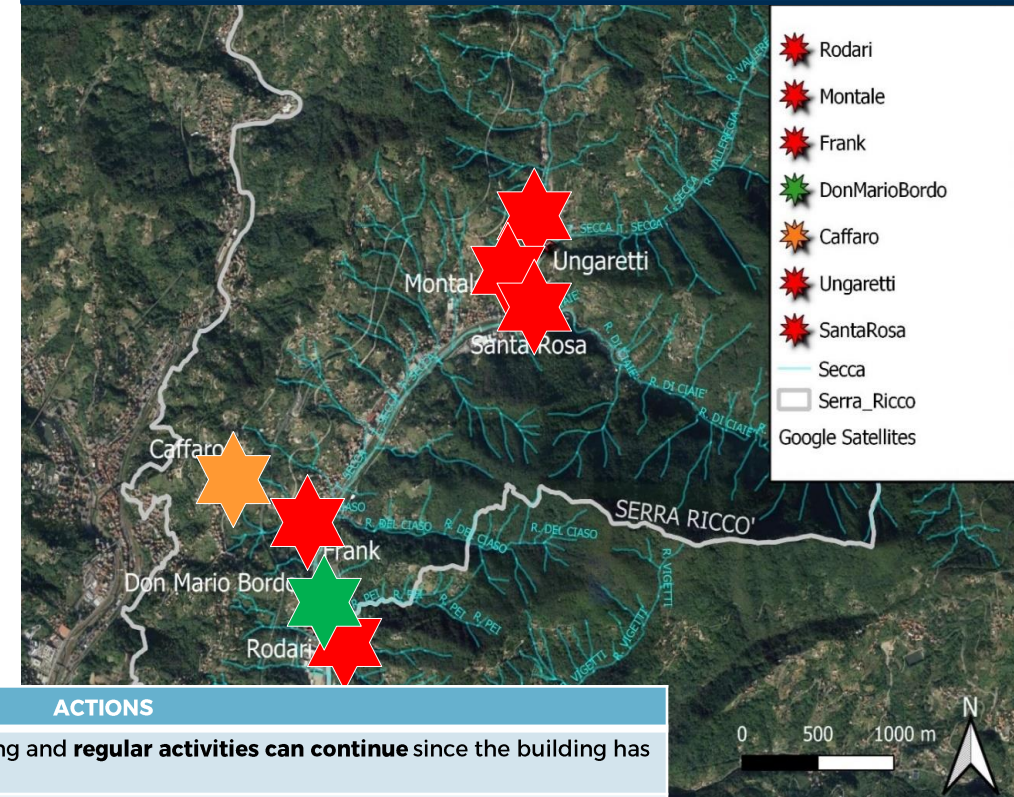


## NEW APPROACH



- Local scale
- Capacity C
- Detail on V
- 'Hot-spots' mapping

## Level of risk related to the local context for CP purposes

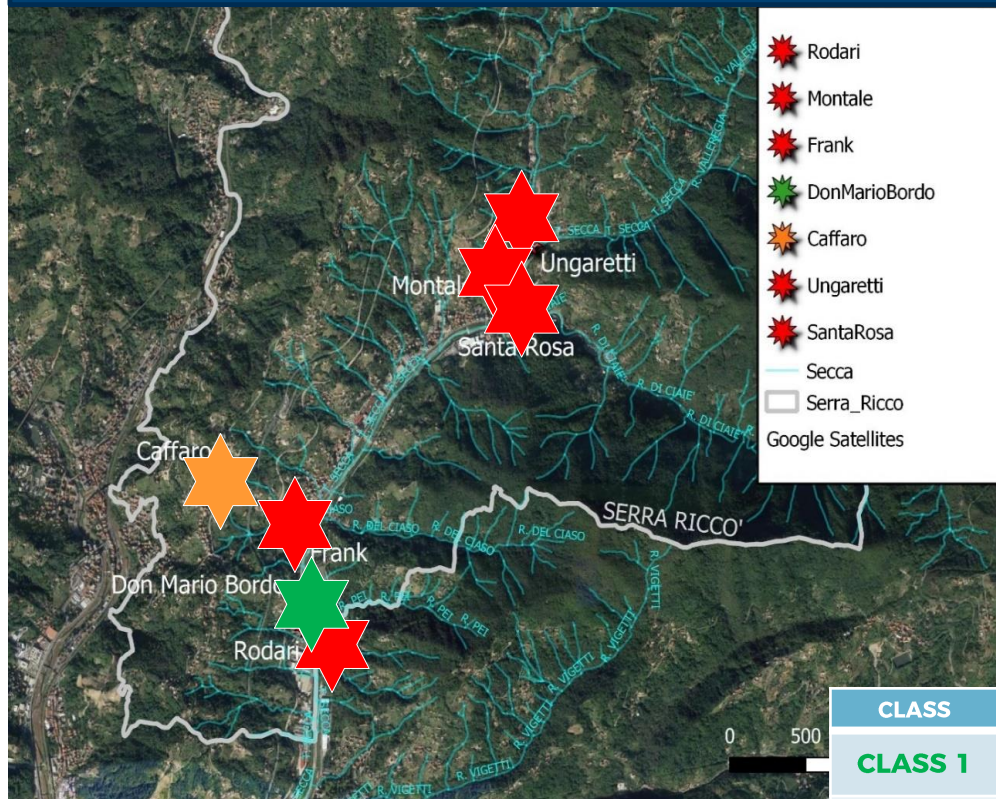


CLASS	ACTIONS
<b>CLASS 1</b>	All people <b>must remain inside</b> the building and <b>regular activities can continue</b> since the building has no flood-prone floors
<b>CLASS 2</b>	All people <b>must remain inside</b> the building and everyone <b>must go to the upper floors</b> , potential emerging issues can be solved with only internal resources
<b>CLASS 3</b>	All people <b>must remain inside</b> the building and everyone <b>must go to the upper floors</b> , but to do it and to solve possible emerging issues <b>some help from outside</b> is necessary
<b>CLASS 4</b>	<b>No one must be inside</b> the building since it is not a safe place

RISK CLASS	HAZARD CLASS		
	P3 (H)	P2 (M)	P1 (L)
DAMAGE CLASS	D4	R4	R4
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	D2	R3	R2
	D1	R1	R1



## Level of risk related to the local context for CP purposes

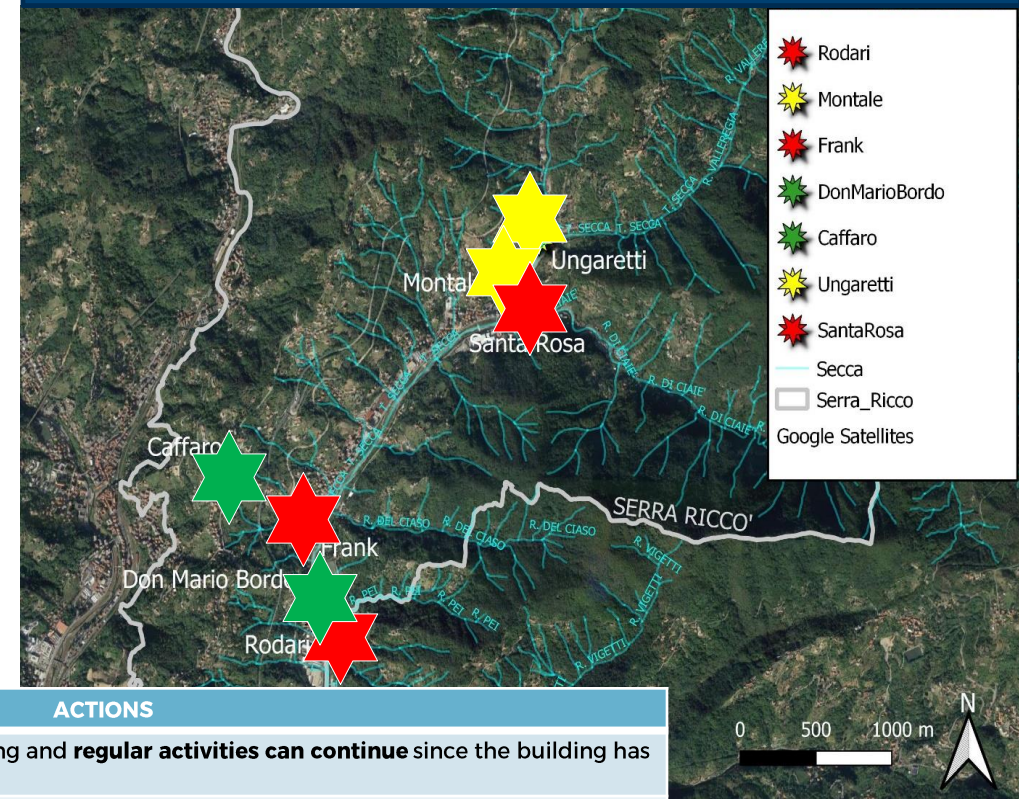


## INCREASING CAPACITY



Each exposed element has an internal updated Emergency Plan and procedures has been tested through drills

## Potential level of risk



CLASS	ACTIONS
<b>CLASS 1</b>	All people <b>must remain inside</b> the building and <b>regular activities can continue</b> since the building has no flood-prone floors
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## FINAL CONSIDERATIONS

- SEVERAL ASSETS TO PROTECT (industries, facilities, housing, infrastructures) → VULNERABILITY AND CAPACITY VARIABLES
- REPLICABLE METHODOLOGY ON DIFFERENT EXPOSED ELEMENTS CATEGORIES
- REPRESENTATION OF THE TERRITORIAL CONTEXT FOR DECISION MAKING SUPPORT → EFFECTIVE EMERGENCY RESPONSE AND MANAGEMENT



CIVIL PROTECTION PLANS  
SUITED TO THE TERRITORY AND ITS RESOURCES



INCREASING COMMUNITY RESILIENCE





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