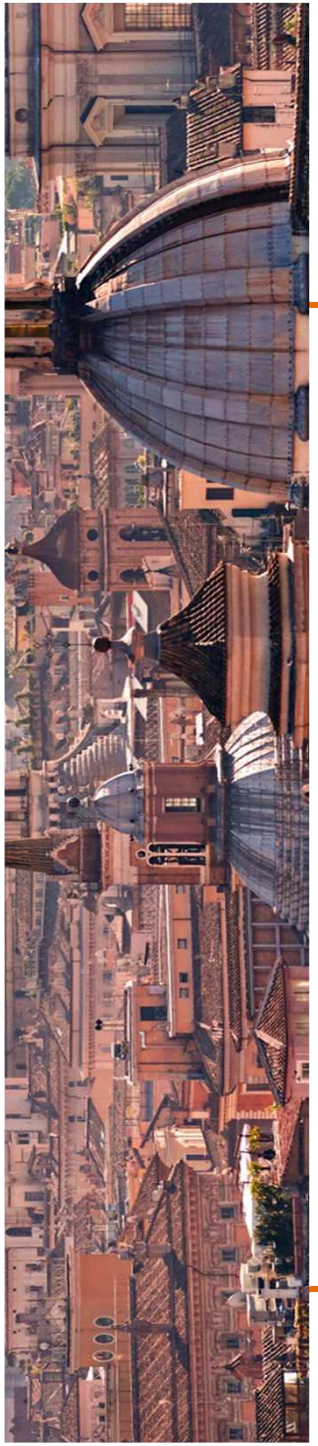

Uso dei grandi basi di dati ed informazioni territoriali per l'analisi del rischio nei grandi sistemi urbani

Vittorio Rosato Ph.D.
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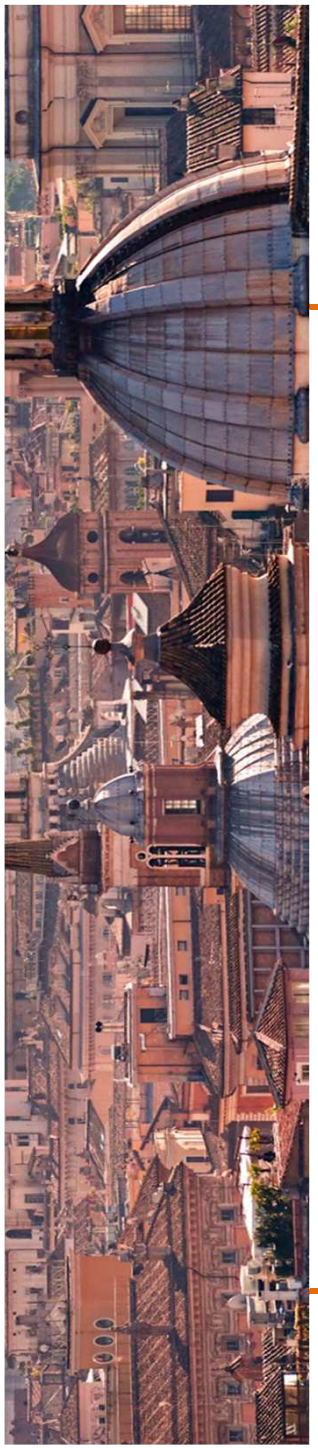
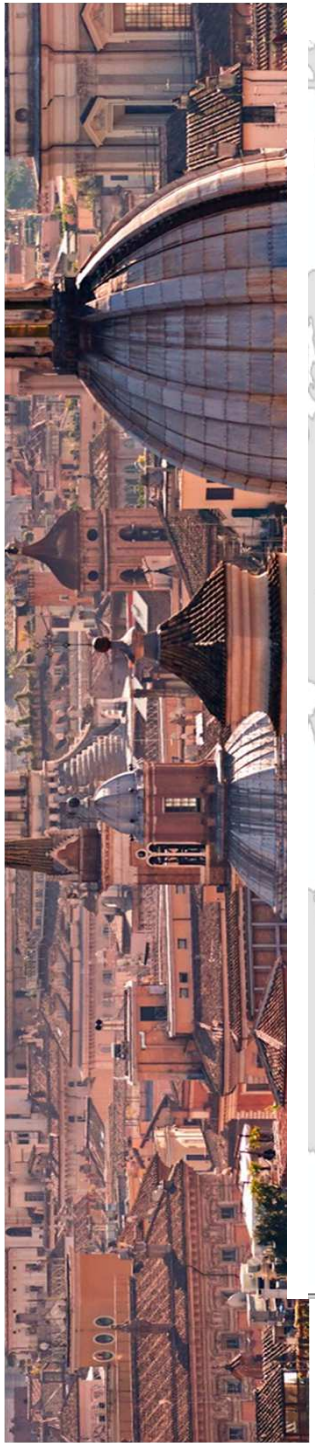
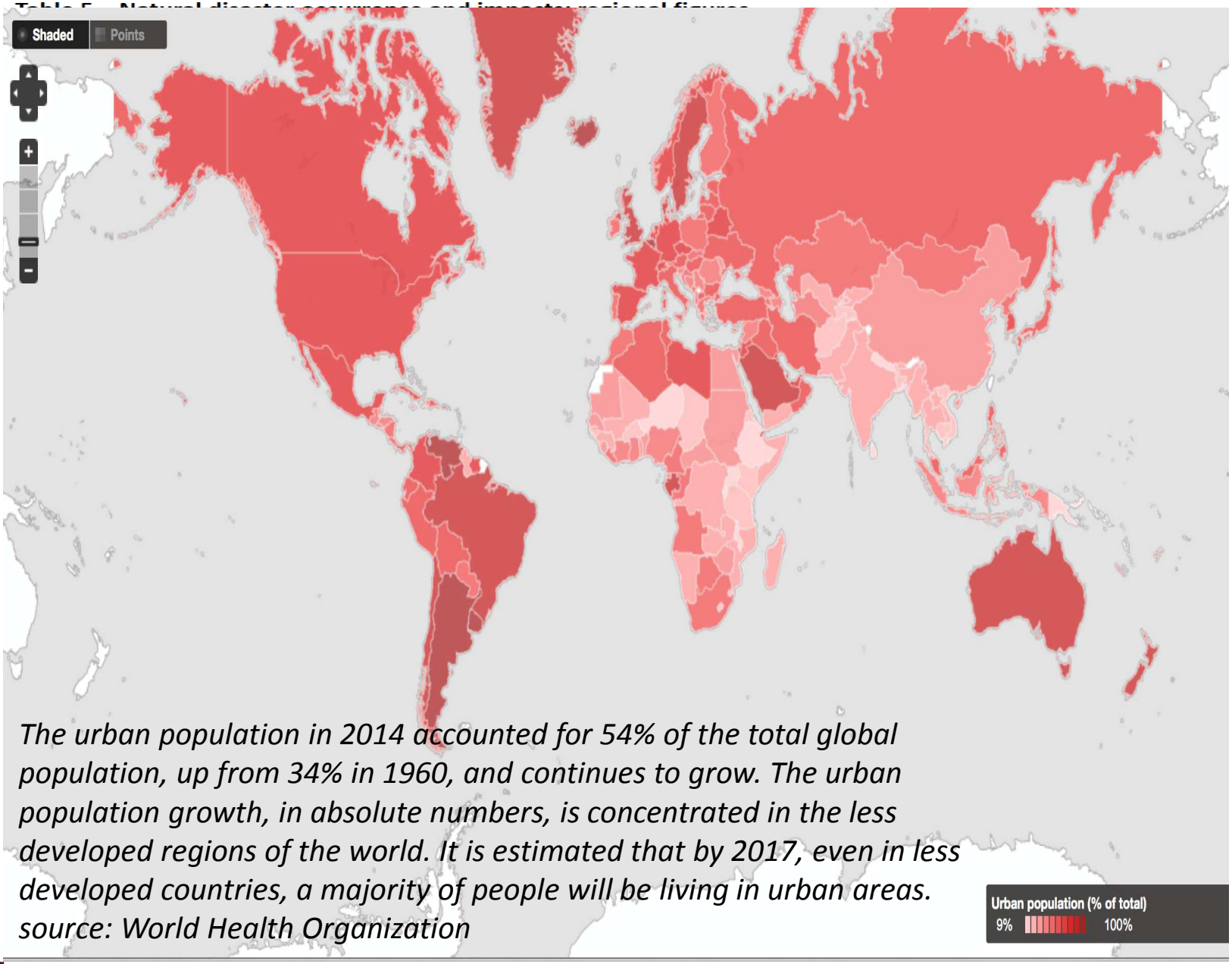


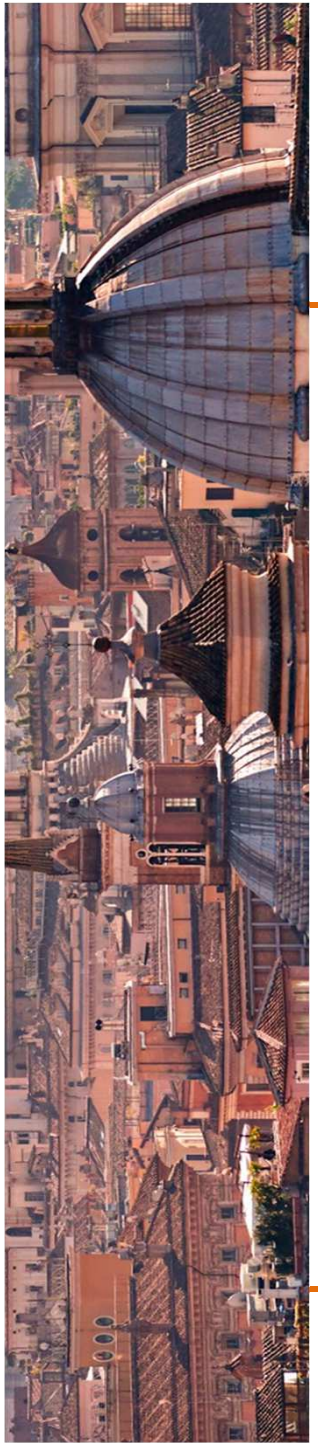
Summary

1. Risk Analysis of Critical Infrastructures (CIP)
2. Needs for operational tools for CIP
3. On-going EU-wide activities and advancements
4. Conclusions





The urban population in 2014 accounted for 54% of the total global population, up from 34% in 1960, and continues to grow. The urban population growth, in absolute numbers, is concentrated in the less developed regions of the world. It is estimated that by 2017, even in less developed countries, a majority of people will be living in urban areas.
source: World Health Organization



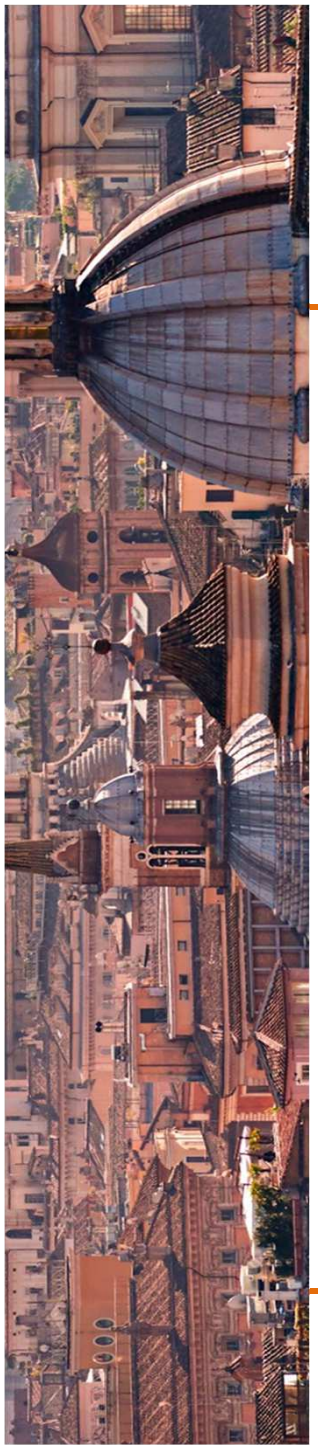
CIP: consequence 1

- A larger fraction of citizens, living in urban areas, is more exposed to (and rely on) the availability of primary services (water, electricity and other energetic products, telecommunications, mobility, garbage disposal etc)
- High cost per outage

Table 10. Tobit Regression Estimated Cost-per-Outage-per-Customer for the U.S.[1]

Duration	Residential	Commercial	Industrial
0 sec	[illegible]	$605	$1,893
1 hour	$2.70	$886	$3,253
Sustained Interruption	$2.99	$1,067	$4,227

[1]Costs shown in U.S. 2002 CPI-weighted dollars



CIP: consequence 2

High concentration of humans reflects into

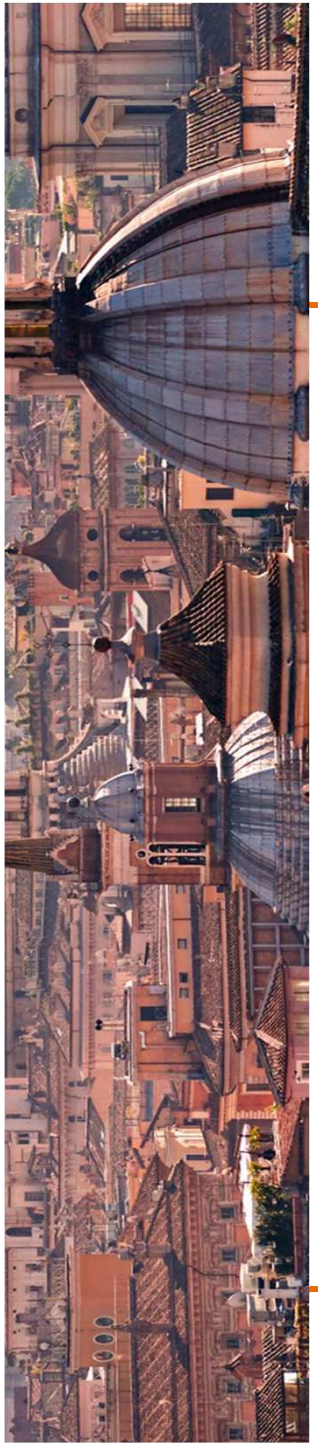
- a large concentration of
- a physical proximity of

Critical Infrastructures.

This enhances system's entanglement which, other than being "functional", also becomes "physical".

CIP: Conclusions

- Possibility of "more concentrated" crisis
- Crisis affecting dense and concentrated systems mutually dependent
- Crisis triggered by sudden events hitting (often) unprepared environments
- Many different players in competition in a single domain (energy, telecom etc.) thus competition → data unavailability
- Lack of governance in the pre-event phases



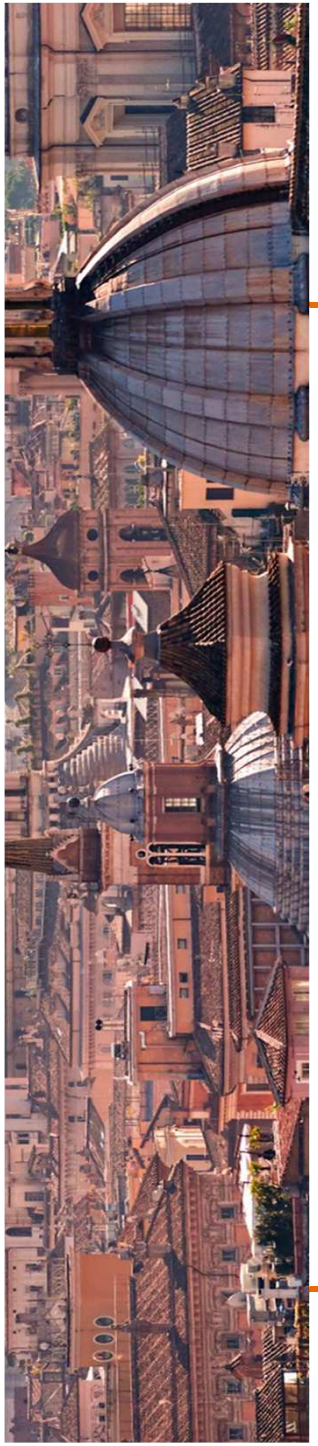
CIP: (inter)dependencies

Could we recognise the main elements which could allow to efficiently acting in such a complex scenario to allow CI to function, at the largest possible efficiency, in all possible physical conditions ?

(1) Increase ability to **predict** the occurrence of critical scenarios

(2) **Prepare** the system to cope with that scenario

(3) Instead of increasing the (single) systems “invulnerability”, **increase** “system of systems” **resilience**



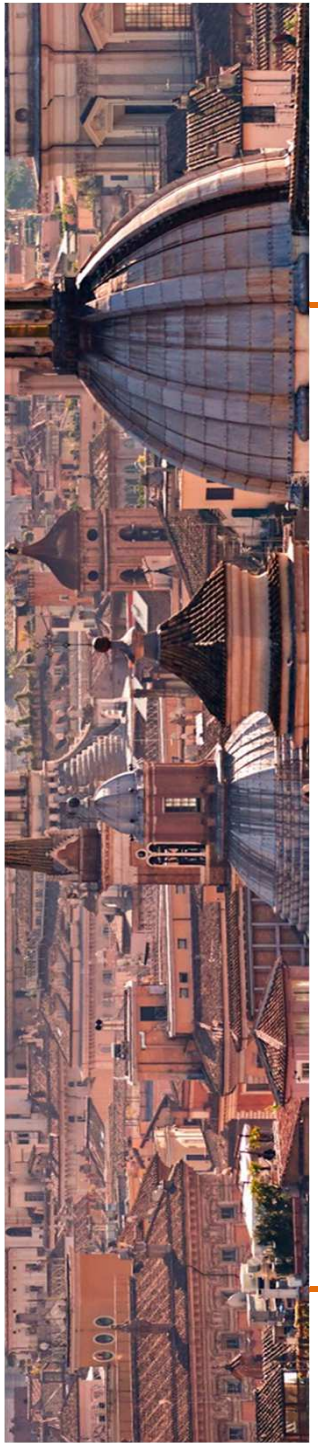
Issue 1: Increase ability to **predict**

The prediction of a critical scenario is composed by TWO steps (not just one…)

(a) predict natural hazard(s) which is(are) going to hit a given area

(b) evaluate the physical damages which could be inflicted to CI elements by the hazard's manifestation(s)

(a) without (b) is poorly informational, providing ineffective support to CI management.

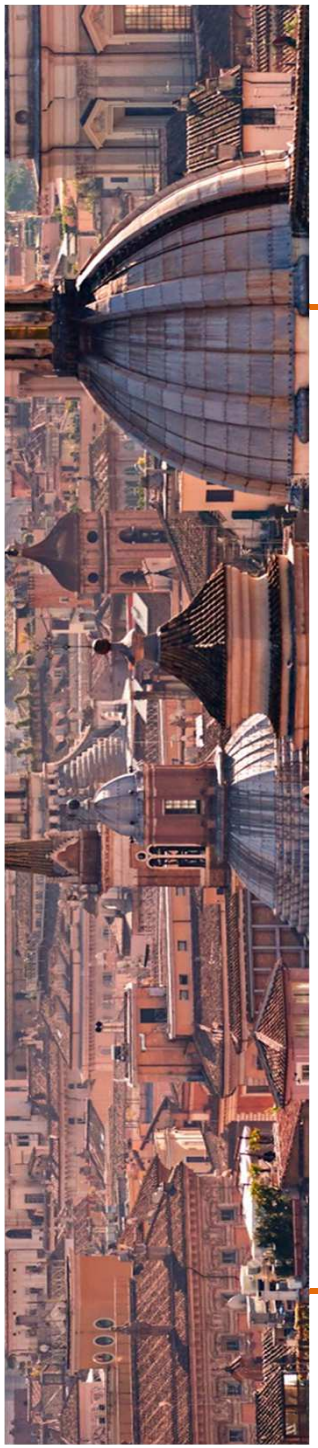


Issue 2: **Prepare** the system to cope with the scenario

Preparedness could be enhanced if the description of the effects of adverse conditions against which you are going to prepare actions could be evaluated at the maximum level of **depth**.

"Depth" means an as-complete as-possible information on

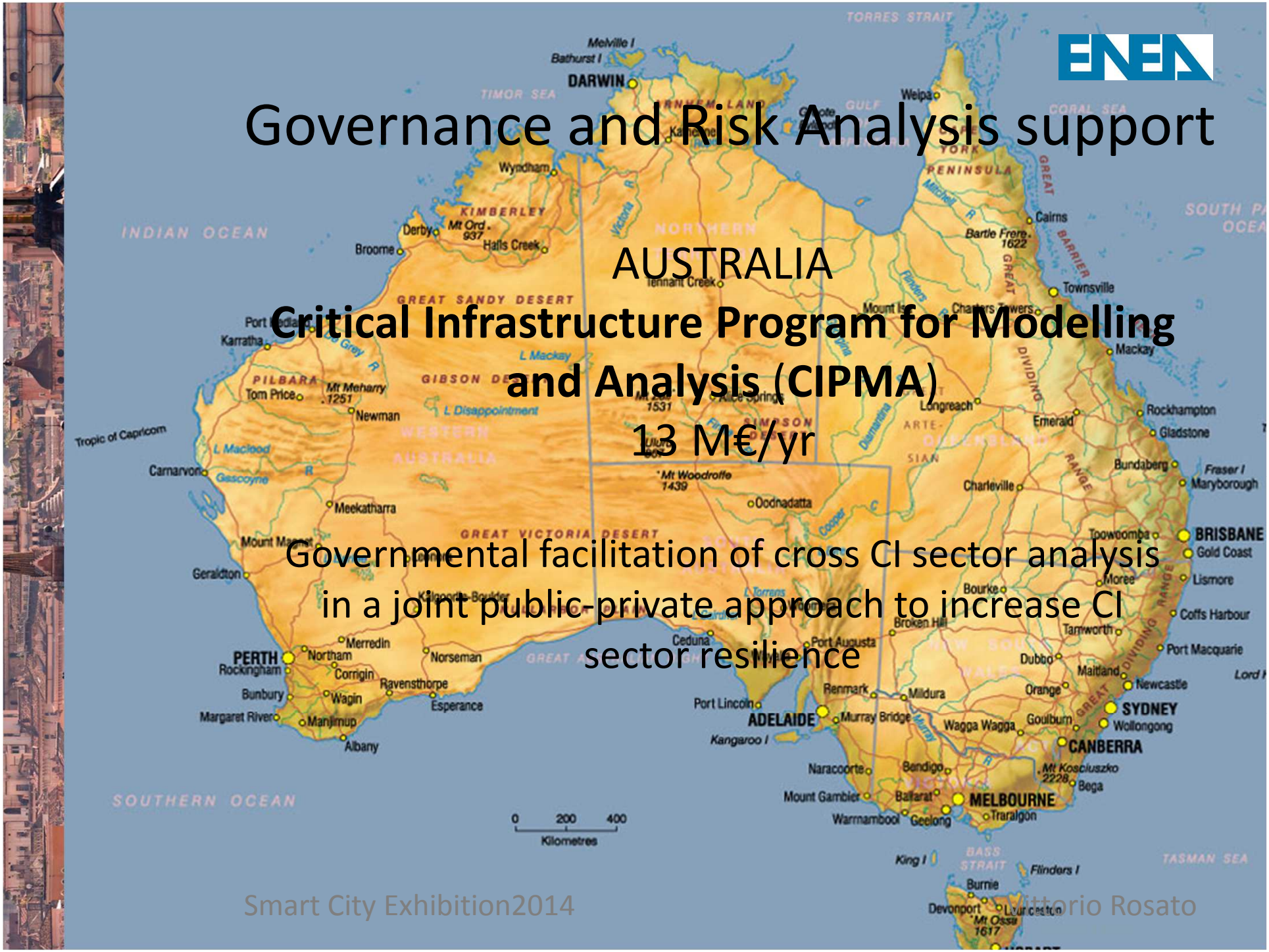
- what is going to happen
- which are the expected damages
- which losses of functionality of the different CI are expected on the bases of those damages
- who and what will be primarily affected by the expected functionality losses.



Issue 3: Increase systems **resilience**

- Forecasting
- Correlate event to damages
- Crisis evaluation in **depth**
  - impact and consequences
- Preparedness
  - Actions set-up prior to the occurrence of the event
- *whatif-ability*
  - Analyse different options (generating synthetic events & analysing different strategies)

Governance and Risk Analysis support



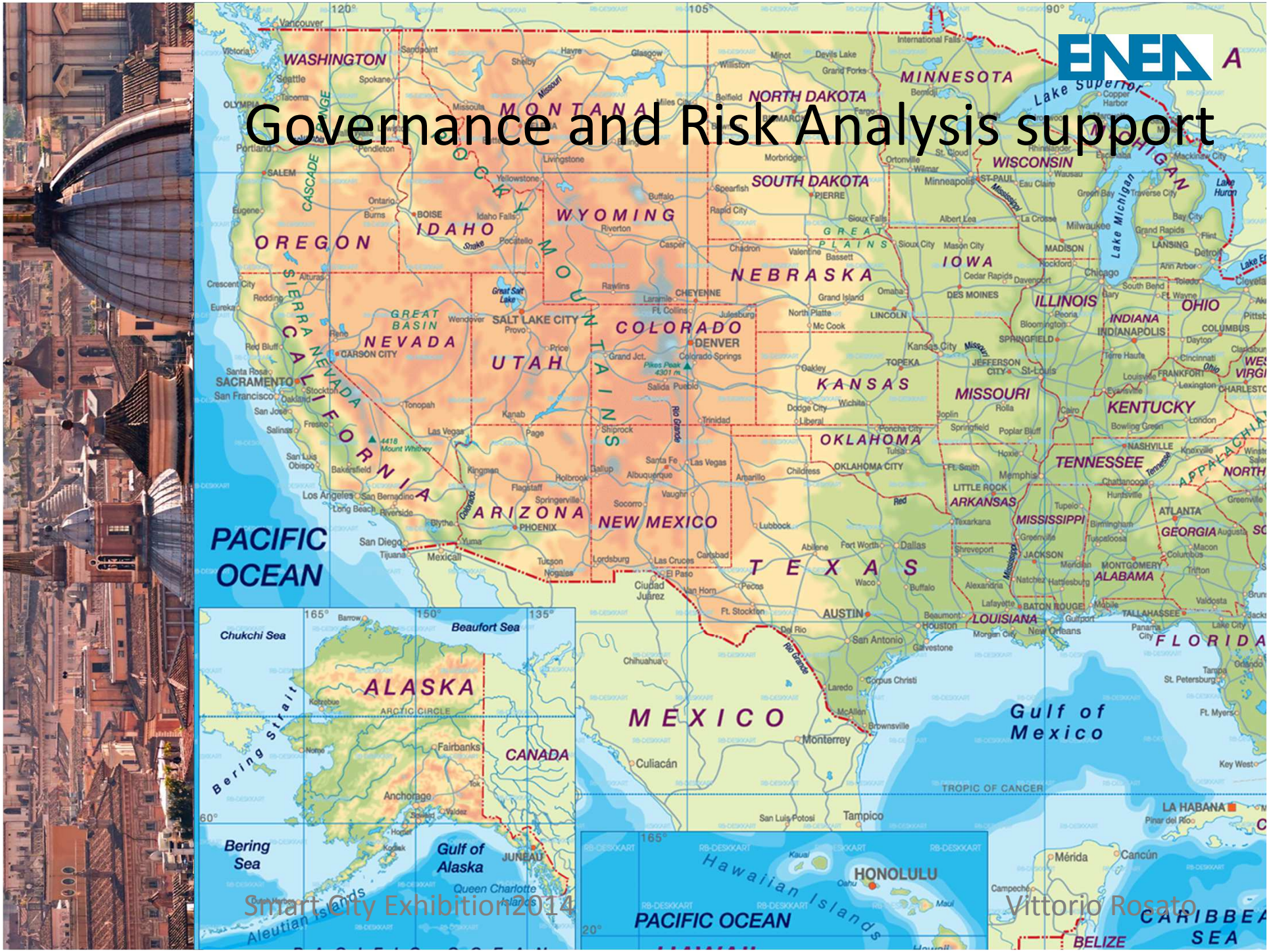
AUSTRALIA

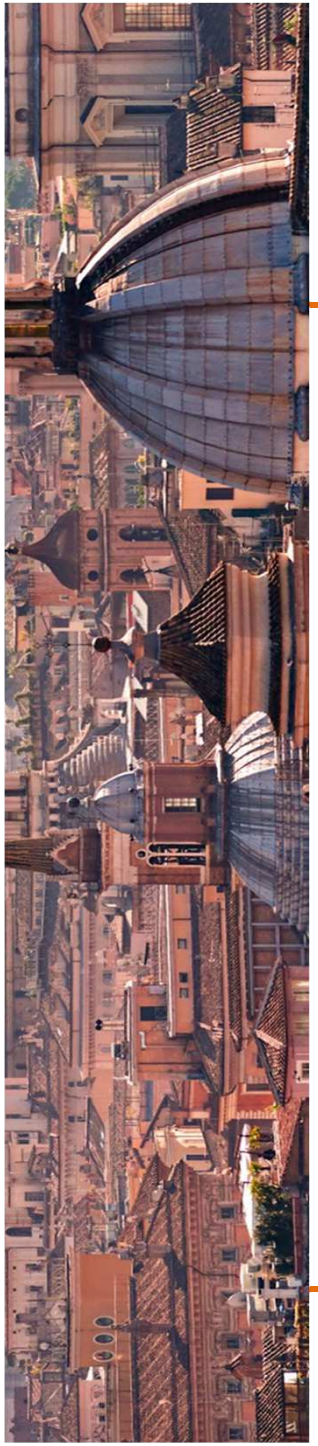
Critical Infrastructure Program for Modelling and Analysis (CIPMA)

13 M€/yr

Governmental facilitation of cross CI sector analysis in a joint public-private approach to increase CI sector resilience

Governance and Risk Analysis support





Governance and Risk Analysis support

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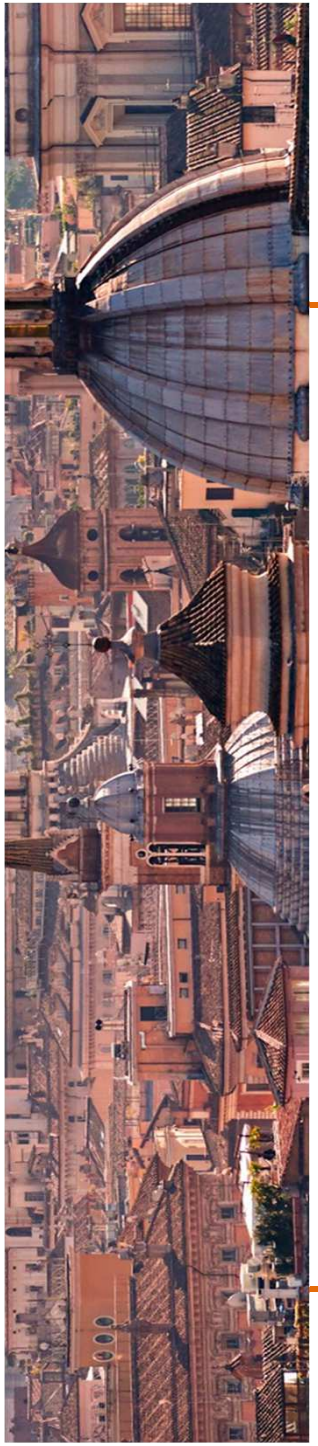
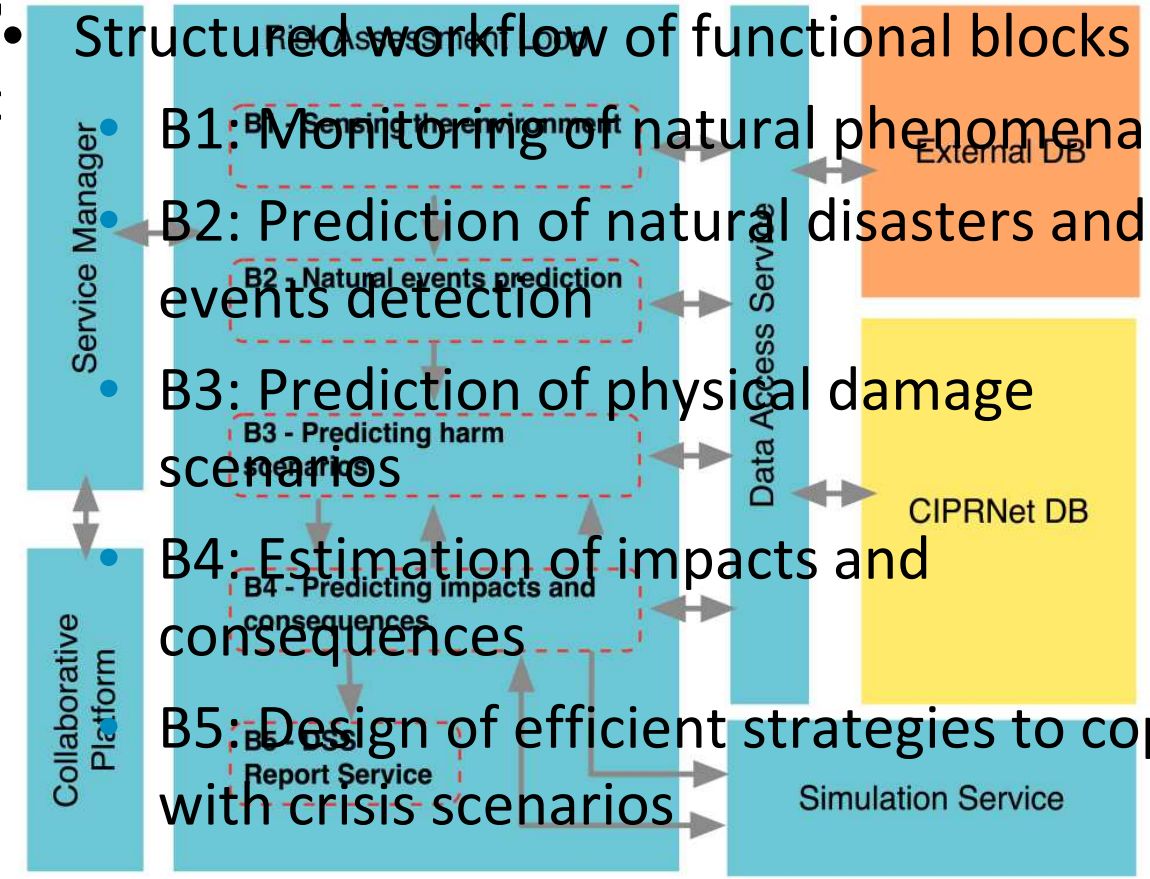
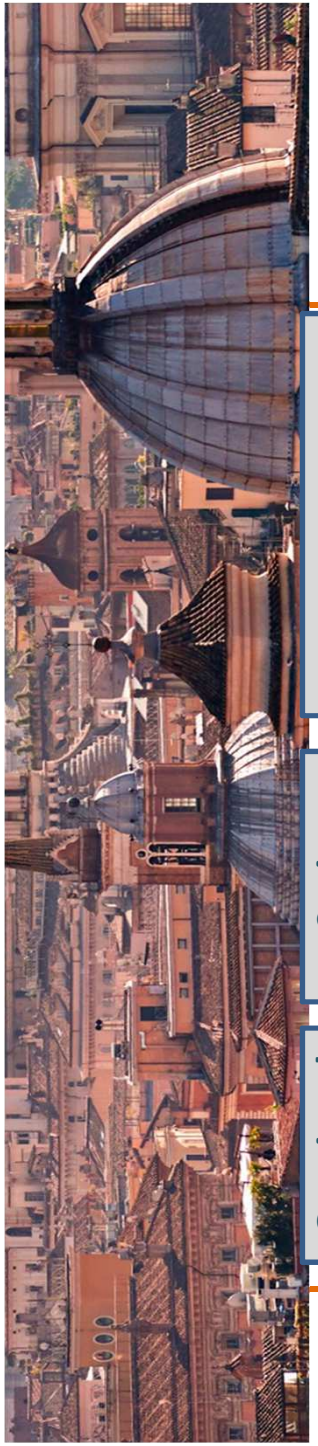


CIPRNet project: DSS & Whatif tools

- Structured workflow of functional blocks
  - B1: Monitoring of natural phenomena
  - B2: Prediction of natural disasters and events detection
  - B3: Prediction of physical damage scenarios
  - B4: Estimation of impacts and consequences
  - B5: Design of efficient strategies to cope with crisis scenarios





Database

Territorial

- Basic territorial layers and maps
- OpenStreetMap free data
- Primary services (hospitals, schools, etc.)
- Morphology and Land Cover
- Geology & Landslides
- Seismic risk
- Hydrogeological Risk & Hazard

Socio-economical

- Census Data (population, buildings, industrial activities, etc.)
- Parcels and Indicators
- Other statistical data

Quasi-real time data

- Seismic event data (epicentre and magnitude), PGA and Shake Maps
- Weather forecast
- Rainfall: Nowcasting data

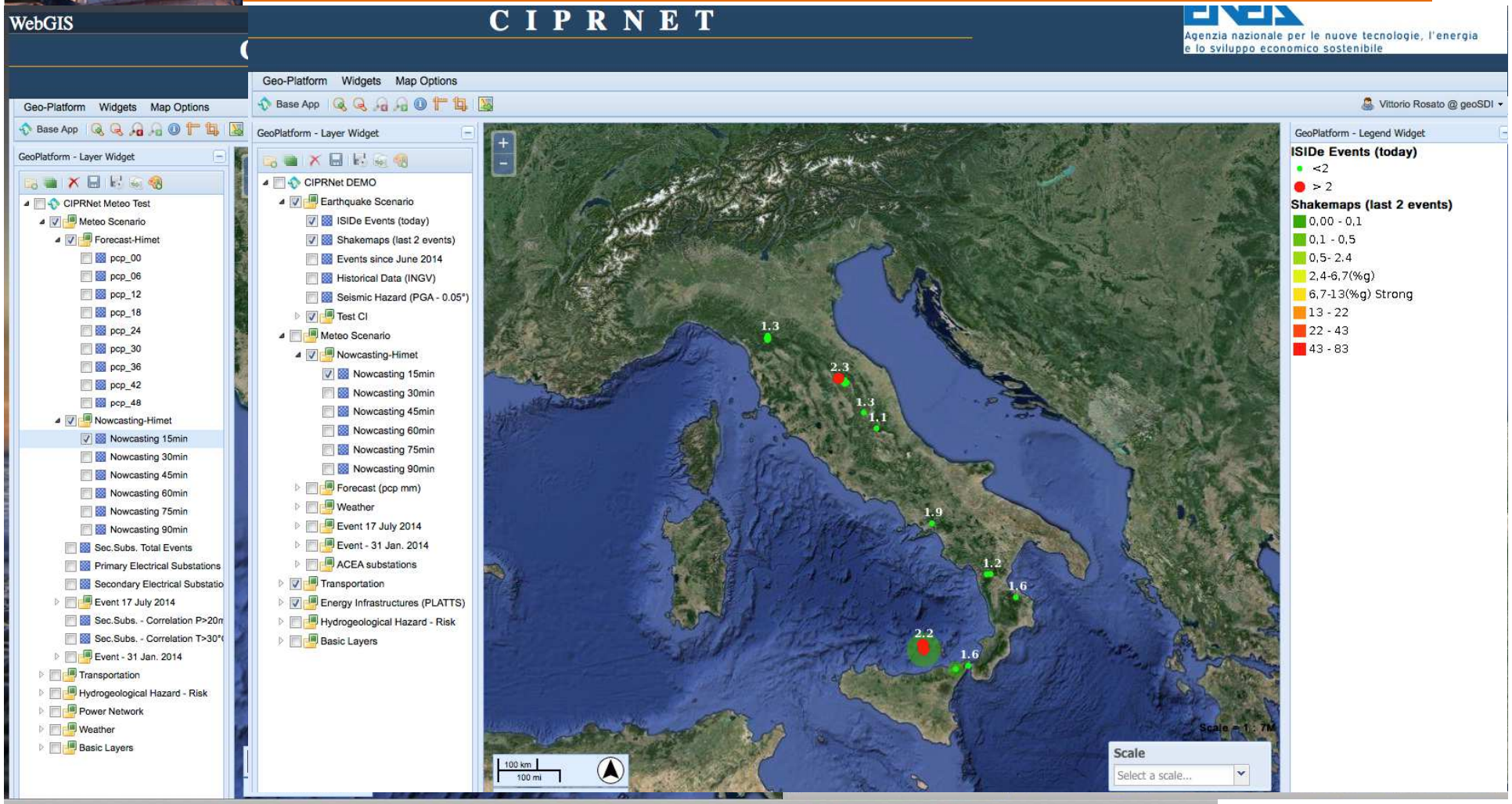
Technological Infrastructure

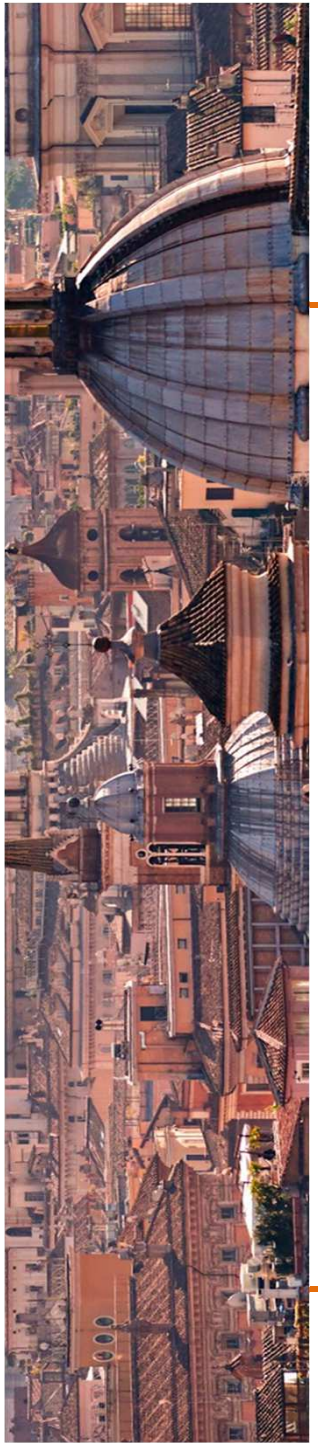
- Electric (Generating Stations, Substations, Transmission Lines, Electric Interconnects, Transmission Zones, Electric Distribution Territories)
- Natural Gas and Oil (Natural Gas Pipelines, Natural Gas Interconnects, Natural Gas Facilities, Natural Gas Production Regions, LNG Receiving Terminals)
- Road network
- Railways

Historical events

- Parametric catalogue of damaging earthquakes
- Inventory of Landslide Phenomena
- Historical data of rainfall and thermometry

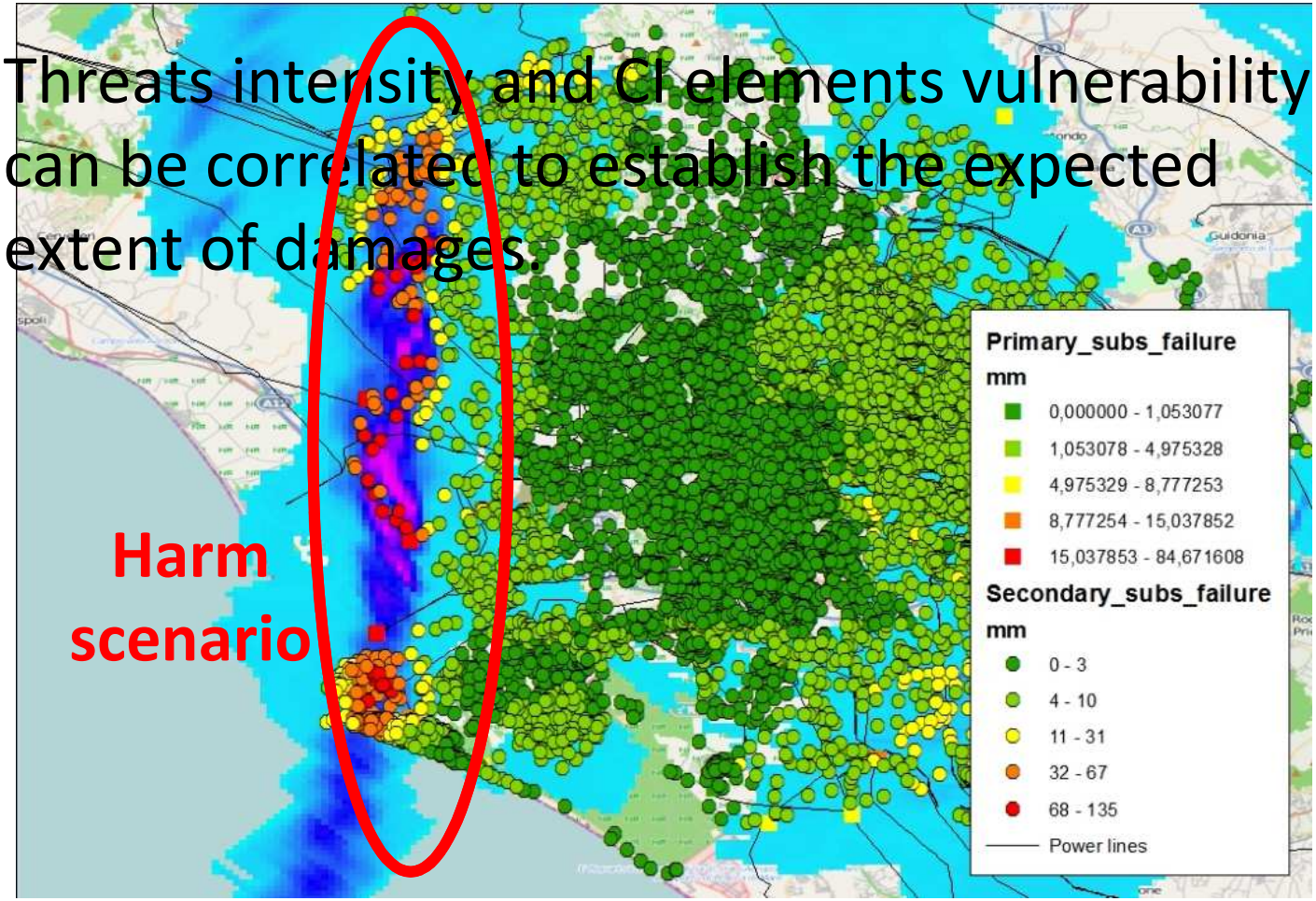
Monitoring and event prediction

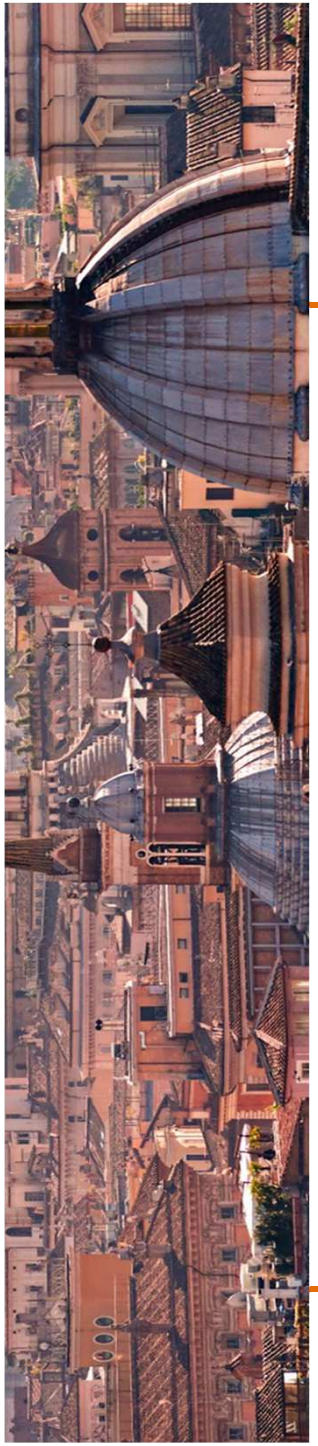




Damage scenarios

Threats intensity and CI elements vulnerability can be correlated to establish the expected extent of damages.



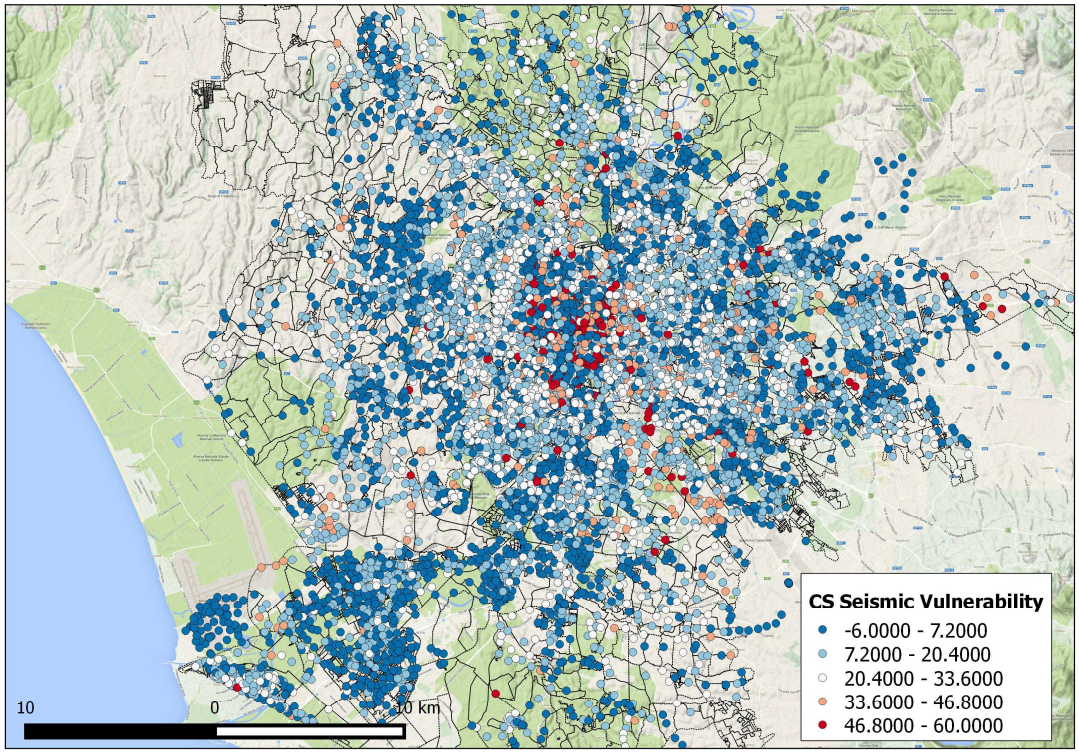


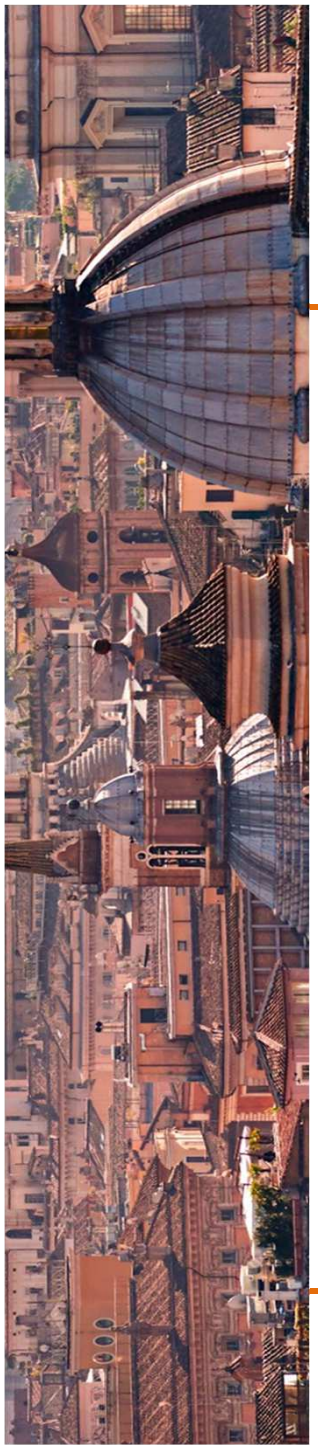
Damage scenarios

This can be used to estimate the risk map for the Secondary Cabins of the Electrical distribut

Risk Map for the

This can be used to estimate the risk map for the Secondary Cabins of the Electrical distribution of the city

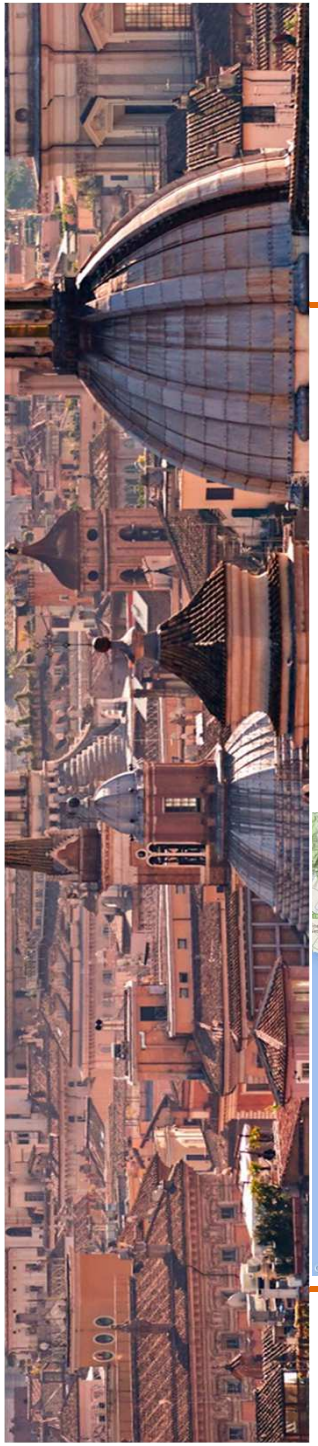




Consequence analysis

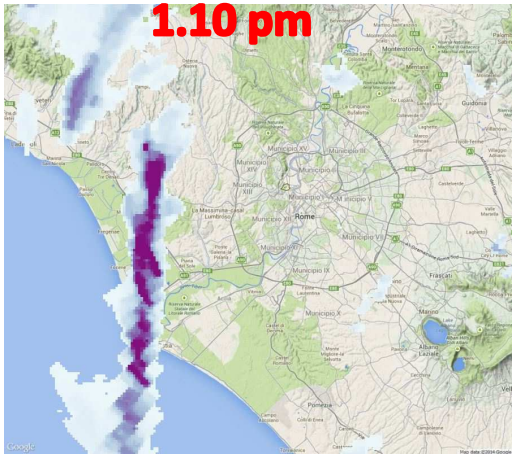
Consequences are the ultimate effects induced by the lack of Services (i.e. the Impacts) on the four Sectors

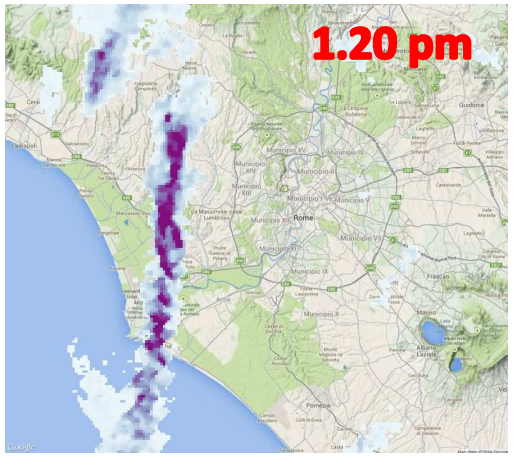
1. Citizens
2. Primary Services (hospitals, schools, public offices, public transportations)
3. Environment
4. Industrial Sectors

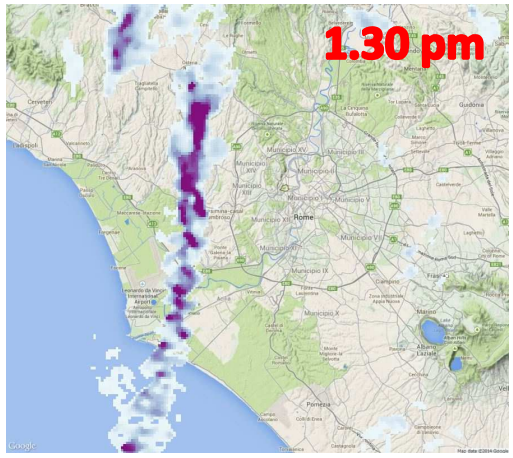


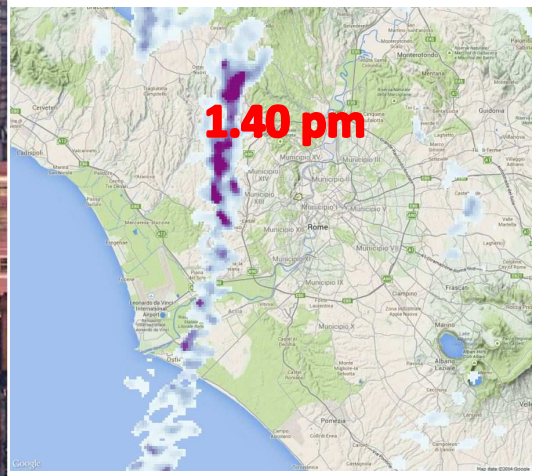
Case 1: DSS on-line functioning

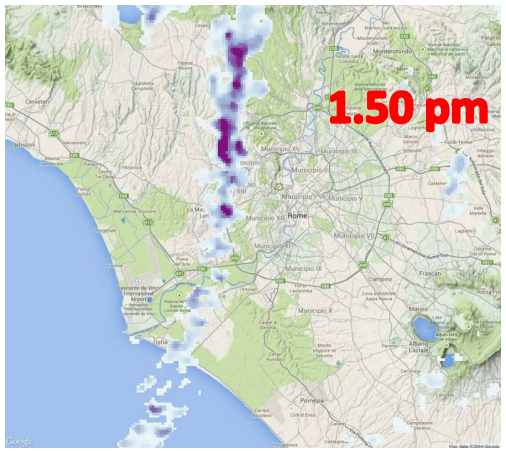
Gennaio 31, 2014

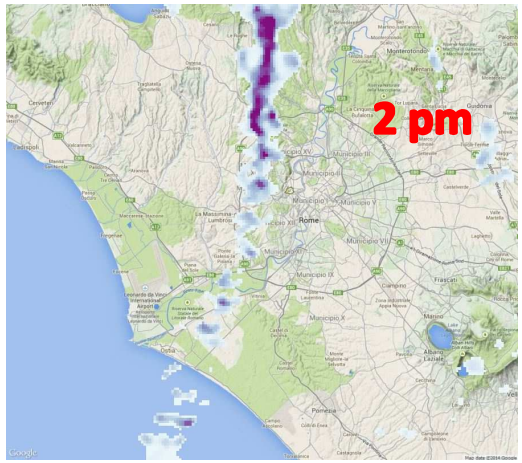


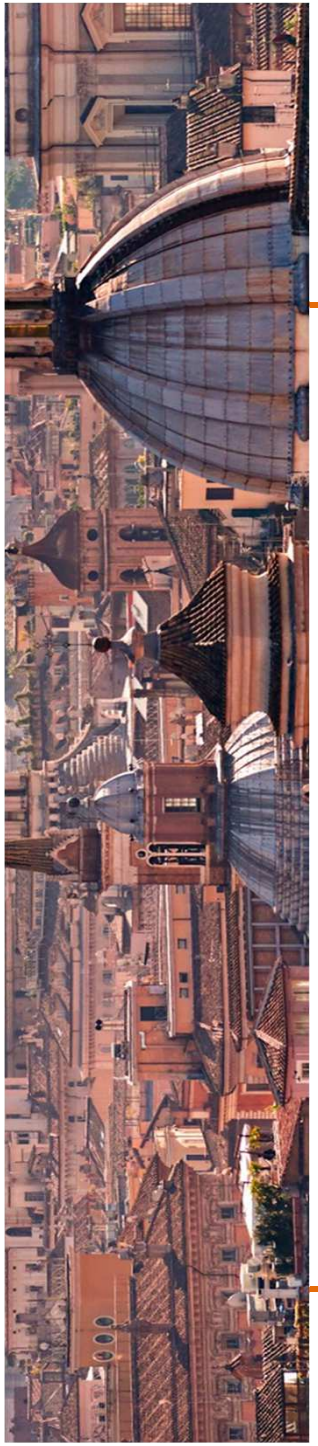




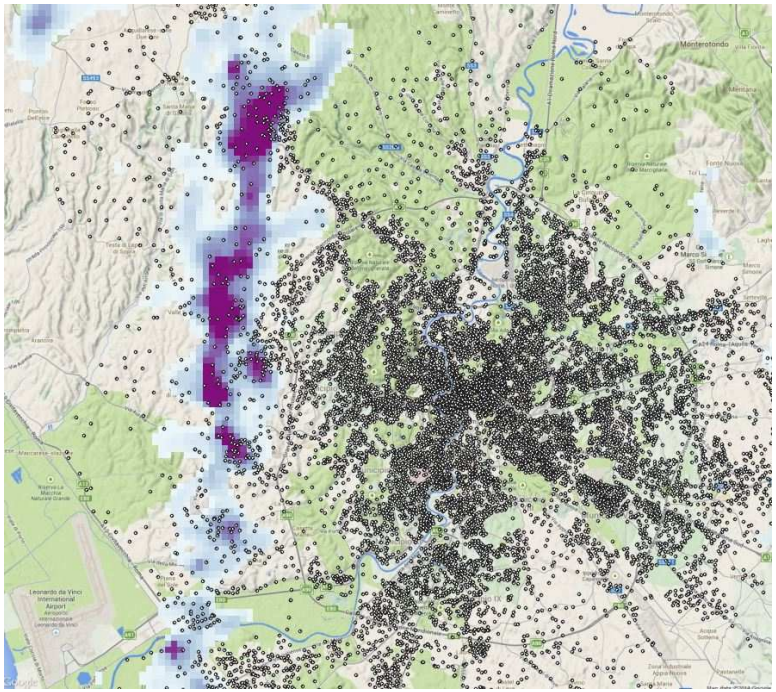


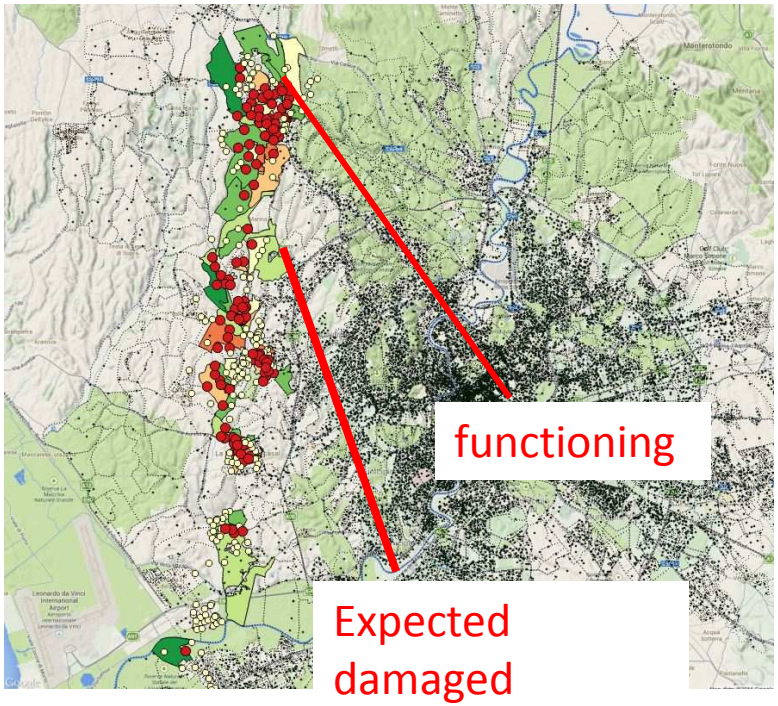




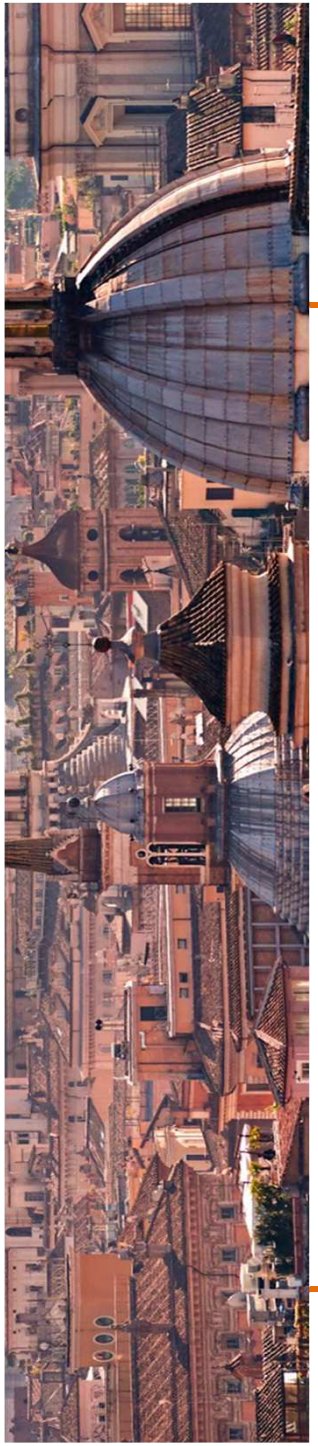


Case 1: DSS on-line functioning



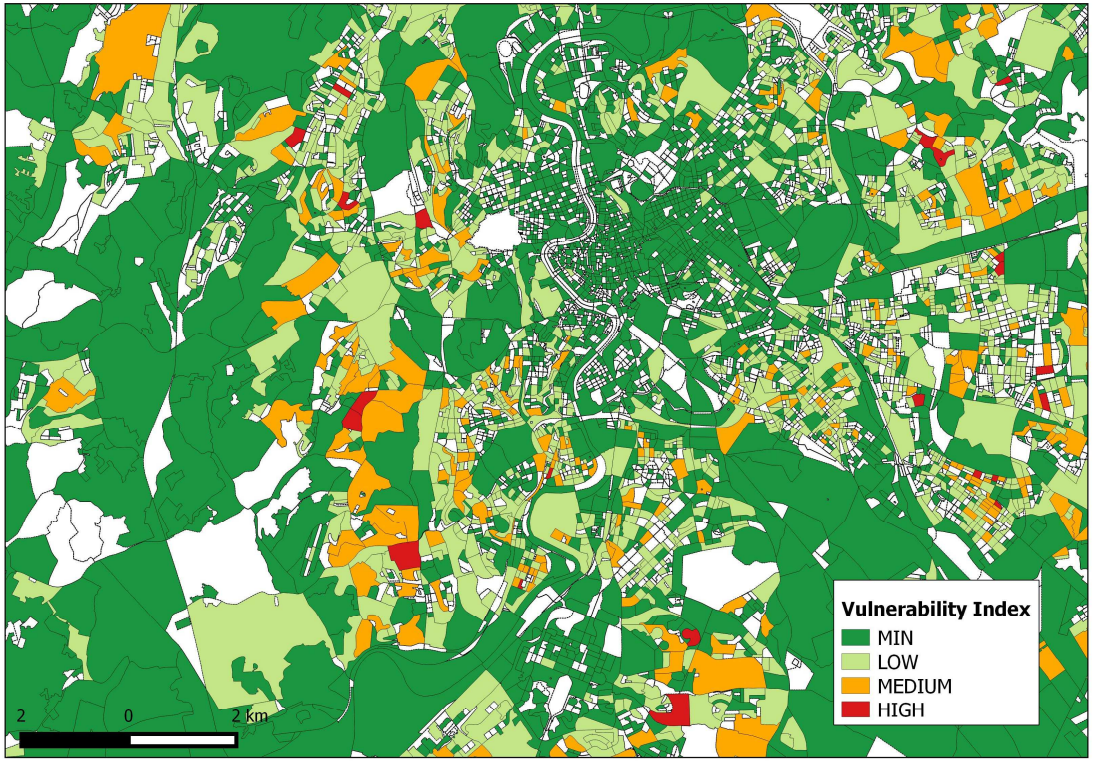


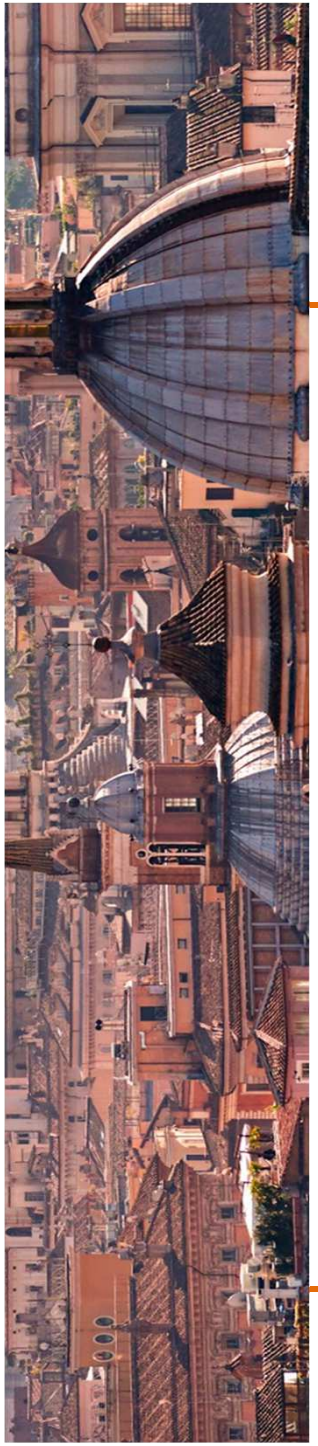
On the bases of the expected damages, the Impact module estimates the expected loss of services (ΔQoS)



Case 1: DSS on-line functioning

Vulnerability index (evaluated on the bases of ΔQoS) are referred to population, children and elder people densities

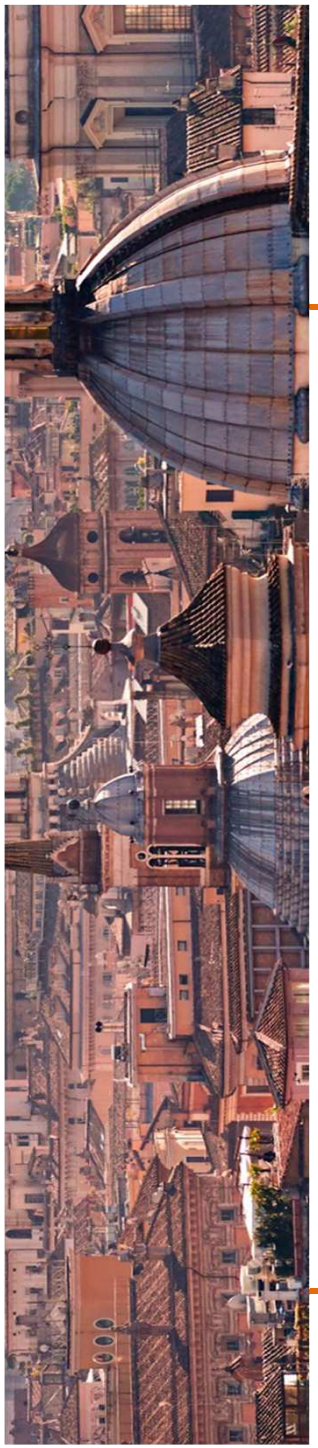




Conclusions

Preparedness and Resilience appear to be the most appropriate properties to enhance, particularly in urban contexts, characterized by high CI densities, their strong (inter)dependence (functional & positional).

Climatic changes, excess of uncontrolled urbanization are going to stress territory, particularly in the Mediterranean areas (hardly accustomed to severe natural hazards and currently striving against economical crisis, inhomogeneous population pressure, bad land usage, drought and costal erosion etc.)

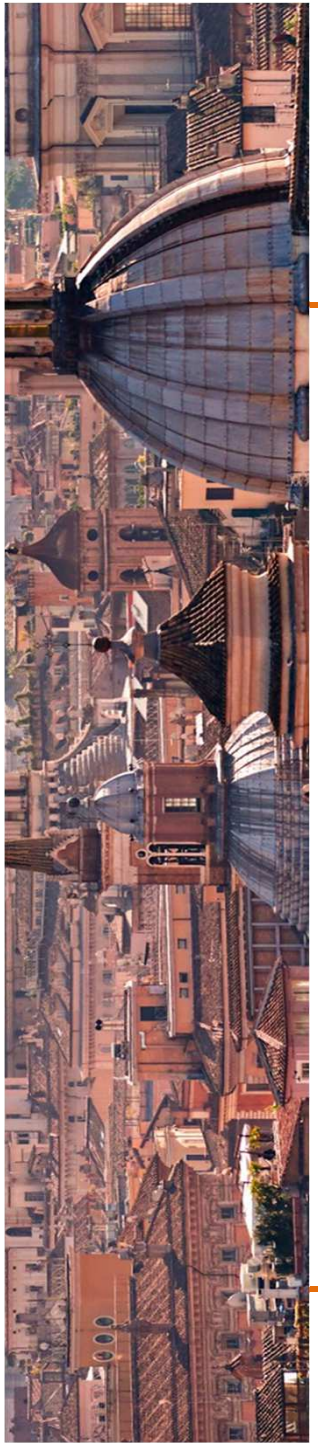


Conclusions

The availability of data coming from Public and also Private database is of primary relevance for pursuing these goals.

A still higher relevance is assumed by the compliance of P.A. in supporting and endorsing R&D coming from the Public and the Private sectors (like, e.g. Smart City projects, H2020 initiatives).

Roma Capitale is undergoing a Rockfeller Foundation project for leading Roma within the “resilient cities” of the planet. Awareness and efforts in gathering and using data and technologies is highly welcome.



Thanks for the attention

CIPR Net

www.ciprnet.eu

RESILIENCE ENHANCEMENT OF A METROPOLITAN AREA

www.progetto-roma.org

vittorio.rosato@enea.it