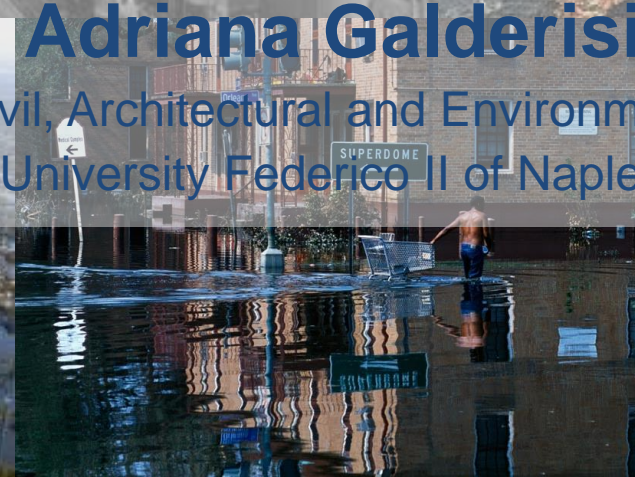
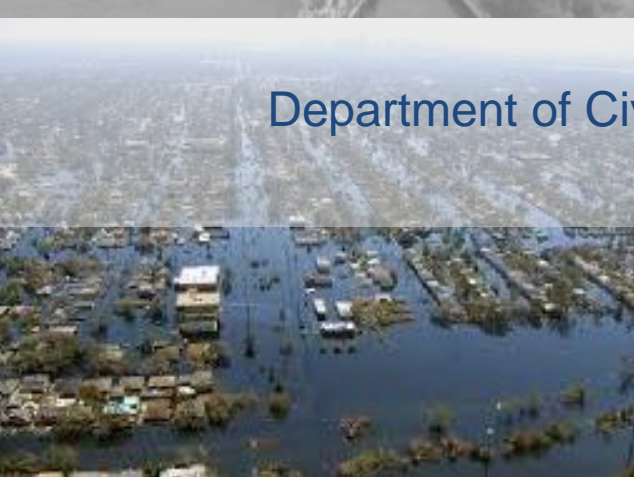




Complex urban disasters challenging cities' development

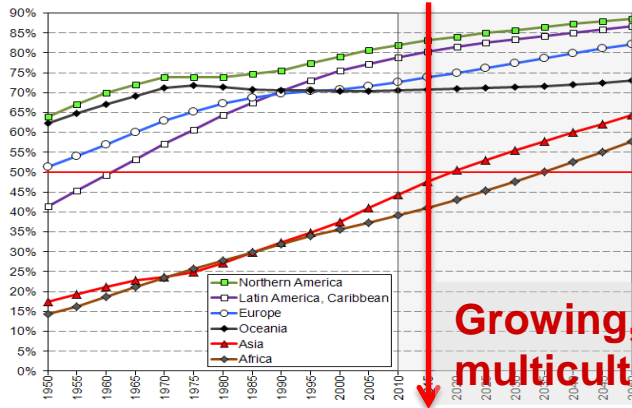
Adriana Galderisi

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University Federico II of Naples

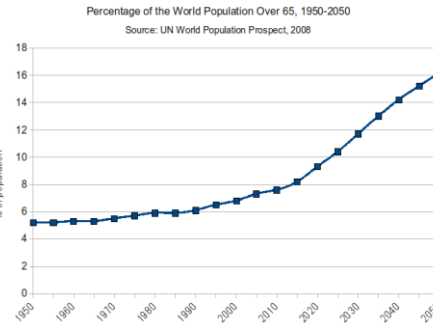


Cities, Complexity and Disasters

Urban Population by major geographical areas (% on total population)



Growing, ageing and multicultural urban population



Urban lifestyle and economy contribute to GHG emissions, strengthening climate-related hazards

Urban activities and assets as hazard sources (e.g. hazardous industrial plants)



Cities located in hazard/multi-hazard prone areas (coastal lowlands, unstable slopes, volcanic and seismic areas, ..)



Cities, Complexity and Disasters

Since the Nineties, numerous scholars have focused on the **increasing complexity of hazards in urban areas**, noting that they were shifting from individual phenomena towards **“an interactive mix of natural, technological and social events”** (Mitchell, 1999).

The complexity of urban disasters, characterized by different phenomena with a great potential for adverse impacts, due to **changes of hazards and vulnerability of exposed urban systems and to the interactive mix of such changes**, has been stressed too (McEntire et al. 2002).



Complex Disasters

Different types of complexity can be identified:

- complexity due to the features of individual hazards;
- complexity due to the relationships between different hazards;
- complexity due to the relationships between hazards and urban activities and assets.

***These various forms of complexity do not
exclude each other***



Complex Disasters

- natural hazards characterized by a spatial and temporal variability



Landslides



Forest fires

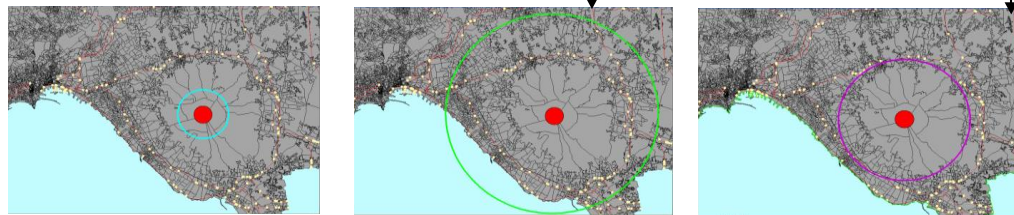
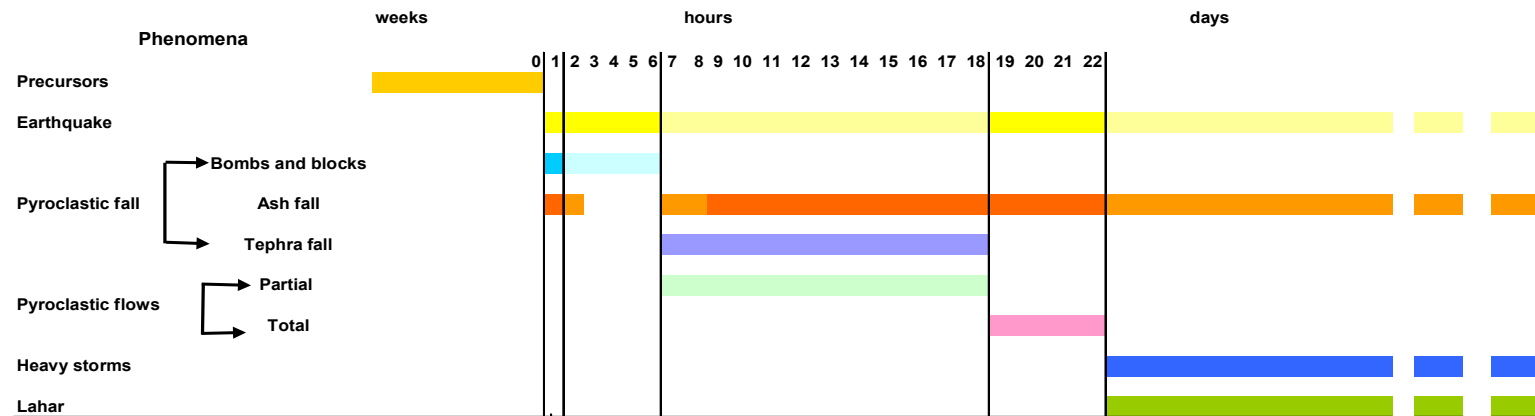


Floods

- **multi-site**: events that affect different places within a large geographical area (metropolitan area, region, nation..)
- **temporal variability**: events showing different time intervals of occurrence (from few seconds to many hours)

Complex Disasters

➤ different hazardous phenomena occurring in a given temporal span



Volcanic phenomena
different phenomena,
different affected areas,
different exposed targets



Complex Disasters

- enchainé events: a triggering hazard inducing one or more secondary hazards



Na-Na chains: natural hazards triggering secondary natural hazards (seismic induced landslides, prolonged drought inducing fires....)



Na-techs: natural hazards triggering technological accidents (toxic releases, explosions, etc.) as a consequence of their impact on industries, laboratories or critical infrastructure as gas pipelines.

These chains can be classified in respect to the **relation** between **triggering-secondary hazard**, to their **temporal development** (fast, slow, ...) or to their **level of complexity** (simple or multiple chains)



Complex Disasters

Hence, in urban areas **different forms of complexity** may arise
and combine one another

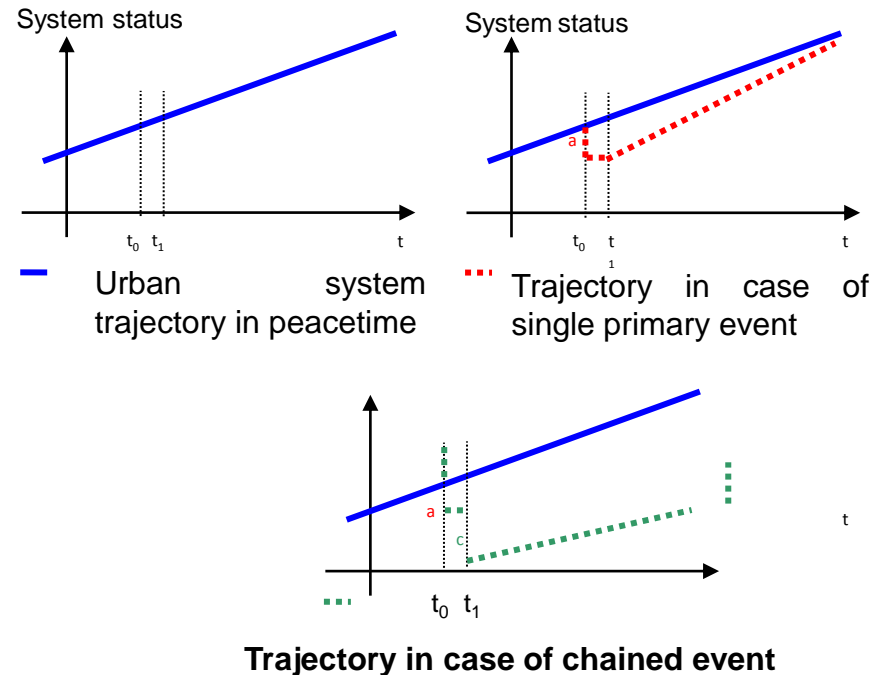


**A multi-risk approach is important in all geographic areas potentially
affected by different types of hazard ...
....but it is crucial in urban areas!**

Complex Disasters

In complex urban disasters:

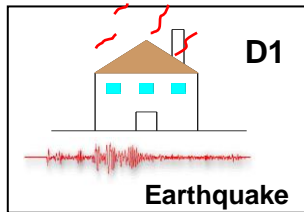
- mitigation measures sized on individual expected phenomena may fail, since in case of complex events impacts are often largely **beyond the expected**, making communities unable to react and respond to the event.



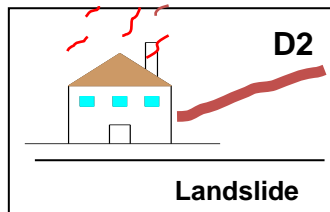
Complex Disasters

- the nature and the amount of **damages** significantly **increase**; **emergency management** is further complicated; the time required for **recovery** significantly lengthens and local, regional and national **resources** are largely stretched.

Physical vulnerability to chained events



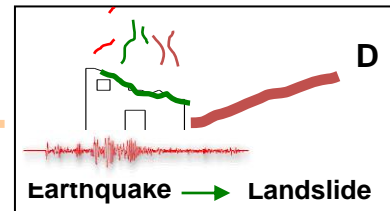
Irpinia earthquake 1980



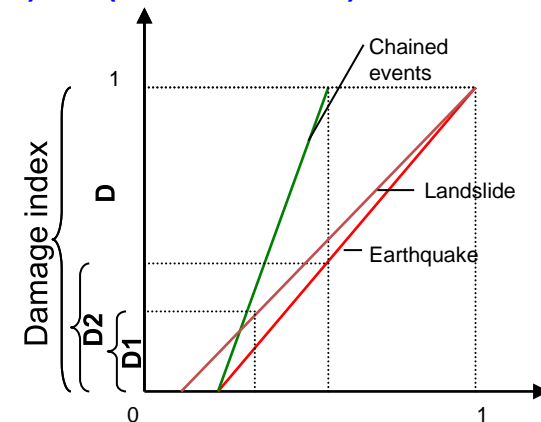
Landslide in Sarno 2001



$D1$ (Landslide) + $D2$ (Earthquake) \neq D (chained events)



Landslide triggered by the Alaska earthquake 1964





Current approaches...in theory

At present, it is largely recognized that the failure in considering complex events may result in a significant underestimation of risk, with relevant consequences for land use planning choices, for emergency management as well as for the prioritization and effectiveness of mitigation measures.

Numerous international documents highlight the relevance of a multi-risk approach both for land-use planning and for emergency management

(World Conference on Disaster Reduction, 2005; EU, Risk Assessment and Mapping Guidelines for Disaster Management, 2010; World Bank, Understanding Risk in an evolving world, 2014)



Current approaches...in practice

HAZARDS' SCIENTISTS:

- *Focus on individual hazards, developing in-depth analyses and assessment*
- *Sometimes multi-hazard assessment is provided*
- *Rarely hazard/risk scenarios taking into account multiple chains of natural and man-made hazards are available*

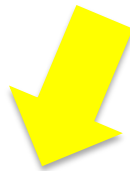
URBAN PLANNERS:

- *Have to deal with complex systems, often located in multi-hazard prone areas, so they should consider all the potential threats in the same picture.*
- *They still struggle to embed hazard analysis into land use planning choices*
- *Vulnerability analyses are rarely developed, even though crucial for mitigation strategies*

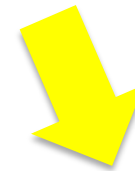


Main Gaps

Which are the main obstacles to the development of a multi-risk assessment, entailing a multi-hazard and a multi-vulnerability perspective and able to take into account hazards and vulnerability interactions, capable to effectively support land use planning decisions and emergency planning and management?



Technical gaps



Institutional gaps



Technical Gaps

➤ available information is generally fragmented



Landslides hazard map

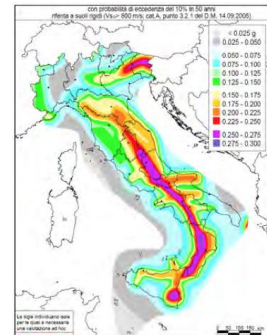
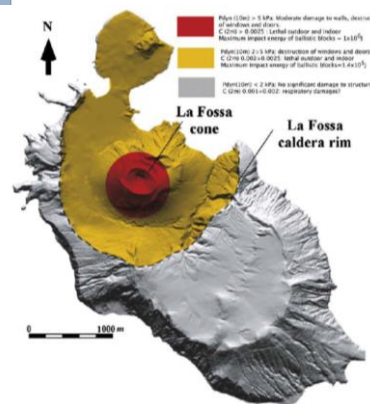
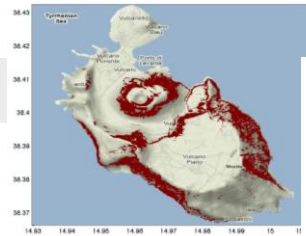
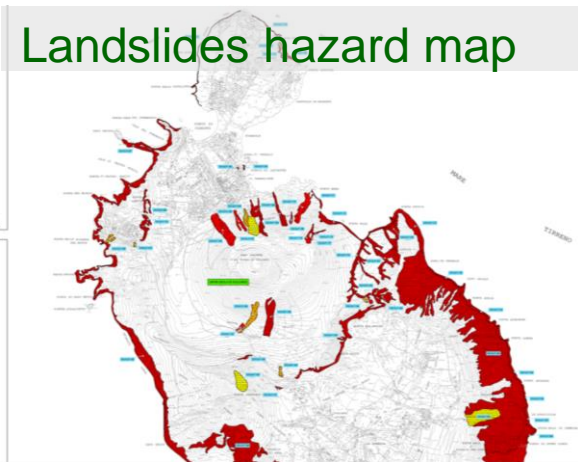
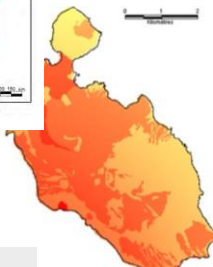
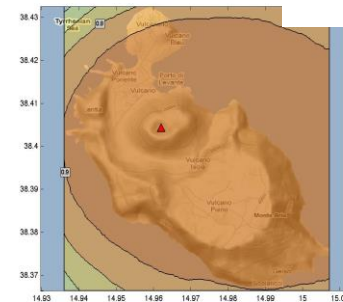


Figura 2 - Classificazione sismica del territorio italiano
Fonte: INGV



Volcanic Hazard maps



Seismic hazard maps

★ $M_w = 4.7$
April 6th, 1981

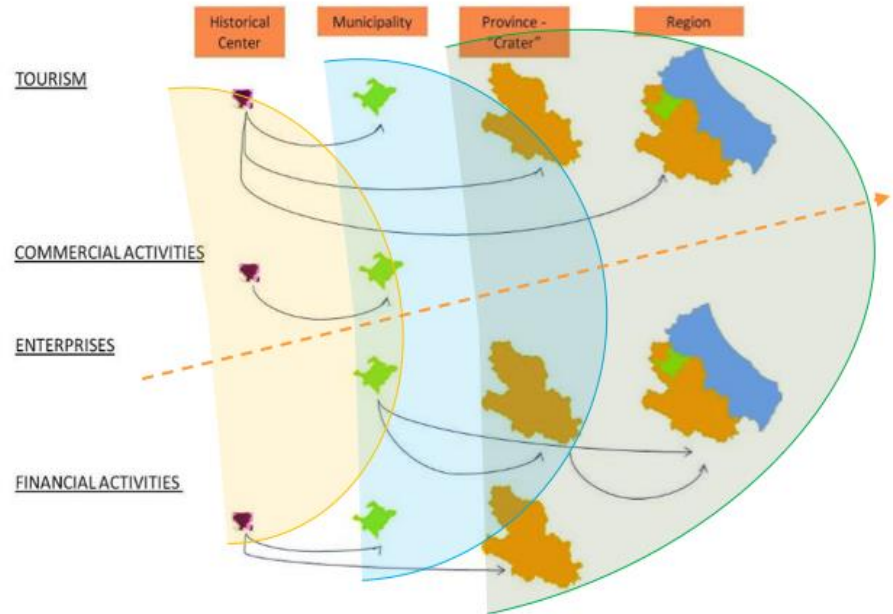


Adriana Galderisi
Geneve, 13 January 2015



Technical Gaps

- The difficulty to compare and rank different hazards, vulnerabilities and risks, which may refer to different time windows, different spatial scales, different typologies of impacts, etc.;



Differences among hazard scientists range from concept definitions to database, methodologies, classification of the hazard/risk levels.....
(Scolobig et al. 2014)

Institutional Gaps

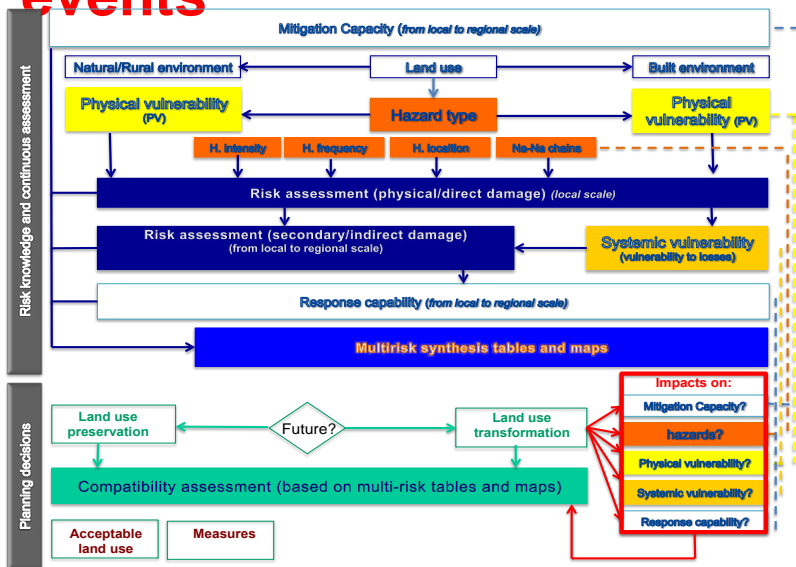
- the lack of a “multi-risk governance”, due to the lack of coordination and interfacing between different Authorities, which deal with specific hazards or risks at different governmental levels, without developing a complete overview of the potential chained effects.

The forest fire department may not be sufficiently knowledgeable about the probability of an industrial accident leading to a forest fire (EC, 2010).

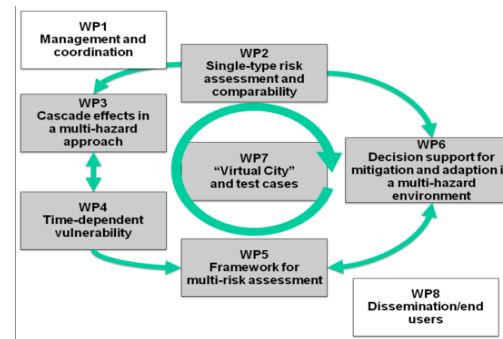


Future challenges

Embrace a **systemic perspective** when considering multi-hazards/multi-risks, providing larger attention to the development over time and in space of a given hazard and of the likely **chains of events**



ARMONIA: Applied multi Risk Mapping of Natural Hazards for Impact Assessment project(2005-2007)



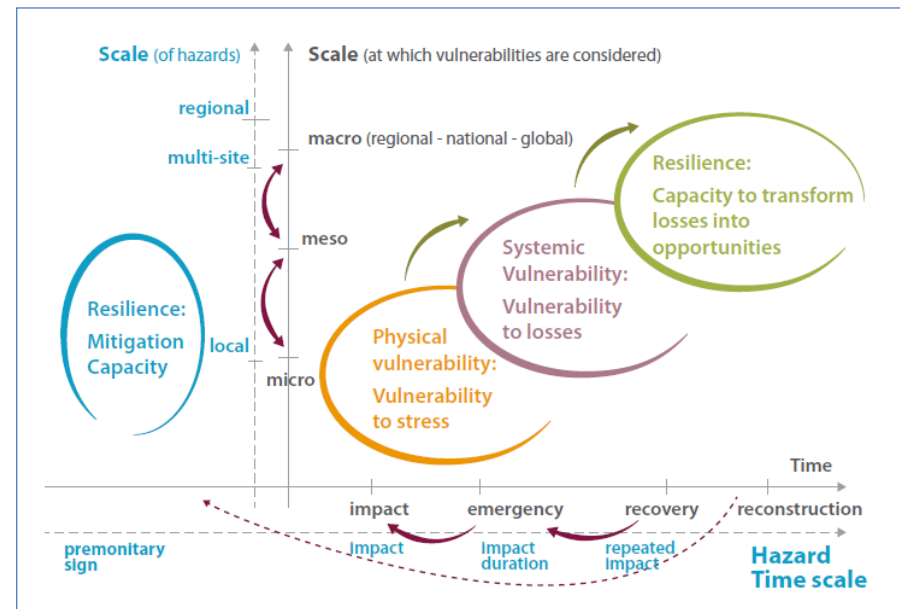
MATRIX: New Multi-Hazard and Multi-Risk Assessment Methods for Europe(2010-2013)



Future challenges

Develop an **integrated, multi-scale and multi-temporal assessment of the vulnerability** of exposed elements and systems in face to **individual and enchainned hazards**, focusing on the different vulnerabilities to each hazard and on the relationships among different targets which may induce new hazards, arising different vulnerabilities and, consequently, new impacts and damages.

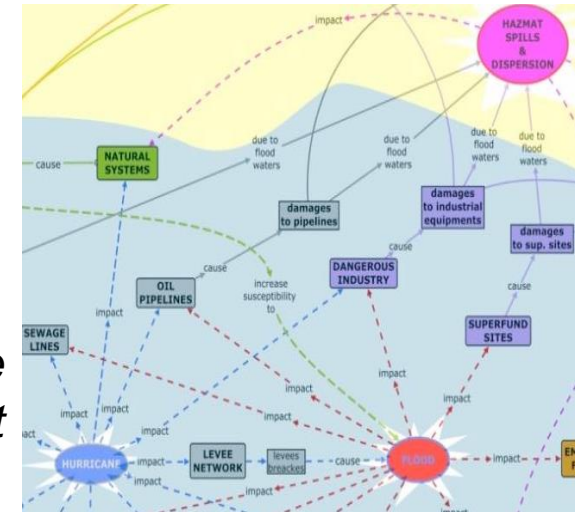
ENSURE: Enhancing resilience of communities and territories facing natural and na-tech hazards (2008-2010)



Future challenges

Improve methods and tools for developing more effective risk scenarios, capable to provide qualitative-quantitative descriptions of how the chains hazards-impacts-damage may develop

Scenario building is mainly based on experiences from the past, but also events and impacts which have so far not occurred should be considered (EC, 2010)



Improve the link between multi-risk assessment and decision making, through the development of platforms and tools for an effective sharing and exchange of information and data among different Authorities managing different risk and acting at different levels





Building resilient communities through urban planning and the integration of the Natural Sciences



Thanks for your attention!



Adriana Galderisi
Geneve, 13 January 2015

