FLOOD AND HYDRO-GEOLOGICAL RISKS MANAGEMENT: TRANSLATING RESEARCH INTO PRACTICE

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Outline

- How is the hydro-geological risk assessed?
- What is the impact of climate change on risk?
- What can we do to reduce and manage the risk?
- Tools to assess and manage the risk
Which hydro-geological risks?

- Floods
- Heavy rainfall
- Landslides (triggered by rainfall)
- Drought
- Storm surge and coastal floods

Other weather related risks
- Windstorms / tropical cyclones
- Heat waves
- Wild fires
How is the hydro-geological risk assessed?

\[ R = H \times V \]
How is the hydro-geological risk assessed?

\[ R = H \times V \times E \]

- **Hazard**
- **Vulnerability**
- **Exposure**
How is the hydro-geological risk assessed?

\[ R = H \times V \times E \]

- Return period (R)
- Intensity (H)
- Value (V)
- Damage (E)

\[ \begin{align*}
\text{Intensity} & \quad \text{Return period} \\
\text{Value} & \quad \text{Damage}\% \quad \text{Intensity} \\
\text{€} & \quad \text{Intensity}
\end{align*} \]
Hazard

TORRENTE BISAGNO - COMUNE DI GENOVA
### Vulnerability

<table>
<thead>
<tr>
<th>TIPOLOGIA</th>
<th>parziale danneggiamento</th>
<th>totale danneggiamento</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EDIFICI LIGNEI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ancorati</td>
<td>$U_h \geq 3 \text{ m}^2/\text{s}$</td>
<td>$U_h \geq 7 \text{ m}^2/\text{s}$</td>
</tr>
<tr>
<td>non ancorati</td>
<td>$U_h \geq 2 \text{ m}^2/\text{s}$</td>
<td>$U_h \geq 3 \text{ m}^2/\text{s}$</td>
</tr>
<tr>
<td><strong>EDIFICI IN MURATURA</strong></td>
<td>$U \geq 2 \text{ m/s} &amp; U_h \geq 3 \text{ m}^2/\text{s}$</td>
<td>$U \geq 2 \text{ m/s} &amp; U_h \geq 7 \text{ m}^2/\text{s}$</td>
</tr>
</tbody>
</table>

**Relazione Tirante-Velocità**  
Finnish Environment Institute (2001)
Exposure
R = H V E

Damage (€)

Return Period
## Risk

### Alluvione

<table>
<thead>
<tr>
<th>Tempo di ritorno</th>
<th>Danno annuo max prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>709.375.596</td>
</tr>
<tr>
<td>20</td>
<td>857.205.943</td>
</tr>
<tr>
<td>25</td>
<td>961.633.073</td>
</tr>
<tr>
<td>50</td>
<td>1.456.006.584</td>
</tr>
<tr>
<td>100</td>
<td>2.328.812.965</td>
</tr>
<tr>
<td>200</td>
<td>3.285.103.608</td>
</tr>
<tr>
<td>250</td>
<td>3.994.842.548</td>
</tr>
<tr>
<td>500</td>
<td>4.142.126.971</td>
</tr>
<tr>
<td>1000</td>
<td>4.274.156.101</td>
</tr>
</tbody>
</table>

- **100 yr % SAT**: 0,06%
- **250 yr % SAT**: 0,10%
- **500 yr % SAT**: 0,11%

<table>
<thead>
<tr>
<th>Danno annuo atteso</th>
<th>230.711.951</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasso x 100.000</td>
<td>5,91</td>
</tr>
</tbody>
</table>
What are the effects of climate change on risk?

The frequency and the intensity of extreme events such as floods, heavy rainfall, drought are increasing.

“Climate change is happening now: temperatures are rising, rainfall patterns are shifting, glaciers and snow are melting, and the global mean sea level is rising. We expect that these changes will continue, and that extreme weather events resulting in hazards such as floods and droughts will become more frequent and intense.”

European Environment Agency
What are the effects of climate change on risk?

The frequency and the intensity of extreme events such as floods, heavy rainfall, drought are increasing.
What are the effects of climate change on risk?

What are the effects of climate change in EUROPE?

Global climate change impacts Europe in many ways, including: changes in average and extreme temperature and precipitation, warmer oceans, rising sea level and shrinking snow and ice cover on land and at sea. These have led to a range of impacts on ecosystems, socio-economic sectors and human health.
What are the effects of climate change on risk?

The increase of the energy accumulated within the climate system causes the increase of extreme events.

© Intergovernmental Panel on Climate Change, 2015
What are the effects of climate change on risk?

…. like a pan on the fire
An example: effects of the increase of Sea Surface Temperature

Increase of the Maximum Wind Speed
An example: Mediterranean tropical-like cyclones

- In the Mediterranean sea are now observed tropical-like cyclones which are typical of other latitudes.
European regions particularly affected by climate change

- **Southern Europe and the Mediterranean basin** (due to increases in heatwaves and droughts);
- **Mountainous areas** (due to increasing melting of snow and ice);
- **Coastal zones, deltas and floodplains** (due to sea level rises, and increasing intense rainfall, floods and storms);
- **Europe's far north and the Arctic** (due to increasing temperatures and melting ice).
... in Italy

- Increase of the mean temperature
- Increase of the frequency of heavy rainfall events
- Decrease of the mean annual precipitation
What are the effects of climate change on risk?

The economic and population trends indicate that also the vulnerability and exposure will increase.
What are the effects of climate change on risk?

\[ R = H \cdot V \]
What are the effects of climate change on risk?

The risks of pervasive and irreversible impacts are expected to increase. They could, however, be reduced by further emissions abatement and adaptation measures, building on past actions in Europe and internationally. Key risks for Europe include flood events, droughts and other weather extremes that damage ecosystems and biodiversity, as well as infrastructure and human well-being.
What can WE do?
Knowing the risk!

- Assess the Hazard
- Assess the Vulnerability
- Estimate the Exposure

\[ R = H \times V \times E \]
Assess the Hazard

- There are several tools and information available
  - Water Information System for Europe (WISE)
Assess the Hazard

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    http://www.progettoiffi.isprambiente.it
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  - (Italy) Geoportale Nazionale
    - [http://www.pcn.minambiente.it](http://www.pcn.minambiente.it)
Knowing the risk!

R = H * V

- Assess the Hazard
- Assess the Vulnerability
- Estimate the Exposure
Assess the Vulnerability

- IUSS have developed a vulnerability model with the contribution of ANIA

- Based on the features of the building, the tool assesses the flood vulnerability

\[ R_3 = U_{R3} \cdot \frac{A - \text{h} \cdot \nu}{B - (1 - s^2)} \]
Knowing the risk!

\[ R = H \times V \times E \]

- Assess the Hazard
- Assess the Vulnerability
- Estimate the Exposure
What can WE do to reduce the risk?

- Risk mitigation: the reduction of any of the risk factors
  - Hazard reduction: prevention
  - Vulnerability reduction: protection
  - Exposure reduction: planning
- Risk transfer:
  - Insurance
- Risk adaptation:
What can WE do to reduce the risk?

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Risk transfer:
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  - Vulnerability reduction: protection
  - Exposure reduction: planning
- Risk transfer:
  - Insurance
- Risk adaptation
Risk adaptation

- Adaptation means *anticipating* the effects of climate change and taking appropriate action to prevent or minimise the damage they can cause or exploit opportunities.

- **Early actions** will save on damage costs later.

- **Adaptation strategies** are needed at all levels of administration, from the local to the international level.
Risk Adaptation

- SESAME project (SME adaptation to flood risk)
  http://sesame.uk.com

The Sesame project aims to understand and model the impacts of flooding on the small businesses and the knock-on effects on the wider economy – and to find ways of encouraging businesses to be better prepared in future.
Risk Adaptation

- BLUEAP (www.blueap.eu) and ACT (www.actlife.eu) for adaptation plans for landslides and coastal erosions

- DERRIS (www.derris.ue)
  - Risk assessment tool for PA and in SMEs to risk management, prevention and adaptation
  - Innovative forms of public-private governance for climate catastrophes involving SMEs, PAs and the insurance sector.
What is the current positions of SMEs in respect of risk?
A recent survey on the Medium Enterprises

“3° Osservatorio Risk Management Focus 2015 sulle Medie Imprese italiane”
(CINEAS in collaboration with Con Mediobanca and with the contribution of UnipolSai)

Characteristics of the survey sample

- 257 enterprises
- Aggregated revenue 16,7 bilions of euro
3° Osservatorio Risk Management Focus 2015 sulle Medie Imprese italiane
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- 590 milions per year invested in risk management
- 2,3 mln/y for each enterprise i.e. 3,5% of the revenue

<table>
<thead>
<tr>
<th>Risk Area</th>
<th>Normalized Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety at work</td>
<td>73.1</td>
</tr>
<tr>
<td>Solvability customer</td>
<td>70.7</td>
</tr>
<tr>
<td>Cash</td>
<td>69.0</td>
</tr>
<tr>
<td>Concentration of clients</td>
<td>66.9</td>
</tr>
<tr>
<td>Concentration of suppliers</td>
<td>66.7</td>
</tr>
<tr>
<td>Incidents, explosion</td>
<td>63.7</td>
</tr>
<tr>
<td>Controversies</td>
<td>62.9</td>
</tr>
<tr>
<td>Earnings per capita</td>
<td>62.4</td>
</tr>
<tr>
<td>Financial risks</td>
<td>61.2</td>
</tr>
<tr>
<td>Environmental risks (privacy)</td>
<td>59.5</td>
</tr>
<tr>
<td>Risks of credit</td>
<td>58.7</td>
</tr>
<tr>
<td>Intellectual property</td>
<td>58.3</td>
</tr>
<tr>
<td>Business plan</td>
<td>57.7</td>
</tr>
<tr>
<td>Business plan</td>
<td>57.5</td>
</tr>
<tr>
<td>Reputation</td>
<td>56.1</td>
</tr>
<tr>
<td>Stability</td>
<td>54.6</td>
</tr>
<tr>
<td>Stability</td>
<td>54.4</td>
</tr>
<tr>
<td>Stability</td>
<td>52.7</td>
</tr>
<tr>
<td>Stability</td>
<td>51.5</td>
</tr>
</tbody>
</table>

- Risks are normalized between 0 and 100 using the transformation: (score - 1) / (4 - 1) * 100
- For each enterprise, the percentage of revenue invested in risk management is 3.5%.
3° Osservatorio Risk Management Focus 2015 sulle Medie Imprese italiane

(Cineas in collaboration with Mediobanca and with the contribution of UnipolSai)

Attese di spesa in RM per il prossimo triennio e Roi
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