Use of models to support Disaster Loss Data collection

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How can models help?

(Sendai Framework Data Readiness Review 2017)
How can models help?

• How can we estimate
  • economic loss per sector (agriculture, productive assets, housing, cultural heritage) → Target C
  • the number of critical infrastructure health, education, critical infrastructure, basic services → Target D

• How can indicators on past event impacts be reconstructed?
Impact assessment through geospatial indicators

\[ \text{Impact} = f(H, E, V) \]

- **Hazard**
- **Exposure**
- **Vulnerability**

**MODELLING APPROACH**

- N. of assets affected
- Economic losses
  - Indicators B,D: 1.5.1, 11.5.1, 13.1.1
  - Indicators C: 11.5.2
The RASOR platform

HAZARD
- Flood
- Landslide
- Earthquake
- Tsunami
- Hurricane
- Volcano
- Wind

EXPOSURE & VULNERABILITY
- Crop
- Forest
- Buildings
- Industry
- Lifelines
- Population
- Transport
- Infrastructures

= IMPACT
- Physical
- Human
- Social
- Economic
- Environmental
Genoa 2014, flood impact on buildings and population
Genoa, 9 October 2014 | Flood hazard: water depth and velocity
Exposure characterization:
- Cadastral dataset
- Open Street Map
- Satellite maps
- Virtual survey
Genoa | Vulnerability curves for building

Water depth [m]

Damage [%]
Genoa | What if: diversion channel for Fereggiano creek (tributary) + new culvert for Bisagno creek

diversion channel on tributary rio Fereggiano

new culvert for the Bisagno river
Genoa, 9 October 2014 event

Current situation

Diversion channel + new culvert

Water depth [m]
- 0.0
- 0.2
- 0.4
- 0.6
- 0.8
- 1.0
- 1.2
- 1.4
- 1.6
- 2.0
- 2.4
- 3.0

Economic damage [M€]
- 0-0.0.1
- 0.01-0.02
- 0.02-0.2
- 0.2-0.5
- 0.5-1.0
- 1.0-2.0
- 2.0-2.5
Genoa, probable maximum loss curve

Scenario | Average Annual Loss (M€/year)
--- | ---
Current situation | 3.2 M€/year
diversion channel + new culvert | 0.8 M€/year

Payback period: 80 years
## Genoa, recent past events…

<table>
<thead>
<tr>
<th>Past event</th>
<th>Discharge peak [m$^3$s$^{-1}$]</th>
<th>Return period [years]</th>
<th>Damage, current situation [M€]</th>
<th>Damage, dev. channel + new culvert [M€]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>760 m$^3$s$^{-1}$</td>
<td>50 years</td>
<td>47 M€</td>
<td>0 M€</td>
</tr>
<tr>
<td>1970</td>
<td>1100 m$^3$s$^{-1}$</td>
<td>100-200 years</td>
<td>194 M€</td>
<td>120 M€</td>
</tr>
<tr>
<td>1992</td>
<td>700 m$^3$s$^{-1}$</td>
<td>30-50 years</td>
<td>??</td>
<td>0 M€</td>
</tr>
<tr>
<td>2011</td>
<td>830 m$^3$s$^{-1}$</td>
<td>50-100 years</td>
<td>43 M€</td>
<td>0 M€</td>
</tr>
<tr>
<td>2014</td>
<td>1040 m$^3$s$^{-1}$</td>
<td>100-200 years</td>
<td>110 M€</td>
<td>14 M€</td>
</tr>
</tbody>
</table>
Genoa, what if the next 50 years are as “unlucky” as the past 50 years

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Structural measure Cost</th>
<th>Average Annual Loss</th>
<th>Payback period</th>
<th>Average Annual Loss (^1) (M€/anno)</th>
<th>Payback period</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current situation</strong></td>
<td>0 M€</td>
<td>3.2 M€/year</td>
<td></td>
<td>6.6 M€/anno</td>
<td>-</td>
</tr>
<tr>
<td><strong>Dev. Channel + New culvert</strong></td>
<td>251 M€</td>
<td>0.8 M€/year</td>
<td>80 years</td>
<td>2.2 M€/anno</td>
<td>about 50 years</td>
</tr>
</tbody>
</table>

Payback period: 80 years

Payback period: 50 years

\(^1\) Average Annual Loss based on the damage last 50 years economic loss
People vulnerability to flood
People vulnerability to flood
People vulnerability to flood
People vulnerability to flood
People vulnerability to flood
Genoa, 9 October 2014 event

Current situation

Diversion channel + new culvert

### Hazard for people
- Low
- Medium
- High
- Very high

### People potentially involved
- 8560
- 660
- 360
- 10
Disaster Loss Data
into a Risk Assessment perspective
(Sendai Framework Priority 1)
How to make informed decisions on DRR measures?

- What is the average annual loss that is experienced in the country due to one or more hazards?

- How can we measure the benefit of different DRR policies?

- Will our decisions be still valid in the future? How can we consider external constraints such as climate change and population growth?

- How can we monitor actual decrease after mitigation?

Quantitative Dynamic Risk Assessment
Quantitative Risk Assessment

Loss Exceedance Curve

Tail Value at Risk

Average Annual Loss

probability

%
Quantitative Risk Assessment

Present condition loss exceedance curve (computed)
Confidential interval observed losses distribution
Observed loss in present condition
Quantitative Risk Assessment

- Present loss exceedance curve (computed)
- Loss exceedance curve (computed) after mitigation measures
- Present losses distribution confidence interval
- Observed losses (after mitigation measures) distribution confidence interval
- Observed loss in present condition
- Observed loss after mitigation
Quantitative Dynamic Risk Assessment

- Climate change → hazard increasing
- Population grow → exposure increasing
- Prevention/mitigation measures → exposure/hazard/vulnerability decrease

climate change, population increase
DRR policies
climate change adaptation
Strong winds impacts on Anse d’Hainault (Hai3)

Economic damage to buildings:
- estimated from satellite (Copernicus EMS): 36 M$
- simulated with RASOR: 29 M$

Thank you

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