Impact of winter storms – modelling for decision support

JRC Workshop October 2018
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risk management options
(examples are: hazard protection, exposure zoning, building code)

weather \rightarrow hazard

climate scenarios

economic development scenarios

exposure

CLIMADA probabilistic event-based simulation (open source)

vulnerability

impact

intensity

outputs:
- risk analysis
  + mapping,
  + (early) warning...

example: building damage

low
middle
high

animated:
http://vimeo.com/22323232

+ appraisal of risk management options
  (effectiveness, cost/benefit)
+ quantification of uncertainty

https://github.com/davidnbresch/climada_python
Risk in Impact Modelling

The “effect of uncertainty on objectives”\(^1\)

Risk is the combination of the probability of a consequence and its magnitude:

\[
\text{risk} = \text{probability} \times \text{severity}
\]

or, to be more specific:

\[
\text{risk} = \text{hazard} \times \text{exposure} \times \text{vulnerability} = (\text{probability} \times \text{intensity}) \times \text{exposure} \times \text{vulnerability}
\]

\(^1\) a positive or negative deviation from what is expected [ISO 31000]

Illustration: IPCC AR5
- Risk = hazard \times exposure \times vulnerability
- Benefits of impact modelling will increase with open-access damage database.
Winter storms

Burglind/Eleanor at the lake of Zug, Switzerland, Photo: A. Hostettler
Winter storms cause the largest insured damages in Europe

Infrastructure damage  Forestry damage  Interruption in traffic  Electricity blackouts

Winter storms Kyrill (2007), Lothar (1999) and Daria (1990) amount to over 5 billion EUR insured damage each (sigma SwissRe, 2011; NatCatSERVICE Munich Re, 2018).
Storm impacts affect many countries

Reported damage for Burglind: 724 Million EUR (perils.org, 2018)
Weather data – wind speed – can inform risk assessment

Gust speed footprint Lothar 27.12.1999
as reported by Windstorm Information Service (WISC)
Values at risk - exposure

Europe: distribution of infrastructure at risk
CLIMADA standard exposure

Latitude

Longitude

Value (USD)
Vulnerability: the link between hazard and exposure

Vulnerability function: (Della-Marta et al., 2010; Schwierz et al., 2010; Bresch, 2014; Welker et al., 2016)
Impact Modelling in simple steps – Impacts

Infrastructure damage footprint of Lothar 27.12.1999
WISC gust and CLIMADA exposure
Austria is hit by damaging winter storms every 5-10 years
Challenges in Impact Modelling

- Hazard ✓
- Exposure ✓
- Vulnerability ❌ are dependent on calibration

damage databases are needed
Data Exchange with Building Insurance Zurich (GVZ)

- Per Event, per Region (postal code), per utilisation type, per decade of construction
  - Number of damaged buildings
  - Sum of Damage (indexed to 2017)
  - Sum of Value (indexed to 2017)

<table>
<thead>
<tr>
<th>Event ID</th>
<th>Postal Code</th>
<th>Utilisation Type</th>
<th>Decade of Construction</th>
<th>Number of Damages</th>
<th>Sum of Damages</th>
<th>Sum of Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>03.01.2018</td>
<td>8002</td>
<td>Residential</td>
<td>1980s</td>
<td>5</td>
<td>20'000 CHF</td>
<td>5'000'000 CHF</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

...
Perils – www.perils.org

- ...aggregates local loss assessments
- ...reports 6 weeks after an event with estimates
- ...issues a final report 1 year after an event
- ...reports for several sectors and per CRESTA zone
Requirements for a damage database

- Machine-readable
- Open-access

- Collaboration with different data providers for maximum coverage

- Using **definitions** and **processes** of existing databases in the industry
Content of a damage database

- What happened, when and where

<table>
<thead>
<tr>
<th>Event_ID</th>
<th>Date</th>
<th>Location</th>
<th>Sector</th>
<th>Impact</th>
<th>Exposure</th>
<th>Currency Definition</th>
<th>Level of Certainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>…</td>
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</tr>
</tbody>
</table>

- Infrastructure damage split in four sectors: urban residential, non-urban residential, urban non-residential and non-urban non-residential

- Depending on the purpose of the database: add additional sectors like forest damage, interruptions of services (railway, roads, electricity)
Conclusion

- A damage dataset is needed to improve the benefits of impact models

- A damage dataset needs to be:
  - Machine-readable
  - Open-access
  - Inspired by existing databases (e.g. Perils)

- Strong collaboration between government, industry and academia
Thank you for your attention

- Questions?