Reinsurance of Natural Hazards

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Geo Risks Research Department - Main Tasks

**Estimation of loss potentials**
- return period
- accumulation PML's
- budgets

**Hazard and risk assessment**
- rating, tariff zones, tariff scheme
- World Map

**Loss investigations (after major events)**
- loss/vulnerability functions
- publications

**Service-Tools**
- NatCatSERVICE, MRHazard/CatPMLService, NATHAN

**Services (internal & external clients)**
- evaluations, presentations, publications
Development of service-tools

NatCatSERVICE

Largest Database for Natural Disasters
Development of service-tools
NATHAN (NATural Hazards Assessment Network)
### Development of service-tools

**NATHAN (NATural Hazards Assessment Network)**

#### Natural Hazard Maps

- **MAJOR DISASTERS**

#### Country Profiles

- Order by date
- Order by event
- Short Report
- Long Report

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### Map

Position in decimal degree:
- Latitude: 53.52°N
- Longitude: 5°19'03"E

Position in degree/minute/second:
- Latitude: 53°31'49"N
- Longitude: 5°19'03"E

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<table>
<thead>
<tr>
<th>Date</th>
<th>Region Affected</th>
<th>Loss Event</th>
<th>Deaths</th>
<th>Insured losses US$ m</th>
<th>Economic losses US$ m</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.19.12.2004</td>
<td>REGION EUROPE Germany, Switzerland</td>
<td>Winter storm</td>
<td>17</td>
<td>est US$ 600 m</td>
<td>est US$ 1200 m</td>
</tr>
<tr>
<td>5.12.2004</td>
<td>Germany NW, Baden-Württemberg</td>
<td>Earthquake</td>
<td>0</td>
<td>est US$ 8 m</td>
<td>est US$ 12 m</td>
</tr>
<tr>
<td>17.19.7.2004</td>
<td>REGION EUROPE Germany, Switzerland</td>
<td>Severe storm, tornado</td>
<td>1</td>
<td>&gt; US$ 10 m</td>
<td>&gt; US$ 100 m</td>
</tr>
</tbody>
</table>
Importance of Natural Hazards for Munich Re
2005: 660 natural disasters

- Major natural catastrophe
- Great natural catastrophe
- Earthquake, tsunami, volcanic eruption
- Windstorm
- Flood
- Temperature extremes (i.e. heat wave, forest fire), Mass movements (i.e. avalanche, landslide)
## History of losses, trends

### 10 Major Natural Disasters 2005

<table>
<thead>
<tr>
<th>Date</th>
<th>Country/region</th>
<th>Event</th>
<th>Fatalities</th>
<th>Economic Loss</th>
<th>Insured Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>August</td>
<td>USA</td>
<td>Hurricane Katrina</td>
<td>1 300</td>
<td>125 000</td>
<td>60 000</td>
</tr>
<tr>
<td>October</td>
<td>USA, Mexico, Caribbean</td>
<td>Hurricane Wilma</td>
<td>42</td>
<td>16 000</td>
<td>11 000</td>
</tr>
<tr>
<td>September</td>
<td>USA</td>
<td>Hurricane Rita</td>
<td>10</td>
<td>15 000</td>
<td>10 000</td>
</tr>
<tr>
<td>January</td>
<td>Western, Northern, Eastern Europe</td>
<td>Winterstorm Erwin</td>
<td>18</td>
<td>5 800</td>
<td>2 500</td>
</tr>
<tr>
<td>August</td>
<td>Europe, Alps</td>
<td>Flood</td>
<td>11</td>
<td>3 000</td>
<td>1 700</td>
</tr>
<tr>
<td>July</td>
<td>USA, Caribbean</td>
<td>Hurricane Dennis</td>
<td>3 100</td>
<td>1 200</td>
<td></td>
</tr>
<tr>
<td>July-August</td>
<td>India</td>
<td>Flood</td>
<td>1 150</td>
<td>5 000</td>
<td>700</td>
</tr>
<tr>
<td>March</td>
<td>USA</td>
<td>Flood</td>
<td>1 000</td>
<td>655</td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>Canada</td>
<td>Thunderstorm, Tornado</td>
<td>550</td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>USA</td>
<td>Thunderstorm</td>
<td>500</td>
<td>300</td>
<td></td>
</tr>
</tbody>
</table>

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Outstanding hurricane seasons 2004 and 2005:

**Average season**

10 named tropical cyclones per season in average
6 of them having hurricane force

**2004: Extreme season**

15 named TCs
9 of them having hurricane force

**2005: Record season**

27 named TCs  (last record year: 1933 – 21 named TCs)
15 of them having hurricane force  (last record year 1969 – 12 hurricanes)
Major Natural Disasters 1950 - 2005
Percentage distribution worldwide

Number of events: 268
- Earthquake/tsunami, volcanic eruption: 29%
- Windstorm: 40%
- Flood: 25%
- Others: 6%

Deaths: 1.7 Mill.
- Earthquake/tsunami, volcanic eruption: 54%
- Windstorm: 38%
- Flood: 7%
- Others: 1%

Economic Losses: 1,400 bn US$
- Earthquake/tsunami, volcanic eruption: 31%
- Windstorm: 35%
- Flood: 27%
- Others: 7%

Insured Losses: 230 bn US$
- Earthquake/tsunami, volcanic eruption: 74%
- Windstorm: 6%
- Flood: 6%
- Others: 14%

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Tropical Cyclone
Tropical Cyclone (Hurricane, Typhoon, Cyclone)
Tropical Cyclone (Hurricane, Typhoon, Cyclone)

- Length of track : 5 000 - 15 000 km
- Life span : 5 - 15 days
- Speed of movement : 10 - 50 km/h
- Maximum wind speed : 300 - 380 km/h
- Source regions : Tropical seas (surface water temperature > 27°C; between 5° and 35° latitude)
- Season : summer and autumn
Risk Analysis of Natural Hazards

Risk Assessment
How can we assess the expected loss?

Risk = Function

Hazard
Vulnerability
Insurance terms
How can we assess the hazard?

Example: Tropical Cyclone

- Records of Tropical Cyclones (Hurricanes, Typhoons) are just available for a very limited time period
- Inconsistencies: early, historical records are incomplete

Solution:

Development of a stochastic model to expand the existing historical records of tropical cyclone tracks.
Gefährdung
Modellierung eines stochastischen Eventsets

Quelle: Jonas Rumpf, Universität Ulm, Abteilung Stochastik
In modelling losses from storm events, the hazard is presented by wind fields.

Wind fields show the maximum wind gust for every point in the area during the passage of the storm.
Tropical Cyclone (Hurricane, Typhoon, Cyclone)

August 29 - September 13, 1960: Hurricane Donna
(Munich Re Windfield Simulation)
Hazard

Wind field

Track Tropical Cyclone

wind speed (km/h)

- 60 - 69
- 70 - 79
- 80 - 89
- 90 - 99
- 100 - 109
- 110 - 119
- 120 - 129
- 130 - 139
- 140 - 149
- 150 - 159
- 160 - 169
- 170 - 189
- 180 - 189
- 190 - 199
- 200 - 209
- 210 - 219
- 220 - 229
- 230 - 239
- 240 - 249
- 250 - 259
- 260 - 269
- 270 - 279
- 280 - 289
- 290 - 299
- ≥ 300
Loss ratio (LR) = Losses per liability zone / sum insured

Loss ratios are generated mainly empirically by analysis of historic losses. Partly (especially earthquakes) also by an approach of engineering technics.

Analysis is executed mainly after events causing great losses (e.g. Lothar 1999) with detailed information about the loss.
Risk analysis Natural Hazards

Vulnerability

Loss ratio (in % of TSI)

Wind speed

- Timber
- Masonry
- Concrete

Germany

USA
Risk analysis Natural Hazards

Vulnerability

Wind field

Zones with information about liability and loss
Risk Analysis of Natural Hazards

Insurance terms

Sum insured per liability zone (here zip code)

- < 1 Mio. €
- 1.0 – 2.0 Mio. €
- 2.1 – 3.0 Mio. €
- 3.1 – 4.0 Mio. €
- > 4 Mio. €

Liabilities (affected)
(Sum insured in m. €)

- 420
- 81
Risk Analysis of Natural Hazards

Estimation of loss potentials

Distribution of liabilities

Vulnerability

Hazard information

Storm scenarios

„PML curve“ (Loss in % of TSI)

„Return period“
PML Curve

PML-Chart

Absolute PML (in Millions)

Return period

0.1  1  10  100  1000  10000
Thank you very much for your attention!
Helga Weindl