Recent Severe Hail Losses in Europe
An overshadowed peril?

- 2 largest German insurance industry losses from hailstorms
  - July/Aug 2013: Manni, Andreas, and Franz hailstorms
    - Germany and France
    - Insured loss: EUR 3.5bn (USD 4bn)
    - Largest DE loss since Munich 1984 event
  - 2014: Ela convective storm was largest European insured loss of the year
    - Germany, France, and Belgium
    - Insured loss: EUR 1.75bn (USD 2.2bn)

- 2010 Prague, Czech Republic
- 2009: Wolfgang – Austria, Switzerland
- European Severe Weather Database (ESWD)
  - https://www.eswd.eu
  - National weather service and crowd-sourced data

The Output that Transformed a Market
Loss Exceedance Probability Curve

Risk and capital management: stress tests to quantify potential impact of risk exposures.

Example: Swiss Re Annual Report

<table>
<thead>
<tr>
<th>Insurance risk stress tests</th>
<th>Single event losses with a 500 year return period*</th>
<th>2005</th>
<th>2015</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural catastrophe</td>
<td></td>
<td>-6.3</td>
<td>-8.2</td>
<td>61</td>
</tr>
<tr>
<td>Natural catastrophes</td>
<td></td>
<td>-7.4</td>
<td>-9.5</td>
<td>38</td>
</tr>
<tr>
<td>Conventional insurance</td>
<td></td>
<td>-4.7</td>
<td>-6.3</td>
<td>56</td>
</tr>
<tr>
<td>National insurance</td>
<td></td>
<td>-7.9</td>
<td>-9.9</td>
<td>26</td>
</tr>
<tr>
<td>Life insurance</td>
<td></td>
<td>0</td>
<td>-0.8</td>
<td>16</td>
</tr>
</tbody>
</table>

Financial market and credit risk stress tests

<table>
<thead>
<tr>
<th>Financial market and credit risk stress tests</th>
<th>2005</th>
<th>2015</th>
<th>Change %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial market stress tests</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Credit risk stress test</td>
<td>0.7</td>
<td>0.9</td>
<td>29</td>
</tr>
</tbody>
</table>

Example: Swiss Re Annual Report 2013 with grateful thanks to Esther Bouw, Swiss Re

Managing Extremes: The history of experience is not an understanding current risk

<table>
<thead>
<tr>
<th>Insurance loss scenarios (USD bn)</th>
</tr>
</thead>
</table>
| Historic insured loss (2001)      | 200
| Florida Hurricane (1992)          | 50  |
| Hurricane Katrina (1969)          | 40  |
| Hurricane Andrew (1992)           | 45  |
| Hurricane Harvey (2017)           | 125 |
| Florida Hurricane (1983)          | 5   |
| Florida Hurricane (1956)          | 5.5 |
| Florida Hurricane (1960)          | 5.5 |
| Florida Hurricane (1926)          | 5.5 |
| Florida Hurricane (1916)          | 5.5 |

*Historic insured loss (2001)
eXtremeTm Tornado - A Maximum Foreseeable Loss Model
What if Moore event occurs in Tulsa?

- Exhaustive set of high-severity events, centred specifically on a portfolio
- ~1 million events can be built specifically for a company's portfolio (no coverage gaps)
- Tornado, hail, or wind swaths independently or together
- Idealised storm swaths
- Historical storm swaths for “what-if” scenarios

Hail Risk Climatology
Pan-European Coverage
From hazard to loss

- 1st hail risk assessment to cover southern, central and eastern Europe with a contiguous hazard model
- ~38,000 individual ‘overshooting top’ events selected, constrained by hail occurrence observation (ESWD)
- Stochastic simulation of 3,500 years of hail activity (~630,000 events)

- E.g. Austrian Client portfolio
  - 1 in 200 year loss
  - Average annual loss
  - Historical scenarios
  - Wolfgang, 2009
  - 1 in 95 year loss

Hail Risk: Australia
Radar and OT data
Brisbane Hailstorm, 27th Nov, 2014

- 100,000 insurance claims
- 25% property, 75% motor
- Insured loss: AUD 1.1bn (USD 900m)

Event Set Construction

- Event footprint defined by 3D radar
- NASA overshooting top (OT) datasets filtered to match radar
- National coverage and longer time-series event sets built from OT data

Deterministic Scenarios for Risk Communication
Validation points on the loss exceedance curve

- Intuitive nature of deterministic scenarios helps communicate with senior managers, board of directors and other stakeholders
- Deterministic methods used for stress testing and developing risk management solutions
- Deterministic scenarios can be paired with stochastic models
- Useful in developing alternative views of risk
- Considering different sizes of events and "what-if" analyses

- E.g. Tornado May 20th, 2013: Moore, OK
  - Peak winds ~210 mph
  - 24 fatalities
  - USD 1.8bn insured loss
  - Previous event in 1999
  - 36 fatalities

El Niño Southern Oscillation (ENSO)
Opportunities for forecasting frequency tornado/hail shifts

- Naturally occurring involving ocean temperatures in the Pacific
- La Niña increases hurricane activity in the Atlantic due to reduced wind shear
- El Niño modifies the jet stream positioning over the continental U.S., which alters severe weather ingredients
- ENSO is believed to influence the large-scale environmental features that produce severe thunderstorms
- Winter ENSO indices can be used to predict spring severe weather frequency
Impact of ENSO on Severe Storm Activity
- Composite mean anomalies of spring (March, April, May) hail and tornadoes conditioned on spring ENSO state

La Niña
- Composite mean anomalies of spring (March, April, May) hail and tornadoes conditioned on spring ENSO state

El Niño

FEMA: Disaster Deductibles
Promoting preparedness, mitigation and resilience?
12th Jan 2017: FEMA 2nd notice on "disaster deductible" proposal
- Recipients expend predetermined amount of own funds before receiving federal funding
- Why?
  - Federal spending on disasters should be reduced
  - Promote risk-informed-decision-making
  - Reduce the costs of future events – more effective use of taxpayer resources
  - Transparency of deductible requirement facilitates planning and budgeting
- Applies to Public Assistance (PA) funds only (not individual assistance)
  - Repair, or replacement of public facilities or infrastructure
  - Currently, federal share of PA funds “shall not be less than 75%” (Stafford Act, 1988)
  - Legislative changes required
- Credits available to reduce deductible requirement with demonstration of:
  - Adopting and enforcing building codes
  - Funding mitigation projects
  - Investing in disaster relief, insurance, and emergency management programs

Disaster Deductibles: OK Not OK?
Federal Register: Vol. 82, No. 8, Jan 12th 2017 / Proposed Rules
OK: has highest number (3) of annual average major disaster declarations
- USD 5.3m – 3.3m starting deductible (~state average potential mitigation discount of 39%)
- CA: Highest credit potential: 2nd highest population (37.2m), 1.5 declarations p.a.
- WA: Lowest credit potential: ~state average population (6.7m), 1.2 declarations p.a.

FEMA National Flood Insurance Program (NFIP)
Reinsurance purchase
Jan 2017: FEMA obtains $1.042bn of reinsurance for NFIP
- Bolster claims-paying ability and reduce reliance on US Treasury borrowings
- 25 reinsurers on programme (e.g. Swiss Re, Munich Re, Liberty Mutual...)
- Carriers responsible for 26% of losses between USD 4-8bn incurred from a single event
  - Occurrence probability of 17.2% chance of taking place during the year (5.8 years)
- Market tested in Sept 2016 with USD1m placement with 3 reinsurers
- US flood models:
- Models enable confidence in underwriting and flood risk management

WRN: Columbia University Tornado and Hail Forecasts
Jan 2017: Comparison with NWS Severe Weather Reports

Natural Disasters Impacting Sovereign Credit Ratings
Standard & Poor’s
- Analysis based on sample of 48 countries
- Insurance mitigates the risk of potential downgrades
Cities / Sub-state Regions
A scale for maximum climate risk impact and financial instability

Resilience to Extreme Weather
Royal Society Report, November 2014

The re/insurance sector has made considerable progress in evaluating the risks posed by extreme weather.

These risks now need to be better accounted for in the wider financial system, in order to inform valuations and investment decisions and to incentivise organisations to reduce their exposure. This could be done through a requirement for public and private sector organisations to report their financial exposure to extreme weather at a minimum of 1 in 100 (1%) per year risk levels.

Financial Stability Board (FSB)
Task Force on Climate-related Financial Disclosures (TCFD)

December 2016

• TCFD Appointed by Mark Carney
  Chair of FSB
  Governor Bank of England

• TCFD chaired by Michael Bloomberg
  Members inc. Asset Managers, Corporates, Banks, Reins

• Company disclosures to promote more informed investment related to climate risks
  • Physical Risk (including natural hazards / disasters)
  • Transition Risk (current policy, new technologies etc.)
  • Liability Risks

• Identify concentrations of climate-related risks

Human Rights, Disaster Resilience & Financial Regulation
Emerging Duties of Care against Natural Hazards

As the UN Human Rights Council asserts:

“Natural hazards are not disasters in and of themselves. Whether or not they become disasters depends on the exposure of a community, and its vulnerability and resilience, all factors that can be addressed by human (including State) action. A failure (by governments and other actors) to take reasonable preventative action to reduce exposure and vulnerability and to enhance resilience, as well as to provide mitigation, is therefore a human rights issue” HRC, 2014a

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