Swiss Re

Sea level rise, storm surge & reinsurance

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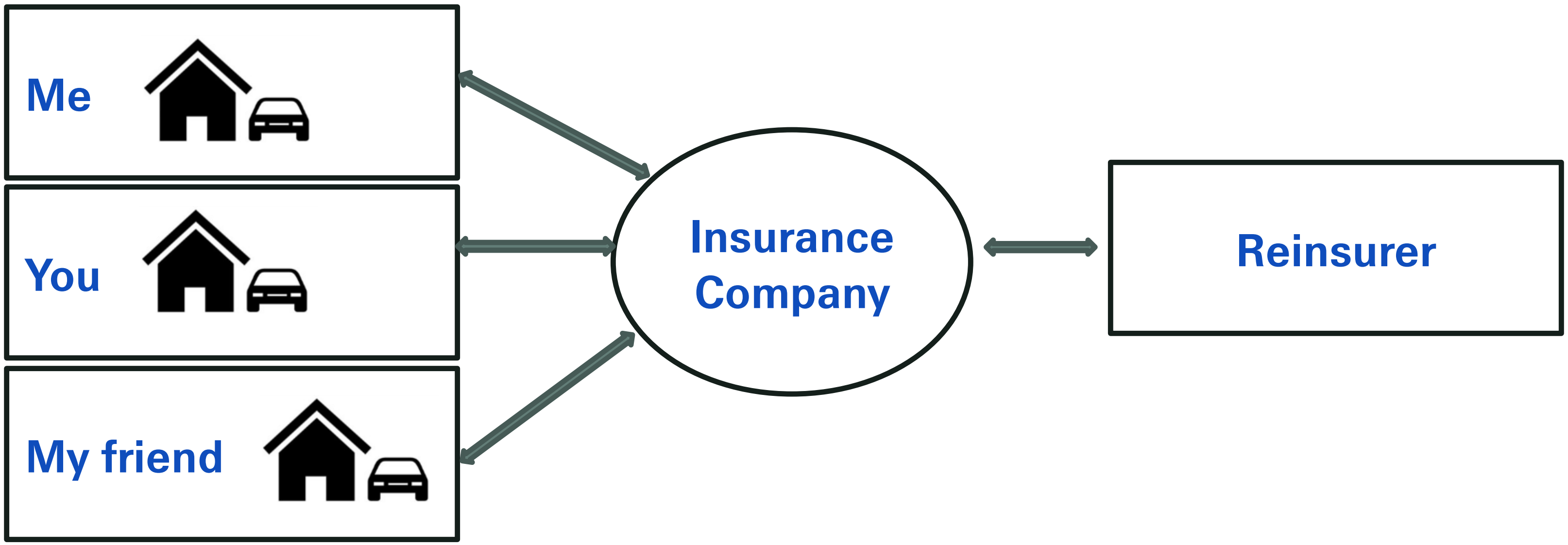
What is reinsurance?

- Reinsurance is insurance for insurance companies.



- Reinsurers pool risks on gigantic scales (global reach, individuals to governments, property and casualty, life and health, etc.)
- This results in better diversification and thus capital efficiency
- Swiss Re is one of the largest global reinsurers

How does sea level rise impact the reinsurance industry?

- Flood is the most common and expensive natural hazard in the United States

- Economic losses due to flood are on the rise.
  - Increasing property values
  - Concentration of risks in coastal areas
  - Changing hazards (climate change, **sea level rise**)

- Modeling and assessing storm surge risk are part of Swiss Re's core business.

Insurance risk stress tests: Single event losses with a 200-year return period[1]

Pre-tax impact on economic capital in USD billions, as of 31 December	2015	**2016**	Change in %
Natural catastrophes			
Atlantic hurricane	−5.6	**−5.1**	−10
Californian earthquake	−3.8	**−3.4**	−11
European windstorm	−2.6	**−2.6**	−2
Japanese earthquake	−3.2	**−3.1**	−4
Life insurance			
Lethal pandemic	−2.4	**−2.4**	−1

[1] Single event losses with a 200-year return preriod show for example that there is a 0.5% probability over the next year that the loss from a single Atlantic hurricane event could exceed USD 5.1 billion. The impact excludes earned premiums for the business written and reinstatement premiums that could be triggered as a result of the event.

  - How does sea level rise translate to large damages in regions with high concentrations of values?

Brief history of US flood protection & insurance

- 1927: Great Mississippi Flood
  - Most destructive river flood in US history
  - Federal government built a complex system of levees and floodways

- 1965: Hurricane Betsy
  - Storm surge event
  - Kick-started FEMA's NFIP. Private insurers left the flood market.
- After Betsy
  - FEMA developed flood risk maps for 98% of the US population
  - Most residential and small commercial flood policies in the US have been written by the NFIP
  - NFIP worked well for moderate floods, but heavily in debt following large losses from Katrina, Ike, Sandy and Harvey

Today: US flood insurance market

- Before ~2010, private insurers were reluctant to write residential flood policies.
  - Flood risk is very hard to understand. Highly localized peril.
  - FEMA flood risk maps have low granularity (i.e. 100 / 500 year zones, or outside)
  - Floods occur frequently outside of designated flood zones

Hurricane Harvey

- Current state of the market:
  - Market is dominated by NFIP policies, but there's a huge **protection gap**.
  - 88% of US homeowners do not have a flood insurance policy.
  - About half of single-family homes in high risk zones have NFIP policies
  - 2% insurance penetration in moderate / low-risk zones

- Now: Protection gap in the US is seen as a **protection opportunity** for private insurers. **Why?**

Private flood insurance: Why now?

1. Public appetite
   - Recent floods, particularly outside designated FEMA flood zones
   - Consumers are losing confidence in the NFIP (low limits, limited definition of flood, premiums are expensive for low-risk properties)

2. Regulatory encouragement
   - NFIP is heavily in debt; government seems to be losing its appetite for insurance

3. Opportunity for private insurers
   - Residential flood coverage is an opportunity; new markets to grow rather than trying to compete on already insured business
   - Better tools to understand coastal/inland flood risk

Improvements in flood risk modeling

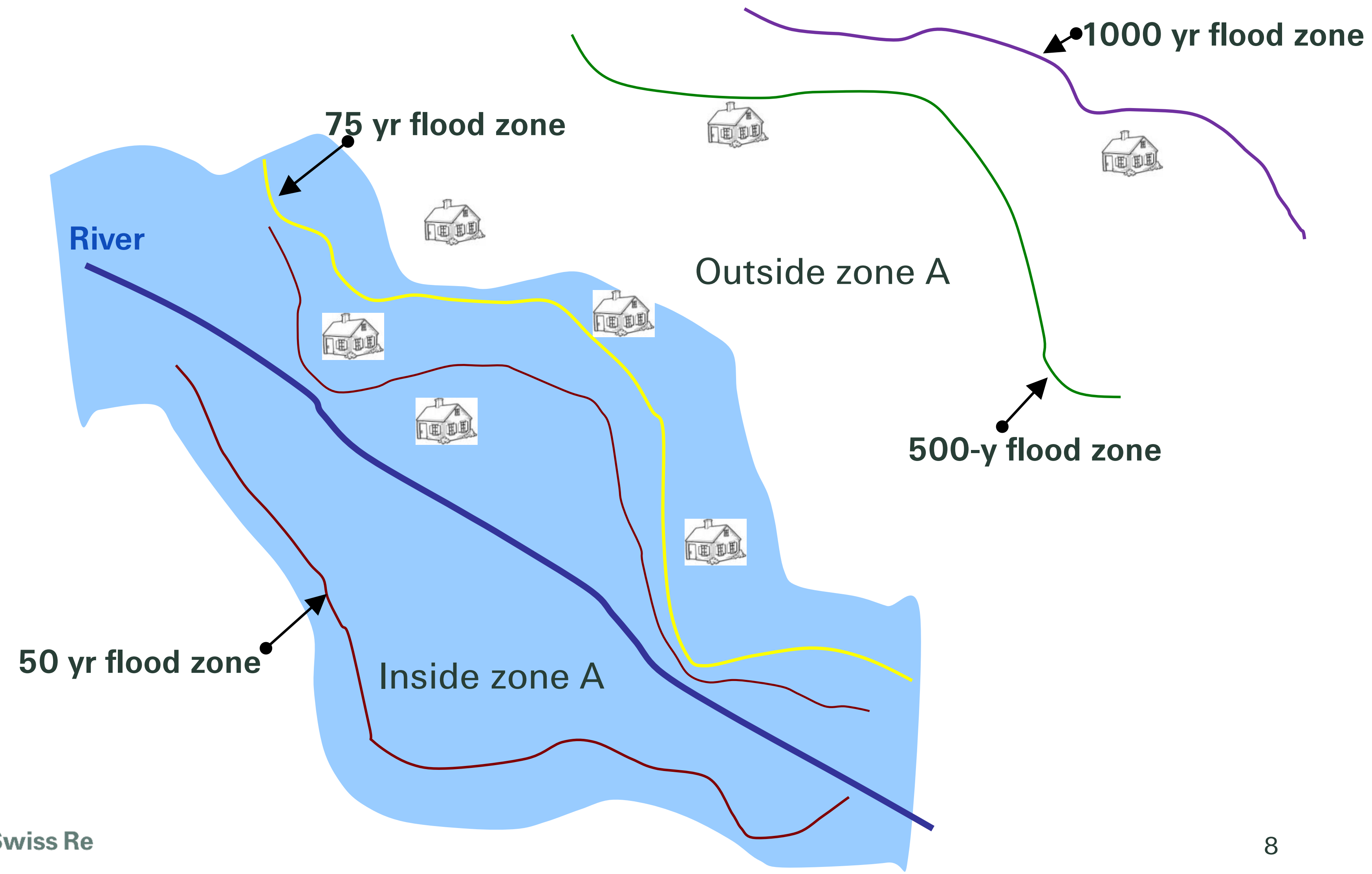
What has changed?

1. Better understanding of physics behind flooding
2. Availability of high-resolution data
3. More powerful computing resources

Latest coastal/inland flood risk models:

- Delineate flood risk at a much higher spatial resolution than FEMA maps
- Account for more than just river flooding and storm surge
- Provide more than just flood zones

Modeling flood risk



Challenges and opportunities

- Policy terms and conditions
  - Can we develop insurance products that provide more comprehensive coverage?

- Mismatch in time scales
  - Sea level rise signals are remarkably clear over 50 or 100 year time scales
  - Lifetime of a reinsurance policy: 1-2 years
  - How can we apply signals in a meaningful way?

- Sea level rise changes the risk landscape of coastal flooding & storm surge.
  - Hard to quantify due to (1) uncertainty in sea level projections and (2) limitations in producing very high resolution projections necessary for risk assessment

- Coastal property values

Key takeaways

- Private re/insurers see residential and small commercial flood as an opportunity to close the US insurance protection gap
  - Affords to ability to rebuild following extreme events

- In many cases, flood insurance can be provided for significantly less and at better terms than an NFIP policy

- Climate change will only exacerbate coastal flood risk, and flood risk assessment tools will only improve.
  - Collaboration and communication are key.

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