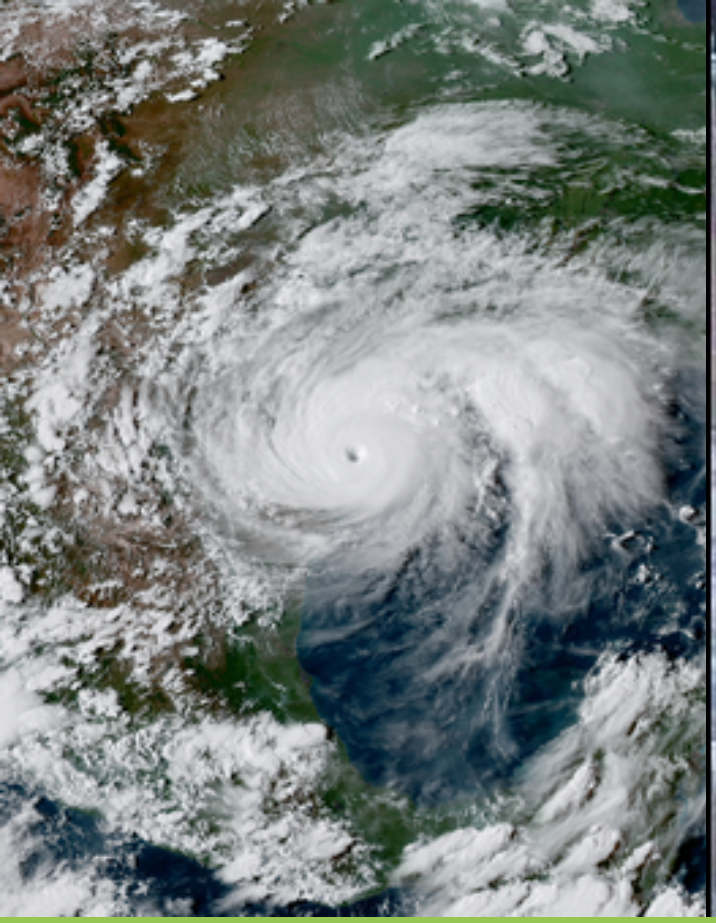


Economic Impacts of Natural Disasters and Climate Change

Prof.dr. Wouter Botzen

IVM Institute for Environmental Studies

vrije Universiteit amsterdam

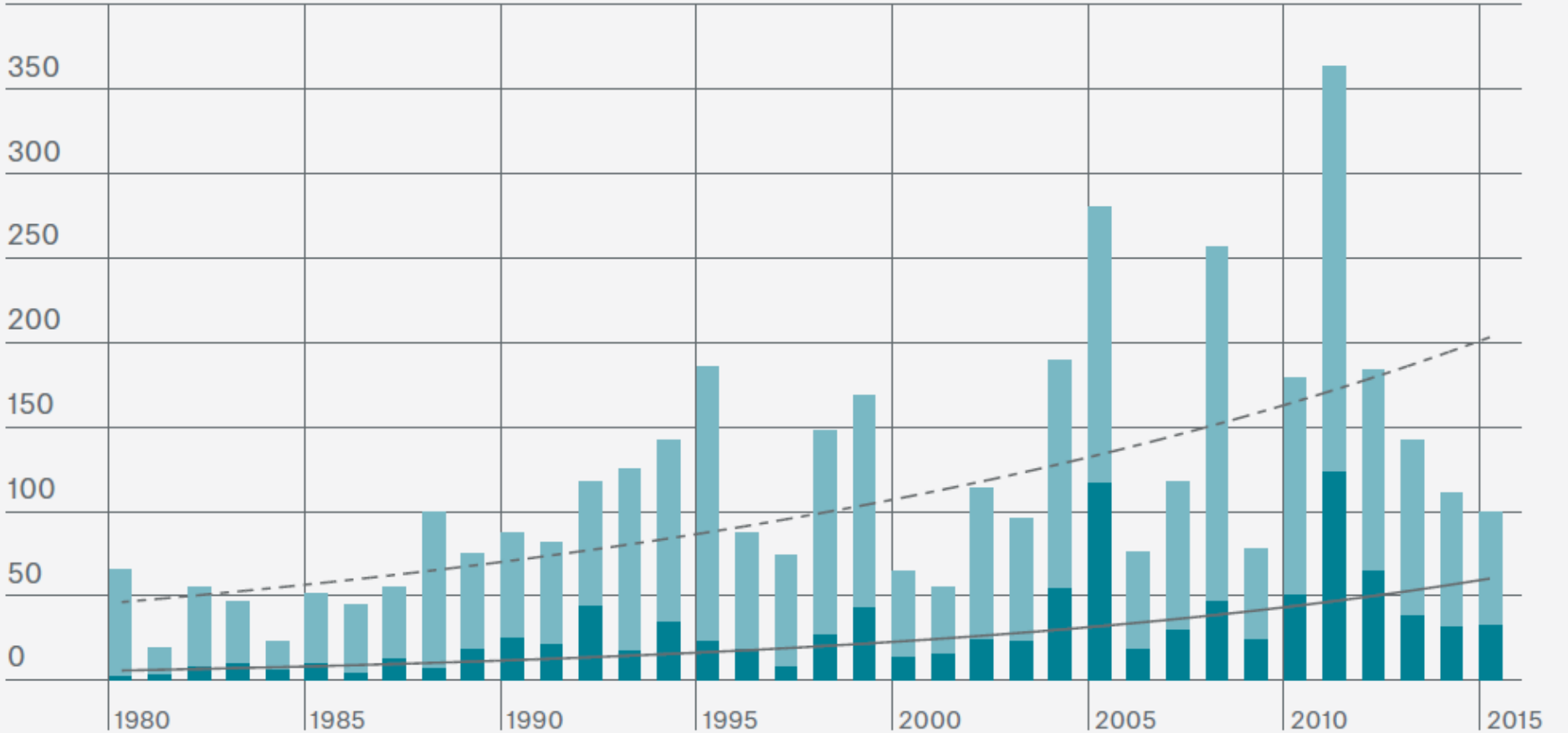
Universiteit Utrecht

Missing Categories and Influence on the Social Cost of Carbon

Category of costs of climate change
More extreme weather and natural disasters
Large biodiversity losses (Amazon, ocean acidification)
Extreme and irreversible climate change (‘positive feedback mechanisms’)
Impact on long term economic growth
Political instability and violent conflicts
Large migration flows

Source: Botzen and van den Bergh, 2014 *Nature Climate Change*

Global Losses from Large Natural Disasters

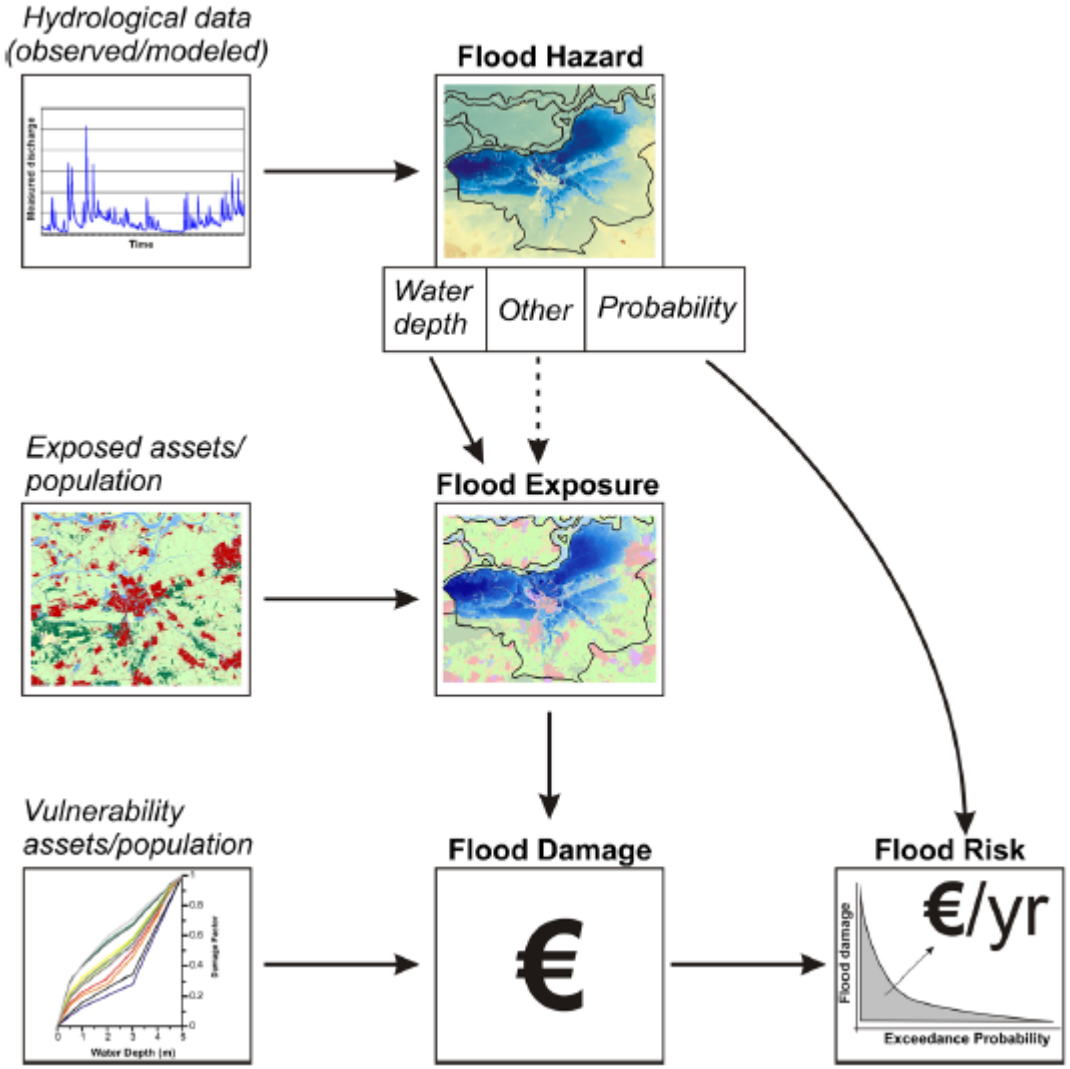


Source:
Munich Re (2016)

Methods for Assessing Natural Disaster Costs

- **Catastrophe models** of direct property damages or casualties
- **Input-Output models** of short run indirect economic damages
- **Computable General Equilibrium Models** of long run indirect economic damages
- **Empirical econometric studies** of consequences of past disasters
  - Short run impacts, like on GDP growth or level
  - Long run impacts and structural changes in the economy

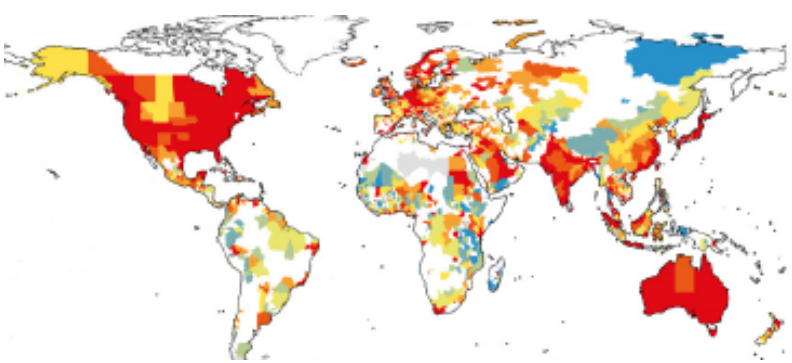
Catastrophe models

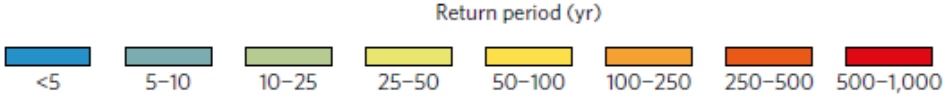


- Purposes
  - Current risk
  - Risk under climate change
  - (cost-benefit) evaluations of risk management strategies
  - Insurance pricing and risk management

Catastrophe models: Scales and policy insights

- Global flood risk models
  - Changes in country and continental scale risk
  - CBA of optimal river basin protection standards and required adaptation funds





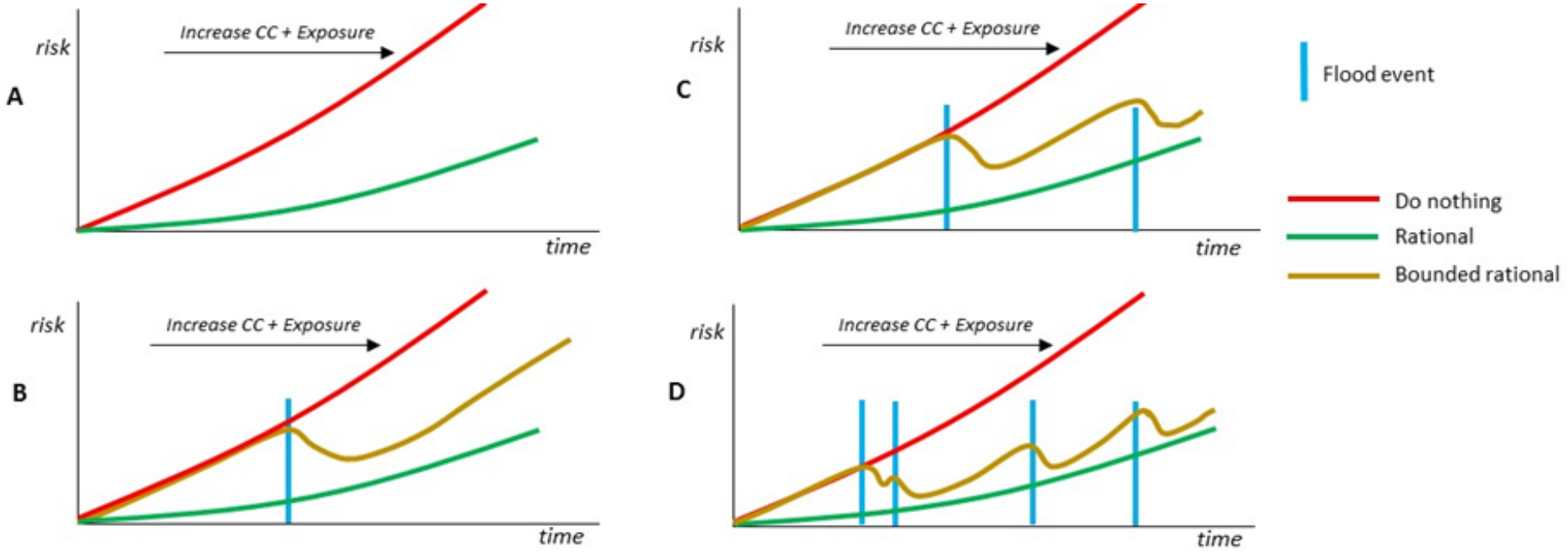
Source: Ward et al. 2017, *Nature Climate Change*

- National scale models (e.g. Kind, 2014, *Journal of Flood Risk Management*)
  - Guide national adaptation planning
  - CBA of optimal river basin protection standards

- Regional and local (e.g. city) scale models (e.g. Aerts et al., *Science*)
  - Create detailed local risk maps
  - CBA of local adaptation measures: building codes, spatial planning, types of protection

Catastrophe models: Key issues of future research

- Advances in detailed exposure information and hazard modelling
- A knowledge gap is vulnerability which changes due to adaptation

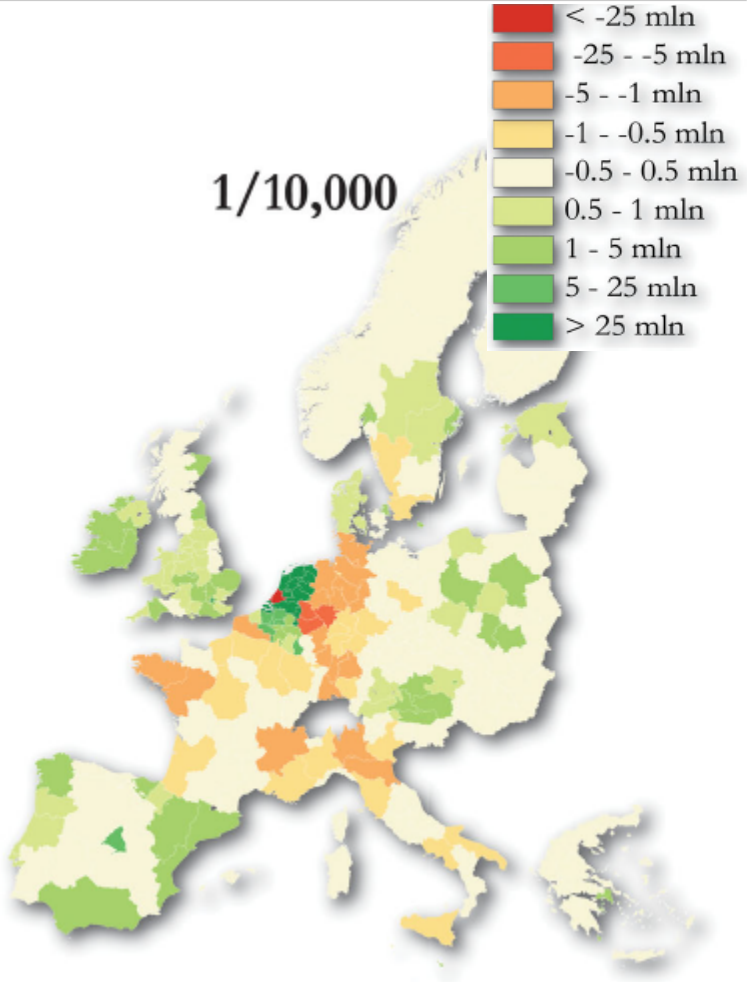


- Agent-based catastrophe models can capture this behavior

(e.g., Haer et al. 2017, *Risk Analysis*)

Input-Output Models: Policy Insights & Future Research

- Disruption of trade-flows of inputs and outputs of different sectors
- Insights into short run production losses, unsatisfied demand and gains from reconstruction
- **Local scale models**: identify vulnerable key sectors for ex ante protection or fast recovery after a disaster
- **Regional scale models:** broader trade dependencies and substitution effects
- **Future research:** empirical calibration disaster impacts, recovery paths and resiliency measures



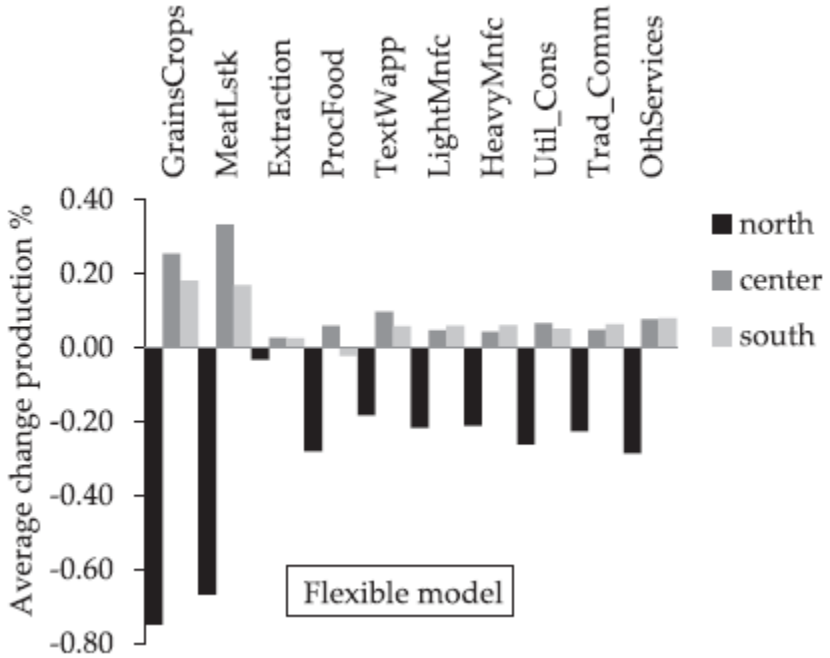
Source: Koks & Thissen, 2016, *Economic Systems Research*

Computable General Equilibrium Models

- Simulates how reduction in production results in price and demand changes and substitution effects in different markets in equilibrium
- Insights into production losses over the longer run than I-O models
- Aggregate scale with homogeneous impacts of disasters

- Exception spatial model:

Carrera et al. 2015. *Env. Model. & Softw.*



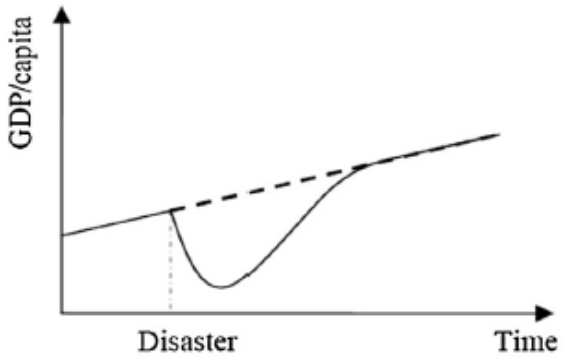
- **Future research:** spatial models, empirical calibration disaster impacts, and resiliency measures

Empirical studies

- Negative direct cost, but insignificant overall indirect cost

(Lazzaroni and Bergeijk, 2014, *Ecol. Econ*)

- Negative indirect cost; climatic disasters in developing countries (Klompi and Valx, 2014, *Global Env. Change*)



- **Scale:** Studies are aggregated in terms of scale (country) and time (year), which misses important short term dynamics and aggregates losses and positive substitution effects
- **Future research:** use of indicators of local economic activity (e.g. light data), physical indicators of hazards, and resiliency factors

Thank you for your attention!

For more information contact: wouter.botzen@vu.nl