Integrated coastal hazard risk reduction and management – a closer look at the dynamic damage cost methodology in COHERENT

Kirsten Halsnæs, M. A. Dahl Larsen, N. Drønen, F. Bach Kristensen, C. Sørensen, B. Brahtz Chrisensen

Innovation Fund Denmark

Urgency

DK:

Urd (Dec. 2016): ?

Gorm (Nov. 2015): ?

Bodil (Dec. 2013): ca. 1.6 bill. DKK.

Allan (Oct. 2013): ca. 2.6 bill. DKK

International:

Katrina (2005): ~700 bill DKK

Xaver (Bodil): 12 bill DKK (total)

Partners

GTS

DHI

Research institute

Danmarks Meteorologiske Institut

Governmental

Miljø- og Fødevareministeriet
Kystdirektoratet

Styrelsen for Dataforsyning og Effektivisering

Research institute (International)

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

University (Lead)

DTU

Municipalities

Aabenraa Kommune

SKIVEKOMMUNE

Ringkøbing-Skjern Kommune

Private enterprises

Smith

STORMFLODSSIKRING.DK

ENVIRONMENT SOLUTIONS
Preventing hydrometeorological disasters

Major Components

- New approach for estimating the most severe storm-surge events and costs
- Integrated modelling of coastal systems, land-use and inland hydrology
- Dynamic damage cost curves
- Updating of warning system, hazard development and optimal management
- Behavioral experiments and studies linking research, local governance and risk management

Outputs

The COHERENT platform will include:

- Statistical and probabilistic climate scenarios, interactive land-use and hydrological modelling, GIS risk maps linked to local data systems
- Dynamic damage curve estimation tool linked to GIS map and sector-specific loss tables
- A framework to link climate adaptation with a wider set of data and tools on damage costs, coping capacity, emergency operational planning, technologies, civil-society engagement and learning

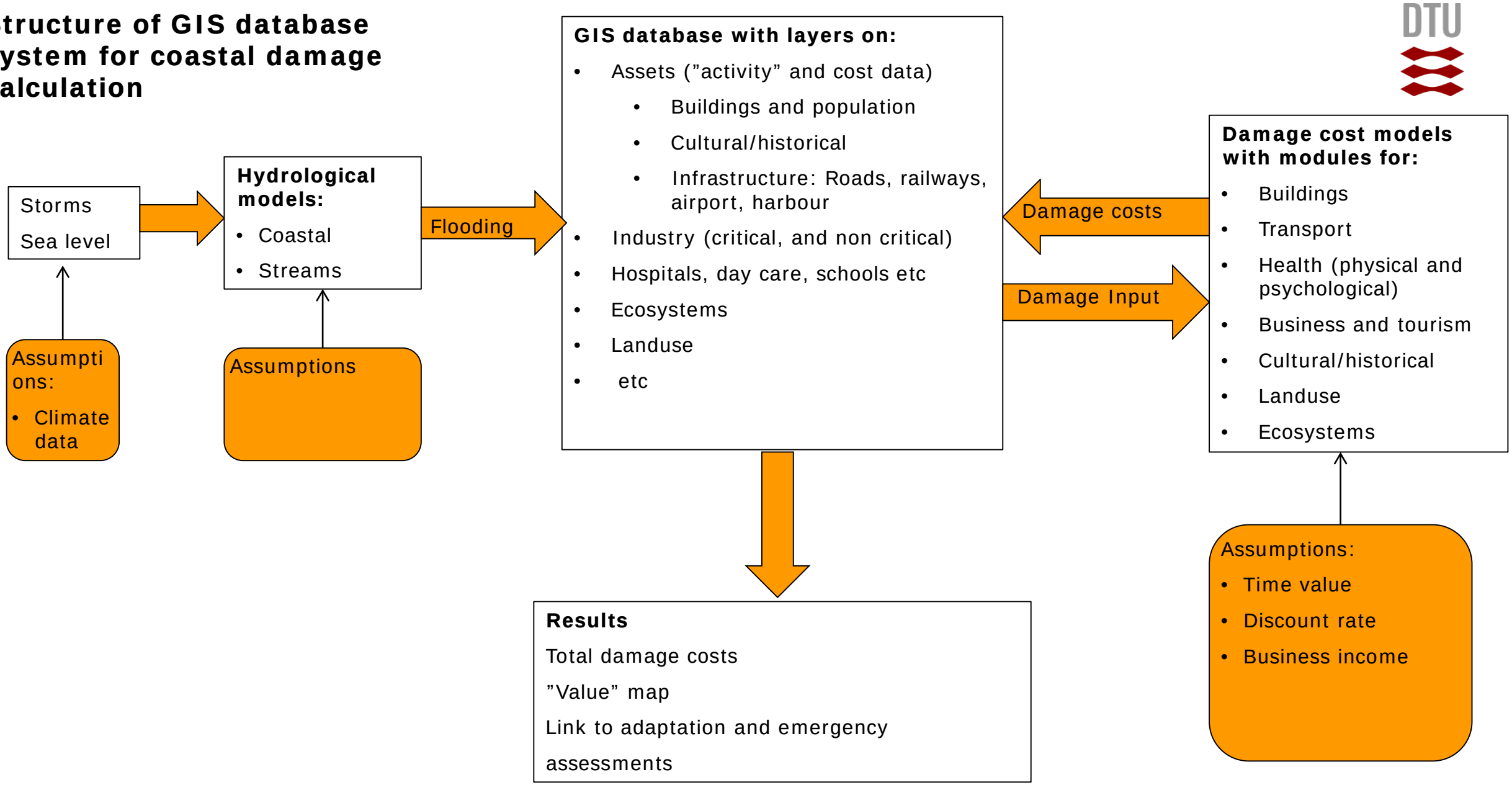
Case studies:

- Skive, including adjacent land (Limfjorden): Interactions between flooding from the fjord/sea, the Karup stream, and urban development
- Aabenraa (Western Baltic Sea/Belt location): Storm surge risks, interactions with upstream water flows, city development, coping strategies and hazard management
- Ringkøbing-Skjern (North Sea/fjord location): Protection of the fjord with an eroding barrier currently maintained by sand nourishment, nature, tourism, emergency response
- Emden (Germany/North Sea/high tide/harbour location): Results of an ongoing national German project focusing on human dimensions

Methodological Challenges

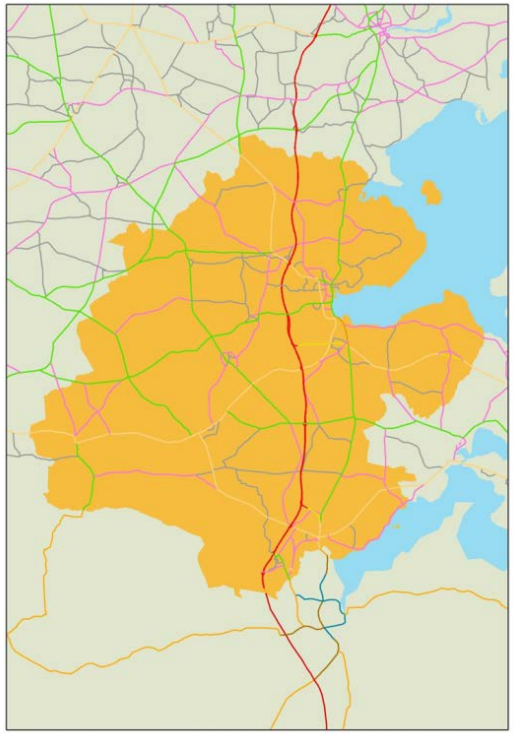
- Flooding probabilities
- Integrated costal- and backwater flooding
- Welfare economic basis:
  - Aggregation of damages across buildings, industry, health, nature etc
  - What happens if some values cannot be substituted (Weitzman versus Nordhaus)
  - Risk aversion
- Is the damage function getting steeper with higher impacts (Concave or convex for different impact areas)
- The dynamic damage cost curve

Structure of GIS database system for coastal damage calculation

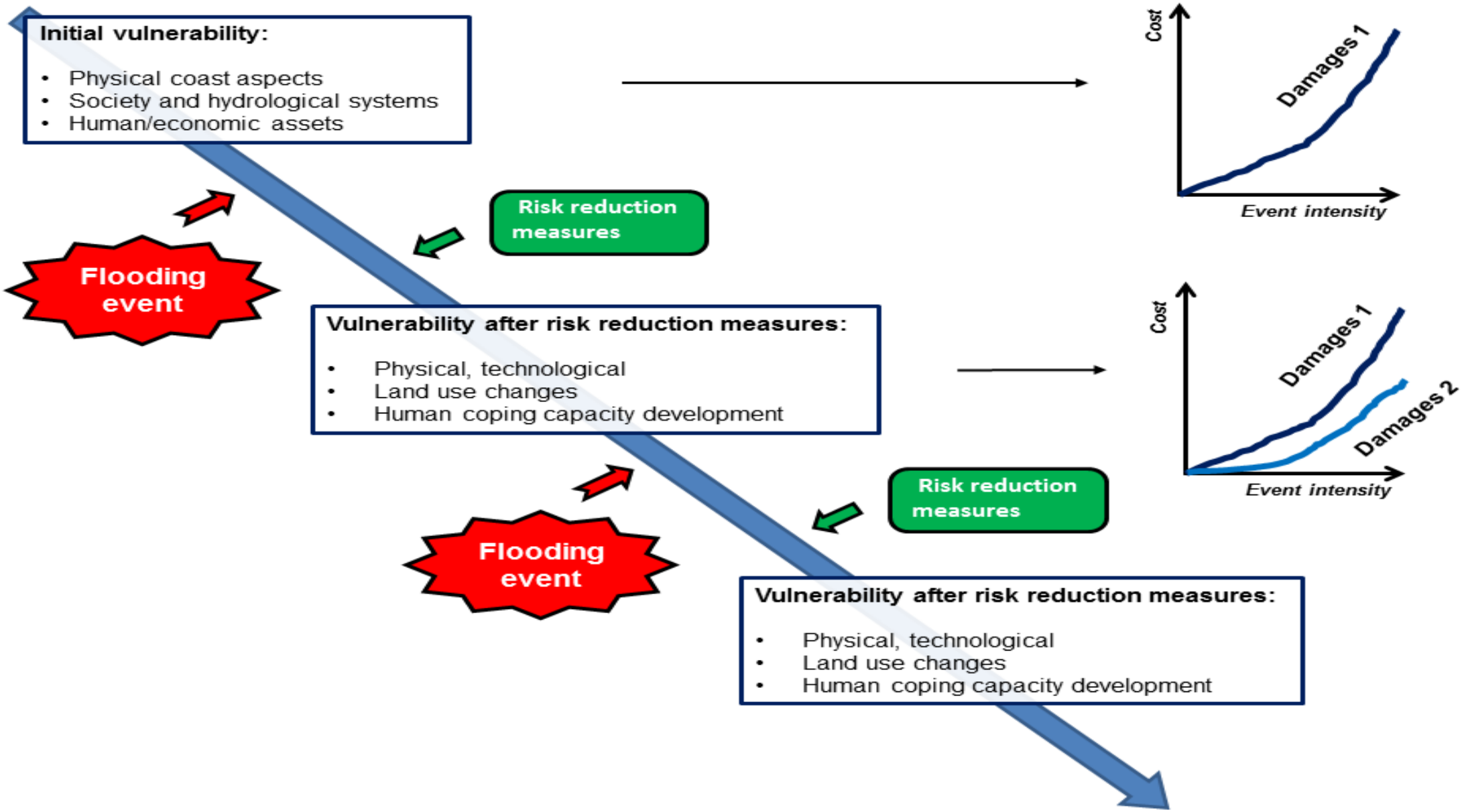


State of the Art and Beyond

- Damage cost curves based on insurance or other event data:
  - – Static picture, city development, governance, and economics purely represented
  - Simplified damage cost concepts with a strong focus on reconstruction of buildings and roads
- Beyond:
  - Traffic, health, emergency, property markets, production and other business
  - City planning perspectives and decision module – sustainable development indicators
  - Welfare function confronted with international research in Integrated Assessment Models

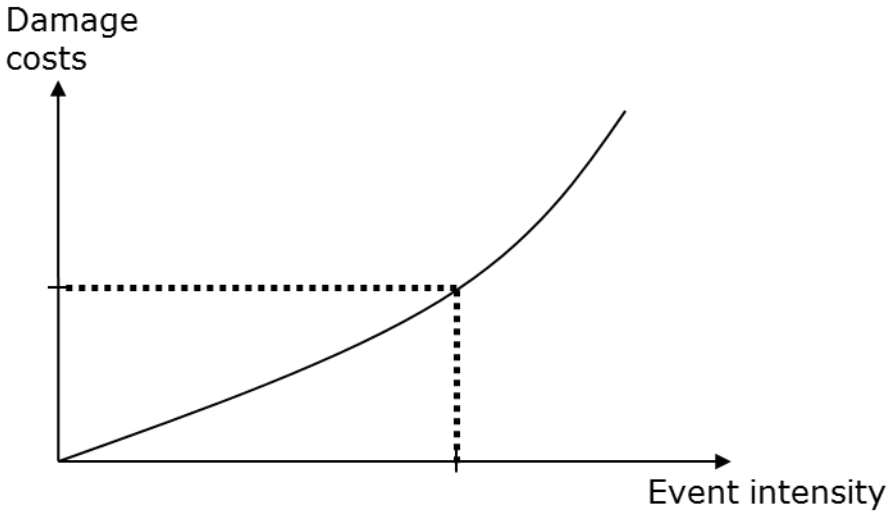


Dynamic Damage Cost Curves

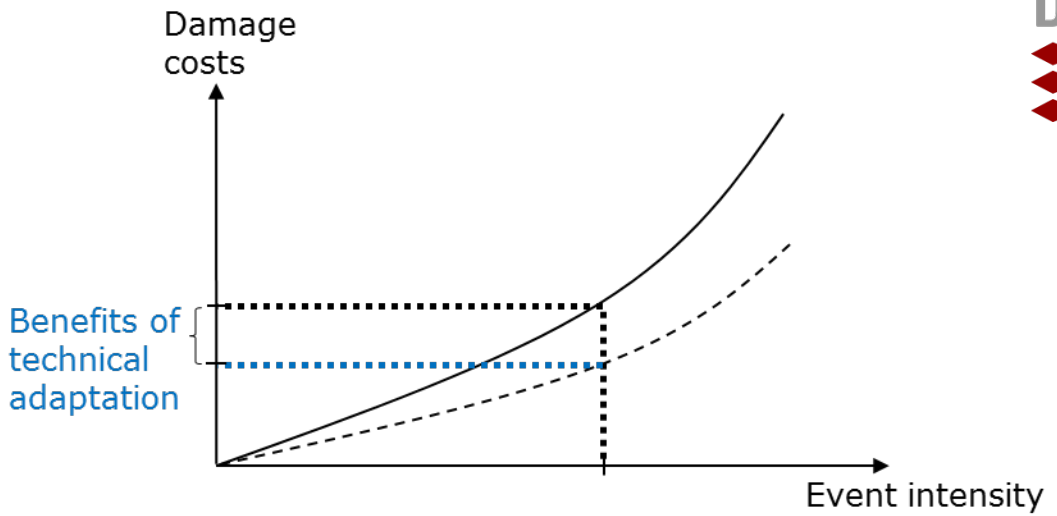


Dynamic Damage Cost Elements

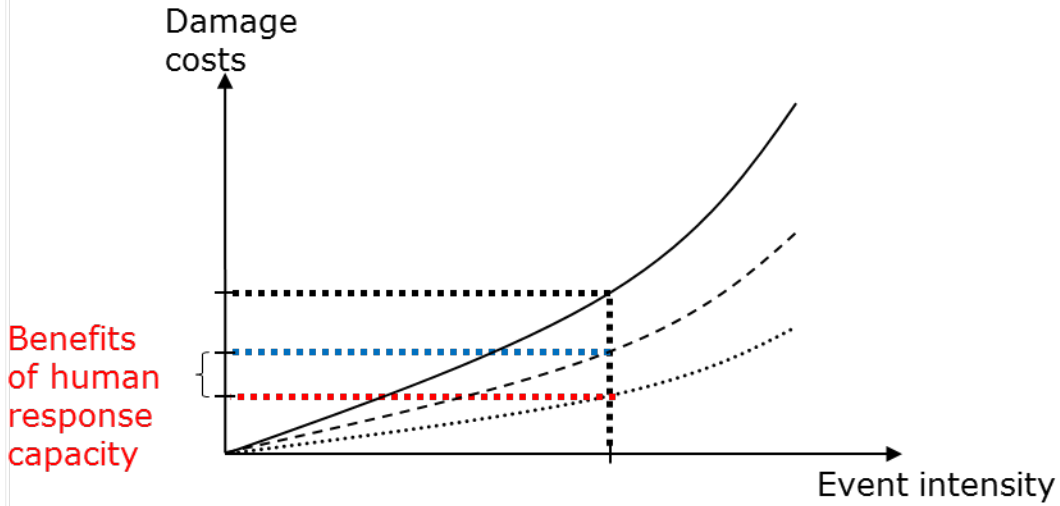
- Damage costs with similar physical exposure can change over time due to:
  - Physical adaptation measures
  - Effective emergency response
  - Societal and human response capacity
- Societal and human response capacity:
  - Knowledge
  - Networks (social capital)
  - Governance
  - Access to finance
  - Etc.
- Efforts to measure response capacity:
  - Work with local focus groups
  - Economic experiments testing risk preferences
  - Compare damages costs for different locations
  - Assess effectiveness of emergency response, incl. international litterature



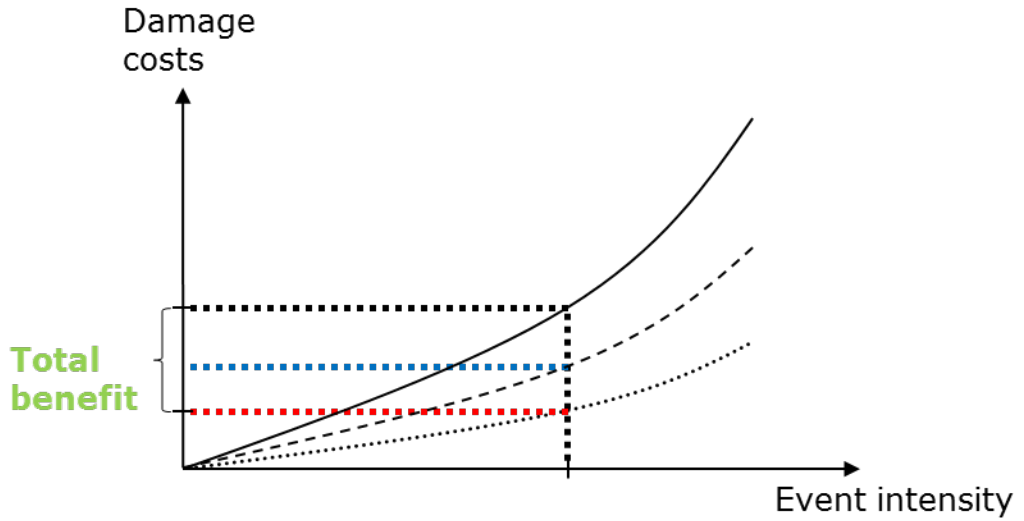
A. Without adaptation and human capacity effect



B. With technical adaptation measures



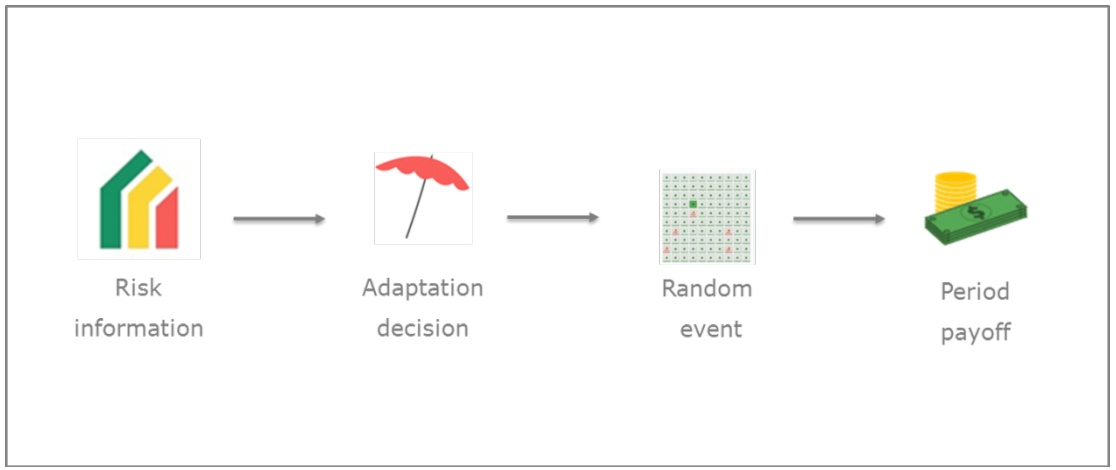
C. With technical adaptation and human capacity



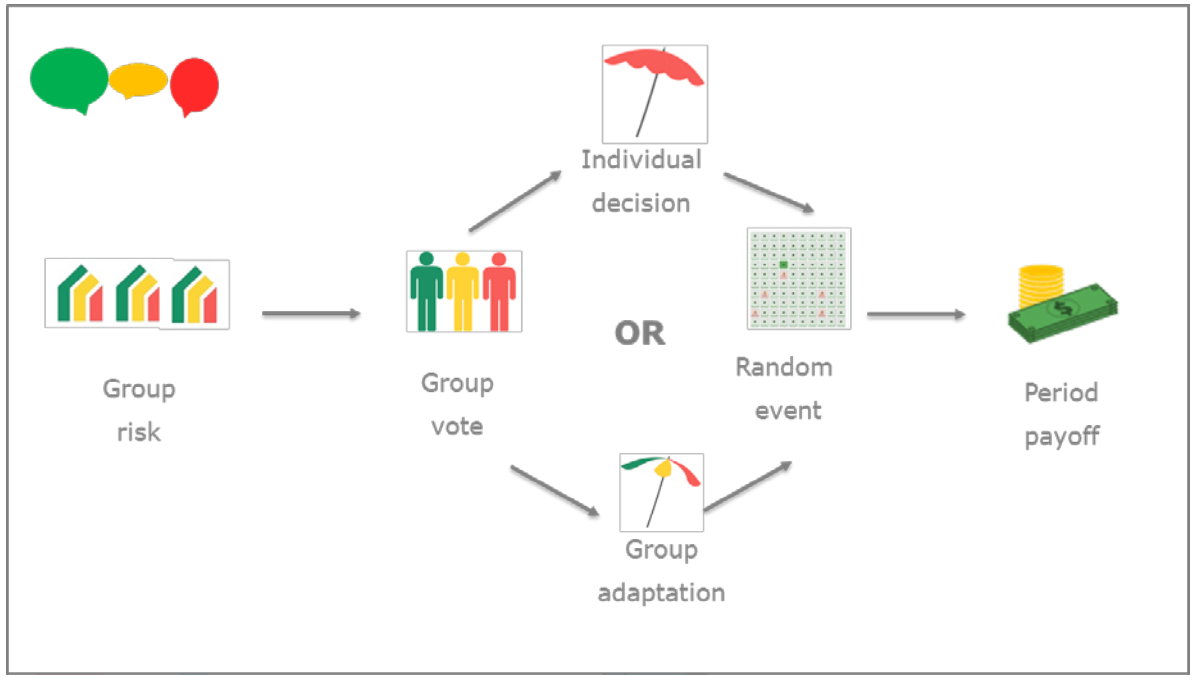
D. With technical adaptation and human capacity

Adaptive Response Experiment

Individual Decisions

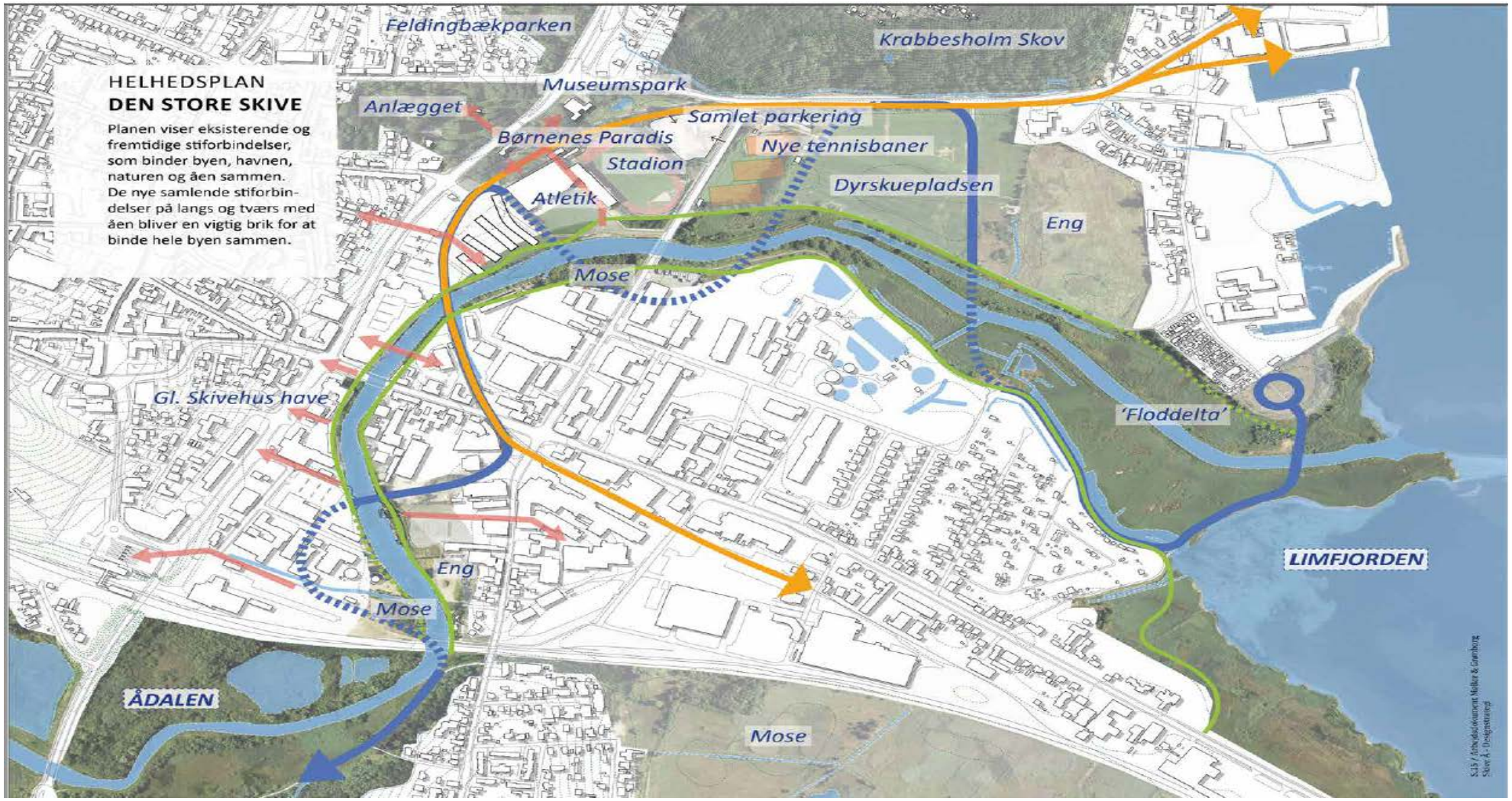


Group Decisions

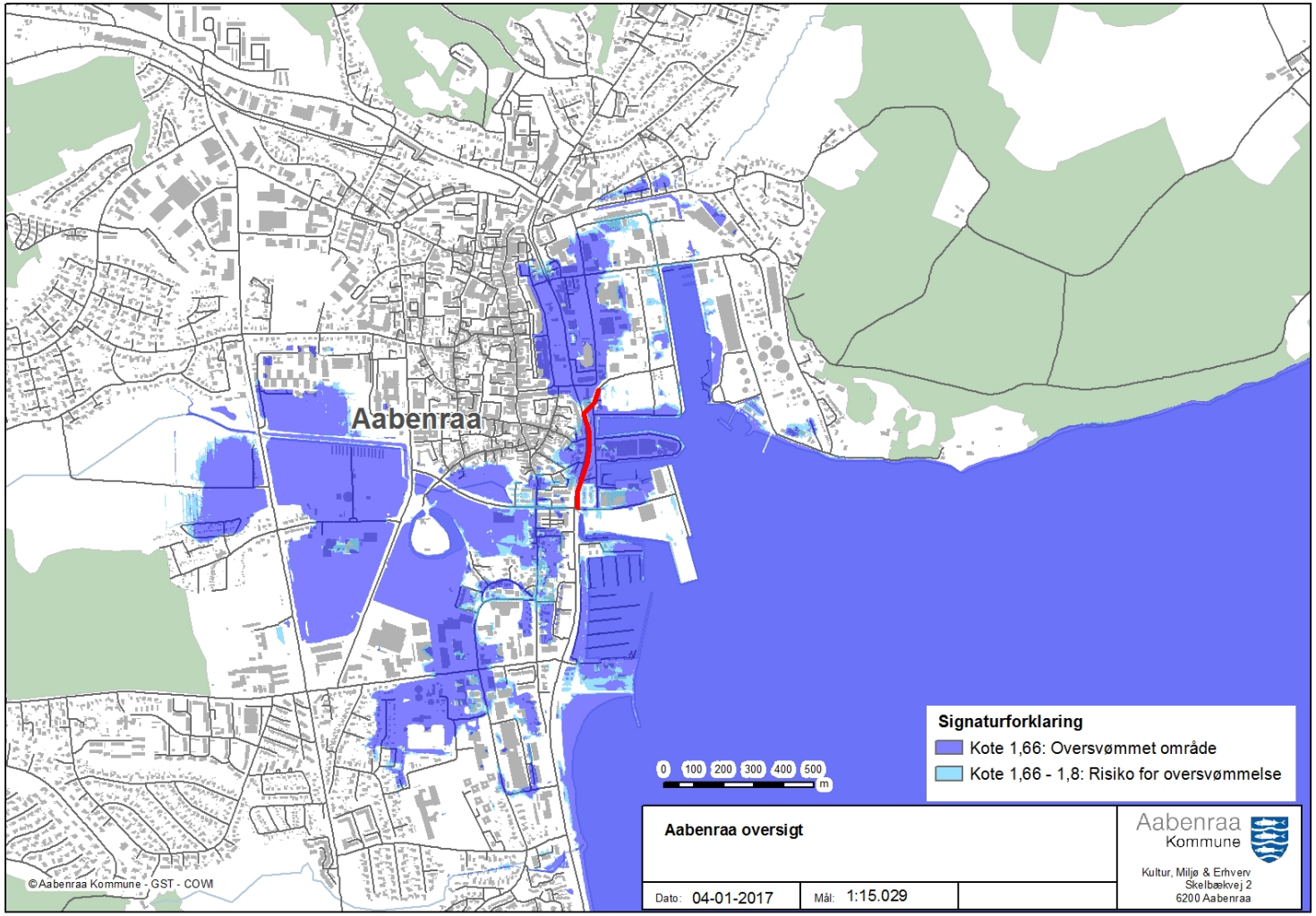


Source: Phd student Catharina Wolf von Bülow

Skive
City Development and Coastal Protection



Aabenraa – Coastal Flooding and Backwater



Conclusions

- Coastal damage risk assessment requires integrated inter-disciplinary modelling
- Many open research questions including:
  - Flooding probabilities
  - Damage costs
  - Human dimensions
  - Detailed bottom up studies offers interesting results
- Aggregate IAM damage costs are challenged
- Risks can probably be reduced significantly by comprehensive coping measures