Adaptive pathways in costal systems for losses reduction due to storm surges under sea-level rise: The case of Ísafjörður, Iceland.

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Climate Impacts and Vulnerability

ensure
enhancing resilience of communities and territories facing natural and na-tech hazards

SEVENTH FRAMEWORK PROGRAMME

PIK

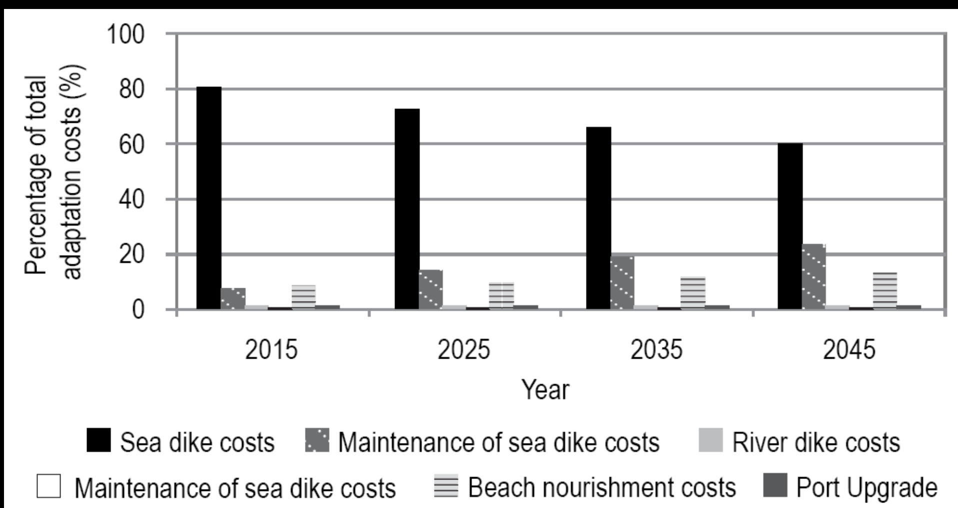
EUROPEAN GEOSCIENCES UNION

Outline:

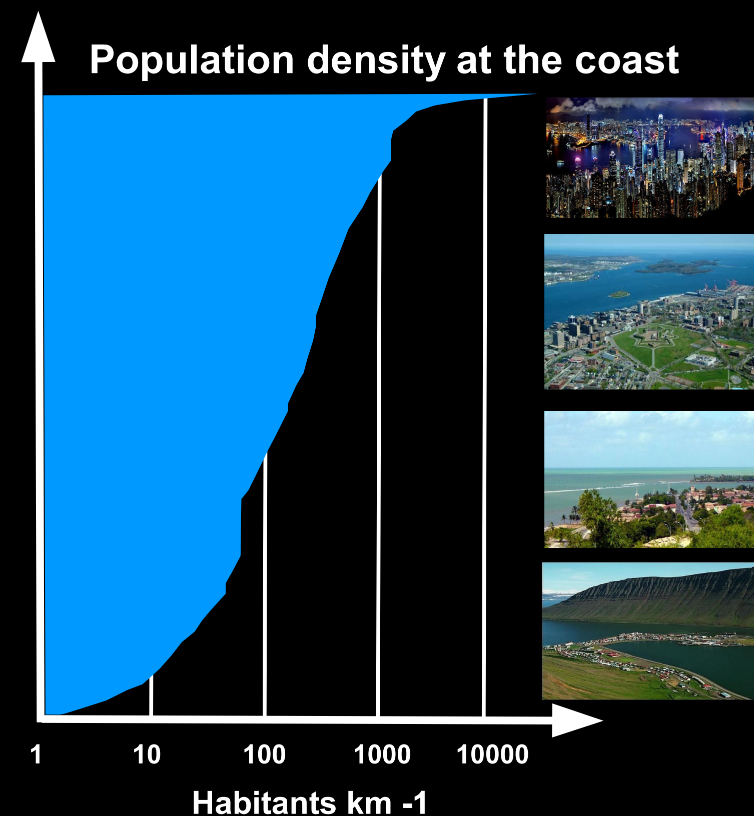
- Motivation
- Conceptualizing adaptation to sea-level rise
    - Portfolio of adaptation options
- Expected damages in Ísafjörður
- Prospective work
- Conclusions

Motivation:

Protection with hard infrastructures versus retreat has dominated most of the impact assessment literature. (Neumann et al 2010)



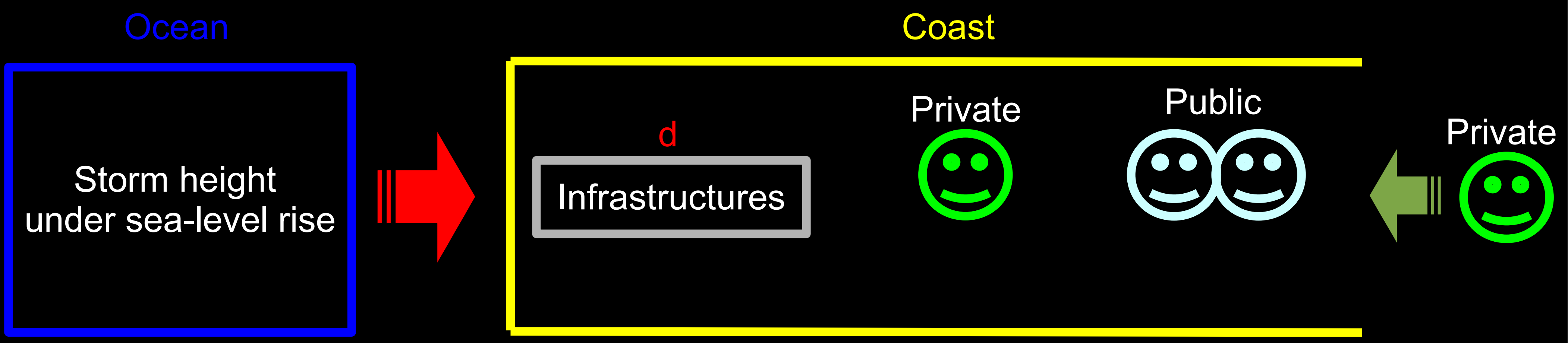
Economics of Adpatation to Climate Change (World bank 2010)



New developments are likely to follow construction of coastal protection (Neumann et al 2010).

„Dike effect“ (Pielke 1999)

Conceptualizing adaptation to sea-level rise:



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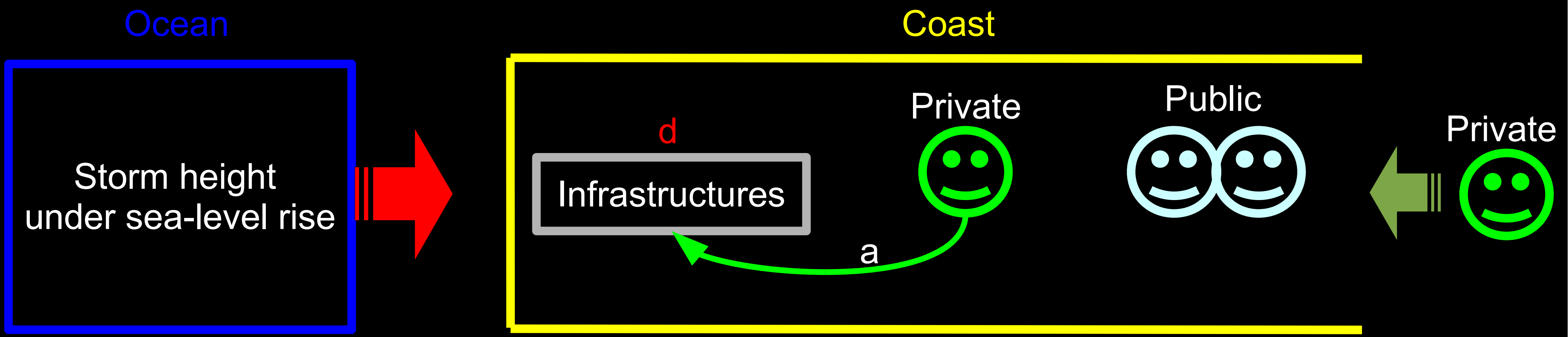

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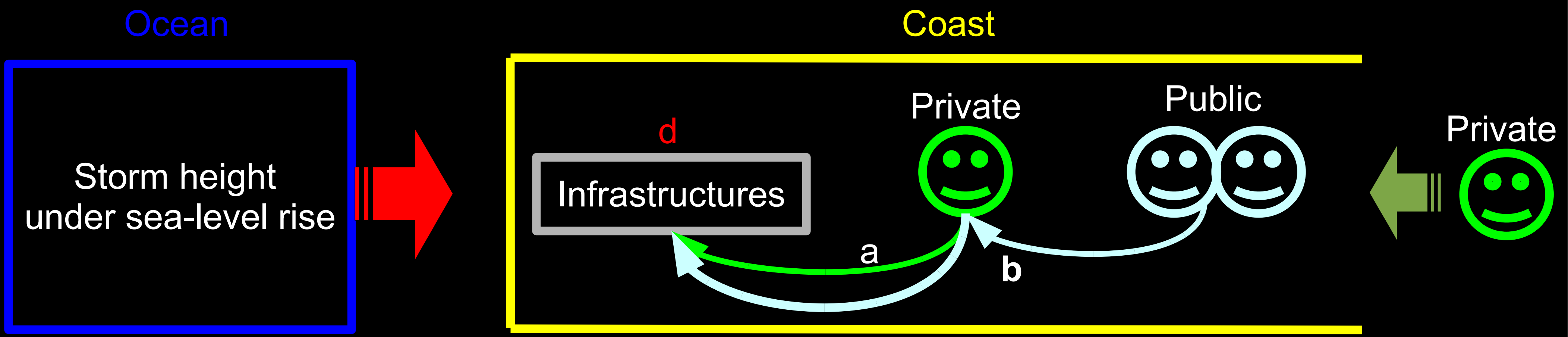

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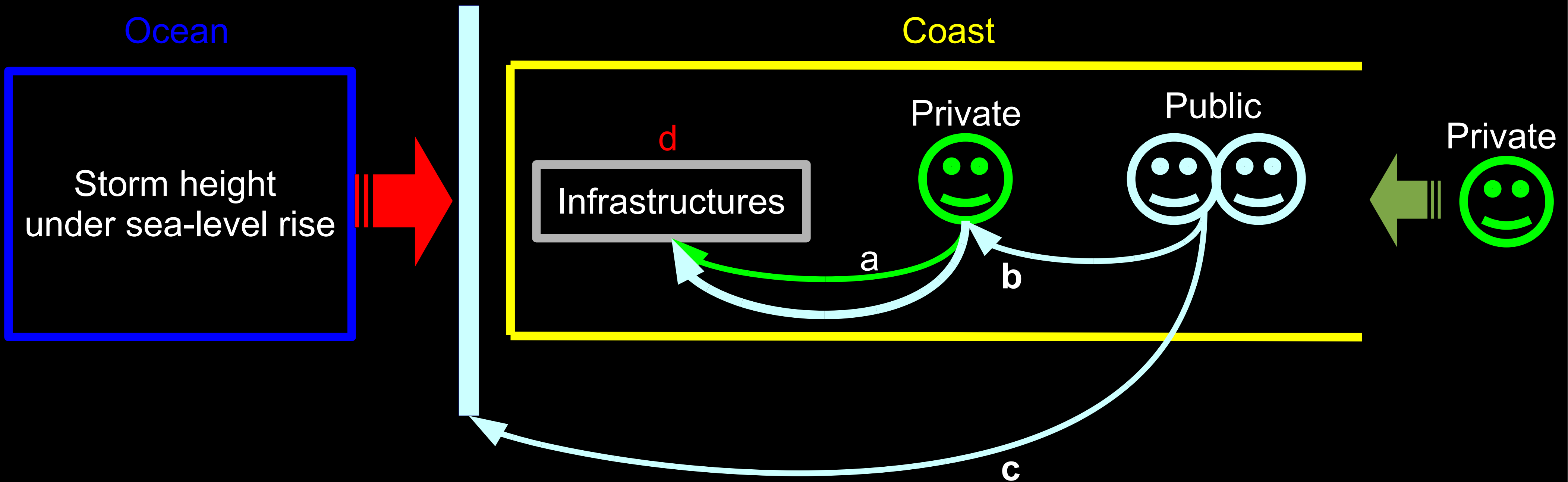

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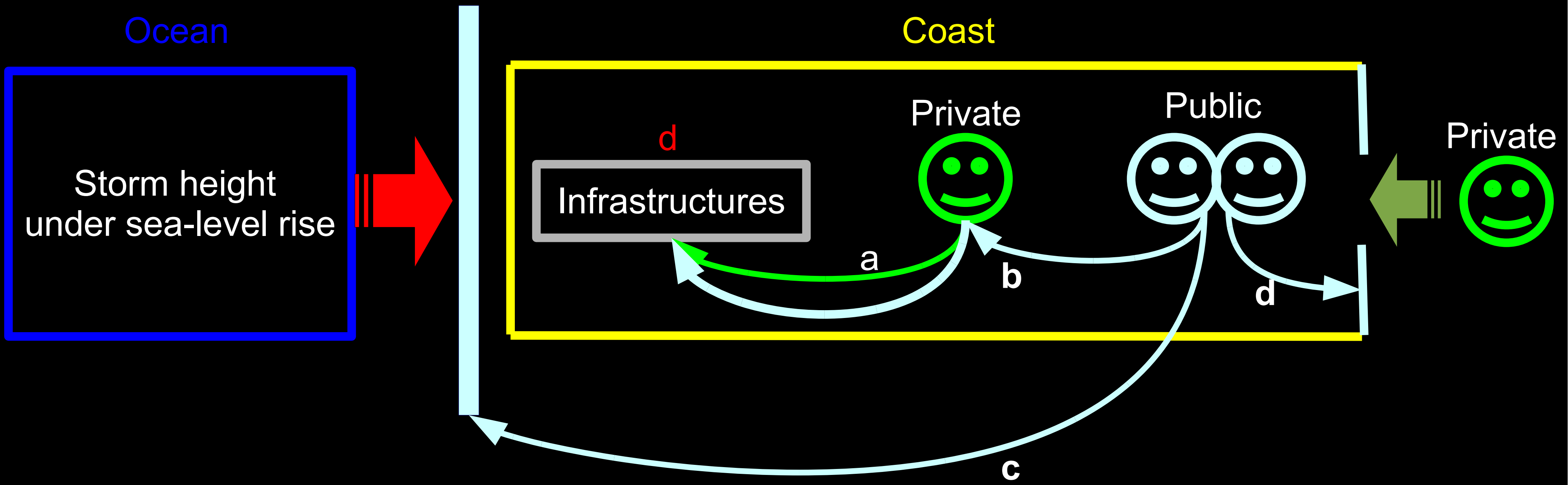

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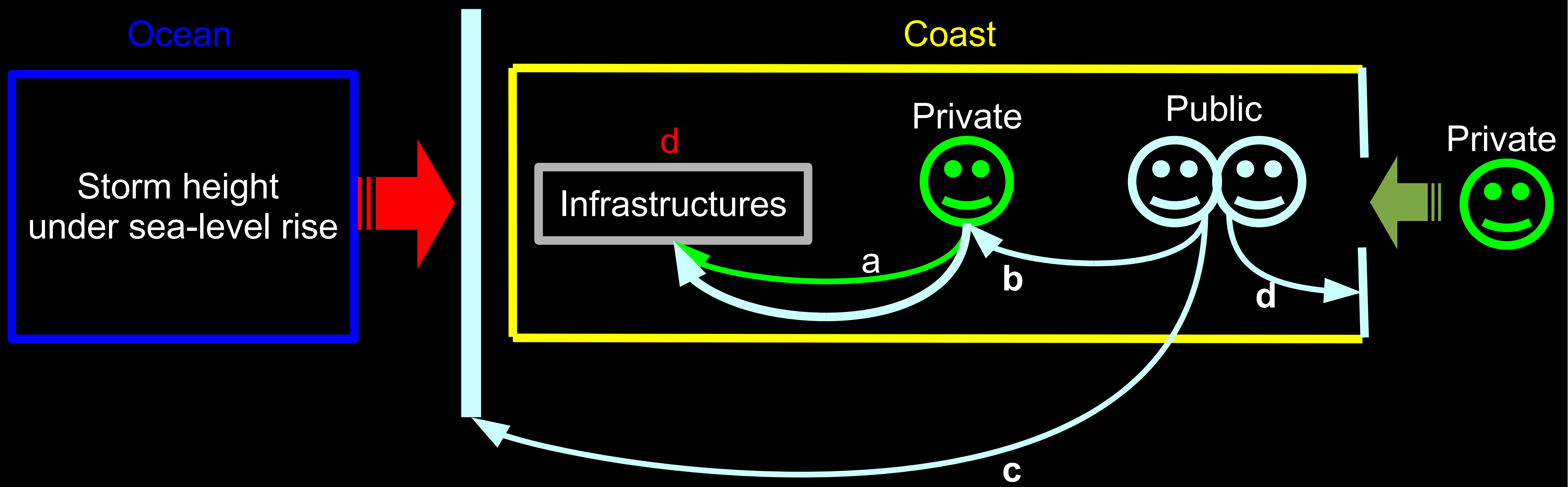

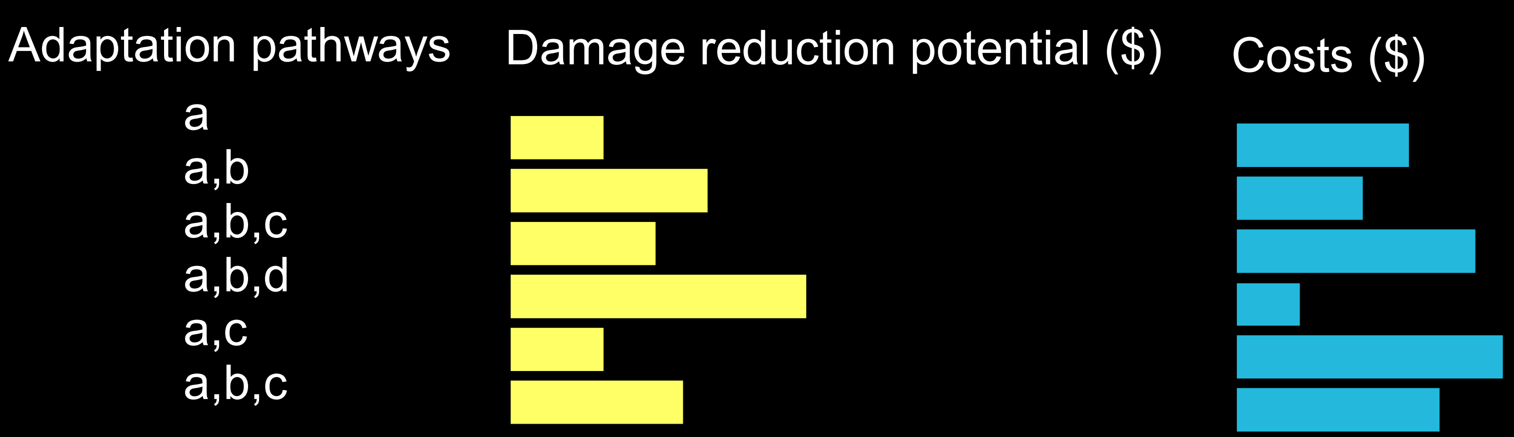

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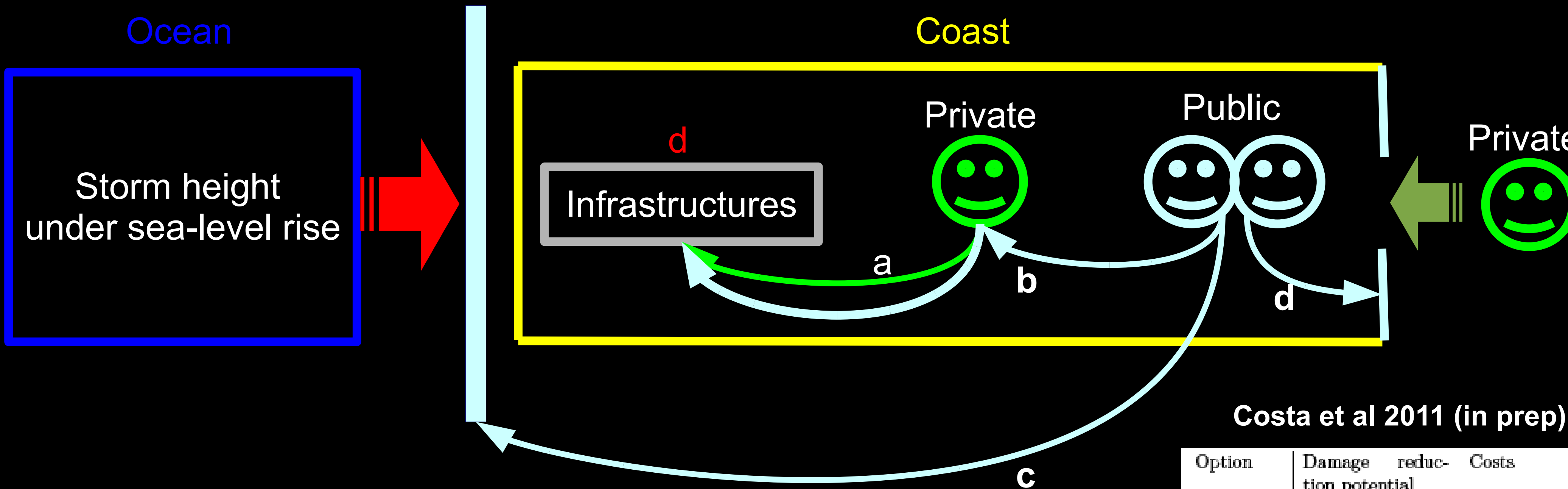
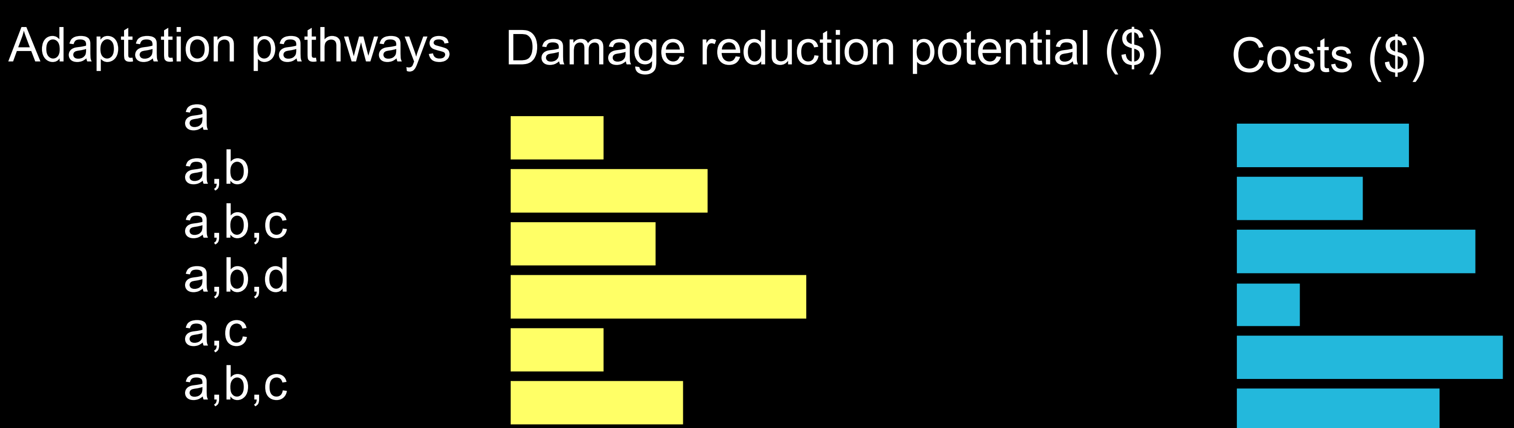


Costa et al 2011 (in prep)

Option	Damage reduction potential	Costs
Coastal protection	100% for surge height ≤ dike height	Numbers from Hoozemans (ordered)
Wet retrofitting	Estimated to be 19% for relative low income high government intervention scenario [17]	40$ m^2 while flood ≤1.2m. Plus 10% of design costs [16]
Elevation for new structures	100% for flood height ≤ structure base height	20$ per m^3 necessary for elevation [18]
Limitation	100% if distance to shore > flood inland penetration	Assumed integrated in regular land use planning



The case study:

Town of Ísafjörðurd in Northen Iceland

2674 inhabitants and expected to grow between 2900- 3150 by 2020 (*Municipal* Master Plan, 2010)

Da ta

- **400 residential structures**
- **Number of inhabitants**
- **Insured value of household**
- **Year of construction**
- **Base area**
- **DEM with 1 m spatial resolution and vertical displacement of 0.1 m.**

Datum *ISN93 Islands Network 1993*

Expected damages in Ísafjörður:

<u>Progressive sea-level</u>

- **Inland water penetration over an hydraulic conected raster (acceptable aproximation)**
- **Provides a <u>worst case scenario</u>**
- **Elevation rasters start to be <u>commonly available</u>**

<u>Storm surges</u>

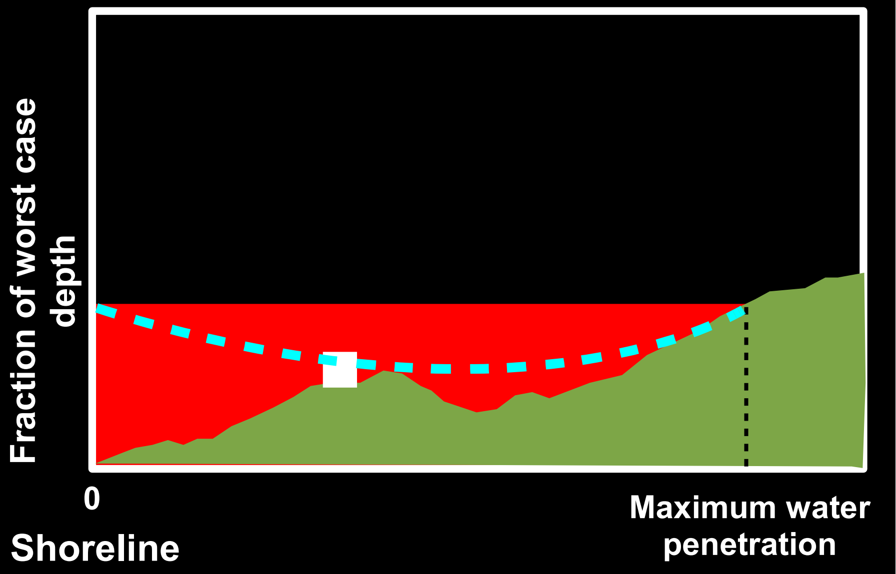
- **In land penetration depends on <u>several factors</u>. Requires the use of models calibrated to local conditions (data scarcity)**

Depth = f (worst case depth, water speed, distance to coast)

$$\text{Water speed} = \sqrt{9.8 * \text{depth}}$$

Distance to coast = Shortest distance from structure to shoreline

The closest to shoreline and the faster, the higher the fraction of maximum projected flood



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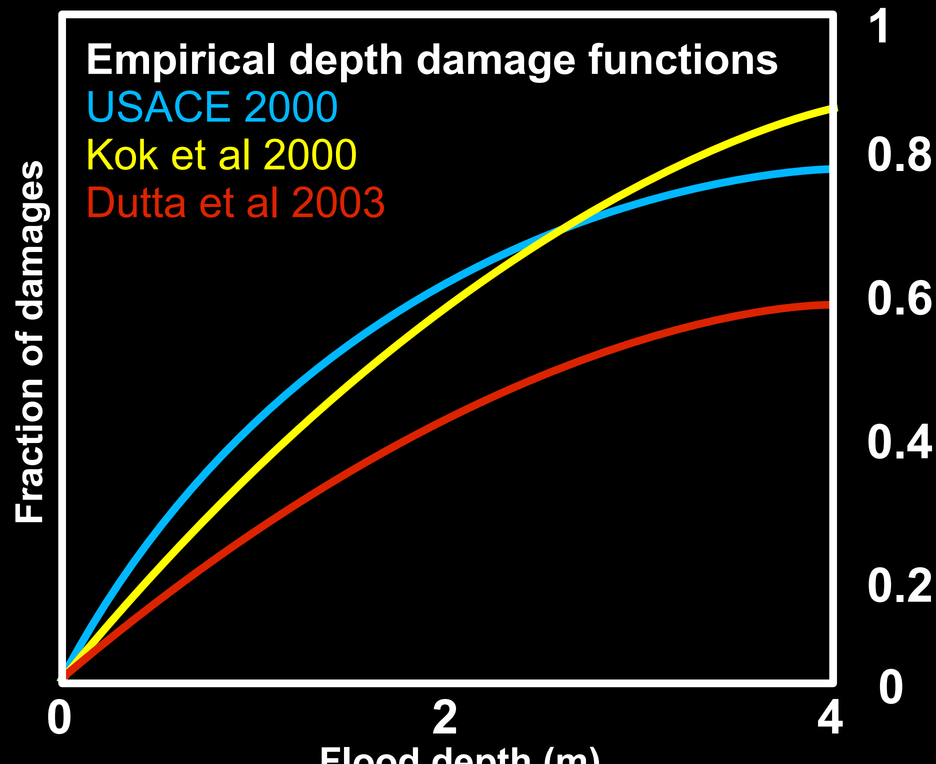
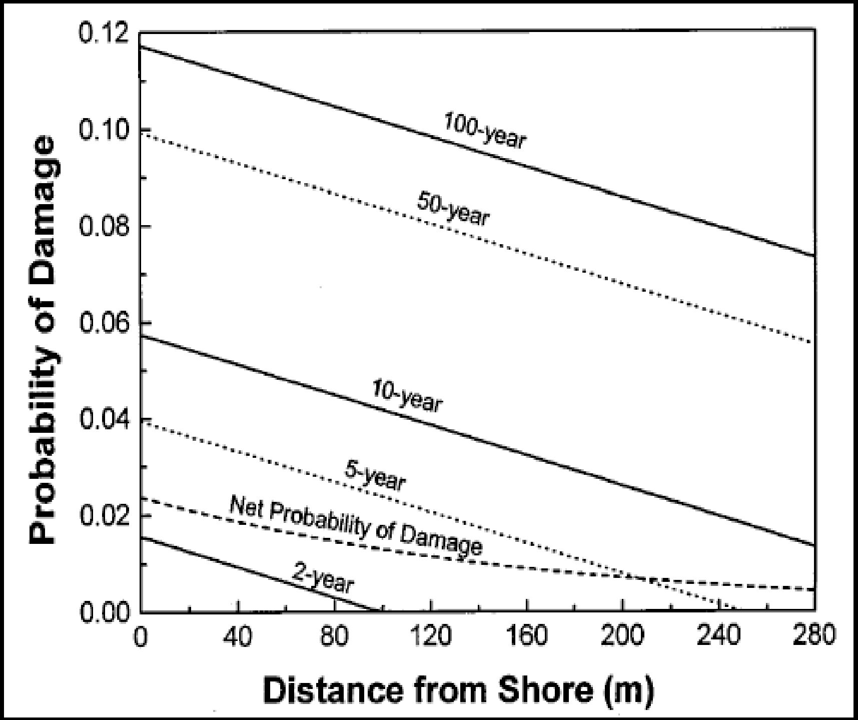
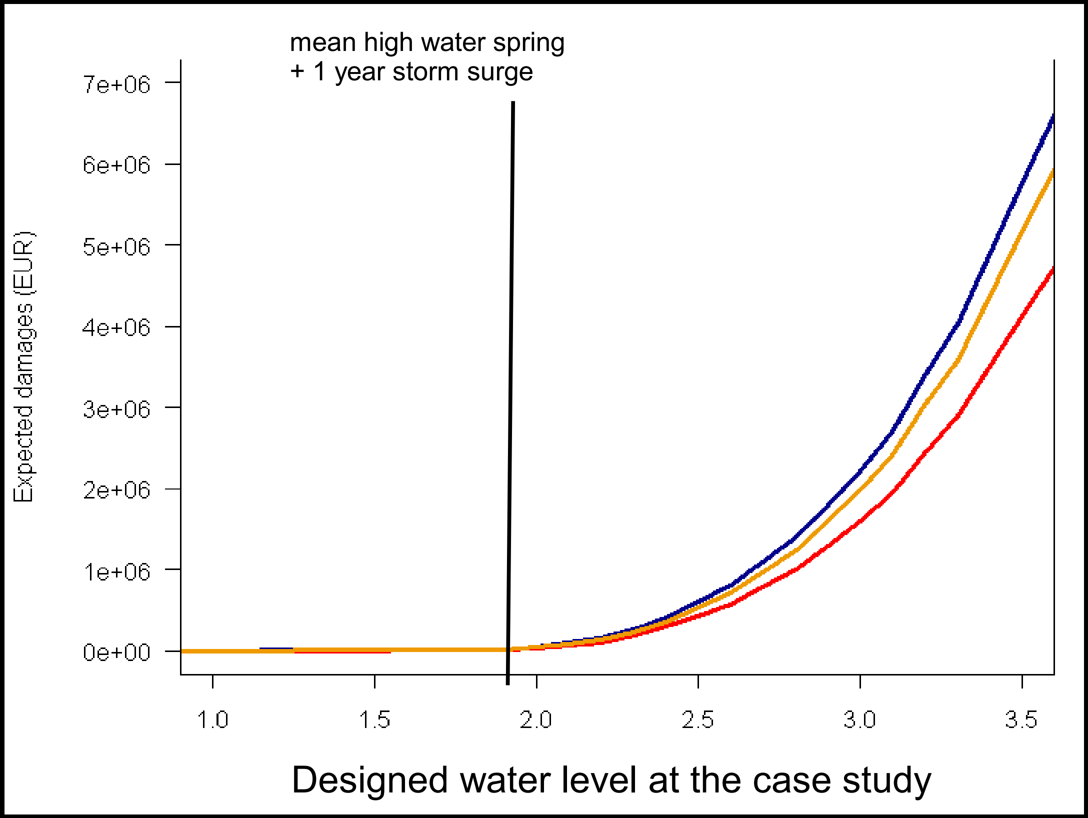




West 2001

Expected damages in Ísafjörður:



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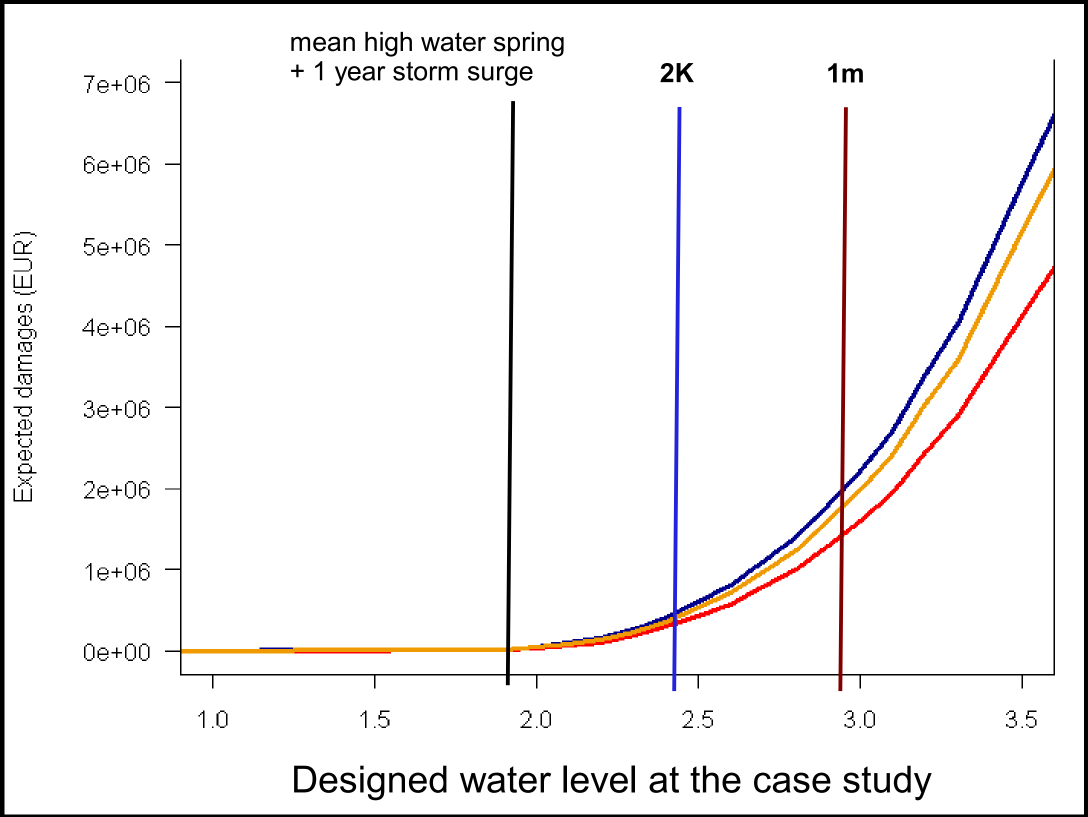

Sharp increase of adamages above a 2 m surge

2K and 1m scenarios to increse substantialy the damages

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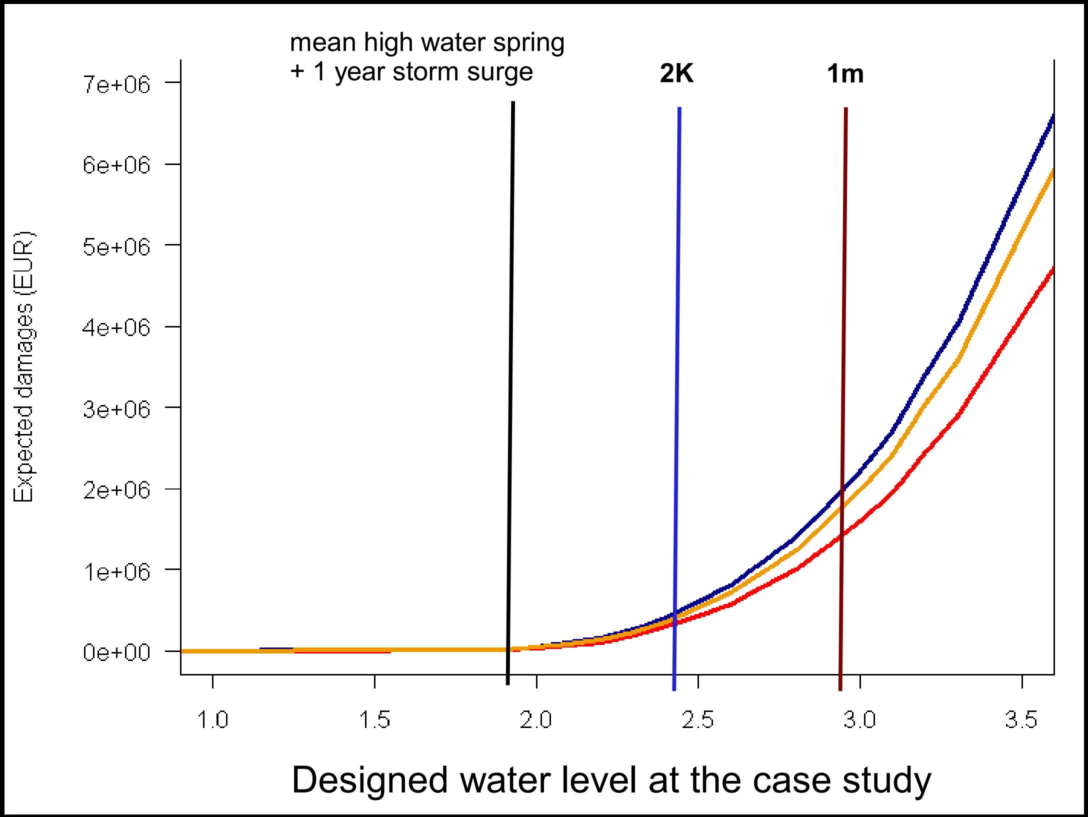
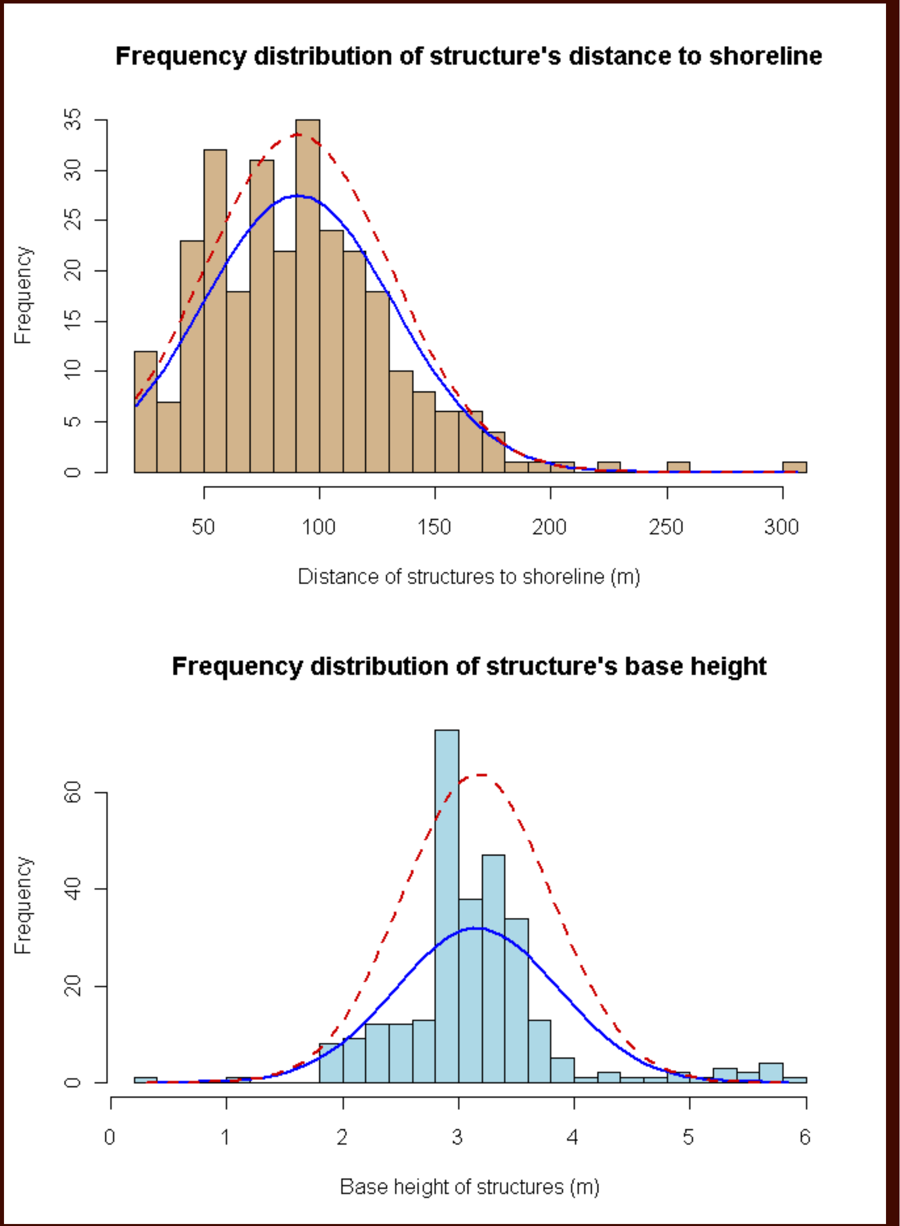
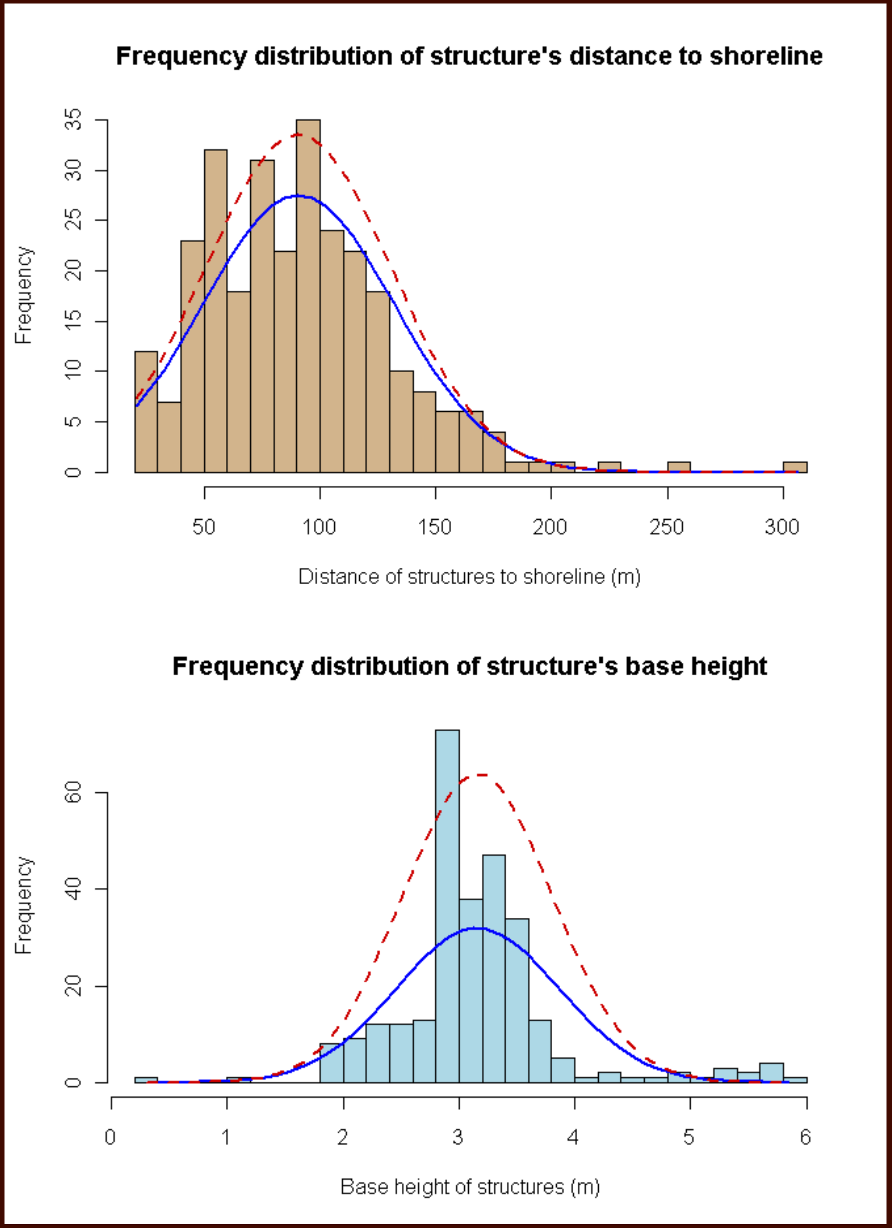




Sharp increase of damages above a 2 m surge

2K and 1m scenarios to increse substantialy the economic damages

Prospective work:



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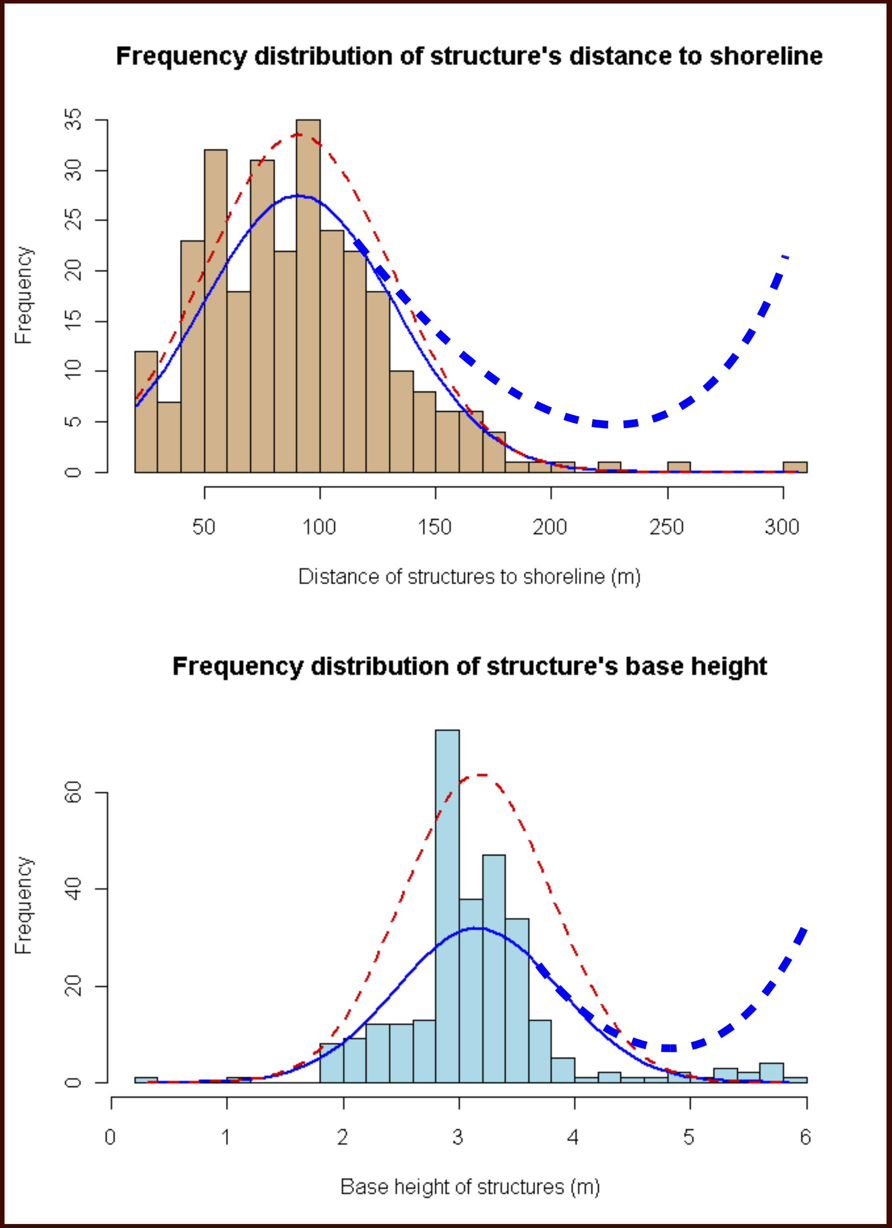

Conclusions:

- Adaptation to sea-level rise lingers for better conceptualization in order to incorporate both a diversity of acttions and actors promoting adaptation.

- A first step in the direction of including multiple pathways for coastal adaptation is proposed.

- For the case study considered, economic impacts rise exponentialy after 2 m surge level.

- Even by holding coastal development static between 0.5 to 2 million euros damages in infrastructures are espect for a 1 year return storm under 2K and 1 m scenarios respectively.

- Modifying settlement patterns has the potentialy to reduce impatcs independent of surge magnitude, when compared with the protection option.

- Interaction between adatation option remains to be tested.

Thank you for your presence...

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