



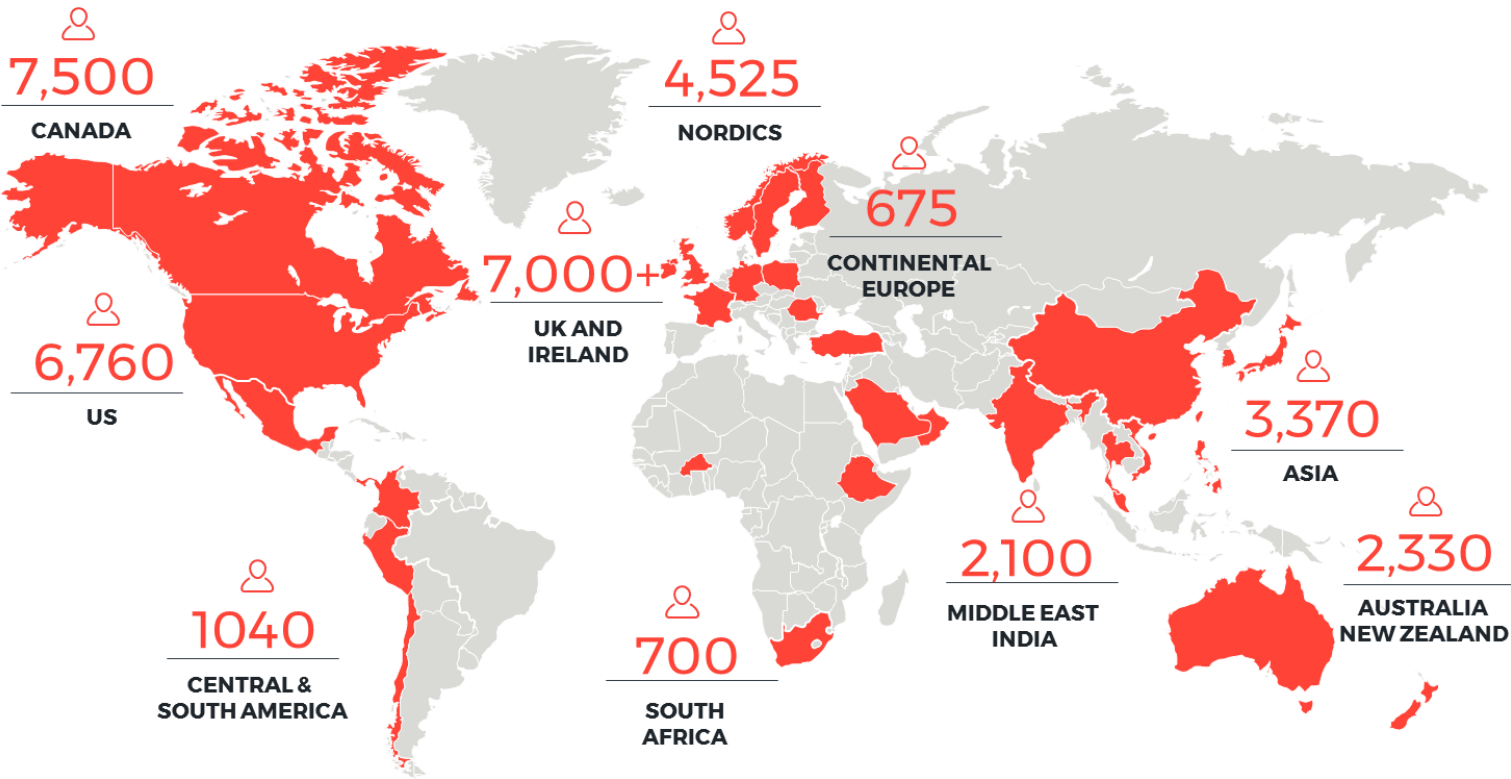
Reducing the Impact on and from Coastal and Marine Environments

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WSP

WSP - A Global Company



43,500 +
Employees

600 +
Countries

55 +
Countries

CAD\$6bn
2017



WSP – A Global Company

CORE SECTORS



TRANSPORTATION



BUILDINGS



INFRASTRUCTURE



ENVIRONMENT



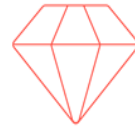
POWER &
ENERGY



OIL AND GAS



INDUSTRIAL



MINING

- Ranked No. 1 International Global Construction & Project Management *(Top 20 non-US ranking by ENR)*
- Ranked No. 1 International Design Firm *(Top 225 ranking by ENR)*



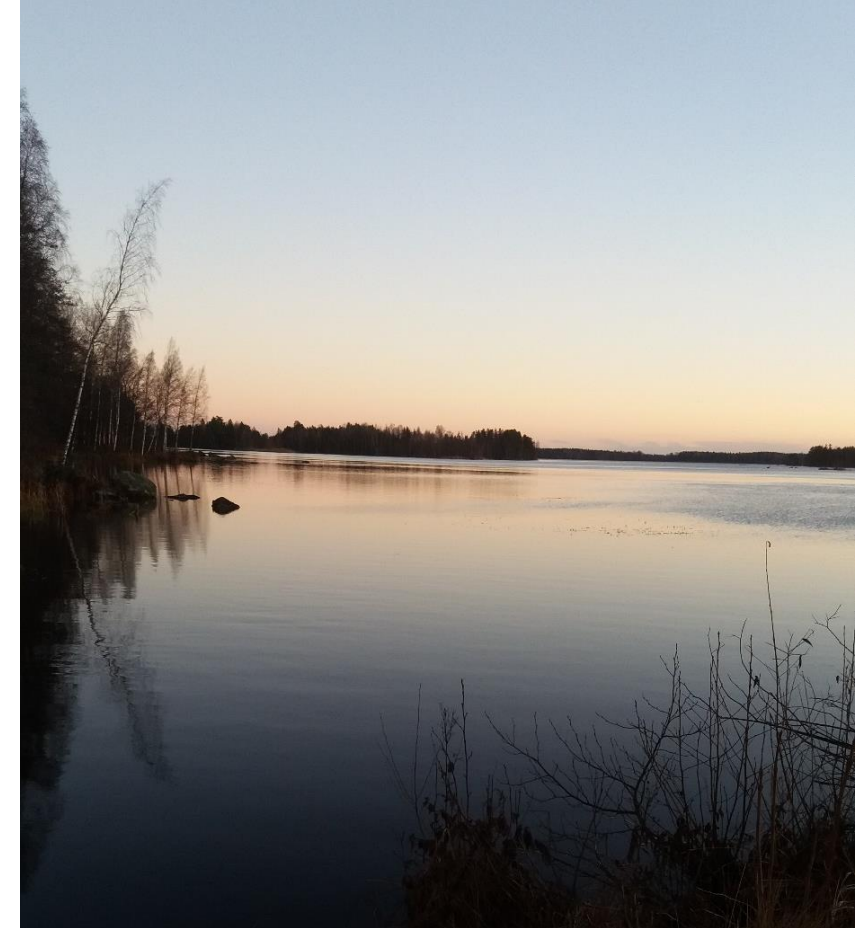
Our International Water Credentials

Iraq
Trinidad & Tobago
Egypt
Libya
Tunisia
Uganda
Tanzania
Colombia
Chile
Morocco
Saudi Arabia
Cote d'Ivoire
Ghana
Brazil
Bahamas
Nigeria
Madagascar
Dominican Republic
China
Burundi

- Integrated water management;
- Policy & government upskilling;
- Sustainable water supply & allocation;
- Water treatment;
- Water distribution;
- Climate change;
- Trans-boundary issues;
- Monitoring networks;
- Regional resource mapping;
- Well development;
- Associated support:
 - Financing
 - Consultation
 - Environmental

Water related projects

- Groundwater, freshwater and marine water.
- Biological values and ecological services.
- Environmental and human health.
- Developing methods for water treatment, cleaning of polluted ground water/waste water from polluted areas/industries.



Regulations

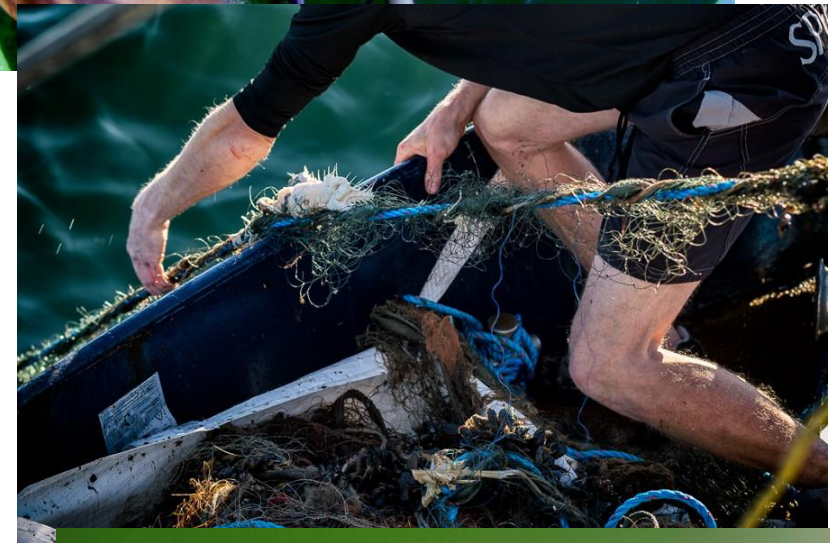
We are working with both national and EU regulations:

- Swedish environmental code
- European Water directive (Ecological and Chemical status)
- Drinking water directive
- Habitat directive
- European flood directive



Marine litter

- 160 km of fishing nets are lost in Sweden annually.
- WWF Germany for the EU INTERREG MARELITT Baltic.
- Environmental impact assessments.
- Different methods are used when retrieving lost fishing nets.
- Method polish fishermen (WWF) have designed a method.
- Different equipment exists which will impact the environment to different extent.



Marine litter

- The methods were compared with bottom trawling and a zero alternative.
- The focus was on benthic/bottom habitat in the Baltic Sea.
- The different habitats have different sensitivity for the different effects.
 - *Example sea grass bed*



Marine litter

The evaluation and to grade the different methods we looked at the:

- Effect (abrasion)
- Sensitivity (Holas II, Helcom)
- Impact=Effects*Sensitivity

	Soft Bottom	Hard bottom	Mixed bottom	Blue mussel bed	Eelgrass/Charophytes	Fucus/Furcellaria	Reefs	Wrecks	Baltic Ecosystem
1	1	1	1	1	2	1	1		
2	2	2	2	2	2	2	2		
1	1	1	1	1	1	1	1		
3	2	3	2	3	2	2	2		
3	3	3	3	3	3	3	3		

Eelgrass/Charophytes			
	Abrasion	Siltation	Introduction of marine litter
			Species extraction
	6	3	
	6	3	
	3	3	
	9	9	
			6
			4
	9	9	4
			6

Marine litter

- The report will be used during planning of retrieval operations.
- Highlights which considerations need to be taken during retrieval.



Photo: Marelitt partner, Simrishamn kommun

Sediment and pollutants

- Pollutants come from many sources.
- Urbanised areas, industry, the shipping industry and agriculture.
- They end up in the water.
- Sediment function as a sink for many pollutants.
- No disturbance the pollutants slowly be buried and taken out of the ecosystem.



Dredging

- Distribution of pollutants.
- The history of different pollutants.
- In Sweden polluted sediment can't be used in any construction.
- Polluted sediment is classified as waste.
- Transported to a waste deposit on land.
- Expensive and large amounts of transport.
- Dumped.



Dredging

- The maritime industry in Sweden is steadily increasing.
- One of the most busiest routes in the world.
- Shallow, many narrow straits and small island.
- The ships are also increasing in size. Increased ship size requires larger and deeper harbours/passages.
- Harbours are high intensity areas often with polluted sediment.
- In order to increase a depth or construct a larger harbour dredging and removal of sediment is necessary.



Source: www.roanokunderwriting.com



Source: www.ourbalticsea.com

Environmental status

- According to the environmental swedish regulation all registered waters has a goal to achieve good envrionmental status.
- Industries are not allowed to worsen the environmental status.

Marine spatial planing

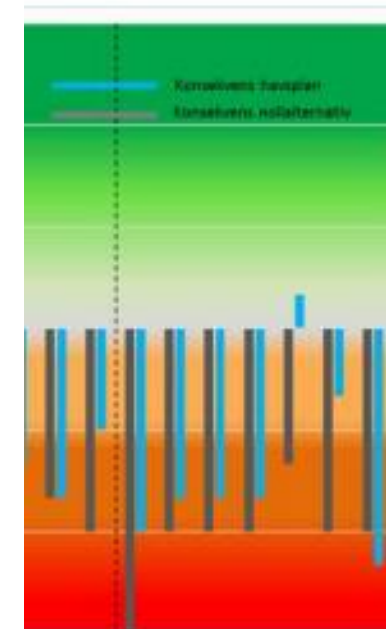
- First Swedish marine spatial plan
- The goal with the plan is to improve the marine environment.
- Swedish waters consist of three basins and each basin had one plan.
- For each basin WSP performed a environmental impact assessment.
- Different habitats, species, protected areas, biological values, ecological services, physio- and chemical factors and geomorphology.



Marine spatial planning

- We identified the environmental effects linked to the marine sectors included in the plan.
- Interaction between each sector and environmental effects and impacts.
- Having a plan was also compared with the zero alternative (not having a plan).

	Biodiversitet	Grön infrastruktur	Värdefulla vattenväxter	Värdefull fauna	Kommersiell fauna	Främmande arter	Skyddat område
Miljöbelastning (p)	A	B	C	D	E	F	G
Bottenpåverkan/strukturer							
Grumling							
Buller							
Tryckvågor							
Utsläpp (näringsämnen)							

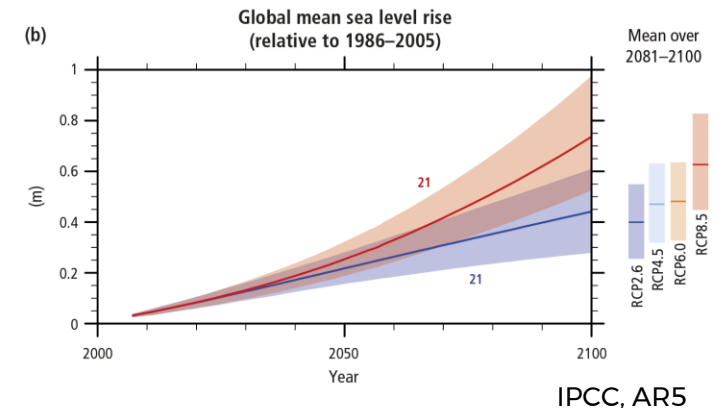




Coastal flood risk

Coasts under pressure

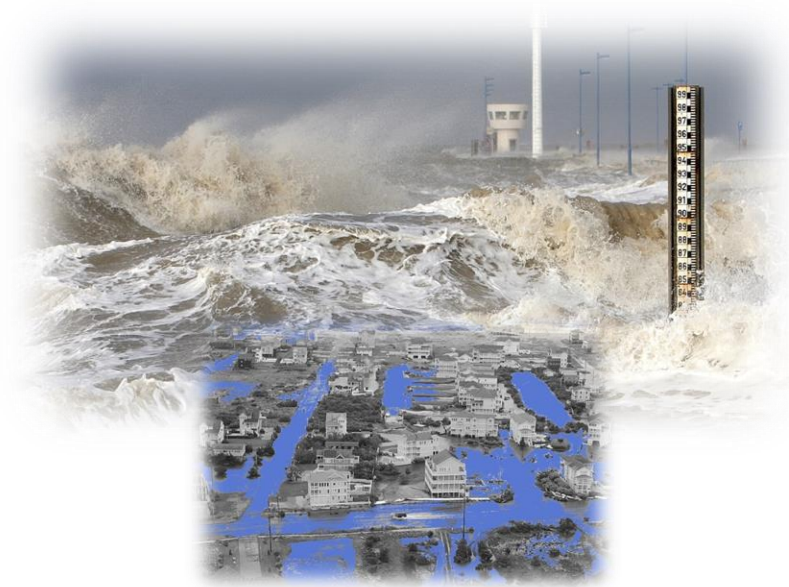
- Growing urbanization, industrialization, and transportation close to the sea
 - Increasing coastal population density
 - Harbours getting larger or transformed into residential areas
 - Land reclamation
 - Degradation of coastal ecosystems and natural buffers
-
- *Sea level rise*
 - *Higher water levels and more extreme events*



➔ Coastal zones are getting more vulnerable to flooding and erosion.

Coastal flood risk

- Risk for injuries and loss of life
- Structural damages to buildings, infrastructure, harbours and coastal defences
- Socio-economic consequences, direct and indirect damages
- Environmental impacts, saltwater intrusion, pollution
- Coastal erosion, loss of land



Risk management in coastal communities

Challenges

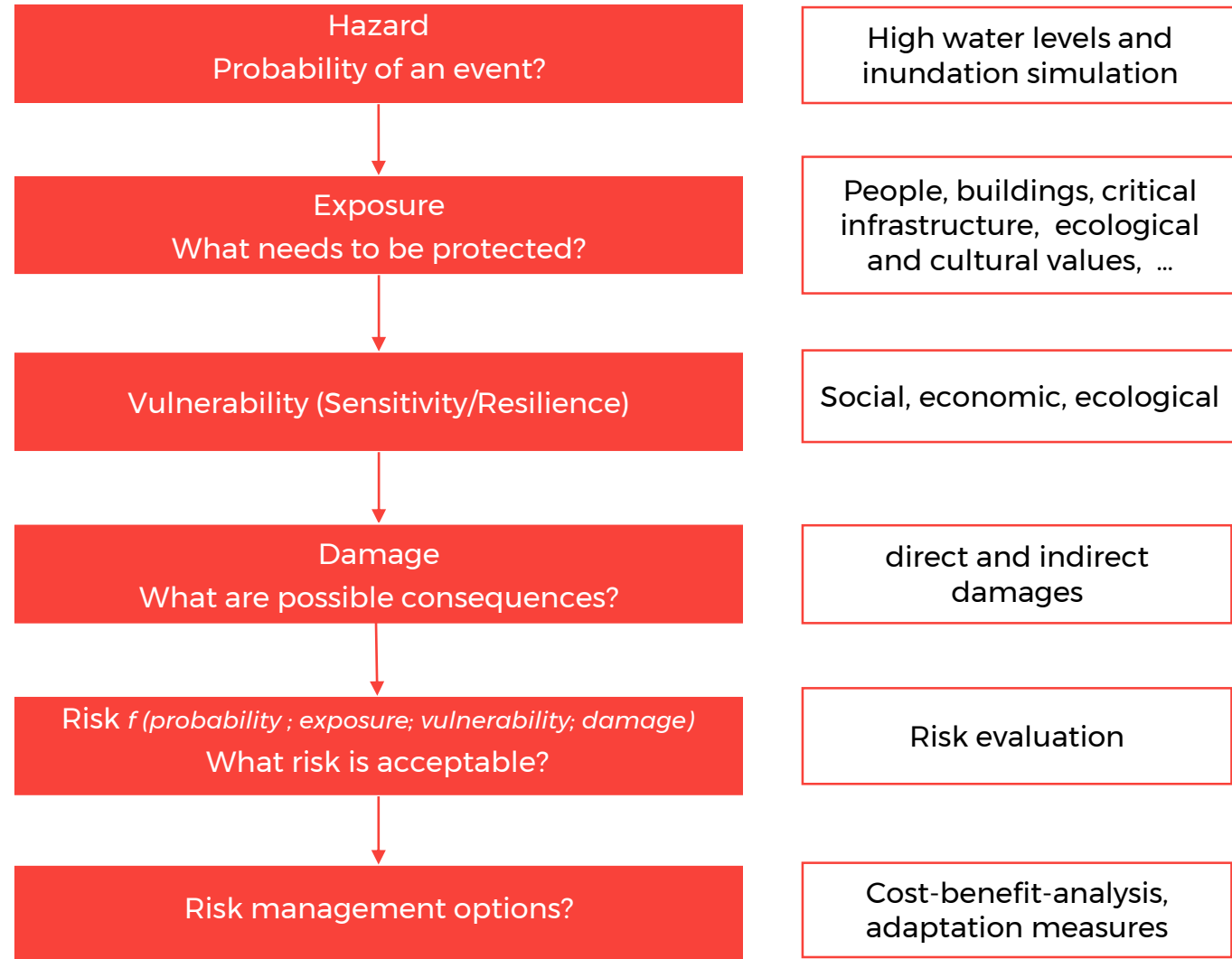
- How can we reduce today's and future risks for coastal communities?
- How close to the water can we build new infrastructure?
- How can we protect what is already there?
- How do we deal with uncertainties in climate scenarios? Time scale?
Acceptable risk?
- What are appropriate adaptation measures?
- What are the costs and the benefits of climate change adaptation?

Coastal protection

WSP, Maritime, Africa (Paul Bouton)

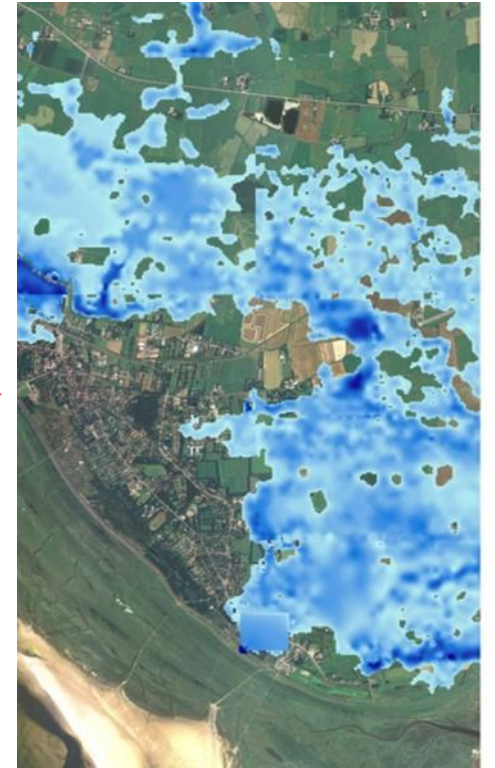
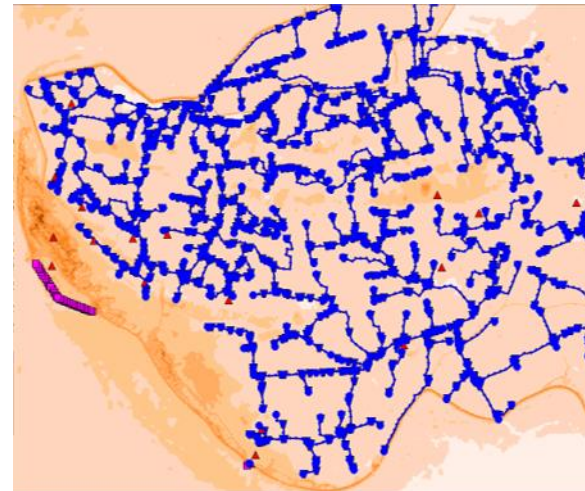
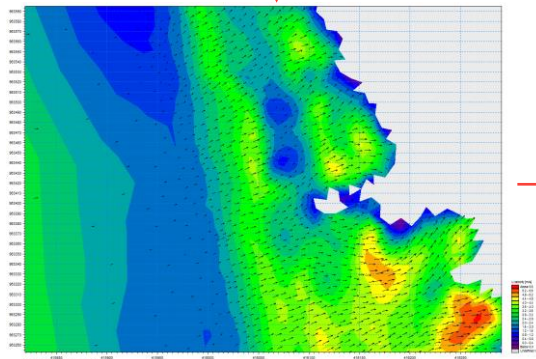
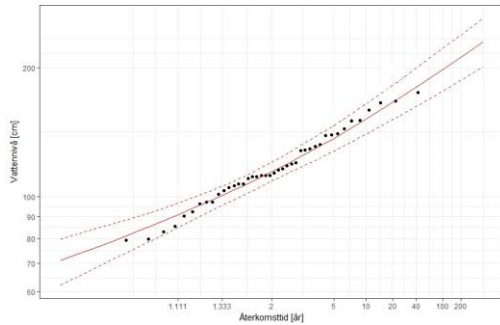


Risk analysis



Risk analysis

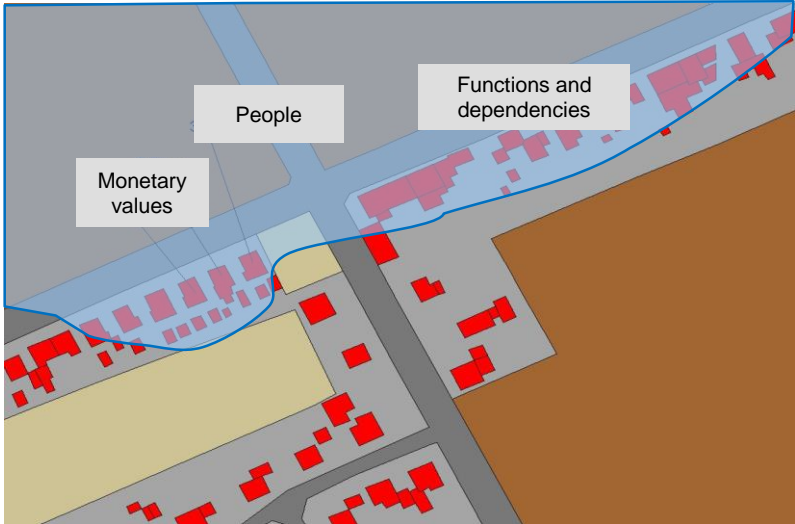
Scenario



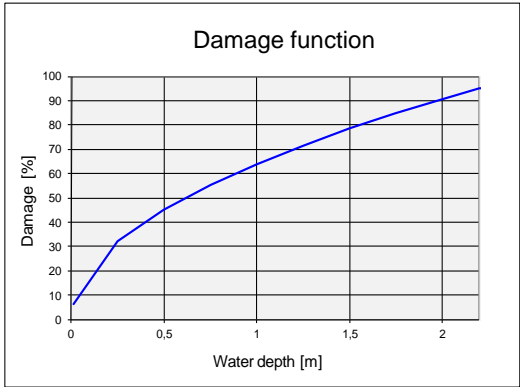
Hydrodynamic modelling
(2D modelling, MIKE21)

Inundation map with
distribution of water depths
and flow velocities)

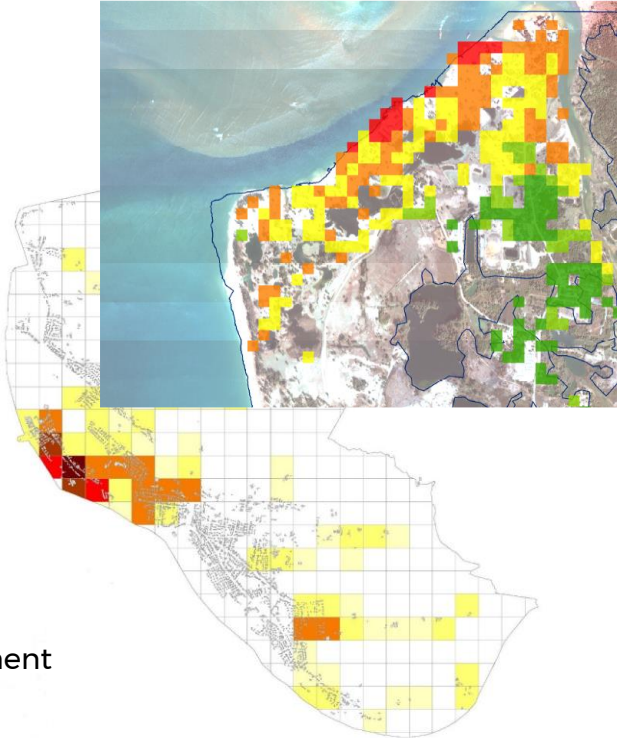
Risk analysis



Vulnerability assessment
Damage calculation



Risk map (damage/probability)



Costs for the society
Cost-Benefit Analysis



Risk assessment in coastal communities

- Multiple hazards, cloudburst, river flooding and high water levels at the coast
- Hydrodynamic modelling of different events and combined scenarios



Risk assessment in coastal communities

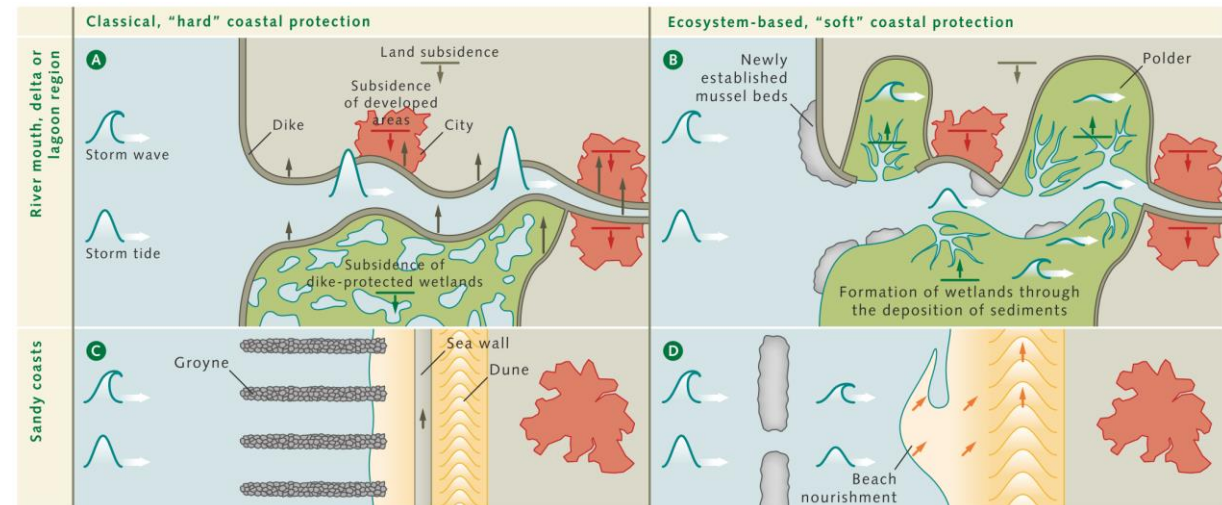
- Multi-risk assessment
- Prioritization of adaptation measures



Risk management in coastal zones - outlook

Climate change requires sustainable adaptation and flexible solutions

- Detailed risk assessment
- Hard -> soft solutions (e.g. concrete structures -> beach nourishment)
- Resistance -> resilience
- Nature-based solutions
- Making space for water



Source: World Ocean Review 5 (2017). maribus gGmbH, <https://worldoceanreview.com/en/wor-5/>
adapted from: Temmerman et al. (2013): Ecosystem-based coastal defence in the face of global change. Nature, 504, 79–83.