CEDA Webinar Series

Climate Change Adaptation As It Affects the Dredging Community

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The Central Dredging Association is committed to environmentally responsible management of dredging activities and this paper – produced by the CEDA Environment Commission – seeks to raise awareness, to help the dredging community prepare for consequences of climate change, and to understand how dredging can contribute to adaptation measures

Climate change is now a fact. It is also now widely accepted that human activities are playing a role in the increase of greenhouse gas emissions that have accelerated global warming during the last century, although the significance of the human contribution is still a matter of debate. The related effects include:

- Sea level rise
- An increase in seawater surface temperature
- Changes in (seasonal) precipitation and hence river flow.

Climate change research moves rapidly and there is still a great deal of uncertainty: some new estimates project faster rates of sea level rise than those reported by IPCC in 2007 (*Rahmstorf, 2010*) whilst other (satellite) data suggest that rates of sea level rise may be slowing (*CU Sea Level Research Group, 2012*).

In addition to trends for an ongoing rise in global temperature and associated sea level rise, it is anticipated there will be an increase in the frequency of such extreme events as storms, surges, floods and droughts.

Climate change effects are also expected to increase in the coming decades, in part because of the relative lack of success to date in implementing mitigation measures (ie measures designed to reduce greenhouse gas emissions), and in part due to the thermal inertia of the oceans, the 'climate engine'.

Low-lying coastal areas worldwide face a large-scale increase in population density, urbanisation, industrialisation and agriculture with associated implications for land subsidence. These increasing pressures make coastal zones and deltas especially vulnerable to climate change impacts – not only flooding and erosion, but also implications for ecosystems (*Nicholls et al, 2010*) such as through intrusion of saline waters.

Adaptation strategies are therefore absolutely necessary to reduce the consequences of climate change by improving resilience and reducing vulnerability. And dredging will often be an important element in the adaptation 'toolkit'.

The dredging community comprises all those involved in any kind of activity related to dredging. This includes not only the dredging industry (contractors, manufacturers) but also port and water authorities, policy makers, regulators, consultants and stakeholder groups. Geographically, this CEDA position paper focuses on north-western Europe but other parts of the CEDA area may face similar challenges.

Mitigation measures designed to reduce the contribution of the dredging sector to greenhouse gas (CO_2) emissions (eg the use of alternative fuels and materials), whilst clearly important, are outside the scope of this paper, which:

- Firstly highlights the main implications of climate change for dredging
- Discusses potential preparatory and adaptation measures in general terms
- Elaborates on specific climate change issues and adaptation requirements/options in relation to three typical environments in which dredging takes place: open coasts; seaports, estuaries and access channels and inland waters.

Potential Climate Change Implications For The Dredging Community

Dredging activities mostly take place in rivers, canals, estuaries, ports and coastal areas. The morphology of these areas is influenced by sediment supply, currents, waves, winds, water levels and tidal range. Changes in these conditions due to global warming may induce changes in erosion and sedimentation patterns, with potential consequences for both inland and offshore dredging requirements.

The dredging community needs to be aware of the projected changes and the type of adaptations likely to be required.

Adaptation measures might relate to dredging volumes or locations, the type or number of dredging tools, or new dredging methodologies. Changes in technology may also be required – eg specific equipment may be required to dredge in harsh and isolated conditions, or different types of equipment may be needed to meet smaller scale, more isolated or more frequent dredging needs (*Jensen, 2007*).

The increased development of offshore windfarms, for example,

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Outline

- Objectives and scope
- Consequences of climate change
- Potential implications for the dredging community
- Adaptation measures
  - Open coast
  - Seaports, access channels and estuaries
  - Inland waters
- Key messages

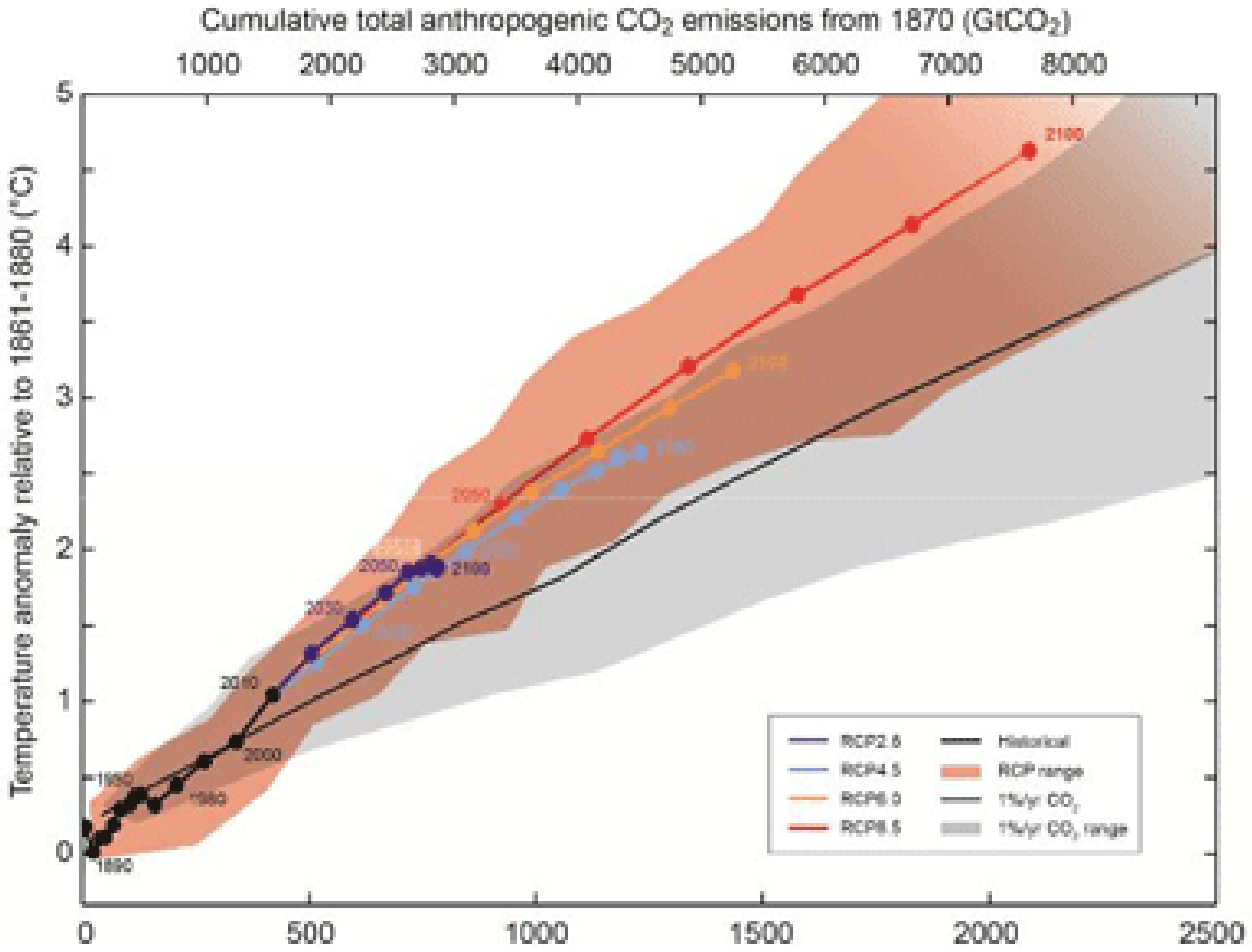
Objectives

- To raise awareness of the dredging community
- To help dredging community to be prepared for climate change
- Understanding how dredging can contribute to adaptation measures

Scope

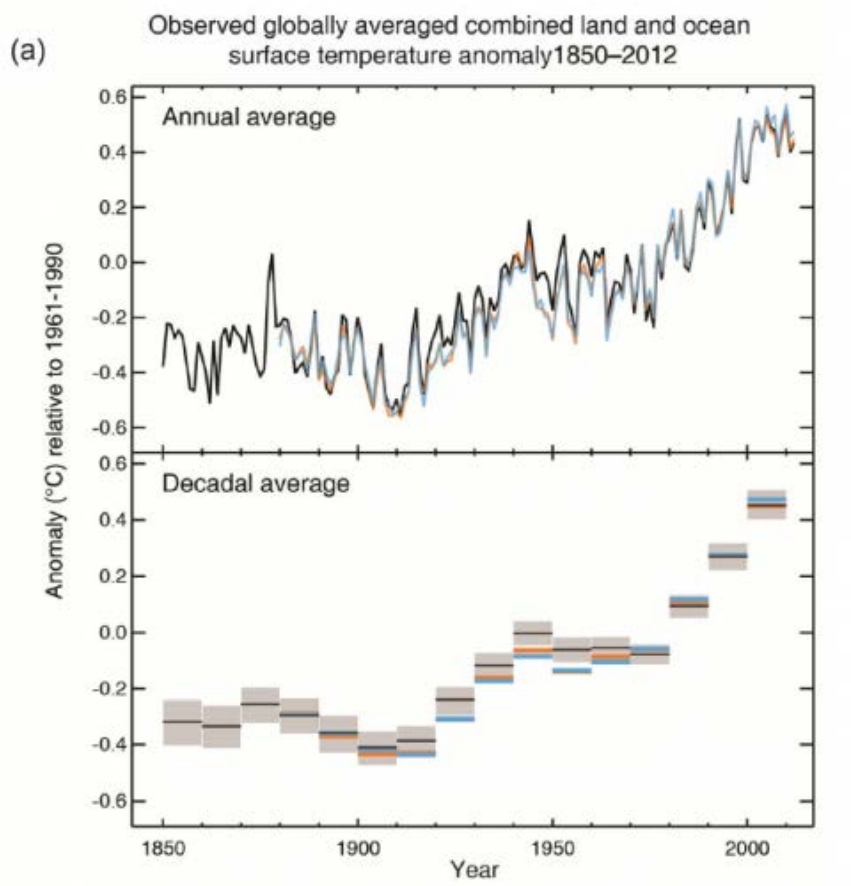
- Focus is on adaptation to consequences of climate change not on causes
- Measures to reduce greenhouse gas emissions of the dredging sector itself are outside the scope of this presentation

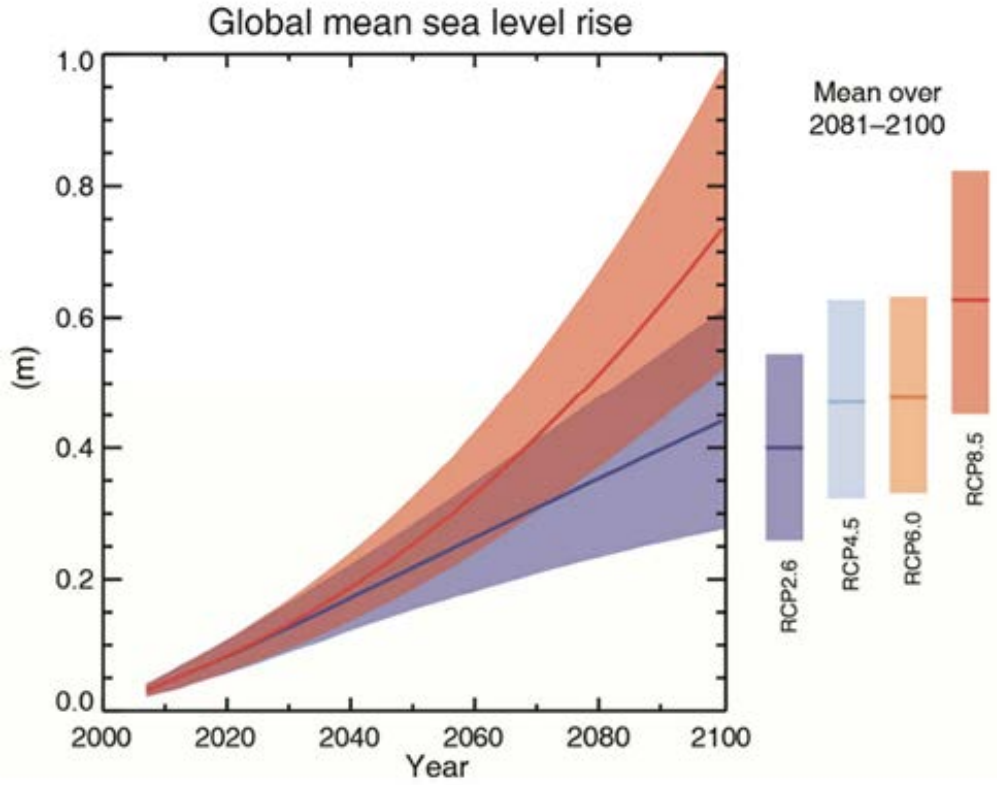
Greenhouse gas emissions



"It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century" (IPCC 2013)

Global warming and SLR

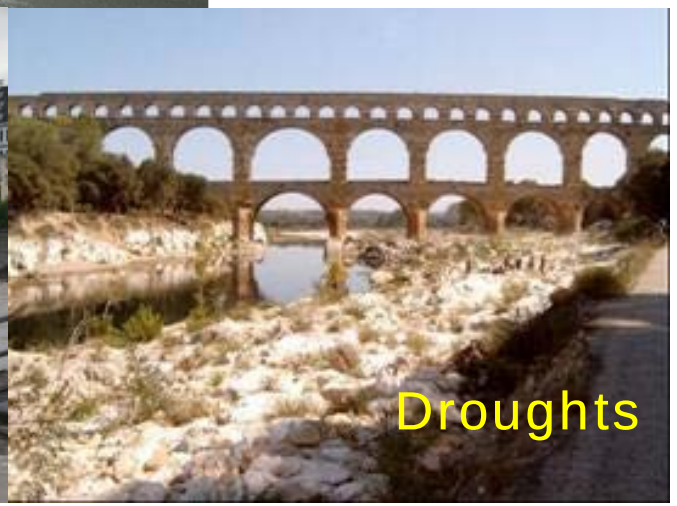




Climate change is a fact

- Although uncertainties remain about the rate and magnitude of consequences, two trends are clear
- Trend for a steady rise in global temperature and associated sea level rise
- Increase in frequency of extreme events like storms, floods and droughts

Consequences of Climate Change



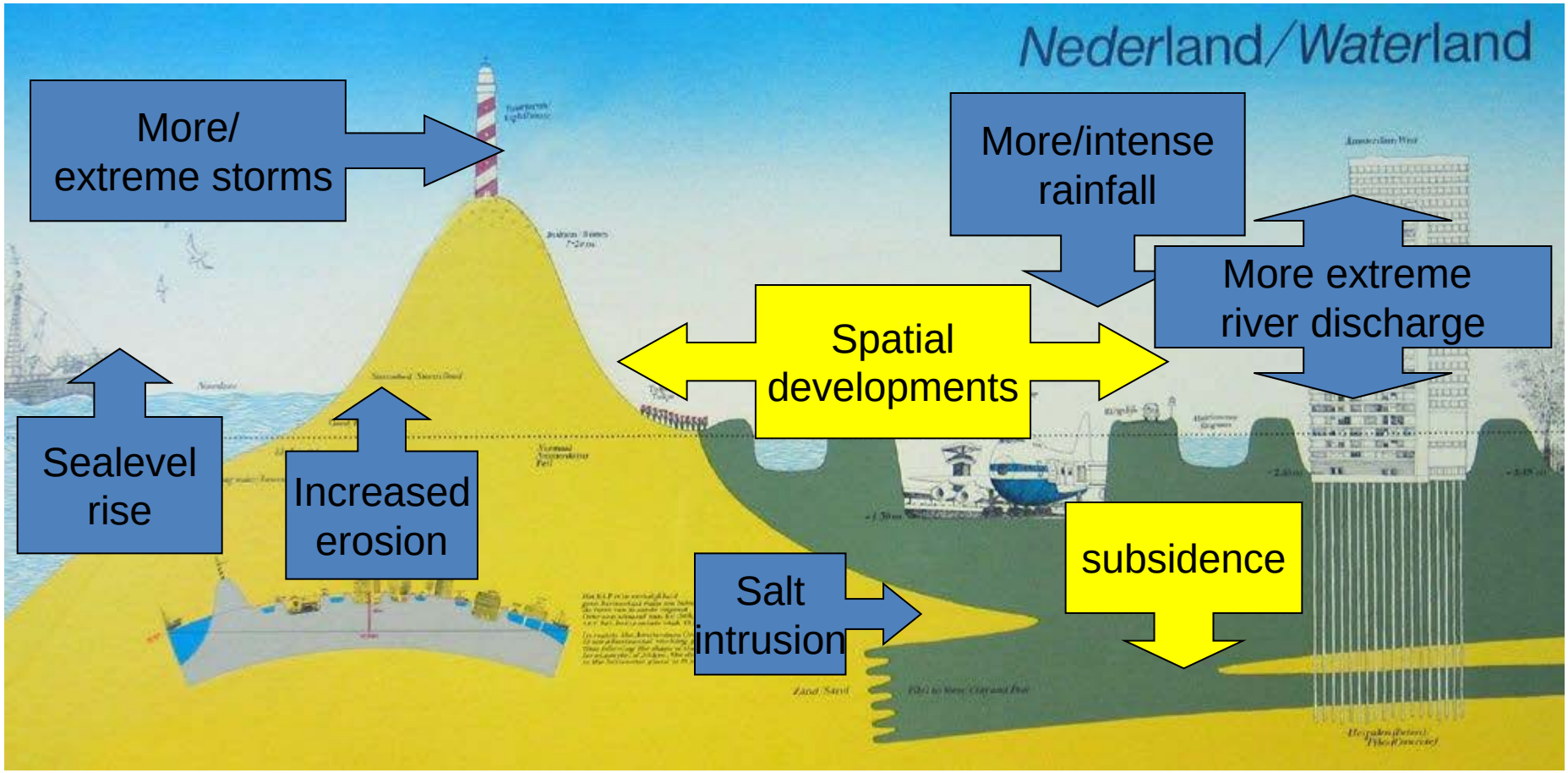
Environmental concern

- Increasing vulnerability of ecosystems (temperature, salinity)
- Increasing risk of erosion of contaminated sediments and remobilisation of contaminants
- Availability of fresh water

Likely consequences for Europe

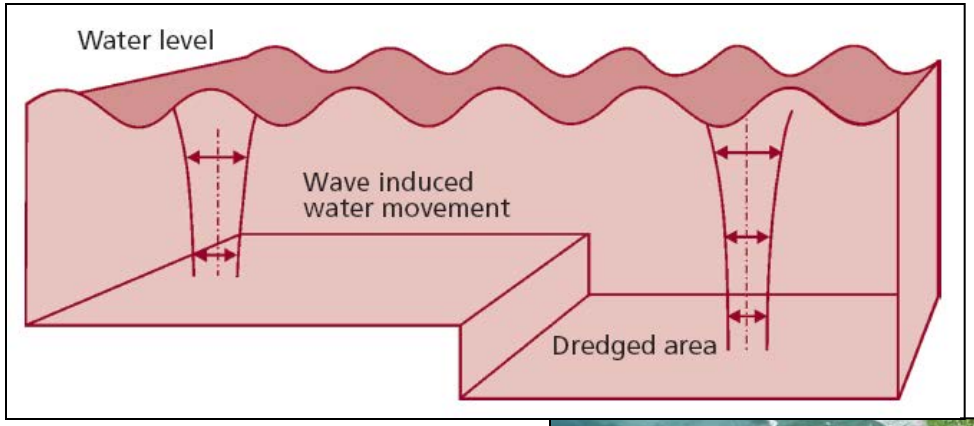
- More frequent and severe storms
- Increased flooding frequency
- Higher precipitation intensity
- More extreme drought periods
- Fewer days with frost and snow cover
- Changes in flora and fauna
- Sea level rise of 0.5-1.0 m until 2100

Delta under pressure

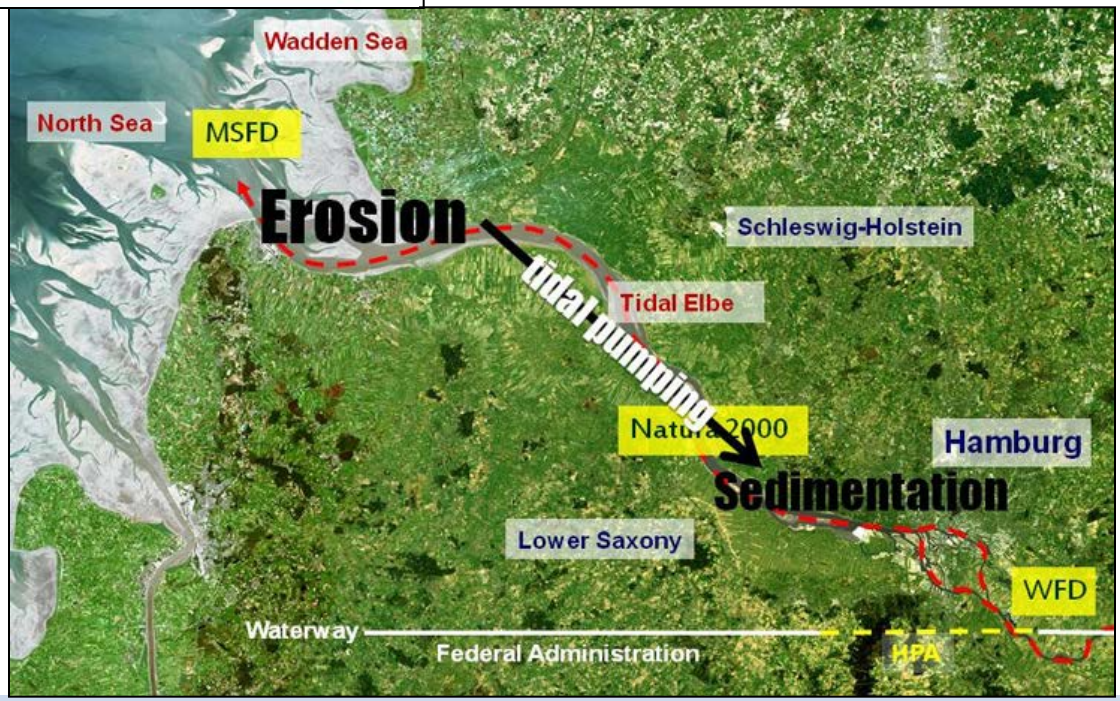


Potential climate change implications for dredging community

Changes in dredging volumes and/or locations



Tidal pumping

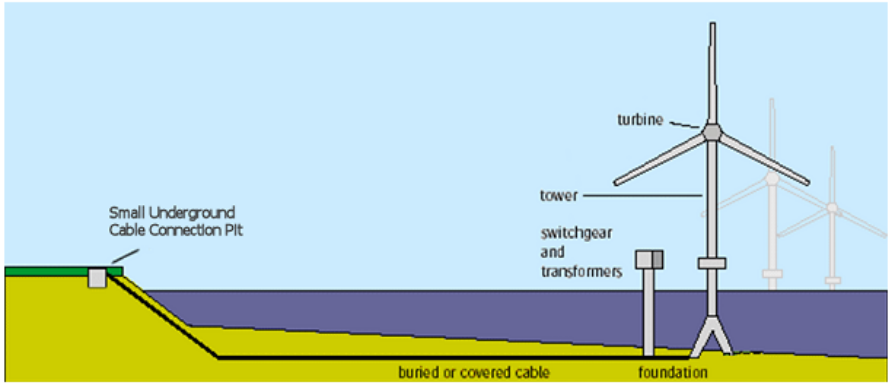


Specific equipment for new types of operations

Offshore Wind Farm off Zeebrugge.

Dredging for foundation of wind farm and cable installation

Figure 2.1 Components of a Typical Offshore Wind Farm

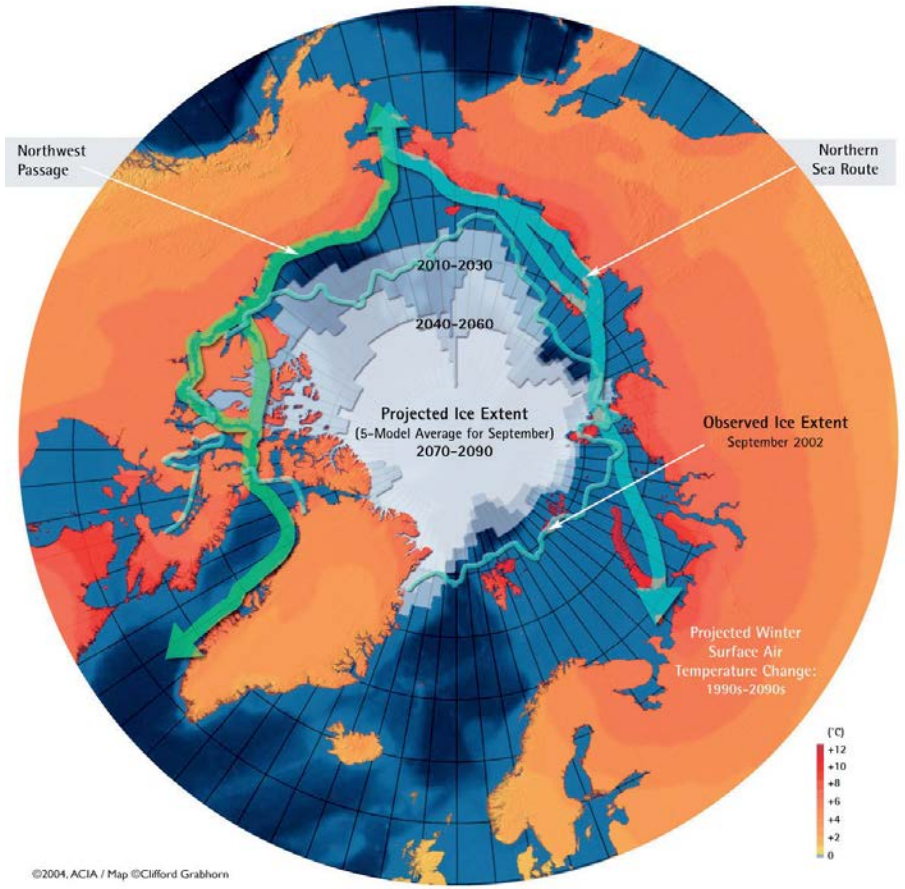


Source: UK Department of Trade & Industry (DTI), 2002.

Changes in dredging requirements

The Arctic ice cap is shrinking in summer and getting thinner

Opening of new shipping lanes



Observed and projected Arctic sea ice extent (reproduced from ACIA, 2004, 2005)

Sustainable solutions will not always involve more dredging

Strategies

- Flexibility needed because of uncertainty in consequences (technology, regulations)
- Adaptive management
- New and innovative solutions required
- Climate proof design

Adaptation measures

- Help society prepare for and adapt to consequences of climate change (more resilience and/or less vulnerability)
- Integrated sustainable approach:
  - safety against flooding
  - safety of navigation
  - environmental protection and improvement
  - economics, and societal interests

Adaptation measures

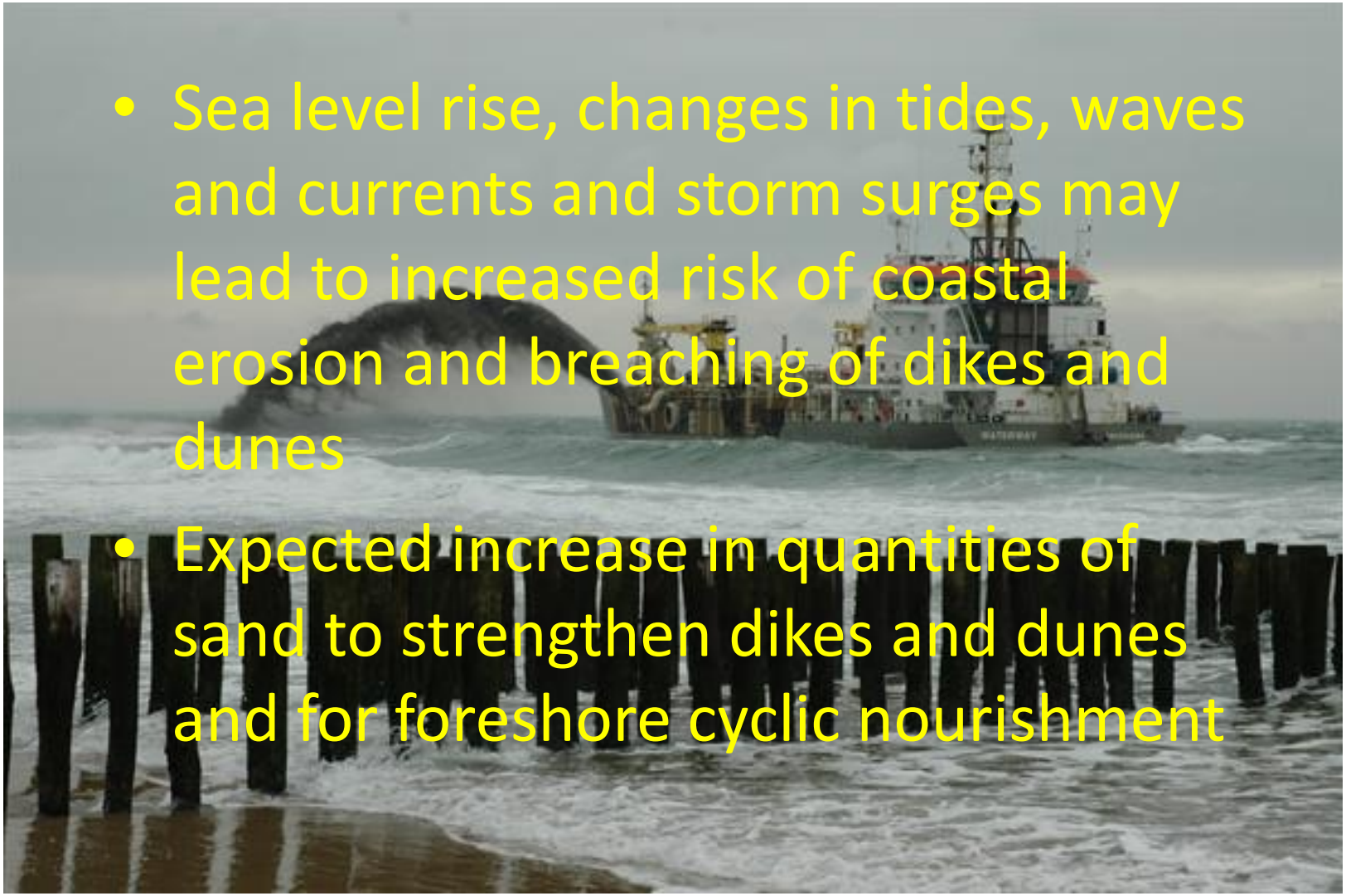
- Short term: data collection and monitoring (understanding and risk assessment)
- Long term: realise adaptation measures (flexibility)
- Dredging is an important tool for adaptation

Types of environment

Examples of climate change adaptation
for 3 interconnected types of environment:

- open coasts
- seaports, access channels and estuaries
- inland waters

Open coasts



- Sea level rise, changes in tides, waves and currents and storm surges may lead to increased risk of coastal erosion and breaching of dikes and dunes
- Expected increase in quantities of sand to strengthen dikes and dunes and for foreshore cyclic nourishment

Nourishment at The Danish West Coast

- Magnitude of existing erosion problem
- The present yearly nourishment: approx. 3 mill m^3
- Typical natural erosion rate: 3 m/year
- Assumption: SLR in year 2100: 0.5 m -1.0 m
- The required nourishment is expected to increase:
  - 20-40 % from SLR
  - 10% from increased littoral drift

Maintenance of Dutch coast line by beach nourishment

- At this moment 12 million m3/yr
- Expectation: in the future 20 million m3/yr
- Present cost +/- 50 million euro/yr
- Increase in sand supply and sources further away
- Complexity: logistics, ecological and morphological response

Beach nourishment Belgian coast

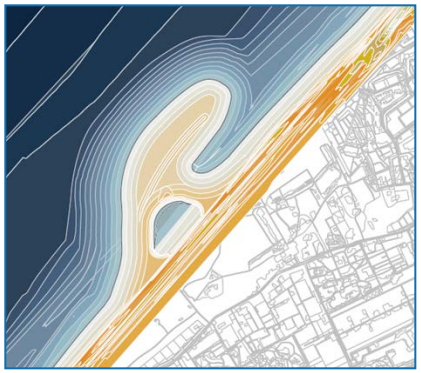
Profile Nourishment in combination by reclamation of the subtidal (submerged) beach at De Haan Belgium for sustainable and integrated coastal defence

Amager Beach Park Copenhagen multifunctional

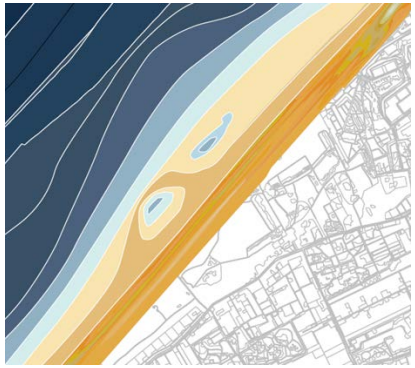
Køge Bay Beach Park: Combining coastal and lagoon rehabilitation, marinas and sea defence

Working or Building with Nature

- Sand Engine: mega nourishment Dutch Coast
- Combining safety with space for nature development and recreation, use natural processes for distribution of sand
- From defensive to proactive approach



construction



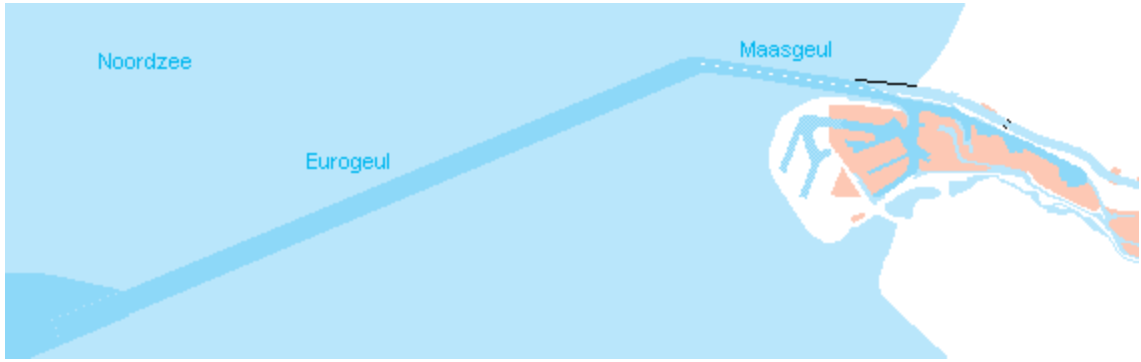
after 20 years

Seaports, access channels (1)

- Seaports are situated in areas vulnerable for sea level rise and increased storm intensity
- Situated at the mouth of rivers risks for flooding
- Few seaports are preparing for the impacts of climate change

Seaports, access channels (2)

- Requirements for better protection of the port against flooding and adjustment of fixed structures
- Changes in sedimentation in harbours and channels
- Alignment access channels: morphology and hydrodynamics
- Changes in maintenance dredging strategy (operational windows, flexibility)



Estuaries

- Increased sedimentation in sheltered areas
- Increased erosion of exposed areas
- Changes in sedimentation of river sediment
- Changes in maintenance dredging

Humber estuary

Inland waters: adaptation measures involving dredging

Minimise restrictions on navigation

retain storage capacity in reservoirs

After extreme rainfall/run-off events
Clean up dredging (contaminants)
Risk of erosion of contaminated sediments

Flood management of river systems

Combining dredging for flood management with extraction of sand and in gravel in the River Meuse the Netherlands

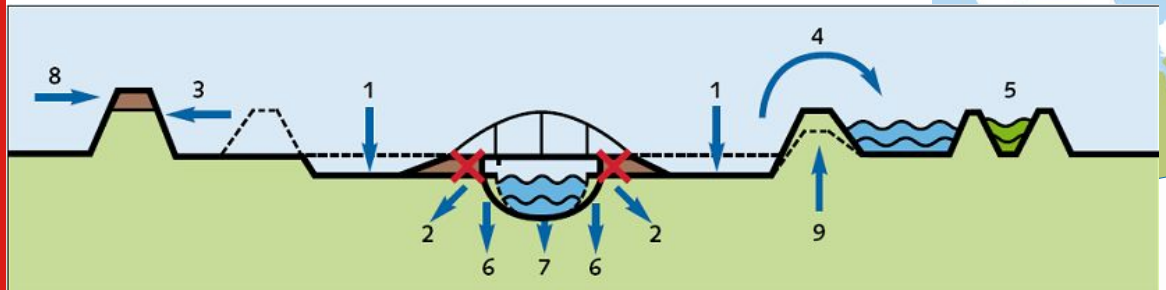
Room for the River Programme

making space for water

Two aims:

Safer Dutch river areas by 2015. Safety for 2-4 millions inhabitants

Enhancement of spatial quality (landscape, recreation etc.)

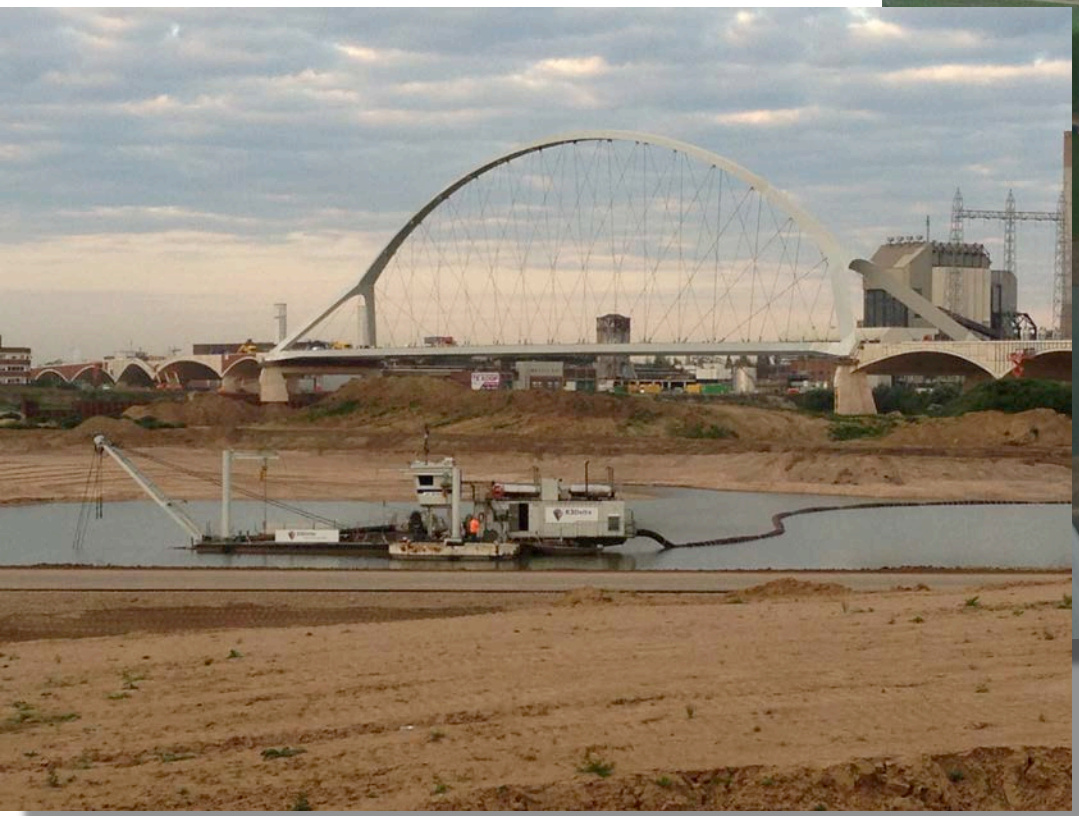


1 **Lowering of floodplains**
2 Removal of obstacles
3 Dyke relocation
4 Waterretention and storage
5 **By-pass**
6 Height reduction of groynes
7 Deepening of summer bed
8 **Heightening of dykes**
9 Dyke improvement

ruimte voor de rivier

Room for the River project in realisation

Dredging secondary channel Nijmegen



Key messages

- Climate change both challenges and opportunities
- Dredging is an important tool for adaptation
- Uncertainties are no excuse not to take action
- Dredging community should be prepared to act
- Climate change measures effective and sustainable: if based on well-informed, adaptive and integrated approach
- Innovation and flexibility are crucial factors both for technical solutions and regulations

Thank you for your attention

Acknowledgements to the members of the CEDA Working Group on Climate Change Adaptation

Q & A