Modelling Future Deltaic Systems
Modelling Future Deltaic Systems

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  o EEMCS

In this flagship, there is a close collaboration with
  o CEG
  o BK
  o TPM
Motivation

The aim of the research in this flagship is to

- Model
- Gain fundamental understanding

of deltaic systems which allows for the assessment of effects of climate change and human interventions (re-design) on

- Safety
- Economic values
- Ecological values

Often competing effects!
Motivation

The aim of the research in this flagship is to

• Model
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of deltaic systems which allows for the assessment of effects of climate change and human interventions (re-design).

We need fundamental knowledge of these systems to

• Minimize possible impacts
• Mitigate unforeseen impacts
Example – Ems Estuary (1/2)
Example – Ems Estuary (2/2)

Oberrecht & Wurpts, 2014
Ems Estuary – Economic Activity (1/3)

Shipyard (1795)
Ems Estuary – Economic Activity (3/3)
Redesigning the Ems Estuary – Construction of a weir

Constructed in 1899
Redesigning the Ems Estuary – Channel deepening

Water depth

[Graph showing water depth changes over time from 1945 to 2005 along the Ems Estuary.]
Redesigning the Ems Estuary – Channel deepening

Water depth

Van Maren et al. (2015)
Redesigning the Ems Estuary – Impact

Landward side

Mean SPM (mg l⁻¹)

2005-2006

0 60 80 100
Emden distance from weir at Herbrum (km) Eemshaven Borkum

De Jonge et al, 2014
• Observations:
  • Low Turbidity before the 90’s
  • High Turbidity since the 90’s

• Research Questions:
  • Can we model this change (over decades)?
  • Can we understand it (identify dominant mechanisms)?
  • Can we propose measures to mitigate these changes?
Can we model this?

In Dijkstra et al (2019) a model is developed that captures these changes without recalibrating the model.
Mechanism: the system has become resonant (M4 tide) due to deepening and reduced friction, which resulted in an enhanced import of sediments from the sea.
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Mitigation Possibility: get the system out of resonance, for example by changing the length.
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Mitigation by changing the length (3/4)

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L = 30 km

L = 60 km

L = 90 km

Critical length of approx. 60 km (tipping point)
Conclusions

- Gaining fundamental insight into the essential mechanisms allows for
  - Clear understanding of impacts of changes, both climate and human-induced
  - Suggestions of mitigation measures (that would otherwise not be considered)

- Each system may react differently to changes (so do not generalize observations from one system).