‘Large-scale sand extraction on ridges offshore of the Netherlands’

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Study area: Zeeland ridges (1)

Study area – Objective – Research method – Results – Conclusions – Recommendations
Study area: Zeeland ridges (2)

• Characteristics ridges:
  – Height: 5-15 m
  – Length: 9-39 km
  – Transverse spacing: 3-7 km
  – Sand waves: 2-8 m
  – Orientation: 0-20 degrees clockwise

• Characteristics area:
  – Tidal range: 2.5-3.5 m
  – Delta: non-closed coastline

Study area – Objective – Research method – Results – Conclusions – Recommendations
Study area: Zeeland ridges (3)

Van Alphen & Damoiseaux (1989)
Laban & Schüttenhelm (1981)

Study area – Objective – Research method – Results – Conclusions – Recommendations
Study area: Zeeland ridges (4)

- Tidal sand ridges?
- Shoreface-connected ridges?
- Conclusion: no clear classification
Framework of research

- Management question Rijkswaterstaat:
  “Long-term physical effects of large-scale sand extraction on the Zeeland ridges?”
  - Long-term: up to 100 years
  - Large-scale: > 10 million m³

Study area – Objective – Research method – Results – Conclusions – Recommendations
Objective research

- Inventory of instruments…
- that could be used to predict….
- long-term physical effects…
- of large-scale sand extraction…
- on the Zeeland ridges…
- to support Dutch decision-making process.
Information cycle

- Study area
- Objective
- Research method
- Results
- Conclusions
- Recommendations
Rugby ball method

Study area – Objective – Research method – Results – Conclusions – Recommendations
Information need

• Effect on coastal user functions:
  – Coastal safety and maintenance
  – Offshore infrastructure
    (cables, pipelines, offshore constructions)
  – Navigation
Coastal State Indicators (1)

• Quantitative concept …
• actual state of system…
• basis for objective and transparent decision-making.

• CSI’s are determined by stakeholders!
Coastal State Indicators (2)

- Example:
  - Seaside visitor
  - Concern: beach erosion
  - CSI: coastline position (MCL)
Rugby ball method

Study area – Objective – Research method – Results – Conclusions – Recommendations
Instruments

- 3 analytical (non-) linear stability type models:
  - Twente model (University of Twente)
  - Amplitude-evolution model (Knaapen & Hommes)
  - Utrecht model (De Swart, Calvete & Walgreen)

- 4 numerical models:
  - Delft3D (WL Delft Hydraulics)
  - SUTRENCH (WL Delft Hydraulics)
  - Telemac (SOGREAH, France)
  - mu-SEDIM (MUMM, Belgium)
Twente model

Study area – Objective – Research method – Results – Conclusions – Recommendations
Amplitude-evolution model

- Model for recovery of sand ridges after extraction
- Landau equation:

\[
\frac{\partial A}{\partial \tau} = A - \alpha |A|^2 A
\]

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Telemac

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Rugby ball method

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Judgement instruments

• **Applicability:** regarding CSI’s
  – Processes (sediment transport, tide, wind)

• **Reliability:** predictions
  – Spatial scales
  – Situation (schematized, realistic)

• Applied to research area of Zeeland ridges!!
Conclusions (1)

• Qualitative and quantitative insight in most CSI’s, regarding sand extraction on Zeeland ridges
  – Delft3D, Telemac and mu-SEDIM large computational time
  – Twente model, Amplitude-evolution model and Utrecht model fast insight in changes
  – SUTRENCH predictions not reliable

• No direct support decision-making process on long-term effects
  – short term effect on tide and waves possible
Conclusions (2)

• Information missing:
  – Sand transport measurements
  – Long-term morphology

• Lack of knowledge:
  – Recovery ridges
  – Effect sand extraction pit on trenches
Recommendations

• Apply Rugby ball method in similar researches
• Feedback on judgement instruments by model developers
• Design information strategy (step 3 information cycle)
• Investigate influence on user function ‘Ecosystem’
• Test case: Kwintebank (Belgium)
Kwintebank case

• 25 million m$^3$ sand extracted
• 3 years closed of extraction (since 2003)
• Intensive monitoring

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Questions