SMARTSEDIMENT project
A spatially explicit GIS tool to estimate effects of sediment management on ecosystem services
Katrien Van der Biest, Annelies Boerema, Dirk Vrebos, Patrick Meire
Ecosystem services

“The benefits people obtain from ecosystems”

Unabated loss of biodiversity

Loss of biodiversity = loss of human well-being

Value of biodiversity invisible in economic indicators, That guide political and economic decisions

Indicators to
- Show importance of ecosystems & biodiversity for welfare, wellbeing, people and economy
- Guide decision making at project level
Ecology meets society

Human interventions

Ecosystem

Ecosystem structures
Soil, groundwater, river bank, ...

Ecosystem processes
Primary production, nutrient cycling, sedimentation, ...

Biodiversity & Ecosystem services
Food, water purification, flood prevention, ...

Human well-being

Based on Tallis et al. 2012
Ecosystem services categories

<table>
<thead>
<tr>
<th>Provisioning</th>
<th>Regulating</th>
<th>Cultural</th>
</tr>
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<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
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<td><img src="image8.png" alt="Image" /></td>
<td><img src="image9.png" alt="Image" /></td>
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</table>
High socio-economic demands...

Scheldt estuary:
- Major harbours (jobs)
- High population densities

... but also high nature values (tidal flats & marshes).
important providers of ecosystem services

1. Water column
2. River bottom
3. Tidal flats
4. Onshore flood areas
5. Air

Adapted from F.L.O.W. Collaborative
Estuaries, sediment management and ecosystem services

Important ecosystem service “Water for navigation”
→ Dredging needed

< 2010: sediment management to support navigation
→ removal of sediment from main navigation channel to side channels

Yves Plancke, 2017
Smart sediment management

New sediment strategy: sediment deposition to increase ecological value

Side channels ➔ edge of tidal flat

Create low dynamic habitat

➔ High benthic production & diversity

➔ Vegetation development

van der Wal et al. 2006

Yves Plancke, 2017
Smart sediment management

Low-dynamic habitats & tidal flats – high ecosystem services

- Carbon storage
- Habitat & biodiversity
- Heritage
- Agriculture
- Wave attenuation
- Water filtration
- Food production
- Recreation
- Navigation

Adapted from F.L.O.W. Collaborative
Smart sediment management

- Food production
- Wave attenuation
- Agriculture
- Navigation
- Ecosystem-based coastal defence
- Nursery function of an estuarine tidal marsh for the brown shrimp
  *Crangon crangon*
  André Cattrijse, Hederick R. Dankwa, Jan

Temmerman et al. 2013

New study reveals value of tidal marshes in fight against climate change

Media release

11 March 2017
SMART SEDIMENT MANAGEMENT

→ CREATES CO-BENEFITS BESIDES NAVIGATION

Carbon storage

Habitat & biodiversity

Heritage

Agriculture

Navigation

Recreation

Food production

Wave attenuation

Water filtration

Smart sediment management → creates co-benefits besides navigation

Adapted from F.L.O.W. Collaborative
Co-benefits from smart sediment management

Regular sediment management  Smart sediment management

Economic interest for smart sediment management

- Recreation
- Fisheries production
- Water purification
- Wave attenuation

→ Reduction of dredging costs by generating new benefits
→ Leverage alternative financing (through interested parties)
→ ...
WP4: Consequences of **sediment management** for **society**?

**Tasks:**
1) Knowledge on ecosystem functioning and services (in relation to sediment management in estuaries)
2) Quantify co-benefits of innovative sediment management
3) Spatially explicit tool

Ecosystem services? & nature?
Selection of ecosystem services

Different classification systems

Selection criteria:
1. Estuarine environment
2. Affected by sediment management
3. Stakeholders

Table 1
Typology of marine ecosystem services.

<table>
<thead>
<tr>
<th>Ecosystem service</th>
<th>Description</th>
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</thead>
</table>
| Provisioning Services | **1 Sea Food** All available marine fauna and flora extracted from coastal/marine environments for the specific purpose of human consumption as food (i.e. excluding for consumption as supplements)
| | **2 Sea Water** Marine water in oceans, seas and inland seas that is extracted for use in human industry and economic activity
| | **3 Raw Materials** The extraction of any material from coastal/marine environments, excluding which is covered by service 6
| | **4 Genetic Resources** The provision/ extraction of genetic material from marine flora and fauna for use in non-marine, non-medicinal contexts, excluding the research value on Genetic Resources which is covered by service 20.
Selection of ecosystem services (# 13)

- Food provision
- Raw materials
- Water & soil quality regulation
- Regulation flood risk
- Water for navigation
- Recreation & tourism
- Climate regulation
- Habitat and species diversity

Research Group
Ecosystem Management
University of Antwerp
Ecosystem functioning – systematic approach

**Sediment management:**
- disposal & dredging

**Ecosystem services**

**Hydrology**
- Water level
- Suspended matter
- Flow velocity
- Salinity
- ...

**Morphology**
- Bathymetry
- Grain size
- Organic matter
- ...

**Ecology**
- Primary production
- Sh elfish
- Birds
- ...

External (meteo, sea level)
GIS-tool

→ Spatially explicit tool to compare effects of different sediment strategies on ecosystem services

→ Based on the knowledge of ecosystem functioning

QGIS plugin
GIS-tool
Tool interface (QGIS)

Input:
Maps/values of ecosystem properties

- Simple & advanced method
- Time-step (e.g. gradual erosion)

Input:
Maps/values of ecosystem properties

- Sedimentation rate (cm/y)
- Bulk density (kg/m³)
- Particulate organic carbon (mg/l)
- Susp. Part. Matter (mg/l)
Suppletions tidal flat Oosterschelde

Today

- continuous erosion
- Disappearance of low-dynamic ecotopes

Suppletions

- 1,3 million m³
- Safeguard low-dynamic ecotopes
## Results – after 1 year

<table>
<thead>
<tr>
<th>Ecosystem service</th>
<th>Today</th>
<th>Suppletions</th>
<th>Unit</th>
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<td><strong>Provisioning</strong></td>
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<td>Food - mussels</td>
<td>-</td>
<td>-</td>
<td>kg/year</td>
</tr>
<tr>
<td>Food - sole</td>
<td>-</td>
<td>-</td>
<td>km² nursery area</td>
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<tr>
<td>Food - shrimp</td>
<td>0,01</td>
<td>0,04</td>
<td>km² nursery area</td>
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<tr>
<td>Raw materials</td>
<td>-</td>
<td>-</td>
<td>m³ sand availability/year</td>
</tr>
<tr>
<td>Navigation</td>
<td>-</td>
<td>-</td>
<td>score</td>
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<td>Flood risk</td>
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<td>Recreation - swimming</td>
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<td># swim recreationists</td>
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<tr>
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<td>km² qualitative habitat</td>
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- Maintenance of existing ecotopes: small effects (creation new habitat)
No suppletions (erosion scenario)

→ Continuous erosion (xx years) → Loss of low-dynamic ecotope

*Today*

*Erosion scenario*
## Results – erosion scenario

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- Validation & fine tuning → benthos densities?
Application

Compare scenarios (spatial planning, MER, ...)
Develop ecosystem-based

Knowledge institutes

Government agencies

Communication
Find common ground

Synergies

Get involved

Nature organisations

Economic sectors

Economic benefits
Cost reduction
Biodiversity