Research Group
Ecosystem Management
University of Antwerp

Interreg
EUROPESE UNIE
Vlaanderen-Nederland
Europees Fonds voor Regionale Ontwikkeling

Smartsediment

Deltares
Enabling Delta Life

IMDC
International Marine & Dredging Consultants

NIOZ

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

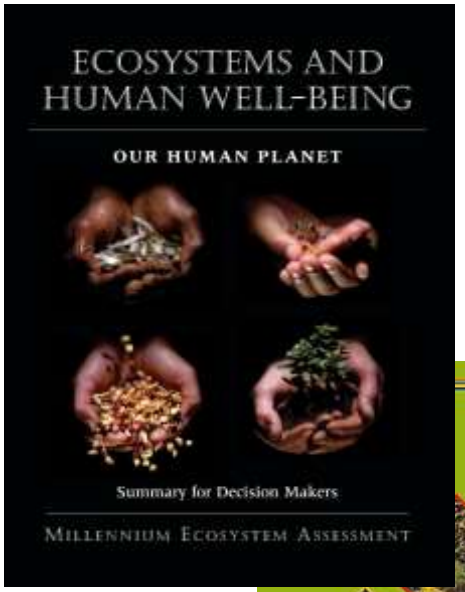
SedNet Conference, 3-5 April 2019, Dubrovnik

University
of Antwerp

Ecosystem services

"The benefits people obtain from ecosystems"

2005



Unabated loss of biodiversity

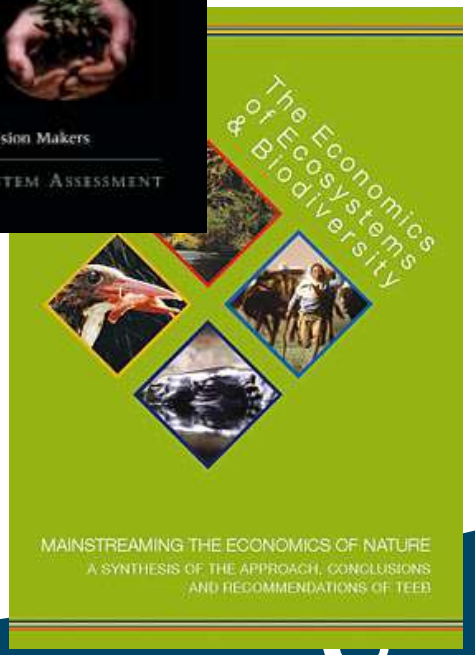
Loss of biodiversity

= loss of human well-being

Value of biodiversity invisible in economic indicators ,

That guide political and economic decisions

2010

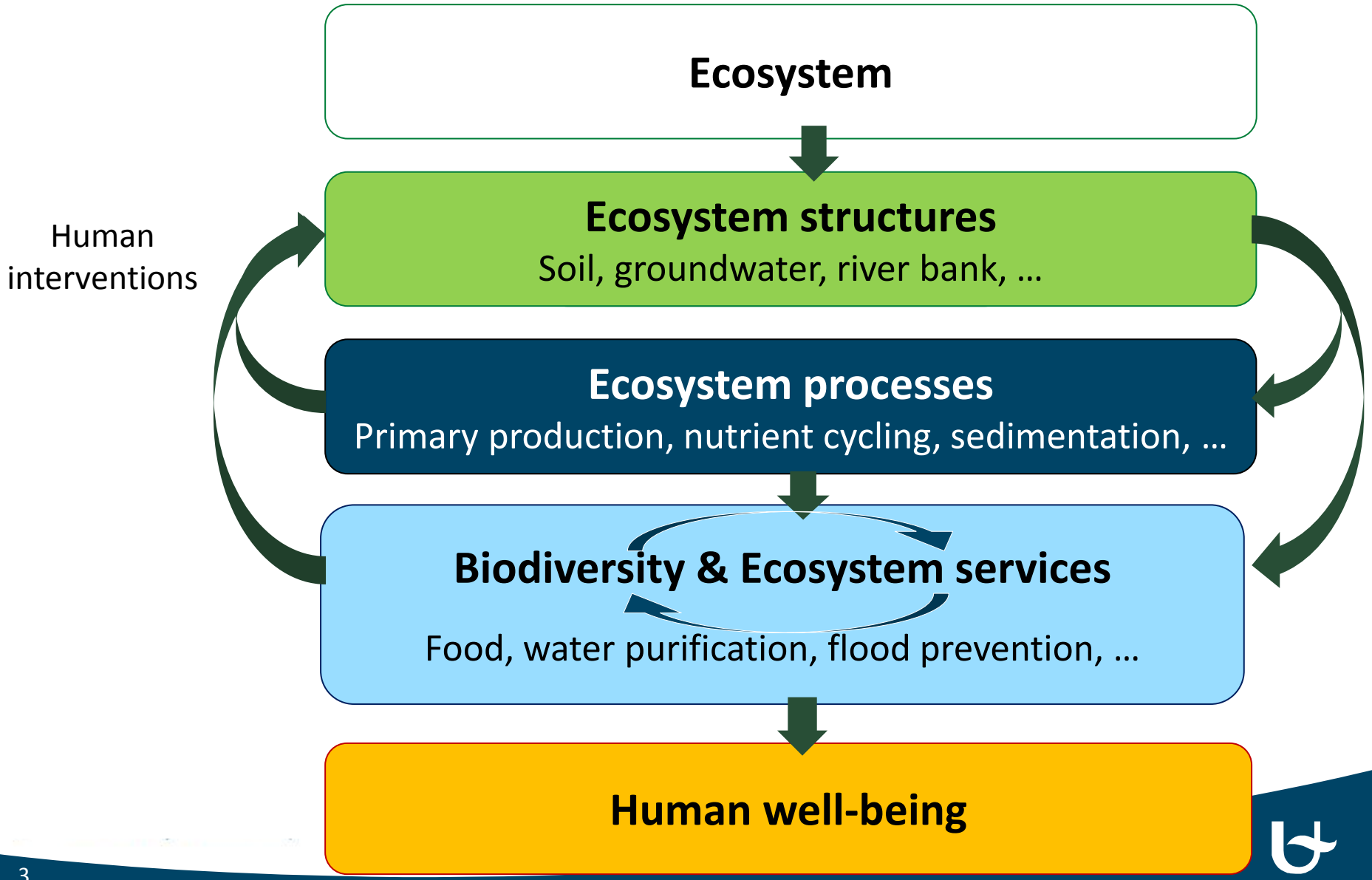


Indicators to

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

Based on Tallis et al. 2012

Ecology meets society



Ecosystem services categories

Provisioning	Regulating	Cultural





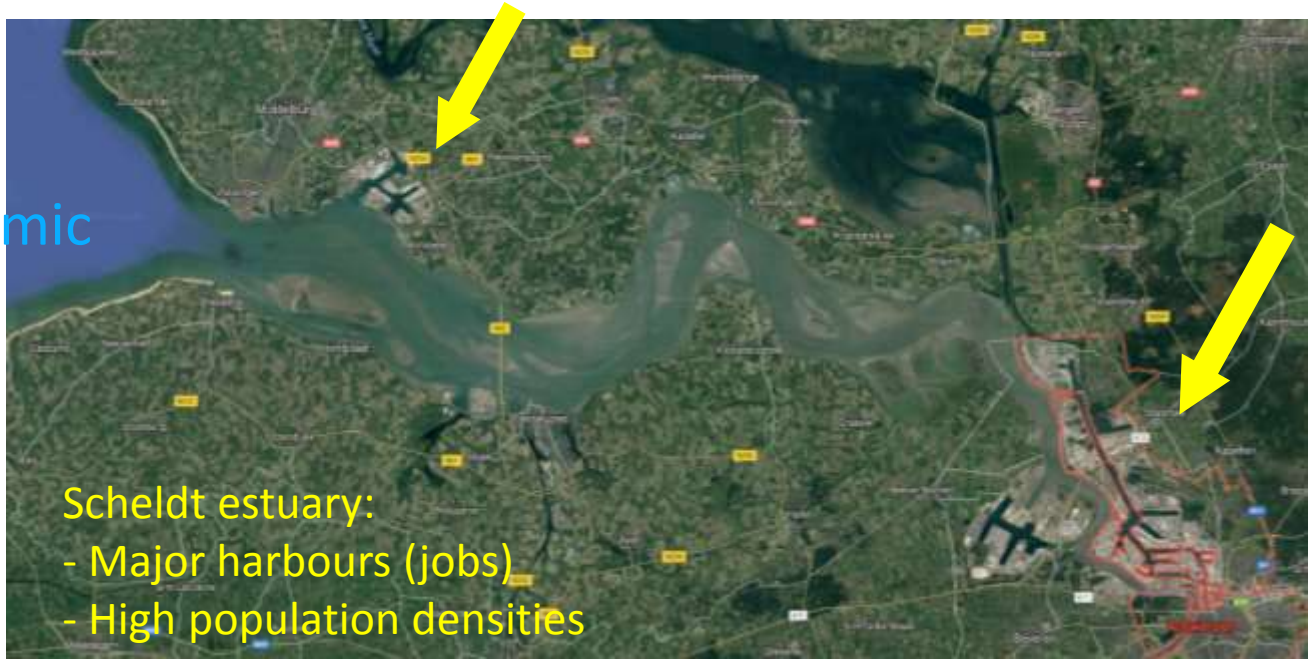




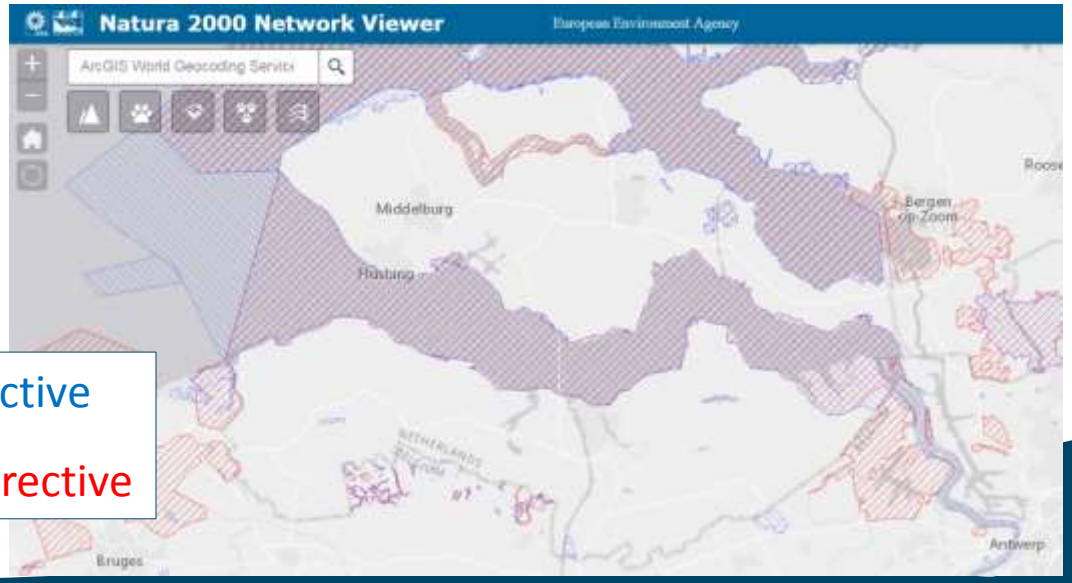
Estuaries

Google maps

High socio-economic demands …



… but also high nature values (tidal flats & marshes).

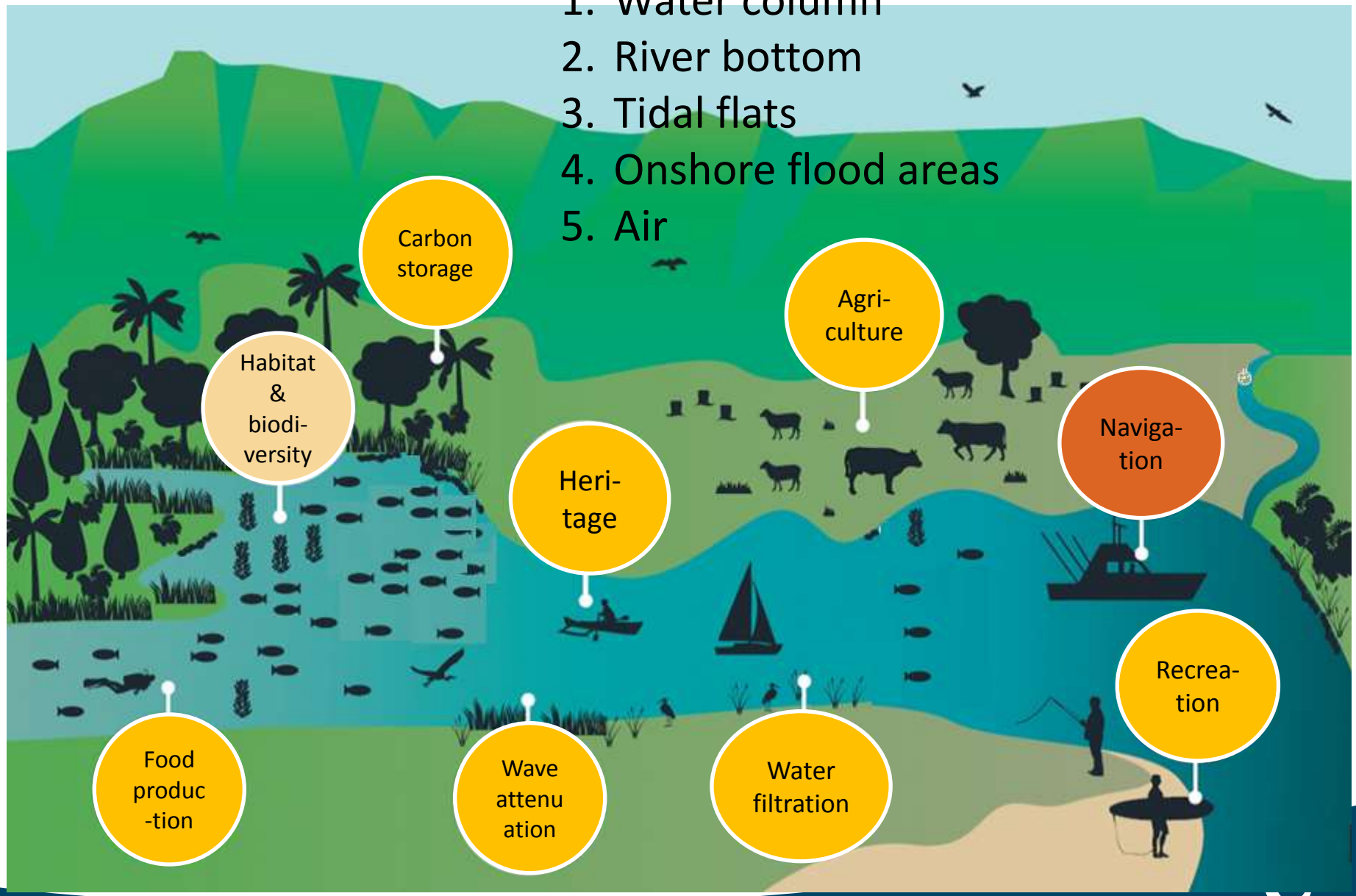


Birds directive

Habitat directive

→ 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

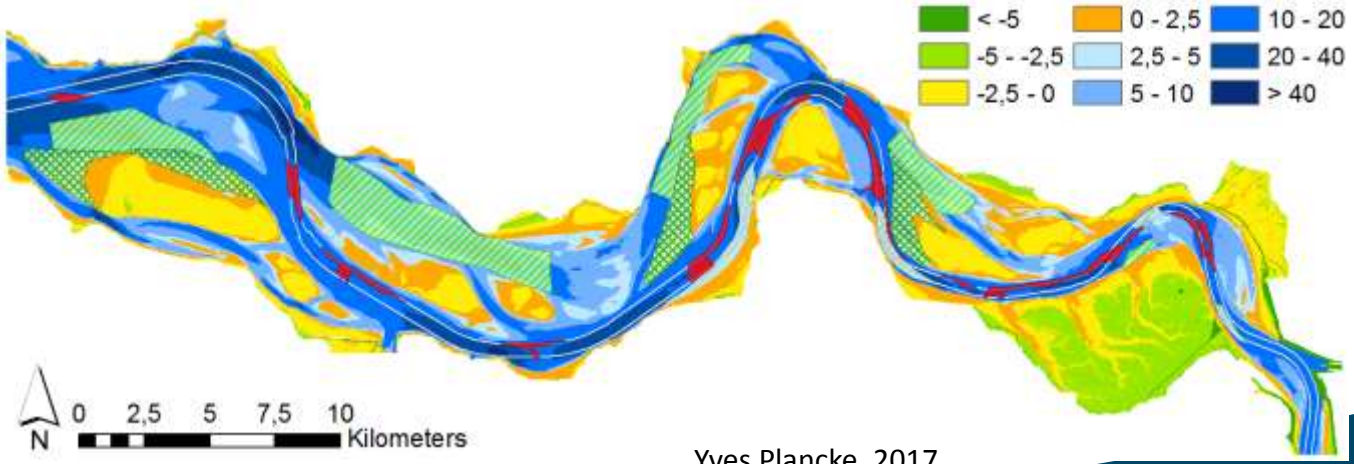
Estuaries, sediment management and ecosystem services

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

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Smart sediment management

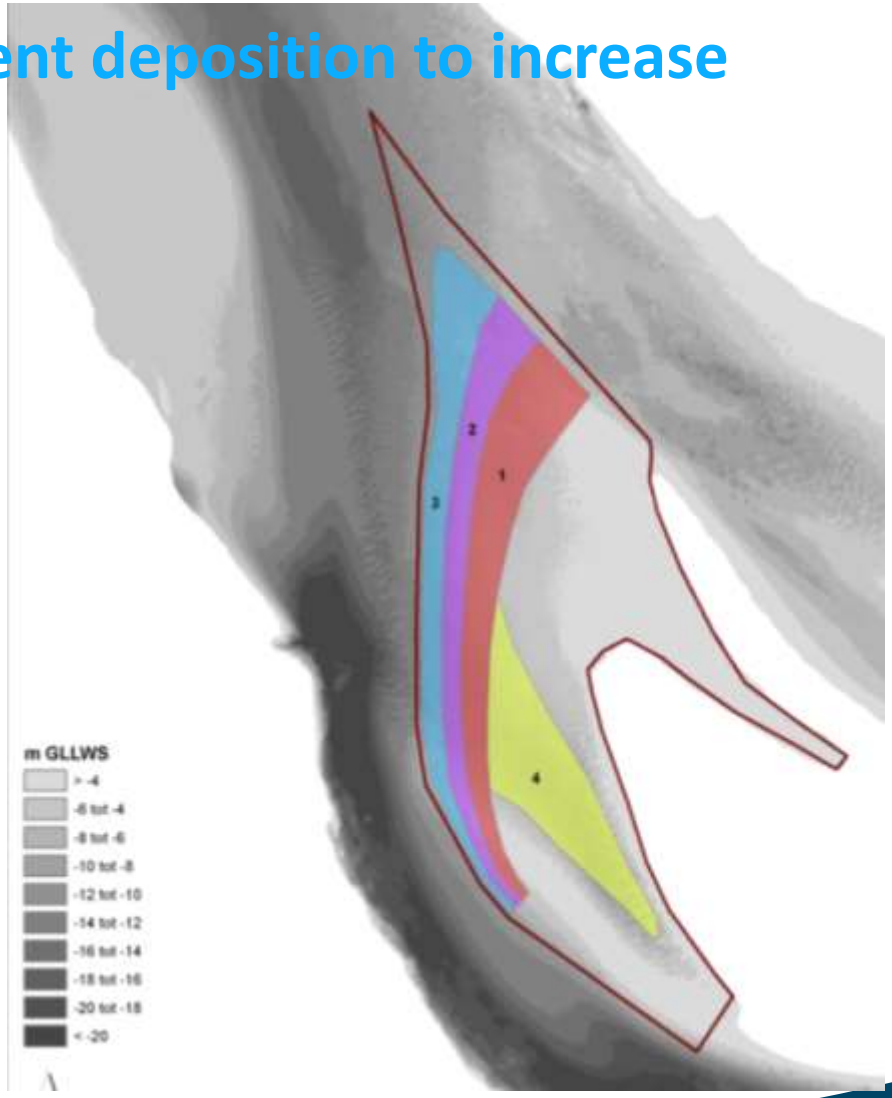
New sediment strategy: sediment deposition to increase ecological value

Side channels → edge of tidal flat

Create low dynamic habitat
→ High benthic production & diversity
→ Vegetation development

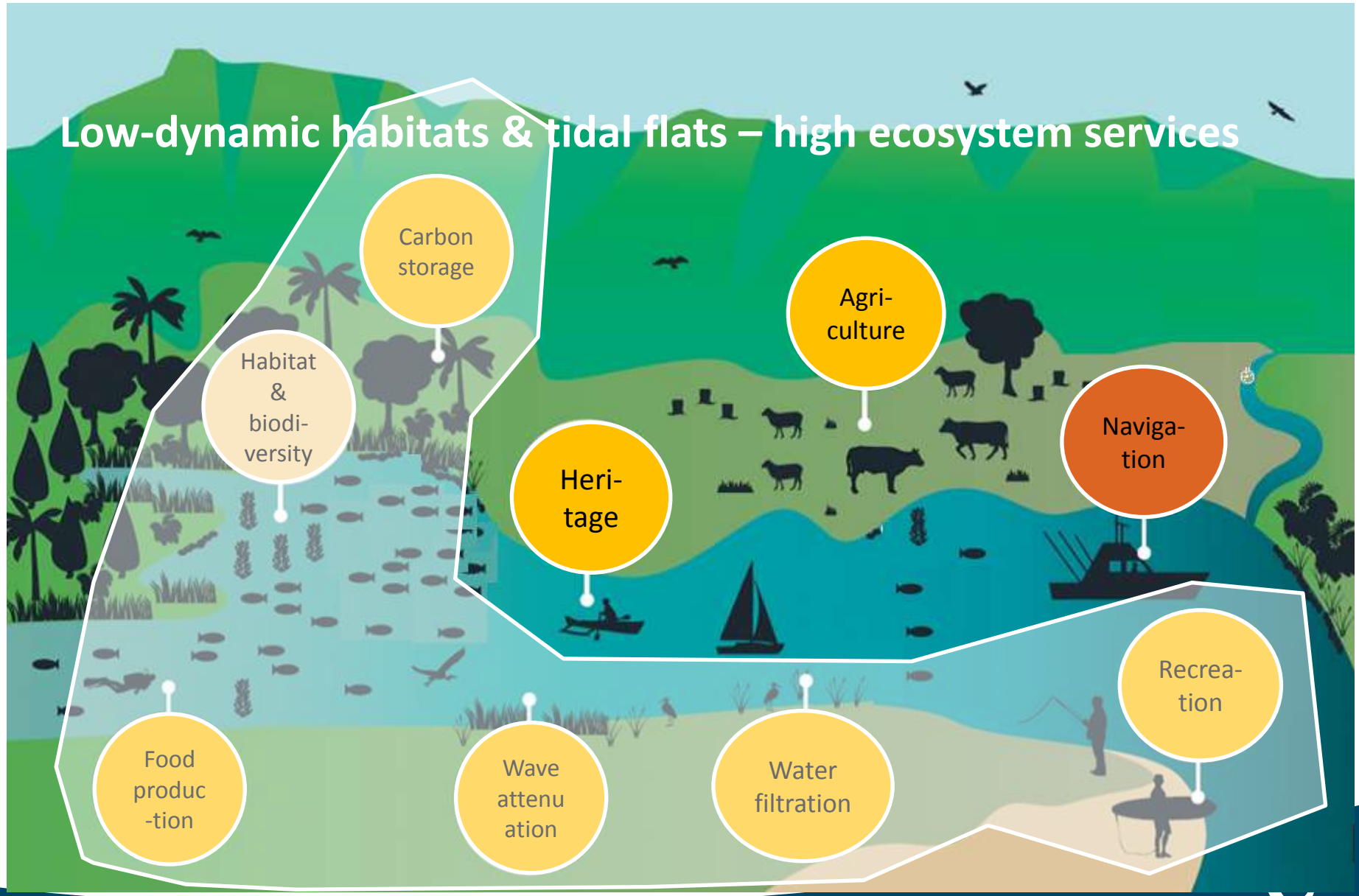

van der Wal et al. 2006


Ludo Goossens



Yves Plancke, 2017

Smart sediment management



Adapted from F.L.O.W. Collaborative

Smart sediment management

Home › About Deakin › Media releases

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

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

Media release

11 March 2017

ats – high ecosystem services

Agri-culture

Naviga-tion

ELSEVIER

In Collaboration with the Netherlands Institute for Sea Research

Journal of Sea Research 38 (1997) 109–121

JOURNAL OF SEA RESEARCH

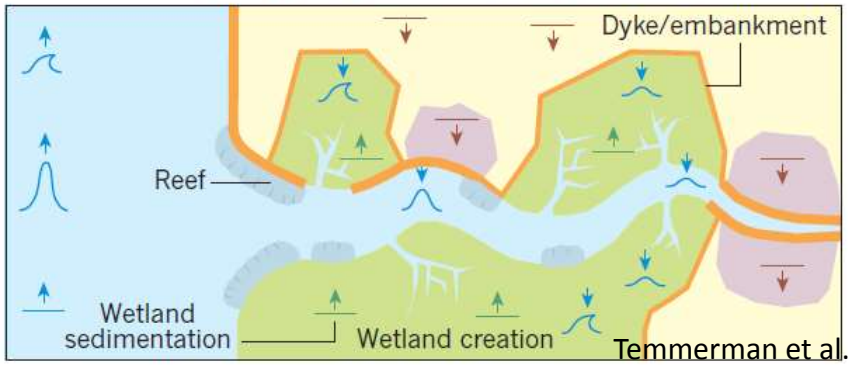
Nursery function of an estuarine tidal marsh for the brown shrimp *Crangon crangon*

André Cattrijsse *, Hederick R. Dankwa, Jan

Food produc-tion

Wave attenu-ation

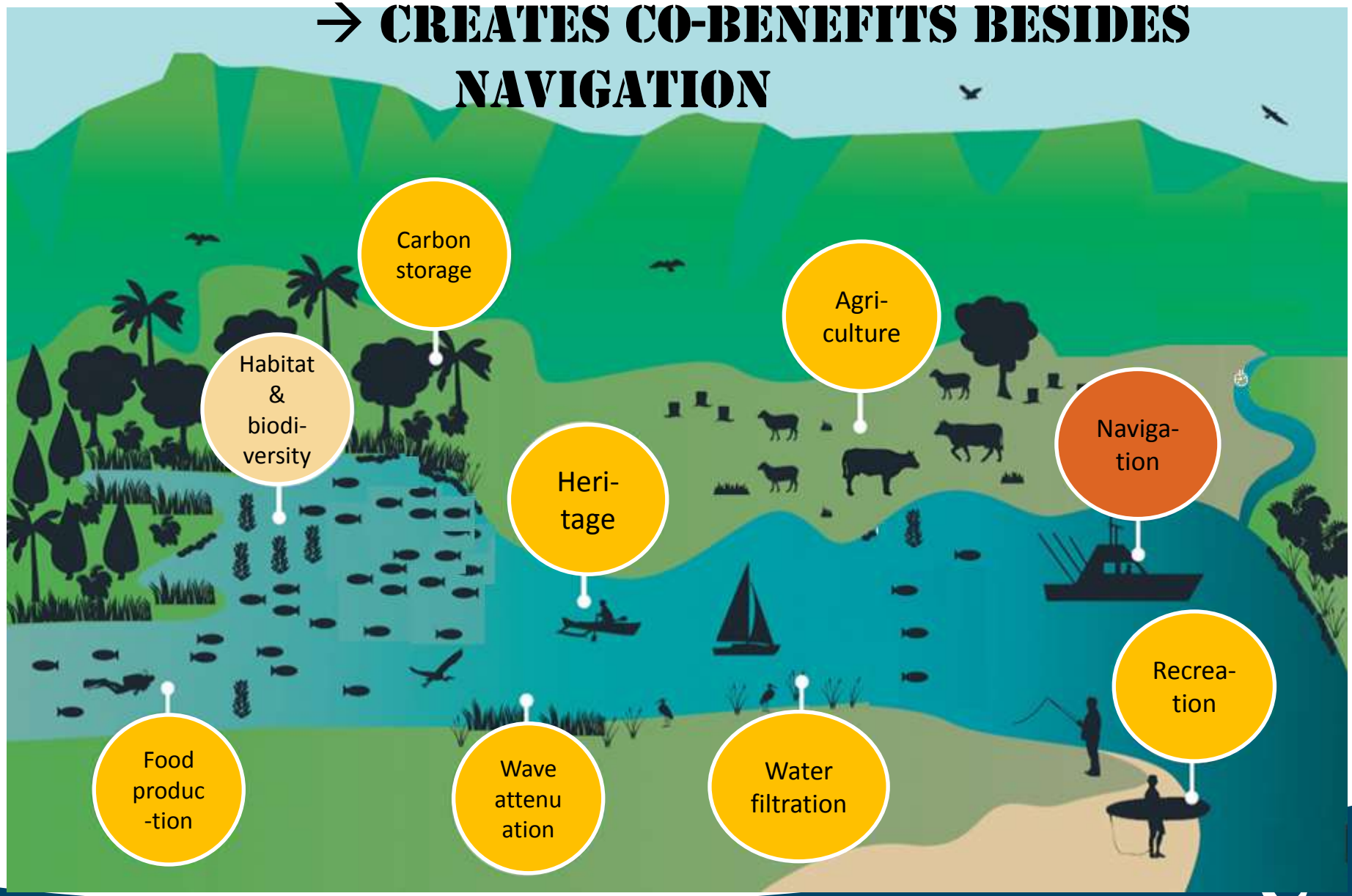
Ecosystem-based coastal defence



Temmerman et al. 2013

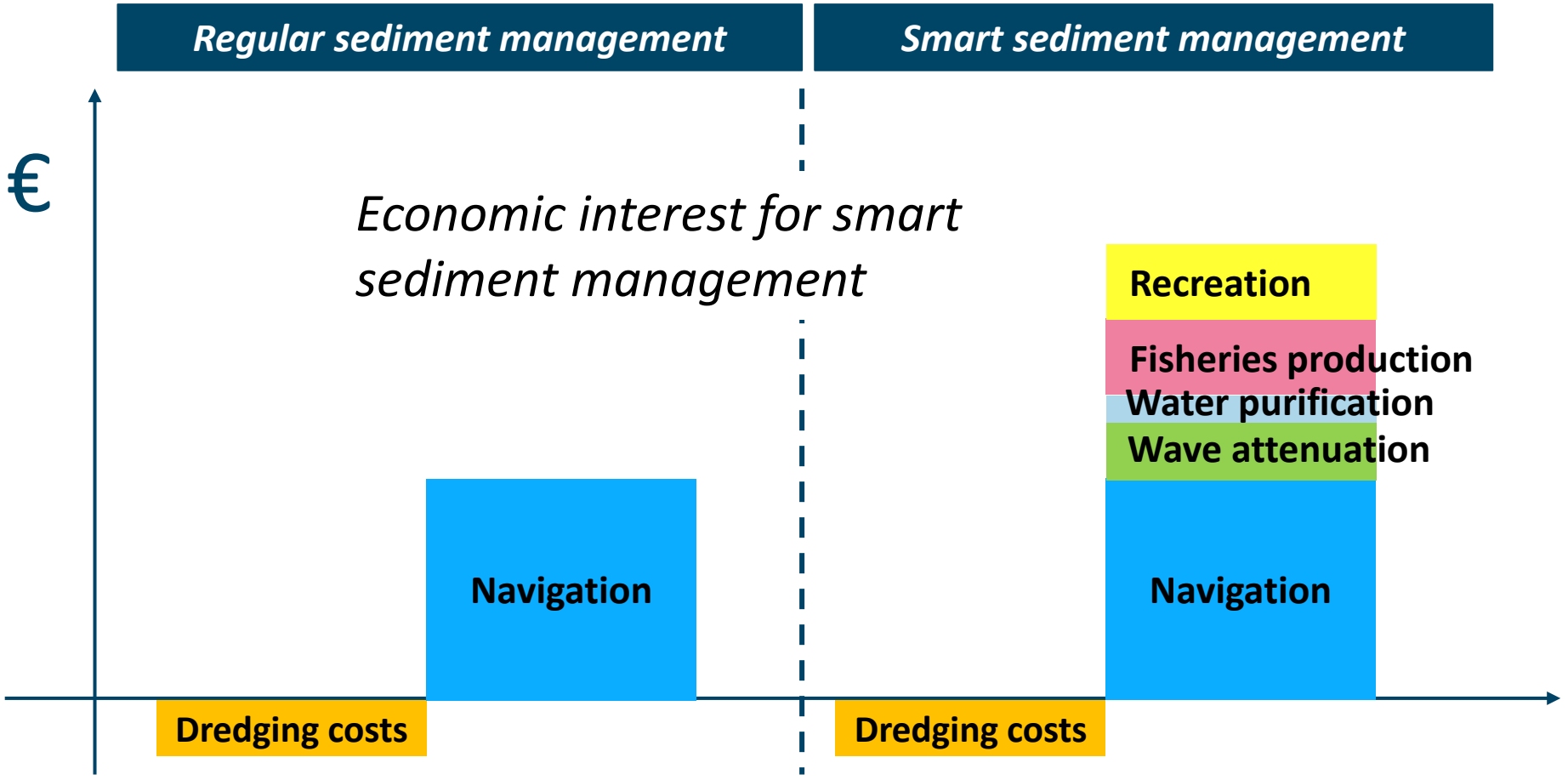
SMART SEDIMENT MANAGEMENT

→ CREATES CO-BENEFITS BESIDES NAVIGATION



Adapted from F.L.O.W. Collaborative

Co-benefits from smart sediment management



→ Reduction of dredging costs by generating new benefits
→ Leverage alternative financing (through interested parties)
→ …

SMARTSEDIMENT project

WP4: Consequences of **sediment management** for **society**?

Project
(dredging, disposal)

Ecosystem services? & nature?

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

Selection of ecosystem services

Different classification systems

Selection criteria:

1. Estuarine environment
2. Affected by sediment management
3. Stakeholders

Common International Classification of Ecosystem Services (draft)

Theme	Class	Group
Provisioning	Nutrition	Terrestrial plant and animal foodstuffs
		Freshwater plant and animal foodstuffs
		Marine plant and animal foodstuffs
		Potable water
	Materials	Biotic materials
		Abiotic materials
	Energy	Renewable biofuels
		Renewable abiotic energy sources
Regulation and Maintenance	Regulation of wastes	Bioremediation
		Dilution and sequestration
	Flow regulation	Air flow regulation
		Water flow regulation
		Mass flow regulation
	Regulation of physical environment	Atmospheric regulation
		Water quality regulation
		Pedogenesis and soil quality regulation
	Regulation of biotic environment	Lifecycle maintenance & habitat protection
		Pest and disease control
		Gene pool protection
Cultural	Symbolic	Aesthetic, Heritage
		Religious and spiritual
	Intellectual and Experiential	Recreation and community activities
		Information & knowledge

CICES: Table E.2: Proposed Thematic, Class and Group Structure – source: EEA & Roy Haines-Young

European Environment Agency

A. Böhnke-Henrichs e

Table 1
Typology of marine ecosystem services.

	Ecosystem service	Desc. ..ption...
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)[a]
	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 for navigation

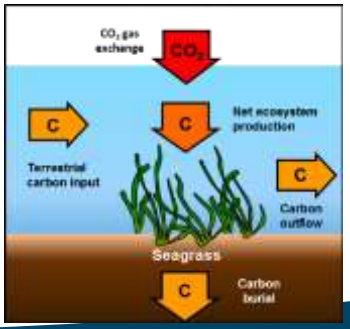
Recreation & tourism

Water & soil quality regulation

Regulation flood risk

Habitat and species diversity

Climate regulation



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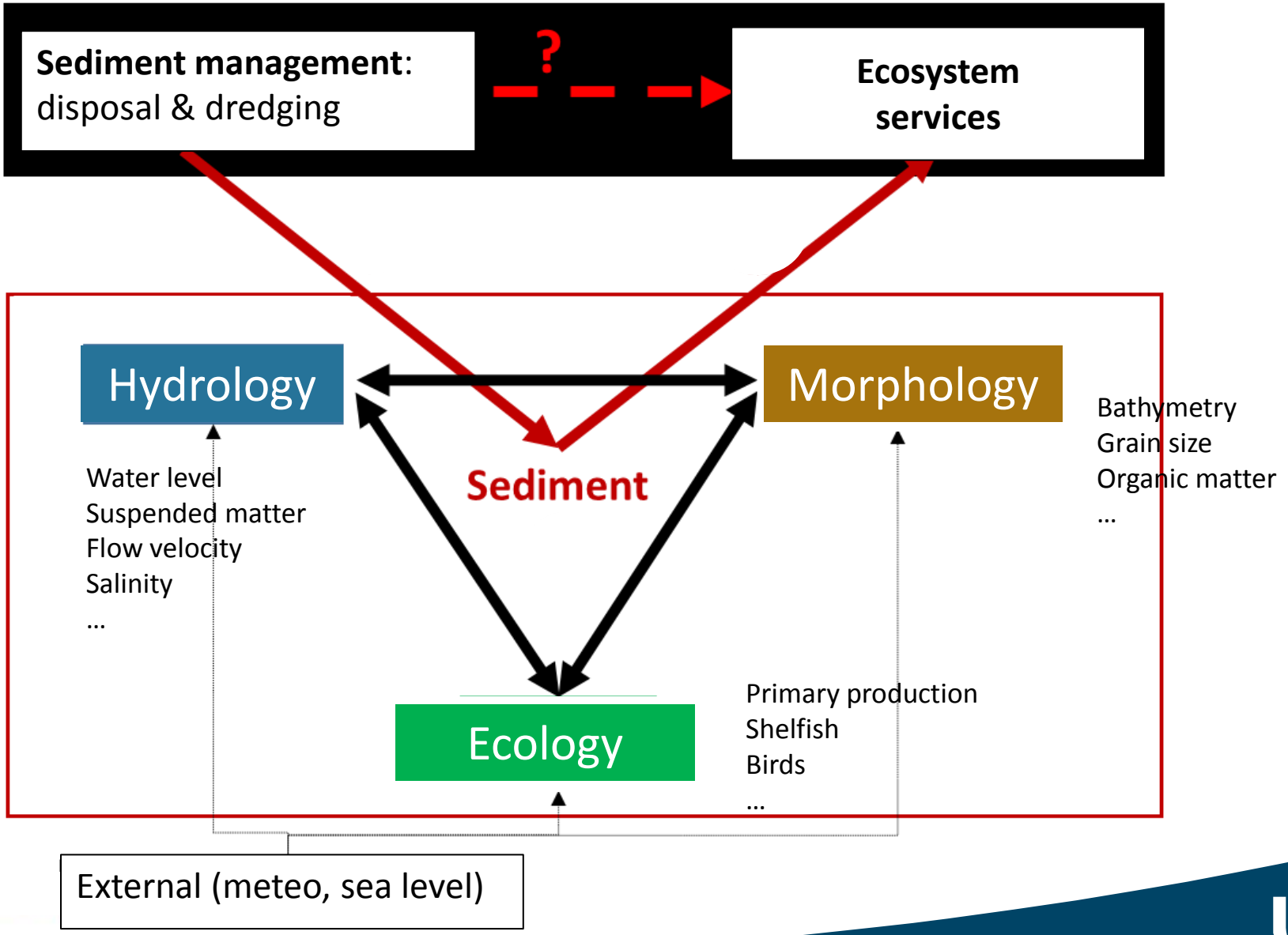
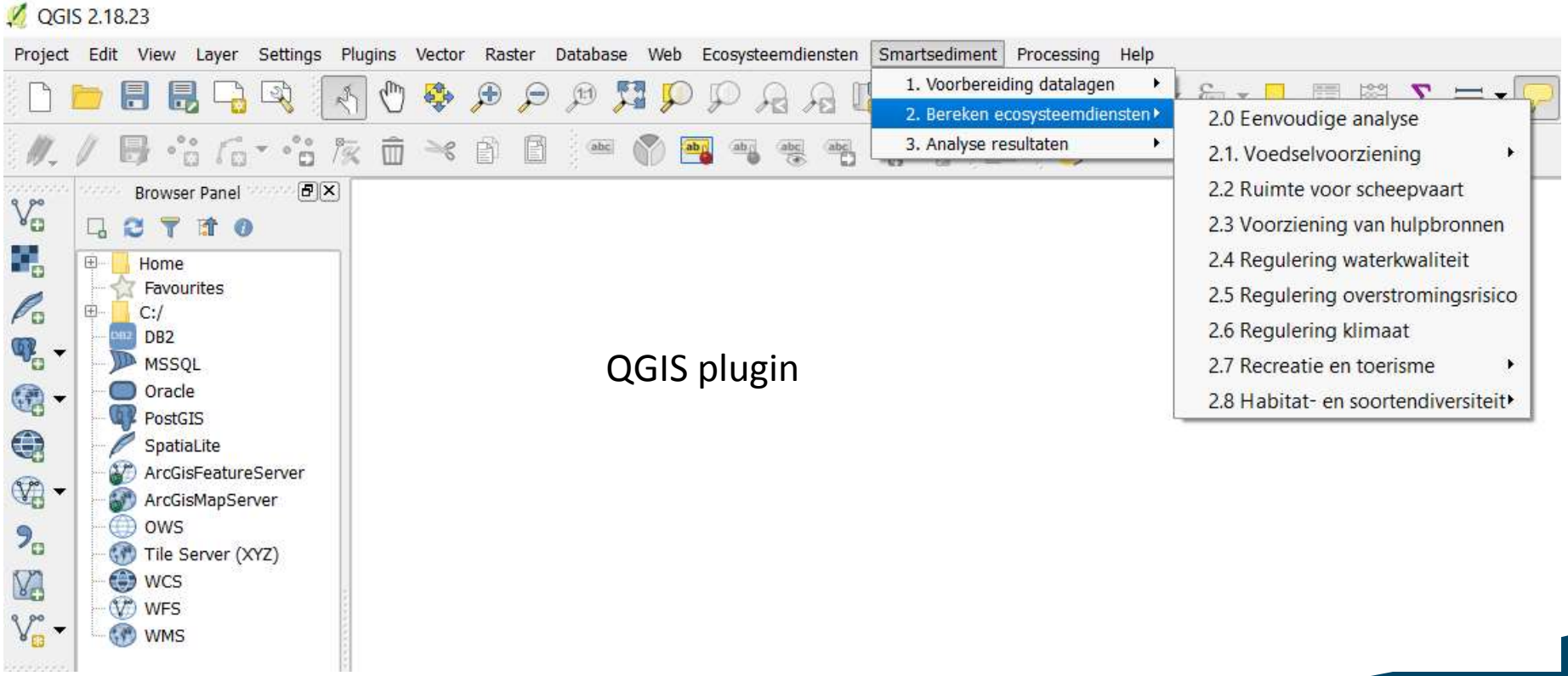
Ecosystem functioning – systematic approach



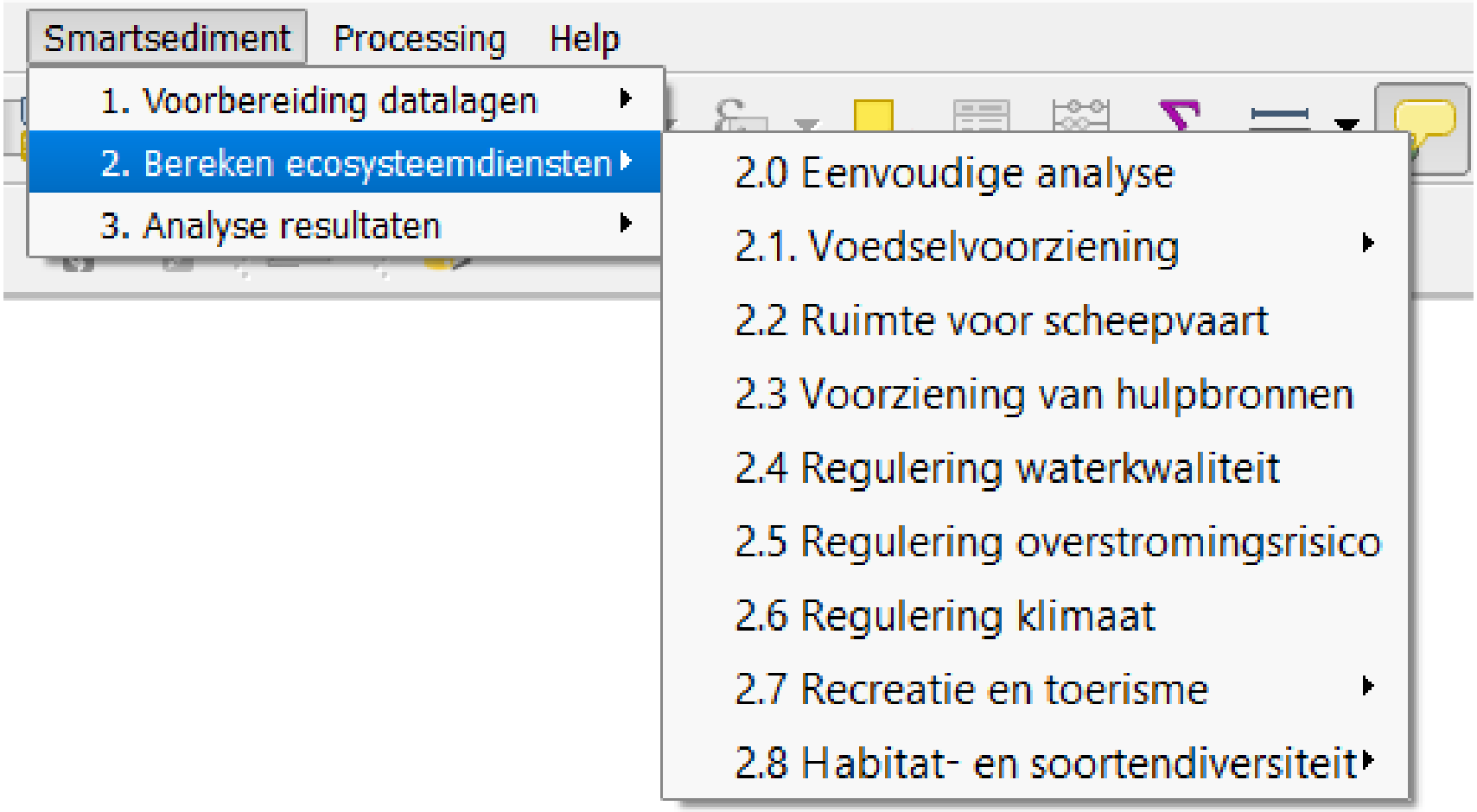
GIS-tool

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

→ Based on the knowledge of ecosystem functioning

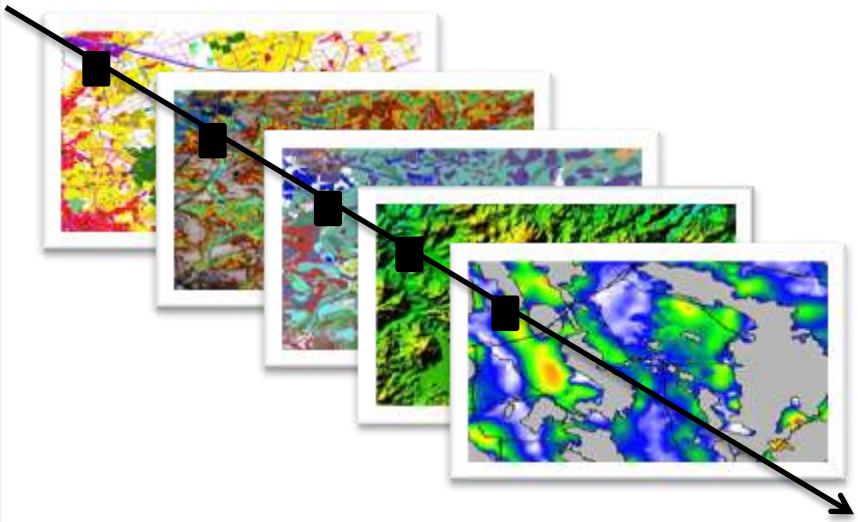


GIS-tool


Smartsediment
Processing
Help
1. Voorbereiding datalagen
2. Bereken ecosysteemdiensten
3. Analyse resultaten
2.0 Eenvoudige analyse
2.1. Voedselvoorziening
2.2 Ruimte voor scheepvaart
2.3 Voorziening van hulpbronnen
2.4 Regulering waterkwaliteit
2.5 Regulering overstromingsrisico
2.6 Regulering klimaat
2.7 Recreatie en toerisme
2.8 Habitat- en soortendiversiteit

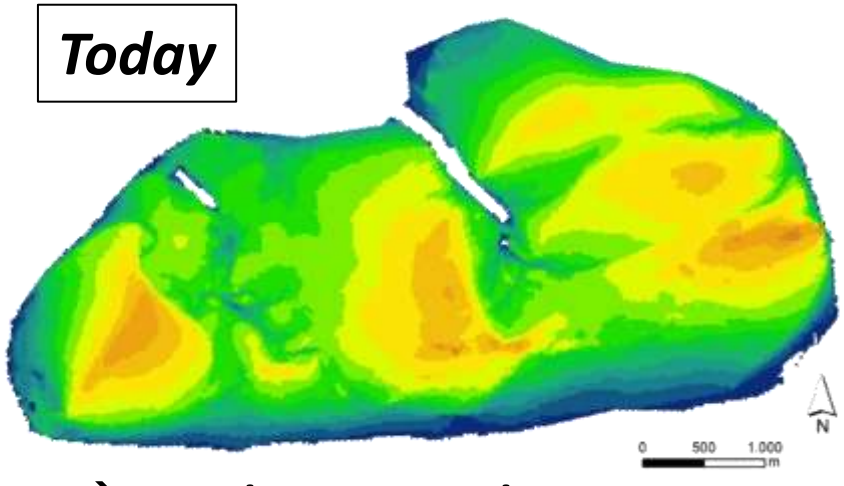
Tool interface (QGIS)

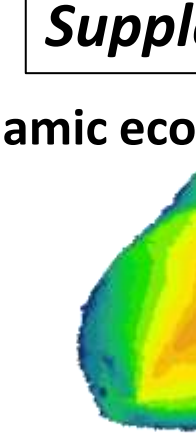
Input:
Maps/values of ecosystem properties



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

Suppletions tidal flat Oosterschelde





Deltares 2016

→ **continuous erosion**

→ **Disappearance of low-dynamic ecotopes**

Suppletions

→ **1,3 million m³**

→ **Safeguard low-dynamic ecotopes**

Results – after 1 year

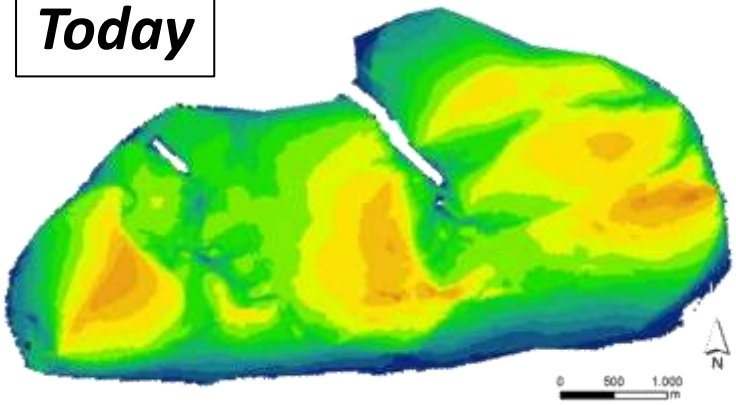
	Ecosystem service	Today	Suppletions	Unit
Provisioning	Food - mussels	-	-	kg/year
	Food - sole	-	-	km² nursery area
	Food - shrimp	0,01	0,04	km² nursery area
	Raw materials	-	-	m³ sand availability/year
	Navigation	-	-	score
Regulating	Flood risk	-	-	trend
	Water quality	-	-	score
	Climate	312,9	312,6	k€/year
Cultural	Recreation - swimming	-	-	# swim recreationists
	Recreation - onshore	-	-	km² qualitative habitat
	Recreation - boating	-	-	# boat passages
Biodiversity	Habitat - seals	-	-	km² qualitative habitat
	Habitat - birds	6,80	6,84	km² qualitative habitat

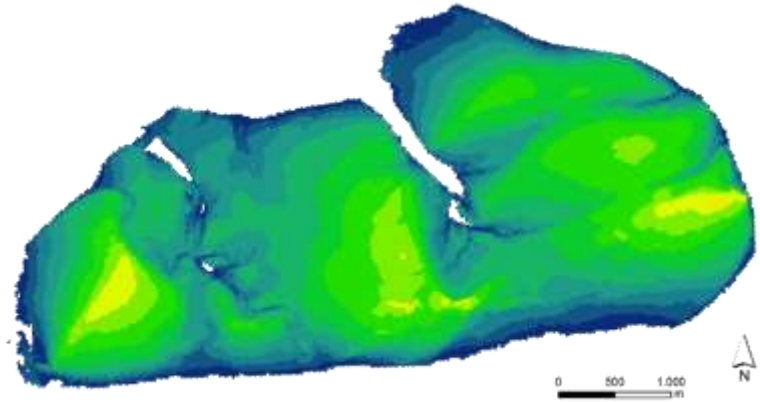
- Maintenance of existing ecotopes: small effects (←→ creation new habitat)

No suppletions (erosion scenario)

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

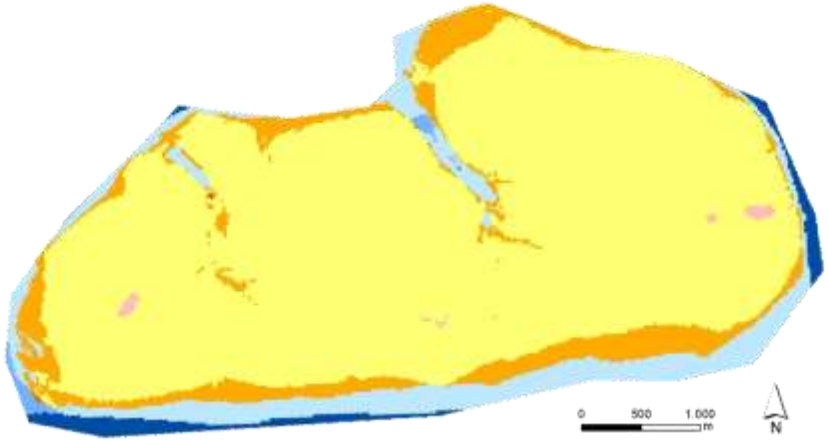
Today

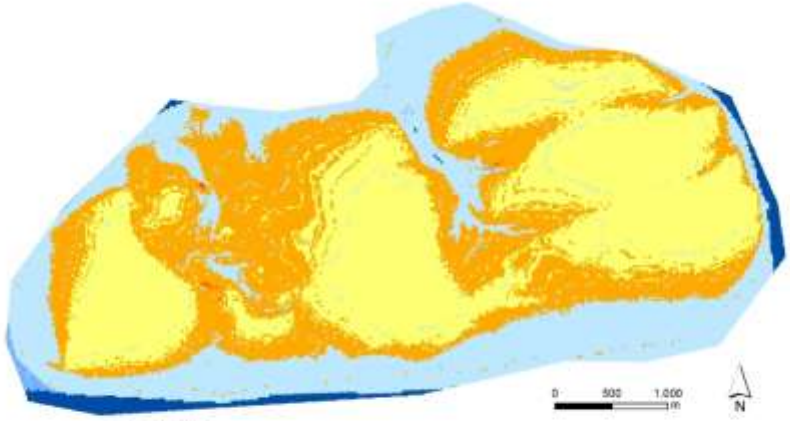




Erosion scenario

Height
m
-2 - -1,75
-1,75 - -1,5
-1,5 - -1,25
-1,25 - -1
-1 - -0,75
-0,75 - -0,5
-0,5 - -0,25
-0,25 - 0
0 - 0,25
0,25 - 0,5
0,5 - 0,75
0,75 - 1
1 - 1,25
1,25 - 1,5
1,5 - 1,75





Ecotope
Deep subtidal
Low dynamic sublittoral
Low dynamic, low tidal flat
Low dynamic, mid tidal flat
Low dynamic, high tidal flat
Low dynamic, supralitoral
High dynamic sublitoral
High dynamic tidal flat

Results – erosion scenario

	Ecosystem service	Today	Suppletions	Erosion	Unit
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	Food - sole	-	-	-	km² nursery area
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	Recreation - boating	-	-	-	# boat passages
Biodiversity	Habitat - seals	-	-	-	km² qualitative habitat
	Habitat - birds	6,80	6,84	3,61	km² qualitative habitat

- 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

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