Coastbusters

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MARINEFF conference – May 2022

Coastbusters

Applying ecosystem engineers for coastal management

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MARINEFF conference – May 2022

AGENTSCHAP INNOVEREN & ONDERNEMEN

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Flanders Research Institute for Agriculture, Fisheries and Food

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DJN Jan De Nul GROUP

DEME

Outline presentation

1. *Why Coastbusters?*
2. *What is Coastbusters?*
3. *Flora reef*
4. *Bivalve reef*
    - *4.1 Installation*
    - *4.2 Monitoring*
    - *4.3 Results*
5. *Coastbusters 2.0*
    - *5.1 Installation*
    - *5.2 Monitoring*
    - *5.3 First results*
6. *Conclusion*

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1. Why?

Innovative Solutions – Future Business

Surpassing traditional
dredging and marine (infrastructure) works

Management

Coastal ~~Protection~~

Nature Inspired Solutions

More resilient
More sustainable

- Applying ecosystem engineering species for coastal management
- Reef facilitating development structures

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2. What?

<u>3 ecosystem engineering species targeted:</u>

1. Flora Reef: **Sugar kelp** (*Saccharina latissima*)
2. Lanice Reef: tube building **sand mason worm** (*Lanice conchilega*)
3. Bivalve reef: **Blue mussel** (*Mytilus edulis*)

Belgian North Sea, close to the city 'De Panne'

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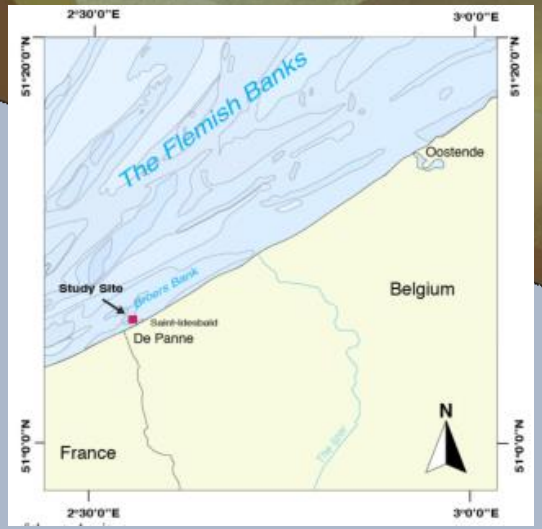
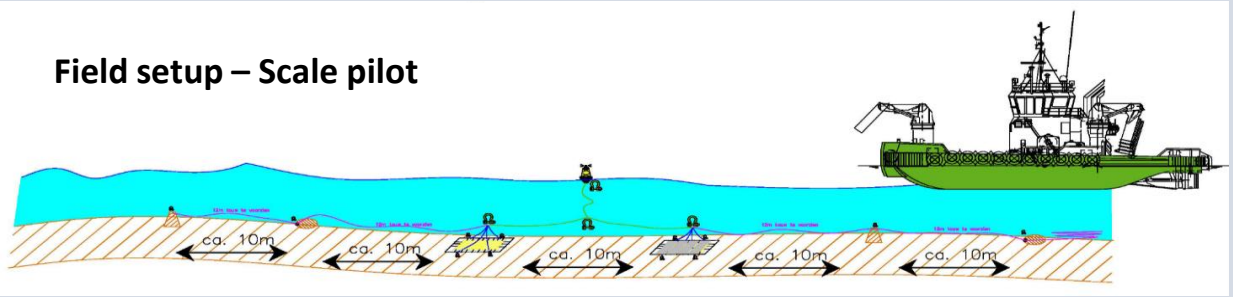
2. What?



Kickstart the development

Belgian North Sea, close to the city ‘De Panne’

1. **Seaweeds**: Installation of innovative spore impregnated (geo)textiles



Result:

- No resistant to the harsh hydro- and morphodynamic circumstances in the nearshore Belgian North Sea -> Spores did not have time to germinate (sanded from substratum)

2. **Seagrasses**: Kickstarting seagrass meadows using prefabricated biodegradable seeded textiles
   - Plant a million seagrasses project -

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Samen sterk voor groei

Plant A Million Seagrasses

FLORA REEF
seagrass and seaweeds (algae)

GHENT UNIVERSITY

CCMAR

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LANICE REEF
sand mason worms
or tube building worms

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Lanice

Using biodegradable/biobased materials to kickstart intertidal sand mason worm reefs for coastal stabilization purposes

For more results see next presentation (G. Van Hoey)

Main goal bivalve reef: stabilizing sediment
Unique set of challenges due to
- the high energy, dynamic environment along Belgian coast
- sandy sediment environment → lack of suitable substrate

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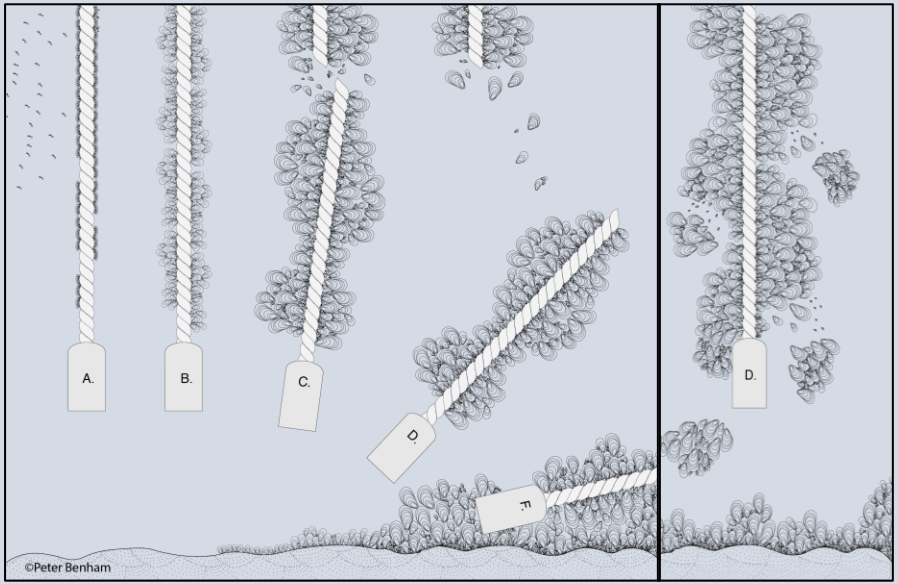
4. Bivalve

General
- Inspiration: conventional aquaculture techniques
- Longline system with vertical dropper lines
- Capture mussel spat on the dropper lines
- When mussels are big and dense enough
  → detach in clumps and fall to bottom
  → or lines break
  → mussel bed creation



BIVALVE REEF
shellfish type mussels and oysters

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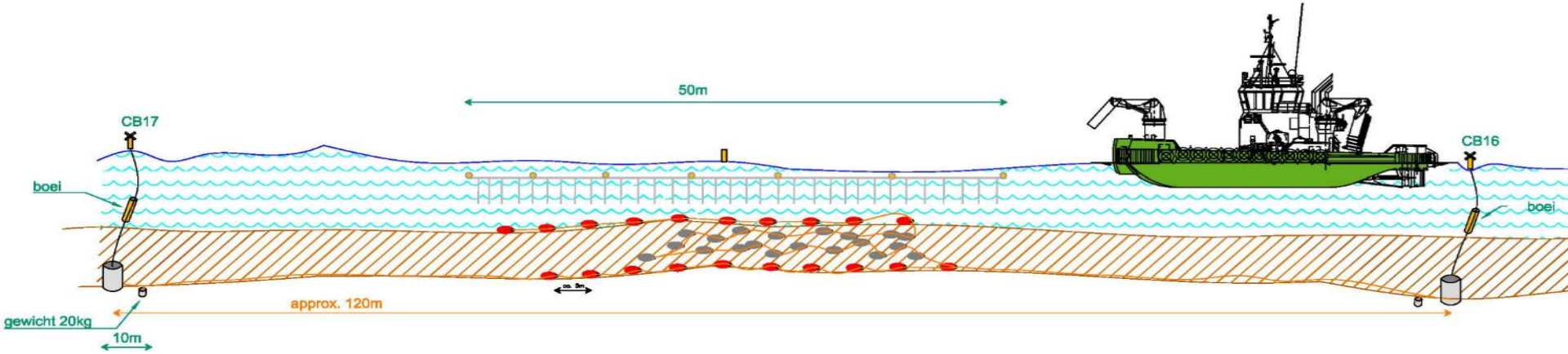
4. Bivalve installation

Coastbusters 1 (2017-2020)

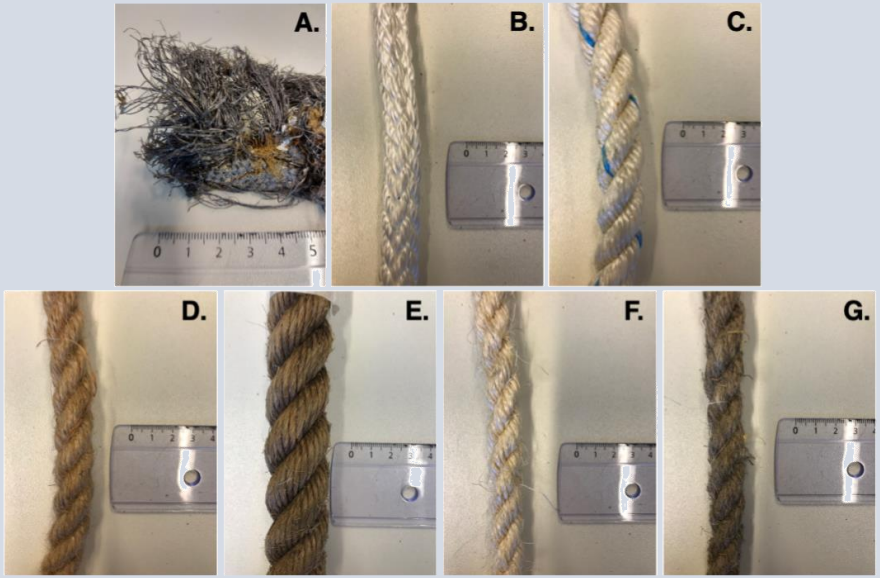
- 50 m Horizontal “backbone” suspended by series of buoys
- 30 x 3.5 m vertical dropper lines existing of several material types
- Mesh bags filled with stones or empty mussels dropped as hard substratum



Material choice: 7 # types tested

Which dropperline is best in terms of:
- Mussel recruitment?
- Highest survival potential?

Vertical dropper lines existing of several material types
A. Polypropylene (PP) – Filamentous (14 mm)
B. Biobased (BB) – Smooth/biodegradable (12 mm)
C. DeltaFlex (DF) – Smooth (20 mm)
D. Hemp – Smooth/biodegradable (16 mm)
E. Coconut – Smooth/biodegradable (30 mm)
F. Sisal – Smooth/biodegradable (16 mm)
G. Jute – Smooth/biodegradable (16 mm)



Monitoring

- Dive expeditions → video surveys along transects
- Measuring samples taken from the dropper lines
- Van Veen grab samples
- BACI (Before/After Control/Impact) approach

Smooth vs. filamentous dropper lines

Filamentous

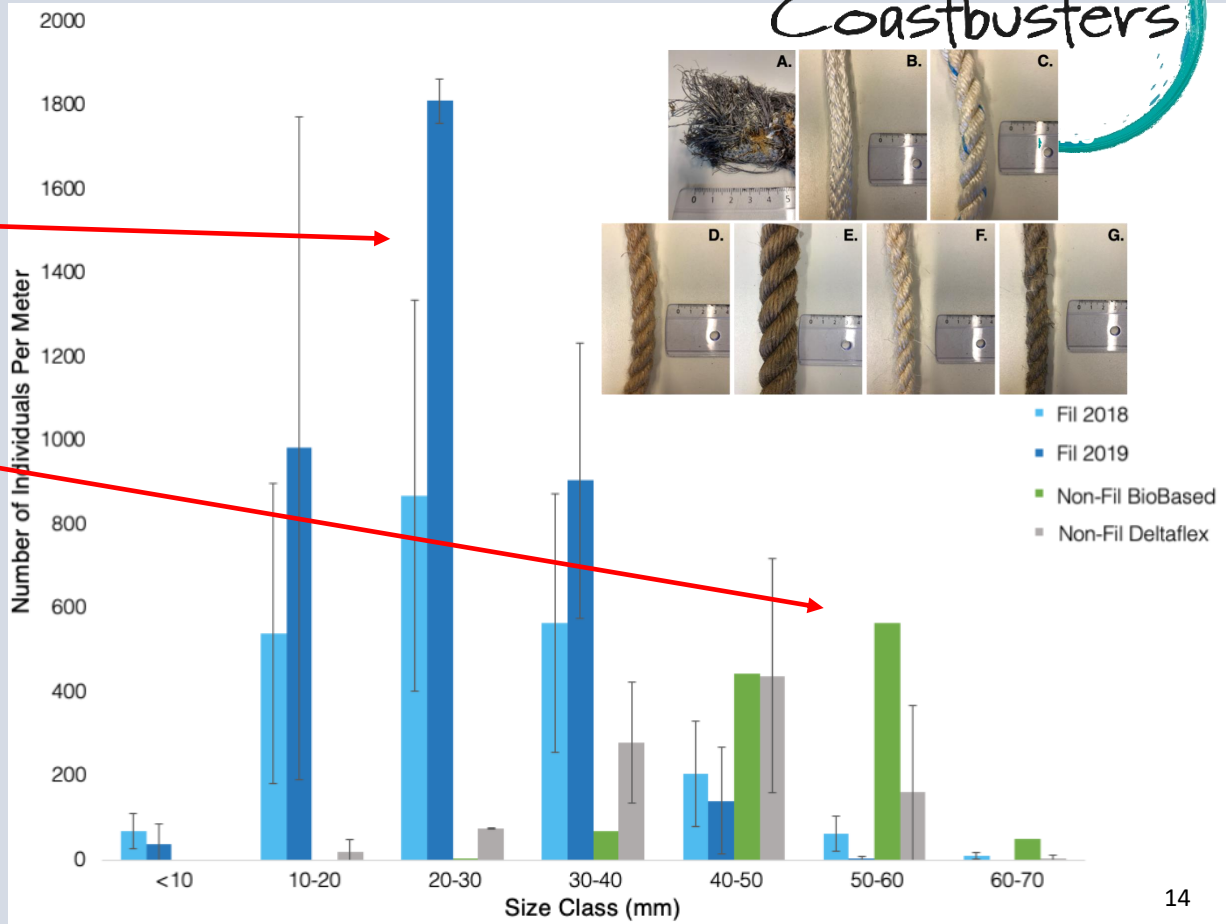
- **highest number** of mussels but **smaller sizes**
- Higher degradation of the ropes

Smooth

- **lower numbers** of mussels but **larger sizes**
- Smooth ropes are more resistant

Prelim conclusion

- Filaments seem key for high larvae catchment, but more fragile
- Catchment efficiency decrease over time



BIVALVE REEF
shellfish type mussels and oysters

High Seasonal variability in mussel population

- winter storms
- predation (shore crab, common starfish & sea urchin)
- No effect of stone bags substrates

Colonizing (microbenthic) community

- Limited effect on species distribution
- Biomass increase on mussel patches

Dive expedition	Mussels present	Substrate
July 2018	No	
September 2018	Extensive beds	Sediment
October 2018	Extensive beds	Stone bags
April 2019	Very few mussel clumps	Sediment + Bags
June 2019	No	
August 2019	Extensive beds	Sediment
December 2019	No	

Conclusion

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A succes story!

Subsequent research questions popping up

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5. CB 2.0

1. ***Can tunable (controlled over time) biobased/biodegradable materials be used***

   → towards self-sustaining, eco-friendly reef

2. ***Can the facilitating setup survive harsher hydrodynamic conditions?***

   → sheltered (non-erosive foreshore) vs. exposed (erosive foreshore)

3. ***How to best underpin/monitor the development of the newly formed reef?***

   → innovative advanced and dedicated monitoring techniques

4. ***What are the boundary conditions (e.g. (bio)safety) and added ecosystem services?***

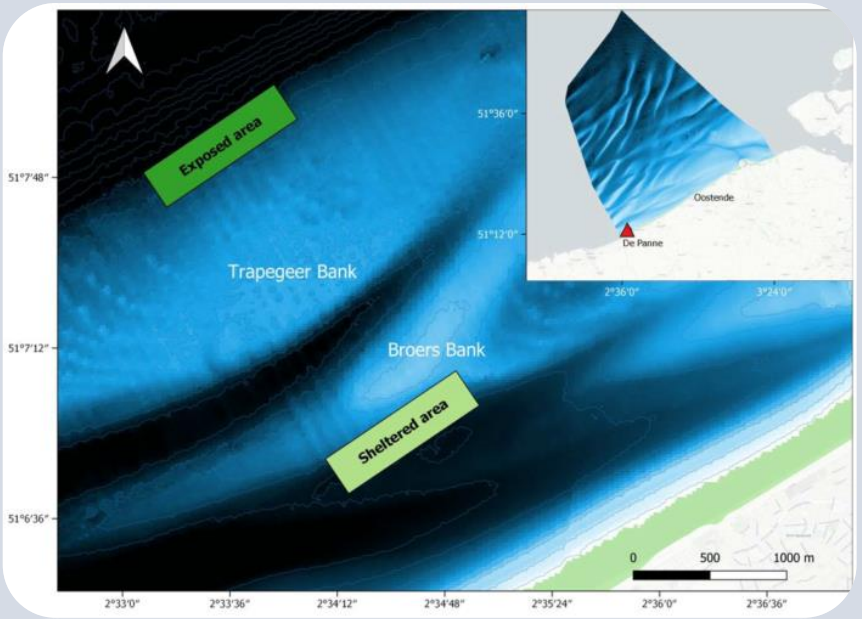
   → biological value of the reefs, framed within the international environmental legislation

=> New project (Coastbusters 2.0 *[2020-2023])* to further develop the bivalve reef

Two experimental areas near 2 sand banks:

- nearshore-sheltered (non-erosive foreshore)
- offshore-exposed (erosive foreshore)

- Backbone configuration as in Coastbusters 1.0
- Innovative modular & scalable installations:
  - tuneable bio-materials (backbone & droppers)
  - monodropper “mussel shaker”
  - bio-facilitating anchor



BIVALVE REEF
shellfish type mussels and oysters

Standard monitoring plan:

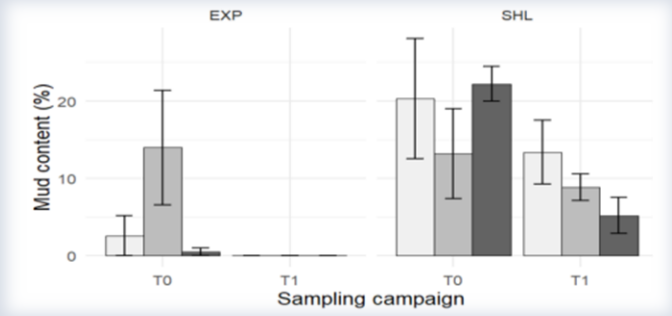
- Multibeam
- Van Veen
- Divers transect
- Weighing droppers

Innovative techniques:

- SPI (Sediment Profile Imaging)
- AUV (Autonomous Underwater Vehicles)
- USV (Unmanned Surface Vehicle)
- Multifunctional mooring frame
    - ADCP
    - scanning sonar
    - fish tracker
    - acoustic release
- Multibeam water column

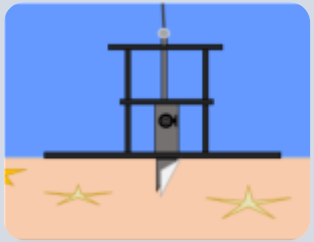
Hydrodynamic conditions → dissimilarity between the 2 areas

- Exposed area:
  - lower mud content
  - higher median grain size
  - lower density, species richness & biomass
- Sheltered area:
  - better resource-use efficiency
  - dominance of Oligochaeta & Lanice
  - more structurally and functionally diverse communities

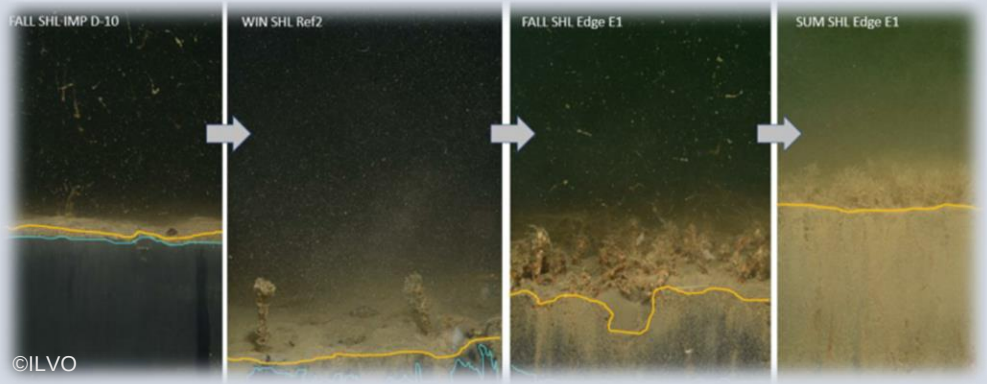


	Top 5 contributing taxa	Av. abundances		Contribution (%)
		EXP	SHL	
EXP vs SHL	Oligochaeta	2.5000	4557.0370	38.28
	Lanice	16.0714	2362.5926	9.33

Sediment Profile Imaging (SPI)



- Detect biogeochemical differences between reef and control localities
- Biogeochemistry of benthos affected by hydrodynamics
  - highly dynamic → poor biological evidence + diffusion fine sediments
  - low dynamic → more macro/epifauna + sediment richer
- Sedimentology & biology affected by seasonality
  - summer and fall → calmer, higher biological activity
  - winter and spring → rougher, lower biological activity



Innovative monitoring

AUV Barabas → side scan sonar

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shellfish type mussels and oysters

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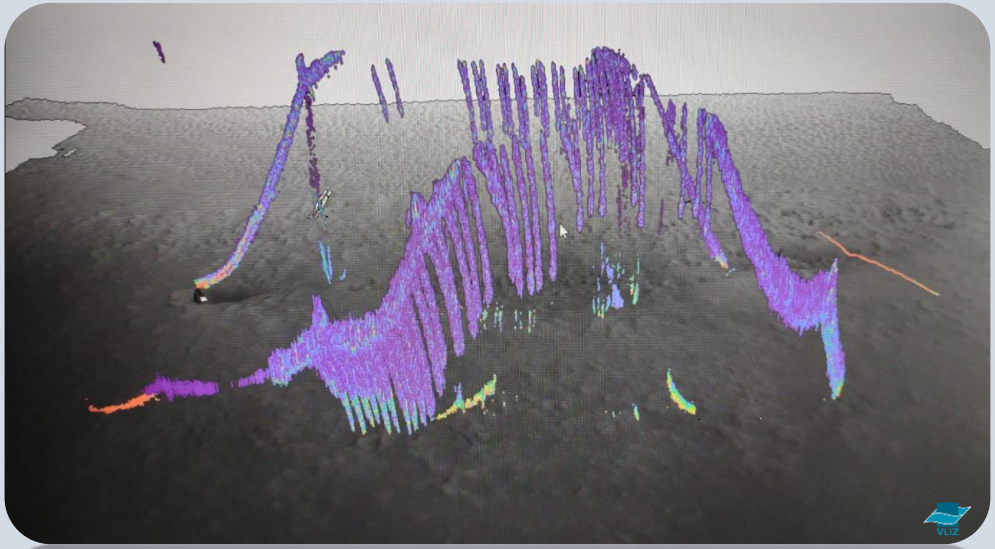
5. CB 2.0
First results

Innovative monitoring

→ Biomass measuring via
- 3D multibeam
- accelerometer



Conclusions

- Shift to coastal management and nature inspired solutions is necessary
- 3 ecosystem engineering species tested

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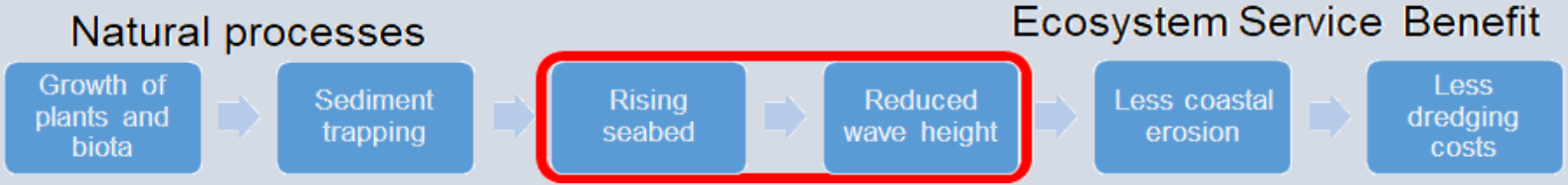
6. Conclusion

flora reef – sugar kelp & seagrasses **in other EU coastsal zones**

lanice reef – sand mason worm has high potential. **Needs first large-scale test**

bivalve reef – blue mussel, a success story. **Ready for upscaling (km's of coastline)**



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Thank you for your attention!

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Join Coastbusters!

We are looking for partners for subsequent topics:

1. Ecofriendly concrete solutions
2. Tunable biodegradable biomaterials
3. European pilot site for Sandmason reef deployment
4. European pilot site for Seagrass meadow hatchery & deployment
5. Large scale European pilot site for Bivalve reef deployment

In addition to Coastbusters, we are also innovating in the fields of beneficial reuse of dredged materials

Contact: Coastbusters@deme-group.com