Workshop **Sediment Management in Ports** (29 October 2019, Eemshaven, NL)

Plastic Flux to the Sea
&
Innovation Trajectories

Erik A. Toorman

Sediment Mechanics Research Unit

KU LEUVEN

Lisa Devriese & Gert Everaert

VLIZ

Vlaams Instituut voor de Zee vzw

Flanders Marine Institute

In collaboration with

vito

Universiteit Antwerpen

UNIVERSITEIT GENT

to be funded by

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Sediment Research @ KU LEUVEN

Fundamental Research:

- **Physics-based process model development**
  - Settling & consolidation
  - Flocculation
  - Mud rheology
  - Erosion & Deposition
  - Particle-turbulence interaction
  - Drag modulation by suspended sediments
  - Wave damping by fluid mud

Sediment Research @ KU LEUVEN

Applied Research:

- CFD for sailing though mud (nautical bottom)
- Coastal morphodynamics:
  - Mixed sand-mud coasts (Belgium, Pacific Colombia)
  - Mangrove-mud coasts (Suriname & Guyanas, Colombia)
- Estuarine morphodynamics
  - Scheldt River
- Plastic dispersion

JPI OCEANS

Open-source software development:

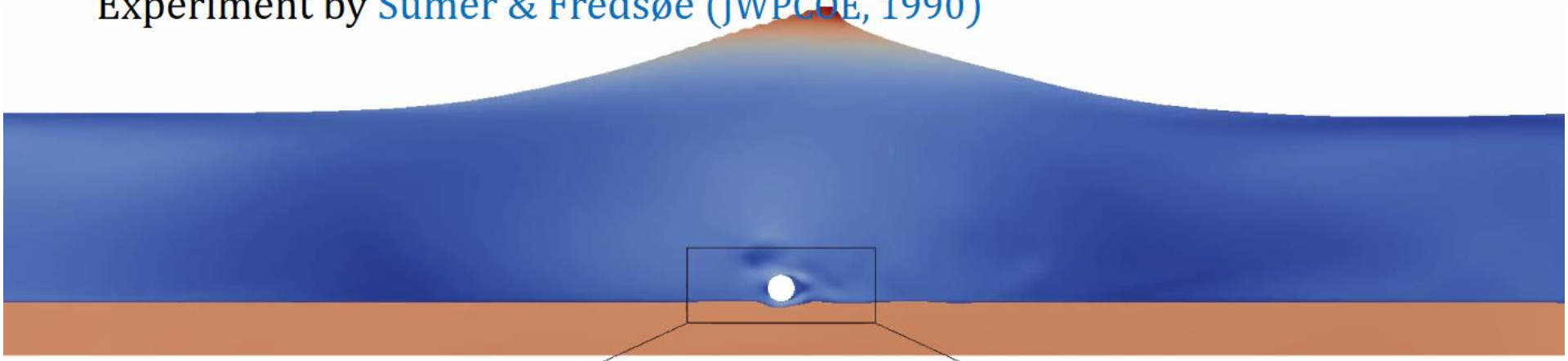
- MixtSedFOAM (OpenFOAM sediment transport)
  as ***numerical laboratory***
- TELEMAC-TOMAWAC-GAIA/SISYPHE
  for large scale studies

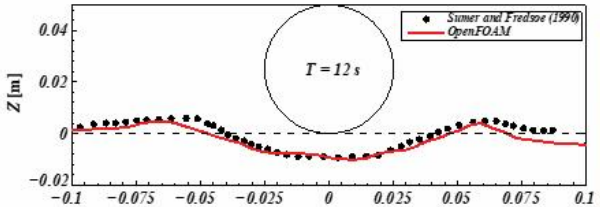
telemac

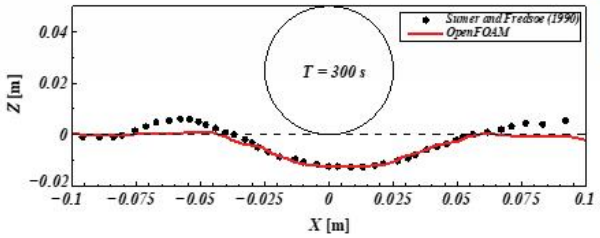
MixtSedFOAM validation case

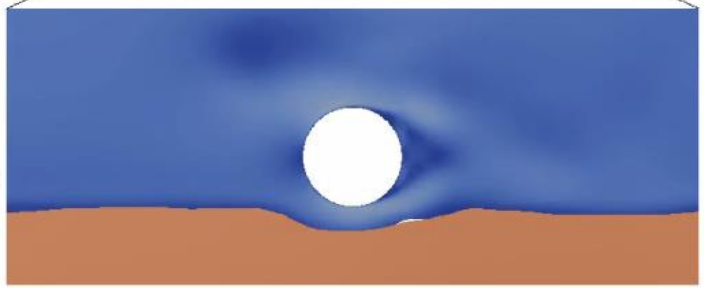
Wave-induced scour under a submarine pipeline

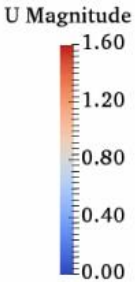
Experiment by Sumer & Fredsøe (JWPCOE, 1990)











Ouda & Toorman (2019), *Int. J. Multiphase Flow* 117: 81-102

Plastic = Sediment

of anthropogenic origin

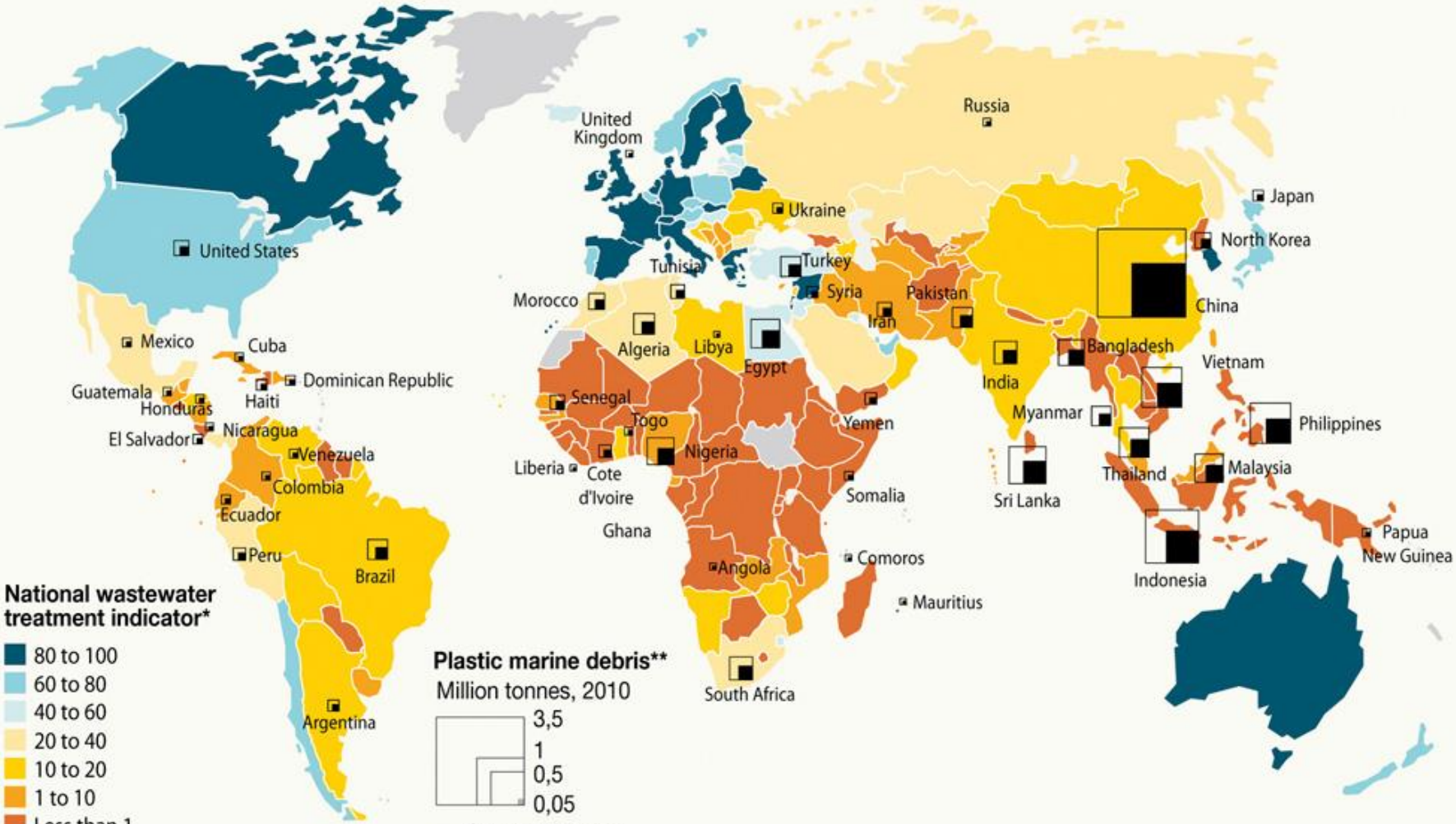
But …

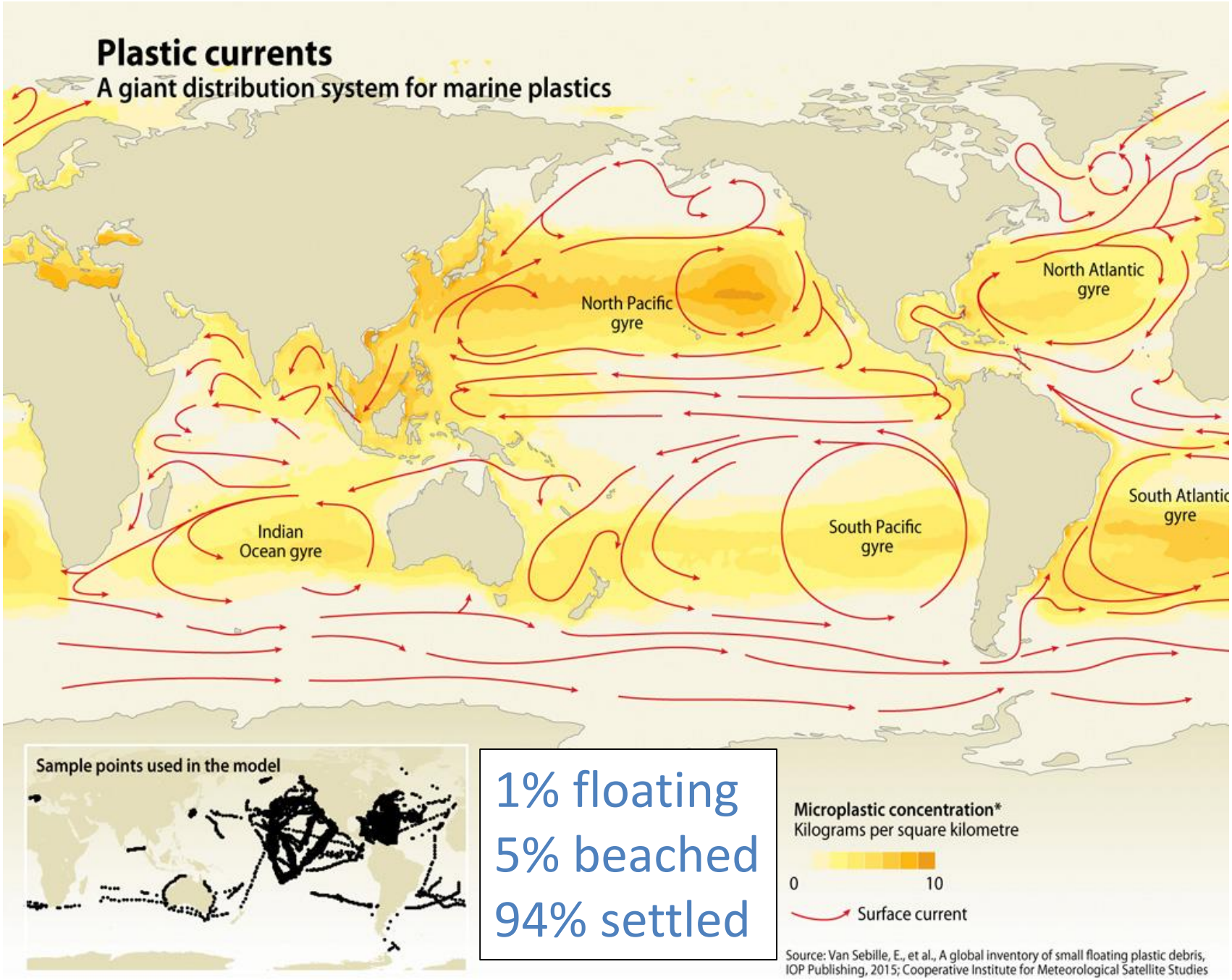
- Very large variety in shapes, sizes and density
- Density close to that of (sea) water

  ➔ Some float, some settle & very sensitive to turbulent drift and wave motion

- Despite the impressive numbers in the media, present in much smaller quantities than natural sediments

Plastic input from municipal solid waste and wastewater




Plastic currents
A giant distribution system for marine plastics
North Pacific gyre
North Atlantic gyre
Indian Ocean gyre
South Pacific gyre
South Atlantic gyre
Sample points used in the model
1% floating
5% beached
94% settled
Microplastic concentration*
Kilograms per square kilometre
0
10
Surface current
Source: Van Sebille, E., et al., A global inventory of small floating plastic debris, IOP Publishing, 2015; Cooperative Institute for Meteorological Satellite Studies

Plastic accumulation on shores

https://inhabitat.com/plastic-beach-audit-in-the-philippines-reveals-which-businesses-are-the-worst-polluters/

Plastic accumulation in ports

© FB/Keolin Moodley

https://www.sapeople.com/2019/04/25/photos-floods-reveal-south-africas-shocking-plastic-pollution-crisis-clean-up-this-weekend/

Strategic Basic Research project (2020-2022)

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***PL**astic Fl**UX** for **IN**novation and Business Opportunities in Flanders*

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Flemish Blue Cluster theme

Ocean pollution & waste solutions

KEY QUESTIONS

Where do we find plastics & How will we detect them?

➔ very little knowlegde available …

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Objectives

- 3-dimensioneel insight in the whereabouts of plastics in aquatic environments
- Automatic detection based on remote sensing

Budget

- 1800 k€ - 1900 k€ for 3 years

PLUXIN project structure

WP4: Field observation

VLIZ (micro) & UA (macro)

Input for model

Model validation

WP2: Movement exp.

UGent & KU Leuven

Model input

WP5: Remote sensing

VITO

Input for model

Model validation

WP3: 2DH model

KU Leuven

WP6: New opportunities for business cases

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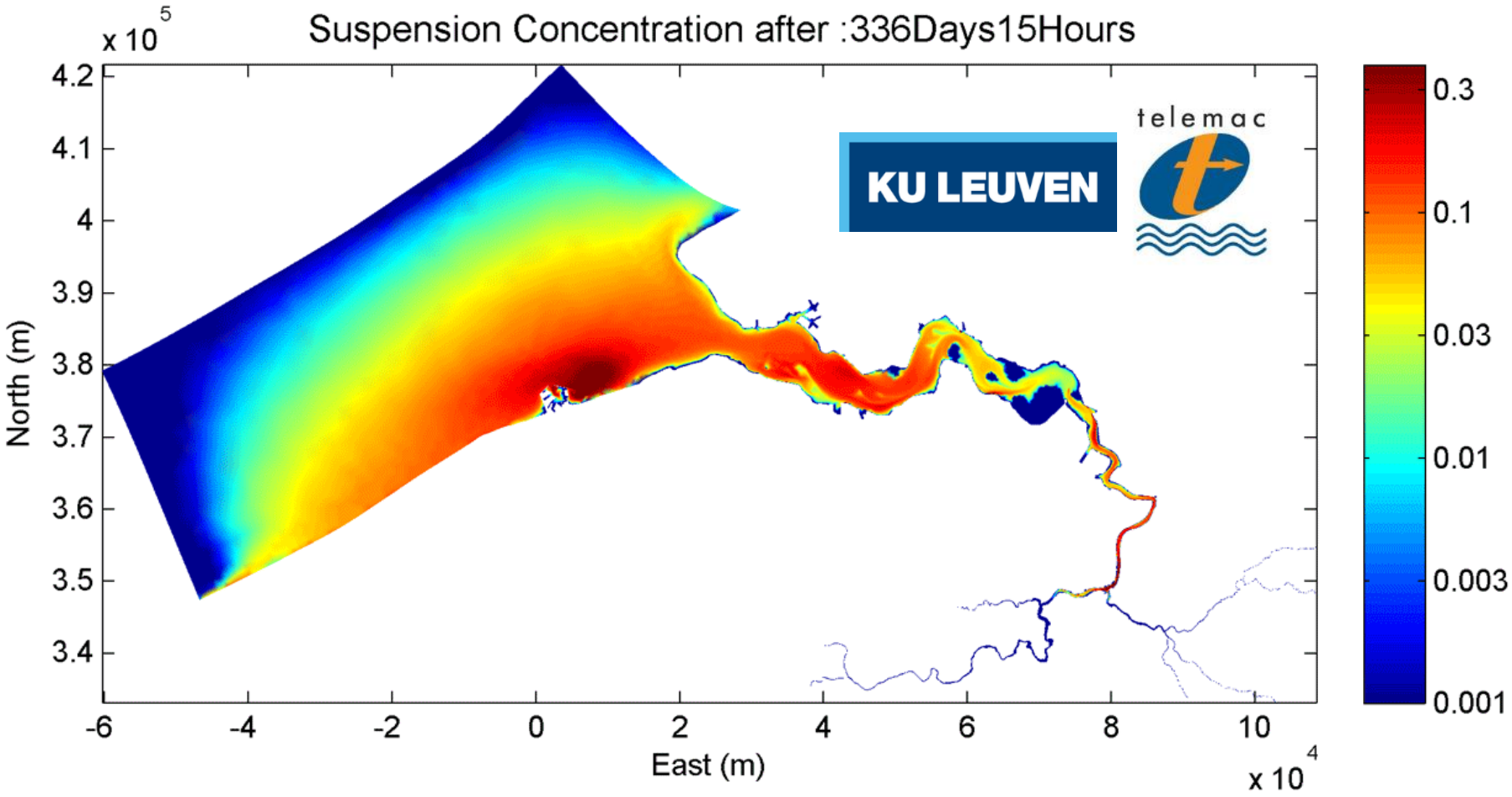
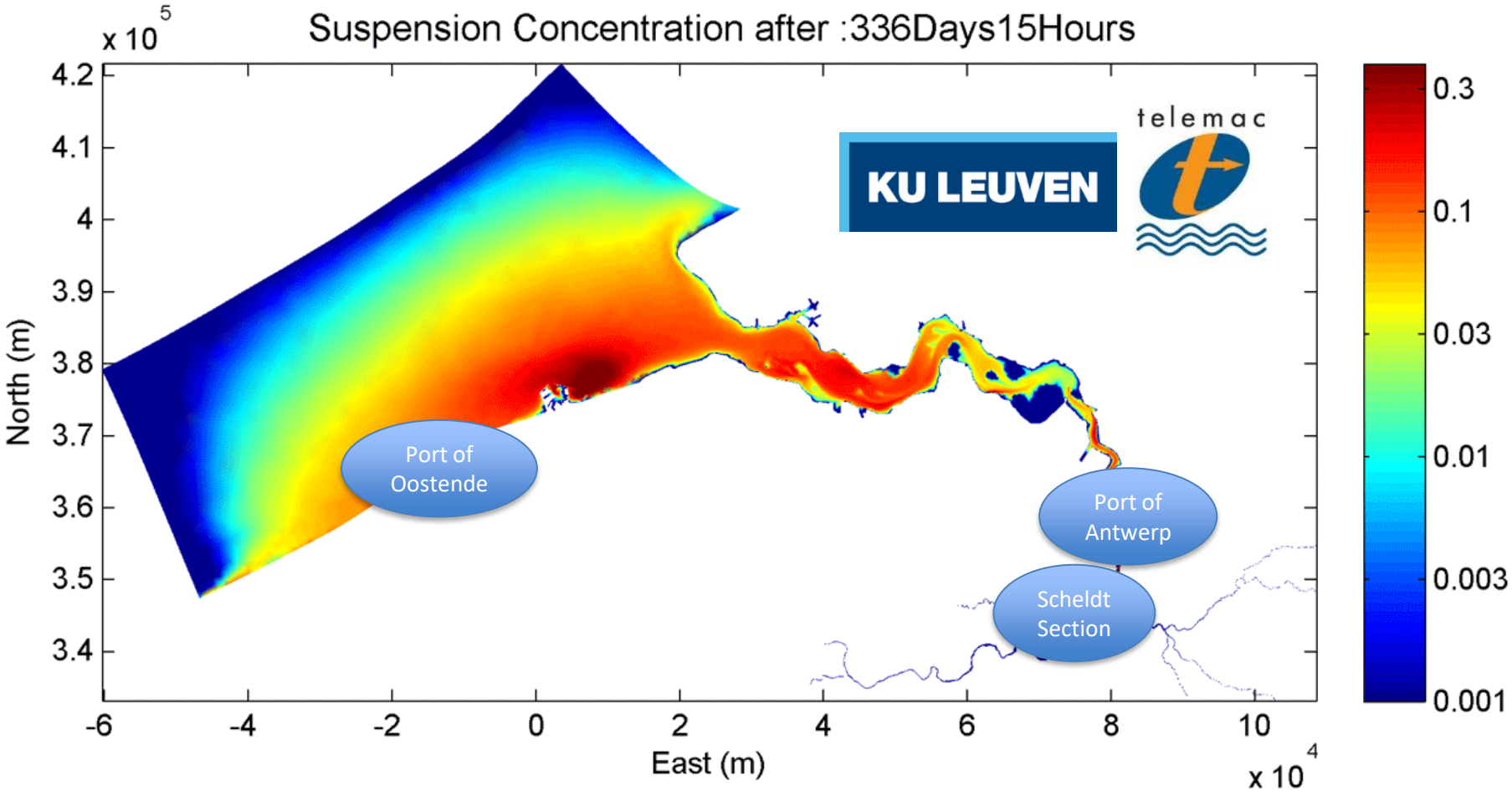
WP1: Project coordination and management

Available 2DH modelling tool



- Transport modes: **floating load**, suspended load, bed load (i.e. 3 layers)
- Sinks & sources: lateral (*rivers, sewers, runoff, sea, …*), bottom, **shorelines**
- **Additional processes** (*fragmentation, interactions with sediments & organic matter, …*)

Pilot areas (proposed)



Field data collection

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Remote sensing using drones and fixed camera's ⇨ resolution O(cm)

➔ *Detection method to be developed!*

- 

Field sampling of macroplastics

- 

Field sampling of microplastics (< 5 mm)

➔ *extrapolations to be made …*

Laboratory studies

- UNIVERSITEIT GENT — Particle properties & settling velocities
- VLIZ (Vlaams Instituut voor de Zee vzw, Flanders Marine Institute) — Particle properties
- KU LEUVEN — Effects of turbulence & biofilms on settling;
- KU LEUVEN — Mechanical fragmentation (e.g. ship propellor)

WP6 - New opportunities for business cases

Lisa Devriese

& PLUXIN Consortium

VLIZ

Vlaams Instituut voor de Zee vzw
Flanders Marine Institute

PLUXIN results:

- Plastic flux
- 2DH model
- Visualisation tool
- Detection methods
- ….

AGENTSCHAP INNOVEREN & ONDERNEMEN

Innovation in Flanders:

- Follow-up innovation project
- Value of plastic debris?
- Thematic cases
- Industry-driven

WP6 - New opportunities for business cases

- Thematic cases linked to the PLUXIN Work Packages
- Unique position, within project we invest time and people to initiate follow-up projects
- Steering committee members are in the driving seat of these cases

WP6 - New opportunities for business cases

- Task 6.1. Multi-actor labs

= Brainstorm session per theme (per case)

- Task 6.2. Selection of promising industry-driven cases

= Selection of promising projects per case/theme

= Industry-driven

- Task 6.3: Project initiation meetings

= Work meeting for each promising project

- Task 6.4. Final event

Business cases & follow-up projects

in collaboration with stakeholders

Preliminary (!) ideas:

- **Case 1: Surveillance system for plastic**
- **Case 2: Automated removal of plastic (and oil)**
- **Case 3: Removing plastic upstream**
- **Case 4: Plastic waste processing in a circular economy**
- **Case 5: Clean freshwater for the food industry**
- **Case 6: Baseline measurement for plastic flux to the North Sea**
- **Case 7: Seawater quality for aquaculture activities**

(*to be reorganized & finalized!*)

INFO:
Lisa.devriese@vliz.be
Erik.toorman@kuleuven.be

Thank you

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