

CleanAtlantic

Tackling marine litter in the Atlantic Area

Challenges in modelling marine litter in the Atlantic area

Brest, France, 5th November 2018

Ricardo Canelas
MARETEC, ULisboa, IST



Index

1. Working with the Ocean?
2. Why modelling?
3. How we model marine environments
4. Modelling litter vs modelling fluid
5. CleanAtlantic project & preliminary results

Work with the Ocean?

The Ocean is a **big place**. **70%** of the planet's surface is Ocean.

Work with the Ocean?

The Ocean is a **big place**. **70%** of the planet's surface is Ocean.

Yet **more than 80%** of our ocean is **unmapped, unobserved, and unexplored**. [NOAA 2018]

Work with the Ocean?

The Ocean is a **big place**. **70%** of the planet's surface is Ocean.

Imagine you want to *clean the Ocean of plastics*.

Yet **more than 80%** of our ocean is **unmapped, unobserved, and unexplored**. [NOAA 2018]

Work with the Ocean?

The Ocean is a **big place**. **70%** of the planet's surface is Ocean.

Yet **more than 80%** of our ocean is **unmapped, unobserved, and unexplored**. [NOAA 2018]

Imagine you want to *clean the Ocean of plastics*.

Area \approx 360 million km², Average depth \approx 3700 m Volume \approx **1.4 billion km³**

At **1€/m³** of cleaning that is
1.4x10¹⁷€



Interreg
Atlantic Area
European Regional Development Fund



Work with the Ocean?

The Ocean is a **big place**. **70%** of the planet's surface is Ocean.

Yet **more than 80%** of our ocean is **unmapped, unobserved, and unexplored.** [NOAA 2018]

Imagine you want to *clean the Ocean of plastics.*

Area \approx 360 million km², Average depth \approx 3700 m Volume \approx **1.4 billion km³**

At **1€/m³** of cleaning that is

1.4x10¹⁷€

Global GDP 2017 \approx 0.00095x10¹⁷€

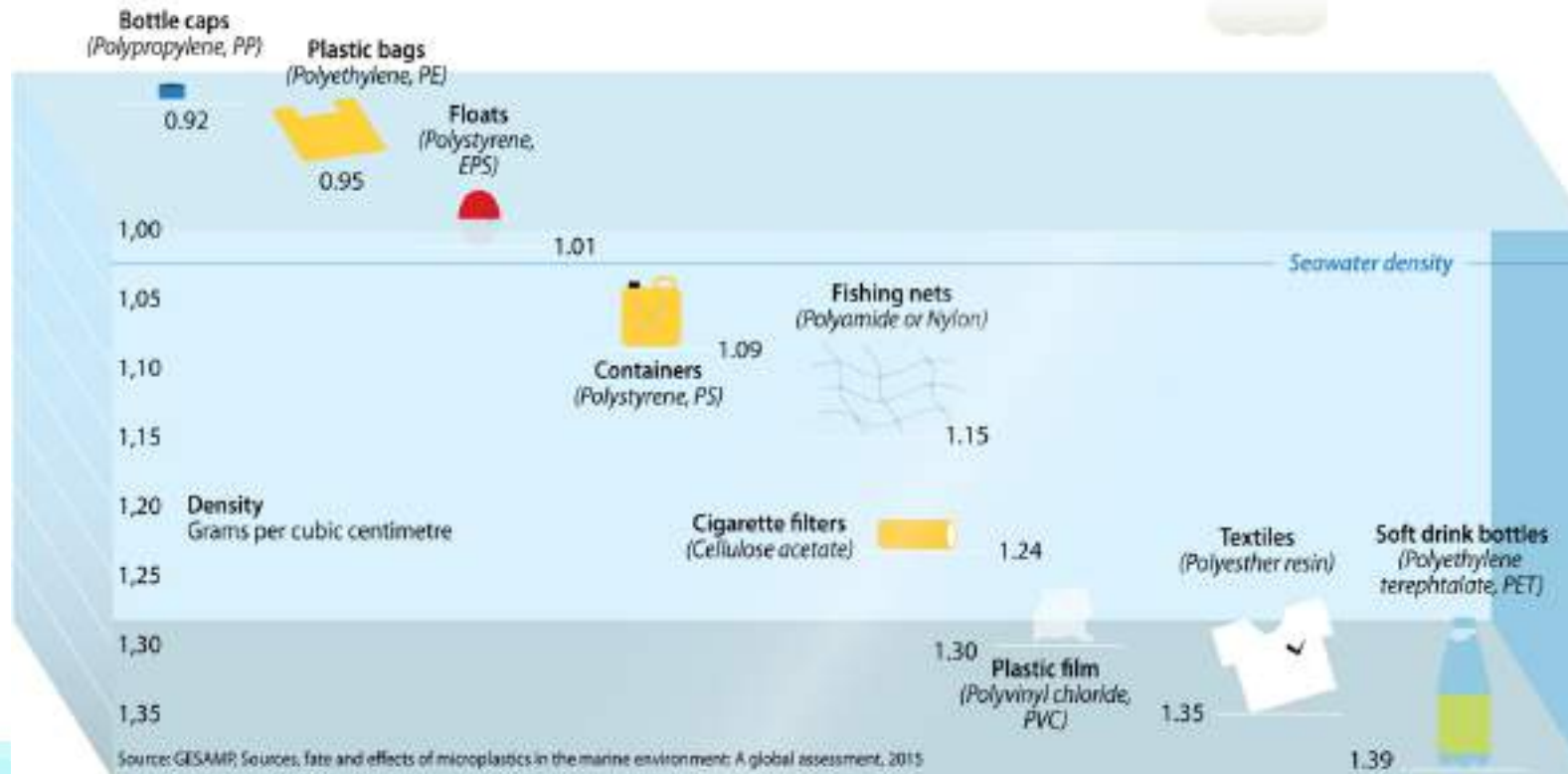


Interreg
Atlantic Area
European Regional Development Fund



Why modelling? *Imagine you want to clean the Ocean of plastics*

Which plastics float and which sink in seawater?



- Where do they go?
- How can we find them?
- Do different debris go to different places?

How to model?

Navier-Stokes Equations

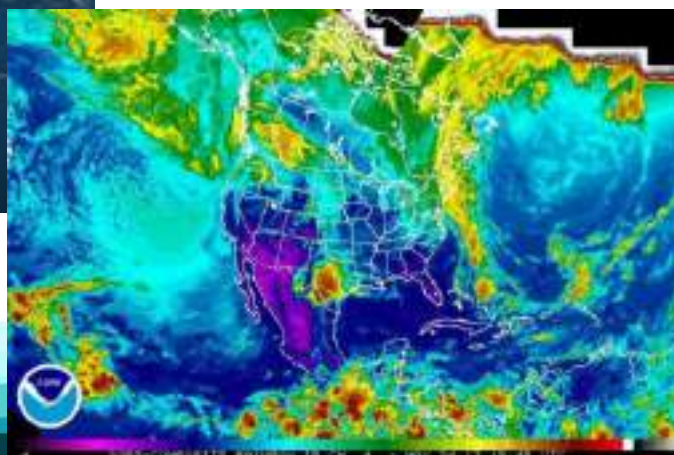
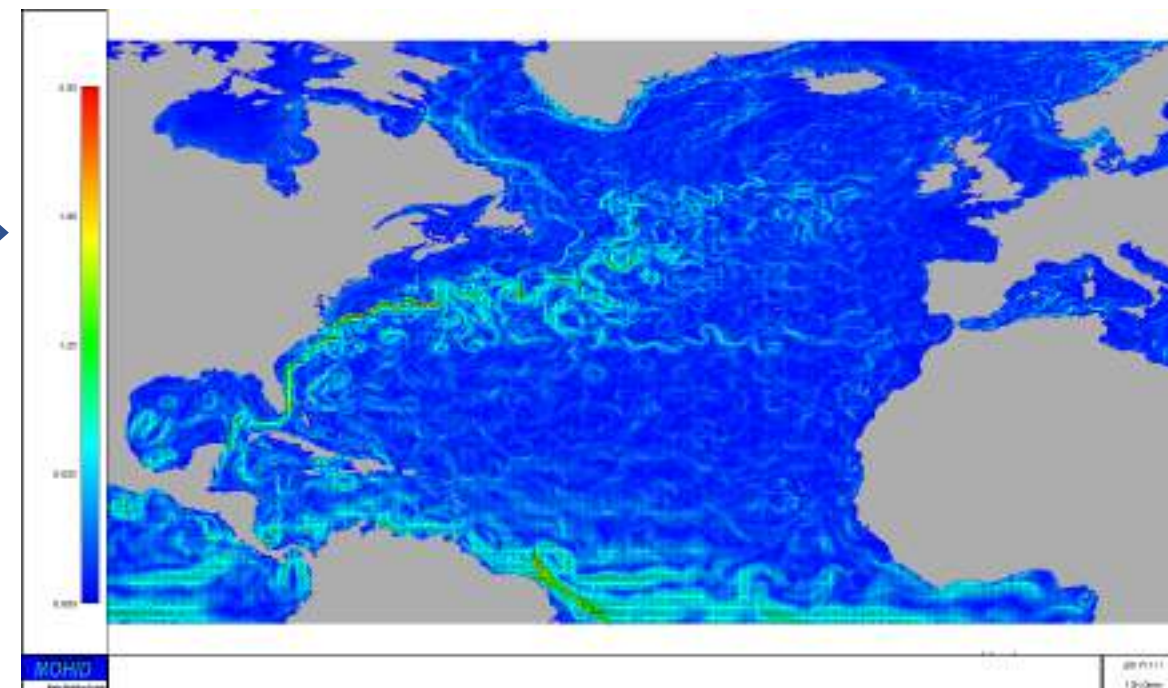
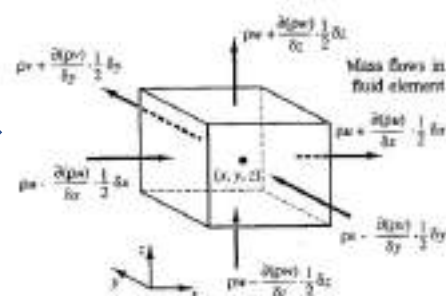
Continuity Equation

$$\nabla \cdot \vec{V} = 0$$

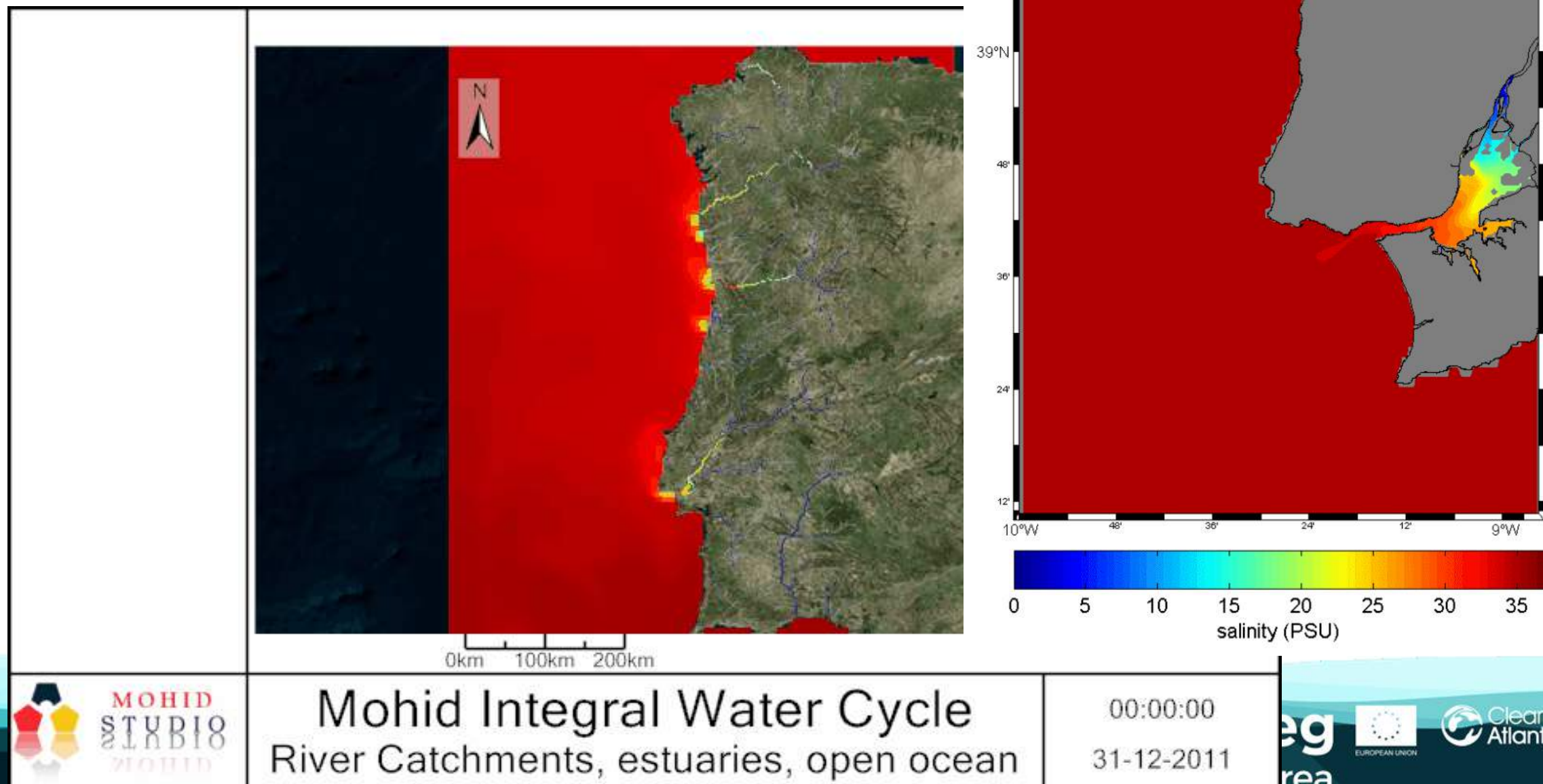
Momentum Equations

$$\rho \frac{D\vec{V}}{Dt} = -\nabla p + \rho \vec{g} + \mu \nabla^2 \vec{V}$$

↑ Total derivative
 ↑ Pressure gradient
 ↑ Body force term
 ↑ Diffusion term



How to model?



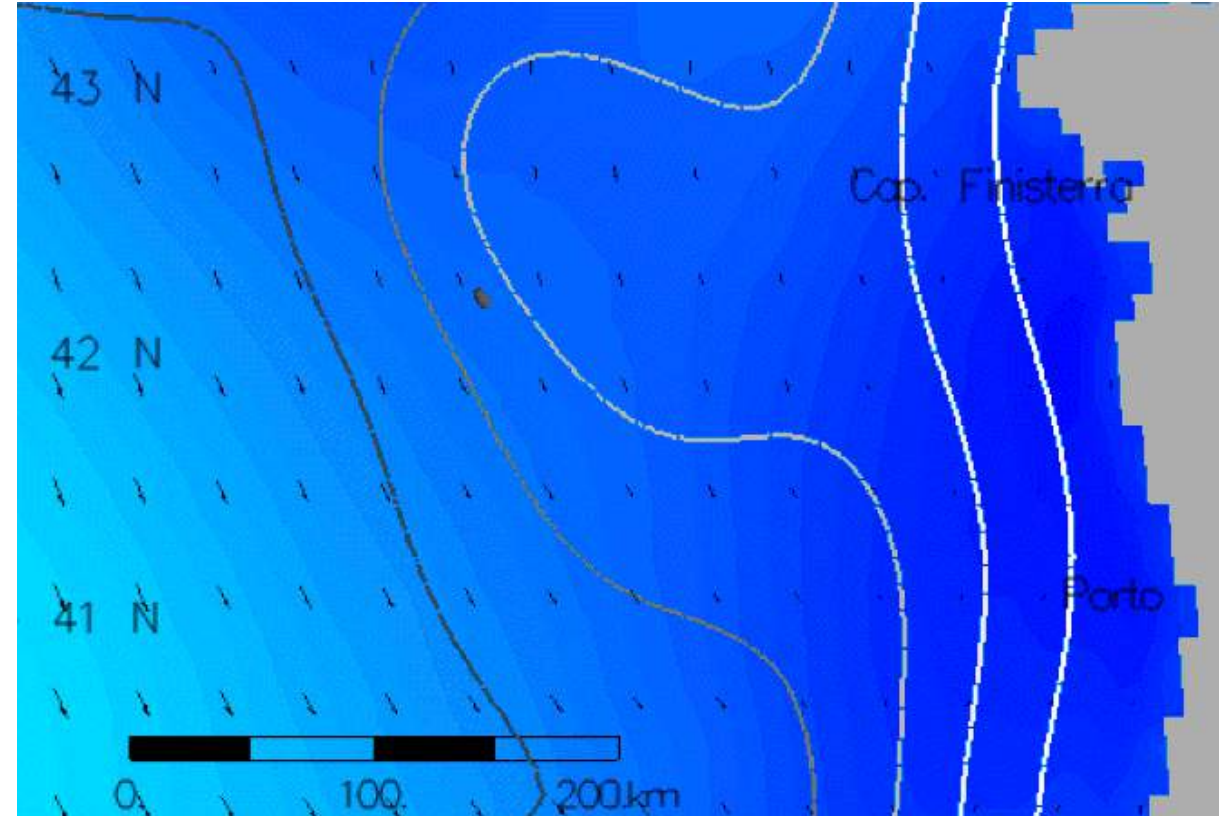
Modelling litter vs modelling fluid

We require the notion of a Tracer – a physical quanta.

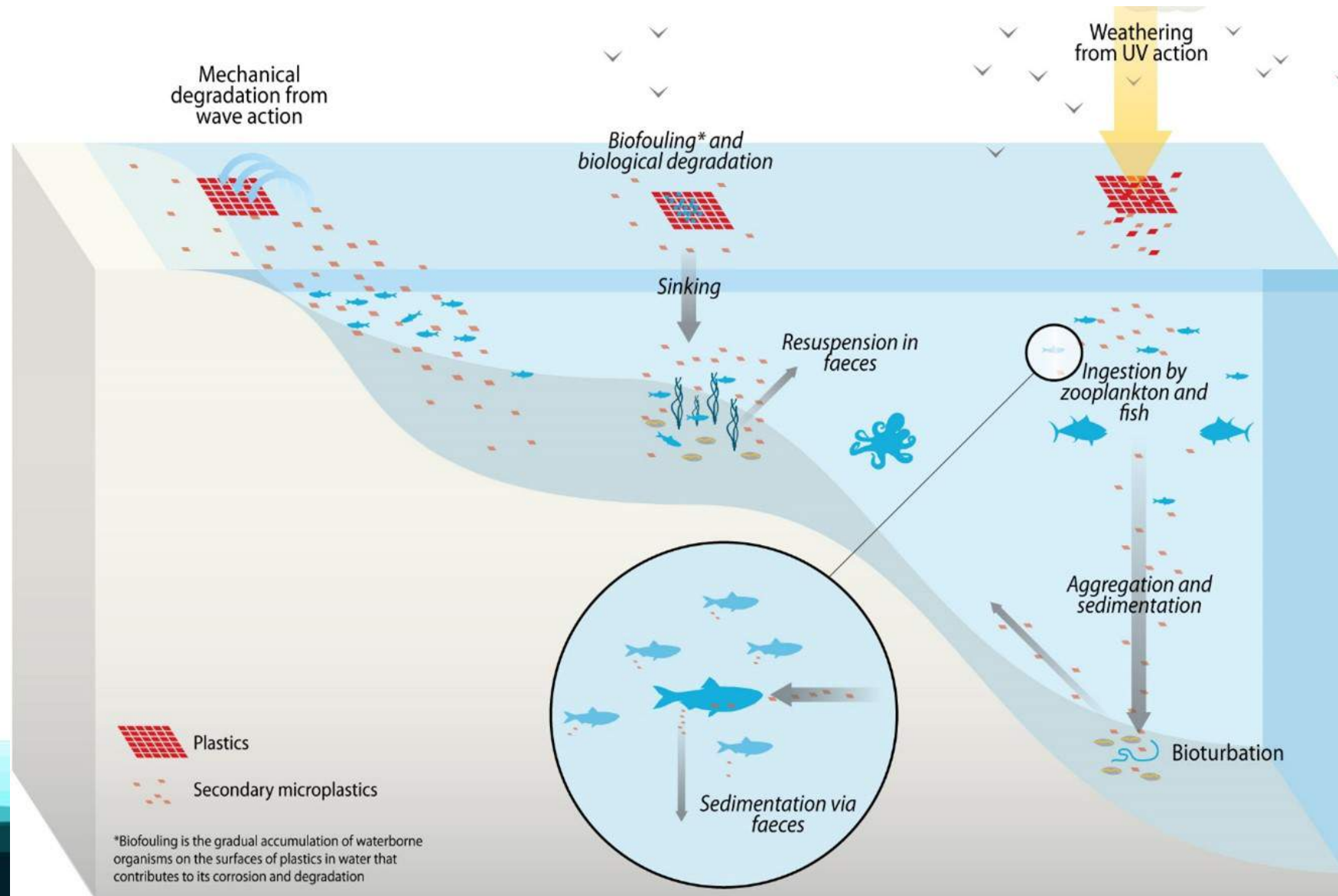
Tracers can be subjected to

- **Currents**
- **Waves**
- **Wind**

Used for contained scenarios such as oil spills.



Numerical modelling of Marine Litter



CleanAtlantic Work Package 6 – what is it?



Objective:

The aim of this WP is to develop sub regional or regional maps of hotspots of floating litter, based on models mapping of circulation of floating masses of marine litter, and identification of hotspots of accumulation on coastal areas and the role of prevailing currents and winds.



Partners:

- IST, CETMAR, INTECMAR, USC, IEO, DGRM, DROTA, IFREMER, Cedre, CEFAS, IMI, ARDITI

CleanAtlantic Work Package 6 – preliminary results

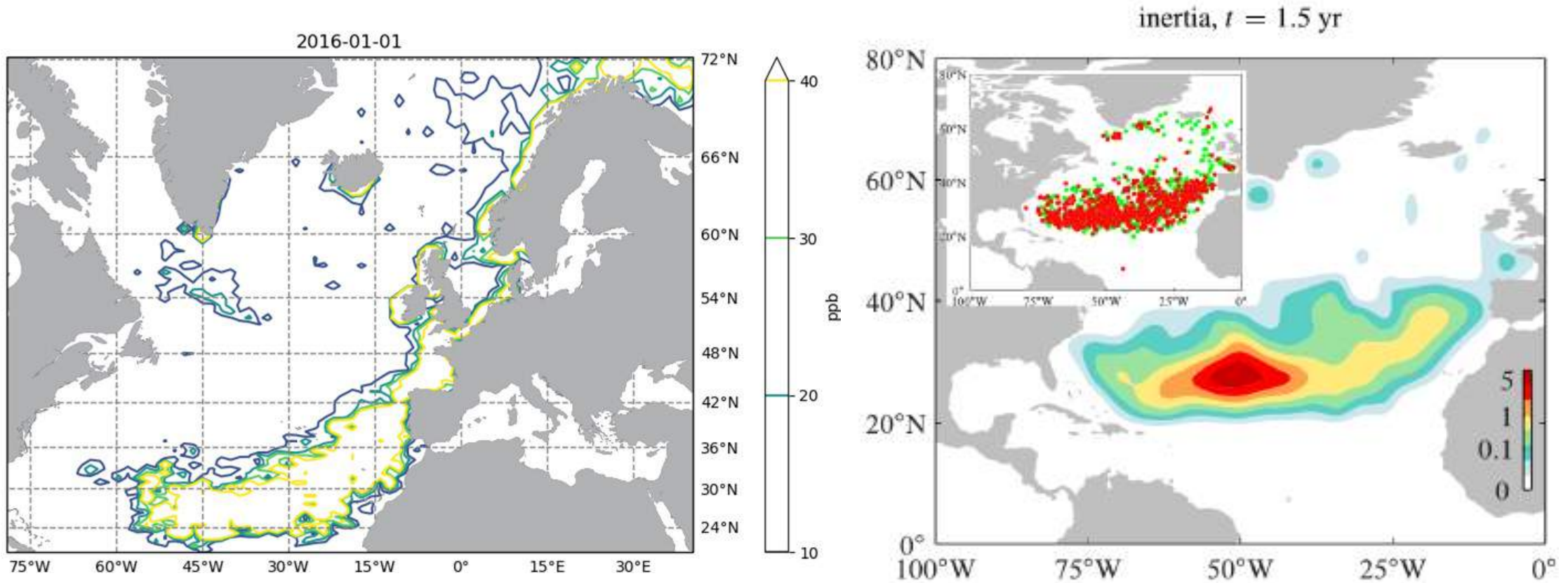
Showing you several working scales, from the oceanic to the harbour



Interreg
Atlantic Area
European Regional Development Fund

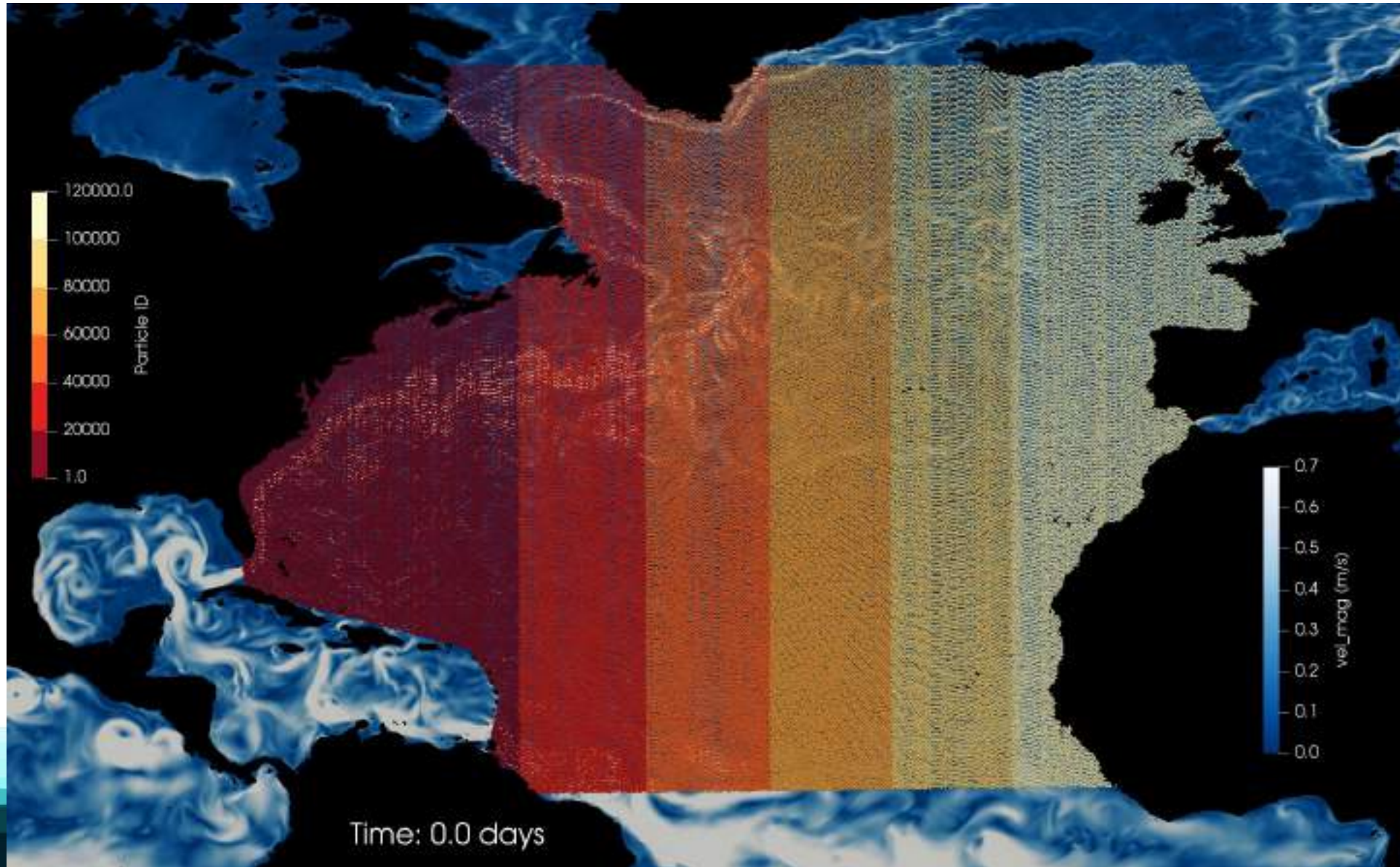


Assessment of the fate of marine litter using models: hotspots



Beron-Vera, F. J., M. J. Olascoaga, and R. Lumpkin (2016), Inertia-induced accumulation of flotsam in the subtropical gyres, *Geophys. Res. Lett.*, 43, 12,228–12,233, doi:10.1002/2016GL071443.

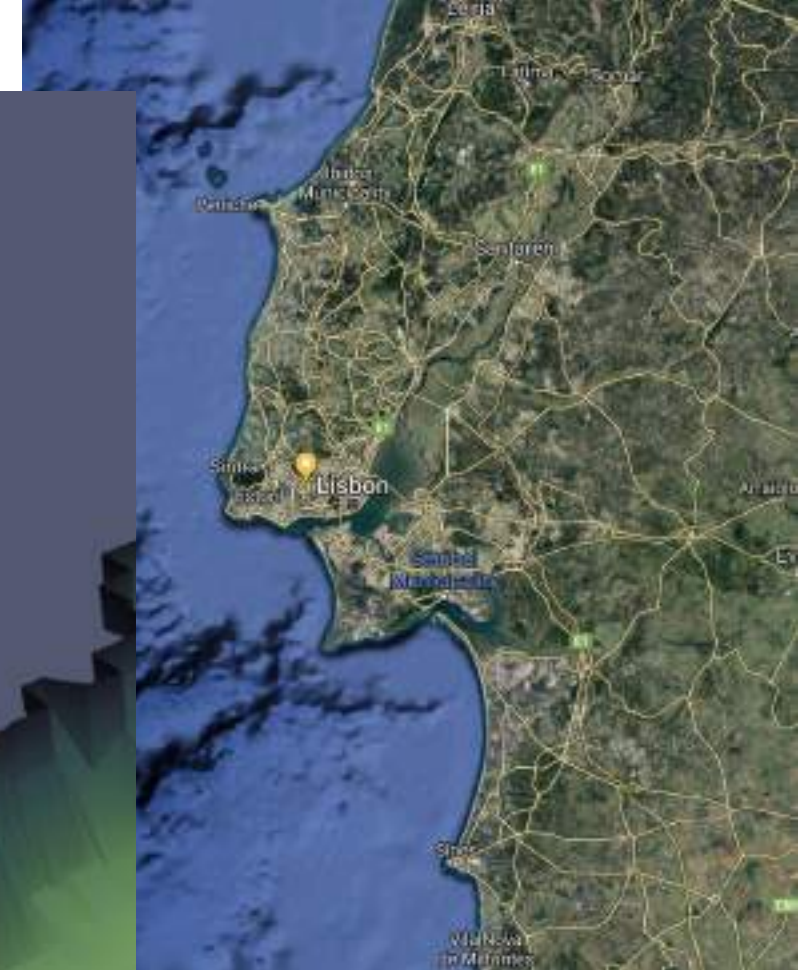
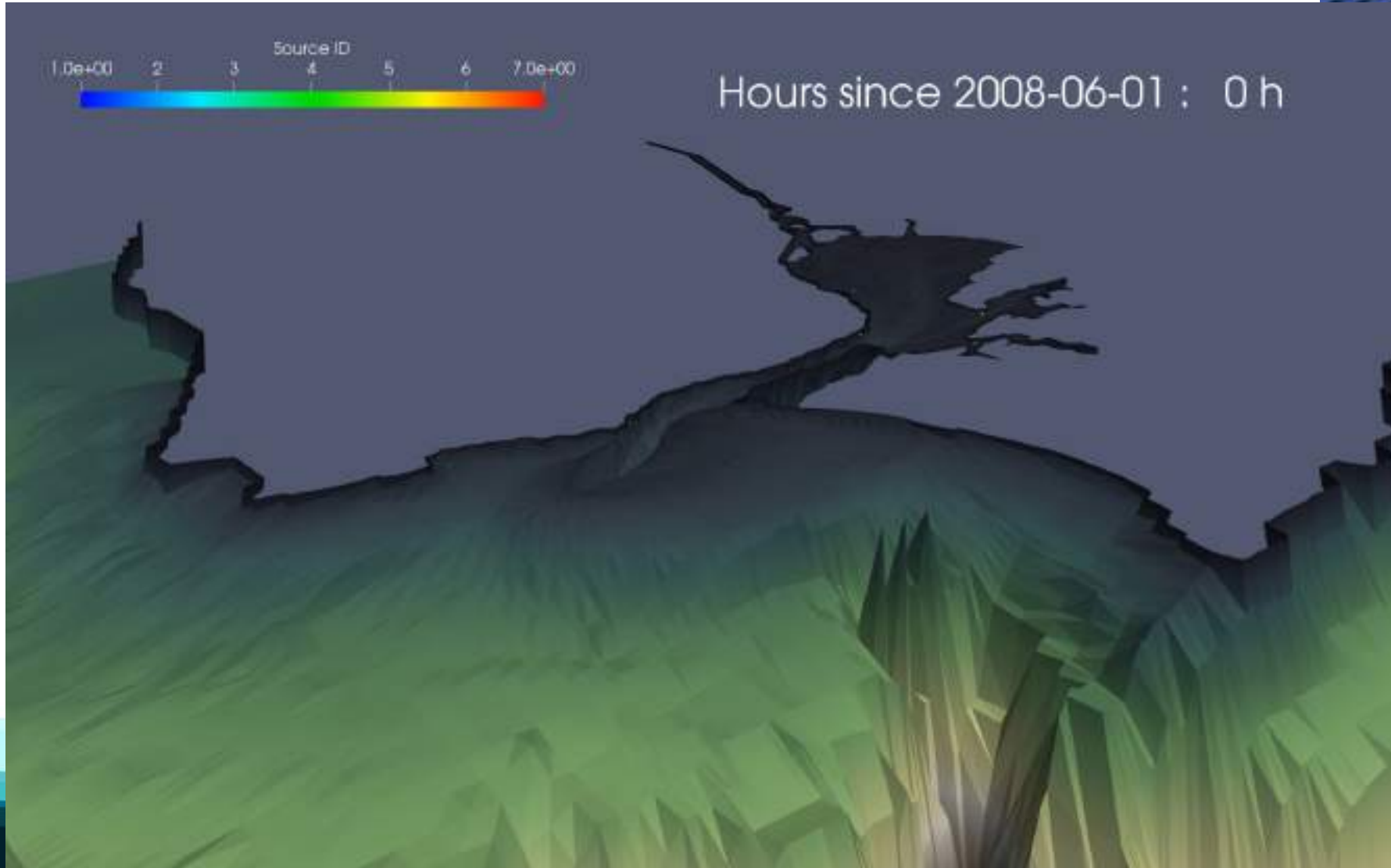
Assessment of the fate of marine litter using models: hotspots



Modelling river and land-based sources of marine litter



Modelling river and land-based sources of marine litter



Challenges in modelling marine litter in the Atlantic area

Brest, France, 5th November 2018

Ricardo Canelas
MARETEC, ULisboa, IST



Merci
Thank you
Gracias
Obrigado