1 TÉCNICO LISBOA MARETEC 2 USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA Grupo de Física No Lineal CRETUS Center for Research in Environmental Technologies 3 Bentley

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Tackling marine litter in the Atlantic Area

MOHID–Lagrangian: A lagrangian transport model from local to global scales. Applications to the marine litter problem

Session ITS2.8/OS4.10 - EGU2020-21895

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The problem:

Working with the ocean:

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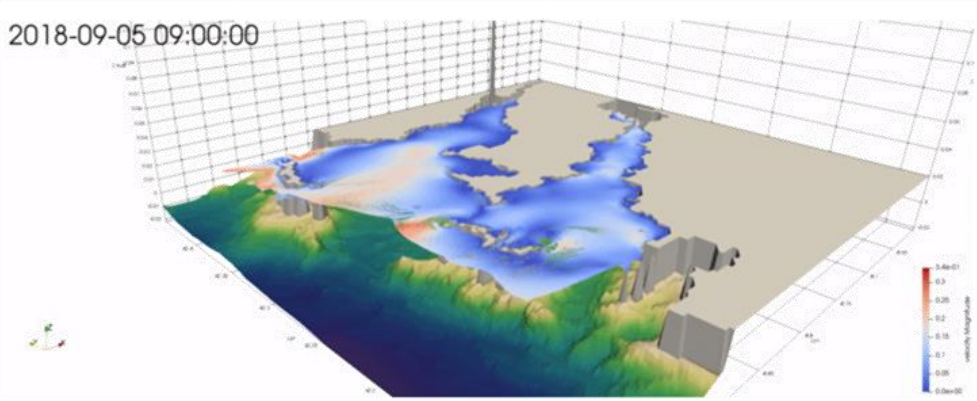
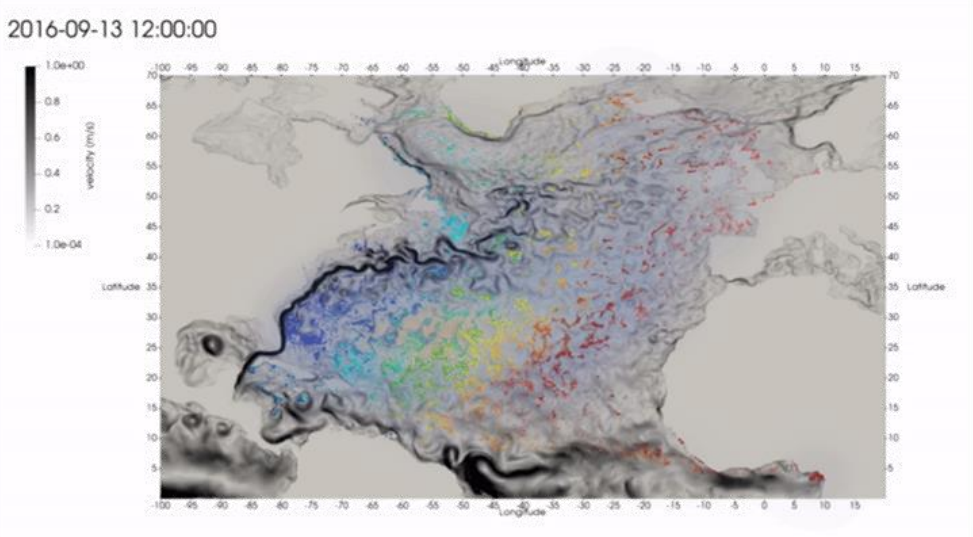
MOHID Lagrangian - V0.2 - Work in progress!



3D passive tracers on a MOHID operational currents solution in Vigo region, Galiza, Spain.



Floating passive tracers on a CMEMS Atlantic currents solution.

Context:

MOHID Lagrangian tool is:

- A unidirectional Lagrangian particle simulator
- Made to easily extend the physical models acting on the particles
- Made to support large scale modelling in both space and time
- Made to support medium independent simulations
- Made to support large tracer numbers
- A cross platform, shared memory parallel tool

Features:

- Define tracer sources in space and time using basic shapes ✓
- Import currents data from .nc or .nc4 files, using CF conventions ✓
- Import 3D/2D structured meshes ✓
- Import data from a file series automatically (constant dt) ✓
- One domain per simulation ✓
- Provides 1st, 2nd and 4th order integrators ✓
- Physics kernels for Lagrangian kinematics and basic isotropic diffusion (disabled) ✓
- Automatic land, beaching and bed interaction masks (assuming CF compliant input files) ✓
- Basic litter modelling physics kernels (settling velocity, buoyancy, degradation) ✓
- Advanced diffusion kernels (random walk based on mixing length and turbulent velocities) ✓
- Beaching behaviors ✓
- Windage and Stokes drift effects ✓
- Basic, python based, postprocessor suite in order to interpolate solutions and cast them on NetCDF CF compliant grids, so they can be published and explored ✓

Assessment of the fate of marine litter using models: hotspots

Global Scenario

- **Hydrodynamic**

CMEMS
  - No waves
  - No tide
  - No rivers

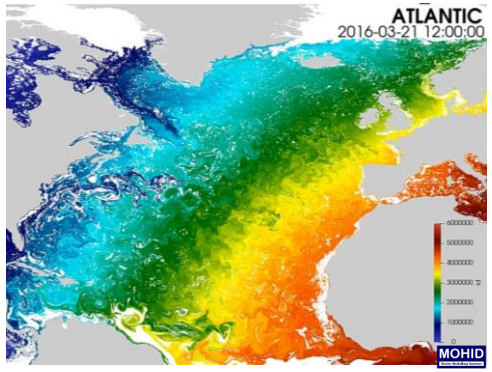
- **Lagrangian**

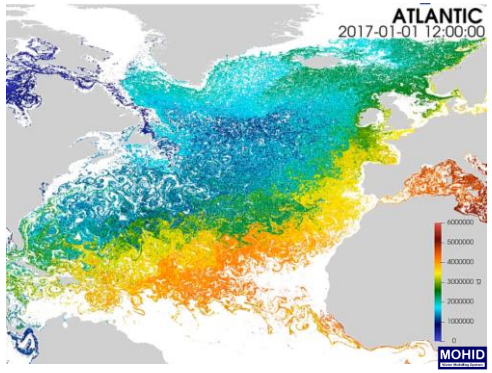
Conservative particles (=water)
Surface
3 200 000 particles

- **Source**: Box
- **Simulation time** = 4 years

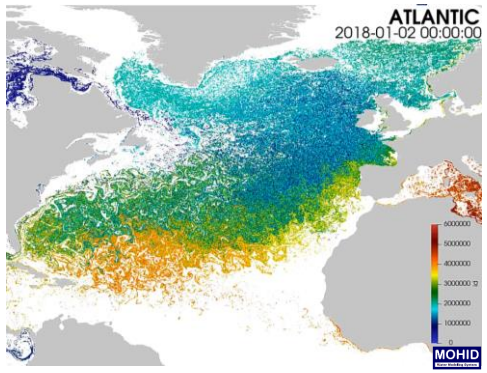
Simulation time:

1 year

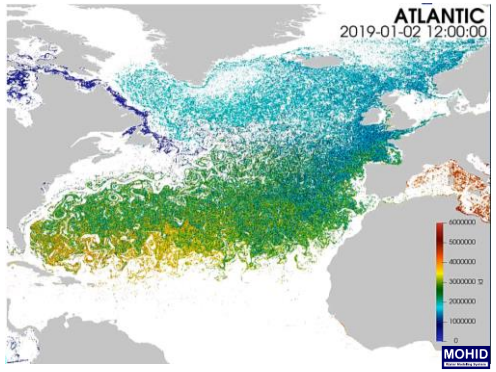




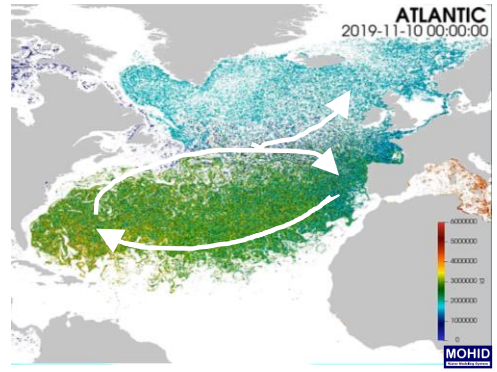
2 years



3 years



4 years



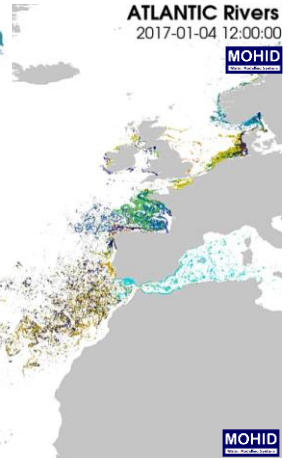
Modelling influence of river and land-based sources of marine litter (Rivers)

61 European Rivers
(daily average)

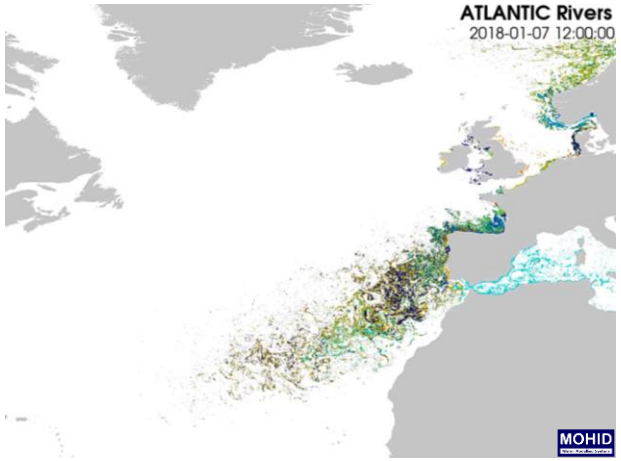
- **Hydrodynamic**
  CMEMS
  No waves
  No tide
  No rivers
- **Lagrangian**
  Conservative particles (=water)
  61 Rivers
  Surface
  1 500 000 particles
- **Source**: Point
- **Simulation time** = 4 years

Global Scenario

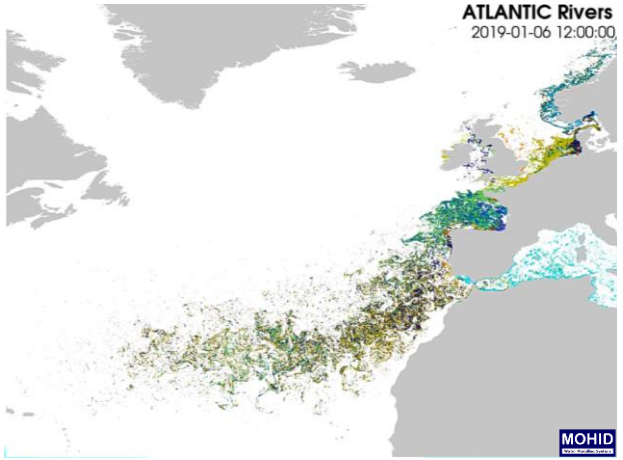
1 year



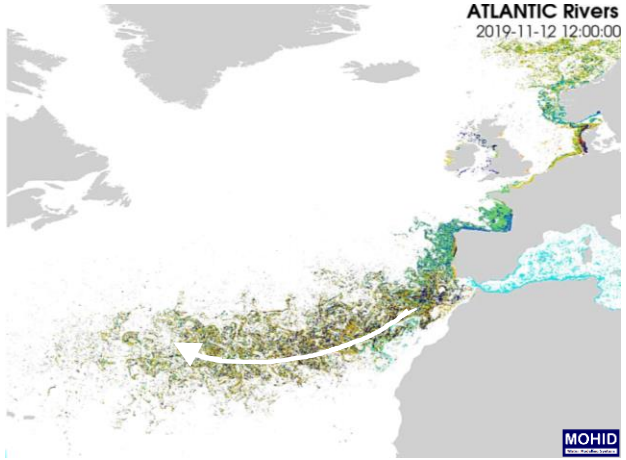
2 years



3 years



4 years



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Modelling influence of river and land-based sources of marine litter (Rivers)

Local Scenario

3 Rivers daily discharge data from MeteoGalicia river stations

Hydrodynamic

Hydrodinamic, temperature and salinity fields from Meteogalicia - MOHID.

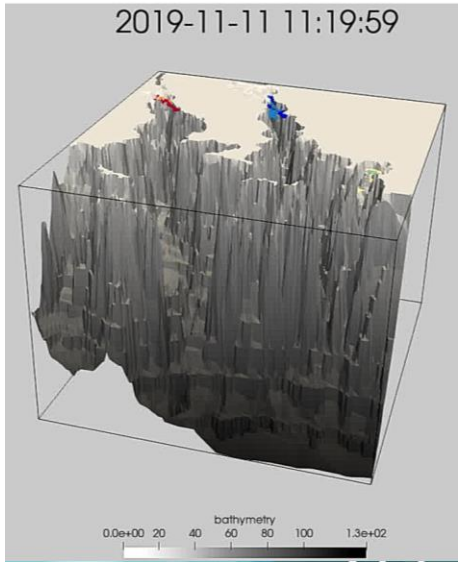
Lagrangian

4 types of MarineLitter per river
Water density (Lagrangian), light, moderate, heavy
Same size
200000 particles in 10 days.

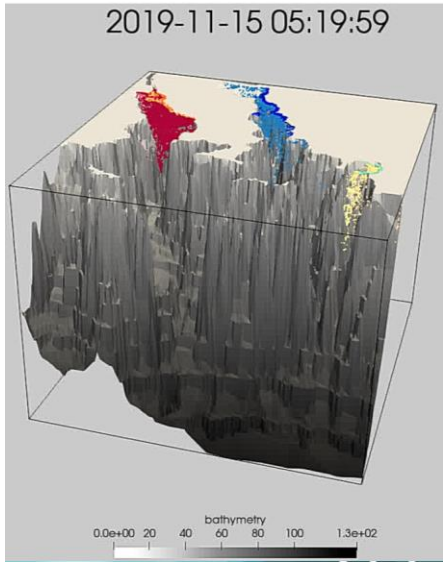
Source: Point

Simulation time = 14 days

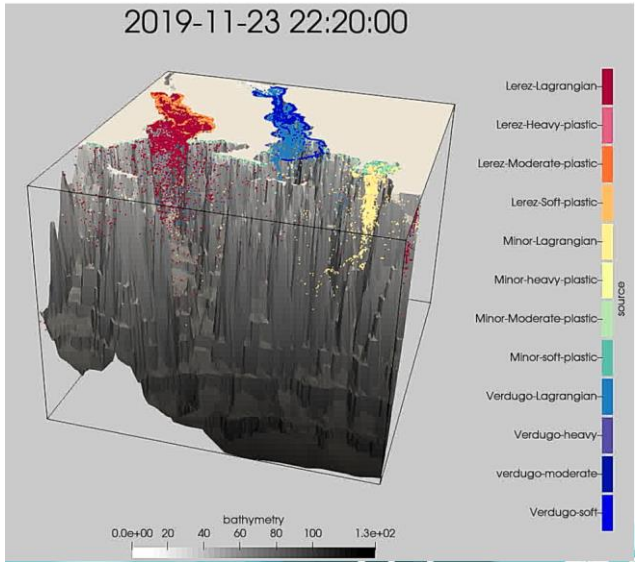
1 day



5 days



13 days



Preliminary Results

Modelling influence of ocean-based sources of marine litter (Marine Traffic)

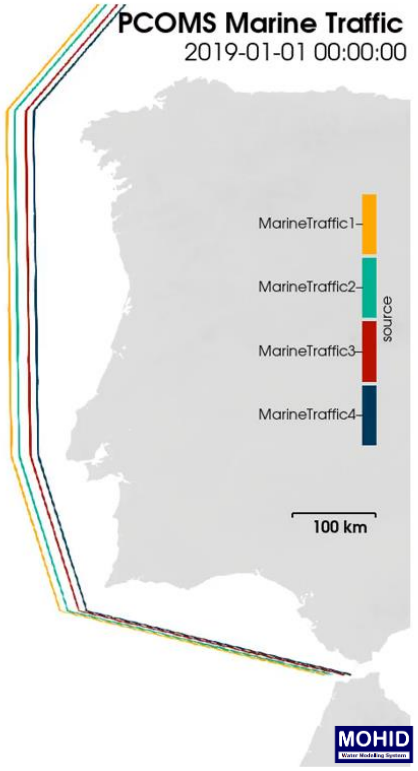
Regional Scenario

Sources

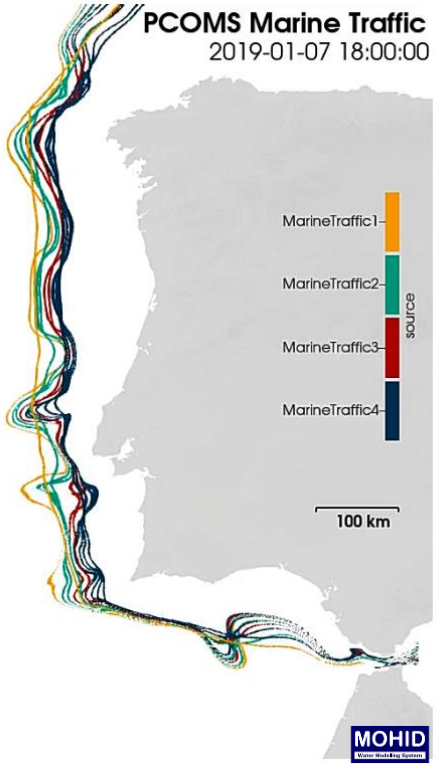
5 20 10 30
(hours/km^2/month)

- **Lagrangian**
  Conservative particles (=water)
  f(density)$_{trajectories}$
  Surface
- **Hydrodynamic**
  PCOMS-3D (Tide, Wind, No waves, No rivers)
- **Simulation time** = 1 year
- **Source**: Line

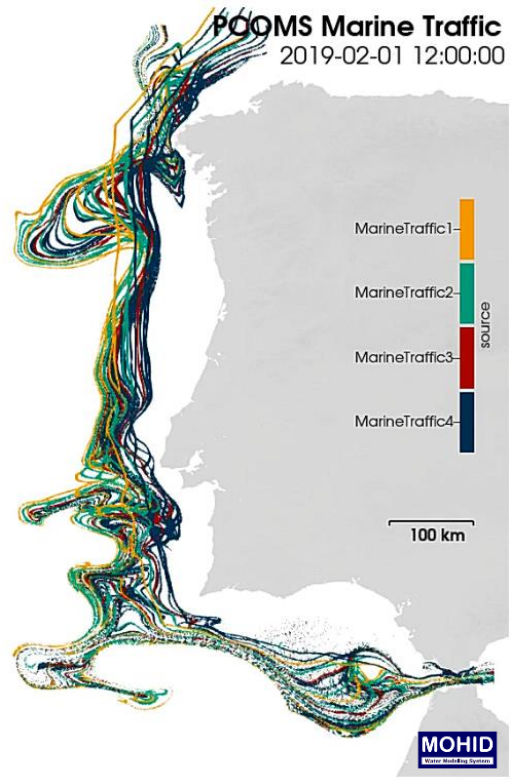
Simulation time:1week

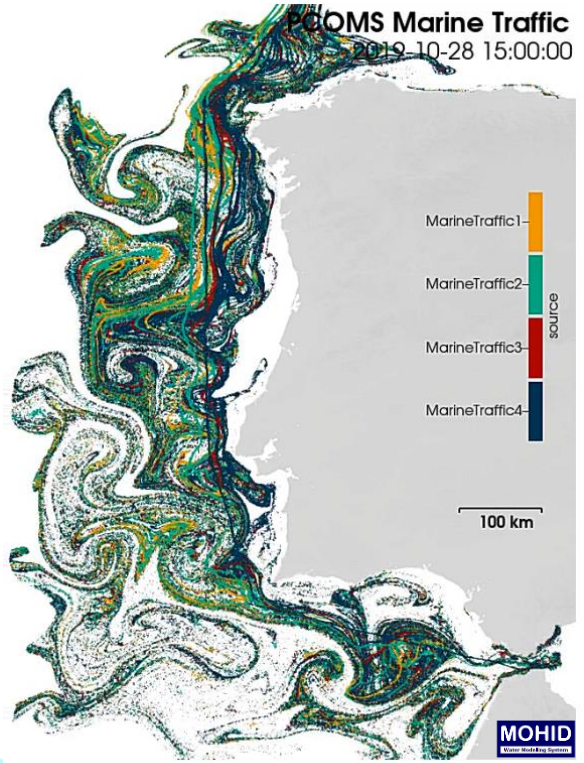


Simulation time:1month



Simulation time:10 months





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FUTURE WORK - Summary:

Maps of accumulations/residence time and hotpots using long trends in Atlantic Area.

Maps of accumulations and hotpots using long trends considering rivers emission at Atlantic, regional and local scenarios.

Maps of accumulations and hotposts using marine traffic and other local sources (mussel pegs)

Reduction scenarios.

Thank you. Questions are welcome!

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