



# EO for Africa Symposium 2024

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# Addressing Marine Pollution in West Africa: Insights from Plastic Drift Modeling



**Laura Corbari<sup>2</sup>, Antonello Aiello<sup>1</sup>, Giulio Ceriola<sup>1</sup>, Giuseppe Ciruolo<sup>2</sup>, Fulvio Capodici<sup>2</sup>**

<sup>1</sup> Planetek Italia s.r.l., Italy;

<sup>2</sup> University of Palermo, Italy.



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[laura.corbari@unipa.it](mailto:laura.corbari@unipa.it)



→ THE EUROPEAN SPACE AGENCY



## Global Development Assistance

### GDA AID Marine Environment & Blue Economy thematic area

Funded by the European Space Agency in collaboration with the Asian Development Bank and World Bank

#### Overview of EO Products/Services developed

Application of Lagrangian TrackMPD model (Jalón-Rojas et al., 2019) to simulate the fate and transport of macroplastics discharged by the West Africa Coastal Area (WACA program).

[laura.corbari@unipa.it](mailto:laura.corbari@unipa.it)





“  
**Marine litter is any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment**  
*(European Commission, Joint Research Centre 2015)*  
 ”

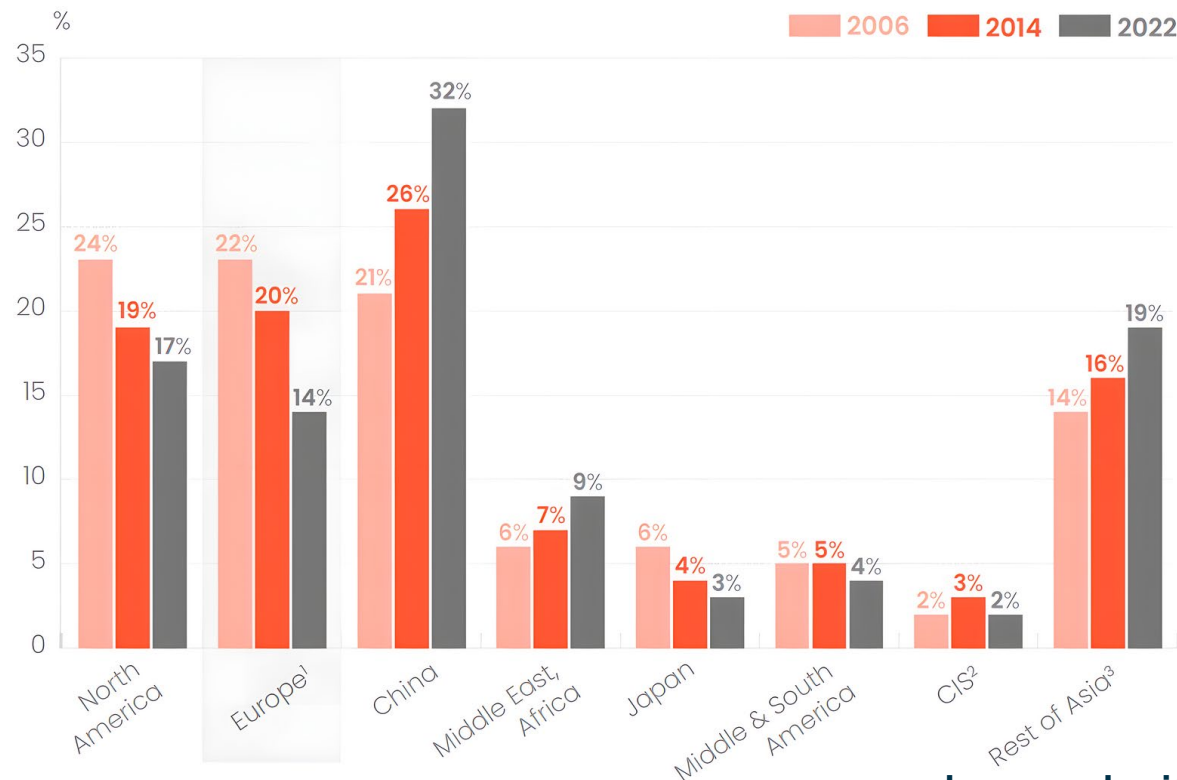
**Around 600 million litter items are released annually into the ocean from European rivers**



**The plastic fraction is ~80% of marine litter. Mainly fragments and single-use items (bottles, packaging and bags)**

*(González-Fernández et al., 2021)*

World plastics production reached **400 Mt in 2022**



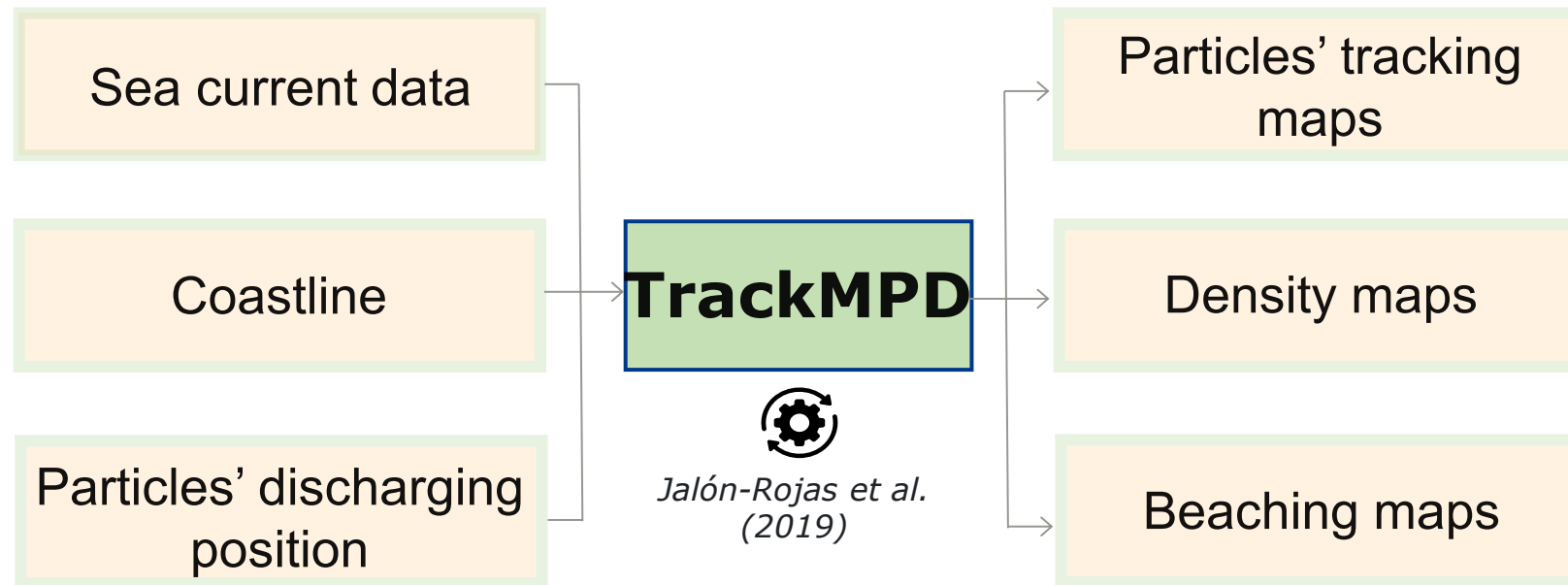
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# Hydrodynamic Lagrangian Model



## TrackMPD model: main input and outputs



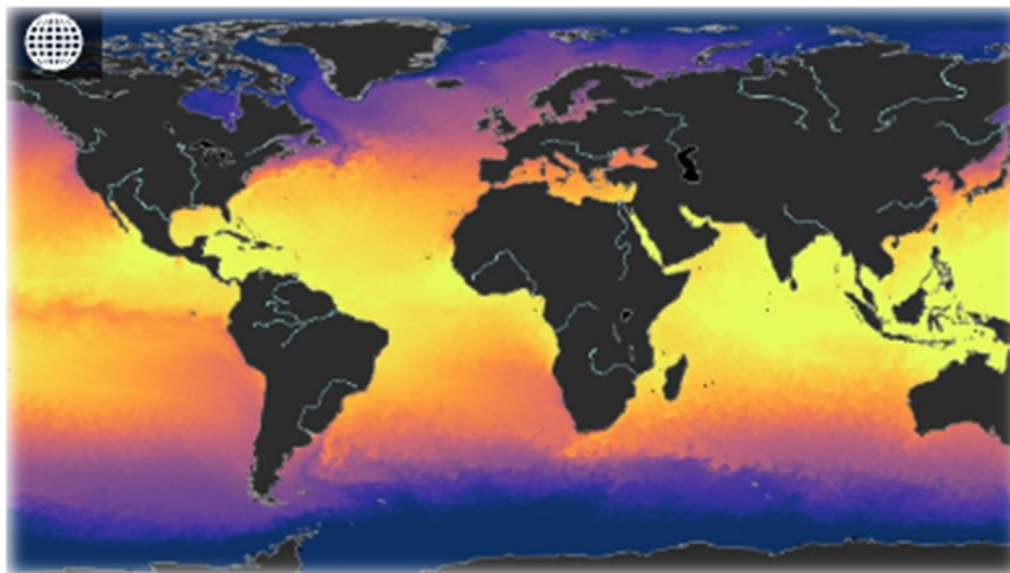
## Particles' direction:

- Forward
- Backward

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# Sea current data



Spatial  
resolutions

$0.083^\circ \times 0.083^\circ$  (~ 10 km)

50 vertical levels  
(from 0 m to 5500 m)

Time  
resolutions

Hourly, Daily,  
Monthly mean

✓ **Sea surface currents data**



✓ **Daily temporal resolution**

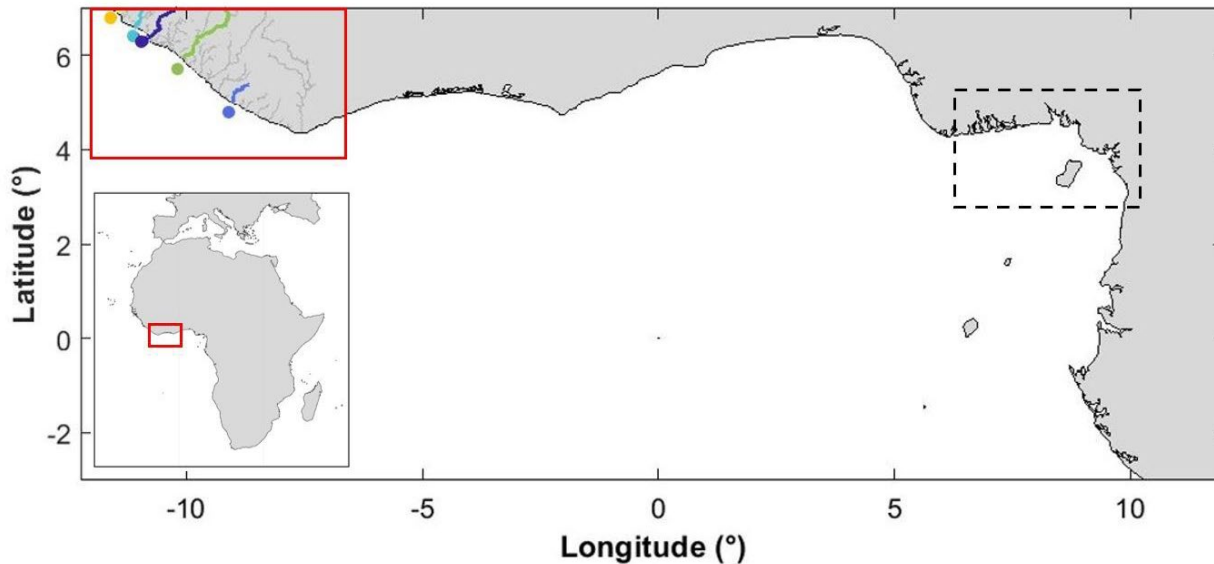


# Case Study: Liberia



Particles' direction: Forward

## Study area: Liberia region



**Direction:** *forward*.

**Spatial resolution:**  $0.083^\circ \times 0.083^\circ$  (~ 10 km)

**Temporal resolution:** 1 day

**Period:** 01/02/2021 – 31/12/2021

**Input:** 5 macroplastics from the main rivers every day  
(Moa, Mesurado, Saint John, Lofa and Sinoe rivers)

**Outputs:** Points tracking maps  
Density maps  
Beaching maps

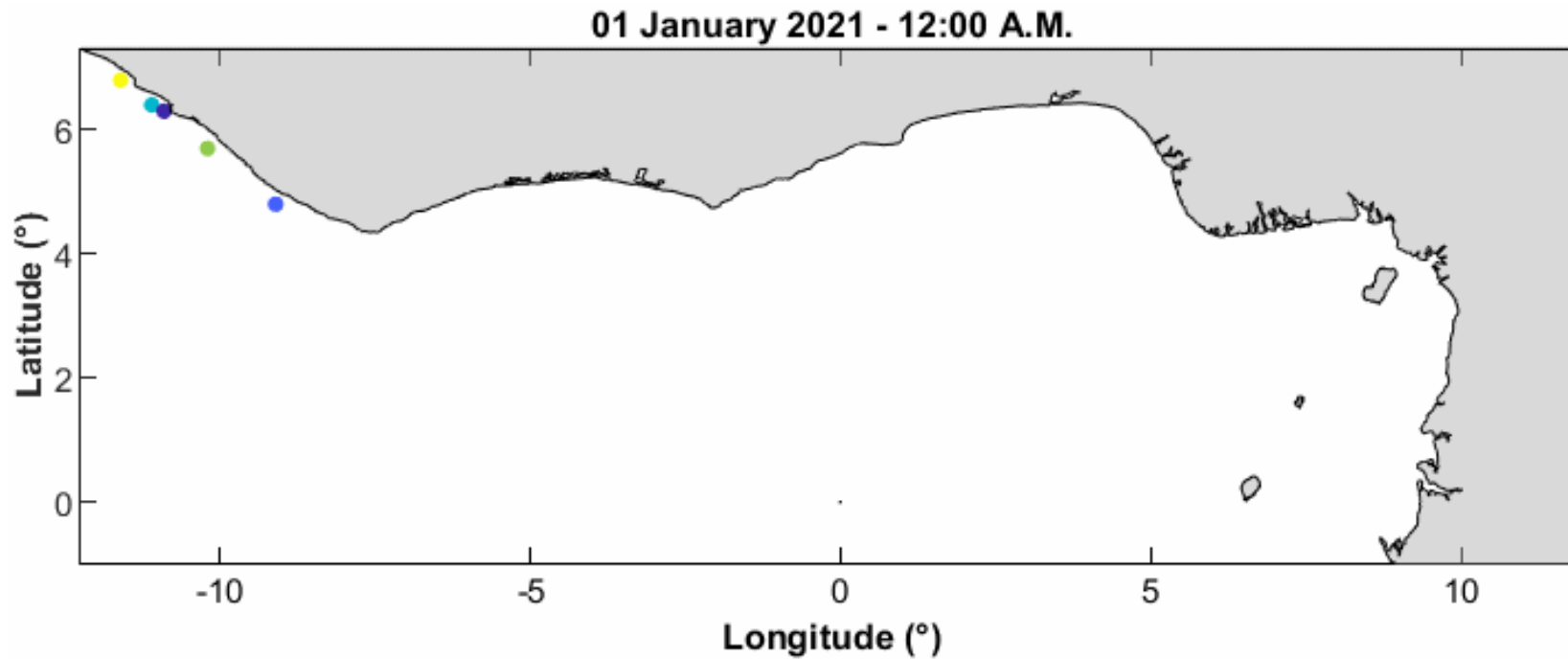
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# Case Study: Liberia



Particles' direction: Forward



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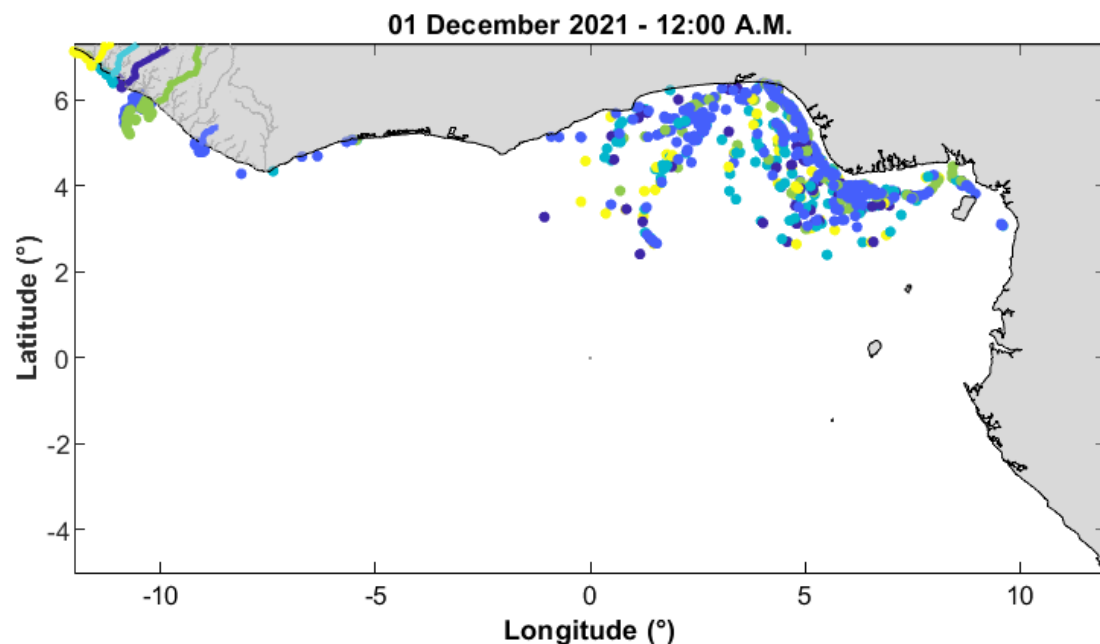


# Case Study: Liberia



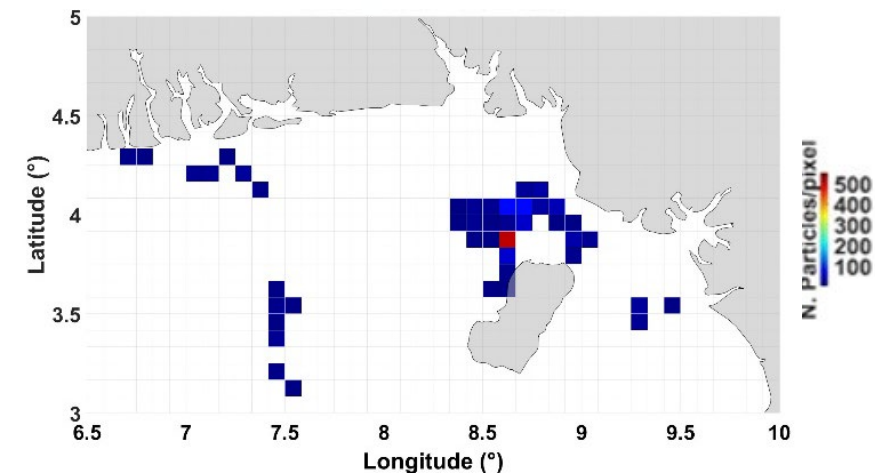
## Particles' direction: Forward

### Points tracking maps

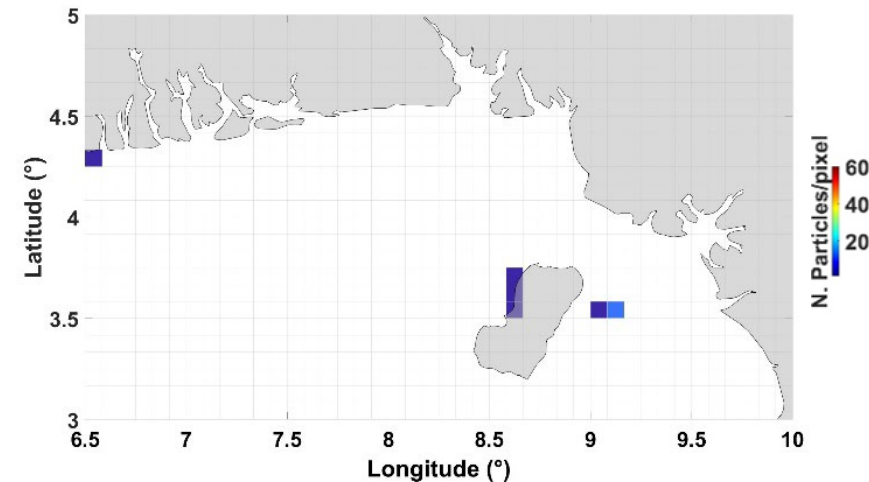


Marine plastic pollution: transboundary issue.

### Density map



### Beaching map



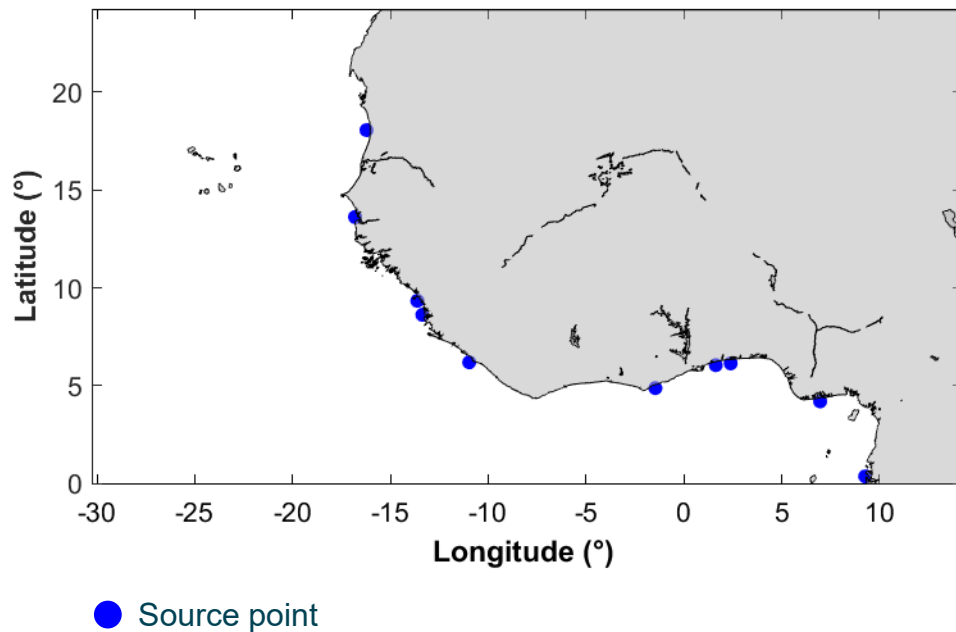


# Case Study: Liberia

## Extension of the area



Particles' direction: Forward



The study area was extended from Mauritania to Gabon region (Mauritania, Gambia, Guinea, Sierra Leone, Liberia, Ghana, Togo, Benin, Nigeria, Gabon), including the Gulf of Guinea.

**Direction:** *forward.*

**Input:** 12 macroplastics from main rivers every day (selected by the OceanCleanUp website)

**Spatial resolution:**  $0.083^{\circ} \times 0.083^{\circ}$  (~ 10 km)

**Temporal resolution:** 1 day

**Period:** 01/05/2023 – 30/10/2023 (Rainy season).

[laura.corbari@unipa.it](mailto:laura.corbari@unipa.it)



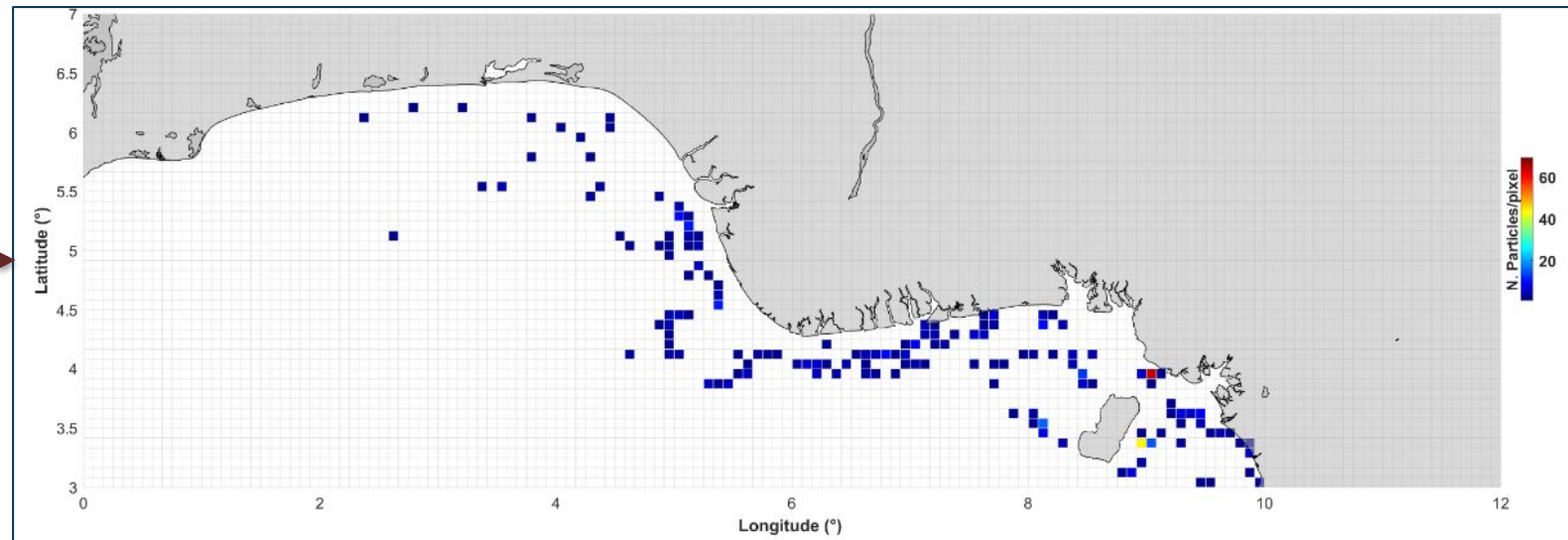
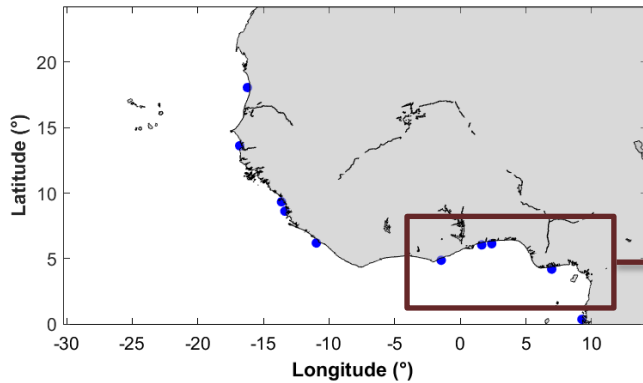
# Case Study: Liberia

## Extension of the area



Particles' direction: Forward

### Density map



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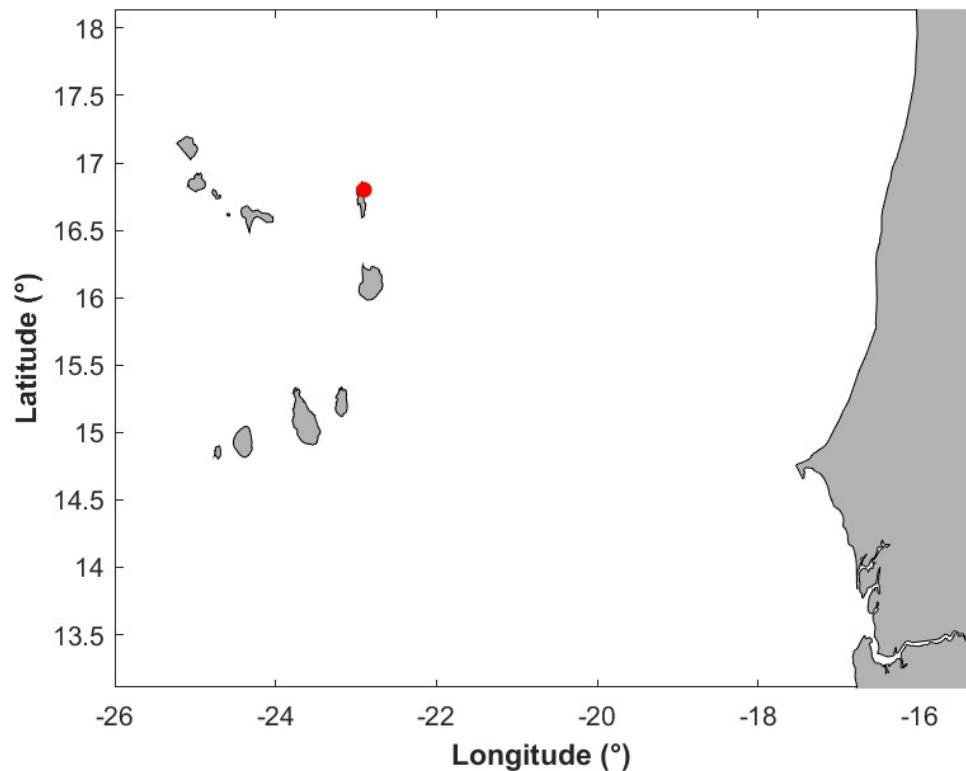


# Case Study: Capo Verde Island



## Particles' direction: Backward

### Study area: Capo Verde island



**Direction: *backward.***

**Spatial resolution:  $0.083^{\circ} \times 0.083^{\circ}$  (~ 10 km)**

**Temporal resolution: 1 day**

**Beaching time: 30/04/2023**

**Latest Time: 01/09/2022**

**Input: 60 macroplastics from the beach of Praia dos Achados (Santa Luzia island, Capo Verde)**

**Output: Points tracking maps**

First simulation: small domain to individuate the possible source area

[laura.corbari@unipa.it](mailto:laura.corbari@unipa.it)

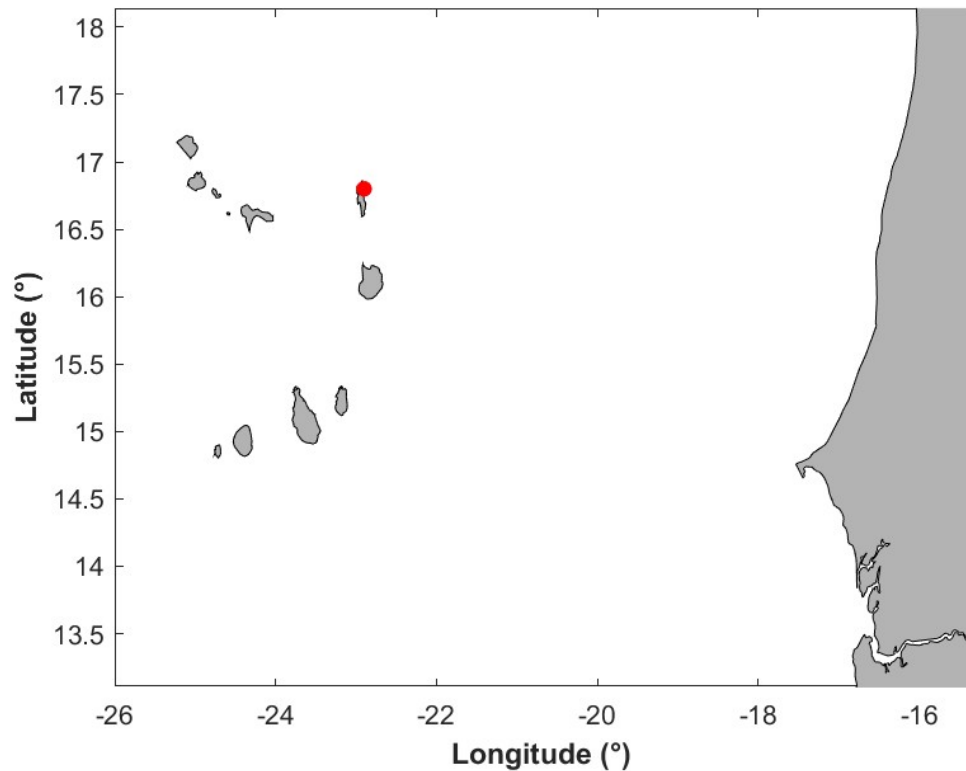


# Case Study: Capo Verde Island

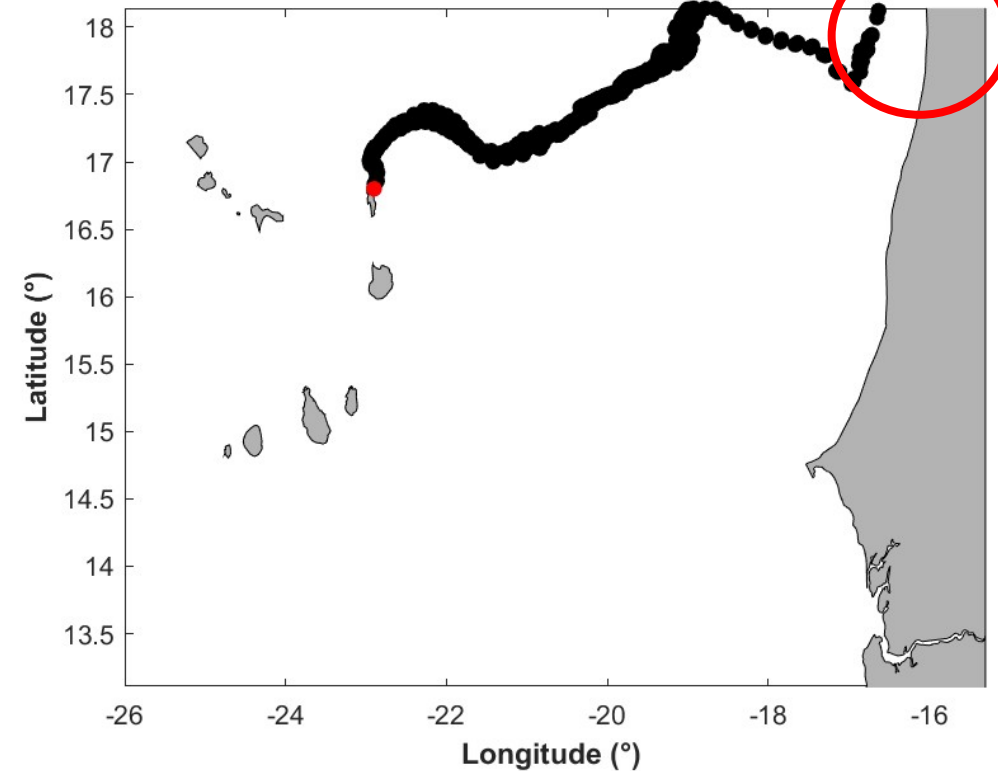


Particles' direction: Backward

### Study area: Capo Verde island



### Points tracking maps



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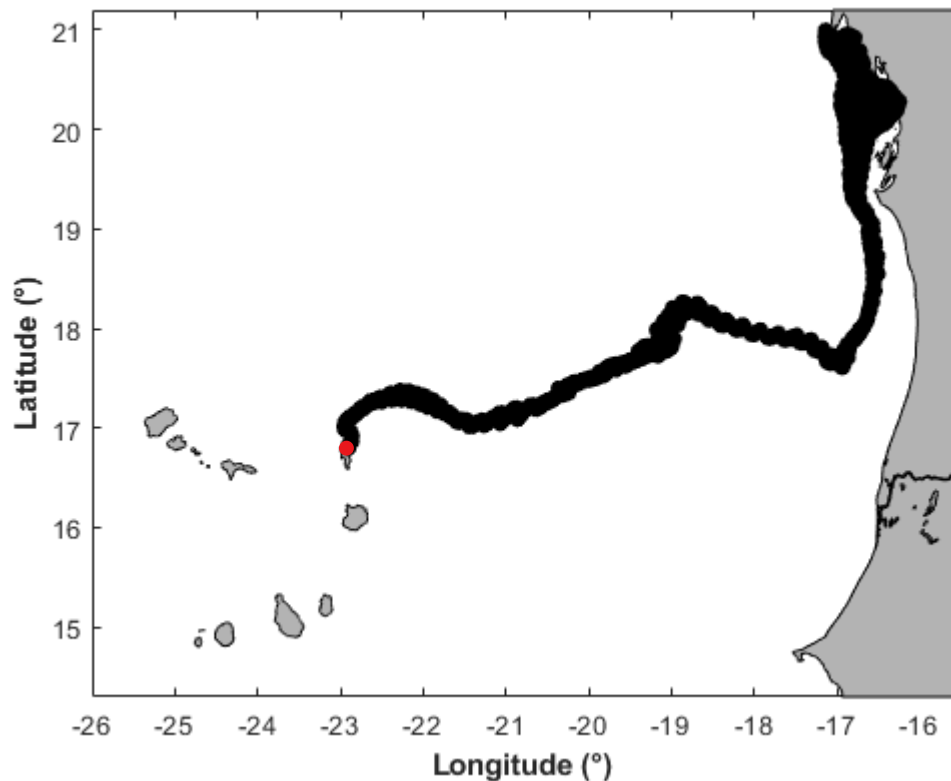
# Case Study: Capo Verde Island



## Particles' direction: Backward

### Study area: Capo Verde island – domain's extension

Points tracking maps



### Outcomes:

Possible source → Arguin Basin, characterized by fishing activity and offshore oil and gas prospecting (Araujo, Antonio, and Pierre Campredon.

*"Banc d'Arguin (Mauritania)." The Wetland Book: II: Distribution, Description, and Conservation (2016): 1319-1332).*

[laura.corbari@unipa.it](mailto:laura.corbari@unipa.it)



# Strengths and weaknesses



## Strengths

- Simulate different phenomena: beaching, washing off, sinking etc.;
- Consider as sources different areas;
- Consider particles having different proprieties (dimension, density, shape etc.);
- Outcomes are reader-friendly.

- Computational demand → need to reduce the investigation area or the temporal/spatial resolution;
- Output validation → in-situ sampling activities are mandatory.

## Weaknesses

[laura.corbari@unipa.it](mailto:laura.corbari@unipa.it)



# Recommendations for further activity



- Analysis on 3D mode simulating other phenomena such as sinking, washing off, etc.
- Improve the temporal simulation (from daily to hourly scale).
- Model's calibration/validation: comparison with in-situ sampling (such as a precise quantification of plastics debris discharge from rivers).
- Additional backward simulations cases.

[laura.corbari@unipa.it](mailto:laura.corbari@unipa.it)





**Thank you for your attention!**

[laura.corbari@unipa.it](mailto:laura.corbari@unipa.it)

