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Tracking sea floating plastics using CMS data through a novel application of the TrackMPD model

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ABSTRACT

The marine pollution caused by the release of plastics' elements is a growing problem. The main sources of plastic litter found at sea are land-based: rivers, plant discharges, beaches, *etc*. One crucial phase in fighting this problem is tracking these particles with the aim of identifying their paths and, consequently, their accumulation. In this framework, the TrackMPD model by Jalón-Rojas et al., 2019 was modified to enable the tracking of particles released over a long time series each day from specific known locations (i.e., several rivers' estuaries). Moreover, two new outputs were generated: density and beaching maps. The study was carried out in the coastal area patch between the Liberia and the Gulf of Guinea within the GDA AID Marine Environment & Blue Economy project. The project, funded by the European Space Agency in collaboration with the Asian Development Bank and World Bank, aims to implement innovative Earth Observation services to assist International Funding Institutions teams in the of marine environment and Blue Economy. The study is part of two Use Cases for the World Bank's PROBLUE and West Africa Coastal Areas (WACA) programs, which focus on the West Africa coastal area. Simulations were performed for the whole 2021 at daily scale by releasing five macroplastics from the five main rivers of the Liberia region. Copernicus Marine Service (CMS) sea current fields were considered as forcing (product GLOBAL_ANALYSISFORECAST_PHY_001_024) together with other ancillary data. Results confirmed that the plastic pollution at sea is a boundless issue, hard to be tackled. pervasive issue that is challenging to address.

CASE STUDY

The study area is located in West Africa, considering the release of macroplastics from the Liberian region. The sources of particles are the five main rivers of Liberia (Figure 1, red box – bolded rivers). For each river estuarine 5 particles per day were deployed and subsequently tracked throughout 2021.

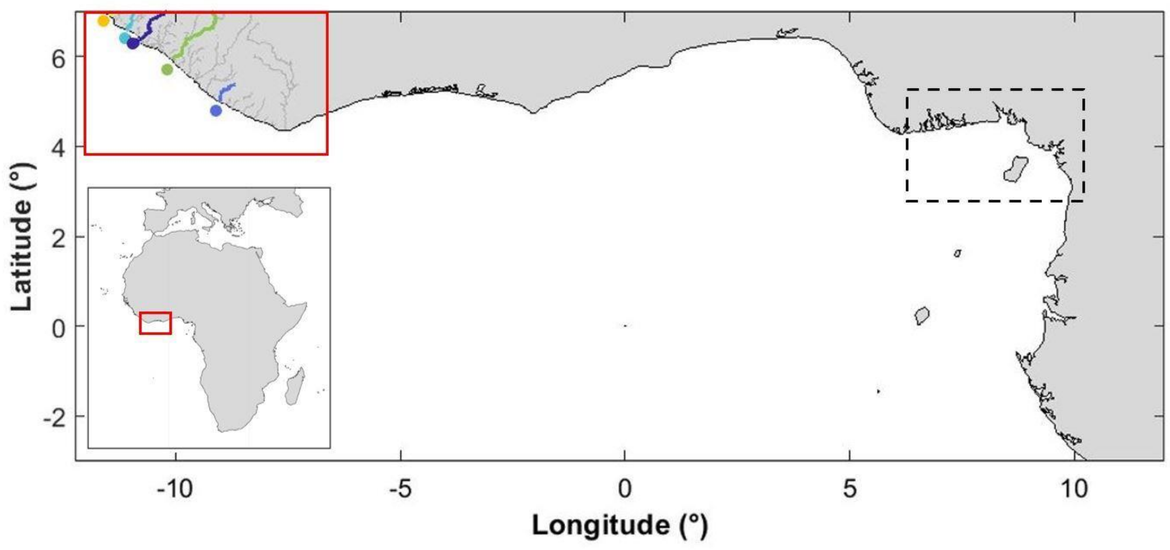

Figure 1 – Study area: Red box represents the input zone while the dashed black box represents the area where the accumulation maps are displayed in the result section.

MATERIALS AND METHODS

The particle tracking is performed by means of the TrackMPD model. It was modified to allow the simulation of the pathways of particles daily released from known locations (*i.e.* the rivers' estuaries).

The forcing of the model are the U (Eastward) and V (Northward) Copernicus marine services (CMS) velocities at surface (product "GLOBAL_ANALYSISFORECAST_PHY_001_024"). The 2D simulations were performed at 1 day temporal and 0.083° × 0.083° (*i.e.*, ~ 9 km) spatial scales. Additional input data were required to achieve the simulations (Figure 2). Among the three outputs of the model the density map represents the number of particles per pixel; whereas the beaching accounting for the density map computed within a coastal buffer of 2 times the spatial resolution of the CMS grid (*i.e.*, ~ 18 km).

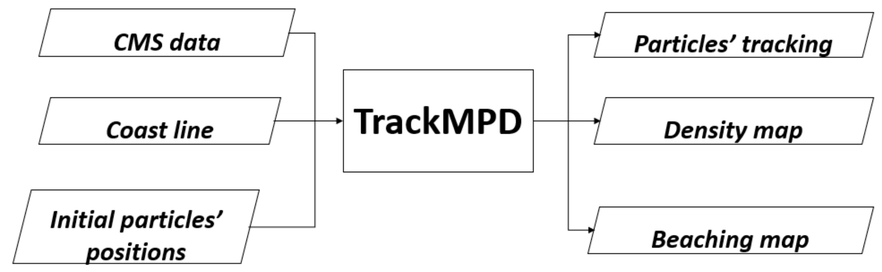

Figure 2 – Research workflow.

RESULTS

Figure 3 shows the outputs achieved for three representative days and in particular the density and the beaching maps.

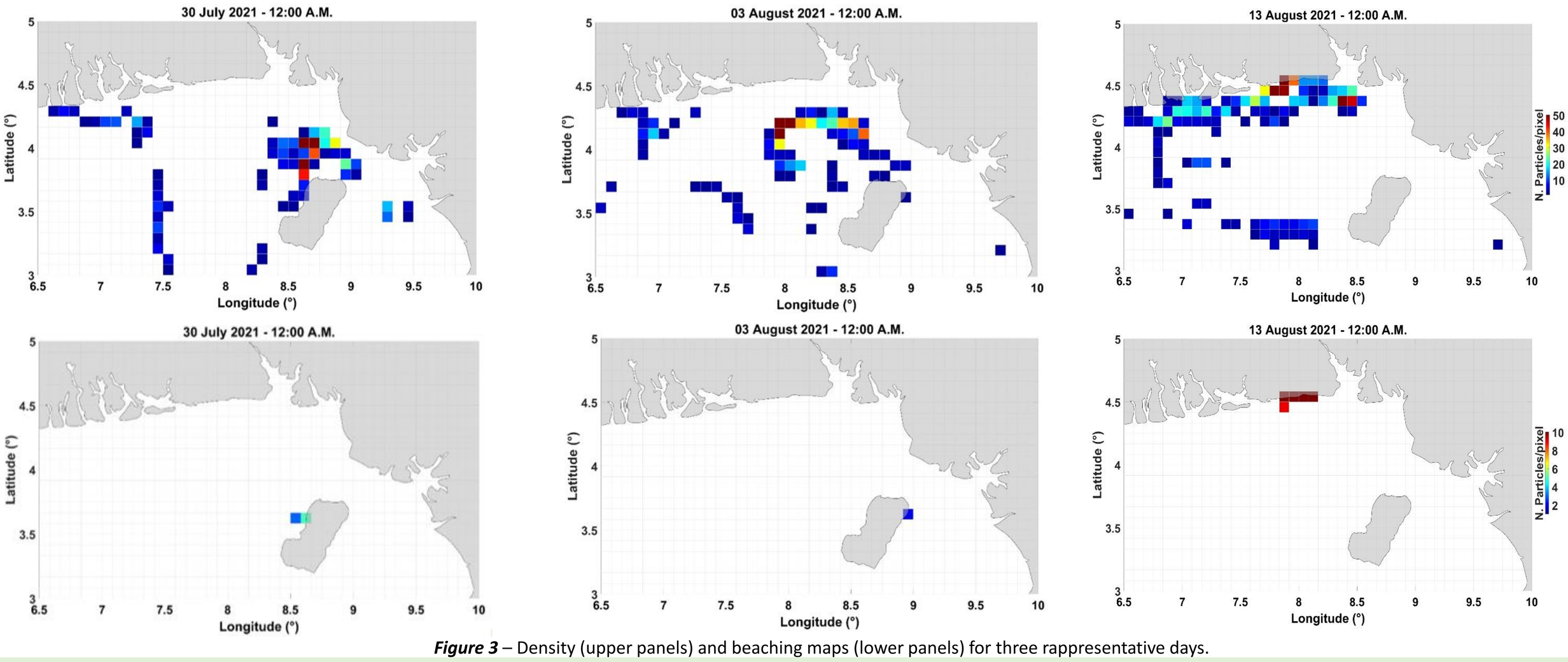

Figure 3 – Density (upper panels) and beaching maps (lower panels) for three rappresentative days.

CONCLUSIONS

This research confirms that the problem of plastics released at sea surface is a boundless issue; thus, a transboundary coordination is mandatory to tackle this growing kind of marine pollution. Results indeed show that, in the considered scenario, the discharge from Liberia's rivers can affects areas quite distant from the source. A further improvement will be the use of different forcing factors (such as hourly-scale sea current fields) available and conducting a real case study where in situ sampling is available related e.g. to quantity of plastics discharged by rivers or beached in specific coastal areas. Also, the World Bank teams suggested testing the 3D model and accounting for biofouling and refloating application of this method n the area of Mauritania to estimate sources of plastics beached in this area (backward simulation).