Technium EcoGeoMarine
Technium EcoGeoMarine Vol. 1, No.2 pp.36-43 (2023)
ISSN: 2971-8112
www.techniumscience.com

Analysis of hydrocarbon dispersion film in Casablanca port area

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Abstract. The main focus of this paper is the analysis of the dispersion of hydro screws in the area of Casablanca harbour. In the following I will analyse the evolution of hydrocarbon dispersion according to the parameters: wind and current and their combined action. Subsequently, based on the analysis performed and depending on the amount of hydrocarbon discharged, in the chosen area, I will also choose how to clean the spilled hydrocarbon.

Keywords: gnome, hydrocarbon, pollution, port of Casablanca

1. Introduction

The aim of the paper is to draw attention to the devastating effects on the marine and coastal environment in terms of oil pollution and the importance of a well-formed system for such events to be significantly reduced. Protecting the marine environment is vital for the health of marine species and for the smooth running of freight transport of any kind.
The analyzed area is Morocco's largest city and port and also among Africa's largest commercial centers. The main trading items are cereals, leather, wool and phosphates. Among the important industrial branches in this city are: fishing, building materials, glass production, tobacco processing. It is also a modern city full of history. [1,2,3]. Casablanca located in the northern hemisphere, at latitude 33 degrees. The comfortable water temperature for swimming is set here in May, almost always only at the end of the month. During a year in Casablanca (Fig.1) there are 162 days of swimming. In general, the swimming season ends in October. Average annual water temperature on the coast in Casablanca is 19.6°C, by the seasons: in winter 17.2°C, in spring 18.0°C, in summer 22.2°C, in autumn 21.0°C. Minimum water temperature (15.8°C) in Casablanca it happens in February, maximum (23.8°C) in August. [4,5,6]
The hydrocarbon despair in the Casa Blanca port area will be analysed from 18.04.2023 to 27.04.2023. This analysis will use wind and current data generated from NOAA's database.

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Figure 1. Casablanca zone [2]

2.Material and Methods

Area of interest generated using information taken from NOAA's database:

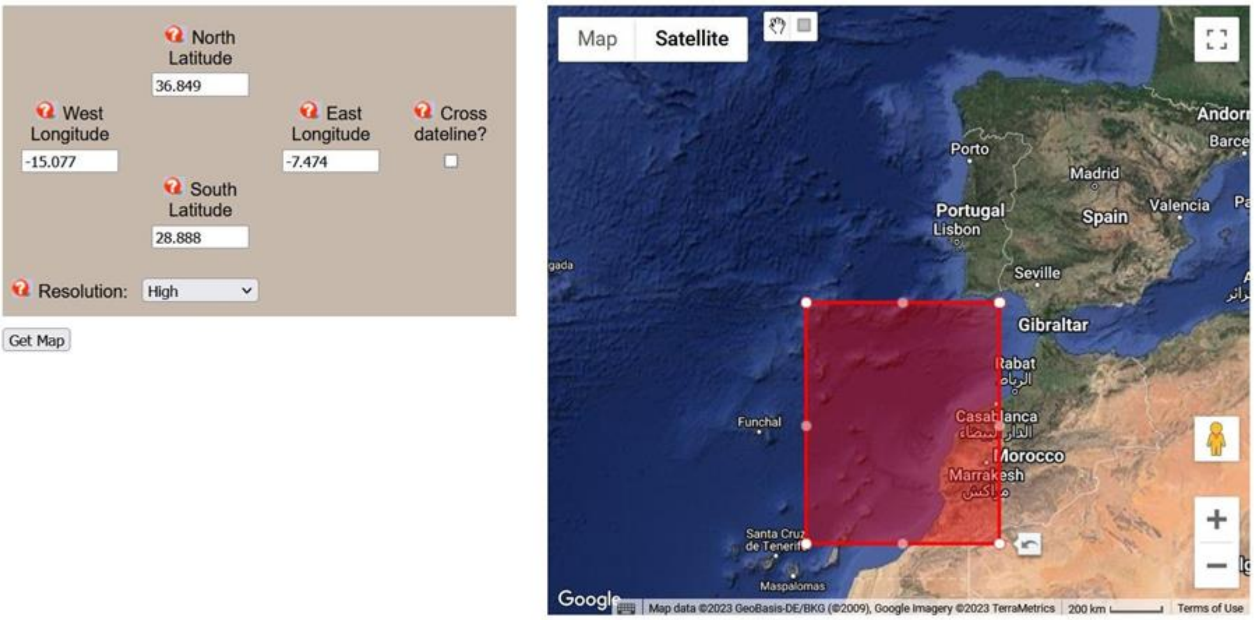

Figure 2. Casablanca Port Area [3]

Next we will use the GNOME program in Diagnostic mode to achieve the evolution of hydrocarbon dispersion in the selected area [7] (Fig. 2).
Step 1. Selection of the area of interest folder in the GNOME program (fig. 3):

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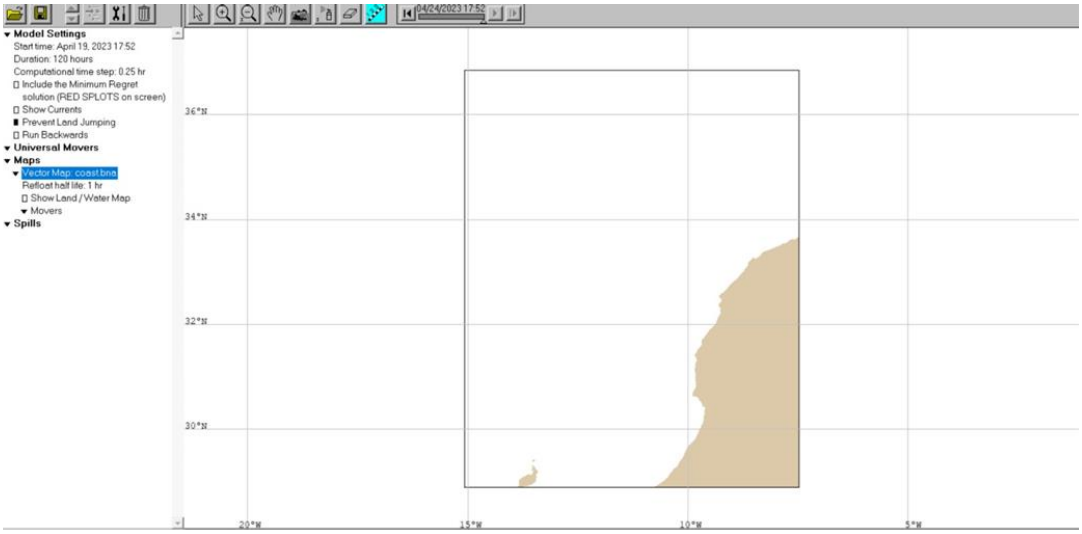

Figure 3. GNOME Software Area of Interest Map

Step 2. Real-time wind generation for the area of interest:

Next, wind data for the chosen area was generated and then generated in the Gnome software. (fig.4 and 5)

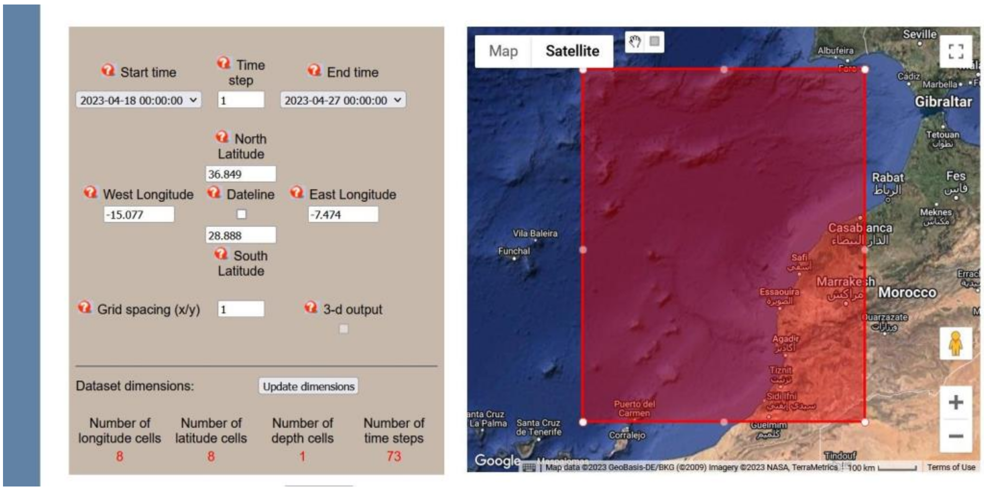

Figure 4. Map generation with wind data in the chosen area [8]

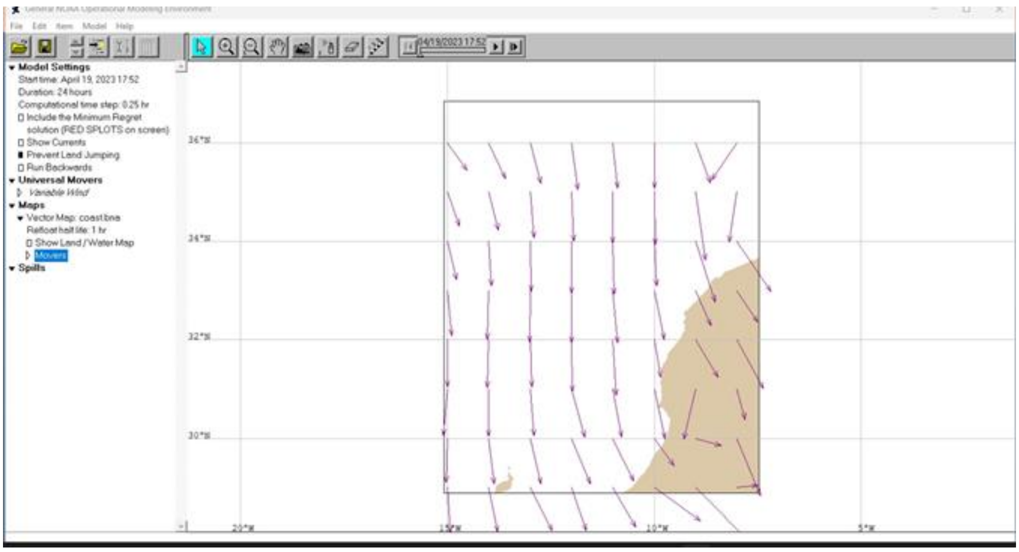

Figure 5. Real-time wind generated in GNOME software

Step. 3. Select data for current (fig.6):

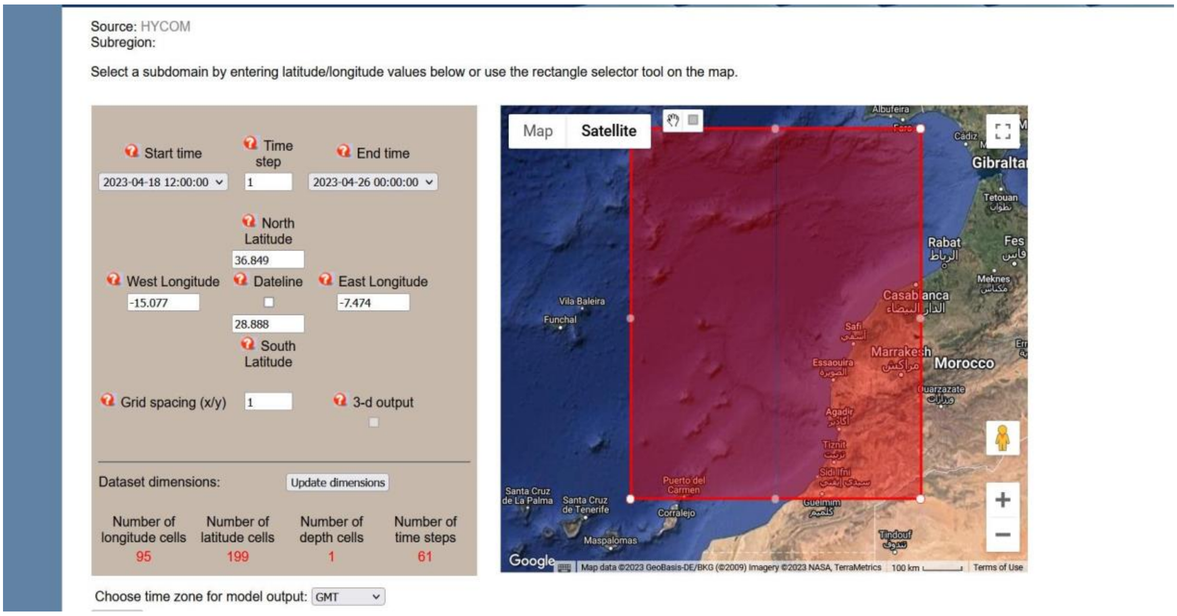

Figure 6. Select the current data map [8]

Step 4. Generation of hydrocarbon analysis according to combined wind and current parameters [9, 10] (fig.7):

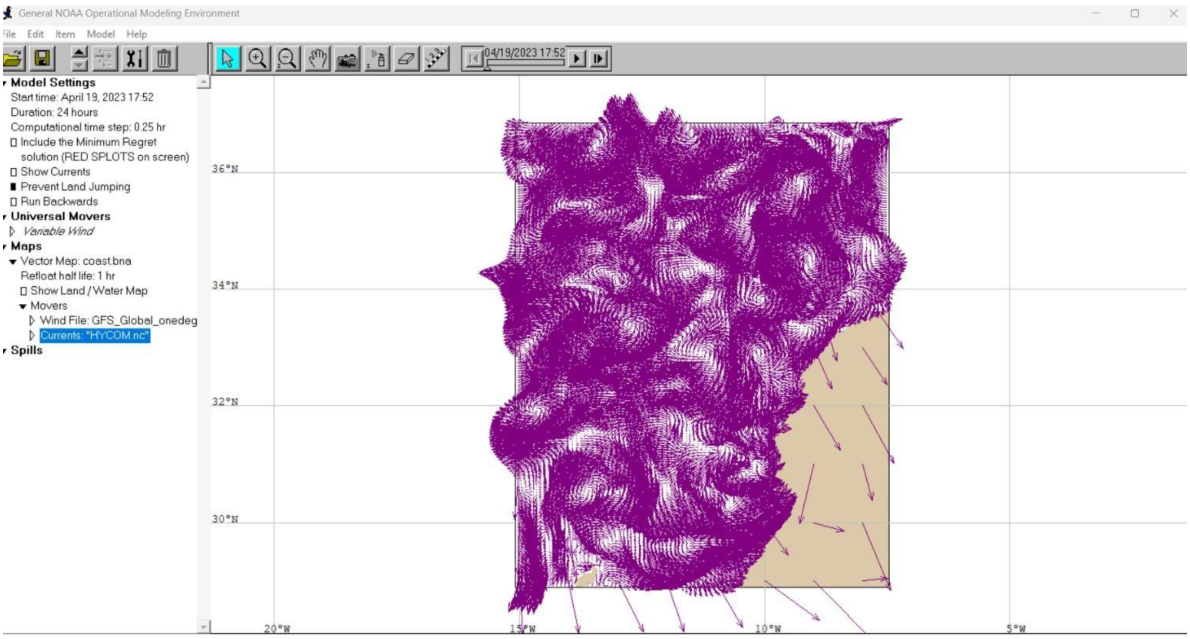

Figure 7. Screenshot showing the combined action of wind and currents in the created area (map)

Step 5. The next step is to represent the amount of hydrocarbon spill (according to a predetermined scenario or any real situation under the conditions of the spill on board) (fig.8):

Select in the Gnome program the option spills, and then create:

a. Pollutant DIESEL, 20000 metric tons:

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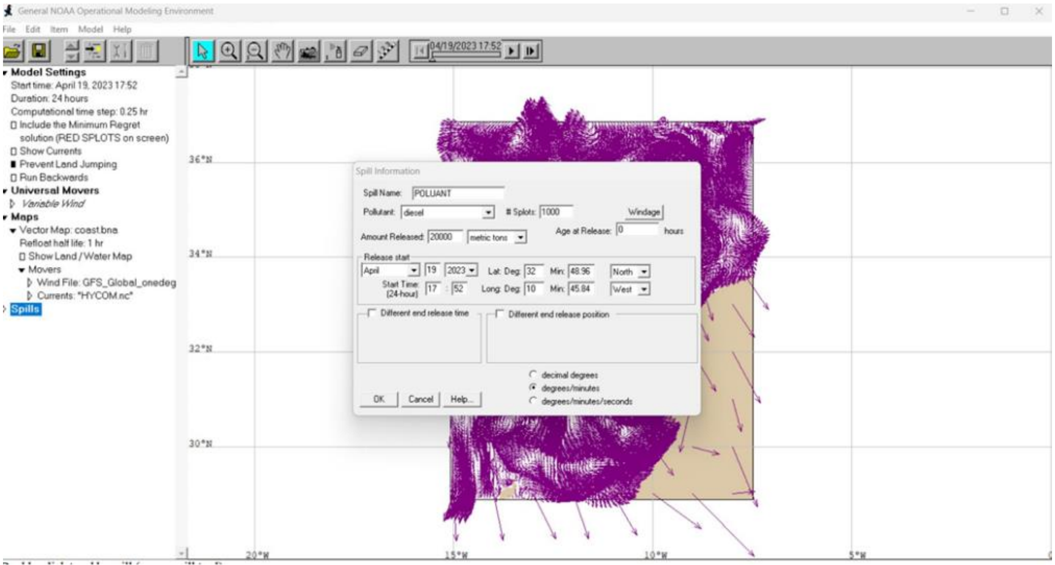

Figure 8. Selection of pollutant type, discharge name, quantity and position with geographical coordinates

Step 6. Select Ok, then model settings with duration option (select 5 days or as much as we want dispersion viewing interval) and press ok (fig. 9):

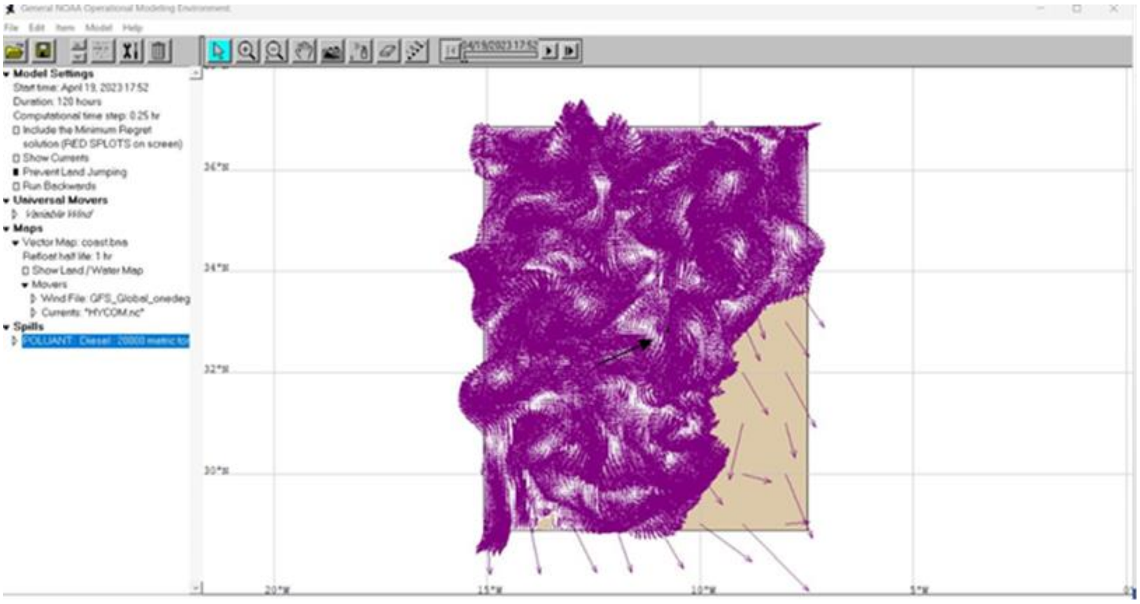

Figure 9. Visualization of the created hydrocarbon film

3. Results and discussion

Following the analysis carried out of the hydrocarbon dispersion between 18.04.2023 and 27.04.2023 in the area of Casablanca port, it can be seen that the spilled film of fuel of 2000 metric tons had a rapid ascent due to the combined action of wind and current (fig.10).

Effects of pollutant spills on the marine environment Oil spills (including gasoline, diesel, bunker fuel and crude oil) remain among the most publicized and damaging disasters worldwide. While transporting oil is responsible for only 12% of all oil spills worldwide, about two-thirds of them come from seagoing vessels. [4] While all petroleum products are transported as cargo, bunker fuel is the main fuel used for seagoing vessels. Accidental discharges result from human error (e.g. stranding) and technological failures (e.g. explosions) [11]. Operational discharges are intentionally caused by neglect or violation of international conventions. Of the 459 "large" discharges (> 700 tonnes) between 1960 and 2016, more than half occurred in the 1970s and only 44 (< 10%) since 2000 according to ITOPF [12, 13].

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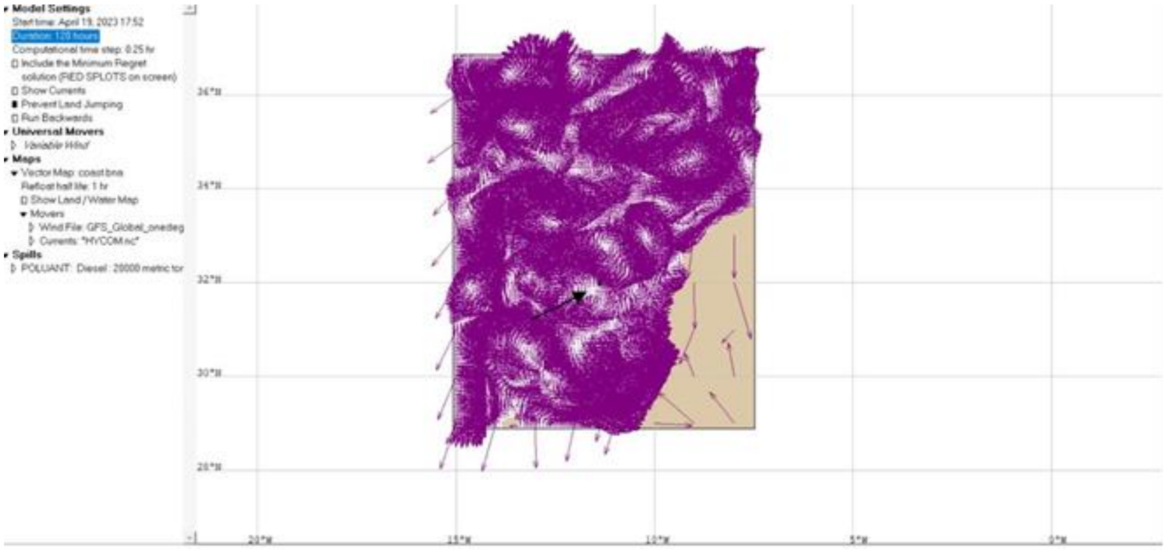

Figure 10. The final position of hydrocarbon film

Once discharged, the physical and chemical properties of the oil undergo weathering, dissolution, oxidation and volatilization, resulting in various environmental impacts. The action of the waves incorporates oil into the water column, while calm conditions allow oil slicks to spread over surface waters and shores. Oil dispersion is higher for medium quality petroleum products (e.g. gasoline) that evaporate rapidly compared to dense, heavy oils that persist longer in the environment and sink through the water column into sediments. Oil stains pose the greatest threat to seabirds and marine mammals, soiling their skin or feathers. The severity of oil spills on marine organisms depends on the type of oil, route of exposure and degree of weathering. Oil damages marine organisms through acute toxicity, sub-lethal health effects that reduce physical fitness. [14]
Seabirds are severely affected by oil spills and often go unreported (fig.11). For every dead bird contaminated with oil discovered and reported, it is estimated that up to 10 times as many birds may die from the effects of oil spills. Seabirds dive to search for food, thereby passing through oil spots, which are easily absorbed by feathers, which become dirty. Even small amounts of surface oil interfere with the natural waterproofing and insulating properties of bird feathers. Ingested oil or oil embedded in feathers can also be transferred into eggs, resulting in reduced shell thickness and poor reproductive success. For fish, eggs and juvenile stages pose the greatest risk due to oil exposure. [13, 14]

Pollution in the North Atlantic: plastic pollution has been reported in the North Atlantic Ocean since the 1970s, but limited data in the coming decades pose challenges when assessing spatio-temporal trends in global runoff and response strategies. This study quantified microplastics in the upper ocean along a longitudinal transsection of the North Atlantic and its subtropical gyration. Microplastics were taken from surface and groundwater (-25 m) using a Manta trawl and NIKSIN bottle, respectively. The community of surface water polymers varied significantly between geographical positions ("term", "gire", "open ocean") and was significantly influenced by the amount of fragments [15].
Compared to other positions, North Atlantic gyration was associated with high concentrations of polyethylene, polypropylene, acrylic and polyamide fragments. Groundwater was dominated by polyamide and polyester fibers. The 2-year Lagrangian simulations illustrated connectivity models. Continuous monitoring of microplastics in the water column of the North Atlantic Ocean is necessary to address knowledge gaps and assess spatio-temporal trends. (fig.12) [15].

Figure 11 The effect of oil spills on birds [14]

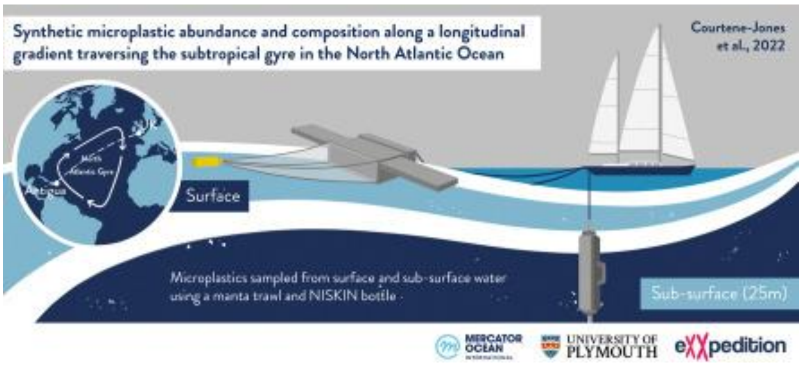

Figure 12. Synthetic micro plastic in the North Atlantic Ocean [15]

4. Conclusions

It is necessary to pay particular attention to the marine and coastal environment in order to address an efficient, practical and achievable system to mitigate marine accidents, especially those involving hydrocarbons that cause imminent disasters and their consequences are seen both at the time of the spill and in the future.
Also, the analyses carried out for the evolution of hydrocarbons in case of pollution accidents, help researchers to make a statistic and concisely evaluate both the effects in case of such an event and the potential solutions that can be adopted to reduce the number of accidents annually.
This analysis was carried out with the help of the Gnome program. Gnome has been specifically designed for such situations involving environmental issues, preventing and combating marine oil pollution. It develops computational and statistical analysis procedures, presents the physical processes that take place at the surface of the ocean/sea and which are important in determining the movement and spread of the pollutant, describes the use of historical information and forecasts regarding the ocean and atmosphere, but also the statistical implications of their use in trajectory analysis.

Acknowledgement

This article is the result of research carried out during my Master's studies in Oceanography and Hydrography at the Naval Academy in 2021-2023.

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