**Report: Visualizing and Analyzing Marine Plastic Dispersion Patterns in the North Atlantic through PlasticADrift Simulations**

**Introduction to Marine Sciences GEO4-1451**

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**September 29, 2024**

Word Count: 539

**Introduction**

This report intends to visualize and analyze dispersion patterns of marine plastic at surface waters which is representative of surface level ocean currents and flow. The model here uses Lagrangian drifter data in an online, free-acess site accessed via adrift.org.au. Distribution of marine plastic over time in the North Atlantic and the limitations of the model will be discussed.

**Methods**

To obtain visual animations and csv files, the webpage adrift.org.au is being used which is an open, online site for analyzing timescale and dispersion patterns of pelagic plastics and is being used as described by Van Sebille et al. (2012) and Van Sebille (2014). Data from drifter buoys present coordinates of the buoy after being deployed and are representative of their movement in the ocean. The animation runs for 10 years forward in time, with increments of 2 months. Data from the visualization is obtained as csv files which is analyzed using R-Studio (Version 2023.06.2+561). Here, the model starts at latitude = 4.2˚, longitude = -44.1˚ and starts in the period Jan-Feb.

**Results**

The initial point for marine plastic can be seen in Figure 1(a) and the apparent change in the distribution of the plastic after almost 10 years can be visualized from Figure 1(b). It is evident that the plastic has been accumulated primarily in the North Atlantic Subtropic Gyre.

A screenshot of a map

Description automatically generated

Figure 1: Visualisation of dispersion of marine plastic through PlasticAdrift at 2 months (a) and after 118 months (b)

A decline in the total plastic concentration can be seen over time with a steep decline in the first 20 months (Figure 2).

A graph with a line going up

Description automatically generated

Figure 2: Total plastic concentration over time (120 months). The maximum probability at any point is 1.00

Figure 3 provides more insights in the spatial distribution of the plastic. We can infer that all the plastic was in the equatorial Atlantic waters (initial point) and see how it dispersed over time with most of it being concentrated in the North Atlantic Subtropical Gyre. This can also be visualized in Figure 4 with an animated bar graph and in Figure 5 with a visual world map showing the time it takes for plastic to disperse in and around the North Atlantic.

A graph with different colored lines

Description automatically generated

Figure 3: Distribution of plastic concentration in different defined regions over time since inferrred via movement of deployed buoys over a period of 120 months

A graph with green bar and colorful text

Description automatically generated with medium confidence

Figure 4: Animated distribution of the fraction of plastic found in different defined marine regions over time inferred via the movement of deployed buoys. The animation progresses from 0 to 120 months

A map of the world

Description automatically generated

Figure 5: Visual representation of the time it takes in years for plastic originally located in the Equatorial Atlantic to reach other regions of the North Atlantic

**Discussion**

Plastic is initially concentrated in the Equatorial Atlantic and Gulf of Mexico, but over time dispersed towards North Atlantic and predominantly in the subtropical gyre (Figure1). This appears to follow major ocean current pathways including the Gulf Stream transport, Trade Winds and Westerlies. The total plastic fraction decreases rapidly within the first 10-20 months and then stabilizes. This indicates a relatively fast initial dispersion from the release point. The fraction of plastic in regions like the Equatorial Atlantic and North Atlantic Subtropical Gyre rises over the first 20 months, then fluctuates (Figure 3,4) suggesting continuous movement and mixing within oceanic currents. The rapid dispersion is consistent with the swift currents in the equatorial and Gulf regions. It is possibly faster than expected for some areas, highlighting the influence of strong oceanic currents (wind) in the dispersion process. The NA subtropical gyre accumulates a significant fraction of plastic, reflecting the role as a convergence zone due to Ekman transport, Coriolis Effect, and Geostrophic Force (Figure 1 (b), 3, 4, 5). Although the visualization and data are consistent with oceanic currents forming the NA subtropical gyre and the garbage patch, PlasticAdrift does not model the effect of wind, waves, storms or vertical mixing with depth requiring additional insights and limiting the actual dispersion (Van Sebille, 2014).

**References**

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