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TITLE: Simulating transport pathways of pelagic Sargassum from the Equatorial Atlantic into the Caribbean Sea

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ABSTRACT:

Since 2011, beach inundation of massive amounts of pelagic Sargassum algae has occurred around the Caribbean nations and islands. Previous studies have applied satellite ocean color to determine the origins of this phenomenon. These techniques, combined with complementary approaches, suggest that, rather than blooms originating in the Caribbean, they arrive from the Equatorial Atlantic. However, oceanographic context for these occurrences remains limited. Here, we present results from synthetic particle tracking experiments that characterize the interannual and seasonal dynamics of ocean currents and winds likely to influence the transport of Sargassum from the Equatorial Atlantic into the Caribbean Sea. Our findings suggest that Sargassum present in the western Equatorial Atlantic (west of longitude 50°W) has a high probability of entering the Caribbean Sea within a year's time. Transport routes include the Guiana Current, North Brazil Current Rings, and the North Equatorial Current north of the North Brazil Current Retroflexion. The amount of Sargassum following each route varies seasonally. This has important implications for the amount of time it takes Sargassum to reach the Caribbean Sea. By weighting particle transport predictions with Sargassum concentrations at release sites in the western Equatorial Atlantic, our simulations explain close to 90% of the annual variation in observed Sargassum abundance entering the Caribbean Sea. Additionally, results from our numerical experiments are in good agreement with observations of variability in the timing of Sargassum movement from the Equatorial Atlantic to the Caribbean, and observations of the spatial extent of Sargassum occurrence throughout the Caribbean. However, this work also highlights some areas of uncertainty that should be examined, in particular the effect of 'windage' and other surface transport processes on the movement of Sargassum. Our results provide a useful launching point to predict Sargassum beaching events along the Caribbean islands well in advance of their occurrence and, more generally, to understand the movement ecology of a floating ecosystem that is essential habitat to numerous marine species.

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