# Researchers trace plastic waste routes from coastlines to massive garbage patches

By Kate Baggaley

Last modified 8 hours ago. Published 12 hours ago.

Plastic waste can now be tracked from shore to garbage patch. (AP Image/Eldar Emric)

Scientists have developed a mathematical model to trace the several million metric tons of plastic trash deposited in the ocean each year, tracking pathways that debris takes on its way to massive garbage patches, such as the Great Pacific Garbage Patch located between Hawaii and California.

The findings, published March 2 in *Chaos*, also identified two areas where previously undiscovered garbage patches may be lurking.

"The identified pollution routes provide targets, alternatives to the great garbage patches themselves, for activities such as ocean cleanup," Philippe M cientist at the University of Miami's Rosenstiel School of

Marine and Atmospheric Science and first author of the study, said in an email.

Garbage patches collect all kinds of litter, from tiny bits of plastic to abandoned fishing gear, and are formed by rotating ocean currents called gyres. The ocean has five gyres — one in the Indian Ocean, two in the Atlantic Ocean and two in the Pacific Ocean — each with garbage patches of varying size, according to the National Oceanic and Atmospheric Administration.

To understand how trash reaches these patches, Miron and his colleagues used trajectories recorded by surface buoys belonging to NOAA's Global Drifter Program, which employs around 1,300 satellite-tracked buoys to measure ocean currents. Like plastic debris, the buoys' movements are shaped by winds, waves and currents, and they tend to wind up in gyres. The team also consulted past estimates of littered or improperly disposed of plastic waste to determine how debris is released from coastlines around the world.

The researchers then split the ocean's surface into about 4,000 boxes and used a mathematical model called a Markov chain to gauge the probability of a piece of plastic moving from one of these sea-surface regions to any of the others. This allowed them to identify the likely routes this debris would follow to travel from the coast to a gyre, from one gyre to another or from a gyre back to the coastline where it might wash up on the beach.

The researchers found that plastic in the Great Pacific Garbage Patch was particularly likely to originate from the coasts of Eastern Asia, and overall, the North Pacific gyre seemed to have the strongest attraction for marine debris. On the other hand, the Indian Ocean gyre seemed to be a relatively weak trap for plastic waste; the researchers identified many pathways from coastlines in the Indian Ocean that led to the South Pacific Ocean and the South Atlantic Ocean. These three regions are connected through a current that travels around Antarctica, Miron said.

Generally, plastic did not seem to travel much from one gyre to another; in the event of unusually intense winds, a subtropical gyre is more likely to send garbage out toward the coastlines than into another gyre. The South Pacific gyre had particularly few pathways to send plastic into other gyres.

Intriguingly, the findings also suggested that there may be two small garbage patches that are relatively close to shore in the Gulf of Guinea and Bay of Bengal.

For this analysis, Miron noted, he and his colleagues did not try to estimate how much plastic moves through any of these pollution routes. Still, identifying where this debris travels is an important step for combating the glut of plastic being dumped into the world's seas. The amount of poorly managed plastic waste around the world could climb to 5 billion metric tons by 2050, according to research published earlier this year, and threatens to suffocate marine animals and contaminate food supplies.

*The article, "Transition paths of m* *ıe stability of the garbage patches," was published March 2 in*

*Chaos. The authors of the study were Philippe Miron and Francisco Beron-Vera, University of Miami; Luzie Helfmann, Freie Universität Berlin, Zuse-Institute Berlin and Potsdam Institute for Climate Impact Research; and Peter Koltai, Freie Universität Berlin.*

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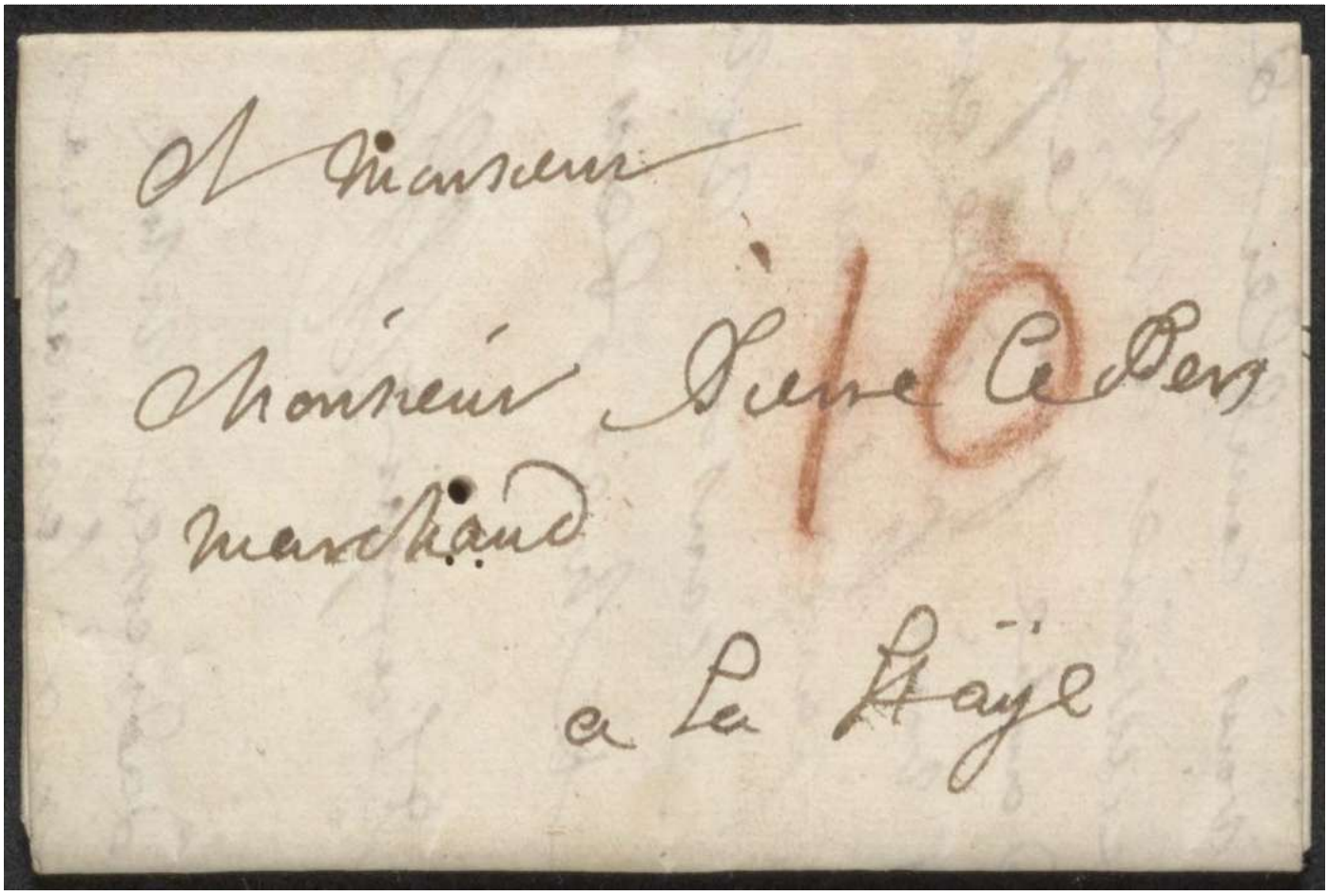

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