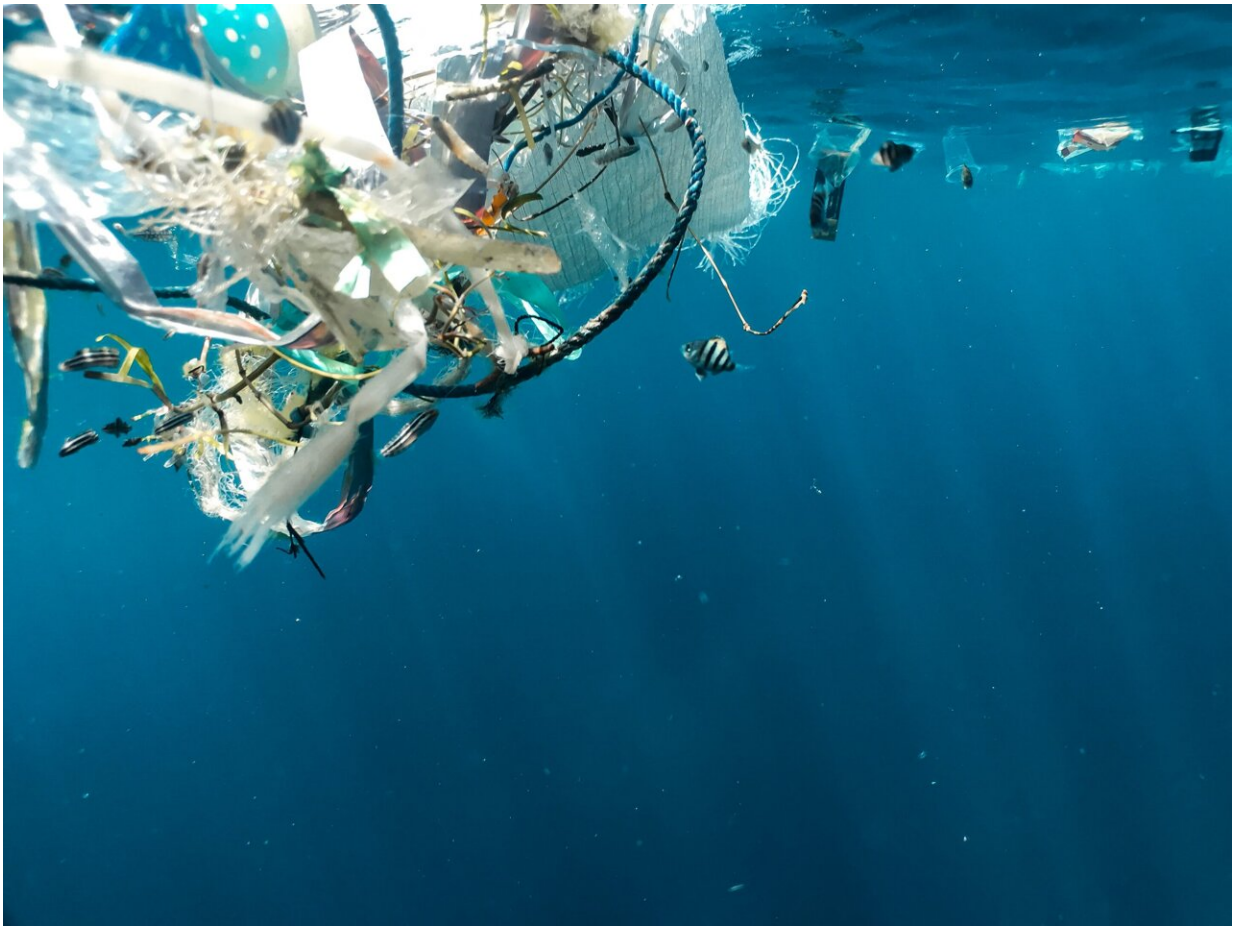
Q&A: Less plastic entering the ocean than previously believed, but it's not all good news

August 16 2023



Credit: Unsplash/CC0 Public Domain

It seems that only about a tenth of the plastics end up in the oceans

compared to what was previously thought. This is the result of a recent analysis by Mikael Kaandorp, who joined Forschungszentrum Jülich in November last year from Utrecht University in the Netherlands. The bad news is that it lingers longer and that there is currently 10 times more plastic waste floating in the sea.

The study, published in the journal *Nature Geoscience*, helps to solve the mystery of the "missing plastic" in the oceans and received worldwide attention.

For years, researchers were faced with the question of where all the plastics that should be ending up in the oceans, according to model calculations, has gone. In the following interview, the data scientist Mikael Kaandorp from the Jülich Institute of Bio- and Geosciences (IBG-3) talks about how to interpret the new figures and the research questions he is currently pursuing.

Dr. Mikael Kaandorp, what was the motivation for this study?

In 2014 and 2015, there were widely cited studies concluding that about 8 million metric tons of plastics enter the ocean every year. But researchers could only find about 250 thousand tons at the ocean surface. There is a huge mismatch. As an analogy, you can also think of a bank account. If you earn 8 million every year but only have 250 thousand in your account, you might wonder where the rest of all this money is ending up. So, the question was: Where is all the plastic? This question was also the focus of my Ph.D. project at Utrecht University.

For my recent paper we created a large, complex computer model using data assimilation techniques. This means we included as many measurements into the model as possible. We integrated for example

measurements of plastics concentrations at the ocean surface and from deeper layers in the ocean, and from beach cleanups. There are a lot of measurements, we found 20,000 of them in the scientific literature.

With the help of these measurements, we tried to estimate how much plastic is going into the ocean and where it ends up. We came up with figures that are very different from those in the studies in 2014 and 2015. According to our model, there is only half a million tons of plastics entering the oceans every year instead of 8 million. And we think that there are more plastics at the surface, 2 million tons instead of the 250 thousand tons estimated in 2015.

Are the new numbers good or bad news?

It's kind of both. One the one hand it is good that the waste seems to be concentrated in larger pieces. These are easier to pick up, especially when they wash up on the beach. And, of course, it is good news that there seems to be much less plastics entering the oceans every year. But on the downside, we really see that the plastics have a very long lifespan in the ocean.

We know this because our model gives a quite concise picture of the mass balance. If you know how much plastics is entering the ocean every year and how much is currently floating in the ocean you can estimate how long it will stay there.

They stay there for decades. This means that the total amount is increasing, according to our estimates by 4%. In theory, the amount of plastics could double in 20 years. So, this is bad news.

What are the differences from previous studies?

Previous studies focused mainly on microplastics, because there are a thousand times more of them in the ocean than larger objects. This means, in measurements you mainly find these microplastics and miss the larger ones. I also had the opportunity to see for myself how these measurements are made. For my Ph.D., I went on a scientific cruise to the Azores in the Atlantic. The aim of the trip was to get a real-life experience of how these measurements were taken and to get a better sense of their limitations. It was really interesting to see how it works.

A crucial point of our study was the finding that larger items that exceed 2.5 cm in size make up the bulk of the mass, about 95 percent, while small microplastics are the most numerous in our ocean. This has likely been overlooked in previous studies.

But even now, there are many open questions. For example, it is not clear how fast the plastics sink into the ocean. This is a super complex problem because you can get a layer of algae on the plastics making them heavier than seawater and causing the pieces sink down. Different regions in the ocean contain different species of algae, so this process might vary from place to place. Fragmentation is also still quite uncertain. It is not clear how quickly larger pieces break down into smaller pieces. There are only some basics estimates but this rate might vary for different types of plastics which all have different properties.

What problems are you currently working on?

In Jülich I am now dealing with completely different issues. I am working on land surface modelling and land subsurface modelling which is part of the collaborative research project DETECT. I am involved in the data assimilation, where we combine numerical models with observational data. The methodology is quite similar to the previous project. The aim is to estimate how humans—through decades of land-use change and intensified water use and management—have caused

lasting changes in the coupled water and energy cycles of land and atmosphere; and to what extent this human activity is influencing the changing climate.

More information: Estimates of global marine plastic mass demystify the missing plastic paradox, *Nature Geoscience* (2023). DOI: 10.1038/s41561-023-01220-4

Mikael L. A. Kaandorp et al, Global mass of buoyant marine plastics dominated by large long-lived debris, *Nature Geoscience* (2023). DOI: 10.1038/s41561-023-01216-0

Provided by Forschungszentrum Juelich