



A tracer like no other: using marine plastic debris observations and models to improve understanding of ocean circulation

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Plastic debris in the ocean is an atrocity, a testament of our wasteful societies and may pose harm to marine life. However, the plastic debris may also provide a unique opportunity to further improve our understanding - and thereby modelling capabilities - of the global ocean circulation, as its distribution can tell us about the way it's transported around.

Oceanographers have used opportunistic tracers like CFCs, bomb carbon and radionuclides to study transport and mixing in the ocean for decades. However, plastic debris has properties unlike any other tracer. It's mostly buoyant, although its buoyancy depends on its material and shape. Its sources are relatively well known, being mostly on densely populated coastlines and productive fishing grounds. Its lifetime in the ocean is much longer than the time since mass production kicked in, implying that most of the plastic that ever entered the ocean is likely still around.

Plastic is found in different forms and different concentrations in many places around the world oceans. Given a large enough data set, it should in principle be possible to set up a large inverse model that relates sources, via transport mechanisms such as ocean currents, to the observed distribution of plastic. Using data assimilation and other machine learning techniques, it might then be possible to constrain some of the properties of the plastic such as fragmentation and biofouling rates. This is the goal of the topios.org project.

Here, I will present some results of preliminary studies where we use regional variations in floating plastic concentration to assess the role of (submesoscale) eddies in mixing surface material. I will first focus on the Southern Ocean, where the relative contributions of the eastward Antarctic Circumpolar Current, the northward Ekman transport, mixing by eddies, and transport by Stokes drift are investigated. I will then show how this framework can be extended to other regions of the world ocean.