

EGU21-4092

<https://doi.org/10.5194/egusphere-egu21-4092>

EGU General Assembly 2021

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## Global modelling of plastic beaching indicates coastlines and coastal waters as significant plastic reservoirs

**Victor Onink**<sup>1,2,3</sup>, Cleo Jongedijk<sup>4</sup>, Matthew Hoffman<sup>5</sup>, Erik van Sebille<sup>3</sup>, and Charlotte Laufkötter<sup>1,2</sup>

<sup>1</sup>Climate and Environmental Physics, Physics Institute, University of Bern, Bern, Switzerland

<sup>2</sup>Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland

<sup>3</sup>Institute for Marine and Atmospheric Research Utrecht, Utrecht University, Utrecht, Netherlands

<sup>4</sup>Department of Civil and Environmental Engineering, Imperial College London, London, United Kingdom

<sup>5</sup>School of Mathematical Sciences, Rochester Institute of Technology, Rochester, United States of America

The distribution of plastic in the ocean is poorly constrained, with the mass of floating plastic at the ocean surface being orders of magnitude smaller than estimated plastic inputs. Coastlines likely contain significant amounts of plastic, but inconsistent methodologies between beached plastic observations prevent determining the mass and distribution of globally beached plastic. We present Lagrangian model sensitivity experiments to estimate the beached fraction of marine plastic and to investigate the global distribution of beached plastic on coastlines.

We perform simulations where particles, representing masses of floating plastic, are inserted at the ocean coasts. The particles are then advected by surface currents (HYCOM/NCODA global reanalysis and surface Stokes drift from the WaveWatch III global reanalysis) for 5 years. Beaching is parametrized stochastically using exponential probability. Here, we test the sensitivity to e-folding time scales between 1 and 100 days, applied when plastic is within the coastal zone, within 10km of the nearest coastline. Resuspension of beached plastic is parameterised exponentially with an e-folding timescale between 69 and 273 days. No other loss processes are implemented.

Between 39-95% of floating plastic mass is beached after 5 years, with the beached fraction depending on the ratio between the beaching and resuspension timescales. In all simulations, at least 77% of floating plastic mass is found either beached or within the coastal zone, indicating coastal regions are a significant reservoir of mismanaged terrestrial plastic. However, plastic entering the ocean from islands or near energetic boundary currents is more likely to reach the open ocean. The distribution of beached plastic is closely related to the input distribution, with the highest concentrations found in Southeast Asia and the Mediterranean.

Our results highlight coastlines and coastal waters as important reservoirs of marine plastic debris and indicate a need for greater understanding of plastic transport near and at the coastlines. Furthermore, improved representation of plastic beaching can help study marine plastic fragmentation, as mechanical stress during the transitions between coastlines and coastal waters and the increased UV exposure of beached plastic likely contribute to the fragmentation.

