A comparative analysis of global models for riverine plastic input to the ocean

Daniel González-Fernández[1], Caspar T.J. Roebroek[2,3], Charlotte Laufkötter[4,5], Tim H.M. van Emmerik[6], and Andrés Cózar[1]

[1]Department of Biology, University Marine Research Institute INMAR, University of Cádiz and European University of the Seas SEA-EU, Puerto Real, Spain
[2]Directorate D-Sustainable Resources-Bio-Economy Unit, European Commission Joint Research Centre, Ispra, Italy, [3]Institute for Atmospheric and Climate Science, ETH Zürich, Zürich, Switzerland,
[4]Climate and Environmental Physics, University of Bern, Bern, Switzerland Oeschger, [5]Centre for Climate Change Research, University of Bern, Bern, Switzerland,
[6]Hydrology and Quantitative Water Management Group, Wageningen University, Wageningen, the Netherlands

daniel.gonzalez@uca.es @LitRivus

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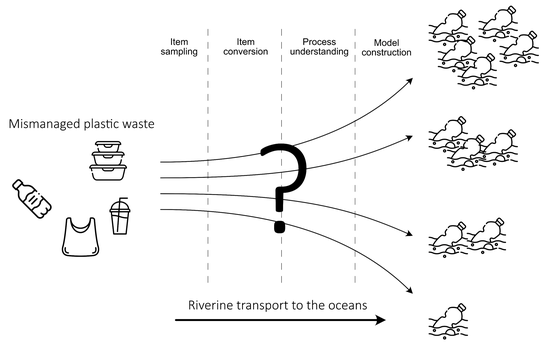
Innovative Solutions for Plastic Free European Rivers

INTRODUCTION

How do we estimate plastic transport by rivers?

- Microplastics sampling
- Macroplastics observations
- Convert items to mass
- Use statistics/discharge to extrapolate to a yearly flux
- Use regression model to get a global estimate (predict plastic flux using river discharge and theoretical plastic waste on land)
  - Concentrations
  - Flux (e.g., items/hour)



» Regression models are not well constrained

TAKE-HOME MESSAGE

How do we reduce uncertainties in riverine plastic input to the ocean?

- Harmonized monitoring methods – improve data comparability
- Representative data (across plastic size spectrum) - better mass estimates
- Long-term monitoring (frequent sampling) - characterize plastic flux variability

Better estimates in individual rivers » better constrained models for global assessments

RESULTS AND DISCUSSION

Global modelling frameworks and estimates of riverine plastic input to the ocean.

		Experimental data in the model			Model framework			
Geograhical coverage	Modelling studies	Number of rivers	Number of samples	Type of samples	Number of basins	Average mass per microplastic (g)	Average mass per macroplastic (g)	Annual loading (MT yr^{-1})
Global scale	Lebreton et al. 2017	13	30	mostly microplastics	40,760	0.003	0.17	1,150,000 - 2,410,000
	Schmidt et al. 2017	57	240	mostly microplastics	1,494	0.0018	0.22	470,000 - 2,750,000
	Mai et al. 2020	24	80	mostly microplastics	1,518	0.00017	0.119	56,000 - 265,000
	Weiss et al. 2021	75	96	microplastics	9,998	0.00023	n.a.	6,100
	Meijer et al. 2021	16	52	macroplastics	31,904	n.a.	2 - 19	800,000 - 2,700,000

n.a. (not applicable)

González Fernández et al., 2023.

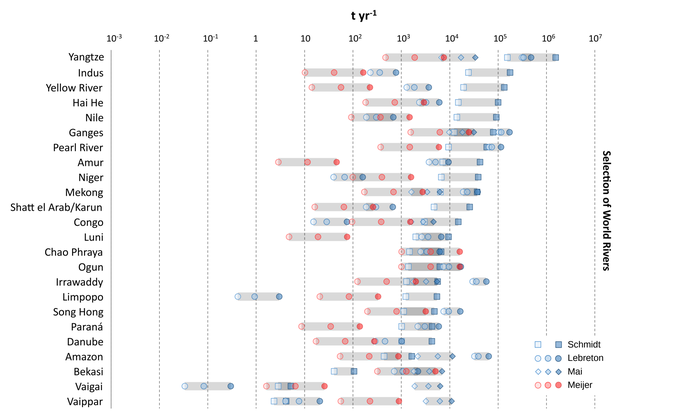
Different and contrasting choices in the modelling approaches:

- highly variable number of rivers in the global outputs
- differing item-to-mass conversion factors
- extrapolations from microplastic to macroplastic loads

LARGE UNCERTAINTIES

Estimates can diverge up to five orders of magnitude when global models are applied to individual rivers, denoting large uncertainties in the data and approaches used to extrapolate results at large scale

Diverging estimates of plastic in individual rivers



González Fernández et al., 2023.

Roebroek et al., 2022. The quest for the missing plastics: large uncertainties in river plastic export into the sea. ***Environmental Pollution.*** **https://doi.org/10.1016/j.envpol.2022.119948**

González Fernández et al., 2023. **Diverging estimates of river plastic input to the ocean.** ***Nature Reviews Earth and Environment*****.** **https://doi.org/10.1038/s43017-023-00448-3**

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